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National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Category: Large Appliances Surface Coating Operations - Background Information for Proposed Standards

NESHAP

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Emission Standards Division

U.S. Environmental Protection Agency
Office of Air And Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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ENVIRONMENTAL PROTECTION AGENCY

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) FOR SOURCE CATEGORY: LARGE APPLIANCES SURFACE COATING OPERATIONS - BACKGROUND INFORMATION FOR PROPOSED STANDARDS

1. The standards regulate organic hazardous air pollutant (HAP) emissions from the surface coating of large appliances. Only those large appliances surface coating operations that are part of major sources under section 112(d) of the Clean Air Act (Act) will be regulated.

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- Select menu item: Recently Signed Rules

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1.0 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The Background Information Document (BID) provides background information on, and rationale for, decisions by the Environmental Protection Agency (EPA) related to the proposed standards for the reduction of hazardous air pollutants (HAP) emitted from large appliances surface coating operations. The BID supplements the preamble for the proposed standards.

This document is separated into seven chapters providing a combination of background information and EPA rationale for decisions made in the standards development process. Chapters 2, 3, and 4 provide background information including: an industry description in Chapter 2, a description of the control techniques used by the industry in Chapter 3, and the model plants developed for this industry in Chapter 4. Chapter 5 provides the determination of the Maximum Achievable Control Technology (MACT) "floors", and an evaluation of control beyond the MACT Floor. Chapters 6 and 7 present the predicted HAP emission reductions and cost impacts associated with the proposed standards. Appendix A provides a listing of major and synthetic minor facilities thought to be subject to the standards. Appendix A also contains factors for converting Metric units to English units. Supporting information and more detailed descriptions for technical and rationale chapters are provided in the items referenced in this document and located in the project docket.

1.2 REGULATORY AUTHORITY

Section 112 of the Clean Air Act (CAA), as amended in 1990 (1990 Amendments) provides the EPA with the authority to establish national standards to reduce air emissions from sources that emit one or more of 188 hazardous air pollutants. Section 112(b) of the Clean Air Act contains a list of HAP to be regulated by National Emission Standards for Hazardous Air Pollutants (NESHAP), and Section 112 (c) directs the EPA to use this pollutant list to develop and publish a list of source categories for which NESHAP will be developed. The EPA must list all known source categories and subcategories of "major sources" that emit one or more of the listed HAP. A major source is defined in Section 112 (a) as any stationary source or group of

stationary sources located within a contiguous area and under common control that emits, or has the potential to emit considering controls, in the aggregate, 10 tons (9.07 Mg) per year of any one HAP or 25 tons (22.7 Mg) per year of any combination of HAP. The list of source categories was first published in the Federal Register on July 16, 1992 (57 FR 31576). This published list of source categories included the large appliances surface coating operations source category.

1.3 DATA GATHERING EFFORTS

Data were collected from the following sources in the development of a database of information for the large appliances surface coating operations source category: (1) the Toxic Release Inventory System (TRIS), (2) the Aerometric Information Retrieval System (AIRS), (3) State and local agencies, (4) Federal and State rules and guidance documents, and (5) site visits. Most of the information gathered from these sources was used to develop an extensive mailing list of large appliance manufacturers and detailed questionnaires to be submitted to the industry under the authority of Section 114.

In order to begin the task of characterizing the industry and to provide a basis from which data could be requested from States, a list of product descriptions was developed. The Standard Industrial Classification (SIC) codes and corresponding North American Industry Classification System (NAICS) codes relevant to the large appliances surfaces coating operations industry were also used to identify these products. This information is presented in Table 1-1.

1.3.1 Data Obtained from States

State and local air pollution control agencies provided information (i.e., permits or emissions inventory data) pertinent to the large appliances source category. A query of the States with the most large appliances surface coating operations was generated through the use of the TRIS and AIRS databases. Using the SIC/NAICS codes listed in Table 1-1, the number of facilities in each of the product categories was found. The results from the TRIS and AIRS searches are presented in Table 1-2.

In addition to the questionnaire and site visit data, the EPA has collected some air quality permit data. The permits provided information useful to this rule development on coating usage, coating HAP content, facility configuration, production technologies, implemented emission

reduction techniques, and add-on emission controls. The facilities for which permit data have been collected are listed in Table 1-3.

TABLE 1-1 PRODUCT DESCRIPTION, SIC CODES AND CORRESPONDING NAICS CODES

SIC Product Description	SIC Code	Corresponding NAICS Product Description	Corresponding NAICS Code
Household Cooking Equipment	3631	Household Cooking Appliance Manufacturing	335221
Household Refrigerators and Home and Farm Freezers	3632	Household Refrigerator and Home Freezer Manufacturing	335222
Household Laundry Equipment	3633	Household Laundry Equipment Manufacturing	335224
Household Appliances; not elsewhere classified	3639		
- Other Household Appliance		Other Major Household Appliance Manufacturing	335228
- Floor Waxing and Floor Polishing Machines		Household Vacuum Cleaners Manufacturing (pt)	335212
Air Conditioning and Warm Air Heating Equipment and Commercial Industrial Refrigeration Equipment	3585		
- Except Motor Vehicle Air Conditioning		Air Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	333415
- Motor Vehicle Air Conditioning		Motor Vehicle Air Conditioning Manufacturer	336391
Service Industry Machinery; not elsewhere classified	3589	Other Commercial and Service Industry Machinery Manufacturing (pt)	333319

NOTE: (pt) indicates that the NAICS code includes additional SIC codes or product codes beyond corresponding SIC codes shown in the table.

TABLE 1-2. NUMBER OF LARGE APPLIANCES SURFACE COATING OPERATIONS BY SIC CODE FOUND IN TRIS AND AIRS DATABASES

Product Category	SIC Code	Number of Facilities
Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment	3585	38
Service Industry Machinery, Not Elsewhere Classified	3589	3
Household Cooking Equipment	3631	5
Household Refrigerators and Home and Farm Freezers	3632	6
Household Laundry Equipment	3633	6
Household Appliances, Not Elsewhere Classified	3639	6

TABLE 1-3. FACILITIES FOR WHICH AIR PERMIT DATA HAVE BEEN COLLECTED

Facility	Products Manufactured	SIC Code
Maytag, Herrin, Illinois	Washers & Dryers	3633
Frigidaire, Kinston, North Carolina	Dishwashers	3639
A.O. Smith Water Products, McBee, South Carolina	Water Heaters	3639
Maytag, Galesburg, Illinois	Refrigerators	3632

1.3.2 Federal and State Rules and Guidance Documents

A Control Techniques Guideline (CTG) for the large appliances surface coating industry, *Control of Volatile Organic Emissions from Existing Stationary Sources Volume V: Surface Coating of Large Appliances* (EPA-450/2-77-034), was published in December 1977. This guidance document recommended a limitation of 0.34 kilogram of organic solvent emitted per liter of coating (minus water and exempt solvents) [2.8 pounds of organic solvent emitted per gallon of coating (minus water and exempt solvents)] for reduction of VOC from existing stationary sources [1].

A New Source Performance Standard (NSPS) with a different VOC emission limit was published in October 1982. In the NSPS for the large appliances surface coating industry (40 CFR Part 60 Subpart SS--*Standards of Performance for New Stationary Sources; Industrial Surface Coating: Appliances*), VOC emissions are limited to 0.90 kilogram of VOC per liter of coating solids applied [7.5 pounds of VOC per gallon of coating solids applied] [2]. This limit is based on the solids (nonvolatiles) that land on the substrate.

The Bureau of National Affairs (BNA) Environmental Library was searched for State regulations pertaining to surface coating of large appliances. Most States generally follow the guidelines or requirements established in the CTG and/or NSPS as described above. Some States have different limits for individual coating type and curing method (e.g., specialty coatings, air-dried general coatings, baked general coatings, enamels, etc.). Several State/local agencies have established guidance for determining Best Available Control Technology (BACT) and Reasonable Available Control Technology (RACT) for surface coating of large appliances [3]. A tabular summary of these regulations is presented in Table A-2 [3, 4].

1.3.3 Questionnaires

To obtain the most up-to-date data from the industry, EPA mailed preliminary questionnaires under the authority of Section 114 of the Clean Air Act to selected industry stakeholders in June 1997. Nine companies were selected by EPA to receive questionnaires. The purpose was to compile detailed information on quantities of HAP and VOC emissions and on current emission control techniques. In addition, data were needed to analyze the environmental, energy, and economic impacts associated with implementing feasible emission control techniques.

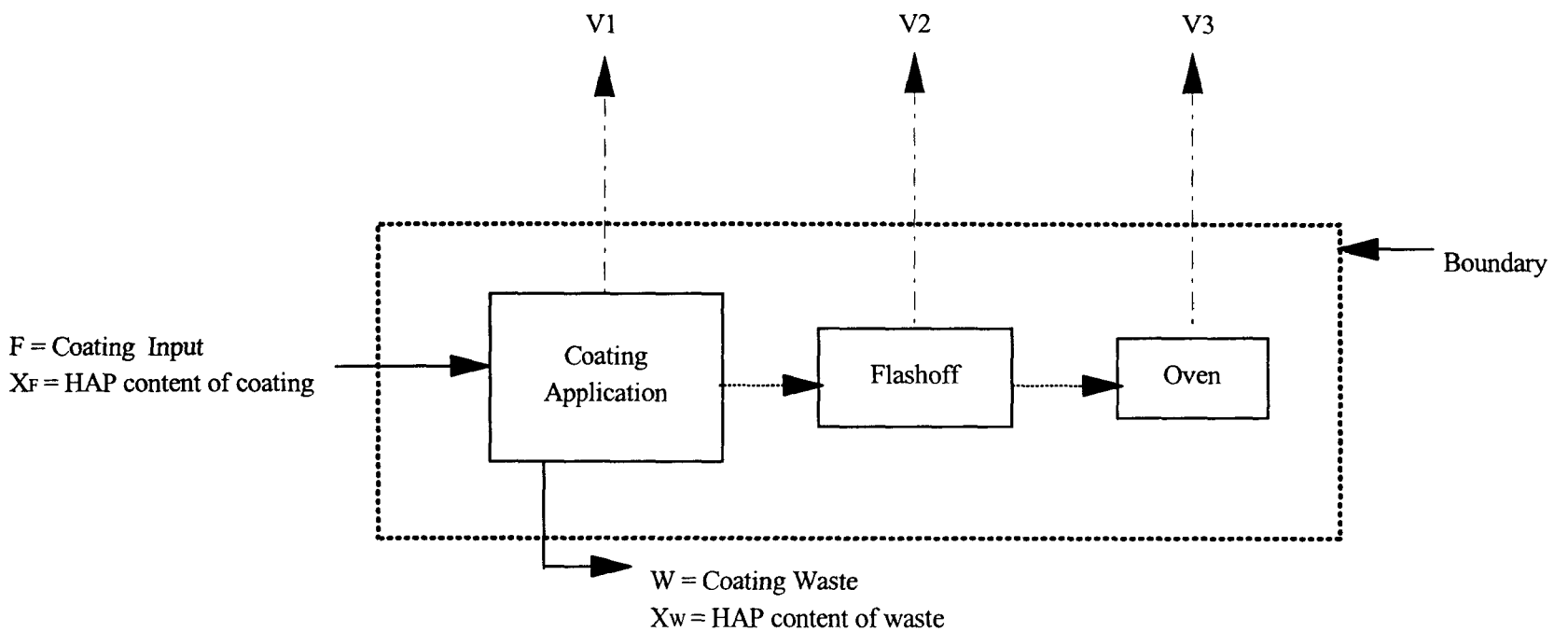
The selection process for facilities to receive questionnaires issued under the authority of Section 114 was intended to obtain information from the major manufacturers of each of the product groups under consideration for the large appliances surface coating operations rulemaking effort. The companies were selected for identifying the major technologies in use and for quantifying emissions from these manufacturing systems.

As a means of identifying and quantifying the possible sources of pollution, the questionnaires used the Unit Operation System (UOS) as the basis for data reporting. A plant (or

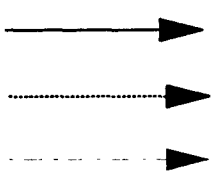
facility) consists of several levels of production activity, which are divided into work areas that are composed of one or more UOS. The term UOS refers to a formalized concept for performing a material balance. A UOS system is the ensemble on which the material balance is performed and includes all sources that contribute to emissions [5]. Furthermore, the facilities were asked to provide a flow diagram of the manufacturing process, which identifies the different unit operations. They were also asked to describe the coating specifications, type of parts and substrate material coated, waste handling procedures, control measures, applicable regulations, and collocated sources.

As illustrated in Figures 1-1 and 1-2, the boundary defines the UOS in which the HAP content of coating equals the HAP content of coating waste plus emissions. Facilities do not need to measure emissions from each of the individual unit operations (Coating Application, Flashoff, and Oven) in order to calculate the total emissions within the boundary. This information can be determined if the HAP contents in the coating and in the coating waste leaving a unit operation are known. The total emissions from each of the unit operations will vary depending on the type of coating applied, the application method, the length of the flashoff area, and other factors that are specific to each facility. In powder coatings systems, most waste coating material may be recirculated into the Coating Application, and there is no flashoff area. For powder coating operations, no HAP or VOC emissions were reported. Figure 1-2 shows all of the UOS examined in the large appliances surface coating operations rulemaking effort.

In June 1998, EPA sent out an additional Section 114 questionnaire designed using information learned from the June 1997 questionnaire. The questionnaire focused on more specific information about the unit operations within a facility, and contained sections concerned with general facility information, material data, add-on control devices, coating application, surface preparation, storage, mixing operations, cleaning operations, and waste and wastewater. The questionnaire also included components that relate data to the UOS. Data collected from



Emissions = (F)(XF) - (W)(Xw)
= V1 + V2 + V3



W= Waste

V= Emissions

F= Coating Input

Figure 1- 1 Liquid

Coating UOS

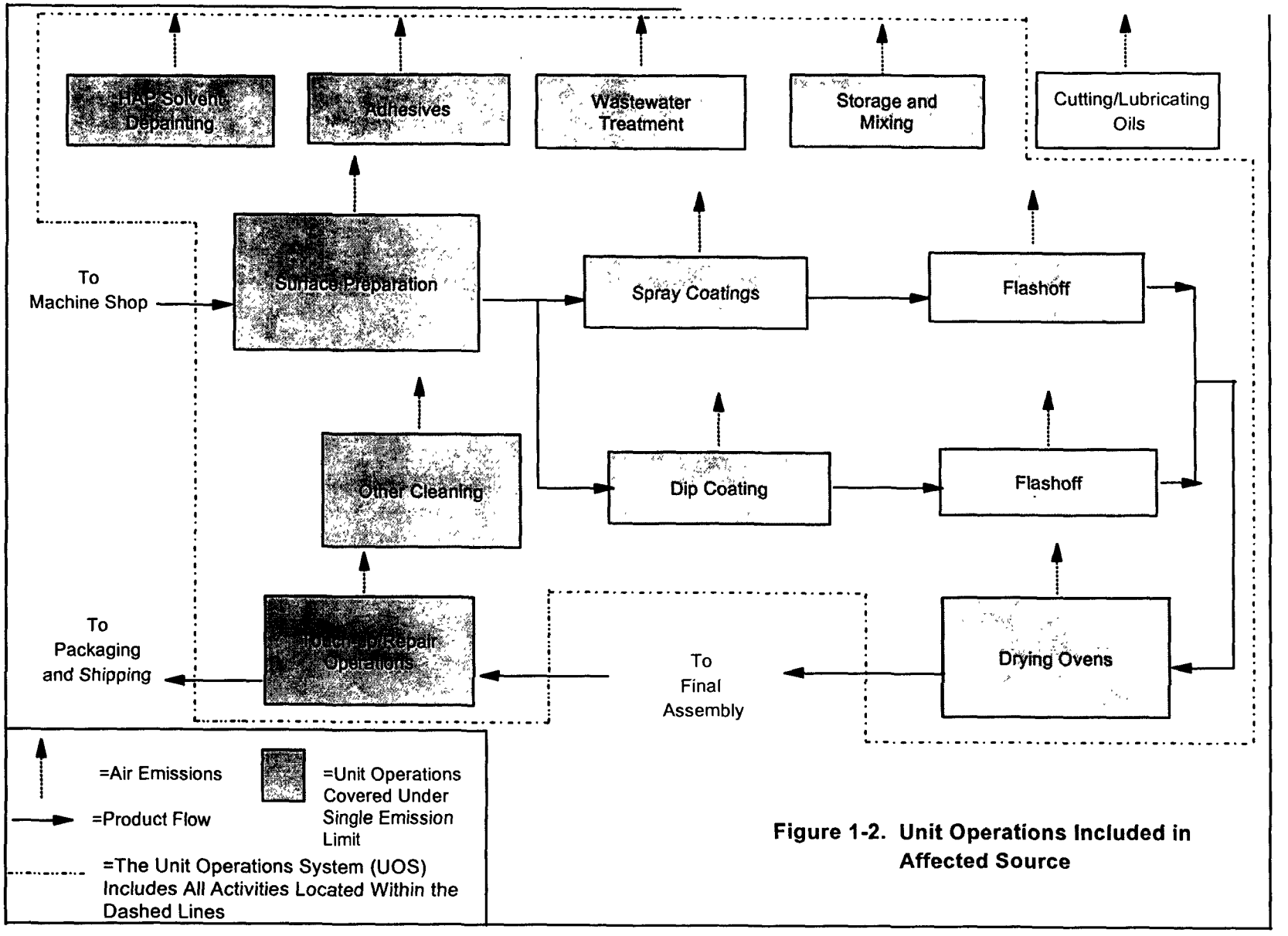


Figure 1-2. Unit Operations Included in Affected Source

this questionnaire included the amount of coatings, organic solvents, adhesives, and cleaners used as well as information on HAP emissions, coating solids, and major source classification. These data were used to calculate the MACT floor and resulting HAP emissions limit.

1.3.4 Site Visits

The EPA made site visits to four large appliances surface coating operations in June and July of 1997 and to four additional facilities in August 1998. These facilities are listed in Table 1-4. The types of information requested during site visits included:

- Description of the plant: size, hours of operation, layout of the unit operations, types of products coated, products manufactured, and production rate.
- Detailed descriptions of the surface coating operations, including the application equipment and coating technology used (e.g., dip coating, flow coating, electrostatic spray, powder coating), the spray booth or application area, and oven.
- Information regarding each material containing any HAP or VOC that is used in or emitted by any operation at the facility (e.g., coatings, parts cleaners, etc.).
- Descriptions of any control measures or add-on devices used to reduce HAP or VOC emissions from surface coating processes or any emitting source.
- Available cost information concerning the materials and equipment used in the surface coating operation, and costs of any HAP or VOC control strategies in place or planned.

TABLE 1-4. SITE VISIT FACILITIES

Facility	Products Manufactured	SIC Code
AAA Plating, Inc. Denver, Colorado	Metal Plating Only	Not available
Amana Refrigeration, Inc. Florence, SC	Residential Ranges, Cook Tops, Wall Ovens	3631
Amana Refrigeration, Inc. Amana, IA	Residential Freezers, Refrigerators, Microwaves, Commercial & Industrial Ovens and Microwaves	3632 (3631 & 3585)
Decorative Coating Systems Denver, Colorado	Contract Paint Shop (no manufacturing)	Not available
Lennox Industries Marshalltown, IA	Residential Heating (Furnaces & Combination Furnace/Water Heater) and Cooling (Air Conditioners, Heat Pumps, Coil Boilers) Products	3585
Maytag Appliances Newton, IA	Residential Washers and Dryers	3633
The Trane Company Pueblo, Colorado	Chillers	3585
Windsor Industries, Inc. Englewood, Colorado	Service Machinery, NEC (Floor Maintenance Equip., Vacuum Equip.)	3589

1.4 REFERENCES

1. Control of Volatile Organic Emissions from Existing Stationary Sources Volume V: Surface Coating of Large Appliances, U. S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-450/2-77-034. December 1977.

2. Industrial Surface Coating: Large Appliances - Background Information for Promulgated Standards, U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-450/3-80-037b. October 1982.

3. Beyond VOC RACT CTG Requirements, U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-453/R-95-010. April 1995.

4. BNA's ENVIRONMENTAL LIBRARY on CD, Windows 3.97, Environmental Compliance Series, The Bureau of National Affairs, Inc., Copyright 1996.

5. "Standardized Accounting for a Formal Environmental Management and Auditing System," Waste Minimization through Process Design, Chapter 20, A. P. Rossiter, ed., McGraw-Hill, Inc., 1995. Pages 289-303.

2.0 THE LARGE APPLIANCES SURFACE COATING OPERATIONS SOURCE CATEGORY

This chapter presents a description of the large appliances surface coating operations source category and identifies types of surface coating operations that would potentially be subject to the proposed standards. Also included in this chapter is a summary of current facility operations and industry practices that contribute to the emission of HAP.

2.1 SOURCE CATEGORY DESCRIPTION

The large appliances surface coating operations source category includes any operation engaged in the surface coating of any large appliance part or product. There are several industries that coat items considered large appliances. These industries coat products such as heating and air conditioning units and parts, chillers, refrigerators and home and farm freezers, laundry equipment, cooking equipment, dishwashers, floor waxers and polishers, garbage disposal units, trash compactors, and water heaters. See Table 2-1 for a listing of examples of large appliances.

The large appliances surface coating operations source category is primarily represented by the following six SIC codes:

3631 Household Cooking Equipment

3632 Household Refrigerators and Home and Farm Freezers

3633 Household Laundry Equipment

3639 Household Appliances, Not Elsewhere Classified

3585 Air Conditioning And Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment

3589 Service Industry Machinery, Not Elsewhere Classified

Products manufactured under these six SIC codes are considered large appliances for purposes of the rule. However, the large appliances surface coating operations source category also encompasses facilities coating similar products under other SIC codes. Therefore, a facility may be operating under a different SIC code but can still be subject to the rule because they coat a product that is a large appliance.

TABLE 2-1. EXAMPLES OF LARGE APPLIANCES

heating and air conditioning units (including home, motor vehicle, industrial)	household refrigerators, iceboxes, and home and farm freezers	household floor waxers and polishers, janitor's carts, mop wringers, floor sanding machines
chillers, heating and air-conditioning parts and equipment (coils, fin plates, compressors, etc.)	refrigerated cabinets, cases, and lockers	household sewing machines and buttonhole and eyelet machines
condensers, electric non-portable dehumidifiers, electric and gravity flow furnaces	household laundry/dry-cleaning equipment, including coin-operated (washers, dryers, wringers, etc.)	snow making machinery
non coin-operated cold drink dispensing equipment, beer dispensers, electric water and milk coolers, refrigerated drinking fountains	cooking equipment (ovens, ranges, stoves, microwaves, grills, barbecues, etc.)	sewage treatment and sewer cleaning equipment, sludge processing equipment
non-household vacuum cleaners and sweepers	dishwashers	industrial water treatment equipment, water conditioners for swimming pools
non-household pressure cookers, steam cookers, corn poppers, and fryers	garbage disposal units and trash compactors	household water filters and softeners, water purification equipment
ice making machinery	water heaters, electric heat pumps	car washing machinery (including coin-operated)

[1]These are only examples of large appliances. This table does not include the entire large appliances industry and is meant to only provide examples of the types of products considered large appliances.

2.1.1 Number of Sources

The questionnaire sent to industry by EPA in 1998 requested data from the 1997 calendar year. Results from the questionnaire indicate there are 222 facilities that perform large appliances surface coating operations. Large appliance surface coating operations are distributed across 38 States and Puerto Rico. Based on data received from the questionnaires, the states with the largest numbers of large appliances surface coating operations are Ohio (19), Tennessee (16),

Illinois (15), Texas (14), Wisconsin (13), and Georgia (10). Table 2-2 presents the distribution of large appliances surface coating operations per state. The size of the facilities and the number of employees represented in the questionnaire vary, ranging from 11 to 5,500. Based on responses to the EPA's Section 114 questionnaire, an average plant employs about 640 people. Table 2-3 presents the total number of employees and the average number of employees per plant for different types of large appliances. For each type of large appliance, the total number of employees reported by the questionnaire respondents was divided by the number of respondents that provided employment data. Of the 222 facilities, 95 are considered potential major sources based on potential facility HAP emissions (see Table 2-4 for those facilities considered major sources).

TABLE 2-2. LARGE APPLIANCES SURFACE COATING OPERATIONS LOCATION DISTRIBUTION BY STATE

State	Number of Facilities	State	Number of Facilities
Alabama	5	Mississippi	6
Arkansas	7	Nebraska	1
Arizona	2	New Hampshire	1
California	6	New Jersey	3
Colorado	3	New York	3
Connecticut	1	North Carolina	9
Delaware	1	Ohio	19
Florida	4	Oklahoma	5
Georgia	10	Oregon	1
Idaho	7	Pennsylvania	8
Illinois	15	Puerto Rico	2
Indiana	5	Rhode Island	1
Kansas	1	South Carolina	8
Kentucky	7	Tennessee	16

State	Number of Facilities	State	Number of Facilities
Louisiana	1	Texas	14
Massachusetts	1	Virginia	6
Maryland	6	Vermont	1
Michigan	4	Washington	3
Minnesota	7	Wisconsin	13
Missouri	8		

TABLE 2-3. LARGE APPLIANCES SURFACE COATING OPERATIONS EMPLOYEE DISTRIBUTION

Appliance Type	Total Employees	Average Employees per Plant
Cooking Equipment	12,766	799
Refrigerators and Freezers	15,344	1,180
Laundry Equipment	12,734	1,415
Miscellaneous Household Appliances	17,797	890
Air Conditioning, HVAC, Industrial Refrigeration, etc.	58,969	627
Miscellaneous Service Equipment	6,407	279
Other Miscellaneous	8,098	253

2.2 LARGE APPLIANCES SURFACE COATING METHODS

The large appliances surface coating operations industry is diverse and uses a range of coating application technologies. The methods used most frequently are typical of surface

coating operations in any industry. The following paragraphs provide a brief discussion of the most common application technologies. Facilities often use several of these methods.

2.2.1 Air and Airless Spray Guns

The processes of air spraying and airless spraying of coatings involve the atomization of a liquid coating in order to apply it to a substrate. Air spraying achieves atomization by the use of compressed air. Airless spraying uses an airless pump system to force a coating through a nozzle designed to atomize the coating [1].

Air spraying offers good coating quality with a wide range of coating systems and a high application rate. Also, the air spray can coat irregular shapes with recessed areas effectively. This technology can provide transfer efficiencies of up to 40 percent. Excessive overspray is the major drawback of an air spray system, which results in high material waste and high cleanup costs [2].

Airless spray systems offer comparable spray characteristics to air spray systems. However, the airless spray system typically has a higher transfer efficiency (50-60 percent) than air spray system (30-40 percent) [3]. Airless systems can also atomize coatings at high flow rates. However, with airless spray the spray nozzles are prone to clogging and wear. Also, stiff high pressure fluid hoses are required with airless systems. Problems with high pressures have been alleviated through the use of the air-assisted airless spray gun. This system uses some air to help atomize the coating and therefore allows for lowering of the pumping pressure [1].

The high-volume low-pressure (HVLP) system is a newer technology which further reduces overspray because it propels the atomized coating at a lower velocity than the air or airless system [2]. However, there are some difficulties with applying coatings with low solvent content and certain water-based coatings using an HVLP system when the flow viscosity is high. In this case proper atomization may not be achieved with high flow rates.

The EPA recently completed an Environmental Technology Verification for a laser-guided targeting device designed to improve the transfer efficiencies of spray guns. The device attaches easily to a regular manual spray gun and enables a precise painting technique. The EPA's Environmental Technology Verification Statement reports that the system increases relative transfer efficiency at an average of 11.1 percent. This would result in a corresponding reduction in material usage and volatile HAP emissions. The EPA's Verification Statement can

be found at http://www.epa.gov/etv/verifrpt.htm#prevention under "P2 Innovative Coatings and Coating Equipment Systems Pilot."

2.2.2 Dip Coating

The dip coating operation involves the immersion of a part into a tank containing the coating. Typical transfer efficiencies are near 85 percent [4]. The high transfer efficiency is due to the fact that there is no atomization and excess coating can be returned to the dip tank as it drips off [5].

Dip coating is advantageous because it is simple and provides a quick and inexpensive way of applying a coating to coat large numbers of substrates. Potential problems with dip coating involve the large amounts of coating required and fire risk in large installations. The fire risk can be eliminated by using water-based coatings [5].

Dip coating is feasible using solvent-based or water-based coatings. However, with either coating type extensive attention must be given to maintaining proper mix characteristics (coating viscosity) in the tank because of evaporative losses [5].

2.2.3 Electrodeposition

Electrodeposition is a dip coating method in which an electric field is used to facilitate the deposition of the coating on the substrate. The substrate to be coated acts as an electrode that is oppositely charged from the coating (particles) in the dip tank [1]. Electrodeposition has the same advantages as dip coating, and , in addition, the transfer efficiency for an electrostatic dip coat operation is closer to 95 percent [4]. Many types of polymers can be used in the electrodepositon process if they are used with solubilizers, which charge the polymer electrically. Early electrodeposition processes were anodic, but due to problems with electrolysis, cathodic systems are now preferred [6].

Like the dip-coating operation, the electrodeposition operation requires close monitoring and recirculation of the coating in the tank [6]. One consideration with electrodeposition is that the use of water-based coatings requires the equipment to be electrically isolated [7].

2.2.4 Electrostatic Spraying

An electrostatic spray can be generated using an air or an airless gun system. In such systems, the transfer efficiency is improved because electrostatic principles are used to attract the coating to the substrate (85 percent transfer efficiency) [1, 4]. Coating droplets are injected into

an electrostatic field set up by several electrodes that impart a charge to the coating. Negatively charged atomized coating droplets are propelled to the substrate to be coated and deposit themselves through electrostatic attraction [5].

A unique advantage of applying coatings in the form of an electrostatic spray is the "wraparound effect." Due to the wraparound effect, an entire product can be coated from one side. This is a result of the electrostatic attraction of the coating to the substrate [5]. The advantages of using an electrostatic spray include high transfer efficiencies (90 percent for automatic systems and 60 percent for manual systems), as well as applicability to coatings containing a high amount of nonvolatiles (coating solids). If water-based coatings are to be used, the system must be electrically isolated to avoid electric shocks [2].

2.2.5 Electrostatic Bell and Disk Gun Systems

The electrostatic bell and disk systems are similar in many respects. They use the rapid rotation of either a bell or disk shaped applicator to mist the coating. The use of oppositely charged substrate and coating allows for higher transfer efficiencies and better coating uniformity [1]. The transfer efficiency of the bell or disk system is close to 90 percent [4].

Electrostatic bell and disk systems can also be used with almost any liquid coating from the thinnest up to 80 percent nonvolatiles [6]. The electrostatic system helps carry the coating to the substrate and causes it to adhere to the surface of the substrate. Hence, the result is a coating of good quality and finish characteristics. Due to the design and purpose of the bell application systems, they are best used on automated large volume coating lines to coat parts that have similar characteristics (size, shape, and material) [2].

2.2.6 Carbon Dioxide Spray System

The carbon dioxide spray application technology was introduced in 1990 as a new pollution prevention (source reduction) technology to reduce the amount of organic solvent needed before the coating is sprayed. The technology was used to apply conventional solvent-based formulations and the higher coating solids formulations [8, 9]. The equipment is a modified airless spray system that makes it possible to mix carbon dioxide, a solvent under certain conditions, with the coating [8]. To dissolve the carbon dioxide in the coating, the mixture is pressurized to supercritical pressures ranging from 1,200 to 1,700 psig, which are well within the capacity of current airless spray application systems. In addition, the solution

is heated to a temperature ranging from 40 to 70 degrees Celsius to make the carbon dioxide supercritical and to offset the cooling that occurs as the carbon dioxide diffuses from the solution as a free gas in the spray.

Even though the carbon dioxide spray is airless in nature, it has all the desirable traits of air spray, without high air volumes [8]. The carbon dioxide spray produces a high quality uniform film which has both good appearance and high transfer efficiency [10]. This technology has been used to apply urethane clear topcoat to exterior plastic automotive components, acrylic clear topcoat to automotive bumpers, adhesion promoter to automotive components, acrylic lacquer to automotive sport wheels, alkyd lacquer to heavy equipment chassis and components, and nonstick silicone coating to metal bakeware [8].

The carbon dioxide spray system appears to have economic, performance, and environmental advantages over conventional spray systems. Using a carbon dioxide spray system also has a number of environmental and safety benefits. The carbon dioxide spray system reduces solid waste, lowers volatile emissions, and reduces flammable solvent inventory. The carbon dioxide used for this application is a by product from other sources, hence it helps reduce greenhouse gas inventory [8].

A few deterrents exist for switching to a carbon dioxide spray system. The system is new relative to more established technologies. Some minor equipment modifications and purchases are required. Coating reformulation in some cases may be required [8].

2.2.7 Powder Coating Technology

Powder coatings (dry resin) are applied to a substrate in a dry form. The resin is typically a thermosetting (polyurethane, acrylic, epoxy, etc.) or thermoplastic (nylon, vinyl, etc.) resin which is electrostatically applied to the surface of a part. Application is done with a spray gun or fluidized bed (powder which has been fluidized by compressed air adheres to the surface of a heated metal part as it passes through the fluidized bed of powder). The powder-coated part is then cured in an oven where the powder fuses to form a continuous, uniform coating [10]. Powder coatings have been used by numerous industries to coat parts such as lawn and garden equipment, appliances, playground equipment, patio furniture, and automotive parts [11].

Powder coating has some distinct advantages over conventional coating operations. First, no organic solvents are normally added to powder coatings. A negligible HAP (less than approximately one percent by mass volatiles [10,12] are released during curing stage compared to e.g., 15 percent for water-based coatings and e.g., 66 percent for conventional solvent-based coatings) [10]. Because organic solvents are not normally added to powder coatings, worker safety is improved, ventilation and pollution control requirements in the workplace are reduced, and permitting and regulatory compliance is more cost effective [11]. Another advantage of using powder coatings is that the overspray can be collected using a vacuum cleaner or compressed air. If the retrieved powder is reused, the overall coating costs and hazardous disposal costs will be reduced [10]. Powder coated surfaces are more resistant to chipping, scratching, fading, and wearing than other finishes [13].

Uncertainty exists as to the validity of testing powder coatings by the same methods as liquid coatings. The Powder Coating Institute recommends an alternative method which involves weighing the powder coating before and after placing it in an oven set to similar conditions as production curing. The difference in mass is the volatile content. Some other concerns associated with powder coating involve storage of powder coating and cleaning of the application equipment. Temperature and humidity must be monitored closely in the areas where the powder coating is stored and applied. Moisture in the powder must be kept at a reasonably low level to prevent cohesion problems (clumping of powder particles) during spraying. Because there are no organic solvents in the dry powder to absorb or disperse contaminants, the air delivery system to the powder spray guns must not deliver significant amounts of water or oil [2]. Cleaning the application equipment can be very time consuming when color changes are required. All of the first color powder must be removed from the system before the second color powder can be started. Equipment duplication may be a cost-effective solution to this problem [10].

2.2.8 UV/EB Coating Technologies

Radiation-cured coatings are specially formulated adhesives, inks, and coatings materials that cure with exposure to either UV light (UV-cured) or focused electrons (EB-cured) rather than heat [14]. All of the material in these coatings enter into the curing reaction and become part of the final solid coating film rather than being volatilized. This UV/EB coating technology is particularly useful for products such as paper, foil, wood, and plastic that can not be exposed to the high temperatures of traditional coating ovens. Some products that

are currently being coated using radiation technology include fiber optics, toiletry bottles, sporting equipment, medical equipment, headlight assemblies, wood trim, windshields, magazines, labels, cereal boxes, milk/juice cartons, CDS, DVDs, and circuit boards [15].

There are several components that are used in the UV/EB cured coatings. These include an oligomer or prepolymer containing double-bond unsaturation, monomers (with varying degrees of unsaturation), a photoinitiator to absorb the UV light radiation (this is not needed for EB curing), and pigments/dyes or other additives. Essentially, the curing process is dependent on the availability of extra electrons to form the bonds with the unsaturated components. This creates a material that has saturated bonds (i.e., the final product or film). The extra electrons come from either the photoinitiator in the UV coating or from the electron beam that is applied in EB coatings.

Unlike conventional coatings, UV/EB coatings emit few or no VOC/HAP. The only HAP expected to be present in the UV/EB coatings as they are applied would be solvents that may be added by the user. Approximately 98 percent of UV and EB coatings are applied as supplied by the coating manufacturer [16]. Other benefits of using radiation-cured UV and EB coatings include: (1) elimination or reduction of solvent use, (2) very rapid curing, (3) high productivity from rapid curing and instant startup and shutdown, (4) low-temperature processing, which allows for the use of heat sensitive substrates such as plastic, (5) good film properties and performance, such as hardness; and improved solvent, stain and abrasion resistance, (6) higher non-volatile content that results in higher gloss, better build, and lower shrinkage, (7) lower energy use because of high efficiency UV/EB systems when compared to thermal ovens, and (8) lower space requirements than conventional coating systems [17].

Radiation-cured coating systems also have a number of limitations, which include: (1) higher cost coating formulations because of expensive raw materials and smaller volume, (2) line-of-sight curing is limited to flat or cylindrical materials that can be directly exposed to the radiation source. Radiation systems for three dimensional substrates are being developed to overcome this limitation, (3) the presence of pigments reduces penetration by UV light, limiting use in high-build applications, (4) many polymers used in radiation-cured coatings are allergens and can cause skin irritation and sensitization, (5) UV/EB curing is not always suitable for porous materials, and (6) EB systems generally require an inert environment because atmospheric oxygen can interfere with the curing of resins [17].

2.2.9 Flow Coating

Flow coating is a method that involves the application of the coating directly onto the substrate without atomizing the coating [1]. Small streams of liquid coating are applied to a flat, horizontally-oriented substrate and allowed to spread to form a continuous film. The typical transfer efficiency for flow coating is 85 percent [4]. Flow coating does not require the large coating volumes that dip coating does. However, the maintenance of mix characteristics is equally important. Flow coating also allows for low ventilation rates and a variety of substrate shapes [6].

For many applications, electrostatic de-tearing is required to control droplet formation in flow coating operations. De-tearing uses electrostatic currents to remove excess paint droplets from the part. Also, if the coating cures too quickly the coating will skim (the surface of the coating will dry before the rest of the coating). Therefore, it is sometimes necessary to place the coated substrate in a solvent-rich environment to slow the curing process and prevent skimming. While flow coating allows for reduced solvent emissions, if a solvent rich environment is maintained emissions rise considerably [6].

2.2.10 Final Touch-up/Reinforcement of Coated Pieces

The majority of touch-up operations are performed by using manual air spray guns and a lacquer based coating. This is because the lacquer coating has good drying characteristics that allow for shorter drying times. In some cases, touch-up might include recoating a product entirely, but the majority of touch-up lines consist of manual coating application to a small portion of the product surface [2].

2.2.11 Coating Type & Composition

Several types of coatings were represented in the questionnaire responses, including powder coatings, organic solvent-based coatings, and water-based coatings. Organic solvent-based coatings are considered to be the more traditional coatings. High nonvolatiles, medium nonvolatiles, and low nonvolatiles coatings fall into this coating category [4]. All three are comprised of some amount of paint nonvolatiles including the pigments, with the balance of their composition being some type of organic solvent. High nonvolatiles formulations of coatings appear to be a principal method of choice for controlling HAP emissions in large appliances surface coating operations. High nonvolatiles formulations simply have a higher nonvolatiles to volatiles ratio than conventional coatings, typically greater than 60 percent nonvolatiles by volume. Medium nonvolatiles formulations typically have 50 to 60 percent nonvolatiles by volume, and low nonvolatiles formulations have less than 50 percent nonvolatiles by volume [1].

The questionnaire responses report that approximately 15,800,000 liters of coating solids were used in 1997 to coat large appliances. Powder coatings make up 65% (10,570,000 liters coating solids) of the total coatings used, waster-based coatings 15% (2,270,000 liters coating solids), and solvent-based coatings 20% (2,970,000 liters coating solids).

Powder coatings are comprised primarily of various types of plastic resin. These coatings produce very low organic emissions relative to solvent-based coatings. Some references state that in some cases, powder coatings may possibly emit up to 6 percent by mass E-caprolactam; however, this substance is not a HAP[1, 18].

Water-based coatings contain at least 5 percent water by mass in the volatile (liquid) fraction. These coatings offer some advantages over conventional solvent-based coatings because they contain significantly less organic solvent, and water-based coatings represent less of a fire risk than solvent-based coatings. However, water-based coatings have longer drying times because water evaporates more slowly than the organic solvents (which can have production impacts), and the water content may present a corrosion problem for the application equipment [1, 4].

2.3 FACILITY OPERATIONS AND CURRENT INDUSTRY PRACTICES

There are several activities that take place to support the coating application process that may contribute to HAP emissions. These activities include cleaning and pretreatment, mixing of paints and thinners, storage of coatings and other solvents, wastewater, and adhesive usage. The following section describes these activities in more detail.

2.3.1 Cleaning and Pretreatment

One of the most important activities in the surface coating industry is cleaning and pretreatment. Proper cleaning removes all organic and inorganic soils from the substrate prior to coating, which is critical for achieving maximum performance from the coating, especially with powder coating. Cleaning and pretreatment can consist of numerous stages that include several types of chemical washes, such as solvent cleaning, an acid wash, a phosphate wash, and a deionized water wash. Facilities use various combinations of these stages. Except for solvent cleaning and wetting oil treatment, most stages do not emit any HAP or VOC emissions. Pretreatment and cleaning requirements vary depending on the type of coating application and curing, as well as the type of metal to be coated.

2.3.2 Mixing

Paint mixing may be performed in an agitated 208 liter (55 gallon) drum, or it may be performed by merging two different coating lines into one. Coating mixing is typically performed by the coating manufacturer prior to shipment to a large appliances manufacturer's facility. Some facilities add water or solvent to the coating, which may be performed in a small mixing booth or it may be automated. Some facilities combine reclaimed coatings from various coating applications and mix the different coatings together in a 208 liter (55 gallon) drum. Mixing also varies depending on the type of coating and usage requirements.

2.3.3 Coating Storage

Storage demands vary based on the type of coating and usage requirements. Container size and type vary depending on coating manufacturer and end user needs. Most coatings are stored in 208 liter (55 gallon) drums. Powder coatings can also be stored in 208 liter (55 gallon) drums, as long as the temperature and the humidity are controlled. To prevent moisture absorption, most facilities store powder coatings in 23 kilogram (50 pound) cardboard boxes that are lined with plastic, but the size of the container can vary from 1.4 to 136 kilograms (3 to 300 pounds) [19].

2.3.4 Wastewater Treatment

Since many of the operations employed by the large appliances surface coating operations produce wastewater, some facilities have wastewater treatment systems on-site. Some of the activities that produce wastewater include pretreatment, molten salt baths, some electrodeposition systems, and many primer and topcoat systems. The effluent from their wastewater handling or treatment systems must be acceptable to discharge either back into a body of water, or to the Publicly Owned Treatment Works (POTW). Otherwise, they must perform some degree of wastewater treatment in order to reach the levels specified by regulations. The effluent limitations for existing indirect discharges are imposed by the EPA through National Pollution Discharge and Elimination Systems (NPDES) permits [20].

2.3.5 Adhesives

Based on data obtained from the questionnaires, the typical application for large quantity adhesive usage in the large appliances surface coating operations industry is attaching insulation to metal substrates. Adhesives are also used to attach brake hubs in products such as washing machines. Small usage of adhesives include thread-lockers, PVC/CPVC adhesives, and other usages. Adhesives are applied using spray guns, rollers, or by brush. Pressure sensitive adhesives, which are characterized by a peel-off, self-stick backing, are also used.

2.4 EMISSIONS

Surface coating activities are a source of both VOC and HAP emissions. Because this regulation only addresses volatile HAP emissions, they will be the only emissions discussed in this section.

2.4.1 General

The typical unit operations at a large appliance surface coating operations that may result in HAP emissions include:

- metal cutting and forming steps using cutting oils and lubricants
- metal surface cleaning and pretreating steps
- bonding of some component parts with adhesives
- application of one or more layers of coatings
- cleaning of coating application areas, conveyors, and coated parts
- storage of coatings and thinners in mix areas
- collection and disposal of waste materials

The coating application unit operation is by far the largest source of HAP emissions, accounting for an estimated 80 percent of emissions from all of the listed activities.

The major HAPs emitted from large appliances surface coating operations are xylene (27% of total HAPs), glycol ethers (21%), toluene (13%), methyl diphenyl diisocyanate (12%), and methyl ethyl ketone (9%). While some HAPs, such as xylene or toluene, may be used as a single component solvent, many are components of solvent blends [21].

2.4.2 Baseline Emissions

To determine the magnitude of the potential HAP reductions that may be achieved by the proposed standards, the current level of emissions must first be determined. The HAP emissions level that exist currently, in the absence of the proposed standards, is referred to as the baseline emission level. Because the proposed standards only affect major sources (as defined in Chapter 1), baseline emissions were calculated for the subset of the 1997 and 1998 industry questionnaire responses that were believed to be potential major sources.

Potential major sources were identified as: (1) those facilities that listed "major source" or "synthetic minor source" as their Title V status on their questionnaire response, (2) those facilities that reported their HAP emissions under "maximum design capacity" as greater than 9.1 Mg/yr (10 tpy), and (3) other facilities that we judged to have the capacity to increase their

HAP emissions to above 9.1 Mg/yr, even though they did not identify themselves as major or synthetic minor sources.

Synthetic minor sources are defined as sources whose emissions are limited to levels below the definition of a major source by their operating permits or other Federally enforceable commitments. Although these sources were included in the determination of the baseline emission level, no emission reductions from these facilities is projected.

The final group of facilities (criteria 3, above) were included because they reported actual HAP emissions of greater than 3 Mg (3.3 tons) during the reporting year and did not report a "maximum design capacity."

The database that resulted from applying these criteria contained 95 facilities and baseline HAP emissions of approximately 2,400 Mg. Table 2-4 presents each potential major source facility and its corresponding HAP emissions. Table A-1 provides a list of the 95 potential major source facilities and the names of the states in which they are located.

TABLE 2-4 HAP EMISSIONS FROM POTENTIAL MAJOR SOURCE FACILITIES

Facility	SIC Codes	Activity	Total 1997 Coating solids Usage (L)	Total 1997 HAP Emissions (kg)
1	3631	gas and electric ranges	167,606	4
2	3585	air conditioner units	18,110	114
3	3585	mix dispensing equip./vending machines	18,419	117
4	3585	air conditioners	109,954	316
5	3585	air conditioning, refrigerators, heating equip.	2,085	449
6	3585	hermetric compressors	11,634	458
7	3634	small kitchen appliances	7,485	817
8	3589	water purification systems	677	932
9	3585	commercial HVAC equipment	160,593	983
10	3585	commercial refrigeration display cases	64,850	997
11	3585	air conditioner units	8,247	1,018
12	3585	large commercial HVAC	730	1,087
13	3585	heat exchangers/air handling equipment	6,059	1,416
14	3632	refrigerators and freezers	26,351	1,493
15	3585	remanufactured refrigerant compressors	4,162	1,515
16	3556	soft serve ice cream/slush machines, gas grill	6,326	1,632
17	3632	refrigerators and freezers	57,559	1,793
18	3585	air conditioners	4,443	1,891
19	3585	heating/cooling units	157,622	2,069
20	3585	chiller refrigeration equipment	5,677	2,616
21	3585	refrigeration compressors	8,197	2,617
22	3585	evaporators, coolers, condensers, cooling towers	1,807	2,821
23	3585	air handling equipment	5,029	3,027
24	3585	refrigerator display cases	136,836	3,036
25	3585	industrial refrigeration pressure vessels	3,682	3,065
26	3585	compressors, motors	1,562	3,401
27	3589	water filters	4,289,470	3,602
28	3589	food machines, mixers, scales	11,281	3,872
29	not provided	not provided	12,446	3,890
30	3585	industrial refrigerators and heat exchangers	6,446	4,199
31	3585	hermetric compressors	43,312	4,535
32	3589	floor scrubber/sweeper	12,379	4,609
33	3585	commercial refrigerators	105,150	4,695
34	3589	various tanks	3,728	5,077
35	3639	ranges	722	5,314
36	3632	refrigerator compressors	15,144	5,552
37	3585	absorption units, chillers, compressors	26,411	5,677
38	3585	commercial and industrial air handler units	10,971	5,767
39	3639	air conditioning compressors	9,512	6,036

TABLE 2-4 HAP EMISSIONS FROM POTENTIAL MAJOR SOURCE FACILITIES
(Concluded)

Facility	SIC Codes	Activity	Total 1997 Coating solids Usage (L)	Total 1997 HAP Emissions (kg)
40	3585	air handling equipment	3,984	7,423
4 1	3585	condensers, chillers	3,070	7,788
42	3585	refrigerant compressors	43,160	7,951
43	3585	air handling systems	6,590	8,029
44	3589,3631	grills, broilers, griddles	2,188	8,551
45	3589	food service equip., gas combustion equip.	341	8,774
46	3639	metal tanks	48,670	9,133
47	3585	refrigerated display cases	31,783	9,188
48	3585	refrigeration equipment	11,286	9,670
49	3639	food waste disposers, hot water dispensers	63,105	10,551
50	3585	air conditioners	4,169	11,523
51	3585	refrigeration equipment	20,438	11,688
52	3631	household cooking equipment	51,919	13,081
53	3633	washers and dryers	118,423	13,701
54	3585	commercial refrigeration	21,573	14,721
55	3585	chillers	12,043	14,796
56	3585	refrigerators	30,379	15,340
57	3632	refrigerators	6,615	16,323
58	3585	waste chillers	9,093	16,604
59	3631	gas and electric ranges	138,263	16,622
60	3632	refrigerators, cooking equip., ovens, microwaves	417,969	17,344
61	3585	compressors, coils, industrial chillers	30,755	17,685
62	Unk	unknown	1,633	19,005
63	3631	metal fabrication	32,657	19,971
64	3585	refrigerated display cases	29,310	20,635
65	3585	air conditioners, heating equipment	12,897	22,553
66	3639	range hoods, bath fans, garbage compactors	58,278	22,757
67	3585	water heaters	156,444	24,231
68	3631	microwaves	167,238	24,558
69	3585	evaporators, coolers, condensers, cooling towers	5,212	25,409
70	3589	floor maintenance equipment	25,509	25,527
71	3632	refrigerator	33,069	26,739
72	3585	motor vehicle air conditioning	7,324	26,780
73	3585	dehumidifiers	68,656	26,994
74	3585	air conditioners, air cleaners	66,278	31,856
75	3632	household refrigerators	80,253	32,401
76	3585	air conditioners, gas heaters	346,102	43,450
77	3585,3632, 3639	air conditioners, refrigerators, dehumidifiers	105,966	64,947
78	3585	furnaces, heat pumps, gas grills	36,226	76,197
79	3639	water heaters	267,894	89,014

TABLE 2-4 HAP EMISSIONS FROM POTENTIAL MAJOR SOURCE FACILITIES (Concluded)

Facility	SIC Codes	Activity	Total 1997 Coating solids Usage (L)	Total 1997 HAP Emissions (kg)
80	3633	laundry products	226,438	89,122
81	3633	clothes dryers	1,112,454	102,025
82	3639	dishwashers	515,602	116,031
83	3633	household laundry equipment	1,078,668	136,567
84	3633	washers and dryers	536,632	141,851
85	3585	heat transfer coils, coolers, ice machines	78,179	142,143
86	3633	household and commercial laundry	580,521	190,521
87	3632	refrigerators and trash compactors	133,146	295,256
88	3639	water heaters and water storage tanks	629,607	0[a]
89	not provided	not provided	77,912	0[a]
90	not provided	not provided	--[b]	--[b]
91	not provided	not provided	--[b]	--[b]
92	3585	air handlers and furnaces	--[b]	--[b]
93	3631	gas and electric ranges	--[b]	--[b]
94	3633,3631, 3632,3639	laundry, ranges, refrigerators, dishwashers	--[b]	--[b]
95	3635	central vacuums	--[b]	--[b]

[a]These facilities reported only powder usage and no other operations were reported (i.e., surface preparation, cleaning, etc.).

[b]These facilities did not provide sufficient data to determine the HAP emissions; however, because these facilities are considered potential major sources on the basis of a facility's statement or its potential to emit, the facilities were counted as part of the potential major source population when determining the number that represented the top 12% performing facilities.

Multiply Liters by 0.264 to obtain gallons

Multiply kilograms by 2.205 to obtain pounds

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3.0 EMISSION REDUCTIONS FROM COATING APPLICATIONS

This chapter presents information about the various methods of emission reduction and control that are currently in use, or are available for use, at large appliances surface coating operations.

3.1 AIR POLLUTION CONTROL TECHNIQUES

There are many types of emission control technologies that could be used to reduce emissions from large appliances surface coating operations. The most common method of volatile HAP emission reduction utilized in surface coating operations is the reformulation of coating materials. Reformulation refers to basic changes in the raw coating materials that allow them to perform their desired function while containing a lower than typical percentage of HAP ingredients. Reformulation is a desirable method of HAP emission reduction because it is a pollution prevention option that often achieves many performance and cost benefits. While volatile HAP emissions are the primary concern in the proposed standards, this chapter also presents brief descriptions of some of the most common particulate and VOC control techniques.

3.1.1 Reformulation of Materials

3.1.1.1 Coating Solids (nonvolatiles)

A coating is composed of a volatile and nonvolatile portion. The nonvolatiles will also be referred to as coating solids to mean the portion of the coating material remaining after a coating dries on the substrate. One method of emission control employed by the coating industry is to increase the ratio of the nonvolatiles to volatiles in a particular coating. The goal is to use less organic solvent per volume of nonvolatiles used for a job. This reduces the amount of organic solvent that is emitted in the process. Coating formulations may be classified as high, medium, or low nonvolatiles. High nonvolatiles coatings would be considered, for our purpose, to be any coating with a nonvolatiles content above 60 percent nonvolatiles by volume. Medium nonvolatiles coatings are considered to be between 50 percent and 60 percent nonvolatiles by volume. A low nonvolatiles coating is considered to contain less than 50 percent nonvolatiles by volume. With all other variables held constant, increasing the nonvolatiles in a coating formulation should produce lower HAP and lower VOC emissions per unit volume of coating used [1].

For the existing industry, the primary short-term, and in some cases the long-term, solution to reduce emissions is to switch from a lower nonvolatiles coating to a coating with a higher nonvolatiles content. This solution is probably the most cost effective means of reducing emissions. In calculating emissions from a coating, any cure volatiles that are HAP or VOC will need to be counted.

3.1.1.2 Water-based Coatings

A water-based coating uses water as the organic solvent rather than a traditional organic solvent. This does not mean that a water-based coating has no organic solvent, it just means that there is less organic solvent than if it were a traditional organic solvent-based coating. A water-based coating is considered to be a coating that contains more than 5 percent by mass water in its volatile fraction. Water-based coatings can have VOC contents less than 120 grams per liter (1.0 lb/gal) [1, 2].

The most commonly available water-based coatings include water-reducible alkyds and modified alkyds, acrylic latexes, and acrylic/epoxy hybrids. Water-reducible coatings are available in a wide range of colors and gloss levels. Typical applications include dipping primers and topcoats, general purpose primers, and spray enamels [2].

3.1.1.3 Powder Coatings

The use of powder coatings, where applicable, provides an opportunity for significant emission reduction. There are practically no organic HAP or VOC emissions during the application of powder. However, small amounts of cure volatiles are emitted from powder coatings during the oven cure stage. The information on cure volatiles is sparse in the literature. However, there are data showing that E-caprolactam (not a HAP or VOC) is emitted from certain powder coatings [3]. Formaldehyde may also be emitted from certain powder coatings. The nature of the cure volatiles can be determined through testing. Other emissions from powder coating result during cleaning of part hangers used to move the parts along the coating line. Even considering these emissions, the powder coating system offers emission reductions that can only be matched by the best performing add-on control devices [3].

3.1.1.4 Add-on Control Devices

There are many types of emission control technologies that could be used to reduce emissions from large appliances surface coating operations. While the most common method of volatile HAP emission reduction utilized in surface coating operations is the reformulation of coating materials, add-on control devices are another technique available for use in reducing

HAP emissions. The responses to the industry questionnaires provided information on seven such devices located at five facilities. Add-on control devices are discussed in the memorandum entitled "Available Add-on Control Devices for Use in the Large Appliances NESHAP" (Docket No. A-97-41, Item No. II-B-11). The memorandum describes the types of add-on control devices and presents the monitoring requirements for these devices and the rationale for selecting these monitoring parameters.

3.2 POLLUTION PREVENTION (SOURCE REDUCTION)

Steps that can be taken to eliminate the generation of pollutants at the source are the preferred approach to reducing HAP emissions. In surface coating operations, there are numerous opportunities to implement pollution prevention measures. In addition to the use of lower-HAP coatings, the use of non-HAP or lower-HAP surface preparation materials and cleaning materials results in the generation of less HAP emissions. Likewise, the conversion of conventional organic solvent-based coating operations to water-based or powder coatings reduces the generation and release of HAP emissions. The increased use of technologies that reduce the overall amount of organic solvents in coating materials can serve as pollution prevention measures. The EPA welcomes comments and recommendations from the industry and the public on additional pollution prevention measures that may be implemented within large appliances surface coating operations.

3.3 EQUIPMENT CHANGES

One of the major factors in making changes to application equipment as a control measure is transfer efficiency. With higher transfer efficiencies less coating is used to coat the same amount of product, resulting in less emissions. Transfer efficiency itself is not simple to quantify. However, some application equipment clearly has a better transfer efficiency than other equipment. For example, a rotational electrostatic spray system typically has a higher transfer efficiency than a simple manual spray gun [2, 4]. A description of the major coating application technologies and their associated transfer efficiencies is presented in Section 2.2.

3.4 DESIGN AND OPERATIONAL CHANGES

Air recirculation can be used to reduce capital and operating costs of the air handling system. Recirculation can also reduce air flow streams to oxidizers, allowing a smaller control

system to be installed. Typical air recirculation systems filter, dehumidify, and return 10 to 80 percent of exhausted air to the supply air stream of a spray system. The remaining air is sent to the HAP/VOC control system [2].

This type of system is most viable for automated systems because it can be hazardous to personnel in manual spray areas. It can only be used for manual spray systems if the personnel are very well protected from the high organic solvent concentrations [2].

Air cascading systems can alleviate the employee risk problems concerning manual spray areas. In this type of scenario, exhausted air from a manual spray system can be used as supply air for an automated system (after particulate and humidity control). Therefore, the organic solvent rich air is cascaded to an automated coating line where there are no employees to be harmed by the air [2].

3.5 WORK PRACTICES

3.5.1 Material Storage and Handling

Storage demands vary based on the type of coating and usage requirements. Container size and type vary depending on coating manufacturer and end user needs. Most coatings are stored in 208 liter (55 gallon) drums. Powder coatings can also be stored in drums, as long as the temperature and the humidity are controlled. Most facilities store powder coatings in 23 kilogram (50 pound) cardboard boxes that are lined with plastic to prevent moisture absorption, but the size of the container can vary from 1.4 to 136 kilograms (3 to 300 pounds) [2].

These containers should be well maintained to prevent leakage and excessive spillage or material loss during transfer to other containers or coating equipment. They should also remain sealed except when it is necessary to remove material from the containers, after which they should be promptly closed again.

3.5.2 Fluid Handling Equipment

All fluid handling equipment such as coating lines, holding tanks, coating storage containers, or any fluid handling equipment that contains a VOC or HAP containing coating should be well maintained to prevent spills, leaks, or other problems that would release some of the contents of the fluid handling system.

3.5.3 Mixing Operations

Coating mixing may be performed in an agitated 208 liter drum, or it may be performed by merging two different coating lines into one. Coating mixing is typically performed at the

coating manufacturer prior to shipment to a large appliances surface coating operation. Some operations add water or organic solvent to the coating, which may be performed in a small mixing booth or it may be automated. Some operations combine reclaimed coatings from various coating applications and mix the different coatings together in a 208 liter drum. Mixing also varies depending on the type of coating and usage requirements [2].

3.5.4 Spraying Operations and Cleaning

Nozzle maintenance, although often overlooked, is a critical component of any metal pretreatment system. In order to keep the system running at maximum efficiency to produce the highest-quality finished product, nozzle maintenance must become a regular part of system operation [5].

Improperly maintained nozzles decrease spray impact and distort spray patterns, reducing cleaning efficiency. As a result, more time will be spent and more chemicals will be used to accomplish cleaning tasks [2].

Learning to identify, solve, and prevent spray nozzle performance problems in a parts washer can cut spray liquid and energy waste, assure better washer performance, and reduce chances of equipment damage. The same holds true for coating spray nozzles [2].

Typical cleaning activities involve organic solvent wipes, dips, and spraying of pure organic solvent which can contribute to the emissions from a facility. The amount of organic solvent released in this manner should be minimized to reduce emissions [2].

3.6 REFERENCES

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4.0 MODEL PLANTS AND COMPLIANCE OPTIONS

The model plants that have been developed for the large appliances NESHAP project are presented in Tables 4-3 through 4-6. Four model plants were developed to represent the facilities in the database that have been projected to be potential major sources, and thus, subject to this rulemaking. The following paragraphs present the methodology used to develop the model plants and the rationale for the assumptions that were made. A model plant does not represent any single actual facility, but rather it represents a range of facilities with similar characteristics that may be impacted by a standard. Each model plant is characterized in terms of facility size and other parameters that affect the estimates of emissions, control costs, and secondary environmental impacts. The model plants developed for this source category incorporate the baseline characteristics presented in this chapter.

The reductions in HAP emissions that will be required by these standards is expected to be achieved through the use of a combination of low-HAP and zero-HAP liquid coatings, thinning solvents, cleaning materials, and powder coatings. As described in Chapter 5 and the memorandum documenting the development of the MACT floor (Docket Item No. II-B-9), these low-HAP materials are in use at some facilities within the source category now, and are believed to be available for use by the entire source category. Because complying low-HAP material technology is believed to be available, none of the model plants are assumed to use add-on control devices.

The first step in developing the model plants was to decide on an approach to characterize the facilities in the database. Because this project focuses on the surface coating and related operations, it was decided that parameters related to the surface coating performed at each facility was the best way to characterize the model plants. Our analysis of the questionnaire responses, site visit reports, and other data available to us did not reveal patterns in the types of coatings or cleaning materials used, the application methods used, or the overall emissions that could be used to group the facilities into subsets for modeling. Tables 4-1 and 4-2 present information showing the distribution of coating application methods and coating types across the source category. The quantity of coating solids (nonvolatiles) annual usage appeared to be the most logical parameter to use to define the models because it relates directly to the level of production. Therefore, liters of coating solids used was chosen as the parameter by which the model plants would be defined.

TABLE 4-1. COATING APPLICATION METHODS VERSUS SIC CATEGORY

Coating Application Method	Number of Facilities Using Each Application Method[a]						Totals
	SIC 3585	SIC 3589	SIC 3631	SIC 3632	SIC 3633	SIC 3639	
Dip coating	13	2	4	3	6	6	34
Air spray	24	3	6	1	2	2	38
Airless spray	8	2	NR	NR	1	1	12
Air-assisted airless spray	17	2	1	2	NR	2	24
Electrostatic spray	30	5	7	3	6	8	59
Rotary bell/ disk	2	NR	NR	1	3	2	8
HVLP	17	7	2		1	2	29
Totals	111	21	20	10	19	23	204

[a]Facilities reporting more than one method are listed under each of the methods that they use.

Note: NR means this technology was not reported in the SIC category.

TABLE 4-2. COATING TYPE VERSUS SIC CATEGORY

Coating Type	SIC CODE					
	SIC 3585	SIC 3589	SIC 3631	SIC 3632	SIC 3633	SIC 3639
Solvent-based	10.90%	0.00%	27.50%	2.00%	28.90%	48.80%
Water-based	47.90%	1.20%	13.60%	98.00%	25.10%	20.20%
Powder	41.20%	98.80%	58.90%	0.00%	45.90%	31.00%

The MACT floor database contains questionnaire responses from 95 potential major source facilities. To determine the size characteristics of the model plants, the 95 facilities in the database were sorted by total volume of coating solids used, with reported values ranging from less than 100 liters to over 1,000,000 liters. An evaluation of various size ranges that could be

created from the database resulted in a decision to develop four groups of facilities, each to be represented by a model plant. The groups were characterized by total coating solids used, as follows: (1) up to 10,000 liters of solids represented by a model plant using 5,000 liters; (2) 10,001 to 50,000 liters of solids represented by a model plant using 25,000 liters; (3) 50,001 to 200,000 liters of solids represented by a model plant using 100,000 liters of solids; and (4) greater than 200,000 liters of solids represented by a model using 625,000 liters. Key parameters used to define each model plant were derived from an analysis of the actual facilities within the size range represented by the model. Because many of the questionnaire responses were incomplete, a subset of the database consisting of 66 facilities was used to calculate the average values used as parameters to define the model plants. These 66 facilities were believed to provide an adequate representation of the entire database of potential affected facilities. The 66 facilities cover the manufacturing of all major product types found within the source category, they include facilities that use small amounts of surface coating materials and 2 of the 3 largest users of surface coatings, they include all types of coating materials and application techniques reportedly used in the source category, and they include facilities covering all NAICS/SIC codes within the source category. Table 1-1 presents a listing of the products and the corresponding NAICS and SIC codes.

Tables 4-7 through 4-10 present the data used for the development of the model plants. Each row of data in these tables lists the HAP content and coating solids derived from the material usage and formulation information provided by one facility. The HAP emission rate for a facility, kg HAP/L coating solids (the last column in Tables 4-7 through 4-10), was determined by first adding all the HAP content shown in a row and dividing that value by the sum of the coating solids values. The rows were sorted and arranged in order of increasing coating solids usage. Table 4-7 contains information for all facilities that reported up to 10,000 liters of solids usage, which was used as the basis for defining model plant number 1. Tables 4-8 through 4-10 present the information used to define model plants 2 through 4, respectively. The HAP and coating solids values in each column were summed and divided by the number of facilities to generate an average value that is characteristic of the model plant. The average total coating solids usage value was then rounded for use in defining each model plant. All other HAP and

coating solids usage values were adjusted (scaled up) by the ratio of the average total coating solids to the rounded total coating solids. [For example, the average total coating solids usage for the facilities in Table 4-7 is 4,254 liters, which was rounded to 5,000 liters. The average HAP content of the water based coatings used by these facilities is 241 kg, which was scaled up to 283 kg (241 kg * 5,000 L / 4,254 L) for model plant number 1. Each of the other parameters were calculated by the same procedure.] The characteristic parameters for model plants 1 through 4 are shown in Tables 4-1 through 4-4, respectively.

Each of the four model plants has some level of material usage, and some HAP emissions, for all of the coating operations included within our affected-source-wide MACT floor approach. Therefore, each model plant has values for coatings, thinning, surface preparation, cleaning, and adhesives. While it is clear that in actual practice not every facility will employ all types of materials, the use of these materials is widespread within each size grouping of facilities. However, the coating technologies used within the four size groupings does exhibit a pattern that was included in the model plants. Water based coatings and solvent based coatings are used extensively in all sizes of facilities, but the use of powder coatings is much more common in larger facilities. For this reason, the two smallest model plants use only water based and solvent based coatings, while the two largest model plants use all three types of coatings.

To summarize, there are currently 95 potential major source facilities in the database that were used to develop the MACT floor. Data from 66 of these facilities were used to develop the characteristics of the 4 model plants because these facilities provided the most complete information. The characteristics of the 66 facilities that provided the most complete information are representative of the other 29 facilities in the database. Of the 95 facilities in the database, 21 facilities are classified as "synthetic minor sources" and, therefore, 74 facilities were assumed to be the population of affected sources. Model plant number 1, using 5,000 liters of solids, represents 26 facilities. Model plant number 2, using 25,000 liters of solids, represents 19 facilities. Model plant number 3, using 100,000 liters of solids, represents 17 facilities. Model plant number 4, using 625,000 liters of solids, represents 12 facilities.

TABLE 4-3. MODEL PLANT NUMBER 1
(UP TO 10,000 LITERS OF COATING SOLIDS)

	Plant Definition					
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)
Water-based Coatings	283	1,186	793	31	2,558	676
Solvent-based Coatings	1,872	1,189	3,794	42	9,011	2,381
Powder Coatings	0		0	100	0	0
Thinning Solvents	630	876	0	0	719	190
Surface Preparation	378	991	0	0	381	101
Cleaning Solvents	721	991	0	0	728	192
Adhesives	3	954	413	47	886	234
Total	3,887		**5,000**		14,284	3,774

kg HAP/L coating solids =0.777

Notes:
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives= Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)

TABLE 4-4. MODEL PLANT NUMBER 2
(10,001 TO 50,000 LITERS OF COATING SOLIDS)

	Plant Definition					
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)
Water-based Coatings	708	1,186	4,741	31	15,294	4,041
Solvent-based Coatings	8,357	1,189	19,612	42	46,584	12,308
Powder Coatings	0		0	100	0	0
Thinning Solvents	1,955	876	0	0	2,232	590
Surface Preparation	324	991	0	0	327	86
Cleaning Solvents	3,242	991	0	0	3,271	864
Adhesives	648	954	647	47	1,388	367
Total	15,234		**25,000**		69,096	18,255

kg HAP/L coating solids = 0.609

Notes:
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives= Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)

TABLE 4-5. MODEL PLANT NUMBER 3
(50,001 TO 200,000 LITERS OF COATING SOLIDS)

	Plant Definition					
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)
Water-based Coatings	4,102	1,186	30,299	31	97,739	25,823
Solvent-based Coatings	11,212	1,189	42,079	42	99,950	26,407
Powder Coatings	0		26,918	100	26,918	7,112
Thinning Solvents	6,500	876	0	0	7,420	1,960
Surface Preparation	229	991	0	0	231	61
Cleaning Solvents	7,340	991	0	0	7,407	1,957
Adhesives	53	954	704	47	1,511	399
Total	29,436		**100,000**		241,175	63,719

kg HAP/L coating solids = 0.294

Notes:
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives= Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)

TABLE 4-6. MODEL PLANT NUMBER 4
(GREATER THAN 200,000 LITERS OF COATING SOLIDS)

	Plant Definition					
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)
Water-based Coatings	24,460	1,186	162,884	31	525,432	138,820
Solvent-based Coatings	31,544	1,189	160,112	42	380,314	100,479
Powder Coatings	0		292,908	100	292,908	77,387
Thinning Solvents	42,992	876	0	0	49,078	12,966
Surface Preparation	122	991	0	0	123	33
Cleaning Solvents	15,408	991	0	0	15,548	4,108
Adhesives	10,709	954	9,096	47	19,519	5,157
Total	125,235		**625,000**		1,282,922	338,949

kg HAP/L coating solids = 0.200

Notes:
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives= Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)

	TABLE 4-7 DATA FOR MODEL PLANT NUMBER 1													
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
SIC Codes	Water Based		Solvent Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coating Solids	HAP Emission Rate
	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coating solids)
3589			564	677			215		153			932	677	1 376
3585			1087	730								1087	730	1 49
3589			74	40				472	174		749	720	789	0.913
3585			3044	920			491		0			3535	920	3.844
3585	244	1472	15	90				3142				3401	1562	2 177
3585			1066	1807			1720		35			2821	1807	1.562
3585	444	1995	5	90								449	2085	0.215
3589, 3631			894	2188			367	2470	4820			8551	2188	3 908
3585	65	588	1580	2482			1367	1633	3143			7788	3070	2.537
3585			1669	3427			435					2104	3427	0.614
3585			732	3682					310			1042	3682	0 283
3589			2337	3728			1010		1730			5077	3728	1.362
3585			6213	3984					1210			7423	3984	1.863
3585	1515	4162										1515	4162	0 364
3585	61	277	1470	4166					360			1891	4443	0.426
3585			2517	5029					510			3027	5029	0.602
3585			2286	5677					330			2616	5677	0 461
3585			3656	6446					543			4199	6446	0 651
3585			3039	6590			4260		730			8029	6590	1 218
3634	360	4599	457	2886								817	7485	0.109
3585			2607	5289						69	2365	2676	7654	0 35
3585			1667	8197			950					2617	8197	0 319
3585	705	2161	220	766					93	0	5320	1018	8247	0 123
3639	2387	939	1035	8573			2041		573			6036	9512	0.635
AVERAGE	241	675	1593	3228	0	0	536	322	613	3	351	3307	4254	0 777
ROUNDED	283	793	1872	3794	0	0	630	378	721	3	413	3887	5000	0.777

NOTES: Information in this table was obtained from the responses to the 1998 industry questionnaires. Responses are located in Docket A-97-41, Category II-D.
Column O (HAP Emission Rate) = Columns (B+D+F+H+I+J+K) ÷ Columns (C+E+G+L)

	TABLE 4-8 DATA FOR MODEL PLANT NUMBER 2													
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
SIC Codes	Water Based		Solvent Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coating Solids	HAP Emission Rate
	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coating solids)
3585	390	3580	2120	6256			624	303	2260	70	1135	5767	10971	0.526
3589			1475	11268					2397	0	13	3872	11281	0 343
3585	885	3208	2085	8078					6700			9670	11286	0 857
3585	458	11634										458	11634	0.039
3585	704	5193	7866	6796				26	6138	62	54	14796	12043	1.229
3585			20012	12897			2541		0			22553	12897	1 749
3632	1057	0	4023	19137			404		67			5551	19137	0.29
3585			473	20438			7985		3230			11688	20438	0.572
3585			4782	21573			8579		1360			14721	21573	0.682
3585			5269	22269			1160		4			6433	22269	0 289
3585			543	25013					440			983	25013	0 039
3589			22370	25509			2887	270	0			25527	25509	1.001
3632			303	26351				360	830			1493	26351	0 057
3585			6579	29310			156		13900			20635	29310	0 704
3585			8742	30379			1213		5385			15340	30379	0 505
3585	1948	15079	3112	9326				5280	1912	5433	6350	17685	30755	0.575
3632			7069	33069			2470		17200			26739	33069	0.809
3585			59771	31297			9497			6929	4929	76197	36226	2 103
3585		4114	4535	39198								4535	43312	0 105
3639	8220	48629	31	41			192		690			9133	48670	0.188
AVERAGE	683	4572	8058	18910	0	0	1885	312	3126	625	624	14689	24106	0 609
ROUNDED	708	4741	8357	19612	-	-	1955	324	3242	648	647	15234	25000	0.609

NOTES: Information in this table was obtained from the responses to the 1998 industry questionnaires. Responses are located in Docket A-97-41, Category II-D.
Column O (HAP Emission Rate) = Columns (B+D+F+H+I+J+K) ÷ Columns (C+E+G+L)

	TABLE 4-9 DATA FOR MODEL PLANT 3													
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
SIC Codes	Water Based		Solvent Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coating Solids	HAP Emission Rate
	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coating solids)
3632			655	57559			69	479	590			1793	57559	0.031
3639	0	42296	9538	15982			809		12410			22757	58278	0.39
3639	10551	63105		0								10551	63105	0.167
3585			17575	64291			13455	35	0	791	1987	31856	66278	0.481
3585	0	2085	14551	58031			4248		8195	0	8540	26994	68656	0.393
3585	8801	43493	32209	34686			51195		49938			142143	78179	1.818
3632			553	80253			11087		20761			32401	80253	0.404
			1795	1478	0	103672		2900				4695	105150	0.045
3632, 3639	5250	78520	57947	27446			1470		280			64947	105966	0.613
3585			4057	108241			91		5040			9188	108241	0.085
3633			6266	93399	0	25024	185		7250			13701	118423	0.116
3631	6617	106731	4136	15008			452		2050			13255	121739	0.109
	12940	9747		147	0	128369	3682					16622	138263	0.12
			17624	11419	0	145025	6437		170			24231	156444	0.155
3631	17116	106615	573	60623			3909		2960			24558	167238	0.147
AVERAGE	4085	30173	11165	41904	0	26806	6473	228	7310	53	702	29313	99585	0.294
ROUNDED	**4102**	**30299**	**11212**	**42079**	-	**26918**	**6500**	**229**	**7340**	**53**	**705**	**29435**	**100000**	**0.294**

NOTES: Information in this table was obtained from the responses to the 1998 industry questionnaires. Responses are located in Docket A-97-41, Category II-D.
Column O (HAP Emission Rate) = Columns (B+D+F+H+I+J+K) ÷ Columns (C+E+G+L)

	TABLE 4-10 DATA FOR MODEL PLANT NUMBER 4													
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
SIC Codes	Water Based		Solvent Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coating Solids	HAP Emission Rate
	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coating solids)
3633			35707	148526	0	77912	36820	840	15755			89122	226438	0.394
3639			33317	266654			15012		39999	686	1240	89014	267894	0.332
3639	6975	86183	6466	29894	0	397851	92400		0	10248	1287	116089	515215	0.225
3633			58133	178182	0	301163	12108		10770	60840	57287	141851	536632	0.264
3633	0	100992	64414	256996	0	219512	108546		15350	2211	3021	190521	580521	0.328
3633	104052	676678	4399	52164	0	349826	3544		24572			136567	1078668	0.127
3633	57956	261434	15485	173724	0	677296	28584					102025	1112454	0.092
AVERAGE	24140	160755	31132	158020	0	289080	42431	120	15207	10569	8976	123598	616832	0.2
ROUNDED	**24460**	**162884**	**31544**	**160112**	**-**	**292908**	**42992**	**122**	**15408**	**10709**	**9095**	**125235**	**625000**	**0.2**

NOTES: Information in this table was obtained from the responses to the 1998 industry questionnaires. Responses are located in Docket A-97-41, Category II-D.
Column O (HAP Emission Rate) = Columns (B+D+F+H+I+J+K) ÷ Columns (C+E+G+L)

5.0 REGULATORY APPROACH

This chapter presents the approach used to determine the MACT floor level of control for new and existing facilities in the large appliances surface coating source category.

5.1 BACKGROUND

Section 112 of the CAA requires that we establish NESHAP for the control of HAP from both new and existing major sources. The CAA requires the NESHAP to reflect the maximum degree of reduction in emissions of HAP that is achievable. This level of control is commonly referred to as the MACT.

The MACT floor is the minimum control level allowed for NESHAP and is defined under section 112(d)(3) of the CAA. In essence, the MACT floor ensures that the standard is set at a level that assures that all major sources achieve the level of control at least as stringent as that already achieved by the better-controlled and lower-emitting sources in each source category or subcategory. For new sources, the MACT floor cannot be less stringent than the emission control that is achieved in practice by the best-controlled similar source. The MACT standards for existing sources can be less stringent than standards for new sources, but they cannot be less stringent than the average emission limitation achieved by the best-performing 12 percent of existing sources in the category or subcategory (or the best-performing five sources for categories or subcategories with fewer than 30 sources).

In developing MACT, we also consider control options that are more stringent than the floor. We may establish standards more stringent than the floor based on the consideration of the cost of achieving the emission reductions, any non-air quality health and environmental impacts, and energy requirements.

5.2 MACT FLOOR APPROACH

Within the large appliances industry, organic HAP emission control for cleaning and surface coating operations is accomplished primarily through the use of lower-HAP coatings, thinners, and cleaning materials. Add-on capture and control systems for organic HAP are rarely used by the industry. While lower organic HAP materials have achieved broad use throughout the industry, each particular coating technology is not used at every facility. Rather, facilities use various combinations of low-HAP coatings, thinning solvents (thinners), and cleaning materials.

Thus, we judged the most reasonable approach to establishing a MACT floor to be the evaluation of a facility's organic HAP emissions from all coating-related operations. To account for differences in production levels from one facility to another, we normalized the organic HAP emissions by the volume of coating solids used to calculate the emision rate. We believe coating solids usage is an appropriate indicator of overall production level.

We used information obtained from industry responses to a 1998 questionnaire submitted under the authority of Section 114 to calculate the source-wide organic HAP emission rate from each survey respondent. The questionnaire was submitted to all known large appliance manufacturers, and the responses represent the most complete (and most current) information available to us. Of the 222 facilities that provided responses to the questionnaire, 95 were found to be potential major sources, with 21 of these identified as synthetic minor sources. Table 5-1 presents a summary of data extracted from the responses submitted by the 95 potential major sources and used in developing the MACT floors. We calculated total organic HAP emissions by assuming that 100 percent of the organic HAP in all coatings (including adhesives), thinners, and cleaning materials (including surface preparation materials) is emitted. This is a reasonable assumption for coatings and thinners, because coated substrates are generally cured in an oven, which will accelerate the release of HAP containing volatile materials. We also expect that a large portion of cleaning solvents will evaporate during the application operation and from waste solvent. Major sources were identified as: (1) those facilities that listed "major source" or "synthetic minor source" as their Title V status on their questionnaire response, (2) those facilities that reported their HAP emissions under "maximum design capacity" as greater than 9.1 Mg/yr (10 tpy), and (3) other facilities that were judged to have the capacity to increase their HAP emissions to greater than 9.1 Mg/yr, based on their reported emissions. Facilities that were included as a result of item (3) were those that did not report a "maximum design capacity," but did report actual emissions of greater than 3 Mg (3.3 tons) during the reporting year. These facilities were assumed to be operating one shift per day and to have the capacity to operate three shifts per day, resulting in emissions of greater than 9.1 Mg per year.

The questionnaire response information from the 95 potential major source facilities was used to determine the total source-wide HAP emissions and the total volume of coating solids used by each facility from all types of coatings. Data provided in the responses to the questionnaires were reviewed for completeness and, where needed, were converted to consistent Metric units. In some cases where facilities did not provide complete information on the quantity

or formulation of materials in the requested units, a default value for material density was used to enable conversion between units of mass and volume. The default values were calculated by averaging the values reported by all other respondents for similar types of materials. Table 5-2 presents the default density values that were used when necessary for unit conversions. The HAP and solids contents of all materials used at each facility were summed by material type (water-based, solvent-based, powders, thinners, surface prep, cleaners, and adhesives) to yield the source-wide data presented in Table 5-1. We included decorative, protective, and functional coatings as well as thinners and surface preparation materials in this total.

Using the source-wide organic HAP emissions and the total volume of coating solids used for each survey respondent, we calculated the normalized organic HAP emission rate in units of kilograms organic HAP per liter of coating solids used. This value is presented on Table 5-1 in column P, titled "HAP emission rate." Using the column headings A through R in Table 5-1 for reference, the equation for this calculation is as follows:

$$(C+E+G+I+J+K+L) \div (D+F+H+M) = \text{HAP emission rate}$$

The facilities were then ranked from the lowest emission rate to the highest (sorted in ascending order based on the values in column P). We did not include in the MACT floor calculations facilities which: (1) did not report any cleaning material usage or did not provide sufficient coating material formulation data; (2) reported more than 90% of their coating solids as being from powder coatings; and (3) used an unusually large percentage of low HAP and non HAP adhesives. The facilities that were excluded from the MACT floor calculations are indicated by the footnotes in Table 5-1. Only those facilities that were evaluated as MACT floor facilities and excluded from the top 12 percent were assigned a footnote in Table 5-1. We excluded facilities that did not report any cleaning material usage or did not provide adequate coating material formulation data because we did not have confidence that the final calculated HAP emission rate value would represent all their emissions. Facilities that reported the predominant use of powder coating technology (greater than 90 percent of all coating solids usage) were excluded from the MACT floor calculations. While powder coating technology is a proven low-HAP coating technology, its applicability is not considered to be universal for all products manufactured within the source category. For those facilities whose products can be coated with this technology, powder coatings are a very effective and efficient means of reducing HAP emissions. However, because not all large appliance parts and products can be satisfactorily coated with powder coating technology, we concluded that it would not be

appropriate to define the MACT floors based primarily on their use. We excluded facilities with very low organic HAP to coating solids ratios due to use of unusually large quantities of low-HAP and non-HAP adhesives. The low- and non-HAP adhesive usage for these facilities ranged from 40 to 84 percent of all coating solids. While many facilities in this source category use adhesives, their use is not as widespread compared to the decorative and protective coatings usually associated with the appearance of large appliance products. On the average, adhesives account for about 4 percent of the total coating solids used by the facilities in the database. Because of the specific function served by adhesives, the low-HAP adhesives technology employed in these coatings may not be transferrable to decorative coatings and protective coatings which account for the remaining 96 percent of the coating solids usage in the surce category. Thus, we concluded that the facilities using atypically large quantities of these adhesives relative to decorative and protective coatings should not be included in the determination of the floors for new and existing sources.

5.3 EXISTING SOURCES

For the existing source MACT floor, the top 12 percent of the facilities were determined based on the number of facilities in the MACT floor database (95 database facilities x 12 percent = 11.4). Because the calculated value was greater than 11, we used data from 12 facilities to determine the MACT floor. The floor was calculated as the arithmetic average of the emission rates of the top 12 best-performing representative facilities. These 12 facilities are identified in Table 5-1 by the shaded rows.

This process resulted in a MACT floor equal to 0.134 kg HAP/L of coating solids. For the proposed standards this value was rounded to two significant figures, i.e., 0.13 kg HAP/L of coating solids (1.1 lb/gal). The MACT floor facilities are typical of the remaining facilities in the database in terms of the substrates coated, the coating and coating application technologies used, or the applicability of control measures across the various operations. The 12 facilities included in the MACT floor calculation include facilities that manufacture a range of products that are typical of the entire industry, and include washers and dryers, laundry equipment, refrigerators/freezers, microwave ovens, dishwashers, water heaters, air conditioners, gas heaters, supermarket refrigerated display cases, chillers, fans, compressors, and air handling units. Coating application techniques used at the 12 facilities include all those typically found within the source category, and include conventional air and airless atomized spraying, electrostatic

spraying, and dip coating. The amount of coatings applied by the 12 MACT floor facilities is representative of facilities throughout the source category. The 12 facilities reported coating solids usage ranging from about 6,000 liters to about 1,079,000 liters. For the entire MACT database of 95 facilities, coating usage ranges from below 1,000 liters to over 4,000,000 liters of coating solids. Only three facilities in the database reported the use of over 1,000,000 liters of coating solids, and one of those facilities is in the MACT floor. The average coating usage for the 12 MACT floor facilities is about 211,000 liters of coating solids and for all facilities in the MACT database the average usage is about 147,000 liters of coating solids. Six of the 12 facilities use a combination of liquid coatings and powder coatings. The other six do not use any powder coatings, and are using only low-HAP liquid coating materials to achieve the low HAP emission rates indicated in Table 5-1. Four of the 12 MACT floor facilities reported the use of adhesives, compared to 19 of the 95 MACT database facilities that reported adhesive use. The amount of adhesives used by the 12 MACT floor facilities and the HAP content of those adhesives is typical of the other facilities in the source category.

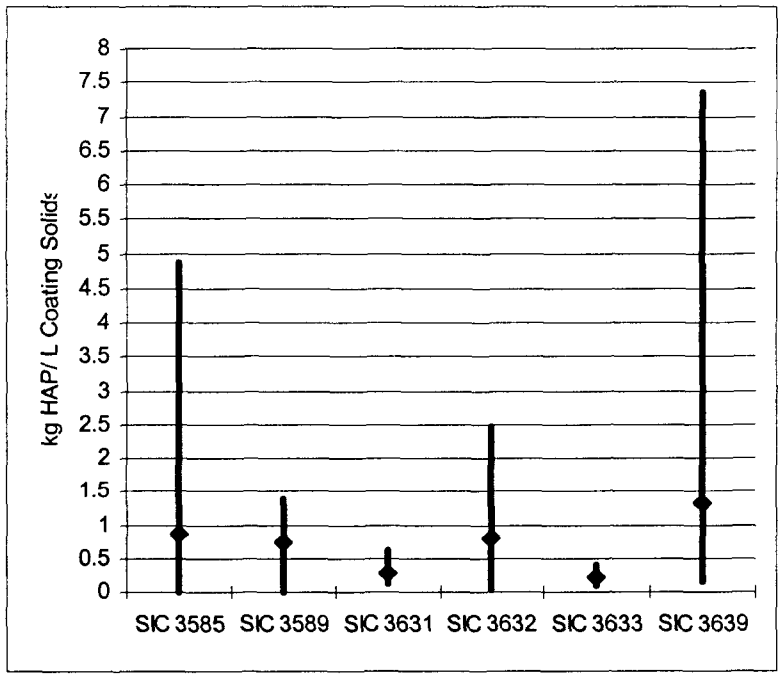
To evaluate the potential availability of low-HAP liquid coatings, an examination of the reported HAP contents of water based and solvent based coatings was performed. When the HAP emission rate for each facility in the spreadsheet was calculated using the HAP and solids data from only liquid coatings plus thinners, 15 facilities were found to have HAP emission rates below 0.13 kg HAP/L coating solids. The coating solids content of the liquid coatings applied at these 15 facilities equals 29 percent of the total coating solids from liquid coatings applied at all facilities in the spreadsheet. Therefore, 29 percent of the liquid coatings currently in use, in terms of coating solids, would comply with the proposed existing-source emission limit.

A similar evaluation was performed to examine the availability of low-HAP adhesives and cleaning materials. Of the 19 facilities that provided data on adhesives, 6 reported using adhesives containing no HAP, and 4 additional facilities reported using adhesives with HAP levels that are less than 0.13 kg HAP/L coating solids. In addition, nine of the facilities in the spreadsheet reported the use of cleaning materials with zero HAP content.

Figure 5-1 shows the range of HAP emission rates calculated for facilities within each of the six activity (SIC) categories, with the arithmetic average HAP emission rate indicated by the diamond-shaped symbol. (Table 1-1 shows the six SIC categories, a description of the major products manufactured under each category, and the corresponding NAICS information.) As shown in Figure 5-1, the average emission rate for each of the SIC categories is in the same

general range. The average for SIC 3639 is somewhat misleading because a single facility reported a HAP level of 7.36 kg per liter of coating solids, and the next highest reported level in the SIC category is only 0.635 kg per liter of coating solids. The similarity of the average values for all SIC categories indicates that the HAP content of materials used throughout the source category does not vary significantly from one product line to another. Also, because low-HAP coatings are already being used within each SIC category, it appears that the use of low-HAP coatings is a viable option for products manufactured under all six of the SIC categories.

Figure 5-1. HAP emission rate (normalized emissions) versus SIC code.



In addition to the availability of low-HAP liquid coatings, the widespread usage of powder coatings within the appliance industry provides evidence of the availability of applicable low-HAP coating technology. Powder coating technology is reported to be the fasted growing industrial finishing method in North America, representing about 15 percent of the total industrial finishing market.[1] The appliance industry is the largest single market sector for thermosetting powders.[1] Current uses within the source category include refrigerators, washer tops and lids, dryer drums, range housings, dishwashers, microwave oven cavities, and freezer cabinets.[1]

With the availability of powder coatings and because the percentages of liquid coatings, adhesives, and cleaners that currently comply with the HAP emission limit are relatively high, and because the use of these materials is reported across the SIC categories, we believe that low-HAP coating technology is available to all facilities within the source category. In addition, for a majority of the facilities within the source category, the "one number" format of the standard would allow the higher HAP emissions from certain operations where low-HAP materials may not be readily available to be offset by increased usage of available low-HAP materials in other operations within the facility.

5.4 NEW SOURCES

To determine the new source MACT limit, we identified the best performing sources from the list of database facilities ranked by their emission rate. As discussed above, two of the best performing of the potential major sources reported a HAP content well below the existing source MACT floor. However, these facilities were judged to be unique in their level of adhesives usage relative to their decorative coating usage and were not considered for the new source MACT.

The next best performing facility reported a HAP content level of 0.022 kg HAP per liter of coating solids. This facility operates under SIC 3585 and manufactures supermarket display cases and equipment. This facility uses both solvent-based coatings and powder coatings, and is considered to be representative of the entire source category. The proposed new source MACT limit was, therefore, established using the data from this facility. The facility-wide HAP content value of 0.022 kg HAP per liter of coating solids was determined to be the new source MACT floor. The fact that the facility upon which the new source MACT level is based uses a

combination of solvent-based and powder coatings indicates that new facilities would not be limited to the use of only powder coatings to comply with the proposed standards. The availability of low-HAP liquid coatings, in conjunction with the widespread increase in the use of powder coatings in the large appliance source category (as discussed in the previous section of this chapter), indicates that the new source MACT level is achievable for new facilities.

5.5 BEYOND THE FLOOR

An analysis of the impacts of establishing standards more stringent than the MACT floors was conducted. For the analysis of standards more stringent than the existing source MACT floor, we considered the impacts of standards based on the average performance of the top 6 percent of the best performing facilities compared to the MACT floor level based on the top 12 percent. This level of stringency was evaluated because it represented roughly the midpoint between the existing and new source MACT floors, and because it was expected to result in significant HAP emission reductions. From Table 5-1, the top 6 percent of the best performing facilities would be the first 6 shaded rows. The average HAP emission rate for these 6 facilities is 0.08 kg/L coating solids. Applying this level of control to Model Plant Number 1 would result in an incremental HAP emission reduction of 250 kg. [MP #1 uses 5,000 liters of coating solids: at the proposed emission limit of 0.13 kg/L coating solids, HAP emissions are 5,000 * 0.13 = 650 kg; at an emission limit of 0.08 kg/L coating solids, HAP emissions are 5,000 * 0.08 = 400 kg] For Model Plants 2 through 4, the incremental emission reductions are 1,250 kg, 5,000 kg, and 31,250 kg, respectively.

At the beyond the floor level considered here, the availability of complying coating materials and cleaning materials that could be used without extensive process or equipment modifications is expected to become a problem for many existing facilities. Because complying materials that can be used with existing coating equipment may not be available, some facilities may be faced with the possibility of being required to convert a liquid coating line to powder coatings or to install add-on control devices to comply with the standards. While a detailed cost analysis for this type of conversion or installation was not performed for our evaluation of the beyond the floor option, it is expected that the cost effectiveness of requiring such steps would not be acceptable. As an example of the range of cost effectiveness values that could be expected, we projected the annual costs for converting Model Plants 2 and 3 to the use of powder coatings. The costs for such a conversion were estimated from information gathered during the

development of the NESHAP for the metal furniture source category.[2] The annual costs to convert Model Plants 2 and 3 from liquid coating lines to powder coating lines were projected from the costs developed to convert similar sized metal furniture model plants. For Model Plant 2, which uses 25,000 liters of coating solids per year, the annual cost for the conversion to powder coatings was estimated to be $150,000. For Model Plant 3, which uses 100,000 liters of coating solids, the annual cost was estimated to be $200,000. In order to project the highest possible emission reduction values, and, thus, the "best-case" cost effectiveness values, it was assumed that the two model plants converted all of their coatings to powder coatings and that they also use zero-HAP cleaning and surface preperation materials. Therefore, for our example, the emission rate for the models under our beyond the floor option would be zero. For Model Plant 2, which could emit 3,250 kg of HAP under the floor level of control (25,000 liters of coatings solids * 0.13 kg per liter of coating solids = 3,250 kg), the projected cost effectiveness is $46,154 per Mg of HAP emissions reduced ($150,000 ÷ 3,250 kg *1,000 kg per Mg). For Model Plant 3, which could emit 13,000 kg of HAP under the floor level of control (100,000 liters of coating solids * 0.13 kg per liter of coating solids = 13,000 kg), the projected cost effectiveness is $15,385 per Mg of HAP emissions reduced ($200,000 ÷ 13,000 kg * 1,000 kg per Mg).

The analysis presented above indicates that the cost effectiveness values are better for the larger facilities. While this may be true in some cases, it should be noted that in actual practice many facilities, regardless of their size, are expected to be unable to use zero-HAP technology for all their coating, cleaning, and surface preperation needs. Thus, the example presented above overstates the potential emission reductions that would be expected if a level of control beyond the MACT floor level were required. The cost effectiveness values projected here were not considered to be reasonable, and a beyond the floor option was not selected.

A beyond the floor option for the new source standards was rejected because no options were identified that were believed to be applicable to all segments of the source category. While the floor level of control is believed to be achievable through the use of a combination of available low-HAP liquid coatings and powder coatings, more stringent control levels would rely on the use of increasing percentages of powder coatings. As discussed in previous sections, powder coatings are not believed to be a technology that can be utilized for all coating needs in all segments of the source category. For example, powder coatings may not be suitable for products with narrow gaps between surfaces or deep recesses where powder may not penetrate or

cover adequately. Thus, establishing beyond the floor standards that could be achieved only by the near exclusive use of powder coatings could not be justified.

TABLE 5-1. SURFACE COATING EMISSION DATA USED IN DEVELOPING THE MACT FLOORS

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Facility	SIC Codes	Water-Based		Solvent-Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coatmg Solids	HAP emission rate	Title V Status	Notes
		HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coatmg Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coatmg solids)		
LA-003	3639	0	534,465			0	95,142						0	629,607	0.000	Synthetic Minor Source	X
LA-401	NA*					0	77,912						0	77,912	0.000	Major Source	X
LA-057	3631			6	13	0	167,593	9		27			42	167,606	0.000	Synthetic Minor Source	Y
LA-123	3589					0	4,288,773			966	2,636	697	3,602	4,289,470	0.001	Major Source (>= 3 Mg)	Y
LA-351-E	3585			316	974	0	42,698	0	0	0	0	66,282	316	109,954	0.003	Major Source	Y
LA-351-D	3585			543	25,013					440	0	135,580	983	160,593	0.006	Major Source	Z
LA-351-JA	3585			114	351	0	15,986				0	1,773	114	18,110	0.006	Synthetic Minor Source	Y
LA-230-B	3585				16	0	18,403			117			117	18,419	0.006	Synthetic Minor Source	Y
LA-205-D	3585	33	34,197	60	61	0	59,537			1,675	301	63,827	2,069	157,622	0.013	Major Source	Z
LA-157	3585			651	6,559	0	58,291		346	0			997	64,850	0.015	Synthetic Minor Source	Y
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-399-E	3585	458	11,634										458	11,634	0 039	Major Source (Max Design >= 9.07 Mg)	X
LA-271-C	3632			17,344	417,969								17,344	417,969	0.041	Major Source	X
LA-045-A	3585			1,795	1,478	0	103,672		2,900				4,695	105,150	0.045	Major Source (>= 3 Mg)	Y
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-387-G	3633	57,956	261,434	15,485	173,724	0	677,296	28,584					102,025	1,112,454	0 092	Major Source	X
LA-399-D	3585		4,114	4,535	39,198								4,535	43,312	0.105	Major Source (>= 3 Mg)	X
LA-360-B	3634	360	4,599	457	2,886								817	7,485	0.109	Major Source	X
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-222-C	3631	12,940	9,747		147	0	128,369	3,682					16,622	138,263	0.120	Synthetic Minor Source	Y
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-278-A	3585			17,624	11,419	0	145,025	6,437		170			24,231	156,444	0.155	Major Source	Y
LA-175	3639	10,551	63,105		0								10,551	63,105	0.167	Major Source	X
LA-089-A	3585	7,951	9,915			0	33,245						7,951	43,160	0.184	Major Source (>= 3 Mg)	X
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-104	3585	444	1,995	5	90								449	2,085	0.215	Synthetic Minor Source	X
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LA-386	3631	6,617	36,911	3,962	15,008			452		2,050			13,081	51,919	0.252	Major Source	
LA-330	3556	1,358	6,232	124	94					150			1,632	6,326	0 258	Major Source (Max Design >= 9.07 Mg)	
LA-222-B	3633			58,133	178,182	0	301,163	12,108		10,770	60,840	57,287	141,851	536,632	0.264	Major Source	
LA-365-A	3585			4,057	31,783			91		5,040			9,188	31,783	0.289	Major Source (>= 3 Mg)	
LA-295	NA*					0	12,446			3,890			3,890	12,446	0.313	Major Source (>= 3 Mg)	
LA-332-A	3585			1,667	8,197			950					2,617	8,197	0.319	Synthetic Minor Source	
LA-222-A	3633	0	100,992	64,414	256,996	0	219,512	108,546		15,350	2,211	3,021	190,521	580,521	0.328	Major Source	

TABLE 5-1. SURFACE COATING EMISSION DATA USED IN DEVELOPING THE MACT FLOORS

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Facility	SIC Codes	Water-Based		Solvent-Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coatmg Solids	HAP emission rate	Title V Status	Notes
		HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coatmg Solids (L)	(kg)	(L)	(kg HAP/L coatmg solids)		
LA-318	3639			33,317	266,654			15,012		39,999	686	1,240	89,014	267,894	0.332	Major Source	
LA-158-E	3589			1,475	11,268					2,397	0	13	3,872	11,281	0.343	Synthetic Minor Source	
LA-089-D	3585	1,515	4,162										1,515	4,162	0.364	Synthetic Minor Source	
LA-402	3632	3,972	15,144					404		1,176			5,552	15,144	0 367	Major Source	
LA-074-B	3589			4,609	12,379					0			4,609	12,379	0.372	Synthetic Minor Source	
LA-055	3639	0	42,296	9,538	15,982			809		12,410			22,757	58,278	0.390	Major Source	
LA-126	3585	0	2,085	14,551	58,031			4,248		8,195	0	8,540	26,994	68,656	0 393	Major Source	
LA-388-O	3633			35,707	148,526	0	77,912	36,820	840	15,755			89,122	226,438	0 394	Major Source	
LA-387-C	3632			553	80,253			11,087		20,761			32,401	80,253	0.404	Major Source	
LA-027	3585	61	277	1,470	4,166					360			1,891	4,443	0.426	Synthetic Minor Source	
LA-399-H	3585			2,286	5,677					330			2,616	5,677	0 461	Major Source (>= 3 Mg)	
LA-132	3585			17,575	64,291			13,455	35	0	791	1,987	31,856	66,278	0.481	Major Source (>= 3 Mg)	
LA-199	3585			8,742	30,379			1,213		5,385			15,340	30,379	0.505	Major Source	
LA-351-G	3585	390	3,580	2,120	6,256			624	303	2,260	70	1,135	5,767	10,971	0 526	Synthetic Minor Source	
LA-399-B	3585			473	20,438			7,985		3,230			11,688	20,438	0 572	Major Source	
LA-069-A	3585	1,948	15,079	3,112	9,326				5,280	1,912	5,433	6,350	17,685	30,755	0.575	Synthetic Minor Source	
LA-399-G	3585			2,517	5,029					510			3,027	5,029	0.602	Major Source (>= 3 Mg)	
LA-266	3631					0	32,657	1		19,970			19,971	32,657	0.612	Major Source (>= 3 Mg)	
LA-387-A	3585,3632,9	5,250	78,520	57,947	27,446			1,470		280			64,947	105,966	0 613	Major Source	
LA-403	3639	2,387	939	1,035	8,573			2,041		573			6,036	9,512	0.635	Major Source	
LA-373	3585			3,656	6,446					543			4,199	6,446	0.651	Major Source (Max Design >= 9.07 Mg)	
LA-388-C	3585			4,782	21,573			8,579		1,360			14,721	21,573	0.682	Major Source	
LA-365-B	3585			6,579	29,310			156		13,900			20,635	29,310	0.704	Major Source	
LA-222-D	3632			7,069	33,069			2,470		17,200			26,739	33,069	0.809	Major Source	
LA-399-F	3585			732	3,682			2,023		310			3,065	3,682	0.833	Major Source (>= 3 Mg)	
LA-399-A	3585	885	3,208	2,085	8,078					6,700			9,670	11,286	0.857	Major Source	
LA-335	3589			22,370	25,509			2,887	270	0			25,527	25,509	1.001	Major Source	
LA-059	3585			3,039	6,590			4,260		730			8,029	6,590	1 218	Major Source (>= 3 Mg)	
LA-351-K	3585	704	5,193	7,866	6,796				26	6,138	62	54	14,796	12,043	1.229	Synthetic Minor Source	
LA-174	3589			2,337	3,728			1,010		1,730			5,077	3,728	1.362	Major Source (>= 3 Mg)	
LA-251-A	3589			564	677			215		153			932	677	1.376	Major Source (Max Design >= 9.07 Mg)	
LA-069-D	3585			1,087	730								1,087	730	1 490	Synthetic Minor Source	
LA-121-C	3585			. 066	1,807			1,720		35			2,821	1,807	1 562	Major Source (>= 3 Mg)	
LA-038	3585			20,012	12,897			2,541		0			22,553	12,897	1.749	Synthetic Minor Source	
LA-205-A	3585	8,801	43,493	32,209	34,686			51,195		49,938			142,143	78,179	1 818	Major Source	
LA-223	3585	1,560	4,511	14,584	4,582					460			16,604	9,093	1 826	Major Source	
LA-399-K	3585			6,213	3,984					1,210			7,423	3,984	1 863	Synthetic Minor Source	
LA-340	3585			59,771	31,297			9,497			6,929	4,929	76,197	36,226	2 103	Major Source	
LA-351-C	3585	244	1,472	15	90				3,142				3,401	1,562	2.177	Major Source (Max Design >= 9.07 Mg)	
LA-387-J	3632			147,456	133,146			147,800					295,256	133,146	2.218	Major Source	
LA-218	3632			6,474	6,615			3,889		5,960			16,323	6,615	2 468	Major Source	
LA-269	3585	65	588	1,580	2,482			1,367	1,633	3,143			7,788	3,070	2.537	Synthetic Minor Source	

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Facility	SIC Codes	Water-Based		Solvent-Based		Powder		Thinning	Surface Prep	Cleaning	Adhesives		Total HAPs	Total Coating Solids	HAP emission rate	Title V Status	Notes
		HAP (kg)	Coating Solids (L)	HAP (kg)	Coating Solids (L)	HAP (kg)	Coatmg Solids (L)	HAP (kg)	HAP (kg)	HAP (kg)	HAP (kg)	Coating Solids (L)	(kg)	(L)	(kg HAP/L coating solids)		
LA-069-C	3585	11,523	4,169										11,523	4,169	2.764	Major Source	
LA-040	3585					0	7,324		26,780				26,780	7,324	3.656	Major Source	
LA-356	3589, 3631			894	2,188			367	2,470	4,820			8,551	2,188	3.908	Major Source (Max Design >= 9.07 Mg)	
LA-121-A	3585			2,281	5,212			8,128		15,000			25,409	5,212	4.875	Major Source (>= 3 Mg)	
LA-388-I	3639			5,314	722								5,314	722	7.362	Synthetic Minor Source	
LA-360-A	NA*			105	1,633				0	18,900			19,005	1,633	11.641	Major Source	
LA-288	3589			507	341			0	8,234	33			8,774	341	25.731	Major Source (>= 3 Mg)	
LA-351-P	3585				0								0	0	??	Major Source	
LA-388-L	3631				0								0	0	??	Major Source (Max Design >= 9.07 Mg)	
LA-388-N	3635				0								0	0	??	Major Source (Max Design >= 9.07 Mg)	
LA-137-L	3631,2,3,9												0		??	Major Source	
LA-170-C	NA*												0		??	Major Source (>= 3 Mg)	
LA-264	NA*												0		??	Major Source (Max Design >= 9.07 Mg)	

* NA = Not Available (Facility did not provide information)

NOTES·

X The facility did not provide sufficient information to calculate their HAP emission rate from all coating operations

Y This data indicates that greater than 90 % of coating solids are from powder.

Z This data indicates a high adhesive usage.

NOTES:

- Information presented in this table was obtained from responses to the 1998 industry questionnaire. Responses are located in Docket A-97-41, Category II-D
- Cells with "0" represent reported values of zero; blank cells represent no data reported
- Column P (HAP emission rate) = Columns (C+E+G+I+J+K+L) ÷ Columns (D+F+H+M)

TABLE 5-2. DEFAULT DENSITIES USED FOR UNIT CONVERSIONS

TYPE OF MATERIAL	DEFAULT DENSITY (GRAMS PER LITER)
Conventional Solvent Based Coatings	1,063
High Solids Solvent Based Coatings	1,315
Water Based Coatings	1,265
Powder Coatings	1,584
Cleaning Materials	991
Thinning Materials	876

NOTES:

- Information presented in this table was obtained from responses to the 1998 industry questionnaire. Responses are located in Docket A-97-41, Category II-D.
- Multiply grams per liter by 0.00835 to obtain pounds per gallon

5.6 REFERENCES

1. G. Bocchi, The Powder Coating Institute. Products Finishing, "Powder Coating in the Year 2000." July, 2000. 4 pp.

2. Memorandum from D. Hendricks, E/CR, Inc. to M. Serageldin, EPA:CCPG. "New Source MACT Cost Impacts for Metal Furniture Surface Coating Source Category," July 10, 2000 (Revised November 16, 2000). Appendix A. Docket No. A-97-40, Item No. II-A-5.

6.0 ENVIRONMENTAL, HEALTH, AND ENERGY IMPACTS

This chapter presents the estimated HAP emission reductions and discusses the non-air quality health and environmental impacts and energy requirements associated with implementing the MACT level of control at existing and new facilities within the large appliances source category. The projected HAP emission reductions were developed using a model plant approach and were then scaled up to the expected number of affected facilities nationwide. The model plants are defined in Chapter 4.0.

6.1 APPROACH TO ESTIMATING IMPACTS

The HAP emission reductions associated with implementing the MACT standard for the large appliance industry were analyzed for each of the four model plants that were identified in Chapter 4.0 and the memorandum entitled "Development of Model Plants for the Large Appliances NESHAP Project (Docket No. A-97-41, Item No. II-B-6). The estimated HAP emission reductions for each model plant were then multiplied by the number of existing facilities represented by each model to project the impacts to a nationwide value. An example of this calculation is included at the end of this Chapter.

Non-air quality health and environmental impacts and energy requirements resulting from the implementation of the proposed standards were also considered. Sufficient information was not available to allow these impacts to be quantified, but the potential impacts of proposed standards are discussed below.

6.2 ESTIMATED HAP EMISSION REDUCTIONS

The estimated reduction in HAP emissions resulting from implementing the proposed standards at existing facilities is presented in Table 6-1. Emission reductions for each of the model plants were based on the existing source MACT floor of 0.134 kg HAP emitted per liter of coating solids. Since the proposed standard is rounded to two significant figures, i.e., 0.13 kg HAP emitted per liter of coating solids (1.1 lbs per gal), the values presented in Table 6-1 slightly underestimate the predicted nationwide emission reduction. According to Table 6-1, total nationwide HAP emission reductions from implementing the MACT level of control at existing facilities are estimated to be around 1,079,871 kg (2,381,113 lbs) per year. This represents a 45 percent reduction in HAP emissions industrywide. In Table 6-1, each model plant was assumed

to comply with the standard by converting to non-HAP surface preparation materials, cleaning materials, and adhesives as well as reduced-HAP coatings and thinners.

It is projected that, even in the absence of the proposed NESHAP, most new sources will use coating technologies that are considered to be "state-of-the-art" coatings (e.g., powder coatings and low HAP liquid coatings). Powder coating technology has advanced rapidly in recent years, and is gaining widespread acceptance in the large appliances industry. Powder coatings are not only very cost effective, their use eliminates the problems associated with worker exposure to organic solvents. Many of the facilities in the database indicated that they were in the process of converting part or all of their coating operations to use powder coatings. Table 6-2 contains a list of these facilities. For these reasons the baseline emission levels for new sources are expected to be at, or below, the requirements in the proposed standards. Therefore, no emission reductions beyond the baseline levels from new sources have been attributed to the proposed standards.

6.3 NON-AIR QUALITY HEALTH AND ENVIRONMENTAL IMPACTS

The compliance options expected to be used by the large appliance industry for this standard are not expected to create significant adverse environmental impacts. Coating material reformulation is expected to be used by most facilities to reduce their emissions of hazardous air pollutants (HAP) from their coating operations. The use of reformulated coating materials is expected to result in the generation of equal, or smaller, amounts of solid waste, waste solvents, and wastewater. In addition, the reformulated coating materials have the benefit of reduced percentages of HAP in the wastes that are generated. The expected increase in the use of powder coatings will result in a decrease in the generation of waste because most powder coating booths utilize dry filters to collect overspray. The dry powder that is collected as overspray can often be recycled, thus reducing the overall amount of waste material. Because of the many variables involved, and the lack of specific information on the control approach that will be selected by the affected sources, these impacts could not be quantified.

6.4 ENERGY REQUIREMENTS

The impact of the standard on the amount of energy consumed by surface coating operations within the affected industry could not be determined with the information available. Energy consumed is extremely variable and depends on the type and formulation of coating materials used, the film thickness needed for each product, the size and shape of the products being coated, curing oven capacity and desired line speed, and the method of heating the curing oven. Increases in energy consumption by the existing capture systems and add-on control devices is also variable and depends on whether increased utilization of these devices will be a part of the control strategy used by the facilities that have these devices. Because there is such a range of factors, and because some compliance options may result in a decrease in energy consumption (for example, high solids coatings may require less energy to cure than conventional coatings), it was assumed that on a nationwide basis there would be no quantifiable change in energy consumption as a result of the standard.

TABLE 6-1. SUMMARY OF ESTIMATED ENVIRONMENTAL IMPACTS

	Baseline Emission Levels (kg)	Compliant Emission Levels (kg)	Emission Reduction (kg)	Number of facilities Nationwide	Nationwide Emission Reduction (kg)
Model Plant 1	3,887	670	3,217	26	83,642
Model Plant 2	15,234	3,350	11,884	19	225,796
Model Plant 3	29,436	13,400	16,036	17	272,612
Model Plant 4	125,235	83,750	41,485	12	497,820
Nationwide					1,079,871

Table 6-2. Facilities Switching to Powder Coatings[a]

FACID	Description of Change in Coating Operation	Docket Item No.
LA-271-C	Installation of a powder coating line will reduce actual VOC emissions from this plant.	II-D-107
LA-351-E	Changed from liquid to powder coating, also changed from solvent based cleaning fluid to an aqueous water wash system	II-D-82
LA-388-C	Jan. 1998, switched from a solvent based paint to a powder paint	II-D-409
LA-222-D	Replaced liquid coating with powder coating application process	II-D-415
LA-218	Currently installing a powder coating line which will replace the solvent coating line.	II-D-295
LA-045-A	Replaced two liquid coating booths (using solvent based coatings) with powder paint booths.	II-D-253
LA-388-N	Added powder coating operation which reduced liquid coating usage and decreased xylene consumption/emissions.	II-D-409
LA-388-A	The original painting operation using a high solids, solvent based coating was replaced by a powder coating operation.	II-D-409
LA-158-M	Eliminated use of solvents in surface preperation operations. Changed from water based to powder coatings.	II-D-262
LA-170-F	Changed from liquid solvent spray coating operation to powder coating operation	II-D-360
LA-322	Changed from wet paint system to powder coating	II-D-364
LA-089-E	Changed from water based enamel dip coating to powder coating	II-D-314
LA-388-M	Replaced solvent based liquid coatings with dry powder coatings	II-D-409
LA-076	Change from VOC - based liquid coatings to powder coatings	II-D-309
LA-247	Replaced liquid coating system with powder coating system	II-D-218
LA-230-C	Eliminated lacquer and replaced with powder coatings about 2.5 years ago	II-D-383
LA-045-C	Changed from baking enamels (liquid coatings) to powder coatings	II-D-255
LA-399-C	Installation of electrostatic powder coating line and recycling system to reuse overspray material	II-D-290
LA-388-G	Voluntarily switched to powder coating in Nov. 1995. This reduced VOC's by over 90%.	II-D-409
LA-170-A	Converted 2 highest volume liquid coating colors to powder coating.	II-D-356
LA-104	Removed and replaced liquid coating system with Eisenmenn dry painting (powder coating) system	II-D-175
LA-157	Instituted program to replace liquid coatings with powder coatings; usage of liquid coatings has decreased about 80-90%	II-D-426
LA-069-A	Eliminated solvent based liquid coating operations & replaced w/ low VOC E-coat and powder coating systems	II-D-347
LA-273	Changed process from liquid (HVLP) to powder coating	II-D-277

a Information presented in this table was obtained from responses to the 1998 industry questionnaire. Responses are located in Docket Number A-97-41. Some facilities' responses were edited so that uniform terminology could be presented, and to fit in this table format.

EXAMPLE OF HAP EMISSION REDUCTION CALCULATION

This example demonstrates the calculations performed to determine the HAP emission reductions from Model Plant number 3.

- As shown in Table 4-5, Model Plant number 3 is representative of facilities that use from 50,001 and 200,000 liters of coating solids; the model plant uses 100,000 liters of coating solids.
- At the baseline conditions Model Plant number 3 emits 29,436 kilograms of HAP (the total from the column labeled "HAP" in Table 4-5.
- The baseline emission rate for Model Plant number 3 is: 29,436 kg HAP ÷ 100,000 liters of coating solids = 0.29436 kg HAP/liter of coating solids.
- Model Plant number 3 will need in this example to reduce its emission rate to a maximum of 0.134 kg HAP/ liter of coating solids.
- At an emission rate of 0.134 kg HAP/liter of coating solids, and assuming the same amount of coating solids will be used as under the baseline condition, Model Plant number 3 will emit: 0.134 kg of HAP/liter of coating solids * 100,000 liters of coating solids = 13,400 kilograms of HAP.
- The proposed standards result in a reduction of: 29,436 kg - 13,400 kg = 16,036 kg of HAP.
- Because this model plant is estimated to represent 17 existing facilities, the nationwide HAP reduction for this segment of the source category is estimated to be: 16, 036 kg of HAP * 17 facilities = 272,612 kilograms of HAP.
- This procedure was applied to each of the four model plants and the results are shown in Table 6-1.

7.0 COST IMPACTS

This chapter presents the approach developed to estimate the cost impacts of implementing the MACT level of control at existing and new large appliances surface coating operations. The cost impacts were developed using a model plant approach and were then projected to a nationwide number of facilities. The first section of this chapter describes the approach that was used to estimate the compliance alternatives and the costing assumptions. The second section presents the results of the cost analysis on a model plant and nationwide basis.

7.1 APPROACH TO ESTIMATING COSTS

The basic approach used to estimate the cost impacts of the standards was to predict the method of compliance to be used by each model plant and the costs associated with that method. The four model plants were developed to represent the range of facility sizes and coating, thinning, and cleaning materials used throughout the industry. Tables 7-1 through 7-4 present the model plant parameters as well as cost impact information.

Because an affected source-wide average HAP limit approach was selected for the standard, there is a wide variety of actions that a facility could take to lower its HAP emissions from coating-related operations to a compliant level. Reductions in the HAP contents of adhesives, surface preparation materials, thinning solvents, and cleaning materials as well as the coatings themselves, all contribute toward compliance. Converting from HAP-containing liquid coatings to powder coatings can essentially eliminate HAP emissions from the coating operation. Add-on control devices could be installed to reduce HAP emissions from selected exhaust gas streams, such as a curing oven exhaust. (Thermal incinerators can achieve HAP reductions in excess of ninety percent.) Various combinations of the actions outlined above can also be implemented to achieve the necessary HAP emission reductions.

An analysis of the model plant parameters and information provided in the industry responses to the 1997 and 1998 questionnaires (114 authority) led to the following selection of compliance alternatives for performing the cost analysis.

It was estimated that no facility within the industry would install add-on control devices as a result of the proposed standards. The capital costs and annual operating costs of add-on

control devices usually make them less desirable than other compliance options for reducing volatile organic emissions from coating operations. The responses to the industry questionnaires included information on seven such devices located at only five out of the total of 222 facilities. Two of these devices are used to reduce VOC emissions from the ovens on spray application operations, and five of the devices are used on dip coating operations. Dip coating operations lend themselves to add-on control because they generally have configurations that facilitate the use of capture systems. Even though these facilities may consider the devices' HAP emission reductions when determining compliance with the proposed standards, no additional cost was attributed to them in our analysis because they would be operated even in the absence of the proposed standards.

Conversion of a liquid coating line to powder coating was also not expected to be a desirable option for the two smallest model plants. While case studies indicate that powder coatings are very cost effective for facilities that apply large volumes of coatings, the initial investment required to convert to powder could discourage smaller coating operations from selecting this option. The two larger model plants currently use both liquid and powder coatings and, therefore, a possible option would be to reduce the use of liquid coatings and apply powder to a larger percentage of their products using existing powder coating capacity. For example, model plant number 4 could achieve compliance with the standard by switching about 60 percent of the current coating solids usage from solvent based coatings (and associated thinners) to powder coatings. For this analysis, it was assumed that the MACT level of control for the final standard will be 0.13 kilograms of HAP emitted per liter of coating solids used.

For the reasons presented above, the option that would most likely be selected by most facilities within the industry is the use of a combination of lower HAP liquid coatings and non-HAP adhesives, surface preparation materials, and cleaning materials. It was also assumed that the use of lower HAP coatings would be accompanied by the use of lower HAP coating thinners.

Because the compliance option expected to be used by most facilities to comply with the standard utilizes reformulated raw materials rather than a different coating technology or add-on controls, no capital costs were estimated. Some facilities will, no doubt, encounter up-front costs during a materials conversion. Some facilities may need to upgrade application equipment to be

able to apply reformulated lower HAP coatings that may have a higher viscosity. These costs will be site specific, however, and will most likely be offset by increased efficiencies of the new equipment and by reductions in the cost of handling and disposal of HAP-containing wastes. The impacts of variables such as shelf life of coatings, curing requirements, or spray booth ventilation rates could also be positive or negative depending on the specific facility being evaluated. No cost information was available for these variables. It should also be noted that there will be some cost incurred for testing or qualifying new coating materials. These costs are also very site specific depending on the products manufactured, the relative usage of each type of material, and the availability of demonstrated reformulated materials.

For liquid coatings there exists a wide range of HAP contents, coating solids contents, and prices. Because of the variability from one facility to another regarding coating needs, it was not possible to estimate each of the variables that must be considered to determine the increase or decrease in costs that would be encountered in converting to a lower HAP coating. Several contacts were made with industry representatives in an attempt to obtain data on the relative costs of lower HAP coatings versus higher HAP coatings (Docket Item No.II-E-12). Most of these contacts did not result in useful cost data. Because the cost of coatings is usually compared in terms of coating solids content ($/L coating solids) or actual coverage capability ($/sq m), we found that cost data was not readily available in terms of HAP content. An assumption was made, therefore, that it was reasonable to expect that the higher percentage of solvent in a low solids coating would result in a corresponding higher percentage of HAP. Likewise, the lower percentage of solvent in a high solids coating would result in a lower percentage of HAP. This assumption correlating high solids to lower-HAP and low solids to higher-HAP allowed us to use available data comparing the costs of low solids and high solids coatings. In an article appearing in Products Finishing Magazine, the costs of high solids coatings were reported to be about 30 percent less than the costs of low solids coatings [1]. One industry representative supplied information indicating that the costs of their new high solids coatings are about 10 percent higher than the costs of low solids coatings [2]. Information from a third source indicated practically no difference in the costs between low solids and high solids coatings [3]. Because of the many site specific variables, and the lack of a trend in the cost information available, it was assumed that

overall there would be no change in annual costs for coatings and, therefore, no cost was estimated for this analysis. It is likely, however, that the annual costs of coatings will increase for some facilities, will remain about the same for many facilities, and may decrease for some when the reformulation to lower HAP coatings is accompanied by an increase in coating solids content (and thus, greater coverage and less waste per a given volume).

For adhesives, as for other coatings, no change in costs was predicted for converting to non-HAP materials. Individual facilities may experience cost increases or decreases depending on the types and quantities of adhesives used. A telephone survey of several adhesives manufacturers conducted during the development of the NESHAP for the Plastic Parts and Products Surface Coating Source Category resulted in the collection of cost and HAP data for seventeen different adhesives. The data showed no clear relationship between the costs of the adhesives and the HAP content, and it was assumed that reformulating to non-HAP adhesives in large appliances would result in no additional costs [4].

The surface preparation materials, thinning solvents, and cleaning materials used by the large appliances surface coating industry in 1997 were evaluated to determine the constituent compositions and the amount of product used. Xylene is a commonly used, inexpensive HAP surface preparation/thinning/cleaning product and isopropyl alcohol is a commonly used, and much more expensive, non-HAP solvent. The cost of non-HAP alternative solvents such as isopropyl alcohol and acetone was estimated to be one hundred percent higher than the cost of higher-HAP solvents. A summary of cost information for xylene and isopropyl alcohol is presented in Docket Item II-B-12. The selection of acceptable non-HAP alternative solvents will be a case-by-case decision to be made by each facility, and the comparison of xylene to isopropyl alcohol is used here only for the purpose of establishing a cost differential. Many types of solvent blends, which have much reduced levels of HAP, may also be acceptable substitutes and may cost less than the non-HAP materials. The one hundred percent increase in cost for these materials is believed to be a conservative (worst-case) assumption, however, and also does not consider the savings that could result from current waste solvent disposal costs [5].

For new sources it is projected that most, if not all, will use coating technologies that are considered to be "state-of-the-art" coatings (e.g., powder coatings and low HAP liquid coatings)

even in the absence of the proposed standards. Powder coating technology has advanced rapidly in recent years, and is gaining widespread acceptance in the large appliances industry. Powder coatings are not only very cost effective, their use eliminates the problems associated with worker exposure to organic solvents. Many of the facilities in the database indicated that they were in the process of converting part or all of their coating operations to use powder coatings. Also, four of the most recently constructed facilities in the database are using powder coatings extensively. Therefore, the baseline condition for new facilities is expected be the use of powder and low HAP liquid coatings and no compliance costs beyond the baseline levels from new sources have been attributed to the proposed standards [6]. New facilities are, however, expected to incur monitoring, recordkeeping, and reporting costs and these have been included in the analysis.

7.2 ESTIMATED COST IMPACTS

Tables 7-1 through 7-4 present the model plants and the estimated cost that each would incur as a result of complying with the standard. Each model plant would comply with the standards by switching to non-HAP adhesives, surface preparation materials, and cleaning materials and reducing the HAP content of the coating materials and thinners to meet the emission limit of 0.13 kg HAP per liter of coating solids. The percentage HAP reduction varies from about 35 percent for model plant 4, which already uses a great deal of powder coatings, to about 83 percent for model plant 1, which uses mostly solvent based coatings. [For model plant 1, current emissions of 3,887 kg of HAP are reduced to a complying level of 650 kg of HAP: ((3,887- 650) ÷ 3,887) * 100 = 83 percent.] As shown in Table 7-5, the total nationwide annual cost of complying with the standard is estimated to be approximately $476,000, the sum of the costs for each of the four industry segments.

In addition to the costs associated with complying with the proposed HAP emissions limitation, affected facilities will incur costs associated with the monitoring, recordkeeping, and reporting (MR&R) requirements of the proposed standards. The MR&R costs were developed for the first five years after proposal, and are summarized in Table 7-6 [7]. Costs were developed for existing affected facilities and for an estimated four new sources each year after the proposed

standards become final. All existing sources were assumed to come into compliance at the end of the three-year compliance period in the proposed standards. New sources are assumed to comply when initial operation begins.

Table 7-7 presents a summary of the estimated nationwide costs for the proposed standards, including the costs to comply with the HAP emissions limit and the monitoring, recordkeeping, and reporting requirements. The fifth-year nationwide total cost is projected to be approximately $2 million.

7.3 REFERENCES

1. G. Bocchi, The Powder Coating Institute. Products Finishing, "Powder Coating Advantages." June 1997. 5 pp.

2. Telecon from K. Maw, PES, Inc., to B. Vogt, Whirlpool. Discussion of costs of lower HAP coatings and thinners. July 29, 1999. 1 p. Docket No. A-97-41, Item No. II-E-10.

3. Facsimile from C. Profilet, Thermal Engineering Corporation, to J. Paumier, PES, Inc. Information on costs and emissions for coatings and two spreadsheets dated January 18 and 27, 1997. 4 pp. Docket No. A-97-41, Item No. II-D-433.

4. Letter from K. Teal, EPA:CCPG, to M. Serageldin, EPA:CCPG. Adhesive Cost Information Prepared for the Plastic Parts and Products Surface Coating NESHAP. December 5, 2000. Docket No. A-97-41, Item No. II-B-13.

5. Alternative Control Techniques Document - Industrial Cleaning Solvents. EPA-453/R-94-015. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, February 1994, pp. 5-8 and 5-9.

6. Memorandum from C. Hester and K. Maw, PES, Inc., to M. Serageldin, EPA:CCPG. "Projected Number of New Sources and Impacts of the Proposed Standards," October 2, 2000. Docket No. A-97-41, Item No. II-B-10.

7. OMB 83-I and Supporting Statement for the Large Appliances Surface Coating Operations NESHAP. EPA Tracking Number 1954.01. Docket No. A-97-41, Item No. II-F-1.

TABLE 7-1. MODEL PLANT NUMBER 1 COST IMPACTS
(UP TO 10,000 LITERS OF COATING SOLIDS)

	Plant Definition						Tabular Costs				
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)	$ Cost/Liter Non-Compliant	Total $ Cost Non-Compliant	$ Cost/Liter Compliant	Total $ Cost Compliant	Change in $ Cost
Water-based Coatings	283	1,186	793	31	2,558	676	NA	NA	NA	NA	**$0**
Solvent-based	1,872	1,189	3,794	42	9,011	2,381	NA	NA	NA	NA	**$0**
Powder Coatings	0		0	100	0	0	NA	NA	NA	NA	**$0**
Thinning Solvents	630	876	0	0	719	190	$0.40	$288	$0.80	$575	**$288**
Surface Preparation	378	991	0	0	381	101	$0.40	$153	$0.80	$305	**$153**
Cleaning Solvents	721	991	0	0	728	192	$0.40	$291	$0.80	$582	**$291**
Adhesives	3	954	413	47	886	234	NA	NA	NA	NA	**$0**
Total	3,887		5,000		14,284	3,774		$731		$1,463	**$731**

kg HAP/L coating solids =0.777

Notes:
NA = Specific costs not available
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives=Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)
Total $ Cost = $Cost/Liter * Total Usage
Change in $ Cost = Total $ Cost Compliant - Total $ Cost Non-Compliant

TABLE 7-2. MODEL PLANT NUMBER 2 COST IMPACTS
(UP TO 10,001 TO 50,000 LITERS OF COATING SOLIDS)

	Plant Definition						Tabular Costs				
	HAP (kg)	Density (g/l)	Coating Solids (liters)	%Coating Solids	Total Usage (liters)	Total Usage (gallons)	$ Cost/Liter Non-Compliant	Total $ Cost Non-Compliant	$ Cost/Liter Compliant	Total $ Cost Compliant	Change in $ Cost
Water-based	708	1,186	4,741	31	15,294	4,041	NA	NA	NA	NA	**$0**
Solvent-based	8,357	1,189	19,612	42	46,584	12,308	NA	NA	NA	NA	**$0**
Powder Coatings	0		0	100	0	0	NA	NA	NA	NA	**$0**
Thinning Solvents	1,955	876	0	0	2,232	590	$0.40	$893	$0.80	$1,785	**$893**
Surface Preparation	324	991	0	0	327	86	$0.40	$131	$0.80	$262	**$131**
Cleaning Solvents	3,242	991	0	0	3,271	864	$0.40	$1,309	$0.80	$2,617	**$1,309**
Adhesives	648	954	647	47	1,388	367	NA	NA	NA	NA	**$0**
Total	15,234		25,000		69,096	18,255		$2,332		$4,664	**$2,332**

kg HAP/L coating solids = 0.609

Notes:
NA = Specific costs not available
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives=Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)
Total $ Cost = $Cost/Liter * Total Usage
Change in $ Cost = Total $ Cost Compliant - Total $ Cost Non-Compliant

TABLE 7-3. MODEL PLANT NUMBER 3 COST IMPACTS
(50,001 TO 200,000 LITERS OF COATING SOLIDS)

	Plant Definition						Tabular Costs				
	HAP (kg)	Density (g/l)	Coating Solids (liters)	% Coating Solids	Total Usage (liters)	Total Usage (gallons)	$ Cost/Liter Non-Compliant	Total $ Cost Non-Compliant	$ Cost/Liter Compliant	Total $ Cost Compliant	Change in $ Cost
Water-based Coatings	4,102	1,186	30,299	31	97,739	25,823	NA	NA	NA	NA	**$0**
Solvent-based	11,212	1,189	42,079	42	99,950	26,407	NA	NA	NA	NA	**$0**
Powder Coatings	0		26,918	100	26,918	7,112	NA	NA	NA	NA	**$0**
Thinning Solvents	6,500	876	0	0	7,420	1,960	$0.40	$2,968	$0.80	$5,936	**$2,968**
Surface Preparation	229	991	0	0	231	61	$0.40	$92	$0.80	$185	**$92**
Cleaning Solvents	7,340	991	0	0	7,407	1,957	$0.40	$2,963	$0.80	$5,925	**$2,963**
Adhesives	53	954	704	47	1,511	399	NA	NA	NA	NA	**$0**
Total	29,436		100,000		241,175	63,719		$6,023		$12,046	**$6,023**

kg HAP/L coating solids = 0.294

Notes:
NA = Specific costs not available
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives=Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)
Total $ Cost = $Cost/Liter * Total Usage
Change in $ Cost = Total $ Cost Compliant - Total $ Cost Non-Compliant

TABLE 7-4. MODEL PLANT NUMBER 4 COST IMPACTS
(GREATER THAN 200,000 LITERS OF COATING SOLIDS)

	Plant Definition						Tabular Costs				
	HAP (kg)	Density (g/l)	Coating Solids (liters)	%Coating Solids	Total Usage (liters)	Total Usage (gallons)	$ Cost/Liter Non-Compliant	Total $ Cost Non-Compliant	$ Cost/Liter Compliant	Total $ Cost Compliant	Change in $ Cost
Water-based	24,460	1,186	162,884	31	525,432	138,820	NA	NA	NA	NA	**$0**
Solvent-based	31,544	1,189	160,112	42	380,314	100,479	NA	NA	NA	NA	**$0**
Powder Coatings	0		292,908	100	292,908	77,387	NA	NA	NA	NA	**$0**
Thinning Solvents	42,992	876	0	0	49,078	12,966	$0.40	$19,631	$0.80	$39,262	**$19,631**
Surface Preparation	122	991	0	0	123	33	$0.40	$49	$0.80	$98	**$49**
Cleaning Solvents	15,408	991	0	0	15,548	4,108	$0.40	$6,219	$0.80	$12,438	**$6,219**
Adhesives	10,709	954	9,096	47	19,519	5,157	NA	NA	NA	NA	**$0**
Total	125,235		625,000		1,282,922	338,949		$25,899		$51,799	**$25,899**

kg HAP/L coating solids = 0.200

Notes:
NA = Specific costs not available
Thinning and cleaning solvents are considered 100% HAP
Total Usage for coatings and adhesives= Coating Solids/(% Coating Solids/100)
Total Usage for solvents = HAP/(density/1000)
Total $ Cost = $Cost/Liter * Total Usage
Change in $ Cost = Total $ Cost Compliant - Total $ Cost Non-Compliant

TABLE 7-5. SUMMARY OF COST IMPACTS FOR EXISTING SOURCES

	Annual Cost ($)	Number of Facilities	Nationwide Costs ($)
Model Plant 1	731	26	19,006
Model Plant 2	2,332	19	44,308
Model Plant 3	6,023	17	102,391
Model Plant 4	25,899	12	310,788
TOTAL		74	476,493

TABLE 7-6. SUMMARY OF ESTIMATED MONITORING, RECORDKEEPING, AND REPORTING COSTS -- YEARS 1 - 5

YEAR	EXISTING SOURCE COSTS ($)	EXISTING SOURCE BURDEN (HOURS)	NEW SOURCE COSTS ($)	NEW SOURCE BURDEN (HOURS)	TOTAL NATIONWIDE ANNUAL COST ($)	TOTAL NATIONWIDE BURDEN (HOURS)
1	158,135	3,404	91,462	1,969	249,597	5,373
2	0	0	153,861	3,312	153,861	3,312
3	458,592	9,872	216,260	4,655	674,852	14,527
4	1,154,386	24,849	278,660	5,998	1,433,046	30,847
5	1,154,386	24,849	341,059	7,342	1,495,445	32,191
AVERAGE	585,100	12,595	216,260	4,655	801,360	17,250

TABLE 7-7. TOTAL ESTIMATED COST OF PROPOSED STANDARDS -- YEARS 1 - 5

YEAR	COST TO COMPLY ($)	MONITORING, RECORDKEEPING, REPORTING COSTS ($)	TOTAL ANNUAL COSTS ($)
1	0	249,597	249,597
2	0	153,861	153,861
3	0	674,852	674,852
4	476,493	1,433,045	1,909,538
5	476,493	1,495,445	1,971,938
AVERAGE	190,597	801,360	991,957

ECONOMIC IMPACT ANALYSIS: LARGE APPLIANCE COATING

THE FULL TEXT OF THE ECONOMIC IMPACT ANALYSIS IS LOCATED IN THE DOCKET FOR THE PROPOSED STANDARDS (DOCKET NUMBER A-97-41, ITEM NUMBER II-A-4) .

APPENDIX A

TABLE A-1. LARGE APPLIANCE POTENTIAL MAJOR AND SYNTHETIC MINOR FACILITIES

Facility	City	State
Major Sources		
Amana Appliances	Searcy	AR
Amtrol, Inc.	West Warwick	RI
Beam Industries	Webster City	IA
Behr Climate Systems, Inc.	Ft. Worth	TX
Beverage-Air	Spartanburg	SC
Bristol Compressors	Bristol	VA
Bristol Compressors - Sparta	Sparta	NC
Broan Mfg.	Hartford	WI
Buffalo Air Handling Company	Amherst	VA
Carrier Corporation	Collierville	TN
Copeland	Sidney	OH
Evapco, Inc. - Midwest	Greenup	IL
Fedders Corp.	Effingham	IL
Friedrich Air Conditioning Company	San Antonio	TX
Frigidaire Commercial Products	Conway	AR
Frigidaire Home Products	Edison	NJ
Frigidaire Home Products	Springfield	TN
Frigidaire Home Products, Laundry Division	Webster City	IA
GE Appliances	Louisville	KY
Goodman Manufacturing Co. LP	Houston	TX
Heatcraft Inc. OEM Plant	Grenada	MS
Hussmann Atlanta Custom Systems	Norcross	GA
In-Sink-Erator	Racine	WI
International Comfort Products Corporation	Lewisburg	TN
International Comfort Products Corporation	Lewisburg	TN
Kysor Warrren	Conyers	GA
Lennox Industries Inc.	Marshalltown	IA
Marvel Industries	Richmond	IN

TABLE A-1. LARGE APPLIANCE POTENTIAL MAJOR AND SYNTHETIC MINOR FACILITIES (Continued)

Facility	City	State
Matsushita Compressor Corporation of America	Mooresville	NC
Matsushita Home Appliance Corporation of America	Danville	KY
Matsushita Refrigeration Company of America	Vonore	TN
Maytag Appliances - Newton Laundry Products-Plant 2	Newton	IA
Maytag- GRP	Galesburg	IL
Maytag Herrin Laundry Products	Herrin	IL
McQuay International, Inc.	Verona	VA
MIDCO International Incorporated	Chicago	IL
Osmonics, Incorporated	Minnetonka	MN
Pitco Frialator, Inc.	Bow	NH
Porcelain Metals Corporation	Louisville	KY
Rheem Manufacturing Company	Montgomery	AL
Scotsman Ice Systems-Fairfax Operations	Fairfax	SC
Sharp Manufacturing Company	Memphis	AL
State Industries, Inc.	Ashland City	TN
Taylor Company	Rockton	IL
Tennant Company	Minneapolis	MN
The Amana Company, L. P.	Amana	IA
The Ducane Co.	Blackville	SC
The Trane Company	Clarksville	TN
The Trane Company	Fort Smith	AR
The Trane Company	La Crosse	WI
The Trane Company	Trenton	NJ
The Trane Company	Charlotte	NC
Thermal Engineering Corporation	Columbia	SC
Toastmaster Inc.	Macon	MO
Toastmaster Inc.	Boonville	MO
Tyler Refrigeration Corp., Niles Case Plant	Niles	MI

TABLE A-1. LARGE APPLIANCE POTENTIAL MAJOR AND SYNTHETIC MINOR FACILITIES (Continued)

Facility	City	State
Tyler Refrigeration Corp., Waxahachie Case Plant	Waxahachie	TX
U.S. Filter / IWT	Rockford	IL
Vilter Manufacturing Corporation	Cudhay	WI
West Bend Company	West Bend	WI
Whirlpool Corporation	LaVergne	TN
Whirlpool Corporation	Evansville	IN
Whirlpool Corporation - Findlay Division	Findlay	OH
Whirlpool Corporation - Marion Division	Marion	OH
Whirlpool Corporation-Clyde Division	Clyde	OH
Whirlpool Corporation-Fort Smith Arkansas Division	Fort Smith	AR
York International - Frick	Waynesboro	PA
York International - Grantley	York	PA
York International - Reco	San Antonio	TX
York International - Tempmaster	Albany	MO
Synthetic Minor Sources		
A.O. Smith Water Products Company	McBee	SC
Addison Products Company	Orlando	FL
ALTO U.S. Inc. American-Lincoln Technology	Bowling Green	OH
Bard Manufacturing Company	Bryan	OH
Brown Stove Works, Inc.	Cleveland	TN
Carrier Corporation	Syracuse	NY
Carrier Corporation, McMinnville	Morrison	TN
Copeland Rushville	Rushville	IN
Dunham Bush Inc	Harrisonburg	VA
Frigidaire Home Products-Dishwasher Prod.	Kinston	NC
Heatcraft Inc.	Danvilee	IL
Hill Phoenix, Inc.	Colonial Heights	VA
Hussmann Corporation	Bridgeton	MO

TABLE A-1. LARGE APPLIANCE POTENTIAL MAJOR AND SYNTHETIC MINOR FACILITIES (Continued)

Facility	City	State
IMI Cornelius, Inc.	Anoka	MN
Maytag Cleveland Cooking Products	Cleveland	TN
PMI Food Equipment Group/Hobart	Hillsboro	OH
RAE Corporation	Pryor	OK
Sub Zero Freezer Co., Inc.	Phoenix	AZ
Sub Zero Freezer Co.,Inc.	Madison	WI
Tecumseh Products Division	Tecumseh	MI
The Trane Company	Lexington	KY
The Trane Company	Macon	GA
The Trane Company	Macon	GA
The Trane Company	Pueblo	CO
York International - Pace	Portland	OR

TABLE A-2. SUMMARY OF REGULATIONS BY STATE

State	Regulation	Applicability	Requirements	Recordkeeping
California - Bay Area	Regulation 8 Rule 14 Surface coating of large appliances and metal furniture.	Not applicable to any facility which applies coatings in volumes of less than 20 gallons (75.7 liters) per year. Not applicable to coating operations employing hand-held aerosol cans. Not applicable to the use of powder coatings provided the emission of VOC does not exceed that which is equivalent to the use of complying coatings.	The method of coating application must have a transfer efficiency of 65% or greater. Emission limits for: •baked coatings 2.3 lbs./gal (275 g/L) of coating, excluding water •air-dried coatings 2 8 lbs /gal (340 g/L) of coating, excluding water Specialty coating VOC limits in lbs/gal (g/L) of coating, excluding water: Baked / Air •high-gloss 3.0 (360) / 3 5 (420) •heat-resistant 3.0 (360) / 3 5 (420) •metallic topcoat 3.0 (360) / 3.5 (420) •pretreatment 3 5 (420) / 3 5 (420) •solar absorbent 3.0 (360) / 3 5 (420)	Facilities shall maintain a current list of coatings in use which includes the following information: •coating, catalyst and reducer used •quantity of each coating •VOC of coatings used. •mix ratios of coatings. •type and amount of solvent Records shall be kept on a daily basis and retained for a period of two years
California - Sacramento	District incorporates 40 CFR 60 Subpart SS - Industrial Surface Coating: Large Appliances. The 30-day emissions averaging periods specified in the federal standard are deleted and replaced with 24-hour maximum emission averaging periods for affected sources.			

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Continued)

State	Regulation	Applicability	Requirements	Recordkeeping
Connecticut	22a-174-32 RACT for VOCs.	Any facility located in a serious nonattainment area for ozone that emits 50 tons of VOCs or more is applicable. Any facility located in a severe nonattainment area for ozone that emits 25 tons of VOCs or more per year is applicable.	Any facility which installs and operates a system of capture and control shall: •reduce VOC emissions by at least 85% of uncontrolled emissions. •oxidize in carbon dioxide and water at least 95% of the non-methane VOCs. •operate so that the VOC emission rate leaving the outlet does not exceed 10% of the VOC mass emission rate entering the system.	Facilities shall retain records for a period of at least three years. Records should include, but are not limited to: •purchase records for all material which contain VOCs. •the name of each coating, the coating density in pounds per unit, the VOC content of each coating by weight, the amount of each coating used, and the total amount of diluent (thinner) used for each coating. •the results of any VOC testing
Florida	62-296.506 Surface coating of large appliances.	Does not apply to quick-drying lacquers for repair during assembly provided the volume of coating does not exceed one quart (0.95 liters) in any 8-hour period	Emission limits shall be achieved by: •the application of low solvent content coating technology; or •incineration, provided that 90% of the VOCs which enter the incinerator are oxidized.	Daily records of operations shall include, but are not limited to: •the application method and substrate type. •the amount and type of coating and solvent used. •the VOC content as applied in each coating and solvent. •oven temperature where applicable.
Louisiana	Part III Chapter 1 Subchapter SS: Standards of performance for industrial surface coating: large appliances.	State follows Federal CTG applicability standards.	Transfer efficiency requirements. •air-atomized spray 0.40 •airless spray 0 45 •manual electrostatic 0.60 •flow coat 0.85 •dip coat 0 85 •nonrotational auto. 0 85 •rotating head auto. 0.90 •electrodeposition 0.95	Records must be retained for a period of at least two years State follows Federal CTG recordkeeping requirements.

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Continued)

State	Regulation	Applicability	Requirements	Recordkeeping
Maine	Chapter 134 RACT for facilities that emit VOCs.	Any facility which has the potential to emit 40 tons of VOC per year or more is applicable.	A facility must comply with one of the following emission standards options: •A VOC capture and control system in which emissions do not exceed 15% of the daily uncontrolled emissions. •A VOC emission reduction program. •An approved VOC alternative reduction program. A facility must comply with one of the VOC emission reduction plans of Section 3(B).	State follows the Federal CTG recordkeeping requirements.
New Hampshire	Chapter 1200 Part 1204 - Stationary sources of VOCs Section 1204.27 - Applicability criteria and compliance options for miscellaneous and multi category stationary sources of VOC sources.	Facilities that emit 50 tons or more of VOCs per year are applicable Sources that meet or exceed RACT criteria are exempt.	Control options: •Installation and operation of capture and control systems that result in reduction of at least 81% of VOC emissions. •Limiting the daily weighted average nonexempt VOC emission rate to 0.40 kg VOC per liter (3.5 lb VOC/gallon) of coating as applied, excluding water and exempt compounds •Implementation of a division and EPA-approvable plan.	Copies of all records shall be retained for a minimum of four years Records shall include: •VOC emissions in tons per year. •VOC emissions during high ozone seasons in pounds per day •coating and diluent (thinner) formulation and analytical data. •method of application. •drying method. •substrate type and form
New Jersey	7:27-16.7 Surface coating and graphic arts operations.	Facilities in which the total surface coatings containing VOCs are applied at rates less than one half gallon per hour AND two and one half gallons per day are exempt.	Facilities may apply for an alternative maximum allowable VOC content provided a transfer efficiency of 60% or greater is demonstrated	Maintenance records shall be kept of •the VOC content of coatings applied. •the percent weight of any exempt organics in coatings. •the daily volume of surface coatings applied.

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Continued)

State	Regulation	Applicability	Requirements	Recordkeeping
New York	Subchapter A Part 288 Surface coating processes.	Does not apply to coatings that are applied manually by brush, roller, or aerosol spray can. Facilities which emit less than 5 tons of VOCs annually are exempt	If a coating system is utilized as a control strategy it must comply with the provisions of 228.3(d) A facility may be allowed to operate with a lesser degree of control than required if it is in compliance with the following provisions: •utilizing compliant coatings. •utilizing proven emission control technologies which achieve overall removal efficiency less than or equal to those required •utilizing proven production modification methods which result in documented reductions in VOC emissions.	Records must be maintained at the facility for a period of five years State follows Federal CTG recordkeeping requirements.
North Carolina	Chapter 2D Section .0900 Volatile organic compounds. Section. 0923 Surface coating of large appliances.	Does not apply to the use of quick-drying lacquers provided the volume of coating does not exceed one quart in any eight-hour period	Modeling shall be used to determine process operational and air pollution control parameters and emission rates for toxic air pollutants	Copies of all records shall be retained for a period of two years. Records shall include, but are not limited to •details of all malfunctions. •details of all testing that is conducted. •details of all monitoring conducted. •any information necessary to determine compliance.

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Continued)

State	Regulation	Applicability	Requirements	Recordkeeping
Ohio	3745-21-09 (K) Surface coating of large appliances.	Not applicable to: •coating line (surface coating operation) at the "Whirlpool Corporation" facility in Findlay, OH. •coating line (surface coating operation) at the "Whirlpool Corporation" facility in Marion, OH. •quick-drying lacquers used for repair during assembly provided the volume of coating does not exceed one quart in any eight-hour period •large appliance coatings which are subject to in-use temperatures in excess of 250°F	Emission limits: •2 8 lbs. of VOC per gallon of coating (excluding water and exempt solvents), or •4.5 lbs. of VOC per gallon of nonvolatiles (Coating Solids) if a control system is employed	A facility which complies with the applicable emission limits by use of complying coatings shall collect and record data on a monthly basis and retain such records for a period of three years.
Rhode Island	Air Pollution Control Regulation # 19 Control of VOCs from surface coating operations.	Applicable to facilities listed under SIC Code 363 Does not include quick drying lacquers used for repair, provided the volume of coating used does not exceed 0.25 gallons in any 8-hour period. A facility that emits less than 1,666 lbs of VOCs per month is exempt. Any facility for which emissions are greater than 15 lbs. of VOCs per day is applicable	Compliance shall be achieved as per subsection 19.3.2. Alternative VOC emission standards (bubble concept) may be approved by the director if requested by the facility. Compliance by use of Daily-Weighted Average according to subsection 19.5.2. Compliance by use of Complying Coatings according to subsection 19 5.3. Compliance by use of Control Devices according to subsection 19 5.4.	Monthly records of the following shall be kept for a period of five years: •the name and identification number of each coating. •the mass of VOCs per volume (excluding water) of coating. •the type and amounts of solvents used

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Continued)

State	Regulation	Applicability	Requirements	Recordkeeping
South Carolina	Appendix C Standard No. 5 Part D - Surface coating of metal furniture and large appliances.	State follows Federal CTG standards.	The emission limit does not apply to the use of quick-drying lacquers used for repairs during assembly provided the volume of coating does not exceed 1 quart (0.95 liters) in any one 8-hour period. Emission limitations can be achieved by: •the application of low solvent coating technology •incineration, provided that 90% of the nonmethane VOCs which enter the incinerator are oxidized •carbon bed solvent recovery system •alternative controls allowed under Section 1 •a capture system used in conjunction with emission control equipment systems.	State follows Federal CTG standards.
Tennessee	1200-3-16-.36 Industrial Surface Coating: Large appliances.	State follows Federal CTG standards.	No facility shall discharge VOC emissions that exceed 0.90 kg of VOCs per liter.	Daily records shall be maintained for a period of at least two years. Facility must maintain records of each instance in which the volume-weighted average of the total mass of VOCs emitted per volume of coating nonvolatiles is greater than 0.90 kg per liter.

TABLE A-2. SUMMARY OF REGULATIONS BY STATE (Concluded)

State	Regulation	Applicability	Requirements	Recordkeeping
Vermont	5-253.20 Other sources that emit VOCs.	Any facility which has annual VOC emissions of 50 tons or more is applicable.	The facility will install and operate emissions capture and control techniques or use complying coatings that have overall VOC reductions of at least 81 weight percent. The daily weighted average VOC for all applicable facilities is 3 5 lbs of VOC per gallon or less Facilities must comply with an alternative control plan approved by the Air Pollution Control Officer. A facility may be required to use and maintain air monitoring equipment and records. A facility may be required to conduct diffusion or other air quality modeling	Facility will maintain records to demonstrate continuing compliance as required by the Air Pollution Control Officer.
Washington - Spokane	Section 6.13 General surface coating.	Not applicable to: •facilities using less than 10 gallons per year of surface coatings. •infrequent outdoor surface coating of large objects where the control officer determines that it is impractical to totally enclose the object. •any coating or other agent from pre-packaged aerosol cans. •application of coatings with VOC content less than 2.1 lbs /gal.	A spraying technique must exhibit a transfer efficiency of at least 65%	Facilities shall maintain the following records for a period of two years· •the most current MSDS or other data sheets which clearly indicate the VOC content of the product. •records of purchases and usage. •annual usage of coatings, coating additives, wipe-down agents, reducers and other materials containing VOCs or volatile toxic air pollutants.

Multiply tons by 0.907 to obtain megagrams (Mg).
Multiply pounds by 0.4536 to obtain kilograms (kg).
Multiply gallons by 3.785 to obtain liters (L).

CONVERSION FACTORS FOR METRIC UNITS

Metric units may be converted to common English units by using the following conversion factors:

Metric Unit	Metric Name	Equivalent English Unit
1 m	meter	3.2808 ft (feet)
2.54 cm	centimeter	1 in. (inch)
0.0283 m^3	cubic meter	1 ft^3 (cubic foot)
liter	liter	0.0353 ft^3
dscm	dry standard cubic meter	35.31 dry standard ft^3
scmm	standard cubic meters per minute	35.31 ft^3/min
kg	kilogram (10^3 grams)	2.2046 lb (pound)
Mg	megagram (10^6 grams)	2,204.6 lb
Mg	megagram (10^6 grams)	1.102 English tons
metric ton	metric ton (10^6 grams)	2,204.6 lb
1 m^3	cubic meter	264.17 gallons
3.785 liters	liters	1 gallon
1.054 kJ	kilojoule	1 Btu (British Thermal Unit)
1.054 X 10^6 kJ	kilojoule	MMBtu
3514 J/s	Joules per second	1 ton (or 12,000 Btu/hr)
16.02 kg/m^3	kilograms per cubic meter	1 lb/ft^3 (pounds/cubic foot)

T (°F) = temperature in degrees Fahrenheit

- Temperature in degrees Celsius (°C) can be converted to temperature in degrees Fahrenheit (°F) by the following formula:

  T (°F) = 1.8 T (°C) + 32

T (°C) = temperature in degrees Celsius or degrees Centigrade

- Temperature in degrees Fahrenheit (°F) can be converted to temperature in degrees Celsius (°C) by the following formula:

  T (°C) = [T (°F) - 32]/1.8

EPA United States **Environmental Protection Agency**

3 TRAVEL AUTHORIZATION CODE
- [x] New
- [ ] Amend
- [ ] Cancel

TRAVEL AUTHORIZATION (Note. If this is Permanent Change of Station travel, EPA Form 2610-1A must be attached)

A No T 4212566	2 SOCIAL SECURITY NUMBER 111-62-0815	6 DATE 03/01/2001
RAVEL AUTHORIZATION TYPE	5 TYPE OF TRAVEL BY NON-EPA TRAVELER	7 APPLICABLE REGULATIONS
Domestic	INVITATIONAL	[x] FTRs [ ] JTRs
Foreign	INTERGOVERNMENTAL PERSONNEL ACT (IPA)	

NAME MOHAMED A. SERAGELDIN | 8B TITLE Environmental Engineer

OFFICIAL STATION RTP, NC | 8D ORGANIZATION OAQPS/ESD/CCPG (MD-13)

10 TRIP INFORMATION

	A FROM - DATES - TO MO DA YR	MO DA YR	B DESTINATION STATE	CITY	C PURPOSE CODE	D PURPOSE OF TRIP
IP 1	03/14/2001	03/15/2001	MI	GRAND RAPIDS	4	To provide an explanation of the provision in the metal furniture regulation, and present an overview of the the MACT Standards.
IP 2						
IP 3						

TINERARY AND OTHER DETAILS

	COST ESTIMATES FOR AUTHORIZED ALLOWANCES				OBJECT CLASS	TOTAL COST ESTIMATES BY CATEGORY AMOUNT
	(PER DIEM AND SUBSISTENCE)					
X	A1 PER DIEM ---------->	$34.00	PLUS AVERAGE COST OF LODGING NOT TO EXCEED ------>	$96.00	(A) 2111 2121	$34.00
	A2 ACTUAL SUBSISTENCE NOT TO EXCEED		---------->			
	A3 ACTUAL SUBSISTENCE GSA HRGA ---------->		AREA ---------->			
	(OTHER ALLOWANCES)					
X	B1 COMMON CARRIER - AIR				(B) 2113 2123	542.81
	B2 COMMON CARRIER - TRAIN, BUS, SHIP					
	B3 FIRST CLASS COMMON CARRIER					
	B4 EXCESS BAGGAGE ------>	LBS				
X	C1 INTRACITY TRANSPORTATION (Taxi, limousine, bus, POV) AND OTHER INCIDENTAL COSTS				(C) 2117 2127	75.00
X	D1 PRIVATELY OWNED VEHICLE (POV) (Auto, plane, etc.)	40	RATE (Cents/mile - Justification Req'd)	$.34.5	(D) 2114 2124	13.80
	E1 GSA CONTRACT RENTAL - BOAC # ---------->		INTERCITY TEMPORARY DUTY		(E) 2115 2125	
	E2 COMMERCIAL CAR RENTAL		INTERCITY TEMPORARY DUTY			
	F1 GOVERNMENT-OWNED (GSA) RENTAL - BOAC #		INTERCITY TEMPORARY DUTY			
	G1 REGISTRATION FEES					

ADVANCE OF FUNDS APPLICATION *(Note Outstanding advances must be liquidated within 0 days of completion of trip When travel is canceled or indefinitely postponed, the amount of ny outstanding advances must be repaid immediately Unliquidated advances are subject to utomatic payroll deductions)*

Total A1 through G1 (above)		665.61
Total H1 through L1 (Form 2610-1A)		
Grand Total	TOTAL	$665.61

YPE ORDINARY CONTINUING	B METHOD OF PAYMENT CASH CHECK ATM	C MAIL CHECK TO OFFICE HOME DIRECT DEPOSIT	OFFICE PHONE --> (919) 541-2379
		ADDRESS	
MOUNT	E SIGNATURE OF APPLICANT	13 TO BE COMPLETED BY SERVICING FINANCE OFFICE	
		SIGNATURE *(And reason for disapproval, if so checked)*	
ASH RECEIVED BY	G DATE CASH RECEIVED		

14. Authorization

RECOMMENDING OFFICER	AUTHORIZATION OFFICER
E AND TITLE *(Typed or electronically entered)* Dianne M. Byrne, Group Leader, CCPG	Authority is granted to travel and incur such expenses as may be necessary for this authorization in accordance with EPA policy and applicable regulations I certify that this trip is essential to the Agency's mission
NATURE	NAME AND TITLE *(Typed or electronically entered)* Sally L. Shaver, Director, ESD
	SIGNATURE

15 Financial and Accounting Data

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
1		01/02	B	53C1	10204A	2111
2		01/02	B	53C1	10204A	2113
3		01/02	B	53C1	10204A	2117

SFO 22 (Max 2)

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
1	$34|00		
2	$542|81		
3	$75|00		

Prepared by. Bertha M Joseph (919) 541-1546

'A Form 2610-1 (Rev 9-98/3-99) Electronic and Paper versions acceptable
evious editions are obsolete

RTP Optional

United States
Environmental Protection Agency
Washington, DC 20460

Financial and Accounting Data Continuation Sheet

ntinuation of Form Number:	Date of Primary Form:	Social Security Number:	DCN
EPA-2610-1	**03/01/2001**	**111-62-0815**	

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
1		01/20	B	53C1	10204A	2114
2						
3						

SFO
22
(Max 2)

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
1	$13|80		
2			
3			

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
4						
5						
6						

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
4			
5			
6			

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
7						
8						
9						

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
7			
8			
9			

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
10						
11						
12						

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
10			
11			
12			

	DCN (Max 11)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	PRC (Max 9)	Object Class (Max 4)
13						
14						
15						

	Amount (Dollars) (Cents)	Sites/Project (Max 8)	Cost Org/Code (Max 7)
13			
14			
15			

nited States of America by (Signature)	Typed Name and Title of Contracting Officer

U.S. Environmental Protection Agency
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