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Sector Policies and Programs Division
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I. **Introduction**

Clean Air Act (CAA) section 172(c)(1) provides that state implementation plans (SIPs) for nonattainment areas must include "reasonably available control measures" (RACM), including "reasonably available control technology" (RACT), for sources of emissions. Section 182(b)(2)(A) provides that for certain nonattainment areas, States must revise their SIPs to include RACT for each category of volatile organic compound (VOC) sources covered by a control techniques guidelines (CTG) document issued between November 15, 1990 and the date of attainment.

The United States Environmental Protection Agency (EPA) defines RACT as "the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility." 44 FR 53761 (Sept. 17, 1979). In subsequent Federal Register notices, EPA has addressed how States can meet the RACT requirements of the Act.

CAA section 183(e) directs EPA to list for regulation those categories of products that account for at least 80 percent of the VOC emissions, on a reactivity-adjusted basis, from consumer and commercial products in areas that violate the NAAQS for ozone (i.e., ozone nonattainment areas). EPA issued the list on March 23, 1995, and has revised the list periodically. *See* 60 FR 15264 (March 23, 1995); *see also* 71 FR 28320 (May 16, 2006), 70 FR 69759 (Nov. 17, 2005); 64 FR 13422 (Mar. 18, 1999). Large appliance coatings are included on the current section 183(e) list.

This CTG is intended to provide State and local air pollution control authorities information that should assist them in determining RACT for VOC from large appliance coatings. In developing this CTG, EPA evaluated the sources of VOC emissions from the large appliance coating industry and the available control approaches for addressing these emissions, including the costs of such approaches. Based on available information and data, EPA provides recommendations for RACT for large appliance coating.

States can use the recommendations in this CTG to inform their own determination as to what constitutes RACT for VOC for large appliance coatings in their particular nonattainment areas. The information contained in this document is provided only as guidance. This guidance does not change, or substitute for, requirements specified in applicable sections of the CAA or EPA's regulations; nor is it a regulation itself. This document does not impose any legally binding requirements on any entity. It provides only recommendations for State and local air pollution control agencies to consider in determining RACT. State and local pollution control agencies are free to implement other technically-sound approaches that are consistent with the CAA and EPA's implementing regulations.

The recommendations contained in this CTG are based on data and information currently available to EPA. These general recommendations may not apply to a particular situation based upon the circumstances of a specific source. Regardless of whether a State chooses to implement the recommendations contained herein through State rules, or to issue State rules that adopt different approaches for RACT for VOC from large appliance coatings, States must submit their RACT rules to EPA for review and approval as part of the SIP process. EPA will evaluate the rules and determine, through notice and comment rulemaking in the SIP approval process, whether the submitted rules to meet the RACT requirements of the CAA and EPA's regulations. To the extent a State adopts any of the recommendations in this guidance into its State RACT rules, interested parties can raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation during the development of the State rules and EPA's SIP approval process.

CAA section 182(b)(2) requires that a CTG issued after November 15, 1990 and the date of attainment include the date by which States subject to section 182(b) must submit SIP revisions in response to the CTG. Accordingly, EPA is providing in this CTG a one-year period for the required submittal. Pursuant to section 182(b)(2), States required to submit rules consistent with section 182(b) must submit their SIP revisions within one year of the date of issuance of the final CTG for large appliance coatings. States subject only to the RACT requirement in CAA section 172(c)(1) may take action in response to this CTG, as necessary to attain.

II. Background and Overview

In December 1977, EPA published a CTG for large appliance coating, entitled "Control of Volatile Organic Emissions from Existing Stationary Sources, Volume V: Surface Coating of Large Appliances," EPA-450/2-77-034 (1977 CTG). The 1977 CTG can be downloaded from EPA's website at www.epa.gov/ttn/naaqs/ozone/ctg_act. The cover page of the 1977 CTG is included as Appendix A to this CTG for additional reference. In October 1982, EPA promulgated the National Standards of Performance for New Stationary Sources (NSPS): Standards of Performance for Industrial Surface Coating: Large Appliances, 40 CFR part 60, subpart SS (1982 NSPS). In 2002, EPA promulgated the National Emission Standards for Hazardous Air Pollutants: Surface Coating of Large Appliances, 40 CFR part 63, subpart NNNN (2002 NESHAP). The 1977 CTG recommends and the 1982 NSPS requires VOC emissions limits based on VOC content of low VOC coating materials. The 2002 NESHAP establishes organic hazardous air pollutants (HAP) emissions limits based on the organic HAP content of low organic HAP coating materials.

At least 24 State and local jurisdictions have specific regulations that control VOC emissions from large appliance coating operations. A discussion of the applicability and control options found in the Federal actions and State and local rules is presented in Section V of this document.

EPA developed the recommended approaches contained in this document after reviewing the 1977 CTG, the 1982 NSPS, the 2002 NESHAP, and existing State and local VOC emission reduction approaches and considering information obtained since issuance of the 2002 NESHAP.

The remainder of this document is divided into six sections. Section III describes the scope of sources to which the control recommendations in this CTG could apply. Section IV describes the large appliance coating processes and identifies the sources of VOC emissions from those processes. Section V describes the available control approaches for addressing VOC emissions from this product category and summarizes Federal, State and local approaches for addressing such emissions. Section VI provides our recommendations for RACT for large appliance coatings. Section VII discusses the cost-effectiveness of the recommended control approaches. Section VIII contains a list of references.

III. Applicability

This CTG provides control recommendations for reducing VOC emissions stemming from the use of coatings in large appliance coating operations. This section addresses EPA's recommendations as to the scope of entities to which the RACT recommendations in this CTG should apply. As explained above, this document is a guidance document and provides information for States to consider in determining RACT. When State and local pollution control agencies develop RACT rules, they may elect to adopt control approaches that differ from those described in this document and/or promulgate applicability criteria that differ from those recommended here.

In terms of applicability, we recommend that the control approaches discussed in Section VI of this CTG apply to any large appliance coating operation where the actual VOC emissions associated with all aspects of the coating operation are equal to or exceed 6.8 kg/day (15 lb/day), or an equivalent level such as 3 tons per 12-month rolling period, before consideration of controls. We do not recommend these control approaches for facilities that emit below this level because of the very small VOC emission reductions that can be achieved. The recommended threshold level is equivalent to the evaporation of about two gallons of solvent per day. Such a level is considered to be an incidental level of solvent usage that could be expected even in facilities using exclusively powder or ultra-violet and electron beam (UV/EB) coatings. Furthermore, based on the 2002 National Emission Inventory (NEI) and the 2004 ozone nonattainment designations, we estimated that all of the large appliance surface coating facilities located in ozone nonattainment areas (68 facilities) emit at or above this level and would therefore be addressed by our recommendations in the draft CTG. For purposes of determining whether a facility meets the 6.8 kg/day (15 lb/day) threshold, aggregate emissions from all large appliance coating operations at a given facility are included.

In developing their RACT rules, State and local agencies should consider carefully the facts and circumstances of the affected sources in their States. As noted above, States can adopt the above recommended 15 lb/day actual VOC emissions or equivalent applicability criterion, or they can develop other applicability criteria that they determine are appropriate considering the facts and circumstances of the sources in their particular nonattainment areas. EPA will review the State RACT rules in the context of the SIP revision process.

The 2002 NEI and a questionnaire sent to industry by EPA during the 2002 NESHAP development (data requested by EPA in 1997 and 1998) were used as the source of emissions data and statistical information concerning the large appliance coating industry as a whole. There were several discrepancies in the number of facilities reporting in the 2002 NEI versus the 1997 and 1998 NESHAP questionnaires. During the evaluation of the 2002 NEI data, it was noted that 14 States had at least one facility that reported emissions from this source category in 1997 but not in 2002. There were also States that showed a number of facility closures based on the comparison of 2002 NEI data to the data collected during the 2002 NESHAP development.

Results from the NESHAP questionnaires indicated that there were 222 facilities that perform large appliance coating operations. These operations were distributed across 38 States and Puerto Rico. The States with the largest number of large appliance coating operations were Ohio (19), Tennessee (16), Illinois (15), Texas (14), Wisconsin (13), and Georgia (10). Although information regarding HAP emissions was the main focus of the NESHAP questionnaires, information regarding VOC was submitted from 153 of the total 222 facilities surveyed. These facilities reported actual VOC emissions totaling approximately 5,000 tpy for 1997. This total only accounts for the VOC emissions generated by these facilities from coatings. In addition, facilities that were excluded from the final rule (coating of chillers) were also included in the total 222 facilities surveyed.

In developing this draft CTG, the 2002 NEI database was queried for VOC emissions generated by facilities that were listed under the SIC codes 3631, 3632, 3633, 3639, 3582, 3585, and 3589 (those SIC used for the 2002 NESHAP). This query resulted in only 128 facilities compared to the 222 facilities identified during the 1997 and 1998 NESHAP questionnaires. The 128 large appliance coating facilities in the 2002 NEI reported total VOC emissions of 6,225 tpy. This total accounts for all of the VOC emissions generated by these facilities and does not specify the amount generated just by large appliance coating operations. Of the 128 facilities that reported, 44 were located in nonattainment areas.

Based on the industry information submitted during the 2002 NESHAP development, it was anticipated that closer to 200 facilities (excluding the number of facilities that reported when chillers were part of the rule development) should have reported during 2002. Based on the fact that only 128 facilities reported and the discrepancies noted, it can be concluded that the 2002 NEI is not as complete as the data collected during the 2002 NESHAP development. Based on the information evaluated for this CTG development, there are an estimated 200 facilities. Approximately 68 of these facilities are believed to be in nonattainment areas. This is based on the fact that 44 facilities out of the 128 large appliance coating facilities (34 percent) that reported emissions in the 2002 NEI were in nonattainment areas (34 percent of the 200 facilities from the 2002 NESHAP development would be 68 facilities estimated to be in nonattainment areas).

IV. Process Description and Sources of VOC Emissions

A. Process Description

Large appliance coatings include, but are not limited to, materials referred to as paint, topcoats, basecoats, primers, enamels, and adhesives used in the manufacture of large appliance parts or products. A large appliance part is defined as any organic surface-coated metal lid, door, casing, panel, or other interior or exterior metal part or accessory that is assembled to form a large appliance product. A large appliance product is also defined as any organic surface-coated metal range, oven, microwave oven, refrigerator, freezer, washer, dryer, dishwasher, water heater, or trash compactor manufactured for household, commercial, or recreational use.

Coatings are a critical constituent to the large appliance industry. Coatings protect the metal from corrosion by providing resistance to moisture, heat, detergent, and sometimes the outdoor elements. Coatings for each type of large appliance have special requirements and contain unique properties because each type will be exposed to somewhat different corrosive elements. The coatings must also be durable and have excellent adhesion properties to avoid peeling or chipping. Finally, the coatings that are applied on home appliances must have esthetic appeal.

The coating application methods used are typical of surface coating operations in many industries. Air atomized spraying and airless spraying of coatings involve the atomization of a liquid coating in order to apply it to a substrate. Air atomized spraying achieves atomization by the use of compressed air and can provide transfer efficiencies of up to 40 percent. Airless spraying uses an airless pump system to force the coating through a nozzle designed to atomize the coating and typically has a transfer efficiency of 50 to 60 percent. 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.

Most spray applied large appliance coatings are applied electrostatically. 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 (up to about 85 percent transfer efficiency). Other electrostatic application methods include electrostatic bell and disk spray 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 (close to 90 percent) and better coating uniformity.

Other application methods commonly used are dip coating, electrodeposition, and flow coating. The dip coating operation involves the immersion of a part into a tank containing the coating and typical transfer efficiencies are near 85 percent. Electrodeposition is a dip coating method in which an electric field is used to facilitate the deposition of the waterborne 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. Electrodeposition has a transfer efficiency closer to 95 percent. Flow coating is a method that involves the application of the coating directly onto the substrate without atomizing the coating and has a typical transfer efficiency of 85 percent.

In typical liquid spray and dip coating operations the coated parts/products typically move from the coating application area through a flash-off area, where solvents in the coating begin to evaporate slowly, thus avoiding bubbling of the coating while it is curing in the oven. After being coated by any of the typical coating operations, large appliance products are dried and cured using heated dryers or by air drying. This step removes any remaining volatiles from the coatings so that the surfaces of the large appliance products meet the hardness, durability, and appearance requirements of customers.

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.

B. Sources of VOC Emissions

VOC emissions from large appliance coating processes result from the evaporation of the components of the coatings and cleaning materials.[1] Provided below are further descriptions of these two emission sources.

1. Coatings

The primary VOC emissions from large appliance coatings occur during coating application (prime, single or topcoat application)/flash-off and drying/curing of the coatings. The remaining emissions are primarily from mixing and/or thinning. In most cases, VOC emissions from storage, handling, and waste/wastewater operations related to coating operations are relatively small.

After being coated by any of the typical coating operations (such as spray coating or dip coating), the large appliance products are cured using heated dryers or allowed to air dry. This step removes any remaining volatiles from the coating so that the surfaces of the large appliance product meet the hardness, durability, and appearance requirements of the customers.

Coating mixing may be performed in an agitated 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 appliance manufacturer's facility. Some facilities add water or solvent to the coating (thinning), which may be performed in a small mixing booth or it may be automated. Some facilities combine reclaimed coating from various coating operations and mix the different coatings together in a drum. Mixing also varies depending on the type of coating and usage requirements.

Until the 1970's, conventional solvent-based coatings, with high VOC content, were the majority of coatings used in the large appliance industry. Due to increased regulation at the State and federal level, the industry has steadily moved to lower VOC content coatings. These alternative coatings include powder coatings, waterborne coatings, higher solids coatings and ultraviolet coatings. The following discussion summarizes each of these alternative coating formulations.

Powder Coatings. The use of powder coating systems in the large appliance industry has increased. Many large appliance coating facilities have replaced existing liquid coating lines with powder coating lines. Compared to conventional liquid coating systems, powder coating produces minimal amounts of VOC emissions because powder coatings are applied as dried particles, no VOC are released during the application operation, and volatile emissions from the curing operation, if any, are generally much less than the volatile emissions from liquid coating systems. Powder coating is applied via powder delivery systems, which in most cases is an electrostatic spray. Particulate emissions resulting from the application of powder coatings can be minimized through the implementation of a

[1] In a previous Federal Register notice, EPA identified specific categories, including large appliances coating, the cleaning operations of which would not be covered by EPA's 2006 CTG for industrial cleaning solvents. 71 Fed Reg. 44522, 44540 (2006). In that notice, EPA expressed its intention to address cleaning operations associated with these categories in the CTGs for these specified categories if the Agency determines that a CTG is appropriate for the respective categories.

recovery and recycling process (reuse of overspray). Depending on the powder formulation, some volatile emissions may occur when the powder is heated during the curing step. Powder coating applications are best suited for long production runs of consistently sized parts without color changes.

Waterborne Coatings. Waterborne coatings produce minimal VOC emissions primarily because a large portion of the solvent carrier is replaced with water. The water component can constitute as much as 80 percent of the coating, with the remaining 20 percent being the coating solids.

Higher Solids Coatings. These coatings contain at least 60 percent by volume of coating solids. VOC emissions are reduced through the use of these coatings because they contain less solvent per unit volume of solids than conventional solvent-based coatings. Thus, a lesser amount of VOC emissions are released during coating preparation, application, and curing to deliver a given amount of coating solids.

Ultraviolet Coatings. Ultraviolet (UV) curable liquid and UV curable powder coatings are used for heat sensitive substrates as they allow for low curing temperatures. UV liquid coatings have been used for several decades on parts made of wood, composite, and metal, but are not commonly used in the large appliance industry. Because the entire coating must be exposed to the UV light source to achieve complete curing of the UV coating, UV curable coating applications present problems in the large appliance industry. Pigmentation used in the majority of large appliance coatings blocks the UV light. The shape of the large appliance also presents curing problems. Many large appliance products have bends or are box-shaped, creating areas which would be shaded from the UV light source.

2. Cleaning Materials

Another main source of VOC emissions from large appliance coating is the cleaning materials. 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 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.

Cleaning materials are also used to clean coating line equipment and to touch up the final products. These materials are typically VOC solvents such as methyl ethyl ketone (MEK) and toluene. However, there has been an increase in the use of alcohol and water-based cleaners.

V. **Available Controls and Existing Federal, State, and Local Recommendations/Regulations**

As previously mentioned, there are two main sources of VOC emissions from large appliance coating operations: (1) evaporation of VOC from the coatings; and (2) evaporation of VOC from the cleaning materials. This section summarizes the available control options for reducing these VOC emissions and existing State and local VOC requirements.

A. Available Controls for VOC Emissions from Coatings

There are two general types of emission control techniques for reducing VOC emissions from large appliance coatings: pollution prevention measures and emission capture and add-on control systems. Pollution prevention is the most prevalent control technique being used by the large appliance surface coating industry. Add-on control systems are available to the industry, but few facilities utilize this control technique. Provided below is a summary of each of these types of control techniques.

1. Pollution Prevention Measures

Pollution prevention measures applicable to the large appliance industry, including product substitution/reformulation and work practice procedures, may be used to decrease VOC emissions from large appliance coatings. Coatings with low VOC content, such as waterborne coatings, higher solids solvent-borne coatings and powder coatings, may be used to reduce VOC emissions from coatings by reducing or eliminating the organic solvent present in the coatings. Work practice procedures may also reduce VOC emissions from coatings during paint mixing, paint storage, and paint transfer operations.

a. Product Substitution/Reformulation

The use of waterborne, higher solids, and powder coatings has increased since 1977. Paint manufacturers have developed and are continuing to develop waterborne, higher solids, and powder coating formulations that replace conventional solvent-borne coatings. These coatings are generally available and often are not produced and marketed specifically for the large appliance coating industry. Conversion to these coatings can lower VOC emissions greatly, and most coatings operations, including most large appliance coating, are capable of converting to these coatings.

b. Work Practices

Work practice procedures are physical actions intended to affect emission reductions. Because work practice procedures are specifically tailored to an industry, they may vary from a few manual operations to a complex program.

For the large appliance industry, work practice procedures may be appropriate for the following activities:

- Coating 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). 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.

- 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-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.
- 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. Mixing vessels should have a top that prevents VOC emissions during the agitation process. Store mixed coatings and solvents in closed containers when not being combined to reduce VOC emissions.

Some large appliance coating facilities, either pursuant to Federal, State and/or local regulations or on their own initiatives, develop and implement work practice plans to control VOC emissions. These plans set forth the steps to be taken to ensure that work practices are implemented properly to minimize VOC emissions during coating processes. Such a plan is a compliance option under the 2002 NESHAP. The use of a work practice plan is a traditional approach for reducing emissions during cleaning operations in various industries, including the large appliance coating industry. As shown by these industries, work practice plans can be easily adopted and managed.

2. Emission Capture and Add-On Control Systems

In addition to pollution prevention measures, VOC emissions from large appliance surface coating operations can be reduced by the use of capture systems, in conjunction with add-on control systems that either destroy or recover the VOC in the exhaust streams. As stated previously, although capture systems and add-on control devices are available to the large appliance surface coating industry, EPA is aware of only a few cases where this control technology is utilized by the industry. The majority of VOC emissions from large appliance coating operations occur in the spray booth. Spray booths typically exhaust a high volume of air with a low concentration of VOC which can result in a high cost of control.

The prevalent method of destruction of organic solvent emissions from coatings is thermal oxidation. The organic solvent-containing exhaust air is heated to a very high temperature, which converts it to carbon dioxide and water through the process of combustion. There are several options for VOC control by oxidation. They include: (1) direct, gas-fired, thermal recuperative incineration; (2) direct, gas-fired, thermal regenerative incineration; (3) direct, electrically heated, thermal regenerative incineration; (4) direct, electrically heated, catalytic incineration; and (5) direct, gas-fired, catalytic incineration.

Direct, gas-fired, thermal recuperative incinerators usually operate at temperatures of 760 EC (1400 EF) and use a natural gas burner. The residence time for organic solvent rich air is about 0.5 seconds. This type of unit is usually constructed solely of steel and utilizes heat exchangers to recover heat. These incinerators can achieve a high VOC destruction (98 percent efficient or better), especially when the VOC concentration in the inlet stream is high. These devices are not the most efficient for heat recovery, but it is possible to use waste heat to produce steam or heated air. Their all steel construction becomes a problem when hydrochloric acid is produced as a product of the combustion of chlorinated organic solvents.

Direct, gas-fired, thermal regenerative incinerators utilize ceramic towers in a 3-, 5- or 7-chamber configuration to achieve heat recovery efficiencies in the 80-95 percent range. For this reason, the unit produces less NO_X emissions and uses very little natural gas. Regenerative incinerators can be effective for airstreams with flow rates of 280 to 4,250 cubic meters per minute (10,000 to 150,000 cubic feet per minute). Regenerative incinerators are capable of achieving high destruction efficiencies similar to those of recuperative incinerators.

Direct, electrically heated, thermal regenerative incinerators are based on the principle that if enough organic solvent emissions enter the unit at high concentrations then the combustion process will maintain itself using only the heat of the organic solvent combustion. Electric coils within the unit are used to bring the unit up to its operating temperature (760 EC) as well as to help maintain operating temperature when the organic solvent concentrations in the effluent stream drop below critical levels. The unit itself creates no NO_X, CO, or CO_2 emissions because it operates on electricity instead of the combustion of natural gas or other fuels. Some problems with these types of units include a long startup time and costly operation due to the electricity required to operate them properly. Another problem with this type of incinerator is that hydrochloric acid from the incineration of chlorinated organic solvents can destroy the electric coils in the unit.

Direct, electrically heated, catalytic incinerators use precious metal catalysts as an integral part of the combustion chamber which allows for lower combustion temperatures in the range of 320 to 430 EC (versus 760 EC for non-catalytic incinerators). These units use electric coils for startup and temperature maintenance. These units are typically constructed completely of steel with integrated catalyst units. They do not produce NO_X or CO, nor do they require large amounts of electricity because they run at relatively low temperatures and they use heat exchangers to pre-heat incoming air. The catalyst must be cleaned periodically. Also, the catalyst effectiveness may be masked by halogens, metals, non-organic solvent resins, and other materials. If appropriate materials are used in the combustion chamber and the electric coils, halogenated solvents can be incinerated.

Direct, gas-fired, catalytic incinerators are similar to the electric catalytic incinerators except that they use gas fired burners, instead of electric coils, for makeup heat. They also use precious metal catalysts. These incinerators utilize heat exchangers to pre-heat exhaust air, which reduces fuel requirements to relatively small amounts. If their catalysts are contaminated by halogen resins or high boiling organic solvents, the units may produce some NO_X or CO emissions.

Carbon adsorption as a technique for organic-solvent recovery has been used commercially for several decades. Spray applied coatings contain a mixture of several organic solvents in order to maximize gloss, transfer efficiency, and other desirable coating properties. Organic solvent recovery is usually most effective economically and technically when used with air streams containing a few, expensive organic solvents. In a carbon adsorption system with steam desorption, carbon beds adsorb organic solvents from the air stream passing through them. In most cases, one bed is in the adsorption phase while the second bed is in the steam desorption phase. In the desorption phase, steam is passed through the carbon to release the collected organic solvent. Once the steam has been passed through the carbon, it is then condensed and the organic solvent is removed through the process of settling or distillation. The carbon desorption phase can be performed on site or the spent carbon can be shipped off-site for regeneration. The efficiency of this type of system can be very high when there are low organic solvent concentrations in the air exhausted from the application booths. Advantages of the carbon adsorption/steam desorption system are that they are relatively inexpensive and have been proven effective over the years. They can handle a relatively high volume of air (about 30 to 1,400 cubic meters per minute) efficiently. Also, because the organic solvent is reclaimed there are no carbon monoxide (CO), carbon dioxide (CO_2), or nitrogen oxide (NO_X) emissions that are usually associated with the destruction of used organic solvent in air streams by combustion. Also, if the recovered organic solvents can be re-used it reduces the demand for production of additional organic solvent. The disadvantages of these systems result from the difficulty of separating organic solvents from each other for re-use. Also, if water soluble organic solvents (i.e., alcohols, etc.) are used, it may be difficult to separate the organic solvents from water. In addition, carbon does not adsorb all organic solvents. Therefore, the blend of organic solvents in use must be determined and considered before choosing this type of system. Another problem with systems of this type is that organic solvent quality can be degraded while the organic solvent is held on the carbon.

B. Available Controls for VOC Emissions from Cleaning Materials

Pollution prevention measures and emission capture and add-on control systems are also employed to reduce VOC emissions from cleaning materials used in large appliance coating facilities.

1. Pollution Prevention Measures

Product substitution/reformulation and work practice procedures are pollution prevention measures that may be used to decrease VOC emissions from cleaning materials. Alternative cleaners, such as alcohols and citrus-based cleaners, may be used to reduce VOC emissions from cleaning operations.

Work practice procedures may also reduce VOC emissions from materials during cleaning operations. An example of a cleaning specific work practice involves 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. 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. 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. 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 emissions released from these activities can be minimized by taking actions such as storing cleaning materials in covered containers, using only the smallest amount of cleaning materials necessary, and collecting and placing solvent-laden cleaning materials in closed containers immediately after they are used.

2. Emission Capture and Add-On Control Systems

Carbon adsorption units or oxidizers can be used to control VOC emissions from cleaning operations as well as coating operations. Large appliance coaters can employ add-on controls to reduce their VOC emissions from cleaning operations.

C. Existing Federal, State, and Local Recommendations/Regulations

Provided below is a summary of EPA actions, as well as State and local regulations, that address VOC emissions from large appliance coating processes. In addition, Table 1 outlines these Federal, State and local provisions and the bases for these provisions.

1. The 1977 CTG

The 1977 CTG recommended limiting VOC emissions from the facility's coating operations (prime, single or topcoat application area, flash-off area and oven) to 0.34 kg/l (2.8 lb/gal) of coating, excluding water and exempt compounds, as applied. The emission limit was based on the use of low VOC content coatings and can be achieved with coatings which contain at least 62 volume percent solids or any waterborne equivalent. It was anticipated that this emission limit would result in approximately an 80 percent reduction in VOC emissions over conventional solvent-borne coatings that contain about 25 volume percent solids. An equivalent reduction could be achieved by use of add-on control devices such as thermal oxidation or carbon adsorbers. Even greater reductions, 90 percent and more, could be achieved by conversion to electrodeposited waterborne coatings or powder coatings. There was no single control technique that was considered best for the entire industry since the large appliance industry included a wide variety of products. At the time, it was believed that most facilities would seek to meet future regulations through the use of low VOC content coatings rather than resort to add-on control techniques.

2. The 1982 NSPS

The 1982 NSPS applies to coating of large appliance products and parts at facilities that commence construction, modification, or reconstruction after December 24, 1980. The NSPS defines a large appliance part as any organic surface-coated metal lid, door, casing, panel, or other interior or exterior metal part or accessory that is assembled to form a large

Table 1. Summary of Existing Requirements

Existing Regulation	Emission Limit	Basis for Emission Limit
Large Appliance Coating CTG (December 1977)	Recommended VOC emission limit of 2.8 pounds of VOC per gallon of coating, excluding water and exempt compounds, as applied	Calculated based on the use of high solids coatings (62 percent solids). Associated with a baseline transfer efficiency of 60 percent.
Large Appliances NSPS (October 27, 1982)	VOC emission limit of 7.52 pounds of VOC per gallon of coating solids deposited from any surface coating operation on a large appliance surface coating line	Considered to be equivalent to the 1977 CTG recommended limit
Large Appliances NESHAP (July 23, 2002)	Existing sources: HAP emission limit of 1.1 pounds of organic HAP per gallon of coating solids used New sources: HAP emission limit of 0.18 pounds of organic HAP per gallon of coating solids used	MACT level of control based on 2000 survey of coating materials used in the industry
California - Bay Area Regulation 8, Rule 14 (Originally adopted March 7, 1979 with last amendment October 16, 2002)	Method of coating application must have a transfer efficiency of 65% or greater. VOC emission limit for baked coatings of 2.3 pounds per gallon (0.275 kilograms per liter) of coating, excluding water and exempt compounds, as applied and for air-dried coatings of 2.8 pounds per gallon (0.34 kilograms per liter) of coating, excluding water and exempt compounds, as applied.	Similar to the 1977 CTG but using a coating with 69 percent solids and a transfer efficiency of 65 percent
State Regulations: 22 State rules specifically for large appliance coating operations were identified	VOC emission limit of 2.8 pounds of VOC per gallon of coating, excluding water and exempt compounds, as applied, or an overall emission reduction of 90 percent by utilization of an add-on control device	1977 CTG

appliance product. Parts subject to in-use temperatures in excess of 250˚F are not included in this definition. Large appliance product is defined as any organic surface-coated metal range, oven, microwave oven, refrigerator, freezer, washer, dryer, dishwasher, water heater, or trash compactor manufactured for household, commercial, or recreational use. The NSPS establishes a VOC limit of 0.90 kg/l (7.5 lb/gal) coating solids deposited from any surface coating operation on a large appliance surface coating line. The 1982 NSPS is considered to be equivalent to the 1977 CTG level, but is expressed in a unit (i.e., the volume-weighted average mass of VOC consumed per unit volume of coating solids deposited) that would encourage the use of higher solids content coatings and improved transfer efficiency.

3. The 2002 NESHAP

EPA promulgated the large appliance surface coating NESHAP on July 23, 2002. Since the rule development was conducted within the past five (5) years, it was determined that the information collected during the rule's development would be consistent with current large appliance coating facilities.

Per the 2002 NESHAP, large appliance surface coating facilities are likely to be included under SIC codes 3631, 3632, 3633, 3639, 3582, 3585, and 3589 (excluding special industry machinery, industrial and commercial machinery and equipment, and electrical machinery equipment and supplies not elsewhere classified). Typical NAICS codes for this industry include 335221, 335222, 335224, 335228, 333312, 333415, and 333319(also excluding special industry machinery, industrial and commercial machinery and equipment, and electrical machinery equipment and supplies not elsewhere classified). The large appliance source category includes facilities that apply coatings to large appliance parts or products. In the NESHAP, large appliances includes "white goods" such as ovens, refrigerators, freezers, dishwashers, laundry equipment, trash compactors, water heaters, comfort furnaces, and electric heat pumps. The source category also includes most heating, ventilating, and air conditioning (HVAC) equipment intended for any application. However, the NESHAP did not include in the source category motor vehicle air-conditioning units, heat transfer coils, and large commercial and industrial chillers.

The NESHAP's affected source includes all of the activities that involve coatings, thinners, and cleaning materials used in large appliance coating operations. These activities include:

1) Surface preparation of the large appliance parts or products;
2) Preparation of coatings for application;
3) Applying the coatings;
4) Flash-off, drying, or curing f the coatings;
5) Cleaning of coating equipment;
6) Storage of coatings, thinners, and cleaning materials;
7) Conveying of these materials; and
8) Handling and conveying of waste materials generated by the coating operation.

For the 2002 NESHAP, EPA selected the pollutants to regulate based on some assumptions generated during the rule development. Emission data collected during the development of the rule showed that the primary organic HAP emitted from the surface coating of large appliances included xylene, glycol ethers, toluene, methylene diphenyl diisocyanate, and MEK. These compounds accounted for approximately 82 percent of this category's nationwide organic HAP emissions. However, many other organic HAP are used, or can be used, in large appliance coatings, thinners, and cleaning materials. Therefore, the rule regulated emissions of all organic HAP. Although most of the coatings used in this source category do not contain inorganic HAP, some special purpose coatings used by this source category were found to contain inorganic HAP such as chromium, cobalt, lead, and manganese. Emissions of these materials to the atmosphere are minimal because the facilities in this source category employ either water curtains or dry filters that remove overspray particles from the spray booth exhaust. At the time, it did not appear that emissions of inorganic HAP from this source category warranted Federal regulation.

The final rule established different emission limits for existing and new sources. For an existing source, the organic HAP emissions limits is no more than 0.13 kilograms per liter (1.1 pounds per gallon) of coating solids used during each compliance (monthly) period. For a new or reconstructed source, the organic HAP emissions limit is no more than 0.022 kilograms per liter (0.18 pounds per gallon) of coating solids. The limits apply to the total of all coatings, thinners, and cleaning materials used in coating operations at the affected source. Existing sources had to be in compliance no later than July 25, 2005. New or reconstructed sources have to be in compliance by this same date or upon startup, whichever is later. These HAP emission limits take into account products that contain MEK even though in December 2005, EPA amended the list of HAP contained in section 112 of the CAA by removing MEK. It is unclear at this point how MEK being delisted as a HAP has affected the large appliance coatings formulation. The NESHAP established three compliance options for meeting the emissions limits.

1) *Compliant Material Optio*n – Each coating used in the operation must meet the limit, and each thinner and cleaning material must contain no organic HAP.
2) *Emission Rate Without Add-on Controls Option* – The facility may average all of the coatings, thinners, and cleaning materials together and demonstrate that the overall emission rate is in compliance with the applicable limit.
3) *Emission Rate With Add-on Controls Option* – This option applies to coating operations for which add-on controls are used to meet the limit. The facility must meet certain operating limits for the capture systems and control devices and follow a work practice plan for material storage, mixing, conveying, and spills.

4. Existing State and Local VOC Requirements

Every State has incorporated the large appliance coating Federal regulations described above (1982 NSPS and 2002 NESHAP). In addition, 22 States have specific large appliance coating regulations. 21 states have adopted the 1977 CTG recommended VOC emissions limit of 0.34 kilogram per liter (2.8 pounds per gallon) of coating, excluding water and exempt compounds, as applied. Five (5) States also have equivalent pound of VOC per gallon of coating solids used emissions limits. Appendix B provides a table which summarizes the large appliance coating regulations that are specific to a State and/or local agency within that State.

The California Bay Area Air Quality Management District (Bay Area) has adopted limits that are more stringent than the 1977 CTG. The Bay Area has established two VOC emission limits for surface coatings of large appliances: (1) 275 grams of VOC per liter (2.3 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied for baked coating; and (2) 340 grams of VOC per liter (2.8 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied for air-dried coating. In addition, the Bay Area rule requires the use of coating application equipment that can meet a 65 percent or greater transfer efficiency. Per the Bay Area regulation, compliance with the standard's 65 percent or great transfer efficiency can be achieved by properly operated electrostatic application or HVLP spray, flow coat, roller coat, dip coat including electrodeposition, and brush coat.

Like the Bay Area's limits, the VOC emissions limits established by the South Coast Air Quality Management District (South Coast) for the coating of metal parts and products (which includes large appliances using a general multi-component coating) are: (1) 275 grams of VOC per liter (2.3 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied for baked coating; and (2) 340 grams of VOC per liter (2.8 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied for air-dried coating. The South Coast regulation specifies the following application methods: electrostatic application, flow coat, dip coat, roll coat, HVLP spray, hand application methods, or other coating application method capable of achieving a transfer efficiency equivalent or better than that achieved by HVLP spraying. As an alternative to the emissions limit and operating equipment requirement, the South Coast regulation allows the use of capture and control equipment to collect at least 90 percent by weight of the VOC emissions generated by the sources of VOC emissions (capture efficiency) and reduce VOC emissions from an emission collection system by at least 95 percent by weight (control efficiency).

VI. Recommended Control Options

We provide flexibility by recommending two alternatives for controlling VOC emissions from coating operations: (1) an emission limit that can be achieved through the use of low-VOC materials; and (2) an overall control efficiency of 90 percent for facilities that choose to use add-on controls instead of low-VOC materials. The low-VOC materials recommendation consists of an emissions limit of 0.275 kilograms of VOC per liter (2.3 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied and the use of specified application methods. These recommendations are based on the Bay Area and South Coast regulations for large appliance surface coating facilities.

We estimate that the control measures under either recommendation would reduce VOC emissions from large appliance coating operations by about 32 percent (a reduction of 1,088 tons of VOC from the nonattainment area facilities). In our analysis of the impacts of the recommended level of control, we have assumed that all facilities will choose to utilize the low-VOC coating materials alternative. We made this assumption for two reasons. First, we believe that complying low-VOC coating materials are already widely available at a cost that is not significantly greater than the cost of coating materials with higher VOC contents. Secondly, the use of add-on controls to reduce emissions from typical spray coating operations would be a more costly alternative.

For cleaning materials, we are recommending work practices to reduce VOC emissions. We do not have information available regarding current VOC content to determine a RACT limit for cleaning materials used in large appliance surface coating operations. Therefore, we are not recommending the use of a VOC content limit for cleaning materials. We are also not recommending the application of add-on controls solely as a means of reducing VOC emissions from cleaning materials. This would be a very costly alternative because the area to be controlled is quite large and a large volume of air would need to be captured and directed to a control device. However, any cleaning activities that occur within a capture device used to control VOC emissions from coating operations would be controlled by the associated control device.

The following paragraphs summarize our specific recommendations for coating operations and cleaning materials used in large appliance surface coating operations. As previously discussed in Section III, we are recommending applying the emission limit to facilities emitting more than 6.8 kg VOC/day (15 lb VOC/day).

A. Emissions Limit based on Low-VOC Coatings

We are recommending an emissions limit of 0.275 kilograms of VOC per liter (2.3 pounds of VOC per gallon) of coating, excluding water and exempt compounds, as applied. We are recommending that all VOC-containing materials (i.e., coatings and thinners) used by each large appliance surface coating unit are included when determining the coating unit's emission rate. The low-VOC material emission limit recommendation also includes the use of the following application methods: electrostatic application, HVLP spray, flow coat, roller coat, dip coat including electrodeposition, brush coat, or other coating application method capable of achieving a transfer efficiency equivalent or better than that achieved by HVLP spraying. This recommendation was based on the Bay Area baked coating VOC emission limit and the South Coast general multi-component coating VOC emission limit (from the metal parts and products coating regulation which includes large appliances).

B. Optional Add-On Controls for Coating Operations

Should product performance requirements or other needs dictate the use of higher-VOC materials than those that would meet the recommended emission limit, a facility could choose to use add-on control equipment to meet an overall control efficiency of 90 percent. Add-on devices include oxidizers and solvent recovery systems, which coupled with their attendant systems to capture the VOC being released at the affected facilities, can achieve an overall control efficiency of 90 percent. This control option, like the low-VOC material option noted above, applies to all coatings and thinners applied to large appliances.

C. Work Practices for Coating Operations and Cleaning Materials

In addition to the control options above, this CTG recommends work practices to further reduce emissions from the coatings as well as to minimize emissions from the cleaning materials used for large appliance coating operations. Although VOC reductions achieved by implementing the work practice recommendations may not be quantifiable, we believe they are beneficial to the overall goal of reducing VOC emissions. We recommend implementing work practices for solvent storage, mixing operations, and handling operations for coatings, thinners, cleaning materials, and waste materials. Specifically, we recommend the following work practices: store all VOC-containing coatings, thinners, and cleaning materials in closed containers; minimize spills of VOC-containing coatings, thinners, and cleaning materials; clean up spills immediately; convey any coatings, thinners, and cleaning materials in closed containers or pipes; close mixing vessels that contain VOC coatings and other materials except when specifically in use; and minimize usage of solvents during cleaning of storage, mixing, and conveying of equipment.

VII. Cost Effectiveness of Recommended Control Options

As previously mentioned, the recommendations in this draft CTG are similar to the Bay Area and South Coat regulations governing large appliance coating operations. Unfortunately, the cost-effectiveness of these regulations was not estimated during those regulations' development. Therefore, cost-effectiveness estimates for the recommended control levels were determined based on information collected during the 1977 CTG and the 2002 NESHAP development. Although the 2002 NESHAP regulates organic HAP, it is still relevant because the regulation recommends the same control measures (pollution prevention and work practice) for large appliance coatings and cleaning materials as those recommended in this document. In addition, the 2002 NESHAP provides data regarding large appliance coating facilities that are more current than the 1977 CTG.

During the development of the 2002 NESHAP, it was estimated that no facility within the industry would install add-on control devices as a result of the standard. The capital costs and annual operating costs of add-on control devices usually make them less desirable than other compliance options for reducing VOC emissions from spray coating operations.

In the development of the 1977 CTG, the cost effectiveness for a medium-sized facility using waterborne prime and higher solids topcoat was estimated to be $141 per megagram ($128 per ton). This would be approximately $425 per ton in 2006 dollars based on historical CPI data from www.inflationdata.com.

The 2002 NESHAP presented a control cost of $480,000 for 1,191 tons of HAP reduction from 74 facilities expected to be subject to the rule ($403 per ton HAP reduced, about $480 per ton in today's dollars). This cost-effectiveness data was assumed to be comparable and used for this CTG development. A conservative $500/ton of VOC reduction was used in the draft FR notice.

To determine emission reductions, a model plant approach was used. The model plants (MPs) developed for the NESHAP give the following as ranges of solids used:

MP 1	26 facilities at 5,000 liters of solids
MP 2	19 facilities at 25,000 liters
MP 3	17 facilities at 100,000 liters
MP 4	12 facilities at 625,000 liters

From this distribution of numbers of facilities and solids usage, it was estimated that an average facility would use about 50,000 liters of solids (about half of the facilities use less and about half use more). We assumed that an average facility is just meeting the 1977 CTG limit of 2.8 pounds of VOC per gallon of coating, excluding water and exempt compounds, as applied (equivalent to 0.9 kilograms of VOC per liter of solids deposited).[2] Accordingly, an average facility would be emitting 45,000 kg of VOC (0.9 kilograms of VOC per liter of solids deposited multiplied by 50,000 liters of solids), or 49.6 tons of VOC. This is considered to be an overestimation because most large appliance coating facilities will be complying with emission limits with some margin of safety. The same facility meeting this draft CTG's recommended emission limit and using the recommended coating application equipment would be emitting 30,500 kilograms of VOC or 33.6 tons, resulting in 16 tons (49.6 tons minus 33.6 tons) of reduction in VOC emissions. Assuming that there are 200 large appliance facilities nationwide and 68 facilities in ozone nonattainment areas (34 percent of 200), the potential baseline emissions from these facilities would be 3,372.8 tons (68 facilities at 49.6 tons each), and the emission reductions would be 1,088 tons of VOC (68 facilities at 16 tons each). At a cost effectiveness of $500 per ton, the cost for an average facility to meet the recommended CTG level would be $8,000 ($500 per ton multiplied by 16 tons).

VIII. References

1. Control of Volatile Organic Emissions from Existing Sources - Volume V: Surface Coating of Large Appliances. Publication No. EPA-450/2-77-034. U. S. Environmental Protection Agency, Research Triangle Park, NC. December 1977.

2. Bay Area (California) Air Quality Management District Regulation 8, Organic Compounds, Rule 14, Surface Preparation and Coating of Large Appliances and Metal Furniture. Amended October 16, 2002.

3. South Coast (California) Air Quality Management District Regulation XI, Source Specific Standards, Rule 1107, Coating of Metal Parts and Products. Amended January 6, 2006.

4. National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Category: Large Appliances Surface Coating Operations - Background Information for Promulgated Standards. EPA-453/R-02-004. U. S. Environmental Protection Agency, Research Triangle Park, NC. April 2002.

5. Industrial Surface Coating: Appliances – Background Information for Proposed Standard. EPA-450/3-80-037a. U. S. Environmental Protection Agency, Research Triangle Park, NC. November 1980.

[2] As previously described, the 1977 CTG limit is equivalent to the 1982 NSPS limit and has been adopted by most of the states that regulate VOC emissions from large appliances coating operations. Accordingly, we believe that we can reasonably assume that most facilities are meeting this limit.

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Appendix A: 1977 Large Appliance Coating CTG Document

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United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park NC 27711
EPA-450/2-77-034
OAQPS No. 1.2-088
December 1977

Air

EPA

OAQPS Guideline Series

Control of Volatile Organic Emissions from Existing Stationary Sources Volume V: Surface Coating of Large Appliances

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Appendix B: Summary of State-Specific Large Appliance Coating Regulations

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State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
AL	Jefferson	Application area(s), flash-off area(s), and oven(s) of coating lines involved in prime, single, or topcoat coating operations. Does not apply to the use of quick-drying lacquers for repair of scratches and nicks that occur during assembly, provided that the volume of coating does not exceed 757 liter/yr (200 gal/yr).	0.34 kg/liter (2.8 lb/gal) of coating, excluding water, delivered to the coating applicator from prime, single, or topcoat coating operations.	
AZ	Maricopa	Application of coating, coating preparation/mixing at the facility applying the coating, & the cleanup of coating application equipment. Does not apply to coatings with VOC content, minus exempt compounds, of less than 0.15 lb VOC/gal (18 g/liter) nor to solvents having a VOC content of material less than 0.15 lb VOC/gal.	2.8 lb/gal or 0.34 kg/liter of coating (minus water)	For coating containing more than 2 lb VOC/gal (240 g/liter) minus exempt compounds: 1. Low-pressure spray gun 2. Electrostatic system 3. Atomizing system by hydraulic pressure, including "airless" and air-assisted airless" 4. Non-atomizing or non-spraying applications such as dipping, rolling, or brushing 5. Any method approved by the Federal EPA Administrator and Control Officer having a transfer efficiency of 65% or greater
CA	Bay Area	Does not apply to the use of any coating used in volumes less than 75.7 liters/yr (20 gal/yr) (facility limited to 208.1 liters or 55 gallons total coating/yr). Does not also apply to surface preparation of electrical and electronic components, stripping of cured inks, coatings and adhesives or cleaning of resin, coating, ink and adhesive mixing, molding and application equipment, or surface preparation associated with research and development operations; performance testing to determine coating, adhesive or ink performance; or testing for QA/QC purposes.	Method of coating application must have a transfer efficiency of 65% or greater and then a VOC emission limit for baked coatings of 2.3 lb/gal (275 g/L) and for air-dried coatings of 2.8 lb/gal (340 g/L) of coating, excluding water	

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
CO		Coating line; prime, single or topcoat application area, flash-off area, and oven	0.34 kg/liter coating or 2.8 lb/gal coating (minus water)	
DE		Any large appliance coating unit. Does not apply to a facility whose actual emissions w/out control devices from all large appliance coating units w/in the facility are <6.8 kg VOC/day (15 lb VOC/day) or the use of quick-drying lacquers for repairs of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.95 liter/any 8-hr period (0.25 gal/any 8-hr period).	0.34 kg/liter (2.8 lb/gal) of coating (minus water & exempt compounds)	1. Installing and operation a capture system 2. Installing and operation a control device 3. Determining the overall emission reduction efficiency for each day needed to demonstrate compliance 4. Demonstration each day that the overall emission reduction efficiency achieved for that day is greater than or equal to the overall emission reduction efficiency required for that day
FL		Application areas, flash-off areas, and ovens of coating lines involved in prime, single, or topcoat coating operations.	0.34 kg/liter (2.8 lb/gal) of coating (excluding water)	1. Application of low solvent content coating technology 2. Incineration, provided that 90% of the VOC which enter the incinerator are oxidized to carbon dioxide and water
IL		Does not apply to use of quick-drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.95 liter/any one 8-hr period (1 qt/any 1 8-hr period)	0.34 kg/liter (2.8 lb/gal) of coating (minus water & exempted compounds)	
IN		Coating application (prime, single, or topcoat coating operations). Does not apply to use of quick-drying lacquers for repair of scratches & nicks that occur during assembly (limited to 1 gal in an 8-hr period).	0.34 kg/liter (2.8 lb/gal) of coating (minus water)	

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
KY		Applies to facilities commenced before 6/29/79 located in a ozone nonattainment county. Does not apply to any affected facility: 1) if the VOC content of the coating is <0.34 kg/liter (2.8 lb/gal) (minus water or exempt solvent) 2) repair coating operations 3) total VOC emissions are less than or equal to 3 lb/hr actual, 15 lb/day actual, or 10 ton/yr potential before control 4) low-use coatings if plantwide consumption of these coatings in the aggregate is less than or equal to 55 gals during the previous 12 months	No facility discharge of VOC into the atmosphere more that 15% by weight of the VOC net input into the facility	
MD		Does not apply to use of quick-drying lacquers for repair of scratches & nicks that occur during assembly.	0.34 kg/liter (2.8 lb/gal) of coating (minus water)	
MI		The primer surface or topcoat coating includes an anti-chip, blackout, or spot primer coating if this coating is applied as part of the primer surface or topcoat coating operation. Does not apply to coatings that are used for the repair of scratches & nicks. Exceptions also include coating lines w/in a stationary source with actual VOC emissions <100 lb/day or 2,0000 lb/month and excludes low-use coatings that total 55 gallons or less per rolling 12-month period.	2.8 lb VOC/gal of coating (minus water) or 7.5 lb VOC/gal of applied coating solids	

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
NJ		Surface coating operation located at a major VOC facility having the potential to emit 3 lb VOC/hr or more.	0.34 kg/liter (2.8 lb/gal) of coating (minus water)	May apply to alternative maximum allowable VOC limit per volume of surface coating formulation provided that the surface coating formulation is applied at a transfer efficiency of greater than 60 percent.
NC		Application area(s), flashoff area(s), and oven(s) of coating lines involved in prime, single, or topcoat coating operations. Does not apply to the use of quick-drying lacquers for repair of scratches and nicks that occur during assembly, if the volume of coating does not exceed 1 qt in any 8-hr period.	4.5 lb VOC/gal of solids delivered to the coating applicator from prime, single, or topcoat coating operations. If controlled by approved air pollution control equipment, the limit is 2.8 lb VOC/gal of coating (excluding water & exempt compounds).	
OH		Prime coat, single coat or topcoat coating line. Does not apply if construction commenced prior to 10/19/79 or is a Whirlpool facility in Findlay or Marion (for these facilities modifications are applicable).	2.8 lb VOC/gal of coating (excluding water & exempt solvents) or, if control system is employed, 4.5 lb VOC/gal of solids	May propose alternative emission limit if transfer efficiency of greater than 60 percent.
OR		Does not apply to sources whose potential to emit from coating of VOC are <10 tpy (or 3 lb VOC/hr or 15 lb VOC/day actual) or research facilities.	2.8 lb/gal (excluding water & exempt solvents)	1. Application of low solvent content coating technology 2. Incineration, provided that 90% of the VOC which enter the incinerator are oxidized to carbon dioxide and water 3. Equivalent means of VOC removal. Meaning it must be approved by proper authority (Dept. of Env. and Nat. Res. or EPA)

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
RI		Does not apply to the use of quick drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.25 gals in any one 8-hr period.	2.8 lb VOC/gal of coating (minus water) or 4.52 lb VOC/gal of solids	Compliance with emission limitation shall be achieved through: 1. Installation of an approved control system such that the total emission reduction is 95% or greater over uncontrolled VOC emissions 2. Coating reformulation such that the emission limitation is met for all coatings 3. Installation of control equipment to reduce emissions to the equivalent of the emission limitations as calculated on a solids applied basis 4. Use of daily-weighted averaging 5. An alternative, approved equivalent method of control
SC		Applies to the prime, single or topcoat from a coating application system. Does not apply to the use of quick-drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 1 qt (0.95 liter) in any one 8-hr period.	2.8 lb/gal (0.34 kg/liter) of coating (excluding water & exempt solvents)	1. Application of low solvent content coating technology 2. Incineration, provided that 90% of the nonmethane VOC which enter the incinerator are oxidized to CO_2 and water 3. Carbon bed solvent recovery system 4. Alternative controls as allowed in Section I, Part C

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
TN		Does not apply to the use of quick-drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.95 liter (0.25 gal) in any one 8-hr period and any large appliance coating line w/in a facility: 1) in Davidson, Rutherford, Sumner, Williamson, or Wilson County whose actual emissions w/our control are <6.8kg (15 lb) VOC per day or whose max emissions from all large appliance coating lines are <10 ton VOC/yr 2) in Hamilton or Shelby County whose potential VOC emissions from all large appliance coating lines are <25 ton VOC/yr 3) in any other county whose potential VOC emissions from all large appliance coating lines are <100 ton VOC/yr	0.34 kg/liter (2.8 lb/gal) of coating (excluding water & exempt compounds)	
TX	Beaumont/Port Arthur Dallas/Fort Worth El Paso Houston/Galveston Gregg County Nueces County Victoria County	VOC emissions from the application, flash-off, and oven areas during the coating of large appliances (prime and topcoat, or single coat).	2.8 lb/gal (0.34 kg/liter) of coating (minus water & exempt solvent) delivered to the application system	

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
UT		Application areas, flash-off areas, and ovens of coating lines involved in prime, singe or top coating operations.	0.34 kg/liter (2.8 lb/gal) of coating (excluding water & exempt solvents) or 4.5 lb VOC/gal solids	1. Application of low solvent content technology 2. Incineration, provided that 90% of the nonmethane VOC which enter the incinerator are oxidized to CO2 and water 3. Use of water-borne electrodeposition 4. Use of water-borne spray, dip or flowcoat 5. Use of powder 6. Use of higher solids spray 7. Carbon adsorption
WA		The operation of a coater and dryer, that may serve one or more process lines, shall comply if the uncontrolled emissions of VOC from the coater, flash-off areas, and dryer would be >18 kg (40 lb) in any given 24-hr period. The emission limits and uncontrolled emission quantity shall include the additional quantity of emissions from the dryer during the 12-hr period after the application of the coating.	0.34 kg/liter (2.8 lb/gal) of coating (minus water)	
WV		Does not apply to any coating line w/in a facility whose actual emissions w/out control from all large appliance coating lines w/in the fenceline are <6.8 kg (15 lb) VOC/day or the use of quick-drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.95 liter (0.25 gal) in any one 8-hr period.	0.34 kg/liter (2.8 lb/gal) of coating (minus water & exempt compounds) as applied	As an alternative to the emission limit: 1. Installation and operation of a capture system 2. Installation and operation of a control device 3. Determination each day of the overall emission reduction efficiency needed to demonstrate compliance 4. Demonstration each day that the overall emission reduction efficiency achieved for that day is greater than or equal to the overall emission reduction efficiency required for that day

State	County/Area	VOC Limit Applies To	VOC Limit	Emission Limitation Achieved By
WI		Application areas, flash-off areas, and ovens of coating lines involved in single, prime or topcoat coating operations. Does not apply to the use of quick-drying lacquers for repair of scratches & nicks that occur during assembly, provided that the volume of coating does not exceed 0.95 liter (1 qt) in any one 8-hr period for any appliance coating line.	0.34 kg/liter (2.8 lb/gal) of coating (excluding water) delivered	