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Auto Refinishing Coatings: VOC Emission Inventory

FINAL REPORT

TCEQ Contract No. 582-7-84003
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EXECUTIVE SUMMARY

The Texas Commission on Environmental Quality (TCEQ) is currently in the process of updating statewide air pollutant emission inventories for several area source categories. Some of these source categories emit pollutants, such as volatile organic compounds (VOC), which can contribute to photochemical ozone formation in ambient air. One of the source categories specifically being assessed is automobile refinishing area sources. These assessments are geared to improving the state's emission inventories by collecting more accurate and current information on automobile refinishing, so that effective emission reduction strategies can be applied as necessary towards improving Texas air quality. The TCEQ is concerned that existing inventories for this category are based on outdated coating composition and use information and they seek to correct these deficiencies as much as possible. For this project, data were developed on the types and amounts of coatings sold and used in Texas, the VOC content of coating formulations, the chemical composition of coating formulations used (for VOC speciation purposes), the county level of the emissions, and the seasonality of auto refinishing operations. The approach used for this study provided a statewide VOC estimate of 4,352.6 tons per year, compared with the Texas NEI submittal for 2002 which was 3,217.1 tons per year.

Because the small paint shops represent approximately 90 percent of auto refinishing facilities in the state, their collective emissions dominate representing 70 percent of VOC emissions (as noted in Table E-1). Application of top coats and solvent clean up account for more than 50 percent of VOC emissions from small shops.

Table E-1. Summary of 2005 Emissions from Texas Automobile Refinishing

Shop	Coating Category								Total
	Primer	Precoats	Pretreatment	Specialty	Sealers	Wipedown	Topcoats	Solvent Cleanup	
	Statewide VOC Emissions (tons per year)								
Small Shops	257.9	159.9	226.7	515.5	149.0	57.3	837.0	837.0	**3,040.3**
Medium Shops	47.6	29.5	41.8	95.1	27.5	10.6	154.4	154.4	**560.9**
Large Shops	63.7	39.5	56.0	127.4	36.8	14.2	206.8	206.8	**751.4**
Total	**369.3**	**228.9**	**324.6**	**738.0**	**213.2**	**82.1**	**1,198.2**	**1,198.2**	**4,352.6**

Table E-1. Summary of 2005 Emissions from Texas Automobile Refinishing (Continued)

Shop	Coating Category								Total
	Primer	Precoats	Pretreatment	Specialty	Sealers	Wipedown	Topcoats	Solvent Cleanup	
	Statewide VOC Emissions (tons per ozone season day)								
Small Shops	0.7	0.4	0.6	1.4	0.4	0.2	2.3	2.3	**8.4**
Medium Shops	0.1	0.1	0.1	0.3	0.1	0.0	0.4	0.4	**1.5**
Large Shops	0.2	0.1	0.2	0.4	0.1	0.0	0.6	0.6	**2.1**
Total	**1.0**	**0.6**	**0.9**	**2.0**	**0.6**	**0.2**	**3.3**	**3.3**	**12.0**

The emissions were mapped to individual counties using county FIP codes and Geographic Information Systems (GIS) shape files and is shown in Figure E-1. The top ten counties represent approximately 65 percent of the auto refinishing VOC emissions. A complete list of all county emissions is included in the Appendix C of this report.

Table E-2. Ten Texas Counties with the Highest VOC Emissions in 2005

County	Annual Emission Estimate (tons per year)	Ozone Season Day Emission Estimate (tons per day)	Percent of State Total
Harris County	1067.7	2.9503	24.5
Dallas County	592.1	1.636	13.6
Tarrant County	314.8	0.8700	7.2
Travis County	221.2	0.6111	5.1
Bexar County	204.2	0.5642	4.7
El Paso County	141.9	0.3921	3.3
Galveston County	79.9	0.2209	1.8
Jefferson County	73.4	0.2028	1.7
McLennan County	71.4	0.1973	1.6
Collin County	68.5	0.1892	1.6
State Total	4352.6	12.0274	

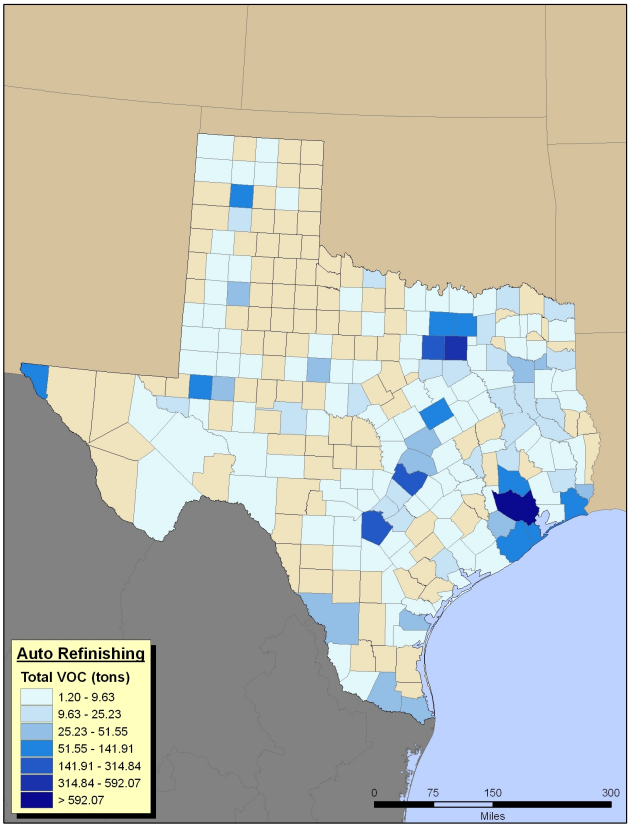

Figure E-1. County Total Emissions Mapping

Table E-3 lists the organic VOC species for which annual emissions were calculated. This list was derived for a comprehensive list of VOC compounds associated with auto refinishing compiled by the California Air Resources Board survey of auto refinishing operations and includes organic compounds in addition to the federally regulated HAPs. Four pollutants account for approximately 75 percent of the organic VOC emissions associated with auto refinishing; these pollutants are: n-butyl acetate, xylene, toluene, and methyl n-amyl ketone.

Table E-3. Texas Auto Refinishing Organic VOC Species Emission Summary

Pollutant Name	CAS	Annual Emissions (tons/year)
1,3 Benzenedicarboxylic Acid	25950349	7.6
1,3,4- Trimethylbenzene	95636	31.7
2,4-Pentanedione	123546	7.9
2-Butoxyethanol	111762	8.4
2-Butoxyethyl Acetate	112072	48.9
2-Pentanone	107879	16.3
5-Methyl- 3-Heptanone	541855	14.0
Acetic Acid, C6-C8 Branched Alkyl Esters	90438792	6.4
Acetic Acid, Hexyl Esters Mixture	88230357	14.9
Aromatic 100	64742956	64.1
Benzoyl Peroxide	94360	8.7
Cellulose Acetate Butyrate	9004368	71.7
Ethyl 3-Ethoxypropionate	763699	74.4
Ethyl Acetate	141786	68.6
Ethyl Benzene	100414	88.5
Heptane	142825	111.2
Hydrotreated Heavy Naphtha	64742489	16.8
Isobutyl Acetate	110190	20.8
Isobutyl Alcohol	78831	9.4
Isophorone Diisocyanate Adduct Soln	Unknown	17.9
Isophorone Diisocyanate Polymer	4098719	21.7
Isopropanol	67630	147.0
l-Methoxy-2-Propanol	107982	12.5
Medium Aliphatic Solvent Naphtha	64742887	42.8
Methanol	67561	19.1
Methyl Ethyl Ketone	78933	178.3
Methyl Isoamyl Ketone	110123	20.0
Methyl Isobutyl Carbinol	108112	7.5
Methyl Isobutyl Ketone	108101	127.0
Methyl n-Amyl Ketone	110430	262.3
Methylcyclohexane	108872	15.3
Naphtha, Petroleum, Hydrotreated Light	64742490	9.6
n-Butanol	71363	66.8
n-Butyl Acetate	123864	936.3
n-Butyl Propionate	590012	29.8

Table E-3. Texas Auto Refinishing Organic VOC Species Emission Summary (Continued)

Pollutant Name	CAS	Annual Emissions (tons/year)
Petroleum Ether	8032324	111.7
Propylene Glycol Monomethyl Ether Acetate	108656	187.9
Solvent Naphtha	64742898	185.9
Stoddard Solvent	8052413	12.4
Styrene	100425	56.3
Toluene	108883	473.6
VOC	VOC	4352.6
Xylene	1330207	501.1

The report is organized such that Section 1.0 provides background for this project, noting the overall project objectives and the intended use of the resulting data. The general approach used in this study is summarized in Section 2.0, along with information concerning the project database, its structure, and a data dictionary that relates to the data tables included in the data structure. Section 3.0 documents how activity and coating characteristics data were compiled and processed for this inventory. Section 4.0 documents how emissions were calculated, including the data sources for activity data, emission factors, equations, and example calculations. The development of temporal adjustment factors that convert annual emissions to ozone season day emissions based, on monthly accident reports for the state of Texas, is described in Section 5.0.

The spatial component of the study is very important, as it was developed to allocate activity and emission estimates to individual counties based on the facilities' latitude and longitude coordinates. The spatial aspects of this project are discussed in Section 6.0. Quality assurance procedures implemented for this project and results from these checks are discussed in Section 7.0. A summary of the emission estimates is provided in Section 8.0. Section 9.0 provides a discussion of the limitations associated with the methods used in developing the inventory and possible enhancements that would provide more accurate or more complete emission estimates. All references used in this project are noted in Section 10.0.

1.0 BACKGROUND

The source category of automobile refinishing is defined under the North American Industrial Classification System (NAlCS) code 811121 (Automotive Body, Paint, and Interior repair and Maintenance) and Standard Industrial Classification (SIC) code 7532 (Top, Body, and Upholstery Repair Shops and Paint Shops). The current default methodology for calculating VOC emissions from these sources includes applying standard employee related emission factors to the number of employees in these NAICS and/or SIC codes for each county. However, in addition to sources found within these industrial categories, automotive refinishing is known to occur in other related sources such as paint and body repair facilities located within automotive sales dealerships and fleet garages, such as those maintained by state and municipal transportation departments, trucking firms, and package and freight delivery services. These additional sources of automotive refinishing emissions arc classified under different SIC and NAICS codes. It should also be noted that these SIC and NAICS codes include facilities that repair and maintain vehicles, but are not involved in painting operations. To address this problem, this area inventory uses a bottom-up approach that identifies specific facilities where painting operations occur.

Automotive refinishing uses a large variety of solvent-based paints and coatings. Upon application of these materials to automotive parts, VOCs are volatilized and emitted into the atmosphere and can contribute to ozone formation. Due to the large number of individual operations and their highly dispersed nature, characterizing VOC emissions from these sources is difficult. Improved and more complete estimates for VOC and speciated VOC emissions from automotive refinishing are necessary to better gauge the category's contribution to ozone formation across Texas and to support analyses of control strategy options.

The purpose of this project was to develop a statewide emission inventory of VOC emissions from automobile refinishing operations. The project used available data representative of the paints applied in Texas that allow for the VOC estimates to be speciated into individual volatile components based on the ingredients in the coating. The VOC species of interest as noted in the work plan for this project are listed in Table 1-1. Emission inventory results are provided for individual counties. Emission estimates are expressed in terms of annual emissions

Table 1-1. Organic VOC Species Included in the 2005 Texas Auto Refinishing Emission Inventory

VOC	CAS Number
1,3 Benzenedicarboxylic Acid	25950-34-9
1,3,4- Trimethylbenzene	95-63-6
2,4-Pentanedione	123-54-6
2-Butoxyethanol	111-76-2
2-Butoxyethyl Acetate	112-07-2
2-Pentanone	107-87-9
5-Methyl- 3-Heptanone	541-85-5
Acetic Acid, C6-C Branched Alkyl Esters	90438-79-2
Acetic Acid, Hexyl Esters Mixture	88230-35-7
Aromatic 100	64742-95-6
Benzoyl Peroxide	94-36-0
Cellulose Acetate Butyrate	9004-36-8
Ethyl 3-Ethoxypropionate	763-69-9
Ethyl Acetate	141-78-6
Ethyl Benzene	100-41-4
Heptane	142-82-5
Hydrotreated Heavy Naphtha	64742-48-9
Isobutyl Acetate	110-19-0
Isobutyl Alcohol	78-83-1
Isophorone Diisocyanate Adduct Soln	Combined
Isophorone Diisocyanate Polymer	4098-71-9
Isopropanol	67-63-0
l-Methoxy-2-Propanol	107-98-2
Medium Aliphatic Solvent Naphtha	64742-88-7
Methanol	67-56-1
Methyl Ethyl Ketone	78-93-3
Methyl Isoamyl Ketone	110-12-3
Methyl Isobutyl Carbinol	108-11-2
Methyl Isobutyl Ketone	108-10-1
Methyl n-Amyl Ketone	110-43-0
Methylcyclohexane	108-87-2
Naphtha, Petroleum, Hydrotreated Light	64742-49-0
n-Butanol	71-36-3
n-Butyl Propionate	590-01-2
n-Butyl Acetate	123-86-4
Petroleum Ether	8032-32-4
Propylene Glycol Monomethyl Ether Acetate	108-65-6
Stoddard Solvent	8052-41-3
Styrene	100-42-5
Toluene	108-88-3
Solvent Naphtha	64742-89-8
Xylene	1330-20-7

(tons per year) and daily emissions during the ozone season (tons per day) for each county. This emissions inventory was compiled into the U.S. Environmental Protection Agency (EPA's) National Emissions Inventory (NEI) Input Format (NIF), Version 3.0 for reporting purposes.

2.0 GENERAL APPROACH

Even though this effort is designed to generate an area source inventory, because individual auto refinishing facilities have been identified from a variety of sources, this emission inventory used a modified bottom-up approach, as depicted in Figure 2-1. This modified bottom-up approach provided more accurate estimates than a top-down approach using surrogates like population or vehicle registration data.

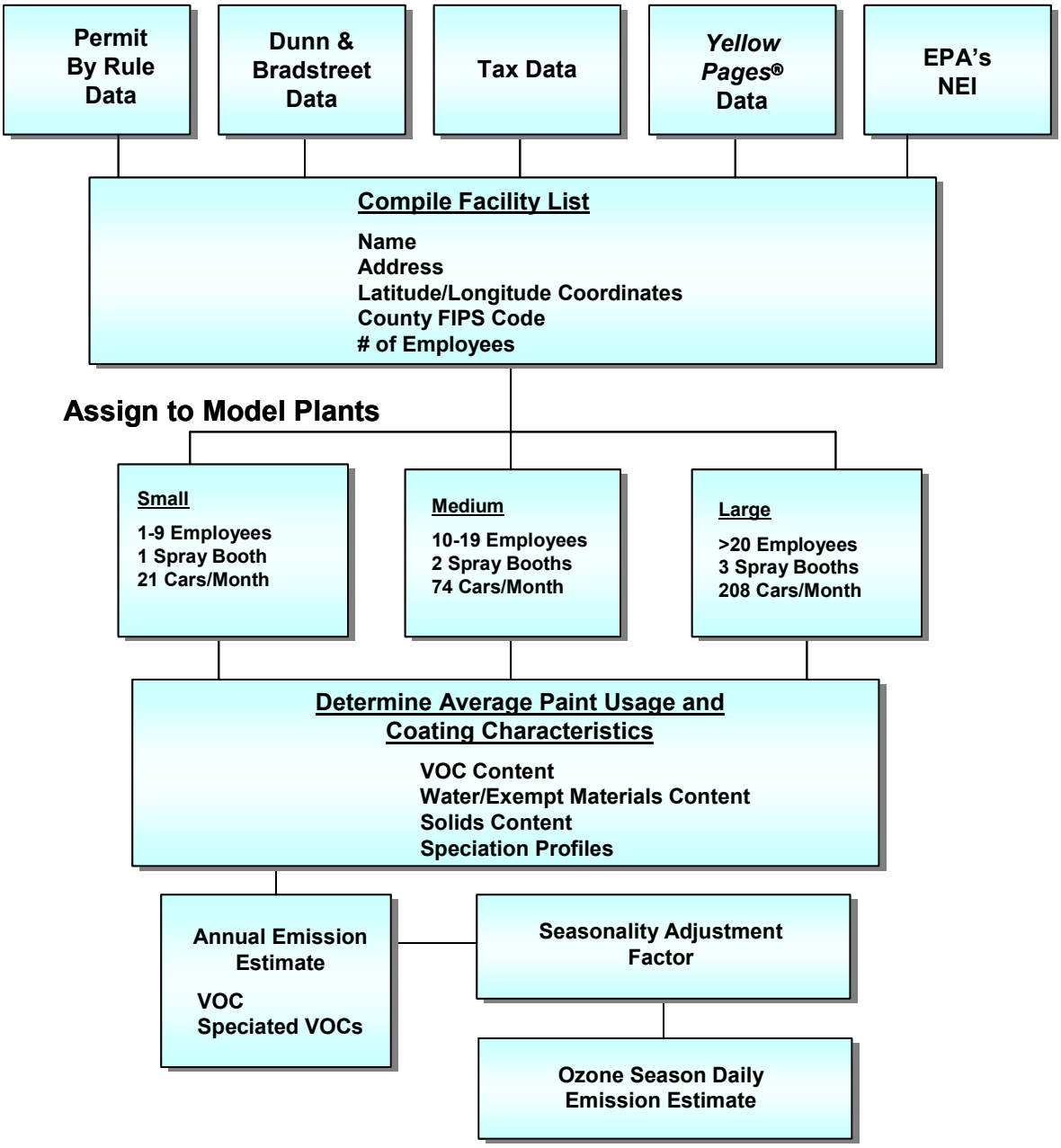

Figure 2-1. Texas Auto Refinishing Area Sources Emission Inventory Approach

The first step of this process was the compilation of a facility list that included an estimate of the number of employees working at a facility and information that helped define the location of the facility (i.e., address, latitude/longitude coordinates, County FIPS codes). A more detailed discussion of the data sources is presented in Section 3.0. In drafting the area source Maximum Achievable Control Technology (MACT) standard (40 CFR Part 63, Subpart HHHHHH) for auto refinishing, the EPA developed a set of model facilities based on the number of employees at a facility.[1] The number of employees documented in the Texas facility list developed for this project was used to group the identified facilities into appropriate model plants (i.e., small, medium, or large). Paint consumption rates were developed for each model facility based on data obtained from the TCEQ's Permitting Branch. As part of the state's permit by rule program, sources are required to report the amount of paint they use annually and the VOC content by paint type in their permit-by-rule application. ERG staff reviewed over 1,000 permit applications, from which roughly two dozen facilities included data on paint usage and VOC content. These paint usage data were converted into per vehicle consumption rates and applied to each model plant type based on the estimated number of vehicles painted. Average paint VOC content estimates were developed based on the permit-by-rule applications and applied to the paint usage rates for each model plant type to estimate the associated VOC emissions. These VOC emissions were speciated into the organic components based on data obtained from the California Air Resources Board (ARB) 2002 Survey of Auto Refinishing Coatings.[2]

An assessment of temporal activity patterns was also implemented to quantify seasonal variations based on monthly accident counts provided by the Texas Department of Transportation.[3] These temporal data were used to adjust the annual emissions to estimate ozone season daily emissions.

The facility-specific emission estimates were retained for this project and provided to TCEQ in an electronic format. These facility-specific data were also used to generate county level totals by summing annual and OSD emissions by the county FIP codes associated with each facility. These county level emissions were provided in electronic form in NIF 3.0 format.

2.1 Project Database

The auto refinishing database is composed of four tables included in a Microsoft Access® database. The first table is the *Facility List* is a compilation of all identified facilities. The second table contains data on the M*odel Facilities* including the emission estimates for each plant type; these emissions were assigned to individual facilities included in the *Facility List.* The next table, *Facility Emissions*, compiles the annual and ozone season daily emissions for each facility. While the *County Emissions* table sums the individual facility emission by county.

2.1.1 *Database Structure*

The *Facility List* table includes identification numbers, facility name, facility address, the number of employees, and the model facility size. The *Model Facility* table includes emission estimated relative to three different size of auto refinishing facility (small, medium, and large). The *Facility Emissions* table links the individual facilities included in the *Facility List* table to the M*odel Facility* table assigning the appropriate emissions to each facility based on the number of employees. The *County Emissions* table sums up each facility's emissions by FIPS code. Both the *Facility Emissions* and Cou*nty Emissions* tables include annual and ozone season daily emissions as well as organic VOC species. Figure 2-2 summarizes the key fields in the various tables and how they link up.

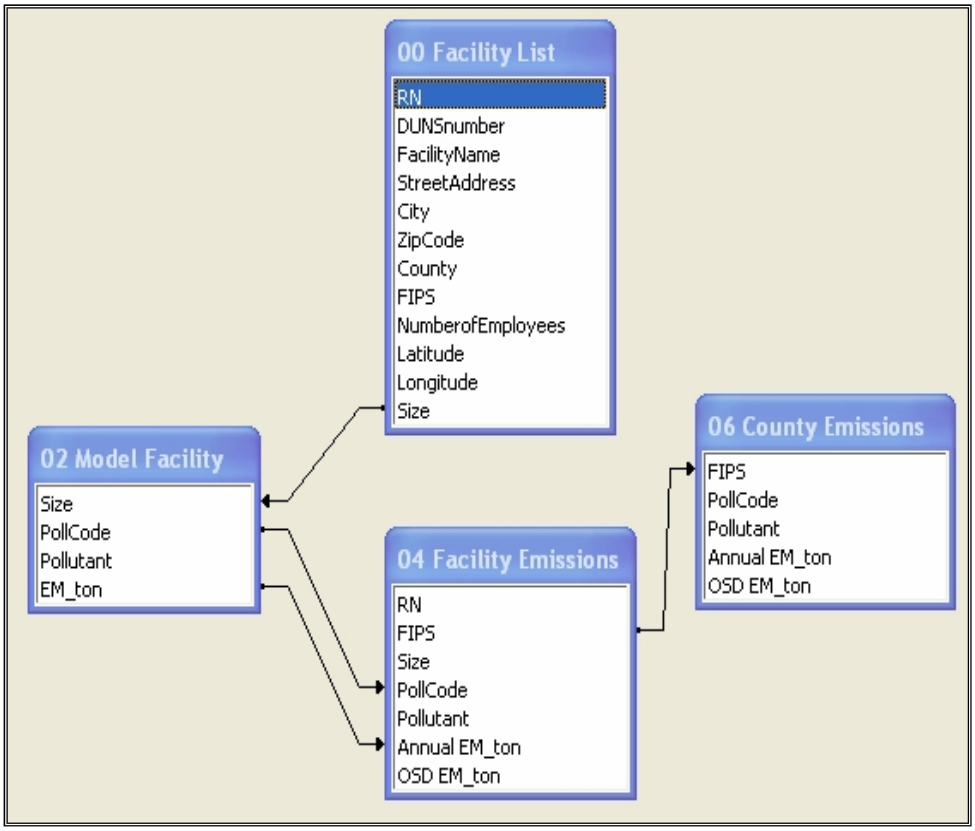

Figure 2-2. Map of Data Structure for the Auto Refinishing Database

2.1.2 *Data Dictionary*

Below is the data dictionary with table names, the field names, and their descriptions.

Facility List

Field Name	Short Description
RN (linked)	Permit Regulated Entity Identification Number
DUNSnumber	Dunn and Bradstreet ID
FacilityName	Facility Name
StreetAddress	Facility Street Address
City	Facility City
ZipCode	Facility Zipcode
County	Facility County Name

Facility List (Continued)

FIPS (linked)	Facility FIPS
NumberofEmployees	Number of Employees
Latitude	Facility Latitude
Longitude	Facility Longitude
Size (linked)	Facility Size based on the employees (<10 is small, 10 - 19 is medium, & >20 is large)

Model Facility

Field Name	**Short Description**
Size (linked)	Facility Size based on the employees (<10 is small, 10 - 19 is medium, & >20 is large)
PollCode (linked)	Pollutant CAS code
Pollutant (linked)	Pollutant name
EM_ton	Annual emissions

Facility Emissions

Field Name	**Short Description**
RN (linked)	RN ID Number
FIPS (linked)	Facility FIPS
Size (linked)	Facility Size based on the employees (<10 is small, 10 - 19 is medium, & >20 is large)
PollCode (linked)	Pollutant CAS code
Pollutant (linked)	Pollutant name
Annual EM_ton	Annual emissions
OSD EM_ton	Ozone Season Daily emissions (calculated from annual emissions)

County Emissions

Field Name	**Short Description**
FIPS (linked)	Facility FIPS
PollCode (linked)	Pollutant CAS code
Pollutant (linked)	Pollutant name
Annual EM_ton	Annual emissions
OSD EM_ton	Ozone Season Daily emissions (calculated from annual emissions)

3.0 COMPILATION OF ACTIVITY AND PAINT CHARACTERISTICS DATA

Every effort was made in this project to identify and obtain Texas-specific data; this included information about specific shops involved in auto refinishing, coating materials used that complied with state standards, and Texas specific data to quantify seasonal variation in painting activities. The project's data collection efforts are discussed for each of the following:

- Facility Identification
- Auto Refinishing Coating Characteristics
- Texas Accident Reporting Data

3.1 Facility Identification

Multiple references were evaluated that identified individual auto refinishing facilities in the state of Texas, these data sources included:

- Texas permit-by-rule data [4]
- Texas tax data [5]
- Dun & Bradstreet (D&B) data [6]
- U.S. EPA National Emission Inventory (NEI) facility matching tool [7]
- *Yellow Pages*® data [8]

The U.S. Census Department's *County Business Patterns* [9] also provided limited data about the number of auto refinishing facilities and associated employment summed to the county level.

Of these references, the Texas permit-by-rule dataset [4] was considered the most complete as it included dealerships as well as municipal and county vehicle painting operations. Unfortunately, nearly 400 sites were listed in the TCEQ permit dataset with generic names such as "Auto Body & Paint Shop" or "Vehicle Repair or Refinish". Others had only addresses in the name column. Another 200 records had an address of "same", with no way of knowing to what it referred. These are all artifacts from the TCEQ data source, which is the New Source Review (NSR) data file. Originally the focus of the NSR data was on individual units, not facilities. Where site names are provided, these probably were pulled in from Texas Permitting Central Registry (CR). Those that do not have a site name probably do not have a record in CR. Because the NSR permit data is at the unit process level, 109 records were for facilities that have multiple

spray booths and therefore were considered to be duplicates. These duplicates were removed from the project data file. An additional 47 duplicates were identified and removed as multiple entries with the same or similar names and addresses. In at least a dozen cases, duplication could not be verified, and the facilities were retained and flagged for future review.

This issue of including process level operations was also a concern for the NEI, and a crosswalk table was developed to link processes to individual facilities.[7] The NEI was used to identify three additional facilities.

The permit-by-rule facility list [4] was matched to the D&B [6] facility list to pull in facility-specific employee data, latitude and longitude coordinates, and to flag and remove specific locations that represented corporate headquarters rather than paint shops. Automated facility matching of permit-by-rule and D&B facilities was implemented by comparing records in the data fields paired in Table 3-1. This table also shows the number of facilities matched for each comparison.

Table 3-1. Automated Facility Matching – Paired Data Fields and Results of Comparison

Field Name in State File	Field Name in D&B file	Number of Facilities Matched
RN Name/Physical Location Address	Company/Mail Address	12
Customer Name/Physical Location Address	Company/Mail Address	21
Site Delivery Address/Site Delivery City	Mail Address/Mail City	22
RE Name/Location County	Company/Mail County	162
Customer Name/Location County	Company/Mail County	267
Physical Location Description	Top Parent Address	3
Physical Location Description	Street Address	9

Manual matching of the permit-by-rule facilities with the D&B list was done by breaking the files down by county, with business names being listed alphabetically within each county. This manual approach provided an additional 519 facility matches. The D&B data could be matched for 34% of all facilities in the permit-by-rule list. It should be noted that D&B contained

data for 223 counties, while the State File included data for 153. A total of 181 facilities appear in the counties contained only on the D&B database. These facilities appeared to be legitimate paint operations. It was assumed that the facilities were too small and did not meet the minimum paint usage threshold (total solvent usage is less than half a pint per hour or less than two gallons per week) that trigger permitting and were therefore not included in the final permit-by-rule facility list and also were not included in this inventory as their emissions would be insignificant.

More than 200 businesses were included in the permit-by-rule data with names that indicated they were car dealerships, and as such would not be included in the D&B file which only included facilities that were specifically designated auto painting operations. For the purpose of this project, it was assumed that these automobile dealership painting activities were similar to the small model plants as their primary business was auto sales and maintenance.

The remaining non-matched facilities were evaluated individually to ensure that they were auto paint shops. In some cases, facilities with adjacent addresses were identified and investigated further to ensure that they were not duplicate facilities. In other cases, several seemingly unrelated facilities appeared to have the same address. Some showed suite numbers, indicating that the facilities did, in fact, share an address, although they were separate facilities. These records were not considered duplicates unless another identifying feature, such as owner name also corresponded.

The Texas tax data [5] were utilized as an additional resource to complete records which otherwise had inadequate addresses. By matching the permit-by-rule file to the Texas tax data file using Tax ID or a combination of the facility name and county, 15 records were corrected with complete address information.

These efforts led to the creation of a data table of 2,722 area source auto refinishing shops in Texas. The facility table contains the following data fields:

- RN
- DUNS Number
- Facility Name
- Street address
- City
- Zip Code
- County

- FIPS Code
- Number of employees
- Latitude coordinate
- Longitude coordinate

3.2 Auto Refinishing Operations and Coating Characteristics

To calculate emissions associated with auto refinishing, it was important to get an accurate estimate of the volume of paint used annually for each model plant type. Typical per vehicle paint consumption rates range from a pint for very small repair jobs to two gallons to completely paint a vehicle. In general, 90 percent of a shop's painting activities relate to spot or panel repairs, and 10 percent involve the entire vehicle.[1]

To estimate the amount of paint used at each model plant, it was necessary to retrieve permit-by-rule applications for auto refinishing. These applications include facility-specific data that quantify monthly paint consumption and the VOC content of the paint being used as noted in Figure 3-1. ERG compiled a list of 1,030 facilities for which D&B employee data could be matched, and grouped the facilities into the appropriate model types based on the number of employees associated with each facility. ERG next matched the RN identification codes with data in the Central Registry to obtain account and permit identification codes. The permit application codes for the identified facilities were applied to TCEQ web-based permit database (https://webmail.tceq.state.tx.us/gw/webpub) and used by staff at the air permitting office to pull permit applications, which were scanned into a laptop computer and later compiled into the project's paint usage and VOC content spreadsheet. The compiled data are included in the Appendices A and B of this report.

VOLATILE ORGANIC COMPOUND CONTENT OF COATINGS USED		
Coating Category	**Coating Limit (lb VOC/gal)**	**Actual VOC (lb VOC/gal)**
Primers or Primer Surfacers	5.0	4.8
Precoats	5.5	None
Pretreatments	6.5	None
Single-Stage Topcoats	5.0	5.0
Basecoat/Clearcoat Systems	5.0	4.46
Three-Stage Systems	5.2	4.65
Specialty Coatings	7.0	None
Sealers	6.0	4.65
Wipe-Down Solutions	1.4	0.50

USAGE RATES OF REFINISHING COATINGS USED		
Coating Category	**Coating Limit (gal/month)**	**Estimated Usage (gal/month)**
Cleanup Solvents	50	None
Wipe Solvents	50	3
Precoats	50	None
Pretreatments	50	None
Sealers	50	2
Primers or Primer Surfacers	175	3
Topcoats	320	4
Specialty Coatings	50	None

Figure 3-1. Example Auto Refinishing Permit-by-Rule Application Data

Most of the paint usage data were related to small plants. To ensure a consistency in our paint usage data set, two large plants that may have operations not typical of the smaller plants were removed from the spreadsheets. Aggregated paint usage per car was calculated by summing the paint usage for each paint type and dividing by the number of cars typically painted per month at a small paint shop (21 cars) and the number of reporting facilities using the following equation:

$$VCR = (\sum PC_i)/(MVR \times RF)$$

Where:

VCR = Vehicle paint consumption rate (gallons of paint/vehicle)
PC_i = Monthly paint consumption rate for facility i (gallons per month)
MVR = Estimate of cars typically painted each month at a small paint shop (21 cars per month)
RF = Number of facilities that reported paint consumption data

Example Calculation – Paint Consumption Calculation

Eighteen small facilities reported usage of primer. Together they used 77.7 gallons of primer a month. A survey of Texas facilities quantified that small shops paints 21 vehicles per month.

$VCR = (\sum PC_i)/(MVR \times RF)$
VCR = 77.7 gal per month / (21 cars per month × 18 facilities)
VCR = 0.206 gallons primer per car

The vehicle paint consumption rate was applied to the annual number of vehicles painted for each model plant type using the following equation:

$$PCR = VCR \times MVR \times 12$$

Where:

PCR = Annual paint consumption rate
VCR = Vehicle paint consumption rate (gallons of paint per vehicle)
MVR = Estimate of cars typically painted each month (small 40 cars; medium = 100 cars; large = 200 cars)
12 = Months per year

Example Calculation –Annual Paint Consumption Calculation

The per vehicle paint consumption rate for primer is 0.11 gallons. A large shop paints 200 vehicles per month to estimate the annual primer paint consumption for large facilities:

PCR = VCR × MVR × 12
PCR = 0.11 gal/car × 200 × 12
PCR = 264 gallons primer per year

Annual paint consumption for each plant type for each paint type is summarized in Table 3-2.

Table 3-2. Average Auto Refinishing Paint Usage (gallons per year)

Paint Type	Model Plant Type		
	Small	Medium	Large
Primer	52.7	183.3	522.3
Precoats	29.4	102.2	291.2
Pretreatment	39.0	135.4	385.8
Specialty coatings	68.7	238.6	680.0
Sealers	27.9	96.8	275.9
Wipe down solution	35.9	124.8	355.5
Topcoats	151.3	526.0	1,498.6
Cleanup Solvents	98.2	341.4	972.8

In addition to getting accurate information about paint usage rates, the permit-by-rule data provided information on the VOC content of the paints being used by facilities operating in Texas. As noted in 30 TAC § 115.421, the paint VOC content reported in the application excludes the water content and exempt VOCs. It should be noted that to calculate the VOC content of a coating product without the water or exempt compound components based on data in a products MSD sheet, may be confusing, and some plant operators may have provided VOC content and unintentionally included water and exempt compounds. This would lead to an over

estimation of actual emissions. The magnitude of this error is probably small as the average content tends to be below regulated levels. The average actual VOC content for each paint type are summarized in Table 3-3.

Some of the compiled permit data were from older applications that only quantified general top coat paint usage, but did not report VOC content. For this project, the average VOC content of the different top coats (i.e., single-stage coating, base/clear coat system, and three stage top coating) was used for topcoats, which may slightly over estimate actual emissions. Note, that specialty coatings were not included as a top coat, but were handled separately. Similarly, the VOC content of cleanup solvents was not provided. For this project it was assumed that cleanup solvents have 6.75 lbs of VOC per gallon which was obtained from EIIP guidance.

Table 3-3. Average Actual VOC Content (Excluding Water and Exempt Compounds) by Paint Type

Paint Type	Percent (lbs/gal)
Primer	3.93
Precoats	4.31
Pretreatment	4.61
Single-stage coatings	4.26
Basecoat /clear coat system	4.47
Three stage top coats	4.47
Specialty coatings	5.95
Sealers	4.26
Wipe down solution	1.22
Topcoats	4.40
Solvent Cleanup	6.75

A limited amount of organic VOC species data can be obtained from Material Safety Data Sheets (MSDS) provided by the paint manufacturers. Auto refinishing paints, which include a large number of specialty paints that are used infrequently by paint shops, have significantly different organic VOC concentrations. Paint manufacturers and trade associations were contacted to obtain information that would help develop appropriate weights for the organic VOC species data presented in the MSD sheets or, at a minimum, identify the dominant auto refinishing paints. These calls did not yield the data required to identify and weight the auto refinishing

paints used in the state. A log of all calls made for this project and a summary of the discussion that ensued is provided as a deliverable for this project.

Alternatively, the California Environmental Protection Agency's Air Resources Board implemented a survey to quantify the use of automobile refinishing coatings. The survey was implemented in June 2002 and solicited paint usage and composition data for activities occurring in the calendar year of 2001.[2] A regulatory assessment was preformed to determine if the 2001 California survey data would be representative of auto refinishing paints used in Texas in 2005. The regulations considered in this assessment are noted in Appendix D of this report, and include current federal and Texas rules as well as current and previous California regulations. Texas follows the auto refinishing paint standards developed by the U.S. EPA in 1998, which are less stringent than the current California standard that went into effect January 2008. It should be noted that the California survey data are for 2001, at which time the standard that California paints needed to comply was similar to the 1998 federal standard, except for primers, single stage topcoats, and clear coats which are more stringent than the Texas standard, while the pretreatment coating, color coating and multi-color coating limits are less stringent than the Texas standard. In aggregate, using the ARB VOC species profile is considered reasonable to apply for the Texas inventory.

Due to issues of confidentiality, the California survey aggregated the organic VOC species profiles for all automotive paints (see Table 3-4); therefore the VOC estimate for all paints were summed for each model plant type prior to application of the California VOC species profile. Total VOC and VOC species emission summaries are presented in Section 8.0 of this report.

Table 3-4. ARB VOC Speciation Profile[2]

Chemical	CAS Number	Percent Composition
n-Butyl Acetate	123-86-4	21.51
Xylene	1330-20-7	11.51
Toluene	108-88-3	10.88
Methyl n-Amyl Ketone	110-43-0	6.03
Propylene Glycol Monomethyl Ether Acetate	108-65-6	4.32
Solvent Naphtha	64742-89-8	4.27
Methyl Ethyl Ketone	78-93-3	4.10
Isopropanol	67-63-0	3.38

Table 3-4. ARB VOC Speciation Profile2 (Continued)

Chemical	CAS Number	Percent Composition
Methyl Isobutyl Ketone	108-10-1	2.92
Petroleum Either	8032-32-4	2.57
Heptane	142-82-5	2.56
Ethyl Benzene	100-41-4	2.03
Ethyl 3-Ethoxypropionate	763-69-9	1.71
Cellulose Acetate Butyrate	9004-36-8	1.65
Ethyl Acetate	141-78-6	1.58
n-Butanol	71-36-3	1.54
Aromatic 100	64742-95-6	1.47
Styrene	100-42-5	1.29
2-Butoxyethyl Acetate	112-07-2	1.12
Medium Aliphatic Solvent Naphtha	64742-88-7	0.98
1,3,4- Trimethylbenzene	95-63-6	0.73
n-Butyl Propionate	590-01-2	0.68
Isophorone Diisocyanate Polymer	4098-71-9	0.50
Isobutyl Acetate	110-19-0	0.48
Methyl Isoamyl Ketone	110-12-3	0.46
Methanol	67-56-1	0.44
Isophorone Diisocyanate Adduct Soln	Combined	0.41
Hydrotreated Heavy Naphtha	64742-48-9	0.39
2-Pentanone	107-87-9	0.38
Methylcyclohexane	108-87-2	0.35
Acetic Acid, Hexyl Esters Mixture	88230-35-7	0.34
5-Methyl- 3-Heptanone	541-85-5	0.32
l-Methoxy-2-Propanol	107-98-2	0.29
Stoddard Solvent	8052-41-3	0.28
Naphtha, Petroleum, Hydrotreated Light	64742-49-0	0.22
Isobutyl Alcohol	78-83-1	0.22
Benzoyl Peroxide	94-36-0	0.20
2-Butoxyethanol	111-76-2	0.19
2,4-Pentanedione	123-54-6	0.18
1,3 Benzenedicarboxylic Acid	25950-34-9	0.17
Methyl Isobutyl Carbinol	108-11-2	0.17
Acetic Acid, C6-C8 Branched Alkyl Esters	90438-79-2	0.15
Remaining 5% by weight of VOC Ingredients	Combined	5.04

4.0 EMISSION ESTIMATES PROCEDURES

The emission estimating methods used for this project supplement the procedures implemented by the U.S. EPA in support of the MACT standard for auto refinishing[1] with data from TCEQ's permit-by-rule applications. In this approach, a set of three model facilities were developed by the EPA based on information obtained during site visits. Based on phone calls to 249 facilities included in the permit-by-rule data, the number of vehicles refinished monthly was modified to more accurately represent activity levels in Texas. The model plants used for this study are summarized in Table 4-1.

4.1 Auto Refinishing Paint Usage

The amount of paint used annually at each model plant was estimated in Section 4.2 and is summarized in Table 4-1 for model plant type.

Table 4-1. Auto Refinishing Model Plants - Texas Annual Paint Usage

Parameter	Small	Medium	Large
Number of employees	1 - 9	10 - 19	≥ 20
Number of shops in Texas	2,525	134	63
Number of spray booths per shop	1	2	3
Number of vehicles refinished per month	21	74	208
Average Paint Usage (gallons per year)			
Primer	52.7	183.3	522.3
Precoats	29.4	102.2	291.2
Pretreatment	39.0	135.4	385.8
Specialty coatings	68.7	238.6	680.0
Sealers	27.9	96.8	275.9
Wipe down solution	35.9	124.8	355.5
Topcoats	151.3	526.0	1,498.6
Cleanup Solvents	98.2	341.4	972.8

To estimate the speciated organic emissions, the VOC estimate was used in conjunction with the speciation profile of the organic VOC components of auto refinishing coatings compiled in Section 4.2.

4.2 VOC Content and Emission Calculations

The average VOC content of each auto coating material was obtained from permit-by-rule applications as discussed in Section 3.2. These average values were used to calculate the annual VOC emissions of each model plant by applying the VOC content value of auto refinishing paints to the annual paint usage reported in Table 3-2, using the following equation:

$$VOC = (VOC_c \times PCR) / 2{,}000$$

Where:

VOC = VOC estimate (tons per year)
VOC_c = VOC content (pounds per gallon)
PCR = Annual paint consumption rate (gallons per year)
2,000 = lbs per ton

Example Calculation - VOC Emission Estimate

The auto refinishing paint has a VOC content of 6 lbs/gal for a facility that has an annual paint consumption rate of 1,200 gallons per year.

$$VOC = (VOC_c \times PCR) / 2{,}000$$
$$VOC = (6 \times 1{,}200) / 2{,}000$$
$$VOC = 3.6 \text{ tons per year}$$

Annual VOC estimates for each plant type are present in Table 4-2. These VOC estimates were applied to each facility based on the facility size which was derived from the number of employees associated with the facility; small plants had less then 10 employees, medium plants had 10-19, and large plants had more than 20 or more employees.

Table 4-2. VOC Emissions by Plant Type

Paint Type	Emissions by Model Plant Type (lbs/yr)		
	Small	Medium	Large
Primer	204.3	710.2	2,023.7
Precoats	126.7	440.3	1,254.6
Pretreatment	179.6	624.3	1,778.8
Specialty	408.3	1,419.4	4,044.2
Sealers	118.0	410.1	1,168.6
Wipedown	45.4	157.9	449.8
Topcoats	663.0	2,304.6	6,566.5
Solvent Cleanup	663.0	2,304.6	6,566.4
Total Annual VOC Emissions (tpy)	**1.2**	**4.2**	**11.9**

4.3 Controlled Emission Adjustment

Typically uncontrolled emissions are adjusted to account for the application of control options. With regard to auto refinishing, there are three approaches that can be used to control emissions:

- Use of lower-VOC coatings;
- Increased transfer efficiency; and
- Use of enclosed equipment cleaning devices

Currently, the use of low VOC water-based paints is limited by a variety of operational factors, for example, water-based coatings require large volumes of warm dry air for curing.[13] Guns used for water-based applications must be cleaned with water and alcohol, not the same cleaning equipment used for guns that apply solvent-based paints, as the solvents cause the water-based coatings to harden instead of dissolve.[12] There are also issues related to shipping and storage of water-based product, as the material is considered unstable and must be shipped in heat-controlled trucks to avoid freezing. It should also be noted that there are no water-based clearcoats in use, vehicle painting operations will still require a solvent-based finish coat.[14]

These operational factors currently limit the appeal of water-based paints, but these paints are increasingly being used in California (see Appendix D) and Europe to meet stringent VOC emissions limits. For the purpose of this study, it was assumed that in 2005 use of water-based paints in Texas was insignificant.

With regard to transfer efficiencies, use of high efficiency spray equipment is required in the Texas Permit-by-Rule. It should also be noted that based on the site visits made for the MACT standard, it was apparent that high volume, low pressure (HVLP) and other types of high transfer efficiency spray equipment have been almost universally adopted in the refinishing industry.[1] The use of high transfer efficient equipment is not only a permitting requirement, but is also driven by economics; higher transfer efficiencies mean less wastage and lower paint consumption rates.

Use of enclosed equipment cleaning devices can reduce cleaning VOC emissions by up to 90 percent. The Texas Auto Refinishing Permit-by-Rule requires use of enclosed solvent cleaners unless the solvents have a low vapor pressure (less than 100 mmHg at 68 degrees

Fahrenheit). For the purpose of this study, it was assumed that all solvent cleaning is enclosed, because actual paint usage and VOC content as reported in the permit-by-rule applications reviewed are used in the auto refinishing calculations, the use of HVLP and enclosed solvent cleaning have already been taken into consideration and further adjustment to the emission estimates are not required to account for the use of these emission control methods.

4.4 VOC Species Emission Estimate

The VOC emissions were speciated into organic VOC components by applying the speciation profiles, discussed in **Section 4.2**, to the following equation:

$$VOC_{sa} = OS_a / 100 \times VOC$$

Where:

VOC_{sa} = Annual emissions of organic VOC species a (tons per year)
OS_a = Organic VOC species fraction for pollutant a (percentage)
VOC = Annual VOC emissions (tons per year)
a = Organic air pollutant

The organic VOC profiles used in this calculation are summarized in Table 3-4.

Example Calculation* - VOC species *Emission Estimate

An auto refinishing paint typically contains 11.51 percent xylene. The model plant of interest has annual VOC emissions of 3.6 tons per year. To estimate annual emissions of xylene the following calculations are made:

$VOC_{sa} = OS_a \times VOC$
$VOC_{sa} = 0.1151 \times 3.6$ tons per year
$HAP_a = 0.4144$ tons per year

5.0 TEMPORAL ADJUSTMENT

The ozone period varies between nonattainment areas in the state, but for this project it was assumed that the ozone season is from April 1 through October 31 (213 days in 2005).[15] The Texas Department of Transportation provided monthly estimates for 2005 of the number of vehicles involved in accidents statewide, as noted in Table 5-1.[3] These monthly accident reports were used as a surrogate to quantify activity during the ozone season.

Example Calculation – Ozone Day Adjustment

There were 914,973 auto crashes in 2005 (TR_{an}), of these 538,537 crashes occurred during the OSD period (AR_{OSD}). To estimate the temporal adjustment factor the following equation was used.

$$TF_{adj} = (AR_{OSD})/(TR_{an} \times 213)$$
$$TF_{adj} = (538{,}537)/(914{,}973 \times 213)$$
$$TF_{adj} = (538{,}537)/(194{,}889{,}249)$$
$$TF_{adj} = 2.763 \times 10^{-3}$$

In 2005, the total number of vehicles reported involved in accidents in Texas was 914,973. During the period from April 1, 2005 to October 31, 2005, there were 538,537 vehicles involved in accidents. Using the following equation, the ozone season adjustment factor to convert annual emissions to ozone season day emissions is 2.763×10^{-3}.

$$TF_{adj} = (AR_{OSD})/(TR_{an} \times P_{oz})$$

TF_{adj} = Temporal adjustment factor
AR_{OSD} = Number of vehicles in auto crashes occurring during ozone season day period
TR_{an} = Total number of vehicles in auto crashes occurring annual in Texas
P_{oz} = Number of days in the ozone period (213 days)

This ozone season adjustment factor was applied to the annual facility emissions to provide the OSD emission estimates.

Table 5-1. Vehicles Involved in Crashes Statewide in 2005 (Ozone Season Highlighted)

Month	Total
January	70,880
February	69,941
March	80,294
April	78,928
May	79,668

Table 5-1. Vehicles Involved in Crashes Statewide in 2005 (Ozone Season Highlighted) (Continued)

Month	Total
June	72,879
July	74,645
August	77,422
September	74,117
October	80,878
November	76,503
December	78,818
Total	914,973

6.0 SPATIAL ALLOCATION PROCEDURES

Because facility-specific data were used in this project, emissions were spatially assigned to a facility's latitude and longitude coordinates bases on matching permit-by-rule facilities to paint shops report in the D&B dataset. For permit-by-rule facilities that could not be matched to shops in the D&B list, latitude and longitude coordinates were obtained by applying the facility's permit address to the TeleAtlas mapping service. Latitude and longitude coordinates were obtained from TeleAtlas for 985 facilities. The spatial distributions of Texas auto refinishing shops are presented in Figure 6-1.

There were 4 facilities that could not be assigned latitude and longitude coordinates as the addresses were missing. For these facilities the latitude and longitude coordinates of the nearest town were used.

The individual facility emissions were summed for each county based on the county FIP code. County emission totals were combined into the project dataset and output into NIF 3.0 format for both annual and OSD emissions. These results are presented in Section 8.0 and Appendix C.

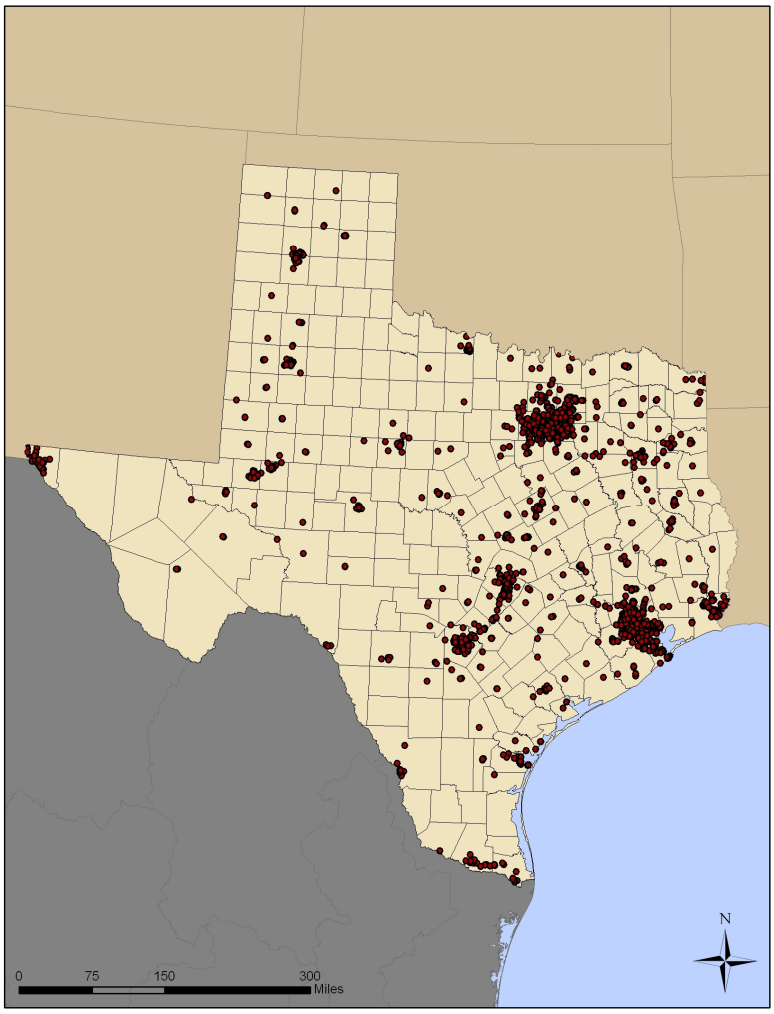

Figure 6-1. Map of Auto Refinishing Area Source Facility Locations

It should be noted that Figure 6-1 shows that some counties appear not to have any auto refinishing facilities which indicates that the permit-by-rule data may be missing facilities involved in auto refinishing operations.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

ERG applied a variety of quality assurance/quality control (QA/QC) procedures in conducting this emission inventory effort to ensure that the data used and resulting emission estimates are complete and reasonable, and the calculations can be independently reproduced. The quality procedures implemented for this project ensure that the results meet TCEQ's high quality standard.

All original information gathered during the course of this project was retained in the shared project directory using appropriate electronic formats. Hard copies or copies of electronic data were made available to the team as working copies for project use.

All information used to determine final emissions estimates (e.g., activity data, emission factors, level of control assessments, and seasonal emissions adjustments) was checked and verified that they were complete and reasonable. Data gaps were identified and appropriate and robust alternative data were used to fill the missing data elements, as noted in Section 3.0 and 4.0 of this report. Where possible, the compiled data were compared with independent sources to insure that the information was reasonable and representative.

For example, Texas data concerning auto refinishing facilities were compiled from the *Yellow Pages*® [8] and compared to the project's list of refinishing facilities. The *Yellow Pages*® reported state wide that there were 4,864 facilities classified as automobile body repairing and painting operations. This value is significantly higher than the facility count developed for this project (2,722). The *Yellow Pages*® data are larger as they include facilities that maintain and repair cars, but do not actually paint them (e.g., Texas International Motors, Houston). Operations that use paint-less techniques to repair dents (e.g., Quality Paint-less Dent Removal, Fort Worth) are also included in the *Yellow Pages*® listing which would also explain why their value is higher then this project's auto painting facility count. It should also be noted that according to a study of members of BodyShopBusiness.com, 42 percent of body shop owners do not market their services through the *Yellow Pages*®. These observations suggest that the *Yellow Pages*® data do not provide an accurate estimate of auto paint shops.

The County Business Patterns Data [9] from the Census Bureau were also considered to check the reasonableness of our facility count. But because the County Business Patterns data were aggregated to the broad NAICS code for auto repair and maintenance, the Census Bureau's facility count (16,269) for Texas was even larger than the facility count from the *Yellow Pages*® and therefore could not be used to quality check the project's facility list.

Another quality check performed on the compiled data was to compare the estimated number of cars painted using data compiled for the model plants with the number of cars involved in crashes as provided by the Texas DOT. An annual estimate of vehicle paint jobs based on the model plants was calculated by applying the number of facilities associated with each of the model plant type to the estimated number of vehicles refinished per month and multiplying that value by 12 to get an annual activity estimate, as noted in Table 7-1.

Table 7-1. Activity Comparison

Model Plant Estimate of Annual Activity				
Plant Type	**Number of Facilities**	**Vehicles Per Month Painted Per Facility**	**Total Number of Vehicles Painted Per Month**	**Vehicles Painted Annually**
Small	2,525	21	53,025	636,300
Medium	134	74	9,916	118,992
Large	63	208	13,104	157,248
Total number of vehicles painted annually				**912,540**
Adjusted DOT Crash Data				
Total TX DOT reported annual estimate of crashes				914,973
Adjustment for unreported accidents				+ 457,500
Adjustment for non-crash painting activities (10%)				+ 137,247
Adjustment for cars totaled and not painted (20%)				-274,495
Adjusted Annual Total				**1,235,225**

Because not all accidents are reported to the police, the TX DOT annual reported crashes were adjusted to account for unreported accidents. The U.S. Department of Transportation's Federal Highway administration estimates that approximately half of accidents are not reported[16], but many of these unreported accidents are believed to be minor and would not require repair. For the purpose of this study, it was assumed that that half of the unreported accidents did require repair and repainting. It should also be noted that the model plant estimates included whole car paint jobs that were unrelated to automobile accidents (e.g., upgrading a

vehicle's original paint job, or repainting old cars where the coating has faded or dulled over the years). Typically these whole car paint jobs represent 10 percent of an auto paint facilities activities; such that the total crash data (i.e., the original TX DOT data plus the adjustment for unreported accidents) were increased by 10 percent to account for these additional non-crash related paint jobs.[1]

An adjustment was also made to the DOT estimate to account for vehicles that are classified as totaled and would not be repaired or repainted. These are vehicles where the cost of repair exceeds the value of the car prior to the accident minus its scrap value. Insurance data indicate that 20 percent of vehicles involved in accidents are classified as totaled. [18]

Taking all of the adjustments into consideration the vehicles that require painting based on the DOT crash data are significantly higher than the number of vehicles estimated using the model plants. This would again suggest that that facilities are missing in permit by rule data.

Another quality check performed on the data was an evaluation of the latitude and longitude coordinates obtained from D&B and TeleAtlas. These coordinates for individual facilities were used to spatially allocate emissions to the correct county. The coordinates were mapped using GIS tools to ensure that the facility was located in the county documented in the permit-by-rule file. Of the 2,722 facilities identified for this project, 2,336 (86 percent) had appropriate latitude and longitude coordinates for the reported FIPS. Eight facilities were corrected when GIS-mapped coordinated matched the address, but not the original FIPS code. Three facilities were corrected based on GIS-mapped coordinates where no address information was available. Coordinates for 329 facilities were outside of the state, these coordinates were ignored and the original FIPS were maintained. 46 facilities had coordinates within the state, but were associated with different FIPS than noted in the permit-by-rule data. Of those, two had enough address information to confirm that the original FIPS were correct. The other 44 did not have enough address information to confirm or deny the original data therefore the original FIPS were maintained. In the end, only 11 records had their FIPS code corrected.

All spreadsheets and databases used to develop the auto refinishing emission estimates include the ERG team member's name, date, and status (i.e., draft, QC completed, final). All

calculations, adjustments, and spatial allocations were independently verified by staff that are familiar with the topic, but not directly involved in developing the emission estimates.

8.0 EMISSION SUMMARY

Table 8-1 summarizes the annual and ozone season daily emission estimates for Texas auto refinishing area sources. Most of the emissions are associated with small shops which account for almost 80 percent of the auto refinishing VOC emissions. Within the small shop operations, topcoats and solvent cleanup collectively represent 56 percent of the total small facility VOC emissions.

Table 8-1. Summary VOC Emissions for Texas Auto Refinishing Area Sources in 2005

Shop	Coating Category								Total
	Primer	Precoats	Pretreatment	Specialty	Sealers	Wipedown	Topcoats	Solvent Cleanup	
	Statewide VOC Emissions (tons per year)								
Small Shops	257.9	159.9	226.7	515.5	149.0	57.3	837.0	837.0	**3,040.3**
Medium Shops	47.6	29.5	41.8	95.1	27.5	10.6	154.4	154.4	**560.9**
Large Shops	63.7	39.5	56.0	127.4	36.8	14.2	206.8	206.8	**751.4**
Total	**369.3**	**228.9**	**324.6**	**738.0**	**213.2**	**82.1**	**1,198.2**	**1,198.2**	**4,352.6**
	Statewide VOC Emissions (tons per ozone season day)								
Small Shops	0.7	0.4	0.6	1.4	0.4	0.2	2.3	2.3	**8.4**
Medium Shops	0.1	0.1	0.1	0.3	0.1	0.0	0.4	0.4	**1.5**
Large Shops	0.2	0.1	0.2	0.4	0.1	0.0	0.6	0.6	**2.1**
Total	**1.0**	**0.6**	**0.9**	**2.0**	**0.6**	**0.2**	**3.3**	**3.3**	**12.0**

The emissions were mapped to individual counties by summing the facility emissions for individual counties and applying these emission summaries to Geographic Information Systems (GIS) shape files shown in Figure 8-1. The ten counties with the highest auto refinishing VOC emissions are presented in Table 8-2. A complete list of all county emissions is included in the Appendix C of this report.

Table 8-2. Texas Counties with the Highest VOC Emissions (tons per year/tons per day)

County	Annual Emission Estimate (tons per year)	Ozone Season Day Emission Estimate (tons per day)	Percent of State Total
Harris County	1067.7	2.9503	24.5
Dallas County	592.1	1.636	13.6
Tarrant County	314.8	0.8700	7.2
Travis County	221.2	0.6111	5.1
Bexar County	204.2	0.5642	4.7
El Paso County	141.9	0.3921	3.3
Galveston County	79.9	0.2209	1.8
Jefferson County	73.4	0.2028	1.7
McLennan County	71.4	0.1973	1.6
Collin County	68.5	0.1892	1.6
State Total	4352.6	12.0274	

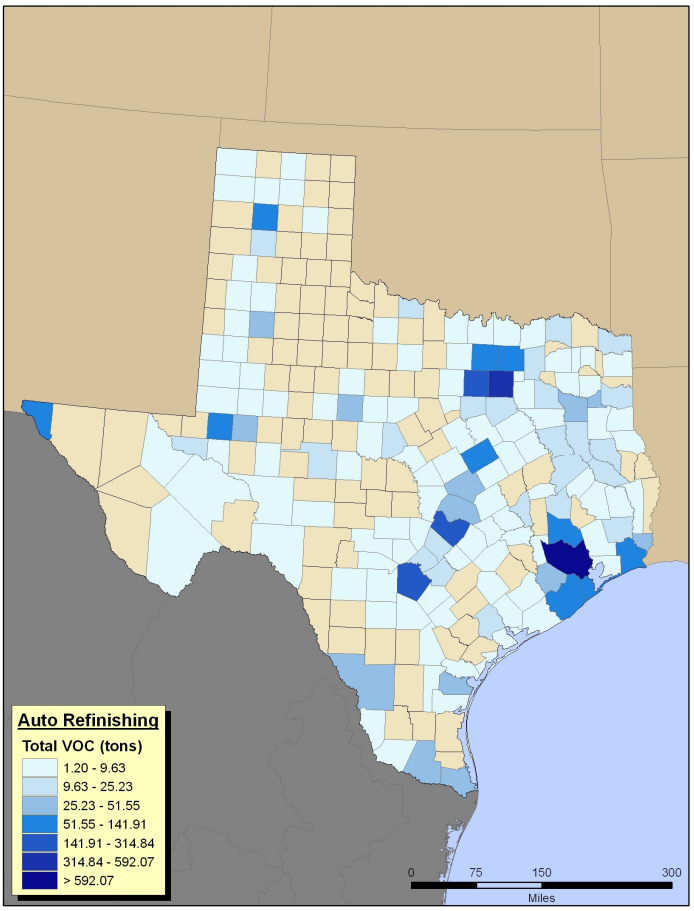

Figure 8-1. Annual Auto Refinishing VOC Emissions

Table 8-3 lists the organic VOC species for which emissions were calculated. Four pollutants account for approximately 50 percent of the VOC emissions associated with auto refinishing; these include n-butyl acetate, xylene, toluene, and methyl n-amyl ketone.

Table 8-3. 2005 Organic VOC Emission Summary from Texas Auto Refinishing Area Sources

Pollutant Name	CAS	Annual Emissions (tons)
1,3 Benzenedicarboxylic Acid	25950349	7.6
1,3,4- Trimethylbenzene	95636	31.7
2,4-Pentanedione	123546	7.9
2-Butoxyethanol	111762	8.4
2-Butoxyethyl Acetate	112072	48.9
2-Pentanone	107879	16.3
5-Methyl- 3-Heptanone	541855	14.0
Acetic Acid, C6-C8 Branched Alkyl Esters	90438792	6.4
Acetic Acid, Hexyl Esters Mixture	88230357	14.9
Aromatic 100	64742956	64.1
Benzoyl Peroxide	94360	8.7
Cellulose Acetate Butyrate	9004368	71.7
Ethyl 3-Ethoxypropionate	763699	74.4
Ethyl Acetate	141786	68.6
Ethyl Benzene	100414	88.5
Heptane	142825	111.2
Hydrotreated Heavy Naphtha	64742489	16.8
Isobutyl Acetate	110190	20.8
Isobutyl Alcohol	78831	9.4
Isophorone Diisocyanate Adduct Soln	Unknown	17.9
Isophorone Diisocyanate Polymer	4098719	21.7
Isopropanol	67630	147.0
l-Methoxy-2-Propanol	107982	12.5
Medium Aliphatic Solvent Naphtha	64742887	42.8
Methanol	67561	19.1
Methyl Ethyl Ketone	78933	178.3
Methyl Isoamyl Ketone	110123	20.0
Methyl Isobutyl Carbinol	108112	7.5
Methyl Isobutyl Ketone	108101	127.0
Methyl n-Amyl Ketone	110430	262.3
Methylcyclohexane	108872	15.3

Table 8-3. 2005 Organic VOC Emission Summary from Texas Auto Refinishing Area Sources (Continued)

Pollutant Name	CAS	Annual Emissions (tons)
Naphtha, Petroleum, Hydrotreated Light	64742490	9.6
n-Butanol	71363	66.8
n-Butyl Acetate	123864	936.3
n-Butyl Propionate	590012	29.8
Petroleum Ether	8032324	111.7
Propylene Glycol Monomethyl Ether Acetate	108656	187.9
Solvent Naphtha	64742898	185.9
Stoddard Solvent	8052413	12.4
Styrene	100425	56.3
Toluene	108883	473.6
VOC	VOC	4352.6
Xylene	1330207	501.1

9.0 RECOMMENDATIONS

The EPA emission estimating procedures used in support of the MACT standard that addresses auto refinishing were enhanced for this project using Texas-specific paint usage and VOC content data, and by assigning emissions to individual facilities based on the latitude and longitude coordinates of each facility. This provided an area source emission inventory with a data quality approaching that of a detailed point source inventory. The draw back to this approach is that it requires a complete set of facility specific data and GIS mapping of the facility locations and comparison of activity data with the DOT monthly accident reports suggest that the permit-by-rule data set does not include all auto refinishing facilities. Additional studies may be needed to identify missing shops.

For this project, a set of facilities for which employee estimates could be obtained was compiled and used to evaluate permit-by-rule applications to quantify typical usage and VOC content for each of the model plants. Out of 1,030 facilities, less than two dozen applications included the required paint usage and VOC content data needed to estimate emissions. If more data were available, more accurate and representative paint usage and VOC content estimates could be developed, enhancing the quality of the final emission estimates. Such information must be retained by paint shops in order to comply with the documentation requirements of their permit-by-rule. It may be possible to work with the compliance office to obtain such data when they implement their field inspections.

There is uncertainty whether the VOC content reported in the permit-by-rule applications always excluded water and exempt compounds, furthermore some of the paint VOC content data seemed to use the State's coating limit rather than report the actual VOC content of the paint used. Both of these errors would lead to an overestimation of actual emission levels. Further study of these operations may be required to get more accurate VOC content data.

Also, an additional evaluation may be required regarding the 184 additional D&B auto painting facilities that are not included in the permit-by-rule listing; it was assumed that these facilities do not require permits as they may be below the regulatory threshold. To ensure that this assumption is correct, further investigation may be needed.

The organic VOC species emission estimates for this study were dependent upon the assumption that the types of auto refinishing paints used in Texas in 2005 were similar to the paints represented in the 2001 ARB survey and have similar volatile organic constituents. A comprehensive survey of paint usage in Texas, similar to that implement by ARB, may be warranted in order to improve the quality of the speciated VOC emission estimates. If such a study is implemented it is recommended that VOC profiles be disaggregated by coating type, not aggregated as in the ARB survey.

10.0 REFERENCES

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Appendix A – Estimated Paint Usage

Appendix A – Estimated Paint Usage

Permit Number[a]	Account Number	Estimated Usage (gal/month)							
		Primer	Precoats	Pretreatment	Specialty	Sealers	Wipedown/ Wipe Solvents	Topcoats	Cleanup Solvents
29660	EE1463P	3				2	3	4	
35750	EE1494E	1	1					5	
36816	HX1644M	10	0.25	1	1	1	3	16	5
43763	LA0187H	4.7	5.5	6.2	4.7		1.4	8.4	
45371	WA0070Q	4	1	1	5	3	2	10	5
46080	NA	3	3	2		3	3	8	5
47910	GL0164V	3			2	2	3	30	15
48487	NA0188R	2.5		1	2	3.5	2	19.2	10
78046	NA	12	12	12	48	12	12	36	
78362	NA	15	0.4	0.5	0.5	0.5	0.5	20	0.5
79107	NA	3	2	2	1	1	2	3	5
79612	DB5327A	1	1	1	2	1	1	10	1
82309	NA	1	1	10		1	10	3	10
82626	NA	2.5			1.2	0.5	0.7	21.5	12.9
82771	NA	1	0.25	0.25	0.25	1	0.25	2.25	10
84099	NA	3	2	2	1	1	2	3	5
84844	NA	5					2	15	22
Sum	NA	77.7	29.4	38.95	68.65	34.5	50.85	218.35	106.4
Divided by total cars painted per month[b]		0.21	0.12	0.15	0.27	0.11	0.14	0.6	0.39
Annual paint usage for small shop[c]		**52.7**	**29.4**	**39.0**	**68.7**	**27.9**	**35.9**	**151.3**	**98.2**
Annual paint usage for medium shop[c]		**183.3**	**102.2**	**135.4**	**238.6**	**96.8**	**124.8**	**526.0**	**341.4**
Annual paint usage for large shop[c]		**522.3**	**291.2**	**385.8**	**680.0**	**275.9**	**355.5**	**1,498.6**	**972.8**

[a] All facilities are small model plant types.

[b] Aggregated paint usage per car was calculated by summing the paint usage and dividing by the number of cars painted per month (21 vehicles) times the number of facilities that reported paint usage.

[c] Annual paint usage per shop was calculated by multiplying the annual paint usage per car times the number of cars painted annually (small =21 x 12; medium=74 x 12; Large 208 x 12).

Appendix B – Estimated VOC Content and Emission Estimates

Appendix B – Estimated VOC Content and Emissions Estimates

Permit Number[a]	Account Number	VOC content excluding water and exempt compounds (lbs/gal)										
		Primer	Precoats	Pre treatment	Specialty	Sealers	Wipedown	Single - stage	Basecoat/ Clearcoat	Three-stage	Topcoats	Solvent Cleanup
26139	NA0093G				7.0	6.0	1.4	5.0	5.0	5.2		
29660	EE1436P	4.8				4.7	0.5	5.0	4.5	4.7		
35750	EE1494E	4.3							4.3			
36816	HX1644M	5.0	5.0	5.9	5.9	5.0		4.6	5.0	5.0		
42035	FB0069A	2.0	2.0	1.0		2.0	2.0	4.0	4.0	1.0		
45371	WA0070Q	4.4	5.5	6.1	6.5	4.9	5.0	4.6	4.9	5.1		
47910	GL0164V	3.5		6.1	7.0	3.5	0.2	4.1	4.9	5.2		
48487	NA0188R	4.3		6.3	6.8	4.5	0.6	4.6	5.0	5.2		
78046	NA	5.0	5.5	6.5	7.0	6.0	1.4	5.0	5.0	5.2		
78362	NA	0.3	0.4	0.3	0.1	0.2	0.3	0.2	0.3	0.4		
79107	NA	4.2	4.8	5.5	6.5	5.5	1.0	4.5	4.8	5.0		
79612	DB5327A	2.6	4.8	4.8	5.9	3.6	1.4	5.0	5.0	5.2		
82079	NA	4.5	4.8	5.0	6.2	5.3	1.1	4.3	4.2	4.6		
82309	NA	4.6	4.6	0.5		2.6	0.5	4.3	3.9	4.1		
82626	NA	4.6	4.6	4.6	7.0	4.6	1.3	3.5	5.0	5.0		
82771	NA	4.2	4.9	6.5	4.9	4.6	1.3		5.0	5.2		
84099	NA	4.2	4.8	5.5	6.5	5.5	1.0	4.5	4.8	5.0		
84844	NA	3.4				3.6			5.0	4.7		
Sum		**65.9**	**51.7**	**64.6**	**77.3**	**72.0**	**18.98**	**63.2**	**80.56**	**75.75**		
Divided by reporting facilities[b]		**3.87**	**4.31**	**4.61**	**5.95**	**4.24**	**1.27**	**4.21**	**4.48**	**4.46**	**4.38**	**6.75**
Regulated limit		**5.0**	**5.5**	**6.5**	**7.0**	**6.0**	**1.4**	**5.0**	**5.0**	**5.2**	**5.0**	

Appendix B – Estimated VOC Content and Emissions Estimates (Continued)

	VOC content excluding water and exempt compounds (lbs/year)								Total Annual VOC Emissions (tpy)
	Primer	Precoats	Pre treatment	Specialty	Sealers	Wipedown	Topcoats	Solvent Cleanup	
Annual VOC emissions per small shop[c]	204.3	126.7	179.6	408.3	118.0	45.4	663.0	663.0	1.2
Annual VOC emissions per medium shop[c]	710.2	440.3	624.3	1,419.4	410.1	157.9	2,304.6	2,304.6	4.2
Annual VOC emissions per large shop[c]	2,023.7	1,254.6	1,778.8	4,044.2	1,168.6	449.8	6,566.5	6,566.4	11.9
Texas VOC total small shop[d]	515,885.2	319,829.1	453,458.0	1,030,980.4	297,907.6	114,659.4	1,673,975.0	1,673,958.5	3,040.3
Texas VOC total medium shop[d]	95,170.0	59,001.8	83,653.5	190,194.3	54,957.7	21,152.2	308,813.3	308,810.2	560.9
Texas VOC total large shop[d]	127,490.0	79,039.0	112,062.5	254,784.9	73,621.5	28,335.6	413,687.3	413,683.2	751.4
								TX VOC Total	**4,352.6**

[a] All facilities are small model plant types.
[b] VOC content was calculated as an average based on the facilities that reported VOC content of their paints (except for general top coats which used the regulatory limit and solvent clean up which assumed a VOC content of 6.75 based on EIIP guidance)
[c] = Annual VOC emissions by paint shop type is the annual paint usage time the VOC content
[d] = Texas total is the annual VOC emissions by paint shop type times the number of paint shops associated with each plant type (small 2525; medium 134; large 63)

Appendix C – County Level VOC Emission Estimates

County Level VOC Emission Estimates

FIPS	County Name	Emissions (tons)	
		Annual	OSD
48001	Anderson County	10.8	0.0298
48003	Andrews County	4.8	0.0133
48005	Angelina County	12.6	0.0349
48007	Aransas County	3.6	0.0100
48013	Atascosa County	7.8	0.0215
48019	Bandera County	1.2	0.0033
48021	Bastrop County	4.8	0.0133
48023	Baylor County	1.2	0.0033
48027	Bell County	51.5	0.1424
48029	Bexar County	204.2	0.5642
48031	Blanco County	3.6	0.0100
48035	Bosque County	1.2	0.0033
48037	Bowie County	21.0	0.0580
48039	Brazoria County	57.0	0.1575
48041	Brazos County	19.8	0.0548
48043	Brewster County	2.4	0.0067
48049	Brown County	13.8	0.0382
48051	Burleson County	2.4	0.0067
48053	Burnet County	6.0	0.0166
48055	Caldwell County	6.6	0.0182
48057	Calhoun County	2.4	0.0067
48059	Callahan County	1.2	0.0033
48061	Cameron County	29.4	0.0811
48067	Cass County	4.8	0.0133
48069	Castro County	1.2	0.0033
48071	Chambers County	3.6	0.0100
48073	Cherokee County	13.8	0.0382
48083	Coleman County	1.2	0.0033
48085	Collin County	68.5	0.1892
48091	Comal County	18.0	0.0498
48095	Concho County	1.2	0.0033
48097	Cooke County	2.4	0.0067
48099	Coryell County	4.8	0.0133
48103	Crane County	1.2	0.0033
48105	Crockett County	1.2	0.0033
48111	Dallam County	3.6	0.0100
48113	Dallas County	592.1	1.6361

County Level VOC Emission Estimates

FIPS	County Name	Emissions (tons)	
		Annual	OSD
48115	Dawson County	6.0	0.0166
48121	Denton County	64.9	0.1794
48133	Eastland County	3.6	0.0100
48135	Ector County	64.3	0.1776
48141	El Paso County	141.9	0.3921
48139	Ellis County	10.8	0.0299
48145	Falls County	1.2	0.0033
48147	Fannin County	1.2	0.0033
48149	Fayette County	3.6	0.0100
48157	Fort Bend County	30.7	0.0848
48159	Franklin County	1.2	0.0033
48161	Freestone County	1.2	0.0033
48163	Frio County	1.2	0.0033
48165	Gaines County	2.4	0.0067
48167	Galveston County	79.9	0.2209
48171	Gillespie County	1.2	0.0033
48179	Gray County	7.8	0.0215
48181	Grayson County	8.4	0.0233
48183	Gregg County	32.4	0.0895
48187	Guadalupe County	22.1	0.0612
48189	Hale County	6.0	0.0166
48195	Hansford County	1.2	0.0033
48199	Hardin County	13.8	0.0382
48201	Harris County	1067.7	2.9503
48203	Harrison County	12.0	0.0333
48205	Hartley County	1.2	0.0033
48209	Hays County	23.4	0.0646
48213	Henderson County	6.0	0.0166
48215	Hidalgo County	33.0	0.0911
48217	Hill County	2.4	0.0067
48219	Hockley County	3.6	0.0100
48221	Hood County	3.6	0.0100
48223	Hopkins County	6.0	0.0166
48225	Houston County	18.5	0.0512
48227	Howard County	9.0	0.0249
48231	Hunt County	16.7	0.0463
48233	Hutchinson County	3.6	0.0100

County Level VOC Emission Estimates

FIPS	County Name	Emissions (tons)	
		Annual	OSD
48239	Jackson County	1.2	0.0033
48241	Jasper County	2.4	0.0067
48245	Jefferson County	73.4	0.2028
48249	Jim Wells County	3.6	0.0100
48251	Johnson County	15.7	0.0433
48253	Jones County	3.6	0.0100
48255	Karnes County	2.4	0.0067
48257	Kaufman County	6.0	0.0166
48259	Kendall County	2.4	0.0067
48265	Kerr County	2.4	0.0067
48273	Kleberg County	1.2	0.0033
48277	Lamar County	11.4	0.0315
48279	Lamb County	2.4	0.0067
48281	Lampasas County	1.2	0.0033
48285	Lavaca County	3.6	0.0100
48287	Lee County	4.2	0.0116
48291	Liberty County	3.6	0.0100
48293	Limestone County	1.2	0.0033
48297	Live Oak County	1.2	0.0033
48303	Lubbock County	41.5	0.1146
48313	Madison County	1.2	0.0033
48317	Martin County	1.2	0.0033
48321	Matagorda County	1.2	0.0033
48309	McLennan County	71.4	0.1973
48325	Medina County	4.8	0.0133
48329	Midland County	32.5	0.0898
48331	Milam County	1.2	0.0033
48333	Mills County	1.2	0.0033
48337	Montague County	1.2	0.0033
48339	Montgomery County	63.0	0.1740
48341	Moore County	4.8	0.0133
48347	Nacogdoches County	10.8	0.0299
48349	Navarro County	4.8	0.0133
48353	Nolan County	1.2	0.0033
48355	Nueces County	43.9	0.1212
48361	Orange County	29.5	0.0814
48365	Panola County	1.2	0.0033

County Level VOC Emission Estimates

FIPS	County Name	Emissions (tons)	
		Annual	OSD
48367	Parker County	7.2	0.0200
48371	Pecos County	4.8	0.0133
48373	Polk County	6.6	0.0182
48375	Potter County	58.7	0.1622
48381	Randall County	25.2	0.0697
48383	Reagan County	2.4	0.0067
48389	Reeves County	2.4	0.0067
48397	Rockwall County	4.8	0.0133
48401	Rusk County	6.6	0.0182
48409	San Patricio County	4.8	0.0133
48419	Shelby County	3.6	0.0100
48423	Smith County	37.2	0.1028
48427	Starr County	1.2	0.0033
48435	Sutton County	2.4	0.0067
48439	Tarrant County	314.8	0.8700
48441	Taylor County	45.6	0.1261
48445	Terry County	3.6	0.0100
48449	Titus County	7.8	0.0215
48451	Tom Green County	21.6	0.0597
48453	Travis County	221.2	0.6111
48455	Trinity County	1.2	0.0033
48457	Tyler County	1.2	0.0033
48459	Upshur County	4.8	0.0133
48463	Uvalde County	4.8	0.0133
48465	Val Verde County	9.6	0.0266
48467	Van Zandt County	12.0	0.0331
48469	Victoria County	13.2	0.0366
48471	Walker County	20.4	0.0562
48473	Waller County	6.0	0.0166
48475	Ward County	12.0	0.0333
48477	Washington County	7.8	0.0215
48479	Webb County	26.4	0.0729
48481	Wharton County	3.6	0.0100
48485	Wichita County	24.0	0.0664
48491	Williamson County	35.4	0.0979
48493	Wilson County	6.0	0.0166
48497	Wise County	9.0	0.0249

County Level VOC Emission Estimates

FIPS	County Name	Emissions (tons)	
		Annual	OSD
48499	Wood County	4.8	0.0133
48501	Yoakum County	1.2	0.0033
48503	Young County	4.2	0.0116
48505	Zapata County	1.2	0.0033
Texas Total		**4,352.6**	**12.0**

Appendix D – Summary of Automotive Coating Regulations

Summary of Automotive Coating Regulations

	Texas	California	Federal
Automotive Coatings Applicability	Body repair and refinishing of motorcycle, passenger car, van, light truck and heavy truck and other vehicle body parts, bodies, and cabs is permitted by rule, provided that all the conditions of this Title 30 TAC Rule 106.436 are met.	(Draft from 2005) Applicable to all who manufacture, sell, use automotive coatings (with noted exceptions)	Applicable to manufacturers and importers of automobile refinish coatings or coating components that sell or distribute these coatings or coating components in the United States. *The OTC model rule is shown below, to allow consideration of potential applicability.
Automotive Coatings Reporting/Permitting Requirements	Records and reports maintained at the shop site for a consecutive 24-month period and be made immediately available upon request of personnel from the commission or any other air pollution control agency with jurisdiction.	(Draft from 2005) Labeling, recordkeeping	Each regulated entity must submit an initial report within 180 days of the date that the regulated entity first manufactures or imports automobile refinish coatings or coating components,

	VOC limit (grams/liter)			
Coating Category:	Current	Prior	Current	Current
Clear Coat	600	250	250	
Color Coat	600	760	420	
Multi-color Coating	630	685	680	680
Pretreatment Coating	660	780	660	
Primer	600	250/340	250	
Temporary Protective Coating			60	
Truck Bed Liner Coating		420	310	
Underbody Coating		840	430	
Uniform Finish Coating		840	540	
Any Other Coating Type			250	
Pretreatment Wash Primers	780			780

Summary of Automotive Coating Regulations (Continued)

	Texas	California		Federal
Primers/Primer Surfacers	660			580
Primer Sealers				550
Single/Two-Stage Topcoats	600	340 (single)		600
Topcoats of More Than Two Stages	630			630
Specialty Coatings	840			840

Automotive Coatings – Texas

Currently requires registration with the commission's Office of Permitting, Remediation and Registration in Austin prior to construction. Facilities must complete a "Registration for Permits by Rule" or "Certification and Registration for Permits by Rule". If total coating and solvent usage rate is less than half pint per hour, and total coating and solvent usage rate is less than two gallons per week, registration is not required, however a list of actual VOC contents of coatings used is required, and must not be above the coating limits stated below. Registration is required if the total coating and solvent usage is expected to be greater than two gallons per week.

Coating Category	VOC Regulatory Limit as Applied (grams/liter)
Primers or Primer Surfaces	600
Precoats	660
Pretreatments	780
Single-stage Topcoats	600
Basecoat/Clear Coat Systems	600
Three-stage System	630
Specialty Coating	840
Sealers	720
Wipe-down Solutions	170

Body repair and refinishing of motorcycle, passenger car, van, light truck and heavy truck and other vehicle body parts, bodies, and cabs is permitted by rule, provided that all the following conditions of this section are met.

(1) Before construction begins, the facility shall be registered with the commission's Office of Permitting, Remediation, and Registration in Austin using Form PI-7-124.

(2) Facilities which satisfy one of the following conditions.

(A) Spray operations that use less than 1/2 pint of coatings and solvents per hour are exempt from all of the requirements of this section except for paragraphs (3), (4), (16), and (17) of this section.

(B) Spray operations that use less than two gallons of coatings and solvents per week are exempt from all of the requirements of this section except for paragraphs (3), (4), (8), (11), (12), (14), (16), and (17) of this section unless additional controls are specified in §115.421 of this title (relating to Emission Specifications). Additionally, all overspray emissions must be vented through a filter system that meets the requirements of paragraph (7) of this section.

(3) Good housekeeping is practiced: spills are cleaned up as soon as possible, equipment is maintained according to manufacturers' instructions, and property is kept clean. In addition, all waste coatings, solvents, and spent automotive fluids including, but not limited to, engine oil, gear oil, transmission fluid, brake fluid, anti-freeze, fresh or waste fuels, and spray booth filters or water wash sludge are disposed of properly. Prior to disposal, all liquid waste shall be stored in covered containers.

(4) There are no visible emissions leaving the property.

(5) All spray coating operations which coat more than nine square feet (one panel) shall be performed in a totally enclosed filtered spray booth or totally enclosed filtered spray area with an air intake area of less than 100 square feet. All spray areas shall be equipped with a fan that achieves one of the following requirements:

(A) A flow capacity of at least 10,000 cubic feet per minute;

(B) A face velocity of at least 100 feet per minute.

(6) All spray coating operations which coat less than nine square feet (one panel) and are not in a totally enclosed booth shall be performed on or in a dedicated preparation area which meets the following requirements.

(A) The preparation area ventilation system shall be operating during spraying, and the exhaust air shall either be vented through a stack to the atmosphere or the air shall be recirculated back into the shop through a carbon adsorption system.

(B) If the preparation area is equipped with a carbon adsorption system, the carbon shall be replaced at the manufacturer's recommended intervals to minimize solvent emissions.

(C) The preparation area ventilation system shall be equipped with a filter or filter system to control paint overspray.

(7) All paint booth, spray area, and preparation area overspray (exhaust) filters or filter systems shall have a particulate control efficiency of at least 90%.

(8) High transfer efficiency coating application equipment shall be used, such as high volume low pressure spray guns. Electrostatic spray guns or other methods, if demonstrated to provide equivalent or better transfer efficiency are acceptable.

(9) Cleanup emissions shall be minimized by implementing the following procedures:

(A) Spray and other equipment cleanup is totally enclosed during washing, rinsing, and draining. Non- enclosed cleaners may be used if the vapor pressure of the cleaning solvent is less than 100 millimeters of mercury at 68 degrees Fahrenheit and the solvent is directed toward a drain that leads directly to a remote reservoir;

(B) All wash solvents are kept in an enclosed reservoir that is covered at all times, except when being refilled with fresh solvents; and

(C) All waste solvents and other cleaning materials are kept in closed containers.

(10) All spray booth spray area, preparation area, and shop heaters that are not electrically heated must use pipeline quality natural gas or liquified petroleum gas only and the heaters are five million British thermal units per hour or smaller. No firing of waste coatings, solvents, oils, or other automotive fluids shall be permitted on-site.

(11) All spray booth, spray area, and preparation area stack heights shall meet the following requirements.

(A) If the stack is located within 200 feet of a building that is taller than the body shop building, the stack height shall be at least 1.2 times the height of the tallest building or higher as measured from ground level.

(B) If the stack is located greater than 200 feet from a building taller than the body shop building, the stack height shall be at least 1.2 times the height of the body shop building as measured from ground level.

(C) If any ground level elevation within 250 feet of the spray booth stack is greater than the stack height required in subparagraphs (A) and (B) of this paragraph, this section cannot be used.

(12) Spray booth, spray area, and preparation area stacks shall be located at least 50 feet away from any residence, recreation area, church, school, child care facility, or medical or dental facility.

(13) Rain caps, goose neck exhaust, or other stack heads that would restrict or obstruct vertical discharge of air contaminants shall not be allowed.

(14) The volatile organic compound (VOC) content limits specified in §115.421 of this title, concerning automobile and light-duty truck coatings, shall apply to the facility regardless of its location.

(15) Definitions of the coating types specified in subparagraphs (A) - (H) of this paragraph are based on §115.10 of this title (relating to Definitions), and the VOC content limits shall be those listed in §115.421 of this title. Shop use of the coating categories listed in subparagraphs (A) - (H) of this paragraph in gallons per month shall not be exceeded:

(A) Cleanup solvents--50 gallons per month;
(B) Wipe solvents--50;
(C) Precoat--50;
(D) Pretreatment--50;
(E) Sealers--50;
(F) Primers/primer surfacer--175;
(G) Top coats--320; and
(H) Specialty coatings--50.

(16) The following records and reports shall be maintained at the shop site for a consecutive 24-month period and be made immediately available upon request of personnel from the commission or any other air pollution control agency with jurisdiction:

(A) Material safety data sheet (MSDS) or other coating data sheets on paint and solvent systems used during the previous 24-month period or currently in use at the shop. The MSDS or coating data sheets should clearly indicate the VOC content of the product and the VOC content of multiple component coatings when mixed according to manufacturers instructions;

(B) Records of monthly coating and solvent purchases (invoices from suppliers are acceptable);

(C) Records of monthly paint and solvent use if purchase volumes are above the levels specified for any category in paragraph (15) of this section;

(D) Additional records are kept in sufficient detail, if necessary, to allow an annual emission inventory to be submitted according to the requirements in §101.10 of this title (relating to Emissions Inventory Requirements);

(E) Records of the United States Environmental Protection Agency and the commission's Office of Permitting, Remediation, and Registration or identification numbers for each waste generator.

(17) Compliance with the requirements of this section does not eliminate the requirement to comply with all rules of the commission, including §101.4 of this title (relating to

Nuisance). The commission may require a facility to cease operation until the matter is resolved.

(18) After December 31, 1994, the conditions of this permit-by-rule are effective as to facilities in existence prior to the adoption of this section.

Source Note: The provisions of this §106.436 adopted to be effective March 14, 1997, 22 TexReg 2439; amended to be effective September 4, 2000, 25 TexReg 8653

Automotive Coatings – California

Suggested Control Measure in place for state districts to use, if desired. Actual Control Measures vary by district:

Applicability

2.1 Except as provided in Section 2.2, this rule is applicable to any person who supplies, sells, offers for sale, manufactures, or distributes any automotive coating or associated solvent for use within the District, as well as any person who uses, applies, or solicits the use or application of any automotive coating or associated solvent within the District.

2.2 This rule does not apply to:

2.2.1 Any automotive coating or associated solvent that is offered for sale, sold, or manufactured for use outside of the District or for shipment to other manufacturers for reformulation or repackaging.

2.2.2 Any aerosol coating product.

2.2.3 Any automotive coating which is sold, supplied, or offered for sale in 0.5 fluid ounce or smaller containers intended to be used by the general public to repair tiny surface imperfections.

2.2.4 Any coating applied to motor vehicles or mobile equipment, or their associated parts and components, during manufacture on an assembly line.

4.1 **Coating Limits:** no person shall apply to any motor vehicle, mobile equipment, or associated parts or components, any coating with a VOC regulatory content in excess of the following limits, except as provided for in Section 4.3:

Coating Category	VOC Regulatory Limit as Applied on or after January 1, 2008 (grams/liter)
Clear coat	250
Color coat	420
Multi-color coating	680
Pretreatment Coating	660
Primer	250
Temporary Protective Coating	60
Truck Bed Liner Coating	310
Underbody Coating	430
Uniform Finish Coating	540
Any other coating type	250

4.2 **Most Restrictive VOC Limit:** if anywhere on the container of any automotive coating, or any label or sticker affixed to the container, or in any sales, advertising, or technical literature supplied by a manufacturer or anyone acting on their behalf, any representation is made that indicates that the coating meets the definition of or is recommended for use for more than one of the coating categories listed in Section 4.1, then the most restrictive VOC content limit shall apply.

4.3 **Alternative Compliance:** in lieu of compliance with the VOC content limits in 4.1, a person may use an emission control system that has been approved, in writing, by the Executive Officer or Air Pollution Control Officer of the District and which achieves an overall control efficiency of at least 85 percent as determined per Section 6.6. Any approved system must be maintained and used at all times in proper working condition.

5. Administrative Requirements

5.1 Compliance Statement Requirement:

5.1.1 The manufacturer of automotive coatings or coating components shall include the VOC content (actual and regulatory), expressed in grams per liter; the weight percentage of volatiles, water, and exempt compounds; the volume percentage of water and exempt compounds; and the density of the material (in grams per liter) on product data sheets, or an equivalent medium, for each individual coating component, and ready-to-spray mixture for coatings (based on the manufacturer's stated mix ratio).

5.1.2 The manufacturer of solvents subject to this rule shall include the VOC content as supplied expressed in grams per liter, on product data sheets, or an equivalent medium.

5.2 Labeling Requirements:

5.2.1 The manufacturer of automotive coatings or coating components shall include on all containers the applicable use category(ies), and the VOC content (actual and regulatory), as supplied, expressed in grams per liter.

5.2.2 The manufacturer of solvents subject to this rule shall include on all containers the VOC content, as supplied, expressed in grams per liter.

5.3 **Maintenance of Records:** records required by this rule shall be retained for a minimum of three years and made available for inspection by District personnel upon request.

5.4 **Record Keeping Requirements:** any person who uses coatings or solvents subject to this rule shall maintain and have available at all times, on site, the following:

5.4.1 A current list of all coatings and solvents used. This list shall include the following information for each coating and solvent:

5.4.1.1 Material name and manufacturer

5.4.1.2 Application method

5.4.1.3 Coating type (as listed in Section 4.1) and mix ratio specific to the coating

5.4.1.4 VOC content of the coating (actual and regulatory), as applied, or VOC content of the solvent.

5.4.1.5 Whether the material is a coating or solvent

5.4.2 Current manufacturer specification sheets, material safety data sheets, technical data sheets, or air quality data sheets, which list the VOC content (actual and regulatory) of each ready-to-spray coating (based on the manufacturer's stated mix ratio) and automotive coating components, and VOC content of each solvent.

5.4.3 Purchase records identifying the coating type (as listed in Section 4.1), name, and volume of coatings and solvents.

5.5 **Record Keeping Requirements for Emission Control Systems:** any person using an emission control system shall maintain daily records of key system operating parameters which will demonstrate continuous operation and compliance of the emission control system during periods of emission producing activities. "Key system operating parameters" are those parameters necessary to ensure compliance with VOC emission limits, including, but not limited to, temperatures, pressure drops, and flow rates.

5.6 **Record Keeping Requirements for Prohibition of Sale:** any person claiming an exception outlined in Section 4.5 shall keep a detailed log of each solvent, automotive coating component , and automotive coating sold showing: the quantity sold, including size and number of containers; the VOC content of each coating component (actual and regulatory); to whom they were sold including the name, address, phone number, retail tax license number, and valid district permit number, if sold within the District; and, the exception being utilized under Section 4.5.

Automotive Coatings – Federal

Title 40: Protection of Environment

PART 59—NATIONAL VOLATILE ORGANIC COMPOUND EMISSION STANDARDS FOR CONSUMER AND COMMERCIAL PRODUCTS

§ 59.100 Applicability and designation of regulated entity.

(a) The provisions of this subpart apply to automobile refinish coatings and coating components manufactured on or after January 11, 1999 for sale or distribution in the United States.

(b) Regulated entities are manufacturers and importers of automobile refinish coatings or coating components that sell or distribute these coatings or coating components in the United States.

(c) The provisions of this subpart do not apply to automobile refinish coatings or coating components meeting the criteria in paragraphs (c)(1) through (c)(6) of this section.

(1) Coatings or coating components that are manufactured (in or outside the United States) exclusively for sale outside the United States.

(2) Coatings or coating components that are manufactured (in or outside the United States) before January 11, 1999.

(3) Coatings or coating components that are manufactured (in or outside the United States) for use by original equipment manufacturers.

(4) Coatings that are sold in nonrefillable aerosol containers.

(5) Lacquer topcoats or their components.

(6) Touch-up coatings.

§ 59.102 Standards.

(a) Except as provided in §59.106 of this subpart, any coating resulting from the mixing instructions of a regulated entity must meet the VOC content limit given in Table 1 of this subpart. VOC content is determined according to §59.104(a).

(b) Different combinations or mixing ratios of coating components constitute different coatings. For example, coating components may be mixed one way to make a primer, and mixed another way to make a primer sealer. Each of these coatings must meet its corresponding VOC content limit in Table 1 of this subpart. If the same combination and mixing ratio of coating components is recommended by a regulated entity for use in more

than one category in Table 1 of this subpart, then the most restrictive VOC content limit shall apply.

Table 1 to Subpart B of Part 59—Volatile Organic Compound (VOC) Content Limits for Automobile Refinish Coatings

Coating Category	Grams VOC per Liter	Pounds VOC per Gallon[a]
Pretreatment wash primers	780	6.5
Primers/primer surfacers	580	4.8
Primer sealers	550	4.6
Single/two-stage topcoats	600	5.0
Topcoats of more than two stages	630	5.2
Multi-colored topcoats	680	5.7
Specialty coatings	840	7.0

[a]English units are provided for information only. Compliance will be determined based on the VOC content limit, as expressed in metric units.

§ 59.105 Reporting requirements.

(a) Each regulated entity must submit an initial report no later than January 11, 1999 or within 180 days of the date that the regulated entity first manufactures or imports automobile refinish coatings or coating components, whichever is later. The initial report must include the information in paragraphs (a)(1) through (a)(4) of this section.

(1) The name and mailing address of the regulated entity.

(2) An explanation of each date code, if such codes are used to represent the date of manufacture, as provided in §59.103.

(3) The street address of each of the regulated entity's facilities in the United States that is producing, packaging, or importing automobile refinish coatings or coating components subject to the provisions of this subpart.

(4) A list of the categories from table 1 of this subpart for which the regulated entity recommends the use of automobile refinish coatings or coating components.

(b) Each regulated entity must submit an explanation of any new date codes used by the regulated entity no later than 30 days after products bearing the new date code are first introduced into commerce.

This model rule was developed by the Ozone Transport Commission (OTC) as part of a regional effort to attain and maintain the one-hour ozone standard, address emission reduction shortfalls that were identified by the U.S. Environmental Protection Agency in specific State's plans to attain the one-hour ozone standard, and reduce eight-hour ozone levels. A June 1, 2000 Memorandum of Understanding (MOU) designated the list of control measures evaluated as part of this effort. This model rule is being reviewed by the OTC at its March 6, 2001 Winter Meeting.

Please note that States opting to promulgate rules based on this model rule must comply with State specific administrative requirements and procedures.

NOTE: "XXXX" is a place holder for State-specific section numbers, title numbers, or State names.

*Model Rule for Mobile Equipment Repair and Refinishing (MERR)

PART Env-A xxxx MOBILE EQUIPMENT REPAIR AND REFINISHING

01 Definitions
02 Standards

Env-A xxxx.01 Definitions. The following words, terms, and abbreviations used in this part (subchapter) shall have the following meanings:

(a) **Airless spray**—A spray coating method in which the coating is atomized by forcing it through a small nozzle opening at high pressure. The coating is not mixed with air before exiting from the nozzle opening.

(b) **Antique motor vehicle**—A motor vehicle, but not a reproduction thereof, manufactured more than 25 years prior to the current year which has been maintained in or restored to a condition which is substantially in conformance with manufacturer specifications.

(c) **Automotive elastomeric coating**—A coating designed for application over surfaces of flexible mobile equipment and mobile equipment components, such as elastomeric bumpers.

(d) **Automotive impact-resistant coating**—A coating designed to resist chipping caused by road debris.

(e) **Automotive jambing clearcoat**—A fast-drying, ready-to-spray clearcoat applied to surfaces such as door jambs and trunk and hood edges to allow for quick closure.

(f) **Automotive lacquer**—A thermoplastic coating applied directly to bare metal surfaces of mobile equipment and mobile equipment components which dries primarily by solvent evaporation, and which is resoluble in its original solvent.

(g) **Automotive low-gloss coating**—A coating which exhibits a gloss reading less than or equal to 25 on a 60° glossmeter.

(h) **Automotive multi-colored topcoat**—A topcoat that exhibits more than one color, is packaged in a single container, and camouflages surface defects on areas of heavy use, such as cargo beds and other surfaces of trucks and other utility vehicles.

(i) **Automotive pretreatment**—A primer that contains a minimum of 0.5% acid, by weight, that is applied directly to bare metal surfaces of mobile equipment and mobile equipment components to provide corrosion resistance and to promote adhesion of subsequent coatings.

(j) **Automotive primer-sealer**—A coating applied to mobile equipment and mobile equipment components prior to the application of a topcoat for the purpose of providing corrosion resistance, promoting adhesion of subsequent coatings, promoting color uniformity, and promoting the ability of the undercoat to resist penetration by the topcoat.

(k) **Automotive primer-surfacer**—A coating applied to mobile equipment and mobile equipment components prior to the application of topcoat for the purpose of:

- Filling surface imperfections in the substrate;
- Providing corrosion resistance; or
- Promoting adhesion of subsequent coatings.

(l) **Automotive specialty coating**—Coatings including, but not limited to, elastomeric coatings, adhesion promoters, low gloss coatings, bright metal trim repair coatings, jambing clearcoats, impact resistant coatings, rubberized asphaltic underbody coatings, uniform finish blenders, weld-through primers applied to automotive surfaces and lacquer topcoats applied to a classic motor vehicle or to an antique motor vehicle.

(m) **Automotive topcoat**—A coating or series of coatings applied over an automotive primer-surfacer, automotive primer-sealer or existing finish on the surface of mobile equipment and mobile equipment components for the purpose of protection or beautification.

(n) **Classic motor vehicle**—A motor vehicle, but not a reproduction thereof, manufactured at least 15 years prior to the current year which has been maintained in or restored to a condition which is substantially in conformity with manufacturer specifications and appearance.

(o) **Mobile equipment**—Equipment which may be driven or is capable of being driven on a roadway including, but not limited to:

- Automobiles;
- Trucks, truck cabs, truck bodies and truck trailers;
- Buses;
- Motorcycles;
- Utility bodies;
- Camper shells;

- Mobile cranes;
- Bulldozers;
- Street cleaners;
- Golf carts;
- Ground support vehicles, used in support of aircraft activities at airports; and
- Farm equipment.

(p) **Automotive touch up repair**—The application of automotive topcoat finish materials to cover minor finishing imperfections equal to or less than 1 inch in diameter.

Env-A xxxx.02 Standards.

(a) Except as provided in subsection (b) the requirements of this section apply to a person who applies mobile equipment repair and refinishing or color matched coatings to mobile equipment or mobile equipment components.

(b) This section does not apply to a person who applies surface coatings to mobile equipment or mobile equipment components under one of the following circumstances:

(1) The surface coating process is subject to other requirements (such as the miscellaneous metal parts finishing requirements relating to surface coating processes).

(2) The surface coating process is at an automobile assembly plant.

(3) The person applying the coatings does not receive compensation for the application of the coatings.

(c) Beginning (<u>one year from final adoption of this rule</u>), a person may not apply to mobile equipment or mobile equipment components any automotive pretreatment, automotive primer-surface, automotive primer-sealer, automotive topcoat and automotive specialty coatings including any VOC containing materials added to the original coating supplied by the manufacturer, that contain VOC's in excess of the limits specified in Table III.

Table III

Allowable Content of VOCs in Mobile Equipment Repair and Refinishing Coatings
(as applied)

Weight of VOC per Volume of Coating (minus water and non-VOC solvents)

Coating Type	**Limit Pounds per Gallon**	**Grams per Liter**
Automotive Pretreatment Primer	6.5	780
Automotive Primer-surfacer	4.8	575
Automotive Primer-sealer	4.6	550
Automotive Topcoat:		
Single Stage-topcoat	5.0	600
2 Stage Basecoat/clearcoat	5.0	600
3 or 4-Stage Basecoat/clearcoat	5.2	625
Automotive Multi-colored Topcoat	5.7	680
Automotive Specialty	7.0	840

(d) A person who provides mobile equipment repair and refinishing coatings subject to this section shall provide documentation concerning the VOC content of the coatings calculated in accordance with the following:

(1) The mass of VOC per combined volume of VOC and coating solids, less water and exempt compounds shall be calculated by the following equation:

$$VOC = \frac{(Wv - Ww - Wec)}{(V - Vw - Vec)}$$

where:

VOC = VOC content in grams per liter (g/l) of coating less water and non-VOC solvents,
W_v = Mass of total volatiles, in grams;
W_w = Mass of water, in grams;
W_{ec} = Mass of exempt compounds, in grams;
V = Volume of coating, in liters;
V_w = Volume of water, in liters; and
V_{ec} = Volume of exempt compounds, in liters.

To convert from grams per liter to pounds per gallon (lb/gal), multiply the result (VOC content) by 8.345 x 10^{-3} (lb/gal/g/l).

(2) The VOC content of a multi-stage topcoat shall be calculated by the following equation:

$$VOCmulti = \frac{VOCbc + \sum_{i=0}^{M} VOCmci + 2(VOCcc)}{M + 3}$$

where:

VOCmulti	= VOC content of multistage topcoat, g/*l*
VOCbc	= VOC content of basecoat, g/*l*
VOCmci	= VOC content of the midcoat(s), g/*l*
VOCcc	= VOC content of the clear coat, g/*l*
M	= Number of midcoats

(e) Beginning _____ (a date 12 months from the date of publication of the effective date of adoption of this proposal), a person at a facility subject to the provisions of this section shall use one or more of the following application techniques to apply any finish material listed in Table III:

(1) Flow/curtain coating;
(2) Dip coating;
(3) Roller coating;
(4) Brush coating;
(5) Cotton-tipped swab application;
(6) Electrodeposition coating;
(7) High volume low pressure (HVLP) spraying;
(8) Electrostatic spray;
(9) Airless spray; and
(10) Other coating application methods that the person has demonstrated and the Department has determined achieve emission reductions equivalent to HVLP or electrostatic spray application methods.

(f) The following situations are exempt from the application equipment requirements listed in paragraphs (g) and (h):

(1) The use of airbrush application methods for stenciling, lettering, and other identification markings;
(2) The application of coatings sold in nonrefillable aerosol containers; and
(3) The application of automotive touch-up repair finish materials.

(g) Spray guns used to apply mobile equipment repair and refinishing coatings shall be cleaned by one of the following:

(1) An enclosed spray gun cleaning system that is kept closed when not in use.
(2) Unatomized discharge of solvent into a paint waste container that is kept closed when not in use.
(3) Disassembly of the spray gun and cleaning in a vat that is kept closed when not in use.
(4) Atomized spray into a paint waste container that is fitted with a device designed to capture atomized solvent emissions.

(h) The owner and operator of a facility subject to the provisions of this section shall implement the following housekeeping and pollution prevention and training measures:

(1) Fresh and used coatings, solvent, and cleaning solvents, shall be stored in nonabsorbent, nonleaking containers. The containers shall be kept closed at all times except when filling or emptying.
(2) Cloth and paper, or other absorbent applicators, moistened with coatings, solvents, or cleaning solvents, shall be stored in closed, nonabsorbent, nonleaking containers.
(3) Handling and transfer procedures shall minimize spills during the transfer of coatings, solvents, and cleaning solvents.
(4) Ensure that a person who applies mobile equipment repair and refinishing coatings has completed training in the proper use and handling of the mobile equipment repair and refinishing coatings, solvents and waste products in order to minimize the emission of air contaminants and to comply with this section.