7.0

EMISSION FACTORS

Using the results of the surveys, we calculated total organic gas (TOG) and reactive organic gas (ROG) emission factors for OEM coatings, the solvents associated with OEM coatings, and the solvents associated with architectural and industrial maintenance coatings. In all cases, emission factors are in pounds of TOG or ROG per gallon of coating material or per gallon of solvent. The factors were used in Section 8 to calculate emissions.

7.1 SOLVENTS ASSOCIATED WITH OEM COATINGS

7.1.1 Solvents in OEM Coatings

Using the data provided by OEM coatings manufacturers, we calculated weighted average values of TOG and ROG per gallon, the weights being the gallons of each coating formulation sold in California. Given the relatively small number of responses, we did not perform the statistical analyses of uncertainty that we did for the other emission factors discussed in this section. Table 7-1 shows the emission factors we calculated.

Table 7-1

EMISSION FACTORS FOR OEM COATINGS

Type of Coating	Coating Base	No. of Coatings	TOG	ROG
			Pounds per Gallon	
Marine	Solvent	3	0.93	0.93
Metal Furniture	Water	3	0.83	0.83
Can and Coil	Solvent	9	2.91	2.91
	Water	15	1.11	1.11
Metal Parts and Products	Solvent	37	2.71	2.35
	Water	20	0.91	0.89
Wood Furniture and Fixtures	Solvent	26	5.53	2.84
	Water	6	0.73	0.73
Other	Solvent	27	2.65	2.65
	Water	14	0.88	0.88

7.1.2 Thinning and Cleanup Solvents

The following information was obtained through the survey of OEM coating users. For each type of solvent (mineral spirits, lacquer thinner, etc.), all solvent formulations were aggregated for analysis, whether they were used as thinners or as cleanup solvents, and whether they were associated with solvent-based or with water-based coatings.

7.1.2.1 Mineral Spirits

Respondents reported use of only three identifiable mineral spirits products. These are listed in Table 7-2, along with their organic gas contents. Because the respondents did not identify the particular type of Sherwin-Williams mineral spirits used, we are reporting a composite value for all the Sherwin-Williams mineral spirits products reported by respondents to the commercial painters survey.

Table 7-2

MINERAL SPIRITS PRODUCTS REPORTED AS BEING USED WITH OEM COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	Density, TOG, and ROG (lb/gal)
Cardinal Industrial Finishes	South El Monte	CA	1300-05 Wash Thinner	30	6.68
Sherwin-Williams Company, The	Cleveland	OH	Average Mineral Spirits[a]	5	6.35
Sunnyside Corporation	Alliance	OH	Mineral Spirits (701)	59	6.43
Weighted Mean					6.51

[a]Average of values reported in the commercial painters survey.

For all the reported mineral spirits formulations, the material consists entirely of ROG. The mean ROG content of the formulations used by the survey respondents (n = 3) is 6.49 lb/gal. It is more realistic, however, to weight the ROG values by the reported volumes of mineral spirits used. When this is done, the weighted mean ROG content is 6.51 lb/gal. A Shapiro-Wilk test of the survey responses for normal distribution could not be performed, because the sample size was less than 5. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.43, 6.58] for the weighted mean.

7.1.2.2 Lacquer Thinner

Respondents reported use of ten identified lacquer thinner products. These are listed in Table 7-3, along with their TOG and ROG contents.

TOG Content of Lacquer Thinners

The lacquer thinners reported by survey respondents were grouped into 10 formulations, according to their TOG concentrations, which ranged from 6.4 to 7.13 lb/gal. The mean value for the products reported was 6.69 lb/gal. A Shapiro-Wilk test of the survey responses showed that one cannot reject the null hypothesis that the data are from a normal distribution (W = 0.9285, p = 0.4270).

It is more realistic, however, to weight the TOG values by the reported volumes of lacquer used. When this is done, the weighted mean TOG content is 6.657 lb/gal. The variance of the weighted mean (x_w) was calculated from:

Table 7-3

LACQUER THINNER PRODUCTS REPORTED AS BEING USED WITH OEM COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Frazee Industries, Inc.	San Diego	CA	Lacquer Thinner 28X	15	6.74	6.74
NAPA Auto Parts (Napier Env. Tech.)	Atlanta	GA	Martin Senor 15242 Econo-Gun Wash Solvent	109.5	6.65	6.65
Pacific Coast Lacquer (Ellis Paint Company)	Los Angeles	CA	Compliant Gun Cleaner Solvent 7002D	75	6.40	2.68
			#77 Lacquer Thinner	6	6.70	4.41
R J McGlennon (Maclac)	San Francisco	CA	Maclac T-88 Lacquer Thinner Blend	15	6.68	6.68
Safety-Kleen Corporation	Elgin	IL	Low-Vapor Pressure Lacquer Thinner (6864)	50	7.13	7.13
Sherwin-Williams Company, The	Cleveland	OH	K119 Lacquer Thinner (154-4709)	80	6.64	5.31
Specialty Coatings & Chemicals Inc.	North Hollywood	CA	Surekote SC-60-2	2	6.90	4.22
Sunnyside Corporation	Wheeling	IL	457 Lacquer Thinner	24	6.52	4.93
W M Barr & Company Inc.	Memphis	TN	Allpro Lacquer Thinner (Klean-Strip)	10	6.54	5.78
Weighted Means					6.66	5.49

$$\text{Var}(x_w) = \sigma^2/b \quad [7\text{-}1]$$

where

$$b = (\Sigma w_i)^2/\Sigma w_i^2 \quad [7\text{-}2]$$

The sample standard deviation was calculated as:

$$s_w = [\text{Var}(x_w)]^{1/2} \quad [7\text{-}3]$$

Because the half-width of a 90-percent confidence interval is proportional to $s_w/n^{1/2}$, it can be shown that

$$CI = x_w \pm 1.645\, s_w/n^{1/2} \quad [7\text{-}4]$$

For the lacquer thinner, the 90-percent confidence interval for the TOG content is [6.61, 6.70].

ROG Content of Lacquer Thinners

The lacquer thinners reported by survey respondents were grouped into 16 formulations, according to their ROG concentrations, which ranged from 2.68 to 7.13 lb/gal. The mean value for the products reported was 5.45 lb/gal. A Shapiro-Wilk test of the survey responses showed that one cannot reject the null hypothesis that the data are from a normal distribution ($W = 0.9296$, $p = 0.4281$). Using the methods described above, we calculated a volume weighted mean ROG concentration of 5.49 lb/gal with a 90-percent confidence interval of [5.17, 5.81].

7.1.2.3 Denatured Alcohol

Respondents reported use of three identifiable denatured alcohol products. These are listed in Table 7-4, along with their organic gas contents. For all the reported denatured alcohol formulations, the material consists entirely of reactive organic gases (ROG).

The denatured alcohol products reported by survey respondents were grouped into three formulations, according to their ROG concentrations, which ranged from 6.61 to 6.8 lb/gal. The mean value for the products reported was 6.698 lb/gal, and the volume-weighted mean was 6.667. A Shapiro-Wilk test of the survey responses could not be performed, because the sample size was less than 5. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.625, 6.724] for the weighted mean.

Table 7-4

DENATURED ALCOHOL PRODUCTS REPORTED AS BEING USED WITH OEM COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Bortz Products	Santa Fe Springs	CA	Denatured Alcohol	2	6.68	6.68
Parks Corporation	Somerset	MA	Denatured Alcohol	4	6.79	6.79
W M Barr & Company Inc.	Memphis	TN	Denatured Alcohol	10	6.61	6.61
Weighted Means					6.67	6.67

7.1.2.4 Other Solvents

OEM coating users reported several solvents as unmixed chemical compounds. These included:

- Acetone
- Isopropyl Alcohol
- Methyl Ethyl Ketone (MEK)
- Methyl Isobutyl Ketone (MIBK)
- Naphtha
- Toluene
- Xylenes

TOG and ROG values for these compounds were obtained from material safety data sheets or reference documents.

Finally, OEM coating users identified seven other solvents used with solvent-based paints, but not readily associated with any of the previously discussed categories. These are listed in Table 7-5. For all but one of these products, the TOG and ROG concentrations are equal. The raw and volume-weighted mean TOG content were 4.965 and 6.175 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [5.495, 6.643] for the weighted mean. The raw and volume-weighted mean

ROG content were 4.434 and 3.159 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [2.315, 3.986] for the weighted mean.

Table 7-5

OTHER SOLVENTS REPORTED AS BEING USED WITH OEM COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG (lb/gal)	ROG (lb/gal)
El Dupont de Nemours & Company	Wilmington	DE	Prep-Sol Solvent (Y-3919-S)	1	6.17	6.17
EW Smith Chemical Company	Industry	CA	EMS Triumph Concentrate /G	7.69	0.45	0.45
Pacific Coast Lacquer (Ellis Paint Company)	Los Angeles	CA	Compliant Gun Cleaner Solvent 7002D	421	6.4	2.68
Products/Techniques, Inc.	Rialto	CA	Solvent MIL-T-81772B TY I (PT-1003TYI)	0.5	7.38	7.38
Sherwin-Williams Company, The	Cleveland	OH	Polane K69 Thinner (R7 K 69)	16	7.04	7.04
			Polane K84 Thinner (R7 K 84)	53	7.25	7.25
Sunshine Makers Inc.	Huntington Harbour	CA	Simple Green	20	0.07	0.07
Weighted Means					6.17	3.16

7.1.2.5 Summary of Emission Factors

Table 7-6 summarizes the mass per volume emission factors for the thinning and cleanup solvents associated with OEM coating use.

Table 7-6

SUMMARY OF EMISSION FACTORS FOR THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH OEM COATINGS

Material	Total Organic Gases (lb/gal)			Reactive Organic Gases (lb/gal)		
	Mean	90% Conf. Interval		Mean	90% Conf. Interval	
		Low	High		Low	High
Mineral Spirits	**6.51**	6.43	6.58	**6.51**	6.43	6.58
Lacquer Thinner	**6.66**	6.61	6.70	**5.49**	5.17	5.81
Denatured Alcohol	**6.67**	6.63	6.72	**6.67**	6.63	6.72
Acetone[a]	**6.6**	Not Applicable		**0**	Not Applicable	
Isopropyl Alcohol[b]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Methyl Ethyl Ketone[c]	**6.7**	Not Applicable		**6.7**	Not Applicable	
Methyl Isobutyl Ketone[d]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Naphtha[b]	**7.3**	Not Applicable		**7.3**	Not Applicable	
Toluene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Xylene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Other	**6.18**	5.50	6.64	**3.16**	2.32	3.99

[a]Mean of values provided on six material safety data sheets (MSDS) for acetone.

[b]SCAQMD, 2003.

[c]Shell, 2001.

[d]Shell, 2002.

7.2 SOLVENTS ASSOCIATED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

7.2.1 Mineral Spirits

Respondents reported use of 17 identifiable mineral spirits products. These are listed in Table 7-7, along with their organic gas contents. Note that many of the products are marketed under up to five or six brand names. In such cases, we used only one of the product names in this table.

Table 7-7

MINERAL SPIRITS PRODUCTS REPORTED AS BEING USED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	Density, TOG, and ROG (lb/gal)
Ashland Specialty Chemical Company	Columbus	OH	66 Paint Thinner (Frazee)	33	6.44
Bortz Products	Santa Fe Springs	CA	Bortz Paint Thinner	1,065	6.56
Cron Chemical Corporation	Dallas	TX	Sureblend Paint Thinner (Kelly Moore)	568	6.40
Dunn-Edwards Corporation	Los Angeles	CA	T 1 Paint Thinner (Bortz)	109	6.68
Frazee Industries Inc.	San Diego	CA	Paint Thinner (4010600)	336	6.67
Hasco/Schreuder (Fine Paints of Europe)	Woodstock	VT	Hasco Mineral Spirits	2,599	6.43
Packaging Service Company Inc.	Pearland	TX	Crown Mineral Spirits	88	6.55
Parks Corporation	Fall River	MA	Ace Paint Thinner 13376	25	6.58
	Somerset	MA	Parks Mineral Spirits	34	6.58
R J McGlennon (Maclac)	San Francisco	CA	Maclac T-302 Paint Thinner	1.5	6.59
Sherwin-Williams Company, The	Cleveland	OH	Exempt Xylol (R4 K 11)	0	6.57
			Mineral Spirits (R1 K 4)	1,487	6.35
Star Bronze Company Inc.	Alliance	OH	Zip-Strip Quality Paint Thinner (76000 & 76600)	348.5	6.44
Sunnyside Corporation	Wheeling	IL	Allpro Paint Thinner	246	6.46
			Mineral Spirits (701)	162.5	6.43
Tarr, Inc.	Portland	OR	Paint Thinner	30	6.51
W M Barr & Company Inc.	Memphis	TN	Klean Strip Paint Thinner 5gl	1,848	6.46
Weighted Mean					6.45

For all the reported mineral spirits formulations, the material consists entirely of reactive organic gases (ROG). For the following analyses, we grouped the mineral spirits brands into "formulations," each formulation having a unique ROG content. Because some brands have the same ROG concentration, the number of formulations, 13, is smaller than the number of brands. The mean ROG content of the formulations used by the survey respondents ($n = 13$) is 6.523 lb/gal. A Shapiro-Wilk test of the survey responses showed that one cannot reject the null hypothesis that the data are from a normal distribution ($W = 0.9608$, $p = 0.7168$).

It is more realistic, however, to weight the ROG values by the reported volumes of mineral spirits used. When this is done, the weighted mean ROG content is 6.452 lb/gal. Using Equations 7-1 through 7-4, we calculated the 90-percent confidence interval to be [6.43, 6.47].

Note that the weighted mean ROG content is statistically significantly lower (at the 90-percent confidence level) than the "default" value of 6.5 lb/gal recommended by the South Coast Air Quality Management District for its annual emissions reports calculations (SCAQMD, 2003), although the difference between the two emission factors is small..

7.2.2 Lacquer Thinner

Respondents reported use of 21 identified lacquer thinner products. These are listed in Table 7-8, along with their TOG and ROG contents. As was the case with mineral spirits, many of the products have more than one product name; certain manufacturers blend solvents and package them under up to five or six brand names.

Table 7-8

LACQUER THINNER PRODUCTS REPORTED AS BEING USED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Ashland Specialty Chemical Company	Columbus	OH	Frazee Lacquer Thinner	1,003	6.57	5.12
			LA 6660 (Vista BB Lacquer Thinner)	210	6.57	5.13
Bortz Products	Santa Fe Springs	CA	Bortz Lacquer Thinner 3231	142.5	6.54	5.82
			Lacquer Thinner LT10	40	6.79	6.79
Coventry Coatings	Garnerville	NY	Medium Acrylic Lacquer Thinner	120	6.89	5.51
Cron Chemical Corporation	Dallas	TX	Sureblend (Kelly Moore) SC Lacquer Thinner	62	6.83	6.83
Gemini Coatings	El Reno	OK	Gemini #500 LT Lacquer Thinner	75	6.83	6.83
Pacific Coast Lacquer (Ellis Paint Company)	Los Angeles	CA	2007 Lacquer Thinner Fast	250	6.77	3.38
Packaging Service Company Inc.	Pearland	TX	Crown Lacquer Thinner	1	6.60	5.07
Parks Corporation	Fall River	MA	Ace Lacquer Thinner #12784	2	6.74	a
R J McGlennon (Maclac)	San Francisco	CA	Maclac T-196 Low Voc Lacquer Thinner	0	6.68	3.00
			Maclac T-88 Lacquer Thinner Blend	132.5	6.68	6.68
Sherwin-Williams Company, The	Cleveland	OH	Composite Lacquer Thinner[b]	485	6.67	5.94
			K119 Lacquer Thinner (154-4709)	815	6.64	5.31
			K120 Thinner (R7 K 120)	0	6.69	5.62
			Lacquer Thinner (R7 K 22)	0	6.63	6.63
			Opex Lacquer Thinner (R7 K 119)	0	6.59	5.38
			Retarder Thinner (R7 K 27)	0	6.76	6.76
Simpson Coatings Group	South San Francisco	CA	Medium Flow Lacquer Thinner (309-313)	122	6.65	5.26
Star Bronze Company Inc.	Alliance	OH	Zip-Strip Lacquer Thinner (76100)	20	6.68	6.68
Sunnyside Corporation	Wheeling	IL	457 Lacquer Thinner	52	6.52	4.93
W M Barr & Company Inc.	Memphis	TN	Allpro Lacquer Thinner (Klean-Strip)	561	6.54	5.78
Weighted Means					6.63	5.41

[a]Unable to obtain data on ROG content of this product.

[b]Average values for Sherwin-Williams lacquer thinners reported; this value was used when the product name was not specified.

7.2.2.1 TOG Content of Lacquer Thinners

The lacquer thinners reported by survey respondents were grouped into 16 formulations, according to their TOG concentrations, which ranged from 6.52 to 6.89 lb/gal. The mean value for the products reported was 6.68 lb/gal. A Shapiro-Wilk test of the survey re-

sponses showed that one cannot reject the null hypothesis that the data are from a normal distribution (W = 0.9530, p = 0.5239). Using the methods described in Section 7.1.2.2, we calculated a volume weighted mean TOG concentration of 6.628 lb/gal with a 90-percent confidence interval of [6.61, 6.65].

7.2.2.2 ROG Content of Lacquer Thinners

The lacquer thinners reported by survey respondents were grouped into 16 formulations, according to their ROG concentrations, which ranged from 3.38 to 6.83 lb/gal. The mean value for the products reported was 5.74 lb/gal. A Shapiro-Wilk test of the survey responses showed that one cannot reject the null hypothesis that the data are from a normal distribution (W = 0.8975, p = 0.0744). Using the methods described in Section 7.2.2.1, we calculated a volume weighted mean ROG concentration of 5.41 lb/gal with a 90-percent confidence interval of [5.35, 5.47].

7.2.3 Denatured Alcohol

Respondents reported use of four identifiable denatured alcohol products. These are listed in Table 7-9, along with their organic gas contents. For all the reported denatured alcohol formulations, the material consists entirely of reactive organic gases (ROG).

Table 7-9

DENATURED ALCOHOL PRODUCTS REPORTED AS BEING USED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Bortz Products	Santa Fe Springs	CA	Denatured Alcohol	67.5	6.68	6.68
Parks Corporation	Somerset	MA	Denatured Alcohol	13	6.59	6.59
Southwest Solvent and Chemical	Houston	TX	Government Formula D - Anhydrous	20	6.62	6.62
Startex Chemical Inc.	Conroe	LA	Denatured Alcohol	53	6.59	6.59
Weighted Means					6.63	6.63

The denatured alcohol products reported by survey respondents were grouped into three formulations, according to their ROG concentrations, which ranged from 6.59 to 6.684 lb/gal. The mean value for the products reported was 6.630 lb/gal, and the volume-weighted mean was 6.635. A Shapiro-Wilk test of the survey responses could not be performed, because the sample size was less than 5. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.598, 6.661] for the weighted mean.

7.2.4 Solvent Naphtha

Respondents reported use of two identifiable solvent naphtha brands. These are listed in Table 7-10, along with their organic gas contents. For both brands, the material consists entirely of ROG. The raw and volume-weighted mean ROG content were 6.255 and 6.206 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.200, 6.255] for the weighted mean. Note that this is considerably be-

low the "default" value of 7.3 lb/gal recommended by the South Coast Air Quality Management District for its annual emissions reports calculations (SCAQMD, 2003).

Table 7-10

SOLVENT NAPHTHA PRODUCTS REPORTED AS BEING USED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Sherwin-Williams Company, The	Cleveland	OH	VM & P Naphtha	50	6.20	6.20
Sunnyside Corporation	Wheeling	IL	VM & P Naphtha	3	6.31	6.31
Weighted Means					6.21	6.21

7.2.5 Other Solvents

Painters used several solvents as unmixed chemical compounds. These included:

- Acetone
- Isopropyl Alcohol
- Methanol
- Methyl Ethyl Ketone (MEK)
- Methylene Chloride
- Toluene
- Xylenes

TOG and ROG values for these compounds were obtained from reference documents.

Finally, painters identified nine other solvents used with solvent-based paints, but not readily associated with any of the previously discussed categories. These are listed in Table 7-11. For all but one of these products, the TOG and ROG concentrations are equal. The raw and volume-weighted mean TOG content were 7.045 and 6.788 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.550, 7.014] for the weighted mean. The raw and volume-weighted mean ROG content were 6.819 and 6.108 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [5.640, 6.654] for the weighted mean.

7.2.6 Summary of Emission Factors

Table 7-12 summarizes the mass per volume emission factors for the thinning and cleanup solvents associated with solvent-based architectural coating use.

Table 7-11

OTHER SOLVENT PRODUCTS REPORTED AS BEING USED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG	ROG
					Pounds per Gallon	
Flood Company, The	Hudson	OH	Penetrol/Marine Penetrol	76	7.10	7.10
ICI Paints North America	Cleveland	OH	I-10 Thinner (010T0000)	0	6.89	6.89
			I-17 Thinner (017T0000)	0	7.91	7.91
			I-5 Thinner (005T0000) (Xylene Solution)	0	7.16	7.16
			I-9 Thinner (009T0000)	60	7.71	7.71
Sherwin-Williams Company, The	Cleveland	OH	Etching Thinner (R7 K 53)	0	6.69	6.69
Star Bronze Company Inc.	Alliance	OH	Zip-Kleen Brush & Roller Cleaner (74000)	284	6.55	5.42
Valspar Corporation	Minneapolis	MN	Goof Off	3	7.34	7.34
W M Barr & Company Inc.	Memphis	TN	Klean-Strip Brush Cleaner (QBC12)	49	6.52	6.52
Weighted Means					6.79	6.11

Table 7-12

SUMMARY OF EMISSION FACTORS FOR SOLVENTS ASSOCIATED WITH SOLVENT-BASED ARCHITECTURAL COATINGS

Material	Total Organic Gases (lb/gal)			Reactive Organic Gases (lb/gal)		
	Mean	90% Conf. Interval		Mean	90% Conf. Interval	
		Low	High		Low	High
Mineral Spirits	**6.45**	6.43	6.47	**6.45**	6.43	6.47
Lacquer Thinner	**6.63**	6.61	6.65	**5.41**	5.35	5.47
Denatured Alcohol	**6.64**	6.60	6.66	**6.64**	6.60	6.66
Naphtha	**6.21**	6.20	6.26	**6.21**	6.20	6.26
Acetone[a]	**6.6**	Not Applicable		**0**	Not Applicable	
Isopropyl Alcohol[b]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Methanol[b]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Methylene Chloride[c]	**11.1**	Not Applicable		**0**	Not Applicable	
Toluene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Xylene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Other	**6.79**	6.55	7.01	**6.11**	5.64	6.65

[a]Mean of values provided on six material safety data sheets (MSDS) for acetone.

[b]SCAQMD, 2003.

[c]Dean, 1985.

7.3 SOLVENTS ASSOCIATED WITH WATER-BASED ARCHITECTURAL COATINGS

7.3.1 Latex Paint Additives

Commercial painters reported using six different paint additives that contained volatile organic compounds. They are shown in Table 7-13. In all cases, all of the TOG was also ROG. Among the products were a mineral spirits formulation and a lacquer thinner. Their inclusion was unexpected; however, the amounts used were almost negligible. The ROG concentration ranged in the additives ranged from 0.25 to 6.68 lb/gal. Almost 97 percent of the gallons reported were for one product, OKON® Paintbooster, with an ROG content of 0.901 lb/gal. The volume-weighted mean ROG concentration was 0.917 lb/gal. Using bootstrap sampling, we calculated a 90-percent confidence interval of [0.9097, 0.9257] for the weighted mean.

Table 7-13

ADDITIVE PRODUCTS ASSOCIATED WITH WATER-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	Density, TOG, and ROG (lb/gal)
Flood Company, The	Hudson	OH	Easy Mix E-B	10	2.92
			Floetrol	92	0.25
M L Campbell	Cleveland	OH	Aquastar Water Flow Additive (WR5024)	15	5.09
Okon Inc.	Denver	CO	Okon Paintbooster (OK-810)	3,657	0.901
Star Bronze Company Inc.	Alliance	OH	Zip-Strip Lacquer Thinner (76100)	2	6.68
Sunnyside Corporation	Wheeling	IL	Mineral Spirits (701)	5	6.43
Weighted Mean					0.917

7.3.2 Cleanup Solvents for Water-Based Coatings

Eleven products for cleaning equipment used for applying waterborne architectural coating were identified. Table 7-14 shows the products and their TOG and ROG contents. The TOG concentrations ranged from 6.4 to 6.68 lb/gal. A Shapiro-Wilk test of the survey responses showed that one cannot reject the null hypothesis that the data are from a normal distribution ($W = 0.9604$, $p = 0.7964$). Using the methods described in Section 7.2.2.1, we calculated a volume weighted mean TOG concentration of 6.452 lb/gal with a 90-percent confidence interval of [6.415, 6.489]. A Shapiro-Wilk test of the survey responses showed that one must reject the null hypothesis that the ROG data are from a normal distribution ($W = 0.6086$, $p = 0.0002$). The raw and volume-weighted mean ROG content were 6.40 and 6.313 lb/gal, respectively. Using bootstrap sampling, we calculated a 90-percent confidence interval of [6.206, 6.444] for the weighted mean.

Table 7-14

CLEANUP SOLVENT PRODUCTS ASSOCIATED WITH WATER-BASED ARCHITECTURAL COATINGS

Manufacturer	City	State	Product Name	Gallons Reported	TOG (lb/gal)	ROG (lb/gal)
Bortz Products	Santa Fe Springs	CA	Bortz Paint Thinner	105	6.56	6.56
Cron Chemical Corporation	Dallas	TX	Sureblend (Kelly Moore) SC Lacquer Thinner	0	6.83	6.83
			Sureblend Paint Thinner (Kelly Moore)	10	6.4	6.4
Hasco/Schreuder (Fine Paints of Europe)	Woodstock	VT	Hasco Mineral Spirits	1,590	6.43	6.43
Packaging Service Company Inc.	Pearland	TX	Crown Mineral Spirits	8	6.546	6.546
Parks Corporation	Somerset	MA	Parks Mineral Spirits	15	6.584	6.584
Star Bronze Company Inc.	Alliance	OH	Zip-Strip Lacquer Thinner (76100)	1	6.68	6.68
			Zip-Kleen Brush & Roller Cleaner (74000)	389	6.55	5.42
Sunnyside Corporation	Wheeling	IL	Allpro Paint Thinner	203.5	6.46	6.46
			Mineral Spirits (701)	830	6.43	6.43
W M Barr & Company Inc.	Memphis	TN	Klean-Strip Brush Cleaner (QBC12)	1	6.52	6.52
Weighted Means					6.45	6.31

8.0

EMISSION INVENTORY

8.1 EMISSIONS FROM USE OF OEM COATINGS

Using emission factors derived from the survey of OEM coating manufacturers and statewide volume estimates determined in Section 3.1, we estimated total organic gas (TOG) and reactive organic gas (ROG) emissions from the only three OEM coating categories for which we had sufficient data:

- Wood furniture and fixtures (solvent- and water-based);
- Can and Coil (solvent- and water-based); and
- Metal Furniture (water-based only)

The statewide coating volume estimates are not broken down by coating base. We therefore used, for each coating type, the reported fractions of each coating base. In addition, because we developed different statewide volume estimates for two different methods of apportioning U.S. values to California (i.e., by employment and by facility), we averaged the two estimates for the purpose of the emission calculations. Tables 8-1 and 8-2 show the estimated statewide emissions of TOG and ROG, respectively. These values are considerably higher than those reported in the ARB's 2003 Emission Inventory (ARB, 2004), as seen in the last column of each table.

Given the limited data base for these calculations, we did not allocate emissions to the county or air basin level.

8.2 SOLVENTS ASSOCIATED WITH ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATING USE

8.2.1 Use by Commercial Painters

We used the following procedure to estimate TOG and ROG emissions from use of solvents associated with architectural and industrial maintenance coatings used by commercial painters:

(1) Statewide estimates of the use of various solvent types by commercial painters were obtained from Table 5-10.

(2) The volume of each solvent material was multiplied by its corresponding emission factors (lb TOG or ROG per gallon of solvent), obtained from Section 7.3, to yield statewide emissions.

(3) Statewide emissions were apportioned to counties and air basins in proportion to each geographic unit's number of painters, as determined in Section 2.6.1.

Table 8-1

ESTIMATED STATEWIDE TOG EMISSIONS FROM THREE OEM COATING CATEGORIES

Type of Coating	Statewide Volume (10^6 Gal/Yr)			Solvent-Based		Water-Based		Total Emissions (Tons/Day)	ARB 2003 Emission Inventory (Tons/Day)
	Total	Solvent-Based	Water-Based	Emission Factor (Lb/gal)	Emissions (Tons/yr)	Emission Factor (Lb/gal)	Emissions (Tons/yr)		
Wood Furniture and Fixtures	5.358	4.089	1.269	5.53	**11,305**	0.73	**463**	**32.2**	13.9
Can and Coil	3.574	2.350	1.224	2.91	**3,420**	1.11	**679**	**11.2**	6.2
Metal Furniture	8.204	0.000	8.204	No Data		0.83	**3,405**	**9.3**	2.4

Table 8-2

ESTIMATED STATEWIDE ROG EMISSIONS FROM THREE OEM COATING CATEGORIES

Type of Coating	Statewide Volume (10^6 Gal/Yr)			Solvent-Based		Water-Based		Total Emissions (Tons/Day)	ARB 2003 Emission Inventory (Tons/Day)
	Total	Solvent-Based	Water-Based	Emission Factor (Lb/gal)	Emissions (Tons/yr)	Emission Factor (Lb/gal)	Emissions (Tons/yr)		
Wood Furniture and Fixtures	5.358	4.089	1.269	2.84	**5,806**	0.73	**463**	**17.2**	12.4
Can and Coil	3.574	2.350	1.224	2.91	**3,420**	1.11	**679**	**11.2**	6.5
Metal Furniture	8.204	0.000	8.204	No Data		0.83	**3,405**	**9.3**	2.4

8.2.1.1 Statewide Emissions

Table 8-3 shows statewide emission estimates for TOG and ROG, based on the emission factors presented in Section 7.3. Note that for the unidentified solvent, we used the same emission factors as for the "Other" solvent category. We estimate statewide emissions of TOG and ROG from solvents used by commercial painters to be 9,284 and 8,440 tons per year, respectively.

Table 8-3

ESTIMATED STATEWIDE TOG AND ROG EMISSIONS FROM USE OF SOLVENTS BY COMMERCIAL PAINTERS

Solvent Category	Gallons per Year	Emission Factors (lb/gal)		Emissions (Tons/Year)	
		TOG	ROG	TOG	ROG
Mineral Spirits	1,609,982	6.45	6.45	5,192	5,192
Lacquer Thinner	784,645	6.63	5.41	2,601	2,122
Denatured Alcohol	106,271	6.64	6.64	353	353
Naphtha	18,572	6.21	6.21	58	58
Acetone	101,332	6.6	0	334	0
Isopropyl Alcohol	1,875	6.6	6.6	6	6
Methanol	422	6.6	6.6	1	1
Methylene Chloride	1,428	11.1	0	8	0
Toluene	73,718	7.2	7.2	265	265
Xylene	19,035	7.2	7.2	69	69
Other	56,765	6.79	6.11	193	173
Not Reported[a]	11,515	6.79	6.11	39	35
Additives	359,073	0.917	0.917	165	165
Totals	3,144,633			9,284	8,440

[a]Emission factor assumed to be same as for "Other."

8.2.1.2 Emissions by County, Air Basin, and Air Pollution Control District

Tables 8-4 and 8-5 show estimated emissions of TOG and ROG from solvents used by commercial painters, by county and air basin, respectively. Emissions by major air pollution control district[38] are shown in Table 8-6. Note that each county's entire emissions are included, even if only a portion of the county is in the indicated district.

[38] Per ARB staff, emissions were to be calculated only for five specified air pollution control districts (Delao, 2003).

Table 8-4

ESTIMATED EMISSIONS FROM USE OF SOLVENTS BY COMMERCIAL PAINTERS, BY COUNTY

County	TOG (Tons/Year)	ROG (Tons/Year)	County	TOG (Tons/Year)	ROG (Tons/Year)
Alameda	458.3	416.6	Orange	938	853
Alpine	0.4	0.4	Placer	92	83
Amador	6.3	5.7	Plumas	5	4
Butte	41.5	37.7	Riverside	394	358
Calaveras	9.1	8.3	Sacramento	293	267
Colusa	1.5	1.4	San Benito	23	21
Contra Costa	363.8	330.7	San Bernardino	387	352
Del Norte	2.1	1.9	San Diego	910	827
El Dorado	50.3	45.7	San Francisco	299	272
Fresno	140.2	127.4	San Joaquin	117	106
Glenn	4.6	4.2	San Luis Obispo	68	62
Humboldt	27.0	24.6	San Mateo	226	205
Imperial	11.2	10.2	Santa Barbara	129	117
Inyo	5.1	4.6	Santa Clara	481	437
Kern	99.9	90.8	Santa Cruz	60	54
Kings	17.5	15.9	Shasta	28	26
Lake	12.7	11.5	Sierra	1	1
Lassen	2.5	2.3	Siskiyou	8	7
Los Angeles	2,526.1	2,296.4	Solano	73	67
Madera	17.3	15.7	Sonoma	152	138
Marin	128.7	117.0	Stanislaus	107	97
Mariposa	3.3	3.0	Sutter	8	7
Mendocino	18.4	16.7	Tehama	6	5
Merced	28.5	25.9	Trinity	2	2
Modoc	1.5	1.4	Tulare	37	34
Mono	8.5	7.7	Tuolumne	15	13
Monterey	100.2	91.1	Ventura	180	164
Napa	52.4	47.6	Yolo	58	53
Nevada	42.7	38.8	Yuba	7	6
			State	9,284	8,440

Table 8-5

ESTIMATED EMISSIONS FROM USE OF SOLVENTS BY COMMERCIAL PAINTERS, BY AIR BASIN

Basin Code	Basin Name	TOG (Tons/Year)	ROG (Tons/Year)
GBV	Great Basin Valleys	14	13
LC	Lake County	13	12
LT	Lake Tahoe	15	14
MC	Mountain Counties	129	118
MD	Mojave Desert	189	172
NC	North Coast	69	62
NCC	North Central Coast	183	166
NEP	Northeast Plateau	12	11
SC	South Coast	3,991	3,628
SCC	South Central Coast	377	343
SD	San Diego	910	827
SF	San Francisco Bay Area	2,193	1,994
SJV	San Joaquin Valley	547	497
SS	Salton Sea	94	85
SV	Sacramento Valley	549	499
	Total	9,284	8,440

Table 8-6

ESTIMATED EMISSIONS FROM USE OF SOLVENTS BY COMMERCIAL PAINTERS, BY AIR POLLUTION CONTROL DISTRICT

Air Pollution Control District	Counties	TOG Emissions (Tons/Year)	ROG Emissions (Tons/Year)
South Coast Air Quality Management District	Los Angeles	2,526.1	2,296.4
	Orange	938.4	853.1
	Riverside	394.1	358.3
	San Bernardino	387.0	351.8
	District Total	**4,245.6**	**3,859.5**
San Diego County Air Pollution Control District	San Diego	909.9	827.2
	District Total	**909.9**	**827.2**
Bay Area Air Quality Management District	Alameda	458.3	416.6
	Contra Costa	363.8	330.7
	Marin	128.7	117.0
	Napa	52.4	47.6
	San Francisco	299.3	272.1
	San Mateo	225.7	205.2
	Santa Clara	481.0	437.3
	Solano	73.4	66.8
	Sonoma	151.5	137.7
	District Total	**2,234.2**	**2,031.1**
San Joaquin Valley Unified Air Pollution Control District	Fresno	140.2	127.4
	Kern	99.9	90.8
	Kings	17.5	15.9
	Madera	17.3	15.7
	Merced	28.5	25.9
	San Joaquin	116.6	106.0
	Stanislaus	106.7	97.0
	Tulare	36.9	33.5
	District Total	**563.6**	**512.3**
Sacramento Metropolitan Air Quality Management District	Sacramento	293.5	266.8
	District Total	**293.5**	**266.8**

8.2.2 Use by Owner-Occupied Households

To estimate emissions from solvent use associated with application of architectural coatings by owner-occupied households, we multiplied the solvent use values shown in Section 6 by the emission factors developed from the commercial painters survey.

Tables 8-7 and 8-8 show TOG and ROG emissions by solvent category and county. Tables 8-9 and 8-10 show these emissions by solvent category and air basin. Finally, Table 8-11 shows total household painting solvent emissions by air pollution control district.

Table 8-7
(Part 1)
TONS/YEAR OF TOG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY COUNTY

County	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine	County	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine
Alameda	4.71	6.45	2.14	3.14	Orange	9.45	12.95	4.30	6.30
Alpine	0.01	0.01	0.00	0.00	Placer	1.12	1.54	0.51	0.75
Amador	0.16	0.22	0.07	0.11	Plumas	0.10	0.14	0.05	0.07
Butte	0.79	1.09	0.36	0.53	Riverside	5.73	7.86	2.61	3.82
Calaveras	0.21	0.29	0.10	0.14	Sacramento	4.34	5.95	1.97	2.89
Colusa	0.06	0.09	0.03	0.04	San Benito	0.18	0.24	0.08	0.12
Contra Costa	3.92	5.37	1.78	2.61	San Bernardino	5.61	7.68	2.55	3.74
Del Norte	0.10	0.13	0.04	0.06	San Diego	9.07	12.43	4.12	6.05
El Dorado	0.72	0.99	0.33	0.48	San Francisco	1.90	2.60	0.86	1.27
Fresno	2.35	3.22	1.07	1.57	San Joaquin	1.80	2.47	0.82	1.20
Glenn	0.10	0.13	0.04	0.06	San Luis Obispo	0.94	1.28	0.43	0.62
Humboldt	0.49	0.67	0.22	0.32	San Mateo	2.57	3.52	1.17	1.71
Imperial	0.38	0.52	0.17	0.25	Santa Barbara	1.26	1.73	0.57	0.84
Inyo	0.08	0.11	0.04	0.06	Santa Clara	5.57	7.63	2.53	3.71
Kern	2.13	2.92	0.97	1.42	Santa Cruz	0.90	1.23	0.41	0.60
Kings	0.32	0.43	0.14	0.21	Shasta	0.69	0.94	0.31	0.46
Lake	0.28	0.38	0.13	0.19	Sierra	0.02	0.02	0.01	0.01
Lassen	0.11	0.15	0.05	0.07	Siskiyou	0.21	0.28	0.09	0.14
Los Angeles	24.66	33.80	11.22	16.44	Solano	1.40	1.92	0.64	0.93
Madera	0.39	0.54	0.18	0.26	Sonoma	1.82	2.49	0.83	1.21
Marin	1.05	1.44	0.48	0.70	Stanislaus	1.48	2.03	0.67	0.99
Mariposa	0.08	0.10	0.03	0.05	Sutter	0.27	0.37	0.12	0.18
Mendocino	0.34	0.46	0.15	0.22	Tehama	0.23	0.32	0.11	0.16
Merced	0.62	0.84	0.28	0.41	Trinity	0.07	0.09	0.03	0.04
Modoc	0.04	0.06	0.02	0.03	Tulare	1.12	1.53	0.51	0.74
Mono	0.05	0.07	0.02	0.03	Tuolumne	0.25	0.34	0.11	0.16
Monterey	1.09	1.49	0.50	0.73	Ventura	2.70	3.70	1.23	1.80
Napa	0.49	0.67	0.22	0.32	Yolo	0.52	0.71	0.24	0.35
Nevada	0.46	0.63	0.21	0.31	Yuba	0.18	0.25	0.08	0.12
Totals						108	148	49	72

Table 8-7
(Part 2)
TONS/YEAR OF TOG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY COUNTY

County	Naphtha	Toluene	Other	County	Naphtha	Toluene	Other
Alameda	0.69	0.15	1.12	Orange	1.39	1.61	2.26
Alpine	0.00	0.00	0.00	Placer	0.17	0.19	0.27
Amador	0.02	0.00	0.04	Plumas	0.02	0.02	0.02
Butte	0.12	0.02	0.19	Riverside	0.84	0.98	1.37
Calaveras	0.03	0.01	0.05	Sacramento	0.64	0.74	1.04
Colusa	0.01	0.00	0.02	San Benito	0.03	0.03	0.04
Contra Costa	0.58	0.12	0.94	San Bernardino	0.82	0.96	1.34
Del Norte	0.01	0.00	0.02	San Diego	1.33	1.55	2.17
El Dorado	0.11	0.02	0.17	San Francisco	0.28	0.32	0.45
Fresno	0.35	0.07	0.56	San Joaquin	0.27	0.31	0.43
Glenn	0.01	0.00	0.02	San Luis Obispo	0.14	0.16	0.22
Humboldt	0.07	0.02	0.12	San Mateo	0.38	0.44	0.61
Imperial	0.06	0.01	0.09	Santa Barbara	0.19	0.21	0.30
Inyo	0.01	0.00	0.02	Santa Clara	0.82	0.95	1.33
Kern	0.31	0.07	0.51	Santa Cruz	0.13	0.15	0.21
Kings	0.05	0.01	0.08	Shasta	0.10	0.12	0.16
Lake	0.04	0.01	0.07	Sierra	0.00	0.00	0.00
Lassen	0.02	0.00	0.03	Siskiyou	0.03	0.03	0.05
Los Angeles	3.63	0.76	5.89	Solano	0.21	0.24	0.33
Madera	0.06	0.01	0.09	Sonoma	0.27	0.31	0.43
Marin	0.15	0.03	0.25	Stanislaus	0.22	0.25	0.35
Mariposa	0.01	0.00	0.02	Sutter	0.04	0.05	0.07
Mendocino	0.05	0.01	0.08	Tehama	0.03	0.04	0.06
Merced	0.09	0.02	0.15	Trinity	0.01	0.01	0.02
Modoc	0.01	0.00	0.01	Tulare	0.16	0.19	0.27
Mono	0.01	0.00	0.01	Tuolumne	0.04	0.04	0.06
Monterey	0.16	0.03	0.26	Ventura	0.40	0.46	0.65
Napa	0.07	0.02	0.12	Yolo	0.08	0.09	0.12
Nevada	0.07	0.01	0.11	Yuba	0.03	0.03	0.04
Totals					16	12	26

Table 8-8
(Part 1)
TONS/YEAR OF ROG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY COUNTY

County	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine	County	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine
Alameda	4.71	5.26	0.00	3.14	Orange	9.4	10.6	0.0	6.3
Alpine	0.01	0.01	0.00	0.00	Placer	1.1	1.3	0.0	0.7
Amador	0.16	0.18	0.00	0.11	Plumas	0.1	0.1	0.0	0.1
Butte	0.79	0.89	0.00	0.53	Riverside	5.7	6.4	0.0	3.8
Calaveras	0.21	0.24	0.00	0.14	Sacramento	4.3	4.9	0.0	2.9
Colusa	0.06	0.07	0.00	0.04	San Benito	0.2	0.2	0.0	0.1
Contra Costa	3.92	4.39	0.00	2.61	San Bernardino	5.6	6.3	0.0	3.7
Del Norte	0.10	0.11	0.00	0.06	San Diego	9.1	10.1	0.0	6.0
El Dorado	0.72	0.81	0.00	0.48	San Francisco	1.9	2.1	0.0	1.3
Fresno	2.35	2.63	0.00	1.57	San Joaquin	1.8	2.0	0.0	1.2
Glenn	0.10	0.11	0.00	0.06	San Luis Obispo	0.9	1.0	0.0	0.6
Humboldt	0.49	0.54	0.00	0.32	San Mateo	2.6	2.9	0.0	1.7
Imperial	0.38	0.42	0.00	0.25	Santa Barbara	1.3	1.4	0.0	0.8
Inyo	0.08	0.09	0.00	0.06	Santa Clara	5.6	6.2	0.0	3.7
Kern	2.13	2.38	0.00	1.42	Santa Cruz	0.9	1.0	0.0	0.6
Kings	0.32	0.35	0.00	0.21	Shasta	0.7	0.8	0.0	0.5
Lake	0.28	0.31	0.00	0.19	Sierra	0.0	0.0	0.0	0.0
Lassen	0.11	0.12	0.00	0.07	Siskiyou	0.2	0.2	0.0	0.1
Los Angeles	24.66	27.58	0.00	16.44	Solano	1.4	1.6	0.0	0.9
Madera	0.39	0.44	0.00	0.26	Sonoma	1.8	2.0	0.0	1.2
Marin	1.05	1.18	0.00	0.70	Stanislaus	1.5	1.7	0.0	1.0
Mariposa	0.08	0.08	0.00	0.05	Sutter	0.3	0.3	0.0	0.2
Mendocino	0.34	0.37	0.00	0.22	Tehama	0.2	0.3	0.0	0.2
Merced	0.62	0.69	0.00	0.41	Trinity	0.1	0.1	0.0	0.0
Modoc	0.04	0.05	0.00	0.03	Tulare	1.1	1.2	0.0	0.7
Mono	0.05	0.06	0.00	0.03	Tuolumne	0.2	0.3	0.0	0.2
Monterey	1.09	1.22	0.00	0.73	Ventura	2.7	3.0	0.0	1.8
Napa	0.49	0.54	0.00	0.32	Yolo	0.5	0.6	0.0	0.3
Nevada	0.46	0.51	0.00	0.31	Yuba	0.2	0.2	0.0	0.1
Totals						108	120	0	72

Table 8-8
(Part 2)
TONS/YEAR OF ROG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY COUNTY

County	Naphtha	Toluene	Other	County	Naphtha	Toluene	Other
Alameda	0.7	0.1	1.0	Orange	1.39	0.29	2.03
Alpine	0.0	0.0	0.0	Placer	0.17	0.03	0.24
Amador	0.0	0.0	0.0	Plumas	0.02	0.00	0.02
Butte	0.1	0.0	0.2	Riverside	0.84	0.18	1.23
Calaveras	0.0	0.0	0.0	Sacramento	0.64	0.13	0.93
Colusa	0.0	0.0	0.0	San Benito	0.03	0.01	0.04
Contra Costa	0.6	0.1	0.8	San Bernardino	0.82	0.17	1.20
Del Norte	0.0	0.0	0.0	San Diego	1.33	0.28	1.95
El Dorado	0.1	0.0	0.2	San Francisco	0.28	0.06	0.41
Fresno	0.3	0.1	0.5	San Joaquin	0.27	0.06	0.39
Glenn	0.0	0.0	0.0	San Luis Obispo	0.14	0.03	0.20
Humboldt	0.1	0.0	0.1	San Mateo	0.38	0.08	0.55
Imperial	0.1	0.0	0.1	Santa Barbara	0.19	0.04	0.27
Inyo	0.0	0.0	0.0	Santa Clara	0.82	0.17	1.20
Kern	0.3	0.1	0.5	Santa Cruz	0.13	0.03	0.19
Kings	0.0	0.0	0.1	Shasta	0.10	0.02	0.15
Lake	0.0	0.0	0.1	Sierra	0.00	0.00	0.00
Lassen	0.0	0.0	0.0	Siskiyou	0.03	0.01	0.04
Los Angeles	3.6	0.8	5.3	Solano	0.21	0.04	0.30
Madera	0.1	0.0	0.1	Sonoma	0.27	0.06	0.39
Marin	0.2	0.0	0.2	Stanislaus	0.22	0.05	0.32
Mariposa	0.0	0.0	0.0	Sutter	0.04	0.01	0.06
Mendocino	0.0	0.0	0.1	Tehama	0.03	0.01	0.05
Merced	0.1	0.0	0.1	Trinity	0.01	0.00	0.01
Modoc	0.0	0.0	0.0	Tulare	0.16	0.03	0.24
Mono	0.0	0.0	0.0	Tuolumne	0.04	0.01	0.05
Monterey	0.2	0.0	0.2	Ventura	0.40	0.08	0.58
Napa	0.1	0.0	0.1	Yolo	0.08	0.02	0.11
Nevada	0.1	0.0	0.1	Yuba	0.03	0.01	0.04
Totals					16	3	23

Table 8-9

TOG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY AIR BASIN

(Tons per Year)

Air Basin	Type of Thinning and Cleanup Solvent							
	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine	Naphtha	Toluene	Other	Total
Great Basin Valleys	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.5
Lake County	0.3	0.4	0.1	0.2	0.0	0.0	0.1	1.1
Lake Tahoe	0.2	0.3	0.1	0.1	0.0	0.0	0.1	0.8
Mojave Desert	2.5	3.4	1.1	1.7	0.4	0.1	0.6	9.7
Mountain Counties	1.9	2.7	0.9	1.3	0.3	0.1	0.5	7.6
North Central Coast	2.2	3.0	1.0	1.4	0.3	0.1	0.5	8.5
North Coast	1.2	1.7	0.5	0.8	0.2	0.0	0.3	4.7
Northeast Plateau	0.4	0.5	0.2	0.2	0.1	0.0	0.1	1.4
Sacramento Valley	8.6	11.8	3.9	5.7	1.3	0.3	2.1	33.6
Salton Sea	1.6	2.2	0.7	1.1	0.2	0.0	0.4	6.2
San Diego	9.1	12.4	4.1	6.0	1.3	0.3	2.2	35.4
San Francisco Bay Area	22.8	31.2	10.4	15.2	3.3	0.7	5.4	89.0
San Joaquin Valley	9.8	13.5	4.5	6.6	1.4	0.3	2.4	38.5
South Central Coast	4.9	6.7	2.2	3.3	0.7	0.2	1.2	19.2
South Coast	42.1	57.7	19.2	28.1	6.2	1.3	10.1	164.7
Statewide	**108**	**148**	**49**	**72**	**16**	**3**	**26**	**421**

Table 8-10

ROG EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY AIR BASIN

(Tons per Year)

Air Basin	Type of Thinning and Cleanup Solvent							
	Mineral Spirits	Lacquer Thinner	Acetone	Turpentine	Naphtha	Toluene	Other	Total
Great Basin Valleys	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.4
Lake County	0.3	0.3	0.0	0.2	0.0	0.0	0.1	0.9
Lake Tahoe	0.2	0.2	0.0	0.1	0.0	0.0	0.0	0.7
Mojave Desert	2.5	2.8	0.0	1.7	0.4	0.1	0.5	7.9
Mountain Counties	1.9	2.2	0.0	1.3	0.3	0.1	0.4	6.2
North Central Coast	2.2	2.4	0.0	1.4	0.3	0.1	0.5	6.9
North Coast	1.2	1.4	0.0	0.8	0.2	0.0	0.3	3.8
Northeast Plateau	0.4	0.4	0.0	0.2	0.1	0.0	0.1	1.1
Sacramento Valley	8.6	9.6	0.0	5.7	1.3	0.3	1.8	27.3
Salton Sea	1.6	1.8	0.0	1.1	0.2	0.0	0.3	5.0
San Diego	9.1	10.1	0.0	6.0	1.3	0.3	1.9	28.8
San Francisco Bay Area	22.8	25.5	0.0	15.2	3.3	0.7	4.9	72.3
San Joaquin Valley	9.8	11.0	0.0	6.6	1.4	0.3	2.1	31.3
South Central Coast	4.9	5.5	0.0	3.3	0.7	0.2	1.1	15.6
South Coast	42.1	47.1	0.0	28.1	6.2	1.3	9.1	133.9
Statewide	**108**	**120**	**0**	**72**	**16**	**3**	**23**	**342**

Table 8-11

ESTIMATED ANNUAL EMISSIONS FROM EVAPORATION OF SOLVENTS APPLIED BY HOMEOWNERS, BY AIR POLLUTION CONTROL DISTRICT

Air Pollution Control District	Counties	TOG Emissions (Tons/Year)	ROG Emissions (Tons/Year)
South Coast Air Quality Management District	Los Angeles	96.4	78.4
	Orange	38.2	30.0
	Riverside	23.2	18.2
	San Bernardino	22.7	17.8
	District Total	**180.6**	**144.4**
San Diego County Air Pollution Control District	San Diego	36.7	28.8
	District Total	**36.7**	**28.8**
Bay Area Air Quality Management District	Alameda	16.4	15.0
	Contra Costa	15.3	12.5
	Marin	4.1	3.3
	Napa	1.9	1.5
	San Francisco	7.7	6.0
	San Mateo	10.4	8.2
	Santa Clara	22.5	17.7
	Solano	5.7	4.4
	Sonoma	7.4	5.8
	District Total	**91.4**	**74.4**
San Joaquin Valley Unified Air Pollution Control District	Fresno	9.2	7.5
	Kern	8.3	6.8
	Kings	1.2	1.0
	Madera	1.5	1.3
	Merced	2.4	2.0
	San Joaquin	7.3	5.7
	Stanislaus	6.0	8.2
	Tulare	4.5	3.5
	District Total	**40.5**	**36.0**
Sacramento Metropolitan Air Quality Management District	Sacramento	17.6	13.8
	District Total	**17.6**	**13.8**

8.3 SUMMARY OF SOLVENT EMISSIONS FROM USE OF ARCHITECTURAL COATINGS

The following three-part table summarizes the results from the two surveys of architectural and industrial maintenance coating use.

Table 8-12

(Part 1)

SUMMARY OF ARCHITECTURAL COATINGS RESULTS

COMMERCIAL PAINTERS SURVEY				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Reported Thinning Ratio	Gallons Thinning Solvent per Gallon SB Coating	0.06918	
	Statewide Coating Volume	Gallons SB Coating	14,165,520	
	Statewide Solvent Volume	Gallons Thinning Solvent for SB Coatings	979,951	
	Weighted Average Emission Factor	Pounds per Gallon	6.5647	5.9276
	Statewide Emissions	Emissions From Thinning SB Coatings (Tons/Year)	**3,217**	**2,904**
ADDITIVES	Reported Additive Ratio	Gallons Additive per Gallon WB Coating	0.0060625	
	Statewide Coating Volume	Gallons WB Coating	59,228,573	
	Statewide Additive Volume	Gallons Additive for WB Coatings	359,073	
	Reported Additive Emission Factor	Pounds per Gallon	0.917	0.917
	Statewide Emissions	Emissions From Additives to WB Coatings (Tons/Year)	**165**	**165**
CLEANUP	Cleanup Ratio	Gallons Cleanup Solvent per (Gallons SB Coating + Gallons WB Coating)	0.02460	
	Statewide Coating Volume	Gallons SB Coating + Gallons WB Coating	73,394,093	
	Statewide Solvent Volume	Gallons Cleanup Solvent	1,805,609	
	Weighted Average Emission Factor	Pounds per Gallon	6.5384	5.9501
	Statewide Emissions	Emissions From Cleanup for SB and WB Coatings (Tons/ Year)	**5,903**	**5,372**

Table 8-12

(Part 2)

SUMMARY OF ARCHITECTURAL COATINGS RESULTS

HOMEOWNER SURVEY				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Total Solvent Volume per Household	Gallons Solvent per Household per Year	0.019287	
	Statewide Number of Households	Number of Households	6,546,344	
	Statewide Total Solvent Volume	Gallons Solvent per Year	126,260	
	Thinner Fraction	Gallons Thinner/Gallons Total Solvent	0.22258	
	Statewide Volume of Thinner	Gallons Thinner per Year	28,103	
	Weighted Average Emission Factor	Pounds per Gallon	6.6633	5.4577
	Statewide Emissions	Emissions from Thinning SB Coatings by Households (Tons/Year)	**94**	**77**
CLEANUP	Total Solvent Volume per Household	Gallons Solvent per Household per Year	0.019287	
	Statewide Number of Households	Number of Households	6,546,344	
	Statewide Total Solvent Volume	Gallons Solvent per Year	126,260	
	Cleanup Fraction	Gallons Cleanup/Gallons Total Solvent	0.777417018	
	Statewide Volume of Cleanup Solvent	Gallons Cleanup Solvent per Year	98,156	
	Weighted Average Emission Factor	Pounds per Gallon	6.6633	5.4577
	Statewide Emissions	Emissions From Cleanup Solvent Use by Household (Tons/Year)	**327**	**268**

Table 8-12
(Part 3)

SUMMARY OF ARCHITECTURAL COATINGS RESULTS

TOTAL STATEWIDE ARCHITECTURAL COATINGS				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Statewide Solvent Volume	Gallons Thinning Solvent for SB Coatings	1,106,211	
	Statewide Coating Volume	Gallons SB Coatings	16,906,211	
	Statewide Thinning Ratio	Gallons Thinning Solvent/ Gallons SB Coating	0.065432	
	Statewide Emissions	Emissions From Thinning of SB Coatings (Tons/Year)	**3,310**	**2,981**
ADDITIVES	Statewide Additive Volume	Gallons Additive for WB Coatings	359,073	
	Statewide Additive Ratio	Gallons Additive/Gallon WB Coating	0.0044032	
	Reported Additive Emission Factor	Pounds per Gallon	0.917	0.917
	Statewide Emissions	Emissions From Additives to WB Coatings (Tons/Year)	**165**	**165**
CLEANUP	Statewide Solvent Volume	Gallons Cleanup Solvent for SB and WB Coatings	1,903,766	
	Statewide Coating Volume	Gallons SB Coating + Gallons WB Coating	98,455,172	
	Statewide Cleanup Ratio	Gallons Cleanup Solvent/ (Gallon SB Coating + Gallon WB Coating)	0.019336	
	Statewide Emissions	Emissions From Cleanup of SB and WB Coatings	**6,230**	**5,640**

8.4 THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH USE OF OEM COATINGS

We estimated statewide emissions of TOG and ROG from use of thinning and cleanup solvents associated with use of OEM coatings by multiplying the volume used for each solvent type by its corresponding emission factor. Emissions were estimated only for two of the SIC codes in the "selected sample:" 34 and 35. As discussed in Section 4.3.3, there is some doubt about the estimate of statewide solvent use in SIC 37. Given the great uncertainty in our estimates of solvent use, we did not attempt to allocate emissions to smaller geographic areas. Tables 8-13 and 8-14 shows the results of the calculations for SIC 34 and SIC 35, respectively.

Table 8-13

STATEWIDE EMISSIONS FROM USE OF THINNING AND CLEANING SOLVENTS IN SIC 34

Solvent Type	Gallons of Solvent Per Year[a]	TOG		ROG	
		Emission Factor[b] (Lb/Gal)	Emissions (Tons/Year)	Emission Factor[b] (Lb/Gal)	Emissions (Tons/Year)
Mineral Spirits	44,378	6.51	144	6.51	144
Lacquer Thinner	178,745	6.66	595	5.49	491
Acetone	839,486	6.6	2,770	0	0
Denatured Alcohol	8,629	6.67	29	6.67	29
Isopropyl Alcohol	15,409	6.6	51	6.6	51
Toluene	2,465	7.2	9	7.2	9
Xylenes	83,209	7.2	300	7.2	300
MEK	3,082	6.7	10	6.7	10
Other	24,655	6.18	76	3.16	39
Totals	1,200,059		**3,985**		**1,072**

Table 8-14

STATEWIDE EMISSIONS FROM USE OF THINNING AND CLEANING SOLVENTS IN SIC 35

Solvent Type	Gallons of Solvent Per Year[a]	TOG		ROG	
		Emission Factor (Lb/Gal)	Emissions (Tons/Year)	Emission Factor (Lb/Gal)	Emissions (Tons/Year)
Mineral Spirits	70,244	6.51	229	6.51	229
Lacquer Thinner	158,693	6.66	528	5.49	436
Acetone	353,795	6.6	1,168	0	0
Toluene	29,422	7.2	106	7.2	106
Other	5,149	6.18	16	3.16	8
Totals	617,303		**2,046**		**778**

[a]Volume estimates based on survey data and U.S. Census data; see Table 4-8.

[b]Emission factors based on MSDS data as summarized in Table 7-6.

9.0

SPECIATION PROFILES

Information on the composition of OEM coatings and the solvents and other VOC-containing materials associated with use of OEM coatings and architectural coatings was obtained through the survey described in previous sections. Using the methods described in Section 2.8, we developed "speciation profiles" for several categories of coatings and solvent formulations. For this report, a speciation profile for a particular category of coating or solvent is defined as a set of mass percentages of individual TOG constituents, averaged over all the samples obtained for the category. Because information on all the constituents of each coating or solvent formulation was not available, the mass percentages for any given formulation do not necessarily sum to 100 percent. They are useful, however, in estimating emissions of individual species, including many hazardous air pollutants (HAPS) from total throughput. Let V_i be the volume of the ith formulation used, and let d_i be its density (in pounds per gallon). Let f_{ij} be the mass percentage of the jth species in the ith formulation. Then emissions of the jth species from use of the ith formulation are:

$$E_j = f_{ij} V_i d_i \qquad [9\text{-}1]$$

9.1 SPECIATION PROFILES FOR OEM COATINGS

Tables 9-1 through 9-10 show the mean weight percentages of OEM coating TOG constituents for which we received data from OEM coating manufacturers. Compounds are listed in decreasing order of weight percent. HAPs are identified with check marks. The coating categories for which these profiles were developed include:

- Marine – Solvent-based
- Can and Coil – Solvent-based
- Can and Coil – Water-based
- Wood – Solvent-based
- Wood – Water-based
- Metal – Solvent-based
- Metal – Water-based
- Metal Furniture – Water-based
- Other – Solvent-based
- Other – Water-based

Table 9-1

SPECIATION PROFILE FOR SOLVENT-BASED MARINE COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
8052-41-3	Mineral Spirits		6.17
96-29-7	Ethyl Methyl Ketone Oxime		0.89
149-57-5	2-Ethylhexanoic Acid		0.89
	TOG Accounted For		7.95

Table 9-2

SPECIATION PROFILE FOR SOLVENT-BASED CAN AND COIL COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
71-36-3	n-Butanol		0.56
763-69-9	Ethyl 3-Ethoxypropionate		0.54
1330-20-7	Xylenes (isomers and mixture)	✓	0.48
123-42-2	Diacetone Alcohol		0.46
108-65-6	Propylene Glycol Monoethyl Ether Acetate		0.31
107-98-2	Propylene Glycol Monomethyl Ether		0.14
64742-95-6	Solvent Naphtha (Petroleum), Light Aromatic		0.13
67-63-0	2-Propanol		0.12
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.09
64742-94-5	Solvent Naphtha (Petroleum) Heavy Aromatic		0.04
64-17-5	Ethyl Alcohol		0.03
108-88-3	Toluene	✓	0.02
8052-41-3	Mineral Spirits		0.01
2807-30-9	Ethylene Glycol Monopropyl Ether	✓	0.01
78-83-1	Isobutyl Alcohol		0.005
67-56-1	Methanol	✓	0.003
108-01-0	N-N-Dimethylethanolamine		0.001
50-00-0	Formaldehyde	✓	0.0001
	TOG Accounted For		2.95

Table 9-3

SPECIATION PROFILE FOR WATER-BASED CAN AND COIL COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
111-76-2	Ethylene Glycol Monobutyl Ether	✓	3.04
2807-30-9	Ethylene Glycol Monopropyl Ether	✓	2.45
64-17-5	Ethyl Alcohol		1.44
108-65-6	Propylene Glycol Monoethyl Ether Acetate		0.90
71-36-3	Butanol		0.70
107-21-1	Ethylene Glycol	✓	0.68
67-63-0	2-Propanol		0.60
108-95-2	Phenol	✓	0.42
64742-95-6	Solvent Naphtha (Petroleum), Light Aromatic		0.29
107-98-2	Propylene Glycol Monomethyl Ether		0.29
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.27
108-01-0	N-N-Dimethylethanolamine		0.25
123-42-2	Diacetone Alcohol		0.21
8052-41-3	Mineral Spirits		0.16
50-00-0	Formaldehyde	✓	0.151
1330-20-7	Xylenes (isomers and mixture)	✓	0.123
34590-94-8	Dipropylene Glycol Monomethyl Ether		0.065
	TOG Accounted For		12.03

Table 9-4

SPECIATION PROFILE FOR SOLVENT-BASED WOOD COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
67-64-1	Acetone		34.52
64742-89-8	VM & P Naphtha		4.83
108-88-3	Toluene	✓	4.56
112-07-2	Ethylene Glycol Monobutyl Ether Acetate	✓	4.18
67-63-0	2-Propanol		3.19
110-43-0	Methyl n-Amyl Ketone		3.08
64-17-5	Ethyl Alcohol		2.29
108-10-1	Methyl Isobutyl Ketone	✓	2.18
123-86-4	n-Butyl Acetate		2.17
71-36-3	n-Butanol		1.87
8052-41-3	Mineral Spirits		1.59
78-83-1	Isobutyl Alcohol		1.38
67-56-1	Methanol	✓	1.26
78-93-3	Methyl Ethyl Ketone (2-Butanone)	✓	0.65
5131-66-8	Propylene Glycol n-Butyl Ether		0.57
8032-32-4	Ligroine		0.54
108-65-6	Propylene Glycol Monoethyl Ether Acetate		0.52
64-63-0	Isopropyl alcohol (Isopropanol)		0.51
1330-20-7	Xylenes (isomers and mixture)	✓	0.49
85-68-7	Butyl Benzyl Phthalate		0.47
2807-30-9	Ethylene Glycol Monopropyl Ether	✓	0.38
141-78-6	Ethyl Acetate		0.37
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.23
64742-94-5	Solvent Naphtha (Petroleum) Heavy Aromatic		0.17
100-41-4	Ethyl Benzene	✓	0.16
97-85-8	Isobutyl Isobutyrate		0.12
109-60-4	n-Propyl Acetate		0.12
84-74-2	Dibutyl Phthalate		0.06
110-19-0	Isobutyl Acetate		0.03
98-56-6	p-Chlorobenzotrifluoride		0.03
142-82-5	n-Heptane		0.03
91-20-3	Naphthalene	✓	0.02
117-81-7	Bis(2-Ethylhexyl) Phthalate (DEHP)	✓	0.01
107-98-2	Propylene Glycol Monomethyl Ether		0.006
123-42-2	Diacetone Alcohol		0.003
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.003
107-87-9	2-Pentanone		0.002
64741-65-7	Naphtha (Petroleum), Heavy Alk		0.001
872-50-4	N-Methylpyrrolidinone		0.0001
	TOG Accounted For		72.61

Table 9-5

SPECIATION PROFILE FOR WATER-BASED WOOD COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
111-76-2	Ethylene Glycol Monobutyl Ether	✓	3.13
108-01-0	N-N-Dimethylethanolamine		0.77
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.73
85-68-7	Butyl Benzyl Phthalate		0.73
25265-71-8	Dipropylene Glycol		0.59
57-55-6	Propylene Glycol		0.36
1569-02-4	Propylene Glycol Ethyl Ether		0.04
872-50-4	N-Methylpyrrolidinone		0.020
107-98-2	Propylene Glycol Monomethyl Ether		0.016
29911-28-2	Dipropylene Glycol Monobutyl Ether		0.006
78-51-3	Tri(butoxyethyl)phosphate		0.003
34590-94-8	Dipropylene Glycol Monomethyl Ether		0.001
	TOG Accounted For		6.40

Table 9-6

SPECIATION PROFILE FOR SOLVENT-BASED METAL COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
67-64-1	Acetone		9.46
123-86-4	n-Butyl Acetate		7.25
64742-89-8	VM & P Naphtha		1.98
64742-88-7	Medium Aliphatic Solvent Naphtha (Petroleum)		1.00
108-38-3	m-Xylenes	✓	0.87
78-93-3	Methyl Ethyl Ketone (2-Butanone)	✓	0.69
108-10-1	Methyl Isobutyl Ketone	✓	0.56
107-87-9	2-Pentanone		0.56
1330-20-7	Xylenes (isomers and mixture)	✓	0.53
64741-65-7	Naphtha (Petroleum), Heavy Alk		0.46
108-88-3	Toluene	✓	0.44
64742-94-5	Solvent Naphtha (Petroleum) Heavy Aromatic		0.44
110-43-0	Methyl n-Amyl Ketone		0.39
71-36-3	n-Butanol		0.32
763-69-9	Ethyl 3-Ethoxypropionate		0.31
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.20
64742-95-6	Solvent Naphtha (Petroleum), Light Aromatic		0.13
100-42-5	Styrene	✓	0.12
1569-01-3	Propylene Glycol Monopropyl Ether		0.08
67-63-0	2-Propanol		0.08
61789-51-3	Naphthenic Acids, Cobalt Salts		0.07
88230-35-7	Acetic Acid, Hexyl Esters Mixture		0.06
64742-88-3	Mineral Spirits		0.06
100-41-4	Ethyl Benzene	✓	0.04
95-63-6	1,2,4-Trimethylbenzene		0.04
96-29-7	Ethyl Methyl Ketone Oxime		0.04
78-83-1	Isobutyl Alcohol		0.01
123-42-2	Diacetone Alcohol		0.01
8052-41-3	Mineral Spirits		0.01
2807-30-9	Ethylene Glycol Monopropyl Ether	✓	0.006
136-52-7	Cobalt 2-Ethylhexanoate		0.004
112-07-2	Ethylene Glycol Monobutyl Ether Acetate	✓	0.004
25551-13-7	Trimethyl Benzene		0.003
7664-38-2	Phosphoric acid		0.002
108-65-6	Propylene Glycol Monoethyl Ether Acetate		0.0002
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.0002
	TOG Accounted For		26.22

Table 9-7

SPECIATION PROFILE FOR WATER-BASED METAL COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
71-36-3	n-Butanol		0.81
108-01-0	N-N-Dimethylethanolamine		0.70
67-63-0	2-Propanol		0.68
78-92-2	sec-Butyl Alcohol		0.55
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.43
1569-01-3	Propylene Glycol Monopropyl Ether		0.35
67-64-1	Acetone		0.17
85-68-7	Butyl Benzyl Phthalate		0.02
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.02
61789-51-3	Naphthenic Acids, Cobalt Salts		0.01
78-83-1	Isobutyl Alcohol		0.004
111-77-3	Diethylene Glycol Monomethyl Ether	✓	0.0004
124-68-5	Isobutanolamine		0.0002
	TOG Accounted For		3.73

Table 9-8

SPECIATION PROFILE FOR WATER-BASED METAL FURNITURE COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
111-76-2	Ethylene Glycol Monobutyl Ether	✓	7.16
25265-77-4	Trimethyl-1,3-Pentanediol Monoisobutyrate,2,2,4-		0.26
112-34-5	Diethylene Glycol Monobutyl Ether	✓	0.25
108-01-0	N-N-Dimethylethanolamine		0.25
67-63-0	2-Propanol		0.07
57-55-6	Propylene Glycol		0.01
124-68-5	Isobutanolamine		0.01
	TOG Accounted For		8.02

Table 9-9

SPECIATION PROFILE FOR OTHER SOLVENT-BASED COATINGS

CAS No.	Description	HAP	Mean Weight Percent
100-42-5	Styrene	✓	15.62
78-93-3	Methyl Ethyl Ketone (2-Butanone)	✓	5.16
141-78-6	Ethyl Acetate		3.69
8052-41-3	Mineral Spirits		3.53
108-88-3	Toluene	✓	3.28
123-86-4	n-Butyl Acetate		2.64
1330-20-7	Xylenes (isomers and mixture)	✓	2.09
110-43-0	Methyl n-Amyl Ketone		1.36
64742-88-7	Medium Aliphatic Solvent Naphtha (Petroleum)		1.15
108-10-1	Methyl Isobutyl Ketone	✓	1.08
108-65-6	Propylene Glycol Monomethyl Ether Acetate		0.70
9004-70-0	Nitrocellulose		0.61
67-63-0	2-Propanol		0.53
78-83-1	Isobutyl Alcohol		0.39
117-81-7	Di (2-Ethylhexyl) Phthalate (DEHP)	✓	0.28
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.22
100-41-4	Ethyl Benzene	✓	0.20
64742-89-8	VM & P Naphtha		0.14
64742-95-6	Solvent Naphtha (Petroleum), Light Aromatic		0.14
584-84-9	2,4-Toluene Diisocyanate	✓	0.10
111-15-9	Ethylene Glycol Monoethyl Ether Acetate	✓	0.10
112-07-2	Ethylene Glycol Monobutyl Ether Acetate		0.08
96-29-7	Ethyl Methyl Ketone Oxime		0.05
91-20-3	Naphthalene	✓	0.03
138-86-3	Limonene		0.03
26471-62-5	Isocyanic Acid, Methyl-M-Phenylene Ester		0.03
5124-30-1	Methylene-bis(4-Cyclohexylisocyanate)		0.02
71-36-3	n-Butanol		0.01
97-64-3	Lactic Acid, Ethyl Ester		0.01
7397-62-8	Acetic Acid		0.01
111-77-3	Diethylene Glycol Monomethyl Ether	✓	0.008
107-98-2	Propylene Glycol Monomethyl Ether		0.004
763-69-9	Ethyl 3-Ethoxypropionate		0.004
136-52-7	Cobalt 2-Ethylhexanoate		0.002
95-63-6	1,2,4-Trimethylbenzene		0.0018
77-58-7	Dibutyltin Dilaurate		0.0006
	TOG Accounted For		43.29

Table 9-10

SPECIATION PROFILE FOR OTHER WATER-BASED COATINGS

CAS No.	Description	HAP	Mean Weight Percent
111-76-2	Ethylene Glycol Monobutyl Ether	✓	2.64
57-55-6	Propylene Glycol		2.55
112-34-5	Diethylene Glycol Monobutyl Ether	✓	2.53
111-77-3	Diethylene Glycol Monomethyl Ether	✓	0.11
25265-77-4	Trimethyl-1,3-Pentanediol Monoisobutyrate,2,2,4-		0.06
85-68-7	Butyl Benzyl Phthalate		0.02
8052-41-3	Mineral Spirits		0.01
84-74-2	Dibutyl Phthalate		0.01
110-91-8	Morpholine		0.01
71-36-3	Butanol		0.00
25265-71-8	Dipropylene Glycol		0.00
96-29-7	Ethyl Methyl Ketone Oxime		0.00
121-44-8	Triethyl Amine	✓	0.001
107-21-1	Ethylene Glycol	✓	0.0004
108-65-6	Propylene Glycol Monomethyl Ether Acetate		0.0003
20324-33-8	Tripropylene Glycol Methyl Ether		0.0001
	TOG Accounted For		7.95

Table 9-11 shows, for each OEM coating type, the number of coating formulations used in the calculations, the three most prevalent chemical species, the total weight percent of all identified species in the coating, and the total weight percentage of HAPs in the coating. For several of the coatings (e.g. solvent- and water-based wood), the identified species comprise all of the TOG. For others, especially solvent-based marine and solvent-based can and coil coatings, the bulk of the volatile organic species have not been identified by the manufacturers.

The percentage of total coating weight represented by HAPs varied from zero (for solvent-based marine coatings) to 28 (for "other" solvent-based coatings). It is interesting to note that for can and coil coatings, the water-based products have a higher percentage of HAPS than do the higher-TOG solvent-based products.

Table 9-11

SUMMARY OF SPECIATION DATA FOR OEM COATINGS

Coating Category	Base	No. of Coatings	Top Three Constituents of TOG	CAS Number	Total Identified TOG as Percent of Product Mass	Weight Percent of HAPs
Marine	Solvent	2	Mineral Spirits	8052-41-3	8.0	0.0
			Ethyl Methyl Ketone Oxime	96-29-7		
			2-Ethylhexanoic Acid	149-57-5		
Can and Coil	Solvent	8	n-Butanol	71-36-3	2.9	0.1
			Ethyl 3-Ethoxypropionate	763-69-9		
			Xylenes	1330-20-7		
	Water	15	Ethylene Glycol Monobutyl Ether	111-76-2	12.0	7.1
			Ethylene Glycol Monopropyl Ether	2807-30-9		
			Ethyl Alcohol	64-17-5		
Wood	Solvent	27	Acetone	67-64-1	72.6	14.1
			VM & P Naphtha	64742-89-8		
			Toluene	108-88-3		
	Water	6	Ethylene Glycol Monobutyl Ether	111-76-2	6.4	3.9
			N-N-Dimethylethanolamine	108-01-0		
			Diethylene Glycol Monobutyl Ether	112-34-5		
Metal	Solvent	32	Acetone	67-64-1	26.2	3.5
			n-Butyl Acetate	123-86-4		
			VM & P Naphtha	64742-89-8		
	Water	17	n-Butanol	71-36-3	3.7	0.4
			N-N-Dimethylethanolamine	108-01-0		
			2-Propanol	67-63-0		
Metal Furniture	Water	3	Ethylene Glycol Monobutyl Ether	111-76-2	8.0	7.4
			Trimethyl-1,3-Pentanediol Monoisobutyrate,2,2,4-	25265-77-4		
			Diethylene Glycol Monobutyl Ether	112-34-5		
Other	Solvent	25	Styrene	100-42-5	43.3	28.2
			Methyl Ethyl Ketone (2-Butanone)	78-93-3		
			Ethyl Acetate	141-78-6		
	Water	10	Ethylene Glycol Monobutyl Ether	111-76-2	7.9	5.3
			Propylene Glycol	57-55-6		
			Diethylene Glycol Monobutyl Ether	112-34-5		

9.2 SPECIATION PROFILES FOR SOLVENTS ASSOCIATED WITH OEM COATINGS

Given the relatively small number of responses to the OEM coating user survey, data were insufficient for characterizing different categories of thinning and cleanup solvent. Instead, we developed a composite speciation profile for all solvent materials combined.[39] As seen in Table 9-12, acetone comprises about 58 percent of the solvents used. The next most common species is methyl isobutyl ketone (MIBK).[40] Other important species are methyl ethyl ketone (MEK), xylenes, and toluene. HAPs comprise about 40 percent of the mass of the solvents.

[39] The calculation includes solvents used in all surveyed SIC codes, not just the three selected two-digit SIC codes.

[40] All of the MIBK was reported by a single survey respondent.

Table 9-12

COMPOSITE SPECIATION PROFILE FOR THINNERS AND CLEANUP SOLVENTS USED WITH OEM COATINGS

CAS No.	Description	HAP	Mean Weight Percent of Coating
67-64-1	Acetone		57.91
108-10-1	Methyl Isobutyl Ketone	✓	28.88
78-93-3	Methyl Ethyl Ketone	✓	7.11
1330-20-7	Xylenes	✓	2.09
108-88-3	Toluene	✓	1.49
64742-89-8	Light Aliphatic Petroleum Solvent Naphtha		0.70
67-63-0	Isopropyl Alcohol		0.66
64742-88-7	Medium Aliphatic Petroleum Solvent Naphtha		0.36
123-86-4	n-Butyl Acetate		0.29
108-21-4	Isopropyl Acetate		0.15
110-19-0	Isobutyl Acetate		0.10
64-17-5	Ethanol		0.07
67-56-1	Methanol	✓	0.07
111-76-2	Ethylene Glycol Monobutyl Ether	✓	0.05
141-78-6	Ethyl Acetate		0.02
108-65-6	Propylene Glycol Monomethyl Ether Acetate		0.02
763-69-9	Ethyl β-Ethoxypropionate		0.02
100-41-4	Ethyl Benzene	✓	0.01
112-07-2	Ethylene Glycol Monobutyl Ether Acetate	✓	0.01
108-94-1	Cyclohexanone		0.001
85-68-7	Benzyl Butyl Phthalate		0.001
64742-94-5	Heavy Aromatic Petroleum Solvent Naphtha		0.0001
95-63-6	1,3,5-Trimethylbenzene		0.0001
	TOG Accounted For		100.00

9.3 SPECIATION PROFILES FOR SOLVENTS AND ADDITIVES ASSOCIATED WITH ARCHITECTURAL COATINGS

9.3.1 Mineral Spirits

Table 9-13 shows the mean weight percentages of the chemical species comprising the mineral spirits reported by the commercial painters survey respondents. Compounds are listed in decreasing order of weight percent. HAPs, which are identified with check marks, comprise about 0.0001 percent by weight of the mineral spirits. The total weight percent of the identified species does not equal 100 because material safety data sheets for some formulations did not list all the constituents.

Table 9-13

SPECIATION OF MINERAL SPIRITS USED BY COMMERCIAL PAINTERS

CAS No.	Description	HAP	Mean Weight Percent
64741-41-9	Petroleum Naphtha, Heavy Straight Run		36.32
8052-41-3	Stoddard Solvent		22.87
64742-88-7	Medium Aliphatic Petroleum Solvent Naphtha		20.44
64742-47-8	Petroleum Distillates, Hydrotreated Light		12.77
8030-30-6	Naphtha		5.00
8002-05-9	Aliphatic Petroleum Naphtha		0.98
95-63-6	Trimethylbenzene, 1,2,4-		0.60
25551-13-7	Trimethylbenzene (Mixed Isomers)		0.37
64742-95-6	Light Aromatic Petroleum Solvent Naphtha		0.27
108-67-8	Trimethylbenzene, 1,3,5-		0.15
25550-14-5	Ethyltoluene (All Isomers)		0.01
108-88-3	Toluene	✓	0.0001
	TOG Accounted For		99.79

9.3.2 Lacquer Thinner

Table 9-14 shows the mean weight percentages of species comprising the lacquer thinners reported in the survey of commercial painters. As in the case of mineral spirits, the total weight percent of the identified species does not equal 100 because material safety data sheets for some formulations did not list all the constituents. HAPs comprise 34.6 percent by weight of lacquer thinner.

Table 9-14

SPECIATION OF LACQUER THINNERS USED BY COMMERCIAL PAINTERS

CAS No.	Description	HAP	Mean Weight Percent
64742-89-8	Medium Aliphatic Petroleum Solvent Naphtha		22.82
108-88-3	Toluene	✓	20.33
67-64-1	Acetone		19.39
78-93-3	Methyl Ethyl Ketone	✓	6.08
67-56-1	Methanol	✓	3.68
67-63-0	Isopropyl Alcohol		3.39
110-19-0	Isobutyl Acetate		3.32
1330-20-7	Xylenes	✓	2.44
111-76-2	Ethylene Glycol Monobutyl Ether	✓	1.52
141-78-6	Ethyl Acetate		0.86
8030-30-6	Naphtha		0.86
108-65-6	Propylene Glycol Monomethyl Ether Acetate		0.76
123-86-4	Butyl Acetate, n-		0.70
8032-32-4	VM & P Naphtha		0.67
142-82-5	Heptane, n-		0.58
64-17-5	Ethanol		0.53
71-36-3	Butanol, n-		0.52
108-87-2	Methylcyclohexane		0.28
100-41-4	Ethyl Benzene	✓	0.27
108-10-1	Methyl Isobutyl Ketone (MIBK, Hexone)	✓	0.26
110-43-0	Methyl (n-Amyl) Ketone		0.17
110-82-7	Cyclohexane		0.07
112-07-2	Ethylene Glycol Monobutyl Ether Acetate	✓	0.01
	TOG Accounted For		89.50

9.3.3 Water-Based Paint Additives

We did not develop speciation profiles for water-based paint additives because we could obtain no composition data for one formulation that constituted 96.5 percent of the additive use.

10.0

IDENTIFICATION AND APPLICATION OF SPATIAL SURROGATES

10.1 INTRODUCTION

The objective of this task was to develop a set of surrogates for allocating county-wide emissions to geographic subdivisions of specific counties, including 2-kilometer (2-km) grid squares. Surrogates are quantities, other than emissions, whose spatial distribution may be related accurately to the spatial distribution of emissions. Because our emissions data were most robust for solvents associated with architectural and industrial maintenance (AIM) coatings, we limited our spatial surrogates investigation to that emission source.

10.2 DESIGNATION OF SURROGATES

In this study, emissions from use of solvents by commercial painters have been allocated from the State to counties in proportion to each county's estimated number of painters. Unfortunately, commercial painter population data are available only down to the county level.[41] Following an approach described by Rocke and Chang (1998), we hypothesized that general population would be a surrogate for the number of painters. To investigate this, we performed a linear regression analysis using data from the 2000 U.S. Census for county populations and the Employment Development Department's 2001 survey values for numbers of painters (EDD, 2003).[42] Figure 10-1 shows the data points and the best-fit linear regression line. The regression formula is, with P in 1000s of persons and N in numbers of painters:

$$N = 1.832104\,P + 2.286505 \quad (r^2 = 0.986) \qquad [10\text{-}1]$$

It therefore appears justified to use general population as a surrogate for the numbers of painters, for spatial allocation purposes.

For emissions from use of solvents by homeowners who do their own painting, the surrogate variable is the number of owner-occupied houses per grid cell.

10.3 DATA SOURCE AND SOFTWARE

10.3.1 Data Source

After reviewing sources of painter and housing unit data against the criteria presented in Section 2.9, Chambers Group, Inc. (CGI) determined that U.S. Census Bureau (USCB) 2000 Census data be used for both surrogates. These data are accurate down to or below the level of reference for the surrogates identified. The advantages for utilizing these data are:

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[41] For some counties, painter population estimates are available only for multi-county "consortiums."

[42] See Section 2.6.1 for the method used to estimate county painter populations.

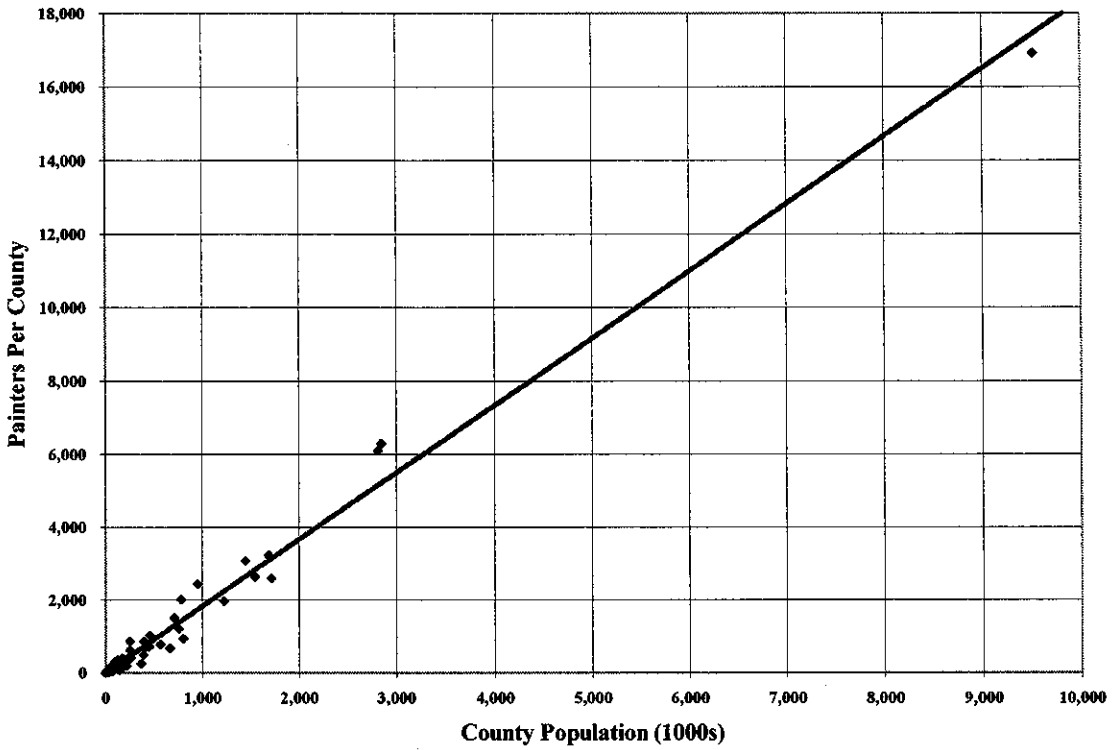

Figure 10-1. Data and Regression Line for Commercial Painters Vs. General Population.

- Census data are available in geographic information system (GIS) format on the Internet from numerous sources at no charge;
- Census data meet or exceed resolution requirements; and
- Data are complete for the entire State of California, and are consistent in nature across county boundaries.

The data are quite reputable and accurate, and are utilized as the standard demographic data set for many applications. The data are not as recent as could be desired. However, the USCB 2000 data are the most available that are also complete and accurate and can be updated as census data are updated.

10.3.2 Software

To allocate emissions to the sub-county level, it is very useful to utilize a GIS to display the geographical distribution of the values of the surrogate, such as the population density. A GIS facilitates the display and analysis of data from relational databases. These data may then be analyzed and displayed in layers; that is data may be overlaid by other categories of similar data. Thus information may be visually analyzed on a geographic

basis when the data are geo-referenced and overlaid within the same geographic coordinate system.

CGI recommends that ESRI GIS software be used for the spatial surrogate data analysis and display. ESRI has led development and set standards for data transfer and formatting that are imbedded in the software of most of its competitors. The USCB 2000 Census data are available online in its native TIGER format and its exported ESRI Shape File format. Since TIGER is proprietary software used only by USCB, the ESRI shape files are the preferred format and are the most commonly downloaded. Additionally, there is no doubt that ESRI's software will be able to handle large datasets such as the USCB 2000 data for the state of California. The tools necessary to divide the surrogates amongst the 2 x 2 km grid and to build the 2 x 2 km grid itself are all inherent within ESRI software.

10.4 IMPLEMENTATION

This discussion focuses on population as a surrogate for commercial painters, although it also applies to owner-occupied housing.[43] The following steps should be used to perform the spatial allocation to a 2-km grid.

1. Obtain county populations at the census block level from the U.S. Census Bureau.

2. Divide the number of commercial painters by the population of the county. This gives "painters per person" for the county.

3. Multiply the "painters per person" value for each county by the population of each block in the county and record that number in a new database field called Painters; the units of the calculated value are "painters per block." The value of painters per block will, in general, be different for each block.

4. For each individual Block, divide the number in the Painters field by the area of the block (in square kilometers) to obtain the number of commercial painters per km^2 in each block. Record that number in its own database field called Factor.

5. Now use the ESRI Union command to join the linework of the Grid and the USCB Blocks to create one coverage.[44] The result should be a merger of grid cells into the county block environment creating many small pieces all with a Factor field that is derived from the block that the piece originated from. In some cases, parts of several different blocks will be in a given grid cell; in others, more than one grid cell will be in a block. Figure 10-2 illustrates a hypothetical union, in which areas "1," "2," and "3" are allocated to grid cells "A," "B," "C," and "D."

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[43] In addition, the analysis must be performed separately for each class of commercial painters identified in this study, i.e. employed and self-employed painters.

[44] CGI recommends performing this in ESRI's Workstation interface. The Union command is much more reliable in this setting than it has been in the GUI environment.

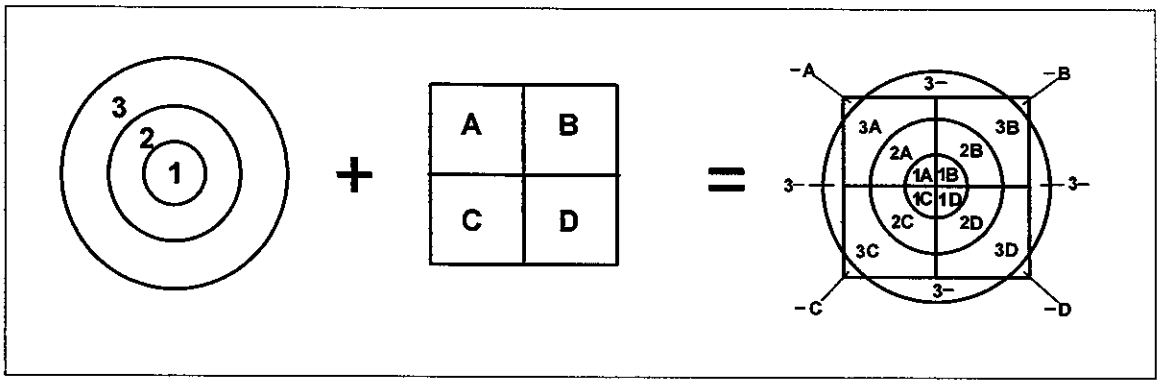

Figure 10-2. Example of Union of Blocks and Grid Cells.

6. Create topology and derive the areas of the new polygons.[45] (The polygons are pieces of blocks within a given grid cell.) The new polygons in the example of Figure 10-2 are "3A," "3C," etc.

7. Multiplying the area of each piece, complete and partial, within the block boundary by its Factor, giving the number of painters in each polygon within the grid cell. Record that result in a new database field named TotalPainters. Reconstitute the grid by adding the pieces of each cell together and dissolving out the Block boundaries to get SumTotalPainters per cell.

A similar process for should be used to allocate owner-occupied households to grid cells. However, it is not necessary to derive an intermediate ratio (e.g., painters per person) from external data. The number of owner-occupied households in each block can be obtained directly from the 2000 Census. Therefore Steps 1-3 above can be skipped.

[45] CGI recommends using the Build command for this unless one is highly skilled and knowledgeable about tolerances in the workstation environment.

11.0

UPDATING METHODOLOGY

Because the quantity and quality of the data for the commercial painters survey were the best, we limited our efforts in developing updating methodologies to that source category. The objective of the updating methodology is to project future solvent use (and associated emissions) from the base year (2001) to the future. To avoid having to perform additional surveys of commercial painters, we will use a "surrogate" measure as a predictor. A surrogate variable is one which can be related to solvent use and/or emissions, and whose values are readily available. For this case, we have chosen the number of painters in each county as the surrogate measure, since (1) in this study we have allocated statewide emissions to counties in proportion to the painter populations and (2) the required painter employment data are available.

For our state-to-county allocations, we used the sum of the numbers of painters employed by others and the number that were self-employed. Forecast data are available only for the employed painters. However, we believe that the number of employed painters is nevertheless a good surrogate for painting activity.

As discussed in Section 2.6.1.2, the California Employment Development Department (EDD) periodically surveys and projects the number of people in various occupations. Using surveys of employers, the EDD estimates employment for a base year and then forecasts future employment on the basis of growth and technology (EDD, 2003a, 2003b). For painters, the EDD has published survey data for 2001 and forecast data for 2008. We used the following method to calculate the projected employment in the intervening years.

Let P_{01} and P_y be the number of painters in a given geographical area in 2001 and in year y, respectively. Let us define a growth factor as follows:

$$GF_y = P_y/P_{01} \qquad [11\text{-}1]$$

From the EDD data, we know P_{01} and P_{08}, which are the number of painters in a given county in 2001 and 2008, respectively. Let r be the annual growth rate, as a fraction. Then

$$P_{08} = P_{01}(1 + r)^7 \qquad [11\text{-}2]$$

Solving for r,

$$r = (P_{08}/P_{01})^{1/7} - 1 \qquad [11\text{-}3]$$

For example, for Fresno County, $P_{01} = 720$ and $P_{08} = 820$. Then:

$$r = (820/720)^{1/7} - 1$$

$$= 1.01875 - 1$$

$$= 0.01875$$

In general, for a year y,

$$GF_y = (1 + r)^{(y-2001)} \quad [11\text{-}4]$$

Continuing with the example of Fresno County, in 2006, the growth factor would be:

$$GF_{06} = (1.01875)^{(2006-2001)}$$

$$= 1.0973$$

Table 11-1 shows the growth rates and growth factors from 2002 to 2010, as calculated from the same EDD database used to estimate the number of employed painters. The annual growth rates range from a loss of 0.43 percent per year (for San Mateo County) to a gain of 5.7 percent per year (for San Bernardino County).

Table 11-1

GROWTH FACTORS FOR USE OF SOLVENTS BY COMMERCIAL PAINTERS, 2002 - 2010

(Part 1 of 2)

County	Annual Growth	Growth Factor (2001 = 1.000)								
		2002	2003	2004	2005	2006	2007	2008	2009	2010
Alameda	0.02340	1.023	1.047	1.072	1.097	1.123	1.149	1.176	1.203	1.231
Alpine	0.03132	1.031	1.064	1.097	1.131	1.167	1.203	1.241	1.280	1.320
Amador	0.03819	1.038	1.078	1.119	1.162	1.206	1.252	1.300	1.350	1.401
Butte	0.02227	1.022	1.045	1.068	1.092	1.116	1.141	1.167	1.193	1.219
Calaveras	0.03819	1.038	1.078	1.119	1.162	1.206	1.252	1.300	1.350	1.401
Colusa	0.03065	1.031	1.062	1.095	1.128	1.163	1.199	1.235	1.273	1.312
Contra Costa	0.02992	1.030	1.061	1.092	1.125	1.159	1.193	1.229	1.266	1.304
Del Norte	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
El Dorado	0.03132	1.031	1.064	1.097	1.131	1.167	1.203	1.241	1.280	1.320
Fresno	0.01875	1.019	1.038	1.057	1.077	1.097	1.118	1.139	1.160	1.182
Glenn	0.03065	1.031	1.062	1.095	1.128	1.163	1.199	1.235	1.273	1.312
Humboldt	0.01371	1.014	1.028	1.042	1.056	1.070	1.085	1.100	1.115	1.130
Imperial	0.02639	1.026	1.053	1.081	1.110	1.139	1.169	1.200	1.232	1.264
Inyo	0.01926	1.019	1.039	1.059	1.079	1.100	1.121	1.143	1.165	1.187
Kern	0.03032	1.030	1.062	1.094	1.127	1.161	1.196	1.233	1.270	1.308
Kings	0.01517	1.015	1.031	1.046	1.062	1.078	1.095	1.111	1.128	1.145
Lake	0.03065	1.031	1.062	1.095	1.128	1.163	1.199	1.235	1.273	1.312
Lassen	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Los Angeles	0.02053	1.021	1.041	1.063	1.085	1.107	1.130	1.153	1.176	1.201
Madera	0.01926	1.019	1.039	1.059	1.079	1.100	1.121	1.143	1.165	1.187
Marin	0.01589	1.016	1.032	1.048	1.065	1.082	1.099	1.117	1.134	1.152
Mariposa	0.03819	1.038	1.078	1.119	1.162	1.206	1.252	1.300	1.350	1.401
Mendocino	0.01926	1.019	1.039	1.059	1.079	1.100	1.121	1.143	1.165	1.187
Merced	0.03907	1.039	1.080	1.122	1.166	1.211	1.259	1.308	1.359	1.412
Modoc	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Mono	0.01926	1.019	1.039	1.059	1.079	1.100	1.121	1.143	1.165	1.187
Monterey	0.01843	1.018	1.037	1.056	1.076	1.096	1.116	1.136	1.157	1.179
Napa	0.02740	1.027	1.056	1.084	1.114	1.145	1.176	1.208	1.241	1.275
Nevada	0.03132	1.031	1.064	1.097	1.131	1.167	1.203	1.241	1.280	1.320

Table 11-1

GROWTH FACTORS FOR USE OF SOLVENTS BY COMMERCIAL PAINTERS, 2002 - 2010

(Part 2 of 2)

County	Annual Growth	Growth Factor (2001 = 1.000)								
		2002	2003	2004	2005	2006	2007	2008	2009	2010
Orange	0.02276	1.023	1.046	1.070	1.094	1.119	1.145	1.171	1.197	1.225
Placer	0.03132	1.031	1.064	1.097	1.131	1.167	1.203	1.241	1.280	1.320
Plumas	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Riverside	0.05705	1.057	1.117	1.181	1.248	1.320	1.395	1.475	1.559	1.648
Sacramento	0.02858	1.029	1.058	1.088	1.119	1.151	1.184	1.218	1.253	1.289
San Benito	0.02065	1.021	1.042	1.063	1.085	1.108	1.130	1.154	1.178	1.202
San Bernardino	0.04609	1.046	1.094	1.145	1.197	1.253	1.310	1.371	1.434	1.500
San Diego	0.02168	1.022	1.044	1.066	1.090	1.113	1.137	1.162	1.187	1.213
San Francisco	0.01767	1.018	1.036	1.054	1.073	1.092	1.111	1.130	1.150	1.171
San Joaquin	0.03819	1.038	1.078	1.119	1.162	1.206	1.252	1.300	1.350	1.401
San Luis Obispo	0.02711	1.027	1.055	1.084	1.113	1.143	1.174	1.206	1.239	1.272
San Mateo	-0.00426	0.996	0.992	0.987	0.983	0.979	0.975	0.971	0.966	0.962
Santa Barbara	0.01854	1.019	1.037	1.057	1.076	1.096	1.117	1.137	1.158	1.180
Santa Clara	0.00983	1.010	1.020	1.030	1.040	1.050	1.060	1.071	1.081	1.092
Santa Cruz	0.01308	1.013	1.026	1.040	1.053	1.067	1.081	1.095	1.110	1.124
Shasta	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sierra	0.03132	1.031	1.064	1.097	1.131	1.167	1.203	1.241	1.280	1.320
Siskiyou	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Solano	0.01648	1.016	1.033	1.050	1.068	1.085	1.103	1.121	1.140	1.158
Sonoma	0.02889	1.029	1.059	1.089	1.121	1.153	1.186	1.221	1.256	1.292
Stanislaus	0.02639	1.026	1.053	1.081	1.110	1.139	1.169	1.200	1.232	1.264
Sutter	0.03065	1.031	1.062	1.095	1.128	1.163	1.199	1.235	1.273	1.312
Tehama	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Trinity	0.00000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Tulare	0.01926	1.019	1.039	1.059	1.079	1.100	1.121	1.143	1.165	1.187
Tuolumne	0.03819	1.038	1.078	1.119	1.162	1.206	1.252	1.300	1.350	1.401
Ventura	0.02227	1.022	1.045	1.068	1.092	1.116	1.141	1.167	1.193	1.219
Yolo	0.02415	1.024	1.049	1.074	1.100	1.127	1.154	1.182	1.210	1.240
Yuba	0.03065	1.031	1.062	1.095	1.128	1.163	1.199	1.235	1.273	1.312

12.0

DISCUSSION

12.1 SURVEY ISSUES

The four main surveys in this project—OEM coating manufacturers, OEM coating users, commercial painters, and households—were not as successful as we had anticipated. Although we used methods that had proven fruitful many times in the past, the response rates were low enough to limit our use of the data obtained.

The survey of OEM coating manufacturers was the most problematic part of this project. Coming on the heels of very successful architectural coating manufacturer surveys by the Air Resources Board, we expected to obtain much useful information, and to be able to account for the majority of OEM coating sales to California. Yet we received responses from only 24 firms, whose sales to the state were a small fraction of our estimated total. One problem, we believe, is that our survey was not conducted by a governmental agency. Even when a survey is not mandatory, it is in the regulated entity's self interest to remain in the good graces of the regulator, so that a response is more likely.

Another problem with the OEM coating manufacturer's survey was that it asked for a large amount of technical information that was either not readily at hand or was proprietary. Smaller firms did not have the personnel or time to commit to obtaining and reporting the data for us.

An even more serious problem with this survey was that it probably never was likely to achieve the project's objectives, even if the response rate had been much better. There are so many pathways from manufacturer to end user, that we would likely have missed many of them. Manufacturers may have no idea of how much of their products reach California, especially if they are sold to distributors in other states. If one wants to know how much OEM coating is used in the State, it would be better to get the information at the point of use.

The survey of OEM coating users was also not very successful. One interesting finding was the high percentage of facilities that reported that they did not use coatings. Our survey plan did not anticipate that many OEM manufacturers send their products out to job shops, such as powder coaters or metal finishing shops, where the coatings are actually applied.

In contrast, the surveys of commercial painters and homeowners provided much useful information. We had planned all along to conduct a telephone survey of the homeowners, and did so, but we also ended up receiving a majority of our commercial painter responses on the phone. The information that the painters provided was more likely than not to be a quick estimate which, in principle, is not as good as information derived from a review of records. On the other hand, we doubt that many of the respondents would

have taken the time to review their records for the sake of our survey; indeed that is why we placed follow-up calls to them.

Most of the respondents to the commercial painters survey were small firms, often with only one painter. Through other work, we are aware that there are several very large painting firms, with hundreds of employees, in the State, yet we did not receive responses from them. Some of them were not even in the purportedly comprehensive database maintained by our mailing list supplier. The effect of "missing" these large companies is not known.

Although it is not discussed in this report, we originally attempted to develop solvent use factors based upon the number of painters (i.e. "gallons per painter"). When we calculated these factors and multiplied them by the estimated number of painters in the state, we obtained values that were unrealistically low. The reason for this outcome is unknown.

12.2 OUNCES SOLVENT PER GALLON OF COATING

Development of new and more application-specific ratios of solvent use to coating use was one of the successes of this project, although in the end we were unable to confirm or invalidate the assumption that one pint of thinning and cleaning solvent is used per gallon of *solvent-based* architectural coating. Our new use ratios (thinner per gallon of solvent-based coating, additive per gallon of water-based coating, and cleanup solvent per gallon of solvent- and water-based coating combined) can be applied to many different situations, whereas the previous assumption applied only to use of solvent-based coatings.

The 90-percent confidence interval about our solvent/coating ratio for cleanup solvents is quite low (about ± 5 percent). The ratios for thinning solvents and water-based coating additives are quite a bit higher (± 28 percent and ± 59 percent, respectively). For the additives, the large uncertainty is partly a consequence of the fact that relatively few commercial painters use VOC-containing additives; these additives were applied to only about 7 percent of the reported water-based coating volume. Furthermore, the application rate varied over three orders of magnitude.

13.0

SUMMARY AND CONCLUSIONS

13.1 OBJECTIVES AND METHODS

The objectives of this study were to:

(1) Determine the amounts of original equipment manufacturing (OEM) coatings, thinning solvents and cleanup solvents associated with OEM coatings, used in California, by county, during 2001;

(2) Determine the amounts of thinning solvents and cleanup solvents associated with architectural and industrial maintenance (AIM) coatings, used in California, by county, during 2001;

(3) Verify, or obtain a new value for, the ARB's assumption that one pint of thinning and cleanup solvents are used per gallon of *solvent-based* AIM coating;

(4) Develop composite emission factors and speciation profiles for various categories of materials;

(5) Develop temporal profiles for the use of OEM coatings, thinning solvents and cleanup solvents;

(6) Construct 2001 emission inventories for the state, counties, air basins, and air pollution control districts for OEM coatings, thinning solvents and cleanup solvents;

(7) Obtain data on the influence of ambient temperature and precipitation on the pattern of coatings and solvents application;

(8) Develop spatial surrogates for the areas of the State where most emissions from these materials are likely to occur; and

(9) Specify sources of information for annual updates for activity factors

To accomplish these objectives, we conducted separate surveys of OEM coating manufacturers, OEM coating users, commercial painters, and homeowners. For each survey, we obtained a mailing list, designed questionnaires and/or telephone scripts, conducted a "pilot survey" to test survey instruments and methods, and then conducted a full survey. A Microsoft® Access database was used to track survey responses, store reported data, and extract information for calculations. In addition, we explored data sources and techniques for allocating county-level data to smaller geographic units, including 2 km x 2

km grid squares. Finally, we obtained information for projecting survey results to future years.

13.2 RESULTS OVERVIEW

Our research succeeded in accomplishing most, but not all, of the objectives. The response to the survey of OEM coating manufacturers was insufficient to account for all but a small fraction of the total OEM coating use in the State; however, we developed an estimate by other means. The response to the OEM coating users survey was good only for three two-digit Standard Industrial Classification (SIC) codes. In contrast, the response to the surveys of commercial painters and homeowners was excellent, and we obtained much useful information on the volumes and composition of the thinning and cleanup solvents and additives associated with AIM coatings. We also were able to develop use ratios (in ounces per gallon of coating) for thinners associated with solvent-based AIM coatings, cleanup solvents associated with solvent- and water-based AIM coatings, and additives to water-based AIM coatings. We also developed new emission factors for several categories of OEM coatings and for many types of solvents. Speciation profiles were developed for OEM coatings, mineral spirits, and lacquer thinner. Excellent data on temporal patterns and response to weather extremes were obtained from the OEM coating users, commercial painters, and homeowners. We identified and outlined a procedure for allocating AIM emissions from counties to grid squares, and developed factors for forecasting AIM coating and solvent emissions. Detailed results of the investigation are as follows.

13.3 RESULTS OF THE INVESTIGATION OF OEM COATINGS

(1) Written questionnaires were sent to 729 presumed manufacturers of OEM coatings, and later to another 24 who were known to sell OEM coatings to California users.

(2) We received detailed coating data from 24 coating manufacturers.

(3) Survey respondents reported sales of 2.58 million gallons of coatings in 162 coating products. The best response was for metal parts and products coatings, for which we received information on 56 products having 1.40 million gallons of sales.

(4) Annual California sales volumes per coating manufacturer for half the products were less than 1,000 gallons per year; volumes for about 77 percent of the products were less than 5,000 gallons per year.

(5) Our survey appears to have sampled relatively small suppliers serving niche markets.

(6) Table 13-1 shows the sales volume-weighted average TOG, ROG and regulatory VOC content of the coatings, according to our survey data.

Table 13-1

SALES VOLUME-WEIGHTED TOG, ROG AND REGULATORY VOC CONTENT OF REPORTED OEM COATINGS, BY COATING CATEGORY

Type of Coating	Coating Base	No. of Coatings	Pounds Per Gallon		
			TOG	ROG	Regulatory VOC
Marine	Solvent	3	0.93	0.93	2.82
Metal Furniture and Fixtures	Water	3	0.83	0.83	1.91
Can and Coil	Solvent	9	2.91	2.91	2.91
	Water	15	1.11	1.11	1.84
Metal Parts and Products	Solvent	37	2.71	2.35	2.52
	Water	20	0.91	0.89	2.31
Wood Furniture and Fixtures	Solvent	26	5.53	2.84	4.47
	Water	6	0.73	0.73	1.78
Other	Solvent	27	2.65	2.65	2.96
	Water	14	0.88	0.88	1.99

(7) Because the OEM coating manufacturers survey response was poor, we also estimated California OEM coating use by apportioning results of a 2001 U.S. Census survey to the state; the surrogate variables for apportionment were the number of establishments and number of employees in the North American Industrial Classification System (NAICS) codes for industries in which OEM coatings are likely to be used.

(8) If one uses employment as the basis for apportionment, then California's share is 10.0 percent of the U.S. value, or 34.2 million gallons per year. If one uses number of establishments, then California's share is 12.5 percent, or about 42.7 million gallons. The means of these values are 11.2 percent and 38.4 million gallons.

13.4 RESULTS OF THE SURVEY OF OEM COATING USERS

(1) Questionnaires were mailed or faxed to 5,038 manufacturing facilities in standard industrial classification (SIC) codes believed *a priori* to use OEM coatings.

(2) After subtracting facilities that were out of business and were not manufacturing plants, the potential sample size was 4,197; of these 732 replied that they were manufacturers but did not use OEM coatings and 66 responded with the requested data.

(3) Sufficient data for analysis of the parameters of interest were received from only three two-digit SIC codes: SIC 34 (Fabricated Metal Products), SIC 35 (Industrial and Commercial Machinery and Computer Equipment), and SIC 37 (Transportation Equipment); these accounted for 43 data responses, and will be referred to as "the selected sample."

(4) Respondents in all the surveyed SIC codes reported use of about 1.175 million gallons of coatings, or about 3 percent of our estimate of total OEM coating use in the state.

(5) For all the SIC codes in the survey, about 14 percent of the reported coating use was of solvent-based coatings; for individual manufacturing facilities, the percentage of solvent-based coatings used was 0 to 100, with a mean of 64.

(6) For the selected sample, acetone comprised about 95 percent of the thinning solvent use and 84 percent of the cleanup solvent use. Other solvent types reported included mineral spirits, lacquer thinner, denatured alcohol, toluene, mixed xylenes, isopropyl alcohol, methyl ethyl ketone, and miscellaneous other formulations.

(7) The survey obtained detailed information on 21 different solvent formulations used for thinning and cleaning by OEM coating users. Table 13-2 shows mass-per-volume emission factors determined from the survey data.

(8) From the survey data, we calculated average use rates (ounces of solvent per gallon of coating) for thinning and cleanup solvents. These are shown in Table 13-3. We suspect that the value of 61 oz/gal for cleanup solvents in SIC 37 is an anomaly, due to the possible use of acetone in processes other than application of OEM coatings.

(9) By apportioning statewide OEM coating use to the selected sample on the basis of employment or number of firms in NAICS codes corresponding to SIC 34, 35 and 37, we estimate that the three SIC codes of interest use about 18.1 million gallons of OEM coatings per year (solvent- and water-based combined).

(10) Using the apportioned OEM coating volumes and the oz/gal rates developed from survey data, we estimate that total solvent use in SICs 34 and 35 is 1,200,000 and 617,000 gallons per year, respectively. Given the doubt about the oz/gal rate for cleanup solvents, we believe that the calculated value of 4,400,000 for SIC 37 is an overestimate.

(11) For the selected sample, the annual pattern of activity is significantly higher (at the 90-percent confidence level) than uniform in April, May, June and August, and significantly lower in September through February. For all other SIC codes, activity is uniform throughout the year.

Table 13-2

SUMMARY OF EMISSION FACTORS FOR THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH OEM COATINGS

Material	Total Organic Gases (lb/gal)			Reactive Organic Gases (lb/gal)		
	Mean	90% Conf. Interval		Mean	90% Conf. Interval	
		Low	High		Low	High
Mineral Spirits	**6.51**	6.43	6.58	**6.51**	6.43	6.58
Lacquer Thinner	**6.66**	6.61	6.70	**5.49**	5.17	5.81
Denatured Alcohol	**6.67**	6.63	6.72	**6.67**	6.63	6.72
Acetone[a]	**6.6**	Not Applicable		**0**	Not Applicable	
Isopropyl Alcohol[b]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Methyl Ethyl Ketone[c]	**6.7**	Not Applicable		**6.7**	Not Applicable	
Methyl Isobutyl Ketone[d]	**6.6**	Not Applicable		**6.6**	Not Applicable	
Naphtha[b]	**7.3**	Not Applicable		**7.3**	Not Applicable	
Toluene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Xylene[b]	**7.2**	Not Applicable		**7.2**	Not Applicable	
Other	**6.18**	5.50	6.64	**3.16**	2.32	3.99

[a]Mean of values provided on six material safety data sheets (MSDS) for acetone.

[b]SCAQMD, 2003.

[c]Shell, 2001.

[d]Shell, 2002.

Table 13-3

SOLVENT USE RATES FOR OEM COATING USERS

Solvent Type	Coating Base	Ounces per Gallon		
		SIC 34	SIC 35	SIC 37
Thinner	Solvent Only	17.32	30.11	11.34
Cleanup	Solvent and Water	19.79[a]	15.16	60.94

[a]Does not include one facility that reported 1 million gallons of coating use and no solvent use.

(12) In the selected sample, painting is done Monday through Saturday; the Saturday percentage is 13 in the fall and winter and 24 in the spring and summer. No painting on Sunday was reported. None of the responding facilities outside the selected sample operate on weekends.

(13) In the selected sample, the main hours of activity are 6 a.m. to 6 p.m., in all seasons. The hour of maximum activity in spring, summer and fall is 10 a.m. to 11

a.m. In winter it is 1 p.m. to 2 p.m. In all seasons, there is a dip in activity during the hour from noon to 1 p.m., presumably for lunch

(14) Diurnal patterns for three SIC codes (24, 25 and 36) outside the selected samplewere very different; they have 5- or 9-hour workdays instead of 12-hour ones.[46]

(15) Unusually hot weather elicits different responses, by two-digit SIC code. For SIC 34, almost all facilities would paint as normal, while more than half the facilities in SICs 35 and 37 would respond by using more thinner or a different thinner. All the facilities outside the selected sample would paint as normal in hot weather.

(16) For unusually cold weather, facilities in SIC 34 would paint as they normally do. In SIC 35, the main reaction would be to use less thinner. In SIC 37 almost 20 percent would not paint at all. Most of the facilities outside the three selected SIC codes would paint as normal, and about 17 percent would paint later in the day.

(17) In inclement weather, over 70 percent of the facilities in SICs 34 and 35 would paint as normal; the next most-reported option would be not to paint at all. For SIC 37, only about 24 percent of the facilities would paint as normal; the largest response would be to use a different thinner. Outside the selected sample, all the responding facilities said that they would paint as normal.

. 13.5 RESULTS OF THE SURVEY OF COMMERCIAL PAINTERS

(1) Questionnaires were mailed or faxed to 2,055 commercial painting firms randomly selected from a list of all painting firms in the state.

(2) After subtracting facilities that were out of business or did not perform AIM coating services, the potential sample size was 1,655; of these 245 (15 percent) responded with the requested data.

(3) Although this was nominally a mail survey, about 61 percent of the data responses were obtain by follow-up telephone call.

(4) Because of different response rates from different air basins, the survey sample was not randomly distributed by basin; the highest response rates (percent of total painting firms) were for the more rural areas, and the lowest rate was for the South Coast and San Francisco Bay Area Air Basins.

(5) The number of painters per firm ranged from 1 to 100. About 30 percent of the responding firms had only one painter, and 64 percent had three or fewer.

[46] Diurnal activity data for all other SIC codes were insufficient for this analysis.

(6) The painters in our survey reported use of 784,000 gallons of coating, of which 70,034 gallons (8.9 percent) was solvent-based.

(7) The survey respondents reported use of 5,400 gallons of thinner and 16,000 gallons of cleanup solvent in association with solvent-based AIM coatings. Figures 13-1 and 13-2 show the breakdown of thinning and cleanup solvent by major product type. For both thinning and cleaning, mineral spirits and lacquer thinner account for over 85 percent of the total solvent volume.

(8) Commercial painters in the survey reported use of 3,200 gallons of cleanup solvents (mostly mineral spirits) and 4,100 gallons of latex paint additives in conjunction with their use of water-based coatings.

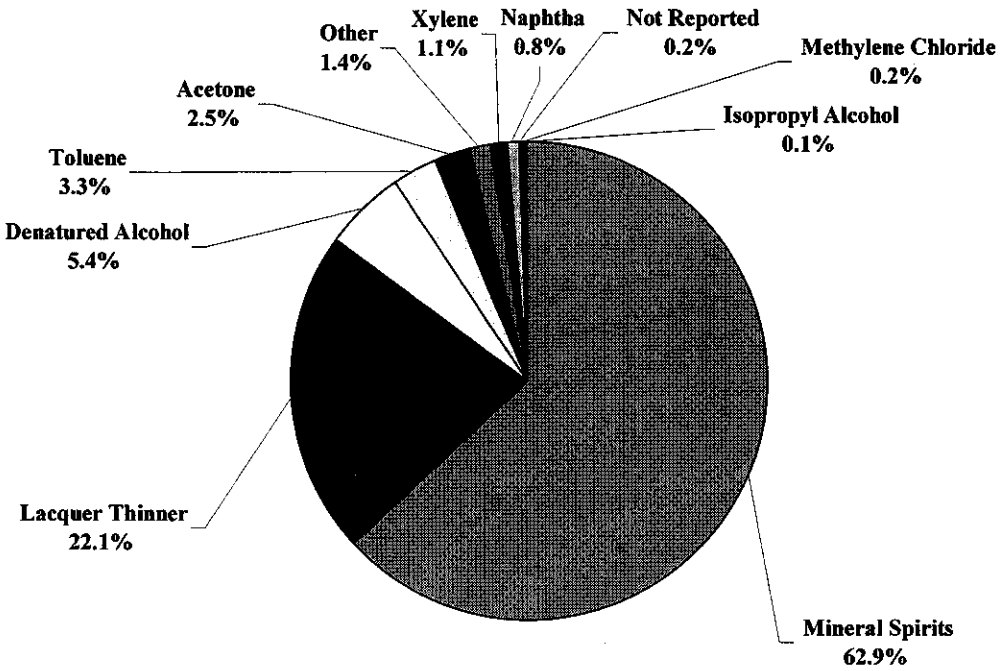

Figure 13-1. Distribution of Reported Thinning Solvent for Solvent-Based Coatings, by Major Product Type.

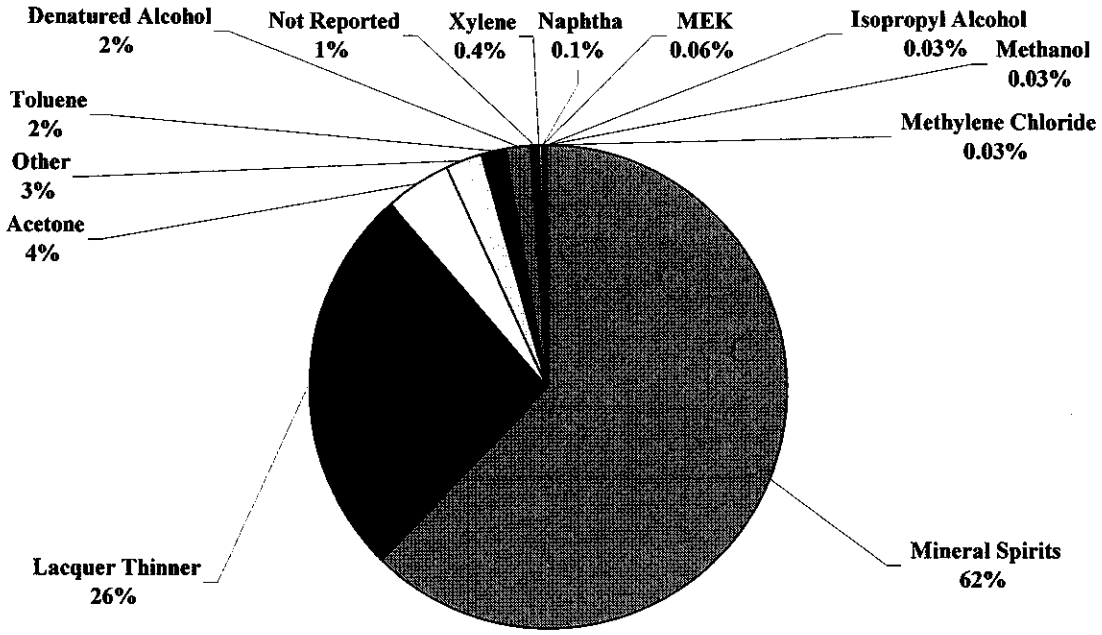

Figure 13-2. Distribution of Reported Cleanup Solvent for Solvent-Based Coatings, by Major Product Type.

(9) Table 13-4 shows the calculated use rates (in ounces per gallon) of solvent materials per gallon of solvent-based coating. The survey-derived value of ounces of thinning and cleanup solvent per gallon of solvent-based coating is 8.85, with a 90-percent confidence interval of [6.62, 11.30]. This is lower than the long-assumed rate of one pint (16 oz) per gallon, but it does not include cleanup solvents, whereas the one-pint-per-gallon assumption does.

(10) The use rate for cleanup solvent was calculated to be 3.15 ounces per gallon of solvent- and water-based coating combined, with a 90-percent confidence interval of [3.00, 3.30] oz/gal.

(11) The use rate for latex paint additives was calculated to be 0.776 ounces per gallon of water-based coatings, with a 90-percent confidence interval of [0.376, 1.23] oz/gal.

(12) Using estimates of statewide coating use derived from the ARB's 2001 architectural coatings survey, we estimate that commercial painters use between 2.45 and 3.5 million gallons per year of thinning and cleanup solvent and between 174,000 and 569,000 gallons per year of water-based coating additives. The breakdown by solvent type is shown in Table 13-5.

Table 13-4

OUNCES OF THINNING SOLVENT PER GALLON OF SOLVENT-BASED COATING

Use Category	Mean[a] (oz/gal)	90-Percent Confidence Interval Low (oz/gal)	High (oz/gal)
Mineral Spirits	4.36	3.83	4.92
Lacquer Thinner	2.96	2.24	3.73
Acetone	0.29	0.20	0.39
Denatured Alcohol	0.55	0.10	1.07
Isopropyl Alcohol	0.0093	0.0073	0.012
Methanol			
Methylene Chloride	0.0015	0.00	0.009
Naphtha	0.12	0.052	0.20
Toluene	0.33	0.20	0.47
Xylene	0.079	0.00	0.18
Other	0.136	0.00	0.27
Not Reported	0.020	0.00	0.05
Total	**8.85**	**6.62**	**11.30**

[a]Weighted by gallons of solvent-based coating per facility.

(13) Statewide solvent use estimates were allocated to counties and air basins in proportion to each geographic unit's fraction of the total number of painting firms in the state.

(14) From the survey responses, commercial painting activity in California is clearly seasonal. It is significantly (at the 90-percent confidence level) higher than uniform in April through October and low from November to March.

(15) In the Mountain Counties, North Coast and San Francisco Bay Area Air Basins, there is a significantly higher level of activity in summer than for the State as a whole.

(16) Painters reported working on all days of the week. However, about 94 percent of the commercial painting activity is during the week. Saturday and Sunday account for about 5 and 1 percent of the activity, respectively.

(17) Diurnal activity patterns are similar for all seasons, although the work day ends about an hour later in summer. In all seasons, the hour of maximum activity is 2 p.m. to 4 p.m. There is a slight dip in activity from noon to 1 p.m., presumably for a lunch break.

Table 13-5

TOTAL STATEWIDE SOLVENT USE BY COMMERCIAL PAINTERS, BY SOLVENT TYPE

(Gallons per Year)

Type of Material	Thinning and Cleanup			Water-Based Additives		
	Mean	90% Confidence Interval		Mean	90% Confidence Interval	
		Low	High		Low	High
Mineral Spirits	1,609,982	1,498,445	1,723,992			
Lacquer Thinner	784,645	683,619	891,184			
Acetone	101,332	87,632	115,678			
Denatured Alcohol	106,271	54,313	166,190			
Isopropyl Alcohol	1,875	1,610	2,172			
Methanol	422	403	442			
Methylene Chloride	1,428	1,208	2,327			
Naphtha	18,572	10,541	27,406			
Toluene	73,718	58,465	90,933			
Xylene	19,035	9,848	30,658			
Other	56,765	39,795	73,714	359,073	173,983	569,150
Not Reported	11,515	8,821	15,313			
Totals	2,785,560	2,454,700	3,140,008	359,073	173,983	569,150

(18) During unusually hot weather, more than 80 percent of the painting activity would be at "normal" levels in seven of the fifteen air basins. The major exceptions are the Great Basin Valleys, Mountain Counties and South Central Coast Air Basins, in which 21 to 65 percent of the responding painters would not paint in hot weather. The most common response to hot weather (other than not painting at all) would be to paint earlier or later in the day.

(19) Statewide, about a third of commercial painting activity would not take place on unusually cold days. In 11 of the 15 air basins, at least one quarter of the activity would cease. The most common responses to very cold weather (other than not painting at all) were painting later in the day or using a different thinner.

(20) Almost 60 percent of the painting activity, statewide, would stop in inclement weather. In three air basins (Lake County, San Diego and South Coast), more than half the painting activity would continue as normal. Very few painters reported that they would alter their painting activity other than not to paint; they would use less thinner, use a different thinner, or paint earlier or later in the day.

13.6 RESULTS OF THE HOMEOWNERS SURVEY

(1) We conducted a telephone survey of 3,889 randomly selected residences. Of these, 1,958 were contacted and were eligible for the survey. We obtained responses from 1,059 of these, including 609 households that provided detailed information.

(2) Of the 609 households that we interviewed in detail, 235 (39 percent) reported that they had used solvent-based paints in the past five years. It should be noted that all 609 households were asked about their temporal patterns of activity, i.e., whether or not they used solvent-based coatings.

(3) Responses were received from 45 counties and 14 air basins.[47] The sample's distribution by air basin closely matched the distribution of owner-occupied households for the same geographic area.

(4) The statewide average fraction of survey respondents who reported having painted (with either solvent- or water-based paint) in the previous five years was 0.60. For a given air basin, this fraction ranged from 0.43 to 1.

(5) Solvent types reported by homeowners who used solvent-based coatings included: mineral spirits, lacquer thinner, acetone, turpentine, naphtha, toluene, and miscellaneous.

(6) Households were asked what percentage of the solvents that they had purchased were used as thinners for solvent-based coatings. For naphtha, over 60 percent of the solvent was used for thinning. For the most heavily used solvents (mineral spirits and lacquer thinner), thinner use constituted no more than 20 percent of solvent use.

(7) Survey responses were used to develop solvent consumption rates, in gallons per five years per household, for each solvent type. These values ranged from 0.0007 for toluene to 0.0340 for lacquer thinner.

(8) Thinner and cleanup solvent use by households was estimated by multiplying the use rate for each solvent type by the number of owner-occupied households in California (6,546,344) and dividing by five.[48]

(9) Table 13-6 shows our estimates of thinner and cleanup solvent use, by solvent type, by households. About 126,000 gallons per year are used statewide.

(10) Statewide solvent consumption was allocated to counties and air basins in proportion to the number of owner-occupied households in each geographic unit.

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[47] No responses were received from the Lake Tahoe Air Basin.

[48] The use rate is in gallons per five years per household.

Table 13-6

USE OF THINNING AND CLEANUP SOLVENTS BY HOUSEHOLDS, BY TYPE OF SOLVENT

Solvent Type	Statewide Use as Thinner (Gallons/Year)	Statewide Use for Cleanup (Gallons/Year)	Total Statewide Use (Gallons/Year)
Mineral Spirits	6,801	26,580	33,381
Lacquer Thinner	7,396	37,112	44,508
Acetone	3,843	10,993	14,836
Turpentine	5,898	14,038	19,936
Naphtha	3,104	1,996	5,100
Toluene	88	839	927
Unidentified	974	6,599	7,572
Total	28,103	98,156	126,260

(11) About two thirds of the survey respondents said that they had painted only once in the past five years, and 95.5 percent had painted three or fewer times. The maximum reported frequency was 15 times.

(12) A 90-percent confidence interval for the number of times that households painted in five years is 1.52 to 1.65; put another way, the average homeowner paints his or her house every 3.0 to 3.3 years.

(13) For many air basins, and the state as a whole, significantly more painting takes place in the spring and summer than in the fall and winter.

(14) About 52 percent of the reporting households said that they painted only during the week. Another 28 percent said that they painted only on weekends, and the rest painted either on weekdays or weekends.

(15) For the state as a whole, about 92 percent of homeowner painting activity is from 6 a.m. to 6 p.m. More homeowners, on average, painted in the mornings than in the afternoon.

13.7 EMISSIONS

(1) In general, we multiplied volumes of coating and solvent use by emission factors expressed in pounds of TOG or ROG per gallon of material. *All the emission estimates reported here are for uncontrolled emissions.*

(2) We had sufficient data for estimating emissions from use of three categories of OEM coatings: wood furniture and fixtures, can and coil, and metal furniture. These emissions are summarized in Table 13-7. These estimates are about 1.4 to 3.9 times those reported for the same source categories in the ARB's 2003 Emission Inventory.

Table 13-7

STATEWIDE EMISSIONS FROM USE OF THREE TYPES OF OEM COATINGS

Type of OEM Coating	Emissions (Tons/Year)	
	TOG	ROG
Wood Furniture and Fixtures	11,768	6,269
Can and Coil	4,099	4,099
Metal Furniture	3,405	3,405

(3) We estimated emissions from use of thinning and cleanup solvents associated with architectural coatings, for both commercial painters and homeowners. Table 13-8 consolidates all the statewide emission estimates, by type of solvent.

(4) Use of thinning and cleanup solvents in association with AIM coatings results in uncontrolled TOG and ROG emissions of 9,540 and 8,620 tons per year, respectively. When latex paint additives are taken into account, these emissions become 9,705 and 8,790 tons per year, respectively. These values are higher than the latest ARB estimates of 6,672.5 and 6,527.1 tons/year, respectively.

(5) We were able to estimate TOG and ROG emissions from use of thinners and cleanup solvents used with OEM coatings only for SIC 34 (Fabricated Metal Products) and SIC 35 (Industrial and Commercial Machinery and Computer Equipment). Table 13-9 summarizes our estimates.

Table 13-8

STATEWIDE EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

(Part 1)

COMMERCIAL PAINTERS SURVEY				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Reported Thinning Ratio	Gallons Thinning Solvent per Gallon SB Coating	0.06918	
	Statewide Coating Volume	Gallons SB Coating	14,165,520	
	Statewide Solvent Volume	Gallons Thinning Solvent for SB Coatings	979,951	
	Weighted Average Emission Factor	Pounds per Gallon	6.5647	5.9276
	Statewide Emissions	Emissions From Thinning SB Coatings (Tons/Year)	**3,217**	**2,904**
ADDITIVES	Reported Additive Ratio	Gallons Additive per Gallon WB Coating	0.0060625	
	Statewide Coating Volume	Gallons WB Coating	59,228,573	
	Statewide Additive Volume	Gallons Additive for WB Coatings	359,073	
	Reported Additive Emission Factor	Pounds per Gallon	0.917	0.917
	Statewide Emissions	Emissions From Additives to WB Coatings (Tons/Year)	**165**	**165**
CLEANUP	Cleanup Ratio	Gallons Cleanup Solvent per (Gallons SB Coating + Gallons WB Coating)	0.02460	
	Statewide Coating Volume	Gallons SB Coating + Gallons WB Coating	73,394,093	
	Statewide Solvent Volume	Gallons Cleanup Solvent	1,805,609	
	Weighted Average Emission Factor	Pounds per Gallon	6.5384	5.9501
	Statewide Emissions	Emissions From Cleanup for SB and WB Coatings (Tons/ Year)	**5,903**	**5,372**

Table 13-8

STATEWIDE EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

(Part 2)

HOMEOWNER SURVEY				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Total Solvent Volume per Household	Gallons Solvent per Household per Year	0.019287	
	Statewide Number of Households	Number of Households	6,546,344	
	Statewide Total Solvent Volume	Gallons Solvent per Year	126,260	
	Thinner Fraction	Gallons Thinner/Gallons Total Solvent	0.22258	
	Statewide Volume of Thinner	Gallons Thinner per Year	28,103	
	Weighted Average Emission Factor	Pounds per Gallon	6.6633	5.4577
	Statewide Emissions	Emissions from Thinning SB Coatings by Households (Tons/Year)	**94**	**77**
CLEANUP	Total Solvent Volume per Household	Gallons Solvent per Household per Year	0.019287	
	Statewide Number of Households	Number of Households	6,546,344	
	Statewide Total Solvent Volume	Gallons Solvent per Year	126,260	
	Cleanup Fraction	Gallons Cleanup/Gallons Total Solvent	0.777417018	
	Statewide Volume of Cleanup Solvent	Gallons Cleanup Solvent per Year	98,156	
	Weighted Average Emission Factor	Pounds per Gallon	6.6633	5.4577
	Statewide Emissions	Emissions From Cleanup Solvent Use by Household (Tons/Year)	**327**	**268**

Table 13-8

STATEWIDE EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS ASSOCIATED WITH ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

(Part 3)

TOTAL STATEWIDE ARCHITECTURAL COATINGS				
Activity	Parameter	Units	Value	
			TOG	ROG
THINNING	Statewide Solvent Volume	Gallons Thinning Solvent for SB Coatings	1,106,211	
	Statewide Coating Volume	Gallons SB Coatings	16,906,211	
	Statewide Thinning Ratio	Gallons Thinning Solvent/ Gallons SB Coating	0.065432	
	Statewide Emissions	Emissions From Thinning of SB Coatings (Tons/Year)	**3,310**	**2,981**
ADDITIVES	Statewide Additive Volume	Gallons Additive for WB Coatings	359,073	
	Statewide Additive Ratio	Gallons Additive/Gallon WB Coating	0.0044032	
	Reported Additive Emission Factor	Pounds per Gallon	0.917	0.917
	Statewide Emissions	Emissions From Additives to WB Coatings (Tons/Year)	**165**	**165**
CLEANUP	Statewide Solvent Volume	Gallons Cleanup Solvent for SB and WB Coatings	1,903,766	
	Statewide Coating Volume	Gallons SB Coating + Gallons WB Coating	98,455,172	
	Statewide Cleanup Ratio	Gallons Cleanup Solvent/ (Gallon SB Coating + Gallon WB Coating)	0.019336	
	Statewide Emissions	Emissions From Cleanup of SB and WB Coatings	**6,230**	**5,640**

Table 13-9

EMISSIONS FROM USE OF THINNING AND CLEANUP SOLVENTS WITH OEM COATINGS IN TWO SIC CODES

Solvent Type	Emissions (Tons per Year)			
	SIC 34		SIC 35	
	TOG	ROG	TOG	ROG
Mineral Spirits	144	144	229	229
Lacquer Thinner	595	491	528	436
Acetone	2,770	0	1,168	0
Denatured Alcohol	29	29	0	0
Isopropyl Alcohol	51	51	0	0
Toluene	9	9	106	106
Xylenes	300	300	0	0
MEK	10	10	0	0
Other	76	39	16	8
Totals	**3,985**	**1,072**	**2,046**	**778**

13.8 IDENTIFICATION AND APPLICATION OF SPATIAL SURROGATES

(1) Our investigation of spatial surrogates focused on allocation of architectural coating emissions from counties to 2 km x 2 km grid cells.

(2) An analysis using Employment Development Department survey data and the 2000 U.S. Census found a very high correlation between population and numbers of painters. We therefore decided to use population as a surrogate variable for commercial painting activity.

(3) Numbers of owner-occupied housing units are known down to the block level, so they were used as surrogates for painting activity by homeowners.

(4) We proposed a method that uses a graphic information system (GIS) to obtain, display and process surrogate variable data. The method includes a technique for allocating census block data to grid squares.

13.9 UPDATING METHODOLOGY

(1) We limited our efforts in developing updating emissions from use of thinning and cleanup solvents in association with architectural coatings.

(2) Numbers of painters in future years were assumed to be a good surrogate for future levels of painting activity.

(3) The Employment Development Department has forecast growth rates in employment of painters from its latest survey year (2001) to 2008, for each county.

(4) Using the EDD information, we developed growth factors (which were in at least one case negative) for each year between 2002 and 2010, for each county.

14.0

RECOMMENDATIONS

We believe that it is still a worthwhile goal to obtain an accurate, detailed estimate of the quantities and composition of the industrial or OEM coatings used in California. We decidedly do not recommend another survey of coating manufacturers. Instead we suggest a two-step approach. The first would be to obtain and thoroughly review annual emissions reporting data required and archived by the major air pollution control districts, such as the South Coast Air Quality Management District (SCAQMD). The SCAQMD requires thousands of facilities to file an annual emissions report, in which facilities are supposed to code their material use and emissions estimates by, among other things, coating types. Not all submittals actually contain the coding, or are coded correctly, but the databases are large enough to be able to cull deficient entries and still have enough remaining for extensive statistical analyses. The analyses would have to take into account that the annual emission report data are somewhat biased, in that facilities having emissions below a threshold do not have to submit reports.

The review of the local district inventories will probably account for the bulk of the OEM coating use in the state. The other step would be to perform very narrowly defined surveys of OEM coating users in the air pollution control districts where the emission inventory data are not detailed enough.

We also recommend further evaluation of the survey data that went into calculation of the ounces-per-gallon ratio. As was discussed in Section 12.2, some of the cleanup solvent attributed to solvent-based coating use may actually have been associated with water-based coating use. That was one of the reasons why we did not calculate a use ratio for cleanup solvents associated specifically with solvent-based coating use. The survey respondents could be contacted by telephone to clarify their previous responses. The ounces-per-gallon ratios might then be recalculated.

15.0

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APPENDIX A
SURVEY FORMS

TETRA TECH, INC.
670 N. Rosemead Blvd.
Pasadena, CA 91107
Telephone: (626) 351-4664
Fax: (626) 351-5291

July 9, 2002

Tetra Tech, Inc. (Tetra Tech), on behalf of the California Air Resources Board (ARB), is conducting a survey of OEM (or "industrial") coatings manufacturers who sell to addresses in California. The purpose of the survey is to obtain information on the sales volume of OEM coatings and the recommended thinners/cleanup solvents associated with OEM coatings. With this information, the ARB can improve its emission inventory for volatile organic compounds (VOC) for this source category.

This survey is intended for paint manufacturers who sell OEM coatings to California users or distributors. The reporting year is 2001. ***If your company is not an OEM coatings manufacturer, please fill out only Form 1 of the survey and fax or mail it back to us.*** *If a product label states "manufactured for (your company)" or the like, we do not regard you as the manufacturer of the product.*

You may be assured that any information given to Tetra Tech, Inc. that you identify as "confidential" or "trade secret" will be held as such by Tetra Tech, Inc. and the ARB. The information you provide will be reported publicly only after combination with other companies' data. Your company's name will not be reported. Please see the enclosed letter from the ARB regarding confidentiality of data.

The questionnaire contains three forms. Form 1 asks for general information about your company. In Forms 2 and 3, we ask about the types and amounts of OEM coatings that you sell. Please attach a Material Safety Data Sheet (MSDS) for each product you report on Forms 2 and 3. Additionally, if you blend commercially available materials in your product, please provide us with a copy of the "Technical Safety Data Sheet" for every commercially obtained material you blend in your product.

We appreciate your participation in this research study. **Please respond by August 9, 2002.** If you have any questions about the project, please call me at (626) 351-4664. You may reach the ARB Contract Manager, Richard Vincent, at (916) 323-5774.

Sincerely yours,

Eddy Huang

Eddy Huang, Ph.D.
Principal Engineer

Winston H. Hickox
Agency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman

Gray Davis
Governor

July 5, 2002

To Whom It May Concern:

Tetra Tech, Inc. (Tetra Tech) is working on a contract for the Air Resources Board (ARB) entitled "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents." Their task is to estimate for each county in California the amount of solvent emitted into the air from the use of these materials.

Tetra Tech is requesting data from you for input to their statistical analyses. They are requesting data on your sales to original equipment manufacturers (OEMs) in California of certain coatings and on the manufacturer's recommended ratios of thinning solvents for the coatings. Obtaining information from companies like yours is a critical part of Tetra Tech's work. I hope that you can help them.

The information being is requested solely for use under the contract. Tetra Tech is prevented by the contract from divulging any information obtained from you without the consent of the ARB. The ARB will not divulge or consent to divulge such information to other parties without first affording you the opportunity to declare the information to be trade secret (confidential) according to the law. (However, ARB can divulge information to other governmental agencies who legally protect trade secrets as does ARB. Also, information may be shared with another contractor on the project, Harding ESE, Inc., who is also legally prevented from divulging information to other parties.)

If you have questions that Tetra Tech cannot answer, please call me (916) 323-5774.

Sincerely,

Richard Vincent, P.E.
Staff Air Pollution Specialist
Research Division

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Website: http://www.arb.ca.gov.

OEM COATING MANUFACTURER SURVEY FOR CARB

FORM 1 – FACILITY INFORMATION

Company Name: _____

Site Address: _____
(Number and Street)

City: _____, State: _____ ZIP: _____ - _____

At your site, do you produce or blend OEM coatings? (See the list below for coating types covered by this survey.)

- ☐ Yes
- ☐ No – This is an administrative or sales location only
- ☐ No – This facility did not operate in 2001
- ☐ No - _____
(Explain briefly)

OEM coatings covered by this survey are listed in the following categories:

Type of Coating
Marine
Paper
Fabric
Metal Furniture and Fixture
Can and Coil
Metal Parts and Products (except furniture)
Wood Furniture and Fixture
Pleasure Craft
Other

If you checked any of the "No" boxes, please return the form (or just this page) and we will remove you from the survey. **Our fax number is (626) 351-5291.** Thank you.

Contact Person: _____ Title: _____

Telephone No. ( ) _____ - _____ Fax: ( ) _____ - _____

E-mail: _____

URL address to download MSDS's if available: _____

Call 626-351-4664, extension 130 if you have any questions about this survey.

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
670 North Rosemead Blvd., Pasadena, CA 91107

FORM 2

Product Information – Reporting Year 2001

(Instructions for completing FORM 2: See reverse side)

Product # _____(Note: This product # must also appear on your corresponding FORM 3)

Product Name: _____

Physical & Other Data			
Coating Density	VOC Actual	VOC Regulatory	How were VOC Actual and Regulatory determined?
lbs/gal	grams/liter	grams/liter	☐ U.S. EPA Method 24
			☐ Formulation Data

2001 Sales to California Destinations in Gallons	
Total Gallons	

Place an "x" in the appropriate box (A or B) and (in C) report your recommended ratio of thinning, reducing and/or retardant compound to gallons coating.

Type of Coating	A	B	C
	Solvent Base	Water Base	Recommended Amount of Thinner, etc. per Gallon of Coating
Marine			
Paper			
Fabric			
Metal Furniture and Fixture			
Can and Coil			
Metal Parts and Products (except furniture)			
Wood Furniture and Fixture			
Pleasure Craft			
Other			

Page ___ __ of _____ Enter the current page # out of the total pages submitted.

NOTE: Each FORM 2 must have a corresponding FORM 3.

Photocopy this page as necessary

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
670 North Rosemead Blvd., Pasadena, CA 91107

FORM 2 Instructions
Product Information – Reporting Year 2001

Product # : Each FORM 2 completed must be numbered sequentially, beginning with number "1." This product # must also appear on your corresponding FORM 3.
Product Name: Enter the product / label name for your products (OEM coatings).

Physical & Other Data

Coating Density: Enter the density of the coating in pounds per gallon (lbs/gal).
VOC Actual: Also known as Material VOC. Enter the VOC content of the coatings, as supplied, in grams of VOC per liter of coating. This is the weight of all volatile materials less the weight of water and less the weight of exempt compounds per the entire volume of the material. This is NOT the same as VOC Regulatory.
Note: VOC content for multi-component coatings are as mixed, applied or fully reacted.
VOC Regulatory: Also known as Coating VOC. Enter the VOC content of the coating(s), as supplied, in grams of VOC per liter of coating, less water, less exempt compounds, and less any colorant added to the tint bases. This may be determined from the formulation data or previously determined by EPA Method 24, 40 CFR Part 60, as amended in Federal Register Vol. 57, No. 133, July 10, 1992, or ASTM D 3960-92.
Note: VOC content for multi-component coatings are as mixed, applied or fully reacted.
Coating Sale to California Destinations: Report volume of OEM coatings sold to **California addresses** for calendar year 2001. If California-specific sales data are not available, sales may be estimated using national or regional figures that are apportioned appropriately.

FORM 3
Individual Component Information – Reporting Year 2001
(Instructions for completing FORM 3: See reverse side)

Product # from FORM 2:	**Speciate Volatile Organic Compounds (VOCs) and Exempt Compounds**		
Individual Component #	VOCs and Exempt Compounds	CAS #	wt %*
Aggregated VOCs < 0.1 wt %			
Aggregated Exempt Compounds < 0.1 wt %			
wt % Water			
wt % Solids			
Total of All Ingredients (Must Equal 100%)			

* List VOCs and Exempt Compounds that individually amount to 0.1% or greater by weight of the final product. Enter the percent by weight to the nearest 0.1% for each ingredient in the final product.

Page _____ of _____ Enter the current page # out of the total pages submitted.

NOTE: Each FORM 3 must have a corresponding FORM 2.

Photocopy this page as necessary

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
670 North Rosemead Blvd., Pasadena, CA 91107

FORM 3 Instructions
Individual Component Information – Reporting Year 2001

FORM 3 requests individual component information about your products (OEM coatings). In this table provide all volatile individual components which are part of the product formulation. Complete one FORM 3 for each FORM 2 completed.

Product # From FORM 2: Enter the Product # from corresponding FORM 2.

Individual Component #: Number each component sequentially.

Individual Component Name: Enter the chemical name of the component. Chemical names must be distinguished from trade names. For example, the chemical name of SD 40 Alcohol is ethanol. Enter the trade name of the component if the chemical name is unknown. If the component is proprietary, identify the trade name and manufacturer / primary supplier.

CAS#: Please enter the Chemical Abstract Registry (CAS) number for the component.

Weight % (of total material): Enter the percent by weight to the nearest 0.1% for each component in the final product.

Aggregated VOCs and Exempt Compounds < 0.1 weight %: Aggregate each of the remaining volatiles that individually account for less than 0.1 weight % of the final product and enter the sum.

Water: Enter the weight percent water.

Solids: Enter the weight percent solids.

Total of All Components: The sum of all volatiles and solids in the table must equal 100 percent by weight. If this value does not sum to 100, please check the component percentages.

Conversion Factors

VOC content: To convert pounds/gallon to grams/liter multiply by 119.83
Density: 1 pound/gallon = 0.11983 kilograms/liter or 119.83 grams/liter
Specific Gravity : To convert specific gravity to pounds/gallon multiply by 8.345
To convert specific gravity to grams/liter multiply by 1000

Units of Volume:
1 fl oz = 0.029574 liters
1 liquid pint = 0.47318 liters
1 liquid quart = 2 liquid pints = 0.94635 liters
1 gallon = 4 liquid quarts = 3.7854 liters

Units of Mass:

Unit	ounce(oz)	pound(lb)	gram(g)	kilogram(kg)
1 oz =	1	0.0625	28.3495	0.02834
1 lb =	16	1	453.592	0.45359

2003 OEM COATING USERS SURVEY
FOR THE CALIFORNIA AIR RESOURCES BOARD

PART 1 – FACILITY INFORMATION

Company Name: _____

Company Address: _____
(Number and Street)

City: _____, CA ZIP: _____ - _____

In 2001, did you apply coatings to any of the products that you manufacture or, as part of the original manufacturing process, to parts fabricated by others?

- ☐ Yes
- ☐ No – We are not a manufacturer or job shop
- ☐ No – We are a manufacturer or job shop but we applied no coatings in 2001
- ☐ No – This is an administrative or sales location only
- ☐ No – This facility has been out of business for at least six months
- ☐ No - _____
(Explain briefly)

If you checked any of the "No" boxes, please return the form (or just this page) and we will remove you from the survey. ***Our fax number is (949) 224-0073.*** *Thank you.*

Contact Person: _____ Title: _____

Telephone No. ( ) _____ - _____ Fax: ( ) _____ - _____

E-mail: _____

PART 2 – INFORMATION ON THE COATINGS YOU USE THE MOST

On the next page, please provide the requested information for the three coating products (including primers) that you used the most during 2001. If you used a family of similar coatings (for example, a brand of enamel that is available in many colors), then report the family, rather than individual colors, as one of your three most-used products.

Call 949-224-0050, Ext. 246 if you have any questions about this survey.

Mail surveys back to: ARB Emission Inventory Survey c/o MACTEC Engineering & Consulting, Inc.
2171 Campus Drive, Suite 100, Irvine, CA 92612-1422.

2003 OEM COATING USERS SURVEY
FOR THE CALIFORNIA AIR RESOURCES BOARD

PART 2 – INFORMATION ON THE COATINGS YOU USE THE MOST (Contd.)

Coating #1

Manufacturer	
Coating Name	
Product Code or Other Identifier	
Gallons Used or Purchased in 2001	
Bought From:	☐ Manufacturer ☐ Distributor
Manufacturer's Address	
Distributor's Name[a]	
Distributor's Address	
Distributor's Phone and Fax No.	Phone: Fax:

[a]If you purchase from more than on distributor, list the one who sells you the most of this coating.

Coating #2

Manufacturer	
Coating Name	
Product Code or Other Identifier	
Gallons Used or Purchased in 2001	
Bought From:	☐ Manufacturer ☐ Distributor
Manufacturer's Address	
Distributor's Name[a]	
Distributor's Address	
Distributor's Phone and Fax No.	Phone: Fax:

[a]If you purchase from more than on distributor, list the one who sells you the most of this coating.

Coating #3

Manufacturer	
Coating Name	
Product Code or Other Identifier	
Gallons Used or Purchased in 2001	
Bought From:	☐ Manufacturer ☐ Distributor
Manufacturer's Address	
Distributor's Name[a]	
Distributor's Address	
Distributor's Phone and Fax No.	Phone: Fax:

[a]If you purchase from more than on distributor, list the one who sells you the most of this coating.

That's all we need! Thank you very much for your help.

Mail surveys back to: ARB Emission Inventory Survey c/o MACTEC Engineering & Consulting, Inc.
2171 Campus Drive, Suite 100, Irvine, CA 92612-1422.

Winston H. Hickox
Agency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
1001 I Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
Governor

September 10, 2003

To Whom It May Concern:

Tetra Tech, Inc. (Tetra Tech) is working on a contract for the Air Resources Board (ARB) entitled "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents." Their task is to estimate for each county in California the amount of solvent emitted into the air from the use of these materials. ARB has no legal authority to levy fees on coatings other than architectural and is not pursuing or supporting any legislation for such authority.

Tetra Tech is requesting data from you for input to their statistical analyses. They are requesting data on your sales to original equipment manufacturers (OEMs) in California of certain coatings. Obtaining information from companies like yours is a critical part of Tetra Tech's work. I hope that you can help them.

The information being requested is solely for use under the contract. Tetra Tech is prevented by the contract from divulging any information obtained from you without the consent of the ARB. The ARB will not divulge or consent to divulge such information to other parties without first affording you the opportunity to declare the information to be trade secret (confidential) according to the law. (However, ARB can divulge information to other governmental agencies who legally protect trade secrets as does ARB. Also, information may be shared with another contractor on the project, MACTEC Engineering and Consulting, Inc., who is also legally prevented from divulging information to other parties.)

If you have questions that Tetra Tech cannot answer, please call me (916) 323-5774.

Sincerely,

Richard Vincent, P.E.
Staff Air Pollution Specialist
Research Division

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Website: http://www.arb.ca.gov.

Winston H. Hickox
Agency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
1001 I Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
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September 10, 2003

To Whom It May Concern:

Tetra Tech, Inc. (Tetra Tech) is working on a contract for the Air Resources Board (ARB) entitled "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents." The objective of their task is to obtain information to be used in estimating the amounts of solvent emitted into the air from the use of these materials. The only objective of the project is to improve the ARB's statewide emission inventory for organic solvents. (The ARB has no legal authority to levy fees on coatings other than architectural and is not pursuing or supporting any legislation for such authority.)

Tetra Tech is requesting data on your sales to original equipment manufacturers (OEMs) in California of certain coatings. Obtaining information from companies like yours is a critical part of Tetra Tech's work. I hope that you can help them.

The information being requested is solely for use under the contract. Tetra Tech is prevented by the contract from divulging any information obtained from you without the consent of the ARB. The ARB will not divulge or consent to divulge such information to other parties without first affording you the opportunity to declare the information to be trade secret (confidential) according to the law. (However, ARB can divulge information to other governmental agencies who legally protect trade secrets as does ARB. Also, information may be shared with another contractor on the project, MACTEC Engineering and Consulting, Inc., who is also legally prevented from divulging information to other parties.)

If you have questions that Tetra Tech cannot answer, please call me (916) 323-5774.

Sincerely,

Richard Vincent, P.E.
Staff Air Pollution Specialist
Research Division

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Website: http://www.arb.ca.gov.

TETRA TECH, INC.
3475 East Foothill Blvd.
Pasadena, CA 91107
Telephone: (626) 470-2417
Fax: (626) 470-2617

September 10, 2003

Tetra Tech, Inc. (Tetra Tech), on behalf of the California Air Resources Board (ARB), is conducting a survey of OEM (or "industrial") coatings manufacturers who sell to addresses in California. The purpose of the survey is to obtain information on the sales volume of OEM coatings and the recommended thinners/cleanup solvents associated with OEM coatings. With this information, the ARB can improve its emission inventory for volatile organic compounds (VOC) for this source category. The reporting year for this OEM coating survey is 2001.

From a preliminary survey of equipment manufacturing plants in California, we have learned that your company sells OEM coatings (Product line XXX) to California users or distributors. You may be assured that any information given to Tetra Tech, Inc. that you identify as "confidential" or "trade secret" will be held as such by Tetra Tech, Inc. and the ARB. The information you provide will be reported publicly only after combination with other companies' data. Your company's name will not be reported. Please see the enclosed letter from the ARB regarding confidentiality of data.

The questionnaire contains three forms. Form 1 asks for general information about your company. In Forms 2 and 3, we ask about the types and amounts of OEM coatings that you sell. Please attach a Material Safety Data Sheet (MSDS) for each product you report on Forms 2 and 3. Additionally, if you blend commercially available materials in your product, please provide us with a copy of the "Technical Safety Data Sheet" for every commercially obtained material you blend in your product.

We appreciate your participation in this research study. **Please respond by October 3, 2003**. If you have any questions about the project, please call me at (626) 470-2417. You may reach the ARB Contract Manager, Richard Vincent, at (916) 323-5774.

Sincerely yours,

Eddy Huang, Ph.D.
Principal Engineer

OEM COATING MANUFACTURER SURVEY FOR CARB

FORM 1 – FACILITY INFORMATION

Company Name: _____

Site Address: _____
(Number and Street)

City: _____, State: _____ ZIP: _____ - _____

Contact Person: _____ Title: _____

Telephone No. ( ) _____ - _____ Fax: ( ) _____ - _____

E-mail: _____

URL address to download MSDS's if available: _____

Call 626-470-2417 if you have any questions about this survey.

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
3475 East Foothill Blvd., Pasadena, CA 91107

FORM 2
Product Information – Reporting Year 2001
(Instructions for completing FORM 2: See reverse side)

Product # _____(Note: This product # must also appear on your corresponding FORM 3)

Product Name: _____

Physical & Other Data			
Coating Density	VOC Actual	VOC Regulatory	How were VOC Actual and Regulatory determined?
lbs/gal	grams/liter	grams/liter	☐ U.S. EPA Method 24
			☐ Formulation Data

2001 Sales to California Destinations in Gallons	
Total Gallons	

For what type(s) of manufactured product(s) is this coating typically used? Please place an "x" in the appropriate box(es).

Type(s) of Manufactured Products	Solvent-Based	Water Based
Marine	☐	☐
Paper	☐	☐
Fabric	☐	☐
Metal Furniture and Fixture	☐	☐
Can and Coil	☐	☐
Metal Parts and Products (except furniture)	☐	☐
Wood Furniture and Fixture	☐	☐
Pleasure Craft	☐	☐
Other	☐	☐

Page _____ of _____ Enter the current page # out of the total pages submitted.

NOTE: Each FORM 2 must have a corresponding FORM 3.
Photocopy this page as necessary

Call 626-470-2417 if you have any questions about this survey.

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
3475 East Foothill Blvd., Pasadena, CA 91107

FORM 2 Instructions
Product Information – Reporting Year 2001

Product # : Each FORM 2 completed must be numbered sequentially, beginning with number "1." This product # must also appear on your corresponding FORM 3.
Product Name: Enter the product / label name for your products (OEM coatings).

Physical & Other Data

Coating Density: Enter the density of the coating in pounds per gallon (lbs/gal).
VOC Actual: Also known as Material VOC. Enter the VOC content of the coatings, as supplied, in grams of VOC per liter of coating. This is the weight of all volatile materials less the weight of water and less the weight of exempt compounds per the entire volume of the material. This is NOT the same as VOC Regulatory.
Note: VOC content for multi-component coatings are as mixed, applied or fully reacted.
VOC Regulatory: Also known as Coating VOC. Enter the VOC content of the coating(s), as supplied, in grams of VOC per liter of coating, less water, less exempt compounds, and less any colorant added to the tint bases. This may be determined from the formulation data or previously determined by EPA Method 24, 40 CFR Part 60, as amended in Federal Register Vol. 57, No. 133, July 10, 1992, or ASTM D 3960-92.
Note: VOC content for multi-component coatings are as mixed, applied or fully reacted.
Coating Sale to California Destinations: Report volume of OEM coatings sold to **California addresses** for calendar year 2001. If California-specific sales data are not available, sales may be estimated using national or regional figures that are apportioned appropriately.

FORM 3

Individual Component Information – Reporting Year 2001

(Instructions for completing FORM 3: See reverse side)

Product # from FORM 2:	**Speciate Volatile Organic Compounds (VOCs) and Exempt Compounds**		
Individual Component #	VOCs and Exempt Compounds	CAS #	wt %*
Aggregated VOCs < 0.1 wt %			
Aggregated Exempt Compounds < 0.1 wt %			
wt % Water			
wt % Solids			
Total of All Ingredients (Must Equal 100%)			

* List VOCs and Exempt Compounds that individually amount to 0.1% or greater by weight of the final product. Enter the percent by weight to the nearest 0.1% for each ingredient in the final product.

Page _____ of _____ Enter the current page # out of the total pages submitted.

NOTE: Each FORM 3 must have a corresponding FORM 2.

Photocopy this page as necessary

Mail surveys back to: CARB OEM Coatings Survey c/o Tetra Tech, attn: Dr. Eddy Huang
3475 East Foothill Blvd., Pasadena, CA 91107

FORM 3 Instructions
Individual Component Information – Reporting Year 2001

FORM 3 requests individual component information about your products (OEM coatings). In this table provide all volatile individual components which are part of the product formulation. Complete one FORM 3 for each FORM 2 completed.

Product # From FORM 2: Enter the Product # from corresponding FORM 2.

Individual Component #: Number each component sequentially.

Individual Component Name: Enter the chemical name of the component. Chemical names must be distinguished from trade names. For example, the chemical name of SD 40 Alcohol is ethanol. Enter the trade name of the component if the chemical name is unknown. If the component is proprietary, identify the trade name and manufacturer / primary supplier.

CAS#: Please enter the Chemical Abstracts Service (CAS) Registry number for the component.

Weight % (of total material): Enter the percent by weight to the nearest 0.1% for each component in the final product.

Aggregated VOCs and Exempt Compounds < 0.1 weight %: Aggregate each of the remaining volatiles that individually account for less than 0.1 weight % of the final product and enter the sum.

Water: Enter the weight percent water.

Solids: Enter the weight percent solids.

Total of All Components: The sum of all volatiles and solids in the table must equal 100 percent by weight. If this value does not sum to 100, please check the component percentages.

Conversion Factors

VOC content: To convert pounds/gallon to grams/liter multiply by 119.83
Density: 1 pound/gallon = 0.11983 kilograms/liter or 119.83 grams/liter
Specific Gravity : To convert specific gravity to pounds/gallon multiply by 8.345
To convert specific gravity to grams/liter multiply by 1000

Units of Volume:
1 fl oz = 0.029574 liters
1 liquid pint = 0.47318 liters
1 liquid quart = 2 liquid pints = 0.94635 liters
1 gallon = 4 liquid quarts = 3.7854 liters

Units of Mass:

Unit	ounce(oz)	pound(lb)	gram(g)	kilogram(kg)
1 oz =	1	0.0625	28.3495	0.02834
1 lb =	16	1	453.592	0.45359

OEM COATING USERS SURVEY
FOR THE CALIFORNIA AIR RESOURCES BOARD

FORM 1 – FACILITY INFORMATION

Company Name: _____

Company Address: _____
(Number and Street)

City: _____, CA ZIP: _____ - _____

In 1999, 2000 or 2001, did you apply coatings to any of the products that you manufacture or, as part of the original manufacturing process, to parts fabricated by others?

- ☐ Yes
- ☐ No – We are not a manufacturer or job shop
- ☐ No – We are a manufacturer or job shop but we applied no coatings
- ☐ No – This is an administrative or sales location only
- ☐ No – This facility has been out of business for at least six months
- ☐ No - _____
(Explain briefly)

If you checked any of the "No" boxes, please return the form (or just this page) and we will remove you from the survey. ***Our fax number is (949) 224-0073.*** *Thank you.*

Number of employees at this location: _____

Contact Person: _____ Title: _____

Telephone No. ( ) _____ - _____ Fax: ( ) _____ - _____

E-mail: _____

About how many gallons of coating do you use in a typical year?

Solvent-Based _____
Water-Based _____

Call 949-224-0050, Ext. 246 if you have any questions about this survey.

Mail surveys back to: ARB Emission Inventory Survey c/o MACTEC Engineering & Consulting, Inc.
2171 Campus Drive, Suite 100, Irvine, CA 92612-1422

CALIFORNIA AIR RESOURCES BOARD OEM COATING USERS SURVEY

FORM 2 - USE OF SOLVENTS AND ADDITIVES

Instructions

1 Please fill out each of the following tables. The first is for the thinners and cleanup solvents you use with solvent-based coatings, and the second is for materials you use for water-based coatings.

2 For each material, please give the manufacturer and/or distributor and the product trade name. An example would be "A.G. Layne Compliant Lacquer Thinner T20."

3 For the gallons used, please give a value for a recent year, and specify the year in the box below.

Type of Material Used With Solvent-Based Coatings	Brand and Product No.	Typical No. of Gallons Used Per Year			Ounces Mixed per Gallon of Coating
		For Thinning	For Cleanup	Total	
Mineral Spirits					
Lacquer Thinner					
Acetone					
Denatured Alcohol					
Isopropyl Alcohol					
Methanol					
Methylene Chloride					
Naphtha					
Toluene					
Xylene					
Other:					

Type of Material Used With Water-Based-Coatings (Specify)	Brand and Product No.	Typical No. of Gallons Used Per Year		
		As an Additive	For Cleanup	Total
Do Not Include Water				

These estimates are for which calendar year? [ ]

PLEASE PROVIDE MATERIAL SAFETY DATA SHEETS FOR ALL MATERIALS LISTED.

Make additional copies of this form if necessary.

CALIFORNIA AIR RESOURCES BOARD
OEM COATING USERS SURVEY

FORM 3 – OPERATING SCHEDULE

A. Month of the Year

In the following table, please indicate the percentage of your annual thinning and cleanup solvent use that occurs in each month of the year. If your business is inactive in a given month, write "0" for that month. If your use of these materials is about the same year round, draw a line through all the boxes.

Percent of Annual Activity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

B. Days of the Week

In the following table, please indicate whether you normally use thinners and cleanup solvents on weekdays, weekends, or both. (Spring = March, April, May; Summer = June, July, August; Fall = September, October, November; Winter = December, January, February).

	SPRING (✓)	SUMMER (✓)	FALL (✓)	WINTER (✓)
WEEKDAY				
SATURDAY				
SUNDAY				

C. Hours of the Day

Mark an "X" for each hour of the day that you apply paint and/or use cleanup solvents. (Do not include hours preparing surfaces, if no VOC-containing materials are used.) ***Circle the "Xs" for hours in which you use cleanup solvents.***

Hours	Spr	Sum	Fall	Win	Hours	Spr	Sum	Fall	Win
Midnight - 1 a.m.					Noon - 1 p.m..				
1 a.m. - 2 a.m.					1 p.m. - 2 p.m.				
2 a.m. - 3 a.m.					2 p.m. - 3 p.m.				
3 a.m. - 4 a.m.					3 p.m. - 4 p.m.				
4 a.m. - 5 a.m.					4 p.m. - 5 p.m.				
5 a.m. - 6 a.m.					5 p.m. - 6 p.m.				
6 a.m. - 7 a.m.					6 p.m. - 7 p.m.				
7 a.m. - 8 a.m.					7 p.m. - 8 p.m.				
8 a.m. - 9 a.m.					8 p.m. - 9 p.m.				
9 a.m. - 10 a.m.					9 p.m. - 10 p.m.				
10 a.m. - 11 a.m.					10 p.m. - 11 p.m.				
11 a.m. - Noon					11 p.m. - Midnight				

Please return completed survey to:
ARB Emission Inventory Survey
c/o MACTEC Engineering & Consulting, Inc.
2171 Campus Drive, Suite 100
Irvine, CA 92612-1422

CALIFORNIA AIR RESOURCES BOARD
OEM COATING USERS SURVEY

FORM 4 – INFLUENCE OF WEATHER ON ACTIVITY

The purpose of this form is to determine what effect, if any, weather conditions have on your use of thinners and cleanup solvents associated with "industrial" or "OEM" coatings.

A. Temperature

On ***hot days*** (such as above 90°F), do you (check all that apply):

- ☐ Not apply OEM coatings on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than you would on "normal" days?
- ☐ Use different cleanup solvents than you would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

On ***cold days*** (such as below 40°F), do you (check all that apply):

- ☐ Not apply OEM coatings on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than you would on "normal" days?
- ☐ Use different cleanup solvents than you would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

B. Precipitation

On ***rainy or snowy days***, do you (check all that apply):

- ☐ Not apply OEM coatings on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than you would on "normal" days?
- ☐ Use different cleanup solvents than you would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

OEM COATING USERS SURVEY
FOR THE CALIFORNIA AIR RESOURCES BOARD

FORM 5 – SUPPLIERS OF "INDUSTRIAL" OR "OEM" COATINGS AND THINNING AND CLEANUP SOLVENTS

To assist us in another portion of our research for the Air Resources Board, we would appreciate it if you would list here the manufacturers and/or distributors of your OEM coatings and thinning and cleanup solvents.

Name of Company	City, State	Check All That Apply			
		Manufac-turer	Distributor	Supplies Coatings	Supplies Solvents
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
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		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

CALIFORNIA AIR RESOURCES BOARD

PAINTING CONTRACTOR SURVEY

FORM 1 – FACILITY INFORMATION

Company Name: _____

Company Address: _____
(Number and Street)

City: _____, CA ZIP: _____ - _____

Are you a contractor who applies coatings to residences, commercial buildings, industrial plants, bridges, or other structures?

- ☐ Yes
- ☐ No – We apply coatings to manufactured parts only
- ☐ No – This company does not do any painting at all
- ☐ No – This is an administrative or sales location only
- ☐ No – This company has been out of business for at least six months
- ☐ No - _____
(Explain briefly)

If you checked any of the "No" boxes, please return the form (or just this page) and we will remove you from the survey. ***Our fax number is (949) 224-0073.*** *Thank you.*

Is the above address

- ☐ Your only location?
- ☐ The main office for a company with more than one location?
- ☐ A branch office?

Number of painters in the field during periods of maximum work: _____

Contact Person: _____ Title: _____

Telephone No. ( ) _____ - _____ Fax: ( ) _____ - _____

E-mail: _____

About how many gallons of coating do you use in a typical year?

Solvent-Based (i.e., Not Water-Based) _____
Water-Based _____

Call 949-224-0050, Ext. 246 if you have any questions about this survey.

Mail surveys back to: ARB Emission Inventory Survey c/o MACTEC
2171 Campus Drive, Suite 100, Irvine, CA 92612.

CALIFORNIA AIR RESOURCES BOARD PAINTING CONTRACTORS SURVEY

FORM 2 - USE OF SOLVENTS AND ADDITIVES

Instructions

1 Please fill out each of the following tables. The first is for the thinners and cleanup solvents you use with solvent-based coatings, and the second is for materials you use for water-based coatings.

2 For each material, please give the manufacturer and/or distributor and the product trade name. An example would be "A.G. Layne Compliant Lacquer Thinner T20."

3 For the gallons used, please give a value for a recent year, and specify the year in the box below.

Type of Material Used With Solvent-Based Paints (i.e. Not Water-Based)*	Brand and Product No.	Typical No. of Gallons Used Per Year			Ounces Mixed per Gallon of Paint
		For Thinning	For Cleanup	Total	
Mineral Spirits					
Lacquer Thinner					
Acetone					
Denatured Alcohol					
Isopropyl Alcohol					
Methanol					
Methylene Chloride					
Naphtha					
Toluene					
Xylene					
Other:					

*Solvent-based includes lacquers and any other coatings that are not water-based.

Type of Material Used With Water-Based-Paints (Specify)	Brand and Product No.	Typical No. of Gallons Used Per Year		
		As an Additive	For Cleanup	Total
Do Not Include Water				

For solvents used in cleanup, what percentage are used for: Spray Equipment _____(%), Brushes and Rollers _____ (%), Other _____ (%)

These estimates are for which calendar year? ☐

PLEASE PROVIDE MATERIAL SAFETY DATA SHEETS FOR ALL MATERIALS LISTED.

Make additional copies of this form if necessary.

CALIFORNIA AIR RESOURCES BOARD
PAINTING CONTRACTORS SURVEY

FORM 3 – OPERATING SCHEDULE

A. Month of the Year

In the following table, please indicate the percentage of your annual thinning and cleanup solvent use that occurs in each month of the year. If your business is inactive in a given month, write "0" for that month. If your use of these materials is about the same year round, draw a line through all the boxes.

Percent of Annual Activity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

B. Days of the Week

In the following table, please indicate whether you normally use thinners and cleanups solvents on weekdays, weekends, or both. (Spring = March, April, May; Summer = June, July, August; Fall = September, October, November; Winter = December, January, February).

	SPRING (✓)	SUMMER (✓)	FALL (✓)	WINTER (✓)
WEEKDAY				
SATURDAY				
SUNDAY				

C. Hours of the Day

Mark an "X" for each hour of the day that you apply paint and/or use cleanup solvents. (Do not include hours preparing surfaces, if no VOC-containing materials are used.) ***Circle the "Xs" for hours in which you use cleanup solvents.***

Hours	Spr	Sum	Fall	Win	Hours	Spr	Sum	Fall	Win
Midnight - 1 a.m.					Noon - 1 p.m..				
1 a.m. - 2 a.m.					1 p.m. - 2 p.m.				
2 a.m. - 3 a.m.					2 p.m. - 3 p.m.				
3 a.m. - 4 a.m.					3 p.m. - 4 p.m.				
4 a.m. - 5 a.m.					4 p.m. - 5 p.m.				
5 a.m. - 6 a.m.					5 p.m. - 6 p.m.				
6 a.m. - 7 a.m.					6 p.m. - 7 p.m.				
7 a.m. - 8 a.m.					7 p.m. - 8 p.m.				
8 a.m. - 9 a.m.					8 p.m. - 9 p.m.				
9 a.m. - 10 a.m.					9 p.m. - 10 p.m.				
10 a.m. - 11 a.m.					10 p.m. - 11 p.m.				
11 a.m. - Noon					11 p.m. - Midnight				

Please return completed survey to:
ARB Emission Inventory Survey
c/o MACTEC Engineering and Consulting, Inc.
2171 Campus Drive, Suite 100
Irvine, CA 92612

CALIFORNIA AIR RESOURCES BOARD
PAINTING CONTRACTORS SURVEY

FORM 4 – INFLUENCE OF WEATHER ON ACTIVITY

The purpose of this form is to determine what effect, if any, weather conditions have on your use of thinners and cleanup solvents.

A. Temperature

On ***hot days*** (such as above 90°F), do you (check all that apply):

- ☐ Not paint on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than I would on "normal" days?
- ☐ Use different cleanup solvents than I would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

On ***cold days*** (such as below 40°F), do you (check all that apply):

- ☐ Not paint on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than I would on "normal" days?
- ☐ Use different cleanup solvents than I would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

B. Precipitation

On ***rainy or snowy days***, do you (check all that apply):

- ☐ Not paint on those days?
- ☐ Use (☐ less ☐ more) thinner per gallon of paint than "normal"?
- ☐ Use different thinners than I would on "normal" days?
- ☐ Use different cleanup solvents than I would on "normal" days?
- ☐ Paint earlier in the day?
- ☐ Paint later in the day?
- ☐ Paint as normal?

TELEPHONE SCRIPT FOR
ARB HOMEOWNERS SURVEY

1 Hello, my name is _____ and I'm conducting an important environmental survey for the California Air Resources Board.

2 Is this [*target phone number*]?

IF WRONG, RE-DIAL.

3 Is this a residence?

Yes **CONTINUE WITH INTERVIEW**
No I'm sorry to bother you. **HANG UP**

4 May I please speak with someone over 18 who lives here?

Yes **CONTINUE WITH INTERVIEW WHEN SOMEONE OVER 18 COMES ON THE LINE**
No **CALL BACK LATER**

IF ORIGINAL ANSWERER IS STILL ON THE LINE, GO TO 6

5 Hello, my name is _____. **GO TO 6**

6 I'm with Harding ESE, a consulting firm in Pomona, California. We're under contract to the California Air Resources Board, a state agency, to obtain some information on the use of paint thinner and cleanup solvents in house painting. I would like to emphasize that we are not selling anything, and we are not asking for any financial or personal information. We obtained your name and telephone number at random from a list of people in California who own their own homes. This interview should take less than five minutes. May we continue?

Yes **CONTINUE WITH INTERVIEW**
No Thank you for your time. **HANG UP**

7 Do you or anyone else who lives here own this residence?

Yes **CONTINUE WITH INTERVIEW**
No I'm sorry, but this interview is for homeowners only. Thank you for your time. **HANG UP**

8 Which of the following residence types best describes this home?

- ❑ Single family, detached
- ❑ Duplex
- ❑ Townhouse
- ❑ Apartment-type condominium
- ❑ Other

9 Have you or anyone else who lives here done any house painting, either indoors or outdoors, at your present home or anywhere else, within the last five years? That would include painting walls, floors, decks, fences or any other part or your property, inside or outside.

Yes **CONTINUE WITH INTERVIEW**
No I have no further questions. Thank you very much for your time. **QUIT**

10 Now I would like to ask you several questions about your painting activities.

11 About how many times in the past five years have you done painting on your property?

12 Please think about the **last** time that you did some painting. In what season was it?

- ❑ Spring (*March, April, May*)
- ❑ Summer (*June, July, August*)
- ❑ Fall (*September, October, November*)
- ❑ Winter (*December, January, February*)
- ❑ Don't Know

13 During which of these hours of the day did you do the painting?

- ❑ Midnight – 6 a.m.
- ❑ 6 a.m. to Noon
- ❑ Noon to 6 p.m.
- ❑ 6 p.m. to Midnight
- ❑ Don't remember

14 During which part of the week did you paint?

- ❑ Weekdays (*Monday through Friday*)
- ❑ Weekends (*Saturday, Sunday*)
- ❑ Both
- ❑ Don't remember

15 Next, I would like to ask you some questions about the effect of weather on your house painting activity. Think about the **next** time that you might paint the inside or outside of your house.

16 On a hot day (say, above 90°F), which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ❑ Not paint at all
- ❑ Paint only indoors
- ❑ Paint earlier in the day than you would if it weren't so hot
- ❑ Paint later in the day than you would if it weren't so hot
- ❑ Hot weather would not affect your painting schedule

17 On a cold day (say, below 40°F), which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ❑ Not paint at all
- ❑ Paint only indoors
- ❑ Paint earlier in the day than you would if it weren't so cold
- ❑ Paint later in the day than you would if it weren't so cold
- ❑ Cold weather would not affect your painting schedule

18 On rainy or snowy days, which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ❑ Not paint at all
- ❑ Paint only indoors
- ❑ Paint earlier in the day than you would if it weren't raining or snowing
- ❑ Paint later in the day than you would if it weren't raining or snowing
- ❑ Rainy or snowy weather would not affect your painting schedule

19 Did you use oil-based paints for any of the painting that you did?

Yes **CONTINUE WITH INTERVIEW**
No I have no further questions. Thank you very much for your time. **QUIT**

20 About how much paint thinner and cleanup solvent did you buy altogether in the past five years? Here are some choices:

- ❑ 1 pint
- ❑ 1 quart
- ❑ 2 quarts
- ❑ More than 2 quarts (**ASK HOW MUCH**) _____

21 Of the solvent that you used in the past five years, about what percentage was used for thinning (as opposed to being used for cleanup)?

- ☐ None
- ☐ 1 to 10%
- ☐ 10 to 25%
- ☐ 25 to 50%
- ☐ 50 to 75%
- ☐ 75 to 90%
- ☐ All

22 If you can remember, what type of product was the paint thinner that you used the last time? I will read you some possible choices.

- ☐ Mineral spirits
- ☐ Lacquer thinner
- ☐ Acetone
- ☐ Turpentine
- ☐ Naphtha
- ☐ Toluene
- ☐ Xylene
- ☐ Other (SPECIFY) _____

23 Well, that's all the questions. Thank you very much for participating. The information that you have provided is very important to our survey.

24 **END**

TELEPHONE SCRIPT FOR PRE-PILOT SURVEY OF OEM COATING USERS

Good [morning, afternoon]. My name is [First, Last] and I'm calling from Pacific Environmental Services in Pomona, California. We're under contract to the California Air Resources Board to do a research study on the use of coatings in manufacturing. We've chosen your company at random from a list of California manufacturers. Could I please ask you a few simple questions about your coating use? It will take less than one minute of your time.

1. Is any manufacturing done at this location? [*If no, end the call.*]

2. Do you use any kinds of coatings on the things that you manufacture? [*If no, end the call.*]

3. Please tell me which of the following types of coatings you use on the items that you manufacture:

   Marine
   Paper
   Fabric
   Metal furniture and fixtures
   Cans or metal coils
   Metal parts and products
   Wood furniture and fixtures
   Plastic

4. On what other types of manufactured items do you use coatings?

Thank you very much for your time. In a few months we may select you at random again for a more detailed, written survey. We hope that you will able to help us then. Thanks again.

APPENDIX B

INTERIM REPORTS

MEMORANDUM

DATE: July 6, 2001

TO: Richard Vincent

FROM: Michael Rogozen

SUBJECT: Results of "Pre-Pilot" Survey of OEM Coatings Users

This week Pacific Environmental Services, Inc. (PES) finished our "pre-pilot" survey of original equipment manufacturing (OEM) coatings users. As you will recall from our May 10, 2001 protocol, the purpose of this survey was to confirm that OEM coatings were used by facilities in certain standard industrial classification (SIC) codes. We followed the protocol except for the interpretation of the survey results, as will be discussed below.

METHODS

In the protocol, we had identified 31 SIC codes to be surveyed. After reviewing this list before the survey, we eliminated four SIC codes that, in our judgment, had an extremely low chance of qualifying for the main OEM coating users survey. We also added SIC codes 2322 (Men & Boys Underwear & Nightwear) and 3845 (Electromedical/therapeutic Apparatus). Table 1 shows the final pre-pilot list of SIC codes and the number of facilities that we had planned to survey.

Please note that the California totals shown in Table 1 turned out not to be accurate. Most of the companies in our mailing list provider's database have more than one SIC code. If any of a company's SIC codes was one of interest to our survey, the company was chosen. Often, however, the selected company's *primary* SIC was very different from what we desired; many, for example, are retail stores. For many *primary* SIC codes, there were fewer than ten companies in California.

In selecting facilities from the CD ROM database described in our protocol, we accepted only those whose primary SIC codes were among the list in Table 1. Our final list contained 204 facilities.

Table 1

STANDARD INDUSTRIAL CLASSIFICATION CODES FOR PRE-PILOT SURVEY OF OEM COATING USERS

SIC Code	Definition	Total[a] in CA	Maximum Sample
2211	Broadwoven Fabric Mills-Cotton	241	10
2231	Broadwoven Fabric Mills-Wool	1	1
2253	Knit Outerwear Mills	44	10
2259	Knitting Mills Nec	336	10
2322	Men & Boys Underwear & Nightware	5	5
2323	Mens & Boys Neckwear	10	10
2331	Womens Misses & Jrs Blouses & Shirts	1,209	10
2339	Womens Misses & Juniors Outerwear Nec	575	10
2353	Hats Caps & Millinery	71	10
2361	Girls Childrens Infants Dresses Blouses	24	10
2369	Girls Childrens Infants Outerwear Nec	157	10
3431	Enameled Iron & Metal Sanitary Ware	12	10
3519	Internal Combustion Engines Nec	74	10
3534	Elevators & Moving Stairways	41	10
3546	Power-Driven Hand Tools	27	10
3552	Textile Machinery	44	10
3553	Woodworking Machinery	235	10
3567	Industrial Process Furnaces & Ovens	95	10
3575	Computer Terminals	30	10
3578	Calculating & Accounting Machines	40	10
3582	Commercial Laundry & Drycleaning Machs	37	10
3586	Measuring & Dispensing Pumps	14	10
3634	Electric Housewares & Fans	33	10
3635	Household Vacuum Cleaners	14	10
3639	Household Appliances Nec	56	10
3844	X-Ray Apparatus & Tubes	103	10
3845	Electromedical/Therapeutic Apparatus	93	10
3873	Watches & Clocks Devices & Parts	79	10
3991	Brooms & Brushes	26	10
	Total		276

[a]The SIC codes shown are not necessarily the *primary* SIC codes for all facilities counted.

The survey was conducted entirely by telephone, between June 20 and July 3, 2001. In a few cases, facilities asked for verification that we were under contract to the ARB, and we faxed them a copy of your April 17, 2001 letter. Responses were recorded immediately in a Microsoft Access™ database.

RESULTS

Table 2 summarizes the results of the pre-pilot survey. After deletion of firms that were out of business, the potential sample was 193. Our overall response rate was 75.1 percent. At least one response was obtained for each SIC code, and the rate within SIC codes ranged from 40 to 100 percent.

Table 2

SUMMARY OF PRE-PILOT SURVEY RESULTS FOR OEM COATING USERS

SIC Code	Potential Sample	Out of Business	Adjusted Potential Sample	Responses	Percent Response	Proportion Using Coatings	Probability of at Least 3 Users (Percent)
2211	10	3	7	6	85.7	0.00	N/A
2231	None in California						
2253	7	0	7	3	42.9	0.00	N/A
2259	4	0	4	3	75.0	0.00	N/A
2322	1	0	1	1	100.0	0.00	N/A
2323	8	0	8	7	87.5	0.00	N/A
2331	9	3	6	3	50.0	0.00	N/A
2339	7	**0**	7	**5**	**71.4**	**0.40**	**99.6**
2353	10	0	10	5	50.0	0.00	N/A
2361	9	0	9	8	88.9	0.00	N/A
2369	11	0	11	10	90.9	0.00	N/A
3431	6	0	6	3	50.0	0.00	N/A
3519	11	1	10	7	70.0	0.00	N/A
3534	7	**0**	7	**6**	**85.7**	**0.17**	**32.3**
3546	**10**	**0**	**10**	**9**	**90.0**	**0.11**	**38.7**
3552	**5**	**0**	**5**	**5**	**100.0**	**0.20**	**38.3**
3553	**8**	**0**	**8**	**8**	**100.0**	**0.13**	**12.0**
3567	**10**	**1**	**9**	**6**	**66.7**	**0.17**	**70.4**
3575	2	0	2	1	50.0	0.00	N/A
3578	9	1	8	6	75.0	0.00	N/A
3582	5	0	5	2	40.0	0.00	N/A
3586	7	0	7	6	85.7	0.00	N/A
3634	**1**	**0**	**1**	**1**	**100.0**	**1.00**	**100.0**
3635	**6**	**0**	**6**	**6**	**100.0**	**0.17**	**9.6**
3639	11	1	10	7	70.0	0.00	N/A
3844	**8**	**0**	**8**	**8**	**100.0**	**0.25**	**92.5**
3845	2	0	2	1	50.0	0.00	N/A
3873	10	1	9	6	66.7	0.00	N/A
3991	**10**	**0**	**10**	**6**	**60.0**	**0.17**	**70.4**
Totals	204	11	193	145	75.1		

In Table 2, entries for the ten SIC codes in which there was at least one "yes" response are shown in boldface. The proportion of OEM coatings users ranged from 0.11 to 1.00.

In our protocol, we had calculated the number of "yes" responses necessary for there to be a 95-percent chance that the fraction of users in a given SIC code was greater than zero. Application of the calculated criteria, however, would have led to rejection of most of the SIC codes for which we received positive responses. As you have pointed out, the fact there was at least one "yes" response is, *per se*, evidence that OEM coatings are used in the SIC code.

As an alternative, we decided to keep all the SIC codes for which there was at least one positive response. Using the binomial distribution, we calculated the probability that there would be at least three users among the entire California population in each SIC code. These values are shown in Table 2. This probability ranged from 0.09 (SIC 3639) to 1.00 (SIC 3634).

In conclusion, we decided to keep 10 of the SIC codes for the main survey, and to eliminate 19 of them.

Harding ESE
A MACTEC COMPANY
973 Corporate Center Drive
Pomona, CA 91768
(909) 525-9100 Phone
(909) 525-9119 Fax

Memorandum

TO: Richard Vincent **DATE:** September 20, 2001

FROM: Michael Rogozen

SUBJECT: Pilot Survey of Original Equipment Manufacturing Coating Users

ARB Agreement No. 00-314, "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents"

The purpose of this memorandum is to summarize the methods and results of the pilot survey of industrial coating users that was conducted under the subject Agreement. A more detailed presentation will be included in the draft final report for the study.

1.0 OBJECTIVES OF THE PILOT SURVEY

The objectives of the *main survey* of industrial coating users, which will be conducted later this year, are to obtain the following information from manufacturing facilities that apply original equipment manufacture (OEM) coatings to the products that they manufacture:

- Temporal patterns of coating and thinner and cleanup solvent use; and
- Effect of weather on use of OEM coatings

The purpose of the *pilot survey* was to identify areas where the survey instruments may be improved, and to obtain initial estimates of the variance in important survey variables.

2.0 SAMPLING FRAME AND SELECTION OF PILOT SURVEY SAMPLE

The sampling frame for both the main survey and the pilot survey is all manufacturing facilities in California that are likely to use significant quantities of OEM coatings and associated thinners and cleanup solvents.

2.1 Initial Definition of the Sampling Frame

Using our general knowledge of industrial processes, we identified 136 four-digit standard industrial classification (SIC) codes where OEM coatings potentially would be used. Our mailing list provider, InfoUSA.com, determined that there are 30,614 facilities in California in those SIC codes (Walker, 2001).[1] It has been the principal investigator's experience in recent surveys that a significant number of SIC codes believed *a priori* to be relevant turned out not to be; one result was a waste of resources on ineligible facili-

[1] The mailing list provider's criteria for this initial estimate were that the facility be in California and that at least one of the SIC codes associated with it was on our list of 136. Later, we restricted the facilities to those whose ***primary*** SIC codes were on our final list.

ties. The applicability of many of the SIC codes could be verified by seeing whether they corresponded to facilities in various point source emission inventory databases. PES reviewed a permit database provided by the San Joaquin Valley Unified Air Pollution Control District. Darryl Look of the ARB searched the California Emissions Inventory Development and Reporting System (CEIDARS II) database. Between the two searches, we verified that OEM coatings were used in 105 of the 136 SIC codes.

2.2 Pre-Pilot Survey

PES conducted a "pre-pilot" survey of the remaining 31 SIC codes to determine whether they should be included in the pilot and main surveys. The methods and results of the pre-pilot survey were described in my July 6, 2001 memorandum to you, a copy of which is attached. Ten SIC codes from the pre-pilot survey were retained for the pilot survey.

2.3 Pilot Survey Potential Sample

For the pilot survey, the sampling frame was defined as those California SIC codes that met at least one of the following criteria:

- Corresponding to at least one facility having a permit for an OEM coating operation in the San Joaquin Valley Air Pollution Control District's permitting database;

- Associated in the ARB's California Emissions Inventory Development and Reporting System (CEIDARS II) database with at least one source classification code (SCC) contained "coatings" in its definition; or

- In our experience and judgment, likely to include OEM coating operations, *except* for those eliminated by the pre-pilot survey.

These criteria were met by 180 SIC codes. For the pilot survey, we attempted to select one facility at random from each of these codes in a CD-ROM database developed by InfoUSA.com (Power Business, Version 1.3). We selected only facilities for which the SIC code of interest was the primary SIC code. For four of the primary SIC codes, there were no California firms. Therefore, the potential sample size was **176**. Table 1 lists the SIC codes in the pilot survey.

3.0 PILOT SURVEY METHODS

3.1 Survey Management Database

Facility contact information (name, address, telephone number, etc.) was copied from the CD-ROM database to a Microsoft Access™ database designed specifically for this project. Fields for various types of data to be obtained through the survey, such as fax numbers, e-mail addresses, and numbers of employees, were included in a facility data table. Other tables were set up to track the status of each company in the survey and to store response data. The database also included various queries to examine the tables, and forms for data entry.

Table 1

SIC CODES FOR THE PILOT SURVEY

SIC Code	Description	SIC Code	Description
2033	Canned Fruits Vegetables & Preserves	2673	Plastics Foil & Coated Paper Bags
2048	Prepared Feeds For Animals & Fowls	2679	Converted Paper & Paperboard Prods Nec
2063	Beet Sugar	2952	Asphalt Felts & Coatings
2084	Wine Brandy & Brandy Spirits	3069	Fabricated Rubber Products Nec
2085	Distilled & Blended Liquors	3086	Plastics Foam Products
2086	Bottled & Canned Soft Drinks	3088	Plastics Plumbing Fixtures
2221	Broadwoven Fabric Mills-Manmade & Silk	3089	Plastics Products Nec
2261	Finishers-Broadwoven Fabrics-Cotton	3211	Flat Glass
2269	Finishers Of Textiles Nec	3231	Glass Products Made Of Purchased Glass
2295	Coated Fabrics-Not Rubberized	3272	Concrete Prods Except Block & Brick
2339	Womens Misses & Juniors Outerwear Nec	3281	Cut Stone & Stone Products
2394	Canvas & Related Products	3312	Steel Works & Blast Furnaces
2396	Automotive Trimmings & Apparel Findings	3316	Cold-Rolled Steel Sheet Strip & Bars
2421	Sawmills & Planing Mills-General	3317	Steel Pipe & Tubes
2426	Hardwood Dimension & Flooring Mills	3411	Metal Cans
2431	Millwork	3412	Metal Shipping Barrels Drums Kegs/Pails
2434	Wood Kitchen Cabinets	3423	Hand & Edge Tools
2435	Hardwood Veneer & Plywood	3429	Hardware Nec
2439	Structural Wood Members Nec	3432	Plumbing Fixture Fittings & Trim
2441	Nailed & Lock Corner Wood Boxes & Shook	3433	Heating Equipment
2449	Wood Containers Nec	3441	Fabricated Structural Metal
2451	Mobile Homes	3442	Metal Doors Sash Frames Molding & Trim
2452	Prefab Wood Buildings & Components	3443	Fabricated Plate Work (Boiler Shops)
2499	Wood Products Nec	3444	Sheet Metal Work
2511	Wood Household Furn Except Upholstered	3446	Architectural & Ornamental Metal Work
2512	Wood Household Furniture Upholstered	3448	Prefabricated Metal Buildings
2514	Metal Household Furniture	3449	Miscellaneous Structural Metal Work
2517	Wood Tv & Radio Cabinets	3451	Screw Machine Products
2519	Household Furniture Nec	3452	Bolts Nuts Screws Rivets & Washers
2521	Wood Office Furniture	3469	Metal Stampings Nec
2522	Office Furniture Except Wood	3471	Electroplating Plating & Polishing
2531	Public Building & Related Furniture	3479	Coating Engraving & Allied Svcs Nec
2541	Wood Office & Store Fixtures	3489	Ordnance & Accessories Nec
2542	Office & Store Fixtures Except Wood	3491	Industrial Valves
2591	Drapery Hardware & Window Blinds/Shades	3492	Fluid Power Valves & Hose Fittings
2599	Furniture & Fixtures Nec	3494	Valve & Pipe Fittings Nec
2652	Setup Paperboard Boxes	3495	Wire Springs
2655	Fiber Cans Tubes Drums & Similar Prods	3496	Miscellaneous Fabricated Wire Products
2656	Sanitary Food Containers Except Folding	3498	Fabricated Pipe & Pipe Fittings
2657	Folding Paperboard Boxes	3499	Fabricated Metal Products Nec
2671	Packaging Paper & Plastics Film-Coated	3511	Steam Gas & Hydraulic Turbines
2672	Coated & Laminated Paper Nec	3523	Farm Machinery & Equipment

Table 1

SIC CODES FOR THE PILOT SURVEY

(Continued)

SIC Code	Description	SIC Code	Description
3524	Lawn & Garden Tractors/Home Lawn Equip	3641	Electric Lamp Bulbs & Tubes
3531	Construction Machinery & Equipment	3645	Residential Electric Lighting Fixtures
3532	Mining Machinery & Equipment	3646	Commercial Electric Lighting Fixtures
3533	Oil & Gas Field Machinery & Equipment	3648	Lighting Equipment Nec
3534	Elevators & Moving Stairways	3651	Household Audio & Video Equipment
3535	Conveyors & Conveying Equipment	3663	Radio & Tv Broadcasting Equipment
3536	Overhead Traveling Cranes & Hoists	3669	Communications Equipment Nec
3537	Industrial Trucks Tractors & Trailers	3672	Printed Circuit Boards
3541	Machine Tools-Metal Cutting Types	3674	Semiconductors & Related Devices
3542	Machine Tools-Metal Forming Types	3675	Electronic Capacitors
3544	Special Dies & Tools & Die Sets	3676	Electronic Resistors
3545	Cutting Tools & Machine Tool Access	3677	Electronic Coils & Transformers
3546	Power-Driven Hand Tools	3678	Electronic Connectors
3547	Rolling Mill Machinery & Equipment	3679	Electronic Components Nec
3552	Textile Machinery	3694	Elec Equip For Internal Comb Engines
3553	Woodworking Machinery	3699	Electrical Machinery Equip & Supls Nec
3554	Paper Industries Machinery	3711	Motor Vehicles & Passenger Car Bodies
3555	Printing Trades Machinery & Equipment	3713	Truck & Bus Bodies
3556	Food Products Machinery	3714	Motor Vehicle Parts & Accessories
3559	Special Industry Machinery Nec	3715	Truck Trailers
3561	Pumps & Pumping Equipment	3716	Motor Homes
3563	Air & Gas Compressors	3721	Aircraft
3564	Industrial & Commercial Fans & Blowers	3724	Aircraft Engines & Engine Parts
3565	Packaging Machinery	3728	Aircraft Parts/Auxiliary Equipment Nec
3567	Industrial Process Furnaces & Ovens	3731	Ship Building & Repairing
3569	General Industrial Machinery Nec	3732	Boat Building & Repairing
3571	Electronic Computers	3743	Railroad Equipment
3577	Computer Peripheral Equipment Nec	3751	Motorcycles Bicycles & Parts
3579	Office Machines Nec	3761	Guided Missiles & Space Vehicles/Parts
3581	Automatic Vending Machines	3764	Guided Missile/Space Vehicle Prop Units
3585	Air Conditioning & Heating Equipment	3769	Guided Missile/Space Vehicle Parts Nec
3596	Scales & Balances-Except Laboratory	3792	Travel Trailers & Campers
3599	Industrial & Commercial Machinery Nec	3795	Tanks & Tank Components
3612	Power & Distribution Transformers	3799	Transportation Equipment Nec
3613	Switchgear & Switchboard Apparatus	3812	Search Detection Systems & Instruments
3621	Motors & Generators	3823	Industrial Instruments For Measurement
3625	Relays & Industrial Controls	3825	Instruments For Measuring Electricity
3629	Electrical Industrial Apparatus Nec	3826	Laboratory Analytical Instruments
3631	Household Cooking Equipment	3827	Optical Instruments & Lenses
3632	Household Refrigerators & Freezers	3829	Measuring & Controlling Devices Nec
3634	Electric Housewares & Fans	3842	Orthopedic & Prosthetic Appliances
3635	Household Vacuum Cleaners	3844	X-Ray Apparatus & Tubes

Table 1

SIC CODES FOR THE PILOT SURVEY

(Continued)

SIC Code	Description
3861	Photographic Equipment & Supplies
3931	Musical Instruments
3944	Games Toys & Childrens Vehicles
3949	Sporting & Athletic Goods Nec
3991	Brooms & Brushes
3993	Signs & Advertising Specialties
3995	Burial Caskets
3999	Manufacturing Industries Nec

3.2 Survey Instruments

Each facility was mailed an envelope containing a cover letter from PES, a six-page questionnaire, and an explanatory letter from the ARB. Neither return envelopes nor return postage were included in the survey packages.[2] The cover letter stated the purpose of the survey and assured the facility that information identified as "confidential" or "trade secret" would be held as such by PES and the ARB. It also instructed the recipient to fill out only the first form of the questionnaire if it was ineligible for the survey.

The questionnaire comprised five forms. Form 1 asked for basic facility information, such as contact information and number of employees. It included a section in which the respondent could identify one or more reasons why it should not be included in the survey. These included:

- Not a manufacturer or job shop;
- Manufacturer or job shop but not a coatings user;
- Administrative or sales location only;
- No operations in 2000; and
- Other (to be explained briefly)

Form 2 asked which general types of thinners and cleanup solvent (solvent-based or water-based) were used with each of eight types of substrates (paper, fabric, etc.). Form 3 asked for information on the facility's operating schedule, including:

- Days of the week, by season of the year;

[2] See Section 6.

- Hours of the day, on weekdays, by season;
- Hours of the day, on weekends, by season; and
- Each month's percentage of annual thinning and cleanup solvent use

The purpose of Form 4 was to obtain data on the influence of weather (temperature and/or precipitation) on use of thinning and cleanup solvents. Finally, Form 5 asked for comments on the questionnaire form itself.[3]

3.3 Mailing and Follow-Up

The Access database was used to generate mailing labels for the pilot survey. Labels were placed on the cover letter so that they would show through the windows of the mailing envelopes. We mailed the surveys in six batches from July 12 to August 6, 2001. The reason for spacing out the mailings was to allow time for the recipients to receive the surveys (and perhaps respond to them) before we made follow-up calls. For all the survey packages that were returned by the U.S. Postal Service, we tried to find a corrected or new mailing address.

Beginning the week of July 16, 2001, we began calling all facilities that had not yet responded. We asked each one if it had received the survey forms and offered our assistance in filling them out. In many cases, we faxed or mailed additional copies of the forms. Often, numerous follow-up calls were necessary.[4]

3.4 Review and Data Entry

All "positive" responses, i.e. those containing the requested survey data, were reviewed by the Principal Investigator. In a few cases, respondents were called to clarify responses or obtain missing data. Results were entered into the Access database through on-screen "forms" having formats similar to those of the questionnaire pages.

4.0 SURVEY RESPONSE

Table 2 characterizes the response to the survey. Twelve facilities (7 percent) were apparently out of business. Thus, 164 facilities were available to participate in the survey. We received some type of response (including refusals to cooperate) from 136 (83 percent) of these. A very large portion of the responding facilities in the potential sample (104 of 136, or 76 percent) declared themselves ineligible. Of the 60 eligible facilities, 11 (18 percent) provided useful data. These 11 useful responses comprise about 6 percent of the original potential sample.

Figure 1 shows the distribution of the mode of responses to the survey. About two thirds of the responses were by telephone. Of the 11 responses with emission inventory data, 9 were by mail and two were by fax.

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[3] This form will not be included in the questionnaire for the main survey.
[4] The efficacy of our follow-up measures is evaluated in Section 6.2.

Table 2

RESPONSES TO THE OEM COATING USERS SURVEY

TOTAL SURVEYS MAILED			176
Presumed Out of Business			12
	Telephone Disconnected	5	
	Returned by USPS	4	
	No Answer	3	
AVAILABLE FOR SURVEY			164
Ineligible for the Survey			104
	Manufacturer But Uses No Coatings	60	
	Not a Manufacturer	27	
	Administrative or Sales Location Only	16	
	No 2000 Operations	1	
ELIGIBLE FOR THE SURVEY			60
	Refused to Respond	20	
	Responded With Data	11	
	Did Not Respond	29	

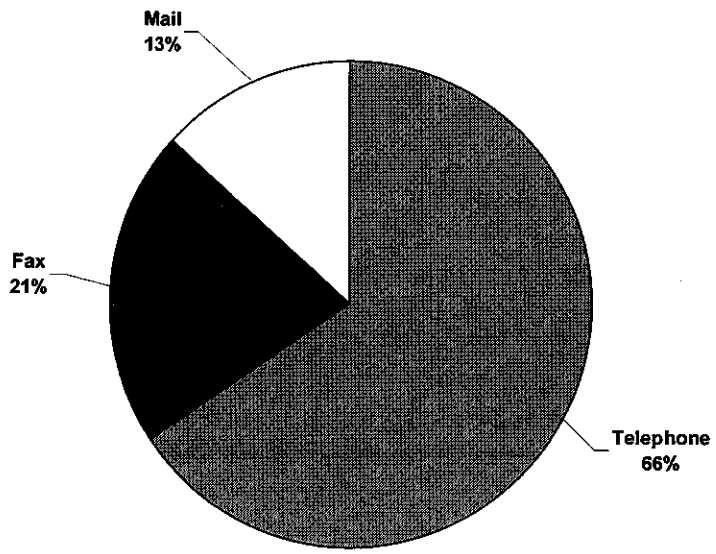

Figure 1. Distribution of Modes of Response to the Pilot Survey.

5.0 SURVEY RESULTS

The purpose of the following discussion is not to develop conclusions about the use of thinners and cleanup solvents – there were too few responses to support generalizations – but rather to illustrate the types of findings to be obtained from the main survey.

5.1 Characteristics of the Survey Sample

As noted above, 11 facilities reported that they used coatings and answered most or all the questions. Table 3 shows their SIC codes, and Table 4 summarizes their geographical distribution. Responding facilities are in five counties and three air basins. Not surprisingly, the three air basins represented all have high concentrations of manufacturing activity. The number of employees per facility ranged from 6 to 424; the median value was 39.

Table 3

SIC CODES FOR THE OEM COATING USERS THAT PROVIDED DATA

SIC Code	Description
2261	Finishers-Broadwoven Fabrics-Cotton
2295	Coated Fabrics-Not Rubberized
2541	Wood Office & Store Fixtures
3448	Prefabricated Metal Buildings
3511	Steam Gas & Hydraulic Turbines
3535	Conveyors & Conveying Equipment
3536	Overhead Traveling Cranes & Hoists
3554	Paper Industries Machinery
3612	Power & Distribution Transformers
3714	Motor Vehicle Parts & Accessories
3715	Truck Trailers

Table 4

GEOGRAPHICAL DISTRIBUTION OF OEM COATING USERS THAT PROVIDED DATA

County	No. of Responses	Percent of Responses	Air Basin	No. of Responses	Percent of Responses
Los Angeles	4	36.4	South Coast	7	63.6
Orange	3	27.3	San Joaquin Valley	2	18.2
San Joaquin	2	18.2	San Francisco Bay Area	2	18.2
Santa Clara	1	9.1			
Sonoma	1	9.1			
Totals	11	100.0	Totals	11	100.0

Table 5 shows the types of coatings, thinners and cleanup solvents reported by the 11 facilities. Coatings reported were in only three categories: marine, fabric, and metal. The distribution of coating categories by industry type appears to be reasonable. For example, fabric coatings were used by fabrics manufacturers (SICs 2261 and 2295). Solvent-based thinners and/or cleaning compounds were reported used in nine of the eleven SIC codes.

5.2 Temporal Patterns

5.2.1 Day of the Week, by Season

To develop weekly activity patterns, we assigned an "activity level" of 1 to days of the week in which thinners and cleanup solvents were used, and a 0 to days without activity, and calculated the mean and standard deviation for each day of the week.[5] We then calculated, for each facility, each day's fraction of the total activity for the week. For example, if a facility used thinners and/or solvents Monday through Friday only, each day's fraction was 0.2. Table 6 shows the results.

For the responding facilities, essentially all the use of thinners and cleaning solvents occurs Monday through Friday. (The small use fraction for Saturday is based upon one response and is not significantly different from zero.)[6] Although, in this small sample, activity on Friday appears to be higher than that of the other weekdays, there is no statistically significant difference among the five days.

[5] This approach was used by the author in the San Joaquin Valley Air Quality Study [Rogozen, M.B. 1994. *San Joaquin Valley Air Quality Study and AUSPEX Program. Emissions Data Collection and Inventory Development. Work Element 5 (Stationary Sources).* Prepared by MBR Environmental Corporation for the California Air Resources Board, Technical Services Division, Sacramento, CA, R-MBR-93-001].

[6] In all references to statistical significance, a confidence level of 95 percent was used.

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Table 6

WEEKLY ACTIVITY PATTERN, BY SEASON OF THE YEAR

		Mon	Tue	Wed	Thu	Fri	Sat	Sun
Spring	Fraction of Weekly Activity	0.174	0.174	0.174	0.174	0.285	0.019	0.000
	C.I - Low	0.123	0.123	0.123	0.123	0.079	-0.024	0.000
	C.I. - High	0.225	0.225	0.225	0.225	0.491	0.061	0.000
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Summer	Fraction of Weekly Activity	0.177	0.177	0.177	0.177	0.277	0.017	0.000
	C.I - Low	0.132	0.132	0.132	0.132	0.095	-0.021	0.000
	C.I. - High	0.222	0.222	0.222	0.222	0.459	0.054	0.000
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Fall	Fraction of Weekly Activity	0.174	0.174	0.174	0.174	0.285	0.019	0.000
	C.I - Low	0.123	0.123	0.123	0.123	0.079	-0.024	0.000
	C.I. - High	0.225	0.225	0.225	0.225	0.491	0.061	0.000
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Winter	Fraction of Weekly Activity	0.174	0.174	0.174	0.174	0.285	0.019	0.000
	C.I - Low	0.123	0.123	0.123	0.123	0.079	-0.024	0.000
	C.I. - High	0.225	0.225	0.225	0.225	0.491	0.061	0.000

5.2.2 Hour of the Day

The method described in Section 5.2.1 was used to determine hourly fractions of daily activity, for each season of the year. For a given hour, there was no significant difference among seasons. Figure 2 shows the four-season average weekday diurnal activity pattern. Although activity was reported by at least one respondent for 20 of the 24 hours of a day, the mean activity fraction was significantly different from zero only for the time interval beginning at 7 a.m. and ending at 5 p.m.

Only one facility reported having operations on weekends. It applies thinners and cleanup solvents from midnight to 5 p.m. on Saturdays.

5.2.2 Month of the Year

All responding facilities but one reported uniform activity throughout the year. The one exception, which is in SIC 3714 (Motor Vehicle Parts & Accessories), has 78 percent of its activity June through September.

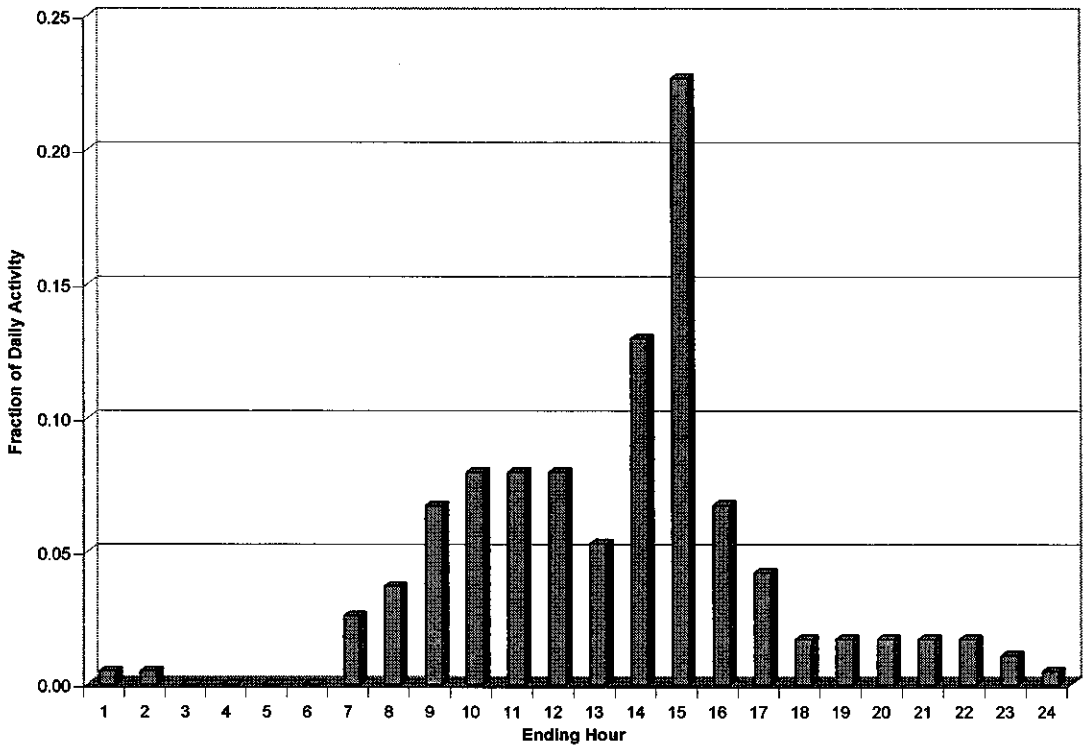

Figure 2. Diurnal Activity Pattern for Weekdays.

5.3 Weather Effects

5.3.1 Hot Weather

One firm (of ten responding to the question about hot weather) stated that it changes its procedures on hot days. The proportion responding positively and its 95-percent confidence interval were 0.1 and [-0.086, 0.29], respectively. Therefore, the result was not significantly different from zero. The facility said that it uses more thinner per gallon of paint than normal and paints both earlier and later in the day.

5.3.2 Cold Weather

None of the survey respondents reported that it changes its operations on cold days.

5.3.3 Inclement Weather

One respondent reported that it changes its operations on rainy or snowy days. Instead of checking one of the boxes on the form, the facility wrote that it uses heat lamps.

6.0 EVALUATION OF THE SURVEY

6.1 Survey Forms

Form 5 of the questionnaire asked respondents to offer any comments or suggestions about the survey, including the wording of the questions and the ease or difficulty in obtaining the requested data. Four facilities had one comment each and one had two comments. Three facilities used Form 5 to clarify information that they had reported on other forms. The only comments about the survey forms were:

> *Form 3 should include a check-off box for OEM's that only use solvent for clean-up occasionally, i.e., job shops.*
>
> *Too many boxes to fill in.*

6.2 Survey Process

One of the purposes of the pilot survey was to determine which follow-up techniques would be most useful for the main survey. The following are analyses of some of our experiences in the pilot survey.

6.2.1 Number of Follow-up Calls

Because our goal was to obtain a 90-percent response rate, we set no limit on the number of attempts to contact non-responding facilities. Instead, we tried to find out how many calls would be necessary to obtain a response. Table 7 shows the number of attempts for facilities whose cases were "resolved" (i.e., eliminated, refused, or provided data) and those that were "unresolved" (i.e., were not eliminated but did not provide data). For this discussion, an "attempt" involves written or oral follow-up contact. It does not include cases in which the facility never answered the telephone.

Table 7

NUMBER OF ATTEMPTS TO OBTAIN RESPONSES FROM NON-RESPONDING FACILITIES

Outcome	Number of Attempts to Obtain a Survey Response					95-Percent Confidence Interval
	Minimum	Maximum	Mode	Median	Mean	
Resolved	0	8	1	1	2.0	[1.7, 2.3]
Unresolved	0	12	4	5	5.4	[4.1, 6.6]

In Table 7, "0" attempts were made for facilities who responded by mail or fax without our needing to encourage them to respond; for survey packages that were returned by the

U.S. Postal Service; and for facilities whom we were unable to contact. Up to eight calls were necessary for the eligible and eliminated firms, and up to 12 calls were made to the facilities that never responded. An average of two calls were made to the facilities that eventually responded and five to six calls were made to the firms that never responded.

It is interesting to note that 34 facilities responded to the survey without any follow-up calls. The corresponding response rate was 34/164, or 20.7 percent. With the follow-up calls, the response rate increased to 136/164, or 82.9 percent. Therefore the follow-ups increased the response rate by a factor of four. The implications of these findings are discussed in Section 6.3.

6.2.2 Modes of Repeat Distribution of Survey Packages

In 57 cases (33 percent of the total), facilities stated that they had never received or had lost or discarded our survey package. Table 8 shows how we re-sent the survey packages, and the success rates of each re-sending mode. A chi square test showed no significant difference (at the 95-percent confidence level) in the rates of response to mailed and faxed follow-up survey packages ($X^2 = 0.22735$, d.f. = 1, critical $X^2 = 3.841$).

Table 8

RESPONSES TO FOLLOW-UP MAILED AND FAXED QUESTIONNAIRES

	Outcome		
Re-Send Mode	Responded	Did Not Respond	Total
Mail	14	4	18
Fax	28	11	39
Totals	42	15	57

6.2.3 Other Findings

Having no information on the names of appropriate contacts at the pilot survey facilities, we addressed all surveys to "Owner or Manager." When making follow-up calls, we learned that, if a contact name was unavailable, it was better to ask for a "manufacturing engineer" or "operations manager." In addition, we confirmed a lesson learned from previous recent surveys: it is rarely useful, and sometimes counterproductive, to leave detailed messages for facility contact people on the initial follow-up call. We suspect that, if the person knows that the call is about the survey, and does not wish to respond, then he or she simply does not call us back. On the other hand, if the message has minimum content, such as just our caller's name and telephone number, then the chance of a call-back is higher; during the telephone conversation, we have at least an opportunity to convince the facility to respond.

6.3 Implications for Main Survey

6.3.1 SIC Codes and Potential Sample Size

We do not wish to place too much emphasis on the fact that responses with data were received from only 11 of the 176 four-digit SIC codes. Only one survey package was sent to each SIC code. Twenty facilities refused to respond and 29 did not respond. There is reason to believe that some of these are OEM coating users. For the main survey, we propose to use all but one of the 176 four-digit SIC codes used in the pilot survey. The exception is SIC 2952 (Asphalt Felts and Coatings). Examination of the definition of this SIC code showed that it applied to the *manufacture*, not the *use*, of coatings.[7]

Our proposed budget for this portion of the project assumed that the potential sample of OEM coating users would be 5,400. That number was based on the assumption that there would be 54 relevant SIC codes; that we would need a sample of 20 facilities in each SIC code to obtain reasonably small confidence limits about our findings; and that we would obtain a 20-percent response rate. As a "worst case," assume that the proportion of responses with useful data in the main survey is the same as that in the pilot survey. This proportion is 11/176. Applying this to the 5,400 budgeted facilities would result in 337.5 useful responses, or about 2 per four-digit SIC code. This is not acceptable. However, we can aggregate the remaining 175 four-digit SIC codes into 15 two-digit SIC codes. Then the expected number of responses per two-digit SIC code would be 22.5, which would appear to be adequate.

Table 9 shows the two-digit SIC codes to be sampled. Please note that we will **not** give the mailing list provider a list of two-digit codes to use as search criteria, as many four-digit codes within each two-digit group are not relevant. Instead, we will use the same list of four-digit codes as was used for the pilot survey (except for SIC 2952).

6.3.2 Survey Forms

The two comments in Section 6.1 notwithstanding, we do not believe it necessary to make any major changes to the survey package. We do recommend the following:

- Delete Form 5 – Survey Recipient Feedback from the questionnaire, as it is no longer needed;
- Correct a typographical error on Form 4: change "A. Precipitation" to "B. Precipitation;" and
- Change the backup letter from the ARB to be more specific to this survey.

[7] The definition is available on the Internet at www.osha.gov/cgi-bin/sic/sicser2.

6.3.2 Survey Procedures

For the main survey, we will make the following changes in our procedures:

- The survey forms will be printed by a commercial printer and mailed by a mailing house, rather than prepared and mailed in-house;

- If the presumed contact at a given facility is not available, we will ask for a "manufacturing engineer" or "operations manager." We will not leave detailed messages for presumed contacts at each facility; and

- It did not appear useful to make more than five (or perhaps six) follow-up calls to non-responding facilities. We will therefore limit our follow-up calls to five, unless the survey response is seriously deficient.

Table 9

STRATIFICATION OF THE MAIN SURVEY: TWO-DIGIT SIC CODES

SIC Code	Description	Positive Response in Pilot Survey
20	Food and Kindred Products	
22	Textile Mill Products	★
23	Apparel and Other Finished Products Made From Fabrics and Similar Materials	
24	Lumber and Wood Products, Except Furniture	
25	Household Furniture	★
26	Paper and Allied Products	
30	Rubber and Miscellaneous Plastics Products	
32	Stone, Clay, Glass, and Concrete Products	
33	Primary Metal Industries	
34	Metal Cans and Shipping Containers	★
35	Industrial and Commercial Machinery and Computer Equipment	★
36	Electronic and Other Electrical Equipment and Components, Except Computer Equipment	★
37	Transportation Equipment	★
38	Measuring, Analyzing and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks	
39	Miscellaneous Manufacturing Industries	

Harding ESE
A MACTEC COMPANY
973 Corporate Center Drive
Pomona, CA 91768
(909) 525-9100 Phone
(909) 525-9119 Fax

Memorandum

TO: Richard Vincent **DATE:** October 3, 2001

FROM: Michael Rogozen

SUBJECT: Pilot Survey of California Homeowners

ARB Agreement No. 00-314, "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents"

The purpose of this memorandum is to summarize the methods and results of the pilot survey of California homeowners that was conducted under the subject Agreement. A more detailed presentation will be included in the draft final report for the study.

1.0 OBJECTIVES OF THE PILOT SURVEY

The objectives of the *main survey* of homeowners, which will be conducted later this year, are to obtain the following information from homeowners who have, within the past five years, applied architectural coatings to their present or former residence:

- Temporal patterns of coating and thinner and cleanup solvent use; and
- Effect of weather on use of architectural coatings

The purpose of the *pilot survey* was to identify areas where the survey instruments may be improved, and to obtain initial estimates of the variance in important survey variables.

2.0 SAMPLING FRAME AND SELECTION OF PILOT SURVEY SAMPLE

The sampling frame for both the main survey and the pilot survey comprised all owner-occupied residences in California for which both addresses and telephone numbers were available. This definition differed in two respects from the one originally proposed. First, in the proposal, only single-family households were to be included. We expanded the sampling frame to include condominiums and other multi-family dwellings, since their owners also use architectural coatings inside individual units. Second, in the proposal we included all households, whether or not they had listed telephone numbers. Because we decided to conduct this survey primarily by telephone, and did not wish to use random-digit dialing, limiting the sampling frame to residences with listed telephone numbers was the only practical approach. A review of an on-line version of a database maintained by InfoUSA.com indicated that there are 2,118,147 households in the sampling frame.

2.1 Potential Sample for the Main Survey

In our proposal, we estimated that a potential sample of 4,025 residences would be necessary to achieve the project's data quality objectives. Accordingly, we obtained a mailing list database of 4,025 California owner-occupied residences with listed telephone numbers from InfoUSA.com. The database supplier was instructed to select the households randomly from the statewide sampling frame.[1]

Table 1 shows how the sampling frame and the potential sample were distributed by county. A chi-square analysis showed that the potential sample's distribution by county was not significantly different from that of the sampling frame ($X^2 = 57.976$, d.f. $= 58$, $p < 0.23$). Note that six counties (Alpine, Amador, Modoc, Mono, Sierra, and Trinity) are not represented in the potential sample. For five of these counties, this was not surprising; the expected size of a randomly selected sample was less than one. For Amador County, four households were expected.

Table 2 shows how the potential sample was distributed by air basin. Because many counties are split among two or more air basins, we could not determine the distribution of the sampling frame by basin.

2.3 Pilot Survey Potential Sample

For the pilot survey, we attempted to select three households at random for each county represented in the main survey potential sample. Ideally, the potential sample would be 3 x 58 = 174 households. However, because our database contained only 0, 1, or 2 entries for several counties, the maximum possible potential sample size was 151. Table 3 shows how the pilot survey potential sample was distributed by air basin. The distribution is somewhat different from that of the main survey potential sample. For example, there are no households in the Mojave Desert Air Basin and there are more in the Mountain Counties Air Basin than in the much more populous South Coast Air Basin. These disparities are not important in the pilot survey, since its purpose is to evaluate materials and methods and obtain only some preliminary data.

3.0 PILOT SURVEY METHODS

3.1 Survey Management Database

The data file received from InfoUSA.com contained the following types of information about each household:

- Name of homeowner
- Address
- Telephone Number
- Age Code
- Household Income Code
- Years in Residence

[1]The database supplier had no practical way of randomly selecting households by county or air basin.

Table 1

DISTRIBUTION OF SAMPLING FRAME AND POTENTIAL SAMPLE, BY COUNTY

County	Sampling Frame	Potential Sample	County	Sampling Frame	Potential Sample
Alameda	94,845	168	Orange	192,433	391
Alpine	34	0	Placer	22,267	34
Amador	2,109	0	Plumas	1,253	1
Butte	19,320	33	Riverside	110,748	198
Calaveras	2,392	2	Sacramento	69,630	144
Colusa	1,176	5	San Benito	3,698	5
Contra Costa	84,203	152	San Bernardino	83,147	177
Del Norte	1,840	1	San Diego	188,292	370
El Dorado	16,217	27	San Francisco	39,799	72
Fresno	43,762	91	San Joaquin	33,400	78
Glenn	2,724	7	San Luis Obispo	22,219	47
Humboldt	9,344	16	San Mateo	56,682	111
Imperial	7,008	9	Santa Barbara	29,126	50
Inyo	1,668	4	Santa Clara	114,819	229
Kern	43,067	80	Santa Cruz	18,013	24
Kings	6,766	12	Shasta	13,158	20
Lake	4,883	9	Sierra	7	0
Lassen	1,589	6	Siskiyou	5,748	13
Los Angeles	468,985	884	Solano	26,399	49
Madera	7,623	9	Sonoma	35,826	65
Marin	22,234	59	Stanislaus	28,567	56
Mariposa	1,853	3	Sutter	6,412	8
Mendocino	7,009	11	Tehama	4,562	6
Merced	13,602	26	Trinity	52	0
Modoc	403	0	Tulare	22,479	33
Mono	56	0	Tuolumne	5,960	15
Monterey	20,174	35	Ventura	58,704	100
Napa	10,875	24	Yolo	11,217	21
Nevada	13,790	26	Yuba	3,979	9
Totals				2,118,147	4,025

Table 2

DISTRIBUTION OF POTENTIAL SAMPLE BY AIR BASIN

Basin Code	Basin Name	Number in Potential Sample
GBV	Great Basin Valleys	4
LC	Lake County	9
LT	Lake Tahoe	5
MC	Mountain Counties	73
MD	Mojave Desert	105
NC	North Coast	38
NCC	North Central Coast	64
NEP	Northeast Plateau	19
SC	South Coast	1,505
SCC	South Central Coast	197
SD	San Diego	370
SF	San Francisco Bay Area	870
SJV	San Joaquin Valley	367
SS	Salton Sea	67
SV	Sacramento Valley	332
	Total	4,025

Table 3

DISTRIBUTION OF PILOT SURVEY POTENTIAL SAMPLE BY AIR BASIN

Basin Code	Basin Name	Number in Potential Sample
GBV	Great Basin Valleys	3
LC	Lake County	3
LT	Lake Tahoe	1
MC	Mountain Counties	15
MD	Mojave Desert	0
NC	North Coast	7
NCC	North Central Coast	9
NEP	Northeast Plateau	6
SC	South Coast	12
SCC	South Central Coast	9
SD	San Diego	3
SF	San Francisco Bay Area	24
SJV	San Joaquin Valley	24
SS	Salton Sea	3
SV	Sacramento Valley	32
	Total	151

- Home Value Code
- Owner vs. Renter
- Single Vs Multi-Family Unit
- County Code and Name
- Metropolitan Statistical Area Code and Name

We copied this information to a Microsoft Access™ database designed specifically for this project. We then added a field for the air basin of residence, as well as for various types of data to be obtained through the survey, such as whether the homeowner was to be offered an incentive coupon. Other tables were set up to track the status of each household in the survey and to store response data. The database also included various queries to examine the tables, and forms for data entry.

3.2 Survey Instruments

To test the efficacy of different survey strategies, we divided the potential sample into four roughly equal parts.[2] Half the homeowners were mailed a notification letter and half were not. Half were offered a grocery certificate and half were not. Table 4 shows the groupings.

Table 4

MODES OF INITIAL CONTACT AND INCENTIVES FOR HOMEOWNERS SURVEY

	Incentive	No Incentive	Totals
Letter	38	35	73
No Letter	39	39	78
Totals	77	74	151

3.2.1 Notification Letter

A one-page letter on PES stationery was mailed to half the residences in the potential sample.[3] The letter stated the purpose of the project and summarized the survey and the questions to be asked. It said that the recipient had been chosen at random "from a list of California residents," and notified the recipient that he or she would be called soon. Recipients were assured that no personal or financial information would be sought, that they would be anonymous, and that we were not trying to sell them anything. The letters to the homeowners in the "Incentive" group offered the grocery certificate.

[2] Two notification letters were returned by the U.S. Postal Service as undeliverable. The corresponding homeowners were changed to the "No Letter" category, and we tried to call them.
[3] Copies of the notification letters are in Attachment 1.

3.2.2 Telephone Script

All telephone callers were required to follow, word for word, a single telephone script.[4] The general format of the script was patterned after one used by Wilson et al. (1991) for a microenvironmental air toxics exposure and monitoring study. Questions were numbered so that, at various junctures, the caller could be instructed where in the script to continue, given the response to the latest question. The purpose of the first nine questions was to determine whether the person answering the telephone was "qualified" to participate. To qualify, one had to meet the following criteria:

- Be over 18 years old;
- Live in the residence that was called;
- Be, or live with, the owner(s) of the residence; and
- Have done house painting (indoors or outdoors) at his or her present home or at another home within the last five years

One of the first questions asked what type of residence best described the home (e.g., detached single-family, duplex, etc.). It was believed that this information could prove useful in statistical analyses of the survey data.

The next group of questions (10 through 19) asked about the *last* time that the person did any painting. Data sought included the season, part of week (weekday or weekend), and time of day; and what general types of materials were used for cleaning.

The last group of questions (20 through 23) concerned *future* painting activities. Homeowners were asked about how they would alter their painting behavior on hot or cold days or in inclement weather.

3.3 Telephone Calls

Household pilot survey telephone calls were made from August 22, 2001 to September 18, 2001. All calls were made on weekdays. If the call reached an answering machine or voice mail, we did not leave a message. We kept a running record of the date and time of the latest call to each household, so that we could later determine the best times to call for the main survey.

3.4 Data Entry

The telephone calling began before the survey management database that was described in Section 3.1 was ready. Results were temporarily entered into a Microsoft Excel™ spreadsheet. When the database was ready, the data from the spreadsheet were copied into Access. Subsequent results were entered into the Access database through on-screen "forms" having formats similar to those of the telephone scripts.

---

[4] A copy of the script is in Attachment 2.

4.0 SURVEY RESPONSE

Table 5 characterizes the response to the survey. We were unable to interview 23 households (15.2 percent of the potential sample). Thus, 128 households were available to participate in the survey. Of these, 31 were ineligible, either because they were not owner-occupied or because the residents had painted in the past five years. That left 97 households that were available *and* eligible. Of these, 43 (44 percent) provided useful survey data and 54 refused. The 43 useful responses comprise 28.5 percent of the original potential sample.

Table 5

RESPONSES TO THE HOMEOWNERS SURVEY

TOTAL POTENTIAL SAMPLE			151
Unable to Respond			23
	Telephone Disconnected or Fax Machine	7	
	Not English Speaking	1	
	Never Answered Telephone	15	
AVAILABLE FOR SURVEY			128
Ineligible for the Survey			31
	Not an Owner-Occupied Household	2	
	No Painting in Past Five Years	29	
ELIGIBLE FOR THE SURVEY			97
	Refused to Respond	54	
	Responded With Data	43	

5.0 SURVEY RESULTS

The purpose of the following discussion is not to develop conclusions about the use of thinners and cleanup solvents – there were too few responses to support generalizations – but rather to illustrate the types of findings to be obtained from the main survey.

5.1 Characteristics of the Survey Sample

5.1.1 Geographic Distribution

As noted above, 43 households reported that they had done painting and answered most or all the questions. Table 6 summarizes their geographical distribution. Responding households are in 30 counties and 11 air basins. A chi-square test showed that the distribution of basins among the responding households is not significantly different from that of the pilot potential sample ($X^2 = 8.189$, d.f. = 10, critical $X^2 = 18.31$). About half the responding residences were in urban areas (in 13 standard metropolitan statistical areas) and half were rural.

Table 6

GEOGRAPHICAL DISTRIBUTION OF HOUSEHOLDS THAT PROVIDED DATA

County	No. of Responses	Percent of Responses
Butte	2	4.7
Calaveras	1	2.3
Colusa	3	7.0
Contra Costa	1	2.3
El Dorado	1	2.3
Fresno	2	4.7
Glenn	3	7.0
Humboldt	2	4.7
Inyo	1	2.3
Kings	1	2.3
Lake	1	2.3
Lassen	1	2.3
Los Angeles	1	2.3
Madera	2	4.7
Mariposa	1	2.3
Mendocino	2	4.7
Napa	2	4.7
Nevada	2	4.7
Plumas	1	2.3
Riverside	1	2.3
Sacramento	1	2.3
San Bernardino	1	2.3
San Diego	1	2.3
Santa Clara	1	2.3
Santa Cruz	1	2.3
Shasta	3	7.0
Sonoma	1	2.3
Sutter	1	2.3
Tehama	1	2.3
Tuolumne	1	2.3
Totals	43	100.0

Air Basin	No. of Responses	Percent of Responses
Great Basin Valleys	1	2.3
Lake County	1	2.3
Mountain Counties	7	16.3
North Coast	4	9.3
North Central Coast	1	2.3
Northeast Plateau	1	2.3
South Coast	3	7.0
San Diego	1	2.3
San Francisco Bay	5	11.6
San Joaquin Valley	5	11.6
Sacramento Valley	14	32.6
Totals	43	100.0

5.1.2 Household Characteristics

The mailing list provider included several types of demographic data with each household entry. Some of the information is based upon examination of individual property records, and some is based upon generalization from U.S. Census data. For example, the household income for a given household is assumed to be the same as the median or mean income for the census tract in which the house is located. In any event, *none of the following information in this subsection was obtained by this survey.*

Figure 1 shows the age distribution of the responding homeowners. Apparently, the sample is comprised largely of older persons. Almost half the respondents were 60 years and older.

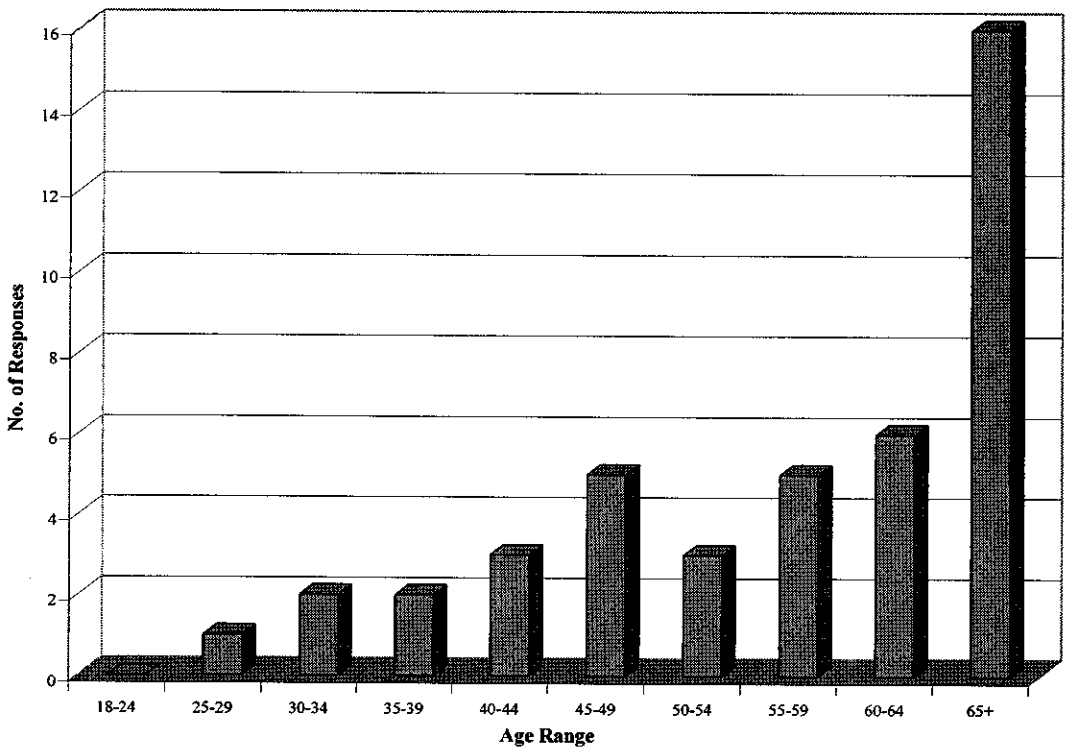

Figure 1. Age Distribution of Responding Homeowners.

All but four of the responding households were single-family dwellings. One was a townhouse, one was a duplex, and two were reported as "other." Figure 2 shows the distribution of the home values, as reported by InfoUSA.com. The modal value range is $100,001 - $150,000.

The median, mean and mode of the number of years of residence in the responding homes was 16 years, and the minimum and maximum were 1 and 33, respectively.

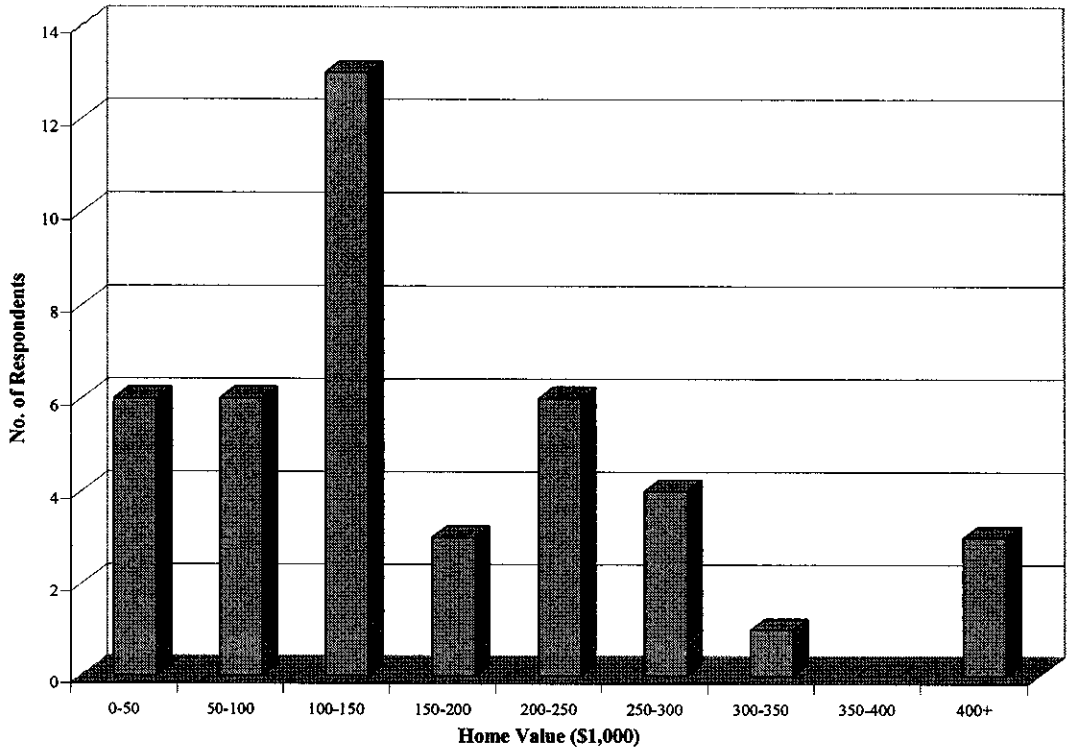

Figure 2. Distribution of Home Values of Responding Residences.

5.2 Frequency of Painting Activity

Homeowners were eligible for the survey only if they had painted within the past five years. As seen in Figure 3, 62 percent of the respondents had painted only once in that time. About 5 percent had painted 5 times.

5.3 Temporal Patterns

5.3.1 Season of Painting Activity

Homeowners were asked to remember the season of the year when they last painted their residences. Some painting was reported in all seasons but, as seen in Figure 4, most of it occurred in the spring and summer. Contrary to what one might suppose, the homeowners who painted in the fall and winter were all in the northern air basins, such as the North Coast and the Sacramento Valley.

5.3.2 Weekday and Weekend

An essentially equal number of homeowners responded "yes" to each of the three categories: "weekday," "weekend" and "both."

5.3.3 Time of Day

To develop a diurnal activity pattern, we assigned an "activity level" of 1 to quarters of the day when thinners and cleanup solvents were used, and a 0 to quarters of the day

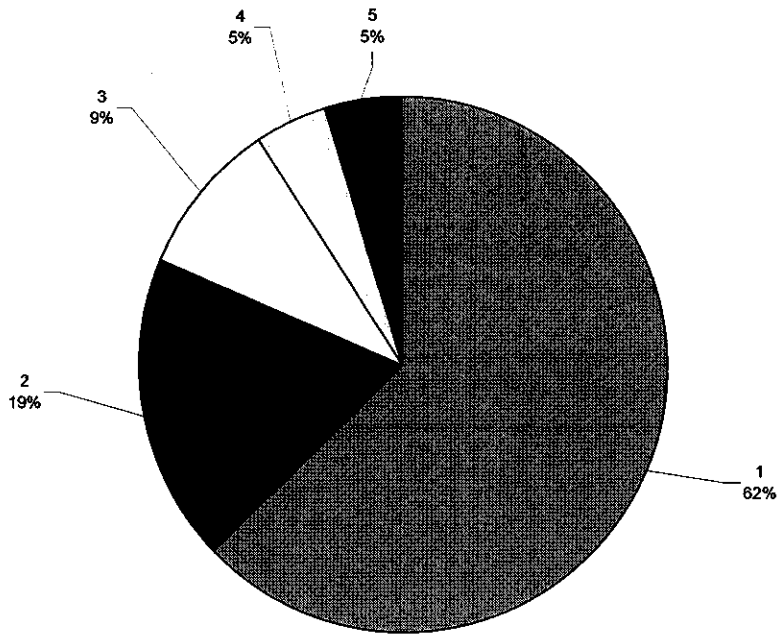

Figure 3. Number of Times Respondents Painted in Past Five Years.

without activity, and calculated the mean and standard deviation for each six-hour period. The results are shown in Table 7. Most painting occurs between 6 a.m. and 6 p.m., but a statistically significant amount occurs in the evening (6 p.m. to midnight). Although some households reported that they had painted from midnight to 6 a.m., the mean activity fraction for that time interval was not significantly different from zero.

Table 7

DIURNAL ACTIVITY PATTERN

	Midnight to 6 a.m.	6 am. to Noon	Noon to 6 p.m.	6 p.m. to Midnight
Fraction of Daily Activity	0.049	0.447	0.374	0.130
C.I - Low	-0.0076	0.342	0.282	0.070
C.I. - High	0.105	0.552	0.466	0.190

5.4 Cleanup Practices

When asked what they used to clean up brushes, rollers, or other painting equipment, 37 of 43 respondents (86 percent) said that they used water. Four used an organic solvent, and two used disposable brushes. This implies that the overwhelming majority used water-based coatings. Of the four who used an organic solvent, one used lacquer thinner and three did not know what type they used.

Two respondents who used water for cleaning also used an organic solvent: in one case it was lacquer thinner and in the other it was acetone. Also, two of the three respondents who used an unknown solvent also used water.

5.5 Weather Effects

5.5.1 Hot Weather

Table 8 shows the effect of unusually hot weather on painting activities, in decreasing order of the number of responses. Note that the percentages add up to more than 100, since not all the choices are mutually exclusive. Slightly over half the households said that they would not paint in hot weather, and about 28 percent said that the heat would not alter their painting behavior. A 95-percent confidence interval for the fraction that would not paint at all is [0.36, 0.66].

5.5.2 Cold Weather

Table 9 shows the effect of unusually cold weather on painting activities, in decreasing order of the number of responses. The response was quite different from that to hot weather. Over 65 percent of the households said that they would not paint in cold weather, and only 9 percent said that the weather would not affect their activities. No one would paint earlier in the day. A 95-percent confidence interval for the fraction that would not paint at all is [0.51, 0.79].

Table 8

RESPONSE TO HOT WEATHER

Response	Number	Percent of Sample
Not Paint at All	22	51.2
No Effect	12	27.9
Paint Indoors Only	10	23.3
Paint Earlier in the Day	6	14.0
Paint Later in the Day	3	7.0

Table 9

RESPONSE TO COLD WEATHER

Response	Number	Percent of Sample
Not Paint at All	28	65.1
Paint Indoors Only	10	23.3
No Effect	4	9.3
Paint Later in the Day	1	2.3
Paint Earlier in the Day	0	0.0

5.5.3 Inclement Weather

Table 10 shows how the respondents would react to rainy or snowy weather. Almost 70 percent would not paint at all. Three homeowners said that their activity would not be affected, and 10 said that they would paint indoors only. A 95-percent confidence interval for the fraction that would not paint at all is [0.56, 0.83].

Table 10

RESPONSE TO INCLEMENT WEATHER

Response	Number	Percent of Sample
Not Paint at All	30	69.8
Paint Indoors Only	10	23.3
No Effect	3	7.0
Paint Later in the Day	0	0.0
Paint Earlier in the Day	0	0.0

6.0 EVALUATION OF THE SURVEY

6.1 Telephone Scripts

In general, the scripts worked quite well. None of the contacts appeared to have difficulty understanding the questions or providing answers.

6.2 Survey Process

One of the purposes of the pilot survey was to determine which survey techniques would be most useful for the main survey. The following are analyses of some of our experiences in the pilot survey.

6.2.1 Number of Calls

Because our goal was to obtain a 90-percent response rate, we set no limit on the number of attempts to contact households. Instead, we tried to find out how many calls would be necessary to obtain a response. Table 11 shows the number of attempts for various outcomes.[5] For the households that answered the telephone, the distribution of the number of attempts was essentially the same whether the person provided data, refused to participate, or was ineligible. It took an average of three calls to resolve each household's status. An average of 11 calls were made to homeowners who never answered the telephone.

Table 11

NUMBER OF ATTEMPTS TO OBTAIN RESPONSES

Outcome	Number of Attempts to Obtain a Survey Response					95-Percent Confidence Interval
	Minimum	Maximum	Mode	Median	Mean	
Provided Data	1	10	1	2	3.2	[2.4, 4.0]
Refused	1	12	1	2	3.0	[2.3, 3.8]
Ineligible	1	9	1	2	3.0	[2.2, 3.8]
Never Answered	3	15	14	13	11.0	[8.9, 13.1]

6.2.2 Time of Successful Contact

One of the objectives of the pilot survey was to determine when would be the best time to call the households. Figure 5 shows the distribution of times of day when homeowners were reached. As there was no significant difference in the distributions for calls yielding survey data, calls in which homeowners refused to participate, and calls that determined that a household was ineligible, the times for all calls in those three categories of response were pooled. Contacts were made from 8:38 a.m. to 7:10 p.m. Four time intervals appeared to be "best" for making contact: 11:00 to 11:30 a.m., 1 p.m. to 2 p.m., 4:00 to 4:30 p.m., and 5 p.m. to 7 p.m.

[5] Note that "attempts" for the household survey include cases in which no one answered the telephone. For the OEM coating users survey, no-answer calls were not included as "attempts."

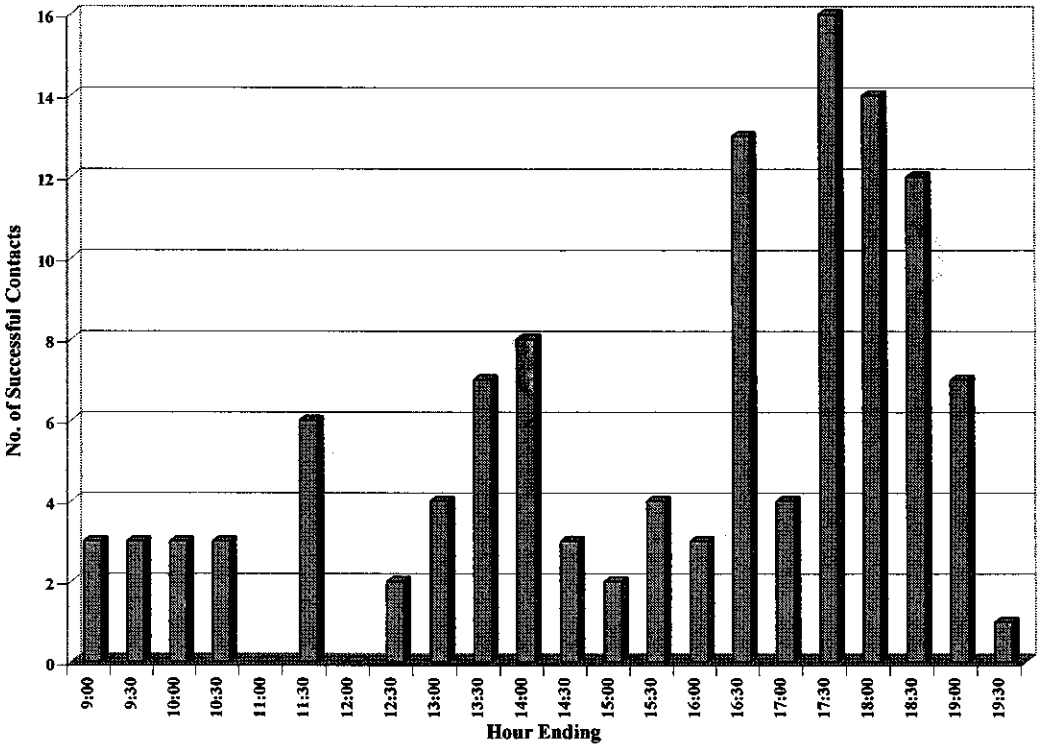

Figure 5. Distribution of Times of Contacts With Homeowners.

6.2.3 Effect of Notification Letters and Reward Offers

To evaluate the efficacy of providing notification letters and/or offering grocery certificates, we defined a desirable outcome as an eligible homeowner providing survey data. To be included in the analysis, a homeowner had to be contacted and be eligible for the survey. The two possible outcomes were then "provided data" or "refused." Table 12 summarizes the results that were used for the analysis.

The overall probability of obtaining survey data from a contacted, eligible household was 0.44. One way of examining the results is to see what combinations of letter and reward resulted in a higher success rate. In the lower part of Table 12, one can see that offering a reward or *not* sending a letter resulting in higher positive response fractions than overall (0.52 and 0.48, respectively). The highest positive response fraction was for those who were offered a reward *and* were not sent a notification letter.

It is important, however, to determine the statistical significance of these results. A chi-square test of the outcomes shows that there is no significant difference (at the 95-percent confidence level) between actual and observed numbers of the positive responses among the four categories ($X^2 = 2.169$, d.f. = 1, $p < 0.14$, critical $X^2 = 3.841$). In addition, the confidence intervals about all of the proportions in Table 12 are quite large. For example, the 95-percent confidence limits around the positive response fraction for the

Table 12

OUTCOMES OF TEST OF NOTIFICATION LETTERS AND REWARDS

TOTAL NUMBER CONTACTED AND ELIGIBLE			
	Reward	No Reward	Totals
Letter	27	20	47
No Letter	25	25	50
Totals	52	45	97
NUMBER PROVIDING SURVEY DATA			
	Reward	No Reward	Totals
Letter	12	7	19
No Letter	15	9	24
Totals	27	16	43
PROBABILITY OF OBTAINING POSITIVE RESPONSE			
	Reward	No Reward	Totals
Letter	0.44	0.35	0.40
No Letter	0.60	0.36	0.48
Totals	0.52	0.36	0.44

reward plus the letter was [0.398, 0.802]. This may be compared with the confidence interval for the overall positive response rate [0.249, 0.638].

6.3 Implications for Main Survey

Because the households in the pilot survey will not be re-surveyed (except perhaps for those we could not contact), there remain 4,025 – 151 = 3,874 households on the mailing list. On the basis of the pilot survey response, we expect to receive survey data from (43/151)(3874) = 1,103 households. This number exceeds the estimate in our proposal of the number of samples required for the 90-percent confidence interval about a sample proportion to be 10 percent of the proportion. For example, in the pilot survey, the proportion of households that would not paint in cold weather was 0.65. If we had had 1,103 responses, then the 90-percent confidence interval half-width would be 0.02815, or 4.3 percent of the proportion.

On the basis of our findings in the pilot survey, we recommend the following for the full survey:

- Retain the telephone script in its present form;

- Concentrate the telephone calls in the most propitious time intervals, i.e. 11:00 to 11:30 a.m., 1 p.m. to 2 p.m., 4:00 to 4:30 p.m., and 5 p.m. to 7 p.m.;

- Do not send notification letters or offer rewards; and

- Limit the number of telephone call attempts to four

Note that if the full survey response rate is significantly lower than that for the pilot survey, then we will reconsider the options of notification letters and/or offers of rewards.

Attachment 1

NOTIFICATION LETTER FOR HOMEOWNERS SURVEY

Pacific Environmental Services, Inc.

973 Corporate Center Drive
Pomona, CA 91768
(909) 525-9115 Phone
(909) 525-9119 FAX

August 22, 2001

Dear Sir or Madam:

Pacific Environmental Services/Harding ESE, Inc. (PES) is under contract to the California Air Resources Board (ARB) to obtain information on the use of paint thinners and cleanup solvents in California. The purpose of the study is to improve the ARB's estimates of air pollutant emissions from several types of painting activities.

As part of the research effort, PES is conducting a telephone survey to obtain information from people on the time patterns (hours of the day, days of the week, etc.) of their thinner and solvent use. Your name has been selected at random from a list of California residents. Within the next few weeks, someone from PES will be calling you to ask a few simple questions about the last time that you did any house painting (at either your current residence or a previous one). We will ask you about the season, day of week and time of day that you painted and the general types of thinners you used (mineral spirits, water, nothing, etc.). We will also ask whether extremely hot or cold weather would have any effect on your painting activity the next time that you paint.

Our survey will not ask for any personal or financial information, and no attempt will be made to sell you anything. Any data that you provide will be combined with data from other participants; no participant will be identified in any published reports.

We earnestly hope that you will help the ARB improve the State's air quality by participating in the survey. As an added incentive, we will mail a $5.00 gift certificate for Albertsons® to people who qualify for the survey and answer all the questions.

Thank you in advance for your cooperation.

Sincerely,

Pacific Environmental Services, Inc.

Michael B. Rogozen, D.Env.
Principal Investigator

Pacific Environmental Services, Inc.

973 Corporate Center Drive
Pomona, CA 91768
(909) 525-9115 Phone
(909) 525-9119 FAX

August 22, 2001

Dear Sir or Madam:

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Our survey will not ask for any personal or financial information, and no attempt will be made to sell you anything. Any data that you provide will be combined with data from other participants; no participant will be identified in any published reports.

We earnestly hope that you will help the ARB improve the State's air quality by participating in the survey.

Thank you in advance for your cooperation.

Sincerely,

Pacific Environmental Services, Inc.

Michael B. Rogozen, D.Env.
Principal Investigator

Attachment 2

TELEPHONE SCRIPT FOR HOMEOWNERS SURVEY

TELEPHONE SCRIPT FOR
ARB HOMEOWNERS SURVEY

1 Hello, my name is _____ and I'm conducting an important environmental survey for the California Air Resources Board.

2 Is this [*target phone number*]?

IF WRONG, RE-DIAL.

3 Is this a residence?

Yes **CONTINUE WITH INTERVIEW**
No I'm sorry to bother you. **HANG UP**

4 May I please speak with someone over 18 who lives here?

Yes **CONTINUE WITH INTERVIEW WHEN SOMEONE OVER 18 COMES ON THE LINE**
No **CALL BACK LATER**

IF ORIGINAL ANSWERER IS STILL ON THE LINE, GO TO 6

5 Hello, my name is _____. **GO TO 6**

6 I'm with Pacific Environmental Services, a consulting firm in Pomona, California. We're under contract to the California Air Resources Board, a state agency, to obtain some information on the use of paint thinner and cleanup solvents in house painting. I would like to emphasize that we are not selling anything, and we are not asking for any financial or personal information. We obtained your name and telephone number at random from a list of people in California who own their own homes. This interview should take less than five minutes. May we continue?

Yes **CONTINUE WITH INTERVIEW**
No Thank you for your time. **HANG UP**

7 Do you or anyone else who lives here own this residence?

Yes **CONTINUE WITH INTERVIEW**
No I'm sorry, but this interview is for homeowners only. Thank you for your time. **HANG UP**

8 Which of the following residence types best describes this home?

- ☐ Single family, detached
- ☐ Duplex
- ☐ Townhouse
- ☐ Apartment-type condominium
- ☐ Other

TELEPHONE SCRIPT FOR
ARB HOMEOWNERS SURVEY

9 Have you or anyone else who lives here done any house painting, either indoors or outdoors, at your present home or anywhere else, within the last five years?

Yes **CONTINUE WITH INTERVIEW**
No I have no further questions. Thank you very much for your time. **QUIT**

10 Now I would like to ask you several questions about your painting activities. If you answer all the questions, we will be happy, as a token of our appreciation, to send you a $5 coupon good at any Albertson's.

11 About how many times in the past five years have you done any house painting?

12 Please think about the last time that you did some painting. In what season was it?

- ☐ Spring (*March, April, May*)
- ☐ Summer (*June, July, August*)
- ☐ Fall (*September, October, November*)
- ☐ Winter (*December, January, February*)
- ☐ Don't Know

13 During which of these hours of the day did you do the painting?

- ☐ Midnight – 6 a.m.
- ☐ 6 a.m. to Noon
- ☐ Noon to 6 p.m.
- ☐ 6 p.m. to Midnight
- ☐ Don't remember

14 During which part of the week did you paint?

- ☐ Weekdays (*Monday through Friday*)
- ☐ Weekends (*Saturday, Sunday*)
- ☐ Both
- ☐ Don't remember

15 What did you use to clean your brushes, rollers or other painting equipment?

- ☐ Water **GO TO 18**
- ☐ A purchased cleaner, such as paint thinner or turpentine **GO TO 16**
- ☐ Nothing (used disposable brushes, etc.) **GO TO 20**

16 Which of the following did you use to clean your brushes, rollers, or other equipment?

- ☐ Mineral spirits
- ☐ Lacquer thinner
- ☐ Acetone
- ☐ Other (*specify*)

17 Did you also use water to clean your equipment?

Yes **CONTINUE**
No **SKIP TO 20**

18 When you used water, did you also use any other kind of cleaner?

- ☐ No **SKIP TO 20**
- ☐ Yes **CONTINUE**

19 Which of the following did you use to clean your brushes, rollers, and other equipment?

- ☐ Mineral spirits
- ☐ Lacquer thinner
- ☐ Acetone
- ☐ Other (*specify*)
- ☐ Nothing (used disposable brushes, etc.)

20 Finally, I would like to ask you some questions about the effect of weather on your house painting activity. Think about the **next** time that you might paint the inside or outside of your house.

21 On a hot day (say, above 90°F), which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ☐ Not paint at all
- ☐ Paint only indoors
- ☐ Paint earlier in the day than you would if it weren't so hot
- ☐ Paint later in the day than you would if it weren't so hot
- ☐ Hot weather would not affect your painting schedule

22 On a cold day (say, below 40°F), which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ☐ Not paint at all
- ☐ Paint only indoors
- ☐ Paint earlier in the day than you would if it weren't so cold

- ☐ Paint later in the day than you would if it weren't so cold
- ☐ Cold weather would not affect your painting schedule

23 On rainy or snowy days, which of the following would you do? Please wait to hear all the options before answering. **READ ALL THE OPTIONS BEFORE THEY RESPOND**

- ☐ Not paint at all
- ☐ Paint only indoors
- ☐ Paint earlier in the day than you would if it weren't raining or snowing
- ☐ Paint later in the day than you would if it weren't raining or snowing
- ☐ Rainy or snowy weather would not affect your painting schedule

24 Well, that's all the questions. Thank you very much for participating. The information that you have provided is very important to our survey. Remember, we offered to send you a $5 coupon good at any Albertson's? Would you like that?

No Thank you again for helping with the survey. **END THE INTERVIEW (GO TO 26)**

Yes We would like to verify your name and mailing address for the certificate. **READ FROM THE DATABASE AND OBTAIN ANY NEEDED CORRECTIONS.**

25 Again, thank you very much for your assistance.

26 **END**

Harding ESE
A MACTEC COMPANY
973 Corporate Center Drive
Pomona, CA 91768
(909) 525-9100 Phone
(909) 525-9119 Fax

Memorandum

TO: Richard Vincent **DATE:** November 20, 2001

FROM: Michael Rogozen

SUBJECT: Pilot Survey of Commercial Painters

ARB Agreement No. 00-314, "Improvement of Emissions Inventories for Industrial Coatings and Thinning and Cleanup Solvents"

The purpose of this memorandum is to summarize the methods and results of the pilot survey of commercial painters that was conducted under the subject Agreement. A more detailed presentation will be included in the draft final report for the study.

1.0 OBJECTIVES OF THE PILOT SURVEY

The objectives of the *main survey* of commercial painters, which will be conducted later this year, are to obtain the following information from companies that apply architectural and industrial maintenance (AIM) coatings:

- Quantities and types of thinners and cleanup solvents associated with AIM coatings and their association with different AIM bases;
- Data on composition of thinners and cleanup solvents;
- Temporal patterns of coating and thinner and cleanup solvent use; and
- Effect of weather on patterns of use of thinners and cleanup solvents for AIM coatings

The purpose of the *pilot survey* was to identify areas where the survey instruments may be improved, and to obtain initial estimates of the variance in important survey variables.

2.0 SAMPLING FRAME AND SELECTION OF PILOT SURVEY SAMPLE

The sampling frame for both the main survey and the pilot survey is all commercial painters in California.

2.1 Definition of the Sampling Frame

On April 18, 2001, we received from InfoUSA.com (a mailing list provider) a database of 4,589 companies in standard industrial classification (SIC) codes SIC 172101 (Painters) and 172102 (Painting Contractors – Commercial & Industrial) located in California.

The list included 166 companies for which one of our search SIC codes was a *secondary* SIC code; i.e., painting was not the main activity.[1] Most of the non-painting primary SIC codes had something to do with painting. For example, many building contractors and drywall contractors were listed. These companies are likely to do a significant amount of painting, and were left in the sampling frame. However, the list included several SIC codes for which commercial painting was unlikely, such as 523107 (Paint – Retail). We attempted to telephone all the companies whose presence in the sampling frame was questionable. We verified that many of these indeed were not commercial painters. In addition, we found several companies to be out of business. We eliminated 39 companies from the mailing list, leaving 4,550 in the sampling frame.

Using air basin maps obtained from the ARB's website, printed road maps, and various online mapping databases, we determined the air basin for every company on the mailing list. Tables 1 and 2 show the geographic distribution of the sampling frame, by county and air basin, respectively.

2.3 Pilot Survey Potential Sample

Commercial painters comprise about 22.4 percent of the budgeted total sample size for the three surveys to be conducted directly by Harding ESE, Inc.[2] The budgeted pilot survey size was 300. Therefore, we allocated (0.224)(300) = 67 pilot survey samples to the commercial painters. (Actually, 69 were chosen.) Companies were chosen at random from the 4,550 companies in the sampling frame. No attempt was made to select them from particular air basins or counties.

3.0 PILOT SURVEY METHODS

3.1 Survey Management Database

Company contact information (name, address, telephone number, etc.) was copied from the InfoUSA.com, Inc. database to a Microsoft Access™ database designed specifically for this project. Fields for various types of data to be obtained through the survey, such as fax numbers, e-mail addresses, and numbers of employees, were included in a company data table. Other tables were set up to track the status of each company in the survey and to store response data. The database also included various queries to examine the tables, and forms for data entry.

As will be discussed below, respondents were asked to provide material safety data sheets (MSDSs) for the thinners and cleanup solvents that they reported. The survey database included tables and data entry forms to record, for each MSDS, information on the manufacturer, the density, and the chemical composition.

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[1] In our search criteria for InfoUSA.com, we did not require SIC codes 172101 and 172102 to be *primary* SIC codes.

[2] Formerly Pacific Environmental Services, Inc. (PES).

Table 1

NUMBER OF COMMERCIAL PAINTERS IN SAMPLING FRAME, BY COUNTY

County	Count	County	Count
Alameda	159	Orange	593
Alpine	4	Placer	58
Amador	6	Plumas	7
Butte	36	Riverside	181
Calaveras	14	Sacramento	175
Colusa	3	San Benito	5
Contra Costa	140	San Bernardino	181
Del Norte	2	San Diego	295
El Dorado	34	San Francisco	127
Fresno	105	San Joaquin	63
Glenn	2	San Luis Obispo	56
Humboldt	23	San Mateo	146
Imperial	6	Santa Barbara	77
Inyo	5	Santa Clara	248
Kern	57	Santa Cruz	59
Kings	9	Shasta	29
Lake	15	Sierra	0
Lassen	6	Siskiyou	7
Los Angeles	918	Solano	42
Madera	8	Sonoma	107
Marin	102	Stanislaus	60
Mariposa	3	Sutter	10
Mendocino	18	Tehama	8
Merced	24	Trinity	1
Modoc	1	Tulare	26
Mono	7	Tuolumne	22
Monterey	68	Ventura	102
Napa	22	Yolo	23
Nevada	39	Yuba	6
		Total	4,550

Table 2

NUMBER OF COMMERCIAL PAINTERS IN SAMPLING FRAME, BY AIR BASIN

Air Basin	Estimated No. of Painters
Great Basin Valleys	16
Lake County	15
Lake Tahoe	19
Mojave Desert	61
Mountain Counties	126
North Central Coast	132
North Coast	54
Northeast Plateau	14
Sacramento Valley	372
Salton Sea	62
San Diego	295
SF Bay Area	1,041
San Joaquin Valley	344
South Central Coast	235
South Coast	1,764
Total	**4,550**

3.2 Survey Instruments

Each company was mailed an envelope containing a cover letter from PES, a six-page questionnaire, and an explanatory letter from the ARB.[3] Neither return envelopes nor return postage were included in the survey packages.[4] The cover letter stated the purpose of the survey and assured the company that information identified as "confidential" or "trade secret" would be held as such by PES and the ARB. It also instructed the recipient to fill out only the first form of the questionnaire if it was ineligible for the survey.

The questionnaire comprised six forms. Form 1 asked for basic company information, such as contact information and number of employees. It included a section in which the respondent could identify one or more reasons why it should not be included in the survey. These included:

- Applies coatings only to manufactured parts;

[3] A copy of the survey package is provided in Attachment A.
[4] See Section 6.

- Does no painting at all;
- Administrative or sales location only;
- No operations in 2000; and
- Other (to be explained briefly)

Form 1 included a list of types of architectural and industrial maintenance coatings to aid the respondent in deciding whether he or she was an AIM coating user.

Form 2 asked for information on the use of thinners in 2000 for thinning. Separate tables were provided for thinners used with solvent-based paints and thinners used with water-based paints. The respondent was to report the type of thinner (mineral spirits, lacquer thinner, or "other"); the gallons used per year, and the amount of thinner mixed per gallon of coating. Form 3 asked for information on the use of cleanup solvents in 2000. Again, separate tables were provided for solvents associated with solvent-based and water-based paints. The respondent was also to report the type of solvent, the amount used per year, and what was cleaned with the material (spray equipment, brushes, or "other").

For both thinners and cleanup solvents, we requested that the painter report the brand and model number and provide material safety data sheets.

Form 4 asked for information on the company's operating schedule, including:

- Days of the week, by season of the year;
- Hours of the day, on weekdays, by season;
- Hours of the day, on weekends, by season; and
- Each month's percentage of annual thinning and cleanup solvent use

The purpose of Form 5 was to obtain data on the influence of weather (temperature and/or precipitation) on use of thinning and cleanup solvents. Finally, Form 6 asked for comments on the questionnaire form itself.[5]

3.3 Mailing and Follow-Up

The Access database was used to generate mailing labels for the pilot survey. Labels were placed on the cover letter so that they would show through the windows of the mailing envelopes. All the commercial painter pilot survey packages were mailed on July 6, 2001. For all the survey packages that were returned by the U.S. Postal Service, we tried to find a corrected or new mailing address.

On July 16, 2001, we began calling all painting companies that had not yet responded. We asked each one if it had received the survey forms and offered our assistance in fill-

[5] This form will not be included in the questionnaire for the main survey.

ing them out. In many cases, we faxed or mailed additional copies of the forms. Often, numerous follow-up calls were necessary.[6]

3.4 Review and Data Entry

All "positive" responses, i.e. those containing the requested survey data, were reviewed by the Principal Investigator. In a few cases, respondents were called to clarify responses or obtain missing data. Results were entered into the Access database through on-screen "forms" having formats similar to those of the questionnaire pages.

4.0 SURVEY RESPONSE

Table 3 characterizes the response to the survey. Five companies (7 percent) were apparently out of business. Thus, 64 companies were available to participate in the survey. We received some type of response (including refusals to cooperate) from 19 (30 percent) of these. Of the 59 eligible companies, 7 (12 percent) provided useful data. These 7 useful responses comprise about 10 percent of the original potential sample.

Table 3

RESPONSES TO THE COMMERCIAL PAINTERS SURVEY

TOTAL SURVEYS MAILED			69
Presumed Out of Business			5
	Telephone Disconnected	2	
	Returned by USPS	3	
AVAILABLE FOR SURVEY			64
Ineligible for the Survey			5
	Claimed to be Out of Business	4	
	Not an AIM Coater	1	
ELIGIBLE FOR THE SURVEY			59
	Explicitly Refused to Respond	7	
	Responded With Data	7	
	Did Not Respond	45	

Figure 1 shows the distribution of the mode of responses to the survey. About 63 percent of the responses were by telephone. All seven responses with emission inventory data were received in the mail.

[6] The efficacy of our follow-up measures is evaluated in Section 6.2.

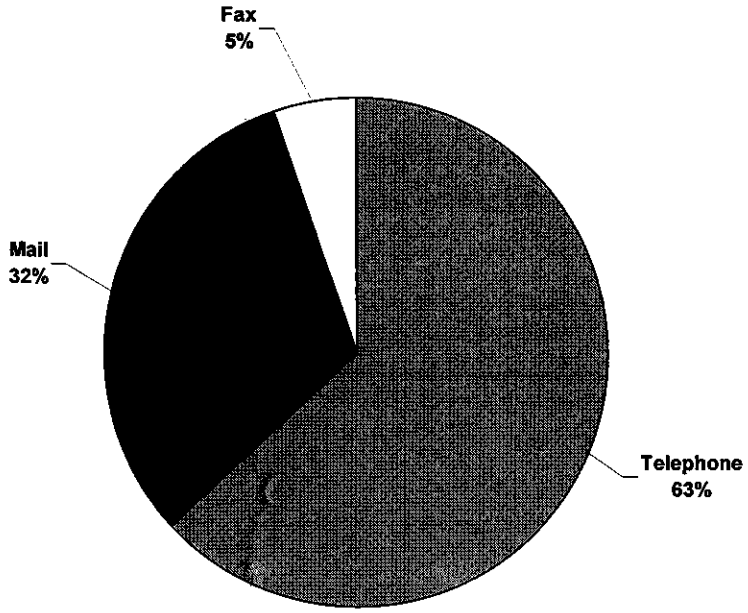

Figure 1. Distribution of Modes of Response to the Pilot Survey.

5.0 SURVEY RESULTS

The purpose of the following discussion is not to develop conclusions about the statewide or basin-specific use of thinners and cleanup solvents – there were too few responses to support generalizations – but rather to illustrate the types of findings to be obtained from the main survey.

5.1 Characteristics of the Survey Sample

As noted above, seven companies provided data on their operations and thinner and cleanups solvent use. Table 4 summarizes their geographical distribution. Responding companies are in six counties and five air basins, from far in the north to the Los Angeles area. The number of employees per company ranged from one to nine; the median value was four.

Table 5 shows the percentages of the different types of painting activity reported by the survey respondents. No attempt was made to weight the values. The most common activity, accounting for about 45 percent of the total reported, was repainting single-family residences. Repainting (of any type of structure) represented about 84 percent of total activity. Residential painting (whether new or repainting) accounted for 63 percent of activity.

Table 4

GEOGRAPHICAL DISTRIBUTION OF COMMERCIAL PAINTERS THAT PROVIDED DATA

County	No. of Responses	Percent of Responses	Air Basin	No. of Responses	Percent of Responses
Alameda	1	14.3	South Coast	2	28.6
Contra Costa	1	14.3	San Francisco Bay Area	2	28.6
Lassen	1	14.3	Northeast Plateau	1	14.3
Los Angeles	2	28.6	North Central Coast	1	14.3
Santa Barbara	1	14.3	South Central Coast	1	14.3
Santa Cruz	1	14.3			
Totals	7	100.0	Totals	7	100.0

Table 5

PERCENTAGES OF TOTAL ACTIVITY BY STRUCTURE AND MODE

Type of Structure Painted	Mode of Painting		Totals
	New Construction	Repaint	
Residential - For Individual Homeowners	15.5	44.6	60.1
Residential - Subdivisions, condos, etc.	0.0	2.9	2.9
Commercial - Office buildings, stores, etc.	0.3	19.5	19.8
Industrial Plants, Bridges, Etc.	0.0	17.1	17.1
Governmental - Buildings	0.0	0.0	0.0
Other	0.0	0.0	0.0
Totals	15.8	84.2	100.0

5.2 Material Use

The seven responding commercial painters reported using 515 gallons per year of VOC-containing thinners and cleanup solvents associated with AIM coatings.[7] All but 2 gallons of these solvents were associated with solvent-based paints. Thinning and cleanup accounted for 80 and 20 percent, respectively, of the volume of material used.

[7] They reported using 30 gallons of water to thin water-based coatings.

5.2.1 Thinners

Types of Thinners Used

As seen in Figure 2, most of the reported thinner used was "mineral spirits." Mineral spirits and lacquer thinner accounted for 93 percent of thinner use. Respondents did not provide any information as to what material(s) comprised the remaining 7 percent.

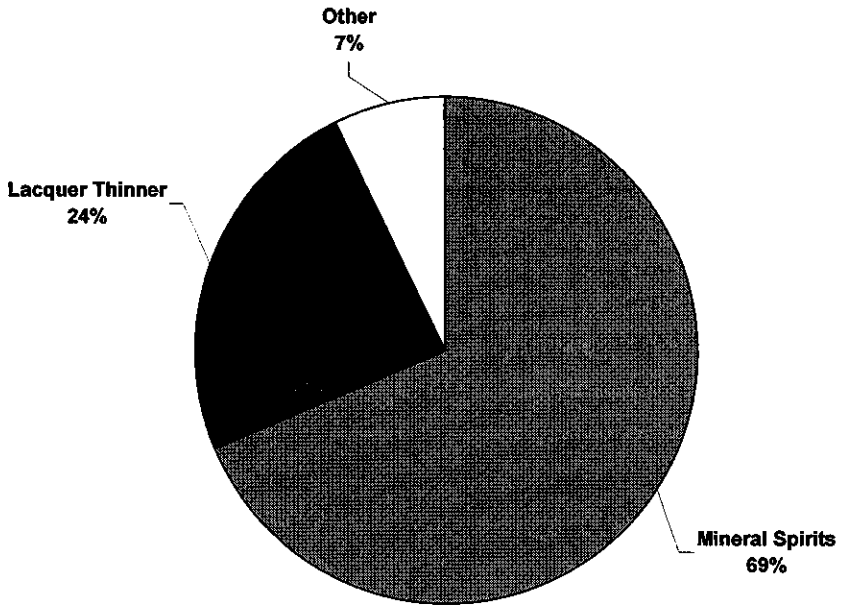

Figure 2. Distribution of Types of Thinner Reported.

Ratio of Thinner to Coating

A major goal of the main survey will be to determine and document a ratio (or range of values thereof) between thinner and coating use, by volume. Only one value was reported for lacquer thinner (25.6 ounces per gallon of coating). For mineral spirits, five values were reported. The median and mean values for the addition of mineral spirits were 8 and 9.28 ounces per gallon (oz/gal), respectively. This may be compared with the assumption in the ARB's area source methodology for architectural coatings that thinner use is one pint (16 oz) per gallon.[8] A 90-percent confidence limit for the mean is 4.7 to 13.8 oz/gal. We wish to emphasize that this is the result of a very small sample, and that the main survey may find very different values. For survey planning purposes, we note that the standard deviation of the responses was 4.75 oz/gal.

[8] Velasco, P. and J. Goonan. 1997. "Section 6.3, Architectural Coatings," California Air Resources Board, Sacramento, CA.

VOC Content and Emissions

The VOC content of the thinners reported did not vary much from painter to painter. A 90-percent confidence interval for the mean value of 6.63 lb/gal was 6.48 to 6.78 lb/gal. The volume-weighted average VOC content of the thinners reported was 6.58 lb/gal. All these values are near a common "rule of thumb" value of 6.5 lb/gal for mineral spirits.

VOC emissions per painting firm from the use of thinners ranged from 19.6 to 1,625 pounds per year (lb/yr). The mean and median were 543 and 297 lb/yr respectively. The sample size is too small to make any generalizations, although the results indicate a considerable amount of variation in the data. For survey planning purposes, we note that the standard deviation of the emissions per painting firm was 664 lb/yr.

Air Toxics Content

For the purpose of this report, we have limited "air toxic" compounds and compound classes to those subject to the Air Toxics "Hot Spots" and Information Assessment Act of 1987 (AB 2588). Air toxics were present in two of the five thinners for which use was quantified. Table 6 shows the weight percent of each air toxics species in each thinner, as well as the composite air toxics profile for the reported thinners. The composite value was calculated as follows. Let V_j and ρ_j be the reported use volume and density of the jth thinner compound. Let m_{ij} be the mass fraction of pollutant i in thinner compound j. Then

$$\text{Composite Fraction Of Pollutant i} = \sum_j m_{ij} V_j \rho_j \Big/ \sum_j V_j \rho_j$$

Note that the calculation includes the three thinners that do not contain air toxics.

5.2.2 Cleanup Solvents

Types of Cleanup Solvents Used

About 71 percent of the reported cleaning solvent use (by volume) was of "mineral spirits." Respondents did not provide any information as to what material(s) comprised the remaining 29 percent.

Materials Cleaned

Three painters identified the materials that they cleaned with their cleaning solvents. All three cleaned brushes, and two also cleaned spray equipment. About 78 percent of the reported volume of solvents was used for brush cleaning, and about 22 percent was used on the spray equipment.

Table 6

AIR TOXICS COMPOSITION OF REPORTED THINNERS

Compound or Compound Class	CAS No.	Weight Percent in Product					
		Product ID Number					Composite Weight Percent
		3	5	7	11	12	
Benzene	71-43-2	0.8		None	None	None	0.06
Ethyl benzene	100-41-4	12.0					0.91
Isopropyl alcohol	67-63-0	28.0					2.13
Methyl isobutyl ketone (Hexone)	108-10-1	22.0					1.67
Toluene	108-88-3	5.0					0.38
Trimethylbenzene (mixed isomers)	25551-13-7		0.3				0.02
Xylenes (isomers and mixture)	1330-20-7	32.0					2.43
Total Weight Percent of Toxics		99.8	0.3	0.0	0.0	0.0	7.6

VOC Content and Emissions

The VOC content of the cleaning solvents reported did not vary much from painter to painter. A 90-percent confidence interval for the mean value of 6.69 lb/gal was 6.28 to 7.09 lb/gal.

The volume-weighted average VOC content of the cleaning solvents reported was 6.74 lb/gal. All these values are near a common "rule of thumb" value of 6.5 lb/gal for mineral spirits.

VOC emissions per painting firm from the use of thinners ranged from 131 to 340 lb/yr. The mean and median were 229 and 216 lb/yr respectively. The sample size is too small to generalize. For survey planning purposes, we note that the standard deviation of the emissions per painting firm was 105 lb/yr.

Air Toxics Content

Air toxics were present in both of the cleanup solvent formulations for which use was quantified. Table 7 shows the weight percent of each air toxics species in each cleanup solvent, as well as the composite air toxics profile for the reported cleaners. The composite value was calculated in the same way as in Section 5.2.1.

Table 7

AIR TOXICS COMPOSITION OF REPORTED THINNERS

Compound or Compound Class	Weight Percent in Product			
	Product ID Number			Composite Weight Percent
	CAS No.	5	10	
Toluene	108-88-3		100	31.43
Trimethylbenzene (mixed isomers)	25551-13-7	0.3		0.21
Total Weight Percent of Toxics		0.3	100.0	31.6

5.3 Temporal Patterns

5.3.1 Day of the Week, by Season

To develop weekly activity patterns, we assigned an "activity level" of 1 to days of the week in which thinners and cleanup solvents were used, and a 0 to days without activity, and calculated the mean and standard deviation for each day of the week.[9] We then calculated, for each painter, each day's fraction of the total activity for the week. For

[9] This approach was used by the author in the San Joaquin Valley Air Quality Study [Rogozen, M.B. 1994. *San Joaquin Valley Air Quality Study and AUSPEX Program. Emissions Data Collection and Inventory Development. Work Element 5 (Stationary Sources).* Prepared by MBR Environmental Corporation for the California Air Resources Board, Technical Services Division, Sacramento, CA, R-MBR-93-001].

example, if a painter used thinners and/or solvents Monday through Friday only, each day's fraction was 0.2. Table 8 shows the results.

Table 8

WEEKLY ACTIVITY PATTERN, BY SEASON OF THE YEAR

		Mon	Tue	Wed	Thu	Fri	Sat	Sun
Spring	Fraction of Weekly Activity	0.157	0.157	0.240	0.157	0.240	0.024	0.024
	C.I - Low	0.091	0.091	0.134	0.091	0.134	-0.024	-0.024
	C.I. - High	0.223	0.223	0.347	0.223	0.347	0.072	0.072
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Summer	Fraction of Weekly Activity	0.157	0.157	0.240	0.157	0.240	0.024	0.024
	C.I - Low	0.091	0.091	0.134	0.091	0.134	-0.024	-0.024
	C.I. - High	0.223	0.223	0.347	0.223	0.347	0.072	0.072
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Fall	Fraction of Weekly Activity	0.124	0.165	0.249	0.165	0.249	0.024	0.024
	C.I - Low	0.043	0.093	0.144	0.093	0.144	-0.024	-0.024
	C.I. - High	0.205	0.238	0.354	0.238	0.354	0.072	0.072
		Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Winter	Fraction of Weekly Activity	0.124	0.124	0.207	0.124	0.207	0.024	0.024
	C.I - Low	0.043	0.043	0.073	0.043	0.073	-0.024	-0.024
	C.I. - High	0.205	0.205	0.341	0.205	0.341	0.072	0.072

For the responding painters, essentially all the use of thinners and cleaning solvents occurs Monday through Friday. (The small use fractions for Saturday and Sunday are not significantly different from zero.)[10] The only statistically significant difference among the five days was between Mondays and Wednesdays in the fall ($t = -1.89957$, d.f. = 9, $p < 0.08995$). However, this result is biased by a single response in which the painter reported working only on Wednesdays and Fridays.

5.3.2 Hour of the Day

The method described in Section 5.2.1 was used to determine hourly fractions of daily activity, for each season of the year. For a given hour, there was no significant difference among seasons. Figure 3 shows the four-season average weekday diurnal activity pattern.[11] The typical work day runs from 7 a.m. to 4 p.m., with reduced activity in the middle of the day (presumably for lunch).

Only one painting company reported having operations on weekends. It applies thinners and cleanup solvents from 7 a.m. to 4 p.m. on Saturdays and Sundays.

[10] In all references to statistical significance, a confidence level of 90 percent was used.
[11] The data for one company that reported working only one hour per day were not included in this analysis.

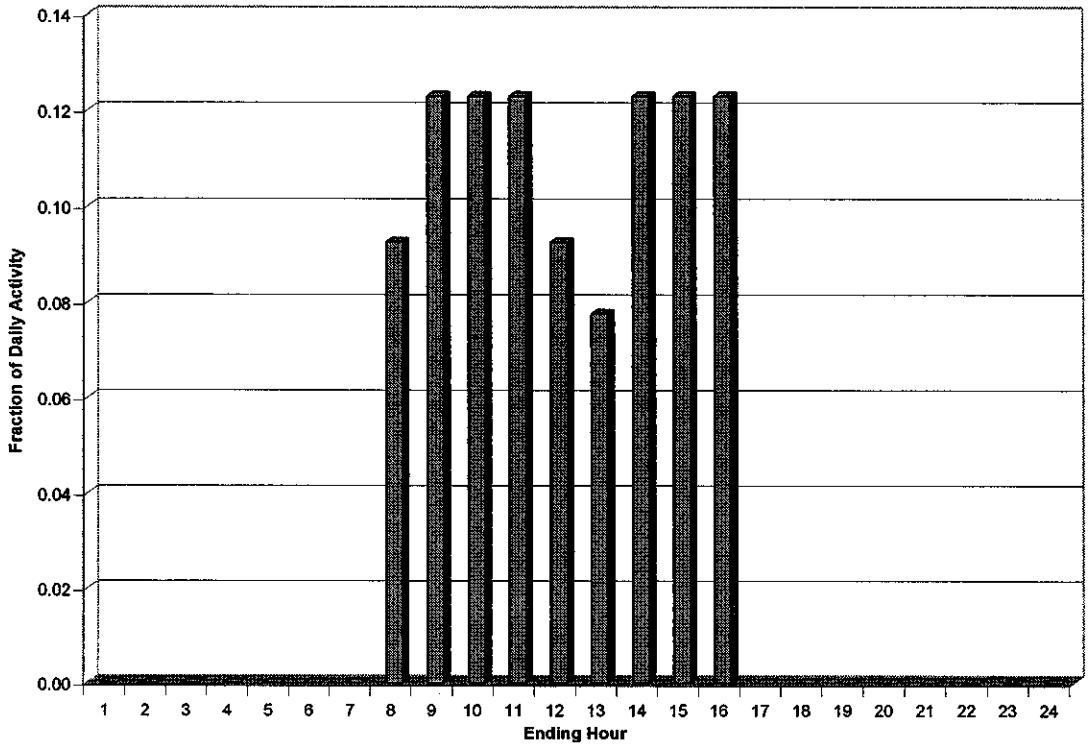

Figure 3. Diurnal Activity Pattern for Weekdays.

5.3.3 Month of the Year

All responding painters but one reported uniform activity throughout the year. The one exception, a company in the San Francisco Bay Area, has 80 percent of its activity June through September.

5.4 Weather Effects

5.4.1 Hot Weather

Two of the five firms responding to the question about hot weather stated that they change their procedures on hot days. The proportion responding positively and its 90-percent confidence interval were 0.4 and [-0.067, 0.87], respectively. Therefore, the result was not significantly different from zero. One firm said that it did not work on hot days and the other reported that it used less thinner per gallon of coating and painted earlier in the day than during "normal" weather.

5.4.2 Cold Weather

The same two painters who reported changing their activity patterns on hot days reported that they would also do so on cold days. They both said that they paint later in the day than during "normal" weather.

5.4.3 Inclement Weather

Three of the five responding painting contractors reported that they would do not apply AIM coatings on rainy or snowy days. The proportion responding positively and its 90-percent confidence interval were 0.6 and [0.13, 1], respectively.

6.0 EVALUATION OF THE SURVEY

6.1 Survey Forms

Form 6 of the questionnaire asked respondents to offer any comments or suggestions about the survey, including the wording of the questions and the ease or difficulty in obtaining the requested data. Four painters had at least one comment, and all the comments were about the survey forms; i.e. the respondents did not use the form to clarify information. The responses to the four questions in Form 6 were:

Which instructions were unclear, confusing, hard to follow, etc.?

- "It's clear – however we don't keep these kind of records."
- "All the instructions were pretty much easy to follow."

What data were difficult (or impossible) to obtain without an unreasonable amount of effort?

- "Everything – we do not keep records of such things. It's impossible!"
- "Year 1999-2000?"
- "The exact days that we do or don't use thinner throughout the year."
- "Percent reduction/unit – varies."

What wording could be improved to make it better understood by the typical painting contractor?

- "Doesn't matter – wording is fine – what you are asking is impossible to answer."
- "Everything is easily understood."

What other comments do you have?

- "Please don't waste our time – I explained on the phone that we could not fill this out
- and you still called 3 times!"
- "Sorry, thinners and their proper disposal is a necessary aspect at 'high end' architectural coatings applications

6.2 Survey Process

One of the purposes of the pilot survey was to determine which follow-up techniques would be most useful for the main survey. The following are analyses of some of our experiences in the pilot survey.

6.2.1 Number of Follow-up Calls

Because our goal was to obtain a 90-percent response rate, we set no limit on the number of attempts to contact non-responding painters. Instead, we tried to find out how many calls would be necessary to obtain a response. Table 9 shows the number of attempts for painters whose cases were "resolved" (i.e., eliminated, refused, or provided data) and those that were "unresolved" (i.e., were not eliminated but did not provide data). For this discussion, an "attempt" involves written or oral follow-up contact. It does not include cases in which the painter never answered the telephone.

Table 9

NUMBER OF ATTEMPTS TO OBTAIN RESPONSES FROM NON-RESPONDING PAINTERS

Outcome	Number of Attempts to Obtain a Survey Response					95-Percent Confidence Interval
	Minimum	Maximum	Mode	Median	Mean	
Resolved	0	6	3	2	2.3	[1.5, 3.1]
Unresolved	0	10	4	5	5.0	[4.3, 5.7]

In Table 9, "0" attempts were made for painters who responded by mail or fax without our needing to encourage them to respond; for survey packages that were returned by the U.S. Postal Service; and for painters whom we were unable to contact. Up to six calls were necessary for the eligible and eliminated firms, and up to ten calls were made to the painters that never responded. An average of two calls were made to the painters that eventually responded and five calls were made to the firms that never responded.

It is interesting to note that three companies responded to the survey without any follow-up calls. The corresponding response rate was 3/64, or 4.7 percent. With the follow-up calls, the response rate increased to 19/164, or 29.7 percent. Therefore the follow-ups increased the response rate by a factor of six

It is also useful to note the marginal yield of additional calls. Making the first call increased the response rate by three painters (4.7 percent). Making the third call increased the rate by five painters (7.8 percent). After three calls, the marginal rate decreased, however; at six calls, it was one (1.6 percent). The implications of these findings are discussed in Section 6.3.

6.2.2 Modes of Repeat Distribution of Survey Packages

In 15 cases (23 percent of the total), painters stated that they had never received or had lost or discarded our survey package. Table 10 shows how we re-sent the survey packages, and the success rates of each re-sending mode. A chi square test showed no significant difference (at the 95-percent confidence level) in the rates of response to mailed and faxed follow-up survey packages ($X^2 = 0.510417$, d.f. = 1, critical $X^2 = 3.841$).

Table 10

RESPONSES TO FOLLOW-UP MAILED AND FAXED QUESTIONNAIRES

Re-Send Mode	Outcome		Total
	Responded	Did Not Respond	
Mail	3	6	9
Fax	3	13	16
Totals	6	19	25

6.2.3 Other Findings

A major problem with this survey was that most of the painting firms were small (i.e. with fewer than 10 employees), and many, if not most, were operated from the owners' homes. These contractors typically have an answering machine to take messages from prospective clients during the day, while they are out painting. This made it difficult to reach them during our normal business hours.

Several of the painters whom we contacted misunderstood the scope of the survey. They apparently did not realize that "architectural and industrial maintenance" included house painting. The term may not be immediately recognizable by the trade.

6.3 Implications for the Main Survey

6.3.1 Potential Sample Size and Allocation to Air Basins

Potential Sample Size

From the pilot survey results, we can develop a reasonable estimate of the sample size necessary to meet the project's statistical criteria. The Request for Proposal required that whole-state and by-county emission factors be within ± 10 percent and ± 15 percent, respectively, of the mean at a 90-percent confidence level. The only statistic that we can practically use at this point is the average VOC emissions per painting firm. Let us consider the more restrictive 10-percent requirement. For emissions from thinner use,[12] the mean and sample standard deviation were 543 and 664 lb/yr, respectively. The maxi-

[12] We consider thinner use here, rather than cleanup solvent use, because the variance in the former is over twice that of the latter.

mum allowable half-width of the 90-percent confidence interval is (0.1)(543) = 54.3 lb/yr.

The required sample size, with finite population correction, is:[13]

$$n = Ns^2/[(N-1)(E/z)^2 + s^2]$$

where

N = Number in the sampling frame

s = Population variance (as estimated by the sample standard deviation)

E = Tolerated error

z = Factor for confidence interval in normal distribution

In this case, z = 1.645 for a 90-percent confidence interval. N is estimated by assuming that the ratio of eligible painting companies to the total surveyed will be the same as in the pilot survey, i.e. 59/69. The sampling frame is thus (59/69)(4550) = 3,891. Substituting known values into the formula yields a required sample size of **367**. We have budgeted for a potential sample of 2,321 firms. The necessary response rate will therefore be (367/2321) = 0.158, or **15.8 percent**. The pilot survey response rate was only 7 of 69, or 10.1 percent. We must therefore find ways of increasing the likelihood of responses.

Allocation to Air Basins

When we first considered various methods of allocating the potential sample among air basins, our objective was to see what sort of distribution of samples among the air basins would lead to the smallest variance around the statewide total for some variable, such as thinner use. It then occurred to us that statewide quantities and variances thereof are not as useful to the ARB as are those for individual basins. Our goal, then, should be to obtain "acceptable" confidence intervals about estimates for means and totals for each basin.

To do this, we first applied the preceding equation to each basin. With no data to demonstrate otherwise, we assumed that the variance in the thinner emissions would be the same in each basin.[14] Following the RFP's requirements, we set the target confidence interval half-width to 15 percent of the mean, rather than the 10 percent value used for a statewide estimate. Table 11 shows how we calculated the necessary sample size in each basin. First, we adjusted the sampling frame for each basin by assuming that the ratio of eligible painting companies to the total surveyed will be the same as in the pilot survey, i.e. 59/69. Using the preceding equation, we then calculated the necessary sample size

[13] Shell, L.W. 1997. "Statistical Sampling Procedures: Stratification and Sample Sizing." Nicholls State University, Thibodaux, LA (Internet: www.nicholls.edu/mnmk-lws/bsad503/503-0090.htm).

[14] Our intuitive guess is that the variance is not the same in each basin. Larger basins would be expected to have a much greater variety of commercial painting firm sizes than would small basins. However, the pilot survey did not obtain enough responses to be able to obtain variance by basin.

Table 11

ALLOCATION OF POTENTIAL SAMPLE TO AIR BASINS

Air Basin	Estimated No. of Painters	No. Likely to be Eligible	Required Sample Size	Potential Sample
Great Basin Valleys	16	14	13	14
Lake County	15	13	12	13
Lake Tahoe	19	16	15	16
Mojave Desert	61	52	41	52
Mountain Counties	126	108	68	108
North Central Coast	132	113	70	113
North Coast	54	46	37	46
Northeast Plateau	14	12	11	12
Sacramento Valley	372	318	115	255
Salton Sea	62	53	41	53
San Diego	295	252	105	233
SF Bay Area	1,041	890	150	333
San Joaquin Valley	344	294	112	249
South Central Coast	235	201	95	201
South Coast	1,764	1,508	161	357
Total	**4,550**	**3,890**	**1,046**	**2,055**

for each basin. As seen in Table 11, the total required sample size is considerably higher than the one necessary if all the basins' results are pooled (1,046 vs 367). As the project budget allows for a potential sample of 2,321, we adjusted each basin's potential samples as follows:

$$P_j = 2321\ (R_j/\Sigma R_j)$$

Where S_j and R_j are, respectively, the potential sample size for the jth county and the minimum required sample size as calculated in the table. For basins for which the apportionment resulting in a value of P_j that exceeded the size of the sampling frame, we decided to sample all the firms in the basin. This limitation of the allocation resulted in a total potential sample size of 2,055, rather than 2,321. We will hold the remaining 266 surveys in reserve, using them late in the survey to "beef up" the potential sample in basins that have larger variances than expected.

6.3.2 Survey Forms

On Form 1, we need to make it abundantly clear what we mean by "architectural and industrial maintenance coatings." We may decide to avoid the term entirely. For example, we could change the first question on the form to "Are you a commercial contractor who paints houses, apartments, factories, or other types of buildings or structures?"

From the pilot survey, it appears likely that a large number of respondents will not report the manufacturers and/or model numbers of their thinners and cleanup solvents; neither will they send us material safety data sheets. We will still ask for the material identification data and the MSDSs. Most likely, we will have to contact the thinner and cleanup solvent manufacturers and distributors ourselves and request MSDSs or other composition information. To maximize the chance of obtaining useful data, however, we believe that we should significantly expand the choices for "Type of Thinner" and "Type of Solvent." Candidate new choices include:

- Acetone
- Denatured Alcohol
- Isopropyl Alcohol
- Methanol
- Naphtha
- Methylene Chloride
- Toluene
- Xylene

We can then use default values for the density and composition of these materials. Other changes that we recommend are:

- Delete Form 6 – Survey Recipient Feedback from the questionnaire, as it is no longer needed;

- Correct a typographical error on Form 3: change "1999" to "2000;"[15] and

- Change the backup letter from the ARB to be more specific to this survey.

6.3.3 Survey Procedures

For the main survey, we will make the following changes in our procedures:

- The survey forms will be printed by a commercial printer and mailed by a mailing house, rather than prepared and mailed in-house;

- We will try to concentrate our follow-up calling in the late afternoon and early evening, so that we may catch the painters at home; and

[15] But see Section 6.3.4.

- It did not appear useful to make more than five follow-up calls to non-responding companies. We will therefore limit our follow-up calls to five, unless the survey response is seriously deficient.

- Because not many respondents are sending MSDSs anyway, we are considering including a stamped, self-addressed envelope with the survey packages.

6.3.4 Other Issues

Because the main survey will likely be conducted early in Calendar Year 2002, we should consider making 2001 the base year for this survey (and all the others under this contract).

Something else, besides the measures mentioned in the previous section, must be done to increase the response rate. At the beginning of this projected, we attempted to secure the cooperation of local painting trade organizations, but had no success. We will try again during the remainder of this year, so that perhaps we can have at least one organization in our corner for the 2002 survey.

MACTEC

MEMORANDUM

DATE: October 11, 2003

TO: Richard Vincent, California Air Resources Board

FROM: Michael Rogozen

SUBJECT: Preliminary Values for Thinning and Cleanup Solvent Emission Factors For Oil-Based Architectural Coatings

At your request, I have prepared a summary of our ***preliminary*** estimates of our commercial painters survey-based estimates of thinning and cleanup solvent emission factors. Please note that these values may change by the time that the draft report is submitted.

INTRODUCTION

The object of this exercise was to calculate the volume of thinning and cleanup solvents used per gallon of solvent-based (oil-based) architectural coatings. The Air Resources Board (ARB) has for many years assumed that this value was one pint (16 ounces) of solvent[1] per gallon of oil-based coating. The documentation for this value was lacking, so the ARB desired either to confirm it or develop a new one, using information obtained from our survey of commercial painters.

Another objective was to compare our survey results with several assumptions that the staff of the South Coast Air Quality Management District (SCAQMD) used in their analysis of proposed amendments to Rule 1171 – Solvent Cleaning Operations.[2]

CALCULATION METHODS

As we discussed on the telephone yesterday, we considered several alternative methods of calculating the solvent use rate from the survey data. A major problem, which affected all the alternative methods except the one finally used, was that many survey respondents apparently reported total solvent use without breaking it down between coating bases. This was especially evident in cases in which the painter used only a few gallons of oil-based paint and many thousands of gallons of water-based coatings. As a result, the reported solvent volume was up to 5.8 gallons of solvent per gallon of oil-based coating.

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[1] In previous discussions and exchanges of correspondence, we agree that "solvent" means thinning and cleanup solvents combined.

[2] Calungcagin, R. 2003. *Draft Staff Report for Proposed Amended Rule 1171 – Solvent Coating Operations.* South Coast Air Quality Management District, Diamond Bar, CA (October 1, 2003).

To get around the problem of possibly ambiguous solvent reporting, we divided the analysis into two parts. First, we calculated the thinner use rates by considering only the ounces-per-gallon (oz/gal) values directly reported by survey respondents. Then we calculated the cleanup solvent use from selected solvent and coating use values.

Thinner Use

We are certain that the oz/gal values reported are associated only with oil-based coatings. The use rates varied from 0 to 64 oz/gal. More than half (55 percent) of the painters reported adding no thinner to their oil-based paints. These zero values were taken into account in our calculations.

The thinner use rate was calculated as a weighted average for each solvent type (mineral spirits, lacquer thinner, etc.). The weights were the gallons of oil-based coatings associated with each use of thinner. We believed that this was the most defensible way of calculating the average, since it took into account how much solvent is actually used. Confidence intervals about the means were determined by bootstrap sampling.

Cleanup Solvent Use

To reduce the uncertainty over whether the responding painters reported total cleanup solvent use rather than cleanup solvent use associated with oil-based coatings, we limited our sample to those responses for which the painter associated cleanup solvent use values with both oil- and water-based coatings. Although the size of the sample meeting this criterion was only 39, we believe that it is more representative of reality than is the entire set of painter responses.

The use rate for each survey response was defined as the ratio between cleanup solvent volume (in ounces) and the reported oil-based coating use (in gallons). Most (71 percent) of the useable cleanup solvent responses were for use of mineral spirits. We decided to pool all the responses and not calculate separate use ratios for each solvent type. The use rates varied from 0 to 76.8 oz/gal. Again, we used volumes of oil-based coatings as weights in calculating the average oz/gal for cleaning solvents. Confidence intervals about the means were determined by bootstrap sampling.

Emission Factors

The ARB's area source methodology for architectural coatings reports emission factors for thinning and cleaning solvents in pounds per 1,000 gallons. As part of our survey data analysis (which will not be discussed here), we determined average total organic gas (TOG) and reactive organic gas (ROG) emission factors for each solvent type. To determine an emission factor for thinning and cleanup solvents as a group (to be consistent with the area source methodology), we weighted the emission factor of each type of thinner by its mean oz/gal ratio. For cleaning solvents, we used composite emission factors determined previously. We then added the TOG and ROG emission factors for thinning and cleanup.

RESULTS

Table 1 summarizes the results of the calculations of use factors. The mean use rate is 16.1 oz/gal, with a 90-percent confidence interval of [13.9, 18.3]. Table 2 shows the TOG and ROG emission factors for thinning and cleanup solvents combined.

Table 1

OUNCES OF THINNING AND CLEANUP SOLVENT PER GALLON OF OIL-BASED COATING

(PRELIMINARY RESULTS)

Use Category	Mean[a]	90-Percent Confidence Interval	
		Low	High
Ounces/Gallon For Thinning			
Mineral Spirits	3.24	2.87	3.62
Lacquer Thinner	1.98	1.61	2.36
Acetone	0.13	0.00	0.28
Denatured Alcohol	0.10	0.01	0.18
Isopropyl Alcohol			
Methanol			
Methylene Chloride	0.004	0.00	0.01
Naphtha	0.14	0.01	0.28
Toluene			
Xylene	0.03	0.00	0.08
Ounces/Gallon for Cleanup	10.44	9.41	11.45
Total	**16.07**	**13.92**	**18.27**

[a]Weighted by gallons of solvent-based coating per facility.

Table 2

EMISSION FACTORS FOR THINNING AND CLEANUP SOLVENTS

(PRELIMINARY RESULTS)

Pollutant	Pounds Per 1000 Gallons Solvent
TOG	6,696
ROG	6,043

DISCUSSION

The thinning and cleanup solvent use rate is essentially the same as the value that is currently in the ARB's architectural coatings area source methodology. The uncertainty in that number is about 13.5 percent.

The TOG emission factor of 6,696 lb/1000 gallons is higher than the area source methodology's value of 6,400 lb/gallon. The area source methodology does not have an ROG emission factor.

Note that, when we first calculated the use rate, the result (about 18 oz/gal) was higher than that reported here. We re-did the calculation after discovering that one survey response, which combined a high lacquer thinner use rate (50 oz/gal) and a high weighting (1,575 gallons of oil-based paint), was not consistent with other information reported on the survey form. We also examined the calculations to determine whether the results were unduly influenced by other responses having either extremely high solvent use rates or weightings. In all those cases, elimination of one of these extremes would change the total use rate by less than 0.5 oz/gal.

The SCAQMD staff report on Rule 1171 states that "the amount of recommended thinning solvent is small as compared to the total solvent volume used for clean up and thinning activities." The report goes on to assume, in its emission inventory calculation, that *all* the solvent is used for cleanup. As seen in Table 1, this assumption is not supported. In our analysis, cleanup represents 65 percent of total solvent use; this is a "high" percentage, but is certainly not all.[3]

The SCAQMD report uses the TOG emission factor of 6,400 lb/1000 gallons that is in the ARB area source methodology. Our value is 6,696 lb/1000 gallons. Finally, the SCAQMD assumes that the fraction of reactive organic gases (FROG) is 0.9652. From the analysis presented here, our value for FROG is 0.9025, which is considerably lower. The main reason is that our review of solvent composition data indicates that lacquer thinners used today have much lower VOC content than they once had.

Using its assumptions, the SCAQMD estimates 2003 VOC emissions from cleanup associated with oil-based coatings in the District to be 8.68 tons per day. Using our results, this value is 5.54 tons/day, which is considerably lower than the SCAQMD result.

[3] In our analysis of total reported solvent use (not presented here), we estimate that about 75 percent of solvent use associated with oil-based paints is used for cleanup.