



## 2006 Area Source Emissions Inventory Methodology 240 – PRINTING

### I. Purpose

This document describes the Area Source Methodology used to estimate emissions of volatile organic compounds (VOC) from Printing Operations such as graphic arts printing, flexographic specialty printing, screen printing, and paper or fabric coating. An area source is a collection of similar emissions units within a geographic area (ie., a County). Area sources collectively represent individual sources that are small and numerous, and that may not have been inventoried as specific point, mobile, or biogenic sources. The California Air Resources Board (CARB) has grouped these individual sources with other like sources into area source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology.

### II. Applicability

The emission calculations from this Area Source Methodology apply to facilities that are identified by the following Category of Emission Source (CES) code and Reconciliation Emission Inventory Code (REIC):

**Table 1. Emission inventory codes.**

CES	REIC	Description
66829	240-995-8000-0000	Printing

### III. Point Source Reconciliation

Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (ARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. The area source in this methodology reconciles against processes in our point source inventory with the SIC/SCC combinations listed in Appendix A.

#### IV. Methodology Description

This methodology is used to inventory emissions of volatile organic compounds (VOC) from inks, solvents, and other graphic arts materials used in the printing of books, magazines, newspapers, fliers, forms, posters, packaging materials and other printed matter.

The total number of printing facilities in each county in the District was estimated using data from the 2002 Economic Census of the US Census Bureau, as well as 2007 data from an on-line database branch of Dunn & Bradstreet at zapdata.com. From this pool of printing operations, permitted facilities that report their emissions through the District's point source inventory were subtracted. The remaining facilities were used to estimate area source emissions for this source category. Emissions were estimated by assuming that each non-permitted facility operated just below levels requiring District permits (400 lbs VOC per month).

#### V. Activity Data

The total number of printing facilities in each county in the District were estimated using data from the 2002 Economic Census of the US Census Bureau as well as 2007 data from an on-line database branch of Dunn & Bradstreet at zapdata.com. Printers were queried using the following SIC codes:

- 2711 newspapers
- 2721 periodical
- 2731 book publishing
- 2732 book printing
- 2752 commercial printing, lithographic
- 2754 commercial printing, lithographic, gravure
- 2759 commercial printing, lithographic, gravure, not elsewhere classified
- 2761 manifold business forms
- 2771 greeting cards

This data is summarized in the following table:

**Table 2. Number of small printing operations per county (2006).**

County	Number of small printing operations	Number of permitted printing operations	Total printing operations
Fresno	156	30	186
Kern*	129	11	140
Kings	19	4	23
Madera	21	4	25
Merced	24	5	29
San Joaquin	95	18	113
Stanislaus	77	15	92
Tulare	49	9	58
TOTAL	501	95	596

## VI. Emission Factors

Printing operations subject to District Rule 4607 must use products compliant with the limits given in Table 3.

**Table 3: Emissions factors for printing operation from District Rule 4607 Graphic Arts.**

Printing Operation Type	Material	VOC emission factors, less water and less exempt compounds	
		g/L	lb/gal
Graphic Arts Printing	Ink	300	2.5
	Coating	300	2.5
	Adhesive	150	1.25
	Web Splicing Adhesive	300	2.5
	Fountains Solution	8% by volume	2.5
Flexographic Specialty Ink	Metallic Ink	485	4.1
	Matte Finish Ink	535	4.5
Screen Printing Ink, Coating, and Adhesive	Ink	400	3.3
	Coating	400	3.3
	Adhesive	150	3.3
	Extreme Performance Ink/Coating	400	3.3
	Metallic Ink	400	3.3
	Sign Ink/Coating	400	3.3
	Resists	600	5.0
Paper or Fabric Coating Operation <sup>al</sup>	Coating	265	2.2
	Wash Primer	265	2.2

Area source emissions are from printing operation exempt from these limits. For these facilities emissions are calculated at 399 pounds of VOC per month (at the upper bound of the exemption limit).

## VII. Emissions Calculations

### A. Assumptions

- All the volatile organic solvent contained in the graphic art materials for small printshops is emitted into the atmosphere.
- Per District Rule 4607 Graphic Arts, requirements on VOC content limits are not applicable to any graphic printing operations that emits less than 400 pounds of VOC per calendar month. This exemption is not applicable to Paper and Fabric coating operations.
- All small sources emit VOC at the upper limit of District Rule 4607's exemption. This is assumes 399 lbs of VOC emissions per calendar month.

### B. Sample Calculations

#### Emissions for Small Area Source Printers

Emissions for this source category area calculated according to the following equation:

$$VOC\ Emissions_{(tons/year)} = No.\ Printers \times \frac{lbs\ VOC}{month - printer} \times \frac{months}{year} \times \frac{1\ ton}{2,000\ lbs}$$

#### Example for Fresno County:

$$VOC\ Emissions_{(tons/year)} = 156\ Printers \times \frac{399\ lbs\ VOC}{month - printer} \times \frac{12\ months}{year} \times \frac{1\ ton}{2,000\ lbs}$$

$$VOC\ Emissions_{(tons/year)} = 373.4\ tons\ per\ year$$

## VIII. Temporal Variation

### A. Daily

ARB Code 24. 24 hours per day - uniform activity during the day.

### B. Weekly

ARB Code 7. 7 days per week - uniform activity every day of the week

### C. Monthly

Uniform monthly activity:

**Table 3. Monthly printing activity.**

Month	Activity Level (% of annual)
January	8.3%
February	8.3%
March	8.3%
April	8.3%
May	8.3%
June	8.4%
July	8.4%
August	8.4%
September	8.4%
October	8.3%
November	8.3%
December	8.3%
Total	100.0%

## IX. Spatial Variation

Printing occurs in all eight counties in the San Joaquin Valley.

## X. Growth Factor

Growth factors are developed by either the District's Planning Department or CARB for each EIC. These factors are used to estimate emissions in future years. The growth factors associated with this emissions category may be obtained from the Air Quality Analysis Section of the District's Planning Department.

## XI. Control Level

Control levels are developed by either the District's Planning Department or CARB for each EIC. Control levels are used to estimate emissions reductions in future years due to implementation of District rules. These control levels take into account the effect of control technology, compliance and exemptions at full implementation of the rules.

Graphic arts printing operations, flexographic specialty inc, screen printing operation, and paper or fabric operation are subject to District Rule 4607 (GRAPHIC ARTS). Control levels associated with this emissions category may be obtained from the Air Quality Analysis Section of the District's Planning Department.

## XII. ARB Chemical Speciation

CARB has developed organic gas profiles in order to calculate reactive organic gasses (ROG), volatile organic compounds (VOC) or total organic gas (TOG) given any one of the three values. For each speciation profile, the fraction of TOG that is ROG and VOC is given. The organic gas profile codes can also be used to lookup associated toxics. CARB's speciation profiles for printing operations are presented in Table 4. Organic gas profile #220 is applied to REIC 240-995-8000-0000.

**Table 4. CARB chemical speciation profiles for gasoline dispensing processes.**

Profile Description	ARB Organic Gas Profile#	Fractions	
		ROG	VOC
Printing evaporation loss - general	220	0.99	0.99

## XIII. Assessment Of Methodology

This methodology does not cover these SICs:

- 2782 blankbooks and loose leaf binders
- 2789 bookbinding and related work
- 2791 typesetting
- 2796 platemaking setting

This methodology conservatively estimates area source emissions using the District's VOC permit exemption limit. No data is available that would specify the quantify and type of ink and related printing process solvents and fountain solutions consumed in our District.

## XIV. Emissions

Following is the 2006 area source emissions inventory for REIC 240-995-8000-0000 estimated by this methodology. Emissions are reported for each county in the District.

**Table 5. Area source emissions for REIC 240-995-8000-0000 (2006).**

County	Emissions (tons/year)					
	NOx	CO	SOx	VOC <sup>(1)</sup>	PM <sub>10</sub>	PM <sub>2.5</sub>
Fresno	--	--	--	373.46	--	--
Kern <sup>(2)</sup>	--	--	--	308.83	--	--
Kings	--	--	--	45.49	--	--
Madera	--	--	--	50.27	--	--
Merced	--	--	--	57.46	--	--
San Joaquin	--	--	--	227.43	--	--
Stanislaus	--	--	--	184.34	--	--
Tulare	--	--	--	117.31	--	--
<b>TOTAL</b>	--	--	--	1364.58	--	--

(1) The District only reports ROG to ARB. As noted in Section XII, ROG is the same as VOC.

(2) Includes both the Valley and non-Valley portions of Kern County.

Following is the 2006 point source emissions inventory for REIC 240-995-8000-0000 as reported to the District by our permit holders. Emissions are reported for each county in the District.

**Table 6. Point source emissions for REIC 240-995-8000-0000 (2006).**

County	Emissions (tons/year)					
	NOx	CO	SOx	VOC <sup>(1)</sup>	PM <sub>10</sub>	PM <sub>2.5</sub>
Fresno	--	--	--	34.62	--	--
Kern	--	--	--	18.93	--	--
Kings	--	--	--	6.50	--	--
Madera	--	--	--	7.87	--	--
Merced	--	--	--	38.84	--	--
San Joaquin	--	--	--	20.54	--	--
Stanislaus	--	--	--	45.43	--	--
Tulare	--	--	--	31.07	--	--
<b>TOTAL</b>	--	--	--	203.79	--	--

(1) The District only reports ROG to ARB. As noted in Section XII, ROG is the same as VOC.

(2) Includes both only the Valley portion of Kern County.

Following is the 2006 total unreconciled (point source plus area source) emissions inventory for REIC 240-995-8000-0000. Emissions are reported for each county in the District.

**Table 7. Total emissions for REIC 240-995-8000-0000 (2006).**

County	Emissions (tons/year)					
	NO <sub>x</sub>	CO	SO <sub>x</sub>	VOC <sup>(1)</sup>	PM <sub>10</sub>	PM <sub>2.5</sub>
Fresno	--	--	--	408.08	--	--
Kern <sup>(2)</sup>	--	--	--	327.76	--	--
Kings	--	--	--	51.99	--	--
Madera	--	--	--	58.14	--	--
Merced	--	--	--	96.30	--	--
San Joaquin	--	--	--	247.97	--	--
Stanislaus	--	--	--	229.77	--	--
Tulare	--	--	--	148.38	--	--
<b>TOTAL</b>	--	--	--	1568.38	--	--

(1) The District only reports ROG to ARB. As noted in Section XII, ROG is the same as VOC.

(2) Includes both the Valley and non-Valley portions of Kern County.

Following is the net change in total unreconciled emissions between this update (2006 inventory year) and the previous update (2005 inventory year) for REIC 240-995-8000-0000. The change in emissions are reported for each county in the District.

**Table 8. Net emissions change for REIC 240-995-8000-0000 (2006).**

County	Emissions (tons/year)					
	NO <sub>x</sub>	CO	SO <sub>x</sub>	VOC <sup>(1)</sup>	PM <sub>10</sub>	PM <sub>2.5</sub>
Fresno	--	--	--	236.07	--	--
Kern	--	--	--	245.26	--	--
Kings	--	--	--	33.98	--	--
Madera	--	--	--	30.30	--	--
Merced	--	--	--	69.07	--	--
San Joaquin	--	--	--	135.50	--	--
Stanislaus	--	--	--	150.06	--	--
Tulare	--	--	--	98.93	--	--
<b>TOTAL</b>	--	--	--	999.16	--	--

(1) The District only reports ROG to ARB. As noted in Section XII, ROG is the same as VOC.

## XV. Revision History

2008: The methodology was reformatted to the new District standard. The number of printing operations within the District was updated, and the VOC emissions per non-permitted facility calculated using the Rule 4604 exemption limit.

1996. This is a new District methodology. The average VOC content was determined to be 4.81 lbs VOC/gallon based on the Material Safety Data Sheets obtained from Hot Spots Emission Inventory reports for inventory year



1992. The number of printers were based on Dun and Bradstreet 1995 database.

## XVI. Update Schedule

In an effort to provide inventory information to ARB and other District programs and maximize limited resources, the District has developed an update cycle based on emissions within the source category as shown in Table 9.

**Table 9. Area source update frequency criteria**

Total Emissions (Tons/Day)	Update Cycle (Years)
<1	4
>1 and <= 2.5	3
>2.5 and <=5	2
>5	1

Since this category has emissions of less than 5 tons per day, it will be updated every two years.

## XVII. References

1. California Emissions Inventory Development and Reporting System (CEIDARS). California Air Resources Board. [Online] Available <http://www.arb.ca.gov/app/emsinv/dist/>, April 4, 2008.
2. Prospect list – summary of selections. (2007). [Online] Available <http://www2.zapdata.com/servlet/iMarketServlet?APIID=130>, January 10, 2008.
3. San Joaquin Valley Unified Air Pollution Control District Rules and Regulations. (2001). Rule 4607 Graphic Arts.
4. San Joaquin Valley Unified Air Pollution Control District Area Source Inventory database.
5. San Joaquin Valley Unified Air Pollution Control District HRA/EI/AAQA/RMR/Toxic System (HEARTs) Database.
6. San Joaquin Valley Unified Air Pollution Control District Permit Administration System (PAS) database.
7. 2002 Economic Census Manufacturing Fresno County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA019\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA019_31.htm), July 30, 2007.
8. 2002 Economic Census Manufacturing Kern County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA029\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA029_31.htm), July 30, 2007.

9. 2002 Economic Census Manufacturing Kings County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA031\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA031_31.htm), July 30, 2007.
10. 2002 Economic Census Manufacturing Madera County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA039\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA039_31.htm), July 30, 2007.
11. 2002 Economic Census Manufacturing Merced County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA047\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA047_31.htm), July 30, 2007.
12. 2002 Economic Census Manufacturing San Joaquin County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA077\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA077_31.htm), July 30, 2007.
13. 2002 Economic Census Manufacturing Stanislaus County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA099\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA099_31.htm), July 30, 2007.
14. 2002 Economic Census Manufacturing Tulare County, CA. (2002) [Online] Available [http://www.census.gov/econ/census02/data/ca/CA107\\_31.htm](http://www.census.gov/econ/census02/data/ca/CA107_31.htm), July 30, 2007.

## **XVIII. Appendix**

### Appendix A. Inventory Reconciliation Codes

## Appendix A. Inventory Reconciliation Codes

Table 10. EIC, SCC and SIC codes in the District's 2006 point source inventory that reconciled to REIC 240-995-80000-0000.			
EIC	SCC	Point Source Type	SIC Codes
---	40500212	Printing/Publish - Printing Process - Letter Press - General	2653
	40500301	Printing/Publish - Printing Process - Flexographic - General	2653
	40500311	Printing/Publish - Printing Process - Flexographic - General	2653, 2656, 2752
	40500598	Printing/Publish - Printing Process - Ink Thin Solvent - Other	3089
	40588801	Printing/Publish - Fugitive Emission - Not Classified - Other	2631, 2732, 2761
240-240-3202-0000	40500413	Printing/Publish - Printing Process - Lithographic - Isopropyl Al/Cleanup	2711
240-240-3314-0000	40500314	Printing/Publish - Printing Process - Flexographic - Propyl Al/Cleanup	2674, 2711
240-240-8302-0000	40200901	Organic Solvent - Surface Coating - Thinning Solvent - Other	2759
	40500598	Printing/Publish - Printing Process - Ink Thin Solvent - Other	2653, 2657, 2711, 2759, 2761
240-260-8400-0000	40500512	Printing/Publish - Printing Process - Rotogravure - General	2657, 2754
	40500301	Printing/Publish - Printing Process - Flexographic - General	2656
240-262-8400-0000	40500312	Printing/Publish - Printing Process - Flexographic - General	2631, 2657, 2674, 2679, 2711, 2752, 2759, 2761, 7336
	40500315	Printing/Publish - Printing Process - Flexographic - Steam:Water-Based	2631
240-264-8400-0000	40500401	Printing/Publish - Printing Process - Lithographic - General	2732
	40500411	Printing/Publish - Printing Process - Lithographic - General	2711, 2752
	40500412	Printing/Publish - Printing Process - Lithographic - General	2653, 2679, 2711, 2759, 2761, 9223
	40500421	Printing/Publish - Printing Process - Offset Lithography - Heatset Ink Mixing	3555
	40500433	Printing/Publish - Printing Process - Offset Lithography - Nonheatset Litho Inks	2679, 5651, 9223
	40500212	Printing/Publish - Printing Process - Letter Press - General	9222
	40500215	Printing/Publish - Printing Process - Letterpress - Cleaning Solution	2761, 9223
	40500212	Printing/Publish - Printing Process - Letter Press - General	2621, 2761, 3089
	40500811	Printing/Publish - Printing Process - General - Screen Printing	2752, 3429
	40500812	Printing/Publish - Printing Process - General - Screen Printing	2759, 3429
240-266-8350-0000	40500312	Printing/Publish - Printing Process - Flexographic - General	2653
	40588801	Printing/Publish - Fugitive Emission - Not Classified - Other	2653