BACKGROUND DOCUMENT

SECTION 4.9 GRAPHIC ARTS

1.0 INTRODUCTION

The section on Graphic Arts is organized as two separate sections with five subsections each, as follows:

4.9.1 Process Description

- 4.9.1.1 General
- 4.9.1.2 Web Offset Lithography
- 4.9.1.3 Web Letterpress
- 4.9.1.4 Rotogravure
- 4.9.1.5 Flexograpy

4.9.2 Emissions and Controls

- 4.9.1.1 General
- 4.9.1.2 Web Offset Lithography
- 4.9.1.3 Web Letterpress
- 4.9.1.4 Rotogravure
- 4.9.1.5 Flexography

Screen printing and manual techniques are not included due to the lack of available information. Direct lithography, in which the image carrier prints the image directly onto the substrate, is also not included because most lithographic operations are web offset (although most plants classified under commercial lithography operate with sheet fed equipment). Sheet fed gravure is excluded because it is slow and little used. Of the three categories of letterpress printing, only web presses using solvent-borne inks are discussed because

- Letterpress newspaper printing (which is web fed) utilizes oxidant drying inks composed of petroleum oils and carbon black, but little or no volatile solvent
- Letterpress sheet fed printing employs nonsolvent inks that dry in racks by air oxidation at room temperature

Moreover, flexographic newspaper printing, like letterpress newspaper printing, uses oxidative drying inks and emits only ink mist and paper dust, so this form of printing is also omitted from Section 4.9.

2.0 EMISSION FACTORS (Table 4.9-1)

The values for S, solvent content of ink, for web offset and letterpress were taken from Table 35 (pages 123-128) of Reference 11. The information was obtained through mail surveys (421 responses) and field visits (86) to printing establishments. The values for rotogravure and flexography were supplied by Ed Vincent of ESED in a private communication.

Values for P, the solvent remaining with the product or destroyed in the dryer, were taken from Table 35 of Reference 11 for web offset and web letterpress, except for the value for web offset using a direct flame dryer, which was taken from Table 18 (page 113) of Reference 12. The data from Reference 11 were derived from surveys and the data from Reference 12 were derived from source tests. Values for P for rotogravure and flexography were supplied by Ed Vincent of ESED in a private communication.

3.0 CONTROL TECHNOLOGY EFFICIENCIES (Table 4.9-2)

The estimated reductions in organic emissions achievable through the use of control technology that are shown in Table 4.9-2 are taken from pages 3-9 and 3-10 of Reference 3, the CTG document on flexography and rotogravure, with the exceptions of the figures for controlling web offset lithography and web letterpress by incineration, which are from References 12 and 13 (page 400), respectively.

The term "capture efficiency" refers to the efficiency of conveying all solvent emissions to the inlet of the control device. The term "removal efficiency" refers to the efficiency of the control device in removing all emissions that pass through it.

4.0 EMISSION FACTOR RATINGS

The factors are essentially based on the data base for estimating the parameters S and P in Table 4.9-1. The factor for web offset publication printing is rated A because it is based on results of a test program specifically designed to evaluate emissions. The factors for web offset newspaper and web letterpress publication printing are rated B because they are based on a combination of engineering analysis and limited test data. The factors for rotogravure and flexography are rated C because they are based on engineerng analysis and plant visits and may have been derived by averaging data from several plants that varied substantially from each other. The numerical rankings are as follows:

Process	Measured Emissions	Process Data	Engineering Analysis	Total
Web Offset				
Publication	17	9	10	36
Newspaper	9	9	10	28
Web Letterpress				
Publication	9	9	10	28
Rotogravure	0	8	9	17
Flexography	0	8	9	17

ADDENDUM TO BACKGROUND DOCUMENT FOR SECTION 4.9 OF AP-42

GRAPHIC ARTS

Calculation of Per Capita Emission Factor for Estimating Graphic Arts Emissions from Small Operations.

OVERVIEW

A per capita emission factor for small graphic arts operations was developed to account for small operations, both external and internal to other industries, which are usually not accounted for by standard point source procedures. The per capita approach was selected since employment would be difficult to identify in captive operations (i.e. support to other industry SIC operations). However, because several facilities in the country are very large emitters of VOC and would thus make assignment of total national emissions unrepresentative, an attempt was made to limit the factor to minor sources (as opposed to the classical approach of using a total per capita factor and substracting all point sources).

DERIVATION OF PER CAPITA FACTOR

The approach to deriving the factor was to take total national emissions for Graphic Arts and substract out "known" emissions from major facilities and other nonemissions. This yields an unaccounted for emissions fraction which is the used to calculate a per capita factor. These calculations are included below.

CAUTION : Because the factor is derived from a subtraction process, the resulting factor is subject to considerable error. Therefore, this factor is provided as a "catch-all" estimate and other methods which may calculate emissions directly are preferred. However, because this is a relatively small category (0.8 lbs/capita/yr versus 6.3 lbs/cap/yr for commercial/consumer solvent use) and considering the difficulty in inventoring captive graphic arts operations, the factors can be used as a default value where an agency does not have the resources to conduct a detailed investigation. Regulation of small graphic arts sources in a nonattainment area should be undertaken only after through study.

Per Capita Emission Factor - Small Graphic Arts Facilities

Total National Graphic Arts Emissions (from Reference 1, 1977 - projected from '76 using 3 percent growth)	- 390,000
Less Total Major Publication Rotogravure (from Reference 2, 1977, sources > 100 tpy)	- 138,000
Less Major Packaging Rotogravure and Flexography (from Reference 3 and 4, 1977, source > 100 tpy)	- 86,000[1]
Less Nonemissions From Letterpress and Web-Offset (from Reference 5)	- 84,000
Balance of Emissions (All Graphic Arts Sources Not Identified Above)	- 82,000 Tons

$$PF_{ga} = \frac{82{,}000 \text{ tons} \times 2000 \text{ lbs/ton}}{215{,}000{,}000 \text{ (mid 70's population for U.S.)}} = 0.8 \text{ lb/cap/yr}$$

[1]From Reference 3 for rotogravure package printing and from Reference 4 for flexographic package printing assuming that 87 percent are major sources based on Reference 4.

References

1. Control of Volatile Organic Emissions from Existing Stationary, Sources, Volume VIII, Graphic Arts - Rotogravure and Flexography, EPA-450/2-78-033, U. S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

2. Background Information Document for the Publication Rotogravure Printing Industry, Draft, Emission Standards and Engineering Division, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1979.

3. Enforceability Aspects of RACT for the Rotogravure and Flexography Portion of the Graphic Arts Industry, EPA Contract Number 68-01-4147, PEDCo Environmental, Inc., Cincinnati, OH, March 1980.

4. Overview Assessment of Organic Emissions of the Flexible Packaging Industry, Draft, EPA Contract Number 68-03-2580, WAPORA, Inc., New York, NY.

5. Written communication from Edwin J. Vincent, Emission Standards and Engineering Division to Bill Lamason, Monitoring and Data Analysis Division, U. S. Environmental Protection Agency, Research Triangle Park, NC, August 1980.

Flexography - Emission points on flexographic printing lines are the ink fountain, the press, the dryer and the chill rolls (see Figure 4.9-3). The dryer is the major emission point, and emissions can be estimated from Equation 1, or from Equation 2 and the appropriate parameters from Table 4.9-1.

Vapor capture systems are necessary to minimize fugitive solvent vapor loss around the ink fountain and at the chill rolls. Fume incinerators are the only devices proven highly efficient in controlling vapors from flexographic operations. VOC emissions can also be reduced by using waterborne inks, which are used extensively in flexographic printing of packaging products.

Table 4.9-3 shows estimated control efficiencies for printing operations.

References for Section 4.9

1. "Air Pollution Control Technology Applicable to 26 Sources of Volatile Organic Compounds", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 27, 1977. Unpublished.

2. Peter N. Formica, Controlled and Uncontrolled Emission Rates and Applicable Limitations for Eighty Processes, EPA-340/1-78-004, U.S. Environmental Protection Agency, Research Triangle Park, NC, April 1978.

3. Edwin J. Vincent and William M. Vatavuk, Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VIII: Graphic Arts - Rotogravure and Flexography, EPA-450/2-78-033, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

4. Telephone communication with C.M. Higby, Cal/Ink, Berkeley, CA, March 28, 1978.

5. T.W. Hughes, et al., Prioritization of Air Pollution from Industrial Surface Coating Operations, EPA-650/2-75-019a, U.S. Environmental Protection Agency, Research Triangle Park, NC, February 1975.

6. Harvey F. George, "Gravure Industry's Environmental Program", Environmental Aspects of Chemical Use in Printing Operations, EPA-560/1-75-005, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1976.

7. K.A. Bownes, "Material of Flexography", ibid.

8. Ben H. Carpenter and Garland R. Hilliard, "Overview of Printing Processes and Chemicals Used", ibid.

9. R.L. Harvin, "Recovery and Reuse of Organic Ink Solvents", ibid.

10. Joseph L. Zborovsky, "Current Status of Web Heatset Emission Control Technology", ibid.

11. R.R. Gadomski, et al., Evaluations of Emission and Control Technologies in the Graphic Arts Industries, Phase I: Final Report, APTD-0597, National Air Pollution Control Administration, Cincinnati, OH, August 1970.

12. R.R. Gadomski, et al., Evaluations of Emissions and Control Technologies in the Graphic Arts Industries, Phase II: Web Offset and Metal Decorating Processess, APTD-1463, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1973.

13. Control Techniques for Volatile Organic Emissions from Stationary Sources, EPA-450/2-78-022, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1978.

14. Telephone communication with Edwin J. Vincent, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1979.

15. W.H. Lamason, "Technical Discussion of Per Capita Emission Factors for Several Area Sources of Volatile Organic Compounds", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 15, 1981. Unpublished.