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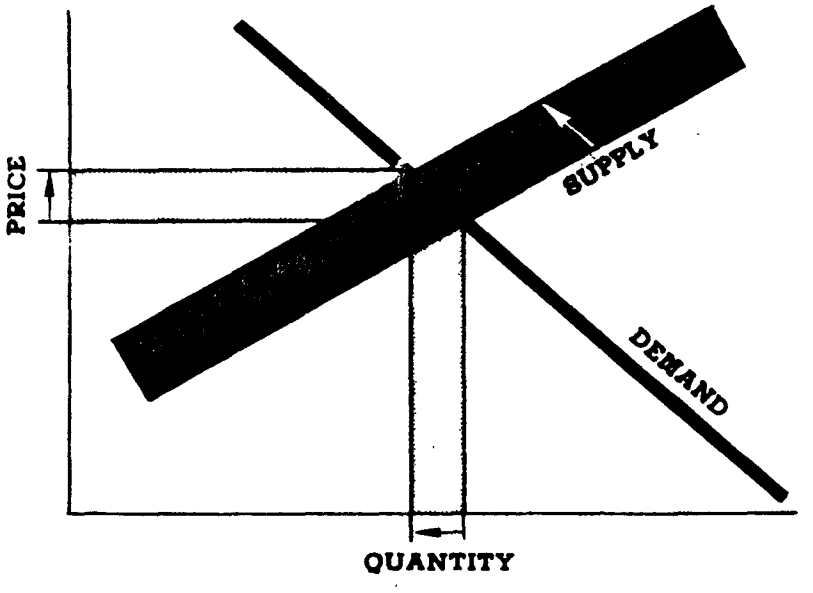
ECONOMIC ANALYSIS
OF
PROPOSED EFFLUENT GUIDELINES

PRINTING INDUSTRY



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Planning and Evaluation
Washington, D.C. 20460

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Contract 68-01-1541

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ENVIRONMENTAL PROTECTION AGENCY

PREFACE

The attached document is a contractors' study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency ("EPA"). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under Sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study ("EPA Development Document") supporting the issuance of proposed regulations under Sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports proposal of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of Sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Planning and Evaluation of EPA. This report was submitted in fulfillment of Task Order No. 23, Contract 68-01-1541 by Arthur D. Little, Inc. Work was completed as of August 1974.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of proposed rule making under Sections 304(b) and 306 of the Act for the subject point source category. The study is not an official EPA publication. It will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rule making proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompanying study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

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EXECUTIVE SUMMARY

It is the purpose of this study to analyze the economic impact of the cost of proposed Effluent Limitation Guidelines and New Source Performance Standards on the printing and publishing industry pursuant to the Federal Water Pollution Control Act, as amended (1972).

This report deals with those segments of Major Group 27 that are concerned with printing, and printing and publishing, and those establishments that perform platemaking services for the printing trade. Specifically, it includes the following industry segments:

SIC Code	Industry
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2761	Manifold Business Forms.
2771	Greeting Card Publishing.
2793	Photoengraving.
2794	Electrotyping and Stereotyping.
2795	Lithographic Platemaking and Related Services.

Industry Characteristics

The printing industry is composed of a heterogeneous collection of over 30,000 companies that range in size from a few employees to several thousand. Each of these businesses performs one or more of the steps necessary to the bulk-production of printed materials: the publication function, typesetting, platemaking, printing, binding, etc.

Some companies are organized to provide all of the services required for a given product (e.g., newspapers and some periodicals) or for several product categories (commercial printers). The industry, however, tends to specialize in that some companies produce only newspapers; others produce only periodicals, or books, or manifold business forms, etc. Even within the corporate framework of the larger printing companies one finds plants dedicated to printing books, other plants that print only periodicals and still others that do commercial printing. This specialization in product follows directly from the fact that the

SIC Code	Industry	Size	Number of Plants
2711	Newpapers	Large	400
2721	Periodicals	Large	4
2741	Miscellaneous Publishing	Large	4
2751	Commercial Printing, Letterpress	Large	4
2751	Commercial Printing, Gravure (Roll making)	Medium	8
	(Printing)	Large	34
2793	Photoengraving	Large	17

It is interesting that in all industries where process wastewater is being generated it is being generated mainly by the large companies. In those few instances in which small companies are producing waste that is not compatible with municipal treatment systems, the volumes involved are small and there are more economic alternatives for disposal than those supplied in the Development Document.

Industry Financial Profile

Many of the companies in the printing and publishing industry are closely-held corporations. As a result, financial information is considered proprietary and is generally difficult to obtain. However, many companies in the industry belong to trade associations and participate annually in association-sponsored financial studies of the various industry segments. In many cases the results of these studies are sold to help defray the cost of the study. In other cases the results are sometimes available from participating companies. The largest trade association in the industry is Printing Industries of America, Inc. Its membership represents firms which account for more than 80% of all the printing produced in the United States.

Clearly, most segments in the printing and publishing industry are strong and healthy. They are able to finance new investments, to take advantage of new technology and to remain competitive and look optimistically to the future as one of expanding markets and growth opportunities. The exception is the Electrotyping and Stereotyping Industry (SIC 2794) which is a dying industry and is expected to be extinct by 1980.

The printing and publishing industry generally does not publish data on earnings. The best source of such information is the Ratio Studies, e.g., the PIA Ratio Studies and similar studies carried out by other industry segments.

Although the investment in each of the segments for new capital improvements will vary from year to year by industry needs and new technological

developments, the data reflect an industry whose plants are attempting to maintain their competitive position vis-à-vis other plants and other communication industries and this trend is expected to continue.

Model Plants

Financial models of representative plants studied for possible impact were constructed for the Newspapers; Periodicals; Miscellaneous Publishing; Commercial Printing, Letterpress; Commercial Printing, Gravure and Photoengraving industries. In all cases the models were for large plants, i.e., those having more than 100 employees, because they are the principal sources of significant amounts of process contact effluent in their platemaking operations. Small and medium printing plants generally rely upon purchased services for their plates and thus avoid such problems. Moreover, the small and medium plants that may be etching metal for platemaking purposes have the option of disposing of their relatively small amounts of waste by means that do not require significant capital investments.

Economic Impact Analysis Methodology

In our determination of the impact of pollution control costs on the printing industry, the principal considerations were the effects of the costs on profit margins and the determination of whether the costs could be passed on in the form of higher prices for printed product. However, a host of secondary effects were also considered. These included possible effects on level of production, employment, growth of the company, ability of the company to raise new capital, hardships on the community, and international trade.

The economic analysis was concentrated on those segments of the printing industry which use technology that causes significant water pollution. The framework for the analysis was the model plants defined for each of the segments studied. The feasibility of investing capital to control pollution was assessed on the basis of the effect of the increased cost on profitability, a comparison of the required capital expenditure for pollution control with annual new capital expenditures for each of the models, and estimates of the revenue or price increases necessary to recover the additional expense and provide the same return on assets with the expanded asset base. The data was also analyzed to determine the probable effect of BPT and BAT standards on plant closures directly related to pollution control requirements. The sensitivity of the analysis under different conditions, such as those that would obtain because a printing plant did not conform exactly to a model plant, was also considered.

Effluent Control Costs

The control costs used in this analysis are those presented in the Development Document for Proposed Effluent Limitations Guidelines.

The BPT requirements for the printing and publishing industry have been determined to be a combination of flow equalization and reduction of pollutants. The BAT requirements for this industry include a further reduction of pollutants to specified levels.

Wastes from the flat-bed letterpress, offset and screen printing operations will be required to meet only the limitations for BOD_5, pH, phenols, TSS, oil and grease, and organic solvents for BPT, BAT and NSPS treatment levels. No pretreatment is required.

Wastes from gravure, flexography and rotary letterpress operations will be required to meet all limitations specified. NSPS requirements are identical to the BAT requirements. Pretreatment requirements for new sources are the same as the BAT requirements.

Impact Analysis

This industry is unusual in that the main source of pollution is the larger companies. Furthermore, the polluting processes themselves are concentrated in one part of the operation, platemaking, and in particular, those steps that involve etching metal with acid. Although some small photoengravers still etch metal, the volume of acid waste generated is easily disposed of by drumming without adding significantly to the cost of the plates. The large companies continue to use polluting technology because of their large investments in printing equipment, the need for duplicate plates, the demand for top-quality printing for long-run national ads, and the cost of conversion to non-polluting printing methods. Thus the analysis focuses on the profitability, captial availability and price effects for the large model plants.

Basic to our analysis is the creation of a hypothetical model plant for each segment with prototypical financial data. Because our decision of no impact is based on an analysis of these hypothetical plants, a sensitivity analysis was performed to determine how different from the prototype a plant can be before the cost of the water pollution control system has significant impact. Thus three sectors were analyzed – Newspapers; Commercial Printing, Gravure; and Photoengraving – because each contained plants of widely varying financial performance. Since the ability of a company to afford the water pollution control system is a function in part of its size, revenue and net assets were used as appropriate measures of size. The sensitivity analysis was designed to determine

the minimum-sized company able to afford the specified effluent control systems. It demonstrates that not only is the model company within a sector unaffected by the standards, but that no company in the sector would be impacted. The loss in after tax ROI for all segments falls in the range of 0.06 to 0.92 percent for BAT control costs. The annual costs as a percent of sales for all segments fall in the range of 0.06 to 1.94.

The impact analysis indicates that the amount of investment required for control of water pollution in the industry is such that no price increase would be anticipated. During the past year the overall increases in the cost of paper, plates, labor, and equipment have overshadowed the small effect of the cost of pollution control on the cost of the preparation of plates. The average cost of the platemaking service is 2 to 5% of the cost of the printing. If the total burden of the water pollution control investment had to be borne by the cost center represented by the platemaking operation in the printing plant and if the company were making a minimum of 100 plates a day (5000 plates per year), the annual cost would be $15,000 or about $3 per plate. Such an increase in the price of plates would be very small in comparison with other price increases that have been affecting this industry. Moreover, the increase will be distributed over the total number of impressions being printed, so the overall effect will be even more miniscule. Thus, no significant price increases are expected as a direct result of the cost of pollution control equipment except in those service industries where the total amount of the cost of pollution control is directly attributable to the plate, since this is the product that is being sold. It is expected, however, that this price increase can be readily passed on to the printer.

For industry suppliers and consumers the competition between the different types of printing is expected to continue. In the past ten years offset printing has been making inroads into letterpress "territory" at higher and higher levels of printing impressions per run or per job order. It is expected that this trend will continue. In recent years there has been an increasing use of plastic plates to replace metal plates in the letterpress industry and it is expected that this trend will continue. Insofar as the need for water pollution control equipment and associated costs could be a factor, they would promote decisions favoring either offset printing or a change to plastic plates in letterpress operations, but the incremental effect of the cost of water pollution control on the decision that has already been made by the industry is expected to be very small.

The new source performance standards will not affect the growth of any segment of the printing industry. No effect on prices is anticipated because of new source performance standards and new plant locations probably will not be affected either. The trend in recent years for the larger plants to build in more rural areas where they have access to land and good transportation will continue independent of the requirements for water pollution control. The decision to

build domestic plants versus foreign plants will not be influenced by the proposed guidelines. Our analysis shows the balance of payments will not affect location or dollar volume of printing. In all cases pretreatment costs are less than BAT costs and since no impacts were found for BAT costs no separate analyses were conducted for pretreatment costs. In addition to the lack of impact noted above there will also be no adverse effects on production, employment, communities, industry growth or international trade.

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I. INTRODUCTION

The purpose of this study is to analyze the economic impact of the cost of the proposed Effluent Limitations Guidelines and New Source Performance Standards on the printing and publishing industry. These requirements are being developed by EPA in response to the Federal Water Pollution Control Act, Amendments of 1972.

For purposes of this analysis, four levels of effluent limitations will be considered for each segment:

(1) Best practicable control technology (BPT) currently available – to be met by industrial dischargers by July 1, 1977.

(2) Best available technology (BAT) economically achievable – to be met by all industrial dischargers by July 1, 1983.

(3) New source performance standards (NSPS) – to be applied to all new facilities (that discharge directly into navigable waters) constructed after the promulgation of these guidelines (approximately November 1, 1974).

(4) New source pretreatment standards – to be applied to all facilities (that discharge to municipal systems) constructed after the promulgation of these guidelines (approximately November 1, 1974).

The major constituents of concern in the printing and publishing industry are the metal salts generated in the etching of plates used for printing. The metals involved include aluminum, chromium, copper, magnesium, and zinc. All of the organic materials present in wastes from this industry are believed to be easily biodegradable and to present no problem in setting effluent limitations.

The BPT Standards for one subcategory – consisting of flat-bed letterpress, offset and screen printing – have been defined in the proposed Effluent Limitations Guidelines Development Document, as normal biological waste treatment with the costs of achieving the BPT Standards in these segments being essentially zero. Such plants that discharge to surface waters must provide normal biological treatment for the sanitary wastes originating in the plants. Because the sanitary waste flows will far exceed the process wastewater flow, the marginal cost of the biological treatment system has been assigned to the requirement to treat sanitary wastes and not the BPT requirement to treat process water. Some metal salts are generated in the etching of bimetallic and trimetallic offset printing plates. However, the amount of metal removed in the developing step is small compared to, for example, a photoengraving prepared for letterpress use. Accordingly, it is

believed that the use of these plates will not constitute a significant source of pollution in the limited applications in which they are used.

Treatment levels for BAT and NSPS for flat-bed letterpress, offset and screen printing are equivalent to that of BPT. The cost of achieving BAT and NSPS Standards is, therfore, also zero, no treatment being required for new sources. No cost data are provided for these standards; thus no impact analysis has been made on these segments of the printing industry.

This report deals with those segments of Major Group 27 that are concerned with printing, printing and publishing and those establishments that perform platemaking services for the printing trade. Specifically, it includes the following industry segments:

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II. WATER USE IN THE PRINTING INDUSTRY

The following sections provide an overview of the printing industry, with comments on pertinent trends and emphasis on water use requirements and sources of water pollution.

A. CHARACTERIZATION OF THE INDUSTRY

The printing and publishing industry is composed of a heterogeneous collection of over 38,000 companies that range in size from a few employees to several thousand. In total it employs about one million people and has sales of over $28 billion per year. Each of these businesses performs one or more of the steps necessary to the bulk-production of printed materials: the publication function, typesetting, platemaking, printing, binding, etc.

Some companies are organized to provide all of the services required for a given product (e.g., newspapers and some periodicals) or for several product categories (commercial printers). The industry, however, tends to specialize in that some companies produce only newspapers; others produce only periodicals, or books, or manifold business forms, etc. Even within the corporate framework of the larger printing companies one finds plants dedicated to printing books, other plants that print only periodicals and still others that do commercial printing. This specialization in product follows directly from the fact that the specialized equipment needed for economical production of one type of product frequently is neither optimum nor competitive for another product.

Printing itself is intrinsically non-polluting; that is, the process of transferring ink from a printing plate to paper in no way involves contact process water and does not in itself cause water pollution. The potential of any segment of the industry to cause water pollution is in general only indirectly associated with the type of printing process used. It is related most directly to the platemaking operation. Only those platemaking operations that involve metal etching or electroplating steps are possible significant sources of pollution. The pollutants are usually strong mineral acids and salts of such metals as copper, zinc, and magnesium in the case of metal etching and salts of copper and chromium from electroplating processes.

Recent developments in printing plate technology offer alternatives to metal processing in the form of organic photopolymer materials. These materials can sometimes be etched with compressed air, water or detergent solutions to provide either satisfactory engravings or complete printing plates. While such plate materials are not completely satisfactory for all applications, they are being improved and their use is growing. The waste materials from such platemaking processes are biodegradable and compatible with municipal treatment systems.

Still other letterpress plate materials are etched with organic solvents. The solvents are usually reclaimed by distillation and the polymer either reused or introduced into the solid waste stream.

The great majority of printing companies and the industries that service them are located in urban areas and are believed to discharge their effluents to municipal systems. According to the Guidelines Document a review of permit files as of September 1973 showed that 33 applications had been received from the printing industry. Of this total, 22 were for permits to discharge non-contact cooling water and/or boiler blow-down, water. We believe that a negligible percentage of printing or platemaking companies discharge process waste waters to navigable streams.

1. Printing Methods

The most widely used printing techniques are letterpress, offset lithography (offset) and gravure. Other processes such as screen printing and intaglio (steel plate printing) are more highly specialized.

a. Letterpress

In this process ink is applied directly from a relief printing plate to the surface to be printed. Relief plates are made by:

(1) setting or casting type (flat-bed letterpress)

(2) molding a duplicate plate from an original (stereotype, as in the newspaper industry)

(3) electroplating a conductive base molded from an original (electrotype for magazine ads)

(4) etching a metal or photopolymer (plastic) plate

Processes (1) and (2) and the photopolymer portion of process (4) are not sources of water pollution. Spent liquors from process (3) and the metal portion of process (4) consist of highly acid metal salts which are potential sources of pollution.

The letterpress process is the oldest printing process in the industry and one where little growth is expected.

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The letterpress process is the oldest printing process in the industry and one where little growth is expected.

b. Offset Lithography

Offset lithography consists of printing from a plane surface, as opposed to printing from a relief surface. It is based on the principle that oil (ink) and water (aqueous fountain solution) do not mix. When the moistening rolls and the inking rolls on the press contact the printing plate in sequence, the former applies a small amount of aqueous fountain solution to the non-image areas (which are chemically different from the image areas) and the inking rolls apply ink to the image areas while maintaining a sharp interface between the two.

Instead of the printing plate contacting the surface to be printed, as is the case with letterpress printing, the printing plate offsets the ink onto a rubber blanket roll which, in turn, contacts the paper to be printed and transfers the ink to it. This printing process is non-water-polluting. Preparation of the plate surface is essentially a photographic process.

There are two major types of offset printing – sheet-fed printing and web printing – and each has quite different technical and economic requirements and characteristics. As the names imply, sheets of paper are used in one case and rolls of paper in the other. Offset has been the most rapidly growing method of printing in this country, partly because of its compatibility with photocomposition. Web offset is the faster growing segment of offset printing and is expected to continue to be so.

c. Gravure

Gravure printing is the opposite of relief printing in that the image is formed by depressions in the printing plate. In use, these depressions are filled with ink; the surface of the plate is wiped clean with a doctor blade; and the ink is transferred, by intimate contact, to the surface to be printed.

In preparing a gravure cylinder, one etches the metal, usually copper, in the desired pattern either chemically or mechanically. There is also the requirement of electroplating gravure cylinders with copper and chromium. Electroplating with copper provides the basic plate surface: chromium plating provides improved gravure cylinders for long runs. Because chemical etching and metal plating involve the use of strong acid salts and other metal salts are by-products, there are sources of water pollution in gravure cylinder preparation. The printing process itself, however, does not contribute to water pollution.

d. Intaglio Printing

The intaglio printing process, a variation of gravure printing, is used mainly to print currency, stamps, and stock certificates. In the preparation of intaglio

plates the original engraving is usually made mechanically. Duplicate plates are made by a process quite similar to that used for electrotypes; i.e., electroplating on a conductive base molded from the original. The water pollution potential of this process is similar to that of the electrotype process.

e. Screen Printing

This method of printing utilizes a fine-coated silk, nylon or metal screen that carries an image prepared by selectively removing portions of the coating. In use, a squeegee forces the ink through the screen to form an image on a substrate that is in intimate contact with the second side of the screen.

Screen printing is used in those applications where conventional printing would not be possible or convenient because of size or shape or surface texture of the material on which the printing is to be done. It is also used in applications where only a few impressions are required or where special artistic effects are desired.

The process of making the screen can be either mechanical or photographic. In the former case no water pollution should be associated with "plate" preparation. In the latter case pollution would be similar to that of other photographic operations. The printing operation itself is non-water-polluting.

2. Photography

Three types of photographic operations are commonly employed in printing and platemaking plants: film developing, plate developing (e.g., offset plates), and photoengraving (e.g., surfaces of letterpress plates or gravure cylinders).

Conventional photography, in which page-sized silver-base positive or negative film is developed, is typical of the operations in the photographic industry. In operations of any size – e.g., a large newspaper – the silver from the developing bath is reclaimed, mainly for economic reasons. The remainder of the process uses a large amount of water relative to the small amount of material that is removed from the photographic film. The organic materials that enter the waste stream are compatible with typical municipal treatment processes.

In the usual offset platemaking operations, a light-sensitive coating on the plate is exposed to light through film. The areas struck by the light are insolubilized and become the image on the plate while the unexposed portions remain soluble and are removed in the developing step by washing. The coating is usually water soluble, in which case the plate is developed with water, but oil-soluble coatings may also be used.

The preparation of photoengravings or entire letterpress printing plates by etching metal with strong acids is a source of water pollution. In areas of the printing industry where these processes are widely used (e.g., newspaper printing), there has been a trend to the use of photopolymer materials. The main attraction of the photopolymers is that they can be etched with water, and in some cases with compressed air. The materials removed during the etching process are either disposed of in the solid waste stream or discharged with the waste water. They are biodegradable and compatible with municipal treatment systems. In recent years much attention has been devoted to research and development on letterpress plates that can be processed in ways that completely avoid the problem of water pollution.

B. WATER USE REQUIREMENTS

1. Cooling Water

None of the three basic printing processes has any unusual requirements for non-contact cooling water. Screen printing and sheet printing processes in general do not require cooling water.

In the preparation of printing plates by mechanical engraving or by hot metal casting, some non-contact cooling water may be used but there should be no associated pollution, nor should there be any significant rise in the temperature of the water because of the relatively small volumes of cooling water that are involved.

Some of the moving parts of printing presses are water cooled, but the water does not come in contact with the printed product and is not contaminated. Water is used in chill rolls that cool the printed paper as it emerges from drying ovens in heat-set printing operations.

None of this water is subject to contamination and many plants refrigerate and recycle their cooling water. In solvent recovery operations, such as those required in the gravure printing industry, considerable cooling water could be used, the temperature of which might be raised significantly.

2. Process Water

Letterpress printers who prepare their own plates use water in the photographic department, where material to be printed is prepared, and the development of most metal and plastic plates requires water. The principal difficulty derives from the etching of metal plates in strongly acidic baths. Water is used in these baths and additional water is used to rinse the plates. Zinc, copper, and magnesium metal ions are typical pollutants.

The offset printing process uses water in the photographic department, in the development of plates for lithographic printing, and in preparing plates for reuse after storage. In so doing, small amounts of normally biodegradable material are introduced into the wash water but this material does not represent a significant source of pollution. Some lithographic plate developers are emulsions that contain phosphoric acid, gum arabic, reinforcing resins and solvents. The use of these materials also represents small additions to the wash water. There are also bimetallic and trimetallic offset plates whose development involves the etching of thin layers of metal. These plates represent a small percentage of the total offset plates used. Their use does not appear to represent a significant source of pollution in a typical offset printing plant.

Water is used in the printing operation to moisten the non-image areas of offset plates before the plates are inked, but this water dissipates into the printed product. In some printing – e.g., offset printing – alkali, alcohol and/or phosphoric acid may be added to the fountain solution, but these also end up in the product.

In the preparation of gravure cylinders, water is used in the photographic department and in the preparation of the gravure rolls if the acid etching process is used. An acid etch (iron chloride) introduces copper into the bath and these metal ions (iron and copper) are a source of pollution. Some gravure processes use water-thinnable inks, but these represent a pollution hazard principally during clean-up operations.

The screen printing process uses water in the photographic department and in the preparation of the screen for printing. This technology resembles that used in preparing lithographic plates, and introduces a small amount of essentially biodegradeable material into the water. Some of the smaller shops still use silk screen coatings that contain sodium or potassium dichromate but these should not produce a significant level of pollution.

In any of the printing plants that include bindery operations, water dilutable adhesives might be used, and some of these materials would in all probability be introduced into the waste stream during clean-up. Most are biodegradable. In general, however, water-base adhesives end up in the product. Many binderies use hot melt adhesives which, of course, are non-water-polluting.

3. Clean-Up Water

The possibility of water pollution from press clean-up operations is minor because the oils and pigments used in printing inks normally are not water soluble. Organic solvents, therefore, are used in the clean-up operations. The normal procedure is to wipe printing plates and press parts with rags wet with organic solvents, with the rags frequently being recovered by commercial cleaning.

In gravure and flexographic printing some water-based inks are now in use and there is a hazard of water contamination during the clean-up operations. The gravure process, however, is usually used for long-run printing jobs, so the amount of clean-up required does not represent a heavy load on the waste system. When solvent-based inks are used in this printing process the waste is usually collected in a drum and similar procedures could be followed with the waste from the water-based inks.

C. WATER POLLUTION CONTROL

No unusual difficulties are anticipated in controlling water pollution levels. In acid etching operations the concentration of metals can be high but the total volume of water used is frequently small. The problem should yield to established techniques for removing any oily materials from the surface of the bath: precipitation of the metals, sedimentation or filtration, and control of pH in the effluent water. Alternatively, with the small amounts of contaminated water that are anticipated in the shops of small photoengravers, and platemakers, it would not be unusual to have the contents of the bath neutralized, drummed, and taken to a sanitary land-fill operation. Rinse water is frequently very small in volume and is sometimes used as make-up water in etching and plating baths.

The Development Document For Proposed Effluent Limitations Guidelines and New Source Performance Standards for the printing and publishing industry describes the recommended technology for achieving the guidelines and will be published as a separate report by EPA. The reader is, therefore, referred to that document for technical descriptions of proposed BPT, BAT, NSPS, and new source pretreatment standards.

III. INDUSTRY SEGMENTS

The purpose of this chapter is to provide a screening of the industry as a basis for narrowing the study so as to focus primarily on those segments that are likely to be impacted.

Because of the general relationship between the printing process used and the water pollution potential, the economic impact analysis would be simplified by segmenting the industry by printing process. Moreover, the technical Contractor segmented the industry in that manner and it would be convenient to adopt the same segmentation. Many companies, however, use more than one printing process and do not report sales and earnings separately. Moreover, company operations overall tend to follow SIC code categories. Consequently, the segmentation of the industry must be product oriented and hence follows the SIC codes. In a number of cases, however, subsegmentation by printing process is useful and therefore has been used as a means of grouping those parts of an industry that are similarly impacted.

A structural characterization of the industry is provided showing the types of companies, types of establishments, number of establishments and their employment by segment. Each segment is analyzed and subsegmented where indicated, and those segments and subsegments that are most likely to be impacted are identified. Included also is a discussion of the trends taking place in each segment, since some of these trends represent switches in technology that will be accompanied by a reduction in pollution potential.

A. TYPES OF FIRMS

In the opening paragraph of his book, *The Printing Industry,** Victor Strauss states, "The printing industry is a collective name for a wide variety of different industries, crafts, and trades which belong together because they all serve fundamentally similar and related purposes within our modern communications system." According to the Census of Manufactures, preliminary 1972 data, there are 38,288 establishments and 969,900 employees in the segments covered by this study.

1. Number of Plants

Table III-1 shows the distribution by number of establishments and number of employees in the various industry segments with which this study is concerned. Of the 14 segments included, only five represent more than 5% of the industry total, measured either as establishments or by employment.

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* Published by Printing Industries of America, 1967.

TABLE III-1

DISTRIBUTION BY NUMBER OF ESTABLISHMENTS

SIC CODE	INDUSTRY	NUMBER OF ESTABLISHMENTS*	PERCENT OF TOTAL	NUMBER OF EMPLOYEES (M)	PERCENT OF TOTAL
2711	Newspapers	8,022**	20.95	347.8	35.86
2721	Periodicals	2,510	6.56	66.4	6.85
2731	Book Publishing	1,186	3.10	57.0	5.88
2732	Book Printing	685	1.79	41.2	4.25
2741	Misc. Publishing	2,000	5.22	37.5	3.87
2751	Comm. Print., L.P.	13,086	34.18	128.4	13.24
2752	Comm. Print., Litho	8,304	21.69	183.2	18.89
2753	Engraving and Plate Print.	553	1.44	9.4	0.97
2754	Comm. Print., Gravure	127	0.33	19.5	2.01
2761	Manifold Bus. Forms	658	1.72	38.4	3.96
2771	Greeting Card Publishing	195	0.51	23.2	2.39
2793	Photoengraving	584	1.53	9.2	0.95
2794	Electrotyping and Stereotyping	80	0.21	1.6	0.16
2795	Litho Platemaking Services	298	0.78	7.1	0.73
		38,288	100.01	969.9	100.01

*The numbers given include all establishments which fall within a given SIC code, in some instances including establi. ents which publish only and do not have printing operations. See Table III-12 for the number of e tablishments in each SIC code that perform printing operations.

**This number is believed to omit some plants with less than 10 employees and therefore to understate the actual total. A more accurate count is believed to be 9402. See Industry Subsegmentation.

SOURCE: Census of Manufacturers, Preliminary 1972.

The industry is composed of a large number of small companies. This is shown in Table III-2, which lists by industry segment the number of establishments having less than 20 employees. Overall, about 80% of the establishments in the printing and publishing industry have less than 20 employees.

Sales concentration in the printing industry tends to follow the pattern established in many manufacturing industries; that is, the more concentrated the industry, the higher the average annual net sales per company within the industry. On the basis of available information, the Greeting Card Publishing industry has the highest concentration of sales, with the four largest companies representing 67% of industry sales and the 50 largest companies representing 95% in 1967 (Table III-3). In 1972 the 195 establishments in the Greeting Card Publishing industry had the high average value of shipments per establishment of $3.9 million. This value, as shown in Table III-4, was exceeded only by the Commercial Printing, Gravure industry whose 127 establishments had an average value of shipments per establishment of $5.3 million in 1972. Unfortunately, the Commercial Printing, Gravure segment is new and such historical data as is available does not appear to be consistent.

Two exceptions to the correlation between sales concentration and high average value of shipments per establishment are the Miscellaneous Publishing industry and the Electrotyping and Stereotyping industry. Both are highly concentrated but have relatively low average values of shipments per establishment: $521,000 for Miscellaneous Publishing, and $455,000 for Electrotyping and Stereotyping.

A breakdown of selected industry segments, based on number of employees, is presented in Table III-5. Included are two relatively stable industries – Newspapers and Commercial Printing, Letterpress – and two that are changing with respect to the number of their constituent plants – Greeting Card Publishing, and Electrotyping and Stereotyping.

In Greeting Card Publishing, there is a trend to larger plants and those plants are producing a higher percentage of the value of shipments. In 1963, only 6.2% of the establishments had over 100 employees but by 1967 that number had increased to 17.6%. Although the total value of shipments increased during this period there were 35 (14%) fewer establishments at the end of 1967 than four years earlier. There was also a substantial decrease in the number of Electrotyping and Stereotyping plants during the same period (51, or 28%) but the decline also was accompanied by a reduction in total value of shipments. While greeting card publishing is a growing industry, electrotyping is a dying industry.

The Commercial Printing, Letterpress segment was remarkably static in all respects. The newspaper industry showed no dramatic change during the period covered by the data.

TABLE III-2

DISTRIBUTION BY NUMBER OF EMPLOYEES

SIC CODE	INDUSTRY	ESTABLISHMENTS WITH LESS THAN 20 EMPLOYEES		ESTABLISHMENTS WITH 20 OR MORE EMPLOYEES		TOTAL ESTABLISHMENTS
		NUMBER OF ESTABLISHMENTS	PERCENT	NUMBER OF ESTABLISHMENTS	PERCENT	
2711	Newspapers	5,951*	74	2,071	26	8,022
2721	Periodicals	2,063	82	447	18	2,510
2731	Book Publishing	886	75	300	25	1,186
2732	Book Printing	409	60	276	40	685
2741	Misc. Publishing	1,745	87	255	13	2,000
2751	Comm. Print., L.P.	11,951	91	1,135	9	13,086
2752	Comm. Print., Litho	6,193	75	2,111	25	8,304
2753	Engraving and Plate Print.	427	77	126	23	553
2754	Comm. Print., Gravure	45	35	82	65	127
2761	Manifold Bus. Forms	290	44	368	56	658
2771	Greeting Card Publishing	116	59	79	41	195
2793	Photoengraving	455	78	129	22	584
2794	Electrotyping and Stereotyping	56	70	24	30	80
2795	Litho Platemaking Services	200	67	98	33	298
		30,787				38,288

*This total is believed to omit some plants with less than 10 employees.

Source: Census of Manufactures, Preliminary 1972

TABLE III-3

SALES CONCENTRATION IN SELECTED SEGMENTS OF THE PRINTING AND PUBLISHING INDUSTRY

SIC CODE	INDUSTRY AND YEAR	ANNUAL VALUE OF SHIPMENTS-PERCENT ACCOUNTED FOR BY			
		4 LARGEST COMPANIES	8 LARGEST COMPANIES	20 LARGEST COMPANIES	50 LARGEST COMPANIES
2771	Greeting Card Publishing				
	1970	75	85	n.a.	n.a.
	1967	67	79	88	95
	1966	64	76	n.a.	n.a.
	1963	57	71	82	92
2794	Electrotyping and Stereotyping				
	1970	n.a.	n.a.	n.a.	n.a.
	1967	34	45	63	87
	1966	n.a.	n.a.	n.a.	n.a.
	1963	31	39	57	80

n.a.-Not available

SOURCE: Quarterly Industry Report, January 1973, U.S. Department of Commerce

TABLE III-4

AVERAGE ANNUAL VALUE OF SHIPMENTS PER ESTABLISHMENT

SIC CODE	INDUSTRY	NUMBER OF ESTABLISHMENTS	VALUE OF SHIPMENTS ($MM)	AVERAGE VALUE OF SHIPMENTS PER ESTABLISHMENT ($M)
2711	Newspapers	8,022	8,271.5	1,031
2721	Periodicals	2,510	3,506.3	1,397
2731	Book Publishing	1,186	2,861.3	2,413
2732	Book Printing	685	929.3	1,357
2741	Misc. Publishing	2,000	1,042.6	521
2751	Comm. Print., L.P.	13,086	3,242.6	248
2752	Comm. Print., Litho	8,304	5,110.8	615
2753	Engraving and Plate Print.	553	197.1	356
2754	Comm. Print., Gravure	127	674.0	5,307
2761	Manifold Bus. Forms	658	1,421.5	2,160
2771	Greeting Card Publishing	195	766.1	3,929
2793	Photoengraving	584	215.4	369
2794	Electrotyping and Stereotyping	80	36.4	455
2795	Litho Platemaking Services	298	201.8	677
TOTAL		38,288	28,476.7	

Source: Census of Manufactures, Preliminary 1972

TABLE III-5

NUMBER OF ESTABLISHMENTS AND ANNUAL VALUE OF SHIPMENTS BY SIZE OF ESTABLISHMENT

SIC CODE YEAR	SIZE OF PLANT	NUMBER OF ESTABLISHMENTS		PERCENT OF TOTAL	VALUE OF SHIPMENTS ($M)		PERCENT OF TOTAL
2711 Newspapers							
1963	Small	6466		77.6	346,508		7.7
	Medium	1,346		16.2	573,947		12.8
	Large	519	8,331	6.2	3,563,137	4,483,592	79.5
1967	Small	6065		74.9	369,500		6.4
	Medium	1453		18.0	712,900		12.4
	Large	576	8,094	7.1	4,674,700	5,757,100	81.2
2751 Comm. Print., L.P.							
1963	Small	10,705		88.4	658,824		24.9
	Medium	1,174		9.7	696,544		26.3
	Large	230	12,109	1.9	1,289,680	2,645,048	48.8
1967	Small	10,659		88.1	762,700		23.4
	Medium	1,198		9.9	863,800		26.6
	Large	241	12,098	2.0	1,628,800	3,255,300	50.0
2771 Greeting Card Publishing							
1963	Small	164		63.8	20,266		5.8
	Medium	77		30.0	39,668		11.5
	Large	16	257	6.2	286,027	345,961	82.7
1967	Small	130		58.5	16,000		3.1
	Medium	53		23.9	45,500		8.8
	Large	39	222	17.6	456,400	517,900	88.1

TABLE III-5 (Continued)

NUMBER OF ESTABLISHMENTS AND ANNUAL VALUE OF SHIPMENTS BY SIZE OF ESTABLISHMENT

SIC CODE YEAR	SIZE OF PLANT	NUMBER OF ESTABLISHMENTS		PERCENT OF TOTAL	VALUE OF SHIPMENTS ($M)		PERCENT OF TOTAL
2794 Electrotyping and Stereotyping		104		56.6	10,754		14.1
1963	Small	72		39.1	44,123		58.0
	Medium	8		4.3	21,191		27.9
	Large		184			76,068	
1967	Small	76		57.1	9,100		14.6
	Medium	51		38.3	35,000		56.3
	Large	6	133	4.6	18,100	62,200	29.1

Small - 1 to 19 employees
Medium - 20 to 99 employees
Large - 100 or more employees

Source: Census of Manufactures, U.S. Department of Commerce, Bureau of Census 1963 and 1966

2. Size of Firms

Establishments in the printing and publishing industry range in size from very small (e.g., less than 5 employees) to large (e.g., 10,000 to 12,000). Many of the small companies specialize in providing a single product or service to the industry and are generally privately owned. The large firms include multimillion dollar corporations that produce a range of printed products and frequently use several printing processes.

The range of size and the degree of concentration as indicated by the average value of shipments by size of company are shown in Table III-6 for the various segments. This table is adapted from 1967 data for percent value of shipments accounted for by the largest companies and applied to 1972 data for number of establishments and value of shipments. In only four of the fourteen industries included in this study is 60% or more of the industry's value of shipments accounted for by the 20 largest companies: Greeting Card Publishing, Manifold Business Forms, Miscellaneous Publishing, and Electrotyping and Stereotyping.

Commercial Printing, Letterpress, is the largest single segment with about 13,000 establishments. The average value of shipments for the 61% of this industry remaining after subtracting the value of shipments attributable to the 50 largest companies amounts to only $152,000.

Much of the statistical information used in this study was obtained from Department of Commerce Publications. Some of the data from different publications appears to be inconsistent, probably because of different definitions, changes in reporting, non-reporting, and the number of manufacturing firms with less than 10 employees that were excused from filing reports in the 1972 Census. These last may be important statistically because so large a percentage of the printing and publishing industry is comprised of firms having less than 20 employees, but is probably insignificant from an impact point of view because the small companies are not sources of pollution. Moreover, these inconsistencies are relatively minor and do not affect the overall conclusions reached in this study.

3. Level of Integration

The printing and publishing industry is not a significantly integrated industry. Most printing companies either carry out all of the steps involved in producing a book, magazine or other printed items or perform a single step and transfer the partially completed work to another non-affiliated company. Rarely is a printing company integrated back to papermaking and woodlands or forward to retail stores. There are, however, several instances of common ownership of large newspapers and newsprint manufacturers, most of whom would also own woodlands. These are non-typical situations and play no particular role in this study. Over 80% of the establishments in the industry have less than 20 employees and several segments show even higher percentages, e.g., 91% for Commercial Printing, Letterpress.

TABLE III-6

INDUSTRY SEGMENT CONCENTRATION AND AVERAGE ANNUAL VALUE OF SHIPMENTS BY SIZE OF COMPANY

(Percent of total) and average value of shipments per company($M)

SIC CODE	INDUSTRY	4 LARGEST	8 LARGEST	20 LARGEST	50 LARGEST	REMAINING ESTABLISHMENTS
2711	Newspapers	(16) 330,900	(25) 258,500	(40) 165,400	(56) 92,600	(44) 457
2721	Periodicals	(24) 210,400	(37) 162,200	(56) 98,200	(72) 50,500	(28) 399
2731	Book Publishing	(20) 143,100	(32) 114,500	(57) 81,600	(77) 44,100	(23) 579
2732	Book Printing	(21) 48,800	(30) 34,800	(48) 22,300	(64) 11,900	(36) 527
2741	Misc. Publishing	(29) 75,600	(46) 59,900	(64) 33,400	(75) 15,600	(25) 134
2751	Comm. Print., L.P.	(14) 113,500	(21) 85,100	(29) 47,000	(39) 25,300	(61) 152
2752	Comm. Print., Litho	(05) 63,900	(08) 51,100	(15) 38,300	(25) 25,600	(75) 464
2753	Engraving and Plate Print.	(21) 10,300	(28) 6,900	(38) 3,700	(52) 2,000	(48) 188
2754	Comm. Print., Gravure	----	----	----	----	---
2761	Manifold Bus. Forms	(47) 167,000	(57) 101,300	(69) 49,000	(81) 23,000	(19) 444
2771	Greeting Card Publishing	(67) 128,300	(79) 75,600	(88) 33,700	(95) 14,600	(05) 264
2793	Photoengraving	(10) 5,400	(16) 4,300	(27) 2,900	(44) 1,900	(56) 226
2794	Electrotyping and Stereotyping	(34) 3,100	(45) 2,000	(63) 1,100	(87) 633	(13) 158
2795	Litho Platemaking Services	----	----	----	----	---

Sources: Census of Manufactures, Preliminary 1972
Quarterly Industry Report, January 1973, U.S. Department of Commerce

By far the largest commercial printer is R.R. Donnelley & Sons Co., with 1972 sales of over $353 million. This represents slightly over 1% of total industry receipts. The revenues for the various segments of Donnelley's business, shown as a percent of the total revenues, are:

Magazines	35.5%
Catalogs	26.4
Hardbound Books	19.4
Telephone Directories	11.0
Other Printing	7.7
	100.0

Donnelley is a horizontally integrated company in the sense that it provides a complete range of automated composition, printing, binding, and shipping services to its customers. Donnelley's two largest competitors are Arcata National Corp. with printing revenues of $159 million and McCall Corp. with estimated printing revenues slightly less than Arcata's. Other major competitors include Cuneo Press, Inc., W.F. Hall Printing Co., W.A. Krueger Co., Meredith Corp. and a number of other companies with sales ranging down to perhaps $5 million. Many of these companies provide services to their customers similar to those provided by Donnelley and are active in up to five SIC code industries. A large number of the smaller establishments frequently do only one type of printing, offer a limited range of services to their customers, and are listed under one SIC code.

During the 1950's and 1960's a number of acquisitions took place in the printing industry. These were largely in the book, magazine and commercial printing segments and appear to have been prompted by a variety of reasons; e.g., the original owner reaching retirement age, the need for major capital investment, or the desire of the owner to diversify his investments. This period, which was associated with growth of the printing industry in general and growth of web-offset printing in particular, saw major growth by several of today's large printing companies as they acquired subsidiaries. Such concentration does not appear to be taking place at present to any significant degree. Other major printing companies increased in size as a result of internal growth.

Integration, in the sense of a company's being both publisher and printer, is not very prevalent in the industry. Meredith Corp. and McCall Corp. in the periodical segment and Doubleday & Company, Inc., and Western Publishing Co., in the book segment are examples of companies that are both publishers and printers. These are exceptions, however; the two functions generally are performed by separate companies. However, integration is common in the newspaper industry where the publishers of almost all daily newspapers and many weekly newspapers own a plant dedicated to printing the newspaper This is believed to be a necessity in order to control the late closing of news pages and to meet delivery schedules.

4. Number of Products

In general, the names of the various segments are descriptive of the main product each produces, although some secondary products are not apparent from the code name and several of the segments do overlap. Table III-7 lists the major products produced in each of the segments.

5. Level of Diversification

Most of the segments of the printing industry are rather specialized despite the number of products listed in Table III-7. The Census of Manufactures measures this degree of specialization with its "specialization ratio," which is defined as the ratio of industry shipments of primary products to total manufactured industry shipments of primary and secondary products.

The primary product specialization ratios are as follows:

SIC Code	Industry	Specialization Ratio
2711	Newspapers	0.96
2721	Periodicals	0.89
2731	Book Publishing	0.91
2732	Book Printing	0.88
2741	Miscellaneous Publishing	0.95
2751	Comm. Print., L.P.	0.86
2752	Comm. Print., Litho	0.86
2753	Engraving and Plate Print.	0.92
2754	Comm. Print., Gravure	0.88
2761	Manifold Bus. Forms	0.92
2771	Greeting Card Publishing	0.76
2793	Photoengraving	0.86
2794	Electrotyping and Stereotyping	0.82
2795	Litho Platemaking Services	[illegible]

Source: Census of Manufactures, Preliminary 1972

TABLE III-7

PRINTING INDUSTRY PRODUCTS

SIC CODE	INDUSTRY	MAJOR PRODUCTS
2711	Newspapers	Daily and Sunday newspaper Weekly newspapers
2721	Periodicals	Farm Periodicals Specialized Business and Professional Periodicals General Interest Periodicals
2731 2732	Book Publishing Book Printing	Elementary and high school text books Technical, scientific, business and professional books and college text books General consumer and trade books Subscription reference books, encyclopedias, and religious subscription books Pamphlets,workbooks and objective tests
2741	Misc. Publishing	Catalogs and directories Business service publications Newsletters Government regulations Miscellaneous products Post cards Sheet music Maps, charts Patterns Racing forms Shopping news
2751	Comm. Print., L.P.	Magazines and periodicals Labels for packaging purposes sheets, rolls Catalogs and directories Financial and legal printing SEC prospectuses Annual reports Insurance forms Bank printing Advertising printing Direct mail Display advertising Preprinted newspaper inserts Scientific and technical recording charts Trading stamps Newspapers Tickets and coupons

TABLE III-7 (Continued)

SIC CODE	INDUSTRY	MAJOR PRODUCTS
2752	Comm. Print., Litho	Same as Comm. Print., L.P.
2753	Engraving and Plate Print.	Securities Social printing Commercial printing Intaglio printing plates Duplicate rubber letterpress printing plates
2754	Comm. Print., Gravure	Same as Comm. Print., L.P.
2761	Manifold Bus. Forms	Unit set forms Sales and other manifold books Custom continuous forms Stock continuous forms
2771	Greeting Card Publishing	Christmas cards Valentine cards Seasonal cards
2793	Photoengraving	Photoengraving plates Zinc Copper Magnesium
2794	Electrotyping and Stereotyping	Electrotype duplicate plates Stereotype duplicate plates Matrices
2795	Litho Platemaking Services	Lithographic plates Diazo type Wipe-on type Deep-etch type Multi-metal type Color corrected process film

Source: Census of Manufactures, Preliminary 1972

TABLE III-7

PRINTING INDUSTRY PRODUCTS

SIC CODE	INDUSTRY	MAJOR PRODUCTS
2711	Newspapers	Daily and Sunday newspaper Weekly newspapers
2721	Periodicals	Farm Periodicals Specialized Business and Professional Periodicals General Interest Periodicals
2731 2732	Book Publishing Book Printing	Elementary and high school text books Technical, scientific, business and professional books and college text books General consumer and trade books Subscription reference books, encyclopedias, and religious subscription books Pamphlets,workbooks and objective tests
2741	Misc. Publishing	Catalogs and directories Business service publications Newsletters Government regulations Miscellaneous products Post cards Sheet music Maps, charts Patterns Racing forms Shopping news
2751	Comm. Print., L.P.	Magazines and periodicals Labels for packaging purposes sheets, rolls Catalogs and directories Financial and legal printing SEC prospectuses Annual reports Insurance forms Bank printing Advertising printing Direct mail Display advertising Preprinted newspaper inserts Scientific and technical recording charts Trading stamps Newspapers Tickets and coupons

TABLE III-7 (Continued)

SIC CODE	INDUSTRY	MAJOR PRODUCTS
2752	Comm. Print., Litho	Same as Comm. Print., L.P.
2753	Engraving and Plate Print.	Securities Social printing Commercial printing Intaglio printing plates Duplicate rubber letterpress printing plates
2754	Comm. Print., Gravure	Same as Comm. Print., L.P.
2761	Manifold Bus. Forms	Unit set forms Sales and other manifold books Custom continuous forms Stock continuous forms
2771	Greeting Card Publishing	Christmas cards Valentine cards Seasonal cards
2793	Photoengraving	Photoengraving plates Zinc Copper Magnesium
2794	Electrotyping and Stereotyping	Electrotype duplicate plates Stereotype duplicate plates Matrices
2795	Litho Platemaking Services	Lithographic plates Diazo type Wipe-on type Deep-etch type Multi-metal type Color corrected process film

Source: Census of Manufactures, Preliminary 1972

The major industry segments have shown little change in their degree of specialization during the last 20 years. The Greeting Card Publishing industry (2771), however, has shown a steady but slow decline over this period, from 0.93 in 1954 to 0.76 in 1972. The Photoengraving industry (2793) has shown a more rapid decrease in specialization since 1967, 0.94 vs 0.86. The Electrotyping and Stereotyping industry (2794) has shown a similar reduction over the same period, 0.89 to 0.82. Both of the latter two industries are experiencing decreasing demands for their primary products even though a substantial number of plants are closing each year. The decline in specialization ratio suggests that companies in these industries are diversifying into other more viable product lines, such as lithographic printing plates.

B. TYPES OF PLANTS

There is great diversity among the plants that comprise the printing and publishing industry. Even within a given segment plants vary in size, in the range of services they provide to a customer, in their degree of sophistication, and in the product mix they are equipped to manufacture. The types of plants are described in the following paragraphs with respect to their size, age, location, level of technology, efficiency and level of integration.

1. Size of Plants

The Census of Manufactures reports plant size by average employment size. For purposes of this report plant size is defined as follows:

Small Plants – 1 to 19 employees
Medium Plants – 20 to 99 employees
Large Plants – 100 or more employees

Approximately three years are required for publication of the detailed census information. Only preliminary information on establishments by employment size is available for 1972 and this is limited to total plants and to those plants with 20 employees or more. After eliminating the two new segments – Commercial Printing, Gravure (2754) and Litho Platemaking Services (2795) – for which comparable data are not available for previous years it is possible to compare the number of small plants as a percentage of the total. This data for the periods 1963, 1967, and 1972 shows the following:

	No. of Plants With Less Than 20 Employees	Total No. of Plants	Percent of Total
1963	28,884	35,348	81.7
1967	27,849	34,992	79.5
1972	30,542	37,863	80.6

The plant size distribution in the printing industry has been remarkably stable with an average of about 80% of the establishments having less than 20 employees. A comparison of the data, segment by segment, for the three periods shows that the percentage of small plants to the total remains essentially constant even though a significant increase in some of the segments has taken place over some of the periods for which data are available.

In 12 of the 14 segments covered by this report, comparable information is available from which plant size distribution can be calculated for the years 1963 and 1967. The data for 1967 show a reduction of about 1% in the total number of establishments in the printing industry compared to 1963. Six of the segments showed a decrease in the number of plants, four showed an increase and two segments remained essentially unchanged. For three of the segments the increases amounted to about 8%. The Greeting Card Publishing, Photoengraving, and Electrotyping and Stereotyping industries showed decreases in the total number of plants amounting to 13.6, 16.8, and 27.7%, respectively, for the period. There was, however, no discernible overall change in the average plant-size distribution from that existing in 1963. The Greeting Card Publishing and Manifold Business Forms industries in 1967 had about 5% fewer plants with less than 20 employees and about the same increase in number of plants with 100 or more employees. Engraving and Plate Printing showed a decrease of about 5% in the number of small plants but no change in the percent of large plants.

Limited data are available for 1972 except for number of plants having less than 20 employees and total number of plants by segment. There was an increase of 9.4% in the total number of plants for the 12 segments covered for 1972 compared to 1967. Some of the highlights for individual segments are worthy of note and are as follows:

PERCENT CHANGE IN NUMBER OF PLANTS, 1972 VS 1967

SIC Code	Industry	Change In Total Number	Change In Total With Less Than 20 Employees
2721	Periodicals	+16	0
2741	Miscellaneous Publishing	+34	+1
2751	Comm. Print., L.P.	+ 8	+3
2752	Comm. Print., Litho	+22	-1
2753	Engraving and Plate Print.	- 4	-1
2761	Manifold Bus. Forms	+21	-2
2771	Greeting Card Publishing	-12	0
2793	Photoengraving	-20	+4
2794	Electrotyping and Stereotyping	-40	+13

TABLE III-8

GEOGRAPHIC DISTRIBUTION OF PRINTING INDUSTRY
BY EMPLOYEES AND ANNUAL VALUE OF SHIPMENTS

AREA NO.	AREA	EMPLOYEES (M)	VALUE OF INDUSTRY SHIPMENTS ($MM)
1.	New England (Me., N.H., Vt., Mass., Conn., R.I.)	76.2	1,712.5
2.	Middle Atlantic (N.Y., N.J., Pa.)	269.2	8,427.6
3.	East North Central (Wisc., Ill, Ind., Ohio, Mich.)	258.2	6,612.8
4.	West North Central (N. Dak., S. Dak., Nebr., Kans., Mo., Iowa, Minn.)	99.5	2,228.0
5.	South Atlantic (W. Va., Va., Md., Del., D.C., N. Car., Sa. Car., Ga., Fla.)	116.7	2,543.2
6.	East South Central (Ky., Tenn., Ala., Miss.)	42.0	961.5
7.	West South Central (Okla., Tex., La., Ark.)	54.9	1,219.5
8.	Mountain (Ida., Nev., Utah, Ariz., N.Mex., Colo., Wyo., Mont.)	26.3	533.8
9.	Pacific (Wash., Ore., Calif.)	105.6	2,643.2

Source: Annual Survey of Manufactures, 1971

TABLE III-9

GEOGRAPHIC CONCENTRATION OF ESTABLISHMENTS IN THE PRINTING INDUSTRY

SIC CODE	INDUSTRY	NUMBER OF ESTABLISHMENTS									
		TOTAL	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6	AREA 7	AREA 8	AREA 9
2711	Newspapers	8,022*	401	1,008	1,470	1,429	975	527	969	427	816
2721	Periodicals	2,510	904	732	467	189	298	73	157	74	348
2731	Book Publishing	1,186	96	458	197	58	112	30	41	29	165
2732	Book Printing	685	57	254	104	44	85	24	37	28	52
2741	Misc. Publishing	2,000	106	600	348	141	196	(86)	(7)	44	357
2751	Comm. Print., L.P.	13,086	877	3,014	2,575	966	1,747	553	1,063	446	1,850
2752	Comm. Print., Litho	8,304	546	1,914	(2,499)		971	258	606	285	1,225
2753	Engraving and Plate Print.	553	36.0	171	115	29	(83)		38	(81)	
2754	Comm. Print., Gravure	127	12	39	(45)				20	(11)	
2761	Manifold Bus. Forms	658	35.0	146	130	53	87	25	64	20	98
2771	Greeting Card Publishing	195	26	73	(45)		13				
2793	Photoengraving	584	54	137	(139)		71	19	40	(124)	
2794	Electrotyping and Stereotyping	80	8	23	(32)			4			
2795	Litho Platemaking Services	298	23	74	(118)			(56)		(21)	

*This number is believed to omit some plants with less than 10 employees and therefore to understate the actual total.

( ) denotes lumping of data for this and adjacent area or areas where blanks exist in the same SIC code.

Sources: Census of Manufactures, Preliminary 1972
Annual Survey of Manufactures, 1971

Arthur D. Little, Inc.

TABLE III 10

GEOGRAPHIC CONCENTRATION OF EMPLOYEES IN THE PRINTING INDUSTRY

INDUSTRY	TOTAL	NUMBER OF AMPLOYEES (M) AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6	AREA 7	AREA 8	AREA 9
Newspapers	347.8	25.4	67.3	72.4	29.0	49.6	15.1	29.3	14.4	45.3
Periodicals	66.4	2.9	31.2	11.5	6.0	6.1	2.6	1.3	0.8	4.1
Book Publishing	57.0	3.8	26.8	13.4	4.8	1.5	1.1	0.6	0.5	4.5
Book Printing	41.2	6.4	9.3	9.7	2.0	5.4	4.2	2.0	0.7	1.4
Misc. Publishing	37.5	1.5	13.2	10.7	2.9	2.9	(0.5)	(0.1)	0.8	3.8
Comm. Print., L. P.	128.4	8.3	31.4	37.4	8.0	14.2	4.3	6.8	3.7	14.3
Comm. Print., Litho	183.2	13.8	43.4	(68.9)		19.7	5.9	10.0	3.6	17.9
Engraving and Plate Print.	9.4	1.0	3.0	1.6	0.4	(1.8)		0.5	(1.2)	
Comm. Print., Gravure	19.5	0.8	4.3	(8.8)				4.7	(0.9)	
Manifold Bus. Forms	38.4	2.7	6.8	9.2	3.2	4.8	1.2	5.0	0.9	4.5
Greeting Cards	23.2	3.9	2.6	(136)		0.4				
Photoengraving	9.2	0.8	3.7	(2.1)		0.6	0.2	0.5	(1.3)	
Electrotyping and Stereotyping	1.6	0.1	0.6	(0.8)			0.1			
Litho Platemaking Services	7.1	0.4	2.1	(3.1)			(1.0)		(0.5)	

( ) denotes lumping of data for this and adjacent area or areas where blanks exist in the same SIC code.

Source: Annual Survey of Manufactures, 1971

TABLE III-9

GEOGRAPHIC CONCENTRATION OF ESTABLISHMENTS IN THE PRINTING INDUSTRY

SIC CODE	INDUSTRY	NUMBER OF ESTABLISHMENTS								
		TOTAL	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6	AREA 7	AREA 8	AREA 9
2711	Newspapers	8,022*	401	1,008	1,470	1,429	975	527	969	427	816
2721	Periodicals	2,510	904	732	467	189	298	73	157	74	348
2731	Book Publishing	1,186	96	458	197	58	112	30	41	29	165
2732	Book Printing	685	57	254	104	44	85	24	37	28	52
2741	Misc. Publishing	2,000	106	600	348	141	196	(86)	(7)	44	357
2751	Comm. Print., L.P.	13,086	877	3,014	2,575	966	1,747	553	1,063	446	1,850
2752	Comm. Print., Litho	8,304	546	1,914	(2,499)		971	258	606	285	1,225
2753	Engraving and Plate Print.	553	36.0	171	115	29	(83)		38	(81)	
2754	Comm. Print., Gravure	127	12	39	(45)				20	(11)	
2761	Manifold Bus. Forms	658	35.0	146	130	53	87	25	64	20	98
2771	Greeting Card Publishing	195	26	73	(45)		13				
2793	Photoengraving	584	54	137	(139)		71	19	40	(124)	
2794	Electrotyping and Stereotyping	80	8	23	(32)			4			
2795	Litho Platemaking Services	298	23	74	(118)			(56)		(21)	

*This number is believed to omit some plants with less than 10 employees and therefore to understate the actual total.

( ) denotes lumping of data for this and adjacent area or areas where blanks exist in the same SIC code.

Sources: Census of Manufactures, Preliminary 1972
Annual Survey of Manufactures, 1971

Arthur D. Little, Inc.

TABLE III 10

GEOGRAPHIC CONCENTRATION OF EMPLOYEES IN THE PRINTING INDUSTRY

INDUSTRY	TOTAL	NUMBER OF AMPLOYEES (M) AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6	AREA 7	AREA 8	AREA 9
Newspapers	347.8	25.4	67.3	72.4	29.0	49.6	15.1	29.3	14.4	45.3
Periodicals	66.4	2.9	31.2	11.5	6.0	6.1	2.6	1.3	0.8	4.1
Book Publishing	57.0	3.8	26.8	13.4	4.8	1.5	1.1	0.6	0.5	4.5
Book Printing	41.2	6.4	9.3	9.7	2.0	5.4	4.2	2.0	0.7	1.4
Misc. Publishing	37.5	1.5	13.2	10.7	2.9	2.9	(0.5)	(0.1)	0.8	3.8
Comm. Print., L. P.	128.4	8.3	31.4	37.4	8.0	14.2	4.3	6.8	3.7	14.3
Comm. Print., Litho	183.2	13.8	43.4	(68.9)		19.7	5.9	10.0	3.6	17.9
Engraving and Plate Print.	9.4	1.0	3.0	1.6	0.4	(1.8)		0.5	(1.2)	
Comm. Print., Gravure	19.5	0.8	4.3	(8.8)				4.7	(0.9)	
Manifold Bus. Forms	38.4	2.7	6.8	9.2	3.2	4.8	1.2	5.0	0.9	4.5
Greeting Cards	23.2	3.9	2.6	(136)		0.4				
Photoengraving	9.2	0.8	3.7	(2.1)		0.6	0.2	0.5	(1.3)	
Electrotyping and Stereotyping	1.6	0.1	0.6	(0.8)			0.1			
Litho Platemaking Services	7.1	0.4	2.1	(3.1)			(1.0)		(0.5)	

( ) denotes lumping of data for this and adjacent area or areas where blanks exist in the same SIC code.

Source: Annual Survey of Manufactures, 1971

Arthur D. Little, Inc.

TABLE III-11

PRINTING DISTRIBUTION BY CITIES

	EMPLOYEES (M)	ANNUAL VALUE OF INDUSTRY SHIPMENTS ($MM)
New York, N. Y.	138.3	5,352.3
Chicago, Ill.	84.5	2,489.5
Los Angeles, Cal.	39.6	1,003.7
Philadelphia, Pa.	32.5	877.7
Washington, D. C.	20.1	564.0
Minneapolis, Minn.	18.3	461.2
Detroit, Mich.	15.8	417.5
St. Louis, Mo.	15.7	367.7
San Francisco, Cal.	15.4	442.1
Cleveland, Ohio	13.6	364.9
Cincinnati, Ohio	13.1	328.6
Paterson, Clifton, Passaic, N.J.	12.5	272.7
Milwaukee, Wisc.	10.3	242.5
Dallas, Texas	9.9	248.4
Newark, N.J.	9.1	251.1
Dayton, Ohio	9.1	238.9
Buffalo, N.Y.	8.5	182.6
Nashville, Tenn.	8.5	167.4
Atlanta, Ga.	8.3	232.2
Indianapolis, Ind.	8.0	185.2

SOURCE: Annual Survey of Manufactures, 1971.

4. Level of Technology

Prior to about 1950 the printing and publishing industry was very much craft oriented. Only in the last 10 to 15 years has there been any significant infusion of new technology. Photocomposition, stimulated by the opportunity to reduce labor costs, made the first inroad into traditional methods of typesetting. While photocomposition is applicable to all methods of printing, it found immediate application in offset printing, stimulating the growth of that process and of the related supplies and equipment.

A number of other significant technological developments have now been adopted by the printing industry, including:

- Automated computer-assisted composition
- High-speed full page metal engravings
- Advances in high-speed photography
- Improvements in color separations
- Photopolymer printing plate developments
- Improvements in offset plates
- Photomechanical (electronic) engraving methods for gravure cylinder preparation
- Advances in automatic press controls

The larger printers, who compete on a national basis, have adopted most of the important technical developments that relate to their areas of activity. The adoption of new technology is usually judged in terms of savings in costs and time. In a broader context, these large printing companies must also invest in cost and time saving technology to meet the competition from other communication services.

Many small printing companies still derive business from local sources and are operating the same equipment in the same manner now as many years ago. While it is unlikely that these companies have either the inclination or the resources to change, the new technical-economical thrust of the larger and more aggressive printing companies will gain these larger companies a greater share of the printing dollar. The small printing companies may not be able to base their competitive posture on amortized plants indefinitely.

C. INDUSTRY SUBSEGMENTATION

Each of the 14 industry segments was subsegmented into small, medium and large plants. Decisions were then made with respect to how many of the plants in each segment should be selected for study for possible impact on the basis of their use of effluent producing processes. The results of the subsegmentation are presented in Table III-12.

In those instances of possible impact when a single plant was found in more than one industry the plant was included in the first industry in which it appeared, taking the industries in numerical order. The exception was a gravure printing plant that first appeared under SIC 2721, Periodicals, which was listed under SIC 2754, Commercial Printing, Gravure, where it could be treated with similar plants.

1. SIC 2711 Newspapers

At the end of 1973 the newspaper industry was composed of weekly and daily newspapers according to the following distribution:

Weekly newspapers	7641	Establishments	Source: NNA
Daily newspapers	1761	Establishments	Source: ANPA
Total	9402		

The total number is not in good agreement with the data provided in the Census of Manufactures, Preliminary 1972 report, and used in several of our statistical tables. The above data are believed to be the more reliable, however, and are used in the remainder of the report.

The weekly newspapers are generally composed of establishments having less than 20 employees. Approximately 2641 weeklies are publishers only; their newspapers are printed by commercial printers or in other newspaper plants. The 5000 weekly newspaper printing plants are divided into about 4250 offset plants and 750 letterpress plants. The offset plants represent the more profitable and growth segment of the business. Most of the letterpress plants use either direct printing-photopolymer plates or flatbed presses, and do no chemical engraving. The few weekly newspapers that may be etching direct printing-metal plates have the option of disposing economically of the small amount of spent etching solution they generate or of adopting the use of a precoated direct printing-photopolymer plate. The weekly newspapers are not sources of pollution.

Some of the 1761 daily newspapers share printing facilities, so only 1560 printing plants are required. These plants print by the stereo, direct printing and offset processes. The direct printing process uses both metal and photopolymer plates. The offset and direct printing-photopolymer processes produce no process contact effluent. The direct printing-metal and stereo processes require metal

TABLE III-12

SUBSEGMENTATION SUMMARY

	Number of Plants	Impact	
		Possible*	None
2711 NEWSPAPERS			
Publishing and Printing			
Small Plants	4,731		4,731
Medium Plants	1,353		1,353
Large Plants	476	400	76
Total	6,560	400	6,160
2721 PERIODICALS			
Publishing and Printing			
Small Plants	231		231
Medium Plants	63		63
Large Plants	30	4	26
Total	324	4	320
2731 BOOK PUBLISHING			
Publishing and Printing			
Small Plants	111		111
Medium Plants	36		36
Large Plants	23		23
Total	170		170
2732 BOOK PRINTING			
Small Plants	409		409
Medium Plants	200		200
Large Plants	76		76
Total	685		685
2741 MISCELLANEOUS PUBLISHING			
Publishing and Printing			
Small Plants	200		200
Medium Plants	40		40
Large Plants	22	4	18
Total	262	4	258
2751 COMMERCIAL PRINTING, LETTERPRESS			
Small Plants	11,951		11,951
Medium Plants	932		932
Large Plants	203	4	199
Total	13,086	4	13,082

*Plants using processes that produce significant amounts of effluent.

TABLE III-12 (Continued)

	Number of Plants	Impact	
		Possible*	None
2752 COMMERCIAL PRINTING, LITHOGRAPHIC			
Small Plants	6,193		6,193
Medium Plants	1,781		1,781
Large Plants	330		330
Total	8,304		8,304
2753 ENGRAVING AND PLATE PRINTING			
Small Plants	427		427
Medium Plants	117		117
Large Plants	9		9
Total	553		553
2754 COMMERCIAL PRINTING, GRAVURE			
Small Plants	45		45
Medium Plants	41	8	33
Large Plants	41	34	7
Total	127	42	85
2761 MANIFOLD BUSINESS FORMS			
Small Plants	290		290
Medium Plants	223		223
Large Plants	145		145
Total	658		658
2771 GREETING CARD PUBLISHING			
Small Plants	116		116
Medium Plants	40		40
Large Plants	39		39
Total	195		195
2793 PHOTOENGRAVING			
Small Plants	455		455
Medium Plants	112		112
Large Plants	17	17	
Total	584	17	567
2794 ELECTROTYPING AND STEREOTYPING			
Small Plants	56		56
Medium Plants	21		21
Large Plants	3		3
Total	80		80
2795 LITHOGRAPHIC PLATEMAKING SERVICES			
Small Plants	200		200
Medium Plants	68		68
Large Plants	30		30
Total	298		298

*Plants using processes that produce significant amounts of effluent.

etching and are sources of metal contamination. It is estimated that plants using these processes number 40 and 360, respectively, as shown in Table III-12.

A summary of the newspaper industry, including those establishments which publish only, and the types of printing processes used by the weekly and daily newspapers, is as follows:

Weekly	
Publishing Only	2641
Offset Plants	4250
Flatbed Letterpress Plants	750
	7641
Daily	
Publishing Only	201
Offset Plants	900
Direct Printing-Photopolymer Plants	260
Direct Printing-Metal Plants (Large)	40
Stereo Plants (Large)	360
	1761
Total	9402

The newspaper industry is working strenuously to reduce its production costs and modernize its operations by adopting new technology and by adapting old technology to new uses. This has resulted in a proliferation of new alternatives in the area of printing. While the traditional printing method in this industry has been stereo, there are now several alternatives. Offset newspaper printing is growing rapidly, with over half of the daily newspapers now being printed by this process. Direct printing, which bridges the gap between photocomposition and letterpress equipment, is also growing rapidly. Both photopolymer and metal plates are used in this method of printing, with the photopolymer variety showing a strong growth trend. Finally, photopolymer plates are being investigated for use in the pattern plate process. This last process, a variation of the stereo process, takes advantage of photocomposition but allows the conventional stereo plate-making process to continue to be used. Eventually there will be no metal etching in the newspaper industry.

Most newspapers are aware of the need to control the metal contamination from their effluents and many have either installed the appropriate treatment equipment or are studying the costs and alternatives of doing so. The need to control contamination has also encouraged a number of newspapers to switch to non-polluting platemaking processes or to offset printing.

TABLE III-12 (Continued)

	Number of Plants	Impact	
		Possible*	None
2752 COMMERCIAL PRINTING, LITHOGRAPHIC			
Small Plants	6,193		6,193
Medium Plants	1,781		1,781
Large Plants	330		330
Total	8,304		8,304
2753 ENGRAVING AND PLATE PRINTING			
Small Plants	427		427
Medium Plants	117		117
Large Plants	9		9
Total	553		553
2754 COMMERCIAL PRINTING, GRAVURE			
Small Plants	45		45
Medium Plants	41	8	33
Large Plants	41	34	7
Total	127	42	85
2761 MANIFOLD BUSINESS FORMS			
Small Plants	290		290
Medium Plants	223		223
Large Plants	145		145
Total	658		658
2771 GREETING CARD PUBLISHING			
Small Plants	116		116
Medium Plants	40		40
Large Plants	39		39
Total	195		195
2793 PHOTOENGRAVING			
Small Plants	455		455
Medium Plants	112		112
Large Plants	17	17	
Total	584	17	567
2794 ELECTROTYPING AND STEREOTYPING			
Small Plants	56		56
Medium Plants	21		21
Large Plants	3		3
Total	80		80
2795 LITHOGRAPHIC PLATEMAKING SERVICES			
Small Plants	200		200
Medium Plants	68		68
Large Plants	30		30
Total	298		298

*Plants using processes that produce significant amounts of effluent.

etching and are sources of metal contamination. It is estimated that plants using these processes number 40 and 360, respectively, as shown in Table III-12.

A summary of the newspaper industry, including those establishments which publish only, and the types of printing processes used by the weekly and daily newspapers, is as follows:

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	7641
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Publishing Only	201
Offset Plants	900
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Direct Printing-Metal Plants (Large)	40
Stereo Plants (Large)	360
	1761
Total	9402

The newspaper industry is working strenuously to reduce its production costs and modernize its operations by adopting new technology and by adapting old technology to new uses. This has resulted in a proliferation of new alternatives in the area of printing. While the traditional printing method in this industry has been stereo, there are now several alternatives. Offset newspaper printing is growing rapidly, with over half of the daily newspapers now being printed by this process. Direct printing, which bridges the gap between photocomposition and letterpress equipment, is also growing rapidly. Both photopolymer and metal plates are used in this method of printing, with the photopolymer variety showing a strong growth trend. Finally, photopolymer plates are being investigated for use in the pattern plate process. This last process, a variation of the stereo process, takes advantage of photocomposition but allows the conventional stereo platemaking process to continue to be used. Eventually there will be no metal etching in the newspaper industry.

Most newspapers are aware of the need to control the metal contamination from their effluents and many have either installed the appropriate treatment equipment or are studying the costs and alternatives of doing so. The need to control contamination has also encouraged a number of newspapers to switch to non-polluting platemaking processes or to offset printing.

2. SIC 2721 Periodicals

This industry is composed largely of establishments that are engaged primarily in publishing activities. Of the 2510 establishments included in the industry, 2186 are publishers only, with the remaining 324 engaged in both publishing and printing.

Subsegmenting the latter into small, medium, and large plants, based on the average size of employment, indicates that not over 30 establishments have the potential to pollute by virtue of being large enough to justify their own rotary letterpress or gravure platemaking activities. A careful analysis of this group shows that only five plants actually engrave metal and have platemaking facilities. One of these uses the gravure process and is more appropriately dealt with under SIC 2754 Commercial Printing, Gravure. Thus the proposed guidelines might have an impact on only four plants under this category.

3. SIC 2731 Book Publishing

The book publishing industry includes establishments engaged primarily in publishing books and pamphlets. Of the 1186 establishments that comprised this industry at the end of 1972, 1016 performed publishing functions only, with the remaining 170 engaged in both publishing and printing.

An estimated 80% of all new books are printed by the offset process, which is non-polluting. Some reprints of older books are still printed by the letterpress process. However, letterpress is used because the printing plates already exist, having been saved from the printing of previous editions, and no significant number of new plates is required. Those that are required to replace lost or broken plates or to accommodate revisions in the text are prepared by a platemaking shop.

A relatively new development in the book industry that is enjoying increasing popularity is the single-book press. This is a printing press that prints a complete book on a web of paper, accordian folds the web into the desired final form and feeds it into a bindery line where it is automatically bound and cased. The printing plates are mounted on an endless flexible belt and are usually non-polluting photopolymer plastic plates.

Some books are still being printed by rotary letterpress, using rubber plates. In this operation, type is set by the hot metal technique and a plastic matrix is prepared from the hot type. The rubber plate is prepared by molding a sheet of rubber against the matrix in a hot press. The technique is non-polluting. This industry is not a source of water pollution.

4. SIC 2732 Book Printing

The book printing industry is primarily engaged in printing books. At the end of 1972 the industry consisted of 685 plants. All of the comment and process descriptions that appear in the previous segment, apply to this segment. This industry is not a source of water pollution.

5. SIC 2741 Miscellaneous Publishing

This industry includes establishments engaged primarily in miscellaneous publishing activities not elsewhere classified, whether or not they are engaged in printing. This segment is comprised of about 2000 establishments.

Separating these establishments into small, medium and large plants shows that 1745 are small, 200 are of medium size and 55 are large. An analysis of the large plants showed that 33 are publishers only and that 22 are both publishers and printers. Further analysis of the 22 plants shows that only 7 are actually engaged in metal etching and platemaking activities and therefore subject to possible impact. Three of these plants are also included under the periodicals segment. Thus the effluent guidelines might have an impact on only four plants under this category, that are not covered elsewhere.

Data are not available for the number of plants in the medium and small plant categories that are publishers only. While the lack of this information in no way influences the conclusions of the study we have estimated and entered in Table III-12 only those plants that are engaged in both printing and publishing.

6. SIC 2751 Commercial Printing, Letterpress

The Commercial Printing, Letterpress industry is comprised of 13,086 plants that are engaged primarily in commercial or job printing using letterpress or screen printing methods. Some of the more important products include magazines, newspapers, periodicals, catalogues, and directories.

A large percentage of these plants, many of which use flat-bed equipment and are non-polluting, have less than 20 employees. Subsegmentation into small, medium, and large plants shows that 203 plants fall in the large category. Of these, only nine are engaged in metal etching and platemaking activities and five of these nine were included in earlier segments. Thus the effluent guidelines might have an impact on only four plants under this segment.

7. SIC 2752 Commercial Printing, Lithographic

The Commercial Printing, Lithographic industry is composed primarily of plants engaged in commercial printing, using the offset process. Segmenting the 8,304 establishments involved into small, medium, and large plants indicates that 330 are large, 1781 are medium, and 6193 are small. All are non-polluting.

8. SIC 2753 Engraving and Plate Printing

This industry is engaged primarily in engraving steel, copper, wood and rubber plates; in using the plates to print stationary and various types of cards, invitations, etc.; and in making wood-cuts for use in printing illustrations. It consists of 553 plants, all of which are non-polluting. Subsegmentation shows that 9 are large plants, 117 medium, and 427 small.

9. SIC 2754 Commercial Printing, Gravure

The Commercial Printing, Gravure industry includes plants that are engaged primarily in gravure printing and plants engaged in preparing gravure plates and cylinders for use by gravure printers. The Commercial Printing, Gravure industry was included as a separate entity in the Census of Manufactures, for the first time in 1972. Prior to that time data for gravure printing was segregated under Commercial Printing, Letterpress but the data for past years are quite variable and do not parallel the growth of gravure printing in the United States. We believe that a number of plants listed under this category may be included more appropriately under another industry.

The gravure printing industry is composed of about 22 large plants. Because of the large size of the presses and of the gravure cylinders used, each printer must engrave the cylinders he uses in his own plant. Accordingly all 22 plants are potential sources of pollution, although some of the newer plants have undoubtedly installed pollution control equipment.

That portion of the industry which is engaged in small gravure cylinder preparation for gravure printers who use smaller presses numbers about 20 plants. Many of these engrave the printing rolls both chemically and mechanically, and some make other types of rolls that are used by the printing industry, all in the same plant. We have estimated that 12 of the plants fall in the large-plant category and 8 in the medium. The decision was based entirely on the estimated revenues from the chemical etching part of the business (ignoring revenues from other operations carried on in the same plant), because the cylinder preparation activities of some are very small and typical of other plants in that industry segment, even though the plants themselves are very large.

The discrepancy between the number of plants included in the Census of Manufactures, Preliminary 1972 report, and the number of large gravure printers and gravure cylinder plants, we have been able to identify is not readily explained. We believe that some plants included in the census do gravure printing, do not etch their own cylinders, and probably are also listed in an entirely different industry. Examples of such plants could be ones that print on paper and foil in connection with the manufacture of various building products and packaging materials.

Subsegmentation of the 127 plants that make up this industry show 41 to be large, 41 to be medium, and 45 to be small. Those plants that might be impacted by pollution control requirements consist of 34 large ones and 8 medium ones.

10. SIC 2761 Manifold Business Forms

This industry includes establishments engaged primarily in designing and printing special forms for use in operation of a business. These may be in single or multiple sets, including carbonized or interleaved with carbon or otherwise processed for multiple reproduction. There are 658 establishments: 145 large, 223 medium, and 290 small.

In addition to printing presses, the forms industry has need for specialized equipment such as collators, folders, gluers, etc., used to combine rolls of paper and carbon paper into a multiple layer suitable for the final product. The need for large capital equipment expenditures has tended to concentrate the industry; in 1973 the three largest companies had 50 plants, and these accounted for 42% of the industry's shipments.

The manifold business forms industry uses both offset and letterpress equipment. The ratio is approximately 80 to 85% for offset and 15 to 20% for printing by letterpress. However, the letterpress operations use rubber plates to produce the impression and the preparation of these plates is non-polluting. This industry is essentially non-polluting.

11. SIC 2771 Greeting Card Publishing

The greeting card publishing segment includes 39 large, 40 medium, and 116 small plants for a total of 195. The Census data indicate that in 1970 the eight largest companies accounted for 85% of the value of industry shipments.

Among the large plants are some that do most of their own printing (primarily offset) but the more usual practice in the industry is to purchase printing services. Most greeting cards are designed well in advance of the occasion for their sale so the publisher can negotiate prices for printing based on the use of

the presses in non-critical times. The medium-sized companies rely heavily on the commercial printing segments for their production. Small business may print their own cards, but they would be using non-polluting printing technology – silk screen, offset, flat bed letterpress. Letterpress is used by many small shops for imprinting the names of the sender. Plates for engraved cards are usually prepared by a mechanical process.

Although this industry utilizes all of the printing methods, the big operations are primarily offset, and where letterpress is used, it is not based on etched metal plates. This industry is non-polluting.

12. SIC 2793 Photoengraving

The photoengraving industry includes establishments engaged primarily in preparing photoengraving plates. Much of this work is performed for advertising agencies, platemakers and printers. Most of the companies in this industry also make color separations and more recently have diversified into the preparation of offset printing plates.

The engraving operations of these companies result in zinc, copper, magnesium, and other metal salts being accumulated in the acid etching baths they use. The quantity of the waste from these operations is not large for a small or medium-sized company. The effluent is frequently placed in plastic drums and removed to land fill. Sometimes it is neutralized, the solids allowed to settle and the solids then removed via the solid waste stream. Only the large plants generate any significant amount of waste.

Subsegmentation of the 584 plants making up this industry shows that 17 are large, 112 medium, and 455 are small plants. The 17 large plants warrant further study, because they are a significant source of pollution.

The total revenues for the photoengraving industry have been declining in recent years as has the number of plants that make up the industry. There will be base line closures of about 35 plants per year through 1980 with total revenues at that time amounting to only $110 million. This is half the revenues for the industry for the year 1972.

13. SIC 2794 Electrotyping and Sterotyping

This industry includes establishments engaged primarily in preparing electrotype and stereotype plates for the printing industry. Subsegmentation by size of the 80 plants that comprise the industry shows that there are 3 large plants, 21 medium plants, and 56 small plants.

The number of plants and the value of shipments in the industry have been decreasing steadily for a number of years. The estimated value of shipments for 1974, for example, is expected to be only one-third of what it was in 1972. A corresponding reduction is taking place in the number of plants. This is clearly a dying industry and it is expected to be extinct by 1980.

14. SIC 2795 Lithographic Platemaking Services

This industry is engaged primarily in manufacturing lithographic plates for use by offset printing establishments. It is a healthy and growing industry. The 298 plants which make up the industry can be subsegmented into 30 large, 68 medium, and 200 small plants. The industry is non-polluting.

D. SUBSEGMENTATION SUMMARY

The analysis of the 14 major segments carried out above has resulted in each segment being subsegmented into small, medium, and large plants. Each of these subsegments has been examined for possible impact as a result of the pollution control standards. The results of our analyses are summarized in Table III-12. All of the plants included in the summary are either printers or platemakers for the printing trade regardless of what other activities the plant might perform.

It is interesting that in all industries where process waste water is being generated it is being generated mainly by the large companies. In those few instances in which small companies are producing waste that is not compatible with municipal treatment systems, the volumes involved are small and there are more economic alternatives for disposal than those supplied in the Development Document.

IV. FINANCIAL PROFILE OF THE INDUSTRY

Many of the companies in the printing and publishing industry are closely-held corporations. As a result, financial information is considered proprietary and is generally difficult to obtain. However, many companies in the industry belong to trade associations and participate annually in association-sponsored financial studies of the various industry segments. In many cases the results of these studies are sold to help defray the cost of the study. In other cases the results are sometimes available from participating companies.

The largest trade association in the industry is Printing Industries of America, Inc. Its membership represents firms which account for more than 80% of all the printing produced in the United States. The general well-being and future of the printing industry was discussed in an address by its president, Rodney L. Borum, at the annual meeting of the National Association of Printing Ink Manufacturers on March 28, 1974. The following are excerpts from Mr. Borum's speech, "The Printing Industry – Its Growth and Future."

"The printing and publishing industries continue to mirror the nation's economic and demographic trends. Demand for printed products is stimulated by a combination of population growth, rising school enrollment, higher income levels and expanded business activity. The printing and publishing industries will always be characterized by steady growth, stable employment, higher wages and a large number of small establishments.

For 1973, total receipts for the printing, publishing and allied industries* amount to approximately $34 billion. Growth through 1974 is expected to continue, and the dollar volume will approximate $37 billion – almost 9% above the 1973 level."

In presenting detailed industry statistics for 1973 and forecasts for 1974 and 1980, Mr. Borum refrained from commenting on the newspaper publishing, periodicals publishing, book publishing and miscellaneous publishing segments of the industry. Those industry segments which were included in both his speech and this study are listed in Table IV-1, which shows estimated revenues by segment for the years 1973, 1974, and 1980.

Clearly, most segments in the printing and publishing industry are strong and healthy. They are able to finance new investments, to take advantage of new technology and to remain competitive and look optimistically to the future as one of expanding markets and growth opportunities.

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*The 17 segments in Major Group 27

TABLE IV-1

PRINTING INDUSTRY REVENUES
($ millions)

	1973	1974	1980
Book Printing	1,045	1,108	1,600
Commercial Printing, Letterpress	4,500	5,000	7,100
Commercial Printing, Lithographic	5,500	6,000	10,500
Engraving and Plate Printing	210	225	350
Commercial Printing, Gravure	825	920	1,800
Manifold Business Forms	1,510	1,650	2,800
Greeting Cards	585	615	815
Photoengraving	200	185	110
Electrotyping and Stereotyping	20	12	–
Lithographic Platemaking Services	260	280	470
	14,655	15,995	25,545

A. SALES

Total values of shipments for the 14 segments included in this study were $28.5 billion in 1972, as shown in Table III-4. Table III-4 also shows the average value of shipments per establishment for all segments. Table IV-1 suggests that the overall average growth in revenues for the industry through 1980 might approximate 10% per year. The two segments in which contraction rather than growth will take place – Photoengraving and Electrotyping, and Stereotyping – together represent less than 1% of the printing and publishing industry. Many companies in these two segments have been consolidating and diversifying into trades that are more in demand.

Table III-5 showed the number of plants and the value of shipments by plant size for selected segments of the industry. Table III-6 provided information on industry concentration by showing the percent of the total and the average value of shipments per plant for the 4, 8, 20, and 50 largest companies in each industry segment. Similar data are provided for the average remaining plants in each industry after deducting the total value of shipments attributable to the 50 largest plants.

B. EARNINGS

The printing and publishing industry generally does not publish data on earnings. The best source of such information is the Ratio Studies, e.g., the PIA Ratio Studies referred to in Chapter V and similar studies carried out by other industry segments.

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B. EARNINGS

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C. CASH FLOW

This information, like that for earnings, is best obtained from PIA and other Ratio Studies. Cash flow data is presented in Table V-1.

D. NEW CAPITAL INVESTMENT

Data on new capital investment are included in the Census of Manufactures reports prepared by the U.S. Department of Commerce. Table IV-2 lists the new investment data for the various segments for the years 1963, 1967, and 1972. It is clear from these data that substantial new investment is made each year by the various industry segments and that the amount is increasing year by year. Between 1963 and 1967 the average new capital investment increase was about 17% per year compared to that of 1963. Between 1967 and 1972 that increase averaged about 7% per year compared to 1967.

Although the investment in each of the segments for new capital improvements will vary from year to year by industry needs and new technological developments, these data reflect an industry whose plants are attempting to maintain their competitive position vis-à-vis other plants and other communication industries and it is expected that this trend will continue.

E. MISCELLANEOUS FINANCIAL INFORMATION

Selected financial information is tabulated in Table IV-3 for the six industry segments studied for possible impact. These data are almost exclusively for large plants. The values given are estimated values for 1972 constructed from the detailed information available from the 1967 Census of Manufactures as applied to the available preliminary 1972 data. There will be discrepancies between the data in this table and other average values presented throughout the report. These values are based on the largest subsegments in each industry segment and should typify those plants studied for impact.

TABLE IV-2

ANNUAL CAPITAL INVESTMENT

SIC Code	Industry	New Capital Expenditures ($MM) 1963	1967	1972
2711	Newspapers	135.2	246.7	360.0
2721	Periodicals	33.8	58.0	54.9
2731	Book Publishing	25.4	55.1	49.0
2732	Book Printing	24.9	45.9	34.0
2741	Misc. Publishing	7.1	10.0	23.4
2751	Comm. Print., L.P.	89.0	120.4	126.1
2752	Comm. Print., Litho	76.9	125.6	220.4
2753	Engraving and Plate Print.	3.8	3.8	4.8
2754	Comm. Print., Gravure	10.2	22.6	20.7
2761	Manifold Bus. Forms	23.1	39.8	45.5
2771	Greeting Card Publishing	6.8	14.9	46.2
2793	Photoengraving	5.7	6.3	4.9
2794	Electrotyping and Stereotyping	1.0	0.7	0.4
2795	Litho Platemaking Services	–	–	8.5
	Total	442.9	749.8	998.8

Source: Census of Manufactures, 1963, 1967 and preliminary 1972.

TABLE IV-3

FINANCIAL PROFILES OF SELECTED INDUSTRY SEGMENTS

SIC Code	Industry	Size of Plant	Average Per Plant		
			Employees	Value of Shipments ($M)	Annual New Investment ($M)
2711	Newspapers	Large	462	12,330	520
2721	Periodicals	Large	389	12,122	312
2741	Misc. Publishing	Large	475	13,300	281
2751	Comm. Printing, L.P.	Large	272	6,979	292
2754	Comm. Printing, Gravure	Large Printer	456	15,867	511
		Medium Roll Maker	47	1,611	29
2793	Photoengraving	Large	107	3,109	68

Sources: Census of Manufactures, 1967 and preliminary 1972; ADL estimates.

V. MODEL PLANTS

Financial models of representative plants studied for possible impact were constructed for the Newspaper; Periodicals; Miscellaneous Publishing; Commercial Printing, Letterpress; Commercial Printing, Gravure and Photoengraving industries. In all cases the models were for large plants, i.e., those having more than 100 employees, because they are the principal sources of significant amounts of process contact effluent in their platemaking operations. Small and medium printing plants generally rely upon purchased services for their plates and thus avoid such problems. Moreover, the small and medium plants that may be etching metal for platemaking purposes have the option of disposing of their relatively small amounts of waste by means that do not require significant capital investments.

A. SIC 2711 NEWSPAPERS

American Newspapers Publishers Association, Research Institute data show that the largest group of newspaper plants is the 25,000-100,000 circulation category and that many of these plants are engraving metal. Smaller plants are predominantly offset and therefore, non-polluting. Larger plants are engaged principally in metal engraving because of their duplicate plate requirements and are contributors to pollution.

We have selected two models as representative of newspaper plants that contribute to pollution. Financial profiles of both are shown in Table V-1. The first plant is a medium circulation plant typical of the largest group of newspapers and characterized as a small city daily. It has an average circulation of 57,000. Our model (Table V-2) conforms to a survey made in 1973 of about 50 newspaper plants of this approximate size. The second plant is a larger (167,000 circulation) newspaper plant characteristic of an urban paper publishing both morning and evening editions. The model is derived on the basis of data for 25 plants of similar size described in the same survey. Table V-2 includes only the basic economic data necessary to make a preliminary judgment of the fit of our model into industry averages. The range, which shows a spread of values for the plants within a similar size group, is compared to the ADL model. This approach also has been used for the other printing industry segments.

B. SIC 2721 PERIODICALS AND SIC 2741 MISCELLANEOUS PUBLISHING

From a review of the Standard & Poors listing of plants in these two classifications and ADL's experience with this industry we identified a limited number of plants large enough to engrave metal and contribute to pollution. We contacted most of these plants to confirm their engraving activities. Both SIC 2721 and 2741 are included as identical models because of overlapping activities and size. Our information indicates that a typical plant for these two classifications would have the financial profile shown in Table V-1.

TABLE V-1

FINANCIAL PROFILE OF MODEL PLANTS
($000's)

	2711 Newspapers		2721	2741	2751 Commercial Printing Letterpress		2754 Commercial Printing Gravure		2793
	Medium Circulation Plant	Large Circulation Plant	Periodicals	Miscellaneous Publishing	Directory Printing Plant	Catalog Printing Plant	Printing Plant	Rollmaking Plant	Photoengra
Sales	6,600	23,400	30,000	30,000	15,470	10,530	10,600	1,000	3,775
Expenses	5,600	20,300	27,150	27,150	14,743	9,993	9,752	890	3,419
PBT	1,000	3,100	2,850	2,850	727	537	848	110	356
PAT	500	1,550	1,425	1,425	363	269	424	55	178
Depreciation	178	565	881	881	557	310	564	65	74
Cash Flow	678	2,115	2,306	2,306	920	579	988	120	252
Net Assets	3,384	15,200	17,625	17,652	10,400	7,410	9,540	1,000	2,085
Number of Employees	298	1,006	1,175	1,175	650	390	425	50	150
Return on Assets (%) (after taxes)	14.80	10.28	8.08	8.08	3.49	3.63	4.44	5.50	8.53

TABLE V-2

CHARACTERISTICS OF MEDIUM- AND LARGE-CIRCULATION NEWSPAPER PLANTS

	Medium Circulation Plant		Large Circulation Plant	
	Range	ADL Model	Range	ADL Model
Sales ($000)	4,200-7,700	6,600	9,700-25,000	23,400
PBT (% of Sales)	11.7-20.2	15.2	10.3-19.2	13.3
Depreciation (% of Sales)	2.7-4.5	2.7	2.3-2.9	2.4
Net Assets (% of Sales)	39-61	51	52-78	65

TABLE V-3

CHARACTERISTICS OF PERIODICALS AND MISCELLANEOUS PUBLISHING PLANTS

	Industry Range	ADL Model
Sales ($000)	22,000-30,000	30,000
PBT (% of Sales)	2.8-9.7	9.5
Depreciation (% of Sales)	3.1-5.0	2.9
Net Assets (% of Sales)	52-60	59

Source: Printing Industries of America, Ratio Study, 1973.

C. SIC 2751 COMMERCIAL PRINTING, LETTERPRESS

A commercial letterpress printer large enough to justify internal platemaking and therefore, a potential polluter, would be oriented primarily to rotary letterpress. Our experience and public information indicate that such a printer would be expected to have a sales volume of at least $8-20 million.

We have constructed two models for this classification; their financial profile is shown in Table V-1. The first model is a web printer primarily engaged in directory printing. The second is a printer primarily engaged in catalog printing. Two models were selected because there are differences in the markets, technology and profits for the two products. Our selection of model plants was based on data abstracted from a 1972 industry survey by PIA (Table V-4).

TABLE V-4

CHARACTERISTICS OF DIRECTORY AND CATALOG PRINTING PLANTS

	Directory Printing Plant		Catalog Printing Plant	
	Range	ADL Model	Range	ADL Model
Sales ($000)	8,000-20,000	15,470	9,000-21,000	10,530
PBT (% Sales)	3.0-9.0	4.7	4.0-10.0	5.1
Depreciation (% Sales)	2.7-3.0	3.6	2.7-3.0	2.9
Assets (% Sales)	59-84	67	59-84	70

Source: Printing Industries of America, Ratio Study, 1973

D. SIC 2754 COMMERCIAL PRINTING, GRAVURE

There is essentially no public information regarding the financial profile of plants engaged in gravure printing or gravure roll preparation. Most of these plant are privately owned and highly competitive and the firms are quite secretive concerning financial data. In fact, one contact reported, "In this industry one comptroller does not even recognize the comptroller of a competitive firm." As a result we have constructed our models on the basis of in-house knowledge but these have been confirmed in principal with private conversations with several financial people in the industry. Our gravure printing plant model prepares its own chemically engraved rolls and is therefore a potential source of pollution.

The model gravure rollmaking plant is only partially engaged in chemical engraving but must be considered a potential source of pollution. The financial profiles of both models are described in Table V-1.

Our choice of models was based on our best estimation of the range of values to be expected in this industry (Table V-5).

TABLE V-5

CHARACTERISTICS OF PRINTING AND ROLLMAKING PLANTS

	Printing Plant		Rollmaking Plant	
	Range	ADL Model	Range	ADL Model
Sales ($000)	6,000-20,000	10,600	300-1,600	1,000
PBT (% Sales)	3.0-11.0	8.0	8.0-14.0	11.0
Depreciation (% Sales)	2.0-6.0	5.3	2.0-8.0	6.5
Assets (% Sales)	70-100	90	50-100	100

Source: Arthur D. Little, Inc., estimates.

E. SIC 2793 PHOTOENGRAVING

Photoengraving, as a primary source of income, is a dying business as shown by most information that is available publicly or from industry contacts. The main reasons are the decline of letterpress printing and the growth of competitive plastic plate systems. Those firms that survive will be supplying mainly services, such as offset plates and color separations, for use in other printing processes. The more successful firms still engaged in a reasonable amount of photoengraving are closely associated with advertising agencies or publishers. The rationale behind their success is their ability to supply the offset and gravure printing industry with photographic preparatory copy that closely simulates letterpress copy found in national ads.

We have constructed a model of a large photoengraver, and the financial profile is shown in Table V-1. It should be kept in mind that photoengraving, as such, is an essential but minor part of the overall business of this model. Our

model is based on data abstracted from 1972 PIA studies supplemented by individual industry contacts (Table V-6).

TABLE V-6

CHARACTERISTICS OF PHOTOENGRAVING PLANTS

	Range	ADL Model
Sales ($000)	3,500-4,000	3,775
PBT (% Sales)	7.4-12.0	9.4
Depreciation (% Sales)	1.0-5.0	2.0
Net Assets (% Sales)	40-60	55

Sources: Printing Industries of America, Ratio Study, 1973, and Industry Contacts.

VI. ECONOMIC IMPACT ANALYSIS METHODOLOGY

In our determination of the impact of pollution control costs on the printing industry, the principal considerations were the effects of the costs on profit margins and the determination of whether the costs could be passed on in the form of higher prices for printed product. However, a host of secondary effects were also considered. These included possible effects on level of production, employment, growth of the company, ability of the company to raise new capital, hardships on the community, and international trade.

The economic analysis was concentrated on those segments of the printing industry which use technology that causes significant water pollution. The framework for the analysis was the model plants defined for each of the segments studied. The feasibility of investing capital to control pollution was assessed on the basis of the effect of the increased cost on profitability, a comparison of the required capital expenditure for pollution control with annual new capital expenditures for each of the models, and estimates of the revenue or price increases necessary to recover the additional expense and provide the same return on assets with the expanded asset base. The data was also analyzed to determine the probable effect of BPT and BAT standards on plant closures directly related to pollution control requirements. The sensitivity of the analysis under different conditions, such as those that would obtain because a printing plant did not conform exactly to a model plant, was also considered.

A. FUNDAMENTAL METHODOLOGY

The development of model plants in the previous chapter shows representative values for profit after taxes, depreciation, cash flow and net assets for each of the segments studied. The primary factors in assessing the financial and production impact of pollution control costs are the changes in profitability as a result of adding the incremental costs to the financial models and the ability to recover these costs and maintain profitability levels through higher prices. A number of factors will, of course, influence closure decisions but these two measures offer an acceptable guide to the financial analyst.

One other factor that might influence closure decisions importantly, and that is a most important variable in this analysis, is the nature of the polluting operation, e.g., whether it is a division of a large printing company, or whether the principal business of the company is supplying printing plates to the printing trade.

The first object of the analysis was to determine the extent of the financial impact. Subsequently, any areas that would suffer significant impact were analyzed for closure decision based on cash flow. If the water pollution control costs

reduced profits or were small relative to annual depreciation expenses, there was no necessity for a detailed cash flow analysis.

B. PRICE EFFECTS

Calculation of the price increase necessary to offset lower profitability took into consideration the expanded asset base resulting from the addition of the water pollution control equipment as well as the associated annual costs. We computed the return on assets before the new investment is made. We then determined the expanded asset base by adding to the present total assets the cost of water pollution control equipment. Multiplying the total asset base by return on assets, we determined the new profit before taxes that is needed to provide the same return being made before the pollution control equipment was installed. This approach does not jeopardize or weaken the competitive position of the affected plant.

Because this is a sales price increase, the additional revenue received will be additional profits before tax and there is no incremental cost of goods sold to be subtracted. Our actual volume of sales does not increase, only the revenues. The difference between necessary new profits computed on the expanded asset base and the previous profit earned equals the necessary increase in revenues. Accordingly, this increase in revenues divided by the previous revenue level defines the percentage revenue increase equal to the percentage price increase. This then is the price effect brought about by passing along, completely to the consumer, the cost of installation of a water pollution control system.

In the printing industry there would appear to be two areas for application of price increases to be imposed on a product though in reality there should be only one. For a company in a service industry or for a company in the roll-making portion of the Commercial Printing, Gravure segment, the cost of pollution control would affect the price of the product, that is, the printing plate or cylinder. This price increase would have to include allowance for profit and depreciation. In an integrated plant where the platemaking operation is part of the whole printing service, the incremental cost from pollution control might not be seen as directly applicable to the cost of preparing the plates although this would be a reasonable method of cost accounting. The latter plant might take the alternate view of spreading the cost of the plate over the cost of the amount of printed material that the plate would produce, in which case the apparent cost per unit of printing would be a function of the length of the run, and thus dilute the burden of the increase.

C. FINANCIAL EFFECTS

The financial characteristics of the model plants were used as the reference base for the analysis of the financial effects of the added costs due to pollution

control. The measures of profitability used were Return on Assets and after-tax profit as a percent of sales. The resulting ability of the industry to finance the required pollution control expenditures will vary from one segment of the industry to another, so capital availability and cost were examined for each model plant in the segments studied.

D. PRODUCTION EFFECTS AND INDUSTRY GROWTH

Production effects are related to price increases and profitability insofar as they influence sales volume and plant closures or adversely affect industry growth. In this industry there is a history of change and adaptation, and the current situation is one of rapid change in technology. We relied principally on our background in and experience with this industry to assess the impact of the costs of pollution control on production curtailment and industry growth.

E. EMPLOYMENT EFFECTS

Employment effects were estimated from the potential plant closures. Where curtailment in production or slowdown of industry growth was anticipated the effect on employment was estimated on the basis of the extent of the change expected in the segment of the industry affected.

F. COMMUNITY EFFECTS

Community effects, direct and indirect, were considered on the basis of the segments shown by the analysis to be adversely affected. Significant factors would be the loss of revenue to employees, loss of employment, the loss of taxes to the community, and the size of the printing industry in the community.

G. INTERNATIONAL TRADE EFFECTS

There is some international trade traffic in raw materials (paper, ink, etc.), and in finished products (books, magazines, etc.), both import and export. This traffic is variable and influenced by many considerations. These were evaluated to determine whether any major production or price effects would have an impact on this trade.

VII. EFFLUENT CONTROL COSTS

The control costs used in this analysis are those presented in the Development Document for Proposed Effluent Limitations Guidelines.

The BPT requirements for the printing and publishing industry have been determined to be a combination of flow equalization and reduction of pollutants to the levels shown in Table VII-1. The BAT requirements for this industry are the reduction of pollutants to the levels shown in Table VII-2. (All tables in this chapter except Table VII-7 are taken from the Development Document.)

TABLE VII-1

CONCENTRATION LIMITATIONS FOR BPT

Parameter	Limitation (mg/l)
Biochemical Oxygen Demand (20°C, BOD_5)	30
Hydrogen Ion (pH)	6.0-9.0 a/
Phenols	0.1
Total Suspended Solids	30
Oil and Grease	10
Organic Solvents	None b/

a/ Expressed as standard units.
b/ Maximum in-plant control to prevent discharge.

Wastes from the flat-bed letterpress, offset and screen printing operations will be required to meet only the limitations shown in Table VII-1. Treatment levels for BAT and NSPS are equivalent to those for BPT. No pretreatment is required.

Wastes from gravure, flexography and rotary letterpress operations will be required to meet all limitations in Table VII-2 to satisfy the requirements for BAT and NSPS.

The Development Document indicates that the cost of achieving BPT, BAT, and NSPS requirements for flat-bed letterpress, offset, and screen printing is zero and that the cost of pretreatment is also zero.

The Development Document estimated costs of the different levels of pollution control for the gravure, flexography and rotary letterpress facilities are

reproduced in Tables VII-3 through VII-6. These cost data are summarized in Table VII-7 for each of the model plants studied in the impact analysis. The Development Document estimated the cost for plants of three sizes. Since the largest plant in existence is only about 5000 gpd (process waste), only this size was considered in the analysis.

TABLE VII-2

CONCENTRATION LIMITATIONS FOR BAT

Parameter	Limitation (mg/l)
Aluminum	0.5
Biochemical Oxygen Demand (20°C, BOD_5)	a/
Chromium, Total	0.5
Copper	0.5
Hydrogen Ion (pH)	6.0-9.0 b/
Iron - Total	1.0
Lead	0.05
Magnesium	100
Manganese	1.0
Phenols	0.1
Total Suspended Solids	a/
Zinc	0.5
Oil and Grease	10
Organic Solvents	None c/

a/ These concentration levels will be the same as those to be defined as best practicable control technology currently available for publicly-owned treatment works.
b/ Expressed as standard units.
c/ Maximum in-plant control to prevent discharge.

TABLE VII-3

ESTIMATED COST OF BPT GRAVURE, FLEXOGRAPHY AND ROTARY LETTERPRESS FACILITIES

	FACILITY SIZE		
	19 m^3/day (5,000 gpd)	95 m^3/day (25,000 gpd)	190 m^3/day (50,000 gpd)
INVESTMENT COSTS:			
Neutralization and flow equalization including automatic pH probe and chemical storage and feed	$10,000	$20,000	$30,000
Package biological treatment plant	15,000	40,000	55,000
Pipes and pumps	1,000	2,000	3,000
Space requirements (sq ft)	(200)	(600)	(1,000)
TOTAL COST	$26,000	$62,000	$88,000
ANNUAL COSTS:			
Chemicals	$ 300	$ 1,300	$ 2,500
Sludge removal	100	500	1,000
Operation & Management	1,000	3,000	4,500
Capital	2,600	6,200	8,800
Depreciation	2,600	6,200	8,800
TOTAL ANNUAL COSTS (less power)	$ 6,600	$17,200	$25,600
Power	$ 500	$ 1,500	$ 2,500
TOTAL ANNUAL COSTS	$ 7,100	$18,700	$28,100

TABLE VII-4

ESTIMATED INCREMENTAL COSTS OF BAT ABOVE BPT GRAVURE, FLEXOGRAPHY AND ROTARY LETTERPRESS FACILITIES

	FACILITY SIZE		
	19 m^3/day (5,000 gpd)	95 m^3/day (25,000 gpd)	190 m^3/day (50,000 gpd)
INVESTMENT COSTS:			
Chemical feed, mix tank	$ 3,500	$ 4,000	$ 4,500
Sedimentation tank	3,000	8,000	15,000
TOTAL COST	$ 6,500	$12,000	$19,500
ANNUAL COSTS:			
Chemicals	$4,000	$20,000	$40,000
Sludge removal	2,500	12,500	25,000
Operation & maintenance	500	1,000	1,500
SUBTOTAL	$ 7,000	$33,500	$66,500
Power		negligible	
Depreciation	650	1,200	1,950
Capital	650	1,200	1,950
TOTAL ANNUAL COSTS	$8,300	$35,900	$70,400

TABLE VII-5

ESTIMATED COSTS OF NSPS GRAVURE, FLEXOGRAPHY AND ROTARY LETTERPRESS FACILITIES

	FACILITY SIZE		
	19 m^3/day (5,000 gpd)	95 m^3/day (25,000 gpd)	190 m^3/day (50,000 gpd)
INVESTMENT COSTS:			
BPT Investment Costs (Table VII-3)	$26,000	$62,000	$88,000
Incremental BAT Investment Costs (Table VII-4)	6,500	12,000	19,500
ANNUAL COSTS:			
BPT (Table VII-3)	6,600	17,200	25,600
Incremental BAT (Table VII-4)	8,300	35,900	70,400
TOTAL ANNUAL COST (less power)	$14,900	$53,100	$96,000
Power	500	1,500	2,500
TOTAL ANNUAL COST	$15,400	$54,600	$98,500

TABLE VII-6

ESTIMATED COSTS OF PRETREATMENT FOR NEW SOURCES GRAVURE, FLEXOGRAPHY AND ROTARY LETTERPRESS FACILITIES

	FACILITY SIZE		
	19 m^3/day (5,000 gpd)	95 m^3/day (25,000 gpd)	190 m^3/day (50,000 gpd)
INVESTMENT COSTS:			
Existing Source Investment Costs	$10,750	$21,500	$32,500
Incremental BAT Investment Costs (Table VII-4)	6,500	12,000	19,500
TOTAL COST	$17,250	$33,500	$52,000
ANNUAL COSTS:			
Existing Source	$ 2,850	$ 6,950	$10,750
Incremental BAT (Table VII-4)	8,300	35,900	70,400
TOTAL ANNUAL COSTS	$11,150	$42,850	$81,150

TABLE VII-7

COST OF PROPOSED EFFLUENT GUIDELINES FOR MODEL PLANTS

SIC CODE	INDUSTRY	PLANT SIZE	FACILITY SIZE m^3/day (gpd)	BPT COSTS ($M) INVESTMENT	BPT COSTS ($M) TOTAL ANNUAL	BAT OR NSPS COSTS ($M) INVESTMENT	BAT OR NSPS COSTS ($M) TOTAL ANNUAL
2711	Newspapers						
	Med. Cir.	Large	19 (5000)	26	7.1	32.5	15.4
	Lge. Cir.	Large	19 (5000)	26	7.1	32.5	15.4
2721	Periodicals	Large	19 (5000)	26	7.1	32.5	15.4
2741	Misc. Publishing	Large	19 (5000)	26	7.1	32.5	15.4
2751	Comm. Printing, L.P.						
	Directory Plant	Large	19 (5000)	26	7.1	32.5	15.4
	Catalog Plant	Large	19 (5000)	26	7.1	32.5	15.4
2754	Comm. Printing, Gravure						
	Lge. Printing Plant	Large	19 (5000)	26	7.1	32.5	15.4
	Roll Making Plant	Medium	19 (5000)	26	7.1	32.5	15.4
2793	Photoengraving	Large	19 (5000)	26	7.1	32.5	15.4

SOURCE: TABLES V-1, VII-3, VII-4, VII-5 and VII-6.

VIII. IMPACT ANALYSIS

As indicated earlier, this industry is unusual in that the main source of pollution is the larger companies. Furthermore, the polluting processes themselves are concentrated in one part of the operation, platemaking, and in particular, those steps that involve etching metal with acid. Although some small photo-engravers still etch metal, the volume of acid waste generated is easily disposed of by drumming without adding significantly to the cost of the plates. The large companies continue to use polluting technology because of their large investments in printing equipment, the need for duplicate plates, the demand for top-quality printing for long-run national ads, and the cost of conversion to non-polluting printing methods. Thus the analysis focuses on the profitability, capital availability and price effects for the large model plants.

A. PROFITABILITY AND CAPITAL AVAILABILITY EFFECTS

Capital availability can be affected on either the cash outflow or inflow side. On the outflow side, if the necessary investment in the water pollution control system is a large percentage of the total funds available, capital will not be available for investment elsewhere.

Table V-1 contains financial data of the model plants who use polluting technology. The models are large companies because polluting technology is used almost exclusively by large printers. The level of investment necessary to comply with the BPT and BAT guidelines is shown in Table VIII-1 to be small, especially with respect to the size (assets, sales, etc.) of these large companies. Our approach begins with an analysis of the size of the company relative to the necessary investment.

In Table VIII-1 we compare the investment cost of BPT and BAT standards with annual depreciation. Faced with inflation and advances in technology, the larger printing companies are probably now investing more in new fixed assets than their depreciation allowances suggest. By using depreciation, we err on the conservative side, showing a higher percentage of capital investment to be invested in water pollution control equipment.

Our second comparison is sales revenue with the annual operating costs of these systems. Again, Table VIII-1 shows the amount to be insignificant. We conclude that the capital outflow will not be increased greatly by installation and operation of water pollution control systems.

On the inflow side, capital availability is affected as investors perceive the potential worth of a company. Money market conditions being otherwise constant, the amount and trend of earnings will affect the price the investor is willing to pay for the company's securities, the price/earnings ratio, or bond rating. This in turn, affects availability of capital.

TABLE VIII-1

POLLUTION CONTROL INVESTMENT AND OPERATING COSTS IN RELATION TO CURRENT FIXED INVESTMENT AND ANNUAL SALES

BPT — investment = $26,000
Incremental BAT — investment = $ 6,500
NSPS — investment = $32,500

BPT Annual operating costs = $ 7,100
NSPS or BAT Annual operating costs = $15,400

	2711		2721	2741	2751		2754		2793
	Newspapers		Periodicals	Miscellaneous Publishing	Commercial Printing Letterpress		Commercial Printing Gravure		Photoengraving
	Medium Circulation Plant	Large Circulation Plant			Directory Printing Plant	Catalog Printing Plant	Printing Plant	Rollmaking Plant	
Depreciation ($000's)	178	565	881	881	557	310	564	65	74
BPT Investment (as % of Depreciation)	14.60	4.60	2.95	2.95	4.66	8.38	4.60	40.00	35.13
Incremental BAT Investment (as % of Depreciation)	3.65	1.15	0.74	0.74	1.17	2.10	1.15	10.00	8.78
NSPS Investment (as % of Depreciation)	18.25	5.75	3.69	3.69	5.83	10.48	5.76	50.00	43.91
Sales Revenue ($000's)	6,601	23,453	30,000	30,000	15,470	10,530	10,600	1,000	3,775
BPT Annual Operating Costs (as % of Sales)	0.10	0.03	0.02	0.02	0.04	0.06	0.06	0.71	0.40
NSPS or BAT Annual Operating Costs (as % of Sales)	0.23	0.06	0.05	0.05	0.09	0.14	0.14	1.54	0.40

Profitability can be measured by return on assets or return on investment. For purposes of this study, the investment is defined as total net assets; therefore, return on assets equals return on investment.

In analyzing return on assets we assume it is not possible to pass on the increase in expenses to the customer. The results, presented in Table VIII-2, Case A, show a very small change in return on assets. The reduction in return on assets amounts to only a fraction of a percent. A correlation can be found between the size of the company and the amount of reduction in return on assets. The larger the company, the smaller the reduction in return on assets. Attention is called to the rollmaking gravure segment where the company size is relatively small and a decrease in return on assets of 0.5 to almost 1% is experienced. We conclude that neither profitability nor capital availability on the inflow side will be affected by installation of a water pollution control system.

B. PRICE AND SECONDARY EFFECTS

Should profitability be affected adversely by an investment in water pollution control equipment, as is true to some extent in the rollmaking gravure segment, a predictable remedy would be to raise product prices to pass on the additional expenses to the customer. Decreased demand, product substitution, etc., could be secondary effects of a price increase.

Case B in Table VIII-2 demonstrates the alternative analysis of assuming that costs can be passed on to the customer. Case B demonstrates that only a 1% to 2% increase in sales price is necessary to maintain present return on assets for the rollmaking gravure segment. A 1% to 2% price increase for rolls is negligible to the printer who has seen a much higher price increase for paper in the recent past. Case B further demonstrates that in other segments the necessary sales price increase is negligible for companies this size. Because the price effect is so negligible in all segments, we conclude that there are no secondary effects.

The variability of water pollution control effects on prices between the largest and smallest plants in a segment may be reflected in reduced profits for the smaller of the plants if the prices of rolls are highly competitive which we do not believe. However, the analysis indicates that the effect on profitability would not result in a closure decision.

C. SENSITIVITY ANALYSIS

Basic to our analysis is the creation of a hypothetical model plant for each segment with prototypal financial data. Because our decision of no impact is based on an analysis of these hypothetical plants, a sensitivity analysis must be

TABLE VIII-2

PROFITABILITY AND PRICE EFFECTS OF POLLUTION CONTROL
(%)

CASE A

Assumption: Additional expenses incurred due to water pollution control equipment cannot be passed on to customer.
Before Pollution Controls: After tax return on net assets before pollution control system is installed.
ΔBPT: Effect on ROA of BPT system.
ΔBAT: Effect on ROA of BAT system.

	2711 Newspapers		2721	2741	2751 Commercial Printing Letterpress		2754 Commercial Printing Gravure		2793
RETURN ON ASSETS	Medium Circulation Plant	Large Circulation Plant	Periodicals	Miscellaneous Publishing	Directory Printing Plant	Catalog Printing Plant	Printing Plant	Rollmaking Plant	Photoengraving
Before Pollution Controls	14.80	10.28	8.08	8.08	3.49	3.63	4.44	5.50	8.53
ΔBPT	(0.21)	(0.04)	(0.03)	(0.03)	(0.05)	(0.07)	(0.05)	(0.49)	(0.27)
ΔBAT	(0.37)	(0.08)	(0.06)	(0.06)	(0.09)	(0.12)	(0.10)	(0.92)	(0.49)

CASE B

Assumption: Additional expenses can be passed on to the customer.
What revenue or price increase is necessary to recover the additional expense and provide the same return on assets with the expanded asset base?

	Newspapers		Periodicals	Miscellaneous Publishing	Commercial Printing Letterpress		Commercial Printing Gravure		Photoengraving
% INCREASE IN REVE	Medium Circulation Plant	Large Circulation Plant			Directory Printing Plant	Catalog Printing Plant	Printing Plant	Rollmaking Plant	
BPT	0.28	0.06	0.03	0.03	0.05	0.09	0.07	1.01	0.29
BAT	0.48	0.12	0.06	0.06	0.10	0.17	0.16	1.94	0.54

performed to determine how different from the prototype a plant can be before the cost of the water pollution control system has significant impact. Analysis was conducted on those three sectors which contained enough plants to have a likelihood of widely varying financial performance: newspapers, commercial gravure printing, and photoengraving. Results are shown in Table VIII-3. The ability of a company to afford the water pollution control system is a function in part of its size. Revenue and net assets were used as appropriate measures of size. Table VIII-3 shows the minimum-sized company able to afford this system.

The assumption is made in Case A that return on sales and return on assets are identical to those of the model plant, but allows a 5% price increase to pass along cost to the customer. Calculations demonstrate how much larger than "necessary" these model plants are.

Case B looks at the other end of the curve by assuming a sick company earning only half the return of the model plant. Furthermore, it assumes the pollution control standards will require investment costs equivalent to the 50,000-gallon-per-day system. The calculation is then performed to answer the question, "How large must the asset and revenue base be under these conditions if the 5% price increase can be passed along to customers?" Case B demonstrates that even assuming a very bad "worst case," all of these model companies are two to ten times larger than the critical threshold for companies that would be impacted under these conditions.

The sensitivity analysis demonstrates that not only is the model company within a sector unaffected by the standards, but that no company in the sector would be impacted. Companies of the size suggested in Table VIII-3 will probably be using different (non-polluting) printing technologies. None of the gravure printers is small enough to fit the lower values calculated.

D. PRICE EFFECTS

The impact analysis indicates that the amount of investment required for control of water pollution in the industry is such that no price increase would be anticipated. During the past year the overall increases in the cost of paper, plates, labor, and equipment have overshadowed the small effect of the cost of pollution control on the cost of the preparation of plates. The average cost of the platemaking service is 2 to 5% of the cost of the printing. If the total burden of the water pollution control investment had to be borne by the cost center represented by the platemaking operation in the printing plant and if the company were making a minimum of 100 plates a day (5000 plates per year), the annual cost would be $15,000 or about $3 per plate. Such an increase in the price of plates would be very small in comparison with other price increases that have been affecting this industry. Moreover, the increase will be distributed over the

TABLE VIII-3

SENSITIVITY ANALYSIS
($000's)

Sample Companies	2711 Newspapers: Medium Circulation Plant	2711 Newspapers: Large Circulation Plant	2754 Commercial Printing Gravure	2793 Photoengraving
Revenue	6,601	23,453	10,600	3,775
Assets	3,384	15,200	9,540	2,085

CASE A

Assumption: Maximum sales price increase of 5%
Derivation: The minimum revenue and asset base to support the incremental expenses of the BPT system (5,000 gpd).

	Newspapers: Medium Circulation Plant	Newspapers: Large Circulation Plant	Commercial Printing Gravure	Photoengraving
Revenue	219	195	165	186
Assets	112	127	149	103

CASE B

Assumption: Worst possible case. Returns on sales and assets half that of the sample company. Standards and expenses of BAT system equivalent to those of 50,000-gpd plant, allowing a 5% sales increase.
Derivation: Minimum revenue and asset base to support the incremental expenses of the BPT system.

	Newspapers: Plant I	Newspapers: Plant II	Commercial Printing Gravure	Photoengraving
Revenue	1,970	2,081	2,018	2,062
Assets	1,009	1,348	1,818	1,140

total number of impressions being printed, so the overall effect will be even more miniscule. Thus, no significant price increases are expected as a direct result of the cost of pollution control equipment except in those service industries where the total amount of the cost of pollution control is directly attributable to the plate, since this is the product that is being sold. It is expected, however, that this price increase can be readily passed on to the printer.

E. PRODUCTION EFFECTS

No production curtailments or plant shutdowns are anticipated as a result of the water pollution control guidelines.

F. EMPLOYMENT EFFECTS

No adverse employment effects are anticipated as a result of these water pollution control regulations on the printing industry.

G. COMMUNITY EFFECTS

No community effects on either plant growth, industry growth, or side effects are anticipated.

H. INDUSTRY GROWTH

Capital availability and profitability will not be obstacles to industry growth.

I. INTERNATIONAL TRADE

No international trade effects are expected as a result of these costs because no general price increases or production curtailments are expected to result from these guidelines.

J. COMPETITION WITHIN THE INDUSTRY

For industry suppliers and consumers the competition between the different types of printing outlined previously is expected to continue. In the past ten years offset printing has been making inroads into letterpress "territory" at higher and higher levels of printing impressions per run or per job order. It is expected that this trend will continue. In recent years there has been an increasing use of plastic plates to replace metal plates in the letterpress industry and it is expected that this trend will continue. Insofar as the need for water pollution control equipment and associated costs could be a factor, they would promote decisions favoring either offset printing or a change to plastic plates in letterpress operations, but the incremental effect of the cost of water pollution control on the decision that has already been made by the industry is expected to be very small.

K. ECONOMIC IMPACT OF NSPS

Neither the new source performance standards nor the new source pretreatment standards will affect the growth of any segment of the printing industry. No effect on prices is anticipated because of new source performance standards and new plant locations probably will not be affected either. The trend in recent years for the larger plants to build in more rural areas where they have access to land and access to good transportation will continue independent of the requirements for water pollution control. The decision to build domestic plants versus foreign plants will not be influenced by the proposed guidelines. Our analysis shows the balance of payments will not affect location or dollar volume of printing. In all cases pretreatment costs are less than BAT costs and since no impacts were found for the BAT costs no separate analyses were conducted for pretreatment costs.

APPENDIX

DERIVATION OF SENSITIVITY ANALYSIS FORMULA

The derivation of the formulas used for sensitivity analysis begins with a definition of return on sales and return on assets. A textbook definition of return is the profit after taxes divided by revenues (Equation 1) or assets (Equation 2).

If assets are going to increase and revenues will be affected or necessarily incremented, we should be able to derive a new formula which will take this into account. Equation 4 does this. Note that the incremental revenue (I) is only for a sales price increase. If it were an increase in volume, we would necessarily have to compute contribution and I would have to be multiplied by the return on sales.

The annual operating expense of this system is subtracted to reduce the profit appropriately. The left side of the equation has an expanded asset base against which the return on assets constant is multiplied to arrive at the new profit level. Substituting return on assets times assets or return on sales times revenue in Equation 4 produces a simplified equality – both sides are equal to profit. The incremental revenue is defined as 5% of previous revenue. Substituting this definition for I we are able to solve for the revenue base, having been given only the original investment cost and annual operating expense. We can use the ratio of return on sales and return on assets defined in the initial description of the company to solve for the net asset base.

$$ROS \equiv P/R \tag{1}$$

$$ROA \equiv P/A \tag{2}$$

$$\therefore A \cdot ROA = R \cdot ROS \tag{3}$$

$$ROA \cdot [A + C] = ROS \cdot R - E + I \tag{4}$$

$$ROA \cdot A + ROA \cdot C = ROA \cdot A - E + I \tag{5}$$

$$ROA \cdot C = I - E \tag{6}$$

$$I \equiv .05R \tag{7}$$

$$\therefore R = 20(ROA \cdot C + E)$$

P = Profit Before Tax
R = Sales Revenue (Before WPC)
A = Total Net Assets*
ROA = Return on Assets
ROS = Return on Sales
C = Investment Cost of WPC System
E = Annual Operating Expense of WPC System
I = Sales Price Revenue Increase

*Total Assets less depreciation on Fixed Assets, Amortization of lease holds and patents, and bad debt allowance of accounts receivables.

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