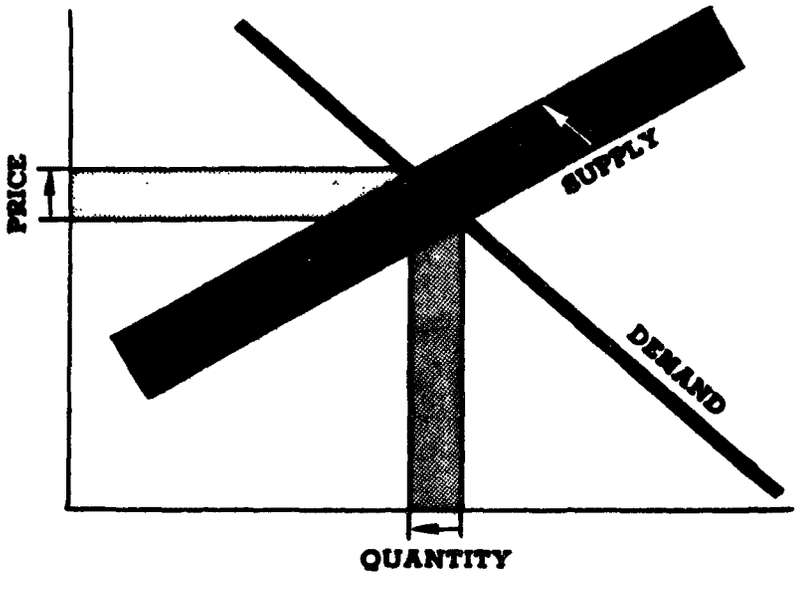
EPA 230/1-73-007
SEPTEMBER, 1973

ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES

THE ELECTROPLATING INDUSTRY

(COPPER, NICKEL, CHROMIUM, and ZINC)



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

EPA - 230/1-73-007

ECONOMIC ANALYSIS

OF

THE PROPOSED EFFLUENT GUIDELINES FOR THE ELECTROPLATING INDUSTRY

(Copper, Nickel, Chromium and Zinc)

SEPTEMBER, 1973

OFFICE OF PLANNING AND EVALUATION
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

CONTRACT NO. 68-01-1545

EPA REVIEW NOTICE

This report has been reviewed by the Office of Planning and Evaluation of EPA and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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 promulgation 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 Contract No. 68-01-1545 by A. T. Kearney, Inc. Work was completed as of September, 1973.

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 has not been reviewed by EPA and is not an official EPA publication. The study 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

INTRODUCTION

It was the objective of this study to determine the impact of the costs of water pollution abatement on the Electroplating Industry. The study was restricted in scope to an analysis of four metals: Copper, Nickel, Chromium and Zinc, used in electroplating and the effluents resulting from the use of these metals. This study covered those plants included in the four digit SIC Code 3471.

We would like to acknowledge the participation of Fred Gurnham Associates amd Mr. Scott Modjeska in the technical aspects of this study, as well as the cooperation of the National Association of Metal Finishers in the supply of data and information relevant to the study.

THE INDUSTRY

(a) Number of Industry Establishments

Due to the nature of the Electroplating Industry and the relative ease of entry into, or withdrawal from, the market place, it is difficult to determine the actual number of electroplating shops operating within the United States.

Based on the best available information from the Bureau of Census, the number of electroplating establishments is as shown in the following table:

TABLE 1

Number of Electroplating Establishments

Industry Segment	Establishments
Captive Installations	2,389
Independent Shops	3,241
Total	5,630

(b) Employment Size

Similar to data on establishment size, data on employment size is also difficult to determine. The following table shows reported employment by type of electroplating installation:

TABLE 2

Industry Employment

Industry Segment	Employment
Captive Installations	23,000
Independent Shops	55,000
Total	78,000

Source: Bureau of Census

(c) Types of Firms

It was determined that segmenetaion of the industry based upon level of integration, number of plants, number of products and level of diversification, is not valid or necessary at this point.

(d) Expected Impact by Industry Segments

It is expected that the impact on the industry will be more significant in the independent shop segment rather than the captive shop segment because of the following:

1. Greater number of small independent shops exist.

2. Employment in the independent segment is greater in small shops than in small captive shops.

3. Captive shops generally have a larger organization capable of supporting additional operating costs of pollution control.

4. Ability to raise necessary capital requirements for equipment is greater in the broader based captive shop environment.

It is expected that within the independent segment, large shops will be impacted but not as severly as the small shops, particularly at the lower employment levels. Information collected during the study indicated the following:

1. Low sales volumes for small shops, thus indicating insufficient cash flow for purchasing expensive control equipment.

2. Constraint on physical plant space thus adding to the capital requirements, particularly if additional land is required to maintain the same volume.

3. Diversification is high in the small shops in order to hold customers. For reasons mentioned, several treatment systems will probably be required as degree of diversification increases.

(c) Scope of the Study

As a result of the expected impact, the scope of the study was limited to the independent (job) shop segment. Although some small captive shops (1-5 employees) are expected to close, the work performed in these shops will probably be transferred to larger independent shops and the employees relocated into other captor industry operations.

The scope was further limited to independent shops of less than 100 employeess. This segment contains the majority of the industry work force. Larger shops in this segment are also expected to be impacted, but few, if any, closures should result from pollution abatement requirements.

METHODOLOGY OF IMPACT ASSESSMENT

The following methodology was used in assessing the economic impact of the cost of water pollution control on the Electroplating Industry:

1. The independent shops were segmented based on numbers of employees, dollars of sales and location of plants, rural or urban.

2. The financial impact on the industry as a whole was measured in terms of the effect on the industry's average profit before taxes as a percent of sales.

3. The impact on prices of electroplating was determined based on the projected maintenance of the industry's average level of profitability before taxes.

4. The impact of ability to raise the necessary capital for pollution abatement equipment was analysed for each segment.

5. The impact on production curtailment, plant closing, etc., was based on:

   (a) Judgemental assessment of the expected financial impact.

   (b) Interviews with industry sources.

   (c) Interviews with technical consultants.

SEGMENTATION

Segments of the industry were analyzed in considerable detail in Section III and IV of the report. In the independent shop segment, model plant size groups were established. The basic parameters of these groups are shown in the table below:

TABLE 3

Model Plant Parameters

Model Plant Code	Number of Plants			Average No. of Employees Per Plant	Average Dollar Sales Per Plant ($.000)
	Urban*	Rural**	Total		
A	952	285	1,237	2	$ 40.3
B	439	131	570	7	135.0
C	446	133	579	14	262.9
D	477	143	620	30	594.3
E	132	39	171	67	1,345.5
Total	2,446	731	3,177		

* Plants discharging effluents to municipal sewer systems

** Plants discharging effluents to navigable waters.

The impact due to water pollution abatement costs on the above plants are discussed in the paragraph, Impact Analysis.

EFFLUENT LIMITATIONS USED FOR THIS STUDY

In order to evaluate the economic impact of pollution abatement requirements on the Electroplating Industry, it was necessary to establish effluent limitations on the model plant groups. In conjunction with the Environmental Protection Agency, two alternates were established for levels of treatment for rural and urban plants. The alternates are shown in the following table:

TABLE 4

Alternate Effluent Limitations

Alternate	1977 Rural	1977 Urban	1983 Rural
A	Level I (1)	Pretreatment (2)	Level II (3)
B	Level I	Level I	Level II

(1) Best Practicable Technology

(2) Pretreatment standards are based on local regulations and are not a requirement of the federal guidelines.

(3) Best Available Technology

COST OF WATER POLLUTION CONTROL

The cost data were supplied by Battelle Memorial Institute. Costs regarding investment requirements were developed based on the number of square feet per hour plated per employee and the number of gallons of water used per hour. Operating costs were based upon the square feet plated per hour per employee and man-hours worked per employee per year.

The investment and operating cost data for 1977 and 1983 for Alternates A and B are summarized in Tables 5 and 6 on the following pages.

FINANCIAL PROFILE

(a) Sales and Profits

A limited amount of information is available within the Electroplating Industry relative to the financial condition of individual firms. However, the limited published data, industry studies and direct contact with individual firms, were used to develop a financial profile of the industry segments.

Five model plant sizes were established with the following financial data:

TABLE 7

Financial Data

Model Plant Code	Employee Range	Average Sales Dollars ($000)	Average Pre-tax Profit on Sales (%)
A	1 - 4	$ 40.3	9.0 %
B	5 - 9	135.0	6.5
C	10 - 19	262.9	4.9
D	20 - 49	594.3	7.2
E	50 - 99	1,345.5	4.2

For the entire group of plants a pre-tax profit of 5.9% was calculated.

TABLE 5

ALTERNATE A

COST OF POLLUTION ABATEMENT
EQUIPMENT FOR ELECTROPLATING INDUSTRY

Model Plant Code	1977 Standards (1) Urban Area (3) Investment (.000)	1977 Standards (1) Urban Area (3) Annual Operating Costs	1977 Standards (1) Rural Area (4) Investment (.000)	1977 Standards (1) Rural Area (4) Annual Operating Costs	1983 Standards (2) Rural Area (4) Investment (.000)	1983 Standards (2) Rural Area (4) Annual Operating Costs
A	25.0	$ 795	50.0	$ 1,590	20.0	$ 825
B	29.4	2,785	58.8	5,565	20.0	2,895
C	58.8	5,565	117.6	11,130	73.0	5,790
D	126.0	11,925	252.0	23,850	133.5	12,405
E	281.0	26,630	562.0	53,265	288.8	27,705

(1) Best practicable technology
(2) Best available technology
(3) Plants discharging to municipal sewer systems
(4) Plants discharging to streams

Source: Battelle Memorial Institute

Environmental Protection Agency

TABLE 6

ALTERNATE B

COST OF POLLUTION ABATEMENT
EQUIPMENT FOR ELECTROPLATING INDUSTRY

Model Plant Code	1977 Standards(1) Urban Area (3) Investment (.000)	1977 Standards(1) Urban Area (3) Annual Operating Costs	1977 Standards(1) Rural Area (4) Investment (.000)	1977 Standards(1) Rural Area (4) Annual Operating Costs	1983 Standards(2) Rural Area (3) Investment (.000)	1983 Standards(2) Rural Area (3) Annual Operating Costs
A	50.0	$ 1,590	50.0	$ 1,590	20.0	$ 825
B	58.8	5,565	58.8	5,565	20.0	2,895
C	117.6	11,130	117.6	11,130	73.0	5,790
D	252.0	23,850	252.0	23,850	133.5	12,405
E	562.0	53,265	562.0	53,265	288.8	27,705

(1) Best practicable technology
(2) Best available technology
(3) Plants discharging to municipal sewer systems
(4) Plants discharging to streams

Source: Battelle Memorial Institute
Environmental Protection Agency

(b) Value of Assets

The Electroplating Industry is characterized by relatively low capital investment in equipment, land and buildings. Once purchased and installed, the market value of electroplating equipment decreases rapidly. It is estimated that the market value of used equipment is worth about 15% to 20% of the purchase price after two years of operation.

(c) Financing Capital Requirements

The following are the methods employed by the electroplating firms to obtain financing for initial or additional capital requirements.

1. Commercial Banks, in general, are the primary source of financing for firms in the Electroplating Industry. However, companies experience some difficulty in obtaining financing for both productive and nonproductive assets. Companies often have to pledge assets of value equal to or greater than the amount of the loan. Since most companies are small with low capital investment, the asset security is a problem.

The Bank's important consideration is the ability to service the debt and the personal reputation of the business owners.

2. SBA Loans are typically available and used by some of the small platers. Although a viable source for small

business, these loans require a considerable amount of detailed information for qualification.

3. Public Financing - Most of the companies in the industry are either closely held corporations or partnerships. There are few public corporations. For this reason, the normal method of outside financing is by bank loan. Very little financing is done by issuance of stock.

4. Private Sources - Since many of the companies are owned and operated as a family business, another source of financing is the family itself. The private resources of the family are drawn upon when necessary.

5. Government Assistance - A source of financing which is available, but is not often used, is government assisted financing. Several people interviewed in the A. T. Kearney industry survey expressed a desire for some form of government assisted financing of pollution control equipment.

6. Industrial Revenue Bonds have been used to finance pollution abatement equipment. The value of bonds issued has increased from $85 million in 1971 to $1 billion in 1973. These bonds generally carry a rate of 6%. Due to the high cost of issuing these bonds, the value issued is generally in excess of one-half million dollars. Presently, only the very largest of the electroplating shops would be able to avail themselves of this type of financing. This type of financing presently will not assist the small independent shops to finance pollution abatement equipment.

IMPACT ANALYSIS

The impact analysis was based on previously described model plant parameters, costs of pollution abatement equipment, average profits for each segment, availability of capital to finance abatement equipment, interviews with consultants and industry sources, and Kearney's assessment of all mentioned factors.

(a) 1977 Standards

The total investment costs required for the Electroplating Industry to meet the 1977 standards are approximately $255 million for Alternate A and approximately $415 million for Alternate B. The annual operating cost increase is expected to amount to $22 million for Alternate A and $36 million for Alternate B. The following are the projected price increases for each of the model plant groups:

TABLE 8

Projected Price Increases

Plant Code	Alternate A Percent Increase Urban	Alternate A Percent Increase Rural	Alternate B Percent Increase Urban and Rural
A	18.4%	36.7%	36.7%
B	7.8	15.5	15.5
C	8.0	16.0	16.0
D	7.6	15.2	15.2
E	7.5	15.0	15.0
Weighted Average	8.3%	16.5%	16.5%

(b) 1983 Standards

The industry is projected to require an additional investment of $43 million in order to meet proposed 1983 standards. The additional annual operating costs of operation are estimated to be $4 million.

It is believed that these costs will, in the majority of cases, be passed on in the form of price increases. If this happens, an average price increase of 8.4% will be incurred for those plants in the rural segment.

(c) Plant Closings

Based on the data analyzed and interviews with the Electroplating Industry and bank representatives, it is believed that the proposed water pollution control standards will have the effect on potential plant closures for Alternates A and B as shown in the following tables.

TABLE 9

Potential Plant Closures - Alternate A

	Number of Plants					
	1977		1983		Total	
Area	Number	Percent	Number	Percent	Number	Percent
Urban	324	13.2 %	-	- %	324	13.2 %
Rural	193	26.4	25	4.6	218	29.8
Total	517	16.3 %	25	4.6 %	542	17.1 %

TABLE 10

Potential Plant Closures - Alternate B

Area	Number of Plants					
	1977		1983		Total	
	Number	Percent	Number	Percent	Number	Percent
Urban	649	26.5%	-	-	649	26.5%
Rural	193	26.4	25	4.6%	218	29.8
Total	842	26.5%	25	4.6%	867	27.3%

It should be noted that of the 542 total potential plant closures for Alternate A, or 867 total potential plant closures for Alterante B, 324 in both alternates are estimated to be the resultant of pretreatment standards which are considered to be the responsibility of the local municipal systems handling plant effluents and not the Environmental Protection Agency Guidelines. It is understood that not all municipalities will have the same regulations. However, for purposes of this analysis, effluent standards were assumed to be equal for all areas and municipalities.

(d) Employment Effects

Based on the estimated potential plant closings and the average number of employees per model plant size, the employment effects for Alternates A and B are shown in the following tables.

TABLE 11

Alternate A

Employment Effects

Area	1977 Number	1977 Percent	1983 Number	1983 Percent	Total Number	Total Percent
Urban	1,513	4.7%	-	-	1,513	4.7%
Rural	844	8.6	248	2.6%	1,132	11.0
Total	2,397	5.4%	248	2.6%	2,645	5.9%

TABLE 12

Alternate B

Employment Effects

Area	1977 Number	1977 Percent	1983 Number	1983 Percent	Total Number	Total Percent
Urban	3,040	8.8%	-	-	3,040	8.8%
Rural	884	8.6	248	2.6%	1,132	11.0
Total	3,924	8.8%	248	2.6%	4,172	9.3%

Of the approximately 2,650 or 4,200 employees estimated to be affected by the potential plant closures, it is estimated that about 50 percent will be re-employed in the remaining firms in the Electroplating Industry. The net effect is, therefore, a displacement of 1,325 or 2,100 employees.

(e) Community Effects

It is believed that little or no impact on local communities will result from plant closings due to pollution abatement requirements.

(f) Production Effects

Based on the estimated potential plant closings and the average dollar sales per model plant size, the production for Alternates A and B effects are shown in the following tables.

TABLE 13

Production Effects - Alternate A

Area	1977		1983		Total	
	$Million	Percent	$Million	Percent	$Million	Percent
Urban	$29.7	4.4%	-	-	$29.7	4.4%
Rural	17.3	8.6	$4.9	2.6%	22.2	11.1
Total	$47.0	5.4%	$4.9	2.6%	$51.9	5.9%

TABLE 14

Production Effects - Alternate B

Area	1977		1983		Total	
	$Million	Percent	$Million	Percent	$Million	Percent
Urban	$59.6	8.8%	$ -	-	$59.6	8.8%
Rural	17.3	8.6	$4.9	2.6%	22.2	11.0
Total	$76.9	8.8%	$4.9	2.6%	$81.8	9.3%

It is believed that the majority of this potential lost sales volume will be shifted to the remaining plants.

LIMITS OF THE ANALYSIS

(a) The accuracy of this study depends upon the accuracy of:

1. Published industry data.
2. Unpublished information supplied by knowledgeable industry personnel.
3. Cost data developed separately from this analysis by Battelle Memorial Institute for the Environmental Protection Agency.
4. Estimates by A. T. Kearney consultants.

The published data consisted of industry sales, number of companies and employees and limited financial data. While conflicts were present in the various data sources, these data were judged to be reasonably accurate for a study of this nature.

The information supplied by members of the Electroplating Industry was assumed to be accurate, and the cost data provided by Battelle were used as supplied.

(b) Critical Assumptions

The assumptions which directly affect the findings and conclusions of this study are :

1. The industry has been assumed to be similar in each segment according to size. Sales, employment and production are assumed to be relevant units of measurement for the plants in the industry.

2. The majority of the small shops were assumed to handle similar waste streams and operate in approximately the same manner according to size, as stated in the above paragraph.

3. In the absence of more accurate data the water discharged into streams versus that discharged into municipal sewers, was assumed to represent the distribution of the plants by geographical location, i.e., rural versus urban areas.

4. The plants in the industry affected by pollution abatement have either zero current investment in water treatment equipment or the estimated costs to meet guidelines are additive for those plants already using some type of treatment.

5. Profitability and costs for the plants located within urban and rural areas was assumed to be similar.

6. It was assumed that all shop owners will attempt to maximize profits. It was also assumed that five years profits would be the maximum amount of investment a shop owner would be willing to forego before going out of business.

I - INTRODUCTION

STATEMENT OF THE PROBLEM

The 1972 Amendments to the Federal Water Pollution Control Act have required the Environmental Protection Agency to establish effluent limitations for most major industries which are sources of water pollution. Studies are now under way to establish these limitations in some 28 industries. These effluent limitations will apply to existing and new plants, and at legislated dates progressively more restrictive limitations will be imposed. Specifically by July, 1977, effluent requirements will be in effect that require application of the best practical control technology currently available. By July, 1983, a more restrictive set of limitations will be enacted that require the application of the best available technology economically achievable; and by 1985, if possible, techniques and systems that enable the industries to effect zero level of discharge will come into effect.

The tremendous effort which has been expended by the EPA and its predecessor agencies in the technical development of the nature of the pollution problem, and its solutions, has resulted in a multiplicity of programs which have begun to bring the pollution problem under control. The establishment of timetables has put time parameters on these control efforts, requiring the expenditure of vast sums of money by all types and levels of industry to meet these deadlines by installation of pollution controls.

In recent years, a recognition of the potential economic problems facing industry in meeting the control requirements has resulted in study programs in which the economic impact of the costs of pollution control on American industry and on the economy in general have been analyzed. These culminated in the Economic Impact Studies sponsored by the Council for Environmental Quality and the EPA in 1971 and 1972, in which 11 industries were studied.

The EPA has now increased the number of industries which are being studied, and expanded the scope of previous studies, by authorizing a series of Economic Impact Studies which are specifically aimed at analyzing the economic impact of the costs of water pollution abatement requirements under the Federal Water Pollution Control Amendments of 1972.

SCOPE OF WORK

The Electroplating Industry included in SIC code 3471 is covered by this study. SIC Code 3471 includes many processes generally found in plating shops including electroplating, other types of plating, polishing, anodizing, and coloring of metallic manufactured end products. Although a wide variety of platings and coatings are in use in shops listed under SIC Code 3471 which include non-metallic coatings, precious metals, and non-precious metals, the study scope has been limited by EPA to copper, nickel, chromium and zinc electroplating.

METHOD OF APPROACH

This study was conducted in three phases. Phase I developed a physical and financial profile of the Electroplating Industry. Phase II analyzed the economic impact of water pollution control costs on the industry, and Phase III was the preparation of the final report.

The method used in conducting this study is discussed in the following paragraphs.

(a) Phase I

1. Collected and reviewed all published data and information which could be found in trade journals, government sources and A. T. Kearney files.

2. Met with representatives of the following agencies and organizations to gather additional information:

(a) Environmental Protection Agency

(b) National Association of Metal Finishers

(c) Chicago Electroplaters Institute

(d) Battelle Memorial Institute

(e) U. S. Department of Commerce

3. Conducted approximately 30 telephone interviews of both job shop and captive electroplaters, located in areas of the United States to gather financial and operating data.

4. Analyzed all of the data collected. A list of reference sources used in this study is given in Exhibit I-1.*

5. Prepared a draft report covering the findings of Phase I.

6. Reviewed Phase I findings and conclusions with the EPA. The results reported in Phase I indicated that the economic impact of water pollution control costs would be greatest on the independent electroplaters employing less than 100 personnel. It was therefore decided by A. T. Kearney and the Environmental Protection Agency that the scope of the analysis of the Electroplating Industry would be narrowed and the assessment of the impact of water pollution control on the Electroplating Industry for independent shops employing less than 100 personnel would be provided.

(b) Phase II

1. Analyzed the data developed by Battelle Memorial Institute with respect to the projected costs of water pollution control.

2. Visited approximately 25 Chicago area electroplaters and re-interviewed by telephone previously contacted electroplaters located in other areas of the United States, based upon segmented groups, to gather additional information.

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*All exhibits are located at the end of the section in which they are discussed.

3. Interviewed five Chicago area banks to assess the ability of electroplating shops to obtain financing for pollution abatement equipment.

4. Revised some of the data collected in Phase I due to the availability of additional information.

5. Analyzed all data collected and developed conclusions based on this analysis.

6. Prepared a draft report covering the findings and conclusions of Phase II.

(c) Phase III

The draft reports covering the results of Phase I and Phase II were combined into a single report, finalized and submitted to the Environmental Protection Agency.

ENVIRONMENTAL PROTECTION AGENCY

LIST OF REFERENCE SOURCES

SECONDARY SOURCES

Annual Statement Studies, Robert Morris Associates

Annual Survey of Manufacturers - 1971, U.S. Department of Commerce

Business and Economic Evaluation of the Metal Finishing Industry, Michigan Business Reports No. 52, Graduate School of Business Administration, University of Michigan

Census Bureau-Electroplating Engineering Handbook, U.S. Department of Commerce

Census of Manufacturers - 1967, U.S. Department of Commerce

Cost of Clean Water - Industrial Waste Profile Study Motor Vehicle and Parts, November 1967, U.S. Department of Interior

Development Document for Effluent Limitations Guidelines and Standards of Performance - Electroplating Industry (Copper, Nickel, Chromium and Zinc) , 1973, Battelle Memorial Institute, Draft

Dun & Bradstreet Reports

Enterprise Statistics - 1967

EPA Technology Transfer Seminar Publication - #1 In-Process Pollution Abatement, July 1973 -- #2 Waste Treatment July 1973, Environmental Protection Agency

Finishers Management - National Association of Metal Finishers

Industrial Water Engineering

Metal Working Market Guide 1973, Iron Age

Moody's Industrial Manual

Predicast, Market Forecasts

PERSONAL INTERVIEWS

(a) Electroplaters

A. T. Kearney industry survey of 41 independent and captive electroplaters.

(b) Banks

A. T. Kearney survey of five Chicago area banks.

(c) Others

American Electroplaters Society
East Orange, New Jersey

Dr. Fred Gurnham, Consultant, Chicago,
Chicago, Illinois

Mr. Scott Modjeska, Consultant
Chicago, Illinois

National Association of Metal Finishers (NAMF)
Upper Montclair, New Jersey
- Also 15 local chapters

II - GENERAL INDUSTRY DESCRIPTION

This section of the report provides a general insight into the operations of the Electroplating Industry. Included is a broad description of the nature of the demand for electroplating and how other industry segments affect the viability of the electroplating industry. A general description of the processes involved and the sources of water pollution are also discussed. The major headings of this section are:

- Demand Characteristics for Electroplating
- Description of the Plating Process
- Sources of Water Pollution

DEMAND CHARACTERISTICS FOR ELECTROPLATING

Electroplating is an electrochemical process performed on manufactured parts when the original surface characteristic of the base metal, used to form or manufacture the product, does not possess the desired surface characteristic. Some examples of the desired finishes would include corrosion protection, hard or durable finishes, bright or decorative characteristics, electrical conductivity and others of a similar nature.

The primary demand for the electroplating process is governed largely by the technical requirements of the industry segments which manufacture the end products. For example, tool makers require a hard chrome finish to provide durability to the finished product. Manufacturers of household products

require a soft chrome finish to provide a decorative finish. Zinc or cadmium finishes can be specified for corrosion resistance.

Although it is exceptionally difficult to provide accurate estimates of the total demand for electroplating, it is possible to provide a general indication of the extent of usage of electroplating in other industry segments. By understanding this broad industry dependence on electroplating, it is then possible to understand some of the factors which can affect the demand for the electroplating service.

Exhibit II-1 depicts the types of finishes required by 9 industry segments. These SIC code 2 digit classifications represent 86 separate industry groupings and well over 20,000 establishments which are potential users of electroplating.

A significant number of the identified industry segments perform their own services in captive electroplating installations. However, a large number purchase their requirements from outside sources, i.e., independent job shop platers. Exhibit II-2 shows approximately 4,800 identified plants which perform some electroplating within their primary operation.

Assuming a relative degree of accuracy of the data, some 15,000 additional plants are potential demand sources for non-captive electroplating services.

A limited number of studies have been conducted to predict the future demand for electroplating. However, Predicast, a market forecasting publication, estimates the consumption of chromic acid to grow at approximately 2.5% per year until 1975. It is also estimated that the consumption of nickel for nickel plating will increase from 47 million pounds per year to 66 million pounds by 1976. Sales of nickel plating are predicted to increase at an annual growth of 6% during the same period.

Clearly the demand for electroplating is broad and used in a wide range of industries. It is also expected that the industry demand is expected to continue growing probably consistent with the growth of those segments which are major users of the service.

DESCRIPTION OF THE PLATING PROCESS

(a) Equipment Used

The equipment requirements in the electroplating process depend upon the physical dimensions of the workpieces being plated. Barrel and still plating are the two primary methods in heavy commercial use.

Many types of barrel finishing equipment are used. Each type essentially consists of a cylinder or barrel which contains the parts being plated and a tank filled with the plating

solution. The barrel is placed in the plating tank and the parts are rotated in the solution. An electrical current is discharged either through the plating solution or directly to the parts to complete the electroplating process.

Typically, still plating methods involve the use of special frames or racks which hold the parts in place while the plating is being performed. The racks serve the function of carrying electrical current to the pieces in the plating tanks.

(b) Materials Used

Raw material needs for the simple electroplating operation are relatively minimum. Acid dips, water, or special cleaning solutions are used for any preliminary treatment that might be required before the actual plating is done. While hundreds of different plating solutions are available commercially, cyanide, alkaline and acid sulfate solutions are among those in popular use. Water is used in great quantities in the rinsing cycles of the electroplating process.

Differences in the plating of various metals are explained to a large extent by the specific properties of each metal, personal knowledge of a particular series of operations and preference for one method over another when a choice is available. For example, sulfuric acid pickling alone is generally considered unsatisfactory for oxide removal from stainless steels and corrosion-resistant alloys because black smut is

left on the workpiece and/or the pickling time required is relatively longer. Sulfuric acid, however, is a good pickling agent for the removal of copper oxide from the copper-rich alloys. Similar situations exist in other plating processes.

(c) Process Flow

A simple electroplating process includes, essentially, four sequential operations -- cleaning, plating, rinsing and drying.

The objective of the initial operation is to prepare the piece for plating by removing all foreign matter such as oil, grease, dirt and oxide that could retard or prevent actual plating of the workpiece surface. If any abrading, pickling, or other preliminary treatment is necessary, rinse tanks may be needed to remove pre-treatment solutions, to provide good surface adhesion and to avoid contamination of plating solutions.

Whatever method is employed, still or barrel plating, all workpieces are rinsed between each step in the process and finally, at the end of the process, before being allowed to dry.

SOURCES OF WATER POLLUTION

Rinsing solutions are the major sources of water pollution in the electroplating process. These toxic substances find

their way to sewage systems and streams by a variety of means:

1. Accidental spillage or tank leaks.
2. Intentional dumpings.
3. Drag-out to rinses.
4. Losses due to the periodic cleaning and repacking of filters.
5. Vapor sprays or mists drawn off by the ventilation system.

Closer supervision over the electroplating process serves to reduce cumulative effects of accidental spillage and leaks, toxic vapors, and the cleaning of filters. Drag-out, however, is a more difficult and continuous problem resulting from the transfer of racks or barrels from one solution to another and is the major source of pollution. Intermediate rinsing solutions become contaminated with solutions from previous tanks, necessitating periodic dumpings. Although volume of plating and the type of process used are important elements in determining the amount of pollution, all electroplating shops contribute to the problem of water pollution.

ENVIRONMENTAL PROTECTION AGENCY

Economic Impact of Pollution Abatement
On The Electroplating Industry

End Uses of Electroplating by Industry Segments

SIC Code	Industry Classification	Type of Finish			
		Durability	Decorative	Conductivity	Corrosion Protection
19	Ordnance	X			X
25	Furniture and Fixtures		X		X
33	Primary Metal Industries		X	X	X
34	Fabricated Metal Products	X	X	X	X
35	Machinery Except Electrical	X	X		X
36	Electrical and Electronic Equipment		X	X	X
37	Transportation Equipment	X	X	X	X
38	Instruments and Related Parts	X	X	X	X
39	Miscellaneous Manufacturing Industries	X	X	X	X

Source: Metal Working Guide

EXHIBIT II-1

EXHIBIT II-2

ENVIRONMENTAL PROTECTION AGENCY

Economic Impact of Pollution Abatement
On Electroplating Industry

Electroplating Operations by Industry Segments

SIC Code	Industry	Plants
25	Furniture and Fixtures	119
33	Primary Metal Industries	232
34	Fabricated Metal Products	1,093
35	Machinery Except Electrical	922
36	Electrical and Electronic Equipment	1,115
37	Transportation Equipment	357
38	Instruments and Related Parts	574
39	Miscellaneous Manufacturing Industries	364
	Total	4,776

Source: Metal Working Guide

III - PHYSICAL CHARACTERISTICS OF THE INDUSTRY

In this section of the report physical characteristics of the electroplating industry are discussed in order to determine the major market segments expected to be significantly impacted by pollution control standards. These are discussed under the following major topic headings.

- Primary industry segments
- Types of firms
- Size of the industry
- Industry survey
- Expected impact by industry segments
- Location of impacted shops
- Industry segment not considered
- Scope of Impact Analysis

PRIMARY INDUSTRY SEGMENTS

The electroplating industry can be primarily segmented into two major categories.

1. Independent (job) shops which sell their services to an extensive listing of metal working industries as indicated in Exhibit II-1 and discussed in Section II, page 2.

2. Captive installations owned and operated by the specific industry requiring the service.

TYPES OF FIRMS

Electroplating shops in the job shop segment can be further defined in the following categories:

- Integrated firms
- Multi-plant firms
- Single or multiple product firms
- Highly diversified firms
- Specialists

The relevance of segmenting firms by these sub-categories is discussed.

(a) Level of Integration

Electroplating is an end product in the job shop segment and a secondary operation in the captive segment. If a shop performed manufacturing, electroplating and polishing and buffing to complete a product, it would be considered an integrated plant within the primary manufactured product group. The electroplating operation would be considered captive.

Where the primary function is electroplating and other secondary operations are performed, i.e., buffing and polishing, this could be defined as an integrated electroplating operation. According to this definition, the independent shops, where secondary operations are required, are for the most part integrated.

Segmenting the industry by level of integration does not appear relevant for either captive or independent shops since level of shop integration would not change as a result of new pollution controls. Since electroplating is the primary operation and the main source of water pollution in both segments, other related operations in the electroplating shops are generally support functions and would not exist in the absence of the primary operation.

(b) Number of Plants

A relatively few independent electroplaters operate as multi-plant firms, and these tend to be the larger shops. Consequently segmenting by size of employment separates the large shops, which results in the multi-plant firms also being segmented. Since the larger shops are not as severely impacted as other segments, sub-segmentation of large shops into single versus multi-plant firms is not considered necessary.

The larger shops, in terms of employee size, represent approximately 8% to 10% of the independent shops and approximately 15% of the captive shops.

(c) Number of Products

Industry sources indicate little relationship exists between the number of products and the extent of pollution problems. A more relevant measure would be the physical shape of

the product since products which drain poorly create greater drag-out problems. Consequently, they are greater sources for pollution. It would certainly be desirable to identify shops which have the major drag-out problems caused by the product design. However, industry data are not compiled in this manner.

(d) Level of Diversification

Many electroplating shops operate as specialists in one or more areas. For example, it is not unusual to find a shop which performs a single plating operation, i.e., hard chrome. However, it is usual for shops to specialize in one product and maintain other types of plating operations to maintain a balanced operation.

It is recognized that single purpose operations have fewer control problems than highly diversified operations. From an economic impact point of view, it would be highly desirable to segment the industry accordingly. However, as previously indicated this method of segmentation is not practical at this time because of the lack of industry data.

SIZE OF THE INDUSTRY

Considerable difficulty exists in determining the actual number of electroplating shops operating within the United States. This is due to the nature of the industry and relative

ease of entry into the market place. A single plating product line requires low initial capital investment and an independent or captive shop can easily be established. When these operations are small, it is understandable that they go undetected and are not included in industry statistical data. This is particularly true with the captive segment since they rarely market services outside the captive environment. Conversely, independent shops seeking stronger market positions tend to be listed in industry directories and other marketing publications; consequently the data are probably more accurate. In addition census enumeration methods are different, and the data more complete in the independent segment.

(a) Number of Industry Establishments

The table below summarizes the number of establishments reported in the electroplating industry.

Table III - 1
Electroplating Establishments

Industry Segment	Establishments
Captive Installations	2,389
Independent Shops	3,241
Total	5,630

Sources: U.S. Department of Commerce. Bureau of Census.

This data indicates that of the total identified establishments, approximately 60 percent are in the independent shop category.

(b) Size of Employment

Similar to data on establishment size, data on employment size is recognized to be understated because of three factors:

1. Aggregate census data for the captive segment excludes specific information which would disclose the actual size of a single firm when that firm is the only one in the group.

2. All captive installations do not respond to census inquiries.

3. Captive shops within industries having less than 10 total employees, including electroplating employees, are not included in the reported number.

The following table shows reported employment by type of electroplating installation.

Table III - 2
Industry Employment

Industry Segment	Employment
Captive Installations	23,000
Job Shops	55,000
Total	78,000

Sources: U.S. Department of Commerce.
Bureau of Census.

INDUSTRY SURVEY

The limited scope of coverage provided by census data required additional information to be compiled for use in the impact analysis phase of the study. These data were obtained in an industry survey.

Exhibit III-1 is a summary of information gathered from 38 independent and 3 captive shops. The data provide a basis for many assumptions used in the analysis of the industry and the effects which pollution controls are expected to have on the independent segment. Particular emphasis on characteristics such as size, diversification, plant location, sales volume and production constraints were of concern to determine the relative degree of impact on the two primary segments of the industry.

(a) Sales

Annual sales range from $60,000 to $8,000,000; however, most of the shops surveyed reported sales of less than one million dollars. Although no definite conclusions can be drawn from the small sample, the independent shops are typically small businesses, operating on relatively small annual sales volumes.

(b) Survey and Industry Employment

Electroplating shops, in the independent segment particularly, are small in terms of employment as indicated by the

survey data. Most of the shops reported employment of less than 50 persons.

Industry employment data are shown on Exhibit III-2 for the independent shops. Approximately 60 percent of independent segment electroplating employees work in shops where total employment is less than 50 persons. These shops, with less than 50 persons, represent 92 percent of the total number of establishments in the independent shop segment.

Exhibit III-3 reflects a total employment for the captive shop segment. Clearly, a large number of the captive shops are small and approximately 80 percent of the total establishments have fewer than 20 people. However, the majority, approximately 70 percent, of electroplating employment occurs in the larger shops.

Exhibit III-4 lists 86 industries which have captive shops and classifies the shops by sizes of employment. According to these data, the average employment in a small shop is two persons. In the large shop approximately 50 persons are employed.

Exhibit III-5 is a listing of 12 of the major industries selected on the basis of total numbers of establishments. The average employment in these shops is also equal to approximately 50 persons. Compared to independent shops, this would be considered a large installation since in many instances, these shops do not require the same level of management and

overhead personnel. They are shared with other operations in the captive industry. This is not true in the independent shop.

Assuming the extent of automation is also greater in a captive installation, because of the similarity of the product and the repetitive nature of the operations, a fifty-man shop is a major installation by comparison to a fifty-employee independent shop.

EXPECTED IMPACT BY INDUSTRY SEGMENTS

Based on the above discussion, we believe the impact of pollution abatement will be significant in two segments of the industry. Small shops will be impacted for both independent and captive segments. However, the major effect will be in the independent segment for the following reasons:

1. A greater number of small independent shops exist.
2. Employment in the independent segment is greater in small shops than in small captive shops.
3. Captive shops generally have a larger organization capable of supporting additional operating costs for pollution control.
4. Ability to raise necessary capital requirements for equipment is greater in the broader based captive shop environment.

It is expected that within the independent segment, large shops will be impacted but not as severely as the small shops, particularly at the lower employment levels. The survey data

in Exhibit III-1 indicated:

1. Low sales volumes for small shops, thus indicating insufficient cash flows for purchasing expensive control equipment.

2. Constraint on physical plan space possibly necessitating additional land and building to house control equipment. This will add to the capital requirements.

3. Diversification is high in the small shops in order to hold customers. Therefore, several treatment systems will probably be required as degree of diversification increases.

LOCATION OF IMPACTED SHOPS

Electroplating shops are located in nearly all fifty states; however, the major concentration is in the principal industrial areas in the Midwest, Northeast and the Western Seaboard.

Exhibit III-6 displays the location of independent shops. The location of captive shops is estimated to be identical to job shops since both segments service the same industries.

Geographical segmentation is important to consider, especially in areas where relatively few shops exist. The impact of pollution control requirements on the electroplating segment can be relatively minor in areas where shops and direct employment are not significant. However, industries dependent upon

these smaller shops for their services can be indirectly impacted as a result of controls, because of expected price increases.

INDUSTRY SEGMENT NOT CONSIDERED

While the study is concerned with electroplating work on manufactured and assembly products using zinc, nickel, chromium and copper as the plating metal, it is recognized that basic industries such as steel and aluminum have sizeable electroplating facilities using these metals and also perform other types of plating. It is our understanding for the purpose of this study that plating in these basic industries (steel and aluminum) will be covered in separate studies of these industries.

SCOPE OF IMPACT ANALYSIS

The impact analysis discussed in Section VII has been limited to cover independent electroplating shops employing fewer than 100 employees. This range of size and industry segment has been selected for the following reasons:

1. Independent shops can be more easily identified in relation to size and location.

2. Cost data are more readily obtainable from the independent segment. Captive installations, particularly the small ones, consider the cost of operating the plating line as overhead. Consequently, extensive plant cost analysis would

be required to gather the required cost information from these shops.

3. Independent shops with a small amount of employment are more likely to be restricted in capital requirements than larger independent shops.

ENVIRONMENTAL PROTECTION AGENCY

ELECTROPLATING INDUSTRY

INDUSTRY SURVEY SUMMARY

Data Item:	Company Identification Number 1	2	3	4	5	6	7	8	9	10
Urban or Rural Location	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban
Job Shop or Captive Shop	Job Shop	Job Shop	Job Shop	Job Shop and Some Captive	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop
Corporation or Other	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation
Number of Years in Business - Company/Owner	18/40	7/-	33/25	13/-	13/20	9/30	13/-	20/30	20/-	30/-
Total Square Feet/Plating Square Feet	17,000/ 8,000	10,000/ 6,000	35,000/ 30,000	18,000/ 8,000	7,000/ 6,000	8,500/ 10,000	18,000/ 17,000	8,000/ 5,500	10,000/ 8,000	3,300/ 500
Total Employees/Plating Employees	25/18	10-12/8	30/15	35-40/8	7/4	8/6	37/29	55/33	30/22	25/19
Plating Lines (Percent of Sales)-										
Nickel	5%	100%	5%	-	50%	-	-	-	-	-
Chrome	95%	-	-	-	-	-	-	-	-	-
Zinc	-	-	70%	-	-	-	75-80%	20%	-	95%
Copper	-	-	20%	-	Minor	-	-	5%	-	-
Cadmium	-	-	5%	-	-	-	-	25%	33%	-
Other	-	-	Brass,Tin, Silver	-	Gold, Silver 50%; Tin	Silver	-	Tin-50%	Aluminum 33%	Tin 5%
Still Plating or Barrel Plating	Still	Both	Both	Barrel	Both	Both	Still	Both	-	Barrel
Major Plant Capacity Constraints	Space	Space	Old building	Space	Space	-	-	Space	Space	Space
Pollution Equipment - Type	Hauling Service; No dumping	Now = Precipitation and Filtration; Future = Batch Process	Semi Continuous; Gas Chlorination.Only on Cyanide	None except for Cyanide conversion	Bath Destruction; Chemical	Destruction	Neutralization and Destruction	Destruction Chlorination, Settling, Centrifuge	None	Integrated Cyanide
Percent Effluent Treated	0%	40%+	100%	-	33%	100%	100%	10%	0%	100%
Water Usage - Gallons per Day	-	7,000	167,000	-	600	48,000	-	200,000	-	6,000
Dispose Into - Sewer or Stream	-	Sewer	Sewer	-	Both	Sewer	Sewer	Sewer	Sewer	Sewer
Sludge Removal - Method	Pick-Up Service	Negligible	Pick-Up and Sewer	-	Pick-Up	Pick-Up	Pick-Up	Pick-Up	Pick-Up	Pick-Up
Pollution Control Equipment - Installation Date	No Equipment	12 Months Ago	-	-	1969	February 1973	Began 13 Years Ago	1971	N/A	1953
Operational Date	No Equipment	3 Months Ago	-	-	1969	Not Operating	-	6 Months Ago	N/A	1953
Cost (Actual or Estimate)	$100,000-$150,000	$20,000-$50,000	$150,000-$200,000	$50,000	$7,000-$8,000	$9,000	-	$70,000	-	$50,000
Estimated Total Cost to Complete	-	$75,000	-	-	-	$9,000	-	$70,000	-	-
Operating Cost of Pollution Control Equipment	-	$5,000-$10,000 per year	$400-$600 per month	-	$25 per week	-	-	$700+ per month	-	-
Results Achieved	-	OK	Cyanide Only	-	Good Shape	Problems	Good	Good-90% of the Time	Doing Nothing	Meeting Guidelines
Capitalization - Total	-	-	$400,000	-	$100,000	$100,000	$250,000	$550,000	$100,000	-
Financing Capability	-	-	Good	-	Minor Problems	Minor Loans	Available	Good	-	-
Sales Per Year	$300,000-$400,000	$500,000	$786,000	-	$300,000	$200,000	$800,000	$1,200,000	$500,000	$500,000-$700,000
Profit Before Taxes	-	10%	$22,000	-	Lost $ Last 3 Years	$20,000	-	-	-	-
Profit After Taxes	6-10%	-	$17,000	-	-	-	-	3.8%	-	-

ELECTROPLATING INDUSTRY SURVEY SUMMARY (CONTINUED)

Data Item:	Company Identification Number 11	12	13	14	15	16	17	18	19	20
Urban or Rural Location	Urban	Urban	Urban	Urban	Urban	Urban	Rural	Urban	Urban	Urban
Job Shop or Captive Shop	Job Shop	Job Shop	Captive Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop
Corporation or Other	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation
Number of Years in Business - Company/Owner	12/-	13/13	-	-/44	20/-	27/8	36/-	40/-	30+/-	39/-
Total Square Feet/Plating Square Feet	15,000/ 4,000	30,000/ 21,000	-/ 3,000	40,000/ 16,000	13,000/ 11,000	75,000/ 45,000	15,000/ 14,000	30,000/ -	36,000/ 28,000	60,000/ 30-35,000
Total Employees/Plating Employees	28/20	70/50-60	-/5	69/45	18/15	43/34	25/23	50/40	59/40-45	120/100
Plating Lines (Percent of Sales)-										
Nickel	-	{20%	-	x	-	-	-	45%	x) 50%	-
Chrome	99%		-	-	90%	20%	100%	30%	x)	-
Zinc	-	55%	-	-	-	-	-	-	-	-
Copper	-	x	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	9%	-	-	-	10%
Other	-	Solder conversion coating	-	Anodizing, etc.	-	Anodizing and Painting	-	Gold and Silver	-	Precious Metal
Still Plating or Barrel Plating	Both	Both	Barrel	Still	Still	Still	Still	Both	Both	Both
Major Plant Capacity Constraints	Space	-	-	Space	-	-	-	-	-	Space
Pollution Equipment - Type	Clearifier	Evaporate; Destruct; Ph control	Atmospheric Evaporators	None	None as such	Clearifiers; Rinses	Dillution	Dillution	Electro-Chemical	Water Conservation; Ph Control
Percent Effluent Treated	100%	60%	Most	-	0	20%	100%	100%	100%	100%
Water Usage - Gallons per Day	60	120,000	-	-	-	200,000	5,000	-	-	133,000
Dispose Into - Sewer or Stream	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer	Stream	Sewer	Stream	Sewer
Sludge Removal - Method	Pick-Up	Pick-Up	No Sludge	Pick-Up	None	Pick-Up	Stream	None	None	Pick-Up
Pollution Control Equipment - Installation Date	1961	12 Months Ago	2 Years Ago	None	N/A	-	1970	June 1968	April 1, 1971	-
Operational Date	-	3 Months Ago	6-12 Months Ago	None	N/A	-	1971	January 1969	December 1973	-
Cost (Actual or Estimate)	-	$125,000	$3,000	$30,000-$40,000	$75,000	$50,000-$250,000	-	-	-	-
Estimated Total Cost to Complete	-	$205,000-$210,000	$3,000	-	$75,000	$50,000-$250,000	-	-	$400,000	$350,000-$375,000
Operating Cost of Pollution Control Equipment	-	$5.10 per Hour	-	-	-	-	-	-	-	-
Results Achieved	Cyanide Only	Good	Good	Not Being Checked	Problem	Problem	Good	Minor Problems	Minor Problems	Problems
Capitalization - Total	$60,000	$620,000	-	$300,000	$83,000	$680,000	-	$700,000	-	$1,760,000
Financing Capability	-	Pretty Good	-	Good for $25,000-$100,000	Pretty Good for Small Plant	Bad	Available	$150,000 Available	-	Near Capacity
Sales per Year	$60,000	$1,500,000	-	$1,250,000 $1,500,000	$275,000	$850,000	$600,000	$1,014,000	$1,000,000	$1,600,000 $1,975,000
Profit Before Taxes	-	$172,500	-	-	-	-	-	10%	-	-
Profit After Taxes	-	$97,500	-	$20,000	5%	-$25,000	$20,000	-	-	-

ELECTROPLATING INDUSTRY SURVEY SUMMARY (CONTINUED)

Data Item:	Company Identification Number 21	22	23	24	25	26	27	28	29	30
Urban or Rural Location	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Rural	Urban
Job Shop or Captive Shop	Job Shop	Job Shop	Job Shop	Job Shop	Captive Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop
Corporation or Other	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Partnership	Partnership
Number of Years in Business - Company/Owner	62/-	40/-	40+/-	21/-	30/-	25/-	23/-	15/13	10/9	58/38
Total Square Feet/Plating Square Feet	140,000/ 50,000	60,000/ 35,000	100,000/ 90,000	21,000/ 17,500	-/ -	28,000/ 14,000	35,000/ 25,000	7,500/ 2,400	1,200/ 800	22,000/ 18,000
Total Employees/Plating Employees	425/375	125/60	140/125	28/23	-/150	75/50	70/35	8/4	2/2	40/34
Plating Lines (Percent of Sales)-										
Nickel	-	-	x) 50%	-	-	*	25%	x	x) 50%	20%
Chrome	70%	70%	x)	-	-	*	-	-	x)	20%
Zinc	-	-	-	90%	10%	25%	-	-	-	15%
Copper	-	-	-	-	5%	*	x) 25%	x	x	15%
Cadmium	-	-	-	-	5%	(* = 50%)	x)	x	-	15%
Other	-	-	Rust Proofing	-	Brass 70%	Anodizing 25%	Precious Metal 50%	Anodizing 40%	Brass, Bronze, Silver	Others 15%
Still Plating or Barrel Plating	Still	Both	Both	Both	Both	Both	Both	Both	Both	Both
Major Plant Capacity Constraints	-	-	-	-	-	-	-	Space	Space	Space, Labor
Pollution Equipment - Type	Conservation; Clearification	Ph Control	Chemical Destruction; Experimental	Cyanide to Cyanate Conversion	Cyanide Treatment	Cyanide to Cyanate Conversion	Clearifiers	None	Cascade	Ph Control Rinse Tanks
Percent Effluent Treated	100%	-	50%	50%	7%	50%	100%	-	100%	100%
Water Usage - Gallons per Day	-	200,000	-	-	3,000,000	340,000	4,000	100,000	1,500	81,000
Dispose Into - Sewer or Stream	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer	Stream	Sewer
Sludge Removal - Method	-	None	Pick-Up	-	Pick-Up	None	Pick-Up	-	City Dump	-
Pollution Control Equipment - Installation Date	-	-	April 1973	-	-	Cyanide- 3 years; Chrome- 6 months ago	-	-	-	May 1972
Operational Date	-	-	2 Months ago	-	-	Chrome- August 1973	-	-	-	June 1973
Cost (Actual or Estimate)	$50,000	$300,000	$75,000	$29,000	$80,000	$12,000	$30,000	$45,000- $85,000	-	$70,000
Estimated Total Cost to Complete	-	$300,000	-	-	$120,000	-	-	$45,000- $85,000	-	-
Operating Cost of Pollution Control Equipment	-	-	-	-	$34,000 per Year	-	-	-	-	$500 per Month
Results Achieved	Problems	Not Being Checked	Minor Problems	-	-	Good	Problems	-	-	Good
Capitalization - Total	$2,000,000	-	$450,000	$61,000	-	$750,000	$240,000	-	-	$600,000
Financing Capability	Good	Good	Good	Good	-	Pretty Good	Very Tight	Bad Problem	-	Good
Sales per Year	$8,000,000	$2,000,000	$2,700,000	$373,600	-	$1,500,000	$1,250,000	$260,000	$30,000	$800,000
Profit Before Taxes	-	-	-	$19,400	-	-	-	-	-	-
Profit After Taxes	-	Lost $	-	$13,500	-	-	-$20,000	$21,600	-	-

ELECTROPLATING INDUSTRY SURVEY SUMMARY (CONTINUED)

Data Item:	Company Identification Number (31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)
Urban or Rural Location	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban
Job Shop or Captive Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop	Job Shop
Corporation or Other	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Corporation	Proprietorship
Number of Years in Business - Company/Owner	26/26	1/9	7/-	11/-	31/31	20/55	25/-	12/12	40/25	50+/43	15/40
Total Square Feet/Plating Square Feet	17,000/ 13,000	40,000/ 18,000	5,000/ -	4,900/ 3,000	15,000/ 7,500	10,000/ 9,000	7,000/ 4,000	8,000/ 6,500	30,000/ 18,000	15,000/ 7,000	10,000/ 9,500
Total Employees/Plating Employees	15/9	12/11	15/15	13/11	30/28	11/9	34/25	15/10	60/50	31/28	18/17
Plating Lines (Percent of Sales)-											
Nickel	-	x) 100%	-	-	x) Major	x	20%	55%	30%	15%	20%
Chrome	100%	x)	-	-	x)	-	10%	13%	x	-	80%
Zinc	-	-	25%	40%	x)	50%	50%	-	30%	20%	-
Copper	-	-	20%	2%	Minor	x	10%	15%	-	10%	x
Cadmium	-	-	40%	40%	-	-	5%	-	30%	18%	-
Other	-	-	Bronze-15%	Tin-12% Phosphating-6%	Gold	Black Oxide-30%	5%	17%	Black Oxide	Brass-20%: Phosphate Coating and Others-17%	-
Still Plating or Barrel Plating	Still	Still	Both	Both	Still	Barrel	Both	Both	Both	Both	Both
Major Plant Capacity Constraints	Space	-	Space, Labor	Space	-	-	Space	Space	Space	Space	Space
Pollution Equipment - Type	Now=None; Future= Finalizer with PH Control	Now=None; Future= Nickel Filter	Cyanide Conversion	Cyanide Conversion	Now=Automatic Foggers; Future=Reverse Osmosis and Evaporator	Now=Neutralization and Setting; Future=Water Conservation	Precipitation and Filtration; Cyanide Destruction	Drag-out Tank; PH Control	Dillution	Now=None Future= Settling	Cyanide Destruction; Conservation
Percent Effluent Treated	0%	0%	10%	5%	0%	100%	-	0%	-	-	100%
Water Usage-Gallons per Day	-	-	385,000	30,000	182,000	5,000	114,000	-	500,000	80,000	11,400
Dispose Into - Sewer or Stream	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer	Other	Sewer	Sewer	Sewer	Sewer
Sludge Removal - Method	-	-	-	Pick-Up	No Sludge	Pick-Up	Pick-Up	Pick-Up	-	Pick-Up	Neligible
Pollution Control Equipment-											
Installation Date	No Equipment	No Equipment	-	1971	-	1968	-	1969	-	No Equipment	1971
Operational Date	No Equipment	No Equipment	-	-	-	-	-	-	-	No Equipment	1972
Cost (Actual or Estimate)	$44,000-55,000	-	$40,000 60,000	$60,000 70,000	-	$40,000	$35,000	$35,000	$100,000	$50,000	$15,000
Estimated Total Cost to Complete	-	-	-	-	$295,000	$86,000+	$85,000	-	-	-	-
Operating Cost of Pollution Control Equipment	-	-	-	-	-	$16,000	-	-	-	-	-
Results Achieved	Meeting Guidelines	Problems	Meeting Guidelines	Meeting Guidelines	Good	Problems	Good	Good-80% of Time	Meeting Guidelines	-	Meeting All Guidelines
Capitalization - Total	$320,000	$80,000	$95,000	$54,000	$336,000	$360,000	$75,000+	$165,000	$1,125,000	$521,000+	$400,000
Financing Capability	Good	Pretty Poor	Loans Available	Loans Available	Problems	Funds Available	-	Problems	No Problem	Loans Available	Loans Available
Sales per Year	$400,000	-	$400,000	$218,000	$550,000	$180,000	-	$307,000	$1,500,000	$768,000	$250,000
Profit Before Taxes	$32,000	-	$25,000	$3,000	-	$12,600	-	$27,000	$225,000	$150,250	$45,000
Profit After Taxes	$24,000	-	$18,000	$2,400	$12,000	$9,000	-	-	$75,000	$100,100	$20,000+

EXHIBIT III-2

ENVIRONMENTAL PROTECTION AGENCY

EMPLOYMENT IN INDEPENDENT SHOP SEGMENT

Shop Size By Number of Employees	Establishments		Employment	
	Number	Percent	Number	Percent
7-9	1,807	56%	6,100	11%
10-19	579	18	8,100	15
20-49	620	19	18,900	34
50-99	171	5	11,400	21
100-499	63	2	10,600	19
500 or More	1	-	(1)	-
Total	3,241	100%	55,100	100%

Note: (1) Information not available to protect individual company.

Source: Census of Manufactures.

EXHIBIT III-3

ENVIRONMENTAL PROTECTION AGENCY

TOTAL EMPLOYMENT IN CAPTIVE SHOP SEGMENT

Shop Size by Number of Employees	Establishments		Employment	
	Number	Percent	Number	Percent
1-4	1,014	49%	1,772	8%
5-19	710	34	5,490	24
20 or More	356	17	15,692	68
Total	2,080	100%	22,954	100%

Source: Census of Manufactures.

ENVIRONMENTAL PROTECTION AGENCY

STUDY OF ECONOMIC IMPACT OF POLLUTION ABATEMENT
ON ELECTROPLATING INDUSTRY

ELECTROPLATING OPERATIONS IN METALWORKING INDUSTRY

SIC Code	Industry	Number of Establishments: Electroplating and Other Plating: Number of Establishments	Number of Establishments: Electroplating and Other Plating: Number of Production Workers: 1 to 4	Number of Establishments: Electroplating and Other Plating: Number of Production Workers: 5 to 19	Number of Establishments: Electroplating and Other Plating: Number of Production Workers: 20 or More	Employment: Electroplating Employees	Employment: Number of Production Workers: 1 to 4	Employment: Number of Production Workers: 5 to 19	Employment: Number of Production Workers: 20 or More
1925	Complete Guided Missiles	12	-	6	6	417	-	62	355
1929	Ammunition	11	7	3	1	78	18	A	A
1931	Tanks and Tank Components	4	1	3	-	A	A	A	
1951	Small Arms	7	4	2	1	86	12	A	A
1961	Small Arms Ammunition	4	1	2	1	53	A	A	A
1999	Guns, Howitzers and Ordnance Access.	9	5	3	1	82	10	A	A
3421	Cutlery	15	9	4	2	112	28	A	A
3423	Hand and Edge Tools	57	32	21	4	357	55	188	114
3425	Hand Saws and Saw Blades	8	6	2		31	A	A	-
3429	Hardware	137	45	56	36	3,120	109	510	2,501
3431	Metal Sanitary Ware	4	1	1	2	A	A	A	A
3432	Plumbing Fittings and Brass Goods	39	12	13	14	681	30	143	508
3433	Heating Equipment	7	3	3	1	52	5	A	A
3441	Fabricated Structural Steel	3	1	1	1	29	A	A	A
3442	Metal Doors, Sash and Trim	20	5	7	8	511	14	58	439
3443	Fabricated Plate Shop - Boiler Shops	7	7	-	-	9	9		
3444	Sheet Metalwork	12	9	3		30	13	17	
3446	Architectural Metalwork	3	3			5	5		
3449	Miscellaneous Metalwork	3	2		1	A	A		A
3451	Screw Machine Products	20	16	4		74	33	41	
3452	Bolts, Nuts, Rivets and Washers	84	44	28	12	856	83	256	507
3461	Metal Stampings	119	61	37	21	1,230	109	322	799
3492	Safes and Vaults	2		2		A		A	
3493	Steel Springs	2	2			A	A	-	-
3494	Valves and Pipe Fittings	34	24	9	1	163	47	A	A
3498	Fabricated Pipe and Fitting	11	8	2	1	93	A	A	A
3499	Fabricated Metal Products	42	25	10	1	194	40	A	A
3511	Steam Engines and Turbines	2	1	1		A	A	A	
3519	Internal Combustion Engine	14	6	4	4	253	16	40	197
3542	Machine Tools	5	5			11	A		
3544	Special Dies, Tools, Jigs and Fixtures	29	21	7	1	139	39	A	A
3545	Machine Tool Accessories	32	22	10		115	23	92	
3548	Metal Working Machinery	16	11	5		66	19	47	
3553	Woodworking Machinery	10	3	4	3	129	4	32	93
3559	Special Industry Machinery	23	15	8		114	26	88	
3562	Ball & Roller Bearing	11	4	6	1	69	5	A	A
3564	Blowers and Fans	4	3	1		17	A	A	
3566	Power Transmission Equipment	16	13	1	2	82	25	A	A
3569	General Industry	10	7	2	1	44	13	A	A
3572	Typewriters	7	-	3	4	279	-	36	243
3573	Electronic Computing Equipment	25	8	12	5	372	19	148	205
3574	Calculating and Accounting Machinery	11	1	7	3	416	A	A	A
3576	Scales and Balances	1		1		A	A	A	A

STUDY OF ECONOMIC IMPACT OF POLLUTION ABATEMENT
ON ELECTROPLATING INDUSTRY

ELECTROPLATING OPERATIONS IN METALWORKING INDUSTRY

SIC Code	Industry	Number of Establishments: Electroplating and Other Plating	Number of Establishments: Number of Production Workers 1 to 4	Number of Establishments: Number of Production Workers 5 to 19	Number of Establishments: Number of Production Workers 20 or More	Employment: Electroplating Employees	Employment: Number of Production Workers 1 to 4	Employment: Number of Production Workers 5 to 19	Employment: Number of Production Workers 20 or More
3579	Office Machines	9	2	6	1	123	A	A	A
3581	Automatic Merchandising Machines	8	6	2		34	A	A	
3582	Commercial Laundry Equipment	5	4	1		14	A	A	A
3585	Refrigeration Machinery	14	7	7		81	14	67	
3589	Service Industry Machines	7	7			16	16		
3599	Miscellaneous Machinery	107	73	27	7	592	122	218	232
3611	Electric Measuring Equipment	37	21	11	5	286	39	85	162
3613	Switch Gear and Switchboard Apparatus	80	52	22	6	583	102	224	257
3621	Motors and Generators	29	20	9		132	39	93	
3622	Industrial Controls	17	6	6	5	262	10	54	198
3631	Household Cooking Equipment	8	4	2	2	106	11	A	A
3632	Household Refrigerators and Freezers	3			3	106			106
3633	Household Laundry Equipment	6	1	3	2	111	A	A	A
3634	Electric Housewares and Fans	36	12	12	12	607	28	133	446
3635	Household Vacuum Cleaners	4			4	105	-	-	105
3636	Sewing Machines	5	3	2		A	A	A	A
3639	Household Appliances	2	1		1	A	A		A
3642	Lighting Fixtures	75	35	30	10	754	62	282	410
3643	Current Carrying Wiring Devices	40	21	13	6	431	141	133	257
3644	Non-Current Carrying Wiring Devices	13	6	4	3	178	17	55	106
3651	Radio and TV Receiving Sets	14	7	5	2	277	17	D	D
3661	Telephone and Telegraph Apparatus	25	5	8	12	615	11	73	531
3662	Radio and TV Communication Equipment	114	51	38	25	1,583	92	360	1,131
3671	Electron Tubes Receiving Set	3		2	1	A		A	A
3672	Cathode Ray Picture Tubes	2	1	1		A	A	A	
3673	Electron Tubes, Transmitting	14	7	6	1	109	21	A	A
3674	Semi Conductors	38	18	15	5	428	39	152	237
3679	Electronic Components	184	107	56	21	1,611	201	540	1,070
3694	Engine Electrical Equipment	24	11	10	3	242	23	93	126
3711	Motor Vehicles	10	3	4	3	A	A	39	A
3713	Truck and Bus Bodies	1	1			A	A		
3714	Motor Vehicles Parts and Accessories	98	40	32	26	1,699	78	288	1,333
3721	Aircraft	23	6	9	8	760	10	96	654
3722	Aircraft Engines and Engine Parts	37	17	7	13	1,353	38	59	1,256
3729	Aircraft Equipment NEC	73	35	23	15	759	70	201	488
3751	Motorcycles, Bicycles and Parts	9	1	5	3	300	A	A	256
3791	Trailer Coaches	1	1	A	A	A	A		
3799	Transportation Equipment	4	2	1	1	A	4	A	A
3811	Engineering and Scientific Instruments	22	20	2	-	58	A	A	
3821	Mechanical Measuring Devices	35	23	7	5	290	36	69	185
3822	Automatic Temperature Controls	17	7	8	2	163	18	A	A
3871	Watches and Clocks	17	5	8	4	276	7	84	185
3872	Watchcases	12	6	6	-	61	10	51	-
		2,389	1,107	704	356	25,474	2,085	5,529	15,692

Note: A - Not Available - Information suppressed to protect specific plants in survey.

EXHIBIT III-4
Page 2 of 2

EXHIBIT III-5

ENVIRONMENTAL PROTECTION AGENCY

EMPLOYMENT IN LARGE CAPTIVE SHOPS

Industry	Number of Establishments	Employment 20 or More	Average Number of Employees
Miscellaneous Machines	7	232	33
Bolts, Nuts, Rivets and Washers	12	507	43
Plumbing Fixtures and Brass Tools	14	508	36
Hand and Edge Tools	4	114	29
Hardware	36	2,501	69
Metal Stampings	21	799	38
Switchgear and Switchboard Apparatus	6	257	43
Lighting Fixtures	10	410	41
Radio and Television Communication	25	1,131	45
Electronic Components	21	1,070	51
Motor Vehicle Parts and Accessories	26	1,333	51
Aircraft Equipment and Engine Parts	33	1,744	53
Total	215	10,606	49

ENVIRONMENTAL PROTECTION AGENCY
ECONOMIC IMPACT OF POLLUTION ABATEMENT ON ELECTROPLATING INDUSTRY
LOCATION OF INDEPENDENT ELECTROPLATERS

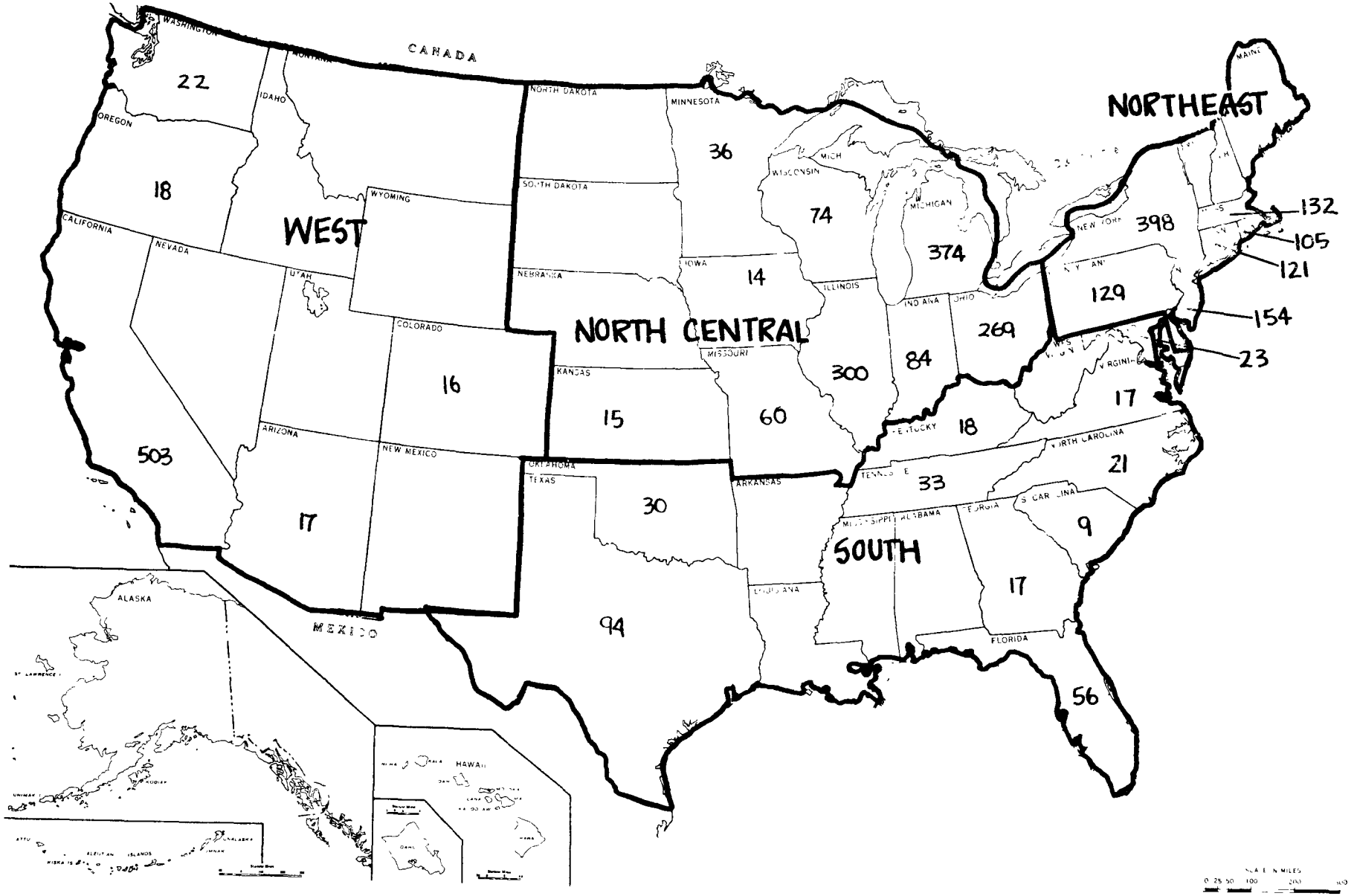

EXHIBIT III-6

IV - FINANCIAL PROFILE

A limited amount of information is available within the Electroplating Industry relative to the financial condition of individual firms. The major reason for the limited amount of financial information is that the majority of the firms are relatively small, family-controlled businesses, and the financial conditions of these firms are considered to be confidential in nature. Industry studies, which have been made available, have been supplemented with direct contacts with individual firms. This was done to cross-check the industry data, and to develop a general profile of firms at varying sizes of employment and sales. Employment and sales values have been further used to develop five groups against which to assess the economic impact of pollution abatement.

GENERAL INDUSTRY FINANCIAL STATISTICS

Exhibit IV-1 page 1 contains general financial statistics for SIC 3471 which includes electroplating.

Exhibit IV-1 page 2 contains some of the same statistics as page 1 but presents a distribution of the data by the average number of employees per establishment.

These two exhibits can be analyzed to show the general trend of the plating and polishing industry. However, it is not possible to isolate the electroplating industry portion of the entire industry from these numbers. Careful analysis of these data

in conjunction with the other data does allow general conclusions to be made. Specific comments appear later in this section of the report.

OPERATING REVENUES

The 1967 Census of Manufacturing Data indicated that the average value of shipments for independent electroplating shops was approximately $15,500 per employee. Based on this information, the small shops employing less than four people, had an average annual sales of approximately $29,000. The larger shops ranging between 250 and 500 employees had average annual sales of approximately $6 million. These data have been summarized in Exhibit IV-2.

In a recent study which covered approximately 45 independent electroplating shops ranging from 2 to 65 employees, sales ranged from $60,000 per year in the small shops to $1.5 million per year in the larger shops. By adjusting the 1967 Census Data for 5 years at an annual increase of 6.9%, a good correlation is found between the sample studies and the 1967 adjusted Census Data. This information is summarized below:

Table IV-1

Annual Sales Per Establishment
($000)

Employee Range	Adjusted 1967 Data	Sample Data
1- 4	$ 40.3	$ 60.0
5- 9	135.0	210.0
10-19	262.9	317.0
20-49	594.3	610.0
50-99	1,345.5	1,500.0

PROFITABILITY

Because of the dissimilar nature of electroplating shops, it is practically impossible to generalize about the industry. Several studies have been conducted which provide a broad view of profit ranges and general profit trends for the industry.

(a) Robert Morris Annual Study

Exhibit IV-3 presents balance sheet, income statement, and operating ratio data for SIC 3471. Whereas it is not possible to isolate the electroplating portion of these data, it can be used as a guide.

The following table summarizes the profit data in Exhibit IV-3.

Table IV-2

Asset Size

Year	Under $250M	$250M to 1,000M	$1,000M to 10,000M	All Sizes
1971	2.9%	2.3%	2.5%	2.7%
1970	.6	4.1	4.5	4.0
1969	4.4	2.3	5.4	4.9

(b) National Association of Metal Finishers 1970 Cost Survey

The 1970 operating cost survey conducted by the National Association of Finishers (NAMF) indicated an average pretax profit of 4½%. The details of this study are shown in Exhibit IV-4. It appears that the very small and the very large firms

are less profitable than those firms with sales in the mid-ranges. The exception appears to be hard chrome platers where the very small shop is the least profitable, and the larger shop the most profitable.

It is noteworthy, however, that no specific pattern is established with regard to profitability according to the type of metal finishing done or by type of operation. Assuming that profitability does not necessarily increase with specialization, a plating shop manager confronted with the alternative of eliminating a small plating operation in order to reduce the pollution control requirement, might in fact not realize increased profits as a result of specialization. Since many small shops attempt to maintain diverse product lines to satisfy customer requirements, it would seem unreasonable to reduce the number of product lines in view of the fact that profits would not necessarily increase. Consequently, the small shop owner would probably maintain the present product lines and be confronted with costs for treating multiple effluent streams as opposed to greater specialization and fewer waste streams.

(c) Kearney Industry Survey

The results of a more recent study conducted by the contractor indicates that the profit position of the Electroplating Industry has improved considerably as compared to the 1970 survey. Sixteen of the 30 respondents indicated their own 1972 pre-tax profit, or what they believed the industry pre-tax

profit was. Nine stated this figure was between 5%-10%. The other seven respondents were essentially evenly divided between having losses and making a profit of 10%-20%.

Because random selection techniques were not used to survey the industry in any of the three studies, and the sample sizes are small, some inaccuracies are expected as the data are used in the impact analyses.

(d) Overall Industry Profitability

The profitability of electroplaters is directly related to the general economic conditions of entire U.S. industry. Toward the end of 1971 and continuing into 1972 the general profitability of electroplaters improved as evidenced by the results of the A. T. Kearney survey. This profit improvement is similar to the general turnaround of the economy during the end of 1971 and in 1972.

A NAMF operating cost study for 1972 which is not yet available for publication also indicates some profit margin improvements have occurred since the 1970 study.

A pre-tax profitability of 5.9% has been calculated for the industry and adjusted to 1972 levels. This is based on findings of the three studies mentioned above. While each study indicated wide profitability ranges, some firms being highly profitable, other firms within the industry having experienced significant losses, the 5.9% is considered a reasonable representation.

PROFIT MARGIN CONSTRAINTS

A major factor affecting profitability in many shops is the level of production obtained. Although the quality of the plating, and the ability of the shop to meet customer delivery requirements and specifications are important considerations, the demand for electroplating is not a function of industry promotion or sales efforts. The Electroplating Industry is highly dependent on other primary industries such as electronics, automotive and housewares. In recent years as the economy has had an upswing, many shops began operating at near full capacity.

An important consideration in assessing the economic impact of pollution abatement is the extent to which shops remaining in the industry will be able to absorb high demands created by shops leaving the industry.

Industry sources indicated that closures could affect capacity. Shops remaining in the industry could absorb some of the plating work by extending the working hours of the shop. This alternative could, in fact also increase profitability as greater utilization is made up of existing fixed assets. However, industry sources further indicate that a labor shortage exists, particularly within the metropolitan areas where a large majority of the shops are located. The environment of the electroplating shop is not conducive to attracting a large number of employees. Consequently, rather than to operate two shifts,

many shops extend shifts to nine to ten hours per day, and operate on a six-day basis.

In addition to labor constraints, it should be noted that shops located within metropolitan areas generally have limited expansion space and are, therefore, restricted as to physical plant size expansion at the same location. This element was emphasized in interviews with shop owners. Extended operating hours can create additional storage problems, particularly where products are bulky or where shipments cannot be done during the off-hours.

VALUE OF ASSETS

As has been indicated earlier, the plating industry and electroplating in particular is characterized by relatively low capital investment in the form of plating tanks, material handling and solution handling equipment, and buildings.

Exhibit IV-1 presents the capital expenditures for the years 1958 through 1970. A study published by the University of Michigan in 1967 on the metal finishing industry presented the following capital investment data:

Table IV-3

Type of Operation	Average Capital Investment per Firm	
	N.A.M.F. Members	Total Industry
Chrome Platers	$224,700	$47,700
General Platers	300,010	63,100

Once purchased and installed, the market value of the equipment used in electroplating decreases rapidly. One respondent in the Kearney survey indicated, and others supported his statement, that the market value of used equipment is worth about 15%-20% of the purchase price after only two years of operation. The corrosive materials used in electroplating are very hard on the tanks and other equipment.

Little can be assumed about the capitalization of firms in the industry. For example, a highly mechanized firm can have a capital to sales ratio of over 80% while the manual shop would be somewhere around 10%-25%. In the Kearney study the overall average for 20 firms reporting sales and capitalization equalled 44%. In another industry study the ratio approached 83%. Obviously the two studies would require isolating the factors which cause the wide variation in the results. It is believed that cost of building and/or land which is included in the data and the degree of automation and type of product line are contributing factors. It would be necessary to identify all of the factors in order to understand the capitalization requirements for electroplating shops.

COST STRUCTURE

Information on the cost structure of the Electroplating Industry is included in the "Price Effects" section of this report.

FINANCING ADDITIONAL CAPITAL REQUIREMENT

In general, companies in the Electroplating Industry

experience some difficulty in obtaining financing for both productive and nonproductive assets. Companies often have to pledge assets of value equal to or greater than the amount of the loan. Since most companies are small with low capital investment, the asset security is a problem.

Exhibit IV-5 summarizes interviews with 5 banks in the Chicago area. While all the banks did not have specific experience with the electroplating industry, this was not deemed a criteria for obtaining financing. The important consideration is the ability to service the debt and the personal reputation of the business owners.

ALTERNATIVE METHOD OF FINANCING

Several methods of financing present capital requirements have been used by the industry.

1. SBA Loans are typically available and used by some of the small platers. Although a viable source for small business, these loans require a considerable amount of detailed information for qualification.

2. Public Financing - Most of the companies in the industry are either closely held corporations or partnerships. There are few public corporations. For this reason, the normal method of outside financing is by bank loan. Very little financing is done by issuance of stock.

3. Private Sources - Since many of the companies are owned and operated as a family business, another source of financing is the family itself. The private resources of the

family are drawn upon when necessary.

4. Government Assistance - A source of financing which is available but is not often used is government assisted financing. Several people interviewed in the A. T. Kearney industry survey expressed a desire for some form of government assisted financing of pollution control equipment.

Some sections of the country have more difficulty in obtaining financing than other sections because of the general economy of the area. Electroplaters on the west coast, who do a lot of work in the aerospace industry, for example, expressed their particular problems because of their geographic location and the economic condition of their main source of business.

Captive platers, especially those which are a part of a large company, find financing easier. They can rely on the credit rating and reputation of the total company. Many times the company is a public corporation which can obtain funding by means of a stock issue.

In recent years, Industrial Revenue Bonds have been used to finance pollution abatement equipment. The value of bonds issued has increased from $85 million in 1971 to an estimated $1 billion in 1972. These bonds generally carry a rate of 6%. Due to the high cost of issuing these bonds, the minimum value issued is usually in excess of one-half million dollars. Presently, only the very largest of the electroplating shops would be able to avail themselves of this type of financing. This type of financing presently will not assist the small independent shops to finance pollution abatement equipment.

ENVIRONMENTAL PROTECTION AGENCY

ELECTROPLATING INDUSTRY

GENERAL INDUSTRY FINANCIAL STATISTICS

SIC: 3471 PLATING & POLISHING

NUMBER OF ESTABLISHMENTS(1967): 3,241 BOOK VALUE OF ASSETS PER EMPLOYEE (1968): $5,937
SPECIALIZATION RATIO (1967): NA% COVERAGE RATIO (1967):NA% CONCENTRATION RATIO (1967): 4 LARGE 5% 8 LARGE 9%

	ALL EMPLOYEES		PRODUCTION WORKERS			VALUE	COST OF	VALUE OF	CAPITAL	END-OF-YEAR
	NUMBER	PAYROLL	NUMBER	MAN-HOURS	WAGES	ADDED	MATERIALS	SHIPMENTS	EXPENDITURES	INVENTORIES
YEAR	(000)	($MIL.)	(000)	(MIL.)	($MIL.)	($MIL.)	($MIL.)	($MIL.)	($MIL.)	($MIL.)
1958	36.5	156.3	30.5	59.1	117.7	253.8	106.1	359.1	15.9	23.5
*1959	43.3	189.5	37.2	72.0	142.3	325.8	127.3	451.3	15.2	21.3
1960	44.2	200.0	38.1	72.6	161.5	337.0	128.3	465.1	19.1	20.5
1961	43.9	200.5	37.1	71.6	161.3	330.9	128.3	458.7	16.2*	20.4
1962	49.2	231.5	41.6	80.4	182.0	401.2	147.9	549.1	25.5	20.9
1963	45.0	223.5	37.7	74.8	169.6	370.2	148.3	517.6	20.0	22.1
1964	45.4	239.1	37.8	75.6	177.5	395.4	165.8	559.6	24.1*	24.4
1965	48.0	261.9	40.5	83.3	193.7	444.6	173.2	630.9	26.8	26.1
1966	51.1	296.2	43.4	91.4	219.5	509.9	199.5	719.8	40.2	33.3
1967	55.1	323.2	46.8	92.5	239.1	574.8	218.1	791.1	33.1	36.9
1968	59.2	363.8	49.4	97.6	270.6	642.6	251.9	892.5	45.0	47.7
1969	62.9	399.7	51.8	101.2	294.4	738.4	282.4	1,020.7	47.0*	53.8
1970	57.4	372.5	46.4	93.4	270.0	693.6	275.0	966.6	58.1*	51.7
% CHANGE										
1969-70	-8.7	-6.8	-10.4	-7.7	-8.3	-6.1	-2.6	-5.3	23.6	-3.9
AVG.RATE										
1958-70	3.8	7.5	3.6	3.9	7.2	8.7	8.3	8.6	11.4	6.8

	RATIO OF VALUE ADDED TO SHIPMENTS	RATIO OF INVENTORIES TO SHIPMENTS	RATIO OF PAYROLL TO VALUE ADDED	VALUE OF SHIPMENTS PER PROD. WORKER ($000)	MANHOURS PER PRODUCTION WORKER (000)	WAGE PER PRODUCTION WORKER MANHOUR ($)	VALUE ADDED PER PRO. WORKER MANHOUR ($)	INDEX OF EMPLOYMENT (1967=100)	INDEX OF VALUE ADDED (1967=100)	INDEX OF SHIPMENTS (1967=100)
YEAR										
1958	.707	.065	.616	11.8	1.938	1.992	4.29	66.24	44.15	45.39
1959	.722	.047	.582	12.1	1.935	1.976	4.52	78.58	56.68	57.05
1960	.725	.044	.593	12.2	1.906	2.225	4.64	80.22	58.63	58.79
1961	.721	.044	.606	12.4	1.930	2.253	4.62	79.67	57.57	57.98
1962	.731	.038	.577	13.2	1.933	2.264	4.99	89.29	69.80	69.41
1963	.715	.043	.604	13.7	1.984	2.267	4.95	81.67	64.41	65.43
1964	.707	.044	.605	14.8	2.000	2.348	5.23	82.40	68.79	70.74
1965	.705	.041	.589	15.6	2.057	2.325	5.34	87.11	77.35	79.75
1966	.708	.046	.581	16.6	2.106	2.402	5.58	92.74	88.71	90.99
1967	.727	.047	.562	16.9	1.976	2.585	6.21	100.00	100.00	100.00
1968	.720	.053	.566	18.1	1.976	2.773	6.58	107.44	111.80	112.82
1969	.723	.053	.541	19.7	1.954	2.909	7.30	114.16	128.46	129.02
1970	.718	.053	.537	20.8	2.013	2.891	7.43	104.17	120.67	122.18
% CHANGE										
1969-70	-0.8	1.5	-0.8	5.7	3.0	-0.6	1.8	-8.7	-6.1	-5.3
AVG.RATE										
1958-70	0.1	-1.7	-1.1	4.9	0.3	3.2	4.7	3.8	8.7	8.6

Source: Annual Survey of Manufacturers - 1970. U.S. Department of Commerce.

ENVIRONMENTAL PROTECTION AGENCY

ELECTROPLATING INDUSTRY

GENERAL INDUSTRY FINANCIAL STATISTICS

Year: 1967

Item	Establishments	All employees		Production workers			Value added by manufacture	Cost of materials	Value of shipments	Capital expenditures, new	End-of-year inventories
	(number)	Number (1,000)	Payroll (million dollars)	Number (1,000)	Man-hours (millions)	Wages (million dollars)	(million dollars)	(million dollars)	(million dollars)	(million dollars)	(million dollars)
3471-- PLATING AND POLISHING											
ESTABLISHMENTS, TOTAL	3 241	55.1	323.2	46.8	92.5	239.1	574.8	218.1	791.1	33.1	36.9
ESTABLISHMENTS WITH AN AVERAGE OF-											
1 TO 4 EMPLOYEES[e]	1 237	2.3	12.0	2.2	3.8	9.8	26.8	8.9	35.7	.5	1.4
5 TO 9 EMPLOYEES[e]	570	3.8	22.9	3.5	6.5	18.1	42.1	13.1	55.1	1.8	2.0
10 TO 19 EMPLOYEES	579	8.1	47.3	6.8	13.4	35.6	81.2	27.8	109.0	4.0	4.1
20 TO 49 EMPLOYEES	620	18.9	110.9	16.0	31.9	82.3	193.0	71.6	264.0	11.6	11.7
50 TO 99 EMPLOYEES	171	11.4	67.4	9.6	19.1	49.0	116.7	48.6	164.8	7.7	8.3
100 TO 249 EMPLOYEES	54	7.2	43.3	6.0	12.4	30.9	76.4	35.5	111.9	4.8	6.9
250 TO 499 EMPLOYEES	9	3.4	19.4	2.7	5.5	13.5	38.5	12.6	50.7	2.7	2.6

Source: Census of Manufacturers-1967

ENVIRONMENTAL PROTECTION AGENCY

INDUSTRY SALES

Employment Range	Total Employees	Number of Establishments	Average Employees per Establishment	Value of Shipments Dollar Million	Average Sales ($000)
1- 4	2,300	1,237	2	$ 35.7	$ 28.9
5- 9	3,800	570	7	55.1	96.7
10- 19	8,100	579	14	109.0	188.3
20- 49	18,900	620	30	264.0	425.7
50- 99	11,400	171	67	164.8	963.8
100-249	7,200	54	133	111.9	2,072.1
250-499	3,400	9	378	50.7	5,633.1
Totals	55,100	3,240	-	$791.1	244.1

Sources: Census of Manufacturing, 1967.
A. T. Kearney.

EXHIBIT IV-2

ENVIRONMENTAL PROTECTION AGENCY
ELECTROPLATING INDUSTRY
FINANCIAL STATEMENTS AND OPERATING RATIOS

SIC 3471:

ASSET SIZE	41 STATEMENTS ENDED ON OR ABOUT JUNE 30, 1971 / 59 STATEMENTS ENDED ON OR ABOUT DECEMBER 31, 1971				
NUMBER OF STATEMENTS	UNDER $250M 34	$250M & LESS THAN $1MM 41	$1MM & LESS THAN $10MM 24	$10MM & LESS THAN $25MM	[illegible]
ASSETS	%	%	%	%	
Cash	8.5	7.9	3.9		
Marketable Securities	.8	1.1	.6		
Receivables Net	30.9	21.4	23.8		24.7
Inventory Net	11.1	8.1	22.8		19.5
All Other Current	1.8	1.3	5.3		3.8
Total Current	52.8	38.9	58.4		51.8
Fixed Assets Net	40.5	49.8	38.6		42.4
All Other Non Current	6.7	11.2	3.0		5.8
Total	100.0	100.0	100.0		100.0
LIABILITIES					
Due To Banks—Short Term	10.2	4.1	4.7		4.3
Due To Trade	14.5	11.0	14.9		13.2
Income Taxes	2.6	1.3	1.6		1.4
Current Maturities LT Debt	5.8	4.3	2.0		2.6
All Other Current	12.3	9.4	5.9		6.6
Total Current Debt	45.3	30.1	29.1		28.1
Non Current Debt Unsub	15.9	23.3	12.5		18.9
Total Unsubordinated Debt	61.2	53.4	41.6		47.0
Subordinated Debt	8.2	2.1	.6		1.1
Tangible Net Worth	32.5	44.4	57.9		51.9
Total	100.0	100.0	100.0		100.0
INCOME DATA					
Net Sales	100.0	100.0	100.0		100.0
Cost Of Sales	63.5	74.0	82.5		7x.8
Gross Profit	36.5	26.0	17.5		20.2
All Other Expense Net	33.5	23.7	15.0		12.5
Profit Before Taxes	2.9	2.3	2.5		2.7
RATIOS					
Quick	1.5 .8 .4	1.4 1.1 .7	1.4 .9 .8		1.5 .9 .6
Current	2.1 1.3 .6	1.7 1.4 .9	2.2 1.8 1.4		2.1 1.5 .9
Fixed/Worth	.6 1.0 7.5	.7 1.0 2.1	.4 .6 1.0		.6 .9 2.8
Debt/Worth	.7 1.8 13.6	.5 1.2 2.8	.3 .8 1.3		.6 1.1 3.2
Unsub Debt/Capital Funds	.7 1.2 7.6	.5 1.0 2.6	.3 .8 1.3		.6 1.0 2.9
Sales/Receivables	27 13.2 39 9.3 56 6.4	39 9.3 48 7.5 59 6.1	38 10.1 47 7.7 62 5.9		35 10.4 46 7.8 56 6.4
Cost Sales/Inventory	14 26.4 30 11.9 71 5.1	15 23.5 26 12.9 48 7.3	34 10.5 45 8.0 64 5.6		16 22.1 34 10.8 62 5.8
Sales/Working Capital	9.5 5.2 -10.0	16.8 7.9 55.3	10.5 6.2 4.3		12.2 6.6 51.9
Sales/Worth	7.2 5.2 3.2	4.7 3.2 2.4	4.5 3.2 2.4		5.9 3.8 2.5
% Profit Bef Taxes/Worth	61.1 9.8 0	25.8 9.5 2.2	23.2 9.3 2.2		27.1 9.8 -.7
% Profit Bef Taxes/Tot Assets	17.1 5.9 -2.2	10.4 3.0 -2.1	11.9 4.7 1.4		13.0 6.1 .9
Net Sales	$130828M	$355545M	$125007M		$1897[illegible]M
Total Assets	4890M	21232M	05831M		104[illegible]M

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ASSET SIZE	42 STATEMENTS ENDED ON OR ABOUT JUNE 30, 1970 / 66 STATEMENTS ENDED ON OR ABOUT DECEMBER 31, 1970				
NUMBER OF STATEMENTS	UNDER $250M 26	$250M & LESS THAN $1MM 41	$1MM & LESS THAN $10MM 30	$10MM & LESS THAN $25MM	ALL SIZES 108
ASSETS	%	%	%	%	%
Cash	8.1	9.4	5.3		6.8
Marketable Securities	.4	1.7	.4		.8
Receivables Net	27.1	22.7	25.7		24.4
Inventory Net	12.7	12.1	22.0		21.4
All Other Current	1.1	3.5	1.9		2.0
Total Current	49.4	49.4	55.2		55.4
Fixed Assets Net	39.4	40.9	39.4		38.2
All Other Non Current	11.3	9.7	5.3		6.4
Total	100.0	100.0	100.0		100.0
LIABILITIES					
Due To Banks—Short Term	9.7	4.9	6.8		6.2
Due To Trade	11.6	11.6	13.2		12.4
Income Taxes	2.6	3.2	2.7		2.6
Current Maturities LT Debt	3.1	2.3	3.6		3.0
All Other Current	9.1	9.0	5.1		5.9
Total Current Debt	38.0	31.1	31.4		30.1
Non Current Debt Unsub	12.0	14.4	11.0		12.0
Total Unsubordinated Debt	48.1	45.5	42.4		42.1
Subordinated Debt	5.2	1.4	3.5		2.8
Tangible Net Worth	46.7	53.2	54.1		55.1
Total	100.0	100.0	100.0		100.0
INCOME DATA					
Net Sales	100.0	100.0	100.0		100.0*
Cost Of Sales	58.5	74.5	77.3		76.0
Gross Profit	41.5	25.5	22.7		24.0
All Other Expense Net	40.8	21.4	18.2		20.0
Profit Before Taxes	.8	4.1	4.5		4.0
RATIOS					
Quick	1.7 1.2 .8	1.7 1.1 .8	1.4 1.0 .7		1.6 1.1 .8
Current	2.2 1.6 1.1	2.2 1.5 1.0	2.5 1.7 1.3		2.3 1.6 1.1
Fixed/Worth	.5 .8 1.2	.5 .9 1.2	.4 .7 1.1		.5 .8 1.2
Debt/Worth	.8 1.0 1.7	.8 1.0 1.4	.4 .8 1.3		.5 .9 1.5
Unsub Debt/Capital Funds	.5 .9 1.4	.5 .8 1.4	.4 .8 1.2		.5 .8 1.3
Sales/Receivables	30 12.1 38 9.5 49 7.4	32 11.3 43 8.3 52 6.9	38 10.1 49 7.3 58 6.2		32 11.4 41 8.7 53 6.8
Cost Sales/Inventory	15 24.0 27 13.2 66 5.5	10 36.1 31 11.6 48 7.5	34 10.5 47 7.6 71 5.1		14 25.1 33 10.8 61 5.9
Sales Working Capital	14.8 8.4 (	11.6 6.6 89.2	10.9 6.4 4.6		13.0 7.0 3.1
Sales/Worth	7.5 4.3 3.0	5.6 3.7 2.9	4.6 3.4 2.5		5.9 3.7 2.8
% Profit Bef Taxes/Worth	21.2 8.0 -18.8	21.1 15.2 4.2	27.8 13.9 3.9		22.9 13.3 1.8
% Profit Bef Taxes/Tot Assets	10.8 3.0 -12.4	11.1 4.9 2.3	11.9 7.6 2.8		11.3 4.9 .8
Net Sales	$12074M	$41033M	$141576M		$213732M
Total Assets	4681M	21202M	73535M		110257M

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ASSET SIZE	40 STATEMENTS ENDED ON OR ABOUT JUNE 30, 1969 / 60 STATEMENTS ENDED ON OR ABOUT DECEMBER 31, 1969				
NUMBER OF STATEMENTS	UNDER $250M 31	$250M & LESS THAN $1MM 37	$1MM & LESS THAN $10MM 30	$10MM & LESS THAN $25MM	ALL SIZES 100
ASSETS	%	%	%	%	%
Cash	10.4	7.8	4.6		6.9
Marketable Securities	0	1	3		6
Receivables Net	31.9	25.6	29.2		27.3
Inventory Net	12.5	16.0	19.5		21.0
All Other Current	1.0	.9	2.1		1.9
Total Current	55.9	50.4	55.7		57.6
Fixed Assets Net	35.5	41.3	36.5		35.4
All Other Non Current	8.7	8.3	7.8		7.0
Total	100.0	100.0	100.0		100.0
LIABILITIES					
Due To Banks—Short Term	9.6	6.9	4.7		4.9
Due To Trade	13.5	18.5	12.5		14.9
Income Taxes	2.7	3.0	4.3		3.8
Current Maturities LT Debt	3.7	2.5	2.4		2.0
All Other Current	12.8	10.5	5.7		6.2
Total Current Debt	42.1	41.3	29.5		31.8
Non Current Debt Unsub	12.5	17.3	11.0		11.9
Total Unsubordinated Debt	54.7	58.5	40.5		43.7
Subordinated Debt	6.0	3.0	1.7		3.3
Tangible Net Worth	39.3	38.5	57.8		53.1
Total	100.0	100.0	100.0		100.0
INCOME DATA					
Net Sales	100.0	100.0	100.0		100.0
Cost Of Sales	66.8	75.8	75.5		78.2
Gross Profit	33.2	24.2	24.5		21.8
All Other Expense Net	28.9	21.9	18.1		17.8
Profit Before Taxes	4.4	2.3	5.4		4.9
RATIOS					
Quick	1.8 1.1 .8	1.4 .9 .6	1.4 1.0 .8		1.6 1.0 .7
Current	2.2 1.4 1.0	2.0 1.3 .8	2.3 1.7 1.4		2.2 1.5 1.0
Fixed/Worth	.3 .5 1.7	.6 .9 1.5	.5 .6 1.0		.5 .7 1.1
Debt/Worth	.5 .8 3.8	.5 .8 1.9	.6 .9 1.6		.5 .8 1.8
Unsub Debt/Capital Funds	.3 .4 1.4	.3 .4 1.0	.3 .4 .8		.3 .4 .8
Sales/Receivables	35 10.3 44 8.2 53 6.8	36 10.0 43 8.3 56 6.4	40 8.9 49 7.3 64 5.6		36 10.0 46 7.8 58 6.4
Cost Sales/Inventory	14 26.6 26 13.8 60 6.0	18 19.8 32 11.3 43 8.3	25 14.3 46 7.9 69 5.2		15 23.4 35 10.3 59 6.1
Sales/Working Capital	15.6 6.5 5.0	13.6 6.7 7.7	11.5 8.0 5.0		13.7 6.6 3.3
Sales/Worth	11.0 5.5 3.1	5.2 3.9 2.7	4.8 3.6 2.7		6.6 4.3 2.8
% Profit Bef Taxes/Worth	28.6 18.0 3.9	23.9 16.1 7.7	30.5 21.2 10.3		30.2 18.4 7.4
% Profit Bef Taxes/Tot Assets	17.9 10.5 3.1	9.5 7.9 2.2	16.2 11.4 5.1		15.3 9.5 4.3
Net Sales	$12051M	$39906M	$137152M		$234141M
Total Assets	4630M	18964M	71206M		116260M

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Source: The Robert Morris Annual Statement Studies.

EXHIBIT IV-3

ENVIRONMENTAL PROTECTION AGENCY

SUMMARY OF PROFITABILITY OF
INDEPENDENT ELECTROPLATING SHOPS

Type of Operation By Sales Dollars	Profitability Percentage		
	Average	High	Low
Automatic General Metal Finishing			
$ 250-$ 499	.97%	4.00%	-5.80%
500- 749	3.39	5.85	1.20
1,000- 1,999	4.56	14.4	-1.32
>2,000	-10.40	4.0	-24.40
Manual General Metal Finishing			
$<100,000	1.30	11.20	-16.21
100-$ 249	3.38	10.6	-12.00
250- 499	1.42	5.98	-8.90
500- 749	2.22	6.20	-4.42
1,000- 1,999	.15	3.80	-9.00
Automatic Barrel Plating			
$ 250-$ 499	-2.02	5.48	-11.44
500- 749	4.76	11.64	-1.10
1,000- 1,999	4.8	5.0	4.8
Manual Barrel Plating			
$ 100-$ 749	5.25	6.80	3.70
1,000- 1,999	4.00	5.50	2.50
Hand Chrome Plating			
$ 100-$ 249	-1.14	12.50	-30.00
250- 749	3.28	9.53	-4.91
>1,000	5.71	22.40	-4.89

Source: National Association of Metal Finishers - 1970 Survey.

V - POLLUTION CONTROL REQUIREMENTS

Effluent limitations proposed by the Environmental Protection Agency (EPA) were developed on the basis of "best practicable control technology currently available" and best practicable control technology economically achievable." In this report, best practicable technology (BPT) is referred to as Level I and best available technology (BAT) is referred to as Level II. These limitations and the cost of attaining them are discussed in this section.

PROPOSED EFFLUENT LIMITATIONS

Guidelines for the Electroplating Industry are proposed at three levels to cover all industry segments. Plants discharging effluents to navigable waters and those disposing waste waters to municipal sewer systems will all be affected by the proposed guidelines. However, the extent of control to be exercised by the different segments of the industry remains somewhat unclear.

In this report, plants discharging effluents to navigable waters are referred to as rural plants and plants disposing of waste waters to municipal sewer systems are referred to as urban plants.

(a) Pretreatment Standards

Pretreatment standards, which are not defined by EPA, are currently considered the responsibility of the local municipal

systems handling plant effluents. Authorities responsible for establishing local effluent limitations recognize the need to reflect federal limitations in their standards, but are not certain of what effects the proposed EPA Level I and Level II limitations will have on the local systems.

(b) Level I Effluent Limits

Proposed Level I limitations based on "best control technology currently available," reflects use of chemical destruction technology. The application of the standard is based upon the "average weight of waste water constituent per unit of production." Three equivalent units of production are proposed as follows:

1. Plated Area. Unit of production as defined by Faraday's Law of Electrolysis using the ampere hours for plating, the average thickness of deposit and typical cathodic current efficiencies.

2. Coulombic Equivalent. Unit of production as defined by the volume of waste discharged per unit of time per unit of current capacity installed are used for the minimum plate thickness and typical current efficiencies.

3. BPCTCA Effluent Equivalent. Unit of production based on use of Best Practicable Control Technology Currently Available (BPCTCA) to conserve water usage and the reduction of effluents discharged at the recommended water usage rate.

(c) Level II
Effluent Limits

The proposed Level II effluent limits, based on "best available technology economically achievable," requires recovery, treatment and reuse of process waters to effect zero discharge of pollutants.

(d) New Source
Performance Standards

New sources in the Electroplating Industry, defined as electroplating plant construction begun after publication of proposed regulations, are required to adhere to Level II effluent limits and achieve zero discharge of pollutants.

Although pretreatment standards are directed to existing plants discharging to municipal sewer systems, new sources discharging to municipal systems are required to meet Level II standards.

EFFLUENT LIMITATIONS USED FOR THIS STUDY

In order to evaluate the economic impact of pollution abatement requirements on the Electroplating Industry, it was necessary to establish effluent limitations on the model plant groups. In conjunction with the Environmental Protection Agency, two alternates were established for levels of treatment for rural and urban plants.

(a) Alternate A -
Effluent Limitations

The following levels of treatment were established for Alternate A.

TABLE V-1

Level I and Level II - Rural and Urban Plants

Group	Level I		Level II
	Rural	Urban	Rural
A	Level I	Pretreatment	Level II
B	Level I	Pretreatment	Level II
C	Level I	Pretreatment	Level II
D	Level I	Pretreatment	Level II
E	Level I	Pretreatment	Level II

Pretreatement standards are based on local regulations and are not a requirement of the federal guidelines (see Section V, pg.1)

(b) Alternate B -
Effluent Limitations

The following levels of treatment were established for Alternate B.

TABLE V-2

Level I and Level II - Rural and Urban Plants

Group	Level I		Level II
	Rural	Urban	Rural
A	Level I	Level I	Level II
B	Level I	Level I	Level II
C	Level I	Level I	Level II
D	Level I	Level I	Level II
E	Level I	Level I	Level II

The required costs for each Level and Plant Group are discussed later in this section.

INDUSTRY SEGMENTATIONS AND EFFLUENT LIMITATIONS

In establishing standards of performance and assessing the capability to meet "best control technology current available," electroplating shops were segmented according to production capacity in terms of installed rectifier capacity in amperes. Five plant sizes were established as follows:

TABLE V - 3

Rectifier Capacity by Size of Shop

Size	Rectifier Capacity in Amperes
Very large	> 20,000
Large	50,000 - 20,000
Medium	10,000 - 50,000
Small	1,000 - 10,000
Very small	< 1,000

Although pollutants can be related to production in terms of amount of plating, and this factor related to rectifier capacity, industry data is not published in this manner. Consequently, segmentation of the industry is not possible by productive capacity.

As previously discussed in Section I, available information on the electroplating shops provide a means of segmenting shops according to employment. However, as shown on Exhibit V-1, some relationship does exist between the installed rectifier capacity and the employment within shops. With some exception, very small shops would tend to have smaller capacitites. The correlations however, would never approach perfection. For example, a highly automatic shop could have a high rectifier capacity and thus be classified large, yet have low employment because of the degree of automation.

Since effluent limitations are proposed applicable to all segments without regard to capacity, the economic analysis covered in this report does not consider plants on basis of size of installed capacity. However, because the relationship between employment and capacity exists, segmentation by these criteria is not deemed necessary.

WATER POLLUTION ABATEMENT COSTS

The costs for capital equipment to meet the proposed effluent guidelines were developed from information supplied by the Environmental Protection Agency. These investment costs were developed for the EPA by another contractor, Battelle Memorial Institute.

(a) Level I
Investment Costs

Exhibit V-2 shows the investment costs for Alternate A Level I pollution abatement equipment for rural and urban plants. These costs are based upon the model plant parameters defined in Section IV. This exhibit indicates that Level I pollution abatement equipment investment costs range from a minimum of $50,000 for small plants, Group A 1 to 4 personnel, to $562,000 for large Plants, Group E 50 to 99 personnel in the rural plants. For urban plants the costs range from $25,000 to $281,000.

Exhibit V-3 shows the investment costs for Alternate B Level I pollution abatement equipment for rural and urban plants, and indicate that the investment costs for this alternate are the same as for rural plants in Alternate A.

In the following table the investment costs for rural and urban plants to meet Level I Alternat A and B are summarized:

TABLE V-4

Summary of Level I Investment Costs

Plant Group	Alternate A		Alternate B
	Rural	Urban	Rural and Urban
A	$ 50,000	$ 25,000	$ 50,000
B	58,800	29,400	58,800
C	117,600	58,800	117,600
D	252,000	126,000	252,000
E	562,000	281,000	562,000

Exhibit V-4 shows the annual amortization costs for Alternate A Level I pollution abatement equipment for both rural and urban plants. Exhibit V-5 shows the annual amortization costs for Alternate B Level I pollution abatement equipment. These amortization costs are based on the assumption of a pay back period of five yeras and a cost of capital of ten percent.

Exhibit V-6 shows Alternate A Level I investment costs for pollution abatement equipment for rural and urban plants as a percentage of annual sales. Exhibit V-7 shows the same information for Alternate B. As can be seem from these exhibits, due to the minimum investment costs for Level I in both Alternates A and B, the investment costs as a percent of annual sales for the very small plant, Group A 1 to 4 personnel, is very high.

For rural and urban plants in Alternate A, the investment costs as a percent of sales are 62 percent and for rural plants 124 percent. In Alternate B, the investment costs as a percent of sales for Group A is also 124%.

In Alternate A rural plants and Alternate B both rural and urban plants, the investment costs as a percent of sales range from 40 to 45 percent. However, in Alternate A urban plants, due to the lower investment costs, the range is from 21 to 22 percent.

In the following table the investment costs as a percent of annual sales for Alternates A and B for Level I are summarized:

TABLE V-5

Summary of Level I Investment Costs as a Percent of Annual Sales

Plant Group	Alternate A Rural	Alternate A Urban	Alternate B Rural and Urban
A	124.1%	62.0%	124.1%
B	43.0	21.5	43.0
C	44.7	22.4	44.7
D	42.4	21.2	42.4
E	41.8	20.9	41.8

(b) Level II Investment Costs

Exhibit V-8 shows the capital investment costs to meet Level II pollution abatement equipment requirements for both Alternate A and B. This exhibit shows that for Level II investment costs range from approximately $20,000 for Groups A and B to $289,000 for Group E.

Exhibit V-9 shows the annual amortization costs for Level II. These amortization costs are again based on a five year pay-back period and a cost of capital of ten percent.

EXHIBIT V-1

ENVIRONMENTAL PROTECTION AGENCY

Number of Plants by Employment and Rectifier Capacity

Size of Plant by Number of Employees	Number of Plants — Rectifier Capacity				
	Very Small	Small 1,000 to 10,000	Medium 10,000 to 50,000	Large 50,000 to 20,000	Very Large 200,000
1 - 10	1	7	2	-	-
11 - 20	-	7	6	1	1
21 - 50	-	1	10	3	-
Under 50	-	-	5	7	1

Source: Battelle Memorial Institute
Environmental Protection Agency

ENVIRONMENTAL PROTECTION AGENCY

Alternate A
Investment Costs for Level I
Pollution Abatement Equipment

Rural and Urban Plants

Plant Group	Employment Range	Average Number of Employees Per Group	Investment Costs Rural	Urban
A	1 - 4	2	$ 50,000	$ 25,000
B	5 - 9	7	58,800	29,400
C	10 - 19	14	117,600	58,800
D	20 - 49	30	252,000	126,000
E	50 - 99	67	562,000	281,000

Assumptions:

Plating - 60 sq. ft./hour/employee

Water Usage - 2.5 gallons/sq.ft. plated

Investment Cost - $56,000/1,000 gallons/hour - Minimum Cost $50,000 for rural plants.

- $28,000/1,000 gallons/hour - Minimum Cost $25,000 for urban plants.

Source: Environmental Protection Agency

Formula:

Investment Cost = 60 sq. ft./hour/employee x 2.5 gallons/ sq. ft. x $56,000 or $28,000/1,000 gallons/hour x Number of Employees

ENVIRONMENTAL PROTECTION AGENCY

Alternate B

Investment Costs for Level I
Pollution Abatement Equipment

Rural and Urban Plants

Plant Group	Employment Range	Average Number of Employees Per Group	Investment Costs
A	1 - 4	2	$ 50,000
B	5 - 9	7	58,800
C	10 - 19	14	117,600
D	20 - 49	30	252,000
E	50 - 99	67	562,000

Assumptions:

Plating - 60 sq. ft./hour/employee

Water Usage - 2.5 gallons/sq. ft. plated

Investment Cost - $56,000/1,000 gallons/hour - Minimum Cost of $50,000

Source: Environmental Protection Agency

Formula:

Investment Cost = 60 sq. ft./hour/employee x 2.5 gallons/ sq. ft. x $56,000/1,000 gallons/hour x Number of Employees

ENVIRONMENTAL PROTECTION AGENCY

Alternate A

Annual Amortization Costs
of Investments for Level I

	Urban		Rural	
	Costs		Costs	
Group	Investment	Amortization	Investment	Amortization
A	$ 25,000	$ 6,595	$ 50,000	$ 13,190
B	29,400	7,650	58,800	15,300
C	58,800	15,511	117,600	31,023
D	126,000	33,238	252,000	66,477
E	281,000	74,127	562,000	148,254

Assumptions:

Cost of Capital - 10%

Payback Period - 5 years

ENVIRONMENTAL PROTECTION AGENCY

Alternate B

Annual Amortization Costs
of Investments for Level I

Rural and Urban Plants

Group	Costs	
	Investment	Amortization
A	$ 50,000	$ 13,190
B	58,800	15,300
C	117,600	31,023
D	252,000	66,477
E	562,000	148,254

Assumptions:

Cost of Capital - 10%

Payback Period - 5 years

ENVIRONMENTAL PROTECTION AGENCY

Alternate A

Level I Investment Costs as a Percent of Annual Sales for Rural and Urban Plants

Plant Group	Average Sales $ .000	Rural		Urban	
		Investment		Investment	
		Per Plant (1)	% of Sales	Per Plant (1)	% of Sales
A	40.3	$ 50,000	124.1%	$ 25,000	62.0 %
B	135.0	58,800	43.0	29,400	21.5
C	263.0	117,600	44.7	58,800	22.4
D	594.0	252,000	42.4	126,000	21.2
E	1,345.5	562,000	41.8	281,000	20.9

(1) From Exhibit V-2

ENVIRONMENTAL PROTECTION AGENCY

Alternate B

Level I Investment Costs as
a Percent of Annual Sales
for Rural and Urban Plants

Plant Group	Average Sales $ .000	Investment Per Plant (1)	Investment % of Sales
A	40.3	$ 50,000	124.1 %
B	135.0	58,000	43.0
C	263.0	117,600	44.7
D	594.0	252,000	42.4
E	1,345.5	562,000	41.8

(1) From Exhibit V-3

ENVIRONMENTAL PROTECTION AGENCY

Investment Costs for Level II Pollution Abatement Equipment

Group	Average Number of Employees Per Group	Number of Gallons/Hour	Investment Cost		
			Reverse Osmosis	Evaporative Recovery	Total
A	2	300	-	-	$ 20,000
B	7	1,050	-	-	20,000
C	14	2,100	$ 48,000	25,000	73,000
D	30	4,500	96,000	37,500	133,500
E	67	10,050	205,000	83,800	288,800

Assumptions:

Reverse Osmosis Costs based on - minimum $8,000 for 125 gallon/hour shop - $14,000 for 275 gallon/hour shop and $125,000 gallon/hour shop

Evaporative Recovery Costs based on - minimum of $25,000 for 300 gallons - Evaporative Recovery Unit handles 10% of gallons per hour of reverse osmosis.

- For Groups A and B assume $20,000 cost for water conservation methods.

Source: Environmental Protection Agency

ENVIRONMENTAL PROTECTION AGENCY

Annual Amortization Cost of Investments
for Level II Pollution Abatement Equipment

Plant Group	Costs	
	Investment	Amortization
A	$ 20,000	$ 5,280
B	20,000	5,280
C	73,000	19,260
D	133,500	35,224
E	288,800	76,200

VI - PRICE EFFECTS

In order to determine the potential changes in prices attributable to the cost of pollution equipment and its maintenance, it is necessary to examine the various methods of costing used in both job and captive shops. In addition, the economics of various alternatives facing the purchasers of plating services will be examined. By combining the costing methods in supplying plating services along with the demand for such services, a viable direction of cost influence may be identified.

BACKGROUND

Because of the relatively low capitalization of firms in the plating industry, there is the tendency to price according to the most significant variable cost components. In some cases, this is not possible because of the competitive environment in which certain services are required. Firms competing in such areas as zinc plating of nuts and bolts find the margin significantly less than in some of the specialized areas of finishing for electronic components and other high quality plating.

PRICING IN JOB SHOPS

There are basically three methods used in the pricing of services in the plating job shops:

1. Labor based costing is the most frequently used method in determining the price of services. Deriving multiples of labor costs for the different sections of plating services

and then aggregating them is used predominantly in the labor intensive job shops. For instance, in Exhibit VI-1, it is noted that the direct labor of an average firm (which is a member of the NAMF) is about 28% of the sales dollar. This company would price its jobs at appropriately 3.6 times the direct variable labor rate of the different people used in the plating process. This multiple of labor will vary with the type of service that is required.

2. Equipment based pricing is used in automatic plating and the plating of hard chrome. In these cases, the equipment is a significant portion of the cost expenditures. Since there is a high investment in automatic equipment, the time per equipment hour is charged in addition to that of the labor used in preparation of this equipment and the parts to be plated. When plating with hard chrome, jobs remain in the plating tanks for extended lengths of time (sometimes days) and the costs are based on the use of the tanks for the time the parts are in the tanks and the labor time of preparation of the parts.

3. Square inches of surface plated is the least used method of pricing plating services. This method is used primarily in the pricing of plating precious metals. Plating of gold, silver, platinum, and other precious metals are frequently evaluated on the basis of square inches plated. Again, the price of the plated part is based on the most significant cost variable factor.

According to industry averages, a pre-tax profit on sales of about 5.9% is traditionally sought, and its derivation is presented in Exhibit VI-1. However, a more relevant measure of financial achievement is the return on invested capital sought by the various firms in the industry. As a rough guide approximately 83% of annual sales is the amount of invested capital in the firms represented by the National Association of Metal Finishers study which is presented in Exhibit VI-2. If this figure is true for the industry as a whole, an overall pre-tax return on investment of approximately 7.0% is desired (Exhibit VI-3). As the amount of capital investment increases, prices would increase proportionately. Increased capital investment of 50% would require price increases of 50% in order to maintain the same level of return on investment. Accordingly, for a firm capitalized at $300,000, the expenditure of $100,000 for capital equipment to abate pollution would require prices to be increased by 30%. If the money were borrowed from a bank rather than invested by the owners, prices would have to be increased to cover interest as well as a return on investment criteria. However, there is reluctance among the banking community to lend money for the purpose of investing in non-productive assets. The question then becomes is it a good investment in the various pollution equipment for the total service lines of a plating company or should only pollution abatement be sought for plating of selected service lines which are more profitable and could justify a return investment through higher prices?

COSTING IN CAPTIVE SHOPS

The cost of plating in a captive shop is traditionally lower than that of a job shop. The reason for this is the economies of scale in operating a manufacturing concern with a plating department. The captive plating department does not have to justify the entire capital expenditure of land, equipment, supervision, and any other factors which have to be completely covered by the job shop. Frequently a captive shop has a very low level of production and is sometimes manned using part-time personnel. Also, the captive plating department is usually not a profit center for the firm but rather an adjunct to a manufacturing line.

There has been a trend in recent years to eliminate the captive shop because of the cost of the required pollution equipment which often cannot be justified from the corporate standpoint on a strict investment basis. However, firms with extensive captive shops and high dependence upon them will and have made these commitments.

Because of the trend away from captive shops, there is becoming a greater dependency upon the job shop plater.

OTHER FACTORS OF CONSIDERATION

It has been previously mentioned that the price of plating services is a function of the significant variable cost. As the cost of capital goes up, prices also will have to increase. However, of even greater significance than the cost aspect of plating is what will happen to competition in the plating industry with the advent of increased pollution controls. Currently there is a double standard in most areas of pollution requirements, i.e., existing facilities operate under one kind of restriction while new facilities are required to operate under another. This has had the effect of restricting entrance into the industry because of the higher capital investment required to begin a plating business. In addition, many firms are unwilling to make the capital investment and thus are electing to leave the industry. The exact quantity of firms leaving the industry and the absence of re-entry is not known at this time.

There will be a substitution effect when prices of plating services are increased. Other types of plating will be sought; for example, changing from nickel and chrome plating to a more economical but less desirable process of plating. Other types of finishes will be sought such as painting or galvanizing. In addition, new materials which do not require plating may also be used (such as the case of stainless steel).

Many plating firms are eliminating plating services that are highly polluting. Lead and cadmium plating have been reduced or eliminated in numerous job plating shops as well as captive facilities.

Aside from the effects of restricted competition, the higher cost of operations would potentially yield significantly higher costs for plating, in some cases upwards of 50% to 100%. However, such increases may not be tolerated by the customers of plating services and other finishes or materials may be substituted in place of plating. At this point the substitution effect is an indeterminate factor. Knowledge of the supply and demand curves for each plating service, and plated product is necessary to determine what the substitution effect would be.

MODEL PLANT PARAMETERS

In order to assess the price effects of pollution abatement on electroplating job shops, a model plant approach has been used. Five plant configurations were developed based on size and sales parameters found to be reasonably correlated in several industry studies.

Exhibit VI-4 describes the model plants and the parameters used to differentiate between plants. These factors are also used to segment the industry in the impact analysis.

Profit margins which were previously determined were applied for each segment of the industry to the model plant sizes as shown in Exhibit VI-5.

This exhibit also details the average sales and the number of plants according to U.S. census of manufacturing statistics for 1967. The sales reported in the census records were adjusted to reflect price levels in 1972. Average pretax profits for each segment were derived from an industry survey which was described in Section IV, page 3.

PROFIT COMMITMENT FOR POLLUTION CONTROL

In order to meet the cost of capital investment in control equipment, firms will either maintain current prices and pay for equipment from existing profits or raise prices to offset the added costs. The decision will be based on many factors

including competition, customer reaction, and level of present profitability.

(a) Maintaining Present Prices

The ability to maintain present prices depends on the ability and willingness of firms to commit future profits to pollution abatement equipment. It is a general rule in the industry that investments are made for plating equipment if the investment represents approximately 1.5 years profits.

While this decision rule is used for normal production equipment which is expected to provide increased profits, it is probably not applicable to pollution abatement equipment. The decision to provide additional production equipment does not normally affect the actual survival of the business. However, the decision to install or not install pollution abatement equipment may affect the survival of the business. Consequently, it is reasonable to assume that the industry's investment in pollution abatement equipment will represent a greater number of years of profits. This period has been estimated to be about five years.

Exhibit VI-6 shows the number of years of profits which would have to be committed by firms in each of the plant size segments given no price increases for the industry for Level I Alternates A and B.

The years are based on the cost of the pollution control equipment at the relevant plant size and the average profit on sales for those plants. At a cost of capital of approximately 10% per annum which has not been included, the time periods would be somewhat longer.

Based on the above, a large number of the model plants would exercise the option to close rather than sacrifice profits. Should this occur, the industry supply would be reduced by the amount of sales these plants generate and employment would also be affected to the same degree.

It is difficult to determine the direct effects of this supply reduction on pricing since there is an insufficient knowledge of the demand function. However, it is safe to assume any or several of the following will occur.

- Substitution of other coating for electroplating
- Absorption by captive shops
- Absorption by remaining job shops
- Price increases

It is not practical to assume the zero price increase and high resultant enclosures. These shops would, in fact, increase prices to meet the cost of pollution control equipment at a rate that would maintain their present

profitability or some level below present profits before electing to go out of business. The amount of these increases would depend on the market, decision of the owner and other variable factors.

Since perfect information is not available in the market place and electroplating products and services are so immensely different it is expected that some number of the prospective firms could increase prices without suffering major competitive disadvantages.

(b) Price Increases To Meet Capital Equipment Requirements

The following price increases will be required to offset the capital equipment costs for firms which are willing to commit to five years payoff for the equipment and maintain the current profit margins.

TABLE VI-1

Price Increases - Level I and Level II

Level	Alternate A		Alternate B	
	Rural	Urban	Rural	Urban
Level I	16.5	8.3	16.5	16.5
Level II	8.4	--	8.4	--

The amount of increases has been based on financing at a cost of capital of 10 percent. The five year period is based on the loan period which several banks, contacted during the study, indicated is typical for equipment purchases.

In estimating the overall price increases expected for the industry, the implicit assumption is that highly profitable firms and those with low profits would offset each other on the whole. This is not the absolute effect since cost of control equipment differs at the five firm sizes and profitability also varies by size.

Exhibit VI-7 and Exhibit VI-8 have been prepared to indicate the extent of the increases for firms in each model plant size group for Alterantes A and B. The exhibit breaks down the increases for Level I and Level II. Exhibits VI-9, VI-10, VI-11 and VI-12 show the calculations used to arrive at the estimated increases.

The implied price changes required at the different plant size configurations is important to understand. The very small plants, one to four people, appear to be confronted with very large price increases approximately two to three times the larger plants. If this occurs, it can be expected that some competitive advantage will exist for the larger plants which could have a long-term negative effect on the viability of the very small shops.

(c) Increases for Operating Cost

Very few plants in the industry are presently meeting the pretreatment limitations and practically none are meeting Level I and Level II standards expected to be applied in 1977 and 1983. For these reasons, operating costs for pollution abatement equipment have not been compiled on an industry-wide basis. Some plants are, however, meeting local standards and do have cost data for their operations.

For the purposes of this study, the annual operating costs for Level I and Level II pollution abatement equipment are based upon information furnished by the Environmental Protection Agency. These operating costs are summarized in Exhibits VI-13, and VI-14. These exhibits show that for Level I, annual operating costs range from approximately $1,600 for the small plant, 1 to 4 personnel, to $53,300 for the large plant, 50 to 99 personnel for Alternate A rural plants and Alternate B. For Alternate A urban plants the operating costs are approximately one-half of rural plants for the same size plants. For Level II annual operating costs range from approximately $800 to $27,700 for the same size plants.

As previously mentioned, some plants in Kearney's survey have compiled data for operating costs of pretreatment equipment. An average cost of 1.7 percent of annual sales has been found to be required for these annual operating costs. If we are to assume

that annual operating costs of Level I abatement equipment are approximately twice that of pretreatment equipment, a reasonable correlation is found between calculated and experienced costs. This comparison is shown in the following table.

Table VI-2

Comparison of Survey and Calculated Annual Operating Costs

Plant Group	Average Sales Dollars Per Group	Operating Costs @ 1.7% of Sales	Operating Costs @ 50% of Level I
A	40.3	$ 685	$ 795
B	135.0	2,295	2,790
C	263.0	4,470	5,565
D	594.0	10,100	11,925
E	1,345.5	22,875	26,635

EXHIBIT VI-1

ENVIRONMENTAL PROTECTION AGENCY

INCOME STATEMENT PROFILE(1)

Cost Elements	Percent of Sales
Production Expense	
Labor - Direct	27.7
Labor - Indirect	4.7
Materials	16.4
Rent	2.6
Utilities	5.2
Repair and Maintenance	2.8
Delivery Expense	2.0
Other Production Expense	9.0
Total Production Expense	70.4
Sales Expense	
Salaries	1.8
Other Sales Expense	1.8
Total Sales Expense	3.6
General and Administrative Expense	
Owner/Officer's Salary	9.4
Office Salary	3.3
Office General and Administrative	7.3
Total General	20.0
Total Expenses	94.1
Profit Before Taxes	5.9
Profit After Taxes	3.0

Notes: (1) Source: National Association of Metal Finishers Cost Survey 1970, adjusted to reflect plating firms only.

EXHIBIT VI-2

ENVIRONMENTAL PROTECTION AGENCY

ESTIMATED CAPITALIZATION OF METAL FINISHING FIRMS (1)

Type of Metal Finishing	Capitalization NAMF	Capitalization Industry
Precious metals	217,000	46,100
Buffing and polishing	141,300	28,800
Chrome	224,700	47,700
General platters	300,000	63,100
Average capitalization at chrome and general platters (2)	262,350	55,400
Average yearly sales of NAMF members (3)	317,000	
Capitalization as a percent of sales (4)	83%	

Notes: (1) Based on 1966 University of Michigan Study

(2) Derived as follows: (224,700 + 300,000)/2 = 262,350

(3) Derived from University of Michigan Study:
18% industry members at NAMF
77% of industry sales from NAMF
Gross industry billings of $200,000,000
2700 firms in industry
(200,000,000 x 77%)/(18% x 2700) = $317,000

(4) Derived by dividing average capitalization by average sales.

ENVIRONMENTAL PROTECTION AGENCY

ELECTROPLATING INDUSTRY

ESTIMATED RETURN ON INVESTMENT OF METAL FINISHING FIRMS

Element	Measure
Index of Average Yearly Sales (3)	100.00
Index of Capitalization (1)	83.00
Margin on Sales (pre tax) (2)	5.9%
Return on Capitalization (3)	7.1%

Notes: (1) See Exhibit V-2

(2) See Exhibit V-1

(3) Derived by dividing pre tax profit margin by capitalization: 5.9/83.00 = 7.1%

ENVIRONMENTAL PROTECTION AGENCY

DESCRIPTION OF MODEL PLANTS

Model Plant	Number of Employees	Average Number of Employees Per Establishment	Annual Sales Range ($000)	Average Sales Dollars Per Establishment	Water Usage(1) (GPH)
A	1 - 4	2	0 - 100	40.3	300
B	5 - 9	7	100 - 300	135.0	1,050
C	10 - 19	14	300 - 500	263.0	2,100
D	20 - 49	30	500 - 900	594.0	4,500
E	50 - 99	67	900 - 2,000	1,345.5	10,050

(1) Assumptions:

Plating - 60 sq. ft./hour/employee
Water - 2.5 gallons/sq. ft.
Source: Environmental Protection Agency

Formula = Water Usage (GPH) = 60 sq. ft./hour/employee x 2.5 gallons/sq. ft. x number of employees.

EXHIBIT VI-4

ENVIRONMENTAL PROTECTION AGENCY

AVERAGE PRE-TAX PROFIT OF MODEL PLANTS

Model Plant Code	Average Sales Per Establishment(1) ($ Thousand)	Number of Establishments	Average(2) Pre-Tax Profit (Percent)
A	40.3	1,237	9.0%
B	135.0	570	6.5
C	263.0	579	4.9
D	594.0	620	7.2
E	1,345.5	171	4.2
		3,177	5.9

Notes: (1) Average sales derived from U.S. Census of Manufacturing Data and adjusted to reflect 1972 price levels.

(2) Based on Kearney study of industry.

Sources: National Association of Metal Finishers
Census of Manufacturing
A. T. Kearney, Inc.

EXHIBIT VI-6

ENVIRONMENTAL PROTECTION AGENCY

YEARS OF PROFIT COMMITMENT
WITH NO PRICE INCREASE

LEVEL I

Plant Size	Alternate A		Alternate B
	Rural	Urban	Rural and Urban
A	13.8%	6.9%	13.8%
B	6.7	3.4	6.7
C	9.1	4.6	9.1
D	5.9	2.9	5.9
E	9.9	5.0	9.9
Weighted Average	7.2%	3.6%	7.2%

EXHIBIT VI-7

ENVIRONMENTAL PROTECTION AGENCY

Alternate A

ESTIMATED PRICE INCREASES
FOR TREATMENT LEVELS

Plant Code	Level I		Level II
	Rural	Urban	Rural
A	36.7%	18.4%	15.2%
B	15.5	7.8	6.1
C	16.0	8.0	9.5
D	15.2	7.6	8.0
E	15.0	7.5	7.7
Weighted Average	16.5%	8.3%	8.4%

EXHIBIT VI-8

ENVIRONMENTAL PROTECTION AGENCY

Alternate B

ESTIMATED PRICE INCREASES
FOR TREATMENT LEVELS

Plant Code	Level I Rural and Urban	Level II Rural
A	36.7%	15.2%
B	15.5	6.1
C	16.0	9.5
D	15.2	8.0
E	15.0	7.7
Weighted Average	16.5%	8.4%

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

POTENTIAL COST INCREASE FOR URBAN PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Annual Amortization Costs		Annual Operating Costs		Total Annual Costs ($ .000)	Sales ($ .000)		Cost Increase as Percent of Sales
			Per Plant	All Plants ($. 000)	Per Plant	All Plants ($ .000)		Per Plant	All Plants	
A	1-4	952	$ 6,595	$ 6,278.4	$ 795	$ 756.8	$ 7,035.2	$ 40.3	$ 38,365.6	18.3%
B	5-9	439	7,650	3,358.4	2,780	1,221.5	4,579.9	135.0	59,265.0	7.7
C	10-19	446	15,512	6,918.1	5,565	2,482.0	9,400.1	262.9	117,253.4	8.0
D	20-49	477	33,238	15,854.5	11,925	5,688.2	21,542.7	594.3	283,481.1	7.6
E	50-99	132	74,127	9,784.8	26,630	3,515.2	13,300.0	1,345.5	177,606.0	7.5
Total		2,449		$27,929.4		$13,663.7	$55,857.9		$675,971.1	8.3

EXHIBIT VI-9

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

POTENTIAL COST INCREASE FOR URBAN PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Annual Amortization Costs		Annual Operating Costs		Total Annual Costs ($ .000)	Sales ($ .000)		Cost Increase as Percent of Sales
			Per Plant	All Plants ($ .000)	Per Plant	All Plants ($ .000)		Per Plant	All Plants	
A	1-4	952	$ 13,190	$12,556.9	$ 1,590	$ 1,513.7	$ 14,070.6	$ 40.3	$ 38,365.6	36.7%
B	5-9	439	15,300	6,716.7	5,565	2,443.0	9,159.7	135.0	59,265.0	15.5
C	10-19	446	31,023	13,836.3	11,130	4,964.0	18,800.3	262.9	117,253.4	16.0
D	20-49	477	66,477	31,709.5	23,850	11,376.5	43,086.0	594.3	283,481.1	15.2
E	50-99	132	148,254	19,569.5	53,265	7,031.0	26,600.5	1,345.5	177,606.0	15.0
Total		2,449		$84,388.9		$27,328.2	$111,717.1		$675,971.1	16.5

EXHIBIT VI-10

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

POTENTIAL COST INCREASE FOR RURAL PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Annual Amortization Costs		Annual Operating Costs		Total Annual Costs ($ .000)	Sales ($ .000)		Cost Increase as Percent of Sales
			Per Plant	All Plants ($ .000)	Per Plant	All Plants ($ .000)		Per Plant	All Plants	
A	1-4	285	$ 13,190	$ 3,759.2	$ 1,590	$ 453.2	$ 4,212.4	$ 40.3	$ 11,485.5	36.7%
B	5-9	131	15,300	2,004.3	5,565	729.0	2,733.3	135.0	17,685.0	15.5
C	10-19	133	31,023	4,126.1	11,130	1,480.3	5,606.4	262.9	34,965.7	16.0
D	20-49	143	66,477	9,506.2	23,850	3,410.6	12,916.8	594.3	84,984.9	15.2
E	50-99	39	148,254	5,781.9	53,265	2,077.3	7,859.2	1,345.5	52,474.5	15.0
Total		731		$25,177.7		$8,150.4	$33,328.1		$201,595.6	16.5

EXHIBIT VI-11

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

POTENTIAL COST INCREASE FOR RURAL PLANTS
FOR LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Annual Amortization Costs		Annual Operating Costs		Total Annual Costs ($ .000)	Sales ($ .000)		Cost Increase as Percent of Sales
			Per Plant	All Plants ($ .000)	Per Plant	All Plants ($ .000)		Per Plant	All Plants	
A	1-4	285	$ 5,280	$ 1,504.8	$ 825	$ 235.1	$ 1,739.9	$ 40.3	$ 11,485.5	15.2%
B	5-9	131	5,280	691.7	2,895	379.2	1,070.9	135.0	17,685.0	6.1
C	10-19	133	19,260	2,561.8	5,790	770.1	3,331.9	262.9	34,965.7	9.5
D	20-49	143	35,244	5,037.0	12,405	1,773.9	6,810.9	594.3	84,986.0	8.0
E	50-99	39	76,200	2,971.8	27,705	1,080.5	4,052.3	1,345.5	52,476.5	7.7
Total		731		$12,767.1		$4,238.8	$17,005.9		$201,595.6	8.4%

EXHIBIT VI-12

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A & B

ANNUAL OPERATING COSTS FOR LEVEL I POLLUTION ABATEMENT EQUIPMENT

Group	Employment Range	Average Number of Employees Per Group	Alternate A		Alternate B
			Rural	Urban	Rural and Urban
A	1 - 4	2	$ 1,590	$ 795	$ 1,590
B	5 - 9	7	5,565	2,790	5,565
C	10 - 19	14	11,130	5,565	11,130
D	20 - 49	30	23,850	11,925	23,850
E	50 - 99	67	53,265	26,635	53,265

Assumptions:

Plating - 60 sq. ft./hour/employee
Operating Cost - $5.30/1000 sq. ft. plated
Annual Hours - 2500 hours/year/employee
Alternate A Urban assumed to be one half of rural costs
Source: Environmental Protection Agency

Formula:

Annual Operating Costs = 60 sq. ft./hour/empl. x $5.30/1000 sq. ft. x number of employees x 2500 hours/yr./empl.

EXHIBIT VI-13

EXHIBIT VI-14

ENVIRONMENTAL PROTECTION AGENCY

Alternates A & B

ANNUAL OPERATING COSTS FOR
LEVEL II POLLUTION ABATEMENT EQUIPMENT

Group	Employment Range	Average Number of Employees Per Group	Annual Operating Costs
A	1 - 4	2	$ 825
B	5 - 9	7	2,895
C	10 - 19	14	5,790
D	20 - 49	30	12,405
E	50 - 99	67	27,705

Assumptions:

$0.0474 per man-hour for reverse osmosis
$0.1180 per man-hour for evaporator
2500 man-hours per year per employee
Source: Environmental Protection Agency

Formula:

Operating Costs = ($0.0474 + 0.1180) X 2500 man-hours/yr. X number of employees.

VII - IMPACT ANALYSIS

The impact analysis for closings and employment effects is based on how the effluent limitation standards are to be applied and the costs of the pollution abatement equipment to meet the effluent limitation standards. The effluent limitation standards used in this analysis are those discussed in Section V. They are:

(a) Alternate A

1. Plants, Model groups A through E, located in urban areas: i.e., plants discharging to municipal sewer systems, will be required to meet pretreatment standards in 1977. Pretreatment standards (Section V, Page 1) are based on local regulations and are not a requirement of the federal guidelines.

2. Plants, Model groups A through E, located in rural areas: i.e., plants discharging to streams will be required to meet Level I standards in 1977.

3. Plants, Model groups A and B located in rural areas will be required to meet modified (water conservation) Level II standards in 1983.

4. Plants, Model groups C, D and E located in rural areas will be required to meet Level II standards in 1983.

(b) Alternate B

1. Plants, Model groups A through E, located in urban areas: i.e., plants discharging to municipal sewer systems will be required to meet Level I in 1977.

2. Plants, Model groups A through E located in rural areas: i.e., plants discharging to streams will be required to meet Level I standards in 1977.

3. Plants, Model groups A and B located in rural areas will be required to meet modified (water conservation) Level II standards in 1983.

4. Plants, Model groups C, D and E, located in rural areas will be required to meet Level II standards in 1983.

Based on census data and other studies, 77 percent of the plants are located in urban areas where municipal sewer plants handle the waste water. The other 23 percent of the plants are located in rural areas where discharge of effluents is direct to streams or to storm sewers discharging to streams.

Implicit in the assumption for all plants discharging to municipal systems is that pretreatment standards will be sufficient in all areas. This, of course, may not apply in small municipalities where the waste treatement plants cannot accept industrial wastes without severe disruption to the system. In these cases the estimated closures in the following analysis may be higher.

ESTIMATED PLANT CLOSINGS

(a) Zero Price Increases

It is assumed that the industry will adjust prices upward to meet the cost of pollution control. Consequently there will probably be few closures resulting from failure or inability to raise prices.

(b) Prices Increased to Meet Cost of Equipment - Level I - 1977

As previously discussed in Section V, the price increases required by model plant groups for Alternate A and B for urban and rural plants for 1977 are shown in the following table:

TABLE VII-1

Price Increases - Level I - 1977

Plant Code	Alternate A Rural % Increase	Alternate A Urban % Increase	Alternate B Rural and Urban % Increase
A	36.7%	18.4%	36.7%
B	15.5	7.8	15.5
C	16.0	8.0	16.0
D	15.2	7.6	15.2
E	15.0	7.5	15.0
Weighted Average	16.5%	8.3%	16.5%

Since electroplating products and services are so immensely different, and each size plant meets certain needs of the market place and the amount of substitution to other methods or processes is limited, it is expected that the majority of firms could raise prices without suffering major competitive disadvantages. The exception being the very small plants, Group A 1 to 4 personnel, where the required price increase is over twice the average industry price increase.

In order to analyze the impact of pollution abatement equipment on the Electroplating Industry, an attempt was made to relate price increases, profits and the standard deviation of profit assuming a normal distribution, to a closure rate.

However, due to the relatively small sample size and deviation inherent in the data, it was determined that this method did not provide the necessary accuracy.

It is expected that the greatest effect on plant closures rather than price increases or profits, will be the inability of the very small plants to raise the necessary capital to purchase the pollution abatement equipment. There are firms today that are unprofitable, lack capital and will have difficulty remaining as a viable firm. These types of firms under normal circumstances probably will not remain in business and pollution control will not cause these failures.

There are, however, firms that are today making a profit, although below the group average, will be able to raise prices to a limited extent but will not be able to raise the necessary capital to finance the pollution abatement equipment. These firms, we believe, will be impacted by the water pollution controls.

Based upon previously discussed profits, price increases, the A. T. Kearney survey and discussions with our consultants, and members of the Electroplating Industry, it is expected that the closure rates for the effluent limitations previously mentioned for 1977, would be as shown in the following table:

TABLE VII-2

Potential Closure Rate

1977

Model Plant Group	Alternate A Percent Closures		Alternate B Percent Closures
	Rural	Urban	Rural and Urban
A	50%	25 %	50%
B	25	12.5	25
C	10	5	10
D	3	1.5	3
E	3	1.5	3

Exhivit VII-1 shows the potential number of plants expected to be closed in the urban areas for Alternate A. This exhibit shows of the 2,446 urban plants that 13.2 percent, or 324, are potential closures.

Exhibit VII-2 shows the potential number of plants expected to be closed in the urban areas for Alternate B. This exhibit shows of the 2,446 urban plants that 26.5 percent, or 649, are potential closures.

Exhibit VII-3 shows the potential number of plants expected to be closed in the rural areas for both Alterantes A and B. In the rural area, 26.4 percent or 193 of a total of 731 are classified as potential closures.

Exhibit VII-4 shows the total potential plant closures, both urban and rural for Alternate A. This is summarized in the following table.

TABLE VII-3

Alternate A
Summary of Total Potential Plant Closures

1977

Plant Code	Total Number of Plants	Potential Closures	
		Number	Percent
A	1,237	380	30.7%
B	570	88	15.4
C	579	35	6.0
D	620	11	1.8
E	171	3	1.8
Total	3,177	517	16.3%

Exhibit VII-5 shows the total potential plant closures, both urban and rural for Alternate B. This is summarized in the following table:

TABLE VII-4

Alternate B
Summary of Total Potential Plant Closures

1977

Plant Code	Total Number Of Plants	Potential Closures Number	Potential Closures Percent
A	1,237	618	50.0%
B	570	143	25.0
C	579	58	10.0
D	620	18	3.0
E	171	5	3.0
Total	3,177	842	26.5%

It is important to emphasize the non-financial decision and other mitigating circumstances are certainly expected to occur that should prevent some closings. However, it is not possible to determine what each of these circumstances are. Rather, it is important that the order of magnitude be emphasized as opposed to the preciseness of the actual numbers.

It should be noted that of the 542 total potential plant closures for Alternate A, or 862 total potential plant closures for Alternate B, 324 in both Alternates are estimated to be the

resultant of pretreatment standards which are considered to be the responsibility of the local municipal systems handling plant effluents, and not the Environmental Protection Agency Guidelines. It is understood that not all municipalities will have the same regulations. However, for purposes of this analysis, effluent standards were assumed to be equal for all areas and municipalities.

(c) Prices Increased to Meet Cost of Level II - 1983

As discussed in Section V, the price increases required by the model plant groups for rural plants for 1983 are as follows:

TABLE VII-5

Price Increases - Rural Plants-1983

Plant Code	Percent Increase
A	15.0 %
B	6.0
C	9.5
D	8.0
E	7.7
Weighted Average	8.4 %

As was noted in the discussion of price increases for Level I-1977, the very small plants again will require a price increase approximately twice that of the industry average.

In assessing the economic impact of Level II pollution abatement requirements on the rural plants, it is believed that those remaining after Level I will probably be the more efficiently run plants and that in the majority they will, because of their locations, be able to get the necessary price increases to meet the cost of Level II equipment costs.

Therefore, the potential percent closure rate for the rural plants in 1983 will be as shown below:

TABLE VII-6

Potential Closure Rate
1983-Rural

Plant Code	Percent Closures
A	10 %
B	5
C	2
D	2
E	2

Based on these closure rates the potential plant closures are 25 or 4.6% of the remaining 538 plants (Exhibit VII-6) in the rural area for both Alternates A and B.

(d) Summary of Plant Closures - 1977 and 1983

Exhibit VII-7 summarizes the total number of potential plant closures as a result of Level I and Level II pollution abatement for both urban and rural plants for Alternate A. This exhibit shows potential closures of 542 of 3,177 plants or 17.1 percent. The potential closures are the greatest in the very small plants, estimated to be 31.9 percent of the total 1,237 plants, and decrease to 2.3 percent of the large plants.

The table below summarizes the estimated plant closures as a result of Level I and Level II for the urban and rural plants.

TABLE VII-7

Alternate A
Summary of Plant Closures
1977-1983

	1977		1983		Total	
Area	Number	Percent	Number	Percent	Number	Percent
Urban	324	13.2%	-	-	324	13.2%
Rural	193	26.4	25	4.6%	218	29.8
Total	517	16.3%	25	4.6%	542	17.1%

Exhibit VII-8 summarizes the total number of potential plant closures as a result of Level I and Level II pollution abatement for Alternate B, rural and urban plants. This exhibit indicates potential closures of 27.3 percent or 867 out of the 3,177 plants.

The following table summarizes the estimated plant closures for Alternate B.

TABLE VII-8

Alternate B

Summary of Plant Closures
1977-1983

Area	1977		1983		Total	
	Number	Percent	Number	Percent	Number	Percent
Urban	649	26.5%	-	-	649	26.5%
Rural	193	26.4	25	4.6%	218	29.8
Total	842	26.5%	25	4.6%	867	27.3%

EMPLOYMENT EFFECTS

The majority of employees is in the large plant segment. Consequently a high closure rate for the affected smaller plants does not necessarily mean that the total unemployment rates will be the same as the total plant closure rates.

The total number of personnel in the plant size groups used in this analysis is 44,627. This number is arrived at by extending the average number of employees per firm times the number of firms in each group. The number of personnel in these groups of 44,627 compares to the 44,500 personnel found in the Census of Manufactures data for 1967. The difference is the effect of the rounding used for the average employees per firm.

(a) Level I - 1977

The estimated number of employees affected by the potential plant closures of urban plants for Alternate A is shown in Exhibit VII-9. This shows an estimated number of employees of 1,513 or 4.7 percent of a total employment of 34,375.

For Alternate B the estimated number of employees affected by the potential plant closures of urban plants is shown in Exhibit VII-10. This exhibit shows 8.8 percent, or 3,040 of 34,375 employees are estimated to be affected by the plant closures.

Exhibit VII-11 shows the estimated number of employees affected by potential closures of rural plants for both Alterantes A and B. It is estimated that 8.6 percent of the total of 10,252 employees, or 874 employees, will be affected.

For Alternate A the total estimated number of employees affected by the potential plant closures in urban and rural areas is estimated to be 5.4 percent or 2,397 employees of a total of 44,627 employees. This is shown on Exhibit VII-12.

For Alternate B the total estimated number of employees affected by the potential plant closures in urban and rural areas is estimated to be 8.8 percent, or 3,924 of a total of 44,627 employees. This is shown in Exhibit VII-13.

It should be noted that whereas the total potential plant closures for Alternate A, as shown in Exhibit VII-4, is 16.3% for Level I, the estimated total number of employees affected by Level I is only 5.4%. For Alternate B the plant closure rate is 26.5% (Exhibit VII-5) as compared to the employee rate of 8.8 percent.

(b) Level II - 1983

Exhibit VII-14 shows the estimated employees affected by Level II potential plant closures for rural areas for both Alternates A and B. It is estimated that 248 out of 9,368 employees or 2.6% will be affected.

(c) Summary 1977-1983

For Alternate A the estimated number of employees affected by potential closures due to Level I and Level II pollution abatement is shown in Exhibit VII-15. This exhibit shows that a total of approximately 2,650 out of a total of 44,627 employees, or 5.9%, would be affected by potential plant closures.

For Alternate A the following table summarizes the estimated number of employees affected by potential plant closures due to pollution controls for 1977 and 1983 levels:

TABLE VII-8

Alternate A
Summary of Estimated Number of Employees Affected

Area	1977		1983		Total	
	Number	Percent	Number	Percent	Number	Percent
Urban	1,513	4.7 %	-	- %	1,513	4.7 %
Rural	884	8.6	248	2.6	1,132	11.0
Total	2,397	5.4 %	248	2.6 %	2,645	5.9 %

For Alternate B the estimated number of employees affected by potential closures due to Level I and Level II pollution abatement is shown in Exhibit VII-16. This exhibit indicates that a total of approximately 4,200 out of a total of 44,627 employees, or 9.3 percent, would be affected by potential plant closures.

The following table summarizes for Alternate B the estimated number of employees affected by potential plant closures due to pollution controls for 1977 and 1983 Levels.

TABLE VII-9

Alternate B
Summary of Estimated Number of Employees Affected

Area	1977		1983		Total	
	Number	Percent	Number	Percent	Number	Percent
Urban	3,040	8.8%	-	-	3,040	8.8%
Rural	884	8.6	248	2.6%	1,132	11.0
Total	3,924	8.8%	248	2.6%	4,172	9.3%

COMMUNITY EFFECTS

Electroplating shops are generally not major employers in any particular community. Consequently, although a number of shops and employees could be affected, it is not believed that a single community will be severely impacted.

In our survey and in later discussions with our consultants, and other members of the Electroplating Industry, it was noted that there is at present a shortage of experienced personnel in the Electroplating Industry. This coupled with increased production volumes to shops that remain, will, we estimate , re-employ approximately 50% of the personnel affected by the potential plant closures. This will not, of course, be an average re-employment across all communities and areas, but is is not possible to predict what region or areas will be more affected. It is expected that the re-employment will probably occur primarily in the urban areas. The net effect, we believe, will be that only 1,325 out of the estimated 2,650 employees for Alternate A will be displaced. For Alternate B these figures would be 2,100 out of the estimated 4,200 affected employees.

PRODUCTION EFFECTS

(a) Level I - 1977

For Alternate A Exhibits VII-17, VII-19 and VII-20 show the estimated production effects or estimated dollars of sales affected by potential closures of plants due to Level I pollution abatement. These are summarized below:

TABLE VII-9

Alternate A

Estimated Dollar Sales Affected by Potential Plant Closures

Area	Estimated Volume Dollars ($.000)	Percent
Urban	$29,651.3	4.4%
Rural	17,318.0	8.6
Total	$46,969.3	5.4%

For Alternate B Exhibits VII-18, VII-19, and VII-21 show the estimated dollars of sales affected by potential closures of plants due to Level I pollution controls. These exhibits are summarized in the table on the following page.

TABLE VII-10

Alternate B

Estimated Dollar Sales Affected
by Potential Plant Closures

Area	Estimated Volume Dollars ($.000)	Percent
Urban	$59,565.5	8.8%
Rural	17,318.0	8.6
Total	$76,883.5	8.8%

(b) Level II - 1983

Exhibit VII-22 shows the estimated production effects of potential closures of rural plants for Level II pollution abatement for both Alternates A and B. This exhibit shows that approximately 2.6% or 5 million dollars of electroplating services will be reduced.

(c) Summary Level I and Level II

The estimated sales volume that will be reduced by potential closures of plants for Level I and Level II pollution abatement Alternates A and B, is shown in Exhibits VII-23 and VII-24. These are summarized in the table on the following page.

TABLE VII-11

Alternate A and B

Total Estimated Dollar Sales Affected
by Potential Plant Closures 1977-1983

Level	Alternate A		Alternate B	
	Dollars ($.000)	Percent	Dollars ($.000)	Percent
Level I	$46,969.3	5.4%	$76,883.5	8.8%
Level II	4,893.4	2.6	4,893.4	2.6
Total	$51,862.7	5.9%	$81,776.9	9.3%

Several possibilities exist to offset the estimated supply reduction. The larger shops should be able to absorb a substantial portion of the demand. Captive shops may also be potential sources of supply. We believe the estimated reduced electroplating services will be shifted to, or absorbed by, the remaining plants in the industry.

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

POTENTIAL CLOSURES OF NUMBER OF URBAN PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	952	238	25.0%	714	75.0%
B	5 - 9	439	55	12.5	384	87.5
C	10 - 19	446	22	5.0	424	95.0
D	20 - 49	477	7	1.5	470	98.5
E	50 - 99	132	2	1.5	130	98.5
Total		2,446	324	13.2%	2,122	86.5%

EXHIBIT VII-1

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

POTENTIAL CLOSURES OF NUMBER OF URBAN PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	952	476	50.0%	476	50.0%
B	5 - 9	439	110	25.0	329	75.0
C	10 - 19	446	45	10.0	401	90.0
D	20 - 49	477	14	3.0	463	97.0
E	50 - 99	132	4	3.0	128	97.0
		2,446	649	26.5%	1,797	73.5%

EXHIBIT VII-2

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

POTENTIAL CLOSURES OF NUMBER OF RURAL PLANTS
FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	285	142	50.0%	143	50.0%
B	5 - 9	131	33	25.0	98	75.0
C	10 - 19	133	13	10.0	120	90.0
D	20 - 49	143	4	3.0	139	97.0
E	50 - 99	39	1	3.0	38	97.0
Total		731	193	26.4%	538	73.6%

EXHIBIT VII-3

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

POTENTIAL CLOSURES OF NUMBER OF URBAN AND RURAL PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Total Number of Plants	Potential Closures		Remaining Plants	
			Number*	Percent	Number	Percent
A	1 - 4	1,237	380	30.7%	857	69.3%
B	5 - 9	570	88	15.4	482	84.6
C	10 - 19	579	35	6.0	544	94.0
D	20 - 49	620	11	1.8	609	98.2
E	50 - 99	171	3	1.8	168	98.2
Total		3,177	517	16.3%	2,660	83.7%

*From Exhibits VII-1 and VII-3

EXHIBIT VII-4

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

POTENTIAL CLOSURES OF NUMBER OF URBAN AND RURAL PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Total Number of Plants	Potential Closures		Remaining Plants	
			Number*	Percent	Number	Percent
A	1 - 4	1,237	618	50.0%	619	50.0%
B	5 - 9	570	143	25.0	427	75.0
C	10 - 19	579	58	10.0	521	90.0
D	20 - 49	620	18	2.9	602	97.1
E	50 - 99	171	5	2.9	166	97.1
Total		3,177	842	26.5	2,335	73.5

*From Exhibits VII-2 and VII-3

EXHIBIT VII-5

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

POTENTIAL CLOSURES OF NUMBER OF RURAL PLANTS
FOR LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants (1)	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	143	14	10.0%	129	90.0%
B	5 - 9	98	5	5.0	93	95.0
C	10 - 19	120	2	2.0	118	98.0
D	20 - 49	139	3	2.0	136	98.0
E	50 - 99	38	1	2.0	37	98.0
Total		538	25	4.6%	513	95.4%

Note: (1) Plants remaining assuming potential closures occur in 1977.

EXHIBIT VII-6

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

POTENTIAL CLOSURES OF NUMBER OF TOTAL PLANTS
FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	1,237	394	31.9%	843	68.1%
B	5 - 9	570	93	16.3	477	83.7
C	10 - 19	579	37	6.4	542	93.6
D	20 - 49	620	14	2.3	606	97.7
E	50 - 99	171	4	2.3	167	97.7
Total		3,177	542	17.1%	2,635	82.9%

EXHIBIT VII-7

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

POTENTIAL CLOSURES OF NUMBER OF TOTAL PLANTS
FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Number of Plants	Potential Closures		Remaining Plants	
			Number	Percent	Number	Percent
A	1 - 4	1,237	632	51.1%	605	49.9%
B	5 - 9	570	148	26.0	422	74.0
C	10 - 19	579	60	10.4	519	89.6
D	20 - 49	620	21	3.4	599	96.6
E	50 - 99	171	6	3.5	165	96.5
Total		3,177	867	27.3%	2,310	72.7%

EXHIBIT VII-8

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF URBAN PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	1,904	238	476	25.0%
B	5 - 9	7	3,073	55	385	12.5
C	10 - 19	14	6,244	22	208	4.9
D	20 - 49	30	14,310	7	210	1.5
E	50 - 99	67	8,844	2	134	1.5
Total			34,375	324	1,513	4.7%

*From Exhibit VII-1

EXHIBIT VII-9

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF URBAN PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	1,904	476	952	50.0%
B	5 - 9	7	3,073	110	770	25.1
C	10 - 19	14	6,244	45	630	10.1
D	20 - 49	30	14,310	14	420	2.9
E	50 - 99	67	8,844	4	268	3.0
Total			34,375	649	3,040	8.8%

*From Exhibit VII-2

EXHIBIT VII-10

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A AND B

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF RURAL PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	570	142	284	49.8%
B	5 - 9	7	917	33	231	25.2
C	10 - 19	14	1,862	13	182	9.8
D	20 - 49	30	4,290	4	120	2.8
E	50 - 99	67	2,613	1	67	2.6
Total			10,252	193	884	8.6%

*From Exhibit VII-3

EXHIBIT VII-11

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF PLANTS (RURAL AND URBAN) FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	2,474	380	760	30.7%
B	5 - 9	7	3,990	88	616	15.4
C	10 - 19	14	8,106	35	490	6.0
D	20 - 49	30	18,600	11	330	1.8
E	50 - 99	67	11,457	3	201	1.8
Total			44,627	517	2,397	5.4%

*From Exhibit VII-4

EXHIBIT VII-12

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF PLANTS (RURAL AND URBAN) FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures *	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	2,474	618	1,236	50.0%
B	5 - 9	7	3,990	143	1,001	25.1
C	10 - 19	14	8,106	58	812	10.0
D	20 - 49	30	18,600	18	540	2.9
E	50 - 99	67	11,457	5	336	2.9
Total			44,627	824	3,924	8.8%

* From Exhibit VII-5

EXHIBIT VII-13

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATES A AND B

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF RURAL PLANTS FOR LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants (1)		Number	Percent
A	1 - 4	2	286	14	28	9.8%
B	5 - 9	7	686	5	35	5.1
C	10 - 19	19	1,680	2	28	1.7
D	20 - 49	30	4,170	3	90	2.2
E	50 - 99	67	2,546	1	67	2.6
Total			9,368	25	248	2.6

Note: (1) Plants remaining after potential Level I closures.

* From Exhibit VII-6

EXHIBIT VII-14

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF PLANTS FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees			Number of Potential Plant Closures*	Estimated Number of Employees Affected	
	Range	Average per Plant	All Plants		Number	Percent
A	1 - 4	2	2,474	394	788	31.9%
B	5 - 9	7	3,990	93	651	16.3
C	10 - 19	14	8,106	37	518	6.4
D	20 - 49	30	18,600	14	420	2.3
E	50 - 99	67	11,457	4	268	2.3
Total			44,627	642	2,645	5.9%

* From Exhibit VII-7

EXHIBIT VII-15

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

ESTIMATED NUMBER OF EMPLOYEES AFFECTED BY POTENTIAL CLOSURES OF PLANTS FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees Range	Number of Employees Average per Plant	Number of Employees All Plants	Number of Potential Plant Closures *	Estimated Number of Employees Affected Number	Estimated Number of Employees Affected Percent
A	1 - 4	2	2,474	632	1,264	51.1%
B	5 - 9	7	3,990	148	1,036	26.0
C	10 - 19	14	8,106	60	840	10.4
D	20 - 49	30	18,600	21	630	3.4
E	50 - 99	67	11,457	6	402	3.5
Total			44,627	867	4,172	9.3%

* From Exhibit VII-8

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
OF URBAN PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures*	Estimated Sales Volume Affected ($ 000) Sales	Estimated Sales Volume Affected ($ 000) Percent
A	1 - 4	$ 40.3	$ 38,365.6	238	$ 9,591.4	25.0%
B	5 - 9	135.0	59,265.0	55	7,425.0	12.5
C	10 - 19	262.9	117,253.4	22	5,783.8	4.9
D	20 - 49	594.3	283,481.1	7	4,160.1	1.5
E	50 - 99	1,345.5	177,606.0	2	2,691.0	1.5
Total			$675,971.1	324	$29,651.3	4.4%

* From Exhibit VII-1

EXHIBIT VII-17

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
OF URBAN PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures *	Estimated Sales Volume Affected ($ 000) Sales	Estimated Sales Volume Affected ($ 000) Percent
A	1 - 4	$ 40.3	$ 38,365.6	476	$19,182.8	50.0%
B	5 - 9	135.0	59,265.0	110	14,850.0	25.0
C	10 - 19	262.9	117,253.4	45	11,830.5	10.1
D	20 - 49	594.3	283,481.1	14	8,320.2	3.0
E	50 - 99	1,345.5	177,606.0	4	5,382.0	3.0
Total			$675,971.1	649	$59,565.5	8.8%

* From Exhibit VII-2

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATES A AND B

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES OF RURAL PLANTS FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures*	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 11,485.5	142	$ 5,722.6	49.8%
B	5 - 9	135.0	17,685.0	33	4,455.0	25.2
C	10 - 19	262.9	34,965.7	13	3,417.7	9.8
D	20 - 49	594.3	84,984.9	4	2,377.2	2.8
E	50 - 99	1,345.5	52,474.5	1	1,345.5	2.6
Total			$201,595.6	193	$17,318.0	8.6

* From Exhibit VII-3

EXHIBIT VII-19

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
(URBAN AND RURAL) FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures *	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 49,851.1	380	$15,314.0	30.7%
B	5 - 9	135.0	76,950.0	88	11,880.0	15.4
C	10 - 19	262.9	152,219.1	35	9,201.5	6.0
D	20 - 49	594.3	368,466.0	11	6,537.3	1.8
E	50 - 99	1,345.5	230,097.6	3	4,036.5	1.8
Total			$877,583.8	517	$846,969.3	5.4%

* From Exhibit VII-4

EXHIBIT VII-20

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
(URBAN AND RURAL) FOR LEVEL I POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures *	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 49,851.1	618	$24,905.4	50.0%
B	5 - 9	135.0	76,950.0	143	19,305.0	25.1
C	10 - 19	262.9	152,219.1	58	15,248.2	10.0
D	20 - 49	594.3	368,466.0	18	10,697.4	2.9
E	50 - 99	1,345.5	230,097.6	5	6,727.5	2.9
Total			$877,583.8	842	$76,883.5	8.8%

* From Exhibit VII-5

EXHIBIT VII-21

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATES A AND B

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
OF RURAL PLANTS FOR LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants(1)	Number of Potential Plant Closures*	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 5,762.9	14	$ 564.2	9.8%
B	5 - 9	135.0	13,230.0	5	675.0	5.1
C	10 - 19	262.9	31,548.0	2	525.8	1.7
D	20 - 49	594.3	82,607.7	3	1,782.9	2.2
E	50 - 99	1,345.5	51,129.0	1	1,345.5	2.6
Total			$184,277.6	25	$4,893.4	2.6

(1) Based upon plants remaining after potential plant closures.

* From Exhibit VII-6

EXHIBIT VII- 22

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE A

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
OF PLANTS FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 49,851.1	394	$15,878.2	31.9%
B	5 - 9	135.0	76,950.0	93	12,555.0	16.3
C	10 - 19	262.9	152,219.1	37	9,727.3	6.4
D	20 - 49	594.3	368,466.0	14	8,320.2	2.3
E	50 - 99	1,345.5	230,097.6	4	5,382.0	2.3
Total			$877,583.8	867	$51,862.7	5.9%

EXHIBIT VII-23

ENVIRONMENTAL PROTECTION AGENCY

ALTERNATE B

ESTIMATED DOLLAR SALES AFFECTED BY POTENTIAL CLOSURES
OF PLANTS FOR LEVEL I AND LEVEL II POLLUTION ABATEMENT

Plant Code	Number of Employees	Annual Sales ($.000) Average per Plant	Annual Sales ($.000) All Plants	Number of Potential Plant Closures*	Estimated Sales Volume Affected ($.000) Sales	Estimated Sales Volume Affected ($.000) Percent
A	1 - 4	$ 40.3	$ 49,851.1	632	$25,469.6	15.1
B	5 - 9	135.0	76,950.0	148	19,980.0	26.0
C	10 - 19	262.9	152,219.1	60	15,774.0	10.4
D	20 - 49	594.3	368,466.0	21	12,480.3	3.4
E	50 - 99	1,345.5	230,097.6	6	8,073.0	3.5
Total			$877,583.8	867	$81,776.9	9.3%

* From Exhibit VII-8

EXHIBIT VII-24

VIII - LIMITS OF THE ANALYSIS

In this section the accuracy of the analysis and the major assumptions inherent in the conclusions are discussed.

ACCURACY

In assessing the impact of pollution abatement on the Electroplating Industry, a considerable amount of data had to be gathered in a limited time frame. Much of the information used was compiled from existing industry studies. These studies were supplemented by direct analysis of specific plants in the Midwest as a cross check of the industry studies. However, because the sample size of the supplemental studies was small, some range of error can be expected.

It is recognized that industry studies also represented a small percent of the plants in the industry, consequently, these studies also had some limitations. It is the opinion of the contractor that while preciseness may not be present, the order of magnitude of the effect of pollution control can be derived from the information.

Specifically, the accuracy of this study depends upon the accuracy of:

1. Published industry data.
2. Unpublished information supplied by knowledgeable industry personnel.

3. Cost data developed separately from this analysis by Battelle Memorial Institute and the Environmental Protection Agency.

4. Estimates by A. T. Kearney consultants.

(a) Published Data

1. Production and Size. The published data provided by the Census of Manufactures - 1967, Annual Survey of Manufacturers - 1971, Metal Working Guide - 1973, and that collected from the National Association of Metal Finishers have some areas of conflict. In general however, the data were felt to be sufficiently accurate to be used as an indicator of the relative size and growth of this industry.

2. Profitability. Little published financial data were available regarding the profitability of the Electroplating Industry except for Robert Morris Associates, Annual Statement Studies. Therefore, much of the profitability data was calculated based on industry average data published by the National Association of Metal Finishers, and A. T. Kearney, Inc. survey and estimates.

(b) Unpublished Data and Information

A. T. Kearney, Inc. conducted a survey in which members of the Electroplating Industry were personally contacted or interviewed by telephone to determine plant capacities, type

of water pollution control facilities in existence, operating and cost data, and plans for future growth and development.

In addition, Kearney was privileged to be privy to some unpublished data regarding sales and profit margins for a sample of electroplating firms.

Kearney also personally interviewed five Chicago area banks to determine criteria for making loans to electroplating firms and the availability of funds for pollution control equipment.

These data have been treated on a confidential basis and are assumed to be accurate. However, not all respondents would, or could, supply the desired information. Thus, some data had to be estimated to provide a complete analysis. The result is that total industry data, particularly that regarding employment levels and sales volumes, are believed to be more accurate than data from surveys.

(c) Cost Data

The cost data provided were used as supplied. No effort was made to audit these data, but the order of magnitude of costs seemed to be in line with industry expectations.

(d) A. T. Kearney, Inc. Estimates

Since some data were treated as proprietary by industry sources, or unavailable, it was occasionally necessary to estimate some industry data. An example of such an estimate would be the profit margins for each of the model plant sizes.

While some of these data were not specifically published in the report, they were a necessary step in the analysis. They were not presented due to the confidentiality of the data.

CRITICAL ASSUMPTIONS IN ANALYSIS

In assessing the impact on the industry, certain assumptions have been made which have direct bearing on the results of the study. The following major assumptions have been made.

(a) Plant Size

The industry has been assumed to be similar in each segment according to size. Sales, employment and production are assumed to be relevant units of measurement for the plants in the industry.

(b) Operating Characteristics of the Industry

The majority of the small shops were assumed to handle similar waste streams and operate in approximately the same manner according to size, as stated in the above paragraph.

(c) Plant Distribution by Geographical Location

In the absence of more accurate data, the water discharged into streams versus that discharged into municipal sewers was assumed to represent the distribution of the plants by geographical location, i.e. rural versus urban areas.

(d) Present Level of Pollution Control Equipment Investment

The plants in the industry affected by pollution abatement have either zero current investment in water treatment equipment or the estimated costs to meet guidelines are additive for those plants already using some type of treatment.

(e) Profitability of Firms

Profitability and costs for the plants located within urban and rural areas were assumed to be similar.

(f) Investment and Profit Maximizing Decision

It was assumed that all shop owners will attempt to maximize profits. It was also assumed that five years profits would be the maximum amount of investment a shop owner would be willing to forego before going out of business.

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA-230/1-73-007	2.	3. Recipient's Accession No.

4. Title and Subtitle

Economic Analysis of the Proposed Effluent Guidelines for the Electroplating Industry (copper, Nickel, Chromium and Zinc)

5. Report Date September, 1973

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

A. T. Kearney, Inc.
100 South Wacker Drive
Chicago, Illinois 20460

10. Project/Task/Work Unit No.

11. Contract/Grant No. 68-01-1545

12. Sponsoring Organization Name and Address

Office of Planning and Evaluation
Environmental Protection Agency
Washington, D. C. 20460

13. Type of Report & Period Covered Final Report

14.

15. Supplementary Notes

16. Abstracts

The report summarizes the economic impact of water pollution abatement on the Electroplating Industry (Copper, Nickel, Chromium and Zinc). Discussed are the industry structure, financial profile, sources of water pollution, projected costs and price increases, and the effects on production, plant closings, and local communities.

17. Key Words and Document Analysis. 17a. Descriptors

Economic factors, Electroplating Industry, pollution, industrial waste treatment, water pollution, ecology.

17b. Identifiers/Open-Ended Terms

Electroplating Industry, water pollution economics, economic impact

17c. COSATI Field/Group (5C)

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 177
	20. Security Class (This Page) UNCLASSIFIED	22. Price