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EPA Office of Compliance Sector Notebook Project

Profile of the Fabricated Metal Products Industry

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Office of Enforcement and Compliance Assurance
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FABRICATED METAL PRODUCTS
(SIC 34)
LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation
NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)

FABRICATED METAL PRODUCTS (SIC 34) LIST OF ACRONYMS (CONT'D)

NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

FABRICATED METAL PRODUCTS
(SIC 34)

I. INTRODUCTION OF THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE FABRICATED METAL PRODUCTS INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Fabricated Metal Products industry. The types of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The fabricated metal products industry comprises facilities that generally perform two functions: forming metal shapes and performing metal finishing operations, including surface preparation. The Standard Industrial Classification (SIC) code 34 is composed of establishments that fabricate ferrous and nonferrous metal products and those that perform electroplating, plating, polishing, anodizing, coloring, and coating operations on metals. Since the main processes associated with this industry can be divided into three types of operations (i.e., metal fabrication, metal preparation, and metal finishing), this profile is organized by the techniques that fall within these three groups.

II.B. Characterization of the Fabricated Metal Products Industry

To provide a general understanding of this industry, information pertaining to the industry size and distribution, product characterization, and economic health and outlook is presented below. This information should provide a basic understanding of the facilities developing the products, the products themselves, and the economic condition of the industry.

II.B.1. Industry Size and Geographic Distribution

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The U.S. fabricated metal products industry comprises approximately 34,000 companies. Exhibit 1 lists the largest companies in selected metal fabricating industries. Companies are ranked by sales figures.

Exhibit 1
Metal Fabrication Companies

Company	Sales ($ Millions)	Number of Employees

SIC 3444 -- *Sheet Metal Work*		
Stolle Corp., Sidney, OH	480	4,600
Alcan Alum. Corp., Warren, OH	120	1,200
Nytronics, Inc., Pitman, NJ	110	2,000
Hart and Cooley Inc., Holland, MI	100	1,200
Syro Steel Co., Girard, OH	100	400
Consolidated Systems, Inc., Columbia,_SC	100	300
SIC 3465 -- *Automotive Stampings*		
Budd Co., Troy, MI	1,000	9,000
Douglas and Lomason Co., Farmington Hts., MI	391	5,800
Northern Engraving Corp., Sparta,_WI	280	3,000
Randall Textron Inc., Cincinnati, OH	210	2,000
SIC 3469 -- *Metal Stampings*		
Hexcel Corp., Pleasanton, CA	386	2,900
JSJ Corp., Grand Haven, MI	260	2,500
Mirro-Foley Co., Manitowoc, WI	210	2,000
Tempel Steel Co., Niles, IL	210	1,100
SIC 3499 -- *Fabricated Metal Products*		
Steel Technologies, Louisville, KY	155	500
R.D. Werner Company, Inc., Greenville, PA	150	1,600
BW/IP Int., Inc., Seal Div., Long Beach,_CA	104	400
LeFebure Corp., Cedar Rapids, IA	100	1,100
Dura Mech. Components, Inc., Troy,_MI	100	1,000

Source: Fabricators & Manufacturers Association, Intl.

Exhibits 2 and 3 show the distribution of employees and the total shipments for the metal finishing industry. A typical "job shop" (i.e., small, independently owned metal finishing company) employs 15 to 20 people and generates $800,000 to $1 million in annual gross revenues.

Exhibit 2
Number of Employees in Metal Finishing Industry

	1988	**1989**	**1990**	**1991**	**1992**
SIC 3471	76,300	76,600	73,200	66,600	65,400
SIC 3479	47,000	44,600	44,300	43,400	43,700
Total	123,300	121,200	117,500	110,000	109,100

Source: U.S. Department of Commerce, 1992 Census of Manufacturers.

Exhibit 3
Value of Shipments for Metal Finishing Establishments ($ Millions)

	1988	1989	1990	1991	1992
SIC 3471	4,324	4,452	4,513	4,124	4,726
SIC 3479	4,867	4,756	4,929	4,634	5,161
Total	9,191	9,208	9,442	8,758	9,887

Source: U.S. Department of Commerce, 1992 Census of Manufacturers.

Exhibits 4 and 5 list the largest companies in selected metal finishing industries. Companies are ranked by sales figures.

Exhibit 4
Inorganic Coating Job Shops

Company	Sales ($ Millions)	Number of Employees
Windsor Plastics, Evansville, IN	50	600
Crown City Plating, El Monte, CA	25	425
Pioneer Metal Finishing, Minneapolis,_MN	20-30	380
Metal Surfaces, Bell Gardens, CA	15-25	310
Victory Finishing Technologies, Inc., Providence, RI	15-25	245
State Plating, Inc., Elwood, IN	15-20	400

Source: "Large Plating Job Shops," Beverly A. Greaves, Products Finishing, April 1994.

Exhibit 5
Organic Coating Job Shops

Company	Sales ($ Millions)	Number of Employees
Metokote Corp., Lima, OH	25+	800
The Crown Group, Warren, MI	25+	659
Industrial Powder Coatings, Inc., Norwalk, OH	25+	620
PreFinish Metals, Chicago, IL	25+	600
E/M Corp., West Lafayette, IN	15-25	300
Chicago Finished Metals, Bridgeview, IL	25+	250
Linetec Co., Wausau, WI	10-15	200
B.L. Downey Co., Inc., Broadview, IL	10-15	175

Source: "Large Coating Job Shops," Beverly A. Greaves, Products Finishing, December 1994.

Between 1982 and 1987, the total number of independent metal finishers employing less than 20 employees declined slightly, while those employing more than 20 employees increased by a corresponding amount. Exhibit 6 shows the number and percent of metal finishers of various sizes.

Exhibit 6
Metal Finishing Establishments, by Size

	1987		1992	
Establishments With and Average of :	**Number of Companies**	**Percent Total**	**Number of Companies**	**Percent Total**
1 to 9 Employees	2481	47.1	2553	48.7
10 to 49 Employees	2262	43.0	2186	41.7
50 to 99 Employees	365+	6.9	381	6.8
100 to 249 Employees	137	2.6	356	2.4
250 or more Employees	20	0.4	127	0.4
Total	**5265**	**100.0**	**5603**	**100.0**

Source: Census of Manufacturers: 1992, U. S. Department of Commerce, Bureau of the Census.

Although the metal finishing industry is geographically diverse, the industry is concentrated in what are usually considered the most heavily industrialized regions in the United States (See Exhibit 7). This geographic concentration occurs in part because it is cost-effective for small metal finishing facilities to be located near their customer base.

Exhibit 7
Geographic Distribution of Fabricated Metal Products Industry

Source: Census of Manufacturers: 1987.

California has more establishments that produce metal-related products than any other State. California's establishments constitute 10.2 percent of the total establishments that produce fabricated structural metal (SIC_3441). In addition, California leads in the number of establishments of other related industries: 15.6 percent of the sheet metal work establishments (SIC_3444); 13 percent of the metal doors, sash, and trim establishments (SIC_3442); and 13.7 percent of the architectural metal work establishments (SIC_3446). California also has the majority of plating and polishing (SIC_3471) and metal coating and allied services (SIC_3479) establishments at 17.3 and 16.1 percent, respectively.

Michigan, Illinois, and Ohio have large numbers of various metal-related industries. Michigan has the largest number of companies in the screw machine products (SIC_3451) and automotive stampings (SIC_3465) industries, at 14 and 46.7 percent of the total companies in the United States, respectively. Illinois is home to 14.1 percent of companies that produce bolts, nuts, rivets, and washers (SIC 3452) and Ohio contains 12.6 percent of companies that produce iron and steel forgings (SIC_3462).

Establishments engaged primarily in metal finishing tend to be small, independently owned job shops, also are referred to as independent metal finishers. Establishments that conduct metal finishing operations as part of a larger manufacturing operation are referred to as "captive" metal finishers. Captive metal finishing facilities are approximately three times more numerous than independent metal finishers. Numerous similarities exist between the independent and captive facilities; for the purposes of this profile, they are considered part of one industry. In addition, the two segments have parallel ties with suppliers and customers. Captive operations may be more specialized in their operations, however, because they often work on a limited number of products and/or employ a limited number of processes. Independent metal finishers, on the other hand, tend to be less specialized in their operations because they may have many customers, often with different requirements.

II.B.2. Product Characterization

The Department of Commerce classification codes divide this industry by product and services. SIC code 34 is further divided as follows:

SIC 341	- Metal Cans and Shipping Containers
SIC 342	- Cutlery, Handtools, and General Hardware
SIC 343	- Heating Equipment, Except Electric and Warm Air, and Plumbing Fixtures
SIC 344	- Fabricated Structural Metal Products
SIC 345	- Screw Machine Products, and Bolts, Nuts, Screws, Rivets, and Washers
SIC 346	- Metal Forgings and Stampings
SIC 347	- Coating, Engraving, and Allied Services
SIC 348	- Ordnance and Accessories, Except Vehicles and Guided Missiles
SIC 349	- Miscellaneous Fabricated Metal Products.

II.B.3. Economic Trends

Most industries in SIC 34 are largely dependent upon the demands of other industries. For example, the success of the commercial construction industry is fundamental to the success of the fabricated structural metal industry; 95 percent of the output from the latter is consumed by the former. The general component-producing industries (e.g., screw machine products, industrial fasteners, etc.) display the same demand structure; the demand for such products is directly related to the demand for automobiles and public works construction.

Fabricated structural metal output declined two percent in 1993 due to a decrease in construction of office buildings, commercial structures, manufacturing facilities, and multi-family housing. Ninety-five percent of structural metal output is consumed by the construction industry. Low demand for structural metal is expected to continue, attributable to the recent overbuilding of commercial space and high levels of vacant office space. A slight increase in demand from the public sector (e.g., highway construction) is expected, however, which will positively influence demand for structural metal products. An increased demand for plumbing products is also likely, as the residential construction industry continues to grow.

Total shipments of general components (e.g., screw machine products, industrial fasteners, valves, and pipe fittings) increased by about 3.1 percent in 1993. Strong demand from the automotive sector, combined with increased demand from equipment and machinery manufacturers, were the major factors causing the increased shipments.

The two primary markets for metal finishing services are the automotive and electronics industries. As illustrated in Exhibit 8, consumer durables, aerospace, and the government also are large segments served by metal finishers.

Exhibit 8
Markets Served by Metal Finishers
Percent of 1992 Market

Source: Surface Finishing Market Research Board, Metal Finishing Industry Market Survey 1992-1993.
NOTE: Data includes both job and captive shops.

The sale of metal finishing services is also essentially a derived demand (i.e., sales depend entirely upon the production of other industries). However, sales by the metal finishing industry have not kept up with sales of the industries served.

In the last several years, many U.S. fastener (nuts, screws, bolts, rivets) companies have become more competitive in the global market by incorporating new technology into production lines to improve efficiency and quality. In 1993, U.S. exports of industrial fasteners edged up about 0.6 percent; Canada and Mexico were the largest importers. U.S. imports of industrial fasteners also increased 11 percent over the last several years. This is because demand in the U.S. out-paced production. The expansion of the U.S. automotive and residential construction sectors was a major factor in the increase in fastener imports.

Exports of U.S. valve and pipe fittings are also expected to grow. 1993 industry exports increased six percent compared with 1992 figures. Although Canada remains the principal foreign market, exports to Chile and the Philippines almost tripled, and exports to developing countries increased dramatically.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the Fabricated Metal Products industry, including the materials and equipment used and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile: pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

Specifically, this section contains a description of commonly used production processes, the associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Fabricated Metal Products Industry

In view of the high cost of most new equipment and the relatively long lead time necessary to bring new equipment into operation, changes in production methods and products are made only gradually; even new process technologies that fundamentally change the industry are only adopted over long periods of time. In addition, the recent financial performance of the Fabricated Metal Products industry combined with the difficulty of raising funds in the bond market, have left many establishments with a limited ability to raise the capital necessary to purchase new equipment.

For the purposes of this profile, the industrial processes associated with the Fabricated Metal Products industry will be grouped into three categories: fabricated metal products; surface preparation; and metal finishing. Each category is discussed in greater depth in the following subsections.

III.A.1. Fabricated Metal Products

Once molten metal (ferrous or nonferrous) containing the correct metallurgical properties has been produced (see SIC 33, which comprises activities associated with the nonferrous metals industry), it is cast into a form that can enter various shaping processes. Recently, manufacturers have been using continuous casting techniques that allow the molten metal to be formed directly into sheets, eliminating interim forming stages. This section identifies some of the many forming and shaping methods used by the metal fabrication industry. In general, the metal may be heat treated or remain cold. Heat treating is the modification of the physical properties of a workpiece through the application of controlled heating and cooling cycles. Cold metal is formed by applying direct physical pressure to the metal.

Regardless of the forming method used, the metal fabricating process usually employs the use of cutting oils (e.g., ethylene glycol), degreasing and cleaning solvents, acids, alkalis, and heavy metals. The oils are typically used when forming and cutting the metal. The solvents (e.g., trichloroethane, methyl ethyl ketone), alkalines, and acids (e.g., hydrochloric, sulfuric) are used to clean the surface of the metals. The current trend in the industry is to use aqueous non-VOCs to clean the metals, whenever possible. The use of 1,1,1-trichloroethane and methyl ethyl ketone is declining.

Once molten metal is formed into a workable shape, shearing and forming operations are usually performed. Shearing operations cut materials into a desired shape and size, while forming operations bend or conform materials into specific shapes. Cutting or shearing operations include punching, piercing, blanking, cutoff, parting, shearing, and trimming. Basically, these operations produce holes or openings, or produce blanks or parts. The most common hole-making operation is punching. Cutoff, parting, and shearing are similar operations with different applications. The rate of production is highest in hot forging operations and lowest in simple bending and spinning operations.

Forming operations, as illustrated in Exhibit 9, shape parts by bending, forming, extruding, drawing, rolling, spinning, coining, and forging the metal into a specific configuration. Bending is the simplest forming operation; the part is simply bent to a specific angle or shape. Other types of forming operations produces both two- and three-dimensional shapes.

Exhibit 9
Forming Operations

Extruding is the process of forming a specific shape from a solid blank by forcing the blank through a die of the desired shape. Extruding can produce complicated and intricate cross-sectional shapes. In rolling the metal passes through a set or series of rollers that bend and form the part into the desired shape (See Exhibit_10). Coining is a process that alters the form of the part by changing its thickness to produce a three-dimensional relief on one or both sides of the part, like a coin.

Exhibit 10
Rolling

In drawing, a punch forces sheet stock into a die, where the desired shape is formed in the space between the punch and die. In spinning, pressure is applied to the sheet while it spins on a rotating form, forcing the sheet to acquire the shape of the form. Forging operations produce a specific shape by applying external pressure that either strikes or squeezes a heated blank into a die of the desired shape. Forging operations may be conducted on hot or cold metal using either single- or multi-stage dies.

Once shearing and forming activities are complete, the material is machined. Machining refines the shape of a workpiece by removing material from pieces of raw stock with machine tools. The principal processes involved in machining are drilling, milling, turning, shaping/planing, broaching, sawing, and grinding.

III.A.2. Surface Preparation

The surface of the metal may require preparation prior to applying a finish. Surface preparation, cleanliness, and proper chemical conditions are essential to ensuring that finishes perform properly. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent corrosion. Surface preparation techniques range from simple abrasive blasting to acid washes to complex, multi-stage chemical cleaning processes. Exhibit 11 provides a flow chart of a representative process used when preparing metal for electroplating. Various surface preparation methods are discussed below.

Exhibit 11
Process for Preparing Metal for Electroplating

Source: Metals Handbook, Ninth Edition; Volume 5, Surface Cleaning, Finishing, and Coating, 1982, American Society for Metals.

Some cleaning techniques involve the application of organic solvents to degrease the surface of the metal. Other techniques, emulsion cleaning, for example, use common organic solvents (e.g., kerosene, mineral oil, and glycols) dispersed in an aqueous medium with the aid of an emulsifying agent. Emulsion cleaning uses less chemical than solvent degreasing because the concentration of solvent is lower.

Alkaline cleaning may also be utilized for the removal of organic soils. Most alkaline cleaning solutions are comprised of three major types of components: (1) builders, such as alkali hydroxides and carbonates, which make up the largest portion of the cleaner; (2) organic or inorganic additives, which promote better cleaning or act to affect the metal surface in some way; and (3) surfactants. Alkaline cleaning is often assisted by mechanical action, ultrasonics, or by electrical potential (e.g., electrolytic cleaning).

Acid cleaning, or pickling, can also be used to prepare the surface of metal products by chemically removing oxides and scale from the surface of the metal. For instance, most carbon steel is pickled with sulfuric or hydrochloric acid, while stainless steel is pickled with hydrochloric or hydrofluoric acids, although hydrochloric acid may embrittle certain types of steel and is rarely used. The metal generally passes from the pickling bath through a series of rinses. Acid pickling is similar to acid cleaning, but is usually used to remove the scale from semi-finished mill products, whereas acid cleaning is usually used for near-final preparation of metal surfaces before electroplating, painting, and other finishing processes.

III.A.3. Metal Finishing

Surface finishing usually involves a combination of metal deposition operations and numerous finishing operations. A diagram depicting the general metal finishing process, including surface preparation, is provided in Exhibit 12. Wastes typically generated during these operations are associated with the solvents and cleansers applied to the surface and the metal-ion-bearing aqueous solutions used in the plating tanks. Metal-ion-bearing solutions are commonly based on hexavalent chrome, trivalent chrome, copper, gold, silver, cadmium, zinc, and nickel. Many other metals and alloys are also used, although less frequently. The cleaners (e.g., acids) may appear in process wastewater; the solvents may be emitted into the air, released in wastewater, or disposed of in solid form; and other wastes, including paints, metal-bearing sludges, and still bottom wastes, may be generated in solid form. Several of the many metal finishing operations are described below.

Exhibit 12
Overview of the Metal Finishing Process

Source: Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, OERR, June 1994.

Anodizing

Anodizing is an electrolytic process which converts the metal surface to an insoluble oxide coating. Anodized coatings provide corrosion protection, decorative surfaces, a base for painting and other coating processes, and special electrical and mechanical properties. Aluminum is the most frequently anodized material. Common aluminum anodizing processes include: chromic acid anodizing, sulfuric acid anodizing, and boric-sulfuric anodizing. The sulfuric acid process is the most common method.

Following anodizing, parts are typically rinsed, then proceed through a sealing operation that improves the corrosion resistance of the coating. Common sealants include chromic acid, nickel acetate, nickel-cobalt acetate, and hot water.

Chemical Conversion Coating

Chemical conversion coating includes chromating, phosphating, metal coloring, and passivating operations. Chromate conversion coatings are produced on various metals by chemical or electrochemical treatment. Solutions, usually containing hexavalent chromium and other compounds, react with the metal surface to form a layer containing a complex mixture of compounds consisting of chromium, other constituents, and base metal. Phosphate coatings may be formed by the immersion of steel, iron, or zinc-plated steel in a dilute solution of phosphate salts, phosphoric acid, and other reagents to condition the surfaces for further processing. They are used to provide a good base for paints and other organic coatings, to condition the surfaces for cold forming operations by providing a base for drawing compounds and lubricants, and to impart corrosion resistance to the metal surface.

Metal coloring involves chemically converting the metal surface into an oxide or similar metallic compound to produce a decorative finish such as a green or blue patina on copper or steel, respectively. Passivating is the process of forming a protective film on metals by immersion into an acid solution, usually nitric acid or nitric acid with sodium dichromate. Stainless steel products are often passivated to prevent corrosion and extend the life of the product.

Electroplating

Electroplating is the production of a surface coating of one metal upon another by electrodeposition. Electroplating activities involve applying predominantly *inorganic* coatings onto surfaces to provide corrosion resistance, hardness, wear resistance, anti-frictional characteristics, electrical or thermal conductivity, or decoration. Exhibit_13 illustrates the important parts of typical electroplating

equipment. The most commonly electroplated metals and alloys include: brass (copper-zinc), cadmium, chromium, copper, gold, nickel, silver, tin, and zinc.

In electroplating, metal ions in either acid, alkaline, or neutral solutions are reduced on the workpieces being plated. The metal ions in the solution are usually replenished by the dissolution of metal from solid metal anodes fabricated of the same metal being plated, or by direct replenishment of the solution with metal salts or oxides. Cyanide, usually in the form of sodium or potassium cyanide, is usually used as a complexing agent for cadmium and precious metals electroplating, and to a lesser degree, for other solutions such as copper and zinc baths.

Exhibit 13
Typical Electroplating Equipment

Source: McGraw Hill Encyclopedia of Science and Technology, Volume 6, 1987.

The sequence of steps in an electroplating includes: cleaning, often using alkaline and acid solutions; stripping of old plating or paint; electroplating; and rinsing between and after each of these operations. Sealing and conversion coating may be employed on the metals after electroplating operations.

Electroless Plating

Electroless plating is the chemical deposition of a metal coating onto a plastic object, by immersion of the object in a plating solution. Copper and nickel electroless plating is commonly used for printed circuit boards. The basic ingredients in an electroless plating solution are: a source of metal (usually a salt); a reducer; a complexing agent to hold the metal in solution; and various buffers and other chemicals designed to maintain bath stability and increase bath life. Immersion plating produces a thin metal deposit, commonly zinc or silver, by chemical displacement. Immersion plating baths are usually formulations of metal salts, alkalis, and complexing agents (e.g., lactic, glycolic, malic acid salts). Electroless plating and immersion plating commonly generate more waste than other plating techniques, but individual facilities vary significantly in efficiency. Exhibit 13 illustrates a typical plating process.

Exhibit 14
Electroless Plating Process

Source: Pollution Prevention and Control Technology for Plating Operations, First Edition, National Center for Manufacturing Sciences and National Association of Metal Finishers, 1994.

Painting

Painting involves the application of predominantly *organic* coatings to a workpiece for protective and/or decorative purposes. It is applied in various forms, including dry powder, solvent-diluted formulations, and water-borne formulations. Various methods of application are used, the most common being spray painting and electrodeposition. Spray painting is a process by which paint is placed into a pressurized cup or pot and is atomized into a spray pattern when it is released from the vessel and forced through an orifice. Electrodeposition is the process of coating a workpiece by either making it anodic or cathodic in a bath that is generally an aqueous emulsion of the coating material. When applying the paint as a dry powder, some form of heating or baking is necessary to ensure that the powder adheres to the metal. These processes may result in solvent waste (and associated still bottom wastes generated during solvent distillation), paint sludge wastes, paint-bearing wastewaters, and paint solvent emissions.

Other Metal Finishing Techniques

Polishing, hot dip coating, and etching are processes that are also used to finish metal. Polishing is an abrading operation used to remove or smooth out surface defects (scratches, pits, or tool marks) that adversely affect the appearance or function of a part. Following polishing operations, area cleaning and washdown can produce metal-bearing wastewaters. Hot dip coating is the coating of a metallic workpiece with another metal to provide a protective film by immersion into a molten bath. Galvanizing (hot dip zinc) is a common form of hot dip coating. Water is used for rinses following precleaning and sometimes for quenching after coating. Wastewaters generated by these operations often contain metals. Etching produces specific designs or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Etching solutions commonly comprise strong acids or bases with spent etchants containing high concentrations of spent metal. The solutions include ferric chloride, nitric acid, ammonium persulfate, chromic acid, cupric chloride, and hydrochloric acid.

III.B. Raw Material Inputs and Pollution Outputs in the Production Line

The material inputs and pollution outputs resulting from metal fabrication, surface preparation, and metal finishing processes are presented by media in Exhibit 15. Exhibit 16 illustrates the general processes associated with this industry, the pollutants generated, and the point in the process at which the pollutants are produced.

Exhibit 15
Process Materials Inputs and Outputs

Process	Material Input	Air Emission	Process Wastewater	Solid Waste
Metal Shaping				
Metal Cutting and/or Forming	Cutting oils, degreasing and cleaning solvents, acids, alkalis, and heavy metals	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)	Waste oils (e.g., ethylene glycol) and acid (e.g., hydrochloric, sulfuric, nitric), alkaline, and solvent wastes	Metal chips (e.g., scrap steel and aluminum), metal-bearing cutting fluid sludges, and solvent still-bottom wastes
Surface Preparation				
Solvent Degreasing and Emulsion, Alkaline, and Acid Cleaning	Solvents, emulsifying agents, alkalis, and acids	Solvents (associated with solvent degreasing and emulsion cleaning only)	Solvent, alkaline, and acid wastes	Ignitable wastes, solvent wastes, and still bottoms
Surface Finishing				
Anodizing	Acids	Metal-ion-bearing mists and acid mists	Acid wastes	Spent solutions, wastewater treatment sludges, and base metals
Chemical Conversion Coating	Metals and acids	Metal-ion-bearing mists and acid mists	Metal salts, acid, and base wastes	Spent solutions, wastewater treatment sludges, and base metals
Electroplating	Acid/alkaline solutions, heavy metal bearing solutions, and cyanide bearing solutions	Metal-ion-bearing mists and acid mists	Acid/alkaline, cyanide, and metal wastes	Metal and reactive wastes
Plating	Metals (e.g., salts), complexing agents, and alkalis	Metal-ion-bearing mists	Cyanide and metal wastes	Cyanide and metal wastes
Painting	Solvents and paints	Solvents	Solvent wastes	Still bottoms, sludges, paint solvents, and metals
Other Metal Finishing Techniques (Including Polishing, Hot Dip Coating, and Etching)	Metals and acids	Metal fumes and acid fumes	Metal and acid wastes	Polishing sludges, hot dip tank dross, and etching sludges

Exhibit 16
Fabricated Metal Products Manufacturing Processes

III.B.1. Metal Fabrication

Each of the metal shaping processes can result in wastes containing chemicals of concern. For example, the application of solvents to metal and machinery results in air emissions. Additionally, wastewater containing acidic or alkaline wastes and waste oils, and solid wastes, such as metals and solvents, are usually generated during this process.

Metal fabrication facilities are major users of solvents for degreasing. In cases where solvents are used solely in degreasing (not used in any other plant operations), records of the amount and frequency of purchases provide enough information to estimate emission rates, based on the assumption that all solvent purchased is eventually emitted. Section V.D., Pollution Prevention Options, illustrates techniques that may be used to reduce the loss of solvents to the atmosphere.

Metalworking fluids are applied to either the tool or the metal being tooled to facilitate the shaping operation. Metalworking fluid is used to:

- Control and reduce the temperature of tools and aid lubrication,
- Control and reduce the temperature of workpieces and aid lubrication,
- Provide a good finish,
- Wash away chips and metal debris, and
- Inhibit corrosion or surface oxidation.

Fluids resulting from this process typically become spoiled or contaminated with extended use and reuse. In general, metal working fluids can be petroleum-based, oil-water emulsions, and synthetic emulsions. When disposed, these fluids may contain high levels of metals (e.g., iron, aluminum, and copper). Additional contaminants present in fluids resulting from these processes include acids and alkalis (e.g., hydrochloric, sulfuric, nitric), waste oils, and solvent wastes.

Scrap metal may consist of metal removed from the original piece (e.g., steel), and may be combined with small amounts of metalworking fluids (e.g., solvents) used prior to and during the metal shaping operation that generates the scrap. Quite often, this scrap is reintroduced into the process as a feedstock. The scrap and metalworking fluids, however, should be tracked since they may be regulated as solid wastes.

III.B.2. Surface Preparation

Surface preparation activities usually result in air emissions, contaminated wastewater, and solid wastes. The primary air emissions from cleaning are due to the evaporation of chemicals from solvent degreasing and emulsion cleaning processes. These emissions may result through volatilization of solvents during storage, fugitive losses during use, and direct ventilation of fumes.

Wastewaters generated from cleaning are primarily rinse waters, which are usually combined with other metal finishing wastewaters (e.g., electroplating) and treated on-site by conventional hydroxide precipitation. Solid wastes (e.g., wastewater treatment sludges, still bottoms, cleaning tank residues, machining fluid residues, etc.) may also be generated by the cleaning operations. For example, solid wastes are generated when cleaning solutions become ineffective and are replaced. Solvent-bearing wastes are typically pre-treated to comply with any applicable National Pollutant Discharge System (NPDES) permits and then sent off-site, while aqueous wastes from alkaline and acid cleaning , which do not contain solvents, are often treated on-site.

III.B.3. Metal Finishing

Many metal finishing operations are typically performed in baths (tanks) and are then followed by rinsing cycles. Exhibit 17 illustrates a typical chemical or electrochemical process step in which a workpiece enters the process bath containing process chemicals that are carried to the rinse water (drag-out). Metal plating and related waste account for the largest volumes of metal- (e.g., cadmium, chromium, copper, lead, and nickel) and cyanide-bearing wastes. Painting operations account for the generation of solvent-bearing wastes and the direct release of solvents (including benzene, methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylene). Paint cleanup operations may contribute to the release of chlorinated solvents (including carbon tetrachloride, methylene chloride, 1,1,1-trichloroethane, and perchloroethylene). Compliance with one law through emission or effluent controls may generate waste regulated under another statute (e.g., effluent controls required by the Clean Water Act may generate sludges which are regulated by the Resource Conservation and Recovery Act). The nature of the wastes produced by these processes is discussed further below.

Exhibit 17
Typical Metal Finishing Process Step

Source: Guides to Pollution Prevention: The Metal Finishing Industry, U.S. EPA, ORD, October 1992.

Anodizing

Anodizing operations produce air emissions, contaminated wastewaters, and solid wastes. Mists and gas bubbles arising from heated fluids are a source of air emissions, which may contain metals or other substances present in the bath. When dyeing of anodized coatings occurs, wastewaters produced may contain nickel acetate, non-nickel sealers, or substitutes from the dye. Other potential pollutants include complexers and metals from dyes and sealers. Wastewaters generated from anodizing are usually combined with other metal finishing wastewaters and treated on-site by conventional hydroxide precipitation. Wastewaters containing chromium must be pretreated to reduce hexavalent chromium to its trivalent state. The conventional treatment process generates a sludge that is usually sent off-site for metals reclamation and/or disposal.

Solid wastes generated from anodizing include spent solutions and wastewater treatment sludges. Anodizing solutions may be contaminated with the base metal being processed due to the anodic nature of the process. These solutions eventually reach an intolerable concentration of dissolved metal and require processing to remove the dissolved metal to a tolerable level or treatment/disposal.

Chemical Conversion Coating

Chemical conversion coating generally produces contaminated wastewaters and solid waste. Pollutants associated with these processes enter the wastestream through rinsing and batch dumping of process baths. The process baths usually contain metal salts, acids, bases, and dissolved basis materials. Wastewaters containing chromium are usually pretreated to reduce hexavalent chromium to its trivalent state. The conventional treatment process generates a sludge that is sent off-site for metals reclamation and/or disposal. Solid wastes generated from these processes include spent solutions and wastewater treatment sludges. Conversion coating solutions may also be contaminated with the base metal being processed. These solutions will eventually reach an intolerable concentration of dissolved metal and require processing to remove the dissolved metal to a tolerable level.

Electroplating

Electroplating operations produce air emissions, contaminated wastewaters and solid wastes. Mists arising from electroplating fluids and process gases can be a source of air emissions, which may contain metals or other substances present in the bath. The industry has recently begun adding fume suppressants to electroplating baths to reduce air emissions of chromium, one of the most frequently electroplated metals. The fume suppressants lower the surface tension of the bath, which prevents hydrogen bubbles in the bath from bursting and producing a chromium-laden mist. The fume suppressants are highly effective when used in decorative plating, but less effective when used in hard-chromium plating. Contaminated wastewaters result from workpiece rinsing and process cleanup waters. Rinse waters from electroplating are usually combined with other metal finishing wastewaters and treated on-site by conventional hydroxide precipitation. Wastewaters containing chromium must be pretreated to reduce hexavalent chromium to its trivalent state. These wastewater treatment techniques can result in solid-phase wastewater treatment sludges. Other wastes generated from electroplating include spent solutions which become contaminated during use, and therefore, diminish performance of the process. In addition to these wastes, spent process solutions and quench bathes may be discarded periodically when the concentrations of contaminants inhibit proper function of the solution or bath.

Electroless Plating

Electroless plating produces contaminated wastewater and solid wastes. The spent plating solution and rinse water are usually treated chemically to precipitate out the toxic metals and to destroy the cyanide. Electroless plating solutions can be difficult to treat; settling and simple chemical precipitation are not effective at removing the chelated metals used in the plating bath. The extent to which plating solution carry-over adds to the wastewater and enters the sludge depends on the type of article being plated and the specific plating method employed. However, most sludges may contain significant concentrations of toxic metals, and may also contain complex cyanides in high concentrations if cyanides are not properly isolated during the treatment process.

Painting

Painting operations result in emissions, contaminated wastewaters, and the generation of liquid and solid wastes. Atmospheric emissions consist primarily of the organic solvents used as carriers for the paint. Emissions also result from paint storage, mixing, application, and drying. In addition, cleanup processes can result in the release of organic solvents used to clean equipment and painting areas. Wastewaters are often generated from painting processes due primarily to the discharge of water from water curtain booths. On-site treatment processes to treat contaminated wastewater generate a sludge that is sent off-site for disposal. Sources of solid- and liquid-phase wastes include:

- Paint application emissions control devices (e.g., paint booth collection systems, ventilation filters, etc.)
- Equipment washing
- Disposal materials used to contain paint and overspray
- Excess paints discarded upon completion of a painting operation or after expiration of the paint shelf-life.

These solid and liquid wastes may contain metals from paint pigments and organic solvents, such as paint solvents and cleaning solvents. Still bottoms also contain solvent wastes. The cleaning solvents used on painting equipment and spray booths may also contribute organic solid waste to the wastes removed from the painting areas.

Other Metal Finishing Techniques

Wastewaters are often generated during other metal finishing processes. For example, following polishing operations, area cleaning and washdown can produce metal-bearing wastewaters. Hot dip coating techniques, such as galvanizing, use water for rinses following pre-cleaning and sometimes for quenching after coating. Hot dip coatings also generate solid waste, anoxide dross, that is periodically skimmed off the heated tank. These operations generate metal-bearing wastewaters. Etching solutions are comprised of strong acids (e.g., ferric chloride, nitric acid, ammonium persulfate) or bases. Resulting spent etchant solutions may contain metals and acids.

III.C. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 18 shows that the fabricated metals industry managed about 798 million pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 34 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 62 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (13.2 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site is projected to decrease and the portions treated or managed through energy recovery on-site have increased between 1992 and 1995 (projected).

Exhibit 18
Source Reduction and Recycling Activity for SIC 34

A	B	C	D	E	F	G	H	I	J
Year	**Production Related Waste Volume (10^6lbs.)***	% Reported as Released and Transferred	**On-Site**			**Off-Site**			**Remaining Releases and Disposal**
			% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	
1992	750	38%	23.22%	12.24%	23.11%	26.03%	1.57%	2.02%	12.05%
1993	798	34%	26.48%	11.04%	24.24%	21.31%	1.54%	2.10%	13.28%
1994	735	—	27.91%	8.90%	26.33%	22.18%	1.53%	2.32%	10.84%
1995	697	—	19.20%	13.86%	27.78%	23.94%	1.63%	2.46%	11.13%

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Fabricated Metal Products Industry

TRI release amounts listed below are not associated with non-compliance with environmental laws. These facilities appear based on self-reported data submitted to the Toxic Release Inventory program.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear in Exhibit 19. Exhibit 20 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, Exhibit 20 includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibits 21 - 24 illustrate the TRI releases and transfers for the Fabricated Metal Products industry (SIC 34). For the industry as a whole, solvents comprise the largest number of TRI releases. This reflects the fact that solvents are used during numerous metal shaping, surface preparation, and surface finishing operations. For example, during metal shaping and surface preparation operations, solvents are used primarily to degrease metal. Solvents are also used during painting operations. All of the processes which use solvents generally result in air emissions, contaminated wastewater, and solid wastes.

Between 1988 and 1993, the Fabricated Metals Products industry substantially reduced its TRI transfers and releases (see section V. Pollution Prevention Opportunities). Exhibits 21 and 22 show the differences in transfers and releases over time, categorized by type of transfer or release.

Exhibit 19 lists the ten facilities with the highest total TRI releases, most of which are continuous coil manufacturers (e.g., facilities that manufacture aluminum cans from long strips of metal). The wastes generated by these manufacturers are not necessarily representative of the wastes generated by the metal fabricating and finishing industries as a whole.

Exhibit 19
Top 10 TRI Releasing Fabricated Metal Products Facilities

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3411	946,923	U.S. Can Co., Plant 20 Weirton	Weirton	WV
3411	880,500	Metal Container Corp., NWB	New Windsor	NY
3710, 3714, 3465	822,902	GMC NAO Flint OPS., BOC Flint Automotive Div.	Flint	MI
3471	708,285	Plastene Supply Co.	Portageville	MO
3731, 3441, 3443	688,540	Ingalls Shipbuilding, Inc.	Pascagoula	MS
3411	636,126	American National Can Co., Winston Salem Plant	Winston-Salem	NC
3411	624,250	Metal Container Corp. FTA	Fort Atkinson	WI
3479	619,436	Ken-Koat, Inc.	Huntington	IN
3714, 3471	618,359	Keeler Brass Automotive, Kentwood Plant	Grand Rapids	MI
3341, 3479, 3355	570,622	Commonwealth Aluminum Corp.	Lewisport	KY

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 20
Top 10 TRI Releasing Metal Fabricating & Finishing Facilities (SIC 34)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	946,923	U.S. Can Co., Plant 20, Weirton	Weirton	WV
2	880,500	Metal Container Corp., NWB	New Windsor	NY
3	708,285	Plastene Supply Co.	Portageville	MO
4	636,126	American National Can Co., Winston Salem Plant	Winston-Salem	NC
5	624,250	Metal Container Corp.	Fort Atkinson	WI
6	619,436	Ken-Koat, Inc.	Huntington	IN
7	545,505	Metal Container Corp.	Columbus	OH
8	541,654	Reynolds Metals Co.	Houston	TX
9	524,346	Hickory Springs Mfg. Co.	Fort Smith	AR
10	492,872	Tennessee Electroplating, Inc.	Ripley	TN

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 21
Reductions in TRI Releases, 1988-1993 (SIC 34)

Releases	1988	1993	Percent Reduction
Total Air Emissions	131,296,827	90,380,667	31.2
Surface Water Discharges	1,516,905	101,928	93.3
Underground Injection	386,120	1,490	99.6
Releases to Land	4,202,919	660,072	84.4

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 22
Reductions in TRI Transfers, 1988-1993 (SIC 34)

Transfers	1988	1993	Percent Reduction
Recycling	213,214,641	244,278,696	-14.6
Energy	12,331,653	13,812,271	-12.0
Treatment	34,313,199	18,561,504	45.9
POTWs	17,149,495	3,809,715	77.8
Disposal	43,529,628	19,736,496	54.7
Other Off-Site Transfers	8,303,148	369,491	95.5

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 23
TRI Reporting Metal Fabricating & Finishing Facilities (SIC 34) by State

State	Number of Facilities	State	Number of Facilities
AL	54	MS	29
AR	25	NC	35
AS	1	NE	9
AZ	17	NH	5
CA	208	NJ	60
CO	19	NV	3
CT	83	NY	101
DE	2	OH	225
FL	36	OK	29
GA	42	OR	20
HI	2	PA	123
IA	30	PR	10
ID	1	RI	30
IL	230	SC	37
IN	111	SD	3
KS	16	TN	47
KY	41	TX	107
LA	12	UT	15
MA	76	VA	30
MD	17	WA	24
ME	5	WI	103
MI	159	WV	16
MN	59	WY	2
MO	54		

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 24
Releases for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Sulfuric Acid	861	186135	149329	41032	547	54700	431743	501
Hydrochloric Acid	652	264628	265452	505	250	255	531090	815
Nitric Acid	390	81650	216384	1510	76	0	299620	768
Xylene (Mixed Isomers)	336	2982600	5985667	25	0	553	8968845	26693
Nickel	311	23285	8126	3558	0	6121	41090	132
Chromium	287	25150	6072	2162	0	30345	63729	222
Manganese	271	29884	9536	834	250	30994	71498	264
Glycol Ethers	269	4990228	13281181	5	0	5	18271419	67923
Copper	267	19231	20632	2795	0	763	43421	163
Methyl Ethyl Ketone	254	2134002	4511723	555	0	71335	6717615	26447
Zinc Compounds	228	87045	55641	13561	0	95457	251704	1104
N-Butyl Alcohol	215	3209678	7372875	0	0	5	10582558	49221
Toluene	205	1366663	3325311	7	0	300	4692281	22889
1-Trichloroethane	189	2046210	2727842	10	0	133	4774195	25260
Trichloroethylene	185	2410195	2903856	51	0	6600	5320702	28761
Chromium Compounds	176	7039	13687	1035	0	15574	37335	212
Phosphoric Acid	175	49587	32213	0	319	0	82119	469
Nickel Compounds	158	7538	9311	876	48	1530	19303	122
Methyl Isobutyl Ketone	114	501363	1156914	5	0	5	1658287	14546
Cyanide Compounds	103	7686	8960	298	0	283	17227	167
Copper Compounds	93	4912	6028	1398	0	256	12594	135
Lead	83	5758	4400	809	0	254	11221	135
Ammonia	79	87916	412960	250	0	0	501126	6343
Ethylbenzene	74	234540	308927	5	0	0	543472	7344
Hydrogen Fluoride	74	12924	27671	0	0	0	40595	549
Zinc (Fume Or Dust)	70	100770	41693	290	0	10146	152899	2184
Acetone	61	407417	1090972	0	0	0	1498389	24564
Manganese Compounds	58	2197	795	0	0	12785	15777	272
Dichloromethane	57	991302	1159594	5	0	6829	2157730	37855
4-Trimethylbenzene	53	255913	319541	5	0	0	575459	10858
Tetrachloroethylene	49	809152	434749	22	0	0	1243923	25386
Methanol	48	64182	182883	0	0	0	247065	5147
Chlorine	40	9181	1021	15	0	0	10217	255
Methylenebis(Phenylisocyanate)	35	2562	1179	0	0	0	3741	107
Naphthalene	33	57791	70271	0	0	0	128062	3881
Cobalt	28	1534	1608	755	0	500	4397	157
Barium Compounds	25	3606	803	250	0	3114	7773	311
Freon 113	19	282200	102624	0	0	0	384824	20254
Lead Compounds	19	967	1840	38	0	0	2845	150
Styrene	17	154377	25726	0	0	0	180103	10594
Cadmium	16	62	6	5	0	250	323	20
Formaldehyde	16	15561	9618	209	0	0	25388	1587
Aluminum (Fume Or Dust)	13	7042	506	0	0	0	7548	581

Trichlorofluoro-methane	13	45312	122318	0	0	250	167880	12914
Cadmium Compounds	11	276	266	0	0	0	542	49
Ethylene Glycol	11	37417	160907	0	0	0	198324	18029
Propylene	11	25423	771	0	0	0	26194	2381
Cumene	9	10383	24238	5	0	0	34626	3847
2-Ethoxyethanol	8	14361	19390	0	0	0	33751	4219
Cyclohexane	7	611237	55929	0	0	0	667166	95309
Isopropyl Alcohol (Manufacturing	6	22111	29351	0	0	0	51462	8577
Antimony Compounds	5	4505	661	260	0	0	5426	1085
Cobalt Compounds	5	2	113	37	0	9	161	32
M-Xylene	5	898	12297	0	0	0	13195	2639
Antimony	4	0	423	0	0	0	423	106

Exhibit 24 (cont'd)
Releases for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Bis(2-Ethylhexyl) Adipate	4	8850	14000	0	0	0	22850	5713
Dimethyl Phthalate	4	2407	6387	0	0	0	8794	2199
Phenol	4	12922	0	3	0	0	12925	3231
Sec-Butyl Alcohol	4	6350	19600	0	0	0	25950	6488
Aluminum Oxide (Fibrous Form)	3	250	250	0	0	0	500	167
Di(2-Ethylhexyl) Phthalate	3	250	3000	0	0	5	3255	1085
Dichlorodifluoro-methane	3	7406	16443	0	0	0	23849	7950
Silver	3	5	0	5	0	0	10	3
Asbestos (Friable)	2	10	0	0	0	0	10	5
Barium	2	5	0	0	0	0	5	3
Butyl Benzyl Phthalate	2	0	0	0	0	0	0	0
Diethyl Phthalate	2	255	250	0	0	0	505	253
Molybdenum Trioxide	2	250	0	0	0	2000	2250	1125
O-Xylene	2	0	37928	0	0	0	37928	18964
Phosphorus (Yellow Or White)	2	10	5	5	0	0	20	10
Toluenediisocyanate (Mixed Isomers)	2	5	148	0	0	0	153	77
2-Methoxyethanol	2	255	24825	0	0	0	25080	12540
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Ammonium Sulfate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	0	0	0	0	5	5
Benzene	1	3122	836	0	0	0	3958	3958
Diethanolamine	1	0	0	0	0	0	0	0
Ethyl Acrylate	1	0	2578	0	0	0	2578	2578
Mercury	1	5	0	0	0	0	5	5
P-Xylene	1	0	22	0	0	0	22	22
Polychlorinated Biphenyls	1	0	0	0	0	0	0	0
Propane Sultone	1	250	0	0	0	0	250	250
Selenium	1	5	0	0	0	0	5	5
Silver Compounds	1	250	250	0	0	0	500	500
2-Dichlorobenzene	1	12000	0	0	0	0	12000	12000
2-Nitropropane	1	186	182	0	0	0	368	368
4'-Isopropylidenediphenol	1	0	250	0	0	0	250	250
Totals	----	24,768,891	46,819,995	73,195	1,490	351,356	72,014,927	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 25
Transfers for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sulfuric Acid	861	1132535	2871580	4011148	4636541	0	12651804	14694
Hydrochloric Acid	652	446440	2768870	1472808	3169967	0	7935080	12170
Nitric Acid	390	37256	309134	946756	623265	0	1916411	4914
Xylene (Mixed Isomers)	336	51	10852	1661765	332850	2139660	4151607	12356
Nickel	311	17355	367278	8848547	464008	0	9727271	31277
Chromium	287	30170	465237	10143210	422090	10	11121986	38753
Manganese	271	5093	834964	8774505	8299	0	9623861	35512
Glycol Ethers	269	385087	55411	824664	142591	2295807	3746528	13928
Copper	267	8784	653024	53401212	60924	667	54124861	202715
Methyl Ethyl Ketone	254	141	32971	2787367	268783	4002200	7107644	27983
Zinc Compounds	228	31969	4797726	23980836	2004640	3249	30847198	135295
N-Butyl Alcohol	215	13302	9306	100928	43711	306263	497761	2315
Toluene	205	93	31782	603704	277628	1892116	2805323	13685
1-Trichloroethane	189	65	34508	1342465	128708	101194	1606940	8502
Trichloroethylene	185	1083	34070	1045702	371432	102092	1554379	8402
Chromium Compounds	176	18099	721452	1222505	500300	2981	2490098	14148
Phosphoric Acid	175	268375	300139	5805346	280512	0	6669606	38112
Nickel Compounds	158	21635	463522	1839379	549790	6	2879204	18223
Methyl Isobutyl Ketone	114	5	1407	813193	30029	471629	1316263	11546
Cyanide Compounds	103	19581	17461	12188	140767	0	190497	1849
Copper Compounds	93	13826	341003	11781033	205196	7	12341065	132700
Lead	83	1160	78382	2392024	10184	281	2482031	29904
Ammonia	79	31527	1030	750	260	0	33567	425
Ethylbenzene	74	5	2	170492	14164	227471	412134	5569
Hydrogen Fluoride	74	382	2581	0	16618	0	19581	265
Zinc (Fume Or Dust)	70	75982	219289	666508	120336	61242	1143857	16341
Acetone	61	5	19917	705690	173168	134723	1033503	16943
Manganese Compounds	58	302	221084	1243001	1299	0	1465686	25270
Dichloromethane	57	647	5	289636	73238	26737	390263	6847
4-Trimethylbenzene	53	5	5	23532	10506	58127	92175	1739
Tetrachloroethylene	49	65	6344	555166	129891	6692	698158	14248
Methanol	48	29686	0	35726	34952	80494	180858	3768
Chlorine	40	4470	750	250	6226	0	11696	292
Methylenebis(Phenylisocyanate)	35	0	25420	250	7014	500	33184	948
Naphthalene	33	0	70	34926	14821	39431	89248	2704
Cobalt	28	319	10978	405387	753	0	440451	15730
Barium Compounds	25	12	56251	2079	20823	0	79165	3167
Freon 113	19	0	0	93230	21794	1917	116941	6155

Lead Compounds	19	797	198398	798893	1590	501	1000179	52641
Styrene	17	0	12000	1180	750	250	14180	834
Cadmium	16	1829	8006	9432	31506	0	50773	3173
Formaldehyde	16	41510	5	0	1611	7202	50328	3146
Aluminum (Fume Or Dust)	13	500	250	157757	5460	0	163967	12613
Trichlorofluoro-methane	13	0	7374	0	4263	0	11637	895
Cadmium Compounds	11	1288	65324	27000	42512	0	136124	12375
Ethylene Glycol	11	22685	86000	17100	19170	3110	148065	13460
Propylene	11	0	0	0	0	0	0	0
Cumene	9	5	0	2020	441	5618	8084	898
2-Ethoxyethanol	8	5	0	516	0	2600	3121	390
Cyclohexane	7	0	750	0	1250	255	2255	322

Exhibit 25 (cont'd)
Transfers for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Isopropyl Alcohol (Manufacturing	6	0	613	97513	15	5688	103829	17305
Antimony Compounds	5	10	104158	0	1104	0	105272	21054
Cobalt Compounds	5	15	18403	41566	5	1	59990	11998
M-Xylene	5	0	0	0	109	3819	3928	786
Antimony	4	0	0	3187	375	0	3562	891
Bis(2-Ethylhexyl) Adipate	4	6400	3145	0	0	0	9545	2386
Dimethyl Phthalate	4	0	0	0	269	1802	2071	518
Phenol	4	250	1176	0	0	0	1426	357
Sec-Butyl Alcohol	4	0	0	0	840	250	1090	273
Aluminum Oxide (Fibrous Form)	3	0	0	25000	0	0	25000	8333
Di(2-Ethylhexyl) Phthalate	3	5	8440	0	0	0	8445	2815
Dichlorodifluoromethane	3	0	0	0	0	0	0	0
Silver	3	10	15	250	0	0	275	92
Asbestos (Friable)	2	0	73822	0	0	0	73822	36911
Barium	2	5	10	0	0	0	15	8
Butyl Benzyl Phthalate	2	0	0	0	0	0	0	0
Diethyl Phthalate	2	500	0	2052	2061	0	4613	2307
Molybdenum Trioxide	2	0	419	3900	0	0	4319	2160
O-Xylene	2	0	0	0	61	0	61	31
Phosphorus (Yellow Or White)	2	0	0	12250	0	0	12250	6125
Toluenediisocyanate (Mixed Isomers)	2	0	0	0	0	1374	1374	687
2-Methoxyethanol	2	5	0	0	0	8520	8525	4263
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Ammonium Sulfate (Solution)	1	128241	0	0	0	0	128241	128241
Arsenic	1	5	10	0	0	0	15	15
Benzene	1	0	0	0	0	0	0	0
Diethanolamine	1	0	0	440	0	0	440	440
Ethyl Acrylate	1	0	0	0	0	0	0	0
Mercury	1	5	10	0	0	0	15	15
P-Xylene	1	0	0	0	51	0	51	51
Polychlorinated Biphenyls	1	0	0	0	2286	0	2286	2286
Propane Sultone	1	0	0	0	0	0	0	0
Selenium	1	5	10	0	0	0	15	15
Silver Compounds	1	250	0	4000	0	0	4250	4250
2-Dichlorobenzene	1	0	0	0	0	0	0	0
2-Nitropropane	1	0	0	0	95	103	198	198

4'-Isopropylidene-diphenol	1	0	250	0	0	0	250	250
Totals	**----**	**2,800,087**	**16,352,393**	**149,241,964**	**15,433,902**	**12,002,720**	**196,188,152**	**----**

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibits 26 - 29 illustrate the TRI releases and transfers for the coating, engraving, and allied services portion (SIC 347) of the fabricated metal products industry. For these activities, solvents, as well as acids, constitute the largest number of TRI releases. Solvents are primarily used during painting operations, while acids are used during most finishing operations (e.g., anodizing, chemical conversion coating, electroplating). The solvents usually produce air emissions, contaminated wastewater, and solid-phase wastes, while the acids generally result in contaminated wastewater. Because NPDES permits do not allow low PH levels, the wastewater is pretreated to reduce the acidity prior to being discharged from the facility.

Exhibit 26
Top 10 TRI Releasing Metal Finishing Facilities (SIC 347)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	708,285	Plastene Supply Co.	Portageville	MO
2	619,436	Ken-Koat, Inc.	Huntington	IN
3	492,872	Tennessee Electroplating, Inc.	Ripley	TN
4	430,781	SR of Tennessee	Ripley	TN
5	418,912	Ken-Koat of Tennessee, Inc., Plant 1	Lewisburg	TN
6	408,628	Anomatic Corp.	Newark	OH
7	406,419	Roll Coater, Inc.	Greenfield	IN
8	381,788	Reynolds Metals Co., Sheffield Plant	Sheffield	AL
9	368,014	Roll Coater, Inc.	Kingsbury	IN
10	344,572	Mottley Foils, Inc.	Farmville	VA

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 27
TRI Reporting Metal Finishing Facilities (SIC 347) by State

State	Number of Facilities	State	Number of Facilities
AL	19	MO	23
AR	4	MS	6
AZ	9	NC	11
CA	117	NE	1
CO	11	NH	1
CT	36	NJ	27
DE	1	NY	43
FL	14	OH	112
GA	14	OK	9
HI	1	OR	11
IA	6	PA	41
IL	121	PR	4
IN	49	RI	23
KS	7	SC	9
KY	13	TN	17
LA	5	TX	48
MA	39	UT	4
MD	7	VA	7
ME	1	WA	14
MI	109	WI	35
MN	36	WV	4

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 28
Releases for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Sulfuric Acid	577	159575	103935	38232	0	54450	356192	617
Hydrochloric Acid	490	229596	186461	505	250	255	417067	851
Nitric Acid	290	51229	140639	1510	0	0	193378	667
Zinc Compounds	158	75329	23316	12202	0	93054	203901	1291
Phosphoric Acid	120	24772	26993	0	0	0	51765	431
Methyl Ethyl Ketone	103	945484	2251059	555	0	71335	3268433	31732
Chromium Compounds	101	4572	10765	625	0	15	15977	158
Nickel Compounds	95	5821	4572	564	0	0	10957	115
Cyanide Compounds	87	6759	4098	224	0	283	11364	131
Nickel	87	4685	3257	1433	0	500	9875	114
Trichloroethylene	81	844061	847701	20	0	0	1691782	20886
Xylene (Mixed Isomers)	79	395089	1226943	5	0	0	1622037	20532
1,1,1-Trichloroethane	73	763993	817417	5	0	0	1581415	21663
Toluene	69	375222	1566048	5	0	300	1941575	28139
Glycol Ethers	59	344040	1463579	0	0	0	1807619	30638
Copper	54	880	3508	1646	0	0	6034	112
Chromium	48	2517	2372	131	0	255	5275	110

N-Butyl Alcohol	44	114102	188305	0	0	0	302407	6873
Copper Compounds	43	2874	1955	207	0	0	5036	117
Ammonia	35	75738	11644	0	0	0	87382	2497
Chlorine	32	5828	1011	5	0	0	6844	214
Lead	31	89	1715	536	0	0	2340	75

Exhibit 28 (cont'd)
Releases for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Methyl Isobutyl Ketone	30	127088	269586	0	0	0	396674	13222
Tetrachloroethylene	25	401718	211664	0	0	0	613382	24535
Acetone	21	166232	250318	0	0	0	416550	19836
Ethylbenzene	20	46499	68675	0	0	0	115174	5759
Naphthalene	20	25677	52326	0	0	0	78003	3900
Zinc (Fume Or Dust)	20	14713	405	0	0	0	15118	756
1,2,4-Trimethylbenzene	20	87617	118935	0	0	0	206552	10328
Dichloromethane	15	420391	395882	5	0	0	816278	54419
Formaldehyde	15	14409	8992	209	0	0	23610	1574
Methanol	15	53243	138202	0	0	0	191445	12763
Cadmium	13	57	6	0	0	0	63	5
Barium Compounds	12	1601	482	0	0	0	2083	174
Hydrogen Fluoride	10	6216	3208	0	0	0	9424	942
Cadmium Compounds	9	266	11	0	0	0	277	31
Manganese	8	21	69	0	0	0	90	11
Cumene	7	9178	18933	0	0	0	28111	4016
Cobalt	6	12	542	5	0	0	559	93
Freon 113	6	93785	0	0	0	0	93785	15631
Lead Compounds	5	255	500	0	0	0	755	151
Manganese Compounds	4	15	5	0	0	0	20	5
Methylenebis (Phenylisocyanate)	4	5	150	0	0	0	155	39
Aluminum (Fume Or Dust)	3	250	250	0	0	0	500	167
Antimony	3	0	418	0	0	0	418	139
Dimethyl Phthalate	3	2407	5438	0	0	0	7845	2615
Ethylene Glycol	3	1160	18552	0	0	0	19712	6571
Propylene	3	503	516	0	0	0	1019	340
Aluminum Oxide (Fibrous Form)	2	0	0	0	0	0	0	0
Isopropyl Alcohol (Manufacturing)	2	250	15000	0	0	0	15250	7625
M-Xylene	2	0	6109	0	0	0	6109	3055
Sec-Butyl Alcohol	2	1000	3000	0	0	0	4000	2000
Silver	2	5	0	0	0	0	5	3
2-Methoxyethanol	2	255	24825	0	0	0	25080	12540
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	0	0	0	0	5	5
Barium	1	0	0	0	0	0	0	0
Bis(2-Ethylhexyl) Adipate	1	0	0	0	0	0	0	0
Ethyl Acrylate	1	0	2578	0	0	0	2578	2578
Mercury	1	5	0	0	0	0	5	5
O-Xylene	1	0	37911	0	0	0	37911	37911
Phenol	1	12000	0	0	0	0	12000	12000
Selenium	1	5	0	0	0	0	5	5
Silver Compounds	1	250	250	0	0	0	500	500
Trichlorofluoromethane	1	5	12000	0	0	0	12005	12005
1,2-Dichlorobenzene	1	12000	0	0	0	0	12000	12000
2-Ethoxyethanol	1	250	7000	0	0	0	7250	7250
2-Nitropropane	1	186	182	0	0	0	368	368
4,4-Isopropylidenediphenol	1	0	250	0	0	0	250	250

Total	**----**	**5,931,789**	**10,560,463**	**58,629**	**250**	**220,447**	**16,771,578**	**----**

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 29
Transfers for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sulfuric Acid	577	804908	1947304	3112900	2266082	0	8131194	14092
Hydrochloric Acid	490	382255	2691567	1467208	3058084	0	7676109	15666
Nitric Acid	290	32756	274177	822830	562997	0	1692760	5837
Zinc Compounds	158	25225	4286331	16726872	1865137	2994	22906591	144978
Phosphoric Acid	120	160428	296366	5126632	120242	0	5718883	47657
Methyl Ethyl Ketone	103	10	0	2060497	110831	1994068	4181588	40598
Chromium Compounds	101	14423	594848	249365	364291	2980	1244457	12321
Nickel Compounds	95	17937	375149	1171327	501971	0	2066384	21751
Cyanide Compounds	87	18577	16451	12127	126143	0	173798	1998
Nickel	87	12239	255282	777750	399252	0	1445523	16615
Trichloroethylene	81	353	4873	214013	103537	63712	386488	4771
Xylene (Mixed Isomers)	79	10	2465	373083	110740	499378	985676	12477
1,1,1-Trichloroethane	73	45	1090	359456	30856	25528	416975	5712
Toluene	69	6	3248	323174	212714	912937	1452079	21045
Glycol Ethers	59	206381	4168	209411	44590	530166	994966	16864
Copper	54	3810	215903	4247604	14524	0	4481841	82997
Chromium	48	4297	253964	245168	402593	0	923657	19243
N-Butyl Alcohol	44	13300	1615	19334	19951	68165	122365	2781
Copper Compounds	43	8404	109090	3397732	118222	0	3633448	84499
Ammonia	35	19727	260	0	255	0	20242	578
Chlorine	32	4210	750	250	6221	0	11431	357
Lead	31	61	10814	428225	7169	0	446269	14396
Methyl Isobutyl Ketone	30	0	0	467583	8208	70164	545955	18199
Tetrachloroethylene	25	20	0	198381	10999	4542	213942	8558
Acetone	21	5	0	482911	134524	37649	655089	31195
Ethylbenzene	20	0	0	95670	2795	67994	166459	8323
Naphthalene	20	0	0	1000	7046	23833	31879	1594
Zinc (Fume Or Dust)	20	4580	9250	181479	75065	0	270624	13531
1,2,4-Trimethylbenzene	20	0	0	12825	8538	37488	58851	2943
Dichloromethane	15	377	0	92499	22453	15138	130467	8698
Formaldehyde	15	41510	5	0	1588	7202	50305	3354
Methanol	15	29686	0	1513	34930	56354	122483	8166
Cadmium	13	1814	6186	9432	31256	0	48688	3745
Barium Compounds	12	5	26665	29	7756	0	34455	2871
Hydrogen Fluoride	10	0	2581	0	16618	0	19199	1920
Cadmium Compounds	9	1287	65319	27000	250	0	93856	10428
Manganese	8	889	851	113	1751	0	3604	451
Cumene	7	0	0	2020	400	5618	8038	1148
Cobalt	6	30	7590	1431	193	0	9244	1541
Freon 113	6	0	0	3900	0	0	3900	650
Lead Compounds	5	751	1520	42677	319	0	45267	9053
Manganese Compounds	4	5	22024	87789	0	0	109818	27455
Methylenebis (Phenylisocyanate)	4	0	0	0	0	0	0	0
Aluminum (Fume Or Dust)	3	250	0	0	5460	0	5710	1903
Antimony	3	0	0	1955	375	0	2330	777
Dimethyl Phthalate	3	0	0	0	269	1802	2071	690
Ethylene Glycol	3	5	0	0	250	994	1249	416
Propylene	3	0	0	0	0	0	0	0

Aluminum Oxide (Fibrous Form)	2	0	0	25000	0	0	25000	12500
Isopropyl Alcohol (Manufacturing)	2	0	0	87932	0	2300	90232	45116
M-Xylene	2	0	0	0	0	0	0	0
Sec-Butyl Alcohol	2	0	0	0	0	0	0	0
Silver	2	5	10	250	0	0	265	133
2-Methoxyethanol	2	5	0	0	0	8520	8525	4263

Exhibit 29 (cont'd)
Transfers for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	10	0	0	0	15	15
Barium	1	5	10	0	0	0	15	15
Bis(2-Ethylhexyl) Adipate	1	0	250	0	0	0	250	250
Ethyl Acrylate	1	0	0	0	0	0	0	0
Mercury	1	5	10	0	0	0	15	15
O-Xylene	1	0	0	0	20	0	20	20
Phenol	1	0	0	0	0	0	0	0
Selenium	1	5	10	0	0	0	15	15
Silver Compounds	1	250	0	4000	0	0	4250	4250
Trichlorofluoromethane	1	0	3400	0	0	0	3400	3400
1,2-Dichlorobenzene	1	0	0	0	0	0	0	0
2-Ethoxyethanol	1	5	0	0	0	750	755	755
2-Nitropropane	1	0	0	0	95	103	198	198
4,4-Isopropylidenediphenol	1	0	250	0	0	0	250	250
Totals	**----**	**1,810,861**	**11,491,656**	**43,172,347**	**10,817,560**	**4,440,379**	**71,879,412**	**---**

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of the Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

The top ten TRI releases for the Fabricated Metal Products industry (SIC_34) as a whole include: glycol ethers, n-butyl, xylene, methyl ethyl ketone, trichloroethylene, toluene-1, dichloromethane, methyl isobutyl ketone, acetone, and tetrachloroethylene. The top ten TRI releases for the coating, engraving, and allied services portion of the fabricated metal products industry (SIC 347) include: methyl ethyl ketone, toluene, glycol ethers, trichloroethylene, xylene (mixed isomers), 1,1,1-trichloroethane, dichloromethane, tetrachloroethylene, hydrochloric acid, and methyl isobutyl ketone. Summaries of most of these chemicals follow.

Acetone

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere. Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

Note: Acetone was removed from the list of TRI chemicals on June 16, 1995 (60 FR 31643) and will not be reported for 1994 or subsequent years.

Glycol Ethers

Due to data limitations, data on diethylene glycol (glycol ether) are used to represent all glycol ethers.

Toxicity. Diethylene glycol is only a hazard to human health if concentrated vapors are generated through heating or vigorous agitation or if appreciable skin contact or ingestion occurs over an extended period of time. Under normal occupational and ambient exposures, diethylene glycol is low in oral toxicity, is not irritating to the eyes or skin, is not readily absorbed through the skin, and has a low vapor pressure so that toxic concentrations of the vapor can not occur in the air at room temperatures.

At high levels of exposure, diethylene glycol causes central nervous depression and liver and kidney damage. Symptoms of moderate diethylene glycol poisoning include nausea, vomiting, headache, diarrhea, abdominal pain, and damage to the pulmonary and cardiovascular systems. Sulfanilamide in diethylene glycol was once used therapeutically against bacterial infection; it was withdrawn from the market after causing over 100 deaths from acute kidney failure.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Diethylene glycol is a water-soluble, volatile organic chemical. It may enter the environment in liquid form via petrochemical plant effluents or as an unburned gas from combustion sources. Diethylene glycol typically does not occur in sufficient concentrations to pose a hazard to human health.

Hydrochloric Acid

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Methylene Chloride (Dichloromethane)

Toxicity. Short-term exposure to dichloromethane (DCM) is associated with central nervous system effects, including headache, giddiness, stupor, irritability, and numbness and tingling in the limbs. More severe neurological effects are reported from longer-term exposure, apparently due to increased carbon monoxide in the blood from the break down of DCM. Contact with DCM causes irritation of the eyes, skin, and respiratory tract.

Occupational exposure to DCM has also been linked to increased incidence of spontaneous abortions in women. Acute damage to the eyes and upper respiratory tract, unconsciousness, and death were reported in workers exposed to high concentrations of DCM. Phosgene (a degradation product of DCM) poisoning has been reported to occur in several cases where DCM was used in the presence of an open fire.

Populations at special risk from exposure to DCM include obese people (due to accumulation of DCM in fat), and people with impaired cardiovascular systems.

Carcinogenicity. DCM is a probable human carcinogen via both oral and inhalation exposure, based on inadequate human data and sufficient evidence in animals.

Environmental Fate. When spilled on land, DCM is rapidly lost from the soil surface through volatilization. The remainder leaches through the subsoil into the groundwater.

Biodegradation is possible in natural waters but will probably be very slow compared with evaporation. Little is known about bioconcentration in aquatic organisms or adsorption to sediments but these are not likely to be significant processes. Hydrolysis is not an important process under normal environmental conditions.

DCM released into the atmosphere degrades via contact with other gases with a half-life of several months. A small fraction of the chemical diffuses to the stratosphere where it rapidly degrades through exposure to ultraviolet radiation and contact with chlorine ions. Being a moderately soluble chemical, DCM is expected to partially return to earth in rain.

Methyl Ethyl Ketone

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Toluene

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

1,1,1-Trichloroethane

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Trichloroethylene

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-term trichloroethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation.

Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels of phosgene in the presence of an intense heat source such as an open arc welder.

When spilled on the land, trichloroethylene rapidly volatilizes from surface soils. The remaining chemical leaches through the soil to groundwater.

Xylene (Mixed Isomers)

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylenes can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylenes in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

IV.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 30 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 30
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292

Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	**3,851**	**16,424**	**1,185**	**3,136**	**4,019**	**102,186**
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 31 is a graphical representation of a summary of the 1993 TRI data for the Fabricated Metals Products industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 32 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of Fabricated Metal Products industry, the 1993 TRI data presented here covers 2,363 facilities. These facilities listed SIC 34 (Fabricated Metal Products industry) as a primary SIC code.

Exhibit 31 Bar graph
Summary of 1993 TRI Data

Exhibit 32
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases: Total Releases (10^6 pounds)	Releases: Average Releases per Facility (pounds)	Transfers: 1993 Total (10^6 pounds)	Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics /Computers	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	**333, 334**	**208**	**182.5**	**877,269**	**98.2**	**472,335**	**280.7**	**1,349,000**
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Fabricated Metal Products industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

V.A. Identification of Pollution Prevention Activities in Use and Environmental and Economic Benefits of Each Pollution Prevention Activity

Pollution prevention (sometimes referred to as source reduction) is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water or other resources, and practices that protect natural resources through conservation or more efficient use.

EPA and the Fabricated Metal Products industry are working together to promote pollution prevention because it is often the most cost-effective way to reduce pollution and the associated risks to human health and the environment. Pollution prevention is often cost effective because it may reduce raw material losses; reduce reliance on expensive "end-of-pipe" treatment technologies and disposal practices; conserve energy, water, chemicals, and other inputs; and mitigate the potential liability associated with waste generation and disposal. Pollution prevention often involves complex re-engineering however, and companies must balance the desired savings in materials and benefits to the environment against the cost of changing operating practices.

All companies in the Fabricated Metal Products industry, regardless of their size, must comply with environmental regulations related to metal fabricating and/or metal finishing processes. Therefore, all companies benefit from the knowledge of pollution prevention techniques which, if implemented, may increase a company's ability to meet these requirements. Many large companies have been successful in identifying and implementing pollution prevention and other techniques allowing them to operate in an efficient and environmentally protective manner. This capability may be due in part because large companies often have resources to devote to tracking and implementing pollution prevention techniques, and maintaining an awareness and understanding of regulations that apply to their facilities.

Smaller companies may have limited resources to devote to these activities, which may make monitoring and understanding regulations more difficult and may result in limited pollution prevention participation. Increased awareness and publication of pollution prevention techniques improve the ability of companies to comply with regulations. Pollution prevention techniques also permit industrial processes to be more efficient and less costly, providing all companies with an opportunity to maximize the efficiency of their operations and reduce their costs while protecting the environment.

Pollution Prevention techniques and processes currently used by the metal fabricating and finishing industry can be grouped into seven general categories:

- Production planning and sequencing
- Process or equipment modification
- Raw material substitution or elimination
- Loss prevention and housekeeping
- Waste segregation and separation
- Closed-loop recycling
- Training and supervision.

Each of these categories is discussed briefly below. Refer to Section V.D. for a list of specific pollution prevention techniques and associated costs, savings, and other information. It should be kept in mind that every pollution prevention option may not be available for each facility.

Production planning and sequencing is used to ensure that only necessary operations are performed and that no operation is needlessly reversed or obviated by a following operation. One example is to sort out substandard parts prior to painting or electroplating. A second example is to reduce the frequency with which equipment requires cleaning by painting all products of the same color at the same time. A third example is to schedule batch processing in a manner that allows the wastes or residues from one batch to be used as an input for the subsequent batch (e.g., to schedule paint formulation from lighter shades to darker) so that equipment need not be cleaned between batches.

Process or equipment modification is used to reduce the amount of waste generated. For example, manufacturers can change to a paint application technique that is more efficient than spray painting, reduce overspray by reducing the atomizing air pressure, reduce drag-out by reducing the withdrawal speed of parts from plating tanks, or improve a plating line by incorporating drag-out recovery tanks or reactive rinsing.

Raw material substitution or elimination is the replacement of existing raw materials with other materials that produce less waste, or a non-toxic waste. Examples include substituting alkali washes for solvent degreasers, and replacing oil with lime or borax soap as the drawing agent in cold forming.

Loss prevention and housekeeping is the performance of preventive maintenance and equipment and materials management so as to minimize opportunities for leaks, spills, evaporative losses, and other releases of potentially toxic chemicals. For example, spray guns can be cleaned in a manner that does not damage leather packings and cause the guns to leak; or drip pans can be placed under leaking machinery to allow recovery of the leaking fluid.

Waste segregation and separation involves avoiding the mixture of different types of wastes and avoiding the mixture of hazardous wastes with non-hazardous wastes. This makes the recovery of hazardous wastes easier by minimizing the number of different hazardous constituents in a given waste stream. It also prevents the contamination of non-hazardous wastes. Specific examples include segregating scrap metal by metal type, and segregating different kinds of used oils.

Closed-loop recycling is the on-site use or reuse of a waste as an ingredient or feedstock in the production process. For example, in-plant paper fiber waste can be collected and recycled to make pre-consumer recycled paper products.

Training and supervision provides employees with the information and the incentive to minimize waste generation in their daily duties. This might include ensuring that employees know and practice proper and efficient use of tools and supplies, and that they are aware of, understand, and support the company's pollution prevention goals.

V.B. Possible Pollution Prevention Future Trends

There are numerous pollution prevention trends in the metal fabrication and finishing industry. These include recycling liquids, employing better waste control techniques, using mechanical forms of surface preparation, and/or substituting raw materials. One major trend is the increased recycling (e.g., reuse) of most process liquids (e.g., rinse water, acids, alkali cleaning compounds, solvents, etc.) used during the metal forming and finishing processes. For instance, instead of discarding liquids, companies are containing them and reusing them to cut down on the volume of process liquids that must eventually be disposed of. Also, many companies are replacing aqueous plating with ion vapor deposition.

Another common approach to reducing pollution is to reduce rinse contamination via drag-out by slowing and smoothing the removal of parts (rotating them if necessary), maximizing drip time, using drainage boards to direct dripping solutions back to process tanks, and/or installing drag-out recovery tanks to capture dripping solutions. By slowing down the processes and developing structures to contain the dripping solutions, a facility can better control the potential wastes emitted.

To reduce the use of acids when cleaning parts, the industry is using and encouraging the use of mechanical scraping/scrubbing techniques to clean and prepare the metal surface. Emphasizing mechanical approaches would greatly diminish the need for acids, solvents, and alkalis. In addition to the mechanical technique for cleaning surfaces, companies are encouraged to substitute acids and solvents with less harmful liquids (e.g., alcohol). Section V.D. lists numerous specific pollution prevention techniques that have been employed in the industry.

V.C. Pollution Prevention Case Studies

Numerous pollution prevention case histories have been documented for the metal fabricating and finishing industries. Many of these have dealt primarily with electroplating or general finishing operations. The Eastside Plating case, presented in this section, is a classic example of the numerous pollution prevention techniques that can be implemented at an electroplating company. For other pollution prevention case studies, see section V.D. Pollution Prevention Options, and the list of pollution prevention contacts in section V.E.

Eastside Plating, an Oregon-based company, has made money complying with new environmental regulations. Under the direction of its Maintenance and Water Treatment Manager, the electroplating firm implemented operational changes that save more than $300,000 annually. Eastside Plating management made the commitment to implement a hazardous waste reduction program in 1982. By changing rinsing techniques, substituting materials, and segregating wastes for treatment, the firm has become a more cost-effective operation.

By setting priorities and upgrading in phases, the firm was able to work toward compliance yet meet increased demand for services during a period of rapid growth. The first operational modification addressed counterflow and cascade rinsing systems. The changes decreased water used for rinsing, a process that accounts for 90 percent of all water used in electroplating. In counterflow rinsing, water is used a number of times, thus dramatically reducing volume. Cascade rinsing requires only one tank with a center divider which allows water to spill into the other side. The filling/draining process is continuous and very slow to reduce the amount of water used. Both systems cut water bills and wastewater treatment costs.

Management next searched for waste treatment chemicals that decreased, rather than increased, the production of sludge. Total chromium and cyanide wastes were cut in half simply by changing reducing agents. Chromium acid wastes are now oxidized by using sodium bisulfite and sulfuric acid instead of ferrous sulfate, while cyanide reduction is now accomplished more efficiently with gaseous, instead of liquid, chlorine.

Eastside Plating also upgraded its three major waste treatment components: the cyanide oxidation tank, the chromium reduction tank, and the acid/alkaline neutralizing tank. The goal was to separate tank flow, eliminate contamination of the acid/alkaline neutralizing tank, and increase efficiency. Automated metering equipment reduced the quantity of costly caustic chemicals needed to treat acid wastes by 50 percent. To eliminate the risks associated with pump failure and the equalize flow rate, cyanide and chromic acid oxidation and reduction tanks were redesigned as gravity flow systems. Additionally, plumbing was segregated to prevent cross-contamination. These simple solutions saved Eastside Plating hundreds of thousands of dollars.

Next, management consulted with suppliers when they modified the company's mixing sump (sometimes called a reaction tank) and a flocculent mix tank (sometimes called a neutralizing tank). The modification to each prohibits 'indigestion' in the mixing sump interfering with the neutralization process. The suppliers helped resolve the problems of inadequate mixing by baffling the neutralization tank.

Since employees can make or break the best anti-pollution plan, Eastside Plating offers an extensive employee education program. The company says "it's a matter of changing how we do business." In addition, Eastside Plating's Safety Committee helps all employees work together more safely. Additionally, the company reported that working with regulators helped the company make the move toward compliance: "The City of Portland and the Department of Environmental Quality were more interested in helping us solve our problems than in blaming us."

Industry Pollution Prevention Activities

Several pollution prevention initiatives focus on the fabricated metal products industry. As identified below, some efforts include Georgia's Pollution Prevention Assistance Division (P^2AD) strategy, the Industrial Technology Corporation collaborative effort, and the Merit Partnership.

Georgia Department of Natural Resources

A core strategy of the Pollution Prevention Assistance Division (P^2AD) of the Georgia Department of Natural Resources (DNR) is to focus technical assistance efforts on Georgia manufacturers that release chemicals posing the greatest risk to the public and the environment. After reviewing those industries which provide significant opportunities for pollution prevention, various strategies will be developed, including on-site technical assistance, financial assistance, fact sheets, workshops, and other outreach activities that will help manufacturers reduce their generation of toxic chemicals. The first phase is an on-going targeting effort, which evaluates waste generation characteristics of Georgia manufacturers producing toxic and hazardous wastes. The fabricated metal products industry was selected as a high priority manufacturing sector, along with the paper and paper products industry, chemical and allied products industry, transportation equipment industry, rubber and plastic products, and printing and publishing.

ITAC

The Industrial Technology Assistance Corporation (ITAC), in collaboration with the New York Branch of the AESF, the New York Masters Association of Metal Finishers, Utility Metal Research Corporation, and ten electroplating companies applied for and received funding to deliver a program coordinated and written by the Wastewater Technology Center of Canada. This is an industry-specific hands on 24 hour training session that integrates the assessment and incorporation of pollution prevention techniques into all types of electroplating and metal finishing operations. The training also includes an economic evaluation of the benefits of resource recovery on a multi-media basis.

Merit Partnership

The Merit Partnership brings industry and government representatives together to identify pollution prevention needs and accelerate pollution prevention technology diffusion. Merit partners and participants include EPA Region 9, The Metal Finishing Association of Southern California (MFASC), the National Institute of Standards and Testing/California Manufacturing Technology Center, EPA's Office of Research and Development/Risk Reduction Engineering Lab, large companies processing pollution prevention technologies applicable to the metal finishing industry, local regulatory agencies, and participating companies. The Merit Partnership is working closely with its members to develop metal finishing projects that are transferable to small businesses. There is an emphasis on having large companies that are involved with metal finishing share their proven metal finishing methods with smaller companies. The Merit Partnership and MFASC have already begun to identify programmatic areas for metal plating pollution prevention opportunities, from which potential projects will be chosen.

V.D. Pollution Prevention Options

The following sections list numerous pollution prevention techniques that may be useful to companies specializing in metal fabrication and finishing operations. These are options available to facilities, but are not to be construed as requirements. The information is organized by metal shaping, surface preparation, plating, and other finishing operations.

V.D.1. Metal Shaping Operations

Technique - Production Planning and Sequencing

Option 1 - Improve scheduling of processes that require use of varying oil types in order to reduce the number of cleanouts.

Technique - Process or Equipment Modification

Option 1 - Standardize the oil types used for machining, turning, lathing, etc. This reduces the number of equipment cleanouts, and the amount of leftovers and mixed wastes.

Option 2 - Use specific pipes and lines for each set of metals or processes that require a specific oil in order to reduce the amount of cleanouts.

Option 3 - Save on coolant costs by extending machine coolant life through the use of a centrifuge and the addition of biocides. **Costs and Savings:** Waste Savings/Reductions: 25 percent reduction in plant-wide waste coolant generation. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 4 - Install a second high speed centrifuge on a system already operating with a single centrifuge to improve recovery efficiency even more. **Costs and Savings:** Capital Investment: $126,000. Payback Period: 3.1 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 5 - Install a chip wringer to recover excess coolant on aluminum chips. **Costs and Savings**: Capital Investment: $11,000 to $23,000 (chip wringer and centrifuge system).Payback Period: 0.9 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 6 - Install a coolant recovery system and collection vehicle for machines not on a central coolant sump. **Costs and Savings:** Capital Investment: $104,000. Payback Period: 1.9 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 7 - Use a coolant analyzer to allow better control of coolant quality. **Costs and Savings:** Capital Investment: $5,000. Payback Period: 0.7 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 8 - Use an ultrafiltration system to remove soluble oils from wastewater streams. **Costs and Savings:** Annual Savings: $200,000 (in disposal costs). Product/Waste Throughput Information: based on a wastewater flow rate of 860 to 1,800 gallons per day.

Option 9 - Use disk or belt skimmers to remove oil from machine coolants and prolong coolant life. Also, design sumps for ease of cleaning. **Costs and Savings:** Waste Savings/Reduction: coolant is now disposed once per year rather than 3-6 times per year.

Technique - Raw Material Substitution

Option 1 - In cold forming or other processes where oil is used only as a lubricant, substitute a hot lime bath or borax soap for oil.

Option 2 - Use a stamping lubricant that can remain on the piece until the annealing process, where it is burned off. This eliminates the need for hazardous degreasing solvents and alkali cleaners. **Costs and Savings:** Annual Savings: $12,000 (results from reduced disposal, raw material, and labor costs). Waste Throughput Information: The amount of waste solvents and cleaners was reduced from 30,000 pounds in 1982 to 13,000 pounds in 1986. Employee working conditions were also improved by removing vapors associated with the old cleaners.

Technique - Waste Segregation and Separation

Option 1 - If filtration or reclamation of oil is required before reuse, segregate the used oils in order to prevent mixing wastes.

Option 2 - Segregation of metal dust or scrap by type often increases the value of metal for resale (e.g., sell metallic dust to a zinc smelter instead of disposing of it in a landfill). **Costs and Savings**: Capital Investment: $0. Annual Savings: $130,000. Payback Period: immediate. Waste Savings/Reduction: 2,700 tons per year. (Savings will vary with metal type and market conditions.)

Option 3 - Improve housekeeping techniques and segregate waste streams (e.g., use care when cleaning cutting equipment to prevent the mixture of cutting oil and cleaning solvent). **Costs and Savings:** Capital Investment: $0. Annual Savings: $3,000 in disposal costs. Waste Savings/Reduction: 66 percent (30 tons reduced to 10 tons).

Technique - Recycling

Option 1 - Where possible, recycle oil from cutting/machining operations. Often oils need no treatment before recycling. **Costs and Savings:** Capital Investment: $1,900,000. Annual Savings: $156,000. Waste Throughput Information: 2 million gallons per year. Facility reclaims oil and metal from process water.

Option 2 - Oil scrap mixtures can be centrifuged to recover the bulk of the oil for reuse.

Option 3 - Follow-up magnetic and paper filtration of cutting fluids with ultrafiltration. By so doing, a much larger percentage of cutting fluids can be reused. **Costs and Savings:** Capital Investment: $42,000 (1976). Annual Savings: $33,800 (1980).

Option 4 - Perform on-site purification of hydraulic oils using commercial “off-the-shelf” cartridge filter systems. **Costs and Savings:** Capital Investment: $28,000. Annual Savings: $17,800/year based on operating costs, avoided new oil purchase, and lost resale revenues. Payback Period: less than 2 years. Product/Waste Throughput Information: example facility handles 12,300 gallons/year of waste hydraulic oil.

Option 5 - Use a continuos flow treatment system to regenerate and reuse aluminum chemical milling solutions. **Costs and Savings:** Capital Investment: $465,000. Annual Savings: $342,000. Payback Period: less than 2 years. Waste Savings/Reduction: 90 percent

Option 6 - Use a settling tank (to remove solids) and a coalescing unit (to remove tramp oils) to recover metal-working fluids. **Costs and Savings:** Annual Savings: $26,800 (resulting from reduced material, labor, and disposal costs).

V.D.2. Surface Preparation Operations

SOLVENT CLEANING

Technique - Training and Supervision

Option 1 - Improve solvent management by requiring employees to obtain solvent through their shop foreman. Also, reuse "waste" solvents from cleaner up-stream operations in down-stream, machines shop-type processes. **Costs and Savings:** Capital Investment: $0. Annual Savings: $7,200. Waste Savings/Reduction 49 percent (310 tons reduced to 152 tons). Product/Waste Throughput Information: original waste stream history: reactive anions (6,100 gallons/year), waste oils (1,250 gallons/year), halogenated solvents (500 gallons/year).

Technique - Production Planning and Sequencing

Option 1 - Pre-cleaning will extent the life of the aqueous or vapor degreasing solvent (wipe, squeeze, or blow part with air, shot, etc.). **Costs and Savings:** Annual Savings: $40,000. Payback Period: 2 years. Waste Savings/Reduction: 48,000 gallons of aqueous waste. Aluminum shot was used to preclean parts.

Option 2 - Use countercurrent solvent cleaning (i.e., rinse initially in previously used solvent and progress to new, clean solvent).

Options 3 - Cold clean with a recycled mineral spirits stream to remove the bulk of oil before final vapor degreasing.

Option 4 - Only degrease parts that must be cleaned. Do not routinely degrease all parts.

Technique - Process or Equipment Modification

Option 1 - The loss of solvent to the atmosphere from vapor degreasing equipment can be reduced by:

- increasing the freeboard height above the vapor level to 100 percent of tank width;
- covering the degreasing unit (automatic covers are available);
- installing refrigerator coils (or additional coils) above the vapor zone;
- rotating parts before removal from the vapor degreaser to allow all condensed solvent to return to degreasing unit;
- controlling the speed at which parts are removed (10 feet or less per minute is desirable) so as not to disturb the vapor line;
- installing thermostatic heating controls on solvent tanks; and
- adding in-line filters to prevent particulate buildup in the degreaser.

Option 2 - Reduce grease accumulation by adding automatic oilers to avoid excess oil applications.

Option 3 - Use plastic blast media for paint stripping rather than conventional solvent stripping techniques. **Costs and Savings:** Waste Savings/Reduction: volume of waste sludge is reduced by as much as 99 percent over chemical solvents; wastewater fees are eliminated.

Technique - Raw Material Substitution

Option 1 - Use less hazardous degreasing agents such as petroleum solvents or alkali washes. For example, replace halogenated solvents (e.g., trichloroethylene) with liquid alkali cleaning compounds. (Note that compatibility of aqueous cleaners with wastewater treatment systems should be ensured.) **Costs and Savings:** Capital Investment: $0. Annual Savings: $12,000. Payback Period: immediate. Waste Savings/Reduction: 30 percent of 1,1,1-trichloroethane replaced with an aqueous cleaner.

Option 2 - Substitute chromic acid cleaner with non-fuming cleaners such as sulfuric acid and hydrogen peroxide. **Costs and Savings:** Annual Savings: $10,000 in treatment equipment costs and $2.50/lb. of chromium in treatment chemical costs. Product/Waste Throughput Information: rinse water flowrate of 2 gallons per minute.

Option 3 - Substitute less polluting cleaners such as trisodium phosphate or ammonia for cyanide cleaners. **Costs and Savings:** Annual Savings: $12,000 in equipment costs and $3.00/lb. of cyanide in treatment chemical costs. Product/Waste Throughput Information: rinse water flowrate of 2 gallons per minute.

Technique - Recycling

Option 1 - Recycle spent degreasing solvents on site using batch stills. **Costs and Savings:** Capital Investment: $2,600-$4,100 and $4,200-$17,000. Product Throughput Information: 35-60 gallons per hour and 0.6-20 gallons per hour, respectively. Two cost and throughput estimates for distillation units from two vendors.

Option 2 - Use simple batch distillation to extend the life of 1,1,1-trichloroethane. **Costs and Savings:** Capital Investment: $3,500 (1978). Annual Savings: $50,400. Product/Waste Throughput Information: facility handles 40,450 gallons 1,1,1-trichloroethane per year.

Option 3 - When on-site recycling is not possible, agreements can be made with supply companies to remove old solvents. **Costs and Savings:** Capital Investment: $3,250 for a temporary storage building. Annual Savings: $8,260. Payback Period: less than 6 months. Waste Savings/Reduction: 38,000 pounds per year of solvent sent off site for recycling.

Option 4 - Arrange a cooperative agreement with other small companies to centrally recycle solvent.

CHEMICAL TREATMENT

Technique - Process or Equipment Modification

Option 1- Increase the number of rinses after each process bath and keep the rinsing counter-current in order to reduce drag-out losses.

Option 2 - Recover unmixed acids in the wastewater by evaporation.

Option 3 - Reduce rinse contamination via drag-out by:
- slowing and smoothing removal of parts, rotating them if necessary;
- using surfactants and other wetting agents;
- maximizing drip time;
- using drainage boards to direct dripping solutions back to process tanks;
- installing drag-out recovery tanks to capture dripping solutions;
- using a fog spray rinsing technique above process tanks;
- using techniques such as air knives or squeegees to wipe bath solutions off of the part; and
- changing bath temperature or concentrations to reduce the solution surface tension.

Option 4 - Instead of pickling brass parts in nitric acid, place them in a vibrating apparatus with abrasive glass marbles or steel balls. A slightly acidic additive is used with the glass marbles, and a slightly basic additive is used with the steel balls. **Costs and Savings:** Capital Investment: $62,300 (1979); 50 percent less than conventional nitric acid pickling.

Option 5 - Use mechanical scraping instead of acid solution to remove oxides of titanium. **Costs and Savings:** Annual Savings: $0; cost of mechanical stripping equals cost of chemical disposal. Waste Savings/Reduction: 100 percent. Waste Throughput Information: previously disposed 15 tons/year of acid with metals.

Option 6 - For cleaning nickel and titanium alloy, replace alkaline etching bath with a mechanical abrasive system that uses a silk and carbide pad and pressure to clean or “brighten” the metal. **Costs and Savings:** Capital Investment: $3,250. Annual Savings: $7,500. Waste Savings/Reduction: 100 percent. Waste Throughput Information: previous etching bath waste total was 12,000 gallons/year.

Option 7 - Clean copper sheeting mechanically with a rotating brush machine that scrubs with pumice, instead of cleaning with ammonium persulfate, phosphoric acid, or sulfuric acid; may generate non-hazardous waste sludge. **Costs and Savings:** Capital Investment: $59,000. Annual Savings: more than $15,000. Payback Period: 3 years. Waste Savings/Reduction: 40,000 pounds of copper etching waste reduced to zero.

Option 8- Reduce molybdenum concentration in wastewaters by using a reverse osmosis/precipitation system. **Costs and Savings:** Capital Investment: $320,000. Waste Throughput Information: permeate capacity of 18,000 gallons per day. Savings Relative to an Evaporative System: installed capital cost savings: $150,000; annual operating cost savings: $90,000.

Option 9 - When refining precious metals, reduce the acid/metals waste stream by maximizing reaction time in the gold and silver extraction process. **Costs and Savings:** Capital Investment: $0. Annual Savings:

$9,000. Waste Savings/Reduction: 70 percent (waste total reduced from 50 tons to 15 tons).

Technique - Raw Material Substitution

Option 1 - Change copper bright-dipping process from a cyanide dip and chromic acid dip to a sulfuric acid/hydrogen peroxide dip. The new bath is less toxic and copper can be recovered.

Option 2 - Use alcohol instead of sulfuric acid to clean copper wire. One ton of wire requires 4 liters of alcohol solution, versus 2 kilograms of sulfuric acid. **Costs and Savings:** Capital Investment: $0.

Option 3 - Replace caustic wire cleaner with a biodegradable detergent.

Option 4 - Replace chromated desmutting solutions with nonchromated solutions for alkaline etch cleaning of wrought aluminum. **Costs and Savings:** Annual Savings: $44,541. Waste Savings/Reduction: sludge disposal costs reduced by 50 percent.

Option 5 - Replace barium and cyanide salt heat treating with a carbonate/chloride carbon mixture, or with furnace heat treating.

Option 6 - Replace thermal treatment of metals with condensation of saturated chlorite vapors on the surface to be heated. **Costs and Savings:** Waste Savings/Reduction: this process is fast, nonoxidizing, and uniform; pickling is no longer necessary.

Technique - Recycling

Option 1 - Sell waste pickling acids as feedstock for fertilizer manufacture or neutralization/precipitation.

Option 2 - Recover metals from solutions for resale. **Costs and Savings:** Annual Savings: $22,000. Payback Period: 14 months. Company sells copper recovered from a bright-dip bath regeneration process employing ion exchange and electrolytic recovery.

Option 3 - Send used copper pickling baths to a continuous electrolysis process for regeneration and copper recovery. **Costs and Savings:** Capital Investment: $28,500 (1977). Product Throughput Information: pickling 12,000 tons of copper; copper recovery is at the rate of 200 gallons/ton of processed copper.

Option 4 - Recover copper from brass bright dipping solutions using a commercially available ion exchange system. **Costs and Savings:** Annual Savings: $17,047; based on labor savings, coppers sulfate elimination, sludge reduction, copper metal savings, and bright dip chemicals savings. Product Throughput Information: example facility processes approximately 225,000 pounds of brass per month.
Option 5 - Treat industrial wastewater high in soluble iron and heavy metals by chemical precipitation. **Costs and Savings:** Annual Savings: $28,000; based on reduced water and sewer rates. Waste Throughput Information: wastewater flow from facility's "patening" line is 100 gallons per minute.

Option 6 - Oil quench baths may be recycled on site by filtering out the metals.

Option 7 - Alkaline wash life can be extended by skimming the layer of oil (the skimmed oil may be reclaimed).

V.D.3. Plating Operations

Technique - Training and Supervision

Option 1 - Educate plating shop personnel in the conservation of water during processing and in material segregation.

Technique - Production Planning and Sequencing

Option 1 - Preinspect parts to prevent processing of obvious rejects.

Technique - Process or Equipment Modification

Option 1 - Modify rinsing methods to control drag-out by:
- Increasing bath temperature
- Decreasing withdrawal rate of parts from plating bath
- Increasing drip time over solution tanks; racking parts to avoid cupping solution within part cavities
- Shaking, vibrating, or passing the parts through an air knife, angling drain boards between tanks
- Using wetting agents to decrease surface tension in tank.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612)_649-5750.

Option 2 - Utilize water conservation methods including:
- Flow restrictors on flowing rinses
- Counter current rinsing systems
- Fog or spray rinsing
- Reactive rinsing
- Purified or softened water
- Dead rinses
- Conductivity controllers
- Agitation to assure adequate rinsing and homogeneity in rinse tank
- Flow control valves.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612)_649-5750.

Option 3 - Implement counter flow rinsing and cascade rinsing systems to conserve consumption of water. **Costs and Savings:** Costs: $75,000 to upgrade existing equipment and purchasing new and used equipment. Waste Savings/Reduction: reduce water use and wastewater treatment costs. **Contact:** Eastside Plating and OR Department of Environmental Quality (800)452-4011**.**

Option 4 - Use drip bars to reduce drag-out. **Costs and Savings:** Capital Investment: $100 per tank. Savings: $600. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 5 - Use drain boards between tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $25 per tank. Savings: $450. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 6 - Install racking to reduce generations of drag-out. **Costs and Savings:** Capital Investment: zero dollars. Operating Costs: minimal. Savings: $600. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 7 - Employ drag out recovery tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $500 per tank. Savings: $4,700. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 8 - Install counter-current rinsing operation to reduce water consumption. **Costs and Savings:**

Capital Investment: $1,800-2,300. Savings: $1,350 per year. Waste Savings/Reductions: reduce water use by 90-99 percent. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 9 - Redesign rinse tank to reduce water conservation. **Costs and Savings:** Capital Investment: $100. Savings: $750 per year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 10 - Increase parts drainage time to reduce drag-out. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 11 - Regenerate plating bath by activated carbon filtration to remove built up organic contaminants. **Costs and Savings:** Capital Investment: $9,192. Costs: $7,973. Savings: $122,420. Waste Savings/Reduction: 10,800 gallons. Reduce volume of plating baths disposed and requirements for virgin chemicals. **Contact:** EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, Harry Freeman.

Option 12 - Install pH controller to reduce the alkaline and acid concentrations in tanks. **Contact:** Securus, Inc., and DBA Hubbard Enterprises.

Option 13 - Install atmospheric evaporator to reduce metal concentrations. **Contact:** Securus, Inc., and DBA Hubbard Enterprises.

Option 14 - Install process (e.g., CALFRAN) to reduce pressure to vaporize water at cooler temperatures and recycle water by condensing the vapors in another container, thus concentrating and precipitating solutes out. **Costs and Savings:** Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water. **Contact**: CALFRAN International, Inc., (413) 525-4957.

Option 15 - Use reactive rinsing and multiple drag-out baths. **Costs and Savings:** Savings: Reduce cost of treating spent process baths and rinse waters. Waste Savings/Reduction: increase lifetime of process baths and reduce the quantity or rinse water requiring treatment. **Contact:** SAIC, Edward R. Saltzberg.

Option 16 - Improve control of water level in rinse tanks, improve sludge separation, and enhance recycling of supernatant to the process by aerating the sludge. **Costs and Savings:** Savings: $2,000. Waste Savings/Reduction: reduce sludge generation by 32 percent. **Contact:** NJ Hazardous Waste Facilities Siting Commission, Hazardous Waste Source Reduction and Recycling Task Force.

Option 17 - Install system (e.g., Low Solids Fluxer) that applies flux to printed wiring boards, leaving little residue and eliminates the need for cleaning CFCs. **Costs and Savings:** Waste Savings/Reduction: reduce CFC emissions over 50 percent. **Contact:** AT&T Bell Laboratories, Princeton, NJ.

Technique - Raw Material Substitution

Option 1 - Substitute cyanide plating solutions with alkaline zinc, acid zinc, acid sulfate copper, pyrophosphate copper, alkaline copper, copper fluoborate, electroless nickel, ammonium silver, halide silver, methanesulfonate-potassium iodide silver, amino or thio complex silver, no free cyanide silver, cadmium chloride, cadmium sulfate, cadmium fluoborate, cadmium perchlorate, gold sulfite, and cobalt harden gold. **Contact:** Braun Intertec Environmental Inc., and MN Office of Waste Management (612) 649-5750.

Option 2 - Substitute sodium bisulfite and sulfuric acid for ferrous sulfate in order to oxidize chromic acid wastes, and substitute gaseous chlorine for liquid chlorine in order to reduce cyanide reduction. **Costs and Savings:** Savings: $300,000 per year. Waste Savings/Reduction: reduces feedstock by 50 percent. **Contact:** Eastside Plating and OR Department of Environmental Quality (800) 452-4011.

Option 3 - Replace hexavalent chromium with trivalent chromium plating systems. **Contact:** City of Los Angeles Hazardous and Toxic Material Project. Board of Public Works (213)_237-1209.

Option 4 - Replace cyanide with non-cyanide baths. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 5 - Replace conventional chelating agents such as tartarates, phosphates, EDTA, and ammonia with sodium sulfides and iron sulfates in removing metal from rinse water which reduces the amount of waste generated from precipitation of metals from aqueous wastestreams. **Costs and Savings:** Costs: $178,830 per year. Savings: $382,995 per year. Waste Savings/Reduction: 496 tons of sludge per year. **Contact:** Tyndall Air Force Base, FL, (904) 283-2942, Charles Carpenter, Dan Sucia, Penny Wilcoff; and John Beller at EG&G (108) 526-1149.

Option 6 - Replace methylene chloride, 1,1,1-trichloroethane, and perchloroethylene (solvent-based photochemical coatings) with aqueous base coating of 1 percent sodium carbonate. **Costs and Savings:** Waste Savings/Reduction: reduce solvent use by 60 tons per year. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 7 - Replace methanol with nonflammable alkaline cleaners. **Costs and Savings:** Waste Savings/Reduction: eliminate 32 tons per year of flammable methyl alcohol. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 8 - Substitute a non-cyanide for a sodium cyanide solution used in copper plating baths. **Costs and Savings:** Waste Savings/Reduction: reduce 7,630 pounds per year. **Contact:** Highland Plating Company, Los Angeles, CA.

Technique - Waste Segregation and Separation

Option 1 - Wastewaters containing recoverable metals should be segregated from other wastewater streams.

Technique - Recycling

Option 1 - Install ion exchange system to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $78,000. Operating Costs: $3,200 per year. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 2 - Employ reverse osmosis system to reduce generation of drag-out. **Costs and Savings:** Savings: $40,000 per year. Capital Investment: $62,000. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919)_733-7015.

Option 3 - Use electrolytic metal recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $1,000. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 4 - Utilize electrodialysis to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $50,000. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 5 - Implement evaporative recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $2,500. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 6- Reuse rinse water. **Costs and Savings:** Savings: $1,500 per year. Capital Investment: $340 per tank. No direct costs. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 7- Reuse drag-out waste back into process tank. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919)_733-7015.

Option 8- Recover process chemicals with fog rinsing parts over plating bath. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 9- Evaporate and concentrate rinse baths for recycling. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 10 - Use ion exchange and electrowinning, reverse osmosis, and thermal bonding when possible. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 11 - Use sludge slagging techniques to extract and recycle metals. **Costs and Savings:** Capital Investment: $80,000 for 80 tons/year and $400,000 for 1,000 tons/year. Operating Costs: $18,000 per year for an 80 ton facility. Waste Savings/Reduction: reduces volume of waste by 94 percent. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 12 - Use hydrometallurgical processes to extract metals from sludge. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 13- Convert sludge to smelter feed. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 14- Remove and recover lead and tin from boards by electrolysis or chemical precipitation. **Contact:** Control Data Corporation and MN Office of Waste Management (612) 649-5750.

Option 15 - Install a closed loop batch treatment system for rinse water to reduce water use and waste volume. **Costs and Savings:** Savings: $58,460 per year. Capital Investment: $210,000. Waste Savings/Reduction: 40,000 gallons per year (40 percent). **Contact:** Pioneer Metal Finishing, Inc., Harry Desoi (609) 694-0400.

Option 16 - Install an electrolytic cell which recovers 92 percent of dissolved copper in drag-out rinses and atmospheric evaporator to recover 95 percent of chromatic acid drag-out, and recycle it into chromic acid etch line. **Contact:** Digital Equipment Corporation and Lancy International Consulting Firm, William McLay (412) 452-9360.

Option 17 - Implement the electrodialysis reversal process for metal salts in wastewater. **Costs and Savings**: Savings: $40,100 per year in operating costs. **Contact:** Ionics, Inc., Separations Technology Division.

Option 18 - Oxidize cyanide and remove metallic copper to reduce metal concentrations. **Contact:** Securus, Inc. and DBA Hubbard Enterprises.

V.D.4. Other Finishing Operations

FINISHING OPERATIONS

Technique - Training and Supervision

Option 1 - Always use proper spraying techniques.

Option 2 - Improved paint quality, work efficiency, and lower vapor emissions can be attained by formal training of operators.

Option 3 - Avoid buying excess finishing material at one time due to its short shelf-life.

Technique - Production Planing and Sequencing

Option 1 - Use the correct spray gun for particular applications:
- conventional air spray gun for thin-film-build requirements
- airless gun for heavy film application
- air assisted airless spray gun for a wide range of fluid output.

Option 2 - Preinspect parts to prevent painting of obvious rejects.

Technique - Process or Equipment Modification

Option 1 - Ensure the spray gun air supply is free of water, oil, and dirt.

Option 2 - Replace galvanizing processes requiring high temperature and flux with one that is low temperature and does not require flux. **Costs and Savings:** Capital Investment: $900,000. Annual Savings: 50 percent (as compared to conventional galvanizing). Product Throughput Information: 1,000 kg/h.

Option 3 - Investigate use of transfer methods that reduce material loss such as:
- dip and flow coating
- electrostatic spraying
- electrodeposition.

Option 4 - Change from conventional air spray to an electrostatic finishing system. **Costs and Savings:** $15,000 per year. Payback Period: less than 2 years.

Option 5 - Use solvent recovery or incineration to reduce the emissions of volatile organics from curing ovens. **Costs and Savings:** Annual Savings: $400,000.

Option 6 - Regenerate anodizing and alkaline silking baths with contemporary recuperation of aluminum salts. **Costs and Savings:** $0.20 per meter of aluminum treated per year. Waste Throughput Information: based on an example plant that previously disposed 180,000 liters of acid solution per year at $0.07 per litre.

Technique - Raw Material Substitution

Option 1 - Use alternative coatings for solvent based paints to reduce volatile organic materials use and emissions, such as:

- high solids coatings (this may require modifying the painting process; including high speed/high pressure equipment, a paint distributing system, and paint heaters); **Costs and Savings:** Waste Savings/Reduction: 30 percent net savings in applied costs per square foot.

- water based coatings **- Costs and Savings:** Waste Savings/Reduction: 87 percent drop in solvent emissions and decreased hazardous waste production;

- powder coatings **- Costs and Savings:** Capital Investment: $1.5 million. Payback Period: 2 years**.** Example is for a large, wrought iron patio furniture company.

Technique - Waste Segregation and Separation

Option 1 - Segregate non-hazardous paint solids from hazardous paint solvents and thinners.

Technique - Recycling

Option 1 - Do not dispose of extended shelf life items that do not meet your facility's specifications. They may be returned to the manufacturer, or sold or donated as a raw material.

Option 2 - Recycle metal sludges through metal recovery vendors.

Option 3 - Use activated carbon to recover solvent vapors, then recover the solvent from the carbon by steam stripping, and distill the resulting water/solvent mixture. **Costs and Savings:** Capital Investment: $817,000 (1978). Waste Savings/Reduction: releases of solvent to the atmosphere were reduced from 700 kg/ton of solvent used to 20 kg/ton.

Option 4 - Regenerate caustic soda etch solution for aluminum by using hydrolysis of sodium aluminate to liberate free sodium hydroxide and produce a dry, crystalline hydrate alumina byproduct. **Costs and Savings:** Capital Investment: $260,000. Savings: $169,282 per year; from reduced caustic soda use, income from the sale of the byproduct, and a reduction in the cost of solid waste disposal. Payback Period: 1.54 years. Product/Waste Throughput Information: anodizing operation for which the surface area is processed at a rate of 200 M^2/hour.

PAINT CLEANUP

Technique - Production Planning and Sequencing

Option 1 - Reduce equipment cleaning by painting with lighter colors before darker ones.

Option 2 - Reuse cleaning solvents for the same resin system by first allowing solids to settle out of solution.

Option 3 - Flush equipment first with dirty solvent before final cleaning with virgin solvent. **Costs and Savings:** Waste Savings/Reduction: 98 percent; from 25,000 gallons of paint cleanup solvents to 400 gallons. Company uses cleanup solvents in formulation of subsequent batches.

Option 4 - Use virgin solvents for final equipment cleaning, then as paint thinner.

Option 5 - Use pressurized air mixed with a mist of solvent to clean equipment.

Technique - Raw Material Substitution

Option 1 - Replace water-based paint booth filters with dry filters. Dry filters will double paint booth life and allow more efficient treatment of wastewater. **Costs and Savings:** Savings per year: $1,500. Waste Savings/Reduction: 3,000 gallons/year.

Technique - Loss Prevention and Housekeeping

Option 1 - To prevent spray gun leakage, submerge only the front end (or fluid control) of the gun into the cleaning solvent.

Technique - Waste Segregation and Separation

Option 1 - Solvent waste streams should be kept segregated and free from water contamination.

Technique - Recycling

Option 1 - Solvent recovery units can be used to recycle spent solvents generated in flushing operations.

- Install a recovery system for solvents contained in air emissions. **Costs and Savings:** Savings: $1,000 per year.
- Use batch distillation to recover isopropyl acetate generated during equipment cleanup. **Costs and Savings:** Payback Period: 2 years.
- Use batch distillation to recover xylene from paint equipment cleanup. **Costs and Savings:** Payback Period: 13 months. Savings: $5,000 per year.
- Use a small solvent recovery still to recover spent paint thinner from spray gun cleanups and excess paint batches. **Costs and Savings:** Capital Investment: $6,000 for a 15 gallons capacity still. Savings: $3,600 per year in new thinner savings; $5,400 in disposal savings. Payback Period: less than 1 year. Waste Savings/Reduction: 75 percent (745 gallons of thinner recovered from 1,003 gallons). Product/Waste Throughput Information: 1,500 gallons of spent thinner processed per year.
- Install a methyl ethyl ketone solvent recovery system to recover and reuse waste solvents. **Costs and Savings:** Savings: $43,000 per year; MEK recovery rate: 20 gallons per day, reflecting a 90 percent reduction in waste.

Option 2 - Arrange an agreement with other small companies to jointly recycle cleaning wastes.

V.E. Pollution Prevention Contacts

Organization	Technique(s) to Promote Pollution Prevention Plating Operations	Telephone Number
Braun Intertec Environmental, Inc. Minnesota Office of Waste Management	Process or Equipment Modification Raw Material Substitution	(612) 649-5750
Eastside Plating Oregon Department of Environmental Quality	Process or Equipment Modification Raw Material Substitution	(800) 452-4011
North Carolina Department of Natural Resources & Community Development (Gary Hunt)	Process or Equipment Modification Recycling	(919) 733-7015
City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works	Process or Equipment Modification Raw Material Substitution Recycling	(213) 237-1209
EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH (Harry Freeman)	Process or Equipment Modification	
Securus, Inc. DBA Hubbard Enterprises	Process or Equipment Modification Recycling	

Organization	Technique(s) to Promote Pollution Prevention Plating Operations	Telephone Number
CALFRAN International, Inc.	Process or Equipment Modification	(413) 525-4957
SAIC (Edward R. Saltzberg)	Process or Equipment Modification	
New Jersey Hazardous Waste Facilities Siting Commission, Hazardous Waste Source Reduction and Recycling Task Force	Process or Equipment Modification	
AT&T Bell Laboratories, Princeton, NJ	Process or Equipment Modification	
Tyndall Air Force Base (Charles Carpenter)	Raw Material Substitution	(904) 283-2942
EG&G Idaho (Dan Sucia, Penny Wilcoff, John Beller)		(208) 526-1149
American Etching and Manufacturing, Pacoima, CA	Raw Material Substitution	
Highland Plating Company, Los Angeles, CA	Raw Material Substitution	
Control Data Corporation Minnesota Office of Waste Management	Recycling	(612) 649-5750
Pioneer Metal Finishing, Inc. (Harry Desoi)	Recycling	(609) 694-0400
Digital Equipment Corporation Lancy International Consulting Firm (William McLay)	Recycling	(412) 452-9360
Ionics, Inc., Separations Technology Division	Recycling	

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to “protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population.” The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements so that the reader is aware of these requirements. The section provides a summary of each major environmental statute, and a description of regulations that may specifically apply to the profiled industry. Some profiles also provide information regarding current rulemaking activity that might specifically impact this sector. The descriptions within Section VI are intended solely for guidance. No statutory or regulatory requirements are in any way altered by any statement(s) contained herein. For more in-depth information, readers should consult the United States Code and the Code of Federal Regulations as well as State or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.B. Industry Specific Regulations

A number of statutes and regulations affect the metal fabrication and finishing industry. The electroplating and metal finishing pretreatment standards promulgated under the Clean Water Act regulate the chemicals in wastewater, the Clean Air Act regulates air emissions, and the Resource Conservation and Recovery Act regulates hazardous waste generation, transportation, treatment, storage, and disposal. Each is discussed briefly below.

Clean Water Act (CWA)

Two Clean Water Act regulations affect the fabricated metal products industry (SIC 34): the Effluent Guidelines and Standards for Metal Finishing (40 CFR Part 433) and the Effluent Guidelines and Standards for Electroplating (40 CFR Part 413). The regulations targeting the electroplating industry were issued before those targeting the metal finishing industry as a whole. Companies regulated by the electroplating standards (40 CFR Part 413) before the metal finishing standards (40 CFR Part 433) were promulgated, become subject to the requirements of the metal finishing standards when (or if) they make modifications to their facility's operating functions (e.g., facility, equipment, process modifications). If companies made no such modifications, they remain regulated by the electroplating standards. All new facilities are subject to the standards set forth in 40 CFR Part_433.

The Effluent Guidelines and Standards for Metal Finishing (40 CFR Part 433) are applicable to wastewater generated by any of these operations:

- Electroplating
- Electroless Plating
- Anodizing
- Coating
- Chemical Etching and Milling
- Printed Circuit Board Manufacturing.

If any of the above processes are performed, the metal finishing standards will also apply to discharges from 40 additional processes, including: cleaning, polishing, shearing, hot dip coating, solvent degreasing, painting, etc.

The standards include daily maximums and maximum monthly average concentration limitations. The standards are based on milligrams per square meter of operation and determine the amount of wastewater pollutants from various operations that may be discharged. The uniformity in standards meets industry requests for equivalent limits for process lines often found together. The metal finishing standards also reduce the need to use the Combined Wastestream Formula.

Specific pretreatment standards may also apply to wastewater discharges from other metal finishing operations. The more specific standards will apply to those metal finishing wastestreams which appear to be covered by both standards. The requirements in the following regulations take precedence over those contained in the general metal finishing regulation:

- Iron and Steel Manufacturing (40 CFR Part 420)

- Battery Manufacturing (40 CFR Part 461)

- Plastic Molding and Forming (40 CFR Part 463)
- Coil Coating (40 CFR Part 465)
- Porcelain Enameling (40 CFR Part 466)
- Aluminum Forming (40 CFR Part 467)
- Copper Forming (40 CFR Part 468)
- Electrical and Electronic Components (40 CFR Part 469)
- Nonferrous Forming (40 CFR Part 471)
- Lead-Tin-Bismuth Forming Category (40 CFR Part 471, Subpart A)
- Zinc Forming Subcategory (40 CFR Part 471, Subpart_H).

The Effluent Guidelines and Standards for Electroplating (40 CFR Part_413) cover wastewater dischargers from electroplating operations, in which metal is electroplated on any basis material, and to related metal finishing operations. As stated previously, facilities regulated by the electroplating standards may become subject to the metal finishing standards if they make modifications to their facility's operating functions (e.g., facility, equipment, process modifications). Independent printed circuit board manufacturers are defined as facilities which manufacture printed circuit boards principally for sale to other companies. These facilities remain subject only to the electroplating standards (40 CFR Part 413), primarily to minimize the economic impact to these relatively small facilities. Also excluded from the metal finishing regulations are facilities which perform metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities.

Operations similar to electroplating which are specifically exempt from coverage under the electroplating standards include:

- Continuous strip electroplating conducted within iron and steel manufacturing facilities (40 CFR Part 420)
- Electrowinning and electrorefining conducted as part of nonferrous metal smelting and refining (40 CFR Part 421)
- Electrodeposition of active electrode materials, electroimpregnation, and electroforming conducted as part of battery manufacturing (40 CFR Part 461)
- Metal surface preparation and conversion coating conducted as part of coil coating (40 CFR Part 465)
- Metal surface preparation and immersion plating or electroless plating conducted as a part of porcelain enameling (40 CFR Part_466)

- Metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities

- Surface treatment including anodizing and conversion coating conducted as part of aluminum forming (40_CFR Part 467).

Clean Air Act (CAA)

The following standards and requirements promulgated under the CAA apply to metal finishing processes:

- National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks (40 CFR Parts 9 and 63, Subpart N, 60 FR 498, January 1995)

- Standards of Performance for Surface Coating of Metal Furniture (40 CFR Part 60, Subpart EE)

- Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations (40 CFR Part 60, Subpart MM)

- Standards of Performance for Industrial Surface Coatings: Large Appliances (40 CFR Part 60, Subpart SS)

- Standards of Performance for Metal Coil Surface Coating (40 CFR Part 60, Subpart TT)

- Standards of Performance for the Beverage Can Surface Coating Industry (40 CFR Part 60, Subpart WW)

- Standards of Performance for Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines (40 CFR Part 60, Subpart TTT).

These standards and requirements, although to varying degrees, regulate the discharge of volatile organic chemicals (VOCs).

Resource Conservation and Recovery Act (RCRA)

The greatest quantities of RCRA listed waste and characteristic hazardous waste present in the fabricated metal products industry are identified in Exhibit 33. For more information on RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 33
Hazardous Wastes Relevant to the Metal Finishing Industry

EPA Hazardous Waste No.	Hazardous Waste
D006 (cadmium) D007 (chromium) D008 (lead) D009 (mercury) D010 (selenium) D011 (silver)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichlorethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10 percent or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	Spent non-halogenated solvents: toluene, methy ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations.
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.

Exhibit 33
Hazardous Wastes Relevant to the Metal Finishing Industry

EPA Hazardous Waste No.	Hazardous Waste
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.
F012	Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum from zirconium phosphating is an exclusive conversion coating process.
K090	Emission control dust or sludge from ferrochromiumsilicon production (ferroalloy industry).
K091	Emission control dust or sludge from ferrochromium production (ferroalloy industry).

Source: Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, OERR, June 1994.

VI.C. Pending and Proposed Regulatory Requirements

Clean Water Act (CWA)

The effluent guidelines and standards for Electroplaters (40 CFR Part 413) and Metal Finishers (40 CFR Part 433) are currently under review. EPA is also currently developing effluent guidelines and standards for the metal products and machinery industry (40 CFR Part 438), which are due by May 1996. It appears that EPA will integrate new regulatory options for the metal finishing industry into this new guideline. Under the anticipated scenario, effluent guidelines for electroplaters and metal finishers would most likely reference appropriate sections of the guideline for the metal products and machinery industry. In is unclear, however, how "job shop" operations, which are not part of the metal products and machinery industry, would be covered under this scenario.

For Phase I of the regulation, EPA will propose effluent limitation guidelines for facilities that generate wastewater while processing metal parts, metal products, and machinery, including: manufacture, assembly, rebuilding, repair, and maintenance. The Phase I regulation will cover seven major industrial groups, including: aircraft, aerospace, hardware (including machine tools, screw machines, metal forgings and stampings, metal springs, heating equipment, and fabricated structural metal, ordinance, stationary industrial equipment (including electrical equipment), mobile industrial equipment, and electronic equipment (including communication equipment).

The legal deadline is May 1996.

Phase II, EPA will propose effluent limitation guidelines for facilities that generate wastewater while processing metal parts, metal products and machinery, including: manufacture, assembly, rebuilding, repair, and maintenance. The Phase II regulation will cover eight major industrial groups, including: motor vehicles, buses and trucks, household equipment, business equipment, instruments, precious and nonprecious metals, shipbuilding, and railroads. The legal deadline is December 31, 1997.

Clean Air Act (CAA)

In addition to the CAA requirements discussed above, EPA is currently working on several regulations that will directly affect the metal finishing industry. Many proposed standards will limit the air emissions from various industries by proposing Maximum Achievable Control Technology (MACT) based performance standards that will set limits on emissions based upon concentrations in the waste stream. Various potential standards are described below.

Organic Solvent Degreasing/Cleaning

EPA proposed a NESHAP (58 FR 62566, November 19, 1993) for the source category of halogenated solvent degreasing/cleaning that will directly affect the metal finishing industry. This will apply to new and existing organic halogenated solvent emissions to a MACT-equivalent level, and will apply to new and existing organic halogenated solvent cleaners (degreasers) using any of the HAPs listed in the CAA Amendments. EPA is specifically targeting vapor degreasers that use the following HAPs: methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and chloroform.

This NESHAP proposes to implement a MACT-based equipment and work practice compliance standard. This would require that a facility use a designated type of pollution prevention technology along with proper operating procedures. However, EPA has also provided an alternative compliance standard. Existing operations, which utilize performance-based standards, can continue to do so if such standards can be shown to achieve the same emission limit as the equipment and work practice compliance standard.

Steel Pickling, HCl

Hydrochloric acid (HCl) and chlorine are among the pollutants listed as hazardous air pollutants in Section 112 of the Clean Air Act Amendments of 1990. Steel pickling processes that use HCl solution and HCl regeneration processes have been identified by the EPA as potentially significant sources of HCl and chlorine air emissions and, as such, a source category for which national emission standards may be warranted. EPA is required to promulgate national emission standards for 50 percent of the source categories listed in Section 112(e) by November 15, 1997.

Other Future Regulatory Actions

EPA is developing MACT standards for several industries, including: miscellaneous metal parts and products (surface coating), asphalt/coal tar application-metal pipes, metal can (surface coating), metal coil (surface coating), and metal furniture (surface coating). The legal deadline for these rulemakings is November 15, 2000.

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facilities Indexing System (FINDS) --- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Fabricated Metal Products Industry Compliance History

Exhibit 34 presents enforcement and compliance information specific to the fabricated metal products industry. As indicated in this exhibit, Regions IV, V, and_IX conduct the largest number of inspections in this industry. This is consistent with the fact that the fabricated metal products industry is geographically concentrated near industrial areas. The data also indicates that nearly all of Region IV's enforcement actions are State-lead.

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 35 - 38 provide enforcement and compliance information for selected industries. The fabricated metal products industry comprises the largest number of facilities tracked by EPA across the selected industries. Likewise, it has the largest number of inspections and enforcement actions. For this industry, RCRA inspections comprise over half of all inspections conducted, while CWA inspections account for 15 percent of these inspections. The low CWA inspection rate is in conflict with the large number of water discharges that are generated by this industry.

Exhibit 34
Fab. Metal Product-Specific
Five Year Enforcement and Compliance Summary for the Fabricated Metal Industry

A	B	C	D	E	F	G	H	I	J
Fabricated Metal SIC 34	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	199	139	585	20	40	99	66%	34%	0.17
Region II	171	127	515	20	39	139	78%	22%	0.27
Region III	186	130	626	18	43	156	86%	14%	0.25
Region IV	320	220	1480	13	48	178	94%	6%	0.12
Region V	880	466	1549	34	54	128	75%	25%	0.08
Region VI	171	85	268	38	17	54	89%	11%	0.20
Region VII	109	71	238	27	13	31	71%	29%	0.13
Region VIII	36	14	50	43	7	8	38%	63%	0.16
Region IX	228	65	125	109	7	20	65%	35%	0.16
Region X	46	23	73	38	12	27	63%	37%	0.37
Total/Average	2,346	1,340	5,509	26	280	840	80%	20%	0.15

Exhibits 35
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibits 36
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.58
Furniture	293	160	113	66	41%	3	2%	5	0.55
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics/Computers	405	60	87	80	133%	8	13%	21	0.24
Motor Vehicle Assembly	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibits 37
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	293	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics/ Computers	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Motor Vehicle Assembly	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

* Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

Exhibits 38
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	293	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics/ Computers	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Motor Vehicle Assembly	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

* Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

VII.C. Review of Major Legal Actions

VII.C.1 Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* publications, 15 significant enforcement actions were resolved between 1991 and 1993 for the metal finishing industry. CWA violations comprised eight of these actions, the most of any statute. Following CWA violations were five actions involving RCRA violations, three involving CERCLA violations, one with a CAA violation, and one with a SDWA violation. The companies against which the cases were brought are primarily metal finishers, including those that provide electroplating, coating, and plating services. Two of the companies perform metal forming and fabrication functions.

Twelve of the fifteen cases resulted in the assessment of a penalty. Penalties ranged from $15,000 to $500,000, and in four cases, additional money was spent by the defendant to improve the processes or technologies and to increase future compliance. For example, in U.S. v. North American Philips Corp. (1992), the company paid a $500,000 penalty and spent approximately $583,000 to eliminate wastewater discharges from some of its non-federally regulated processes. The average penalty per case was approximately $322,000. Supplemental Environmental Projects (SEPs) were required in two of the cases. Texas Instruments, Inc. (1993), for example, was required to pay a penalty and replace a vapor degreaser unit with a more environmentally-protective unit.

Although many cases involved civil penalties, four of the cases involved criminal convictions, resulting in penalties and/or jail sentences for the owners and/or operators of the facilities. For example, the case of U.S. v. John Borowski and Borjohn Optical Technology, Inc., resulted in the first criminal endangerment conviction under CWA; the company president was sentenced to 26 months in prison, folloshwed by two years of supervised release.

VII.C.2 Supplemental Environmental Projects

Supplementary Environmental Projects (SEPs) are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. The following exhibit contains a representative sample of the Regional responses addressing the fabricated metal products industry. The information contained in the exhibit is not comprehensive and provides only a sample of the types of SEPs developed for the fabricated metal products industry. Please note that the projects describes in this section do not necessarily apply to all facilities in this sector. Facility-specific conditions must be considered carefully when evaluating potential supplemental environmental projects.

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Truex, Inc. Pawtucket, RI (metal parts manufacturing)	1	EPCRA	Pollution Reduction	$ 70,000	Install and operate a cooling water and process rinse recycling system and a metal recovery system to reduce the water used and to recover copper and zinc process waste for recycling.	$ 54,000	$ 29,000
Walton & Lonsbury Attleboro, MA (electroplating facility)	1	RCRA	Pollution Prevention and Pollution Reduction	$ 18,270	Implement a system to reclaim and reuse chromic acid rinse waters. Eliminate the use of trichloroethane in the degreasing operation. Install a filtration system which will extend the life of the hydrochloric acid strip solution.	$ 15,100	$ 15,100
Verilyte Gold, Inc. Chelsea, MA (electroplating facility)	1	RCRA	Pollution Prevention	$ 21,450	Install a hot-air metal parts drying unit which eliminates 100 percent of the use of freon.	$ 26,400	$ 15,675
The Torrington Company (precision bearings, assemblies, gears, and couplings manufacture)	1	EPCRA	Equipment Donation	$ 16,792	Donate emergency and/or computer equipment to the Local Emergency Planning Committee (LEPC) to respond to and/or plan for chemical emergencies. Participate in LEPC activities.	$ 35,364	$ 18,572
Texas Instruments, Inc. Attleboro, MA (metallurgic materials manufacture)	1	EPCRA	Equipment Donation	$ 8,063	Purchase computer hardware and software for the LEPC and Attleboro Fire Department (AFD) to assist the LEPC in tracking and storing information about identity and location of hazardous chemicals and to assist the AFD in responding to accidental releases.	$ 14,025	$ 5,962

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Texas Instruments, Inc. Attleboro, MA (metal finishing)	1	CAA	Pollution Prevention	$ 170,000	Replace the current vapor degreasor unit with a closed-loop degreaser unit to prevent the use of Freon 113.	$ 90,000	$ 49,900
L.S. Starrett Company, Inc. Athol, MA (tool manufacture)	1	EPCRA	Pollution Prevention	$ 290,000	Install three alkaline-based aqueous agitation wash systems, replace Freon cleaning units in two departments, and a methylene chloride cleaning unit in a third department to reduce Freon and methylene chloride by 100 percent.	$ 176,800	$ 83,200
Teradyne, Inc Nashua, NH (soldering products manufacture)	1	RCRA	Pollution Prevention	$ 800,000	Purchase and install solvent replacement units for two facilities. Stop using Freon 113 in manufacturing operations at one facility and stop using 1,1,1-trichloroethane (except in water sensitive assemblies) at another facility.	$ 120,000	$ 50,000
M.W. Dunton Company West Warwick, RI (soldering products manufacture)	1	EPCRA	SERC/LERC	$ 4,754	Donate emergency response equipment to the volunteer fire department to assist the LEPC in tracking and storing information about identity and location of hazardous chemicals and to assist the fire department in responding to accidental releases.	$ 9,500	$ 4,745

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
The Drawn Metal Tube Company Thomaston, CT	1	CWA	Pollution Prevention	$ 145,000	Install a closed loop evaporator system to eliminate the discharge of copper forming wastewater to the river.	$ 77,624	$ 45,000
Pioneer Metal Finishing	2	EPCRA	Pollution Prevention	$ 13,128	Pretreat used nickel bags and used filter bags from nickel filters to recover waste nickel, thus minimizing the disposal of hazardous nickel waste.		$ 5,000
Elken Metals Company Alloy, WV	3	xxxx	Pollution Reduction	$ 449,000	Remove PCB transforers, PCB capapcitors, and retrofilling PCB-contaminated transformers to reduce the amount of PCBs which may be released.	$ 280,000	$ 17,250
Southern Foundry Supply	4	EPCRA	Pollution Reduction	$ 34,000	Assess the feasibility of a process to recover pure nickel from plant wastestreams and construct a pilot plant to perform the recovery to reduce the quantity of heavy metals entering the environment.	$ 15,840	$ 2,376
Cerro Metal Products, Inc. Bellefonte, PA	3	TSCA	Accelerated Compliance	$ 40,000	Replace PCB transformers fluid with non-PCB fluid to eliminate the potential for uncontrolled releases of PCBs.	$ 31,700	$ 18,450

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

Numerous compliance activities and initiatives are occurring throughout the fabricated metal products industry. Many companies are conducting private research on developing new alloys and experimenting with the use of citric acid oils or terpenes instead of the more toxic degreasers (e.g., 1,1,1-trichloroethane).

Several projects currently underway are sponsored by Federal, State, and county governments; universities; and trade associations. Several of these initiatives are described below.

Common Sense Initiative

The Common Sense Initiative (CSI), a partnership between EPA and private industry, aims to create environmental protection strategies that are cleaner for the environment and cheaper for industry and taxpayers. As part of CSI, representatives from Federal, State, and local governments; industry; community-based and national environmental organizations; environmental justice groups; and labor organizations, come together to examine the full range of environmental requirements affecting the following six selected industries: automobile manufacturing; computers and electronics, iron and steel, metal finishing, petroleum refining; and printing.

CSI participants are looking for solutions that:

- Focus on the industry as a whole rather than one pollutant
- Seek consensus-based solutions
- Focus on pollution prevention rather than end-of-pipe controls
- Are industry-specific.

The Common Sense Initiative Council (CSIC), chaired by EPA Administrator Browner, consists of a parent council and six subcommittees (one per industry sector). Each of the subcommittees have met and identified issues and project areas for emphasis, and workgroups have been established to analyze and make recommendation on these issues. (Contact: Greg Waldrip at (202) 564-7024)

Design for the Environment (DfE)

DfE is an EPA program operated by the Office of Pollution Prevention and Toxics. DfE is a voluntary program which promotes the use of safer chemicals, processes, and technologies in the earliest product design stages. The DfE program assists industry in making informed, environmentally responsible design choices by providing standardized analytical tools for industry application and providing information on the comparative environmental and human health risk, cost, and performance of chemicals, processes, and technologies. DfE also helps small businesses by analyzing pollution prevention alternatives and disseminating the information to industry and the public. By helping to translate pollution prevention into meaningful terms, DfE contributes to building the institutional structure in corporations to support pollution prevention. DfE activities fall into two broad categories: (1) the industry-specific projects which encourage businesses to incorporate pollution prevention into their designs; and (2) long-term projects that translate pollution prevention into terms that make sense to professions such as chemistry, chemical engineering, marketing, accounting, and insurance.

One DfE effort (in partnership with the Manufacturing Extension Partnership) is the development of a benchmarking database and accompanying questionnaire to serve as an incentive mechanism for companies. Metal fabricators are encouraged to complete a company-specific questionnaire and return it to the Manufacturing Extension Partnership for analysis. The company will then receive a report comparing its data to that of other companies. Based on the results, companies are encouraged to voluntarily implement mechanisms that will minimize environmental damage resulting from the manufacturing processes. Subjects included in the questionnaire, database, and report range from the use of automation and monitoring technologies to the volumes of wastes generated, treated, and recycled.

Minnesota Technical Assistance Program (MnTAP)

In the State of Minnesota, waste reduction is receiving increased attention as an alternative to waste disposal. To help companies reduce waste, Minnesota developed MnTAP, a program that helps facilities identify waste reduction opportunities. MnTAP recognizes that each company's operations are unique and has, therefore, developed a series of checklists to help identify waste reduction possibilities. The checklists are designed to assist each facility evaluate wastestreams and identify waste reduction opportunities. The checklists cover several areas relevant to this profile, including operating procedures, cleaning, machining, plating/metal finishing, coating/painting, and formulating.

To ensure effective use of MnTAP's checklists, staff is available to answer questions over the phone or on-site once checklists have been completed. MnTAP has also gathered vendor and technical information for many of the options listed which may be useful in assessing a facility's waste reduction opportunities. In addition, MnTAP has developed lists of vendors who provide recycling services on a contract basis if it is not feasible to implement the options listed on the checklists. MnTAP staff can be reached at (612) 625-4949.

Pollution Prevention and Waste Minimization in the Metal Finishing Industry Workshop

The University of Nebraska-Lincoln sponsored a Pollution Prevention and Waste Minimization in the Metal Finishing Industry workshop in 1993. The workshop was designed for managers and operators of electroplating and galvanizing operations; engineers; environmental consultants; waste management consultants; Federal, State, and local government officials; and individuals responsible for training in the area of metal finishing waste management. Topics covered included:

- Saving money and reducing risk through pollution prevention and waste minimization
- Incorporating pollution prevention into planning electroplating and galvanizing operations
- Conducting waste minimization audits
- Developing and analyzing options for pollution prevention/waste minimization
- Innovative techniques for implementing a pollution prevention/waste minimization program.

For more information concerning this workshop, contact David Montage of the University of Nebraska at W348 Nebraska Hall, Lincoln, NE 68588-0531.

Pollution Prevention Opportunities Checklists

The County Sanitation Districts of Los Angeles County developed a detailed pollution prevention opportunities checklist to help companies identify and implement pollution prevention methods where possible. The County Sanitation Districts has identified specific opportunities for the metal fabricators and metal finishing industries.

Southeast Michigan Initiative (SEMI)

EPA and the Michigan Department of Natural Resources (MDNR) have launched a geographic initiative in the Southeast Michigan area because of the magnitude of contaminant releases and human population in the area. Eight counties within the Initiative have been identified as having major environmental problems. Several rivers in the area suffer from impaired uses, polluted airsheds, combined sewer overflows, contaminated sediments, and major toxic pollutant releases.

A Steering Committee, composed of senior managers of MDNR and EPA, meet quarterly and are responsible for making decisions concerning the overall direction of the Initiative. There are also four working committees, including: public participation; remedial action plans/sediments; pollution prevention; and compliance and enforcement.

For more information regarding SEMI contact Rufus Anderson, Assistant Deputy Director, MDNR Region 5 at (313) 953-1444 or Mardi Klevs, EPA SEMI Coordinator at (312) 353-5490.

The Blackstone Project

The Blackstone Project, a joint initiative by the Massachusetts Department of Environmental Protection (DEP) and the Department of Environmental Management (DEM), is intended to make environmental protection more efficient and less costly to companies. As Doug Fine, the Compliance and Enforcement Coordinator, explains, the Blackstone Project's two goals are to encourage industry to use less toxic material in manufacturing, and to increase the efficiency of DEP's industrial inspections by conducting one-stop, facility-wide inspections. The project focused first on fabricated metal products facilities near the Blackstone River Valley and later expanded to all types of manufacturers in that region. The State of Massachusetts now conducts facility-wide inspections in a continuous effort to reduce pollution.

The NCMS/NAMF Pollution Control Assessment Project

The National Center for Manufacturing Sciences (NCMS) and the National Association of Metal Finishers (NAMF) worked jointly to develop the *Pollution Prevention and Control Technology for Plating Operations* publication which documents pollution prevention techniques and pollution control equipment used in plating operations. To develop this document and the associated database, NCMS and NAMF collected pollution prevention information through surveys, literature searches, and interviews with industry experts. The resulting publication illustrates pollution prevention techniques and equipment used, assesses the effectiveness of these techniques as illustrated by historical data, and indicates the types of facilities in which these techniques were employed.

The Sustainable Industry Project

The EPA Office of Policy, Planning, and Evaluation's Sustainable Industry Project represents a new approach to the development of environmental policy for industry. The primary goal of the Sustainable Industry Project is to develop, test, and implement industry-specific policy recommendations that will remove barriers to innovation and promote strategic environmental protection in the selected industries (i.e., photoimaging, metal finishing, and thermoset plastics). To do this, EPA gained a thorough understanding of the relevant characteristics of the industries—the industry-specific economic, institutional, cultural, technical, life-cycle, and regulatory factors that may promote or hinder environmental improvements. Further, EPA identified driving factors and barriers that influence corporate decision-making and environmental performance. Understanding the factors that influence environmental performance in a given industry provides the basis for designing policies that will encourage improved performance. Working with industries, States, non-government organizations (NGOs), and other interested parties, EPA intends to design policies that will protect the environment and human health while fostering competitive and sustainable industries.

U.S. Bureau of Mines (USBM)

The U.S. Bureau of Mines has developed a technique to regenerate chromium bearing solutions such as those used in chromate conversion aluminum electroplating. The process is in commercial use and a company is preparing to license the technology to manufacture and market solution treatment equipment. In related work, the Bureau worked with the specialty steel industry to reduce waste generated by pickling operations. Other USBM research includes the dewatering of sludges, extraction of metals from a variety of liquid and solid wastes, recycling of metals, and development of lead-free free-machining copper alloys.

Wastewater Technology Center

The Wastewater Technology Center (WTC) is an organization of scientists, chemists, technologists, and support staff dedicated to the research and development of technologies to control industrial and municipal discharges. Conducting bench-scale, pilot plant, and full-scale studies for 25 years, over 100 WTC staff have assisted industry in solving a wide variety of environmental concerns. Recently, WTC has worked closely with the Metal Finishing Task Force, a committee of Federal government, provincial government, and metal finishing industry representatives to develop a pollution prevention guide. The document is designed to assist metal finishers in establishing a pollution prevention planning process. WTC also provides assistance in interpreting and using this guide and facilitates other pollution prevention planning programs that metal finishers have or are anticipating establishing. In addition, to help metal finishers better understand and use the pollution prevention planning, WTC, in conjunction with Sheridan College, has prepared an extensive training course in pollution prevention planning in metal finishing.

Other Initiatives

The metal finishers and platers industry is being considered by EPA for several upcoming initiatives. Work has already begun by the NPDES and the RCRA programs. The NPDES Branch began an Industrial User initiative in May 1993 that targeted metal finishers who failed to report their compliance status with categorical pretreatment effluent standards (40 CFR 433). In addition, the RCRA program has an initiative that applies to iron and steel and metal plating/finishing industries. The State of Utah plans to inspect each of the iron and steel and metal plating/finishing industries in the State.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who meet their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

The number of companies that use 33/50 chemicals per industry sector ranged from a low of six in the tobacco industry to a high of 1,803 in the fabricated metal products industry. Of these companies, 187 participate in the 33/50 program. Some 33/50 chemicals that are particularly relevant to this industry include: lead and lead compounds, methyl ethyl ketone, nickel and nickel compounds, tetrachloroethylene, toluene, trichloroethane, trichlorethylene, and xylenes.

Exhibit 40 lists those companies participating in the 33/50 program that reported under SIC code 34 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to Fabricated Metal Products industry. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 40
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
A B Chance Co.	Centralia	MO	3644, 3613, 3423	1	59,907	***
ABC Holdings Inc.	Eufaula	AL	2851, 3449	4	55,230	**
Acme Metals Inc.	Riverdale	IL	3312, 3499, 3479, 3398	5	157,232	38
Adolph Coors Company	Golden	CO	2082, 3411, 3443	1	158,792	59
Aero Metal Finishing Inc.	Fenton	MO	3471	1	12,900	43
Akzo Nobel Inc.	Chicago	IL	3412	1	930,189	13
Aladdin Industries Inc.	Nashville	TN	3086, 3469, 3648	1	53,741	91
All Metal Stamping Inc.	Abbotsford	WI	3429, 3469, 3499	1	1,112	50
Allied-Signal Inc.	Morristown	NJ	3728, 3471, 3724	2	2,080,501	50
Aluminum Company Of America	Pittsburgh	PA	3463	5	2,403,017	51
America's Best Quality	Milwaukee	WI	3471	1	1,025	74
American National Can Company	Chicago	IL	3411	9	2,303,898	50
Ameron Inc. Delaware	Pasadena	CA	3272, 3317, 3443, 3479	1	184,882	**
Amsted Industries Incorporated	Chicago	IL	3315, 3496, 3471	1	1,834,493	66
Anderson Screw Products Inc.	Jamestown	NY	3451	1	7,860	100
Anomatic Corporation	Newark	OH	3471	1	403,270	50
Apogee Enterprises Inc.	Minneapolis	MN	3479	1	423,862	15
Armco Inc.	Pittsburgh	PA	3446	2	1,849,709	4
Asea Brown Boveri Inc.	Stamford	CT	3443	2	501,017	50
Asko Processing Inc.	Seattle	WA	3479	2	36,991	50
Atlas Die Inc.	Elkhart	IN	3479	1	26,400	100
Atlas Plating Inc.	Cleveland	OH	3471	1	505	33
Automatic Pltg Of Bridgeport	Bridgeport	CT	3471	1	635	***
B. L. Downey Co. Inc.	Broadview	IL	3479	1	250	75
Baker Hughes Incorporated	Houston	TX	3533, 3471	1	193,116	20
Ball And Socket Mfg. Co. Inc.	Cheshire	CT	3965, 3469, 3471	1	9,820	**
Ball Corporation	Muncie	IN	3411	7	721,859	86
Bausch & Lomb Incorporated	Rochester	NY	3471, 3851, 3827	1	51,706	*
Bead Industries Inc.	Bridgeport	CT	3499, 3679, 3432	1	107,143	***
Bethlehem Steel Corporation	Bethlehem	PA	3312, 3462	1	792,550	50
BHP Holdings (USA) Inc.	San Francisco	CA	3479	1	64,365	***

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Black & Decker Corporation	Baltimore	MD	3429	6	487,188	50
Blaser Die Casting Co.	Seattle	WA	3471	1	38,900	78
Bmc Industries Inc.	Minneapolis	MN	3479	1	207,147	5
Brod & Mcclung-Pace Co.	Portland	OR	3433, 3564, 3585	1	20,300	**
Brooklyn Park Oil Co. Inc.	Minneapolis	MN	3364, 3471	1	12,606	13
Burnham Corporation	Lancaster	PA	3433	1	34,149	96
C. A. Dahlin Co.	Elk Grove	IL	3469	1	12,900	***
Caldwell Products Inc.	Abilene	TX	3471	1	11,880	50
Canon Business Machines Inc.	Costa Mesa	CA	3479	1	5	95
Cargill Detroit Corporation	Clawson	MI	3462	1	717,558	31
Channellock Inc.	Meadville	PA	3423	1	118,913	***
Chart Industries Inc.	Willoughby	OH	3443	2	8,260	79
Chrysler Corporation	Highland Park	MI	3465	2	3,623,717	80
Cold Heading Co.	Detroit	MI	3471	1	16,021	52
Collis Inc.	Clinton	IA	3496, 3471, 3499	1	63,010	60
Commercial Enameling Co.	Huntington	CA	3431	1	250	100
Conagra Inc.	Omaha	NE	3411	1	39,588	8
Cooper Industries Inc.	Houston	TX	3462, 3317	7	1,048,465	75
Corning Inc.	Corning	NY	3469, 3471	1	1,521,528	14
Crenlo Inc.	Rochester	MN	3444	1	66,945	***
Crown City Plating Co.	El Monte	CA	3471	1	151,509	30
Crown Cork & Seal Company	Philadelphia	PA	2752, 3479	20	1,236,689	50
Crown Metal Finishing Co. Inc.	Kenilworth	NJ	3479	1	50,282	21
Dana Corporation	Toledo	OH	3451, 3492	3	1,652,123	**
Davis & Hemphill	Elkridge	MD	3451	1	13,365	*
Delbar Products Inc.	Perkasie	PA	3089, 3465	2	102,983	50
Delta Engineering & Mfg. Co.	Tualatin	OR	3444	1	8,239	***
Disston Company	Danville	VA	3425	1	27,000	*
Duo-Fast Corp.	Franklin Park	IL	3469	1	652,519	45
Dynamic Metal Products Company	Manchester	CT	3444	1	255	***
Eagle-Picher Industries Inc.	Cincinnati	OH	3053, 3479	3	227,242	50
Eaton Corporation	Cleveland	OH	3462	4	450,211	50
Ektron Industries Inc.	Aumsville	OR	3471	1	4,354	50
Electro-Platers Of York Inc.	Wrightsville	PA	3471	1	29,462	***
Emerson Electric Co.	Saint Louis	MO	3569, 3541, 3496, 3449	4	2,140,497	50
Enamelers & Japanners Inc.	Chicago	IL	3479	1	40,000	*
Ernie Green Industries Inc.	Dayton	OH	3465	3	329,828	*
Excell Polishing & Buffing Co.	Wadsworth	OH	3471	1	13,149	***
Federal-Mogul Corporation	Southfield	MI	3365, 3366, 3471	3	255,996	50
Feldkircher Wire Fabg Co.	Nashville	TN	3471, 3496	1	750	18

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Fleet Design Inc.	Portland	TN	3471	3	522	80
Fmc Corporation	Chicago	IL	3462, 3324, 3325	1	502,318	50
Ford Motor Company	Dearborn	MI	3465, 3711	5	15,368,032	15
Foto Mark Inc.	Mendota	MN	3479	1	73,325	5
Fulcrum II Limited Partnership	New York	NY	3462	1	77,680	24
G M Nameplate Inc.	Seattle	WA	2759, 2752, 3679, 3993,	1	15,405	50
G. W. Lisk Co. Inc.	Clifton Springs	NY	3499, 3451, 3471, 3491	1	15,548	*
Gates Corporation	Denver	CO	3429, 3451	1	478,941	***
Gayston Corporation	Springboro	OH	3483, 3463	1	33,355	56
Gefinor (USA) Inc.	New York	NY	3471, 3951	1	9,088	50
General Dynamics Corporation	St Louis	MO	3441, 3621	1	588,246	84
General Electric Company	Fairfield	CT	3444, 3724	7	5,010,856	50
General Motors Corporation	Detroit	MI	3651, 3694, 3679, 3672, 3471	15	16,751,198	*
Gillette Company	Boston	MA	3421	1	21,497	99
Globe Engineering Company Inc.	Wichita	KS	3728, 3724, 3444, 3599	1	18,678	*
Hager Hinge Company	Saint Louis	MO	3429	2	97,121	64
Halliburton Company	Dallas	TX	3443	1	16,884	**
Hand Industries Inc.	Warsaw	IN	3471	1	37,000	***
Handy & Harman	New York	NY	3471, 3469	3	477,150	50
Harrow Industries Inc.	Grand Rapids	MI	3429	1	128,355	*
Harsco Corporation	Camp Hill	PA	3469, 3449	8	415,574	**
Henkel Corporation	Kng Of Prussa	PA	3479	1	164,363	55
Heresite Protective Coatings	Manitowoc	WI	3479, 2851, 2821	1	367	50
Hi-Shear Industries Inc.	New Hyde Park	NY	3452, 3471, 3451, 3479	1	8,226	50
HM Anglo-American Ltd	New York	NY	3423	4	1,265,741	2
Hohman Plating & Mfg. Inc.	Dayton	OH	3471, 2851, 3479	1	13,293	**
Hoover Sys. Inc.	Dallas	TX	2542, 3444, 3441	1	510	27
Houston Plating Co.	South Houston	TX	3471	1	997	*
IBM	Armonk	NY	3672, 3579, 3471	1	1,411,304	1
Illinois Tool Works Inc.	Glenview	IL	3469	3	673,128	***
Imagineering Enterprises Inc.	South Bend	IN	3471	1	11,282	***
Inco United States Inc.	New York	NY	3462, 3463	1	346,594	26

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Indal Ltd	Weston,		3442	3	303,909	*
Indianhead Plating Inc.	Chippewa	WI	3471	1	14,005	***
Industrial Hard Chrome Ltd.	Geneva	IL	3471	2	13,213	*
Ingersoll-Rand Company	Woodcliff	NJ	3429	4	96,553	60
Interlake Corporation	Lisle	IL	3441	1	159,932	37
International Paper Company	Purchase	NY	8731, 3471, 3544	1	2,784,831	50
ITT Corporation	New York	NY	3471, 3479, 3498	3	735,332	7
Jacobson Mfg Co. Inc.	Kenilworth	NJ	3452	1	12	*
Jefferson City Mfg. Co. Inc.	Jefferson City	MO	3363, 3451, 3469	1	4,850	**
Jor-Mac Company Inc.	Grafton	WI	3499, 3479	1	4,995	***
Jordan-Edmiston Group Inc.	New York	NY	3421	1	332,930	27
Kaspar Electroplating Corp	Shiner	TX	3471	1	56	*
Kelso Asi Partners L P	New York	NY	3585, 3433, 3564	1	355,557	43
Kennedy Mfg. Co.	Van Wert	OH	3469	2	69,756	80
Kitzinger Cooperage Corp	Saint Francis	WI	3412, 5085, 5805	1	84	50
Lacks Enterprises Inc.	Grand Rapids	MI	3089, 3471	3	867,354	27
Lawrence Brothers Inc.	Sterling	IL	3429	1	6,827	50
Leco Corporation	Saint Joseph	MI	3826, 3471, 3229	1	6,800	14
Litton Industries Inc.	Beverly Hills	CA	3731, 3441, 3443	1	332,264	**
Lord Corporation	Erie	PA	3069, 3471	2	1,111,309	58
Lorin Ind.	Muskegon	MI	3471, 3354	1	25,500	50
LTV Steel Co. Inc.	Cleveland	OH	3471	1	612,924	60
Luke Engineering & Mfg Corp	Wadsworth	OH	3471	1	6,600	**
Macklanburg-Duncan Co.	Oklahoma City	OK	3429	1	23,376	***
Marmon Group, Inc.	Chicago	IL	3451	5	1,092,218	1
Martin Marietta Corporation	Bethesda	MD	3769, 3499, 3479, 3471	1	223,286	73
Masco Industries Inc.	Taylor	MI	3398, 3471	13	488,484	***
Mascotech	Taylor	MI	3465	9	3,163,830	35
Matec Corporation	Hopkinton	MA	3479, 2899, 3489	1	21,800	*
Meaden Screw Products Company	Burr Ridge	IL	3451	1	12,860	40
Mechanical Galv-Plating Corp	Sidney	OH	3479	1	3,448	***
Meco Inc.	Paris	IL	3443	1	51,864	***
Metallics Inc.	Onalaska	WI	3479	1	27,720	50
Metromedia Company	E Rutherford	NJ	3451, 3499	1	295,322	*
Midwest Plating Company Inc.	Grand Rapids	MI	3471	1	520	50

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Miller Smith Mfg. Co.	Spring Lake	MI	3471	1	17,247	***
Modern Metal Products Co.	Loves Park	IL	3471	1	163	71
Modern Welding Company	Owensboro	KY	3441, 3443	1	5	*
Modine Manufacturing Company	Racine	WI	3443, 3714	4	488,996	50
Morgan Stanley Leveraged Fund	New York	NY	3724, 3471	2	2,166,420	13
Napco Inc.	Valencia	PA	3499, 3444, 3446, 3442, 3479	1	41,037	60
Nashua Corp.	Nashua	NH	2672, 3572, 3577, 2869,	2	1,818,504	**
National Forge Company	Irvine	PA	3462	1	3,100	*
National Semiconductor Corp.	Santa Clara	CA	3679, 3674, 3471	1	23,173	6
New Dimension Plating Inc.	Hutchinson	MN	3471	1	17,300	35
Newell Co.	Freeport	IL	3471, 3496	5	324,283	23
Norandal USA	Brentwood	TN	3353, 3479	1	627,740	6
North American Investment Prop	Hawthorne	NY	3443	1	11,755	70
Northland Stainless Inc.	Tomahawk	WI	3443	1	7,570	***
Norton Company	Worcester	MA	3425	1	40,831	63
Oak Industries Inc.	Waltham	MA	3451, 3471, 3398	1	34,128	16
Oberg Industries Inc.	Freeport	PA	3469, 3471, 3089	1	18,435	85
Oregon Sand Blasting & Coating	Tualatin	OR	3479	1	14,660	*
Owens-Illinois Inc.	Toledo	OH	3469	2	412,573	***
Pace Industries Inc.	New York	NY	3639, 3444, 3469	1	14,530	**
Parker Hannifin Corporation	Cleveland	OH	3451, 3492, 3494	9	244,966	50
Pechiney Corporation	Greenwich	CT	3479, 3724	1	216,177	***
Penn Engineering & Mfg	Danboro	PA	3452	1	111,897	100
Philip Morris Companies Inc.	New York	NY	3479, 3468	1	259,053	**
Photocircuits Corporation	Glen Cove	NY	3672, 3471	1	292,178	92
PMF Ind. Inc.	Williamsport	PA	3499, 3471	1	13,015	34
Precision Plating Inc.	Minneapolis	MN	3471	1	10,155	***
Precision Products Group Inc.	Rockford	IL	3398, 3469, 3495, 3493, 3499	1	149,834	***
Premark International Inc.	Deerfield	IL	3556, 3325, 3444	2	140,313	***
Process Engineering Co. Inc.	Jackson	MS	3471	1	10,305	50
Production Paint Finishers	Bradford	OH	3479	1	11,584	60
Prospect Purchasing Co. Inc.	N Brunswick	NJ	3412	1	47,275	50

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Protective Coatings Inc.	Kent	WA	3471, 3479	1	41,137	***
Providence Metallizing Co. Inc.	Pawtucket	RI	3479, 3471	1	35,347	70
Quality Rolling & Deburring Co.	Thomaston	CT	3471	1	287,324	***
R P Adams Company Inc.	Tonawanda	NY	3469	1	20	***
Raytheon Company	Lexington	MA	3672, 3471, 3674	1	706,045	50
Rehrig International Inc.	Richmond	VA	3471	1	2,261	***
Reilly Plating Co.	Nanticoke	PA	3471	1	750	2
Reliance Finishing Co.	Grand Rapids	MI	3479	1	11,400	**
Reynolds Metals Company	Richmond	VA	3479	1	2,055,294	38
S. K. Williams Co.	Wauwatosa	WI	3471	1	126	*
Schuller Corporation	Denver	CO	3444	1	24,694	***
Seneca Foods Corporation	Pittsford	NY	3411	1	19,717	50
Siebe Industries Inc.	Richmond	VA	3400, 3471	2	849,335	2
Skills Inc.	Seattle	WA	3479	1	7,650	***
Smith Everett Investment Co.	Milwaukee	WI	3444	1	240,445	89
Smith System Manufacturing Co.	Plano	TX	3444, 2531	1	499	*
Sommer Metalcraft Corp	Crawfordsville	IN	3471	1	1,500	*
Sonoco Products Company	Hartsville	SC	2655, 3469	2	621,380	1
Southline Metal Products Co.	Houston	TX	3412	1	77,552	***
Spx Corporation	Muskegon	MI	3479	1	554,822	2
Stanley Works	New Britain	CT	3471	10	508,199	50
Sunset Fireplace Fixtures	City Of	CA	3429	1	12,800	25
Super Radiator Coils Ltd	Minneapolis	MN	3400	1	139,235	82
Superior Plating Inc.	Minneapolis	MN	3471	1	39,406	***
Surftech Finishes Company	Kent	WA	3471	1	20,270	*
Swva Inc.	Huntington	WV	3441	1	43,405	27
Tawas Plating Company	Tawas City	MI	3471	1	3,265	50
Tech Industries Inc.	Woonsocket	RI	3089, 3471	1	27,003	64
Techmetals Inc.	Dayton	OH	3471	1	10,645	50
Tektronix Inc.	Beaverton	OR	3663, 3444	1	12,393	*
Tenneco Inc.	Houston	TX	3441	1	1,272,423	8
Texas Instruments Incorporated	Dallas	TX	3822, 2812, 3356, 3471,	1	344,225	25
Therma-Tru Corp	Sylvania	OH	3442, 3089	1	17,255	41
Thiokol Corporation	Ogden	UT	3452	2	1,001,162	40
Thomas Steel Strip Corp	Warren	OH	3471, 3316	1	6,839	50
Trinova Corporation	Maumee	OH	3451, 3498	1	488,879	50
U T I Corporation	Collegeville	PA	3469	1	473,872	50
United States Can Company Del	Hinsdale	IL	3412, 3411	1	5,299	*
United Technologies Corp	Hartford	CT	3086, 3471	2	2,393,252	50
US Can Corporation (Del)	Oak Brook	IL	3411	7	573,088	37

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers	% Reduction 1988 to 1993
Valley Plating Works	Los Angeles	CA	3471	1	130	75
Valley Technologies Inc.	Valley Park	MO	3398, 3463	1	0	**
Van Der Horst Usa Corporation	Terrell	TX	3471	1	20,623	**
Veba Corporation	Houston	TX	3471, 3599	1	24,254	10
W W Custom Clad Inc.	Canajoharie	NY	3471	1	8,595	50
W. J. Roscoe Co.	Akron	OH	2851, 2891, 2517, 3479	1	40,051	50
Walter Industries Inc.	Tampa	FL	3321, 3479	1	859,751	***
Warner-Lambert Company	Morris Plains	NJ	3421	1	146,333	40
Weiss-Aug Co. Inc.	East Hanover	NJ	3465, 3469	1	15,834	**
Wheeling-Pittsburgh Corp	Wheeling	WV	3479	1	560,055	66
Whirlpool Corporation	Benton Harbor	MI	3450, 3471, 3490	1	1,540,866	50
Whyco Chromium Company Inc.	Thomaston	CT	3471	1	88,737	50
Winona Corporation	Winona Lake	IN	3479	1	47,260	50
Wisconsin Tool & Stamping Co.	Schiller Park	IL	3469	1	42,000	**
WNA Inc.	Wilmington	DE	3449	2	248,148	***
Worldwide Cryogenics Holdings	Minneapolis	MN	3443	1	133,810	*
Wright Products Corp	Minneapolis	MN	3429	1	45,287	***
York Metal Finishing Co.	Philadelphia	PA	3471	1	5	*
Zippo Manufacturing Company	Bradford	PA	3421	2	189,929	50
*** = not quantifiable against 1988**						

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. At present, no metal finishing or fabricating facilities are carrying out ELP pilot projects. (Contact: Tai-ming Chang, ELP Director, (202) 564-5081 or Robert Fentress, (202) 564-7023)

Gillette ELP Project

The objective of the Gillette Environmental Leadership Program is the development and implementation of a third party compliance and management systems audit and verification process. The project will involve the development of environmental compliance and environmental management systems audit protocol criteria that can be adopted and easily implemented by other facilities to assess compliance with relevant regulations. The three Gillette facilities that are participating are: South Boston Manufacturing Center, blade and razor manufacturing; North Chicago Manufacturing Center, batch chemical manufacturing; and Santa Monica, CA, stationary products manufacturing. (Contact: Scott Throwe, (202) 564-7013).

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. Contact Jon Kessler, Office of Policy Analysis, (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard, (202) 233-9065 or the Green Light/Energy Star Hotline at (202) 775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, (202) 260-0700 or the WasteWi$e Hotline at (800) 372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, (202) 260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, (303) 275-4729)

VIII.C. Trade Association/Industry Sponsored Activity

Associations, universities, and the industry are currently working with EPA to make the Agency aware of issues that relate to metal fabricating and finishing industries. As a result of these relationships and overall interest in achieving compliance and reducing pollution, additional research relating to process techniques and pollution prevention alternatives is being conducted. Various workshops and training opportunities have resulted from these efforts. A summary of some trade association and industry activities is presented below, along with some associations related to this industry.

VIII.C.1. Environmental Programs

Several trade and professional associations are working with EPA to make the Agency aware of issues that relate to metal fabricating industries. For example, the Copper and Brass Fabricators Council (CBFC) has been assisting EPA's Office of Solid Waste regarding recycling issues as it develops or redrafts RCRA regulations. CBFC is communicating its experiences with metal fabricating to EPA, in terms of materials used and possible recycling options, in hopes that future regulations might complement the industry's processes.

Additionally, several organizations have sponsored workshops focusing on waste minimization and pollution prevention in several fabricated metal related industries. Three workshops, the Hazardous Waste Management for Small Business Workshop, the Environmentally Conscious Painting Workshop, and the Pollution Prevention Workshop for the Electroplating Industry, are discussed below.

Hazardous Waste Management for Small Business Workshop

The University of Northern Iowa, with support from EPA, Des Moines Area Community College, Northeast Iowa Community College, Scott Community College, and Indiana Hills Community College, sponsored a *Hazardous Waste Management for Small Business* workshop. This workshop was geared towards small businesses and was intended to provide practical answers to environmental regulatory questions. Small businesses covered by the workshop include: manufacturers, vehicle maintenance and repair shops, printers, machine shops, and other businesses that generate potentially hazardous waste. Topics covered include: hazardous waste determination, waste generator categories, management of specific common waste streams, including used oil and solvents, and pollution prevention. (Contact: Duane McDonald, (319) 273-6899)

Environmentally Conscious Painting Workshop

Kansas State University, NIST/Mid-America Manufacturing Technology Center, Kansas Department of Health & Environment, EPA Region 7, Allied Signal, Inc., Kansas City Plant, and the U.S. Department of Energy sponsored the *Environmentally Conscious Painting* workshop. This workshop covered topics such as upcoming regulations and the current regulatory climate, methods to cost-effectively reduce painting wastes and emissions, and alternative painting processes. (Contact: the Kansas State University Division of Continuing Education, (913) 532-5566)

Pollution Prevention Workshop for the Electroplating Industry

Kansas State University Engineering Extension, EPA Region 7, Kansas Department of Health and Environment, and the University of Kansas sponsored the *Pollution Prevention Workshop for the Electroplating Industry*. The workshop described simple techniques for waste reduction in the electroplating industry, including: plating, rinsing processes and wastewater, wastewater management options, metals recovery options, waste treatment and management, and product substitutions and plating alternatives. (Contact: the Kansas State University Division of Continuing Education, (800) 432-8222)

VIII.C.2. Summary of Trade Associations

Various trade associations represent the interests of metal fabricator workers and the industry itself. Some of these organizations are discussed in greater detail below.

American Electroplaters and Surface Finishers Society (AESF) 12644 Research Parkway Orlando, FL 32826 Phone: (407) 281-6441 Fax: (407) 281-6446	Members: 10,000 Staff: 21 Budget: 2,000,000 Contact: Ted Witt, Executive Director

Founded in 1909, AESF is an international professional society of scientists, technicians, job shop operators, and others interested in research in electroplating, surface finishing, and allied arts. AESF offers classroom training courses, home study courses, cooperative programs, and a voluntary certification program. In addition, it bestows awards, conducts research programs, and provides an insurance program for job shop owners. AESF also publishes *Plating and Surface Finishing* (monthly), *AESF Shop Guide*, books, symposia proceedings, research reports, and training booklets with slide presentations; and makes available films and videotapes.

ASM International (ASM) 9639 Kinsman Materials Park, OH 44073 Phone: (216) 338-5151	Members: 54,000 Staff: 145 Budget: $19,500,000 Contact: Edward L. Langer

Founded in 1920, ASM represents metallurgists; materials engineers; executives in materials producing and consuming industries; and teachers and students. This association disseminates technical information about the manufacture, use, and treatment of engineered materials. It offers in-plant, home study, and intensive courses through the Materials Engineering Institute; conducts conferences, seminars, and lectures; presents awards to teachers of materials science and for achievements in the field; and grants scholarships and fellowships. Additionally, it maintains a library of 10,000 volumes on metals and other materials.

Copper and Brass Fabricators Council (CBFC) 1050 17th Street, NW, Suite 440 Washington, DC 20036 Phone: (202) 833-8575	Contact: Joseph L. Mayer

Founded in 1966, CBFC represents copper and brass fabricators. Its activities involve foreign trade in copper and brass fabricated products, and Federal regulatory matters including legislation, regulations, rules, controls, stockpiling, and other similar measures affecting domestic fabricators of copper and brass products. CBFC holds an annual convention.

Metal Construction Association (MCA) 1101 14th Street, NW, Suite 1100 Washington, DC 20005 Phone: (202) 371-1243 Fax: (202) 371-1090	Members: 100 Staff: 5 Contact: David W. Barrack

Founded in 1983, MCA represents individuals engaged in the manufacture, design, engineering, sale, or installation of metal used in construction, and others interested in the metal construction industry. It promotes the use of metal in all construction applications. Additionally, MCA represents all sectors of the metal construction industry; fosters better trade practices and improved communication within the industry; serves as liaison between members and other industry organizations. The association collects and disseminates information; maintains the Merit Award Program to acknowledge outstanding buildings, products, and systems in the industry; plans programs in institutional advertising, voluntary standards, and statistics; proposed educational programs including structure erection, estimating, and bookkeeping; compiles statistics; and bestows scholarships. MCA also prepares and distributes two publications: the *Metal Construction Association-Membership Directory* (annually) and the *Metal Construction Association-Newsletter* (quarterly). Its newsletter includes technical articles, meeting reviews, committee reports, minutes, and a calendar of events. MCA holds a semiannual meeting and Metalcon International Trade Show and an annual meeting.

Metal Fabricating Institute (FMI) PO Box 1178 Rockford, IL 61105 Phone: (815) 965-4031	Staff: 4 Contact: Ronald L. Fowler

Founded in 1968, MFI conducts technical seminars for structural and sheet metal fabricators to update management on the latest manufacturing techniques. MFI also presents a Fabricating Engineer of the Year Award. In addition, it publishes *Metal Fabricating News* (bimonthly), which contains a calendar of events, new products and literature, book reviews, and a buyers guide. The association also holds a semiannual conference in West Lafayette, Indiana.

Metal Finishers Suppliers Association (MFSA) 801 North Cass, Ste. 300 Westmont, IL 60559 Phone: (708) 887-0797	Members: 180 Companies Staff: 2-4 Budget: $400,000 Contact: Richard Crain

Incorporated in 1951, MFSA is the only trade association representing companies that supply chemicals and equipment to the metal finishing industry. MFSA works closely with organizations that represent the metal finishing industry, such as AESF (see above) and the National Association of Metal Finishers (see below), and is involved in several joint programs, including an annual conference. In addition, MFSA publishes a monthly newsletter and has published a dozen technical papers to inform and assist its members.

National Association of Metal Finishers (NAMF) 401 N. Michigan Avenue Chicago, IL 60611-4267 Phone: (312) 644-6610	Members: 940 Staff: 6 Budget: $750,000 Contact: Brad Parcells

Founded in 1955, NAMF represents management executives of firms engaged in plating, hard chroming, galvanizing, electroforming, metalizing, organic coating, phosphating, rust proofing, polishing, buffing, anodizing, and other forms of metal finishing. NAMF is concerned primarily with management education, development of finishing standards, and legislative issues. In addition, it publishes *Finishers' Management*, a trade magazine of the plating and finishing industry. NAMF also produces *Finishing Line* (monthly), *Legislative Line* (bi-monthly), and *NAMF Regulatory Compliance Manual*. NAMF holds an annual trade show.

Precision Metalforming Association (PMA) 27027 Chardon Road Richmond Heights, OH 44143 Phone: (216) 585-8800 Fax: (216) 585-3126	Members: 1,000 Staff: 20 Budget: $3,000,000 Contact: Jon E. Jenson

Founded in 1942, PMA represents manufacturers of metal stampings, precision metal fabrications, and metal spinnings, and their suppliers. PMA provides information and technical services to members. It also presents numerous awards and publishes *Metalforming*, a monthly magazine that addresses: materials and equipment, electronics in metal forming and assembly, taxes, legal issues, and management.

Society for Mining, Metallurgy, and Exploration, Inc. (SME) PO Box 625005 Littleton, CO 80162 Phone: (303) 973-9550	Members: 20,000 Staff: 31 Budget: $3,700,000 Contact: Gary D. Howell

Founded in 1871, SME represents individuals engaged in the finding, exploitation, treatment, and marketing of all classes of minerals (metal ores, industrial minerals, and solid fuel) except petroleum. Additionally, it offers specialized education programs; and compiles enrollment and graduation statistics from schools offering engineering degrees in mining, mineral, mineral processing/metallurgical, geological, geophysical technology.

United Steelworkers of America (USWA) 5 Gateway Center Pittsburgh, PA 15222 Phone: (412) 562-2400 Fax: (412) 562-2445	Members: 675,000 Staff: 475 Contact: George Becker

Founded in 1936, this association has absorbed numerous associations for steel workers. Currently, this agency publishes *Steelabor* ten times a year. This news magazine reports on legislation and regulation affecting the union, union activities at the national and chapter levels, economic developments, pension news, and information on safety and health. USWA also publishes the *Steelworker Old Time*, quarterly; and holds a biennial convention.

IX. Contacts/Acknowledgments/Resource Materials/Bibliography and Other References

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[1] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances),

and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

[2] EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

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