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Effluent Guidelines Division
and Permits Division
Washington DC 20460

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EPA

Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards

GUIDANCE MANUAL
FOR
ELECTROPLATING AND METAL FINISHING
PRETREATMENT STANDARDS

Prepared by
The
Effluent Guidelines Division
Office of Water Regulations and Standards
and
Permits Division
Office of Water Enforcement and Permits

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U.S. Environmental Protection Agency
401 M Street S.W.
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

MEMORANDUM

SUBJECT: Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards

FROM: Martha G. Prothro, Director
Permits Division (EN-336)

Jeffery D. Denit, Director
Effluent Guidelines Division (WH-552)

TO: Users of the Guidance Manual

This manual provides information to assist Control Authorities and Approval Authorities in implementing the National Categorical Pretreatment Standards for the Electroplating and Metal Finishing Point Source Categories (40 CFR Parts 413 and 433, respectively). It is designed to supplement the more detailed documents listed as references in the manual; it is not designed to replace them. If you need more complete information on a specific item, you should refer to the appropriate reference.

EPA developed this manual to fill several needs. First, it should be useful to Control Authorities in responding to most routine inquiries from regulated manufacturers. More complex inquiries may require the use of the listed references.

Second, Approval Authorities should find this manual useful in responding to specific category determination requests submitted by industries under the Electroplating and Metal Finishing regulations. In addition, many integrated facilities have raised questions regarding the relationship between the Electroplating regulation and the Metal Finishing regulation and between the Metal Finishing regulation and other regulations listed in Section 433.10 of the Metal Finishing regulation. The manual will provide information on responding to category determination requests and questions from integrated facilities.

Finally, the manual addresses application of the combined wastestream formula to integrated facilities with regulated and unregulated wastestreams. It also provides current information on removal credits and the status of the fundamentally different factors variance provision in light of the recent court decision. It further explains how facilities subject to these regulations may use the certification procedure to minimize their sampling and analysis for total toxic organic pollutants.

We hope that POTWs will find this manual to be a useful tool in implementing the Electroplating and Metal Finishing Categorical Pretreatment Standards. It may also be useful in implementing other categorical pretreatment standards. Please feel free to write to either the Office of Water Regulations and Standards (WH-551) or the Office of Water Enforcement and Permits (EN-336) with suggestions, additions, or improvements.

ACKNOWLEDGEMENTS

We wish to acknowledge the considerable efforts and cooperation of the many people whose contributions helped in the successful completion of this document.

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1. INTRODUCTION

The National Pretreatment Program establishes an overall strategy for controlling the introduction of nondomestic wastes to publicly owned treatment works (POTWs) in accordance with the overall objectives of the Clean Water Act. Sections 307(b) and (c) of the Act authorize the Environmental Protection Agency to develop national pretreatment standards for new and existing dischargers to POTWs. The Act made these pretreatment standards enforceable against dischargers to publicly owned treatment works.

The General Pretreatment Regulations (40 CFR Part 403) establish administrative mechanisms requiring nearly 1,700 POTWs to develop local pretreatment programs to enforce the general discharge prohibitions and specific Categorical Pretreatment Standards. These Categorical Pretreatment Standards are designed to prevent the discharge of pollutants which pass through, interfere with, or are otherwise incompatible with the operation of the POTWs. The standards are technology-based for removal of toxic pollutants and contain specific numerical limitations based on an evaluation of specific technologies for the particular industrial categories. As a result of a settlement agreement, the EPA was required to develop Categorical Pretreatment Standards for 34 industrial categories with a primary emphasis on 65 classes of toxic pollutants.

This manual will provide guidance to POTWs on the application and enforcement of the Categorical Pretreatment Standards for the Electroplating and Metal Finishing Categories. This document is based primarily on two sources: Federal Register notices, which include the official announcements of the Categorical Standards, and the Final Development Documents for Electroplating and Metal Finishing, which provide a summary of the technical support for the regulations. Additional information on the regulations, manufacturing processes, and control technologies can be found in these sources. A listing of the references used in the development of this manual is provided at the end of this document.

1.1 HISTORY OF THE ELECTROPLATING AND METAL FINISHING CATEGORICAL PRETREATMENT STANDARDS

There are 13,500 plants in the electroplating/metal finishing industry. Many discharge wastewaters from several metal finishing operations other than, and in addition to, electroplating. Part 413 (electroplating) currently applies only to flows from the six specified electroplating processes. These Part 433 (metal finishing regulations) will apply to those electroplating streams and also to wastestreams from most other metal finishing operations within the same plants. The Part 433 PSES will apply only to plants already covered by Part 413; however Part 433 will often cover additional wastewater within the same plants. Thus the Part 433 limits on discharge of toxic metals, toxic organics, and cyanide will apply to most facilities in the electroplating/metal finishing industry.

The industry can be divided into the sectors indicated on Table 1.1. Facilities are either "captives" (those which in a calendar year own more than 50% [area basis] of the materials undergoing metal finishing); or "job shops" (those which in a calendar year do not own more than 50% [area basis] of material undergoing metal finishing).

Captives can be further divided by two definitions: "integrated" plants are those which, prior to treatment, combine electroplating waste streams with significant process waste streams not covered by the electroplating category; "non-integrated" facilities are those which have significant wastewater discharges only from operations addressed by the electroplating category. Many captives (50%) are "integrated" facilities. Whereas captives often have a complex range of operations, job shops usually perform fewer operations. In theory job shops can be divided like captives; in actuality, however, approximately 97% of all job shops in this industry are "non-integrated."

Pretreatment standards for the electroplating industry were first established in 1974 but it was not until promulgation of 40 CFR Part 413 on September 7, 1979 that Electroplating Categorical Pretreatment Standards became a reality. The 1979 Standards established specific numerical limitations for dischargers falling within seven subcategories. Shortly thereafter,

Table 1.1

BREAKDOWN OF THE
ELECTROPLATING/METAL FINISHING INDUSTRY

(Number of plants per sector 13,470)

	Job shops and IPCBM[1] (3,470)	Captive facilities (10,000)	
		Nonintegrated	Integrated
Indirect dischargers (10,561)	3,061 job & IPCBM indirect	3,750 non-integrated captive	3,750 integrated captive
Direct dischargers (2,909)	409 job & IPCBM directs	(2)	(2)

1 Independent printed circuit board manufacturers.

2 2,500 captive directs.

petitions to review the electroplating pretreatment standards were filed in the Court of Appeals by several industry groups. EPA reached a settlement agreement with the industry groups and agreed to adopt changes to the Standards which were promulgated on January 28, 1981. The major changes incorporated by the 1981 amendments to the Electroplating Standards included:

1) Revision of the daily maximum limitation for total cyanide from 0.8 to 1.9 mg/l

2) Revision of 30-day average limits to 4-day average limits

3) Adoption of the concept of integrated and non-integrated facilities

4) Extension of compliance dates

5) Recognition of the development of additional pretreatment standards to be called "Metal Finishing" which would regulate processes currently falling under electroplating as well as many other metal finishing processes. However, EPA stated that in light of the potentially severe economic impact of these anticipated regulations on the job shop (and independent printed circuit board) segment of the industry, the Agency would not impose more stringent pretreatment standards for that segment of the industry for several years.

In accordance with the Agency's plan, EPA promulgated the Metal Finishing Categorical Pretreatment Standards on July 15, 1983 as 40 CFR Part 433. The effect of the 1983 Metal Finishing Standards was to create a new category - Metal Finishing - which <u>most</u> electroplaters would have to comply with following their compliance with the Electroplating Standard. These subsequent limits would apply uniformly to discharges from electroplating and other metal finishing operations. This would meet industry's requests for equivalent limits for process lines often found together and would greatly reduce the need for the combined wastestream formula (see Section 5.5). Once the compliance date for the Metal Finishing Standards is reached, all firms, conducting one or more of the six basic operations of the Electroplating Category (see Section 2.1) must come into compliance with the Metal Finishing Pretreatment Standards, with the exception of existing job shop electroplaters and independent printed circuit board manufacturers. Existing indirect job shop electroplaters and independent printed circuit board manufacturers must still comply with the Part 413 Electroplating Pretreatment Standards and are exempt from the Part 433 Metal Finishing Standards.

Non-integrated and integrated electroplaters must comply with Electroplating Pretreatment Standards for Existing Sources (PSES) for Metals and Cyanide by April 27, 1984, and June 30, 1984, respectively. All electroplaters must comply with the Total Toxic Organics (TTO) PSES by no later than July 15, 1986 (See Table 2.2).

Electroplaters subject to the Metal Finishing PSES must comply with the Metals, Cyanide, and Final TTO PSES by no later than February 15, 1986 (See Table 3.5). After this date, the Metal Finishing PSES supercede the Electroplating PSES. With the exception of plants covered by the Iron and Steel standards, electroplaters subject to the Metal Finishing PSES must comply with an interim TTO PSES by no later than June 30, 1984. A more complete discussion of compliance dates is presented in subsequent sections of this manual.

2. ELECTROPLATING CATEGORICAL PRETREATMENT STANDARDS (40 CFR PART 413)

2.1 AFFECTED INDUSTRY

The Electroplating Standards are applicable to wastewater from any or all of these six specific operations (See the Electroplating Final Development Document).

1. Electroplating
2. Electroless Plating
3. Anodizing
4. Coatings
5. Chemical Etching and Milling
6. Printed Circuit Board Manufacturing

These six electroplating operations are briefly discussed below:

1. Electroplating is the production of a thin surface coating of oné metal upon another by electrodeposition. Ferrous or nonferrous basis materials may be coated by a variety of common (copper, nickel, lead, chromium, brass, bronze, zinc, tin, cadmium, iron, aluminum or combinations thereof) or precious (gold, silver, platinum, osmium, iridium, palladium, rhodium, indium, ruthenium, or combinations thereof) metals. In electroplating, metal ions supplied by the dissolution of metal from anodes or other pieces, are reduced on the work pieces (cathodes) while in either acid, alkaline, or neutral solutions.

   The electroplating baths contain metal salts, alkalies, and other bath control compounds in addition to plating metals such as copper, nickel, silver or lead. Many plating solutions contain metallic, metallo-organic, and organic additives to induce grain refining, leveling of the plating surface, and deposit brightening.

2. Electroless Plating is the chemical deposition of a metal coating on a workpiece by immersion in an appropriate plating solution. Electricity is not involved, therefore uniform deposits are easily obtained. Copper and nickel electroless plating for printed circuit boards are the most common operations. In electroless nickel plating the source of nickel is a salt, and a reducer is used to reduce the nickel to its base state. A complexing agent is used to hold the metal ion in solution. Immersion plating, which for purposes of this

regulation is considered part of electroless plating, produces a metal deposit by chemical displacement; however, it is not an autocatalytic process but is promoted by one of the products of the reaction. Immersion plating baths are usually formulations of metal salts, alkalies and complexing agents (typically cyanide or ammonia).

3. Anodizing is an electrochemical process which converts the metal surface to a coating of an insoluble oxide. Aluminum is the most frequently anodized material. The formation of the oxide occurs when the parts are made anodic in dilute sulfuric or chromic acid solutions. The oxide layer begins formation at the extreme outer surface, and as the reaction proceeds, the oxide grows into the metal. Chromic acid anodic coatings are more protective than sulfuric acid coatings and are used if a complete rinsing of the part cannot be achieved.

   Anodizing wastewater typically contains the basis material and either chromic or sulfuric acid. When dyeing of anodized coatings occurs, the wastewaters will contain chromium or other metals from the dye. Other potential pollutants include nickel acetate (used to seal anodic coatings) or other complexes and metals from dyes and sealers.

4. Coatings include chromating, phosphating, metal coloring and passivating. 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. In chromating, a portion of the base metal is converted to a component of the protective film formed by the coating solutions containing hexavalent chromium and active organic or inorganic compounds. Phosphate coatings are formed by the immersion of steel, iron, or zinc plated steel in a dilute solution of phosphoric acid plus other reagents to condition the surfaces for cold forming operations, prolong the life of organic coatings, provide good paint bonding and improve corrosion resistance. Metal coloring involves the chemical method of converting the metal surface into an oxide or similar metallic compound to produce a decorative finish. A variety of solutions utilizing many metals may contribute to the wastestream. Passivating is the process of forming a protective film on metals by immersion in an acid solution, usually nitric acid or nitric acid with sodium dichromate.

5. Etching and Chemical Milling are processes used to produce specific design configurations or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Chemical etching is the same process as chemical milling except the rates and depths of metal removal are usually much greater in chemical milling. The major wastestream constituents are the dissolved basis material and etching solutions.

6. Printed Circuit Board Manufacturing involves the formation of a circuit pattern of conductive metal (usually copper) on nonconductive board materials such as plastic or glass. There are five basic steps

involved in the manufacturing of printed circuit boards: cleaning and surface preparation, catalyst and electroless plating, pattern printing and masking, electroplating, and etching.

Wastewater is produced in the manufacturing of printed circuit boards from the following processes:

a. Surface preparation - The rinses following scrubbing, alkaline cleaning, acid cleaning, etchback, catalyst application, and activation.

b. Electroless plating - Rinses following the electroless plating step.

c. Pattern plating - Rinses following acid cleaning, alkaline cleaning, copper plating, and solder plating.

d. Etching - Rinses following etching and solder brightening.

e. Tab plating - Rinses following solder stripping, scrubbing, acid cleaning, and nickel, gold, or other plating operations.

f. Immersion plating - Rinses following acid cleaning and immersion tin plating.

Additionally, water may be used for subsidiary purposes such as rinsing away spills, air scrubbing water, equipment washing, and dumping spent process solutions. The principal constituents of the wastestreams from the printed circuit board industry are suspended solids, copper, fluorides, phosphorus, tin, palladium, and chelating agents. Low pH values are characteristic of the wastes because of the necessary acid cleaning and surface pretreatment.

In addition to the above operations, the Electroplating Standards also apply to the related operations of alkaline cleaning, acid pickle, and stripping when each operation is followed by a rinse.

2.2 EXCEPTIONS FROM REGULATION COVERAGE

Operations similar to electroplating which are specifically exempt from coverage under the Electroplating Categorical Pretreatment Standards include:

1. Electrowinning and electrorefining conducted as part of nonferrrous metal smelting and refining (40 CFR Part 421);

2. Metal surface preparation and conversion coating conducted as part of coil coating (40 CFR Part 465);

3. Metal surface preparation and immersion plating or electroless plating conducted as a part of porcelain enameling (40 CFR Part 466);

4. Electrodeposition of active electrode materials, electroimpregnation, and electroforming conducted as part of battery manufacturing (40 CFR Part 461);

5. Metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities; and

6. Continuous strip electroplating conducted within iron and steel manufacturing facilities.

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

2.3 PRETREATMENT STANDARDS FOR THE ELECTROPLATING CATEGORY

Indirect dischargers that perform electroplating operations are currently subject to the Electroplating Categorical Pretreatment Standards (40 CFR Part 413). The Electroplating Standards were developed based on the best practicable control technology (BPT) and apply only to existing indirect sources (PSES). EPA established Pretreatment Standards on the basis of concentration with alternate mass-based standards for Electroplating. The production based standards are based on milligrams per square meter of operation. Electroplating Standards are based on daily maximum and four day average value limits (with four day average value limits defined as the average value from four consecutive sampling days). The PSES limitations for electroplaters and the alternate mass-based standards are presented in Table 2.1. Note that the limitations and the pollutants regulated are different for dischargers of less than 10,000 gallons per day of regulated Electroplating process wastewater as compared to dischargers of 10,000 gallons per day or more of regulated Electroplating process wastewater.

Also, all new sources which perform electroplating operations are subject to the Metal Finishing regulations (40 CFR Part 433).

TABLE 2.1

PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES)
ELECTROPLATING CATEGORY

Facilities Discharging <38,000 liters (10,000 gallons) per day

Pollutant	Daily Maximum (mg/l)	Maximum 4 Day Average (mg/l)
Cadmium (T)	1.2	0.7
Lead (T)	0.6	0.4
Cyanide, A	5.0	2.7
Total Toxic Organics (TTO)[1]	4.57	--

Facilities Discharging >38,000 liters (10,000 gallons) per day

Pollutant	Daily Maximum (mg/l)	Maximum 4 Day Average (mg/l)
Cadmium (T)	1.2	0.7
Chromium (T)	7.0	4.0
Copper (T)	4.5	2.7
Lead (T)	0.6	0.4
Nickel (T)	4.1	2.6
Zinc (T)	4.2	2.6
Silver (T)[2]	1.2	0.7
Total Metals[3]	10.5	6.8
Cyanide, T	1.9	1.0
Total Toxic Organics (TTO)[1]	2.13	--

Cyanide, A = Cyanide, amenable to chlorination
Cyanide (T) = Cyanide, Total
(T) = Total

[1]No regulation of the maximum 4-day average for TTO.

[2]The silver pretreatment standard applies only to precious metals plating.

[3]Total metals is defined as the sum of the concentration of copper, nickel, total chromium, and zinc.

TABLE 2.1
(continued)

Alternate Mass-Based Limitations For Electroplating Subcategories
Discharging 38,000 liters (10,000 gallons) per day or more

Pollutant	Daily Maximum (mg/sq m of Operation)		Maximum 4 Day Average (mg/sq m of Operation)	
	Electroplating, Electroless Plating, Chemical Etching and Milling, Coatings, Anodizing	Printed Circuit Board Manufacturing	Electroplating, Electroless Plating, Chemical Etching and Milling, Coatings, Anodizing	Printed Circuit Board Manufacturing
Cadmium (T)	47	107	29	65
Chromium, (T)	273	623	156	357
Copper (T)	176	401	105	241
Lead (T)	23	53	16	36
Nickel (T)	160	365	100	229
Zinc (T)	64	374	102	232
Silver (T)[1]	47	---	29	---
Total metals[2]	410	935	267	609
Cyanide (T)	74	169	39	89

TTO - Maximum for any one day is 2.13 mg/l

[1]The silver pretreatment standard applies only to precious metals plating.

[2]Total metals is defined as the sum of the masses of copper, nickel, total chromium, and zinc.

2.4 POLLUTANTS EXCLUDED FROM REGULATION

The EPA excluded from regulation 7 of the 126 toxic pollutants which are given priority consideration (antimony, arsenic, asbestos, beryllium, mercury, selenium, and thallium). These pollutants are found in only a small number of sources and are effectively controlled by the technologies on which the limits are based.

2.5 COMPLIANCE DATES

The Agency divided the industry into two groups on the basis of wastewater complexity:

a. Integrated facility - a facility which performs electroplating as only one of several operations necessary for manufacture of a product at a single physical location, which has significant quantities of process wastewater from nonelectroplating operation, and which, prior to or at the point of treatment (or proposed treatment), combines one or more electroplating process water lines with one or more plant sewers carrying process wastewater from non-electroplating manufacturing operations.

b. Non-integrated - any facility which is not integrated.

This division results in different compliance dates as shown in Table 2.2, below.

TABLE 2.2

COMPLIANCE DATES FOR ELECTROPLATING PRETREATMENT STANDARDS
40 CFR PART 413

	Existing Indirect Dischargers Compliance Dates	
Pollutant Parameter	Non-Integrated Facilities	Integrated Facilities
Metals and Cyanide	April 27, 1984	June 30, 1984
Total Toxic Organics (TTO)	July 15, 1986	July 15, 1986

3. METAL FINISHING CATEGORICAL PRETREATMENT STANDARDS (40 CFR PART 433)

3.1 AFFECTED INDUSTRY

The Metal Finishing Category covers wastewater discharges from 46 unit operations, the six operations previously addressed by the Electroplating regulation, plus an additional 40 operations. If any of the six electroplating operations are present, then the Metal Finishing pretreatment regulations apply to wastewater from any of the 46 listed metal finishing operations. If a facility does not perform at least one of six Electroplating operations, it is not subject to the Metal Finishing regulation. These metal finishing unit operations are summarized and described in Table 3.1. Table 3.2 summarizes the wastewaters potentially generated by each of the metal finishing unit operations. Since the Standards regulate processes and not industry groups, specific SIC codes do not determine coverage.

3.2 EXCEPTIONS FROM REGULATION COVERAGE

Excluded from the Metal Finishing regulations are all existing indirect discharging job shop electroplaters, independent printed circuit board manufacturers, and any facility which does not perform at least one of the six basic Electroplating processes. Job shops are defined as those facilities which in a calendar year own 50% (area basis) or less of the material undergoing metal finishing. Independent Printed Circuit Board Manufacturers (IPCBMs) are defined as facilities which manufacture printed circuit boards principally for sale to other companies. These facilities remain subject only to the Electroplating (Part 413) Standards, primarily to minimize the economic impact to these relatively small facilities. Also excluded from the Metal Finishing regulations are those facilities which perform metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS

Unit Operations	Summary Description of Unit Operations
1. Electroplating	The production of a thin surface coating of one metal upon another by electrodeposition. Ferrous or nonferrous basis materials may be coated by a variety of common (copper, nickel, lead, chromium, brass, bronze, zinc, tin, cadmium, iron, aluminum or combinations thereof) or precious (gold, silver, platinum, osmium, iridium, palladium, rhodium, indium, ruthenium, or combinations thereof) metals. In electroplating, metal ions supplied by the dissolution of metal from anodes or other pieces, are reduced on the work pieces (cathodes) while in either acid, alkaline, or neutral solutions.
2. Electroless Plating	The chemical deposition of a metal coating on a workpiece by immersion in an appropriate plating solution in which electricity is not involved. Copper and nickel electroless plating for printed circuit boards are the most common operations. Immersion plating, which for purposes of the Metal Finishing regulation is considered part of electroless plating, produces a metal deposit by chemical displacement.
3. Anodizing	An electrochemical process which converts the metal surface to a coating of an insoluble oxide. Aluminum is the most frequently anodized material. The formation of the oxide occurs when the parts are made anodic in dilute sulfuric or chromic acid solutions. The oxide layer begins formation at the extreme outer surface, and as the reaction proceeds, the oxide grows into the metal.
4. Coatings	Any operation that includes chromating, phosphating, metal coloring and passivating. In chromating, a portion of the base metal is converted to a component of the protective film formed by the coating solutions containing hexavalent chromium and active organic or inorganic compounds. Phosphate coatings are formed by the immersion of steel, iron, or zinc plated steel in a dilute solution of phosphoric acid plus other reagents to condition the surfaces for further processing. Metal coloring involves the chemical method of converting the metal surface into an

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
	oxide or similar metallic compound to produce a decorative finish. Passivating is the process of forming a protective film on metals by immersion in an acid solution, usually nitric acid or nitric acid with sodium dichromate.
5. Etching and Chemical Milling	These operations are used to produce specific design configurations or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Chemical etching is the same process as chemical milling except the rates and depths of metal removal are usually much greater in chemical milling.
6. Printed Circuit Board Manufacturing	This operation involves the formation of a circuit pattern of conductive metal (usually copper) on nonconductive board materials such as plastic or glass. There are five basic steps involved in the manufacturing of printed circuit boards: cleaning and surface preparation, catalyst and electroless plating, pattern printing and masking, electroplating, and etching.
7. Cleaning	This operation involves the removal of oil, grease, and dirt from the basis material using water with or without detergents or other dispersing agents. Acid cleaning is a process in which an acid is used with a wetting agent or detergent to remove oil, grease, dirt, or oxide from the metal surface.
8. Machining	This operation involves the general process of removing stock from a workpiece by forcing a cutting tool through the workpiece, thereby removing a chip of basis material. Machining operations incorporate the use of natural and synthetic oils for cooling and lubrication.
9. Grinding	This operation involves the process of removing stock from a workpiece by the use of a tool consisting of abrasive grains held by a rigid or semi-rigid binder. Natural and synthetic oils are used for cooling and lubrication in many grinding operations.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
10. Polishing	This abrading operation is used to remove or smooth out surface defects (scratches, pits, tool marks, etc.) that adversely affect the appearance or function of a part. Area cleaning and washdown can produce wastes that enter wastewater streams. The wastes would belong to the common metals and oily waste types.
11. Barrel Finishing (or Tumbling)	This operation is a controlled method of processing parts to remove burrs, scale, flash, and oxides as well as to improve surface finish. Barrel finishing produces a uniformity of surface finish not possible by hand finishing and is generally the most economical method of cleaning and surface conditioning. Wastewater is generated by rinsing of parts following the finishing operation and by periodic dumping of process solutions. Contributions to the common metals, hexavalent chromium, cyanide, and oily waste types could be made by this operation, depending upon the chemical solutions employed.
12. Burnishing	This operation involves the process of finish sizing or smooth finishing a workpiece (previously machined or ground) by displacement, rather than removal, of minute surface irregularities. Wastes may come from spills, leaks, process solution dumps and post-finish rinsing and could contribute to the common metals, precious metals, and oily waste types depending upon the basis material finished. In addition, sodium cyanide (NaCN) may be used as a wetting agent and rust inhibitor (for steel), thus contributing cyanide wastes from this operation.
13. Impact Deformation	This operation involves the process of applying an impact force to a workpiece such that the workpiece is permanently deformed or shaped. Wastes containing common metals and oily wastes may come from cleaning the parts or cleanup of leaks or spills.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
14. Pressure Deformation	This operation involves the process of applying force (at a slower rate than at impact force) to permanently deform or shape a workpiece. Wastes containing common metals and oily wastes may come from cleaning the parts or cleanup of leaks or spills.
15. Shearing	This operation involves the process of severing or cutting a workpiece by forcing a sharp edge or opposed sharp edges into the workpiece stressing the material to the point of shear failure and separation. Wastes containing common metals and oily wastes may come from cleaning the parts or cleanup of leaks or spills.
16. Heat Treating	This operation involves the modification of the physical properties of a workpiece through the application of controlled heating and cooling cycles. Wastewater is generated through rinses, bath discharges, spills, and leaks, and often contain the solution constitutents as well as various scales, oxides, and oils.
17. Thermal Cutting	This operation involves the process of cutting, slotting or piercing a workpiece using an oxyacetylene oxygen lance or electric arc cutting tool. Water may be used for rinsing or cooling of parts and equipment following this operation. Wastewaters produced would contribute to the common metals and oily waste types.
18. Welding	This operation involves the process of joining two or more pieces of material by applying heat, pressure or both, with or without filler material, to produce a localized union through fusion or recrystallization across the interface. This operation is followed by quenching, cooling or annealing in a solution of water or emulsified oils. When this is done, wastes produced can belong to the common metals waste type.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
19. Brazing	This operation involves the process of joining metals by flowing a thin, capillary thickness layer of nonferrous filler metal into the space between them. Bonding results from the intimate contact produced by the dissolution of a small amount of base metal in the molten filler metal, without fusion of the base metal. The term brazing is used where the temperature exceeds 425°C (800°F). This operation is followed by quenching, cooling or annealing in a solution of water or emulsified oils. When this is done, wastes produced can belong to the common metals waste type.
20. Soldering	This operation involves the process of joining metals by flowing a thin (capillary thickness) layer of nonferrous filler metal into the space between them. Bonding results from the intimate contact produced by the dissolution of a small amount of base metal in the molten filler metal, without fusion of the base metal. The term soldering is used where the temperature range falls below 425°F (800°F). This operation is followed by quenching, cooling or annealing in a solution of water or emulsified oils. When this is done, wastes produced can belong to the common metals waste type.
21. Flame Spraying	This operation involves the process of applying a metallic coating to a workpiece using finely powdered fragments of wire, together with suitable fluxes, which are projected through a cone of flame onto the workpiece. This operation is followed by quenching, cooling or annealing in a solution of water or emulsified oils. When this is done, wastes produced can belong to the common metals waste type.
22. Sand Blasting	This operation involves the process of removing stock, including surface films, from a workpiece by the use of abrasive grains pneumatically impinged against the workpiece.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
23. Abrasive Jet Machining	This operation is a mechanical process for cutting hard brittle materials. It is similar to sand blasting but uses much finer abrasives carried at high velocities (500-3000 fps) by a liquid or gas stream. Wastewater can be produced through solution dumps, spills, leaks or washdowns of work areas and contributes to the common metals and oily waste types.
24. Electrical Discharge Machining	This operation is a process which can remove metal from any metal with good dimensional control. The machining action is caused by the formation of an electrical spark between an electrode, shaped to the required contour, and the workpiece. Rinsing of machined parts and work area cleanups can generate wastewaters which also contain base materials. These wastewaters contribute to the common metals and oily waste types.
25. Electrochemical Machining	This operation is a process based on the same principles used in electroplating except the workpiece is the anode and the tool is the cathode. Electrolyte is pumped between the electrodes and a potential applied which results in removal of the metal. In addition to standard chemical formulations, inorganic and organic solvents are sometimes used as electrolytes for electrochemical machining and with the basis material being machined, can enter waste steams via rinse discharges, bath dumps, and floor spills. Generated wastes can belong to the common metals, cyanide, and solvent waste types depending upon the solvent used.
26. Electron Beam Machining	This operation is a thermoelectric process whereby heat is generated by high velocity electrons impinging on part of the workpiece. At the point where the energy of the electrons is focused, it is transformed into sufficient thermal energy to vaporize the material locally and is generally carried out in a vacuum.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
27. Laser Beam Machining	This operation is the process whereby a highly focused monochromatic collimated beam of light is used to remove material at the point of impingement on a workpiece. Laser beam machining is a thermoelectric process with material removal largely accomplished by evaporation, although some material is removed in the liquid state at high velocity.
28. Plasma Arc Machining	This operation is the process of material removal or shaping of a workpiece by a high velocity jet of high temperature ionized gas. A gas (e.g., nitrogen, argon, or hydrogen) is passed through an electric arc causing it to become ionized and raised to temperatures in excess of 16,649°C (30,000°F). The relatively narrow plasma jet melts and displaces the workpiece material in its path.
29. Ultrasonic Machining	This operation is a mechanical process designed to effectively machine hard, brittle materials. It removes material by the use of abrasive grains which are carried in a liquid between the tool and the work, and which bombard the work surface at high velocity.
30. Sintering	This operation is the process of forming a mechanical part from a powdered metal by fusing the particles together under pressure and heat. The temperature is maintained below the melting point of the basis metal.
31. Laminating	This operation is the process of adhesive bonding layers of metal, plastic, or wood to form a part. Water is not often used in this operation; however, occasional rinsing or cooling may occur in conjunction with laminating. The waste generated could contribute to the common metals and oily waste types.
32. Hot Dip Coating	This operation is the process of coating a metallic workpiece with another metal to provide a protective film by immersion in a molten bath. Galvanizing (hot dip zinc) is the most common hot dip coating. Water is used for rinses following precleaning and sometimes for quenching after coating. These wastewaters can contribute to the common metals waste type.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
33. Sputtering	This operation is the process of covering a metallic or non-metallic workpiece with thin films of metal. The surface to be coated is bombarded with positive ions in a gas discharge tube, which is evacuated to a low pressure.
34. Vapor Plating	This operation is the process of decomposition of a metal or compound upon a heated surface by reduction or decomposition of a volatile compound at a temperature below the melting point of either the deposit or the basis material.
35. Thermal Infusion	This operation is the process of applying a fused zinc, cadmium, or other metal coating to a ferrous workpiece by inbuing the surface of the workpiece with metal powder or dust in the presence of heat.
36. Salt Bath Descaling	This operation is the process of removing surface oxides or scale from a workpiece by immersion of the workpiece in a molten salt bath or a hot salt solution. Molten salt baths are used to remove oxides from stainless steels and other corrosion-resistant alloys. These baths contain molten salts, caustic soda, sodium hydride and chemical additives. These contaminants (and a small amount of base material and oils) enter wastewater streams through rinsing, spills, leaks, batch dumps of process solutions, and improper handling of sludge produced by the process. Wastewaters produced by salt bath descaling contribute to the common metals and oily waste types.
37. Solvent Degreasing	This operation is a process for removing oils and grease from the surface of a workpiece by the use of organic solvents such as aliphatic petroleums, aromatics, oxygenated hydrocarbons, halogenated hydrocarbons, and combinations of these classes of solvents. These pollutants can enter wastewater streams and contribute to the toxic organic waste type.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
38. Paint Stripping	This operation is the process of removing an organic coating from a workpiece. The stripping of such coatings is usually performed with caustic, acid, solvent, or molten salt. The stripping wastes can contain any of the constituents of the paint being removed, as well as a small amount of the basis material beneath the paint and the constitutents of the stripping solution. Wastes are primarily generated by rinsing and can also contain small amounts of emulsified oils. Wastes produced belong to the common metals and oily waste types and may contain toxic organics.
39. Painting	This operation is the process of applying an organic coating to a workpiece.
40. Electrostatic Painting	This operation involves the application of electrostatically charged paint particles to an oppositely charged workpiece followed by thermal fusing of the paint particles to form a cohesive paint film.
41. Electropainting	This operation 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. Electropainting is used primarily for primer coats because it gives a fairly thick, highly uniform, corrosion resistant coating in relatively little time. Ultrafiltration is used in connection with electropainting to concentrate paint solids. Wastewaters from these unit operations can contribute to the common metals, hexavalent chromium, and solvent waste types.
42. Vacuum Metalizing	This operation is the process of coating a workpiece with metal by flash heating metal vapor in a high-vacuum chamber containing the workpiece. The vapor condenses on all exposed surfaces.
43. Assembly	This operation involves the fitting together of previously manufactured parts or components into a complete machine, unit of a machine, or structure.

TABLE 3.1. METAL FINISHING CATEGORY UNIT OPERATIONS (Continued)

Unit Operations	Summary Description of Unit Operations
44. Calibration	This operation involves the application of thermal, electrical, or mechanical energy to set or establish reference points for a component or complete assembly.
45. Testing	This operation involves the application of thermal, electrical, or mechanical energy to determine the suitability or functionality of a component or complete assembly. Leak testing, final washing (automobiles, etc.), and test area washdowns enter wastestreams and may contain oils and fluids used at testing stations as well as heavy metal contamination derived from the component being tested. These wastewaters can contribute to the common metals and oily waste types.
46. Mechanical Plating	This operation is the process of depositing metal coatings on a workpiece via the use of a tumbling barrel, metal powder, and usually glass beads for the impaction media. The operation is subject to the same cleaning and rinsing operations that are applied before and after the electroplating operation.

Note: Unit Operations 1 through 6 are considered to be core operations. If a facility does not perform at least one of these six electroplating operations, it is not subject to the Metal Finishing regulation.

TABLE 3.2

POTENTIAL WASTEWATER POLLUTANTS GENERATED BY METAL FINISHING UNIT OPERATIONS

Unit	Operations	Metals	Hexavalent Chromium	Cyanide	Oils	Toxic Organics	Zero Discharge
1.	Electroplating	x	x	x		x	
2.	Electroless Plating	x	x			x	
3.	Anodizing	x	x			x	
4.	Conversion Coating	x	x	x		x	
5.	Etching (Chemical Milling)	x	x	x		x	
6.	Printed Circuit Board Manufacturing	x				x	
7.	Cleaning	x	x	x	x	x	
8.	Machining	x			x		
9.	Grinding	x			x		
10.	Polishing	x			x		
11.	Barrel Finishing (Tumbling)	x	x	x	x		
12.	Burnishing	x		x	x		
13.	Impact Deformation	x			x		
14.	Pressure Deformation	x			x		
15.	Shearing	x			x		
16.	Heat Treating	x		x	x		
17.	Thermal Cutting	x					
18.	Welding	x					
19.	Brazing	x					
20.	Soldering	x					
21.	Flame Spraying	x					
22.	Sand Blasting	x					
23.	Other Abrasive Jet Machining	x					
24.	Electric Discharge Machining	x			x		
25.	Electrochemical Machining	x		x		x	
26.	Electron Beam Machining						x
27.	Laser Beam Machining						x
28.	Plasma Arc Machining						x

TABLE 3.2

POTENTIAL WASTEWATER POLLUTANTS GENERATED BY METAL FINISHING UNIT OPERATIONS

Unit	Operations	Metals	Hexavalent Chromium	Cyanide	Oils	Toxic Organics	Zero Discharge
29.	Ultrasonic Machining						x
30.	Sintering						x
31.	Laminating	x					
32.	Hot Dip Coating	x					
33.	Sputtering						x
34.	Vapor Plating						x
35.	Thermal Infusion						x
36.	Salt Bath Descaling	x			x		
37.	Solvent Degreasing	x			x	x	
38.	Paint Stripping	x			x	x	
39.	Painting	x				x	
40.	Electrostatic Painting	x	x			x	
41.	Electropainting	x				x	
42.	Vacuum Metalizing						x
43.	Assembly	x			x	x	
44.	Calibration						x
45.	Testing				x		
46.	Mechanical Plating	x	x				

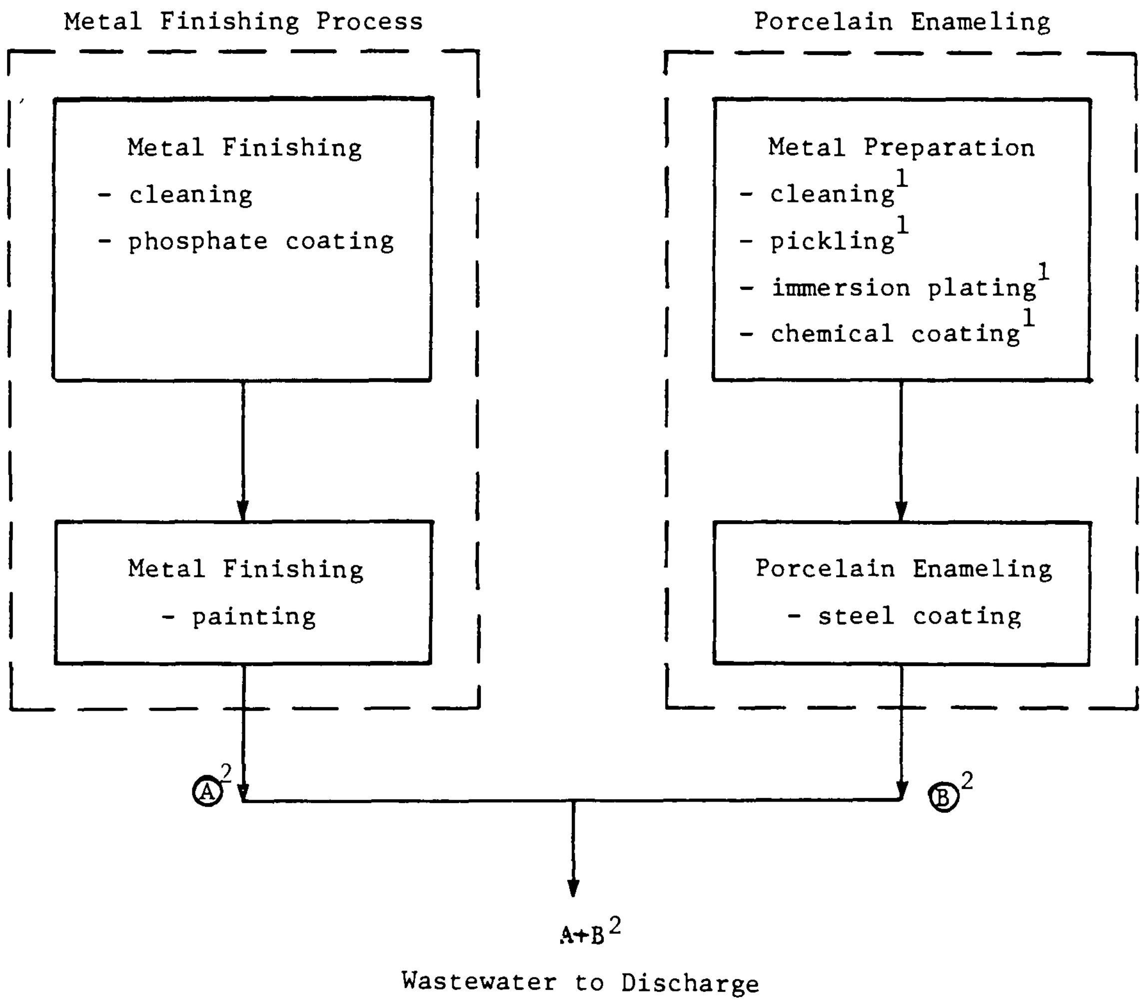
In certain cases, another Categorical Pretreatment Standard may also cover wastewater discharges from metal finishing operations. In these situations, the more specific standards will apply to those metal finishing wastestreams which appear to be covered by both standards. The following regulations take precedence over the Metal Finishing regulation.

- Nonferrous Smelting and Refining (40 CFR Part 421)
- Coil Coating (40 CFR Part 465)
- Porcelain Enameling (40 CFR Part 466)
- Battery Manufacturing (40 CFR Part 461)
- Iron and Steel Manufacturing (40 CFR Part 420)
- Metal Casting Foundries (40 CFR Part 464)
- Aluminum Forming (40 CFR Part 467)
- Copper Forming (40 CFR Part 468)
- Plastic Molding and Forming (40 CFR Part 463)
- Electrical and Electronic Components (40 CFR Part 469)
- Nonferrous Forming (40 CFR Part 471)

For example, if a plant performs a cleaning and phosphate coating operation, in preparation for painting and also performs cleaning, pickling, immersion coating, and chemical coating as part of a porcelain enameling process, then the Metal Finishing PSES apply to the discharge from the cleaning and phosphate coating operation, while the Porcelain Enameling PSES apply to the discharge from application of the porcelain enamel, and also the preparatory operations of cleaning, pickling, immersion plating, and chemical coating operation. Normally, the metal preparation operations (cleaning, pickling, immersion plating, and chemical coating) would be subject to the Metal Finishing regulation. However, because the Porcelain Enameling regulations specifically include those operations performed in preparation for the porcelain enameling operation, the Porcelain Enameling regulation takes precedence for those wastestreams (See Figure 3.1).

3.3 PRETREATMENT STANDARDS FOR THE METAL FINISHING CATEGORY

The Metal Finishing Standards (40 CFR Part 433) establish pretreatment standards for new and existing facilities performing electroplating and other



[1] These four operations are normally subject to the Metal Finishing regulation; however, in this case, they are performed immediately prior to a porcelain enameling operation. These types of operations were included as part of the data base used to develop the Porcelain Enameling regulations, thus, in this situation, they are subject to the Porcelain Enameling regulation.

[2] Wastestream A is subject to Part 433 if discharged. Wastestream B is subject to Part 466 if discharged. If the wastestreams are combined before discharge, the combined discharge (A+B) is subject to the combined wastestream formula.

FIGURE 3.1

SCHEMATIC SHOWING EXAMPLE OF OVERLAP COVERAGE OF CATEGORICAL STANDARDS AT INTEGRATED FACILITIES metal finishing operations. These standards are BAT-equivalent and represent the best available technology economically achievable. All existing indirect discharging electroplating facilities (except job shop electroplaters and IPCBMs) must first comply with the Electroplating (Part 413) and then with the Metal Finishing (Part 433) regulations. Another exception is continuous strip electroplating at Iron and Steel Mills which is subject only to the Metal Finishing regulation; this unit operation is not subject to the Electroplating regulation. The limits apply uniformly to discharges from all electroplating and other metal finishing operations. 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. No production based standards were developed for the Metal Finishing (Part 433) Regulation. The Metal Finishing standards are based on the 99th percentile of expected variations from observed long-term unconstructed averages. They include daily maximums and maximum monthly (statistically based on 10 samples per month) average concentration limitations. The PSES and PSNS limitations for metal finishing facilities are presented in Table 3.3. If a plant intends to consistently comply with the regulatory limit it should use the long term concentration average as the basis for design and operation. Table 3.4 presents long-term concentration averages which were found to be attainable by the technology EPA assessed. They are presented as guidance to dischargers and control authorities.

The pretreatment standards for new sources (PSNS) apply to electroplating and metal finishing facilities which began their operation after August 31, 1982, the date of the proposed regulation. The PSNS for metal finishing facilities are the same as those for existing sources, with the exception that cadmium must be controlled more stringently.

3.4 POLLUTANTS EXCLUDED FROM REGULATION

The EPA excluded from regulation 7 of the 126 toxic pollutants which are given priority consideration (antimony, arsenic, asbestos, beryllium, mercury, selenium, and thallium). These pollutants are found in only a small number of sources and are effectively controlled by the technologies on which the limits are based.

TABLE 3.3

PRETREATMENT STANDARDS FOR THE METAL FINISHING CATEGORY
40 CFR PART 433

PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES)

Pollutant	Daily Maximum (mg/l)	Maximum Monthly Average (mg/l)
Cadimium (T)	0.69	0.26
Chromium (T)	2.77	1.71
Copper (T)	3.38	2.07
Lead (T)	0.69	0.43
Nickel (T)	3.98	2.38
Silver (T)	0.43	0.24
Zinc (T)	2.61	1.48
Cyanide, total	1.20	0.65
Total Toxic Organics (interim)	4.57	--
Total Toxic Organics (final)	2.13	--
Alternative to total cyanide:		
Cyanide, amenable to chlorination	0.86	0.32

PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

Pollutant	Daily Maximum (mg/l)	Maximum Monthly Average (mg/l)
Cadmium (T)	0.11	0.07
Chromium (T)	2.77	1.71
Copper (T)	3.38	2.07
Lead (T)	0.69	0.43
Nickel (T)	3.98	2.38
Silver (T)	0.43	0.24
Zinc (T)	2.61	1.48
Cyanide, total	1.20	0.65
Total Toxic Organics	2.13	--
Alternative to total cyanide:		
Cyanide, amenable to chlorination	0.86	0.32

Note:
No maximum monthly average TTO concentration regulated.
(T) = total.

TABLE 3.4

LONG TERM CONCENTRATION AVERAGES

Pollutant of Pollutant Property	Long Term Concentration Average Milligrams Per Liter (mg/l)
Cadmium (T)[1]	0.13
Chromium (T)	0.572
Copper (T)	0.815
Lead (T)	0.20
Nickel (T)	0.942
Silver OT)	0.096
Zinc (T)	0.549
Cyanide (T)	0.18
Cyanide, A	0.06
TTO (raw water)	1.08
TTO (effluent)	0.434

[1] Cadmium (T) for new sources is 0.058 mg/l.

3.5 COMPLIANCE DATES

All industries subject to the Electroplating Standards (except job shop electroplaters and IPCBMs) will have to comply with the Metal Finishing (Part 433) regulations. The control of toxic organics is an additional requirement for facilities currently under Electroplating PSES. Compliance was found to be achievable with good management practices (recovering solvents for contract hauling or reclamation) and at low costs. An interim TTO limit based solely on achieving compliance with good housekeeping practices before end-of-pipe treatment is required to be in-place, and was established to prevent organics from being completely uncontrolled during the time before final compliance. The Metal Finishing compliance dates are shown in Table 3.5.

3.6 ALTERNATIVE CYANIDE LIMITATION

An alternative cyanide limit is available for facilities with significant forms of complexed cyanide (i.e. iron cyanides) not controllable by the technology basis. These complexed forms are less toxic but may still undergo transformation to the more toxic free cyanide form in the waterways. Before allowing the cyanide amenable alternative, the Control Authority should consider possible water quality impacts due to the discharge of cyanide. Complex cyanides can be controlled by the addition of ferrous sulfate to the precipitation/clarification system.

TABLE 3.5

COMPLIANCE DATES FOR METAL FINISHING PRETREATMENT STANDARDS
40 CFR PART 433

Pollutant Parameter	Existing Sources Capitives	New Sources
Interim TTO[1]	June 30, 1984[2]	--
Metals, Cyanide, and Final TTO[1]	February 15, 1986	on commencement of discharge

[1]TTO = Total Toxic Organics

[2]July 10, 1985 for plants covered by 40 CFR Part 420, Iron and Steel

4. TREATMENT TECHNOLOGIES

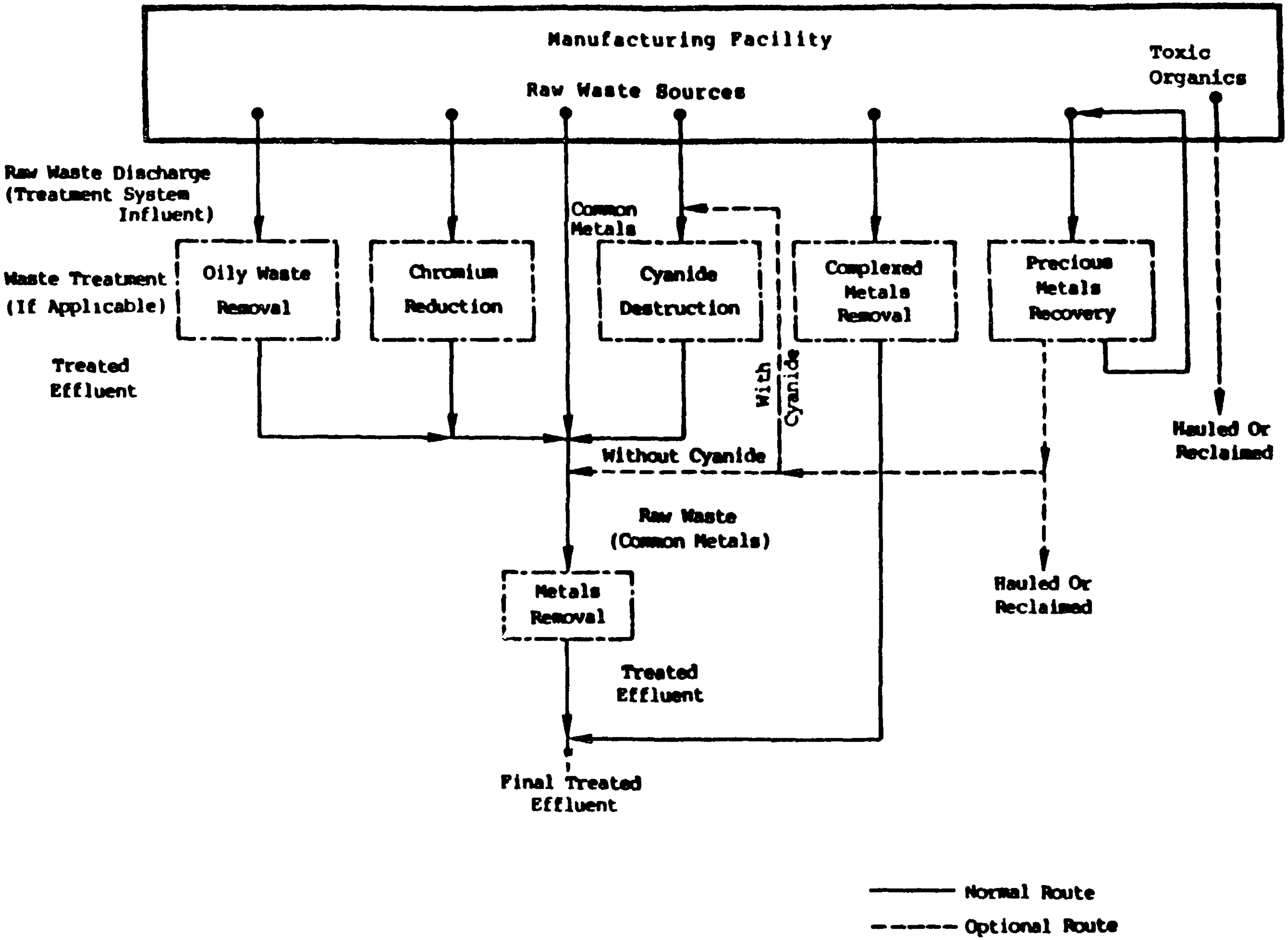
The treatment technologies described in this section are currently used by metal finishers/electroplaters to remove or recover wastewater pollutants normally generated. Figure 4.1 is an example of the current technology commonly used for treatment of metal finishing wastewater. As indicated, wastestream segregation allows the recovery of precious metals, the reduction of hexavalent chromium, the destruction of cyanide, and the removal and recovery of oils prior to the removal of common metals. Wastestream segregation can reduce the flow of wastewater to the treatment system and, accordingly, reduce the cost of treatment.

4.1 TREATMENT OF COMMON METALS WASTE

The technology basis for the pretreatment standards consists of hydroxide precipitation followed by sedimentation. Hydroxide precipitation is used to precipitate dissolved metals by chemical addition so that they can be removed by physical means such as sedimentation or filtration. Hexavalent chromium is not removed by this treatment system and cyanide will interfere with the system's ability to remove the dissolved metals. These raw waste types should be treated <u>before</u> entering this system.

The EPA also considered but rejected the addition of filtration to the selected technology basis to remove additional suspended solids (such as metal hydroxides) which did not settle out in the clarifier. It may be appropriate in cases where there are specific ambient water quality problems. The technology basis treatment system plus in-plant cadmium controls (such as evaporative recovery and ion exchange) was used as the technology basis for new source pretreatment standards.

Alternative treatment methods for common metals removal, to be used in conjunction with or in place of the preceeding methods, include peat adsorption, insoluble starch xanthate filtration, sulfide precipitation, flotation, and membrane filtration.



Note: Discharge from precious metals recovery may be hauled in alternative ways, depending on the recovery method in use.

FIGURE 4.1

WASTEWATER TREATMENT SCHEMATIC

4.2 TREATMENT OF COMPLEXED METAL WASTES

Complexed metals are tied up by chemicals (complexing agents such as ammonia and citric acid) which prevent the metals from settling out of solution. Complexed metal wastes are a product of electroless plating, immersion plating, etching and printed circuit board manufacturing. Metals tied up in solution counteract the conventional precipitation technique. As a result, segregated treatment of the complexed metal wastes is recommended.

High pH precipitation is a process involving the addition of chemicals which drastically increase the pH to around 12, prompting a shift in the complex dissociation equilibrium and resulting in the production of free metal ions. The metal ions can then be precipitated by available hydroxide ions and removed by sedimentation.

The chemical reduction process adds chemicals to lower the pH of the wastestream (to break up the various metal complexes) followed by the addition of a reducing agent to reduce the metals to an oxidation state which permits precipitation of the metals. Additional chemicals to raise the pH are then added to form metallic precipitates which settle out of solution. Media or membrane filtration is an alternate method to sedimentation for solids removal.

Modifying the hydroxide precipitation process by substituting sulfide precipitation can improve system performance in the removal of complexed heavy metals. The ferrous sulfate technique is capable of achieving low metal solubilities in spite of the presence of certain complexing agents.

4.3 TREATMENT OF PRECIOUS METALS WASTES

Treatment of precious metals consists of the technology basis for common metals wastes plus precious metals recovery including evaporation, ion exchange, and electrolytic recovery. Evaporation is used to recover precious metals by boiling off the water portion of the precious metal solution and removing the metal.

Ion exchange is the process in which ions, held by electrostatic forces to charged functional groups on the surface of an ion exchange resin, are exchanged for ions of similar charge from the solution in which the resin is immersed. Ion exchange is commonly used for precious metal recovery, especially gold.

Electrolytic recovery is particularly applicable to precious metals recovery because the valuable precious metals offer a faster payback on equipment and energy costs. The process consists of a dragout rinse after the plating step and an off line electrolytic recovery tank.

4.4 TREATMENT OF HEXAVALENT CHROMIUM

The treatment of hexavalent chromium involves reducing hexavalent chromium to trivalent chromium and removal with a conventional precipitation-solids removal system. Reduced (trivalent) chromium is able to be separated from solution in conjunction with other metallic salts by alkaline precipitation. In most cases, gaseous sulfur dioxide is used as the reducing agent in the reduction of hexavalent chromium which enables the trivalent chromium to be separated from solution by alkaline precipitation.

Alternative hexavalent chromium treatment techniques include electrochemical chromium reduction, regeneration, evaporation, and ion exchange.

4.5 TREATMENT OF CYANIDE WASTES

Treatment of cyanide is almost exclusively performed by alkaline chlorination which focuses upon oxidizing the cyanide which is amenable to chlorination. The destruction of cyanide results in products of carbon dioxide and nitrogen. Additionally, ferrous sulfate may be used to precipitate complexed cyanides.

Alternative treatment techniques for the destruction of cyanide include oxidation by ozone, ozone with ultraviolet radiation, hydrogen peroxide, and electrolytic oxidation.

4.6 TREATMENT OF OILY WASTES

Techniques commonly used by electrolaters and metal finishers to remove oils include skimming, coalescing, emulsion breaking, flotation, centrifugation, ultrafiltration, and reverse osmosis. Treatment of oily wastes is most efficient and cost effective if oils are segregated from other wastes and treated separately. The process of separation varies depending on the type of oil involved.

4.7 IN-PLANT CONTROL OF TOXIC ORGANICS

The primary control technology for toxic organics is proper storage of concentrated toxic organics without discharging directly into wastestreams and segregation from other wastes that will enter the waste treatment system. Spent degreasing solvents may be segregated from other wastes by providing and identifying the necessary storage containers, training personnel in the use of the techniques, and holding periodic check-ups to ensure that proper segregation is occurring. The separate waste solvents can then be recovered on-site or contract hauled.

Using cleaning techniques that require no solvents will eliminate or reduce the quantity of toxic organics found in wastewater. Cleaning techniques may include wiping, immersion, spray techniques using water, alkaline and acid mixtures, and solvent emulsions.

Toxic organics that enter the wastestreams can be removed by treatment technologies used for the control of other pollutants. Toxic organics tend to be more soluble in oil and grease than in water. Thus removal of oil and grease will reduce the discharge of toxic organics. Other possible mechanisms for removal include adsorption, settling, and volatilization, which can occur during treatment of metals, cyanide, and oil and grease.

Specific treatment technologies which are not part of the technology basis of the regulation but are applicable for the treatment of TTO include carbon adsorption and reverse osmosis, resin adsorption, ozonation, chemical oxidation, and aerobic decomposition.

4.8 TREATMENT OF SLUDGES

Sludges are created by waste treatment technologies which remove solids from wastewater. Sludge thickening is used to concentrate dilute sludges by a mechanical device such as a vacuum filter or centrifuge. Doubling the solids content reduces capital and operating costs and reduces costs for hauling. Pressure filtration is achieved by pumping the liquid through a filter material which is impenetrable to the solid phase. Sludge bed drying is employed to reduce the water content of sludges so that they can be mechanically collected for removal. Sludge may then be transported to landfills or incinerated.

Additional removal methods for industrial waste sludges include chemical containment, encapsulation, fixation, and thermal conversion.

4.9 IN-PROCESS CONTROL TECHNOLOGIES

In-process control techniques have been developed and are being utilized by electroplaters and metal finishers. These techniques deal with reducing water usage, reducing drag out of pollutants and efficient handling of process wastes and include:

- Flow reduction through efficient rinsing
- Countercurrent and static rinsing
- Process bath conservation
- Waste oil segregation
- Process bath segregation
- Process modification
- Cutting fluid cleaning
- Integrated waste treatment
- Good housekeeping

Reducing the water usage at metal finishing facilities is the most important control and results in reduced pollutant discharge and consequently reduced costs for wastewater treatment. It is estimated that rinse steps consume most of the water used at metal finishing facilities. Therefore, efficient rinse systems would lead to the greatest water use reductions. Several rinsing techniques are currently used at metal finishing facilities.

Of these, the countercurrent rinse provides for the most efficient water usage, and consists of only one fresh water feed introduced in the last tank. The dead or static rinse is applicable for initial rinsing after metal plating and allows for easier metals recovery and lower water usage.

5. REQUIREMENTS OF THE GENERAL PRETREATMENT REGULATIONS

5.1 INTRODUCTION

This section provides a brief overview of the General Pretreatment Regulations and identifies those provisions of the Regulations which have a direct bearing on the application and enforcement of Categorical Pretreatment Standards for the Electroplating and Metal Finishing category.

The General Pretreatment Regulations for Existing and New Sources (40 CFR Part 403) establish the framework and responsibilities for implementation of the National Pretreatment Program. The effect of 40 CFR Part 403 is essentially three-fold. First, the General Pretreatment Regulations establish general and specific discharge prohibitions as required by Sections 307(b) and (c) of the Clean Water Act. The general and specific prohibitions are described in Section 403.5 of the Pretreatment Regulations and apply to all nondomestic sources introducing pollutants into a POTW whether or not the source is subject to Categorical Pretreatment Standards.

Second, the General Pretreatment Regulations establish an administrative mechanism to ensure that National Pretreatment Standards (Prohibited Discharge Standards and Categorical Pretreatment Standards) are applied and enforced upon industrial users. Approximately 1,700 POTWs are required to develop a locally run pretreatment program to ensure that non-domestic users comply with applicable pretreatment standards and requirements.

Third, and most importantly for the purposes of this guidance manual, the General Pretreatment Regulations contain provisions relating directly to the implementation and enforcement of the Categorical Pretreatment Standards. Reporting requirements, local limits, monitoring or sampling requirements, and category determination provisions are discussed. POTW representatives should refer to 40 CFR Part 403 for specific language and requirements where appropriate.

5.2 CATEGORY DETERMINATION REQUEST

An existing industrial user (IU) or its POTW may request written certification from EPA or the delegated State specifying whether or not the industrial user falls within a particular industry category or subcategory and is subject to a categorical pretreatment standard. Although the deadline for submitting a category determination request by existing industrial users subject to the electroplating and metal finishing categorical pretreatment standards has passed, a new industrial user or its POTW may request this certification for a category determination anytime prior to commencing its discharge. The contents of a category determination request and procedures for review are presented in Section 403.6(a) of the General Pretreatment Regulations.

5.3 MONITORING AND REPORTING REQUIREMENTS OF THE GENERAL PRETREATMENT REGULATIONS

In addition to the requirements contained in the Electroplating and Metal Finishing Categorical Pretreatment Standards, industrial users subject to these Standards must fulfill the reporting requirements contained in Section 403.12 of the General Pretreatment Regulations. These requirements include the submission of baseline monitoring reports, compliance schedules, compliance reports (initial and periodic), notices of slug loading, and record-keeping requirements. Each of these reporting requirements is briefly summarized below.

5.3.1 Baseline Monitoring Reports

All industrial users subject to Categorical Pretreatment Standards must submit a baseline monitoring report (BMR) to the Control Authority. The purpose of the BMR is to provide information to the Control Authority to document the industrial user's current compliance status with a Categorical Pretreatment Standard. The Control Authority is defined as the POTW if it has an approved pretreatment program, otherwise the BMR will be submitted to the State (if the State has an approved State Pretreatment Program) or to the EPA Region. Additional guidance on BMR reporting is available from the EPA Regional Pretreatment Coordinator.

BMR Due Dates

Section 403.12(b) requires that BMRs be submitted to the Control Authority within 180 days after the effective date of a Categorical Pretreatment Standard or 180 days after the final administrative decision made upon a category determination request [403.6(a)(4)], whichever is later. Table 5.1 shows the respective due dates for electroplating and metal finishing BMRs.

BMR Content

A BMR must contain the following information as required by Section 403.12(b).

1. Name and address of the facility, including names of operator(s) and owner(s).

2. List of all environmental control permits held by or for the facility.

3. Brief description of the nature, average production rate and SIC code for each of the operation(s) conducted, including a schematic process diagram which indicates points of discharge from the regulated processes to the POTW.

4. Flow measurement information for regulated process streams discharged to the municipal system. Flow measurements of other wastestreams will be necessary if application of the combined wastestream formula is necessary.

5. Identification of the pretreatment standards applicable to each regulated process and results of measurements of pollutant concentrations and/or mass. All samples must be representative of daily operations and results reported must include values for daily maximum and average concentration (or mass, where required). Where the flow of the regulated stream being sampled is less than or equal to 250,000 gallons per day, the industrial user must take three samples within a two week period. Where the flow of the stream is greater than 250,000 gallons per day, the industrial user must take six samples within a two week period. If samples cannot be taken immediately downstream from the regulated process and other wastewaters are mixed with the regulated process, the industrial user should measure flows and concentrations of the other wastestreams sufficient to allow use of the combined wastestream formula. Requirements for demonstrating compliance with TTO standards are discussed in Section 5.4.1.

TABLE 5.1

DUE DATES FOR SUBMISSION OF
BASELINE MONITORING REPORTS

	Existing Indirect Dischargers			
	Non-integrated Job Shops & IPCBM's	Integrated Job Shops IPCBM's	Non-integrated Captives	Integrated Captives
Electroplating (Part 413) Metals and Cyanide	September 12, 1981	June 25, 1983	September 12, 1981	June 25, 1983
Electroplating (Part 413) TTO	February 24, 1984	February 24, 1984		
Metal Finishing (Part 433) Metals, Cyanide, and TTO	--	--	February 24, 1984	February 24, 1984

Note: If a request for a category determination has been made, then the BMR is due 180 days after the final decision on the category determination.

6. Statement of certification concerning compliance or noncompliance with the Pretreatment Standards.

7. If not in compliance, a compliance schedule must be submitted with the BMR that describes the actions the user will take and a timetable for completing those actions to achieve compliance with the standard. This compliance schedule must contain specific increments of progress in the form of dates for the commencement and completion of major events, however, no increment of the schedule shall exceed 9 months. Within 14 days of each completion date in the schedule, the industrial user shall submit a progress report to the Control Authority indicating whether or not it complied with the increment of progress to be met on such date, and, if not, the date on which it expects to comply with this increment of progress and the steps being taken to return to the schedule.

BMR Reporting of Toxic Organics

Since promulgation of the Metal Finishing pretreatment standards, some questions have been raised regarding BMR reporting of total toxic organics (TTO). BMR sampling requirements clearly apply to all regulated metals. However, since monitoring for toxic organics can be expensive, BMR sampling and analysis for TTO will only be required for those organics "which would reasonably be expected to be present" in the industrial user's effluent [Section 413.03(c)]. For routine compliance monitoring, not BMR monitoring, the regulations allow for the IU to certify that the regulated toxic organics are not used at the facility or to present a plan demonstrating appropriate controls to prevent organic compounds from entering the wastestream. Even if the industrial user expects to use the certification procedure to demonstrate regular compliance with the TTO limitation, the user must still sample and analyze for any toxic organic "reasonably expected to be present" for the purposes of the baseline monitoring report. If no toxic organics are used or expected to be discharged, then no TTO monitoring is required for the BMR.

5.3.2 Report on Compliance

Within 90 days after the compliance date for the Electroplating and Metal Finishing Pretreatment Standards or in the case of a New Source following commencement of the introduction of wastewater into the POTW, any industrial user subject to the Standards must submit to the Control Authority a "report on compliance" that states whether or not applicable pretreatment standards are being met on a consistent basis. The report must indicate the nature and concentration of all regulated pollutants in the facility's regulated process wastestreams; the average and maximum daily flows of the regulated streams; and a statement of whether compliance is consistently being achieved, and if not, what additional operation and maintenance and/or pretreatment is necessary to achieve compliance. See 40 CFR 403.12(d).

5.3.3 Periodic Reports on Continued Compliance

Unless required more frequently by the Control Authority, all industrial users subject to the Electroplating and Metal Finishing Categorical Pretreatment Standards must submit a biannual "periodic compliance report" during the months of June and December. The report shall indicate the precise nature and concentrations of the regulated pollutants in its discharge to the POTW, the average and maximum daily flow rates of the facility, the methods used by the indirect discharger to sample and analyze the data, and a certification that these methods conformed to those methods outlined in the regulations. See 40 CFR 403.12(e).

5.3.4 Notice of Slug Loading

Section 403.12(f) requires industrial users to notify the POTW immediately of any slug loading of any pollutant, including oxygen demanding pollutants (BOD, etc.) released to the POTW system at a flow rate and/or pollutant concentration which will cause interference with the POTW.

5.3.5 Monitoring and Analysis to Demonstrate Continued Compliance

Section 403.12(g) states that the frequency of monitoring to demonstrate continued compliance shall be prescribed in the applicable Pretreatment Standard. Neither the Electroplating nor Metal Finishing Pretreatment Standard establish any monitoring frequency. Therefore, the appropriate Control Authority must establish the monitoring frequency to adequately demonstrate that indirect dischargers subject to these pretreatment standards are in compliance with the applicable standards. Unless otherwise noted in the appropriate paragraph of Section 403.12, the monitoring frequency established by the Control Authority shall be used in the baseline monitoring report (403.12(b)(5)), the report on compliance with categorical pretreatment standard deadline (403.12(d)), and the periodic reports on continued compliance (403.12(e)).

Sampling and analysis shall be in accordance with the procedures established in 40 CFR Part 136 and any amendments to it or shall be approved by EPA. When Part 136 techniques are not available or are inappropriate for any pollutant, then sampling and analysis shall be conducted in accordance with procedures established by the POTW or using any validated procedure. However, all procedures for sampling and analysis not included in Part 136 must be approved by EPA.

5.3.6 Signatory Requirements for Industrial User Reports

All reports submitted by industrial users (BMR, Initial Report on Compliance, and Periodic Reports, etc.) must be signed by an authorized representative in accordance with Section 403.12(k).

5.3.7 Recordkeeping Requirements

Any industrial user subject to the reporting requirements of the General Pretreatment Regulations shall maintain records of all information resulting from any monitoring activities required by 403.12 for a minimum of three years [403.12(n)]. These records shall be available for inspection and copying by the Control Authority.

5.4 SPECIAL INDUSTRIAL SELF-MONITORING CONSIDERATIONS

5.4.1 Toxic Organics Certification

In lieu of monitoring for TTO, the Control Authority may allow dischargers subject to Electroplating and Metal Finishing regulations to certify that no dumping of toxic organics to the wastestream has occurred. In cases where monitoring to determine TTO compliance is necessary, sampling and analysis for TTO will only be required for those organics "which would reasonably be expected to be present" in the industrial user's effluent [Section 413.03(c)]. When dischargers request that no monitoring be required, they must submit a toxic organic management plan that specifies the toxic organic compounds used, the method of disposal used (instead of dumping into wastestreams), and procedures for assuring that toxic organics do not routinely spill or leak into wastewater discharged to the POTW. This certification is added as a comment to the baseline monitoring report as well as periodic reports.

A toxic management plan provides methods for the reduction of toxics in effluents and assists industrial facilities in achieving compliance with Categorical Pretreatment Standards. An example of a toxic organic management plan that is required when industrial users wish to certify that no discharge of toxic pollutants has occurred is presented below.

The plan has three basic steps:

Step 1 - Process engineering analysis should consist of:

a. An examination of published reports on the specific industry;

b. A water flow diagram to identify all possible wastewater sources;

c. A list of raw materials used in the industrial processes, including chemical additives, water treatment chemicals and cleaning agents, and the wastewater stream that each material potentially enters;

d. Comparison of the toxics found in the effluent with the list of raw materials and selection of the most probable wastewater source;

e. Evaluation of the toxics found in the effluent, but <u>not</u> on the raw materials list and determination of those formed as reaction products or by-products;

f. Examination of sources such as equipment corrosion or raw materials impurities contributing inorganic pollutants.

Step 2 - Pollutant control evaluation should be determined on a case-by-case basis and may include:

a. Inplant process modification, including chemical substitution, partial or complete recycling, reuse, neutralization, ion exchange, or operation changes.

Step 3 - Toxics reduction evaluation report is submitted to the Control Authority and contains:

a. Identification of source(s) of pollutant(s).

b. Control options explored.

c. Effectiveness of control options in meeting effluent limits.

d. Industrial user's choice of options and the projected schedule for achieving necessary control.

In certain cases, the industrial user will not achieve compliance with the effluent standard. In these cases, additional evaluations will be necessary.

5.4.2 Self-Monitoring for Cyanide

For facilities subject to Metal Finishing regulations, self-monitoring for cyanide must be conducted after cyanide treatment and before dilution with other wastestreams. Alternatively, samples may be taken of the final effluent if the plant limitations are adjusted based on the dilution ratio of the cyanide wastestream flow to the effluent flow.

5.5 APPLICATION OF THE COMBINED WASTESTREAM FORMULA

One provision of the General Pretreatment Regulations that will often be necessary for POTWs and industries to properly monitor and report on compliance with Categorical Pretreatment Standards is the Combined Wastestream Formula (CWF) [40 CFR 403.6(e)]. The CWF is a mechanism for calculating appropriate limitations specified in applicable regulations to a wastewater in which process wastestreams are mixed with regulated, unregulated or dilution streams, thereby resulting in a mixed effluent. The CWF is applied to the mixed effluent to account for the presence of the additional wastestreams.

The following definitions and conditions are important to the proper use of the CWF.

Definitions

- Regulated Process Wastestream - an industrial process wastestream regulated by National Categorical Pretreatment Standards.

- Unregulated Process Wastestream - an industrial process wastestream that is not regulated by a categorical standard.

Note: Definitions apply to individual pollutants. A wastestream from a process may be "regulated" for one pollutant and "unregulated" for another.

- Dilute Wastestream - Boiler blowdown, sanitary wastewater, noncontact cooling water or blowdown, and Paragraph 8 excluded wastestreams containing none of the regulated pollutant or only trace amounts of it.

- Concentration-based Limit - a limit based on the relative strength of a pollutant in a wastestream, usually expressed in mg/l (lb/gal).

- Mass-based Limit - a limitation based on the actual quantity of a pollutant in a wastestream, usually expressed in mg/some unit of production for a given operation such as square meter (lb/square foot per operation).

CWF Conditions

To ensure proper application of the CWF, the following conditions must be met by a municipality and its industries [40 CFR 403.6(e)]:

- Alternative discharge limits that are calculated in place of a Categorical Pretreatment Standard must be enforceable as Categorical Standards.

- Calculation of alternative limits must be performed by the Control Authority (POTW) or by the industrial user with written permission from the POTW.

- Alternative limits must be established for all regulated pollutants in each of the regulated processes.

- The Control Authority and/or the industrial user may use mass-based limitations in place of the concentration-based limitations, when they are provided for by a given Categorical Pretreatment Standard such as electroplating, as long as a prior agreement exists between the regulated industrial user and the municipality that is receiving these wastes.

- Both daily maximum and long-term average (usually monthly) alternative limits must be calculated for each regulated pollutant.

- If process changes at an industry warrant, the Control Authority may recalculate the alternative limits at its discretion or at the request of the industrial user. The new alternative limits must be calculated and become effective within 30 days of the process change.

- The Control Authority may impose stricter alternative limits, but may not impose alternative limits that are less stringent than the calculated limits.

- A calculated alternative limit cannot be used if it is below the analytical detection limit for that pollutant. If a calculated limit is below the detection limit, the IU must either: 1) not combine the dilute streams before they reach the combined treatment facility, or 2) segregate all wastestreams entirely.

- The categorical standards of the regulated wastestreams which are applied to the CWF must be consistent in terms of the number of samples the standard is based on. Electroplating wastestreams are regulated by a 4-day average standard and are not consistent with other categorical standards regulated by a maximum monthly average (based on 10 sample days) standard. According to 40 CFR Part 413.04, if a non-electroplating wastestream is regulated by a monthly average standard and is combined with an electroplating wastestream, monthly standards rather than 4-day average standards are to be used in calculating an alternative limit with the CWF. Also, if two electroplating wastestreams regulated under different subcategories of the electroplating regulations are combined, the 4-day limits may be used to calculate the alternate limits, unless an additional wastestream subject to monthly standards is added. The following equivalent monthly averages (based on 10 sample days per month) have been developed for use in the CWF:

Pollutant	Equivalent Monthly Average (mg/l)
Cadmium (T)	0.63
Chromium (T)	3.56
Copper (T)	2.44
Lead (T)	0.37
Nickel (T)	2.38
Zinc (T)	2.37
Silver (T)	0.63
Total Metals	6.26
Cyanide, A	2.37
Cyanide (T)	0.87

Monitoring Requirements For Industrial Users Using the CWF

Self-monitoring requirements by an industrial user are necessary to ensure compliance with the alternative categorical limit. Because neither the Metal Finishing nor Electroplating Pretreatment Standards include self-monitoring requirements, the Control Authority will establish minimum self-monitoring requirements.

Application of the CWF

The actual combined wastestream formulas are presented in Table 5.2. Tables 5.3 and 5.4 present an example of how the CWF is used to calculate alternative limits and four example calculations applied to specific electroplating/metal finishing situations. Three of the examples differ because of the individual compliance deadlines for the different categorical pretreatment standards. The fourth example represents an example showing conversion from a production (mass) based standard to a concentration based standard. It is important to remember that when two or more regulated wastestreams are mixed prior to treatment, before using the CWF it is necessary to determine which pretreatment regulation applies to each regulated wastestream before they are mixed.

5.6 REMOVAL CREDITS

A removal credit allows a POTW to provide categorical industrial users of its system with a credit (in the form of adjusted categorical pretreatment standards) for removal of pollutants by the POTW. Industrial users receiving such a credit are allowed to discharge to the POTW greater quantities of regulated pollutants than otherwise permitted by applicable categorical standards. Whether or not to seek authority to grant removal credits is completely at the discretion of the POTW. Section 403.7 of the General Pretreatment Regulations establishes the conditions under which a POTW would obtain approval to grant removal credits and specifies the means by which these removal credits are to be determined.

In 1977, Congress amended section 307(b) of the Clean Water Act to provide for removal credits. EPA originally implemented that provision and established the conditions under which POTWs could obtain authorization to

TABLE 5.2

COMBINED WASTESTREAM FORMULAS

Alternative Concentration Limit Formula:

$$C_t = \left(\frac{\sum_{i=1}^{N} C_i F_i}{\sum_{i=1}^{N} F_i} \right) \quad X \quad \left(\frac{F_t - F_d}{F_t} \right)$$

C_t - alternative concentration limit for the pollutant

C_i - Categorical Pretreatment Standard concentration limit for the pollutant in regulated stream i

F_i - average daily flow (at least 30 day average) of regulated stream i

F_d - average daily flow (at least 30 day average) of dilute wastestream(s)

F_t - average daily flow (at least 30 day average) through the combined treatment facility (including regulated, unregulated and dilute wastestreams)

N - total number of regulated streams

Alternate Mass Limit Formula

$$M_t = \left(\sum_{i=1}^{N} M_i \right) \quad X \quad \left(\frac{F_t - F_d}{\sum_{i=1}^{N} F_i} \right)$$

M_t - alternative mass limit for the pollutant

M_i - Categorical Pretreatment Standard mass limit for the pollutant in regulated stream i

F_i - average daily flow (at least 30 day average) of regulated stream i

F_d - average daily flow (at least 30 day average) of dilute wastestream(s)

F_t - average daily flow (at least 30 day average) through the combined treatment facility (including regulated, unregulated and dilute wastestreams)

N - total number of regulated streams.

TABLE 5.3

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

The following examples provide the calculations for determining alternat discharge limits using the combined wastestream formula. The examples assume combinations of various industries with the following wastestreams:

Industrial Category (Subcategory)	Wastestream Type	Flow (mgd)	Daily Max. Zn Limit (mg/l)	Compliance Date
Electroplating (Common Metals)	Regulated	0.4	4.2[2]	June 30, 1984
Metal Finishing	Regulated			
(Electroplating)[1]		0.4	2.61	February 15, 1986
(Coating and Painting)[1]		0.1	2.61	
Porcelain Enameling (Steel-coating only)	Regulated	0.075	1.33[3]	November 25, 1985
Copper Forming	Regulated	0.4	Mass/Production Based[4]	August 15, 1986
Sanitary Waste	Dilution	0.05	N/A	N/A

[1] These are not subcategories; they are metal finishing processes.

[2] Alternate production based limit = 164 mg/m^2 plated.

[3] Alternate Mass/Production based limits = 53.3 mg/m^2 for preparation and 0.85 mg/m^2 for coating.

[4] Mass/Production based limits = 0.943 mg/off-kg of copper heat treated for solution heat treatment.

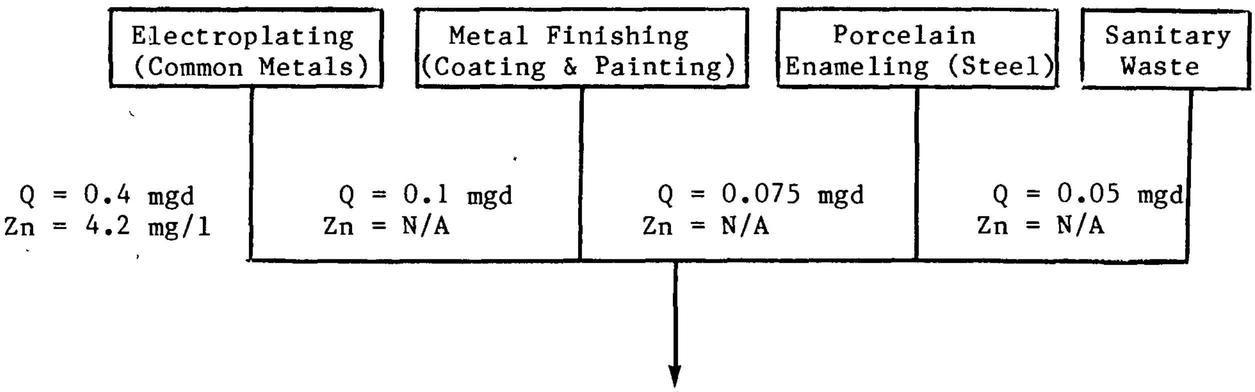
The calculated alternate discharge limits (Zn_{cwf}) in the following examples are based on phased compliance dates for Electroplating, Porcelain Enameling, and Metal Finishing.

TABLE 5.4

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE A

Alternative discharge limit for integrated electroplater/porcelain enameler from June 30, 1984 (compliance date for electroplating) until November 25, 1985 (compliance date for porcelain enameling).



$$Zn_{cwf} = \frac{(4.2 \text{ mg/l} \times 0.4 \text{ mgd})}{0.4 \text{ mgd}} \text{ X } \frac{(0.4 \text{ mgd} + 0.1 \text{ mgd} + 0.075 \text{ mgd} + 0.05 \text{ mgd} - 0.05 \text{ mgd})}{0.625 \text{ mgd}}$$

$$Zn_{cwf} = 3.86 \text{ mg/l}$$

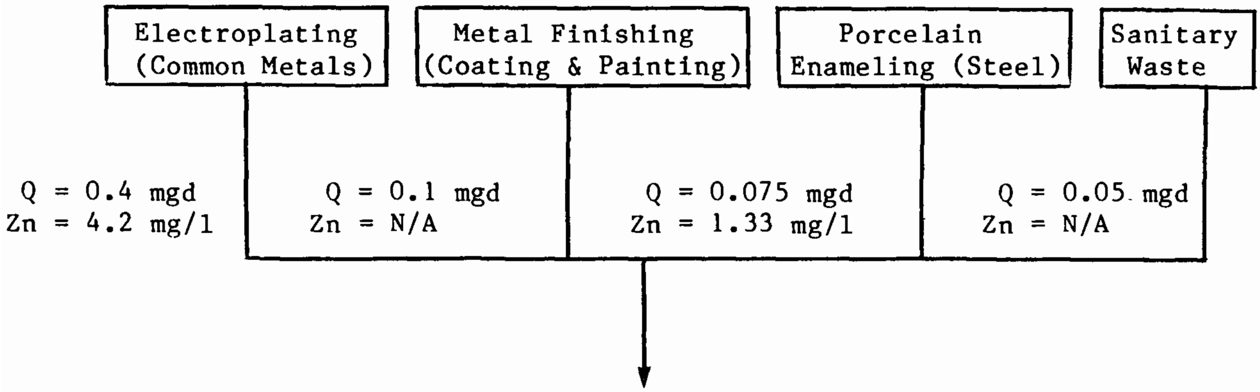
Note: Due to dilution from sanitary waste, the applicable Zn limit, 4.2 mg/l, is reduced to 3.86 mg/l.

TABLE 5.4 (Continued)

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE B

Alternative discharge limit for integrated electroplater/porcelain enameler from November 25, 1985 until February 15, 1986 (compliance date for metal finishing)



$$Zn_{cwf} = \frac{4.2 \text{ mg/l } (0.4 \text{ mgd}) + 1.33 \text{ mg/l } (0.075 \text{ mgd})}{(0.4 \text{ mgd} + 0.075 \text{ mgd})} \times \frac{(0.4 \text{ mgd} + 0.1 \text{ mgd} + 0.075 \text{ mgd} + 0.05 \text{ mgd} - 0.05 \text{ mgd})}{0.625 \text{ mgd}}$$

$$Zn_{cwf} = 3.45 \text{ mg/l}$$

Note: Alternate discharge limit is based on Electroplating and Porcelain Enameling categorical standards and proportioned by the flow of the regulated electroplating and porcelain enameling wastestreams. Due to dilution from sanitary waste, the alternate discharge limit is reduced.

TABLE 5.4 (Continued)

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE C

Alternative discharge limit for integrated electroplater/porcelain enameler after February 15, 1986 (compliance date for metal finishing).

Metal Finishing (Electroplating Common Metals)	Metal Finishing (Coating & Painting)	Porcelain Enameling (Steel)	Sanitary Waste
Q = 0.4 mgd Zn = 2.61 mg/l	Q = 0.1 mgd Zn = 2.61 mg/l	Q = 0.075 mgd Zn = 1.33 mg/l	Q = 0.05 mgd Zn = N/A

$$Zn_{cwf} = \frac{2.61 \text{ mg/l } (0.5 \text{ mgd}) + 1.33 \text{ mg/l } (0.075 \text{ mgd})}{(0.5 \text{ mgd} + 0.075 \text{ mgd})} \text{ X } \frac{(0.5 \text{ mgd} + 0.075 \text{ mgd} + 0.05 \text{ mgd} - 0.05 \text{ mgd})}{0.625 \text{ mgd}}$$

$$Zn_{cwf} = 2.25 \text{ mg/l}$$

Note: Electroplating (common metals) is now covered by Metal Finishing, and is subject to a Zn limit of 2.61 mg/l. Thus, the alternate discharge limit is based on Metal Finishing and Porcelain Enameling categorical standards and proportioned by the flow of the three regulated wastestreams. Due to dilution from sanitary waste, the alternate discharge limit is reduced to 2.25 mg/l.

TABLE 5.4 (Continued)

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE D

Copper Forming and several other categorical standards are expressed as production-based limits. The example below converts production-based limits to equivalent concentration-based limits. These equivalent concentration-based limits can then be used as the standard for Copper Forming.

Copper Forming (Solution Heat Treatment) Maximum Daily Limit for Zinc	=	0.943 mg/off-kg of copper heat treated
Average Daily Production During Last 12 months	=	30,000 off-kg of copper heat treated per day
Average Daily Water Usage in Solution Heating Treating During Last 12 months	=	400,000 gpd

Step 1: Convert Production-based Limit to Equivalent Concentration Limit

$$\text{Concentration Equivalent} = \frac{\text{(Production-Based Limit)(Avg. Daily Production Rate)}}{\text{(Avg. Daily Flow from Regulated Process) (Conversion Factor)}}$$

$$Zn_{(equivalent)} = \frac{0.943 \text{ mg/off-kg } (30{,}000 \text{ off-kg/day})}{400{,}000 \text{ gpd } (3.785 \text{ liters/gallon})} = 0.019 \text{ mg/l}$$

Step 2: Once the concentration-based equivalent is determined, then the alternate limit can be calculated as in Example A.

Copper Forming (Solution Heat Treatment)	Metal Finishing (Coating & Painting)	Porcelain Enameling (Steel)	Sanitary Waste
Q = 0.4 mgd Zn = 0.019 mg/l	Q = 0.1 mgd Zn = 2.61	Q = 0.075 mgd Zn = 1.33	Q = 0.05 mgd Zn = N/A

$$Zn_{cwf} = \frac{(0.019 \text{ mg/l} \times 0.4 \text{ mgd}) + (2.61 \text{ mg/l} \times 0.1 \text{ mgd}) + (1.33 \text{ mg/l} \times 0.075 \text{ mgd})}{(0.4 \text{ mgd} + 0.1 \text{ mgd} + 0.075 \text{ mgd})} \times \frac{(0.4 \text{ mgd} + 0.1 \text{ mgd} + 0.075 \text{ mgd} + 0.05 \text{ mgd} - 0.05 \text{ mgd})}{0.625 \text{ mgd}}$$

$$Zn_{cwf} = 0.59 \text{ mg/l}$$

Note: Off-kg shall mean the mass of copper ore copper alloy removed from a forming or ancillary operation at the end of a process cycle for transfer to a different machine or process.

TABLE 5.4 (Continued)

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE E

For the several categorical standards shown in Example D, permit authorities may wish to utilize mass limits. The example below converts concentration limits to mass-based limits and utilizes the production-based limits (and alternate limits).

Copper Forming

Copper Forming (Solution Heat Treatment) Maximum Daily Limit for Zinc	= 0.943 mg/off-kg of copper heat treated
Average Daily Production During Last 12 months	= 30,000 off-kg of copper heat treated per day
Average Daily Water Usage in Solution Heat Treating During Last 12 months	= 400,000 gpd
Allowable Zn Mass = 0.943 (30,000)	= 28,290 mg

Metal Finishing

Metal Finishing Maximum Daily Limit for Zinc	= 2.61 mg/l
Average Daily Production During Last 12 months	= not required
Average Daily Water Usage in Metal Finishing	= 100,000 gpd
Allowable Zn Mass = 2.61 (100,000 x 3.78)	= 986,580 mg

Porcelain Enameling

Porcelain Enameling (steel basis material) Maximum Daily Limit for Zinc	= (53.3 + 0.85) mg/m^2 of area processed or coated thru metal preparation and coating operation, respectively.
Average Daily Production During Last 12 months	= 5570 m^2 of preparation 7250 m^2 of coating

TABLE 5.4 (Continued)

COMBINED WASTESTREAM FORMULA EXAMPLE CALCULATION

EXAMPLE E (Continued)

Average Daily Water Usage in Porcelain Enameling	= 75,000 gpd
Allowable Zn Mass	= 53.3(5570)+0.85(7250)=303,044 mg

Copper Forming (Solution Heat Treatment)	Metal Finishing (Coating & Painting)	Porcelain Enameling (Steel)	Sanitary Waste

$$Zn_{cwf} = 28,290 + 986,580 + 303,044$$

$$= 1,317,914 \text{ mg/day}$$

$$Zn_{cwf} = 1.3 \text{ kg/day or } (2.86 \text{ lbs/day})$$

grant removal credits in the June 26, 1978 General Pretreatment Regulations. On January 28, 1981, the removal credits provision, as well as many other portions of the pretreatment regulations, were amended. Under the 1981 provision, any POTW seeking removal credit authority was required to demonstrate its removal performance by sampling its influent and effluent and calculating its removal rates based on this data. Removal capability of each POTW, therefore, was to be determined on a case-by-case basis. In addition to the sampling requirements the provision specified the other prerequisites for obtaining removal credit authority. Only the Approval Authority (either EPA or the State) can grant removal credit authority to a POTW.

A revised removal credit regulation was proposed on September 28, 1982 (47 Fed. Reg. 42698). The final regulation on removal credits is due for promulgation in March 1984. Until then, POTWs may apply for removal credit authority under the existing procedures contained in Section 403.7 of the January 28, 1981 General Pretreatment Regulations.

5.7 FUNDAMENTALLY DIFFERENT FACTORS VARIANCE

A request for a fundamentally different factors (FDF) variance is a mechanism by which a Categorical Pretreatment Standard may be adjusted, making it more or less stringent, on a case-by-case basis. If an indirect discharger, a POTW, or any interested person believes that the factors relating to a specific indirect discharger are fundamentally different from those factors considered during development of the relevant categorical pretreatment standard and that the existence of those factors justifies a different discharge limit from that specified in the Categorical Standard, then they may submit a request to EPA for such a variance (See 40 CFR 403.13).

This section was the subject of a recent court decision (U.S. Court of Appeals for the Third Circuit) in September of 1983. The Court held that the EPA lacks authority to issue variances to indirect dischargers for toxic pollutants. As a result of the Court's decision, FDF variances can only be granted for non-toxic pollutants. Since the electroplating and metal finishing categorical standards contain limits only for toxics, no variance is available for this industry.

5.8 LOCAL LIMITS

Local limits are numerical pollutant concentration or mass-based values that are developed by a POTW for controlling the discharge of conventional, non-conventional or toxic pollutants from indirect sources. They differ from National Categorical Pretreatment Standards in that Categorical Pretreatment Standards are developed by EPA and are based upon the demonstrated performance of available pollutant control technologies (for specific categorical industries). These national technology-based categorical standards do not consider local environmental criteria or conditions, and are only developed to assure that each industry within a specified category meets a minimum discharge standard which is consistent across the United States for all POTWs. Local limits, on the other hand, are developed to address specific localized impacts on POTWs and their receiving waters. Local limitations are typically designed to protect the POTW from:

- The introduction of pollutants into the POTW which could interfere with its operation
- Pass-through of inadequately treated pollutants which could violate a POTW's NPDES permit or applicable water quality standards
- The contamination of a POTW's sludge which would limit sludge uses or disposal practices.

Local limits, as the name implies, take into consideration the factors that are unique to a specific POTW, whereas categorical pretreatment standards are developed only for a general class of industrial dischargers. Local limits are required under 40 CFR 403.5 and must be developed when it is determined that Categorical Pretreatment Standards are not sufficient to enable the POTW to meet the above three Pretreatment Program objectives.

To assist municipalities in developing defensible and technically sound numerical effluent limitations, EPA has prepared some general guidelines on limit development in its document "Guidance Manual for POTW Pretreatment Program Development." Appendix L of this document lists the general methodology, required formulas and typical environmental criteria used to develop local limits. This manual is available from EPA Regional offices and NPDES

States and should be carefully followed when developing local limits. Although a detailed discussion of local limit development is beyond the scope of this document, the general methodology includes the following four steps:

Step 1 - Determine the maximum headworks loading (for each specific pollutant) that will assure that the three fundamental objectives of the pretreatment program are met.

Step 2 - Calculate the allowable loading to the POTW by subtracting the uncontrollable portion of pollutant discharge to the POTW (from domestic, commercial and infiltration/inflow sources) from the total headwork loading value.

Step 3 - Distribute the controllable loading to industrial users through an allocation process.

Step 4 - Derive specific local limits from the allocation results.

The above four step process must be performed for each pollutant which the POTW determines may need a specific local limitation. As a general rule, the limit setting analysis should be performed for all pollutants which are discharged to the POTW in significant quantities. The POTW should identify pollutants of concern through an evaluation of the POTW's industrial waste survey. A procedure for evaluating industrial waste survey results is included in the EPA guidance manual mentioned earlier.

To assist POTWs with the development of local limits EPA has developed a computer program that incorporates the general methodology required to develop local limits and alleviates a substantial amount of the tedious calculations required to develop these limits. This computer program has the following capabilities to aid the POTW in limit development:

- Performs the four-step limit setting analysis on microcomputer or mainframe
- Screens input data provided by the POTW
- Supplements POTW data with "built-in" files containing data on Industrial/Municipal wastewater characteristics, POTW removal rates, and POTW inhibition values

- Allocates controllable pollutant loads using several different methodologies

- Compares calculated local limits to EPA Categorical Standards.

POTWs may obtain information on this computer program by contacting any of the ten EPA Regional offices. Instructions will be provided on how to use the computer program as well as how to access a computer system which supports it.

REFERENCES

Electroplating	Federal Register Notice	
Final Regulations Promulgated	09/07/79	44FR52618
Correction Notice (Typographical errors)	10/01/79	44FR56330
Correction Notice (Delayed compliance for Integrated Facilities)	03/25/80	45FR19246
Revision to 9/07/79 Promulgation of 7/03/80	01/28/81	40CFR9462
Amended (Integrated Facilities Compliance)	01/21/83	48FR2774
Amended (Added total toxic organic limit)	07/25/83	48FR32482
Amended (Allows PSES compliance beyond 7/1/84)	09/15/83	48FR41410
Correction/Clarification Notice (Compliance Dates)	09/26/83	48FR43680

Metal Finishing		
Final Regulations Promulgated	07/15/83	48FR32485
Amended (Allows PSES Compliance beyond 7/1/84	09/15/83	48FR41410
Correction/Clarification Notice (Compliance Dates)	09/26/83	48FR43681
Correction Notice (Typographical Errors)	10/03/83	48FR45105

General Pretreatment Regulations	
40 CFR Part 403, 46 FR 9404	01/28/81

Final Development Document - Electroplating	August 1979	440/1 - 79/003
Final Development Document - Metal Finishing	June 1983	440/1 - 83/091
Guidance Manual for POTW Pretreatment Program Development	October 1983	---
Procedures Manual for Reviewing a POTW Pretreatment Program Submission	October 1983	---

Copies of the technical and economic documents may be obtained from the National Technical Information Services, Springfield, VA. 22161 (703/487-4650). Pretreament Program Manuals may be obtained from U.S. EPA, Permits Division (EN-336), Washington, D.C. 20460

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