EPA 744-B-95-001

FEDERAL ENVIRONMENTAL REGULATIONS AFFECTING THE ELECTRONICS INDUSTRY

September 1995

Design for the Environment Program
Economics, Exposure and Technology Division
Office of Pollution Prevention and Toxics
United States Environmental Protection Agency

Acknowledgments

A special thanks is extended to the participants of the Design for the Environment Printed Wiring Board Project and the Environmental, Health & Safety Committee of the Institute for Interconnecting and Packaging Electronic Circuits for their helpful comments.

PREFACE

This discussion of environmental regulations potentially affecting the electronics industry is intended for information purposes only. It is not an official EPA guidance document and should therefore not be relied on by companies in the electronics industry to determine applicable regulatory requirements.

The applicability of many Federal regulations is determined in part by the chemicals being used at a facility. This document covers chemicals that the electronics industry has identified as being in use in the semiconductor manufacturing, printed wiring board manufacturing, semiconductor packaging, and display manufacturing industries. Electronic assembly is not considered in this report. Individual facilities have their own chemical use patterns, however, which means that a particular facility may use chemicals that are not listed in this report or may use some but not all of them. As a result, each facility must identify the universe of rules that apply to it by examining the regulations themselves.

This report only discusses Federal environmental statutes. However, implementation of many Federal programs is delegated to States with programs at least as stringent as the Federal program. Thus, even where Federal regulations apply, State laws may impose additional requirements that are not addressed in this document.

This study covers the following kinds of Federal environmental requirements: Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Superfund and Emergency Planning and Community Right to Know Act, and Toxic Substances Control Act. The study provides an overview of regulations affecting the electronics industry and of the specific chemicals used in the industry that may trigger particular regulatory requirements.

TABLE OF CONTENTS

CLEAN AIR ACT REQUIREMENTS

Section A. CLEAN AIR ACT REQUIREMENTS

Law: Federal Clean Air Act (amended 1990)

The Clean Air Act (CAA), with its 1990 amendments, sets the framework for air pollution control as it affects the electronics industry. This framework has several elements. Several portions of Title I of the CAA address requirements for the attainment and maintenance of National Ambient Air Quality Standards (NAAQS). Section A.1 discusses how the implementation of Title I of the CAA may affect the electronics industry.

Section 112 of the CAA covers emissions of hazardous substances. For a wide variety of such substances, Congress directed the EPA to base its limits on emissions and technologies rather than on ambient air quality per se. Section A.2 discusses how controls on hazardous air pollutants may affect the semiconductor industry.

The 1990 amendments to the CAA provide a new mechanism for implementing both the National Ambient Air Quality Standards and the Act's hazardous substance limitations. This new mechanism is the permit, which would be required of major sources of (1) pollutants affecting ambient air quality, (2) hazardous air pollutants, and (3) new sources. Permits are discussed in Section A.3 of this report.

Finally, Title VI of the Clean Air Act addresses ozone-depleting chemicals. Several solvents used in the computer industry are affected by this law. These requirements are discussed in Section A.4 of this report.

A.1 EPA RESTRICTIONS ON NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS (40 CFR 50)

EPA's National Ambient Air Quality Standards (NAAQS) establish levels of air quality that are to be applied uniformly throughout regions in the United States. An air quality control region is classified as a "nonattainment" area if a NAAQS is violated anywhere in the region. (In the case of ozone, a violation occurs if the 4th highest reading over any 24-hour period in the past 3 years exceeds the NAAQS for ozone.) Two types of NAAQS are set:

(1) Primary standards that define the level of air quality necessary to prevent any adverse impact on human health, and

(2) Secondary standards that define the level of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

These standards recognize that the severity of the adverse health effects associated with exposure often depends on the duration of exposure. Accordingly, "short-term" standards set limits for a 1-hour, an 8-hour, or a 24-hour period, while "long-term" standards are established on an annual basis.

The EPA has set National Ambient Air Quality Standards for the six pollutants shown in Exhibit 1. These standards are used as a foundation for the regulatory framework discussed in this section. Of the six, only

the NAAQS for ozone is likely to have a significant impact on the electronics industry.[1] Electronics manufacturing facilities are not, of course, major sources of ozone per se; however, they are sources of emissions of volatile organic compounds (VOCs), the precursors of ozone. Thus, although there is a NAAQS for ozone, the relevant emissions for monitoring purposes are VOCs.

EXHIBIT 1. National Ambient Air Quality Standards for Criteria Pollutants (As of July 1, 1991)

Pollutant	Primary Standards (Protective of Health)[2]
Ozone	0.120 ppm (235 $\mu g/m^3$) (1-hour average)
Carbon Monoxide	9 ppm (10 mg/m^3) (8-hour average) 35 ppm (40 mg/m^3) (1-hour average)
Particulate Matter (PM-10)	150 $\mu g/m^3$ (24-hour average) 50 $\mu g/m^3$ (annual arithmetic mean)
Sulfur Dioxide	0.140 ppm (365 $\mu g/m^3$) (24-hour average) 0.03 ppm (80 $\mu g/m^3$) (annual arithmetic mean)
Nitrogen Dioxide	0.053 ppm (100 $\mu g/m^3$) (annual arithmetic mean)
Lead	1.5 $\mu g/m^3$ (arithmetic mean averaged quarterly)

A.1.1 New Sources of Volatile Organic Compounds (VOC) Emissions

In both attainment and nonattainment areas, whenever new plants are built or emissions from existing sources increase as a result of expansion, a New Source Review (NSR) is triggered. Special rules apply in

[1] Emissions of lead from the use of lead in soldering and other processes are unlikely to be large enough to trigger air pollution control requirements. However, EPA has not yet studied the electronics industry as a source of lead emissions.

[2] See 40 CFR Part 50. The Clean Air Act also requires that EPA establish secondary standards, which protect against adverse effects on the environment. Secondary standards have been established for most of the listed pollutants, and, in most cases, the levels are lower than those in the primary standards.

attainment areas. These are called Prevention of Significant Deterioration (PSD) requirements and include the following:

- Installation of Best Available Control Technology (BACT)[3];
- A detailed air quality analysis showing that there will be no violation of PSD "increments";
- Prediction of future air quality standards; and
- Possible monitoring of air quality for one year prior to the issuance of the permit.

Restrictions in nonattainment areas are more severe. The principal requirements of NSR in nonattainment areas are:

- Installation of Lowest Achievable Emission Rate (LAER) technology[4];
- Provision for "offsets" (see Exhibit 2) representing emission reductions that must be made from other sources; and
- Demonstration of standard attainment through the undertaking of an air quality analysis.

EXHIBIT 2. Major Source Definitions and Offset Ratios in Ozone Nonattainment Areas

Category	Size of Major Source[5] (Tons/Year of VOCs)	Offset Ratios
Marginal	100	1.1:1
Moderate	100	1.15:1
Serious	50	1.2:1
Severe	25	1.3:1
Extreme	10	1.5:1

[3] EPA determines BACT requirements by: (1) identifying all control technologies; (2) eliminating technically infeasible options; (3) ranking remaining control options by control effectiveness; (4) evaluating the most effective controls and documenting results; and (5) selecting BACT. See *Draft New Source Review Workshop Manual*, U.S. EPA, OAQPS, October 1990.

[4] LAER is the most stringent emission limitation derived from either of the following: (1) the most stringent emission limitation contained in the implementation plan of any State for such class or category of source; or (2) the most stringent emission limitation achieved in practice by such class or category of source. See CAA §171(3).

[5] States have the option of choosing a major source definition of 5 tons per year (TPY) (and accepting other conditions) to avoid complying with the requirement that emissions be reduced by 15 percent over the first 6 years. See Section 182(b)(1)(A)(ii).

A.1.2 Existing Sources of VOC Emissions

A.1.2.1 Ozone non-attainment areas

The "design value" shown in column 3 of Exhibit 3 is the 4th highest reading taken over any 24-hour period in a nonattainment area. Based on this figure, a nonattainment area is classified as Marginal, Moderate, Serious, Severe, or Extreme. As shown in this exhibit, attainment deadlines are based on a sliding scale that reflects the severity of the pollution.

EXHIBIT 3. Classification of Ozone Nonattainment Areas

Classification	Deadline to Attain (from November 15, 1990)	Design Value (ppm)
Marginal	3 Years	0.121 - 0.138
Moderate	6 Years	0.138 - 0.160
Serious	9 Years	0.160 - 0.180
Severe	15 Years 17 Years	0.180 - 0.190 0.190 - 0.280
Extreme	20 Years	Above 0.280

Areas that are likely to be classified as Extreme, Severe, or Serious as of late-1990 are presented in Exhibit 4.

EXHIBIT 4. Ozone Nonattainment Areas

Extreme (1 area)	**Serious (16 Areas)**
Los Angeles-Anaheim-Riverside, CA	Atlanta, GA
	Bakersfield, CA
Severe (8 areas)	Baton Rouge, LA
	Beaumont-Port Arthur, TX
Baltimore, MD	Boston, MA
Chicago, IL-IN-WI	El Paso, TX
Houston-Galveston-Brazoria, TX	Fresno, CA
Milwaukee-Racine, WI	Hartford, CT
Muskegon, MI	Huntington-Ashland, WV-KY-OH
New York, NY-NJ-CT	Parkersburg-Marietta, WV-OH
Philadelphia, PA-NJ-DE	Portsmouth-Dover-Rochester, NH-ME
San Diego, CA	Providence, RI
	Sacramento, CA
	Sheboygan, WI
	Springfield, MA
	Washington, DC-MD-VA

A source defined as "major" must install Reasonably Available Control Technology (RACT) as prescribed in the applicable State Implementation Plan (SIP). A major source is defined both by the size of the source's emissions and the category of the nonattainment area. These conditions are presented in Exhibit 5. In addition, if a firm has the potential to emit more than 100 tons per year (TPY), it is also considered to be a major source. Potential to emit means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design.

A determination of the necessary RACT requirements is made on the basis of a case-by-case review of each facility. In an attempt to issue uniform guidelines, the EPA has begun to issue Control Technique Guidance (CTGs) for industrial categories. The following Control Technique Guidances may apply to the semiconductor industry:

- Miscellaneous Metal Parts and Products
- Plastic Parts (expected 1993)
- Alternative Control Technology (ACT) for Solvent Cleaning

To the extent that an computer industry source is covered by any of EPA's CTGs, it may be covered by a State Implementation Plan (SIP) RACT rule even if it is not a major source.

Each State is required to develop a SIP for all nonattainment areas. SIPs contain a wide range of requirements that are designed to decrease ozone levels by controlling VOC emissions.

EXHIBIT 5. Existing Source Reasonably Available Control Technology (RACT) Requirements for Each Ozone Nonattainment Category

Category of Nonattainment Area	Size of VOC or NOx Sources Affected (Tons/Year)
Extreme	10
Severe	25
Serious	50
Moderate and Marginal	100

A.2 HAZARDOUS AIR POLLUTANTS AND MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT) STANDARDS

The National Ambient Air Quality Standards apply to a small number of the most common pollutants. Additional controls that directly restrict the emission of 189 hazardous air pollutants are established in Section 112 of the Clean Air Act. EPA is authorized to establish Maximum Achievable Control Technology (MACT) standards for source categories that emit at least one of the pollutants on the list. Chemicals listed in Part 112 of the Clean Air Act that are used in semiconductor manufacturing, semiconductor packaging, printed wiring board manufacturing, and display manufacturing are shown in Exhibits 6 - 9.

EXHIBIT 6. Chemicals Used in Semiconductor Manufacturing That are Scheduled for Maximum Achievable Control Technology (MACT) Standards

HAZARDOUS AIR POLLUTANT	
Antimony compounds	Hydrochloric acid
Arsenic compounds	Hydrofluoric acid
Arsine	Methanol
Carbon tetrachloride	Methyl isobutyl ketone
Catechol	Nickel compounds
Chlorine	Phosphine
Chromium compounds	Phosphorus
Ethyl acrylate	1,1,1-Trichloroethane
Ethyl benzene	Trichloroethylene
Ethylene glycol	Xylene

EXHIBIT 7. Chemicals Used in Semiconductor Packaging That are Scheduled for Maximum Achievable Control Technology (MACT) Standards

HAZARDOUS AIR POLLUTANT	
Chlorine	Methanol
Chromium	Methylene chloride
Ethyl benzene	Nickel compounds
Ethylene glycol	Toluene
Hydrochloric acid	1,1,1 Trichloroethane
Hydrofluoric acid	Xylene
Lead compounds	

EXHIBIT 8. Chemicals Used in Printed Wiring Board Manufacturing That are Scheduled for Maximum Achievable Control Technology (MACT) Standards

HAZARDOUS AIR POLLUTANT	
Chlorine	Lead compounds
Dimethylformamide	Methylene chloride
Formaldehyde	Nickel compounds
Hydrochloric acid	Perchloroethylene
Hydrofluoric acid	1,1,1-Trichloroethane
Ethylene glycol	

EXHIBIT 9. Chemicals Used in Display Manufacturing That are Scheduled for Maximum Achievable Control Technology (MACT) Standards

HAZARDOUS AIR POLLUTANT	
Lead compounds	Trichloroethylene

In addition, EPA is in the process of identifying categories of industrial facilities that emit substantial quantities of any of these 189 pollutants. Regulations that will apply specifically to the semiconductor industry are expected in 1997. These standards, which will require the maximum degree of pollution reduction, can be imposed on listed sources and may require a wide range of control measures, including:

- Installation of control equipment;
- Process changes;
- Material substitution;
- Work practice changes; and
- Operator training or certification.

These measures are expected to achieve a 75- to 90-percent emission reduction below current levels.

A source will receive a 6-year extension in the compliance date for a MACT standard if it achieves a 90-percent reduction in its air toxic emissions prior to the date on which the MACT standard is proposed for its industry category. There is no requirement to notify EPA before issuance of the standard; however, the demonstration of emissions reduction must be made before the standard is proposed. A source should submit its demonstration either along with its Title V permit application or as a permit modification. EPA has issued regulations specifying how the demonstration must be made (40 CFR Part 63, Subpart D).

A.3 PERMITS (40 CFR 70)

The CAA and its implementing regulations (at 40 CFR 70) define the minimum standards and procedures required for State operating permit programs. The permit system is a new approach established by the Amendments that is designed to define each source's requirements and to facilitate enforcement. In addition, permit fees will generate revenue to fund implementation of the program.

Any facility defined as a "major source" is required to secure a permit. Part 70.2 defines a source as a single point from which emissions are released or as an entire industrial facility that is under the control of the same person(s), and a major source is defined as any source that emits or has the potential to emit:

- 10 TPY or more of any hazardous air pollutant;
- 25 TPY or more of any combination of hazardous air pollutants; or
- 100 TPY of any air pollutant.

For ozone nonattainment areas, major sources are defined as sources with the potential to emit:

- 100 TPY or more of volatile organic compounds (VOCs) in areas defined as marginal or moderate;

- 50 TPY or more of VOCs in areas classified as serious;
- 25 TPY or more of VOCs in areas classified as severe; and
- 10 TPY or more of VOCs in areas classified as extreme.

In addition to major sources, all sources that are required to undergo New Source Review, are subject to New Source Performance Standards, or are identified by Federal or State regulations, must obtain a permit.

By November 15, 1993, each State must submit a design for an operating permit program to the EPA for approval. The EPA must either approve or disapprove the State's program within one year after submission. Once approved, the State program goes into effect.

Major sources, as well as the other sources identified above, must submit their permit applications to the State within one year of approval of the State program. (This will take place near the end of 1995). Once a source submits an application, it may continue to operate until the permit is issued. When issued, the permit will include all air requirements applicable to the facility. Among these are compliance schedules, emissions monitoring, emergency provisions, self-reporting responsibilities, and emissions limitations. Five years is the maximum permit term.

As established in 40 CFR 70, the States are required to develop fee schedules to ensure the collection and retention of revenues sufficient to cover permit program costs. The CAA sets a presumptive minimum annual fee of $25 per ton for all regulated pollutants (except carbon monoxide), but States can set higher or lower fees so long as they collect sufficient revenues to cover program costs.

A.4 STRATOSPHERIC OZONE PROTECTION (40 CFR 82)

The CAA Amendments provide for a phase-out of the production and consumption of chlorofluorocarbons (CFCs) and other chemicals that are causing the destruction of the stratospheric ozone layer. The requirements apply to any individual, corporate, or government entity that produces, transforms, imports, or exports these controlled substances.

Section 602 of the Clean Air Act identifies ozone-depleting substances and divides them into two classes. Class I substances are divided into five groups, as shown in Exhibit 10. Section 604 of the Clean Air Act calls for a complete phase-out of Class I substances by January 1, 2000 (January 1, 2002, for methyl chloroform). Class II chemicals, which are hydrochlorofluorocarbons (HCFCs), are generally seen as interim substitutes for Class I CFCs.

Class II substances consist of 33 HCFCs. The law calls for a complete phase-out of Class II substances by January 1, 2030. The schedule for the HCFC phase-out has not yet been finalized; however, EPA has proposed to begin phase-out of some HCFCs by 2002, with a complete phase-out of all HCFCs to take place by 2030. This same proposal would phase-out CFCs, carbon tetrachloride, hydrobromofluorocarbons, and methyl chloroform by January 1, 1996. Halons used as fire extinguishers were to be phased-out by January 1, 1994.

On January 19, 1993, EPA issued a rule under Section 611 of the Clean Air Act that requires both domestically produced and imported goods containing or manufactured with Class I chemicals to carry a warning

label. The rule covers items whose manufacture involves the use of Class I chemicals, even if the final product does not contain such chemicals. The EPA cited circuit boards, whose manufacture requires cleaning with methyl chloroform, as an example of an item of this type.

Exports are exempt from this rule's labeling requirements, as are products that do not have direct contact with these chemicals. In addition, if direct contact occurs but is non-routine and intermittent (e.g., spot-cleaning of textiles), no labeling is required. Moreover, if a second manufacturer incorporates a product made with an ozone-depleting chemical into another item, the final product need not carry a label.

EXHIBIT 10. Class I Substances

Group I	Group II
Chlorofluorocarbon-11 (CFC-11)	Halon-1211
Chlorofluorocarbon-12 (CFC-12)	Halon-1301
Chlorofluorocarbon-113 (CFC-113)	Halon-2402
Chlorofluorocarbon-114 (CFC-114)	
Chlorofluorocarbon-115 (CFC-115)	
Group III	**Group IV**
Chlorofluorocarbon-13 (CFC-13)	Carbon tetrachloride
Chlorofluorocarbon-111 (CFC-111)	
Chlorofluorocarbon-112 (CFC-112)	
Chlorofluorocarbon-211 (CFC-211)	
Chlorofluorocarbon-212 (CFC-212)	
Chlorofluorocarbon-213 (CFC-213)	**Group V**
Chlorofluorocarbon-214 (CFC-214)	Methyl chloroform
Chlorofluorocarbon-215 (CFC-215)	
Chlorofluorocarbon-216 (CFC-216)	
Chlorofluorocarbon-217 (CFC-217)	

CLEAN WATER ACT REQUIREMENTS

Section B. CLEAN WATER ACT REQUIREMENTS

Law: Federal Water Pollution Control Act (Clean Water Act)

The Clean Water Act (CWA) is the basic Federal law governing water pollution control in the United States today. The electronics industry produces a number of pollutants that are regulated under the CWA. Applicable provisions of the CWA are described below, including Spills of Oil and Hazardous Substances, the National Pollutant Discharge Elimination System (NPDES) Permit Program, and the Underground Injection Control Program, which may impact the electronics industry in the future.

B.1 SPILLS OF OIL AND HAZARDOUS SUBSTANCES

B.1.1 Discharge of Oil (40 CFR 110)

The regulations in this part apply to the discharge of oil, which is prohibited by Section 311(b)(3) of the CWA. Prohibited discharges include certain discharges into or upon the navigable waters of the United States or adjoining shorelines or into or upon the waters of the contiguous zone, those occurring in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or those that may affect natural resources belonging to, appertaining to, or under the exclusive management of the United States.

These regulations define the term "discharge" used in Section 110.11 of the CWA as including (but not being limited to) any spilling, leaking, pumping, pouring, emitting, emptying, or dumping into the marine environment of quantities of oil that:

(1) Violate applicable water quality standards,[6] or

(2) Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines.

B.1.2 Oil Pollution Prevention (40 CFR 112)

This section establishes procedures, methods, equipment, and other requirements to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable waters of the United States or adjoining shorelines. A business that owns or operates above-ground oil storage tanks having capacities greater than 1,320 gallons, and that could reasonably be expected to discharge oil to the navigable waters of the United States, must prepare a written Spill Prevention Control and Counter-measure (SPCC) Plan in accordance with Section 112.7 of the CWA. No SPCC Plan is considered to satisfy the requirements of this part unless it has been reviewed and certified by a Registered Professional Engineer.

In addition to the minimal prevention standards listed in Section 112.7(c), the SPCC Plan should include a complete discussion related to the following:

- Facility drainage (onshore);

---

[6] Water quality standards are discussed in section B.2.3 below.

- Bulk storage tanks (onshore);
- Facility transfer operations, pumping, and in-plant processes (onshore);
- Facility tank car and tank truck loading/unloading rack (onshore);
- Oil production facilities;
- Oil drilling and workover facilities;
- Oil drilling, production, or workover facilities (onshore);
- Inspections and records;
- Security (excluding oil production facilities); and
- Personnel training and spill prevention procedures.

B.1.3 Designation and Reportable Quantities of Hazardous Substances Under the Federal Water Pollution Control Act (40 CFR 116 and 40 CFR 117)

Part 116 of the Federal Water Pollution Control Act (FWPCA) designates hazardous substances under Section 311(b)(2)(a) of the Clean Water Act, and Part 117 of the FWPCA establishes the Reportable Quantity (RQ) for each substance listed in Part 116. When an amount equal to or in excess of the RQ is discharged, the facility must provide notice to the Federal government of the discharge, following Department of Transportation requirements set forth in 33 CFR 153.203. This requirement does not apply to facilities that discharge the substance under an NPDES Permit or a CWA Section 404 (dredge and fill) Permit, or to a publicly owned treatment works (POTW), as long as any applicable effluent limitations or pretreatment standards have been met. Examples of RQs listed in 40 CFR 117.3 that may apply to chemicals used in semiconductor manufacturing, semiconductor packaging, printed wiring board manufacturing, and display manufacturing are shown in Exhibits 11 - 14.

EXHIBIT 11. Reportable Quantities (RQs) That May Apply to the Semiconductor Industry

Hazardous Substance	RQ in Pounds
Acetic acid	5,000
Ammonia	1 00
Ammonium fluoride	100
Ammonium hydroxide	1,000
Antimony trichloride	1,000
Antimony trioxide	1,000
Arsenic trioxide	1
Carbon tetrachloride	10
Chlorine	10
Chromic acid	10
Ethyl benzene	1,000
Ethylenediamine	5,000
Ferric chloride	1,000
Ferric nitrate	1,000
Hydrochloric acid	5,000
Hydrofluoric acid	100
Isoprene	100
Nickel compounds	10 to 100
Nitric acid	1,000
Phosphoric acid	5,000
Phosphorus oxychloride	1,000
Phosphorus trichloride	1,000
Potassium cyanide	10
Potassium hydroxide	1,000
Sodium hydroxide	1,000
Sulfuric acid	1,000
Trichloroethylene	100
Xylene	1,000

EXHIBIT 12. Reportable Quantities (RQs) That May Apply to Semiconductor Packaging

Hazardous Substance	RQ in Pounds
Ammonium hydroxide	1,000
Antimony trioxide	1,000
n-butyl acetate	5,000
Chlorine	10
Chromic acid	10
Cupric chloride	10
Cupric nitrate	100
Ethyl benzene	1,000
Ferric chloride	1,000
Hydrochloric acid	5,000
Hydrofluoric acid	100
Nickel chloride	100
Nickel sulfate	100
Nitric acid	1,000
Potassium cyanide	10
Sulfuric acid	1,000
Toluene	1,000
Xylene	1,000

EXHIBIT 13. Reportable Quantities (RQs) That May Apply to the Printed Wiring Board Industry

Hazardous Substance	RQ in Pounds
Ammonia	100
Ammonium bifluoride	100
Ammonium chloride	5,000
Ammonium hydroxide	1,000
Chlorine	10
Chromic acid	10
Cupric chloride	10
Cupric nitrate	100
Cupric sulfate	10
Formaldehyde	100
Hydrochloric acid	5,000
Hydrofluoric acid	100
Nickel chloride	100
Nitric acid	1,000
Potassium hydroxide	1,000
Potassium permanganate	100
Sodium hydroxide	1,000
Sulfuric acid	1,000

EXHIBIT 14. Reportable Quantities (RQs) That May Apply to the Display Manufacturing Industry

Hazardous Substance	RQ in Pounds
Nitric acid	1,000
Trichloroethylene	100

B.2 EPA NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT PROGRAM

B.2.1 National Pollutant Discharge Elimination System Permit Regulations (40 CFR 122)

Sections 301, 304, 306, 307, and 402 of the Clean Water Act authorize the establishment of regulations and the issuance of permits to control the discharge of pollutants to waters of the United States. The National Pollutant Discharge Elimination System (NPDES) permit program includes regulations governing these discharges. Forty States and one territory are authorized to administer NPDES programs that are at least as stringent as the federal program; EPA administers the program in States that are not authorized to do so. The following discussion covers federal NPDES requirements; where a State implements the program, the facility may be required to comply with additional requirements not covered in this document.

The NPDES program requires permits for the discharge of "pollutants" from any "point source" into "navigable waters," except those covered under dredge and fill permits (CWA Section 404 permits). The Act defines all of these terms broadly. The term "pollutant" encompasses almost anything that a source might discharge, including dredge spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural wastes discharged into water. The term "point source" means any discernible, confined, and discrete conveyance, such as a ditch or a pipe. The Act defines "navigable

waters" as "waters of the United States." Courts have construed the term "waters of the United States" very broadly; the waters need not be navigable in fact and can include wetlands.

Thus, a source will be required to obtain an NPDES permit if it discharges almost anything (except dredge and fill) directly to surface waters. A source that sends its wastewater to a publicly owned treatment works (POTW) will not be required to obtain an NPDES permit, but may need to comply with pretreatment requirements and be required to obtain an industrial user permit from the POTW to cover its discharge. Even if the source does not produce any wastewater, it may still be subject to the NPDES permit program if it discharges "storm water associated with industrial activity," including construction activity that results in the disturbance of 5 or more acres of land area. Section B.2.5 of this document discusses when facilities need to obtain a storm water permit.

Permit application requirements are set forth in 40 CFR 122.21(f) and (g) for discharges of process wastewater, 40 CFR 122.21(k) for new sources and new discharges, 40 CFR 122.21(h) for non-process wastewater, and 40 CFR 122.26(c)(1) for storm water. Application requirements for variances are set forth in 40 CFR 122.21(m).

An application for a permit for process wastewater must include information on the location of the outfall(s), a line drawing showing the water flow through the facility (with a water balance), a description of average flows and the treatment of wastewater before discharge, and an estimate of the facility's actual production if an effluent limitation guideline applies (see below). In addition, the applicant must report quantitative data for every outfall for the following pollutants:

- Biochemical Oxygen Demand (BOD5);
- Chemical Oxygen Demand (COD);
- Total Organic Carbon (TOC);
- Total Suspended Solids (TSS);
- Ammonia (measured as N);
- Temperature (both winter and summer); and
- pH.

The application also must report the results of any biological toxicity tests that may have been conducted on its effluent within the previous three years. Finally, the facility must provide information on its "effluent characteristics." Semiconductor manufacturing facilities will need to test for all 126 priority pollutants listed in 40 CFR 122, Appendix D. Semiconductor packaging, printed wiring board, and display facilities must provide quantitative data only for those priority pollutants which the applicant knows or has reason to believe will be discharged in greater than trace amounts. Exhibits 15 - 17 list the priority pollutants likely to be discharged by these facilities.

EXHIBIT 15. Priority Pollutants Used in Semiconductor Packaging That May Be Present in Discharge

Antimony	Lead
Chromium	Methylene chloride
Copper	Nickel
Cyanide	Silver
Ethyl benzene	1,1,1 trichloroethane

EXHIBIT 16. Priority Pollutants Used in Printed Wiring Board Manufacturing That May Be Present in Discharge

Chromium	Methylene chloride
Copper	Nickel
Cyanide	Perchloroethylene
Lead	1,1,1 trichloroethane

EXHIBIT 17. Priority Pollutants Used in Display Manufacturing That May be Present in Discharge

Lead compounds	Trichloroethylene

Each applicant also must indicate whether it knows or has reason to believe it discharges any of the other hazardous substances, or non-conventional pollutants located at 40 CFR 122 Appendix D. Quantitative testing is not required for the other hazardous pollutants; however, the applicant must describe why it expects the pollutant to be discharged and provide the results of any quantitative data about its discharge of that pollutant. Quantitative testing is required for the non-conventional pollutants if the applicant expects them to be present in its discharge. Exhibits 18 - 21 list the other hazardous substances and other non-conventional pollutants likely to be discharged by semiconductor, semiconductor packaging, printed wiring board, and display manufacturing.

EXHIBIT 18. Hazardous and Non-Conventional Chemicals Used in Semiconductor Manufacturing

HAZARDOUS POLLUTANTS	NON-CONVENTIONAL POLLUTANTS
Butyl acetate	Aluminum, total
Ethylene diamine	Boron, total
Isoprene	Chlorine, total residual
Xylene	Iron, total
	Nitrate/nitrite
	Phosphorus, total
	Titanium, total

EXHIBIT 19. Hazardous and Non-Conventional Chemicals Used in Semiconductor Packaging

HAZARDOUS POLLUTANTS	NON-CONVENTIONAL POLLUTANTS
Butyl acetate	Chlorine, total residual
Xylene	Iron, total
	Nitrate/nitrite
	Phosphorus, total
	Tin, total
	Titanium, total

EXHIBIT 20. Hazardous and Non-Conventional Chemicals Used in Printed Wiring Board Manufacturing

HAZARDOUS POLLUTANTS	NON-CONVENTIONAL POLLUTANTS
Formaldehyde	Boron, total
	Chlorine, total residual
	Nitrates/nitrites
	Tin, total

EXHIBIT 21. Hazardous and Non-Conventional Chemicals Used in Display Manufacturing

HAZARDOUS POLLUTANTS	NON-CONVENTIONAL POLLUTANTS
	Nitrates/nitrites

If the facility discharges only non-process wastewater, the application must include information on the location of the outfall(s), a description of the type of waste, and the results of quantitative testing for the following:

- Biochemical Oxygen Demand (BOD5);
- Total Suspended Solids (TSS);
- Fecal Coliform;
- Total Residual Chlorine;
- Oil and Grease;
- Chemical Oxygen Demand (COD);
- Total Organic Carbon (TOC);
- Ammonia (measured as N);
- Discharge Flow;
- pH; and
- Temperature (both winter and summer).

A description of the frequency of flow and the duration of any seasonal or intermittent discharge and a brief description of any system used or to be used must also be provided.

"Standard permit conditions" apply to all NPDES permits and are contained in 40 CFR 122.41. These conditions describe the legal effect of the permit and its revocability, as well as explaining the affirmative defenses which may be available to a non-compliant permittee. They also put the permittee on notice of penalties which may be assessed if the permit is violated. Standard permit conditions also describe the permittee's duties and obligations during the effective period of the permit, including the duty to comply with all conditions in a current permit. The permittee must maintain records of all monitoring information for a period of at least three years from the date of the sample, and monitoring results must be reported at the intervals specified in the permit. The NPDES permitting authority (either EPA or an approved State) is allowed to enter the facility at any reasonable time to conduct an inspection or to monitor activity. The NPDES permitting authority must be notified if the discharger knows or has reason to believe that any toxic discharge has exceeded any effluent limitation in the permit. Other generic requirements are also contained in this section of the permit.

Along with standard permitting conditions, NPDES permits contain technology and water-quality based effluent limitations, monitoring, reporting, and record keeping requirements and, potentially, storm water treatment provisions. Other site-specific conditions ("special conditions") may be imposed on facilities through their NPDES permits, including:

- Construction schedules;
- Best Management Practices (BMPs);
- Additional monitoring for non-regulated pollutants of concern; and
- Spill prevention plans.

B.2.2 Effluent Limitation Guidelines and Standards for Electronics Manufacturing

A principal means for attaining water quality objectives under the Clean Water Act is the establishment and enforcement of technology-based effluent limitations, which are based on the pollutant control capabilities of available technologies, taking into consideration the economic achievability of these limitations and a number of other factors. Because of differences in production processes, quantities, and composition of discharges, separate standards are established for discharges associated with different industry categories. These standards are referred to as technology-based effluent limitation guidelines.

The effluent limitation to be applied to a particular pollutant in a particular case depends on the following:

(1) Whether the pollutant is conventional, nonconventional, or toxic;

(2) Whether the point source is a new or existing source; and

(3) Whether the point source discharges directly to the waters of the United States, or to a publicly-owned treatment works (POTW). (Facilities who discharge to POTWs must comply with the pretreatment standards discussed at B.2.4 below.)

Existing sources must comply with either BPT (best practicable control technology currently available) standards, BCT (best conventional pollution control technology) standards, which includes the technology-based requirements for "conventional" pollutants (oil and grease, fecal coliform, biochemical oxygen demand, total suspended solids, and pH), or BAT (best available control technology economically practicable) standards.

In the absence of effluent limitation guidelines for a facility category, permit writers establish technology-based controls using their Best Professional Judgement. In essence, the permit writer undertakes an effluent guideline-type analysis for a single facility. The permit writer will use information such as permit limits from similar facilities using similar treatment technology, performance data from actual operating facilities, and scientific literature. Best Professional Judgement may not be used in lieu of existing effluent guidelines. These guidelines apply only to direct dischargers of wastewater.

Part 469, Subpart B of the Code of Federal Regulations applies to discharges resulting from the manufacture of electronic crystals. For the purposes of this document, we assume that electronic crystals are bought from manufacturers. However, if electronic crystals are manufactured on the premises, facilities must be in compliance with this part of the Code.

The following guidelines apply to the semiconductor, printed wiring board, and display manufacturing industries.

Semiconductor Manufacturing

The provisions in Part 469, Subpart A (Exhibits 22-25) apply to discharges resulting from all process operations associated with the manufacture of semiconductors (except sputtering, vapor deposition, and electroplating). As used in this Part, the term "total toxic organics" (TTO) means the sum of the concentrations of each of the following toxic organic compounds found in the discharge at a concentration greater than ten (10) micrograms per liter:

- 1,2,4-Trichlorobenzene chloroform
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene Ethyl benzene
- 1,1,1-Trichloroethane methylene chloride naphthalene
- 2-Nitrophenol phenol bis (2-ethylhexyl) phthalate tetrachloroethylene toluene trichloroethylene
- 2-Chlorophenol
- 2,4-Dichlorophenol
- 4-Nitrophenol pentachlorophenol di-n-butyl phthalate anthracene
- 1,2-Diphenylhydrazine isophorone butyl benzyl phthalate
- 1,1-Dichloroethylene
- 2,4,6-Trichlorophenol carbon tetrachloride
- 1,2-Dichloroethane
- 1,1,2-Trichloroethane dichlorobromomethane.

The effluent limitations shown in Exhibits 22 - 25 are used as the basis for NPDES permits for the semiconductor industry.

EXHIBIT 22. Semiconductor Best Practicable Control Technology Currently Available (BPT) Effluent Limitations

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Total Toxic Organics	1.37	Not applicable
pH	Within the range of 6.0 to 9.0	Within the range of 6.0 to 9.0

EXHIBIT 23. Semiconductor Best Available Control Technology Economically Available (BAT) Effluent Limitations

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Total Toxic Organics	1.37	Not applicable
Fluoride (T)	32.0	17.4

EXHIBIT 24. Semiconductor New Source Performance Standards (NSPS) Effluent Limitations[1]

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Total Toxic Organics	1.37	Not applicable
Fluoride (T)	32.0	17.4
pH	N/A	Within the range of 6.0 to 9.0

[1] Applies to facilities that commenced construction after April 18, 1983.

EXHIBIT 25. Semiconductor Best Conventional Pollution Control Technology (BCT) Effluent Limitations

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Monitoring Days Shall Not Exceed (mg/l)
pH	Within the range of 6.0 to 9.0	Within the range of 6.0 to 9.0

The provisions of Part 433, Subpart A (Exhibits 26-28) apply to semiconductor manufacturing plants that perform any of the following six metal finishing operations on any basis material: electroplating, electroless plating, anodizing, coating, chemical etching and milling, and printed wiring board manufacture.

As used in this part, the term "total toxic organics" (TTO) means the sum of the concentrations of each of the following toxic organic compounds found in the discharge at a concentration greater than ten (10) micrograms per liter:

- Acenaphthene
- Acrolein
- Acrylonitrile
- Benzene
- Benzidine
- Carbon tetrachloride (tetrachloromethane)
- Chlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobenzene
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- Hexachloroethane
- 1,1-Dichloroethane
- 1,1,2-Trichloroethane
- 1,1,2,2-Tetrachlorophenol
- Chloroethane
- Bis (2-chloroethyl) ether
- 2-Chloroethyl vinyl ether (mixed)
- 2-Chloronaphthalene
- 2,4,6-Trichlorophenol
- Parachlorometa cresol
- Chloroform (trichloromethane)
- 2-Chlorophenol
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 3,3-Dichlorobenzidine
- 1,1-Dichloroethylene
- 1,2-Trans-dichloroethylene
- 2,4-Dichlorophenol
- 1,2-Dichloropropane
- 1,3-Dichloropropylene (1,3-dichloropropene)

- 2,4-Dimethylphenol
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- 1,2-Diphenylhydrazine
- Ethyl benzene
- Fluoranthene
- 4-Chlorophenyl phenyl ether
- 4-Bromophenyl phenyl ether
- Bis (2-chloroisopropyl) ether
- Bis (2-chloroethoxy) methane
- Methylene chloride (dichloromethane)
- Methyl chloride (chloromethane)
- Methyl bromide (bromomethane)
- Bromoform (tribromomethane)
- Dichlorobromomethane
- Chlorodibromomethane
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Isophorone
- Naphthalene
- Nitrobenzene
- 2-Nitrophenol
- 4-Nitrophenol
- 2,4-Dinitrophenol
- 4,6-Dinitro-o-cresol
- N-nitrosodimethylamine
- N-nitrosodiphenylamine
- N-nitrosodi-n-propylamine
- Pentachlorophenol
- Phenol
- Bis (2-ethylhexyl) phthalate
- Butyl Benzyl Phthalate
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Diethyl phthalate
- Dimethyl phthalate
- 1,2-Benzanthracene (benzo(a)anthracene)
- Benzo(a)pyrene (3,4-benzopyrene)
- 3,4-Benzofluoranthene (benzo(b)fluoranthene)
- 11,12-Benzofluoranthene (benzo(k)fluoranthene)
- Chrysene
- Acenaphthylene
- 1,12-Benzoperylene (benzo(ghi)perylene)
- Fluorene
- Phenanthrene
- 1,2,5,6-Dibenzanthracene (dibenzo(a,h)anthracene)
- Indeno(1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
- Pyrene
- Tetrachloroethylene
- Toluene
- Trichloroethylene
- Vinyl chloride (chloroethylene)
- Aldrin
- Dieldrin
- Chlordane (technical mixture and metabolites)

- 4,4-DDT
- 4,4-DDE (p,p-DDX)
- 4,4-DDD (p,p-TDE)
- Alpha-endosulfan
- Beta-endosulfan
- Endosulfan sulfate
- Endrin
- Endrin aldehyde
- Heptachlor
- Heptachlor epoxide (BHC-hexachlorocyclohexane)
- Alpha-BHC
- Beta-BHC
- Gamma-BHC
- Delta-BHC (PCB-polychlorinated biphenyls)
- PCB-1242 (Arochlor 1242)
- PCB-1254 (Arochlor 1254)
- PCB-1221 (Arochlor 1221)
- PCB-1232 (Arochlor 1232)
- PCB-1248 (Arochlor 1248)
- PCB-1260 (Arochlor 1260)
- PCB-1016 (Arochlor 1016)
- Toxaphene
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

The provisions in Part 433, Subpart A (Exhibits 26 - 28) apply to discharges resulting from metal finishing operations associated with the manufacture of semiconductors. The effluent limitations shown in Exhibits 26 - 28 are used as the basis for NPDES permits for semiconductor facilities.

EXHIBIT 26. Semiconductor Best Available Technology Economically Achievable (BAT) Effluent Limitations (Metal Finishing)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)[1]	0.69	0.26
Cr (T)	2.77	1.71
Copper (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
CN (A)[2]	0.86	0.32
TTO	2.13	

[1] T=Total

[2] May apply for industrial facilities with cyanide treatment, upon agreement between a source subject to those limits and the pollution control authority. A=amenable to alkaline chlorination.

EXHIBIT 27. Semiconductor Best Control Technology Currently Available (BPT) Effluent Limitation (Metal Finishing)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.69	0.26
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	
Oil and Grease	52	26
TSS	60	31
pH	(1)	(1)

(1) Within 6.0 to 9.0.

EXHIBIT 28. Semiconductor New Source Performance Standards (NSPS) (Metal Finishing)[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.11	0.07
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	
Oil and Grease	52	26
TSS	60	31
pH	(2)	(2)

[1] Applies to facilities that commenced construction after July 15, 1983.
(2) Within 6.0 to 9.0

Printed Wiring Board Manufacturing

The provisions in Part 433, Subpart A (Exhibits 29 - 31) apply also to discharges resulting from process operations associated with the manufacture of printed wiring boards (except indirect discharging job shops and independent printed wiring board manufacturers who discharge to publicly owned treatment works; these sources

are covered by 40 CFR Part 413 and their requirements are discussed at B.2.4). As used in this Part, the term "total toxic organics" (TTO) is defined in the previous section, semiconductor manufacturing (metal finishing).

EXHIBIT 29. Printed Wiring Board Best Available Technology Economically Achievable (BAT) Effluent Limitations

Pollutant Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)[1]	0.69	0.26
Cr (T)	2.77	1.71
Copper (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
CN (A)[2]	0.86	0.32
TTO	2.13	

[1] T=Total

[2] May apply for industrial facilities with cyanide treatment, upon agreement between a source subject to those limits and the pollution control authority. A=Amenable to alkaline chlorination.

EXHIBIT 30. Printed Wiring Board Best Control Technology Currently Available (BPT) Effluent Limitations

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.69	0.26
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	
Oil and Grease	52	26
TSS	60	31
pH	(1)	(1)

(1) Within 6.0 to 9.0.

EXHIBIT 31. Printed Wiring Board New Source Performance Standards (NSPS) Effluent Limitations[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.11	0.07
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	
Oil and Grease	52	26
TSS	60	31
pH	(2)	(2)

[1] Applies to facilities that commenced construction after July 15, 1983.

(2) Within 6.0 to 9.0.

Display Manufacturing

The provisions in Part 469, Subpart C (Exhibit 32), apply to discharges resulting from display manufacturing. As used in this part, the term "total toxic organics" (TTO) means the sum of the concentrations for each of the following toxic organic compounds that is found in the discharge at a concentration greater than ten (10) micrograms per liter:

- 1,1,1 Chloroform
- Trichloroethane
- Methylene chloride
- Bis (2-ethyl hexyl) phthalate
- Toluene
- Trichloroethylene

The effluent limitations shown in Exhibit 27 are used as the basis for NPDES permits for the display manufacturing industry.

EXHIBIT 32. Cathode Ray Tube New Source Performance Standards (NSPS) Effluent Limitations[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
pH	(2)	(2)
TTO	1.58	
Cd	0.06	0.03
Cr	0.56	0.26
Pb	0.72	0.27
Zn	0.80	0.33
Fluoride	35.0	18.0
TSS	46.0	24.0

[1] Applies to facilities that commenced construction after December 14, 1983.
(2) Within the range of 6.0 to 9.0.

The provisions in Part 469, Subpart D (Exhibit 33), apply to discharges resulting from the manufacture of luminescent materials. As used in this part, the term "luminescent materials" means materials that emit light upon excitation by such energy sources as photons, electrons, applied voltage, chemical reactions, or mechanical energy, and that are specifically used as coatings in fluorescent lamps and cathode ray tubes. Luminescent materials include, but are not limited to, calcium halophosphate, yttrium oxide, zinc sulfide, and zinc-cadmium sulfide.

EXHIBIT 33. Luminescent Materials New Source Performance Standards (NSPS) Effluent Limitations[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
pH	(2)	(2)
Cadmium	0.55	0.26
Antimony	0.10	0.04
Zinc	1.64	0.67
Fluoride	35.0	18.0
TSS	60.0	31.0

[1] Applies to facilities that commenced construction after December 14, 1983.
(2) Within the range of 6.0 to 9.0.

B.2.3 Water Quality-Based Effluent Limitations (40 CFR 131)

NPDES permits must also contain any more stringent permit limitations based on State water quality standards. Unlike the technology-based limitations discussed above, water quality-based controls focus on the effects of the discharge on the receiving water. Such limitations may be necessary for surface water discharges to protect local water quality.

States determine the appropriate uses of each water body within the State (e.g., drinking water supply, fishable/swimmable, agriculture). States then establish water quality standards, or maximum pollutant levels, for those bodies of water that are necessary to attain or maintain the designated use. An appropriate standard may be expressed as a numerical ambient water quality criterion (e.g., a specified amount of dissolved oxygen per unit of water). State standards also may include a narrative water quality criterion, for example, no discharge of toxic pollutants in toxic amounts. Some States may allow for the attainment of water quality standards at some point within the receiving water (rather than at the end of pipe). Consequently, permit writers must first calculate available dilution and determine a proper mixing zone (if allowed by the State) to develop an effluent limit.

B.2.4 Indirect Discharger Requirements

B.2.4.1 Categorical Pretreatment Standards for the Semiconductor, Printed Wiring Board, and Display Manufacturing Industries

As mentioned above, only those facilities that discharge pollutants directly into waters of the United States need to obtain an NPDES permit. Facilities that discharge to POTWs, however, must comply with pretreatment requirements. Pretreatment requirements were developed because of concern that dischargers' waste containing toxic, hazardous, or concentrated conventional industrial wastes might "pass through" POTWs or that pollutants will interfere with the successful operation of the POTW's biological treatment system..

The following tables show national pretreatment standards for existing and new semiconductor, printed wiring board, and display manufacturing facilities. (In addition, local pretreatment programs may impose additional requirements on facilities.)

Part 469, Subpart B, applies to discharges resulting from the manufacture of electronic crystals. For the purposes of this document, we assume that electronic crystals are bought. However, if electronic crystals are manufactured on the premises, facilities must be in compliance with this part of the Code of Federal Regulations.

Semiconductor Manufacturing

The provisions in Part 469, Subpart A (Exhibits 34 - 35), apply to discharges resulting from all process operations associated with the manufacture of semiconductors (except sputtering, vapor deposition, and electroplating). The term "total toxic organics" (TTO) is defined for this part in the effluent limitation guidelines (Section B.2.2).

EXHIBIT 34. Semiconductor Pretreatment Standards for Existing Sources (PSES)

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Days (mg/l)
Total toxic organics	1.37	Not applicable

EXHIBIT 35. Semiconductor Pretreatment Standards for New Sources (PSNS)[1]

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Days (mg/l)
Total toxic organics	1.37	Not applicable

[1] Applies to facilities that commenced construction after April 8, 1983.

The provisions of Part 413, Subparts A, F, and G (Exhibits 36 - 38), apply to electroplating of common metals, chemical etching and milling, and electroless plating, respectively. Subpart A applies to dischargers of pollutants in process wastewaters resulting from the process which a ferrous or non-ferrous material is electroplated with copper, nickel, chromium, zinc, tin, lead, cadmium, iron, aluminum, or any combination thereof; Subpart F applies to process wastewaters resulting from the chemical milling or etching of ferrous or non-ferrous materials; and Subpart G applies to process wastewaters resulting from the electroless plating of a metallic layer on a metallic or non-metallic substrate. Because the effluent limitations in each of these subcategories are the same, the requirements have been consolidated in the exhibits below.

As used in this part, the term "total toxic organics" (TTO) means the sum of the concentrations of each of the following toxic organic compounds found in the discharge at a concentration greater than ten (10) micrograms per liter:

- Acenaphthene
- Acrolein
- Acrylonitrile
- Benzene
- Benzidine
- Carbon tetrachloride (tetrachloromethane)
- Chlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlororbenzene
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- Hexachloroethane
- 1,1-Dichloroethane
- 1,1,2-Trichloroethane
- 1,1,2,2-Tetrachlorophenol
- Chloroethane
- Bis (2-chloroethyl) ether
- 2-Chloroethyl vinyl ether (mixed)

- 2-Chloronaphthalene
- 2,4,6-Trichlorophenol
- Parachlorometa cresol
- Chloroform (trichloromethane)
- 2-Chlorophenol
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 3,3-Dichlorobenzidine
- 1,1-Dichloroethylene
- 1,2-Trans-dichloroethylene
- 2,4-Dichlorophenol
- 1,2-Dichloropropane
- 1,3-Dichloropropylene (1,3-dichloropropene)
- 2,4-Dimethylphenol
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- 1,2-Diphenylhydrazine
- Ethyl benzene
- Fluoranthene
- 4-Chlorophenyl phenyl ether
- 4-Bromophenyl phenyl ether
- Bis (2-chloroisopropyl) ether
- Bis (2-chloroethoxy) methane
- Methylene chloride (dichloromethane)
- Methyl chloride (chloromethane)
- Methyl bromide (bromomethane)
- Bromoform (tribromomethane)
- Dichlorobromomethane
- Chlorodibromomethane
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Isophorone
- Naphthalene
- Nitrobenzene
- 2-Nitrophenol
- 4-Nitrophenol
- 2,4-Dinitrophenol
- 4,6-Dinitro-o-cresol
- N-nitrosodimethylamine
- N-nitrosodiphenylamine
- N-nitrosodi-n-propylamine
- Pentachlorophenol
- Phenol
- Bis (2-ethylhexyl) phthalate
- Butyl Benzyl Phthalate
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Diethyl phthalate
- Dimethyl phthalate
- 1,2-Benzanthracene (benzo(a)anthracene)
- Benzo(a)pyrene (3,4-benzopyrene)
- 3,4-Benzofluoranthene (benzo(b)fluoranthene)
- 11,12-Benzofluoranthene (benzo(k)fluoranthene)
- Chrysene

- Acenaphthylene
- 1,12-Benzoperylene (benzo(ghi)perylene)
- Fluorene
- Phenanthrene
- 1,2,5,6-Dibenzanthracene (dibenzo(a,h)anthracene)
- Indeno(1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
- Pyrene
- Tetrachloroethylene
- Toluene
- Trichloroethylene
- Vinyl chloride (chloroethylene)
- Aldrin
- Dieldrin
- Chlordane (technical mixture and metabolites)
- 4,4-DDT
- 4,4-DDE (p,p-DDX)
- 4,4-DDD (p,p-TDE)
- Alpha-endosulfan
- Beta-endosulfan
- Endosulfan sulfate
- Endrin
- Endrin aldehyde
- Heptachlor
- Heptachlor epoxide (BHC-hexachlorocyclohexane)
- Alpha-BHC
- Beta-BHC
- Gamma-BHC
- Delta-BHC (PCB-polychlorinated biphenyls)
- PCB-1242 (Arochlor 1242)
- PCB-1254 (Arochlor 1254)
- PCB-1221 (Arochlor 1221)
- PCB-1232 (Arochlor 1232)
- PCB-1248 (Arochlor 1248)
- PCB-1260 (Arochlor 1260)
- PCB-1016 (Arochlor 1016)
- Toxaphene
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD).

EXHIBIT 36. Semiconductor Pretreatment Standards for Common Metals, Chemical Etching and Milling, Electroless Plating, and Electroplating Facilities Discharging Less Than 38,000 Liters Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
CN, A[1]	5.0	2.7
Pb	0.6	0.4
Cd	1.2	0.7
TTO	4.57	

[1] Cyanide amenable to chlorination.

EXHIBIT 37. Semiconductor Pretreatment Standards for Common Metals, Chemical Etching and Milling, Electroless Plating, and Electroplating Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
CN, T[1]	1.9	1.0
Cu	4.5	2.7
Ni	4.1	2.6
Cr	7.0	4.0
Zn	4.2	2.6
Pb	0.6	0.4
Cd	1.2	0.7
Total Metals	10.5	6.8
TSS	20.0	13.4
pH	(2)	(2)
TTO	2.13	

[1] Cyanide, total

(2) Within the range of 7.5 to 10.0.

Alternatively, the following mass-based standards are equivalent to and may be applied in place of those limitations specified in Exhibit 37 under prior agreement between a source subject to these standards and the publicly owned treatment works receiving such regulated wastes. These facilities must also comply with the total suspended solids, pH, and total toxic organics limits listed in Exhibit 37.

EXHIBIT 38. Semiconductor Pretreatment Standards for Common Metals, Chemical Etching and Milling, Electroless Plating, and Electroplating Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations (Mg/Square M-Operation)

Pollutant or Pollutant Property	Maximum for Any 1 Day	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed
CN, T	74	39
Cu	176	105
Ni	160	100
Cr	273	156
Zn	164	102
Pb	23	16
Cd	47	29
Total Metals	410	267

The provisions of Part 413, Subpart B (Exhibits 39 - 41), apply to electroplating of precious metals, or any dischargers of process wastewaters resulting from the process in which a ferrous or non-ferrous basis material is plated with gold, silver, iridium, palladium, platinum, rhodium, ruthenium, or any combination of these.

As used in this part, the definition of "total toxic organics" (TTO) is the same as it is for common metals, chemical etching and milling, electroless plating, and electroplating.

EXHIBIT 39. Semiconductor Pretreatment Standards for Precious Metals Electroplating Facilities Discharging Less Than 38,000 Liters Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
CN, A	5.0	2.7
Pb	0.6	0.4
Cd	1.2	0.7
TTO	4.57	

EXHIBIT 40. Semiconductor Pretreatment Standards for Precious Metals Electroplating Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Ag	1.2	0.7
CN, T	1.9	1.0
Cu	4.5	2.7
Ni	4.1	2.6
Cr	7.0	4.0
Zn	4.2	2.6
Pb	0.6	0.4
Cd	1.2	0.7
Total Metals	10.5	6.8
TSS	20.0	13.4
pH	(1)	(1)
TTO	2.13	

(1) Within the range of 7.5 to 10.0.

Alternatively, the following mass-based standards are equivalent to and may be applied in place of those limitations specified in Exhibit 40 under prior agreement between a source subject to these standards and the publicly owned treatment works receiving such regulated wastes. These facilities must also comply with the total suspended solids, pH, and total toxic organics limits listed in Exhibit 40.

EXHIBIT 41. Semiconductor Pretreatment Standards for Precious Metals Electroplating Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations (Mg/Square M-Operation)

Pollutant or Pollutant Property	Maximum for Any 1 Day	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed
Ag	47	29
CN, T	74	39
Cu	176	105
Ni	160	100
Cr	273	156
Zn	164	102
Pb	23	16
Cd	47	29
Total Metals	410	267

The provisions in Part 433, Subpart A (Exhibits 42 - 43), apply to plants that perform any of the following six metal finishing operations on any basis material: electroplating, electroless plating, anodizing, coating, chemical etching and milling, and printed wiring board manufacturing, except existing indirect discharging job shops and independent printed wiring board manufacturers that are covered by the pretreatment standards at 40 CFR Part 413. The term "total toxic organics" (TTO) is defined for this part in the effluent limitation guidelines (Section B.2.2.).

EXHIBIT 42. Semiconductor Pretreatment Standards for All Plants Except Job Shops and Independent Printed Wiring Board Manufacturers Pretreatment Standards for Existing Sources (PSES) Limitations (Metal Finishing)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.69	0.26
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	

EXHIBIT 43. Semiconductor Pretreatment Standards for New Sources (PSNS) Limitations (Metal Finishing)[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.11	0.07
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
TTO	2.13	

[1] Applies to facilities that commenced construction after July 15, 1983.

Printed Wiring Board Manufacturing

Part 413, Subpart H (Exhibits 44 - 46), applies to existing sources who manufacture printed wiring boards, including all manufacturing operations required or used to convert an insulating substrate to a finished printed wiring board. Existing sources are those who, since July 15, 1983, have not commenced construction of any building or facility which might result in a discharge. The term "total toxic organics" (TTO) for this part is defined in Section B.2.4, under semiconductor manufacturing.

EXHIBIT 44. Printed Wiring Board Pretreatment Standards for Facilities Discharging Less Than 38,000 Liters Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
CN, A	5.0	2.7
Pb	0.6	0.4
Cd	1.2	0.7
Total toxic organics	4.57	

EXHIBIT 45. Printed Wiring Board Pretreatment Standards for Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
CN, T	1.9	1.0
Cu	4.5	2.7
Ni	4.1	2.6
Cr	7.0	4.0
Zn	4.2	2.6
Pb	0.6	0.4
Cd	1.2	0.7
Total Metals	10.5	6.8
TSS	20.0	13.4
pH	(1)	(1)
Total toxic organics	2.13	

[1] Within the range 7.5 to 10.0.

Alternatively, the following mass-based standards are equivalent to and may be applied in place of those limitations specified in Exhibit 45 under prior agreement between a source subject to these standards and the publicly owned treatment works receiving such regulated wastes. These facilities must also comply with the total suspended solids, pH, and total toxic organics limits listed in Exhibit 45.

EXHIBIT 46. Printed Wiring Board Pretreatment Standards for Facilities Discharging 38,000 Liters or More Per Day Pretreatment Standards for Existing Sources (PSES) Limitations (Mg/Square M-Operation)

Pollutant or Pollutant Property	Maximum for 1 Day	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed
CN, T	169	89
Cu	401	241
Ni	365	229
Cr	623	357
Zn	374	232
Pb	53	36
Cd	107	65
Total Metals	935	609

The provisions in Part 433 (Exhibits 47 - 48) apply to plants that perform any of the following six metal finishing operations on any basis material: electroplating, electroless plating, anodizing, coating, chemical etching and milling, and printed wiring board manufacturing. These provisions do not apply to existing discharging job shops and independent printed wiring board manufacturers, who are subject only to Part 413 (discussed above).

Discharging job shops and independent printed wiring board manufacturers who commenced construction after July 15, 1983, however, must comply with the pretreatment standards for new sources listed below. The term "total toxic organics" (TTO) for this part is defined in Section B.2.2.

EXHIBIT 47. Printed Wiring Board Pretreatment Standards for All Plants Except Job Shops and Independent Printed Wiring Board Manufacturers Pretreatment Standards for Existing Sources (PSES) Limitations (Metal Finishing)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.69	0.26
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
CN (A)	0.86	0.32
TTO	2.13	

EXHIBIT 48. Printed Wiring Board Pretreatment Standards for New Sources (PSNS) Limitations (Metal Finishing)[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cd (T)	0.11	0.07
Cr (T)	2.77	1.71
Cu (T)	3.38	2.07
Pb (T)	0.69	0.43
Ni (T)	3.98	2.38
Ag (T)	0.43	0.24
Zn (T)	2.61	1.48
CN (T)	1.20	0.65
CN (A)	0.86	0.32
TTO	2.13	

[1] Applies to facilities that commenced construction after July 15, 1983.

Display Manufacturing

Part 469, Subpart C (Exhibits 49 - 50), applies to discharges resulting from the manufacture of cathode ray tubes. The term "total toxic organics" (TTO) for this part is defined in Section B.2.2.

EXHIBIT 49. Cathode Ray Tube Pretreatment Standards for Existing Sources (PSES) Limitations

Pollutant or Pollutant Property	Maximum for for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
TTO	1.58	
Cd	0.06	0.03
Cr	0.65	0.30
Pb	1.12	0.41
Zn	1.38	0.5
F	35.0	18.0

EXHIBIT 50. Cathode Ray Tube Pretreatment Standards for New Sources (PSNS) Limitations[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
TTO	1.58	
Cd	0.06	0.03
Cr	0.56	0.26
Pb	0.72	0.27
Zn	0.80	0.33
F	35.0	18.0

[1] Applies to facilities that commenced construction after December 14, 1983.

Part 469, Subpart D (Exhibit 51), applies to the discharges resulting from the manufacture of luminescent materials.

EXHIBIT 51. Luminescent Materials Pretreatment Standards for New Sources (PSNS) Limitations[1]

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Cadmium	0.55	0.26
Antimony	0.10	0.04
Zinc	1.64	0.67
Fluoride	35.0	18.0

[1] Applies to facilities that commenced construction after December 14, 1983.

B.2.4.2 General EPA Pretreatment Standards (40 CFR 403)

In addition to the "categorical" standards applicable to the semiconductor and printed wiring board industries, general pretreatment standards apply to all facilities. These general pretreatment standards prohibit the following from being introduced into a POTW:

(1) Pollutants that create a fire hazard in the POTW including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using specified test methods;

(2) Pollutants that will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges;

(3) Solid or viscous pollutants in amounts that will cause obstruction to the flow in the POTW, resulting in interference;

(4) Any pollutant, including oxygen demanding pollutants (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration that will cause interference with the POTW;

(5) Heat in amounts that will inhibit biological activity in the POTW, resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40 degrees Centigrade, unless the approval authority, upon request of the POTW, approves alternate temperature limits;

(6) Petroleum oil, non-biodegradable cutting oil, or products of mineral oil in amounts that will cause interference or pass through;

(7) Pollutants that result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

(8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.

When a POTW uses physical, chemical, or biological means to reduce the amount of a pollutant during treatment, industrial users may be granted removal credits to reflect the level of treatment achieved by the POTW. Removal credits enable the user to revise his/her discharge limits, which may, in turn, help to ensure that indirect dischargers do not expend resources unnecessarily to treat their own effluents to levels below the removal level achievable by the POTW.

A single discharger may find it advantageous to combine wastestreams prior to treatment, which often results in more cost-effective treatment. In Section 403.6(e), EPA provides a "combined wastestream formula" that incorporates flow, mass, and concentration to establish effluent limits.

B.2.5 Storm Water Permits (40 CFR 122.26)

Storm water permits are required for facilities where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water which drains to a municipal separate storm sewer system or directly to a receiving water. (Storm water permits are not required where the runoff flows through a combined sewer to a POTW and is treated prior to discharge.) Storm water permit applications must include a site map showing the topography of the facility, including: drainage and discharge structures; the drainage area of each storm water outfall; paved areas and buildings within each drainage area; areas used for outdoor storage or disposal; each existing structural

control measure to reduce pollutants in storm water runoff; materials loading and access areas; areas where pesticides, herbicides, soil conditioners, and fertilizers are applied; each of the facility's hazardous waste treatment, storage, or disposal facilities; each well where fluids from the facility are injected underground; and springs and other surface water bodies that receive storm water discharges. An estimation of the area of impervious surfaces, the total area drained by each outfall, and a description of the storage, handling, and disposal of "significant" materials in the three years prior to the submittal of the application must also be documented. A certification that all outfalls have been tested or evaluated for the presence of non-storm water discharges that are not covered by a NPDES permit must be made, and this certification must include a description of the method used, dates, and the observed on-site drainage points.

Quantitative data based on samples collected during storm events from all outfalls for the following must be documented:

(1) Any pollutant limited in an effluent guideline to which the facility is subject;

(2) Any pollutant listed in the facility's NPDES permit;

(3) Oil, grease, pH, BOD5, COD, TSS, total phosphorus, total Kjeldahl nitrogen, and nitrate plus nitrite nitrogen;

(4) Flow measurements or estimates of the flow rate, and the total amount of discharge for the storm event(s) sampled and the method of the measurement; and

(5) The date and duration of the storm event(s) sampled and rainfall measurements and the duration between the storm event sampled and the end of the previous measurable storm event.

B.3 UNDERGROUND INJECTION CONTROL PROGRAM

All States, U.S. Territories, and Indian Tribes have EPA-approved Underground Injection Control (UIC) programs to prevent the subsurface emplacement of fluids through wells (injection wells) from endangering underground sources of drinking water (USDW). EPA and State programs: (1) impose minimum UIC standards for the siting, construction, operation, monitoring and closure of injection wells; (2) authorize injection by permit or by rule; incorporate hazardous waste requirements under the Resource Conservation and Recovery Act; and (3) forbid the disposal of hazardous and radioactive wastewater into or above a USDW where the waste may endanger a USDW (Class IV injection category).

UIC programs apply to owners and operators of deep wells, into which trillions of gallons of hazardous and nonhazardous fluids associated with manufacturing processes and municipal wastewater disposal (Class I), oil and gas production (Class II), and solution mining (Class III) are injected annually. UIC programs also apply to owners and operators of shallow wells, which are designed to release fluids either directly into USDW or into the shallow subsurface that overlies USDW (Class V). Class V injection wells are generally shallow wastewater disposal wells, stormwater and agricultural drainage systems, or other devices that are used to release fluids either directly into USDW or into the shallow subsurface that overlies USDW.

State and EPA UIC program directors require that the operation of any UIC well does not endanger an underground source of drinking water. If a drinking water supply is threatened, the owner or operator of the well

must stop the injection practice, close the drainage system, and eventually, may face fines and expensive ground water clean-up costs.

EPA's goal is to manage Class V wells so that the highest risk wells get addressed first in the most sensitive areas. Rather than impose a one-size-fits-all set of federal UIC program requirements on businesses, EPA is working with its State partners to design management tools, including: regulations, program implementation guidance, technical guidance, outreach and education, and a Compliance Assurance Initiative.

RCRA-Related Requirements

Section C. RCRA-RELATED REQUIREMENTS

Law: Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976 (as amended in 1984) may have a direct regulatory impact on the electronics industry in three ways. First, RCRA sets up a cradle-to-grave system for tracking and regulating hazardous wastes. This system affects most segments of the electronics industry. Second, Subtitle I of RCRA sets up a system for regulating underground storage tanks (USTs) containing petroleum or other hazardous substances (other than hazardous wastes). A facility in the electronics industry would be affected by regulations issued under Subtitle I only if it owns an underground storage tank containing petroleum or hazardous substances. Third, Subtitle D of RCRA sets up a framework for regulating solid wastes that are not classified as hazardous wastes. In general, the impacts of Subtitle D on the industry are indirect, that is, they arise as a result of the industry's use of solid waste disposal facilities, including municipal solid waste disposal facilities. (Subtitle D requirements are not discussed further in this report because they will not directly impact most electronics industry facilities.)

EPA has issued regulations, found in 40 CFR Parts 260-299, which implement Subtitles C and I. These regulations are Federal requirements. Many RCRA requirements will be implemented through RCRA-authorized State laws, which may be more stringent than Federal requirements. There are also non-RCRA State laws that set out UST and hazardous waste management requirements. A facility should always check with the State when analyzing which requirements apply to their activities.

The Federal hazardous waste regulations are summarized in the 1990 edition of the RCRA Orientation Manual (#055-000-00364-5), copies of which are available from the Superintendent of Documents at the Government Printing Office (202-512-0000) for $16.00 (although for up-to-date information, the current regulations should be consulted).

C.1 HAZARDOUS WASTE MANAGEMENT

The major factors that determine whether and to what extent RCRA requirements apply to a facility that generates hazardous waste are the types and kinds of hazardous wastes being produced, the volume of hazardous waste produced per month, and the length of time the hazardous waste remains on site. This section discusses (1) how to determine if particular wastes are hazardous; (2) which requirements apply to the generators of hazardous waste; and (3) what the facility's status is if a waste is determined to be hazardous. (Requirements applicable to facilities that treat or dispose of hazardous waste, or engage in long-term storage of hazardous waste on-site are not addressed here; however, Appendix I of 40 CFR 260 contains a valuable flow chart for determining what RCRA regulations may apply in given situations.)

C.1.1 Waste Classification

Part 261 of 40 CFR addresses the identification and listing of hazardous wastes. The generator has the responsibility for determining whether a waste is hazardous and what classification, if any, applies to the waste. The generator must examine the regulations and undertake any tests necessary to determine if the wastes generated are hazardous. In some cases, waste generators may use their own knowledge and familiarity with the waste to determine whether it is hazardous. (Generators may be subject to enforcement penalties for improperly determining that a waste is not hazardous.) Wastes can be classified as hazardous either because they are listed by EPA through regulations that appear in the CFR or because they exhibit certain characteristics. Listed hazardous wastes are specifically named, for example, discarded commercial toluene, spent non-halogenated solvents, and spent cyanide plating bath solutions from electroplating operations. Characteristic hazardous wastes are solid wastes that "fail" a characteristic test, such as the RCRA test for ignitability.

C.1.1.1 Listed Wastes

There are four separate lists of hazardous wastes in 40 CFR 261. Part 261.31 lists wastes from non-specific sources and includes wastes generated by industrial processes that may occur in several different industries; the codes for such wastes always begin with the letter "F." F001, F002, F003, and F004, which designate various types of spent solvent wastes, are examples of wastes from non-specific sources that may be generated by facilities in the electronics industry. The second category of listed wastes (40 CFR 261.32) includes hazardous wastes from specific sources; these wastes have codes that begin with the letter "K." Unless a facility engages in the production of chemicals on site, it is unlikely that any electronics manufacturing facility would have wastes falling into this category. The remaining lists (40 CFR 261.33) cover commercial chemical products that have been or are intended to be discarded; waste codes beginning with "P" are considered acutely hazardous, while those beginning with "U" are simply considered hazardous. Exhibits 52 - 55 show listed wastes that are commonly used in semi-conductor manufacturing, semiconductor packaging, printed wiring board manufacturing, and display manufacturing. (While these exhibits are intended to be as comprehensive as possible, individual facilities may generate other hazardous wastes and may wish to consult 40 CFR 261.31 - 261.33.)

In addition, most wastes that are (1) derived from a listed hazardous waste, or (2) are a mixture of a listed hazardous and non-hazardous waste are considered hazardous wastes. Environmental media (such as soil or ground water) that contain a listed hazardous waste may also be considered hazardous.

C.1.1.2 Characteristic Wastes

EPA also considers a waste hazardous if it exhibits one or more of four characteristics. Three characteristics are determined by tests of the properties of the waste; these characteristics (and the section of the CFR defining the tests and applicable waste codes) are:

- Ignitability (40 CFR 261.21, D001);
- Corrosivity (40 CFR 261.22, D002); and

- Reactivity (40 CFR 261.23, D003).

Several waste streams in the electronics industry may be characterized as hazardous because they exhibit one or more of these characteristics. For example, one of the definitions of corrosivity is any aqueous "solid" waste with a pH of less than or equal to 2 or more than or equal to 12.5. Examples from the printed wiring board industry include the ammoniacal etchant used in the strip/etch process, which is characterized as "corrosive" and falls within the D002 designation, and the waste oil product generated by all PWB manufacturers that must be manifested and managed as a D001 waste if it is destined for disposal.

EXHIBIT 52. Some Examples of Listed Wastes Found in Semiconductor Manufacturing

Waste Code	Name or Description of Waste
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/ blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
P012	Arsenic trioxide
P056	Fluorine
P096	Phosphine
P098	Potassium cyanide
U002	Acetone
U112	Ethyl acetate
U113	Ethyl acrylate
U134	Hydrofluoric acid
U154	Methanol
U161	Methyl isobutyl ketone
U211	Carbon tetrachloride
U226	1,1,1-Trichloroethane
U228	Trichloroethylene
U239	Xylene
U359	Ethylene glycol monomethyl ether

EXHIBIT 53. Some Examples of Listed Wastes Found in Semiconductor Packaging

Waste Code	Name or Description of Waste
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
P098	Potassium cyanide
P099	Potassium silver cyanide
U002	Acetone
U080	Methylene chloride
U104	Silver cyanide
U112	Ethyl acetate
U134	Hydrofluoric acid
U154	Methanol
U161	Methyl isobutyl ketone
U226	1,1,1 Trichloroethane
U239	Xylene
U359	Ethylene glycol monomethyl ether

EXHIBIT 54. Some Examples of Listed Wastes Found in Printed Wiring Board Manufacturing

Waste Code	Name or Description of Waste
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations.
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.
P098	Potassium cyanide
U002	Acetone
U080	Methylene chloride
U122	Formaldehyde
U134	Hydrofluoric acid
U226	1,1,1 Trichloroethane
U359	Ethylene glycol monomethyl ether

EXHIBIT 55. Some Examples of Listed Wastes Found in Display Manufacturing

Waste Code	Name or Description of Waste
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
U228	Trichloroethylene

The fourth characteristic is toxicity. The toxicity characteristic applies to a list of 40 substances, including metals, non-metals, pesticides, and other organic chemicals. If a waste leachate (derived from putting the waste through a test called the Toxicity Characteristic Leaching Procedure, or TCLP) contains any one of these 40 constituents at levels above the level of regulatory concern, the waste is considered a hazardous waste. Exhibits 56 - 59 list some of the toxicity characteristic substances that are likely to be constituents of electronics-industry wastes. Individual facilities may generate waste containing other constituents that exhibit the toxicity characteristic.

EXHIBIT 56. EPA Toxic Characteristic Contaminants That May be Found in Semiconductor Manufacturing Waste

Waste Code	Contaminant
D004	Arsenic
D007	Chromium
D011	Silver
D019	Carbon tetrachloride
D040	Trichloroethylene

EXHIBIT 57. EPA Toxic Characteristic Contaminants That May be Found in Semiconductor Packaging Waste

Waste Code	Contaminant
D008	Lead
D011	Silver

EXHIBIT 58. EPA Toxic Characteristic Contaminants That May be Found in Printed Wiring Board Manufacturing Waste

Waste Code	Contaminant
D008	Lead

EXHIBIT 59. EPA Toxic Characteristic Contaminants That May be Found in Display Manufacturing Waste

Waste Code	Contaminant
D040	Trichloroethylene

C.1.2 Categories of Hazardous Waste Generators

C.1.2.1 Distinction Between Large and Small Quantity Generators

The application of some RCRA requirements is dependent on whether a hazardous waste generator is classified as a large or small quantity or conditionally exempt generator. Small quantity generators are generators who produce more than 100 but less than 1,000 kilograms of hazardous waste at a site per month (and accumulate less than 6,000 kilograms at any one time). All generators who do not meet these requirements or those for conditionally exempt small quantity generators are classified as large quantity generators. (40 CFR 261.5(d) provides guidance concerning how to measure the quantity of hazardous waste generated and stored.)

C.1.2.2 Conditionally Exempt Hazardous Waste Generators

Only a few hazardous waste regulations apply to firms that qualify as "conditionally exempt small quantity generators." A facility qualifies for this category if it:

- Generates less than 100 kg per month of hazardous waste;
- Generates less than 1 kilogram per month of acutely hazardous waste (for special limitations that apply to materials contaminated by a spill of acutely hazardous waste, see 40 CFR 261.5(e)(2)); and
- Never has more than 1,000 kilograms of accumulated hazardous waste or 1 kilogram of acutely hazardous waste on site at any one time (see 40 CFR 261.5(f)(2)).

C.1.2.3 Determination of When a Generator Becomes a Treatment, Storage, or Disposal Facility

Any generator (except some conditionally exempt small quantity generators (see 40 CFR 261.5(g)), no matter what monthly waste output, who disposes of waste on-site is classified as a treatment, storage, or disposal facility (TSDF). A small quantity generator who stores waste on-site for more than 180 days (without seeking an extension) is also classified as a hazardous waste storage facility, as is any large generator who stores waste on-site for more than 90 days (without seeking an extension). Extensions are granted only under very limited circumstances. Every hazardous waste TSDF must comply with 40 CFR 264 through 267 and 40 CFR 270, including requirements to apply for a permit and meet certain technical and financial responsibility requirements.

C.1.3 Requirements that Apply to Conditionally Exempt Hazardous Waste Generators

Conditionally exempt small quantity generators need meet only the following requirements:

- They must evaluate the waste to determine whether it is a hazardous waste;
- They may not accumulate more than 1,000 kilograms of hazardous waste or 1 kilogram of acutely hazardous waste at any time; and
- They must treat or dispose of the waste on site or ensure delivery to a:
  - Permitted or interim status treatment, storage, or disposal facility (TSDF), or
  - State approved municipal or industrial solid waste facility, or
  - Legitimate recycling facility.

C.1.4 Requirements for All Generators Other Than Conditionally Exempt Small Quantity Generators

Hazardous waste generators that do not meet the conditions for conditionally exempt small quantity generators must (among other requirements such as record keeping and reporting):

- Obtain a generator identification number;
- Store and ship hazardous waste in suitable containers or tanks (for storage only);
- Manifest the waste properly;
- Maintain copies of the manifest (a shipment log covering all hazardous waste shipments) and test records;
- Comply with applicable land disposal restriction requirements; and
- Report releases or threats of releases of hazardous waste.

These requirements are discussed below.

C.1.4.1 Waste Containers

Both large and small quantity generators must ensure that hazardous wastes to be shipped off-site are kept in areas that meet basic safety requirements. The wastes must be properly stored to prevent leaks and must be labeled as hazardous waste. Specific requirements include:

(1) 40 CFR Part 262.34 requires that containers maintained on-site be labeled with the words "HAZARDOUS WASTE."

(2) 40 CFR Parts 262.31 and 262.32 require that containers be labeled with the name of the waste and that labels and placards be used in accordance with applicable EPA (40 CFR 262.32 and 262.33) and Department of Transportation (49 CFR Part 172 Subpart F) requirements.

(3) 40 CFR Part 262.34 requires that the date on which accumulation begins be shown on the container.

(4) 40 CFR 265 Subpart I requires that, except when adding or removing waste, hazardous waste be stored in a closed container that is in good condition, be inspected at least weekly (40 CFR 265.174), and be compatible with the waste to be stored. This subpart also explains special requirements for ignitable (40 CFR 265.176) and incompatible wastes (40 CFR 265.177).

Wastes stored in tanks or tank systems and waste generators that use drip pads are subject to more extensive requirements (see 40 CFR 265 Subparts J and W, respectively).

C.1.4.2 Hazardous Waste Shipments

Hazardous wastes being shipped off-site must go to a RCRA-permitted facility. Large and small quantity generators must complete a Uniform Hazardous Waste Manifest (40 CFR Part 262.20), which can usually be obtained from State environmental agencies. (Small quantity generators who have a contractual agreement with a reclaimer that specifies the waste types and frequency of shipments and states that the reclaimer provides the vehicle used to transport the waste do not need to manifest these wastes if they maintain a copy of the agreement in their files. See 40 CFR 262.20 for details.) The manifest must have enough copies to provide the generator,

each transporter, and the owner or operator of the designated facility with one copy each for their records, and another copy to be returned to the generator by the owner or operator of the facility. Many states also require a copy of the manifest.

C.1.4.3 Document Retention Period

Large and small quantity generators must maintain copies of each manifest, exception report (described below in section C.1.5.3), test result, and waste analysis, for at least three years (40 CFR Part 262.40). Large quantity generators must maintain copies of their biennial report for the same period of time. This time period is automatically extended during the course of an unresolved EPA enforcement action regarding the regulated activity, or as requested by the Administrator.

The generator must keep a copy of each land disposal restriction notification form for at least 5 years (40 CFR Part 268.7).

C.1.4.4 Land Disposal Restriction Notification

Hazardous wastes must be treated in accordance with EPA treatment standards (40 CFR 268) before being land disposed. 40 CFR Part 268.7 requires that a written land disposal restriction notification be transmitted to the destination facility with each shipment of hazardous waste.

(1) The notification must be signed by the generator and must include the following:

- EPA hazardous waste number (e.g., F002);
- The corresponding treatment standard(s) (see 40 CFR 268.7(a)(1)(ii) for details);
- The manifest number associated with the shipment of waste; and
- Waste analysis data, where available.

(2) A copy of the written notification and certification statement must be filed with the associated manifest copies.

Most electronics industry hazardous wastes are covered by the land disposal restrictions. For example, spent solvents that are hazardous wastes are banned from land disposal unless treated to appropriate levels. Many other wastes also must be treated prior to land disposal. For example, glass cullet from the manufacture of cathode ray tubes (CRTs) usually qualifies as hazardous debris because it commonly fails the toxicity characteristic for lead. After May 8, 1994, such wastes will have to be treated to remove their lead or must undergo either micro- or macro-encapsulation prior to land disposal; any treatment capacity available before that date will have to be utilized.

C.1.4.5 Release or Threat of Release Reporting (40 CFR Part 262.34)

In case of fire, explosion, or other release of hazardous material to the environment, the generator must immediately contact the National Response Center at 800-424-8802 and be prepared to supply the following information:

- Generator name, address, and EPA Identification Number;
- Date, time, and type of incident;
- Quantity and type of hazardous waste(s) involved;
- Extent of injuries, if any;
- Estimated quantity and disposition of recovered material, if any; and
- For large quantity generators, an assessment of the actual or potential hazards to human health and the environment.

C.1.5 Requirements That Apply to All Hazardous Waste Generators But Vary In Accordance With the Volume of Waste Generated

This section discusses requirements that vary according to whether a generator is classified as a small or large quantity generator.

C.1.5.1 Biennial Reporting (40 CFR Part 262.41)

Large quantity generators must submit a biennial report of their hazardous waste generation and management activity by March 1 of every even-numbered year. In the report, the generator must identify each waste transporter and each TSDF used throughout the year. The generator also must describe the hazardous waste generated and shipped, efforts made to reduce the volume and toxicity of the waste, and changes made in the volume and toxicity of the waste compared with those achieved in previous years. For generators who treat, store, or dispose of wastes on-site, additional reporting is required on methods of treatment, storage, or disposal (because they are TSDFs).

C.1.5.2 Training, Preparedness, and Emergency Procedures (40 CFR Part 262.34(a)(4), (d)(5)(iii))

These sections, respectively, apply only to large or small quantity generators who store on-site for up to 90/180/220 days. The requirements in these sections state that, among other things, personnel must be familiar with emergency procedures to be followed in the event of spills, fires, or other releases of hazardous waste. Large quantity generators must establish an appropriate hazardous waste handling training program for their employees. Small quantity generators must ensure that employees handling hazardous wastes are thoroughly familiar with proper waste handling procedures and that there is always a person on call or at the premises with responsibility for coordinating all response measures in the event of an emergency. Large quantity generators also must prepare for each facility a contingency plan designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned release of hazardous waste or hazardous waste constituents.

C.1.5.3 Exception Reporting (40 CFR 262.42)

If a signed manifest copy has not been received from the designated facility within 35 days of shipment, large quantity generators must contact the transporter and/or the designated facility to determine the status of the hazardous waste. If the manifest copy has still not been received after 45 days, an exception report must be submitted to EPA. (Exception reports are sent to the Regional Administrator of the appropriate EPA Regional Office.) This exception report must include:

- A legible copy of the manifest, and
- A cover letter signed by the generator explaining efforts taken to locate the waste and the results of those efforts.

Small quantity generators must submit a legible copy of the manifest with an indication that the generator has not yet received confirmation of delivery to the appropriate Regional Administrator if they do not receive a signed copy of the manifest within 60 days of shipment. (States may impose more stringent requirements for exception reporting.)

C.2 UNDERGROUND STORAGE TANK MANAGEMENT

Subtitle I of the Resource Conservation and Recovery Act (as amended) establishes a program to prevent and clean up leaks from underground storage tanks. Subtitle I covers underground storage tanks containing petroleum products and hazardous substances as defined by Superfund,[7] except for hazardous waste storage tanks, which are regulated under Subtitle C of RCRA. A storage tank is defined as underground if 10 percent or more of the volume, including the volume of underground pipes, is beneath the surface of the ground. Thus, a tank that is 90 percent aboveground is classified as an underground storage tank. Some types of underground storage tanks are not covered by Subtitle I. For example, in the electronics industry, the following Subtitle I exceptions may be important: underground storage tanks storing heating oil used on the premises, septic tanks and other tanks for collecting waste water and storm water, flow-through process tanks, and emergency spill tanks that are emptied immediately after use.

If a facility in the electronics industry owns or operates an underground storage tank that is not covered by any of the allowed exemptions, the facility must comply with the requirements set forth in 40 CFR 280 or, if the facility is located in a State authorized to carry out the Underground Storage Tank program, with the requirements of the approved State program. These generally include requirements for:

- Design, construction, installation, and notification;
- General operations;
- Release detection;
- Release reporting, investigation, and confirmation;
- Release response and corrective action;
- Closure of underground storage tanks; and
- Financial assurance (for petroleum underground storage tanks).

---

[7] See the next section for a partial listing of hazardous substances covered by Superfund.

SUPERFUND

AND COMMUNITY RIGHT-TO-KNOW

REQUIREMENTS

Section D. SUPERFUND AND COMMUNITY RIGHT-TO-KNOW REQUIREMENTS

Law: Comprehensive Environmental Response, Compensation, and Liability Act and Emergency Planning and Community Right-to-Know Act

This section describes the reporting requirements established by the Comprehensive Environmental Response, Compensation, and Liability Act (also known as CERCLA, or more commonly as Superfund) and the Emergency Planning and Community Right-to-Know Act. CERCLA, the Act that created the Superfund and set up a variety of mechanisms to address risks to public health, welfare, and the environment caused by hazardous substance releases, was enacted in 1980 and, among other amendments, was amended in 1986 by Title I of the Superfund Amendments and Reauthorization Act (SARA). Title III of SARA is the Emergency Planning and Community Right-to-Know Act (EPCRA), which created an emergency planning framework and established the right of local governments and members of the public to obtain information on the hazards posed by potential toxic substance releases. For example, under EPCRA Section 313, certain manufacturers, processors, and users of over 600 designated toxic chemicals must report to EPA and designated state agencies annually on emissions of those chemicals to the air, water, and land. Also, emergency planning requirements are included under EPCRA Sections 301-303, emergency release notification is required under Section 304, and community right-to-know reporting requirements are contained in Sections 311 and 312. This chapter does not address Superfund liability rules, but focuses instead on regulatory reporting requirements.

The relevant statutory and regulatory reporting requirements derived from these acts mandate the reporting of: (1) releases of CERCLA hazardous substances to the National Response Center (Section 102 and 40 CFR 302); (2) the presence of certain amounts of extremely hazardous and hazardous substances at a facility (40 CFR 355 and 370); (3) the emergency release of certain extremely hazardous and hazardous substances (40 CFR 355); and (4) other toxic chemical releases (40 CFR 372). Although these reporting requirements often use similar phrases, for example, "reportable quantity" and "threshold planning quantity," these terms may have different definitions or may apply differently under various requirements.

D.1 REPORTING OF RELEASES TO THE NATIONAL RESPONSE CENTER

Most substances deemed hazardous by CERCLA are listed in 40 CFR 302.4 (some are listed directly in Section 101(14) of the statute). Based on criteria that relate to the possibility of harm associated with the release of each substance, EPA by regulation has assigned a substance-specific reportable quantity (RQ) to most hazardous substances; RQs are either 1, 10, 100, 1000, or 5000 pounds (except for radionuclides). If EPA has not assigned a regulatory RQ to a hazardous substance, its statutory default RQ is 1 pound. Exhibits 60 - 63 list RQs for some of the chemicals used in semiconductor manufacturing, semiconductor packaging, printed wiring board manufacturing, and display manufacturing. Any person in charge of a facility (or a vessel) must immediately notify the National Response Center as soon as a person has knowledge of a release (within a 24-hour period) of an amount of a hazardous substance that is equal to or greater than its RQ. There are some exceptions to this requirement, including exceptions for certain continuous releases and for Federally permitted releases.

EXHIBIT 60. Reportable Quantities for Some Chemicals Used in Semiconductor Manufacturing

Chemical	Reportable Quantity (Lbs)
Acetic acid	5,000
Acetone	5,000
Ammonia	100
Ammonium hydroxide	1,000
Ammonium fluoride	100
Antimony	5,000
Antimony trioxide	1,000
Antimony trichloride	1,000
Arsenic trioxide	1
Arsenic	1[8]
n-Butyl acetate	5,000
Carbon tetrachloride	10
Chlorine	10
Chrome	5,000
Chromic acid	10
Chromium	5,000
Copper	5,000
Ethyl acetate	5,000
Ethyl acrylate	1,000
Ethyl benzene	1,000
Ethylene glycol monomethyl ether	1,000
Ethylenediamine	5,000
Ferric nitrate	1,000
Ferric chloride	1,000
Hydrochloric acid	5,000
Hydrofluoric acid	100
Hydrogen chloride	5,000
Isoprene	100
Methanol	5,000
Methyl isobutyl ketone	5,000
Nickel	100
Nitric acid	1,000
Phosphine	100
Phosphoric acid	5,000
Phosphorus oxychloride	1,000
Phosphorus trichloride	1,000
Potassium hydroxide	1,000
Potassium cyanide	10
Silver	1,000
Sodium hydroxide	1,000
Sulfuric acid	1,000
1,1,1-Trichloroethane	1,000
Trichloroethylene	100
Xylene	1,000

[8] Quantity may be subject to change when EPA completes its assessment of the potential carcinogenicity of this substance.

EXHIBIT 61. Reportable Quantities for Some Chemicals Used in Semiconductor Packaging

Chemical	Reportable Quantity (Lbs)
Acetone	5,000
Ammonium hydroxide	1,000
Antimony trioxide	1,000
n-butyl acetate	5,000
Chlorine	10
Chromic acid	10
Chromium	5,000
Copper	5,000
Cupric chloride	10
Cupric nitrate	100
Ethyl acetate	5,000
Ethyl benzene	1,000
Ferric chloride	1,000
Hydrochloric acid	5,000
Hydrofluoric acid	100
Lead	1[9]
Methanol	5,000
Methylene chloride	1,000
Nickel	100
Nickel chloride	100
Nickel sulfate	100
Nitric acid	1,000
Potassium cyanide	10
Potassium hydroxide	1,000
Potassium silver cyanide	1
Silver	1,000
Silver cyanide	1
Sodium hydroxide	1,000
Sulfuric acid	1,000
Toluene	1,000
1,1,1 Trichloroethane	1,000
Xylene	1,000

[9] Quantity may be subject to change when EPA completes its assessment of the potential carcinogenicity of this substance.

EXHIBIT 62. Reportable Quantities for Some Chemicals Used in Printed Wiring Board Manufacturing

Chemical	Reportable Quantity (Lbs)
Acetone	5,000
Ammonia	100
Ammonium hydroxide	1,000
Ammonium chloride	5,000
Ammonium bifluoride	100
Chlorine	10
Chromic acid	10
Copper	5,000
Cupric chloride	10
Cupric nitrate	100
Cupric sulfate	10
Formaldehyde	100
Hydrochloric acid	5,000
Hydrofluoric acid	100
Lead	1[10]
Methylene chloride	1,000
Nickel	100
Nickel chloride	100
Nitric acid	1,000
Perchloroethylene	100
Potassium hydroxide	1,000
Potassium permanganate	100
Sodium hydroxide	1,000
Sulfuric acid	1,000
1,1,1-Trichloroethane	1,000

EXHIBIT 63. Reportable Quantities for Some Chemicals Used in Display Manufacturing

Chemical	Reportable Quantity (Lbs)
Nitric acid	1,000
Trichloroethylene	100

D.2 EMERGENCY PLANNING AND NOTIFICATION FOR EXTREMELY HAZARDOUS SUBSTANCES

Any facility that has an extremely hazardous substance, as defined by the Emergency Planning and Community Right-to-Know Act (EPCRA), at or above threshold planning quantities needs to notify, for the purposes of emergency response planning, the State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC). Any facility producing, using, or storing a hazardous chemical, as

[10] Quantity may be subject to change when EPA completes its assessment of the potential carcinogenicity and/or chronic toxicity of this substance.

defined by Occupational Safety and Health Administration (29 CFR 1910.1200(c)), that releases a reportable quantity of an EPCRA extremely hazardous substance or a Superfund hazardous substance must immediately notify the LEPC and the SERC. (See 40 CFR 355 for further details concerning these reporting requirements.) Exhibits 64 - 67 show the threshold planning quantities and reportable quantities for some EPCRA-designated extremely hazardous chemicals used to manufacture semiconductors, semiconductor packaging, printed wiring boards, and displays.

EXHIBIT 64. Threshold Planning and Reporting Quantities for Some EPCRA-Designated Extremely Hazardous Chemicals Used By the Semiconductor Industry

Chemical Name	Threshold Planning Quantity (Lbs.)	Reportable Quantity (Lbs.)
Ammonia	500	100
Arsine	100	1
Boron trichloride	500	1
Boron trichloride	500	1
Chlorine	100	10
Diborane	100	1
Ethylenediamine	10,000	5,000
Fluorine	500	10
Hydrogen peroxide	1,000	1
Hydrogen chloride	500	5,000
Hydrofluoric acid	100	100
Nitric acid	1,000	1,000
Phosphine	500	100
Phosphorus pentoxide	10	1
Phosphorus trichloride	1,000	1,000
Phosphorus oxychloride	500	1,000
Phosphorus	100	1
Potassium cyanide	100	10
Silanes	1,000	1
Sulfuric acid	1,000	1,000

EXHIBIT 65. Threshold Planning and Reporting Quantities for Some EPCRA-Designated Extremely Hazardous Chemicals Used By the Semiconductor Packaging Industry

Chemical Name	Threshold Planning Quantity (Lbs.)	Reportable Quantity (Lbs.)
Chlorine	100	10
Hydrogen peroxide	1,000	1
Hydrochloric acid	500	5000
Hydrofluoric acid	100	100
Nitric acid	1,000	1,000
Potassium silver cyanide	500	1
Potassium cyanide	100	10
Sulfuric acid	1,000	1,000

EXHIBIT 66. Threshold Planning and Reporting Quantities for Some EPCRA-Designated Extremely Hazardous Chemicals Used by the Printed Wiring Board Industry

Chemical Name	Threshold Planning Quantity (Lbs.)	Reportable Quantity (Lbs.)
Ammonia	500	100
Chlorine	100	10
Formaldehyde	500	100
Hydrochloric acid	500	5000
Hydrofluoric acid	100	100
Hydrogen peroxide (conc. > 52%)	1,000	1
Nitric acid	1,000	1,000
Sulfuric acid	1,000	1,000

EXHIBIT 67. Threshold Planning and Reporting Quantities for Some EPCRA-Designated Extremely Hazardous Chemicals Used by the Display Manufacturing Industry

Chemical Name	Threshold Planning Quantity (Lbs.)	Reportable Quantity (Lbs.)
Hydrogen peroxide (conc. > 52%)	1,000	1
Nitric acid	1,000	1,000

D.3 REPORTING OF PRESENCE, STORAGE, OR USE OF HAZARDOUS CHEMICALS

Any facility that is required by OSHA's Hazard Communication Standard (29 CFR 1910.1200) to have a Material Safety Data Sheet (MSDS) for an OSHA hazardous chemical, and that has such a chemical above a certain minimum threshold level, must provide a copy of the MSDS for the substance (or a list of such substances) to the State Emergency Response Commission (SERC), the Local Emergency Planning Committee (LEPC), and the local fire department. In addition, facilities must annually submit to the SERC, the LEPC, and the fire department a Tier I report indicating the aggregate amount of chemicals (above threshold quantities) at their facilities, classified by hazard category. If any agency that receives a Tier I report requests a Tier II report requiring additional information, facilities must submit this second report to the agency within 30 days of receiving a request for such a report. Many states require Tier II reports and waive the requirement to submit Tier I reports. Tier II reports include an inventory of all chemicals at the facility. Tier II reports may be (and generally are) submitted in lieu of Tier I reports. Virtually all of the chemicals used in the electronics industry are subject to these MSDS and Tier reporting requirements (40 CFR 370).

D.4 REPORTING REQUIREMENTS FOR RELEASES OF TOXIC SUBSTANCES

A facility in the electronics industry in SIC Codes 20-39 that has 10 or more full-time employees and that manufactures, processes, or otherwise uses more than 10,000 pounds per year of any toxic chemical listed in 40 CFR 372.65 must file a toxic chemical release inventory (TRI) reporting form (EPA Form R) covering releases of these toxic chemicals (including those releases specifically allowed by EPA or State permits) with EPA and the State agency where the facility is located. In 1994, EPA established an alternate threshold for facilities with low annual reportable amounts of a listed toxic chemical. If a facility meets the TRI reporting thresholds for a particular chemical but estimates that the total annual reportable amount of the chemical released or transferred off-site for treatment and/or disposal does not exceed 500 pounds per year, it may use the alternate threshold of manufacturing, processing, or otherwise using 1 million pounds per year, for that chemical, provided certain conditions are met (59 *Federal Register* 61488; November 30, 1994). Facilities eligible to use the alternate threshold must submit a certification statement to EPA, rather than a full Form R report.

Beginning with the 1991 reporting year, facilities subject to TRI reporting must also report pollution prevention and recycling data for TRI chemicals, pursuant to Section 6607 of the Pollution Prevention Act (42 U.S.C. 13106). Form R is filed annually, covers all toxic releases for the calendar year, and must be filed on or before the first of July of the following year. Exhibits 68 - 71 list many of the toxic chemicals used by firms in the electronics industry that were listed in the Toxic Release Inventory as of the date of this publication.

EXHIBIT 68. Chemicals Used by the Semiconductor Industry That Are Listed in the Toxic Release Inventory

TOXIC CHEMICAL	
Aluminum (fume or dust)	Hydrochloric acid
Ammonia	Isopropyl alcohol
Antimony	Methanol
Arsenic	Methyl isobutyl ketone
Boron trichloride	Nickel
Boron trifluoride	Nitric acid
Carbon tetrachloride	Phosphine
Catechol	Phosphoric acid
Chlorine	Phosphorus
Chromium	Silver
Copper	Sulfuric acid
Ethyl acrylate	1,1,1-Trichloroethane
Ethyl benzene	Trichloroethylene
Ethylene glycol	Xylene
Fluorine	

EXHIBIT 69. Chemicals Used in Semiconductor Packaging That Are Listed in the Toxic Release Inventory

TOXIC CHEMICAL	
Acetone	Methanol
Chromium	Nickel
Copper	Nitric acid
Ethyl benzene	Silver
Ethylene glycol	Sulfuric acid
Hydrochloric acid	Toluene
Isopropyl alcohol	1,1,1 Trichloroethane
Lead	Xylene

EXHIBIT 70. Chemicals Used in Printed Wiring Board Manufacturing That Are Listed in the Toxic Release Inventory

TOXIC CHEMICAL	
Ammonia	Lead
Chlorine	Nickel
Copper	Nitric acid
Formaldehyde	Sulfuric acid
Isopropyl alcohol	1,1,1 Trichloroethane
Hydrochloric acid	

EXHIBIT 71. Chemicals Used in Display Manufacturing That Are Listed in the Toxic Release Inventory

TOXIC CHEMICAL	
Nitric acid	Trichloroethylene

TOXIC SUBSTANCES CONTROL ACT REQUIREMENTS

Section E. TOXIC SUBSTANCES CONTROL ACT

Law: Toxic Substances Control Act, 15 U.S.C. Sections 2601 to 2692 (Regulations found at 40 CFR 700 to 799)

The Toxic Substances Control Act (TSCA), originally passed in 1976 and subsequently amended, applies to the manufacturers, processors, importers, distributors, users, and disposers of chemical substances or mixtures. The major sections of interest to this report, and their areas of coverage, are:

- Section 4, which authorizes EPA to require testing of certain chemical substances or mixtures to determine their potential risk to human health or the environment;
- Section 5, which grants EPA the authority to regulate the manufacture, processing, distribution in commerce, use, and disposal and to require testing of new chemical substances or significant new uses of existing chemical substances;
- Section 6, which provides EPA with the authority to regulate the manufacture, processing, distribution in commerce, and use and disposal of chemical substances;
- Section 8, which requires manufacturers and others to keep certain records and to submit reports to EPA;
- Section 12, which requires exporters to notify EPA when exporting certain chemicals; and
- Section 13, which requires importers to certify the TSCA status of the chemicals in an import shipment.

The major requirements having the potential to impact the electronics industry are briefly described below.

Development of Test Data (Section 4)

Manufacturers, importers, and processors of specific chemicals may be required to conduct health effect, environmental effect, or chemical fate testing under a test rule or enforceable consent agreement and order (40 CFR 799). Companies subject to section 4 testing requirements may also be required to submit to EPA, under TSCA Section 8(d), unpublished health and safety studies on the chemical(s).

Premanufacture Notification Requirements (Section 5)

Any person who manufactures or imports a new chemical substance, or that manufactures, imports, or processes a chemical substance for a significant new use, must notify EPA at least 90 days before manufacturing, importing, or processing the substance (40 CFR 720 to 723). Upon review of this notice, EPA may issue an order regulating the manufacture, processing, use, or disposal of the substance. EPA may promulgate a significant new use rule regulating activities by manufacturers, importers, or processors of a chemical, either in response to a premanufacture notice or independently (i.e., on a chemical that is already in commerce). EPA may also require a manufacturer or importer of a new chemical or a manufacturer, importer, or processor of a chemical subject to a significant new use rule to develop test data.

Chemical Regulation (Section 6)

Section 6(a) of TSCA gives the EPA Administrator broad authority to issue rules regulating a chemical substance or mixture if "there is a reasonable basis to conclude" that its manufacture, distribution in commerce, use, or disposal "presents or will present an unreasonable risk of injury to health or the environment." Under Section 6, the EPA Administrator may take a variety of actions to control or mitigate the risk posed by a chemical, including prohibiting the manufacture, import, processing, or distribution of a chemical substance. Chemicals regulated under Section 6 include chlorofluorocarbons (prohibiting their use as aerosol propellants), asbestos, and certain substances in metalworking fluids. EPA regulates polychlorinated biphenyls under Section 6(e).

Reporting and Recordkeeping for Identified Chemical Substances (Sections 8(a) and 8(b))

Under TSCA Section 8(a), any person (except a "small business") who imports, manufactures, or processes chemical substances identified by EPA by rule must report information on production volume, environmental releases, and/or chemical uses. EPA implements Section 8(a) by adding chemical substances to the Preliminary Assessment Information Rule (PAIR) and Comprehensive Assessment Information Rule (CAIR) (40 CFR 712 and 704, respectively). Small businesses are required to report such information in some situations. Section 8(b) of TSCA requires EPA to compile and maintain a list (the TSCA Inventory) of all chemical substances manufactured or processed in the United States, and every four years chemical manufacturers and importers are required to report the information necessary to allow EPA to develop and maintain the inventory (40 CFR 710).

Records of Significant Adverse Reactions to Health or the Environment (Section 8(c))

Any person who manufactures, imports, or processes chemical substances and mixtures must keep records of significant adverse reactions to health or the environment, as specified in 40 CFR 717.

Reports of Unpublished Health and Safety Studies (Section 8(d))

Any person who manufactures, imports, or processes, or proposes to manufacture, import, or process a chemical substance or mixture identified by rule in 40 CFR 716 must submit to EPA copies of certain unpublished health and safety studies with respect to that substance or mixture.

Notice of Substantial Risk of Injury to Health or the Environment Reporting Requirement (Section 8(e))

Any person who (1) manufactures, imports, processes, or distributes in commerce a chemical substance or mixture, and (2) obtains information that reasonably supports the conclusion that such substance or mixture presents a substantial risk of injury to health or the environment, must promptly report the information to EPA, unless the person has actual knowledge that EPA has been adequately informed of the information (see 43 *Federal Register* 11110 (1978) and 58 *Federal Register* 37735 (1993)).

Export Notification (Section 12(b))

A business that intends to export a chemical substance or mixture for which rules or orders have been issued under certain sections of TSCA (sections 4, 5, 6, or 7) must notify EPA within seven days of exporting or forming the intent to export the chemical, whichever is earlier, for the first time to a particular country in a calendar year (40 CFR 707). For chemicals subject to TSCA section 4, exporters must notify EPA only once for each country, rather than once per calendar year per country.

Import Certification (Section 13)

Because the definition of "manufacture" under TSCA includes importation, importers of chemical substances must comply with all TSCA requirements applicable to manufacturers. In addition, importers must comply with an import certification requirement established by the United states Customs Service under the authority of TSCA section 13 (40 CFR 707 and 19 CFR 12). The importer must certify for every import shipment that all of the chemical substances in the shipment (1) are subject to TSCA and comply with all applicable rules and orders, or (2) are not subject to TSCA.