

3.8.4 Electronics Manufacturing: Printed Circuit Boards

Tip Sheet #1

WASTE ORIGIN: Fabrication

WASTE TYPES: Spent Process Baths, Sludges, and Rinsewaters

WASTE REDUCTION AND RECYCLING METHODS:

- ! Substitute **drip pans** for rinse tanks.
 - ! Extend chemical process **bath replacement period** through filtration, analysis, and maintenance.
 - ! Introduce low-water demand **spray rinses** on conveyORIZED processes.
 - ! Provide direct recovery of **copper sulfate** from etch/strip processes by cooling and crystallization.
 - ! Replace common **chemical precipitation** with electrochemical reduction processes.
 - ! Reduce **chemical oxidation** demand loading of sewer by changing manufacturing process chemistries.
 - ! Replace **electrochemical reduction** with ion exchange, crystallization, and heavy metal extraction/recovery through electrodeposition techniques.
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WASTE ORIGIN: Electronic and Final Assembly

WASTE TYPES: Petroleum-based Solvents, Coolants and Oils, Volatile Organic Compound (VOC) Air Emissions, and Shelf-Life Expired Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **in-line solvent recovery** on vapor degreasers.
- ! Extend **solvent life** by monitoring solvent quality to avoid unnecessary additions of solvent.
- ! Implement **recycling** of glycol coolants and hydraulic oil.
- ! Change to **low-VOC coating** operations.
- ! Install centralized chlorinated **solvent recovery** system.
- ! Implement **shelf-life** sensitive material reduction program.

Source:

Fact Sheet, *Waste Reduction for the Aerospace Industry*, CA DHS Alternative Technology Division, August 1989.

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Tip Sheet #2

WASTE ORIGIN: PC Board Fabrication

WASTE TYPES: General Wastes

WASTE REDUCTION AND RECYCLING METHODS:

- ! Substitute **surface mount** technology.
 - ! Substitute injection molded **substrate** and additive **plating**.
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WASTE ORIGIN: Cleaning and Surface Preparation

WASTE TYPES: Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **abrasives**.
 - ! Use non-chelated **cleaners**.
 - ! Use **mild chelators** if chelators are required in the process.
 - ! Extend **bath life**.
 - ! Improve **rinse efficiency**.
 - ! Use **counter-current cleaning**.
 - ! **Recycle or reuse** cleaners and rinses.
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WASTE ORIGIN: Pattern Printing and Masking

WASTE TYPES: Acid Fumes, Organic Vapors, Vinyl Polymers, Spent Resist Removal Solution, Spent Acid Solution, and Waste Rinsewater

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use aqueous **processable resist**.
 - ! Do screen printing versus **photolithography**.
 - ! Use dry **photoresist removal**.
 - ! **Recycle or reuse** photoresist stripper.
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WASTE ORIGIN: Etching

WASTE TYPES: Etching Solutions and Rinsewaters

WASTE REDUCTION AND RECYCLING METHODS:

- ! Eliminate **differential plating**.
 - ! Use **dry plasma etching**.
 - ! Use **non-chelated etchants**.
 - ! Use **non-chrome etchants**.
 - ! Use thinner **copper cladding**.
 - ! Use pattern instead of **panel plating**.
 - ! Use additive instead of **subtractive method**.
 - ! **Reuse of recycle** etchants (e.g. through filtration and regeneration).
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Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992. EPA/6000/R-92/088.

Guides to Pollution Prevention: The Printed Circuit Board Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/007.

Hazardous Waste Reduction Facts: Printed Circuit Board Industry, City of Santa Monica, Dept. Of General Services.

Fact Sheet: *Printed Circuit Board Manufacturers*, CA DHS Alternative Technology Division, August 1989.

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Tip Sheet #3

WASTE ORIGIN: Electroplating and Electroless Plating

WASTE TYPES: Plating Solutions, Rinsewater, and Sludges

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use non-cyanide baths and non-cyanide **stress relievers**.
- ! Design and maintain **rack** properly to extend bath life and reduce carryover:
 - ! Use better *precleaning or rinsing*;
 - ! Use *de-mineralized water* as make-up;
 - ! Store *solutions* properly.
- ! Extend **bath life** and reduce **drag-out**:
 - ! Minimize *bath chemical concentration*. Over time, gradually add reagents to prolong life until achieving full strength;
 - ! Increase *bath temperature*;
 - ! Use *wetting agents*;
 - ! Use proper *positioning in rack*;
 - ! Slow withdrawal and sample *drainage*;
 - ! *Computerize or automate* systems;
 - ! Use airstream or fog to rinse *plating solution* into the tank;
 - ! Collect drips between process and rinse tanks with *drain boards*;
 - ! *Recover* drag-out.
- ! Extend bath life; maintain **bath solution** quality:
 - ! Monitor *solution activity*;
 - ! Control *temperature*;
 - ! Use mechanical *agitation*;
 - ! Use continuous *filtration/carbon treatment*, electrolytic dummyming;
 - ! Remove *impurities*.
- ! Properly design and operate **equipment**.
- ! Use **closed-circuit** rinses, spray rinses, and fog nozzles.
- ! Increase **agitation**; use air agitation or work piece agitation.
- ! **Conserve** water:
 - ! Install *turbulence* devices;
 - ! Increase *contact* between water and the board;
 - ! reuse *acid rinse effluent* as influent for alkaline rinse tank;
 - ! Use *countercurrent rinsing*;
 - ! Apply *flow restriction devices* such as pH-controlled and pressure-controlled shutoffs.
- ! Use **de-ionized water** to reduce sludge volume.
- ! Ask supplier to recommend chemicals which **generate less sludge**.
- ! **Recover metal** values.
- ! **Separate** waste streams.

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992. EPA/6000/R-92/088.

Guides to Pollution Prevention: The Printed Circuit Board Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/007.

Hazardous Waste Reduction Facts: Printed Circuit Board Industry, City of Santa Monica, Dept. of General Services.

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