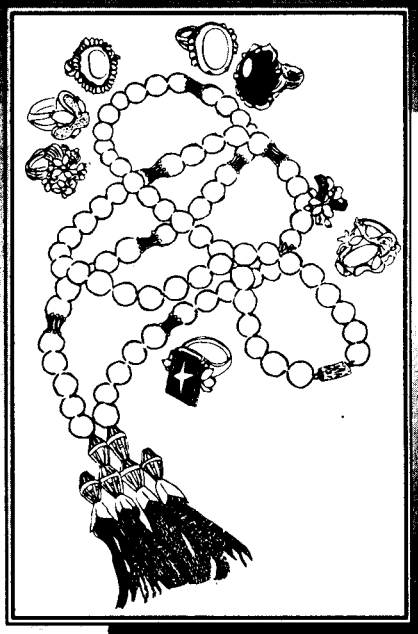
Hazardous Waste Minimization Checklist & Assessment Manual for Jewelry Manufacturers



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Department of Toxic Substances Control
Office of Pollution Prevention and Technology Development
Technology Clearinghouse Unit

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Hazardous Waste Minimization Checklist & Assessment Manual for Jewelry Manufacturers

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

OFFICE OF POLLUTION PREVENTION AND TECHNOLOGY DEVELOPMENT

TECHNOLOGY CLEARINGHOUSE UNIT

September 1994

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DISCLAIMER

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INTRODUCTION

Waste minimization consists of source reduction and recycling, the first two elements of the preferred waste management hierarchy, which consists of source reduction, recycling, treatment, and residuals disposal. Tackling waste management problems using the hierarchy can help save you money by reducing the amount of hazardous wastes you have to manage. Waste minimization can involve simple and easily implemented strategies, or complex, state-of-the-art technologies. The extent to which you implement a hazardous waste minimization program depends upon your plant or shop's particular operations and procedures.

Waste minimization can help you achieve compliance with regulatory requirements by reducing the waste generated. In some instances, it might even allow small quantity generators to drop out of the regulatory loop altogether. Waste minimization may also be able to reduce the fines or fees assessed by publicly owned treatment works (POTWs) by reducing your loads on their pretreatment systems.

This manual was developed by the Technology Clearinghouse Unit of the Office of Pollution Prevention and Technology Development to aid jewelry manufacturers in evaluating their shops for waste minimization opportunities. The manual contains three sections. Section 1 is a checklist to help you in evaluating your shop for waste minimization opportunities. Section 2 is comprised of tables listing the waste minimization options from the checklist and the following four areas for evaluation:

- Waste Minimization Hierarchy (WMH)
- Implementation Potential (IP)
- Type of Option
- Cost of Option

Each of these areas have different point values which will be explained in Section 2. The total scores of the options will allow you to prioritize the options. Section 3 is an economics worksheet to help you decide which options are cost-effective for implementation.

SECTION 1: JEWELRY MANUFACTURERS CHECKLIST

Jewelry manufacturers generate a variety of hazardous wastes in their operations. Common waste types include:

- spent stripping solutions that contain free cyanide and cyanide complexes
- sulfur and chlorine compounds that are released as gases
- spent plating baths and concentrated rinsewaters
- acid and alkaline cleaning solutions
- chlorinated solvents
- cadmium fumes
- chlorofluorocarbons (CFCs)
- obsolete stock
- spills

In general, a waste is hazardous if it is toxic, corrosive, ignitable, or reactive. The criteria for determining these hazardous properties are complex. You can find the criteria in Title 22, California Code of Regulations (CCR), Section 66262.10. There is an address in the Appendix if you want to request a copy **of** the CCR. According to these regulations, it is the generator's responsibility to use these criteria to find out if your wastes are hazardous. If you are not sure if your wastes are hazardous or you need help understanding the criteria, call your local Department of Toxic Substances Control (Department) regional office (telephone numbers are listed in the Appendix).

INTRODUCTION TO WASTE MINIMIZATION

Waste minimization consists of waste management approaches that reduce the amount of hazardous waste generated or requiring disposal.

Waste minimization can reduce the amount of hazardous wastes generated in your shop. This benefits you by minimizing:

- disposal costs
- regulatory compliance costs (recordkeeping, reporting, tracking, etc.)
- costs of future liabilities
- current operating costs (i.e., raw material costs)
- transportation costs
- offsite treatment costs
- worker safety cost
- laboratory costs (for compliance with land disposal restrictions)
- fees and taxes
- insurance costs

Additionally, waste minimization can increase plant productivity, improve environmental protection, and enhance community relations. These benefits may be realized by your firm by implementing the following waste minimization methods:

Source reduction: is any activity that prevents or reduces the generation of hazardous waste that may otherwise be released to air, land, or water. Examples include: substituting input material or changing production processes to reduce the amount of waste generated.

Recycling: is the use, reuse, or reclamation of hazardous constituents. Examples include: employing onsite or offsite techniques to remove contaminants from a waste stream so that the regenerated material can be reused.

To be successful, your waste minimization program must be organized. It is not hard to organize waste minimization, but you will need to spend a little bit of time at first to get started. Keep in mind the following principles of waste minimization.

Principles of Waste Minimization

1. Plant owners and managers must be committed to waste minimization for it to work.

2. Your waste minimization program should include a written policy with specific goals and objectives.

3. You should know how your hazardous waste is managed and how much your present waste management costs.

4. Train all your employees in hazardous waste handling and waste minimization methods.

5. Be aware of the hazardous materials regulations that apply to you.

Table 1: The Waste Minimization Assessment Procedure

The recognized need to minimize waste

	Procedure	Result
Planning and Organization	• Get management commitment • Set overall assessment program goals • Organize assessment program task force	Assessment organization and commitment to proceed
Assessment Phase	• Collect process and facility data • Prioritize and select assessment targets • Select people for assessment teams • Review data and inspect site • Generate options • Screen and select options for further study	Assessment report of selected options
Feasibility Analysis Phase	• Technical evaluation • Economic evaluation • Select options for implementation	Final report, including recommended options
Implementation	• Justify projects and obtain funding • Installation (equipment) • Implementation (procedure) • Evaluate performance	Successfully implemented waste minimization projects

(Source: The EPA Manual for Waste Minimization Opportunity Assessments)

ASSESSING YOUR WASTEMINIMIZATION OPPORTUNITIES

This booklet will help you perform a waste minimization assessment. The objective of this assessment is to identify ways to reduce or eliminate waste through a careful review **of** your operations and waste streams. After you select a specific area(s) to focus on in your waste minimization efforts, a number of options should be developed and evaluated. Then, evaluate the technical and economic feasibility of the selected options. Finally, select the most promising waste minimization options for implementation.

When performing your waste minimization assessment, the answers to the following questions can help guide your efforts:

1. What are the waste streams generated at your plant? What are the volumes generated?

2. Which processes or operations generate these waste streams?

3. Which wastes are classified as hazardous and which are not? What makes them hazardous?

4. What are the input materials used that generate the waste streams of a particular process or plant area?

5. How much of a particular input material enters each waste stream?

6. How much of a raw material can be accounted for through fugitive losses?

7. How efficient is the process?

8. Are unnecessary wastes generated by mixing otherwise recyclable hazardous waste with other process wastes?

9. What types of housekeeping practices are used to limit the quantity of wastes generated?

10. What types of process controls are used to improve process efficiency?

11. What are the facility's current costs for hazardous waste/materials compliance (i.e., disposal fees, permit fees, fines, raw material purchases, etc.)?

(Source: EPA Waste Minimization Assessment Manual)

WASTE MINIMIZATION OPTIONS

Complete the following waste minimization checklist to see if you are maximizing waste minimization techniques. The preferred answers are in bold print and helpful hints are in the right hand column.

MANAGEMENT PRACTICES

1. Does your facility have an established waste minimization program in place?

☐ Yes ☐ No

Is a specific person or committee assigned to oversee the success of the program?

☐ Yes ☐ No

Does the program have a set waste minimization goal?

☐ Yes ☐ No

✓ If there is enough staff available, a committee may be more successful than a single person because one person is not always available when necessary, could leave the compnay or be otherwise absent, and may not have expertise in all necessary areas.

J Waste minimization programs are more successful if they contain the elements listed above.

2. How frequently are overall material balances for the facility performed?_____

_____

J In order to accurately assess your waste minimization efforts, you must keep track of the raw materials entering and the products and wastes leaving your processes.

3. Are there employee education programs on how to avoid excessive waste generation?

☐ Yes ☐ No

How often are the training programs offered? _____

_____

J You can reduce the amount of waste generated by spills if you train your employees to properly handle and store hazardous materials. Some trade associations and local environmental health agencies sponsor employee training seminars and some consulting firms offer employee training as part of their package of services for hazardous waste management. Employees feel committed to waste minimization when they recommend ways to eliminate or reduce waste at the source and see their suggestions implemented.

Are there employee incentive programs regarding waste minimization?

☐ Yes ☐ No

Have you increased employee supervision?

☐ Yes ☐ No

4. Are you fully aware of the current local, state, and federal regulations related to hazardous material storage, treatment, disposal, and recycling?

☐ Yes ☐ No

✓ Compliance with existing laws and regulations is essential to a good waste minimization program.

5. Has your facility conducted an environmental audit to assess compliance with these regulations?

Yes No

PLANT OPERATIONS MANAGEMENT

Plant operations management involves the proper scheduling of production to reduce the need for equipment cleaning, and dealing with management practices, such as employer/ employee relationships, that may have an influence on the amount of waste generated.

1. Are sequential operations adjacent to each other?

Yes No

➲ Sequential operations should be adjacent to avoid excess material handling. This would reduce the potential for precious metal losses and hazardous waste spills.

2. Are process baths prepared by trained personnel?

Yes No

✓ You can often minimize waste and improve the consistency of process baths by assigning a limited number of properly trained personnel to mix chemicals.

3. Does your facility maintain dust collectors and fans in top working condition?

Yes No

➲ Dust collectors and fans that pull tripoli dust away from the workers should be maintained in top working order. Good maintenance practices will reduce health risks to employees and allow better collection of the small gold particles that can escape during polishing.

4. Does your facility have a formal facility inspection plan?

Yes No

➲ Regular inspections of your facility's storage, waste treatment, and production areas will help maintain optimal production and identify equipment malfunctions early.

RAW MATERIALS INVENTORY AND STORAGE

Raw materials are the unused supplies of materials that you keep on hand. If you allow these supplies to become too old to use, they may become hazardous wastes. Obsolete stock can be minimized by proper planning and inventory control.

1. Do you inspect raw materials and their containers before you accept them?

Yes No

✓ Off-specification raw materials, if accepted, can become hazardous waste. Materials may also be delivered in containers that are damaged, have loose-fitting lids, and leaky valves.

2. Is the inventory system computerized?

Yes No

✓ Installation of a computerized inventory system can improve raw material tracking. By using such a system, inventory can be checked more frequently. This reduces overstocking and ensures chemicals in containers are completely used prior to opening a new container. A full-scale inventory should be scheduled at least once a year.

3. Are new material containers labeled and dated as they are received?

Yes No

✓ By labeling all materials clearly with their expiration dates, you can rotate your stock *so* that the earliest labeled stock is used first. This is often referred to as a "first-in, first-out'' policy. Also, check labels on containers to ensure they are not deteriorated. Unlabeled containers are often disposed of as hazardous waste due to the uncertainty of their contents. Material that no longer has a useful shelf-life is considered a hazardous waste which must be properly disposed. Some suppliers may accept unused materials and charge a disposal fee.

4. Do you purchase only the quantity of material you need?

Yes No

✓ Although it may be less expensive to purchase materials in bulk, materials degraded by prolonged storage must be disposed of as hazardous waste.

5. Do you maintain and enforce a clear policy of using raw materials only for their intended uses?

Yes No

✓ You may generate unnecessary hazardous waste if you use supplies for purposes other than their intended uses.

6. Are materials stored in reusable containers?

☐ Yes ☐ No

J Check with your supplier to see if they will allow you to return empty containers and reduce the amount of waste you must dispose. Ensure single-trip containers and nonreusable containers are handled according to the regulations.

7. Are hazardous materials stored separately from nonhazardous materials.

☐ Yes ☐ No

J Storing hazardous and nonhazardous materials separately will reduce the risk of **a** hazardous waste being generated due to a hazardous waste leaking and contaminating a nonhazardous waste. Maintain distance between different types of materials/ chemicals to prevent cross-contamination and reactions, in case of spills or leaks.

8. Do you limit raw materials access?

☐ Yes ☐ No

J Limiting access to raw materials to designated personnel will help you reduce the amount of raw materials wasted.

9. Do you stack containers of materials?

☐ Yes ☐ No

✓ Do not stack containers higher than recommended by the manufacturers, or in such a manner where they can tip over, tear, puncture, or break. Also, do not stack equipment against material containers to avoid damaging the containers.

10. Are materials and/or wastes kept in proper storage areas?

☐ Yes ☐ No

✓ Proper storage areas can help you reduce wastes generated due to spills, cross-contamination, or leaks. Be sure to store materials and wastes in covered containers and in a locked and covered indoor area with a concrete floor. It should also include adequate lighting, insulated electrical circuitry (checked frequently for corrosions to prevent potential sparking), curbs for spill containment, and aisles clear of obstructions.

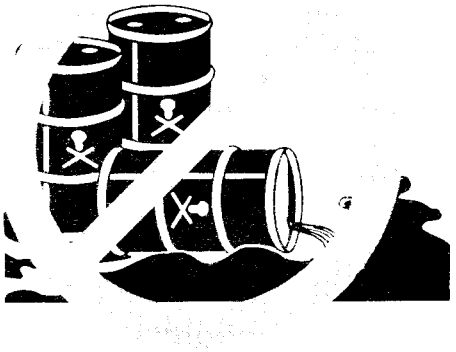
Table 2: How do you store your raw materials and hazardous wastes?

Check the boxes that apply to your storage area(s).

Storage	Hazardous Wastes	Raw Materials	Comments
Indoors			Some fire departments recommend storing flammable wastes outdoors to reduce fire danger, but remember to follow the other storage hints.
Outdoors			
Covered			A covered storage area is important because rain water can increase your waste volumes or contaminate raw materials. Also, exposure to sunlight can change the characteristics of raw materials or dangerously raise the pressure inside sealed containers. You should keep individual containers covered to prevent evaporation and spills.
Uncovered			
Diked Concrete Pad			A diked concrete pad will contain spills better than asphalt or dirt. Storage of materials on dirt surfaces should always be avoided. In addition to potential ground contamination, moisture collecting under drums can lead to corrosion and failure of the drum. For facilities with limited space, combination pallet/ containment systems are available.
Dirt Surface			
Asphalt Surface			
Locked			Without secure storage facilities, some unscrupulous hazardous waste generators may deposit their wastes in your containers, increasing your disposal costs.
Unlocked			

SPILL CONTROL

Spill control is especially important for jewelry manufacturers because of the value of the precious metals found in the process solutions. If you spill a raw material or hazardous waste and absorb it with sawdust (or some other absorbent), the sawdust becomes a hazardous waste and is subject to all of the hazardous waste regulations. Reduce this type of waste by handling all materials carefully to reduce spills.



1. Does your facility conduct equipment inspections on a routine basis to identify leaks or equipment malfunctions?

Yes [No

✓ Routine inspections of your shop's production, storage, and waste treatment areas should be conducted on a daily basis to identify leaks and malfunctioning equipment. Identifying problems at an early stage helps reduce spills and other uncontrolled releases.

2. Do you have procedures in place to handle leaks or spills?

Yes No

✓ Regulations require spill containment around storage areas to minimize the spread of any spilled material. Ensuring a quick and proper response to leaks and spills can help you reduce wastes generated by the cleanup of spills. Keep an emergency plan available and educate your employees in its use. Training your employees is also a legal requirement.

MATERIAL AND CHEMICAL SUBSTITUTION

Material and chemical substitution measures reduce or eliminate hazardous materials entering the production process, thereby avoiding the generation of hazardous wastes within the production process. Some common substitution options are presented below.

1. Have you explored the possibility of using bright or de-ox alloys?

Yes [No

✓ The use of bright or de-ox alloys may allow you to reduce or eliminate the use of certain chemicals such as tripoli compounds and cyanide. Check with your alloy manufacturer for more information on this product.

Casting

1. Have you replaced hydrofluoric acid with dilute hydrochloric acid to clean the investment from the casting?

] **Yes** [No

✓ Hydrofluoric acid can cause serious, painful burns. Safer techniques, such as dilute hydrochloric acid are now available.

Stripping

2. Has your shop replaced potassium and sodium cyanide stripping compounds with noncyanide processes?

☐ **Yes** ☐ No

✓ Cyanide-bearing waste streams must undergo an additional treatment step to destroy the cyanide before they can be treated with other wastes. Noncyanide practices, such as electrostripping can minimize the costs associated with treatment and disposal of cyanide waste. Cyanide is also an acutely toxic compound that can cause fatality even with minimal exposure so its elimination is encouraged whenever possible.

Polishing

3. Have you considered replacing tripoli compounds with other polishing compounds?

☐ **Yes** ☐ No

✓ Tripoli polishing compounds contain silica particles. Microcrystalline silica has been linked to delayed respiratory problems in workers exposed to silica dust over long periods of time. Nonsilica-based compounds may be available from your supplier. Dust collection devices can also be connected to the polishing wheels. The dust is then recycled ***to*** reclaim any precious metals.

Waxing

4. Does your facility use a chlorofluorocarbon (CFC) containing mold release spray in creating wax images?

☐ **Yes** ☐ No

✓ CFCs are known atmospheric ozone depleters and are stringently regulated under federal and state requirements. Although various products on the market still contain CFCs, their production will be phased out in the next few years. Products containing CFCs will become increasingly expensive and eventually will not be available. Non-CFC sprays are currently available.

Soldering

5. Does your facility use cadmium-based compounds in soldering applications?

☐ **Yes** ☐ No

✓ Cadmium fumes generated from soldering applications have been linked to kidney and respiratory damage and may cause cancer. Cadmium-free solders are now widely available and can be cost-effective. By eliminating cadmium solders, you can also minimize the need for expensive ventilation systems and employee personal protection equipment.

Cleaning

6. Has your facility replaced chlorinated solvents used in degreasing or cleaning applications with water-based or other nonhazardous solvents?

☐ **Yes** ☐ No

✓ Water-based or other nonhazardous solvents can often be used effectively in place **of** chlorinated solvents and may generate wastes that are not hazardous. In addition, chlorinated solvents such as 1,1,1-Trichloroethane (TCA) are hazardous compounds when inhaled and can cause cardiac arrest in extreme exposure situations.

Plating

Electroplating involves the application of a precious metals coating to a surface using an electric potential which is created by passing a current between an anode and a cathode in solution. The electroplating solutions contain free cyanide and cyanide complexes as their major constituents. The waste stream generated from this process is a spent plating solution that contains cyanide and metal ions.

7. Have you attempted to use deionized water in place of common tap or softened water during electroplating?

☐ Yes ☐ No

✓ When tap or softened water is used, anions in solution will combine with the metal ions, creating contaminants. This will hasten the exhaustion of the process solution. Deionized water can extend the life of the plating solution, thus extending the bath life and reducing waste generation.

8. Have you attempted to reduce the acid in cleaning or pickling solutions used to remove rust or other deposits?

☐ Yes ☐ No

✓ Lower acidity cleaning solutions will still remove rust and other deposits and may generate wastes which are not hazardous.

PROCESS OPERATIONS

Casting

1. Does your facility use dewaxing techniques, other than oven burnout, to remove wax from the flask prior to casting?

☐ Yes ☐ No

✓ Casting wax often contains sulfur and chlorine compounds that are released as gases when the wax is burned off in an oven. Steam dewaxing machines that melt wax from the flasks and deposit it on shallow water-filled trays are currently available from your supplier and can be used in place of oven burnout techniques. When purchasing a steam dewaxing machine, make sure that the machine actually allows the water to boil when generating steam. Machines that can not be adjusted to water's boiling temperature, are less efficient and make the dewaxing process time consuming. Steam dewaxing prior to casting can also improve cast quality, lower required oven temperatures, decrease oven time, and decrease overall energy costs.

2. Are flasks kept under water when cured investment is broken up to free the cast trees?

☐ Yes ☐ No

✓ Keeping flasks under water while breaking up the investment will prevent the silica dust from floating in the air. Investment dust contains silica which can cause silicosis, a disabling lung disease, and cancer. Once the investment is broken up, let the water and silica sit until the silica can be separated out and any precious metal retrieved from the silica.

Stripping

3. Has your facility researched the possibility of substituting cyanide bombing with electrostripping processes?

Yes No

✓ Cyanide peroxide bombing often results in a greater loss of valuable gold product because the gold is dissolved into the bombing solution. Electrostripping systems contribute to a lesser loss of precious metal and are significantly safer than potassium or sodium cyanide systems. Electrostripping is best suited for jewelry pieces with many recesses, heavy designs, and those that lend themselves to racking. Cyanide peroxide systems are better suited for jewelry pieces that are very small or have prongs.

Polishing

4. Has your facility investigated the possibility of substituting some mechanical polishing and buffing operations with automatic processes?

Yes No

✓ Liquid spray polishing systems that use a water-based product can minimize tripoli use and decrease the wastes associated with polishing processes. An electrochemical process, called electropolishing, can also be used to minimize the need for mechanical polishing.

Soldering

5. Do you use antioxidant soldering flux solutions prior to soldering?

Yes No

✓ Antioxidant soldering flux solutions can be used prior to soldering to minimize oxidation and reduce the need for boric acid and alcohol to clean oxidation and fire scale deposits.

Blasting

6. Is your sandblaster equipped with particulate emission controls?

Yes No

✓ Implementing a control technology such as a baghouse or cartridge dust collector will prevent blasting material from escaping.

PLATING

Reduction of Dragout

Dragout loss of process chemicals is a significant source of waste generation. Dragout is the film of plating or stripping solution remaining on the surface of a part being plated when it is withdrawn from the solution bath. This film transfers with the part to the next bath or process. Each process step is considered separately to determine the dragout. Dragout can be reduced in many ways.

7. Have you replaced the commonly used parallel tank system with countercurrent washing?

☐ **Yes** ☐ No

✓ This can reduce the amount of wastewater generated. In a parallel system, fresh water enters each wash tank and effluent leaves each wash tank. In countercurrent rinsing, the water from previous rinsings is used in the initial washing stage. Fresh water enters the process only at the final rinse stage, at which point much of the contamination has already been rinsed off the film. Water exiting the first tank (the last tank that the film is immersed into) becomes the feed water to the second tank. After being used, this water feeds the third tank, and so on for the number of tanks in the line. The diagram below illustrates the use of a triple-stage countercurrent rinse system. If you do not have available space for new tanks, try to reduce the size of the rinse tanks or divide large tanks into smaller tanks to create your own multiple countercurrent rinse system.

Figure 1: Countercurrent Rinse System

Multiple rinse tanks can be used to provide sufficient rinsing while significantly reducing the volume of rinse water used. The use of a multistage countercurrent rinsing system can use up to 90% less rinse water than a conventional single-stage rinse system.

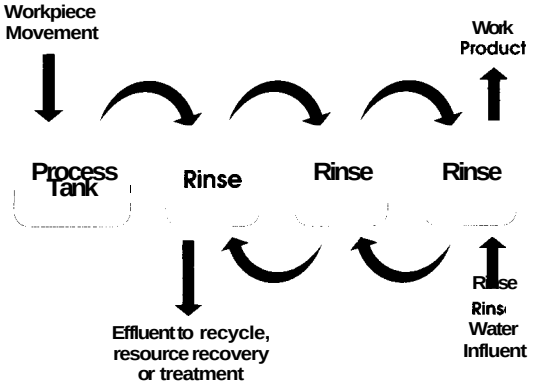
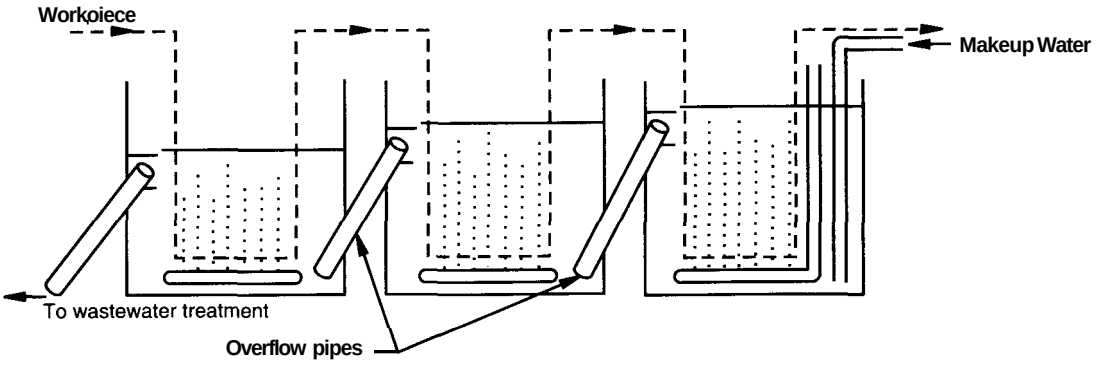


Figure 1: Countercurrent Rinse System



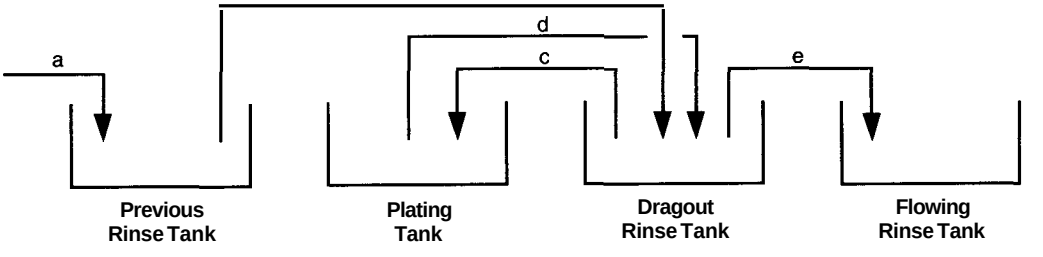
8. Do you employ "Drag-in/ Drag-out" rinsing techniques?

☐ **Yes** ☐ No

✓ "Drag-iddrag-out" rinsing employs the following steps:

a. Parts are immersed in a previous rinse tank where the parts pick up clean water on their surfaces.
b. Normally, the parts next go to the plating tank, dragging in the water on their surfaces. Instead, the parts are first dipped into the dragout tank after the plating tank where the parts pick up plating solution on their surfaces.
c. The parts are then immersed in the plating tank dragging in normally lost plating solution.
d. After plating, the parts are again immersed in the dragout tank to rinse the majority of solution from their surfaces.
e. The parts then go in the process, normally through a flowing rinse.

Figure 2: Drag-in/Drag-out Rinsing Technique



Chemical Concentration and Viscosity

Viscosity of a process solution can be described as its resistance to motion or removal by another liquid (in this case rinsewater). The difference between a high and low viscosity solution can be demonstrated with honey and water. An object dipped into honey will have a much thicker film than one dipped in water. Therefore, honey is considered to have a higher viscosity. This same effect can be seen in process solutions. If two identical surfaces are dipped in similar types of process baths, but only differing in chemical concentrations, the lower concentration bath will produce a lower volume of dragout.

9. Do you operate process baths at the lower end of the manufacturer's suggested range of operating concentrations?

☐ **Yes** ☐ No

✓ Controlling the chemical concentration of the process bath can reduce the dragout losses. Higher concentrations of chemicals in the process bath create a thicker film on the workpiece when it is removed from the process bath. This film does not drain back into the process bath as quickly, increasing the volume of dragout which also contains a higher chemical concentration. Chemical suppliers may recommend an operating concentration which is higher than necessary to perform the job. Determine the lowest process bath concentration that will provide adequate product quality.

10. Do you operate fresh baths at lower concentrations than replenished baths?

☐ **Yes** ☐ No

✓ Fresh baths can be operated at lower concentrations than replenished baths because make-up chemicals need to be added to used baths to gradually increase their concentration. Lower process bath concentrations translate into lower volumes of dragout loss.

11. Do you operate process baths at elevated temperatures?

☐ **Yes** ☐ No

✓ As the temperature of a process bath is increased, its viscosity and surface tension are reduced. Reducing the surface tension and viscosity decrease the dragout and allow much of the solution film to return to the bath when the part is withdrawn. Make sure that elevated temperatures will not contribute to an unsafe working environment or adversely affect product quality.

Surface Tension

Surface tension can have a very significant effect on process solutions. The volume of solution that clings to a workpiece surface depends largely on the surface tension. The force of the surface tension seems to be effective at the bottom edge of the part as it passes through and leaves the process solution. Surface tension and the dragout volume it creates appear to be affected by the orientation of the part relative to the surface of the liquid. Rearranging **parts *so*** that only a small surface area makes contact with the bath surface as you remove the part reduces the volume of dragout.

12. Have you determined an optimal removal rate and drainage time for workpiece racks?

Yes No

✓ Slower workpiece removal rates and suspension of the workpiece above the bath after dipping or plating decreases the volume of dragout. Determine the optimal removal rate and drainage time that will help you reduce the dragout volume from your process tanks. Once you have determined the removal rates, ensure that personnel are trained to follow these procedures. Also, periodically retrain personnel to follow these procedures.

13. Can you install bars or railings above process tanks?

Yes No

✓ Installing bars or railings above process tanks will allow operators to hang workpieces for drainage of dragout into the process tanks.

14. Are the plating solution tanks at your facility equipped with drip collection devices?

Yes No

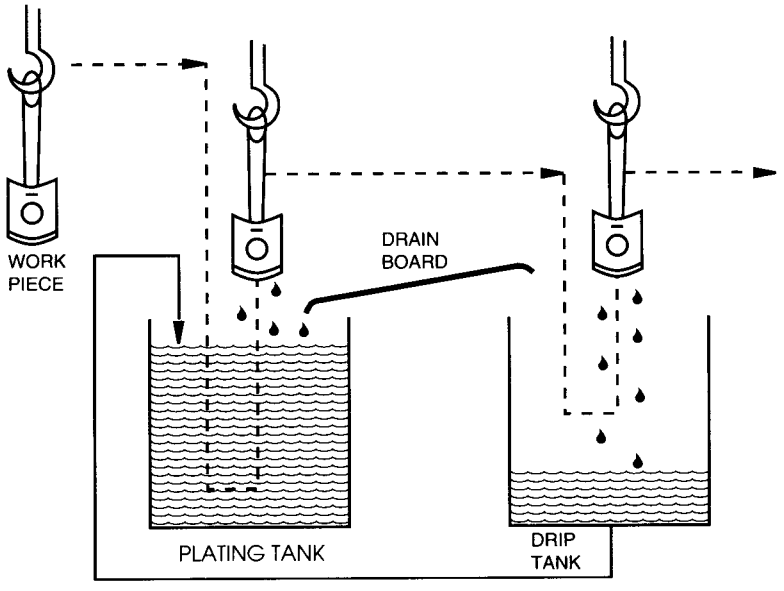
✓ Dragout of plating solutions can be minimized by installing lip (drip) collection devices after each tank.

15. Are there gaps between process bath tanks and their associated rinse tanks?

Yes **No**

✓ Gaps between process baths and their rinse tanks allow chemicals to drip onto the floor and into the wastewater treatment system increasing the waste load. Installation of drain boards bridging the gap between the process tanks and the rinse tank can direct the dragout back into the process tank. Drain boards should also be installed with hinges to allow access to the space between the tanks if necessary.

Figure 3: Drain Board



16. When a workpiece is carried to the rinse tank (or between adjacent tanks), is a drip tray held below the workpiece to collect any dragout?

Yes ☐ No

✓ Periodically, the drip tray should be rinsed in the countercurrent flow rinse stage to retrieve plating solutions and precious metals.

17. Do process baths operating at elevated temperatures utilize static dragout tanks as the initial rinse tank?

☐ Yes ☐ No

✓ Use of static dragout tanks after the process bath can capture process chemicals that adhere to the workpiece, which then can be returned to the bath to compensate for the evaporative losses. They also help increase the efficiency of the final rinse.

Process Baths

18. Are process baths and rinsewaters filtered to remove precious metal particles?

Yes No

✓ Filtration systems can be used to remove solids that contaminated the process baths, thereby extending the life of the bath. Filters placed in sinks can retain a significant amount of valuable metal product prior to discharge to sewer.

19. Does your facility periodically treat process baths to remove organic contaminants?

☐ Yes ☐ No

✓ Carbon filters can often be placed directly into the process bath to remove organic contaminants.

20. Are anodes removed from the plating bath when not in use?

☐ Yes ☐ No

✓ This would reduce the potential for bath contamination. Buildup of metals in the plating solution can result in a concentration of metals higher than acceptable in the bath. This would require disposal of a portion of the bath in order to reduce the metal concentration. Personnel should be properly trained in the importance of minimizing bath contamination.

Rinsing

21. Does your facility use separate dragout and rinse tanks for each plating process?

☐ Yes ☐ No

✓ Product loss and wastewater volume can be reduced by using separate dragout and rinse tanks for each plating process.

22. Have you determined the most efficient flow rate for each rinse stage?

☐ Yes ☐ No

✓ Using the optimal rinse flow rate can reduce the volume of wastewater generated, conserve water usage, and sewage fees.

23. Does your facility use flow control devices to regulate water flow through rinse tanks?

☐ Yes ☐ No

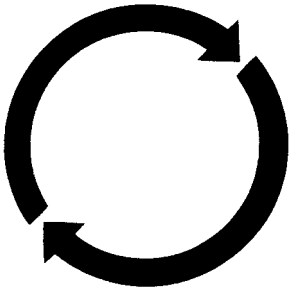
✓ Water flow control devices, such as flow restrictors on faucet heads or flow meters on water lines can be used to reduce water usage.

24. Does the total of each rinse system's estimated daily water usage approximately equal the average daily volume of wastewater generated?

☐ Yes ☐ No

✓ If the estimated water usage and the actual wastewater generated are not close, chances are that water lines are being left on even when the process line is not operating. This problem can be corrected by training personnel in water conservation.

RECYCLING AND RESOURCE RECOVERY



Recycling and resource recovery (reclamation) includes technologies that directly recover valuable materials from a process or that recover valuable materials from a waste stream before the waste is disposed. Spent chemical process baths and much of the rinsewater can be reused for other processes. **Also,** process chemicals can be removed from rinsewaters, and precious metals can be recovered from waste streams.

Most jewelry manufacturers reclaim precious metals because of the high economic value of the metals. Reclaimers specialize exclusively in recovering metals from other companies' wastes. Metals can be recovered from a variety of different sources, including spent stripping and plating solutions, acid cleaning solutions, rinsewaters, alkaline degreasers, jewelry scraps, and spent solvents. These recovery techniques can produce process solutions relatively free of metal contamination. These solutions can then be returned to their previous function and effectiveness. This is an excellent way to get maximum productivity out of these process solutions.

Recycling of Aqueous Wastes

1. Does your facility generate spent acid and/or alkaline solutions?

☐ Yes ☐ No

✓ Spent acid and/or alkaline solutions may be used to adjust pH in onsite treatment systems or filtered and reused for additional cleaning. Spent acids may be used for reducing hexavalent chromium to the trivalent state. Reuse of your spent materials will help you reduce your disposal costs. Reuse of process solutions for wastewater pretreatment activities should only be carried out by trained professionals with the proper permits.

2. Do you add the dragout or rinse solution back to the process bath?

☐ Yes ☐ No

✓ The dragout tank solution can be used to compensate for evaporative losses due to operating at higher temperatures. As workpieces are passed through the dragout tanks, the concentration of chemicals in the tanks will increase. After a time, the concentration will increase to a point where it can be used to replenish the process bath.

3. Do you regenerate or recover electroplating process baths?

☐ Yes ☐ No

✓ Some types of electroplating process baths can be regenerated or recovered. These may involve changes in process to reduce the bath contamination or the processing required for recovering solids. Make-up chemicals can be added to bring a process bath up to strength.

4. Do you segregate and categorize waste solutions by the type of metal they contain?

☐ Yes ☐ No

✓ Waste segregation consists of placing different wastes into different containers. While neither a source reduction nor a recycling practice itself, waste segregation is critical to the success of any program designed to reduce or recycle waste materials. When only a single container is provided for all waste materials, it is common for nonhazardous wastes to be placed in the same container with hazardous wastes. This increases the amount of hazardous waste being generated, and places additional burdens on already overtaxed offsite treatment and disposal facilities. By providing separate, prominently labeled containers for each waste type, less nonhazardous waste will be placed in hazardous waste containers. Many companies have noticed a decrease in the total amount of hazardous waste being sent offsite after implementing waste segregation.

Precious Metal Recovery

5. Have you researched the possibility of onsite recovery of gold or other precious metals from spent plating and rinse streams?

☐ Yes ☐ No

✓ There are several recycling technologies available for resource recovery and include the following:

Ion Exchange — This recovery method uses charged sites on a solid matrix (resin) to selectively remove one or more charged species (ions) from a solution such as wastewater. The removed ion is then replaced in solution by ions originating from the resin. This process is utilized to recover metal cations from wastewaters. The metal is collected on the resin and then recovered using a solvent wash containing dimethylformaide.

Reverse Osmosis — This process demineralizes the wastewater by forcing it through a semipermeable membrane at high pressures. The dissolved metal salts do not pass through the membrane and are concentrated for recovery. Organic components are removed using activated carbon filters. The purified water is often recovered and reused.

Electrodialysis — Electrodialysis separates ionic species in water using an electric current and a semipermeable ion-selective membrane. The metal cations migrate toward the negative electrode where they are collected.

Metallic Displacement — This recovery method filters a solution through a metallic filament, usually steel wool, aluminum, or zinc. The metal ions in the solution precipitate as elemental metals by being ionically displaced by the metal of the filament. It allows capture of the metal from the wastewater.

Plating — Metals can be plated out of solution in the same fashion as they are electrolytically plated onto a precious metal product. A current is passed through the solution, and the metals species are pulled to the cathode where they are recovered.

6. Do you test your casting residue for precious metal content?

☐ **Yes** ▲ No

✓ Precious metal product is often lost in the casting process. The greatest source of gold waste occurs in the casting machine dirt and flask scrapings. Wash tank and quench materials can also account for a potential precious metal loss. Spent investment should be tested for precious metal content.

7. Does your facility recover precious metals from floor and bench sweeps?

Yes ☐ No

✓ Floor and bench sweeps often contain a large amount of precious metals that deposit on shoes and in cracks and crevices. All work benches should be swept clean several times a day. Floor mesh screens can be used to line the shop floor to collect fallen debris. Direct-melt materials (such as karat gold and sterling silver) can be melted and cast into bars for refining. Precious metals can be separated from the other filled jewelry items by electrolytic stripping in a cyanide cell or by acid leaching of the other metals. Low-grade items, including costume jewelry, sweeps, and resins, can be melted in batch and recovered by a variety of methods.

8. Will hazardous material suppliers accept your waste materials?

☐ Yes ☐ No

✓ Suppliers will often accept waste chemicals. Reclaimers may or may not charge a service fee per unit weight or volume of waste; this is typically a function of transportation. A reclaimer may assay the waste and provide you with an estimate of the recoverable metal value. The reclaimer will treat the wastes to recover the metal, usually removing or destroying other toxic contaminants, such as cyanide, in the process. A portion of the recovered metal is returned to you, based on the assayed value of the waste and the quantity treated. The reclaimer's portion covers expenses and profit. Each supplier or reclaimer should be consulted about their own policy.

9. Does your facility segregate and pretreat spent solutions from the ultrasonic and caustic soda baths or other cleaning operations?

☐ Yes ☐ No

✓ Product loss can be minimized by pretreating these solutions to recover precious metals. Wastewater after recovery can be discharged or appropriately treated and the recovered precious metals sent to a refinery.

10. Does your facility recover precious metals from wastewater sludges?

☐ Yes ☐ No

✓ Wastewater sludges resulting from onsite treatment processes can contain a large amount of precious metals. If these concentrations are high enough, these sludges can be sent to refineries for recovery of precious metals. Be sure all hazardous waste is hauled offsite by registered hazardous waste haulers.

11. Have you considered contacting a waste exchange organization?

☐ Yes ☐ No

✓ Waste exchange organizations such as the California Waste Exchange and the California Materials Exchange facilitate the transfer of wastes between industries such that one generator's waste material might be another industry's usable product. The telephone numbers for these organizations are listed under **"Further Information."**

TREATMENT AND PRETREATMENT

The ultimate goal of waste minimization is to reduce the amount **of** hazardous waste that is sent offsite for disposal. If the waste can not be reduced, recycled, or reused, it may be treated. Treatment refers to processes that destroy wastes and yield waste streams that pose little or no environmental risk. Pretreatment is applied to waste streams to make them more suitable for recycling or final treatment in a POTW. Many of the same processes can be used for treatment and pretreatment, and the terms are often used interchangeably.

1. Does your shop treat hazardous waste onsite?

__ **Yes** __ No

✓ If your shop generates a large amount of a specific hazardous waste, it may be cost-effective to invest in an onsite treatment system. For example, many jewelry manufacturers treat silver or gold cyanide waste onsite. This activity is considered "hazardous waste treatment." Onsite treatment requires hazardous waste permitting and may be costly for small facilities. For more information contact your local Department office.

2. Does your shop generate process bath wastes that are shipped for offsite treatment and disposal?

Yes No

✓ Process bath wastes that are not treated onsite must be shipped offsite for treatment and disposal. Since offsite treatment is often expensive due to transportation, treatment, and disposal costs, you should look for opportunities to reduce wastes shipped offsite whenever possible. Substituting hazardous materials that result in hazardous wastes with nonhazardous or recyclable materials can reduce the amount of waste requiring offsite treatment and disposal.

3. Do you segregate your process chemistries containing cyanide?

Yes __ No

✓ Cyanide-containing wastes need **to** be treated separately from other wastes because they must undergo chemical oxidation to destroy the cyanide. Cyanide-metal complexes must also be destroyed before metals recovery can be implemented. Overall, the cyanide must be oxidized until the carbon-nitrogen bond is completely disassociated.

4. Are waste streams needing only neutralization kept separate from those requiring metal removal?

Yes No

✓ Acidic or alkaline waste streams that do not contain metals may only need to be neutralized prior to discharge without having to undergo metal removal treatment. This will save on chemical usage and costs. If both acid and alkaline wastes are generated at a particular company, they can often be used to treat each other.

VOLUME REDUCTION

A small quantity of concentrated waste will generally cost less to treat than a large volume of dilute waste, whether performed onsite or by a reclaimer. Although the absolute quantity of metal recovered from both may be the same, the net value recovered is greater from the concentrated waste. As long as the cost of concentrating the waste stream does not exceed the difference, it is an economic advantage to reduce the quantity of waste through some type of concentration process.

HAZARDOUS WASTE STORAGE AND HANDLING

You may generate additional hazardous waste if you store raw materials or hazardous wastes improperly. Store them in covered containers. **A** locked, covered, indoor area with a concrete floor and curbs for spill containment would be ideal for storage. Inspect the storage area often, at least once a month, to look for leaky containers or improper storage.

1. Do you inspect storage area(s) to make sure containers are not leaking and are stored properly?

☐ **Yes** ☐ No

✓ A good time to inspect your storage area(s) is during your raw materials inventory.

2. Do you store different waste types in separate containers?

☐ **Yes** ☐ No

✓ Waste minimization requires waste segregation. Mixed wastes cost more to manage and can increase total volumes of hazardous wastes generated. Nonhazardous wastes become hazardous when mixed with hazardous wastes. Portable secondary containment units are now commercially available. These are found in various sizes and can even segregate waste streams. They are generally constructed of polypropylene or another resistant plastic.

3. How long do you usually store your hazardous wastes?

_____

_____

_____

_____

_____

_____

_____

_____

J You may store hazardous waste in tanks or containers (less than 5,000 gallons in any single tank or less than 50,000 gallons aggregate stored in tanks and containers) for up to 90 days. If you generate less than 220 pounds of hazardous waste in a month, you may begin counting the 90 days of storage after you have collected a total of 220 pounds or 27 gallons of hazardous waste (or 2.2 pounds of extremely hazardous waste). **If** you store hazardous waste for more than 90 days, you will need a storage permit or variance. Note: You may store up to 55 gallons of hazardous waste, one quart of acutely hazardous waste, or one quart of extremely hazardous waste in containers other than tanks. You may hold it onsite at or near the point of generation for up to one year from the initial date of accumulation without a permit. Contact your Department regional duty officer for information on applying for a permit and your local environmental health office for more information on local requirements. Your county or city requirements may be more restrictive.

4. Do you document individual wastes with their sources of origin and eventual disposal, along with the incurred disposal costs?

☐ **Yes** ☐ No

✓ Computerized waste documentation and control can help track the wastes in the process and can help in undertaking control strategies.

SECTION 2: EVALUATION OF WASTE MINIMIZATION AND WASTE MANAGEMENT OPTIONS

After completing the checklist and identifying your waste minimization options, you can use the following table to evaluate your options. Each option will be evaluated in four areas: 1) waste management hierachy, 2) implementation potential, 3) type of options, and 4) cost of the option.

1. The waste management hierarchy (WMH) consists of the following which are in the preferred order: 1) source reduction, 2) resource recovery and recycling, and 3) treatment.

SR = Source Reduction = 5 points
RR = Resource Recovery = 4 points
RI = Recycling (in-process) = 4 points
RE = Recycling (end-of-pipe) = 3 points
TI = Treatment (in-process) = 2 points
TE = Treatment (end-of-pipe) = 1 point

2. The implementation potential (IP) is the chance that you believe this option has of being implemented in your shop.

High = 4 points Low = 2 points
Medium = 3 points None = 0 points

For options that you evaluate as "none" or having no potential for being implemented into your shop, no further evaluation is necessary since you feel that you can not implement those options.

3. "Type of option" refers to the groups or classes the authors felt would cover the majority of the options. These four classes or types of options are our designations; you may feel that a further breakdown is necessary. You may want to establish your own classes, which is okay, since only you know about your individual shop practices. The four classes:

P/P = Policy or Procedural Change = 4 points
PM = Process Modification = 3 points
EM = Equipment Modification = 2 points
NE = New Equipment = 1 point

4. The "cost of option" refers to what you feel it will cost to implement this waste minimization option.

None/no cost = 4 points Medium cost = 2 points
Low cost = 3 points High cost = 1 point

Example: Evaluate the following two options to determine the most attractive waste minimization option:

1) "First-in, First-out" Material Usage Policy
2) Recycling Rinsewater

Table 3: Waste Minimization Option Evaluation

Waste Minimization Technique	WMH* Scored By Authors	IP* H (4) M (3) L (2) N (0)	Option Type P/P (4) PM (3) EM (2) NE (1)	Option Cost N (4) L (3) M (2) H (1)
1. First-in, First-out Material Policy	SR (5)	H (4)	P/P (4)	N (4)
2. Recycling (in-process)	RI (4)	L (2)	NE (1)	M (2)

*WMH = Waste Minimization Hierarchy *IP = Implementation Potential

After totaling the scores you can see that implementing a "first-in, first-out" material usage policy should be implemented before recycling rinsewater. The next step is further evaluation of the economic feasibility and associated payback period using the worksheet in Section 3.

After evaluating each option in the four areas, add up their scores and complete the table. After completion of the table for the options identified for use in your shop, a prioritization or order in which to further explore the options should result.

This is a preliminary analysis of the options to quickly identify those options desireable for implementation in your shop. A more detailed study into the costs of each option should be conducted to see exactly how the option will affect your shop financially.

The above classes and point values for each area were determined by the authors of this document; they are not hard and fast rules, only guidelines. If you feel you have more than four types of options, you can develop your own type of options and their respective point values.

This document is to stimulate your thinking about waste minimization options within your plant.

Table 3A: Summary of Waste Minimization Options

Waste Minimization Technique	WMH' Scored By Authors	IP* H (4) M (3) L (2) N (0)	Option Type P/P (4) PM (3) EM (2) NE (1)	Option Cost N (4) L (3) M (2) H (1)
1. Management Practices	N/A			
Established waste minimization program				
Material balances performed				
Regulatory compliance				
2. Plant Operations Management				
Sequential operations adjacent	SR (5)			
Proper process bath preparation	SR (5)			
Maintain dust collectors and fans	SR (5)			
Formal facility inspection plan	SR (5)			
3. Raw Materials Storage and Handling				
Inspect raw materials	SR (5)			
Computerized inventory storage	SR (5)			
"First-in, first-out" usage	SR (5)			
Label and date raw materials	SR (5)			
Return obsolete material to supplier	SR (5)			
Periodic inspections	SR (5)			
Minimize stock	SR (5)			
Clear policy for materials use				
Return empty containers to supplier	SR (5)			
Separate hazardous from nonhazardous	SR (5)			
Segregate materials	SR (5)			
Limit raw materials access	SR (5)			
4 Spills				
Equipment inspections	SR (5)			
Spill prevention policy	SR (5)			
5. Material and Chemical Substitution				
Substitute for hazardous materials				
• bright or de-ox alloy	SR (5)			
• hydrofluoric acid	SR (5)			
• potassium and sodium cyanide stripping compounds	SR (5)			

*WMH = Waste Minimization Hierarchy

*IP = Implementation Potential

Table 3A: Summary of Waste Minimization Options

Waste Minimization Technique	WMH* Scored By Authors	IP* H (4) M (3) L (2) N (0)	Option Type P/P (4) PM (3) EM (2) NE (1)	Option Cost N (4) L (3) M (2) H (1)
5. Material and Chemical Substitution (cont.)				
• tripoli compounds	SR (5)			
• chlorofluorocarbon spray	SR (5)			
• cadmium-based compounds	SR (5)			
• chlorinated solvents	SR (5)			
Substitute with deionized water	SR (5)			
Reduce acid in cleaning solutions	SR (5)			
6. Process Operations				
Replace oven burnout	SR (5)			
Break investment under water	SR (5)			
Substitute for cyanide bombing	SR (5)			
Substitute for mechanical polishing and buffing operations	SR (5)			
Use antioxidant soldering flux solutions	SR (5)			
Particulate emission controls	SR (5)			
Reduction of dragout				
• reduce bath concentrations	SR (5)			
• increase bath temperatures	SR (5)			
• optimal workpiece removal rate	SR (5)			
• install bars or railings	SR (5)			
• use drip collection devices	SR (5)			
• countercurrent rinse system	SR (5)			
• drag-iddrag-out rinsing technique	SR (5)			
Process baths				
• static dragout tanks	SR (5)			
• remove impurities from solutions	SR (5)			
• remove anodes	SR (5)			
Rinsing				
• separate dragout and rinse tanks	SR (5)			
• optimal rinse flow rate	SR (5)			
• flow control devices	SR (5)			
• water line supervision	SR (5)			

*WMH = Waste Minimization Hierarchy

IP = Implementation Potential

Table 3A: Summary of Waste Minimization Options

Waste Minimization Technique	WMH* Scored By Authors	IP* H (4) M (3) L (2) N (0)	Option Type P/P (4) PM (3) EM (2) NE (1)	Option cost N (4) L (3) M (2) H (1)
7. Recycling and Resource Recovery				
Recycling of aqueous wastes				
• recycle rinsewater	RI (4)			
• bath regeneration	RI (4)			
• segregate waste streams	SR (5)			
Precious metals recovery				
• recover precious metals	RE (3)			
• test casting residue	RE (3)			
• floor and bench sweeps	RE (3)			
• wastewater sludges	RE (3)			
Offsite recycling	RE (3)			
Waste exchanges	RE (3)			
8. Treatment and Pretreatment				
Onsite treatment	TE (1)			
Offsite treatment	TE (1)			
Waste segregation	SR (5)			
9. Hazardous Waste Storage and Handling				
Inspect storage areas	SR (5)			
Store different waste types in separate containers	SR (5)			
Cover storage containers	SR (5)			
Containment (curbs or dikes)	SR (5)			
Document wastes (i.e., origin and disposal with incurred disposal costs)	SR (5)			

*WMH = Waste Minimization Hierarchy

*IP = Implementation Potential

Waste Minimization Technique	WMH* Scored By Authors	IP* H (4) M (3) L (2) N (0)	Option Type P/P (4) PM (3) EM (2) NE (1)	Option Cost N (4) L (3) M (2) H (1)
The following section is for you to identify waste minimization opportunities that are specific to your shop, or that we may have overlooked. The table is for your use only, as is this entire document.				
1.				
2.				
3.				
4.				
5.				

*WMH = Waste Minimization Hierarchy

*IP = Implementation Potential

SECTION 3: PROFITABILITY WORKSHEET

The worksheet below can be used to calculate rough estimates **of** projected costs, savings, and payback periods associated with each waste minimization technology. These worksheets do not take into account amortization, depreciation, or tax factors.

Waste Minimization Technique: _____

Capital Costs _____
Equipment _____
Installation _____
Utilities _____
Production Down Time _____
Construction Materials _____
Other _____
Implementation Costs: _____

Payback **Period** =

Capital Investment

Annual Operating Cost Savings

TABLE 4: Annual Operating Cost Savings
(Use negative numbers to indicate costs that will increase.)

Estimated Savings Materials or **Service**	Cost per unit (units) (1)	**Total Savings** ($/unit) (2)	(1) x (2)
Water			
Sewer			
Power			
Chemicals			
Waste Handling			
Fees/Penalties			
Labor			
Miscellaneous			
		Total Annual Savings:	

APPENDIX A:
TABLES OF WASTE MINIMIZATION OPPORTUNITIES

The following tables summarize the waste minimization options in the checklist sections. They will assist you in prioritizing the options you may be able to implement. (Tables summarizing the waste minimization options are included for each section of the checklist.)

Table A1: Summary of Management Practices and Plant Operations Management Waste Minimization Opportunities

Waste Minimization Technique	Currently Used Yes/No	High	Medium	Low	None
Management Practices					
Established waste minimization program					
Material balances performed					
Regulatory compliance					
Plant Operations Management					
Sequential operations adjacent					
Proper process bath preparation					
Maintain dust collectors and fans					
Formal facility inspection plan					

TABLE A2: Summary of Raw Materials Storage and Handling and Spill Prevention Waste Minimization Opportunities

Waste Minimization Technique	Currently Used Yes/No	Implementation Potential			
		High	Medium	Low	None
Raw Materials Storage and Handling					
Inspect raw materials					
Computerized inventory storage					
"First-in, first-out " usage					
Label and date raw materials					
Return obsolete material to supplier					
Periodic inspections					
Minimize stock					
Clear policy for materials use					
Return empty containers to supplier					
Separate hazardous from nonhazardous					
Segregate materials					
Limit raw materials access					
Spills					
Equipment inspections					
Spill prevention policy					

TABLE A3: Summary of Material and Chemical Substitution Waste Minimization Opportunities

Waste Minimization Technique	Currently Used Yes/No	Implementation Potential			
		High	Medium	Low	None
Material and Chemical Substitution					
Substitute for hazardous materials					
• bright or de-ox alloy					
• hydrofluoric acid					
• potassium and sodium cyanide stripping compounds					
• tripoli compounds					
• chlorofluorocarbon spray					
• cadmium-based compounds					
• chlorinated solvents					
Substitute with deionized water					
Reduce acid in cleaning solutions					

TABLE A4: Summary of Process Operations Waste Minimization Opportunities

Waste Minimization Technique	Currently Used Yes/No	Implementation Potential			
		High	Medium	Low	None
Process Operations					
Replace oven burnout					
Break investment under water					
Substitute for cyanide bombing					
Substitute for mechanical polishing and buffing operations					
Use antioxidant soldering flux solutions					
Particulate emission controls					
Reduction of dragout					
• reduce bath concentrations					
• increase bath temperatures					
• optimal workpiece removal rate					
• install bars or railings					
• use drip collection devices					
• countercurrent rinse system					
• drag-in/drag-out rinsing technique					
Process baths					
• static dragout tanks					
• remove impurities from solutions					
• remove anodes					
Rinsing					
• separate dragout and rinse tanks					
• optimal rinse flow rate					
• flow control devices					
• water line supervision					

TABLE A5: Summary of Recycling and Resource Recovery, Treatment and Pretreatment, and Hazardous Waste Storage and Handling Waste Minimization Opportunities

Waste Minimization Technique	Currently Used Yes/No	Implementation Potential			
		High	Medium	Low	None
Recycling and Resource Recovery					
Recycling of aqueous wastes					
• recycle rinsewater					
• bath regeneration					
• segregate waste streams					
Precious metals recovery					
• recover precious metals					
• test casting residue					
• floor and bench sweeps					
• wastewater sludges					
Offsite recycling					
Waste exchanges					
Treatment and Pretreatment					
Onsite treatment					
Offsite treatment					
Waste segregation					
Hazardous Waste Storage and Handling					
Inspect storage areas					
Store different waste types in separate containers					
Cover storage containers					
Containment (curbs or dikes)					
Document wastes (i.e., origin and disposal with incurred disposal costs)					

ADDITIONAL PUBLICATIONS

Waste Audit Studies:	Metal Finishing Industry
	Fabricated Metal Products Industry
	Printed Circuit Board Industry
	Gold, Silver, Platinum, and Other Precious Metals Product and Reclamation
Technical Reports:	Guide to Solvent Waste Reduction Alternatives, Final Report
	Reducing California's Metal-Bearing Waste Streams

FURTHER INFORMATION

For more information and a complete publications list, contact the Technology Clearinghouse at:

Department of Toxic Substances Control
Office of Pollution Prevention and Technology Development
P.O. Box 806
Sacramento, CA 95812-0806
(916) 322-3670

For information about your regulatory requirements, contact the Department's regional office nearest you:

Region 1	-	Sacramento	(916) 255-3545
		Fresno	(209) 297-3901
Region 2	-	Berkeley	(510) 540-2122
Region 3	-	Glendale	(818) 551-2800
Region4	-	Long Beach	(310) 590-4868

For information about waste exchanges, contact the:
California Waste Exchange at (916) 322-4742 or
California Materials Exchange at (800) 553-2962

To get an €FA ID number, contact the:

Department of Toxic Substances Control
Generator Information Services Unit (GISU)
(916) 324-1781
(916) 324-1790
(800) 618-6942

To purchase a copy of the California Code of Regulations, call (415) 244-66II, or write:

Barclays Law Publishers
P.O. Box 3066
South San Francisco, CA 94083-3066
(There is a charge for the regulations.)

For information on registered haulers, contact:

Motor Carrier Safety Unit
1551 Benicia Road
Vallejo, CA 94591
(707) 648-4180

California Highway Patrol
Motor Carrier Safety Unit
437 North Vermont Avenue
Los Angeles, CA 90004
(213) 664-1108

California Highway Patrol
Motor Carrier Safety Unit
11336 Trade Center Drive
P.O. Box 640
Rancho Cordova, CA 95741-0640
(916) 464-2090

For general questions about small quantity generators or federal regulations, call:

U.S. EPA, Small Business Ombudsman Clearinghouse Hotline	(800) 368-5888
U.S. EPA, RCRA (Resource Conservation and Recovery Act) Hotline	(800) 424-9346
U.S. EPA, Community Regulations, Region IX, San Francisco, CA	(800) 231-3075
U.S. EPA, RCRA Information Line, Region IX, San Francisco, CA	(415) 744-2074

For Jewelry Manufacturers Association Member services information, contact the:

Manufacturing Jewelers and Silversmiths Association
100 India Street
Providence, Rhode Island 02903
(401) 274-3840

NOTES:

NOTES:

California Department
of Toxic Substances Control
Office of Pollution Prevention
and Technology Development
***Technology Clearinghouse** Unit*

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