

Writing a Waste Reduction Plan for Health Care Organizations

Sponsored by:

Tennessee Hospital Association

Tennessee Valley Authority

The University of Tennessee Center for Industrial Services

In cooperation with Tennessee Department of Environment and Conservation

About This Handbook

This handbook will help your hospital comply with the Tennessee Hazardous Waste Reduction Act of 1990, the Resource Conservation and Recovery Act (RCRA), and the Joint Commission requirement for a management plan to consider hazardous wastes.

In it, you will find information to help you identify and assess pollution prevention/waste reduction options. You will also find answers to questions such as:

- How do I identify RCRA hazardous wastes?
- What are the rules for hazardous waste generators?
- How do I write a plan to reduce wastes?
- How do I conduct a waste reduction assessment?
- How do I implement waste reduction practices?

Because individual hospital circumstances and needs vary widely, you should modify the waste reduction opportunities to meet your own unique requirements.

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ABOUT THE SPONSORS

Tennessee Hospital Association, established in 1938 as a not-for-profit membership association, serves as an advocate for hospitals and the patients they serve, provides education and information for its members, and informs the public about hospitals and health care issues at the state and national levels.

The Tennessee Department of Environment and Conservation's Division of Pollution Prevention and Environmental Awareness and Division of Solid Waste Assistance exist to help industries and counties implement voluntary pollution prevention measures.

Tennessee Valley Authority is a resource development arm of the federal government committed to environmental leadership supporting creative solutions to environmental problems. Through public and private partnerships, TVA promotes sustainable economic development by educating corporate America on the value of waste reduction.

The University of Tennessee Center for Industrial Services is Tennessee's statewide industrial extension program. CIS provides technical and management assistance to Tennessee industry and hospitals to help them prosper. CIS was created in 1963 by the Tennessee General Assembly to "render service to the industries in this state by providing information, data, and materials relating to the needs and problems of industry."

Why Do We Need A Written Plan?

The first answer to this question is that The Joint Commission 1995 Accreditation Manual for Hospitals standard on “Management of the Environment of Care” requires that health care organizations have “a documented management plan(s) for the environment of care that considers... hazardous materials and wastes.”¹

Secondly, the Hazardous Waste Reduction Act of 1990² requires a plan to reduce RCRA hazardous waste from all large and small quantity generators in Tennessee. The Act provides for civil penalties of up to \$10,000 per day for failure to file, refusal to comply, or knowingly giving false information.

In addition, every time you dispose of your hazardous wastes with a disposal company, you prepare and sign the EPA-required manifest. Above your signature is a certification statement that states “**I [you] certify that you are making your best efforts to reduce hazardous waste generation.**” Having this written plan and making annual progress reports documents that certification of having a program-in-place.

Additional reasons include:

- A plan may help you lower your waste disposal cost and other less obvious expenditures. These costs make your operation less profitable. The plan may also help you justify capital expenditures to upper management for waste reduction investments.

Remember, the true cost of wastes include:

- **Management or oversight costs** (administrative record keeping costs, regulatory reporting and compliance cost, environmental training cost, spill and emergency response costs, and monitoring costs)
- **Waste disposal costs** (on-site labor, safe and legal storage space, laboratory analysis costs, value of raw materials lost, and off-site disposal cost), and
- **Potential liability costs** (cleanup cost, long-term employee health care cost, legal fees, and bad public image impact).

- A plan may help you reduce your “cradle to grave” liabilities.

When your organization generates hazardous wastes, it assumes perpetual liability for any future impacts those wastes may have on the environment because of storage, treatment, or disposal practices.

- A plan will identify waste reduction opportunities.

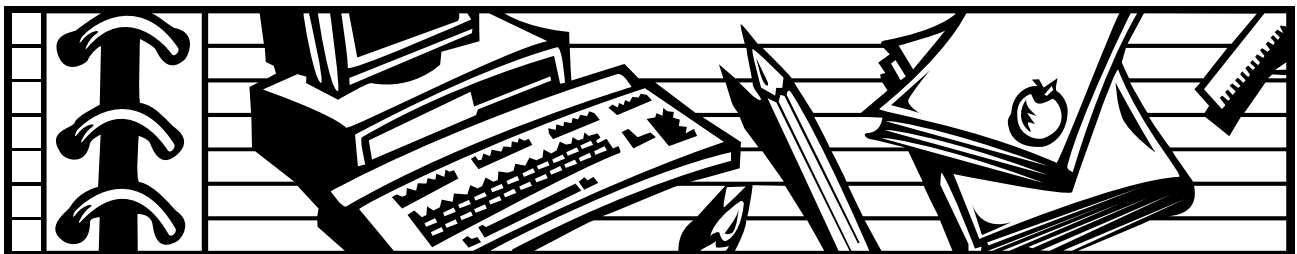
The procedure involved in writing an effective waste reduction plan requires that you and a team carefully examine all operations and practice, including procurement. Close observation of processes and procedures by a team of people with different expertise is likely to result in improvements in productivity, quality, safety, and waste reduction.

- A plan is good for employees.

Reducing the facility hazardous waste generation rate reduces employee exposure to materials that may harm their health. It also involves them as stakeholders in the waste reduction program.

- A plan can be inexpensive and easily implemented.

Much of the waste may be generated unnecessarily and is easily eliminated with minimal efforts, modest changes in procedures, and waste awareness training. These better operating procedures can improve profitability without significant expenditure.



Four Commonly Asked Questions



1. Is our plan a public record and available to anyone who wants to see it?

No. Your plan and annual updates remain on your premises. The plan and updates must be available for on-site inspection by the Tennessee Department of Environment and Conservation (TDEC). You are not required to file them with the Solid Waste Control Board or any other state agency. You report progress to TDEC in your Annual Hazardous Waste Activities Report.

2. Am I required to reduce my hazardous waste by 25 percent?

No. The 25 percent reduction before June 30, 1995 is a statewide reduction goal. Individual generators have no limits. However, generators are expected to set goals that support Tennessee's policy that states, "wherever economically and technically feasible, the generation of hazardous waste is to be prevented or reduced as expeditiously as possible."³



3. Does the Solid Waste Management Act of 1991 require us to reduce solid waste generated and hauled to the landfill?

No. It does require Solid Waste Planning Regions (counties or groups of counties) and municipalities to reduce the amount of solid waste landfilled and incinerated by 25 percent before December 31, 1995. This means that industrial, commercial, and institutional generators will eventually find disposal costs increasing. So, solid waste reduction will make greater economic sense as the years progress. For this reason, you should consider writing a waste reduction plan to include solid waste reduction. **Many generators of hazardous waste will find greater economic benefits for reducing solid waste than for hazardous waste.**

4. How do we get started on a waste reduction plan?

In order to plan waste reduction, it is first necessary to identify your wastes. You must at least know what your wastes are and how much is generated. To do this you must conduct a waste reduction assessment.

Most companies that have a plan believe the team approach will include a cause champion, or team leader. The cause champion will have ideas, broad-based talents and insights. Other cause champions may include the environmental or safety director for the hospital or a laboratory technician who knows instrumentation and may easily observe wasteful equipment performance. Purchasing department personnel and lab managers who oversee test quality can help identify wasteful practices and propose corrective action. The assessment team should have members from different disciplines such as safety and environment, facility maintenance, laboratory services, infection control, and housekeeping. Independent consultants from university-based programs or private companies can be of great benefit because they can more easily observe and objectively question “traditional ways of doing things.”



During an assessment, identify, quantify, and profile each waste stream. The profile must include a description of the operation or process that causes generation and factors impacting generation and quantities. Once the wastes are profiled, the opportunities for waste reduction are easily identified. Remember, every waste stream is a waste reduction opportunity.

Chapter 1 Hazardous Waste



The first responsibility for a hazardous waste generator is to identify all RCRA hazardous wastes generated. A waste is hazardous if it appears on one of EPA's hazardous waste lists or if it exhibits a hazardous characteristic.

EPA has four hazardous waste lists. These lists are found in 40 CFR 261. Any RCRA waste that appears on these lists is hazardous and has a designated waste code. The first list is for nonspecific sources and is called the "F" list. An example of an "F" listed material is spent xylene found in histology laboratories and the sludge generated from distilling xylene. The waste has an F003 hazardous waste code.

The "K" list is for wastes from specific sources. The lists typically include waste water sludge and probably will not apply to hospitals.

The "P" and "U" lists contain chemical products, off-spec materials, container residues and spill residues. The "P" list contains acutely toxic wastes and if 1kg (2.2 lbs) of a "P" listed waste is generated, the facility is a Large Quantity Generator (LQG). Mercury is a typical "U" listed waste.

If a waste exhibits a hazardous characteristic, then it is a hazardous waste. The four characteristics are:

IGNITABLE (D001) means the waste has a flash point $< 140^{\circ}$ F. An example of an ignitable waste is xylene which is a D001 and a F003 waste. Both numbers must be used on the hazardous waste manifest.

CORROSIVE (D002) means the $\text{pH} \leq 2.0$ or ≥ 12.5 . Strong acids and strong bases are examples of corrosive hazardous wastes.

REACTIVE (D003) means the waste is unstable or reacts with water—unstable ethyl ethers that easily form explosive peroxides, for example.

TOXIC (D004-D043) means that the waste exceeds regulatory concentrations of toxic chemicals such as lead, chromium or mercury. A complete list of toxic wastes are in the TCLP Technical Bulletin produced by CIS in Appendix A.

The first step for identifying a hazardous waste is to review the four lists and determine if any of the wastes appear on them. Next, determine if the wastes exhibit one of the four characteristics. With most materials it will be obvious. Other times, it is not so clear. It may be necessary to obtain a laboratory analysis of the waste to determine if it exhibits one of the four characteristics.

Most Material Safety Data Sheets (MSDSs) will list the characteristic properties of the material. Just because an MSDS shows that the raw material has a hazardous waste characteristic (e.g. a flash point < 140° F) does not mean the waste from the process that uses that material will exhibit the characteristic. The process may alter the chemical properties so that the flash point is 140° F or greater.

Also, materials that do not display the hazardous characteristic may produce a waste that is characteristic. You must combine your knowledge of the materials and the process to determine if the wastes are characteristic or listed.

You can get assistance with identifying hazardous wastes from TDEC (615) 532-0780, from disposal vendors, from the EPA Superfund Hotline (800) 424-9346, and from the University of Tennessee Center for Industrial Services (615) 532- 8657.

LIST ALL HAZARDOUS AND NON-HAZARDOUS WASTE STREAMS GENERATED AT YOUR FACILITY.



1. Xylene

2.



3.

HANDS ON TASK

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

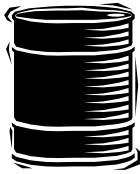
Identify wastes that have been eliminated, reduced, or recycled. Check the action taken and comment if appropriate. **List your RCRA hazardous wastes first.**

TABLE 3 Hazardous Waste Regulations

CONDITIONALLY EXEMPT SMALL QUANTITY GENERATOR (CESQG) HAZARDOUS WASTE RULES AND REGULATIONS

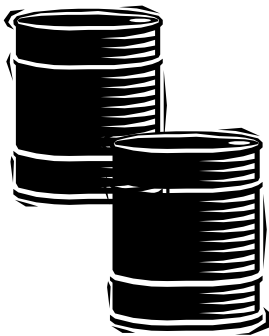
CESQGs have the least compliance requirements. In addition to the accumulation limits in Table 3, they must also comply with numbers 1, 5, and 6 of the SQG requirements.

Category	Generation Rate	Accumulation Limit
Conditionally Exempt Small Quantity Generator (CESQG)	Generates less than 100 kg (220 lbs) in any calendar month	Accumulate no more than 1000 kg (2200 lbs)
Small Quantity Generator (SQG)	Generates between 100 kg (220 lbs) and 1000 kg (2200 lbs) in any calendar month	Accumulate no more than 6000 kg (13,200 lbs or thirty, 55 gallon drums). Must be shipped within 180 days of Accumulation Start Date. If the waste must be shipped more than 200 miles, the waste must be shipped within 270 days.
Large Quantity Generator (LQG)	Generates more than 1000 kg (2200 lbs) in any calendar month	Wastes must be shipped within 90 days of Accumulation Start Date. Unforeseen circumstances that delay shipping may be eligible for a 30 day extension from TDEC.



SMALL QUANTITY GENERATOR HAZARDOUS WASTE RULES AND REGULATIONS

1. The SQG must determine the types and amounts of hazardous waste generated and the waste code for each waste. Records documenting the basis of this determination (generator's knowledge, laboratory analysis, etc.) must be kept for three years.
2. The SQG must have an EPA Identification number.
3. Label each hazardous waste container "Hazardous Waste."



- If the drum is in the hazardous waste storage area, mark the date accumulation begins on each container so it is visible for inspection.
 - If the drum is in a satellite accumulation area, the official **Accumulation Start Date** is the date when the drum becomes full. When the drum is full, it must be transported from the satellite accumulation area to the main storage area within three days.
4. Package, label and mark the waste according to DOT regulations prior to shipping. The labeling must include the SQGs name, address, and manifest number.
 5. Use only EPA permitted waste transporters, storage and disposal facilities to dispose of wastes. They should be bonded, insured, and able to show you permits upon request. If the transporter does not have placards, the hospital must provide the appropriate placards before shipping wastes.
 6. Ship the wastes with a Uniform Hazardous Waste Manifest and keep the manifest for three years. If you have not received a signed copy of the manifest within 45 days of shipment, file an Exception Report with TDEC. The hazardous waste manifest is used to track hazardous wastes from "cradle to grave". It also contains information about the wastes in case of an emergency.
 7. Submit by March 1 an Annual Report on hazardous waste activity for the previous calendar year. Generators with EPA ID numbers receive these Annual Report from TDEC at the beginning of the calendar year.
 8. Develop a Hazardous Waste Reduction Plan and an annual "Plan Update Report." Keep these reports on-site and have them available for inspection by TDEC.

9. Emergency Coordination

- a. The generator must name an emergency coordinator who is either on premises or on call.
- b. The generator must post next to a telephone:
 1. The emergency coordinators name and phone number.
 2. The location of fire extinguishers, spill control material and fire alarm(s).
 3. The fire department phone number (unless there is a direct alarm).
- c. Employees must be thoroughly familiar with proper waste handling and emergency procedures relevant to their responsibilities. They must know when an emergency requires third party intervention.
- d. If the generator has knowledge that a spill has reached surface water, the generator must notify the Tennessee Emergency Management Agency (800) 262-3300 or the National Response Center (800) 424-8802.

10. Preparedness and Prevention

- a. Maintain and operate the facilities to minimize the possibility of fire, explosion or an unplanned release of hazardous waste.
- b. All facilities must have an internal communications or alarm capable of providing immediate emergency instruction (voice or signal).
- c. A device (e.g., telephone) to summon police, fire department or emergency response teams must be maintained.
- d. Maintain portable fire extinguishers, fire control equipment, spill control equipment and decontamination equipment.
- e. Provide employees with immediate access to an internal alarm or emergency communication (visual or voice contact) whenever hazardous waste is being poured, mixed, spread, or otherwise handled.
- f. Be sure that aisle space permits the movement of personnel,

fire, and spill containment equipment around stored hazardous waste.

- g. Make arrangements to familiarize police, fire departments, hospitals and emergency response teams to potential emergency situations that will require their services.
- h. Periodically test and maintain communication systems and control equipment.

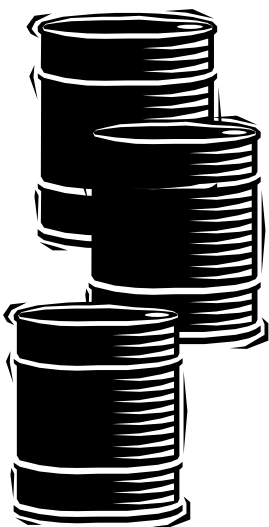
11. Storage

Keep containers in good condition and keep them closed except when adding waste. Inspect storage areas for leaks and deterioration every week. A sample container inspection log is in Appendix B.

LARGE QUANTITY GENERATOR (LQG) HAZARDOUS WASTE RULES AND REGULATIONS

Large Quantity Generators (LQGs) must meet the specific requirements in Table 3 and numbers 1-11 listed in “Small Quantity Generator Hazardous Waste Rules and Regulations” section. In addition to those requirements, the LQG must also comply with the following:

- 12. Prepare a “Hazardous Waste Emergency Contingency Plan.” The Emergency Coordinator has additional duties during and after an emergency event. You can find those duties in the “Hazardous Waste Contingency Planning” technical bulletin produced by CIS is in Appendix C.



- 13. Train personnel on handling hazardous wastes in emergencies, emergency waste management, and implementing the hospital's hazardous waste contingency plan. The training must include numbers 9 and 10 for SQGs and:

- a. Response to ground water contamination
- b. Shutdown of operations

- 14. Maintain documentation demonstrating employee class-room or on-the-job training. Keep training records of former employees for three years beyond the last date of employment. Keep records of current employees until the facility closes. Those documents must show:

- a. Title and name of each employee with a hazardous waste position, a written job description giving requisite qualifications and assigned duties.
- b. Records that document training of employees.

15. SQGs and LQGs must also file a report and pay remedial action fees to TDEC's Superfund by October 15 of each year.

You have just been familiarized with some very important generator rules. There will be additional regulations for disposal of individual wastes in your facility. Now, let's write a plan to reduce wastes.

WRITING A WASTE REDUCTION PLAN

STEP 1

The first step in writing a plan is drafting a preface. The preface is not a mandatory requirement. A preface will list the successes and accomplishments in waste reduction prior to writing the plan and/or the impediments to hazardous waste reduction specific to the facility. Remember, this plan is for **RCRA hazardous waste** reduction. Ideally, you will want to have a separate plan for solid

and regulated medical wastes.

STEP 2

The second step is drafting a policy statement. The policy statement is a formal statement that best conveys waste reduction program objectives to employees. In the policy statement for your hospital, you may want to list motivations for waste reduction planning. A sample plan is in Chapter 4.



STEP 3

The third step is development of the scope, objectives, and waste reduction plan administration. The checklist helps you with the contents of this section of the plan. [Information on the final step, **Step 4**, begins on page 23]



I. The **SCOPE** identifies what and whom the plan involves, and why.

II. The **OBJECTIVES** describe what the plan is expected to accomplish, and when.



III. The **MEANS** identifies what and who will be used to accomplish the plan.



From the items below, check what you want to include in your statement.



I. Scope

A. Why will the hospital develop a plan?



1. To comply with the Tennessee Hazardous Waste Reduction Act of 1990

2. To comply with Joint Commission standard that requires this organization to have a documented management plan(s) for The Environment of Care that considers hazardous materials and hazardous wastes
3. To reduce the hospital's impact on the environment:
4. To improve hospital's corporate image.
5. To protect the safety and health of employees.
6. Other(s) _____



B. Who is involved?

1. Corporate-management
2. Hospital administrators
2. All employees
3. Other(s) _____

C. What wastes will the plan reduce?

1. RCRA hazardous wastes
(e.g., xylene, mercury, formaldehyde, silver, pharmaceutical, etc.)
2. Wastewater
3. Other(s) _____
4. Solid Wastes (e.g., cardboard, plastics, packaging wastes, etc.) *Note: Include solid wastes in another plan because they are not hazardous.*

II. Objectives

A. What is our final goal?

1. To reduce all waste streams (as defined in the plan's scope) to the technically feasible and economically practicable minimum.
2. To reduce RCRA hazardous wastes by ____ percent.

Note: Each hazardous waste stream must have its own specific goal per production unit to comply with the law.

3. Other

B. By what dates?

1. By June 30, 1995 *Note: This date is TDECs deadline for a 25 percent reduction statewide.*
2. In calendar year 1995.
3. Each year until eliminated.
4. According to other timetable(s) established by team.
5. Other _____

III. Means

A. What will we use to accomplish our objectives?

1. Waste Reduction Team Assessments (every 6 months or annually;). See page 9 for who to include in your team.
2. Annual progress report required by law.
3. New processes, equipment or process changes.
4. Employee training.
5. Raw material substitution.
6. Waste tracking system.
7. Charging waste management cost to generating department.
8. Improved maintenance and preventive maintenance programs.
9. Improved scheduling and inventory controls.
10. On-site recycling.
11. Off-site recycling.
12. Waste stream separation.

13. Employee incentives.

14. Other _____

B. Who is responsible?

1. An individual
(Name) _____

2. A position (Job Title) _____

3. A team composed of: (names and job titles)

4. Individuals or positions, depending on area of responsibility

Now, take your choices and put them together into a one-page or shorter statement similar to the sample plan in Chapter 4. You have just initiated the first steps toward completing your plan.

STEP 4

The fourth step in completing your hazardous waste reduction plan will require you to develop quantitative goals in numeric terms. The preferred unit of measurement is **grams or pounds** of waste generated **per unit of production**. You may define your unit of production. If numeric goals are not practical, the plan must include a clearly stated list of actions leading to the establishment of numeric goals as soon as practicable.



HANDS ON TASK

Chapter 2 OPPORTUNITIES

THE WASTE REDUCTION ASSESSMENT

In order to assess your facility for waste reduction opportunities, you must know some definitions **and** be able to identify wasteful processes and procedures.

Waste Reduction Hierarchy

Your waste reduction plan requires that you identify source reduction opportunities. Source reduction refers to any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or released into the environment prior to recycling, treatment, or disposal.

Source reduction opportunities includes identifying wasteful **purchasing patterns, raw material substitution, process or procedure modifications, improvements in inventory control, training, maintenance, and housekeeping.** Periodically assess these areas to reduce unnecessary waste generation.

If you cannot eliminate the generation of waste, then evaluate **recovery, reclamation, reuse, and recycling** of wastes. Successes in recycling are documented in non-hazardous, solid waste streams like cardboard and paper. However, distillation units can successfully recycle xylene in histology laboratories for reuse.

If source reduction and recycling are not feasible or possible, then consider **treatment.** Neutralizing acids and bases and diluting alcohols for POTW disposal are examples of waste treatment.

As a final option, consider **disposal** through permitted transporters and waste management companies. Municipal landfills will not accept hazardous wastes.

OPPORTUNITIES

On the following pages you will read about opportunities to reduce waste in your facility. When appropriate, you will also find regulatory requirements for the waste streams listed.

Check off with an ink pen the opportunities that will definitely help your facility reduce waste. Then, with a pencil (or different colored pen) check off the waste reduction opportunities that would help you but are more difficult to implement because of barriers. You can use this information to complete your waste reduction plan and develop your implementation schedule.

PURCHASING

Look at your hospital's purchasing program. Purchasing practices may contribute significantly to waste generation. Chemicals can become obsolete due to expired shelf-life. Mismanaged supplies can become waste. Eliminate, reduce, or recycle packaging materials where possible. Inventory controls and practices can help to reduce wastes. While purchasing programs will vary, they should:

1. Monitor requests for chemicals and implement policies to reduce over-purchasing that results in waste generation. Those policies can include:

- Procure chemicals through a central department or person.
- Minimize of on-hand inventory.
- Determining where Just-In-Time inventory can be implemented in the hospital.
- Stagger deliveries.
- Accommodate partial purchasing of orders from departmental managers if quantities seem excessive.
- Arrange for partial shipment of supplies with the remainder shipped on as-needed basis.
- Negotiation with purchasing alliance to exclude certain items in patient care kits that are repeatedly not used in patient procedures and become unused waste.
- Negotiating the return of unused reagent chemicals or obsolete raw materials and their containers to the supplier or manufacturer.
- Purchase smaller quantities of chemicals and supplies not frequently used.
- Purchase chemicals in totes or in recyclable containers.
- Control acquisition and use of reagents that have limited shelf-life. These supplies should be ordered in smallest practical container (e.g. ethyl ether and its formation of explosive peroxides).
- Purchase of large quantities of chemicals and supplies frequently used.



HANDS ON TASK

- Avoid over-purchase of supplies. Order reagents and chemicals in exact amounts to be used. Be careful when ordering extra quantities to take advantage of unit cost savings. You can lose the net savings for unused chemicals.
2. Encouraging suppliers to become responsible partners by providing quick delivery of small orders, accept return of unopened stock, and accept sealed bottles of stable chemicals that may be resold.
 3. Requiring an on-going relationship involving waste reduction with suppliers and purchasing alliance representatives.

INVENTORY CONTROL

Managing the inventory provides the next best opportunity to reduce hazardous waste generation. A good inventory control program will attempt to:



- Adopt first-in, first-out order.
- Ensure distribution throughout the facility through one person.
- Reduce chemical use where possible.
- Promote sharing of chemicals between common users.
 - Develop and implement a program involving the reuse of unwanted, but usable chemicals. A computerized, running inventory of unused reagent chemicals for re-use in other departments is helpful.
- Track waste generation:
 - Develop data (chemical inventories) by user.
 - Identify high volume users and generators.
 - Locate where caches of unused reagents are and why they accumulate.
 - Monitor reagent chemicals half-life and expiration dates.
- Include every department that contains inventoried chemicals.
- Develop management plans for leftover chemicals with disposal as a last resort. Reduce high volume chemical inventories to an

ideal (four weeks or less) supply level.

- Ensure that the identity of all chemicals is clearly marked on all containers. It is illegal to ship unused reagent chemicals, containers, and solution mixtures and unidentified wastes for disposal without analysis.

XYLENE

Source Reduction Opportunities

MATERIAL SUBSTITUTION

Xylene is used in processors and stainers. Xylene is typically used as a clearing agent that removes paraffin from the tissue. There are alternative chemicals that have been used to replace xylene in the stainers.

Carefully evaluate citrus-based substitutes. Citrus-based alternatives may reduce worker exposure but may produce a hazardous waste because these products may have a flashpoint less than 140°F. These citrus-based solvents may process samples slower than xylene and will require temperature and time modifications. Generally, these products are effective on samples in the micrometer range. However, thicker samples may be difficult or impossible to process. Evaluate hazardous waste and quality issues before using xylene alternatives.

PROCEDURE MODIFICATION

Do not mix wastes unnecessarily. Sometimes wastes are mixed without respect to characteristic and compatibility at the point of generation. In one hospital, five 16-gallon drums of formalin (fixation), alcohols (dehydrators), xylene(processors), chromic acid (glass cleaners), paraffin wax , and water were mixed. In this case, the hospital reduced 75 percent of its RCRA hazardous waste by **not** mixing formalin waste with alcohol waste. The hospital diluted or treated formalin and alcohol and discharged it to the sewer system.

INVENTORY CONTROL

Mounting chemicals are used to stabilize the sample on the slide. These mounting chemicals contain polymers and solvents such as toluene and xylene. Control the inventories of these chemicals because they have limited shelf lives.

Evaluate routine laboratory processes or tests such as fixation and extraction to determine if quantities of reagents are reducible. The evaluation can include:

- using calibrated solvent dispensers.
- using unitized test kits.
- reducing volumes of reagents.
- increasing the use of instrumentation in tests and experiments.

Recycling⁴

There is significant opportunity to reduce hazardous waste generation in hospital histology laboratories by distilling xylene. You can eliminate hazardous waste that must be manifested except for an extremely small quantity of sludge (still bottoms) from distillation, which is an F003 hazardous waste. Other solvent wastes may not have sufficient generation rates to use distillation. Distillation of xylene will reduce xylene raw material costs. At a minimum:

- Evaluate the quality of distilled xylene. Laboratory personnel and/or chemical review board members should agree on recycled xylene quality. Distilled xylene often exceeds virgin xylene quality.
- Do not mix waste streams because this practice may complicate or negate distillation opportunities.
- Standardize solvent usage if possible.

Check with your local fire marshall and OSHA field office to determine if there are location and safety issues that must be addressed. Fire-rated doors and walls, impermeable floors, designated ventilation, and locations away from patient care areas are some issues that must be addressed. Appendix N contains a complete checklist for evaluating the purchase of a distillation unit.

Treatment

Waste xylene that results from the tissue-preparation procedure is often contaminated with an ethanol and water solution. Xylene is

immiscible with water. Any water-miscible solute (e.g., ethanol and formalin) is readily extracted by multiple washes with water. Decanting by gravity separation may make the wash water suitable for disposal to the sewer. Addition of a desiccant salt would remove practically all remaining water. Consult your POTW and/or sewer use permits to ensure that discharge of small amounts of ethanol and formalin will not result in a violation or fines.

Disposal

If distillation of xylene is not feasible, and off-site waste disposal is chosen, wastes should be separated from other wastes. The fuel value decreases when water and oxygenated organic compounds (alcohols) are present. Fuel blenders charge less to dispose of wastes with high heating values.

CHROMIC ACID

Chromic acid is typically used as a glass cleaner. Some POTWs allow disposal of chromic acid solutions provided the pH is adjusted to six and the chromium is reduced. The pH is adjusted by slowly adding NaOH. After this neutralization step is complete, reduce the hexavalent chromium to trivalent chromium by adding saturated sodium bisulfite solution. However, contact your POTW to determine if this neutralization/reduction practice is acceptable to the wastewater treatment process.

ALCOHOL

Methyl, ethyl, and propyl alcohols are sometimes eligible for sewer disposal if quantities are small (less than 100g) and diluted (20 to 50 fold). The alcohols eligible for disposal are generally water soluble, present low toxicity hazard, contain few carbons and acceptable to the local POTW.

FORMALDEHYDE

Source Reduction Opportunities

MATERIAL SUBSTITUTION

Formalin (formaldehyde and water) is used to disinfect dialysis machines and dialyzers. Some dialysis machines are designed to use alternative disinfectants. Check with your machine vendors to determine if bleach, peracetic acid, or other disinfectants can be used instead of formalin. Carefully evaluate all substitutes for cleaning effectiveness and comply with all machine manufacturer requirements.

PROCEDURE MODIFICATIONS

Determine the effective cleaning formalin concentrations. Effective formalin concentration for disinfecting and cleaning machines and disinfecting dialyzers are in the Centers for Disease Control Guidelines. Great potential exists for minimizing formalin waste by optimizing formalin concentration.

MACHINES

Formalin concentrations used to disinfect dialysis machines varies among machines and hospitals. Formalin is typically purchased in concentrations that range from 10 to 37 percent. Many machines will dilute the 37 percent formalin to a 10:1 ratio to achieve a 4 percent **disinfecting** concentration. Formalin concentrations of 2 percent are not recognized as effective disinfectants.

However, some machines will require mixing of formaldehyde and water to produce formalin that is poured into machines. These machines don't internally dilute formalin. Therefore, the effective formalin concentration (4 percent) should be measured accurately and maintained consistently. Using formalin concentrations greater than 4 percent for disinfecting machines may generate unnecessary wastes.

DIALYZERS

Formalin usage may be reduced in dialyzers. The use of special incubators to heat dialyzers in 1.0 percent formalin solution at 40° C for 24 hours may be an effective alternative to using 4 percent formalin at room temperature for 24 hours.⁵

Recycling (Reuse)

In autopsy and pathology laboratories, it may be possible to reuse formaldehyde. These solutions retain their desired properties for periods far longer than the usual holding times for specimens. In addition, the desired preservative properties may be effective at concentrations less than the standard 10 percent.

Treatment

Suppliers may offer chemicals that neutralize formalin. The neutralizers polymerize the aldehyde groups into carbon dioxide and ammonium. The neutralized formalin may be eligible for POTW disposal. Check with your POTW to determine if this practice is acceptable before purchasing these chemicals.

Disposal

Formaldehyde is a listed waste **if** its shelf-life has expired. It is not considered a RCRA hazardous waste when generated from standard tissue processing in histology laboratories. Disposing of formalin in the POTW followed by copious amounts of water may be an acceptable disposal practice. However, consult with local POTWs to determine if discharging formalin wastewater is acceptable.

MERCURY

Mercury is a U listed, RCRA hazardous waste. It is also a characteristic hazardous waste when its concentration is above 0.2 ppm. Mercury is present in significant, but reducible quantities in health care organizations. Significant opportunities exist to reduce its usage.

Source Reduction Opportunities

MATERIAL SUBSTITUTION

Replace mercury-formalin tissue fixatives with zinc-formalin fixatives.

Mercury B-3 and B-5 fixatives are typically used as tissue fixatives. Zinc fixatives are substitutes and can reduce or eliminate mercury chloride precipitates that require costly hazardous waste disposal. The pH in zinc-formalin mixtures has to be carefully controlled. Zinc fixatives provide good nuclear detail but not as good as mercury fixatives. Surgical specimen, biopsies, and skin lesions generally work well with zinc. Bone marrow and cytology specimens may require the use of mercury.

TECHNOLOGY MODIFICATIONS

Replace mercury thermometers and sphygmomanometers with electronic, solid state devices.

The higher initial cost of these devices are typically justified because costly spills, clean-ups and hazards from glass breakage are eliminated.

Evaluate the continued use of Cantor Tubes.

Mercury-containing Cantor tubes contain significant amounts of mercury that must be managed properly.

RECYCLING

Provide mercury spill kits. Mercury recyclers may provide airtight, steel containers that the facility can use for collecting and shipping waste mercury without additional packaging.

FLUORESCENT LIGHTS

Many fluorescent lights are hazardous under the Toxic Characteristic Leaching Procedure (TCLP) testing protocol and are hazardous wastes. The mercury that is released to the environment depends on how the spent lamp is handled during disposal. In order for Tennessee to exempt these lights from the hazardous waste determination requirements, an exemption will require a federal written policy and adoption by states. Fluorescent light recyclers are in Appendix E. For the latest development in federal regulations on fluorescent lamp disposal call:

Toxic Substance Control Hotline (202) 554-1404

Resources Conservation and Recovery Hotline (800) 424-9346

US EPA (202) 775-6650.

Source Reduction Opportunities

To reduce the mercury waste that is generated when lights are disposed, consider:

- Using T8 lamps instead of T-12 lamps.
- Using timed lights or lights with occupancy switches instead of manual switches.
- Implementing the Green Lights Program.



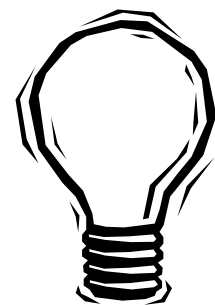
Green Lights Program

The U. S. EPA Office of Air and Radiation operates the Federal Green Lights Program. If you are using fluorescent lights, this program can help you. Many health care organizations have reduced costs significantly by using a combination of T-8 lamps with electronic ballasts, compact fluorescent and other proven lighting technologies.

The internal rate of return for hospitals from lighting upgrades can be as much as 50 percent and savings of up to \$100,000 are typical for a 400,000 s.f. hospital. For the latest information on the Green Lights Program and a list of participating health care organizations, contact the Green Lights General Hotline at (202) 775-6650 or Green Lights Technical Hotline at (202) 862-1145.

RECYCLING

Instead of disposing fluorescent lights as hazardous wastes, consider recycling them. Appendix E contains a list of light recyclers that may service your area. If you choose a recycler, document where and how your lights are disposed. Appendix F contains a list of mercury recyclers.



SILVER

Many chemicals are sensitive to temperature and light. Design photosensitive film and paper storage areas for economical and efficient use. Chemical containers list the recommended storage conditions. Meeting the recommended conditions will increase their shelf life. Store materials properly.

Test materials having expired shelf-life for effectiveness. The materials may be usable, rather than becoming a waste. A recycling outlet should be found for raw materials that are no longer wanted.

PROCESS MODIFICATION

Silver can be recovered from fixing baths to permit bath regeneration. In addition:

- Add ammonium thiosulfate, which increases the allowable concentration of silver buildup in the bath.
- Use an acid stop bath prior to the fixing bath.
- Add acetic acid to the fixing bath as needed to keep the pH low.
- Use counter-current washing to reduce waste water generation from parallel tank systems. In counter-current rinsing, water from previous rinsings is used in the initial film washing stage. Fresh water enters the process only at the final stage, at which point much of the contamination has already been rinsed off the film.
- Accurately adding and monitoring chemical replenishment of process baths will cut down chemical waste. Protect stored process bath chemicals from oxidation by reducing exposure to air. Store chemicals in plastic containers.
- Determine if off-spec chemicals can be returned to the supplier.

Recycling

The two most common methods of recovering silver are metallic replacement and electrolytic replacement. Metallic replacement involves ion exchange between silver and another metal. The other metal is usually iron (mesh) or steel wool. Electrolytic replacement involves the accumulation of silver on a negative cathode. The silver is reclaimed from a 5-10 percent fixer solution.

There are four major waste streams associated with electrolytic image processing at hospital radiology departments that must be managed properly. They are:

- Silver that is recovered from recycling units. This silver waste is not a hazardous waste.
- Discharged waste water. The waste water may contain silver. The waste water is hazardous if its concentration is greater than 5ppm.
- Spent fixer is hazardous if its silver concentration is greater than 5ppm.
- Discarded X-ray film has recoverable amounts of silver that is typically removed by a recycler for processing. The reclaimed silver can be used in other industrial or commercial applications. If the silver is removed, the remaining X-ray film is a recyclable polyester.

PHARMACY

The US EPA says that pharmaceutical products do not become waste until the decision has been made to discard them. If the damaged or outdated products are returned to the manufacturer, distributor, or third party processors with an intent to receive credit, **and** if the pharmacy has no role in the decision to recycle, reclaim, or destroy the products, they are regarded as products (not wastes) at the time they are shipped.^{6,7} The only requirement for shipping will be proper DOT labeling.

Source Reduction Opportunities

- Consider closed formularies.

In addition to making monitoring patient drug use more difficult, open formularies may significantly contribute to the volume of drugs that must be disposed. Open formularies allow providers to dispense samples to patients. This dispensing practice encourages the development of secondary storage areas. Once established, secondary storage areas and their environments cannot be controlled. When drugs are improperly stored (e.g. improper cooling

requirements) they may become obsolete and require disposal which will increase disposal costs.

- Monitor outside drug sources.

Medical providers (who may have off-site offices) with hospital privileges accumulate samples that may become a disposal problem for pharmacies. Typically, pharmacies dispose of these drugs gratuitously for the provider.

- Track and reduce the distribution of drug samples.

Some examples of preparations and chemicals that are likely to be characteristic wastes are found in the table below.

TABLE 4 CHARACTERISTIC WASTES

IGNITABLE	CORROSIVE	REACTIVE	TOXIC
rubbing alcohol ^b	Strong acids and bases used in compounding	Nitroglycerin	Barium
wart removers			Lindane
spirits			Chloroform
flexible collodion			
tinctures			
aerosols			

If the sole active ingredient in the waste is named on the “P” or “U” list, it is hazardous. Below are examples of “listed” wastes found in pharmacies.

TABLE 5 LISTED WASTES

P LISTED	U LISTED
Epinephrine	Diethylstilbestrol
Nicotine	Hexachlorophene
	Lindane
	Paraldehyde
	Phenol
	Resorcinol
	Reserpine
	Chloroform
	Saccharin

CLEANING CHEMICALS

Source Reduction Opportunities

Reducing waste at its source may ensure that no hazardous waste need disposal. Many cleaning chemicals are flammable and contain chlorinated solvents. Thus, cleaning processes may provide an opportunity for reducing and eliminate hazardous wastes.

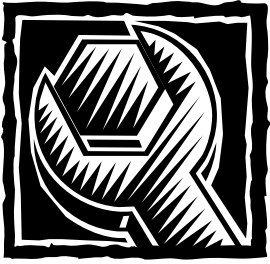
MATERIAL SUBSTITUTION

Evaluate the use of less hazardous materials and cleaning agents in non-critical areas

Evaluate physical cleaning methods that may replace and reduce chemical cleaning requirements

Evaluate the use of sonic or steam cleaning instead of chemical sterilization.

Evaluate specialty detergents, potassium hydroxide, or sonic baths to replace chromic and sulfuric acid for cleaning glassware. Sodium or potassium dichromate dissolved in sulfuric acid and chromic acid cleaning solutions are common methods of cleaning glassware. However there are alternative cleaning agents that have proven effective and less hazardous. They are found in Appendix G.



Chapter 3 Maintenance Wastes

BATTERIES

Recycling

If batteries are sent back to the manufacturer for recycling, the batteries are not a hazardous waste. A tolling agreement with the facility and the recycler documenting this arrangement should be in place. A manifest for the batteries is unnecessary provided eight requirements are met. They are:

- A written contract to collect, reclaim and return at a specified frequency.
- Transport vehicle owned by reclaimer.
- Generator or reclaimer maintains title to material at all times.
- Comply with record keeping requirements.
- Comply with DOT shipping paper requirements.
- A copy of contract filed with both generator and reclaimer.
- Reclaimer/Transporter records on shipping document or log (*This information must accompany waste*):
 - a. EPA ID #
 - b. Quantity of waste
 - c. DOT shipping information
 - d. Date

Disposal

According to TDEC, if lead acid batteries are not cracked **and** the contents are wholly contained within, a broker or recycler may receive the batteries. If these two conditions are met, lead acid batteries are non-hazardous.

However, the following batteries are hazardous

- Nickel-cadmium batteries are hazardous because of the cadmium present. Nickel-cadmium batteries are found in alarm systems, pagers, backup power sources in medical monitors and equipment. These batteries are often rechargeable but need eventual disposal.
- Mercuric oxide batteries are hazardous because of the mercury present. These batteries are typically used in hearing aids, smoke detectors, oxygen monitors, fetal monitors, and portable EKG monitors. They must be disposed of as a hazardous waste.
- Lithium batteries are hazardous and must be disposed of as a hazardous waste.
- Silver cadmium batteries are in medical electronics. These batteries contain silver and cadmium and must be disposed of as a hazardous waste.
- Zinc-air batteries may be used to replace mercuric oxide batteries. These batteries are typically found in hearing aids and electronic pagers. They contain zinc and mercury and are a hazardous waste. A list of battery recyclers is in Appendix H.

In Tennessee, these hazardous waste batteries are exempted from **reporting** requirements if the facility generates less than 100 kg of hazardous waste (including the batteries) in any calendar month **and** those batteries are handled properly. **You do not have to notify TDEC on the waste battery generation but you must manage and dispose of them as a hazardous waste.** If the facility generates more than 100kg of hazardous wastes (including the batteries) in any calendar month, the total generation must be reported to TDEC on the Annual Hazardous Waste Report.

PARTS WASHING

Source Reduction Opportunities

MATERIAL SUBSTITUTION

When you evaluate for alternative cleaning methods, look for non-hazardous substitutes. There are petroleum distillates available that are non-hazardous (non-ignitable) because the product has been formulated so that the flash point is 140⁰ F or greater.

Consider, aqueous-based cleaning technologies. Hot soap cleaners are very effective for parts washing. They may replace parts washers and eliminate all hazardous wastes associated with parts cleaning. Oil skimmers can recover oil before water is discharged to the POTW. Mix the skimmed oil with other used oils for recycling. However, consult with wastewater authorities to determine if any local limits restrict hot soap wastewater discharges.

Evaluate whether all maintenance functions that require cleaning are compatible with ketone, ester, or aqueous-based cleaning technologies.

PROCEDURE MODIFICATION

Do not locate solvent parts washer stations near exhaust fans and door drafts. Pumps that are continuously running volatilize product into the air. Make sure parts washers are off when not in use. If the parts washers have lids, keep the lids closed when the washer is not in use.

MAINTENANCE IMPROVEMENTS

Efficient operating procedures for parts washing in maintenance areas can help eliminate some solvent wastes. For example, do not have more parts washer stations than necessary nor allow unnecessary “pick ups.” **Neglecting these two strategies could unnecessarily change your status from small quantity generator to large quantity generator.**

PAINTS

Source Reduction Opportunities

MATERIAL SUBSTITUTION

Replace oil-based paints with water-based paints in facility maintenance operations to eliminate the use of solvents and thinners as cleaners. Using paints without metal pigments or paints with high solid, low volatile organic compound will also help reduce hazardous waste.

INVENTORY CONTROL

Controlling inventory is important when trying to reduce waste. It helps to eliminate excess supplies that are potential wastes. Three practices that can help control inventory are:

- Adopt first-in, first-out inventory practices for paints to reduce waste associated with expired shelf life.
- Purchase paints only in needed quantities.
- Do not mix more paint than is needed for a painting job.
- Standardize paint colors used in the facility.

TRAINING

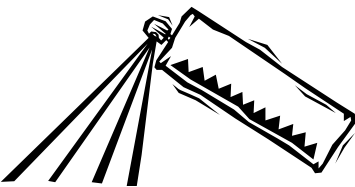
Over-spray is the paint that does not reach the part. Over-spray creates waste and increases raw materials cost. To reduce over spray:

- Use spray system equipment with high transfer efficiency. High volume, low pressure (HVLP) guns provide the highest transfer efficiency. Electrostatic spray guns also improve transfer efficiency.
- Maintain proper pressure as identified in the operator's manual for specific gun systems. Higher pressures contribute to overspray.
- Clean spray gun nozzles.
- Replace damaged nozzles.

- Keep spray gun perpendicular to the surface.
- Maintain a fifty percent overlap of spray pattern.
- Maintain gun distance of six to eight inches from workpiece.
- Trigger gun at the beginning and end of each stroke.
- Use heaters to reduce paint viscosity instead of adding thinners.

RECYCLING

If paint guns are cleaned with solvents, consider investing in a gun cleaner system that recirculates the solvent. Gun cleaners can save you as much as 30 percent on disposal and raw material costs.



AEROSOLS

Aerosols are present in the facility maintenance areas in health care organizations. Aerosols include adhesive cleaners, non-flammable glues, cutting oils, stainless steel cleaners, electronic solvent cleaners, touch-up paints, and ceiling tile renewers. These aerosols represent a very small portion of the total aerosol inventory.

Implement or improve procedures for inventory controls to ensure the review and use of all aerosols in the facility.

Source Reduction Opportunities

PROCEDURE MODIFICATION

To increase the shelf-life of aerosol cans, keep them away from moisture, sunlight, and extreme heat and cold. It is also important to keep protective caps on the containers when not in use. This help prevent contamination, rusting of the container top, and nozzle damage.

INVENTORY CONTROL

An inventory control system can assist in reducing waste. Order products according to demand because expired shelf-life may require excess inventories to be disposed. Dispense aerosol cans when an empty can is returned. This process should be controlled through one person in one location to prevent unnecessary usage.

Disposal

Contact your local landfill authorities to determine if notification is required before you dispose of your aerosol cans.

Contact TDEC to determine if you need a special waste approval application and if you must pay fees. You must have approval from your local landfill and state regulatory agency for disposal.

PESTICIDES

Source Reduction Opportunities

Reduce generation of pesticide waste generated by grounds maintenance activities by:

Reducing pesticide inventories toward a goal of just-in-time

Reducing pesticide, herbicide and fertilizer application

Preparing and using only the required quantities

Using non-chemical pest control methods

Using dry pesticides that are spread on the ground and watered into the ground. Using this method may eliminate the need for pesticide spraying containers and the resulting contaminated waste water from clean up operations.

Using contract services for insect control, rodent control, and lawn maintenance. Waste is managed by the contractor and doesn't impact the hospital's generation rates.



LAUNDRY CHEMICALS

Source Reduction Opportunities

Laundry chemicals are often supplied in 5 gallon containers. Consider receiving chemicals in totes. See "Drums" for a description of totes and its applications.

TRAINING AND TECHNOLOGY MODIFICATION

Poor handling of laundry chemicals can lead to accidental spills, underuse, or overuse of chemicals. Underuse of laundry chemicals

results in poorly cleaned articles that must be cleaned again. The overuse of laundry chemicals unnecessarily increases the volume of chemicals and increases raw material costs.

Optimizing the use of laundry chemicals and minimizing accidental spills is achieved through worker training, prepackaged laundry chemicals, or the use of an automated laundry chemical feed system. While laundries might incur initial capital costs to install an automated system, the savings from optimal chemical usage and reduction in labor costs may have long-term benefits.

USED OIL



Used oil is exempt from most federal regulations in order to encourage recycling and energy recovery. If used oil is not recycled, it must be disposed as a hazardous waste. Used oil that is burned for energy recovery is exempted from EPA hazardous waste regulations unless it has been contaminated with another listed hazardous waste (e.g. chlorinated solvents). If the generator provides used oil directly to an end-user, the generator must register with EPA as a Used Oil Fuel Marketer. There are three options to manage waste oil properly:

- Burn the used oil on-site in a used oil space heater.
- Provide used oil to an end-user directly.
- Work with a marketer who may provide the oil to end-users. If a marketer transports your used oil to a cement kiln, asphalt plant, or industrial boiler and that used oil is processed to create energy, recycling requirements have been satisfied.

Recycling

The generator is required to use a transporter with an EPA identification number when shipping used oil off-site. Generators should know that the used oil hauler has made appropriate notifications and know that the used oil is stored, recycled, and managed properly. A checklist for selecting a transporter is in Appendix I. A list of used oil handlers is found in Appendix J.

Except as provided in paragraphs (a) through (c) of this section, generators must ensure that their used oil is transported only by transporters who have obtained EPA identification numbers.

- (a) Self-transportation of small amounts to approved collection centers is acceptable. Generators may transport, without an EPA identification number, used oil that is generated at the generator's site to a used oil collection center provided that:
1. The generator transports the used oil in a vehicle owned by the generator or owned by an employee of the generator;
 2. The generator transports no more than 55 gallons of used oil at any time; and,
 3. The generator transports the used oil to a used oil collection center that is registered, licensed, permitted, or recognized by a state/county/municipal government to manage used oil.
- (b) Self-transportation of small amounts to aggregation points owned by the generator is acceptable. Generators may transport, without an EPA identification number, used oil that is generated at the generator's site to an aggregation point provided that:
1. The generator transports the used oil in a vehicle owned by the generator or owned by an employee of the generator;
 2. The generator transports no more than 55 gallons of used oil at any time; and
 3. The generator transports the used oil to an aggregation point that is owned and/or operated by the same generator.
- (c) Tolling arrangements. Used oil generators may arrange for used oil to be transported by a transporter without an EPA identification number if the used oil is reclaimed under a contractual agreement pursuant to which reclaimed oil is returned by the processor/re-refiner to the generator for use as a lubricant, cutting oil, or coolant. The contract (known as a "tolling arrangement") must indicate:
1. The type of used oil and the frequency of shipments;
 2. That the vehicle used to transport the used oil to the processing/re-refining facility and to deliver recycled used oil back to the generator is owned and operated by the used oil processor/re-refiner; and
 3. That reclaimed oil will be returned to the generator.

Storage

Spill Prevention Control and Countermeasures (SPCC) rules apply to above-ground storage tanks that are 660 gallons or greater **and** to aboveground oil storage facilities storing more than 1320 gallons. For example, three, 435 gallon tanks are exempt. One 660 gallon tank and one 650 gallon tank would not be exempt from SPCC. A technical bulletin, “Spill Prevention Control and Countermeasures (SPCC)” is in Appendix K.

An underground oil storage tank (UST) less than 110 gallons is exempt from UST regulations.

USTs that store oil for on-site heating are exempt from UST regulations. Keep containers in good condition, and clearly labeled them “Used Oil” to prevent contamination. Do not mix solvents with used oil. When solvents are mixed with used oil, the oil mixture may be subject to regulation as a hazardous waste. That means the used oil may no longer be subject to the recycling exclusion.

Store used oil in areas with oil-impervious flooring and secondary containment structures.



DRUMS

A drum is empty if all material has been removed using the practices commonly employed (e.g., pouring, pumping, and aspirating), and no more than one inch remains on the bottom of the 55 gallon container or inner liner.

For a container of less than 110 gallons, the “empty” containers must contain less than 3 percent by weight of the original contents. For containers greater than 110 gallons, “empty” containers must contain less than 0.3 percent of the original contents. It is important to manage empty drums properly, particularly if contents were hazardous.

Drums that contained acutely hazardous (P listed) materials must be triple rinsed to be considered nonhazardous. Dispose of waste rinsates as a hazardous waste.

Source Reduction Opportunities

Evaluate the use of totes (bulk dispensers) and reusable transfer containers. Many chemicals used in hospital engineering, facility maintenance, and laboratories are supplied in drums. Unless the empty drums containing P listed chemicals are triple rinsed before disposal, they may have to be handled as hazardous waste.

Many industrial facilities receive solvents, inks, adhesives, and chemicals in 400-gallon, reusable totes. When empty, the tote is returned to the supplier for cleaning and refilling. Using totes ensures that the container and any chemical residue left inside does not have to be disposed of by the hospital.

RECYCLING

Empty containers can be sent to scrap metal vendors. However, you may consider crushing or cutting the drums and containers into metal scraps to ensure that they are not being reused for storing or transporting other material. Before cutting or crushing drums, determine if the drum contained a flammable material. These drums may contain an explosive mixture of air and vapor. Drums should be thoroughly purged before cutting operations.

Determine if a drum reclamation company can recondition your drums for resale. Visit the site to insure that your drums are managed responsibly and lawfully. If you decide to scrap your drums, visit your scrap metal vendor to note how scrap is handled. Ask questions on how your scrap is received and processed. Tour the company to monitor how the containers are managed.

You have just “assessed” your departments and practices for waste management and reduction. Now, review your checks and comments that identify opportunities you can include in your plan and barriers that may prevent implementation of other opportunities. Record them in your hazardous waste reduction plan.



HANDS ON TASK

HAZARDOUS WASTE STORAGE

A good hazardous waste storage and training program will contain:

- A formal training on the safe handling of raw materials, hazardous wastes, and the types of drums, containers, and packages received.
- Provide and encourage the use of mechanical handling aides for handling drums.
- A documented spill prevention and control program. In addition evaluate all processes that require on-site mixing. Work with the suppliers or manufacturers to provide pre-mixed compounds. Pre-mixed compounds may significantly reduce spills that result from on-site mixing.
- Clean-up kits.
- Weekly inspection for drums (See Appendix B for a sample checklist).
- A designated, centralized facility or place for hazardous waste storage, preferably isolated from main buildings. The storage area should be ventilated, contain a safety shower, eye wash, sealed berm floors, and an emergency telephone nearby.
- Ensure that the storage area is located away from storm drains, equipment or traffic. Also, chemicals and liquid wastes should be stored in areas that do not drain or spill directly to the sewers.
- A storage area large enough to handle wastes for planned business growth or accommodation for smaller designs to accommodate waste reduction goals.
- Diking and drainage containment.
- An explosion proof area.
- Electrical lighting systems that are designed to meet safety requirements for flammable hazardous waste storage.
- No tools that may produce ignition with stored flammables.

- An overhead sprinkler system.
- A fire detection system.
- Identification of all chemicals and wastes.
- A running inventory that indicates the type and amount of hazardous wastes on-site.
- Separation of hazardous wastes from non-hazardous waste and chemicals. *Note: If non-hazardous wastes or chemicals are mixed in any proportion with hazardous wastes, the entire amount will become a hazardous waste.*
- Compliance with local fire and building code requirements. A local fire department representative should be invited to audit your hazardous chemical and waste storage areas.
- Metal storage containers should be grounded and bonded. Pouring and transfer containers must be bonded to receiving drums.

ADDITIONAL ISSUES

Consider the wastes that will be generated when planning procedures and experiments. Into every laboratory procedure used, design the steps to render residues non-hazardous.

Identify all wastes that are disposed to the POTW (publically owned treatment works) and the federal water and local POTW disposal requirements that apply.

Do not mix solvent waste streams with water or any other non-hazardous waste. This practice ensures that your disposal costs will increase.



SECONDARY CONTAINMENT

Secondary containment collects leaks and spills. It protects your property, resources and employees from hazardous waste spills. Secondary containment investment is minimal compared to clean up costs associated with one spill or accident.

Use secondary containment systems in satellite accumulation areas and final waste accumulation areas.

Secondary containment should:

- Ensure that the storage area keeps out rain, snow, and standing water.
- Prevent water, such as storm water from a parking lot, from entering the containment system. Careful layout, sloping or elevating the containment area above grade usually works.
- Ensure that the stored wastes can not penetrate the base or floor of the system. Sealed concrete and impervious plastic may work well while asphalt generally does not. Avoid cracks or unsealed joints.
- Make sure the system can hold the entire volume of the largest container. Appendix L contains examples of secondary containment systems.

CHAPTER 4

HOSPITAL XYZ WASTE REDUCTION PLAN

OCTOBER 1, 1994 Revision: New

PREFACE

Hospital XYZ is committed to compliance, risk reduction, protecting the environment, and pollution prevention. Prior to the first reporting date, Hospital XYZ had completed, or had in progress, the following waste reduction efforts.

In 1991, we phased in zinc-formalin usage for surgical specimen, for biopsies in 1992, and for skin lesions in 1993. Mercury-formalin is only used as a fixative in cytology and bone marrow.

WASTE REDUCTION POLICY STATEMENT

Hospital XYZ

Hospital XYZ advocates a safe and supportive environment for patients and other individuals served by or providing services in the hospital. Hospital XYZ's policy is to periodically evaluate and minimize the generation of solid wastes, especially hazardous wastes.

Hospital XYZ is committed to a leadership role in protecting the environment. Whenever feasible, we will eliminate, reduce, or recycle our waste in full compliance with Federal and State Regulations.

Furthermore, Hospital XYZ wants its employees to be fully aware of all hazardous and potentially dangerous chemicals or equipment used in the environment of care and to use them in a completely safe manner. Our employees will be informed and included in the hospital's effort to reduce waste generation.

CEO, Hospital XYZ

Date

SCOPE AND OBJECTIVES

To comply with the Tennessee Hazardous Waste Reduction Act of 1990 and improve the environment, all employees of Hospital XYZ will be involved in waste reduction. RCRA hazardous wastes will be our first priority for waste reduction.

Our goal is to reduce hazardous waste streams to the technically feasible and economically practicable minimum by the timetable noted in this plan. We will achieve these reductions through waste reduction assessments, procedure improvements, equipment changes, material substitution, employee training and other effective reduction methods.

WASTE REDUCTION PLAN ADMINISTRATION

(Name), (Position) will act as the Waste Reduction Coordinator for Hospital XYZ. The Waste Reduction Coordinator will administer the plan, prepare the annual progress report, update the plan, and supply information for the Annual Hazardous Waste Report.

Waste reduction options will be evaluated by the Safety Director, Purchasing Director, Housekeeping and/or Environmental Services Manager, Laboratory Services Manager(s), and other applicable employees involved in the assessment team.

Waste reduction can only be achieved with the cooperation of employees generating the waste. Therefore, all employees will be made aware of the need for waste reduction. Training will be incorporated into the Hazard Communication Training. Employees will also be polled on ways to implement waste reduction and managers will incorporate their suggestions, where practicable, into training activities.

The true cost of waste management will be tracked. Where applicable, the following costs will be included in the plan and be documented in the footnotes. Those costs can include:

Cost of raw materials lost to waste stream, **management or oversight costs** (administrative record keeping cost, regulatory reporting and compliance cost, record keeping costs, environmental training cost, spill and emergency response management costs), and **waste disposal costs** (labor, space, on-site storage and management costs, transportation costs, and off-site disposal costs).

WASTE STREAM #1: Xylene Waste

Hospital XYZ uses xylene in its processors and stainers. Xylene is typically used as a clearing agent that removes paraffin from the tissue.

Waste Generation:

	Waste Generated (kg)	Blocks Completed	Waste (g) per Block	Annual Cost of Waste (\$)
1989	1957	51500	38	4308
1990	2028	52000	39	4350
1991	1939	53000	37	4433
1992	2068	55000	38	4601
1993	2819	60000	47	5019
1994*	2480	62000	40	5186

* 1994 figures are estimates

Note: Waste generation may be significantly reduced (up to 75 percent) if barriers to waste reduction (implementing distillation process to recover and reuse xylene) can be eliminated.

BARRIERS TO WASTE REDUCTION

1. Lack of upper management support for testing alternative solvents
2. Citrus- based alternatives to xylene are widely believed by hospital to compromise test quality and results.
3. Long-term payback for distillation
4. Reluctance to use distilled xylene.
5. Lack of time to plan and design xylene distillation location. Joint Commission EC 1.1.2 states that when moving a process to an existing, vacant room that designated ventilation, fire-rated door and walls, and safety shut down capabilities must be present.

WASTE REDUCTION OPPORTUNITIES

1. Distilled xylene can save money without compromising test quality.
2. Currently, we changeout staining chemical baths daily. Sometimes, the changeout occurs twice a day. These frequent changeouts are not believed to be related to quality. This long-standing practice generates unnecessary xylene waste. We will evaluate how long baths can be used.

GOALS

	Waste (g)/Block
1995	10
1996	5
1997	0

WASTE STREAM #2: Mercury (II) Chloride

Hospital XYZ uses mercury-formalin in its tissue fixative process for cytology and bone marrow. The mercury chloride is precipitated with NaOH to form mercury (II) oxide that is ultimately disposed with an off-site waste management company.

Waste Generation:

	Waste Generated (kg)	Blocks Completed	Waste (g) per Block	Annual Cost of Waste (\$)
1989	Not Available	51,500	Not Available	Not Available
1990	Not Available	52,000	Not Available	Not Available
1991	15.0	53,000	.28	775
1992	12.7	55,000	.23	656
1993	6.1	60,000	.10	315
1994*	6.3	62,000	.10	325

* 1994 figures are estimates

BARRIERS TO WASTE REDUCTION

Zinc-formalin has good nuclear detail on surgical specimen, biopsies, and skin lesions. However, we are concerned about the reliability on bone marrow and cytology specimen. We will continue to use mercury fixatives for bone marrow and cytology.

WASTE REDUCTION OPPORTUNITIES

GOALS

Chapter 5 HAZARDOUS MATERIALS TRAINING

The Tennessee Right-to-Know Law requires hospitals (nonmanufacturers) to inform workers about the chemicals that are in the work place. This “Worker Right to Know” law applies to facilities that **store or use** 55 gallons or 500 pounds of any hazardous chemical that appears on your Chemical Inventory List.

The Joint Commission recommends that each department complete an inventory list to be forwarded to a central location where the Chemical Inventory List is maintained. OSHA requires the list to be updated annually.

- If the facility **stores** 55 gallons or 500 pounds of an inventory listed chemical, the list of those chemicals must be forwarded to your local fire department.
- If the facility **stores or uses** four, or more, compressed gas cylinders, your building must be marked with NFPA 704M placards.
- If the facility **uses** 55 gallons or 500 pounds of an inventory listed chemical, those chemicals must be reported to the Tennessee Occupational Safety and Health Administration (TOSHA).
- If the facility **uses** 55 gallons or 500 pounds of an inventory listed chemical, the facility must:
 - Develop a Hazard Communication Program.

A technical bulletin “The Hazard Communication Program” is in Appendix M. Methods to coordinate employee education and training requirements of OSHA Hazard Communication Standard with RCRA hazardous waste identification, emergency coordination (for SQGs), preparedness and prevention requirements (for SQGs), or hazardous waste contingency planning (for LQGs) should be carefully considered.

A comprehensive training program can cover requirements for hazardous materials and handling (OSHA) to hazardous

wastes (RCRA) that will be generated and disposed. A coordinated training program can eliminate duplicate training requirements and reduce confusion for the employer and employee.

- Correct labeling of all hazardous materials (and waste) containers.

The Joint Commission recommends all portable containers that contain chemicals transferred from a labeled container also be labeled.

- Maintain a file of MSDSs for hazardous materials located in the facility.

The Joint Commission recommends that you never discard MSDSs even if the hazardous material is no longer used. The MSDS should always be accessible by employees and the Emergency Room Care Providers. They also recommend that MSDSs be centralized for small facilities and be available on the departmental level for large facilities.

MSDS AND WASTE REDUCTION

Maintaining a current and complete file of the MSDSs of each hazardous chemical and mixture used in the hospital can effectively reduce waste. The MSDS identifies the physical and chemical properties of the hazardous material. Knowing information on the MSDS may help you by providing:

Information on flash point. The flash point is the temperature at which a substance will ignite. Hazardous materials with flashpoints less than 140° F used in tests or processes will probably produce a hazardous waste. Flashpoints identify potential fire hazards.

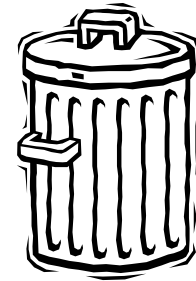
Information on specific gravity. Specific gravity is the density of a substance relative to water. Hazardous materials with specific gravity less than 1 will float on water, may be flammable, and will be very difficult to extinguish with water.

Information on boiling points. Boiling point is the temperature at which a hazardous material evaporates. Low boiling points may contribute to flammability.

An MSDS can help you identify toxic characteristics in the

hazardous material. You can determine if toxic lead and chromium (pigments) metals and are formulated in the paints before you purchase them. Waste codes for solvents can be determined from MSDSs. For example, if a MSDS lists xylene as a component, the wastes from the process that uses xylene will carry an F003 waste code.

Chapter 6 SOLID WASTE



Paper and paperboard are the largest volume solid waste stream in hospitals. Because of the high volumes, paper and plastics may represent the next best opportunity for recycling. Developing and maintaining in-house solid waste collection programs and identifying recyclers (markets) are key components of a successful recycling program.

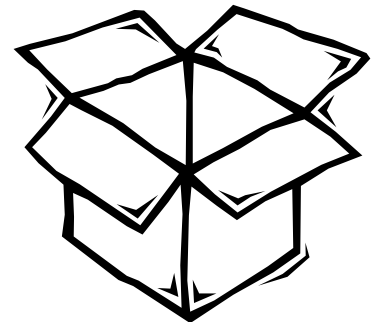
- There are many variables to consider before implementing a recycling program. They will include:
- A comprehensive, well planned employee education and collection program.
- Availability of recyclers in this area. Remember, prices will fluctuate seasonally.

Transportation costs may reduce revenues (but landfill disposal costs will also be reduced.)

The potential for regulated medical waste contaminating recyclable solid wastes is high in health care organizations. Contamination could jeopardize or terminate your recycling relationship and investment. Identify special agreements and assurances that must be in place.

CARDBOARD

Corrugated cardboard is composed of two layers of flat cardboard with a middle layer of corrugated cardboard. Cardboard will vary in thickness, color and configuration. Collection containers designated for cardboard often incorrectly contain boxboard which is a single-layer paperboard.



ADDITIONAL PACKAGING

Boxboard is typically used as a secondary packaging material (inside the shipping containers). Before mixing cardboard and boxboard, check with your recycler to ensure that this practice is acceptable.

UNUSUAL PACKAGING

Unusual packaging may complicate cardboard recycling efforts. Materials managers should work with hospital purchasing managers and suppliers to ensure that all packaging entering the facility is recyclable. An example of unusual packaging is corrugated cardboard with foams (or other shock absorbing material) adhered to the surface.

CARDBOARD BALING

Cardboard baling operations are generally successful if space is available and generation rates are sufficient. In order to determine the cardboard that to be baled and sold to a cardboard recycler, assume:

Assumptions:

1. 70 percent census
2. 16 lbs of solid waste/day/patient⁹
3. 33 percent of waste stream is cardboard¹⁰
4. 75 percent capture rate

Calculation:

*# of Beds x .70 census x 16 lbs/day x 30 days/month x 1 ton/2000 lbs x .33 x .75 =
cardboard generation*

If you can exactly determine how much of your waste stream is cardboard and the capture rate, or if you feel these figures can be adjusted to better reflect your facility's status, then use those exact numbers instead of the assumptions given to determine your potential cardboard generation rates.

Determining the facilities solid waste generation is the first step in justifying commitments to baling and recycling. Based on the formula in the previous section, the rates for hospitals of various sizes (beds) are given in the following table.



Table 6 Estimating Your Cardboard Generation:

Beds	Estimated Cardboard Generation (tons/month)
0-50	2
50-100	2-4
100-200	4-8
200-300	8-12
300-400	12-16
400-500	16-20
500-750	20-31
750-1000	31-41

For a 300-bed hospital, approximately 12 tons of cardboard are generated per month. That means 144 tons of cardboard are generated per year. Currently, brokers are paying \$85/ton for cardboard.¹¹

Therefore, 144 tons/year X \$85/ton = \$12,240 (potential revenue)

Add avoided disposal costs @ \$30/ton = \$ 4,320

\$16,560 (total revenue)

Capture rates may not be 75 percent when you begin your program. Education and training will gradually improve your rate. However, 75 percent is not an unrealistic rate.

There are a variety of arrangements available to hospitals to recycle cardboard. Some arrangements include:

- Using compactor or container provided by a waste management company or recycler at no charge in exchange for your collected cardboard. These arrangements usually provide no revenues to your hospital.
- Purchasing and operate a baler and sell the bales to a recycler.
- Purchasing and operate your baler, compactor or container and pay a transporter to deliver your baled cardboard to a recycler. The recycler usually pays you directly for the bales.

PAPER

EPA reports that by 2000 half of the current 6,500 operating landfills will be closed. Therefore, many hospital's may notice an increase in the cost of disposing solid waste. A paper recycling program may help your hospital reduce its disposal costs.

Computer printer out (CPO) paper is a continuous paper printed on an impact printer. It can be solid white, blue- or green- lined, or pin-fed printer paper and is untreated and uncoated. CPO does not include laser-printed paper. White ledger paper is the white office paper in single sheets or continuous forms. White computer paper, copy paper, letterhead, white notebook paper, and ledger paper fall into this category. These types of paper are choice waste streams for the paper recycler.

Based on the formula below, estimated paper generation rates were determined. Those rates for hospitals of various sizes (beds) are given in the table below.

Assumptions:

1. 70 percent census
2. 16 lbs of solid waste/day/patient
3. 12 percent of waste stream is paper¹²
4. 75 percent capture rate



Calculation:

of Beds x .70 census x 16 lbs/day x 30 days/month x 1 ton/2000 lbs x .12 x .75 =
cardboard generation

Table 7 Estimating Your Paper Generation

Beds	Estimated Paper Generation (tons/month)
0-50	.75
50-100	.75-1.5
100-200	1.5-3
200-300	3-4.5
300-400	4.5-6
400-500	6-7.6
500-750	7.6-11
750-1000	11-15

A 300-bed hospital generates 4.5 tons of paper per month. That means 54 tons of paper are generated per year. Currently, brokers will pay \$70/ton for white ledger paper.¹³

Therefore, 54 tons/year X \$70/ton = \$3,780 (potential paper revenue)

Add avoided disposal costs @ \$30/ton = \$1,620

\$5,400 (total revenue)

Make available several designated accumulation points for employees to take recyclable paper from their work area. Requiring housekeeping staff to monitor and maintain a paper recycling program generally does not work well.

Like cardboard, capture rates may not be 75 percent when you begin your program. However, education and training will gradually improve your rate. Paper types vary. Identify markets or recyclers for the type of paper you generate before developing a collection program.

PLASTIC

Based on the formula below, estimates of plastic generation rates are in the table. Those rates for hospitals of various sizes (beds) are given in the table below.

Assumptions:

1. 70 percent census
2. 16 lbs of solid waste/day/patient
3. 15 percent of waste stream is plastic¹⁴
4. 75 percent capture rate

Calculation:

of Beds x .70 census x 16 lbs/day x 30 days/month x 1 ton/2000 lbs x .15 x .75 = plastic generation

Table 8 Estimating Your Plastic Generation

Beds	Estimated Plastic Generation (tons/month)
0-50	1
50-100	1-2
100-200	2-4
200-300	4-6
300-400	6-8
400-500	8-10
500-750	10-14
750-1000	14-19

For a 300 bed hospital, 6 tons of plastic are generated per month. That means 72 tons of plastic are generated per year. Currently, brokers will pay \$60 /ton for plastic.¹⁵

Therefore, 72 tons/year X \$60/ton = \$4,320 (potential plastic revenue)

Add avoided disposal costs @ \$30/ton= \$2,160
\$6,480 (total revenue)

If you add the total revenues for cardboard, paper, **and** plastics you get a good idea of the revenues if no recycling activities are implemented. **Now that you know how to estimate potential generation, you can determine your generation rate for metals. Metals comprise about ten percent of the hospital waste stream. Steel cans (dietary) would be another good waste stream to recycle.**

Remember, visit your recyclers before implementing any collection and recycling program for your solid wastes to discuss your needs and your broker/recyclers requirements.

FOOTNOTES

¹ 1995 Accreditation Manual for Hospitals. "Management of the Environment of Care." Section 2, p 45.

² The Tennessee Hazardous Waste Reduction Act of 1990 (TCA 68-46-301 et seq.) required large quantity generators to have had the plan in place on January 1, 1992; small quantity generators must have had a plan in place by January 1, 1994.

³ TCA 68-46-302(a)

⁴ Recycled xylene has to be "counted" using special rules.

⁵ CDC guidelines

⁶ Alan Corson, Chief, Waste Characterization Branch, Hazardous and Industrial Waste Division, US EPA, Office of Solid Waste.

⁷ Sylvia Lowrance, Director, Office of Solid Waste, USEPA

⁸ Aqueous mixtures with an alcohol concentration of 24 percent or higher are ignitable.

⁹ National Solid Waste Management Association, 1987

¹⁰ Fenwick, R.C. AHA conference on hospitals and the environment, May 1991

¹¹ Prices for cardboard vary according to supply and demand. The price range varies between \$15-\$110 per ton.

¹² Fenwick, R.C. AHA conference on hospitals and the environment, May 1991

¹³ Prices for paper vary according to supply and demand. The price range varies between \$70-\$100 per ton.

¹⁴ Fenwick, R.C. AHA conference on hospitals and the environment, May 1991

¹⁵ Prices for plastic vary according to supply and demand. The price range varies between \$20-\$100 per ton.

APPENDIX A

(omitted)

APPENDIX B

Hazardous Waste Storage Weekly Inspection Log

DATE OF INSPECTION _____

YES NO

- | | | |
|--------------------------|--------------------------|-----------------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | ARE DRUMS LEAKING OR RUPTURED? |
| <input type="checkbox"/> | <input type="checkbox"/> | ARE DRUMS FREE OF DENTS, HOLES, RUST, ETC.? |
| <input type="checkbox"/> | <input type="checkbox"/> | ARE DRUM BUNGS CLOSED AND TIGHT? |
| <input type="checkbox"/> | <input type="checkbox"/> | ARE DRUMS MARKED PROPERLY? |
| <input type="checkbox"/> | <input type="checkbox"/> | IS THE ACCUMULATION DATE ON THE DRUM? |
| <input type="checkbox"/> | <input type="checkbox"/> | IS THERE A FIRE EXTINGUISHER IN THE VICINITY? |
| <input type="checkbox"/> | <input type="checkbox"/> | IS THERE PROPER AISLE SPACE BETWEEN DRUMS? |
| <input type="checkbox"/> | <input type="checkbox"/> | IS THERE SPILL CONTROL EQUIPMENT AVAILABLE? |

CORRECTIVE ACTIONS TAKEN (INCLUDE DATE):

SIGNATURE OF INSPECTOR _____

APPENDIX C

HOW TO COUNT HAZARDOUS WASTE USING DISTILLATION

Assume that 10 gallons of xylene is needed each 5-day week for processing and staining tissues.

Without Distillation

If xylene is not distilled, then hazardous waste for the **calendar month** is generated and counted as shown below.

WORK DATE	HAZARDOUS WASTE GENERATED	HAZARDOUS WASTE COUNTED
Day 1	2 gallons	2 gallons
Day 2	2 gallons	2 gallons
*	*	*
*	*	*
*	*	*
Day 20	2 gallons	2 gallons
TOTAL	40 gallons	40 gallons

There will be 40 gallons of hazardous waste generated which must be counted during this calendar month.

With Distillation

A 10 gallon distillation unit was installed to recover waste xylene for reuse.

WEEK 1

WORK DATE	WASTE GENERATED	RECYCLED XYLENE USED	HAZARDOUS WASTE COUNTED
Day 1	2 gallons	0 gallons	2 gallons
Day 2	2 gallons	0 gallons	2 gallons
Day 3	2 gallons	0 gallons	2 gallons
Day 4	2 gallons	0 gallons	2 gallons
Day 5	2 gallons	0 gallons	2 gallons
Total			10 gallons

At the end of Week 1, ten gallons of hazardous waste were generated and must be counted. Since 10 gallons of virgin xylene were used during the first week, no recycled xylene was used for Week 1.

The 10 gallons of hazardous xylene waste generated during Week 1 were distilled. Eight gallons of xylene were recovered from the distillation unit. There were 2 gallons of hazardous waste still bottoms generated after distillation. Since eight gallons of xylene were recovered by distillation, two gallons of virgin xylene must be added because the laboratory needs ten gallons of xylene for Week 2.

For Week 2, the xylene used for tissue processing and staining will be 80% recycled xylene and 20% virgin xylene. Therefore, the waste generated from this xylene mixture should be expressed in the same 4:1 ratio (waste fraction from recycled xylene: waste fraction from virgin xylene).

WEEK 2

WORK DATE	WASTE GENERATED	WASTE FRACTION FROM RECYCLED XYLENE	WASTE FRACTION FROM VIRGIN XYLENE COUNTED
Day 6	2 gallons	1.6 gallons	0.4 gallons
Day 7	2 gallons	1.6 gallons	0.4 gallons
Day 8	2 gallons	1.6 gallons	0.4 gallons
Day 9	2 gallons	1.6 gallons	0.4 gallons
Day 10	2 gallons	1.6 gallons	0.4 gallons
Total			2 gallons

At the end of Week 2, the waste xylene (10 gallons) was distilled. Again, 8 gallons of xylene were recovered and 2 gallons of distillation bottoms were generated. Two gallons of virgin xylene were added because ten gallons of xylene has to be available for Week 3.

WEEK 3

WORK DATE	WASTE GENERATED	WASTE FRACTION FROM RECYCLED XYLENE	WASTE FRACTION FROM VIRGIN XYLENE COUNTED
Day 11	2 gallons	1.6 gallons	0.4 gallons
Day 12	2 gallons	1.6 gallons	0.4 gallons
Day 13	2 gallons	1.6 gallons	0.4 gallons
Day 14	2 gallons	1.6 gallons	0.4 gallons
Day 15	2 gallons	1.6 gallons	0.4 gallons
Total			2 gallons

At the end of Week 3, the waste xylene (10 gallons) was distilled. And, again 8 gallons of xylene were recovered and 2 gallons of distillation bottoms were generated. Two gallons of virgin xylene were added because there must be ten gallons of xylene available for Week 4.

WEEK 4

WORK DATE	WASTE GENERATED	WASTE FRACTION FROM RECYCLED XYLENE	WASTE FRACTION OF VIRGIN XYLENE COUNTED
Day 16	2 gallons	1.6 gallons	0.4 gallons
Day 17	2 gallons	1.6 gallons	0.4 gallons
Day 18	2 gallons	1.6 gallons	0.4 gallons
Day 19	2 gallons	1.6 gallons	0.4 gallons
Day 20	2 gallons	1.6 gallons	0.4 gallons
Total			2 gallons

The hazardous waste xylene and still bottoms generated for the month is given below.

Monthly Hazardous Waste Generation Summary

WEEK	HAZARDOUS WASTE GENERATED	AMOUNT GENERATED	AMOUNT COUNTED
1	Xylene Distillation Bottoms	10 gallons 2 gallons	10 gallons 0 gallons
2	Xylene Distillation Bottoms	2 gallons 2 gallons	2 gallons ¹ 0 gallons
3	Xylene Distillation Bottoms	2 gallons 2 gallons	2 gallons ² 0 gallons
4	Xylene Distillation Bottoms	2 gallons 2 gallons	2 gallons ³ 0 gallons
Total			16 gallons

In Tennessee, hazardous waste regulations exempt the distillation bottoms in determining generator status if they are generated from a waste (xylene) that has been counted as a hazardous waste. Since 10 gallons of xylene were counted in Week 1, distillation bottoms generated in Weeks 1, 2, 3, and 4 should not be counted. Therefore, the **total** waste generation for this month is 16 gallons (24 total gallons - 8 gallons). While distillation bottoms are not counted, they must be managed and disposed as a hazardous waste.

If you use the recycled xylene from Week 4 in Week 1 of the next calendar month, you must count the recycled xylene as if it were virgin xylene.

Benefits

Generator Category

Distilling waste xylene may have benefits in changing your hazardous waste generator category. Without distillation, a facility that generates 40 gallons of waste xylene in a month, would be a SQG. If the generation rate is less than 25 gallons/month, then the facility would be a CESQG as shown in the example above.

Raw Material Savings

If recycled xylene is used at the beginning of each week, instead of virgin xylene, raw material costs will decrease significantly.

^{1,2,3} The amount of hazardous waste generated for the week is the sum of the daily waste fractions of virgin xylene added (.4 gallons/day @ 5 days). Recycled xylene should never be counted.

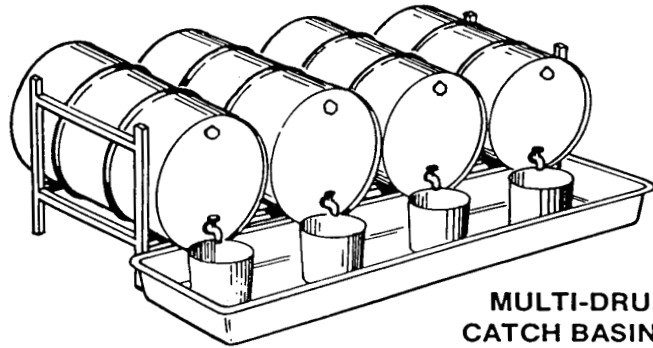
FIBERGLASS POLY-BASIN™ INDUSTRIAL SECONDARY CONTAINMENT SYSTEMS

POLY-BASIN™ secondary containment systems have been designed to assist users in meeting all Federal and state requirements for spillage containment when working with drums or small vats. Their light weight and portability make them an ideal choice for truck or van usage, especially when paired together to form a sealed container.

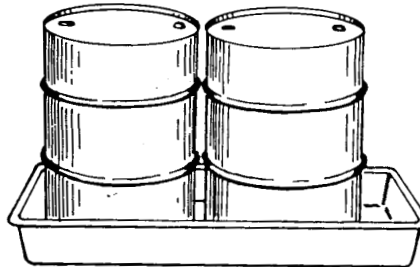
Possible applications include secondary spill containment and transportation in the various manufacturing, chemical, metals, oil field, agricultural, food and medical industries. POLY-BASIN may be used both indoors and out, with little or no concern for chemical or UV degradation.

POLY-BASIN is an ideal, light-weight, low-cost answer for smaller containment needs not requiring the large scale protection offered by *Polystar's* POLY-TUB™ and POLY-DIKE™ product lines. Refer to forms 1020 and 1030 for details.

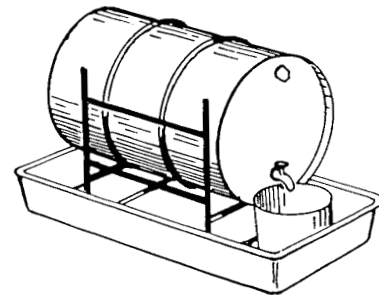
- ★ TOUGH FIBERGLASS CONSTRUCTION
- ★ CHEMICALLY RESISTANT
- ★ VERSATILE AND REUSABLE
- ★ INEXPENSIVE TO INSTALL AND USE
- ★ LIGHT WEIGHT AND EASILY HANDLED



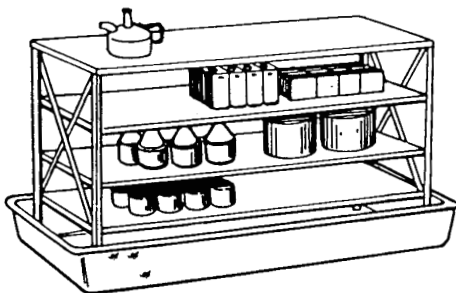
**MULTI-DRUM
CATCH BASINS**



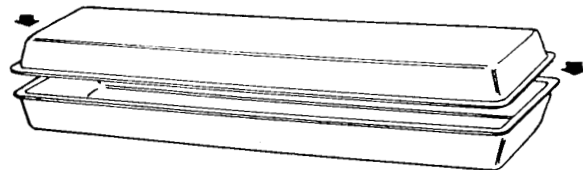
**DUAL DRUM
CONTAINMENT**



**SINGLE DRUM
CONTAINMENT**



STORAGE RACK SPILL CONTAINMENT



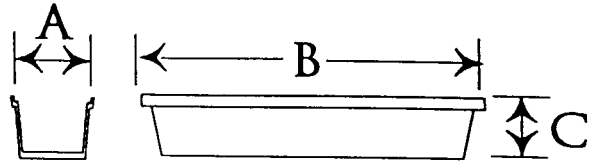
INVERTED CONTAINER



POLYSTAR INC

573-7 HIGHLAND RD.
MACEDONIA, OHIO 44056
PHONE 216/467-8300 FAX 216/467-8342

Poly-Basin™



<i>Model</i>	<i>Capacity</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>Wall Thick.</i>	<i>Weight</i>
PB-4	55 gal.	28"	4'6"	10"	3/16"	30 lbs.
PB-6	67 gal.	28"	6'	10"	3/16"	40 lbs.
PB-8	90 gal.	28"	8'	10"	1/4"	55 lbs.
PB-10	112 gal.	28"	10'	10"	1/4"	68 lbs.
PB-12	135 gal.	28"	12'	10"	1/4"	80 lbs.

- * Ideal for use beneath the spigots of rack-mounted 55 gallon drums.
- * Versatile, appropriate for most applications not requiring a full diking system.
- * Tough, resilient fiberglass construction for long life.
- * Chemically resistant and impermeable
- * Flame retardant resin system - STANDARD
- * Extremely light weight (easy to handle, store and install).
- * Smooth inside surface for easy clean-out.
- * Can be inverted for use as a weather or security cover.
- * Attractive
- * Reusable
- * Available with a matching cover (either hinged or "shoe-box" type)

Standard colors, all models: Seafoam Green, Sky Blue, Gray

POLYSTAR CONVERTIBLE™

FIBERGLASS SECONDARY CONTAINMENT SYSTEMS

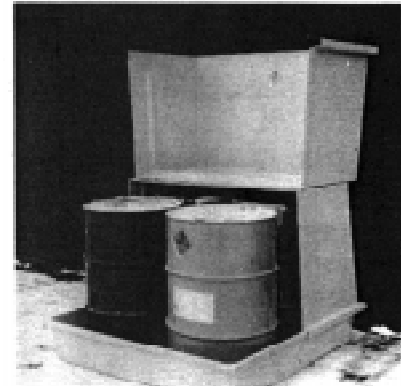
POLYSTAR CONVERTIBLES combine the benefits and features of **POLYSTAR's POLY-TUB™ Model PT-10** with a truly unique high strength and corrosion resistant fiberglass hood system. Two models are available (4 drum and 2 drum) offering up to 60 cubic feet of spill and spoilage protection for valuable or hazardous material storage.



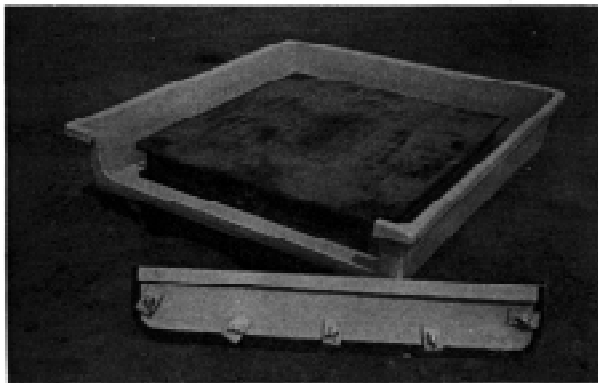
POLYSTAR Model PT-10 CONVERTIBLE displaying an attractive, compact, and weatherproof enclosure that minimizes unwanted entry.



DESIGNED to be easily accessible and universal, **POLYSTAR CONVERTIBLES** are available in three bright colors: blue, green and gray.



POLYSTAR PT-10 CONVERTIBLE allows protected storage for up to (4) 55 gallon drums or up to 60 cubic feet of bulk materials.



POLY-TUB Model PT-10-G Gate Model with removable front section for easy access with hand carts or forklifts. See all **POLY-TUB** models: refer to form 1020.



POLYSTAR Model PT-10-G Gate Models are available as Convertible Models, and offer a truly unique concept in small capacity secondary containment protection.



POLYSTAR INC

573-7 HIGHLAND RD.
MACEDONIA, OHIO 44056
PHONE 216/467-8300

FAX 216/467-8342

SOLID WASTE MARKETS

REPRESENTATIVE RECYCLING FIRMS OPERATING IN TENNESSEE

GLASS RECYCLERS

Strategic Materials Inc., 1035 Thompson Rd., Ashland City, TN 37015	615-792-5097
North Central Recycling, Inc., 410 Warehouse Lane, Hartsville, TN 37074	615-374-4776

PLASTICS RECYCLERS

Jeanell Foam (Residue of TN, Inc.), 216 W Front St., Bradford, TN 38316	901-742-2201
Deka Plastics, Inc., Airport Road, Greenfield, TN 38230 (Industrial Scrap)	901-235-3347
Dyna-Pak Corp., 112 Helton Dr., Lawrenceburg, TN 38464 (LDPE only)	615-762-4016
Pad Warehouse, 2640 Faxon Ave., Memphis, TN 38112 (Carpet Padding)	901-327-9506
Appertain Corp., 280 9th St., Pulaski, TN 38478 (Foam & Industrial Scrap)	615-424-0423
Earth Care Products, 149 Industrial Park Rd., PO Box 537, Sharon, TN 38255 (Plastic Lumber)	901-456-2681
Createch, Inc., 207 Industrial Dr, Tullahoma, TN 37388-4076	615-454-9000
<i>A directory of scrap plastics processors & buyers is available from Resource Recycling Mgz</i>	<i>503-227-1319</i>
<i>A directory of plastics recyclers is available from Plastics News</i>	<i>800-678-9595</i>
<i>For the nearest Expanded Polystyrene Foam (EPS) packaging material collection center, call</i>	<i>800-944-8448</i>

POST-CONSUMER GOODS RECYCLER (Packaged Goods, Out-dated/Off-Spec, etc.)

Recycle, Inc., 53 Evans Dr., Bells, TN 38006	901-663-3900
----------------------------------------------	--------------

TEXTILE MATERIALS RECYCLERS

Leggett & Platt, 400 Davidson St., Nashville, TN 37213	615-734-1600
OHCO, Inc., 4158 Robinson St., Covington, GA 30209	800-241-1008
Lafayette Cone Company, Hwy. 27N, Lafayette, GA 30728	706-764-1089
Alpha Cellulose Corp., 1000 E Noir St. Lumberton, NC 28358	910-738-4201
Leigh Fibers, P.O. Box 1132, Spartanburg, SC 29304	864-439-4111
A list of textile recyclers is available from the Council for Textile Recycling	301-656-1077

PAPER PRODUCTS RECYCLING INFORMATION

The following mills and companies are involved at some level in recycling paper or paper products. This compilation is not a complete listing, and does not indicate endorsement of any listee. Please contact the businesses for more information, because certain restrictions may apply.

PAPER

Rock-Tenn, 701 Manufacturing Rd., Chattanooga, TN 37405-3703	423-266-7381
Knoxville Recycled Fibers Etc., 410 Frazier St., Knoxville, TN 37917-6752	423-522-6129
Paperstock Dealers, 111 Mitchell St., Knoxville, TN 37917	423-524-0309
Power Paper, 200 W. Springdale Ave., Knoxville, TN 37917	423-544-7522
Jefferson-Smurfit Corp., 707 19th Avenue N, Nashville, TN 37203	615-329-4855
National Paper Recycling, Inc., 4006 Elkins Ave., Nashville, TN 37209	615-269-3228
Tenneco Packaging, 207 River Hills Dr., Nashville, TN 37210	615-889-0605
Jefferson-Smurfit Corp., 265 W. Trigg Ave., Memphis, TN 38106	901-942-3274
Memphis Waste Paper, Inc., 704 South Dudley St., Memphis, TN 38104	901-774-3110

CARDBOARD AND CORRUGATED BOARD

Chattanooga Paperboard, Box 431, Chattanooga, TN 37410	423-267-3801
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Chattanooga Recycled Fiber, 2900 Home Dr., Chattanooga, TN 37410	423-267-0097
Tenneco Packaging, P.O. Box 33, Counce, TN 38326	901-689-1457
Tennessee River Pulp and Paper Company, P.O. Box 33, Counce, TN 38326 (Factory Kraft Liner Board)	901-689-3111
Lydall Corporation, P.O. Box 599, Covington, TN 38019	901-476-7174
BOXES BOXES BOXES, 157 South Pkwy. E. #3, Memphis, TN 38106 (Buys clean, knocked-down used boxes)	901-948-1117
Jefferson Smurfit Corp., 707 19th Ave. N, Nashville, TN 37203	615-329-4855
Inland Container Corp., P.O. Box 299, New Johnsonville, TN 37134	615-535-2161
Sonoco Products, 766 Industrial Rd., Newport, TN 37821	615-623-8611

WASTE OIL HANDLERS

Laidlaw Environmental Services, 1640 Antioch Pk., Antioch, TN 37013	615-833-2059
H&H Oil Recovery Co., RR #3 Box 158A, Camden, TN 38320	901-584-2043
A-1 Shipley's Waste Oil, 2846 Harrison Pk., Chattanooga, TN 37406	423-622-7039
Goins Waste Oil Co., 1606 E. 48th St., Chattanooga, TN 37407	423-867-2216
Jack Goins Waste Oil, 801 15th St. NE, Cleveland, TN 37311	423-476-7492
Industrial Oil Services, 1130 Hwy. 109 N., Gallatin, TN 37066	615-451-1806
Ferguson Harbor Inc., 340 Rockland Rd., Hendersonville, TN 37075	615-822-3295
Purified Lubricants Inc., 7700 Dune Lane, Hixson, TN 37343	423-843-3284
Enterprise Oil, P.O. Box 52044, Knoxville, TN 37951	423-558-0533
Industrial Oil Services, P.O. Box 22695, Knoxville, TN 37933	423-693-7627
Excel TSD Inc., 552 Rivergate Rd., Memphis, TN 38109	901-774-8146
Purified Lubricants Inc., 7009 Rocky Creek, Memphis, TN 38125	901-759-1759
Laidlaw Environmental Services, 3536 Fite Rd., Millington, TN 38053	901-357-3600

Laidlaw Environmental Services of Nashville Inc., 7230 Centennial Pl., Nashville, TN 37209	615-350-5300
Robert Sun Company, 240 Great Circle Rd., Nashville, TN 37228	615-251-0680
AAA Services, P.O. Box 78068, Nashville TN 37207	615-265-8280
Industrial Oil, 610 Jefferson St., West Memphis, AR 72301	501-732-2548
Specialty Oil Environmental Services, 4000 Interstate 55, West Memphis, AR 72301	501-735-2840
Necessary Oil Co., 497 Island Rd., Bristol, VA 24201 (process plant is in Tennessee)	540-669-2971

METALS RECYCLERS

Seaton Iron & Metal Co., 1507 Decator Pike, Athens, TN 37303	423-745-3870
Bristol Scrap Metal, 1115 5th St., Bristol, TN 37620	423-764-1442
Chattanooga Scrap & Metal Co., 529 E. 11th St., Chattanooga, TN 37403	423-266-8254
Commercial Metals Co., 400 E. 20th St., Chattanooga, TN 37408	423-267-2181
P&J Iron & Metal, 2145 Chestnut St., Chattanooga, TN 37408	423-267-0517
Dayton Iron & Metal Co., 301 W. California Ave., Dayton, TN 37321	423-775-6911
DeVandry's Unlimited, 240 Skyline Dr., Dickson, TN 37055	615-446-7769
Elizabethton Herb & Metal Co., P.O. Box 610, Elizabethton, TN 37644	423-543-1991
Burleson Scrap Metal, RR #1 Box 17, Ethridge, TN 38456	615-829-2281
Greenville Iron & Paper Co., 315 Old Stage Rd., Greenville, TN 37745	615-639-1562
Hutcherson Scrap Co., Inc., 14293 Hwy. 210 N., Halls, TN 38040	901-836-9435
David J. Joseph Co., 801 Florida Steel Rd., Jackson, TN 38305	901-423-0194
Hutcherson Metals, Inc., 101 H.O. Forge Dr., Jackson, TN 38301	901-427-6412
Johnson City Iron & Metal Co., 110 Perma Rd., Johnson City, TN 37604	423-928-1609
Kingsport Iron & Metal Co., 424 Riverport Rd., Kingsport, TN 37660	423-245-5124

Knox Metals Corp., P.O. Box 3247, Knoxville, TN 37927	423-637-4353
Lawrence County Recycling Co., 932 N. Military Ave, Lawrenceburg, TN 38464	615-762-5848
Airways Iron & Metal Co., 2103 E. Person Ave., Memphis, TN 38114	901-276-6346
Ben Mogy & Son Co., 2530 Shasta Ave., Memphis, TN 38108	901-458-0925
Iskiwitz Metals, 604 Marble Ave., Memphis, TN 38107	901-526-8944
H. Blockman & Co., 376 N. Front St., Memphis, TN 38103	901-526-6545
Lazarov Brothers, 1167 N. 7th St., Memphis, TN 38107	901-525-0683
Perlco Metals Recycling, 540 Weekly Ave., Memphis, TN 38107	901-526-7531
South Memphis Iron & Metal Co., 2250 S. 3rd St., Memphis, TN 38109	901-942-2220
Southern Tin Compress Corp., 1270 N. 7th St., Memphis, TN 38107	901-525-1354
Environmental Salvage Co., 1650 Thomas R. James Dr., Morristown, TN 37813	423-581-6870
Clark Iron & Metal Co., 217 Hillard Dr., Murfreesboro, TN 37129	615-893-7281
Mid-Tenn Metal Exchange, 118 S. Rutherford Blvd., Murfreesboro, TN 37130	615-848-1727
Pelhamn Iron & Metal, 1572 Mt. Herman Rd., Murfreesboro, TN 37127	615-893-8731
Steiner-Liff Iron & Metal Co., P.O. Box 1182, Nashville, TN 37202	615-271-3300
Denbo Scrap Metals, 821 W. College St., Pulaski, TN 38478	615-363-3593
Rockwood Iron & Metal Co., 619 W. Rockwood St., Rockwood, TN 37854	423-354-0215
Clean Rite Environmental Services, Big Poor Valley Rd., Rogersville, TN 37857	423-272-2223
East Tennessee Iron & Metal, P.O. Box 460, Rogersville, TN 37857	423-235-4119
Holston Salvage, P.O. Box 535, Rogersville, TN 37857	423-235-4492
Smith Metals Co., P.O. Box 330, Selmer, TN 38375	901-645-6302
James Recycling Center, P.O. Box 605, Waverly, TN 37185	615-296-2718
Tuttle's Salvage, 190 Sam Tuttle Rd., Westmoreland, TN 37186	615-644-2688

David Reed's Metal & Recycling, 156 Eugene Reed Rd., Woodbury, TN 37190	615-765-5782
John Smith Scrap Metals, Jim Cummins Hwy., Woodbury, TN 37190	615-563-4343

WOODEN PALLETS RECYCLERS

Hardwood Pallets, Inc., 3418 Alton Park Blvd., Chattanooga, TN 37410	423-756-5664
Bradley Pallet, 1565 37th St. NE, Cleveland, TN 37311	423-478-2183
Preferred Pallets, P.O. Box 466, Cookeville, TN 38503	615-526-3369
Elora Pallet, P.O. Box 36, Elora, TN 37328	615-937-6344
Cranfill's Pallet Service, 2572 Hwy. 411 N, Englewood, TN 37329	423-263-1645
Howell Wood Specialties, 473 Old Lincoln Rd., Fayetteville, TN 37334	615-433-1163
Palatec Manufacturing, Inc., 2998 Huntsville Hwy., Fayetteville, TN 37334	615-433-7935
Conservation Pallet Sales, 3208 Hwy. 79, Indian Mound, TN 37079	615-232-4268
Tennessee Industrial Pallet, 100 Quinn Dr., Jackson, TN 38301	901-424-1675
Pallet Factory, Inc., 923 Campbell, Jackson, TN 38301	901-427-3373
Services Industries, 884 E. Highway 11 E, Jefferson City, TN 37760	423-475-6754
B&S Pallet Co., 650 Willow Ave., Knoxville, TN 37915	423-971-4157
Pallet Factory, Inc., 508 Omni Lane, Knoxville, TN 37932	423-671-0390
Pallet Exchange, 202 W. Morelia Ave., Knoxville, TN 37917	423-523-1203
East Tennessee Pallet, 1704 E. Raccoon Valley Rd., Knoxville, TN 37754	423-947-6864
Highway 10 Lumber Yard, Hwy. 10, Lafayette, TN 37083	615-666-5404
Tri-State Pallet Recycler, 3769 Hwy. 11 E, Limestone, TN 37681	423-257-6522
Travis Pallet Business, 410 Bakers Chapel Rd., Medina, TN 38355	901-783-3545
Best Pallet, 845 Corrine Ave., Memphis, TN 38107	901-527-6764
D&B Pallet Co., 1288 Lincoln St., Memphis, TN 38114	901-323-0900

D&B Pallet Co., 4135 Barron Ave., Memphis, TN 38111	901-744-1626
Mansard Pallet Co., 1018 N. Hollywood St., Memphis, TN 38108	901-452-4036
Pallet Factory Inc., 821 Vance Ave., Memphis, TN 38126	901-526-8055
Pallet Supply Co., Inc., 587 Hernando St., Memphis, TN 38101	901-529-0051
Southern Pallet, Inc., P.O. Box 807, Memphis, TN 38101	901-942-4603
Turner Pallets, 1036 Hollywood North, Memphis, TN 38108	901-452-4449
Morristown Pallet Service, 1547 N. Liberty Hill Rd., Morristown, TN 37814	423-587-6108
Bromley Pallets, 1441 Elm Hill Pike, Nashville, TN 37210	615-259-3117
Nashville Pallet Supply Co., 2611 Powell Ave., Nashville, TN 37204	615-383-5840
Pallet Factory, Inc., 915 Cherokee Ave., Nashville, TN 37207	615-226-9945
Cocke County Pallet, Enka Hwy., Newport, TN 37821	423-623-2559
Newport Pallet Co., P.O. Box 1161, Newport, TN 37821	423-623-6990
Portland Pallet Co., P.O. Box 25, Portland, TN 37148	615-325-2353
Tennessee Pallet Co., Inc., 501 W. Market St., Portland, TN 37148	615-325-7993
Meadows Pallet Co., 34 Meadows Lane, Red Boiling Springs, TN 37150	615-699-2866
Pinkston Pallet Shop, Bulls Gap Rd., Rodgersville, TN 37857	423-272-2886