United States
Environmental Protection
Agency

Office of
Research and Development
Washington, DC 20460

EPA/625/7-91/013
October 1991

EPA

Guides to Pollution Prevention

The Automotive Repair Industry

For Display Only

EPA/625/7-91/013
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Guides to Pollution Prevention

The Automotive Repair Industry

Risk Reduction Engineering Laboratory
and
Center for Environmental Research Information
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Printed on Recycled Paper

Notice

This report has been subjected to the U.S. Environmental Protection Agency's peer and administrative review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This document is intended as advisory guidance only to automotive repair businesses in developing approaches for pollution prevention. Compliance with environmental and occupational safety and health laws is the responsibility of each individual business and is not the focus of this document.

Worksheets are provided for conducting waste minimization assessments of automotive repair shops. Users are encouraged to duplicate portions of this publication as needed to implement a waste minimization program.

Foreword

This report provides many waste minimization options for wastes generated by the automotive repair industry. Significant quantities of waste can be eliminated or avoided by establishing proper waste automotive fluid management practices, operating equipment properly (e.g., solvent sinks, hot tanks and jet spray washers), avoiding spills, and using detergents in place of solvents. Use of drip trays and collection of solid residues from cleaning further controls waste discharges.

In addition to waste minimization, segregation of solvent and aqueous waste by small to medium size repair shops must be promoted. Many of these small businesses generate less than 10 gallons of waste per month. These quantities can cost more for disposal than the original purchase price. Waste motor oils are often used as the vehicle for solvent waste disposal. Aqueous wastes often contain hazardous levels of grease, oil, and heavy metals. Many small shops dispose of this waste into the municipal sewer. Use of a service company to supply cleaning chemicals and remove waste materials is becoming an economical option.

Contents

Acknowledgments

This guide is based in part on waste minimization assessments conducted by Wesley M. Toy, for the California Department of Health Services (DHS) under the direction of Benjamin Fries, DHS Toxic Substances Control Program, Alternate Technology Division. Additional information was taken from waste minimization assessments performed by Jacobs Engineering Group Inc. (Jacobs) for the City of Santa Monica (CSM), under the direction of Brian Johnson, CSM Water/Wastewater Division, Department of General Services. Michael Callahan and David Shoemaker of Jacobs edited and developed this version of the waste minimization assessment guide, under subcontract to PEI Associates (USEPA contract 68-D8-0112). Teresa Harten of the U.S. Environmental Protection Agency, Office of Research and Development, Risk Reduction Engineering Laboratory, was the project officer responsible for the preparation and review of this document. Wesley M. Toy, Moonyean Kistler of the Automotive Service Councils of California, and Carol Bartels of D & L Automotive Repair served as reviewers.

Section 1
Introduction

This guide is designed to provide automotive repair facilities with waste minimization options appropriate for the industry. It also provides worksheets designed to be used for a waste minimization assessment of an automotive repair facility, to develop an understanding of the facility's waste generating processes and to suggest ways that the waste may be reduced.

The guide is designed primarily for use by operators of automotive repair shops. Others who may find this document useful are operators of vehicle fleets, regulatory agency representatives, and consultants. In the following sections of this report you will find:

- An overview of the automotive repair industry (Section 2);
- Waste minimization options for automotive repairers (Section 3);
- Waste minimization assessment worksheets (Section 4);
- Appendices containing:
  - Case studies of two automotive repair shops and one parts washer lease and service company. Also included are completed waste minimization assessment worksheets for a hypothetical shop.
  - Where to get help: Regional EPA offices and other sources.

The worksheets and the list of waste minimization options were developed through assessments of two Northern California-area automotive repair facilities and one Northern California parts washer lease and service company as commissioned by the California Department of Health Services (CDHS 1987). The firms' operations, and waste generation and management practices were surveyed, and their existing and potential waste minimization options were characterized. Economic analyses were performed on selected options. Additional information was developed from the assessment of three Southern California automotive repair facilities commissioned by the City of Santa Monica Department of General Services (CSM 1989).

Overview of Waste Minimization

Waste minimization is a policy specifically mandated by the U.S. Congress in the 1984 Hazardous and Solid Wastes Amendments to the Resource Conservation and Recovery Act (RCRA). As the federal agency responsible for writing regulations under RCRA, the U.S. Environmental Protection Agency (EPA) has an interest in ensuring that new methods and approaches are developed for minimizing hazardous waste and that such information is made available to the industries concerned. This guide is one of the approaches EPA is using to provide industry-specific information about hazardous waste minimization. The options and procedures outlined can also be used in efforts to minimize other wastes generated in a business.

In the working definition used by EPA, waste minimization consists of *source reduction* and *recycling*. Of the two approaches, source reduction is considered environmentally preferable to recycling. While a few states consider *treatment* of waste an approach to waste minimization, EPA does not and thus treatment is not addressed in this guide.

Waste Minimization Opportunity Assessments

EPA has developed a general manual for waste minimization in industry. The *Waste Minimization Opportunity Assessment Manual* (USEPA 1988) tells how to conduct a waste minimization assessment and develop options for reducing hazardous waste generation. It explains the management strategies needed to incorporate waste minimization into company policies and structure, how to establish a company-wide waste minimization program, conduct assessments, implement options, and make the program an on-going one.

A Waste Minimization Opportunity Assessment (WMOA) is a systematic procedure for identifying ways to reduce or eliminate waste. The four phases of a waste minimization opportunity assessment are: planning and organization, assessment, feasibility analysis, and implementation. The steps involved in conducting a waste minimization assessment are illustrated in Figure 1, and presented in more detail below. Briefly the assessment consists of a careful review of a plant's operations and waste streams and the selection of specific areas to assess. After a particular waste stream or area is established as the WMOA focus, a number of options with the potential to minimize waste are developed and screened. The technical and economic feasibility of the selected options are then evaluated. Finally, the most promising options are selected for implementation.

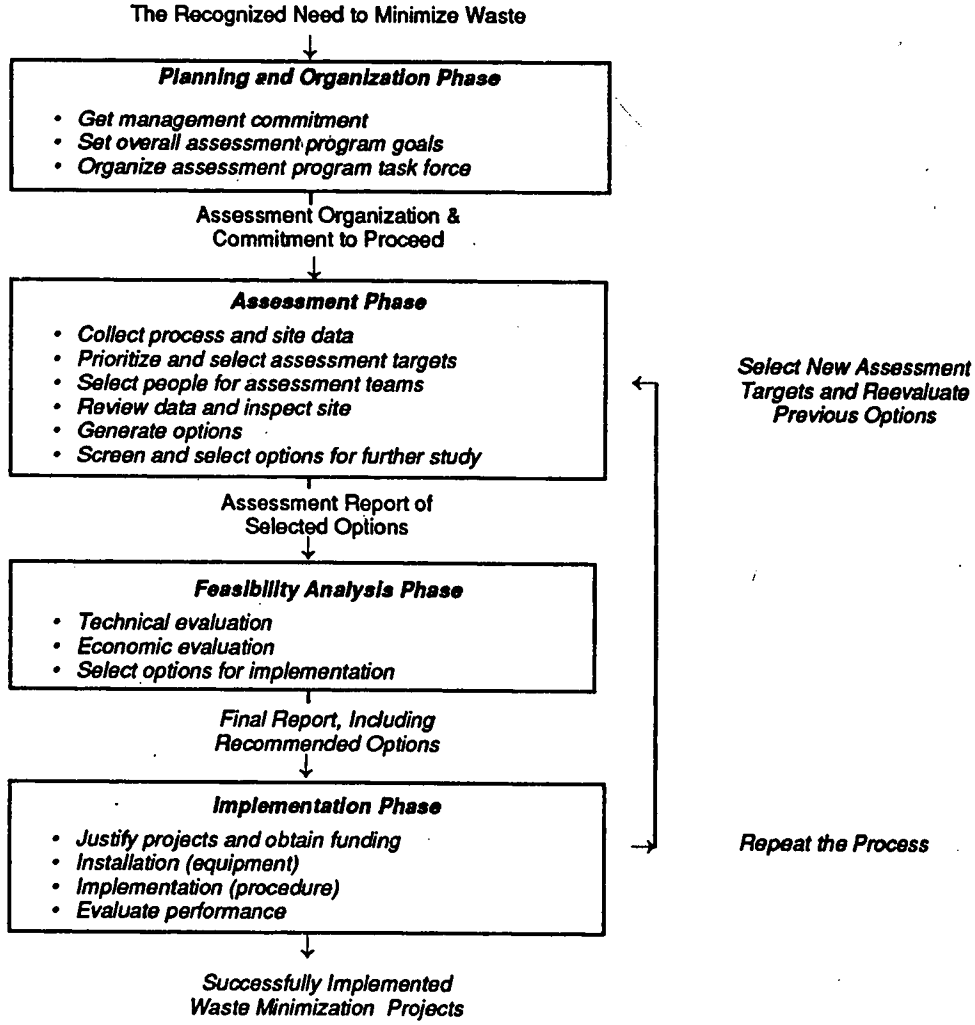

Figure 1. The waste minimization assessment procedure.

Planning and Organization

Essential elements of planning and organization for waste minimization are: getting management commitment; setting waste minimization goals; and organizing an assessment task force.

Assessment Phase

The assessment phase involves a number of steps:

1. Collect process data
2. Prioritize and select assessment targets
3. Select assessment team
4. Review data and inspect site
5. Generate options
6. Screen and select options for feasibility study

Collect process data. The waste streams at a shop should be identified and characterized. Information about waste streams may be available on hazardous waste manifests, National Pollutant Discharge Elimination System (NPDES) reports, routine sampling programs and other sources.

Developing a basic understanding of the processes that generate waste is essential to waste minimization. Flow diagrams should be prepared to identify the quantity, types and rates of waste generated. Also, preparing material balances for various processes can be useful in tracking various process components and identifying losses or emissions that may have been unaccounted for previously.

Prioritize and select assessment targets. Ideally, all waste streams should be evaluated for potential waste minimization opportunities. With limited resources, however, a plant manager may need to concentrate waste minimization efforts in a specific area. Such considerations as quantity of waste, hazardous properties of the waste, regulations, safety of employees, economics, and other characteristics need to be evaluated in selecting a target stream.

Select assessment team. The team should include people with direct responsibility and knowledge of the particular waste stream or area of the shop or plant.

Review data and inspect site. The assessment team evaluates process data in advance of the inspection. The inspection should follow the target process from the point where raw materials enter the shop or plant to the points where products and wastes leave. The team should identify the suspected sources of waste. This may include the production process; maintenance operations; and storage areas for raw materials, finished product, and work in progress. The inspection may result in the formation of preliminary conclusions about waste minimization opportunities. Full confirmation of these conclusions may require additional data collection, analysis, and/or site visits.

Generate options. The objective of this step is to generate a comprehensive set of waste minimization options for further consideration. Since technical and economic concerns will be considered in the later feasibility step, no options are ruled out at this time. Information from the site inspection, as well as trade associations, government agencies, technical and trade reports, equipment vendors, consultants, and plant engineers and operators may serve as sources of ideas for waste minimization options.

Both source reduction and recycling options should be considered. Source reduction may be accomplished through good operating practices, technology changes, input material changes, and product changes. Recycling includes use and reuse of waste, and reclamation.

Screen and select options for further study. This screening process is intended to select the most promising options for full technical and economic feasibility study. Through either an informal review or a quantitative decision-making process, options that appear marginal, impractical or inferior are eliminated from consideration.

Feasibility Analysis

An option must be shown to be technically and economically feasible in order to merit serious consideration for adoption. A technical evaluation determines whether a proposed option will work in a specific application. Both process and equipment changes need to be assessed for their overall effects on waste quantity and product quality. Also, any new products developed through process and/or raw material changes need to be tested for market acceptance.

An economic evaluation is carried out using standard measures of profitability, such as payback period, return on investment, and net present value. As in any project, the cost elements of a waste minimization project can be broken down into capital costs and economic costs. Savings and changes in revenue also need to be considered.

Implementation

An option that passes both technical and economic feasibility reviews should then be implemented. It is then up to the assessment team, with management support, to continue the process of tracking wastes and identifying opportunities for waste minimization, throughout a facility and by way of periodic reassessments. Either such ongoing reassessments or an initial investigation of waste minimization opportunities can be conducted using this manual.

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Calif. DHS. 1987. *Waste audit study: automotive repairs.* Report prepared by Wesley M. Toy, P.E. Saratoga, Calif., for the California Department of Health Services, Alternative Technology Section, Toxic Substances Control Division. May 1987.

CSM. 1989. *Hazardous waste minimization audits of automotive repair and refinishing facilities.* Prepared by Jacobs Engineering Group Inc., Pasadena, Calif., for the City of Santa Monica Department of General Services. September 1989.

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Section 2
Automotive Repair Industry Profile

Industry Description

The automotive repair industry is composed of three primary segments: automotive repair shops; new car dealerships; and diesel engine repair shops. These three segments produce significant solvent wastes, aqueous wastes, and sludges which require disposal as hazardous waste. Of small quantity generators of hazardous waste located in the United States, automotive repair leads in number of generators and in quantity of total waste produced (USEPA 1985). Autobody shops and paint shops are covered by a another guide in the pollution prevention guide series (USEPA 1991b).

The most common activities performed at automotive repair shops include replacement of automotive fluids (e.g., motor oil, radiator coolant, transmission fluid, brake fluid), replacement of non-repairable equipment (e.g., brake shoes/pads, shocks, batteries, belts, mufflers, electrical components, water pumps), and repair of fixable equipment (e.g., brake calipers/rotors/drums, alternators, fuel pumps, carburetors, power train components). Equipment removed for repair often requires cleaning. Cleaning is performed to allow for better visual inspection of the parts and to remove contaminated lubricants/greases that would lead to early failure of the repaired part. Clean lubricants/greases are applied to the parts (if needed) during reassembly. Repairable parts are often replaced with new or commercially rebuilt parts at the discretion of the customer. Most repairable parts that are not fixed at the shop and many non-repairable parts are sold to automotive part remanufacturers.

Overview of Waste Generation

The major waste generating activities that occur in automotive repair and servicing include: clean up of the shop area, cleaning of parts in order to perform repairs, scheduled car

Table 1. Typical Automotive Repair Wastes

Operation	Waste Material	Pollutants
Shop Cleanup	Out-dated Supplies	Solvents, caustic cleaners, automotive fluids (oils, alcohols, ethylene glycol, acids).
	Dirty Rags and Sawdust	Oil and grease, heavy metals, solvents.
	Alkaline Floor Cleaner	Caustics, oil and grease, heavy metals.
	Clarifier Sludge	Oil and grease, heavy metals.
Parts Cleaning	Solvents	Petroleum distillates, aromatic hydrocarbons, mineral spirits, naphtha, chlorinated compounds, oil and grease, heavy metals.
	Air Emissions	See solvents.
	Aqueous Cleaners	Acids and alkalis, oil and grease, heavy metals, blended heavy oils, heavy metals.
	Dirty Baths	See aqueous cleaners.
Auto Maintenance	Motor Oil	Blended mineral oil, heavy metals.
	Transmission Fluid	Blended mineral oil, heavy metals.
	Engine Coolant	Ethylene glycol, lead.
	Batteries	Sulfuric acid, lead.
	Brakes	Asbestos.
	Refrigerant	CFC-12

maintenance (replacement of engine oil, oil filters, transmission fluid, radiator fluids), and nonscheduled maintenance/ repair (replacement of spent batteries, worn brakes, shocks, tires, etc.). Table 1 provides a description of materials and wastes. Additional information regarding waste generation is presented in the following sections.

Shop Cleanup Wastes

The amount of sawdust, rags, and wash-down waste generated during shop cleanup is a direct function of the care employees take in preventing spills and leaks of the automobile fluids handled. Waste management practices for these are discussed below.

Dirty rags. Rags are often used to cleanup a liquid spill or to wipe off grease from a part being repaired. Dirty rags are typically disposed of in the trash. To reduce the costs and liability associated with disposal of dirty rags which might be classified as hazardous, some shops are investigating the use of leasing arrangements in which a laundry service picks up the dirty rags, cleans them, and returns them to the shop.

Sawdust. Sawdust is commonly used to absorb a spill of raw materials or hazardous wastes. Depending on the material absorbed, used sawdust might be classified as a hazardous waste and be subject to hazardous waste regulations. Most shops currently dispose of this waste in the trash.

Area washdowns. Alkaline floor cleaners are used to remove oil and grease from shop floors. Shop operators should strive to employ the least hazardous type of floor cleaner available. To reduce the need for and use of alkaline cleaners, well run shops pay careful attention to the prevention of leaks and spills. For facilities with clarifiers, discharge of cleaner can upset the operation of the clarifier by forming oil emulsions. Sludge removed from the clarifier might require disposal as a hazardous waste depending on its composition.

Parts Cleaning

Parts cleaning often involves the use of a parts washer. Washers can be categorized as solvent parts washers, hot tanks, jet spray washers, ultrasonic cleaners, and steam cleaners. The devices used primarily in this industry are solvent parts washers, hot tanks, and jet spray washers. Ultrasonic cleaners have not been adapted to handle the waste loading found in the industry. The use of steam cleaning requires an investment in water treatment and steam generator equipment. A brief discussion of solvent parts washers and hot tank/jet spray washers follows.

A solvent parts washer recirculates solvent continuously from the solvent drum to the solvent wash tray where the parts are cleaned. Solvent is normally replaced with fresh solvent on a monthly basis. The solvents used for parts cleaning contain petroleum-based ingredients or mineral spirits. Carburetor cleaner contains methylene chloride.

Air emissions occur when the solvent is sprayed onto parts placed in the wash tray and when parts are improperly drained of solvent. Many air quality control districts specify that equipment cannot be designed so as to provide a fine spray mist (which leads to high evaporation rates) and that parts must be properly drained before removal from the washer. For washers in which the solvent bath is always exposed to the atmosphere (i.e. wash tanks), lids must be kept closed whenever the tank is not in use. Add-on emission control devices are extremely rare.

Electrically heated hot tanks are also used to clean parts. Parts are placed in a tank of hot aqueous detergent or caustic solution to achieve cleaning. Air or mechanical agitation is employed to increase cleaning efficiency. Jet spray washers also use hot aqueous solutions for cleaning, but in this application, rotating jets spray the parts with cleaner. Both hot tanks and jet sprays are usually serviced monthly by removing the spent cleaner and sludge and recharging the washer with fresh detergent. Disposal of 10 to 80 gallons of cleaning solution per device on a monthly basis is typical of most operations. Sludge that accumulates in the waste sump of the pressure spray cleaning bays and in area wash-down clarifiers is often taken off site to a local municipal landfill.

Scheduled Car Maintenance

The amount of waste oil, lube oil, transmission fluid, oil filters, and engine coolant handled by each shop is a direct function of the number of cars serviced. Since rules and regulations regarding the proper management and disposal of these wastes vary from state to state, readers should check with their appropriate agencies.

Waste oil. Waste oil is regulated as a hazardous waste in several states and must be transported by a licensed hazardous waste hauler to a licensed treatment facility. Many shops store waste oil, dirty lube oils and greases, and transmission fluids in underground tanks for pick up by an off-site recycler.

Oil filters. Oil filters are typically drained of oil and are then disposed of as nonhazardous waste. Because some shops in the California DHS assessments have had trouble with oil filters continuing to leak and drip oil in their trash dumpsters, they are investigating the use of special oil filter receptacles that would be picked up and handled by their waste oil hauler.

Engine coolant. Engine coolant may be regulated as a hazardous waste because it contains ethylene glycol (toxic) and detectable concentrations of benzene, toluene, lead, zinc, arsenic, mercury and copper accumulated from the cooling system. Spent radiator solution is generated at 30 to 100 gallons per month by medium-sized to large repair shops and is commonly collected, stored, and disposed of as a hazardous waste. Many smaller shops sewer this waste.

Nonscheduled Maintenance and Repair

Nonscheduled maintenance and repair is required when automotive parts fail due to routine wear, damage, or neglect. Typical wastes include broken belts and hoses, tires, batteries, brake pads and shoes, water pumps, fuel pumps, carburetors, mufflers, and others. The first step in reducing or avoiding the generation of these wastes is for customers to follow routine scheduled maintenance as specified by the automobile manufacturers and to practice good driving techniques. Both of these can reduce wear and tear on the automobile.

Many of the broken parts removed from an automobile that are not cost-effective to repair are sold to parts remanufacturers. Such parts include brake shoes and pads, master cylinders, water pumps, fuel pumps, alternators, compressors, engines, transmissions, and many others. Worn tires can sometimes be recapped, but the demand for recapped tires is limited. There is also a limited market for rebuilt batteries. Most tires are landfilled while spent batteries are often sold to a smelter for the recovery of lead. Cracked or broken batteries should be managed as a hazardous waste.

References

Calif. DHS. 1987. *Waste audit study: automotive repairs.* Report prepared by Wesley M. Toy, P.E. Saratoga, Calif., for the California Department of Health Services, Alternative Technology Section, Toxic Substances Control Division. May 1987.

CSM. 1989. *Hazardous waste minimization audits of automotive repair and refinishing facilities.* Prepared by Jacobs Engineering Group Inc., Pasadena, Calif., for the City of Santa Monica Department of General Services. September 1989.

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Section 3
Waste Minimization Options for Automotive Repair Shops

This section discusses recommended waste minimization methods for automotive repair shops. These methods come from accounts published in the open literature and through industry contacts. The primary waste streams associated with automotive repair are listed in Table 2 along with recommended waste minimization options. Typical waste streams are shop clean up wastes, parts cleaning wastes, and automotive maintenance wastes.

The waste minimization options listed in Table 2 can be classified generally as source reduction (which can be achieved through material substitution, process or equipment modification, or better operating practices) or as recycling. Better operating practices are procedural or institutional policies that result in a reduction in waste. They include:

- Waste stream segregation
- Personnel practices
  - Management initiatives
  - Employee training
  - Employee incentives
- Procedural measures
  - Documentation
  - Material handling and storage
  - Material tracking and inventory control
  - Scheduling
- Loss prevention practices
  - Spill prevention
  - Preventive maintenance
  - Emergency preparedness
- Accounting practices
  - Apportion waste management costs to departments that generate the waste.

Better operating practices apply to all waste streams. In addition, specific better operating practices that apply to certain waste streams are identified in the appropriate sections that follow.

Shop Cleanup

The human aspects of industrial activity can be very important in waste reduction. Often termed "good operating practices" or "good housekeeping," these methods can be very effective in reducing the amount of shop clean up wastes generated. Typical wastes include outdated supplies, dirty rags, sawdust, area washdowns, and clarifier sludges.

Good housekeeping methods include improved employee training, management initiatives to increase employee awareness of the need for and benefits of waste minimization, and requiring increased use of preventive maintenance in an effort to reduce the number of leaks and spills that occur. Additional ways to reduce or minimize waste include:

- Improve inventory control
- Use first-in, first-out (FIFO) policy
- Minimize storage quantities
- Increase storage area inspections
- Conduct employee training
- Employ spill containment techniques

In one survey of automotive repair businesses (CSM 1989), all shops assessed used computerized inventory control; however, none reported the use of rigid control to maximize the use of supplies. This suggests that workers were free to obtain supplies at will. Workers should be made to return empty containers of materials before they are issued new supplies. This type of policy has been reported to be effective in reducing the solvent use at several automotive refinishing businesses. For more information, refer to the EPA pollution prevention guide for automotive refinishers (USEPA 1991).

Cleanup wastes can be minimized by improving spill containment techniques and by implementing policies to reduce spillage. When a spill of raw material or hazardous waste occurs, sawdust (or some other adsorbent) may be used to adsorb it. Depending on the nature of the spilled material, the sawdust may become a hazardous waste and be subject to all hazardous waste regulations. If floors are heavily soiled with oil and other hazardous materials when washed, then large quantities of wash water may acquire hazardous waste classification. Ways to reduce spillage include:

Award program for worker with cleanest bay. Awards should be based on the care a mechanic takes in preventing spills as well as the worker's efficiency of cleanup after a spill. At some facilities, work bays out of sight of the customer tend to be dirtier than bays in sight. Special attention should be given to inspection of areas where the general feeling might be "out of sight, out of mind".

Use of drip trays. To assist workers in keeping their assigned bays clean, drip pans should be provided and used. Most shops do not use drip pans and the occurrence of fluids leaking from automobiles and parts placed on the floor is common. By using drip pans, shop floors will remain cleaner

Table 2. Waste Minimization Methods for the Automotive Repair Industry

Activity	Waste	Waste Minimization Options
Shop Cleanup	Out-dated Supplies	Computerize inventory control, use first-in, first-out policy, minimize storage quantities, and perform routine storage area inspections.
	Dirty Rags and Sawdust	Use good housekeeping measures to reduce spills and leaks. Lease rags from a laundry cleaning service.
	Alkaline Floor Cleaner	Use good housekeeping measures to reduce spills and leaks such as award program for worker with cleanest bay, use of drip trays under leaking cars and removed parts, and proper storage of waste materials (use of pallet/containment systems and installation of self-closing non-leak safety faucets on portable waste oil drums).
	Clarifier Sludges	Use good housekeeping measures to reduce spills and leaks. Don't flush dust or floor sweepings to the clarifier unit.
Parts Cleaning	Solvent Baths/Air Emissions	Use less hazardous or safer solvents. Determine how clean parts need to be. Use solvents properly, don't use to clean floors. Increase cleaning efficiency. Monitor solvent composition. Operate solvent sinks properly, use drip trays and allow more drainage time. Keep lids closed when not in use. Contract with a service company to maintain solvent sinks. Install on-site solvent recovery equipment.
	Aqueous Baths	Switch from caustic to detergent-based cleaning solutions. Use dry precleaning methods such as wire brushing. Maintain solution quality by monitoring composition. Maintain equipment in proper working order. Filter solids from the bath on a continuous basis. Screen solids before they reach the waste sump. Employ two-stage parts cleaning sequence. Install or convert free running rinses to still rinse. Use a hot tank or jet spray washer lease service. Switch to bake-off ovens.
Automotive Maintenance	Spent Fluid (Oil, Coolant, and Transmission Fluids)	Store all wastes properly and keep segregated to promote the potential for recycling.
	Rebuildable parts	Give or sell to a parts remanufacturer.
	Batteries	If unbroken, sell batteries to an off-site recycler.
	CFC-12	Purchase recycling system to recover refrigerant.

and hence less frequent cleaning of the floors should be required. Added benefits would be a reduction in use of rags and adsorbent to clean the floors, and a safer work environment.

Proper storage of waste materials. Waste materials should always be kept segregated and stored in proper containers. Storage areas should be bermed or diked so that accidental spills can be contained. This is especially important for spent battery storage. Batteries may be stored in the parts supply room awaiting pick up. If these were to leak, the resulting acid spill could be dangerous. For shops with limited space, combination pallet/containment systems are available.

Another option for reducing leaks and spills is the use of self-closing non-leak safety faucets on the portable waste oil collection tanks. Leaking valves should be replaced as soon as possible whenever leaking is noticed. If immediate replacement of the valve is not feasible, then a small collection cup should be hung under the valve to catch drippings. Accidental opening of the valve, which might occur if the valve handle were kicked or hit, can be prevented by using padlockable valves and inserting lock pins.

Parts Cleaning

The recommended strategy for developing effective waste minimization options for parts cleaning operations relies on systematic exploration of the following *sequence* of steps:

1. Avoid the need to clean.
2. Select the least hazardous cleaner.
3. Maximize cleaning efficiency.
4. Segregate cleaning wastes.
5. Maximize recycling and reuse.

This strategy is consistent with the multi-media approach and general emphasis of reducing the waste at the source. The following sections discuss waste minimization options for users of solvents and aqueous cleaners.

Solvents

Solvent wastes were among the first to be banned from land disposal by the EPA. The 1984 RCRA amendments specify five categories of solvent waste (F-001 to F-005) which are banned from land disposal effective November 1986 (RCRA 3004 (e)(1)). Due to the diverse problems associated with solvent use, solvents should always be used only when no other cleaner is suitable for the job. The major ways to avoid or reduce the generation of solvent waste include eliminating the need to use solvent; finding adequate substitutes for solvents; minimizing losses associated with solvent use; and segregation, recycle, recovery, and reuse of waste solvents.

Product reformulation or substitution. The auto repair industry has reformulated carburetor cleaner compound to exclude the use of 1,1,1 trichloroethane (TCA), which had been used typically in 5 percent concentrations with methylene chloride and cresylic acid. TCA is a known toxic substance and irritant absorbed through the skin.

Another potential substitution that is increasing in use is terpene cleaners in place of Stoddard solvent. The terpene cleaners are available commercially in neat form or as water solutions with surfactants, emulsifiers, rust inhibitors, and other additives. Terpenes have tested favorably as substitutes for halogenated solvents for removal of heavy greases, oily deposits, and carbonized oils. Reported disadvantages of terpenes include inability to separate long chain aliphatic oils for recycling of the cleaning solution both in neat form and in aqueous emulsions. Ultrafiltration to remove oil is not viable for recycle and is only useful for treating dilute emulsions prior to wastewater treatment. Recovery by distillation is impractical since terpenes boil around 340°F, which means that many light oils would be carried over with the solvent. Energy cost for distillation recovery, even with vacuum assist, would be high.

Determine how clean parts need to be. Before using a solvent or aqueous cleaner, one should determine whether cleaning is necessary and just how clean a part needs to be. Rigorous chemical cleaning should only be performed when parts require it (e.g., bearings, engine internals, etc.). Stationary structural members typically require cleaning only for inspection.

Use solvents properly. Solvent should never be used for the general cleaning of shop floors, and should only be used in a well-maintained self-contained cleaning system. When not in use, all solvent cleaning tanks must be covered and/or drain plugs closed. Solvent losses due to inappropriate usage, equipment leaks or spills, and evaporation can range from 25 to 40 percent of total solvent usage. Cans of spray cleaner should only be used when parts cannot be removed from the car and the placement of a cleaning sink or a pan under the part to catch drippage is not feasible.

Increase cleaning efficiency. The need to dispose of or replace dirty solvent can often be reduced by increasing the degree of cleaning efficiency. While cold cleaning operations can be successfully performed at up to 10 percent soil solids content, solvent baths are often replaced when the contamination level reaches two to three percent, due to slow cleaning action. A simple way to increase cleaning efficiency is to employ manual brushing. Manual brushing is extremely effective at removing caked-on solids and is a common precleaning technique. Use of ultrasonic or mechanical agitation also increases the cleaning efficiency.

Monitor solvent composition. Because decisions to replace dirty solvent are made arbitrarily, much solvent is disposed of prematurely. Solvent monitoring may be performed to ensure that solvent is replaced only when it is truly dirty. In the dry cleaning industry, the level of solvent contamination is monitored by measuring the transmittance of light through a sample of dirty solvent. Work performed by the military on monitoring the quality of Stoddard solvent used for cleaning showed that light transmittance, as measured by visible absorbance at 500 nanometers (nm), was a reliable indicator of contamination. Solvent replacement was required when light transmittance dropped below 25 percent.

Operate solvent sinks properly. Improper use of solvent sinks can lead to excessive solvent losses and increased waste generation. To reduce solvent losses and waste generation, solvent sinks should be operated properly. Ways to reduce losses include using a solvent sink with recirculating base tank as opposed to a rinse tank or open bucket, placing of sinks in a convenient location, removing parts slowly after immersion to reduce drippage, installing drip trays or racks to drain cleaned parts, allowing more drainage time over the sink after withdrawal, and turning off the solvent stream, covering or plugging sink when not in use.

Contract with a solvent service company. For a monthly fee, solvent service companies will pickup dirty solvent, clean and maintain the solvent sink, and refill the sink with clean solvent. Depending on the arrangement, solvent sinks may be owned by the shop or leased from the solvent service company. The cost for contracting with a solvent service company is often less than the combined cost of solvent purchase, tank maintenance, and waste disposal. Safety-Kleen Corp. and Safe-Way Chemical Company as well as others offer this service. Over 95 percent of automotive repair operations have some type of solvent sink. The use of solvent sinks for parts washing either on an owned or leased basis is being accepted as general good practice.

Safety-Kleen, a nationally-franchised organization, recovers for reuse approximately 10,000 gallons of solvent per month in the San Francisco Bay area alone. Dirty solvent is taken to the recycling facility, where it is distilled and returned to the users. Safe-Way Chemical Company sells waste solvent to solvent recovery operations such as Solvent Services of San Jose, where a waste fuel is produced by distillation.

In addition to cleaning solvent, both companies offer similar services for carburetor cleaner. Safety-Kleen recovers carburetor cleaner for reuse by distillation. Product fees charged include pickup and disposal of spent solutions. Safe-Way Chemical sends waste carburetor cleaner for solvent recovery to Solvent Services, where a lacquer wash is produced. Lacquer wash is used in paint stripping, among other uses.

Install on-site solvent recovery equipment. Purchase of an on-site solvent recovery system is often viewed as a viable waste minimization option for solvent wastes. Recent prices (August 1990) for 5 and 15 gallon batch stills designed to process Stoddard solvent are $3,600 and $12,500 respectively. These stills utilize a bag liner (for ease of cleaning) and microprocessor control. Based on the results of the California DHS assessments, the low volume of solvent normally used at most small to medium repair operations does not justify the added expense of on-site solvent recovery equipment and maintenance costs. For large operations that do generate significant volumes of solvent, labor costs to operate the equipment and additional costs for disposal of waste residues are not competitive with current solvent sink lease and maintenance service operations. Given the poor economics of this option, not to mention the increased liabilities and regulatory requirements which may be associated with on-site recycling, this option would be viable only for a few automotive repair facilities.

Aqueous Cleaners

Aqueous cleaning comprises a wide range of methods that use water, detergents, acids, and alkaline compounds to displace soil rather than dissolving it in organic solvent. Aqueous cleaning has been found to be a viable substitute for many parts cleaning operations currently using solvents. Its principle disadvantage is that the parts are wet after cleaning and carbon steel parts rust easily in this environment. Techniques for reducing wastes from aqueous cleaning include:

Switch to bake-off ovens. Small bake-off ovens are being adopted for use in this industry to replace caustic cleaners. Bake-off ovens are designed to pyrolize the dirt and grease, leaving a dry residue that can be brushed off. In most cases, abrasive blasting of the parts is required to remove all of the residue. The advantage of a bake-off oven is that it produces a small volume of dry solid wastes compared to a large volume of liquid waste. Disadvantages of bake-off ovens include potential for increased air emissions, need for abrasive blasting equipment, and potential distortion or alteration of the part shape.

Switch to detergent-based cleaners. Many shops are switching from solvent or caustic-based cleaners to less hazardous detergent-based cleaners. Operators should check that the type of cleaner used consists of surfactants that are good detergents but are poor emulsifiers (stable oil emulsions limit reuse of the cleaner and hasten its disposal). Agitation of the bath during use keeps the solids in suspension. Following prolonged periods of inactivity, however, the oily solids separate via flotation or settle to form a bottom sludge. Solution strength is maintained and bath life prolonged by removing these solids frequently.

Use dry precleaning (wire brushing). To reduce the loading of dirt and grime on chemical cleaners and reduce the generation of chemical-laden sludge, the use of dry wipes and wire brushing to pre-clean the part prior to soaking should be considered. While these methods would not be appropriate for precision cleaning, they can be used to remove the bulk of the dirt and grime from external surfaces.

Maintain solution quality. In addition to dirt loading, excessive consumption of alkaline cleaner can also be caused by using air for agitation and hard water for make-up. Air agitation introduces carbon dioxide which reacts with alkali, and use of hard water can result in the formation of particulate solid sludge. In some applications, the decrease in cleaner effectiveness due to carbon dioxide and hard water salts can equal the decrease due to soil loading. Mechanical agitation by means of jet sprays and use of demineralized water for make-up is preferred. Analytical checks of solution strengths, performed by the operator using simple titration techniques, should be made routinely. The correction of solution strength by making small and frequent additions is more effective than making a few large additions.

Maintain equipment in good working order. Rack systems should be maintained in good condition, free from cracks, rust, and corrosion which can flake off and contaminate the bath. Metal tanks should be properly coated with protective finishes both inside and out. Spray nozzles should be inspected regularly to avoid clogging. A still rinse following the cleaning tank is a good way to avoid the loss of cleaner and reduce the discharge of contaminants to the sewer.

Another important item that should be maintained regularly is the float valve that supplies make-up water to tanks of heated cleaning solutions. While maintaining an adequate level is necessary, it is also imperative that the valve does not leak and result in dilution of the cleaner. In addition to maintenance, routine analytical checks of solution strength is a good way to detect slow leaks. Decreases in solution strength during a time when the tank has not been used is a sure indication of a leaking valve (provided that the tank is not leaking).

Screen solids before they reach the waste sump. The majority of the heavy metal residue, oil and grease removed from the hot tank operations occurs after the actual hot tank use. The heavier concentrations of solid residues are found in the waste sump. Standard practice currently is to use a high-velocity spray wand to dislodge these solids into the sump. Proper capture and disposal of these wastes is necessary. This can be done by use of a solids collection tray with overflow to the sump or periodic cleanout of the sump by a waste hauler for disposal at a Class I landfill.

Two-stage parts cleaning. Use of a two-stage parts cleaning arrangement can help to reduce the amount of spent cleaning solution requiring disposal. In a single-stage washer, cleaning solution must be replaced when it can no longer remove or dissolve all of the surface contamination on the part. In a two-stage washer, dirty solution is used to mechanically dislodge bulk contamination from the part followed by the use of clean solution. When the clean solution can no longer be used in the second stage, it is used to replace the dirty solution in the first stage.

Install or convert free running rinses to still rinse. Installing a still rinsing tank immediately after an aqueous cleaning tank allows for cleaner recovery and lowered rinsewater discharges. In such a system, the workpiece is immersed in the still rinse tank following the cleaning operation. Since the still rinse has no free running inflow or outflow of water, cleaner concentration builds up in it. As water evaporates from the heated cleaning system, water from the still rinse is used as make-up. Fresh water is then added to the still rinse. In the case of radiator cleaning, use of a still rinse following the boil-out tank is an effective way of reducing heavy metal discharge (most notably lead) to the sewer.

Use a lease service. Similar to solvent lease arrangements, some companies offer a leasing service for hot tanks and jet spray washers. Hot tank arrangements include monthly leasing of a hot tank and monthly general maintenance service with removal of 10 gallons of solution and sludge and recharge of solution with caustic or alkaline detergent and make-up water. Jet spray washer arrangements include monthly leasing of a jet spray and monthly general maintenance service with removal of 10 gallons of solution and sludge and recharge of solution with caustic or alkaline detergent and make-up water.

Automotive Maintenance

To minimize problems associated with disposal of maintenance wastes, automotive repair shops should manage wastes properly. Proper management includes keeping all incompatible wastes segregated and contracting with appropriate recyclers and waste handlers. Viable options include:

Solvent segregation. Proper manifesting and recovery of spent solvent solutions can only occur if small and medium-size repair operations segregate solvent wastes in suitable storage containers. Current practice at many operations is to commingle the wastes with the waste oil. This practice should be discouraged.

Carburetor cleaner segregation. Similarly, carburetor cleaner is often mixed with waste oils. Carburetor cleaner is a corrosive liquid and contains chlorinated compounds. This waste should be accumulated separately for proper waste management in a suitable container or system.

Spent antifreeze solution and waste motor oils recycling. Both spent antifreeze solution and waste motor oils are generated in substantial quantity at both medium-size and large automotive repair operations. Proper compliance may require collection of these wastes by a registered hazardous waste hauler. Several companies offer off-site recycling services.

Spent lead-acid battery recycling. On a weight basis, spent lead-acid batteries are one of the largest categories of hazardous wastes generated. Recyclers pay auto repair businesses between $1.00 and $1.50 per battery recycled. Spent batteries are either rebuilt for resale or sent to a processor for material salvage. One in six batteries received is rebuildable.

Recover and recycle CFC-12. Rather than venting refrigerant to the atmosphere during air conditioning servicing, recovery and recycling systems are available (MACS 1989). The shops assessed in the Santa Monica study (CSM 1989) reported that the cost of an on-site recovery and recycling system was $3,500. Assuming that it is possible to recover 20 ounces per air conditioner and that the cost of refrigerant is $30 per gallon, a recycling system will pay for itself after servicing approximately 750 air conditioners.

Consumer education. Another way to minimize the generation of automotive maintenance wastes is through promotion of good consumer practices by public agencies and the automotive industry. Consumers should be encouraged to follow specified maintenance schedules and not have service performed needlessly. Simple test methods should be developed to determine if automotive fluids are being replaced prematurely. This could avoid unnecessary fluid changes. Use of synthetic lube oils, which reportedly last 10,000 to 15,000 miles before requiring replacement, could also be a viable waste reduction measure.

References

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Section 4
Waste Minimization Assessment Worksheets

The worksheets provided in this section are intended to assist auto repair shops in systematically evaluating waste generating processes and in identifying waste minimization opportunities. These worksheets include only the waste minimization assessment phase of the procedure described in the *Waste Minimization Opportunity Assessments Manual*. A comprehensive waste minimization assessment includes a planning and organizational step, an assessment step that includes gathering background data and information, a feasibility study on specific waste minimization options, and an implementation phase. For a full description of waste minimization assessment procedures please refer to the manual. Table 3 lists the worksheets included in this section. After completing the worksheets, the assessment team should evaluate the applicable waste minimization options and develop an implementation plan.

Table 3. List of Waste Minimization Assessment Worksheets

Number	*Title*	*Description*
1.	*Waste Sources*	*Typical wastes generated at automotive repair shops due to shop clean-up, parts cleaning, and maintenance and repair operations.*
2a.	*Waste Minimization: Material Handling*	*Questionnaire on procedures used for handling drums, containers and packages.*
2b.	*Waste Minimization: Material Handling*	*Questionnaire on procedures used for bulk liquid handling.*
3.	*Option Generation: Material Handling*	*Waste minimization options for material handling operations.*
4a.	*Waste Minimization: Parts Cleaning*	*Questionnaire on use of solvents and aqueous cleaners.*
4b.	*Waste Minimization: Parts Cleaning*	*Continuation of questionnaire on use of aqueous cleaners.*
5.	*Option Generation: Parts Cleaning*	*Waste minimization options for parts cleaning operations.*
6a.	*Waste Minimization: Waste Handling*	*Questionnaire on handling of waste automotive fluids and other automotive wastes.*
6b.	*Waste Minimization: Waste Handling*	*Questionnaire on handling of waste due to shop clean-up.*
7.	*Option Generation: Waste Handling*	*Waste minimization options for waste handling.*

Firm ______ Site ______ Date ______	**Waste Minimization Assessment** Proj. No. ______	Prepared By ______ Checked By ______ Sheet 1 of 1 Page 1 of 10

WORKSHEET 1

WASTE SOURCES

Shop Clean-Up	Significance at Shop		
	Low	Medium	High
Obsolete raw materials			
Spills & leaks (liquids & powders)			
Dirty rags & adsorbent			
Area wash water			
Clarifier sludges			
Container disposal			
Pipeline/tank drainage			
Evaporative losses			
Parts Cleaning			
Spent solvent cleaner			
Spent carburetor and brake cleaner			
Evaporative losses			
Leaks and spills (solvents)			
Spent alkaline cleaner			
Leaks and spills (alkali)			
Rinse water discharge			
Sludges and filter wastes			
Maintenance and Repair			
Motor oil			
Oil filters			
Gear and lube oil			
Transmission fluid			
Brake fluid			
Radiator coolant			
Brakes (asbestos)			
Radiators (lead)			
Batteries (lead and acid)			
Junk parts			

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Firm ______ Site ______ Date ______	**Waste Minimization Assessment** Proj. No. ______	Prepared By ______ Checked By ______ Sheet 1 of 2 Page 2 of 10

WORKSHEET

2a

WASTE MINIMIZATION: Material Handling

A. DRUMS, CONTAINERS, AND PACKAGES

Are drums, packages and containers inspected for damage before being accepted? ☐ yes ☐ no

Are employees trained in ways to safely handle the types of drums and packages received? ☐ yes ☐ no

Are they properly trained in handling of spilled raw materials? ☐ yes ☐ no

Is there a formal personnel training program on raw material handling, spill prevention proper storage techniques, and waste handling procedures? ☐ yes ☐ no

Describe handling procedures for damaged items: ______

How often is training given and by whom? ______

Is obsolete raw material returned to the supplier? ☐ yes ☐ no

Is inventory used in first-in first-out order? ☐ yes ☐ no

Is the inventory system computerized? ☐ yes ☐ no

Does the current inventory control system adequately prevent waste generation? ☐ yes ☐ no

What information does the system track? ______

Are stored items protected from damage, contamination, or exposure to rain, snow, sun and heat? ☐ yes ☐ no

Is the dispensing of raw materials supervised and controlled? ☐ yes ☐ no

Are users required to return empty containers before being issued new supplies? ☐ yes ☐ no

Do you maintain and enforce a clear policy of using raw materials only for their intended use? ☐ yes ☐ no

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Firm ____ Site ____ Date ____	Waste Minimization Assessment Proj. No. ____	Prepared By ____ Checked By ____ Sheet 1 of 2 Page 3 of 10

WORKSHEET **2b**

WASTE MINIMIZATION: Material Handling

B. BULK LIQUIDS HANDLING

What safeguards are in place to prevent spills and avoid ground contamination during the filling of storage tanks?

- High level shutdown/alarms ❑
- Flow totalizers with cutoff ❑
- Secondary containment ❑
- Other ❑

Describe the system: ____

Are air emissions from solvent storage tanks controlled by means of:

Conservation vents	❑ yes	❑ no
Nitrogen blanketing	❑ yes	❑ no
Absorber/Condenser	❑ yes	❑ no
Other vapor loss control system	❑ yes	❑ no

Describe the system: ____

Are all storage tanks routinely monitored for leaks? If yes, describe procedure and monitoring frequency for above-ground/vaulted tanks: ____

Underground tanks: ____

How are the liquids in these tanks dispensed to the users? (i.e., in small containers or hard piped.) ____

What measures are employed to prevent the spillage of liquids being dispensed? ____

When a spill of liquid occurs in the facility, what cleanup methods are employed (e.g., wet or dry)? Also discuss the way in which the resulting wastes are handled: ____

Firm ____ Site ____ Date ____	**Waste Minimization Assessment** Proj. No. ____	Prepared By ____ Checked By ____ Sheet 1 of 1 Page 4 of 10

WORKSHEET 3

OPTION GENERATION: Material Handling

Meeting Format (e.g., brainstorming, nominal group technique) ____

Meeting Coordinator ____

Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Drums, Containers, and Packages		
Raw Material Inspection		
Proper Storage/Handling		
Return Obsolete Material to Supplier		
Minimize Inventory		
Computerize Inventory		
Formal Training		
Waste Segregation		
B. Bulk Liquids Handling		
High Level Shutdown/Alarm		
Flow Totalizers with Cutoff		
Secondary Containment		
Air Emission Control		
Leak Monitoring		

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Firm ________ Site ________ Date ________	**Waste Minimization Assessment** Proj. No. ________	Prepared By ________ Checked By ________ Sheet 1 of 2 Page 5 of 10

WORKSHEET

4a

WASTE MINIMIZATION:
Parts Cleaning

A. SOLVENTS

Do you use parts cleaning solvent for uses other than cleaning parts? ☐ yes ☐ no

Have you established guidelines as to when parts should be cleaned with solvents? ☐ yes ☐ no

Do you use solvent sinks instead of pails or dunk buckets? ☐ yes ☐ no

Are solvent sinks and/or buckets located near service bays? ☐ yes ☐ no

Do you allow cleaned parts to drain inside the sink for a few minutes to minimize dripping of residual solvent onto the shop floor? ☐ yes ☐ no

Are you careful when immersing and removing parts from the solvent bath so as not to create splashes? ☐ yes ☐ no

Do you keep all solvent sinks/buckets covered when not in use? ☐ yes ☐ no

Do you lease your solvent sinks? ☐ yes ☐ no

If yes, does your lease include solvent supply and spent solvent waste handling? ☐ yes ☐ no

If you own your solvent sinks, does a registered waste hauler collect your dirty solvent for recycling or treatment? ☐ yes ☐ no

Do you own on-site solvent recovery equipment such as a distillation unit? ☐ yes ☐ no

If yes, how are the treatment residues handled? ________________________________

____

____

What other methods are you using to reduce solvent use/waste? ________________________

____

____

B. AQUEOUS CLEANERS

Do you use dry pre-cleaning methods such as baking and/or wire brushing to reduce loading on the aqueous cleaner? ☐ yes ☐ no

Have you switched from caustic-based cleaning solutions to detergent-based cleaners? ☐ yes ☐ no

Do you use drip trays on hot tanks to minimize the amount of cleaner dripped on the floor? ☐ yes ☐ no

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WORKSHEET
4b

WASTE MINIMIZATION:
Parts Cleaning

B. AQUEOUS CLEANERS (continued)

Are the hot tanks/jet spray washers located near the service bays?	❑ yes	❑ no
Do you pre-rinse dirty engine parts in a tank of dirty cleaning solution so as to reduce loading on the clean tank?	❑ yes	❑ no
Do you routinely monitor solution composition and make adjustment accordingly?	❑ yes	❑ no
Do you routinely remove sludge and solids from the tank?	❑ yes	❑ no
Are sludge and solids screened out before they reach the waste sump?	❑ yes	❑ no
Have you installed still rinses or converted free running rinses to still rinses? This water can be used as make-up to your cleaner bath.	❑ yes	❑ no
Do you use demineralized water for your cleaning bath make-up ?	❑ yes	❑ no
Is your cleaning tank agitated?	❑ yes	❑ no
Do you lease your hot tank(s)/jet spray washer(s)?	❑ yes	❑ no
If yes, do you use mechanical agitation instead of air agitation?	❑ yes	❑ no
Do you own your hot tanks/jet spray washer(s)?	❑ yes	❑ no
Do you own on-site aqueous waste treatment equipment?	❑ yes	❑ no
Does a hazardous waste hauler collect aqueous waste for recycling or treatment?	❑ yes	❑ no

If not, how is your waste handled and disposed of? ____________________

____

____

Firm ____ Site ____ Date ____	Waste Minimization Assessment Proj. No. ____	Prepared By ____ Checked By ____ Sheet 1 of 1 Page 7 of 10

WORKSHEET

5

OPTION GENERATION:
Parts Cleaning

Meeting Format (e.g., brainstorming, nominal group technique) ____

Meeting Coordinator ____

Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Solvents		
Proper solvent use		
Established guidelines		
Use solvent sinks		
Careful drainage		
Cover tanks		
Lease equipment/service		
Recycle solvent		
B. Aqueous Cleaners		
Dry pre-cleaning		
Use detergents		
Drip trays		
Pre-rinse parts		
Monitor solution		
Remove sludge and solids		
Employ still rinse		
Use demineralized water		
Use mechanical agitation		
Lease equipment		

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Firm ______ Site ______ Date ______	Waste Minimization Assessment Proj. No. ______	Prepared By ______ Checked By ______ Sheet 1 of 2 Page 8 of 10

WORKSHEET

6a

WASTE MINIMIZATION: Waste Handling

A. AUTOMOTIVE FLUIDS

For facilities servicing fleet vehicles, do you test fluid quality to determine when automotive fluids should be changed? ❑ yes ❑ no

When fluids must be drained to service a part, are they stored in a clean container so they may be used to refill the vehicle? ❑ yes ❑ no

Have you had experience using any longer lasting synthetic motor oils? ❑ yes ❑ no

If yes, please discuss: ______________________________

____

____

Are all waste fluids kept segregated? ❑ yes ❑ no

If no, have you notified your waste hauler or recycler? ❑ yes ❑ no

Have you ever had a load of waste fluid rejected by a hauler or recycler because of cross contamination? ❑ yes ❑ no

Please describe how you store and dispose of waste fluids (motor and lube oils, greases, transmission fluids and spent anti-freezes) ______________________________

____

____

B. OTHER WASTES

Are removed oil filters drained before disposal? ❑ yes ❑ no

Do you dispose of filters in the trash? ❑ yes ❑ no

If yes, have you contacted your waste oil hauler about alternative means of disposal? ❑ yes ❑ no

If yes, what was the response? ______________________________

____

____

Does a battery collector remove your used batteries? ❑ yes ❑ no

Do you take used batteries to a storage or recycling facility? ❑ yes ❑ no

When replacing brakes, do you contain loose asbestos waste that may be released? ❑ yes ❑ no

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Firm __________ Site __________ Date __________	**Waste Minimization Assessment** Proj. No. __________	Prepared By __________ Checked By __________ Sheet 1 of 2 Page 9 of 10

WORKSHEET

6b

WASTE MINIMIZATION: Waste Handling

B. OTHER WASTES (continued)

Do you use a collection/recycling system to service air conditioning units? ☐ yes ☐ no

Do you sell or give worn parts to a re-manufacturer? ☐ yes ☐ no

Do you have any suggestions for reducing other wastes? ____________________

____

____

C. SHOP CLEAN-UP

Are drip pans placed under leaking cars to reduce the need for floor cleaning? ☐ yes ☐ no

Are dirty parts removed and placed on a drip pan instead of directly on the shop floor? ☐ yes ☐ no

Are all work bays kept clean and neat? ☐ yes ☐ no

Do your workers wipe up small spills of fluids as soon as they occur? ☐ yes ☐ no

Do you have an award program for workers who keep their work bays clean (i.e.: prevent leaks and spills)? ☐ yes ☐ no

Do you use a laundry service to clean your rags and uniforms? ☐ yes ☐ no

Do you use a biodegradible detergent for cleaning shop floors? ☐ yes ☐ no

Have you tried using a steam cleaner in place of chemical cleaners? ☐ yes ☐ no

Do you discharge area washdown wastewater to a POTW or industrial sewer, instead of to the storm drain? ☐ yes ☐ no

If no, how is this waste handled? ____________________

____

____

Firm ____ Site ____ Date ____	Waste Minimization Assessment Proj. No. ____	Prepared By ____ Checked By ____ Sheet 1 of 10 Page 10 of 10

WORKSHEET
7

OPTION GENERATION:
Waste Handling

Meeting Format (e.g., brainstorming, nominal group technique) ____
Meeting Coordinator ____
Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Automotive Fluids		
Test fluid quality		
Store fluids for reuse		
Use longer lasting fluids		
Keep wastes segregated		
Send to recycler		
B. Other Wastes		
Drain filters and dispose properly		
Recycle batteries		
Collect asbestos dust		
Collect/recycle refrigerant		
Sell or give parts to re-manufacturer		
C. Shop Clean-up		
Use drip pans		
Wipe up spills (cotton rags)		
Keep bays clean		
Award program		
Use laundry service		
Use biodegradible detergents		
Use steam cleaners		

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Appendix A
Automotive Repair Shop Assessments
Case Studies of Shops A, B, and C

In 1987, the California Department of Health Services (DHS) commissioned a waste minimization study of automotive repair shops. The objectives of the waste minimization assessments were to:

- Gather site-specific information concerning the generation, handling, storage, treatment, and disposal of hazardous waste;
- Evaluate existing waste reduction practices;
- Develop recommendations for waste reduction through source control, treatment, and recycling techniques; and
- Assess costs and benefits of existing and recommended waste reduction techniques.

The first step in conducting the assessments was selecting and contacting several shops to solicit voluntary participation in the study. Selection emphasized small businesses, which generally lack the financial and/or internal technical resources to perform a waste reduction assessment.

This appendix presents a summary of the assessments performed at three sites (here identified as Shops A, B, and C). Shop A is an auto repair shop, shop B is a new car dealership, and shop C is a parts washing lease and service company. The third shop was included in the study because it services a large segment of the automotive repair industry. The original assessments may be obtained from Mr. Benjamin Fries at:

California Department of Health Services
Alternative Technology Division
Toxic Substances Control Program
714/744 "P" Street
Sacramento, CA 94234-7320
(916) 324-1807

Following the assessments is an example set of completed waste minimization assessment worksheets. Information presented in these worksheets is for a hypothetical automotive repair shop. The answers to each question are based on the author's experience regarding industry practices.

Shop A Assessment

Shop A is representative of many small to medium sized auto repair shops. With 15 years of auto engine repair and maintenance experience, it represents an established auto repair shop. The firm services approximately 20 cars per week and uses one jet spray washer, 2 solvent buckets, and 1 carburetor cleaner bucket. Shop A has 6 general maintenance bays. Of the 20 cars per week serviced, 60 percent are for transmission maintenance, 20 percent are for brake service, 10 percent are for engine repair, and 10 percent are other.

Chemical Usage

Monthly chemical and raw material usage at Shop A amounts to 10 gallons of parts cleaning solvent, 25 pounds of alkaline detergent, 8 gallons of carburetor cleaner, 11 gallons of antifreeze solution, 60 gallons of engine oil, 2 bags (100 pounds) of sawdust, and 3 lead-acid batteries.

Waste Generation

Monthly waste generation amounts at Shop A include 7 gallons of spent solvent, 90 gallons of aqueous detergent, 8 gallons of carburetor cleaner, 32 gallons of spent antifreeze, 55 gallons of waste engine oil, 110 pounds of spent sawdust, and 3 spent lead-acid batteries. Spent acid batteries are currently being sent to a spent lead-acid battery processor.

Waste Minimization—Current Practices and Recommendations

The following recommendations are suggested for waste minimization at Shop A:

1. The most hazardous waste generated, aqueous detergent wastes, is produced by the jet spray washer. The current practice of servicing by the equipment leasing company should be continued to properly dispose and manifest wastes shipped off-site. The jet spray washer in use provides good containment and recovery of aqueous wastes high in heavy metal contaminants.

2. Spent motor oils are stored in 8 miscellaneous containers ranging in size from 5 to 30 gallons. Spent oil should be stored in one properly-designed container

to avoid spills to the pavement and runoff to the storm sewer. Waste engine oils are presently shipped off-site by a licensed waste handler. Isolation of spent solvent wastes and carburetor cleaner is necessary to avoid contamination of waste oils.

3. Clean-up and maintenance of the back parts storage and rear driveway service area will prevent oil and grease run-off to the storm sewer.

4. Use solvent equipment leasing and maintenance service. Costs range from $34 to $38 per month for a sink with a recirculation system and spent solvent pick-up and fresh solvent recharge. Current cost for solvent purchase and disposal is $33 per month excluding maintenance and transportation costs. Use of on-site solvent recovery equipment is not recommended at this level of solvent use.

5. The current method of disposal of carburetor cleaner with the waste oil is unacceptable. Options include purchase of the product from a supplier who provides disposal of the spent cleaner or disposal of the spent solution at a toxic substances disposal facility.

6. Spent antifreeze solution should be accumulated in 55-gallon drums and processed as a hazardous waste.

7. Sawdust should be properly disposed of as a diluted hazardous waste. Options would include use of an aqueous detergent-based cleaner and avoidance of leaks and spills.

Shop B Assessment

Shop B is a large automotive dealership in Northern California which services 500 cars and trucks per month in its repair shop. Shop B uses two hot tanks, 10 solvent sinks, and 2 carburetor cleaners. Shop B has 25 general car maintenance bays, 5 wheel alignment bays, and 9 auto painting bays. Of the 500 cars and trucks serviced each month, 30 to 35 percent are for warranty repair work (light duty, noise), 25 percent are for periodic maintenance, 10 to 12 percent are for engine repair, 10 percent are for tune-ups, and 16 to 18 percent are for other (transmission, brakes, front-end, etc.).

Chemical Usage

Monthly chemical and raw material usage amounts to 100 gallons of parts cleaning solvent, 10 pounds of alkaline detergent, 7 pounds of caustic soda, 10 gallons of carburetor cleaner, 40 gallons of antifreeze solution, 330 gallons of engine oil, 10 bags (500 pounds) of sawdust, and 10 lead-acid batteries.

Waste Generation

Monthly waste generation amounts at Shop B include 80 gallons of spent solvent, 10 gallons of aqueous detergent waste, 10 gallons of caustic detergent waste, 10 gallons of carburetor cleaner, 100 gallons of spent antifreeze solution, 300 gallons of waste engine oil, 550 pounds of spent sawdust, and 10 spent lead-acid batteries.

Waste Minimization—Current Practices and Recommendations

The following recommendations are suggested for waste minimization at Shop B:

1. General practice of leasing of solvent parts washers, hot tanks, and agitator-type carburetor cleaners and contracting for monthly maintenance with chemical removal and fresh chemical make-up should be continued to minimize losses and maintain solution quality. Manifesting is being performed by equipment service companies.

2. Spent antifreeze solution is being properly disposed of by a waste management service.

3. Steam cleaning waste sump should be properly disposed of to a Class I type of disposal site due to a high heavy metals content.

4. Current practice of containment and recirculation of solvent in parts washers provides minimum solvent losses. Solvent sinks are serviced on a monthly basis. Further economy could be achieved by use of an on-site solvent recovery device, depending on cost of labor.

5. The current practice of hot tank lease and maintenance provides minimum losses and maintains solution activity.

Shop C Assessment

Shop C leases solvent sinks and parts washing equipment to over 700 auto repair firms, ranging from large dealerships to small repair shops. The company sells the solvents and detergents used in its equipment, and recovers, processes, and disposes of the waste materials produced. Shop C services 450 hot tanks, 50 jet sprayers, and 460 solvent sinks. Periodic maintenance of leased equipment is based upon:

- Hot Tanks and Jet Sprays:
  Removal of an average of 10 gallons of spent material from a 60 gallon batch of aqueous solution, replenishment with water and recharge with 8-10 lb of alkali or detergent compounds.

- Solvent Sinks:
  Removal of 7-8 gallons of spent solvent solution and replacement of 10 gallons of fresh solvent.

The volume of liquid required in each device to suspend waste materials is dependent upon the type and degree of use, and the frequency of servicing. The existing pattern of use for hot tanks is primarily on a monthly service basis (75%). Solvent sinks are serviced in the following proportions: 63% monthly, 25% bimonthly, 12% every 3 months.

Chemical Usage

Monthly chemical and raw materials supplied by Shop C to their customers include 3700 gallons of parts cleaning solvent, 1500 pounds of alkaline detergent, 500 pounds of caustic detergent, and 30 gallons of carburetor cleaner.

Waste Generation

Monthly waste collection by Shop C amounts to 2200 gallons of spent solvent, 2000 gallons of aqueous and caustic waste, and 13 gallons of carburetor cleaner.

Waste Minimization—Current Practices and Recommendations

1. Drip trays should be provided on solvent sinks to increase recovery of spent solvents. Anticipated increase in solvent recovery is expected to be 500 gallons per month.

2. Provide drip pan/cool down tray for parts cleaned in hot tanks. Benefits would be improved repair shop cleanliness and increased solvent recovery.

3. Repair fractured concrete pad to prevent ground water contamination. Provide curbing and containment of run-off wastes from site for processing by waste volume reduction.

4. The current method used to dispose of waste solvent solutions by off-site processing fuel use could be improved by installing on-site solvent recovery equipment. Anticipated benefits are recovery of 2000 gallons per month of spent solvent and lower solvent material costs.

5. The current method used to dispose of aqueous wastes, separation of solids followed by municipal sewer discharge, is unacceptable. The planned installation of seven aqueous waste evaporation concentrators should solve this problem. Anticipated impacts are compliance with local municipal sewer discharge codes, lower off-site disposal costs, and increased equipment and labor costs.

Firm A&A Auto Site Anytown USA Date	**Waste Minimization Assessment** Proj. No.	Prepared By Checked By Sheet 1 of 1 Page 1 of 10

WORKSHEET 1

WASTE SOURCES

Shop Clean-Up	Significance at Shop		
	Low	Medium	High
Obsolete raw materials	X		
Spills & leaks (liquids & powders)	X		
Dirty rags & sawdust		X	
Area wash water	X		
Clarifier sludges	X None		
Container disposal	X		
Pipeline/tank drainage	X None		
Evaporative losses	X		
Parts Cleaning			
Spent solvent cleaner		X	
Spent carburetor and brake cleaner	X		
Evaporative losses	X		
Leaks and spills (solvents)	X		
Spent alkaline cleaner	X None		
Leaks and spills (alkali)	X None		
Rinse water discharge	X None		
Sludges and filter wastes	X None		
Maintenance and Repair			
Motor oil			X
Oil filters			X
Gear and lube oil	X		
Transmission fluid		X	
Brake fluid	X		
Radiator coolant	X		
Brakes (asbestos)	X		
Radiators (lead)	X Don't Repair		
Batteries (lead and acid)	X		
Junk parts	X		

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WORKSHEET
2a

WASTE MINIMIZATION: Material Handling

A. DRUMS, CONTAINERS, AND PACKAGES

Are drums, packages and containers inspected for damage before being accepted? ☒ yes ☐ no

Are employees trained in ways to safely handle the types of drums and packages received? ☒ yes ☐ no

Are they properly trained in handling of spilled raw materials? ☒ yes ☐ no

Is there a formal personnel training program on raw material handling, spill prevention proper storage techniques, and waste handling procedures? ☐ yes ☒ no

Describe handling procedures for damaged items: Not accepted, returned to supplier

How often is training given and by whom? Owner, when needed

Is obsolete raw material returned to the supplier? ☐ yes ☒ no

Is inventory used in first-in first-out order? ☒ yes ☐ no

Is the inventory system computerized? ☐ yes ☒ no

Does the current inventory control system adequately prevent waste generation? ☒ yes ☐ no

What information does the system track?

Are stored items protected from damage, contamination, or exposure to rain, snow, sun and heat? ☒ yes ☐ no

Is the dispensing of raw materials supervised and controlled? ☐ yes ☒ no

Are users required to return empty containers before being issued new supplies? ☐ yes ☒ no

Do you maintain and enforce a clear policy of using raw materials only for their intended use? ☒ yes ☐ no

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WORKSHEET 2a

WASTE MINIMIZATION: Material Handling

A. DRUMS, CONTAINERS, AND PACKAGES

Are drums, packages and containers inspected for damage before being accepted? ☒ yes ☐ no

Are employees trained in ways to safely handle the types of drums and packages received? ☒ yes ☐ no

Are they properly trained in handling of spilled raw materials? ☒ yes ☐ no

Is there a formal personnel training program on raw material handling, spill prevention proper storage techniques, and waste handling procedures? ☐ yes ☒ no

Describe handling procedures for damaged items: NOT ACCEPTED, RETURNED TO SUPPLIER

How often is training given and by whom? OWNER, WHEN NEEDED

Is obsolete raw material returned to the supplier? ☐ yes ☒ no

Is inventory used in first-in first-out order? ☒ yes ☐ no

Is the inventory system computerized? ☐ yes ☒ no

Does the current inventory control system adequately prevent waste generation? ☒ yes ☐ no

What information does the system track? ______

Are stored items protected from damage, contamination, or exposure to rain, snow, sun and heat? ☒ yes ☐ no

Is the dispensing of raw materials supervised and controlled? ☐ yes ☒ no

Are users required to return empty containers before being issued new supplies? ☐ yes ☒ no

Do you maintain and enforce a clear policy of using raw materials only for their intended use? ☒ yes ☐ no

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WORKSHEET 3

OPTION GENERATION:
Material Handling

Meeting Format (e.g., brainstorming, nominal group technique)

Meeting Coordinator

Meeting Participants

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Drums, Containers, and Packages		
Raw Material Inspection	Y	
Proper Storage/Handling	Y	
Return Obsolete Material to Supplier	N	USE ALL MATERIALS QUICKLY
Minimize Inventory	Y	
Computerize Inventory	N	NOT NEEDED
Formal Training	N	SMALL GROUP · 2 MECHANICS
Waste Segregation	Y	& OWNER
B. Bulk Liquids Handling		
High Level Shutdown/Alarm	Y	NEW GASOLINE TANK INSTALLED
Flow Totalizers with Cutoff	Y	
Secondary Containment	Y	
Air Emission Control	Y	CONSERVATION VENT/EMISSION
Leak Monitoring	Y	CONTROL NOZZELS

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WORKSHEET

4a

WASTE MINIMIZATION:
Parts Cleaning

A. SOLVENTS

Do you use parts cleaning solvent for uses other than cleaning parts?	☐ yes	[x] no
Have you established guidelines as to when parts should be cleaned with solvents?	[x] yes	☐ no
Do you use solvent sinks instead of pails or dunk buckets?	[x] yes	☐ no
Are solvent sinks and/or buckets located near service bays?	[x] yes	☐ no
Do you allow cleaned parts to drain inside the sink for a few minutes to minimize dripping of residual solvent onto the shop floor?	[x] yes	☐ no
Are you careful when immersing and removing parts from the solvent bath so as not to create splashes?	[x] yes	☐ no
Do you keep all solvent sinks/buckets covered when not in use?	[x] yes	☐ no
Do you lease your solvent sinks?	[x] yes	☐ no
If yes, does your lease include solvent supply and spent solvent waste handling?	[x] yes	☐ no
If you own your solvent sinks, does a registered waste hauler collect your dirty solvent for recycling or treatment?	☐ yes	☐ no
Do you own on-site solvent recovery equipment such as a distillation unit?	☐ yes	☐ no

If yes, how are the treatment residues handled? ______________________

____

____

What other methods are you using to reduce solvent use/waste? ______________________

____

____

B. AQUEOUS CLEANERS N/A

Do you use dry pre-cleaning methods such as baking and/or wire brushing to reduce loading on the aqueous cleaner?	☐ yes	☐ no
Have you switched from caustic-based cleaning solutions to detergent-based cleaners?	☐ yes	☐ no
Do you use drip trays on hot tanks to minimize the amount of cleaner dripped on the floor?	☐ yes	☐ no

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WORKSHEET
4b

WASTE MINIMIZATION:
Parts Cleaning

B. AQUEOUS CLEANERS (continued) N/A

Are the hot tanks/jet spray washers located near the service bays?	☐ yes	☐ no
Do you pre-rinse dirty engine parts in a tank of dirty cleaning solution so as to reduce loading on the clean tank?	☐ yes	☐ no
Do you routinely monitor solution composition and make adjustment accordingly?	☐ yes	☐ no
Do you routinely remove sludge and solids from the tank?	☐ yes	☐ no
Are sludge and solids screened out before they reach the waste sump?	☐ yes	☐ no
Have you installed still rinses or converted free running rinses to still rinses? This water can be used as make-up to your cleaner bath.	☐ yes	☐ no
Do you use demineralized water for your cleaning bath make-up ?	☐ yes	☐ no
Is your cleaning tank agitated?	☐ yes	☐ no
Do you lease your hot tank(s)/jet spray washer(s)?	☐ yes	☐ no
If yes, do you use mechanical agitation instead of air agitation?	☐ yes	☐ no
Do you own your hot tanks/jet spray washer(s)?	☐ yes	☐ no
Do you own on-site aqueous waste treatment equipment?	☐ yes	☐ no
Does a hazardous waste hauler collect aqueous waste for recycling or treatment?	☐ yes	☐ no

If not, how is your waste handled and disposed of?____________________________

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WORKSHEET 5

OPTION GENERATION:
Parts Cleaning

Meeting Format (e.g., brainstorming, nominal group technique)

Meeting Coordinator

Meeting Participants

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Solvents		
Proper solvent use	Y	
Established guidelines	Y	
Use solvent sinks	Y	
Careful drainage	Y	
Cover tanks	Y	
Lease equipment/service	Y	
Recycle solvent	N	
B. Aqueous Cleaners	N/A	
Dry pre-cleaning		
Use detergents		
Drip trays		
Pre-rinse parts		
Monitor solution		
Remove sludge and solids		
Employ still rinse		
Use demineralized water		
Use mechanical agitation		
Lease equipment		

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WORKSHEET

6a

WASTE MINIMIZATION: Waste Handling

A. AUTOMOTIVE FLUIDS

For facilities servicing fleet vehicles, do you test fluid quality to determine when automotive fluids should be changed? ☐ yes ☐ no

When fluids must be drained to service a part, are they stored in a clean container so they may be used to refill the vehicle? ☐ yes ☒ no

Have you had experience using any longer lasting synthetic motor oils? ☐ yes ☒ no

If yes, please discuss: ______________________

Are all waste fluids kept segregated? ☐ yes ☒ no

If no, have you notified your waste hauler or recycler? ☒ yes ☐ no

Have you ever had a load of waste fluid rejected by a hauler or recycler because of cross contamination? ☐ yes ☒ no

Please describe how you store and dispose of waste fluids (motor and lube oils, greases, transmission fluids and spent anti-freezes) OIL, TRANS, & GREASE STORED IN DRUM, SEPARATE DRUM FOR ANTI-FREEZE. ALL DRUMS LABELED AS TO CONTENTS.

B. OTHER WASTES

Are removal oil filters drained before disposal? ☒ yes ☐ no

Do you dispose of filters in the trash? ☒ yes ☐ no

If yes, have you contacted your waste oil hauler about alternative means of disposal? ☐ yes ☒ no

If yes, what was the response? ______________________

Does a battery collector remove your used batteries? ☒ yes ☐ no

Do you take used batteries to a storage or recycling facility? ☐ yes ☒ no

When replacing brakes, do you contain loose asbestos waste that may be released? ☒ yes ☐ no

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WORKSHEET
6b

WASTE MINIMIZATION: Waste Handling

B. OTHER WASTES (continued)

Do you use a collection/recycling system to service air conditioning units? ☐ yes ☒ no

Do you sell or give worn parts to a re-manufacturer? ☒ yes ☐ no

Do you have any suggestions for reducing other wastes? ______

C. SHOP CLEAN-UP

Are drip pans placed under leaking cars to reduce the need for floor cleaning? ☐ yes ☒ no

Are dirty parts removed and placed on a drip pan instead of directly on the shop floor? ☒ yes ☐ no

Are all work bays kept clean and neat? ☒ yes ☐ no

Do your workers wipe up small spills of fluids as soon as they occur? ☒ yes ☐ no

Do you have an award program for workers who keep their work bays clean (i.e.: prevent leaks and spills)? ☐ yes ☒ no

Do you use a laundry service to clean your rags and uniforms? ☐ yes ☒ no

Do you use a biodegradible detergent for cleaning shop floors? Dont Know ☐ yes ☐ no

Have you tried using a steam cleaner in place of chemical cleaners? ☐ yes ☒ no

Do you discharge area washdown wastewater to a POTW or industrial sewer, instead of to the storm drain? ☐ yes ☒ no

If no, how is this waste handled? Runs down street to sewer(?)

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WORKSHEET **7**

OPTION GENERATION:
Waste Handling

Meeting Format (e.g., brainstorming, nominal group technique) ______

Meeting Coordinator ______

Meeting Participants ______

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Automotive Fluids		
Test fluid quality	N	CUSTOMER ORDERS WORK
Store fluids for reuse	N	MIGHT FOUL FLUID
Use longer lasting fluids	N	MIGHT RECCOMEND TO CUST
Keep wastes segregated	Y	
Send to recycler	Y	
B. Other Wastes		
Drain Filters and dispose properly	Y	
Recycle batteries	Y	
Collect asbestos dust	Y	
Collect/recycle refrigerant	N	EXPENSIVE?
Sell or give parts to re-manufacturer	Y	
C. Shop Clean-up		
Use drip pans	Y	WILL TRY
Wipe up spills (cotton rags)	Y	
Keep bays clean	Y	
Award program	N	
Use laundry service	N	WILL CONSIDER
Use biodegradible detergents	N	NEED TO CHECK
Use steam cleaners	N	DETERGENT USE IS MINOR
Discharge to POTW/industrial sewer	N	EXPENSIVE/NOT REQUIRED

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Appendix B
Where to Get Help
Further Information on Pollution Prevention

Additional information on source reduction, reuse and recycling approaches to pollution prevention is available in EPA reports listed in this section, and through state programs and regional EPA offices (listed below) that offer technical and/or financial assistance in the areas of pollution prevention and treatment.

Waste exchanges have been established in some areas of the U.S. to put waste generators in contact with potential users of the waste. Twenty-four exchanges operating in the U.S. and Canada are listed.

U.S. EPA Reports on Waste Minimization

Waste Minimization Opportunity Assessment Manual. EPA/625/7-88/003.***

Waste Minimization Audit Report: Case Studies of Corrosive and Heavy Metal Waste Minimization Audit at a Specialty Steel Manufacturing Complex. Executive Summary. NTIS No. PB88-107180*

Waste Minimization Audit Report: Case Studies of Minimization of Solvent Waste for Parts Cleaning and from Electronic Capacitor Manufacturing Operation. Executive Summary. NTIS No. PB87-227013*

Waste Minimization Audit Report: Case Studies of Minimization of Cyanide Wastes from Electroplating Operations. Executive Summary. NTIS No. PB87-229662.*

Report to Congress: Waste Minimization, Vols. I and II. EPA/530-SW-86-033 and -034 (Washington, D.C.:U.S.EPA,1986).**

Waste Minimization - Issues and Options, Vols. I-III EPA/530-SW-86-041 through -043. (Washington, D.C.: U.S.EPA,1986.**

* Executive Summary available from EPA, CERI Publications Unit, 26 West Martin Luther King Drive, Cincinnati, OH, 45268; full report available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

** Available from the National Technical Information Service as a five-volume set, NTIS No.PB-87-114328.

*** Available from EPA, CERI Publications Unit, 26 West Martin Luther King Drive, Cincinnati, OH 45268. (513) 569-7562.

The Guides to Pollution Prevention manuals*** describe waste minimization options for specific industries. This is a continuing series which currently includes the following titles:

Guides to Pollution Prevention Paint Manufacturing Industry. EPA/625/7-90/005

Guides to Pollution Prevention The Pesticide Formulating Industry. EPA/625/7-90/004

Guides to Pollution Prevention The Commercial Printing Industry. EPA/625/7-90/008

Guides to Pollution Prevention The Fabricated Metal Industry. EPA/625/7-90/006

Guides to Pollution Prevention For Selected Hospital Waste Streams. EPA/625/7-90/009

Guides to Pollution Prevention Research and Educational Institutions. EPA/625/7-90/010

Guides to Pollution Prevention The Printed Circuit Board Manufacturing Industry. EPA/625/7-90/007

Guides to Pollution Prevention The Pharmaceutical Industry. EPA/625/7-91/017

Guides to Pollution Prevention The Photoprocessing Industry. EPA/625/7-91/012

Guides to Pollution Prevention The Fiberglass Reinforced and Composite Plastic Industry. EPA/625/7-91/014

Guides to Pollution Prevention The Automotive Refinishing Industry. EPA/625/7-91/016

Guides to Pollution Prevention The Marine Repair Industry. EPA/625/7-91/015

U.S. EPA Pollution Prevention Information Clearinghouse (PPIC): *Electronic Information Exchange System (EIES)—User Guide, Version 1.1.* EPA/600/9-89/086

Waste Reduction Technical/Financial Assistance Programs

The EPA Pollution Prevention Information Clearinghouse (PPIC) was established to encourage waste reduction through technology transfer, education, and public awareness. PPIC collects and disseminates technical and other information about pollution prevention through a telephone hotline and an electronic information exchange network. Indexed bibliographies and abstracts of reports, publications, and case studies about pollution prevention are available. PPIC also lists a calendar of pertinent conferences and seminars; information about activities abroad and a directory of waste exchanges. Its Pollution Prevention Information Exchange System (PIES) can be accessed electronically 24 hours a day without fees.

For more information contact:

PIES Technical Assistance
Science Applications International Corp.
8400 Westpark Drive
McLean, VA 22102
(703) 821-4800

or

U.S. Environmental Protection Agency
401 M Street S. W.
Washington, D. C. 20460

Myles E. Morse
Office of Environmental Engineering
and Technology Demonstration
(202) 475-7161

Priscilla Flattery
Pollution Prevention Office
(202) 245-3557

The EPA's Office of Solid Waste and Emergency Response has a telephone call-in service to answer questions regarding RCRA and Superfund (CERCLA). The telephone numbers are:

(800) 242-9346 (outside the District of Columbia)

(202) 382-3000 (in the District of Columbia)

The following programs offer technical and/or financial assistance for waste minimization and treatment.

Alabama

Hazardous Material Management and Resources
Recovery Program
University of Alabama
P.O. Box 6373
Tuscaloosa, AL 35487-6373
(205) 348-8401

Alaska

Alaska Health Project
Waste Reduction Assistance Program
431 West Seventh Avenue, Suite 101
Anchorage, AK 99501
(907) 276-2864

Arkansas

Arkansas Industrial Development Commission
One State Capitol Mall
Little Rock, AR 72201
(501) 371-1370

California

Alternative Technology Division
Toxic Substances Control Program
California State Department of Health Services
714/744 P Street
Sacramento, CA 94234-7320
(916) 324-1807

Connecticut

Connecticut Hazardous Waste Management Service
Suite 360
900 Asylum Avenue
Hartford, CT 06105
(203) 244-2007

Connecticut Department of Economic Development
210 Washington Street
Hartford, CT 06106
(203) 566-7196

Florida

Waste Reduction Assistance Program
Florida Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee. FL 32399-2400
(904) 488-0300

Georgia

Hazardous Waste Technical Assistance Program
Georgia Institute of Technology
Georgia Technical Research Institute
Environmental Health and Safety Division
O'Keefe Building, Room 027
Atlanta, GA 30332
(404) 894-3806

Environmental Protection Division
Georgia Department of Natural Resources
Floyd Towers East, Suite 1154
205 Butler Street
Atlanta, GA 30334
(404) 656-2833

Guam

Solid and Hazardous Waste Management Program
Guam Environmental Protection Agency
ITCE E. Harmon Plaza, Complex Unit D-107
130 Rojas Street
Harmon, Guam 96911
(671) 646-8863

Illinois

Hazardous Waste Research and Information Center
Illinois Department of Energy and Natural Resources
1808 Woodfield Drive
Savoy, IL 61874
(217) 333-8940

Illinois Waste Elimination Research Center
Pritzker Department of Environmental Engineering
Alumni Building, Room 102
Illinois Institute of Technology
3200 South Federal Street
Chicago, IL 60616
(313)567-3535

Indiana

Environmental Management and Education Program
Young Graduate House, Room 120
Purdue University
West Lafayette, IN 47907
(317) 494-5036

Indiana Department of Environmental Management
Office of Technical Assistance P.O. Box 6015
105 South Meridian Street
Indianapolis, IN 46206-6015
(317) 232-8172

Iowa

Center for Industrial Research and Service
205 Engineering Annex
Iowa State University
Ames, IA 50011
(515) 294-3420

Iowa Department of Natural Resources
Air Quality and Solid Waste Protection Bureau
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034
(515) 281-8690

Kansas

Bureau of Waste Management
Department of Health and Environment
Forbesfield, Building 730
Topeka, KS 66620
(913) 269-1607

Kentucky

Division of Waste Management
Natural Resources and Environmental Protection Cabinet
18 Reilly Road
Frankfort, KY 40601
(502) 564-6716

Louisiana

Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 44307
Baton Rouge, LA 70804
(504) 342-1354

Maryland

Maryland Hazardous Waste Facilities Siting Board
60 West Street, Suite 200 A
Annapolis, MD 21401
(301) 974-3432

Maryland Environmental Service
2020 Industrial Drive
Annapolis, MD 21401
(301) 269-3291
(800) 492-9188 (in Maryland)

Massachusetts

Office of Safe Waste Management
Department of Environmental Management
100 Cambridge Street, Room 1094
Boston, MA 02202
(617) 727-3260

Source Reduction Program
Massachusetts Department of Environmental Quality Engineering
1 Winter Street
Boston, MA 02108
(617) 292-5982

Michigan

Resource Recovery Section
Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-0540

Minnesota

Minnesota Pollution Control Agency
Solid and Hazardous Waste Division
520 Lafayette Road
St. Paul, MN 55155
(612) 296-6300

Minnesota Technical Assistance Program
1313 5th Street SE Suite 207
Minneapolis, MN 55455
(612) 627-4555
(800) 247-0015 (in Minnesota)

Missouri

State Environmental Improvement and Energy Resources Agency
P.O. Box 744
Jefferson City, MO 65102
(314) 751-4919

New Jersey

New Jersey Hazardous Waste Facilities Siting Commission
Room 614
28 West State Street
Trenton, NJ 08608
(609) 292-1459
(609) 292-1026

Hazardous Waste Advisement Program
Bureau of Regulation and Classification
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 292-8341

Risk Reduction Unit
Office of Science and Research
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 984-6070

New York

New York State Environmental Facilities Corporation
50 Wolf Road
Albany, NY 12205
(518) 457-3273

North Carolina

Pollution Prevention Pays Program
Department of Natural Resources and Community Development
P.O. Box 27687
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7015

Governor's Waste Management Board
325 North Salisbury Street
Raleigh, NC 27611
(919) 733-9020

Technical Assistance Unit
Solid and Hazardous Waste Management Branch
North Carolina Department of Human Resources
P.O. Box 2091
306 North Wilmington Street
Raleigh, NC 27602
(919) 733-2178

Ohio

Division of Solid and Hazardous Waste Management
Ohio Environmental Protection Agency
P.O. Box 1049
1800 WaterMark Drive
Columbus, OH 43266-1049
(614) 481-7200

Ohio Technology Transfer Organization
Suite 200
65 East State Street
Columbus, OH 43266-0330
(614) 466-4286

Oklahoma

Industrial Waste Elimination Program
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, OK 73152
(405) 271-7353

Oregon

Oregon Hazardous Waste Reduction Program
Department of Environmental Quality
811 Southwest Sixth Avenue
Portland, OR 97204
(503) 229-5913

Pennsylvania

Pennsylvania Technical Assistance Program
501 F. Orvis Keller Building
University Park, PA 16802
(814) 865-0427

Center of Hazardous Material Research
320 William Pitt Way
Pittsburgh, PA 15238
(412) 826-5320

Bureau of Waste Management
Pennsylvania Department of Environmental Resources
P.O. Box 2063
Fulton Building
3rd and Locust Streets
Harrisburg, PA 17120
(717) 787-6239

Rhode Island

Ocean State Cleanup and Recycling Program
Rhode Island Department of Environmental Management
9 Hayes Street
Providence, RI 02908-5003
(401) 277-3434
(800) 253-2674 (in Rhode Island)

Center for Environmental Studies
Brown University
P.O. Box 1943
135 Angell Street
Providence, RI 02912
(401) 863-3449

Tennessee

Center for Industrial Services
102 Alumni Hall
University of Tennessee
Knoxville, TN 37996
(615) 974-2456

Virginia

Office of Policy and Planning
Virginia Department of Waste Management
11th Floor, Monroe Building
101 North 14th Street
Richmond, VA 23219
(804) 225-2667

Washington

Hazardous Waste Section
Mail Stop PV-11
Washington Department of Ecology
Olympia, WA 98504-8711
(206) 459-6322

Wisconsin

Bureau of Solid Waste Management
Wisconsin Department of Natural Resources
P.O. Box 7921
101 South Webster Street
Madison, WI 53707
(608) 267-3763

Wyoming

Solid Waste Management Program
Wyoming Department of Environmental Quality
Herchler Building, 4th Floor, West Wing
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7752

Waste Exchanges

Alberta Waste Materials Exchange
Mr. William C. Kay
Alberta Research Council
Post Office Box 8330
Postal Station F
Edmonton, Alberta
CANADA T6H 5X2
(403) 450-5408

British Columbia Waste Exchange
Ms. Judy Toth
2150 Maple Street
Vancouver, B.C.
CANADA V6J 3T3
(604) 731-7222

California Waste Exchange
Mr. Robert McCormick
Department of Health Services
Toxic Substances Control Program
Alternative Technology Division
Post Office Box 942732
Sacramento, CA 94234-7320
(916) 324-1807

Canadian Chemical Exchange*
Mr. Philippe LaRoche
P.O. Box 1135
Ste-Adele, Quebec
CANADA JOR ILO
(514) 229-6511

Canadian Waste Materials Exchange
ORTECH International
Dr. Robert Laughlin
2395 Speakman Drive
Mississauga, Ontario
CANADA L5K IB3
(416) 822-4111 (Ext. 265)
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TECHNICAL REPORT DATA

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1. REPORT NO. EPA/625/7-91/013	2.	3. RECIPIENT'S ACCESSION NO. PB91-227975
4. TITLE AND SUBTITLE GUIDES TO POLLUTION PREVENTION THE AUTO REPAIR INDUSTRY		5. REPORT DATE October 1991
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Jacobs Engineering Group, Inc.		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Jacobs Engineering Group, Inc. Pasadena, California 91101-3063		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-D8-0112
12. SPONSORING AGENCY NAME AND ADDRESS Risk Reduction Engineering Laboratory--Cin., OH Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268		13. TYPE OF REPORT AND PERIOD COVERED Guidance Manual
		14. SPONSORING AGENCY CODE EPA/600/14

15. SUPPLEMENTARY NOTES

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16. ABSTRACT

Automotive maintenance and repair shops generate a variety of waste streams during activities such as replacing fluids (e.g., motor oil, radiator coolant, transmission fluid, brake fluid), replacing non-repairable parts (e.g., brake shoes/pads, shocks, batteries, belts, mufflers, electrical components, water pumps) and repairing fixable parts (e.g., brake calipers/rotors/drums, alternators, fuel pumps, carburetors, power train components). Of small quantity generators of hazardous waste in the nation, the automotive repair industry leads in number of generators and in quantity of total waste produced. Many opportunities exist to reduce the oils, sludges, and solvent and aqueous cleaning wastes that are generated.

This guide describes the typical waste generating processes of the industry as well as source reduction and/or recycling options for each. The guide also includes a set of worksheets which take the user step-by-step through an analysis of the on-site waste generating activities and the possibilities for minimizing each waste. Besides its obvious usefulness to owners and operators of auto repair shops, the guide would also be instructive to environmental consultants serving the automotive repair industry and government agencies who regulate waste streams generated by these shops.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Hazardous materials Materials recovery	Automative maintenace waste; automative repair waste; motor oil recycle /recovery; pollution prevention waste minimization waste reduction; source reduction; waste reduction	worksheets

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

☆U.S. GOVERNMENT PRINTING OFFICE: 1995 - 650-006/22014

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