

*Georgia Department of Defense  
Pollution Prevention Partnership*

Source Reduction Team

Vehicle Maintenance

Waste Reduction Assessment

Fort Gordon

Disclaimer:

*The Pollution Prevention Assistance Division (P<sup>2</sup>AD) and all technical sources referenced in this report make no warranty or representation, expressed or implied, with respect to the information contained in this report. The use of any information, apparatus, method, or process disclosed in this report may not infringe upon privately owned rights. P<sup>2</sup>AD assumes no liability with respect to use of, or damages resulting from the use of any information, apparatus, method, or process disclosed in this report. Mention of trade names, of commercial products does not constitute endorsement or recommendation for use.*

**June 14, 2000**

## Table of Contents

<b>Section</b>	<b>Page</b>
Introduction	1
Partnership Background	
Project Survey	
Fort Gordon's Mission	
Assessment of Military Motor Pools	2
Operation	
Waste Handling	
Chart 1 - Waste Stream Quantities	
Observations and Comments	
Chart 2 - Waste Disposal Cost Analysis	
Assessment of Central Vehicle Maintenance	6
Operation	
Waste Handling	
Chart 3 - Waste Disposal Cost Analysis	
Observations and Comments	
Waste Minimization Opportunities	9
Used Oil and Transmission Fluid	
Used Antifreeze	
Shop Rags and Paper Towels	
Fuel Injector Pump Rebuilding	
General Waste Reduction Methods for Vehicle Maintenance Shops - Appendix A	15
Savings Estimates for Potential Improvements - Appendix B	19
Program and Equipment Information - Appendix C	23

# GEORGIA DOD/POLLUTION PREVENTION PARTNERSHIP SOURCE REDUCTION WORK TEAM

## Waste Reduction Assessment

### Project: *Vehicle Maintenance at DOD Facilities*

#### Source Reduction Work Team Members

- \*Bill Vondersmith, P<sup>2</sup>AD - Co-Chair
- \*Michael Bien, Fort Gordon - Co-Chair
- \*Nelson Rivera, Moody AFB
- \*Roger Cannon, Robins AFB
- Randy Jones, Fort Stewart
- Linda Willis, Lockheed Martin

\*Denotes members that performed the on-site assessment

#### **Introduction**

##### **Partnership Background**

In April 1998 the Department of Defense (DOD) and the Georgia Pollution Prevention Assistance Division (P<sup>2</sup>AD) established a partnership to assist DOD facilities throughout the state to further their pollution prevention activities. In an effort to do this, four work teams consisting of representatives from all the branches of the military and P<sup>2</sup>AD were formed to address P2 planning, technology transfer, solid waste/recycling, and **source reduction**. The mission of the Source Reduction Team (SRT) is to identify activities at DOD facilities that present waste reduction opportunities and recommend improvements that would be applicable to a wide range of facilities. The observations and recommendations from the waste reduction assessments are to be documented and made available to all members of the partnership.

##### **Project Survey**

To select an initial project the SRT surveyed the DOD partnership installations to identify the top ten processes or services based on activity, waste reduction priority, and waste stream quantities. Of the installations responding to the survey, 89% ranked vehicle maintenance and solvent cleaning the highest in waste stream quantity and waste reduction priority. The team selected vehicle maintenance as the area to perform the initial waste reduction assessment since it is performed to some degree at most installations. Also, operations and waste streams associated with vehicle maintenance are relatively common between facilities, with some facilities using solvents to clean parts and equipment. **Fort Gordon** volunteered and was selected for the first on-site vehicle maintenance waste reduction assessment.

### **Fort Gordon's Mission**

Fort Gordon, located on 56,000 acres near Augusta, Georgia, is home to the United States Army Signal Center. The Fort's population of 18,300 is composed of 12,800 military personnel, 3,200 civilians, and 2,300 dependents. The primary military mission of the installation is to train soldiers to install, operate, and maintain modern military electronic communication equipment and systems. In addition to their military mission, Executive Order 12873, signed by President Clinton October 20, 1993, directs all federal facilities to make more efficient use of natural resources by maximizing recycling and preventing waste wherever possible. DoD installations have responded to this Order with many improvements in preventing pollution. The purpose of this assessment is to identify opportunities for waste reduction that are both cost effective and environmentally sound.

### **Assessment of Military Motor Pools**

#### **Operation**

Members of the SRT performed an on-site assessment of four military motor pools at Fort Gordon on October 7, 1998. These facilities perform basic vehicle maintenance including tire, battery, and fluid changes, brake repair, and small component replacement. The central vehicle maintenance shop that performs heavy repair was evaluated during a separate visit on January 14, 1999 and will be addressed later on in this report.

#### **Waste Handling**

The team visited the 63rd Signal Battalion, 67th Signal Battalion, 359th Signal Brigade, and the 513th Military Intelligence (M.I.) Brigade motor pools. Each motor pool's waste handling and disposal procedures were reviewed. Hazardous waste generated by the motor pools is segregated, collected in closed containers (primarily 55 gallon drums) and stored in a designated area prior to disposal. All hazardous waste (RCRA and non-RCRA regulated wastes) is sent to a 90 day storage area at the newly erected Hazardous Materials Control Center (HMCC) and then on to the Defense Reutilization and Marketing Office (DRMO) for off-site disposal. The disposal process begins with the motor pool

completing the necessary documentation, denoting generating process, container, and type and amount of waste, in accordance with Fort Gordon Environmental and Natural Resources Management Office's (ENRMO's) disposal guidance. The drums used to ship the hazardous waste are generally 55 gallon steel drums. The hazardous waste stream quantities from these units for fiscal year 1998 are shown in **Chart 1**.

**Chart 1**  
**Fort Gordon Military Motor Pools**  
**Waste Streams - Annual Quantities FY 98 in Pounds**

No.	Waste Type	63 <sup>rd</sup> Signal Battalion	513 <sup>th</sup> M.I. Brigade	359 <sup>th</sup> Signal Brigade	67 <sup>th</sup> Signal Battalion	Total Pounds per year
1.	Used motor oil	3,800	6,300	3,400	2,280	15,780
2.	Contaminated diesel fuel	1,850	2,787	400	2,700	7,737
3.	Used antifreeze	800	2,236		2,850	5,886
4.	Used transmission fluid	750	405		680 <sup>1</sup>	1,835
5.	Used oil filters	200	300	200		700
6.	Used fuel filters	200	120	200		520
7.	Contaminated soil	20,100	8,980	4,000	10,519	43,599
8.	Used absorbent	1,750	1,700		2,495	5,945
9.	Rags/oil & grease		1,620	720	300	2,640
10.	Contaminated gasoline		2,040		320	2,360
11.	Brake Fluid		370		45 <sup>1</sup>	415
12.	Grease	290	341		290	921
13.	Lead Acid Batteries				200	200
14.	Ni Cad Batteries		100			100
15.	Lithium Batteries		26			26
16.	Paint Related					115

Note: Waste quantities are based on estimates from Fort Gordon's Environmental and Natural Resources Management Office (ENRMO). Used absorbent paper towels are included with used absorbent.

1. Reflects disposal of new uncontaminated material usually due to expired shelf life (67<sup>th</sup> Signal Battalion transmission and brake fluid)

## **Motor Pools - Observations and Comments**

### **Used Shop Towels (Rags)**

The post laundry facility laundered used rags until the facility closed in 1998. Following the closure of the laundry point, unit motor pools acquired rags from a variety of sources, and contained and disposed of their rags as non-RCRA regulated waste in 55 gallon drums through the HMCC and DRMO.

DRMO's disposal contractor charges \$.18 per pound to remove and dispose of this waste stream, including the weight of the drum. In 1998, used rag disposal for the four motor pools was estimated to cost \$475. Since units procure rags for a number of activities other than vehicle maintenance, the amount the amount of new rags used by just the motor pools is not readily available. However, the total new rag cost for the four units in 1998 was estimated at \$4,454.

In December of 1999 each of Fort Gordon's major motor pools entered into a Closed Loop Shop Towel Recycling Program. The contractor, G & K Services, delivers clean 18-inch blue cotton shop towels to the motor pool for use with Petroleum, Oil, and/or Lubricant (POL) products only. The used towels are picked up weekly by G & K from the motor pools and replaced with an equal amount of clean towels. G & K launders the dirty towels in compliance with all environmental regulations, to complete the cycle. Fort Gordon expects to virtually eliminate this waste stream on post through this program. Exceptions include towels/rags used with solvents, paint, or sensitive electronic equipment.

### **Parts Cleaning**

Fort Gordon's motor pools use parts washers with a self-renewable bioremediation aqueous cleaning system. The system uses enzymes to digest hydrocarbons (oil and grease) and a filter to remove dirt. As a result, the enzymes and filter keep the solution clean. Theoretically, the only waste generated by this process are the spent filters. The filters, which are changed every 30 to 45 days, are periodically tested to determine if they contain hazardous contaminants. Personnel in all of the motor pools indicated that they were satisfied with these units and were not using any other parts washers. However, all of the shops were only performing light duty maintenance (remove and replace) and did not have to remove heavy grease and dirt. For parts such as wheel bearings, heavy grease is removed as much as possible by wiping with rags before final cleaning in the parts washer.

### **Vehicle Washing**

Fort Gordon units are not permitted to use detergents when washing vehicles or cleaning of service bay floors. The use of detergents emulsify the oils washed from vehicles and shop floors preventing the site's oil/water separators from functioning properly. In addition, detergents reduce the biological activity of the wastewater treatment plant and allow oil to pass through and discharge into the environment.

## **Oil Changes**

Fort Gordon employs the Army Oil Analysis Program (AOAP) to schedule oil changes. The motor oil in each vehicle is sampled every 6 weeks or 1000 miles and sent to a laboratory for analysis. The results, based on the American Petroleum Institute (API) Standards dictate if the vehicle's oil is to be changed. The use of oil analysis in place of mileage or a scheduled time interval for changing oil reduces the frequency of oil changes, saving oil and reducing the amount of waste oil generated. This program is estimated to have extended the period between oil changes by 33%, reducing waste oil by 975 gallons during 1998. While this is a significant improvement, the four motor pools generated an estimated 1,950 gallons of used oil in 1998 costing \$2,682 for disposal fees and \$1,800 for steel shipping drums.

On March 10, 2000, the Fort Gordon Director of Public Works signed a memorandum mandating the use of re-refined motor oils whenever possible and encouraging participation in the Closed Loop Re-refined Oil Program. Recycling oil, and using re-refined oils supports environmental legislation, saves energy, lowers this country's on foreign natural resources, and reduces the potential for groundwater contamination and air pollution. Additional information, including cost savings potential, is detailed in the Waste Minimization Opportunities section.

## **Hazardous Waste Handling - Present Method**

Hazardous waste streams, except fluorescent bulbs, that are generated by the motor pools are segregated and placed in steel drums. The drummed waste is sent through the HMCC to the DRMO where it is consolidated for pick-up by the disposal contractor. The hazardous waste disposal company has a contract to handle all hazardous waste sent to DRMO. **Chart 2** lists the waste types generated by all motor pools and the associated disposal costs for fiscal 1998.

**Chart 2**  
**Fort Gordon's Military Motor Pools**  
**Waste Disposal Cost Analysis**

No.	Waste Source	Waste Type	Lbs./yr.	Cost/lb.	Cost/yr.
1.	Vehicle oil change	Used motor oil	15,780	\$.17	\$2,682
2.	Repairs & maintenance	Contaminated diesel fuel	7,737	\$.25	\$1,934
3.	Repairs & maintenance	Used antifreeze	5,886	\$.17	\$1,001
4.	Repairs & maintenance	Transmission fluid	1,835	\$.17	\$312
5.	Vehicle oil changes	Oil filters	700	\$.17	\$119
6.	Repairs & maintenance	Fuel filters	520	\$.25	\$130
7.	Field operations	Contaminated soil	43,599	\$.18	\$7,848
8.	Spill Clean-up	Used absorbent	5,945	\$.18	\$1,070
9.	Hand & parts wipe	Dirty rags/oil & grease	2,640	\$.18	\$475
10.	Repairs & maintenance	Contaminated gasoline	2,360	\$.25	\$590
11.	Repairs & maintenance	Brake fluid	415	\$.17	\$71
12.	Repairs & maintenance	Grease	921	\$.17	\$157
13.	Repairs & maintenance	Lead acid batteries	200	\$.55	\$110
14.	Repairs & maintenance	Ni Cad batteries	100	\$.23	\$23
15.	Repairs & maintenance	Lithium batteries	26	\$1.01	\$26
16.	Repairs & maintenance	Paint related	115	\$.25	\$29
Totals			88,779		\$16,577

Notes:

1. DRMO includes used paper towels with used absorbents.
2. All quantities are from the hazardous material/hazardous waste turn-in logs for 1998.
3. The cost for 55 gallon steel drums to ship waste is not included above since number of drums used in 1998 was not available for all waste streams. The estimated cost to provide empty 55 gallon drums for waste shipment is a minimum of \$50 each.

## Assessment of Central Vehicle Maintenance

### Operation

Members of the Source Reduction Team (SRT) performed an on-site assessment of Fort Gordon's Central Vehicle Maintenance facility on January 14, 1999. The contractor, Johnson Controls World Services, operates this facility for Fort Gordon, performing vehicle maintenance ranging from routine fluid changes to engine and power train rebuilding and replacement. All major repairs to military vehicles for the Fort are performed at this facility including de-painting and painting of vehicles. In addition, this shop maintains the Fort's roads and grounds equipment which includes fork lifts, front loaders, bulldozers, tractors, and lawn maintenance equipment.

### Waste Handling

The Source Reduction Team was introduced to the facility supervisor, Mr. Buddy Kelly of Johnson Controls, who conducted a tour of the Central Maintenance Facility. During the tour the team reviewed maintenance operations, waste handling methods, and disposal procedures employed by the facility. Like the motor pools, all hazardous waste is placed in closed containers (primarily 55 gallon steel drums) stored in a secured area prior to disposal. All hazardous waste is sent to the DRMO for off-site disposal. The disposal process begins with central maintenance notifying Fort Gordon's Environmental and Natural Resources Management Office (ENRMO) of the type of hazardous waste, container, and estimated quantity for disposal (e.g. 2 full drums of used oil at 898 pounds gross weight). The drums used to ship hazardous waste are 55 gallon steel drums. The hazardous waste stream quantities and disposal costs from the Central Maintenance facility for the fiscal year 1998 are shown in **Chart 3**.

The team also visited the DRMO waste storage area where they reviewed waste handling procedures and associated costs. Disposal of all hazardous waste sent to DRMO is performed under a contract with Safety-Kleen. Disposal costs are fixed under the contract for each type of waste which includes pick-up and transportation by the contractor. The motor pools and central maintenance can send waste out to be reused or recycled but once sent to DRMO, disposal is normally handled through the contract with Safety-Kleen. Safety-Kleen, in turn, delivers the materials to a recycling or treatment facility when practical. If no reuse, recycling or treatment methods are feasible, the wastes are disposed of in a hazardous waste landfill.

**Chart 3**  
**Fort Gordon's Central Vehicle Maintenance Facility**  
**Waste Disposal Cost Analysis**

No.	Waste Source	Waste Type	lbs./yr	Cost/lb.	Cost/yr.
1.	Vehicle oil change	Used motor oil	11,315	\$.17	\$1,924
2.	Repairs & maintenance	Contaminated diesel fuel	1,003	\$.25	\$251
3.	Repairs & maintenance	Used antifreeze	2,874	\$.17	\$489
4.	Repairs & maintenance	Transmission fluid	0	\$.17	\$0
5.	Vehicle oil changes	Oil filters	832	\$.17	\$141
6.	Repairs & maintenance	Fuel filters	400	\$.25	\$100
7.	Field operations	Contaminated soil	1,607	\$.18	\$289
8.	Spill Clean-up	Used absorbent	1,191	\$.18	\$214
9.	Hand & parts wipe	Dirty rags/oil & grease	2,708	\$.18	\$487
10.	Repairs & maintenance	Contaminated gasoline	0	\$.25	\$0
11.	Repairs & maintenance	Brake fluid	0	\$.17	\$0
12.	Repairs & maintenance	Grease	0	\$.17	\$0
13.	Repairs & maintenance	Lead acid batteries	1,645	\$.55	\$905
14.	Repairs & maintenance	Ni Cad batteries	206	\$.23	\$47
15.	Repairs & maintenance	Lithium batteries	27	\$1.01	\$27
16.	Repairs & maintenance	Paint related	5,038	\$.25	\$1,260
Totals			28,846		\$6,134

1. DRMO includes used absorbent paper towels with used absorbents.
2. All quantities are from the hazardous materials/hazardous waste turn-in logs at the Environmental and Natural Resources Management Office.
3. The cost of new 55 gallon steel drums to ship waste is not included above since the number of drums used in 1998 was not available for all waste streams. The estimated cost to provide empty 55 gallon drums for waste shipment is a minimum of \$50 each.

## **Central Maintenance - Observations and Comments**

### **Shop Rags**

Central Maintenance uses disposable paper towels in place of rags. The contaminated towels are placed in 55 gallon steel drums and sent through HMCC to the DRMO for off-site disposal as used absorbent.

In December of 1999, Central Maintenance and each of Fort Gordon's major motor pools entered into a Closed Loop Shop Towel Recycling Program. The contractor, G & K Services, delivers clean 18-inch blue cotton shop towels to the motor pool for use with Petroleum Oil Lubrication (POL) products only. The used towels are picked up weekly by G & K from the motor pools and replaced with an equal amount of clean towels. G & K launders the dirty towels in compliance with all environmental regulations, to complete the cycle. Fort Gordon expects to virtually eliminate this waste stream on post through this program. Exceptions include towels/rags used with solvents, paint, or sensitive electronic equipment.

### **Oil Changes**

The Army Oil Analysis Program (AOAP) is used to schedule oil changes. Motor oil from each vehicle is sampled every 6 weeks or 1000 miles and sent to a laboratory for analysis. The results, based on the American Petroleum Institute (API) Standards dictate if the vehicle's oil is to be changed. The use of this oil analysis program in place of mileage or scheduled time interval for changing oil has extended the time between oil changes by 33%. Based on 1998 activity by Central Maintenance, it is estimated that this program has reduced motor oil waste annually by over 700 gallons. While this is a significant reduction, Central Maintenance generated an estimated 1,400 gallons of used motor oil during 1998 costing \$1,924 in disposal fees and \$1,300 for steel drums to ship the waste oil.

Johnson Controls, along with the military motor pools on post, has agreed to participate in the Closed Loop Re-refined Oil Program, mentioned previously and detailed in the Waste Minimization Opportunities section on page 10.

### **Used Oil and Fuel Filters**

Central Maintenance is crushing oil and fuel filters using a commercial unit from Emerson Manufacturing Corporation (telephone 800-633-5124). The crushed filters are sent to DRMO for off-site disposal as hazardous waste. Crushing the filters reduces the volume of waste using fewer 55

gallon drums for handling.

## **Parts Cleaning**

**Small parts** - Central Maintenance has nine ChemFree parts washers for cleaning small parts. These parts washers use an aqueous cleaner containing enzymes that digest hydrocarbons (oil and grease) and a filter to remove dirt. As a result, the enzymes and filter keep the solution clean. Theoretically, the only waste generated by this process is spent filters. The filters, which are changed every 30 to 45 days, are periodically tested to determine if they contain hazardous contaminants. Parts that contain heavy grease and dirt are cleaned as much as possible using shop towels and scrappers prior to cleaning in the ChemFree unit.

**Large parts and assemblies** - Large components are taken to an outside wash rack where they are cleaned with hot water using a pressure washer. The water is heated by natural gas as it is sprayed which eliminates the need to maintain a hot water reserve for on demand use. Detergent is not used at the wash rack. The wastewater containing oil, grease, and dirt drains to an oil/water separator. The sump containing the contaminated oil and grease is periodically pumped out by a contractor. Moving large assemblies from the shop to the wash rack frequently leaves a trail of oil, grease, and dirt that must be cleaned up.

## **Vehicle battery charging area**

Fort Gordon participates in the Vehicle Battery Consignment Program. Through a contract between the Department of the Army and the Exide Corporation, spent lead-acid batteries are picked up and replaced with fresh recycled ones. Exide owns the batteries, and is responsible for their removal, delivery, and maintenance. This program has for the most part eliminated lead-acid battery disposal. The contact for the Defense Logistics Agency's battery program with Exide is Vince Vincent at the Defense Supply Center Richmond telephone (800) 345-6333, e-mail: [Vincent@dscr.dla.mil](mailto:Vincent@dscr.dla.mil)

A pulse charging system is used in the lead-acid battery charging area to keep battery plates clean (desulphates plates). The system, manufactured by Pulse Tech Products Corporation, telephone (800) 580-7554, was purchased for \$5,000 in 1998. The system performs at an 83% recovery rate, and has saved Fort Gordon over \$62,000. Pulse Tech's Web site: [www.pulsetech.net](http://www.pulsetech.net)

## **Fuel injector pump rebuilding**

A solvent previously used to clean pumps during rebuilding was replaced with Viscor Calibration Fluid due to its higher flash point. According to the maintenance supervisor the Viscor fluid requires more effort and has resulted in more rework. Viscor Calibration Fluid is supplied by Rock Valley Oil and Chemical Co. (telephone 800-798-8635).

## **Vehicle painting**

Central Maintenance operates two paint booths equipped with down draft air exhaust dry filter systems. Several pollution prevention initiatives have been incorporated in this area. High Volume Low Pressure (HVLP) paint guns having the capability to provide a transfer efficiency up to 90% have been provided. Conventional paint guns deliver between 20-30% transfer efficiency. A closed loop paint gun cleaning system minimizes the use of solvent to clean paint guns. Also, by applying a peelable coating to the surface of the paint booth interior, the need to use solvent to clean booths is eliminated.

### **Aerosol cans**

Central Maintenance has one Aerosolv Deluxe aerosol can recycling system manufactured by Katec Incorporated (telephone 800 843-6808) to remove residual contents making the steel can suitable for recycling. This system punctures the can draining the residual liquid contents to a steel drum, and a carbon filter absorbs and treats gases and vapors released during the draining. The Aerosolv system, at the time of this assessment, was scheduled to be relocated to a new Hazardous Material Control Center and was not currently in use. Also, there was a concern about mixing of materials from various aerosols when draining the containers. Aerosol cans are not listed in either the Motor Pools or Central maintenance waste stream because quantities from vehicle maintenance could not be separated from the total from all of the other facilities at Fort Gordon.

### **Waste Minimization Opportunities**

*(Savings estimates are detailed in Appendix B and program / equipment information in Appendix C)*

#### **Used Oil and Transmission Fluid**

- C **Closed Loop Re-refined Oil Program:** The Defense Supply Center Richmond (DSCR) administers the Closed Loop Re-refined Oil Program, which provides a contracted service to pick-up used oil when re-refined oil is ordered under a national stock number (NSN). Under this program the service would pick-up, at no cost, used oil up to 120% of re-refined oil purchased under the applicable NSN. Used oil in excess of the 120 percent may be removed for a fee of \$.18 per gallon. Comparing this to the current disposal cost of \$.17 per pound (\$1.25 per gallon) through DRMO, a savings of \$1.07 per gallon would be realized. The program allows mixing of transmission and hydraulic fluids with the used motor oil. The re-refined oil can be purchased in bulk, 55 gallon drums, 5 gallon containers, and quart quantities at competitive prices in most military specifications. An advantage of this program is that it does not require a capital investment, unless storage tanks are required for purchase of bulk oil. Based on the used oil generated in 1998 by the motor pools and central maintenance there is a potential for an estimated savings of \$6,000 in waste disposal cost by implementing this program. For additional information, national stock numbers, and prices contact the Defense Supply Center Richmond, Virginia at 800-345-6333 or (804) 279-4908.

According to officials of the Chesapeake Bay Foundation, approximately 42 gallons of crude oil are needed to refine two quarts of lubricating oil and other petroleum products. It only takes one gallon of recycled oil and about half as much energy to produce the same two quarts of lubricating oil (Hauffman, Autumn 1998)<sup>1</sup>.

- C **Oil Fired Hot Water Heater:** An optional use for used oil is a water heater that can be fueled by used oil and transmission fluid to provide domestic hot water for living quarters, dining facilities, or offices. Commercial water heaters of this type rated at 500,000 BTU per hour or less do not require a permit from the Environmental Protection Agency (EPA). However, local and state requirements may differ. This unit has a hot water output of 470 gallons per hour at 100<sup>0</sup> F temperature rise. An estimated cost for the 500,000 BTU unit is \$13,000. In addition to the savings of \$4,918 from the elimination of waste disposal cost, elimination of the need for steel shipping drums will save \$3,300, the energy saved in generating hot water would save an estimated \$1,603 for a total annual savings of \$9,821. The simple payback for this project is estimated at 1.3 years. Two companies that can provide the subject water heaters (boilers) are the Shenandoah Manufacturing Company, Harrisonburg, Virginia telephone (800) 476-7436 or (540) 434-3838 and Clean Burn, Leola, Pennsylvania, telephone (800) 331-0183.

### Used Antifreeze

- C Purchase equipment with ion exchange technology to do on-site recycling of the used antifreeze. Currently, ion exchange and vacuum distillation are technologies approved by the Army for recycling used engine coolant<sup>2</sup>. During the course of this assessment Fort Gordon has elected to purchase a ion exchange system to recycle used antifreeze. Fort Gordon's four motor pools and central maintenance generate 897 gallons per year of used antifreeze. The capital expenditure for one ion exchange recycling unit and accessories is estimated at \$18,670 with 78% of the cost assigned to the facilities covered by this assessment. Recycling the antifreeze, assuming an efficiency of 90%, would result in an estimated annual savings of \$5,483 based on FY 1998 data providing a simple payback of 2.7 years.

**Ion Exchange**<sup>4</sup> is the reversible interchange of ions between a solid and a liquid in which no permanent change occurs in the structure of the solid that is the ion-exchange material. Ion exchange is a standard technology for the removal of dissolved metals from waste solutions. These systems have demonstrated the ability to remove most of the dissolved metal cations and decomposition products from used engine coolant. An Antifreeze Recycling Users Guide is available from the U.S. Army Tank-Automotive and Armaments Command, Mobility Tech Center-Belvoir, Mr. Dwayne Davis at DSN 654-3720 or commercial (703) 704-3720. The users guide provides product recommendations, operating procedures, and precautions.

**Vacuum Distillation**<sup>2</sup> is a method for separating the components of a solution by vaporization under a vacuum and then condensing the vapors. Under a vacuum, components of the solution will vaporize at temperatures below their standard atmospheric boiling point. Because of the lower temperatures of the vacuum distillation process, the chemical composition and integrity of heat sensitive compounds is preserved.

The two principal methods used to perform vacuum distillation are vacuum distillation in batch mode and fractional distillation. The batch mode has been approved for recycling used engine coolant at Army installations (HTIS, Jan-Feb 1995).

- C Contract with an vendor for the purchase of recycled antifreeze requiring the vendor to take the used antifreeze back to recycle. This would eliminate a waste disposal cost annually of \$2,839 for 897 gallons of used antifreeze.

### **Shop Rags and Paper Towels**

- C Contract with a vendor to provide a shop rag service (launder and reuse) in place of the purchase and dispose system currently employed. Fort Gordon's major vehicle maintenance facilities in 1998 used an estimated 820 cotton shop rags and 400 paper towels per week. The cost in 1998 to provide the cotton rags and paper towels amounted to \$5,265 with another \$3,967 for disposal for a total annual cost of \$9,232. The projected cost from a contractor to supply cotton shop rag needs for these vehicle maintenance facilities for one year is \$7,074. Implementing this service would result in a saving of \$2,158 per year without a capital investment.

### **Fuel Injector Pump Rebuilding**

- C Investigate using a Minimax steam cleaner with a rust inhibitor to clean the fuel injector pumps during rebuilding in place of the calibration fluid currently used. These units generate dry steam at 190 to 295 psi at 500 degrees F operating from a distilled water supply (gallon jug). The Minimax steam cleaner is manufactured by PDQ Precision Inc., telephone (800) 253-3731 or (619) 581-6370, web site: [www.minimaxcleaner.com](http://www.minimaxcleaner.com) . This would eliminate the cleaning fluid waste stream.

### **References:**

1. Eddie Hauffman, Material Maintenance Specialist, HQ FORSCOM DCSLOG, Closed Loop Re-refined Oil Program - *FORSCOM Environmental Grapevine, Autumn 1998*. For additional information contact the Defense Supply Center Richmond, Virginia at 800-345-6333 or 804 279-4908.
2. Pollution Prevention Plan for Fort Gordon, Georgia ESE No. 3195191G Revised March 1997 page 5-9 section 5.2.2.2 'At Fort Belvoir, VA, the U.S. Army evaluated four commercial engine coolant recycling processes. Based on compatibility and performance with engine coolant currently used at Army facilities, e.g. conforming to MIL-A-46153, ion exchange and vacuum distillation were recommended as the process alternatives for recycling used engine coolant (HTIS, Jan.-Feb. 1995).'
3. Minimizing Aerosol Waste, MnTAP Source, Summer 1996 Issue, Volume 11, Number 3, Minnesota Technical Assistance Program, University of Minnesota, web site: [www.mntap.umn.edu/mntap/p2/general/aero-gl.htm](http://www.mntap.umn.edu/mntap/p2/general/aero-gl.htm)
4. Kirk-Othmer, Concise Encyclopedia of Chemical Technology, Wiley - Interscience Publication, Jon Wiley & Sons, page 665, Definition of ION Exchange.
5. Pollution Prevention Assistance Division (P<sup>2</sup>AD), Georgia Department of Natural Resources - For information telephone (404) 651-5120, Fax (404) 651-5130, e-mail: [p2ad@ix.netcom.com](mailto:p2ad@ix.netcom.com), internet: <http://www.ganet.org/dnr/p2ad>

### **Source Reduction Team:**

Bill Vondersmith is a Principal Pollution Prevention Engineer with the Pollution Prevention Assistance Division (P<sup>2</sup>AD), Georgia Department of Natural Resources. He can be contacted at (404) 651-5120, e-mail: [bill\\_Vondersmith@mail.dnr.state.ga.us](mailto:bill_Vondersmith@mail.dnr.state.ga.us)

Michael Bien is an Environmental Specialist, REMSA, Inc, Environmental and Natural Resources Office, U.S. Army Signal Center and Fort Gordon. He can be contacted at (706) 791-6127, e-mail: [bienm@gordon.army.mil](mailto:bienm@gordon.army.mil)

Nelson Rivera is a Pollution Prevention Manager at Moody Air Force Base, Georgia. He can be contacted at (912) 257-4979, e-mail: [nelson.rivera@moody.af.mil](mailto:nelson.rivera@moody.af.mil) .

Roger Cannon is the chief of Hazmat/Haz Waste Management Branch at Robins Air Force Base. He can be contacted at (912) 926-2909, e-mail: [roger.cannon@robins.af.mil](mailto:roger.cannon@robins.af.mil)

Randy Jones is an Environmental Specialist at Fort Stewart, Georgia. He can be contacted at (912) 767-7925, e-mail: [powell-jonesrd@emh5.stewart.army.mil](mailto:powell-jonesrd@emh5.stewart.army.mil)

Linda Willis is a Pollution Prevention Coordinator for Lockheed Martin Aeronautics Company - Marietta, Marietta, Georgia. She can be contacted at (770) 494-6441, e-mail: [linda.g.willis@lmco.com](mailto:linda.g.willis@lmco.com)

# **Appendix A**

## **GENERAL WASTE REDUCTION METHODS FOR VEHICLE MAINTENANCE SHOP**

## **General Waste Reduction Methods for Vehicle Maintenance Shops**

*(See Appendix C for equipment and material information)*

### **Dirty Rags**

- C Use an industrial laundry service to recycle shop rags.
- C Use scrappers to remove heavy grease and grime as much as possible when cleaning components.
- C Use dry steam to clean components to conserve rag use.
- C Set up a control system to limit rag use.
- C Keep dirty rags in a closed container marked 'USED SHOP RAGS ONLY'.
- C Use an enclosed aqueous jet spray unit equipped with a water recycling system to clean large components.

### **Contaminated Dry Sweep (absorbent)**

- C Use reusable absorbent pads to absorb oil spills. Absorbent pads and pigs can be reused by passing them through a set of rollers to squeeze out the oil.
- C Wet dry vacuum cleaners can be used to pick up spills in place of absorbents.
- C Practice good housekeeping to avoid the need for absorbents. Use drip pans and funnels as appropriate.
- C Use a minimum amount of absorbent to do the job.

### **Used Motor Oil**

- C Contract with a vendor to purchase re-refined oil and take back the used oil. Keep used oil in a separate container marked 'USED OIL ONLY'. See Closed Loop Re-refined Oil Program under waste minimization opportunities and Appendix B for program information.
- C If there is a need purchase a water heater that is fueled by used oil. There are heaters that do not require a permit to operate (see **Appendix B** for cost/savings estimates)

### **Used Oil Filters**

- C Crush or split filters to drain oil and recycle as scrap metal.

### **Used Antifreeze**

- C Contract with a vendor to recycle the used antifreeze
- C Purchase equipment to recycle the antifreeze on-site. Two antifreeze recycling units have been approved by the Army. One unit uses an ion exchange process and the other vacuum distillation.

### **Parts cleaning**

- C Switch to an aqueous cleaner - use filtration to extend cleaner life
- C Switch to an aqueous cleaner with enzymes
- C Use steam to clean parts
- C Determine the need to clean and/or the degree of cleaning required
- C If solvent is used recycle it in house - filtration, distillation
- C Remove as much dirt as possible by hand - rags, scrappers etc.

### **Batteries**

- C Lead acid batteries must be recycled. They cannot be sent to a landfill or incinerated.
- C To eliminate handling of battery acid, battery storage, and disposal cost of used batteries, contract with a vendor to provide new fresh (filled with acid) batteries and take back used ones. The Department of the Army has contracted with Exide Corporation to handle lead-acid batteries
- C Equip vehicles that are not started for long periods with solar panels to extend the battery life. The solar panels are designed to prevent the sulfur in the battery from becoming crystallized, which prevents it from carrying the charge to start the vehicle. This will increase battery life and reduce disposal.
- C Use a pulse charging system to keep battery plates clean (desulphate plates).
- C Ni-cad batteries - use rechargeable batteries

### **Aerosol cans<sup>3</sup>**

- C Use refillable, rechargeable or pump-spray containers instead of aerosols whenever possible. Compressed air can be used as the propellant. Refillable containers often have replacement parts available. With refillable containers, materials may be purchased in bulk at reduced cost.
- C Use non hazardous products in place of hazardous aerosol products.
- C Do not accept free samples of aerosols that contain hazardous products.
- C Practice inventory control by using aerosol materials until the containers are completely empty.
- C Audit your inventory, determine what aerosol products are essential and stop purchasing unnecessary or duplicate aerosol products.
- C Install a system to puncture and drain residual material from aerosol cans to make them suitable for recycling.
- C Train employees how to use aerosols sparingly and completely.

### **Material exceeding expiration date**

- C Improve inventory controls
- C Contact manufacturer as to the possibility of extending expiration date.

## **Vehicle Emissions**

- C Use alternative-fueled commercial vehicles - Fort Gordon has 42 Compressed Natural Gas (CNG) powered vehicles

# **Appendix B**

## **SAVINGS ESTIMATE FOR POTENTIAL IMPROVEMENTS**

## Estimated Savings Employing Water Heater Fired by Used Oils Generated by Fort Gordon's Motor Pools and Central Maintenance Facility

The following calculations provide the basis for the estimated savings resulting from installing a hot water heater that can be fueled with waste oil and transmission fluid generated by Fort Gordon's motor pools and central maintenance facility. The savings result from the elimination of waste disposal costs and energy savings by producing domestic hot water. This savings estimate assumes that there is an application for the hot water produced by this equipment.

Waste oil and transmission fluid disposal in fiscal 1998:

Motor pools - used oil	15,780 lbs.
?     '     - transmission fluid	1,835 lbs.
Central maintenance - used oil	11,315 lbs.
?     '     - transmission fluid	<u>0 lbs.</u>
Total	28,930 lbs

Disposal weight includes 55 gallon steel drums in which the used oil is shipped. To convert disposal pounds to gallons of oil, a drum weight of 40 pounds and a oil density of 7.35 lbs./gal were used.

Weight of a 55 gal. Steel drum filled with used oil = 55 gal x 7.35 lbs./gal + 40 lbs./drum = 444.25 lbs  
 No. of 55 gal drums = 28,930 lbs. ? 444.25 lbs./drum = 66 drums  
 Total weight of drums = 66 drums x 40 lbs./drum = 2,640 lbs.  
 Quantity of used oils only = 28,930 lbs. - 2,640 lbs. = 26,290 lbs ? 7.35 lbs./gal. = 3,577 gallons/yr.  
 Estimated cost of natural gas = \$4.00 per million BTU

Proposed hot water heater - 500,000 BTU unit:

- C Fuel consumption 3.5 gallons/hour
- C Hot water output = 470 gallons /hour
- C Assume a water temperature rise of 100 degrees Fahrenheit
- C Capital cost = \$13,000

Heater operating hours = 3,577 gal./yr. ? 3.5 gal./hr. = 1,022 hours/year

Hot water produced = 1,022 hr./yr x 470 gal./hr = 480,340 gallons/year ? 365 days/yr = 1,316 gal./day

Pounds of water produced = 480,340 gal x 8.345 lbs./gal = 4,008,437 pounds

BTU for 100<sup>0</sup> F rise = 4,008,437 lbs. H<sub>2</sub>O x 100<sup>0</sup> F x 1<sup>0</sup> F/pound H<sub>2</sub>O = 400,843,700 BTU

Cost to heat H<sub>2</sub>O with natural gas = \$4.00 /million BTU x 400.843 million BTU = \$1,603 per year

**Energy cost savings = \$1,603 per year**

**Disposal cost of used oil and transmission fluid = 28,930 lbs./yr x \$.17/lb = \$4,918 per year**

**Cost of 55 gal. drums to ship oil for disposal = 66 drums/yr. x \$50/drum = \$3,300/yr.**

**Total savings = \$1,603 + \$4,918 + \$3,300 = \$9,821 per year**

**Simple Payback = \$13,000 ? \$9,821 = 1.3 year**

1. Waste oil includes transmission fluid.
2. This estimate does not include labor to operate the hot water heater.

## **Estimated Savings Associated with Operating On-Site Ion-exchange Antifreeze Recycling Equipment**

The following calculations provide the basis for the estimated savings resulting from the acquisition and operation of equipment to recycle antifreeze generated by Fort Gordon's motor pools and central vehicle maintenance facility. Savings are derived from the elimination of waste disposal costs and reduction in the purchase of new antifreeze.

Estimated savings are based on waste quantities generated during fiscal year 1998

Equipment: Ion-exchange technology  
National Stock Number (equipment)- NSN 4250-01-380-9034  
Cool'r Clear'r System  
Vendor - KFM Corporation Tel (813) 221-6467  
Equipment & accessories cost - \$18,670  
Supplies: Extended supply start-up kit NSN 6850-01-411-6650  
Filters 1-5 micron (change filters every 200 to 500 gallons)  
Process rate: 180 gallons per hour

Antifreeze disposal FY98:

C Four motor pools = 5,886 lbs.  
C Central maintenance = 2,874 lbs.  
C Total = 8,760 lbs./yr  
C Number of 55 gallon steel drums used to ship antifreeze = 27 drums @ 40 lbs each  
C Weight of antifreeze only = 8760 lbs./yr - (27 drums/yr x 40 lbs./drum) = 7,680 lbs./yr  
C Gallons of antifreeze = 7,680 lbs./yr ? 8.5645 lbs./gal = 897 gal/yr

Cost of new antifreeze = \$6.55 per gallon (composite cost)

**Antifreeze disposal cost savings = 8,760 lbs/yr x \$.17/lb = \$1,489/year**

**Cost of 55 gallon drums to ship waste antifreeze = 27 drums/yr x \$50/drum = \$1,350/yr**

**Cost of virgin antifreeze = (897 gal/yr ? 2) x \$6.55/gal = \$2,938/yr**

**Reduced antifreeze usage savings = \$2,938 x .90 = \$2,644/year (assumes 90% recycling efficiency)**

**Total savings = waste disposal + drums + virgin antifreeze**

**= \$1,489 + \$1,350 + \$2,644 = \$5,483/yr**

The new antifreeze recycling equipment will be used by other units in addition to those covered by this assessment. Therefore, for the purpose of calculating a simple payback for this project, only 78% of the capital expenditure will be used. This is the percent of waste antifreeze generated by the units in this assessment.

Percent of waste antifreeze from assessed units = (8,760 lbs./yr ? 11,218 lbs./yr) x 100 = 78%

**Simple payback = (\$18,670 x .78) ? \$5,483/yr = 2.7 years**

Note: Sufficient information was not available to determine labor and operating costs for the above project. However, some

of these costs should be offset by reductions in handling associated with antifreeze disposal.

## **Estimated Savings Associated with Implementing a Program for Shop Rag Reuse**

The following calculations provide the estimated savings that result from replacing a purchase and disposal system for shop rags and paper towels with a service that will launder shop rags for reuse. The savings are derived from the elimination of waste disposal costs and the purchase of shop rags and paper towels.

### **1998 usage/cost of shop rags and towels:**

Cotton rag usage = 820 rags/wk. = 4.92 bundles/wk. x 52 wks./yr = 255.84 bundles/yr

Cotton rag cost = 255.84 bundles/yr. x \$17.41/bundle = **\$4,454/yr**

Paper towel usage = 400 towels/wk. x 52 wks./yr = 20,800 towels/yr

Paper towel cost = 20,800 towels/yr x \$.039/towel = **\$811/yr**

**Total cost of cotton rags & paper towels = \$4,454 + \$811 = \$5,265/yr**

### **1998 disposal of shop rags and towels:**

Used rags and towels are disposed of in 55 gallon steel drums.

Disposal weight of rags and towels (includes drums) = 5,040 lbs./yr

Number of 55 gallon steel drums = 36/yr

Disposal cost = 5,040 lbs. x \$.18/lb = **\$907/yr**

Cost of drums = 36 drums/yr x \$85/drum = **\$3,060/yr**

**Total disposal cost = \$907 + \$3,060 = \$3,967/yr**

Total cost of purchase and disposal system = (rag & towel cost + disposal fees + drum cost)

**Total cost of purchase and disposal system = (\$5,265 + \$907 + \$3,060) = \$9,232/yr**

**Projected cost for a contractor to supply reusable shop rags (launder and reuse) = \$7,074/yr**

Estimated savings = ( purchase and dispose system - launder and reuse system)

**Estimated savings = \$9,232 - \$7,074 = \$2,158/yr**

# Appendix C

## PROGRAM AND EQUIPMENT INFORMATION

## Program and Equipment Contacts

### Programs:

**P1 - Closed Loop Re-refined Oil Program** - Contact the Defense Supply Center Richmond (DSCR), Virginia at 800-345-6333 or 804-279-4908.

[www.dscr.dla.mil/products/pol/cl-pr.html](http://www.dscr.dla.mil/products/pol/cl-pr.html)

**P2 - Vehicle Battery Consignment Program** - Department of the Army contract with Exide Corporation. The contract is administered by the Defense Logistics Agency (DLA) at the Defense Supply Center Richmond. The contact is Vince Vincent telephone (800) 345-6333, e-mail:

[vvincent@dscr.dla.mil](mailto:vvincent@dscr.dla.mil)

[www.dscr.dla.mil/vbcp2/](http://www.dscr.dla.mil/vbcp2/)

*Fort Gordon participates in this program, contact Mike Bien at (912) 257-6127.*

### Equipment:

#### E1 - Used Oil Hot Water Heaters (Boilers):

Shenandoah Manufacturing Co., PO Box 839, 1070 Virginia Ave., Harrisonburg, VA 22801 Telephone (800) 476-7436 or (540) 434-3838, Fax (800) 434-3068 or (540) 434-3068

[www.shenmfg.com/wasteoil/boilers.html](http://www.shenmfg.com/wasteoil/boilers.html)

[www.shenmfg.com/wasteoil/boilerinside.htm](http://www.shenmfg.com/wasteoil/boilerinside.htm)

[www.shenmfg.com/wasteoil/L60.htm](http://www.shenmfg.com/wasteoil/L60.htm)

[www.shenmfg.com/wasteoil/burner.htm](http://www.shenmfg.com/wasteoil/burner.htm)

[www.shenmfg.com/wasteoil/L24.htm](http://www.shenmfg.com/wasteoil/L24.htm)

[www.shenmfg.com/wasteoil/BufordTest.htm](http://www.shenmfg.com/wasteoil/BufordTest.htm)

Clean Burn Inc., 83 South Groffdale Road, Leola, PA 17540, telephone (800) 331-0183

[www.cleanburn.com/prodwatr.cfm](http://www.cleanburn.com/prodwatr.cfm)

[www.cleanburn.com/prodwatrSpecs.cfm](http://www.cleanburn.com/prodwatrSpecs.cfm)

[www.cleanburn.com/carwash.cfm](http://www.cleanburn.com/carwash.cfm)

#### E2 - Antifreeze Recycling Equipment:

Ion exchange and vacuum distillation technologies have been recommended by the Army as the process alternatives for recycling engine coolant (P2 Plan, Fort Gordon) <sup>2</sup>.

KFM Industries Inc., 1310 Harrison Bridge Road, Anderson, SC 29621-3410, telephone (800) 736-1404

Cool'r Clear'r System - ION exchange technology, National Stock Number NSN4250-01-380-9034

Extended supply start-up kit NSN6850-01-411-6650

*This system has been purchased by Fort Gordon, contact Mike Bien for details at (912) 257-6127*

Finish Thompson, telephone (814) 455-4478  
BE-15C (15 gal batch) or BE-55C (55 gal Batch) - vacuum distillation technology  
[www.finishthompson.com](http://www.finishthompson.com)

Antifreeze Recycling Users Guide - The guide is available from the U.S. Army Tank - Automotive and Armaments Command, Mobility Tank Center - Belvoir at DSN 654-3720 or commercial (703) 704-3720. The users guide provides product recommendations, operating procedures, and precautions.

### **E3 - Aqueous Enzymes Parts Washers:**

Smart Washer™  
ChemFree Corporation, 8 Mecca Way, Norcross, GA 30093, telephone (770) 564-5580, Fax (770) 564-5533  
[www.chemfree.com/frmain.htm](http://www.chemfree.com/frmain.htm)  
[www.chemfree.com/Products/overview.htm](http://www.chemfree.com/Products/overview.htm)  
[www.chemfree.com/Products/modspecs.htm](http://www.chemfree.com/Products/modspecs.htm)

*Used by Fort Gordon in their vehicle maintenance shops, contact Mike Bien (912) 257-6127.*

ZYMO Parts Washer  
ABS, Incorporated, 3395 Fox Street, Suite 103-C, Duluth, GA 30096, telephone (770) 232-0448, Fax (770) 232-5307, e mail: GRWman@aol.com  
[www.zymo.com/index2top.htm](http://www.zymo.com/index2top.htm)  
[www.zymo.com/machine.htm](http://www.zymo.com/machine.htm)  
[www.zymo.com/contact\\_information.htm](http://www.zymo.com/contact_information.htm)

BIOMATIC™ BIO436  
Graymills, 3705 N. Lincoln Ave., Chicago, IL 60613, telephone (888) 472-9645, Fax (800) 478-8673  
[www.graymills.com/parts/bioremediationintro.html](http://www.graymills.com/parts/bioremediationintro.html)

BIOFLOW 20  
ATEC Trans-Tool, 110 Connelly, San Antonio, TX 78203, telephone (800) 531-5978, Fax (210) 225-2114, e-mail: [sales@atec-trans-tool.com](mailto:sales@atec-trans-tool.com) Internet: [www.atec-trans-tool.com](http://www.atec-trans-tool.com)

### **E4 - Aqueous Jet Washers**

Better Engineering Inc., 8361 Town Center Court, Baltimore, MD 21236, telephone (800) 229-3380  
[www.thomasregister.com/olc/betterengineer/](http://www.thomasregister.com/olc/betterengineer/)  
[www.thomasregister.com/olc/betterengineer/aqueous.htm](http://www.thomasregister.com/olc/betterengineer/aqueous.htm)  
[www.thomasregister.com/olc/betterengineer/tumbling.htm](http://www.thomasregister.com/olc/betterengineer/tumbling.htm)

Mart Corporation, 2450 Adie Road, Maryland Heights, MO 63043, telephone (800) 543-6278 or (314) 567-7222

Mart EQ-1 water treatment systems and jet washers.

[www.martwash.com](http://www.martwash.com)

*The above Better Engineering Jet Washer and the Mart EQ-1 are in use at Moody AFB, contact Nelson Rivera at (912) 257-4979.*

#### **E5 - Steam Cleaners**

Minimax Steam Cleaner

PDQ Precision Inc. P.O. Box 99838, San Diego, CA 92169, telephone (800) 253-3731 or (619) 581-6370, web site: [www.minimaxcleaner.com/products.htm](http://www.minimaxcleaner.com/products.htm)

#### **E6 - Painting Equipment:**

PRO WASH™ GUN WASHER - A closed loop system for cleaning paint spray guns  
GRACO Inc., P.O. Box 1441, Minneapolis, MN 55440-1441, telephone (800) 367-4023 or (612) 623-6743, Fax (612) 623-6580

*NEED PAINT GUN, PAINT BOOTH, PEELABLE COATING INFO. AND CONTACTS*

#### **E7 - Aerosol Can Recycling Systems**

Aerosolv Deluxe Aerosol Can Recycling System model #5000

Manufactured by Katec Incorporated, P.O. Box 3399, Virginia Beach, VA 23454, telephone (800) 843-6808, web site: [www.aerosolv.com/technical.html](http://www.aerosolv.com/technical.html)

*This equipment has been purchased by Fort Gordon, contact Mike Bien (912) 257-6127 for details.*

Herkules AFC-2 Can Crusher & Processor

Herkules Equipment Corporation, 2760 Ridgeway Court, Walled Lake, MI 48390-1662 USA, telephone (800) 444-4351 or (248) 960-7100, web site: [www.thomasregister.com/olc/herkules](http://www.thomasregister.com/olc/herkules)  
[www.advenvironmental.com/herkules.htm](http://www.advenvironmental.com/herkules.htm)

#### **E8 - Used Oil Filter Crushers**

EMERSON EZ CRUSH Model TC-24

Emerson Manufacturing Corporation, 112 Main Street, Emerson, NE 68733, telephone (800) 633-5124  
*Used by Fort Gordon Central Maintenance to reduce the volume of used oil and fuel filters, Contact Mike Bien at (912) 257-6127 for details.*

Automotive Oil Filter Crusher No. 236-76000

NXT, INC., Network Tool Warehouse, telephone (800) 939-8665, web site: [www.ntxtools.com/ls76000.htm](http://www.ntxtools.com/ls76000.htm)

#### OBERG Oil Filter Crushers

NXT, INC., Network Tool Warehouse, telephone (800) 939-8665, web site: [www.ntxtools.com/p-100wm.htm](http://www.ntxtools.com/p-100wm.htm)  
[www.ntxtools.com/p-300.htm](http://www.ntxtools.com/p-300.htm)  
[www.ntxtools.com/environmentalsafety/p-2001.htm](http://www.ntxtools.com/environmentalsafety/p-2001.htm)

#### Automotive and Truck Oil Filter Crushers AFC-100 and HDC-150

John Dow Industries, Inc., 151 Snyder Ave., Barberton, OH 44203, telephone (800) 433-0708, web site: [www.johndow.com/html/about.html](http://www.johndow.com/html/about.html)  
[www.johndow.com/html/products.html](http://www.johndow.com/html/products.html)

#### CRUSH MASTER

##### Ben Pearson Oil Filter Crushers

Automotive Tools, 51270 Milano, Suite C, Macomb, MI 48042, telephone (888) 966-3976, web site: <http://automotivetools.com/expo/expocenter/automotive-lifts/crusher1.shtml>  
<http://automotivetools.com/expo/expocenter/automotive-lifts/crusher2.shtml>  
<http://automotivetools.com/expo/expocenter/automotive-lifts/specs1.shtml>

#### Herkules Oil Filter Crushers

Herkules Equipment Corporation, 2760 Ridgeway Court, Walled Lake, MI 48390-1662 USA, telephone (800) 444-4351 or (248) 960-7100, web site: [www.thomasregister.com/olc/herkules/page21.htm](http://www.thomasregister.com/olc/herkules/page21.htm)

### **E9 - Battery Pulse Charging Systems**

Pulse Tech Products Corporation, 1100 South Kimball Ave., Southlake, TX 76092, telephone (800) 580 7554, web site: [www.pulsetech.net](http://www.pulsetech.net)  
[www.pulsetech.net/products/charging/4b1.html](http://www.pulsetech.net/products/charging/4b1.html)  
[www.pulsetech.net/about/dealerlocations/The\\_Americas/USA/Georgia/georgia.html](http://www.pulsetech.net/about/dealerlocations/The_Americas/USA/Georgia/georgia.html)

*This system is used by Fort Gordon's Central vehicle maintenance, contact Mike Bien at (706) 791-6127 for additional information.*

IES Innovative Energy Systems, 9351-J Philadelphia Road, P.O. Box 70060, Baltimore, MD 21237-3120, telephone: (410) 686-3120, web site: [www.innovativeenergy.com/contact.htm](http://www.innovativeenergy.com/contact.htm)  
[www.innovativeenergy.com/desulf.htm](http://www.innovativeenergy.com/desulf.htm)

Battery Management Equipment available through the Defense Supply Center Richmond  
[www.dscr.dla.mil/vbcp2/battery\\_management\\_equipment.htm](http://www.dscr.dla.mil/vbcp2/battery_management_equipment.htm)