

Ohio's First Ethanol-Fueled Light-Duty Fleet: Final Study Results



Prepared by:

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for the

**U.S. Department of Energy's
National Renewable Energy Laboratory**

and the

State of Ohio Department of Administrative Services

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Acronyms and Abbreviations

AFDC	Alternative Fuels Data Center
ASTM	American Society for Testing and Materials
ATL	Automotive Testing Laboratories, Inc.
Btu	British thermal unit
CFR	<i>Code of Federal Regulations</i>
CH ₃ CHO	Chemical formula for acetaldehyde
CH ₃ OH	Chemical formula for methanol
C ₂ H ₅ OH	Chemical formula for ethanol
CO	Chemical formula for carbon monoxide
CO ₂	Chemical formula for carbon dioxide
DAG	Ohio Department of Agriculture
DOE	U.S. Department of Energy
E85	Blend of 85% transportation-grade ethanol and 15 % gasoline
EPA	U.S. Environmental Protection Agency
FFV	Flexible-fuel vehicle
FTP	Federal Test Procedure
gal	Gallon
GC	Gasoline control
GSLN	Gasoline
HC	Hydrocarbon
HCHO	Chemical formula for formaldehyde
lb	Pound
LHV	Lower heating value
LV	Liquid volume
mpeg	Miles per equivalent gallon
mpg	Miles per gallon
N/A	Not applicable
NMHC(E)	Non-methane hydrocarbon (equivalent)
NO _x	Oxides of nitrogen
NREL	National Renewable Energy Laboratory
ODOT	Ohio Department of Transportation
ppm	Parts per million
PUCO	Public Utilities Commission of Ohio
RFG	Reformulated gasoline (California Phase 2 certification gasoline)
rvp	Reid vapor pressure
THC(E)	Total hydrocarbon (equivalent)
VIN	Vehicle identification number

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Thanks to Jeff Westhoven, deputy director of Energy Services for the Ohio Department of Administrative Services, and to Peg Whalen of the National Renewable Energy Laboratory for their direction and support of this project. Thanks to Wendy Clark and Walt Dudek of Automotive Testing Laboratories, Inc., for supporting and coordinating emissions testing for the project. Thanks also to Fairman Thompson and Mike Wagner of the Ohio Corn Growers Association for help with monitoring the fuel supply and also for coordinating the construction of fuel facilities for this project.

Without the support and cooperation of personnel from each participating state agency listed below, this project would not have been possible.

Participating Personnel	State Agency
Leilani Napier	Department of Administrative Services
Russ Perry	Department of Administrative Services
Mark List	Department of Agriculture
Gina Moraine	Office of Industrial Commission
Joe Shuster	Public Utilities Commission
Aaron Eakin	Department of Liquor Control
John York	Department of Commerce
John Daniels	Department of Transportation
Barbara Frye	Department of Transportation
Don Baker	Department of Agriculture

Introduction

In 1996, the State of Ohio established a project to demonstrate the use of an ethanol blend (E85, which is 85 percent transportation-grade ethanol and 15 percent gasoline) as a transportation fuel in flexible-fuel vehicles (FFV). The term "flexible-fuel" refers to the technology that enables the vehicles to use all gasoline, all E85 fuel, or any combination of the two fuels (up to 85% ethanol). This study included ten FFVs and three gasoline vehicles operated by five state agencies. The standard gasoline vehicles were used as controls for a baseline comparison. The project included 24 months of data collection on vehicle operations. This report presents the data collection and analysis from this study, with a focus on the last year.

The vehicles included in this study were delivered to state agencies during the spring and summer of 1996. For this study, data were collected on vehicle performance, cost of operation, and limited emissions testing. Comments from fleet managers were also recorded.

Emissions testing was performed at the Automotive Testing Laboratories (ATL) in East Liberty, Ohio, during May and June of 1997. Emissions testing was performed on two ethanol FFVs and two standard gasoline vehicles.

This document presents an analysis of all data from the project (data generated from April 1996 through March 1998). The data analysis tables included in Appendices A, B, and C show the overall fleet statistics, fuel usage and fuel economy, and maintenance records, along with all available cost data. Appendix D provides the results of emissions testing, and Appendix E shows the fuel analysis results for the ethanol fuel. Appendix F comprises additional information, including letters from Ford on a recall and on the use of a special engine oil. Appendix G presents equations and sample calculations for the data analysis shown in this report. Finally, Appendix H is the survey form used to obtain comments from fleet managers during this study.

Project Participants

This project has required the cooperation and support of the groups listed below. Also noted are the role and the responsibilities of each.

State of Ohio, Department of Administrative Services and Participating State Agencies. The State of Ohio is hosting this project. Each participating state agency purchased the vehicles. The state and the participating state agencies were responsible for operating the vehicles and administering this project.

Council of Great Lakes Governors. The Council gave the State of Ohio a grant to be used toward purchase of vehicles and fuel, as well as to promote the use of ethanol for the first year of the project.

Public Utilities Commission of Ohio Biomass Energy Program. The Biomass Energy Program gave the State of Ohio a grant to be used toward purchase of vehicles and fuel and also to promote the use of ethanol for the second year of the project.

Ohio Corn Growers Association. The Ohio Corn Growers Association provided ethanol refueling equipment and coordinated fuel delivery for the project.

U.S. Department of Energy (through the National Renewable Energy Laboratory [DOE/NREL]). DOE/NREL provided funding for data collection, analysis, and reporting. DOE/NREL also provides the mechanism for national exposure of the demonstration project, and contributes valuable experience in projects of this type, allowing for meaningful comparisons of results.

Battelle. Battelle, under contract to DOE/NREL and the State of Ohio, served as the project manager. Battelle collected, analyzed, and reported data; coordinated emissions testing at Automotive Testing Laboratory; coordinated fuel analysis at Core Labs (to help to ensure fuel quality); supported the state with public relations events; and provided technical support to the state and the participating state agencies.

All project participants agreed to share all data and information generated from this project.

As Table 1 shows, five state agencies who purchased Ford Taurus FFVs agreed to participate in this study. Table 2 identifies all state agencies that purchased and are operating 1996, 1997, and 1998 ethanol Ford Taurus FFVs.

Table 1. State Agencies Participating in the Study

Agency	Number of Vehicles	
	FFV	Gasoline
Department of Administrative Services	1	0
Public Utilities Commission	4	0
Department of Agriculture	5	0
Office of Industrial Commission	0	1
Department of Commerce/Liquor Control	0	2
Total	10	3

Table 2. State Agencies Purchasing Model Year 1996, 1997, and 1998 Ethanol FFVs

Agency	Number of Vehicles		
	Model Year 1996	Model Year 1997	Model Year 1998
Alcohol & Drug Addiction Services	0	1	0
Attorney General	14	12	22
Auditor of State	3	0	0
Department of Agriculture	5	32	10
Bureau of Worker's Compensation	0	4	43
Department of Commerce	0	52	64
State Board of Cosmetology	3	2	2
Department of Administrative Services	3	30	21
Department of Development	0	5	2
Department of Public Safety	3	41	47
Department of Mental Health	3	6	3
Department of Mental Retardation	1	2	1
Department of Natural Resources	0	12	14
Department of Taxation	0	0	10
Department of Transportation	0	15	33
Department of Rehabilitation & Correction	1	10	15
Department of Youth Services	0	15	9
Environmental Protection Agency	0	12	18
Employment Relations Board	1	2	3
Ohio Ethics Commission	0	1	0
Department of Liquor Control	2	6	0
Ohio Lottery Commission	0	0	5
Ohio Consumers Counsel	0	1	0
Ohio Industrial Commission	2	10	1
Public Utilities Commission	4	9	10
Racing Commission	0	2	0
Total	45	282	335

Project Objectives

The State of Ohio initiated this project to demonstrate the effectiveness of ethanol as a fuel for an FFV. The state established six key objectives at the beginning of the program:

- Establish and operate a fleet of ethanol-fueled vehicles in the State of Ohio fleet.
- Use ethanol fuel while operating the fleet.
- Collect and compare operations, maintenance, and cost data for selected ethanol and gasoline vehicles.
- Evaluate the selected ethanol-fueled vehicles and the selected gasoline-fueled vehicles following 24 months of operation.
- Promote the use of ethanol (DOE and NREL already encourage the use of various alternative fuels, including ethanol).
- Report project findings.

Transportation-Grade Ethanol

Ethanol is an alcohol derived from biomass (corn, sugar cane, grasses, trees, and agricultural waste). The intent of this study was to maximize the use of E85 fuel during the data collection period. Ethanol blends used in this study were E85, E70, and E65, which consist of 80%, 65%, and 60% ethanol by volume, respectively. The remaining volume of each of these fuels is usually gasoline, which is designated as a denaturant. Transportation-grade ethanol is a combination of 95% ethanol by volume and 5% denaturant, usually gasoline. Transportation-grade ethanol is denatured to prevent human consumption and to avoid the taxes associated with consumable ethanol.

The environmental benefits of using ethanol as an alternative fuel arise from its oxygen content. The oxygen in the ethanol makes it a potentially cleaner burning fuel than gasoline. In addition, the relatively simple chemical composition of ethanol is beneficial because the fuel contains no toxic compounds or sulfur. Because it is made from agricultural crops, ethanol is designated a "renewable" fuel. One bushel of corn produces approximately 2.5 gallons of ethanol and a few other usable by-products. In addition, producing ethanol from renewable crops does not result in additional carbon dioxide (CO₂, which contributes to the "greenhouse effect"), being released into the atmosphere. Table 3 shows several properties of ethanol.

Refueling

Ethanol for this project was available at two refueling stations—the Department of Agriculture facility in Reynoldsburg, Ohio, and at the central garage for the Ohio Department of Transportation (ODOT) on West Broad Street. The Department of Agriculture ethanol refueling station was in operation before this project began. ODOT originally planned to open its refueling facility during the summer of 1996.

Table 3. Properties of Transportation-Grade Ethanol

Property	Comment
Vapor density	Ethanol vapor, like gasoline vapor, is denser than air and tends to settle in low areas; however, ethanol vapor disperses rapidly.
Solubility in water	Fuel ethanol will mix with water, but at high enough concentrations of water, the ethanol will separate from the gasoline.
Energy content	For identical volumes, ethanol contains less energy than gasoline. On an energy basis, 1.0 gallon of E85 is equivalent to approximately 0.72 gallon of gasoline.
Flame visibility	A fuel ethanol flame is dimmer than a gasoline flame but is easily visible in daylight.
Specific gravity	Pure ethanol and ethanol blends are heavier than gasoline.
Conductivity	Ethanol and ethanol blends conduct electricity. Gasoline, by contrast, is an electrical insulator.
Stoichiometric fuel-to-air ratio	E85 needs more fuel per pound of air than gasoline; therefore, E85 cannot be used in a conventional vehicle.
Toxicity	Ethanol is less toxic than gasoline or methanol. Carcinogenic compounds are not present in pure ethanol; however, because gasoline is used in the blend, E85 is considered to be potentially carcinogenic.
Flammability	At low temperature (32°F), E85 vapor is more flammable than gasoline vapor. However, at normal temperatures, E85 vapor is less flammable than gasoline, because of the higher autoignition temperature of E85.

Source: *Guidebook for Handling, Storing, & Dispensing Fuel Ethanol*, U.S. Department of Energy, Argonne National Laboratory

However, permitting issues, such as determining the appropriate contact person and identifying the necessary paperwork, delayed the opening several times. The ODOT station has been operating since early March 1997, and a public relations event was held during Earth Week (April 17, 1997) to dedicate the station. The Department of Administrative Services distributed press releases and produced a video of the event. Figure 1 shows photos from the station opening event, and the Department of Agriculture ethanol station is shown in Figure 2.

The gasoline vehicles were fueled at any gasoline station in the area of operations. The ethanol vehicles were fueled at the two E85 stations being used in the study (ODOT and Department of Agriculture) or were fueled with standard gasoline as required. The five E85 vehicles at the Department of Agriculture used the department's E85 station as their primary point of fueling. The E85 vehicle at the Department of Administrative Services was fueled at the Department of Agriculture as the primary point of fueling until the ODOT E85 station was opened, then that station became the primary point of fueling. The four E85 vehicles at the Public Utilities Commission of Ohio (PUCO) were fueled with gasoline prior to the opening of the ODOT E85 station. The PUCO vehicles were held out of service as much as possible during this period.



Figure 1. ODOT E85 station opening event (April 17, 1997)

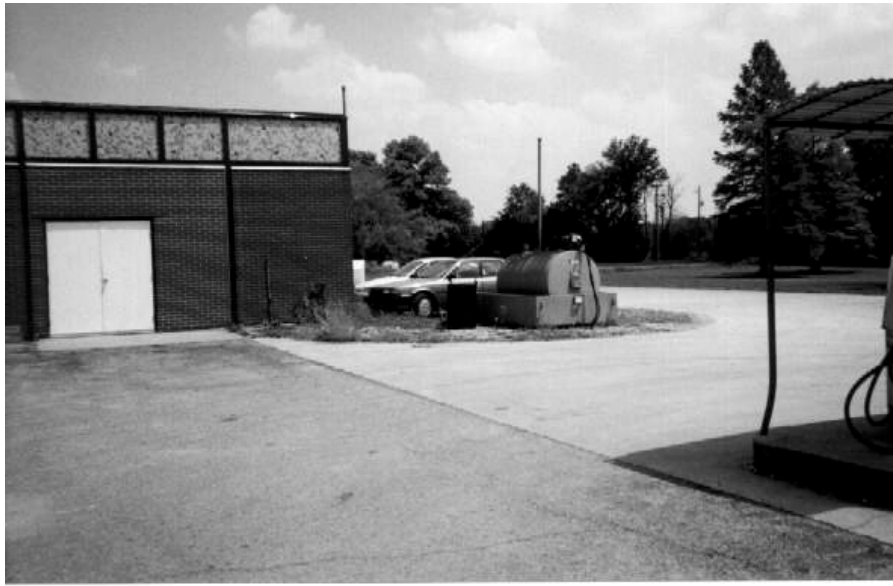


Figure 2. Ethanol station at the Department of Agriculture

After the ODOT E85 station was opened, it became the primary point of fueling for the PUCO vehicles. There were two other ethanol refueling stations planned in conjunction with this project: in Wooster, Ohio and in Cincinnati, Ohio. The Wooster site has been completed and is operational. The Cincinnati site was planned to be a public refueling station near the University of Cincinnati; however, this site has not been completed. These refueling sites were not used by the vehicles included in the data collection and evaluation for this project. Figure 3 shows a map of Ohio with the locations of the participating state agencies and E85 refueling sites marked.

Facility Descriptions and Capital Costs

No maintenance facilities changes were required for the ethanol vehicles. As described above, ethanol refueling for this project took place at two stations: the Department of Agriculture in Reynoldsburg, Ohio, which is an eastern suburb of Columbus; and the ODOT central garage, which is located in western Columbus. The Department of Agriculture ethanol refueling station is a temporary 500-gallon tank and was in operation before this project began. The ODOT facility was originally planned to open during the summer of 1996, but opening was delayed until March 1997. The cost of the new ODOT ethanol station was approximately \$28,000 for a 2,000-gallon tank, barrier, refueling nozzle and hose, and installation. The cost of the 1996 model year Taurus for the state was approximately \$13,200, with a \$1,000 premium for the ethanol FFV option.

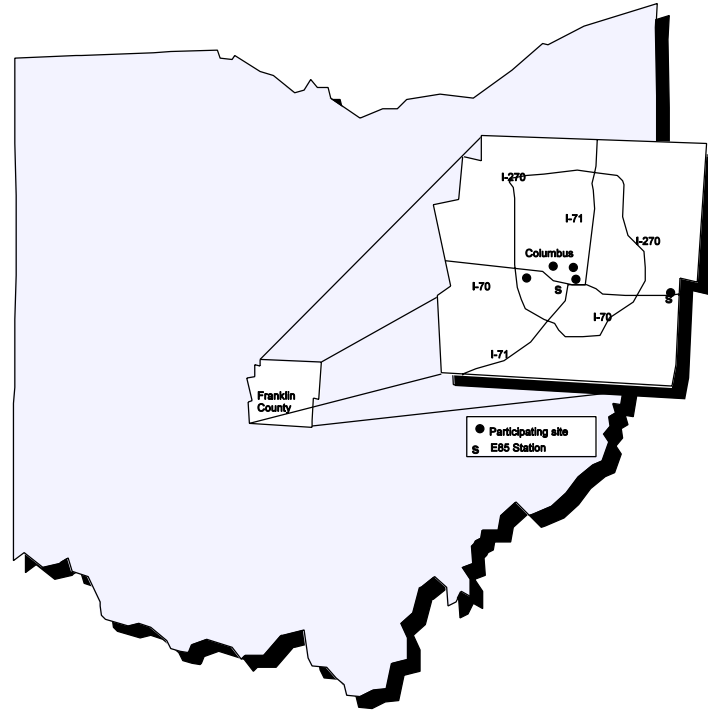


Figure 3. Location of participating state agencies in the Columbus, Ohio, area

Data Collection and Evaluation

This study included four categories of data:

- Vehicle descriptions—vehicle systems (specifications) and expected vehicle usage
- Vehicle operations—fuel consumption, engine oil consumption, maintenance (scheduled, unscheduled, and warranty) for each vehicle, a description of any safety incidents, and survey results from fleet managers in the study
- Emissions testing—performed by ATL in East Liberty, Ohio
- Fuel analysis—performed by Core Laboratories in Carson, California.

The data collection depended completely on the cooperation and participation of each state agency involved in the study. The data were collected from existing data collection systems used by each state agency, which includes paper and electronic databases. Each state agency submitted fuel logs, fuel receipts, and maintenance receipts for each study vehicle on a monthly basis. The data is processed for quality control and for analysis purposes. During data analysis, all data inconsistencies have been checked for data entry error.

Each of the four categories of data is discussed below. Data evaluation equations and sample calculations used in this report are shown in Appendix G.

Vehicle Descriptions

Table 4 describes the program vehicles. A number of design changes were necessary to ensure that the FFVs would perform well on ethanol fuel blends. Some of the changes included adding alcohol-resistant materials to the fuel system and an alcohol fuel-sensor linked to a control module calibrated to compensate for varying fuel blends (Coward, et al. 1995). In addition, the E85 vehicles have a slightly larger fuel tank to offset the energy density difference between ethanol and gasoline. In other words, it takes slightly more volume of E85 fuel to drive the same distance as the gasoline-only vehicles.

Table 5 lists the license plate number and vehicle identification number (VIN) for the vehicles in this study, as well as the typical service in which the vehicles were used. The Department of Administrative Services E85 vehicle was used as a pool car and for promotional events, used mostly in the Columbus area. A pool car is assigned to multiple users over time as individuals require a passenger vehicle. The Department of Agriculture has five E85 vehicles that were assigned to individuals at the department, used mostly in the Columbus area. The Public Utilities Commission used four E85 vehicles for pool car operations in the Columbus area. The gasoline control vehicle at the Industrial Commission was used as a pool car in the Columbus area. The Department of Commerce had two gasoline control vehicles used by assignment to Liquor Control agents in the Columbus and New Lexington areas.

Table 4. Vehicle Descriptions for E85 and Gasoline Fleets

Specifications	E85 Fleet	Gasoline Fleet
Number of Vehicles	10	3
Make	Ford	Ford
Model	Taurus	Taurus
Model Year	1996	1996
Engine Displacement (L)	3	3
Engine Maximum Horsepower	140	140
Engine Configuration	V-6	V-6
Compression Ratio	9.0:1	9.0:1
Fuel Tank Capacity (gal)	18.4	16
Air Conditioning (Y/N)	Yes	Yes
Axle Ratio	3.77:1	3.77:1

Table 5. License Numbers, VINs, Fuel Types, and Functions for the Study Vehicles

License Plate Number	State Agency	VIN	Fuel	Function
32-311	Department of Administrative Services	1FALP5222TG309376	FFV/E85	Car pool operations; promotional events
14-164	Department of Agriculture	1FALP5221TG234671	FFV/E85	Individual use in the Columbus area
14-178	Department of Agriculture	1FALP522GTG244278	FFV/E85	
14-220	Department of Agriculture	1FALP5226TG237145	FFV/E85	
14-221	Department of Agriculture	1FALP5228TG237146	FFV/E85	
14-222	Department of Agriculture	1FALP522XTG237147	FFV/E85	
54-125	Public Utilities Commission	1FALP5226TG195916	FFV/E85	Car pool operations
54-181	Public Utilities Commission	1FALP5228TG195917	FFV/E85	
54-218	Public Utilities Commission	1FALP5221TG195919	FFV/E85	
54-219	Public Utilities Commission	1FALP522XTG195918	FFV/E85	
92-107	Industrial Commission	1FALP52U9TG225007	Gasoline	Car pool operations
24-151	Department of Commerce/Liquor Control	1FALP52U7TG225006	Gasoline	Liquor Control agent use in Columbus and New Lexington
24-202	Department of Commerce/Liquor Control	1FALP52U5TG225005	Gasoline	

Vehicle Operations

The following discussion addresses vehicle usage, fuel usage and fuel economy, fuel usage costs, maintenance costs, warranty repairs, and total operating costs. The discussion is based on the analytical tables shown in Appendices A, B, and C. The analysis for operations and costs are divided into the total analysis of all data collected and the last year of data collection (April 1997 through March 1998). Discussing the data in two parts (from the project's inception and from the last year) enables analysis of trends and also removes any start-up issues for operating costs for the last year period. Also, it enabled highlighting the period after the opening of the ODOT refueling station in March 1997 (because the use of ethanol fuel increased significantly).

Vehicle Usage

Vehicle usage is calculated on a monthly per-vehicle basis. The vehicle usage during the study period (per month) was 7% higher for the gasoline control (GC) vehicles (GC: 1,199 miles/month; E85: 1,121 miles/month) than for the E85 vehicles. During the last year, the vehicle usage was actually 3% higher for the ethanol vehicles (GC: 1,151 miles/month; E85: 1,181 miles/month). These numbers indicate that the vehicle usage was about the same for the two types of vehicles. The average monthly mileage-per-vehicle numbers for each fleet are equivalent to about 14,000 miles per year for each vehicle type. No problems, such as significant downtime or reduced operation of the ethanol fleet, affected vehicle usage.

Fuel Usage and Fuel Economy

Table 6 summarizes the fuel usage and economy for the study vehicles for the total study period and for the last year. The E85 usage for the FFV fleet averaged 63% by volume for the total data set; E85 usage was an average of 72% by volume of E85 for the last year of data (April 1997 through March 1998). The E85 fuel usage increased significantly after the new fueling station opened at the ODOT facility.

The five vehicles used by the Department of Agriculture (14-164, 14-178, 14-220, 14-221, and 14-222) used an average of 82% ethanol fuel for the total data collection period and 80% ethanol fuel for the last year. The vehicle used by the Department of Administrative Services (32-311) used 57% ethanol fuel for the total data collection period and 62% ethanol fuel for the last year. The four vehicles used by PUCO (54-125, 54-181, 54-218, and 54-219) used only 33% ethanol fuel for the total data collection period, but this increased significantly to 61% ethanol fuel use for the last year.

The volumetric fuel economy of the FFVs was consistently lower than that of the gasoline vehicles. This is the actual in-use fuel economy that vehicle operators would see, and is expected considering the difference in energy content between E85 and gasoline. Although the "real" fuel economy is lower, the range of the FFVs was very similar to the gasoline-only version. The manufacturer installed larger fuel tanks in the FFVs to keep the vehicle range comparable.

When evaluated on an equivalent-energy basis, the fuel economy of the ethanol fleet was consistently higher than that of the gasoline control vehicles (12% higher for the total data collection period and 10% higher for the last year, all on an energy-equivalent basis). One of the gasoline control vehicles (24-202) had a consistently lower fuel economy than the other two gasoline vehicles and all the ethanol vehicles. This vehicle was reported to have a slightly different duty cycle, specifically longer idle time and more city driving. Vehicle 24-202 had a fuel economy of 22.3 mpg. Averaged together, the other two gasoline control vehicles had a fuel economy of 26.6 mpg, which is only slightly lower (3%) than that of the ethanol vehicles (on an energy-equivalent basis). Based on the results from the emissions testing (covered in the Emissions Testing Results section), the fuel economies of the FFVs were 3% to 4% higher on an energy-equivalent basis when using E85 compared to using gasoline only. Also based on the emissions testing, the average energy-equivalent fuel economy for the E85 vehicles was 2% higher than that of the gasoline-only vehicles.

Other than the lower fuel economy for Vehicle 24-202, the fuel economies are consistent with the controlled emissions testing results. On an energy-equivalent basis, the ethanol vehicles have a slightly higher fuel economy than the gasoline-only vehicles.

Table 6. Fuel Economy and Fuel Usage Results

		All Data			Last Year		
Vehicle	End Odometer (3/31/98)	Actual Volumetric (mpg)*	Miles/Energy Equivalent Gallon (MPEG)	Percent E85 Usage by Volume	Actual Volumetric (mpg)*	Miles/Energy Equivalent Gallon (MPEG)	Percent E85 Usage by Volume
Flexible-Fuel Vehicles							
32-311	30,190	22.8	26.7	56.7	22.3	26.4	61.8
14-164	23,648	21.2	27.7	85.7	21.2	27.2	81.6
14-178	19,808	21.3	27.0	75.8	21.6	27.4	76.7
14-220	26,699	20.5	25.6	73.9	20.7	25.4	68.9
14-221	37,315	22.7	29.1	80.2	22.3	29.0	84.5
14-222	25,126	20.5	27.6	93.5	21.2	28.1	89.7
54-125	23,030	25.5	27.8	33.8	24.5	28.9	62.6
54-181	20,444	26.2	28.8	38.1	23.2	28.3	75.3
54-218	21,788	25.4	27.2	28.1	24.2	27.5	50.9
54-219	21,358	25.3	27.4	33.5	24.2	27.8	56.0
Average	24,941	23.1	27.5	63.4	22.5	27.5	72.3
Gasoline-Only Vehicles							
92-107	24,800	27.8	N/A	N/A	27.8	N/A	N/A
24-151	38,400	25.3	N/A	N/A	25.3	N/A	N/A
24-202	24,086	21.6	N/A	N/A	22.3	N/A	N/A
Average	29,095	24.6	N/A	N/A	24.9	N/A	N/A

*Fuel economy based on total miles driven divided by total gallons of fuel

Energy equivalence for ethanol fuel was calculated based on documented net energy content (lower heating value) of ethanol fuels and gasoline (shown in Table 7). Fuel sample analysis was also performed to verify the energy equivalence calculations for the data collection. For energy equivalence calculations, several grades of ethanol fuel were used: E65, E70, and E85. The E65 and E70 fuel grades were used to account for one fuel load to ODOT and one fuel load to the Department of Agriculture, both of which had lower than intended ethanol content. The fuel analysis results and definitions of the ethanol fuel grades are discussed later in the Ethanol Fuel Analysis Results section. Sample energy-equivalent fuel economy calculations are shown in Appendix G.

Table 7. Lower Heating Values and Energy Equivalence for Fuels Used

Fuel	Lower Heating Value (Btu/gal)	Test Fuel/Baseline Gasoline	Baseline Gasoline/Test Fuel
Gasoline	115400	1	1
Ethanol (100%)	75591	0.655	1.527
E85	83553	0.724	1.381
E70	89524	0.776	1.289
E65	91515	0.793	1.261

Source: AFDC data for the lower heating value of gasoline and 100% ethanol; E85, E70, and E65 lower heating values were calculated from the gasoline and 100% ethanol numbers.

Fuel Usage Costs

Fuel usage costs represent the fuel cost per volume with the fuel economy taken into account. In other words, the cost of the actual fuel used per mile is the fuel usage cost. The average gasoline cost per gallon (same grade gasoline) fluctuated significantly during the data collection period—from \$1.03 to \$1.33. The gasoline cost was under \$1.10 per gallon for the last 4 months of the data collection. The average gasoline cost per gallon was \$1.23 for the total data collection period and \$1.18 for the last year. These gasoline costs were taken from the fleet’s actual fuel-purchase receipts from commercial stations in the Columbus area.

The E85 fuel price was \$1.88 per gallon at the Department of Agriculture station. The E85 fuel price at the ODOT station averaged \$1.30 per gallon. The lower E85 fuel price at ODOT was due to the larger size of the fuel tank (the more fuel, the lower the transportation cost per gallon) and because the fuel for this tank was provided through a cooperative that purchased a large quantity of fuel for distribution in the Ohio Valley area. It appears that selection of the small station may not have been the best approach from a cost standpoint. It became clear that the price of bulk fuel purchases (and fuel storage capacity) can have a significant effect on fuel usage cost, and should be looked at closely when considering on-site fueling.

The fuel usage costs for the ethanol vehicles are based on the gasoline and E85 fuel usage because both fuels were used in these vehicles. The average monthly fuel costs per volume for the E85 fleet has fluctuated between \$1.20 and \$1.63. Figure 4 shows the monthly average fuel prices per gallon for each vehicle type. For the E85 vehicles, the average fuel cost per gallon (all fuel) was \$1.50 for the total data collection period and \$1.52 for the last year.

Fuel usage costs for the two study vehicle types have been calculated on a per-1,000-mile basis for comparison purposes. For the total data collection period, the fuel usage costs per 1,000 miles was \$50.09 for the gasoline fleet and \$65.54 for the E85 fleet. The higher fuel usage cost per 1,000 miles for the E85 fleet is consistent with the fuel cost, usage, and fuel economy. For the last year, the fuel usage costs per 1,000 miles was \$47.48 for the gasoline fleet and \$68.16 for the E85 fleet. For the last year, the fuel usage cost difference between the gasoline and E85 vehicles is higher than for the total data collection period because ethanol fuel was used more, and also cost more.

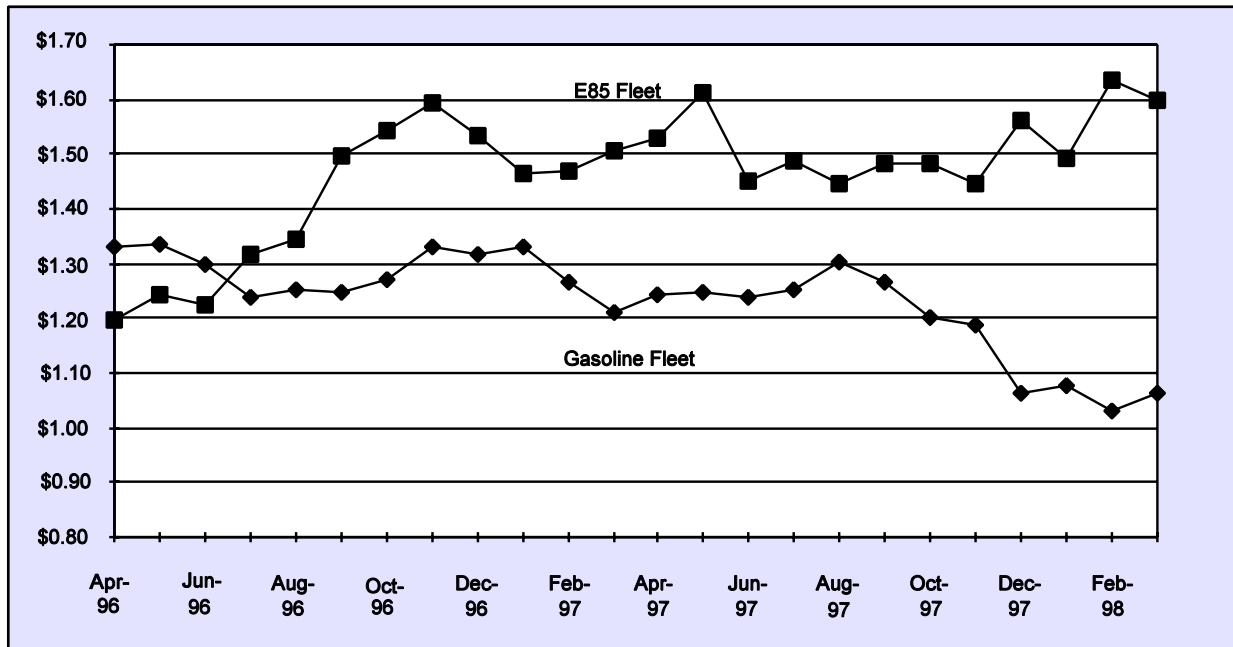


Figure 4. Average monthly fuel price per gallon

Maintenance Costs

State vehicles are generally maintained or repaired by local auto repair facilities or the local Ford dealer, depending on the nature of the servicing required. The vehicles operated by the Department of Agriculture were maintained in the department's own shop, with the exception of warranty repairs (if any). All warranty repairs were done at the local Ford dealership.

Maintenance costs shown in this report include actual parts costs, actual labor costs, and other costs. The other costs represent recycling costs, disposal costs of parts and engine oil, and maintenance costs that could not be separated into parts and labor. For the analysis shown in this report, the body system and wheels and tires maintenance costs have been removed from the maintenance cost totals. The costs for the body system and wheels and tires are shown separately as part of Table 8. The body system maintenance items include accidents causing body damage (Vehicle 54-219: \$1,654.77; 32-311: \$454.85; 32-311: \$96.86; 24-151: \$940.15), car washes, windshield wiper replacements, and windshield wiper fluid additions. The wheels and tires maintenance costs include tire rotations, wheel balancing, and tire repairs.

As shown in Tables 9 and 10, the maintenance costs for the gasoline control vehicles was lower (14%) for all data on a per-1,000-mile basis. The higher cost for the ethanol vehicles was due to the higher engine oil cost (a special low ash oil) for oil changes. The ethanol vehicles used standard engine oil for the last 6 to 12 months of data collection (with Ford's permission). This has reduced the maintenance costs for the ethanol vehicles significantly. For the last 12 months, the maintenance costs for the gasoline control vehicles was 12% higher.

Table 8. Breakdown of Body, Tire, Wheel, and All Other Maintenance Costs

Maintenance Costs in \$ per 1,000 Miles	Total—All Data		Last Year	
	GC	E85	GC	E85
Body	11.89	9.64	1.53	12.56
Tires and Wheels	1.66	0.2	2.12	0.34
All Other	7.69	8.81	9.64	8.47
Total	21.24	18.65	13.29	21.37

**Table 9. Breakdown of Scheduled and Unscheduled Maintenance Costs
for the All Other Maintenance Costs**

Maintenance Costs in \$ per 1,000 Miles	Total—All Data		Last Year	
	GC	E85	GC	E85
Scheduled	7.42	8.36	9.07	7.71
Unscheduled	0.27	0.45	0.57	0.76
Total	7.69	8.81	9.64	8.47

**Table 10. Breakdown of Parts, Labor, and Other Maintenance Costs
for the All Other Maintenance Costs**

Maintenance Costs in \$ per 1,000 Miles	Total—All Data		Last Year	
	GC	E85	GC	E85
Parts	3.38	3.89	3.84	3.32
Labor	3.09	3.16	3.37	3.47
Other	1.22	1.76	2.42	1.68
Total	7.69	8.81	9.64	8.47

The higher maintenance costs for the gasoline control vehicles resulted in part from the vehicles having been in service a little longer (3 to 4 months or about 5,000 miles per vehicle more on the odometer as shown in Table 6) as compared to the ethanol vehicles (April 1996 versus July 1996). Only four of the ethanol vehicles (out of 10) were in service in April 1996, and those four vehicles were held to low mileage for the first few months of the study. The 3 or 4 more months of operation on the gasoline control vehicles caused a few preventive maintenance actions to be performed that were not performed on the ethanol vehicles such as a brake adjustment and cleaning, a coolant flush and refill, and an air filter change. The maintenance costs on all of the vehicles were so low (except for the body system

maintenance costs, which are not being included here) that these extra maintenance actions made a significant impact on a per-mile basis. The unscheduled maintenance costs for both vehicle types were low.

The major issue for the higher maintenance costs for the gasoline control vehicles is the low maintenance costs for the three PUCO FFVs. The PUCO FFVs saw minimal maintenance compared to the other vehicles in the study. The maintenance was stretched as close to 5,000 miles between oil changes as possible (the maximum allowed by Ford), and the PUCO FFVs never used the low-ash engine oil. When the PUCO FFV maintenance costs are removed, the other six FFVs have a maintenance cost of \$10.28 per 1,000 miles for the last year, compared to the \$9.64 for the gasoline control vehicles. Also, when the PUCO FFV maintenance costs are removed, the other six FFVs have a maintenance cost of \$11.44 per 1,000 miles for all data, compared to the \$7.69 per 1,000 miles for the gasoline control vehicles. These maintenance cost comparisons are more in line with the expected results from the study. The ethanol vehicles have a slightly higher maintenance cost (7%) resulting mostly from the special, more costly engine oil.

Vehicle 14-222 (an FFV) needed maintenance that may have been fuel-related. The vehicle had a low power problem that was traced to a spark plug coil problem. The spark plugs were replaced at the state agency's cost and the coil pack was replaced under warranty. No more problems were reported with the vehicle.

Unscheduled Maintenance and Warranty

During the data collection, there were seven incidences of unscheduled maintenance for the gasoline control vehicles: broken window, windshield seal (warranty), transmission shifter cable (warranty), two tire repairs, service engine light with no trouble found (warranty), and brake clean and adjust. Of these seven repairs, three were covered under warranty. The ethanol vehicles experienced 12 unscheduled repairs: two for accident/body damage, two for engine oil addition, three for a seal in the wiring of the fuel system (warranty/recall), driver seat, power steering fluid spill, tie rod replacement (warranty), spark plug and fuel filter replacement, and spark plug and coil pack replacement (warranty for the coil). Of these 12 unscheduled repairs, five were warranty repairs.

Total Operating Costs

As shown in Table 11, the total cost on a per-1,000-mile basis (excluding the body system and wheel and tire maintenance costs for both types of vehicles) was higher for the ethanol vehicle operation for all data and for the last year. The difference in operating costs was due almost entirely to the higher fuel cost for E85.

Table 11. Total Operating Costs

Operating Costs in \$ per 1,000 Miles	Total—All Data		Last Year	
	GC	E85	GC	E85
Fuel Usage	50.09	65.54	47.48	68.16
Maintenance	7.69	8.81	9.64	8.47
Total	57.78	74.35	57.12	76.63

Survey of E85 Fleet Managers

A survey was prepared and distributed to state fleet managers who operate E85 vehicles. The actual survey form used is shown in Appendix H. The intent of the survey was to get general feedback from the fleet managers on how the Ford Taurus FFVs were operating in comparison to other similar vehicles in their fleets. Twenty-five surveys were distributed and 13 were returned. Here are the general results from the returned surveys:

- All responding fleet managers felt that there were few or no problems with the vehicles.
- The FFVs were about the same in comparison of operations with gasoline vehicles.
- The range of the FFVs was acceptable.
- Availability of E85 fuel was the major concern with the FFVs.
- Oil changes were expensive because of the special engine oil (a requirement later discontinued by Ford).

Emissions Testing Results

During May and June of 1997, ATL conducted emissions testing on the study vehicles, and then provided the results shown here. The Federal Test Procedure (FTP) was performed twice for each test vehicle on each test fuel. The FTP was performed following EPA certification procedures and tolerances. Alcohol speciation was performed during any tests with an alcohol-containing fuel. Figure 5 shows the vehicle test procedure used, and Table 12 shows the number of FTP tests performed and fuels used by vehicle.

The gasoline baseline fuel selected for this program was California Phase 2 Certification gasoline (designated RFG). This is a clean-burning gasoline selected to provide the “best” modern gasoline for comparison of the FFVs to conventional gasoline vehicles. All the FFV and gasoline vehicles in the test program received duplicate tests with the RFG fuel. The E85 fuel consisted of 85% ethanol blended with the base RFG fuel. Table 13 shows the properties of the liquid test fuels. The RFG and E85 fuels for this program were supplied directly to ATL by the Phillips Petroleum Company through a contract with NREL.

Ethanol Calculations

The EPA regulates methanol-fueled vehicle exhaust (and evaporative) hydrocarbons (HC) as total hydrocarbon equivalent (THCE). The *Code of Federal Regulations* (CFR) defines THCE as including HCs as well as the equivalent HC portion of formaldehyde and methanol (40 CFR 86-99):

$$\text{THCE} = \text{HC} + \frac{13.8756}{32.042} \text{CH}_3\text{OH} + \frac{13.8756}{30.0262} \text{HCHO}$$

The Tier 1 EPA HC certification standards for methanol vehicles are written in terms of the non-methane portion or non-methane hydrocarbon equivalent (NMHCE).

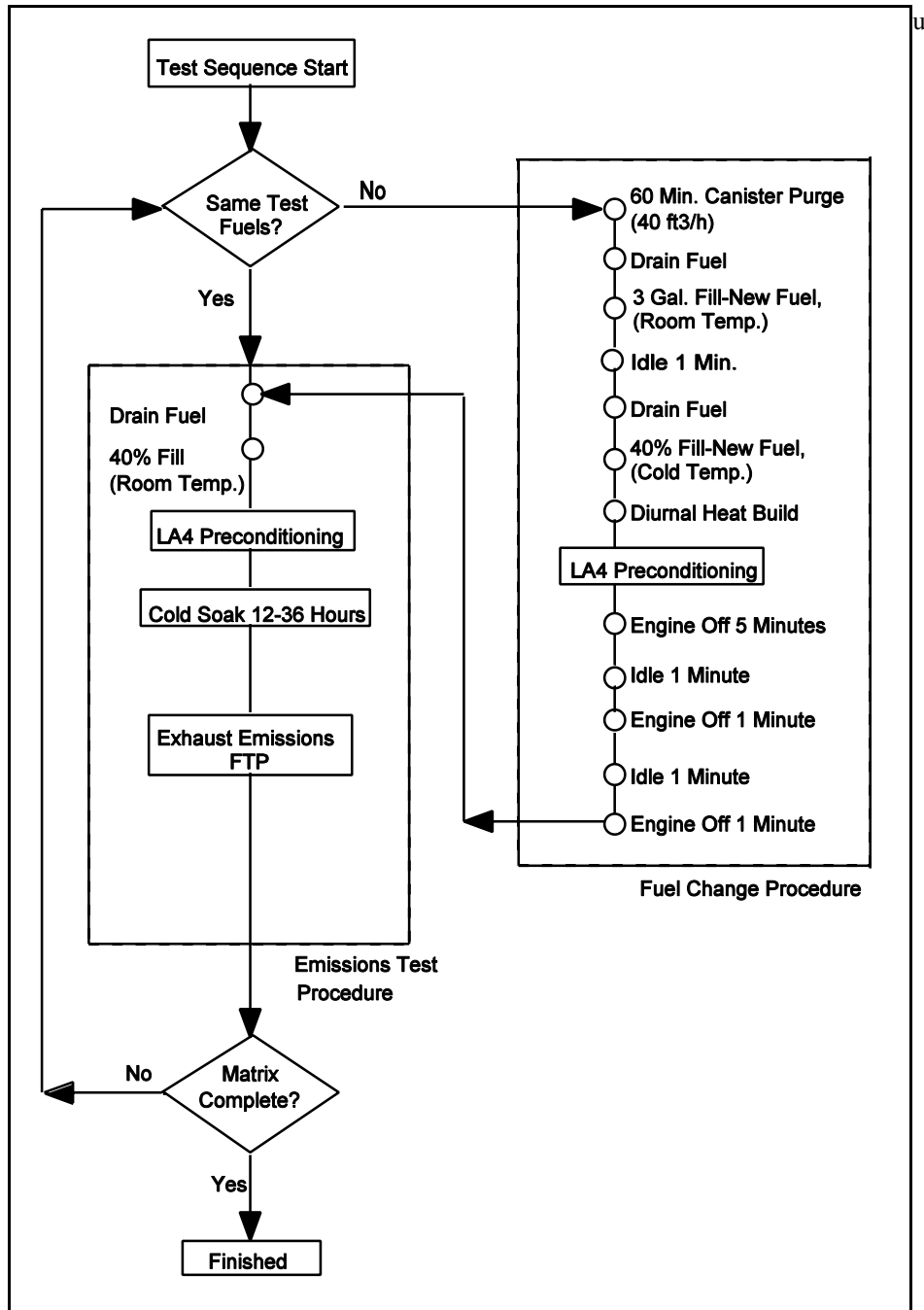


Figure 5. Test Procedure

Table 12. Number of FTP Emissions Tests

Vehicle	Test Vehicle Number	Odometer	License Plate Number	Number of FTP Tests	
				RFG	E85
FFV Taurus	1	13700	32-311	2	2
FFV Taurus	2	14200	14-222	2	2
Std. Gasoline Taurus	3	14700	24-202	2	N/A
Std. Gasoline Taurus	4	15200	92-107	2	N/A

Table 13. Liquid Test Fuel Properties

Test Fuel Analysis	RFG	E85
Fuel Blend	100% RFG	85% Ethanol 15% RFG
Specific Gravity	0.739	0.781
Carbon (wt %)	84.1	57.3
Hydrogen (wt %)	13.8	13.3
Oxygen (wt %)	2.1	29.3
Estimated Net Heat of Combustion (Btu/gal)	111780	82600
Reid Vapor Pressure (psi)	6.9	7.5

The calculations employed for ethanol tests are not defined by the CFR. ATL, through an agreement with NREL and other contract laboratories, modified the methanol calculations for use with ethanol:

$$THCE = HC + \frac{27.752}{46.07} C_2H_5OH + \frac{27.751}{44.05} CH_3CHO$$

These changes consisted of substitutions of ethanol molecular weights for methanol weights and the use of acetaldehyde rather than formaldehyde results. Acetaldehyde is the major product of the incomplete combustion of ethanol (as formaldehyde is for methanol).

Discussion

Table 14 shows the average results from the vehicles tested in this program. Although the emissions testing was limited in this project, the results followed trends seen in more extensive test programs (Kelly, et al. 1996), in terms of the relative emissions levels of the FFV and standard gasoline models. Similar work performed by ATL for NREL with earlier models of the FFV Ford Taurus supports the data from this program. Results by vehicle and test are shown in Appendix D.

The differences between the FFV and standard gasoline emissions results are a by-product of calibration compromises between E85 and RFG operation in the FFV. As control technology improves, it is reasonable to believe that the differences between E85 and RFG operation will decrease. Regardless of test fuel or vehicle type, all of the emissions results from this program were well below the applicable useful life standards.

The FFV and gasoline vehicles did not show major differences in emissions test results. Interestingly, FFV NO_x emissions results were lower than the corresponding standard gasoline NO_x results. In the past, FFV and standard gasoline Taurus have generally produced very similar NO_x emissions levels (Kelly, et al. 1996).

Table 14. FFV and Standard Gasoline Vehicles—Average Emissions Results

Type	FFV		Std. Gas
Fuel	E85	RFG	RFG
Regulated Emissions			
NMHC(E) (g/mi)	0.149	0.101	0.114
THC(E) (g/mi)	0.189	0.117	0.132
CO (g/mi)	1.33	1.01	1.39
NO _x (g/mi)	0.09	0.08	0.22
Greenhouse Gases			
CO ₂ (g/mi)	389.8	412.1	407.6
Methane (g/mi)	0.046	0.021	0.023
Aldehydes			
Formaldehyde (g/mi)	0.00226	0.00099	0.00127
Acetaldehyde (g/mi)	0.01302	0.0003	0.00035
Fuel Economy			
MPG (actual)	15.81	21.08	21.32
MPEG	21.4		

As expected, acetaldehyde (and to a lesser extent, formaldehyde) emissions were elevated when E85 fuel was used. This is an expected result because acetaldehyde is a product of the incomplete combustion of ethanol. However, as the amount of ethanol in the fuel increases, the benzene and 1,3-butadiene (both potent toxics) emissions levels will decrease. This decrease can be explained by the dilution of 1,3-butadiene and benzene in the exhaust by the presence of unburned ethanol and its combustion products rather than gasoline combustion products. Others have shown that the total toxics and the ozone-forming potential of ethanol hydrocarbons tend to be significantly lower than for gasoline hydrocarbons (Kelly, et al. 1996). Because hydrocarbon speciation was not performed as part of this program, 1,3-butadiene and benzene emissions could not be reported.

Ethanol Fuel Analysis Results

Transportation-grade ethanol fuel is specified in standard protocol "ASTM D 5798 Standard Specification for Fuel Ethanol (E_d75-E_d85) for Automotive Spark-Ignition Engines." For transportation-grade ethanol, the notation E75 up to E85 represents that the fuel contains up to 70% and 80%, respectively, by volume ethanol including up to 0.5% methanol. The remaining 20% to 30% of fuel essentially consists of gasoline (including denaturant). Transportation-grade ethanol is transported as 95% ethanol by volume and 5% denaturant (minimum 2% required), usually gasoline (or hydrocarbons). Transportation-grade ethanol is denatured to prevent consumption and to avoid the taxes associated with consumable ethanol. The designation E85 or E75 should be interpreted as mixtures of 85% and 75% by volume of transportation-grade ethanol, which is already made up of 5% gasoline. Transportation-grade ethanol fuel specifications, material compatibility, fuel quality, fuel transport and delivery, fuel handling, and safety are described in the *Guidebook for Handling, Storing, & Dispensing Fuel Ethanol*, which is available from DOE's AFDC at www.afdc.doe.gov.

As part of this study, limited ethanol fuel sample analysis was performed for both ethanol fueling sites. All analysis was performed by Core Laboratories of Carson, California. The ethanol fuel sample analysis was included in the project to determine the ethanol content, heating value, and water content of the fuels being dispensed at the Department of Agriculture and ODOT fueling facilities. Ethanol fuel sample analysis results to date are shown in Table 15. Detailed fuel analysis results from Core Laboratories are shown in Appendix E.

The first two samples taken (one from each site) showed that the ethanol content was much lower than expected (64% and 67%). However, based on discussions with the fuel suppliers, this appeared to be a one-time event. All other fuel samples since the first two have been close to the E85 specification. This fuel composition information was used to validate conversion factors used for calculations to assess in-use vehicle fuel economy.

Summary

Results from this project show that the ethanol FFVs are operating well and meeting the requirements of the operators. The ethanol vehicles are operating at a usage level similar to the gasoline control vehicles. Although actual fuel economy (volumetric) is slightly lower for the E85 vehicles, the larger fuel tanks result in the same range as that of the gasoline vehicles. On an energy-equivalent basis, the fuel economy is slightly higher for the ethanol fleet for in-use data and from the results of the emissions testing. The fuel usage cost for the ethanol fleet is significantly more expensive than the gasoline fleet, as expected, because ethanol fuel costs more than gasoline.

The in-use data show that the maintenance costs are slightly lower for the ethanol fleet. However, one site with FFVs had extremely low maintenance costs because the engine oil change interval was extended to the maximum allowed by Ford and because the special low-ash engine oil requirement was lifted. With the four FFVs from the one site removed from the maintenance cost calculations, the ethanol fleet (six vehicles) had a 7% higher maintenance cost than that of the gasoline control vehicles. This difference in maintenance cost is consistent with the higher engine oil costs, and the maintenance costs are expected to be reduced because use of the higher cost engine oil was discontinued.

The emissions testing showed that the ethanol FFVs have very low exhaust levels for this type of vehicle. The survey of fleet managers at the state who operate ethanol FFVs showed that the vehicles had very few problems or complaints. Despite the fleet's planning and installation of refueling sites, the only major issue reported by vehicle users was availability of the E85 fuel.

The State of Ohio plans to continue to use and add more FFVs to its fleet, and also to work on expanding the E85 fueling infrastructure within the state.

Table 15. Ethanol Fuel Sample Analysis Results

Test	Method	ODOT 1	ODOT 2	ODOT 3	DAG* 1	DAG 2	DAG 3	DAG 4	DAG 5
Date Sample Taken		9/17/97	9/19/97	5/5/97	6/4/97	7/1/97	7/30/97	9/24/97	1/27/98
Methanol (LV%)	ASTM D-4815	<0.01	<0.01	<0.10	<0.01	0.21	0.22	0.18	<0.10
Ethanol (LV %)	ASTM D-4815	63.99	83.66	86.19	66.53	77.6	76.86	77.86	83.67
Specific Gravity (60/60)	ASTM D-1298	0.7788	0.784	0.7806	0.7826	0.7826	0.782	0.7835	0.7794
Heating Value, Gross (Btu/lb)	ASTM D-240	14798	14063	14479	14798	14466	14489	14305	15522
Water, Karl Fischer (ppm)	ASTM D-1744	4250	6277	5031	4724	6008	6242	6154	5194

* DAG = Ohio Department of Agriculture

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Appendix A

State of Ohio E85 Fleet Summary Statistics

State of Ohio E85 Fleet Summary Statistics

10/18/00

Fleet Operations and Economics	Total (all data)		Last 12 Months	
	Gasoline Control	E85	Gasoline Control	E85
Number of Vehicles	3	10	3	10
Period Used for Fuel and Oil Op Anaysis	4/96 - 3/98	4/96 - 3/98	4/97 - 3/98	4/97 - 3/98
Total Number of Months in Period	24	24	12	12
Fuel and Oil Analysis Base Fleet Mileage (2)	80,010	243,157	41,419	140,467
Period Used for Maintenance Op Analysis	4/96 - 3/98	4/96 - 3/98	4/97 - 3/98	4/97 - 3/98
Total Number of Months in Period	24	24	12	12
Maintenance Analysis Base Fleet Mileage (2)	86,345	244,376	41,419	141,686
Average Mileage per Car per Month	1,199	1,121	1,151	1,181
Fleet Fuel Usage in Gasoline Equiv. Gal.	3,253	8,842	1,662	5,101
Representative Fleet MPG (volumetric)	24.6	23.1	24.9	22.5
Representative Fleet MPEG (energy equiv)	24.6	27.5	24.9	27.5
Ratio of MPG (AF/GC)		1.12		1.10
Average Fuel Cost as Reported	1.23	1.50	1.18	1.52
Total Fuel Cost \$	4,007.69	15,936.66	1,966.52	9,574.92
Fuel Usage Cost \$ per 1,000 Miles	50.09	65.54(1)	47.48	68.16(1)
Number of Make-up Oil Quarts per 1,000 Mi.	0.00	0.00	0.00	0.00
Oil Cost per 1,000 Miles	0.00	0.00	0.00	0.00
Total Scheduled Repair Cost per 1,000 Miles	7.42	8.36	9.07	7.71
Total Unscheduled Repair cost per 1,000 Miles	0.27	0.45	0.57	0.76
Total Maintenance Cost per 1,000 Miles (3)	7.69	8.81	9.64	8.47
Total Operating Cost per 1,000 Miles	57.78	74.35	57.12	76.63
Total Operating Cost per Mile	0.058	0.074	0.057	0.077

Maintenance Costs

	Gasoline Control	E85	Gasoline Control	E85
Fleet Mileage	86,345	244,376	41,419	141,686
Total Parts Cost per 1,000 Miles	3.38	3.89	3.84	3.32
Total Labor Cost per 1,000 Miles	3.09	3.16	3.37	3.47
Total Other Cost per 1,000 Miles	1.22	1.76	2.42	1.68
Total Maintenance Cost per 1,000 Miles (3)	7.69	8.81	9.64	8.47

State of Ohio E85 Fleet Summary Statistics

10/18/00

Body System (01.00.00)

Total Parts Cost per 1,000 Miles	10.70	0.51	0.30	0.56
Total Labor Cost per 1,000 Miles	0.33	1.73	0.00	0.00
Total Other Cost per 1,000 Miles	0.86	7.40	1.23	12.00
Total Maintenance Cost per 1,000 Miles	11.89	9.64	1.53	12.56

Wheels and Tires (04.04.00)

Total Parts Cost per 1,000 Miles	0.14	0.04	0.29	0.07
Total Labor Cost per 1,000 Miles	1.52	0.16	1.83	0.27
Total Other Cost per 1,000 Miles	0.00	0.00	0.00	0.00
Total Maintenance Cost per 1,000 Miles	1.66	0.20	2.12	0.34

Notes

1. The fuel cost for the E85 vehicles is based on a rate of 61% for usage by volume. The other 39% by volume was gasoline. For the last 12 months, the E85 fuel cost was based on a rate of 67% for usage by volume and the other 33% was gasoline.
2. The mileage reported for fueling and maintenance for the gasoline and E85 vehicles is different because fueling data were missing for 92-107 and 14-178.
3. Maintenance costs for the body system and wheels and tires have been removed from all analysis. The actual costs for the body system are shown above but are excluded from the totals for maintenance. Body system maintenance items include accident/repair for body damage, car wash, and windshield wiper and fluid.

Appendix B

State of Ohio E85 Detailed Fuel Data

State of Ohio E85 Fuel Data
April, 1996 through March, 1998

Group Total		Gasoline Control																				All Data Last 12 Months					
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage		3,141	3,321	2,333	4,563	3,606	2,194	3,478	2,720	2,149	2,824	4,973	3,289	2,390	3,741	2,564	4,205	3,498	4,243	4,531	3,116	4,048	2,807	1,979	4,297	80,010	41,419
Fuel (GSLN)		133.9	141.9	102.2	183.8	138.4	91.4	145.2	116.2	93.7	129.2	188.3	126.4	96.5	137.5	101.3	168.1	141.4	157.5	196.9	125.8	161.3	120.5	77.6	177.8	3252.5	1662.1
MPG		23.47	23.41	22.83	24.83	26.05	24.02	23.95	23.42	22.93	21.86	26.41	26.02	24.76	27.21	25.31	25.02	24.75	26.94	23.01	24.77	25.09	23.30	25.50	24.17	24.60	24.92
Total Fuel Cost		178.36	189.29	132.90	227.48	173.35	114.05	184.55	154.35	123.25	171.72	238.59	153.28	119.90	171.33	125.51	210.37	183.91	199.58	236.85	149.25	171.25	129.66	80.01	188.90	4007.69	1966.52
Avg Cost/Gal		1.33	1.33	1.30	1.24	1.25	1.25	1.27	1.33	1.32	1.33	1.27	1.21	1.24	1.25	1.24	1.25	1.30	1.27	1.20	1.19	1.06	1.08	1.03	1.06	1.23	1.18

Data for 92-107 has been removed for 6/96, 8/96, 9/96, 11/96, 1/97 because of missing information

Group Total		E85																				All Data Last 12 Months					
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage	0	1,205	444	3,437	7,780	13,625	13,867	11,305	12,065	8,359	11,582	8,632	10,389	12,703	10,827	8,158	14,535	13,589	11,890	12,641	9,253	11,076	10,889	11,611	13,295	243,157	140,467
Fuel (E85)	0.0	0.0	0.0	0.0	191.9	311.2	297.5	235.0	265.5	182.0	211.3	186.6	303.4	490.8	453.6	232.7	439.3	334.4	371.5	378.3	235.8	379.6	349.1	467.9	420.9	6,738.1	4,553.8
Fuel (GSLN)	0.0	44.8	17.6	135.2	142.6	230.2	297.3	242.5	255.4	164.0	302.8	189.1	134.0	86.0	65.1	144.4	184.8	253.3	153.7	169.6	168.4	119.9	192.6	47.2	158.0	3,898.4	1,742.9
Fuel (GSLN E85)	0.0	44.8	17.6	135.2	281.5	455.5	512.7	412.6	447.6	295.8	455.8	324.1	358.1	455.4	404.0	326.4	516.4	504.6	422.7	443.5	339.0	394.8	445.4	386.0	462.7	8,842.2	5,100.8
MPG		26.90	25.23	25.42	27.63	29.91	27.05	27.40	26.95	28.26	25.41	26.63	29.01	27.89	26.80	24.99	28.15	26.93	28.13	28.50	27.29	28.06	24.45	30.08	28.73	27.50	27.54
Total Fuel Cost	0.00	53.54	21.87	165.28	440.28	727.54	890.08	737.30	829.64	530.93	754.13	552.52	658.63	882.06	836.97	546.33	929.80	850.32	778.65	812.01	584.26	780.37	807.77	842.09	924.29	#####	9574.92
Avg Cost/Gal		1.20	1.24	1.22	1.32	1.34	1.50	1.54	1.59	1.53	1.47	1.47	1.51	1.53	1.61	1.45	1.49	1.45	1.48	1.48	1.45	1.56	1.49	1.63	1.60	1.50	1.52
% E85 by Vol	0.00	0.00	0.00	0.00	57.37	57.48	50.01	49.22	50.97	52.60	41.10	49.67	69.36	85.09	87.45	61.71	70.39	56.90	70.74	69.05	58.34	76.00	64.44	90.84	72.71	63.35	72.32

11/97-14-178 Removed, data missing

24-151	Gasoline Control																				All Data Last 12 Months						
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage	0	1,334	1,355	1,301	2,339	1,868	1,628	1,674	1,614	1,342	1,827	2,007	1,688	1,371	1,339	1,710	1,924	1,638	966	1,643	1,250	1,551	1,197	1,325	2,287	38,178	18,201
Fuel (GSLN)	0.0	54.0	54.8	52.1	90.0	73.4	65.7	64.6	64.5	53.2	75.0	78.8	63.1	54.5	50.2	67.4	75.3	63.7	38.7	65.1	49.0	66.9	48.2	52.2	88.1	1508.3	719.3
MPG	0.00	24.73	24.75	24.97	25.99	25.45	24.80	25.91	25.04	25.23	24.36	25.47	26.75	25.14	26.67	25.37	25.55	25.71	24.96	25.24	25.51	23.18	24.83	25.38	25.96	25.31	25.30
Total Fuel Cost	0.00	71.35	72.95	65.30	111.10	87.20	80.45	79.65	82.60	67.50	94.71	96.13	74.70	64.60	61.00	81.35	89.74	79.75	47.43	74.21	57.85	70.05	50.45	53.45	89.15	1802.67	819.03
Avg Cost/Gal	0.00	1.32	1.33	1.25	1.23	1.19	1.23	1.23	1.28	1.27	1.26	1.22	1.18	1.18	1.22	1.21	1.19	1.25	1.23	1.14	1.18	1.05	1.05	1.02	1.01	1.20	1.14
End Odometer	222	1,556	2,911	4,212	6,551	8,419	10,047	11,721	13,335	14,677	16,504	18,511	20,199	21,570	22,909	24,619	26,543	28,181	29,147	30,790	32,040	33,591	34,788	36,113	38,400	38,400	

24-202		Gasoline Control																				All Data Last 12 Months					
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage	0	699	963	1,032	1,081	1,738	566	1,073	1,106	807	997	1,118	575	1,019	1,235	504	1,173	1,207	1,528	1,561	1,154	935	1,049		774	23,894	12,139
Fuel (GSLN)	0.0	37.9	51.7	50.1	52.1	65.0	25.7	54.0	51.7	40.5	54.2	53.7	26.1	42.0	54.5	22.4	53.2	53.5	67.2	67.5	52.6	40.4	51.7	0.0	39.8	1107.4	544.7
MPG	0.00	18.44	18.63	20.60	20.75	26.74	22.02	19.87	21.39	19.93	18.39	20.82	22.03	24.26	22.65	22.50	22.06	22.58	22.74	23.13	21.94	23.14	20.29		19.47	21.58	22.29
Total Fuel Cost	0.00	51.00	70.50	67.60	67.70	86.15	33.60	72.00	71.75	55.75	77.01	71.51	33.50	55.30	69.88	30.18	71.00	72.01	86.60	85.00	64.50	44.50	57.56	0.00	47.50	1442.10	684.03
Avg Cost/Gal	0.00	1.35	1.36	1.35	1.30	1.33	1.31	1.33	1.39	1.38	1.42	1.33	1.28	1.32	1.28	1.35	1.34	1.35	1.29	1.26	1.23	1.10	1.11		1.19	1.30	1.26
End Odometer	192	891	1,854	2,886	3,967	5,705	6,271	7,344	8,450	9,257	10,254	11,372	11,947	12,966	14,201	14,705	15,878	17,085	18,613	20,174	21,328	22,263	23,312		24,086	24,086	24,086

92-107		Gasoline Control																				All Data Last 12 Months					
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage	0	1,108	1,003	1,959	1,143	354	1,606	731	1,426		990	1,848	1,026		1,167	350	1,108	653	1,749	1,327	712	1,562	561	654	1,236	16,771	11,079
Fuel (GSLN)	0.0	42.0	35.4	39.4	41.7	8.9	40.2	26.6	28.7	0.0	23.6	55.8	37.2	0.0	32.8	11.5	39.6	24.2	51.6	64.3	24.2	54.0	20.6	25.4	49.9	604.0	398.1
MPG	0.00	26.38	28.33	49.72	27.41	39.95	40.00	27.48	49.69	0.00	41.95	33.12	27.58	0.00	35.62	30.43	27.98	26.98	33.90	20.64	29.45	28.92	27.25	25.75	24.75	27.77	27.83
Total Fuel Cost	0.00	56.01	45.84	49.22	48.68	11.43	50.26	32.90	39.56	0.00	29.61	70.95	45.08	0.00	40.45	13.98	49.63	32.15	65.55	77.64	26.90	56.70	21.65	26.56	52.25	722.47	463.46
Avg Cost/Gal	0.00	1.33	1.29	1.25	1.17	1.29	1.25	1.24	1.38	0.00	1.25	1.27	1.21	0.00	1.23	1.22	1.25	1.33	1.27	1.21	1.11	1.05	1.05	1.05	1.05	1.20	1.16
End Odometer		1,635	2,638	4,597	5,740	6,094	7,700	8,431	9,857		10,847	12,695	13,721		14,888	15,238	16,346	16,999	18,748	20,075	20,787	22,349	22,910	23,564	24,800	24,800	24,800

Data for 92-107 has been removed for 6/96, 8/96, 9/96, 11/96, 1/97 because of missing information

14-164			E85		All Data Last 12 Months																							
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total	
Mileage				0	735	702	1,023	1,312	1,196	1,011	740	912	975	760	1,143	892	1,112	1,336	1,353	1,516	1,361	615	724	828	1,748	21,994	13,388	
Fuel (E85)				0.0	38.0	36.0	47.1	61.8	45.5	41.2	31.4	30.0	44.0	38.5	54.0	29.0	38.6	52.1	40.6	45.0	45.5	30.8	24.1	38.5	78.3	890.0	515.0	
Fuel (GSLN)				0.0	0.0	0.0	0.0	0.0	11.2	0.0	8.2	13.2	0.0	0.0	0.0	13.5	10.0	25.4	15.5	18.6	15.0	0.0	13.3	0.0	5.0	148.9	116.3	
Fuel (GSLN EQ)				0.0	27.5	26.1	34.1	44.7	44.1	29.8	30.9	34.9	31.9	28.6	39.1	36.0	37.9	63.1	44.9	51.2	47.9	22.3	30.7	27.9	61.7	795.5	491.4	
MPG				0.00	26.72	26.93	30.00	29.32	27.09	33.89	23.92	26.12	30.61	26.55	29.24	24.78	29.30	21.17	30.14	29.62	28.39	27.58	23.55	29.70	28.34	27.65	27.24	
Total Fuel Cost				0.00	53.58	50.76	89.97	118.05	103.16	78.61	64.64	68.20	76.56	62.22	99.42	68.02	83.57	126.62	94.63	104.55	103.65	57.91	58.66	72.38	152.20	1787.36	1083.83	
Avg Cost/Gal				0.00	1.41	1.41	1.91	1.91	1.82	1.91	1.63	1.58	1.74	1.62	1.84	1.60	1.72	1.63	1.69	1.64	1.71	1.88	1.57	1.88	1.83	1.72	1.72	
% E85 by Vol				0.00	100.00	100.00	100.00	100.00	80.25	100.00	79.29	69.44	100.00	100.00	100.00	68.24	79.42	67.23	72.37	70.75	75.21	100.00	64.44	100.00	94.00	85.67	81.58	
End Odometer				1,654	2,389	3,091	4,114	5,426	6,622	7,633	8,373	9,285	10,260	11,020	12,163	13,055	14,167	15,503	16,856	18,372	19,733	20,348	21,072	21,900	23,648	23,648		

14-178 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage				0	251	466	240	805	1,171	596	600	251	921	1,003	1,128	650	252	1,040	924	996	1,219	1,627	1,948	1,307	2,136	18,312	13,011
Fuel (E85)				0.0	11.0	29.7	14.1	13.5	29.2	15.0	32.9	16.0	28.0	27.5	29.0	0.0	11.8	28.0	29.0	29.0	24.2	78.7	82.3	60.8	85.0	650.5	461.1
Fuel (GSLN)				0.0	0.0	0.0	0.0	14.8	22.8	14.7	0.0	0.0	15.0	13.7	29.9	27.4	0.0	22.7	13.4	12.1	0.0	0.0	8.3	0.0	13.0	207.8	140.5
Fuel (GSLN EQ)				0.0	8.0	21.5	10.2	24.6	43.9	25.6	23.8	11.6	35.3	33.6	50.9	27.4	8.5	43.0	34.4	33.1	17.5	57.0	67.9	44.0	74.5	678.8	474.3
MPG				0.00	31.52	21.67	23.51	32.76	26.65	23.32	25.19	21.67	26.11	29.84	22.16	23.72	29.50	24.20	26.86	30.09	69.57	28.55	28.70	29.69	28.66	26.98	27.43
Total Fuel Cost				0.00	15.61	45.44	26.93	44.42	85.17	46.80	57.19	27.84	67.01	65.47	87.40	27.26	22.19	81.91	70.02	69.52	45.42	147.93	163.03	114.30	172.96	1438.40	1021.99
Avg Cost/Gal				0.00	1.42	1.53	1.91	1.57	1.64	1.58	1.74	1.74	1.56	1.59	1.48	0.99	1.88	1.62	1.65	1.69	1.88	1.88	1.80	1.88	1.76	1.68	1.70
% E85 by Vol				0.00	100.00	100.00	100.00	47.70	56.15	50.51	100.00	100.00	65.12	66.75	49.24	0.00	100.00	55.23	68.40	70.56	100.00	90.84	100.00	86.73	75.79	76.65	
End Odometer				277	528	994	1,234	2,039	3,210	3,806	4,406	4,657	5,578	6,581	7,709	8,359	8,611	9,651	10,575	11,571	12,790	14,417	16,365	17,672	19,808	19,808	

11/97 Removed, data missing

14-220 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage				0	1,463	1,887	1,267	1,181	580	584	693	731	1,024	1,553	1,214	1,061	2,258	1,631	1,469	1,325	750	976	895	1,418	1,450	25,410	16,000
Fuel (E85)				0.0	76.6	91.4	56.6	42.5	24.3	0.0	36.0	28.0	29.5	51.9	53.5	44.0	61.0	35.0	38.5	24.5	23.5	36.0	48.5	62.9	53.5	917.7	532.8
Fuel (GSLN)				0.0	0.0	4.2	4.1	15.3	9.7	20.9	0.0	13.0	16.2	23.5	8.2	4.2	45.6	38.2	24.5	37.6	13.1	9.6	4.6	15.4	16.5	324.4	241.0
Fuel (GSLN EQ)				0.0	55.5	70.4	45.1	46.1	27.3	20.9	26.1	33.3	37.6	61.1	46.9	38.3	89.8	63.5	52.4	55.3	30.1	35.7	39.7	60.9	55.2	991.1	629.0
MPG				0.00	26.38	26.81	28.11	25.63	21.25	27.94	26.59	21.97	27.26	25.43	25.87	27.68	25.15	25.67	28.05	23.94	24.91	27.37	22.54	23.27	26.25	25.64	25.44
Total Fuel Cost				0.00	108.00	133.87	104.62	94.18	59.41	26.50	62.64	64.72	70.33	123.64	110.58	87.72	166.18	111.30	102.38	85.56	58.68	77.68	96.18	134.44	117.58	1996.19	1271.92
Avg Cost/Gal				0.00	1.41	1.40	1.72	1.63	1.75	1.27	1.74	1.58	1.54	1.64	1.79	1.82	1.56	1.52	1.63	1.38	1.60	1.70	1.81	1.72	1.68	1.61	1.64
% E85 by Vol				0.00	100.00	95.61	93.25	73.53	71.47	0.00	100.00	68.29	64.55	68.83	86.71	91.29	57.22	47.81	61.11	39.45	64.21	78.95	91.34	80.33	76.43	73.88	68.86
End Odometer				1,289	2,752	4,639	5,906	7,087	7,667	8,251	8,944	9,675	10,699	12,252	13,466	14,527	16,785	18,416	19,885	21,210	21,960	22,936	23,831	25,249	26,699	26,699	

14-221 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage				0	1,415	1,720	1,644	1,663	2,273	1,295	1,658	2,133	1,824	2,031	1,888	1,776	1,626	2,052	1,795	1,419	1,457	1,717	1,653	1,792	1,980	36,811	21,186
Fuel (E85)				0.0	43.3	76.5	77.0	61.6	80.0	7.0	42.5	51.1	61.2	95.0	93.8	44.0	63.2	52.7	52.1	55.6	51.5	72.5	40.0	85.5	95.9	1302.0	801.8
Fuel (GSLN)				0.0	8.8	0.0	0.0	13.5	20.5	46.0	31.0	37.9	17.5	0.0	0.0	32.0	0.0	37.5	12.0	9.5	13.0	9.0	33.7	0.0	0.0	321.9	146.7
Fuel (GSLN EQ)				0.0	40.1	55.4	55.7	58.1	78.4	51.1	61.8	74.9	61.8	68.8	67.9	66.1	45.8	75.7	49.7	49.8	50.3	61.5	62.7	61.9	69.4	1266.8	729.5
MPG				0.00	35.24	31.05	29.49	28.62	28.98	25.36	26.84	28.48	29.51	29.53	27.80	26.85	35.54	27.12	36.13	28.52	28.97	27.92	26.38	28.95	28.52	29.06	29.04
Total Fuel Cost				0.00	68.54	107.89	123.32	128.97	170.10	52.41	108.80	126.81	124.99	169.92	176.35	114.64	118.82	136.59	112.23	114.01	109.82	145.26	108.85	160.74	180.29	2659.35	1647.52
Avg Cost/Gal				0.00	1.32	1.41	1.60	1.72	1.69	0.99	1.48	1.42	1.59	1.79	1.88	1.51	1.88	1.51	1.75	1.75	1.70	1.78	1.48	1.88	1.88	1.64	1.74
% E85 by Vol				0.00	83.11	100.00	100.00	82.02	79.60	13.21	57.82	57.42	77.76	100.00	100.00	57.89	100.00	58.43	81.26	85.41	79.84	88.96	54.27	100.00	100.00	80.18	84.53
End Odometer				504	1,919	3,639	5,283	6,946	9,219	10,514	12,172	14,305	16,129	18,160	20,048	21,824	23,450	25,502	27,297	28,716	30,173	31,890	33,543	35,335	37,315	37,315	

14-222		E85		All Data Last 12 Months																							
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage				0	440	754	761	863	1,493	1,927	791	993	1,336	1,454	1,445	535	1,907	1,301	519	1,934	1,434	1,088	1,145	1,403	913	24,436	15,078
Fuel (E85)				0.0	23.0	43.0	42.0	40.5	74.5	94.5	43.0	49.5	65.5	74.2	71.1	28.5	68.4	33.8	36.1	75.0	29.0	49.5	59.6	68.1	44.0	1112.7	637.3
Fuel (GSLN)					0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	5.0	12.5	32.9	0.0	0.0	0.0	5.0	77.4	73.4
Fuel (GSLN EQ)				0.0	16.7	31.1	30.4	33.3	53.9	68.4	31.1	35.8	47.4	53.7	51.5	22.1	49.5	42.5	31.1	66.8	53.9	35.8	43.2	49.3	36.9	884.5	536.3
MPG				0.00	26.42	24.22	25.03	25.90	27.68	28.16	25.41	27.73	28.17	27.07	28.07	24.20	38.51	30.63	16.69	28.95	26.61	30.36	26.53	28.46	24.77	27.63	28.12
Total Fuel Cost				0.00	32.43	60.63	72.46	82.35	142.31	180.48	74.82	86.03	113.97	129.07	131.71	53.58	128.60	81.54	72.76	153.50	90.27	93.06	112.04	128.03	87.72	2107.36	1261.88
Avg Cost/Gal				0.00	1.41	1.41	1.73	1.85	1.91	1.91	1.74	1.74	1.74	1.74	1.85	1.88	1.88	1.57	1.77	1.75	1.46	1.88	1.88	1.88	1.79	1.77	1.78
% E85 by Vol				0.00	100.00	100.00	100.00	91.01	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	65.25	87.82	85.71	46.85	100.00	100.00	100.00	89.80	93.50	89.67
End Odometer				690	1,130	1,884	2,645	3,508	5,001	6,928	7,719	8,712	10,048	11,502	12,947	13,482	15,389	16,690	17,209	19,143	20,577	21,665	22,810	24,213	25,126	25,126	25,126

32-311 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage						802	2,303	886	1,257	1,367	1,825	1,507	1,421	1,481	779	1,000	2,578	1,061	1,975	1,082	1,166	1,585	1,491	1,845	2,631	30,042	18,674
Fuel (E85)						34.6	60.7	15.1	12.0	24.3	25.5	12.0	43.7	45.6	29.1	20.3	60.4	35.1	54.7	30.3	26.0	48.2	50.3	72.5	45.2	745.5	517.6
Fuel (GSLN)						5.8	40.2	25.0	39.2	21.9	59.5	48.9	10.3	16.4	15.4	33.0	46.7	7.9	35.3	18.6	25.8	21.2	21.0	12.4	65.9	570.3	319.5
Fuel (GSLN EQ)						30.9	84.1	35.9	47.9	39.5	78.0	57.5	44.2	51.8	38.4	49.1	94.6	35.7	74.9	40.5	44.6	56.1	57.4	64.9	98.6	1124.7	706.7
MPG						26.00	27.38	24.68	26.25	34.61	23.40	26.19	32.14	28.61	20.26	20.36	27.26	29.69	26.37	26.69	26.13	28.24	25.96	28.44	26.69	26.71	26.42
Total Fuel Cost						58.15	162.01	60.75	75.06	68.72	122.99	83.73	74.15	86.07	56.41	63.61	131.57	55.67	113.47	61.12	60.83	85.36	86.90	107.72	130.94	1745.23	1039.67
Avg Cost/Gal						1.44	1.61	1.52	1.47	1.49	1.45	1.38	1.37	1.39	1.27	1.19	1.23	1.29	1.26	1.25	1.17	1.23	1.22	1.27	1.18	1.33	1.24
% E85 by Vol						85.64	60.14	37.68	23.44	52.60	29.99	19.72	80.90	73.53	65.41	38.08	56.41	81.68	60.79	61.96	50.23	69.47	70.50	85.39	40.66	56.66	61.83
End Odometer						950	3,253	4,139	5,396	6,763	8,588	10,095	11,516	12,997	13,776	14,776	17,354	18,415	20,390	21,472	22,638	24,223	25,714	27,559	30,190	30,190	30,190

54-125 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage		529	0	720	833	1,292	1,547	1,134	1,065	971	1,687	215	1,031	197	974	728	862	1,727	1,750	2,188	1,102	576	477	500	815	22,920	11,896
Fuel (E85)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	41.4	26.8	24.5	36.5	77.5	26.1	0.0	11.2	26.3	18.0	6.0	304.2	304.2
Fuel (GSLN)		20.5	0.0	33.5	30.9	46.0	57.3	41.1	38.1	36.9	64.9	7.3	37.6	0.0	0.0	4.2	12.2	36.5	4.1	49.8	40.9	9.4	0.0	4.5	20.0	595.7	181.6
Fuel (GSLN EQ)		20.5	0.0	33.5	30.9	46.0	57.3	41.1	38.1	36.9	64.9	7.3	37.6	7.9	32.8	25.5	31.6	65.4	60.2	68.7	40.9	17.5	19.0	17.5	24.3	825.6	411.5
MPG		25.80	0.00	21.49	26.96	28.09	27.00	27.59	27.95	26.31	25.99	29.45	27.42	24.84	29.70	28.60	27.25	26.39	29.07	31.84	26.94	32.92	25.05	28.52	33.48	27.76	28.91
Total Fuel Cost		24.51	0.00	39.25	37.75	54.65	73.03	51.00	49.85	46.00	85.09	9.25	45.97	13.00	53.77	39.84	46.85	92.50	105.71	90.79	51.86	24.89	34.19	28.40	28.60	1126.75	610.40
Avg Cost/Gal		1.20	0.00	1.17	1.22	1.19	1.27	1.24	1.31	1.25	1.31	1.27	1.22	1.30	1.30	1.29	1.28	1.27	1.30	1.20	1.27	1.21	1.30	1.26	1.10	1.25	1.26
% E85 by Vol		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	86.45	66.76	50.00	94.97	34.40	0.00	54.32	100.00	80.00	23.08	33.81	62.62
End Odometer		639		1,359	2,192	3,484	5,031	6,165	7,230	8,201	9,888	10,103	11,134	11,331	12,305	13,033	13,895	15,622	17,372	19,560	20,662	21,238	21,715	22,215	23,030	23,030	23,030

54-181 E85		All Data Last 12 Months																								Total	Total
	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage		263	152	677	258	3,540	1,457	1,324	1,401	175	1,237	528	230	1,453	951	354	1,181	668		1,181		1,403	650	1,251	0	20,334	9,092
Fuel (E85)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	38.7	13.0	32.5	20.2	0.0	59.7	0.0	31.8	9.0	35.1	0.0	295.2	295.2
Fuel (GSLN)		9.1	6.7	25.6	10.8	94.4	55.2	47.9	51.3	6.3	48.9	19.6	8.0	4.2	7.1	0.0	12.9	9.5	0.0	0.0	0.0	28.3	25.5	9.3	0.0	480.6	96.8
Fuel (GSLN EQ)		9.1	6.7	25.6	10.8	94.4	55.2	47.9	51.3	6.3	48.9	19.6	8.0	48.0	37.8	10.3	38.7	25.5	0.0	43.2	0.0	51.3	32.0	34.7	0.0	705.3	321.5
MPG		28.90	22.69	26.45	23.89	37.50	26.39	27.64	27.31	27.78	25.30	26.94	28.75	30.29	25.17	34.34	30.54	26.20		27.32		27.33	20.30	36.03		28.83	28.28
Total Fuel Cost		11.28	8.20	32.85	12.75	120.31	72.00	57.75	66.39	8.00	64.17	24.80	9.20	76.76	59.33	16.90	58.75	37.72	0.00	77.59	0.00	69.94	41.91	55.63	0.00	982.23	494.53
Avg Cost/Gal		1.24	1.22	1.28	1.18	1.27	1.30	1.21	1.29	1.27	1.31	1.27	1.15	1.29	1.30	1.30	1.29	1.27	0.00	1.30	0.00	1.16	1.21	1.25		1.27	1.26
% E85 by Vol		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	92.93	84.50	100.00	71.59	67.98	0.00	100.00	0.00	52.91	26.09	79.05		38.05	75.30
End Odometer		373	525	1,202	1,460	5,000	6,457	7,781	9,182	9,357	10,594	11,122	11,352	12,805	13,756	14,110	15,291	15,959		17,140		18,543	19,193	20,444	20,444	20,444	20,444

54-218 E85 All Data Last 12 Months

	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage			0	805	1,032	1,998	2,116	1,147	1,051	387	764	726	252	1,453	624	913	1,885	1,394	1,925	1,000	601		599	712	276	21,660	11,382
Fuel (E85)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.7	19.4	12.1	32.2	18.7	35.7	33.1	23.3	0.0	0.0	15.5	0.0	239.6	239.6
Fuel (GSLN)			0.0	33.7	42.4	69.2	74.6	41.5	42.4	13.8	29.9	25.1	9.0	10.6	0.0	30.1	47.4	40.1	43.9	10.9	0.0	0.0	29.7	5.6	13.1	613.0	231.4
Fuel (GSLN EQ)			0.0	33.7	42.4	69.2	74.6	41.5	42.4	13.8	29.9	25.1	9.0	50.0	15.4	39.7	72.9	54.9	69.7	34.9	16.9	0.0	29.7	16.8	13.1	795.6	414.0
MPG			0.00	23.89	24.34	28.87	28.36	27.64	24.79	28.04	25.55	28.92	28.00	29.08	40.56	23.00	25.84	25.38	27.61	28.66	35.62		20.17	42.32	21.07	27.22	27.49
Total Fuel Cost			0.00	39.33	50.88	83.03	89.31	50.90	51.89	18.41	37.46	30.34	10.50	77.30	25.22	55.26	99.87	75.30	97.70	55.37	30.29	0.00	31.90	26.15	17.00	1053.41	591.36
Avg Cost/Gal			0.00	1.17	1.20	1.20	1.20	1.23	1.22	1.33	1.25	1.21	1.17	1.28	1.30	1.31	1.25	1.28	1.23	1.26	1.30	0.00	1.07	1.24	1.30	1.24	1.26
% E85 by Vol		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.41	100.00	28.67	40.45	31.80	44.82	75.24	100.00	0.00	0.00	73.46	0.00	28.11	50.87
End Odometer		128		933	1,965	3,963	6,079	7,226	8,277	8,664	9,428	10,154	10,406	11,859	12,483	13,396	15,281	16,675	18,600	19,600	20,201		20,800	21,512	21,788	21,788	21,788

54-219 E85 All Data Last 12 Months

	#####	#####	May-96	Jun-96	Jul-96	Aug-96	Sep-96	#####	Nov-96	Dec-96	Jan-97	Feb-97	#####	#####	May-97	Jun-97	Jul-97	Aug-97	Sep-97	#####	Nov-97	Dec-97	Jan-98	Feb-98	#####	Total	Total
Mileage		413	292	1,235	1,353	464	1,509	990	578	46	1,587	636	1,375	1,318	681	249	874	1,379	180		1,382	1,489	1,307	555	1,346	21,238	10,760
Fuel (E85)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.5	43.3	23.7	15.0	46.7	22.3	7.5	0.0	36.9	20.9	9.0	11.0	13.0	280.8	249.3
Fuel (GSLN)		15.2	10.9	42.4	49.7	10.6	65.9	39.4	20.2	3.5	60.4	24.1	20.4	17.6	4.5	0.0	10.0	17.5	0.0	0.0	27.7	42.4	56.5	0.0	19.5	558.4	195.7
Fuel (GSLN EQ)		15.2	10.9	42.4	49.7	10.6	65.9	39.4	20.2	3.5	60.4	24.1	45.4	51.9	23.3	11.9	47.0	35.2	5.4	0.0	54.4	57.5	63.0	8.0	28.9	774.3	386.6
MPG		27.17	26.79	29.13	27.22	43.77	22.90	25.13	28.61	13.14	26.27	26.39	30.30	25.38	29.25	20.93	18.59	39.19	33.14		25.40	25.88	20.74	69.68	46.55	27.43	27.83
Total Fuel Cost		17.75	13.67	53.85	60.74	12.81	76.43	48.93	26.30	5.00	76.33	30.80	65.95	78.61	36.78	19.50	73.40	51.17	9.75	0.00	78.86	78.34	74.11	14.30	37.00	1040.38	551.82
Avg Cost/Gal		1.17	1.25	1.27	1.22	1.21	1.16	1.24	1.30	1.43	1.26	1.28	1.27	1.29	1.31	1.30	1.29	1.29	1.30	0.00	1.22	1.24	1.13	1.30	1.14	1.24	1.24
% E85 by Vol		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.69	71.10	84.03	100.00	82.36	56.03	100.00	0.00	57.17	33.02	13.74	100.00	40.00	33.46	56.03
End Odometer		533	825	2,060	3,413	3,877	5,386	6,376	6,954	7,000	8,587	9,223	10,598	11,916	12,597	12,846	13,720	15,099	15,279		16,661	18,150	19,457	20,012	21,358	21,358	21,358

Appendix C

State of Ohio E85 Detailed Maintenance Data

State of Ohio E85 Maintenance Data
April, 1996 through March, 1998

7/30/98

Group Total	Gasoline Control																								All Data Last 12 Months		
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage	0	3,141	3,321	4,292	4,563	3,960	3,800	3,478	4,146	2,149	3,814	4,973	3,289	2,524	3,607	2,564	4,205	3,498	4,243	4,531	3,116	4,048	2,807	1,979	4,297	86,345	41,419
Parts Cost \$	0.00	0.00	0.00	10.95	26.10	22.05	0.00	10.95	0.00	22.05	14.50	26.40	0.00	10.95	11.60	37.40	0.00	22.55	0.00	7.05	54.40	0.00	27.28	0.00	12.58	316.81	183.81
Labor Hours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$	0.00	0.00	0.00	9.00	13.30	47.75	0.00	9.00	0.00	68.56	4.50	30.45	0.00	9.00	21.75	74.50	0.00	29.80	0.00	0.00	63.00	0.00	17.50	0.00	0.00	398.11	215.55
Other Cost \$	0.00	0.00	1.00	2.00	1.00	6.15	1.00	1.00	2.89	2.20	5.63	1.00	4.00	12.30	13.71	4.65	0.00	6.00	9.30	56.85	0.00	8.44	11.95	0.00	36.40	187.47	159.60
Total Cost \$	0.00	0.00	1.00	21.95	40.40	75.95	1.00	20.95	2.89	92.81	24.63	57.85	4.00	32.25	47.06	116.55	0.00	58.35	9.30	63.90	117.40	8.44	56.73	0.00	48.98	902.39	558.96
Total \$ per 1,000	0.00	0.00	0.30	5.11	8.85	19.18	0.26	6.02	0.70	43.19	6.46	11.63	1.22	12.78	13.05	45.46	0.00	16.68	2.19	14.10	37.68	2.08	20.21	0.00	11.40	10.45	13.50
Cum Tot per 1,000	0.00	0.00	0.15	2.13	4.14	7.23	6.08	6.07	5.35	7.82	7.68	8.15	7.64	7.92	8.28	10.06	9.33	9.75	9.26	9.57	10.77	10.31	10.66	10.40	10.45		
Odometer Min	192	891	1,854	2,886	3,967	5,705	6,271	7,344	8,450	9,257	10,254	11,372	11,947	13,100	14,201	14,705	15,878	16,999	18,613	20,075	20,787	22,263	22,910	23,564	24,086		
Odometer Max	222	1,635	2,911	4,597	6,551	8,419	10,047	11,721	13,335	14,677	16,504	18,511	20,199	21,570	22,909	24,619	26,543	28,181	29,147	30,790	32,040	33,591	34,788	36,113	38,400		

5/96-24-151 data removed for body damage/accident

Group Total		E85																								All Data Last 12 Months			
		Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total	
Mileage		0	1,205	444	3,437	7,780	13,625	13,867	11,305	12,065	8,359	11,582	8,632	10,389	12,703	10,827	8,158	14,535	13,589	11,840	12,691	10,472	11,076	10,889	11,611	13,295	244,376	141,686	
Parts Cost \$		0.00	0.00	0.00	0.00	0.00	77.10	38.55	77.10	87.99	43.55	0.00	116.80	64.81	76.90	44.44	96.37	45.97	80.78	24.50	83.10	30.89	6.50	7.50	52.97	9.00	1,064.82	558.92	
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Labor Cost \$		0.00	0.00	0.00	0.00	0.00	50.00	25.00	50.00	33.80	25.00	0.00	71.75	95.50	50.00	8.80	50.00	34.00	50.00	33.50	80.00	25.00	0.00	25.00	125.00	48.95	881.30	530.25	
Other Cost \$		0.00	0.00	0.00	0.00	0.00	18.00	65.64	31.47	6.07	3.00	0.00	64.79	28.69	31.00	0.00	0.00	98.52	6.00	1.00	50.76	41.76	0.00	42.38	12.00	0.00	501.08	283.42	
Total Cost \$		0.00	0.00	0.00	0.00	0.00	145.10	129.19	158.57	127.86	71.55	0.00	253.34	189.00	157.90	53.24	146.37	178.49	136.78	59.00	213.86	97.65	6.50	74.88	189.97	57.95	2,447.20	1,372.59	
Total \$ per 1,000		0.00	0.00	0.00	0.00	0.00	10.65	9.32	14.03	10.60	8.56	0.00	29.35	18.19	12.43	4.92	17.94	12.28	10.07	4.98	16.85	9.32	0.59	6.88	16.36	4.36	10.01	9.69	
Cum Tot per 1,000		0.00	0.00	0.00	0.00	0.00	5.48	6.80	8.38	8.80	8.77	7.56	9.59	10.46	10.68	10.19	10.66	10.82	10.75	10.36	10.80	10.72	10.19	10.02	10.34	10.01			
Odometer Min		0	128	525	277	528	950	1,234	2,039	3,210	3,806	4,406	4,657	5,578	6,581	7,709	8,359	8,611	9,651	10,575	11,571	12,790	14,417	16,365	17,672	19,808			
Odometer Max		0	639	825	2,060	3,413	5,000	6,457	7,781	9,219	10,514	12,172	14,305	16,129	18,160	20,048	21,824	23,450	25,502	27,297	28,716	30,173	31,890	33,543	35,335	37,315			

9/96-32-311 data removed for body damage/accident

11/97-54-219 data removed for body damage/accident

24-151		Gasoline Control																							All Data Last 12 Months		
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage	0	1,334	1,355	1,301	2,339	1,868	1,628	1,674	1,614	1,342	1,827	2,007	1,688	1,371	1,339	1,710	1,924	1,638	966	1,643	1,250	1,551	1,197	1,325	2,287	38,178	18,201
Parts Cost \$	0.00	0.00	911.35	10.95	0.00	11.90	0.00	10.95	0.00	11.90	0.00	26.40	0.00	10.95	0.00	10.90	0.00	10.95	0.00	0.00	0.00	0.00	0.00	0.00	12.58	117.48	45.38
Labor Hours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$	0.00	0.00	28.80	9.00	0.00	26.00	0.00	9.00	0.00	35.72	0.00	30.45	0.00	9.00	0.00	17.00	0.00	21.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	157.17	47.00
Other Cost \$	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.99	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	29.90	0.00	4.65	11.95	0.00	29.90	81.39	77.40
Total Cost \$	0.00	0.00	940.15	19.95	0.00	38.90	0.00	20.95	0.00	47.62	0.99	57.85	0.00	20.95	0.00	27.90	0.00	31.95	0.00	29.90	0.00	4.65	11.95	0.00	42.48	356.04	169.78
Total \$ per 1,000	0.00	0.00	693.84	15.33	0.00	20.82	0.00	12.51	0.00	35.48	0.54	28.82	0.00	15.28	0.00	16.32	0.00	19.51	0.00	18.20	0.00	3.00	9.98	0.00	18.57	9.33	9.33
End Odometer	222	1,556	2,911	4,212	6,551	8,419	10,047	11,721	13,335	14,677	16,504	18,511	20,199	21,570	22,909	24,619	26,543	28,181	29,147	30,790	32,040	33,591	34,788	36,113	38,400	38,400	38,400

Removed

24-202	Gasoline Control																							All Data Last 12 Months			
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage	0	699	963	1,032	1,081	1,738	566	1,073	1,106	807	997	1,118	575	1,153	1,101	504	1,173	1,207	1,528	1,561	1,154	935	1,049	774	23,894	12,139	
Parts Cost \$	0.00	0.00	0.00	0.00	11.60	10.15	0.00	0.00	0.00	10.15	0.00	0.00	0.00	0.00	11.60	0.00	0.00	11.60	0.00	7.05	0.00	0.00	0.00	0.00	0.00	62.15	30.25
Labor Hours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$	0.00	0.00	0.00	0.00	8.80	21.75	0.00	0.00	0.00	32.84	0.00	0.00	0.00	0.00	21.75	0.00	0.00	8.80	0.00	0.00	0.00	10.00	0.00	0.00	0.00	103.94	40.55
Other Cost \$	0.00	0.00	1.00	2.00	1.00	5.15	1.00	0.00	2.89	2.20	4.64	0.00	4.00	11.30	13.71	4.65	0.00	6.00	9.30	26.95	0.00	3.79	0.00	0.00	6.50	106.08	82.20
Total Cost \$	0.00	0.00	1.00	2.00	21.40	37.05	1.00	0.00	2.89	45.19	4.64	0.00	4.00	11.30	47.06	4.65	0.00	26.40	9.30	34.00	0.00	3.79	10.00	0.00	6.50	272.17	153.00
Total \$ per 1,000	0.00	0.00	1.04	1.94	19.80	21.32	1.77	0.00	2.61	56.00	4.65	0.00	6.96	9.80	42.74	9.23	0.00	21.87	6.09	21.78	0.00	4.05	9.53		8.40	11.39	12.60
End Odometer	192	891	1,854	2,886	3,967	5,705	6,271	7,344	8,450	9,257	10,254	11,372	11,947	13,100	14,201	14,705	15,878	17,085	18,613	20,174	21,328	22,263	23,312	24,086	24,086	24,086	

92-107		Gasoline Control																				All Data Last 12 Months					
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage	0	1,108	1,003	1,959	1,143	354	1,606	731	1,426		990	1,848	1,026		1,167	350	1,108	653	1,749	1,327	712	1,562	561	654	1,236	24,273	11,079
Parts Cost \$		0.00	0.00	0.00	14.50	0.00	0.00	0.00	0.00	0.00	14.50	0.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00	0.00	54.40	0.00	27.28	0.00	0.00	137.18	108.18
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$		0.00	0.00	0.00	4.50	0.00	0.00	0.00	0.00	0.00	4.50	0.00	0.00	0.00	0.00	57.50	0.00	0.00	0.00	0.00	63.00	0.00	7.50	0.00	0.00	137.00	128.00
Other Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Cost \$		0.00	0.00	0.00	19.00	0.00	0.00	0.00	0.00	0.00	19.00	0.00	0.00	0.00	0.00	84.00	0.00	0.00	0.00	0.00	117.40	0.00	34.78	0.00	0.00	274.18	236.18
Total \$ per 1,000		0.00	0.00	0.00	16.62	0.00	0.00	0.00	0.00	0.00	19.19	0.00	0.00	0.00	0.00	240.00	0.00	0.00	0.00	0.00	164.89	0.00	62.00	0.00	0.00	11.30	21.32
End Odometer		1,635	2,638	4,597	5,740	6,094	7,700	8,431	9,857		10,847	12,695	13,721		14,888	15,238	16,346	16,999	18,748	20,075	20,787	22,349	22,910	23,564	24,800	24,800	24,800

E85																								All Data Last 12 Months			
14-164	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage				0	735	702	1,023	1,312	1,196	1,011	740	912	975	760	1,143	892	1,112	1,336	1,353	1,516	1,361	615	724	828	1,748	21,994	13,388
Parts Cost \$				0.00	0.00	38.55	0.00	0.00	43.55	0.00	0.00	0.00	38.45	0.00	0.00	48.40	0.00	0.00	0.00	7.50	0.00	0.00	0.00	7.50	0.00	183.95	63.40
Labor Hours				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$				0.00	0.00	25.00	0.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	150.00	75.00
Other Cost \$				0.00	0.00	15.00	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	27.00	6.00
Total Cost \$				0.00	0.00	78.55	0.00	0.00	71.55	0.00	0.00	0.00	66.45	0.00	0.00	73.40	0.00	0.00	0.00	35.50	0.00	0.00	0.00	35.50	0.00	360.95	144.40
Total \$ per 1,000				0.00	0.00	111.89	0.00	0.00	59.82	0.00	0.00	0.00	68.15	0.00	0.00	82.29	0.00	0.00	0.00	23.42	0.00	0.00	0.00	42.87	0.00	16.41	10.79
End Odometer				1,654	2,389	3,091	4,114	5,426	6,622	7,633	8,373	9,285	10,260	11,020	12,163	13,055	14,167	15,503	16,856	18,372	19,733	20,348	21,072	21,900	23,648	23,648	23,648

14-178	E85																								All Data Last 12 Months		
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage				0	251	466	240	805	1,171	596	600	251	921	1,003	1,128	650	252	1,040	924	996	1,219	1,627	1,948	1,307	2,136	19,531	14,230
Parts Cost \$				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.45	0.00	0.00	0.00	0.00	0.00	7.50	0.00	1.50	0.00	12.61	0.00	60.06	60.06
Labor Hours				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	75.00	75.00
Other Cost \$				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	9.00	9.00
Total Cost \$				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.45	0.00	0.00	0.00	0.00	0.00	35.50	0.00	1.50	0.00	40.61	0.00	144.06	144.06
Total \$ per 1,000				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.25	0.00	0.00	0.00	0.00	0.00	35.64	0.00	0.92	0.00	31.07	0.00	7.38	10.12
End Odometer				277	528	994	1,234	2,039	3,210	3,806	4,406	4,657	5,578	6,581	7,709	8,359	8,611	9,651	10,575	11,571	12,790	14,417	16,365	17,672	19,808	19,808	19,808

14-220 E85																								All Data Last 12 Months			
	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage				0	1,463	1,887	1,267	1,181	580	584	693	731	1,024	1,553	1,214	1,061	2,258	1,631	1,469	1,325	750	976	895	1,418	1,450	25,410	16,000
Parts Cost \$				0.00	0.00	0.00	38.55	0.00	0.00	0.00	0.00	38.45	0.00	0.00	0.00	0.00	33.55	0.00	0.00	7.50	0.00	0.00	0.00	7.50	0.00	125.55	48.55
Labor Hours				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$				0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	30.00	0.00	0.00	0.00	25.00	0.00	130.00	80.00
Other Cost \$				0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	15.00	9.00
Total Cost \$				0.00	0.00	0.00	66.55	0.00	0.00	0.00	0.00	66.45	0.00	0.00	0.00	0.00	61.55	0.00	0.00	40.50	0.00	0.00	0.00	35.50	0.00	270.55	137.55
Total \$ per 1,000				0.00	0.00	0.00	52.53	0.00	0.00	0.00	0.00	90.90	0.00	0.00	0.00	0.00	27.26	0.00	0.00	30.57	0.00	0.00	0.00	25.04	0.00	10.65	8.60
End Odometer				1,289	2,752	4,639	5,906	7,087	7,667	8,251	8,944	9,675	10,699	12,252	13,466	14,527	16,785	18,416	19,885	21,210	21,960	22,936	23,831	25,249	26,699	26,699	26,699

E85																								All Data Last 12 Months			
14-221	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage				0	1,415	1,720	1,644	1,663	2,273	1,295	1,658	2,133	1,824	2,031	1,888	1,776	1,626	2,052	1,795	1,419	1,457	1,717	1,653	1,792	1,980	36,811	21,186
Parts Cost \$				0.00	0.00	38.55	0.00	38.55	0.00	43.55	0.00	38.45	0.00	0.00	0.00	47.97	0.00	38.55	0.00	0.00	30.89	5.00	0.00	25.36	0.00	306.87	147.77
Labor Hours				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$				0.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	25.00	0.00	0.00	25.00	0.00	0.00	50.00	0.00	225.00	125.00
Other Cost \$				0.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00	3.00	18.00	0.00	0.00	18.00	3.00	0.00	0.00	3.00	0.00	0.00	3.00	0.00	60.00	45.00
Total Cost \$				0.00	0.00	66.55	0.00	66.55	0.00	71.55	0.00	66.45	3.00	18.00	0.00	72.97	18.00	66.55	0.00	0.00	58.89	5.00	0.00	78.36	0.00	591.87	317.77
Total \$ per 1,000				0.00	0.00	38.69	0.00	40.02	0.00	55.25	0.00	31.15	1.64	8.86	0.00	41.09	11.07	32.43	0.00	0.00	40.42	2.91	0.00	43.73	0.00	16.08	15.00
End Odometer				504	1,919	3,639	5,283	6,946	9,219	10,514	12,172	14,305	16,129	18,160	20,048	21,824	23,450	25,502	27,297	28,716	30,173	31,890	33,543	35,335	37,315	37,315	37,315

14-222

E85

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Last 12 Months
Mileage				0	440	754	761	863	1,493	1,927	791	993	1,336	1,454	1,445	535	1,907	1,301	519	1,934	1,434	1,088	1,145	1,403	913	24,436	15,078
Parts Cost \$				0.00	0.00	0.00	0.00	38.55	0.00	0.00	0.00	0.00	0.00	38.45	0.00	0.00	0.00	42.23	0.00	0.00	0.00	0.00	7.50	0.00	9.00	135.73	97.18
Labor Hours				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$				0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	25.00	0.00	48.95	148.95	123.95
Other Cost \$				0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	12.00	9.00
Total Cost \$				0.00	0.00	0.00	0.00	66.55	0.00	0.00	0.00	0.00	0.00	66.45	0.00	0.00	0.00	70.23	0.00	0.00	0.00	0.00	35.50	0.00	57.95	296.68	230.13
Total \$ per 1,000				0.00	0.00	0.00	0.00	77.11	0.00	0.00	0.00	0.00	0.00	45.70	0.00	0.00	0.00	53.98	0.00	0.00	0.00	0.00	31.00	0.00	63.47	12.14	15.26
End Odometer				690	1,130	1,884	2,645	3,508	5,001	6,928	7,719	8,712	10,048	11,502	12,947	13,482	15,389	16,690	17,209	19,143	20,577	21,665	22,810	24,213	25,126	25,126	25,126

32-311

E85

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Last 12 Months
Mileage						802	2,303	886	1,257	1,367	1,825	1,507	1,421	1,481	779	1,000	2,578	1,061	1,975	1,082	1,166	1,585	1,491	1,845	2,631	30,042	18,674
Parts Cost \$						0.00	19.05	0.00	44.44	0.00	0.00	39.90	26.36	0.00	44.44	0.00	0.00	0.00	24.50	0.00	0.00	0.00	0.00	0.00	0.00	179.64	68.94
Labor Hours						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$						0.00	352.80	0.00	8.80	0.00	0.00	21.75	70.50	0.00	8.80	0.00	0.00	0.00	33.50	0.00	0.00	0.00	0.00	0.00	0.00	143.35	42.30
Other Cost \$						0.00	87.50	6.09	3.07	0.00	0.00	0.65	3.31	7.00	0.00	0.00	0.00	1.00	3.00	0.00	0.00	0.00	20.00	0.00	0.00	48.62	31.00
Total Cost \$						0.00	459.35	6.09	56.31	0.00	0.00	62.30	100.17	7.00	53.24	0.00	0.00	0.00	59.00	3.00	0.00	0.00	20.00	0.00	0.00	371.61	142.24
Total \$ per 1,000						0.00	199.46	6.87	44.80	0.00	0.00	41.34	70.49	4.73	68.34	0.00	0.00	0.00	29.87	2.77	0.00	0.00	13.41	0.00	0.00	12.37	7.62
End Odometer						950	3,253	4,139	5,396	6,763	8,588	10,095	11,516	12,997	13,776	14,776	17,354	18,415	20,390	21,472	22,638	24,223	25,714	27,559	30,190	30,190	30,190

Removed

54-125

E85

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Last 12 Months
Mileage		529	0	720	833	1,292	1,547	1,134	1,065	971	1,687	215	1,031	197	974	728	862	1,727	1,700	2,238	1,102	576	477	500	815	22,920	11,896
Parts Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	9.00
Other Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	77.52	38.76
Total Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	28.38	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	86.52	47.76
Total \$ per 1,000		0.00	0.00	0.00	0.00	0.00	12.53	0.00	0.00	0.00	0.00	90.14	0.00	0.00	0.00	0.00	32.92	0.00	0.00	0.00	17.59	0.00	0.00	0.00	0.00	3.77	4.01
End Odometer		639		1,359	2,192	3,484	5,031	6,165	7,230	8,201	9,888	10,103	11,134	11,331	12,305	13,033	13,895	15,622	17,322	19,560	20,662	21,238	21,715	22,215	23,030	23,030	23,030

54-181

E85

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Last 12 Months
Mileage		263	152	677	258	3,540	1,457	1,324	1,401	175	1,237	528	230	1,453	951	354	1,181	668		1,181		1,403	650	1,251	0	20,334	9,092
Parts Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.42	0.00	0.00	30.30	0.00	0.00	0.00	0.00	0.00	42.72	42.72
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	19.38	19.38	0.00	19.38	0.00	0.00	116.28	77.52
Total Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	31.80	0.00	0.00	49.68	19.38	0.00	19.38	0.00	0.00	159.00	120.24
Total \$ per 1,000		0.00	0.00	0.00	0.00	0.00	13.30	0.00	0.00	0.00	0.00	36.70	0.00	0.00	0.00	0.00	26.93	0.00	0.00	42.07		0.00	29.82	0.00	0.00	7.82	13.22
End Odometer		373	525	1,202	1,460	5,000	6,457	7,781	9,182	9,357	10,594	11,122	11,352	12,805	13,756	14,110	15,291	15,959		17,140		18,543	19,193	20,444	20,444	20,444	20,444

54-218

E85

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Last 12 Months
Mileage		0	0	805	1,032	1,998	2,116	1,147	1,051	387	764	726	252	1,453	624	913	1,885	1,394	1,925	1,000	601		599	712	276	21,660	11,382
Parts Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.30	0.00	0.00	0.00	0.00	0.00	30.30	30.30
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	19.38	0.00	0.00	19.38	0.00	0.00	0.00	0.00	0.00	77.52	38.76
Total Cost \$		0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	19.38	0.00	0.00	49.68	0.00	0.00	0.00	0.00	0.00	107.82	69.06
Total \$ per 1,000		0.00	0.00	0.00	0.00	0.00	9.16	0.00	0.00	0.00	0.00	0.00	76.90	0.00	0.00	0.00	10.28	0.00	0.00	49.68	0.00	0.00	0.00	0.00	0.00	4.98	6.07
End Odometer		128		933	1,965	3,963	6,079	7,226	8,277	8,664	9,428	10,154	10,406	11,859	12,483	13,396	15,281	16,675	18,600	19,600	20,201		20,800	21,512	21,788	21,788	21,788

54-219

E85

All Data Last 12 Months

	Mar-96	Apr-96	May-96	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97	Oct-97	Nov-97	Dec-97	Jan-98	Feb-98	Mar-98	Total	Total
Mileage		413	292	1,235	1,353	464	1,509	990	578	46	1,587	636	1,375	1,318	681	249	874	1,379	180		1,382	1,489	1,307	555	1,346	21,238	10,760
Parts Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labor Hours		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labor Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	1654.77	0.00	0.00	0.00	0.00	0.00	58.14	19.38
Total Cost \$		0.00	0.00	0.00	0.00	0.00	0.00	19.38	0.00	0.00	0.00	19.38	0.00	0.00	0.00	0.00	19.38	0.00	0.00	1654.77	0.00	0.00	0.00	0.00	0.00	58.14	19.38
Total \$ per 1,000		0.00	0.00	0.00	0.00	0.00	0.00	19.58	0.00	0.00	0.00	30.47	0.00	0.00	0.00	0.00	22.17	0.00	0.00		0.00	0.00	0.00	0.00	0.00	2.74	1.80
End Odometer		533	825	2,060	3,413	3,877	5,386	6,376	6,954	7,000	8,587	9,223	10,598	11,916	12,597	12,846	13,720	15,099	15,279		16,661	18,150	19,457	20,012	21,358	21,358	21,358

Removed

Appendix D

Emissions Testing Results (by vehicle and test)

Emissions Testing Results by Vehicle and Test

Vehicle 32-311 – FFV

FTP1 Gasoline

Bag ID	1	2	3	WT
Test Date	5/28/97	5/28/97	5/28/97	5/28/97
Odometer	13753	13753	13753	13753
Fuel	RFG	RFG	RFG	RFG
MPG	20.94	20.41	24.34	21.47
Corrected THC (g/mi)	0.311	0.028	0.034	0.088
NMHC (g/mi)	0.283	0.017	0.024	0.074
NOx (g/mi)	0.26	0.01	0.07	0.08
CO (g/mi)	3.25	0.35	0.25	0.92
CO ₂ (g/mi)	410.8	426.9	358.1	404.7
Formaldehyde (g/mi)	0.00412	0.0002	0.00011	0.00099
Acetaldehyde (g/mi)	0.00137	0.00001	0.00002	0.00029

Vehicle 32-311 – FFV

FTP2 Gasoline

Bag ID	1	2	3	WT
Test Date	5/29/97	5/29/97	5/29/97	5/29/97
Odometer	13765	13765	13765	13765
Fuel	RFG	RFG	RFG	RFG
MPG	20.73	20.29	24.23	21.34
Corrected THC (g/mi)	0.304	0.029	0.045	0.091
NMHC (g/mi)	0.274	0.018	0.032	0.075
NOx (g/mi)	0.31	0	0.1	0.09
CO (g/mi)	3.08	0.32	0.31	0.89
CO ₂ (g/mi)	415.3	429.4	359.6	407.3
Formaldehyde (g/mi)	0.00433	0.00011	0.00008	0.00097
Acetaldehyde (g/mi)	0.0014	0	0.00006	0.00031

Vehicle 32-311 – FFV
FTP3 E85

Bag ID	1	2	3	WT
Test Date	5/22/97	5/22/97	5/22/97	5/22/97
Odometer	13716	13716	13716	13716
Fuel	E85	E85	E85	E85
MPG	15.36	15.13	18.07	15.89
Corrected THCE (g/mi)	0.579	0.033	0.069	0.156
NMHCE (g/mi)	0.497	0.012	0.028	0.117
NO _x (g/mi)	0.37	0.02	0.13	0.12
CO (g/mi)	4.71	0.36	0.45	1.28
CO ₂ (g/mi)	394.6	409.4	342.4	387.9
Formaldehyde (g/mi)	N/A	N/A	N/A	N/A
Acetaldehyde (g/mi)	N/A	N/A	N/A	N/A

Vehicle 32-311 – FFV
FTP4 E85

Bag ID	1	2	3	WT
Test Date	5/23/97	5/23/97	5/23/97	5/23/97
Odometer	13727	13727	13727	13727
Fuel	E85	E85	E85	E85
MPG	15.51	15.19	18.35	16.01
Corrected THCE (g/mi)	0.631	0.028	0.05	0.159
NMHCE (g/mi)	0.549	0.011	0.019	0.125
NO _x (g/mi)	0.34	0.03	0.09	0.11
CO (g/mi)	4.44	0.31	0.45	1.2
CO ₂ (g/mi)	391.1	407.8	337.3	385
Formaldehyde (g/mi)	0.00988	0.00023	0.00012	0.0022
Acetaldehyde (g/mi)	0.05342	0.00006	0.00054	0.01123

Vehicle 14-222 – FFV
FTP1 Gasoline

Bag ID	1	2	3	WT
Test Date	6/19/97	6/19/97	6/19/97	6/19/97
Odometer	13745	13745	13745	13745
Fuel	RFG	RFG	RFG	RFG
MPG	20.24	19.64	23.43	20.68
Corrected THC (g/mi)	0.41	0.085	0.062	0.146
NMHC (g/mi)	0.382	0.068	0.05	0.128
NO _x (g/mi)	0.19	0.01	0.07	0.06
CO (g/mi)	3.05	0.85	0.48	1.2
CO ₂ (g/mi)	425.2	442.8	371.6	419.6
Formaldehyde (g/mi)	0.00422	0.00031	0.00011	0.00107
Acetaldehyde (g/mi)	0.00139	0.00002	0.00001	0.0003

Vehicle 14-222 – FFV
FTP2 Gasoline

Bag ID	1	2	3	WT
Test Date	6/20/97	6/20/97	6/20/97	6/20/97
Odometer	13756	13756	13756	13756
Fuel	RFG	RFG	RFG	RFG
MPG	20.24	19.75	23.79	20.83
Corrected THC (g/mi)	0.399	0.092	0.044	0.142
NMHC (g/mi)	0.374	0.075	0.033	0.125
NO _x (g/mi)	0.23	0.01	0.09	0.08
CO (g/mi)	2.71	0.74	0.36	1.04
CO ₂ (g/mi)	425.6	440.4	366.1	416.9
Formaldehyde (g/mi)	0.00442	0	0	0.00092
Acetaldehyde (g/mi)	0.0014	0	0	0.00029

Vehicle 14-222 – FFV
FTP3 E85

Bag ID	1	2	3	WT
Test Date	6/12/97	6/12/97	6/12/97	6/12/97
Odometer	13708	13708	13708	13708
Fuel	E85	E85	E85	E85
MPG	15.09	15.12	17.74	15.76
Corrected THCE (g/mi)	0.753	0.035	0.058	0.19
NMHCE (g/mi)	0.662	0.014	0.019	0.15
NO _x (g/mi)	0.15	0	0.03	0.04
CO (g/mi)	4.63	0.34	0.63	1.31
CO ₂ (g/mi)	401.6	409.6	348.5	391.1
Formaldehyde (g/mi)	0.01094	0.00037	0.00003	0.00247
Acetaldehyde (g/mi)	0.06781	0.00009	0.00035	0.01421

Vehicle 14-222 – FFV
FTP4 E85

Bag ID	1	2	3	WT
Test Date	6/13/97	6/13/97	6/13/97	6/13/97
Odometer	13719	13719	13719	13719
Fuel	E85	E85	E85	E85
MPG	14.32	15.07	17.91	15.58
Corrected THCE (g/mi)	1.035	0.038	0.054	0.249
NMHCE (g/mi)	0.929	0.009	0.021	0.203
NO _x (g/mi)	0.26	0	0.05	0.07
CO (g/mi)	5.58	0.41	0.56	1.52
CO ₂ (g/mi)	421.3	410.9	345.3	395
Formaldehyde (g/mi)	0.01	0.00005	0	0.0021
Acetaldehyde (g/mi)	0.06498	0.00011	0.00032	0.01362

Vehicle 24-202 – Gasoline Only
FTP1 Gasoline

Bag ID	1	2	3	WT
Test Date	6/11/97	6/11/97	6/11/97	6/11/97
Odometer	14727	14727	14727	14727
Fuel	RFG	RFG	RFG	RFG
MPG	20.21	19.4	22.87	20.42
Corrected THC (g/mi)	0.439	0.017	0.091	0.125
NMHC (g/mi)	0.402	0.011	0.075	0.109
NO _x (g/mi)	0.49	0.11	0.22	0.22
CO (g/mi)	5.66	0.09	0.59	1.38
CO ₂ (g/mi)	421.5	449.7	380.4	424.8
Formaldehyde (g/mi)	0.0056	0.00003	0.00001	0.00118
Acetaldehyde (g/mi)	0.002	0.00008	0.00005	0.00047

Vehicle 24-202 – Gasoline Only
FTP2 Gasoline

Bag ID	1	2	3	WT
Test Date	6/12/97	6/12/97	6/12/97	6/12/97
Odometer	14738	14738	14738	14738
Fuel	RFG	RFG	RFG	RFG
MPG	20.1	19.84	23.17	20.71
Corrected THC (g/mi)	0.491	0.021	0.086	0.136
NMHC (g/mi)	0.443	0.014	0.07	0.118
NO _x (g/mi)	0.48	0.08	0.21	0.2
CO (g/mi)	6.74	0.1	0.63	1.62
CO ₂ (g/mi)	422	439.6	375.5	418.4
Formaldehyde (g/mi)	0.00521	0.00028	0.00006	0.00124
Acetaldehyde (g/mi)	0.00135	0.00001	0	0.00029

Vehicle 92-107 – Gasoline Only
FTP1 Gasoline

Bag ID	1	2	3	WT
Test Date	6/19/97	6/19/97	6/19/97	6/19/97
Odometer	15263	15263	15263	15263
Fuel	RFG	RFG	RFG	RFG
MPG	22.85	21.03	27.07	22.81
Corrected THC (g/mi)	0.464	0.018	0.107	0.135
NMHC (g/mi)	0.422	0.008	0.087	0.115
NO _x (g/mi)	0.48	0.06	0.2	0.19
CO (g/mi)	5.42	0.09	0.63	1.34
CO ₂ (g/mi)	371.9	414.7	321.1	380.1
Formaldehyde (g/mi)	0.00547	0.00058	0.00007	0.00145
Acetaldehyde (g/mi)	0.00142	0.00001	0.00004	0.00031

Vehicle 92-107 – Gasoline Only
FTP2 Gasoline

Bag ID	1	2	3	WT
Test Date	6/20/97	6/20/97	6/20/97	6/20/97
Odometer	15274	15274	15274	15274
Fuel	RFG	RFG	RFG	RFG
MPG	20.96	20.08	24.51	21.33
Corrected THC (g/mi)	0.467	0.017	0.096	0.132
NMHC (g/mi)	0.424	0.009	0.079	0.114
NO _x (g/mi)	0.62	0.09	0.31	0.26
CO (g/mi)	5.04	0.04	0.55	1.22
CO ₂ (g/mi)	407	434.5	354.8	406.9
Formaldehyde (g/mi)	0.00533	0.00016	0	0.00119
Acetaldehyde (g/mi)	0.00147	0.00003	0.00004	0.00033

Appendix E

Ethanol Fuel Sample Analysis



CORE LABORATORIES

LABORATORY TESTS RESULTS 07/18/97

JOB NUMBER: 970799

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Ethanol, Gasoline E85

DATE SAMPLED: 06/17/97

TIME SAMPLED: 00:00

WORK DESCRIPTION: Ethanol, Gasoline E85

LABORATORY I.D.: 970799-0001

DATE RECEIVED: 06/20/97

TIME RECEIVED: 12:54

REMARKS: 1 liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	06/23/97	LS
Methanol	<0.01	0.01	LV %	ASTM D-4815		
Ethanol	63.99	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Oxygen Content	24.38	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7788	0.0002		ASTM D-1298	06/24/97	PCW
Heating Value, (Gross)	14798	175	BTU/lb	ASTM D-240	06/26/97	OE
Water, Karl Fischer	4250	1	ppm	ASTM D-1744	07/18/97	DD

ODOT 1

3700 Cherry Avenue
Long Beach, CA 90807
(310) 595-8401



CORE LABORATORIES

LABORATORY TESTS RESULTS 10/13/97

JOB NUMBER: 971319

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Ethanol, Cart 198, 1272mi

DATE SAMPLED: 09/19/97

TIME SAMPLED: 02:00

WORK DESCRIPTION: Ethanol, Cart 198, 1272mi

LABORATORY I.D.: 971319-0003

DATE RECEIVED: 10/06/97

TIME RECEIVED: 10:00

REMARKS: 1 liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	10/07/97	FH
Methanol	<0.01	0.01	LV %	ASTM D-4815		
Ethanol	83.66	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Ethyl tert-Butyl Ether	<0.01	0.01	LV%	ASTM D-4815		
Oxygen Content	29.43	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7839	0.0002		ASTM D-1298	10/13/97	LS
Heating Value, (Gross)	14063	175	BTU/lb	ASTM D-240	10/09/97	OE
Water, Karl Fischer	6277	1	ppm	ASTM D-1744	10/13/97	GS
ODOT 2						

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031



CORE LABORATORIES

LABORATORY TESTS RESULTS 06/12/98

JOB NUMBER: 980692

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Ethanol, 8964mi T586, ODOT

DATE SAMPLED: 05/05/98

TIME SAMPLED: 00:00

WORK DESCRIPTION: Ethanol, #1017302

LABORATORY I.D.: 980692-0002

DATE RECEIVED: 06/01/98

TIME RECEIVED: 10:58

REMARKS: 1000ml Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815 (Mod)	06/08/98	FH
Methanol	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
Ethanol	86.19	0.10	LV %	ASTM D-4815 (Mod)		
MTBE	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
TBA	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
tert-Amyl methyl ether	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
Ethyl tert-Butyl Ether	<0.10	0.10	LV%	ASTM D-4815 (Mod)		
Oxygen Content	30.45	0.20	% Wt. Oxygen	ASTM D-4815 (Mod)		
Specific Gravity 60/60	0.7806	0.0002		ASTM D-1298	06/05/98	PW
Heating Value, (Gross)	14479	175	BTU/lb	ASTM D-240	06/10/98	OE
Water, Karl Fischer	5031	1	ppm	ASTM D-1744	06/05/98	PW

ODOT 3

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031



CORE LABORATORIES

LABORATORY TESTS RESULTS 07/18/97

JOB NUMBER: 970793

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Ethanol 85%-Gasoline 15%
DATE SAMPLED: 06/04/97
TIME SAMPLED: 00:00
WORK DESCRIPTION: Ethanol 85%-Gasoline 15%

LABORATORY I.D.: 970793-0001
DATE RECEIVED: 06/20/97
TIME RECEIVED: 09:25
REMARKS: 1 Liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	06/23/97	LS
Methanol	<0.01	0.01	LV %	ASTM D-4815		
Ethanol	66.53	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Oxygen Content	24.18	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7826	0.0002		ASTM D-1298	06/24/97	PCW
Heating Value, (Gross)	14798	175	BTU/lb	ASTM D-240	06/26/97	OE
Water, Karl Fischer	4724	1	ppm	ASTM D-1744	07/18/97	DD

DAG 1

3700 Cherry Avenue
Long Beach, CA 90807
(310) 595-8401



CORE LABORATORIES

LABORATORY TESTS RESULTS 10/13/97

JOB NUMBER: 971319

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Gasoline E85, 07/01/97

LABORATORY I.D.: 971319-0001

DATE SAMPLED: 07/01/97

DATE RECEIVED: 10/06/97

TIME SAMPLED: 00:00

TIME RECEIVED: 10:00

WORK DESCRIPTION: Gasoline E85, 07/01/97

REMARKS: 1 liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/**DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	10/07/97	FH
Methanol	0.21	0.01	LV %	ASTM D-4815		
Ethanol	77.60	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Ethyl tert-Butyl Ether	<0.01	0.01	LV %	ASTM D-4815		
Oxygen Content	27.45	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7826	0.0002		ASTM D-1298	10/13/97	LS
Heating Value, (Gross)	14466	175	BTU/lb	ASTM D-240	10/09/97	OE
Water, Karl Fischer	6008	1	ppm	ASTM D-1744	10/13/97	GS

DAG 2

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031



CORE LABORATORIES

LABORATORY TESTS RESULTS 10/13/97

JOB NUMBER: 971319

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Gasoline E85, 07/30/97

LABORATORY I.D.: 971319-0002

DATE SAMPLED: 07/30/97

DATE RECEIVED: 10/06/97

TIME SAMPLED: 00:00

TIME RECEIVED: 10:00

WORK DESCRIPTION: Gasoline E85, 07/30/97

REMARKS: 1 liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	10/07/97	FH
Methanol	0.22	0.01	LV %	ASTM D-4815		
Ethanol	76.86	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Ethyl tert-Butyl Ether	<0.01	0.01	LV%	ASTM D-4815		
Oxygen Content	27.21	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7822	0.0002		ASTM D-1298	10/13/97	LS
Heating Value, (Gross)	14489	175	BTU/lb	ASTM D-240	10/09/97	OE
Water, Karl Fischer	6242	1	ppm	ASTM D-1744	10/13/97	GS

DAG3

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031



CORE LABORATORIES

LABORATORY TESTS RESULTS 10/13/97

JOB NUMBER: 971319

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Gasoline E85, 09/24/97

LABORATORY I.D.: 971319-0004

DATE SAMPLED: 09/24/97

DATE RECEIVED: 10/06/97

TIME SAMPLED: 00:00

TIME RECEIVED: 10:00

WORK DESCRIPTION: Gasoline E85, 09/24/97

REMARKS: 1 liter Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815	10/07/97	FH
Methanol	0.18	0.01	LV %	ASTM D-4815		
Ethanol	77.86	0.01	LV %	ASTM D-4815		
MTBE	<0.01	0.01	LV %	ASTM D-4815		
TBA	<0.01	0.01	LV %	ASTM D-4815		
tert-Amyl methyl ether	<0.01	0.01	LV %	ASTM D-4815		
Ethyl tert-Butyl Ether	<0.01	0.01	LV%	ASTM D-4815		
Oxygen Content	27.49	0.2	% Wt. Oxygen	ASTM D-4815		
Specific Gravity 60/60	0.7835	0.0002		ASTM D-1298	10/13/97	LS
Heating Value, (Gross)	14305	175	BTU/lb	ASTM D-240	10/09/97	OE
Water, Karl Fischer	6154	1	ppm	ASTM D-1744	10/13/97	GS

DAG 4

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031



CORE LABORATORIES

LABORATORY TESTS RESULTS 06/12/98

JOB NUMBER: 980692

CUSTOMER: Battelle

ATTN: Kevin Chandler

CLIENT I.D.: Gasoline, E85, ODA
DATE SAMPLED: 01/27/98
TIME SAMPLED: 00:00
WORK DESCRIPTION: Gasoline, E85, ODA

LABORATORY I.D.: 980692-0001
DATE RECEIVED: 06/01/98
TIME RECEIVED: 10:58
REMARKS: 1000ml Glass Bottle

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Oxygenates in Gasoline		*1		ASTM D-4815 (Mod)	06/08/98	FH
Methanol	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
Ethanol	83.67	0.10	LV %	ASTM D-4815 (Mod)		
MTBE	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
TBA	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
tert-Amyl methyl ether	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
Ethyl tert-Butyl Ether	<0.10	0.10	LV %	ASTM D-4815 (Mod)		
Oxygen Content	29.60	0.20	% Wt. Oxygen	ASTM D-4815 (Mod)		
Specific Gravity 60/60	0.7794	0.0002		ASTM D-1298	06/05/98	PW
Heating Value, (Gross)	15522	175	BTU/lb	ASTM D-240	06/10/98	OE
Water, Karl Fischer	5194	1	ppm	ASTM D-1744	06/05/98	PW

DAG 5

21730 S. Wilmington Suite 201
Carson, CA 90810
(310) 513-2031

Appendix F

Other Information

- Recall letter from Ford Motor Company
- Letter from Ford Motor Company regarding engine oil requirement for FFVs

A. R. Kaduk
Manager
Vehicle Service and Programs
Ford Customer Service Division



Ford Motor Company
P.O. Box 1904
Dearborn, MI 48121-1904

96 Taurus
Vehicle ID #: 1FALP5221TG195919 96E59 Kit AA

March, 1997

PUBLIC UTILITIES
180 EAST BROAD ST
COLUMBUS, OH 43215

Ford Motor Company is voluntarily recalling (Emissions Recall 96E59) certain 1996 Taurus flexible fuel cars.

What The Dealer Will Do: At no cost to you your dealer will replace a wiring connector seal in the fuel delivery module and the fuel tank vapor vent valve assembly, which is part of the fuel vapor management system of your car according to the instructions provided by Ford.

This service should have little or no effect on your car except to reduce air pollutants.

If you do not have this service done;

- Your car may not start due to failure of the fuel delivery module electrical connector.
- Your emissions warranty may be reduced.
- Your vehicle may not pass emissions or smog tests that may be required in your area.

How Long Will It Take?

The time needed for this service is less than one full day. However, due to service scheduling times, your dealer may need your vehicle for a longer period of time.

Call The Toll-Free Number:

Call toll-free 1-800-248-0186 and inform the Ford representative that you wish to have your car serviced under Emissions Recall 96E59. Representatives are available 7:30 AM to 7:30 PM Monday through Friday and 8:00 AM to 3:00 PM on Saturday (times are Eastern Time).

Please have this letter available when you call. The Ford representative will ask for the serial number of your car. It is printed on the top of this letter.



Arrangements will be made with the dealership of your choice to have replacement parts available. The dealership will call you to schedule a service appointment. You need do nothing else except bring your car to the dealership on the service date.

If you do not hear from your dealer within two business days, call the dealer service manager and request a service appointment.

Changed Address Or Sold The Car? If you have changed your address or sold the car, please fill out the enclosed prepaid postcard and mail it to us.

If the repair offered by this recall is not made promptly and without charge, talk to the dealer service manager. You may also contact the Ford Customer Assistance Center at 300 Renaissance Center, P. O. Box 43360, Detroit, Michigan 48243.

We regret any inconvenience this recall may cause you. We are taking this action to ensure your continued satisfaction with your Ford-built car. Please have your car serviced promptly to maintain full emission warranty coverage.

Sincerely,



A. R. Kaduk
Manager
Vehicle Service and Programs

Emission Recall
96E59



E. W. Alcock
Special Projects
Vehicle Service & Programs
Ford Customer Service Division

Ford Motor Company
Fairlane Business Park III
Suite 200
Allen Park, MI 48101

July, 1997

Mr. Phillip Lampert
National Ethanol Vehicle Coalition
Suite 120
3702 W. Truman Blvd.
Jefferson City, MO 65109

Subject: Engine Oil Requirement For Taurus FFVs

Dear Mr. Lampert:

This letter is in response to your request for the current engine oil requirement on Ford Taurus FFVs.

If a Taurus FFV is operated on Ethanol Blended Fuel (E85) or unleaded gas only, the engine oil requirement has changed from Ford synthetic to Motorcraft 5W30, 10W30 or equivalent. If a Ford Taurus FFV is operated on Methanol Blended Fuel (M85), use of Ford synthetic engine oil (part number XO-10W30-FFV) or equivalent is still required. Engine oil change intervals must be maintained at 5,000 miles with use of either oil.

Thank you for your inquiry. If you have any additional questions, please contact me at (313) 248-7626 or fax (313) 845-7231.

Sincerely yours

E. W. Alcock

E. W. Alcock



RECEIVED

OFFICE OF

FLEET MANAGEMENT

The National Ethanol Vehicle Coalition is jointly supported by the
Governors' Ethanol Coalition, National Corn Growers Association
and its affiliated state corn associations.

FYI

AUG 12 11 34 AM '97

August 1, 1997

Dear Friend,

We are very pleased to report to you that Ford Motor Company has revised their position on the use of high cost synthetic oils in the E85 flexible fuel Taurus!

Up until this time, Ford has indicated that it was a manufacturer requirement that any time the FFV ~~was operated on either E85 or M85, the use of the synthetic oil was mandatory.~~ Unfortunately, this added to the cost of changing the oil in an FFV. In our ongoing efforts to make E85 vehicles as "transparent" (similar to the operation of a gasoline vehicle) as possible, we have continued to discuss the need for this oil with Ford engineers.

Ford recently issued a service statement to all North American dealers indicating that the synthetic oil was no longer required in the FFV Taurus when operated on either E85 or unleaded gasoline. The synthetic engine oil is still required when operating the FFV Taurus on M85. The oil change interval remains at 5,000 miles, regardless of operation on E85 or unleaded gasoline.

Ford Motor Company has provided us the attached correspondence as confirmation of their change in motor oil policy.

Thank you for your continuing support of ethanol as an alternative transportation fuel. Should you have questions concerning this engine oil issue or other E85 issues, please feel free to contact Sandy Hentges or me at your convenience at (573) 635-8445 or email nevc@sockets.net.

Sincerely,

NATIONAL ETHANOL VEHICLE COALITION

Phillip J. Lampert
Project Coordinator

enclosure

Appendix G

Equations and Sample Calculations

Equations and Sample Calculations

This appendix presents equations and sample calculations for the analysis in this report. The calculations covered here are: vehicle usage, energy equivalence, fuel economy, fuel usage costs, maintenance costs, and total operating costs.

Vehicle Usage

Vehicle usage for this report was calculated for each fleet on a monthly average basis. The equation of this calculation is shown below:

$$\text{Average Monthly Vehicle Usage} = \text{Fleet Mileage} / \text{Number of Months} / \text{Number of Vehicles in Fleet}$$

A sample calculation can be made for the gasoline control fleet for the total data collection period, using data from Appendix A:

Fleet mileage is 61,324
Number of months is 17
Number of vehicles in fleet is 3

$$\text{Average Monthly Vehicle Usage} = 61,324/17/3 = 1,202 \text{ miles}$$

This sample calculation is not as simple for the ethanol fleet because the number of months of data for each vehicle is different. In this case, the total number of months of operation that make up the fleet mileage is made, then the calculation is fleet mileage/total number of months of operation of all vehicles in fleet, using data from Appendix C.

Fleet mileage is 162,502
Number of months of operation is 148

$$\text{Average Monthly Vehicle Usage} = 162,502/148 = 1,098 \text{ miles}$$

Energy Equivalence

Energy equivalence for this study involves converting the ethanol fuel gallons into gallons of gasoline energy-equivalent gallons. In this study, three grades of ethanol fuel have been used and converted into energy equivalent gallons of gasoline: E65, E70, and E85. The ethanol fuel grade will affect the numbers used to calculate an energy equivalent gallon of gasoline. The general equation for the conversion follows:

$$\text{Gasoline Energy Equivalent Gallon} = \text{Volume of ethanol fuel} * (\text{Lower heating value for ethanol fuel} / \text{Lower heating value of gasoline})$$

The division of the two lower heating values creates the conversion factor for ethanol fuel to energy equivalent gallons of gasoline. Table 7 in the report shows conversion factors for straight ethanol, E85, E70, and E65.

A sample calculation for converting ethanol fuel gallons to gallons of energy equivalent gasoline follows:

Volume of ethanol fuel is 10 gallons of E85
E85 conversion factor (in parentheses in equation above) = E85 LHV 83,553/Gasoline LHV 115,400 = 0.724
Gasoline Energy-Equivalent Gallons = 10 * 0.724 = 7.24 gallons

Fuel Economy

Fuel economy for this report is strictly based on miles per gallon of fuel; the equations follow:

Miles per Gallon (MPG) = Miles/gallons of fuel consumed to travel distance

Miles per Energy Equivalent Gallon (MPEG) = Miles/gallons of energy equivalent fuel consumed to travel distance

A fuel economy calculation for a gasoline vehicle is straightforward and includes (1) counting all of the gasoline fuel used, (2) calculating the mileage traveled during the consumption of the gasoline, and (3) calculating the MPG. A sample calculation follows:

Gallons of gasoline are 10

Mileage during consumption is 250

MPG = 250 miles/10 gallons = 25 miles/gallon

The above sample calculation is shown to be very simple; however, one of the more difficult portions of the calculation has been removed by providing the mileage during consumption. The fuel economy calculation for an ethanol FFV vehicle is more involved and will be used to demonstrate a fuel economy calculation from the fuel receipts of a vehicle. The steps for calculating the fuel economy include (1) all of the gasoline fuel used and all of the ethanol fuel used is counted, (2) the ethanol fuel is converted into an energy-equivalent gallon of gasoline, (3) the energy-equivalent gallons of gasoline for the ethanol fuel and the gasoline gallons are added together, (4) the mileage that the vehicle was driven during the consumption of that fuel is calculated, (5) the miles per energy-equivalent gallon is calculated by dividing the mileage by the total gallons of gasoline and energy-equivalent gasoline.

Sample data for ethanol FFV fuel economy calculation are shown in the following table:

Date	Amount (gal)	Fuel Type	Odometer
2/12/97	3.9	gasoline	9490
2/14/97	12	E85	9589
2/15/97	12.8	gasoline	9833
2/21/97	10.5	gasoline	10095
3/6/97	8	E65	10267
3/7/97	10	E65	10487
3/12/97	4.3	E65	10603
3/13/97	4.2	gasoline	10849
3/13/97	10.4	E65	10965
3/14/97	11	E85	11224

Steps to calculate miles per energy equivalent gallon for the above interval:

1. Gallons of gasoline = 12.8 + 10.5 + 4.2 = 27.5 gal

Note that 3.9 gallons of gasoline at the top was excluded; an assumption has been made that the fuel tank was full at the end of that fueling, so only the following fuelings were consumed during the mileage shown in the data.

$$\text{Gallons of E85} = 12 + 11 = 23 \text{ gal}$$

$$\text{Gallons of E65} = 8 + 10 + 4.3 + 10.4 = 32.7 \text{ gal}$$

2. Calculate energy-equivalent gallons of gasoline for E85 fuel and E65 fuel shown in step 1.

$$\text{E85} - 23 \text{ gal} * 0.724 \text{ (from Table 7)} = 16.7 \text{ energy-equivalent gallons of gasoline}$$

$$\text{E65} - 32.7 \text{ gal} * 0.793 = 25.9 \text{ energy-equivalent gallons of gasoline}$$

3. Add all the gallons of fuel = 27.5 gal + 16.7 gal + 25.9 gal = 70.1 gal
4. Calculate mileage by subtracting the starting odometer reading from the ending odometer reading.

$$\text{Mileage} = 11224 - 9490 = 1734 \text{ miles}$$

5. Calculate the miles per energy-equivalent gallons (mpeg).

$$\text{mpeg} = 1734 \text{ miles} / 70.1 \text{ gal} = 24.7 \text{ mpeg}$$

Fuel Usage Costs

Fuel usage costs are based on the fuel cost per volume with the fuel economy taken into account. In other words, the cost of the actual fuel used per mile is the fuel usage cost. For this study, all fuel receipts were tracked, including the total cost for fuel for each fill up. The fuel usage cost calculation is based on the fleet mileage operated during the period of fuel costs. This is done to base the cost on operation of each vehicle so that the cost is in perspective to usage. The 1,000 miles is just a multiplier so that the small number is easier to see and discuss for comparison. The equation used for the fuel usage costs is shown below:

$$\text{Fuel Usage Cost} = \text{Total fuel cost} * 1,000 \text{ miles} / \text{miles traveled during consumption of fuel}$$

A sample calculation can be made for the gasoline control fleet for the total data collection period, using data from Appendix A:

Total fuel cost is \$2,741.84

Fleet mileage is 52,538

$$\text{Fuel Usage Cost} = \$2,741.84 * 1,000 \text{ miles} / 52,538 \text{ miles} = \$52.19$$

The ethanol fleet has a similar calculation:

Total fuel cost is \$10,391.28

Fleet mileage is 162,502

$$\text{Fuel Usage Cost} = \$10,391.28 * 1,000 \text{ miles} / 162,502 = \$63.95$$

Maintenance Costs

Maintenance costs consist of actual parts costs, labor costs, and other costs (recycling costs, disposal costs of parts and engine oil, and car washes). The maintenance cost equation used for this report follows:

$$\text{Maintenance Cost} = (\text{parts cost} + \text{labor cost} + \text{other cost}) * 1,000 \text{ miles} / \text{fleet mileage}$$

A sample calculation can be made for the gasoline control fleet for the total data collection period, using data from Appendix C:

Total parts cost is \$1,126.85

Total labor cost is \$346.41

Total other cost is \$53.23

Fleet mileage is 61,324

Maintenance Cost = $(\$1,126.85 + \$346.41 + \$53.23) * 1,000 \text{ miles} / 61,324 \text{ miles} = \24.89

The ethanol fleet has a similar calculation:

Total parts cost is \$872.31

Total labor cost is \$896.65

Total other cost is \$432.18

Fleet mileage is 162,502

Maintenance Cost = $(\$872.31 + \$896.65 + \$432.18) * 1,000 \text{ miles} / 162,502 \text{ miles} = \13.55

Total Operating Costs

Total operating costs for this report include fuel usage and maintenance costs. The equation for this calculation is very simple now that the fuel usage and maintenance costs have been calculated:

$$\text{Total Operating Costs} = \text{Fuel Usage Costs} + \text{Maintenance Costs}$$

A sample calculation for the gasoline control fleet for the total data collection period follows:

Total Fuel Usage Costs are \$52.19

Total Maintenance Costs are \$24.89

Total Operating Costs = $\$52.19 + \$24.89 = \$77.08$

The ethanol fleet has a similar calculation:

Total Fuel Usage Costs are \$63.95

Total Maintenance Costs are \$13.55

Total Operating Costs = $\$63.95 + \$13.55 = \$77.49$ (rounding error)

Appendix H

Survey of E85 Fleet Managers

FORD E85 FLEX-FUEL TAURUS SURVEY

April 29, 1998

The following page is a survey for the Ford Taurus E85 FFVs in the state program (all model years). Please take a few minutes to fill the survey out and fax it to (614) 424-5069 by Friday, May 8, 1998. Feel free to comment positively or negatively. We do not plan to publish these forms in their entirety, only the aggregate results of the survey. If you do not have or operate any E85 Taurus FFVs, please mark the top of the survey with NO VEHICLES and fax it back.

Thank you for your participation. If you have any questions or comments, please feel free to call Kevin Chandler at (614) 424-5127 at Battelle or Lani Napier at (614) 466-6607 at the Office of Fleet Management.

April 27, 1998

Survey of E85 Study Participants

Name _____

Agency _____

Number of E85 FFVs in Fleet Total _____ In Study _____

1. What is your overall evaluation of how the vehicle(s) performance on E85?

- ☐ Excellent - no problems or concerns
- ☐ Very well - minimal problems or concerns
- ☐ Average - some problems now and then
- ☐ Fair - tends to have problems
- ☐ Poor - seems to always have some sort of problem or concern

2. How does this vehicle(s) compare to similar gasoline fueled vehicles?

- ☐ Better
- ☐ About the same
- ☐ Not as well

Comments/Why? _____

3. How satisfied are you with the mileage range of this vehicle (that is, how far you can travel on a tank of E85)?

- ☐ Acceptable
- ☐ Marginal
- ☐ Not acceptable

Comments/Why? _____

4. How satisfied are you with the availability and location of E85 fuel?

- ☐ Acceptable
- ☐ Marginal
- ☐ Not acceptable

Comments/Why? _____

5. Please comment on things that you liked or disliked about E85 vehicle operation, refueling, or maintenance.

Thank you for your participation in this study and for filling out this survey. Please fax this page back to Kevin Chandler at Battelle at (614) 424-5069. Call at (614) 424-5127 with questions, comments, or problems with this survey.

REPORT DOCUMENTATION PAGE

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