APPENDIX C

DISCUSSION OF OBD II RESULTS

Data Collection and Analysis

Throughout the test program, tailpipe emissions data were supplemented with OBD II data to determine if there was any significant response to fuel characteristics not evident in the regulated pollutants.

OBD II data was collected using EASE Diagnostics PC Based Scan Tool software. The PC was connected directly to the vehicle's OBD II port through an EASE ST12-INT interface. A generic data set was selected for each vehicle. Data recording was manually controlled by reference to an audible signal produced by the driver's aid at the beginning and end of each cycle. A data file was saved at the end of each cycle to facilitate identification of the particular run. Following testing, the EASE data files were converted to comma delineated files and parsed into QuattroPro for analysis. Statistical analyses were performed with ProStat 2.0 software.

It was anticipated that the following parameters, available for both vehicles, would be of primary interest, with the indicated potential interpretation:

oxygen sensor voltage	-	oxygen sensor response
long term fuel trim	-	fuel injection frequency adjustment, deviation from normal
throttle opening	-	driver awareness of fuel characteristics.

This appendix presents typical graphs of the data collected by the OBD II scan tool used during all testing in this study. Other OBD II data are available upon request.

Figure C1 illustrates the effect of all four test fuels on long term fuel trim for the Plymouth Breeze when operated on the FTP cycle Bag 1. Moving to the right on the X-axis indicates longer injection times, or simply more fuel injected per intake cycle. The baseline fuel is the left most curve on the graph and the progression is the non-oxygenated ERFG fuel second from the left, the ethanol oxygenated RFG fuel second from the right and the MTBE oxygenated RFG fuel to the right. This illustrates that, as the fuels provide more oxygen, the feedback control system is able to enrichen the mixture while maintaining the desired levels of residual oxygen in the exhaust. The reduced energy content of the oxygenated fuels may compound this tendency toward enrichment.

Figure C1
Normalized Cumulative Frequency for Long Term Fuel Trim
for the Plymouth Breeze Operated on Bag 1 of the FTP for All Fuels

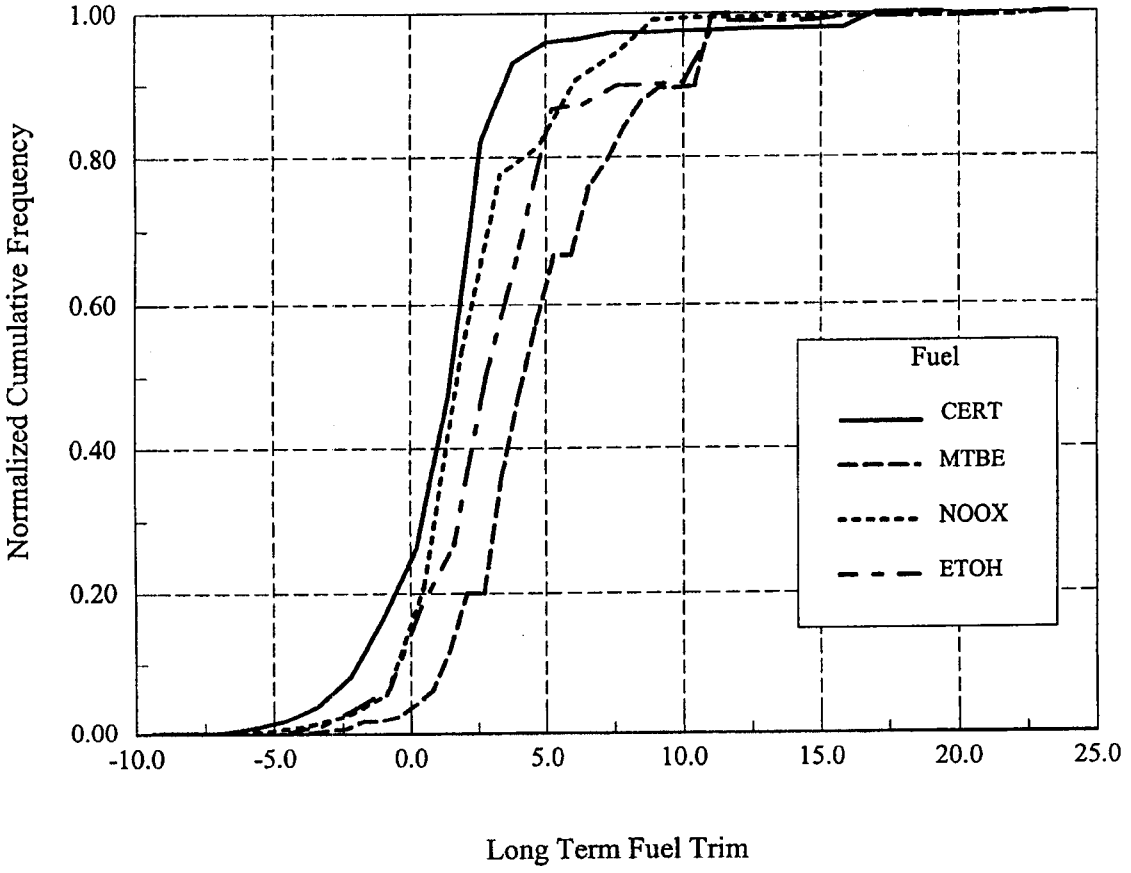
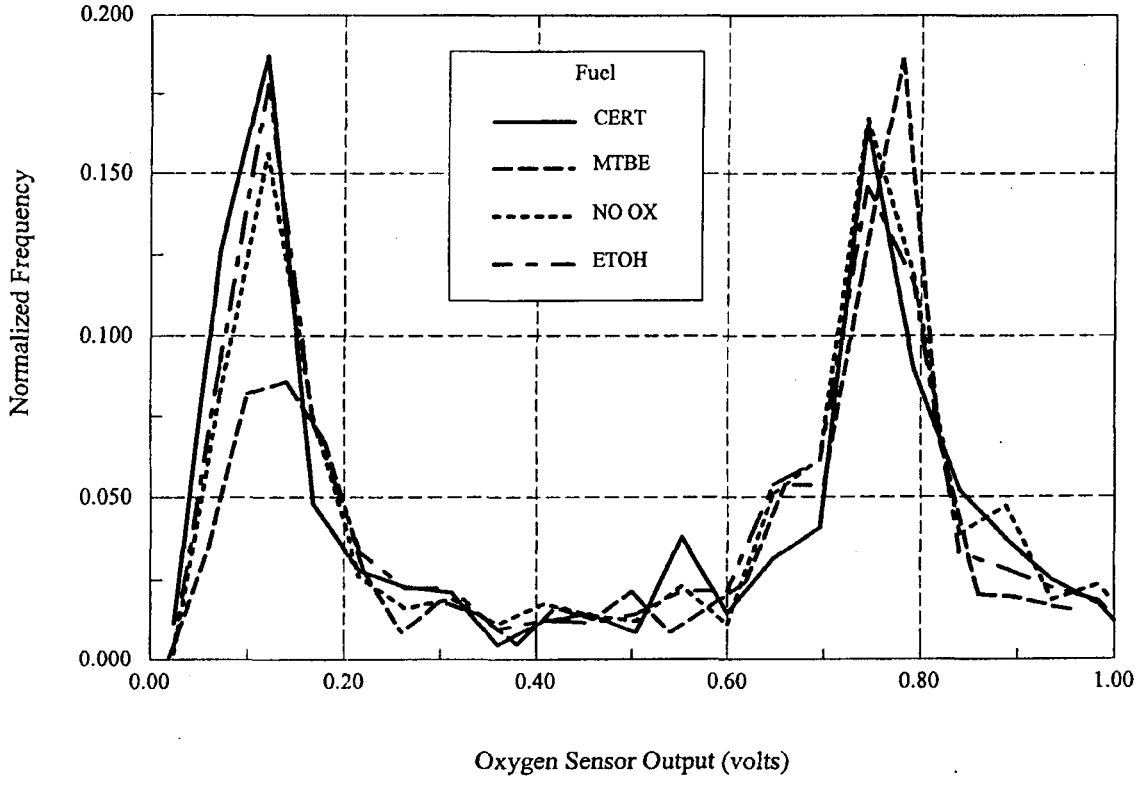


Figure C2 illustrates the response of the oxygen sensor for all four test fuels on the Plymouth Breeze when operated on the FTP Cycle Bag 1. Stoichiometric combustion occurs at approximately 0.5 volts for this vehicle. The bimodal distribution in Figure C2 demonstrates the constant dithering of the fuel management system between a rich and lean mixture to maintain optimal 3-way catalyst function. The important fact disclosed by this graph is that the feedback control system achieves residual oxygen levels that are essentially independent of the oxygen content of the fuel.

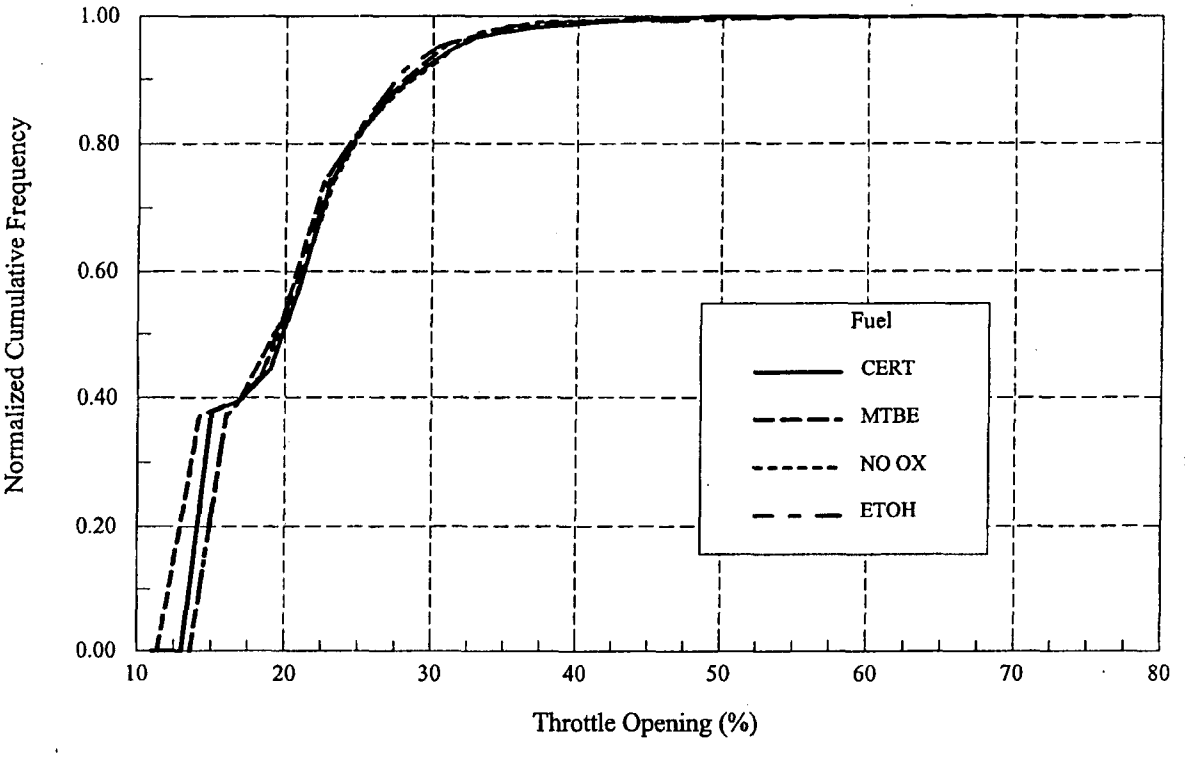
Figure C2
Normalized Frequency for Oxygen Sensor Output
for the Plymouth Breeze Operated on Bag 1 of the FTP for All Fuels



Together, Figures C1 and C2 suggest that oxygenated fuels have been rendered largely obsolete by modern feedback mixture controls. The additional oxygen content, desirable in carbureted engines, now permits enrichment of the mixture beyond levels experienced on certification fuel.

Below, Figure C3 shows that throttle position is essentially the same regardless of fuel type, thus the change in fuel composition would be transparent to the driver of the vehicle.

Figure C3
Normalized Cumulative Frequency of Throttle Opening
for the Plymouth Breeze Operated on the Bag 1 of the FTP for All Fuels



These results were fairly typical for all of the test cycles and all of the fuels tested in this program. We were able to determine that the engine management systems for both vehicles operated essentially the same, that fuel mixture control is dithered about stoichiometric AFR to optimize and maintain catalyst function.

Furthermore, throttle position sensor data suggest that fuel composition would be transparent to the driver of either vehicle. Throttle position for each vehicle was essentially the same for all four fuels on any specific test cycle, hence the driver should not feel a need to modify throttle operation across fuels to achieve desired vehicle performance.