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2006 CRC HOT-FUEL-HANDLING PROGRAM

Final Report

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2006 CRC Hot-Fuel-Handling Program

(CRC Project No. CM-138-06)

Prepared by the

CRC Volatility Group

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CRC Performance Committee
of the
Coordinating Research Council

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ABSTRACT

The 2006 CRC Hot-Fuel-Handling Program was conducted at the GM Desert Proving Grounds (DPG) in Mesa, Arizona, May 22 through July 8, 2006. The objective of the program was to determine the effect under hot ambient temperature conditions (over 100°F) of fuel front-end volatility and ethanol content on hot-fuel-handling driveability performance in a large group of late-model vehicles and a smaller group of nominal ten-year-old vehicles, all equipped with fuel-injection systems. There were 23 late-model and 4 older-model vehicles chosen from a larger fleet of 66 1995 – 2007 vehicles. The test fuel design consisted of 12 test fuels: a hydrocarbon-only fuel and blends with three concentrations of ethanol (5, 10, and 20 volume percent) at low, intermediate, and high volatility levels. Because of a lack of significant levels of driveability demerits, not all the design test fuels were used in the program. Two additional blends with higher volatility procured on-site from the Desert Proving Grounds were tested in all vehicles in place of the untested design fuels.

Several small side programs tested a variety of theories to try to explain the lack of significant levels of demerits. One of these side programs involved testing the high-volatility, hydrocarbon-only fuel and the high-volatility, 10 volume percent ethanol fuel at the lower intermediate temperature (less than 100°F) used in the 2001 CRC Hot-Fuel-Handling Program conducted in Yakima, Washington, to see if the current vehicles responded differently than those used in the 2001 program. The properties of these two 2006 fuels resemble properties of two of the 2001 fuels. These comparisons did not show that the current vehicles were less sensitive, which could have accounted for the lack of driveability demerits in the current program. Other possible factors investigated but yet did not account for the lack of fuel response were potential rapid weathering of the fuel during vehicle warm-up, the fuel flushing procedure, and the vehicle warm-up procedure.

The range of fuel properties investigated in this program provided too few driveability demerits to assess the effects of fuel volatility properties or ethanol content on hot-fuel-handling driveability. No statistically significant relationship was found between driveability demerits and measured TVL20, DVPE (Dry Vapor Pressure Equivalent), or ethanol content. Fuel weathering in vehicles increased with an increase in fuel vapor pressure, with an increase in ambient temperature, and with an increase in ethanol content. The fuel weathering that was observed was not of sufficient magnitude to explain the lack of results.

I. INTRODUCTION

The CRC Volatility Group conducted a program in 2006 to determine the effect under hot ambient temperature conditions of fuel front-end volatility and ethanol content on hot-fuel-handling driveability performance in a large group of late-model vehicles and a smaller group of nominal ten-year-old vehicles equipped with fuel-injection systems. CRC had also conducted hot-fuel-handling programs in 1999 and 2001, one of which investigated 10 volume percent ethanol, and the other of which investigated a range of ethanol concentrations.[1,2] Both programs were conducted under warm ambient temperatures nominally ranging from 80°F to 100°F. The best volatility parameter that correlated with hot-fuel-handling problems was derived from an experimental test apparatus which measured the temperature for a vapor-liquid ratio of 1 at 500 kPa (TVL1-500). The temperature for a vapor-liquid ratio of 20 (TVL20), which is the parameter currently used in ASTM D 4814[3] to control vapor lock and hot-fuel-handling driveability problems, did not adequately predict performance for hydrocarbon-only fuels and ethanol blends. An index using TVL20 and ethanol content terms predicted performance nearly as well as TVL1-500 in both programs. The resulting equations to adjust the measured TVL20 for the ethanol effect were:

1999 Program: Adjusted TVL20 = TVL20 – 1.33*Ethanol Content
2001 Program: Adjusted TVL20 = TVL20 – 1.27*Ethanol Content

When a study was undertaken to incorporate the ethanol effect into ASTM D 4814, it became apparent that, for the southeastern portion of California in the summertime, the current minimum TVL20 limit of 60°C (140°F) could not be met using ethanol blends and still comply with California Phase 3 reformulated gasoline regulations, specifically the 50 volume percent evaporated point, along with the minimum federal vapor pressure limit. From the study, it was not known: (1) whether the above TVL20 adjusted for ethanol content equation was or was not applicable at high ambient temperatures; (2) if the current TVL20 minimum limit was or was not too restrictive for modern fuel-injected vehicles; or (3) if the lack of reported volatility-related problems for the area correctly reflected an absence of problems. The need to know the answers to these questions became greater as other hot-weather areas adopted reformulated gasolines or introduced ethanol blends.

The above TVL20 ethanol offset models are derived from data obtained with test fuels containing 3 to 10 volume percent ethanol. With recent increased interest in 20 volume percent ethanol blends (E20), an E20 fuel series was incorporated into the 2006 CRC program.

The 2006 CRC Hot-Fuel-Handling Program was conducted from May 22 through July 8, 2006, at the General Motors Desert Proving Grounds (DPG), in Mesa, Arizona. Members of the Data Analysis Panel and participants in the program are shown in Appendices A and B, respectively. Appendix C outlines the program as approved by the CRC Performance Committee. Also included in Appendix C are the recently developed draining and flushing procedures[4].

II. CONCLUSIONS

The conclusions of the 2006 CRC Hot-Fuel-Handling Program are as follow:

- Under high ambient temperature conditions, this program provided too few driveability demerits to assess the effects of fuel volatility properties or ethanol content on hot-fuel-handling driveability. No statistically significant relationship was found between driveability demerits and measured TVL20, DVPE (Dry Vapor Pressure Equivalent), or ethanol content.

- Possible causes of the low level of driveability demerits that were investigated and determined to be invalid were:

    - rapid weathering of the fuel during warm-up
    - the fuel flushing procedure
    - the warm-up procedure
    - vehicle technology changes

- The normal screening process utilized to identify fuel-sensitive vehicles proved to be unsuccessful, even with the higher volatility test fuels. Test vehicles were thus selected based on the screening data to the maximum extent possible. If that was not possible, they were selected to represent as wide a variety as possible of engines, makes, and models. This had no impact on the findings.

- The complete design set of test fuels was not evaluated because of a lack of driveability demerits on the most volatile fuels. Two additional fuels with increased volatility (around 11 psi DVPE) were obtained on-site from the DPG, but they also did not produce any significant increase in driveability demerits.

- Under intermediate ambient temperature conditions, a limited study to tie back to the 2001 hot-fuel-handling intermediate-temperature program showed that two 2006 fuels similar in vapor pressure and TVL20 to those in the 2001 study had about the same level of driveability demerits as the 2001 program.

- Fuel weathering in vehicles increased with an increase in fuel vapor pressure, with an increase in ambient temperature, and with an increase in ethanol content.

- Although a change in the fuel flushing procedure did not affect the results of the program because of the low level of demerits, it did result in poorer flushing efficiency. The original procedure should thus be used in future volatility programs.

III. TEST VEHICLES

Approximately 20 late-model and 5 ten-year-old fuel-injected vehicles were planned to be used in the program. As it turned out, 23 late-model and 4 older-model vehicles were chosen from a larger fleet of 66 vehicles (61 late-model rental vehicles, and 5 1995-1998 privately-owned vehicles). The 61 late-model rental vehicles were screened for fuel sensitivity by testing them first on their tank fuel and then testing them on the high-volatility 10 volume percent ethanol blend (designated as Fuel H10). The plan was that those vehicles that showed few demerits on both fuels would be returned to the rental agency, as would those vehicles showing high demerits on both fuels. The vehicles that showed few demerits on their tank fuel and high demerits on Fuel H10 would be sensitive vehicles to be retained as part of the final fleet.

Unfortunately, things did not go as planned. All 61 rental vehicles gave few demerits on both fuels, so there was no basis from which to select the final fleet. Test vehicles were thus selected based on the screening data to the maximum extent possible. If that was not possible, they were selected to represent as wide a variety as possible of engines, makes, and models. The final fleet was thus selected as follows: All replicate models, except for a single vehicle of each make and model, were returned to the rental agency. The fleet was still too large for budgetary and logistical constraints, so makes and models that shared a common engine were eliminated except for one vehicle of each engine displacement. The decision as to which one of the vehicles to keep was not an obvious one to make, so each was selected randomly. The PT Cruiser was returned, even though it was the only one in the fleet, because the air-conditioner was not operating properly, and it was unclear whether the compressor was working and putting a load on the engine. This selection procedure left the fleet with 23 late-model test vehicles.

There was a great deal of difficulty in procuring the nominally ten-year-old vehicles. Once it became obvious that these older vehicles were not easily available, a contractor in Phoenix was used to locate and provide them. It had been hoped to have a twelve-vehicle base from which to select the most fuel-sensitive older vehicles, but the contractor was only able to find five such vehicles. CRC thus took all five for the program. As the vehicles were being prepared for testing, however, it was discovered that the 1996 Chevrolet Cavalier had a hard fuel line running much of the length of the vehicle that would require breaking into in order to drain the fuel tank. Since it was a privately owned vehicle, it was decided not to be that invasive into the fuel system, so this car was returned to the contractor.

In the large fleet, there were one 2007, forty-five 2006, fifteen 2005, two 1998, one 1997, one 1996, and one 1995 vehicles. All were equipped with air conditioning, automatic transmissions, and port fuel injection. Engine displacements ranged from 1.6 to 6.0 liters. The fleet had both types of fuel return strategies – return and returnless – although most were returnless. Vehicles in the final fleet were manufactured by DaimlerChrysler, Ford, General Motors, Honda, Hyundai, Kia, Mazda, Toyota, and Nissan. The 27 vehicles in the final fleet are shown in Table 1, and a complete description of the 66-vehicle fleet is presented in Appendix D.

IV. TEST FUELS

The test fuel matrix consisted of twelve test fuels: three sets each of four fuels possessing low, intermediate, and high volatility properties. Each set of four fuels consisted of 0, 5, 10, and 20 volume percent ethanol. The low volatility test fuels were designated as L0, L5, L10, and L20, where the number represents volume percent ethanol. The intermediate volatility test fuels were designated as I0, I5, I10, and I20. The high volatility test fuels were designated as H0, H5, H10, and H20. The primary fuel volatility parameter utilized to design the fuel sets was TVL20 minus 1.27 x volume percent ethanol from the 2001 program.

Not all the design test fuels were used in the test program. H0, H5, H10, H20, I0, and L0 were tested. Because these more volatile fuels were not providing significant levels of driveability demerits, it was decided not to test the lower volatility fuels. Instead, three additional blends procured on-site from the DPG were tested: (1) a fuel that was much like the CRC H10 fuel was tested, except that the T50 was lower (designated as Low T50 Fuel); (2) a fuel was also tested that had a vapor pressure of about 11 psi with 20 volume percent ethanol (designated as X20 Fuel), and (3) a fuel that had a vapor pressure of about 8 psi and had 10 volume percent ethanol (designated as House Fuel, which was tested in only three vehicles).

Average DVPE, TVL20, distillation temperatures, ethanol content, and other property inspection results as determined by the supplier (Laboratory A) and Fuel Acceptance Panel Laboratories (B, C, and D) are shown in Table 2. Individual test results obtained by each inspecting laboratory are shown in Table E-1 of Appendix E. Inspections for the three fuels provided by the DPG are shown in Table 3.

V. TEST SITE

The test program was conducted at the General Motors Desert Proving Grounds in Mesa, Arizona, outside of Phoenix, Arizona. The DPG are at an altitude of approximately 1,200 feet above sea level. A large, rectangular, flat, paved area of the Brake Test Facility was used as the test site. A container which had been purchased by CRC for equipment storage was converted into a refrigerated fuel storage container, and GM provided a swamp-cooled fuel storage room, as well. A small office trailer was rented, and a nearby building was utilized for analyzing the fuel samples to obtain the DVPE readings. Four roofless wooden sheds for hot-soaking a vehicle were used, each capable of holding two vehicles. A group of two sheds was set up at the east end of the test site, and the other group of two sheds was set up at the west end of the test site. The defueling/flushing/refueling/sampling area was mid-site as were the fuel and vehicle storage, and the office trailer.

The program was conducted from May 22, 2006, through July 8, 2006. The week of May 15 was used for repair of the soak sheds and the conversion of the equipment storage container into the refrigerated fuel storage container. The weeks of May 22 and May 29 were used for vehicle screening for fuel sensitivity, and the core program was conducted June 5 through July 8. The target ambient testing temperature range was 105°F - 115°F. Once testing had begun, it was decided to broaden the temperature range. Because of the scarcity of demerits, it was decided to extend the upper end of the ambient temperature range to the lower 120s°F. Also, in an attempt to tie back to the 2001 data, it was decided to test in the 90s°F those fuels with similar properties to those tested in the earlier program.

VI. TEST PROGRAM

A. Test Procedure

The test procedure used in this program is similar to the one used in the 1999 and 2001 CRC Hot-Fuel-Handling Programs. In this test procedure, after switching fuels, the test vehicle is warmed-up for 20 miles. This consists of a short drive at which the vehicle is driven at 15 mph, 25 mph, 35 mph, and 45 mph to the 2.5 mile oval track for 15 miles accumulation at 55 mph and then back to the test site at 45 mph, 35 mph, 25 mph, and 15 mph to the soak sheds. The test vehicle is then parked in a soak shed for 20 minutes with the ignition off. The engine is then restarted after the 20-minute soak. Recording of data for calculation of total weighted demerits (TWDs) begins when the engine is restarted. The starting time, idle quality, and the occurrences of any stalls are recorded. The vehicle is accelerated at wide-open-throttle (WOT) to 35 mph. Driveability malfunctions, such as hesitation, surge, stumble, stall, or backfire, and their severity are recorded. The test vehicle is then returned and parked in a soak shed. The transmission is shifted into park and the engine is idled for 20 minutes. The idle quality is assessed, and if the engine stalls, the stall is recorded and an attempt to restart the engine is made immediately. If the engine continues to stall after three restarts, the test is aborted. At the end of the 20-minute idle test period, the transmission is shifted into drive, and the idle quality and any stalls are recorded. The vehicle is then slowly driven from the soak shed and accelerated at light-throttle to 35 mph. Driveability malfunctions and their severity are recorded. The vehicle is driven back to the soak shed and parked with the engine off for 20 minutes. The starting time is recorded, and idle quality and number of stalls are recorded. The vehicle is accelerated out of the soak shed at light-throttle to 35 mph. Driveability malfunctions and their severity are recorded. This concludes the testing sequence.

B. Fueling and Sampling Procedures

All test fuel, prior to being used to supply the test vehicles, including the fuel that had been stored in the DPG swamp-cooled storage room, was stored in the 70°F refrigerated container for at least 24 hours prior to being used. The fuel was delivered to the test vehicles through metered dispensing pumps installed inside the refrigerated container. Samples were taken for vapor pressure from each drum when it was opened. The samples were analyzed using a Grabner DVPE instrument provided by the DPG. A sample of each test fuel was taken from a drum and sent to the volunteer laboratory (Laboratory E) for ASTM D 5191 vapor pressure, ASTM D 86 distillation, and ASTM D 5599 oxygenate inspections. The results from these inspections are shown in Table E-2.

Each vehicle was tested on Fuel L0 immediately after being tested on Fuel H10. A separate sample was collected from each vehicle while Fuel L0 was being drained, and this sample was shipped to the volunteer Laboratory E for ethanol analysis to determine fuel carryover and assess the current flushing procedure. The results of this fuel carryover analysis are presented in Table E-3.

After each test, the fuel from the vehicle tank was sampled through a valve on the fuel rail by running the discharge through a copper cooling coil in an ice chest. Ice was kept in the coolers to keep the copper coils cold to chill the fuel. Chilled one-quart cans were flushed with the chilled fuel and then filled with the same fuel. The samples were immediately placed in an ice chest containing ice. The samples were then removed for evaluation from the ice chest, opened for air saturation as required by ASTM D 5191 and then tested in the Grabner DVPE instrument. The inspection results for the end-of-test vehicle samples are shown in Table E-4.

C. <u>Test Plan</u>

At the beginning of the program, when very few demerits were seen with the high volatility fuel H10, the on-site participants confirmed the fuel properties of Fuel H10. Some crude field tests were conducted to check the actual properties of the fuel; for example, a visual ethanol extraction test was performed. Subsequently, a decision was made to use a fuel that was available on-site from the DPG that was known to have a nominal 8-psi vapor pressure and 10 volume percent ethanol. This fuel was tested in three of the more fuel-sensitive vehicles, and it also failed to give many demerits.

At this point, to test several theories about why the H10 fuel was not giving the expected demerits, several techniques and tests were conducted. Vehicle 48 was sampled to see if there was a difference between the 20-mile warm-up being used and a 10-mile warm-up. This was done to determine if the fuel might be weathering during the warm-up period because of the hot ambient conditions being encountered. Samples were taken from the drum, from Vehicle 48 immediately after the fueling process (to see if there was any significant weathering during the fueling process), and immediately upon return from the 20-mile warm-up. The vehicle was then double-flushed and filled again and sent out on a 10-mile warm-up. The vehicle was sampled immediately upon return from the 10-mile warm-up. This was done in a temperature range of 110°-112°F on two different days (June 7 and June 11) with Vehicle 48 using Fuels H10 and H0. The results are as follows:

Date	Fuel	Sample ID	DVPE (psi)
6/7/2006	H10	Drum	8.06
6/7/2006	H10	Before 20-Mile Run	8.11
6/7/2006	H10	After 20-Mile Run	8.05
6/7/2006	H10	Before 10-Mile Run	8.12
6/7/2006	H10	After 10-Mile Run	8.09
6/7/2006	H10	Drum	8.15
6/11/2006	H0	Before 20-Mile Run	11.65
6/11/2006	H0	After 20-Mile Run	10.41
6/11/2006	H0	Before 10-Mile Run	11.02
6/11/2006	H0	After 10-Mile Run	10.65

Since there was no evidence that significant fuel light-ends were flashing off during the 20-mile warm-up which possibly could have been the cause of low TWDs, an on-site decision was made to retain the 20-mile warm-up.

On June 12, another version of the warm-up procedure was tested with Vehicles 32 and 66 on Fuel H0. To test whether the fuel might be weathering during the warm-up because of the length of the warm-up, the two vehicles were driven for one-mile around the oval Brake Test Facility track. Ten 0-35 mph “bunny hops” (quick accelerations, followed by quick stops) were performed to bring the vehicles to a quick operating temperature, followed by a sustained 50 mph cruise around the track, and then parked in the soak sheds. The results of the vapor pressure tests are as follows:

Weathering Results with Alternative “Bunny Hop” Warm-up

Date	Fuel	Sample ID	DVPE (psi)	TWD
6/12/2006	H0	Car 66 Before Test	11.39	-
6/12/2006	H0	Car 66 After Test	9.30	25
6/12/2006	H0	Car 32 Before Test	11.10	-
6/12/2006	H0	Car 32 After Test	10.43	11

Weathering Results with 20-Mile Warm-up

6/12/2006	H0	Car 66 After Test	7.79	39
6/12/2006	H0	Car 32 After Test	9.99	17

The purpose of the above exercise was to see if there was any obvious evidence that a different type and length of warm-up might affect the test fuel weathering which might in turn affect TWDs. Since no obvious effect with TWDs was seen, the 20-mile warm-up was retained.

On June 8, to test another theory, the remaining eleven vehicles not tested on June 5 had been drained, but not double-flushed (as explained in Reference 4). Only the first flush had been performed after the vehicles had been drained the night of June 5. The fuelers did a single flush the morning of June 8 (using the second-flush procedure of engine-on and shaking) and fueled the vehicles for test immediately before going out on the warm-up. This was intended to minimize the weathering during the flushing. A comparison of the screening TWDs from earlier in the program and the results of that experiment are below:

Car No.	6/8/06 TWD	Max Temp, ° F	Screening TWD	Max Temp,° F
4	24	112	13	110
7	41	110	16	118
10	25	111	13	116
32	14	113	8	119
35	11	109	15	117
41	14	113	6	110
42	24	113	3	117
46	9	111	7	120
47	29	113	19	114
61	9	110	16	113
66	61	111	28	112

It appeared that doing the second flush immediately before preconditioning the vehicle does make a difference; thus, an on-site decision was made to use two two-gallon flushes immediately prior to sending the vehicle out for warm-up to minimize fuel weathering within the fuel system prior to test. This was a modification of the fuel flushing procedure developed during the contract study described in Reference 4.

An added consideration to the decision to use two two-gallon flushes rather than two four-gallon flushes was the need to conserve fuel. When the fuel requirements were first estimated, all calculations were made under the belief that all the fuels in the design matrix would be used. Once on-site, it was quickly realized that testing would be concentrated on only a few of the fuels in the design matrix, and it would be necessary to conserve those fuels.

Although it was recognized that the possibility existed that cutting the fuel flush amount in half might impact the fuel carryover effect, the decision was made to do so to minimize possible weathering before a test and to conserve fuel. Without the luxury of on-site statistical analysis and the absence of on-site fuel analysis capability, it was necessary to rely on experience gained from prior on-site CRC programs and engineering judgment.

Because low demerits were still being seen with the H10 (high-volatility, 10 volume percent ethanol) fuel, a fuel obtained from the DPG that was much like the CRC H10 fuel was tested, except that the T50 was lower (thus, the fuel was designated as the Low T50 Fuel) and the vapor pressure was higher like H0. This fuel was tested to determine if the high T50 of the design fuel set might be contributing to the lack of demerits. Another DPG fuel was also tested that had a vapor pressure of about 11 psi with 20 volume percent ethanol (designated as the X20 Fuel). A comparison of results from the above experiment is shown below:

Comparison of TWD Results With Fuels H10, Low T50, and X20*

Vehicle		Fuel	TWD		Fuel	TWD		Fuel	TWD
4		H10	16		LOW T50	11		X20	10
7		H10	30		LOW T50	28		X20	38
10		H10	23		LOW T50	26		X20	18
11		H10	25		LOW T50	24		X20	32
15		H10	38		LOW T50	16		X20	26
17		H10	20		LOW T50	14		X20	17
22		H10	7		LOW T50	13		X20	12
28		H10	8		LOW T50	17		X20	27
31		H10	29		LOW T50	24		X20	30
32		H10	22		LOW T50	28		X20	35
34		H10	18		LOW T50	24		X20	28
35		H10	11		LOW T50	15		X20	17
37		H10	31		LOW T50	17		X20	12
39		H10	21		LOW T50	9		X20	24
41		H10	16		LOW T50	12		X20	10
42		H10	18		LOW T50	22		X20	30
46		H10	23		LOW T50	30		X20	31
47		H10	22		LOW T50	24		X20	35
48		H10	21		LOW T50	31		X20	25
49		H10	34		LOW T50	32		X20	18
58		H10	12		LOW T50	9		X20	4
59		H10	18		LOW T50	16		X20	15
61		H10	36		LOW T50	22		X20	22
62		H10	34		LOW T50	24		X20	20
63		H10	38		LOW T50	30		X20	27
64		H10	20		LOW T50	52		X20	31
66		H10	33		LOW T50	75		X20	47

*The TWDs for Low T50 and X20 represent single observations from individual test runs and are intended to be used as examples for comparison. The H10 observations used are averages from the high-temperature testing.

Since the preceding results show no obvious effect on TWDs with any of the three fuels, a high T50 was not the cause of the low TWDs, and the X20 fuel with a high vapor pressure and 20 volume percent ethanol also did not create high TWDs.

Fuels H0 and H10 were tested at "intermediate temperatures" throughout the program whenever possible. "Intermediate temperature" refers to ambient temperatures of nominally 90°-100°F. These fuels were tested at those temperatures to provide a tie-back to the 2001 CRC Hot-Fuel-Handling Programs conducted in Yakima, Washington. The 2006 H0 and H10 fuels resemble properties of the 2001 L0 and L10 fuels, respectively.

D. Modified Test Plan

The experiments to test the various theories as to why the H10 fuel was not giving the expected demerits resulted in two changes to the original test plan. The fuel flushes were cut from four to two gallons and done immediately prior to vehicle warm-up, and the test fuel matrix was changed to exclude some of the low-volatility design fuels and test some new replacement fuels.

E. Data Worksheets

The data from the vehicle data sheets were summarized each day and entered into an Excel spreadsheet for each test. Information such as testing date, vehicle, fuel, and rater was given, and for each sequence of the test, start-of-test ambient temperature, and driveability malfunctions and their severity were recorded and entered into a computer summary sheet. A summary of the data is presented in Appendix F in Table F-1 for the test vehicles. A summary of the screening data are presented in Table F-2 for the non-selected vehicles only on Fuel H10.

VII. DISCUSSION OF RESULTS

A. Data Set Analysis

The final data set was analyzed using the SAS® System to calculate least square mean values for each vehicle and all vehicles, as well as for each fuel and all fuels. The initial model included fuel, vehicle, fuel x vehicle interactions, ambient temperature, vehicle x ambient temperature interactions, and rater. As is common with driveability data, the TWD values were log transformed due to the wide range of vehicle/fuel TWDs (4 - 75). Log transforming the data leads to a data set that is more normally distributed and has approximately constant variance. The data were corrected using the rater and ambient temperature variables, but not the interaction terms. The original intent was to not have raters test common vehicles so there would be no requirement for rater correction. Since they did test common vehicles, however, a rater correction was applied to the data (the raters were statistically significantly different from each other: 19.6 vs. 17.5 TWD, p-value = 0.00). The designed test fuels that actually were tested in the program at the target ambient temperatures were evaluated twice in all of the vehicles. The DPG X20 fuel was tested twice too, but the Low T50 was only evaluated once in each vehicle. Table 4a presents the least-squares mean corrected natural log TWD for each fuel for each vehicle. The results were corrected to the 110°F average temperature. Table 4b presents the least-squares mean corrected TWD values (antilog of Table 4a). Two fuels (H0 and H10) which had volatilities similar to some of the 2001 program fuels were tested at a lower temperature and the data were corrected to the 95°F average temperature. Since the fuels in the intermediate program were only tested once, Table 5 shows the reported TWD values for this side program. The regression analyses are on file at the CRC offices and are available upon request.

The least-squares mean corrected TWD data from Table 4b averaged across all fuels for each vehicle are shown graphically in Figure 1. Analysis of these data shows that the average TWD of the four older vehicles (26.0) is statistically significantly higher (p-value = 0.00) than the average of the new vehicles (17.7). Figure 2 shows the mean corrected TWD for each fuel averaged across all the vehicles. A statistical analysis shows that fuel I0 has a significantly (p-value = 0.00) lower mean corrected TWD than L0, H5, H10, Low T50, and X20. These confounding results illustrate some of the difficulties encountered during testing and demonstrate why so many various theories were tested during the program to explain the unexpected results.

B. Ambient Temperature

The testing ambient temperatures ranged from 100°F to 121°F versus the target temperature range of 105°F to 115°F for the designed program. The add-on side program at a lower intermediate temperature had temperatures that ranged from 89°F and 99°F. The low, high, and average maximum ambient temperatures for each test vehicle on each fuel are shown in Table 6a for the designed program, and in Table 6b for the intermediate-temperature side program. Table 6c shows the low, high, and average maximum temperatures for each fuel across all the fuels. Surprisingly, the effect of ambient temperature on least square mean TWD was not statistically significant.

C. Fuel Property Effect Analysis

Using the TWD data from Table 4a, regression analyses were undertaken against TVL20 and DVPE. The natural logarithm (LN) mean corrected TWD is plotted against TVL20 in Figure 3. The adjusted R^2 was 0.066 indicating a poor correlation. A similar plot for vapor pressure is shown in Figure 4 with an adjusted R^2 was 0.082 again indicating a poor correlation. More extensive regressions using the additional properties of ethanol content and the 50 percent evaporated distillation point (T50) also were run. The adjusted R^2 values for each regression along with the p-values for each variable are shown in Table 7. The adjusted R^2 values indicated poor correlations and the p-values showed that none of the regression variables were significant. In addition, the European vapor lock index (VLI = 68.95*VP + 7*E158) alone and with ethanol content was regressed. As shown in Table 7, VLI also was not a significant variable. Thus, the

TWDs could not be correlated with any volatility property or ethanol variable in this program.

D. 2001 CRC Program Comparison

Fuels H0 and H10 from this program were similar in volatility to L0 and L10 of the 2001 CRC volatility program. In an effort to explain the low response to changes in volatility that occurred in the current program, it was decided to conduct a side program at the lower intermediate temperature used in the 2001 program to see if the current vehicles responded differently than those used in the 2001 program. The comparison of the hydrocarbon-only fuels showed very little difference (17.6 TWD for the current program versus 16.9 TWD for the 2001 program). The 10 volume percent ethanol blends showed 19.2 TWD versus 12.7 TWD. These comparisons did not show that the current vehicles were less sensitive, which could have accounted for the lack of TWDs in the current program.

E. Fuel Flushing Efficiency

To assess the efficiency of the flushing procedure used to switch fuels, the ethanol content was determined for H0 hydrocarbon-only fuel following a H10 test run for each vehicle. Figure 5 shows for each vehicle the residual amount of ethanol found in the H0 fuel. The average amount across all vehicles was 0.28 volume percent ethanol. Similar determinations in the 2001 and 2003 CRC volatility programs showed average ethanol contents to be 0.10 and 0.13 volume percent. As described earlier, the flushing procedure used in the current program was modified to minimize possible weathering before a test and to conserve fuel. The comparisons among the test programs suggest that the modification of the flushing procedure (two gallons instead of four gallons) had an adverse effect on the flushing efficiency and should not be adopted for future programs. Because of the lack of vehicle sensitivity in the current program, it is believed that the change in flushing procedure did not have a significant effect on the results.

F. Fuel Weathering

Fuel samples were obtained from each vehicle fuel tank at the end of each test run and analyzed on-site for DVPE. Fresh fuel samples were analyzed for DVPE when each drum was opened. Taking the difference between the average fresh fuel DVPE drum value and the end of test value provides the fuel vapor pressure weathering for each run. The drum determinations were used in the calculation rather than the values in Table 2 to eliminate any possible measurement bias. The final data set is shown in Table E-4. Figure 6 shows the average loss in vapor pressure across all fuels for each vehicle. Only four of the 26 test vehicles had fuel injection systems wherein the fuel is returned back to the fuel tank from the engine. Figure 7 shows for two fuels the lower loss observed for the side program at a lower intermediate temperature. Figure 8 shows the loss in vapor pressure for each fuel across all of the vehicles.

The data were analyzed using the SAS System to correct for differences in testing ambient temperatures. The significant variables in the weathering model included vehicle, initial DVPE, maximum ambient temperature (T) during a test, and ethanol content. The resulting model for all vehicles is as follows:

Loss = -6.398 + 0.394*DVPE + 0.023*EtOH Content + 0.030*T

The R^2 for this regression equation is 0.574, and the standard error is 0.53. When individual vehicles are included as variables in the regression, the R^2 improves to 0.795, and the standard error is 0.38. This equation is applicable within the vapor pressure range (7.9 to 11.4 psi) assessed in this program and for ambient temperatures between 95°F and 110°F.

Figure 9 shows the average predicted loss in vapor pressure (weathering) as a function of the initial DVPE for three ambient temperature conditions (average for the program and two lower temperatures including the average for the side intermediate temperature study). As expected, when fuel vapor pressure increases, the loss in vapor pressure increases. Also, as ambient temperature increases, the loss in vapor pressure increases. The ambient temperature effect is better seen in Figure 10 at three constant vapor pressures and 10 volume percent ethanol content. Figure 11 directly shows how weathering increases with increasing ethanol content at constant vapor pressure.

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2. Coordinating Research Council, Inc., 2001 CRC Hot-Fuel-Handling Program, CRC Report No. 629, June 2002.

3. ASTM International, ASTM D 4814 Specification for Automotive Spark-Ignition Engine Fuel, 2006 Annual Book of ASTM Standards.

4. Southwest Research Institute, A Vehicle Fuel Tank Flush Effectiveness Evaluation Program, August 2001.

TABLES

AND

FIGURES

Table 1
2006 CRC Hot-Fuel-Handling Program
Test Vehicle List

Year	Make	Model	Displacement (Liters)	VIN	Return vs. Returnless
2006	Buick	Lucerne	3.8	1G4HP57226U224306	Returnless
2005	Chevrolet	Aveo	1.6	KL1TD52605B321782	Returnless
2005	Chevrolet	Classic	2.2	1G1ND52F85M198960	Return
1997	Chevrolet	Pick-Up	5.7	2GCEK19R8V1241808	Return
2006	Chevrolet	Pick-Up	4.8	1GCEC19VX6Z222406	Returnless
1995	Chevrolet	Van 20	5.7	1GBEG25K7SF220408	Return
2006	Chevrolet	2500 Van	6.0	1GCGG25U961122375	Returnless
2006	Chrysler	Pacifica	3.5	2A4GM68416R778331	Returnless
2005	Chrysler	Sebring	2.4	1C3EL46X55N641071	Returnless
1998	Dodge	Caravan	3.3	2B4GP25R8WR819489	Returnless
2006	Dodge	Dakota	4.7	1D7HE48N56S539714	Returnless
2005	Dodge	Neon	2.0	1B3ES56C25D166391	Returnless
2006	Ford	Econoline	4.6	1FTRE14WX6DA15846	Returnless
2006	Ford	Taurus	3.0	AFAFP53U27A116344	Returnless
1998	Honda	Accord	2.3	1HGCG5641WA076329	Return
2005	Honda	Civic	1.7	2HGES16545H599319	Returnless
2006	Hyundai	Tucson	2.7	KM8JN72D36U385193	Returnless
2006	Jeep	Liberty	3.7	1J4GK48K96W209727	Returnless
2006	Kia	Optima	2.4	KNAGD126065459998	Returnless
2006	Kia	Rio	1.6	KNADE123066079530	Returnless
2006	Mazda	6	3.0	1YVHP80D765M40142	Returnless
2006	Nissan	Pathfinder	4.0	5N1AR18U16C617997	Returnless
2006	Nissan	Sentra	1.9	3NICB51D96L532402	Returnless
2005	Pontiac	Grand Am	3.4	1G2NW12E45M135327	Return
2006	Saturn	Ion	2.2	1G8AJ55F46Z205444	Returnless
2006	Toyota	Camry	2.4	4T1BE32K86U67177	Returnless
2006	Toyota	RAV4	2.4	JTMBD33V266008287	Returnless

Table 2
2006 CRC Volatility Program Design Test Fuel Inspections

Fuel Code			Low Volatility Series				Intermediate Volatility Series				High Volatility Series			
Property	**Method**	**Units**	**L0**	**L5**	**L10**	**L20**	**I0**	**I5**	**I10**	**I20**	**H0**	**H5**	**H10**	**H20**
Temperature for V/L=20	ASTM D 5188	°F	137.6	146.0	152.2	148.9	133.0	137.3	144.0	144.1	124.1	127.0	135.7	138.4
Calc TVL20			139.6	155.4	156.7	151.7	134.6	141.2	149.4	146.6	127.2	132.6	140.0	138.7
Corr. Calc TVL20			100.6	80.4	81.0	78.7	96.5	105.6	111.2	76.5	125.3	99.9	136.2	72.9
DVPE	ASTM D 5191	psi	9.3	7.2	5.9	5.9	9.8	8.5	7.1	6.6	11.0	9.7	8.2	7.9
Distillation	ASTM D 86													
Initial Boiling Point		°F	92.1	110.9	122.6	123.5	90.8	95.3	111.2	116.7	85.8	99.5	101.9	106.5
5% Evaporated		°F	111.7	134.1	144.2	143.1	111.1	122.9	134.7	141.2	102.4	114.5	124.6	129.7
10% Evaporated		°F	125.7	142.4	149.9	148.9	122.7	131.5	142.0	149.1	113.1	122.1	131.7	139.4
20% Evaporated		°F	150.1	157.3	156.1	155.4	142.4	143.7	150.7	156.5	131.0	134.2	141.3	151.1
30% Evaporated		°F	175.9	195.9	161.4	159.6	165.3	171.8	156.2	161.5	153.1	147.1	149.9	157.4
40% Evaporated		°F	200.2	213.0	202.5	162.6	174.5	205.0	189.1	165.0	181.7	187.9	157.8	162.4
50% Evaporated		°F	218.2	222.8	223.4	165.7	214.2	220.6	219.2	197.3	212.0	214.5	206.1	165.4
60% Evaporated		°F	228.9	235.0	234.0	229.1	228.2	231.8	228.8	237.7	229.5	227.3	223.1	208.7
70% Evaporated		°F	248.4	251.3	253.2	252.6	248.3	252.0	249.8	266.0	253.6	247.9	240.6	248.2
80% Evaporated		°F	274.9	281.3	285.9	289.5	275.2	282.7	281.4	303.5	284.3	279.1	267.9	281.1
90% Evaporated		°F	317.0	326.4	328.6	334.8	315.8	326.7	326.4	342.0	325.6	325.0	313.2	326.1
95% Evaporated		°F	350.6	359.9	361.7	370.7	346.4	364.3	359.6	382.7	365.4	364.7	351.0	364.9
End Point		°F	398.5	411.8	413.6	422.6	399.4	414.4	414.4	408.0	414.9	414.7	392.3	415.2
Recovery		vol %	97.2	97.8	98.4	98.6	97.8	97.5	98.0	98.1	97.9	97.9	97.8	97.6
Residue		vol %	1.1	1.0	1.0	0.8	1.0	1.2	1.1	1.0	33.0	33.2	25.3	1.2
Loss		vol %	1.6	1.2	0.7	0.7	1.2	1.3	0.9	0.9	1.3	1.3	1.3	1.2
% Evap at 158°F			23.2	20.4	28.6	28.7	26.8	25.6	30.9	24.0	32.0	33.2	40.2	32.0
Gravity	ASTM D 4052	°API	62.5	58.6	55.9	53.9	63.0	59.6	57.4	54.8	63.4	61.4	60.2	56.0
Relative Density		g/gal	0.7294	0.7466	0.7552	0.7632	0.7274	0.7405	0.7489	0.7597	0.7260	0.7334	0.7383	0.7546
Ethanol	ASTM D 4815	vol %	0.0	4.7	11.0	20.3	0.0	4.9	10.1	20.2	0.0	5.0	10.0	19.3
MTBE	ASTM D 4815	vol %	0.0	0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0
Uncorrected Composition														
Aromatics	ASTM D 1319	vol %	23.4	6.2	29.6	33.0	24.7	26.1	27.7	32.6	24.3	24.0	25.0	30.0
Olefins	ASTM D 1319	vol %	6.0	68.0	7.5	10.4	5.6	6.7	7.5	10.2	7.2	6.9	5.8	6.9
Saturates	ASTM D 1319	vol %	70.7	0.0	63.0	56.8	69.8	67.3	46.6	59.6	68.6	69.2	69.2	63.1
Corrected Composition														
Aromatics	ASTM D 1319	vol %	23.7	6.0	26.3	26.3	24.7	24.5	25.1	24.6	23.9	23.4	22.7	27.0
Olefins	ASTM D 1319	vol %	5.4	67.0	6.7	8.2	5.1	6.0	5.9	8.7	6.3	6.7	5.0	6.1
Saturates	ASTM D 1319	vol %	70.8	0.0	56.1	45.2	70.2	64.7	48.0	58.1	69.8	66.2	64.6	56.7
Benzene	ASTM D 3606	vol %	0.68	0.53	0.59	0.61	-	0.55	0.55	0.57	0.38	0.5	0.66	0.53
Solvent washed gum	ASTM D 381	mg/100ml	0	2.6	0.4	1.8	-	0.4	1	1	1	1.2	<0.5	1
Research Octane Number	ASTM D 2699	ON	90.28	91.22	90.84	92.5	90.38	90.65	90.55	91.14	90.28	90.93	90.3	90.73
Motor Octane Number	ASTM D 2700	ON	83.1	83.59	83.32	82.5	83.51	83.19	82.92	82.1	83.8	83.79	83	82.54
(R+M)/2	D 2699/2700	ON	86.7	87.4	87.1	87.5	86.9	86.9	86.7	86.6	87	87.36	86.7	86.6
Sulfur	ASTM D 2622	ppm	22.3	20.6	42.1	60.7	23.2	46.5	39.8	-	44.8	41.8	16.8	40.1

Table 3
2006 CRC Volatility Program
Additional Test Fuel Inspections

Fuel Code			**DPG Test Fuels**		
Property	**Method**	**Units**	**Low T50**	**X20**	**House**
Temperature for V/L=20	ASTM D 5188	°F	118.2	120.9	122.7
DVPE	ASTM D 5191	psi.	11.2	11.4	11.6
Distillation	ASTM D 86				
Initial Boiling Point		°F	95.1	90.8	76.8
5% Evaporated		°F	109.5	110.3	111.5
10% Evaporated		°F	116.6	122.3	122.7
20% Evaporated		°F	127.2	140.7	139.8
30% Evaporated		°F	137.1	152.9	151.7
40% Evaporated		°F	146.1	159.4	160.7
50% Evaporated		°F	153.5	162.6	216.8
60% Evaporated		°F	205.3	169.1	233
70% Evaporated		°F	238.2	241.3	250.5
80% Evaporated		°F	269.7	268.7	285.6
90% Evaporated		°F	322.5	324.1	327.5
95% Evaporated		°F	332.7	349.3	353.1
End Point		°F	367.7	394.5	402.2
Recovery		vol %	97.4	96.5	96.8
Residue		vol %	1	1.2	1
Loss		vol %	1.6	2.3	2.2
Gravity	ASTM D 4052	°API	62.8	60.9	61.9
Relative Density		g/gal	0.7283	0.7354	0.7316
Ethanol	ASTM D 4815	vol %	10.27	18.81	9.86
MTBE	ASTM D 4815	vol %	0.0	0.0	0.0
Uncorrected Composition					
Aromatics	ASTM D 1319	vol %	21.4	18.6	18.3
Olefins	ASTM D 1319	vol %	15.7	6.1	7.1
Saturates	ASTM D 1319	vol %	69.9	75.3	74.6
Corrected Composition					
Aromatics	ASTM D 1319	vol %	19.2	15.1	16.5
Olefins	ASTM D 1319	vol %	14.1	5.0	6.4
Saturates	ASTM D 1319	vol %	62.7	61.1	67.2
Benzene	ASTM D 3606	vol %	0.09	0.34	0.38

Table 4a
Least-Squares Mean Natural Log Corrected TWD Values

	Test Vehicle								
Fuel	**4**	**7**	**10**	**11**	**15**	**17**	**22**	**28**	**31**
L0	3.10	3.20	2.80	2.59	3.14	2.70	2.69	2.75	2.80
I0	2.04	3.05	3.18	2.40	2.91	2.86	1.86	1.97	3.11
H0	2.58	3.29	3.10	2.18	2.88	2.58	2.10	2.54	2.98
H5	1.97	3.16	2.91	2.22	2.81	2.84	1.86	3.41	3.21
H10	2.81	3.41	3.00	2.93	3.14	2.81	2.17	2.74	3.06
H20	2.94	2.80	3.31	2.58	2.69	2.72	2.85	2.76	3.11
LOW T50	2.32	3.35	3.18	3.10	2.80	2.63	2.59	2.86	3.10
X20	2.36	3.40	3.18	3.28	3.21	2.92	2.16	3.02	3.53

	Test Vehicle								
Fuel	**32**	**34**	**35**	**37**	**39**	**41**	**42**	**46**	**47**
L0	2.86	2.51	2.51	1.97	2.73	2.69	2.97	3.39	3.62
I0	2.48	2.22	2.63	1.79	2.59	2.42	2.91	3.56	3.20
H0	3.12	3.09	2.88	2.15	2.80	2.44	3.44	3.38	3.21
H5	2.22	3.14	2.46	2.42	2.97	2.96	3.32	3.43	2.97
H10	2.70	3.12	2.67	2.74	2.88	2.26	3.04	3.07	3.19
H20	2.62	2.61	2.63	2.26	2.59	2.01	3.12	3.07	2.98
LOW T50	3.25	3.10	2.73	2.75	2.22	2.51	3.01	3.30	3.07
X20	3.15	3.40	2.86	2.64	2.85	2.02	3.22	3.04	3.37

	Test Vehicle									
Fuel	**48**	**49**	**58**	**59**	**61**	**62**	**63**	**64**	**66**	**All**
L0	3.66	2.91	2.96	2.81	3.11	3.16	3.14	3.18	3.43	2.96
I0	2.51	3.18	1.81	2.00	2.63	3.01	2.75	2.51	3.53	2.65
H0	3.08	3.15	2.24	2.53	3.22	3.14	2.75	2.88	3.57	2.87
H5	3.32	3.49	2.32	2.66	3.25	3.35	3.01	3.32	4.17	2.95
H10	3.22	3.37	2.43	2.97	2.85	3.34	3.09	2.77	3.69	2.95
H20	3.13	3.34	1.70	2.91	3.19	3.42	3.23	2.57	3.18	2.85
LOW T50	3.35	3.49	2.22	2.80	3.11	3.10	3.32	3.97	4.23	3.03
X20	3.32	3.34	1.86	2.52	3.14	2.99	3.35	3.34	3.73	3.02

Table 4b
Least-Squares Mean Corrected TWD Values

	Test Vehicles								
Fuels	**4**	**7**	**10**	**11**	**15**	**17**	**22**	**28**	**31**
L0	22.10	24.55	16.36	13.30	23.02	14.83	14.73	15.65	16.36
I0	7.67	21.18	23.94	11.05	18.41	17.39	6.45	7.16	22.50
H0	13.15	26.83	22.23	8.83	17.83	13.26	8.14	12.73	19.74
H5	7.16	23.52	18.41	9.20	16.57	17.03	6.45	30.39	24.86
H10	16.69	30.22	20.12	18.79	23.17	16.60	8.80	15.56	21.42
H20	18.84	16.41	27.31	13.14	14.73	15.13	17.22	15.78	22.48
LOW T50	10.13	28.64	23.94	22.10	16.36	13.81	13.30	17.39	22.10
X20	10.57	29.91	24.00	26.56	24.84	18.51	8.68	20.58	34.21

	Test Vehicles								
Fuels	**32**	**34**	**35**	**37**	**39**	**41**	**42**	**46**	**47**
L0	17.39	12.27	12.27	7.16	15.34	14.73	19.43	29.66	37.29
I0	11.97	9.20	13.81	5.99	13.30	11.25	18.42	35.28	24.55
H0	22.58	22.03	17.89	8.57	16.52	11.49	31.09	29.32	24.76
H5	9.20	23.02	11.76	11.25	19.43	19.34	27.62	30.85	19.43
H10	14.91	22.70	14.47	15.56	17.83	9.56	20.98	21.49	24.36
H20	13.78	13.65	13.87	9.59	13.34	7.48	22.55	21.56	19.78
LOW T50	25.78	22.10	15.34	15.65	9.20	12.27	20.26	27.16	21.64
X20	23.43	29.94	17.41	13.96	17.36	7.52	24.93	20.97	28.99

	Test Vehicles									
Fuels	**48**	**49**	**58**	**59**	**61**	**62**	**63**	**64**	**66**	**All**
L0	38.67	18.42	19.34	16.57	22.50	23.52	23.02	23.94	30.85	19.3
I0	12.27	23.94	6.14	7.37	13.81	20.26	15.65	12.27	34.26	14.2
H0	21.77	23.29	9.35	12.58	24.95	23.09	15.59	17.83	35.55	17.7
H5	27.61	32.73	10.13	14.32	25.78	28.64	20.26	27.61	64.91	19.1
H10	25.03	28.98	11.38	19.52	17.36	28.25	21.96	15.90	40.03	19.1
H20	22.95	28.12	5.45	18.44	24.24	30.61	25.38	13.09	24.01	17.2
LOW T50	28.54	32.73	9.20	16.36	22.50	22.10	27.62	53.18	68.60	20.8
X20	27.62	28.12	6.44	12.47	23.21	19.94	28.62	28.08	41.85	20.5

Table 5
Intermediate-Temperature TWD Values

	Test Vehicles								
Fuels	**4**	**7**	**10**	**11**	**15**	**17**	**28**	**31**	**32**
H0	16	30	26	6	-	11.5	12	22	27
H10	11.5	30	14	-	16	11.5	18	-	14
X20	-	-	32	-	-	-	-	-	-

	Test Vehicles								
Fuels	**34**	**35**	**37**	**39**	**41**	**42**	**46**	**47**	**48**
H0	19	18	-	13	-	48	-	22	27
H10	21	28.5	11	11	11	17	32.5	27	27
X20	-	-	-	-	-	-	-	-	-

	Test Vehicles								
Fuels	**49**	**58**	**59**	**61**	**62**	**63**	**64**	**66**	**LS Mean**
H0	-	16	-	20	16	-	20	36	17.6
H10	34	10	18	12	24	21	-	36	19.2
X20	-	-	-	-	-	-	-	-	-

Table 6a
Maximum Ambient Temperature by Vehicle
High Temperature Testing

	Maximum Ambient Temperature		
Vehicle	**Low**	**High**	**Average**
4	105	121	111.5
7	104	121	110.2
10	87	115	106.5
11	102	113	108.5
15	101	119	110.5
17	102	116	109.7
22	102	117	107.8
28	103	118	108.8
31	101	114	109.3
32	103	117	110.1
34	104	116	110.9
35	104	117	110.3
37	102	118	110.2
39	103	119	111.0
41	100	116	110.2
42	102	114	110.6
46	100	120	109.7
47	103	113	108.5
48	101	119	110.5
49	102	117	109.8
58	104	113	109.5
59	100	118	108.3
61	103	116	108.9
62	100	114	109.3
63	101	119	110.6
64	100	115	109.8
66	101	118	109.0

Table 6b
Maximum Ambient Temperature by Vehicle
Intermediate Temperature Testing

	Maximum Ambient Temperature		
Vehicle	**Low**	**High**	**Average**
4	98	99	98.5
7	91	93	92.0
10	95	95	95.0
11	91	96	93.5
15	96	96	96.0
17	93	93	94.5
22	97	97	97.0
28	96	97	96.5
31	95	95	95.0
32	94	95	94.5
34	94	95	94.5
35	95	96	95.5
37	94	94	94.0
39	93	96	94.5
41	97	97	97.0
42	97	99	98.0
46	94	94	94.0
47	88	96	92.0
48	-	-	-
49	93	93	93.0
58	98	98	98.0
59	89	89	89.0
61	97	99	98.0
62	95	97	96.0
63	89	89	89.0
64	89	94	91.5
66	89	94	91.5

Vehicle 48 was not tested at intermediate temperatures.

Table 6c
Maximum Ambient Temperature by Fuel

		Maximum Ambient Temperature		
Fuel	**Temp Range**	**Low**	**High**	**Average**
L0	High	104	115	109.8
I0	High	104	111	107.5
H0	Intermediate	89	99	95.5
H0	High	100	114	108.3
H5	High	109	118	113.8
H10	Intermediate	88	98	94.0
H10	High	100	121	110.2
H20	High	105	116	109.9
Low T50	High	105	115	110.9
X20	High	98	115	108.3

Table 7
Regression Models

Model	Adjusted R^2	RMSE	TVL20		DVPE		T50		VLI		EtOH Content	
			Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
TVL20	0.066	2.1	-0.124	0.267	-	-	-	-	-	-	-	-
TVL20, EtOH	0.063	2.1	-0.113	0.319	-	-	-	-	-	-	0.098	0.368
TVL20, T50, EtOH	0.157	2.3	-0.133	0.411	-	-	0.0165	0.834	-	-	0.143	0.567
DVPE	0.082	2.3	-	-	0.443	0.518	-	-	-	-	-	-
DVPE, EtOH	0.025	2.2	-	-	0.526	0.442	-	-	-	-	0.120	0.301
DVPE, T50, EtOH	0.280	2.5	-	-	0.566	0.572	0.0053	0.95	-	-	0.136	0.634
VLI	0.118	2.0	-	-	-	-	-	-	0.0085	0.214	-	-
VLI, EtOH	0.099	2.1	-	-	-	-	-	-	0.0076	0.277	0.092	0.391

Figure 1
Mean Corrected TWD vs. Vehicle

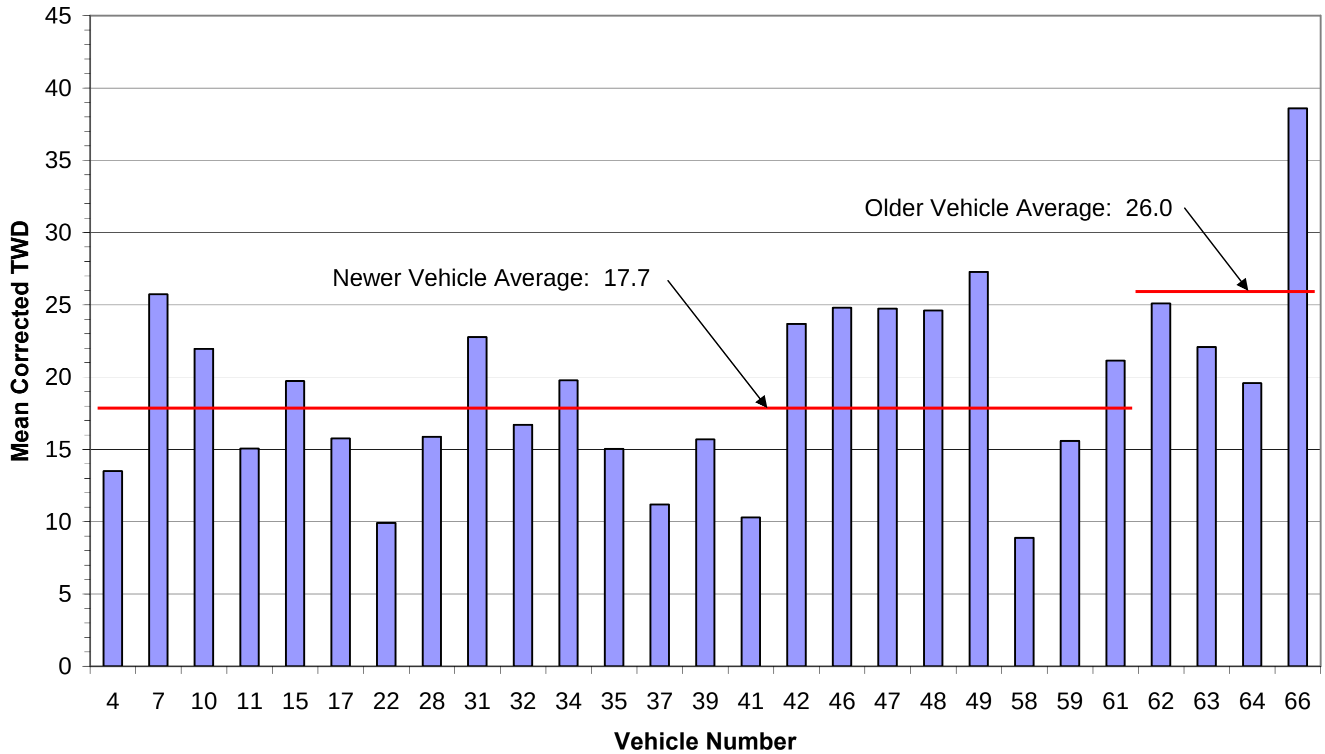


Figure 2
Mean Corrected TWD vs. Fuel

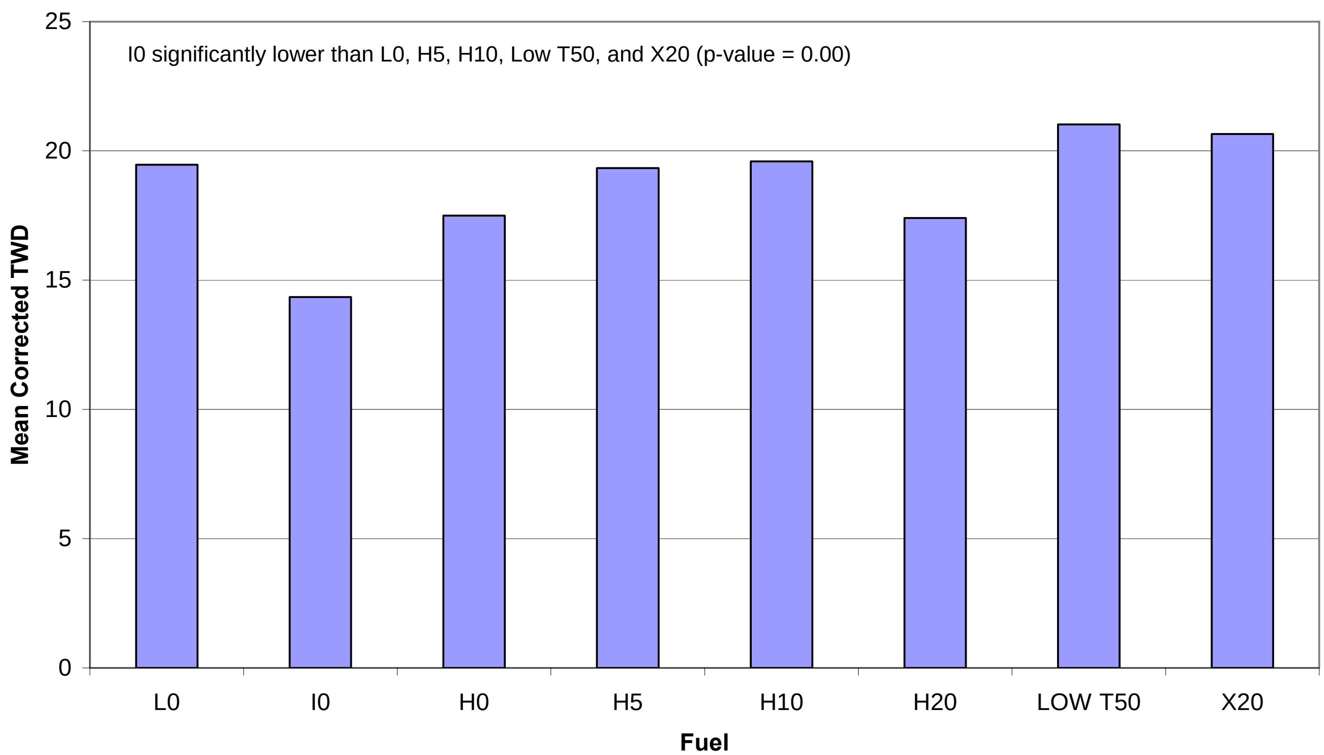


Figure 3
Relationship Between LN Mean Corrected TWD and TVL20

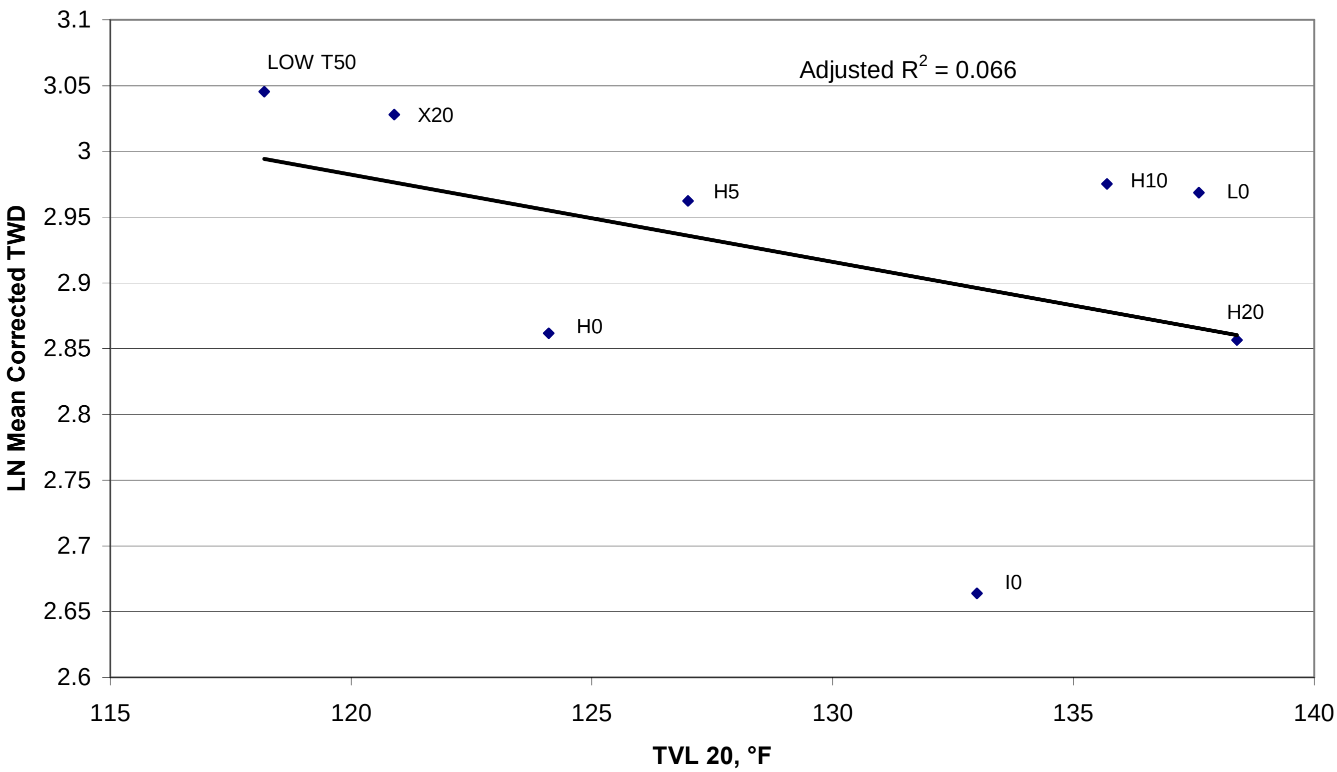


Figure 4
Relationship Between LN Mean Corrected TWD and Vapor Pressure

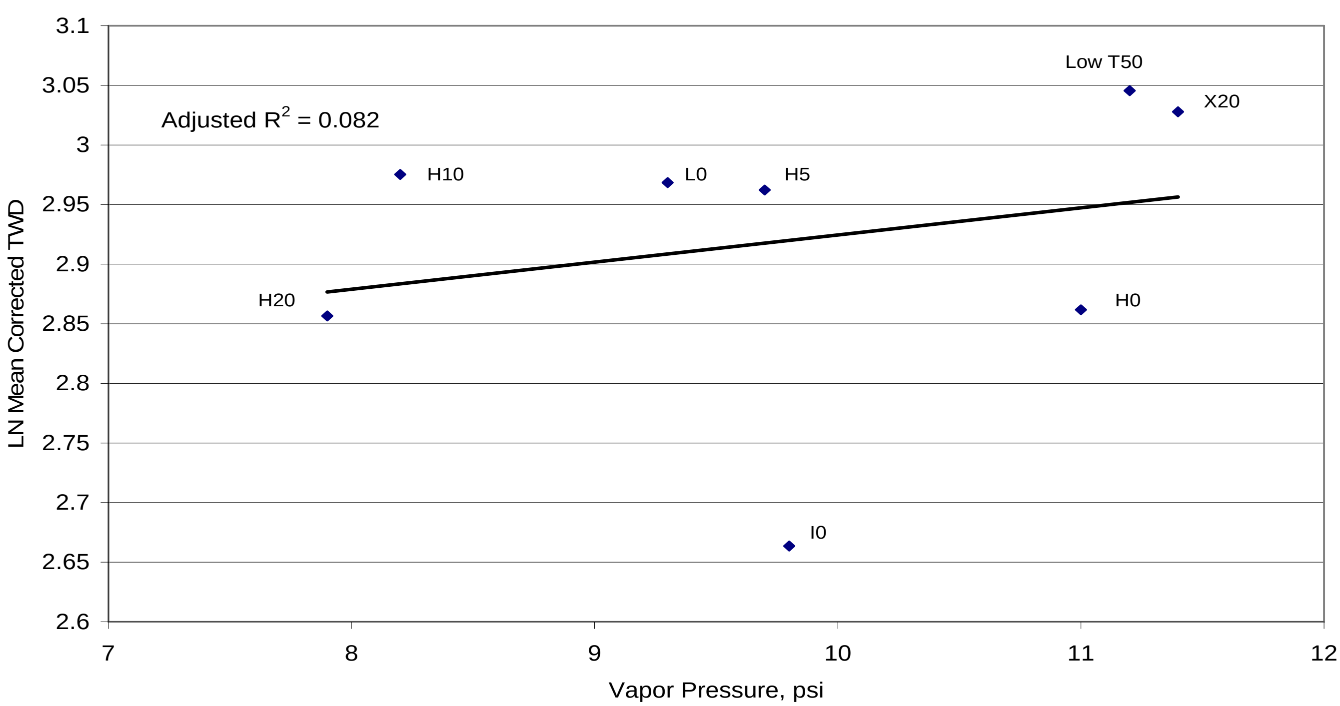


Figure 5
Ethanol Carry-Over From H10 After Flushing with H0 Hydrocarbon-Only Fuel

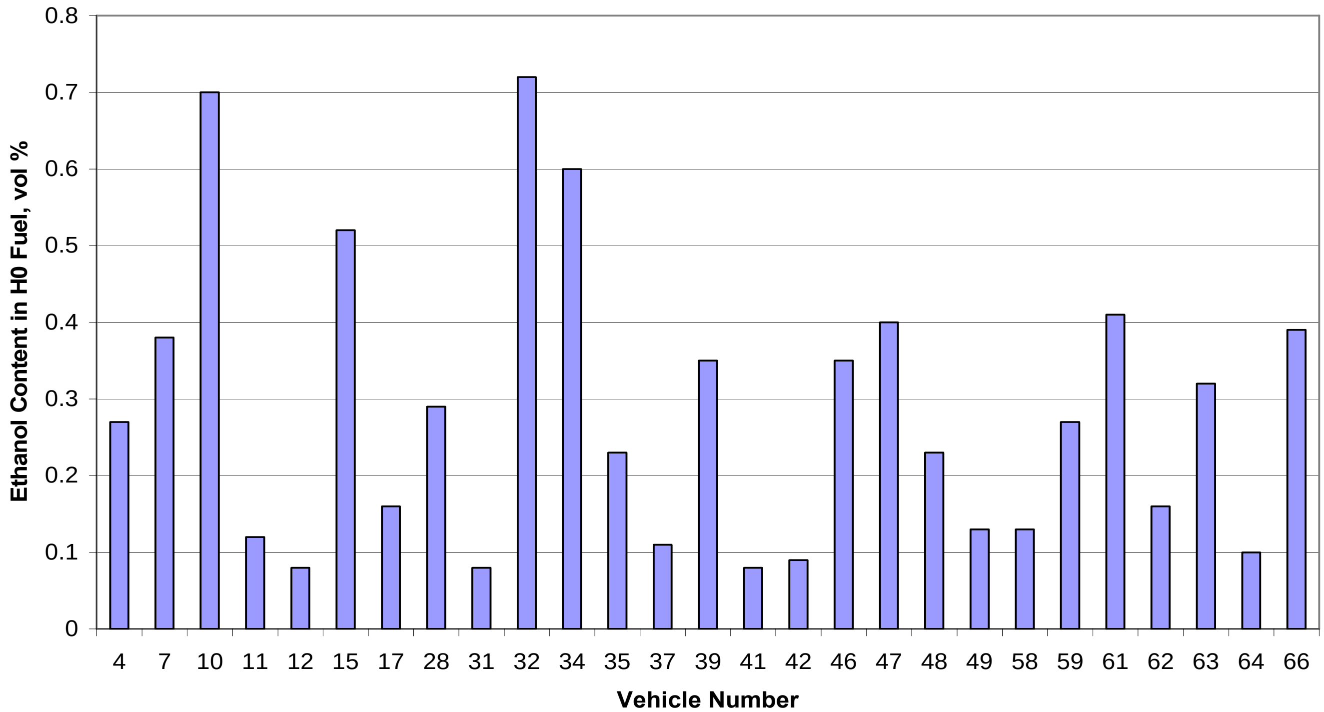


Figure 6
Vehicle Effect on Fuel Weathering

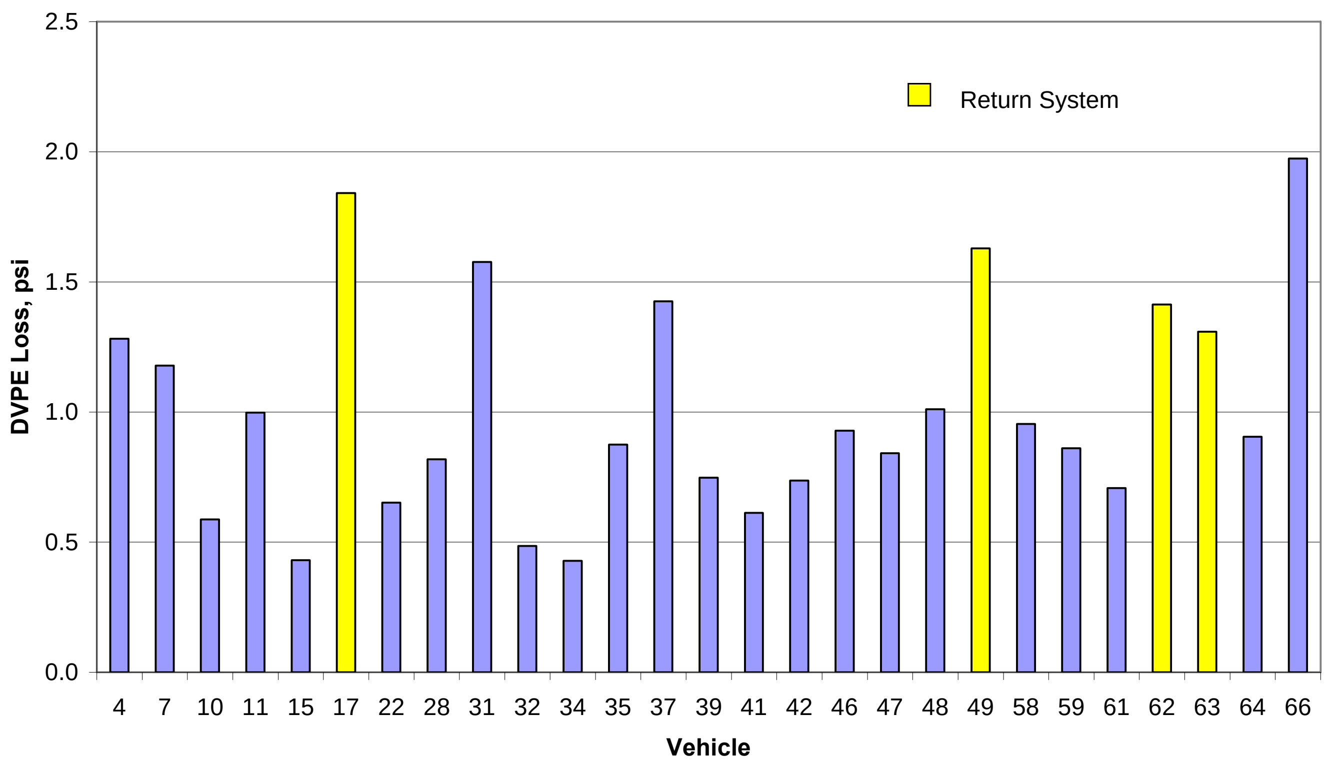


Figure 7
Vehicle Effect on Fuel Weathering
H0 and H10 at Lower Temperature

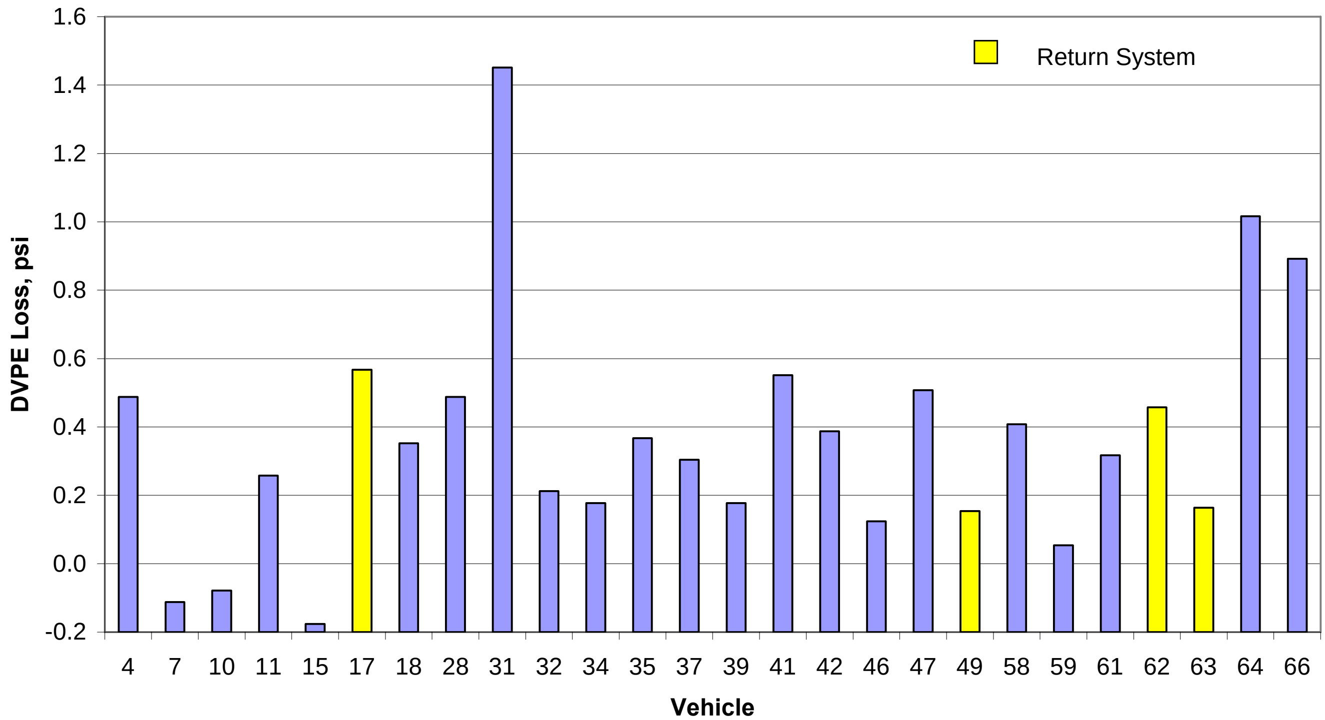


Figure 8
Fuel Effect on Fuel Weathering

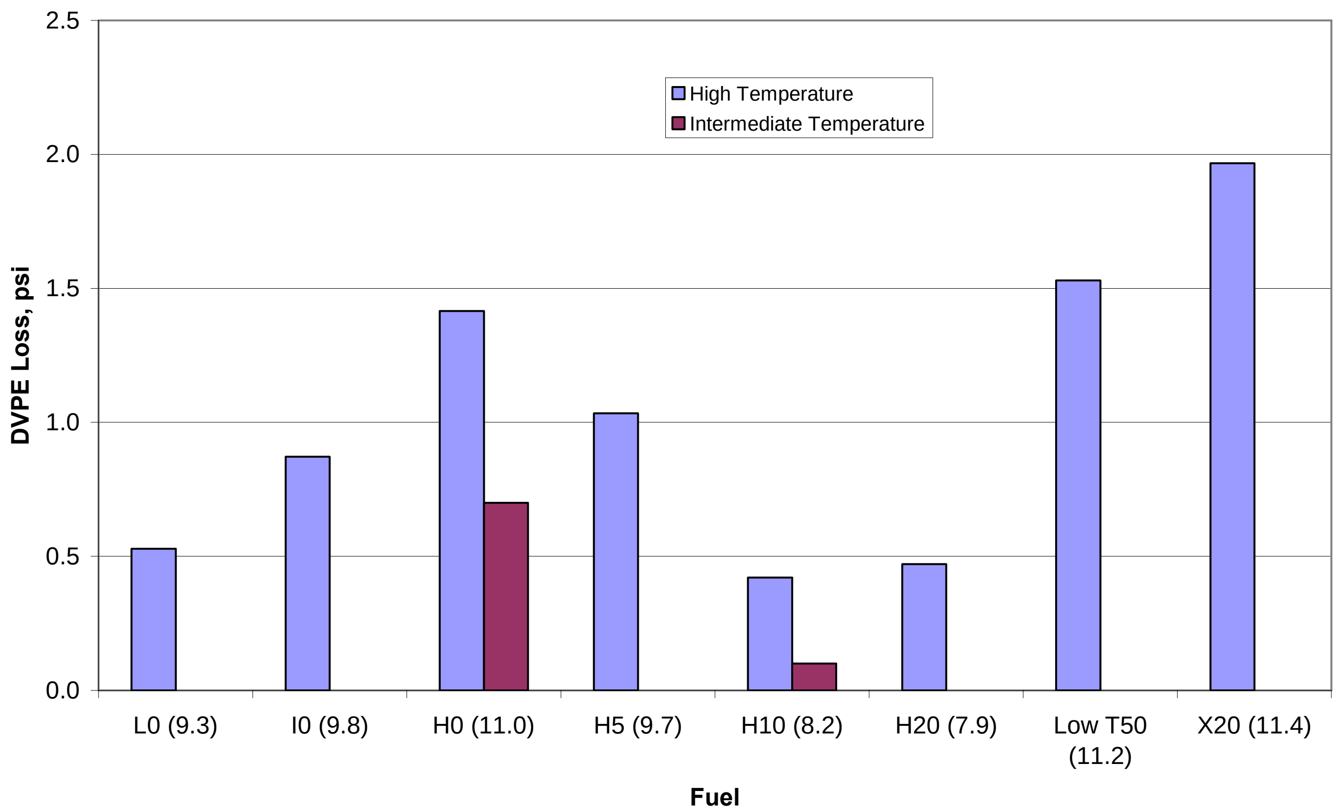


Figure 9
Effect of Vapor Pressure,Temperature and Ethanol Content on Fuel Weathering

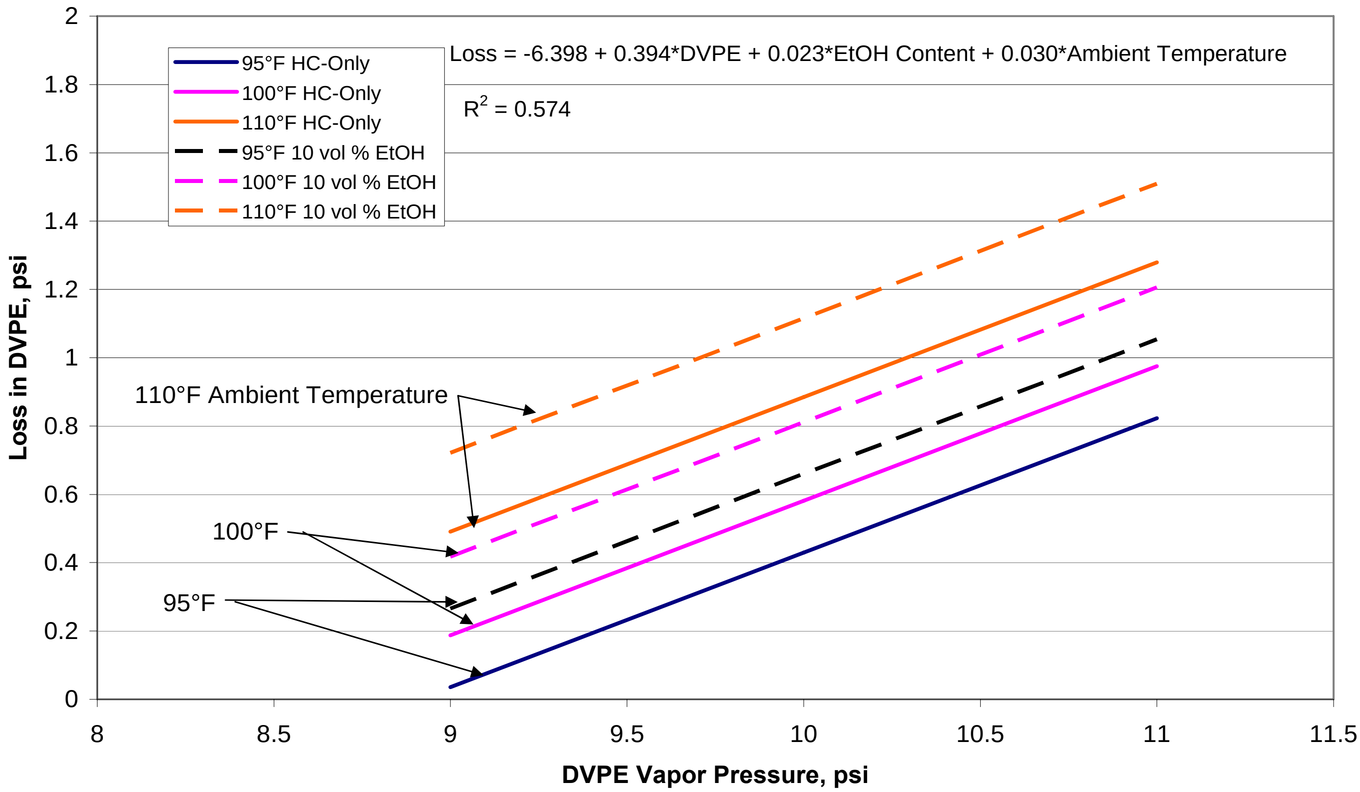


Figure 10
Effect of Temperature, Vapor Pressure, and Ethanol Content on Fuel Weathering

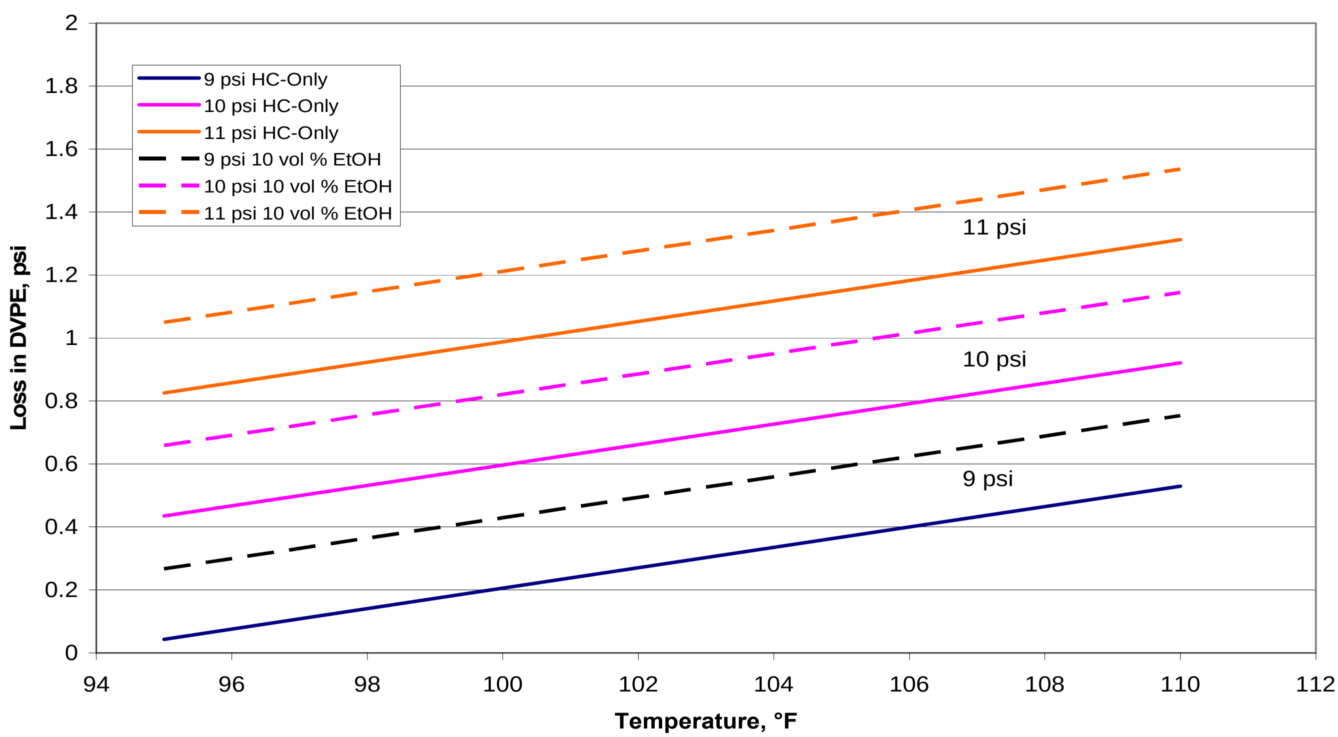
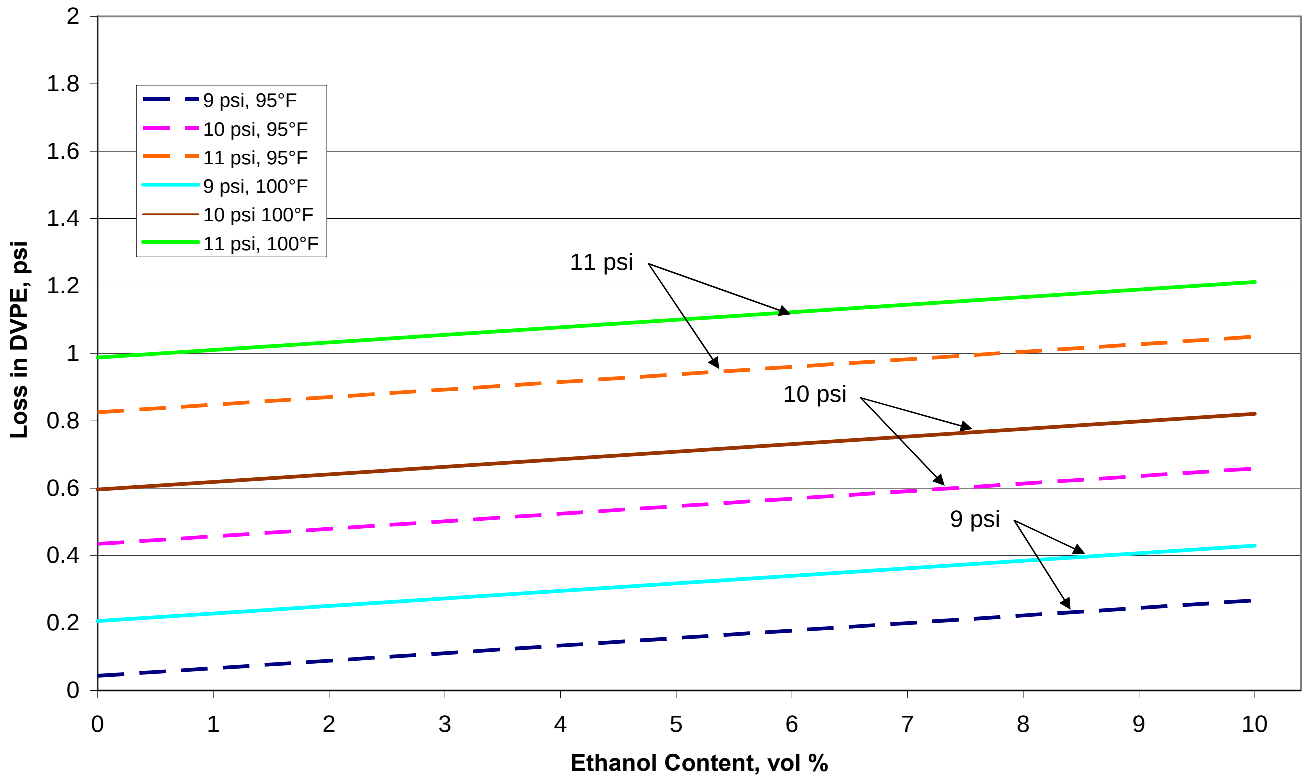


Figure 11
Effect of Ethanol Content, Vapor Pressure, and Temperature on Fuel Weathering



APPENDIX A

MEMBERS OF THE

2006 CRC HOT-FUEL-HANDLING PROGRAM

DATA ANALYSIS PANEL

Appendix A

Members of the 2006 CRC Hot-Fuel-Handling Program Data Analysis Panel

Name	Affiliation
Lew Gibbs, Leader	Chevron Products Company
King Eng	Shell Global Solutions (US)
Beth Evans	Evans Research Consultants
Jeff Farenback-Brateman	ExxonMobil Research & Engineering
Pat Geng	General Motors Powertrain
Carl Jewitt	Renewable Fuels Association
Winnie Torres-Ordonez	BP Global Fuels Technology

APPENDIX B

PARTICIPANTS IN THE

2006 CRC HOT-FUEL-HANDLING PROGRAM

ON-SITE AT MESA, ARIZONA

Appendix B

Participants in the 2006 CRC Hot-Fuel-Handling Program On-Site at Mesa, Arizona

Name	Affiliation
Harold "Archie" Archibald	Evans Research Consultants
Brent Bailey	Coordinating Research Council
Dwight Bare	Consultant
Andy Buczynsky	General Motors Powertrain
King Eng	Shell Global Solutions (US)
Beth Evans	Evans Research Consultants
Pat Geng	General Motors Powertrain
Marlin Gilles	Consultant
Steve Hardin	Chevron Products Company
Carl Jewitt	Renewable Fuels Association
Adrian Juergens	Shell Global Solutions (US)
Mike Lynch	ExxonMobil Research & Engineering
Greg Pawczuk	Ford Motor Company
Dave Sporleder	Shell Canada
Phil Van Acker	BP Global Fuels Technology
Ken Wright	ConocoPhillips

APPENDIX C

2006 CRC HOT-FUEL-HANDLING PROGRAM

2006 CRC HOT-FUEL-HANDLING PROGRAM

Revised Copy: November 2, 2005

Objective

Determine under hot ambient temperature conditions the effect of fuel front-end volatility and ethanol content on hot-fuel-handling driveability performance in a large group of late model vehicles equipped with fuel injection systems.

Deliverables

An assessment of hydrocarbon-only and various concentration of ethanol blends under hot temperature ambient conditions of the front-end volatility parameter involving the temperature for a vapor-liquid ratio of 20 (TVL20) and ethanol content that was developed in the 2001 CRC Hot-Fuel-Handling Program (CRC Report No. 629). A new correlation with performance may be developed if necessary.

Introduction

In 1999 and 2001, the CRC Volatility Group conducted hot-fuel-handling programs, one investigating 10 volume % ethanol and the other looking at a range of ethanol concentrations. Both were conducted under warm ambient temperature nominally ranging from 80°F and 100°F. The best volatility parameter that correlated with hot-fuel-handling problems was an experimental one that measured the temperature for a vapor-liquid ratio of 1 at 500 kPa (TVL1-500). The temperature for a vapor-liquid ratio of 20 (TVL20), which is the parameter currently used in ASTM D 4814 to control vapor lock, did not predict performance the same for hydrocarbon-only fuels and ethanol blends. An index using TVL20 and ethanol content terms predicted performance nearly as well as TVL1-500 in both programs. The resulting equations are as follows:

1999 Program – TVL20 – 1.33*Ethanol Content
2001 Program – TVL20 – 1.27*Ethanol Content

When a study was undertaken to incorporate the ethanol effect into ASTM D 4814 Standard Specification for Automotive Spark-Ignition Engine Fuel, it became apparent that, for the southeastern portion of California in the summertime, the current minimum TVL20 limit of 60°C (140°F) could not be met using ethanol blends and still comply with California Phase 3 reformulated gasoline regulations, specifically the maximum 50% evaporated point along with minimum federal vapor pressure limit. From the study, it is not known: 1) whether the above TVL20 adjusted for ethanol content equation is not applicable at high ambient temperatures, 2) if the current TVL=20 minimum limit is too restrictive for modern fuel injected vehicles, or 3) if the lack of reported volatility related problems for the area correctly reflects an absence of problems. The need to know the answers to these questions becomes greater as other hot weather areas adopt reformulated gasolines. With the recent increased interest in 20 vol % ethanol blends (E20), an E20 fuel series was incorporated into the program.

Test Program

Vehicle hot-fuel-handling performance will be determined using the test procedure from the 2001 CRC volatility test program including the fuel-flushing procedure. This program will be conducted in the summer of 2006.

Test Fuels

The test fuel design will evaluate hydrocarbon-only fuel and three concentrations of ethanol blends (5, 10, and 20 volume percent) at three volatility levels. The three volatility levels will be such that the low volatility fuel series will be acceptable, but borderline regarding driveability problems, the intermediate volatility series will cause mild driveability problems, and the high volatility series will cause severe driveability malfunctions. The primary volatility parameter used to design the fuel sets will be TVL20 – 1.27*Ethanol content. The volatility levels will be selected to cover the currently required limits for three classes. To allow the blending of the least volatile fuel, the distillation property limits will have to exceed those of California Phase 3 reformulated gasoline.

The specifications for the 12 test fuels are shown in Table 1. The limits are designed around the TVL20/ethanol parameter from the 2001 CRC Volatility Program. Estimates of equivalent TVL20 values for the fuels are shown. This initial proposal requires that each test fuel be specially blended. A Fuel Blending and Analysis Task Force will be formed to develop the final detailed specifications for the test fuels and to assist in the analyses of the fuels.

Test Vehicles

Approximately 20 late model and 5 10-year old model fuel injected equipped vehicles will be used in this test program to evaluate the hot-fuel-handling driveability performance of the test fuels. The late model vehicles will be selected from a total fleet of about 80 vehicles based on their response to the lowest TVL20 – 1.27*ethanol content blend with the highest level of ethanol. Those vehicles giving driveability problems will be further tested on the highest TVL20 hydrocarbon-only gasoline to verify sensitivity to fuel properties. The late model vehicles will nominally cover 2005-2006 model years and will have stabilized mileages at over 6,000 odometer miles, and be in good mechanical condition with functional air conditioning systems. The 10-year old models must be evaluated to ensure that they are in good mechanical condition, equipped with functional air conditioning, and also will be screened for fuel response.

Test Procedure

The Test Procedure used in the 2001 CRC volatility program will be used in this follow-up program. Each vehicle will be flushed with test fuel following the latest flushing procedure and filled to 40 percent of tank capacity. The most volatile fuel will be tested in each vehicle at increasing ambient temperatures until malfunctions are reported. If no problems are observed at the highest available temperature with the most volatile fuel, the vehicle will be parked and eliminated from the test fleet. If driveability problems are observed, lower volatility fuels will be tested at several ambient temperatures.

It is not planned to instrument the test vehicles as was done in 2001. On-site inspection of the test fuels to confirm they have not weathered and to evaluate fuels after vehicle testing will be undertaken.

Test Temperatures

The ambient test temperature will be a minimum of 105°F. It is desirable to conduct testing above 110°F, but below 115°F.

Test Location

Because the ambient temperature conditions at the Renegade Raceways in Yakima, Washington, are not reliably high enough for this program, this test program will be conducted at the GM Desert Proving Grounds in Mesa, Arizona (a suburb of Phoenix).

Timing

The timing will be as follows:

The week of May 15, 2006 – 2 to 3 people will be required on-site to receive delivery of equipment, repair soak sheds, etc.

The weeks of May 22 and 29, 2006 – 5 to 7 people will be required on-site for vehicle screening.

June 5 through July 7, 2006 – the core test program with the 25 selected vehicles and 12 test fuels will be conducted.

This time period has been selected as the most advantageous time at the GM Desert Proving Grounds for the desirable ambient temperatures and the least precipitation.

It is planned that the data analysis and report-writing activities can be completed within about nine-months following the completion of the testing portion of the program.

Personnel Requirements

The core 5-week program will require 13 people on-site for each testing week for a total of 65 person-weeks. Mechanics and set-up people will be required for the weeks prior to the start of testing.

Table 1
2006 CRC Volatility Program Test Fuel Specifications

	Test	Low Volatility Series				Intermediate Volatility Series				High Volatility Series			
Property	Methods	L0	L5	L10	L20	I0	I5	I10	I20	H0	H5	H10	H20
Ethanol, Vol %	D 4815	0	4.5-5.5	9.5-10.5	19.5-20.5	0	4.5-5.5	9.5-10.5	19.5-20.5	0	4.5-5.5	9.5-10.5	19.5-20.5
TVL20 - 1.27*EtOH, °F Target	D 5188 + Calc	140	140	140	140	133	133	133	133	124	124	124	124
TVL20. °F Approximate	D 5188	140	146	153	165	133	139	146	158	124	130	137	149
DVPE, psi	D 5191	6.5-7.2	6.5-7.2	6.5-7.2	6.5-7.2	7.0-9.0	7.0-9.0	7.0-9.0	7.0-9.0	7.0-10.0	7.0-10.0	7.0-10.0	7.0-10.0
10% Evaporated, °F	D 86	135-155	135-155	135-155	135-155	135-155	135-155	135-155	135-155	125-150	125-150	125-150	125-150
50% Evaporated, °F	D 86	185-230	185-230	185-230	170-220	185-230	185-230	185-230	170-220	170-220	170-220	170-220	170-220
90% Evaporated, °F	D 86	290-330	290-330	290-330	290-330	290-330	290-330	290-330	290-330	290-330	290-330	290-330	290-330
Aromatics, vol %	D 1319	20-30	15-25	15-25	15-25	20-30	15-25	15-25	15-25	20-30	15-25	15-25	15-25
Olefins, vol %	D 1319	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10	0-10
Saturates, vol %	D 1319	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
Benzene, vol %	D 3606	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
MTBE, vol %	D 4815	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead, g/gal	D 3237	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Washed Gum, mg/100mL	D 381	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
RON	D 2699	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90
MON	D 2700	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
(R+M)/2	Calculation	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
API Gravity	D 4052	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report

All blends are to be made using refinery gasoline blending components.
Fuels are to contain all of the appropriate carbon numbers for each hydrocarbon type to represent commercial gasoline.

FUELING AND DEFUELING PROCEDURE

VEHICLE PREPARATION

Used test fuel from the vehicle is drained just before the fuel rail. The fuel line is disconnected at the OEM quick-disconnect to the fuel rail, and a Hansen fitting with hose is inserted between the fuel line and the fuel rail. During defueling, a tee is inserted between the two fittings, with one end of the tee leading to the “slop” fuel drum.

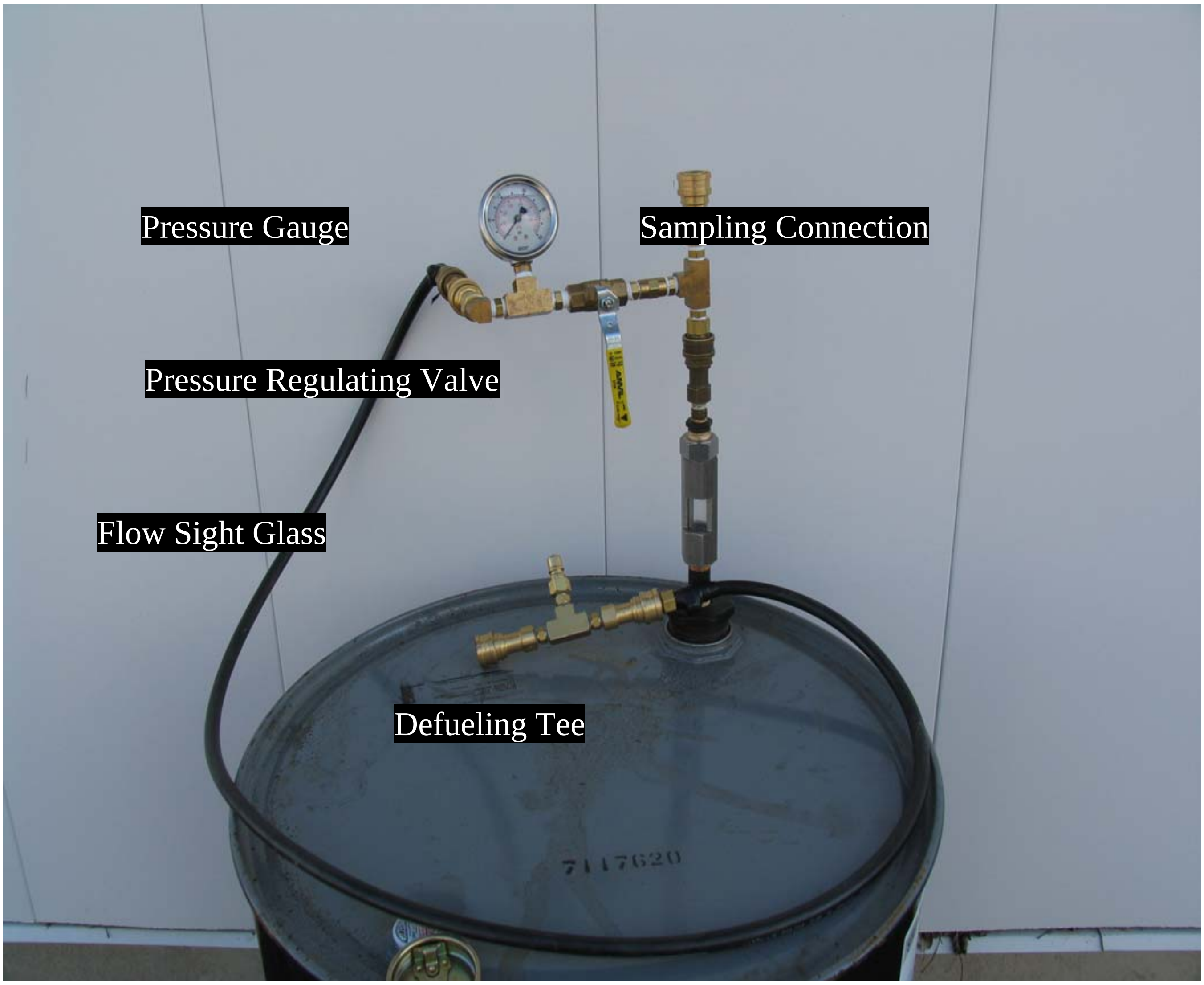
The next step in vehicle preparation is to install voltmeter leads to either the throttle-position-sensor (TPS) or the accelerator pedal, whichever is appropriate. The wires are routed into the passenger compartment of the vehicle to allow the rater to attach a voltmeter during testing. These wires should be long enough to allow either the rater or the observer to be able to read the voltmeter.

DEFUELING PROCEDURE

The fuel is drained into a “slop” drum. This draining system is a closed system, and requires the vehicle engine to be running during the draining procedure. The large bung of the “slop” drum is removed and replaced with a bung that has a two-foot stainless steel tube welded through it. The top of the tube has a Swedgelock fitting on it which attaches to a Hansen coupler. Atop the coupler is an apparatus which has a pressure gauge, a regulating valve, and a sight glass, along with an extra Hansen fitting to obtain fuel samples. During defueling, this apparatus is connected to the vehicle’s fuel line via the tee inserted as described above.

The small bung of the drum is removed and replaced by a bung with a float arrangement fabricated to indicate when the drum is full. This float arrangement has corks mounted on a rod on the underside of the small bung and a flag mounted on the same rod on the top-side of the small bung. As the fuel level in the drum rises, it pushes the corks up, which in turn pushes the flag up. This notifies the defueling personnel that the drum is full and must be changed.

Following is the procedure for draining and flushing the fuel system:


Pressure Gauge
Sampling Connection
Pressure Regulating Valve
Flow Sight Glass
Defueling Tee

FUEL TANK FLUSHING PROCEDURE

Precautionary notes:

1. ***When draining the vehicle fuel tank, the vehicle engine is running, and the pressure to keep the engine running is regulated at the "slop" drum.***
2. ***Some vehicles require that the accelerator pedal be depressed to keep the engine running. An adjustable rod may be used to do this.***
3. ***Use a UL approved ground strap to ground defueling equipment to the fuel injector rail or fuel line fitting for all fuel draining.***

Flushing Procedure:

1. When a vehicle comes in from testing, the defueling apparatus is connected to the vehicle, and the engine is started so the fuel will flow. The flow to the "slop" drum is controlled by the regulating valve.

2. If a fuel sample is required, allow fuel to be drained for one minute through the draining apparatus on the "slop" drum before taking a fuel sample. Fuel from the vehicle should also be drained through the sampling line to ensure that the sample is not contaminated. A sample can then be taken from the sampling port on the draining apparatus.

3. Completely drain the vehicle's fuel tank, at which time the engine will shut down.

4. Remove the fill cap, add four gallons of the next test fuel to the vehicle fuel tank, and replace the fill cap.

5. Start and idle the vehicle for a total of 2 minutes.

6. Completely drain the fuel tank through the draining apparatus, at which time the engine will shut down.

7. Remove the fill cap, add four gallons of the next test fuel to the vehicle fuel tank, and replace the fill cap.

8. Start and idle the vehicle for a total of 2 minutes. From approximately 15 seconds into the idle for a period of 30 seconds, rock the rear end of the vehicle from side to side. This task will require one person on each side of the vehicle.

9. Completely drain the fuel tank through the draining apparatus, at which time the engine will shut down.

10. When the vehicle is ready, remove the fill cap, add four or five gallons as required of the test fuel to the vehicle fuel tank, and replace the fill cap.

FUELING PROCEDURE

The vehicles are fueled out of a 55-gallon drum of test fuel, using a portable dispensing pump. This dispensing pump has been fabricated by mounting the motor and gauge on a hand-truck. The dispensing pump is service station quality. The large bung of the drum is removed, and a steel pipe is inserted into the drum. The top of the pipe has the male side of the Hansen coupler on it and is connected to the female side of the coupler on the dispensing pump inlet hose. The small bung is loosened just enough to keep the drum from collapsing while fuel is being pumped out of it.

Ground straps are used throughout the fueling and defueling process to avoid static electricity.

APPENDIX D

LISTING OF SCREENED VEHICLES

TEST VEHICLES
2006 CRC Hot-Fuel-Handling Program
GM Proving Grounds, Mesa, Arizona

Year	Make	Model	Displacement (Liters)	VIN
2006	Buick	Lacrosse	3.8	2G4WC552961181164
2006	Buick	Lucerne	3.8	1G4HP57226U173244
2006	Buick	Lucerne	3.8	1G4HP57226U224306
2005	Chevrolet	Aveo	1.6	KL1TD52605B321782
2006	Chevrolet	Aveo	1.6	KL1TD56606B644161
2006	Chevrolet	Aveo	1.6	KL1TD56636B44154
1996	Chevrolet	Cavalier	2.2	2G1JC52XTS889467
2005	Chevrolet	Classic	2.2	1G1ND52F75M248313
2005	Chevrolet	Classic	2.2	1G1ND52F85M198960
2006	Chevrolet	Cobalt	2.2	1G1AK55F267658310
2006	Chevrolet	Cobalt	2.2	1G1AK55F067657706
2006	Chevrolet	Cobalt	2.2	1G1AK55F76787714
1997	Chevrolet	Pick-Up	5.7	2GCEK19R8V1241808
2006	Chevrolet	Pick-Up	4.8	1GCEC19VX6Z222406
2006	Chevrolet	Pick-Up	5.3	2GCEK13Z661283923
2005	Chevrolet	Trailblazer	4.2	1GNES16S366123996
1995	Chevrolet	Van 20	5.7	1GBEG25K7SF220408
2006	Chevrolet	2500 Van	6.0	1GCGG25U961122375
2006	Chrysler	Pacifica	3.5	2A4GM68416R778331
2006	Chrysler	PT Cruiser	2.4	3A47FY58B16T227709
2005	Chrysler	Sebring	2.4	1C3EL46X55N641071
2005	Chrysler	Sebring	2.4	1C3EL46X85N592478
2005	Chrysler	Sebring	2.4	1C3EL46X35N641070
1998	Dodge	Caravan	3.3	2B4GP25R8WR819489
2006	Dodge	Dakota	4.7	1D7HE48N96S605357
2006	Dodge	Dakota	4.7	1D7HE48N56S539714
2006	Dodge	Dakota	4.7	1D7HE48N16S605353
2006	Dodge	Durango	4.7	1D4HD48N26F154801
2006	Dodge	Grand Caravan	3.8	2D4GP44LX6R765529
2005	Dodge	Neon	2.0	1B3ES56C35D179019
2005	Dodge	Neon	2.0	1B3ES56C25D166391
2005	Dodge	Neon	2.0	1B3ES26CX5D170784
2005	Dodge	Ram	3.3	1D4GP24R55B327250
2006	Dodge	Ram	4.7	1D7HA18N56J178629
2006	Dodge	Stratus	2.4	1B3EL46X66N177223
2006	Dodge	Stratus	2.4	1B3EL46XX6N246124

TEST VEHICLES
2006 CRC Hot-Fuel-Handling Program
GM Proving Grounds, Mesa, Arizona

Year	Make	Model	Displacement (Liters)	VIN
2006	Ford	Econoline	4.6	1FTRE14WX6DA15846
2006	Ford	Escape	3.0	1FMYU931X6KC35305
2006	Ford	F150	4.6	1FTRW12W26FA69274
2006	Ford	F150	4.6	1FTRW12W16KC29703
2006	Ford	F150	4.6	1FTRW12W66KC29681
2005	Ford	Focus	2.0	1FAFP34N65W252181
2006	Ford	Taurus	3.0	1FAFP53UX6A215251
2006	Ford	Taurus	3.0	AFAFP53U27A116344
2007	Ford	Taurus	3.0	1FAFP53U97A116339
1998	Honda	Accord	2.3	1HGCG5641WA076329
2005	Honda	Civic	1.7	2HGES16545H599319
2006	Hyundai	Tucson	2.7	KM8JN72D36U385193
2006	Jeep	Liberty	3.7	1J4GK48K96W209727
2006	Kia	Optima	2.4	KNAGD126065459998
2006	Kia	Rio	1.6	KNADE123366076699
2006	Kia	Rio	1.6	KNADE123066079530
2006	Lincoln	Town Car	4.6	1LNHM81W26Y600937
2006	Mazda	6	3.0	1YVHP80D765M40142
2006	Nissan	Pathfinder	4.0	5N1AR18U16C617997
2006	Nissan	Sentra	1.8	3NICB51D75L560312
2006	Nissan	Sentra	1.9	3NICB51D96L532402
2005	Pontiac	Grand Am	2.2	1G2NE52F55M189660
2005	Pontiac	Grand Am	3.4	1G2NW12E45M135327
2006	Pontiac	Grand Prix	3.8	2G2WP552161138676
2006	Pontiac	Grand Prix	3.8	2G2WP552261275187
2006	Pontiac	Grand Prix	3.8	2G2WP552261134877
2006	Pontiac	Grand Prix	3.8	2G2WP552961283237
2006	Saturn	Ion	2.2	1G8AJ55F46Z205444
2006	Toyota	Camry	2.4	4T1BE32K86U67177
2006	Toyota	RAV4	2.4	JTMBD33V266008287

APPENDIX E

DETAILED FUEL INSPECTIONS, TEST FUEL DRUM INSPECTIONS, FLUSHING EFFICIENCY INSPECTIONS, AND ON-SITE VAPOR PRESSURE DETERMINATIONS

Table E-1
Individual Laboratory Fuel Inspections

Fuel Code			L 0				L 5			
Laboratory			A	C	D	Average	A	C	D	Average
Property	Method	Units								
Temperature for V/L=20	ASTM D 5188	°F	139.0	136.7	137.0	137.6	146.0	146.0	146.0	146.0
DVPE	ASTM D 5191	psi	8.7	9.5	9.7	9.3	7.6	6.8		7.2
Distillation	ASTM D 86									
Initial Boiling Point		°F	101.3	92.4	82.5	92.1	109.8	111.9		110.9
5% Evaporated		°F	113.2	114.9	107.1	111.7	130.6	137.6		134.1
10% Evaporated		°F	126.5	127.9	122.6	125.7	140.0	144.8		142.4
20% Evaporated		°F	150.4	152.2	147.8	150.1	155.5	159.0		157.3
30% Evaporated		°F	176.0	177.9	173.9	175.9	193.1	198.6		195.9
40% Evaporated		°F	200.7	201.3	198.7	200.2	211.3	214.7		213.0
50% Evaporated		°F	219.4	218.8	216.5	218.2	221.2	224.4		222.8
60% Evaporated		°F	230.4	232.5	223.7	228.9	233.1	236.8		235.0
70% Evaporated		°F	248.9	249.0	247.3	248.4	250.3	252.3		251.3
80% Evaporated		°F	275.4	275.5	273.9	274.9	279.9	282.7		281.3
90% Evaporated		°F	317.5	316.9	316.6	317.0	325.4	327.3		326.4
95% Evaporated		°F	348.4	346.8	356.6	350.6	361.2	358.5		359.9
End Point		°F	398.5	399.9	397.0	398.5	406.4	417.2		411.8
Recovery		vol %	97.3	97.5	96.8	97.2	97.7	97.9		97.8
Residue		vol %	1.0	1.1	1.3	1.1	1.0	1.0		1.0
Loss		vol %	1.7	1.4	1.7	1.6	1.3	1.1		1.2
Gravity	ASTM D 4052	°API	62.5	62.4	62.6	62.5	58.9	58.2		58.6
Relative Density		g/gal	0.7295	0.7298	0.7290	0.7294	0.7433	0.7459		0.7446
Ethanol	ASTM D 4815	vol %	0.00	0.00	0.10	0.03	4.73	5.07		4.90
MTBE	ASTM D 4815	vol %	0.00		0.01			0.00		
Uncorrected Composition										
Aromatics	ASTM D 1319	vol %	22.6	24.1		23.4	25.0	26.8		25.9
Olefins	ASTM D 1319	vol %	5.4	6.5		6.0	4.7	7.6		6.2
Saturates	ASTM D 1319	vol %	72.0	69.4		70.7	70.3	65.6		68.0
Corrected Composition										
Aromatics	ASTM D 1319	vol %	22.6	24.1	24.5	23.7	23.8	25.4	21.8	23.7
Olefins	ASTM D 1319	vol %	5.4	6.5	4.4	5.4	4.5	7.2	6.4	6.0
Saturates	ASTM D 1319	vol %	72.0	69.4	71.0	70.8	67.0	62.3	71.8	67.0
Benzene	ASTM D 3606	vol %	0.68				0.53			
Solvent washed gum	ASTM D 381	mg/100ml	0.0				2.6			
Research Octane Number	ASTM D 2699	ON	90.28				91.22			
Motor Octane Number	ASTM D 2700	ON	83.10				83.59			
(R+M)/2	D 2699/2700	ON	86.70				87.40			

Table E-1 Continued
Individual Laboratory Fuel Inspections

Fuel Code			L 10				L 20			
Laboratory			A	C	D	Average	A	C	D	Average
Property	Method	Units								
Temperature for V/L=20	ASTM D 5188	°F	152.0	152.6	152.0	152.2	148.0	150.7	148.0	148.9
DVPE	ASTM D 5191	psi	5.9	5.9		5.9	5.9	5.9		5.9
Distillation	ASTM D 86									
Initial Boiling Point		°F	123.4	121.8		122.6	122.2	124.7		123.5
5% Evaporated		°F	144.0	144.3		144.2	142.5	143.6		143.1
10% Evaporated		°F	149.9	149.9		149.9	148.8	149.0		148.9
20% Evaporated		°F	156.7	155.4		156.1	155.5	155.3		155.4
30% Evaporated		°F	162.9	159.8		161.4	159.6	159.6		159.6
40% Evaporated		°F	202.1	202.8		202.5	162.7	162.5		162.6
50% Evaporated		°F	221.9	224.9		223.4	166.1	165.3		165.7
60% Evaporated		°F	233.6	234.3		234.0	228.9	229.2		229.1
70% Evaporated		°F	252.0	254.4		253.2	251.2	253.9		252.6
80% Evaporated		°F	285.3	286.5		285.9	288.7	290.3		289.5
90% Evaporated		°F	328.1	329.0		328.6	336.4	333.1		334.8
95% Evaporated		°F	362.3	361.0		361.7	373.1	368.2		370.7
End Point		°F	408.0	419.1		413.6	423.5	421.7		422.6
Recovery		vol %	98.7	98.0		98.4	99.0	98.2		98.6
Residue		vol %	1.0	1.0		1.0	0.5	1.0		0.8
Loss		vol %	0.3	1.0		0.7	0.5	0.8		0.7
Gravity	ASTM D 4052	°API	55.9	55.8		55.9	53.9	53.9		53.9
Relative Density		g/gal	0.7550	0.7555		0.7552	0.7631	0.7632		0.7632
Ethanol	ASTM D 4815	vol %	10.40	11.51		10.96	20.00	20.57		20.29
MTBE	ASTM D 4815	vol %		0.00				0.00		
Uncorrected Composition										
Aromatics	ASTM D 1319	vol %	29.6	29.5		29.6	34.1	31.9		33.0
Olefins	ASTM D 1319	vol %	6.0	9.0		7.5	7.0	13.7		10.4
Saturates	ASTM D 1319	vol %	64.4	61.5		63.0	59.1	54.4		56.8
Corrected Composition										
Aromatics	ASTM D 1319	vol %	26.5	26.1		26.3	27.3	25.3		26.3
Olefins	ASTM D 1319	vol %	5.4	8.0		6.7	5.6	10.9		8.2
Saturates	ASTM D 1319	vol %	57.7	54.4		56.1	47.3	43.2		45.2
Benzene	ASTM D 3606	vol %	0.59				0.61			
Solvent washed gum	ASTM D 381	mg/100ml	0.4				1.8			
Research Octane Number	ASTM D 2699	ON	90.84				92.50			
Motor Octane Number	ASTM D 2700	ON	83.32				82.50			
(R+M)/2	D 2699/2700	ON	87.10				87.50			

Table E-1 Continued
Individual Laboratory Fuel Inspections

Fuel Code			**I 0**				**I 5**			
Laboratory			**A**	**C**	**D**	**Average**	**A**	**C**	**D**	**Average**
Property	**Method**	**Units**								
Temperature for V/L=20	ASTM D 5188	°F	133.4	132.6	133.0	133.0	137.1	137.7	137.0	137.3
DVPE	ASTM D 5191	psi	9.9	9.9	9.7	9.8	8.5	8.5	8.5	8.5
Distillation	ASTM D 86									
Initial Boiling Point		°F	95.0	92.8	84.7	90.8	104.5	101.1	80.2	95.3
5% Evaporated		°F	111.2	112.4	109.6	111.1	125.4	122.5	120.7	122.9
10% Evaporated		°F	122.9	123.2	122.0	122.7	133.0	131.3	130.2	131.5
20% Evaporated		°F	141.4	143.2	142.5	142.4	145.8	142.7	142.5	143.7
30% Evaporated		°F	163.6	166.4	165.8	165.3	174.4	172.0	169.0	171.8
40% Evaporated		°F	139.3	192.7	191.6	174.5	205.2	205.5	204.3	205.0
50% Evaporated		°F	212.7	215.2	214.6	214.2	220.6	220.8	220.5	220.6
60% Evaporated		°F	229.3	231.8	223.6	228.2	234.1	234.3	227.1	231.8
70% Evaporated		°F	246.1	249.2	249.7	248.3	251.8	252.3	251.8	252.0
80% Evaporated		°F	273.4	276.0	276.1	275.2	282.7	282.9	282.6	282.7
90% Evaporated		°F	315.0	315.8	316.7	315.8	327.4	325.5	327.2	326.7
95% Evaporated		°F	347.2	345.9	346.0	346.4	363.0	361.9	367.9	364.3
End Point		°F	395.2	400.6	402.5	399.4	416.8	414.5	411.8	414.4
Recovery		vol %	97.8	97.5	98.2	97.8	98.4	96.8	97.2	97.5
Residue		vol %	1.0	1.0	1.0	1.0	1.0	1.2	1.5	1.2
Loss		vol %	1.2	1.5	0.8	1.2	0.6	2.0	1.2	1.3
Gravity	ASTM D 4052	°API	63.0	63.0	63.1	63.0	59.7	59.5	59.6	59.6
Relative Density		g/gal	0.7277	0.7275	0.7271	0.7274	0.7403	0.7408	0.7405	0.7405
Ethanol	ASTM D 4815	vol %	0.00	0.00	0.00	0.00	4.77	4.95	4.88	4.87
MTBE	ASTM D 4815	vol %	0.00		0.02		0.00		0.00	
Uncorrected Composition										
Aromatics	ASTM D 1319	vol %	23.8	25.5		24.7	26.4	25.7		26.1
Olefins	ASTM D 1319	vol %	4.2	7.0		5.6	5.1	8.2		6.7
Saturates	ASTM D 1319	vol %	72.0	67.5		69.8	68.5	66.1		67.3
Corrected Composition										
Aromatics	ASTM D 1319	vol %	23.8	25.5	24.8	24.7	25.1	24.4	23.9	24.5
Olefins	ASTM D 1319	vol %	4.2	7.0	4.0	5.1	4.9	7.8	5.3	6.0
Saturates	ASTM D 1319	vol %	72.0	67.5	71.2	70.2	65.2	62.8	65.9	64.7
Benzene	ASTM D 3606	vol %					0.55			
Solvent washed gum	ASTM D 381	mg/100ml					0.4			
Research Octane Number	ASTM D 2699	ON	90.38				90.65			
Motor Octane Number	ASTM D 2700	ON	83.51				83.19			
(R+M)/2	D 2699/2700	ON	86.90				86.90			

Table E-1 Continued
Individual Laboratory Fuel Inspections

Fuel Code			I 10				I 20			
Laboratory			**A**	**C**	**D**	**Average**	**A**	**C**	**D**	**Average**
Property	**Method**	**Units**								
Temperature for V/L=20	ASTM D 5188	°F	143.6	144.3	144.0	144.0	144.0	144.3	144.0	144.1
DVPE	ASTM D 5191	psi	7.1	7.1	7.1	7.1	6.6	6.6		6.6
Distillation	ASTM D 86									
Initial Boiling Point		°F	114.3	112.6	106.8	111.2	117.9	115.5		116.7
5% Evaporated		°F	133.2	135.8	135.2	134.7	138.4	143.9		141.2
10% Evaporated		°F	141.3	143.0	141.7	142.0	145.2	152.9		149.1
20% Evaporated		°F	151.0	150.2	150.9	150.7	153.9	159.0		156.5
30% Evaporated		°F	155.3	156.3	157.0	156.2	160.0	163.0		161.5
40% Evaporated		°F	188.8	189.1	189.5	189.1	163.8	166.2		165.0
50% Evaporated		°F	218.1	219.9	219.7	219.2	167.2	227.4		197.3
60% Evaporated		°F	230.2	230.9	225.3	228.8	222.4	253.0		237.7
70% Evaporated		°F	248.0	250.7	250.8	249.8	247.3	284.7		266.0
80% Evaporated		°F	279.9	281.6	282.8	281.4	277.9	329.0		303.5
90% Evaporated		°F	323.6	327.0	328.5	326.4	322.2	361.7		342.0
95% Evaporated		°F	354.7	359.2	364.8	359.6	347.9	417.5		382.7
End Point		°F	413.4	415.5	414.3	414.4	394.2	421.7		408.0
Recovery		vol %	98.3	98.1	97.6	98.0	99.0	97.2		98.1
Residue		vol %	0.8	1.0	1.5	1.1	1.0	1.0		1.0
Loss		vol %	0.9	0.9	0.9	0.9	0.0	1.8		0.9
Gravity	ASTM D 4052	°API	57.5	57.3	57.5	57.4	54.8	54.7		54.8
Relative Density		g/gal	0.7485	0.7495	0.7487	0.7489	0.7595	0.7599		0.7597
Ethanol	ASTM D 4815	vol %	9.90	10.48	10.05	10.14	19.55	20.87		20.21
MTBE	ASTM D 4815	vol %	0.00		0.00			0.00		
Uncorrected Composition										
Aromatics	ASTM D 1319	vol %	27.9	27.4		27.7	33.9	31.3		32.6
Olefins	ASTM D 1319	vol %	6.3	8.7		7.5	6.6	13.7		10.2
Saturates	ASTM D 1319	vol %	65.8	27.4		46.6	59.5	59.7		59.6
Corrected Composition										
Aromatics	ASTM D 1319	vol %	25.1	24.5	25.6	25.1		24.8	24.4	24.6
Olefins	ASTM D 1319	vol %	5.7	7.8	4.3	5.9		10.8	6.6	8.7
Saturates	ASTM D 1319	vol %	59.3	24.5	60.1	48.0		47.2	69.0	58.1
Benzene	ASTM D 3606	vol %	0.55				0.57			
Solvent washed gum	ASTM D 381	mg/100ml	1.0				1.0			
Research Octane Number	ASTM D 2699	ON	90.55				82.10			
Motor Octane Number	ASTM D 2700	ON	82.92				86.60			
(R+M)/2	D 2699/2700	ON	86.70				91.14			

Table E-1 Continued
Individual Laboratory Fuel Inspections

Fuel Code			**H 0**				**H 5**			
Laboratory			**A**	**C**	**D**	**Average**	**A**	**C**	**D**	**Average**
Property	**Method**	**Units**								
Temperature for V/L=20	ASTM D 5188	°F	123.7	123.7	125.0	124.1	127.8	126.1	127.0	127.0
DVPE	ASTM D 5191	psi	10.9	11.1	10.9	11.0	9.7	9.7	9.6	9.7
Distillation	ASTM D 86									
Initial Boiling Point		°F	86.0	87.2	84.3	85.8	108.1	98.4	92.1	99.5
5% Evaporated		°F	105.1	104.3	97.8	102.4	115.2	116.4	111.8	114.5
10% Evaporated		°F	114.8	114.6	109.8	113.1	121.6	123.4	121.3	122.1
20% Evaporated		°F	132.1	132.8	128.2	131.0	134.2	135.1	133.2	134.2
30% Evaporated		°F	153.9	155.1	150.3	153.1	146.7	149.1	145.6	147.1
40% Evaporated		°F	182.8	183.5	178.9	181.7	188.6	189.3	185.8	187.9
50% Evaporated		°F	212.5	213.4	210.1	212.0	214.9	215.2	213.5	214.5
60% Evaporated		°F	232.3	234.5	221.6	229.5	230.0	230.1	221.9	227.3
70% Evaporated		°F	252.7	255.0	253.1	253.6	247.5	248.1	248.0	247.9
80% Evaporated		°F	283.6	285.4	284.0	284.3	281.3	278.6	277.5	279.1
90% Evaporated		°F	324.5	327.3	324.9	325.6	327.4	324.8	322.7	325.0
95% Evaporated		°F	356.4	360.3	379.4	365.4	364.8	359.0	370.3	364.7
End Point		°F	411.4	417.9	415.5	414.9	412.0	415.7	416.4	414.7
Recovery		vol %	98.6	98.7	96.4	97.9	97.9	98.8	96.9	97.9
Residue		vol %	0.7	97.0	1.2	33.0	1.0	97.4	1.1	33.2
Loss		vol %	0.7	1.0	2.2	1.3	1.1	1.1	1.8	1.3
Gravity	ASTM D 4052	°API	63.4	63.3	63.5	63.4	61.4	61.4	61.5	61.4
Relative Density		g/gal	0.7259	0.7264	0.7256	0.7260	0.7336	0.7335	0.7332	0.7334
Ethanol	ASTM D 4815	vol %	0	0	0	0.0	4.95	4.99	4.94	4.96
MTBE	ASTM D 4815	vol %	0		0		0			
Uncorrected Composition										
Aromatics	ASTM D 1319	vol %	24.7	23.9		24.3	22.8	25.1		24.0
Olefins	ASTM D 1319	vol %	6.9	7.4		7.2	5.1	8.6		6.9
Saturates	ASTM D 1319	vol %	68.4	68.7		68.6	72.1	66.3		69.2
Corrected Composition										
Aromatics	ASTM D 1319	vol %	24.7	23.9	23.1	23.9	22.6	23.8	23.8	23.4
Olefins	ASTM D 1319	vol %	6.9	7.4	4.7	6.3	5.0	8.2	7.0	6.7
Saturates	ASTM D 1319	vol %	68.4	68.7	72.2	69.8	71.4	63.0	64.3	66.2
Benzene	ASTM D 3606	vol %	0.38				0.50			
Solvent washed gum	ASTM D 381	mg/100ml	1.0				1.2			
Research Octane Number	ASTM D 2699	ON	90.28				90.93			
Motor Octane Number	ASTM D 2700	ON	83.80				83.79			
(R+M)/2	D 2699/2700	ON	87.00				87.36			

Table E-1 Continued
Individual Laboratory Fuel Inspections

Fuel Code			H 10					H 20			
Laboratory			**A**	**B**	**C**	**D**	**Average**	**A**	**C**	**D**	**Average**
Property	**Method**	**Units**									
Temperature for V/L=20	ASTM D 5188	°F	137.8		135.2	134.0	135.7	138.9	138.4	138	138.4
DVPE	ASTM D 5191	psi	8.19	8.22	8.22	8.30	8.23	7.93	7.97	7.86	7.9
Distillation	ASTM D 86										
Initial Boiling Point		°F	106.3	104.0	101.4	96.0	101.9	110.7	108.1	100.8	106.5
5% Evaporated		°F	125.6	126.0	124.8	122.0	124.6	128.1	132.8	128.2	129.7
10% Evaporated		°F	131.9	132.0	131.9	130.8	131.7	138.2	141.0	139.1	139.4
20% Evaporated		°F	141.6	142.0	140.5	141.1	141.3	150.8	151.5	151.1	151.1
30% Evaporated		°F	150.1	151.0	149.0	149.4	149.9	156.0	158.1	158.1	157.4
40% Evaporated		°F	159.4	158.0	157.2	156.4	157.8	162.7	162.1	162.3	162.4
50% Evaporated		°F	204.4	211.0	204.4	204.5	206.1	165.2	165.7	165.2	165.4
60% Evaporated		°F	223.0	222.0	224.4	222.8	223.1	223.7	227.1	175.4	208.7
70% Evaporated		°F	239.6	244.0	238.6	240.2	240.6	247.3	249.2	248.1	248.2
80% Evaporated		°F	263.5	277.0	265.2	265.9	267.9	282.4	281.1	279.7	281.1
90% Evaporated		°F	308.8	326.0	310.2	307.8	313.2	327.0	325.5	325.8	326.1
95% Evaporated		°F	339.3	379.0	340.5	345.3	351.0	370.8	359.0	365.0	364.9
End Point		°F	390.7	394.0	393.6	391.0	392.3	414.5	415.5	415.7	415.2
Recovery		vol %	99.0	96.2	98.9	96.9	97.8	97.4	98.0	97.5	97.6
Residue		vol %	0.5	1.1	98.3	1.4	25.3	1.4	1.0	1.1	1.2
Loss		vol %	0.5	2.1	1.0	1.7	1.3	1.2	1.0	1.3	1.2
Gravity	ASTM D 4052	°API	60.1	60.3	60.0	60.2	60.2	56.1	55.9	56.1	56.0
Relative Density		g/gal	0.7384	0.7377	0.7389	0.7381	0.7383	0.7544	0.7551	0.7543	0.7546
Ethanol	ASTM D 4815	vol %	9.66	10.70	9.87	9.60	9.96	19.55	19.21	19.08	19.28
MTBE	ASTM D 4815	vol %	0					0		0	
Uncorrected Composition											
Aromatics	ASTM D 1319	vol %	25.3	24.8	24.9		25.0	30.5	29.5		30.0
Olefins	ASTM D 1319	vol %	4.9	5.1	7.5		5.8	5.4	8.4		6.9
Saturates	ASTM D 1319	vol %	69.8	70.1	67.6		69.2	64.1	62.1		63.1
Corrected Composition											
Aromatics	ASTM D 1319	vol %	25.2	22.1	22.4	21	22.7	30.1	23.8		27.0
Olefins	ASTM D 1319	vol %	4.9	4.6	6.8	3.8	5.0	5.3	6.8		6.1
Saturates	ASTM D 1319	vol %	69.5	62.6	60.9	65.6	64.6	63.2	50.2		56.7
Benzene	ASTM D 3606	vol %	0.66			0.78		0.53			
Solvent washed gum	ASTM D 381	mg/100ml	<0.5					1			
Research Octane Number	ASTM D 2699	ON	90.3					90.73			
Motor Octane Number	ASTM D 2700	ON	83					82.54			
(R+M)/2	D 2699/2700	ON	86.7					86.6			

Table E-2
Test Fuel Drum Inspections

Fuel Code		LO	IO Drum 1	HO DRUM 2	H5	H10	H20 DRUM 2	LOW T-50	X2O	House
Property	**Units**									
Temperature for V/L=20	°F	136.8	135.3	127.4	135.4	141.8	138.2	118.7	119.5	130.5
Calc TVL20		136.8	134.6	126.4	132.1	139.8	138.7	116.8	119.5	129.8
Corr. Calc TVL20		135.7	133.4	124.3	129.1	136.0	135.0	115.4	117.8	127.1
DVPE	psi	9.58	9.67	10.95	9.64	8.1	7.84	11.05	11.36	11.01
Distillation										
Initial Boiling Point	°F	89.2	85.9	86.6	95.2	103.8	104.0	89.1	88.6	91.3
10% Evaporated	°F	124.5	121.1	111.6	121.4	130.3	138.9	116.7	119.4	124.4
20% Evaporated	°F	148.2	140.6	129.0	133.0	139.7	150.6	126.9	138.4	139.8
30% Evaporated	°F	173.9	163.2	150.4	143.8	147.8	157.7	137.1	151.9	151.4
50% Evaporated	°F	215.3	212.8	208.0	212.2	202.3	164.5	153.3	162.2	213.0
70% Evaporated	°F	246.0	247.2	250.9	246.6	236.5	245.1	233.6	238.6	247.2
90% Evaporated	°F	314.1	314.5	322.4	322.0	309.3	323.0	322.7	323.2	331.6
End Point	°F	395.4	396.9	412.8	411.4	389.8	410.3	361.7	395.6	397.5
Recovery	vol %	97.8	98.3	97.1	97.3	97.0	97.9	98.4	96.2	98.1
Residue	vol %	0.8	0.8	0.8	0.9	0.9	0.9	0.7	0.9	1.0
Loss	vol %	1.4	0.9	2.1	1.8	2.1	1.2	0.9	2.9	0.9
Driveability Index	vol %	1147	1135	1114	1141	1112	1025	958	989	1157
E 200	vol %	41.0	44.2	47.0	44.4	49.3	59.6	59.5	62.2	46.5
E 300	vol %	87.0	86.8	84.4	85.3	88.0	85.1	85.8	85.7	83.2
Gravity	°API	62.4	62.8	63.2	61.3	60.0	55.7	62.9	61.0	62.0
Relative Density	g/gal	0.7298	0.7282	0.7267	0.7340	0.7390	0.7558	0.7279	0.7352	0.7314
Ethanol	vol %	0.30	0.00	0.00	5.14	9.61	18.10	9.86	16.38	9.35
Total Oxygen	mass %	0.11	0.00	0.00	1.93	3.59	6.60	3.74	6.14	3.53
MTBE	vol %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corrected Composition										
Aromatics	vol %	21.4	19.8	22.9	22.1	20.9	23.3	17.6	14.1	14.4
Olefins	vol %	5.4	5.8	6.3	5.7	5.4	6.2	13.6	4.6	5
Saturates	vol %	72.9	74.4	70.8	67.1	64.1	52.4	58.9	64.9	71.3
NIR RON	ON	90.7	90.8	90.8	91.8	91.6	NoResult	100.9	NoResult	96.2
NIR MON	ON	83.8	84.1	83.9	84.1	83.6	NoResult	88.2	NoResult	87.6
NIR (R+M)/2 CALC	ON	87.3	87.4	87.4	88	87.6	NoResult	94.6	NoResult	91.9

Table E-3
Assesment of Flushing Procedure

Vehicle Number	4	7	10	11	12	15
Fuel	LO DRUM 3	LO DRUM 1	LO DRUM 1	LO DRUM 1	LO DRUM 1	LO DRUM 1
Relative Density	0.7352	0.7327	0.7317	0.7321	0.7324	0.7312
MTBE, Vol%	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol,Vol %	0.27	0.38	0.70	0.12	0.08	0.52
Total O, mass %	0.10	0.14	0.26	0.05	0.03	0.20

Vehicle Number	17	28	31	32	34	35
Fuel	LO DRUM 3	LO DRUM 1	LO DRUM 5	LO DRUM 4	LO DRUM 5	LO DRUM 2
Relative Density	0.7351	0.7321	0.7348	0.7319	0.7313	0.7330
MTBE, Vol%	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol,Vol %	0.16	0.29	0.08	0.72	0.60	0.23
Total O, mass %	0.06	0.11	0.03	0.27	0.23	0.09

Vehicle Number	37	39	41	42	46	47
Fuel	L0 DRUM 4	LO DRUM 2	LO DRUM 5	LO DRUM 2	LO DRUM 4	LO DRUM 3
Relative Density	0.7339	0.7314	0.7320	0.7314	0.7319	0.7334
MTBE, Vol%	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol,Vol %	0.11	0.35	0.08	0.09	0.35	0.40
Total O, mass %	0.04	0.13	0.03	0.03	0.13	0.15

Vehicle Number	48	49	58	59	61	62
Fuel	LO DRUM 2	LO DRUM 4	LO DRUM 4	LO DRUM 4	LO DRUM 3	LO DRUM 3
Relative Density	0.7326	0.7387	0.7337	0.7329	0.7320	0.7329
MTBE, Vol%	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol,Vol %	0.23	0.13	0.13	0.27	0.41	0.16
Total O, mass %	0.09	0.05	0.05	0.10	0.15	0.06

Vehicle Number	63	64	66
Fuel	LO DRUM 2	LO DRUM 2	LO DRUM 3
Relative Density	0.7353	0.7338	0.7359
MTBE, Vol%	0.00	0.00	0.00
Ethanol,Vol %	0.32	0.10	0.39
Total O, mass %	0.12	0.04	0.15

Table E-4

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/14/2006	House	49	108	8.53	11.65	3.12
6/14/2006	House	62	108	8.72	11.65	2.93
6/14/2006	House	66	108	8.22	11.65	3.43
6/11/2006	H0	4	113	9.21	11.28	2.07
6/16/2006	H0	4	99	10.23	11.28	1.05
7/3/2006	H0	7	93	10.91	11.28	0.37
6/12/2006	H0	7	108	8.79	11.28	2.49
7/3/2006	H0	10	95	11.36	11.28	-0.08
6/12/2006	H0	10	114	9.82	11.28	1.46
6/12/2006	H0	11	113	9.82	11.28	1.46
6/16/2006	H0	11	91	10.59	11.28	0.69
7/3/2006	H0	15	101	11.33	11.28	-0.05
6/12/2006	H0	15	109	10.49	11.28	0.79
7/4/2006	H0	17	93	10.34	11.28	0.94
6/12/2006	H0	17	111	7.94	11.28	3.34
6/18/2006	H0	17	103	9.05	11.28	2.23
6/11/2006	H0	22	111	10.69	11.28	0.59
7/4/2006	H0	22	102	10.50	11.28	0.78
6/18/2006	H0	22	102	10.42	11.28	0.86
6/11/2006	H0	28	112	9.78	11.28	1.50
6/16/2006	H0	28	97	10.47	11.28	0.81
7/1/2006	H0	31	102	9.56	11.28	1.72
6/12/2006	H0	31	114	8.66	11.28	2.62
7/4/2006	H0	31	95	9.83	11.28	1.45
6/12/2006	H0	32	109	9.99	11.28	1.29
6/18/2006	H0	32	94	11.02	11.28	0.26
6/11/2006	H0	34	113	10.44	11.28	0.84
6/16/2006	H0	34	94	10.85	11.28	0.43
6/11/2006	H0	35	110	9.98	11.28	1.30
6/16/2006	H0	35	96	10.42	11.28	0.86
6/12/2006	H0	37	109	9.02	11.28	2.26
6/16/2006	H0	37	102	10.04	11.28	1.24
6/11/2006	H0	39	112	10.43	11.28	0.85
6/17/2006	H0	39	96	10.85	11.28	0.43
6/11/2006	H0	41	111	10.10	11.28	1.18
6/17/2006	H0	41	97	10.73	11.28	0.55
7/1/2006	H0	42	107	10.50	11.28	0.78
7/4/2006	H0	42	99	10.62	11.28	0.66
6/12/2006	H0	42	111	10.20	11.28	1.08
6/12/2006	H0	46	113	9.43	11.28	1.85
6/18/2006	H0	46	100	10.78	11.28	0.50
7/3/2006	H0	47	107	10.57	11.28	0.71

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
7/6/2006	H0	47	96	10.38	11.28	0.90
6/12/2006	H0	47	109	9.91	11.28	1.37
6/12/2006	H0	48	112	9.24	11.28	2.04
6/18/2006	H0	48	97	10.79	11.28	0.49
6/11/2006	H0	49	111	8.63	11.28	2.65
6/18/2006	H0	49	102	9.94	11.28	1.34
7/1/2006	H0	58	104	10.65	11.28	0.63
7/4/2006	H0	58	98	10.59	11.28	0.69
6/12/2006	H0	58	108	10.08	11.28	1.20
7/3/2006	H0	59	100	10.36	11.28	0.92
6/11/2006	H0	59	113	9.78	11.28	1.50
7/3/2006	H0	61	107	10.67	11.28	0.61
7/4/2006	H0	61	99	10.76	11.28	0.52
6/12/2006	H0	61	110	10.65	11.28	0.63
7/1/2006	H0	62	97	10.67	11.28	0.61
6/11/2006	H0	62	112	9.25	11.28	2.03
7/3/2006	H0	63	101	10.27	11.28	1.01
6/11/2006	H0	63	111	9.49	11.28	1.79
6/11/2006	H0	64	111	9.66	11.28	1.62
7/5/2006	H0	64	89	10.59	11.28	0.69
6/16/2006	H0	64	106	10.43	11.28	0.85
6/12/2006	H0	66	111	7.79	11.28	3.49
6/16/2006	H0	66	94	9.94	11.28	1.34
6/6/2006	H10	4	112	7.21	8.20	0.99
6/29/2006	H10	4	98	8.28	8.20	-0.08
6/25/2006	H10	4	121	7.63	8.20	0.57
6/8/2006	H10	7	110	7.79	8.20	0.41
7/5/2006	H10	7	91	8.80	8.20	-0.60
6/25/2006	H10	7	121	7.61	8.20	0.59
6/28/2006	H10	7	104	8.17	8.20	0.03
6/8/2006	H10	10	110	7.79	8.20	0.41
7/5/2006	H10	10	87	8.21	8.20	-0.01
6/24/2006	H10	10	115	8.04	8.20	0.16
6/28/2006	H10	10	106	8.17	8.20	0.03
6/26/2006	H10	11	113	7.82	8.20	0.38
6/28/2006	H10	11	102	8.04	8.20	0.16
6/5/2006	H10	15	112	7.75	8.20	0.45
6/24/2006	H10	15	119	7.93	8.20	0.27
6/28/2006	H10	15	96	8.38	8.20	-0.18
6/5/2006	H10	17	112	7.36	8.20	0.84
6/29/2006	H10	17	96	8.01	8.20	0.19
6/26/2006	H10	17	110	7.77	8.20	0.43
6/6/2006	H10	22	109	7.66	8.20	0.54

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/24/2006	H10	22	113	7.75	8.20	0.45
6/28/2006	H10	22	102	8.05	8.20	0.15
6/8/2006	H10	28	107	7.86	8.20	0.34
6/30/2006	H10	28	104	8.05	8.20	0.15
7/5/2006	H10	28	96	8.04	8.20	0.16
6/24/2006	H10	28	114	7.72	8.20	0.48
7/1/2006	H10	28	103	7.40	8.20	0.80
6/5/2006	H10	31	110	7.12	8.20	1.08
6/23/2006	H10	31	107	7.65	8.20	0.55
6/30/2006	H10	31	101	7.73	8.20	0.47
6/25/2006	H10	31	110	7.67	8.20	0.53
7/1/2006	H10	31	109	7.63	8.20	0.57
6/8/2006	H10	32	110	7.93	8.20	0.27
6/24/2006	H10	32	109	8.12	8.20	0.08
6/30/2006	H10	32	105	8.18	8.20	0.02
7/4/2006	H10	32	95	8.04	8.20	0.16
6/26/2006	H10	32	117	8.22	8.20	-0.02
6/5/2006	H10	34	110	7.76	8.20	0.44
6/23/2006	H10	34	112	8.25	8.20	-0.05
6/26/2006	H10	34	116	8.08	8.20	0.12
6/29/2006	H10	34	95	8.28	8.20	-0.08
6/8/2006	H10	35	107	7.70	8.20	0.50
6/24/2006	H10	35	117	7.76	8.20	0.44
6/29/2006	H10	35	95	8.33	8.20	-0.13
7/1/2006	H10	37	94	7.90	8.20	0.30
6/26/2006	H10	37	118	7.54	8.20	0.66
7/1/2006	H10	37	110	7.14	8.20	1.06
6/6/2006	H10	39	110	7.46	8.20	0.74
6/25/2006	H10	39	119	7.63	8.20	0.57
6/29/2006	H10	39	93	8.28	8.20	-0.08
6/8/2006	H10	41	107	7.88	8.20	0.32
6/23/2006	H10	41	109	8.08	8.20	0.12
6/30/2006	H10	41	100	8.04	8.20	0.16
6/26/2006	H10	41	116	8.01	8.20	0.19
7/1/2006	H10	41	115	7.51	8.20	0.69
6/8/2006	H10	42	109	7.99	8.20	0.21
6/29/2006	H10	42	102	8.05	8.20	0.15
7/5/2006	H10	42	97	8.09	8.20	0.11
6/26/2006	H10	42	114	7.89	8.20	0.31
6/8/2006	H10	46	108	7.79	8.20	0.41
7/1/2006	H10	46	94	8.08	8.20	0.12
6/24/2006	H10	46	103	7.90	8.20	0.30
6/26/2006	H10	46	120	7.79	8.20	0.41

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/8/2006	H10	47	107	7.64	8.20	0.56
6/26/2006	H10	47	111	7.73	8.20	0.47
6/29/2006	H10	47	103	7.98	8.20	0.22
7/5/2006	H10	47	88	8.09	8.20	0.11
7/5/2006	H10	48	97	7.99	8.20	0.21
6/25/2006	H10	48	119	8.01	8.20	0.19
6/28/2006	H10	48	101	8.08	8.20	0.12
6/6/2006	H10	49	110	7.41	8.20	0.79
6/24/2006	H10	49	105	7.82	8.20	0.38
6/29/2006	H10	49	93	8.05	8.20	0.15
6/26/2006	H10	49	117	7.41	8.20	0.79
6/30/2006	H10	58	98	8.08	8.20	0.12
6/26/2006	H10	58	112	8.01	8.20	0.19
6/23/2006	H10	59	111	8.14	8.20	0.06
7/1/2006	H10	59	103	7.99	8.20	0.21
7/5/2006	H10	59	89	8.15	8.20	0.05
6/26/2006	H10	59	118	7.90	8.20	0.30
6/8/2006	H10	61	107	7.73	8.20	0.47
6/29/2006	H10	61	103	8.44	8.20	-0.24
7/5/2006	H10	61	97	8.09	8.20	0.11
6/24/2006	H10	61	105	8.05	8.20	0.15
6/25/2006	H10	61	112	7.82	8.20	0.38
6/5/2006	H10	62	110	7.46	8.20	0.74
6/30/2006	H10	62	95	7.90	8.20	0.30
6/25/2006	H10	62	114	7.46	8.20	0.74
6/5/2006	H10	63	112	7.00	8.20	1.20
6/24/2006	H10	63	119	7.19	8.20	1.01
6/29/2006	H10	63	89	8.04	8.20	0.16
6/5/2006	H10	64	111	7.53	8.20	0.67
6/29/2006	H10	64	100	8.05	8.20	0.15
6/26/2006	H10	64	114	8.04	8.20	0.16
6/8/2006	H10	66	111	7.47	8.20	0.73
6/29/2006	H10	66	104	7.47	8.20	0.73
7/5/2006	H10	66	89	7.76	8.20	0.44
6/26/2006	H10	66	114	7.59	8.20	0.61
7/1/2006	H20	66	110	6.88	7.99	1.11
6/10/2006	H20	4	110	7.08	7.99	0.91
6/30/2006	H20	4	109	7.51	7.99	0.48
6/9/2006	H20	7	112	7.28	7.99	0.71
6/30/2006	H20	7	107	8.21	7.99	-0.22
6/9/2006	H20	10	107	7.57	7.99	0.42
6/10/2006	H20	11	110	7.40	7.99	0.59
6/30/2006	H20	11	105	7.82	7.99	0.17

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/10/2006	H20	15	109	7.57	7.99	0.42
6/9/2006	H20	17	109	6.85	7.99	1.14
6/30/2006	H20	17	111	7.47	7.99	0.52
6/10/2006	H20	22	107	7.48	7.99	0.51
6/30/2006	H20	22	109	8.22	7.99	-0.23
6/9/2006	H20	28	109	7.43	7.99	0.56
6/9/2006	H20	31	109	7.31	7.99	0.68
6/9/2006	H20	32	116	7.64	7.99	0.35
6/30/2006	H20	32	112	8.34	7.99	-0.35
6/9/2006	H20	34	109	7.63	7.99	0.36
6/9/2006	H20	35	113	7.22	7.99	0.77
6/30/2006	H20	35	106	8.08	7.99	-0.09
6/10/2006	H20	37	107	7.01	7.99	0.98
6/10/2006	H20	39	110	7.44	7.99	0.55
6/30/2006	H20	39	112	7.64	7.99	0.35
6/9/2006	H20	41	109	7.51	7.99	0.48
6/9/2006	H20	42	113	7.59	7.99	0.40
6/30/2006	H20	42	110	7.63	7.99	0.36
6/9/2006	H20	46	113	7.48	7.99	0.51
7/1/2006	H20	46	115	7.47	7.99	0.52
6/9/2006	H20	47	107	7.35	7.99	0.64
6/30/2006	H20	47	113	7.95	7.99	0.04
6/9/2006	H20	48	113	7.47	7.99	0.52
6/30/2006	H20	48	106	7.96	7.99	0.03
6/10/2006	H20	49	108	7.51	7.99	0.48
6/30/2006	H20	49	110	7.79	7.99	0.20
6/9/2006	H20	58	113	7.37	7.99	0.62
6/30/2006	H20	58	111	7.38	7.99	0.61
7/1/2006	H20	59	108	7.44	7.99	0.55
6/9/2006	H20	61	116	7.30	7.99	0.69
6/30/2006	H20	61	110	7.63	7.99	0.36
6/9/2006	H20	62	109	7.50	7.99	0.49
6/30/2006	H20	62	111	7.35	7.99	0.64
6/10/2006	H20	63	109	7.05	7.99	0.94
6/30/2006	H20	63	111	7.64	7.99	0.35
6/10/2006	H20	64	107	7.32	7.99	0.67
6/30/2006	H20	64	110	7.99	7.99	0.00
6/10/2006	H20	66	105	6.94	7.99	1.05
6/20/2006	H5	4	114	8.76	9.89	1.13
6/20/2006	H5	7	113	9.05	9.89	0.84
6/20/2006	H5	10	109	9.41	9.89	0.48
6/19/2006	H5	11	111	8.93	9.89	0.96
6/20/2006	H5	15	114	9.51	9.89	0.38

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/19/2006	H5	17	116	7.93	9.89	1.96
6/19/2006	H5	22	117	8.91	9.89	0.98
6/19/2006	H5	28	118	9.17	9.89	0.72
6/20/2006	H5	31	114	8.08	9.89	1.81
6/19/2006	H5	32	112	9.60	9.89	0.29
6/19/2006	H5	34	115	9.53	9.89	0.36
6/19/2006	H5	35	113	8.83	9.89	1.06
6/19/2006	H5	37	117	8.47	9.89	1.42
6/19/2006	H5	39	117	9.21	9.89	0.68
6/19/2006	H5	41	115	9.02	9.89	0.87
6/20/2006	H5	42	113	8.96	9.89	0.93
6/19/2006	H5	46	113	8.80	9.89	1.09
6/23/2006	H5	47	112	8.85	9.89	1.04
6/20/2006	H5	48	112	9.05	9.89	0.84
6/19/2006	H5	49	115	8.25	9.89	1.64
6/23/2006	H5	58	113	9.36	9.89	0.53
6/20/2006	H5	59	111	8.99	9.89	0.90
6/20/2006	H5	61	113	9.21	9.89	0.68
6/23/2006	H5	62	109	8.60	9.89	1.29
6/20/2006	H5	63	114	8.44	9.89	1.45
6/19/2006	H5	64	115	8.63	9.89	1.26
6/19/2006	H5	66	118	7.47	9.89	2.42
6/15/2006	I0	4	105	8.92	9.81	0.89
6/14/2006	I0	7	110	8.19	9.81	1.62
6/14/2006	I0	10	109	9.14	9.81	0.67
6/15/2006	I0	11	106	9.11	9.81	0.70
6/16/2006	I0	15	111	9.65	9.81	0.16
6/14/2006	I0	17	106	8.28	9.81	1.53
6/15/2006	I0	22	106	9.09	9.81	0.72
6/15/2006	I0	28	105	9.17	9.81	0.64
6/14/2006	I0	31	108	8.73	9.81	1.08
6/14/2006	I0	32	107	9.79	9.81	0.02
6/15/2006	I0	34	106	9.65	9.81	0.16
6/15/2006	I0	35	106	9.09	9.81	0.72
6/15/2006	I0	37	105	8.66	9.81	1.15
6/14/2006	I0	39	107	9.36	9.81	0.45
6/16/2006	I0	41	108	9.46	9.81	0.35
6/14/2006	I0	42	111	8.92	9.81	0.89
6/14/2006	I0	46	107	8.91	9.81	0.90
6/14/2006	I0	47	106	8.83	9.81	0.98
6/14/2006	I0	48	107	8.91	9.81	0.90
6/14/2006	I0	49	111	7.89	9.81	1.92
6/14/2006	I0	58	109	9.01	9.81	0.80

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/16/2006	I0	59	104	9.18	9.81	0.63
6/14/2006	I0	61	109	8.75	9.81	1.06
6/14/2006	I0	62	110	8.49	9.81	1.32
6/16/2006	I0	63	109	8.63	9.81	1.18
6/15/2006	I0	64	106	9.24	9.81	0.57
6/14/2006	I0	66	108	8.34	9.81	1.47
6/27/2006	L0	4	115	8.28	9.40	1.12
6/27/2006	L0	7	108	9.04	9.40	0.36
6/27/2006	L0	10	106	9.41	9.40	-0.01
6/27/2006	L0	11	105	8.93	9.40	0.47
6/27/2006	L0	15	108	9.60	9.40	-0.20
6/27/2006	L0	17	115	8.22	9.40	1.18
6/27/2006	L0	22	106	8.88	9.40	0.52
6/27/2006	L0	28	104	9.18	9.40	0.22
6/28/2006	L0	31	114	8.31	9.40	1.09
6/28/2006	L0	32	106	9.31	9.40	0.09
6/28/2006	L0	34	111	9.60	9.40	-0.20
6/27/2006	L0	35	114	8.80	9.40	0.60
6/28/2006	L0	37	109	8.51	9.40	0.89
6/27/2006	L0	39	111	9.35	9.40	0.05
6/28/2006	L0	41	113	8.99	9.40	0.41
6/27/2006	L0	42	114	9.12	9.40	0.28
6/28/2006	L0	46	106	9.18	9.40	0.22
6/28/2006	L0	47	111	9.11	9.40	0.29
6/27/2006	L0	48	114	8.95	9.40	0.45
6/28/2006	L0	49	112	7.64	9.40	1.76
6/28/2006	L0	58	107	8.63	9.40	0.77
6/28/2006	L0	59	113	8.88	9.40	0.52
6/28/2006	L0	61	104	9.25	9.40	0.15
6/28/2006	L0	62	107	9.18	9.40	0.22
6/27/2006	L0	63	111	8.44	9.40	0.96
6/27/2006	L0	64	114	8.47	9.40	0.93
6/28/2006	L0	66	106	8.18	9.40	1.22
6/18/2006	Low T50	4	108	9.36	11.38	2.02
6/18/2006	Low T50	7	115	9.30	11.38	2.08
6/17/2006	Low T50	10	105	10.75	11.38	0.63
6/18/2006	Low T50	11	113	9.69	11.38	1.69
6/17/2006	Low T50	15	111	10.95	11.38	0.43
6/17/2006	Low T50	17	112	8.96	11.38	2.42
6/17/2006	Low T50	22	111	10.54	11.38	0.84
6/18/2006	Low T50	28	108	10.44	11.38	0.94
6/17/2006	Low T50	31	114	8.37	11.38	3.01
6/17/2006	Low T50	32	112	10.15	11.38	1.23

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

			Maximum	DVPE (psi)		
Date	Fuel	Vehicle	Amb Temp, °F	EOT	Initial	Loss
6/18/2006	Low T50	34	113	10.92	11.38	0.46
6/18/2006	LOW T50	35	109	10.27	11.38	1.11
6/18/2006	Low T50	37	114	9.73	11.38	1.65
6/18/2006	Low T50	39	111	9.99	11.38	1.39
6/18/2006	Low T50	41	115	10.60	11.38	0.78
6/17/2006	Low T50	42	112	10.19	11.38	1.19
6/18/2006	Low T50	46	112	9.33	11.38	2.05
6/17/2006	Low T50	47	112	10.05	11.38	1.33
6/17/2006	Low T50	48	113	9.65	11.38	1.73
6/17/2006	Low T50	49	109	9.24	11.38	2.14
6/17/2006	Low T50	58	108	10.05	11.38	1.33
6/17/2006	Low T50	59	105	10.20	11.38	1.18
6/17/2006	Low T50	61	107	10.20	11.38	1.18
6/17/2006	Low T50	62	112	8.89	11.38	2.49
6/17/2006	Low T50	63	110	9.85	11.38	1.53
6/18/2006	Low T50	64	111	10.05	11.38	1.33
6/18/2006	Low T50	66	113	8.35	11.38	3.03
6/23/2006	X20	4	109	9.56	11.72	2.16
7/6/2006	X20	4	110	9.96	11.72	1.76
6/23/2006	X20	7	109	8.99	11.72	2.73
7/6/2006	X20	7	105	9.22	11.72	2.50
6/23/2006	X20	10	112	9.92	11.72	1.80
7/6/2006	X20	10	98	10.72	11.72	1.00
6/24/2006	X20	11	111	9.02	11.72	2.70
7/6/2006	X20	11	105	10.02	11.72	1.70
6/23/2006	X20	15	114	10.56	11.72	1.16
7/6/2006	X20	15	108	10.79	11.72	0.93
6/23/2006	X20	17	109	8.08	11.72	3.64
7/6/2006	X20	17	102	8.85	11.72	2.87
7/6/2006	X20	22	107	9.96	11.72	1.76
6/23/2006	X20	22	113	10.30	11.72	1.42
6/23/2006	X20	28	115	9.86	11.72	1.86
7/6/2006	X20	28	106	10.11	11.72	1.61
6/24/2006	X20	31	112	8.06	11.72	3.66
7/6/2006	X20	31	106	8.53	11.72	3.19
6/24/2006	X20	32	113	10.12	11.72	1.60
7/6/2006	X20	32	103	10.28	11.72	1.44
6/24/2006	X20	34	111	10.56	11.72	1.16
7/6/2006	X20	34	104	10.66	11.72	1.06
6/23/2006	X20	35	114	9.34	11.72	2.38
7/6/2006	X20	35	104	10.88	11.72	0.84
6/24/2006	X20	37	112	9.69	11.72	2.03
7/6/2006	X20	37	109	9.38	11.72	2.34

Table E-4 Continued

END OF VEHICLE TEST VAPOR PRESSURES

Date	Fuel	Vehicle	Maximum Amb Temp, °F	DVPE (psi) EOT	Initial	Loss
6/23/2006	X20	39	109	10.56	11.72	1.16
7/6/2006	X20	39	103	10.28	11.72	1.44
6/24/2006	X20	41	113	10.34	11.72	1.38
7/6/2006	X20	41	102	10.70	11.72	1.02
6/23/2006	X20	42	114	9.75	11.72	1.97
7/6/2006	X20	42	108	10.69	11.72	1.03
6/24/2006	X20	46	114	9.73	11.72	1.99
7/6/2006	X20	46	102	10.41	11.72	1.31
6/24/2006	X20	47	106	9.56	11.72	2.16
7/6/2006	X20	47	107	10.59	11.72	1.13
6/23/2006	X20	48	114	9.08	11.72	2.64
7/6/2006	X20	48	104	10.05	11.72	1.67
6/24/2006	X20	49	115	8.73	11.72	2.99
7/6/2006	X20	49	104	9.12	11.72	2.60
6/24/2006	X20	58	110	9.15	11.72	2.57
7/6/2006	X20	58	110	10.47	11.72	1.25
6/24/2006	X20	59	109	9.44	11.72	2.28
7/6/2006	X20	59	104	10.44	11.72	1.28
7/6/2006	X20	61	108	10.23	11.72	1.49
6/24/2006	X20	61	114	9.42	11.72	2.30
6/24/2006	X20	62	109	9.57	11.72	2.15
7/6/2006	X20	62	100	9.79	11.72	1.93
6/23/2006	X20	63	114	9.54	11.72	2.18
7/6/2006	X20	63	106	9.62	11.72	2.10
6/23/2006	X20	64	113	9.07	11.72	2.65
6/24/2006	X20	66	108	8.43	11.72	3.29
7/6/2006	X20	66	101	8.63	11.72	3.09

APPENDIX F

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY

Table F-1

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
4	H0	ARCH	11-Jun-06	12	113
4	H0	ARCH	16-Jun-06	16	99
4	H10	ARCH	05-Jun-06	24	112
4	H10	ARCH	08-Jun-06	24	112
4	H10	ARCH	25-Jun-06	16	121
4	H10	ARCH	29-Jun-06	12	98
4	H20	ARCH	10-Jun-06	29	110
4	H20	PHIL	30-Jun-06	13	109
4	H5	PHIL	20-Jun-06	7	114
4	I0	PHIL	15-Jun-06	8	105
4	L0	ARCH	27-Jun-06	24	115
4	Low T50	ARCH	17-Jun-06	11	108
4	X20	PHIL	23-Jun-06	10	109
4	X20	ARCH	06-Jul-06	13	110
7	H0	ARCH	12-Jun-06	24	108
7	H0	PHIL	03-Jul-06	30	93
7	H10	PHIL	08-Jun-06	41	110
7	H10	PHIL	25-Jun-06	30	121
7	H10	ARCH	28-Jun-06	24	104
7	H10	ARCH	05-Jul-06	30	91
7	H20	ARCH	09-Jun-06	22	112
7	H20	PHIL	30-Jun-06	13	107
7	H5	PHIL	20-Jun-06	23	113
7	I0	ARCH	14-Jun-06	23	110
7	L0	PHIL	27-Jun-06	24	108
7	Low T50	PHIL	18-Jun-06	28	115
7	X20	ARCH	23-Jun-06	38	109
7	X20	PHIL	06-Jul-06	25	105
10	H0	PHIL	12-Jun-06	19	114
10	H0	ARCH	03-Jul-06	26	95
10	H10	ARCH	08-Jun-06	25	111
10	H10	ARCH	25-Jun-06	23	115
10	H10	ARCH	28-Jun-06	24	106
10	H10	PHIL	05-Jul-06	14	87
10	H20	PHIL	09-Jun-06	18	107
10	H20	ARCH	30-Jun-06	44	109
10	H5	PHIL	20-Jun-06	18	109
10	I0	ARCH	14-Jun-06	26	109
10	L0	PHIL	27-Jun-06	16	106
10	Low T50	ARCH	17-Jun-06	26	105
10	X20	PHIL	23-Jun-06	18	112
10	X20	ARCH	06-Jul-06	32	98

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
11	H0	PHIL	12-Jun-06	13	113
11	H0	ARCH	16-Jun-06	6	91
11	H10	ARCH	05-Jun-06	17	110
11	H10	ARCH	26-Jun-06	25	113
11	H10	ARCH	28-Jun-06	20	102
11	H20	PHIL	10-Jun-06	11	110
11	H20	PHIL	30-Jun-06	15	105
11	H5	PHIL	19-Jun-06	9	111
11	I0	ARCH	15-Jun-06	12	106
11	L0	PHIL	27-Jun-06	13	105
11	Low T50	ARCH	18-Jun-06	24	113
11	X20	ARCH	24-Jun-06	32	111
11	X20	ARCH	06-Jul-06	26	105
15	H0	PHIL	12-Jun-06	16	109
15	H0	PHIL	03-Jul-06	19	101
15	H10	ARCH	05-Jun-06	20	112
15	H10	PHIL	25-Jun-06	38	119
15	H10	PHIL	28-Jun-06	16	96
15	H20	ARCH	10-Jun-06	16	109
15	H20	ARCH	30-Jun-06	16	110
15	H5	ARCH	20-Jun-06	18	114
15	I0	PHIL	16-Jun-06	18	111
15	L0	ARCH	27-Jun-07	25	108
15	Low T50	PHIL	17-Jun-06	16	111
15	X20	ARCH	23-Jun-06	26	114
15	X20	ARCH	06-Jul-06	28	108
17	H0	ARCH	12-Jun-06	20	111
17	H0	ARCH	18-Jun-06	11	103
17	H0	PHIL	04-Jul-06	12	93
17	H10	PHIL	05-Jun-06	18	112
17	H10	PHIL	26-Jun-06	20	110
17	H10	PHIL	29-Jun-06	12	96
17	H20	ARCH	09-Jun-06	15	109
17	H20	ARCH	30-Jun-06	18	111
17	H5	ARCH	19-Jun-06	19	116
17	I0	PHIL	14-Jun-06	17	106
17	L0	PHIL	27-Jun-06	15	115
17	Low T50	PHIL	17-Jun-06	14	112
17	X20	ARCH	23-Jun-06	17	109
17	X20	ARCH	06-Jul-06	25	102

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
22	H0	ARCH	11-Jun-06	10	111
22	H0	PHIL	18-Jun-06	8	102
22	H0	PHIL	04-Jul-06	7	102
22	H10	PHIL	05-Jun-06	13	109
22	H10	PHIL	25-Jun-06	7	113
22	H10	PHIL	28-Jun-06	7	102
22	H20	PHIL	10-Jun-06	15	107
22	H20	ARCH	30-Jun-06	21	109
22	H5	ARCH	19-Jun-06	7	117
22	I0	ARCH	15-Jun-06	7	106
22	L0	ARCH	27-Jun-06	16	106
22	Low T50	PHIL	17-Jun-06	13	111
22	X20	PHIL	23-Jun-06	12	113
22	X20	PHIL	06-Jul-06	6	107
28	H0	ARCH	11-Jun-06	15	112
28	H0	ARCH	16-Jun-06	12	97
28	H10	PHIL	08-Jun-06	16	110
28	H10	ARCH	25-Jun-06	8	114
28	H10	ARCH	30-Jun-06	27	104
28	H10	PHIL	05-Jul-06	18	96
28	H20	PHIL	09-Jun-06	14	109
28	H20	PHIL	01-Jul-06	17	103
28	H5	ARCH	19-Jun-06	33	118
28	I0	PHIL	15-Jun-06	7	105
28	L0	ARCH	27-Jun-07	17	104
28	Low T50	PHIL	17-Jun-06	17	108
28	X20	PHIL	23-Jun-06	27	115
28	X20	PHIL	06-Jul-06	15	106
31	H0	ARCH	12-Jun-06	19	114
31	H0	PHIL	01-Jul-06	20	102
31	H0	ARCH	04-Jul-06	22	95
31	H10	ARCH	05-Jun-06	15	110
31	H10	PHIL	23-Jun-06	21	107
31	H10	PHIL	26-Jun-06	29	110
31	H10	ARCH	30-Jun-06	26	101
31	H20	PHIL	09-Jun-06	21	109
31	H20	PHIL	01-Jul-06	23	109
31	H5	ARCH	20-Jun-06	27	114
31	I0	PHIL	14-Jun-06	22	108
31	L0	PHIL	28-Jun-06	16	114
31	Low T50	ARCH	17-Jun-06	24	114
31	X20	ARCH	24-Jun-06	30	112
31	X20	ARCH	06-Jul-06	46	106

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
32	H0	PHIL	12-Jun-06	17	109
32	H0	PHIL	18-Jun-06	27	94
32	H10	PHIL	24-Jun-06	9	109
32	H10	PHIL	08-Jun-06	14	113
32	H10	PHIL	26-Jun-06	22	117
32	H10	PHIL	30-Jun-06	16	105
32	H10	PHIL	04-Jul-06	14	95
32	H20	ARCH	09-Jun-06	14	116
32	H20	ARCH	30-Jun-06	16	112
32	H5	PHIL	19-Jun-06	9	112
32	I0	ARCH	14-Jun-06	13	107
32	L0	PHIL	28-Jun-06	17	106
32	Low T50	ARCH	17-Jun-06	28	112
32	X20	PHIL	24-Jun-06	35	113
32	X20	PHIL	06-Jul-06	15	103
34	H0	PHIL	11-Jun-06	23	113
34	H0	PHIL	16-Jun-06	19	94
34	H10	PHIL	05-Jun-05	28	110
34	H10	ARCH	23-Jun-06	24	112
34	H10	PHIL	26-Jun-06	18	116
34	H10	PHIL	29-Jun-06	21	95
34	H20	ARCH	09-Jun-06	11	109
34	H20	PHIL	30-Jun-06	18	105
34	H5	ARCH	19-Jun-06	25	115
34	I0	PHIL	15-Jun-06	9	106
34	L0	PHIL	28-Jun-06	12	111
34	Low T50	ARCH	18-Jun-06	24	113
34	X20	PHIL	24-Jun-06	28	111
34	X20	ARCH	06-Jul-06	34	104
35	H0	PHIL	11-Jun-06	16	110
35	H0	PHIL	16-Jun-06	18	96
35	H10	ARCH	08-Jun-06	11	109
35	H10	PHIL	25-Jun-06	11	117
35	H10	ARCH	29-Jun-06	29	95
35	H20	PHIL	09-Jun-06	16	113
35	H20	PHIL	30-Jun-06	12	106
35	H5	PHIL	19-Jun-06	12	113
35	I0	ARCH	15-Jun-06	15	106
35	L0	PHIL	27-Jun-06	12	114
35	Low T50	PHIL	18-Jun-06	15	109
35	X20	ARCH	23-Jun-06	17	114
35	X20	PHIL	06-Jul-06	20	104

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
37	H0	ARCH	12-Jun-06	7	109
37	H0	PHIL	16-Jun-06	12	102
37	H10	ARCH	05-Jun-05	12	113
37	H10	ARCH	26-Jun-06	31	118
37	H10	PHIL	01-Jul-06	11	94
37	H20	PHIL	10-Jun-06	8	107
37	H20	PHIL	01-Jul-06	11	110
37	H5	PHIL	19-Jun-06	11	117
37	I0	ARCH	15-Jun-06	7	105
37	L0	PHIL	28-Jun-06	7	109
37	Low T50	ARCH	18-Jun-06	17	114
37	X20	PHIL	24-Jun-06	12	112
37	X20	ARCH	06-Jul-06	18	109
39	H0	PHIL	11-Jun-06	21	112
39	H0	ARCH	17-Jun-06	13	96
39	H10	PHIL	05-Jun-06	24	110
39	H10	ARCH	25-Jun-06	21	119
39	H10	PHIL	29-Jun-06	11	93
39	H20	ARCH	10-Jun-06	10	110
39	H20	ARCH	30-Jun-06	21	112
39	H5	PHIL	19-Jun-06	19	117
39	I0	PHIL	14-Jun-06	13	107
39	L0	PHIL	27-Jun-06	15	111
39	Low T50	PHIL	18-Jun-06	9	111
39	X20	PHIL	23-Jun-06	24	109
39	X20	PHIL	06-Jul-06	12	103
41	H0	ARCH	11-Jun-06	12	111
41	H0	PHIL	17-Jun-06	11	97
41	H10	ARCH	23-Jun-06	7	109
41	H10	PHIL	08-Jun-06	14	113
41	H10	ARCH	26-Jun-06	16	116
41	H10	PHIL	30-Jun-06	6	100
41	H20	ARCH	09-Jun-06	11	109
41	H20	ARCH	01-Jul-06	6	115
41	H5	ARCH	19-Jun-06	21	115
41	I0	PHIL	16-Jun-06	11	108
41	L0	ARCH	28-Jun-06	16	113
41	Low T50	PHIL	18-Jun-06	12	115
41	X20	PHIL	24-Jun-06	10	113
41	X20	ARCH	06-Jul-06	6	102

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
42	H0	PHIL	12-Jun-06	20	111
42	H0	ARCH	01-Jul-06	34	107
42	H0	ARCH	04-Jul-06	48	99
42	H10	ARCH	08-Jun-06	24	113
42	H10	PHIL	26-Jun-06	18	114
42	H10	ARCH	29-Jun-06	28	102
42	H10	PHIL	05-Jul-06	17	97
42	H20	PHIL	09-Jun-06	27	113
42	H20	PHIL	30-Jun-06	18	110
42	H5	ARCH	20-Jun-06	30	113
42	I0	ARCH	14-Jun-06	20	111
42	L0	PHIL	27-Jun-06	19	114
42	Low T50	ARCH	17-Jun-06	22	112
42	X20	ARCH	23-Jun-06	30	114
42	X20	PHIL	06-Jul-06	22	108
46	H0	ARCH	12-Jun-06	22	113
46	H0	PHIL	18-Jun-06	42	100
46	H10	ARCH	24-Jun-06	42	103
46	H10	ARCH	08-Jun-06	9	111
46	H10	ARCH	26-Jun-06	23	120
46	H10	ARCH	01-Jul-06	33	94
46	H20	ARCH	09-Jun-06	22	113
46	H20	ARCH	01-Jul-06	26	115
46	H5	ARCH	19-Jun-06	34	113
46	I0	PHIL	14-Jun-06	35	107
46	L0	PHIL	28-Jun-06	29	106
46	Low T50	ARCH	17-Jun-06	30	112
46	X20	ARCH	24-Jun-06	31	114
46	X20	ARCH	06-Jul-06	17	102
47	H0	PHIL	12-Jun-06	25	109
47	H0	ARCH	03-Jul-06	27	107
47	H0	PHIL	06-Jul-06	22	96
47	H10	PHIL	08-Jun-06	29	113
47	H10	PHIL	26-Jun-06	22	111
47	H10	PHIL	29-Jun-06	18	103
47	H10	PHIL	05-Jul-06	27	88
47	H20	ARCH	09-Jun-06	21	107
47	H20	ARCH	30-Jun-06	23	113
47	H5	PHIL	23-Jun-06	19	112
47	I0	PHIL	14-Jun-06	24	106
47	L0	ARCH	28-Jun-06	41	111
47	Low T50	ARCH	17-Jun-06	24	112
47	X20	ARCH	24-Jun-06	35	106
47	X20	PHIL	06-Jul-06	26	107

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
48	H0	ARCH	12-Jun-06	20	112
48	H0	ARCH	18-Jun-06	27	97
48	H10	PHIL	05-Jun-06	32	110
48	H10	PHIL	25-Jun-06	21	119
48	H10	PHIL	28-Jun-06	21	101
48	H10	ARCH	05-Jul-06	27	97
48	H20	PHIL	09-Jun-06	27	113
48	H20	PHIL	30-Jun-06	19	106
48	H5	PHIL	20-Jun-06	27	112
48	I0	PHIL	14-Jun-06	12	107
48	L0	ARCH	27-Jun-06	42	114
48	Low T50	ARCH	17-Jun-06	31	113
48	X20	ARCH	23-Jun-06	25	114
48	X20	ARCH	06-Jul-06	36	104
49	H0	ARCH	11-Jun-06	32	111
49	H0	ARCH	18-Jun-06	20	102
49	H10	PHIL	05-Jun-06	30	110
49	H10	ARCH	24-Jun-06	24	105
49	H10	ARCH	26-Jun-06	34	117
49	H10	ARCH	29-Jun-06	34	93
49	H20	PHIL	10-Jun-06	28	108
49	H20	PHIL	30-Jun-06	27	110
49	H5	PHIL	19-Jun-06	32	115
49	House	PHIL	14-Jun-06	20	108
49	I0	ARCH	14-Jun-06	26	111
49	L0	ARCH	28-Jun-06	20	112
49	Low T50	PHIL	17-Jun-06	32	109
49	X20	PHIL	24-Jun-06	18	115
49	X20	PHIL	06-Jul-06	42	104
58	H0	PHIL	12-Jun-06	5	108
58	H0	PHIL	01-Jul-06	10	104
58	H0	ARCH	04-Jul-06	16	98
58	H10	ARCH	05-Jun-06	12	110
58	H10	PHIL	26-Jun-06	12	112
58	H10	PHIL	30-Jun-06	10	98
58	H20	ARCH	09-Jun-06	5	113
58	H20	ARCH	30-Jun-06	7	111
58	H5	ARCH	23-Jun-09	11	113
58	I0	PHIL	14-Jun-06	6	109
58	L0	ARCH	28-Jun-06	21	107
58	Low T50	PHIL	17-Jun-06	9	108
58	X20	ARCH	24-Jun-06	4	110
58	X20	PHIL	06-Jul-06	11	110

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
59	H0	PHIL	11-Jun-06	12	113
59	H0	ARCH	03-Jul-06	14	100
59	H10	PHIL	05-Jun-06	24	110
59	H10	PHIL	23-Jun-06	21	111
59	H10	PHIL	26-Jun-06	18	118
59	H10	ARCH	01-Jul-06	18	103
59	H10	ARCH	05-Jul-06	18	89
59	H20	PHIL	10-Jun-06	13	110
59	H20	PHIL	01-Jul-06	25	108
59	H5	PHIL	20-Jun-06	14	111
59	I0	ARCH	16-Jun-06	8	104
59	L0	ARCH	28-Jun-06	18	113
59	Low T50	PHIL	17-Jun-06	16	105
59	X20	ARCH	24-Jun-06	15	109
59	X20	PHIL	06-Jul-06	11	104
61	H0	PHIL	12-Jun-06	18	110
61	H0	PHIL	03-Jul-06	38	107
61	H0	PHIL	04-Jul-06	20	99
61	H10	PHIL	24-Jun-06	26	105
61	H10	ARCH	08-Jun-06	9	110
61	H10	ARCH	26-Jun-06	36	112
61	H10	ARCH	29-Jun-06	18	103
61	H10	PHIL	05-Jul-06	12	97
61	H20	PHIL	09-Jun-06	24	116
61	H20	ARCH	30-Jun-06	26	110
61	H5	ARCH	20-Jun-06	28	113
61	I0	ARCH	14-Jun-06	15	109
61	L0	PHIL	28-Jun-06	22	104
61	Low T50	PHIL	17-Jun-06	22	107
61	X20	ARCH	24-Jun-06	22	114
61	X20	PHIL	06-Jul-06	26	108
62	H0	PHIL	11-Jun-06	30	112
62	H0	PHIL	01-Jul-06	16	97
62	H10	PHIL	05-Jun-06	30	110
62	H10	ARCH	26-Jun-06	34	114
62	H10	ARCH	30-Jun-06	24	95
62	H20	PHIL	09-Jun-06	32	109
62	H20	PHIL	30-Jun-06	28	111
62	H5	PHIL	23-Jun-06	28	109
62	House	ARCH	14-Jun-06	22	108
62	I0	ARCH	14-Jun-06	22	110
62	L0	PHIL	28-Jun-06	23	107
62	Low T50	ARCH	17-Jun-06	24	112
62	X20	PHIL	24-Jun-06	20	109
62	X20	PHIL	06-Jul-06	19	100

Table F-1 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Selected Test Vehicles

Vehicle	Fuel	Rater	Date	TWD	Max Amb. Temp.,F
63	H0	PHIL	11-Jun-06	15	111
63	H0	PHIL	03-Jul-06	16	101
63	H10	ARCH	05-Jun-06	16	112
63	H10	ARCH	25-Jun-06	38	119
63	H10	ARCH	29-Jun-06	21	89
63	H20	ARCH	10-Jun-06	19	109
63	H20	ARCH	30-Jun-06	40	111
63	H5	ARCH	20-Jun-06	22	114
63	I0	ARCH	16-Jun-06	17	109
63	L0	ARCH	27-Jun-06	25	111
63	Low T50	ARCH	17-Jun-06	30	110
63	X20	PHIL	23-Jun-06	27	114
63	X20	PHIL	06-Jul-06	29	106
64	H0	ARCH	11-Jun-06	28	111
64	H0	PHIL	16-Jun-06	11	106
64	H0	ARCH	05-Jul-06	20	89
64	H10	ARCH	05-Jun-06	15	111
64	H10	ARCH	26-Jun-06	20	114
64	H10	PHIL	29-Jun-06	16	100
64	H20	ARCH	10-Jun-06	14	107
64	H20	PHIL	30-Jun-06	13	110
64	H5	PHIL	19-Jun-06	27	115
64	I0	PHIL	15-Jun-06	12	106
64	L0	ARCH	27-Jun-06	26	114
64	Low T50	PHIL	17-Jun-06	52	111
64	X20	ARCH	23-Jun-06	31	113
66	H0	ARCH	12-Jun-06	39	111
66	H0	ARCH	16-Jun-06	36	94
66	H10	PHIL	08-Jun-06	61	111
66	H10	PHIL	26-Jun-06	33	114
66	H10	PHIL	29-Jun-06	31	104
66	H10	PHIL	05-Jul-06	36	89
66	H20	ARCH	10-Jun-06	20	105
66	H20	ARCH	01-Jul-06	34	110
66	H5	ARCH	19-Jun-06	71	118
66	House	ARCH	14-Jun-06	92	108
66	I0	PHIL	14-Jun-06	34	108
66	L0	ARCH	28-Jun-06	34	106
66	Low T50	ARCH	18-Jun-06	75	113
66	X20	PHIL	24-Jun-06	47	108
66	X20	ARCH	06-Jul-06	40	101

Table F-2

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Screening Data

Vehicle	Fuel	Rater	Date	TWD	Max Amb Temp, F
1	H10	ARCH	03-Jun-06	7	117
1	TANK	ARCH	25-May-06	10	110
2	H10	ARCH	03-Jun-06	10	113
2	TANK	ARCH	25-May-06	22	110
3	H10	ARCH	29-May-06	19	100
3	H10	ARCH	01-Jun-06	12	115
3	TANK	ARCH	26-May-06	25	104
4	H10	ARCH	31-May-06	13	110
4	TANK	ARCH	27-May-05	7	100
5	H10	ARCH	03-Jun-06	8	118
5	TANK	ARCH	27-May-06	18	99
6	H10	ARCH	03-Jun-06	2	112
6	TANK	STEVE	24-May-06	8	108
7	H10	STEVE	01-Jun-06	16	118
7	TANK	ARCH	26-May-06	31	107
8	H10	ARCH	01-Jun-06	18	116
8	TANK	ARCH	24-May-06	24	106
9	H10	ARCH	04-Jun-06	4	116
9	TANK	ARCH	24-May-06	7	110
10	H10	ARCH	03-Jun-06	13	116
10	TANK	STEVE	26-May-06	5	106
11	H10	ARCH	29-May-06	7	100
11	H10	ARCH	01-Jun-06	6	114
11	TANK	ARCH	25-May-06	26	110
12	H10	STEVE	01-Jun-06	13	110
12	TANK	STEVE	24-May-06	10	106
13	H10	ARCH	01-Jun-06	26	113
13	TANK	ARCH	24-May-06	22	106
14	H10	ARCH	01-Jun-06	6	112
14	TANK	STEVE	24-May-06	12	104
15	H10	STEVE	01-Jun-06	12	119
15	TANK	STEVE	25-May-06	8	110
16	H10	STEVE	01-Jun-06	5	109
16	TANK	STEVE	25-May-06	4	107
17	H10	ARCH	29-May-06	9	101
17	H10	ARCH	31-May-06	9	109
17	TANK	ARCH	25-May-06	26	110
18	H10	ARCH	02-Jun-06	6	116
18	TANK	ARCH	25-May-06	8	110

Table F-2 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Screening Data

Vehicle	Fuel	Rater	Date	TWD	Max Amb Temp, F
19	H10	ARCH	31-May-06	15	108
19	TANK	ARCH	27-May-06	13	101
20	H10	STEVE	29-May-06	6	102
20	H10	STEVE	31-May-06	6	109
20	TANK	STEVE	24-May-06	13	106
21	H10	ARCH	04-Jun-06	10	116
21	TANK	ARCH	26-May-06	18	106
22	H10	ARCH	31-May-06	9	107
22	TANK	ARCH	24-May-06	6	104
23	H10	ARCH	02-Jun-06	1	120
23	TANK	ARCH	24-May-06	6	107
24	H10	ARCH	03-Jun-06	7	114
24	TANK	ARCH	24-May-06	5	113
25	H10	STEVE	31-May-06	0	111
25	TANK	ARCH	29-May-06	6	100
26	H10	ARCH	01-Jun-06	9	109
26	TANK	ARCH	25-May-06	26	114
27	H10	STEVE	31-May-06	8	114
27	TANK	STEVE	24-May-06	8	107
28	H10	PHIL	03-Jun-06	18	110
28	TANK	ARCH	26-May-06	12	103
29	H10	STEVE	31-May-06	6	109
29	TANK	STEVE	29-May-06	6	96
30	H10	STEVE	31-May-06	0	106
30	TANK	STEVE	24-May-06	4	108
31	H10	STEVE	01-Jun-06	17	114
31	TANK	STEVE	25-May-06	6	108
32	H10	STEVE	02-Jun-06	12	119
32	TANK	STEVE	26-May-06	1	106
33	H10	ARCH	01-Jun-06	6	115
33	TANK	ARCH	27-May-06	11	100
34	H10	ARCH	04-Jun-06	17	117
34	TANK	STEVE	27-May-05	8	100
35	H10	PHIL	03-Jun-06	15	117
35	TANK	STEVE	26-May-06	0	104
36	H10	STEVE	29-May-06	2	101
36	H10	STEVE	31-May-06	6	107
36	TANK	STEVE	27-May-06	0	100
37	H10	ARCH	31-May-06	6	111
37	TANK	ARCH	29-May-06	2	101

Table F-2 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Screening Data

Vehicle	Fuel	Rater	Date	TWD	Max Amb Temp, F
38	H10	ARCH	01-Jun-06	18	113
38	TANK	ARCH	29-May-06	26	100
39	H10	STEVE	02-Jun-06	6	110
39	TANK	STEVE	25-May-06	1	108
40	H10	ARCH	31-May-06	0	110
40	TANK	ARCH	24-May-06	5	106
41	H10	STEVE	29-May-06	1	100
41	H10	STEVE	01-Jun-06	6	110
41	TANK	STEVE	27-May-06	0	98
42	H10	STEVE	01-Jun-06	3	117
42	TANK	STEVE	24-May-06	10	105
43	H10	STEVE	29-May-06	6	99
43	H10	STEVE	01-Jun-06	10	114
43	TANK	STEVE	26-May-06	6	105
44	H10	STEVE	31-May-06	14	110
44	TANK	STEVE	25-May-06	6	110
45	H10	ARCH	03-Jun-06	6	116
45	TANK	ARCH	24-May-06	14	105
46	H10	STEVE	02-Jun-06	7	120
46	TANK	STEVE	25-May-06	0	110
47	H10	PHIL	03-Jun-06	19	114
47	TANK	STEVE	25-May-06	5	114
48	H10	ARCH	02-Jun-06	14	118
48	TANK	ARCH	25-May-06	24	107
49	H10	STEVE	01-Jun-06	14	113
49	TANK	STEVE	25-May-06	6	106
50	H10	ARCH	03-Jun-06	10	115
50	TANK	ARCH	25-May-06	16	104
51	H10	ARCH	03-Jun-06	7	115
51	TANK	ARCH	26-May-06	8	106
52	H10	ARCH	29-May-06	17	99
52	H10	ARCH	01-Jun-06	12	116
52	TANK	ARCH	26-May-06	22	105
53	H10	STEVE	01-Jun-06	3	118
53	TANK	STEVE	24-May-06	6	118

Table F-2 Continued

VEHICLE TOTAL WEIGHTED DEMERIT SUMMARY
Screening Data

Vehicle	Fuel	Rater	Date	TWD	Max Amb Temp, F
54	H10	STEVE	29-May-06	0	102
54	H10	STEVE	31-May-06	8	104
54	TANK	STEVE	26-May-06	0	101
55	H10	ARCH	01-Jun-06	4	116
55	TANK	STEVE	29-May-06	0	96
56	H10	ARCH	03-Jun-06	9	116
56	TANK	ARCH	25-May-06	20	108
57	H10	ARCH	29-May-06	7	100
57	H10	ARCH	31-May-06	5	104
57	TANK	ARCH	26-May-06	5	101
58	H10	ARCH	01-Jun-06	3	114
58	TANK	STEVE	29-May-06	2	95
59	H10	ARCH	02-Jun-06	11	118
59	TANK	ARCH	26-May-06	13	103
60	H10	ARCH	03-Jun-06	10	116
60	TANK	STEVE	25-May-06	1	105
61	H10	PHIL	03-Jun-06	16	113
61	TANK	ARCH	26-May-06	15	105
62	H10	ARCH	04-Jun-06	27	117
62	TANK	ARCH	03-Jun-06	26	111
63	H10	STEVE	02-Jun-06	12	113
64	H10	ARCH	02-Jun-06	10	109
66	H10	ARCH	03-Jun-06	28	112
66	TANK	STEVE	02-Jun-06	16	118