CRC Report No. E-90-2b

IMPACT OF ETHANOL BLENDS ON THE OBDII SYSTEM OF IN-USE VEHICLES

August 2013

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FUELS AND LUBRICANTS RESEARCH DIVISION

CRC Project E-90-2b
Effects of Ethanol Blends on OBDII Systems of In-Use Vehicles

Final Report

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FOREWORD

This work was funded by the Coordinating Research Council (CRC), Inc. The Southwest Research Institute® Project Manager was Mr. Brent Shoffner, Manager, Fuel Performance Evaluations. Technical staff members who contributed to this work were Ms. Suzanne Timmons, Senior Research Engineer; Mr. Matthew Hinojosa, Engineer; Mr. Kevin Whitney, Manager, Light Duty Vehicle Emissions; Mr. Jeff Mathis, Staff Technician; and Mr. Don Hart, Principal Administrative Coordinator. Mr. Jeff Jetter, Principal Chemist, Honda R&D Americas, Inc., served as the CRC technical contact for this project and Dr. Chris Tennant from CRC represented the project sponsor, CRC.

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APPENDICES

ACRONYMS

CFM	Cubic feet per minute
CFR	Code of Federal Regulations
COV	Coefficient of variation
CRC	Coordinating Research Council
DOE	Department of Energy
DTC	Diagnostic trouble code
E0	Gasoline without ethanol
E10	Gasoline with 10% ethanol by volume
E10+	Gasoline with greater than 10% ethanol by volume
E15	Gasoline with 15% ethanol by volume
E20	Gasoline with 20% ethanol by volume
E30	Gasoline with 30% ethanol by volume
E40	Gasoline with 40% ethanol by volume
E50	Gasoline with 50% ethanol by volume
EISA	Energy Independence and Security Act of 2007
EPA	Environmental Protection Agency
FFV	Flexible-fuel vehicle
FTP	Federal Test Procedure
GVW	Gross vehicle weight
LTFT	Long term fuel trim
MIL	Malfunction indicator light
MY	Model year
NMOG	Non-methane organic gas
OBDII	On-board diagnostic – second generation
P0171	DTC – System too lean (Bank 1)
P0174	DTC – System too lean (Bank 2)
SAE	Society of Automotive Engineers
SRC	Standard road cycle
STFT	Short term fuel trim
SULEV	Super ultra low emission vehicle
SwRI®	Southwest Research Institute
TCEE	Temperature-Controlled Environmental Enclosure
ULEV	Ultra low emission vehicle
VIN	Vehicle identification number

EXECUTIVE SUMMARY

In October 2010 and January 2011 the U.S. Environmental Protection Agency (EPA) granted two separate partial waivers to allow the use of gasoline fuel blends containing up to fifteen percent volume ethanol (E15) in model year 2001 and newer light-duty motor vehicles (i.e., cars, light-duty trucks, and medium-duty passenger vehicles).

The Coordinating Research Council (CRC) has sponsored three studies to investigate the potential for E10+ blends to trigger a malfunction identified via the on-board diagnostic (OBD) system on vehicles that are problem-free on E0 or E10.

CRC Project E-90 concluded that the malfunction indicator light (MIL) may illuminate on some problem-free vehicles while operating on gasoline fuel blends containing more than ten percent ethanol (E10). This study was conducted with privately-owned vehicles, so E10+ fuel blends could not be assessed, as this would void owners' warranties.

CRC Project E-90-2a performed a detailed assessment of inspection and maintenance program data to identify specific vehicle makes and models with a propensity for lean-limit failures. That propensity could be exacerbated when operating on E10+ blends.

This project, CRC E-90-2b, was conducted by Southwest Research Institute® (SwRI®) in order to assess the impact of E10+ blends on MIL illumination and exhaust emissions compliance. The original objectives of this study were to:

- Document the change in fuel trim and other engine parameters as vehicles operate on a range of ethanol fuels under real-world conditions.
- Determine if the MIL would illuminate and/or diagnostic trouble codes (DTCs) would be set on potentially sensitive vehicles when exposed to E15 and/or E20.
- Determine if a vehicle with an illuminated MIL induced by E15 or E20 still meets its emission category target, using a standard cold-start FTP-75 test.

An interim report for this project was published in November 2012 at the request of CRC. The interim report covered the work completed on the project through August 17, 2012, which was designated Phase 1. The work on the project after this date was defined as Phase 2. Note that these definitions were assigned as a convenience. There is no distinction between Phase 1 and Phase 2 in the scope of work for this project. This final report includes all work performed (i.e., Phase 1 and Phase 2).

One hundred and forty-two vehicles meeting CRC specifications were inspected and two hundred and thirteen vehicles were screened. Eight vehicles were selected by CRC for further evaluation (Table ES-1). At the direction of CRC, identification of the vehicles has been coded throughout this report.

Table ES-1. Vehicles Selected for Evaluation

Make	Model	Model Year
Acura	TL	2008
BMW	325i	2004
BMW	X3	2004
Cadillac	Deville	2001
Dodge	Caliber	2008
GMC	Sonoma	2003
Honda	Pilot	2008
Mitsubishi	Montero	2002

Vehicle fuel control systems, based on O_2 sensor input during closed-loop operation, "trim" (slightly increase or decrease) the fuel for a given condition to achieve stoichiometry. The combination of the short term fuel trim (STFT) and long term fuel trim (LTFT) parameter values indicates the magnitude of the adjustment required. The trim values in the units of percent are positive (adds fuel) if the engine seems to be running lean and are negative (subtracts fuel) if the engine is running rich. Since the addition of ethanol to gasoline elevates the oxygen content of the fuel, the long term trim value will increase with an increase in the ethanol volume percent in the fuel.

The OBD program monitors trim values for potential problems with a vehicle's emissions system. A P0171 (lean bank 1) diagnostic trouble code (DTC) and/or a P0174 (lean bank 2) DTC will be set if the on-board diagnostic limits of fuel trim are exceeded. The logic and limits are specific to a vehicle's engine OBD calibration. A vehicle with no emissions system problems that passed applicable emissions limits when operated on E0 or E10 could potentially set a P0171 or P0174 code when using an E10+ blend.

As noted above, the logic to set a P0171 or P0174 DTC is specific to calibration of each vehicle. However, in general a "pending code" is set during the first time that the OBD monitor completes and determines that the long term trim has exceeded a specific calibration limit. During the next drive cycle that the monitor completes, the "pending code" will either be erased if the long term trim is under the design calibration limit, or changed to a MIL if the LTFT has again exceeded the limit.

Vehicles were initially evaluated with E0 and E20 for MIL illumination by operating them on the SwRI campus and local public roads. An on-road test cycle was developed that consisted of 23.5 miles of city and highway driving, including a twenty-minute soak and fifteen minutes of idle. Vehicles were typically operated over ten cycles during a span of three to five days; in certain cases CRC directed SwRI to conduct less than or more than ten on-road cycles. Based on direction from CRC, all on-road testing was conducted at ambient temperatures of 67ºF or warmer.

Seven of the eight vehicles were tested on the road cycles. During the on-road evaluations of the seven cars, P0174 pending codes for a lean-limit malfunction were observed on two vehicles operated on E20. However, no MILs were illuminated for lean operation (P0171-bank 1 or P0174-bank 2) while operating over the road on E20 at ambient temperatures ranging from 67°F to 100°F. Three vehicles received additional on-road evaluations with E30. All three vehicles illuminated a MIL for lean operation with E30 fuel, as noted in Table ES-2.

The LTFT results obtained during the on-road evaluations indicated that the LTFT was affected by the ambient temperature. To investigate this effect, seven vehicles were chosen by CRC for further evaluations at ambient temperatures ranging from 20°F to 100°F. These tests were conducted on a chassis dynamometer installed in a temperature-controlled enclosure. In Table ES-2 the test site is noted as "dyno". The chassis dynamometer test cycle was validated at room temperature with Vehicles B and D using E30. In each case on-dynamometer long term fuel trim values were similar to on-road measurements.

Vehicles B and D were tested on the chassis dynamometer over the full range of ambient temperatures. Analysis of results from Vehicles B and D indicated that LTFT values were highest during operation at 20°F. Therefore, five other vehicles (A, E, F, G, and H) were tested at this temperature, except where noted. Results are as follows:

- MILs for lean bank operation were illuminated with Vehicle B at 20°F with both E20 and E30, and at 50°F with E30.

- Vehicle D was tested on the chassis dynamometer with E30 and lean bank operation MILs were set at all temperatures. When attempting to test Vehicle D with lower ethanol concentrations, LTFT values were 10% to 15% higher than those observed during on-road testing, indicating the vehicle did not properly readapt following exposure to E30. Therefore, subsequent testing of Vehicle D was abandoned.

- At 20°F Vehicle E set a MIL with DTC P0174 on both E20 and E15. Additional tests were conducted on E15 at 50°F and on E10 at 20°F. No lean bank operation DTCs were observed during either of these two subsequent tests.

- Vehicle H was initially tested on E20 at 20°F, and set a MIL with DTC P0171 during the second cycle. No pending or set DTCs were observed during subsequent testing on E15.

- Vehicles A, F, and G were also tested on E20 at 20°F. None of these vehicles illuminated a MIL or had pending DTCs.

Table ES-2. Summary of Results

Vehicle	Test Site	E0			E10			E15			E20			E30		
		No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?
A	Road	10	No	No							10	No	No			
A	Dyno 20°F										10	Yes	P0128[4]			
B	Road (driver & observer)	10	No	No							14	No	No	4	Yes	P0171
B	Road (GVW)										10	No	No			
B	Dyno 20°F							10	No	No	5	Yes	P0171	2	Yes	P0171/4
B	Dyno 50°F										10	No	No	2	Yes	P0171
B	Dyno 70°F										10	No	No	5	No	No
B	Dyno 100°F										10	No	No	10	No	No
C	Road	16	No	No							10	No	No			
D	Road	10	No	No							10	No	No	1	Yes	P0174
D	Dyno 20°F										LTFT did not adapt from E30 to E20[1]			2	Yes	P0171/4
D	Dyno 50°F													2	Yes	P0174
D	Dyno 70°F													3	Yes	P0171
D	Dyno 100°F													2	Yes	P0174
E	Road	10	No	No							10	No	P0174*	2	Yes	P0171/4
E	Dyno 20°F				10	No	P0741[5]	3	Yes	P0174	2	Yes	P0174			
E	Dyno 50°F							10	Yes	P0410[2]						
E	Dyno 50°F								No	P1416[3]						
F	Road	10	No	No							14	No	P0174+			
F	Dyno 20°F										10	No	No			
G	Road	10	No	No							10	No	No			
G	Dyno 20°F										10	No	No			
H	Dyno 20°F							10	No	No	2	Yes	P0171			

Color Code

Separates vehicle information
Ballast was added to the vehicle to achieve gross vehicle weight. The test was conducted on-road.
The DTC was unrelated to the effect of ethanol in the fuel.
The DTC was related to the ethanol content in the fuel.

***** After E20 cycle 4 a pending P0174 system too lean (Bank 2) was set. The MIL was not illuminated. After all the other cycles the pending code P0174 was not present.

\+ Pending code P0174 was present after the 10th cycle. Four more cycles were performed but the code did not illuminate the MIL; however, the pending code remained.

1 Also would not adapt to E0.

2 P0410: Secondary Air Injection system malfunction. Pending code after 1st cycle (cold start day one), cleared during 2nd cycle. Pending code after 6th cycle (cold start day two), set MIL during 8th cycle.

3 P1416: Secondary Air Injection system Bank 2. Pending code after 10th cycle.

4 P0128: Coolant temperature below thermostat regulating temperature. Pending code after 3rd cycle. MIL illuminated at 1,140 seconds into 4th cycle.

5 P0741: Torque converter clutch circuit performance.

The following are the conclusions of the E-90-2b project.

- The test results of this project corroborated the conclusions of the previous phases.

- A portion of the in-use fleet will experience MIL illumination when using mid-level ethanol blends. A graph showing the effect of mid-level ethanol content on long term trim values is shown in Figure 1.

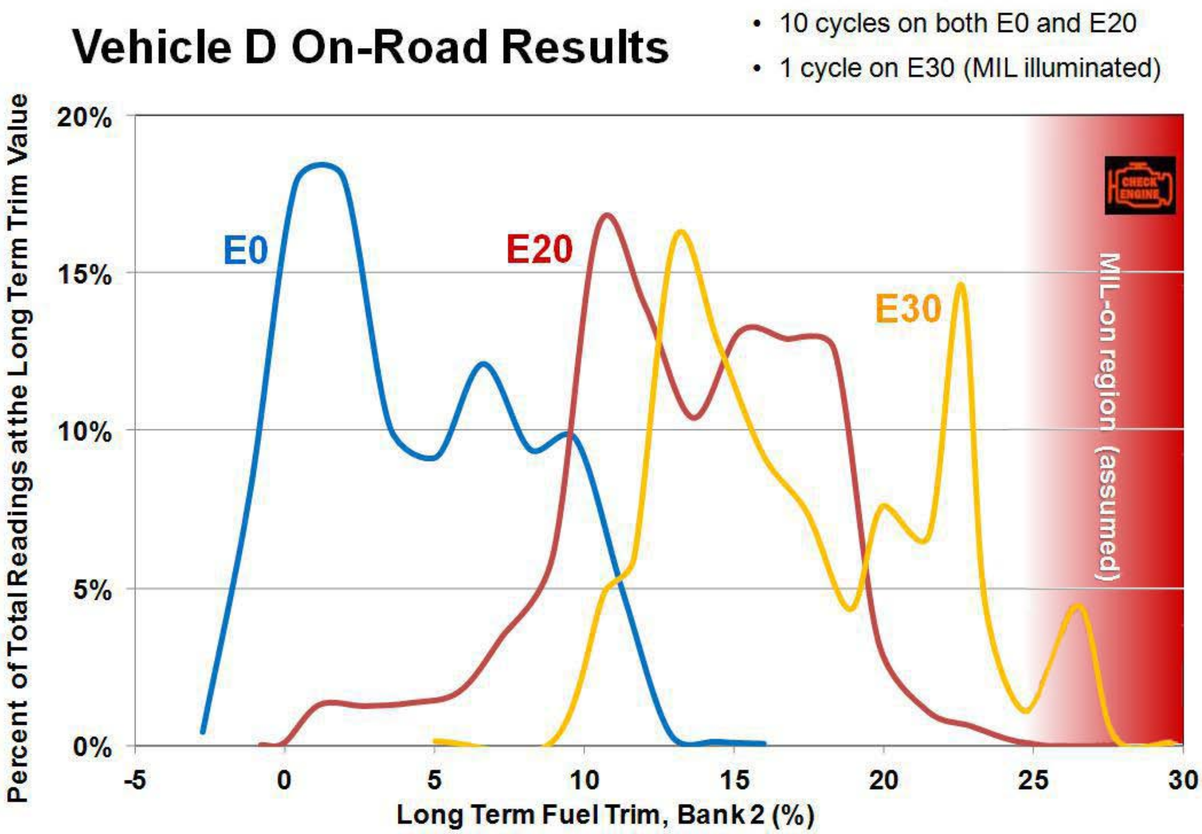

Figure 1. Example of the Effect of Ethanol Content on the Long Term Fuel Trim

- The results of the vehicles tested in this project at 20ºF indicate that the long term fuel trim tends to increase with lower ambient temperatures. Thus, the vehicles were more susceptible to MIL illumination when using ethanol blends >E10 at lower temperatures. A graph that shows the effect of ambient temperature on the long term trim values is shown in Figure 2. The fuel vapors purged from the canister of a vehicle's evaporative emissions system into the engine intake affect long term fuel trim values. This may cause the differences in LTFT values at different ambient temperatures.

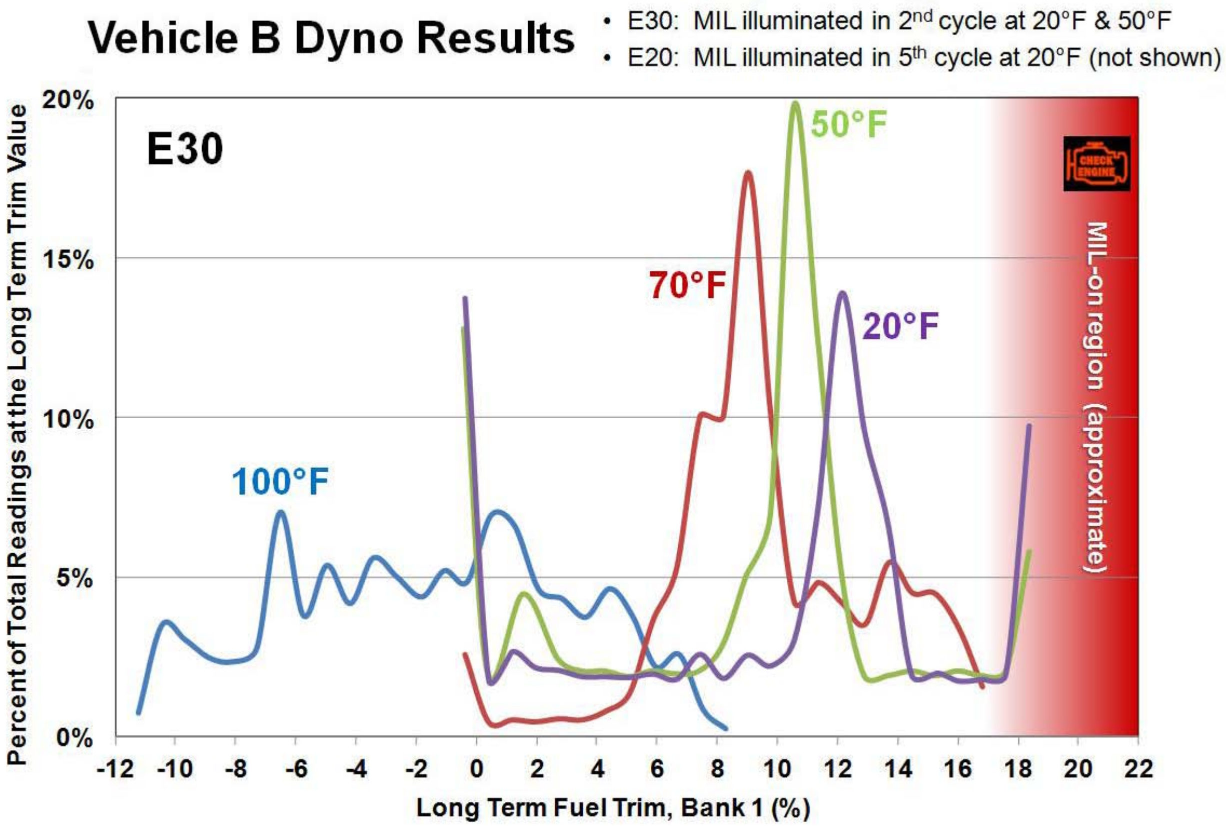

Figure 2. Example of Ambient Temperature on the Long Term Fuel Trim

- Based on experience with one of the test vehicles, some of the vehicles in the in-use fleet might have difficulty adapting back to lower blends after exposure to intermediate ethanol blends.

I. BACKGROUND

The 2007 Energy Independence and Security Act (EISA) mandates that significant additional volumes of renewable fuels be introduced into the transportation fuel pool in the U.S. It is anticipated that much of the renewable fuel will be ethanol for use in gasoline vehicles. Assuming the EISA mandates are met, ethanol volumes will likely exceed 10 volume percent in gasoline in the future.

Significant programs have been conducted by the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Coordinating Research Council (CRC), and other organizations to determine whether so-called mid-level ethanol or E10+ blends (e.g., E15 or E20) can be used in the existing motor vehicle fleet without causing harm to those vehicles using an E10+ blend. On October 13, 2010, EPA granted the first partial waiver for E15 for use in model year 2007 and newer light-duty motor vehicles (i.e., cars, light-duty trucks, and medium-duty passenger vehicles). On January 21, 2011, EPA granted the second partial waiver for E15 for use in model year 2001-2006 light-duty motor vehicles.

A study released by CRC designated as project E-90[1] concluded that the malfunction indicator light (MIL) may illuminate on some problem-free vehicles while operating on an E10+ blend. The MIL can be triggered when the OBDII system determines that the vehicle requires an "excess" amount of fuel to maintain stoichiometric operation, based on a threshold value for long term fuel trim (LTFT). Data were collected from in-use vehicles operating in regions where E0 or E10 was marketed exclusively, allowing projections of LTFT if the vehicles were to be operated on E15 or E20. Actual testing of the vehicles with E10+ blends was not possible in this project; test time was limited to less than 15 minutes and the privately-owned vehicles could not be exposed to a fuel that is typically not allowed according to the vehicle owners' manuals.

CRC Project E-90-2a performed a detailed assessment of inspection and maintenance program data to identify specific vehicle makes and models with a propensity for lean-limit failures. That propensity could be exacerbated when operating on E10+ blends.

II. INTRODUCTION

An interim report for this CRC Project E-90-2b was published in November 2012 at the request of CRC. The interim report covered the work completed on the project through August 17, 2012, which was designated Phase 1. The work on the project after the August 2012 date was defined as Phase 2. Note that these definitions were assigned as a convenience. There is no distinction between Phase 1 and Phase 2 in the scope of work for this project. This final report for CRC E-90-2b includes all work performed (i.e., Phase 1 and Phase 2).

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[1] CRC Project No. E-90, "IMPACT OF E15/E20 BLENDS ON
OBDII SYSTEMS – PILOT STUDY"
Dated March 9, 2010
Torre Klausmeier Consulting, Inc.

The basic project defined in the request for proposal is given below and a logic diagram of the test procedure is given in Appendix A.

1. CRC specified vehicles (make, model, model year, and engine) which, based on previous studies and input from vehicle manufacturers, would tend to illuminate a MIL for "lean operation".

2. SwRI located candidate vehicles meeting these specifications and an SwRI technician performed an evaluation (designated an "inspection") in the field on the candidate vehicles.

3. Based on the results of the field inspections, CRC selected vehicles which SwRI then purchased for further test work in the project.

4. The selected vehicles were tested for emissions (FTP-75) with E0 fuel.

5. The vehicles were operated over a "real-world" on-road driving cycle initially on an E20 blend. During the "real-world" on-road operation:

    a. The change in fuel trim and other engine parameters were documented.

    b. It was determined whether the MIL illuminated and/or diagnostic trouble codes (DTCs) were set.

6. If the MIL illuminated and/or DTCs were set, then the initial procedure at the start of the test program was to test the vehicle on-road on E15. If a MIL illumination and/or DTC was observed on E15, the vehicle was then to be evaluated on-road on E10.

None of the first six vehicles initially evaluated on-road in this program illuminated a MIL and/or set a DTC with E20. Therefore, the following scope was added later:

1. CRC decided to conduct on-road testing with E30 to ensure that the test program provided discrimination and to test for an ethanol content that would illuminate the MIL.

2. Vehicle testing on a chassis dynamometer in an ambient temperature-controlled chamber was conducted at ambient temperatures of 20°F, 50°F, 70°F, and 100°F to determine the effect of ambient temperature on long term fuel trim values.

3. With concurrence from CRC, SwRI technicians performed a vehicle "screener" procedure documenting long term fuel trim during closed-loop operation of all available vehicle makes and models that were 2008 model year or earlier. Later the model year criteria were limited to 2001 through 2008.

III. RESULTS AND CONCLUSIONS

The following is a summary of the results and conclusions for the project. One hundred and forty-two vehicles meeting CRC specifications were inspected and two hundred and thirteen vehicles were screened. Eight vehicles were inspected and selected by CRC for evaluations in the project. Photographs of the vehicles are included in Appendix F.

Vehicle fuel control systems, based on O_2 sensor input during closed-loop operation, “trim” (slightly increase or decrease) the fuel for a given condition to achieve stoichiometry. The combination of the short term fuel trim (STFT) and long term fuel trim (LTFT) parameter values indicates the magnitude of the adjustment required. The trim values in the units of percent are positive (adds fuel) if the engine seems to be running lean and are negative (subtracts fuel) if the engine is running rich. Since the addition of ethanol to gasoline elevates the oxygen content of the fuel, the long term trim value will increase with an increase in the ethanol volume percent in the fuel.

The OBD program monitors trim values for potential problems with a vehicle’s emissions system. A P0171 (lean bank 1) diagnostic trouble code (DTC) and/or a P0174 (lean bank 2) DTC will be set if the on-board diagnostic limits of fuel trim are exceeded. The logic and limits are specific to a vehicle’s engine OBD calibration. A vehicle with no emissions system problems that passed applicable emissions limits when operated on E0 or E10 could potentially set a P0171 or P0174 code when using an E10+ blend.

As noted above, the logic to set a P0171 or P0174 DTC is specific to calibration of each vehicle. However, in general a “pending code” is set during the first time that the OBD monitor completes and determines that the long term trim has exceeded a specific calibration limit. During the next drive cycle that the monitor completes, the “pending code” will either be erased if the long term trim is under the design calibration limit, or changed to a MIL if the LTFT has again exceeded the limit.

The results of both the on-road and dyno evaluations are summarized in Table 1. The detailed results for each vehicle are given in the Appendices listed in Table 3, Section VII. An on-road “cycle” consists of approximately 23.5 miles on the SwRI campus and the local public road system (refer to Appendix I).

The following is a textual summary of results presented in Table 1:

- Seven of the eight vehicles were driven over the road for at least ten 23.5-mile driving cycles with E20 fuel. Two of the vehicles (“E” and “F”) set pending codes for a P0174 lean-limit malfunction. However, no MILs were illuminated during on-road testing for lean bank operation (P0171-bank 1 or P0174-bank 2).

- Three of the vehicles were evaluated on-road with E30 fuel and all three vehicles illuminated a MIL for lean bank operation, as noted in Table 1.

- Vehicles B and D were tested on the chassis dynamometer at 20°F, 50°F, 70°F, and 100°F. The LTFT measurements recorded on these two vehicles were highest during operation at 20°F. Therefore, five other vehicles (A, E, F, G, and H) were tested at only this temperature, except where noted.

- MILs for lean bank operation were illuminated with Vehicle B when tested on the chassis dynamometer at 20°F with both E20 and E30, and at 50°F with E30.

- Vehicle D was tested on the chassis dynamometer with E30 and lean bank operation MILs were set at all temperatures. When attempting to test Vehicle D with lower ethanol concentrations, LTFT values were 10% to 15% higher than those observed during on-road testing. Therefore, subsequent testing of Vehicle D was abandoned.

- At 20°F Vehicle E set a MIL with DTC P0174 on both E20 and E15. Additional tests were conducted on E15 at 50°F and on E10 at 20°F. No lean bank operation DTCs were observed during either of these two subsequent tests.

- Vehicle H was initially tested on E20 at 20°F, and set a MIL with DTC P0171 during the second cycle. No pending or set DTCs were observed during subsequent testing on E15.

- Vehicles A, F and G were also tested on E20 at 20°F. None of these vehicles illuminated a MIL or had pending DTCs.

Table 1. Summary of Results

Vehicle	Test Site	E0			E10			E15			E20			E30		
		No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?	No. of Test Cycles	MIL Illumi-nated?	DTC Set?
A	Road	10	No	No							10	No	No			
A	Dyno 20°F										10	Yes	P0128[4]			
B	Road (driver & observer)	10	No	No							14	No	No	4	Yes	P0171
B	Road (GVW)										10	No	No			
B	Dyno 20°F							10	No	No	5	Yes	P0171	2	Yes	P0171/4
B	Dyno 50°F										10	No	No	2	Yes	P0171
B	Dyno 70°F										10	No	No	5	No	No
B	Dyno 100°F										10	No	No	10	No	No
C	Road	16	No	No							10	No	No			
D	Road	10	No	No							10	No	No	1	Yes	P0174
D	Dyno 20°F										LTFT did not adapt from E30 to E20[1]			2	Yes	P0171/4
D	Dyno 50°F													2	Yes	P0174
D	Dyno 70°F													3	Yes	P0171
D	Dyno 100°F													2	Yes	P0174
E	Road	10	No	No							10	No	P0174*	2	Yes	P0171/4
E	Dyno 20°F				10	No	P0741[5]	3	Yes	P0174	2	Yes	P0174			
E	Dyno 50°F							10	Yes	P0410[2]						
									No	P1416[3]						
F	Road	10	No	No							14	No	P0174+			
F	Dyno 20°F										10	No	No			
G	Road	10	No	No							10	No	No			
G	Dyno 20°F										10	No	No			
H	Dyno 20°F							10	No	No	2	Yes	P0171			

Color Code

Separates vehicle information
Ballast was added to the vehicle to achieve gross vehicle weight. The test was conducted on-road.
The DTC was unrelated to the effect of ethanol in the fuel.
The DTC was related to the ethanol content in the fuel.

* After E20 cycle 4 a pending P0174 system too lean (Bank 2) was set. The MIL was not illuminated. After all the other cycles the pending code P0174 was not present.

\+ Pending code P0174 was present after the 10th cycle. Four more cycles were performed but the code did not illuminate the MIL; however, the pending code remained.

1 Also would not adapt to E0.

2 P0410: Secondary Air Injection system malfunction. Pending code after 1st cycle (cold start day one), cleared during 2nd cycle. Pending code after 6th cycle (cold start day two), set MIL during 8th cycle.

3 P1416: Secondary Air Injection system Bank 2. Pending code after 10th cycle.

4 P0128: Coolant temperature below thermostat regulating temperature. Pending code after 3rd cycle. MIL illuminated at 1,140 seconds into 4th cycle.

5 P0741: Torque converter clutch circuit performance.

IV. VEHICLE SEARCH, INSPECTION, AND SCREENING

A. Vehicle Search

The list of vehicles that CRC identified for inspection during Phase 1 is given in Appendix B. The project started with an initial list of four vehicles and expanded during the project. The vehicles of interest identified by CRC were based on data from previous CRC programs and vehicle manufacturer input, as noted in Section I, Background.

SwRI located potential candidate vehicles meeting these specifications that were for sale at dealerships in the San Antonio, Texas area and as far away as Austin, Texas and Houston, Texas. SwRI made arrangements with the dealerships to allow an SwRI technician to perform the inspection procedure on the vehicles, which included an engine idle and soak test, while monitoring engine parameters including long term fuel trim.

Challenges encountered during the vehicle search and inspection included:

- Some of the vehicles were produced in relatively small volumes, and were therefore difficult to locate.

- The vehicles tended to have high mileage, and were often found to have pending codes and/or mechanical issues not necessarily related to lean-limit malfunctions.

B. Inspection Procedure

The inspection procedure included the tasks listed below. An inspection work order is attached in Appendix C.

1. The following vehicle information was included in the documentation:

   a. Vehicle make
   b. Vehicle model
   c. Vehicle model year
   d. Vehicle identification number (VIN)
   e. Odometer reading
   f. Engine displacement
   g. Engine family
   h. Transmission – auto/standard shift?
   i. Evaporative emission family

2. The technician checked for a MIL and/or DTC(s) with a scanner.

3. The following inspection evaluation was performed while recording engine speed, coolant temperature, and long term fuel trim information from each vehicle's data bus:

a. Warm up the engine at normal engine idle speed.
b. Turn the engine off and allow a 20-minute soak period.
c. Restart the vehicle and allow the engine to idle for a minimum of 15 minutes.

The list of vehicles that SwRI evaluated in this manner is given in Appendix D. The information from each vehicle inspection was tabulated and a graph of the vehicle parameters versus time was included in an Excel® workbook. A typical graph is shown in Figure 3. The workbook was uploaded to the password-protected ftp site established for this project. An e-mail summarizing the results of the vehicle inspection was sent to the CRC Project Manager.

The CRC Project Manager with input from CRC members decided whether to select a vehicle for the project. The basic target criterion was a long term fuel trim value that fell between 2σ and 3σ in the distribution of positive LTFT values for a particular model, when the vehicle is operated on E10. This criterion was based on data from earlier phases of the project. If a vehicle was selected for the project, SwRI purchased the vehicle and arranged for transportation to the SwRI campus in San Antonio, Texas. Photographs of the eight vehicles purchased for the project are shown in Appendix F.

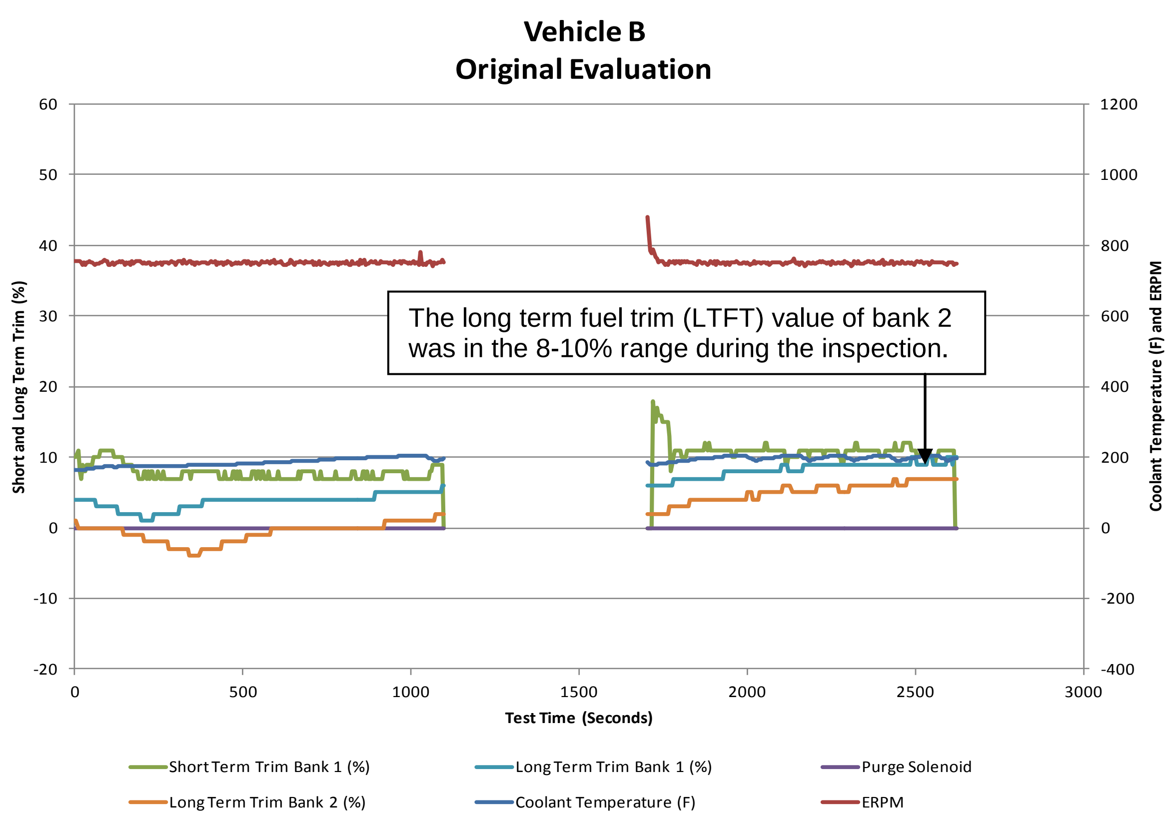


Figure 3. Typical Vehicle Inspection Graph

C. Screener Procedure

As noted in Section IV.A, the vehicle search presented challenges which made it difficult to find suitable vehicles for this project. SwRI suggested another vehicle evaluation method, designated the "screener" procedure, which would augment the vehicle search. The major difference of the screener compared to the vehicle search is that rather than looking for a specific make and model and performing a full warm-up and idle, the SwRI technician idled all vehicles 2008 model year or earlier on a used car lot and read the long term fuel trim values with a scanner. Later the model year range was modified to include only 2001 through 2008 model years. In February 2012 CRC gave SwRI approval to utilize the screener technique defined below in addition to the vehicle search procedure. For efficiency the SwRI technician would screen as many vehicles as possible at a dealership after performing an inspection.

1. SwRI made arrangements with local used car dealerships to allow SwRI technicians to conduct the screener procedure on vehicles on a used car lot.

2. The procedure was conducted only on vehicles that were 2008 model year or earlier.

3. Each vehicle's engine was warmed up at idle in drive or park with the air conditioning on until the engine went into closed loop and the coolant temperature was at least 150°F.

4. The technician waited a minimum of one minute before recording the following information with a scan tool:

    a. Coolant temperature
    b. Long term fuel trim
    c. Visual average of short term fuel trim

5. The technician checked for a MIL and/or DTC(s).

6. If there were DTC(s), all the code information was recorded.

The screener procedure provided CRC with long term fuel trim data on a broad spectrum of vehicles. Vehicles screened in this manner are listed in Appendix E. The results of the screener procedure were sent to the CRC technical contact. Based on the results, particular vehicles of interest to CRC were identified. With concurrence of the CRC technical contact, a full inspection of selected vehicles was conducted. One of the eight test vehicles was identified from a screener search, inspected, and procured for the project.

V. PROJECT TEST FUEL

All the fuel used in this project was EEE emissions fuel or a blend of EEE emissions fuel and road grade ethanol to produce an intermediate ethanol blend. Since no MILs were illuminated with E20 fuel during on-road testing, E15 and E10 were never used for the on-road tests. (Refer to the test procedure defined by CRC given in Appendix A.) However, E15 and E10 were used to test Vehicles B, E, and H on the chassis dynamometer (refer to Table 1).

To ensure that the project test method had adequate discrimination and could produce a MIL based on lean engine operation, E30, E40, and E50 fuels were blended and selected vehicles were tested with E30. The results of analytical evaluations of samples of the test fuel used in the project are given in Appendix G.

All the "fuel changes" in this project were performed by a fuel tank cleaning method, which has been used successfully in past fleet test programs to ensure that the previous test fuel is removed from the tank before filling with the new test fuel.

The fuel tank cleaning method is described below.

1. The technician wore the proper personal protective equipment for this operation, which was performed in an appropriately ventilated area.

2. The geometry of the outside of the fuel tank was visually inspected to look for indications of areas where fuel might exist below the fuel pump pick-up screen or grooved areas that might hold the fuel back from flowing to the fuel pump pick-up screen.

3. If the vehicle had a fuel tank inspection port, it was used to access and remove the fuel pump and sending unit. If the vehicle did not have a fuel tank inspection port, the fuel tank was removed to access and remove the fuel pump and sending unit.

4. As much fuel as possible was removed from the fuel tank using an external fuel pump. During the project the amount of fuel in the fuel tank prior to a fuel change was minimized.

5. As much as visually accessible, the fuel tank geometry was assessed similar to item 2 above. The remaining fuel inside the fuel tank was then dried by hand using KimWipes®, which are manufactured to alleviate lint.

6. The fuel pump and sending unit were reinstalled into the tank and the fuel tank or the inspection port was reinstalled into the vehicle. All fuel lines were reconnected.

7. The next fuel in the project was installed into the fuel tank.

VI. FTP-75 EMISSIONS TESTS

The first steps in the vehicle evaluation as indicated in the test procedure outlined in Appendix A were to inspect the vehicle, change the fuel in the vehicle's tank to EEE emissions fuel, and conduct an FTP-75 emissions test. The weighted FTP-75 emissions results for each vehicle and emissions certification limits are provided in Table 2. The phase-by-phase emissions results are provided in Appendix H. Except as noted, all the vehicles complied with the applicable emissions limits. Vehicle C slightly exceeded the relevant non-methane organic gas (NMOG) standard, primarily due to high cold-start emissions. However, CRC approved this vehicle for testing. Vehicle E exceeded its applicable NMOG and CO 120,000-mile emissions limits, and had exceeded its full useful life mileage. SwRI's emissions measurement variability is provided in Appendix H.

At CRC's direction, SwRI removed and replaced the upstream O_2 sensors and the catalytic converter on Vehicle E with original equipment manufacturer parts. These new parts were conditioned for 500 miles on a mileage accumulation dynamometer using a simulated standard road cycle (SRC) driving profile. A second FTP-75 emissions test was then conducted and the emissions results were significantly reduced. (Refer to Table 2.) These results indicated that the vehicle was otherwise operating properly (i.e., the LTFT measurements would be valid) and a "spent" catalyst was causing the increased emissions.

Since no MILs were illuminated with E20 during the on-road testing, no additional FTP-75 tests were conducted.

Table 2. FTP-75 Weighted Emissions Results and Emissions Limits

Vehicle Code	WEIGHTED RESULTS							US EPA FTP EMISSIONS LIMITS					
	THC	CO	NO_X	CO_2	NMHC	Est NMOG*	FE	Limit	Durability	THC	CO	NO_X	NMOG
	g/mi	g/mi	g/mi	g/mi	g/mi	g/mi	MPG			g/mi	g/mi	g/mi	g/mi
A	0.066	0.448	0.042	491.59	0.053	0.055	18.09	NLEV	80K	0.41	3.4	0.2	0.08
B	0.027	0.237	0.013	409.57	0.022	0.023	21.72	ULEV	50K	–	1.7	0.2	0.04
C	0.118	2.121	0.060	589.64	0.109	0.113	15.02	LEV	100K	–	4.2	0.3	0.09
D	0.056	0.902	0.062	359.22	0.027	0.028	24.73	Interim Non-Tier 2 Bin 9	100K	–	4.2	0.3	0.09
E	0.287	5.278	0.130	490.73	0.237	0.246	17.83	NLEV	120K	–	4.2	0.2	0.09
E**	0.126	1.202	0.055	501.60	0.116	0.121	17.68	NLEV	120K	–	4.2	0.2	0.09
F	0.030	1.257	0.017	399.79	0.025	0.026	22.19	Tier 2 Bin 5	120K	–	4.2	0.07	0.09
G	0.059	0.902	0.066	366.69	0.050	0.052	24.06	LEV-II ULEV	120K	–	2.1	0.07	0.055
H	0.034	0.689	0.020	471.00	0.029	0.030	18.78	LEV-II ULEV	120K	–	2.1	0.07	0.055

*Estimated NMOG calculated by multiplying MNHC by 1.04 per CFR Title 40, Part 86, Subpart S, Section 86.1810-01.

**After installation of aged converter and O_2 sensor.

Testing utilized a Horiba 48-inch single-roll chassis dynamometer. These chassis dynamometers utilize a feed-forward control system for inertia and road load simulation. The dyno electrically simulates vehicle tire/road interface forces, including parasitic and aerodynamic drag. The vehicle experiences the same speed, acceleration/deceleration, and distance traveled as it would on the road. The dynamometer electrically simulates inertia weights up to 12,000 lbs. over the FTP-75 and provides programmable road load simulation of up to 150 hp continuous at 65 mph. A preprogrammed road load curve is the basis for the required force during each second of the driving schedule. For light-duty passenger cars, average observed road load and simulated inertia errors are typically less than ±0.15 percent over the FTP-75.

The dynamometer target and set coefficients for each vehicle were obtained through the EPA's test vehicle database and submitted to CRC for verification prior to emissions testing. The actual coefficients used for this project were provided to CRC, but have been omitted from this document to ensure the results for individual vehicles cannot be identified.

Gaseous emissions were determined in a manner consistent with EPA protocols for light-duty emissions testing as given in the Code of Federal Regulations (CFR), Title 40, Part 86. A constant volume sampler was used to collect proportional dilute exhaust in Kynar bags for analysis of carbon monoxide (CO), carbon dioxide (CO_2), total hydrocarbons (THC), methane (CH_4), and oxides of nitrogen (NO_x). Exhaust emissions were analyzed as shown below.

CONSTITUENT	ANALYSIS METHOD
Total hydrocarbon	Heated flame ionization detector
Methane	Gas chromatography
Carbon monoxide	Non-dispersive infrared analysis
Carbon dioxide	Non-dispersive infrared analysis
Oxides of nitrogen	Chemiluminescence analysis

Fuel economy was determined using the EPA-specified carbon balance method in a manner consistent with the CFR, Title 40, Part 600.

VII. ON-ROAD EVALUATIONS

On-road evaluations were performed using the driver's work order given in Appendix I. The driving route, designated a "cycle", which is included in Appendix I, consisted of city, suburban, and highway driving on the public road system. The CRC request for proposal (RFP) included this description of the desired driving cycle: "*A mixture of "city" and "highway" driving modes. Acceleration profiles similar to those found in emission driving cycles (e.g., FTP, US06, LA92) shall be included. (In the interest of safety, specific driving maneuvers will not be required. This will also facilitate driving the cycle on the open road, over a predetermined course consisting of actual city and highway driving conditions.)*" The CRC RFP also specified a 20 minute soak and 15 minute idle after the drive cycle. Based on this description, SwRI proposed the driving cycle for this project, which is shown in terms of typical vehicle speed versus time in Figure 4.

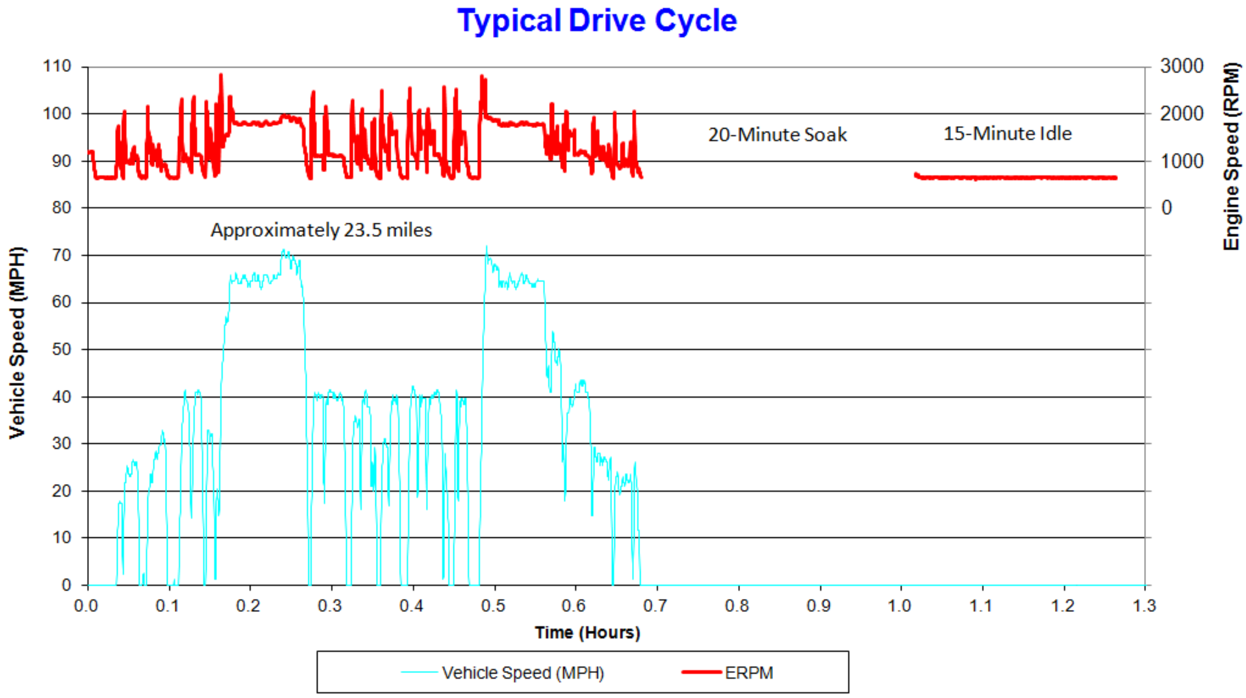


Figure 4. Typical Vehicle Speed and Engine RPM versus Time of an On-Road Driving Cycle

Seven of the eight test vehicles were tested on the road. CRC directed SwRI to conduct only chassis dynamometer evaluations on one of the vehicles. A minimum of ten cycles was conducted with each fuel as long as no MIL was illuminated. Each cycle was approximately 23.5 miles in length and vehicle parameter data were recorded at 1 Hertz. The fuel order is shown in Appendix A. No MILs occurred with E20 so no on-road testing was performed with either E15 or E10, as specified in the test plan.

Three vehicles (B, D, and E) were tested on the road with E30.

On-road and subsequent chassis dynamometer results for vehicles A through H are given in the Appendices listed in Table 3.

Table 3. Vehicle On-Road Results

Vehicle A	Appendix J
Vehicle B	Appendix K
Vehicle C	Appendix L
Vehicle D	Appendix M
Vehicle E	Appendix N
Vehicle F	Appendix O
Vehicle G	Appendix P
Vehicle H	Appendix Q

Results were analyzed in the following manner.

1. For all valid cycles the vehicle parameters versus time are stored in an Excel® workbook and are graphed. Sample graphs for vehicles A through H are shown in the Appendices and sample graphs for typical Vehicle D driving cycles are shown in Figures 5–8.

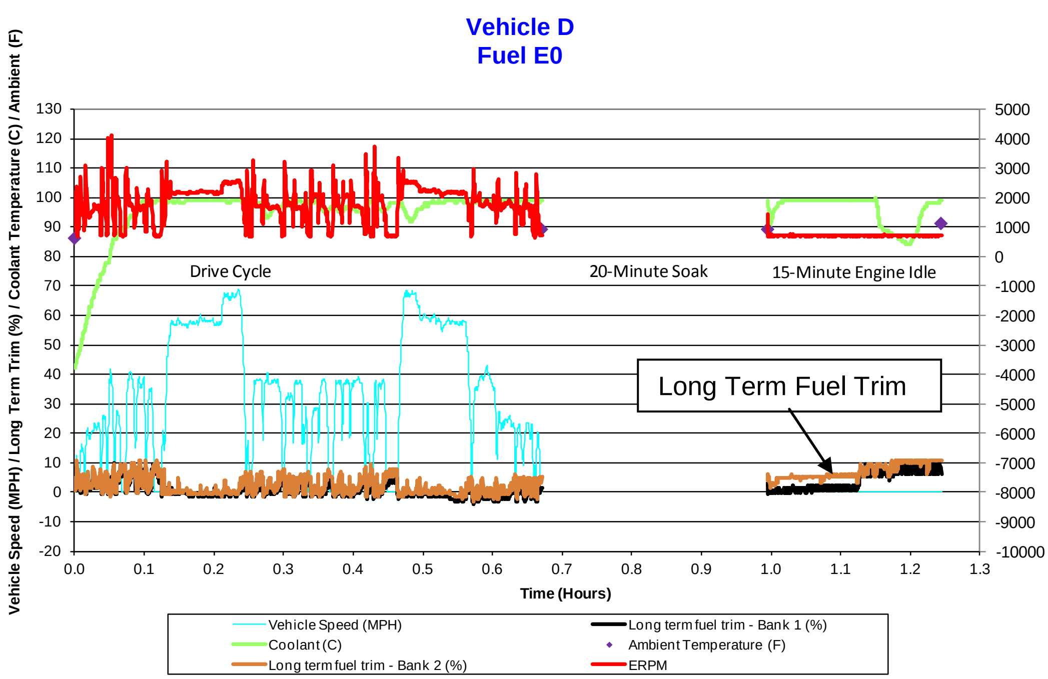


Figure 5. Vehicle D E0 On-Road Drive Cycle

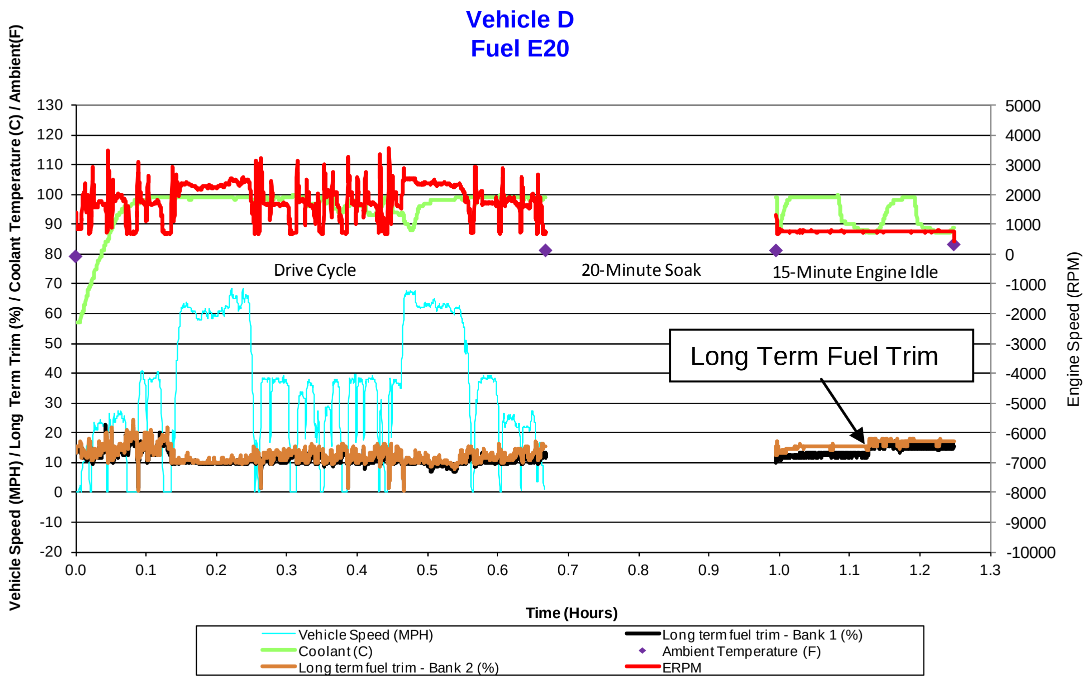


Figure 6. Vehicle D E20 On-Road Drive Cycle

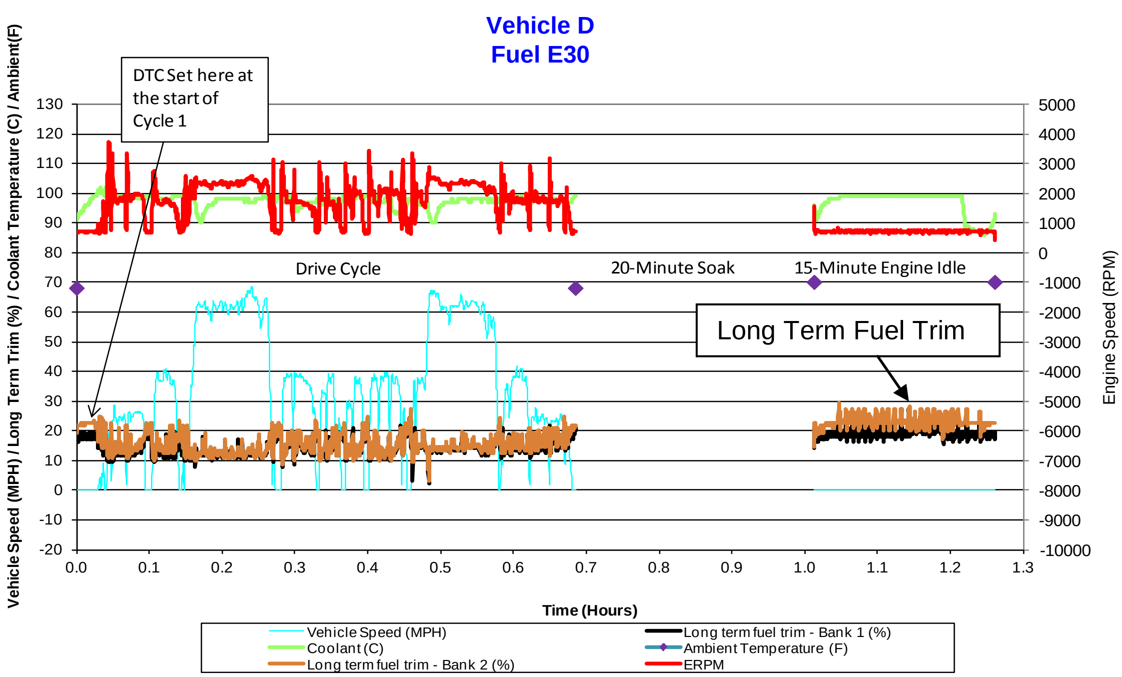


Figure 7. Vehicle D E30 On-Road Drive Cycle

Figure 8 displays the long term trim values of driving cycles with E0, E20, and E30 on a single graph.

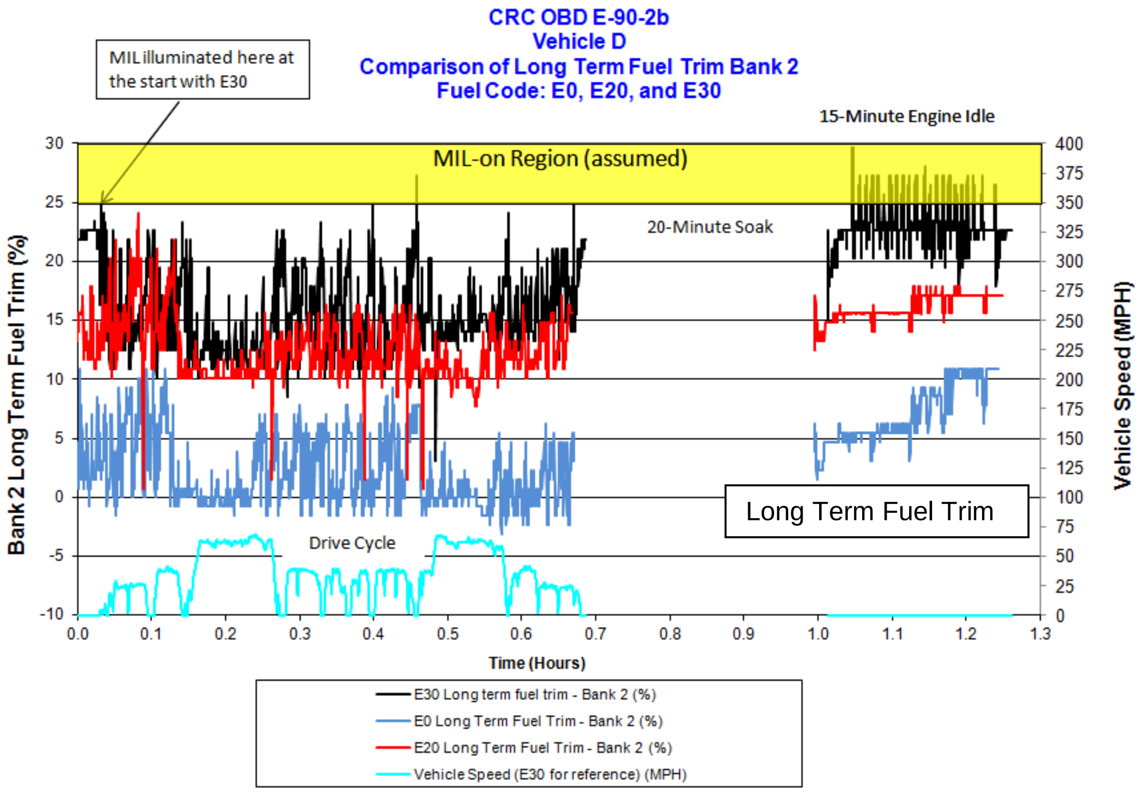


Figure 8. Bank 2 LTFT – Vehicle D E0, E20, and E30 On-Road Drive Cycle Comparison

2. The long term trim values for the last minute of the 15 minute idle condition during each cycle were averaged and this average value was tabulated and graphed. During the project the data indicated that the ambient temperature affected the long term fuel trim. The approximate ambient temperature during the 15 minute idle was also recorded and graphed as displayed in Figure 9.

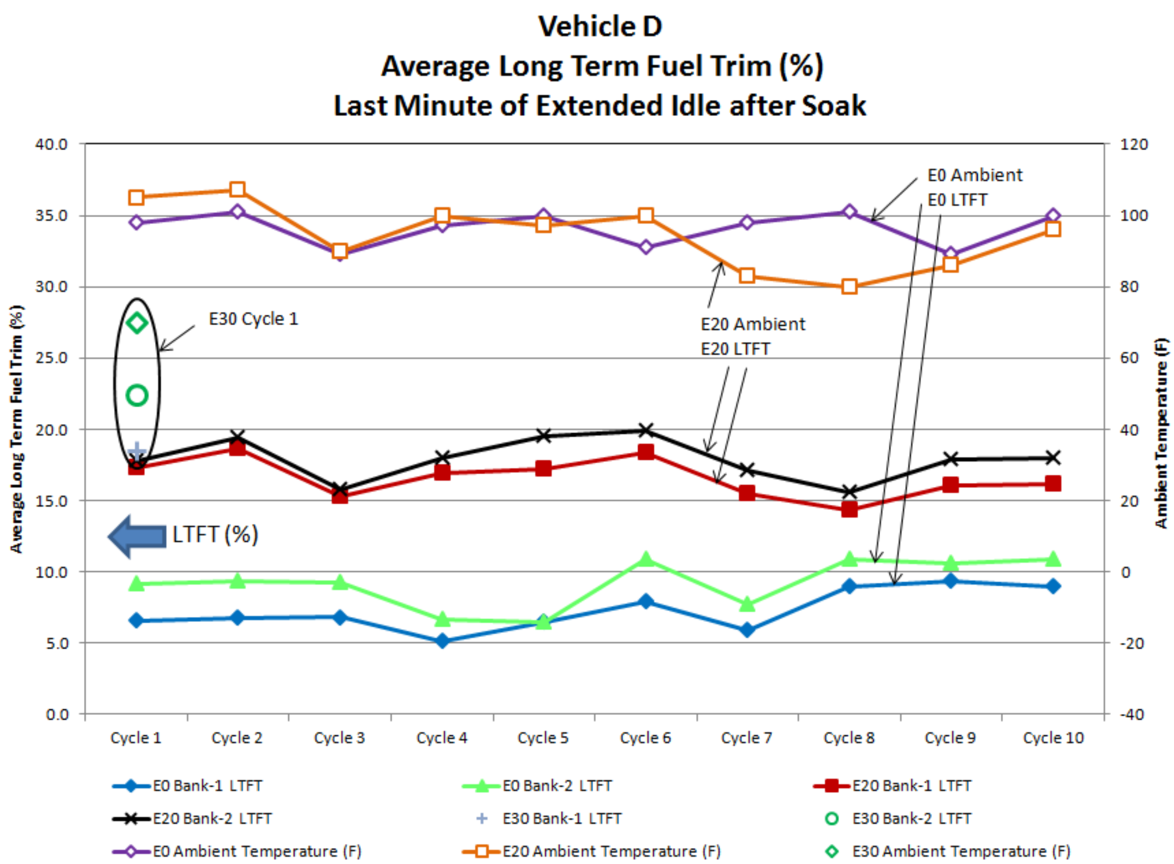


Figure 9. Analysis of the LTFT during the Last Minute of Idle

3. Histograms of percent time of long term trim values during the cycles with the same fuel were also calculated and graphed. Figure 10 is a histogram showing an example of the effect of ethanol content on the LTFT. The 1 Hertz data of long term fuel trim were grouped into histogram bins and plotted. Note that as the ethanol content of the fuel increased the values of the long term fuel trim also increased. An example of a range where the potential limit of long term values could be specified to set a “lean limit malfunction” is highlighted in red.

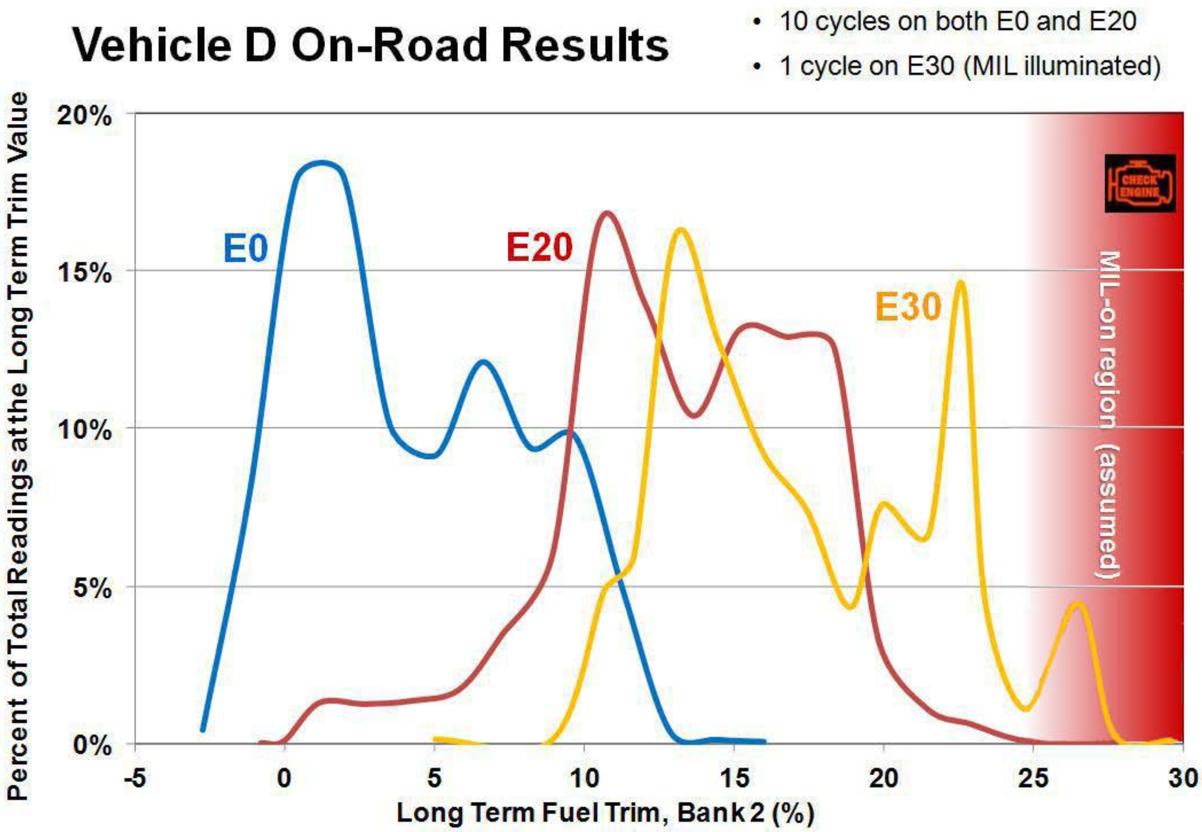


Figure 10. Example of the Effect of Ethanol Content on the Long Term Fuel Trim

Ballast was added to Vehicle B to achieve maximum gross vehicle weight (GVW) and was tested for 10 cycles on-road with E20. This evaluation was performed at the request of CRC to provide an indication whether the long term trim values were affected by the vehicle weight. Since the ambient temperature does seem to affect the long term trim values, the comparison shown in Figure 11 was made between a test cycle conducted with driver, observer, and instrumentation (4,025 lbs. vehicle weight) and maximum GVW (4,595 lbs.) at similar ambient temperatures. There was no apparent difference in the long term trim values.

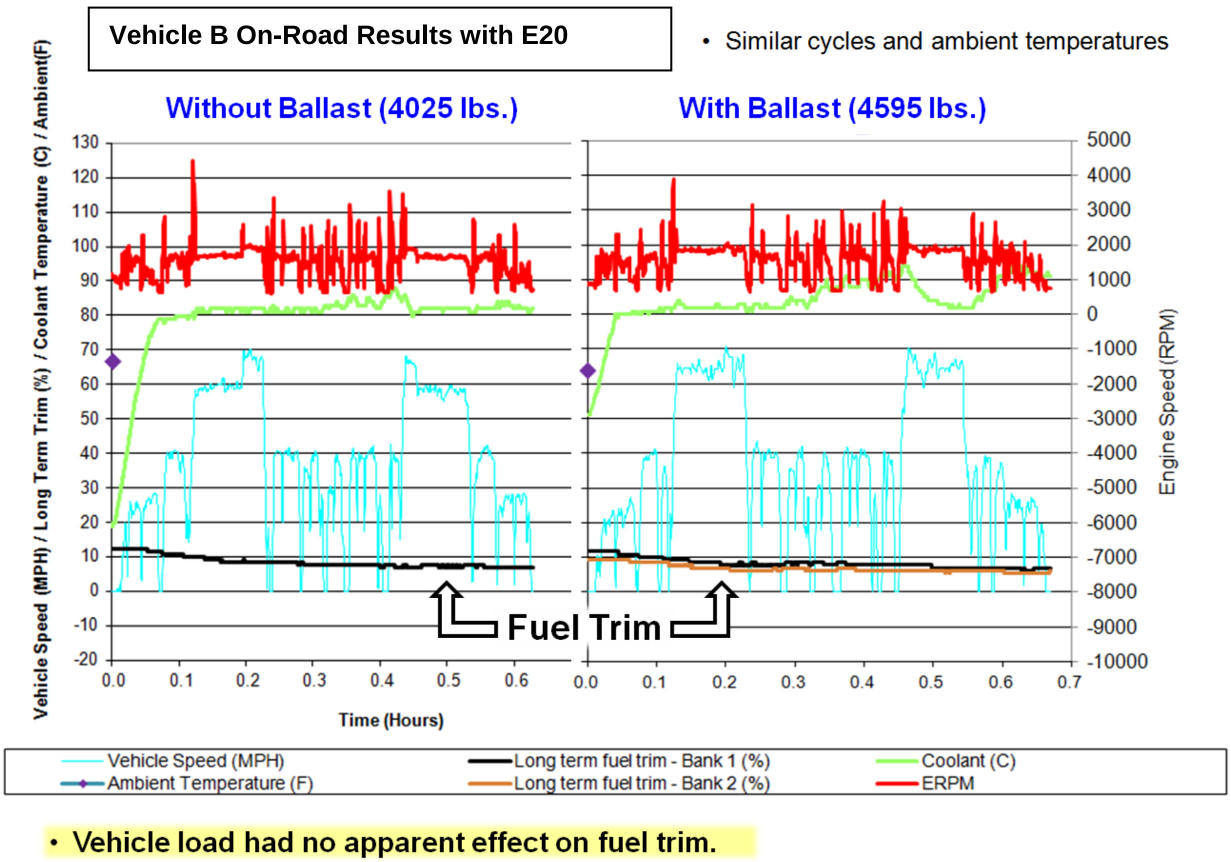


Figure 11. On-Road Testing at Gross Vehicle Weight

VIII. CHASSIS DYNAMOMETER TEMPERATURE EVALUATIONS

CRC requested additional driving evaluations at different ambient temperatures as part of Phase 2. There are two potential test methods:

1. On-road testing would require awaiting the ambient temperature range requested by CRC. This could potentially be several months depending on the desired temperature range and the time of year.

2. The tests could be conducted on a chassis dynamometer in an ambient temperature-controlled chamber. The speed data from the on-road test would be used to develop the drive cycle for dynamometer testing.

CRC chose initially to test Vehicles B and D on a chassis dynamometer at 20°F, 50°F, 70°F, and 100°F, in order of increasing temperature, using E30 and E20 fuels. After assessing the results, Vehicles A, E, F, G, and H were tested on the chassis dynamometer at 20°F. Vehicle E was also tested at 50°F. (Due to operational issues during on-road testing, Vehicle C was not tested on the chassis dynamometer.)

To verify the similarity of chassis dyno and on-road LTFT values,room temperature (72°F nominal) validation testing was conducted in a chassis dynamometer temperature-controlled enclosure.

Chassis dynamometer testing was conducted by the Light-Duty Vehicle Emissions Section in an SwRI-built enclosed chassis dynamometer cell, known as the Temperature-Controlled Environmental Enclosure (TCEE). The TCEE is capable of testing vehicles from 0°F to 120°F over most driving cycles, and contains two Clayton 8.65-inch twin-roll dynamometers for testing of either front- or rear-wheel-drive vehicles. These dynamometers are capable of absorbing up to 50 hp continuously. The front and rear dynamometers are capable of simulating up to 4,875 lbs. and 6,750 lbs. of inertia, respectively, through direct-drive variable inertia flywheel systems.

Prior to chassis dyno testing, each vehicle's evaporative canister was removed and purged overnight with nitrogen at 0.8 cfm in a fume hood. Each canister's weight was monitored and noted before and after purging. This was done before the start of each ten-cycle test sequence in an effort to obtain consistent initial conditions for each vehicle's evaporative system. It should be noted that vehicle evaporative systems are expected to behave differently at the various test temperatures. The purging apparatus is illustrated in Appendix K (page K-11). An example work order for the chassis dynamometer testing is given in Appendix R.

Chassis dynamometer confirmatory testing was conducted with Vehicles B and D at 72°F using E30. Five drive cycles were completed with Vehicle B in order to record LTFT for comparison with with on-road results, which are shown in Figure 12. No MIL or DTC was observed after the five cycles, as opposed to the on-road testing where the MIL illuminated following four cycles. However, Vehicle B's chassis dynamometer LTFTs were similar to the on-road results.

Because Vehicle B's MIL activity on the chassis dynamometer did not replicate the on-road results, Vehicle D was also used to compare on-road and chassis dyno test results. Vehicle D set a MIL during the third cycle on the chassis dyno, compared to setting a MIL during the first cycle on-road. As with Vehicle B, the LTFT values recorded on-road and on the chassis dynamometer were very similar (Figure 13).

Based on the results obtained with Vehicles B and D, further chassis dynamometer testing was approved by CRC.

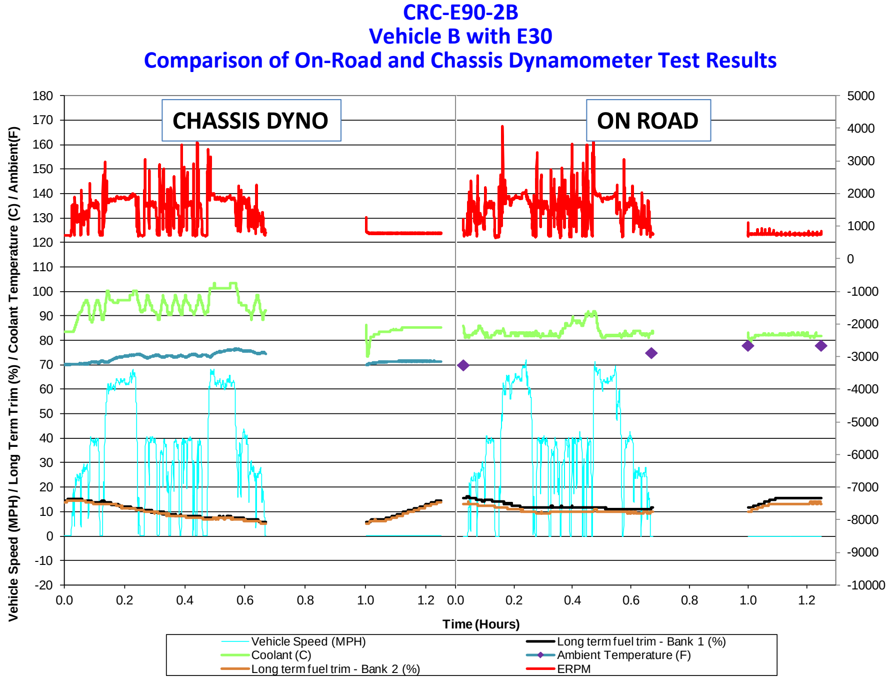


Figure 12. Vehicle B Comparison of On-Road and 72°F Chassis Dynamometer Testing

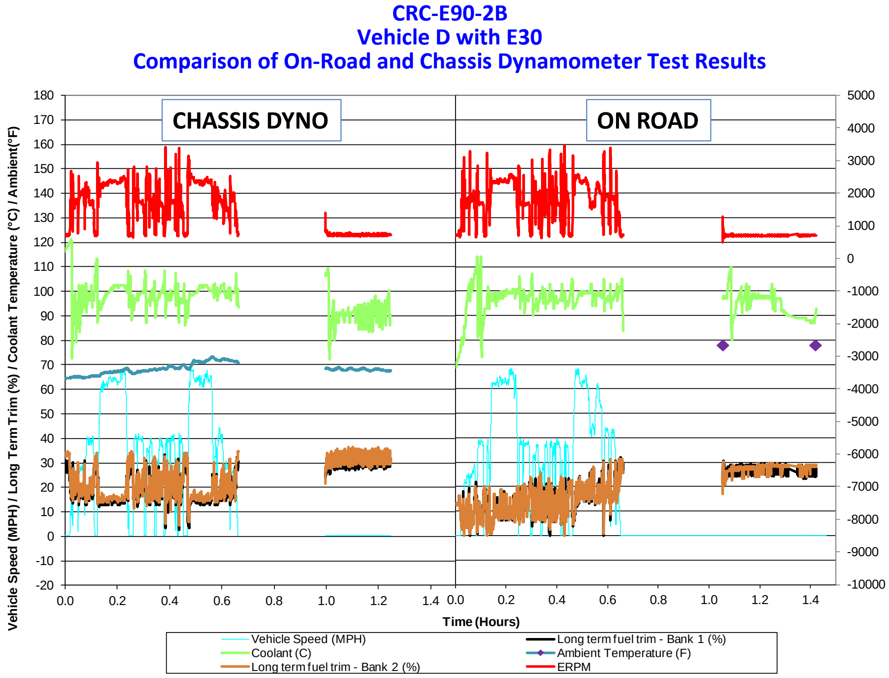


Figure 13. Vehicle D Comparison of On-Road and 72°F Chassis Dynamometer Testing

Lean bank operation MILs were set on Vehicle B at 20°F with both E20 and E30, and at 50°F with E30. Figure 14 shows the MIL-on event at 20°F with E20. Figures 15 and 16 show a comparison of Vehicle B bank 1 long term fuel trim at various test temperatures while running on E20 and E30, respectively. Because the vehicle appeared most sensitive to the lean bank MIL at 20°F, the vehicle was tested on E15 at only this temperature, with no MILs or pending codes observed.

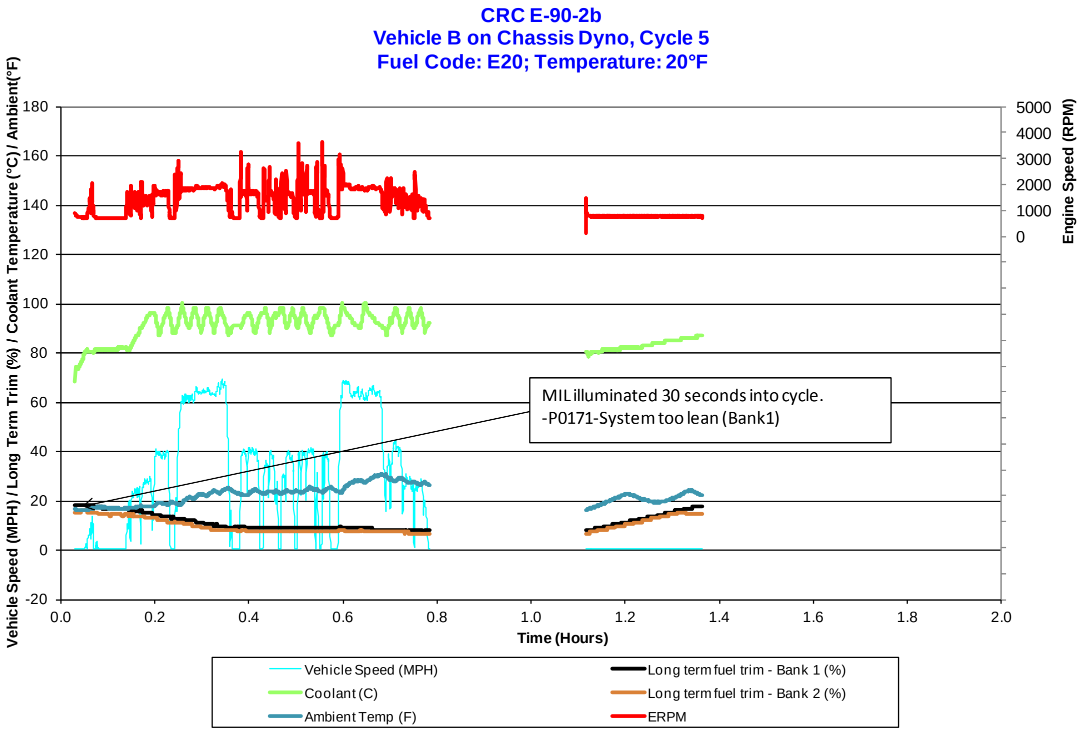


Figure 14. Vehicle B 20°F E20 Drive Cycle

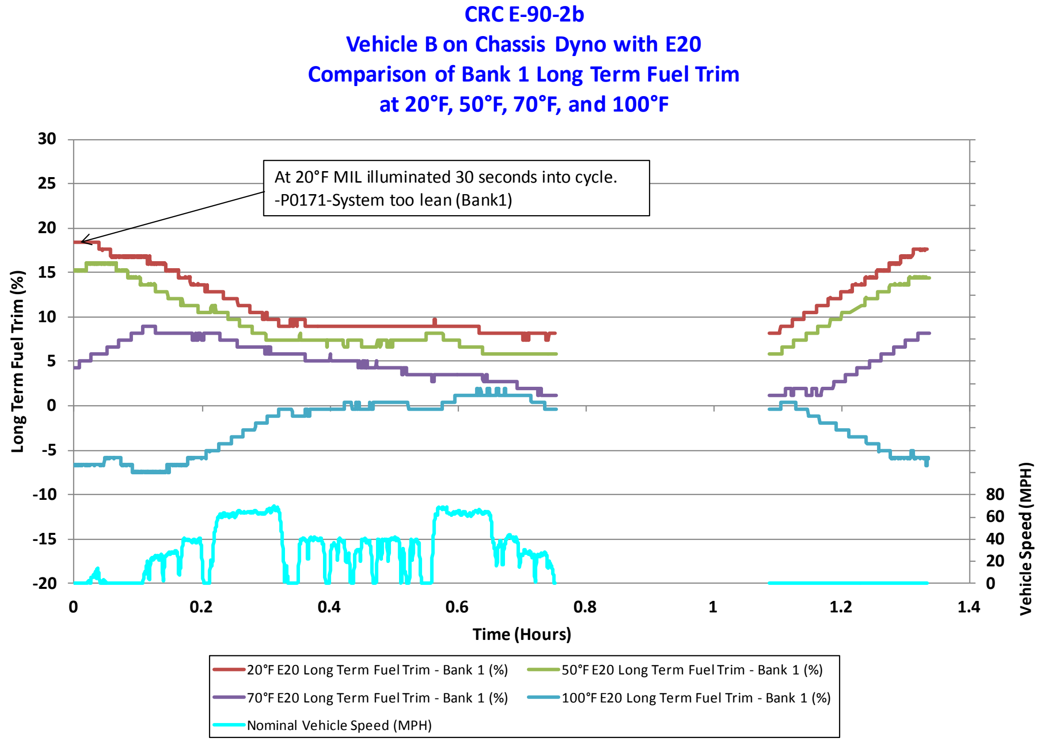


Figure 15. Vehicle B Comparison of Bank 1 Long Term Fuel Trim at Various Temperatures with E20

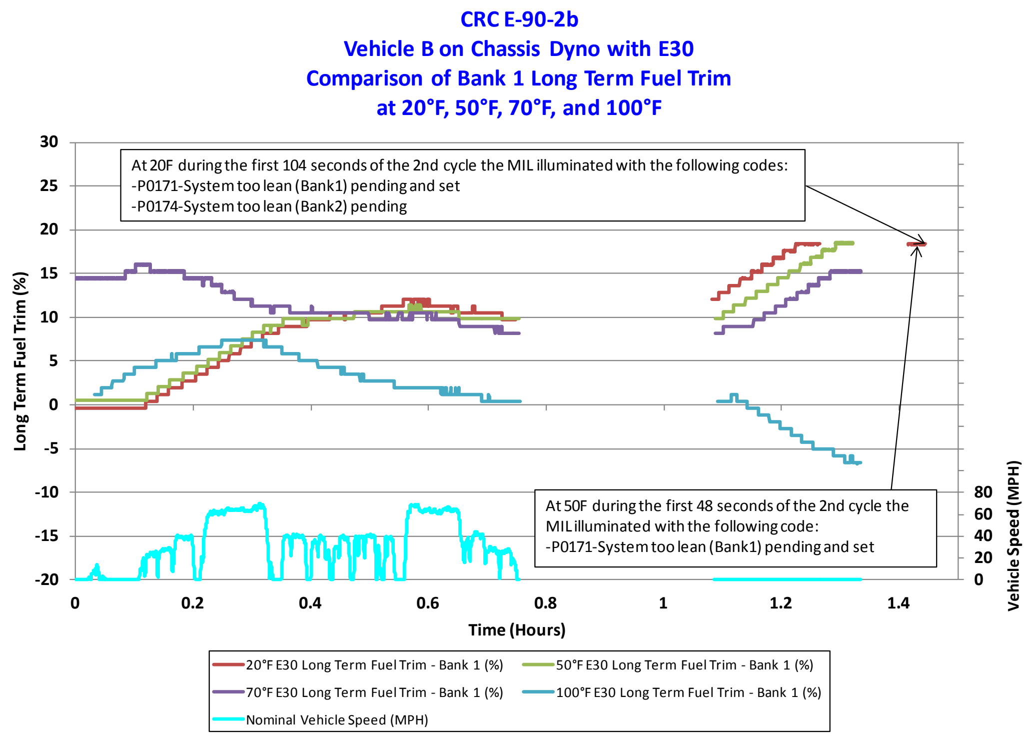


Figure 16. Vehicle B Comparison of Bank 1 Long Term Fuel Trim at Various Temperatures with E30

Vehicle D was tested on the dyno with E30 and lean bank operation MILs were set at all temperatures. Figure 17 shows a comparison of Vehicle D bank 1 long term fuel trim at various test temperatures while running on E30.

After changing from E30 to E20, the MIL illuminated 1,226 seconds into the 2nd cycle with DTCs P0171 and P0174. LTFT was about 31% on both banks during the idle, similar to what was measured on E30. This was substantially different than what was observed during the on-road tests where no DTCs were set and LTFT during the idle ranged from 15% to 20%.

A modified version of the EPAct/E-98 FFV fuel change and conditioning procedure was used to change from E20 to E0, after which LTFT shifted from 30% down to about 20%. This compares to on-road LTFTs that ranged from 0% to 10%. SwRI tried several methods to try to reset LTFT including disconnecting the battery overnight and using an OEM scan tool, and going through a real-world fuel change scenario (130 miles of on-road driving with several 5 minute key-off events followed by topping off the tank).

After all of these efforts, LTFT on E0 still ranged from 10% to 20%. No pending or set codes were observed once the vehicle was fueled with E0. The OEM did not respond to requests for assistance in this matter, so testing with Vehicle D was terminated.

During this investigation, the vehicle set DTC P0442 – Evaporative Leak Small. This was addressed by replacing the fuel cap and the hose from the fuel tank to the canister and modified the attachment. This repair did not impact LTFT.

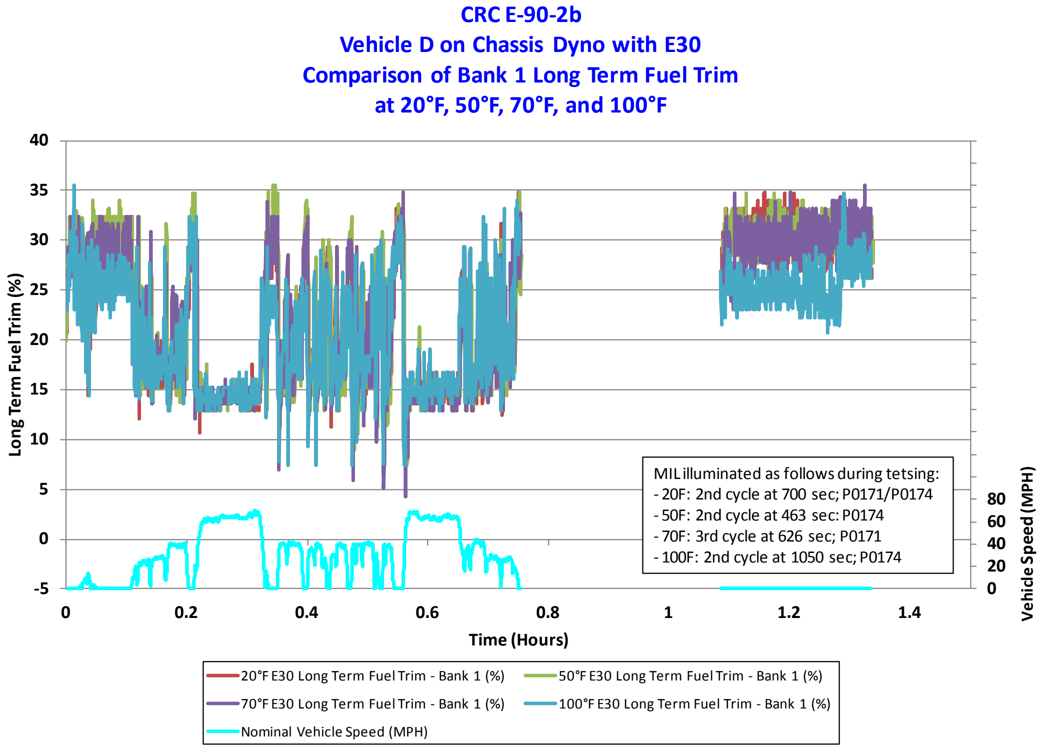


Figure 17. Vehicle D Comparison of Bank 1 Long Term Fuel Trim at Various Temperatures with E30

Analysis of results from Vehicles B and D indicated that LTFT values were highest during operation at 20°F. Therefore, all additional vehicles were tested at only this temperature, except where noted.

Vehicle E was tested next, since it had registered a pending P0174 DTC on the road with E20. At 20°F this vehicle set a MIL with DTC P0174 on both E20 and E15 (Figures 18 and 19). Additional tests were conducted on E15 at 50°F and with E10 at 20°F without observing any lean bank operation DTCs. However, with E15 during 50°F testing the vehicle set a MIL for a secondary air injection system malfunction. It also set a pending DTC related to the torque converter clutch circuit during E10 testing at 20°F. Specific DTCs are given in Table 1 on page 10 of this report.

Vehicle H was added to the test project during chassis dynamometer testing, so it was not tested on the road. It was initially tested on E20 at 20°F, and set a MIL with DTC P0171 during the second cycle (Figure 20). No pending or set DTCs were observed during subsequent testing on E15.

Vehicles A, F, and G were also tested on E20 at 20°F. None of these vehicles illuminated a MIL or had pending DTCs.

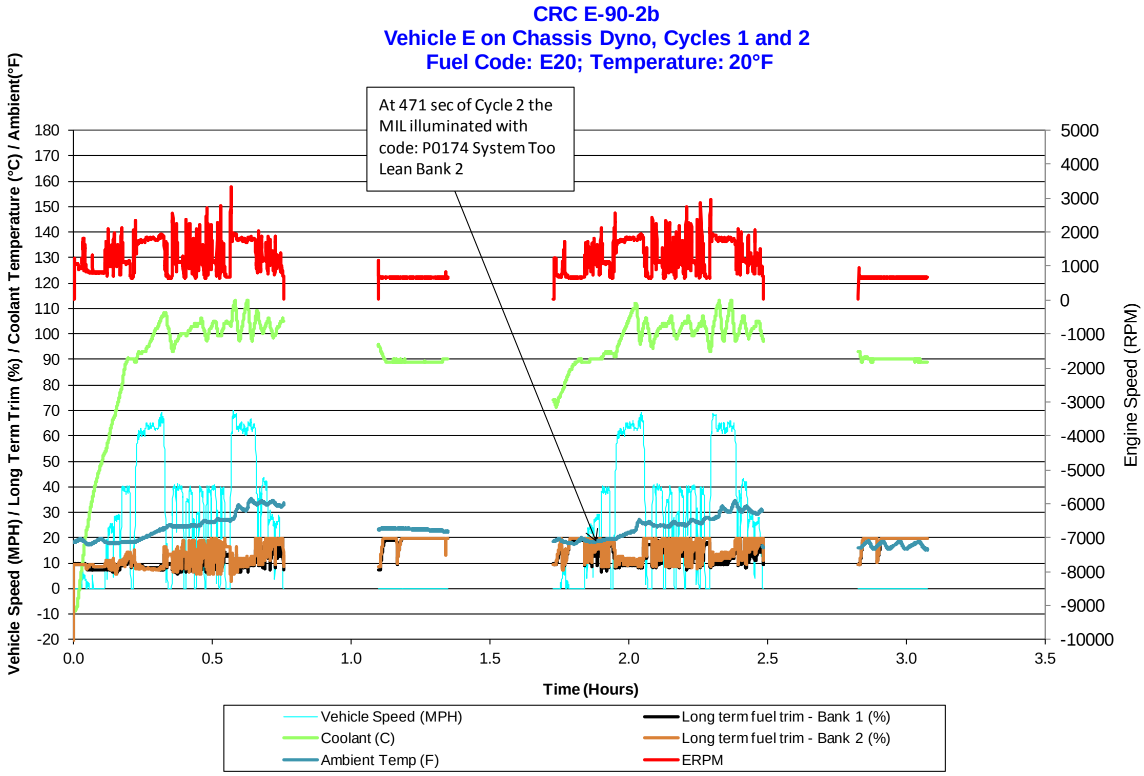


Figure 18. Vehicle E 20°F E20 Drive Cycles 1 and 2

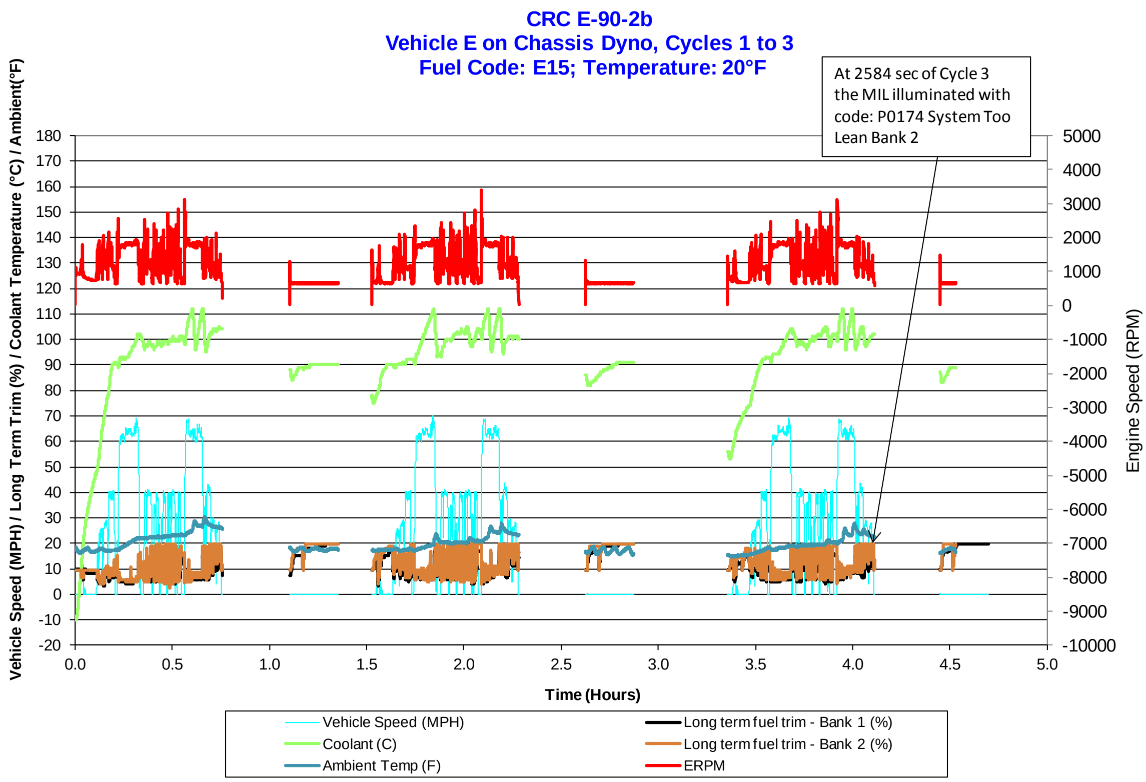


Figure 19. Vehicle E 20°F E15 Drive Cycles 1 to 3

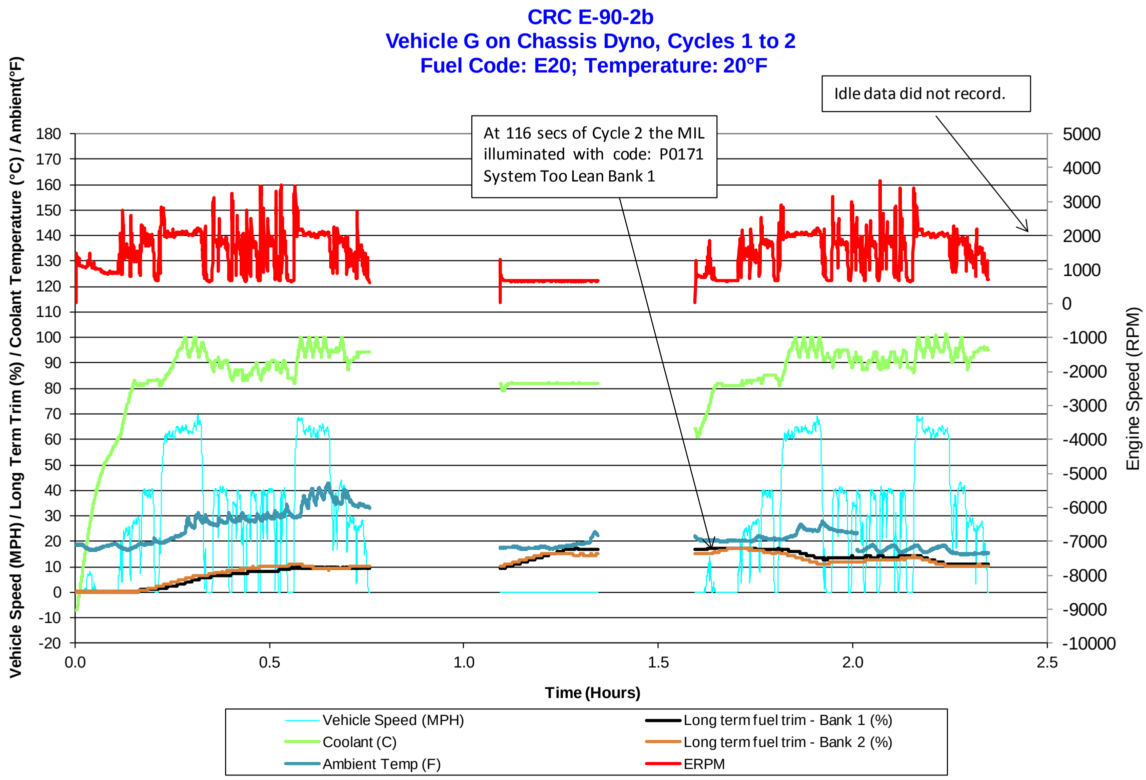


Figure 20. Vehicle H 20°F E20 Drive Cycles 1 and 2

IX. CONCLUSIONS

The following are the conclusions of the E-90-2b project.

- The test results of this project corroborated the conclusions of the previous phases.
- A portion of the in-use fleet will experience MIL illumination when using mid-level ethanol blends. A graph showing the effect of mid-level ethanol content on long term trim values is shown in Figure 21.

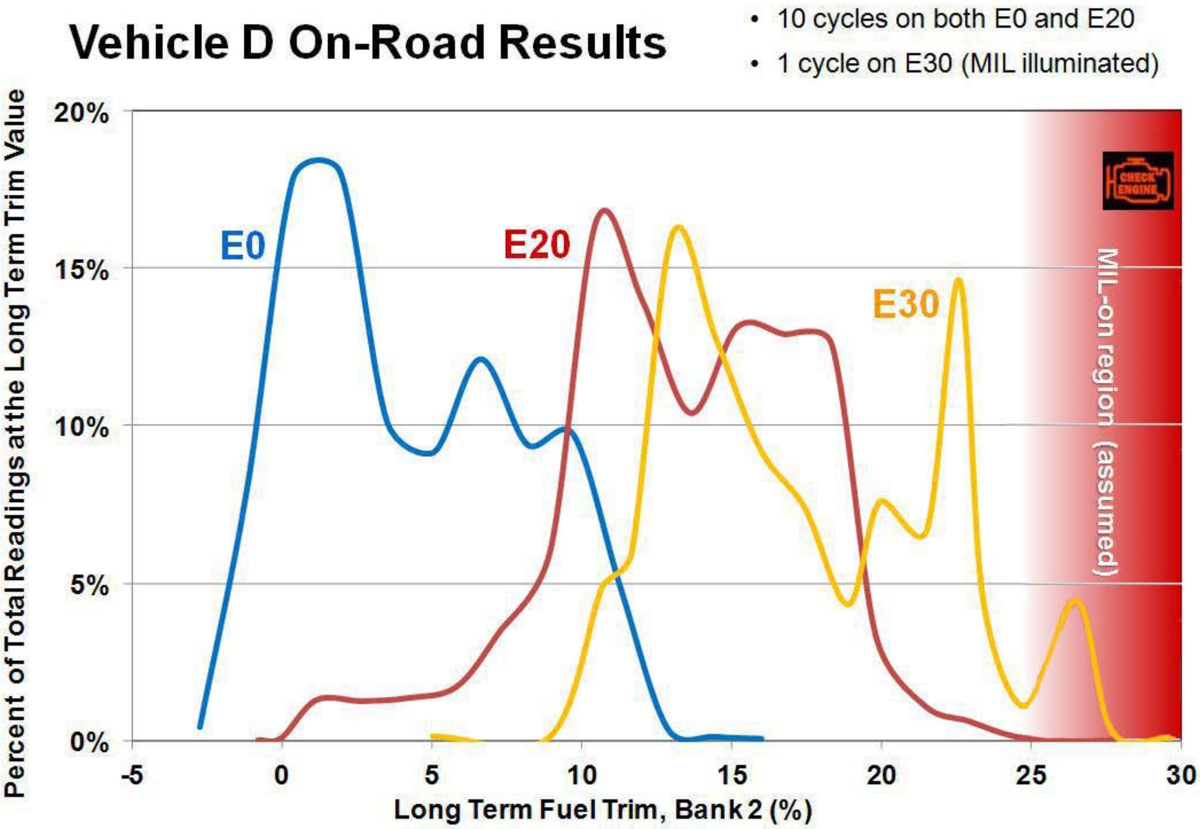


Figure 21. Example of the Effect of Ethanol Content on the Long Term Fuel Trim

- The results of the vehicles tested in this project at 20ºF indicate that the long term fuel trim tends to increase with lower ambient temperatures. Thus, the vehicles were more susceptible to MIL illumination when using ethanol blends >E10 at lower temperatures. A graph that shows the effect of ambient temperature on the long term trim values is shown in Figure 22. The fuel vapors purged from the canister of a vehicle's evaporative emissions system into the engine intake affect long term fuel trim values. This may cause the differences in LTFT values at different ambient temperatures.

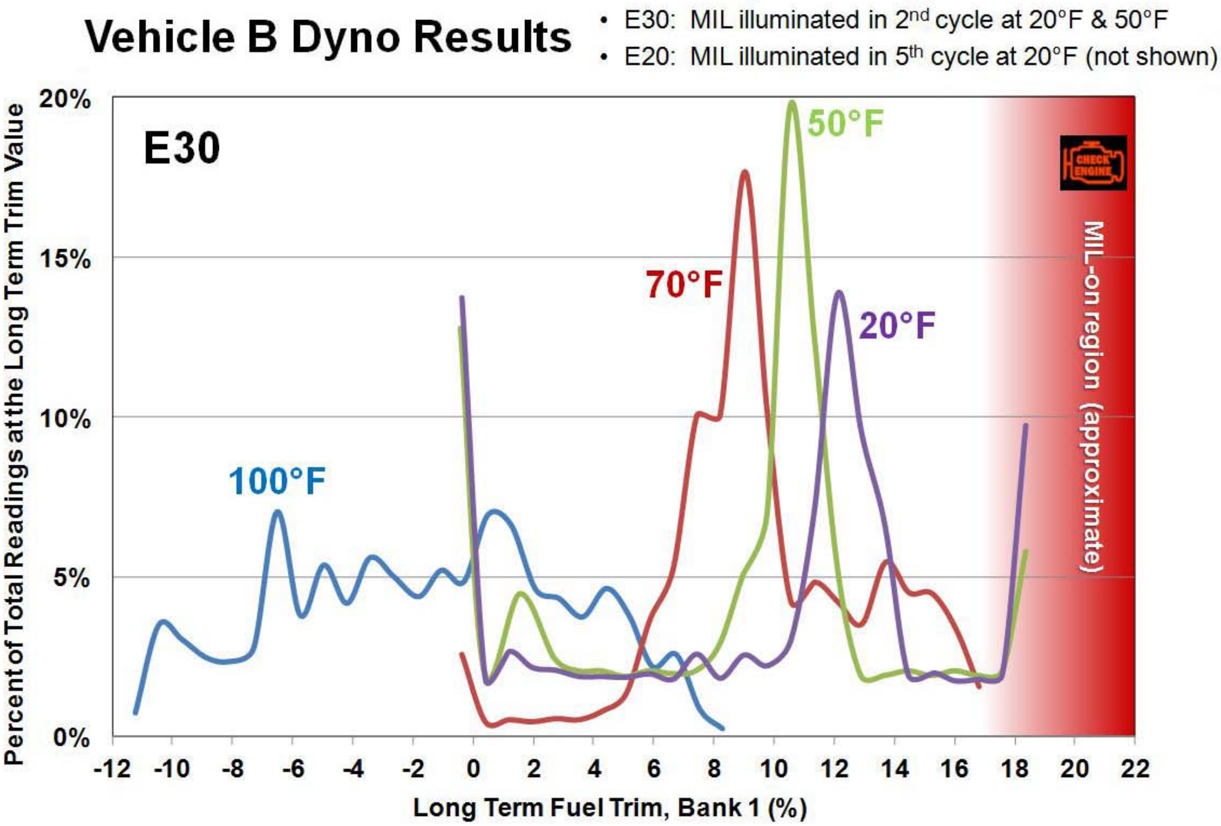


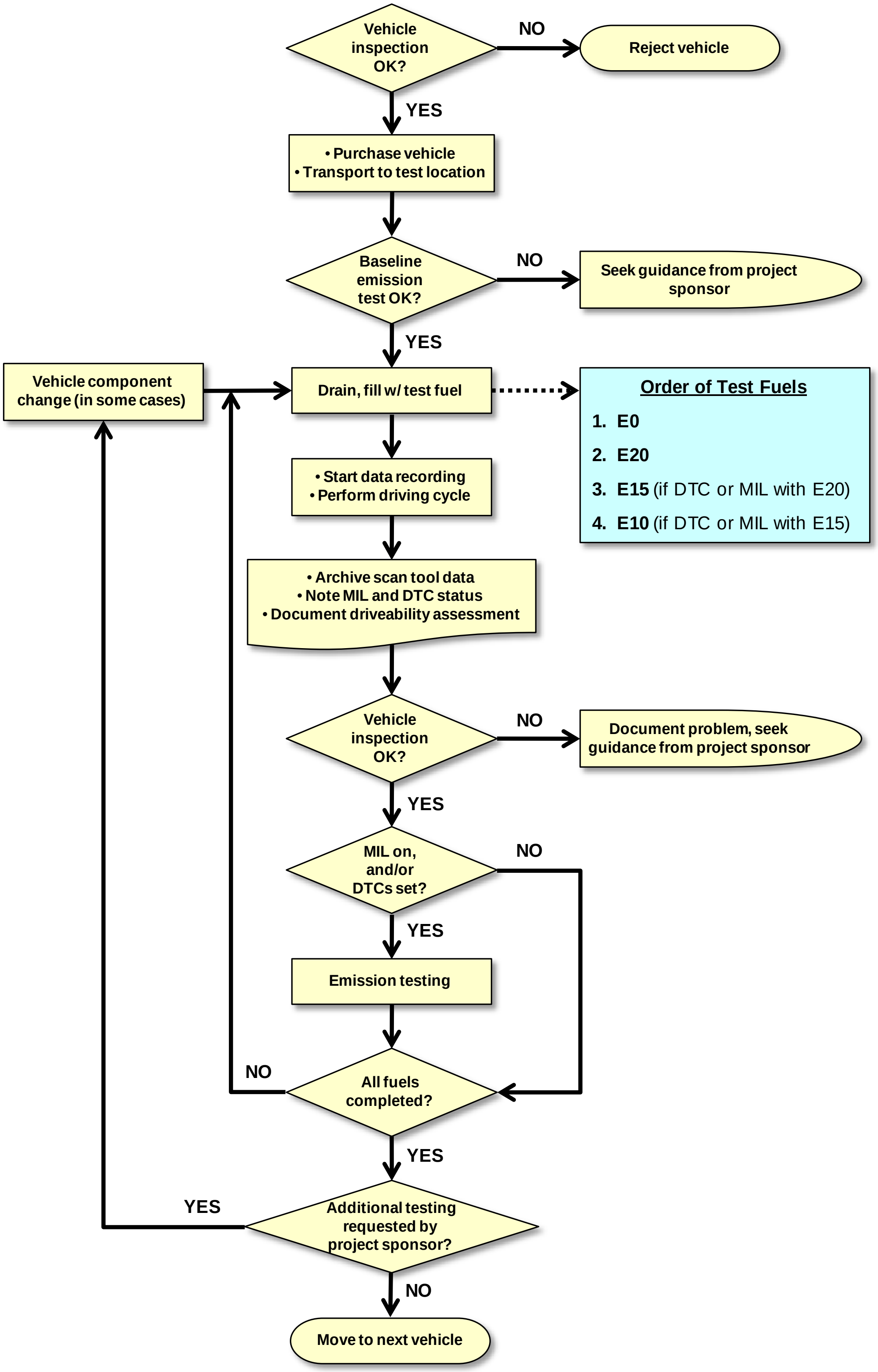
Figure 22. Example of Ambient Temperature on the Long Term Fuel Trim

- Based on experience with one of the test vehicles, some of the vehicles in the in-use fleet might have difficulty adapting back to lower blends after exposure to intermediate ethanol blends.

Appendix A

Logic Diagram of the Test Procedure

Appendix A – Test Procedure



Appendix B

Candidate Vehicle List

Appendix B – Vehicles Specified for Evaluation and Test Vehicles Purchased

Purchased Vehicles

Vehicle Make/Model	Details
GMC Sonoma	4.3 L, MY 2000-2004
Acura MDX & Acura TL	MY 2004-2008
Mitsubishi Montero	3.5L, MY 2002-2003
BMW 3-SERIES	2.5L/3.0L, MY 2001-2004
Cadillac DeVille	4.6L, MY 2001
BMW X3	3.0L, MY 2004
Dodge Caliber	2.0L, MY 2008
Honda Pilot	3.5L, MY 2008

Vehicles Specified for Inspection

Make / Model	Details	Status
Toyota Yaris	1.5 L, MY 2007 - later	CRC directed SwRI to discontinue the search.
Chrysler Grand Cherokee	5.7L, MY 2007-2008 (CA or similar), 2009 (50-state)	A suitable vehicle was not located.
Suzuki Verona	2.5L, MY 2004	
BMW Z4	2.5L, MY 2003	
Geo Prizm	1.8L, MY 2001	
Volkswagen Passat	1.8L, MY 2001	
Volkswagen New Beetle	2.0L, MY 2001	
BMW X5	3.0L, MY 2001	
BMW 5-SERIES	4.4L, MY 2001	
Saturn Vue	3.0L, MY 2003	
Mazda MPV	2.5L, MY 2001	
Mercedes C230	1.8L, MY 2004	
BMW 7-SERIES	4.4L, MY 2001	
Subaru	2.0L, MY Any	
Land Rover Freelander	2.5L, MY 2002	
Ford Windstar	3.8L, MY 2003	
Ford F150	4.2L, MY 2003-2004	

Honda vehicles of various models and years were added to the list later in the project.

Appendix C

Vehicle Inspection Work Order

CRC OBD Program E-90-2b

Vehicle Checkout for Potential Purchase

15995.01.002

Date:______________________ Technician__________________________

Location of the vehicle:_______________________________
____
____
Contact person:______________________________________
Contact's cell phone:_________________________
Vehicle Make:______________________
Vehicle Model:_______________________
Vehicle Model Year:__________
Vehicle VIN:___________________________________
Vehicle Stock #:________________________________

To be filled out by the technician:
Record the following information including VIN from the vehicle as a double check.

Description	**Value**	**Comment**
Date and time of inspection		
VIN		
Odometer reading		
Engine displacement		
Engine Family		
Transmission – Auto/Standard shift?		
Evap Emission Family		
Flex-fuel (Yes or No)		
ECM Calibration ID #1		
ECM Calibration Version #1		
ECM Calibration ID #2		
ECM Calibration Version #2		
Engine Codes yes/no		

Description	**Value**	**Comment**
Exhaust Aftertreatment Number of catalytic converters Where placed? Warmup / underfloor		
Visual Accident damage? Note and/or photograph		
Did you see any "non-OEM" parts installed Yes or No?		

On-Board Diagnostic and Long Term Fuel Trim Check

1. _______ Install the Autoenginuity® scanner and program to record the following at a rate of 1 Hertz:

   Engine speed
   Output to evaporative emissions system purge solenoid
   Long term trim (if there are two trim values (left and right) record both)
   Short term trim
   Coolant temperature

2. _______ Setup the file name as follows for the warm-up

   (Manufacturer)(vehicle number)(model year)(date)(last three digits of the VIN)
   The following is an example:
   (Mitsubishi)-(Montero9)-(2002)-(April 12 2011)-(857)_warmup.csv

3. _______ ***Warm up the engine by idling in drive with the air conditioning on. Do not idle faster than the normal vehicle control. Do not force the idle by using the accelerator pedal.***
4. _______ The engine must be hot (cooling fan has come on once and the radiator hose is warm to the touch, indicating that the thermostat has opened).
5. _______ Continue idling the engine for one minute after warm-up has occurred.
6. _______ While the engine is running check the data to ensure that it looks correct.

7. _______ Is the check engine light on? Yes or No?
8. _______ Turn off the engine and save the file to the memory stick with this file name.

   (Manufacturer)(vehicle number)(model year)(date)(last three digits of the VIN)

9. _______ Allow the vehicle to soak for 10 minutes.

10. _______ Check for engine codes with the scan tool. Are there any codes yes or no?
11. _______ If there are codes write them below and call Brent Shoffner (260-3830) for disposition.

	OEM	Global
Active codes		
Pending codes		
Historical codes		

12._______ Set up the datalogger with a ***new file.***

(Manufacturer)(vehicle number)(model year)(date)(last three digits of the VIN)_idle

13._______ Restart the vehicle and idle for 15 minutes while recording the parameters noted above.

14._______ While the engine is running check the parameter data to ensure the values look correct.

15._______ Is the check engine light on? Yes or No?

16._______ Check for engine codes with the scan tool. Are there any codes yes or no?

17._______ If there are codes write them below and call Brent Shoffner for disposition.

	OEM	Global
Active codes		
Pending codes		
Historical codes		

18._______ Check the data before leaving the dealership.

19.________ Turn on the engine and allow it to run at idle in drive for two minutes. During that time record the readings with the scan tool and note below.

Minutes from Engine Start	Long Term Trim Bank One	Long Term Trim Bank Two (if 2 trim values)
One		
Two		

Appendix D

Inspected Vehicles

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date of Inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
1	Yaris1	Toyota	Yaris	2009	JTDBT903X91331853	10/6/2010	49,516	1.5L	9TYXV01.5BEA	9TYXR0085P12
2	Yaris2	Toyota	Yaris	2009	JTDBT903291330163	10/6/2010	39,460	1.5L	9TYXV01.5BEA	9TYXR0085P12
3	Yaris3	Toyota	Yaris	2010	JTDBT4K36A1356186	10/12/2010	13,503	1.5L	ATYXV01.5BEA	ATYXR0085P12
4	Yaris4	Toyota	Yaris	2010	JTDBT4K34A4064714	10/12/2010	15,424	1.5L	ATYXV01.5BEA	ATYXR0085P12
5	Yaris5	Toyota	Yaris	2010	JTDGT4K35A1356230	10/12/2010	17,436	1.5L	ATYXV01.5BEA	ATYXR0085P12
6	Sonoma1	GMC	Sonoma	2000	1GTCS14W1Y8204671	10/19/2010	82,464	4.3L V6	YGMXT04.3181	YGMXE0095904
7	Sonoma2	GMC	Sonoma	2003	1GTCS19XX38270016	11/2/2010	68,520	4.3L V6	3GMXT04.3187	3GMXR0175922
8	Sonoma3	GMC	Sonoma	2003	1GTDT13X73K153300	11/2/2010	40,484	4.3L V6	3GMXT04.3187	3GMXR0175922
9	Sonoma4*	GMC	Sonoma	2003	1GTDT19X638154491	11/16/2010	67,064	4.3L V6	3GMXT04.3187	3GMXR0175922
10	Grand_Cherokee1	Chrysler	Grand Cherokee	2009	1J8HS58TX9C535916	10/19/2010	17,907	5.7L	9CRXT05.74P0	9CRXR0180RC0
11	Grand_Cherokee2	Chrysler	Grand Cherokee	2009	1J8HS58T69C521009	1/4/2011	17,997	5.7L	9CRXT05.74P0	9CRXR0180RC0
12	Grand_Cherokee3	Chrysler	Grand Cherokee	2009	1J8HS58T99C550908	2/9/2011	13,355	5.7L	9CRXT05.74P0	9CRXR0180RC0
13	Grand_Cherokee4	Chrysler	Grand Cherokee	2009	1J8HR68T79C536457	2/9/2011	24,053	5.7L	9CRXT05.74P0	9CRXR0180RC0
14	Yaris6	Toyota	Yaris	2007	JTDBT923771065850	10/25/2010	57,923	1.5L	7TYXV01.5BEA	7TYXR0085P12
15	Yaris7	Toyota	Yaris	2007	JTDBT923871049530	10/25/2010	53,179	1.5L	7TYXV01.5BEA	7TYXR0085P12
16	Yaris8	Toyota	Yaris	2008	JTDBT923481205936	11/2/2010	45,323	1.5L	8TYXV01.5BEA	8TYXR0085P12
17	Yaris9	Toyota	Yaris	2007	JTDBT923771026062	11/4/2010	74,731	1.5L	7TYXV01.5BEA	7TYXR0085P12
18	Yaris10	Toyota	Yaris	2009	JTDBT903891338719	1/6/2010	36,353	1.5L	9TYXV01.5BEA	9TYXR0085P12
19	Yaris11	Toyota	Yaris	2009	JTDBT903791334435	1/6/2010	28,082	1.5L	9TYXV01.5BEA	9TYXR0085P12
20	Yaris12	Toyota	Yaris	2009	JTDBT903091329173	1/6/2010	32,518	1.5L	9TYXV01.5BEA	9TYXR0085P12
21	Yaris13	Toyota	Yaris	2009	JTDBT903491332948	1/7/2010	38,140	1.5L	9TYXV01.5BEA	9TYXR0085P12
22	Yaris14	Toyota	Yaris	2009	JTDBT903991333058	1/7/2010	38,063	1.5L	9TYXV01.5BEA	9TYXR0085P12
23	Yaris15	Toyota	Yaris	2008	JTDBT923984005228	1/7/2010	27,628	1.5L	8TYXV01.5BEA	8TYXR0085P12
24	Yaris16	Toyota	Yaris	2008	JTDJT923385150075	1/20/2010	47,645	1.5L	8TYXV01.5BEA	8TYXR0085P12
25	Yaris17	Toyota	Yaris	2009	JTDBT90389132009	1/21/2010	36,437	1.5L	9TYXV01.5BEA	9TYXR0085P12

*Purchased for the program

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date and time of inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
26	Yaris18	Toyota	Yaris	2009	JTDBT903491340614	1/20/2010	40,224	1.5L	9TYXV01.5BEA	9TYXR0085P12
27	Yaris19	Toyota	Yaris	2010	JTDBT4K35A1356244	1/20/2010	23,799	1.5L	ATYXV01.5BEA	ATYXR0085P12
28	Yaris20	Toyota	Yaris	2010	JTDBT4K39A4064692	1/20/2010	20,296	1.5L	ATYXV01.5BEA	ATYXR0085P12
29	Yaris21	Toyota	Yaris	2010	JTDBT4K33A4066258	1/20/2010	10,707	1.5L	9TYXV01.5BEA	9TYXR0085P12
30	Acura1	Acura	TL	2008	19UUA66298A002668	10/28/2010	39,262	3.2L	8HNXV03.5HKR	8HNXR0146BBA
31	Acura2	Acura	TL	2008	19UUA66248A022505	10/28/2010	34,905	3.2L	8HNXV03.5HKR	8HNXR0146BBA
32	Acura3	Acura	TL	2008	19UUA66218A021912	11/4/2010	40,566	3.2L	8HNXV03.5HKR	8HNXR0146BBA
33	Acura4	Acura	TL	2008	19UUA66248A009270	11/4/2010	28,774	3.2L	8HNXV03.5HKR	8HNXR0146BBA
34	Acura5	Acura	TL	2006	19UUA66256A011008	10/28/2010	48,704	3.2L	6HNXV03.2NKR	6HNXR0140BBA
35	Acura6	Acura	TL	2008	19UUA66248A018177	11/10/2010	33,901	3.2L	Not Avail	Not Avail
36	Acura7	Acura	TL	2008	19UUA66238A022074	11/10/2010	28,213	3.2L	8HNXV03.5HKR	8HNXR0146BBA
37	Acura8	Acura	TL	2008	19UUA66278A021283	11/10/2010	35,763	3.2L	8HNXV03.5HKR	8HNXR0146BBA
38	Acura9	Acura	TL	2008	19UUA66258A017376	11/16/2010	24,720	3.2L	8HNXV03.5HKR	8HNXR0146BBA
39	Acura10	Acura	TL	2008	19UUA66278A034647	11/16/2010	32,192	3.2L	8HNXV03.5HKR	8HNXR0146BBA
40	Acura11	Acura	TL	2005	19UUA662X5A077875	11/17/2010	62,148	3.2L	N/A	N/A
41	Acura12*	Acura	TL	2008	19UUA66298A046038	11/17/2010	45,260	3.2L	8HNXV03.5HKR	8HNXR0146BBA
42	Acura13	Acura	TL	2008	19UUA66278A021283	11/17/2010	35,771	3.2L	8HNXV03.5HKR	8HNXR0146BBA
43	Montero2	Mitsubishi	Montero Sport	2002	JA4LS31R62J032271	2/18/2011	84,841	3.5L	2MTXT03.5GNS	2MTXR0175A1A
44	Montero3	Mitsubishi	Montero	2002	JA4MW51R32J013262	2/18/2011	136,860	3.5L	2MTXT03.5GNS	2MTXR0200A1A
45	Montero4	Mitsubishi	Montero	2002	JA4LS31R62P000952	3/15/2011	179,711	3.5L	2MTXT03.5GNS	2MTXTR0175A1A
46	Montero5	Mitsubishi	Montero	2002	JA4LS41R11P047990	3/15/2011	127,241	3.5L	2MTXT03.5GNS	2MTXTR0175A1A
47	Montero6	Mitsubishi	Montero	2003	JA4LS31R23J044614	3/22/2011	37,157	3.5L	3MTXT03.5GNS	3MTXR0175A1A
48	Montero7	Mitsubishi	Montero	2003	JA4LS31R73J003296	4/1/2011	66,422	3.5L	3MTXT03.5GNS	3MTXR0175A1A
49	Montero8	Mitsubishi	Montero	2003	JA4NW51S63J018142	4/4/2011	75,773	3.8L	3MTX3T03.8GNS	3MTXR0200A1A
50	Montero9*	Mitsubishi	Montero	2002	JA4MW51R62J069857	4/12/2011	88,875	3.5L	2MTXT03.5GNS	2MTXR0200A1A

*Purchased for the program

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date and time of inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
51	BMW325i1	BMW	325i	2003	WBAAZ33483PH33709	6/2/2011	89,151	2.5L	3BMXV02.5M56	3BMXR0134M56
52	BMW_X31	BMW	X3	2004	WBXPA93444WC31703	6/3/2011	95,968	3.0L	4BMXX03.0UL2	4BMXR0128E85
53	Deville1	Cadillac	DeVille	2001	1G6KD54Y91U222124	6/6/2011	97,409	4.6L	1GMXV04.6065-5	1GMXR0133910
54	GeoPrism1	Chevrolet	Geo Prism	2001	1Y1SK528712423055	6/6/2011	76,360	1.8L	1NTXV01.8FFA	1NTXR0115AK1
55	BMW_Z41	BMW	Z4	2003	2USBT33423LS0258	6/16/2011	73,733	2.5L	38MXV03.3LER	38MXR0136E46
56	BMW325i2*	BMW	325i	2004	WBAEV33444KL62492	6/16/2011	65,266	2.5L	4BMXV03.0SMG	4BMXR136E46
57	BMW325i3	BMW	325i	2003	WBAET37443NJ29516	6/16/2011	57,976	2.5L	Not Available	Not Available
58	Vue1	Saturn	Vue	2003	5GZCZ63B335807719	6/17/2011	73,371	3.0L	3GMXT03.0162	3GMXR0124919
59	Vue2	Saturn	Vue	2003	5GZCZ53B63S877774	6/17/2011	80,287	3.0L	3GMXT03.0162	3GMXR0124919
60	Beetle1	Volkswagen	Beetle	2001	3VWCS21C11M401502	6/17/2011	112,902	2.0L	1VWXV02.0222	1VWXR0110234
61	Beetle2	Volkswagen	Beetle	2001	3VWCK21C41M439094	7/15/2011	130,756	2.0L	1VWXV02.0223	1VWXR0110234
62	Impreza1	Subaru	Impreza WRX	2003	JF1GG29623G809644	7/15/2011	168,832	2.0L	3FJXV020LGL	33FJXR01251BD
63	Impreza2	Subaru	Impreza WRX	2005	JF1GG29615G802381	7/14/2011	110,272	2.0L	5FJXX02.5PGT	5FJXR01253BG
64	Verona1	Suzuki	Verona	2004	KL5VJ52264B109442	7/27/2011	83,099	2.5L	4GDXV02.5D03	4GDR0117LOL
65	Impreza3	Subaru	Impreza WRX	2003	JF1JD29683G510877	8/17/2011	119,878	2.0L	3FJXV02.0LGL	3FJXR01251BD
66	BMWX32	BMW	X3	2004	WBXPA93474WC32294	8/24/2011	100,013	3.0L	4BMX03.0VL2	4BMXR0128E85
67	Beetle3	Volkswagen	Beetle GL	2001	3VWBK21C11M448881	9/14/2011	110,157	2.0L	1VMXV02.0223	1VMXR0110234
68	VUE3	Saturn	VUE	2003	5GCZCZ63B63S881975	9/14/2011	94,672	3.0L	3GMXY03.0162	3GMXR0124919
69	BMWX51	BMW	X5	2001	WBAFA53521LM61788	9/15/2011	136,572	3.0L	1BMXT03.0E53	1BMXR016UE39
70	Impreza4	Subaru	Impreza	2002	JF1GD29672G527538	9/21/2011	82,112	2.0L	EJ205AW3B9	Not Available
71	Beetle4	Volkswagen	Beetle	2001	3VWCB21C01M471055	9/21/2011	85,149	2.0L	AZG035096	Not Available
72	Deville2	Cadillac	DeVille	2001	1G6KD54Y61U280143	10/7/2011	98,524	4.6L	XV04.60655	1GMXR0133910
73	Deville3*	Cadillac	DeVille	2001	1G6KD54Y51U212464	10/10/2011	175,340	4.6L	1GMXV04.60655	1GMXR0133910
74	Verona2	Suzuki	Verona	2004	KL5VJ52L24B135746	10/26/2011	72,028	2.5L	4GDXV02.5D03	4GDXR011COL
75	Grand_Cherokee6	Jeep	Grand Cherokee	2009	1J8HS58T09C523659	11/1/2011	53,711	5.7L	9CRXT05.74P0	9CRX9R0180RC0

*Purchased for the program

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date and time of inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
76	BMWX33	BMW	X3	2004	WBXPA93484WA64441	11/1/2011	80,671	3.0L	4BMXX03.0UL2	4BMXR0128E85
77	Verona3	Suzuki	Verona LX	2004	KL5VJ52L94B100511	11/4/2011	104,936	2.5L	4GDXV02.5D03	4GDXR0117C02
78	BMW_Z42	BMW	Z4	2003	4USBT33433LR65643	11/8/2011	46,196	2.5L	3BMXV03.0LER	3BMXR0136E46
79	Impreza5	Subaru	Impreza	2003	JF1GG29673H801128	12/1/2011	134,707	2.0L	3FJXV02.0LGL	3FJXR01251BD
80	BMWx34*	BMW	X3	2004	WBXPA93414WC34168	12/2/2011	82,989	3.0L	4BMXX03.0UL2	4BMXR012BE85
81	Verona4	Suzuki	Vernona	2004	KL5VJ52L74B135774	12/6/2011	145,382	2.5L	4GDXV02.5003	4GDXR011760L
82	Verona5	Suzuki	Verona	2004	KL5VJ52LX4B099353	12/7/2011	99,738	2.5L	N/A	N/A
83	Verona6	Suzuki	Verona	2004	KL5VJ52L94B100511	12/9/2011	105,002	2.5L	4GDXV02.5D03	4GDXR0117C0L
84	Verona7	Suzuki	Verona	2004	KL5VJ52L04B103412	2/10/2012	119,456	2.5L	4GDXV02.5D03	4GDXR0117COL
85	Impreza6	Subaru	Impreza	2002	JF1GD29662G528891	2/13/2012	114,659	2.0L	2FJXV.020LGL	2FJXR0125BA
86	Impreza7	Subaru	Impreza	2004	JF1GD29644G504625	2/13/2012	97,550	2.0L	4FJXV02.5PGT	4FJXR01251BD
87	MPV1	Mazda	MPV	2001	JM3LW28Y610207129	2/15/2012	140,115	2.5L	1TKXT02.5CMB	1TKXR0150PMA
88	Passat1	Volkswagen	Passat	2001	WVWVD63B61E178025	2/15/2012	123,337	1.8L Turbo	1ADXV01.8342	1ADXR01140232
89	C2301	Mercedes-Benz	C230	2004	WDBRF40J64F549967	2/17/2012	97,998	1.8L Turbo	4MBXV01.8LB1	4MBXR0155LNZ
90	c2302	Mercedes-Benz	C230	2004	WDBRF40J54A638068	2/17/2012	97,640	1.8L Turbo	4MBXV01.8LB1	4MBXR0155LNZ
91	Passat2	Volkswagen	Passat	2001	WVWPD63B51P198778	2/22/2012	191,183	1.8L Turbo	1ADXV01.8342	1ADXR0140232
92	RAV4_7896	Toyota	RAV4	2008	JTMBK31V286037896	3.8.2012	60,686	3.5L V6	8TYXT03.5BEM	8TYXR0130A22
93	Caliber_7496*	Dodge	Caliber	2008	1B3HBz8B88D777496	3/8/2012	77,126	2.0L I4	8CRSR011.2GHA	8CRXB0144MB1
94	Avalon_6075	Toyota	Avalon	2006	4T1BK36B06U096075	3/23/2012	54,910	3.5L	6TYXV03.5PEA	6TYXR0130A12
95	F150_7718	Ford	F150	2008	1FTRX12W88GB47718	3/23/2012	32,279	4.6L V8	8FMXR04.63HB	8FMXR0240NBR
96	F150_2	Ford	F150	2004	2FTRX17274CA34516	5/11/2012	114,622	4.2L V6	4FMXT04.2PN2	4FMXE0160BAF
97	Windstar1	Ford	Windstar	2003	2FMZA52443BB59331	5/17/2012	127,125	3.8L	3FMXT03.82HA	3FMXR0230BBE
98	Windstar2	Ford	Windstar	2003	2FMZA514X3BB28814	6/7/2012	131,771	3.8L	3FMXT03.82HA	3FMXR0230BBE
99	F150-3	Ford	F150	2004	2FTRF17234CA66317	6/13/2012	76,699	4.2L	4FMXT04.2PN2	4FMXE0160BAF
100	300_1	Chrysler	300	2007	2C3KA53G17H724110	6/15/2012	58,834	3.5L	7CRSV03.5MEO	7CRXR0150GHA

*Purchased for the program

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date and time of inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
101	300_2	Chrysler	300	2007	2C3KA53G07H827647	6/15/2012	67,195	3.5L	7CRSV03.5MEO	7CRXR0150GHA
102	F150-5	Ford	F150	2003	1FTRF07263KC12455	6/15/2012	117,385	4.2L 6Cyl	Not Legible	Not Legible
103	Windstar3	Ford	Windstar	2003	2FMZA52423BA11436	6/20/2012	99,935	3.8L	3FMXT03.82H7	3FMXR0230BBE
104	Beetle5	Volkswagen	Beetle	2001	3VWCT21C51M403878	6/28/2012	103,885	2	1VWXV02.0227	1VWXR0110234
105	Passat3	Volkswagen	Passat	2001	WVWAC63B61P021777	7/12/2012	108,219	1.8	1ADXV01.8342	1ADXR0140232
106	Windstar4	Ford	Windstar	2003	2FMZA51423BA59066	7/18/2012	142,117	3.8L	3FMXT03.82H7	3FMSR0230BBE
107	Windstar5	Ford	Windstar	2003	2FTZA54413BB20732	7/18/2012	101,382	3.8L	3FMXT03.82HA	3FMSR0230BBE
108	MPV2	Mazda	MPV	2001	JM3LW28G210202310	8/1/2012	119,458	2.5L	1TKXT02.5CMB	1TKSR0150PMA
109	F150-6	Ford	F150	2003	1FRRX07223KC28231	8/9/2012	110,779	4.2L	3F(? illegible) 4.22H6	33F(? illegible) E0155BAF
110	Pilot1	Honda	Pilot	2003	2HKYF18733H600110	8/22/2012	126,683	3.5L	3HNYT03.5DAP	3HNYR016AAA
111	Acura14	Acura	TL	2003	19UUA56843A001693	8/29/2012	114,991	3.2L	3HNXV03.2CYC	3HNXR00130AAA
112	CRV1	Honda	CRV	2004	JHLRD68444C019065	8/29/2012		2.4L	4HNXT02.4YBP	4HNXR0130AAB
113	Accord1	Honda	Accord	2004	1GHCM568X4A098855	9/13/2012	117,683	2.4L	4HNXU02.4KCV	4HNXR0135BCA
114	Accord2	Honda	Accord	2005	1HGCM66585A023133	9/13/2012	90,347	3.0L V6	5HNXV03.0TBP	5HNXR0140BBA
115	Accord3	Honda	Accord	2004	1HGCM66504A013014	9/14/2012	111,754	3.0L V6	4HNXV03.0FBP	4HNXR0140BBA
116	Accord4	Honda	Accord	2002	JHMCG56782C013931	9/19/2012	156,201	2.3L	2HNXV02.3RDA	2HNXR0130ARF
117	Pilot2	Honda	Pilot	2008	5FNYF285X8B008357	9/27/2012	97,780	3.5L	8HNXT03.SNKR	8HNXR0156BBA
118	Pilot3*	Honda	Pilot	2008	5FNYF28258B008787	9/27/2012	84,825	3.5L	8HNXTO3.SNKR	8HNXR0156BBA
119	AcuraRL1	Acura	RL	2005	JH4KB16505C015484	10/10/2012	72,960	3.5L	5HNXV3.5PB4	5HNXR0156BBB
120	AcuraTL1	Acura	TL	2006	19UUA66206A048838	10/10/2012	65,660	3.2L	6HNXV03.2NKR	6HNXO0140BBA
121	AcuraTL2	Acura	TL	2009	19UUA86529A019531	10/10/2012	69,224	3.5L	9HNXV03.56B9	9HNXR0151VEA
122	AcuraTL3	Acura	TL	2004	19UUA662X4A029551	10/17/2012	91,241	3.2L	4HNXV03.2CKR	4HNXR0140BBA
123	AcuraRSX1	Acura	RSX	2006	JH4DC530X6S011021	10/17/2012	97,033	2.0L	6HNXV02.0DKC	6HNXR0102BBA
124	Accord5	Honda	Accord	2005	1HGCM56875A046083	10/25/2012	51,805	2.4L	5HNXV02.4VBP	5HNXR0140BBA
125	Accord6	Honda	Accord	2007	1HGCM826X7A006198	10/25/2012	70,017	3.0L	7HNXV03.0RKC	7HNXR0140BBA

*Purchased for the program

Vehicles Inspected

Nbr.	Description	Make	Model	Model Year	VIN	Date and time of inspection	Odo-meter reading	Engine displace-ment	Engine Family	Evap Emission Family
126	Grand_Cherokee7	Jeep	Grand Cherokee	2009	1J8HS58TX9C515259	10/26/2012	31,070	5.7L	9CRXT0574PO	9CRSR0180RCO
127	Hybrid1	Honda	Accord Hybrid	2006	JHMCN36476C001212	10/31/2012	79,091	3.0L	6HNXV03.0WMC	6HNXR0135BCA
128	Accord7	Honda	Accord	2005	1HGCM56855A011395	10/31/2012	83,251	2.4L	5HNXV02.4VBP	5HNXR0140BBA
129	Accord8	Honda	Accord	2007	1HGCM66557A055380	10/31/2012	54,902	3.0L	No Label	No Label
130	Grand_Cherokee8	Jeep	Grand Cherokee	2009	1J8HR68T79C507346	11/7/2012	61,884	5.7L	9CRXT05.74PO	9CRXR0180RCO
131	Grand_Cherokee9	Jeep	Grand Cherokee	2009	1J8HS58T79C508480	11/7/2012	46,484	5.7L	No sticker	No sticker
132	F150_10	Ford	F150	2004	2FTRX172X4CA71317	11/9/2012	116,743	4.2L	4FMXT04.2PN2	4FMXE0160BAF
133	Accord9	Honda	Accord	2002	1HGCG16582A018391	11/9/2012	97,490	3.0L	2HNXV03.0WYC	2HNXR0130AAF
134	F150_11	Ford	F150	2003	1FTRX17223NA22301	11/15/2012	109,187	4.2L	3FMXT04.22HG	33FMXEB156BOF
135	Accord10	Honda	Accord	2005	JHMCN36485C010547	12/4/2012	64,907	3.0L	5HNXV03.0184	5HNXR0140BBA
136	Accord11	Honda	Accord	2007	1HGCM66557A043536	12/4/2012	81,104	3.0L	No Sticker	No Sticker
137	CRV2	Honda	CRV	2006	JHLRD78826C020274	12/4/2012	75,313	2.4L	6HNXB02.4EKC	6HNXR0140BBA
138	Grand_Cherokee10	Jeep	Grand Cherokee	2009	1J8HS68T79C547057	12/11/2012	36,636	5.7L	9CRXT05.74PO	9CRXXR0180RCO
139	Grand_Cherokee11	Jeep	Grand Cherokee	2009	1J8HS68TX9C517549	12/11/2012	80,840	5.7L	9CRXT05.74PO	9CRXXR0180RCO
140	Ridgeline1	Honda	Ridgeline	2008	2HJYK16598H521078	12/26/2012	72,799	3.5L	8HNXT03.5MKR	8HNXR0063BBA
141	CRV3	Honda	CRV	2006	JHLRD78846C026318	12/26/2012	74,088	2.4L	6HNXB02.4EKC	6HNXR0140BBA
142	Ridgeline2	Honda	Ridgeline	2008	2HJYK16548H536538	12/28/2012	40,591	3.5L	8HNXT03.5MKR	8HNXR0163BBA

Appendix E

Vehicles Screened

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
1	Chrysler	300	2006	2C3KA53G96H4498106	3/2/2012	N.R.	3.5L V6
2	Ford	Expedition	2003	1FMFU17L13LB15788	3/2/2012	N.R.	5.4L V8
3	Infinity	G35	2008	JNKBV61E78M210220	3/2/2012	N.R.	3.5L V6
4	Toyota	RAV4	2008	JTMBK31V286037896	3/2/2012	N.R.	3.5L V6
5	Toyota	Tundra	2008	5STFRV54148X058625	3/2/2012	N.R.	5.7L V8
6	Mercury	Grand Marque	2007	2MEFM74V97X633961	3/5/2012	60,270	4.6L V8
7	Ford	Mustang	2007	1ZVFT80N475299532	3/5/2012	61,201	4.0L V6
8	Ford	F-150	2008	1FTPW12V28KB72784	3/5/2012	76,968	5.4L V8
9	Dodge	Caliber	2008	1B3HB28B88D777496	3/5/2012	77,122	2.0L I4
10	Ford	Fusion	2006	3FAFP07Z26R217204	3/5/2012	113,128	2.3L I4
11	Ford	Fusion	2006	3FAFP07Z56R225121	3/5/2012	63,216	2.3L I4
12	Dodge	Ram	2008	1D7HA18K68J141968	3/5/2012	39,138	3.7L V6
13	Ford	Focus	2003	1FAFP34P33W292846	3/5/2012	109,439	2.0L I4
14	Chevrolet	Suburban	2004	1GNEC16Z24J267320	3/5/2012	121,976	5.3L V8
15	Mercury	Mountaineer	2008	4MZEU47E98UJ10417	3/5/2012	108,317	4.0L V6
16	Ford	Explorer Sport	2004	1FMZU67K64UB42661	3/5/2012	125,240	4.0L V6
17	Toyota	Corolla	2006	1NXBR32E26Z594547	3/5/2012	83,023	1.8L I4
18	Ford	Expedition	2007	1FMFK19587LA08893	3/5/2012	84,410	5.4L V8
19	Ford	Expedition	2005	1FMPU17575LA11363	3/5/2012	96,677	5.4L V8
20	Volvo	V70	2004	YV1SW61T042396647	3/5/2012	146,430	2.4L I5
21	Pontiac	Montana	2006	1GMPV33L46D130791	3/5/2012	86,645	3.5L V6
22	Nissan	Altima	2005	1N4AL11D445N491286	3/5/2012	95,326	2.5L I4
23	Mitsubishi	Eclipse	2008	4A3AK24F68E031810	3/9/2012	80,585	2.4L I4
24	GMC	Denali	2008	1GKFK63828J140490	3/6/2012	55,295	6.2L V8
25	Chevrolet	Impala	2008	2G1WB58K481376992	3/6/2012	30,882	3.5L V6

N.R. Not Recorded

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
26	Chevrolet	Avalanche	2008	3GNFK12318G267115	3/6/2012	38,232	5.3L V8
27	Chevrolet	Avalanche	2008	3GNEC12048G162289	3/6/2012	82,791	5.3L V8
28	Lexus	RX-330	2005	JTJGA31UX50058880	3/21/2012	75,599	3.3L
29	Lincoln	Navigator	2006	JCMFU27596L528829	3/21/2012	81,300	5.4L
30	Acura	TSX	2008	JH4CL96808C007884	3/21/2012	26,719	2.4L
31	Chrysler	Town & County	2008	2A8HR64X38R646727	3/21/2012	24,556	4.0L
32	Lincoln	MKZ	2008	3LNHM26T08R646442	3/21/2012	59,647	3.5L
33	Toyota	Tacoma	2006	STETU62N062192038	3/21/2012	74,756	4.0L
34	Chrysler	PT Cruiser	2007	3A8FY58B77T531109	3/21/2012	61,034	2.4L
35	Ford	F150	2008	1FTRX12W88GB47718	3/21/2012	32,279	4.6L
36	Lincoln	Towncar	2006	1LNHM82V26Y641834	3/21/2012	51,738	4.6L
37	GMC	Sierra	2007	2GTEK13M971638119	3/21/2012	35,143	5.3L
38	Honda	Ridgeline	2008	2HJYK16S18H504565	3/21/2012	35,996	3.5L
39	Toyota	Highlander	2007	JTEDP21A870141355	3/21/2012	89,597	3.3L
40	Subaru	Impreza STI	2008	JF1GR89648L835271	3/21/2012	16,679	2.5L
41	Mercury	Sable	2008	1MEHM42W28G620558	3/21/2012	79,007	3.5L V-6
42	Lincoln	Towncar	2007	1LNHM81VX7Y615503	3/21/2012	40,361	4.6L V8
43	Mercury	Mountaineer	2005	4M2DU66W85ZJ06701	3/21/2012	60,171	4.6L V8
44	Lincoln	MKX	2008	2LMDU68C08BJ20415	3/21/2012	46,854	3.5L V6
45	Lincoln	MKX	2008	2LMDU68C78BJ08598	3/21/2012	31,474	3.5L V6
46	Mercury	Grand Marquis	2006	2MEFM75W86X633813	3/21/2012	38,675	4.6L V8
47	Lincoln	MKZ	2007	3LNHM28T97R648704	3/21/2012	32,603	3.5L V6
48	Lincoln	MKX	2008	2KNDY68C68BJ03957	3/21/2012	34,963	3.5L V6
49	Jeep	Wrangler	2008	1J4FA24158L524738	3/21/2012	21,598	3.8L V6
50	Ford	F150	2007	1FTRW12W17KD55786	3/21/2012	49,873	4.6L V8

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
51	Lincoln	MKX	2008	2LMDU68C08BJ40230	3/21/2012	49,208	3.5L V6
52	Lexus	RX350	2007	2T2GK31U87C013456	3/21/2012	68,628	3.5L V6
53	Chrysler	Pacifica	2004	2C8GM68464R326389	3/21/2012	47,448	3.5L V6
54	Honda	Ridgeline	2007	2HJYK165S7H539768	3/21/2012	115,683	3.5L V6
55	Nissan	Frontier	2008	1N6AD07U58C403271	3/21/2012	78,679	4.0L V6
56	Mitsubishi	Endeavor	2008	4A4MM31S28E031300	3/21/2012	64,416	3.8L V6
57	Toyota	RAV4	2004	JTEGD20V440014608	3/21/2012	97,742	2.4L I4
58	Honda	CRV	2004	JHLRD77894C034753	3/21/2012	94,418	2.4L I4
59	Toyta	Avalon	2006	4T1BK3GB06U096075	3/21/2012	54,909	3.5L V6
60	Subaru	Legacy	2007	4S4BP61C477313971	3/21/2012	62,051	2.5L I4
61	Subaru	Forester	2006	SG69676H709300	3/21/2012	109,693	2.5L I4
62	Toyota	Tacoma	2008	3TMJU62NX8M067248	3/21/2012	70,127	4.0L V6
64	Ford	Expedition	2007	1FMFK19587LA08893	4/18/2012	84,592	5.4L
65	Dodge	Caravan	2007	204GP44L77R04641	4/18/2012	68,600	3.8L
66	GMC	Envoy	2008	1GKD513S082152864	4/15/2012	40,267	4.2L
67	Honda	Civic	2008	2HGFG21538H705699	4/18/2012	57,769	2.0L
68	Ford	Fusion	2008	3FAHP08Z08R126149	4/18/2012	69,561	2.3L
69	Toyota	4Runner	2007	JTEBU14R978086637	4/18/2012	81,453	4.0L
70	GMC	Sierra	2007	1GTHK23U37F196479	4/18/2012	77,023	6.0L
71	Cadillac	SRX	2005	1GYEE637550125905	4/18/2012	77,090	3.6L
72	Ford	Expedition	2002	1FMRU15W82LA60992	5/11/2012	115,601	4.6L
73	GMC	Yukon	2000	1GKEC136YJ153744	5/11/2012	162,847	5.3L
74	Chevrolet	Tahoe	1999	1GNEC13R2XJ359987	5/11/2012	146,019	5.7L
75	Chevrolet	Suburban	2001	3GNEC16TS1G265053	5/11/2012	N/A	5.7L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
76	Chevrolet	Trailblazer	2002	1GNDS135622371631	5/11/2012	128,049	4.2L
77	Hyundai	Veracruz GLC	2008	KM8NU13C18U037368	5/17/2012	78,701	3.8L
78	Dodge	Nitro SXT	2007	1D8GT28K57W589076	5/17/2012	69,106	3.7L
79	Mercury	Grand Marquis	2006	2M8FM75V06X641203	5/17/2012	66,375	4.6L
80	GMC	Sierra 1500	2006	1GTEC19Z66Z213981	5/17/2012	87,479	5.3L
81	Nissan	Titan	2008	1N6BA07C28N318140	5/17/2012	96,964	5.6L
82	Dodge	Ram 1500	2007	1D7HU18N2J507506	5/17/2012	85,952	4.7L
83	Ford	Freestyle	2006	1FMDK02106GA52970	5/17/2012	186,259	3.0
84	Jeep	Liberty	2005	1J4GL38KX5W576108	5/17/2012	81,715	3.7
85	BMW	X3	2008	WBXPC93418WJ02993	5/17/2012	59,237	3.0L I6
86	Dodge	Nitro	2008	1D8GT58618W150625	5/17/2012	42,510	4.0L V6
87	Jeep	Liberty	2006	1J4GL48K36W223622	5/17/2012	73,791	3.7L V6
88	Ford	Expedition	2005	1FMPU15565LA31042	5/17/2012	100,494	5.4L V8
89	Mazda	Tribute	2008	4F2CE02ZX8KM24431	5/17/2012	129,272	2.3 I4
90	Infinity	G35	2008	JNKBV61E58M209809	5/17/2012	65,517	3.5L V6
91	Dodge	2500 4x4	2006	3D7K528D766120118	5/17/2012	76,052	5.7L V8
92	Chevrolet	Tahoe	2007	1GNFC13047R177389	5/17/2012	94,078	5.3L V8
93	Audi	Q7	2007	WA1BY74L37D099845	5/17/2012	81,092	3.6L V6
94	Ford	Expedition	2006	1FMFU17596LA34236	5/17/2012	101,888	5.4L V8
95	Chevrolet	Suburban	2007	1GNFK16337R3388978	6/8/2012	104,441	5.3L
96	Chevrolet	Tahoe	2007	1GNEC13597R140729	6/8/2012	146,902	5.3L
97	Chevrolet	Uplander	2007	1GNDV231270211178	6/8/2012	115,348	3.9L
98	Mitubishi	Montero	2001	JA4MW51R51J038680	6/8/2012	146,590	3.5L
99	Chevrolet	1500	1999	1GTGC24RdXR707000	6/8/2012	141,264	5.7L
100	Mercury	Grand Marquis	2002	2MEFM74W02X616855	6/8/2012	241,112	4.6L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
101	Chevrolet	1500	1998	1GCEK19R7WR103931	6/8/2012	248,320	5.7L
102	Mercedes Ben	ML320	2001	4JGABJ4E51A276537	6/8/2012	155,301	3.2L
103	GMC	Yukon	2007	1GFKC16J97J228322	6/8/2012	140,811	5.3L
104	Ford	Taurus	2006	1FAFP53U46A150705	6/8/2012	110,659	3.0L
105	Mercury	GrandMarquis	2005	2MEFM74W25X627117	6/8/2012	222,408	4.6L
106	Jeep	Cherokee	1998	1JF4T28S6WL265185	6/8/2012	172,095	4.0L
107	Ford	Crown Victoria	2001	2FAFP73W31X102481	6/8/2012	121,621	4.6L
108	Hyundai	Sonota	2003	KMHWF25S43A876174	6/8/2012	115,602	2.4L
109	Jeep	Liberty Sport	2002	1J4GK48K32W172328	6/8/2012	138,643	3.7L
110	Ford	Expedition	2006	1FMFU18506LA8614	6/13/2012	85,797	5.4L
111	Suzuki	Forenza	2008	KL5JD56Z88K807304	6/13/2012	75,185	?
112	Ford	F150	2007	1FTRW12W57KC78582	6/13/2012	60,627	4.6L
113	Chevrolet	Malibu	2008	1G1ZH57BX8F216007	6/13/2012	84,835	2.4L
114	Chevrolet	Colorado	2008	1GCCS19E988170639	6/13/2012	95,455	3.7L
115	Chrysler	Town&Country	2006	1A4GP45R0GB611050	6/13/2012	58,605	3.3L
116	Chevrolet	Uplander	2007	1GNDLL23127D132290	6/13/2012	93,092	3.9L
117	Nissan	Altima	2008	1NA4AL21E48C180973	6/13/2012	98,573	2.5
118	Chrysler	300	2007	2C3KA53G07H827647	6/13/2012	67,195	3.5L V-6
119	Dodge	Caliber	2008	1B3HB48D28P647239	6/13/2012	60,508	2.0L
120	Chrysler	Pacifica	2007	2A8GM48L27R356516	6/13/2012	44,059	3.8L V6
121	Chrysler	300	2007	2C3KA53G174724110	6/13/2012	58,834	3.5L V6
122	Jeep	Liberty	2008	1J8GN28K78W223820	6/13/2012	56,102	3.7L V6
123	Jeep	Grand Cherokee	2007	1J8GS48K576507015	6/13/2012	73,075	3.7L V6
124	GMC	Envoy	2004	1GKDS135542170044	6/19/2012	72,419	4.2L
125	Mazda	Tribute	2001	4F2CU08151KM12029	6/19/2012	122,582	3.0L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
126	Honda	CRV	2005	SHSRD78585U327025	6/19/2012	86,192	2.4L
127	Lincoln	Mark LT	2006	SLTPW18516FJ13753	6/19/2012	78,388	5.4L
128	Toyota	Tacoma	2006	1TMKU72N266M006063	6/19/2012	145,811	4.0L
129	Ford	Freestar	2004	2FMDA58234BB16259	6/19/2012	88,742	4.2L
130	Ford	Windstar	2001	2FMZA52451BB87247	6/19/2012	122,047	3.8L
131	Volkswagen	Jetta	2007	3VWGF81K47M014208	6/19/2012	72,732	2.5L
132	Mercury		2003	1MEFM5563AG633492	6/19/2012	99,562	V6 Duratec
133	Ford	Mustang	2001	1FAFP42X7205701	6/20/2012	96,828	V8
134	Ford	Crown Victoria	1997	2FALP74W3VX112841	6/20/2012	93,262	4.6L
135	GMC	Envoy	2002	1GKDS13S022512609	6/20/2012	108,137	4.2L
136	Toyota	Sonoma	2005	STDZA23C25S327895	6/20/2012	111,163	3.3 V6
137	Chevrolet	S10	2003	1GCDT13S13K132183	6/20/2012	96,907	4.3L
138	Chrysler	Concord	1997	2C3HD56F1VH720477	6/20/2012	97,572	3.5L
139	Ford	Focus	2007	14FAFP34N27W121512	6/20/2012	59,734	4 Cyl
140	Mitubishi	Eclipse	2002	4A3AE8SH22E093633	6/20/2012	94,618	3.0L
141	Lexus	ES300	2000	JT8BF28G4YS101561	6/20/2012	119,671	3.0L V6
142	Pontiac	Grand Prix	2004	2G2WP542241275222	6/20/2012	157,344	3.8 V6
143	Ford	Taurus	2006	1FAFP53U56A179511	6/20/2012	131,901	3.0L
144	Plymouth	Neon	2001	1P3ES46C610273690	6/20/2012	85,390	2.0L
145	Hyundai	Elantra	2004	KMHDN56024U102176	6/20/2012	141,554	2.0L
146	Chevrolet	Suburban	1999	3GNEC16R5XG118051	6/20/2012	220,954	5.7L
147	GMC	1/2 Ton P/U	2006	2GTEK13T661233616	6/21/2012	56,000	5.3L
148	Toyota	Corolla	2000	2T1BR12E2YC363883	6/21/2012	115,404	1.8L
149	Nissan	Sentra	2005	3N1CB51D65L593964	6/21/2012	95,420	1.8L
150	Chevrolet	Cavalier	2004	1G1JC52F547372613	6/21/2012	112,590	2.2L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
151	Toyota	Camry	2003	4T1BE32K03U744748	6/21/2012	164,067	2.4L
152	Pontiac		2006	1G2ZM151264165265	6/21/2012	97,300	3.9L
153	Honda	Civic	2002	JHMES262812S001964	6/21/2012	122,443	1.7L
154	Chevrolet	C1500	1998	2GCLC19M9W1257731	6/21/2012	199,702	5.0L
155	Chevrolet	Impala	2007	2G1WTSSK279275600	6/21/2012	92,991	3.5L
156	Mercury	Grand Marquis	2003	2MEFM74W93X629976	6/21/2012	200,931	4.6L
157	Nissan	Maxima	2005	1N4BA41E2SC824245	6/21/2012	95,887	3.5L
158	Saturn	L200	2003	1G8JU54F53Y539217	6/21/2012	162,997	2.2L
159	Ford	Windstar	1998	2FMZA5146WBC77628	6/21/2012	199,058	3.8L
160	Mitsubishi	Montero Sport	2001	JA4LS31H1YP031217	6/21/2012	156,578	3.0L
161	Chevrolet	Impala	2005	2G1WFS2E959257968	6/21/2012	122,343	3.4L
162	Toyota	Camry	2002	4T1BF32K52U018167	6/21/2012	154,074	3.0L
163	Chevrolet	Malibu	2005	1G12T6284SF129408	7/13/2012	34,793	3.5L
164	Suzuki	Forenza	2007	KLSIDS6Z37K530673	7/13/2012	90,138	2.0L
165	Mazda	6	2004	1YVFP80C74SN17510	7/13/2012	127,763	2.3L
166	Nissan	Altima	2004	1N4AL11D14C173765	7/13/2012	142,452	2.5L
167	Pontiac	Grand Prix	2006	2G2WP552S61257640	7/13/2012	116,855	3.8L
168	Jeep	Grand Cherokee	2006	1J4HR58246C117691	7/13/2012	156,899	5.7L
169	Suzuki	Forenza	2008	KLSJDS6Z88K807304	7/25/2012	75,214	2.0L
170	Chevrolet	Colorado	2008	1GCCS19E988170639	7/25/2012	95,490	3.7L
171	Jeep	Grand Cherokee	2007	1J8GS48K57C507015	7/25/2012	73,961	3.7L
172	Chrysler	Town & Country	2005	2C4GP54L15R571330	7/25/2012	90,663	3.8L
173	Jeep	Compas	2007	1J8FFS7W07D123177	7/25/2012	78,208	2.4L
174	Chevrolet	Aveo	2005	KL1TD62645B343595	8/1/2012	68,679	1.6L
175	Chevrolet	Malibu	2007	1G1ZT58N17F240153	8/1/2012	103,603	3.5L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
176	Toyota	Camry	2007	4T1BK46K97U043835	8/1/2012	95,302	3.5L
177	Chrysler	Town & Country	2005	2C4GP54L25R443906	8/1/2012	73,938	3.8L
178	Chrysler	Town & Country	2008	2A8HR44HXR138414	8/1/2012	87,791	3.3L
179	Chevrolet	Tahoe	2007	1GNEK132X2R263585	8/9/2012	181,702	5.3L
180	Chevrolet	1500	2006	3GCEK14V26G246659	8/9/2012	97,102	4.8L
181	Dodge	Dakota	2003	1D7HG48N43S151928	8/9/2012	138,639	4.7
182	Dodge	1500	2004	1D7HA18N24S644833	8/9/2012	140,556	4.7L
183	Dodge	1500	2007	1D7HA16P57J518125	8/9/2012	75,291	4.7L
184	Honda	CRV	2002	JHLRD078862C041851	8/14/2012	53,794	2.8L
185	Honda	Odyssey	2007	5FNRL38237B034029	8/14/2012	62,331	3.5L
186	Honda	Pilot	2005	5FNYF18405B023320	8/14/2012	120,092	3.5L
187	Volkswagen	Beetle	2002	3VWFE21C82M461511	8/14/2012	47,542	1.8L
188	Nissan	Xterra	2007	5N1AN08U57C536864	8/14/2012	63,030	4.0L
189	Ford	Edge	2008	2FMDK38C68BB24839	8/14/2012	76,699	3.5L
190	Dodge	1500	2007	1D71TU18P97S235127	8/14/2012	67,721	4.7L
191	Toyota	Sequoia	2005	5TDZT38A75S261871	8/14/2012	104,183	4.7L
192	Jeep	Wrangler	2008	1J4FA241X8L530244	8/14/2012	37,674	3.8L
193	Ford	Escape	2007	1FMYU03167KC05022	8/14/2012	50,039	3.0L
194	Toyota	Highlander	2002	JTEGF21A420042802	8/22/2012	134,420	3.0L
195	Honda	Ridgeline	2007	2HJYK16457H526056	8/22/2012	63,829	3.5L
196	Toyota	RAV4	2008	JTMZD31V085088232	8/22/2012	39,991	2.4L
197	Jeep	Wrangler	2008	1J4FA24168L543251	8/22/2012	53,390	3.8L
198	Hyundai	Santa Fe GLS	2008	5NMSH13E28H131912	8/22/2012	85,036	2.7L
199	Ford	Taurus	2007	1FAFP56U87A167200	8/22/2012	48,894	3.0L
200	Toyota	Tacoma	2001	5TEGN92N41Z782527	8/22/2012	129,895	3.4L

Vehicles Screened

Nbr.	Make	Model	Model Year	VIN	Date of inspection	Odometer reading	Engine
201	Lexus	LS430	2001	JTHBN30F610048098	8/22/2012	103,035	4.3L
202	Honda	Accord	2008	JHMCP26708C043674	8/22/2012	36,970	2.4L
203	Honda	Accord	2008	JHMCP26438C053881	8/22/2012	14,689	2.4L
204	Ford	T-Bird	2002	1FAHP60A92Y116236	8/22/2012	67,762	3.9L
205	Honda	CRV	2001	JHLP0186X1C018907	8/22/2012	87,234	2.0L
206	Honda	Odyssey	2006	5FNRL38686B402464	8/22/2012	94,605	3.5L
207	Volkswagen	Jetta	2008	3VWRJ71K35M193537	8/22/2012	64,509	2.0L
208	Dodge	2500	2003	3D7KA28D03G849642	8/22/2012	89,000	5.7L
209	Cadillac	Escalade	2008	1GYFK66838R253092	8/22/2012	71,208	6.2L
210	Hyundai	Elantra	2007	KMHDU460X74108728	8/22/2012	73,544	2.0L
211	Honda	Accord	2002	JHMCG56682C024001	8/22/2012	78,138	2.3L
212	Honda	Civic	2005	1HGEM2295L012732	8/22/2012	100,611	1.7
213	Honda	Civic	2006	1HGFA16576L024417	8/22/2012	117,635	1.8

Appendix F

Photographs of Test Vehicles

GMC Sonoma

Acura TL

Mitsubishi Montero

BMW 325i

Cadillac Deville

BMW X3

Dodge Caliber

Honda Pilot

Appendix G

Analytical Results of Test Fuel Samples

Fuel Analytical Results

		Batch 1		
		Drum #1	Drum #2	Vehicle B - Fuel Tank
	Description	E20	E20	E20
	Date	3/9/2011	2/1/2011	8/11/2011
	Laboratory	PPRD-96047	PPRD-95094	PPRD-00063
TEST METHOD / PROPERTY	UNITS	RESULTS	RESULTS	RESULTS
RVP by Grabner	psi			
Density by Digital Meter (ASTM D4052)				
API Gravity	--	56.3	56.6	54.7
Specific Gravity	--	0.7536	0.7524	0.76
Density @ 15°C	grams/L	753.3	752.1	759.8
Oxygenates (ASTM D5599)				
Diisopropylether (DIPE)	vol%	<0.1	<0.1	<0.2
Ethyl tert-butylether (ETBE)	vol%	<0.1	<0.1	<0.2
Ethanol (EtOH)	vol%	19.71	19.68	20.60
Isobutanol (iBA)	vol%	<0.1	<0.1	<0.2
Isopropanol (iPA)	vol%	<0.1	<0.1	<0.2
Methanol (MeOH)	vol%	<0.1	<0.1	<0.2
Methyl tert-butylether (MTBE)	vol%	<0.1	<0.1	<0.2
n-Butanol (nBA)	vol%	<0.1	<0.1	<0.2
n-Propanol (nPA)	vol%	<0.1	<0.1	<0.2
sec-Butanol (sBA)	vol%	<0.1	<0.1	<0.2
tert-amyl methylether (TAME)	vol%	<0.1	<0.1	<0.2
tert-Butanol (tBA)	vol%	<0.1	<0.1	<0.2
tert-Pentanol (tPA)	vol%	<0.1	<0.1	<0.2
Total Oxygen in WT%	vol%	7.21	7.21	7.47

Fuel Analytical Results

	Sample Code	Batch 2	CGB-8131	CGB-8213	CGB-8132	CGB-8133
	Description	Tank 187	Drum #1	Blend Tank 187	Drum #1	Drum #1
		E20	E30	E30	E40	E50
		9/15/2011	12/27/2011	3/27/2012	12/27/2011	12/27/2011
RESULTS	RESULTS	PPRD-1101	PPRD-3928	PPRD-6550	PPRD-3929	PPRD-3930
TEST REQUEST		RESULTS	RESULTS	RESULTS	RESULTS	RESULTS
RVP by Grabner	D5191	8.73	8.74	9.20	8.56	8.28
	METHOD					
API Gravity	D4052 (used to calculate D5599 vol %)	55.6	54.5	55.3	53.3	52.2
Specific Gravity		0.7563	0.7609	0.7573	0.7657	0.7701
Density @ 15°C (grams/L)		756.1	760.7	757	765.4	769.9
Oxygen and Oxygenates (Volume %)	D5599					
Diisopropylether (DIPE)		<0.1	<0.1	<0.1	<0.1	<0.1
Ethyl *tert*-butylether (ETBE)		<0.1		<0.1		
Ethanol (EtOH)		20.08	30.83	29.34	41.21	49.63
Isobutanol (iBA)		<0.1	<0.1	<0.1	<0.1	<0.1
Isopropanol (iPA)		<0.1	<0.1	<0.1	<0.1	<0.1
Methanol (MeOH)		<0.1	<0.1	<0.1	<0.1	<0.1
Methyl *tert*-butylether (MTBE)		<0.1	<0.1	<0.1	<0.1	<0.1
n-Butanol (nBA)		<0.1	<0.1	<0.1	<0.1	<0.1
n-Propanol (nPA)		<0.1	<0.1	<0.1	<0.1	<0.1
sec-Butanol (sBA)		<0.1	<0.1	<0.1	<0.1	<0.1
tert-amyl methylether (TAME)		<0.1	<0.1	<0.1	<0.1	<0.1
tert-Butanol (tBA)		<0.1	<0.1	<0.1	<0.1	<0.1
tert-Pentanol (tPA)		<0.1	<0.1	<0.1	<0.1	<0.1
Total Oxygen in WT%		7.31	11.17	10.18	14.83	17.76
D86 Distillation						
IBP	D86	94	95	91	100	101
5%		121	123	119	126	127
10%		131	134	129	136	139
15%		138	141	137	145	149
20%		144	147	143	151	156
30%		154	157	155	161	164
40%		161	163	162	165	167
50%		165	166	166	168	169
60%		169	168	168	169	170
70%		235	170	172	170	171
80%		256	242	245	172	173
90%		310	297	295	280	176
95%		335	330	330	325	319
FBP		386	372	380	376	369
Recovered, mL		97.5	98.4	98	98.6	98.5
Residue, mL		0.9	0.7	0.9	0.5	0.6
Loss, mL		1.6	0.9	1.1	0.9	0.9

Appendix H

FTP-75 Emissions Results

Emissions Measurement Variability

SwRI routinely evaluates exhaust emissions from ultra low emission vehicles (ULEVs) and super ultra low emission vehicles (SULEVs) for government and industry organizations. Select data sets generated over the past several years give an indication of the variation in emission measurements that SwRI has experienced, as shown in the table below. These data include sets of triplicate FTP-75s (at a minimum) for >30 in-use vehicles, and represent more than 400 individual FTP-75s. Coefficients of variation (COVs) were calculated for over 70 data sets, which typically represented back-to-back runs, and are given in the table below. Because COVs are dependent on vehicle operation, as well as emissions measurement equipment, a typical range of observed COVs is also given.

TYPICAL EMISSIONS VARIABILITY

CONSTITUENT	SULEV/ULEV COVS	
	AVERAGE	TYPICAL RANGE
THC	5 %	3 ~ 9 %
CO	7 %	5 ~ 11 %
NO_X	10 %	7 ~ 16 %

FTP-75 Emissions Results

Vehicle Code	PHASE 1							PHASE 2							PHASE 3							WEIGHTED RESULTS						
	THC	CO	NO_X	CO_2	NMHC	Est. NMOG*	FE	THC	CO	NO_X	CO_2	NMHC	Est. NMOG*	FE	THC	CO	NOX	CO2	NMHC	Est. NMOG*	FE	THC	CO	NO_X	CO_2	NMHC	Est. NMOG*	FE
	g/mi	g/mi	g/mi	g/mi	g/mi	g/mi	MPG	g/mi	g/mi	g/mi	g/mi	g/mi	g/mi	MPG	g/mi	g/mi	g/mi	g/mi	g/mi	g/mi	MPG	g/mi	g/mi	g/mi	g/mi	g/mi	g/mi	MPG
A	0.265	1.847	0.169	531.73	0.239	0.249	16.64	0.009	0.0725	0.007	507.64	0.001	0.001	17.55	0.024	0.104	0.01	431.22	0.009	0.009	20.68	0.066	0.448	0.042	491.59	0.053	0.055	18.09
B	0.113	0.586	0.049	429.67	0.101	0.105	20.68	0.003	0.122	0.001	429.61	0.001	0.001	20.73	0.006	0.191	0.01	356.46	0.001	0.001	25.02	0.027	0.237	0.013	409.57	0.022	0.023	21.72
C	0.519	6.804	0.160	620.03	0.493	0.513	14.00	0.007	0.949	0.010	605.48	0.004	0.004	14.70	0.027	0.808	0.079	536.80	0.019	0.020	16.56	0.118	2.121	0.060	589.64	0.109	0.113	15.02
D	0.137	1.367	0.070	363.68	0.102	0.106	24.32	0.029	0.789	0.063	381.70	0.002	0.002	23.26	0.044	0.768	0.053	313.56	0.018	0.019	28.27	0.056	0.902	0.062	359.22	0.027	0.028	24.73
E	0.883	13.33	0.449	497.01	0.800	0.832	17.12	0.091	2.643	0.022	526.69	0.053	0.055	16.78	0.205	4.172	0.092	417.91	0.016	0.017	20.97	0.287	5.278	0.130	490.73	0.237	0.246	17.83
E**	0.588	5.11	0.180	507.62	0.554	0.576	17.22	0.003	0.152	0.018	530.15	0.001	0.001	16.82	0.011	0.236	0.030	443.13	0.003	0.003	20.11	0.126	1.202	0.055	501.60	0.116	0.121	17.68
F	0.123	3.043	0.036	397.59	0.109	0.113	22.14	0.003	0.808	0.014	430.48	0.001	0.001	20.65	0.108	0.754	0.009	343.52	0.005	0.005	25.86	0.030	1.257	0.017	399.79	0.025	0.026	22.19
G	0.242	1.93	0.211	360.15	0.225	0.234	24.37	0.005	0.46	0.016	374.59	0.001	0.001	23.60	0.202	0.954	0.051	356.77	0.009	0.009	24.73	0.059	0.902	0.066	366.69	0.050	0.052	24.06
H	0.140	1.154	0.079	498.86	0.461	0.479	17.689	0.005	0.607	0.001	487.80	0.002	0.002	18.133	0.008	0.492	0.009	418.22	0.004	0.004	21.172	0.034	0.689	0.020	471.00	0.029	0.030	18.78

* Estimated NMOG calculated by multiplying NMHC by 1.04 per CFR Title 40, Part 86, subpart S, section 86.1810-01

** After installation of aged converter and O2 sensor.

Appendix I

On-Road Procedure and Driving Cycle

CRC OBD Program – Modified ASTM D5500 Route

15995.01.001

Car Number:_______ Date:____________

Laps Compl:	**One □**	**Two □**	**Three □**	**Four □**	**Five □**

Name of driver:_______________

Name of observer:_______________

Start of Shift Odometer:__________Time:__________ (Engine turned on)

After First Engine Idle:__________ Time:__________

After Second Engine Idle:__________ Time:__________

After Third Engine Idle:__________ Time:__________

After Fourth Engine Idle:__________ Time:__________

After Fifth Engine Idle:__________ Time:__________(Engine turned off)

Did a check engine light (or malfunction light of any kind) come on with the engine running at any time during the shift? Yes □ No □ If yes, explain below in the comments every time. Also comment on any drivability issues.

FLUID LEVELS

Before the vehicle is started:

1. **Check the engine oil level and mark the level that is nearest to the actual reading.** ***Notify driver's supervisor or driver's scheduler if the engine oil level is one quart low or more. Do not add engine oil!***

1 ¼ Quart Low	1 Quart Low	¾ Quart Low	½ Quart Low	¼ Quart Low	Full

2. **Check the coolant level and record below.**

Above "hot" line	
Between "hot" and "cold" lines	
Below "cold" add line	

Program Specifications

1. The heater, defroster, or air conditioning will be turned on for safety and comfort. However, the HVAC compressor must be requested to come on as needed for these systems.
2. Drive the speed limit or slower for safety.
3. The rule for cell phones is: "The observer can use a cell phone but the driver must not use a cell phone while driving."
4. In case of emergency (examples: accident, breakdown, or flat tire) call David Moczygemba (210-240-3712) or Brent Shoffner (210-260-3830). Stay with the vehicle until a wrecker or SwRI vehicle arrives.
5. The driver and/or observer can take a break during the soak period. However, make sure the vehicle is restarted in 20 minutes.

Modified D5500 Route - One Lap

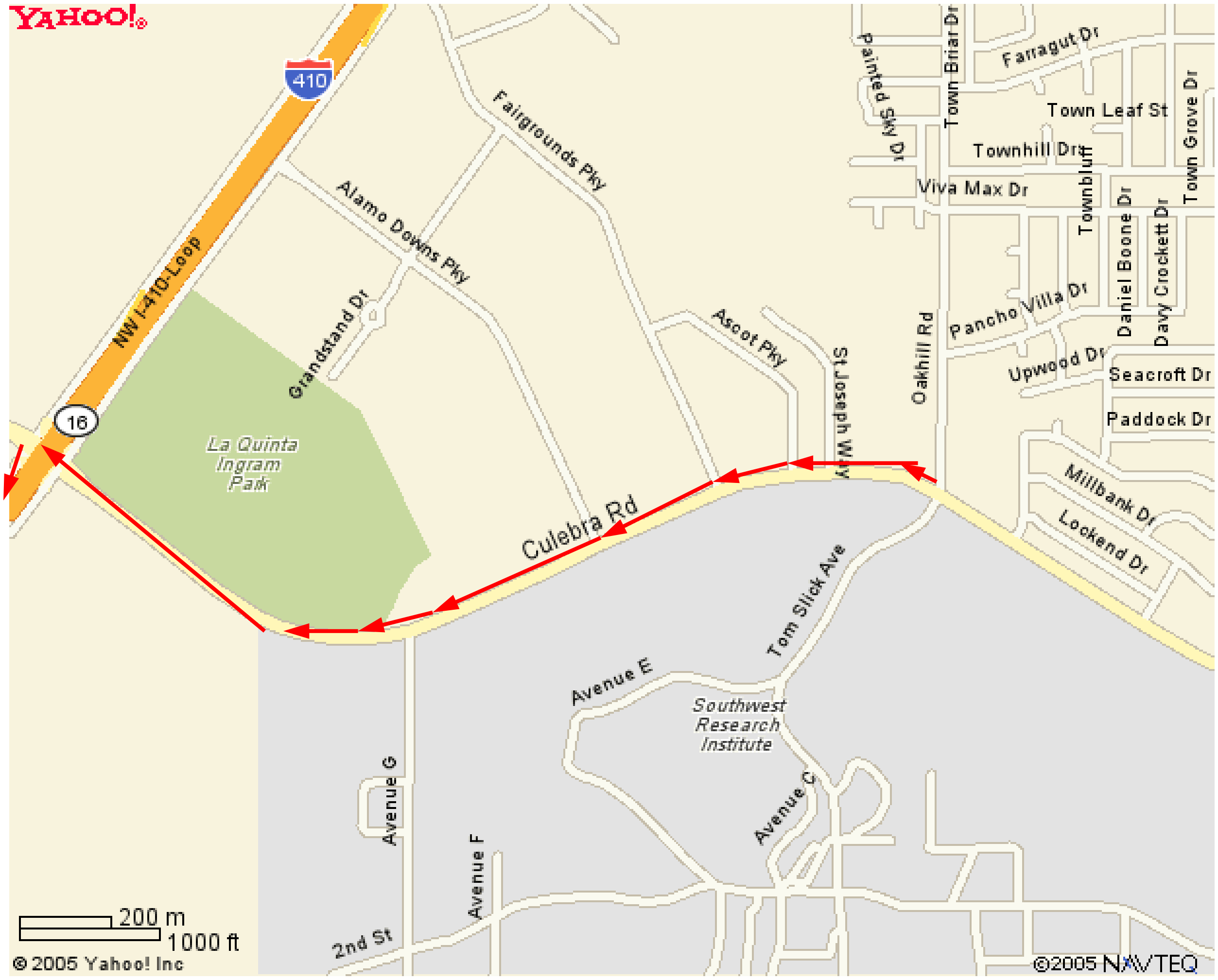
Task #	Description
1.	Start the engine and allow it to idle for 15 seconds.
2.	Drive to Tom Slick Boulevard. Make a right hand turn on Tom Slick Boulevard and drive north
3.	Proceed to the main gate.
4.	Turn left at the main gate onto Culebra Road.
5.	Proceed to Highway 410. Drive under the bridge and turn left going south on the Highway 410 service drive. Make a ¾ throttle acceleration (traffic permitting) and merge onto Highway 410.
6.	Accelerate to 70 mph after crossing Highway 90 when the speed limit is raised to 70 mph.
6.	Continue on Highway 410 to the Ray Ellison road exit.
7.	Perform the 5.9 mile AMA route.
8.	Take the service drive and re-enter the ramp Highway 410 going north. Accelerate to 70 mph with at least a ¾ throttle traffic permitting.
9.	Exit at Culebra Road and turn right to go back to Southwest Research Institute.
10.	Turn right into Southwest Research Institute at the main gate.
11.	Proceed on Tom Slick Boulevard to Building 209.
12.	Turn off the engine and turn the key back to the “ON” position to record data. The engine will be off but the key will be in the “ON” position. Allow the engine to soak for 20 minutes. Restart the engine and allow it to idle for 15 minutes. If another lap is required go to instruction #2. If this is the last lap for the day, turn off the vehicle.

Comments:
Record the time and odometer when the observation was made.

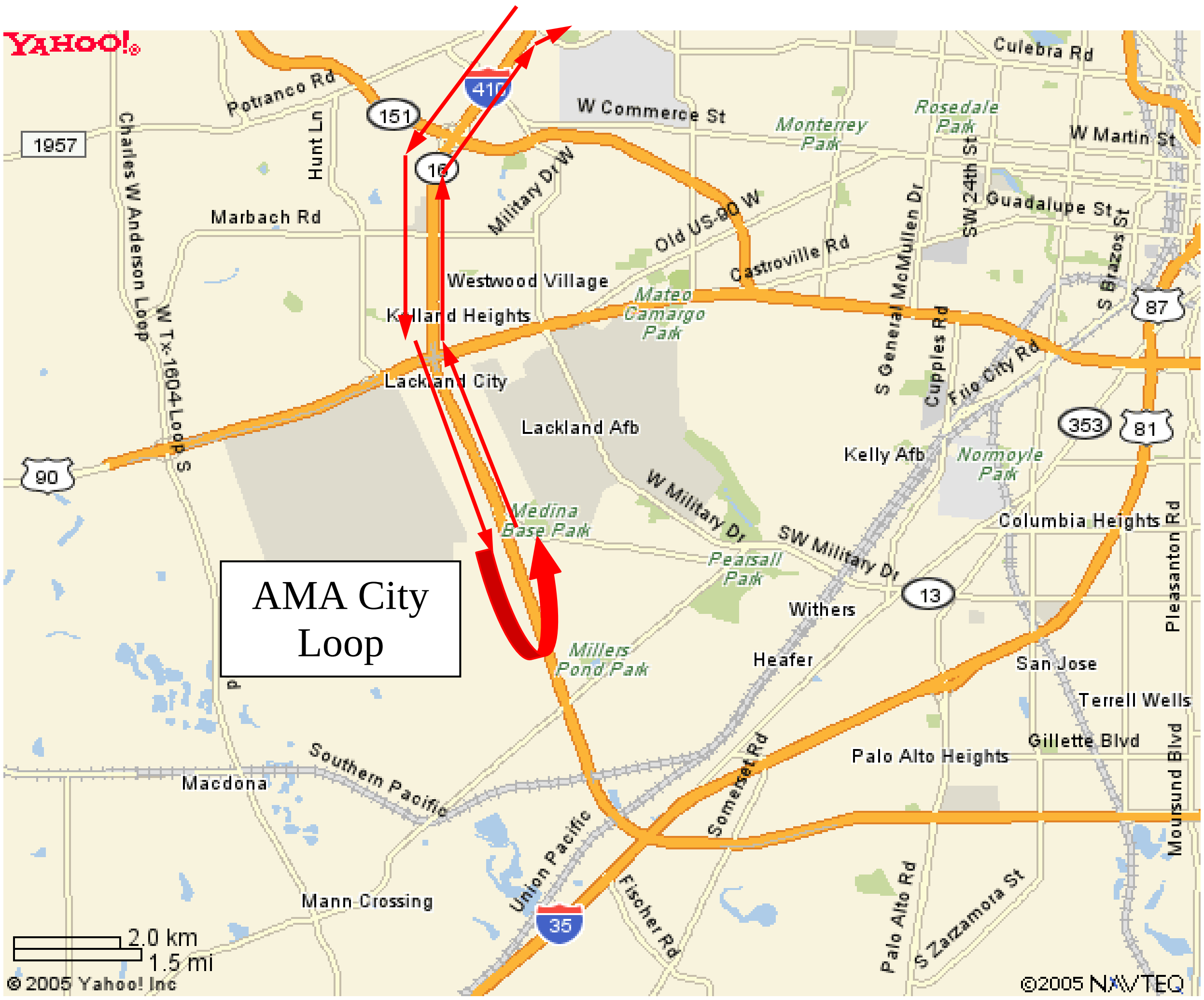
Date	Time	Odometer	Details

City Driving on the SwRI Campus

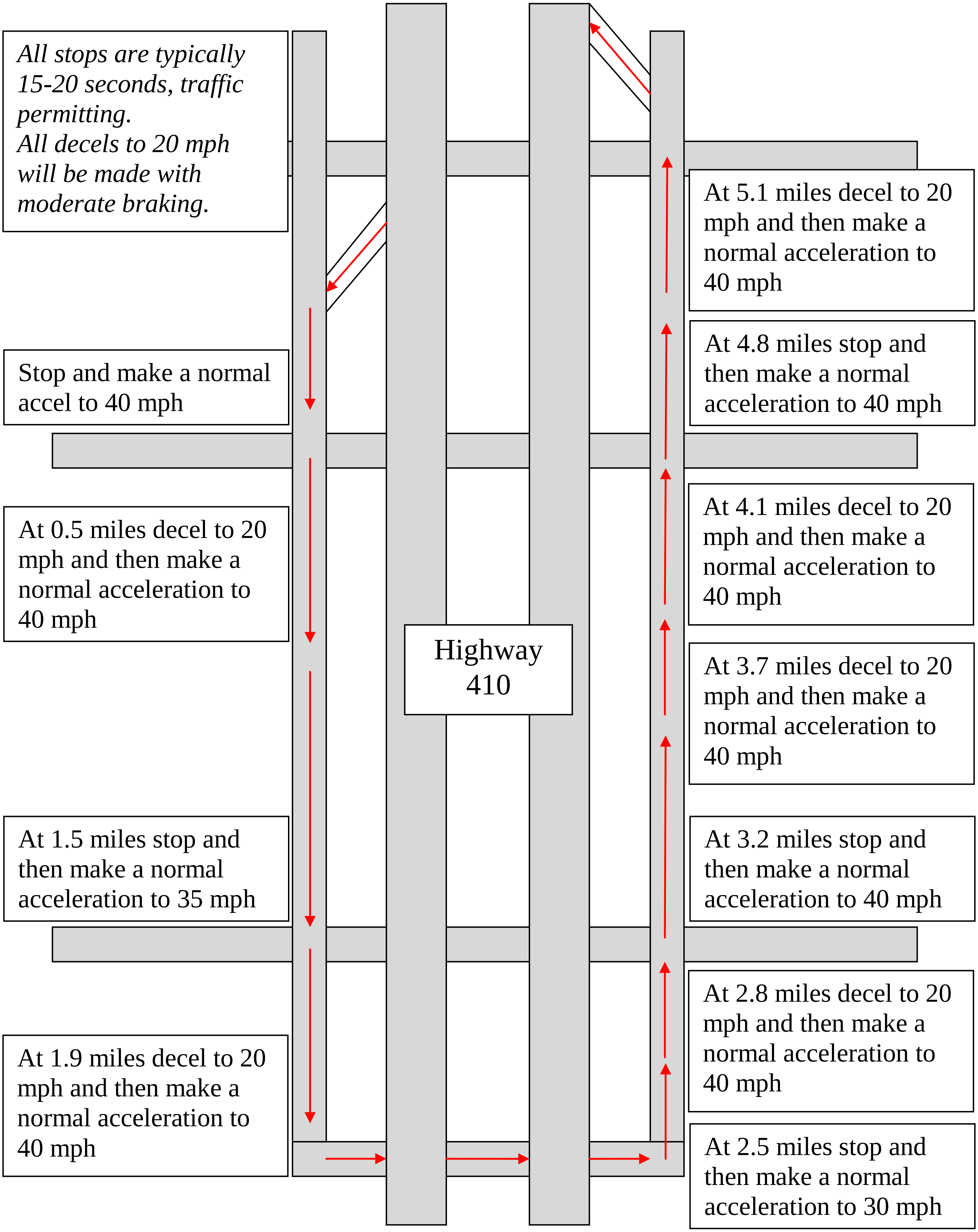
Suburban Driving



Highway Driving



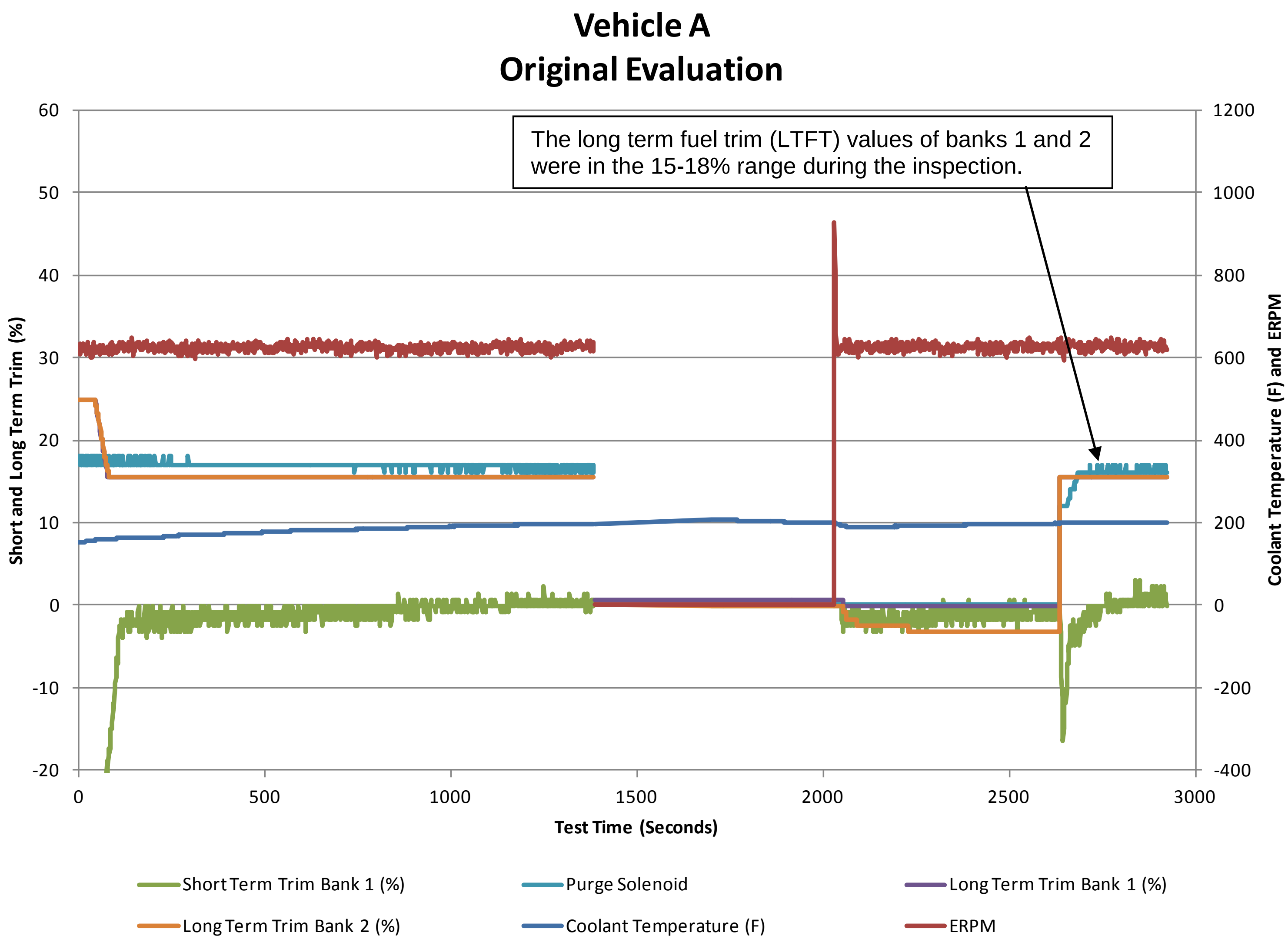
City Route Detail



Return to SwRI

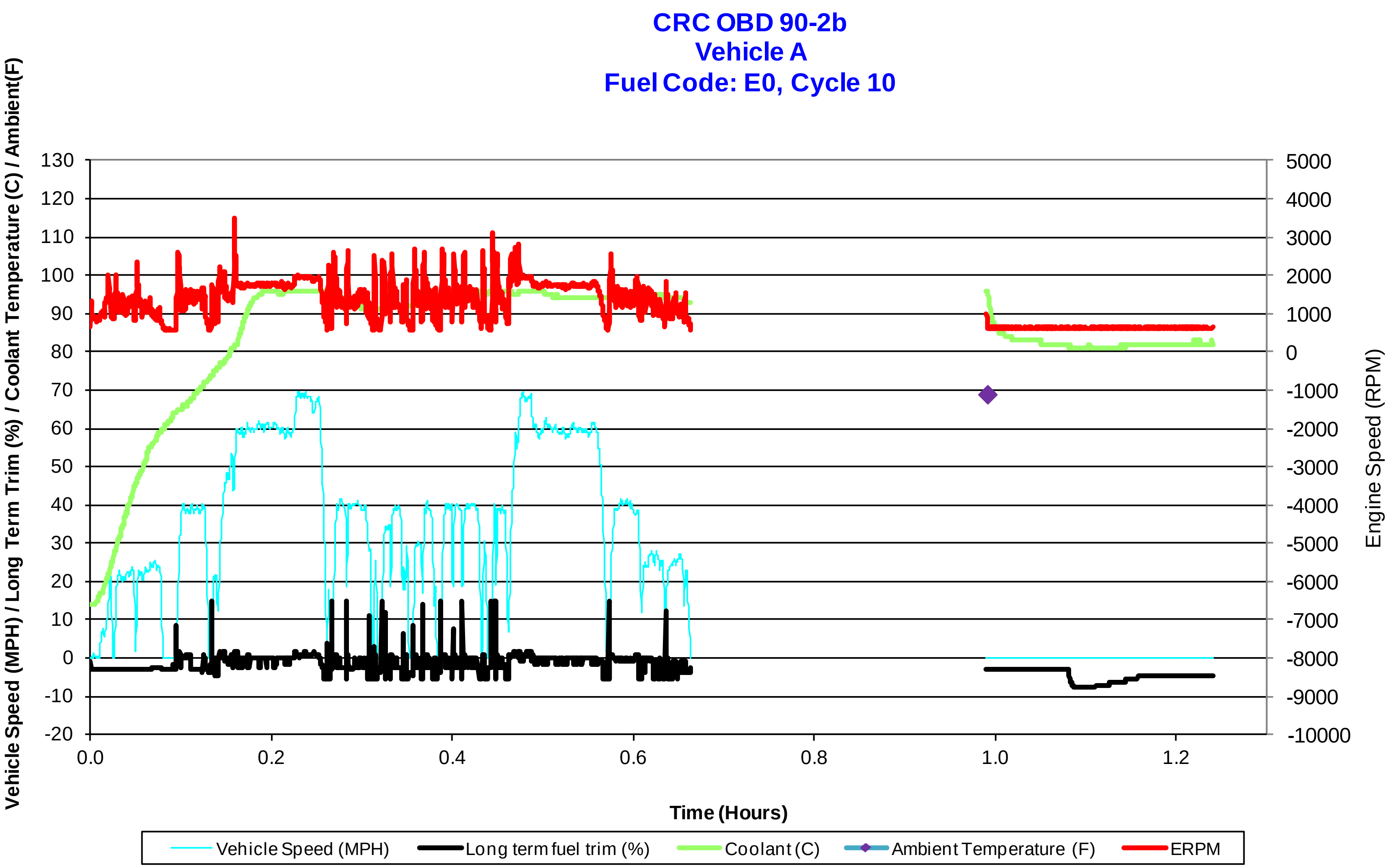
Appendix J

Vehicle A Results

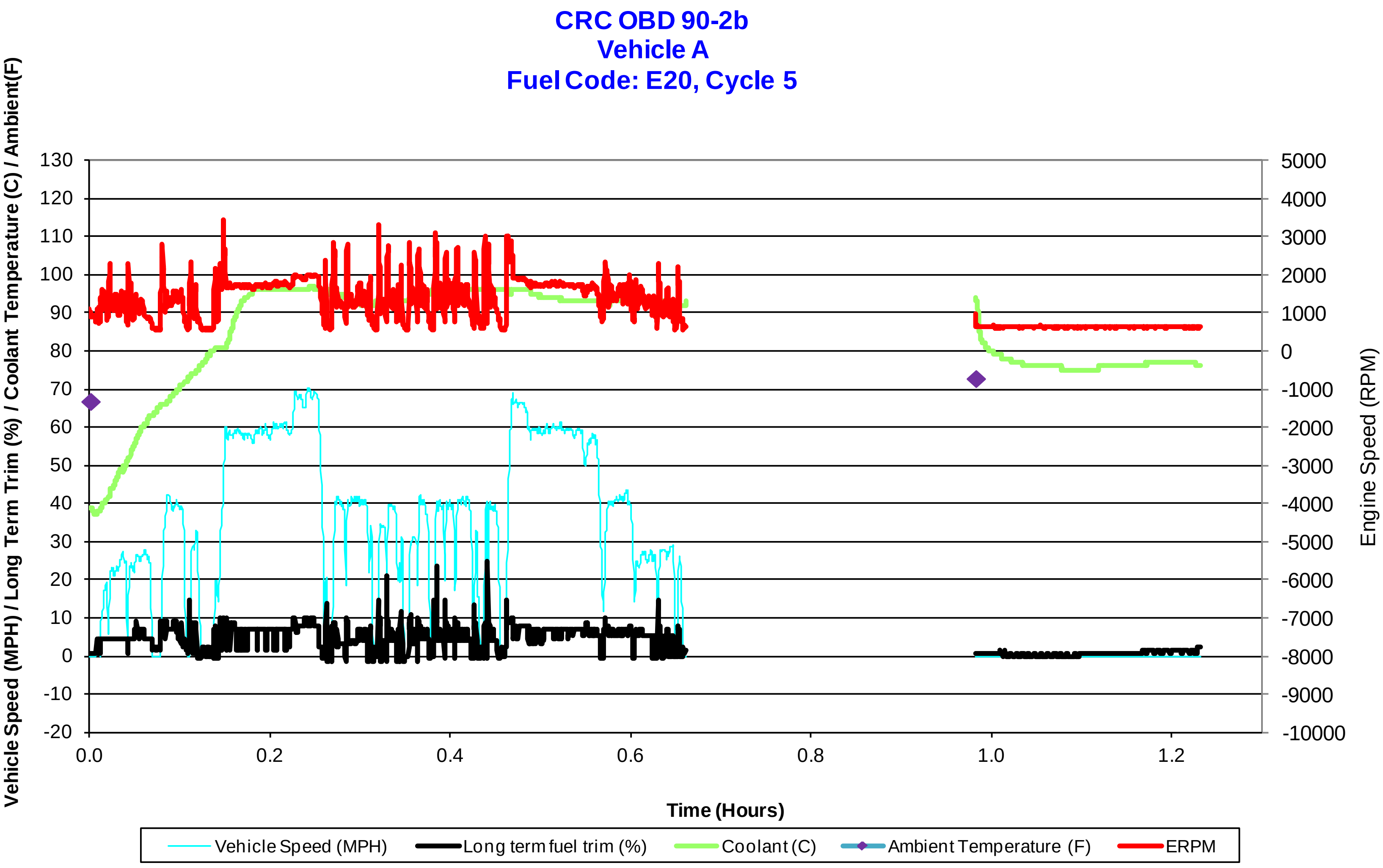


Vehicle A
Original Evaluation
The long term fuel trim (LTFT) values of banks 1 and 2 were in the 15-18% range during the inspection.
Short and Long Term Trim (%)
60
50
40
30
20
10
0
-10
-20
Coolant Temperature (F) and ERPM
1200
1000
800
600
400
200
0
-200
-400
0
500
1000
1500
2000
2500
3000
Test Time (Seconds)
Short Term Trim Bank 1 (%)
Purge Solenoid
Long Term Trim Bank 1 (%)
Long Term Trim Bank 2 (%)
Coolant Temperature (F)
ERPM

Sample Road Data



Sample Road Data



On-Road

Vehicle A
Start of Test Date: 12/30/2010
Start of Test Odometer: 67249 miles

Long Term Fuel Trim (%) - Average of Last Minute of Idle

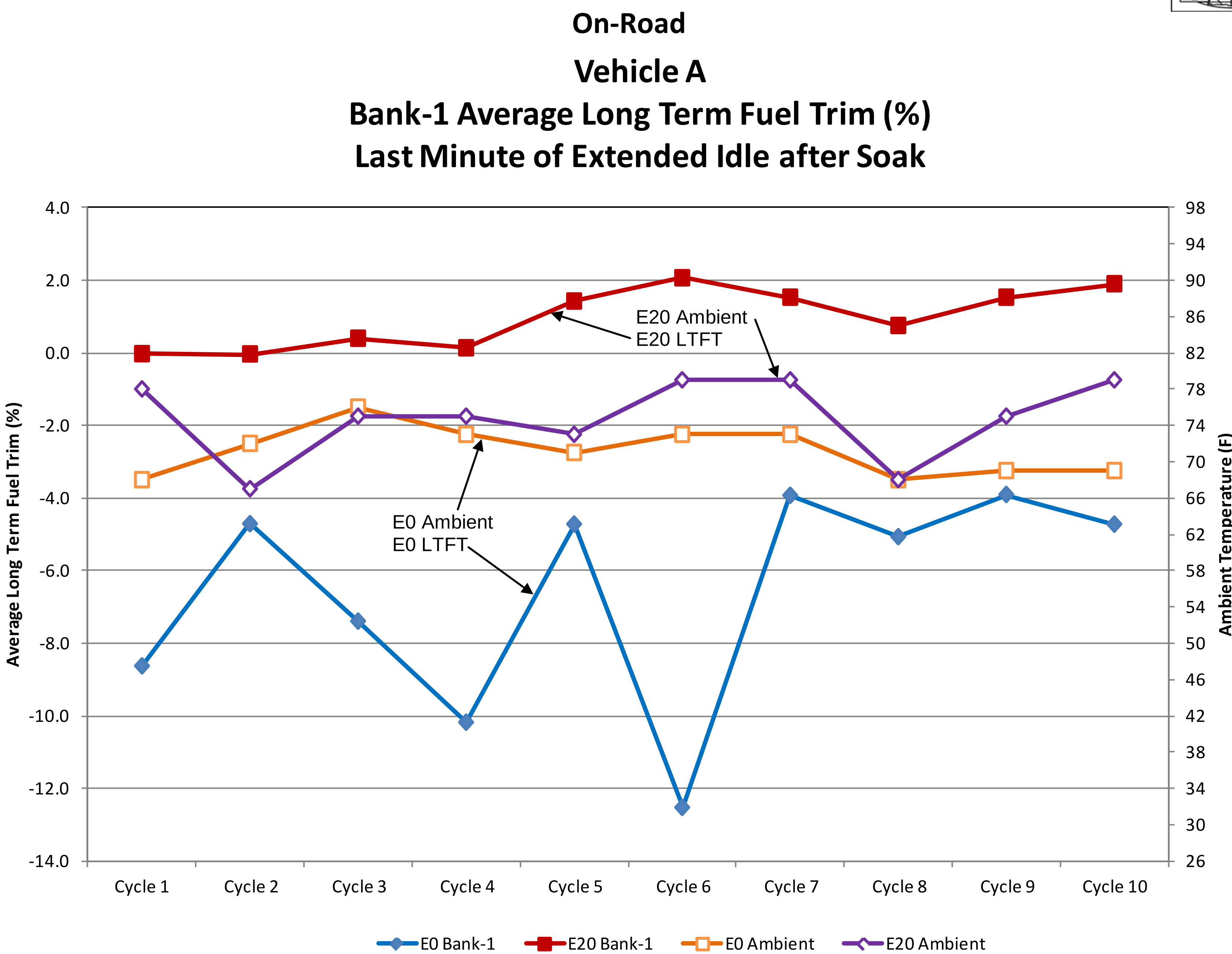
				E0 Bank1	
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1	12/30/2010	12:07	13:23	-8.63	68
Cycle 2	12/30/2010		14:38	-4.71	72
Cycle 3	12/30/2010		16:01	-7.40	76
Cycle 4	12/30/2010		17:15	-10.18	73
Cycle 5	1/5/2011	11:50	13:04	-4.72	71
Cycle 6	1/5/2011		14:17	-12.53	73
Cycle 7	1/5/2011		15:31	-3.93	73
Cycle 8	1/6/2011	13:02	14:16	-5.07	68
Cycle 9	1/6/2011		15:30	-3.91	69
Cycle 10	1/7/2011	12:36	13:51	-4.73	69

+ Military time

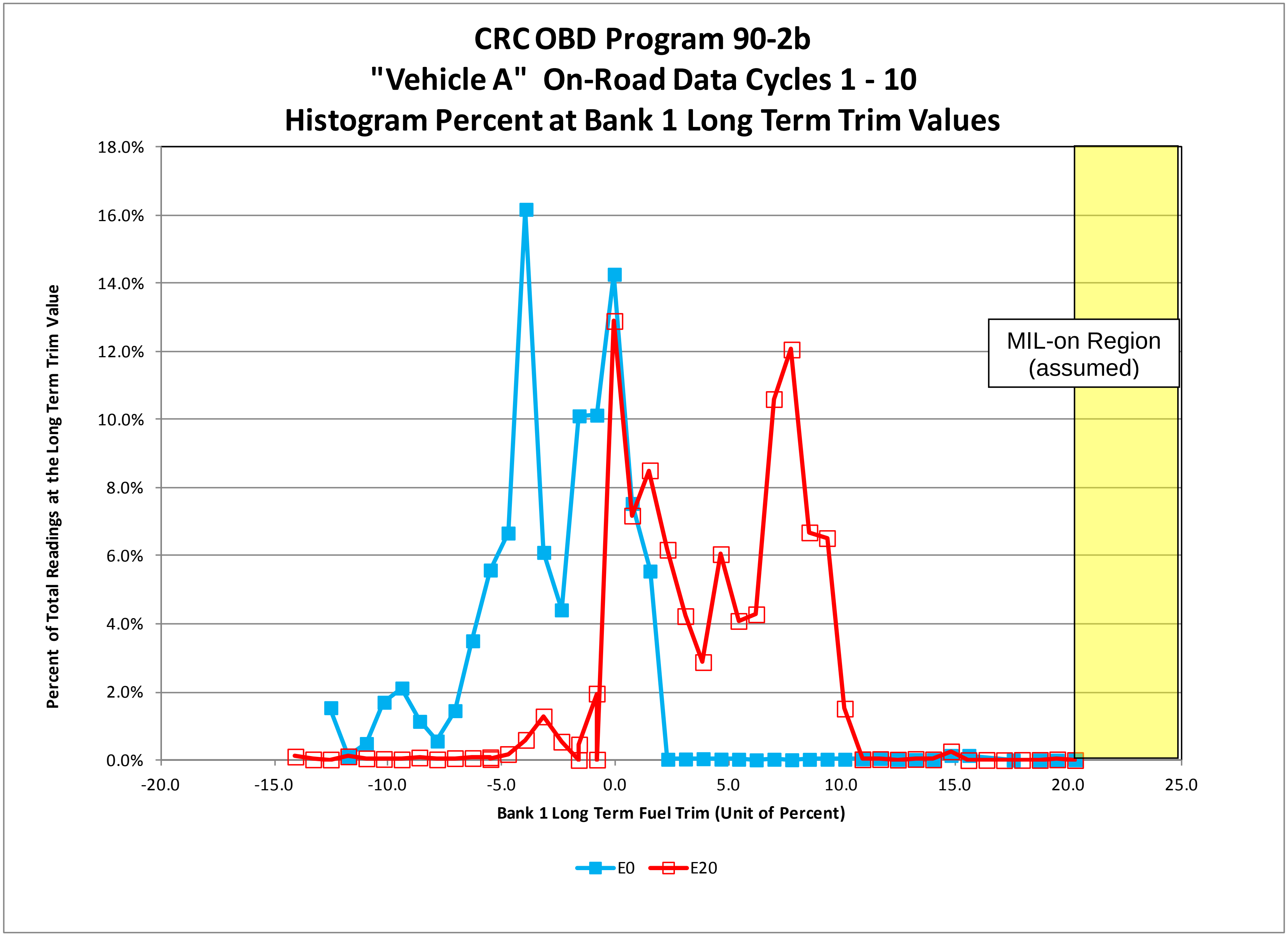
Long Term Fuel Trim (%) - Average of Last Minute of Idle

				E20 Bank1	
	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle1	2/28/2011	13:49	15:03	-0.03	78
Cycle2	3/1/2011	10:32	11:47	-0.04	67
Cycle3	3/1/2011		14:15	0.40	75
Cycle4	3/1/2011		15:30	0.13	75
Cycle5	3/2/2011	10:22	11:36	1.42	73
Cycle6	3/2/2011		13:35	2.06	79
Cycle7	3/2/2011		14:46	1.53	79
Cycle8	3/3/2011	10:40	11:53	0.75	68
Cycle9	3/3/2011		13:40	1.53	75
Cycle10	3/3/2011		14:54	1.90	79

+ Military time

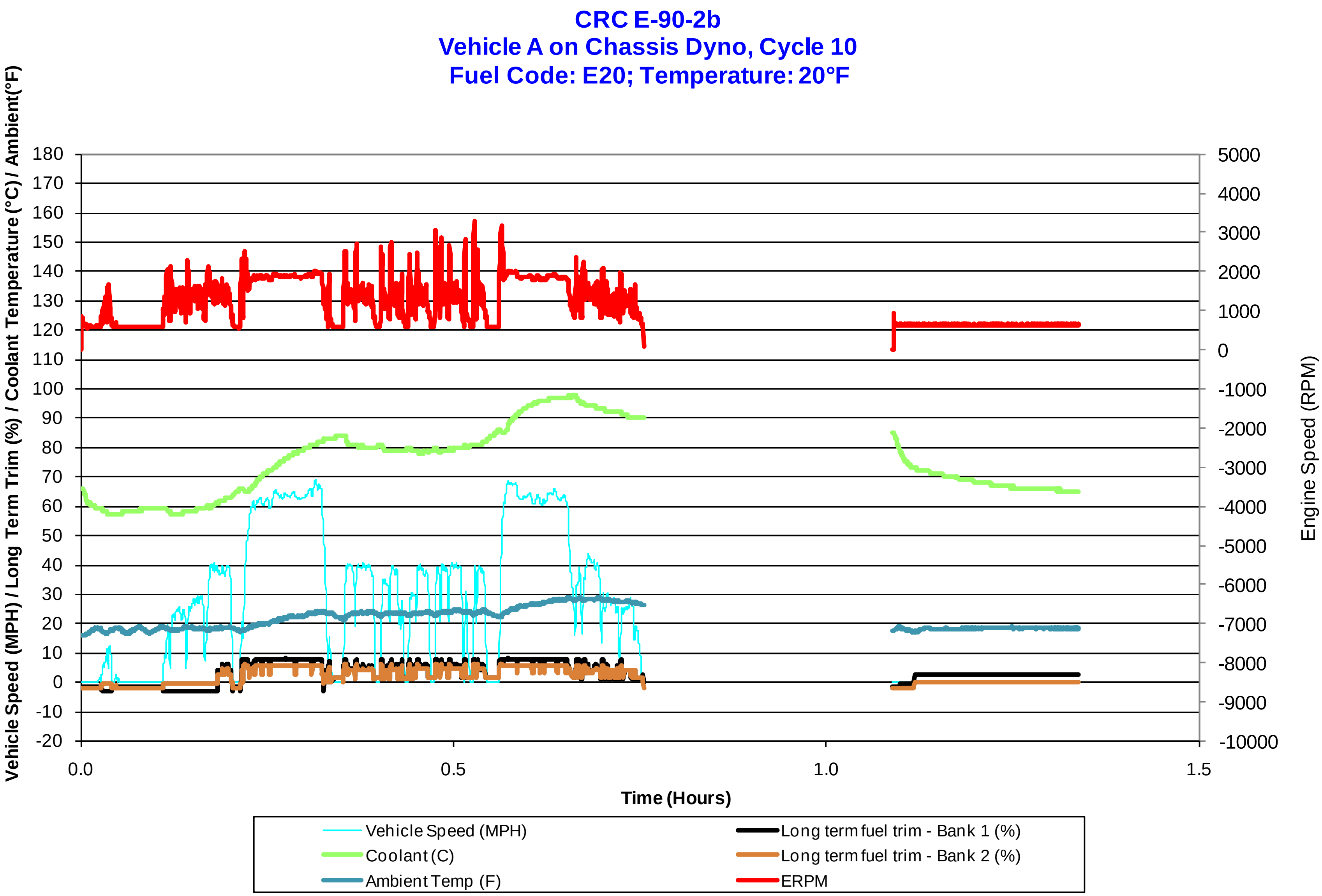

On-Road
Vehicle A
Bank-1 Average Long Term Fuel Trim (%)
Last Minute of Extended Idle after Soak
Average Long Term Fuel Trim (%)
Ambient Temperature (F)
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
98
94
90
86
82
78
74
70
66
62
58
54
50
46
42
38
34
30
26
Cycle 1
Cycle 2
Cycle 3
Cycle 4
Cycle 5
Cycle 6
Cycle 7
Cycle 8
Cycle 9
Cycle 10
E20 Ambient
E20 LTFT
E0 Ambient
E0 LTFT
E0 Bank-1
E20 Bank-1
E0 Ambient
E20 Ambient

On-Road



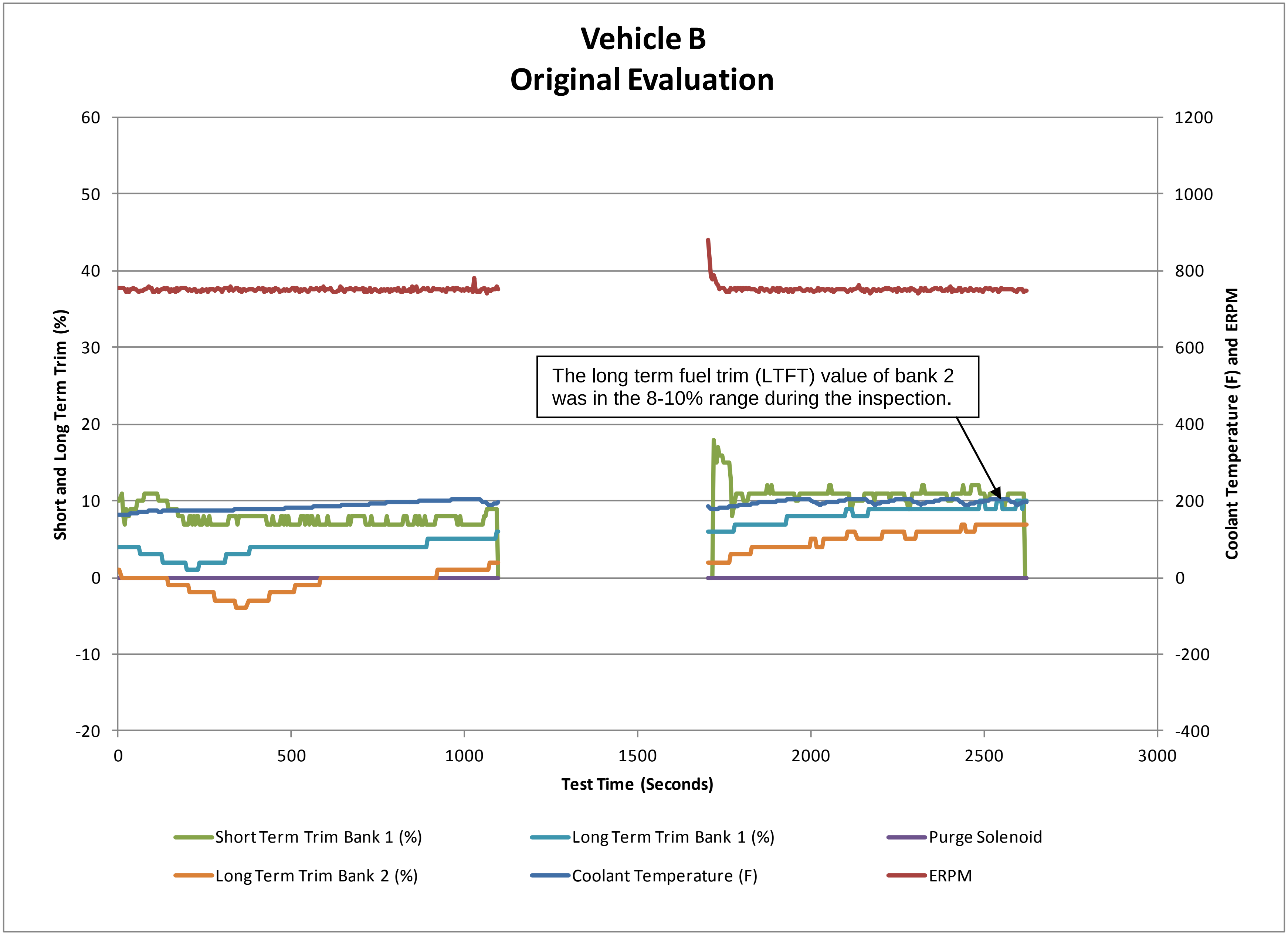
CRC OBD Program 90-2b
"Vehicle A" On-Road Data Cycles 1 - 10
Histogram Percent at Bank 1 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
-20.0
-15.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
Bank 1 Long Term Fuel Trim (Unit of Percent)
MIL-on Region
(assumed)
E0
E20

SAMPLE CHASSIS DYNO DATA



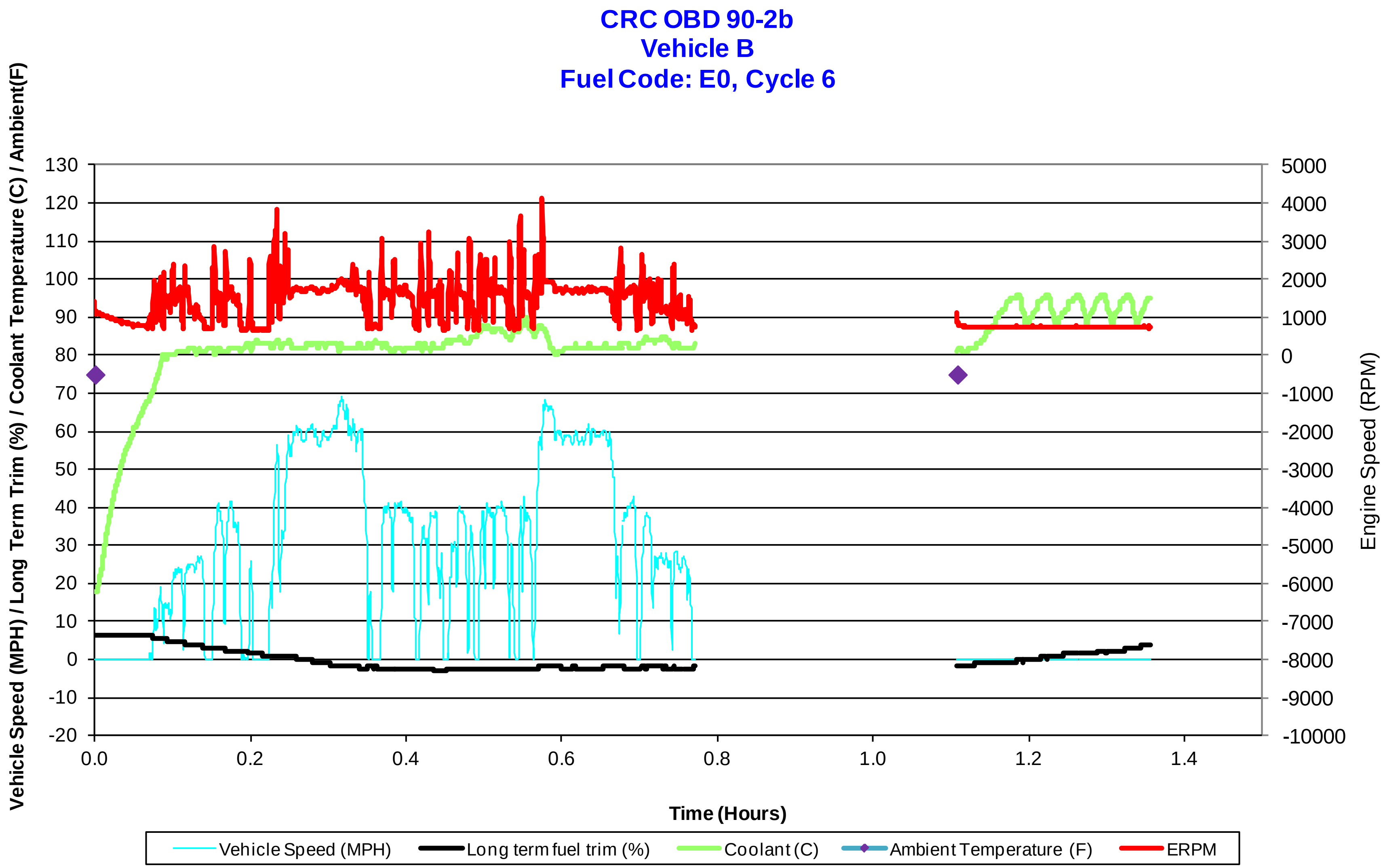
Appendix K

Vehicle B Results

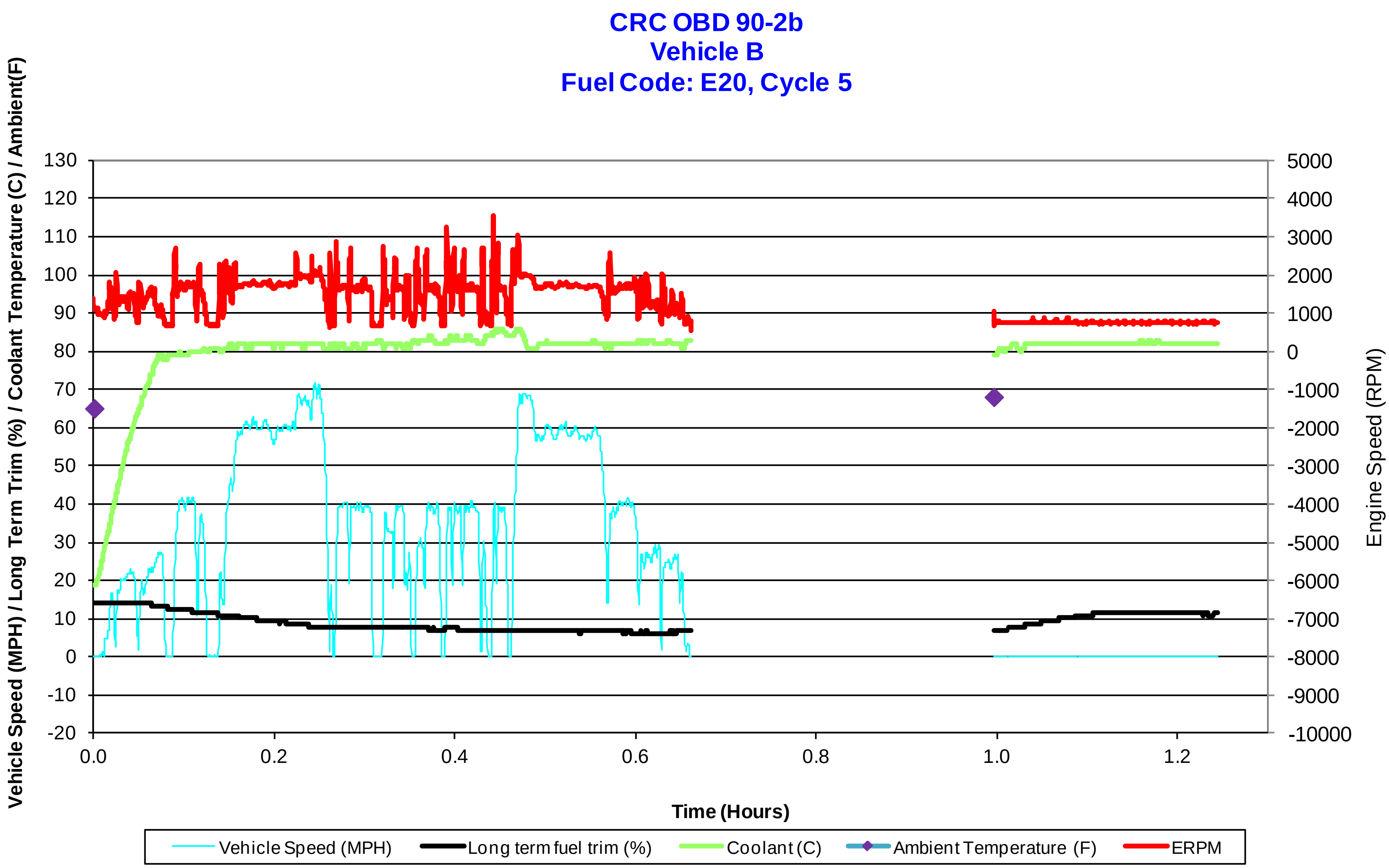


Vehicle B
Original Evaluation
60
50
40
30
20
10
0
-10
-20
1200
1000
800
600
400
200
0
-200
-400
0
500
1000
1500
2000
2500
3000
Short and Long Term Trim (%)
Coolant Temperature (F) and ERPM
Test Time (Seconds)
The long term fuel trim (LTFT) value of bank 2 was in the 8-10% range during the inspection.
Short Term Trim Bank 1 (%)
Long Term Trim Bank 1 (%)
Purge Solenoid
Long Term Trim Bank 2 (%)
Coolant Temperature (F)
ERPM

Sample Road Data



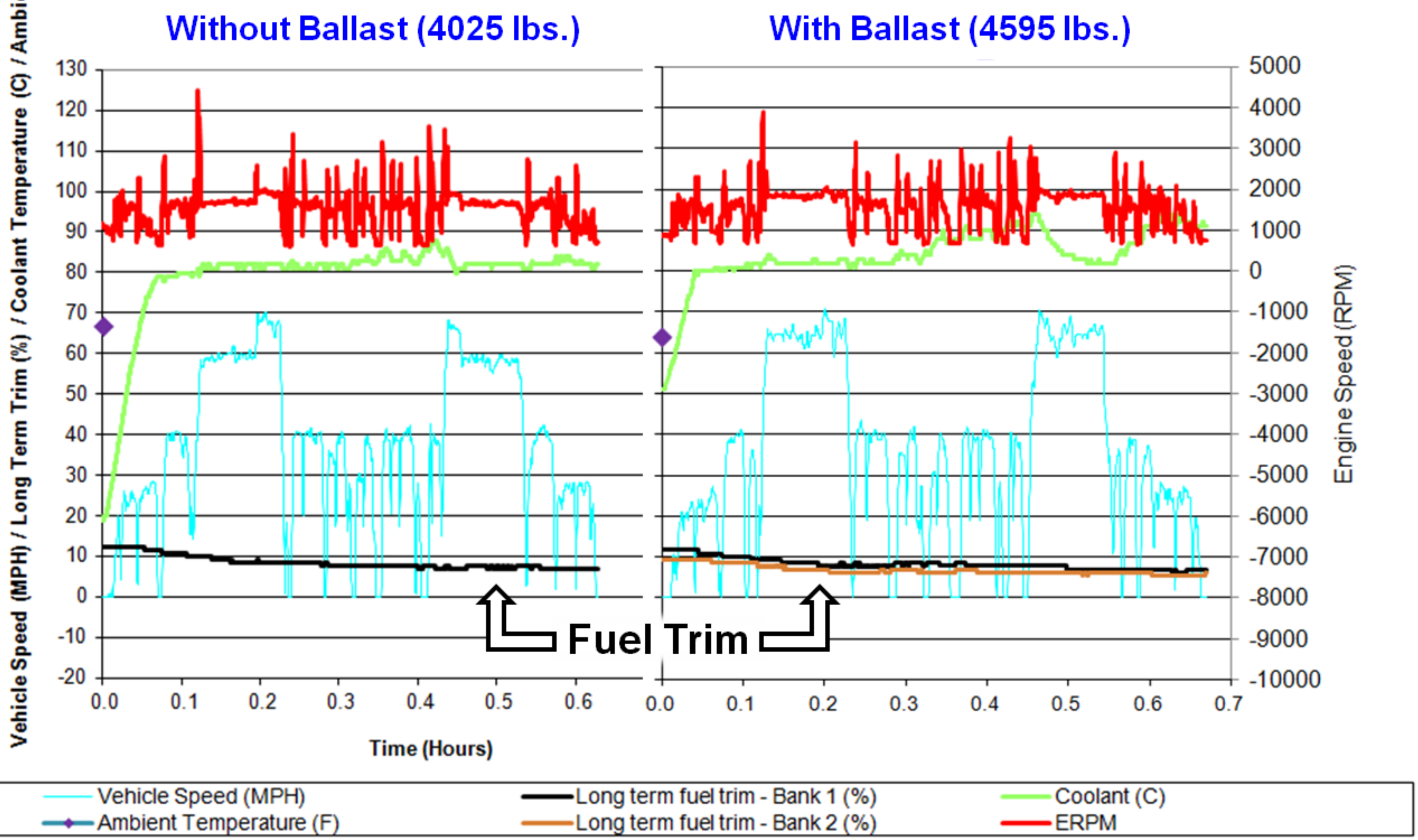
Sample Road Data



Effect of Ballast on the Long Term Fuel Trim Values with E20

Vehicle B On-Road Results

- Similar cycles and ambient temperatures



- **Vehicle load had no apparent effect on fuel trim.**

On-Road
Vehicle Weight Approximately 4,025 Lbs.

Vehicle B
SOT Date: 1/27/2011
Start of Test Odometer: 48,352 miles

Long Term Fuel Trim (%) - Average of Last Minute of Idle

				E0 Fuel	
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E0 Bank1 Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1	1/27/2011	14:00	15:32	6.06	68
Cycle 2	1/28/2011	12:02	13:19	2.92	72
Cycle 3	1/28/2011		14:32	4.64	73
Cycle 4	1/28/2011		15:45	4.64	74
Cycle 5	1/28/2011		17:03	5.77	72
Cycle 6	2/14/2011	2:11	15:30	3.75	75
Cycle 7	2/15/2011	11:14	12:28	3.86	65
Cycle 8	2/15/2011		13:43	3.91	70
Cycle 9	2/16/2011	12:14	13:29	4.65	70
Cycle 10	2/16/2011		14:10	6.52	71

				E20 Fuel		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E20 Bank1 Long Term Fuel Trim (%)	E20 Bank2 Long Term Fuel Trim (%)	Ambient Temp (F)
Cycle 1	2/21/2011	13:23	14:06	10.11		75.0
Cycle 2	2/21/2011		15:55	13.23		77.0
Cycle 3	2/22/2011	13:03	14:17	14.86		64.0
Cycle 4	2/22/2011		15:30	14.00		65.0
Cycle 5	2/23/2011	10:13	11:28	11.54		68.0
Cycle 6	2/23/2011		13:45	8.39		77.0
Cycle 7	2/23/2011		14:58	12.45		77.0
Cycle 8	2/24/2011	10:03	11:16	12.45		70.0
Cycle 9	2/24/2011		13:51	11.31		76.0
Cycle 10	2/24/2011		15:04	13.23		82.0
Cycle 11	8/3/2011	9:53	11:10	7.00	3.88	88.0
Cycle 12	8/3/2011		13:57	6.22	3.23	98.0
Cycle 13	8/3/2011		15:13	5.29	2.87	99.0
Cycle 14	8/31/2011	14:20	16:06	7.80	7.00	100.0

				E30 Fuel - On Road		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E30 Bank1 Long Term Fuel Trim (%)	E30 Bank2 Long Term Fuel Trim (%)	Ambient Temp (F)
Cycle 1	1/16/2012	9:44	11:03	14.02	11.70	68
Cycle 2	1/16/2012		13:35	15.57	13.23	70
Cycle 3	1/16/2012		14:50	15.58	13.63	78
Cycle 4*	1/19/2012	10:06	11:21	18.21	16.36	66
Cycle 5**	1/19/2012	13:38	13:39			71

* Pending code P0171 - System too lean Bank 1

** MIL illuminated after the start for cycle 5
The DTC was P0171
Cycle 5 was discontinued after the MIL was illuminated

+ Military time

On-Road
Vehicle Weight Approximately 4,595 Lbs. (GVW)

Long Term Fuel Trim (%) - Average of Last Minute of Idle

				E20 Fuel		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E20 Bank1 Long Term Fuel Trim (%)	E20 Bank2 Long Term Fuel Trim (%)	Ambient Temp (F)
Cycle 1	8/21/2012	14:18	14:59	5.43	3.66	93
Cycle 2	9/7/2012	8:58	10:18	3.06	0.98	81
Cycle 3	9/7/2012	10:20	11:36	6.20	4.64	88
Cycle 4	9/7/2012	12:34	13:51	8.79	7.76	95
Cycle 5	9/10/2012	6:03	7:19	15.50	13.22	65
Cycle 6	9/10/2012	9:13	10:29	10.88	9.32	69
Cycle 7	9/11/2012	6:03	7:19	12.44	10.55	64
Cycle 8	9/11/2012	7:21	8:40	11.01	8.99	67
Cycle 9	9/12/2012	7:27	8:50	10.09	8.53	72
Cycle 10	9/12/2012	8:52	10:07	9.31	7.75	78

Incident Report
CRC OBD
Vehicle: Vehicle B

SwRI Project Number: 08.15995.01.002
Date of First Occurrence: 1/19/2012
Approximate Odometer: 49,067
Test miles: 72
Test Interval: E30 On-Road Testing

Incident Description: Vehicle B set a MIL light for a P0171 “System Too Lean (Bank 1)” DTC

Action Taken:

On 1/16/2012, Vehicle B completed three test cycles using E30 test fuel. After each cycle was completed the vehicle was scanned for pending and current diagnostic trouble codes (DTCs). There were no pending or current engine DTCs present after the three cycles were completed. Due to temperatures below the specified minimum temperature for testing, the evaluation of Vehicle B was suspended until 1/19/2012.

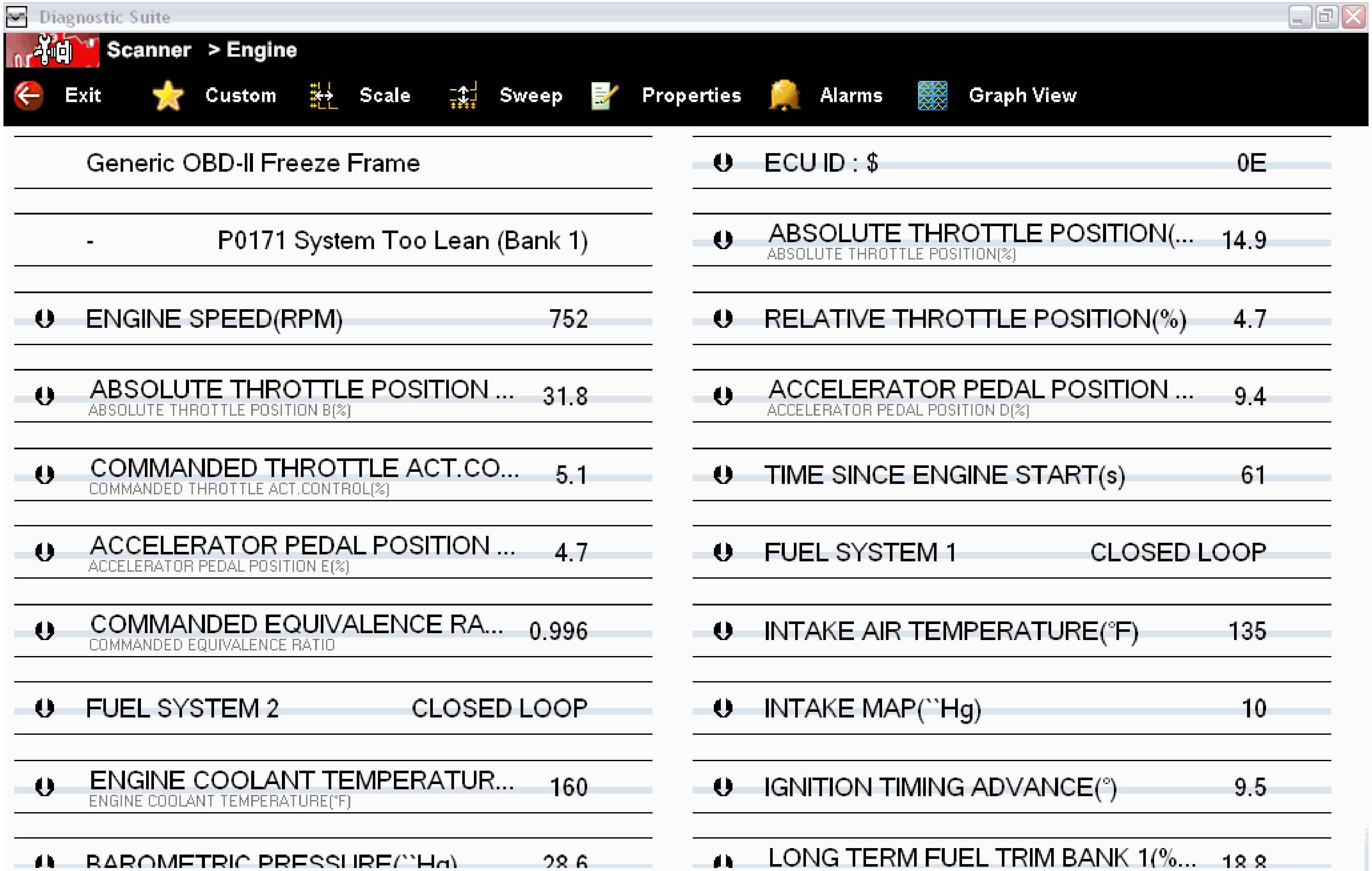
On 1/19/2012, Vehicle B began the second day of on-road testing using E30 test fuel. The first cycle of the day, Cycle 4, was completed and the vehicle was scanned for engine DTCs after the idle segment of the cycle. A pending code, P0171 “System Too Lean (Bank1), was observed. The driver was instructed to continue testing until a MIL light was displayed. Before Vehicle B could leave SwRI property for the next cycle, a MIL light was displayed. The vehicle was scanned for engine DTCs and the P0171 “System Too Lean (Bank1)” DTC was observed.

Resolution:

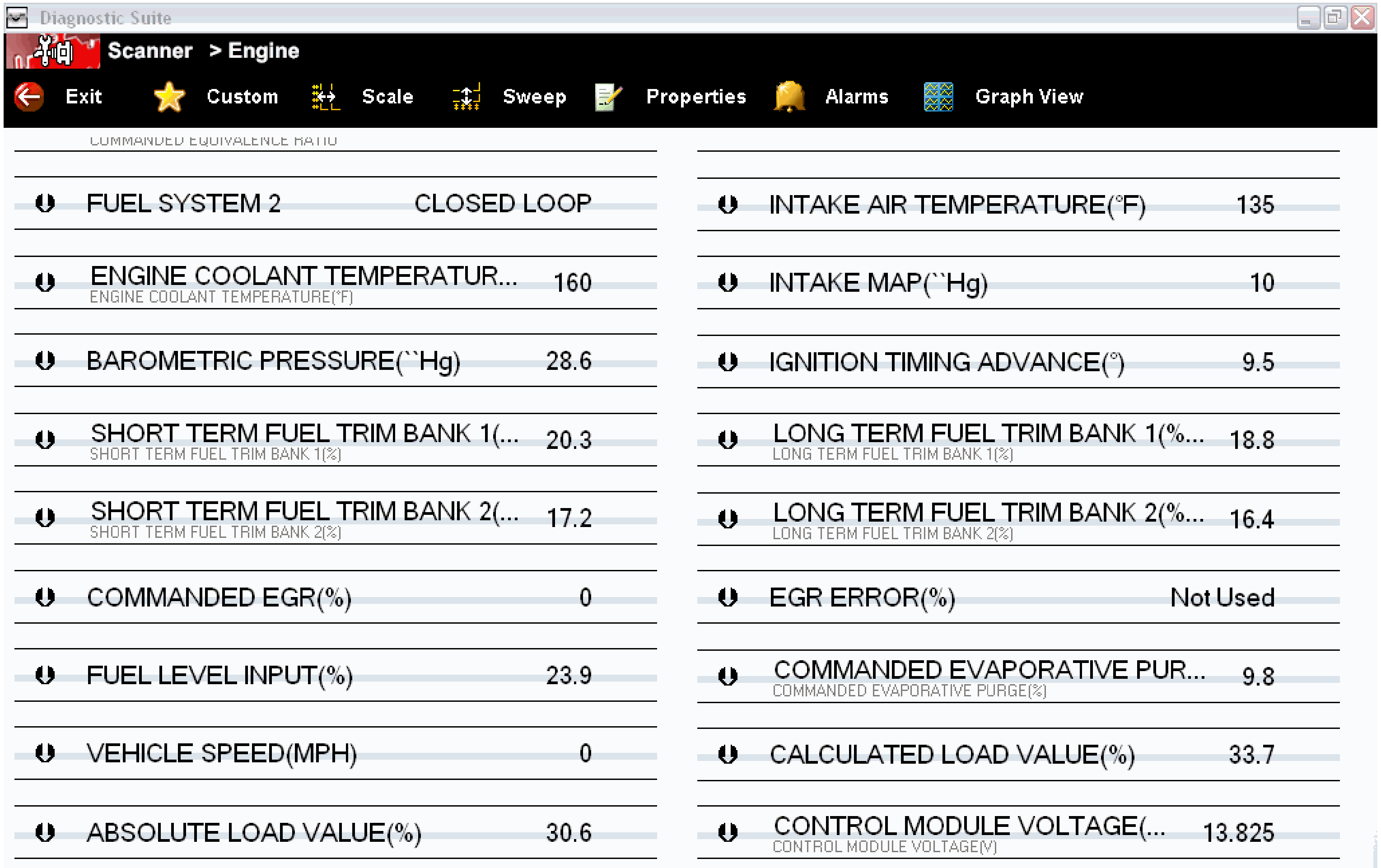
The P0171 DTC is one of the engine codes indicative of engine performance related to ethanol content in the fuel. The on-road testing was discontinued and the vehicle will be used for the temperature-controlled portion of the program.

Figures K-1 and K-2 display the freeze frame data which lists the values of various engine parameters at the moment the MIL light turned on.

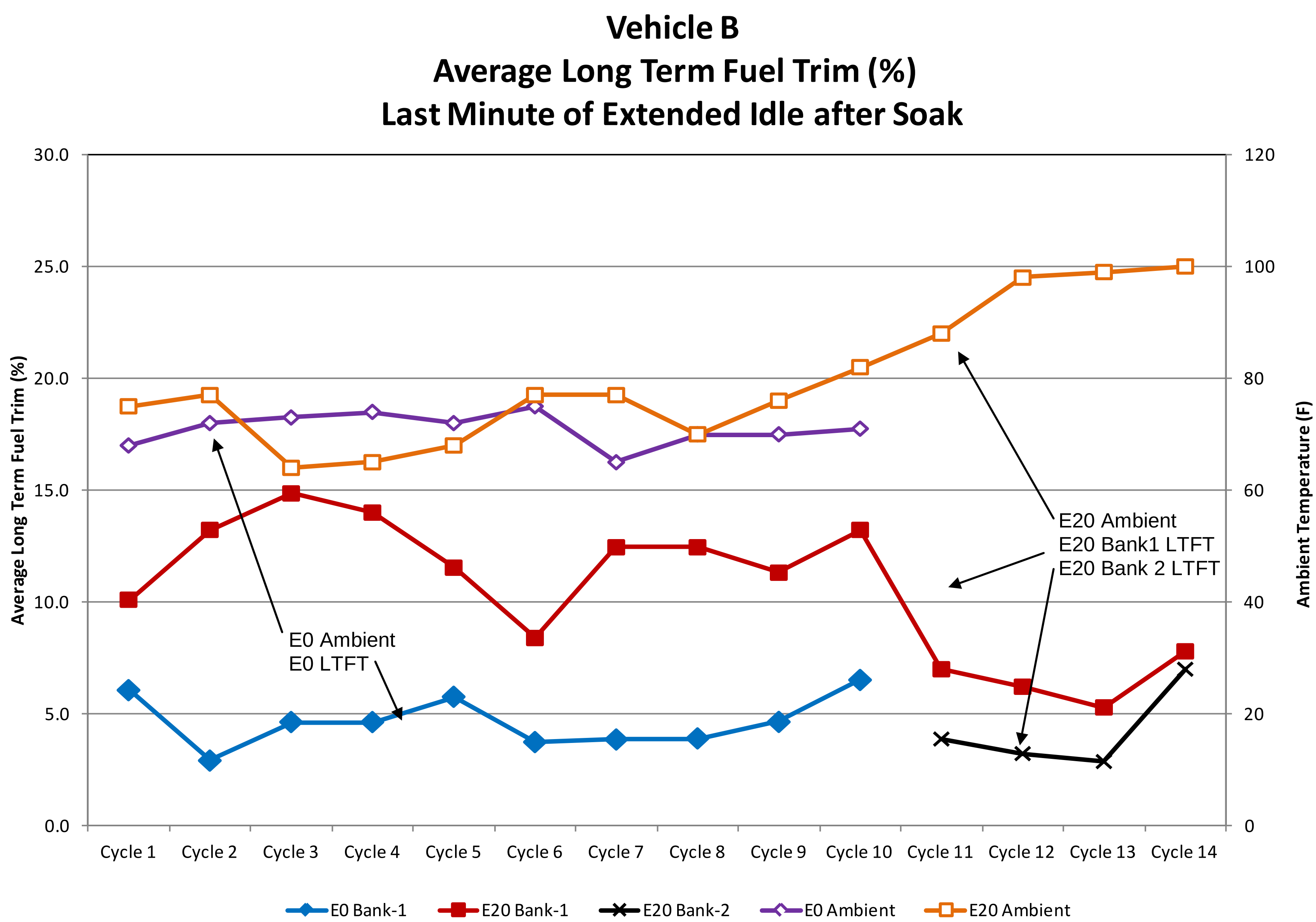
Freeze Frame Data – Vehicle B (Figure K-1 of 2)



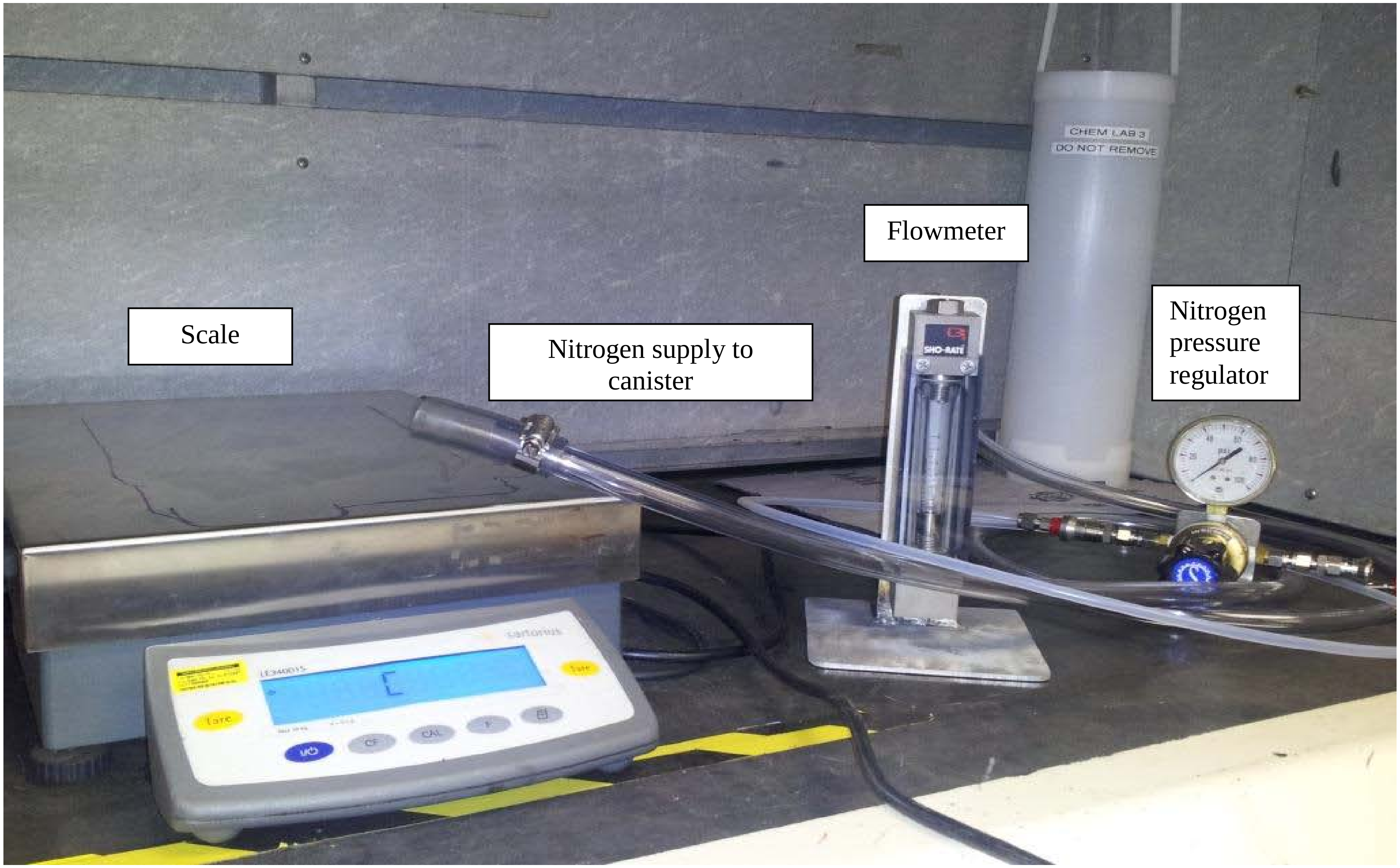
Freeze Frame Data – Vehicle B (Figure K-2 of 2)



On-Road

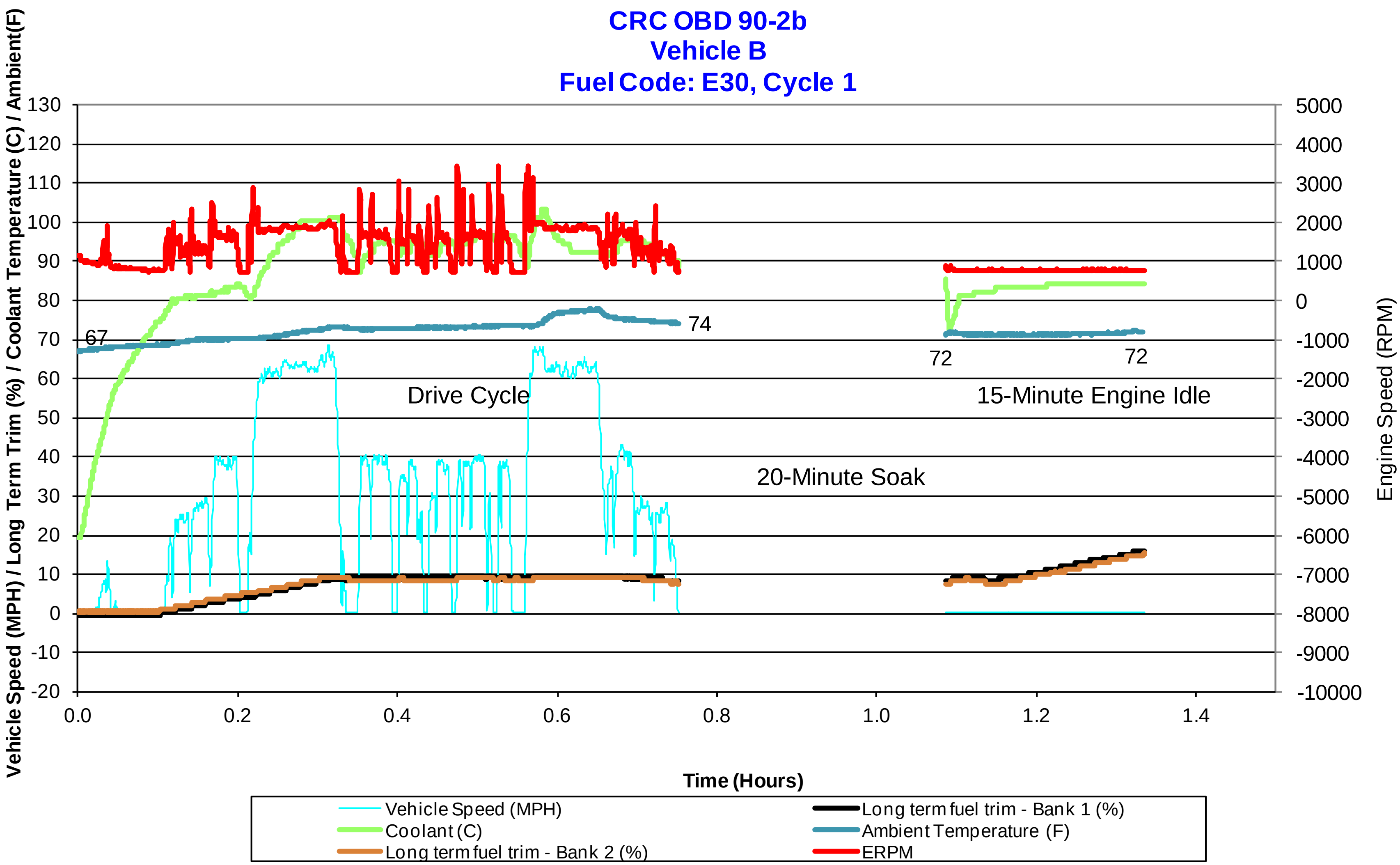


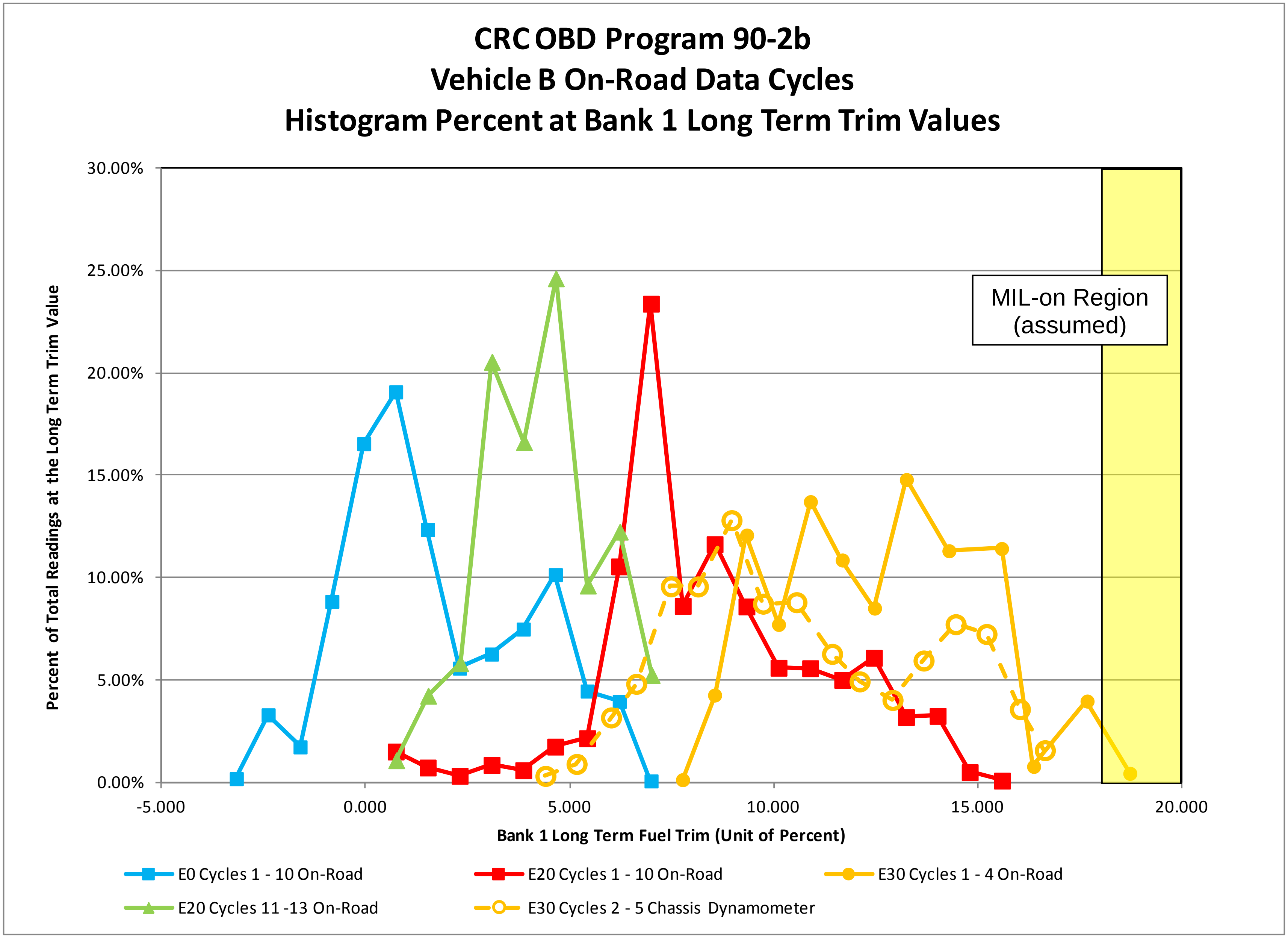
Vehicle B
Average Long Term Fuel Trim (%)
Last Minute of Extended Idle after Soak
Average Long Term Fuel Trim (%)
Ambient Temperature (F)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
120
100
80
60
40
20
0
Cycle 1
Cycle 2
Cycle 3
Cycle 4
Cycle 5
Cycle 6
Cycle 7
Cycle 8
Cycle 9
Cycle 10
Cycle 11
Cycle 12
Cycle 13
Cycle 14
E0 Ambient
E0 LTFT
E20 Ambient
E20 Bank1 LTFT
E20 Bank 2 LTFT
E0 Bank-1
E20 Bank-1
E20 Bank-2
E0 Ambient
E20 Ambient



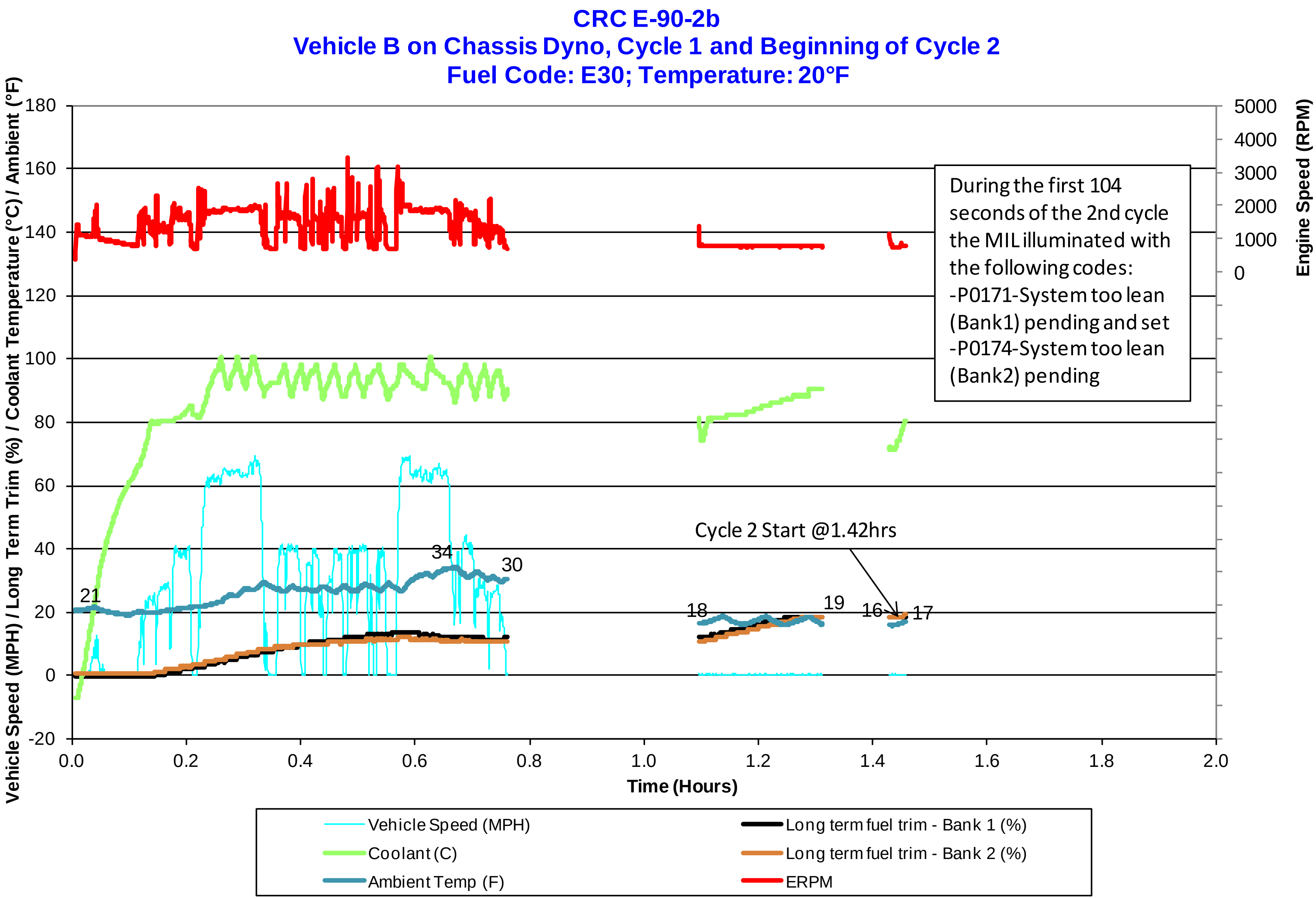
EVAPORATIVE CANISTER NITROGEN PURGE SETUP

SAMPLE CHASSIS DYNO DATA

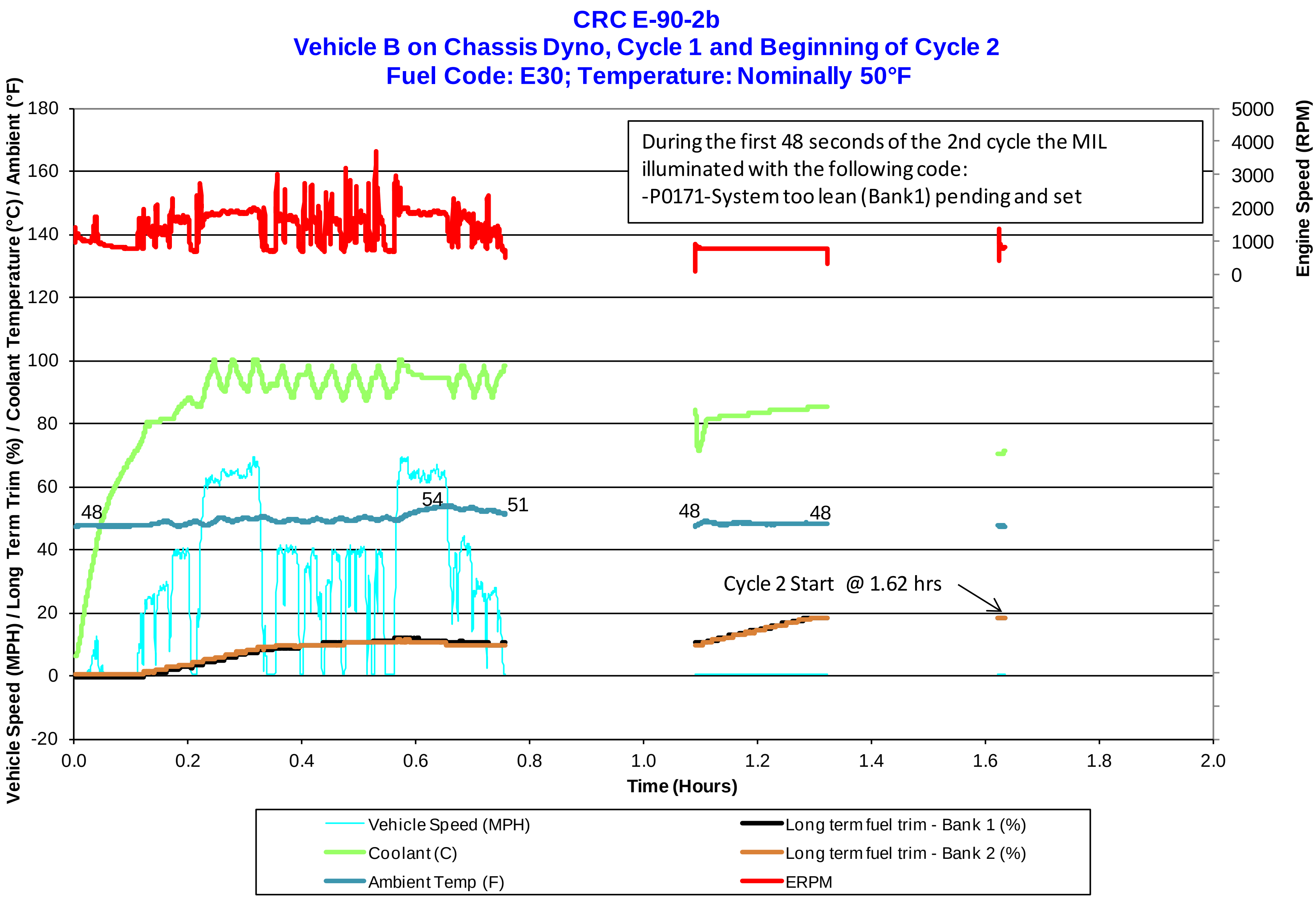



CRC OBD Program 90-2b
Vehicle B On-Road Data Cycles
Histogram Percent at Bank 1 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
-5.000
0.000
5.000
10.000
15.000
20.000
Bank 1 Long Term Fuel Trim (Unit of Percent)
MIL-on Region
(assumed)
E0 Cycles 1 - 10 On-Road
E20 Cycles 1 - 10 On-Road
E30 Cycles 1 - 4 On-Road
E20 Cycles 11 -13 On-Road
E30 Cycles 2 - 5 Chassis Dynamometer

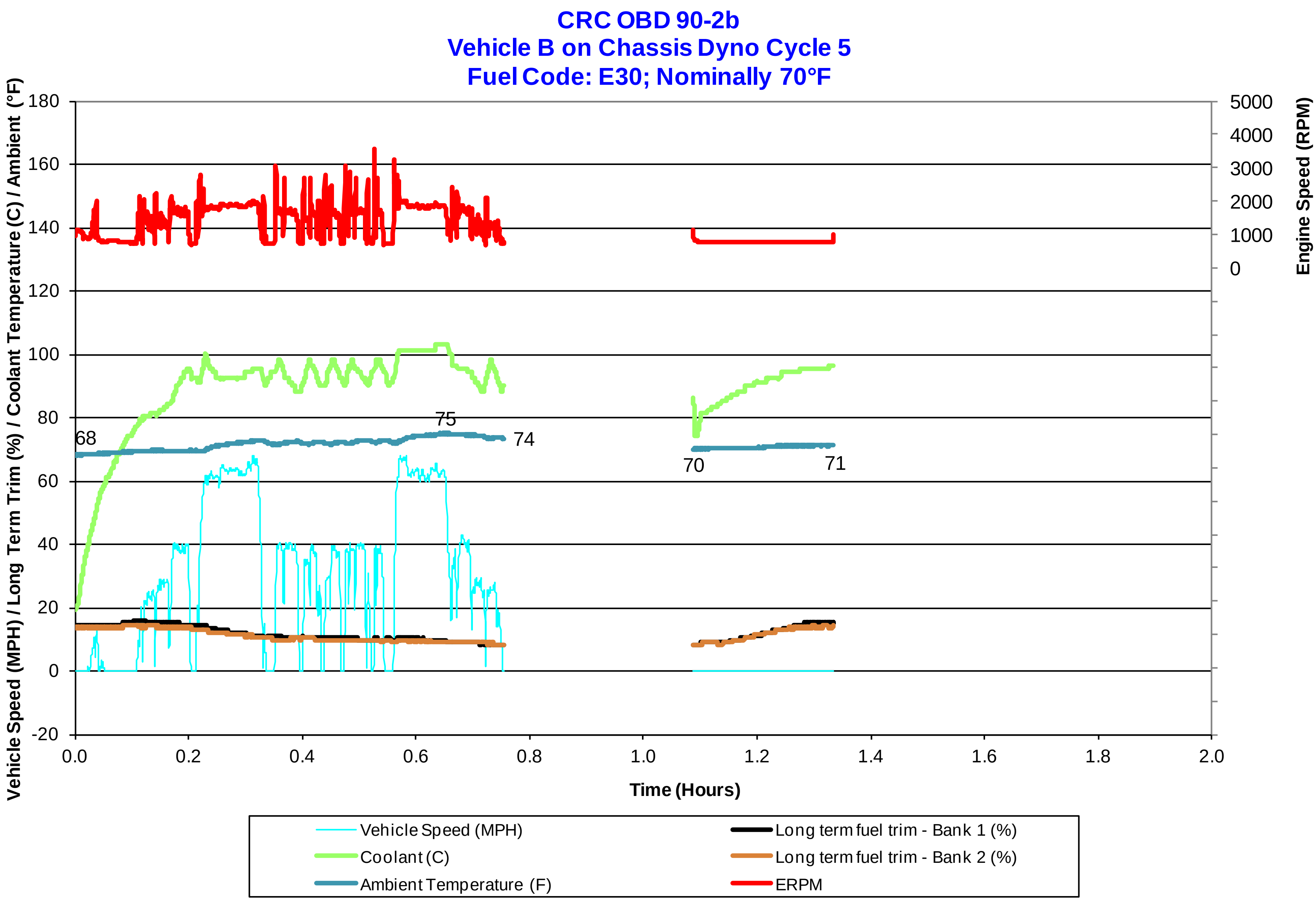
SAMPLE CHASSIS DYNO DATA



SAMPLE CHASSIS DYNO DATA

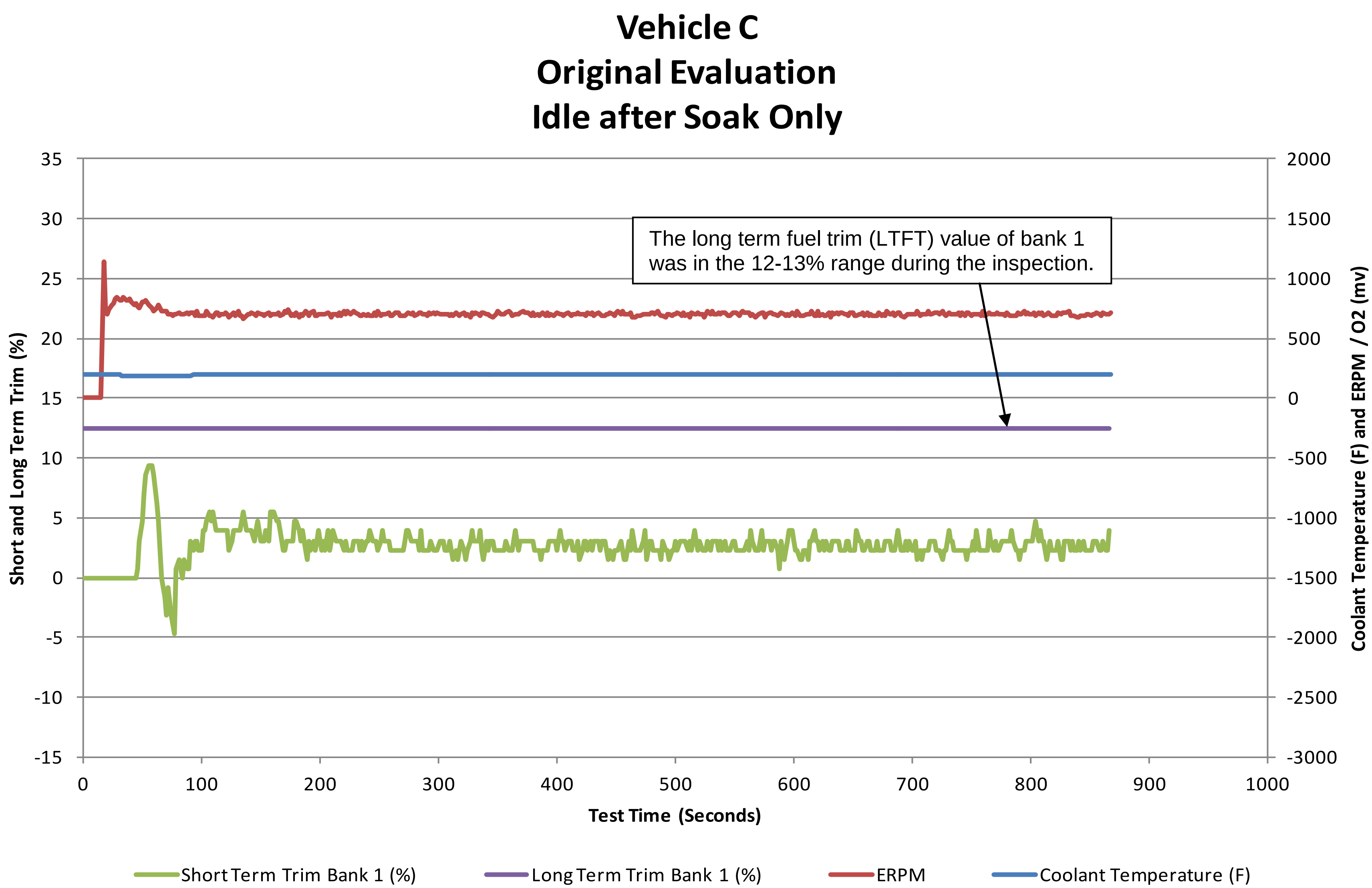


SAMPLE CHASSIS DYNO DATA



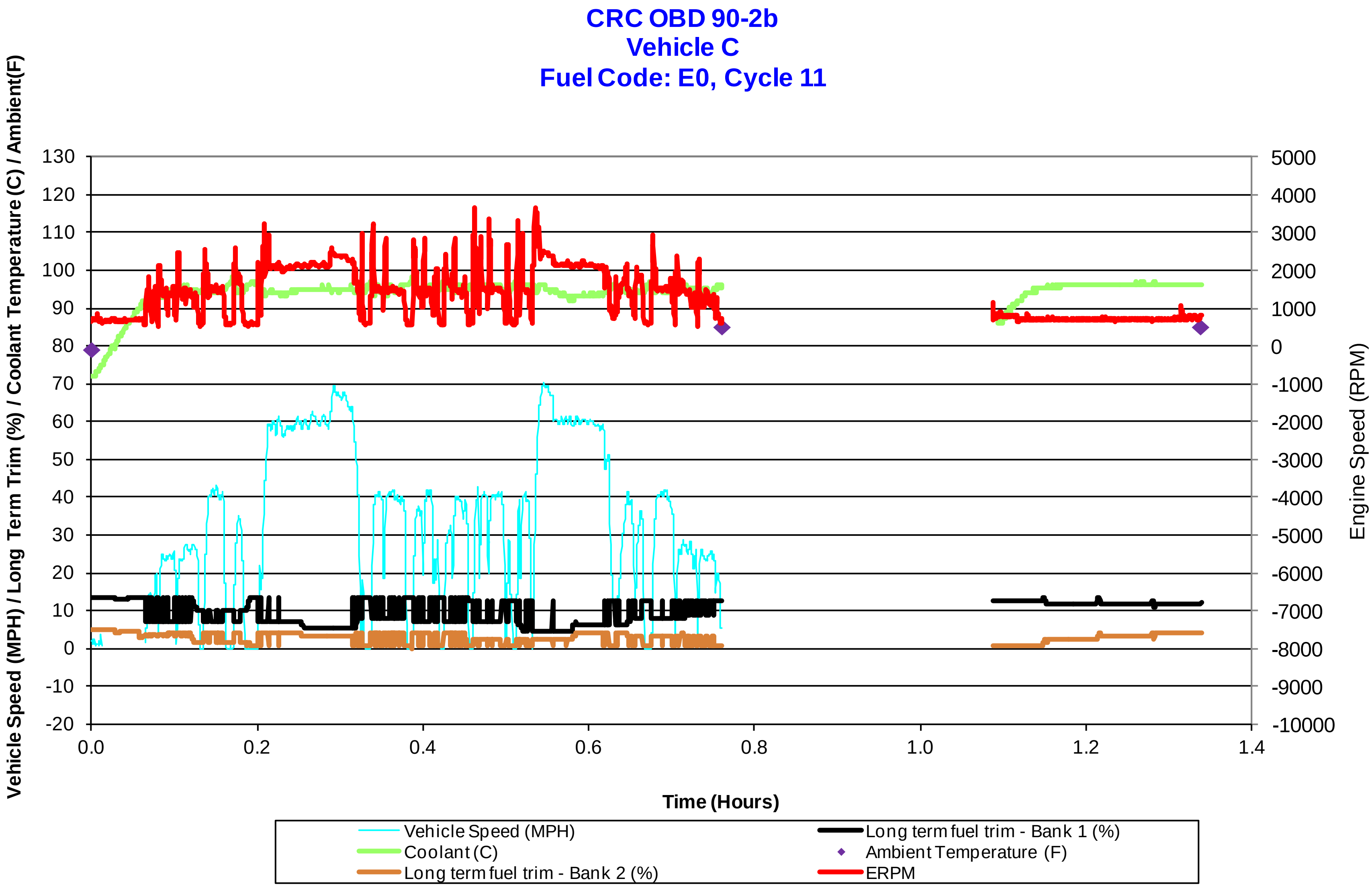
Appendix L

Vehicle C Results

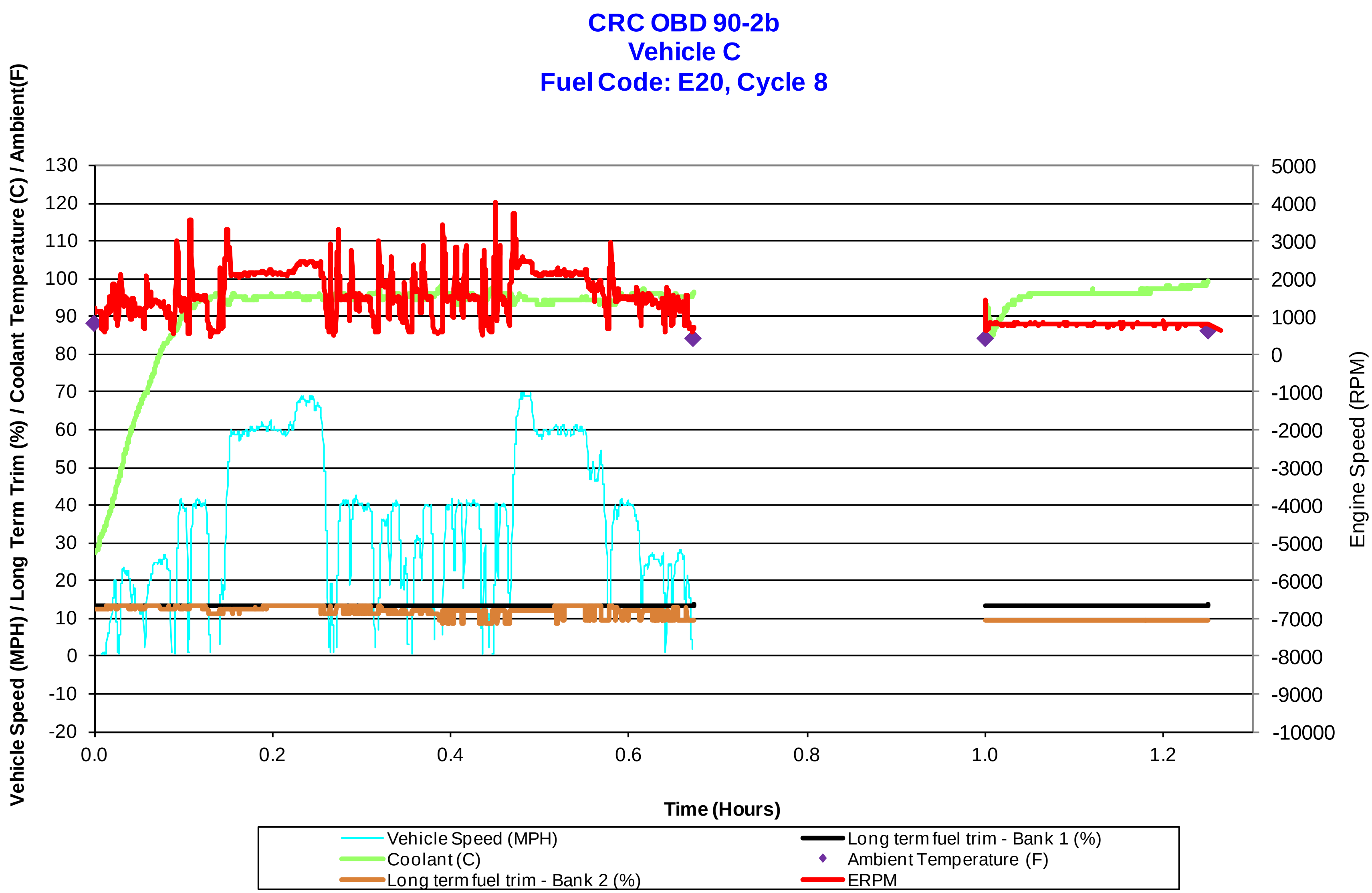


Vehicle C
Original Evaluation
Idle after Soak Only
The long term fuel trim (LTFT) value of bank 1 was in the 12-13% range during the inspection.
Short and Long Term Trim (%)
35
30
25
20
15
10
5
0
-5
-10
-15
Coolant Temperature (F) and ERPM / O2 (mv)
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
0
100
200
300
400
500
600
700
800
900
1000
Test Time (Seconds)
Short Term Trim Bank 1 (%)
Long Term Trim Bank 1 (%)
ERPM
Coolant Temperature (F)

Sample Road Data



Sample Road Data



On-Road

Vehicle C
Start of Test Date: 5/26/2011
Start of Test Odometer: 88,995 miles

Long Term Fuel Trim (%) - Average of Last Minute of Idle

				E0 Fuel		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E0 Bank1 Long Term Fuel Trim (%)	E0 Bank2 Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1						
Cycle 2	5/26/2011	9:06	10:20	10.32		90
Cycle 3	5/26/2011		13:52	9.42		92
Cycle 4**	5/26/2011	7:02	8:24	10.93		74
Cycle 5***	6/9/2011	9:00	10:16	11.02		85
Cycle 6	6/9/2011		11:30	13.45		91
Cycle 7	6/9/2011		13:42	13.48		92
Cycle 8	6/10/2011	9:01	10:15	11.11		79
Cycle 9	6/10/2011		11:31	11.91		85
Cycle 10	6/10/2011		13:54	13.51		93
Cycle 11	6/20/2011	9:44	11:01	11.90	4.02	85
Cycle 12	6/20/2011		13:52	13.49	5.61	93
Cycle 13	6/21/2011	9:30	10:45	11.93	3.25	89
Cycle 14	6/21/2011		13:12	13.52	3.09	92
Cycle 15	6/22/2011	8:32	9:47	8.79	0.91	72
Cycle 16	6/22/2011		13:42	12.73	1.54	84

** P0154 O2 - Sensor No Activity
MIL illuminated during the cycle

*** Installed new Bank 2 - Sensor 1 prior to Cycle 5.

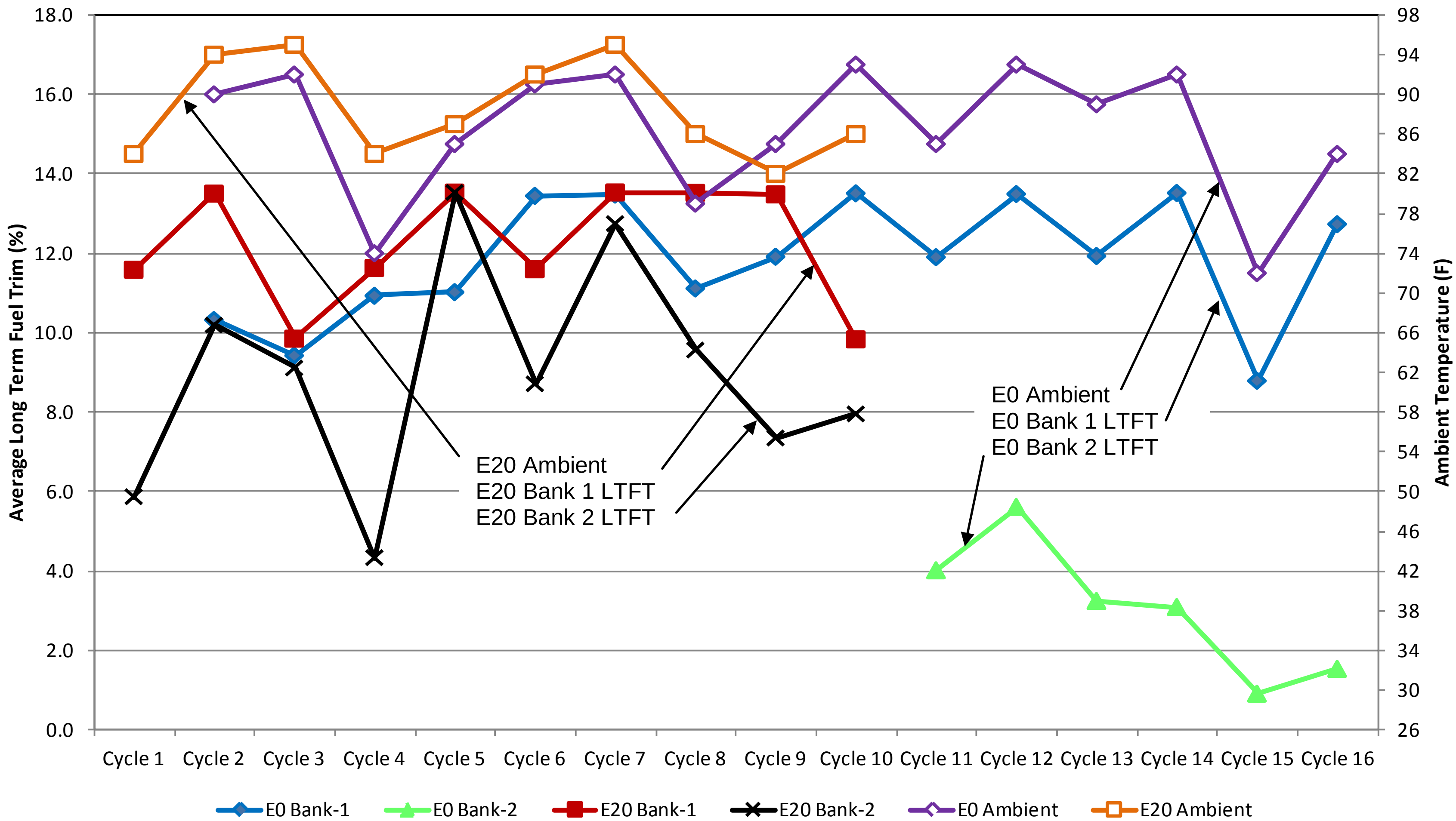
				E20 Fuel		
	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E20 Bank1 Long Term Fuel Trim (%)	E20 Bank2 Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1	6/30/2011	8:35	9:51	11.59	5.87	84
Cycle 2	6/30/2011		13:43	13.50	10.19	94
Cycle 3	6/30/2011		14:58	9.85	9.11	95
Cycle 4	7/1/2011	8:27	9:42	11.63	4.34	84
Cycle 5	7/1/2011		10:55	13.53	13.53	87
Cycle 6	7/1/2011		13:39	11.60	8.71	92
Cycle 7	7/1/2011		14:53	13.53	12.75	95
Cycle 8 ++	7/5/2011	9:39	10:54	13.52	9.56	86
Cycle 9	7/11/2011	8:52	10:10	13.48	7.35	82
Cycle 10	7/11/2011		11:24	9.83	7.96	86

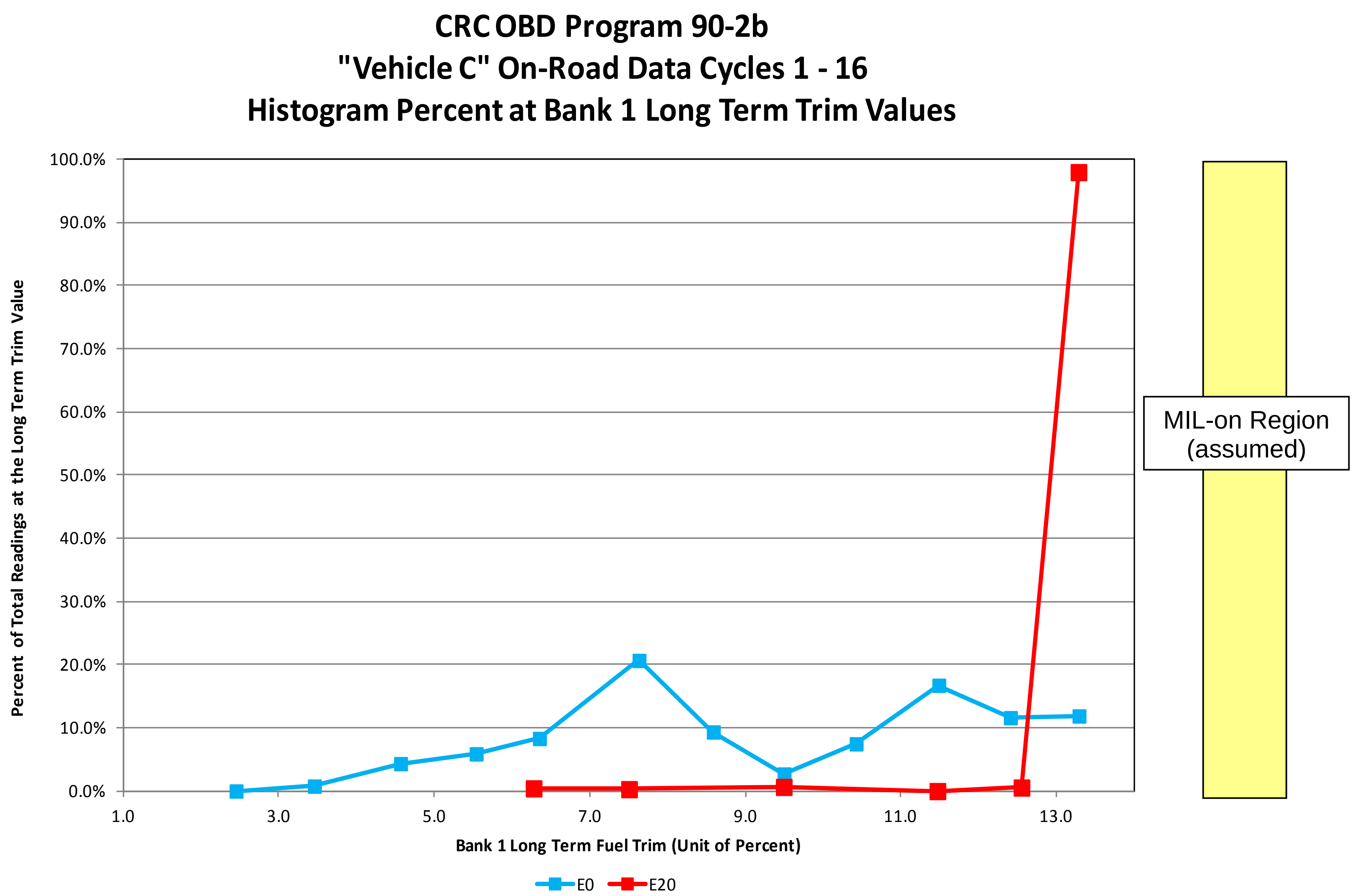
++ On a deceleration from 40 to 20 mph the MIL set.
It was a "P0401 EGR flow insufficient" code.
Test 8 was completed with the code.
The code was reset prior to test 9.
The MIL did not illuminate during tests 9 and 10.

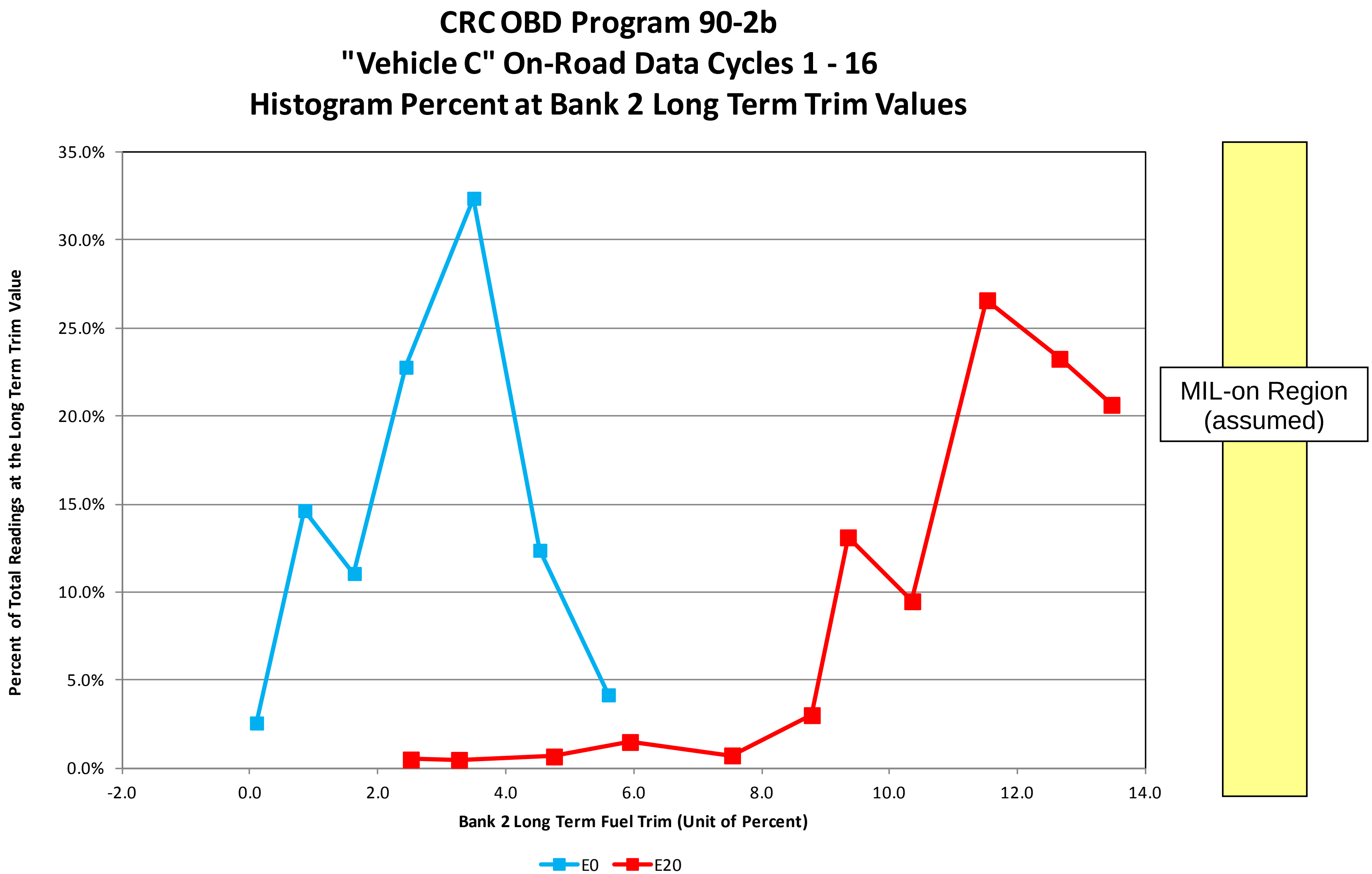
+ Military time

On-Road

Vehicle C
Average Long Term Fuel Trim (%)
Last Minute of Extended Idle after Soak



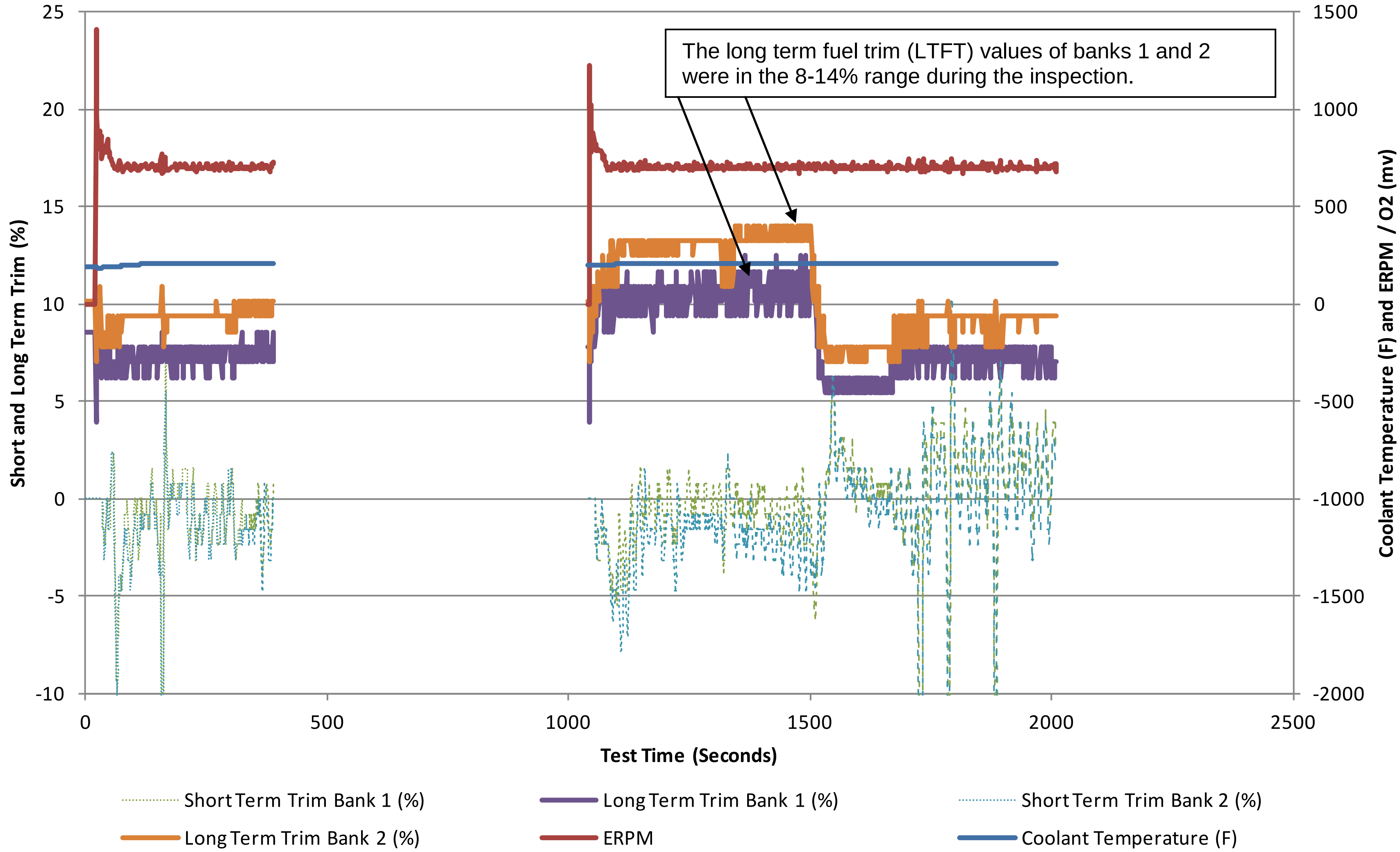

CRC OBD Program 90-2b
"Vehicle C" On-Road Data Cycles 1 - 16
Histogram Percent at Bank 1 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
1.0
3.0
5.0
7.0
9.0
11.0
13.0
Bank 1 Long Term Fuel Trim (Unit of Percent)
E0
E20
MIL-on Region
(assumed)


CRC OBD Program 90-2b
"Vehicle C" On-Road Data Cycles 1 - 16
Histogram Percent at Bank 2 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Bank 2 Long Term Fuel Trim (Unit of Percent)
E0
E20
MIL-on Region
(assumed)

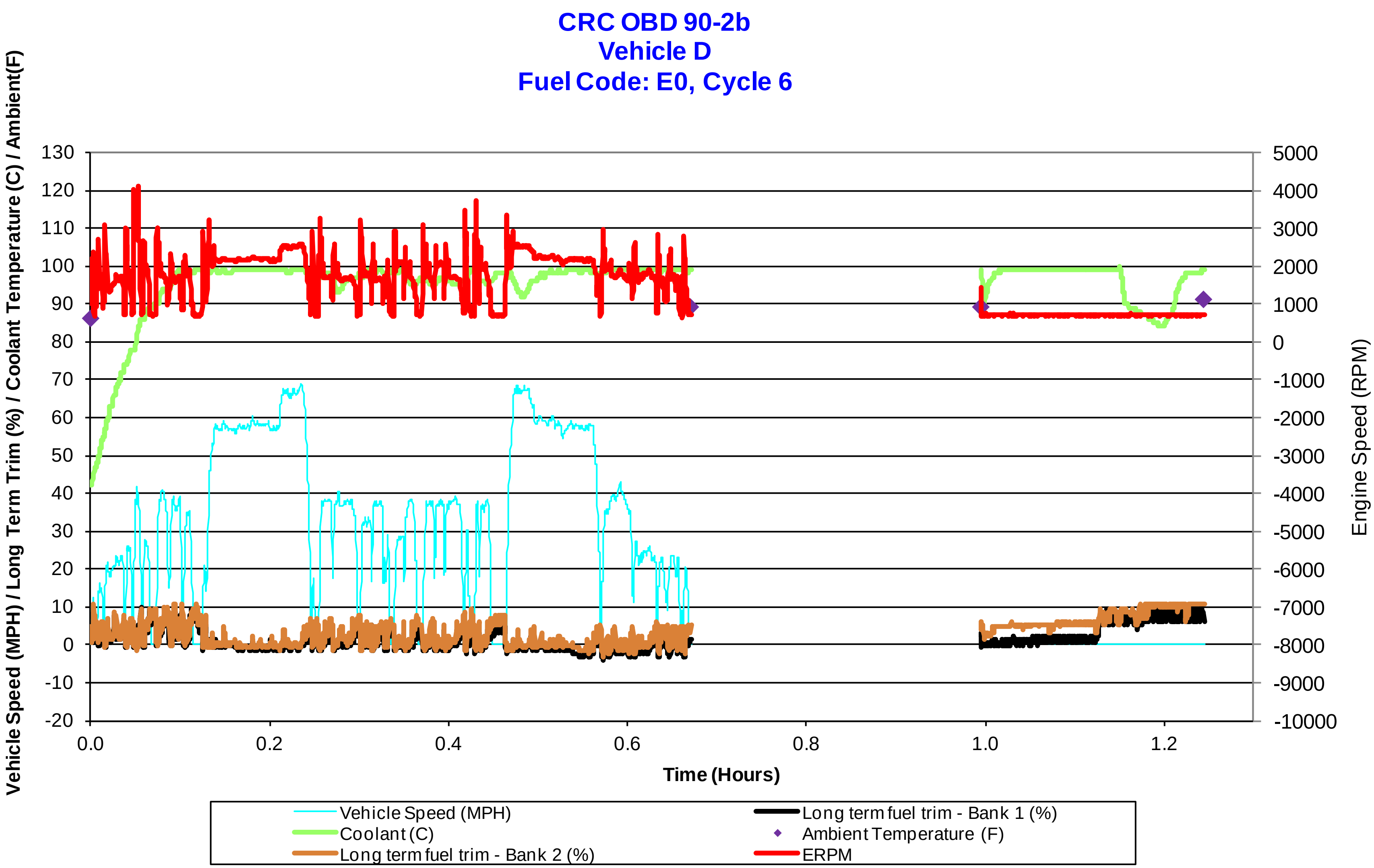
Appendix M

Vehicle D Results

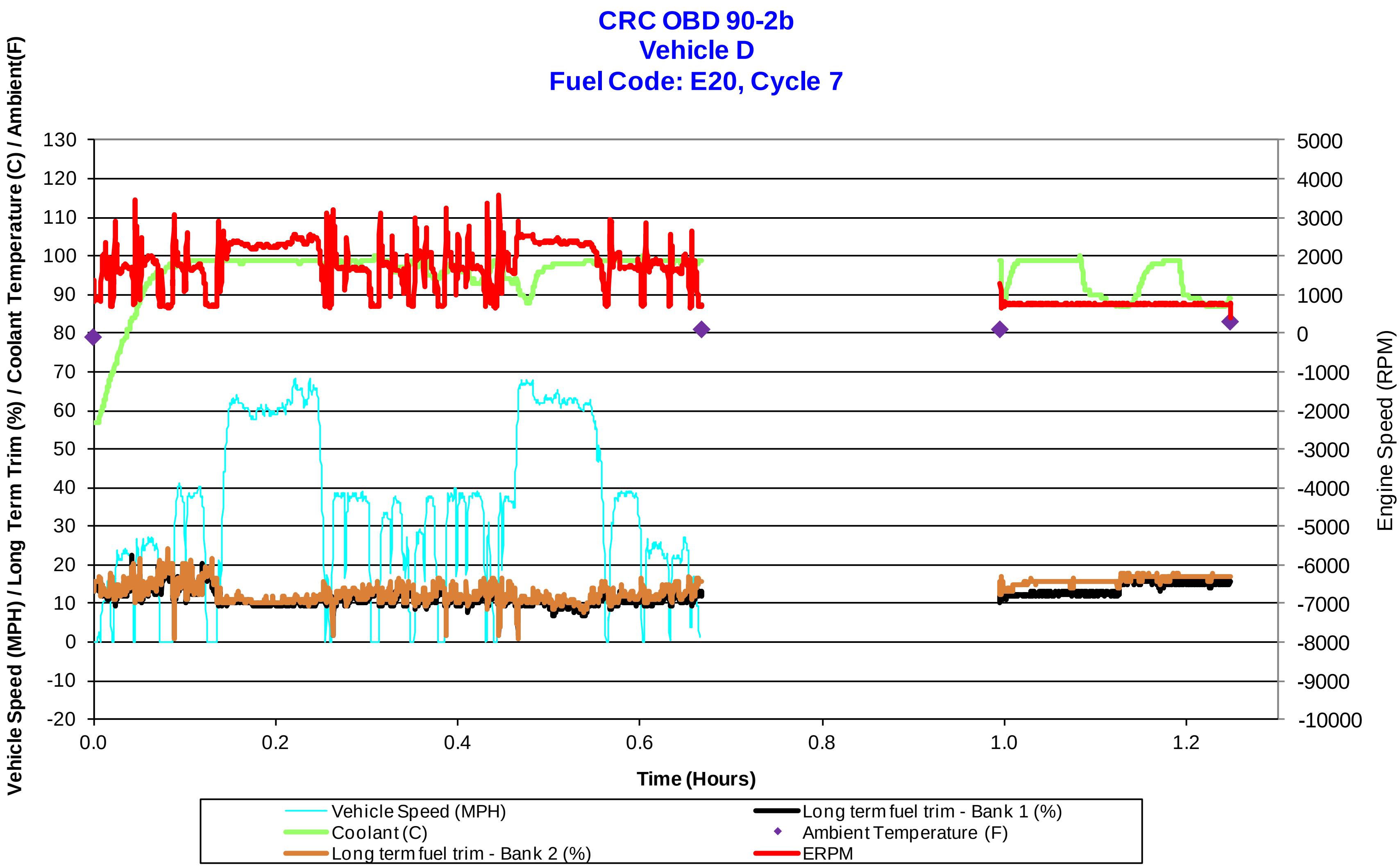
Vehicle D
Original Evaluation



Sample Road Data



Sample Road Data



Vehicle D
On-Road

Vehicle D
Start of Test Date: 8/11/2011
Start of Test Odometer: 65,354 miles

Long Term Fuel Trim (%) - Average of Last Minute of Idle

	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E0 Bank1 Long Term Fuel Trim (%)	E0 Bank2 Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1	8/11/2011	12:40	13:59	6.60	9.15	98
Cycle 2	8/11/2011		15:13	6.76	9.35	101
Cycle 3	8/12/2011	9:51	11:09	6.80	9.29	89
Cycle 4	8/12/2011		13:49	5.13	6.64	97
Cycle 5	8/12/2011		15:06	6.50	6.50	100
Cycle 6	8/17/2011	10:05	11:21	7.89	10.90	91
Cycle 7	8/17/2011		13:46	5.89	7.68	98
Cycle 8	8/17/2011		15:02	8.98	10.90	101
Cycle 9	8/18/2011	9:50	11:06	9.32	10.62	89
Cycle 10	8/18/2011		13:44	8.91	10.90	100

	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E20 Bank1 Long Term Fuel Trim (%)	E20 Bank2 Long Term Fuel Trim (%)	Ambient Temperature (F)
Cycle 1	8/29/2011	12:22	13:39	17.35	17.75	105
Cycle 2	8/29/2011		14:54	18.61	19.40	107
Cycle 3	8/30/2011	10:03	11:20	15.30	15.77	90
Cycle 4	8/30/2011		13:42	16.89	17.96	100
Cycle 5	9/1/2011	12:40	13:04	17.22	19.51	97
Cycle 6	9/1/2011		15:11	18.39	19.90	100
Cycle 7	9/26/2011	10:00	11:15	15.50	17.15	83
Cycle 8	9/28/2011	8:40	9:59	14.32	15.58	80
Cycle 9	9/28/2011		11:13	16.07	17.89	86
Cycle 10	9/28/2011		14:10	16.19	17.93	96

	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E30 Bank1 Long Term Fuel Trim (%)	E30 Bank2 Long Term Fuel Trim (%)	Ambient Temp (F)
Cycle 1 **	1/27/2012	13:50	15:06	18.45	22.38	70

** Approximately two minutes into the first test cycle, Vehicle D illuminated the MIL.
The driver finished the cycle including the engine soak and idle segments.
After the idle segment, the vehicle was scanned for engine diagnostic trouble codes (DTCs) and a P0174 “System Too Lean (Bank 2)” DTC was observed.

+ Military time

Incident Report
CRC OBD
Vehicle: Vehicle D

SwRI Project Number: 08.15995.01.002
Date of First Occurrence: 1/27/2012
Approximate Odometer: 65,838
Test miles: 1
Test Interval: E30 On-Road Testing

Incident Description:

Vehicle D set a MIL light for a P0174 “System Too Lean (Bank 2)” DTC.

Action Taken:

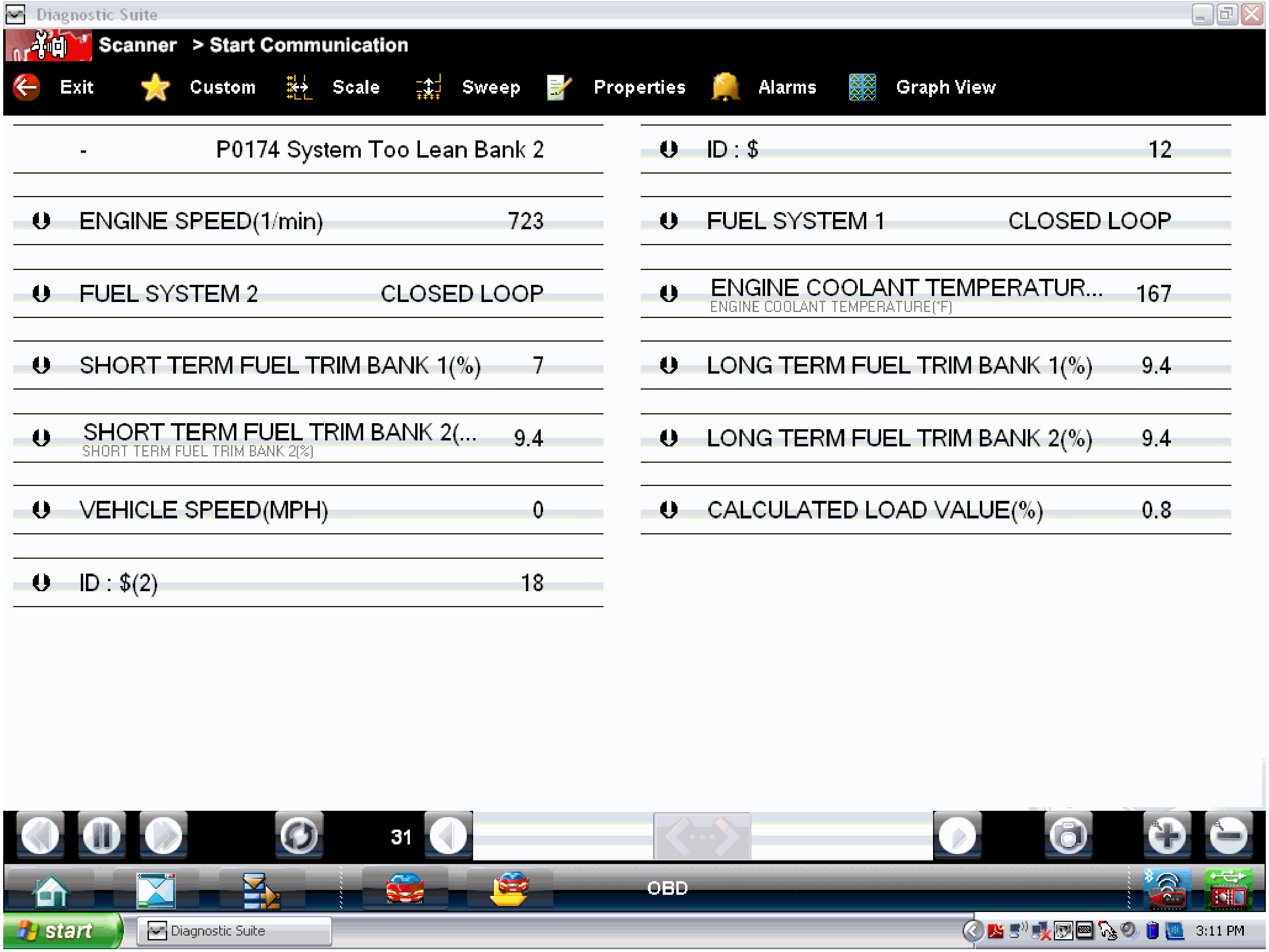
On 1/27/2012, Vehicle D began the on-road testing using E30 test fuel. Approximately two minutes into the first test cycle, Vehicle D set a MIL light. The driver finished the cycle including the engine soak and idle segments. After the idle segment, the vehicle was scanned for engine diagnostic trouble codes (DTCs) and a P0174 “System Too Lean (Bank 2)” DTC was observed.

Resolution:

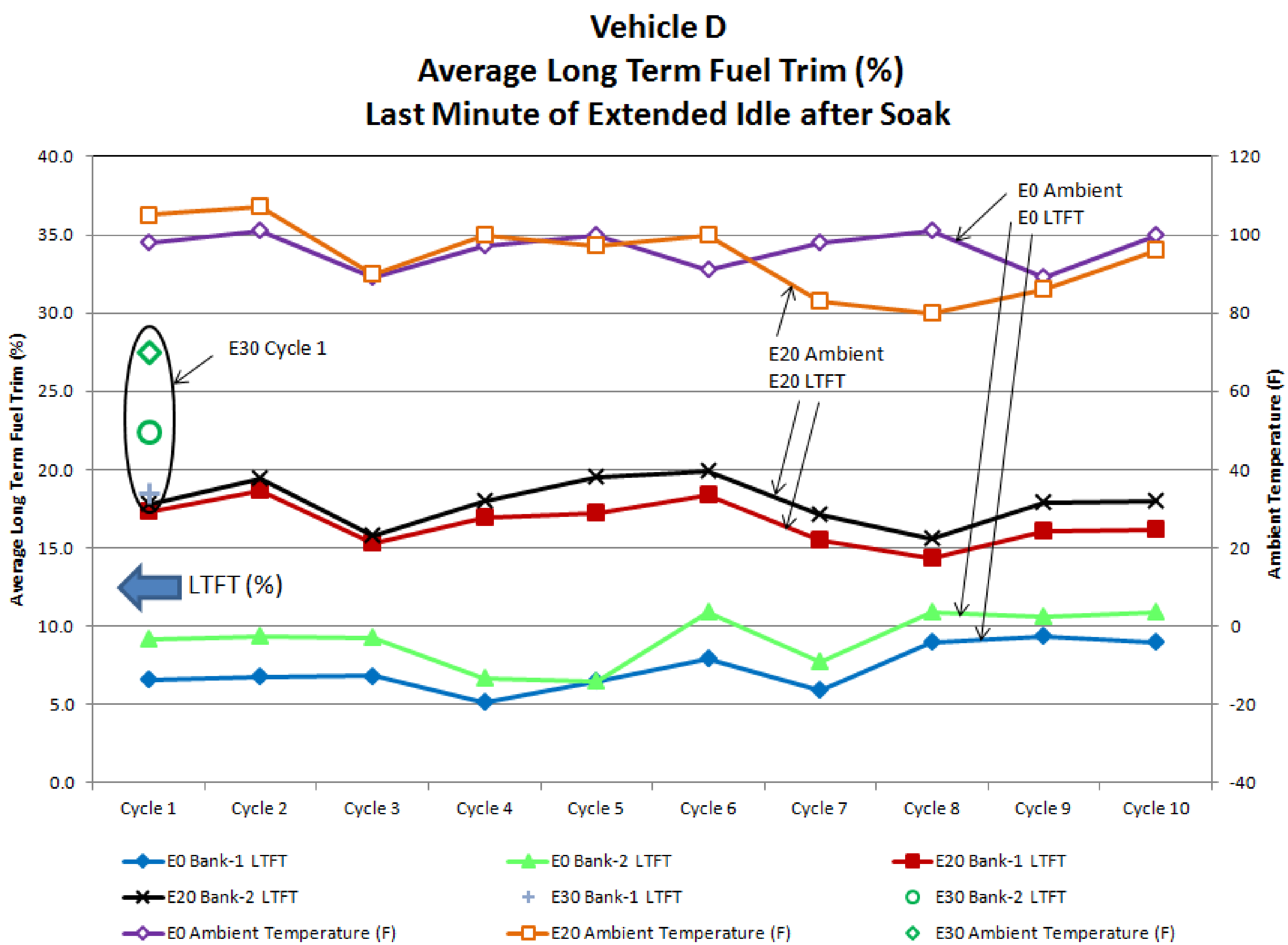
The P0174 DTC is one of the engine codes indicative of engine performance related to ethanol content in the fuel. The on-road testing was discontinued and the vehicle will be used for the temperature-controlled portion of the program.

Figure M-1 displays the freeze frame data which lists the values of various engine parameters at the moment the MIL light turned on.

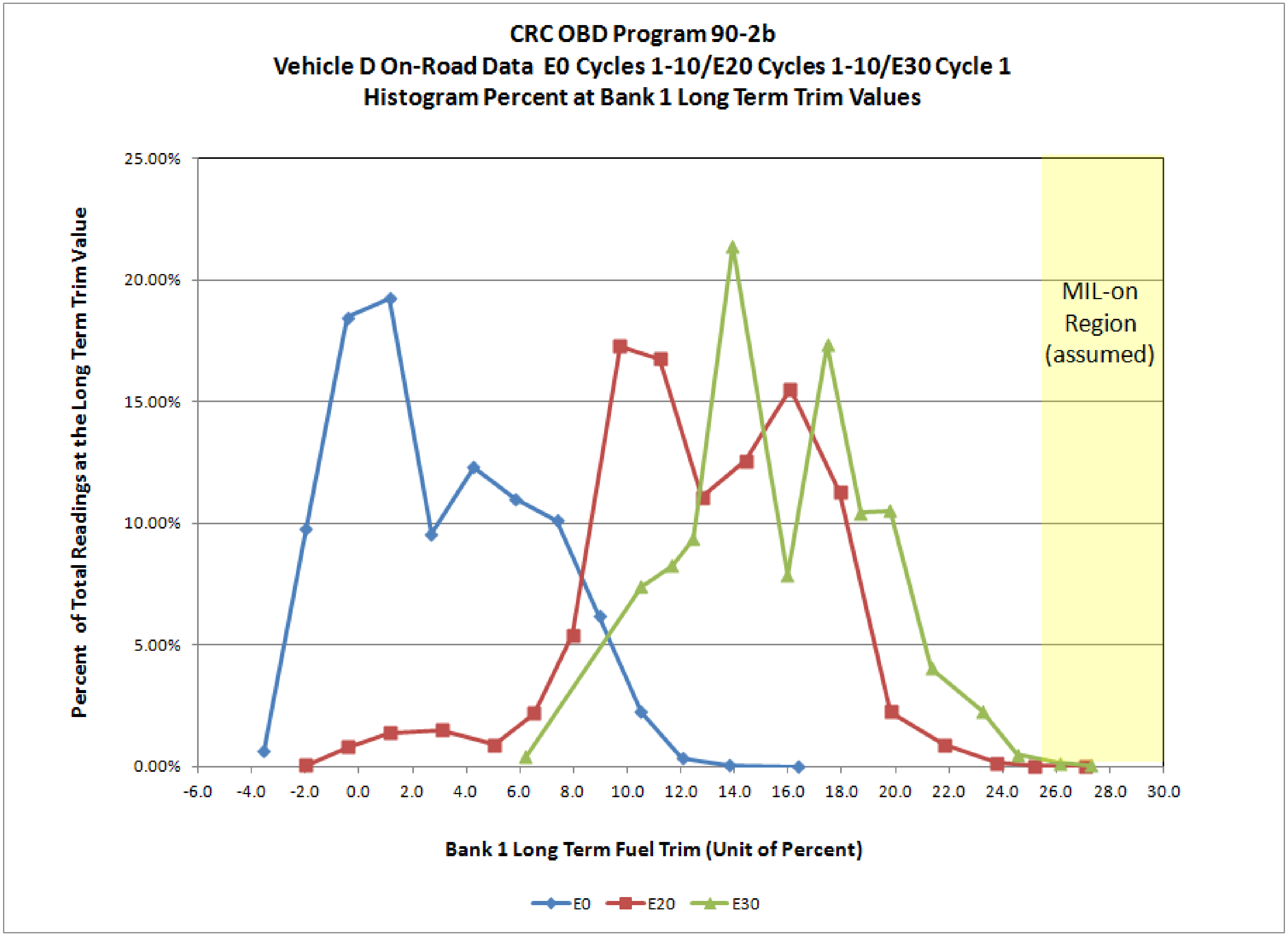
Freeze Frame Data – Vehicle D (Figure M-1 of 1)

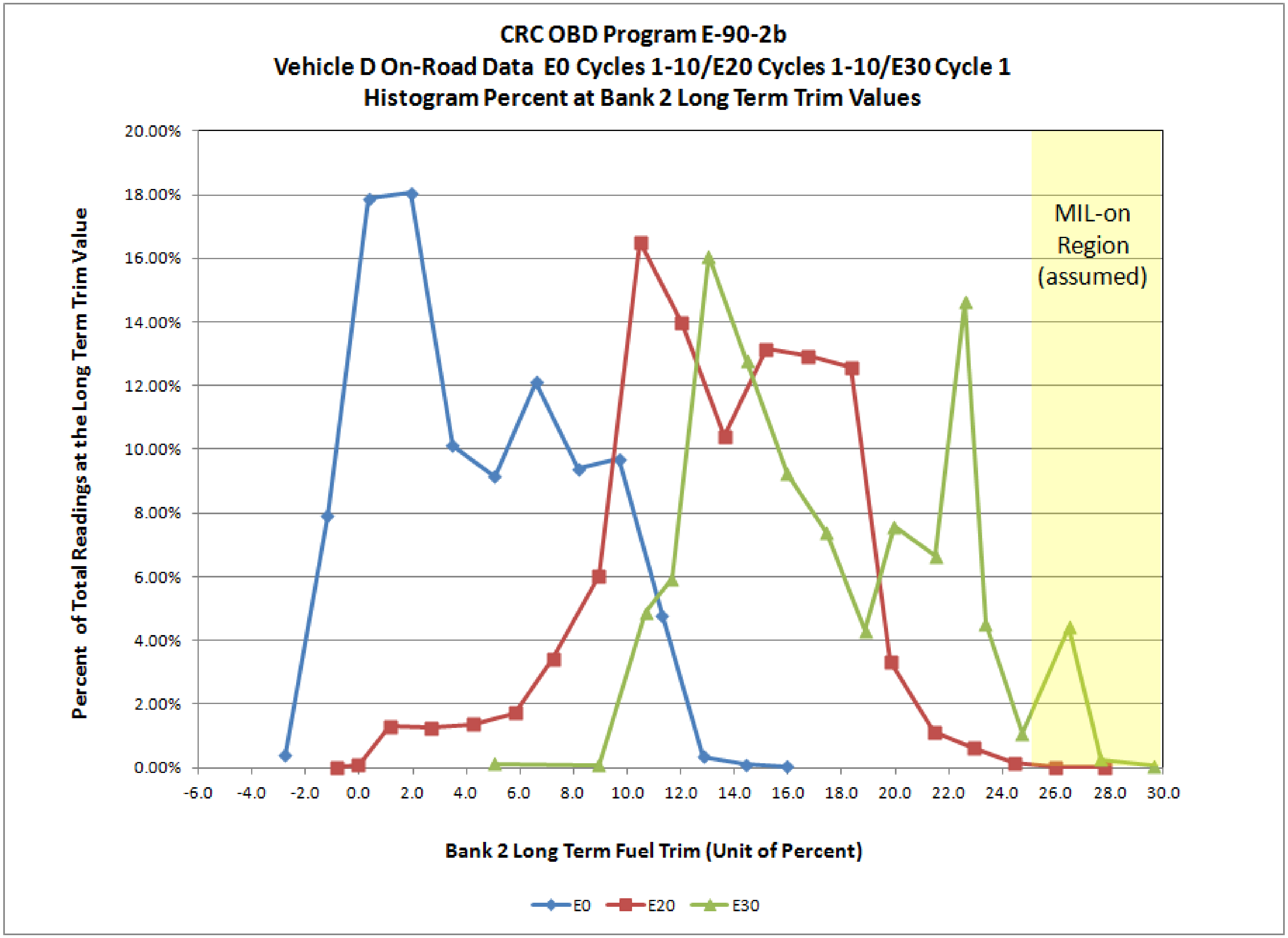


On-Road



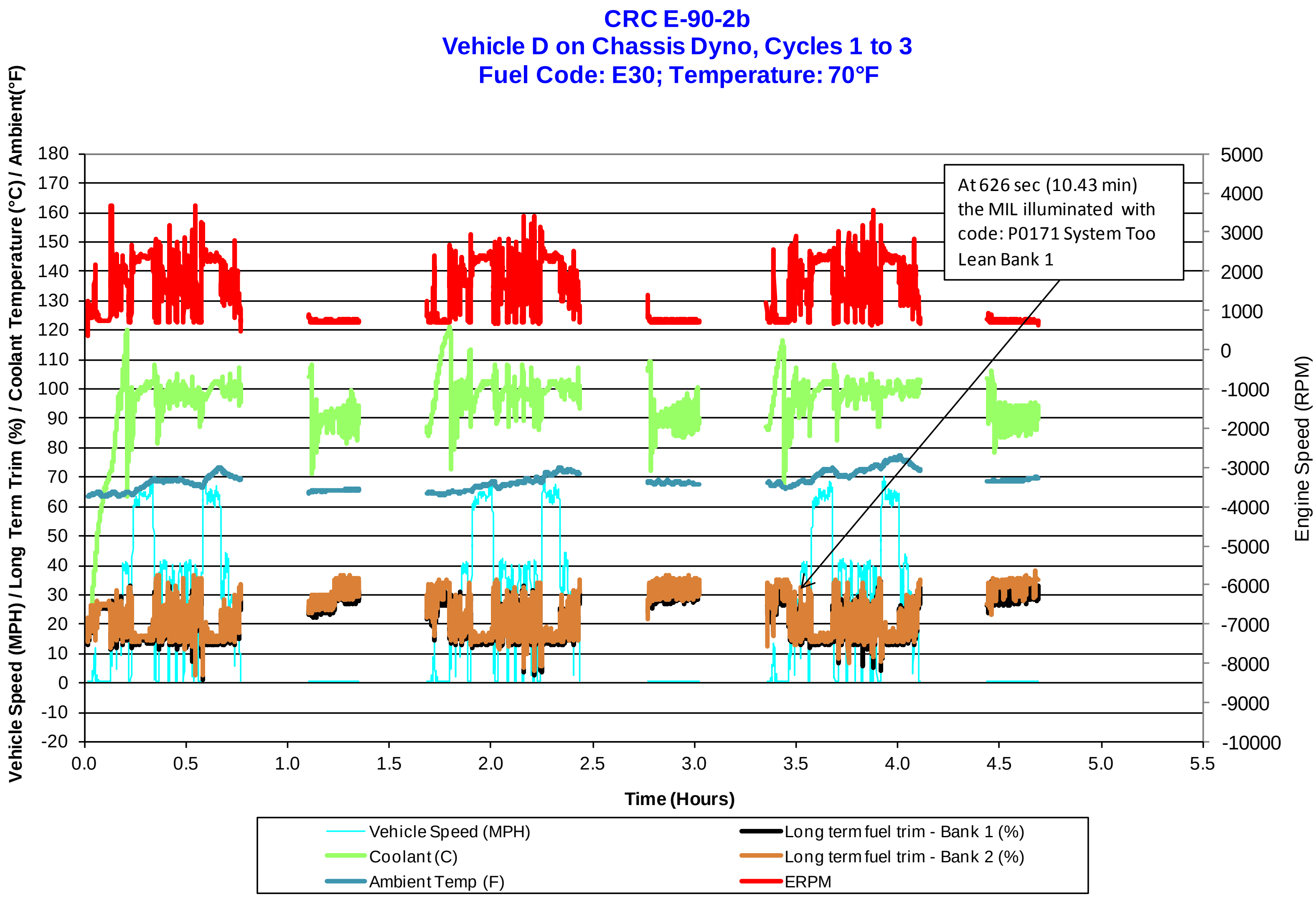
Vehicle D
Average Long Term Fuel Trim (%)
Last Minute of Extended Idle after Soak
Average Long Term Fuel Trim (%)
Ambient Temperature (F)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
120
100
80
60
40
20
0
-20
-40
E30 Cycle 1
LTFT (%)
E0 Ambient
E0 LTFT
E20 Ambient
E20 LTFT
Cycle 1
Cycle 2
Cycle 3
Cycle 4
Cycle 5
Cycle 6
Cycle 7
Cycle 8
Cycle 9
Cycle 10
E0 Bank-1 LTFT
E0 Bank-2 LTFT
E20 Bank-1 LTFT
E20 Bank-2 LTFT
E30 Bank-1 LTFT
E30 Bank-2 LTFT
E0 Ambient Temperature (F)
E20 Ambient Temperature (F)
E30 Ambient Temperature (F)


CRC OBD Program 90-2b
Vehicle D On-Road Data E0 Cycles 1-10/E20 Cycles 1-10/E30 Cycle 1
Histogram Percent at Bank 1 Long Term Trim Values
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Percent of Total Readings at the Long Term Trim Value
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
Bank 1 Long Term Fuel Trim (Unit of Percent)
MIL-on
Region
(assumed)
E0
E20
E30



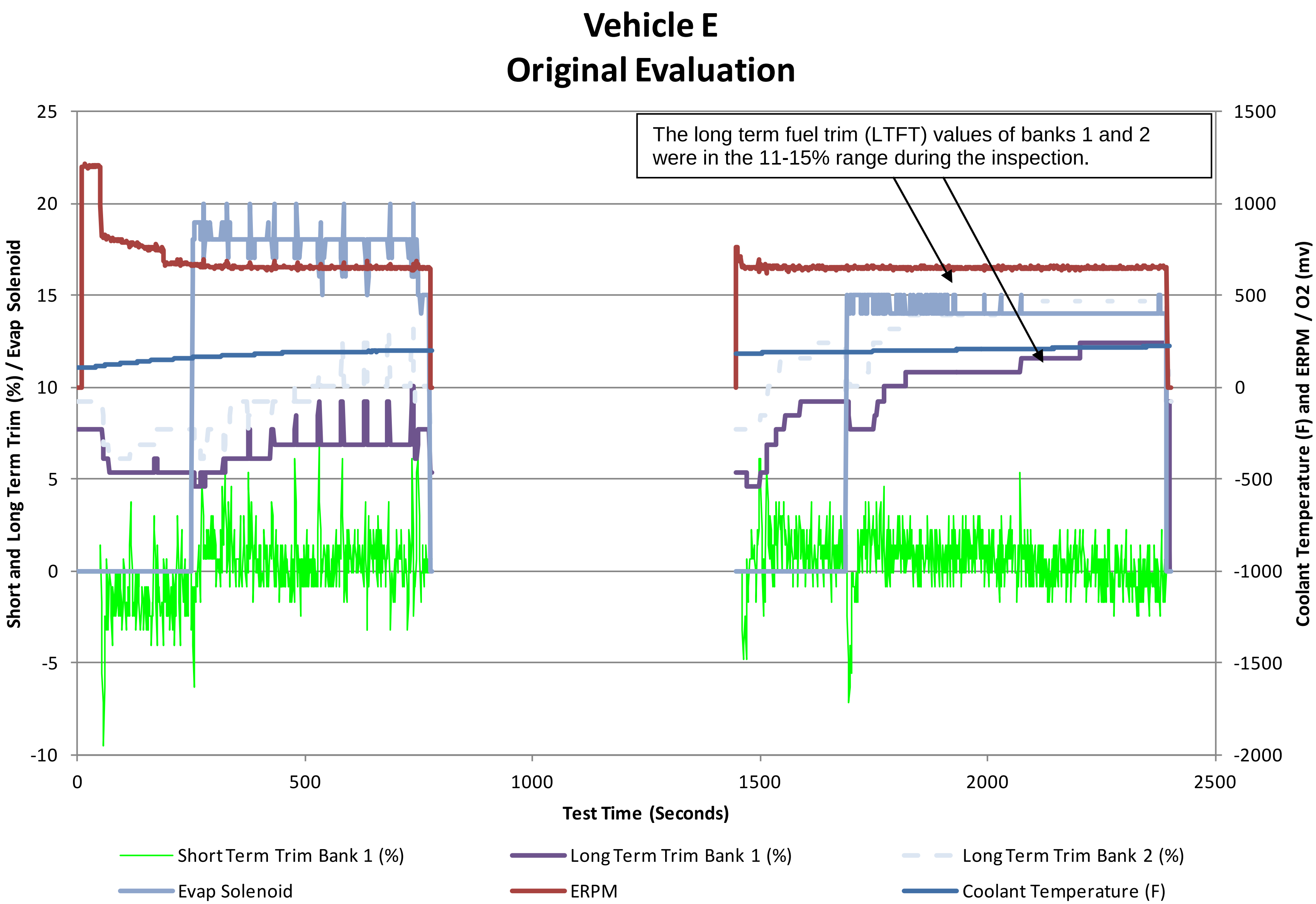
CRC OBD Program E-90-2b
Vehicle D On-Road Data E0 Cycles 1-10/E20 Cycles 1-10/E30 Cycle 1
Histogram Percent at Bank 2 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
20.00%
18.00%
16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
MIL-on
Region
(assumed)
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
Bank 2 Long Term Fuel Trim (Unit of Percent)
E0
E20
E30

SAMPLE CHASSIS DYNO DATA

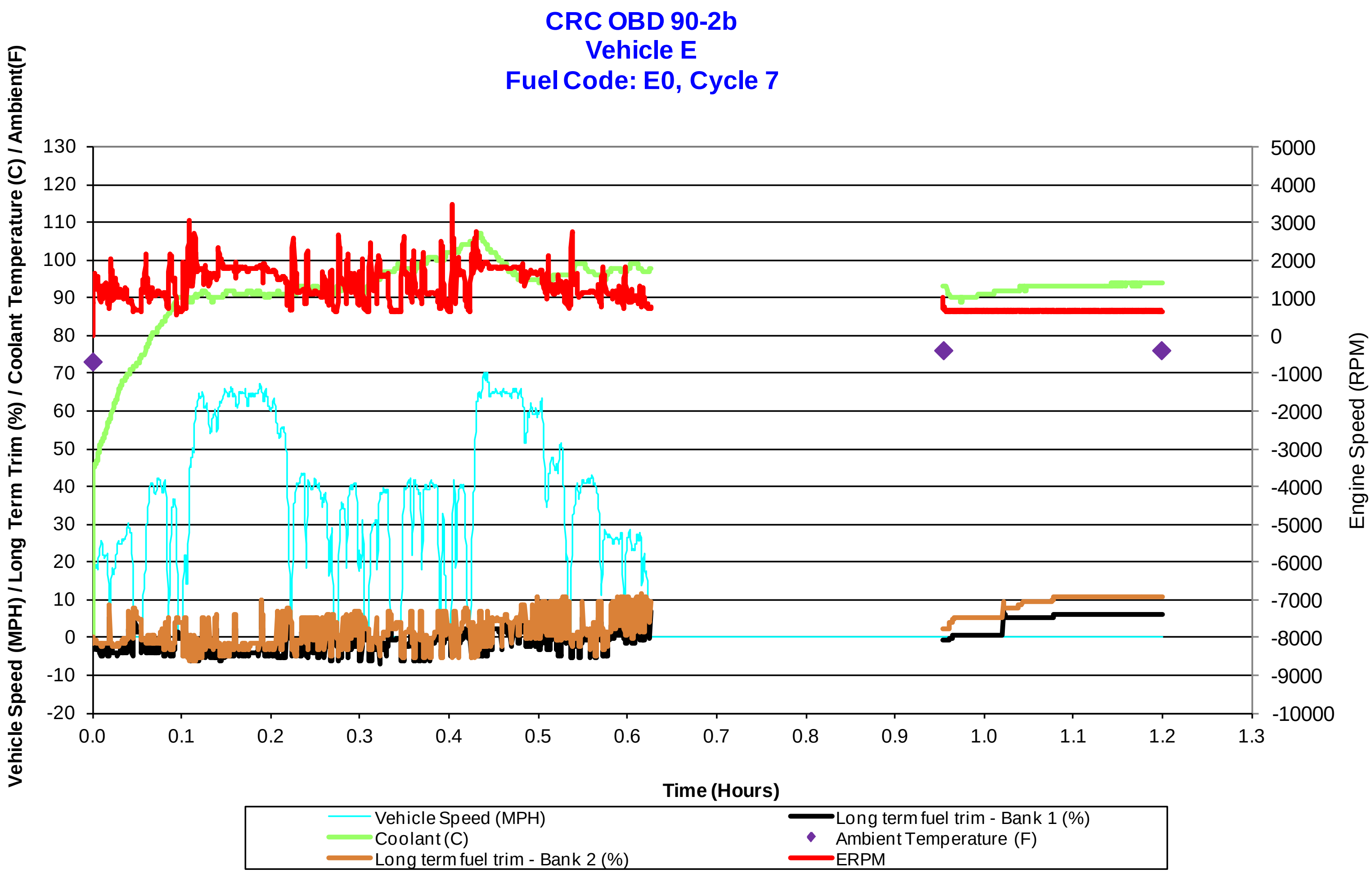


Appendix N

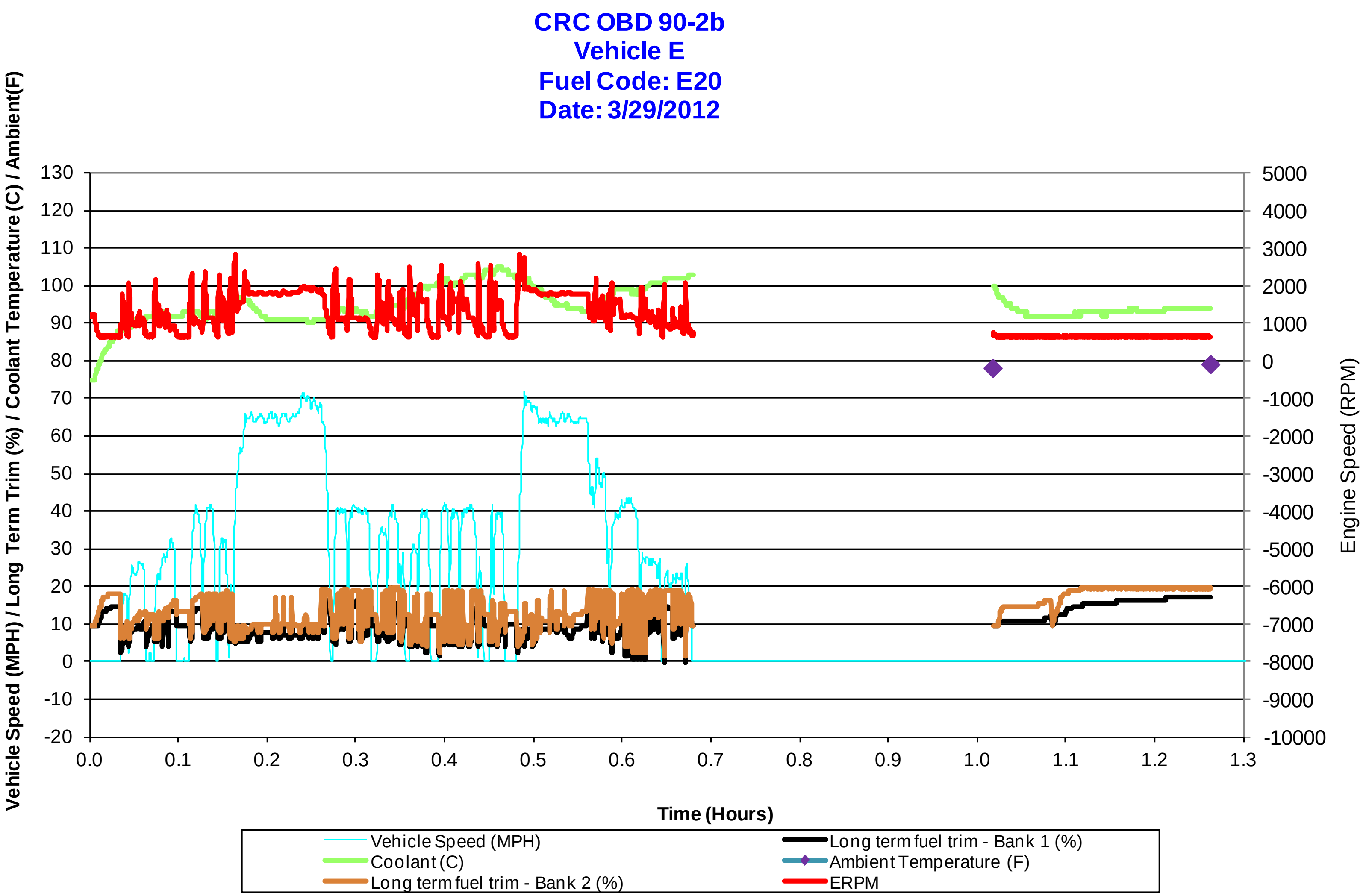
Vehicle E Results


Vehicle E
Original Evaluation
The long term fuel trim (LTFT) values of banks 1 and 2 were in the 11-15% range during the inspection.
Short and Long Term Trim (%) / Evap Solenoid
Coolant Temperature (F) and ERPM / O2 (mv)
Test Time (Seconds)
25
20
15
10
5
0
-5
-10
1500
1000
500
0
-500
-1000
-1500
-2000
0
500
1000
1500
2000
2500
Short Term Trim Bank 1 (%)
Long Term Trim Bank 1 (%)
Long Term Trim Bank 2 (%)
Evap Solenoid
ERPM
Coolant Temperature (F)

Sample Road Data



Sample Road Data



On-Road

Vehicle E

Long Term Fuel Trim (%) - Average of Last Minute of Idle

				Long Term Fuel Trim Avg. Last Minute of Idle		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E0 Bank_1 (%)	E0 Bank_2 (%)	Ambient Temp (F)
Cycle 1	3/14/2012	11:41	12:56	2.291	7.756	74
Cycle 2	3/14/2012		14:19	5.427	10.107	78
Cycle 3	3/14/2012		15:33	6.985	11.671	79
Cycle 4	3/15/2012	9:13	10:28	5.427	9.321	71
Cycle 5	3/15/2012		11:46	6.204	10.880	74
Cycle 6	3/15/2012		14:04	6.985	11.670	80
Cycle 7	3/16/2012	11:55	13:09	3.136	10.881	76
Cycle 8	3/16/2012		14:25	7.760	12.450	79
Cycle 9	3/21/2012	12:38	13:51	11.239	17.111	70
Cycle 10	3/21/2012		15:07	10.881	16.359	74

				Long Term Fuel Trim Avg. Last Minute of Idle		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E20 Bank_1 (%)	E20 Bank_2 (%)	Ambient Temp (F)
Cycle 1*	3/29/2012	12:00	13:13	17.130	19.483	79
Cycle 2*	3/29/2012		14:33	18.705	19.480	81
Cycle 3	3/30/2012	11:45	13:01	18.700	19.487	84
Cycle 4**	3/30/2012		14:29	18.710	19.487	86
Cycle 5	4/4/2012	8:50	10:05	19.467	19.482	69
Cycle 6*	4/4/2012		13:04	17.561	19.477	84
Cycle 7*	4/4/2012		14:21	17.026	19.314	87
Cycle 8*	4/5/2012	9:03	10:17	16.351	19.376	69
Cycle 9	4/5/2012		11:32	17.922	19.481	83
Cycle 10*	4/5/2012		13:41	17.868	19.480	87

*After E20 cycles 1, 2, 6, 7, 8, and 10 a Code P0410 Seconday air injection system code was pending
The MIL was not illuminated.

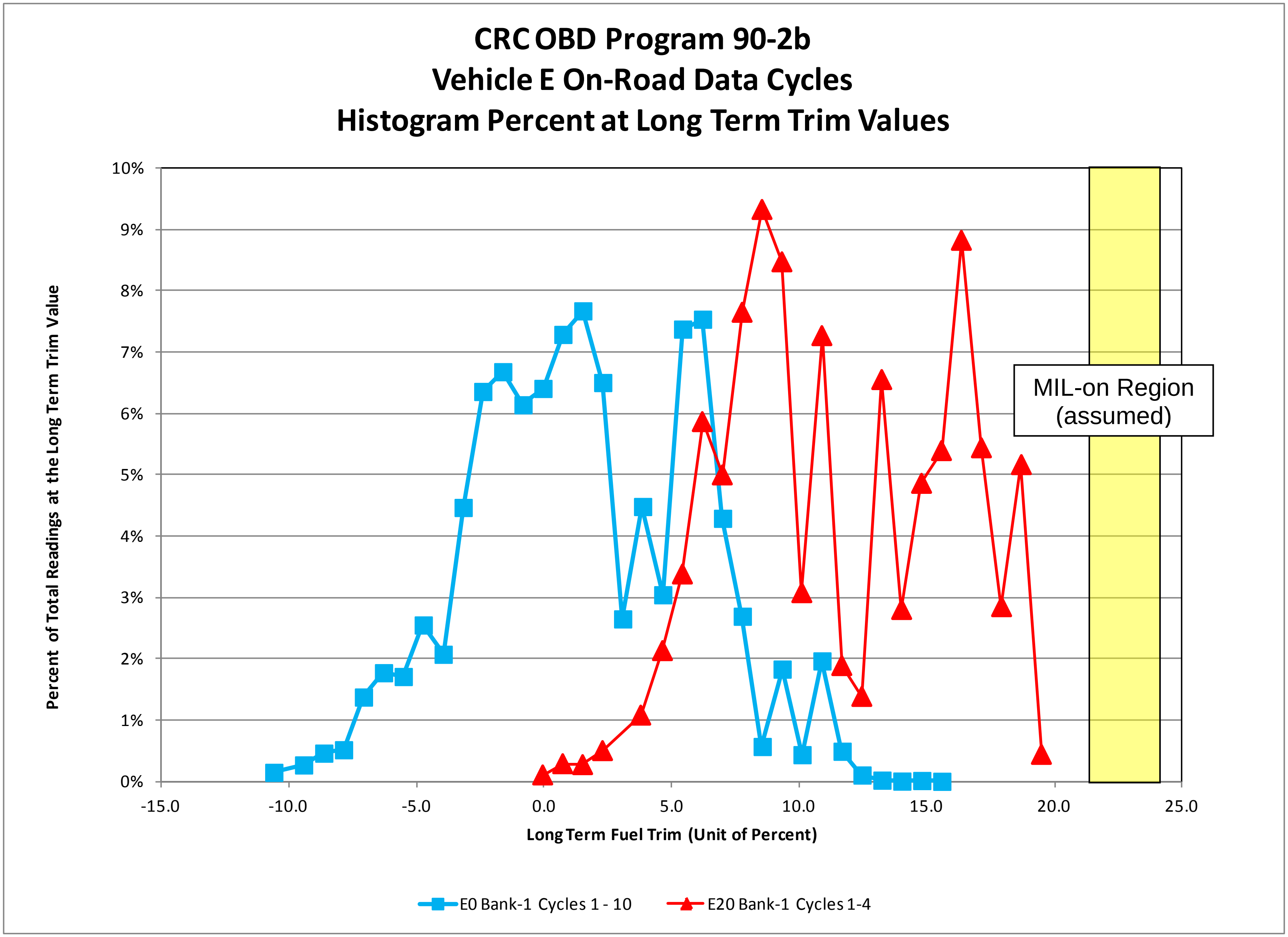
**After E20 cycle 4 a P0174 System too lean bank 2 was active.
The MIL was not illuminated.
After the other cycles the pending code P0174 was not present

				Long Term Fuel Trim Avg. Last Minute of Idle		
Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	E30 Bank_1 (%)	E30 Bank_2 (%)	Ambient Temp (F)
Cycle 1 **	4/18/2012	12:47	14:12	19.500	19.500	81
Cycle 2***	4/19/2012	9:45	9:59			72

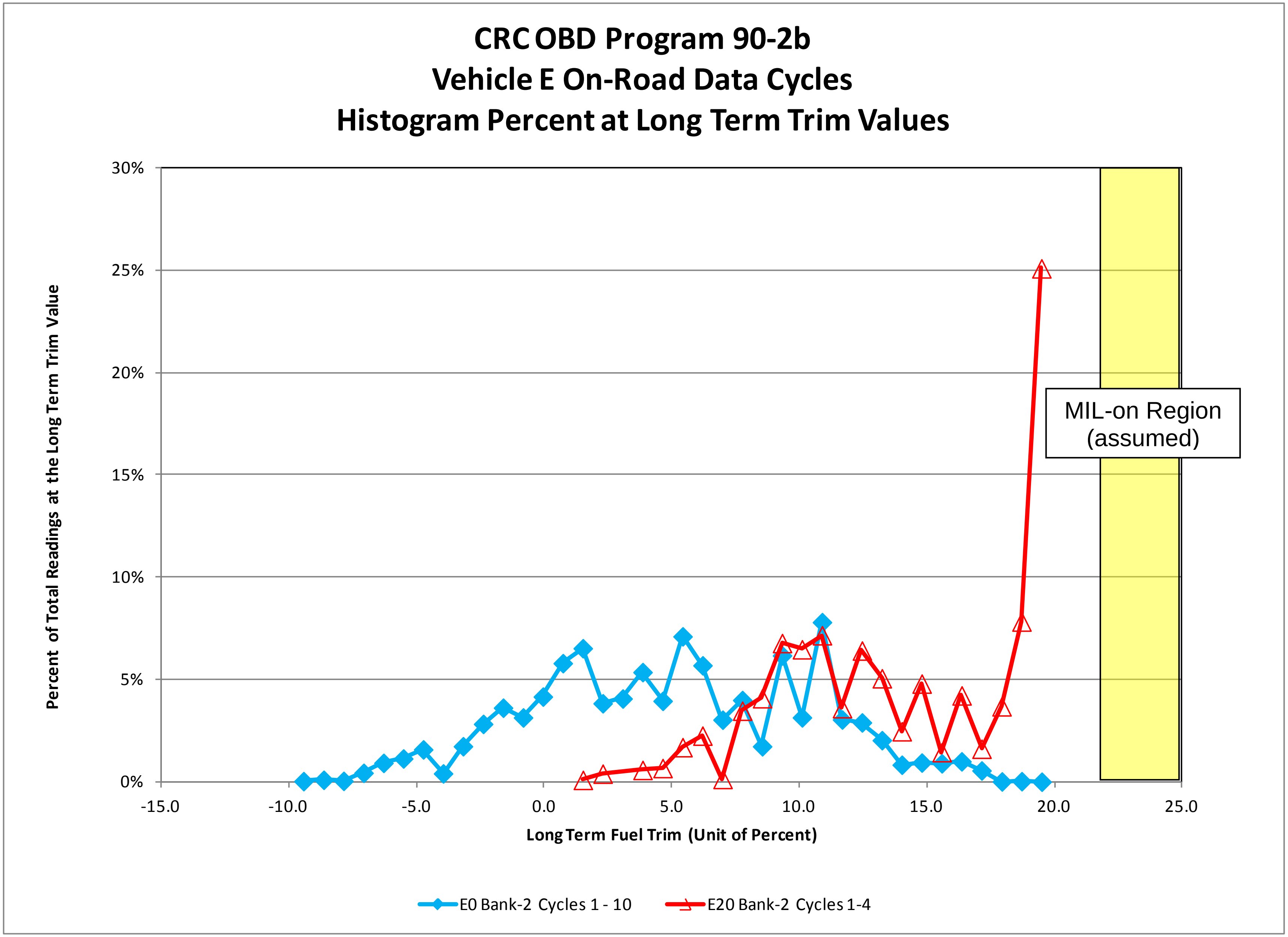
** Pending codes P0171 and P0174 were set.
The MIL was not illuminated

***During Cycle 2 the MIL light came during the drive cycle prior to the idle.
Both codes P0171 and P0174 were set

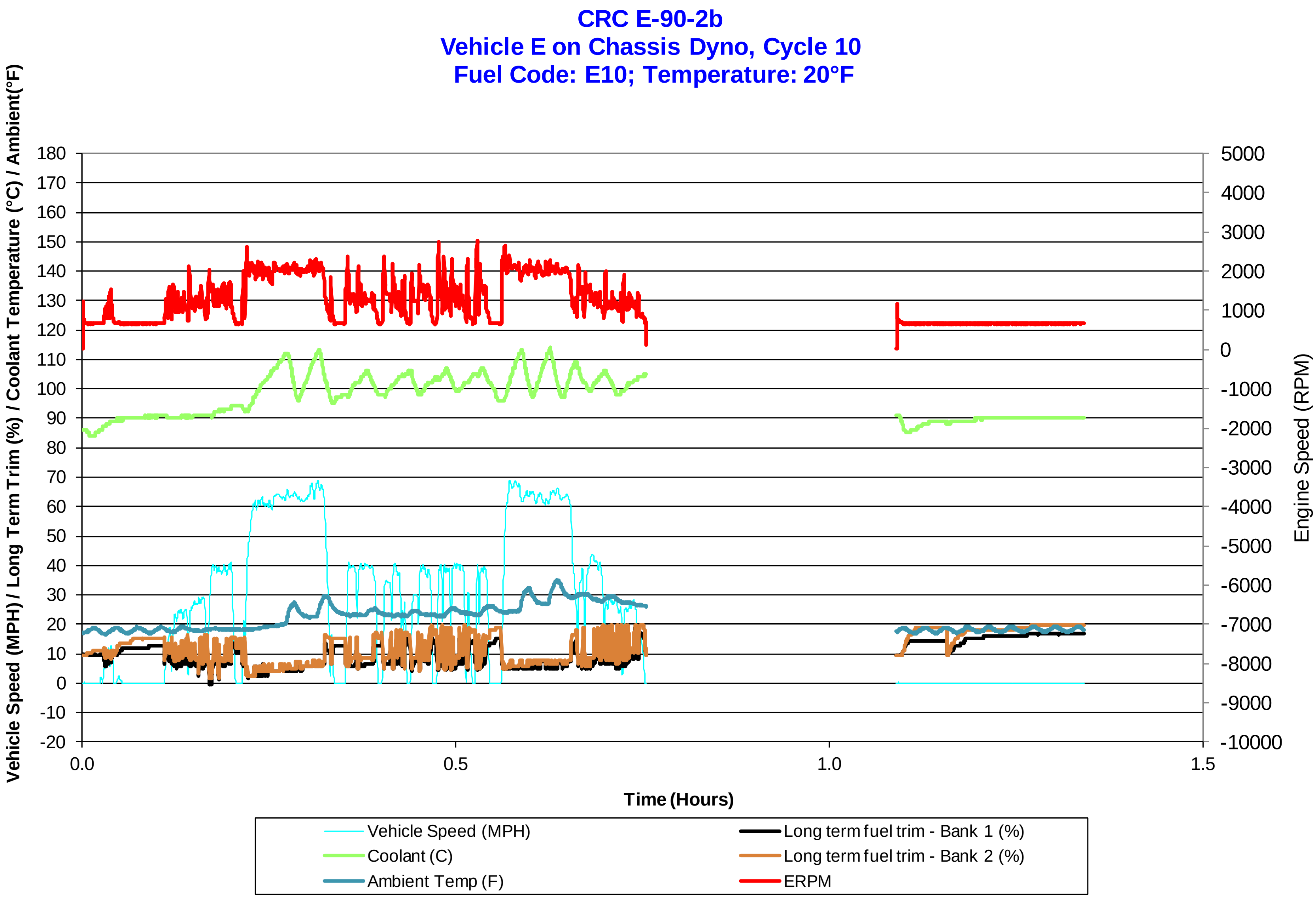
+ Military Time



CRC OBD Program 90-2b
Vehicle E On-Road Data Cycles
Histogram Percent at Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-15.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
Long Term Fuel Trim (Unit of Percent)
MIL-on Region
(assumed)
E0 Bank-1 Cycles 1 - 10
E20 Bank-1 Cycles 1-4

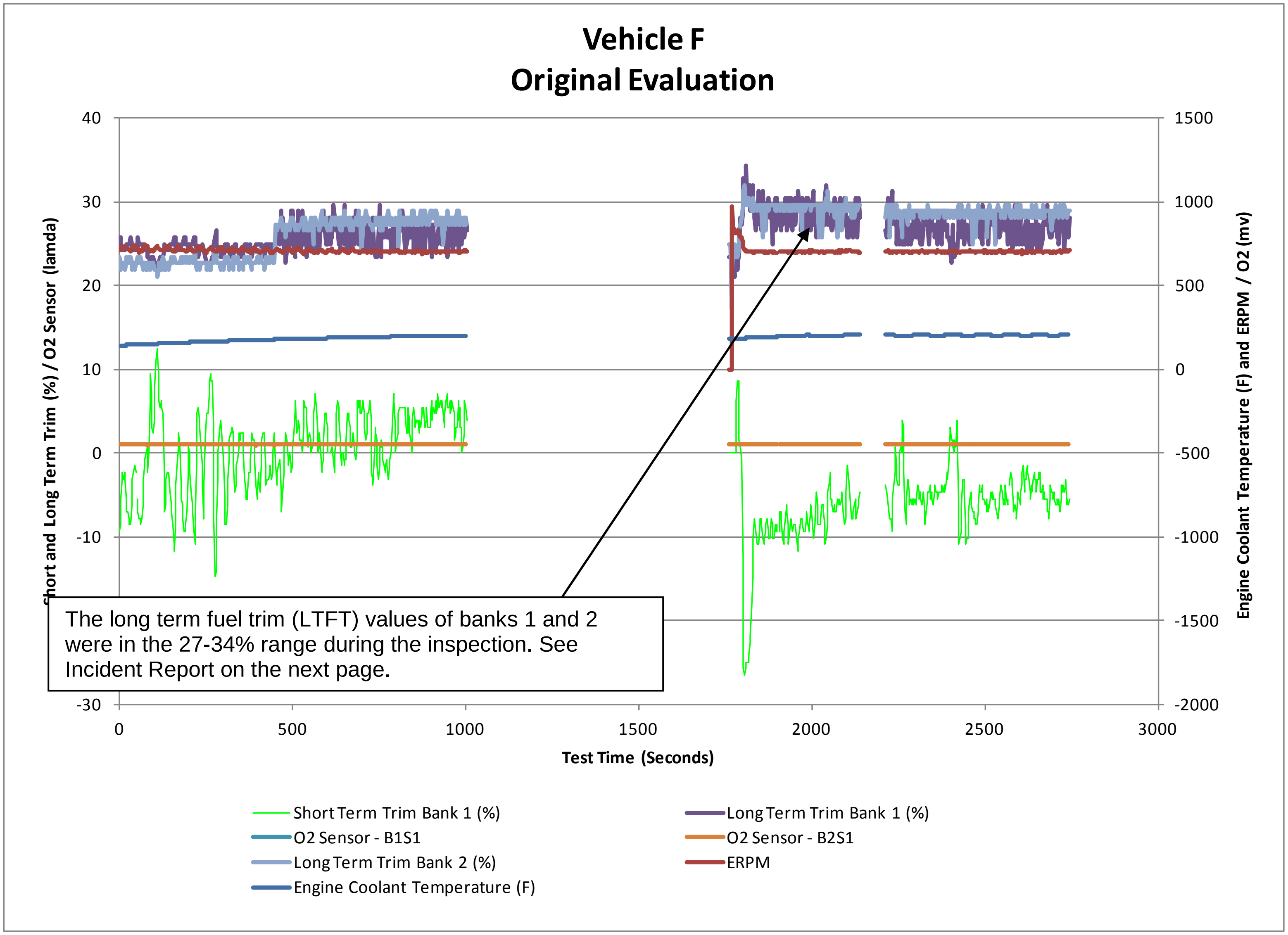

CRC OBD Program 90-2b
Vehicle E On-Road Data Cycles
Histogram Percent at Long Term Trim Values
30%
25%
20%
15%
10%
5%
0%
-15.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
Percent of Total Readings at the Long Term Trim Value
Long Term Fuel Trim (Unit of Percent)
MIL-on Region (assumed)
E0 Bank-2 Cycles 1 - 10
E20 Bank-2 Cycles 1-4

SAMPLE CHASSIS DYNO DATA



Appendix O

Vehicle F Results


Vehicle F
Original Evaluation
Short and Long Term Trim (%) / O2 Sensor (lamda)
Engine Coolant Temperature (F) and ERPM / O2 (mv)
Test Time (Seconds)
40
30
20
10
0
-10
-30
1500
1000
500
0
-500
-1000
-1500
-2000
0
500
1000
1500
2000
2500
3000
The long term fuel trim (LTFT) values of banks 1 and 2 were in the 27-34% range during the inspection. See Incident Report on the next page.
Short Term Trim Bank 1 (%)
Long Term Trim Bank 1 (%)
O2 Sensor - B1S1
O2 Sensor - B2S1
Long Term Trim Bank 2 (%)
ERPM
Engine Coolant Temperature (F)

Incident Report
CRC OBD Project E-90-2b
Vehicle: Vehicle F

SwRI Project Number: 08.15995.01.002
Date of First Occurrence: 12/21/2011
Approximate Odometer: 83,003
Test miles: 0
Test Interval: Vehicle Check-In / Test Preparation

Incident Description:

Vehicle F had a torn intake boot allowing excess air into the system.

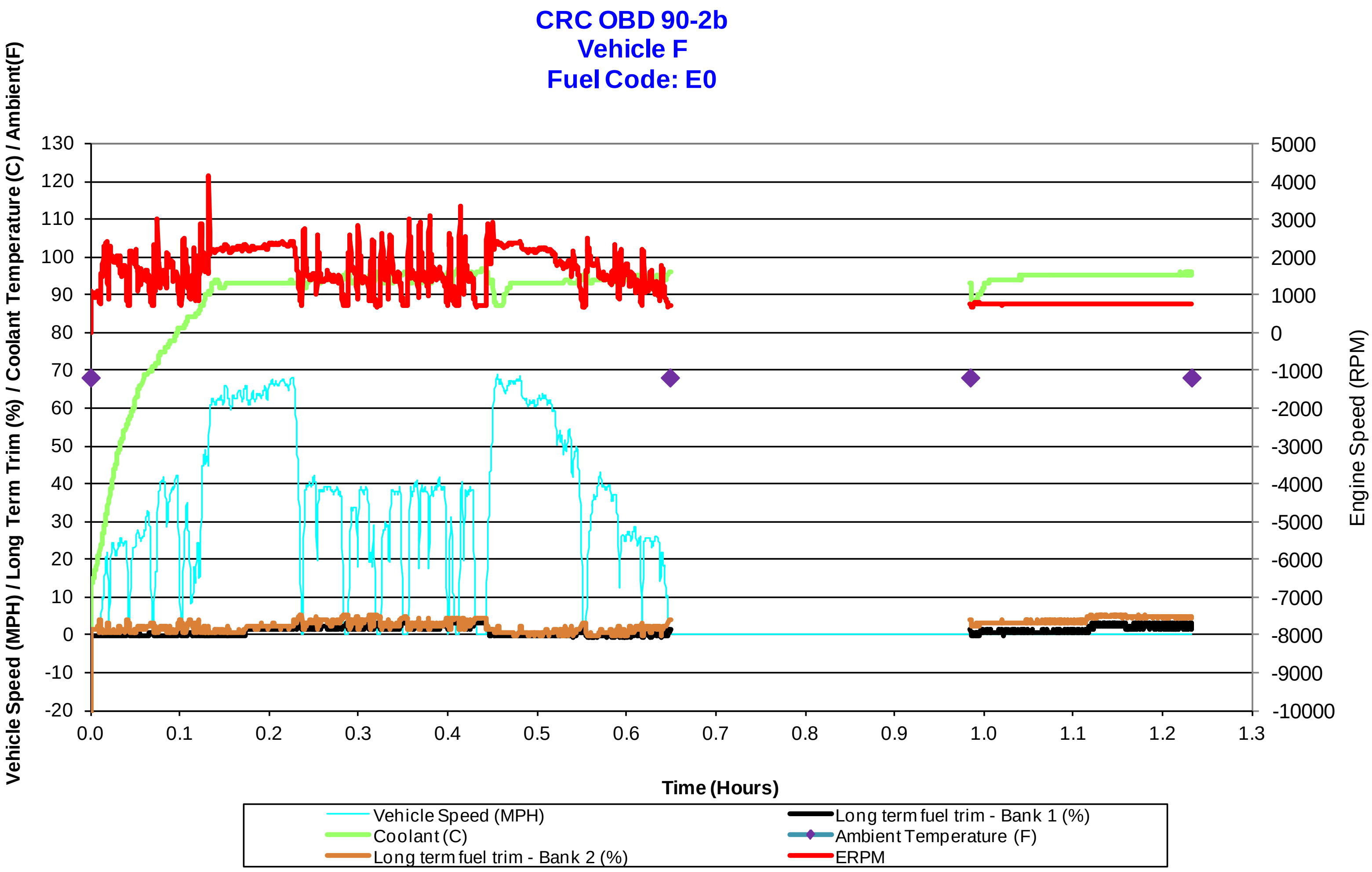
Action Taken:

On 12/21/2011, Vehicle F was in the “Test Preparation” phase where the vehicle is thoroughly inspected and prepared for mileage accumulation. During the inspection, a large hole was found in the intake boot that runs from the intake air box to the throttle body and idle valve. This hole was allowing excess air into the system and possibly contributing to the high trim values. A new intake boot was purchased and installed.

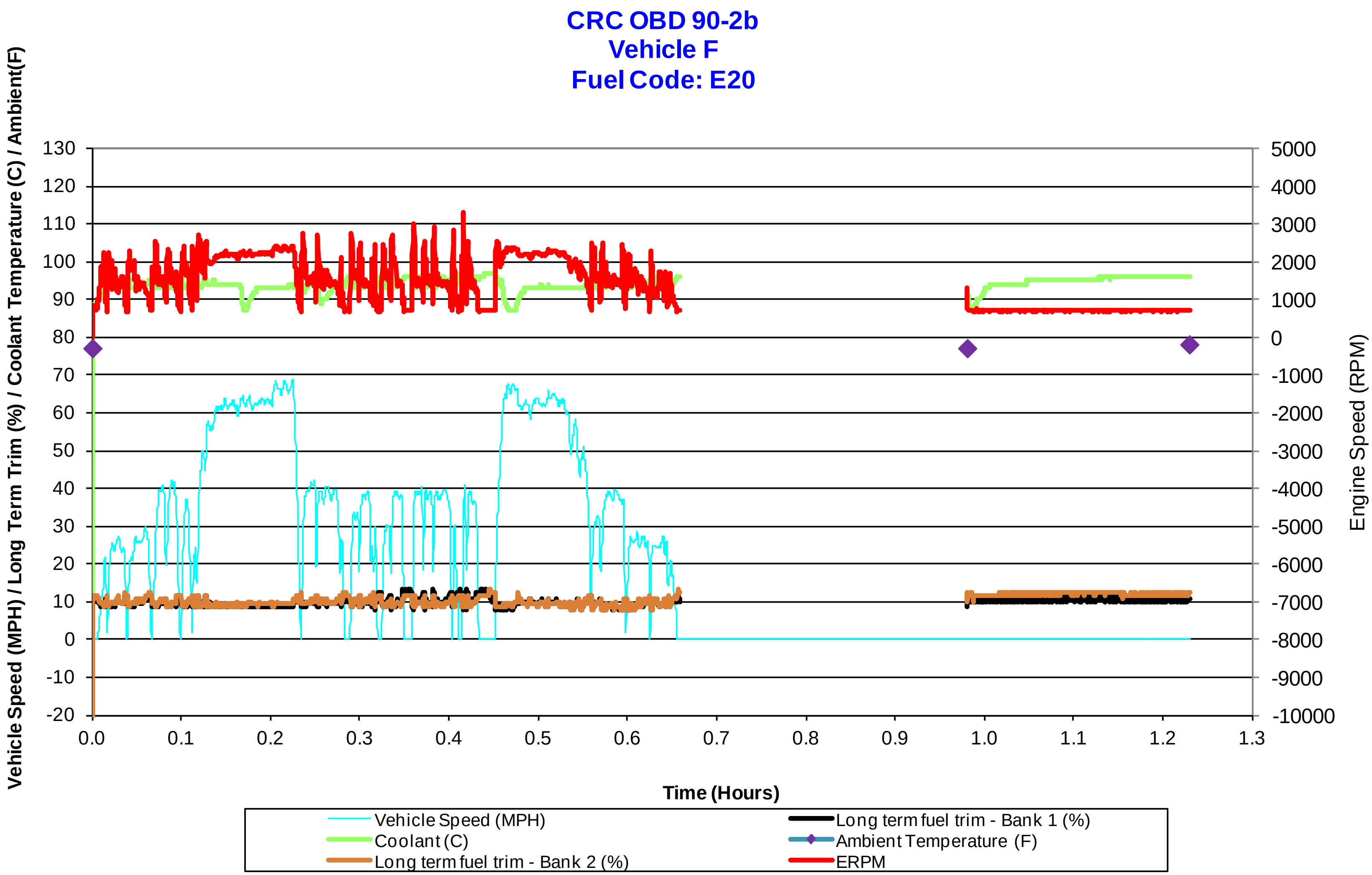
Resolution:

After the new intake boot was installed, a recheck evaluation was run on the vehicle. The evaluation was identical to the inspection that would be run on a prospective vehicle prior to purchase. With the damaged intake boot, the vehicle displayed long term trim values approaching 25%. After the new intake boot was installed, the vehicle displayed long term trim values approximately 8-10%. Although lower than the initial evaluation, these long term trim values were still higher than expected for a commercially available fuel.

Sample Road Data



Sample Road Data



On-Road

Vehicle F

Long Term Fuel Trim (%) - Average of Last Minute of Idle

Cycle Number	Date	Time - First Test Start of the Day	Time Completion of the Idle	Long Term Fuel Trim Avg. Last Minute of Idle E0 Bank_1 (%)	E0 Bank_2 (%)	Ambient Temp (F)
Cycle 1	2/1/2012	11:45	13:01	1.867	3.815	71
Cycle 2	2/1/2012		14:15	1.615	4.208	74
Cycle 3	2/1/2012		15:30	2.463	5.435	78
Cycle 4	2/2/2012	9:32	10:44	1.185	3.085	67
Cycle 5	2/2/2012		13:17	-1.138	0.515	70
Cycle 6	2/2/2012		14:32	1.316	2.511	72
Cycle 7	2/3/2012	9:50	11:05	1.212	3.841	73
Cycle 8	2/3/2012		13:13	1.750	4.753	76
Cycle 9	2/3/2012		14:27	1.243	4.649	75
Cycle 10	2/14/2012	13:08	14:22	2.356	4.648	68

Cycle Number	Date	Time - First Test Start of the Day +	Time Completion of the Idle +	Long Term Fuel Trim Avg. Last Minute of Idle E20 Bank_1 (%)	E20 Bank_2 (%)	Ambient Temp (F)
Cycle 1	2/29/2012	8:54	10:09	8.277	10.312	72
Cycle 2	2/29/2012		11:23	8.291	10.248	73
Cycle 3	2/29/2012		14:05	8.993	11.674	79
Cycle 4	3//1/2012	9:10	10:23	9.703	11.425	67
Cycle 5	3//1/2012		11:40	9.850	10.907	68
Cycle 6	3//1/2012		14:23	7.887	10.110	73
Cycle 7	3/2/2012	9:58	11:11	9.916	10.963	75
Cycle 8	3/2/2012		13:47	12.117	13.266	86
Cycle 9	3/6/2012	9:38	10:52	11.098	12.447	68
Cycle 10*	3/6/2012		13:13	11.441	12.445	75
Cycle 11*	3/6/2012		14:46	10.890	12.197	78
Cycle 12*	3/8/2012	9:00	10:13	9.084	11.513	74
Cycle 13*	3/8/2012		13:15	8.955	10.888	78
Cycle 14*	3/8/2012		14:40	10.636	12.101	79

* Pending code P0174 system too lean - bank 2 was read after the idle
  MIL was not illuminated

+ Military Time

Incident Report
CRC OBD Project E-90-2b
Vehicle: Vehicle F

SwRI Project Number: 08.15995.01.001
Date of First Occurrence: 3/6/2012
Approximate Odometer: 83,541
Test miles: 237
Test Interval: E20 – Cycle 10

Incident Description:

During a driving cycle the codes are checked twice: after the driving portion but prior to shutting the vehicle down for a soak, and then after the 15-minute idle. On 3/6/2012 during Cycle 10 of the on-road testing of Vehicle F after the driving portion, a pending P0174 "System Too Lean (Bank 2)" diagnostic trouble code (DTC) was read with a scanner.

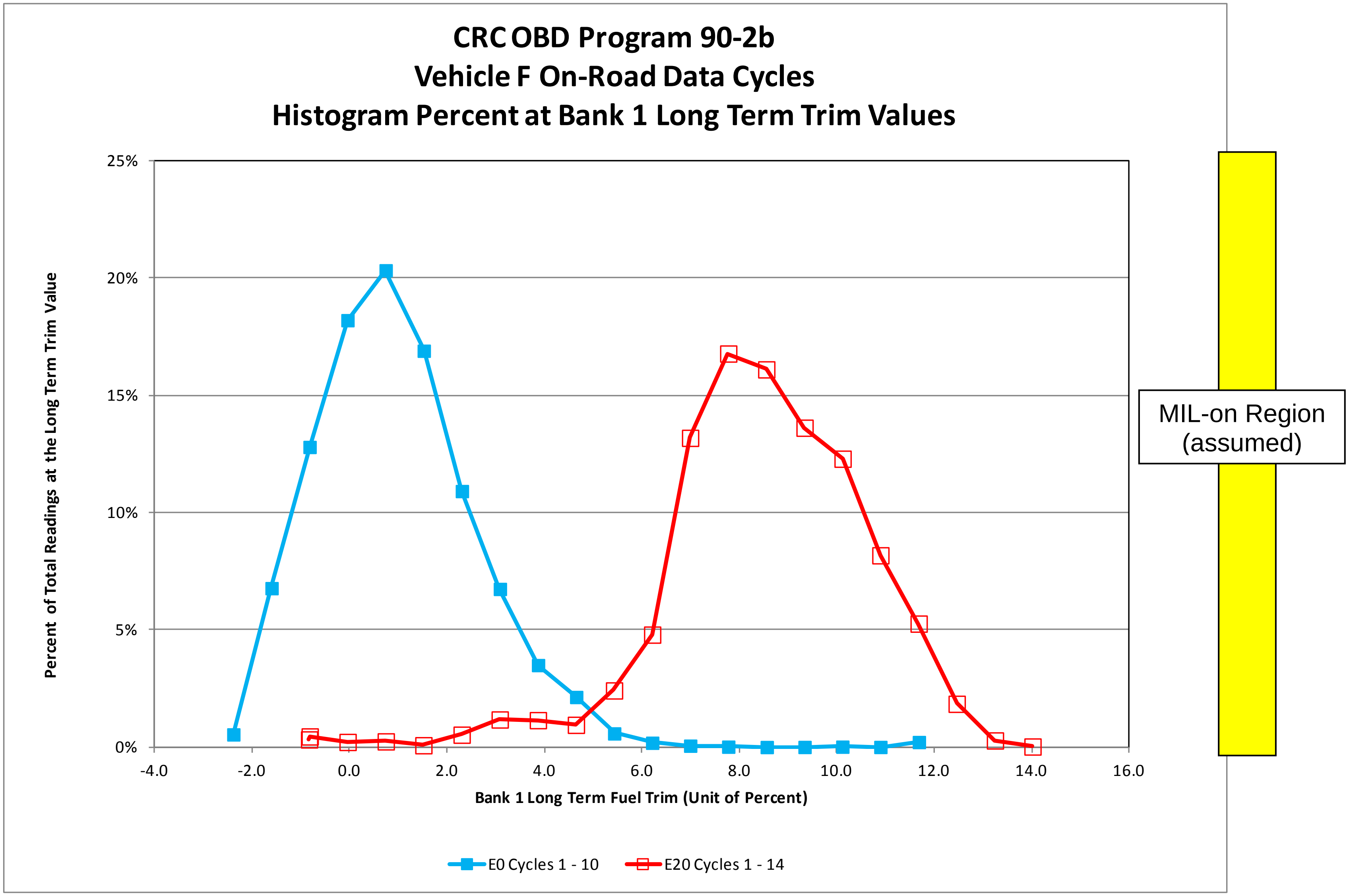
Action Taken:

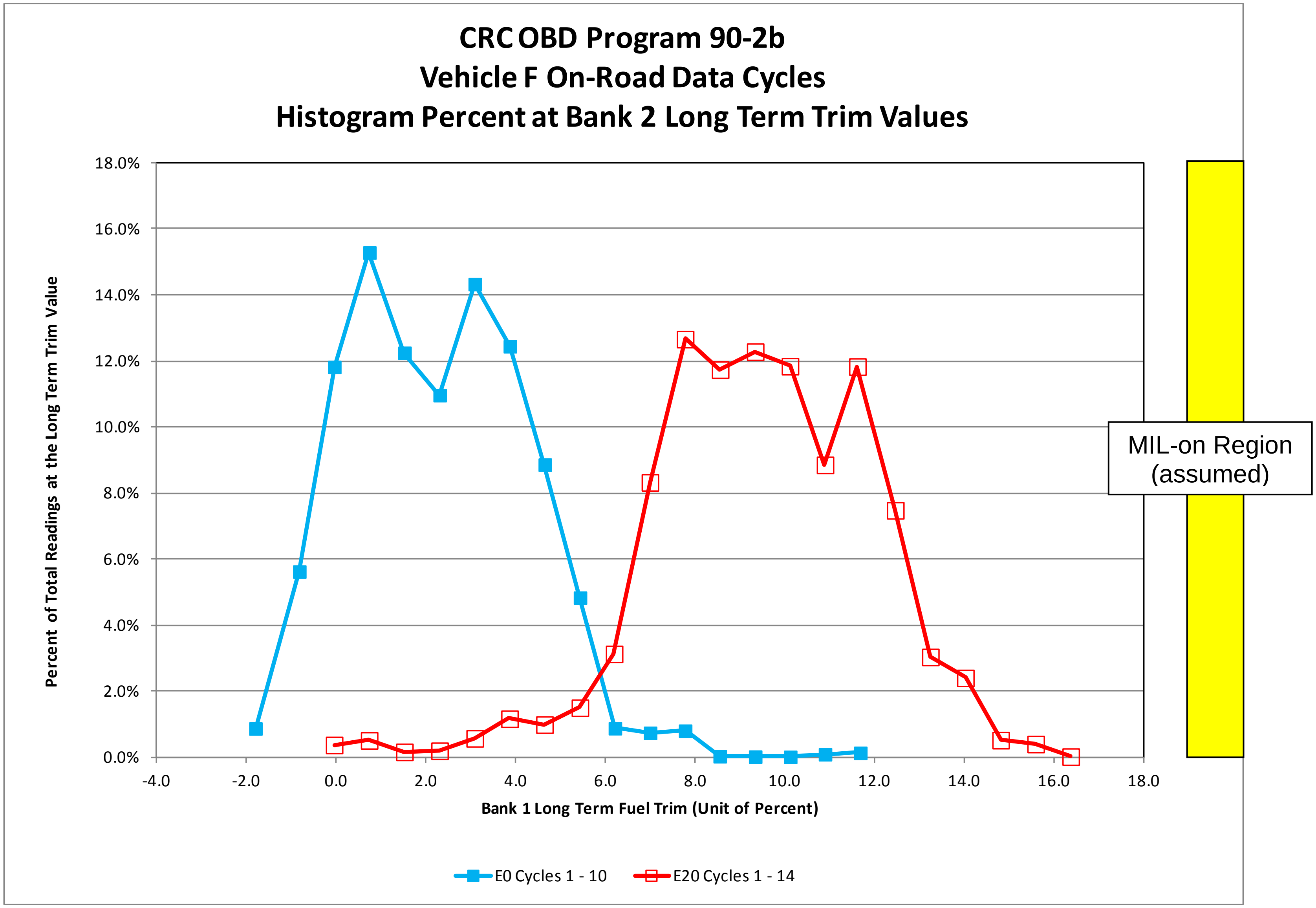
After completion of the 10^{th} driving cycle of Vehicle F on E20 fuel, the vehicle was scanned for pending DTCs prior to shutting the vehicle down for the soak step of the test sequence (drive, soak, idle). The pending P0174 "System Too Lean (Bank 2)" DTC read with a scanner. The P0174 DTC is one of the engine codes indicative of engine performance related to ethanol content in the fuel. However, the DTC was a pending code and not an active code that would have triggered a malfunction indicator light (MIL). The driver finished the soak step and started the idle step of the test sequence. The vehicle was rescanned for DTCs and the pending P0174 code was still present. The operator contacted the SwRI project manager. An 11^{th} driving cycle of Vehicle F was completed on 3/6/2012 to see if the pending code would become an active code and set the MIL. After completion of the 11^{th} test sequence, however, the pending code had not changed to active status.

Resolution:

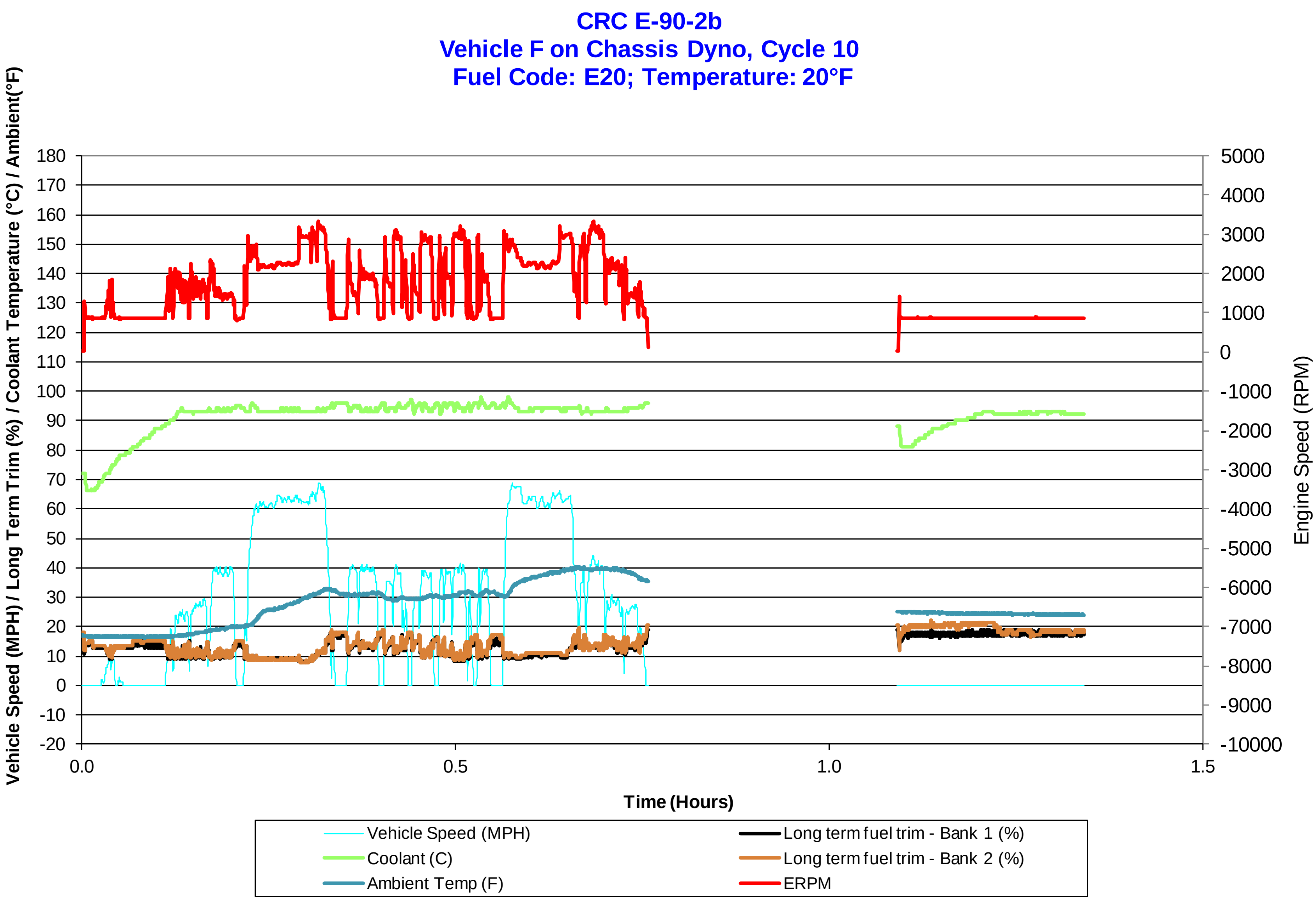
The CRC technical contact was notified of the pending code. SwRI was instructed to run one additional day of testing on E20 fuel to determine if the pending code would activate.

On 3/8/2012, Vehicle F completed three additional driving cycles for a total of 14 driving cycles on E20 fuel. The pending code never activated but was still pending at the completion of the 14^{th} test sequence. The vehicle will continue testing on E30 fuel.


CRC OBD Program 90-2b
Vehicle F On-Road Data Cycles
Histogram Percent at Bank 1 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
25%
20%
15%
10%
5%
0%
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Bank 1 Long Term Fuel Trim (Unit of Percent)
E0 Cycles 1 - 10
E20 Cycles 1 - 14
MIL-on Region
(assumed)

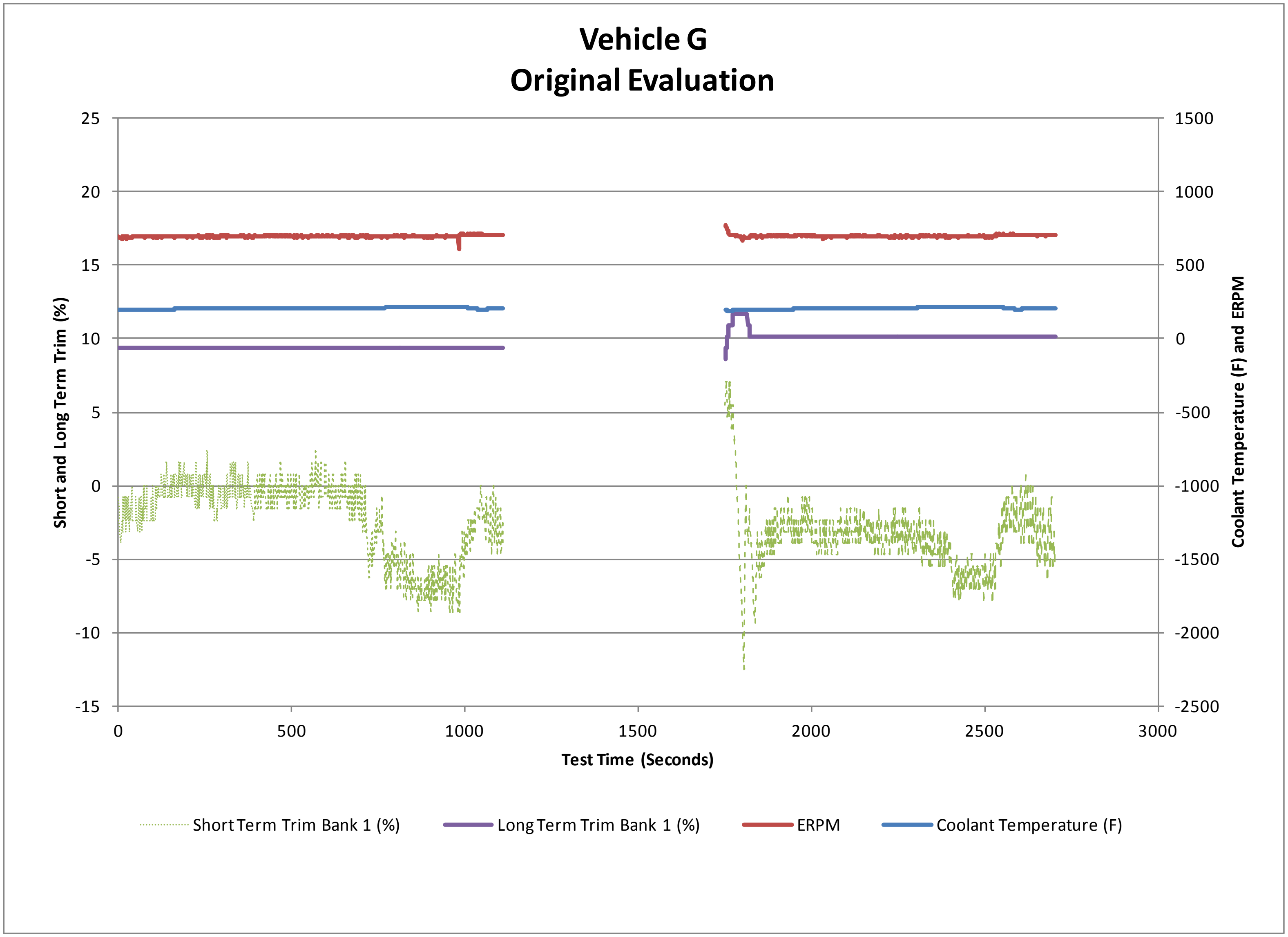

CRC OBD Program 90-2b
Vehicle F On-Road Data Cycles
Histogram Percent at Bank 2 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
Bank 1 Long Term Fuel Trim (Unit of Percent)
MIL-on Region (assumed)
E0 Cycles 1 - 10
E20 Cycles 1 - 14

SAMPLE CHASSIS DYNO DATA

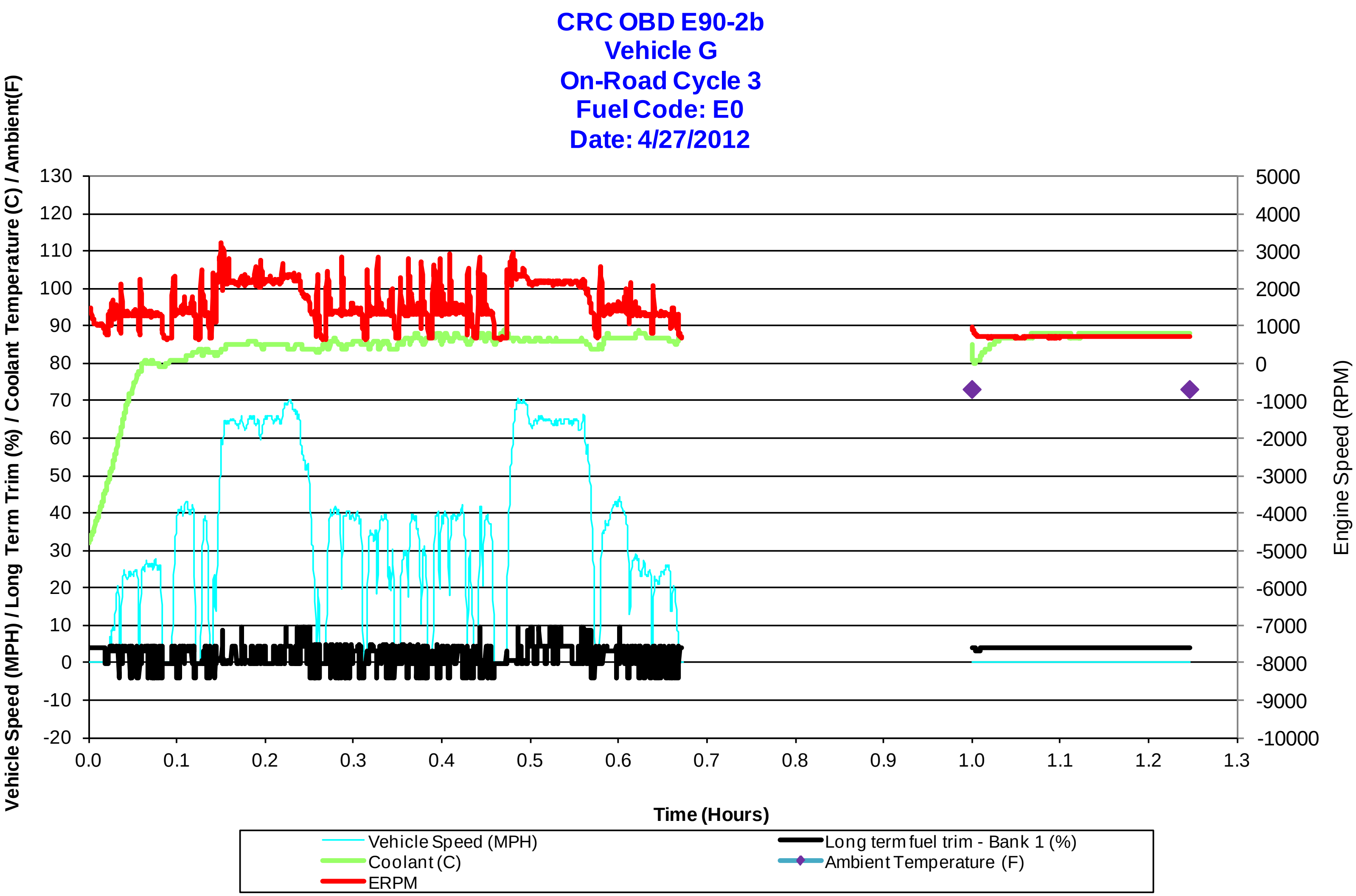


Appendix P

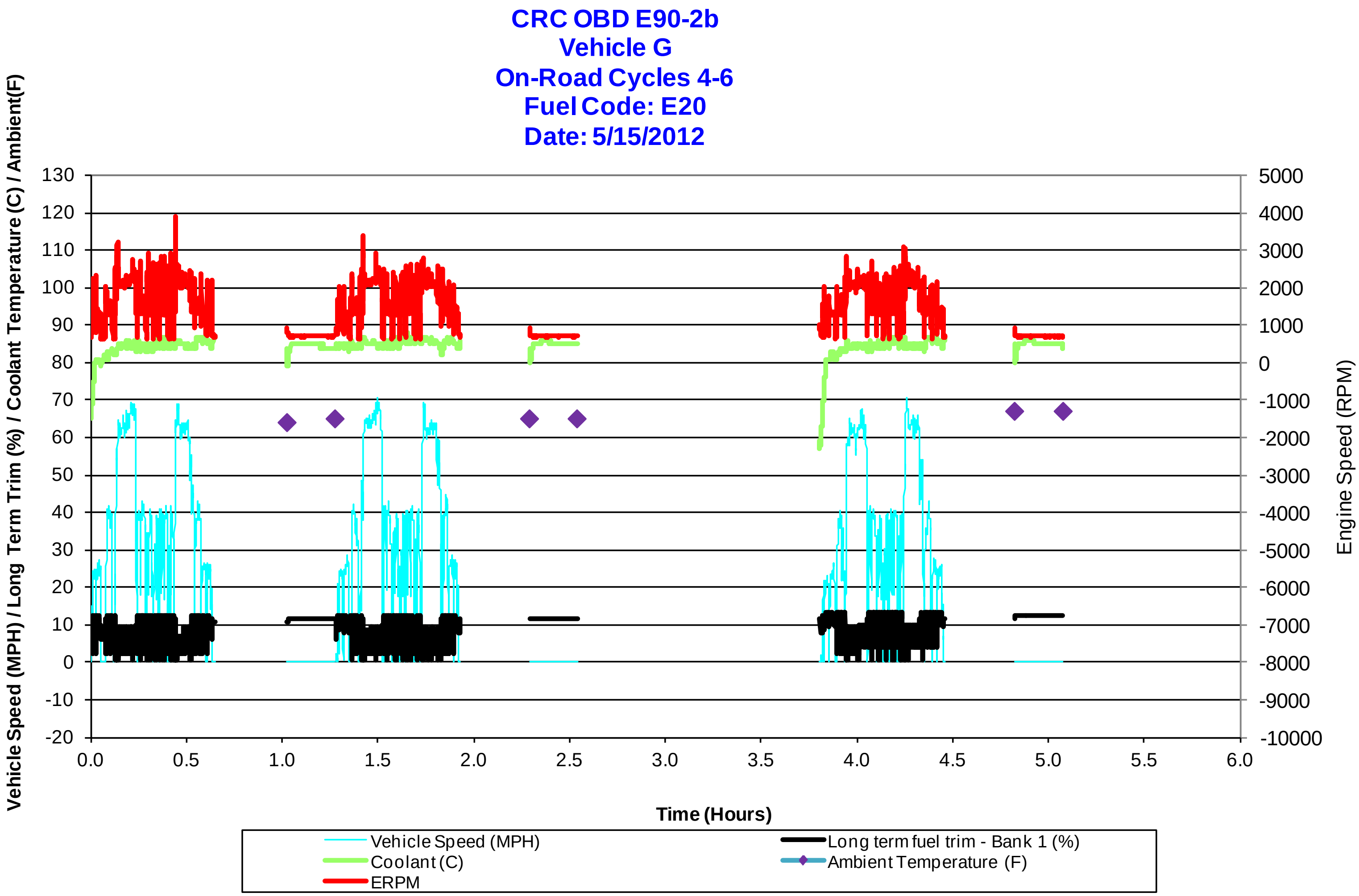
Vehicle G Results


Vehicle G
Original Evaluation
Short and Long Term Trim (%)
Coolant Temperature (F) and ERPM
Test Time (Seconds)
25
20
15
10
5
0
-5
-10
-15
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
0
500
1000
1500
2000
2500
3000
Short Term Trim Bank 1 (%)
Long Term Trim Bank 1 (%)
ERPM
Coolant Temperature (F)

Sample Road Data



Sample Road Data



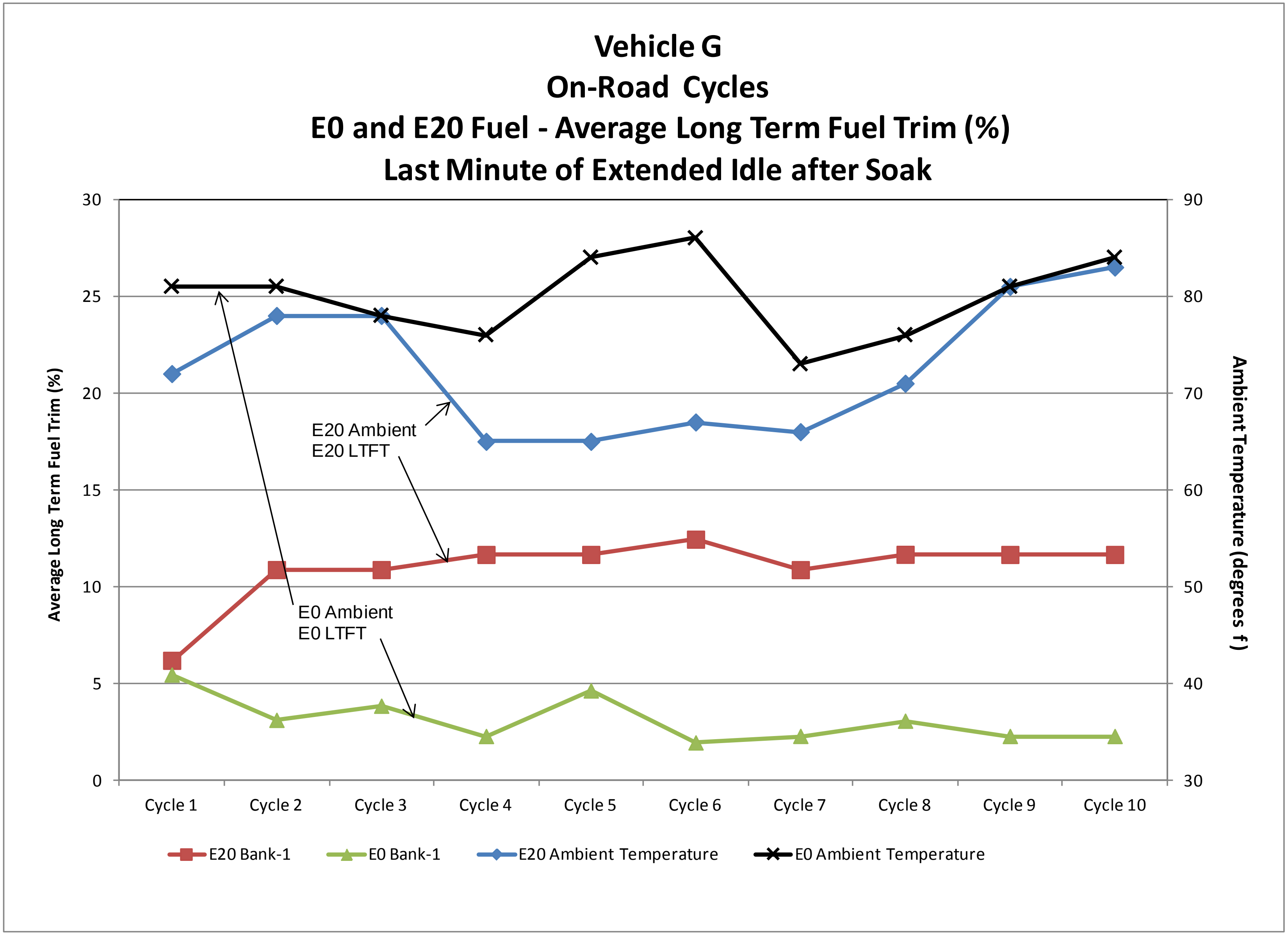
On-Road

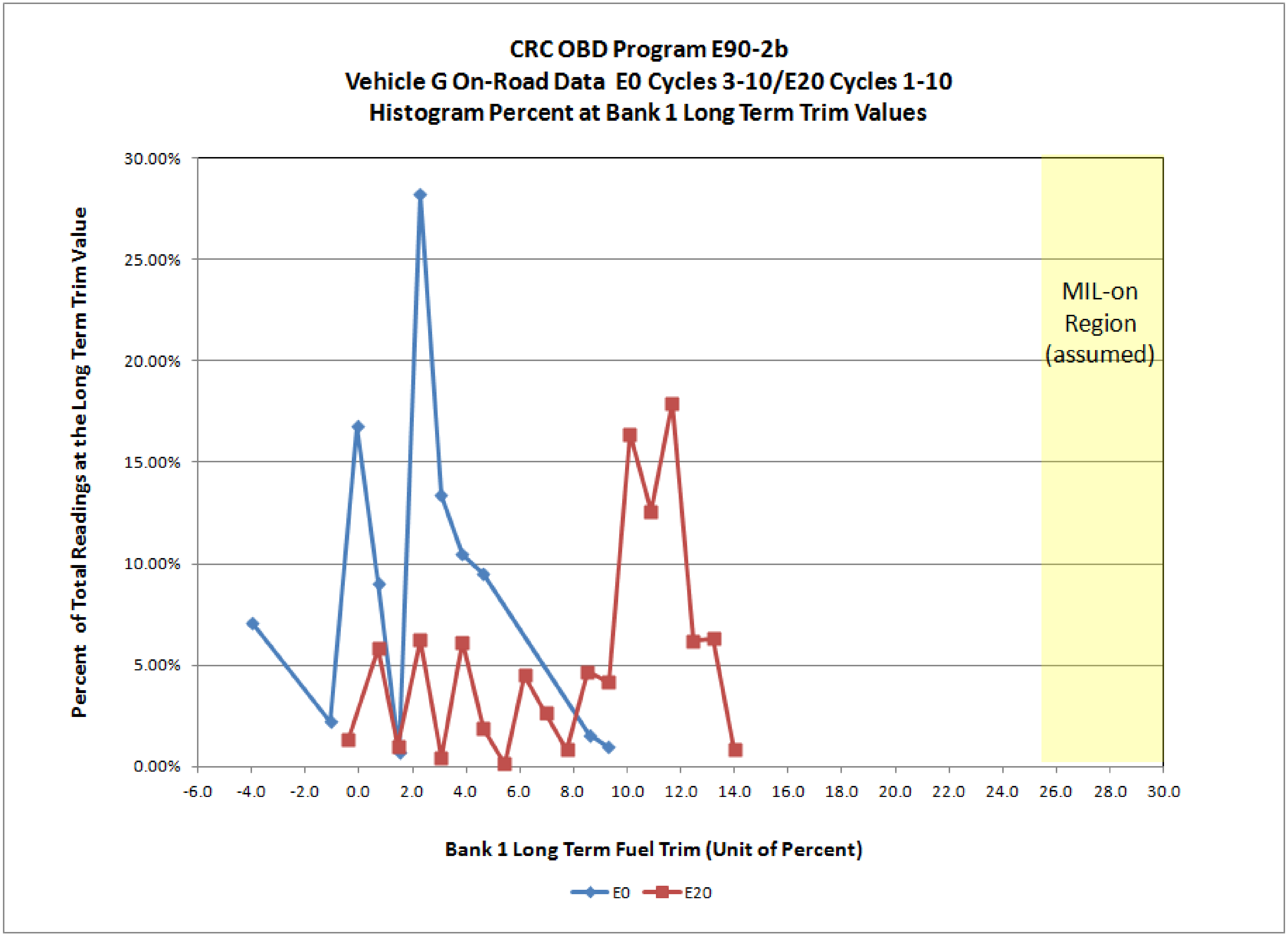
Vehicle G

Start of Test Date: 4/19/2012
Start of Test Odomter: 77234

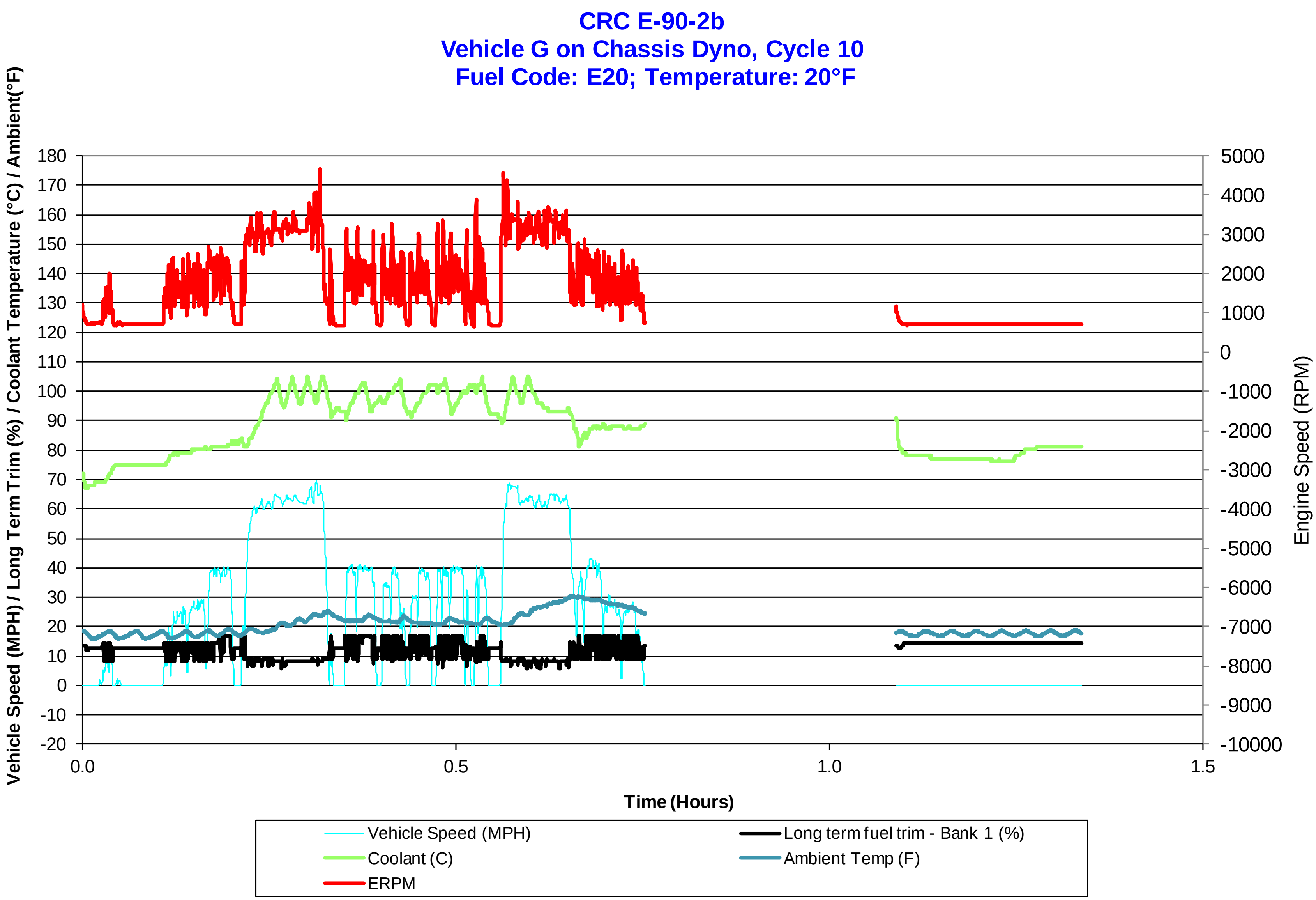
Cycle Number	Date	Time - First Test Start of the Day	Time Completion of the Idle	Long Term Fuel Trim Avg. Last Minute of Idle E0 Bank_1 (%)	Ambient Temp (F)
Cycle 1	4/19/2012	12:20	13:56	5.460	81
Cycle 2	4/24/2012	12:02	13:17	3.120	81
Cycle 3	4/27/2012	9:21	10:36	3.850	78
Cycle 4	5/1/2012	9:26	10:39	2.286	76
Cycle 5	5/1/2012		13:14	4.639	84
Cycle 6	5/1/2012		14:29	1.955	86
Cycle 7	5/2/2012	8:59	10:11	2.291	73
Cycle 8	5/2/2012		11:25	3.077	76
Cycle 9	5/2/2012		13:37	2.287	81
Cycle 10	5/2/2012		14:53	2.286	84

Cycle Number	Date	Time - First Test Start of the Day	Time Completion of the Idle	Long Term Fuel Trim Avg. Last Minute of Idle E20 Bank_1 (%)	Ambient Temp (F)
Cycle 1	5/11/2012	9:48	11:03	6.194	72
Cycle 2	5/11/2012		13:14	10.880	78
Cycle 3	5/11/2012		14:29	10.880	78
Cycle 4	5/15/2012	8:41	9:58	11.660	65
Cycle 5	5/15/2012		11:14	11.661	65
Cycle 6	5/15/2012		13:46	12.449	67
Cycle 7	5/16/2012	8:08	9:24	10.877	66
Cycle 8	5/16/2012		10:41	11.667	71
Cycle 9	5/16/2012		13:14	11.660	81
Cycle 10	5/16/2012		14:29	11.660	83


Vehicle G
On-Road Cycles
E0 and E20 Fuel - Average Long Term Fuel Trim (%)
Last Minute of Extended Idle after Soak
Average Long Term Fuel Trim (%)
Ambient Temperature (degrees f)
E20 Ambient
E20 LTFT
E0 Ambient
E0 LTFT
Cycle 1
Cycle 2
Cycle 3
Cycle 4
Cycle 5
Cycle 6
Cycle 7
Cycle 8
Cycle 9
Cycle 10
E20 Bank-1
E0 Bank-1
E20 Ambient Temperature
E0 Ambient Temperature


CRC OBD Program E90-2b
Vehicle G On-Road Data E0 Cycles 3-10/E20 Cycles 1-10
Histogram Percent at Bank 1 Long Term Trim Values
Percent of Total Readings at the Long Term Trim Value
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
MIL-on
Region
(assumed)
Bank 1 Long Term Fuel Trim (Unit of Percent)
E0
E20

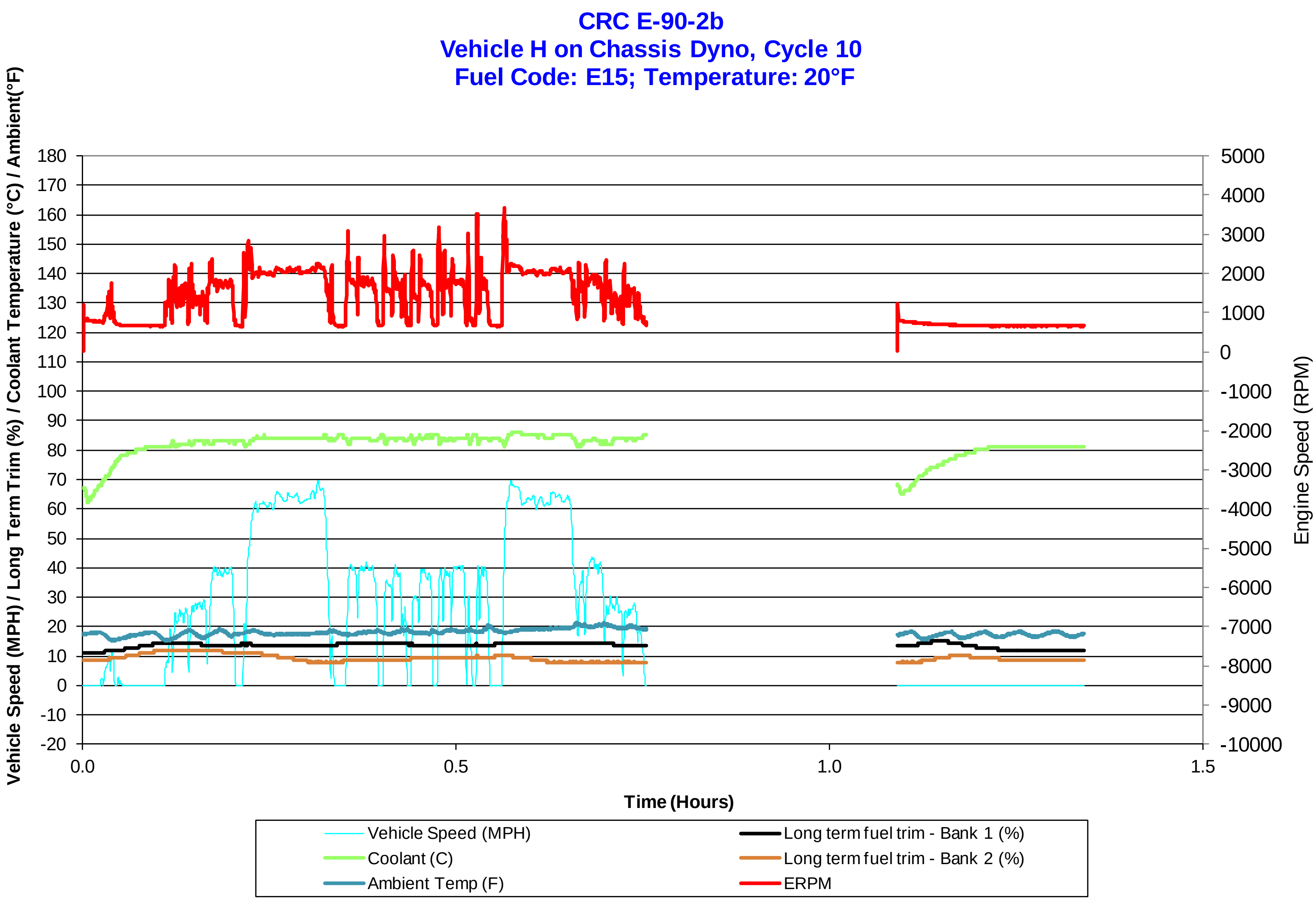
SAMPLE CHASSIS DYNO DATA



Appendix Q

Vehicle H Results

SAMPLE CHASSIS DYNO DATA



Appendix R

Chassis Dynamometer Test Procedure

CHASSIS DYNAMOMETER TEST PROCEDURE

Test #: Vehicle B-E30- 70F-C5 **Fuel Specs:As Rec'd**
Fuel Code: GB-8131 **Carbon: ________ Hydrogen: _______**
Fuel Type: E30 **Oxygen: __________Density:______kg/l**

Date:___________
Odometer: _____________
Tank Set Temp:____________ **Box Set Temp:____70°F________**
"√" Initial_ Task

YOU WILL NEED A STOP WATCH TO KEEP TRACK OF THE 20 MINUTE SOAK.

☐ 1)_____ Check vehicle for any MIL codes or pending codes. Notify project manager if any are detected.

____
____
____
____
____
____

☐ 2)_____ Remove floor mat from driver's footwell
☐ 3)_____ Install vehicle chocks on the front of rear wheels
☐ 4)_____ Set drive wheel tire pressure to Manuf. Specs. on door jamb
- Record drive tire pressures; L: __________ R: __________.

☐ 5)_____ Set strap tension to 200 lbs. (straps are at a 30 deg angle to the vehicle)
☐ 6)_____ Connect winch line to rear of vehicle- light tension.
☐ 7)_____ Connect transfer pipe out to roof.
☐ 8)_____ **Labview Computer:** Open DBK 70 PidPro. Select "Connect". Select "Load Config file". Select "obdcanext – CRC3-1750.mdb." Select "display current channel values".

a) Short term fuel trim – Bank1
b) Long term fuel trim – Bank1
c) Short term fuel trim – Bank2
d) Long term fuel trim – Bank2
e) Engine RPM
f) Vehicle Speed
g) Calculated load
h) Coolant temperature

☐ 9)_____ Connect the ALDL cable.
☐ 10)_____ Place cooling fan in front of vehicle in designated space and at designated angle

☐ 11)_____ Set up the VETS computer

a) Switch monitor – zero/span monitor to Dyno 5
b) Switch pendant – Dyno 7 to Dyno 5
c) Switch speed – Dyno 7 to Dyno 5 (behind panel)
d) Change VETS parameters- Edit/cell equipment/cell parameters/ File/Open/Dynamometer
   - Speed PPR: 600
   - Roll Dia: 8.6485

☐ 12)_____ Connect TC; To Labview #58.
☐ 13)_____Warm up Dyno @ 50 MPH = _13.3__ hp (ETW =3875 lbs.) for 30 minutes.

Verify dyno speed is reading correctly.

☐ 14)____Confirm that DBK-70 data reads properly during “Key-on”.
☐ 15)_____ Record warm-up end time: __________.
☐ 16)_____ Run test cycle “CRC2” drive cycle
☐ 17)_____Setup data file for Labview 58
☐ 18)_____Once dyno roll stops moving, lower vehicle down from floor jacks to dyno roll. Make sure dyno plate doesn’t touch either tire.
☐ 19)_____ Turn Axial fan on.
☐ 20)_____ Record vehicle test start time.___________
☐ 21)_____ Note End of drive cycle 1:____Start 20 minute soak period. While the vehicle is soaking, prepare the vehicle, dyno and Vets for the next cycle. Complete Vehicle Drivability Comments below:

Cycle 1:

☐ 22)_____ Did the vehicle do any of the following:

a) Long crank time?____
____
____

b) Rough idle?____
____
____
____

c) Hesitation/stumble?____
____
____

d) Note any instance of MIL illumination:_________________________
____

- Right:________
- Left:________

☐ 24)_____ End of Cycle 1:
☐ Translate data file

Cycle 2:

- ☐ 25)________**Test Name: Vehicle B-E30- 70F-C2**
- ☐ 26)________Run test cycle "CRC2" drive cycle
- ☐ 27)________Setup data file for Labview 58
- ☐ 28)________Record vehicle test start time.____________

- ☐ 29)Note End of drive cycle 2:_____ Start 20 minute soak period. While the vehicle is soaking, prepare the vehicle, dyno and Vets for the next cycle. Complete Vehicle Drivability Comments below:

- ☐ 30)______ Did the vehicle do any of the following:
  - a) Long crank time?____
  - b) Rough idle?____
  - c) Hesitation/stumble?____
  - d) Note any instance of MIL illumination:___________________________

- ☐ 31)______ Note post test strap tension:
  - Right:_________
  - Left:_________

- ☐ 32)______ End of Cycle 2:
- ☐ Translate data file

Cycle 3:

☐ 33)______**Test Name: Vehicle B-E30- 70F-C3**
☐ 34)______ Run test cycle "CRC2" drive cycle
☐ 35)_____Setup data file for Labview 58
☐ 36)_____ Record vehicle test start time.___________

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☐ 37)______ Note End of Cycle 3:____Start 20 minute soak period. While the vehicle is soaking, prepare the vehicle, dyno and Vets for the next cycle. Complete Vehicle Drivability Comments below:

☐ 38)_____ Did the vehicle do any of the following:

a) Long crank time?____
____
____

b) Rough idle?____
____
____
____

c) Hesitation/stumble?____
____
____

d) Note any instance of MIL illumination:__________________________
____
____

☐ 39)_____ Note post test strap tension:
- Right:________
- Left:________

☐ 40)_____ End of Cycle 3:
☐ Translate data file

Cycle 4:

☐ 41)______**Test Name: Vehicle B-E30- 70F-C4**
☐ 42)______ Run test cycle "CRC2" drive cycle
☐ 43)_____Setup data file for Labview 58
☐ 44)_____ Record vehicle test start time.___________

☐ 45)______Note End of Cycle 4:____Start 20 minute soak period. While the vehicle is soaking, prepare the vehicle, dyno and Vets for the next cycle. Complete Vehicle Drivability Comments below:

☐ 46)_____ Did the vehicle do any of the following:

a) Long crank time?____
____
____

b) Rough idle?____
____
____
____

c) Hesitation/stumble?____
____
____

d) Note any instance of MIL illumination:__________________________
____
____

e) 47)_____ Note post test strap tension:
- Right:________
- Left:________

f) 48)_____Conduct ASCI translations using file "CRC_OBD_TRANSLATION"

g) 49)_____ End of Cycle 3:

h) 50)_____ Jack-up front wheels of vehicle of the dyno roll.

i) 51)_____ Place the vehicle on trickle-charge during soak.

j) 52)_____ Leave vehicle in box at 70°F for overnight soak.

k) 53)_____ End of Test:
   a. Translate data file

☐ 54)_____ Check vehicle for any MIL codes or pending codes. Notify project manager if any are detected.

☐ 55)_____Technician's Signature:_________________________