
CRC E-90 Phase 2b
Effect of Ethanol Fuels upon OBD-II Systems
Vehicle Test Phase

CHECK
ENGINE

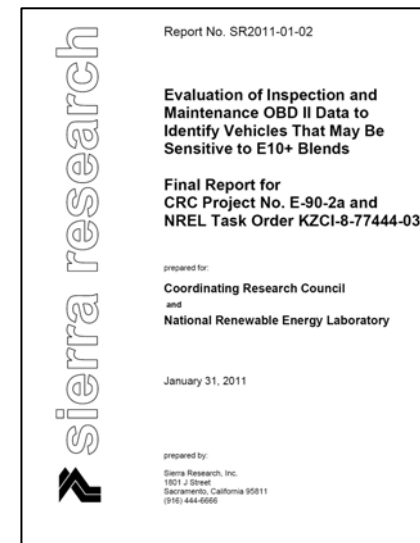
Status as of June, 2011

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- The first phase of this project concluded that the MIL (Malfunction Indicator Lamp) may illuminate on some problem-free vehicles when intermediate ethanol blends are used.
- Actual testing of vehicles with E10+ blends was not possible; test time was limited, and the privately-owned vehicles could not be exposed to illegal fuel blends.
- The second phase of this project has been divided into two sections:
 - Phase 2a: Supplement the Phase 1 results by mining OBD data from state I/M programs. (Summary on next slide.)
 - Phase 2b: Purchase vehicles and operate on a range of ethanol blends from E0 → E20.

- Performed by Sierra Research. NREL was co-sponsor with CRC.
- Analyzed I/M OBD data for lean-limit failures (P0171 and P0174 DTCs).
- Compared E10 and ~E0/E6, focusing on areas with recent transitions to E10.
- Results indicated that certain make/model/model-year/displacement categories showed higher-than-average failure rate increases.
- Detailed results provided to CRC/individual manufacturers to inform vehicle selection for Phase 2b.
- Final report posted to CRC website in February.



- Document the change in fuel trim and other engine parameters as the vehicle is operated on a range of ethanol blends under real-world conditions.
- Determine if the MIL will illuminate and/or DTCs will be set on sensitive vehicles when exposed to E15 and/or E20. (DTC = Diagnostic Trouble Code)
- Determine if a vehicle with an illuminated MIL induced by E15 or E20 still meets its emissions category target, using a standard cold-start FTP-75 test mode.

Fuels

- E0, E10, E15, and E20. E0 = Federal emission certification fuel.
- Each ethanol blend made by splash-blending ethanol into the E0.

Vehicles

- Candidate test vehicles will be screened to confirm (1) absence of tampering and damage and (2) conformance to target criteria.*
- After approval by the CRC, SwRI will purchase each vehicle and transport it to their facility. Target for this phase: 10 vehicles.
- Criteria for identifying target vehicles:

- Primary criteria used thus far
1. Phase 1 indicates it to be a good candidate
 2. Phase 2a indicates it to be a good candidate
 3. OBD threshold criteria are appropriate
 4. OEM recommendation (based on in-use data, calibration, etc.)

* The basic target criterion is a long term fuel trim (LTFT) value that falls 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 program.

Test Procedure Overview

- Each vehicle is equipped with a recording scan tool, and receives an initial emission test to confirm that it meets its emission category target on E0.
- For each test fuel:
 1. Vehicle is driven over a specified route in San Antonio for 200 miles, while data are recorded by a scan tool.
 2. ECU of vehicle is queried for DTCs, even if MIL does not illuminate.
 3. Visual inspection of vehicle is performed to check for leaks or obvious hardware problems.
 4. If the MIL illuminates or DTCs are set, emission testing is performed. (FTP-75)

See Appendix for complete procedure and driving route details

- SwRI chosen as contractor
- 61 vehicles have been screened at dealerships.
- 4 of these vehicles have been purchased.
- 3 have completed testing.
- A second target list (14 models) has been compiled, based on “second tier” models* from the Phase 2a results. SwRI has recently begun searching for these vehicles.

Note:

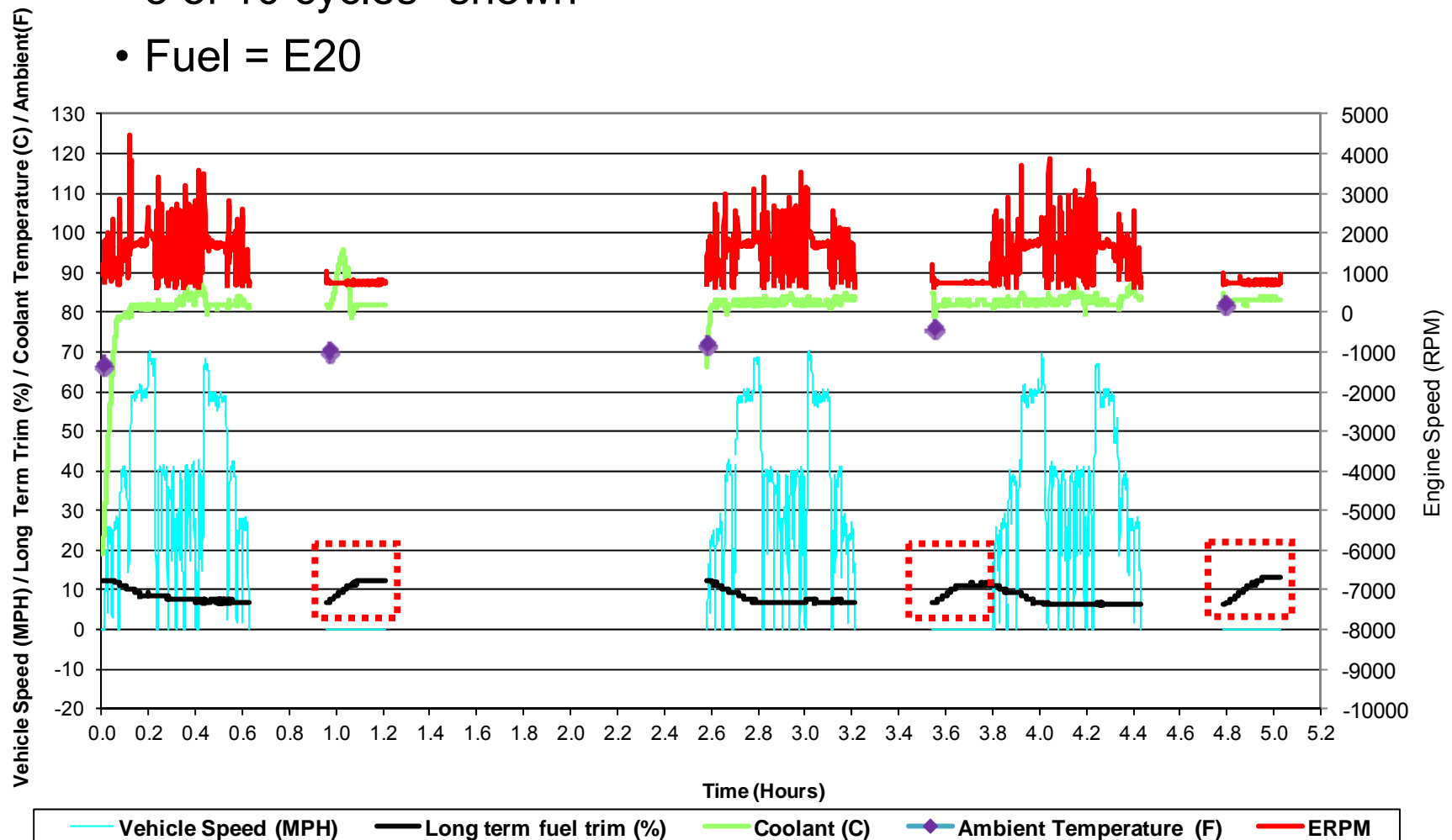
Vehicles meeting the target criteria have proven difficult to locate during the screening process. This was expected, given that such vehicles represent only a few percent of the total on-road population for a particular model. To expedite the project, the criteria have been loosened for the vehicles selected thus far; i.e., the selected vehicles are less “ethanol sensitive” than originally planned.

*All criteria met, other than total sample size.

- All tested vehicles met their emission certification target categories when tested with E0.
- No DTCs or MILs were observed in the first two vehicles tested. The third vehicle has exhibited some MILs, but these may not be related to the fuel; this is currently under investigation.
- The fuel trim value of the second vehicle tested approached its MIL-on region when operated on E20, but did not enter the region. (See data examples on subsequent slides.)

Example of On-Road Data

- 2008 passenger vehicle
- 3 of 10 cycles* shown
- Fuel = E20

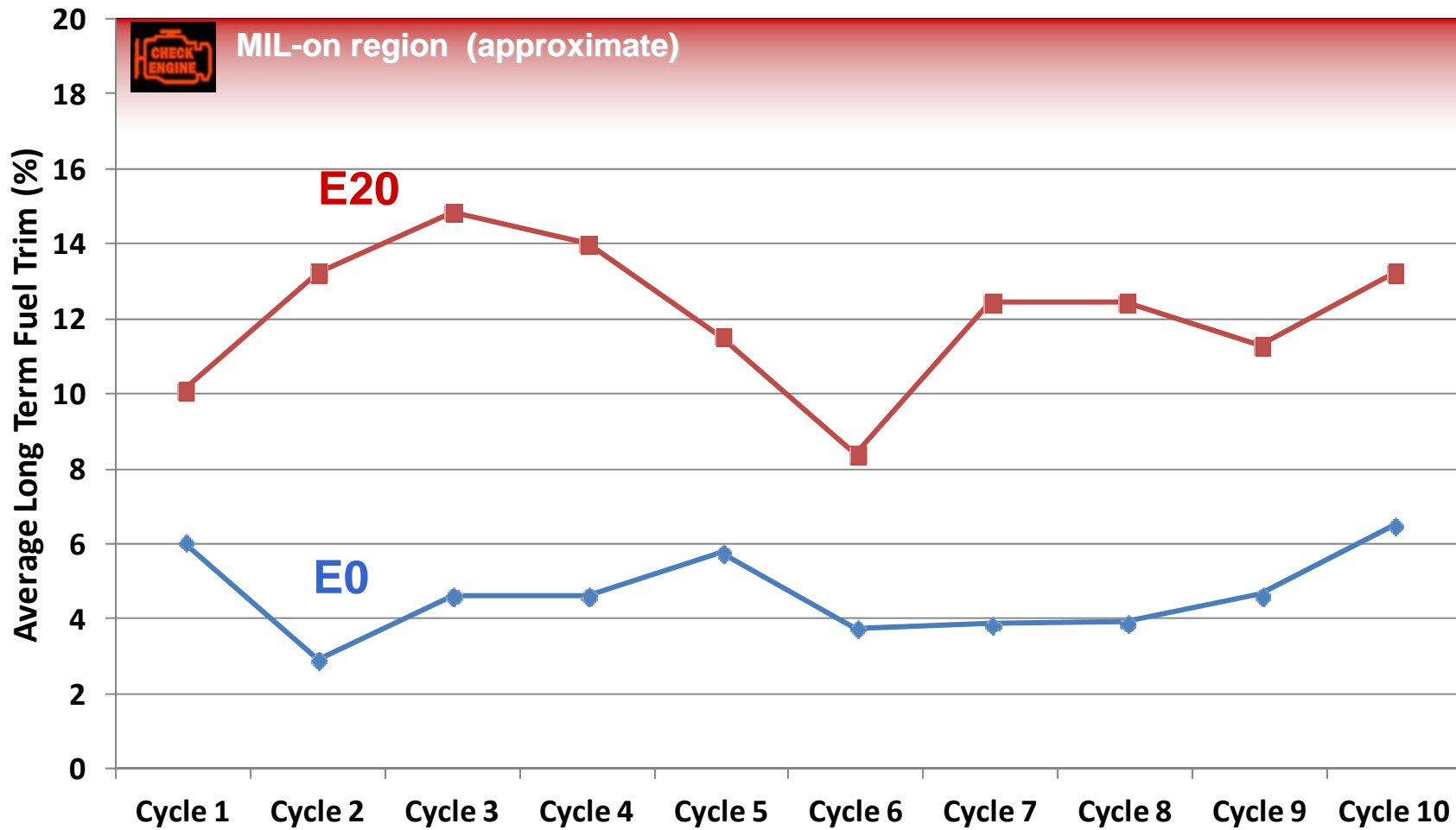


◆ = Long term fuel trim during extended idle after soak (see next slide)

* 1 cycle = 1 “lap” through the driving course, followed by a hot soak (ignition off) and subsequent idle period.

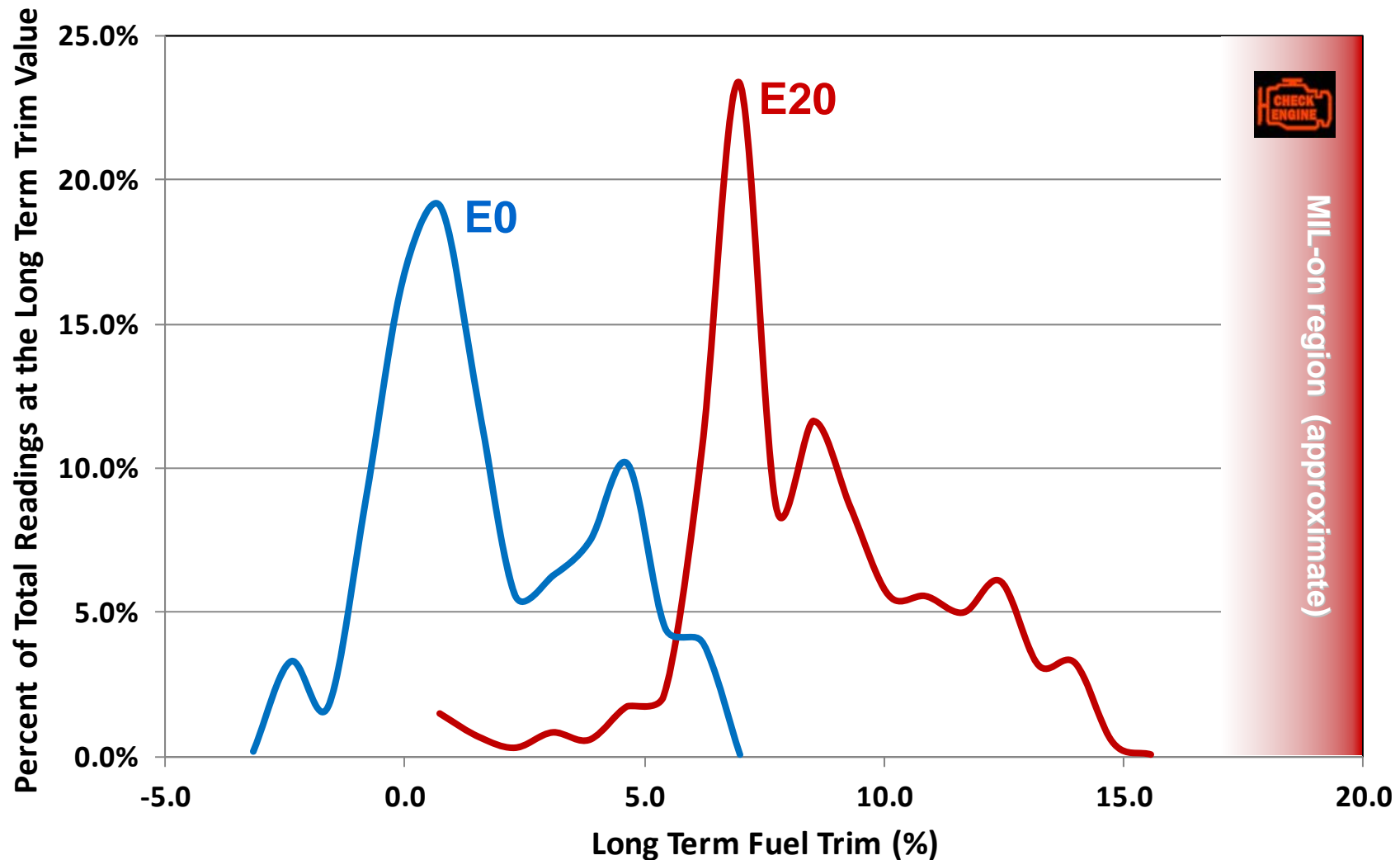
Example of On-Road Data

- 2008 passenger vehicle (same vehicle as previous slide)
- Average long term fuel trim during last minute of idle (after hot soak)



Example of On-Road Data

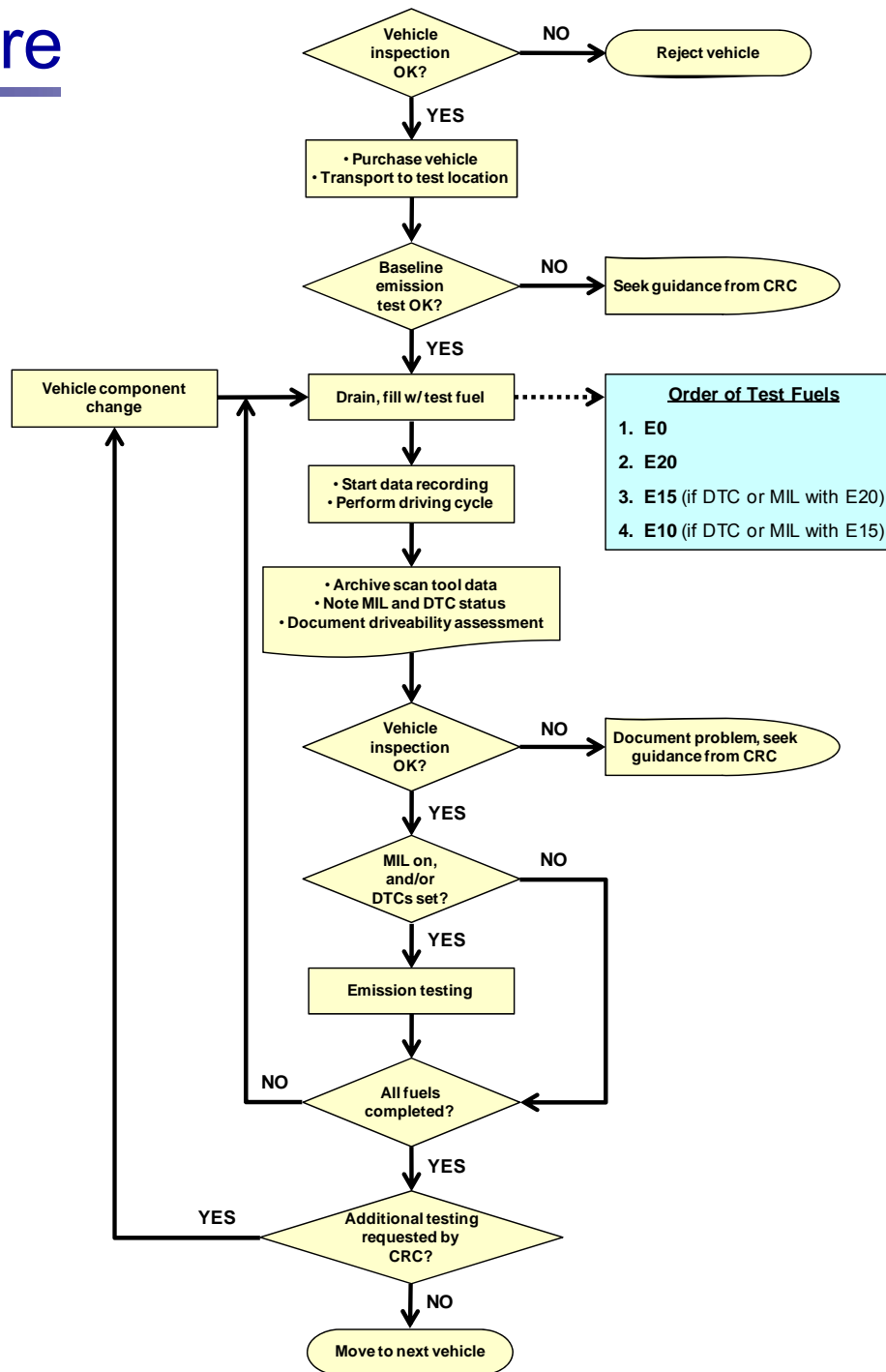
- 2008 passenger vehicle (same vehicle as previous slide)
- Histogram of long term fuel trim values over entire cycle (all 10 cycles combined)



Appendix:

Test Procedure and Driving Route

Test Procedure



Modified ASTM D5500 Route

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 $\frac{3}{4}$ 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 $\frac{3}{4}$ 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.

City Route Detail

