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As Fast As Lightning Strikes... Automotive Technology Changes.

LBT-146 FUNCTIONAL SCAN TOOL TESTING

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"Before everything else, getting ready is the secret of success."

- Henry Ford

Disclaimer of Warranties:

This manual contains test procedures and test information obtained by an ASE Certified Master Technician with known good test equipment on real vehicles, your tests may vary due to your equipment or technician procedures.

No warranty can be made from the ideas presented due to personal testing procedures, nor does the author or anyone connected with him assume responsibilities or liabilities. The use of this manual is conditional on the acceptance of this claimer. If the terms of this disclaimer are not acceptable, please return this manual.

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Functional Scan Tool Diagnostics:
There are Six Primary sensor inputs that should be checked on all vehicles to insure the vehicle is operating properly.

DataStream Diagnostics Six Primary Sensor Inputs:
There are Six Primary sensor inputs that should be checked on all vehicles to insure the vehicle is operating properly.

RPM:
The RPM sensor input is used to trigger the Injector Pulse-width and other functions. The input can be a crankshaft sensor or a combination of a Crankshaft and Camshaft inputs. If the RPM sensor input is missing then we have a no start condition.

Coolant Temperature Sensor:
The Coolant Temperature Sensor input will help to set the base Pulse-Width and Ignition Timing Curves based on coolant temperature. The emission control devices are also controlled by this input. Idle speeds for different temperatures are based on CTS input. A cold start CTS and IAT should be within 10 degrees of each other and at ambient temperature.

Inlet Temperature Sensor:
The Inlet Temperature sensor input to the PCM will fine tune Fuel Injector Pulse-Width, Timing, and Idle Speed settings.

Manifold Pressure Sensor/BARO:
The MAP and BARO should read the same Key ON Engine Off. The Key ON Engine readings are used for engine start-up fuel injection pulse-width calculation, and engine running pulse-width and timing calculations. The MAP sensor is used for EGR Diagnostics on some vehicles. The normal idle readings range between .9 to 1.5 volts with 18 to 21 inches of vacuum.

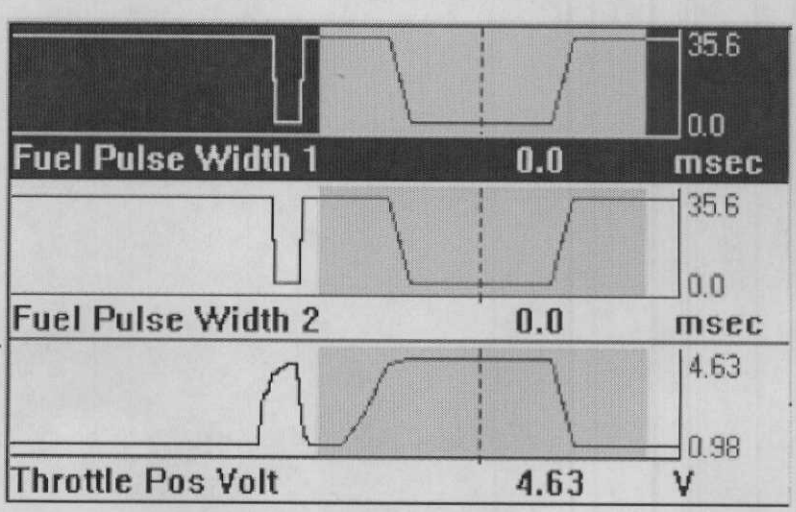
Mass Air Flow Sensor:
The Mass Air Flow sensor readings are used for timing and fuel curves based on the Mass of the air entering the engine. The BARO readings on Ford vehicles can be calculated from the flow of the MAF sensor. Idle readings should run about 3 to 7 grams per second and increase with engine speed.
Quick Tech Tip: The GPS reading should have a minimum of one gram per liter of engine displacement at Idle.

Throttle Position Sensor:
The Throttle Position Sensor input is used for Injector Pulse-Width and Ignition calculations. The readings are used for transmission, A/C, and emission devices operations. This sensor is what I call the on demand sensor give the input of the driver demand.

O2 Sensors:
The Oxygen sensor inputs are used for fuel trim to feed the proper Catalytic Converter the proper mixture. The O2 sensor inputs can also be used for Open and Closed loop criteria, EGR diagnostics, Catalytic efficiency, Secondary Air, and EVAP Diagnostics.

Scan tool Setup for Clear Flood
The Throttle Position sensor and Injector pulse-width should be graphed for this test.

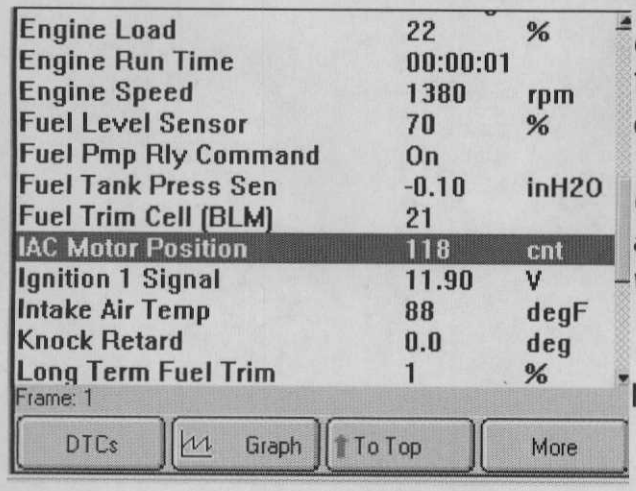
The Fuel Injector Pulse Width readings drop to 0.0 msec when the Throttle Position Voltage increases to above 4.0 volts. This indicates injector control based on TPS input, not all vehicles have clear flood mode.



Quick Tip: some vehicles have an acceleration enrichment based on TPS input driving the vehicle rich Snap throttle test to check this function.

Idle Air Control Tests
The Idle Air Control counts at warm no load idle should range between 10 to 30 Counts and Ford readings are in percentage, but in the same range. If the readings are high you could have carbon build up in the air passages or a dirty throttle plate. If the readings are below 10 indicates, a possible vacuum leak in the engine.

Quick Tip: Check the PCV operation for proper flow when the IAC counts are off. The RPM should drop 50 to 150 when the PCV is blocked off.



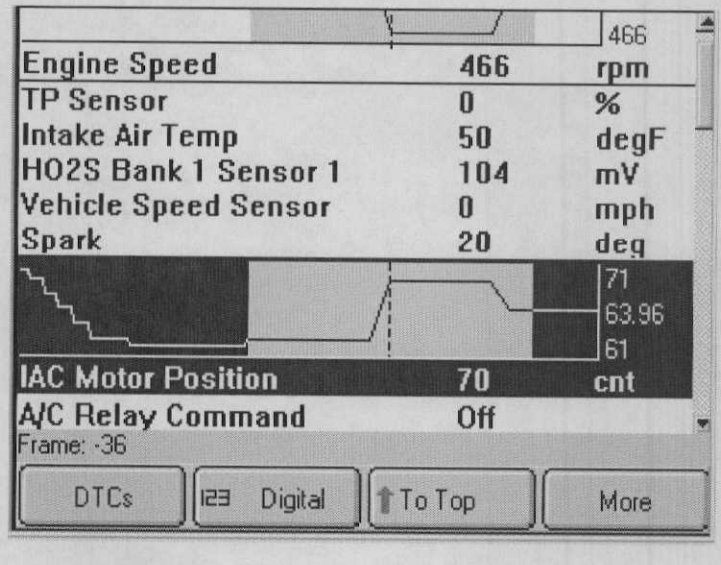
Idle Air Control Cold Counts

Cold startup readings should be over 70 Counts. Then as the engine warms up the readings slowly drop to normal readings of 10 to 30.

Quick Tip: Exit the Datastream and then enter again reset the min/max/average settings when graphing an item.

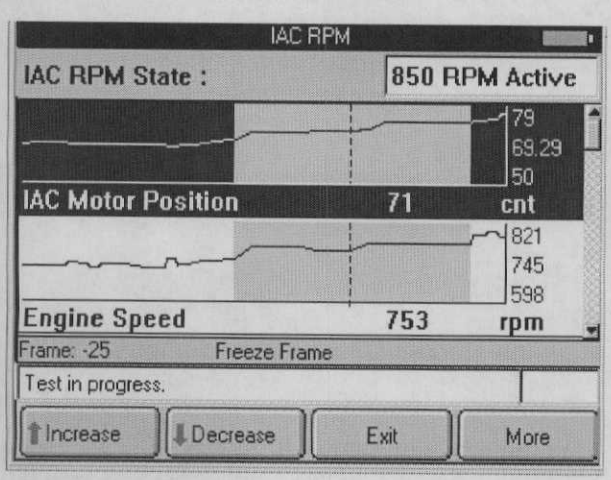
IAC Control Exercise Tests:

If there is an idle problem, then do an IAC Control Exercise Test.
The counts should be checked at idle in park, in drive, and idle in park with A/C on the IAC counts should change to compensate for the load changes.



Special Tests

Idle Air Control RPM



IAC RPM control allows the scan tool to increase or decrease the RPM and watch for a change to check operation of the IAC.

Idle Air Position:
The Idle Air Position can also be increased by percentage to check the computer control.

Throttle Plate Cleaning:
When the IAC counts are high, the throttle needs cleaning or there is a mechanical problem with the engine. Check for a high voltage readings from the MAP which indicates possible mechanical problems.

PCV Replacement:
The PCV is a calibrated vacuum leak and can affect the idle speed and IAC counts. Make sure the correct replacement PCV is installed for idle problems .

Manifold Pressure Sensor

Key on Engine off Test
The key on engine off readings should run about 4.4 to 4.8 volts or the right reading for the altitude of your shop. Sea Level Readings of iHg should be close to 30" and be lower at different altitudes.

GM/Chrysler BARO SPECS

Altitude	Scan data iHg	Voltage
0-1000 '	30-29"	4.8-4.5 V
1000 to 2000'	29-28"	4.5-4.3 V
2000 to 3000'	28-27"	4.3-4.1 V
3000 to 4000'	27-26"	4.1 -3.9 V
4000 to 5000'	26-25"	4.0-3.8 V

FORD BARO SPECS

Altitude	Vs.	Frequency
0-1000'	30-29"	163-159 Hz
1000-2000'	29-28"	157-153 Hz
2000-3000'	28-27"	153-150 Hz
3000-4000'	27-26"	153-147 Hz
4000-5000'	26-25"	150-144 Hz

Cranking Vacuum:
Throttle Plates closed crank the engine with the MAP sensor reading graphed. It starts at 30 and drops to 10 while cranking showing good cranking vacuum.

TIP: A good engine will pull at least 3-5 iHg while cranking. A low reading could be a worn engine or the IAC stuck open.

Idle readings:
The Idle readings need to run from about 8 to 12 iHg and .9 to 1.5 volts. The Voltage readings are off, but using iHg will still allow diagnosis of this input.

Snap Throttle Test:
A snap throttle reading should closely match the Key ON MAP reading indicating a good volumetric efficiency of the engine. After the snap when the throttle plate closes the reading should indicate a high vacuum reading and a low iHg reading normally 5 iHg or under which should read 5 inches or under on the Vacuum Gauge.

Vacuum	SCAN DATA iHg	Voltage
0"	30-29"	4.8-4.5 V
3"	27-26"	4.2-4.0 V
6"	24-23"	3.7-3.5 V
9"	21-20"	3.2-3.0 V
12"	18-17"	2.7-2.5 V
15"	15-14"	2.3-2.1 V
18"	12-11"	1.7-1.5 V
21"	9-8"	.9-1.1 V

MAP and Throttle Position Sensor:
When The TPS indicates Wide Open Throttle the MAP will show an Increase in pressure by a higher iHg reading.

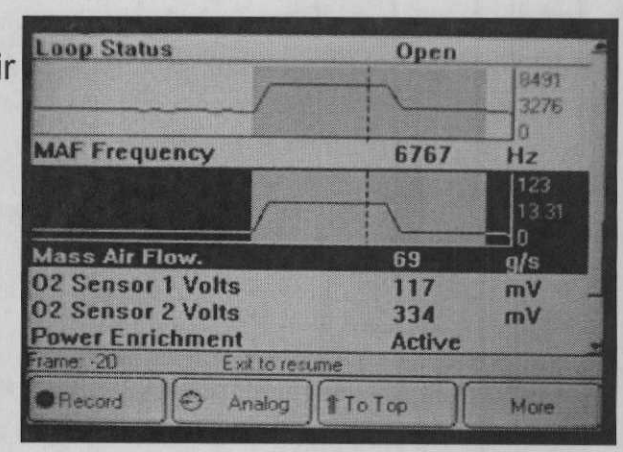
TIP: Use Custom Data Stream and Pick just the sensors you need for a faster screen rate.

Map and Injector Pulse-width:
The injector Pulse-Width readings should range from about 1.5 to 3.5 msec at idle. The normal range of the Injector Pulse-Width is 1 to 5msec on most vehicles.
Snapping the Throttle should show the MAP increase to near Key On readings and show a large increase in injector Pulse-Width.

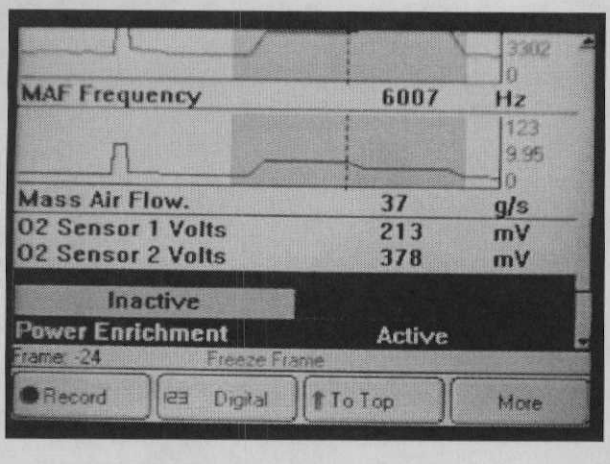
Mass Air Flow Sensor Testing

Normal Idle readings are 3 to 7 Grams per Second, .6 to .9 volts on Ford MAF and GM MAF in 2.2 to 2.4 kHz. The MAF determines the fuel needed for the vehicle and can cause mixture problems. Checking the LTFT at idle and 2500 RPM can determine if the MAF is contaminated. If the LTFT is taking away injector pulse-width with a negative reading and adding fuel at 2500 RPM, then the MAF needs cleaning or replacing. Some trainers used to suggest graphing the MAF at 25 to 50 RPM increments but most tech find this time consuming so we will try to show some easier methods.

Idle testing:
Graphing the MAF Frequency and Mass Air Flow the readings are 2730 Hz and 6 g/s which are ok at idle.

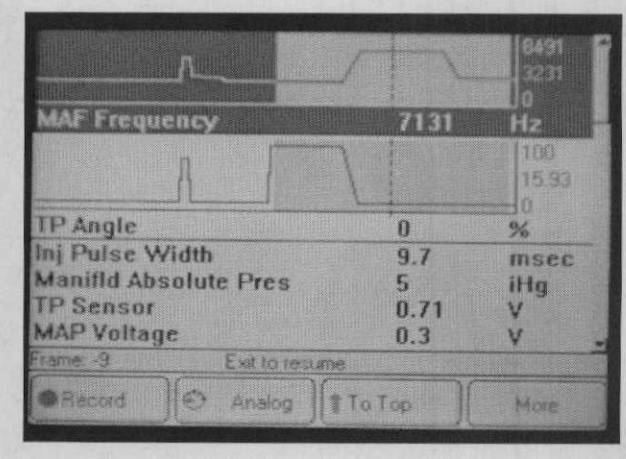


Snap throttle test normal data stream:
A snap shows 69 g/s and 6767 Hz which shows the vehicle response to an RPM quick increase. The specs for a snap are 7,000 Hz and g/s reaching close to 100.

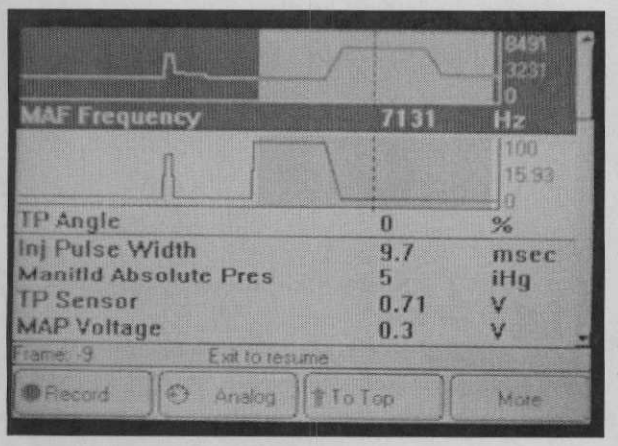


Power Enrichments:
As the throttle is snapped the Power Enrichment becomes Active indicating the need to increase Injector Pulse-Width for Acceleration.

MAF and TPS:
Graph the TPS and sort by graph to get these two items on the screen after putting MAF in digital view. The throttle angle increases to 100% before the MAF starts to change and goes to 7000 Hz indicating a good response.



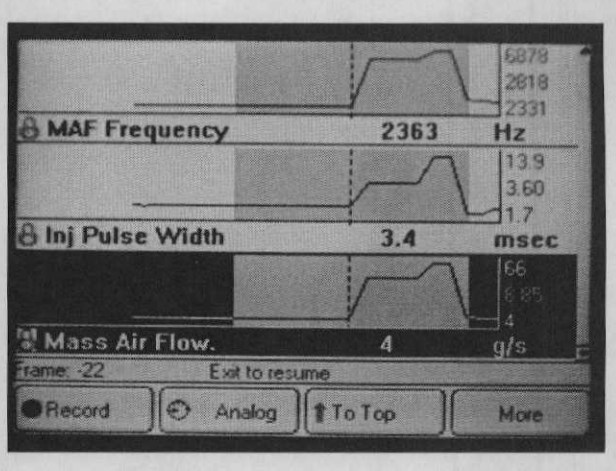
MAF and TP Angle and Injector Pulse-width:
After graphing the TP Angle it seems like the MAF frequency and Injector Pulse Width are responding together.

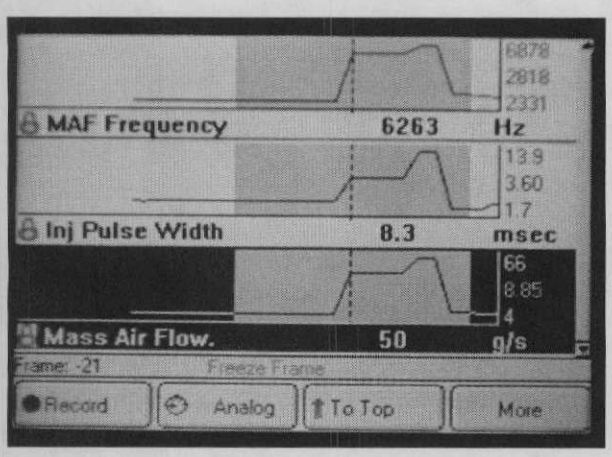


Custom Data stream:
Exit to Custom Datastream and select MAF Frequency, MAF Airflow, and Engine Speed by scrolling and press enter on each one. Press the View Data button to see the data, and then graph each one.

Snap Throttle Readings:
The data displayed is now at 7 to 9 frames per and the data displayed is only the three sensor inputs. The increases show a good response from the engine.

Graphing MAF Frequency, Injector Pulse Width, and Mass Air Flow:
As you can see, the display shows an MAF Frequency of 2363 Hz, the Injector Pulse Width at 3.4 msec and Mass Air Flow at 4g/s all demonstrating good control of the engine.

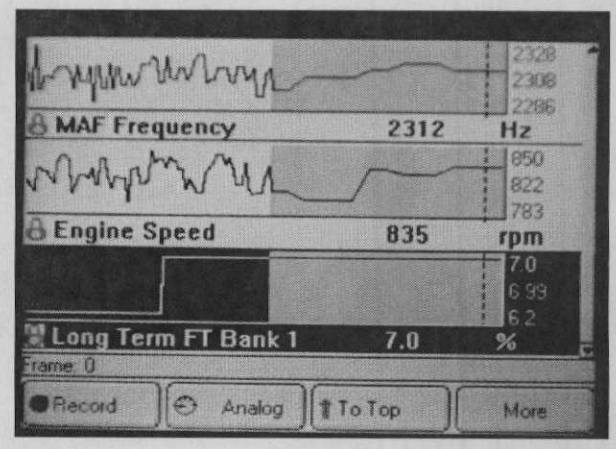


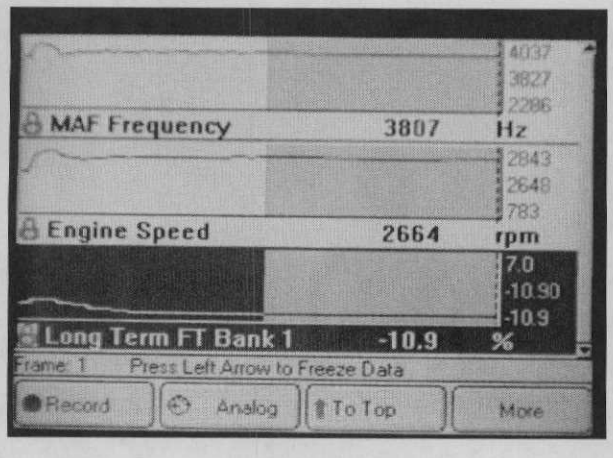


Snap throttle readings:
MAF Frequency at 6263 Hz, Injector Pulse Width at 8.3 msec and Mass Air Flow at 50 g/s. Both of these readings are demonstrating good control of the engine based on the MAF readings.

TIP: Using Custom Datastreams gives you a much better look at the patterns.

Long Term Fuel Trim: A normal MAF Frequency should be in the range of about 2200 Hz - 2400 Hz at idle with Long Term Fuel Trim at around 7.0%. If the Long Term Fuel Trim had a negative reading of 11.0 % or more, it would indicate a calibration issue with the Mass Air Flow Sensor.





As you can see, the Mass Air Flow and the Long Term Fuel Trim are within a normal range with the engine at around 2500-2700 rpm. This is a good conclusive test indicating that the Mass Air Flow sensor is not contaminated and is working correctly.

Mass Air Flow Testing Conclusion

As you can see from testing the Mass Air Flow Sensor you can gather quite a bit of information. By watching the RPM change you can see the MAF follow the RPM or the throttle, which it should do.

Many Technicians try to graph them out. Although the data is informative, it does not give you a realistic test as the vehicle is running. You want to use the sensor inputs you need and correlate them together.

As the throttle was snapped, we saw that the fuel would increase as would the MAF frequency would increase. Also, Technicians need to observe the Long Term Fuel Trim at idle and observe the Long term Fuel Trim at 2500 RPM (or higher). If a drastic change from one to the other, those readings would indicate a possible damaged or contaminated Mass Air Flow Sensor which is quite common in Ford and GM Vehicles.

These tests will allow you to test the Mass Air Flow Sensor and give you a good indication if it in fact is feeding the proper information into the vehicle.

Engine Coolant Temperature (ECT) Sensor & Intake Air Temperature (IAT) Sensor Testing

Testing the ECT and/or IAT sensors is a good place to start for vehicles with hard starting symptoms.

One of the things that should be checked with hard starting is the Engine Coolant Temperature and Inlet Air Temperature sensors.

First thing to check for on a cold engine is the ECT and IAT to be within 10° of each other and at ambient temperature for correct operation. In most cases, the sensor that reading higher in temperature is the sensor that is reading correctly.

The Coolant Temperature Sensor has a large control over fuel and timing, and increases idle speed on cold engines. The IAT sensor can increase the fuel injection Pulse Width as much as 66% on some engines.

Both the ECT and the IAT are critical sensors based on fuel and starting problems.

USB Drive Recording and ConnectTech
Monitoring the ECT and IAT for glitches can be done using the USB drive to record for long periods of time.
Use the download feature on ConnectTech to replay the file to determine if there is a glitch with a voltage or temperature change.

Oxygen Sensor Testing

Older Single Wire Sensors:
Disconnect the O2 sensor and tie into the wire going back to PCM, with one hand hold this lead and touch the Positive Battery Post with the other had. The input voltage will go about 1.0 and the PCM will lean out the mixture. Touching the negative battery post will send a low voltage signal and the PCM should respond by adding fuel to enrich the mixture. This removes the O2 senor input from the system and determines if the PCM has control and the wiring is correct. The use of propane on most vehicles is needed, because it is hard to hook up to the sensors. I use the scan data to determine if the O2 is working properly before I use my lab scope for additional testing.

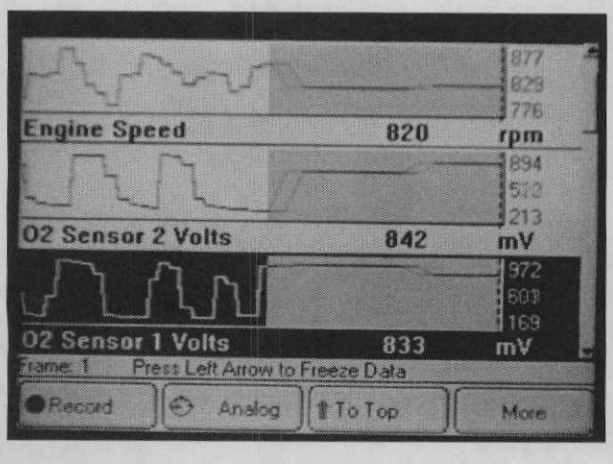
Start Up O2 sensors:
The readings will run key on engine off cold engine at .450 V for GM and .440-.500 V or 5.0 V for Chrysler. If the engine has warmed up the reading and key is on the readings will be lower as the heaters are active. Startup the O2 should go high front and rear with the rich starting mixture. Cold engine the rear O2 will tend to match the changes in the front O2 till the Catalytic Converter gets to operating temperature.

Propane testing of hard to get to O2 sensors:
The use of propane to richen up the mixture is a great way of testing O2 sensors.
First find a vacuum port downstream of the MAF sensor that feed all the cylinders.
Use a enrichment tool to add propane till the engine starts to drop RPM, the O2 readings should be over .900 V and closer to 1.0 V. Next step stop the propane flow and remove the hose, the O2 should drop in a straight line. Custom Datastream will show a drop to less than .200 V in one frame, if it drops in steps of voltage changes then the O2 is defective and needs replaced.

Short Term Fuel Trim & O2:
As a rule, Short Term Fuel Trim reacts directly to the O2 Sensor input. Short Term Fuel Trim should move in the opposite direction as the O2 Senosr.

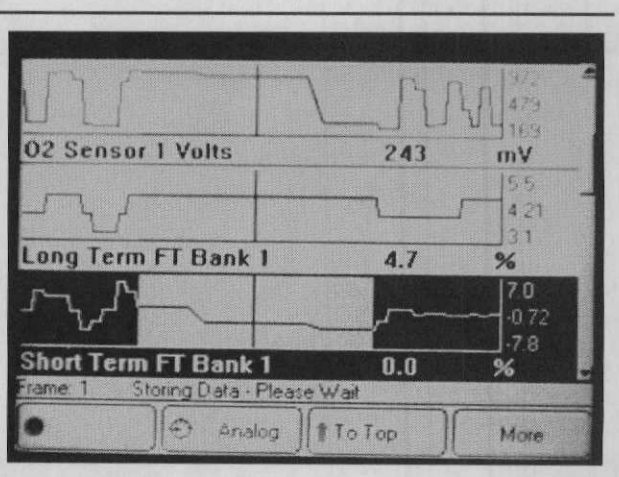
A more involved test would be to graph Short Term Fuel Trim, O2 Sensor, and Fuel Injectors. All should change proportionally to each other.

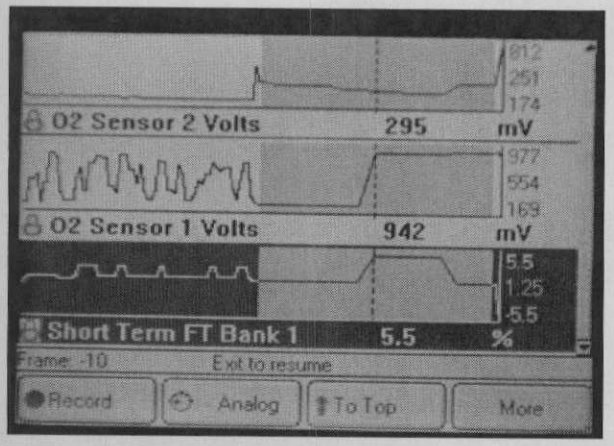
Catalyst Efficiency O2 Testing:
Use Custom Datastream and set up the screen to see the pre and O2 sensors.
If the rear O2 mimics the front then the catalytic converter or O2 Sensor is bad.



Fuel trim and O2 Testing:
Looking at the screen you can see that the readings for 02 Sensor #1 and O2 Sensor #2 are almost identical or mimicking each other. This is a good indication that there is a malfunction with one of the two sensors.

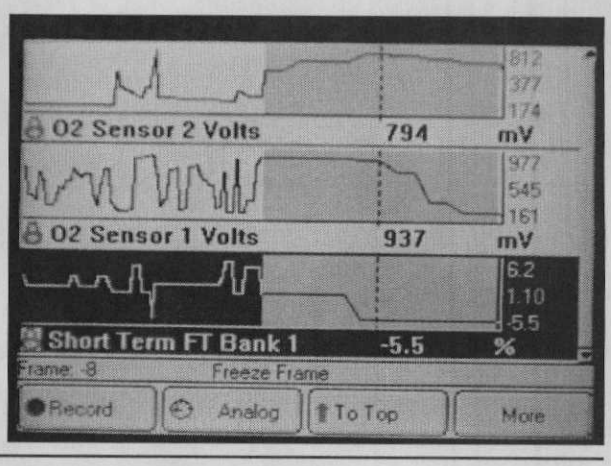
In this screen capture we have recorded 75 frames before and 75 frames after. Notice that when the O2 Sensor goes higher, the Short Term Fuel Trim goes lower which indicates proper sensor function.



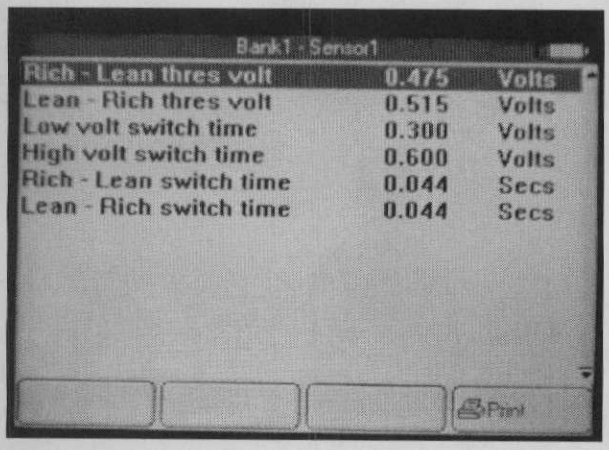


Custom Datastream
Snap Throttle Test:
Looking at the readings after a quick Snap Throttle Test, we can see that O2 Sensor 1 has the ability to go high. However, it appears to be reacting slow.

A good O2 Sensor should have a clean drop in voltage reading. As you can see in this screen capture, O2 Senosr 1 has a gradual voltage drop which indicates a possible malfunction with O2 sensor.



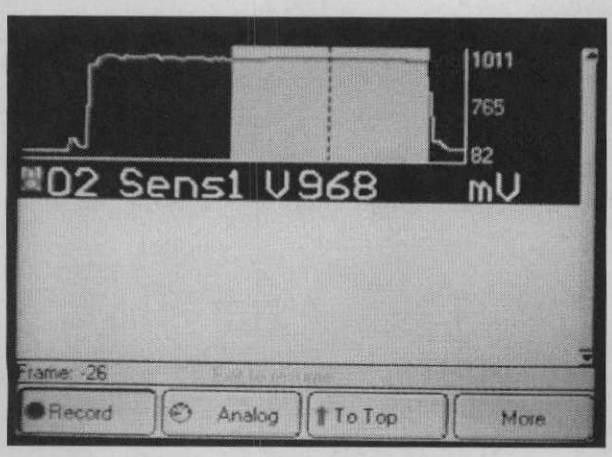
Mode 5:
Exit back to the menu and choose special tests then O2 tests.
The low Volt switch time is 0.300 Volts; this is really the switch point.
The readings on the screen are the time it takes for the voltage to transition between .300 to .600 volts and it needs to be less than .100 seconds. Some Techs use a lab scope to determine if the O2 is switching above .800 and below .200 V in .100 seconds or 100 milliseconds. Most OBD2 vehicles will be under 0.030 Seconds on the Rich-Lean time and lower than that on lean to rich. This vehicle has a slow O2 sensor and needs to be replaced.



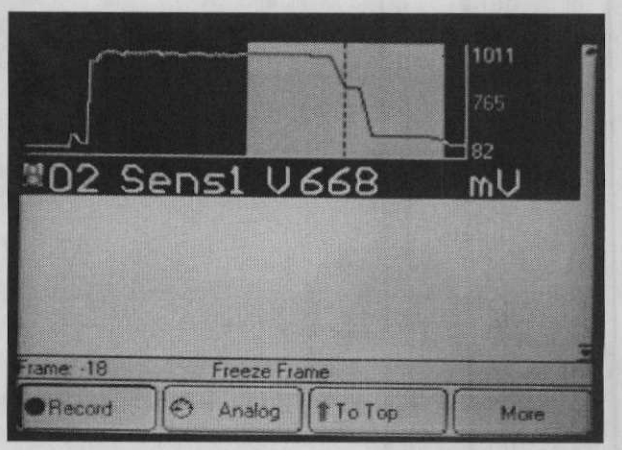
Propane Testing:
Propane testing adds propane downstream of the MAF sensor through a good manifold vacuum source. Add Propane till the rpm begins to drop and then shut off the propane and remove the hose. The O2 voltage should drop in on frame and drop below .200 V for a good O2 sensor. Any step in voltage changes and slow changes to below .200 V indicates the O2 sensor is defective and needs to be replaced.

Observe the screen captures below. In (***Screen Capture #1***), you can see O2 Sensor 1 has a voltage reading of 968 mV. After shutting off the propane source the voltage drops to 668 mV as shown in (***Screen Capture #2***). Finally the voltage drops to 178 mV in (***Screen Capture #3***).

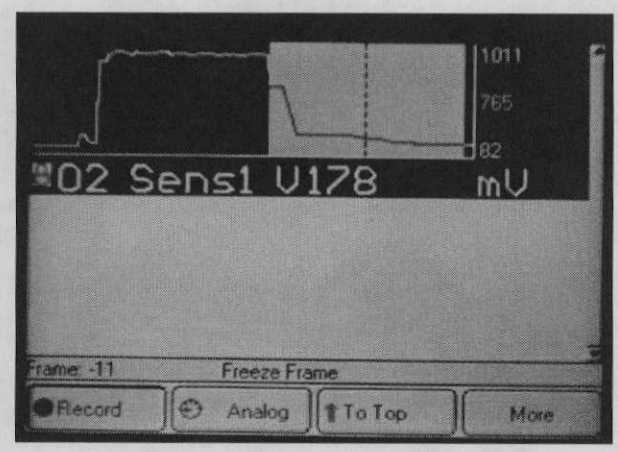
Again, these steps in voltage indicates the O2 sensor is defective and needs to be replaced.



screen capture #1



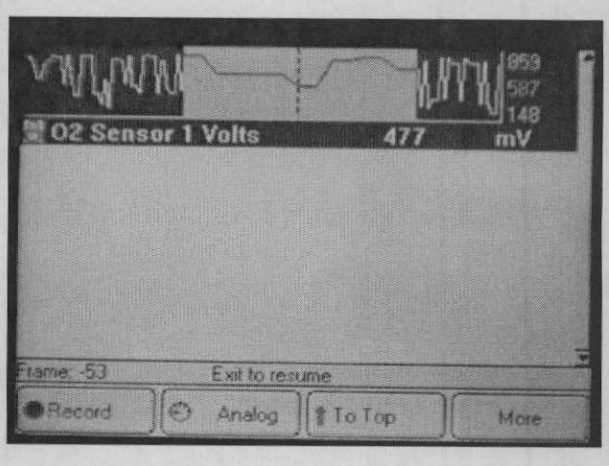
screen capture #2



screen capture #3

O2 Trending:
Use the max/min/average readings to determine if the PCM has fuel control. Graph the O2 sensor and watch the pattern to see if it trends rich or lean.

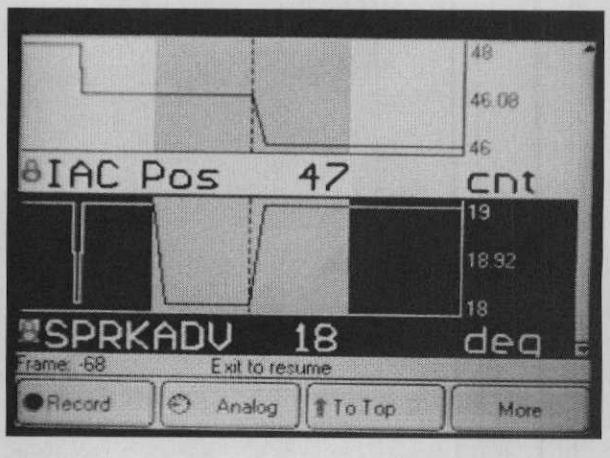
This O2 Sensor is trending towards the rich side and needs to be replaced.



Timing Advance Control

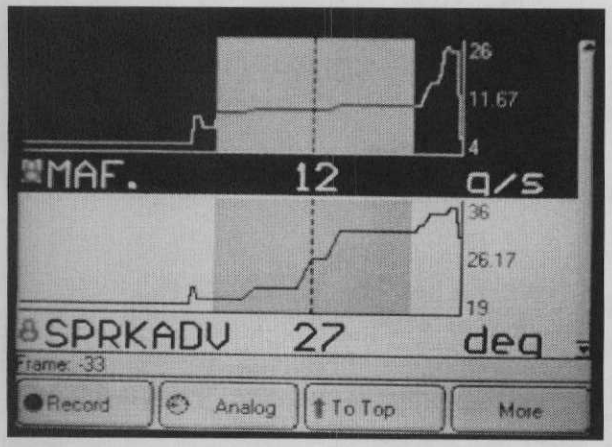
The main six inputs have a direct input on Timing advance settings. On Chrysler and OBD2 vehicles the IAC is the coarse adjustment for idle speed and timing advance fine adjustments. Maximum timing advance is under cruise conditions as much 50° and will retard or go lower under Wide Open Throttle conditions. Checking the Timing advance readings against other inputs can help diagnose problems quickly.

Idle Air Control and Timing Advance:
The idle readings should run 10-25 Counts with the Spark Advance will changes 2 degrees or more. This vehicle has an IAC Position of 47 counts and Spark Advance changing one degree.



Clean Throttle Plates
If the IAC counts are high and the Spark advance is fixed, clean the throttle plates. Servicing the PCV system and intake manifold cleaning should be done at the same time.

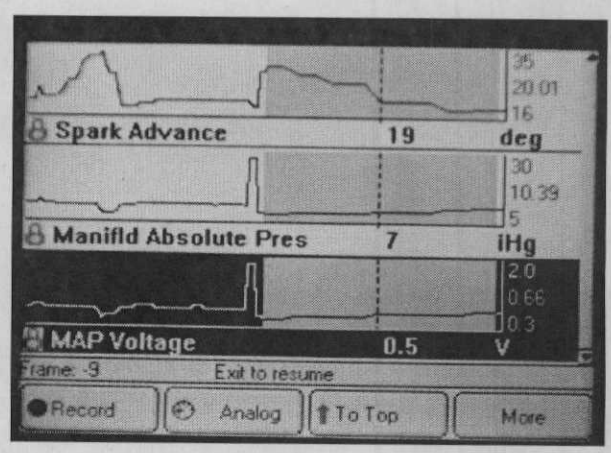
Quick Tip: Some larger engines in Trucks are more of a problem.



Mass Air Flow and Timing Advance:
Mass Airflow should run 3 to 7 G/S with a minimum reading of 1 gram per liter of engine displacement. As the throttle is snapped the MAF should increase along with the Timing advance for proper function.

As you can see in the screen capture, the MAF is in fact increasing along with the Timing Advance indicating proper function.Manifold Absolute

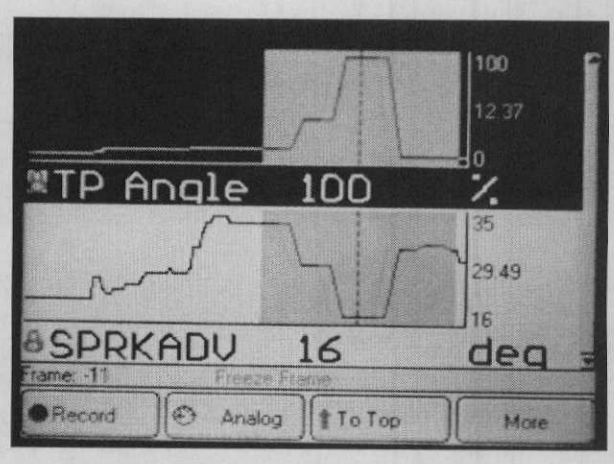
Manifold Absolute Pressure Sensor and Timing Advance:
The Timing Advance should follow the MAP sensor voltage changes.



Throttle Position Sensor and Timing Advance:
Spark Advance and TP Angle at Idle 0% and 19 degrees and steady (**Screen Capture #1**).
Snap Throttle with 100 TP Angle at 100% the Spark Advance decrease in prevent detonation. The TP Angle input has control over the Timing Advance based on this screen (**Screen Capture #2**).

Snap Test Wide Open Throttle:
As the throttle is snapped to Wide Open Throttle the Timing advance should follow the TPS. But at near WOT the timing should decrease like the older vacuum advance systems.

Screen Capture #1



Screen Capture #2

Misfire testing

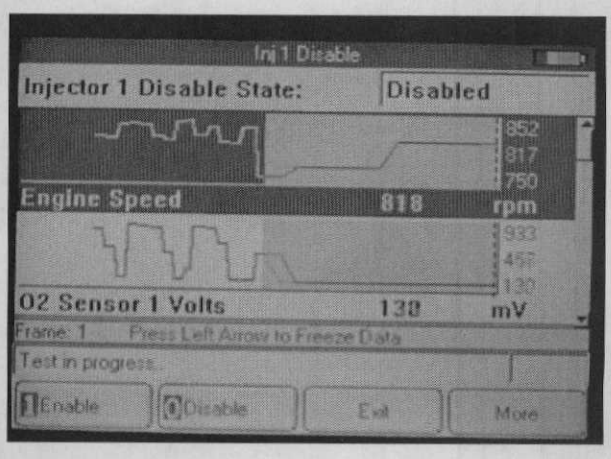
MAP and RPM can help determine if the misfire on the engine is Mechanical or Fuel and Ignition related.

If the RPM is varying with a saw-toothed like pattern and the MAP is steady then the problem is either fuel or ignition related. If the MAP has a similar pattern then it is most likely a Mechanical problem.

Long Term Fuel Trim is another good indicator. A change in Long Term Fuel Trim would also correspond to the misfire problem.

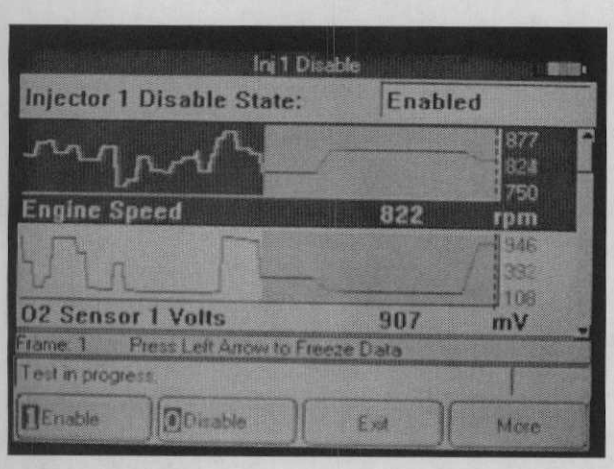
Ford Tip: Use Mode 06 Data and execute test 51 or 53. Observing the individual parameters will help you identify the cylinder that is misfiring.

Special test setup:
When using special tests you must set up your graphs beforehand. Select Datastream, Enginedata1. Select Engine Speed and the respective O2 Sensor(s). Exit out to the Diagnostic Menu and enter Special Tests and start the engine.



Select Fuel System Controls and Disable Injector #1.

As you can see in the screen capture Injector #1 state is Disabled. When the injector is disabled the engine will misfire and the RPM will drop. If there were no RPM drop, it would indicate that the injector had a malfunction.



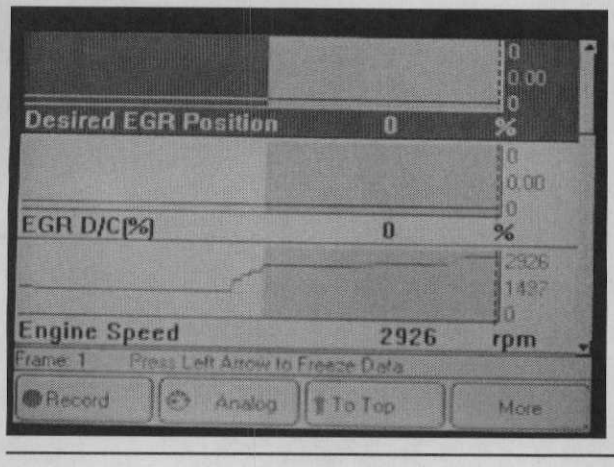
Here we have enabled Injector #1 and it has started to deliver fuel and the O2 Sensor voltage goes high. This indicates the the injector was delivering the proper amount of fuel and is probably not malfunctioning.

Exhaust Gas Recirculation Tests

If you are working on a vehicle with a rough running engine, one thing to check is the EGR system for proper operation. There are many ways to test the EGR but what we will cover here is Bi-Directional testing.

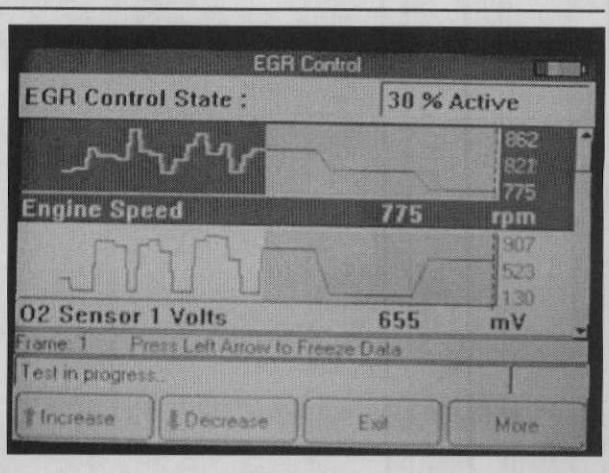
We will observe the O2 Sensor input and the engine RPM. As we open up the EGR we should observe an RPM loss and the O2 Sensor should go slightly rich.

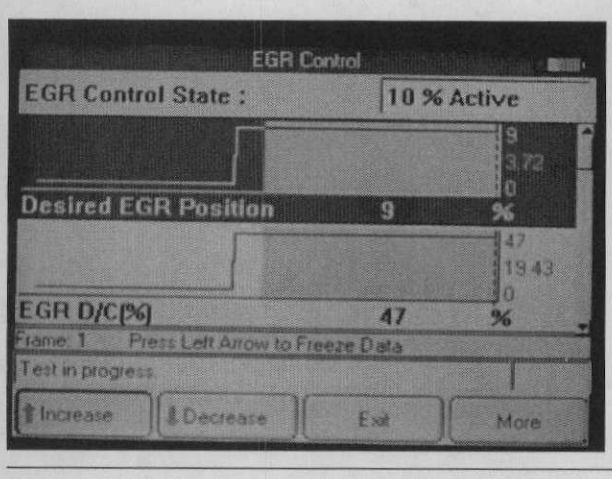
From the Datastream Groups select EGR data. Select Engine Speed, Desired EGR Position, EGR Closed Val Pintle, and EGR D/C %.



As you can see, we have slowly increased the engine RPM. At this point there is no change in the EGR position. Some vehicles must have a vehicle speed in order to change EGR position.

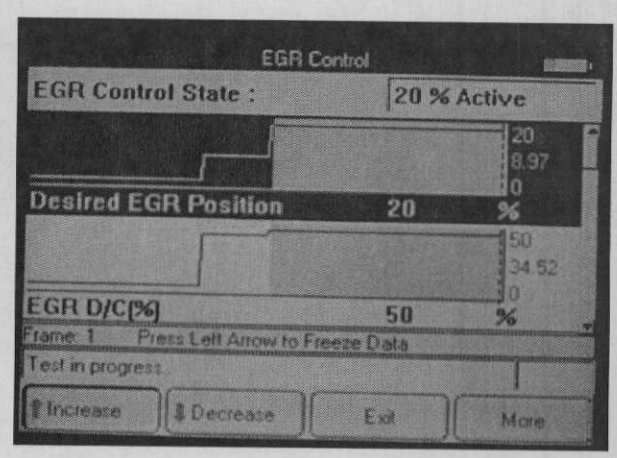
Exit and enter Special Tests and select EVAP/EGR Controls then select EGR Controls.
Observe the screen capture. You will notice an RPM loss as well as the O2 Sensor trending toward the rich side.





You will see here that we have increased the EGR Control state to 10% Active and the Desired EGR Position is at 9%. If the reading was off by more than 3%, we would know that there was a malfunction.

You will see here that we have increased the EGR Control state to 20% Active and the Desired EGR Position is at 20%. Both tests indicate proper EGR function.



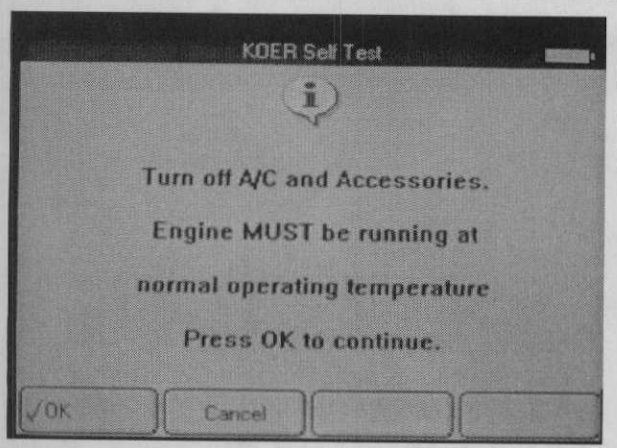
As you can see, as we increased the EGR Control State the O2 Sensor began to go rich and the PCM tried to compensate. At the same time there was an RPM loss on the engine. If you were observing the MAP readings, they would increase in voltage because the load on the engine was changed. All of the tests indicate that the EGR is operating properly.

Key On Engine Running (KOER) - FORD:

One of the easiest tests for the EGR on FORD vehicles is the Key On Engine Running (KOER) Test. Before performing this test, T into the vacuum line going to the EGR. When performing the KOER test it will actually run the EGR and pull it open and closed. You want to observe and make sure that about 3 inches of vacuum is being supplied to the EGR while the test is being performed.

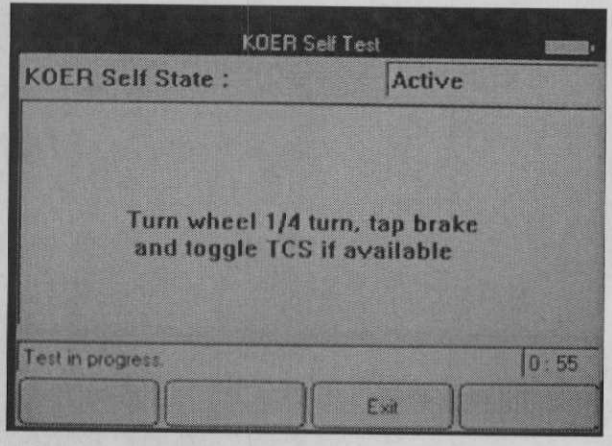
If while applying vacuum there are still issues you may want to check for restrictions or clogs in the passages and need to be cleaned. Also you can apply vacuum to the EGR and watch the DPFE change on the engine.

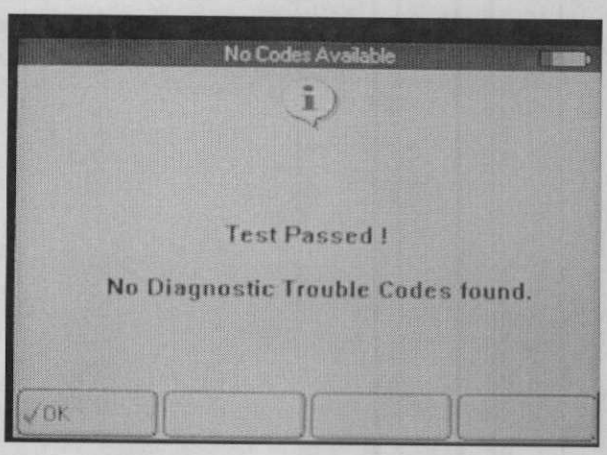
NOTE: when you have completed the test, you should do a Keep Alive Memory (KAM) reset and erase the memory so you can start fresh and get a good reading.



Key On Engine Running (KOER) Self Test: Make sure all A/C and Accessories are off. Failure to do so could set a false code. Engine must also be at operating temperature.

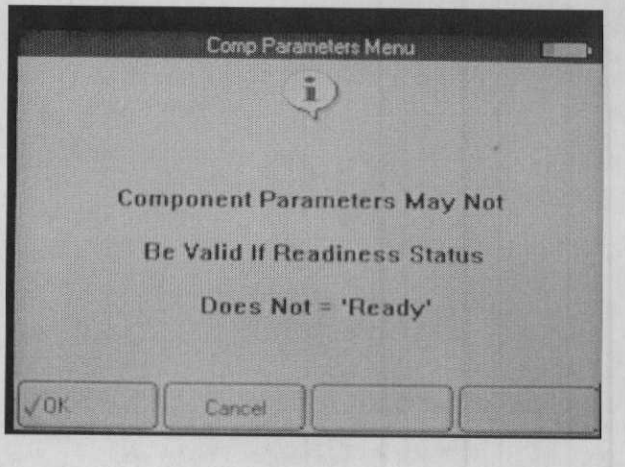
Turn steering wheel 1/4 turn, tap brake and toggle TCS switch if equipped. This test could take up to 2 minutes or more depending on the vehicle that you are working on.





MODE 06:
Using Mode 06 and component parameters will also aid in identifying if the EGR flow rate is correct.

Start by going to the Special Tests menu and select Component Parameters. Scroll through and check all desired parameters.

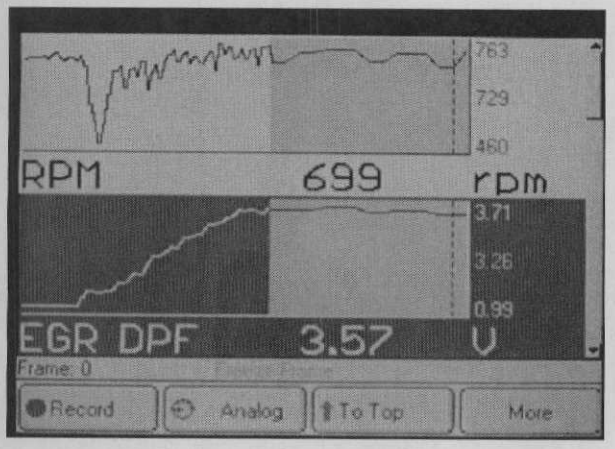


For the EGR Flow Test the minimum limit is 33536 and the demonstration vehicle measured value is at 34944. If the measured value was close to the minimum limit you may have clogged or restricted passages.

Testing DPFE:
Exit Special Tests and enter Datastream and select Emission.

Apply about 5 inches of vacuum and you should see about a 4 volt change in the DPFE.

As you can see in Screen Capture #1, the EGR DPFE is about 4 volts with about 6 inches of vacuum. In Screen Capture #2, we have released the vacuum and the EGR DPFE has returned to 1.0 volt and the engine has returned to about 800 RPM.These are both good readings and they tell us that the EGR DPFE is operating correctly.



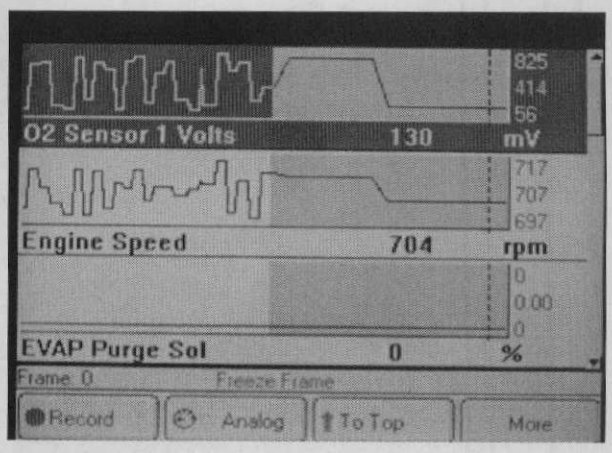
Screen Capture #1

Screen Capture #2

EVAP Testing

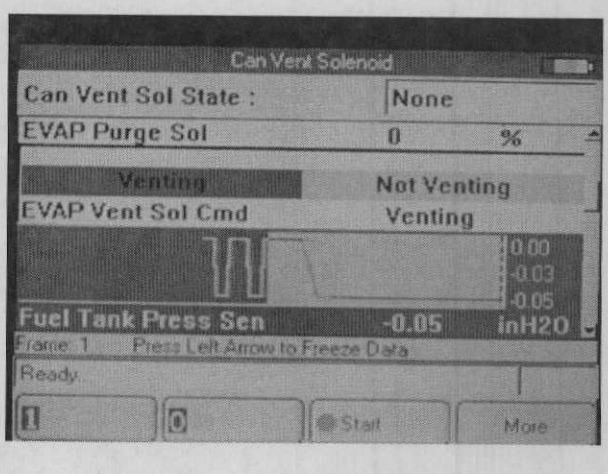
In this section we will review Bi-Directional testing of the EVAP system. We will take a close look at the response from the EVAP, how to close the vent, and test the EVAP canister vent. We will also take a close look at the effect of opening the EVAP Canister Purge Solenoid and its effect on the engine in respect to O2 Sensor change, and the Fuel Mixture change.

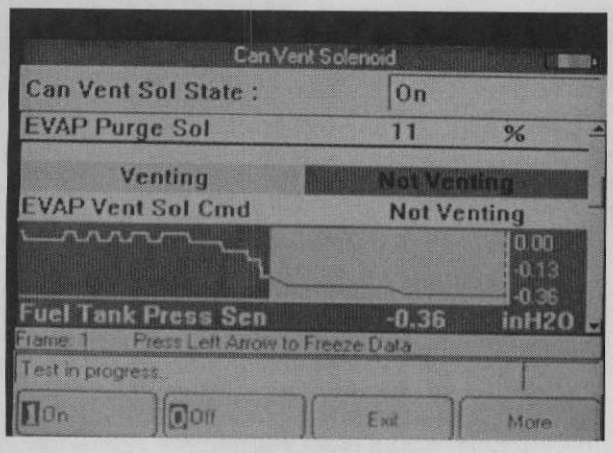
The first thing to do is enter Datastream from the Diagnostic menu and select Engine Data 1.
NOTE: Keep in mind that you have to pre-set the graphs that you need before entering this test. As you can see from the Screen Capture, we have selected O2 Sensor 1 Volts, Engine Speed and EVAP Purge Sol.



Now exit and enter the Special Tests menu and select EVAP/EGR Controls then select Canister Vent Solenoid.

In this screen capture you can see that we are venting to the atmosphere and the Fuel Tank Pressure Sensor is on the low side.

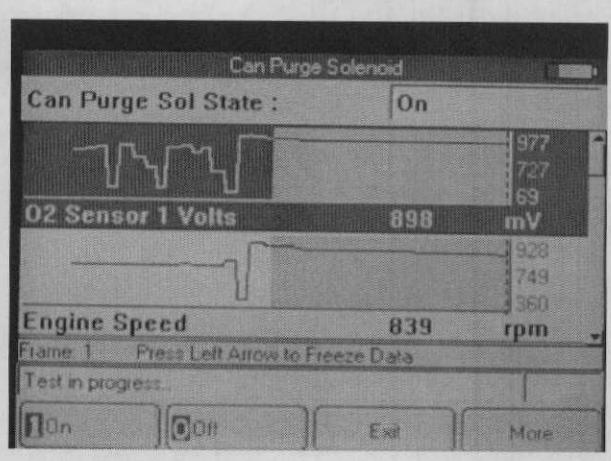




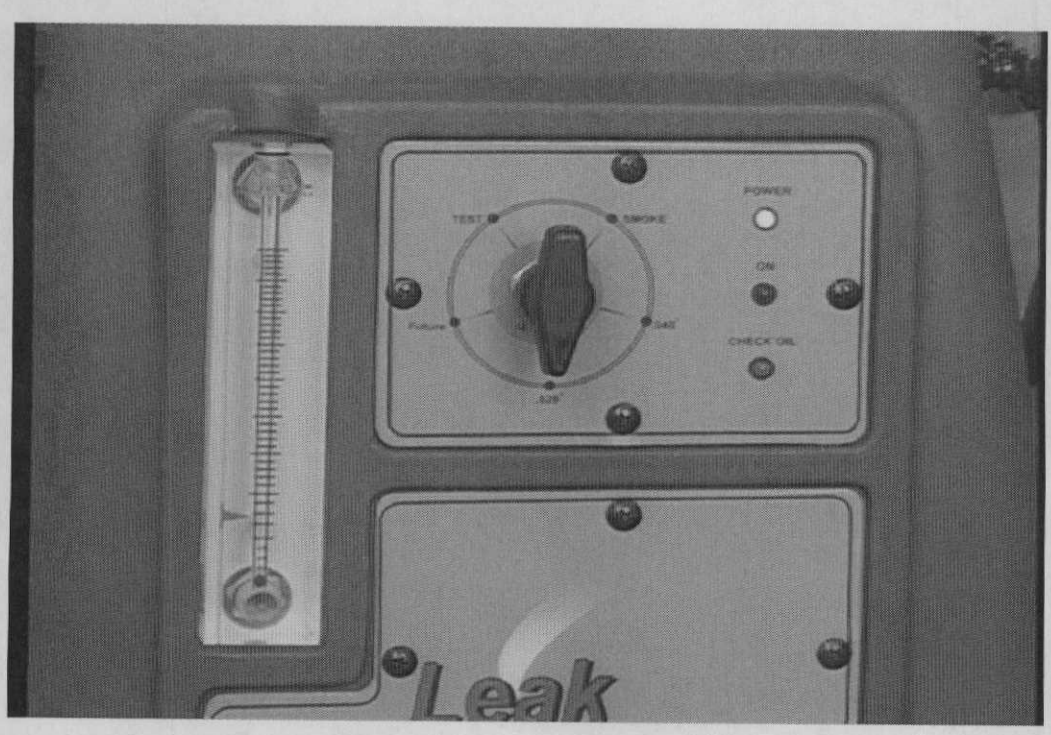
Here you will see that the vent is now closed and the Fuel Tank Pressure Sensor is at -0.36 inH2O. This indicates that vacuum is being applied and it is working properly.

Canister Purge Solenoid Testing:
Exit back to the EVAP/EGR Controls menu and select Canister Purge Solenoid.

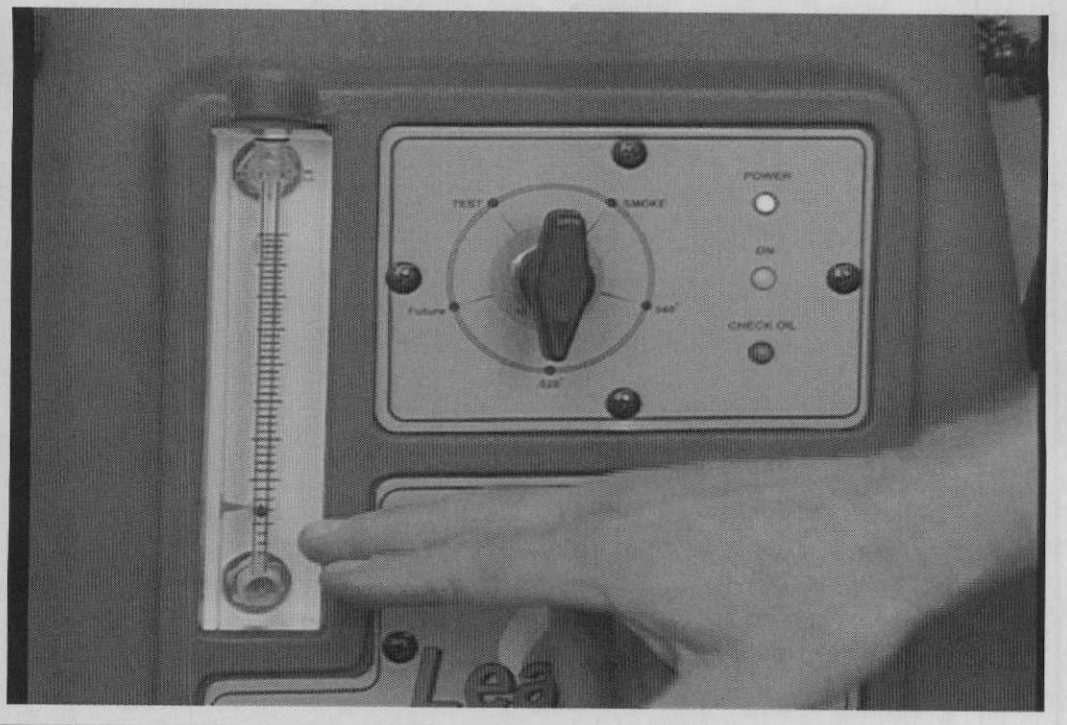
Here you can see that we have selected Can Vent Sol State to "On". Notice that the fuel has gone full rich indicating that the canister has adequate vapor and is working properly.



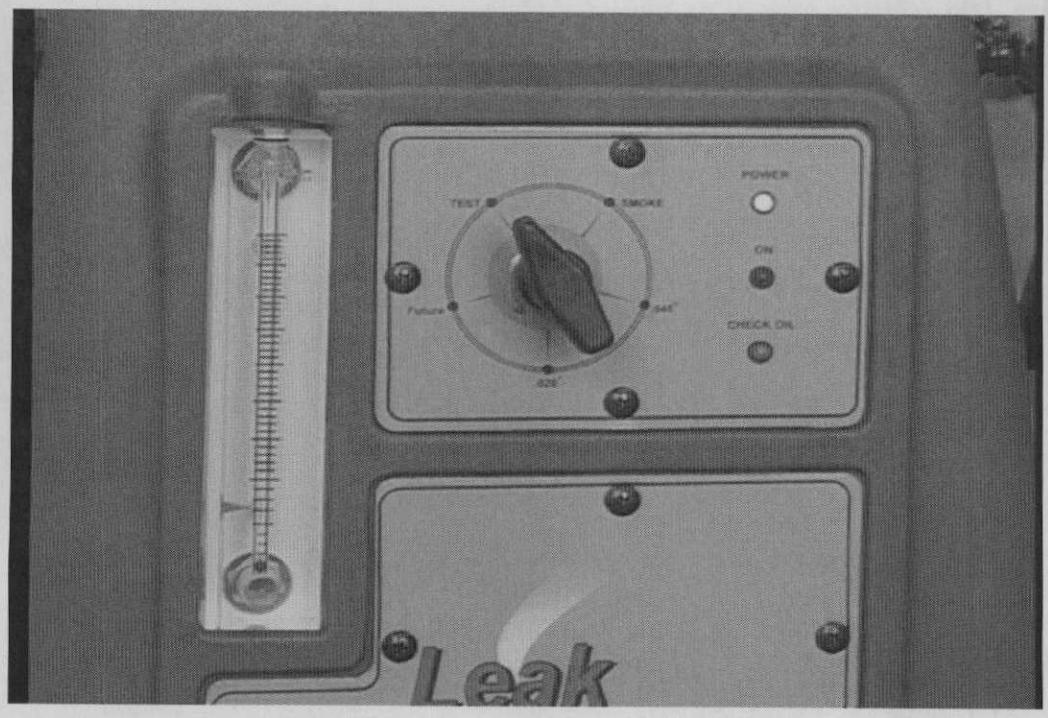
Manual EVAP Leak Testing:
Here we have set up the Leak Master for a 2005 Model Year Vehicle which is a .020 leak. Any vehicle 1999 and older would be set up for a .040 leak



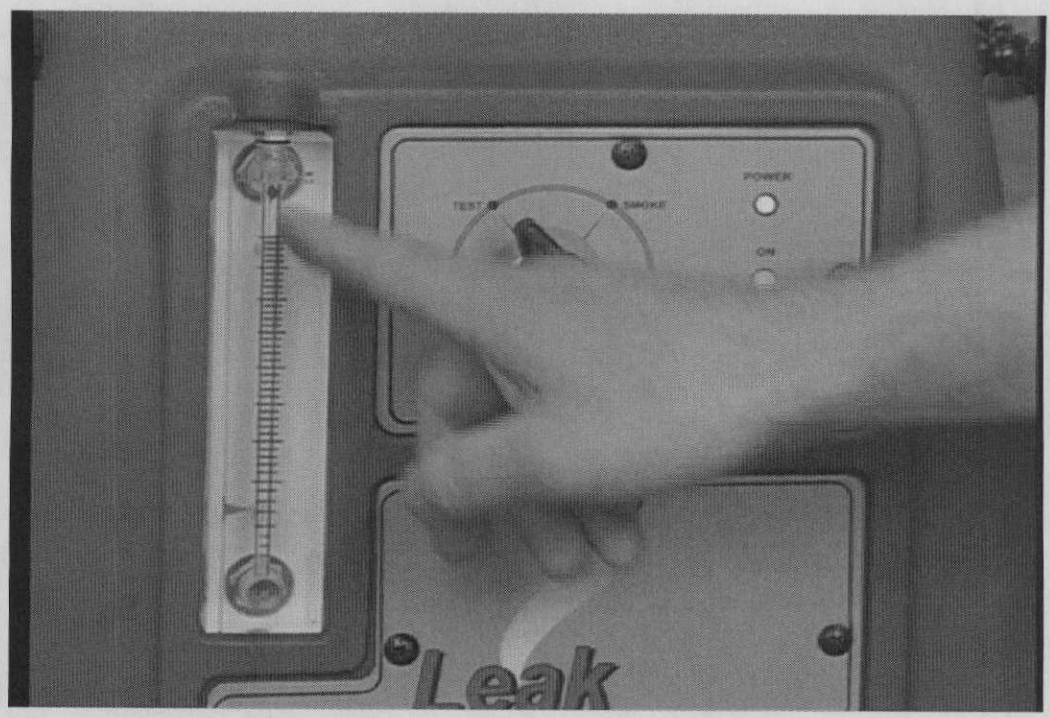
The ball in the cylinder should line up pretty close to the flag to the left of the cylinder. If the ball were higher than the flag to the left of the cylinder it would indicate a leak greater than .020. Any reading under the flag indicates a pass situation.



Next, turn the unit off and switch it to "Test" mode.

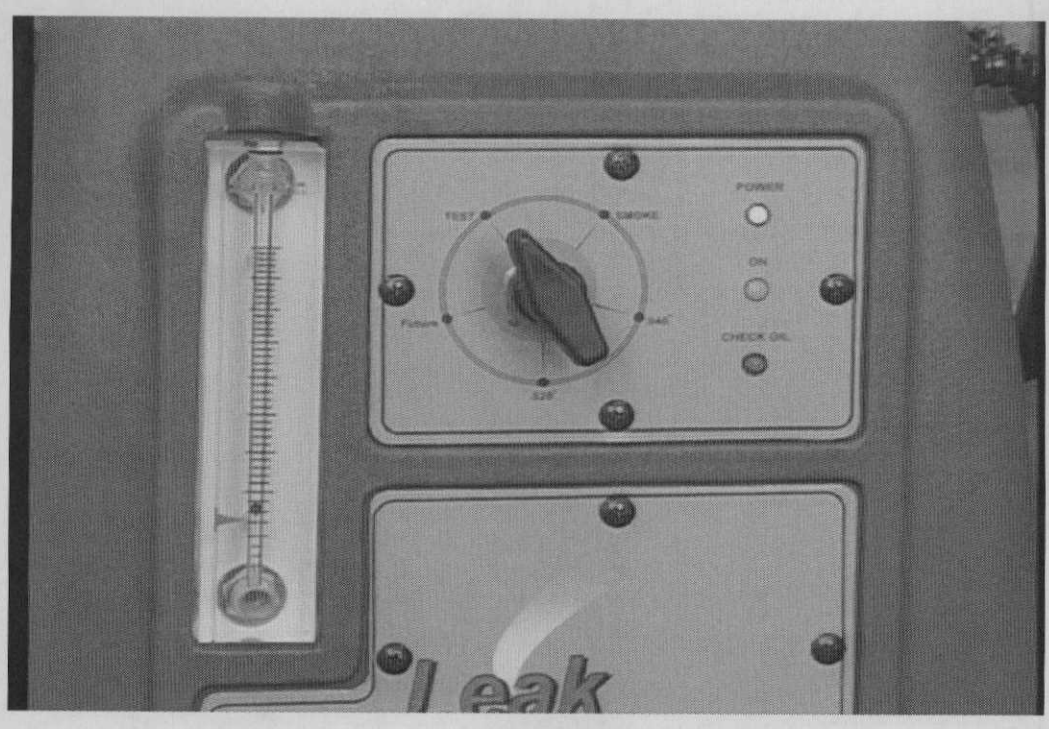


Since the Canister Vent is open, you can see when we turn the unit on we have a gross leak.



In this screen capture we have already gone back to the Scan Tool and closed the vent. You can see that the ball is now dropping. We may still have a leak but you must wait until the ball has reached its lowest level and is no longer dropping. As long as the ball goes below the indicator flag we can be assured that the system is working correctly.

This test does take a while, but you want to perform it several times to make sure the system is operating correctly.



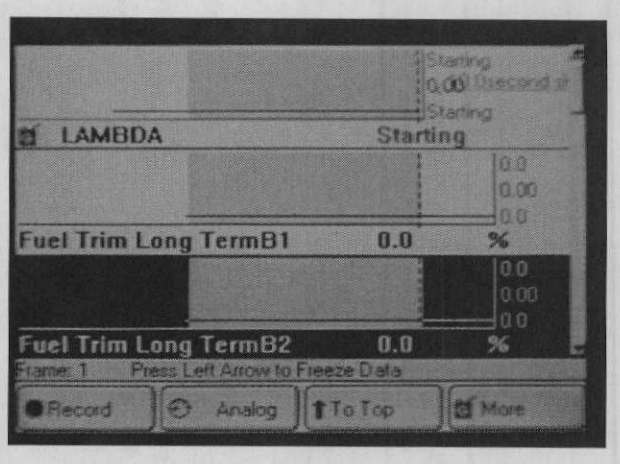
Fuel trim Testing/Lambda

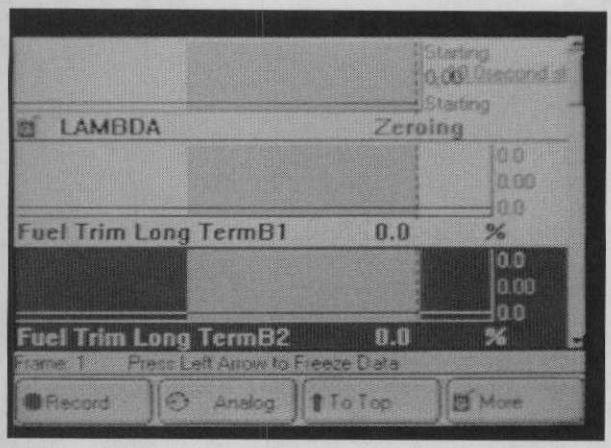
Fuel trim readings along with use Lambda to determine proper fuel control is the one of the last steps for a complete repair. The Lambda readings are at 1.0 when the fuel mixture delivered to the vehicle is 14.7 to 1. So if the Long Term fuel Trim numbers are in -10 to 10% area and Lambda is at 1.0 then we have fuel control. The normal range of Lambda is .97 to 1.03 with numbers lower than 1.0 indicates a rich mixture and higher than 1.0 lean mixture.

Lambda is what's delivered to the engine. Short Term Fuel Trim is the correction on the vehicle from the sensors based on the O2 Sensor(s) and whether the computer has full control.

Scan Tool Integrated with GAS:
From the Diagnostic Menu select Integrated Diagnostics - Scan/Gas, select Engine Data 1

You can see in the screen capture that we have selected LAMBDA, Fuel Trim Long TermB1 and Fuel Trim Long TermB2.

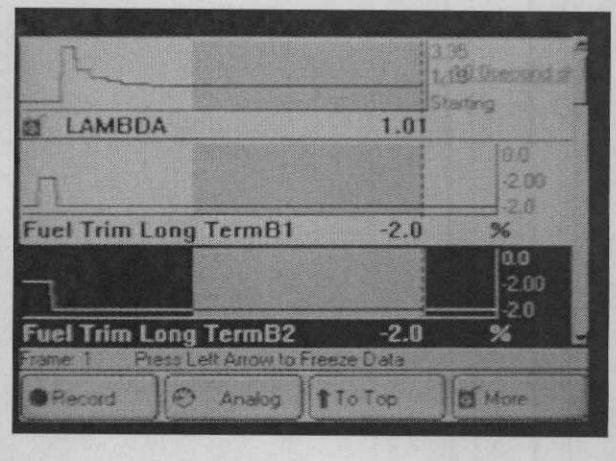


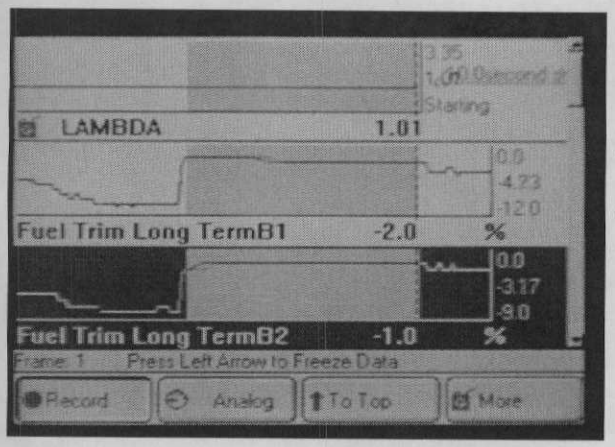


Here you can see that we have already removed the Sample Hose from the vehicle exhaust and select OK to begin Zero the analyzer.

At this point the LAMBDA has gone down to 1.01 and Fuel Trim Long TermB1 and Fuel Trim Long TermB2 are both at -2.0%. This means we have fuel control.

If the LAMBDA was out and the Fuel trims were wrong, it could mean that we have a faulty O2 Sensor or a bad Input Sensor.

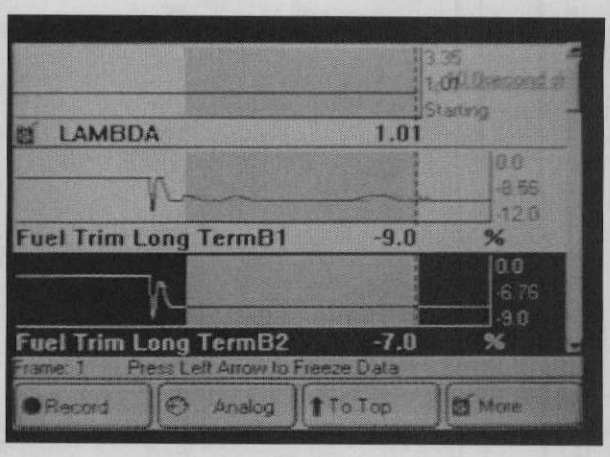




In this screen capture we have brought the engine speed up to about 2500 RPM.

The readings here eliminate the possibility of a MAF problem for this particular vehicle.

Here you can see that the engine has returned to idle. The readings indicate that the vehicle is running a little bit rich but the computer does have control. Computer control is indicated because LAMBDA is reading 1.01.



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