Team AVI Team AVI

A Training Solution Company

Call 1-800-71-TRAIN • (1-800-718-7246)

TEAM A.V.I.

A Training Solution Company

and

Randy Bernklau, BC Automotive

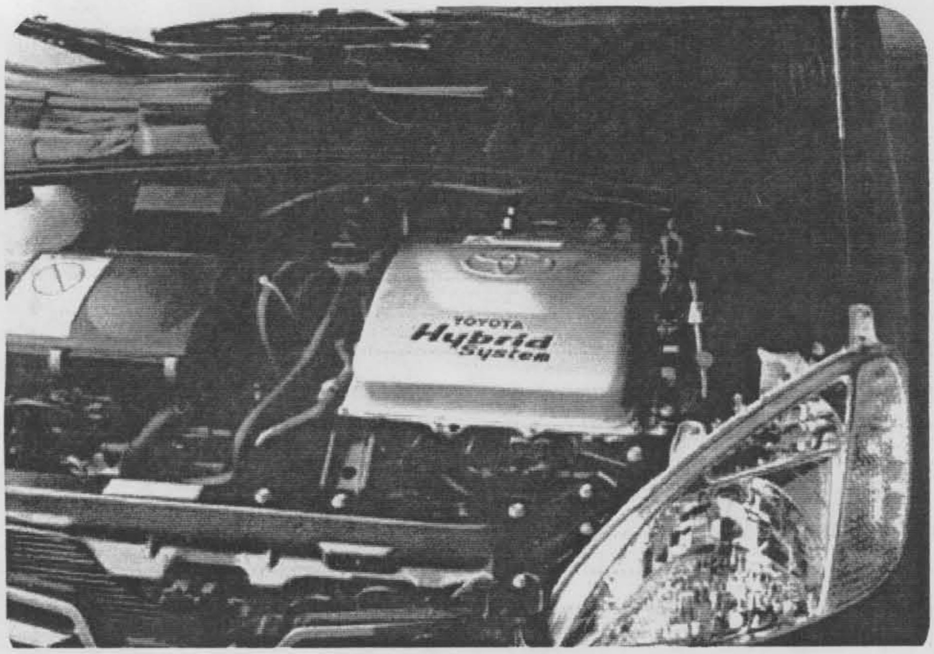
present

Asian Drivability
focus on Toyota
LBT-63

As Fast As Lightning Strikes...

Automotive Technology Changes...

Contents



Introduction

This manual is intended to be used along with the AVI video "Asian OBD II" by Randy Bernklau. The intent of this material is to give an overview of OBD II monitors and how they relate to the real world. The final part will deal specifically with Toyota evaporative systems.

OBD II was developed by the California Air Resource Board (CARB) and began showing up on some 1994 and 1995 model year vehicles. OBD is the acronym for On Board Diagnostics and describes the method used by the vehicle's computer to check for emission related problems.

OBD I began in the late 1980's and was required for California vehicles. Some Federally produced models had this as well because it was cheaper for the automakers to produce one version. Early examples that technicians are familiar with are EGR monitors.

Asian manufacturers preferred to use temperature to measure EGR flow and these systems have been around for quite some time. Anyone working on Asian vehicles for any length of time has had to deal with an EGR flow code. These codes reflect a system that is able to check for a fault in an emission related system.

Federally speaking, OBD I did not really exist and you will see EPA refer to OBD II as simply OBD. Do not let this confuse you.

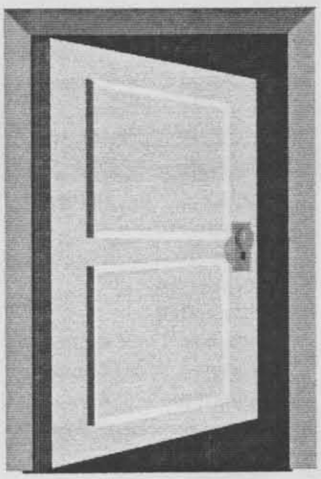
1994 and 1995 model years were limited as to which vehicles had OBD II installed and to the depth of the monitoring system. Many of these vehicles have "deficiencies", a term used to describe a condition where some monitors are either turned off or do not exist. You could say that these were the "beta" years for OBD II.

1996 is referred to as the first year of OBD II since the original documents required all vehicles under 8500 GVW (14,000 GVW for California) to be OBD II compliant. Of course there were still some areas in which the software was unable to correctly identify problems and so some deficiencies were still present. An example of this would be that some evaporative leak checks were delayed on certain models until 1997 or even 1998. These are usually very easy to identify by checking for readiness status. A message will appear such as "unsupported" if the system does not check that area. Each scan tool can have its own wording for this.

There are many controversies surrounding OBD II, but one thing remains constant; As a technician, you will need to "Kill the MIL" if you want to repair OBD II and make your customer happy.

Monitors

- Comprehensive Component Monitor
- Catalyst Efficiency
- EGR System
- EVAP System
- Secondary AIR System
- Oxygen Sensor
- Oxygen Sensor Heater
- Fuel System
- Misfire Detection



What's going on in there?

Monitors are the workhorse of OBD II. A monitor is an action or procedure that the ECM will perform to see if a system is not functioning as it should. The number of monitors will vary from one car to the next as defined in the rules set forth by CARB. To see which monitors are supported on the vehicle you are working on, go the readiness codes on your scanner.

Monitors are either continuous or non-continuous. Generally, continuous monitors are those that are watching for a problem most anytime. Non-continuous are those that are run at specific times during the drive cycle.

An easier way to define these two groups are that Misfire, Comprehensive and Fuel System monitors are continuous. The remaining monitors are non-continuous.

Monitors can be grouped into two additional categories; intrusive and non-intrusive. Intrusive monitors are those that can change something and check to see if this change is seen. For example, an EGR monitor that opens the valve on decel to see if there is a change in vacuum is an intrusive monitor.

Non-intrusive monitors simply "watch" what is going on and see if things are being done correctly. An example of this would be a sensor mounted on an EGR valve to see if it really opened when it was commanded to open.

In the following pages we will describe readiness codes, then show each monitor and what it will look for when it is run. These descriptions are generic in nature since each manufacturer will have different parameters.

Readiness Codes

Continuous Monitoring Tests		
Monitor	**Availability**	**Status**
✓ Misfire	Supported	Complete
✓ Fuel System	Supported	Complete
✓ Component	Supported	Complete

Non-Continuous Monitoring Tests		
Monitor	**Availability**	**Status**
✓ Catalyst	Supported	Complete
⊘ Heated Catalyst	Unsupported	
⊘ Evaporative System	Unsupported	
⊘ Secondary Air System	Unsupported	
⊘ A/C System	Unsupported	
✓ Oxygen Sensor	Supported	Complete
✓ Oxygen Sensor Heater	Supported	Complete
✓ EGR System	Supported	Complete

Even the monitors have a monitor. These are called readiness codes and can be checked with any generic scan tool. These codes will give you two forms of information. The first is the availability of the monitor for the vehicle you are working on. Some scan tools only display the monitors available to that particular car, while others will display all the monitors and tell you which ones are supported and which ones aren't.

The second piece of information that can be gathered here is the status of the monitor. With only a few exceptions (see "Manufacturers Known to Have OBD Readiness Issues" section in this manual) the readiness code will be set to complete once the monitor has run. The only time it will be set to "not complete" is during a battery disconnect or a reset of the DTC's. This means that the readiness code only tells you that the monitor has run and completed since the last time one of these two events happened. It does not necessarily mean the monitor has run recently. In fact, it is entirely possible that the monitor has not run for a very long time, an important consideration when servicing OBD II vehicles.

Continuous Monitoring Tests		
Monitor	**Availability**	**Status**
✓ Misfire	Supported	Complete
✓ Fuel System	Supported	Complete
✓ Component	Supported	Complete

Non-Continuous Monitoring Tests		
Monitor	**Availability**	**Status**
⧗ Catalyst	Supported	Not Complete
⊘ Heated Catalyst	Unsupported	
⊘ Evaporative System	Unsupported	
⊘ Secondary Air System	Unsupported	
⊘ A/C System	Unsupported	
⧗ Oxygen Sensor	Supported	Not Complete
✓ Oxygen Sensor Heater	Supported	Complete
⧗ EGR System	Supported	Not Complete

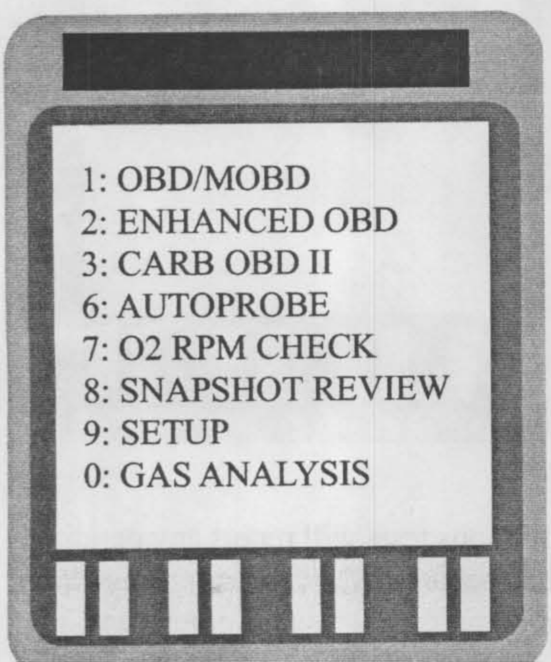
Each scan tool can use its own description for these codes. Some examples are "ready" and "not ready" or "complete" and "not complete". The actual wording is not important as long as it tells you what has happened.

Pending Faults

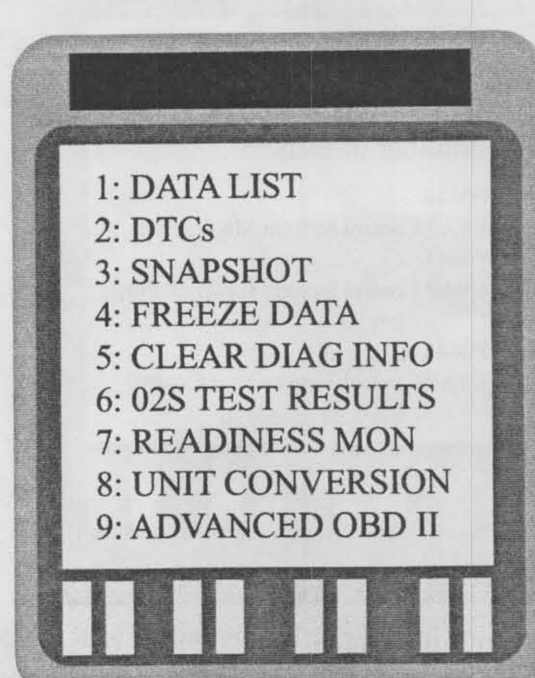
Pending faults are those that have failed one trip but not the second. Depending on the strategy used, these may prevent another monitor from running or perhaps another code from maturing.

Manufacturers will address pending faults in different ways. Some will display them on your generic scanner as "pending" while others will not show them at all. Toyota uses a SAE defined generic mode $07 to report single trip failures of a two-trip code. Some will erase this information once the key is cycled off.

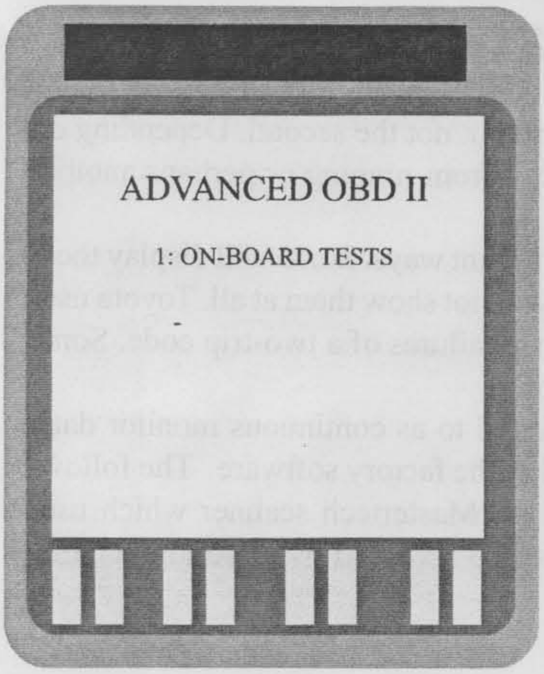
Mode $07 is not well known and is often referred to as continuous monitor data. This can be accessed with a generic scanner as well as the factory software. The following charts will show you how to get there using the Mastertech scanner which uses factory software for Toyota vehicles. Mode $07 is also accessed by selecting pending codes on some scanners.



After selecting the proper Toyota model and year, you should end up at a screen like the one shown here. We want to go to generic mode or CARB OBD II. Select "3" to get to the next screen.



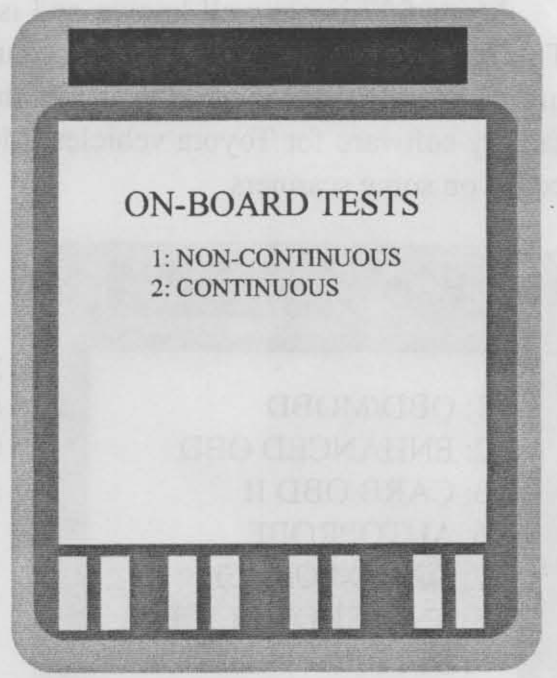
The CARB OBD II (generic) screen should look like the one to the right. ADVANCED OBD II is the one we need. Select "9".

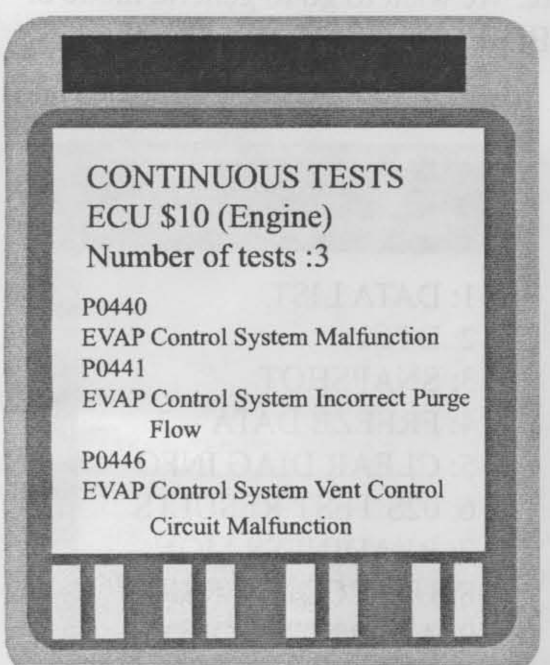


From the ADVANCED OBD II screen we see that only one choice is present. This will take us to the On-Board tests shown below.

Mode $06 is for non-continuous and Mode $07 is for continuous results. Toyota uses continuous results to report all pending codes for all monitors.

Choose "2" from the menu below.





Continuous tests will report any pending codes that occurred during the current key cycle on some models while others will retain mode the codes until they mature. It is imperative that you check continuous tests for pending codes after the monitor has run and before turning the key off.

The image to the left shows an example of codes set after failing the first trip of a two-trip monitor. This is the only area Toyota reports pending codes. If you plan on using monitors to verify repairs, be sure to check Mode $07 for the results.

OBD II DLC

SAE defines certain pins in the OBD II Data Link Connector (DLC). Defined pin

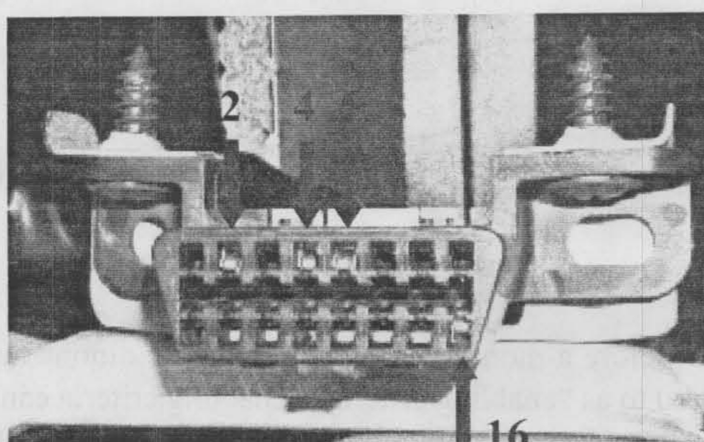
2 = Bus +
5 = Signal ground
10 = Bus -
16 = Battery +
4 = Chassis Ground
7 = ISO K Line
15 = ISO L Line

The remaining pins are left undefined and can be used as needed by the manufacturer. Numbering is 1 through 8 from left to right on the top row and 9 through 16 on the bottom row. This is viewing the DLC as seen in the picture below.

This DLC is from a 1997 Toyota Tacoma and is located under the dash to the right of the steering column. Toyota, like some other Asian manufacturers, use two DLC's. Toyota refers to this one as DLC3. The DLC under the hood is identified as DLC2.

This particular DLC3 utilizes 4 pins. Starting from top left and working across, we see that pin 2, 4 and 5 are used. The bottom right pin is also used and it is pin 16. From this we can conclude that Bus positive, chassis ground, signal ground and battery positive are the only ones needed.

Chassis ground and battery positive are used to power up the scanner. Always make sure the scanner powers up on the DLC when it is connected. This tells you that these two pins are active. A volt drop test may be necessary if any problems are encountered in this area. Sometimes, repairing this problem can fix the customer's complaint as a bad ground may be affecting other components.



Pins 2 and 5 are used as a communication link between the scanner and the PCM. This Toyota uses a Variable Pulse Width (VPW) signal to transmit data while other Toyota's use ISO. Pin 2 is the positive or high side and Pin 5 is the ground or low side of the signal. Many Imports use ISO as the communication protocol and pins 7 and 15 would be occupied in these cases. Pins 2 and 10 are used for Pulse Width Modulated (PWM) signals such as on Ford-built vehicles.

Diagnostic Executive Task Manager

- Controls the operation of each monitor
- Ensures good vehicle operation during monitor operation
- Controls the sequence of each monitor
- Prevents monitors from interfering with each other
- Interfaces with the Scan Tool

Enabling Criteria

Before a monitor can run, certain conditions must exist. These conditions are referred to as "enabling criteria". Enabling criteria can vary considerably between manufacturers. Even certain models may have different standards than a model of the same make. This can be complicated further by vehicles with EEproms or flash memory. A monitor's criteria can be changed when the PCM is flashed with an upgraded program. This will not always be reflected in the printed manual you are using to describe the monitor.

Enabling criteria is not always as complicated as it first seems. Many times, simple logic can be used to understand why the monitor did or did not run. Running a catalyst monitor when the engine is cold will not tell you the condition of the catalytic converter.

The most important thing to understand about enabling criteria is that it exists and a monitor will not run unless certain conditions are met. These conditions are necessary to prevent false passes or failures. Substituting false sensor values to force a monitor may lead to erroneous results.

Comprehensive Component Monitor – CCM

- Tests inputs and outputs for failure
- Functionality
  - Open Circuit = FAILURE
  - Shorted Circuit = FAILURE
  - Out of Range = FAILURE
- Rationality
  - PCM compares data to determine if the input or output make sense for the operating conditions present

Catalyst Monitor

- The catalyst monitor compares the activity of the pre-catalyst oxygen sensor to the post-catalyst oxygen sensor. A DTC only indicates an oxygen storage problem. A cat that passes could be faulty. This means that the monitor relates O2 storage with HC oxidation but not necessarily CO oxidation or NOx reduction.

EGR Monitor

- Low Flow Rates
- High Flow Rates
- Active Tests
- Passive Tests

Fuel System Monitor

- Monitors Fuel Trim
- Biased Rich
- Biased Lean
- Biased too long

Misfire Detection Monitor

- Detect misfire that could cause catalyst damage.
- Type 1 – exceeds FTP by 1.5 times
- Type 2 – will damage the catalyst, MIL will flash.

Oxygen Sensor Monitor

- Slow Response
- Limited Range
- Lack of Switching
- Bias
- Open
- Shorted
- Grounded

Oxygen Sensor Heater Monitor

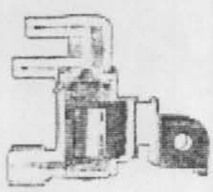
- Functionality
- Time to Activity
- KOEO or running Test

EVAP Monitor

- Functionality.
- Leak Check
- How many gas caps are *really* loose? Don't get caught by this crutch
- Vacuum or pressure

Toyota Evaporative Systems

- First Design
  - Early EVAP 1996 - 1999 MY
    - Checks for large leak (0.040")
    - Uses pressure
    - OBVR introduced 1998
    - Checks purge flow
- Second Design
  - Late EVAP introduced 2000 MY
    - Looks for small (0.020") and large (0.040) leaks
    - Uses vacuum
    - Checks purge flow
    - Uses OBVR
    - Added CCV
    - Moved VP sensor to tank



Toyota uses two very different methods for testing evaporative systems. Beginning in 1996, the early design relied on pressure to test for leaks. In order to meet tougher OBD II standards, the vacuum method was adopted for the 2000 MY. The second design or "Late EVAP" was developed to find smaller leaks required by OBD II. Year 2000 saw the introduction of leak detection for .020". This is a phase-in requirement and only 20% of the fleet is required to find small leaks during the first year, although Toyota implemented the second design on all 2000 models.

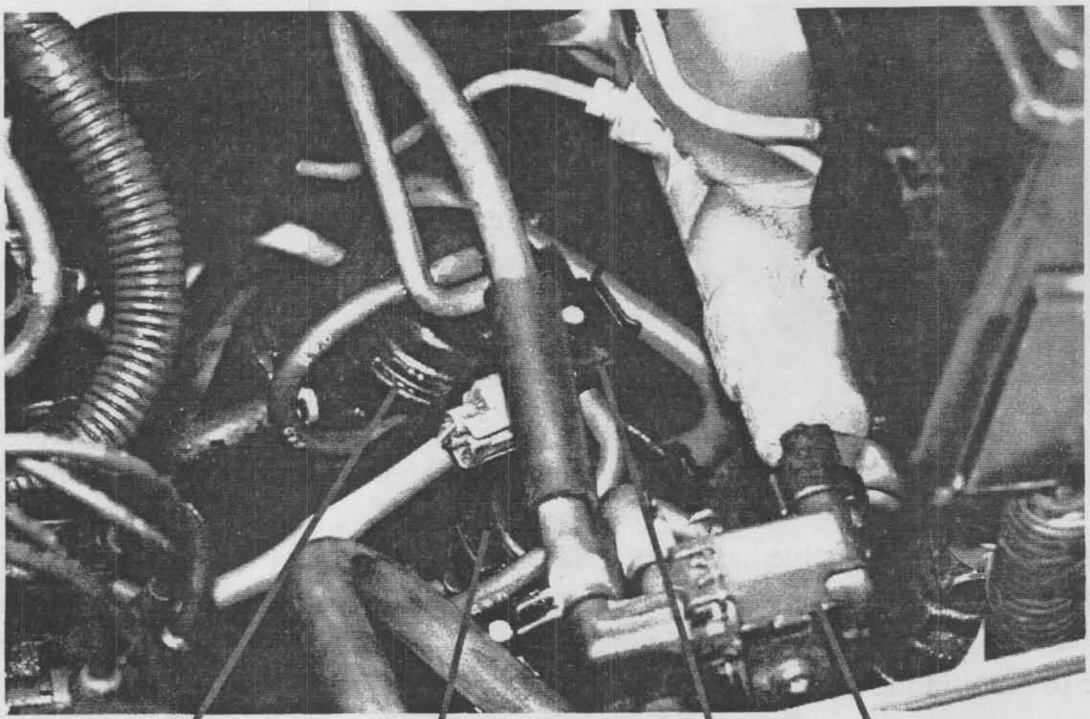
Early EVAP Monitor

- Utilizes temperature rise in fuel tank
  - Exhaust
  - Ambient
  - Heat from Fuel Return
- Enabling Criteria
  - Temperature
    - IAT and ECT within 12 ° at start-up
    - Ambient between 40 ° and 100 ° (ideally a 95 °) F
  - Load
    - Fuel slosh is inferred
      - TPS, MAP etc.
  - Toyota does not use fuel level input
- Monitor will run in 12 - 15 minutes
    - Key must not be turned off.
    - May take longer (20+ minutes) if it detects a malfunction..

Early EVAP Components

- Fuel tank & gas cap
- Vapor separator / roll over valve
- Lines (purge & vapor)
- Air control valves
- Charcoal canister
- Vapor Pressure sensor
- Electrically controlled VSV's
- OBVR (On Board Vapor Recovery)

RAV4 VSV & Air Valve



Notes

Air Control Valve

Air control valves are mechanically operated valves that direct or control air flow and pressure. These are found mounted to the charcoal canister. Two designs are commonly found on Toyota's' canister air control valve and tank air control valve.

The canister air control valve contains two "regulators" that direct flow based on pressure differential. As the pressure differential changes, the valves either close or open passages allowing air and/or fuel vapors to pass through the correct passages. These two regulators maintain a pressure of approximately 0.3 psi or about 1/3 psi.

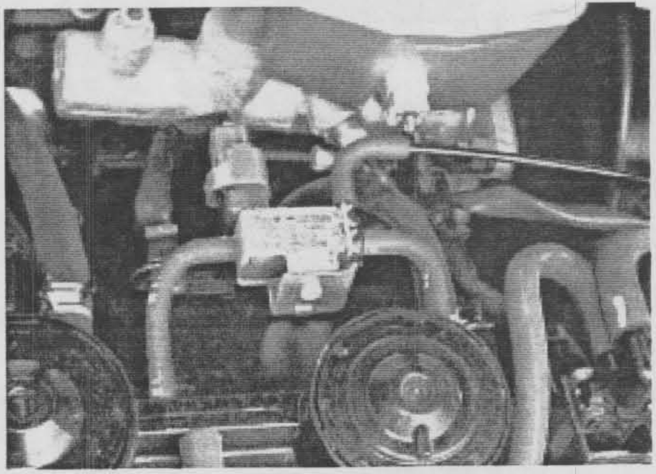
The tank air control valve has one regulator and one check valve. The check valve allows air to pass into the tank via the charcoal canister in the event of a low pressure area or vacuum produced in the fuel tank. The regulator in the tank air valve allows pressure to build in the fuel tank as heat builds. This pressure rises to 0.30 psi at which time the vapors are allowed to escape and into the charcoal canister. The pressure is maintained much like a fuel pressure regulator maintains fuel pressure in the fuel rail.

Notes

Vacuum Switching Valve

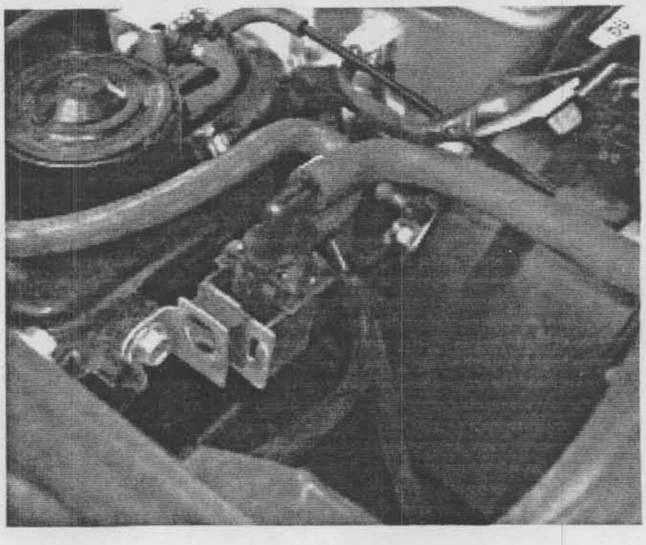
Vacuum switching valves (VSV's) are used by Toyota to direct air flow within a particular system by commanding the solenoid electrically. VSV's can come in two versions, two port and three port design. A VSV has an electrically operated solenoid connected to a mechanical valve that turns the ports on and off depending on the desired condition.

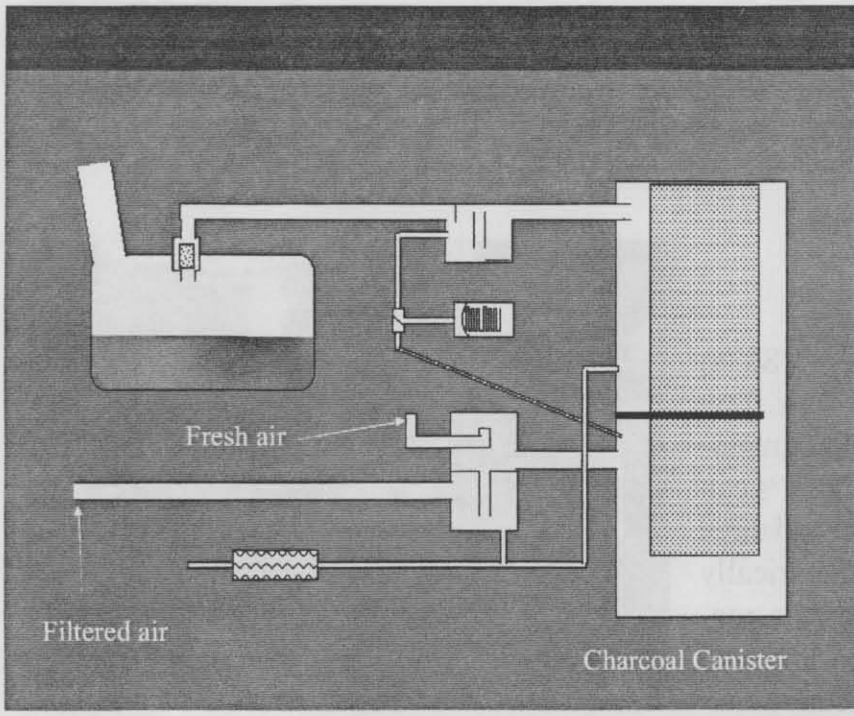
VSV's can be duty cycle controlled or simply turned on and left on. The purge solenoid is an example of a two port VSV that is duty cycle controlled. A VP VSV is an example of a three port design that is either "off" or "on".



This three port design is used on a 1997 Tacoma to control the vapor pressure readings. It allows the VP sensor to read either fuel tank or canister pressure.

This picture shows a two port VSV that controls purge vapors. It is a duty cycle controlled VSV.



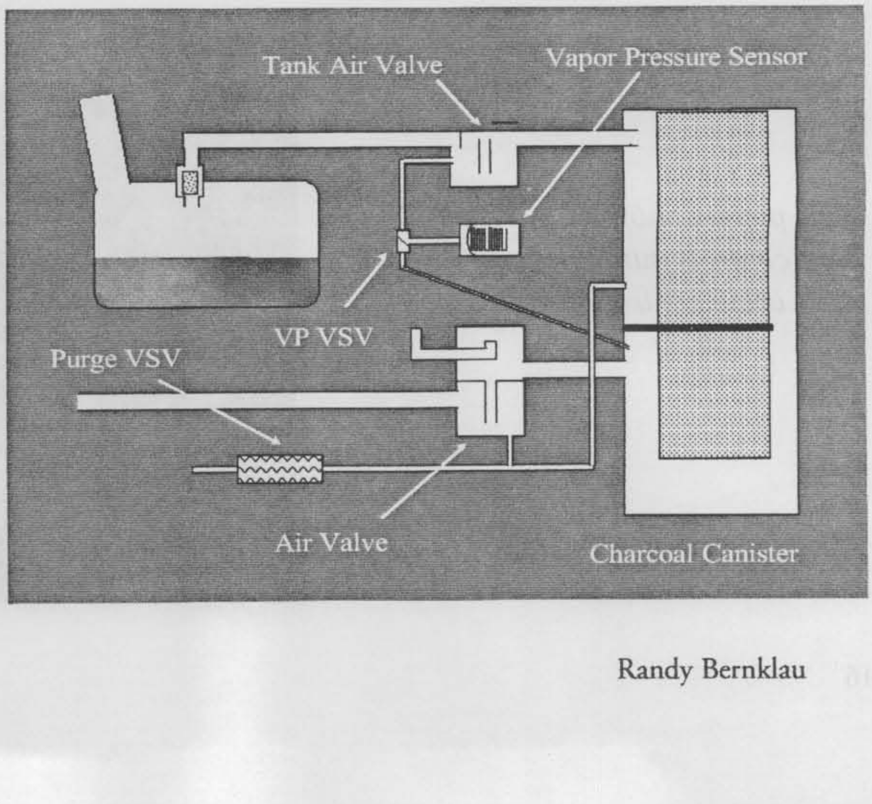


Early EVAP diagram

The charcoal canister used on Toyota systems work like those on any other car. The fuel vapors are trapped in activated charcoal as the fuel in the tank expands. As the fuel retracts, air is allowed to return to the tank. The canister becomes the filter that allows the tank to breath during normal operations without letting harmful hydrocarbons into the atmosphere.

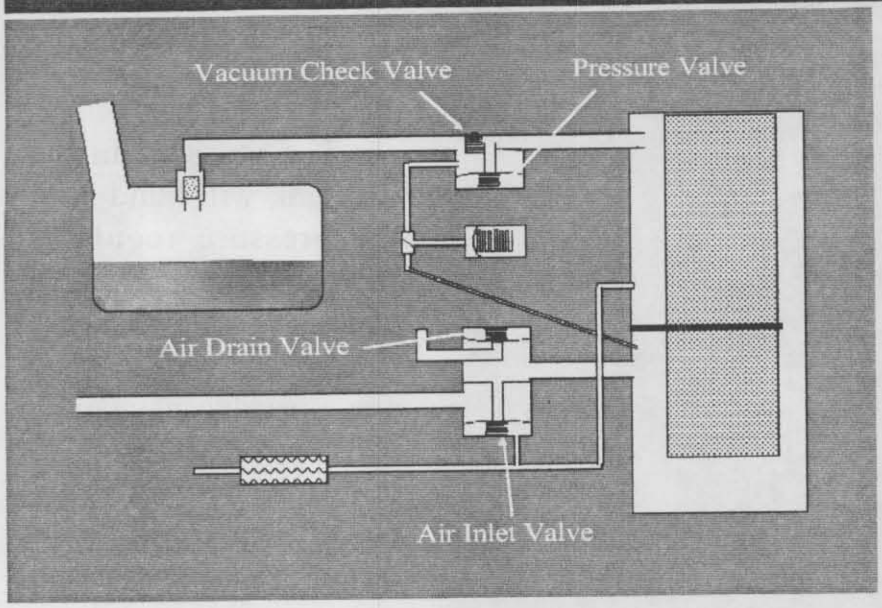
Early Toyota EVAP systems do not use an electrically controlled solenoid on the air inlet/outlets of the charcoal canister. Instead, these two lines are controlled by air valves.

Early Toyota EVAP system with labels of main components.



The air valves are critical in controlling air flow and are an integral part of the canister. The Vapor Pressure (VP) sensor may be mounted on the canister or might be on the firewall. The VP sensor is attached to the EVAP system via a three port VSV.

The purge VSV allows vapors to enter the intake manifold where they can be burned.



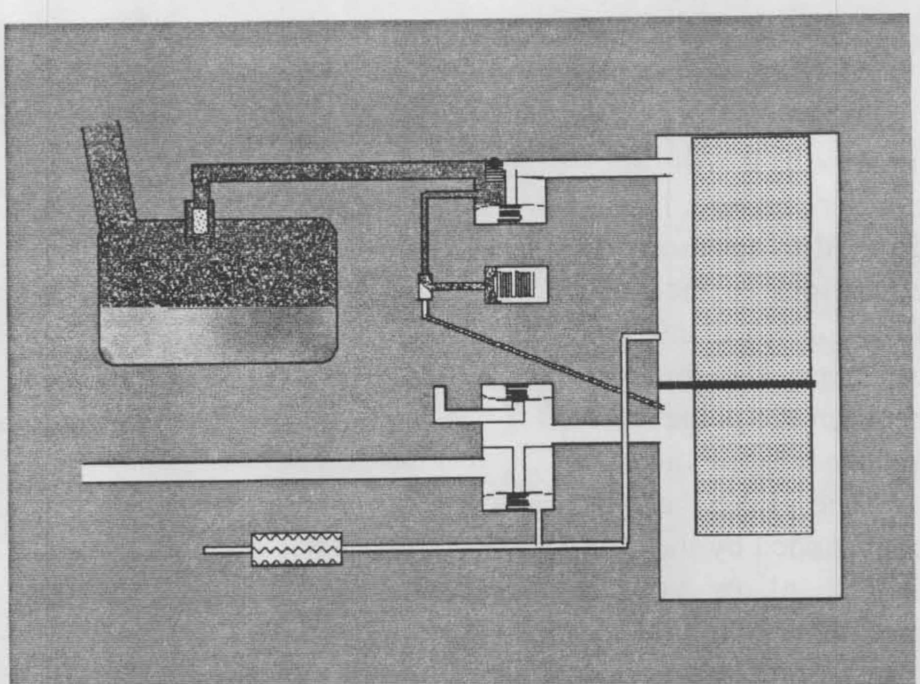
Regulator/check valves.

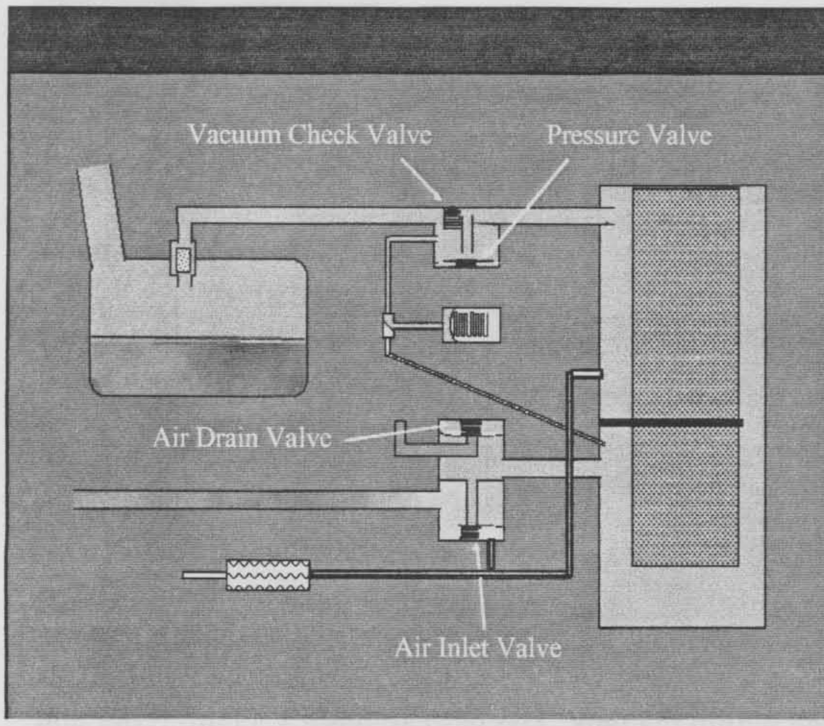
Within the two air valves are pressure and check valves. The pressure valves act as regulators to control pressure and flow.

The check valve is used so that air may return to the fuel tank as a low pressure area is established within the tank. The gas cap has a vacuum relief and can allow air to enter the tank as well.

Pressure in Tank.

This diagram depicts normal pressure in the fuel tank with the system monitoring tank pressure. Pressure can build due to adding fuel or when heat builds up in the fuel. As pressure builds in the tank, the tank air control valve keeps the vapors from entering the canister. This continues until 0.3 psi "pushes" the tank air control valve regulator open.





Pressure exceeds 0.3 psi in tank.

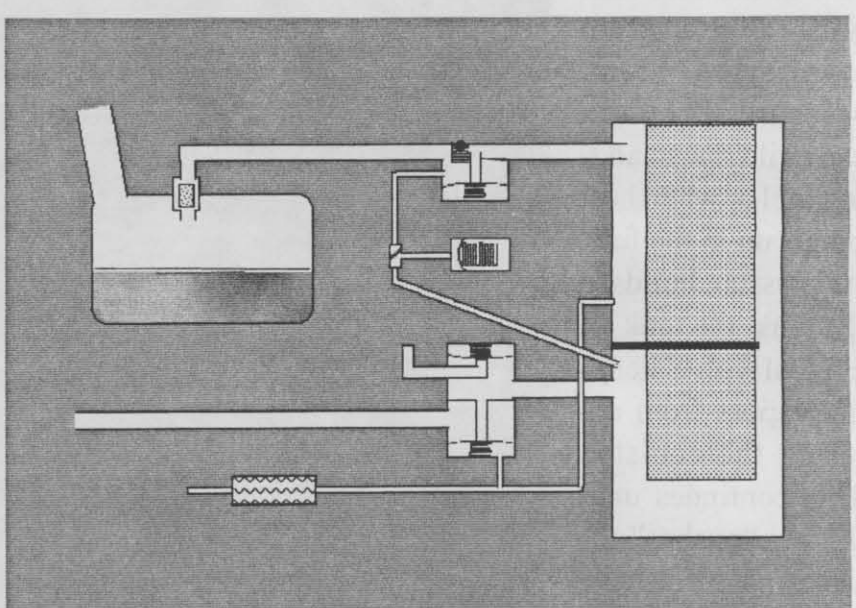
The pressure in the fuel tank will build until the pressure regulator valve in the tank air valve opens. This allows vapors to enter the canister. The pressure valve maintains a constant pressure of 0.3 PSI. If the VP VSV is on, the VP sensor will be directed toward the tank to monitor tank pressure.

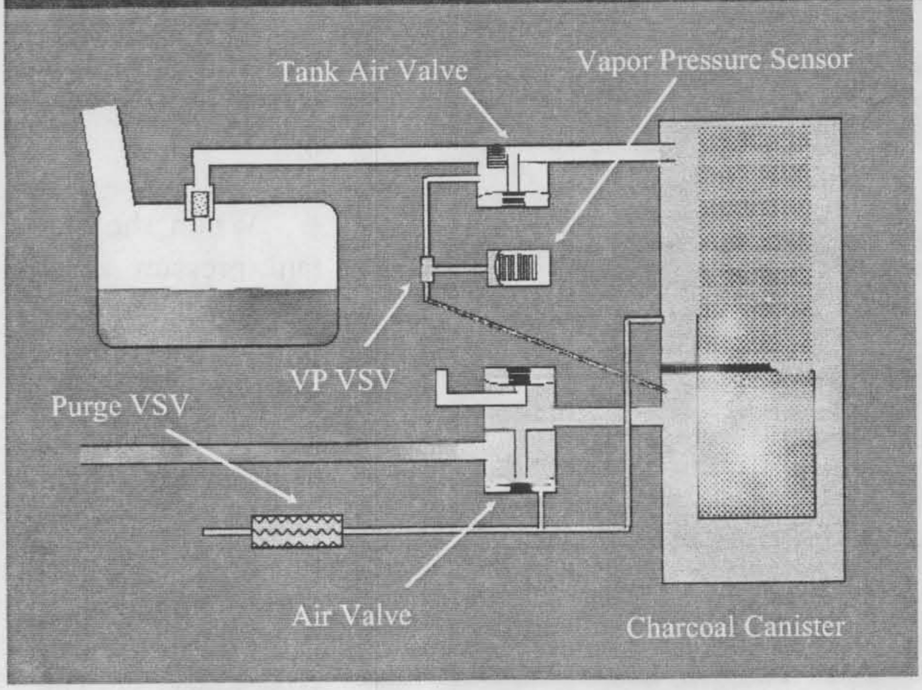
In this diagram, the purge VSV is off and pressure is not high enough to open the canister air control valve . As pressure increases, the air drain valve will open before the air inlet valve. The air inlet valve has equal pressure on both sides of the diaphragm. The purge side must have low pressure (vacuum) before it will open. This means that the charcoal in the canister should remove the fuel vapors from the air flowing out of the fuel tank. This "clean" air will exit the canister via the air drain valve located in the canister air valve.

VP VSV switching to canister.

When the VP VSV is turned off, it will "see" canister pressure. This is done during monitor conditions to measure flow and to check the canister system for leaks between the purge VSV and the tank air valve.

The VP VSV can be commanded by the scan tool to allow you to monitor either tank or canister pressure.





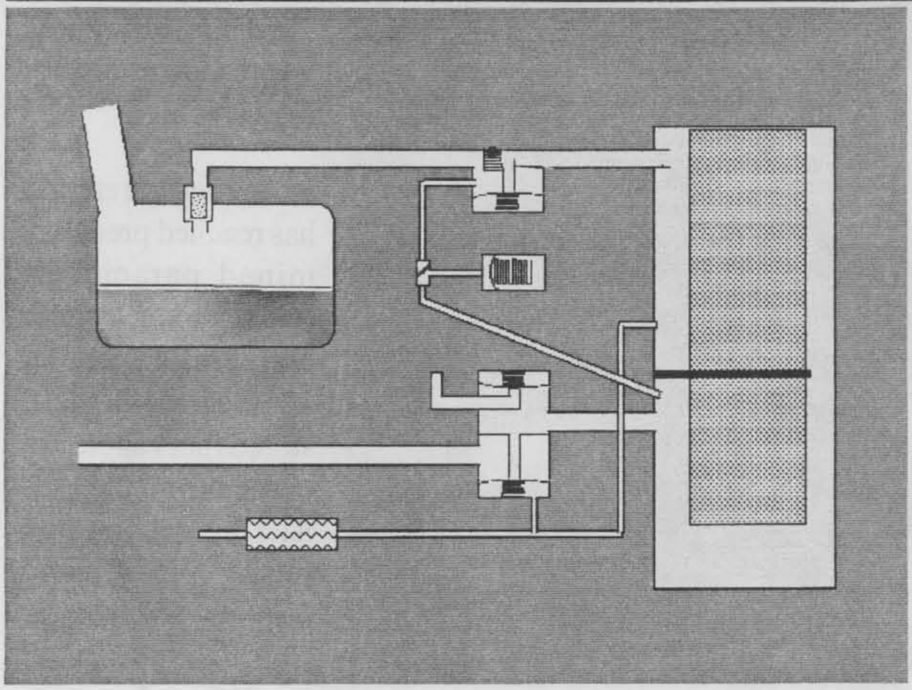
Purging and VP sensor monitoring flow.

When the engine has reached predetermined parameters (closed loop, engine temperature above 125 degrees F, etc.), stored fuel vapors are purged from the canister by opening the purge VSV. The purge VSV is controlled by the ECM.

When the purge VSV is commanded on (duty cycle high) it will allow the vapors to be purged from the canister. It also creates a low pressure area in the canister air valve which opens this valve to permit filtered air to enter the canister replacing the space created by vapors leaving. This strategy keeps dirty air from entering canister but still allows air to exit the canister via the fresh air line on the air drain valve.

If the VP VSV is off, the VP will monitor the canister for flow and leaks. When the purge is cycled, it will cause low pressure pulses into the canister. These pulses can be seen by monitoring the VP sensor with a DMM, DSO or GMM as shown in the VP sensor voltage charts.

Notes



Monitoring canister for leaks with purge VSV off.

When the fuel tank pressure is below 0.3 psi and the purge VSV is turned off, a low pressure area is trapped in the canister. When conditions are correct for this to occur, the VP VSV is turned off so the VP can see canister pressure. This pressure is monitored to see if it holds. A rapid decay indicates a leak between the purge VSV and the tank air valve.

The PCM will know when to check for this condition because it looks at fuel tank pressure with VP VSV on before switching the VP VSV off.

Notes

Evaporative Codes

- P0440 (Evaporative Control System Malfunction)
- P0441 (Incorrect Purge Flow)
- P0442 (Small Leak Late system)
- P0446 (CCV or 3 way VSV Problem)
- P0450 (Vapor Pressure Sensor)
- P0451 (Vapor Pressure Sensor)

P0440

- Enhanced EVAP
- Two trip logic
- Indicates a leak in the EVAP system on fuel tank side
  - Tank is at atmosphere under specific conditions.

P0441

- Vapor purge flow detection
- May indicate a leak
- Should see pressure drop and change as purge VSV is cycled.
- Restricted flow
  - No pressure drop when opened
    - During normal purge conditions, pressure does not pulsate.
    - This can be caused by a leak
- Inappropriate flow
  - Stuck open
    - Pressure at atmosphere then drops to near intake pressure after starting.

P0446

- Three way VSV malfunction
- Looks for difference when VP VSV is switched
- No difference then ECM looks for:
  - Pulsation's in tank position.
  - Or lack of pulsation's in canister position
  - ECM switches VP VSV and tests for both conditions. A change should be seen.

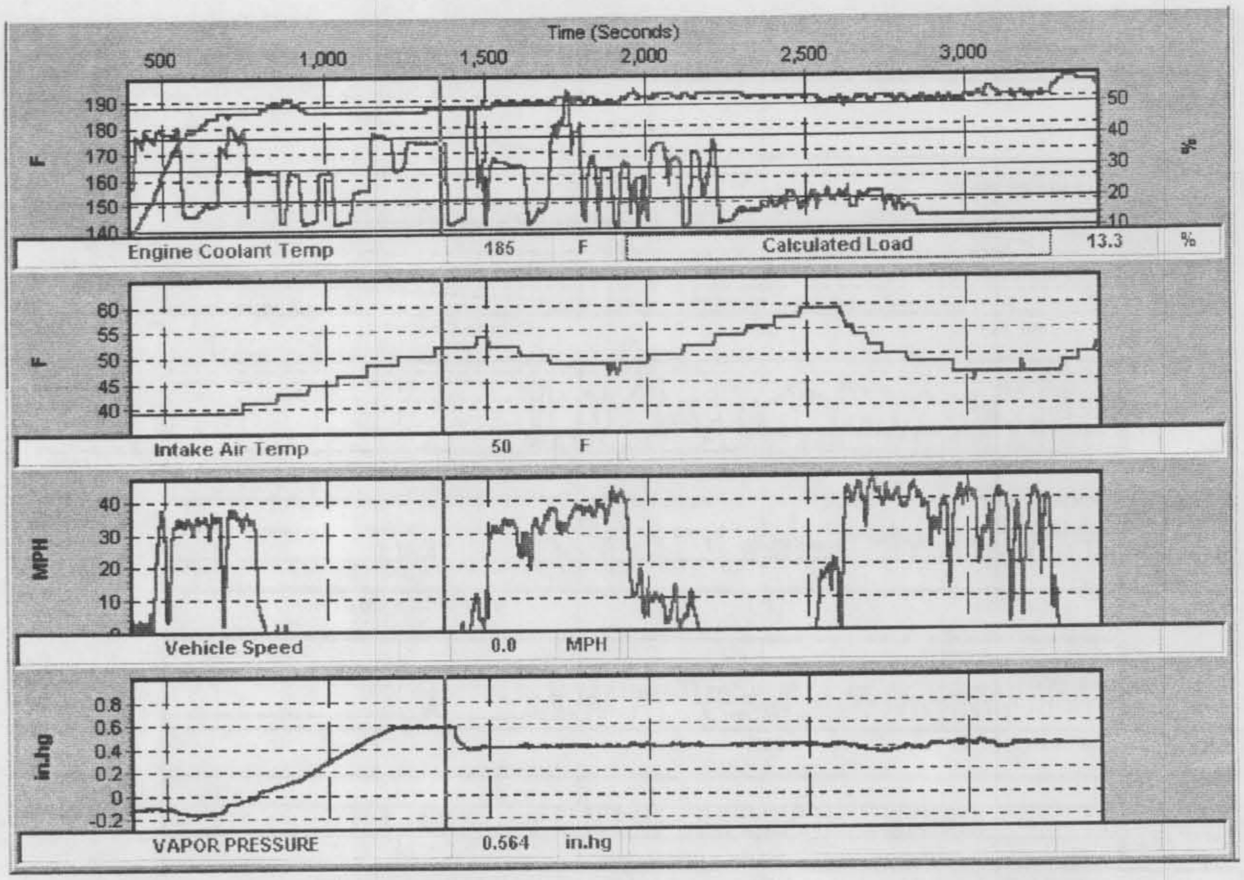
P0450

- Indicate a faulty VP sensor circuit
  - VP voltage > 4.5V or < 0.5V.
  - Monitored for 10 seconds after starting.
  - Must not exceed for 7 of 10 seconds for tank and canister side.

P0451

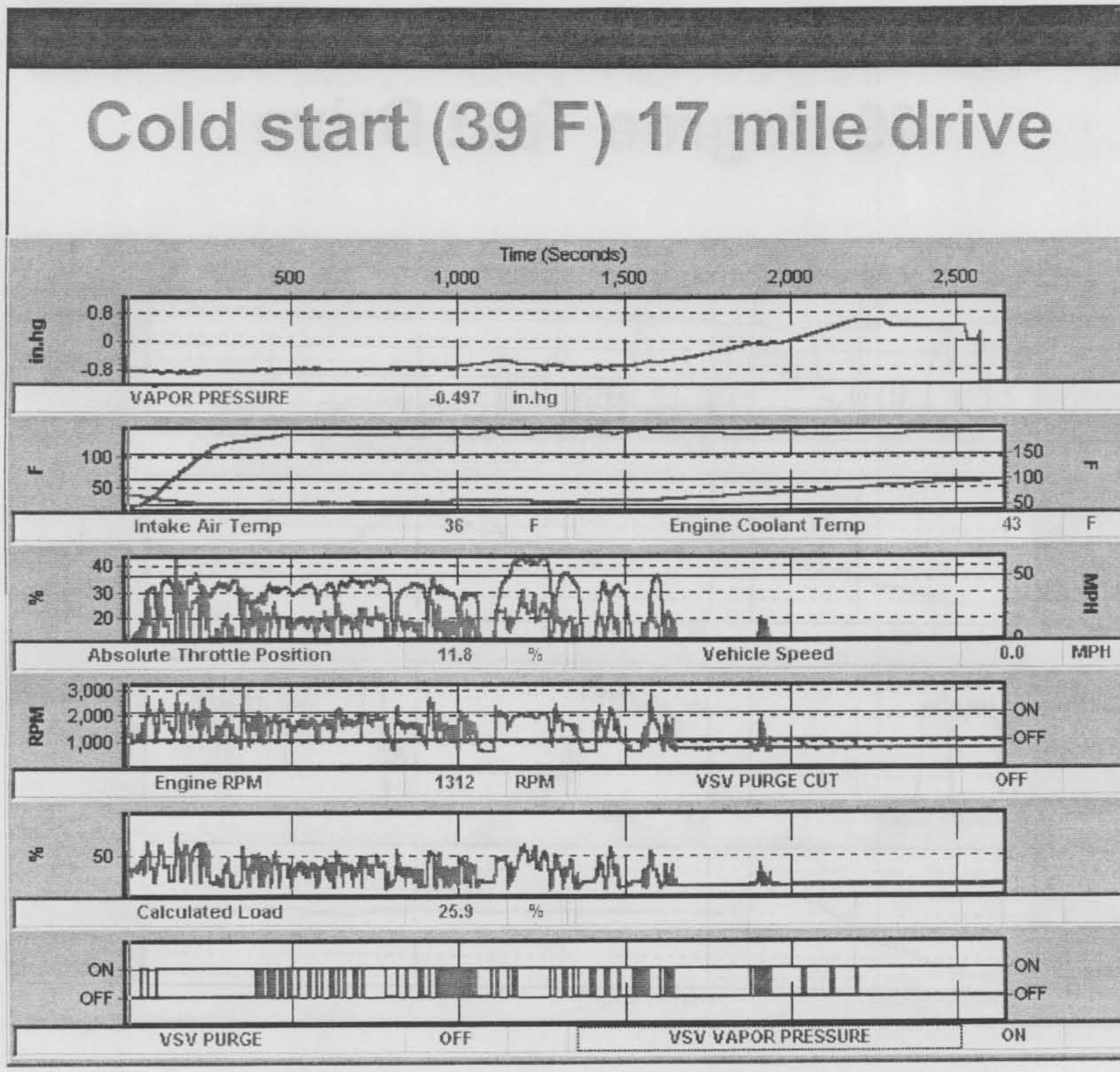
- Indicate a faulty VP sensor circuit
  - After 10 seconds criteria is 4.9V and 0.10V.
    - Can't exceed for 7 of 10 seconds.
  - After stopping vehicle, between 5 and 15 seconds, tank pressure is tested.
    - Must not exceed 3.83V (0.20 in hg) or -2.77V (-0.20 in hg) more than 7 times in 10 seconds. (Changing value)

40 degree Test Drive



The following images are taken from various road tests on a 1997 Toyota Tacoma 3.4L. This image shows the pressure topping out at 1/3 psi. This is the point the fuel tank air control valve opened its regulator. The pressure then started dropping because the vehicle began to move. The air temperature was cool enough to cause a drop in pressure.

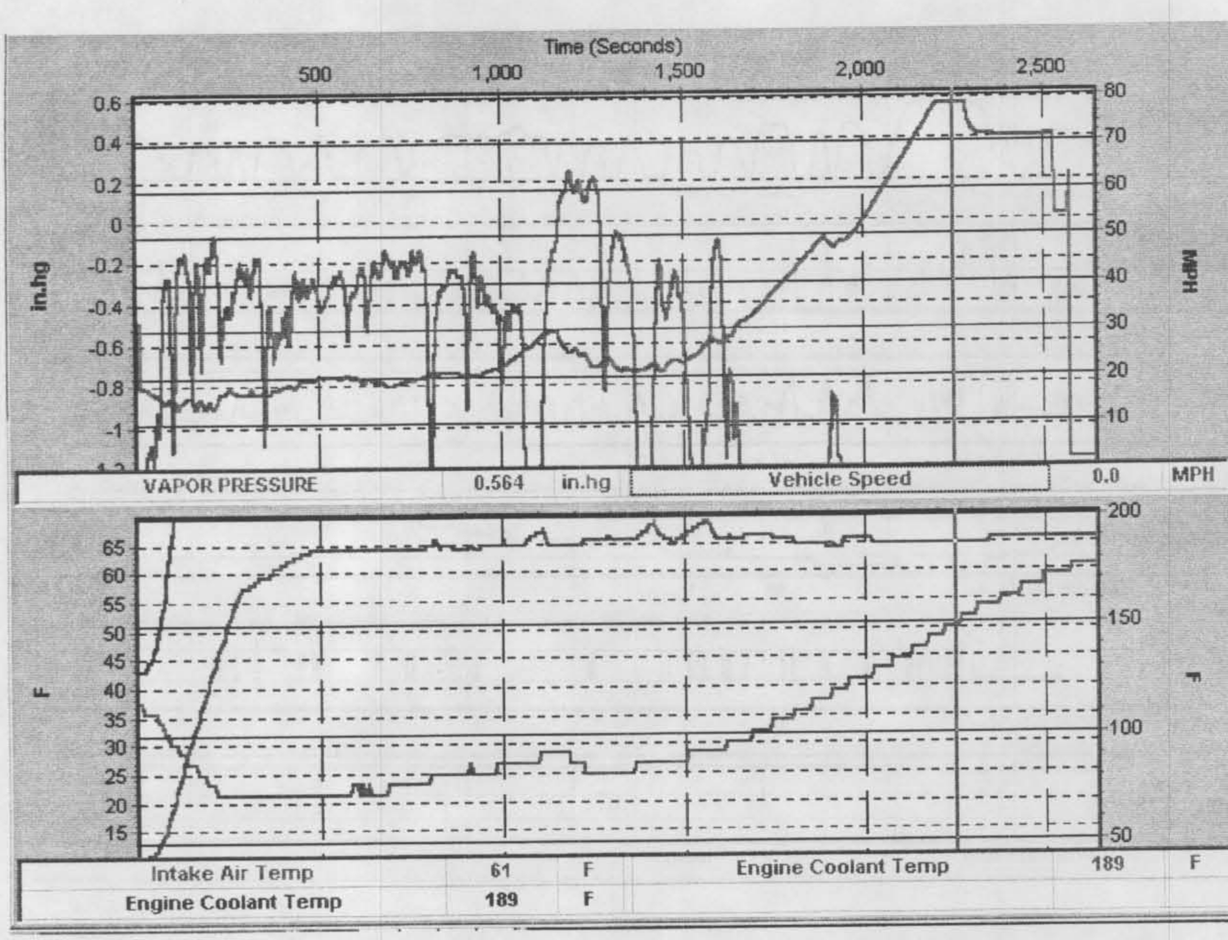
Following the IAT you can see the start up temperature was about 40 degrees F and began to rise after the vehicle stopped. This change in air temperature is due to engine heat rather than actual air temperature. IAT is not a good indicator of actual ambient temperature unless the vehicle is moving at highway speeds.



In this image we see a long test drive in which the pressure did not rise. If the monitor were to run during this trip it would set a leak code. However, the enabling criteria has not been met so no code was set. In reality, there is no leak as you can see at the end of the capture. When the ambient temperature went high, the pressure did indeed rise to 1/3 psi. This rise in temperature was caused by driving the vehicle into the shop where heaters were running.

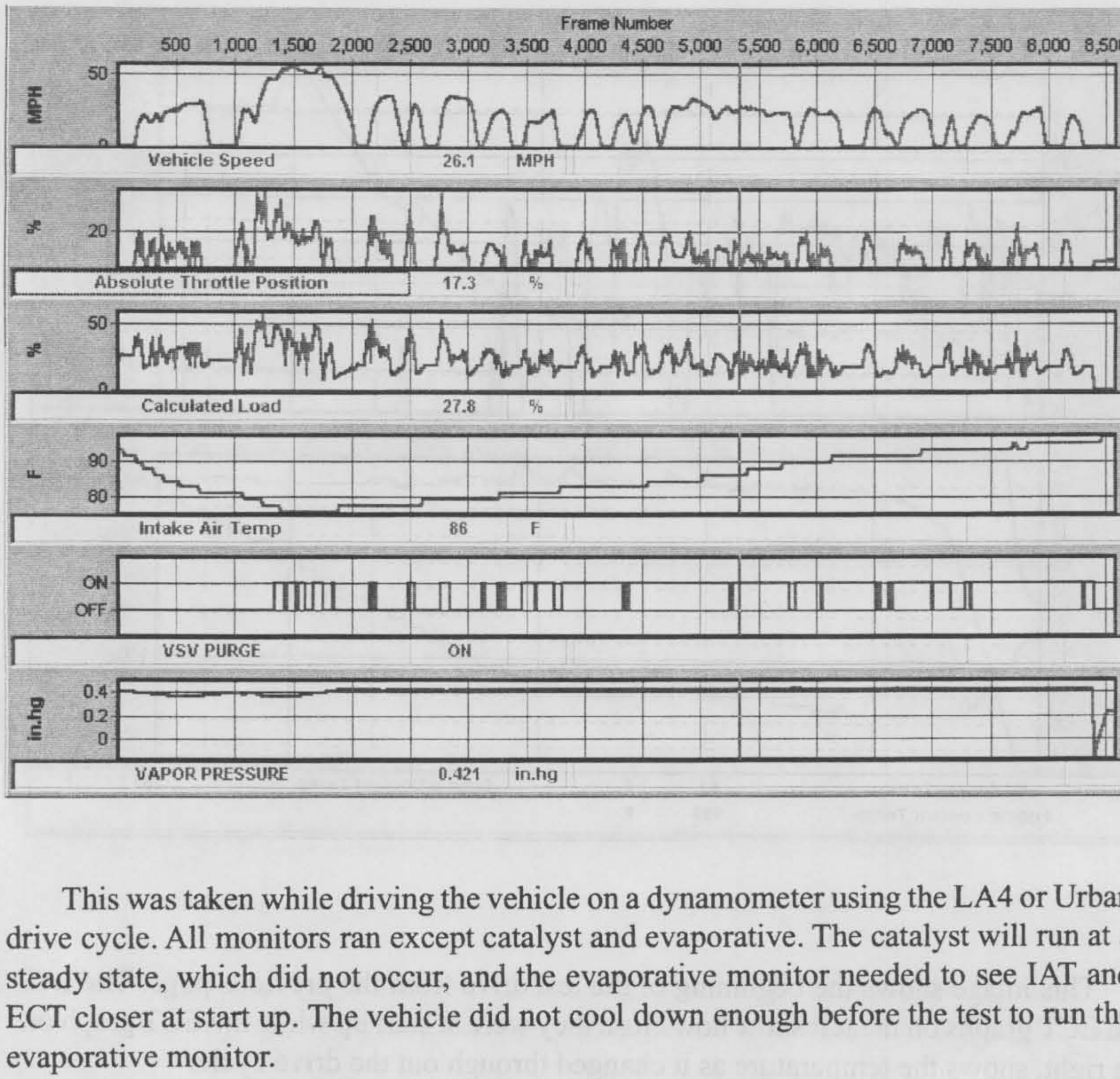
The last section where you see a temperature drop is caused by removing the VP line and then connecting a vacuum pump to see VP range. The vehicle was started inside an unheated garage and then driven outside. Outside air temperature was 21 degrees F.

Cold start (39 F) 17 mile drive



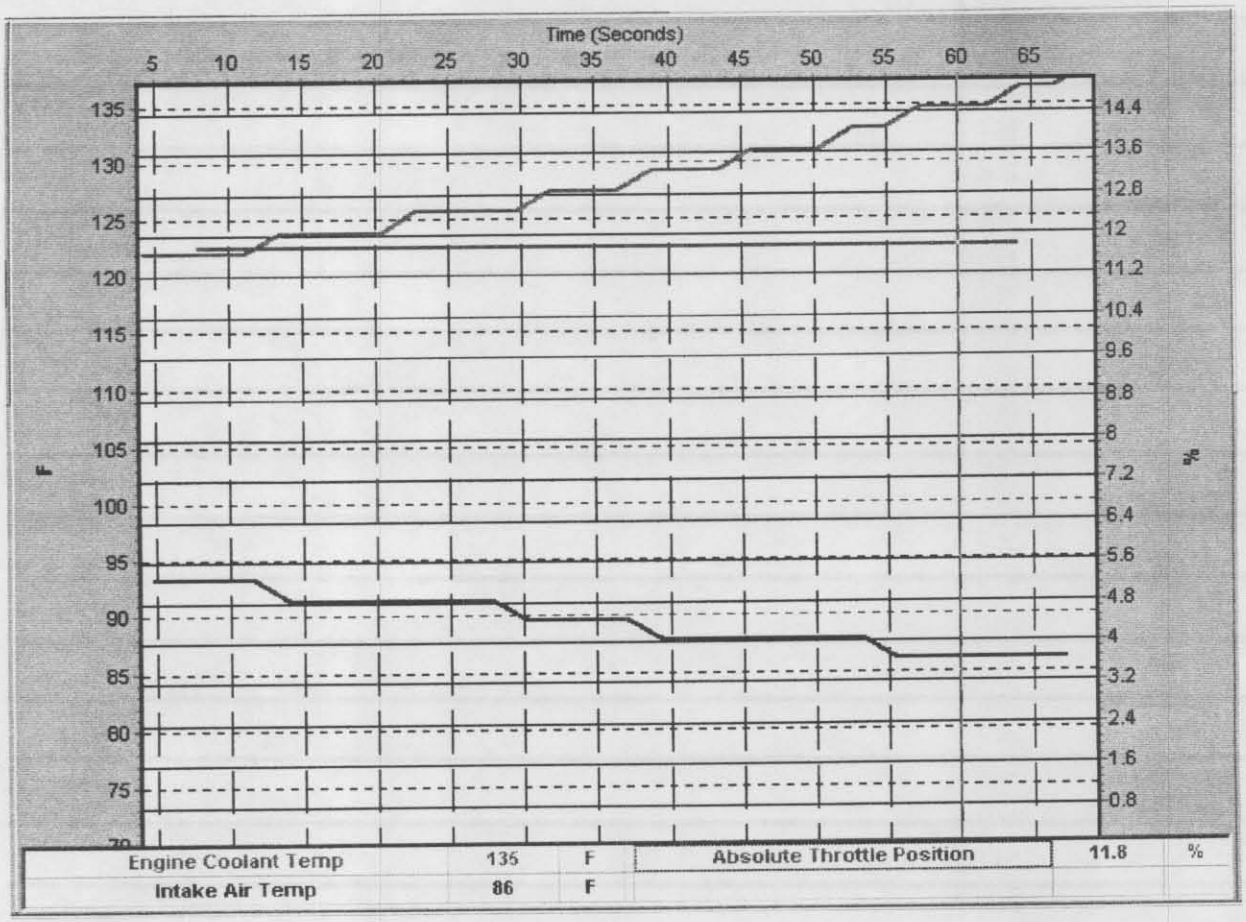
This image shows the beginning of the test drive from the previous page. The IAT and ECT graphs on the left show how close they were at start up while the ECT graph on the right, shows the temperature as it changed through out the drive cycle.

LA4 Drive cycle



This was taken while driving the vehicle on a dynamometer using the LA4 or Urban drive cycle. All monitors ran except catalyst and evaporative. The catalyst will run at a steady state, which did not occur, and the evaporative monitor needed to see IAT and ECT closer at start up. The vehicle did not cool down enough before the test to run the evaporative monitor.

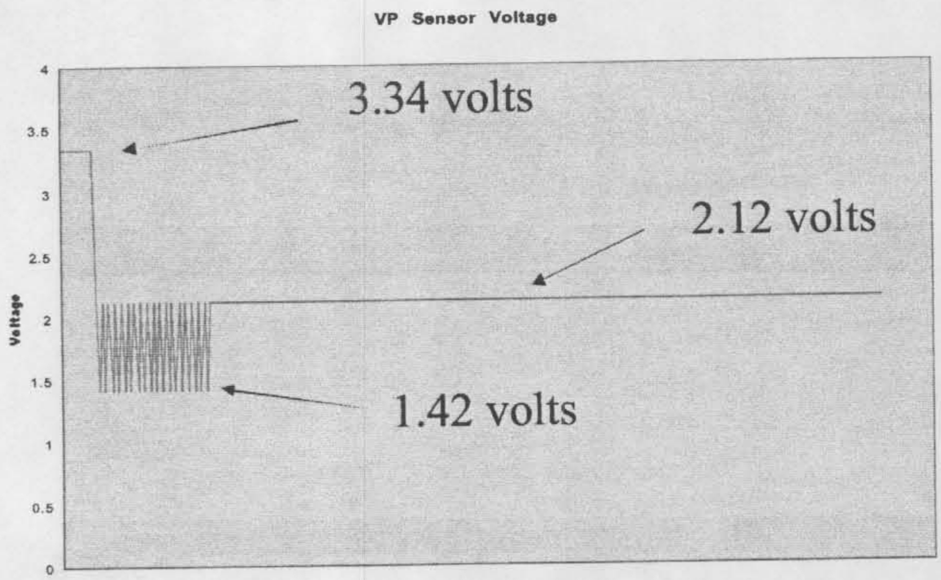
Start of LA4 showing ECT & IAT.



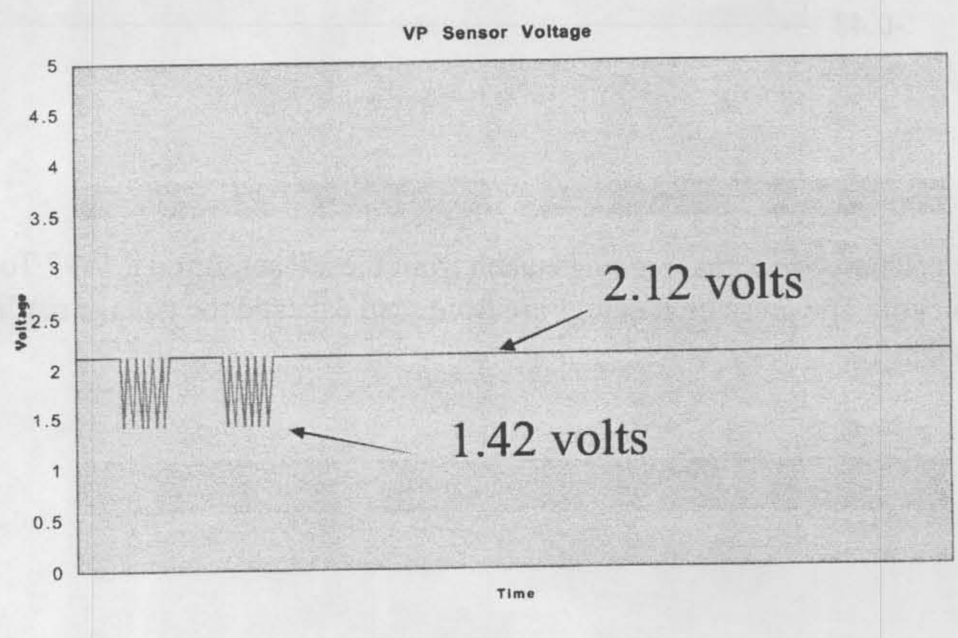
This graph shows IAT and ECT at the beginning of the LA4 drive cycle. These two readings must be within 12 degrees F of each other before the monitor will run.

NOTES

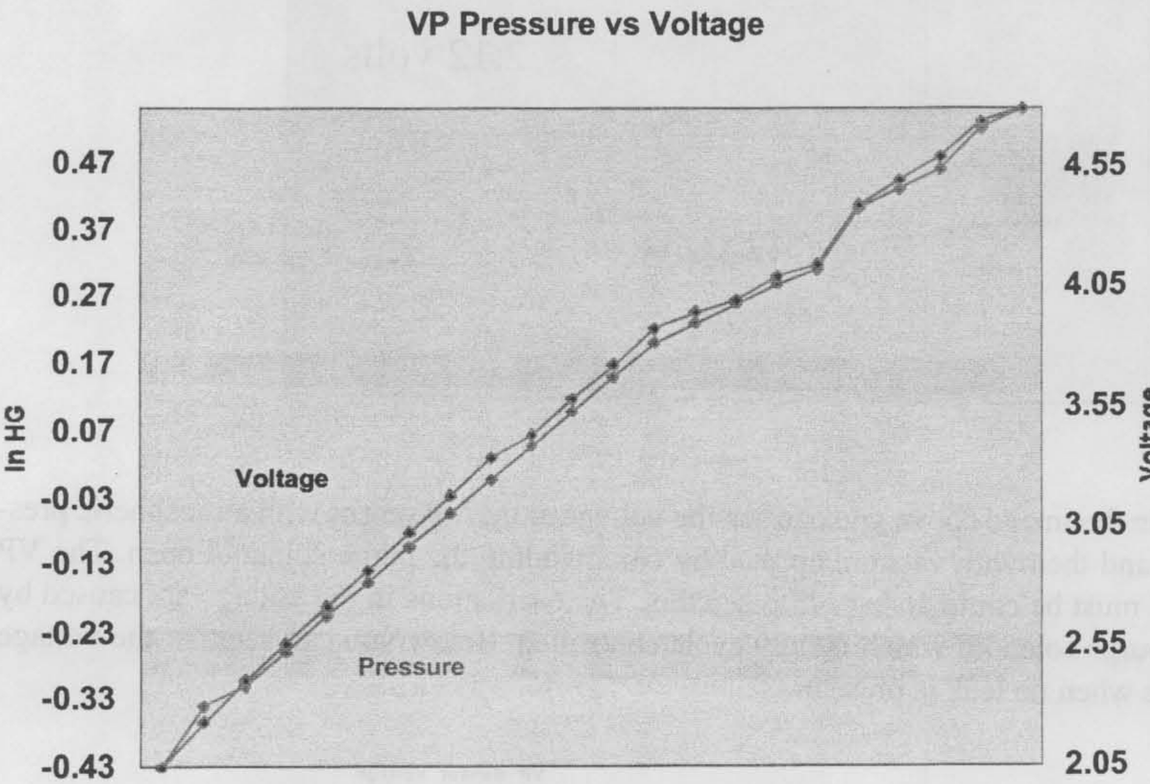
VP Sensor Voltage



In the image above you can see the voltage at the VP sensor with atmospheric pressure and then with vacuum applied by commanding the purge solenoid open. The VP VSV must be commanded off to see this. The oscillations in the voltage are caused by the purge solenoid which is duty cycle controlled. Below you can see that the voltage holds when no leak is present.



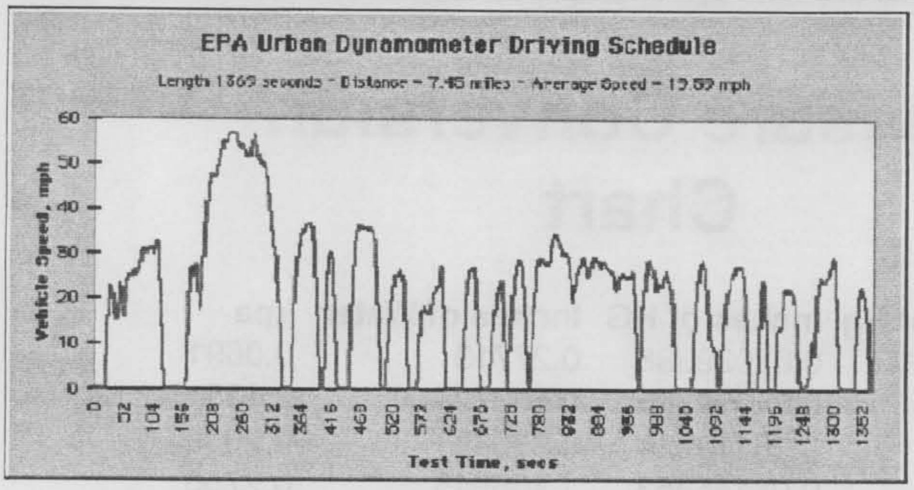
VP Pressure VS Voltage



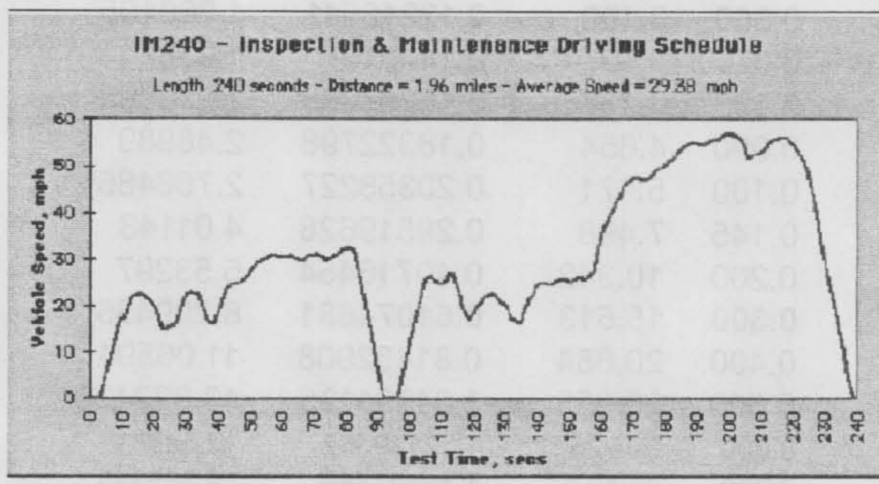
These are actual readings taken from the VP sensor on a 1997 Toyota Tacoma 3.4L pickup. The pressure readings are from scan data and the voltage readings are taken with a DMM.

Pressure Conversion Chart

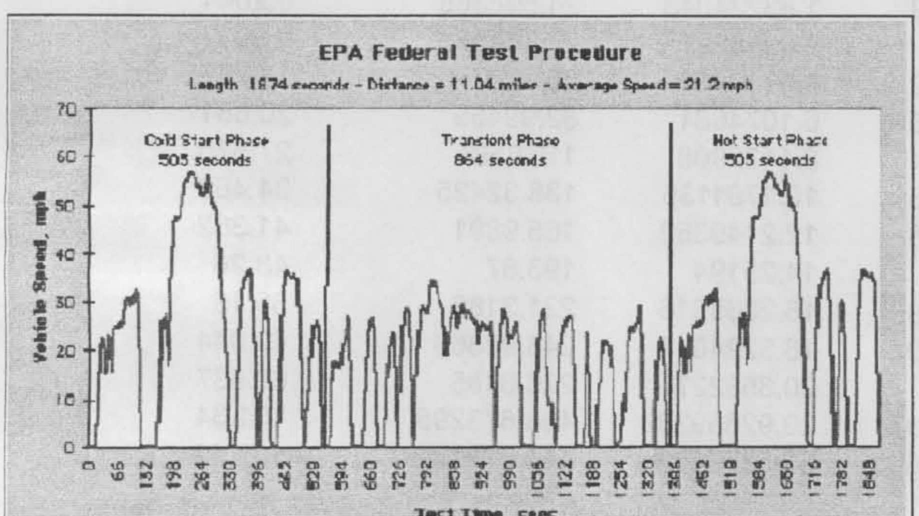
PSI	mm of Hg	Inches of HG	Inches of Water	kpa
0.010	0.518	0.02039366	0.27713	0.0691
0.020	1.035	0.04074795	0.553725	0.138
0.030	1.552	0.06110224	0.83032	0.2069
0.040	2.069	0.08145653	1.106915	0.2758
0.050	2.586	0.10181082	1.38351	0.3448
0.060	3.103	0.12216511	1.660105	0.4137
0.070	3.62	0.1425194	1.9367	0.4826
0.080	4.137	0.16287369	2.213295	0.5515
0.090	4.654	0.18322798	2.48989	0.6205
0.100	5.171	0.20358227	2.766485	0.6894
0.145	7.498	0.29519626	4.01143	0.9996
0.200	10.342	0.40716454	5.53297	1.3787
0.300	**15.513**	**0.61074681**	**8.299455**	**2.0681**
0.400	20.684	0.81432908	11.06594	2.7575
0.500	25.855	1.01791135	13.832425	3.4469
0.600	31.026	1.22149362	16.59891	4.1362
0.700	36.197	1.42507589	19.365395	4.8256
0.800	41.368	1.62865816	22.13188	5.515
0.900	46.539	1.83224043	24.898365	6.2044
1.000	51.71	2.0358227	27.66485	6.8937
2.000	103.42	4.0716454	55.3297	13.787
3.000	155.13	6.1074681	82.99455	20.681
4.000	206.84	8.1432908	110.6594	27.575
5.000	258.55	10.1791135	138.32425	34.469
6.000	310.26	12.2149362	165.9891	41.362
7.000	362	14.25194	193.67	48.26
8.000	413.68	16.2865816	221.3188	55.15
9.000	465.39	18.3224043	248.98365	62.044
10.000	517.1	20.358227	276.6485	68.937
14.700	760.137	29.92659369	406.673295	101.34
15.000	775.65	30.5373405	414.97275	103.41



LA4 or Urban Drive Trace



IM 240 Drive Trace



FTP Drive Trace

Manufacturers Known to Have OBD Readiness Issues

1996 Chrysler vehicles - Vehicles will clear readiness at key-off unless reprogrammed with updated software. These vehicles should be reprogrammed according to Chrysler Technical Service Bulletin.

1996 Subaru vehicles - Vehicles will clear readiness at key-off. There is no reprogramming available for this line of vehicles. These vehicles should be scanned for MIL illumination without regard to readiness status. Subaru Technical Service Bulletin.

1996 Nissan vehicles and 1997 Nissan 2.0 liter 200SX - These vehicles may have a high degree of "Not Ready" for catalyst and evaporative monitors due to a "trip based" design. Nissan has provided driving cycles in its service information to allow monitors to operate. These vehicles should be treated as other non-problematic vehicles. Nissan Technical Service Bulletin.

1997 Toyota Tercel and Paseo - Vehicles will never clear the evaporative monitor to "Ready". At this time no fix is available. Vehicles should be scanned using remaining readiness monitors as described for non-problematic vehicles.

1996 - 1998 Mitsubishi vehicles - These vehicles may have a high degree of "Not Ready" due to a "trip based" design. Mitsubishi has provided driving cycles in its service information to allow monitors to operate. These vehicles should be scanned for MIL illumination without regard to readiness status. Mitsubishi Technical Service Bulletin.