6.0L V8 Gas Engine Driveability
Module 2

ISUZU TRUCK UNIVERSITY

Table of Contents

Table of Contents

6.0L V8 Gas Engine Driveability, Module 2

Section

1. OBD II Diagnostics
2. Diagnostic Strategy
3. Heated Oxygen Sensors Diagnostics
4. Fuel System Diagnostics
5. Misfire Diagnostics
6. Enhanced EVAP System Diagnostics

Course Objectives:

After completing this course, participants will be able to identify and be familiar with:

- OBD II and Diagnostic Trouble Codes
- Recommended Diagnostic Strategy
- Scan tool data for Fuel, Ignition and Emissions
- Fuel Trim data
- Engine Misfire data
- Enhanced EVAP System diagnostic testing

6.0L V8 Gas Engine Driveability

Module 2, Section 1
On Board Diagnostics II

- Description of OBD II
- ECM system Monitoring
- Diagnostic Trouble Codes
- Freeze Frame/Failure Records

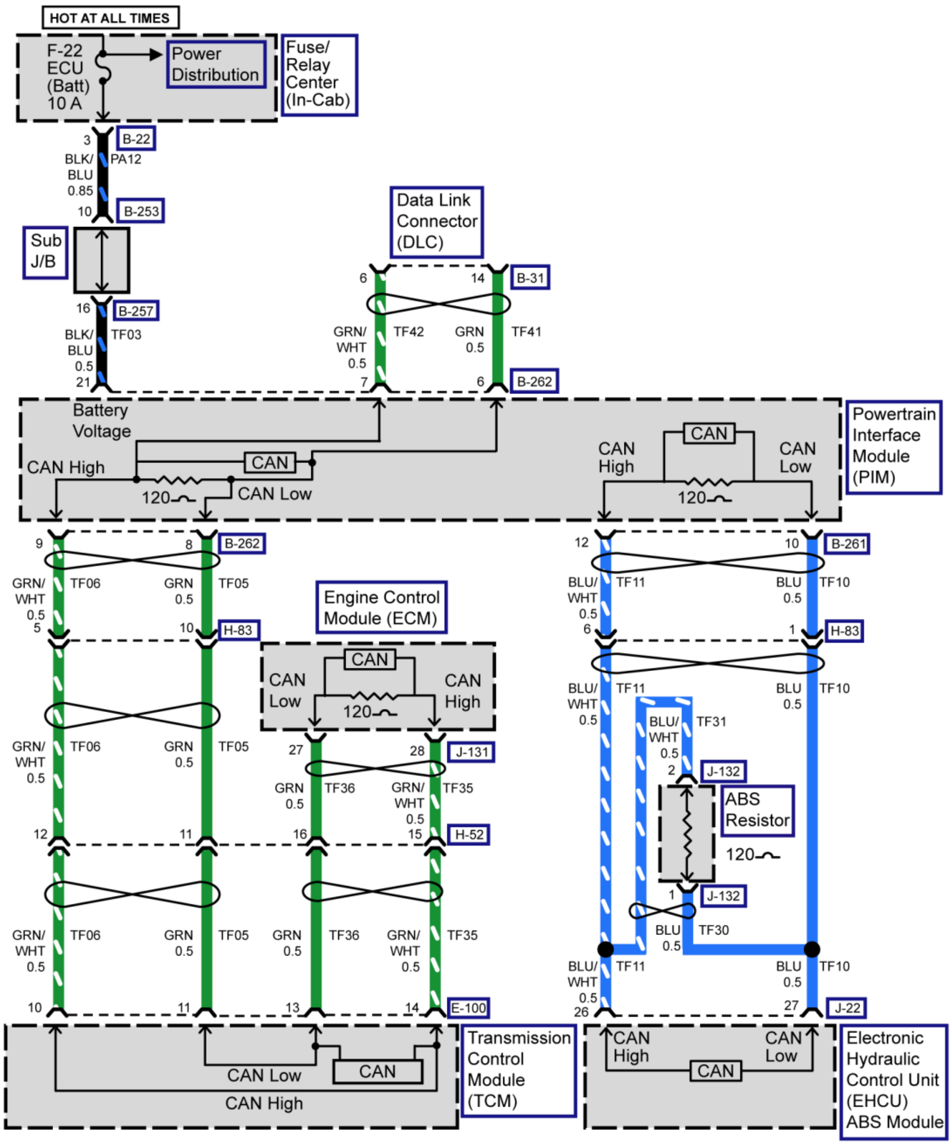
OBD II

Introduction to OBD II
OBD II was first introduced in the mid-1990’s and is a sophisticated computer system that controls the engine and emissions operations. This system has extensive diagnostic capabilities that can monitor, detect and report vehicle emissions and performance malfunctions.

When the vehicle's on-board computer detects a failure in an emissions-related component or system, the computer:

- assigns a very specific diagnostic trouble code, or DTC
- saves the code in the computer's memory, and
- may light up the Malfunction Indicator Lamp (MIL)

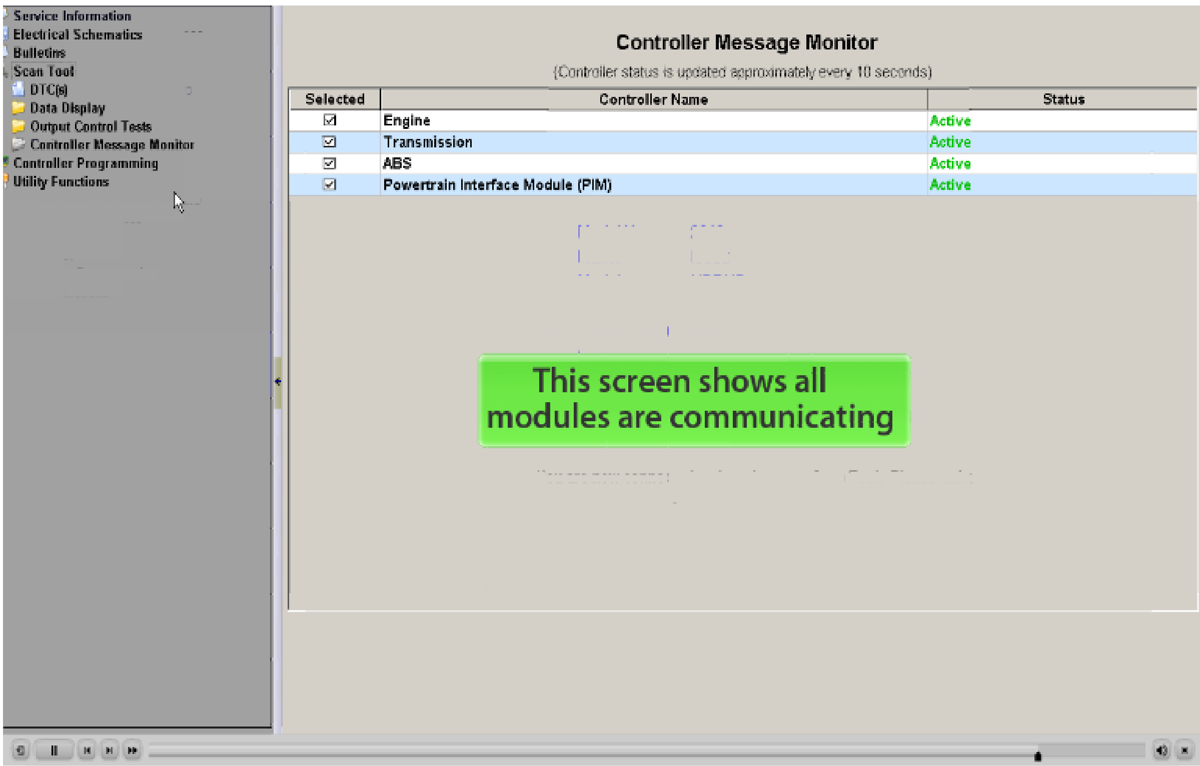
MODULE COMMUNICATIONS



Module Communications
As discussed in Module 1, the main components of the OBD II system are the Engine Control Module (ECM), the Transmission Control Module (TCM), the Powertrain Interface Module (PIM), and the Anti-Lock Brake System (ABS) module.

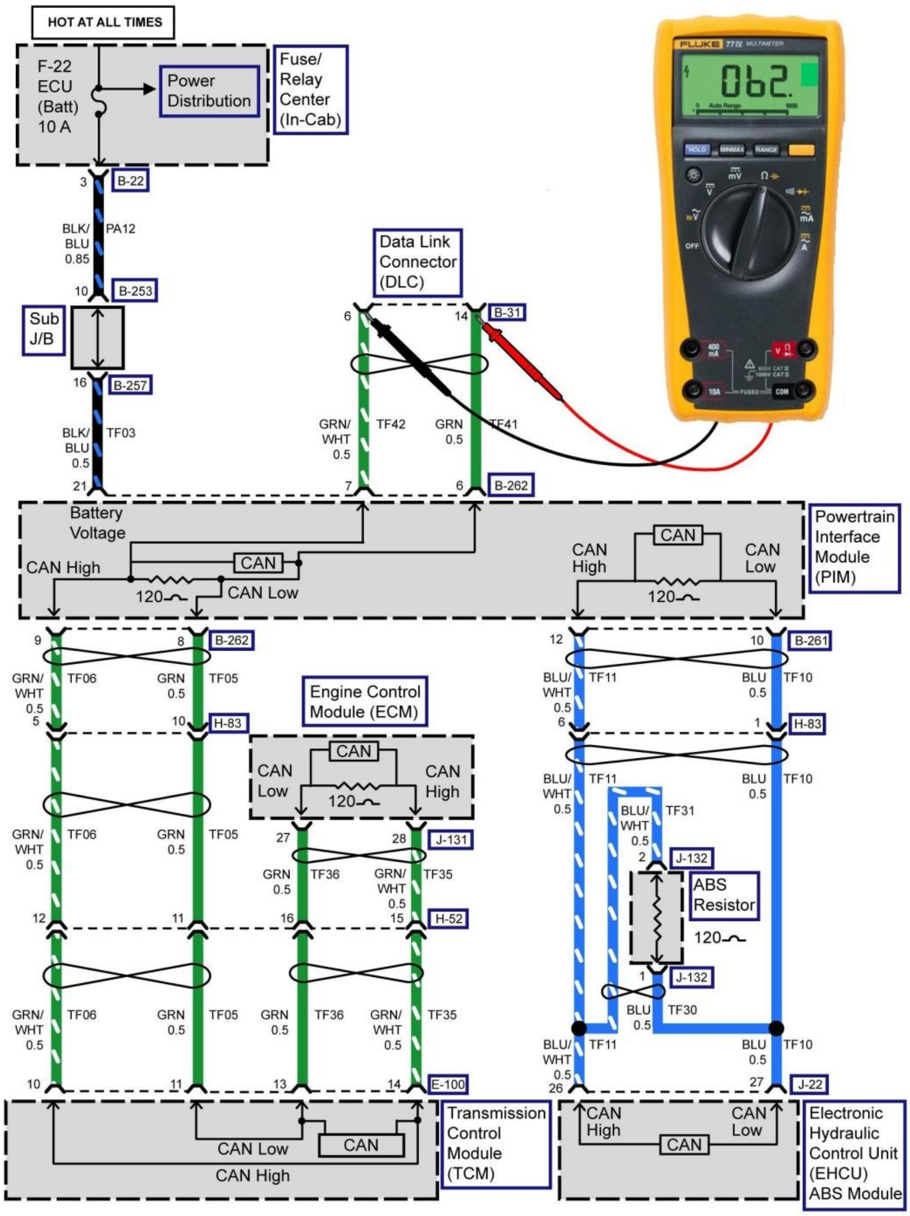
The various modules communicate with each other and the diagnostic scan tool equipment, through a dual wire, high speed communication link called the CAN Bus. The Scan Tool connects to the Bus through the Data Link Connector (DLC).

Controller Message Monitor



Controller Message Monitor
Communication between modules can be verified with IDSS using the Controller Message Monitor function. This screen shows all modules are active and transmitting data.

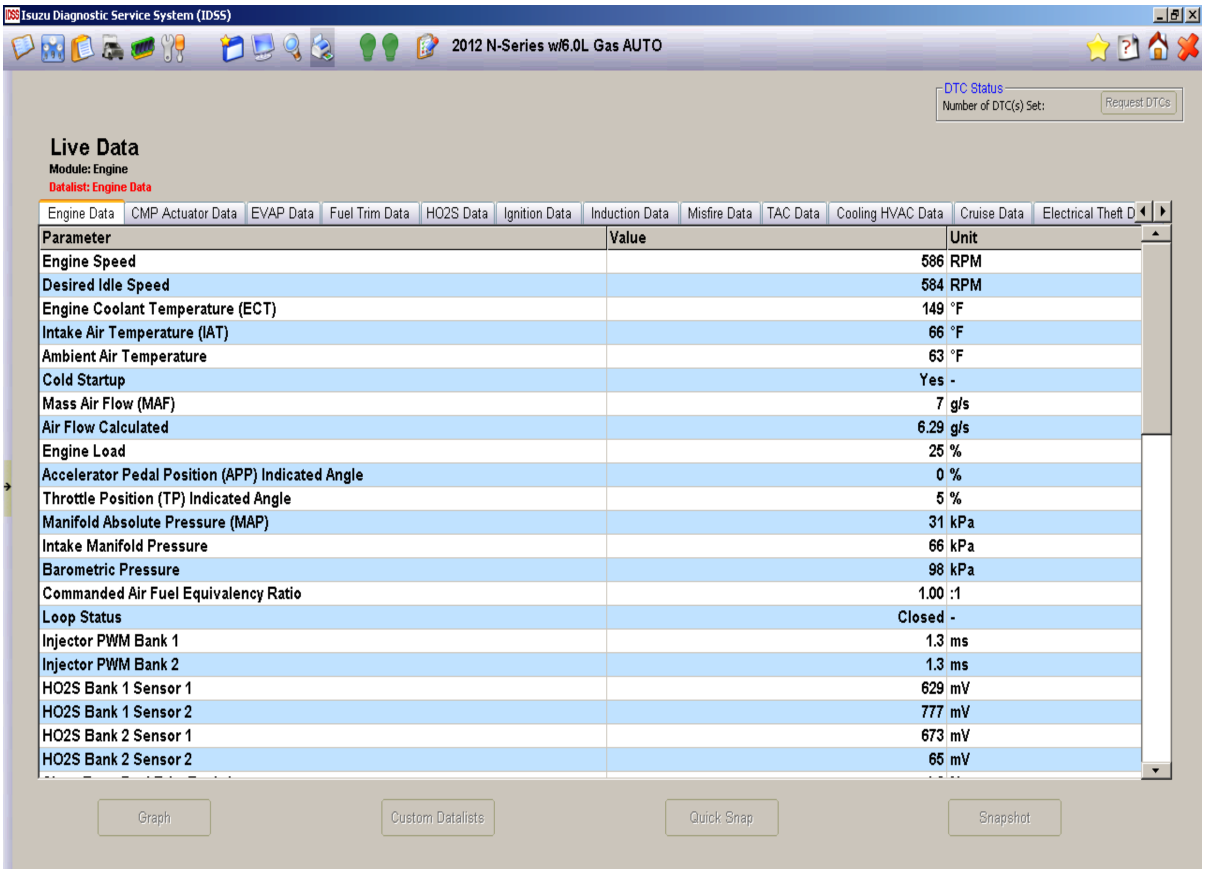
MODULE COMMUNICATIONS



Checking Module Communications

If there is a failure to communicate between any of the on board modules, check the resistance between the high and low circuits of the CAN lines. A normal reading should be around 60 ohms. If it is 120 ohms or higher, there could be a bad resistor in the module or an open in the CAN line.

Enabling Criteria and Drive Cycle

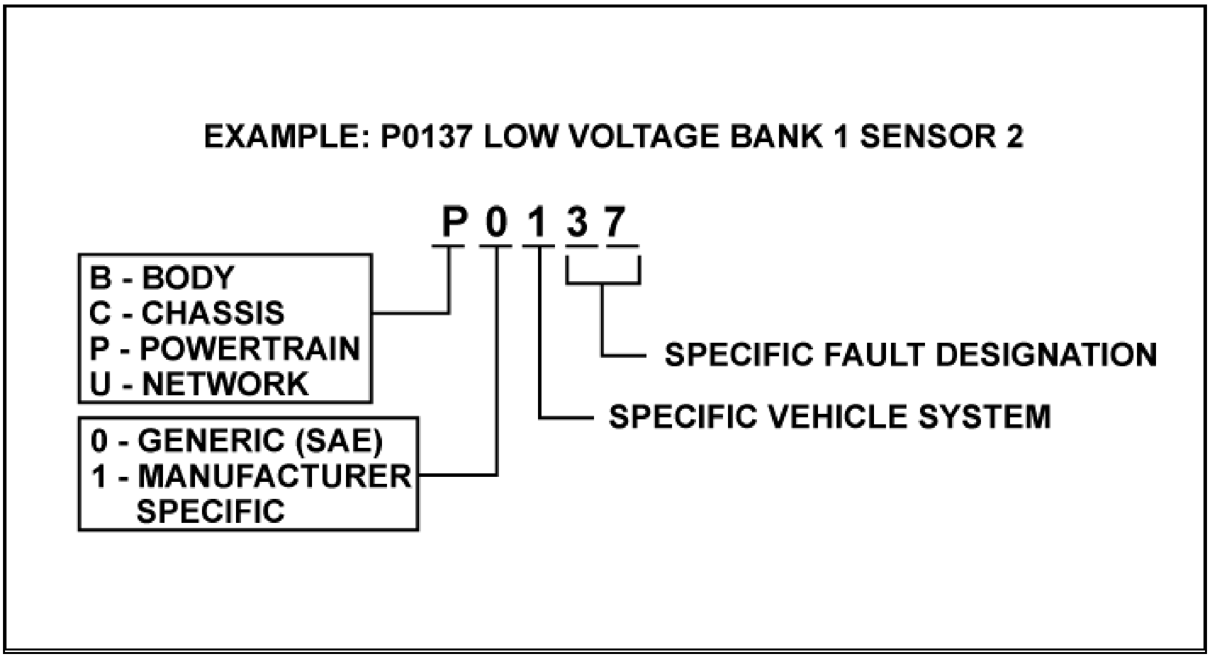


Parameter	Value	Unit
Engine Speed	586	RPM
Desired Idle Speed	584	RPM
Engine Coolant Temperature (ECT)	149	°F
Intake Air Temperature (IAT)	66	°F
Ambient Air Temperature	63	°F
Cold Startup	Yes	-
Mass Air Flow (MAF)	7	g/s
Air Flow Calculated	6.29	g/s
Engine Load	25	%
Accelerator Pedal Position (APP) Indicated Angle	0	%
Throttle Position (TP) Indicated Angle	5	%
Manifold Absolute Pressure (MAP)	31	kPa
Intake Manifold Pressure	66	kPa
Barometric Pressure	98	kPa
Commanded Air Fuel Equivalency Ratio	1.00	:1
Loop Status	Closed	-
Injector PWM Bank 1	1.3	ms
Injector PWM Bank 2	1.3	ms
HO2S Bank 1 Sensor 1	629	mV
HO2S Bank 1 Sensor 2	777	mV
HO2S Bank 2 Sensor 1	673	mV
HO2S Bank 2 Sensor 2	65	mV

Enabling Criteria and Drive Cycle
Enabling Criteria is a specific set of conditions that must be met before the ECM can run any of the diagnostic tests.

Some tests will only run during an extended set of driving procedures known as the Drive Cycle, or Ignition Cycle. This is also sometimes referred to as a Trip. An example of a Drive Cycle would start when the ignition key is turned "ON" and includes the vehicle reaching a certain temperature, speed, and Loop status, then end when the vehicle is shut off. If all enabling conditions are met, and the diagnostic test fails, a Diagnostic Trouble Code (DTC) could set.

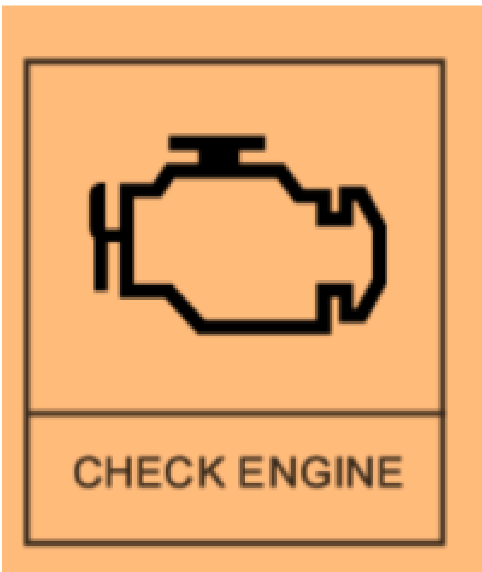
Diagnostic Trouble Code (DTCs)



Diagnostic Trouble Codes (DTCs)
DTCs can be retrieved using the IDSS and are displayed as five-digit alphanumeric codes.

- The first digit is a letter which designates what computer control module it came from. For example, the ECM or Powertrain module.
- The second digit is a number which indicates whether it is generic or manufacturer specific.
- The third digit is a number which points at the specific system. For example the number 1 represents Fuel and Air Metering. The number 2 represents an injector circuit. The ignition system is represented by the number 3, and an auxiliary emission control system by the number 4.
- The fourth and fifth digits identify the section of the system that is malfunctioning which will be defined when referencing the service information.

DTC Type A



Examples:

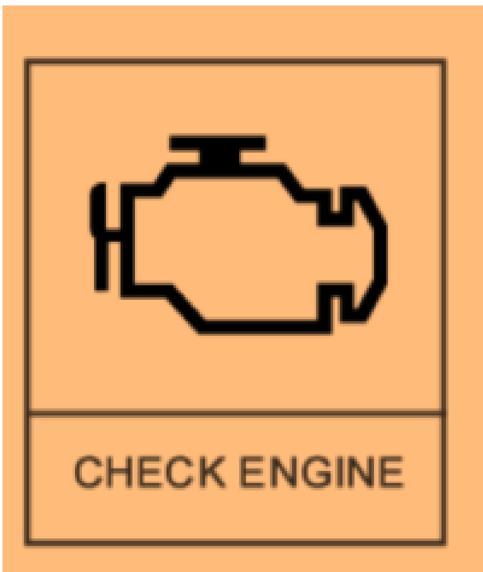
- P0120 - Throttle Position (TP) Sensor 1 Circuit
- P0122 - Throttle Position Sensor 1 Circuit Low Voltage
- P0123 - Throttle Position Sensor 1 Circuit High Voltage

DTC Type A
Type A Diagnostic Trouble Codes (DTCs) are the most serious and will turn on the Malfunction Indicator Lamp (MIL) as soon as the ECM detects a problem. Some examples of Type A codes are:

- P0120, which means that the ECM has identified a malfunction on Throttle Position Sensor 1 Circuit.
- P0122 indicating the ECM is seeing low voltage on the Throttle Position Sensor 1 Circuit.
- P0123 indicating that the ECM is seeing high voltage on the Throttle Position Sensor 1 Circuit.

When a Type A code is set, the OBD II system stores it as a History code. It also stores Freeze Frame and Failure Record Data. This stored data can be very helpful in diagnosing the problem and will be discussed later in this section.

DTC Type B



Examples:

- P0101 - Mass Air Flow (MAF) Sensor Performance
- P0116 - Engine Coolant Temperature (ECT) Sensor Performance

DTC Type B
Type B Codes indicate a fault but of a less serious concern to vehicle emissions. An example of a Type B Code would be:

- P0101 Mass Air Flow Sensor Performance
- P0116 Engine coolant Temperature Sensor Performance

In the case of a Type B Code, the fault must occur on two consecutive Drive Cycles before the MIL lamp will come on. If a fault occurs during one Drive Cycle but not during the next, the code won't "mature" and the MIL lamp will remain off. Only when all the conditions are met on two back to back Drive Cycles will a History Code set and the MIL lamp come on.

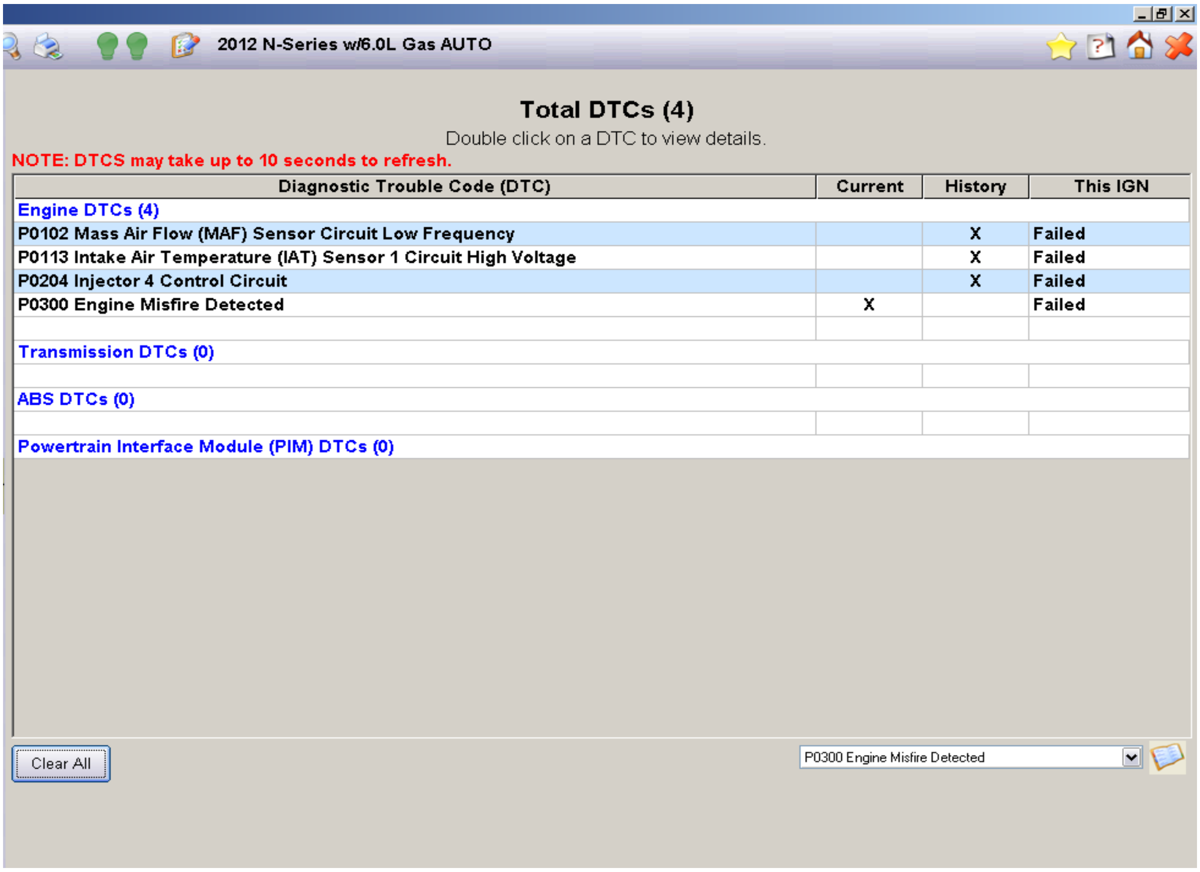
DTC Type C

Example of Type C Codes-Non Emission related

- U0140 - Lost Communication with Powertrain Interface Module (PIM)
- P0564 - Cruise Control Multi-Function Switch Circuit

DTC Type C
Type C Codes are non-emission related. These codes do not turn on the MIL lamp, but may turn on a separate indicator lamp such as the SERVICE VEHICLE SOON LIGHT. An example of a Type C Code would be:
- U0140 Lost Communication with Powertrain Interface Module
- P0564 Cruise Control Multi-function Switch Circuit

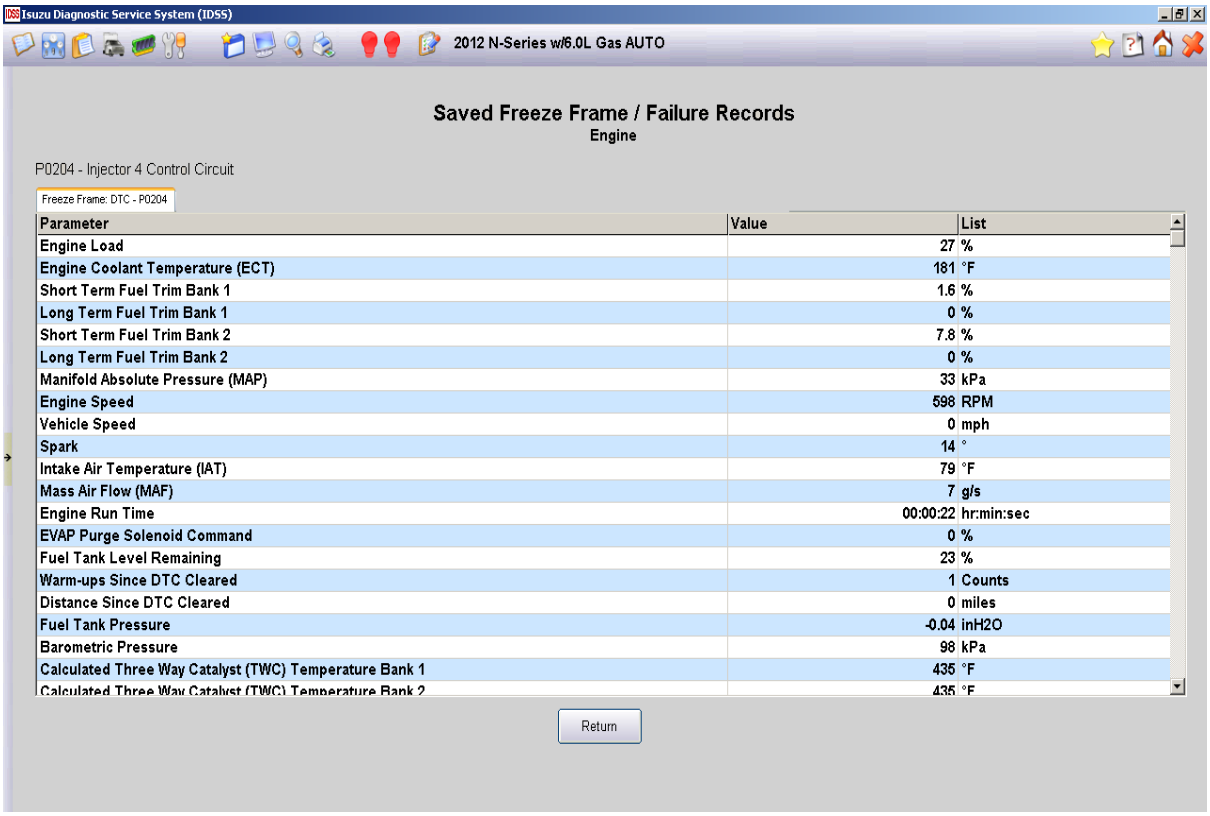
Current/History DTCs



Current/History DTCs:

- Current codes are based on real time data and reflect conditions that are currently present. Type A codes stay current until cleared.
- History codes are stored in ECM memory and indicate a failure occurred but may not be currently present. This IDSS screen shows both.
- An Intermittent condition can cause a History code to be stored in memory. If it is a Type B code, and the failure hasn't occurred two consecutive times, it isn't mature yet so the MIL lamp may not come on.

Freeze Frame/Failure Records

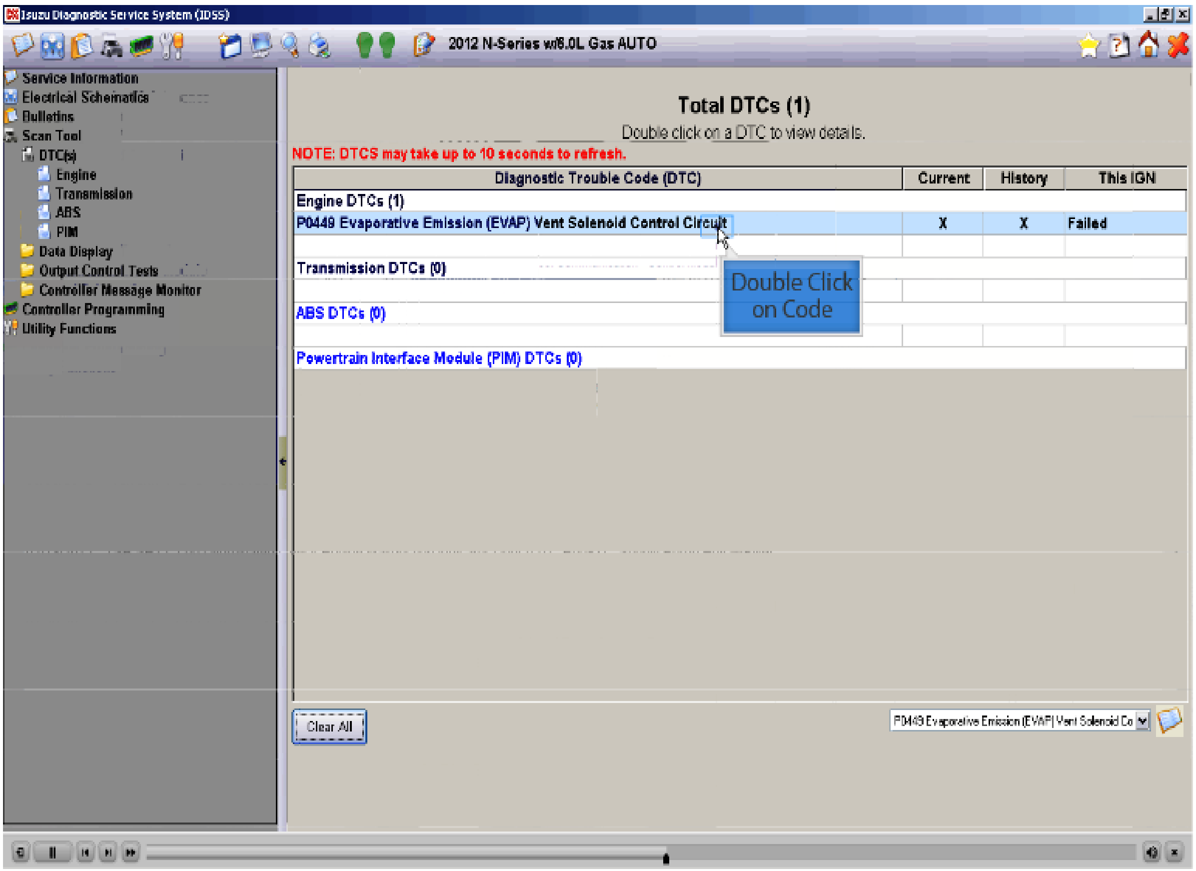


Parameter	Value	List
Engine Load	27	%
Engine Coolant Temperature (ECT)	181	°F
Short Term Fuel Trim Bank 1	1.6	%
Long Term Fuel Trim Bank 1	0	%
Short Term Fuel Trim Bank 2	7.8	%
Long Term Fuel Trim Bank 2	0	%
Manifold Absolute Pressure (MAP)	33	kPa
Engine Speed	598	RPM
Vehicle Speed	0	mph
Spark	14	°
Intake Air Temperature (IAT)	79	°F
Mass Air Flow (MAF)	7	g/s
Engine Run Time	00:00:22	hr:min:sec
EVAP Purge Solenoid Command	0	%
Fuel Tank Level Remaining	23	%
Warm-ups Since DTC Cleared	1	Counts
Distance Since DTC Cleared	0	miles
Fuel Tank Pressure	-0.04	inH2O
Barometric Pressure	98	kPa
Calculated Three Way Catalyst (TWC) Temperature Bank 1	435	°F
Calculated Three Way Catalyst (TWC) Temperature Bank 2	435	°F

Freeze Frame/Failure Records
As stated earlier, when a Type A or B code sets, the ECM saves a record of data. The data saved is of actual engine conditions at the time that the failure occurred and is viewed on the scan tool as Freeze Frame/Failure Records. This record will include many critical parameters such as Engine Coolant Temperature, Fuel Trim, Engine Speed, and Vehicle Speed.

It's important to note that if more than one DTC is stored, only the code stored first will store a Freeze Frame Record. Additional codes will store only Failure Records. This information can be very helpful when trying to diagnose an intermittent condition.

Saving Freeze Frame Data

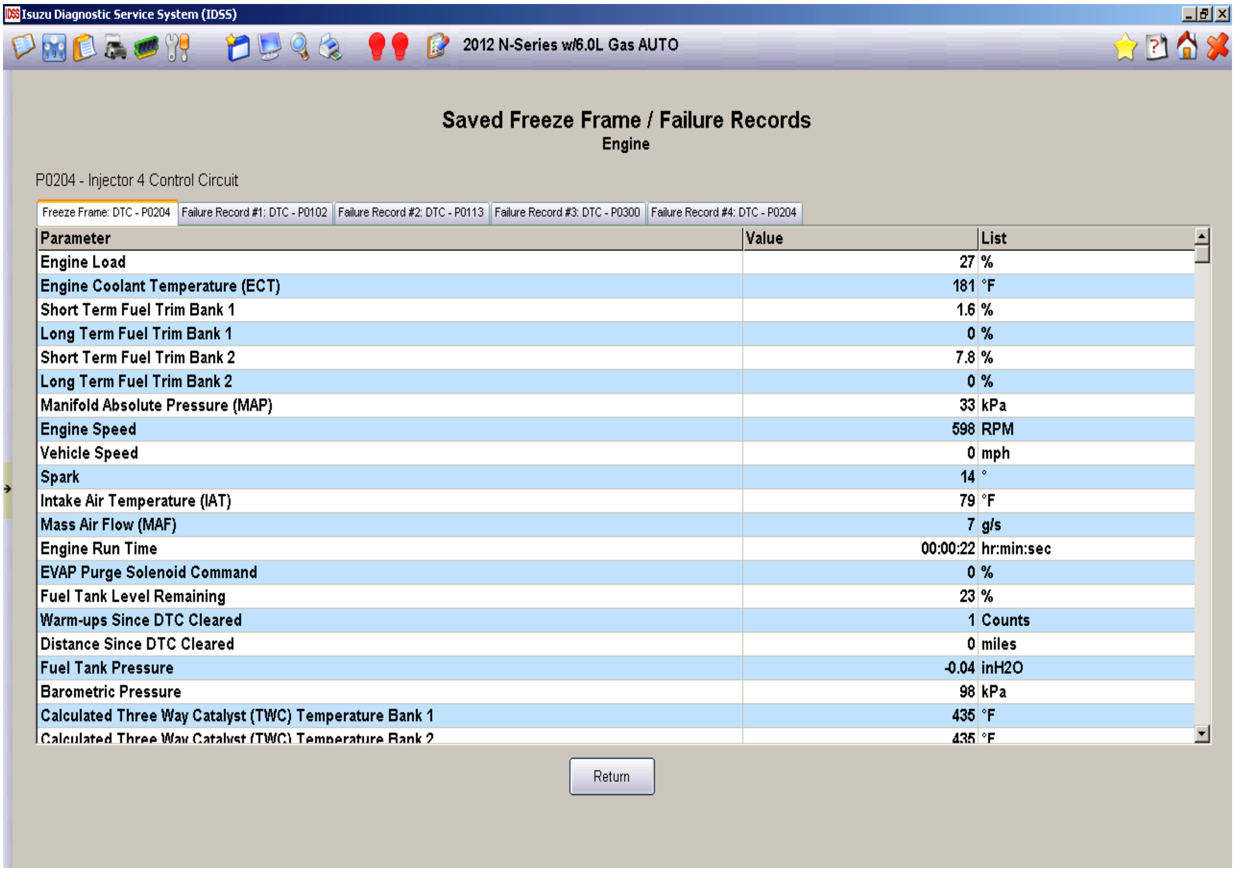


Saving Freeze Frame/Failure Records
It's a good idea to always save Freeze Frame and Failure Records Data before clearing codes. If not saved, data records will be lost.

To do this, go to the Scan Tool menu in IDSS and click on DTCs.
1) Double click on the stored DTC.
2) Click on Freeze Frame/Failure Records.
3) Click Save.
4) Click OK.

After data has been saved, click on Utility Functions to open Saved Freeze Frame/Failure Records.

Multiple Codes


Isuzu Diagnostic Service System (IDSS)

2012 N-Series w/6.0L Gas AUTO

Saved Freeze Frame / Failure Records

Engine

P0204 - Injector 4 Control Circuit

Freeze Frame: DTC - P0204 | Failure Record #1: DTC - P0102 | Failure Record #2: DTC - P0113 | Failure Record #3: DTC - P0300 | Failure Record #4: DTC - P0204

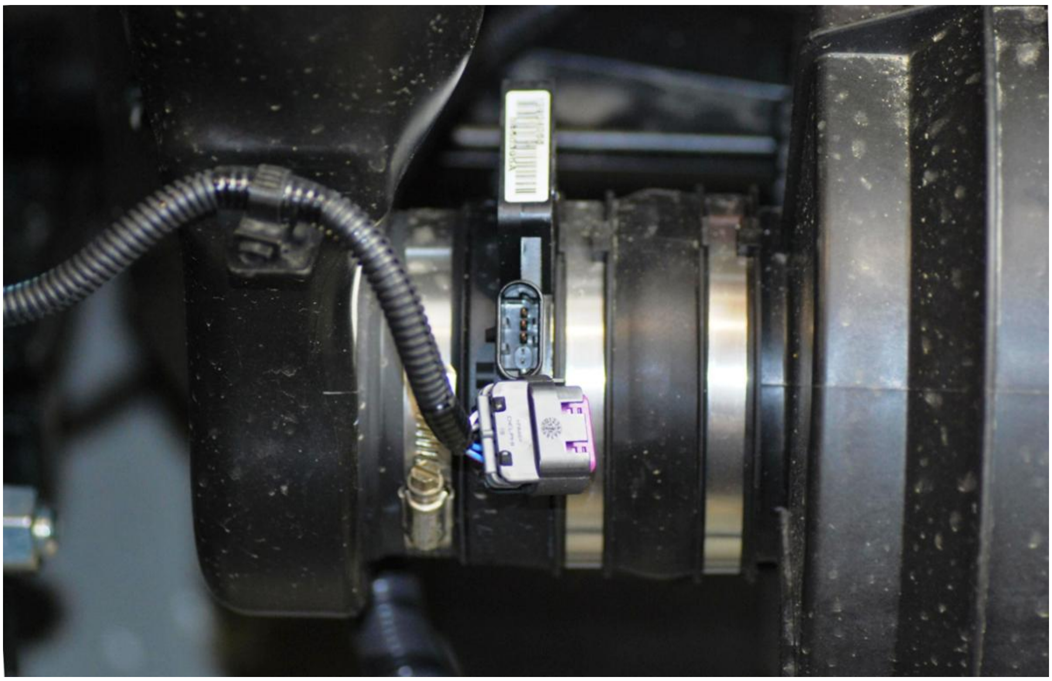
Parameter	Value	List
Engine Load	27	%
Engine Coolant Temperature (ECT)	181	°F
Short Term Fuel Trim Bank 1	1.6	%
Long Term Fuel Trim Bank 1	0	%
Short Term Fuel Trim Bank 2	7.8	%
Long Term Fuel Trim Bank 2	0	%
Manifold Absolute Pressure (MAP)	33	kPa
Engine Speed	598	RPM
Vehicle Speed	0	mph
Spark	14	°
Intake Air Temperature (IAT)	79	°F
Mass Air Flow (MAF)	7	g/s
Engine Run Time	00:00:22	hr:min:sec
EVAP Purge Solenoid Command	0	%
Fuel Tank Level Remaining	23	%
Warm-ups Since DTC Cleared	1	Counts
Distance Since DTC Cleared	0	miles
Fuel Tank Pressure	-0.04	inH2O
Barometric Pressure	98	kPa
Calculated Three Way Catalyst (TWC) Temperature Bank 1	435	°F
Calculated Three Way Catalyst (TWC) Temperature Bank 2	435	°F

Return

Multiple Codes

It's not uncommon for more than one DTC to be stored. When there are multiple codes, it can be difficult to know where to begin diagnosis. The correct diagnostic strategy is to always start with the first code stored, which is the DTC that has saved Freeze Frame data.

Service Tips

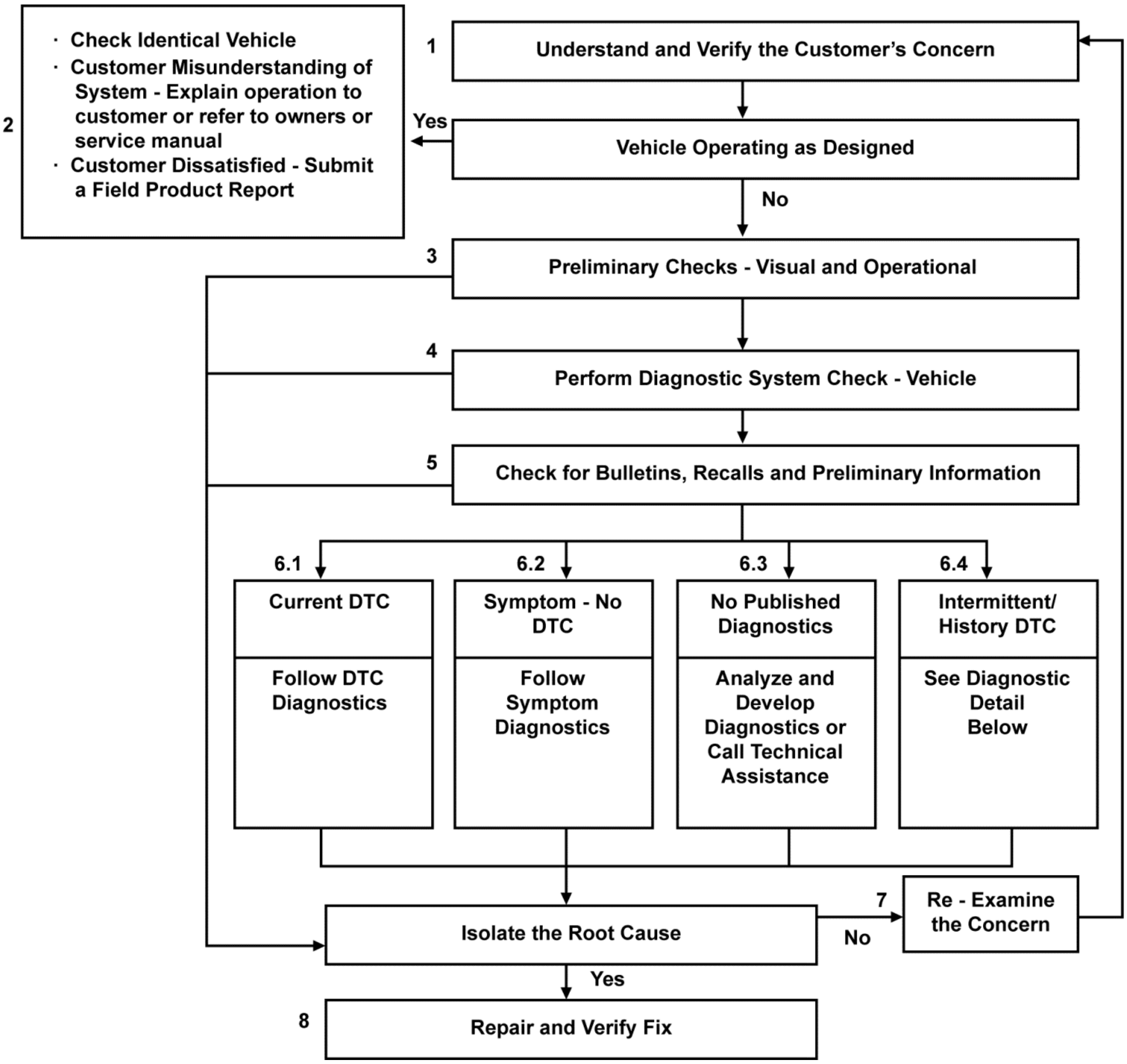


Service Tips
When analyzing scan tool data, if a sensor signal is out of range, do not assume it is a bad sensor. For instance, a Mass Air Flow Sensor with a loose or corroded connection will be out of range and can cause poor performance, stalling, and hard starting. This can even cause an intermittent DTC to set. The sensor may be OK, just the connector needs to be repaired.

6.0L V8 Gas Engine Driveability
Module 2, Section 2
Diagnostic Strategy

- Introduction to Diagnostic Strategy
- Diagnostic Starting Point
- Code or No Code Diagnostics

Diagnostic Strategy



Diagnostic Strategy, Step #1
Strategy Based Diagnosis provides a systematic approach to diagnosing the vehicle, in other words, a plan of action. Using this strategy helps reduce diagnostic time and improves the chances to fix it right the first time. Each customer's concern may be different but the basic Diagnostic Strategy is always the same.

Step #1 is to verify the customer's concern. It's important to understand this before doing anything else.

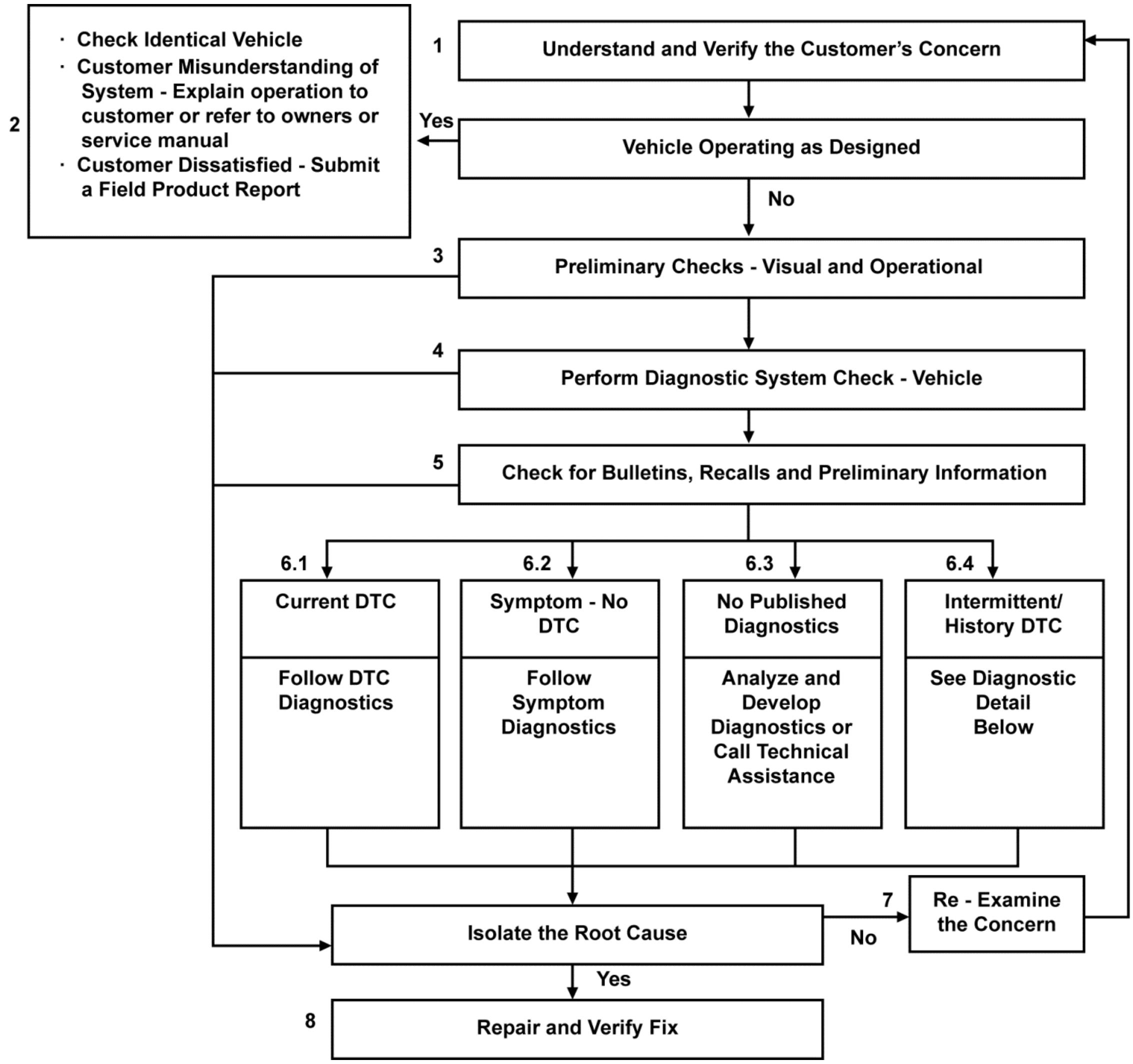
Driveability Diagnosis Starting Point

Isuzu Repair Service **REPAIR ORDER**

WORK PERFORMED	CUSTOMER INFORMATION	OTHER
	Name **Ph#**	Date
	Address	Staff
	City **State** **Zip**	**PAYMENT**
	Make **Year**	Cash ☐
	Odometer **License#**	Check ☐
	Vin#	Charge ☐
	CUSTOMER CONCERNS	**RATE**
	Hard starting, low power, stalls and hesitates.	Labor ☐
		Serv Call ☐
		Hourly ☐
		PM Call ☐
		CHARGES
		Labor Hours $
		Parts $
	Down Payment ☐ Yes ☐ No **Amount $**	Gas/Oil/Grease $
	I hereby authorize NAME OF COMPANY to perform the above work to be done with the necessary materials and grant permission to operate car/truck herein described on streets or highways for the purpose of testing. As explained to me a mechanics lien may be placed on said vehicle in order to obtain unpaid repairs/services left at Joe's Diesel Service for more than 30 days. I understand JDS is not responsible for loss or damage to vehicles or articles left in car/trucks in case of fire, theft or any other cause beyond our control.	Outside Repairs $
		Storage Fee(s) $
		Tax $
		AMOUNT DUE
	Customer Signature **Date**	**$**

The Work Order
Most driveability diagnosis starts with the work order. The first step is "understanding" what the customer is experiencing and verifying the symptoms. It may be necessary to talk to the customer or operate the vehicle if information on the work order is vague or incomplete.

Diagnostic Strategy

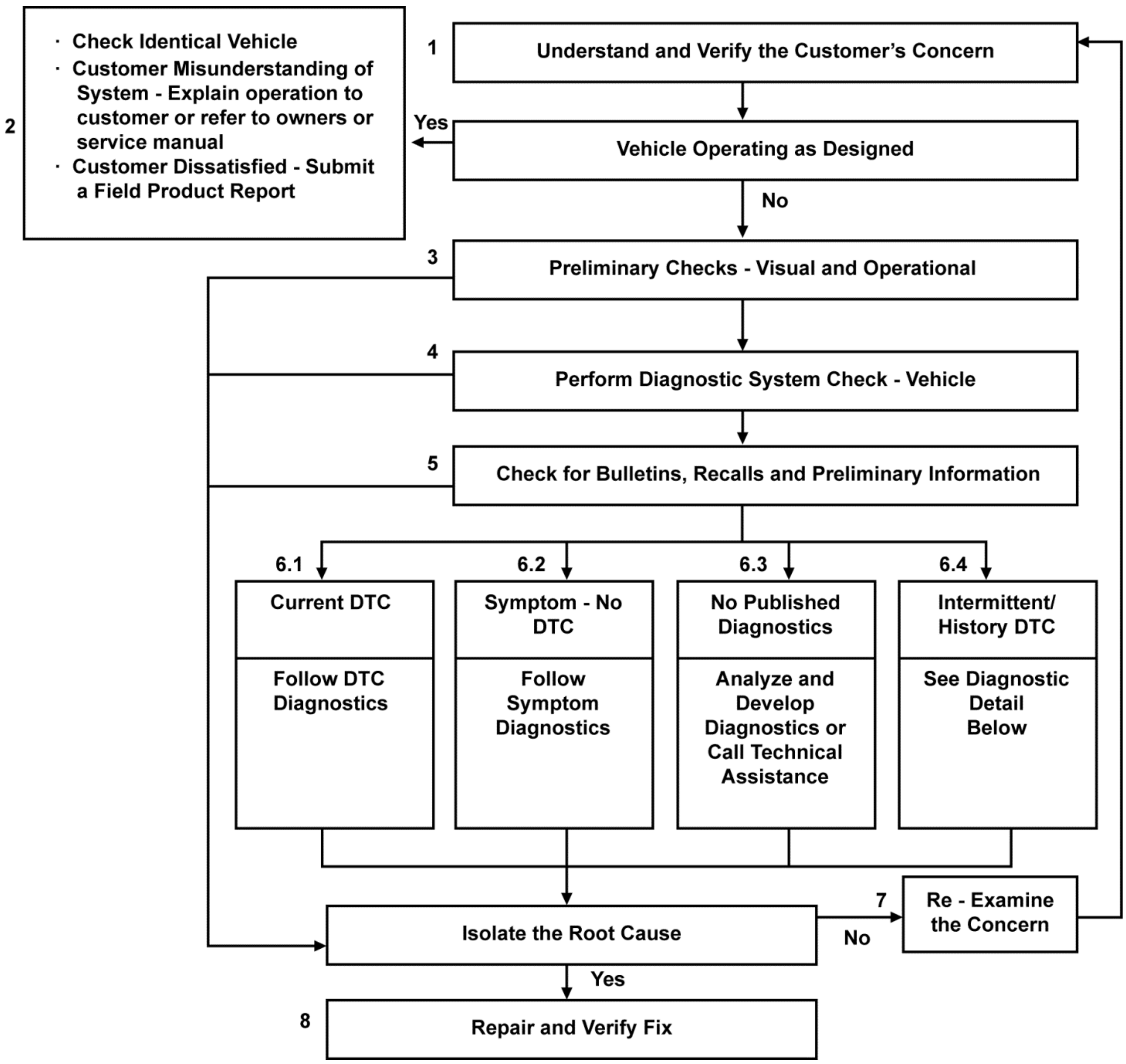


Diagnostic Strategy, Step #2 and #3
Step #2 is to determine if the customer's concern is a normal operating characteristic. It is very important not to attempt repairs in an attempt to appease the customer if the vehicle is operating as designed. It can be helpful to use a known good vehicle for comparison. If the customers concern is verified, go on to the next step.

Step #3 is to perform preliminary checks including a very careful visual inspection. Don't skip this step because it can often lead to identifying the concern quickly and save time. Even if the MIL lamp is on, indicating there is a current DTC, don't skip the visual inspection. A DTC may point you in the right direction, but sometimes, it can be misleading.

It's also important to keep in mind that the OBD II system assumes that the mechanical systems are all functioning properly. With all the electronics on the vehicle, it's easy to overlook the basic mechanical systems.

Diagnostic Strategy

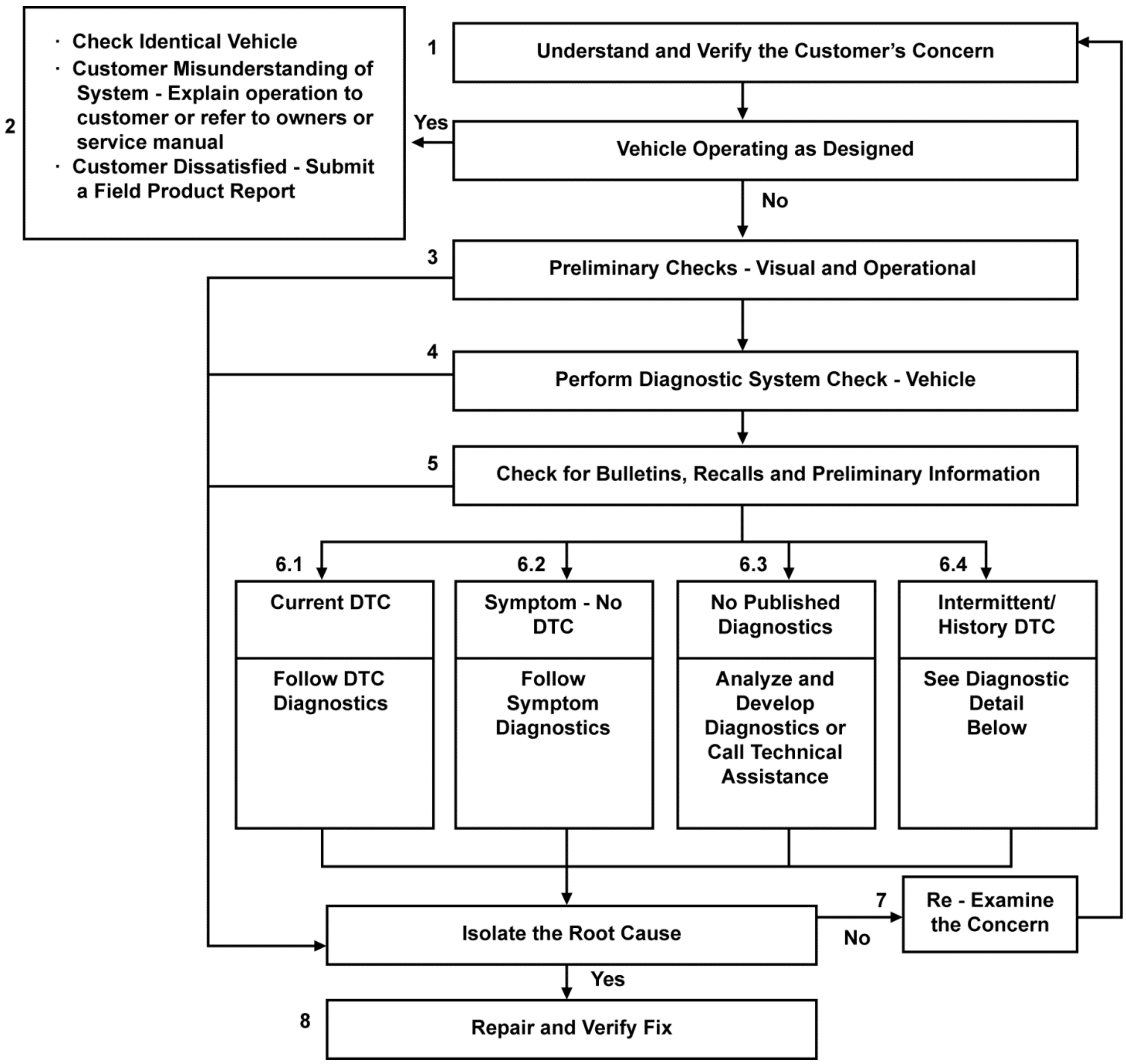


Diagnostic Strategy, Step #4:
Step #4 is to perform the Diagnostic System Check. This is found in the service manual and performing this check will:

- Identify what control modules are commanding the system
- Verify the ability of the control modules to communicate
- And identify if any DTCs are stored and if they are current or history

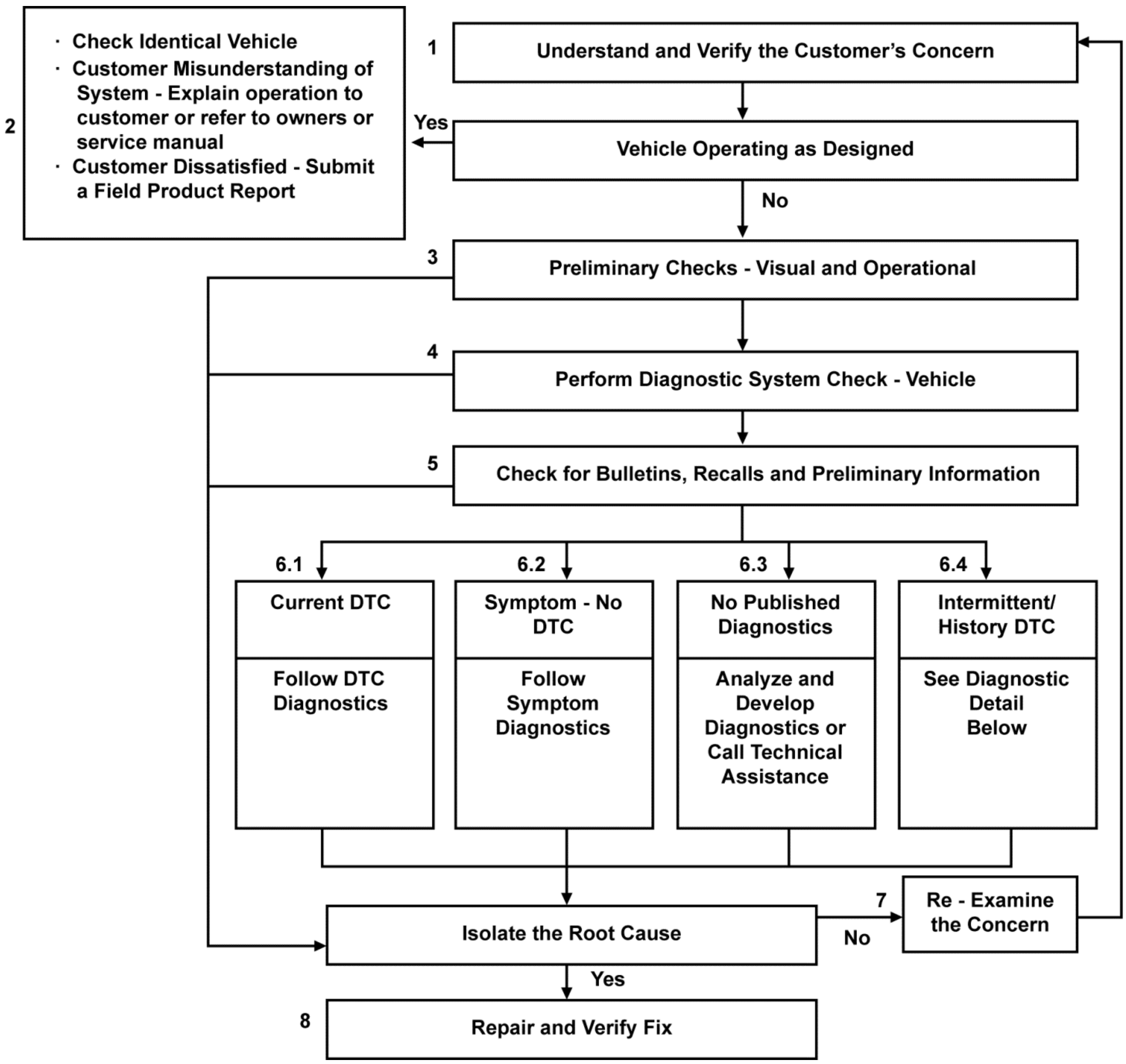
Record all DTC's on the repair order for future reference before clearing codes.

Diagnostic Strategy



Diagnostic Strategy, Step #5
Step #5. is to check for bulletins. This can save a lot of time and effort.

Diagnostic Strategy

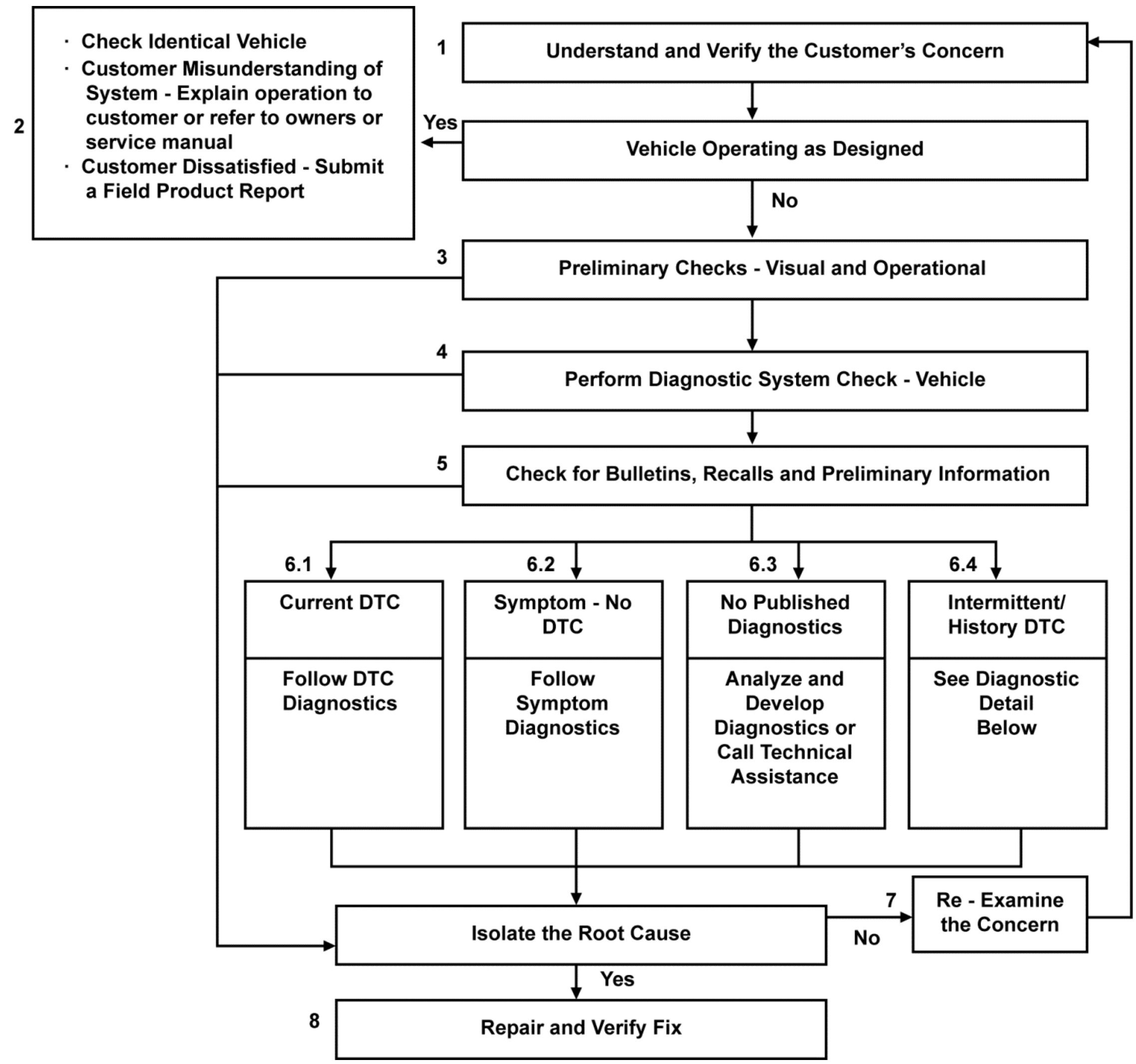


Diagnostic Strategy, Step #6

In Step #6, the diagnostic path will be determined by what was learned from the Diagnostic System Check:

- If there is a current code, follow the correct procedure in the service manual. If there are multiple codes, start with the first code set.
- If symptoms seem to be intermittent, check for a history code. If there is one, refer to the DTC chart in the service manual. This may help get to the root cause.
- If there are no codes stored, diagnostics will be based on the emissions or drivability conditions.
- If there is no code and no published diagnostics related to the concern, it may be necessary to call the Technical Assistance Center.

Diagnostic Strategy



Diagnostic Strategy, Step #7
Following the Diagnostic Strategy and the procedures as outlined in the service information, should eventually lead to finding the root cause of the concern. If not, it may be necessary to re-examine the information from the beginning.

Diagnostic Strategy

Isuzu Repair Service **REPAIR ORDER**

WORK PERFORMED	CUSTOMER INFORMATION	OTHER
Visually inspected vehicle. Test drive vehicle. Scan vehicle for DTCs. Found P0300 Checked for service bulletins And recalls. Check fuel system pressure. Fuel pressure low. Inspect fuel lines and check Electrical circuit at pump. Replace fuel pump and clear codes. Test drive okay.	**Name** **Ph#**	Date
	Address	Staff
	City **State** **Zip**	**PAYMENT**
	Make **Year**	Cash ☐
	Odometer **License#**	Check ☐
	Vin#	Charge ☐
	CUSTOMER CONCERNS	**RATE**
	Hard starting, low power, stalls and hesitates.	Labor ☐
		Serv Call ☐
		Hourly ☐
		PM Call ☐
		CHARGES
		Labor Hours $
		Parts $
	Down Payment ☐ **Yes** ☐ **No** **Amount $**	Gas/Oil/Grease $
	I hereby authorize NAME OF COMPANY to perform the above work to be done with the necessary materials and grant permission to operate car/truck herein described on streets or highways for the purpose of testing. As explained to me a mechanics lien may be placed on said vehicle in order to obtain unpaid repairs/services left at Joe's Diesel Service for more than 30 days. I understand JDS is not responsible for loss or damage to vehicles or articles left in car/trucks in case of fire, theft or any other cause beyond our control.	Outside Repairs $
		Storage Fee(s) $
		Tax $
		AMOUNT DUE
	Customer Signature **Date**	**$**

Diagnostic Strategy, Step #8
The final step after the root cause has been identified and the vehicle repaired, is to clear codes and verify the fix.

Remember that some codes require two ignition cycles to turn on the MIL lamp so always recheck for codes when verifying the fix.

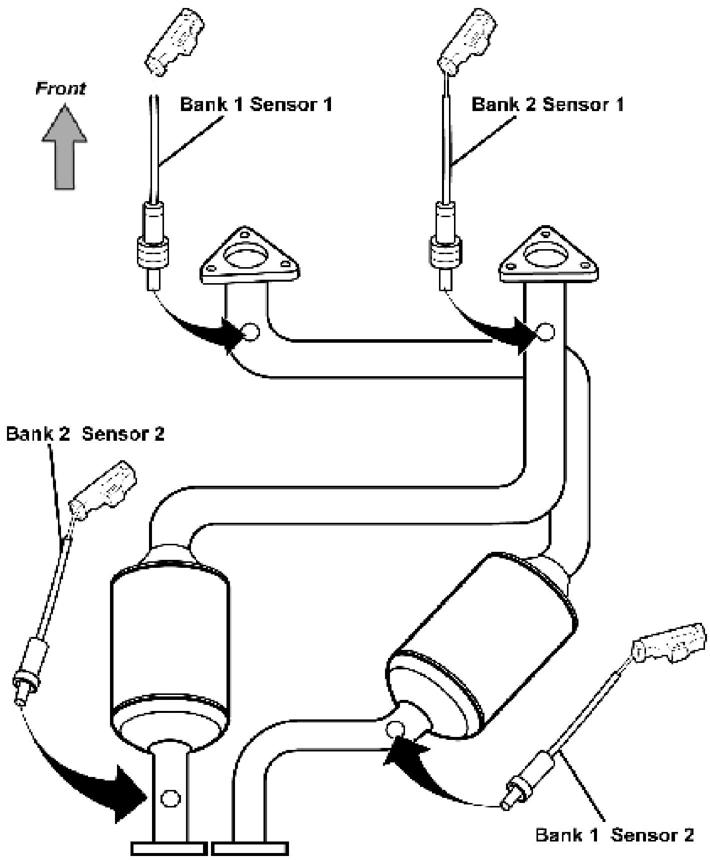
6.0L V8 Gas Engine Driveability Module 2, Section 3 Heated Oxygen Sensors (HO2S)

- Pre-catalyst Heated Oxygen Sensors
- Post-catalyst Heated Oxygen Sensors
- Catalyst Monitoring
- Diagnostics and Service

Heated Oxygen Sensor (HO2S)

Heated Oxygen Sensors (HO2S)
The 6.0L gas engine has four Heated Oxygen Sensors, also referred to as HO2S, that provide important information to the ECM for fuel control and catalytic converter monitoring.

Oxygen Sensor Location



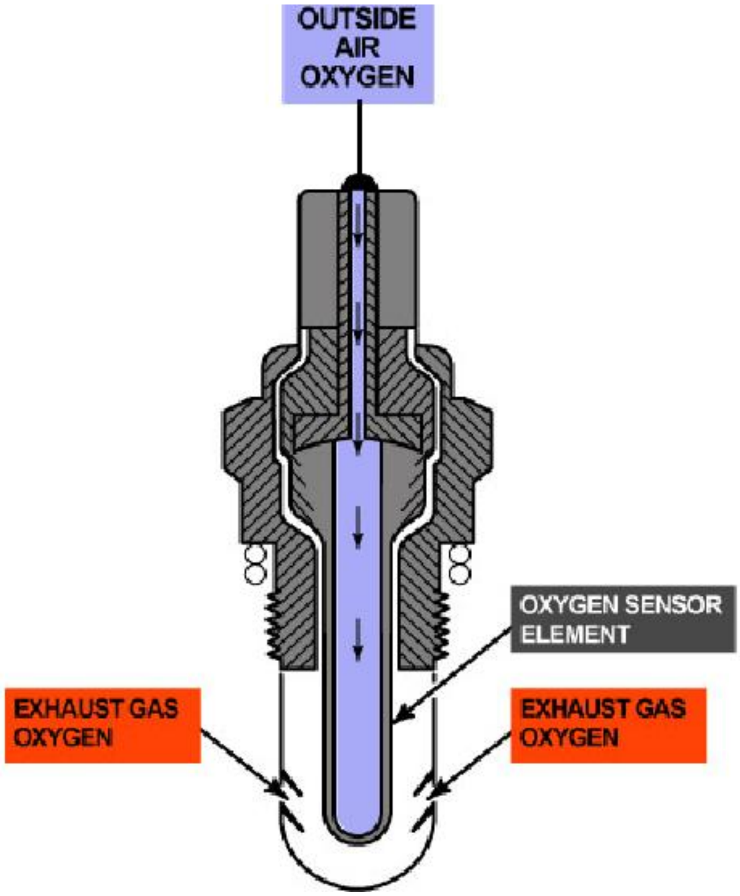
Oxygen Sensor Location
The two Pre-Catalyst Oxygen Sensors are located in the exhaust pipes before the catalytic converters.

The signals from the Pre-Catalyst Oxygen Sensors provide critical information to the ECM when the system is in Closed Loop. By monitoring the Oxygen Sensor signals, the ECM constantly adjusts fuel delivery, trying to maintain an air-to-fuel ratio of 14.7:1, the optimal air/fuel ratio for low emissions and driveability.

The ECM uses the two Post-Catalyst Oxygen Sensor signals to monitor the efficiency of the Catalytic Converters.

The Pre-Catalyst Oxygen Sensor on the driver side is referred to as Bank 1, Sensor 1. Bank 1, Sensor 2 is a Post-Catalyst Oxygen Sensor and is located on the passenger side after the Catalytic Converter. This is because the exhaust pipes cross over. The Pre-Catalyst Oxygen Sensor on the passenger side is referred to as Bank 2, Sensor 1. Bank 2 Sensor 2 is a Post-Catalyst Oxygen Sensor and is located after the Catalytic Converter on the driver side.

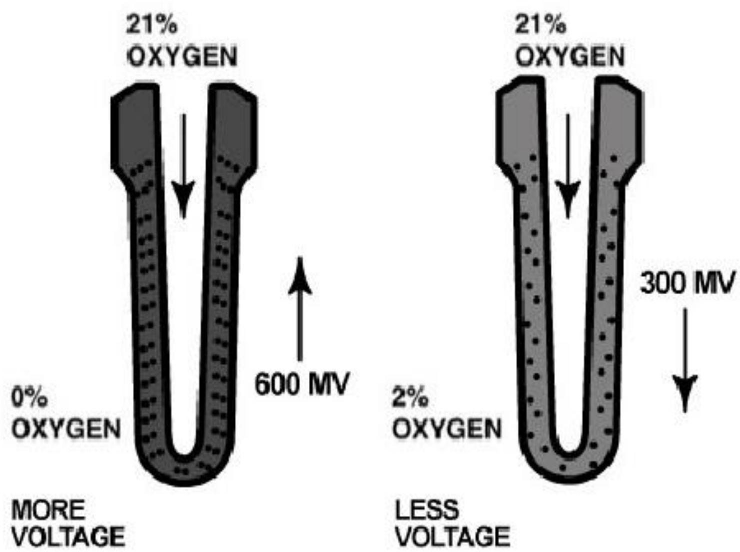
Oxygen Sensor Construction

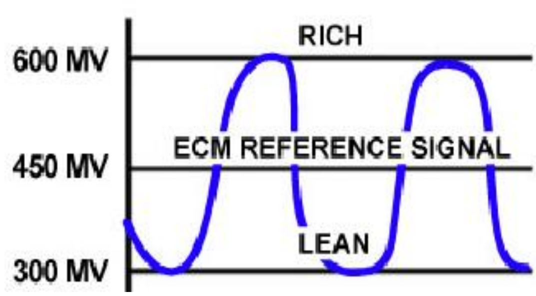


Oxygen Sensor Construction
An Oxygen Sensor is simply a thimble shaped battery that produces a very low voltage, less than one volt. The inner surface of the sensor is exposed to outside air which contains 21% oxygen. This air enters the center of the sensor through the wire connector.
The outside surface of the Oxygen Sensor element is exposed to exhaust gases, containing far less oxygen or no oxygen at all after combustion.

This difference in oxygen levels in the exhaust verses outside air creates a chemical reaction that produces the very low voltage signal.

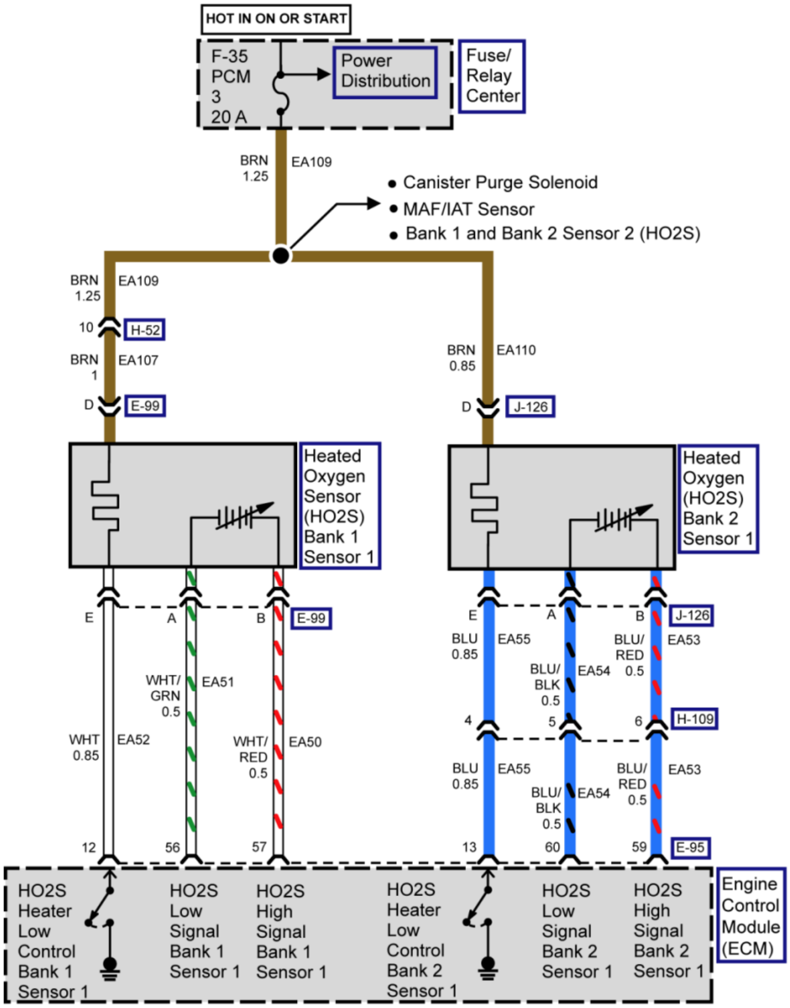
Oxygen Sensor Signal





Oxygen Sensor Signal
Oxygen Sensor output voltage will normally be between 100 and 900 mV. When there is a rich air fuel mixture nearly all the oxygen will be burned up during combustion, leaving little to no oxygen in the exhaust. This produces a higher voltage output from the sensor.
If the air fuel mixture is lean there is likely to be unburned oxygen in the exhaust. The sensor reacts to this by producing a lower voltage.

Heated Oxygen Sensor Circuit



HO2S Heater Circuit

The Heated Oxygen Sensor (HO2S) is a four wire sensor: two wires carry the signal to the ECM and two wires are for the heater circuit.

In order for the HO2S to provide an active signal, it must be at operating temperature. The sensors are located some distance from the engine exhaust ports and would be slow to heat up if relying on just engine temperature. Instead, the sensors have an internal electric heater that brings them up to operating temperature in just seconds.

The heater circuit voltage comes from the ignition circuit. Once the ignition is turned ON, the ECM grounds the heater low control circuit and the HO2S reaches operating temperatures in less than 90 seconds. The ECM uses pulse width modulation on the ground side to maintain a steady operating temperature.

To make sure the heaters are working, the ECM monitors the amperage and the voltage on the HO2S heater low control circuit. If the ECM detects something out of range, a DTC will set.

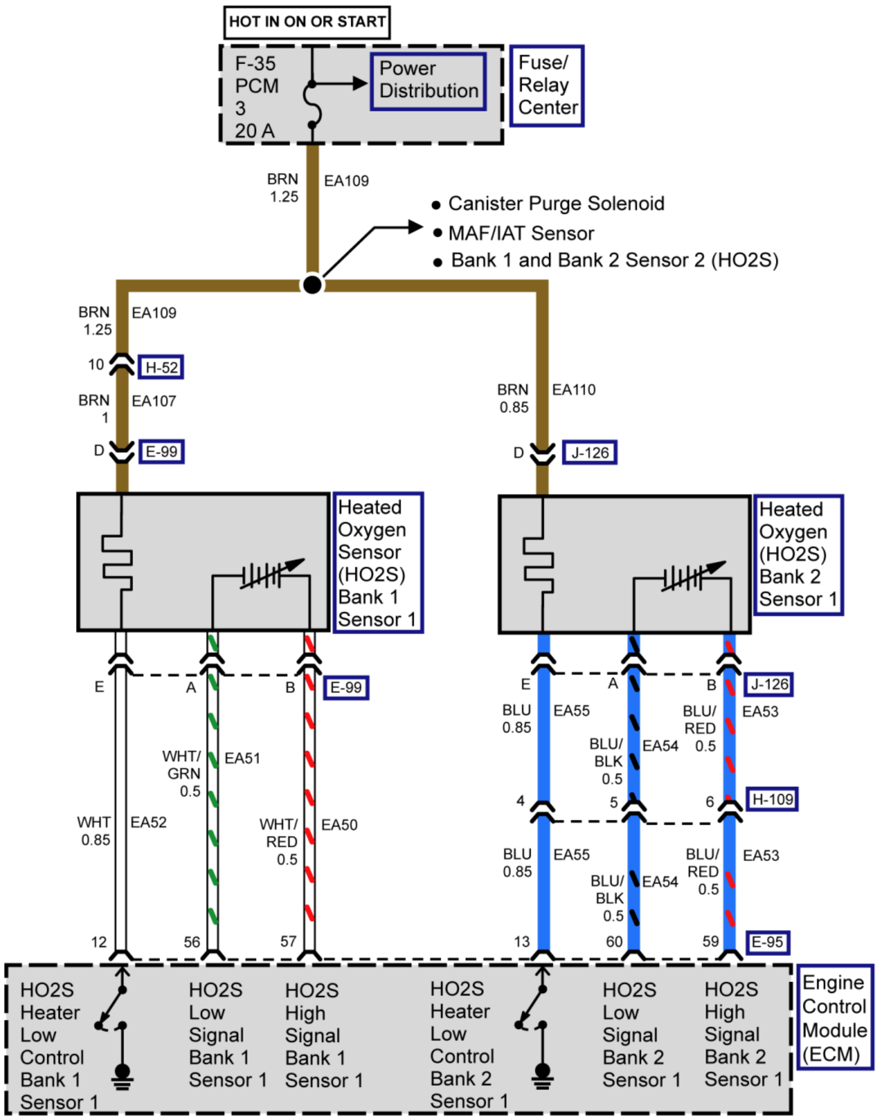
H02S Heater Circuit Codes

DTC	DTC Description	Type	MIL
P0030	HO2S Heater Control Circuit Bank 1 Sensor 1	B	On
P0036	HO2S Heater Control Circuit Bank 1 Sensor 2	B	On
P0050	HO2S Heater Control Circuit Bank 2 Sensor 1	B	On
P0053	HO2S Heater Resistance Bank 1 Sensor 1	B	On
P0054	HO2S Heater Resistance Bank 1 Sensor 2	B	On
P0056	HO2S Heater Control Circuit Bank 2 Sensor 2	B	On
P0059	HO2S Heater Resistance Bank 2 Sensor 1	B	On
P0060	HO2S Heater Resistance Bank 2 Sensor 2	B	On
P0135	HO2S Heater Performance Bank 1 Sensor 1	B	On
P0141	H02S Heater Performance Bank 1 Sensor 2	B	On
P0155	HO2S Heater Performance Bank 2 Sensor 1	B	On
P0161	HO2S Heater Performance Bank 2 Sensor 2	B	On

HO2S Heater Circuit Codes
There are 42 codes associated with the HO2S and 12 of these codes are associated with the heater circuit.

If an Oxygen Sensor heater circuit code sets, don't assume the heater element has failed. It's a good idea to inspect the wiring and connectors leading to the sensor for possible damage.

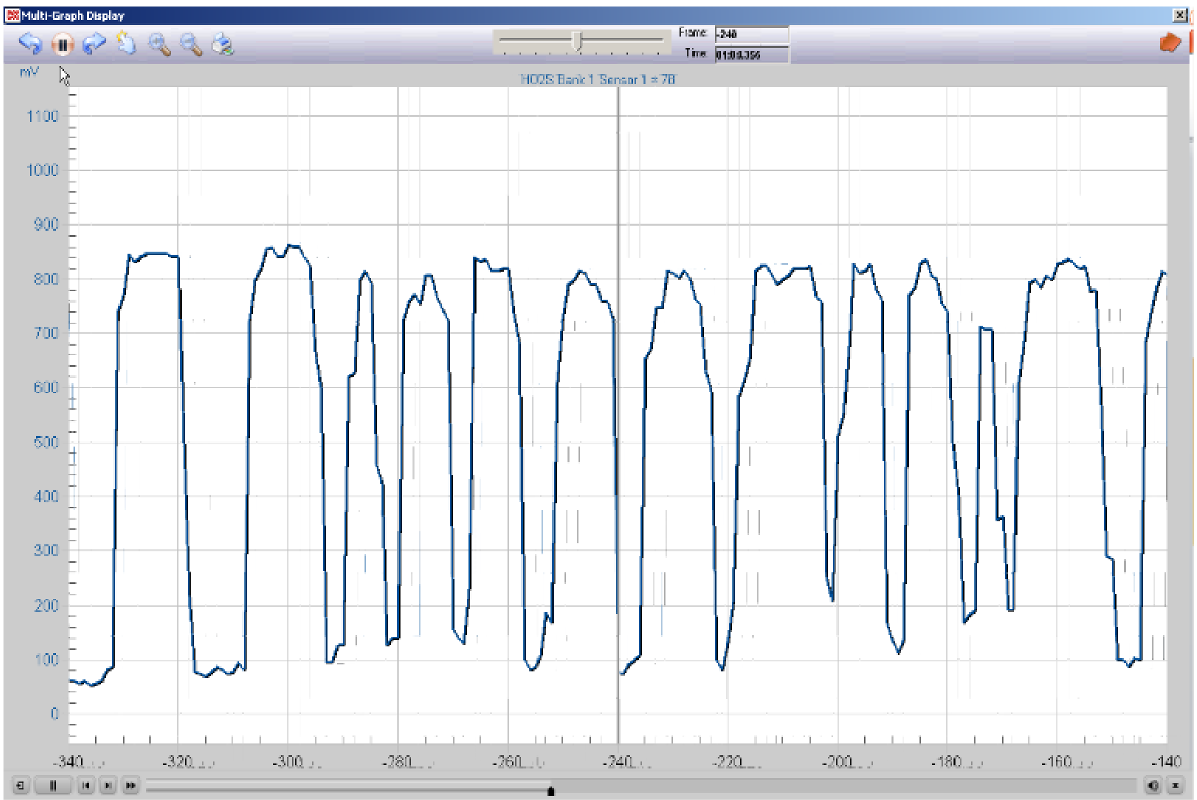
Oxygen Sensor Signal Circuit



HO2S Signal Circuit

The ECM applies a reference voltage, also referred to as a bias voltage, of 450 mV to the HO2S signal wire. The ECM determines if the system is rich or lean, depending on whether the voltage generated by the sensor is greater than or less than 450 mV.

Pre-Catalyst H02S Signal

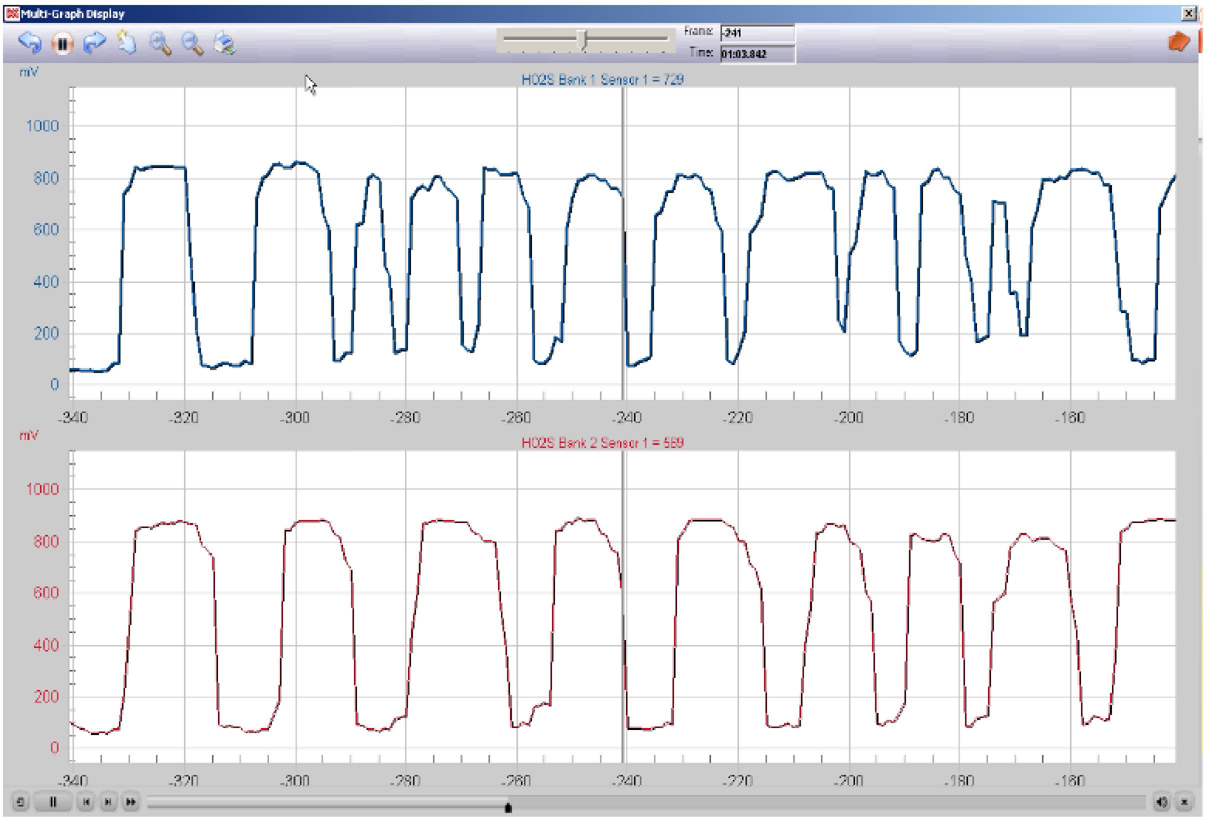


Pre-Catalyst HO2S Signal

Each time the exhaust valve opens the oxygen levels in the exhaust change. This is why the oxygen sensor signal rapidly cycles between 100 and 900 mV while the engine is running.

Voltage above 450 mV indicates a rich exhaust and voltage below 450 mV indicates a lean exhaust. The ECM is continuously adjusting the fuel to maintain the optimum air/fuel ratio. This is referred to as Fuel Trim, and will be discussed later in this section.

Pre-Catalyst H02S Signals



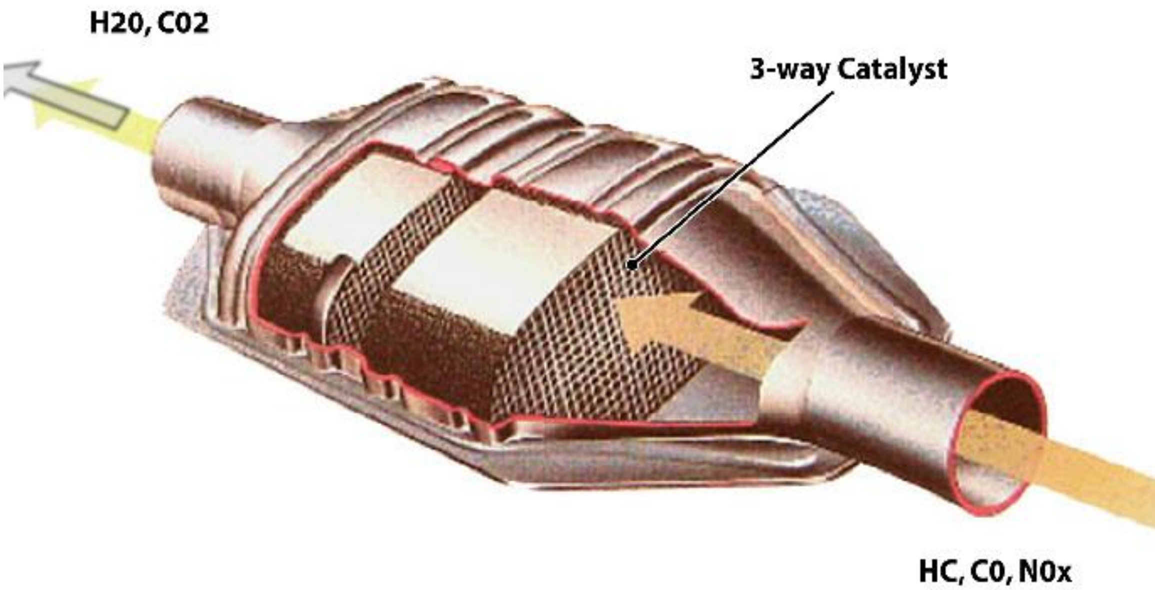
Pre-Catalyst HO2S Bank 1/Bank2 Signals
The ECM monitors the HO2S signal voltage for:

- response rate
- signal range
- various other parameters

If the sensor signal rate is too slow, too fast, or the signal is beyond the normal limit, the ECM will interpret this as a defective sensor, set a DTC and illuminate the MIL.

When a HO2S signal DTC sets it may not mean the Oxygen Sensor is defective. Conditions such as fuel delivery or misfire can also cause these DTCs to set so be sure to follow the diagnostic charts carefully.

Three-way Catalytic Converter

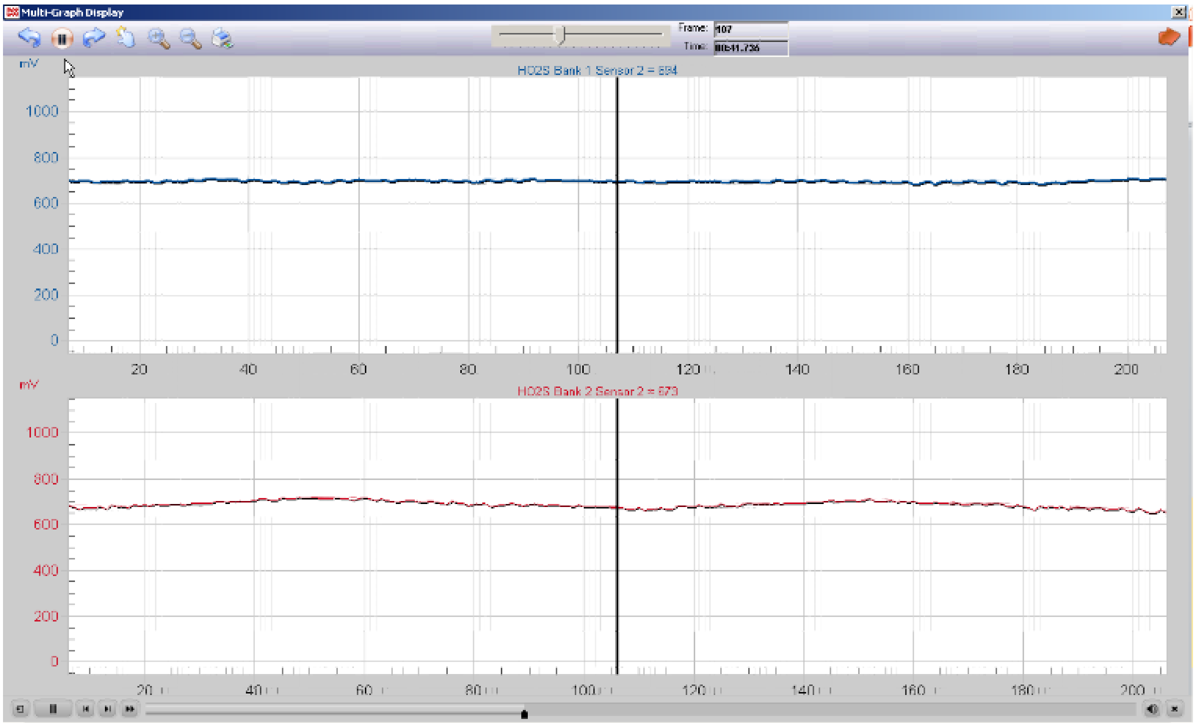


Three-way Catalytic Converter
The best air/fuel ratio for combustion and emissions control is 14.7 to 1. This air/fuel ratio is also what allows the Catalytic Converter to work efficiently. The three-way Catalytic Converter reduces exhaust gas emissions, mainly oxides of nitrogen (NOx), hydrocarbons (HC), and carbon monoxide (CO).

In the first stage of the converter, the catalyst promotes a chemical reaction which reduces the NOx, into nitrogen and oxygen. When the Catalytic Converter is working efficiently, it stores oxygen to be used for converting HC and CO emissions into water vapor and carbon dioxide.

If the catalyst is functioning correctly and the oxygen storage capacity is working, tail pipe emissions are minimal.

Post-Catalyst H02S Signals



Post-Catalyst HO2S Signal
The ECM monitors the catalytic converter efficiency using the Post-Catalyst HO2S. If the catalyst is working, there will be very little fluctuation in the oxygen levels coming out of the converter. This is evident by the Post-Catalyst HO2S signals being far less active than the signals produced by the Pre-Catalyst Oxygen Sensors.

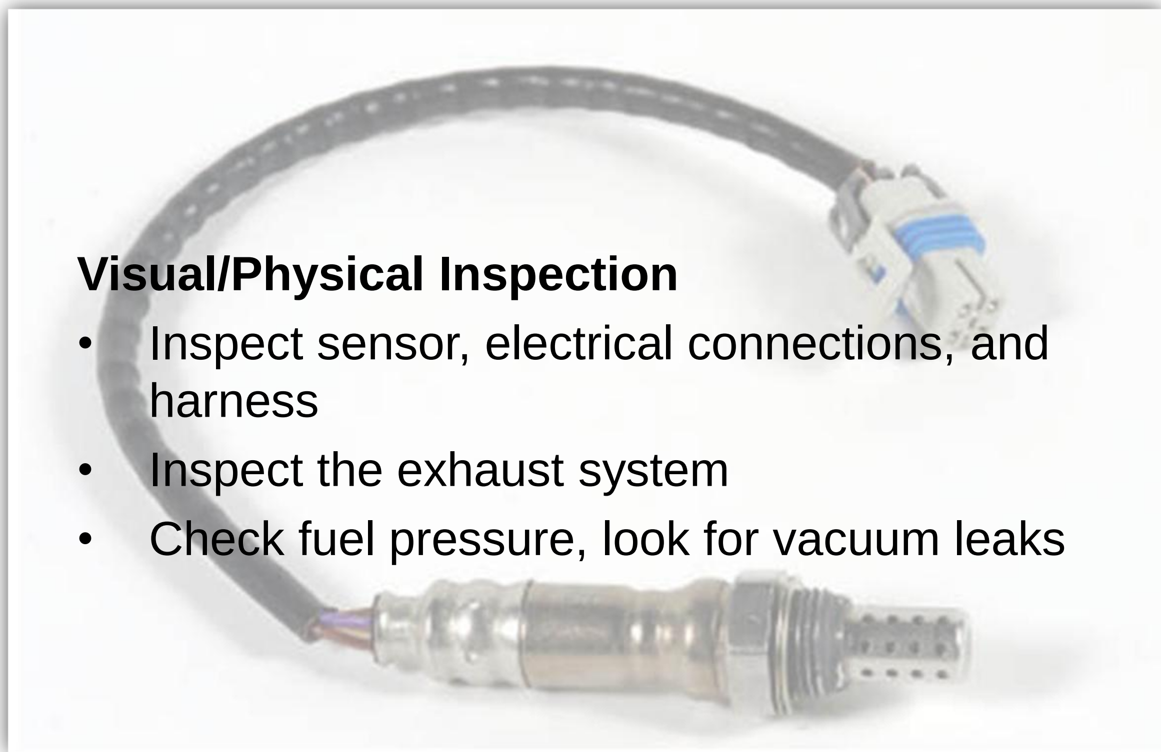
The signal shown here indicates that the catalytic converter oxygen storage capacity is at an acceptable level. When the response time of the Post-Catalyst HO2S are close to that of the Pre-Catalyst Sensor, this may indicate that the converter is not working properly and may have come apart internally.

Catalyst Efficiency

DTC	DTC Description	Type	Mil
P0133	H02S Slow Response Bank 1 Sensor 1	B	On
P0134	H02S Circuit Insufficient Activity Bank 1 Sensor 1	B	On
P0140	H02S Circuit Insufficient Activity Bank 1 Sensor 2	B	On
P0153	H02S Slow Response Bank 2 Sensor 1	B	On
P0154	H02S Circuit Insufficient Activity Bank 2 Sensor 1	B	On
P0160	H02S Circuit Insufficient Activity Bank 2 Sensor 2	B	On
P0420	Catalyst System Low Efficiency Bank 1	A	On
P0430	Catalyst System Low Efficiency Bank 2	A	On

Catalyst Efficiency
The ECM monitors the Post-Catalyst Oxygen Sensor signals and if there is an indication of low efficiency, a DTC will set. There may also be symptoms such as a rough/hard idle when cold, or rattling noise from the converter. There may be no noticeable driveability concerns and the only indication is the DTC set.

HO2S Diagnosis

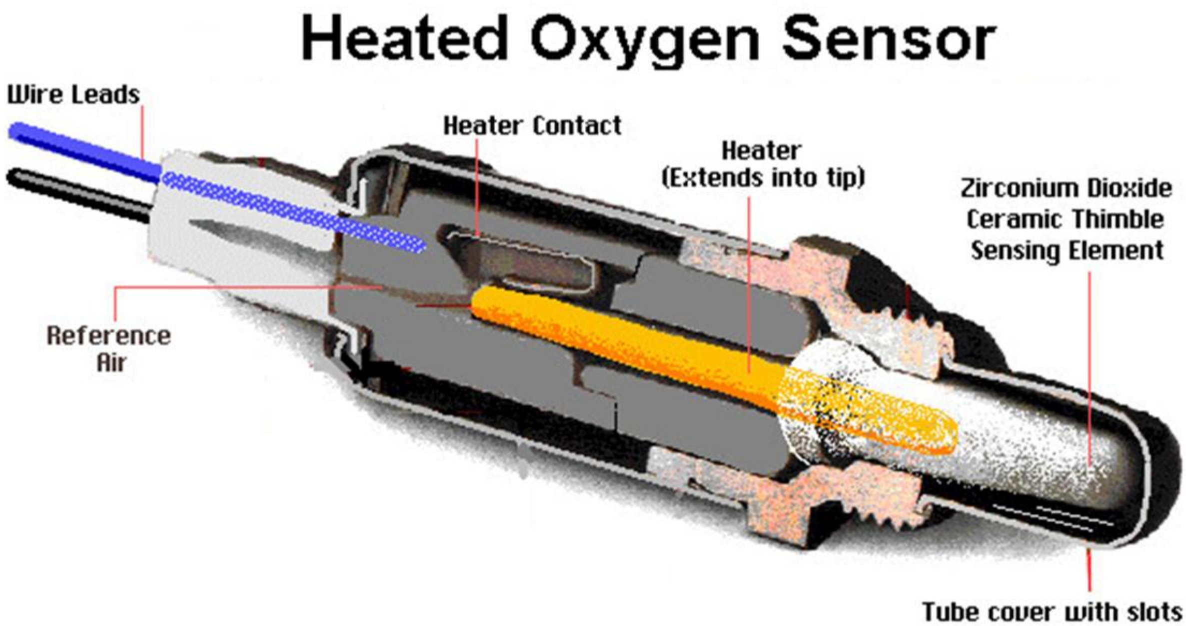


HO2S Diagnosis

If engine performance or scan tool data suggest a potential HO2S malfunction, don't forget the basics.

- Always conduct a visual inspection of the electrical connections and wiring harness. Electrical connections should be clean and tight. Be sure the wiring harness is routed away from hot exhaust pipes.
- Inspect the exhaust for leaks or holes that may affect the oxygen sensor readings. The HO2S measures oxygen, so a tightly sealed exhaust system is very important for accurate sensor readings.
- Remember that improper fuel pressure or vacuum leaks can also cause HO2S readings to be out of range.

Service tips



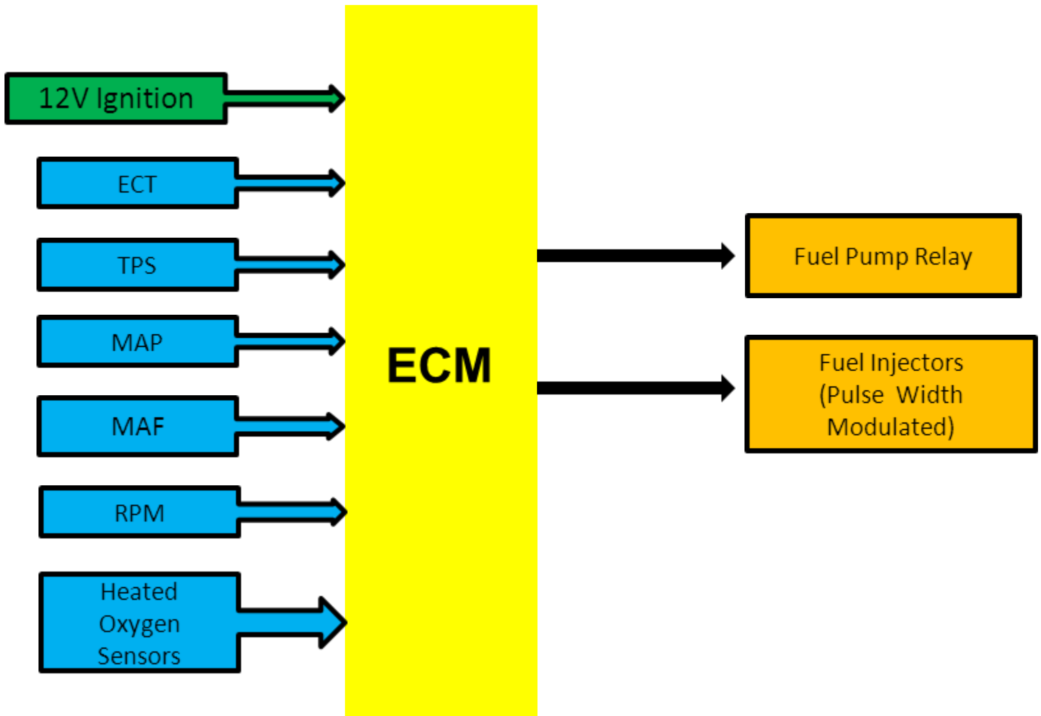
Service Tips
If the heated oxygen sensor pigtail wiring, connector, or terminals are damaged, replace the entire heated oxygen sensor assembly. Do not attempt to repair it. In order for the sensor to function properly, a clean air reference must pass through the sensor wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degrade sensor performance.

When installing an oxygen sensor, apply anti-seize to the threads only. Avoid getting the anti-seize anywhere else on the sensor, and refer to service information for proper torque.

6.0L V8 Gas Engine Driveability
Module 2, Section 4
Fuel System Diagnostics

- Closed Loop Fuel Control
- Short and Long Term Fuel Trim
- Diagnostic Tips

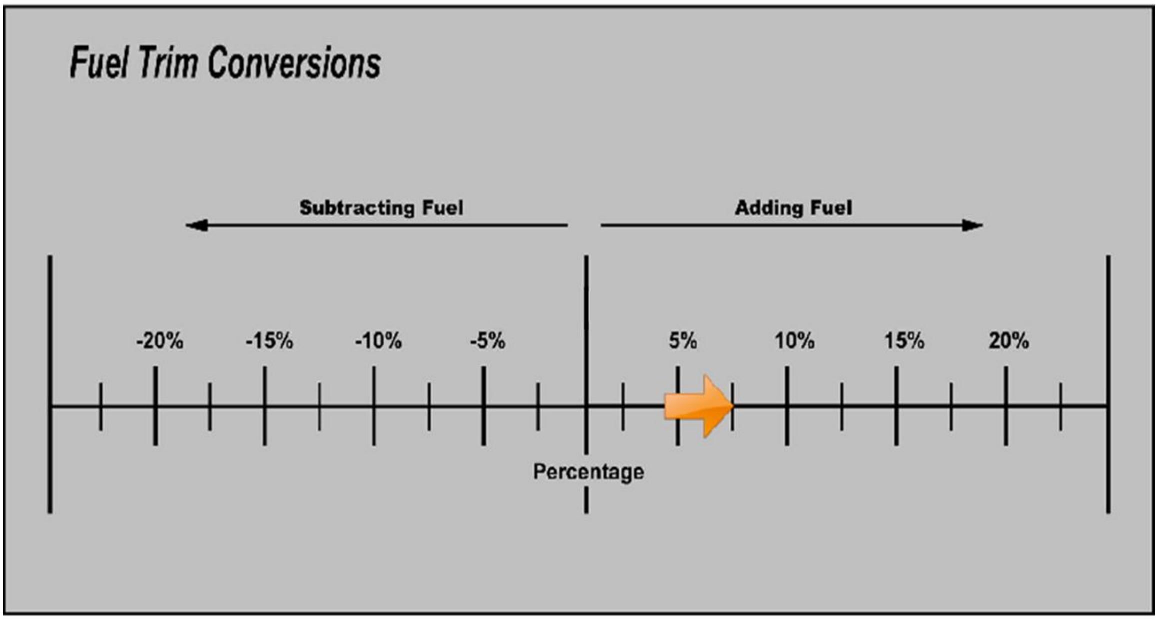
Closed Loop Mode



Closed Loop Mode
As discussed in module 1, the system enters Closed Loop Fuel Control Mode shortly after start up, once the Heated Oxygen Sensors (HO2S) are providing feedback. As long as the engine is running, the ECM manages fuel delivery based on the signals from the HO2S and many other critical inputs.

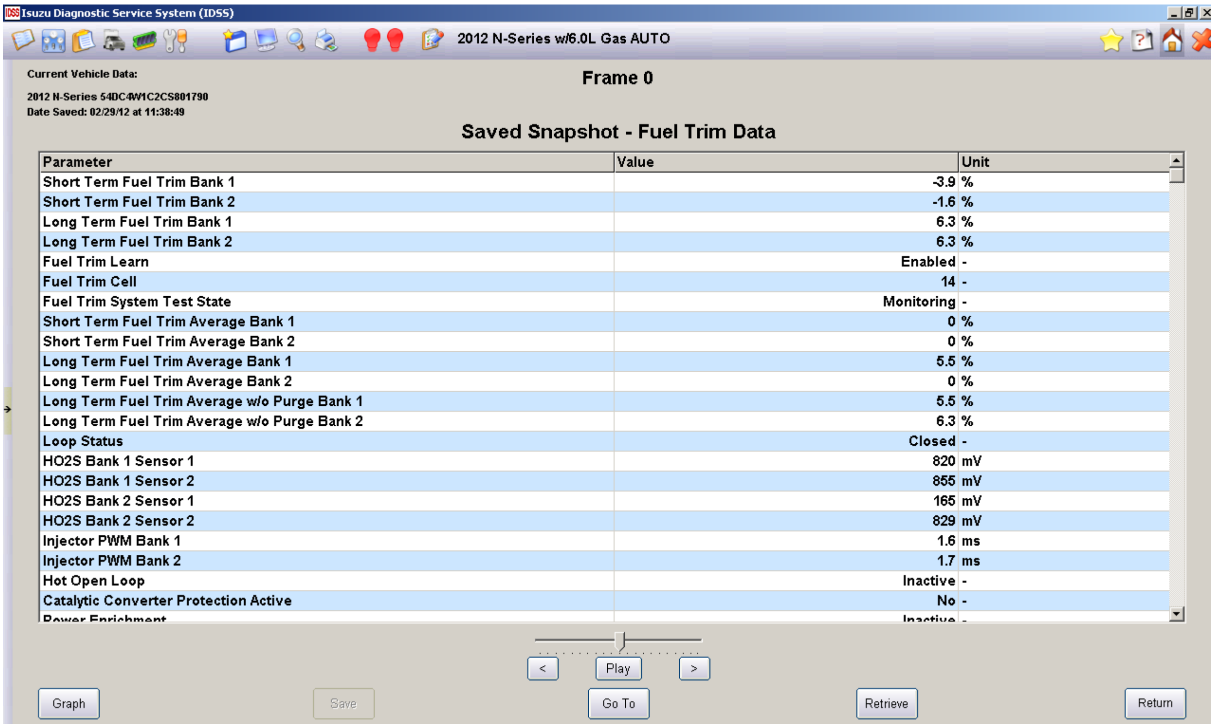
In Closed Loop, the ECM is constantly fine tuning, or correcting, the fuel delivery to maintain as close to 14.7:1 air/fuel ratio as possible. This constant correction is called Fuel Trim.

Fuel Trim Values



Fuel Trim Values
Fuel Trim is shown as a positive or negative value that represent the adding or subtracting of fuel from the engine. A Positive Fuel Trim Value indicates the ECM is adding fuel in order to compensate for a lean condition. A Negative Fuel Trim value indicates that the ECM is reducing the amount of fuel to compensate for a rich condition.

Fuel Trim



Parameter	Value	Unit
Short Term Fuel Trim Bank 1	-3.9	%
Short Term Fuel Trim Bank 2	-1.6	%
Long Term Fuel Trim Bank 1	6.3	%
Long Term Fuel Trim Bank 2	6.3	%
Fuel Trim Learn	Enabled	-
Fuel Trim Cell	14	-
Fuel Trim System Test State	Monitoring	-
Short Term Fuel Trim Average Bank 1	0	%
Short Term Fuel Trim Average Bank 2	0	%
Long Term Fuel Trim Average Bank 1	5.5	%
Long Term Fuel Trim Average Bank 2	0	%
Long Term Fuel Trim Average w/o Purge Bank 1	5.5	%
Long Term Fuel Trim Average w/o Purge Bank 2	6.3	%
Loop Status	Closed	-
HO2S Bank 1 Sensor 1	820	mV
HO2S Bank 1 Sensor 2	855	mV
HO2S Bank 2 Sensor 1	165	mV
HO2S Bank 2 Sensor 2	829	mV
Injector PWM Bank 1	1.6	ms
Injector PWM Bank 2	1.7	ms
Hot Open Loop	Inactive	-
Catalytic Converter Protection Active	No	-
Power Enrichment	Inactive	-

Short Term/Long Term Fuel Trim
Fuel Trim can be viewed using a scan tool and is useful when diagnosing driveability concerns. Short Term Fuel Trim represents the constant fine tuning of the fuel delivery system. Short Term Fuel Trim values show what the “current” fuel correction is in response to the input signal from the Pre-Catalyst Oxygen Sensors.

Long Term Fuel Trim values, on the other hand, are the fuel delivery corrections that has been “learned” over time. This is a coarser fuel correction that the ECM stores in long term memory to adjust for rich or lean conditions or to compensate for normal wear and aging.

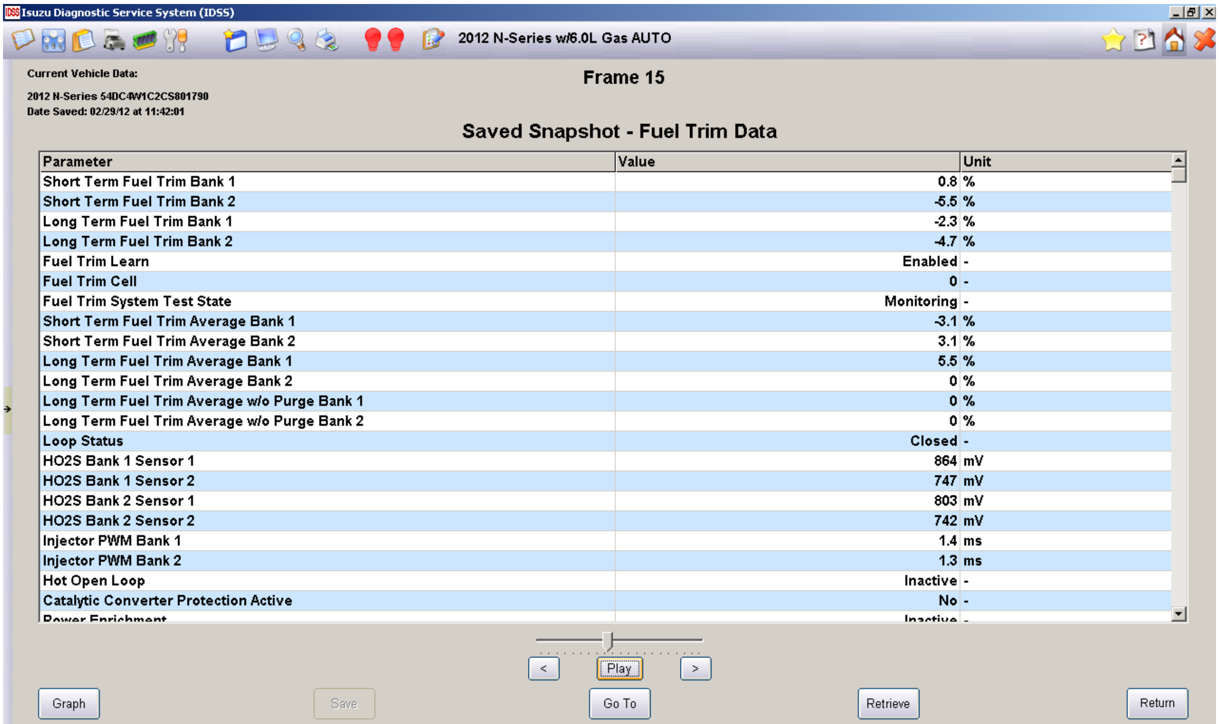
Fuel Trim Codes

DTC	Description	Type	MIL
P0171	Fuel Trim System Lean Bank 1	B	On
P0172	Fuel Trim System Rich Bank 1	B	On
P0174	Fuel Trim System Lean Bank 2	B	On
P0175	Fuel Trim system Rich Bank 2	B	On
P219A	Fuel Trim Cylinder Balance Bank 1	B	On
P219B	Fuel Trim Cylinder Balance Bank 2	B	On
P0230	Fuel Pump Control Circuit	B	On

Fuel Trim Codes
The ECM constantly monitors the Fuel Trim values. If they exceed the allowable percentage over a certain time period, a DTC will set.

Note that Fuel Trim Codes are Type B codes so it will take two consecutive ignition cycles, with all the Enabling Criteria to be met, for the MIL to come on.

Fuel Trim Cylinder Balance


Isuzu Diagnostic Service System (IDSS)

2012 N-Series w/6.0L Gas AUTO

Current Vehicle Data:

2012 N-Series 54DC4W1C2CS801790

Date Saved: 02/29/12 at 11:42:01

Frame 15

Saved Snapshot - Fuel Trim Data

Parameter	Value	Unit
Short Term Fuel Trim Bank 1	0.8	%
Short Term Fuel Trim Bank 2	-5.5	%
Long Term Fuel Trim Bank 1	-2.3	%
Long Term Fuel Trim Bank 2	-4.7	%
Fuel Trim Learn	Enabled	-
Fuel Trim Cell	0	-
Fuel Trim System Test State	Monitoring	-
Short Term Fuel Trim Average Bank 1	-3.1	%
Short Term Fuel Trim Average Bank 2	3.1	%
Long Term Fuel Trim Average Bank 1	5.5	%
Long Term Fuel Trim Average Bank 2	0	%
Long Term Fuel Trim Average w/o Purge Bank 1	0	%
Long Term Fuel Trim Average w/o Purge Bank 2	0	%
Loop Status	Closed	-
HO2S Bank 1 Sensor 1	864	mV
HO2S Bank 1 Sensor 2	747	mV
HO2S Bank 2 Sensor 1	803	mV
HO2S Bank 2 Sensor 2	742	mV
Injector PWM Bank 1	1.4	ms
Injector PWM Bank 2	1.3	ms
Hot Open Loop	Inactive	-
Catalytic Converter Protection Active	No	-
Power Enrichment	Inactive	-

Fuel Trim Cylinder Balance
On the scan tool, the Fuel Trim Average is shown as a percentage and helps identify a rich or lean condition that is occurring in one bank of the engine. For example, if only one cylinder is rich, perhaps from a leaking injector, the HO2S Sensor on that bank may not be completely out of range, but the ECM will consistently see signals that are above the desired value.

The number shown as the Fuel Trim Average is one way to narrow down which bank has a cylinder that is richer than the others. A positive number indicates there is a lean condition and a negative number indicates a rich condition.

Diagnostic Tips

Beware of non-OE Parts such as:

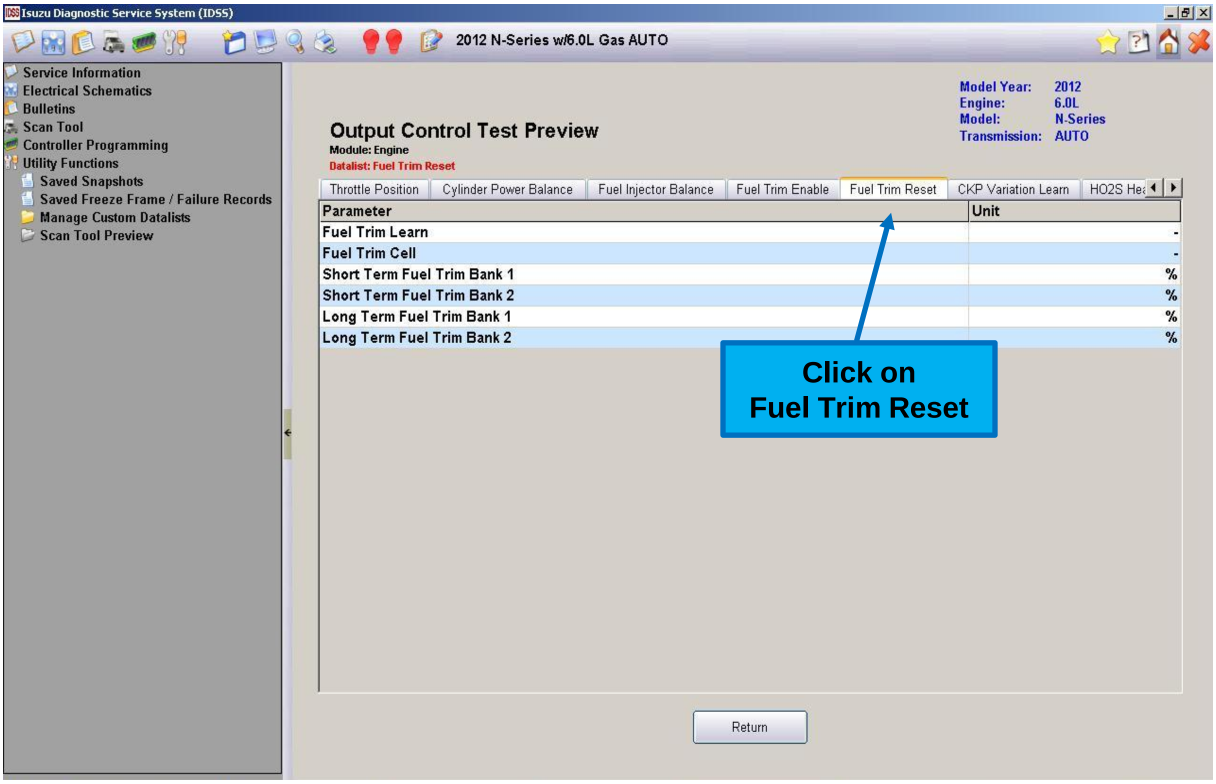
- Oxygen Sensor
- Air Filters
- Exhaust components

All can cause DTCs

Diagnostic Tips
Non-OE sensors, an incorrect part number, or certain aftermarket parts, such as oxygen sensors and air filters, can cause DTCs to set.

Induction system modifications, or non-OE exhaust system components can affect the HO2S signals and fuel delivery. Be sure to look for these conditions when doing the preliminary visual inspection.

Fuel Trim Reset



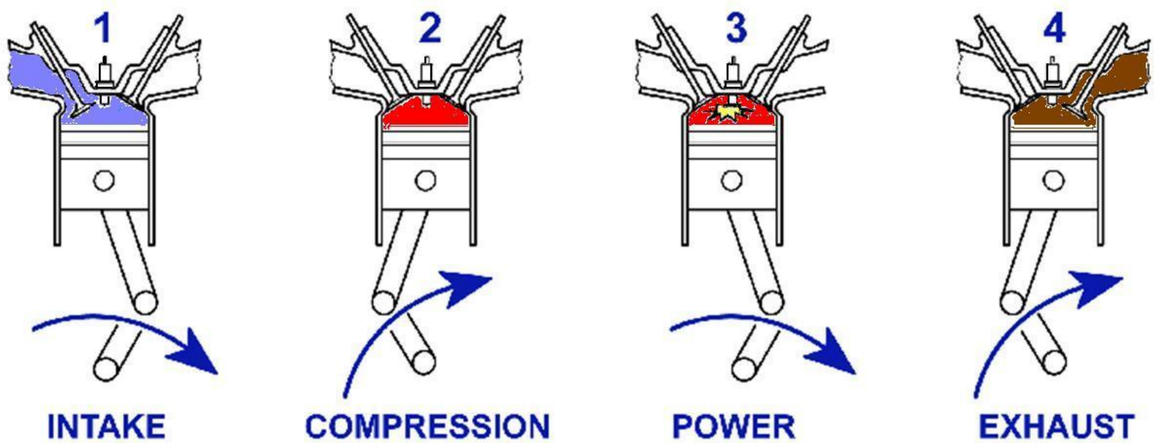
Fuel Trim Reset
After doing any type of performance repair, it is a good idea to reset Fuel Trim. This will reset the Long Term Fuel Trim values back to zero percent and the fuel delivery back to factory preset values. Skipping this step could cause poor performance until the ECM has had time to relearn Fuel Trim on it's own.

To do this, go to the Scan Tool menu in IDSS and click on Output Control Tests.
1) Then click on Engine.
2) Advance the arrow on the right to get to Fuel Trim Reset and click on it.
3) Click the Reset box.
4) Then Stop Test.
Return to Data Display and click on Fuel Trim Data to view changes.

6.0L V8 Gas Engine Driveability
Module 2, Section 5
Misfire Diagnostics

- Causes of Engine Misfire
- Misfire Monitoring
- Misfire Counters
- Diagnostic Tips

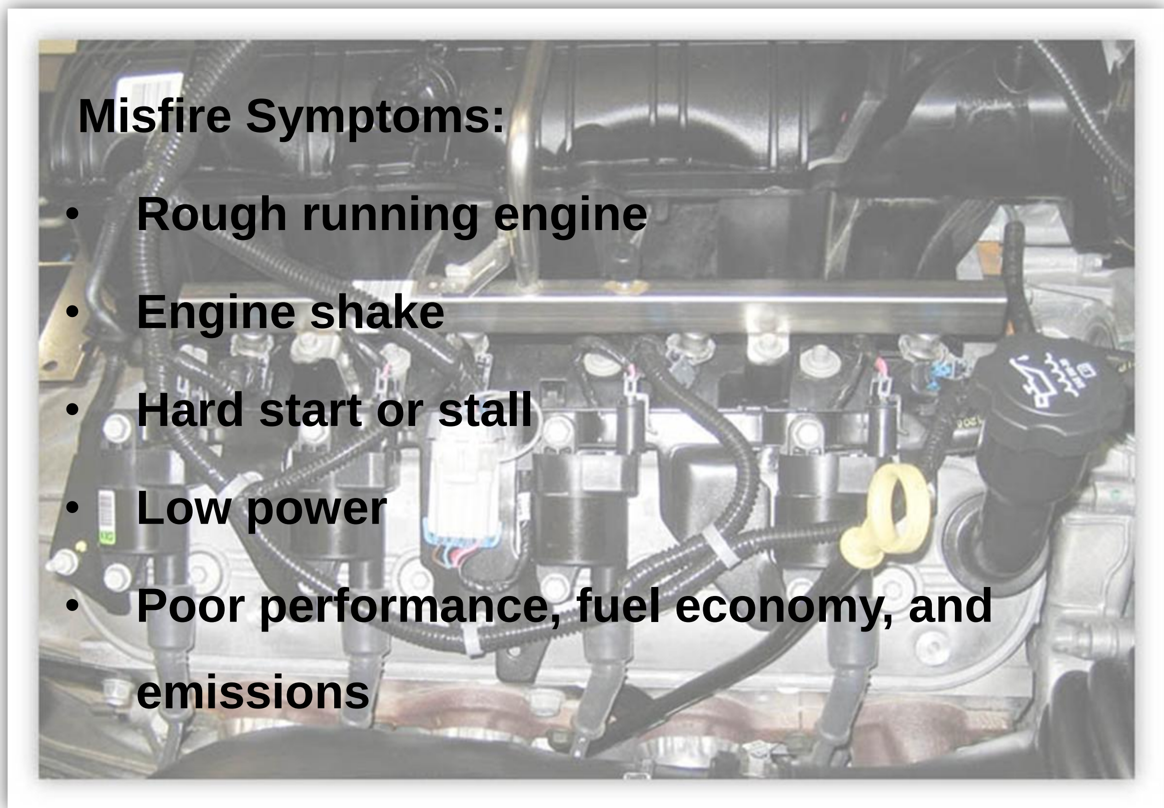
Engine Cycles



Four Stroke Engine Cycles
During normal combustion of a four stroke gasoline engine, ignition is a precisely timed occurrence during the compression cycle. When the air/fuel mixture in the cylinder does not ignite properly, it is called Misfire.

The cause of misfire can be mechanical, electrical, or related to the fuel system. It can also be a combination of these.

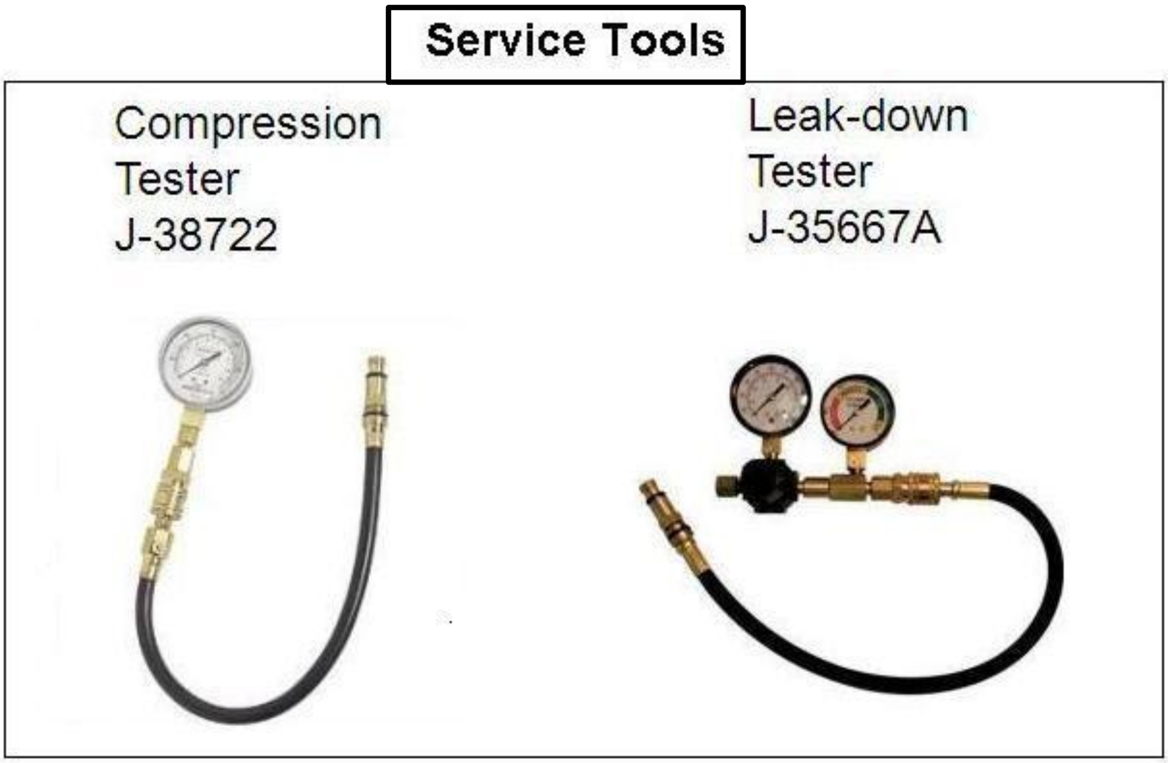
Engine Misfire



Engine Misfire
Although misfire is a common driveability complaint, it is not easily diagnosed. Symptoms of misfire vary. It may cause a rough running engine or the engine may shake so badly that it causes vibrations throughout the vehicle. The engine can be hard to start, or stall at idle, depending on the load. Or, it may simply cause the engine to feel sluggish or low on power.

Whatever the symptoms, when misfire occurs, performance suffers along with fuel economy and emissions.

Causes of Misfire



Causes of Misfire
When the compression in a cylinder is too low, the air/fuel mixture will not burn properly and can result in misfire. Worn components such as:

- Piston rings
- Cylinder walls
- Valves or springs
- Cam to roller lifter contact, and
- Leaking head gaskets can all cause low cylinder compression

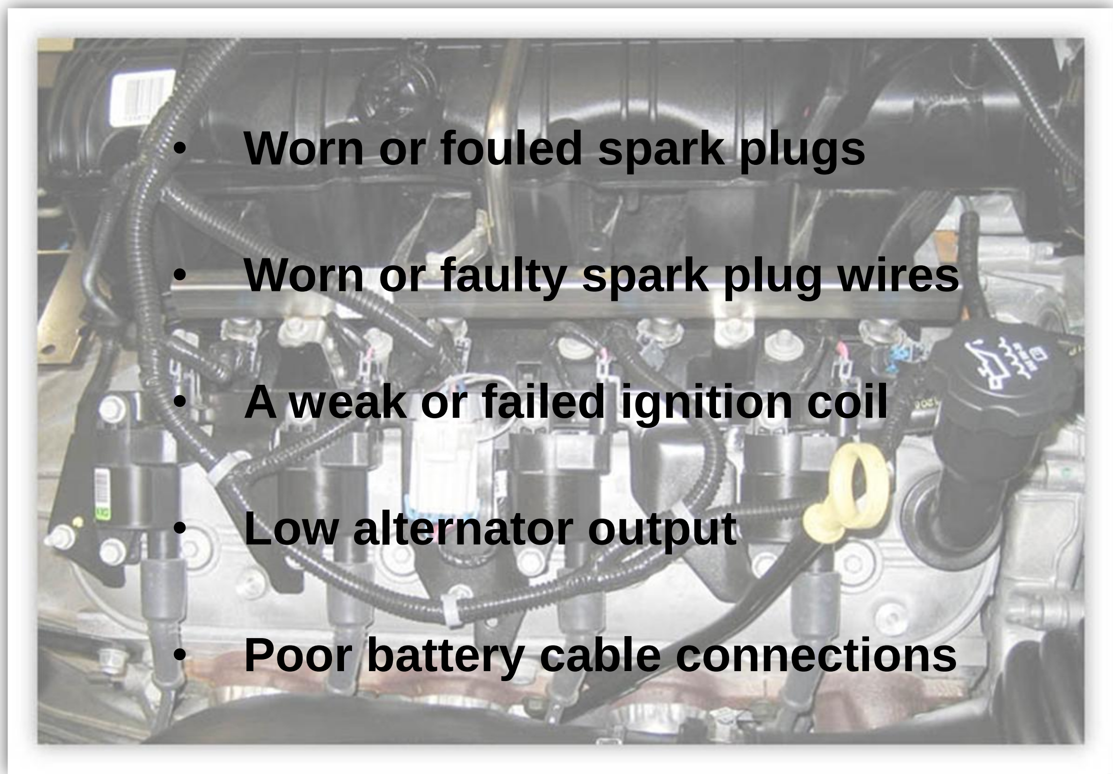
Procedures that can help diagnose this condition include, Cranking Compression Test, Cylinder Leak Down Testing, and a Running Compression Test. Refer to the service information in the engine mechanical section for information on how to perform these procedures or contact Isuzu Technical Assistance for help.

Causes of Misfire

Causes of Misfire (continued)
Here are some other conditions to look for:

- When performing a visual inspection, check vacuum hoses, intake gaskets, the PCV system, and valve cover seals for vacuum leaks.
- Check for a restricted air cleaner. This can limit the amount of intake air, causing the air fuel mixture to be too rich.
- Inspect for damaged or restricted exhaust, which can cause higher than normal backpressure. This can cause misfire in all cylinders on one bank of the engine. If this is the case, you may need to use a back pressure gauge like the one shown above. Refer to the service information for exhaust system diagnosis.

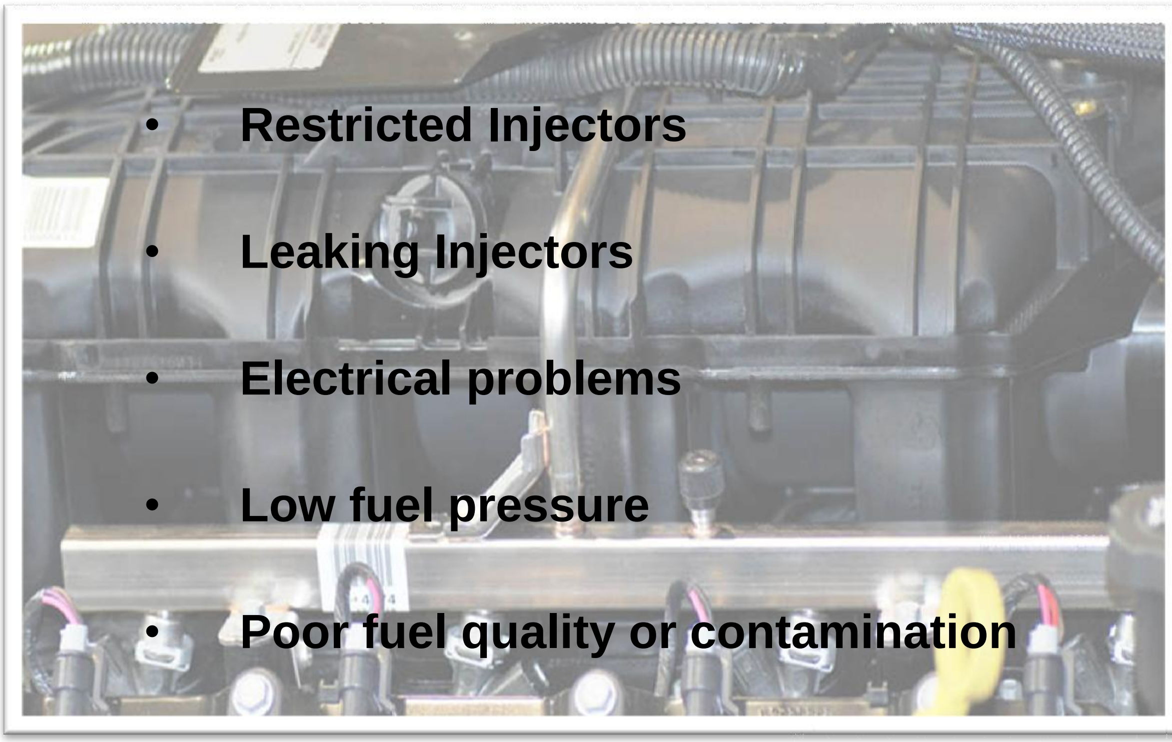
Ignition Misfire



Ignition Misfire
A no-spark condition is a common cause of misfire. This can be due to:
- worn or fouled spark plugs
- worn or faulty spark plug wires
- weak or failed ignition coil or wire harness connections

For the ignition system to function, it must have adequate voltage. If the alternator output is low, it can cause a no-spark condition. The same is true if there is a poor battery cable connection or if engine grounds are loose or corroded. These conditions also affect the available voltage for the ignition system to function properly.

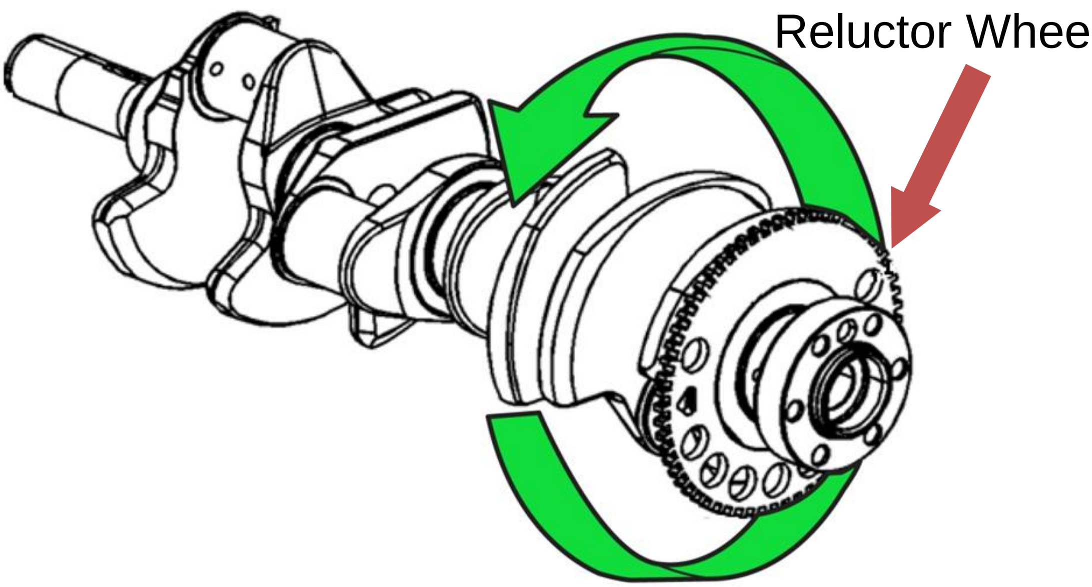
Misfire Caused by Fuel Delivery



Misfire Caused by Fuel Delivery
For normal combustion to take place, there must be the right amount of fuel and air in the cylinder. If the mixture is too lean, or too rich, it may not ignite and burn, even if there is a spark. One way to check if a misfire condition is because of a rich or lean condition is to check the HO2S data. The Long Term Fuel Trim can be very helpful for this.

Some fuel system conditions that may cause misfire include:
- Restricted Injectors causing a lean condition
- Leaking Injectors causing a rich condition
- Electrical conditions causing an Injector not to fire properly
- Low fuel pressure due to pinched fuel lines, restrictions, or low Fuel Pump output
- Misfire can also be caused by poor fuel quality or contamination

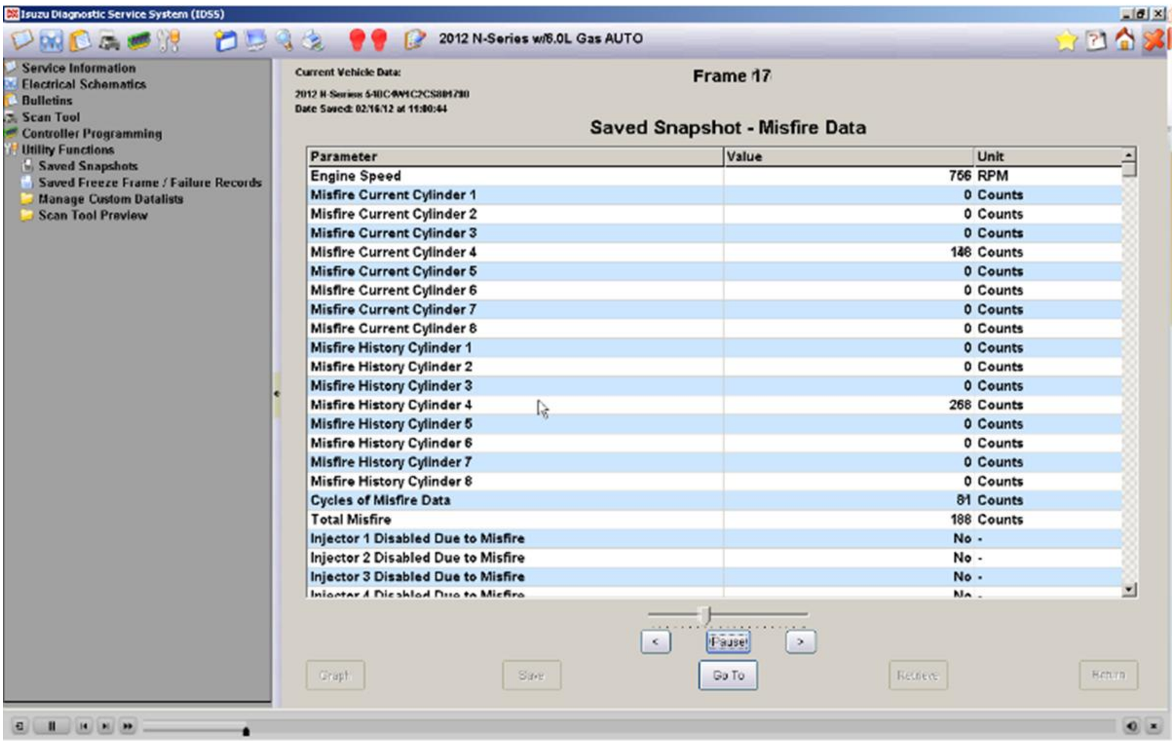
Misfire Monitoring



Misfire Monitoring
As stated earlier, misfire results in poor fuel economy and excessive tailpipe emissions. For this reason, the OBD II system has continuous misfire monitoring.

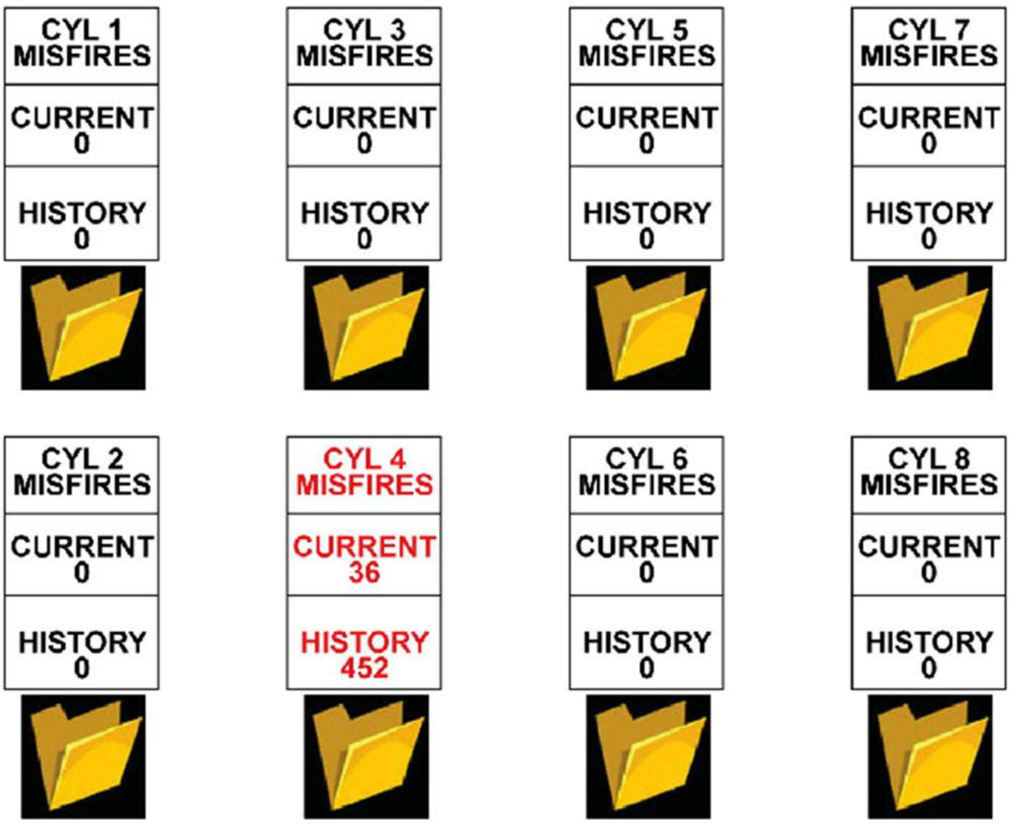
The ECM can detect a misfire by watching certain inputs, mainly the Crankshaft and Camshaft Position Sensors. When a misfire occurs, that cylinder does not produce the same amount of power as one with normal combustion. As a result, the crankshaft slows down each time a cylinder misfires. The Crankshaft Position Sensor can sense these engine speed fluctuations by the changes in the reluctor wheel speed.

Misfire Monitoring



Misfire Monitoring on IDSS
The ECM uses the Camshaft Position Sensor to determine exactly which cylinder, or cylinders, the misfire is coming from. Here, the IDSS screen shows cylinder #4 with a misfire. This shows both current and history data, which can be helpful to determine how long the condition has been present.

Misfire Counts



Misfire Counters

Current and History misfire counts are stored in ECM memory. The Misfire Current Counts display real time data. Every 200 cylinder firing events, the misfire counts are saved in the Misfire History Counts file. The History Counts accumulate over time and can be an important diagnostic tool. For instance, an intermittent misfire may be enough to cause a performance concern, but not set a DTC.

Be aware that Misfire History Counts will reset to zero when you clear codes. Be sure to check misfire data “before” clearing codes to avoid loosing this important diagnostic information.

Misfire Events Recorded

Types of Catalyst Events:
- Non-Catalyst Damaging
- Catalyst Damaging

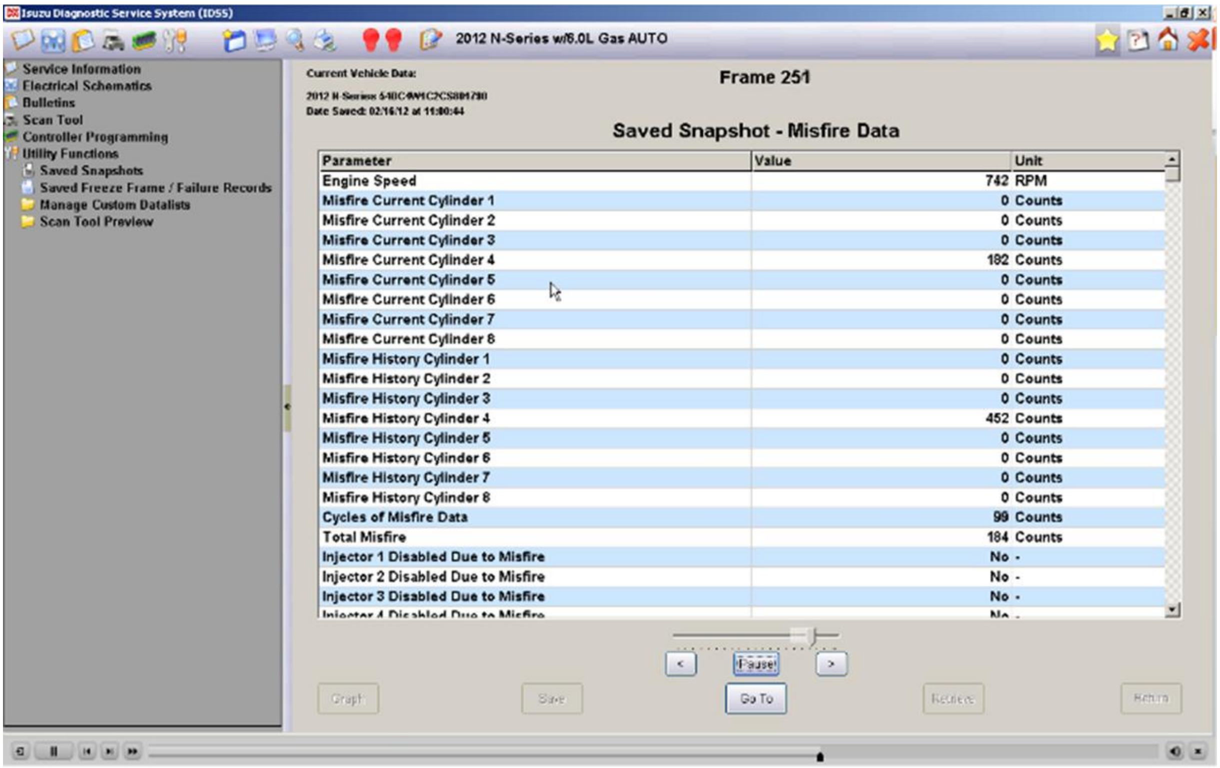
DTC P0300				
Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check – Vehicle?	—	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	1. Start the engine. 2. Allow the engine to idle or operate within the conditions listed in the Freeze Frame/Failure Records. 3. Monitor all of the Misfire counters with the scan tool. Are any of the Misfire current counters incrementing?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any DTCs other than P0300 set?	—	Go to Diagnostic Trouble Code (DTC)	Go to Step 4
4	Can any abnormal engine noise be heard?	—	Go to Symptoms - Engine Mechanical	Go to Step 5

Recorded Misfire Events
When misfire is detected, a DTC P0300 will set. The ECM will respond differently, depending on how severe the misfire is.

When a Non-Catalyst Damaging Misfire occurs and a DTC sets, the MIL lamp comes on solid and stays on. This is a misfire that happened only a few times within 1,000 to 3,200 engine revolutions. An example of this would be a misfire caused by a partially restricted injector.

When a Catalyst Damaging Misfire occurs, the MIL lamp will flash on and off as long as the condition persists. This misfire is happening more frequently, within 200 engine revolutions, and is considered severe. An example of this would be the misfire created by a failed spark plug wire. The Catalytic Converter can be damaged from all the unburned fuel in the exhaust and the flashing MIL lamp is a warning to the driver.

Misfire Diagnostic Tips



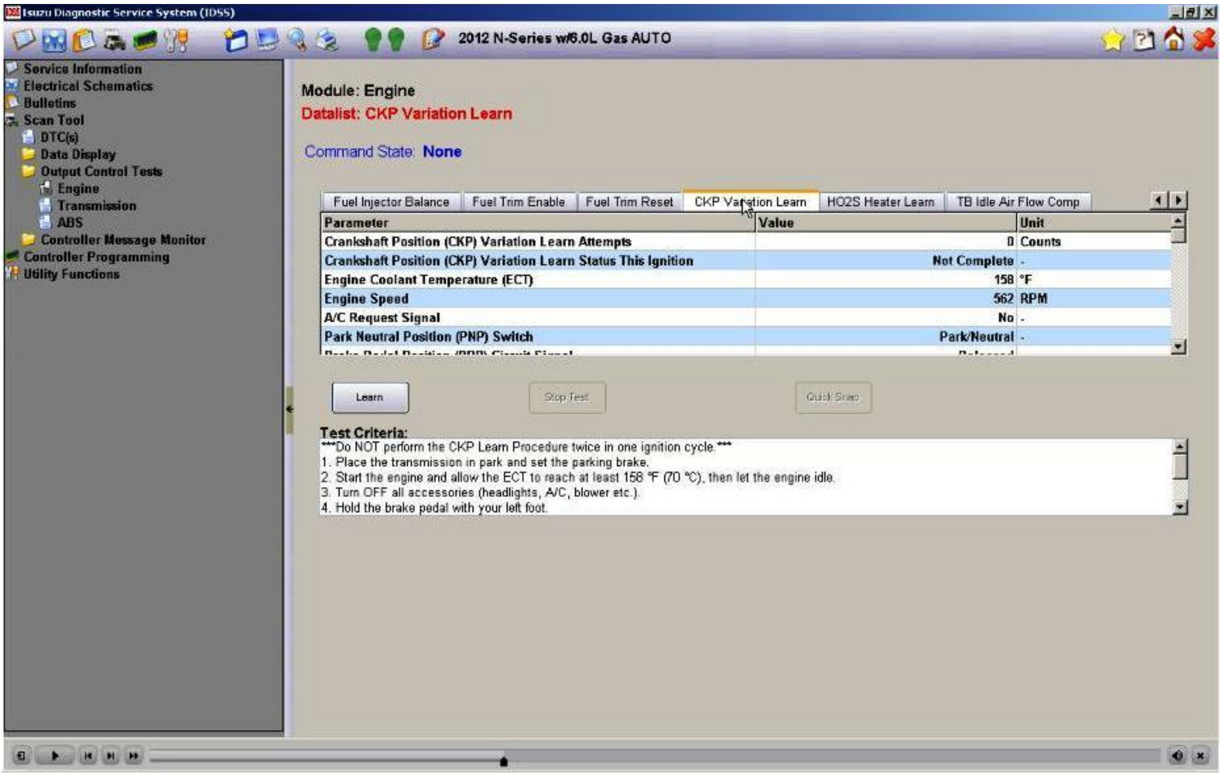
Diagnostic Tips
Because DTCs can be set by mechanical, as well as electrical or OBD II systems concerns, always follow the recommended Diagnostic Strategy and begin with the Diagnostic Starting Point.

If the MIL lamp is on and there are multiple codes set along with a DTC P0300, it is recommended that you diagnose all other DTC’s first, before diagnosing the misfire DTC. This is because the other codes could be indicating a fault that is causing the misfire.

One way to pin point a component suspected of causing misfire is to swap parts, such as ignition coils, plug wires, and injectors, between cylinders, one at a time. If the part is at fault, the misfire counts will follow the failed part.

Important: Perform a Crankshaft Variation Learn procedure after repairs. This should be done only if no other codes are set.

CKP System Variation Learn

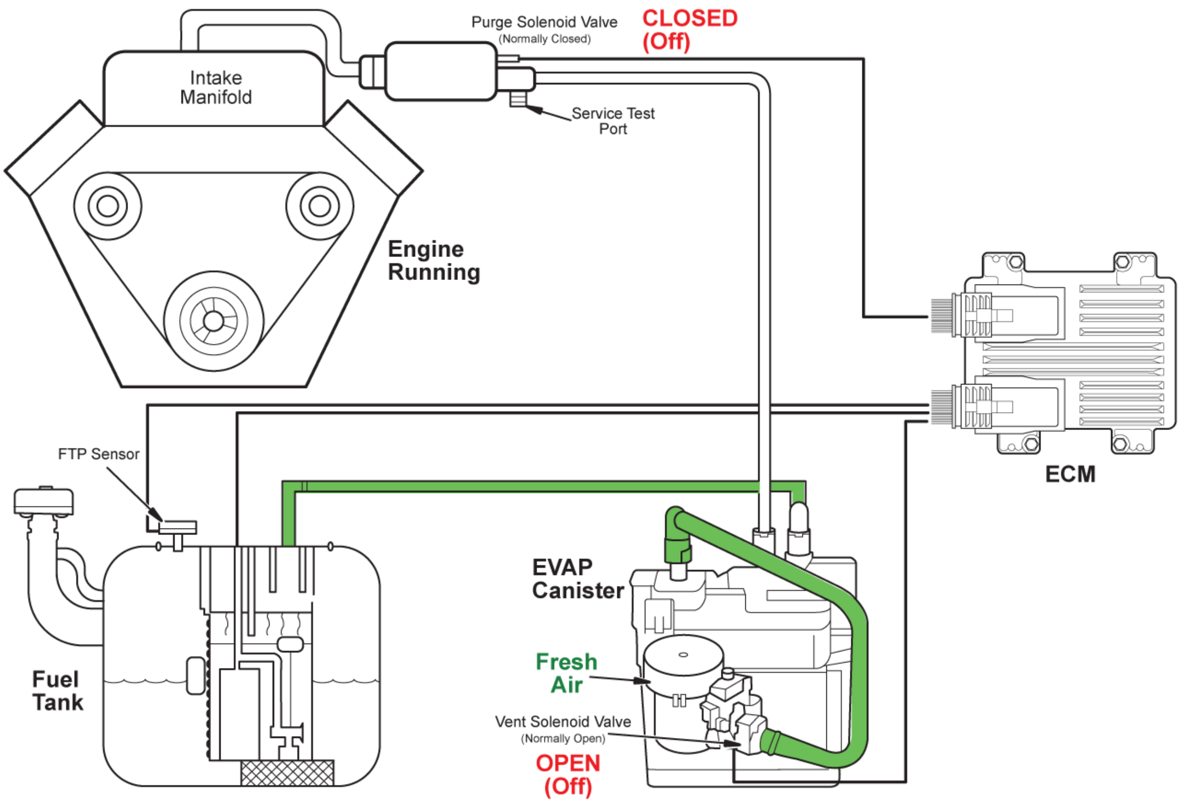


As mentioned in Module 1, it is a good idea to perform a Crankshaft Variation Learn Procedure after certain repairs. This is done by selecting ECM Output Control Test, CKP Variation Learn tab in IDSS. This resets and calibrates the Crankshaft Position Sensor (CKP) to reluctor wheel relationship. Follow the Test Criteria provided in the box on the screen.

6.0L V8 Gas Engine Driveability Module 2, Section 6 Enhanced EVAP System

- System operation
- Diagnostic Trouble Codes
- System Monitoring and Diagnostic Tests
- Diagnostic Service Tips

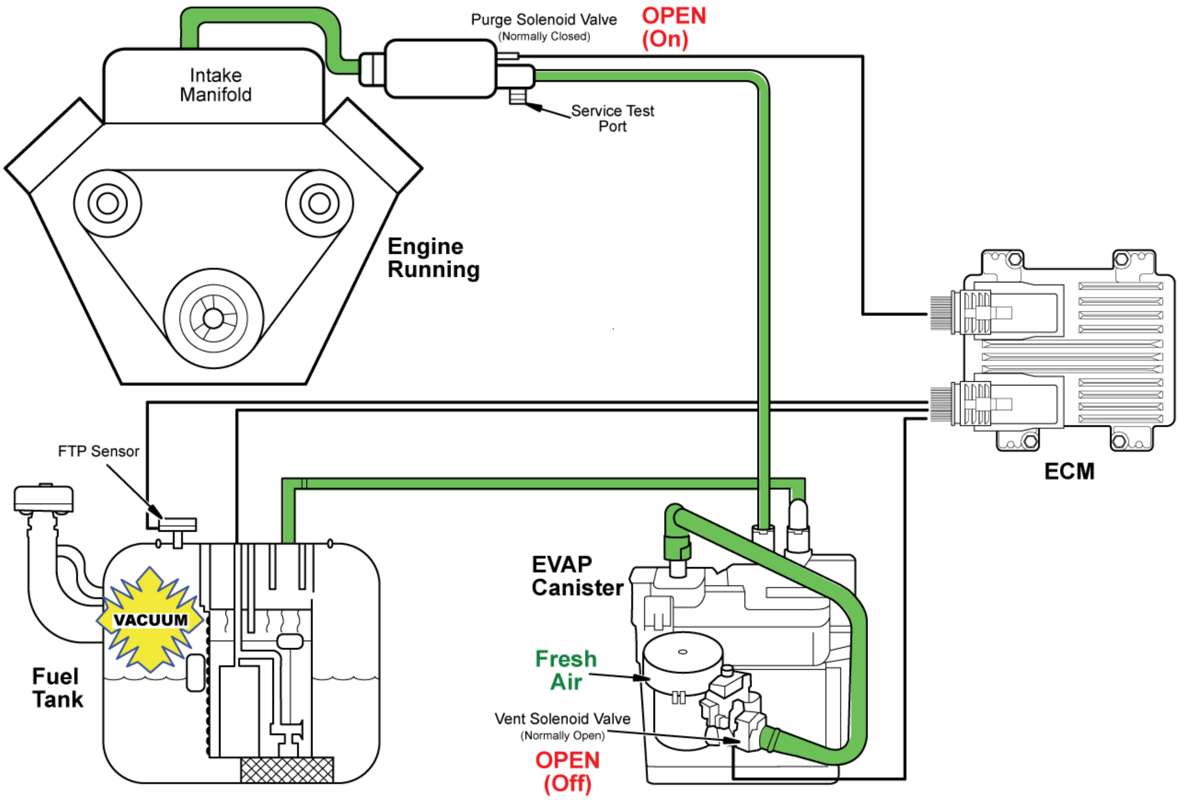
Enhanced EVAP Operation



Enhanced EVAP System Operation
The purpose of the Enhanced Evaporative Emissions, or EVAP, System is to prevent fuel vapor from escaping into the atmosphere. Fuel vapors from the tank are stored in a Charcoal Canister, until they can be routed through the Vapor Lines to the intake manifold and burned during normal combustion.

The Vent Solenoid is located on the EVAP Canister and is normally open to allow fresh air into the canister. The Purge Solenoid, located in the vapor line between the canister and the engine, is normally closed so vapors cannot be drawn into the engine until the right running conditions are met.

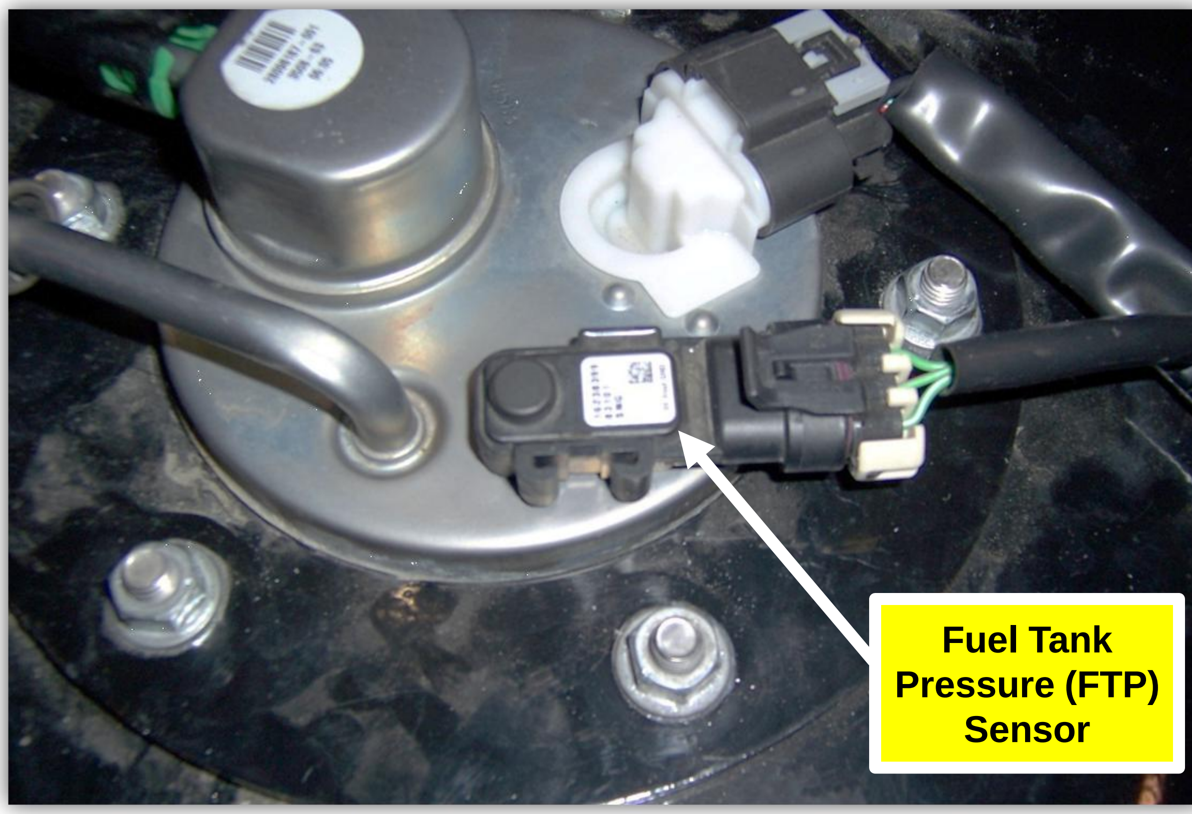
Enhanced EVAP Operation



Enhanced EVAP System Operation

Under certain running conditions the ECM will purge the fuel vapors from the canister by commanding the Purge Solenoid to turn ON. This opens the valve and allows engine vacuum to draw on the EVAP Canister. The EVAP Vent solenoid remains OFF and in the open position, allowing fresh air to be drawn through the canister. The air mixes with the stored fuel vapors and is pulled into the intake manifold to be burned during normal combustion.

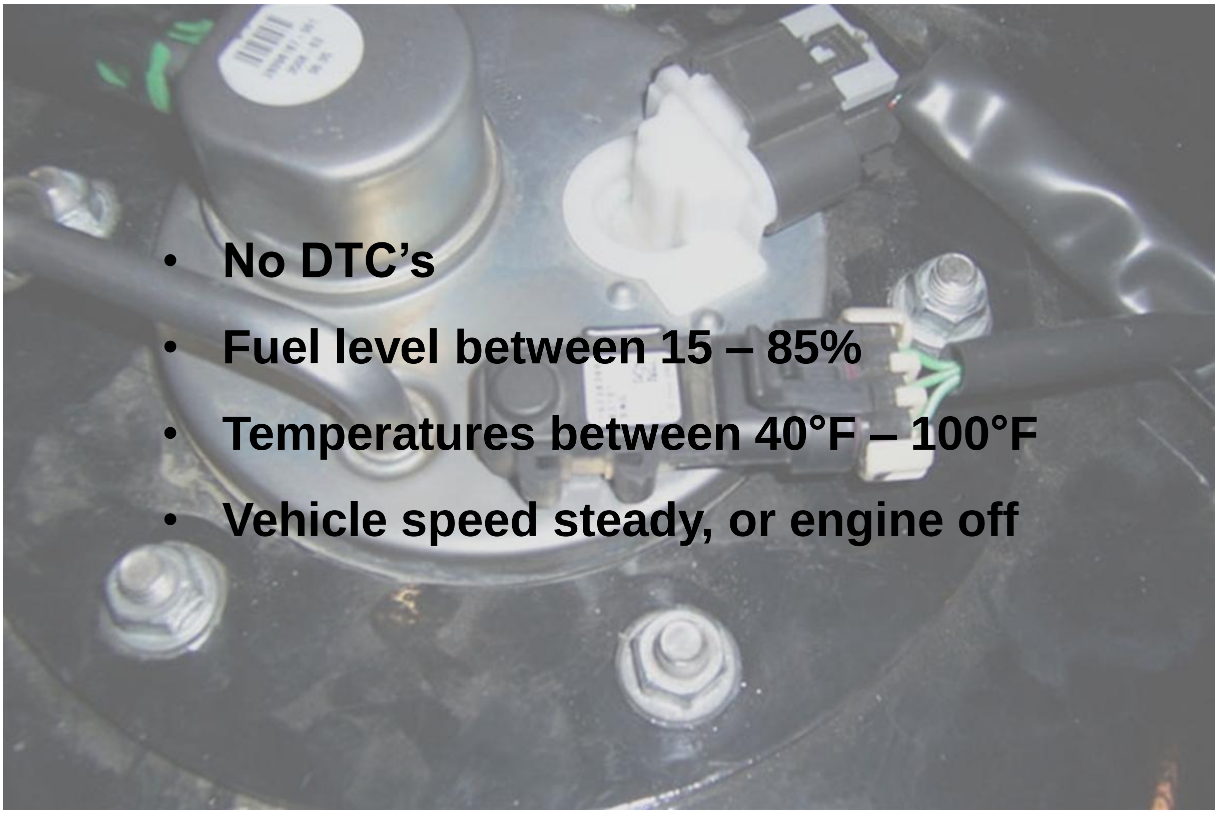
FTP Sensor



Fuel Tank Pressure (FTP) Sensor
The reason this is called an “Enhanced” EVAP system is because of the on-board diagnostic capabilities. The ECM can perform functional tests to monitor the purge system to detect system leaks.

It is the Fuel Tank Pressure (FTP) Sensor, located on the top of the fuel tank sending unit, which gives the ECM the necessary feedback to determine if the system is working properly.

EVAP Test Criteria



EVAP Test Criteria
For the ECM to perform these EVAP tests, certain Enabling Criteria must be met. For example:

- No current DTC's can be present and the malfunction indicator lamp must be off
- Fuel level must be stable and between 15 and 85 percent
- Ambient temperature needs to be between 40°F and 100°F
- Vehicle speed and load conditions steady, or engine shut off

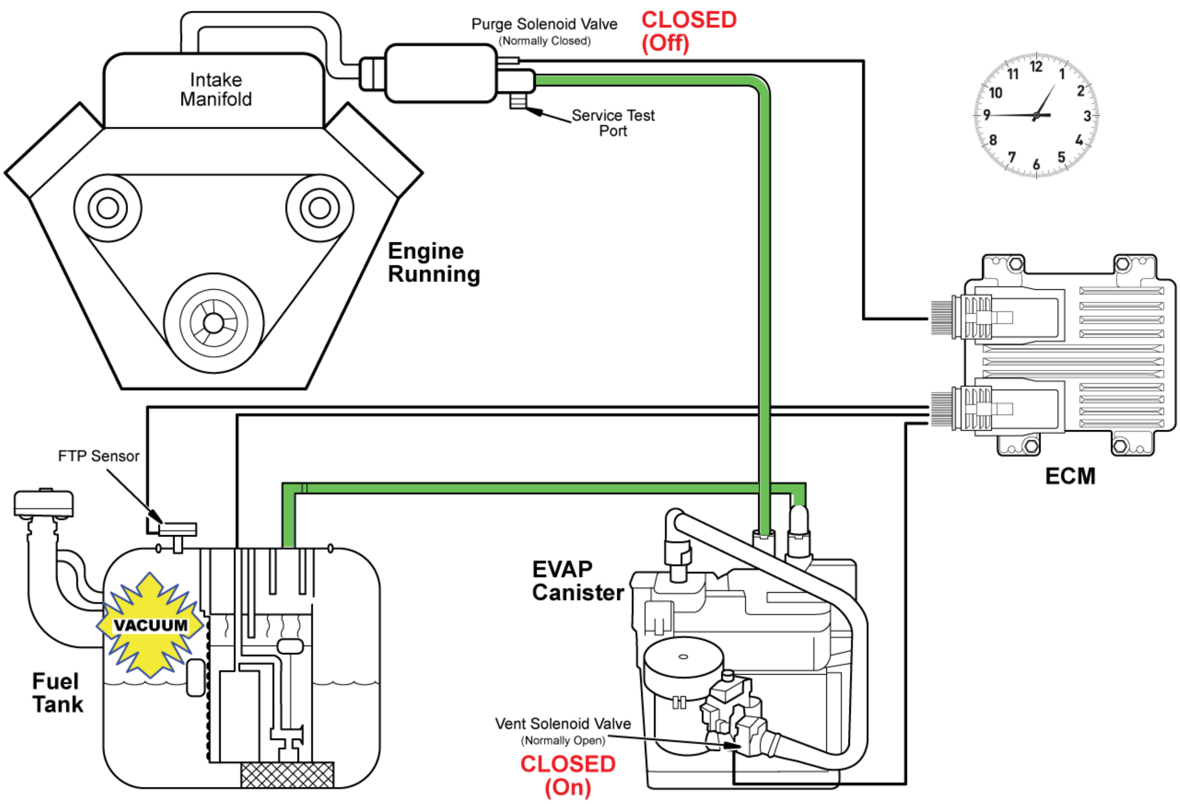
Because these Enabling Criteria are very specific, it is possible that the ECM will not run these tests every time the vehicle is driven.

EVAP Codes

DTC	DTC Description	Type	MIL
P0442	Evaporative Emission (EVAP) System Small Leak Detected	A	On
P0443	Evaporative Emission (EVAP) Purge Solenoid Control Circuit	B	On
P0446	Evaporative Emission (EVAP) Vent System Performance	B	On
P0449	Evaporative Emission (EVAP) Vent Solenoid Control Circuit	B	On
P0451	Fuel Tank Pressure (FTP) Sensor Circuit Performance	A	On
P0454	Fuel Tank Pressure (FTP) Sensor Circuit Intermittent	A	On
P0455	Evaporative Emission (EVAP) System Large Leak Detected	B	On
P0496	Evaporative Emission (EVAP) System Flow During Non-Purge	B	On

EVAP Codes
This is a list of some of the Diagnostic Trouble Codes specific to the EVAP System. Refer to the service information for more on these DTC's and additional Enhanced EVAP System diagnostics.

EVAP System Large Leak Test



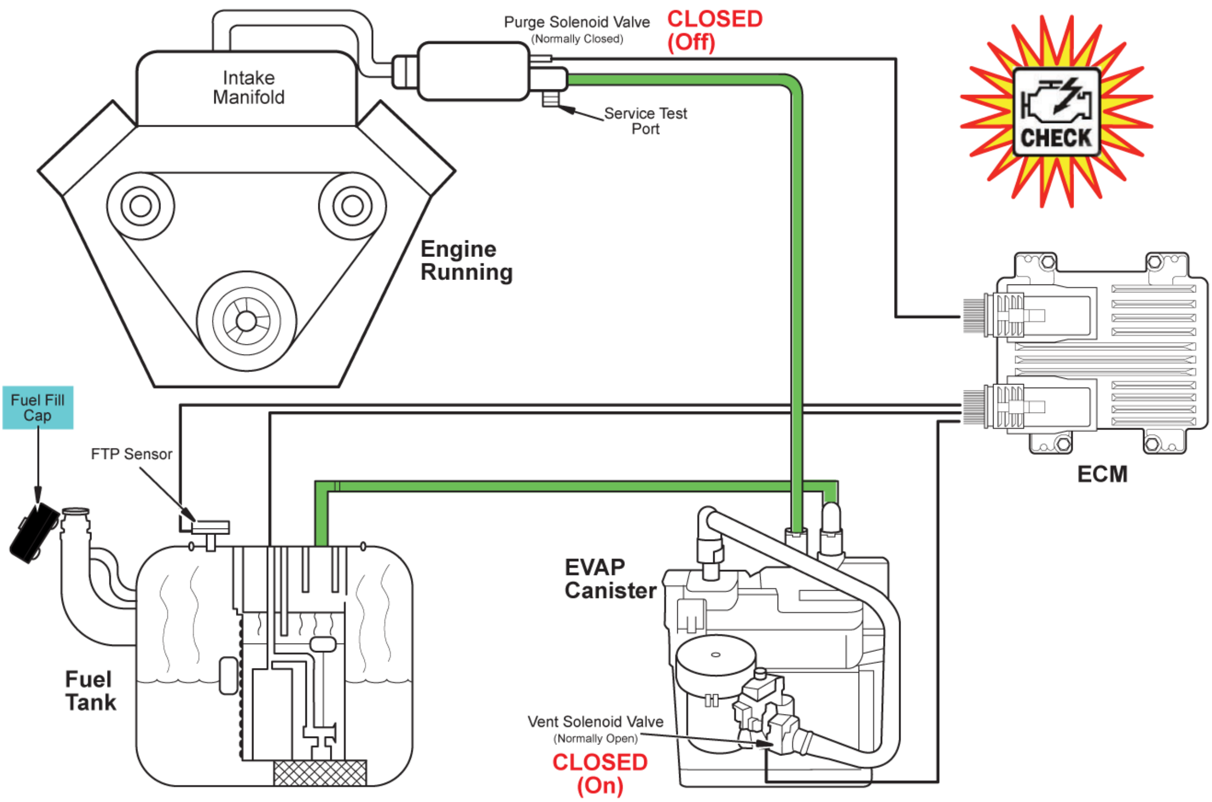
EVAP System Large Leak Test

One of the functional tests that the ECM performs is the Large Leak Test. While the engine is running, the ECM turns “ON” both the Vent and the Purge Solenoid Valves. This will close the Vent Valve and open the Purge Valve, allowing engine vacuum to draw on the fuel tank. The ECM then monitors the FTP Sensor to see if the system is able to reach a specific level of vacuum within a set amount of time.

Next, the ECM commands the EVAP Purge Solenoid Valve “OFF”. This seals the system, and the ECM monitors the FTP Sensor to see if the vacuum holds.

If the specific vacuum level is not reached, or the vacuum does not hold once the system is sealed, the system fails the Large Leak Test. Since this is a Type B failure code, the system must fail this test on two consecutive trips before a DTC will set.

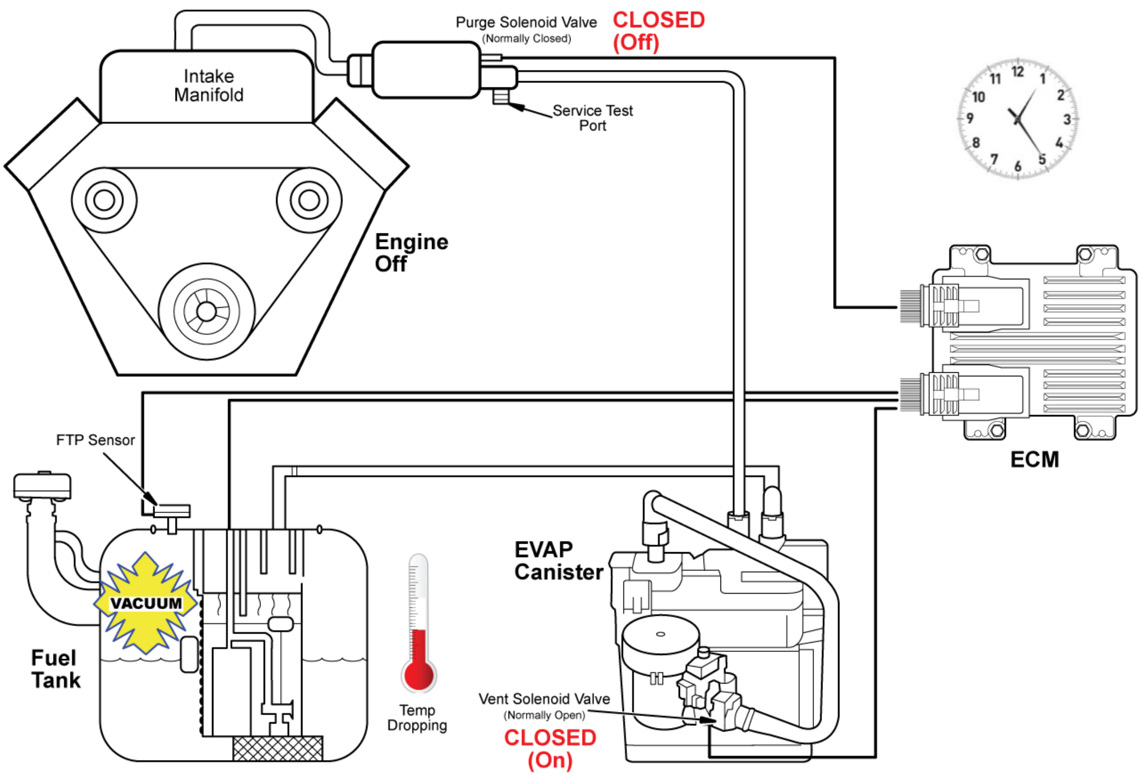
Large Leak (Fuel Cap Off)



Large Leak Test- Fuel Cap Off
The most common condition for the Large Leak Test to fail is when the fuel fill cap is not tightened properly after a refueling.

The ECM can detect when the vehicle has been refueled based on information from the Fuel Sender unit and may run a Large Leak Test right away. This is a Type B code so it may take several trips for the MIL lamp to come on.

EVAP System Small Leak Test

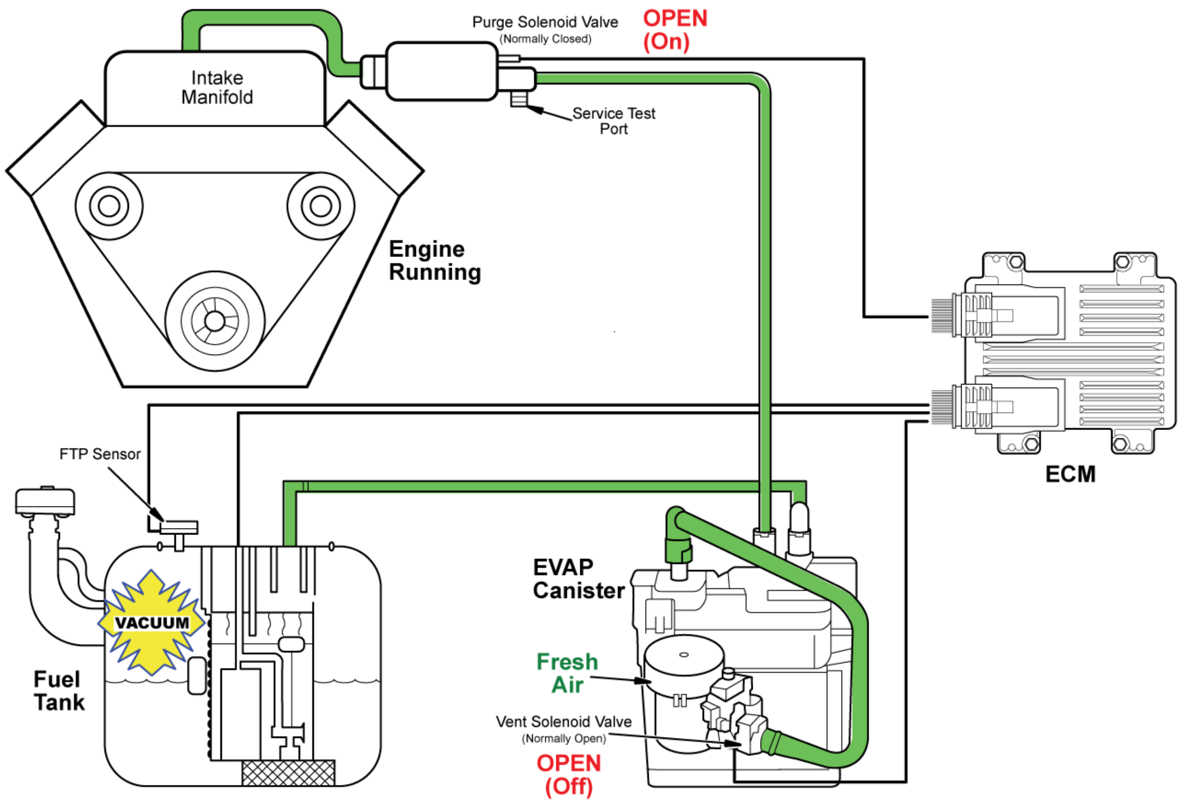


EVAP System Small Leak Test
The ECM is also able to detect a very small leak in the EVAP System; as small as .020 of an inch, or .51 mm. It's typical for temperature, and pressure, to increase in the fuel tank immediately following a drive cycle and the engine is shut off. After some time, the temperature begins to drop and so does the pressure. This can eventually become a vacuum condition if the system is closed tight.

To make sure there are no small leaks, the ECM performs the Small Leak Test. After the ignition is turned off and certain Enabling Criteria are met, the ECM commands the EVAP Vent Solenoid "ON". This will completely seal the system and the tank should hold vacuum for a specified time. The ECM monitors the FTP Sensor and if the system does not hold vacuum, the Small Leak Test will fail and a DTC will set. This is a Type A code so the MIL lamp will come on the first time the test fails.

It's important to note that the ECM may remain active for up to 40 minutes after the ignition is turned off in order to run this test. Keep this in mind when performing a Parasitic Draw Test on the vehicle.

EVAP Canister Vent Test

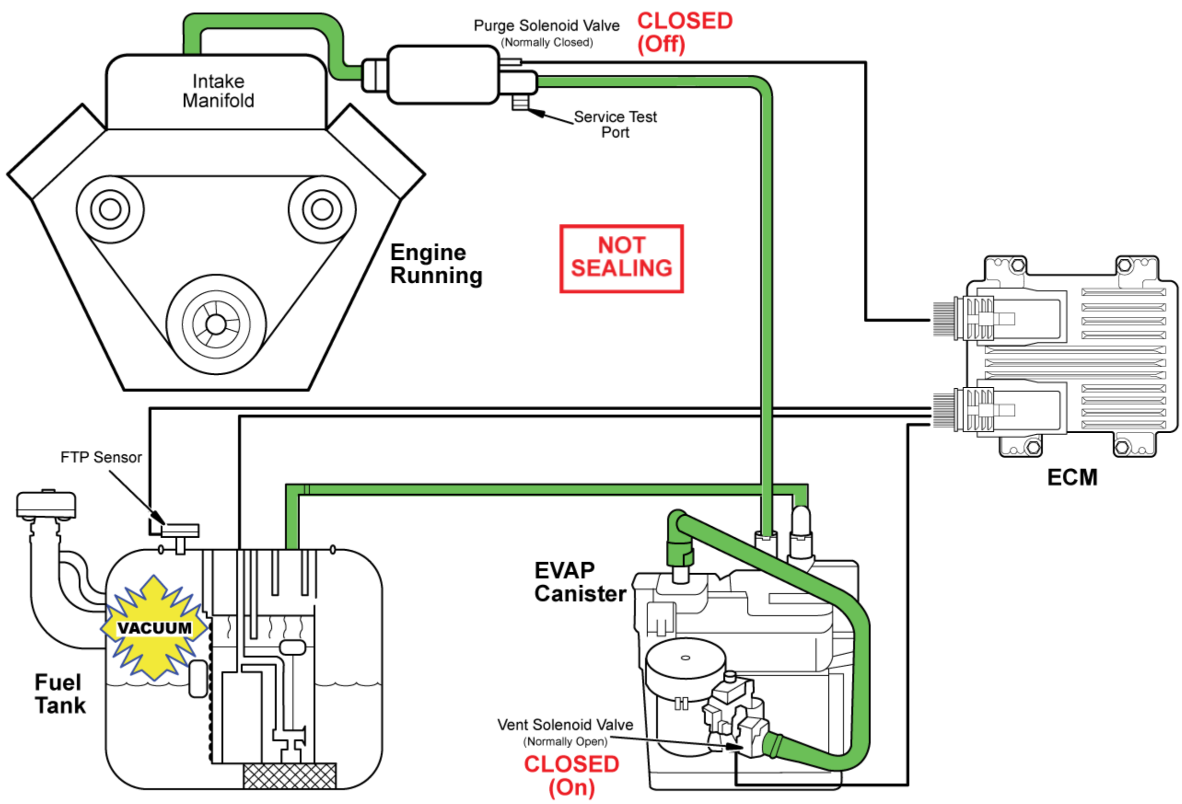


EVAP Canister Vent Test

If there is a restriction in the vent of EVAP system, the fuel vapors cannot be purged from the EVAP Canister. To test for restrictions, while the engine is running the ECM commands the EVAP Purge Solenoid Valve “ON”. The Vent Solenoid Valve stays “OFF” for this test. This opens the Purge Lines between the engine and fuel tank while leaving the Vent Valve open to fresh air.

If there is a restriction in the Vent Valve, a vacuum would build in the fuel tank which would show up on the FTP Sensor signal. If the vacuum reaches a specific calibrated value, the test fails. This is a Type B code so the test must fail twice before a DTC will set.

EVAP Purge/Seal Test

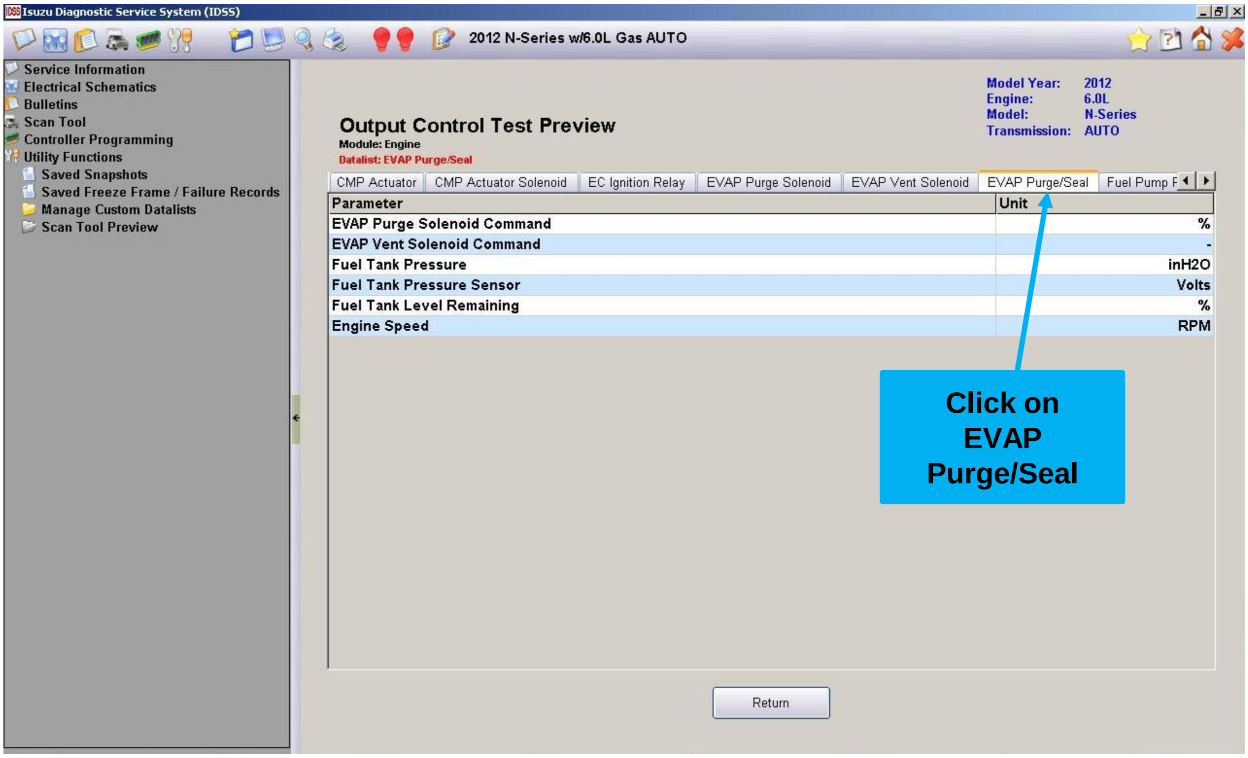


EVAP Purge/Seal Test
If the EVAP Purge Valve does not seal properly, fuel vapors could be drawn into the engine at an undesired time. This can change the air fuel mixture and cause driveability concerns. To monitor for this condition, the ECM performs the EVAP Purge/Seal Test.

While the engine is running, the ECM leaves the Purge Solenoid “OFF” and commands the Vent Solenoid “ON” while monitoring the FTP Sensor. This should completely seal the system and pressure in the fuel tank should not change.

If the ECM detects any vacuum in the fuel tank, it means that the EVAP Purge Valve is not sealing properly. If the vacuum in the fuel tank gets above a calibrated value, a DTC can set. This is a Type B code so the test must fail on two consecutive drive cycles before the MIL lamp comes on.

Service Tips



Service Tips
If manual leak testing is required, this can be done using the PURGE/SEAL function of the IDSS Output Control Test. This test commands the EVAP Purge Solenoid “OFF” and EVAP Vent Solenoid “ON” at the same time while observing the FTP Sensor signal. This should seal the system to any venting. With the engine running, this should create a vacuum in the fuel tank. If there is an external leak, the system will not hold vacuum.

To find the exact location of the leak, there is an Evaporative Emissions System Tester available through SPX. This tool can be very helpful in diagnosing intermittent system leaks. It introduces smoke into the EVAP system so technicians can visibly check for leaks. This is not an Isuzu essential tool therefore it is not covered in the service information, so contact SPX for more information.

Acronyms

A, AMP	Ampere (s)
ABS	Anti-lock Brake System
AC	Alternating Current
A/C	Air Conditioning
ACC	Accessary
A/F	Air Fuel Ratio
AOH	Air Over Hydraulic
APP	Accelerator Pedal Position Sensor
AT	Automatic Transmission
ATDC	After Top Dead Center
ATF	Automatic Transmission Fluid
BARO	Barometric Pressure
Bat	Battery
BCM	Body Control Module
B+	Battery Positive Voltage
BHP	Brake Horsepower
BTDC	Before Top Dead Center
CAC	Charge Air Cooler
CAN	Controller Area Network
CBR	Clutch Braking
cc	Cubic Centimeter
CEL	Check Engine Light
CID	Cubic Inch Displacement
CKP	Crankshaft Position Sensor
CKT	Circuit
cm	Centimeter
CMP	Camshaft Position Sensor
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
CPP	Clutch Pedal Position
CSV	Clutch Select Valve
Cu. In	Cubic Inch
DC	Direct Current
DEF	Diesel Exhaust Fluid
DEFCM	Diesel Exhaust Fluid Control Module
DIC	Driver Information Center
DLC	Diagnostic Link Connector
DMM	Digital Multimeter
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
DRL	Daytime Running Lights

Acronyms

DRM	Data Recording Module
DSC	Driver Shift Control
DSR	Driver Shift Request
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
EBCM	Electronic Brake Control Module
EBD	Electronic Braking-force Distribution
ECCC	Electronically-Controlled Capacity Clutch
ECM	Electronic Control Module
ECT	Engine Coolant Temperature Sensor
EEPROM	Electronically Erasable Programmable Read Only Memory
EGR	Exhaust Gas Recirculation
EGT	Exhaust Gas Temperature
EHCU	Electronic Hydraulic Control Unit
EI	Electronic Ignition
EMI	Electromagnetic Interference
EOP	Engine Oil Pressure
ESD	Electrostatic Discharge
ETBC	Electronic Trailer Brake Controller
EVAP	Evaporative (Emissions System)
EXH	Exhaust
FP	Fuel Pump
FRP	Fuel Rail Pressure (regulator, sensor)
FRPRV	Fuel Rail Pressure Reduction Valve
FTP	Fuel Tank Pressure
FT	Fuel Temperature sensor
GEN	Generator
GMLAN	General Motors in vehicle Local Area Network
GND	Ground
GPCM	Glow Plug Control Module
GVWR	Gross Vehicle Weight Rating
HBB	Hydraulic Brake Booster
HC	Hydrocarbons
HO2S	Heated Oxygen Sensor
HVAC	Heater-Vent-Air Conditioning
IAC	Idle Air Control
IAF	Intake Airflow Valve
IAT	Intake Air Temperature Sensor
IC	Ignition Coil, Integrated Circuit, Ignition Control
ICS	Idle Control Solenoid
ID	Identification, Inside Diameter
IDSS	Isuzu Diagnostic Service System

Acronyms

IGN	Ignition
IMS	Internal Mode Switch
in	Inch
Inj	Injector
Int	Intake
IP	Instrument Panel
IPC	Instrument Panel Cluster
IQC	Isuzu Quality Center
ISC	Idle Speed Control
ISS	Input Speed Sensor
kg	Kilograms
km	Kilometers
km/h	Kilometers per Hour
KPa	KiloPascals
KS	Knock Sensor
kV	Kilovolts
kW	Kilowatts
L	Liter
lb ft	Foot Pounds
lb in	Inch Pounds
LPG	Liquefied Petroleum Gas
mA	Milliamps
MAF	Mass Air Flow
MAP	Manifold Absolute Pressure
MID	Multi Information Display
MIL	Malfunction Indicator Lamp
mm	Millimeter
MMU	Mimamori Unit
MPa	MegaPascal
MPH	Miles per Hour
M/T	Manual Transmission
mV	Millivolt
NA	Naturally Aspirated
NC	Normally Closed
N•m	Newton Meter
NO	Normally Open
NOx	Nitrogen, Oxides of
OBD II	On Board Diagnostics Two
OD	Outside Diameter
O/D	Over Drive
OE	Original Equipment
OSS	Output Speed Sensor

Acronyms

O2	Oxygen
O2S	Oxygen Sensor
PC	Pressure Control
PCM	Powertrain Control Module
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation, Pressure Control Valve
PIM	Powertrain Interface Module
p/l	pressure limiter
PM	Particulate Matter, Preventative Maintenance
PNP	Park/Neutral Position
PS	Pressure Switch
P/S	Power Steering
PSI	Pounds per Square Inch
PTO	Power Take Off
PWM	Pulse Width Modulation
RAM	Random Access Memory
RCT	Radiator Coolant Temperature Sensor
ROM	Read Only Memory
RPM	Revolutions per minute
RPO	Regular Production Option
RPS	Revolutions Per Second
RTV	Room Temperature Vulcanizing
SAE	Society of Automotive Engineers
SCR	Selective Catalyst Reduction
SCV	Suction Control Valve
SDGM	Serial Data Gateway Module
SLS	Stop Lamp Switch
Sol	Solenoid
SS	Shift Solenoid
ST	Start, Scan Tool
STL	Service Transmission Lamp
SVS	Service Vehicle Soon
Sw	Switch
TAC	Throttle Actuator Control
Tach	Tachometer
TAL	Technical Assistance Line
TB	Throttle Body
TCC	Torque Converter Clutch
TCM	Transmission Control Module
TDC	Top Dead Center

Acronyms

TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
T/M	Transmission
TP	Throttle Position
TUTD	Tap Up Tap Down
TWC	Three Way Catalytic Converter
V	Volt (s)
VAC	Vacuum, Volts Alternating Current
VCM	Vehicle Control Module
VDC	Voltage Direct Current
VHR	Vehicle Health Report
VIN	Vehicle Identification Number
VNT	Variable Nozzle Turbo
V-ref	ECM Reference Voltage
VSS	Vehicle Speed Sensor
VSV	Vacuum Switching Valve
VTD	Vehicle Theft Deterrent
WIF	Water In Fuel
W/L	Warning Light
WOT	Wide Open Throttle
WSS	Wheel Speed Sensor