

H: Fuel Control

⚠ WARNING: While conducting tests on a hot engine take all safety precautions to prevent skin contact with hot engine components. Failure to follow these instructions may result in personal injury.

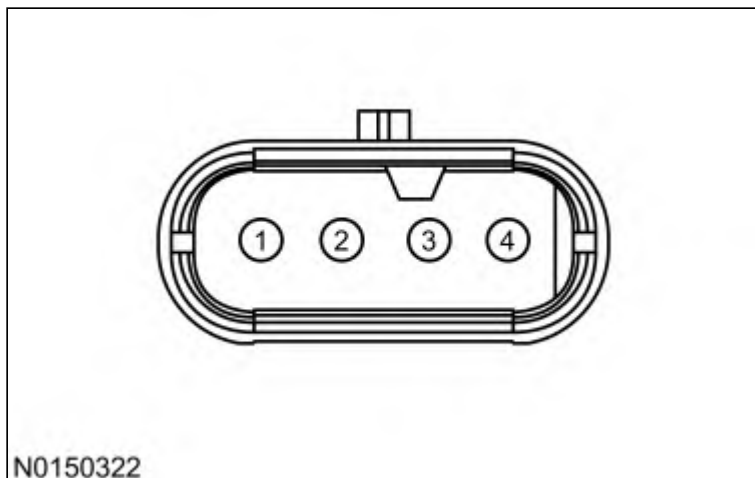
This pinpoint test is intended to diagnose the following:

- HO2S (9G444)
- universal HO2S (9Y460)
- fuel injectors (9F593)
- harness circuits: HO2S12, HO2S22, HTR12, HTR22, SIGRTN, UO2SPC and VPWR
- vacuum systems
- PCM (12A650)

For additional information on heated oxygen sensor (HO2S), refer to Section 1, [Catalyst And Exhaust Systems](#).

Heated Oxygen Sensor Bank 1, Sensor 2 (HO2S12) Connector

The pin numbering for the connector is in reference to the connector lock tab. Not all connector key combinations are shown.

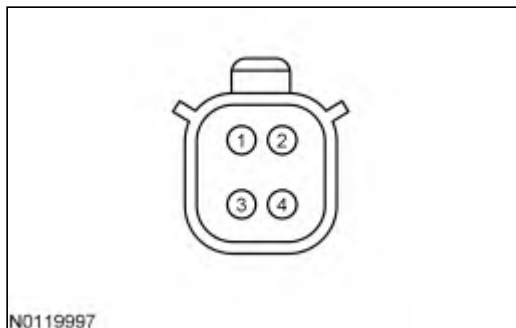
A**B**

Vehicle	Connector	Pin	Circuit
Continental 2.7L, Continental 3.0L, Continental 3.7L, E-Series, F-650 / F-750, Flex, Fusion 2.0L, Fusion 2.5L, Fusion 2.7L, MKZ, Mustang TiVCT 5.2L, Ranger 2.5L	A	2 1 3 4	HTR12 VPWR SIGRTN HO2S12
Continental 2.0L, Expedition, F-Series Super Duty, Ford GT, Fusion 1.5L, Motorhome / Stripped Chassis / Step Van, Navigator	B	2 1 3 4	HTR12 VPWR SIGRTN HO2S12
All other vehicles	B	1 2 3 4	HTR12 VPWR SIGRTN HO2S12

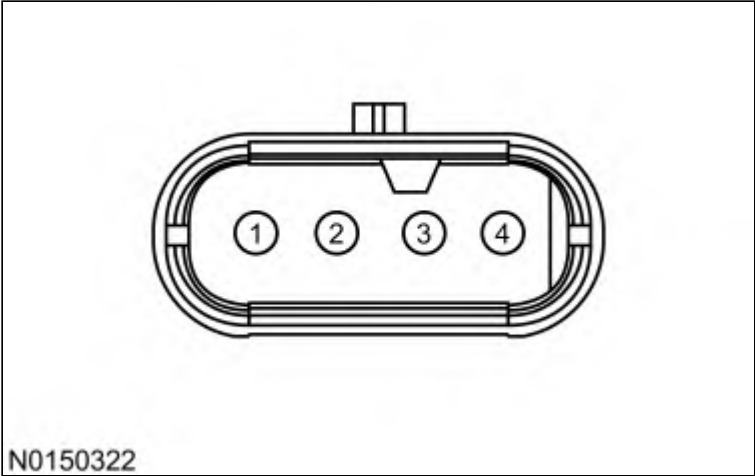
Heated Oxygen Sensor Bank 2, Sensor 2 (HO2S22) Connector

The pin numbering for the connector is in reference to the connector lock tab. Not all connector key combinations are shown.

A



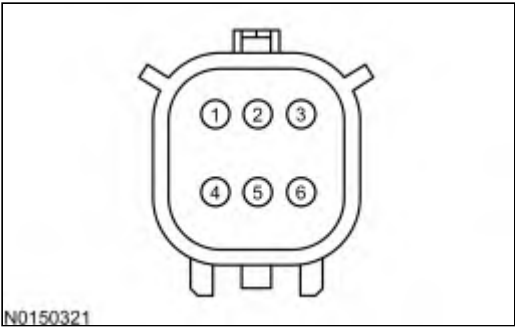
B

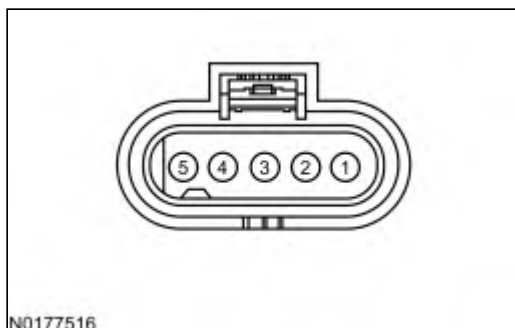
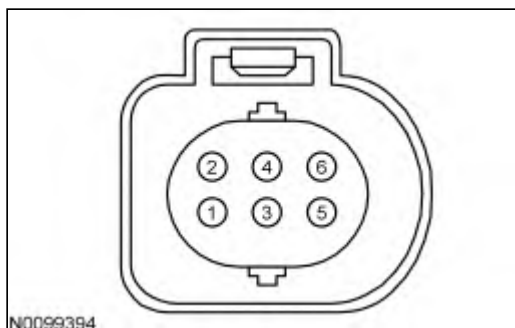


Vehicle	Connector	Pin	Circuit
Continental, E-Series, F-650 / F-750, Flex, Fusion, MKZ, Mustang TiVCT 5.2L	A	2 1 3 4	HTR22 VPWR SIGRTN HO2S22
Expedition, F-Series Super Duty, Ford GT, Mustang 5.2L Supercharged, Navigator	B	2 1 3 4	HTR22 VPWR SIGRTN HO2S22
All other vehicles	B	1 2 3 4	HTR22 VPWR SIGRTN HO2S22

Universal HO2S Connector

A



B**C**

Vehicle	Connector	Pin	Circuit
Continental 3.7L, E-Series, F-650 / F-750, Flex TiVCT 3.5L, Mustang TiVCT 5.2L	A	6	UO2SPC
Corsair, Edge 2.0L, Escape/Kuga 2.0L, Escape/Kuga 2.5L, Explorer 2.3L, F-150 3.3L, F-150 5.0L, Fusion 2.5L, Mustang 5.0L, Mustang 5.2L Supercharged, Nautilus 2.0L, Ranger, Transit TiVCT 3.5L, Transit Connect 2.0L, Transit Connect 2.5L	B	3	UO2SPC
All other vehicles	C	1	UO2SPC

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6, Reference Values.

Vehicle	Connector	Pin	Circuit
Continental 2.0L, EcoSport 1.0L Automatic Transmission, EcoSport 2.0L, Fusion 1.5L, Fusion 2.0L, MKZ 2.0L	198 PIN	E63 B101, B102, B103 B1 B38 B57	UO2SPC11 VPWR HTR12 SIGRTN HO2S12
Continental 2.7L, Continental 3.0L, Flex GTDI 3.5L, Ford GT, Fusion 2.7L, MKZ 3.0L	198 PIN	E61 E63 B61 B37 B56 B101, B102, B103 B1 B38 B57	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12
Continental 3.7L, E-Series, Flex TiVCT 3.5L	198 PIN	E36 E35 E83 B90 B91 B97, B99 E78 B71 B72	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12
Corsair 2.0L, Corsair 2.3L, Escape/Kuga 2.0L	198 PIN	E33 B100, B101, B102 E26 B55 E81	UO2SPC11 VPWR HTR12 SIGRTN HO2S12
Corsair 2.5L, Escape/Kuga 2.5L, Fusion 2.5L, Transit Connect 2.5L	198 PIN	E6 B97, B99 E92 B71 B72	UO2SPC11 VPWR HTR12 SIGRTN HO2S12
EcoSport 1.0L Manual Transmission	198 PIN	E39 B101, B102, B103 B1 B37 B57	UO2SPC11 VPWR HTR12 SIGRTN HO2S12

Vehicle	Connector	Pin	Circuit
EcoSport 1.5L Automatic Transmission, KA 1.5L Automatic Transmission	198 PIN	B97, B99 E92 B53 B72	VPWR HTR12 SIGRTN HO2S12
EcoSport 1.5L Manual Transmission, KA 1.2L, KA 1.5L Manual Transmission	112 PIN	B55, B56 E49 E1 E14	VPWR HTR12 SIGRTN HO2S12
Edge 2.0L, Nautilus 2.0L	198 PIN	E33 B100, B101, B102 E81 B26 E26	UO2SPC11 VPWR HTR12 SIGRTN HO2S12
Edge 2.7L, Nautilus 2.7L	306 PIN	T30 T29 T16 B28 T26 B1, B16, B2 T77 T84 T10	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12
Escape/Kuga 1.5L, Explorer 2.3L, Mustang 2.3L, Ranger 2.3L, Transit Connect 1.0L, Transit Connect 2.0L	198 PIN	E33 B100, B101, B102 E81 E13 E26	UO2SPC11 VPWR HTR12 SIGRTN HO2S12
Expedition, F-150 3.5L High Output, Navigator	198 PIN	E63 E62 B78 B94 B95 B101, B102, B103 B1 B75 B76	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12
F-150 3.5L Base	306 PIN	T30 T29 T16 T85 T26 T77 T84 T10	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 HTR12 SIGRTN HO2S12

Vehicle	Connector	Pin	Circuit
F-650 / F-750	198 PIN	E36 E35 B97, B99 E78 B71 B72	UO2SPC21 UO2SPC11 VPWR HTR12 SIGRTN HO2S12
KA 1.0L	128 PIN	B36, E24 E36 E8 E19	VPWR HTR12 SIGRTN HO2S12
Motorhome / Stripped Chassis / Step Van	306 PIN	T30 T29 B1, B16, B2 T77 T84 T10	UO2SPC21 UO2SPC11 VPWR HTR12 SIGRTN HO2S12
Mustang TiVCT 5.2L	198 PIN	E35 E36 E83 B90 B91 B1, B16, B2 E78 B71 B72	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12
Ranger 2.5L	128 PIN	B11, B12 E47 E9 E20	VPWR HTR12 SIGRTN HO2S12
Transit GTDI 3.5L	306 PIN	T30 T29 T16 T85 T26 B101, B102, B103 T77 T84 T10	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12

Vehicle	Connector	Pin	Circuit
All other vehicles	306 PIN	T30 T29 T16 T85 T26 B1, B16, B2 T77 T84 T10	UO2SPC21 UO2SPC11 HTR22 SIGRTN HO2S22 VPWR HTR12 SIGRTN HO2S12

H1 CHECK FOR DTCS

Are DTCs P0171, P0172, P0174, P0175, P1137, P1138, P1157, P1158, P2195, P2196, P2197, P2198, P219A, P219B, P219C, P219D, P219E, P219F, P21A0, P21A1, P2270, P2271, P2272, P2273, P2BEC, P2BED, P2BEE, P2BEF, P2BF0, P2BF1, P2BF2 or P2BF3 present?

Yes	For DTCs P1137, P1138, P1157, P1158, P2270, P2271, P2272 or P2273, GO to H3 . For all others, GO to H2 .
No	RETURN to Section 3, Symptom Charts for further direction.

H2 RICH OR LEAN SYSTEM DTCS

Note: All PIDs may not be available on all vehicles.

Note: Do not clear the DTCs or reset the keep alive memory (KAM).

- Access the PCM and record the ECT or ECT1 PID from the freeze frame data. The freeze frame data is used to recreate the concern.
- Carry out the PCM self-test.

Are any DTCs present other than the following: P0171, P0172, P0174, P0175, P2195, P2196, P2197, P2198, P219A, P219B, P219C, P219D, P219E, P219F, P21A0, P21A1, P2BEC, P2BED, P2BEE, P2BEF, P2BF0, P2BF1, P2BF2 or P2BF3 present??

Yes	DISREGARD the current diagnostic trouble code (DTC) at this time. DIAGNOSE the next DTC. GO to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions .
No	GO to H3 .

H3 CARRY OUT A VISUAL INSPECTION

- Ignition OFF.
- Check the air filter element and housing for restrictions.
- Inspect the entire air intake system from the mass airflow (MAF) sensor to the intake manifold for leaks such as:
 - hoses connecting to the MAF sensor assembly
 - cracked or punctured intake air tube
 - loose connections on the intake air tube at the air cleaner housing or throttle body
 - hoses connecting to the throttle body
 - obstructions, restrictions, or damage
- Check the throttle plate for obstructions or sludge.
- Inspect the entire length of all the vacuum hoses for:
 - correct connections
 - damage or cracks
 - damaged or cracked vacuum tees
- Inspect the EVAP system lines and hoses for incorrect connections or damage.
- Inspect the intake manifold or gasket for leaks.

- Inspect the exhaust gas recirculation (EGR) system for leaks such as:
 - EGR valve gasket leak to intake manifold
 - EGR valve diaphragm or control solenoid
- Verify the integrity of the positive crankcase ventilation (PCV) system.
- Verify the correct PCV valve part number, (if equipped).
- Inspect the exhaust system for leaks at flanges and gaskets.
- Visually inspect the HO2S for:
 - pinched, shorted, and corroded wiring and pins
 - oil or water contamination
 - crossed sensor wires
- Inspect for an incorrectly seated engine oil dipstick, dipstick tube, or oil fill cap.

Is a concern present?

Yes	For vacuum leak concerns, GO to H9 . For all others, REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to H4 .

H4 CARRY OUT THE POWER BALANCE TEST

Note: The scan tool test referenced in this step may not be available on all vehicles. Follow the YES answer if the scan tool test is not available.

- Carry out the Power Balance Test. Refer to the instruction manual provided by the scan tool manufacturer.

Does the test pass?

Yes	For DTCs P1137, P1138, P1157, P1158, P2270, P2271, P2272 or P2273, GO to H25 . For DTCs P219C, P219D, P219E, P219F, P21A0 or P21A1, GO to H6 . For all others, GO to H5 .
No	INSTALL a new Fuel Injector. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.

H5 CHECK THE EVAP SYSTEM FOR A STUCK OPEN EVAP PURGE VALVE

- Ignition OFF.
- Install the fuel filler cap or remove the supplemental refueling adaptor.
- Ignition ON, engine OFF.
- Access the PCM and monitor the FTP (VOLT) PID.
- Record the FTP PID value.
- Ignition ON, engine running.
- Access the PCM and control the EVAPCP (PER) PID.
- Close the EVAP purge valve by commanding the EVAPCP PID to 0%.
- Access the PCM and control the EVAPCV (MODE) PID.
- Close the EVAP canister vent valve by commanding the EVAPCV PID to ON (100% duty cycle).

Does the FTP PID voltage value remain within 0.5V of the recorded PID voltage value within 30 seconds of opening the EVAP purge valve?

Yes	For Aviator, Continental, Corsair, EcoSport 1.0L, EcoSport 1.5L, Edge, Escape/Kuga, Expedition, Explorer, F-150, F-Series Super Duty 6.2L, Flex 3.5L GTDI, Fusion 1.5L, Fusion 2.0L, Fusion 2.7L, KA, MKZ, Mustang 2.3L, Nautilus, Navigator, Ranger, Transit, Transit Connect 1.0L and Transit Connect 2.0L with DTCs P0171, P0174, P2195, P2197, P2BEC, P2BEE, P2BF0 or P2BF2, GO to H7 . For Ecosport 1.5L and KA with DTC P2196, GO to H11 . For all others with DTC P2196 or P2198, GO to H10 .
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	For DTCs P0172, P0175, P219A, P219B, P2BED, P2BEF, P2BF1 or P2BF3, GO to H11 . For all others, GO to H6 .
No	INSTALL a new Evaporative Emission (EVAP) Purge valve. REFER to the Workshop Manual Section 303-13, Evaporative Emissions. Clear the PCM DTCs. REPEAT the self-test.

H6 CHECK FOR THE PRESENCE OF A VACUUM LEAK

Note: All PIDs may not be available on all vehicles.

Note: Fuel trim values at idle are more sensitive to a vacuum leak. The vacuum leak (unmetered air) represents a larger portion of the total airflow at idle than at part throttle.

Note: When calculating the total fuel correction in the following steps, if LONGFT1 equals +13% and SHRTFT1 equals +23%, the total fuel correction for bank 1 equals +36%. If LONGFT2 equals +24% and SHRTFT2 equals -3% the total fuel correction for bank 2 equals +21%.

Note: If the freeze frame ECT or ECT1 PID is available, stabilize the engine at the temperature recorded by the freeze frame ECT or ECT1 PID. If the freeze frame ECT or ECT1 PID is not available, maintain the engine coolant temperature between 82°C - 101°C (180°F - 215°F) and the intake air temperature less than 46°C (115°F).

- Ignition ON, engine running.
- Access the PCM and monitor the CHT (TEMP), ECT (TEMP), ECT1 (TEMP) and IAT (TEMP) PIDs.
- Access the PCM and monitor the LONGFT1 (PER), SHRTFT1 (PER), LONGFT2 (PER) and SHRTFT2 (PER) PIDs.
- Allow the engine to stabilize at the temperature necessary to recreate the concern.
- Mathematically add and record the LONGFT PID value to the SHRTFT PID value for each bank, for a total fuel correction at idle.
- Increase the engine speed to 3,500 RPM for 10 seconds.
Record the LONGFT1, SHRTFT1, LONGFT2, and SHRTFT2 PID values.
- Mathematically add and record the LONGFT PID value to the SHRTFT PID value for each bank, for a total fuel correction at 3,500 RPM.

Is the total fuel correction value difference between idle and 3,500 RPM, less than 15 percent of the total value at idle?

Yes	No vacuum leak is present. For DTCs P0171, P0174, P219C, P219D, P219E, P219F, P21A0 or P21A1, GO to H11 . For all others, GO to H10 .
No	GO to H8 .

H7 MONITOR THE KOEO AND KOER MAP SENSOR VOLTAGE

- Ignition ON, engine OFF.
- Access the PCM and monitor the MAP_V (VOLT) PID.
- Record the MAP voltage.
- Ignition ON, engine running.
- Record the MAP voltage.

Does the PID value change?

Yes	For EcoSport 1.5L and KA with DTC P2195, GO to H11 . For DTCs P0171, P0174, P219C, P219D, P219E, P219F, P21A0, P21A1, P2BEC, P2BEE, P2BF0 or P2BF2, GO to H11 . For all others, GO to H10 .
No	GO to Pinpoint Test DM .

H8 LOCATE THE VACUUM LEAK

NOTICE: Do not clamp or pinch a hard plastic hose. Use a vacuum cap or equivalent to restrict the hose.

Note: Restricting the EVAP vapor hose while the EVAP emission canister is purging may shift the SHRTFT. Carry out a visual inspection as necessary.

Note: When monitoring for a decrease in the SHRTFT PIDs in the following steps, if SHRTFT1 equals +15% and the hose is restricted, SHRTFT1 decreases to -7%. The total decrease in the SHRTFT PIDs equals 22%.

- Locate the vacuum tees for the intake air and PCV systems.
- Ignition ON, engine running.
- Access the PCM and monitor the SHRTFT1 (PER) and SHRTFT2 (PER) PIDs.
- Restrict the vacuum lines one at a time for 30 seconds. If a vacuum leak is present, the SHRTFT PID values decrease as the hose is restricted.

Is the decrease in the SHRTFT PIDs greater than 15 percent when one of the vacuum hoses is restricted?

Yes	GO to H9 .
No	INSPECT the intake air system for a vacuum leak in the intake manifold or intake gaskets. REPAIR as necessary. For repair verification, GO to H9 .

H9 VACUUM LEAK REPAIR VERIFICATION

Note: If the freeze frame ECT or ECT1 PID is available, stabilize the engine at the temperature recorded by the freeze frame ECT or ECT1 PID. If the freeze frame ECT or ECT1 PID is not available, maintain the engine coolant temperature between 82°C - 101°C (180°F - 215°F) and the intake air temperature less than 46°C (115°F).

- Ignition ON, engine running.
- Access the PCM and monitor the SHRTFT1 (PER) and SHRTFT2 (PER) PIDs.
- Allow the engine to stabilize at the temperature necessary to recreate the concern.
- Record the SHRTFT1 and SHRTFT2 PID values.
- Ignition OFF.
- Repair the vacuum leak.
- Ignition ON, engine running.
- Allow the engine to stabilize at the temperature necessary to recreate the concern.
- Compare the recorded SHRTFT PID values, prior to the vacuum leak repair, to the current SHRTFT PID values.

Is the decrease in the SHRTFT PIDs greater than 15 percent?

Yes	RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.
No	A vacuum leak is still present. GO to H8 .

H10 CHECK THE UO2SPC CIRCUIT FOR AN OPEN

Note: Only the suspect universal HO2S needs to be diagnosed.

- Ignition OFF.
- Universal HO2S connector disconnected.
- PCM connector disconnected.
- Measure the resistance between:

(+) Universal HO2S Connector, Harness Side	(-) PCM Connector, Harness Side
UO2SPC	UO2SPC

Is the resistance less than 5 ohms?

Yes	GO to H11 .

No	REPAIR the open circuit. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.
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H11 CHECK THE FUEL PRESSURE

⚠ WARNING: When checking the fuel system remember that the fuel system may still be pressurized when the engine is switched off. Always follow the instructions related to fuel system pressure relief. All fuel handling safety precautions must be observed. Failure to follow these instructions may result in personal injury.

Note: For vehicle specific fuel pressure ranges, refer to the Fuel System Specification Chart in Pinpoint Test HC.

- Universal HO2S connector connected.
- Relieve the fuel pressure. Refer to the Workshop Manual Section 310-00, Fuel System for the Fuel System Pressure Release procedure.
- Mechanical fuel pressure gauge connected.
- Pressurize the fuel system. Refer to the Workshop Manual Section 310-00, Fuel System for the Fuel System Pressure Release procedure to pressurize the fuel system.
- Ignition ON, engine running.
- Allow the fuel pressure to stabilize.
- Ignition OFF.
- Ignition ON, engine running.
- Access the PCM and control the FP (MODE) PID.
- Run the fuel pump to obtain maximum fuel pressure.

Is the fuel pressure within range for the vehicle being diagnosed?

Yes	GO to H12 .
No	GO to Pinpoint Test HC .

H12 CHECK THE FUEL SYSTEM FOR PRESSURE STABILITY - FAST LEAKDOWN

Note: When the fuel pump is commanded off, the fuel pressure may substantially decrease and then stabilize.

Note: During output state control, the fuel pump stays commanded on for approximately 5 seconds.

- Ignition OFF.
- Ignition ON, engine OFF.
- Access the PCM and control the FP (MODE) PID.
- Run the fuel pump to obtain maximum fuel pressure.
- Command the fuel pump OFF.
- Allow the fuel pressure to stabilize.
- Record the stabilized reading.
- Monitor the fuel pressure for 10 seconds.

Does the fuel pressure remain within 34 kPa (5 psi) of the recorded reading after 10 seconds?

Yes	GO to H14 .
No	GO to H13 .

H13 CHECK FOR AN EXTERNAL FUEL LEAK

- Inspect the fuel tank, lines, and filler pipe for a fuel leak.

Is a concern present?

Yes	REPAIR as necessary. REFER to the fuel system WARNING information at the beginning of Pinpoint Test HC. GO to Pinpoint Test HC .
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	RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.
No	For KA with DTCs P0171 or P2195, Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z . For DTCs P219A, P219B, P219C, P219D, P219E, P219F, P21A0 or P21A1, GO to H14 . For all others, GO to HC12 .

H14 CHECK THE FUEL SYSTEM FOR PRESSURE STABILITY - SLOW LEAKDOWN

- Continue to monitor the fuel pressure for 1 minute.

Does the fuel pressure remain within 34 kPa (5 psi) of the recorded reading (MRFS) or greater than 275 kPa (40 psi) (ERFS) after 1 minute?

Yes	For DTCs P219A or P219B, INSTALL a new Universal HO2S. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test. For DTCs P219C, P219D, P219E, P219F, P21A0 or P21A1, GO to H15 . For E100 vehicles, GO to H22 . For all others, GO to H16 .
No	GO to HC12 .

H15 CHECK FOR ELECTRICAL NOISE

- Ignition OFF.
- Check the crankshaft position (CKP) sensor harness for routing, alterations, incorrect shielding or electrical interference from other systems.
- Check for radio frequency interference and excessive audible generator noise.

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	UNABLE to duplicate or identify the concern at this time. GO to Pinpoint Test Z .

H16 CHECK THE SEPARATION LEVEL OF THE ETHANOL, WATER AND GASOLINE MIXTURE IN THE FUEL

Note: This step requires the use of a locally obtained 200 ml beaker and a 25 ml graduated cylinder.

Note: After approximately 3 minutes of standing, the ethanol and water mixes together and settles to the bottom of the 25 ml graduated cylinder. The gasoline rises to the top.

- Fill the 200 ml beaker with 5 ml of clean water.
- Use the pressure relief valve on the mechanical fuel gauge to drain 22 ml of fuel into an approved clean container.
- Pour 20 ml of fuel from the approved clean container into the 25 ml graduated cylinder.
- Add enough water from the 200 ml beaker to the 25 ml graduated cylinder to bring the total volume of liquid to 24 ml.
- Insert a stopper plug in the opening of the 25 ml graduated cylinder.
- Firmly hold the stopper in place and shake the 25 ml graduated cylinder to mix the water and fuel.
- Allow the liquid to stand and separate for approximately 3 minutes.
- Record the separation level from the 25 ml graduated cylinder where the ethanol and water mixture and gasoline meet.

Does the ethanol and water mixture and gasoline separate?

Yes	GO to H17 .
No	The ethanol and water mixture will separate from the gasoline. If the fuel does not appear to separate,

then the fuel is either 100% ethanol or a mixture of ethanol and water. REPLACE the contaminated fuel.

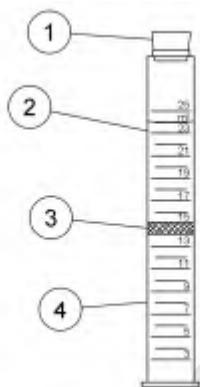
Clear the PCM DTCs. REPEAT the self-test.

H17 CALCULATE THE PERCENTAGE OF ETHANOL IN THE FUEL

Note: Use the illustration as an example for calculating the percentage of ethanol in the following steps. If the separation level is at 14 ml the calculation becomes; 14 minus 4, then multiply by 5 to equal 50. The percentage of ethanol in the fuel is 50%.

- Ignition OFF.
- Take the recorded separation level from the previous step and subtract the amount of water added.
- Multiply the new value by 5. This new value is the percentage of ethanol in the fuel.
-

Item Number	Description
1	Stopper
2	Gasoline
3	Separation Point at 14 ml
4	Ethanol and Water Mixture



N0048579

- Record the calculated percentage of ethanol in the fuel.

Is any ethanol present in the fuel?

Yes	For flex fuel vehicles, GO to H18 . For all others, GO to H21 .
No	For DTCs P0171, P0174, P2195, P2197, P2BEC, P2BEE, P2BF0 or P2BF2, GO to Pinpoint Test HC . For all others, GO to H22 .

H18 COMPARE THE FF_INF PID TO THE CALCULATED PERCENTAGE OF ETHANOL

Note: When determining if the FF_INF PID value is within 20% of the calculated percentage of ethanol, for example, if the calculated percentage of ethanol value is 40% then the PID value should be between 32 - 48%. The PID value cannot be less than zero.

- Ignition ON, engine OFF.
- Access the PCM and monitor the FF_INF (PER) PID.
- Compare the FF_INF PID to the calculated percentage of ethanol.

Is the FF_INF PID value within 20% of the calculated percentage of ethanol?

Yes	For DTCs P0171, P0174, P2195, P2197, P2BEC, P2BEE, P2BF0 or P2BF2, GO to Pinpoint Test HC . For all others, GO to H22 .
No	GO to H19 .

H19 RESET THE PERCENT ETHANOL PARAMETER IN THE PCM

Note: Certain customer fueling practices such as only fueling with small amounts of fuel or repeatedly switching between gasoline and an ethanol blend greater than E15 may prevent the PCM from learning the correct ethanol content in the fuel.

- Reset the keep alive memory (KAM). Refer to Section 2, [Resetting The Keep Alive Memory \(KAM\)](#).
- Ignition ON, engine running.
- Access the PCM and monitor the FF_LRND (MODE) PID.
- Drive the vehicle approximately 11.3 km (7 miles) or until the FF_LRND PID indicates yes.

Is the PID state YES?

Yes	GO to H20 .
No	GO to H30 .

H20 COMPARE THE UPDATED FF_INF PID TO THE CALCULATED PERCENTAGE OF ETHANOL

- Ignition OFF.
- Ignition ON, engine OFF.
- Access the PCM and monitor the FF_INF (PER) PID.

Is the FF_INF PID value within 20% of the calculated percentage of ethanol?

Yes	RETURN the vehicle to the customer. ADVISE the customer of the correct fueling practices when using flex fuel. REFER to the Owner's Literature for additional information. ADVISE the customer to continue to use the same fuel for the next 2-3 refuels. This practice helps to verify the PCM is learning the correct percentage of ethanol in the fuel.
No	A fuel system concern may be present, which prevents the PCM from learning the correct percentage of ethanol in the fuel, GO to HC12 .

H21 DETERMINE IF THE PERCENTAGE OF ETHANOL IN THE FUEL IS LESS THAN 25%

- Check the recorded calculated percentage of ethanol in the fuel.

Is the calculated percentage of ethanol in the fuel less than 25%?

Yes	For DTCs P0171, P0174, P2195, P2197, P2BEC, P2BEE, P2BF0 or P2BF2, GO to Pinpoint Test HC . For all others, GO to H22 .
No	REPAIR as necessary. ADVISE the customer of the correct fuel type required for this vehicle. REFER to the Owner's Literature for additional information. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.

H22 CARRY OUT A VISUAL INSPECTION

- Ignition OFF.
- Universal HO2S connector disconnected.
- Visually inspect for:
 - pinched, shorted, and corroded wiring and pins
 - oil or water contamination
 - crossed sensor wires
 - contaminated or damaged sensor

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	For Aviator, Continental, Corsair, EcoSport 1.0L, EcoSport 1.5L, Edge, Escape/Kuga, Expedition, Explorer, F-150, F-Series Super Duty 6.2L, Flex 3.5L GTDI, Fusion 1.5L, Fusion 2.0L, Fusion 2.7L, MKZ, Mustang 2.3L, Nautilus, Navigator, Ranger, Transit, Transit Connect 1.0L, and Transit Connect 2.0L, GO to H24 . For all others, GO to H23 .

H23 CHECK THE FUNCTIONALITY OF THE MASS AIRFLOW (MAF) SENSOR

Note: All PIDs may not be available on all vehicles.

- Ignition ON, engine running.
- Access the PCM and monitor the RPM (RPM) PID.
- Access the PCM and monitor the MAF (VOLT) PID.
- Access the PCM and monitor the MAF_HZ (FREQ) PID.
- Run the engine up to 1,500 RPM for 5 seconds, then bring it back to idle. Run the engine up to 1,500 RPM for 5 seconds, then bring it back to idle.
- Check that the PID value at idle is within 30% of the normal PID value listed in Section 6, Reference Values.

Is the PID value within the expected range?

Yes	GO to H24 .
No	To continue diagnosis of the MAF/IAT sensor, GO to Pinpoint Test DC .

H24 CHECK THE UNIVERSAL HO2S ACTIVITY

- Universal HO2S connector connected.
- Ignition ON, engine running.
- Access the PCM and monitor the FUELSYS (MODE) PID.

- Allow the engine to enter closed loop fuel control.
- Access the PCM and monitor the O2S11_CUR (CUR) and O2S21_CUR (CUR) PIDs.

Does the O2S11_CUR or O2S21_CUR PID value switch?

Yes	Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z .
No	INSTALL a new Universal HO2S. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.

H25 CHECK FOR KOER DTCS

- Ignition ON, engine OFF.
- Clear the PCM DTCS.
- Ignition ON, engine running.
- Run the engine at approximately 2,000 RPM. Maintain the engine speed for 3 minutes.
- Carry out the PCM self-test.

Are DTCS P1137, P1138, P1157, P1158, P2270, P2271, P2272 or P2273 present?

Yes	GO to H26 .
No	Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z .

H26 CHECK FOR SHORTS BETWEEN CIRCUITS IN THE HO2S HARNESS

Note: Diagnose the suspect sensor indicated by the DTC.

- PCM connector disconnected.
- For HO2S12,
- HO2S12 connector disconnected.
- Measure the resistance between:

(+) HO2S12 Connector, Harness Side	(-)
HO2S12	Ground

- Measure the resistance between:

(+) HO2S12 Connector, Harness Side	(-) HO2S12 Connector, Harness Side
HO2S12	SIGRTN
HO2S12	VPWR
HO2S12	HTR12

- For HO2S22,
- HO2S22 connector disconnected.
- Measure the resistance between:

(+) HO2S22 Connector, Harness Side	(-)
HO2S22	Ground

- Measure the resistance between:

(+) HO2S22 Connector, Harness Side	(-) HO2S22 Connector, Harness Side
HO2S22	SIGRTN
HO2S22	VPWR
HO2S22	HTR22

Are the resistances greater than 10K ohms?

Yes	GO to H27 .
No	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.

H27 CHECK THE HO2S CIRCUIT FOR AN OPEN

- For HO2S12,
- Measure the resistance between:

(+) HO2S12 Connector, Harness Side	(-) PCM Connector, Harness Side
HO2S12	HO2S12
SIGRTN	SIGRTN
HTR12	HTR12
VPWR	VPWR

- For HO2S22,
- Measure the resistance between:

(+) HO2S22 Connector, Harness Side	(-) PCM Connector, Harness Side
HO2S22	HO2S22
SIGRTN	SIGRTN
HTR22	HTR22
VPWR	VPWR

Are the resistances less than 5 ohms?

Yes	GO to H28 .
No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

H28 CHECK THE HO2S CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- For HO2S12,
- Measure the voltage between:

(+) HO2S12 Connector, Harness Side	(-)
HO2S12	Ground
SIGRTN	Ground

- For HO2S22,
- Measure the voltage between:

(+) HO2S22 Connector, Harness Side	(-)
HO2S22	Ground
SIGRTN	Ground

Is any voltage present?

Yes	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.
No	GO to H29 .

H29 CHECK THE HO2S OUTPUT VOLTAGE

- PCM connector connected.
- For HO2S12,
- HO2S12 connector connected.
- Ignition ON, engine running.
- Allow the engine to idle for 2 minutes.
- Access the PCM and monitor the O2S12 (VOLT) PID.
- Record the HO2S PID value.
- For HO2S22,
- HO2S22 connector connected.
- Ignition ON, engine running.
- Allow the engine to idle for 2 minutes.
- Access the PCM and monitor the O2S22 (VOLT) PID.
- Record the HO2S PID value.

Is the PID voltage less than 1.6 V?

Yes	Unable to duplicate or identify the concern at this time. GO to Pinpoint Test Z .
No	INSTALL a new HO2S. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test.

H30 CHECK FOR CORRECT PCM OPERATION

- Disconnect all the PCM connectors.
- Visually inspect for:
 - pushed out pins
 - corrosion
- Connect all the PCM connectors and make sure they seat correctly.
- Carry out the PCM self-test.
- Verify the concern is still present.

Is the concern still present?

Yes	INSTALL a new PCM. REFER to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM) , Programming the VID Block for a Replacement PCM.
No	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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