Computers and Control Systems: Pinpoint Tests
H - Fuel Control

Injector Bank Resistance (Multiport Fuel Injection)
Injector bank resistance ..... 3.0-4.0 Ohms

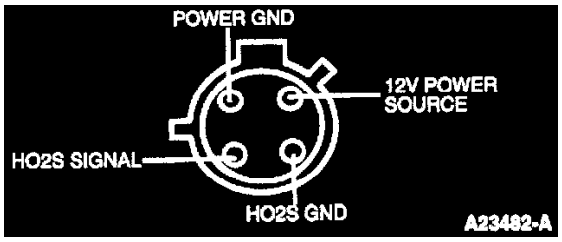
Single Injector Resistance (Sequential Fuel Injection)
Injector resistance ..... 11.0-18.0 Ohms

H - Fuel Pressure Specification Table
Key on engine running ..... 210-310 kPa (30-45 psi)
Key on engine off ..... 240-310 kPa (35-45 psi)

NOTE: Maximum fuel pressure is obtained at Wide Open Throttle **(WOT)** or with the vacuum hose removed from the fuel pressure regulator.

MFI

Fuel Injector Connector View



Heated Oxygen Sensor Connector View

CIRCUIT / PIN / WIRE COLOR

HO2S / 29 / gray/light blue

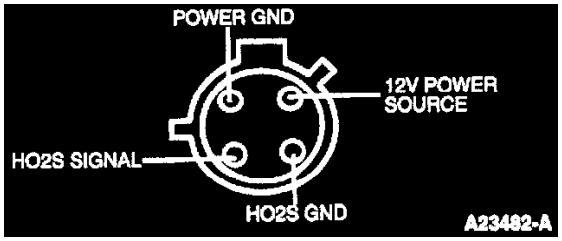
HO2S GND / 49/46 / gray/red

BANK 1 / 58 / tan

BANK 2 / 59 / white

SFI

Fuel Injector Connector View



Heated Oxygen Sensor Connector View

CIRCUIT / PIN / WIRE COLOR

HO2S 1 / 44 / gray/light blue

HO2S 2 / 43 / red/black

HO2S GND / 46 / gray/red

CYL 1 / 58 / tan

CYL 2 / 59 / white

CYL 3 / 39 / brown/yellow

CYL 4 / 35 / brown/light blue

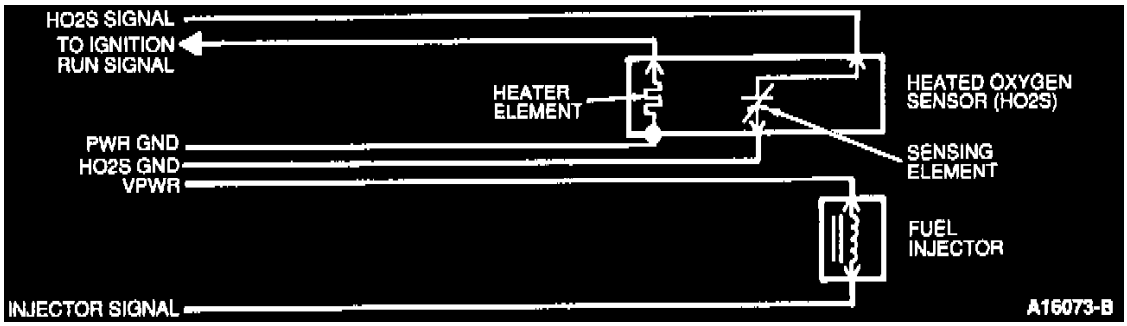
CYL 5 / 15 / tan/black

CYL 6 / 12 / light green/orange

CYL 7 / 13 / tan/red

CYL 8 / 14 / light/blue

H - Testing Notes



Heated Oxygen Sensor

DESCRIPTION

The Heated Oxygen Sensor **(HO2S)** reacts with the oxygen in the exhaust gases and generates a voltage based on this reaction. A low voltage indicates too much oxygen or a lean condition. A high voltage indicates not enough oxygen or a rich condition. The fuel injector is a typical on/off device. The amount of fuel delivered is determined by how long the injector is held open.

NOTE

You should enter this Pinpoint Test only when you have been directed here from Diagnostic Routines, or Pinpoint Test S.

REMEMBER

To prevent the replacement of good components, be aware that the following non-Electronic Engine Controls **(EEC)** areas may be at fault:

- Ignition System
- Evaporative Emission **(EVAP)** System
- Positive Crankcase Ventilation System
- Secondary Air Injection System
- Exhaust Gas Recirculation **(EGR)** System
- Air Intake System/Filter
- Fuel and Engine Oil Contamination
- Electrical System

- Fuel System (i.e. Fuel Filter Pump Pressure)
- Intake Manifold, Supercharger, charge Air Cooler Leaks
- Exhaust Manifold System Leak/Plugged
- Engine Cooling System
- Base Engine (i.e. cam timing, compression)

This Pinpoint Test is intended to diagnose only the following:

- HO2S/Heater
- HO2S Connection
- Vacuum Systems
- Fuel Injector
- Powertrain Control Module **(PCM)**
- Harness Circuits: HO2S GND, HO2S, INJ. 1-8, VPWR and SIG RTN

H1 - Check For Diluted Engine Oil

DIAGNOSTIC TROUBLE CODES (DTC)

136r ..... Left/front Heated Oxygen Sensor **(HO2S)** lean.
137r ..... Left/front HO2S rich.
139c ..... Left/front HO2S not switching.
144c ..... Right/rear HO2S not switching.
171c ..... Adaptive fuel limit reached on right/rear HO2S.
172r ..... Right/rear HO2S lean.
173r ..... Right/rear HO2S rich.
175c ..... Adaptive fuel limit reached on left/front HO2S.
176c ..... Left/front HO2S lean.
177c ..... Left/front HO2S rich.

NOTE: A DTC followed by an "r" indicates an on demand code, while a "c" indicates a continuous memory code.

Possible Causes:

- Fuel injectors.
- HO2S.
- Secondary Air Injection **(AIR)** system.
- Positive Crankcase Ventilation **(PCV)**/Hose.
- Vacuum.
- Evaporative Cannister Purge.
- Manifold Absolute Pressure **(MAP)** sensor.
- Electronic Ignition Coil Failure.

- Key "OFF".
- Remove the PCV valve from the valve cover. Inspect both rocker cover hole and PCV for damage, sludge build up, blockage and movement of valve plunger. Service as necessary.

- Run Key On Engine Off **(KOEO)** and Key On Engine Running **(KOER)** Self-Tests. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)
- Address any continuous ignition DTCs before servicing KOER DTCs.

NOTE: For a No Start, go directly to H2. See: H2 - Check Fuel Pressure

- **Are any of the above DTCs present in KOER Self-Test?**

Yes -- Reinstall PCV valve. Go to H2. See: H2 - Check Fuel Pressure

No -- For Continuous Memory DTCs 139, 144, 171, 176, 177 Go to H2. See: H2 - Check Fuel Pressure

All Others: Change engine oil and filter. Reinstall PCV valve. Drive vehicle 5 miles/55mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H2 - Check Fuel Pressure

WARNING: The fuel system will remain pressurized when engine is not running. To prevent injury or fire use caution when working on the fuel system.

- Key "OFF".
- Install fuel pressure gauge.
- Verify that manifold vacuum is connected to the fuel pressure regulator if applicable. If engine will start:
- Start and run engine at idle. Note fuel pressure.
- Increase engine speed to 2500 rpm and maintain for one minute. Note fuel pressure.
- If engine will not start, cycle the key off and on several times. Note fuel pressure.
- **Is fuel pressure within specification?**

Key on engine running	210-310 kPa (30-45 psi)
Key on engine off	240-310 kPa (35-45 psi)

Yes -- Go to H3. See: H3 - Check Systems Ability to Hold Fuel Pressure

No -- Refer to **Fuel Delivery and Air Induction.**

H3 - Check Systems Ability to Hold Fuel Pressure

- Pressurize fuel system per step H2.
- Visually look for fuel leaking at the injector O-ring, fuel pressure regulator, and the fuel lines to the fuel charging assembly. Service as necessary.
- Key "ON", engine "OFF".
- **Does fuel pressure remain at specification for 60 seconds?**

Yes -- For no starts: Go to H4. See: H4 - Fuel Delivery Test

For Service Codes or other Symptoms:

MFI: Go to H5. See: H5 - Cylinder Balance Diagnostic Test Mode: MFI Engines

SFI: Go to H6. See: H6 - Cylinder Balance Diagnostic Test Mode: SFI Engines

No -- Refer to Fuel Delivery and Air Induction/Testing and Inspection.

H4 - Fuel Delivery Test

- Key "OFF".
- Fuel pressure gauge installed.
- Pressurize fuel system per step **H2.**
- Locate and disconnect the Inertia Fuel Shutoff **(IFS)** switch.
- Crank engine for five seconds.
- **Does pressure drop more than 5 psi (34 kPa) by the end of the five second crank cycle?**

Yes -- The EEC system is not the cause of the no start. Remove the fuel pressure gauge. Reconnect the IFS switch. Refer to **Diagnostic Routines for further diagnosis.**

No -- Remove fuel pressure gauge. Reconnect IFS switch.

For MFI: Go to H7. See: H7 - Check Resistance of Injector(s) and Harness MFI Engines

For SFI: Go to H8. See: H8 - Check Resistance of Injector(s) and Harness SFI Engines

H5 - Cylinder Balance Diagnostic Test Mode: MFI Engines

- Connect tachometer to engine. Run engine at idle.
- Disconnect and reconnect the injectors one at a time: Note rpm drop for each injector.
- **Does each injector produce a momentary drop in rpm?**

NOTE: Idle Air Control **(IAC)** will attempt to re-establish rpm.

Yes -- For Symptoms: Return to Diagnosis by Symptom (Diagnostic Routines).

For Diagnostic Trouble Codes **(DTC)** 136, 172, 176: Go to H13. See: H13 - Check Secondary Air Injection Operation

For DTCs 137, 173, 177: Go to H24. See: H24 - Check HO2S Signal For Short to Power

For all others: Go to H14. See: H14 - Check HO2S Integrity

No -- Go to H7. See: H7 - Check Resistance of Injector(s) and Harness MFI Engines

H6 - Cylinder Balance Diagnostic Test Mode: SFI Engines

DTC TABLE VS. CYLINDER

DIAGNOSTIC TROUBLE CODES	90	10	20	30	40	50	60	70	80	538
CYLINDER/INJECTOR NUMBER	PASS	1	2	3	4	5	6	7	8	RERUN TEST*

Cylinder Balance Test Chart

The cylinder balance diagnostic test switches each injector OFF and ON one at a time. Diagnostic Trouble Codes **(DTC)** correspond to the cylinder number (i.e., Service DTC 30 indicates a problem with cylinder No. 3, a DTC 90 indicates a pass.) The cylinder balance test is designed to aid in the detection of a weak or non-contributing cylinder. The pinpoint test steps are designed to isolate only Electronic Engine Controls **(EEC)** related problems.

NOTE: If throttle is touched (moved) during the cylinder balance test, DTC 538 will appear, indicating test was not completed. DTC 538 could also be output if a continuous memory DTC 214 is present. If DTC 214 is present proceed with diagnosising DTC 214 prior to running the cylinder balance test.

- Run the Key On Engine Running **(KOER)** Self-Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test

- After the last repeated code, wait 5-10 seconds.
- "Goose" throttle lightly (not wide-open-throttle).
- Cylinder balance test will be performed. Time of test is approximately 2-3 minutes.
- **Are there any cylinder balance DTCs requiring service?**

  Yes -- Go to H8. See: H8 - Check Resistance of Injector(s) and Harness SFI Engines

  No -- For Symptoms: Return to Diagnostic Routines.

  For DTC 136, 172, 176: Go to H13. See: H13 - Check Secondary Air Injection Operation

  For DTC 137, 173, 177: Go to H24. See: H24 - Check HO2S Signal For Short to Power

  For all others: Go to H14. See: H14 - Check HO2S Integrity

H7 - Check Resistance of Injector(s) and Harness MFI Engines

- Key "OFF".
- Disconnect Powertrain Control Module **(PCM)**. Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary.

  NOTE: This erases Continuous Memory.
- Install breakout box, leave PCM disconnected.
- Measure resistance of injector bank 1 between test pin 37 and test pin 58 at the breakout box. Record resistance.
- Measure resistance of injector bank 2 between test pin 37 and test pin 59 at the breakout box. Record resistance.
- Refer to Fuel Injector Resistance Specification/Injector Bank Resistance (Multiport Fuel Injection). See: H - Fuel Injector Resistance Specification Table/Injector Bank Resistance (Multiport Fuel Injection)
- **Is each resistance within specification for the appropriate engine?**

  Yes -- Go to H12. See: H12 - Check Injector Driver Signal

  No -- For no start: Service open in VPWR circuit.

  For others: Go to H9. See: H9 - Check Continuity of Fuel Injector Harness

H8 - Check Resistance of Injector(s) and Harness SFI Engines

- Key "OFF".
- Disconnect Powertrain Control Module **(PCM)**. Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary.

  NOTE: This erases Continuous Memory.
- Install breakout box, leave PCM disconnected.
- Measure resistance between the suspect injector circuit test pin and test pin 37 at the breakout box. Record resistance.
- For No Starts:
  - Pick any injector and measure resistance between that INJECTOR circuit's test pin and test pin 37 at the breakout box. Record resistance.
- Refer to Fuel Injector Resistance Specifications/Single Injector Resistance (Sequential Fuel Injection). See: H - Fuel Injector Resistance Specification Table/Single Injector Resistance (Sequential Fuel Injection)
- **Is each resistance within specification for the appropriate engine?**

Yes -- Go to H12. See: H12 - Check Injector Driver Signal

No -- **For NO Start:** Service open in VPWR circuit.

For others: Go to H9. See: H9 - Check Continuity of Fuel Injector Harness

H9 - Check Continuity of Fuel Injector Harness

- Key "OFF".
- Breakout box installed, Powertrain Control Module **(PCM)** disconnected.
- Disconnect injector vehicle harness connector at the suspect injector.
- Measure resistance between test pin 37/57 at the breakout box and the VPWR pin at the injector vehicle harness connection.
- Refer to the Pinpoint Testing Schematic for the appropriate injector pin identification. See: H - Test Schematic
- Measure resistance between the injector test pin(s) at the breakout box and the same injector circuit signal pin at each injector vehicle harness connector.
- **Is each resistance less than 5.0 ohms?**

Yes -- Go to H10. See: H10 - Check Injector Harness Circuit For Short to Power/Ground

No -- Service open circuit. Remove breakout box. Reconnect PCM and injectors. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H10 - Check Injector Harness Circuit For Short to Power/Ground

- Key "OFF".
- Breakout box installed, Powertrain Control Module **(PCM)** disconnected.
- Suspect fuel injector vehicle harness disconnected.
- Refer to the Pinpoint Test Schematic for the appropriate injector pin identification. See: H - Test Schematic
- Measure resistance between the injector test pin(s) and test pins 37/57, 40, 46 and 60 at the breakout box.
- Measure resistance between the injector test pin(s) at the breakout box and chassis ground.
- **Is each resistance greater than 10,000 ohms?**

Yes -- **For Sequential Fuel Injection (SFI):** Replace injector per cylinder balance test fault code. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

For Multiport Fuel Injection (MFI): Go to H11. See: H11 - Isolate Faulty Injector Circuit

No -- Service short circuit. Remove breakout box. Reconnect PCM and injectors. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H11 - Isolate Faulty Injector Circuit

- Key "OFF".
- Breakout box installed, PCM disconnected.
- Disconnect all injectors on suspect bank.
- DVOM on 200 ohm scale.

- Connect one injector and measure resistance between test pin 37 and either test pin 58 or 59 as appropriate.
- Disconnect that injector and repeat process for each of the remaining injectors.

Specification

Injector resistance ..... 11.0-18.0 Ohms

- **Is each resistance within specification for the appropriate engine?**

Yes -- Go to H12. See: H12 - Check Injector Driver Signal

No -- Replace injector. Remove breakout box. Reconnect PCM and injectors. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H12 - Check Injector Driver Signal

Requires standard nonpowered 12 volt test lamp.

- Key "OFF".
- Breakout box installed.
- Connect Powertrain Control Module **(PCM)** to breakout box.
- **For Multiport Fuel Injection (MFI):**
  - Connect test lamp between test pin 37 and test pin 58 at the breakout box.
  - Connect test lamp between test pin 37 and 59 at the breakout box.
- **For Sequential Fuel Injection (SFI):**
  - Connect test lamp between test pin 37 and the suspect injectors test pin at the breakout box.
- Crank or start engine.

NOTE: Properly operating systems will show a dim glow on the lamp.

- **Is glow on lamp dim?**

Yes -- Remove breakout box. Reconnect PCM. Follow instructions for injector testing in **Fuel Delivery and Air Induction**. Also refer to **Ignition System** for other possible causes. After any servicing, Drive vehicle 5 miles/55 mph. Rerun Quick Test and Cylinder Balance test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

No -- No light/Bright light: Replace PCM. Remove breakout box. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H13 - Check Secondary Air Injection Operation

NOTE: If vehicle is not equipped with Secondary Air Injection **(AIR)** or is equipped with Pulsed-Secondary Air Injection **(PAIR)**, ignore this step and go to H14. See: H14 - Check HO2S Integrity

With dual Heated Oxygen Sensor **(HO2S)**, Diagnostic Trouble Code **(DTC)** 172 refer to right or rear HO2S; DTC 136, 176 refers to left or front HO2S. HO2S always lean could be caused by:

- Thermactor air being diverted upstream from the HO2S.

- Key "OFF".
- Disconnect the AIR hose(s) from the AIR pump so that secondary air is bypassed to atmosphere during testing.

- Run Engine Running Self-Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
- **Are DTCs 136, 172, 176 present?**

  Yes -- Reconnect AIR Hose. Go to H14. See: H14 - Check HO2S Integrity

  No -- For Continuous Memory DTCs 139, 144, 171, 176, 177: Go to H90. See: H90 - Check Continuous Monitor Diagnostic Test Mode

  All Others: Go to Emission Control Systems/Testing and Inspection for AIR systems diagnosis.

H14 - Check HO2S Integrity

Heated Oxygen Sensor **(HO2S)** always lean, slow to switch or lack of switching. Fuel at adaptive limit could be caused by:

- Moisture inside the HO2S harness connector resulting in a short to ground.
- HO2S coated with contaminants.
- HO2S circuit open.
- HO2S circuit shorted to ground.

- Key "OFF".
- Inspect the HO2S harness for chafing, burns or other indications of damage. Service as necessary.
- Inspect HO2S and connector for indication of submerging in water, oil, coolant, etc. Service as necessary.
- Run engine at 2000 rpm for two minutes.
- Key "OFF".
- Run Engine Running Self-Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
- **Are fault codes present?**

  Yes -- **For engines with Manifold Absolute Pressure (MAP) sensor:** Go to H15. See: H15 - Check HO2S On Engines With MAP Sensors

  For engines with Mass Air Flow (MAF) sensor: Go to H16. See: H16 - Check HO2S On Engines With MAF Sensor

  No -- Go to H21. See: H21 - Check For Power at HO2S Harness Connector

H15 - Check HO2S On Engines With MAP Sensors

NOTE: Vacuum/air leaks in non-Electronic Engine Controls **(EEC)** areas could also cause Diagnostic Trouble Codes **(DTC)** 136, 172 or 176. Check for:

- Leaking vacuum actuator (e.g. A/C control motor).
- Engine sealing.
- Exhaust Gas Recirculation **(EGR)** system.
- Positive Crankcase Ventilation **(PCV)** system.
- Lead contaminated Heated Oxygen Sensor **(HO2S)**.

- Key "OFF".
- Verify Manifold Absolute Pressure **(MAP)** sensor output voltage (refer to procedure in pinpoint test step DF3). See: DF - Manifold Absolute Pressure (MAP)/Barometric Pressure (BP)/DF3

- Disconnect appropriate HO2S from vehicle harness.
- Connect to HO2S circuit and HO2S GND or SIG RTN at the HO2S connector.
- Disconnect and plug vacuum line at MAP sensor.
- Digital Volt/Ohm Meter **(DVOM)** on 20 volt scale.
- Start engine and apply 33-46 kPa (10-14 in Hg) to MAP sensor.
- Run engine at approximately 2000 rpm for two minutes.
- **Does the DVOM indicate greater than 0.5 volt within two minutes?**

  Yes -- Go to H17. See: H17 - Check Continuity of HO2S Signal and HO2S Ground

  No -- Replace HO2S. Reconnect MAP sensor vacuum line. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H16 - Check HO2S On Engines With MAF Sensor

NOTE: The purpose of this test is to verify the Heated Oxygen Sensor **(HO2S)** can generate greater than 0.5 volt during Engine Running Self-Test.

Any vacuum/air leaks in non-Electronic Engine Controls **(EEC)** areas could also cause Diagnostic Trouble Code **(DTC)** 136,172 or 176. Check for:

- Leaking vacuum actuator (e.g. A/C control motor).
- Engine sealing.
- Exhaust Gas Recirculation **(EGR)** system.
- Positive Crankcase Ventilation **(PCV)** system.
- Unmetered air leak between Mass Air Flow **(MAF)** sensor and throttle body.
- Lead contaminated HO2S.

- Key "OFF".
- Disconnect appropriate HO2S from vehicle harness.
- Connect Digital Volt/Ohm Meter **(DVOM)** to HO2S circuit and HO2S SIG RTN or HO2S GND at the HO2S connector.
- DVOM on 20 volt scale.
- Run engine at approximately 2000 rpm for two minutes.
- Rerun Engine Running Self-Test and monitor HO2S voltage. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
- **Does DVOM indicate greater than 0.5 volt at the end of Self-Test?**

  Yes -- Go to H17. See: H17 - Check Continuity of HO2S Signal and HO2S Ground

  No -- Replace HO2S. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H17 - Check Continuity of HO2S Signal and HO2S Ground

- Key "OFF".
- Breakout box installed, Powertrain Control Module **(PCM)** disconnected.

- Disconnect suspect Heated Oxygen Sensor **(HO2S)** from vehicle harness. Inspect both ends of connector for damaged or pushed out pins, moisture, corrosion, loose wires, etc. Service as necessary.
- Measure resistance between HO2S circuit test pin at the breakout box and HO2S circuit at the vehicle harness connector.
- Measure resistance between SIG RTN test pin at the breakout box and HO2S SIG RTN at the vehicle harness connector.
- Where applicable measure resistance between HO2S GND and SIG RTN at the breakout box.
- **Is each resistance less than 5.0 ohms?**

  Yes -- Go to H18. See: H18 - Check HO2S Circuit For Short to Ground

  No -- Service open circuit. Remove breakout box. Reconnect PCM, HO2S, and any other components that have been disconnected. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H18 - Check HO2S Circuit For Short to Ground

- Key "OFF".
- Breakout box installed, Powertrain Control Module **(PCM)** disconnected.
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Measure resistance between the HO2S circuit test pin at the breakout box and test pins 40, 46 or 49 where applicable at the breakout box.
- **Is each resistance greater than 10,000 ohms?**

  Yes -- Go to H19. See: H19 - Check HO2S For Short to Ground

  No -- Service short circuit. Remove breakout box. Reconnect PCM, HO2S, and any other components that are disconnected. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H19 - Check HO2S For Short to Ground

- Key "OFF".
- Breakout box installed, Powertrain Control Module **(PCM)** disconnected.
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Measure resistance between PWR GND and HO2S circuit at the HO2S connector.
- Measure resistance between HO2S circuit and HO2S GND and/or SIG RTN at the HO2S connector. See: H - Test Schematic
- **Is resistance greater than 10,000 ohms?**

  Yes -- **For Diagnostic Trouble Codes (DTC)**: 136, 139, 144, 171, 172, 175 or 176, go to H20. See: H20 - Check Resistance of Heated Element on HO2S

  No -- Replace HO2S. Remove breakout box. Reconnect PCM. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H20 - Check Resistance of Heated Element on HO2S

- Key "OFF".
- Disconnect suspect Heated Oxygen Sensor **(HO2S)** from vehicle harness.
- Inspect both ends of the connector for damaged or pushed out pins, moisture, corrosion, loose wires, etc. Service as necessary.
- Measure resistance between KEY PWR circuit and PWR GND circuit at HO2S connector (refer to schematic). See: H - Test Schematic

- Hot to warm resistance specification is 5.0 to 30.0 ohms.
- Room temperature resistance specification is 2.0 to 5.0 ohms.

- **Is resistance within specification?**

  Yes -- Go to H21. See: H21 - Check For Power at HO2S Harness Connector

  No -- Replace HO2S. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H21 - Check For Power at HO2S Harness Connector

- Key "ON", engine "OFF".
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Measure voltage between KEY POWER circuit and PWR GND circuit at the HO2S vehicle harness connector (refer to schematic). See: H - Test Schematic
- **Is voltage greater than 10.5 volts?**

  Yes -- Go to H22. See: H22 - Check Continuity of Power Ground Circuit

  No -- Service open in KEY PWR circuit. Reconnect HO2S. Rerun Quick Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H22 - Check Continuity of Power Ground Circuit

- Key "OFF".
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Measure resistance between PWR GND circuit at the HO2S vehicle harness connector and battery negative post.
- **Is resistance less than 5.0 ohms?**

  Yes -- For Diagnostic Trouble Codes **(DTC)** 136, 172 and 176 go to H23. See: H23 - Attempt to Eliminate DTC 136, 172 or 176

  No -- Service open in PWR GND circuit. Reconnect HO2S sensor. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H23 - Attempt to Eliminate DTC 136, 172 or 176

- Key "OFF".
- Breakout box installed.
- Disconnect and plug Manifold Absolute Pressure **(MAP)** vacuum line.
- Connect Powertrain Control Module **(PCM)** to breakout box.
- Reconnect Heated Oxygen Sensor **(HO2S)**.
- Start engine and apply 34.47 kPa (10-14 in Hg) vacuum to MAP sensor.
- Run engine at approximately 2000 rpm for two minutes. Allow engine to return to idle.
- Rerun Engine Running Self-Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test

  NOTE: If you are here for Continuous Memory Diagnostic Trouble Codes **(DTC)** the vehicle has to be driven 5 miles/55 mph.

- **Is DTC 136, 172 or 176 still present (ignore all other DTCs)?**

  Yes -- Remove breakout box. Reconnect MAP sensor vacuum line. If engine runs rough, go to S2. See: S - System Check/S2 - Check For RPM Drop

  All others Replace PCM. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

  No -- Remove breakout box. Reconnect PCM and MAP sensor vacuum line. HO2S input OK. Fuel delivery is OK. Problem is in an area common to all cylinders, i.e. air/vacuum leak, fuel contamination, Exhaust Gas Recirculation **(EGR)**, Secondary Air Induction **(AIR)** , check MAP frequency, ignition system, etc. Service as necessary.

H24 - Check HO2S Signal For Short to Power

With dual Heated Oxygen Sensor **(HO2S)**, Diagnostic Trouble Code **(DTC)** 173 refers to right or rear HO2S; DTCs 137 and 177 refer to left or front HO2S.

HO2S always rich could be caused by:

- Moisture inside HO2S harness connector resulting in a short to power.
- HO2S circuit shorted to power.

- Key "OFF".
- Disconnect the suspect HO2S from vehicle harness.
- Inspect both ends of the connector for damaged or pushed out pins, moisture, corrosion, loose wires, etc. Service as necessary.
- Key "ON", engine "OFF".
- Measure voltage between HO2S circuit and PWR GND at the HO2S vehicle harness connector (refer to schematic). See: H - Test Schematic
- **Is voltage less than 0.5 volt?**

  Yes -- Go to H26. See: H26 - Check HO2S For Short to Ignition Run Circuit

  No -- Go to H25. See: H25 - Check For Short to Power

H25 - Check For Short to Power

- Key "OFF".
- Inspect HO2S GND and HO2S circuit harness for chaffing, burns or other indications of short to power. Service as necessary.
- Disconnect Powertrain Control Module **(PCM)**. Inspect for damaged, or pushed out pins, corrosion, loose wires etc. Service as necessary.
- Install breakout box, leave PCM disconnected.
- Suspect HO2S disconnected.
- Measure resistance between HO2S circuit, and KEYPWR at the breakout box.
- **Is the resistance greater than 10,000 ohms?**

  Yes -- Replace PCM. Remove breakout box. Reconnect HO2S. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

  No -- Service short to power. Remove breakout box. Reconnect PCM. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H26 - Check HO2S For Short to Ignition Run Circuit

Key **"OFF"**.
Heated Oxygen Sensor **(HO2S)** disconnected.
Measure resistance between KEY PWR circuit and HO2S SIG circuit at the connector (refer to schematic). See: H - Test Schematic

Is resistance greater than **10,000 ohms?**

Yes -- For Diagnostic Trouble Codes **(DTC) 137, 173 and 177**: Go to H27. See: H27 - Attempt to Generate DTC 136, 172, or 176

For DTCs **171, 174, 175, 178:**

Manifold Absolute Pressure **(MAP)** sensor: Go to H28. See: H27 - Attempt to Generate DTC 136, 172, or 176

Mass Air Flow **(MAF)** sensor: Go to H30. See: H30 - HO2S Check

No -- Replace HO2S. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H27 - Attempt to Generate DTC 136, 172, or 176

- Key "OFF".
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Jumper HO2S circuit at the HO2S vehicle harness connector to battery negative post.
- Rerun Engine Running Self-Test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)/Key ON Engine Running (KOER) Self-Test
- **Is Diagnostic Trouble Code (DTC) 136, 172 or 176 present?**

Yes -- Remove jumper.

With Mass airflow sensor, go to H30. See: H30 - HO2S Check

With Manifold absolute pressure sensor, go to H28 See: H28 - Check MAP Sensor For Vacuum Leak

No -- Remove jumper. Reconnect HO2S. Disconnect Powertrain Control Module **(PCM)** 60 pin connector. Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary. If OK Replace PCM. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H28 - Check MAP Sensor For Vacuum Leak

NOTE: Due to the Manifold Absolute Pressure **(MAP)** sensor's large influence on fuel control, there is a possibility that MAP could be at fault without a Diagnostic Trouble Code **(DTC)** 126. The next two test steps will verify proper vacuum to the MAP sensor and its ability to hold vacuum.

- Key "OFF".
- Disconnect vacuum line from MAP sensor.
- Inspect hose for blockage (kinks or gel build up), damage from wear or aging. Service as necessary.
- Plug vacuum hose at the MAP side.
- Connect a vacuum pump to the MAP sensor and apply 60 kPa (18 in Hg) vacuum to MAP sensor.
- **Does MAP sensor hold vacuum?**

Yes -- Release vacuum. Go to H29. See: H29 - Check For Loss of Vacuum to MAP Sensor

No -- Replace MAP sensor. Remove vacuum pump. Reconnect HO2S. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H29 - Check For Loss of Vacuum to MAP Sensor

- Tee a vacuum gauge into the manifold vacuum line at Manifold Absolute Pressure **(MAP)** sensor
- Start the engine and let rpm stabilize. Note vacuum level.
- Key "OFF".
- Remove vacuum gauge and tee and reconnect vacuum line to MAP sensor.
- Tee in vacuum gauge at a different source of intake manifold vacuum and restart the engine. Note vacuum level.
- **Does the vacuum level differ more than 3.4 kPa (1.0 in-Hg)?**

Yes -- Inspect engine vacuum integrity. Service as necessary. Remove vacuum gauge and Tee. Reconnect Heated Oxygen Sensor **(HO2S)**. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

No -- Go to H30. See: H30 - HO2S Check

H30 - HO2S Check

- Key "OFF".
- Heated Oxygen Sensor **(HO2S)** disconnected.
- Connect Digital Volt/Ohm Meter **(DVOM)** to HO2S circuit and HO2S GND or SIG RTN at the HO2S connector.
- DVOM on 20 volt scale.
- Create a vacuum leak to cause HO2S to go lean.

For all engines with Mass Air Flow (MAF) sensors:

- Disconnect any vacuum hose from the manifold vacuum tree.

For all other applications:

- Disconnect the Positive Crankcase Ventilation **(PCV)** valve hose from the PCV valve.
- Start engine and run at approximately 2000 rpm.
- **Does the DVOM indicate less than 0.4 volt within 30 seconds?**

Yes -- Go to H90. See: H90 - Check Continuous Monitor Diagnostic Test Mode

No -- Replace HO2S. Reconnect vacuum hoses. Drive vehicle 5 miles/55 mph. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

H90 - Check Continuous Monitor Diagnostic Test Mode

- Key "OFF".
- Verify engine at operating temperature.
- Start engine and run at 2000 rpm for two minutes.
- With engine rpm at idle enter Engine Running Continuous Monitor **(DTM)**. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Continuous Monitor Diagnostic Test Mode (Wiggle Test)
- Observe Analog Volt/Ohm Meter **(VOM)** or STAR LED for indication of fault.
- Wiggle, shake or bend a small section of the Electronic Engine Controls **(EEC)** harness while working your way from the Heated Oxygen Sensor **(HO2S)** to the Powertrain Control Module **(PCM)**.

- Wiggle, shake or bend a small section of the EEC harness while working your way from the HO2S GND to the PCM.
- **Is a fault indicated?**

Yes -- Isolate fault and service as necessary. Remove breakout box. Clear continuous memory. See: Reading and Clearing Diagnostic Trouble Codes/Clearing Diagnostic Trouble Codes

Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

No -- Remain in Engine Running Continuous Monitor Test Mode. Go to H91. See: H91 - Continuous Monitor DTM Test Drive Check

H91 - Continuous Monitor DTM Test Drive Check

- Remain in Engine Running Continuous Monitor test mode.
- Test drive vehicle at 55 mph with minimum road load for five miles.
- Continue to drive on a rough road at 55 mph for five miles.
- If possible drive vehicle through a pool of water on the road to shower the Heated Oxygen Sensor **(HO2S)** and/or connector.
- **Is a fault indicated?**

Yes -- Isolate fault and service as necessary. Remove breakout box. Clear continuous memory code. See: Reading and Clearing Diagnostic Trouble Codes/Clearing Diagnostic Trouble Codes

Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)

No -- Exit Engine Running Continuous Monitor test mode. Go to H92. See: H92 - Check HO2S Switching

H92 - Check HO2S Switching

- Key "OFF".
- Inspect Electronic Engine Controls **(EEC)** wire harness for proper routing and insulation; burnt, chafed, intermittently shorted or open. Service as necessary.
- Disconnect Powertrain Control Module **(PCM)** 60 pin connector and inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary.
- Install breakout box and connect PCM to breakout box.
- Connect analog voltmeter to the suspect Heated Oxygen Sensor **(HO2S)** test pin and HO2S GND at the breakout box.
- Test drive vehicle at 55 mph with minimum road load for five miles.
- Observe voltmeter for HO2S switching from 0.3 to 0.9 volts within three seconds.
- **Did HO2S voltage switch?**

Yes -- Unable to duplicate or identify fault at this time. Clear continuous memory Diagnostic Trouble Codes **(DTC)**. See: Reading and Clearing Diagnostic Trouble Codes/Clearing Diagnostic Trouble Codes

For further diagnosis, refer to **Diagnosis by Symptom (Diagnostic Routines).**

No -- Replace HO2S. Remove breakout box. Reconnect PCM. Rerun quick test. See: Reading and Clearing Diagnostic Trouble Codes/Reading Diagnostic Trouble Codes/Quick Test Appendix (Detailed Testing Instructions)