HC: Fuel Delivery System

HC: Introduction

HC1 DTC P0148 OR SYMPTOMS WITHOUT DTCS: CHECK THE SYSTEM INTEGRITY

- Visually inspect the complete fuel delivery system for damage and leakage.
- Check the following:
  - fuel lines and connections
  - relays
  - fuel tank
  - fuel pump
  - fuel pressure regulator
  - fuel pulse damper
  - fuel rail at injectors
  - damaged connector pins
  - electrical connectors not fully engaged
- Verify the vehicle has followed the maintenance schedule. A new fuel filter should have been installed within the last 48,280 km (30,000 miles) (vehicles with inline fuel filter).
- Verify the inertia fuel shutoff (IFS) switch is set (button pushed in). Refer to the Owner's Literature, Roadside Emergencies for the location of the IFS switch (if equipped).
- Verify the fuse integrity.
- Verify the battery is fully charged.
- Verify clean sufficient fuel.

Is a concern present?

Yes	No
REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.	GO to HC2 .

HC2 CHECK ALL SYSTEM RELATED DEVICES (SENSOR, DAMPER OR REGULATOR) FOR LEAKAGE

- Ignition OFF.
- FP connector connected.
- Remove the vacuum hose on each system device connected to the fuel rail.
- Inspect for the presence of fuel in the vacuum line of each device connected to the fuel rail.
- Ignition ON, engine running.
- Check for manifold vacuum at each system related component with a vacuum line.
- Ignition OFF.

Are all vacuum lines for system related devices indicating no fuel present?

Yes	No
GO to HC3 .	If the vacuum line connected to a component indicates that a fuel leak is present, INSTALL a new component. CLEAR the DTCs. REPEAT the self-test.

HC3 CHECK THE FUEL PRESSURE

- Ignition OFF.
- 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.
- Ignition ON, engine OFF.
- 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.
- FP connector connected.
- Cycle the ignition several times to charge the fuel system.
- Compare the fuel pressure reading to the Fuel System Specification Chart.

Is the fuel pressure within range?

Yes	No
For DTCs P0171, P0174, P2195 or P2197, GO to HC15 . For all others, GO to HC6 .	GO to HC4 .

HC4 CHECK THE FUEL PUMP GROUND CIRCUIT FOR AN OPEN CIRCUIT IN THE HARNESS

Note: Refer to the Wiring Diagrams Manual for schematic and connector information.

- FP connector disconnected.
- Measure the voltage between:

(+) Vehicle Battery	(-) FP Connector, Harness Side
Positive terminal	FPGND

Is the voltage greater than 10 V?

Yes	No
GO to HC5 .	REPAIR the open circuit. CLEAR the DTCs. REPEAT the self-test.

HC5 CHECK THE FUEL PUMP POWER CIRCUIT FOR AN OPEN IN THE HARNESS

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

- Verify the inertia fuel shutoff (IFS) switch is set (button pushed in). Refer to the Owner's Literature, Roadside Emergencies for the location of the IFS switch (if equipped).
- FP connector disconnected.
- Ignition ON, engine OFF.
- Access the PCM and control the FP PID.
- Be aware that output state control turns off the FP after a calibrated time. If this happens, command the outputs on again to continue testing.
- Measure the voltage between:

(+) FP Connector, Harness Side	(-) Vehicle Battery

FPPWR	Negative terminal

Is the voltage greater than 10 V?

Yes	No
GO to HC12 .	REPAIR the open circuit. CLEAR the DTCs. REPEAT the self-test.

HC6 CHECK THE SEPARATION LEVEL OF THE ETHANOL/WATER MIXTURE AND GASOLINE 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/water mixture and gasoline meet.

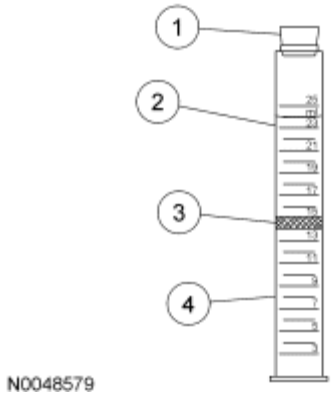
Did the ethanol/water mixture and gasoline separate?

Yes	No
GO to HC7 .	COMPLETE all steps before continuing. The ethanol/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.

HC7 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/Water Mixture

- Record the calculated percentage of ethanol in the fuel.

Is any ethanol present in the fuel?

Yes	No
For flex fuel vehicles, GO to HC8 . For all others, GO to HC11 .	GO to HC12 .

HC8 COMPARE THE FF_INF PID TO THE CALCULATED PERCENTAGE OF ETHANOL

Note: When determining if the FF_INF PID value is within 50% of the calculated percentage of ethanol, if the calculated percentage of ethanol value is 40% then the PID value should be between 0 - 90%. The PID value cannot be less than zero.

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

Is the FF_INF PID value within 50% of the calculated percentage of ethanol?

Yes	No
GO to HC12 .	GO to HC9 .

HC9 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 PID.
- Drive the vehicle approximately 11.3 km (7 miles) or until the FF_LRND PID indicates yes.

Is the PID state YES?

Yes	No
GO to HC10 .	GO to HC18 .

HC10 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 PID.

Is the FF_INF PID value within 50% of the calculated percentage of ethanol?

Yes	No
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 verify the PCM is learning the correct percentage of ethanol in the fuel.	A fuel system concern may be present, which prevents the PCM from learning the correct percentage of ethanol in the fuel, GO to HC12 .

HC11 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	No
GO to HC12 .	REPAIR as necessary. ADVISE the customer of the correct fuel type required for this vehicle. REFER to the Owner's Literature for additional information. CLEAR the DTCs. REPEAT the self-test.

HC12 CHECK THE FUEL PRESSURE 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 only about 5 seconds.

- Mechanical fuel pressure gauge connected.
- Ignition ON, engine OFF.
- Access the PCM and control the FP 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 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	No
For Crown Victoria, Explorer, Explorer Sport Trac, F-Super Duty, Grand Marquis, Mountaineer, Mustang, and Town Car, GO to HC14 . For all others, GO to HC15 .	GO to HC13 .

HC13 CHECK THE FUEL INJECTOR FLOW AND LEAKAGE

Note: Observe the Warnings, Cautions, and Notes.

- Check the fuel injectors for leakage and flow rate using the injector flow tester or other method such as inspecting the intake manifold for fuel.

Are the test results satisfactory?

Yes	No
For Crown Victoria, Explorer, Explorer Sport Trac, F-Super Duty, Grand Marquis, Mountaineer, Mustang, and Town Car, GO to HC14 . For all others, GO to HC15 .	INSTALL a new fuel injector as necessary. 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.

HC14 COMPARE THE FRP PID TO THE MECHANICAL GAUGE

Note: Most mechanical gauges are referenced to atmospheric pressure. The FRPT sensor is referenced to manifold pressure. In order to make a valid comparison, the engine must be off.

Note: The vehicle may exhibit a long crank until the fuel system is pressurized.

- Ignition OFF.
- Relieve the fuel pressure. Refer to the Workshop Manual Section 310-00, Fuel System for the Fuel System Pressure Release procedure.
- Disable the fuel pump.
- Ignition ON, engine OFF.
- Monitor the mechanical gauge.
- Access the PCM and monitor the FRP PID.
- Compare the FRP PID value to the mechanical gauge.
- Ignition OFF.
- 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 OFF.
- Compare the FRP PID value to the mechanical gauge.

Are the FRP PID values within 34 kPa (5 psi) of the mechanical gauge readings?

Yes	No
GO to HC15 .	INSTALL a new FRPT sensor. REFER to the fuel system WARNING information at the beginning of this pinpoint test. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CLEAR the DTCs. REPEAT the self-test.

HC15 MONITOR THE FUEL PRESSURE WHILE ROAD TESTING THE VEHICLE

WARNING: STRICT OBSERVANCE OF POSTED SPEED LIMITS AND ATTENTION TO DRIVING CONDITIONS ARE MANDATORY WHEN CARRYING OUT THE ROAD TEST. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

Note: Some concerns may only be present during certain fuel level conditions. Determine the fuel level at the time of the concern. Access the information from the customer information worksheet and the customer.

- Ignition OFF.
- Securely route the mechanical gauge so that the gauge is viewable while road testing the vehicle.
- Ignition ON, engine running.
- Engine at normal operating temperature.
- Monitor the mechanical gauge.
- From a stop, accelerate to 89 km/h (55 mph) at full throttle. Repeat this 3 times.

Is the fuel pressure always greater than 240 kPa (35 psi)?

Yes	No
For misfire DTC diagnosis, GO to HD8 . For DTCs P0171, P0174, P2195, or P2197, GO to H27 . For symptoms without DTCs, the concern is elsewhere. RETURN to Section 3, No Diagnostic	GO to HC16 .

Trouble Codes (DTCs) Present Symptom Chart Index for further direction. For all others, unable to duplicate or identify the concern at this time.	

HC16 CHECK THE FUEL SUPPLY LINE FOR RESTRICTION

Note: Observe the Warnings, Cautions, and Notes.

- Ignition OFF.
- Disconnect the fuel supply line at the fuel rail.
- Disconnect the fuel supply line at the fuel pump.
- Check the fuel supply line for restriction.
- Apply 21 to 34 kPa (3 to 5 psi) air pressure to the fuel supply line.

Does air flow freely through the line?

Yes	No
INSTALL a new Fuel Filter assembly. REFER to the Workshop Manual Section 310-01, Fuel Tank and Lines. GO to HC17.	REPAIR the cause of the restriction. CLEAR the DTCs. REPEAT the self-test.

HC17 VERIFY THE REPAIR

WARNING: STRICT OBSERVANCE OF POSTED SPEED LIMITS AND ATTENTION TO DRIVING CONDITIONS ARE MANDATORY WHEN CARRYING OUT THE ROAD TEST. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

- Ignition ON, engine running.
- Engine at normal operating temperature.
- Monitor the mechanical gauge.
- From a stop, accelerate to 89 km/h (55 mph) at full throttle. Repeat this 3 times.

Is the fuel pressure always greater than 240 kPa (35 psi)?

Yes	No
The test is complete and no concerns are present.	INSTALL a new FP module. REFER to the Workshop Manual Section 310-01, Fuel Tank and Lines. CLEAR the DTCs. REPEAT the self-test.

HC18 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 and verify the concern is still present.

Is the concern still present?

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