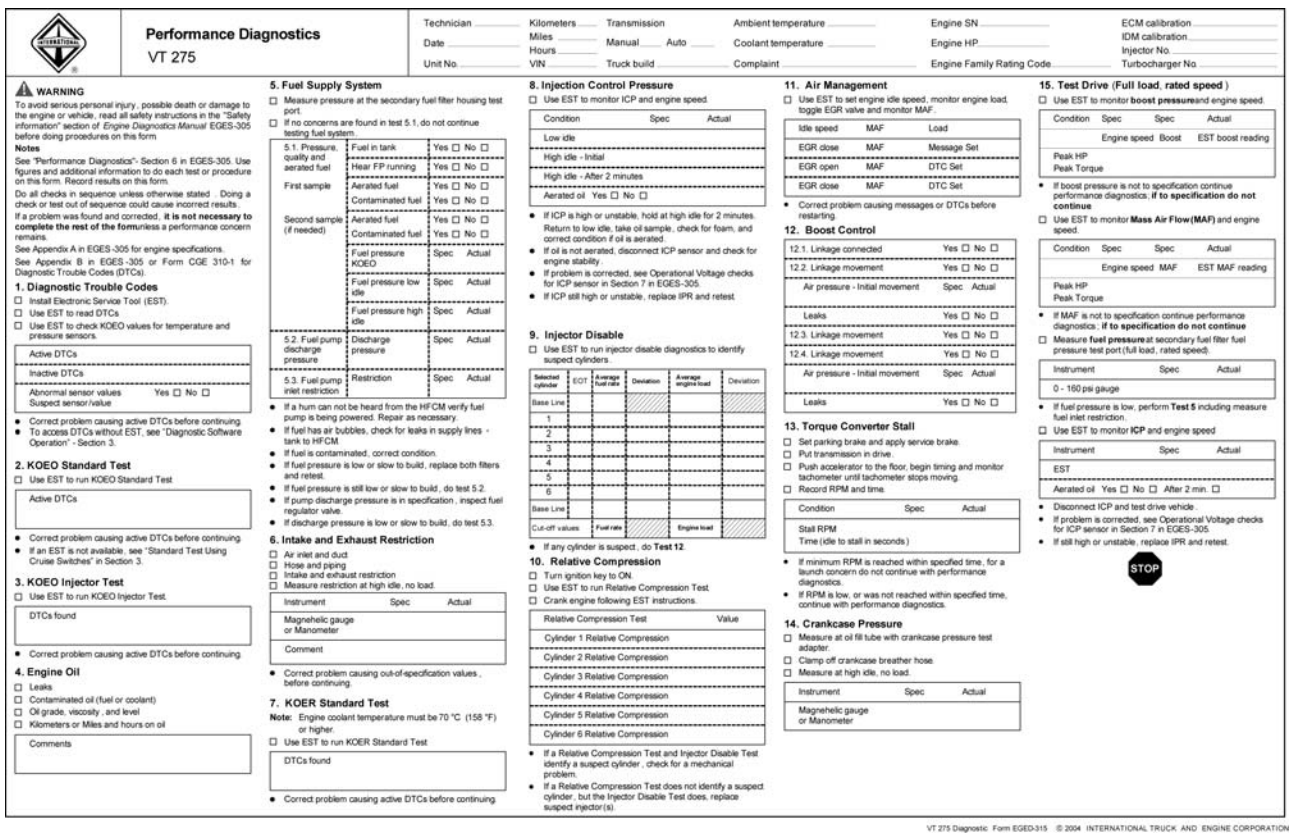
Table of Contents

Description

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake , and block wheels before doing diagnostic or service procedures.

Engine diagnostic forms assist technicians in troubleshooting International® diesel engines. Diagnostic test procedures help technicians solve problems systematically and quickly to avoid unnecessary repairs.

Diagnostic Form EGED-315 Information



Performance Diagnostics
VT 275

Technician ____ Kilometers ____ Transmission ____ Ambient temperature ____ Engine SN ____ ECM calibration ____
Date ____ Miles ____ Manual ____ Auto ____ Coolant temperature ____ Engine HP ____ IDM calibration ____
Hours ____ Injector No. ____
Unit No. ____ VIN ____ Truck build ____ Complaint ____ Engine Family Rating Code ____ Turbocharger No. ____

WARNING
To avoid serious personal injury, possible death or damage to the engine or vehicle, read all safety instructions in the "Safety Information" section of *Engine Diagnostics Manual* EGES-305 before doing procedures on this form.

Notes
See "Performance Diagnostics"- Section 6 in EGES-305. Use figures and additional information to do each test or procedure on this form. Record results on this form.
Do all checks in sequence unless otherwise stated . Doing a check or test out of sequence could cause incorrect results.
If a problem was found and corrected, **it is not necessary to complete the rest of the form** unless a performance concern remains.
See Appendix A in EGES-305 for engine specifications.
See Appendix B in EGES-305 or Form CGE 310-1 for Diagnostic Trouble Codes (DTCs).

1. Diagnostic Trouble Codes
☐ Install Electronic Service Tool (EST).
☐ Use EST to read DTCs
☐ Use EST to check KOEO values for temperature and pressure sensors.

Active DTCs
Inactive DTCs
Abnormal sensor values Yes ☐ No ☐ Suspect sensor/value

- Correct problem causing active DTCs before continuing.
- To access DTCs without EST, see "Diagnostic Software Operation" - Section 3.

2. KOEO Standard Test
☐ Use EST to run KOEO Standard Test.

Active DTCs

- Correct problem causing active DTCs before continuing.
- If an EST is not available, see "Standard Test Using Cruise Switches" in Section 3.

3. KOEO Injector Test
☐ Use EST to run KOEO Injector Test.

DTCs found

- Correct problem causing active DTCs before continuing.

4. Engine Oil
☐ Leaks
☐ Contaminated oil (fuel or coolant)
☐ Oil grade, viscosity , and level
☐ Kilometers or Miles and hours on oil

Comments

5. Fuel Supply System
☐ Measure pressure at the secondary fuel filter housing test port.
☐ If no concerns are found in test 5.1, do not continue testing fuel system.

5.1. Pressure, quality and aerated fuel	Fuel in tank	Yes ☐ No ☐
	Hear FP running	Yes ☐ No ☐
First sample	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
Second sample (if needed)	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
	Fuel pressure KOEO	Spec Actual
	Fuel pressure low idle	Spec Actual
	Fuel pressure high idle	Spec Actual
5.2. Fuel pump discharge pressure	Discharge pressure	Spec Actual
5.3. Fuel pump inlet restriction	Restriction	Spec Actual

- If a hum can not be heard from the HFCM verify fuel pump is being powered. Repair as necessary.
- If fuel has air bubbles, check for leaks in supply lines - tank to HFCM.
- If fuel is contaminated, correct condition.
- If fuel pressure is low or slow to build, replace both filters and retest.
- If fuel pressure is still low or slow to build , do test 5.2.
- If pump discharge pressure is in specification , inspect fuel regulator valve.
- If discharge pressure is low or slow to build, do test 5.3.

6. Intake and Exhaust Restriction
☐ Air inlet and duct
☐ Hose and piping
☐ Intake and exhaust restriction
☐ Measure restriction at high idle, no load.

Instrument	Spec	Actual
Magnehelic gauge or Manometer		
Comment		

- Correct problem causing out-of-specification values , before continuing.

7. KOER Standard Test
Note: Engine coolant temperature must be 70 °C (158 °F) or higher.
☐ Use EST to run KOER Standard Test.

DTCs found

- Correct problem causing active DTCs before continuing.

8. Injection Control Pressure
☐ Use EST to monitor ICP and engine speed.

Condition	Spec	Actual
Low idle		
High idle - Initial		
High idle - After 2 minutes		
Aerated oil Yes ☐ No ☐		

- If ICP is high or unstable, hold at high idle for 2 minutes. Return to low idle, take oil sample , check for foam, and correct condition if oil is aerated.
- If oil is not aerated, disconnect ICP sensor and check for engine stability.
- If problem is corrected, see Operational Voltage checks for ICP sensor in Section 7 in EGES-305.
- If ICP still high or unstable, replace IPR and retest.

9. Injector Disable
☐ Use EST to run injector disable diagnostics to identify suspect cylinders.

Selected cylinder	EOT	Average fuel rate	Deviation	Average engine load	Deviation
Base Line					
1					
2					
3					
4					
5					
6					
Base Line					
Cut-off values		Fuel rate		Engine load	

- If any cylinder is suspect , do **Test 12**.

10. Relative Compression
☐ Turn ignition key to ON.
☐ Use EST to run Relative Compression Test.
☐ Crank engine following EST instructions.

Relative Compression Test	Value
Cylinder 1 Relative Compression	
Cylinder 2 Relative Compression	
Cylinder 3 Relative Compression	
Cylinder 4 Relative Compression	
Cylinder 5 Relative Compression	
Cylinder 6 Relative Compression	

- If a Relative Compression Test and Injector Disable Test identify a suspect cylinder , check for a mechanical problem.
- If a Relative Compression Test does not identify a suspect cylinder , but the Injector Disable Test does, replace suspect injector(s).

11. Air Management
☐ Use EST to set engine idle speed, monitor engine load, toggle EGR valve and monitor MAF.

Idle speed	MAF	Load
EGR close	MAF	Message Set
EGR open	MAF	DTC Set
EGR close	MAF	DTC Set

- Correct problem causing messages or DTCs before restarting.

12. Boost Control

12.1. Linkage connected	Yes ☐ No ☐
12.2. Linkage movement	Yes ☐ No ☐
Air pressure - Initial movement	Spec Actual
Leaks	Yes ☐ No ☐
12.3. Linkage movement	Yes ☐ No ☐
12.4. Linkage movement	Yes ☐ No ☐
Air pressure - Initial movement	Spec Actual
Leaks	Yes ☐ No ☐

13. Torque Converter Stall
☐ Set parking brake and apply service brake.
☐ Put transmission in drive.
☐ Push accelerator to the floor, begin timing and monitor tachometer until tachometer stops moving.
☐ Record RPM and time.

Condition	Spec	Actual
Stall RPM Time (idle to stall in seconds)		

- If minimum RPM is reached within specified time, for a launch concern do not continue with performance diagnostics.
- If RPM is low, or was not reached within specified time, continue with performance diagnostics.

14. Crankcase Pressure
☐ Measure at oil fill tube with crankcase pressure test adapter.
☐ Clamp off crankcase breather hose.
☐ Measure at high idle, no load.

Instrument	Spec	Actual
Magnehelic gauge or Manometer		

15. Test Drive (Full load, rated speed)
☐ Use EST to monitor **boost pressure** and engine speed.

Condition	Spec	Spec	Actual
	Engine speed	Boost	EST boost reading
Peak HP			
Peak Torque			

- If boost pressure is not to specification continue performance diagnostics, **if to specification do not continue**.

☐ Use EST to monitor **Mass Air Flow (MAF)** and engine speed.

Condition	Spec	Spec	Actual
	Engine speed	MAF	EST MAF reading
Peak HP			
Peak Torque			

- If MAF is not to specification continue performance diagnostics , **if to specification do not continue**.

☐ Measure **fuel pressure** at secondary fuel filter fuel pressure test port (full load, rated speed).

Instrument	Spec	Actual
0 - 160 psi gauge		

- If fuel pressure is low, perform **Test 5** including measure fuel inlet restriction.

☐ Use EST to monitor **ICP** and engine speed

Instrument	Spec	Actual
EST		
Aerated oil Yes ☐ No ☐ After 2 min. ☐		

- Disconnect ICP and test drive vehicle.
- If problem is corrected, see Operational Voltage checks for ICP sensor in Section 7 in EGES-305.
- If still high or unstable, replace IPR and retest.

STOP

VT 275 Diagnostic Form EGED-315 © 2004 INTERNATIONAL TRUCK AND ENGINE CORPORATION

Figure 232 Diagnostic Form EGED-315 (Performance Diagnostics side)

Test Procedures

1. Diagnostic Trouble Codes

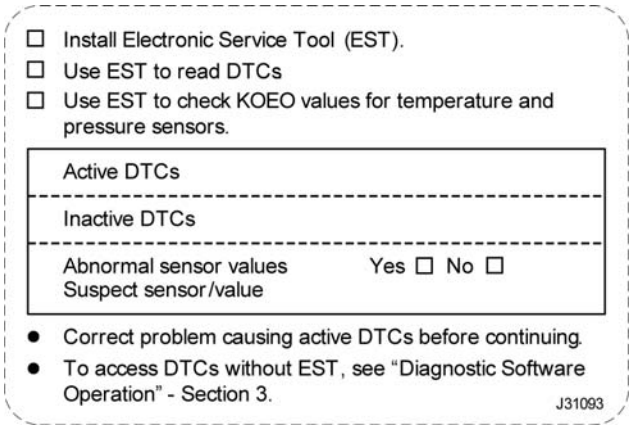


Figure 233

Purpose

- To determine if the ECM has detected Diagnostic Trouble Codes (DTCs) indicating conditions that could cause engine problems
- Fill out Diagnostic Form heading.
- Check for abnormal sensor readings.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

Vehicle Information for Form Heading

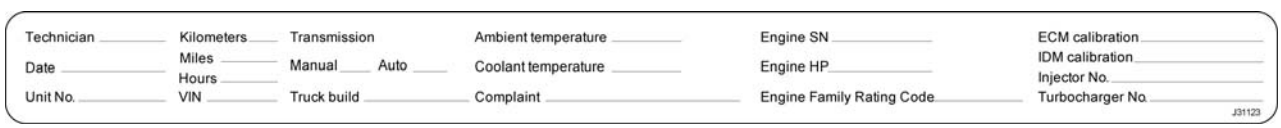


Figure 234

NOTE: Before continuing diagnostic tests, fill out the form heading on Diagnostics Form.

Entering Vehicle Information without using the Electronic Service Tool (EST)

1. Enter mechanical information in the form heading:

Technician
Date (for warranty)
Unit No (dealer's quick reference for customer's vehicle identification)
Truck build (date)
Complaint (for warranty)

2. Enter electronic information in the form heading, see Entering Vehicle Information using the Electronic Service Tool (EST).

Entering Vehicle Information using the Electronic Service Tool (EST)

Figure 235 American Trucking Association (ATA) connector (typical)

1. ATA connector

Figure 236 EZ-Tech® interface cable

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

1. Connect the EZ-Tech® interface cable to the EST and the ATA connector.
2. Boot EST.

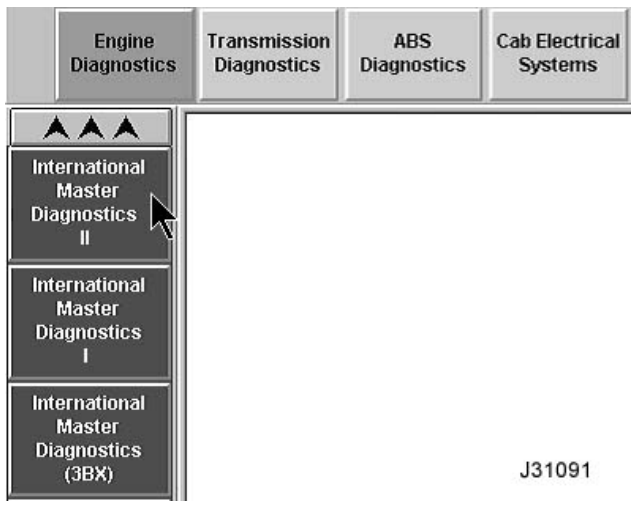


Figure 237 International® launchpad

3. Select Engine Diagnostics, then International® MasterDiagnostics® for Diamond Logic® Control II.

WARNING: To prevent personal injury, use care to prevent contact with the door edge when the cab is up and the door is open.

4. Turn ignition switch to ON.

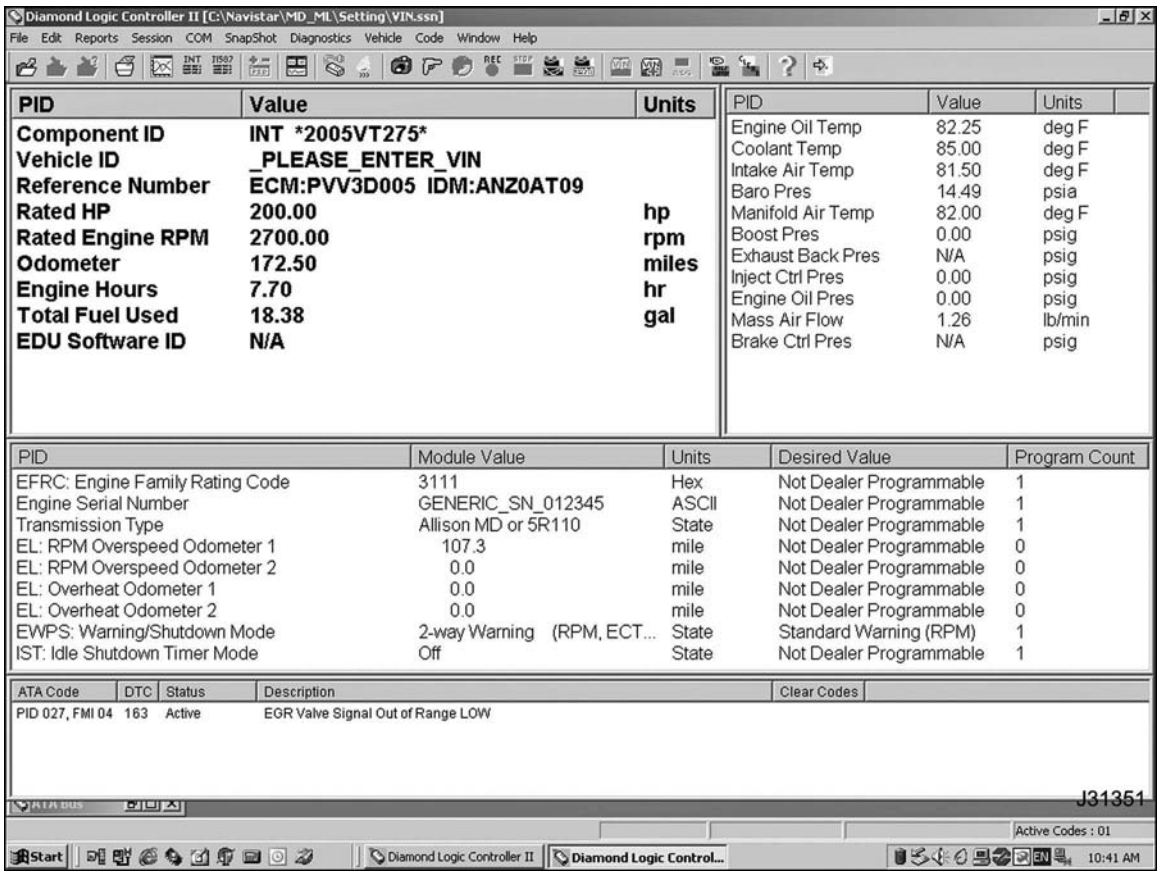


Figure 238 Open VIN+ session

5. Select VIN+ icon to open VIN+ session. VIN (for warranty, ordering parts, and service information). The Vehicle Identification Number is also on the door jamb on the operator's side.
6. Complete the form heading using the on-screen information and the Information List.

Information List

Heading Information	VIN+ session PID	Description
Miles	Odometer	For warranty
Hours	Engine Hours	For warranty
Transmission	Transmission Type	Automatic
Ambient temperature	Intake Air Temp	
Coolant temperature	Coolant Temp	

Information List (cont.)

Engine SN	Engine Serial Number	Engine SN (for ordering parts and service information).

The engine serial number is stamped on a crankcase pad on the rear of the left side crankcase below the cylinder head. The engine serial number is also on a separate serial number label next to the engine emission label on the left side valve cover. Compare the Engine SN in the Vehicle Programming window of the VIN+ session with the Engine SN on the engine. The engine could have been replaced without a programming change to the ECM to upgrade the Engine SN.

Engine HP	Rated HP	For correct engine application

Information List (cont.)

Engine Family Rating Code	EFRC: Engine Family Rating Code	For troubleshooting
ECM calibration	Reference Number PVVXXXXX (First group)	
IDM calibration	Reference Number ANZXXXXX (Second group)	
Fill in the Turbocharger No and Injector No if a mismatch of components is suspected.		
Injector Number	N/A	Requires removal of valve covers
Turbocharger Number	N/A	Plate on the inside edge of the low pressure compressor housing

Accessing DTCs

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

NOTE: When opening VIN+ session to fill out form heading, the DTC window automatically appears.

NOTE: If an EST is not available, see "Accessing DTCs (page 71)" in "Using Cruise Switches (page 71)" in the "Diagnostic Software Operation (page 70)" section of this manual.

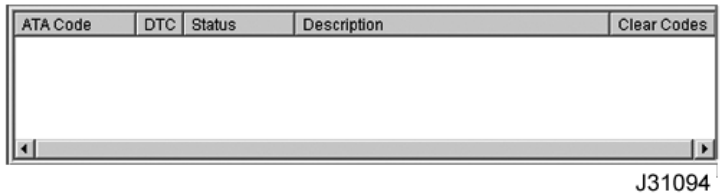


Figure 239 DTC window

1. Record all DTCs from DTC window on the Diagnostic Form. See "Appendix B: Diagnostic Trouble Codes (page 581)" for definitions of the DTCs.
2. Correct problem causing active DTCs before continuing.
3. Clear DTCs.
4. Use EST to check KOEO values for temperature and pressure sensors. Record results on Diagnostic Form.

KOEO values for temperature and pressure sensors

If engine has not been run for 8 to 12 hours Engine Coolant Temperature (ECT), Engine Oil Temperature (EOT), and Manifold Absolute Temperature (MAT) should be within 2 °C (5 °F) of each other. The Inlet Air Temperature (IAT) could be a few degrees higher or lower due to faster outside engine temperature changes.

Injection Control Pressure (ICP) values may fluctuate as much as 345 kPa (50 psi). Electromagnetic Interference (EMI) or ground shift can cause an insignificant voltage shift that does not indicate a problem.

Manifold Absolute Pressure (MAP) values may fluctuate as much as 7 kPa (1 psi). EMI or ground shift can cause an insignificant voltage shift that does not indicate a problem.

Barometric Absolute Pressure (BAP) values should equal the barometric reading for your region.

Are values normal?

If abnormal values are suspected, record on Diagnostic Form and see Operational Voltage tables in the "Electronic Control Systems Diagnostics (page 279)" section of this manual.

5. Continue with KOEO Standard test.

Reading DTCs

ATA code: Codes associated with a Subsystem Identifier (SID), Parameter Identifier (PID), and Failure Mode Indicator (FMI)

DTC: Diagnostic Trouble Code

Status: Indicates active or inactive DTCs

- **Active**: With ignition switch on, active indicates a DTC for a condition currently in the system. When the ignition switch is turned off, an active DTC becomes inactive. (If a problem remains, the DTC will be active on the next ignition switch cycle and the EST will display active/inactive.)
- **Inactive**: With ignition switch on, inactive indicates a DTC for a condition during a previous key cycle. When the ignition switch is turned off, inactive DTCs from a previous ignition switch cycle, are stored in the ECM memory.
- **Active/Inactive**: With ignition switch on, active/inactive indicates a DTC for a condition currently in the system and was present in previous key cycles, if the codes were not cleared.

Description: Defines each DTC

Possible Causes

Electronics failure
Failure of the ICP sensor or ICP system
Failure of the Air Management System (AMS)

2. KOEO Standard Test

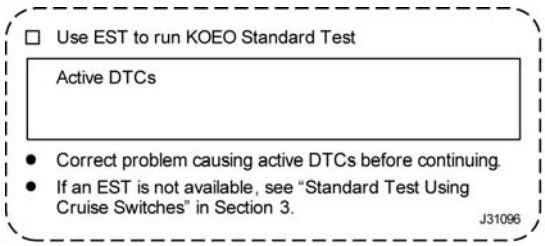


Figure 240

Purpose

To determine electrical malfunctions detected by the ECM self-test and Output Circuit Check (OCC)

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

NOTE: For CF only: If an EST is not available, see "Standard Test Using Cruise Switches (Except Stripped Chassis) (page 74)" in the "Diagnostic Software Operation (page 70)" section of this manual.

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury, use care to prevent contact with the door edge when the cab is up and the door is open.

1. Set parking brake.
2. Turn ignition switch to ON. (Do not crank engine.)

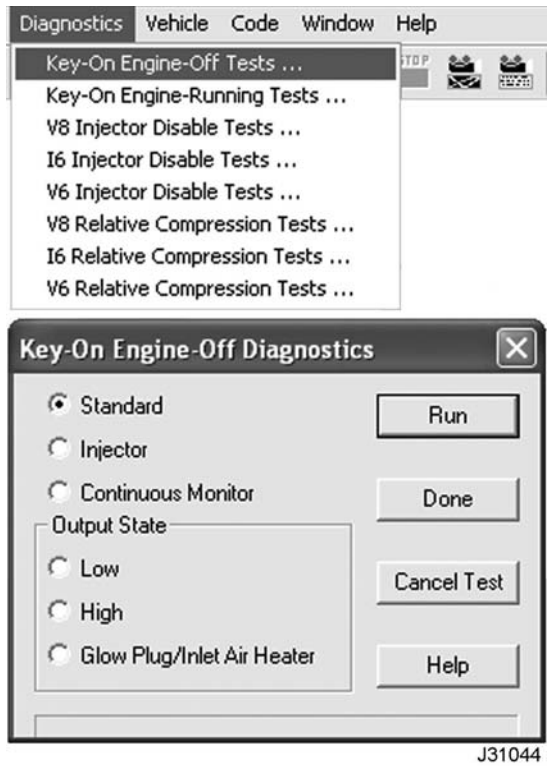


Figure 241 KOEO Standard test

3. Select Diagnostics from the menu bar.
4. Select Key-On Engine-Off Tests from the drop down menu.
5. From the KOEO Diagnostics menu, select Standard, then select Run to start the test.

   The ECM will complete an internal self-test and an OCC. When the OCC is completed, the DTC window will show DTCs, if there is a problem.

NOTE: This test initially takes up to 60 seconds. Look at the bottom of the diagnostic screen, the screen will display Diagnostics Running while the test is running. Each subsequent test performed without a key-off will take less than five seconds.

NOTE: When using the EST to do KOEO or KOER diagnostic tests, Standard test is always selected and run first. If the ignition switch is not cycled, the Standard test does not have to be run again.

6. Record all DTCs on Diagnostic Form. See "Appendix B: Diagnostic Trouble Codes (page 581)" for a definition of the DTCs.

7. Correct problem causing active DTCs.
8. Clear DTCs.
9. When finished with this test, continue with KOEO Injector Test.

Possible Causes
Failed electrical components or circuitry
OCC fault for the Injection Pressure Regulator (IPR) valve
OCC fault for the Inlet Air Heater (IAH) relay
OCC fault for the glow plug relay
OCC for fuel pump control
OCC fault for the Air Conditioning Control (ACC), this will not cause a hard start no start condition.

3. KOEO Injector Test

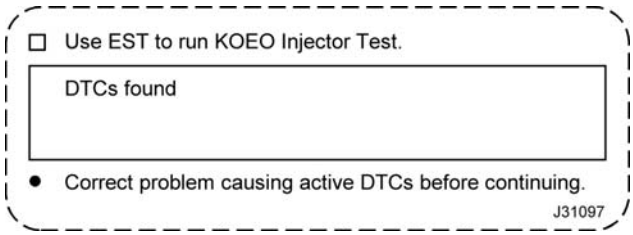


Figure 242

Purpose

To determine if fuel injectors are working (electronically) by energizing injectors in a programmed sequence. The ECM monitors the IDM results from this test and transmits DTCs, if injectors or injector circuits are not working correctly.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

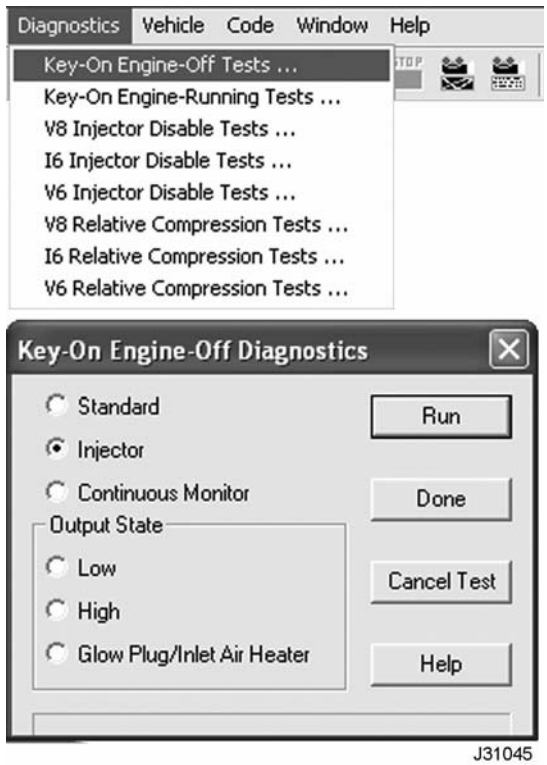


Figure 243 KOEO Injector test

NOTE: When using the EST to do KOEO or KOER diagnostic tests, Standard test is always selected and run first. If the ignition switch is not cycled, the Standard test does not have to be run again.

1. From the KOEO Diagnostics menu, select Injector, then select Run to start the test.

   NOTE: During this test, injector solenoids should click in a numerical sequence, not the firing order, when actuated. If a series of clicks are not heard for each injector, one or more injectors are not activating.

   The DTC window will show DTCs for electrical problems.

2. Record DTCs on Diagnostic Form. See "Appendix B: Diagnostic Trouble Codes (page 581)" for a definition of the DTCs.
3. Correct problem causing active DTCs.
4. Clear DTCs.

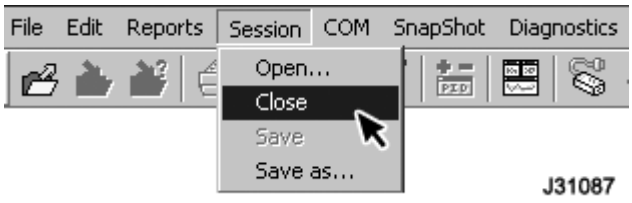


Figure 244 Close session

5. When finished with this test, close the VIN+ session. Select Session from menu bar, then Close.

Possible Causes
Injector wiring harness open or shorted
Failed injector wiring harness connector and the wiring connection to the injector coil
Failed injector coil
Failed Injector Drive Module (IDM)
Failed ECM

4. Engine Oil

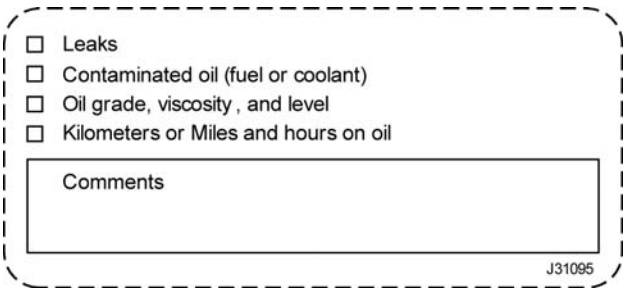


Figure 245

Purpose

To determine if crankcase oil level and oil quality are correct to ensure operation of the Injection Control Pressure (ICP) system

Tools

- None

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, on the ground, in sewers, or in bodies of water.

1. Park vehicle on level ground.
2. Check oil level with oil level gauge.

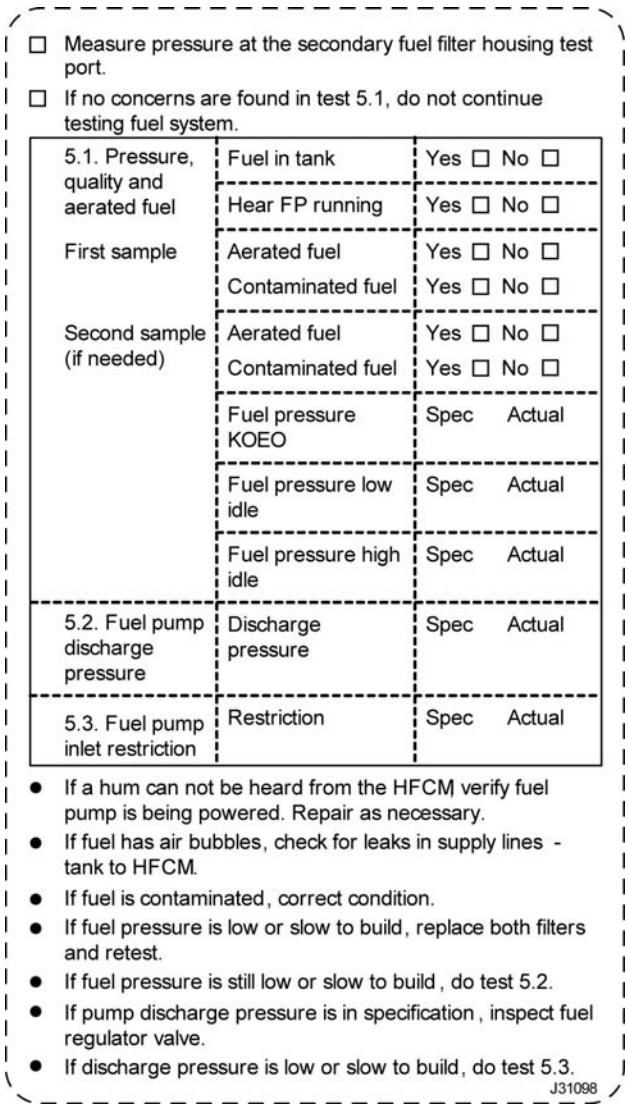
   NOTE: Never check the oil level when the engine is running or immediately after engine shutdown; the reading will be inaccurate. Allow 15 minute drain down time, before checking oil level.

   NOTE: If the oil level is too low, the fuel injectors will not work correctly. If the oil level is above the operating range, the engine has been incorrectly serviced, fuel is in the oil, or coolant is in the oil.
3. Check oil for thickening and odor.
   - Oil contaminated with long life coolant will cause thickening or coagulation.
   - Does oil have a diesel fuel odor?
4. Check engine service records for correct oil grade and viscosity for ambient operating temperatures. See "Lubrication Requirements" in the *Engine Operation and Maintenance Manual* (for engine's model number and model year). Confirm that oil meets correct API category.

   CAUTION: Do not use 15W-40 oil below -7 °C (20 °F). Long oil drain intervals can increase oil viscosity; thicker oil will make engine cranking and starting more difficult below freezing temperatures.

Possible Causes	
Low oil level	Oil leak
	Oil consumption
	Incorrect servicing
High oil level	Incorrect servicing
	Fuel in oil
	Coolant in oil
	Incorrect oil level gauge
Coolant in oil	Cylinder head gasket leak
	Cylinder head cup plug leak
	Injector sleeve leak
	Glow plug sleeve leak
	Front cover gasket leak
	Failed oil cooler or seals
	Front cover, cylinder head, or crankcase porosity
Fuel in oil	Injector seal leak
	Cylinder head porosity
	Inoperative injector

5. Fuel Supply System



☐ Measure pressure at the secondary fuel filter housing test port.

☐ If no concerns are found in test 5.1, do not continue testing fuel system.

5.1. Pressure, quality and aerated fuel	Fuel in tank	Yes ☐ No ☐
	Hear FP running	Yes ☐ No ☐
First sample	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
Second sample (if needed)	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
	Fuel pressure KOEO	Spec Actual
	Fuel pressure low idle	Spec Actual
	Fuel pressure high idle	Spec Actual
5.2. Fuel pump discharge pressure	Discharge pressure	Spec Actual
5.3. Fuel pump inlet restriction	Restriction	Spec Actual

- If a hum can not be heard from the HFCM, verify fuel pump is being powered. Repair as necessary.
- If fuel has air bubbles, check for leaks in supply lines - tank to HFCM.
- If fuel is contaminated, correct condition.
- If fuel pressure is low or slow to build, replace both filters and retest.
- If fuel pressure is still low or slow to build, do test 5.2.
- If pump discharge pressure is in specification, inspect fuel regulator valve.
- If discharge pressure is low or slow to build, do test 5.3.

J31098

Figure 246

Purpose

- To check for fuel aeration
- To check for fuel system contamination
- To check the fuel supply system for efficient engine operation

NOTE: Breaking any fuel system joints will induce air in the fuel system.

Tools

- 0-160 psi gauge (on Gauge Bar Tool)
- ICP System Test Adapter
- In-line shut off valve
- 3/8 inch clear sample line
- Clear container with a wide opening (approximately 1 liter or 1 quart US)

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, comply with the following:

- **Do not mix gasoline, gasohol or alcohol with diesel fuel. This practice creates a fire hazard and is potentially explosive.**
- **Do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.**

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never put engine fluids in the trash, on the ground, in sewers, or other bodies of water.

5.1. Pressure, Quality, and Aerated Fuel

1. See "Appendix A: VT 275 Performance Specifications (page 571)" for fuel pump pressure specification and record on Diagnostic Form.
2. Verify there is fuel in the fuel tank(s). Check fuel in fuel tank(s) for odors other than diesel fuel, for example: kerosene, alcohol, or gasoline.

NOTE: Low Biodiesel blends (up to 5%) should not cause engine or fuel system problems. If low biodiesel blends are used the odor in the fuel tank(s) may not match diesel fuel.

3. Turn ignition switch to ON, listen for a hum coming from the fuel pump. The ECM turns fuel pump on, it should run for 60 seconds. After 60 seconds the ECM turns the fuel pump off unless the engine is running.

   NOTE: Engine may run without the fuel pump, but damage to the injectors could occur.

   - If the fuel pump can be heard running, continue with step 4.
     a. If the fuel pump cannot be heard running, turn ignition switch to OFF.
     b. Disconnect the fuel pump harness connector and measure voltage between the power and ground circuits.
     c. Turn ignition switch to ON, battery voltage should be present for 60 seconds.
     d. If battery voltage is not present, see “Fuel Pump Pin-Point Diagnostics (page 424)” in the “Electronic Control Systems Diagnostics(page 279)” section of this manual, and see the applicable truck *Circuit Diagram Manual* for relay and fuse locations.

4. Turn ignition switch to OFF.

WARNING: To prevent personal injury, use care to prevent contact with the door edge when the cab is up and the door is open.

5. Remove air inlet duct on the engine to aid in plug removal and system testing.

CAUTION: To prevent damage to the engine, take precautions to prevent foreign materials from entering the air intake system when the air inlet duct is removed.

NOTE: When removing the test plug, there is a possibility of a small amount of fuel leaking out. Put in a drain pan or rag to collect this leakage. Collect and dispose of this fuel according to local regulations.

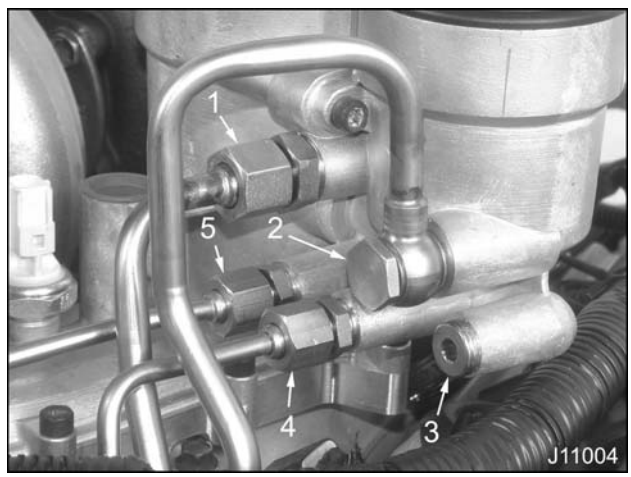


Figure 247 Secondary fuel filter

1. Fuel return to fuel pump
2. Fuel supply from fuel pump
3. Fuel pressure test port plug
4. Conditioned fuel to left cylinder head
5. Conditioned fuel to right cylinder head

6. Remove plug from the fuel pressure test port plug at the bottom of the secondary fuel filter housing.

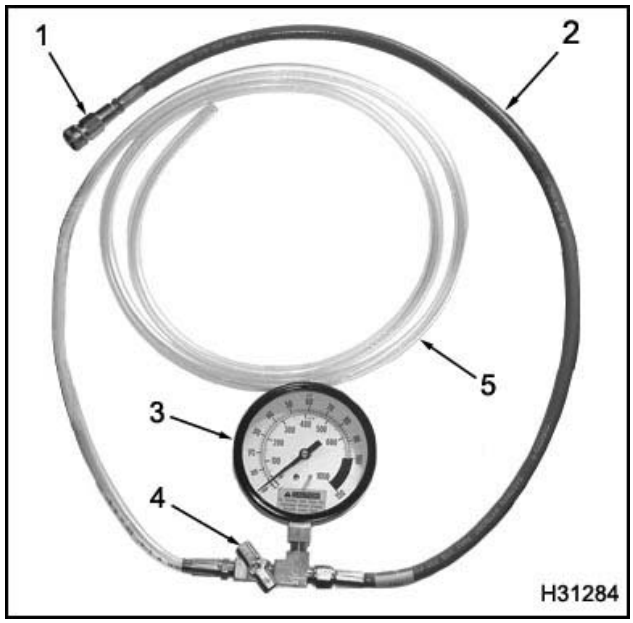


Figure 248 Fuel Pressure Gauge

1. Test fitting connection (remove to adapt to the ICP System Test Adapter)
2. Pressure test line
3. Pressure gauge
4. In-line shut off valve
5. 3/8 inch clear sample line

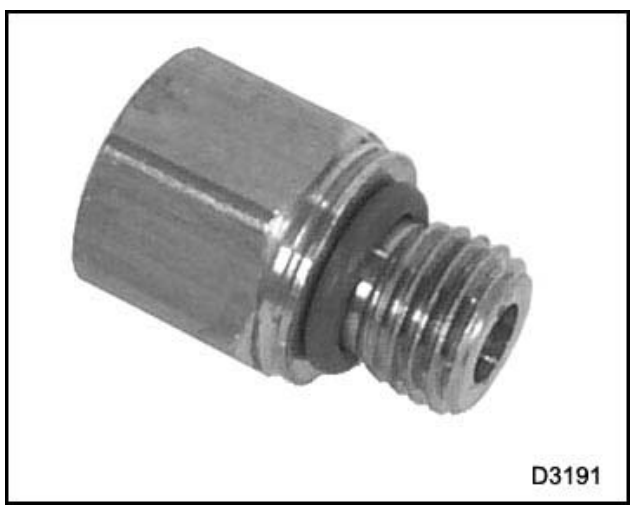


Figure 249 ICP System Test Adapter

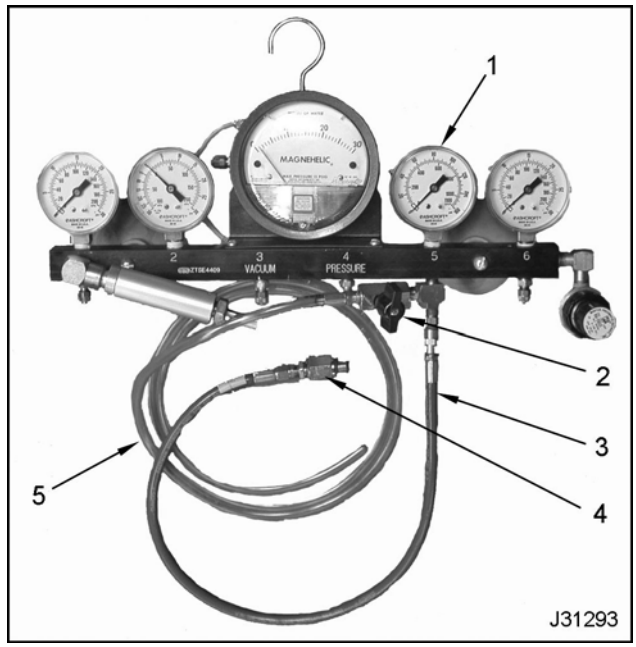


Figure 250 Fuel pressure setup

1. Gauge Bar Tool (0-160 psi gauge)
2. In-line shut off valve
3. Pressure test line
4. ICP System Test Adapter (attached to test fitting connection)
5. 3/8 inch clear sample line

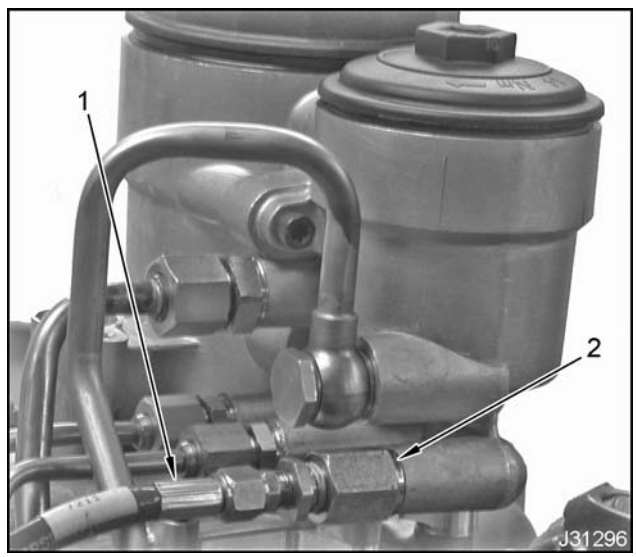


Figure 251 ICP System Test Adapter installed with Fuel Pressure Gauge

1. Test line
2. ICP System Test Adapter

7. Install the ICP System Test Adapter and assemble and attach Fuel Pressure Gauge.
   - The Fuel Pressure Gauge (Figure 248) is available through the tool supplier. It is recommend this tool be used for pressure and sampling.
   - If the Fuel Pressure Gauge can not be obtained. Test setup can be made using tools from the dealer supplied Essential Tool Kits (Figure 250).
8. Run the clear test line to clear container
9. Turn ignition switch to ON (do not crank the engine).

WARNING: To prevent personal injury or death:

- **Dispose of fuel according to local regulations in the correct container clearly marked DIESEL FUEL.**
- **DO NOT smoke.**
- **Keep away from open flames and sparks.**

10. Open the in-line shut off valve, drain sample in the clear container. As filling, observe the clear test line for indication of air bubbles.

NOTE: Breaking any fuel system joints will induce air in the fuel system, it should clear shortly.

11. Close in-line shut off valve.
12. Check for contamination and record results on Diagnostics Form.

Sample should be clear, free of debris, water and other contaminates. Sample should not be cloudy or dyed (blue or red).

If air bubbles stop with sample flowing, the fuel is not aerated and if there is no contamination, continue with step 15.

If the air bubbles do not clear before the sample container is almost full, a second sample needs to be taken to determine if air bubbles have cleared, continue with step 13.

If fuel is contaminated with water, debris or other contaminates, take a second sample. Some sediment and water may be present in the fuel sample if the fuel filter has not been replaced for a prolonged period of time or if the sediment and water have not been drained recently, continue with step 13.

If the fuel sample is cloudy in colder temperatures, this indicates waxing or gelling. Summer fuels are not suitable in colder temperatures. Change to the recommended fuel grade. See “Fuel Requirements” in the *Engine Operation and Maintenance Manual* (for engine’s model number and model year).

If the fuel sample is dyed, either blue or red, this indicates off-road use fuel and could cause a performance problem. Change to a recommended fuel grade. See “Fuel Requirements” in the *Engine Operation and Maintenance Manual* (for engine’s model number and model year).

13. If a second sample is needed, cycle the ignition switch to restart the fuel pump, drain sample and check for air bubbles and contamination in the fuel.

14. Record the results on the Diagnostic Form.

    If air bubbles did not clear, check the fuel supply system from the fuel tank(s) to the HFCM inlet for leaks. Correct the condition and retest. The check should include wiggling all fuel line connections, checking the primary fuel filter cover and the HFCM drain plug for leaks with the fuel pump turned off. With the fuel pump off, the primary fuel filter cover and the drain plug may show a slow drip of fuel indicating cover or plug is loose or seals are worn, cracked, or broken.

    Excessive water or contaminants may indicate that the tank and fuel system may need to be flushed and cleaned. Take a sample from the HFCM drain plug for verification. See “Drain Water from HFCM (page 116)” in the “Engine Symptoms Diagnostics (page 99)” section of this manual.

    If fuel doesn’t clear up, the system may have to be flushed to correct the condition. Replace the primary and secondary fuel filters and verify fuel is the recommended grade and clean.

    NOTE: Any residue or microbial growth in the tank(s) will compound with the use of biodiesel. This can cause serious plugging of filters and deposits in the fuel system. Fuel tanks should be thoroughly cleaned and dried before operating with any biodiesel blends. Adding biocides will help minimize growth.

15. Cycle the ignition switch to OFF and back to ON.
16. Check fuel pressure on the gauge when the pump starts. Pressure should increase to specification quickly.
17. Turn the ignition switch to OFF.
18. Record the results on the Diagnostic Form.
    - If fuel pressure is within specification, continue with step 19.
    - If fuel pressure is below specification or slow to build, replace both the primary and secondary fuel filters and retest.
    - If fuel pressure is still below specification or slow to build, after replacing both primary and secondary fuel filters, measure fuel pump discharge pressure. Do “Test 5.2. Fuel Pump Discharge Pressure (page 231).”
19. Start the engine.

NOTE: See “Combustion Leaks to Fuel (page 102)” in the “Engine Symptoms Diagnostics (page 99)” section of this manual, if all of the following conditions are noted:

- If the fuel system develops air bubbles with the engine running.
- Black exhaust smoke
- Pulsating fuel pressure

20. Run the engine at low idle, check the low idle pressure indication on the test gauge.
21. Run the engine at high idle, check the high idle pressure indication on the test gauge.
22. Record results on Diagnostic Form.
    - If fuel pressure is low or is slow to build, replace both the primary and secondary fuel filters and retest.
    - If all pressures are in specification, do “Test 6. Intake and Exhaust Restriction (page 235).”

Possible Causes	
Contaminated Fuel	Water or contaminants in fuel tank
	Ice in fuel lines
	Debris in fuel tank
	Fuel colored, cloudy, or colored
	Fuel is waxy or gelled
	Off road fuel red colored or blue colored
Aeration	Low or no fuel level in fuel tank(s).
	Failed seals for fuel lines between fuel tank(s) and the HFCM, fuel supply line broken or crimped.
	A cracked or restricted pickup tube screen or pickup tube.
	HFCM fuel filter cap seal damaged, HFCM drain plug loose, or HFCM drain plug O-ring broken or missing
	A loose fuel line or fuel line connector on the suction side of the fuel pump
No Fuel	Low or no fuel level in fuel tank(s).
	Inoperative fuel tank transfer pump
	A restricted, kinked, bent, loose, cracked, or broken fuel pickup tube or screen.
	Failed seals for fuel lines between fuel tanks, ice in fuel lines, fuel supply line broken or crimped, or restriction in the fuel line from the fuel tank to the HFCM.
Low fuel pressure	Debris in tank
	Restriction from the fuel tank to the HFCM
	A kinked or bent fuel supply line or a blocked pickup tube screen
	A loose fuel line or fuel line connector on the suction side of the fuel system
	Dirty or plugged fuel filters
	Inoperative fuel pump
	Debris in the fuel regulator valve
	Inoperative or stuck fuel pressure regulator valve.

Possible Causes (cont.)

Fuel Restriction	Debris in fuel
	A kinked or bent fuel supply line or a blocked pickup tube strainer
	Dirty or plugged filter element
	Waxed or gelled fuel in the fuel filter
	Ice in fuel lines
High fuel pressure	Debris in the fuel regulator valve
	Inoperative fuel pressure regulator valve.
	Restriction in the fuel return to the HFCM
	Combustion gases leaking into fuel system

5.2. Fuel Pump Discharge Pressure

NOTE: This procedure should only be performed when directed by “Test 5.1. Pressure, Quality, and Aerated Fuel (page 224)” when fuel pressure is still below specification or slow to build, after replacing both primary and secondary fuel filters.

Purpose

To measure fuel pump discharge pressure

NOTE: Breaking any fuel system joints will induce air in the fuel system.

Tools

- 0-160 psi gauge (on Gauge Bar Tool)
- Fuel Pressure Test Adapter

NOTE: When removing the banjo bolt, fuel will leak out. Put in a suitable container to collect this leakage. Collect and dispose of this fuel according to local regulations.

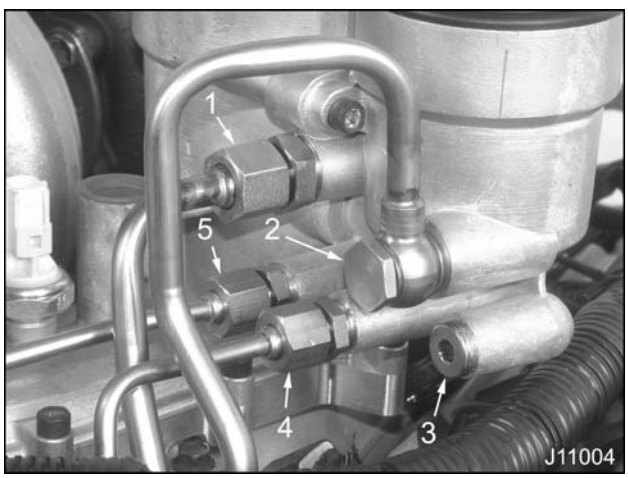


Figure 252 Secondary fuel filter

1. Fuel return to fuel pump
2. Fuel supply from fuel pump
3. Fuel pressure test port plug
4. Conditioned fuel to left cylinder head
5. Conditioned fuel to right cylinder head

1. Remove the banjo bolt from fuel supply from fuel pump (item 2) at the bottom of the secondary fuel filter housing.

NOTE: Use existing copper gaskets for testing. Replace the copper gaskets on the banjo bolt when testing is over and repairs have been made.

Figure 253 Fuel Pressure Test Adapter

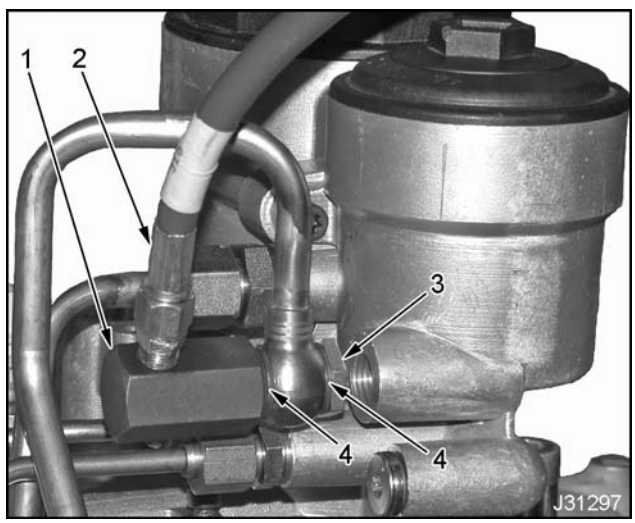


Figure 254 Fuel Pressure Test Adapter installed in fuel supply from fuel pump

1. Fuel Pressure Test Adapter
2. Test line
3. Banjo bolt
4. Copper gaskets

2. Connect the Fuel Pressure Test Adapter to the fuel supply, using the banjo bolt and copper gaskets.
3. Connect the Fuel Pressure Gauge to the Fuel Pressure Test Adapter.
4. Turn ignition switch to ON (do not crank the engine).

5. Check fuel pressure on the test gauge immediately when the pump starts. The fuel pressure should increase to specification quickly.

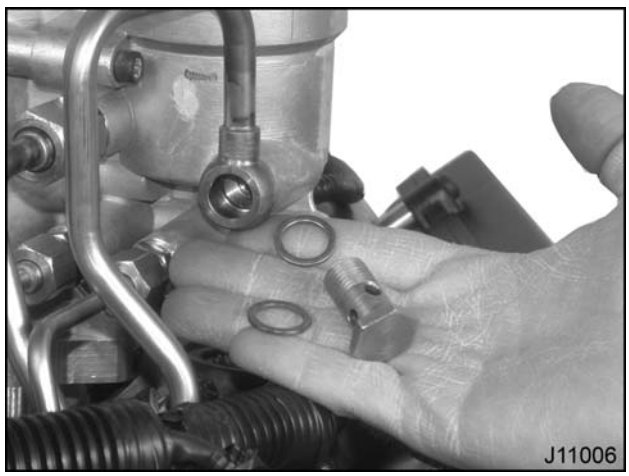


Figure 255 Replace two copper gaskets

CAUTION: To prevent possible fire and damage to the engine from leaking fuel, replace the two copper gaskets when reattaching fuel supply from the HFCM to the secondary fuel filter housing.

6. Record the results on the Diagnostic Form.
   - If the discharge pressure is within specification, turn the ignition switch to OFF, continue with step 7.
   - If the discharge pressure is not within specifications or slow to build, turn the ignition switch to OFF. Reconnect the fuel line and banjo bolt to secondary fuel filter housing, do “Test 5.3. Fuel Inlet Restriction (page 233).”
7. Remove the fuel pressure test adapter.
8. Remove, clean, and inspect the fuel pressure regulator, see the *Engine Service Manual*.
9. After reinstallation of the secondary fuel filter housing and all fuel lines. Attach the filter pressure gauge to the secondary fuel filter test port and retest fuel pressure.

5.3. Fuel Inlet Restriction

NOTE: This procedure should only be performed when directed by “Test 5.2. Fuel Pump Discharge Pressure (page 231)” when discharge pressure is within specification or slow to build. This procedure may also be directed to be performed by the “Test 15 Test Drive (Full load, rated speed) (page 265)” Fuel Pressure portion when fuel pressure is below specification.

Purpose

To measure fuel pump inlet restriction

NOTE: Breaking any fuel system joints will induce air in the fuel system.

Tools

- 0-30 in Hg gauge (on gauge bar tool)
- Fuel Inlet Restriction Adapter
- In-line shut off valve

1. Put a clean flat drain pan under the HFCM drain plug
2. Wipe down the frame around and under the drain plug. Wipe down the HFCM area around the drain plug also.
3. Open the drain plug and drain the HFCM to flat drain pan.

NOTE: When removing the drain plug fuel will leak out. Collect and dispose of this fuel according to local regulations.

Figure 256 Fuel Inlet Restriction Adapter

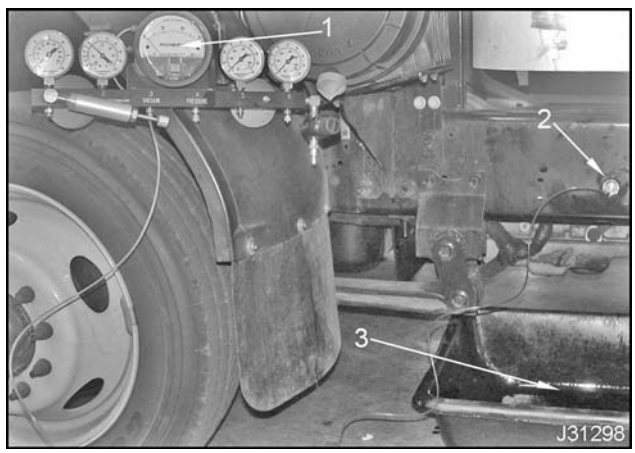


Figure 257 Fuel inlet restriction test setup (typical)

1. Gauge Bar Tool
2. Fuel Inlet Restriction Adapter
3. Catch pan

4. Remove the HFCM drain plug, install the fuel inlet restriction adapter, hand tighten only.

NOTE: Inspect the drain plug O-ring for damage from removal. Care must be taken when installing drain plug to prevent damaging the O-ring.

5. Connect to 0-30 in Hg gauge on the gauge bar tool through an in-line shut off valve. Make sure the shut off valve is in the closed position.

NOTE: The fuel pump runs for 60 seconds when ignition switch is turned on. The in-line shut off valve must be closed before the fuel pump shuts off. This will prevent the gauge from filling with fuel.

6. Turn ignition switch to ON. Open the in-line shut off valve and check for restriction indication on the test gauge. Close the in-line shut off valve. Turn ignition switch to OFF.
7. Record results on Diagnostic Form.
   - If vacuum indication is above the specification, check for restrictions in the fuel supply lines from the fuel pickup tube in the fuel tank to the HFCM. Visually inspect for bent, crimped, or damaged fuel supply lines and connections from the fuel tank(s) to the HFCM. Correct any restrictions and retest fuel pressure at the secondary fuel filter housing test port.
   - If vacuum indication is below the specification and fuel pump discharge pressure is low, replace the fuel pump and retest fuel pressure at the secondary fuel filter housing test port.

6. Intake and Exhaust Restriction

☐ Air inlet and duct
☐ Hose and piping
☐ Intake and exhaust restriction
☐ Measure restriction at high idle, no load.

Instrument	Spec	Actual
Magnehelic gauge or Manometer		
Comment		

● Correct problem causing out-of-specification values, before continuing.

J31100

Figure 258

Purpose

To check for restriction in the air intake or exhaust systems likely to cause engine performance problems.

NOTE: High intake or exhaust restriction can cause a large amount of black or blue smoke.

Tools

- Flashlight
- Gauge Bar Tool (Magnehelic Gauge)
- Test line

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

1. Inspect the following parts for restriction, damage or incorrect installation:
   - Air filter inlet and duct - look inside the duct for any restrictions. Remove any restrictions found.
   - Air inlet hoses and clamps
   - Air filter housing, filter element, and gaskets
   - Exhaust pipes
   - Chassis mounted CAC and piping
   - Air filter restriction indicator (if equipped)

Figure 259 Low restriction (typical)

Figure 260 High restriction (typical)

2. See “Appendix A: VT 275 Performance Specifications (page 571)” for intake and exhaust specification and record on Diagnostic Form.

NOTE: Intake restriction should be below 6.2 kPa (25 in H_2O) at full load condition. Intake restriction performed for this test at high idle should be below 3.1 kPa (12.5 in H_2O).

When the filter element reaches maximum allowable restriction, the yellow indicator will reach the top of the window and automatically lock in this position.

3. Remove air intake restriction indicator from air filter housing.
4. Attach test line to the restriction tap for air filter housing.
5. Connect line to Magnehelic Gauge or Manometer.

WARNING: To prevent personal injury or death, comply with the following:

- **When routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine surfaces.**
- **Use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.**
- **Before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.**

6. Run engine at high idle, no load.
7. Record results on Diagnostic Form.
   - If restriction is more than 3.1 kPa (12.5 in H_2O), replace air filter element.
   - If restriction is more than 3.1 kPa (12.5 in H_2O), and a new filter is in place, check for obstructions in air inlet.
   - If restriction is less than 3.1 kPa (12.5 in H_2O), continue with Performance Diagnostics.

Possible Causes

Snow in air cleaner inlet
Ice in air cleaner inlet
Foreign material in air cleaner inlet
Collapsed, plugged, or dirty air filter
On engines recently repaired, rags or cap plugs may have been left in the intake system.
Tailpipe or muffler may be damaged or collapsed.
Plugged or restricted Catalytic converter - if equipped
Plugged or restricted Catalyzed Diesel Particulate Filter (CDPF) - if equipped

7. KOER Standard Test

Note: Engine coolant temperature must be 70 °C (158 °F) or higher.

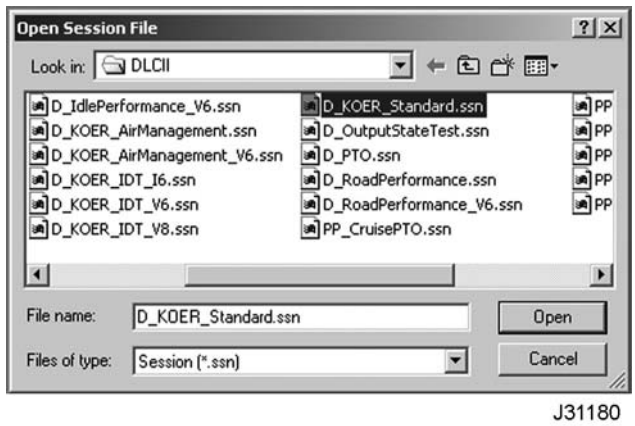
☐ Use EST to run KOER Standard Test

DTCs found

- Correct problem causing active DTCs before continuing.

J31102

Figure 261



J31180

Figure 262 KOER Standard session

Purpose

To verify that the engine sensors and IPR are operating correctly within their specified operating ranges.

NOTE: The ECM will actuate the IPR and monitor ICP sensor feedback signals. If an IPR problem or ICP sensor problem exists, the ECM will set DTCs and the EST will read the DTCs.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

⚠ WARNING: To prevent personal injury or death, comply with the following:

- **Read all safety instructions in the "Safety Information" section of this manual.**
- **Use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.**
- **Before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.**

1. Select D_KOER_Standard.ssn in the Open Session File window, select Open to monitor engine operation.
2. Start and run engine to reach minimum operating temperature 70 °C (158 °F) or higher.

   NOTE: Engine coolant temperature must reach 70 °C (158 °F) minimum for the ECM to accurately test engine actuators and sensors. If engine coolant temperature is below self-test range, the EST will display - Coolant temperature is out of range.

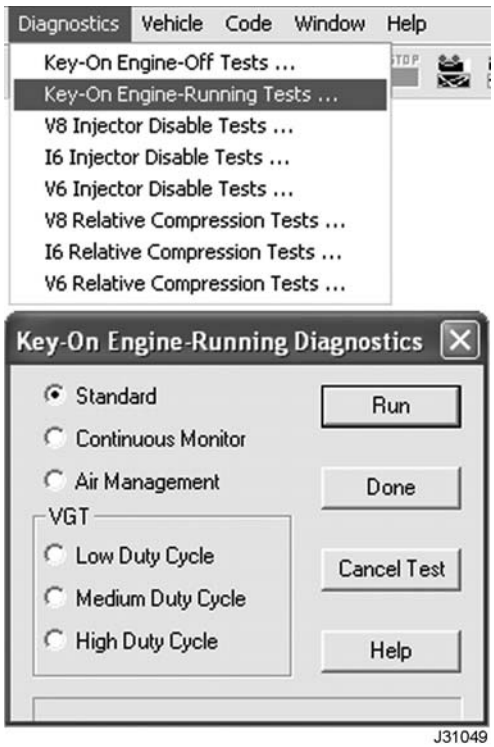


Figure 263 KOER Standard test

3. Select Diagnostics from menu bar.
4. Select Key-On Engine-Running Tests from the drop down menu.
5. From the KOER Diagnostics Menu, select Standard and select Run to start the test.
6. The ECM will start the KOER Standard test and command the engine to accelerate to a predetermined rpm.

   During the test, the ECM commands the IPR through a Step Test to determine if the ICP system is performing as expected. The ECM monitors signal values from the ICP sensor and compares those values to the expected values. When the test is done, the ECM returns the engine to the normal operating mode and transmits any DTCs set during the test.
7. Record DTCs on Diagnostic Form. See “Diagnostic Trouble Codes (page 581)” for a definition of the DTCs.
8. Correct problems causing active DTCs.
9. Clear DTCs.

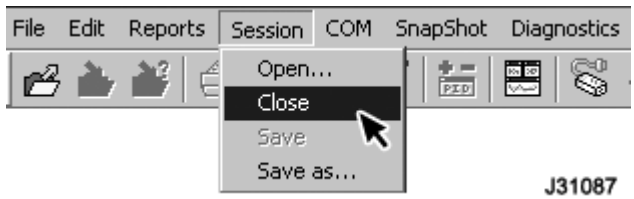


Figure 264 Close session

10. When finished with this test, select Session from menu bar, then Close.

Possible Causes

Oil leakage in high-pressure injection control system
Loose or corroded engine wiring harness for ICP sensor or IPR valve
Open or shorted wiring harness to ICP sensor or IPR valve
Failed ICP sensor
Inoperative IPR valve
Inoperative high-pressure oil pump
Not enough oil from lube oil system to high-pressure pump

8. Injection Control Pressure

☐ Use EST to monitor ICP and engine speed.

Condition	Spec	Actual
Low idle		
High idle - Initial		
High idle - After 2 minutes		
Aerated oil Yes ☐ No ☐		

- If ICP is high or unstable, hold at high idle for 2 minutes. Return to low idle, take oil sample, check for foam, and correct condition if oil is aerated.
- If oil is not aerated, disconnect ICP sensor and check for engine stability.
- If problem is corrected, see Operational Voltage checks for ICP sensor in Section 7 in EGES-305.
- If ICP still high or unstable, replace IPR and retest.

J31103

Figure 265

Purpose

To determine if the ICP system is providing enough hydraulic pressure to operate the injectors.

Tools

EST with MasterDiagnostics® software
EZ-Tech® interface cable
Fuel pressure test fitting
Oil sample line with in-line shut off valve
Container (for oil sample)

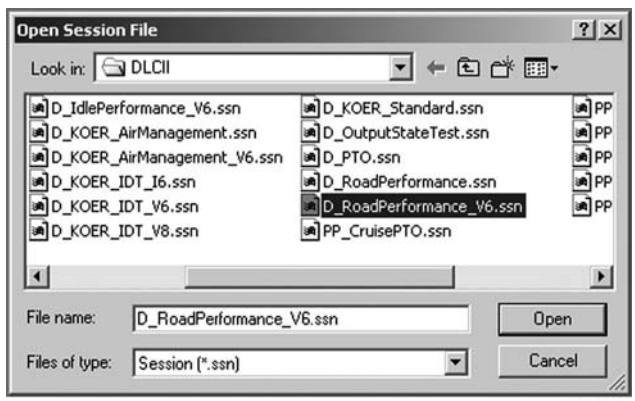
Monitoring ICP Using EST

⚠ WARNING: To prevent personal injury or death, comply with the following:

- **Read all safety instructions in the "Safety Information" section of this manual.**
- **Before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.**

⚠ WARNING: To prevent personal injury or death, use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.

1. See "Appendix A: VT 275 Performance Specifications (page 571)" for specifications and record on Diagnostic Form.



J31181

Figure 266 Road Performance session

2. Select D_RoadPerformance_V6.ssn in the Open Session File window, select Open to monitor engine operation.
3. Run engine at low idle, monitor ICP, and record results on Diagnostic Form.
4. Run engine at high idle, monitor ICP, and record initial results on Diagnostic Form. Continue to

run the engine at high idle for 2 minutes, monitor ICP, and record the 2 minute results on Diagnostic Form. Compare the two ICP readings. ICP that rises above the specification at any point during the two minutes, indicates oil aeration.

- If ICP is high or unstable for low or high idle, continue with step 5.
- If ICP is in specification for low and high idle, select Session from menu bar, then Close. Continue with “Test 9. Injector Disable (page 242).”

WARNING: To prevent personal injury or death, comply with the following when taking oil sample:

- **Do not route oil line too close to moving parts.**
- **Do not let oil line touch hot engine surfaces.**
- **Use caution not to burn hands.**

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, by pouring on the ground, in sewers, or in bodies of water.

5. Turn off engine
6. Connect fitting on test line with Fuel/Oil Pressure Test Coupler to a 0 to 1723 kPa (0 to 250 psi) gauge.

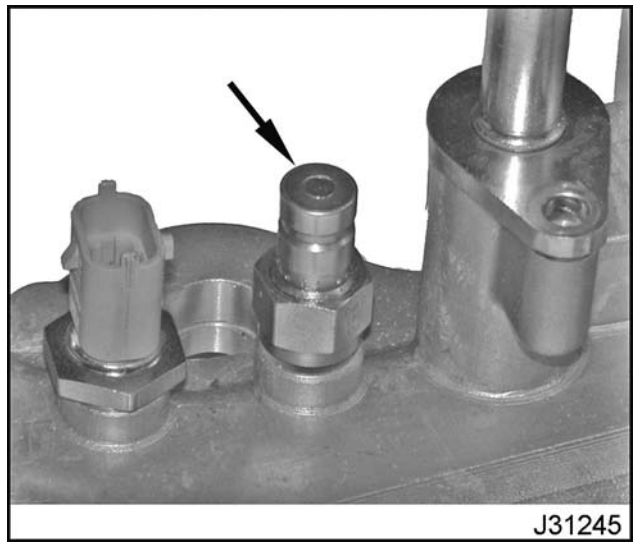


Figure 267 Fuel Pressure Test Fitting installed in EOP switch port

7. Remove EOP switch and install Fuel Pressure Test Fitting.
8. Connect Fuel/Oil Pressure Test Coupler to Fuel Pressure Test Fitting.

   NOTE: See fuel pressure gauge manufactured or obtained in “Test 5. Fuel Supply System (page 224)” in this section.
9. Start and run engine at high idle for two minutes. Record ICP initially as high idle is set, then again after two minutes.
10. Return engine to low idle, take oil sample, and check for foam.
    - If oil is aerated, a large quantity of air bubbles mixed throughout the oil, or foam build up on top of the oil sample will be seen. Correct condition.
    - If oil is not aerated, disconnect ICP sensor and check engine stability. If problem is corrected, see “ICP (Injection Control Pressure) Sensor (page 447)” in the “Electronic Control Systems Diagnostics (page 279)” section of this manual.
    - If ICP is still high or unstable, replace IPR following procedures in *Engine Service Manual* and retest.

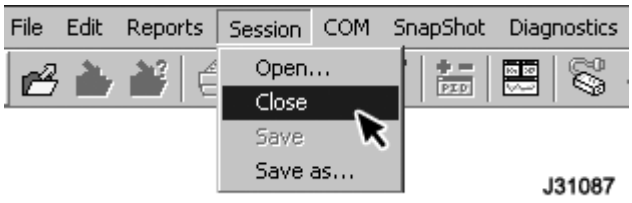


Figure 268 Close session

11. When finished with this test, select Session from menu bar, then Close.

Possible causes
Poor quality oil, oil not to API specifications, oil not serviced correctly
ICP system leakage
Failed ICP sensor circuit
Failed ICP sensor
Failed IPR valve
Failed high-pressure oil pump
Failed lube oil pump
Failed oil pick up tube
Missing or failed gasket for oil pick up tube
If ECM detects low boost pressure, an incorrect feedback signal from APS or the ICP sensor, the ECM commands the IPR valve to reduce ICP.

9. Injector Disable

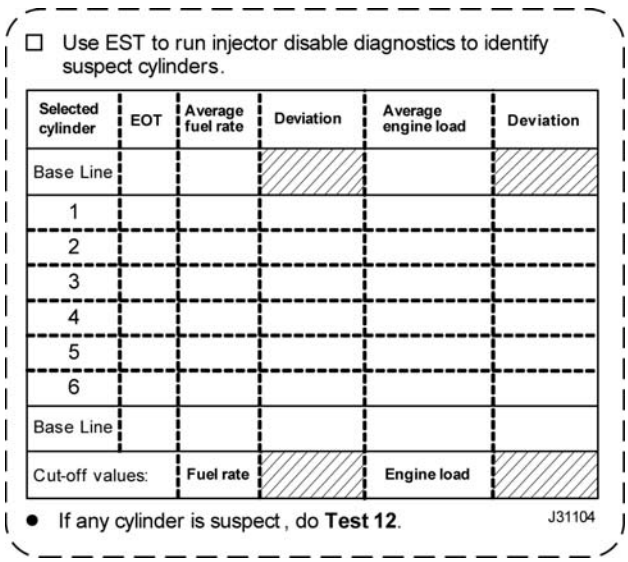


Figure 269

Purpose

To determine the cause of rough engine idle

The Injector Disable tests can only be done with the EST; MasterDiagnostics® software is required.

The Injector Disable tests allows the technician to shut off injectors to determine if a specific cylinder is contributing to engine performance. Injectors can be shut off one at a time.

Firing order: 1-2-5-6-3-4

When all cylinders are active, the contribution of each cylinder is 17% of its overall effect to maintain governed speed. The technician should monitor fuel rate and engine load.

This test is used in conjunction with “Test 10. Relative Compression (page 247)” to distinguish between an injector problem or a mechanical problem.

Before doing the Automatic Test make sure Tests 1 through 8 were completed and the following conditions are maintained:

- Make sure accessories are turned off (for example: fan and air conditioning). If these items were to cycle during this test it could corrupt the test results.
- Maintain engine idle.
- Keep EOT within a 2 °C (5 °F) range from the beginning to the end of the test. EOT affects injection timing; too much of a change in EOT temperature could corrupt the test results.

The Automatic Test is the preferred test, do the Manual Test - Engine Cold only if investigating a cold misfire.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

Automatic Test

NOTE: If any injectors are removed and reinstalled or replaced, test drive vehicle for 32 km (20 mi) before checking for misfire or rough idle.

The automatic test is best done when comparing cylinder to cylinder test data.

NOTE: Do “Test 7. KOER Standard (page 237)” before doing this test.

WARNING: To prevent personal injury or death, use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.

WARNING: To prevent personal injury or death, before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.

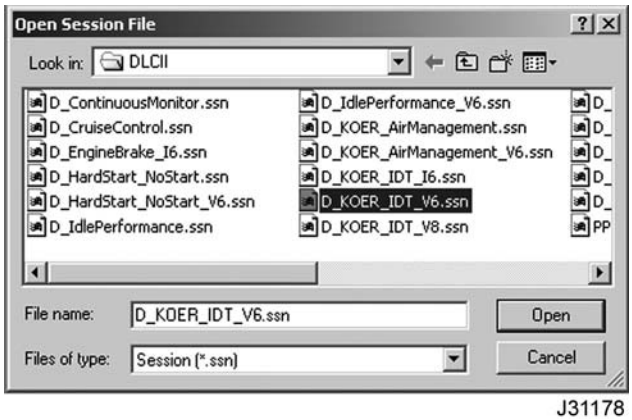


Figure 270 KOER injector disable session

1. While engine is running, select D_KOER_IDT_V6.ssn in the Open Session File window, select Open to monitor engine operation.

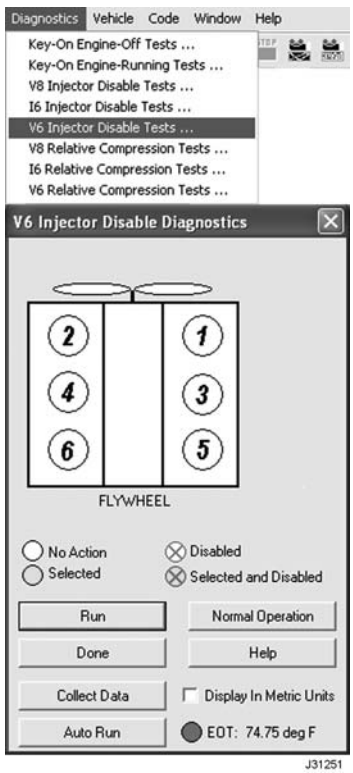


Figure 271 Injector Disable Diagnostics

2. Select Diagnostics from menu bar.
3. Select V6 Injector Disable Tests from drop down menu.

NOTE: The EOT indicator will change from red to green when engine temperature reaches 70 °C (158 °F) or higher.

- If the EOT indicator is red, erroneous comparisons are likely from cylinder to cylinder.
- When the EOT indicator is green and the engine temperature is 70 °C (158 °F) or higher, fuel rate and timing are more stable, making comparisons from cylinder to cylinder more accurate. Overall engine operation is more stable.

4. Select Auto Run.

NOTE: If any injectors are removed and reinstalled or replaced, test drive vehicle for 32 km (20 mi) before checking for misfire or rough idle.

NOTE: While running the engine, listen for sound variations from cylinder to cylinder.

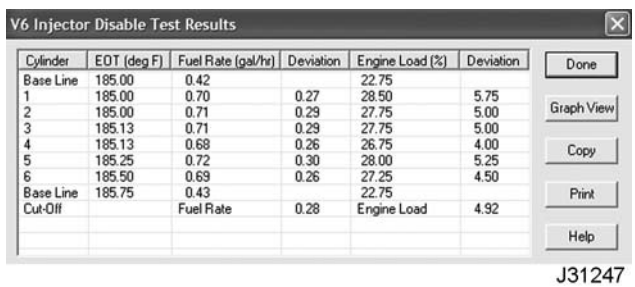


Figure 272 V6 Injector Disable Test Results (Auto Run - Text View)

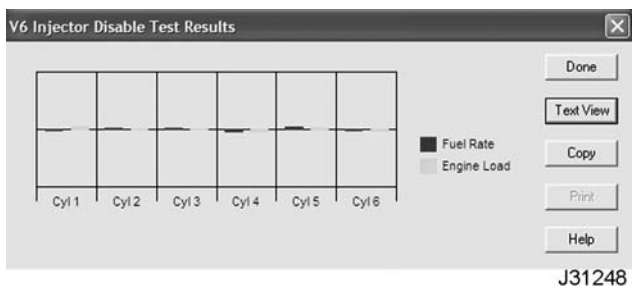


Figure 273 V6 Injector Disable Test Results (Auto Run - Graph View)

During Auto Run, injectors are shutoff one at a time (1 through 6 in numerical sequence). Base line data and

results for each cylinder is displayed in the window (Text View) for V6 Injector Disable Test Results. Test data for each injector can also be viewed by selecting the (Graph View). When finished the engine will return to normal operation.

5. Record data from window (Text View) on Diagnostic Form.
   - If deviation values for average fuel rate and average engine load are less than the cut off values for fuel rate and engine load, the injector is suspect for weak cylinder contribution.
   - If only one deviation value is less than a cut off value, do not suspect that cylinder.
   - If a suspect cylinder(s) is identified, do “Test 10. Relative Compression (page 247)” to distinguish between an injector or mechanical problem.
   - If Test 10 shows that cylinders are mechanically sound, but Test 9 shows that one or more cylinders are bad, continue with step 6.

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, by pouring on the ground, in sewers, or in bodies of water.

6. Remove valve covers following procedure in *Engine Service Manual*.
7. Replace faulty injector(s) and replace valve covers following procedures in the *Engine Service Manual*.
8. Test drive vehicle for 32 km (20 mi) to purge air from the ICP system fuel supply system, and check for rough idle.
9. If rough idle continues, do this test again.

Possible Causes

Failed connection from wiring harness to injector solenoid
Open or shorted wiring harness to injector solenoid
Failed solenoid on fuel injector
Failed IDM
Failed ECM
Scuffed or damaged injector

Manual Test - Engine Cold

The Manual Test is only done when diagnosing each cylinder for cold misfire, considering EOT changes.

NOTE: The EOT indicator will change from red to green when engine temperature reaches 70 °C (158 °F) or higher.

- If the EOT indicator is red, erroneous comparisons are likely from cylinder to cylinder.

  However, when diagnosing a cold misfire, a technician can listen to tone changes from cylinder-to-cylinder.
- When the EOT indicator is green and the engine temperature is 70 °C (158 °F) or higher, fuel rate and timing are more stable, making comparisons from cylinder to cylinder more accurate. Overall engine operation is more stable.

Shut off one injector at a time and listen for changes in exhaust tone.

NOTE: If any injectors are removed and reinstalled or replaced, test drive vehicle for 32 km (20 mi) before checking for misfire or rough idle.

WARNING: To prevent personal injury or death, use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.

WARNING: To prevent personal injury or death, when running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.

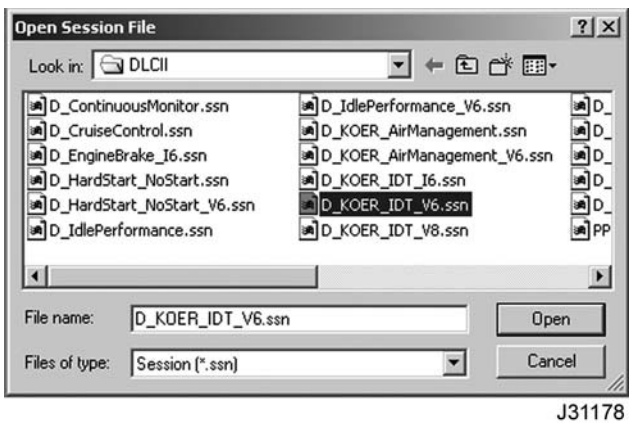


Figure 274 KOER injector disable session

1. While engine is running, select D_ KOER_IDT_V6.ssn. in the Open Session File window, select Open to monitor engine operation.

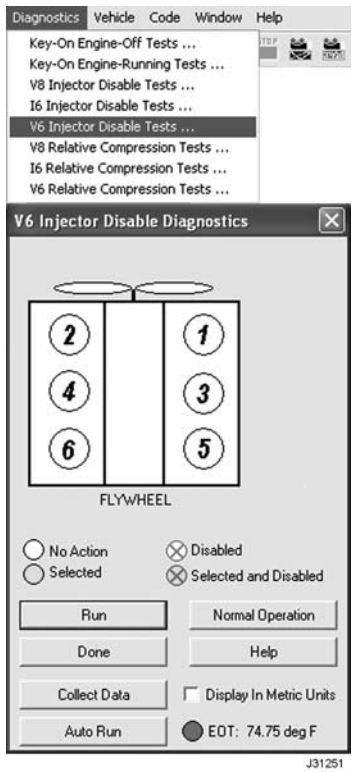


Figure 275 Injector Disable Tests

2. Select Diagnostics from menu bar.
3. Select V6 Injector Disable Tests from drop down menu.
4. Select cylinder number and select Run. (Injector selected will be disabled and engine noise should change.)
5. Select Normal Operation. Injector will be enabled and engine noise should return to normal.
6. Repeat steps 4 and 5 for the remaining cylinders.

NOTE: Listen for sound variations from cylinder to cylinder.

NOTE: If any injectors are removed and reinstalled or replaced, test drive vehicle for 32 km (20 mi) before checking for misfire or rough idle.

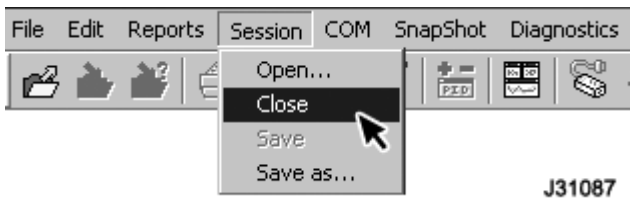


Figure 276 Close session

7. When finished with this test, select Session from menu bar, then Close.

10. Relative Compression Test

☐ Turn ignition key to ON.
☐ Use EST to run Relative Compression Test.
☐ Crank engine following EST instructions.

Relative Compression Test	Value
Cylinder 1 Relative Compression	
Cylinder 2 Relative Compression	
Cylinder 3 Relative Compression	
Cylinder 4 Relative Compression	
Cylinder 5 Relative Compression	
Cylinder 6 Relative Compression	

- If a Relative Compression Test and Injector Disable Test identify a suspect cylinder, check for a mechanical problem.
- If a Relative Compression Test does not identify a suspect cylinder, but the Injector Disable Test does, replace suspect injector(s).

J31105

Figure 277

Purpose

To determine if compression is too low in any cylinder

NOTE: This test can only be done with the EST; MasterDiagnostics® software is required.

NOTE: This test is used in conjunction with Test 9 to distinguish between an injector problem or a mechanical problem.

The relative compression test provides the difference between the fastest and slowest crankshaft speed during the power stroke of each cylinder.

As the engine is cranked, the IDM uses the CMP and CKP sensor signals to measure crankshaft speed, as piston reaches two points: Top Dead Center (TDC) compression and about 30 degrees after TDC compression.

When the piston approaches TDC, crankshaft speed should be slower because of compression resistance. As the piston passes TDC, compression resistance dissipates and crankshaft speed increases.

At TDC compression, the cylinder reaches its highest compression and resistance to crankshaft rotation - Crankshaft speed is the slowest. A cylinder with low compression will have less resistance to crankshaft rotation. Crankshaft speed will be faster than normal.

About 30 degrees after TDC, crankshaft speed should be fastest because compression has dissipated. On a cylinder that has low compression, crankshaft speed will be close to, or less than crankshaft speed at TDC.

At TDC of each power cylinder, and about 30 degrees past TDC, the IDM collects data for crankshaft speed.

NOTE: If not cranked long enough to collect data, the EST will display 255. 255 represents an erroneous rpm value.

The TDC value is subtracted from the value about 30 degrees after TDC and records for each cylinder.

Example

200 rpm (30 degrees after TDC) - 180 rpm (TDC) = 20 rpm

The EZ-Tech® will display a value on the screen for each cylinder.

Relative Compression Test	Value
Cylinder 1 Relative Compression	69
Cylinder 2 Relative Compression	70
Cylinder 3 Relative Compression	61
Cylinder 4 Relative Compression	68
Cylinder 5 Relative Compression	31
Cylinder 6 Relative Compression	67

J31160

Figure 278 Example

Compare the compression values of each cylinder with the other cylinder values. A cylinder with compression lower than the other cylinders indicates a suspect cylinder. Test value of 31 for cylinder five indicates a suspect cylinder.

If a cylinder value is zero or a much lower than other cylinders and this cylinder is a non-contributor (identified in the injector disable test), check for a mechanical problem.

Relative Compression Test	Value
Cylinder 1 Relative Compression	35
Cylinder 2 Relative Compression	70
Cylinder 3 Relative Compression	61
Cylinder 4 Relative Compression	68
Cylinder 5 Relative Compression	61
Cylinder 6 Relative Compression	0

J31161

Figure 279 Example

If TDC rpm is greater than rpm 30 degrees after TDC, the EST will display 0.

If the test value for a power cylinder is 0, the cylinder is suspect.

If the test value for a power cylinder is significantly below 50 rpm or above 80 rpm, the cylinder is suspect.

Test value 35 for cylinder 1 indicates a suspect cylinder. Test value of 0 for cylinder 6 indicates a suspect cylinder.

When the Relative Compression Test is done, the EST indicates, stop cranking the engine, and will display test values.

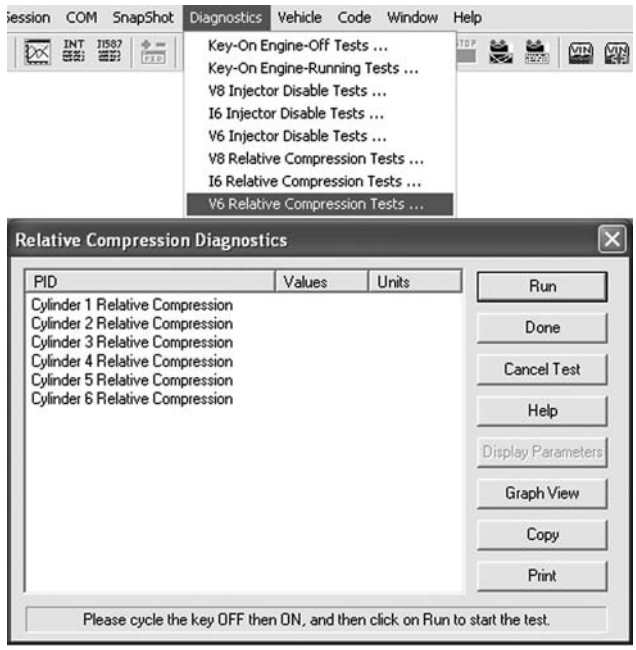
Test data displayed in this test should be compared with data collected from the Injector Disable test.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

NOTE: Batteries must be fully charged before doing this test. If multiple tests are necessary, use a battery charger during this test; battery drain can be extensive.



J31140

Figure 280 Relative Compression Test

1. Select Diagnostics from the menu bar.
2. Select Relative Compression Test from the drop down menu.
3. Follow the messages at the bottom of the window.
   - Turn ignition switch to ON.
   - Select Run.

WARNING: To prevent personal injury or death, after selecting Run, turn the ignition switch, within 5 seconds, to crank the engine; if not done in 5 seconds, the EST will cancel the test and the engine will start.

   - Within 5 seconds of selecting run, crank engine for 15 seconds. Another message will read Stop Cranking within 5 seconds.

NOTE: Do not turn ignition switch to OFF. If the ignition switch is turned to OFF, test results will be lost.

NOTE: If test results are identical to previous test results, the current test failed and the previous results were displayed.

4. Interpret results.
   - If a Test 10 and Test 9 identify a suspect cylinder, check for a mechanical problem.
   - If a Test 10 does not identify a suspect cylinder, but the Test 9 does, replace suspect injector(s).

NOTE: If any injectors are removed and reinstalled or replaced, test drive vehicle for 32 km (20 mi) before checking for misfire or rough idle.

Possible Causes
Broken compression rings
Leaking or bent valves
Bent push rods
Bent connecting rods
Loose fuel injectors
Scored injection bore
Piston damage

11. Air Management

☐ Use EST to set engine idle speed, monitor engine load, toggle EGR valve and monitor MAF.

Idle speed	MAF	Load
EGR close	MAF	Message Set
EGR open	MAF	DTC Set
EGR close	MAF	DTC Set

- Correct problem causing messages or DTCs before restarting.

J31106

Figure 281

Purpose

To check the operation of the Air Management System and the Exhaust Gas Recirculation (EGR) valve

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

⚠ WARNING: To prevent personal injury or death, comply with the following:

- **Read all safety instructions in the "Safety Information" section of this manual.**
- **Before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.**

⚠ WARNING: To prevent personal injury or death, use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.

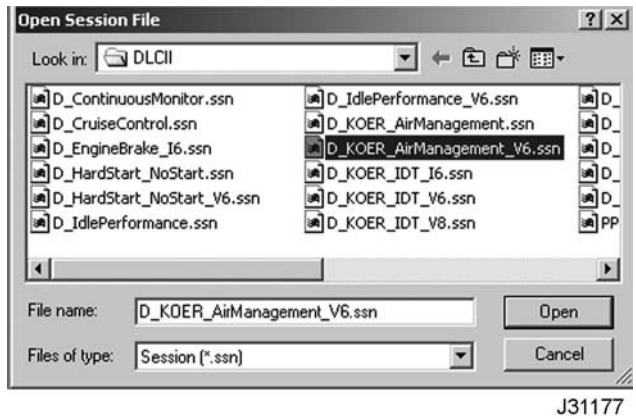


Figure 282 KOER Air Management session

1. Select D_KOER_AirManagement_V6.ssn in the Open Session File window, select Open to monitor engine operation.

NOTE: When using the EST to do KOEO or KOER diagnostic tests, Standard Test is always selected and run first. If the ignition switch is not cycled, the Standard Test does not have to be run again.

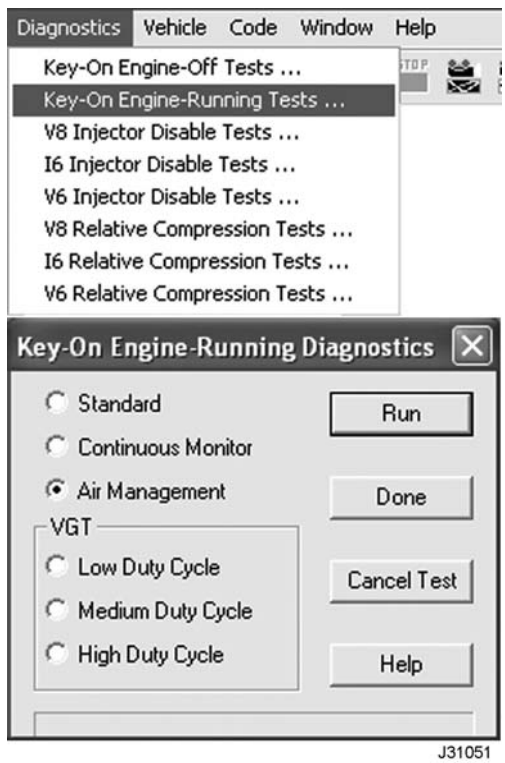


Figure 283 Air Management test

2. Select Diagnostics from menu bar.
3. Select Key-On Engine-Running Tests from the drop down menu.
4. From the KOER Diagnostics menu, select Air Management and select Run to start the test.

   The ECM will start the Air Management test and direct the engine to accelerate to a predetermined rpm. The ECM will monitor the effects of the EGR valve movement using MAF.

   - If a problem is detected the ECM will cancel the test, set a DTC, and restore normal engine operation.

NOTE: If engine load is above the engine load specification the test won't run.

5. Record DTCs on Diagnostic Form. See "Appendix B: Diagnostic Trouble Codes (page 581)" for a definition of the DTCs.
6. Correct problems causing active DTCs. Before replacing the EGR valve, check all other possible causes.
7. Clear DTCs.

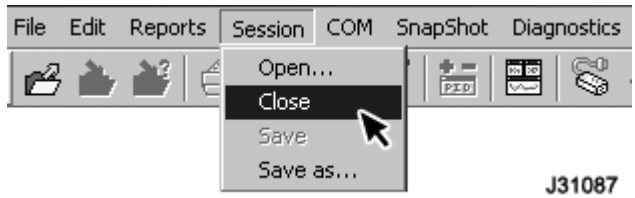


Figure 284 Close session

8. When finished with this test, select Session from menu bar, then Close.

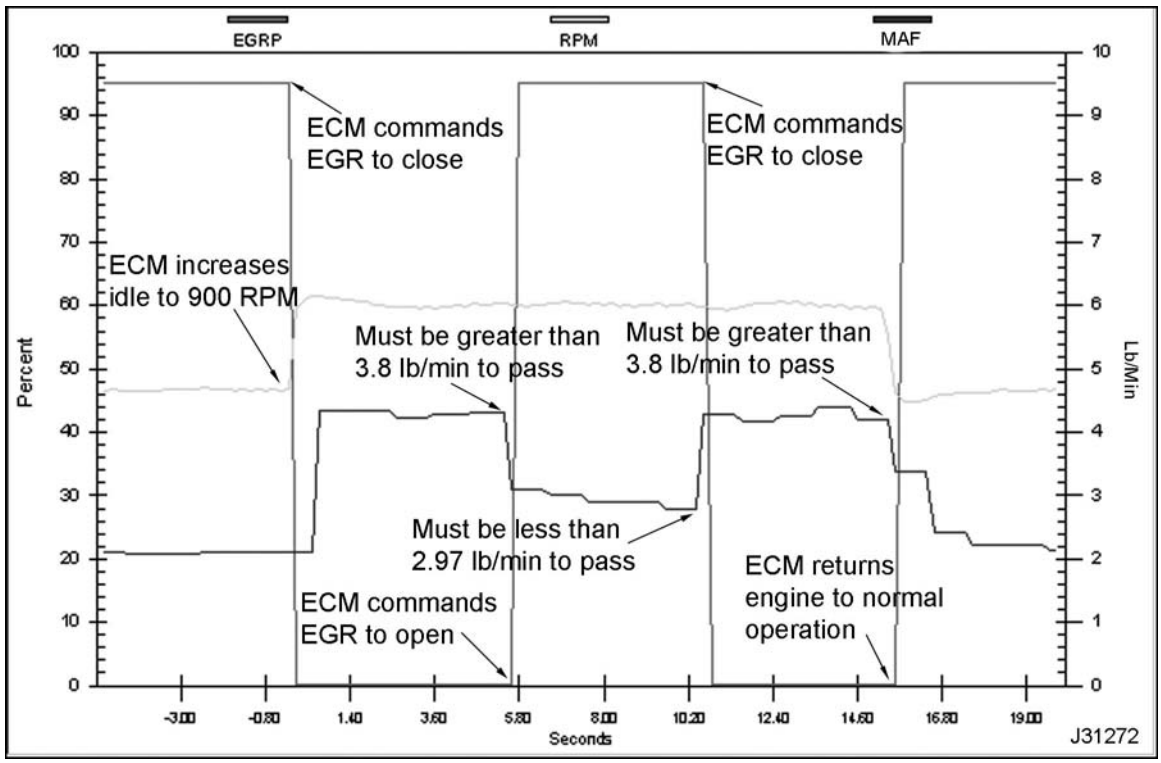


Figure 285 Air Management diagnostic readout for engine rpm, EGR position, and MAF

The ECM commands the EGR valve to close and increases the engine idle speed to 900 rpm. The ECM allows the Manifold Air Flow (MAF) to stabilize. The ECM reads and matches the MAF pressure to the expected values; pressure is expected to increase to greater than 3.8 lb/min to pass. If the MAF does not meet the expected pressure, DTC 346 is set and the test is cancelled.

The ECM commands the EGR to open, and allows MAF to stabilize. The ECM reads MAF pressure and matches it to the expected pressure; pressure is expected to decrease to less than 2.97 lb/min to pass. If the MAF pressure does not match the expected pressure, DTC 346 is set and the test is cancelled.

The ECM commands the EGR valve to close, and allows MAF to stabilize. The ECM reads MAF pressure and matches it to the expected pressure; pressure is expected to increase to greater than 3.8 lb/min to pass. If the MAF pressure does not match the expected pressure, DTC 346 is set and the test is cancelled.

The ECM returns the EGR valve and engine idle speed to normal operation. If all flows matched or exceeded the expected flows, no DTC is set and the engine is returned to normal operation.

Possible Causes

Exhaust leaks
Intake leaks
Biased MAF sensor
Failed turbocharger
Failed EGR control valve and drive module
Plugged or restricted Catalytic converter - if equipped
Plugged or restricted Catalyzed Diesel Particulate Filter (CDPF) - if equipped

12. Boost Control

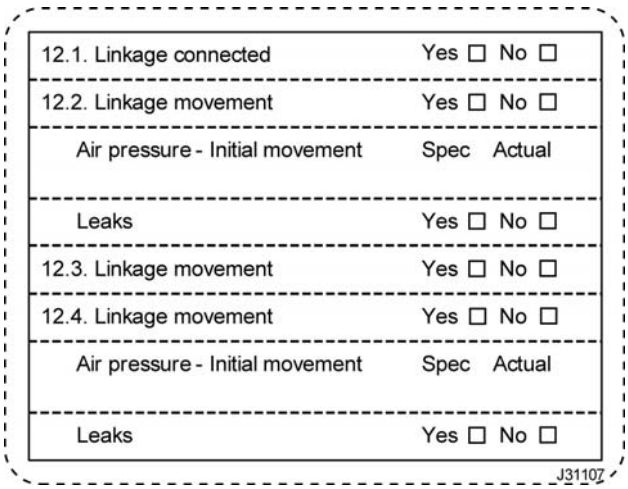


Figure 286

Purpose

To verify Turbocharger Bypass Control (TCBC) is operating correctly.

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable
- Gauge Bar Tool
- Hose and adapters from vacuum pump kit
- Marker

Possible Causes

- Failed or damaged pneumatic actuator
- Broken, cracked, or disconnected tubing
- Pneumatic actuator linkage disconnected
- Failed BCS
- Electrical failure to BCS
- Failed turbocharger bypass valve

12.1. Linkage Inspection

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

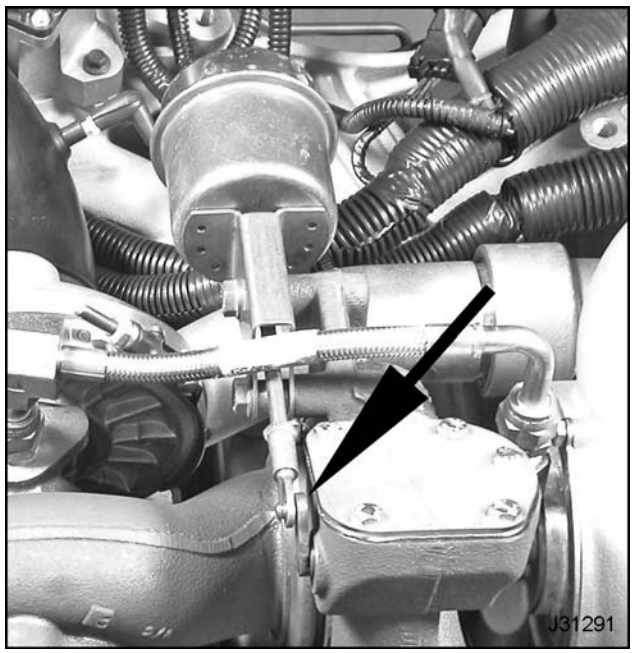


Figure 287 Turbocharger pneumatic actuator linkage connection to bypass valve lever

1. Inspect the turbocharger pneumatic actuator linkage connection to bypass valve.
   - If the actuator linkage is disconnected, continue with step 2.
   - If the actuator linkage is connected, do "Test 12.2. Actuator and Bypass Valve Operation (page 255)."
2. Check the bypass valve lever for freedom of movement.
   - If the bypass valve lever moves freely, connect the pneumatic actuator linkage, do "Test 12.2. Actuator and Valve Operation (page 255)."
   - If the bypass valve lever is hard to move. Remove the bypass valve cover, inspect the internal components for damage. Clean bypass valve if possible or replace turbocharger, and retest. When replacing the bypass valve cover, replace the cover gasket and torque the fasteners to 13.6 N·m (120 lbf·in).

12.2. Actuator and Bypass Valve Operation

1. See “Appendix A: VT 275 Performance Specifications (page 571)” for specifications and record on Diagnostic Form.

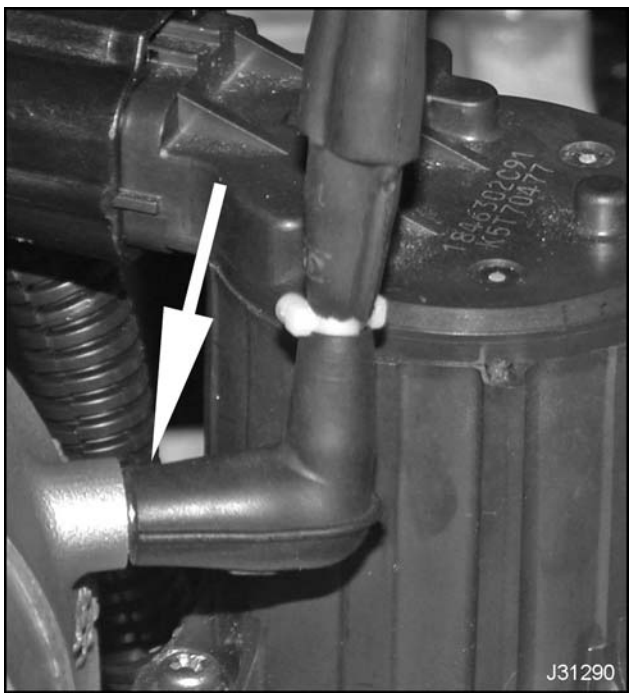


Figure 288 Boost pressure tube connector on inlet elbow

2. Disconnect the boost pressure tube from the intake manifold inlet elbow. Inspect all boost pressure tube connectors when removed for cracking.

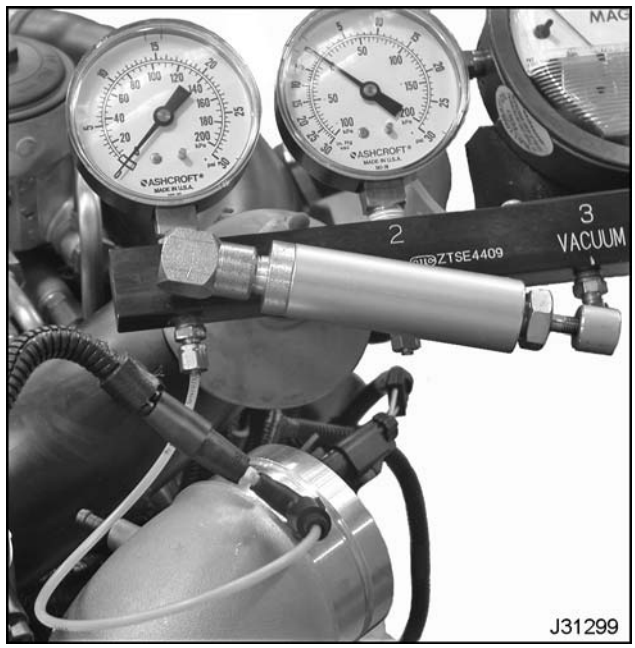


Figure 289 Actuator and bypass valve operational test

3. Attach pressure tubing from the Gauge Bar Tool hand pump and 0-30 psi gauge to the boost pressure tube.

   NOTE: Use adapters from a vacuum pump kit to make test hose connections.

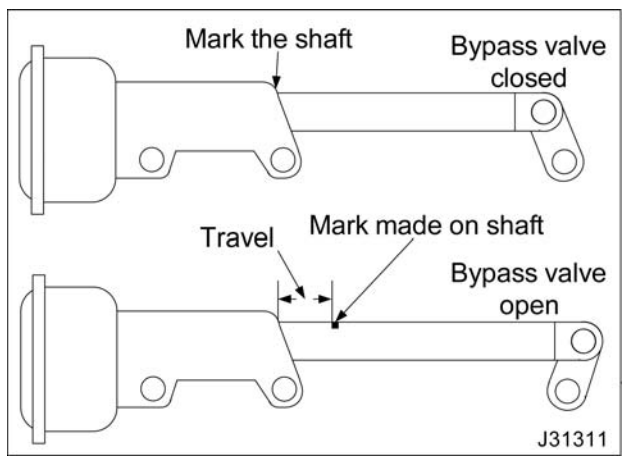


Figure 290 Bypass valve linkage movement

4. Mark a reference spot on the linkage shaft.
5. Using the Gauge Bar Tool hand pump, apply pressure to the pneumatic actuator. As pressure

starts to build up, linkage movement (indicated by mark on the linkage) should begin to move at specified pressure.

NOTE: If unable to build pressure with the hand pump, attach shop air to the regulator and 0-30 psi gauge on the Gauge Bar Tool to supply air pressure. Gradually increase air pressure (do not exceed 30 psi) to check linkage movement and test for leaks.

6. Record results on the Diagnostic Form.
   - If the pneumatic actuator linkage moves, and test pressure is within specification, continue with “Test 12.3. BCS Control (page 257).”
   - If the pneumatic actuator linkage does not move, or initial movement is not at specified pressure, continue with Step 7.
7. With pressure applied spray leak detector or soap solution on the boost pressure tubes including the pneumatic actuator housing and pneumatic actuator housing. Also leak test of boost pressure tube to the BCS, the BCS housing, and all rubber connectors.
   - If boost pressure tubes are leaking, replace and retest.
   - If the BCS housing is leaking, replace and retest.
   - If pneumatic actuator is leaking do “Test 12.4. Pneumatic Actuator Operation (page 259)” in this section to verify pneumatic actuator leakage.
   - If the pneumatic actuator linkage does not move, or initial movement is not at specified pressure, and there are no leaks, do “Test 12.4. Pneumatic Actuator Operation (page 259)” in this section.

12.3. BCS Control

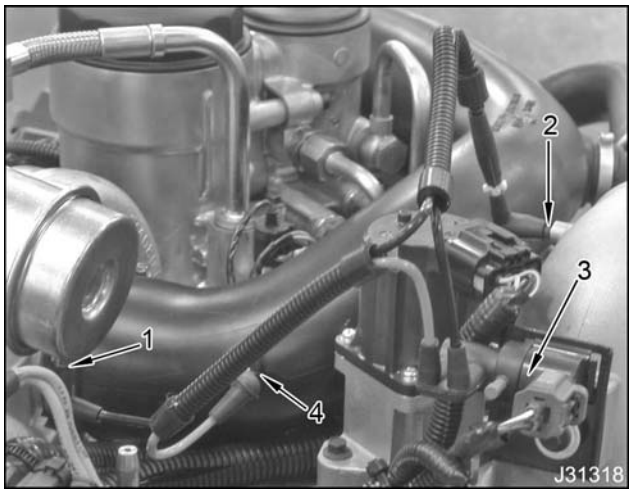


Figure 291 BCS Control system

1. Air supply to pneumatic actuator
2. Supply air inlet elbow
3. Boost Control Solenoid
4. Vent inlet to low-pressure compressor

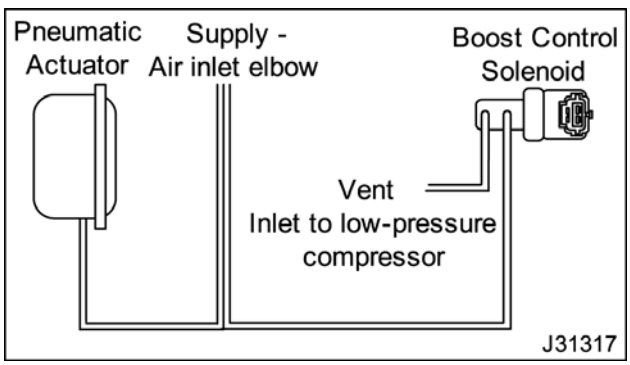


Figure 292 BCS Control system functional diagram

1. Connect the EZ-Tech® interface cable to the EST and the ATA connector.
2. Turn ignition switch to ON. (Do not crank engine.)

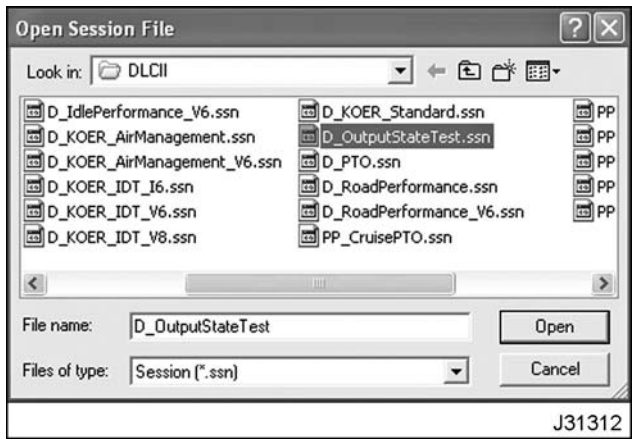


Figure 293 Output State Test Session

3. Select D_OutputStateTest.ssn from the Open Session File window, select Open to open the session.
4. Using the Gauge Bar Tool hand pump, apply pressure of 172 kPa (25 psi), do not exceed 206 kPa (30 psi) to the pneumatic actuator through the supply tube and fully open the bypass valve.

   NOTE: Shop air may be used to supply air pressure. Attach shop air to the regulator and 0-30 psi gauge on the Gauge Bar Tool to supply air pressure. Gradually increase air pressure, do not exceed 206 kPa (30 psi) to open bypass valve.

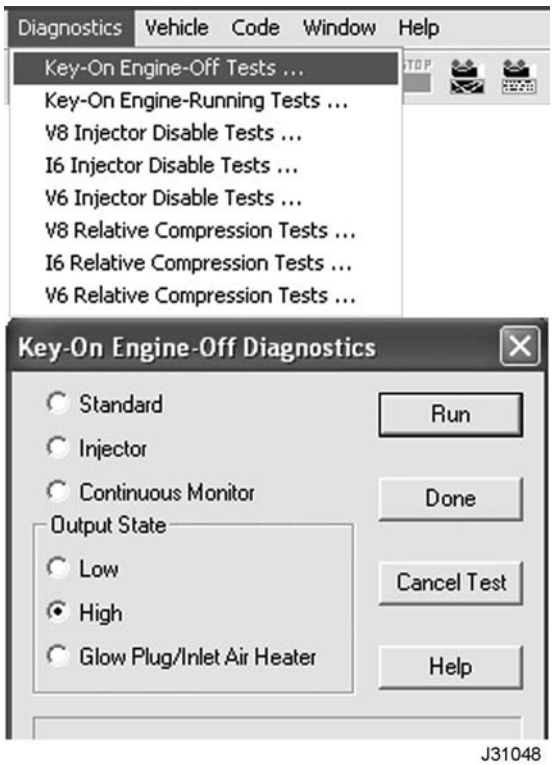


Figure 294 Output State High test

5. Select Diagnostics from the menu bar.
6. Select Key-On Engine-Off Tests from the drop down menu.

NOTE: When using the EST to do KOEO or KOER diagnostic tests, Standard test is always selected and run first. If the ignition switch is not cycled, the Standard test does not have to be run again.

7. From the KOEO Diagnostics menu, select Output State Test High and select Run to start the test.
   - If the bypass valve linkage moves to the closed position, the boost control system is working correctly, do “Test 13. Torque Converter Stall (page 261).”
   - If the bypass valve linkage does not move to the closed position, see “BCS (Boost Control Solenoid) Assembly (page 316)” in the “Electronic Control Systems Diagnostics (page 279)” section of this manual.

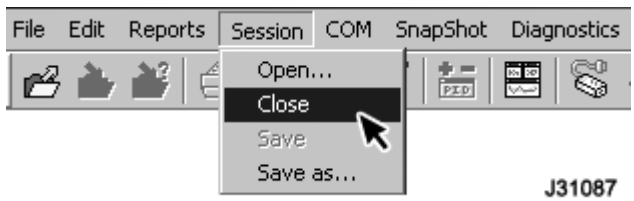


Figure 295 Close session

8. When finished with this test, select Session from menu bar, then Close.

12.4. Pneumatic Actuator Operation

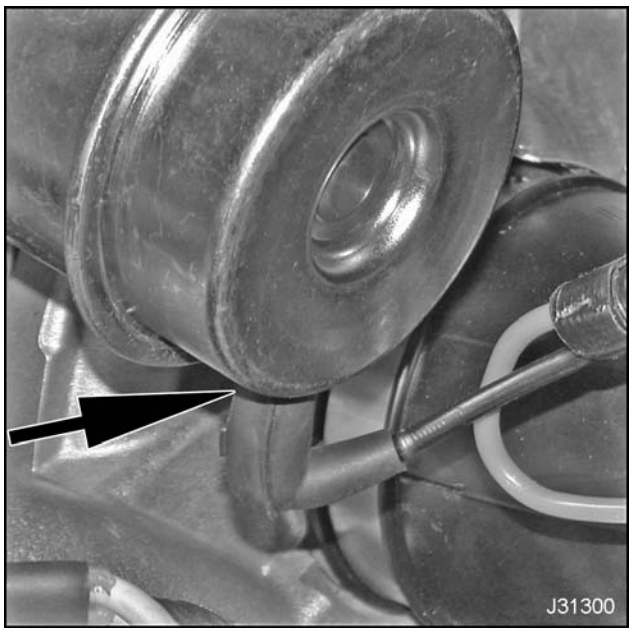


Figure 296 Pressure control connector on pneumatic actuator

1. Disconnect pressure tube connector from the bottom of the pneumatic actuator.

Figure 297 Pneumatic actuator operational test

2. Attach pressure tubing from the Gauge Bar Tool hand pump and 0-30 psi gauge to the bottom of the pneumatic actuator.

   NOTE: Use adapters from a vacuum pump kit to make test tube connections.

3. Using the Gauge Bar Tool hand pump, apply pressure to the pneumatic actuator. As pressure starts to build up, linkage movement (indicated by mark on the linkage) should begin to move at specified pressure.

   NOTE: If unable to build pressure with the hand pump, attach shop air to the regulator and 0-30 psi gauge on the Gauge Bar Tool to supply air pressure. Gradually increase air pressure, do not exceed 206 kPa (30 psi) to check linkage movement and test for leaks.

4. Record pressure reading on the Diagnostic Form.
   - If the pneumatic actuator linkage moves, test pressure is within specifications, and there is no leak, continue with Step 5.
   - If the pneumatic actuator linkage does not move, or initial movement is not at specified pressure, continue with Step 6.
5. Check BCS assembly electrical circuits, see “BCS (Boost Control Solenoid) Assembly (page 316)” in the “Electronic Control Systems Diagnostics (page 279)” section of this manual.
   - If electrical control is operating properly, check BCS assembly. It could be stuck in the vent position. If BCS assembly is stuck, replace and retest.
   - If electrical control circuits are not operating properly, repair as needed and retest.
6. With pressure applied spray leak detector or soap solution around the boost pressure tube to the pneumatic actuator and pneumatic actuator housing.
   - If pneumatic actuator is leaking, replace and retest.
   - If pneumatic actuator is not leaking, continue with Step 7.

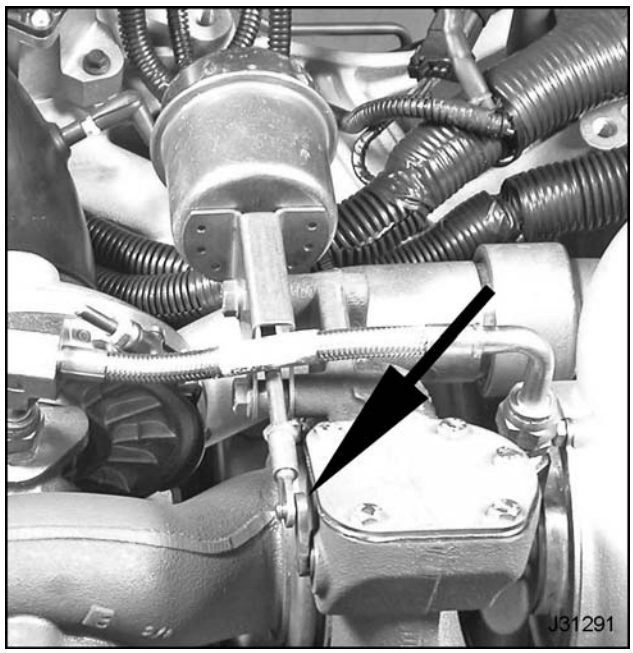


Figure 298 Turbocharger pneumatic actuator linkage connection to bypass valve

7. Disconnect pneumatic actuator linkage at the bypass valve, check the bypass valve lever for freedom of movement.
   - If the bypass valve lever moves freely, replace the pneumatic actuator and retest.
   - If the bypass valve lever is hard to move or is stuck. Remove the bypass valve cover, inspect the internal components for damage, clean and free up the bypass valve and retest.
   - If unable to clean and free up the bypass valve, replace the turbocharger.

13. Torque Converter Stall

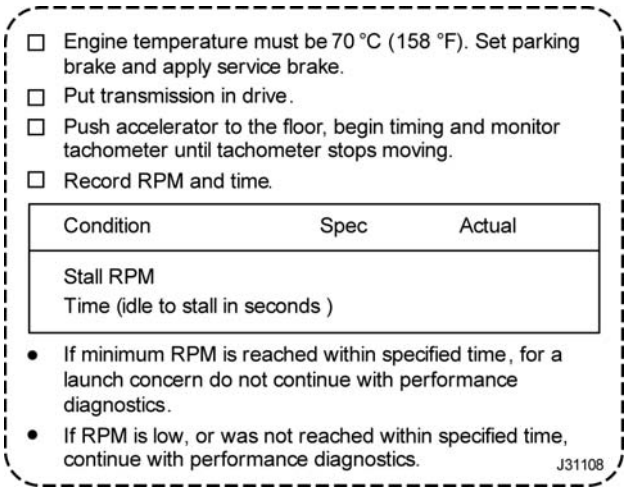


Figure 299

Purpose

To determine if the engine develops specified stall rpm within idle to stall time, when diagnosing a poor launch concern.

Tools

- None

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, make sure brakes are correctly adjusted and in good condition before performing brake stall test. This procedure should be done in an open lot.

CAUTION: To prevent damage to the drive train, do not test for more than 10 seconds at a time or more than twice back to back. (If doing twice, wait 2 minutes between tests.)

1. See "Appendix A: VT 275 Performance Specifications (page 571)" for specifications and record on Diagnostic Form.
2. Verify engine temperature is 70 °C (158 °F).
3. Set parking brake, apply service brake, and make sure no one is in front of the vehicle.
4. Put transmission in drive.
5. Press accelerator pedal fully to the floor, begin timing and monitor TACH until TACH stops moving.
6. Record stall RPM and idle to stall time on Diagnostic Form.
   - If minimum RPM is reached in the specified time, with Performance Diagnostics, for a poor launch concern do not continue with Performance Diagnostics.
   - If RPM is low or not reached in the specified time, continue Performance Diagnostics.

Possible causes

Intake leaks (tubes, clamps)
Boost leaks
Restricted intake or exhaust
Exhaust leaks
Low fuel pressure
Low ICP
Control system faults
Failed EGR control valve and drive module
Failed fuel injectors
Failed turbocharger
Biased BAP, ICP or MAP sensors
Power cylinder condition

14. Crankcase Pressure

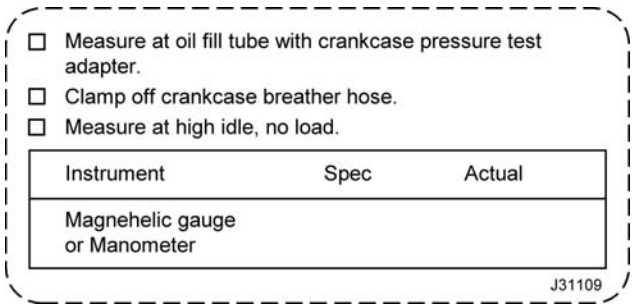


Figure 300

Purpose

To measure the condition of the power cylinders

Tools

- Magnehelic gauge on gauge bar or water manometer
- Extended oil fill tube
- Crankcase pressure test adapter
- Heater hose pliers

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

1. See "Appendix A: VT 275 Performance Specifications (page 571)" for specifications and record on Diagnostic Form.
2. Park vehicle on level ground.

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, by pouring them on the ground, in sewers, or in bodies of water.

3. Make sure the engine oil level is not above operating range and the oil level gauge is secured.

   Make sure crankcase breather hose is clean and secure in crankcase breather assembly, and make sure the crankcase breather assembly and the valve cover are tight.
4. Make sure all hoses are secure and not leaking.
5. Clamp off road draft hose or crankcase breather hose with heater hose pliers.
6. Remove oil fill cap or oil fill extension tube (on stripped chassis).

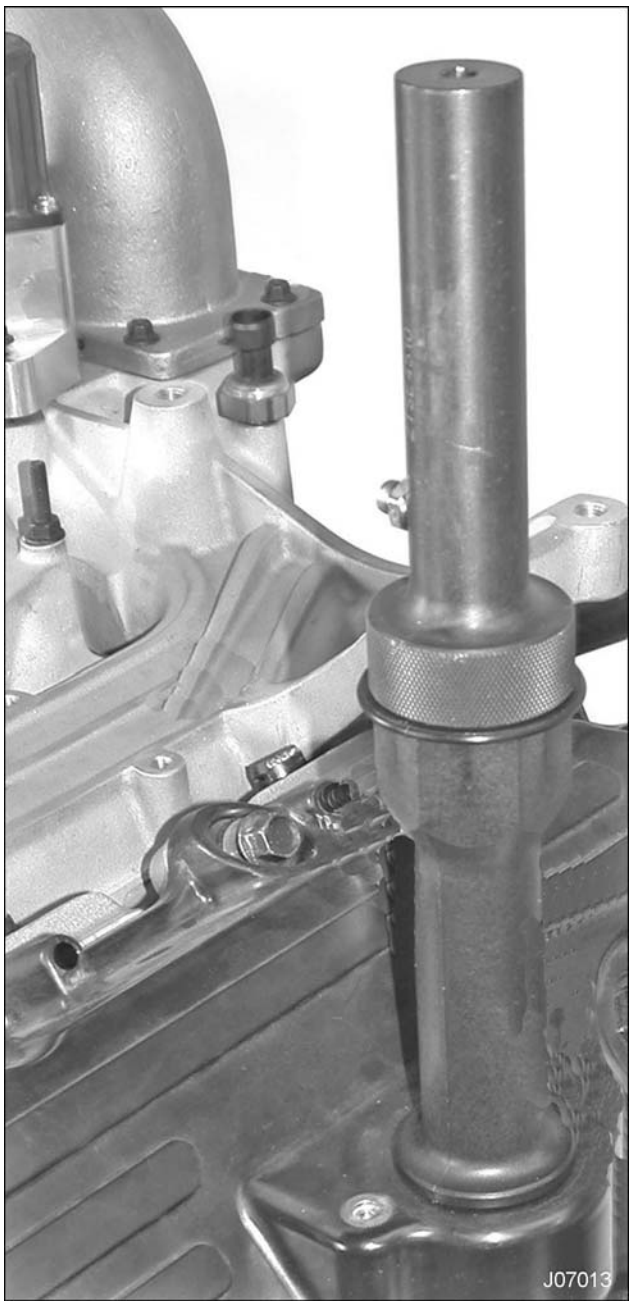


Figure 301 Crankcase pressure sounding tube

7. Install extended oil fill tube in oil fill cap opening
8. Install Crankcase Pressure Test Adapter on the extended oil fill tube.

WARNING: To prevent personal injury or death, comply with the following:

- **When routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine surfaces.**
- **Before running engine for diagnostic or service procedures, shift transmission to park or neutral, set parking brake, and block wheels.**

9. Connect a test line from the crankcase pressure test adapter to the magnehelic gauge on the gauge bar or to a water manometer.

WARNING: To prevent personal injury or death, use proper ventilation when operating an engine in a closed area, in order to remove deadly exhaust fumes. Inhalation of exhaust fumes may be fatal.

10. Run the engine to reach normal engine operating 70 °C (158 °F) or higher, before measuring crankcase pressure.
11. Run engine at high idle (no load) rpm. Allow the gauge reading to stabilize before taking pressure reading.
12. Record crankcase pressure on Diagnostic Form.
    - If pressure is below specification, go to “Test 15. Test Drive (Full load, rated speed) (page 265).”
    - If pressure is above specification, continue with step 13.
13. Do “Test 10. Relative Compression (page 247)” to pin point suspect cylinders.
14. Do “Test 9. Injector Disable (page 242)” to further pin point suspect cylinders.
15. Inspect air induction for dirt ingestion.
16. Measure compression with compression test adapter and gauge. Compare compression cylinder to cylinder.

Possible Causes	
High oil consumption and excessive crankcase pressure may indicate	Dirt in air induction system
	Badly worn or broken rings
	Cylinder sleeves badly worn or scored
	Leaking valve seals or worn valve guides
	A restricted orifice in crankcase breather tool
	Inoperative turbocharger
Normal oil consumption and excessive crankcase pressure may indicate	Leaking intake manifold gasket

15. Test Drive (Full load, rated speed)

Do the following tests in this section during one test drive:

Monitor Boost Pressure (MAP) using EST
Monitor MAF using EST
Fuel Pressure
Monitor ICP using EST

15.1. Monitor Boost Pressure Using EST

☐ Use EST to monitor **boost pressure** and engine speed.

Condition	Spec Engine speed	Spec Boost	Actual EST boost reading
Peak HP			
Peak Torque			

- If boost pressure is not to specification continue performance diagnostics; **if to specification do not continue**.

J31111

Figure 302

Purpose

To determine if the engine develops enough boost pressure at the specified rpm.

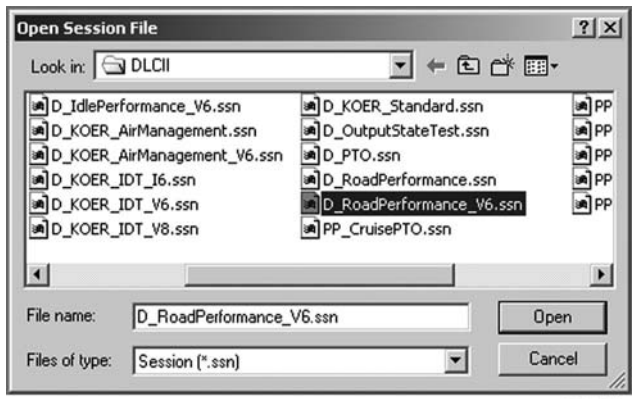
Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

1. See "Appendix A: VT 275 Performance Specifications(page 571)" for specifications and record on Diagnostic Form.

WARNING: To prevent personal injury or death, when routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine surfaces.



J31181

Figure 303 Road performance session

2. Select D_RoadPerformance_V6.ssn in the Open Session File window, select Open to monitor engine operation.
3. Monitor boost pressure (also called Manifold Absolute Pressure (MAP)).
4. Drive vehicle and make sure engine operating temperature reaches 70 °C (158 °F) or higher.
5. Find a long, open stretch of road and setup EST to record MAP during test drive.
6. When driving conditions are safe, select a suitable gear, press accelerator pedal fully to the floor, and accelerate to rated speed at 100% load.
7. After parking vehicle, replay snapshot for MAP and find data for MAP reading. Record MAP reading on Diagnostic Form.
   - If boost pressure is to specification, do not continue with Performance Diagnostics
   - If boost pressure is not to specification, continue Performance Diagnostics.

Possible causes

Intake leaks (hoses, clamps)
Boost leaks
Restricted intake or exhaust
Exhaust leaks
Low fuel pressure
Low ICP
Control system faults
Inoperative EGR control valve
Inoperative fuel injectors
Inoperative turbocharger
Biased BAP, ICP, MAF, or MAP sensor
Power cylinder condition

15.2. Monitor Mass Air Flow (MAF) Using EST

☐ Use EST to monitor **Mass Air Flow (MAF)** and engine speed.

Condition	Spec	Spec	Actual
	Engine speed	MAF	EST MAF reading
Peak HP			
Peak Torque			

- If MAF is not to specification continue performance diagnostics; **if to specification do not continue**. J31292

Figure 304

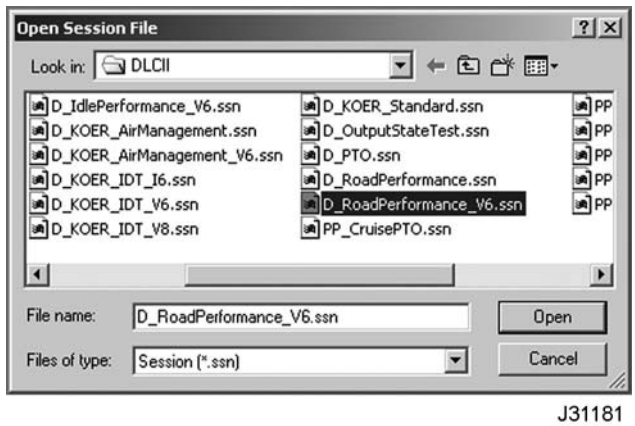


Figure 305 Road performance session

Purpose

To determine if the engine develops enough MAF at the specified rpm

Tools

- EST with MasterDiagnostics® software
- EZ-Tech® interface cable

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

1. See "Appendix A: VT 275 Performance Specifications(page 571)" for specifications and record on Diagnostic Form.

WARNING: To prevent personal injury, death, including damage to the engine or vehicle, when routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine surfaces.

2. Select D_RoadPerformance_V6.ssn in the Open Session File window, select Open to monitor engine operation.
3. Monitor Mass Air Flow (MAF).
4. Drive vehicle and make sure engine operating temperature reaches 70 °C (158 °F) or higher.
5. Find a long, open stretch of road and setup EST to record MAF during test drive.
6. When driving conditions are safe, select a suitable gear, press accelerator pedal fully to the floor, and accelerate to rated speed at 100% load.
7. After parking vehicle, replay snapshot for MAF and find data for MAF reading. Record MAF reading on Diagnostic Form.
   - If MAF is to specification, do not continue with Performance Diagnostics
   - If MAF is not to specification, continue Performance Diagnostics.

Possible causes

Intake leaks (hoses, clamps)
Restricted intake
Control system faults
Inoperative turbocharger
Biased MAF sensor
Power cylinder condition

15.3. Fuel Pressure (Full Load, Rated Speed)

Do the following tests this section during one test drive:

- Monitoring Boost Pressure using EST
- Fuel Pressure
- Monitoring ICP using EST

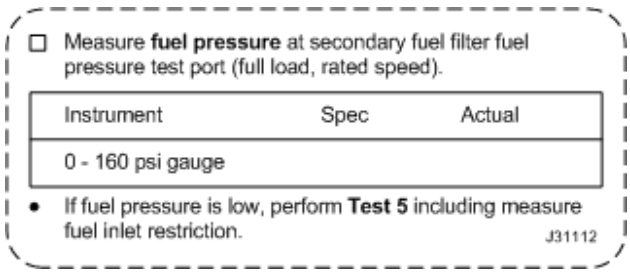


Figure 306

Purpose

To determine if the fuel system supplies the engine with the correct fuel quantity and pressure at full load

Tools

- 0-160 psi gauge (on gauge bar tool)
- ICP system test adapter
- Fuel pressure gauge, see “Test 5. Fuel Supply System (page 224).”

WARNING: To prevent personal injury or death, comply with the following:

- **Read all safety instructions in the “Safety Information” section of this manual.**
- **When taking fuel sample:**
  - **Do not smoke.**
  - **Keep away from open flames and sparks.**

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, on the ground, in sewers, or bodies of water.

1. See “Appendix A: VT 275 Performance Specifications” (page 571) for specifications and record on Diagnostic Form.
2. Remove interference parts on the engine to aid in plug removal and system testing.
3. Remove plug from the fuel pressure test port at the bottom of the secondary fuel filter housing, see “Test 5. Fuel Supply System (page 224).”
4. Install the ICP system test adapter and assemble and attach fuel pressure gauge, see “Test 5. Fuel Supply System (page 224).”
5. The clear test line should be secured to prevent it from being crimped, damaged, or lost. It will be used later.

WARNING: To prevent personal injury or death, when routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine. Secure the gauge and test line to not obstruct vehicle operation.

6. Reinstall interference parts remove, route test line and gauge to the cab for monitoring.
7. Drive vehicle and make sure engine operating temperature reaches 70 °C (158 °F) or higher.
8. Find a long, open stretch of road.
9. When driving conditions are safe, select a suitable gear, press accelerator pedal fully to the floor, and accelerate to rated speed at 100% load.
10. Memorize gauge reading for fuel pressure. After parking vehicle, record reading on Diagnostic Form; do not record reading while driving.
    - If fuel pressure is below specification, do Test 5 including measure fuel inlet restriction.
11. Remove interference parts on the engine to aid in removing test equipment and reinstallation of plug.
12. Remove fuel test fitting, inspect and lubricate the plug O-ring and install plug.
13. Replace interference parts.

Possible Causes	
No Fuel	Low or no fuel level in fuel tank(s).
	Inoperative fuel tank transfer pump
	Debris in tank
	Water or contaminants in fuel tank
	A kinked, bent, loose, or broken fuel supply line or a cracked or restricted pickup tube screen.
	Failed seals for fuel lines between fuel tanks, ice in fuel lines, fuel supply line broken or crimped, or restriction in the fuel line from the fuel tank to the HFCM
	The primary or secondary fuel filter restricted or leaking. Waxed or jelled fuel in either of the fuel filters. (Usually Grade 2-D). Cloudy fuel indicates that fuel grade is unsuitable for cold temperatures.
Low fuel pressure	Debris in tank
	Restriction from the fuel tank to the HFCM can cause high-restriction and low fuel pressure.
	A kinked or bent fuel supply line or a blocked pickup tube screen can cause high restriction and low fuel pressure.
	A loose fuel line on the suction side of the fuel system can ingest air into the system and cause low fuel pressure.
	Dirty or plugged fuel filters can cause high-restriction and low fuel pressure.
	Inoperative HFCM
	Debris in the fuel regulator valve
	Inoperative or stuck fuel pressure regulator valve.
Fuel Restriction	Debris in tank
	A kinked or bent fuel supply line or a blocked pickup tube strainer can cause high-restriction and low fuel pressure.
	Dirty filter element
	Waxed or jelled fuel in the fuel filter will cause high-restriction and low fuel pressure. (Usually Grade 2-D)
High fuel pressure	Debris in the fuel regulator valve
	Inoperative fuel pressure regulator valve.
	Combustion gases leaking into fuel system

15.4. Monitoring ICP using EST

Do the following tests this section during one test drive:

- Monitoring Boost Pressure using EST
- Fuel Pressure
- Monitoring ICP using EST

☐ Use EST to monitor **ICP** and engine speed

Instrument	Spec	Actual
EST		
Aerated oil Yes ☐ No ☐ After 2 min. ☐		

- Disconnect ICP and test drive vehicle.
- If problem is corrected, see Operational Voltage checks for ICP sensor in Section 7 in EGES-305.
- If still high or unstable, replace IPR and retest.

J31113

Figure 307

Purpose

To determine if the ICP system is providing sufficient hydraulic pressure to operate the injectors

Tools

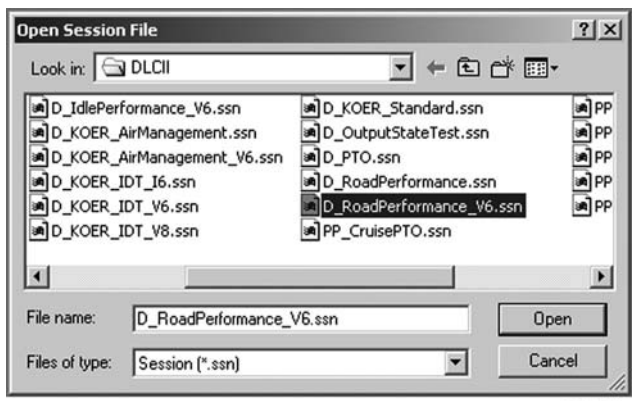
EST with MasterDiagnostics® software
EZ-Tech® interface cable
ICP system test adapter
Fuel pressure gauge, see “Test 5. Fuel Supply System (page 224).”
Clear container (for oil sample)

WARNING: To prevent personal injury or death, read all safety instructions in the “Safety Information” section of this manual.

WARNING: To prevent personal injury or death, do not allow engine fluids to stay on your skin. Clean skin and nails with soap and water, or a good hand cleaner. Wash or properly dispose of clothing or rags containing engine fluids. Engine fluids contain elements that may be unhealthy for skin and could cause cancer.

NOTE: Engine fluids, oil, fuel, and coolant, are a threat to the environment. Recycle or dispose of engine fluids according to local regulations. Never dispose of engine fluids in the trash, on the ground, in sewers, or bodies of water.

1. See “Appendix A: VT 275 Performance Specifications(page 571)” for specifications and record on Diagnostic Form.



J31181

Figure 308 Road performance session

2. Select D_RoadPerformance_V6.ssn in the Open Session File window, select Open to monitor engine operation.
3. Monitor ICP.
4. Drive vehicle and make sure engine operating temperature reaches 70 °C (158 °F) or higher.

5. Find a long, open stretch of road and setup EST to record ICP during test drive.
6. When driving conditions are safe, select a suitable gear, press accelerator pedal fully to the floor, and accelerate to rated speed at 100% load.
7. After parking vehicle, replay snapshot for ICP and find data for ICP reading. Record ICP reading on Diagnostic Form.
   - If ICP is to specification, do not continue with Performance Diagnostics
   - If ICP is not to specification, continue with step 8.
8. Turn off engine
9. Connect fitting on test line with Fuel/Oil Pressure Test Coupler to a 0 to 1723 kPa (0 to 250 psi) gauge.

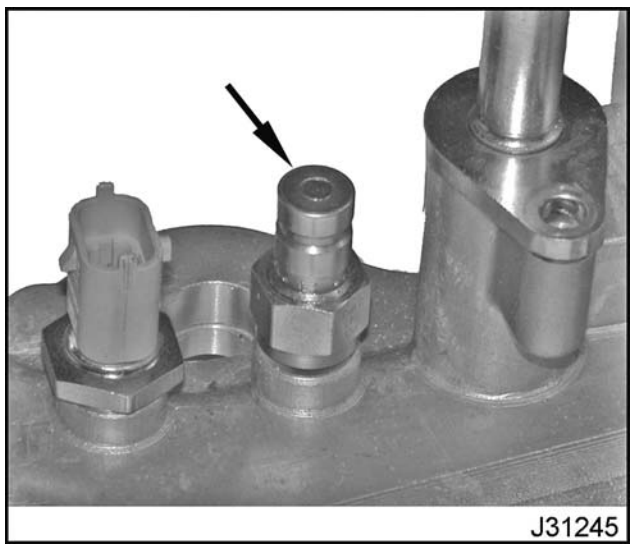


Figure 309 Fuel pressure test fitting installed

10. Remove EOP switch and install Fuel Pressure Test Fitting.
11. Connect Fuel/Oil Pressure Test Coupler to Fuel Pressure Test Fitting.

    NOTE: See fuel pressure gauge manufactured or obtained in “Test 5. Fuel Supply System (page 224)” of this section.

WARNING: To prevent personal injury or death, comply with the following when taking oil samples:

- **Do not route oil line close to moving parts.**
- **Do not let oil line touch hot engine surfaces.**
- **Use caution not to burn hands.**

12. Start and run engine at high idle for two minutes. Record ICP initially as high idle is set, then again after two minutes. Compare the two ICP readings. ICP that rises above the spec, at any point during the two minutes, indicates aeration.
13. Return engine to low idle, take oil sample, and check for foam.
    - If oil is aerated, a large quantity of air bubbles mixed throughout the oil, or foam build up on top of the oil sample will be seen. Correct condition.
    - If oil is not aerated, disconnect ICP sensor and check engine stability. If problem is corrected, see “ICP (Injection Control Pressure) Sensor (page 447)” in the “Electronic Control Systems Diagnostics (page 279)” section of this manual.
    - If ICP is still high or unstable, replace IPR following procedures in *Engine Service Manual* and retest.
14. Turn off engine
15. Clean and inspect the EOP switch sealing surfaces and O-ring. Replace O-ring if necessary. Lubricate the EOP switch O-ring.
16. Remove Fuel Pressure Test Fitting from EOP port. Install the EOP switch in the EOP port.

    NOTE: Oil will spill out; catch oil in a container or catch provided in step 14. As quickly as possible install the EOP switch.

Possible causes
Failed ICP sensor circuit
Failed ICP sensor
Inoperative IPR valve
Inoperative high-pressure oil pump
ICP system leakage
The ECM directs the IPR valve to reduce ICP caused by low boost pressure, an incorrect feedback signal from APS, or an incorrect feedback signal from the ICP sensor.