SMCS - 1290
i09551905

This procedure covers the following diagnostic codes:

Table 1

Diagnostic Trouble Codes for Injector Solenoid			
J1939 Code	**CDL Code**	**Code Description (code descriptions may vary)**	**Comments**
651-5	1-5	Engine Injector Cylinder #01 : Current Below Normal	These diagnostic codes indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector. The Electronic Control Module (ECM) detects the following conditions: A low current condition (open circuit) for each of five consecutive attempts to operate Battery voltage above 9 VDC for 2 seconds The warning light will come on. The ECM will log the diagnostic code. The engine may have low power and/or rough running. When an "Cylinder Cutout Test" is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors. The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged. An open circuit will prevent the operation of the electronic unit injector.
652-5	2-5	Engine Injector Cylinder #02 : Current Below Normal	
653-5	3-5	Engine Injector Cylinder #03 : Current Below Normal	
654-5	4-5	Engine Injector Cylinder #04 : Current Below Normal	
655-5	5-5	Engine Injector Cylinder #05 : Current Below Normal	
656-5	6-5	Engine Injector Cylinder #06 : Current Below Normal	
651-6	1-6	Engine Injector Cylinder #01 : Current Above Normal	These diagnostic codes indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector. The ECM detects the following conditions: A high current condition (short circuit) for each of five consecutive attempts to operate Battery voltage above 9 VDC for 2 seconds The warning light will come on. The ECM will log the diagnostic code. The engine will have low power and/or rough running. The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code
652-6	2-6	Engine Injector Cylinder #02 : Current Above Normal	
653-6	3-6	Engine Injector Cylinder #03 : Current Above Normal	
654-6	4-6	Engine Injector Cylinder #04 :	

		Current Above Normal	has been logged. A short circuit will prevent the operation of the electronic unit injector.
655-6	5-6	Engine Injector Cylinder #05 : Current Above Normal	
656-6	6-6	Engine Injector Cylinder #06 : Current Above Normal	
Follow the troubleshooting procedure to identify the root cause of the fault.			

Perform this procedure under conditions that are identical to the conditions that exist when the fault occurs. Typically, faults with the injector solenoid occur when the engine is warmed up and/or when the engine is under vibration (heavy loads).

These engines have Electronic Unit Injectors (EUI) that are mechanically actuated and electronically controlled. The Engine Control Module (ECM) sends a pulse to each injector solenoid. The pulse is sent at the correct time and at the correct duration for a given engine load and speed. The solenoid is mounted on top of the fuel injector body.

If an open circuit is detected in the solenoid circuit, a diagnostic code is generated. The ECM continues to try to fire the injector. If a short circuit is detected, a diagnostic code is generated. The ECM will disable the solenoid circuit. The ECM will periodically try to fire the injector. If the short circuit remains, this sequence of events will be repeated until the fault is corrected.

"Injector Solenoid Test"

Use the "Injector Solenoid Test" in the electronic service tool to aid in diagnosing an open circuit or a short circuit diagnostic code while the engine is not running. The "Injector Solenoid Test" will send a signal to each solenoid. The electronic service tool will indicate the status of the solenoid as "OK", "Open", or "Short".

WARNING

Electrical Shock Hazard. The electronic unit injectors use DC voltage. The ECM sends this voltage to the electronic unit injectors. Do not come in contact with the harness connector for the electronic unit injectors while the engine is operating. Failure to follow this instruction could result in personal injury or death.

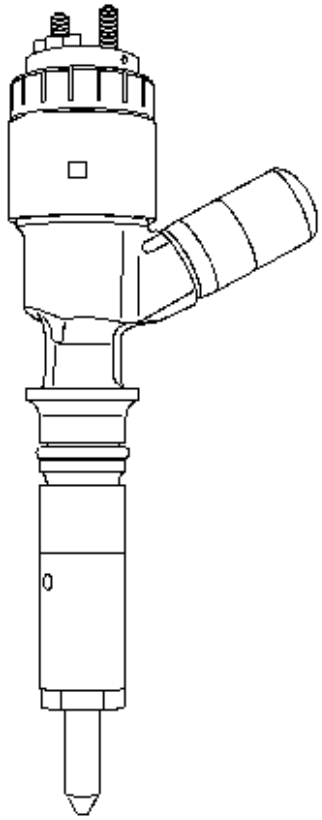

Illustration 1 g01336666
Typical example of the fuel injector

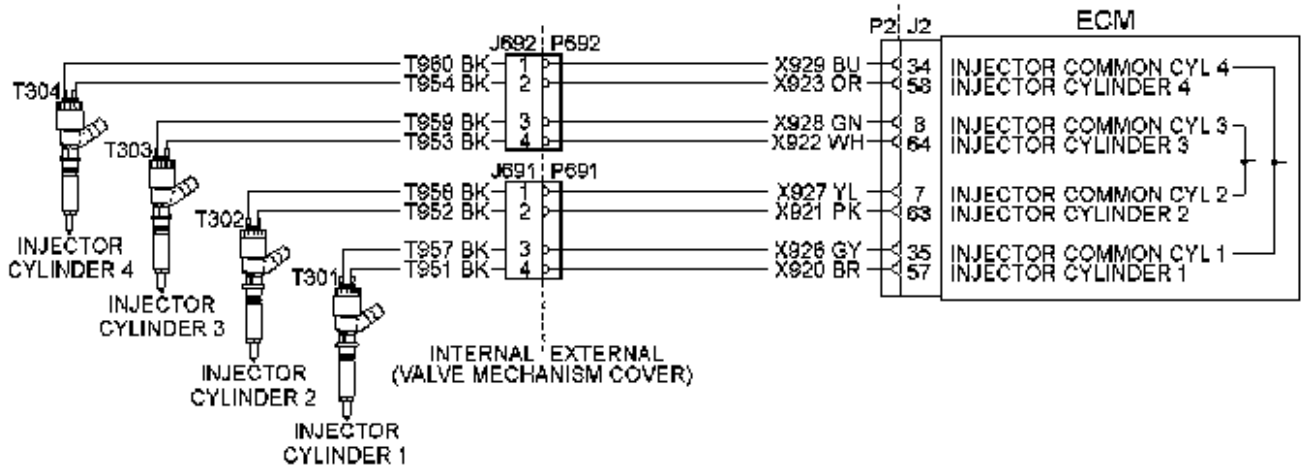

Illustration 2 g01805273
Schematic of the circuit for the injector solenoids in the C4.4 engine

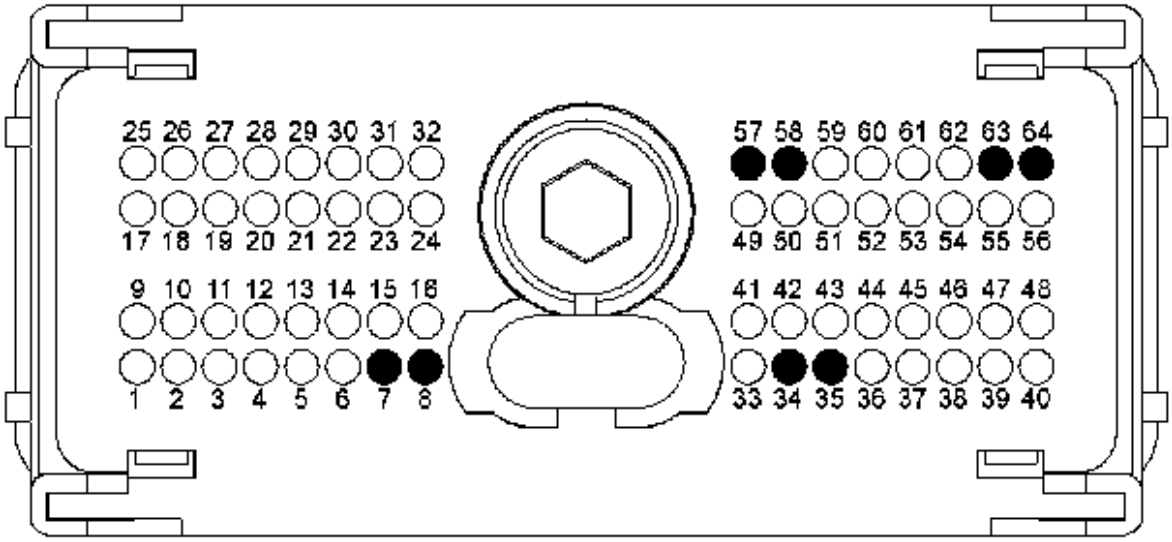

Illustration 3 g01805296

View of the pin locations on the P2 connector for the injector solenoids in the C4.4 engine
(57) Injector Cylinder (No. 1)
(35) Injector (No. 1 Cylinder Return)
(63) Injector Cylinder (No. 2)
(7) Injector (No. 2 Cylinder Return)
(64) Injector Cylinder (No. 3)
(8) Injector (No. 3 Cylinder Return)
(58) Injector Cylinder (No. 4)
(34) Injector (No. 4 Cylinder Return)

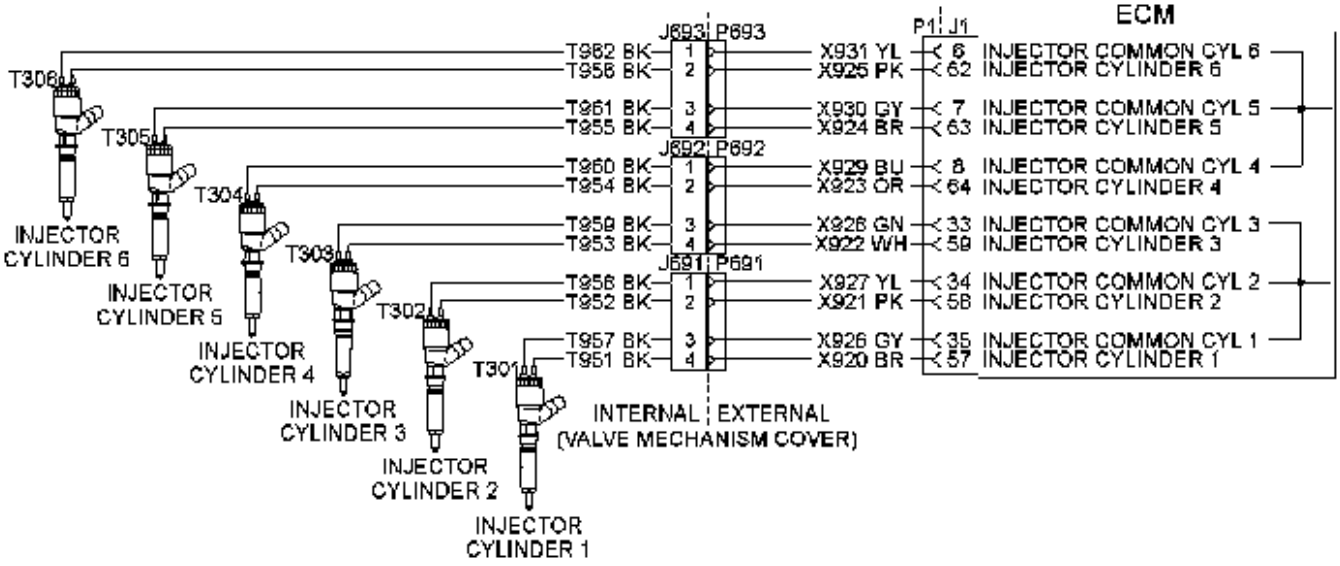

Illustration 4 g01805313

Schematic of the circuit for the injector solenoids in the C6.6 engine

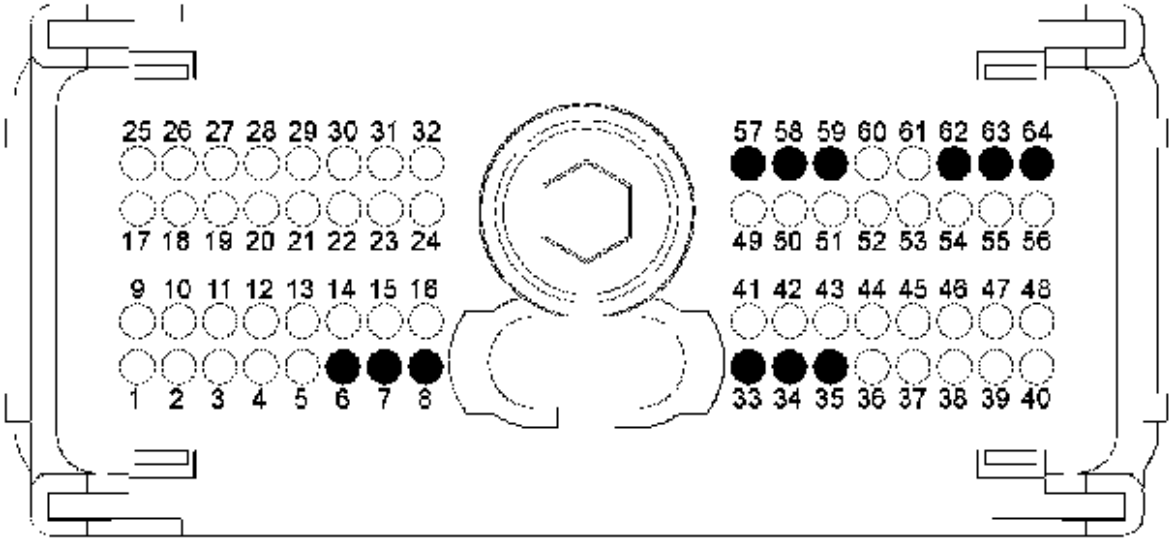

Illustration 5 g01171366

View of the pin locations on the P2 connector for the injector solenoids in the C6.6 engine

(57) Injector Cylinder (No. 1)
(35) Injector (No. 1 Cylinder Return)
(58) Injector Cylinder (No. 2)
(34) Injector (No. 2 Cylinder Return)
(59) Injector Cylinder (No. 3)
(33) Injector (No. 3 Cylinder Return)
(64) Injector Cylinder (No. 4)
(8) Injector (No. 4 Cylinder Return)
(63) Injector Cylinder (No. 5)
(7) Injector (No. 5 Cylinder Return)
(62) Injector Cylinder (No. 6)
(6) Injector (No. 6 Cylinder Return)

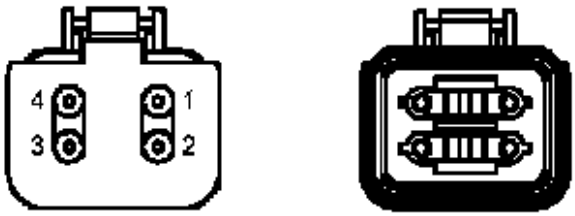

Illustration 6 g01237524

Typical example of the harness connector for the fuel injector

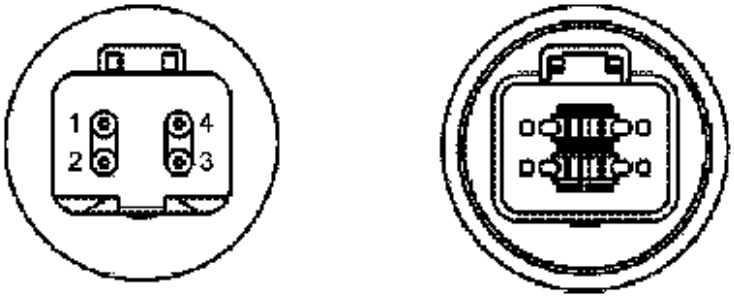

Illustration 7 g01237558
Typical example of the connector in the valve mechanism cover

During the following procedure, refer to the electrical schematic for the application.

Complete the procedure in the order in which the steps are listed.

Table 2

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Thoroughly inspect the P2 connector. Thoroughly inspect the connectors at the valve cover base. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details. **C.** Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with injector solenoids. **D** Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in). **E.** Check the harness and wiring for abrasion and for pinch points from the injectors to the ECM.	Electrical Connector and Wiring	**Result:** All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2. **Result:** There is a fault in the connector or wiring. **Repair:** Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all the seals are correctly in place and ensure that the connectors are completely coupled. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.
2. Check for Logged Diagnostic Codes that are related to the Injector Solenoids **A.** Connect the electronic service tool to the diagnostic connector. **B.** Turn the keyswitch to the ON position.	Diagnostic Codes	**Result:** One or more diagnostic codes from table 1 have been logged. Proceed to Test Step 3 to verify that the fault still exists.

C. Check for logged diagnostic codes that are related to the injector solenoids on the electronic service tool.		**Result:** No diagnostic codes have been logged. Proceed to Test Step 3 to test the injector solenoids.
3. Use the Injector Solenoid Test **A.** Start the engine. **B.** Allow the engine to warm up to the normal operating temperature. **C.** Stop the engine. **D.** Turn the keyswitch to the ON position. **E.** Access the "Injector Solenoid Test" by accessing the following display screens in order: "Diagnostics" "Diagnostic Tests" "Injector Solenoid Test" **F.** Activate the test. **Note:** Do not confuse the "Injector Solenoid Test" with the "Cylinder Cutout Test". The "Cylinder Cutout Test" is used to shut off fuel to a specific cylinder while the engine is running. The "Injector Solenoid Test" is used to actuate the injector solenoids while the engine is not running. This test allows the click of the injector solenoids to be heard while the engine is not operating to determine that the circuit is functioning correctly. **G.** As each solenoid is energized by the ECM, an audible click can be heard at the valve cover.	Injector Solenoid Test	**Result:** All cylinders indicate "OK". There is not an electronic fault with the injectors. Use the electronic service tool to clear all logged diagnostic codes. Return the unit to service. **Result:** "OPEN" Note the cylinders that indicate "OPEN". **Note:** On four cylinder engines, if two injectors that share a supply indicate "Open Circuit" fault codes, the open circuit is probably caused by a faulty ECM. **Note:** On six cylinder engines, if three injectors that share a supply indicate "Open Circuit" fault codes, the open circuit is probably caused by a faulty ECM. Proceed to Test Step 4. **Result:** "SHORT" Note the cylinders that indicate "SHORT". Proceed to Test Step 7.

Electrical Shock Hazard. The electronic unit injectors use DC voltage. The ECM sends this voltage to the electronic unit injectors. Do not come in contact with the harness connector for the electronic unit injectors while the engine is operating. Failure to follow this instruction could result in personal injury or death.

Table 3

4. Check the Harness between the ECM and the Valve Cover Base for an Open Circuit **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Disconnect the connectors from the valve cover base. **C.** Turn the keyswitch to the ON position. **D.** Fabricate a jumper wire 100 mm (4 inch) long with terminals on both ends of the wire. **E.** Insert one end of the jumper wire into the terminal for the supply to the suspect injector. Insert the other end of the jumper wire into the terminal for the return circuit for the suspect injector. **F.** Perform the "Injector Solenoid Test" at least two times. **G.** Repeat this test for each suspect injector. Stop the "Injector Solenoid Test" before handling the jumper wires.	"OK", "OPEN", or "SHORT"	**Result:** The electronic service tool displays "Current Above Normal" for the cylinder with the jumper wire. The harness between the ECM and the valve cover base is OK. Proceed to Test Step 5. **Result:** The electronic service tool does not display "Current Above Normal" for the cylinder with the jumper wire. There is a fault between the ECM and the valve cover base. Proceed to Test Step 6.
5. Check the Injector Harness under the Valve Cover **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Remove the valve cover. **C.** On four cylinder engines, disconnect the harness from the suspect injector. Disconnect the harness from the injector that shares the same supply circuit as the suspect injector. **Note:** On four cylinder engines, injectors 1 and 4 share a common injector driver circuit in the ECM. Injectors 2 and 3 share a common injector driver circuit in the ECM. If the two injectors that share a common supply indicate "Open Circuit Fault Codes", the open circuit is probably caused by a faulty ECM. **D.** On six cylinder engines, disconnect the	Injector Harness	**Result:** Exchanging the harness between the two injectors causes the fault to move to the other injector. There is a fault with the injector harness under the valve cover. **Repair:** Repair the injector harness or replace the injector harness under the valve cover. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. Proceed to Test Step 6. **Result:** Exchanging the harness between the two injectors does not cause the fault to move to the other injector. The injector may be faulty. **Repair:** Replace the faulty

harness from the suspect injector. Disconnect the harness from the injectors that shares the same supply circuit as the suspect injector. **Note:** On six cylinder engines, injectors 1, 2, and 3 share a common injector driver circuit in the ECM. Injectors 4, 5, and 6 share a common injector driver circuit in the ECM. If three injectors that share a common supply indicate "Open Circuit Fault Codes", the open circuit is probably caused by a faulty ECM. **E.** On four cylinder engines, thoroughly clean the terminals on the two injectors and on the harness connectors. **F.** On six cylinder engines, thoroughly clean the terminals on the three injectors and on the harness connectors. **G.** On four cylinder engines, exchange the harness between the two injectors that share the common driver. **H.** On six cylinder engines, exchange the harness between two of the injectors that share the common driver. **I.** Turn the keyswitch to the ON position. **J.** Perform the "Injector Solenoid Test" at least two times.		injector. Refer to Disassembly and Assembly, "Electronic Unit Injector - Remove" and Disassembly and Assembly, "Electronic Unit Injector - Install". Restore the wiring to the correct injectors. Perform the "Injector Solenoid Test". Verify that the repair eliminates the fault.
6. Check the ECM for an Open Circuit **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Disconnect connector P2 from the ECM. **C.** Remove the supply wire and the return wire for the suspect injector from the P2 connector. Install a jumper wire into the P2 connector to provide a short between the supply and the return of the suspect injector. **D.** Reinstall the P2 connector to the ECM. **E.** Turn the keyswitch to the ON position. **F.** Perform the "Injector Solenoid Test" at least two times.	ECM Open Circuit	**Result:** The electronic service tool displays "Current Above Normal" for the cylinder with the jumper wire. The ECM is OK. **Repair:** Repair the engine harness or replace the engine harness, as required. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result:** The electronic service tool does not display "Current Above Normal" for the cylinder with the jumper wire. There may be a fault with the ECM. **Repair:** Perform the following repair:

		Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "ECM Software - Install". Contact the Dealer Solutions Network (DSN). If the DSN recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "ECM - Replace". Remove the jumper wire from the P2 connector and reinstall the injector wires. Perform the "Injector Solenoid Test". If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the ECM. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.
7. Check the Harness between the ECM and the Valve Cover Base for a Short Circuit **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Disconnect the connectors from the valve cover base. **C.** Turn the keyswitch to the ON position. **D.** Perform the "Injector Solenoid Test" at least two times.	Harness Short Circuit	**Result:** All cylinders indicate "Current Below Normal". Proceed to Test Step 9. **Repair:** Repair the suspect injector harness or replace the suspect injector harness under the valve mechanism cover. **Result:** One or more cylinders indicate "Current Above Normal". Note the cylinders that indicate "Current Above Normal". Proceed to Test Step 8.
8. Check the ECM for a Short Circuit **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.	ECM Short Circuit	**Result:** All cylinders indicate "Current Below Normal" when connector P2 is disconnected from the ECM. The short circuit is in the engine harness.

B. Disconnect the P2 connector from the ECM and check for evidence of moisture entry. **C.** Turn the keyswitch to the ON position. **D.** Perform the "Injector Solenoid Test" at least two times.		**Note:** When the engine harness is disconnected, all the diagnostic codes for supply voltage to the sensors will be active. This condition is normal. Clear all the logged diagnostic codes after completing this test step. **Repair:** The fault is most likely to be in one of the wires to the injector. Inspect the connectors for moisture and for corrosion. Also, check the wire insulation for damage and for strands that are exposed. Repair the engine harness or replace the engine harness, as required. Clear all diagnostic codes after completing this test step. Verify that the repair eliminates the fault. **Result:** Not all cylinders indicate "Current Below Normal" when connector P2 is disconnected from the ECM. There may be a fault with the ECM. **Repair:** Perform the following repair: Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "ECM Software - Install". Contact the Dealer Solutions Network (DSN). If the DSN recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "ECM - Replace". Remove the jumper wire from the P2 connector and reinstall the injector wires. Perform the "Injector Solenoid Test". If the fault is eliminated with the test ECM, reconnect the suspect ECM.

		If the fault returns with the suspect ECM, replace the ECM. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.
9. Check the Engine Harness under the Valve Cover for a Short Circuit **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Remove the valve cover. **C.** Disconnect each of the injectors that indicate a "Short" from the wiring harness. Ensure that each of the connectors from the disconnected injector harness does not touch any other components. **D.** Turn the keyswitch to the ON position. **E.** Perform the "Injector Solenoid Test" at least two times.	Short Circuit under the Valve Cover	**Result:** All the injectors that were disconnected indicate "Current Below Normal". Proceed to Test Step 10. **Result:** One or more of the injectors that were disconnected indicate "Current Above Normal". **Repair:** The fault is most likely in the supply to the injector. Inspect the connectors for moisture and for corrosion. Also, check the supply wire insulation for damage and for strands that are exposed. Repair the injector harness or replace the injector harness under the valve cover. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.
10. Check for a Short Circuit in the Return Wire **A.** Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF. **B.** Disconnect the P2 connector from the ECM. **C.** Locate the terminal for the supply of the faulty injector in the P2 connector. Measure the resistance from the terminal to the engine ground stud.	> 10 Ohms	**Result:** The resistance is greater than 10 Ohms. **Repair:** Reconnect the P2 connector. Replace the faulty injector. Use the electronic service tool to clear all logged diagnostic codes. Perform the "Injector Solenoid Test". Verify that the repair eliminates the fault. **Result:** The resistance is less

		than 10 Ohms. There is a short in the return line. **Repair:** Disconnect the connectors from the valve cover base Measure the resistance of the return wire between the P2 connector and the engine ground stud. If the resistance is less than 10 Ohms, the fault is in the return wire between the ECM and the valve cover base. If the resistance is greater than 10 Ohms, the fault is in the return wire under the valve cover. Repair the injector harness or replace the injector harness. Use the electronic service tool to clear all logged diagnostic codes and then perform the "Injector Solenoid Test" to verify that the repair eliminates the fault.