

Technical Service Information



TSI-05-12-07

This TSI replaces 04-12-11 that replaced Test 16 Low ICP System Pressure in "Hard Start and No Start Diagnostics" Section 5 of EGES-240.

Date: April 2005

Subject File: Engines

Subject: Low Injection Control Pressure (ICP) Test

Engine Family: International® VT 365 2004 MY Diesel Engines
SN Range: 112360-Up

Description

New photo illustrations and procedures were added for using new tools. The ICP Adapter/Plug Kit and Crankcase-to-head Tube Removal Tool were released to support the introduction of a running change to the Crankcase-to-head tubes. Reference TSI-05-12-11.

File this TSI-05-12-07 in Appendix C of *Engine Diagnostic Manual*. Also, file a copy of TSI-05-12-07 in the TSI library.

NOTE: Follow the procedures in this TSI. Failure to follow procedures in sequence can lead to incorrect test results.

16. Low ICP System Pressure

Do only the following tests, if ICP was not to spec during the EST Data List test.

Start and continue Test 16.1 System Function, if lube oil pressure is not a concern and terminals on the IPR valve and engine harness are not damaged or corroded.

If either test result is yes for System Function, **do not do Tests 16.2 through 16.5 for low ICP.**

Low ICP test	Question	Result
16.1 System function	IPR connectors: Corroded, bent or pushed back pins Over 3.45 Mpa (500 psi) (0.82V)?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No
16.2 IPR function	Audible air leak?	Unplugged B+ applied <input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
16.3 Under valve cover leaks	Audible air leak?	Cylinder Head Left Right <input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No Crankcase Left Right <input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
16.4 Cylinder Head isolation	Audible air leak?	Left Right <input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
16.5 High-pressure pump	Over 3.45 Mpa (500 psi) (0.82V)?	<input type="checkbox"/> Yes <input type="checkbox"/> No

D31342

Figure 1

NOTE: Make copies of the Low ICP System Pressure Chart on last page (Figure 33). Record test results on this chart.

Purpose

To determine the cause of low injection control pressure that prevents engine starting

Tools

- EST with MasterDiagnostics®
- EZ-Tech® interface cable
- DMM (Digital multimeter)
- Actuator Breakout Harness
- Pressure Sensor Breakout Harness
- Crankcase Pressure Test Adapter
- ICP System Test Adapter
- ICP Adapter/Plug Kit (Short)
 - ICP Sensor Adapter
 - ICP Leak Test Plug
- ICP Adapter/Plug Kit (Long)
 - ICP Sensor Adapter
 - ICP Leak Test Plug
- Oil fill extension
- Compressed air source 689 kPa (100 psi)

16. Low ICP System Pressure (cont.)

! 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 Diagnostic manual*.

NOTE: Do the following procedures in sequence or test results will be incorrect.

Before starting Test 16.1 System Function, make sure the engine lubrication system will build oil pressure, while the engine is cranking.

Continue Test 16.1, if terminals on the Injection Pressure Regulator (IPR) valve and engine harness are not damaged or corroded.

16.1 System Function

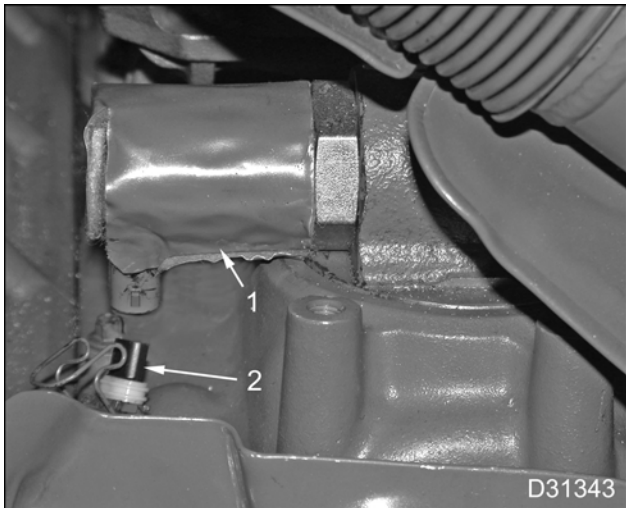


Figure 2 IPR valve coil in weather protected position

1. IPR valve coil with heat shield
2. Engine harness connector

1. Disconnect engine wiring harness from IPR valve and inspect engine wiring harness connector and IPR valve terminal for corrosion. Inspect terminal for bent pins, or pushed back pins.

NOTE: The IPR coil can be rotated 90 degrees to make disconnection and inspection easier. (Tools are not required.)

- If there is corrosion on either the IPR valve or the wiring harness connector for the IPR valve, replace both the IPR valve and wiring harness connector for the IPR valve. Retest ICP pressure.
- If the wiring harness connector and IPR valve are not corroded or damaged, continue with step 3.

CAUTION: If the IPR coil was rotated, return IPR valve to the weather protected position as shown above, after repairs are made

2. Connect Actuator Breakout Harness only to the IPR valve.

CAUTION: If the engine harness is connected to the actuator breakout Harness, the V_{IGN} fuse will blow or cause damage to wiring harness.



Figure 3 B+ on power distribution post

16. Low ICP System Pressure (cont.)



Figure 4 Ground to post on cowl

3. Apply B+ volts and ground to the IPR valve.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, understand and comply with the following:

While cranking the engine, the engine could start.

Before cranking the engine do the following:

- Set the parking brake.
- Put the Transmission in neutral.
- Block the wheels.

If the engine starts, turn ignition switch to OFF and disconnect B+ or ground to the Actuator Breakout Harness.

4. Crank the engine and monitor ICP pressure using the EST or DMM and Pressure Sensor Breakout Harness.
5. Record results on Low ICP System Pressure Chart (Figure 33).
 - If ICP increases above 3.45 MPa (500 psi) (0.82 volts), the mechanical system is operating correctly for the engine to start. Do not continue with ICP system diagnostics.
 - Check Diagnostic Trouble Codes (DTCs) recorded during test 8 on Electronic Control System Diagnostics form EGED-245. (Make sure problems were corrected.)
 - For problems in the electrical circuit, see Section 7 in *Engine Diagnostics Manual*.
 - If 3.45 MPa (500 psi) (0.82 volts) can not be reached, continue with test 16.2 IPR Function.

16. Low ICP System Pressure (cont.)

16.2 IPR Function

NOTE: Before doing this test, inspect O-ring for the ICP Sensor Adapter and D-rings for ICP Leak Test Plug. Replace if worn, cracked or cut.



Figure 5 Oil fill extension and Crankcase Pressure Test Adapter

1. Crankcase Pressure Test Adapter
2. Oil fill extension (Part No. 1830971C91)

1. Remove the oil fill cap from oil fill extension.
2. Insert Crankcase Pressure Test Adapter or a piece of rubber hose into oil fill extension.

NOTE: The Crankcase Pressure Test Adapter or rubber hose will magnify the sound of an air leak.

3. Disconnect engine harness from ICP sensor.

4. Remove ICP sensor from the right oil rail.

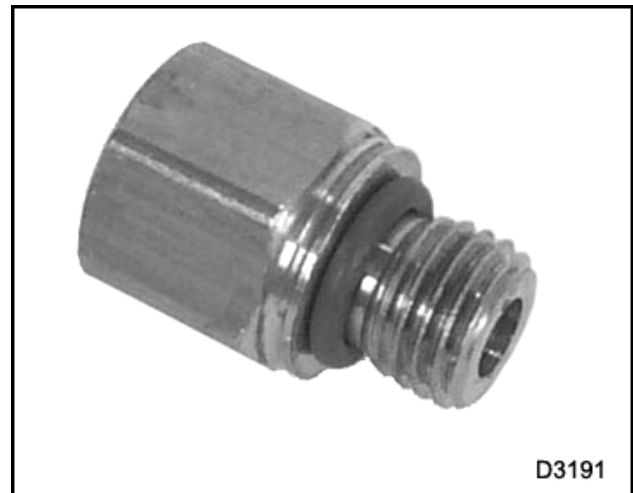


Figure 6 ICP System Test Adapter

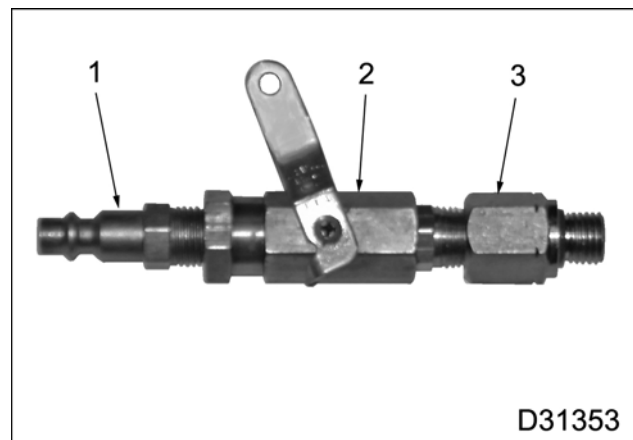


Figure 7 ICP system test assembly

1. Air chuck
2. Shutoff valve
3. ICP System Test Adapter

16. Low ICP System Pressure (cont.)

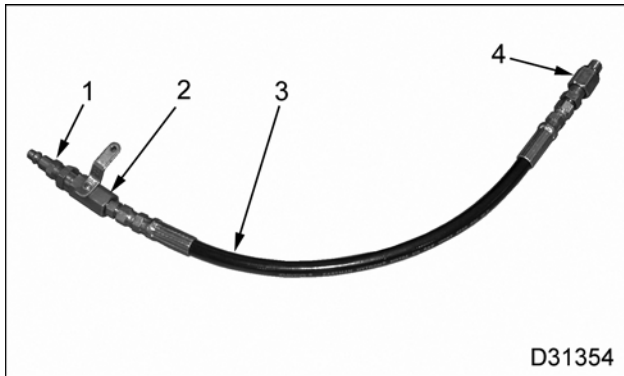


Figure 8 ICP system test assembly with hose

1. Air chuck
 2. Shutoff valve
 3. Hose
 4. ICP System Test Adapter
5. Assemble ICP System Test Adapter to a shutoff valve and an air chuck.

NOTE: Depending on chassis application, a hose may be used to provide easier access for a compressed air supply.



Figure 9 ICP system test assembly

1. Air chuck
 2. Shutoff valve
 3. ICP System Test Adapter
6. Install ICP system test assembly. (ICP System Test Adapter, shutoff valve, and air chuck)

WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

7. Connect the compressed air supply line to air chuck.
8. Apply 689 kPa (100 psi) of pressure and open shutoff valve. Use Crankcase Pressure Test Adapter or hose to listen for an air leak.

NOTE: When air pressure is first applied, it may take up to 5 minutes before an air leak can be heard. This allows air pressure to displace the engine oil in the ICP system. Once engine oil is displaced, an air leak can be heard almost immediately.

- A faint air leak should be heard. Air should be passing through the IPR valve and returning to the crankcase when the IPR valve is not energized.
9. Record the results on Low ICP System Pressure Chart (Figure 33).
 10. Connect the Actuator Breakout Harness to the IPR valve and apply B+ and ground. (Compressed air supply should still be applied to the ICP system.) Use Crankcase Pressure Test Adapter or hose to listen for an air leak.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

11. Record results on Low ICP System Pressure Chart (Figure 33).
- When the IPR valve is energized, the air leak should stop.
 - If a faint air leak is still heard, replace the IPR valve. Follow procedure in the *Engine Service Manual*. Repeat step 10 to verify if the IPR valve is functioning correctly.

16. Low ICP System Pressure (cont.)

- If a loud air leak is heard while the IPR valve energized or a leak is still heard after replacement of an IPR valve, continue with 16.3 Under Valve Cover Leaks.
- If an air leak is not heard when the IPR valve is energized, continue with 16.5 High-pressure Pump. This test result indicates no leaks in the high-pressure oil system.

16. Low ICP System Pressure (cont.)

16.3 Under Valve Cover Leaks

NOTE: Before doing this test, inspect the O-ring for the ICP Sensor Adapter and D-rings for the ICP Leak Test Plug. Replace if worn, cracked or cut.

1. Close shutoff valve before disconnecting compressed air.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

2. Remove ICP system test assembly. (ICP System Test Adapter, shutoff valve, and air chuck)
3. Remove the left and right valve covers. Follow the procedures in the *Engine Service Manual*.

NOTE: This will help you hear where the leak is coming from.



Figure 10 Compressed air supply with valve cover off

1. Air chuck
2. Shutoff valve
3. ICP System Test Adapter

4. Reinstall ICP system test assembly. (ICP System Test Adapter, shutoff valve, and air chuck)

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

5. Connect the compressed air supply line to air chuck.
6. Apply 689 kPa (100 psi) of pressure and open shutoff valve. Use Crankcase Pressure Test Adapter or hose to listen for an air leak.
 - A faint air leak should be heard. Air should be passing through the IPR valve and returning to the crankcase when the IPR valve is not energized.
7. Use the Actuator Breakout Harness to apply B+ and ground to the IPR valve.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

8. Record results on Low ICP System Pressure Chart (Figure 33).
 - Repair any defects found in the area under the valve covers. If more detailed instructions are needed to isolate a leak in the oil rail area, see 16.4 Cylinder Head Isolation. Retest after repairs to verify mechanical operation of the ICP system.
 - If leaks are not detected in areas under the valve covers, but air leaks are coming from the crankcase, continue with step 9.
9. Remove ICP system test assembly (ICP System Test Adapter, shutoff valve, and air chuck) from right oil rail.
10. Install the ICP sensor into right oil rail.

16. Low ICP System Pressure (cont.)

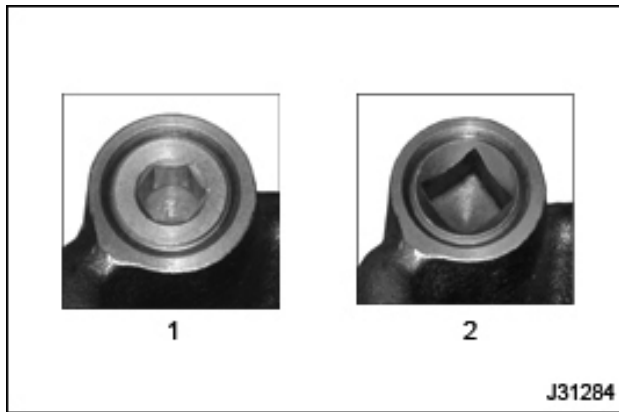


Figure 11 Socket heads for long and short crankcase-to-head tube plugs

1. Hex head socket (Long crankcase-to-head tube plugs and common rail port plugs)
2. Square head socket (Short crankcase-to-head tube plugs and common rail port plugs)

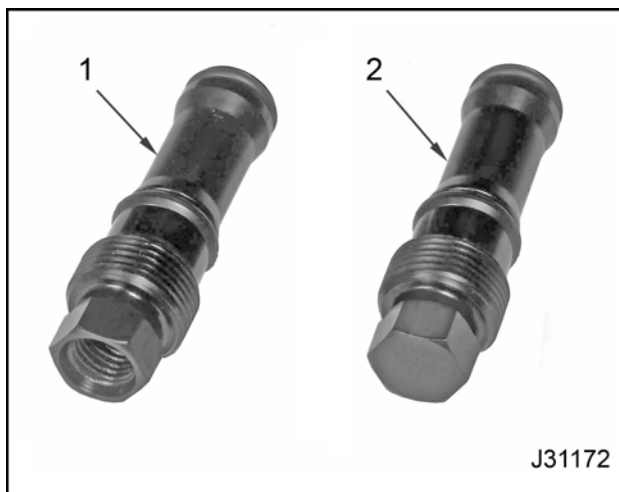


Figure 12 ICP Adapter/Plug Kit (Short)

1. ICP Sensor Adapter (Threaded hex head)
2. ICP Leak Test Plug (Solid hex head)

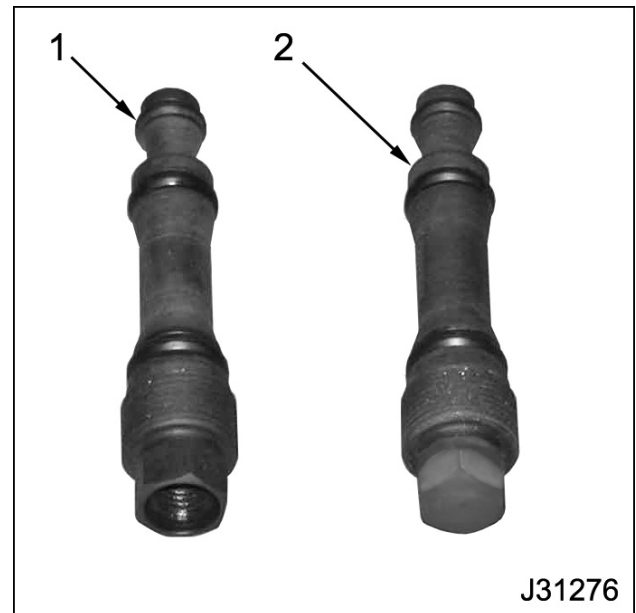


Figure 13 ICP Adapter/Plug Kit (Long)

1. ICP Sensor Adapter (Threaded hex head)
2. ICP Leak Test Plug (Solid hex head)

CAUTION: To avoid damage to the engine, make sure the crankcase-to-head tube plug (long or short) is installed with the correct crankcase-to-head tube.

16. Low ICP System Pressure (cont.)



Figure 14 ICP system test assembly and ICP Sensor Adapter (Right cylinder head)

1. Air chuck
2. Shutoff valve
3. ICP System Test Adapter
4. ICP Sensor Adapter
5. ICP sensor

11. Remove the crankcase-to-head tube plug in the rear of right side oil rail and install the ICP Sensor Adapter in this port.

NOTE: Understand and comply with the following:

- This will block air flow to the right oil rail and injectors.
- If the long crankcase-to-head tube plug is removed and the crankcase-to-head tube is still attached, use mild cleaner to remove oil from D-rings and inspect.

If D-rings are damaged, replace the crankcase-to-head tube assembly and retest.

If D-rings are not damaged remove tube from plug. Attach crankcase-to-head tube to ICP Sensor Adapter. Install assembly and continue with step 12.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

- If the wrong diagnostic tool is used, a misdiagnosis will result.

12. Install ICP system test assembly. (ICP System Test Adapter, shutoff valve, and air chuck)

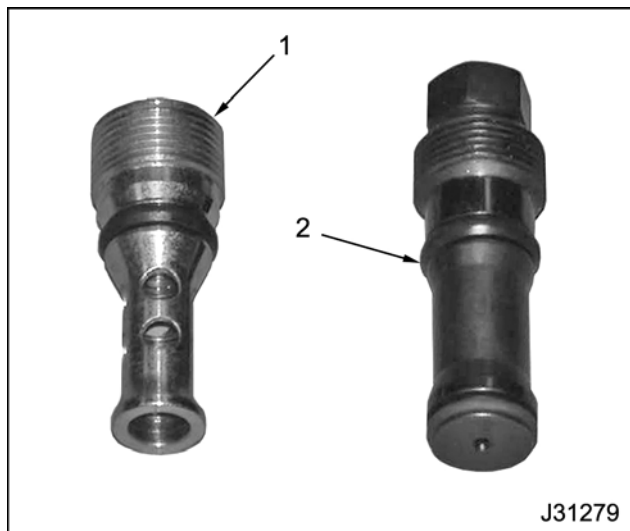


Figure 15 Crankcase-to-head tube plug (Short) and ICP Leak Test Plug (Short)

1. Crankcase-to-head tube plug
2. ICP Leak Test Plug (Solid hex head)

16. Low ICP System Pressure (cont.)

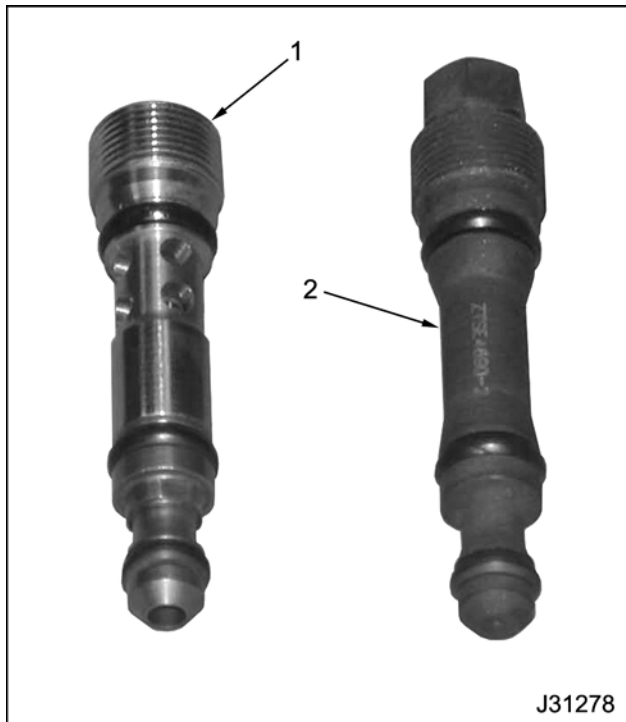


Figure 16 Crankcase-to-head tube plug (Long) and ICP leak test plug (Long)

1. Crankcase-to-head tube plug
2. ICP Leak Test Plug (Solid hex head)

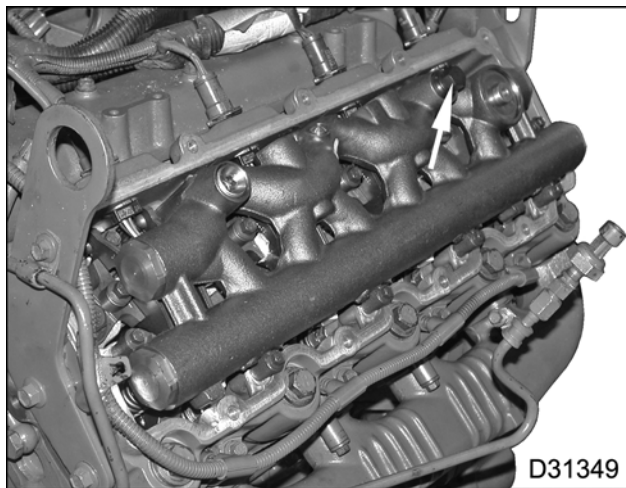


Figure 17 ICP leak test plug (Long)

1. ICP Leak Test Plug (Solid hex head)
13. Remove the crankcase-to-head tube plug from the rear of the left side oil rail. Install the ICP Leak Test Plug in this port.

NOTE: Understand and comply with the following:

- This will block air flow to the left oil rail and injectors.
- If the long crankcase-to-head tube plug is removed and the crankcase-to-head tube is still attached, use mild cleaner to remove oil from D-rings and inspect.

If D-rings are damaged, replace the crankcase-to-head tube assembly and retest.

If D-rings are not damaged remove tube from plug. Attach crankcase-to-head tube to ICP Leak Test Plug. Install assembly and continue with step 14.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

- If the wrong diagnostic tool is used, a misdiagnosis will result.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

14. Connect compressed air supply line to air chuck.
15. Apply 689 kPa (100 psi) of pressure and open shutoff valve. Use Crankcase Pressure Test Adapter or hose to listen for an air leak.
 - A faint air leak should be heard. Air should be passing through the IPR valve and returning to the crankcase when the IPR valve is not energized.
16. Use the Actuator Breakout Harness to apply B+ and ground to the IPR valve.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

16. Low ICP System Pressure (cont.)

17. Listen for an air leak.

- If an air leak is heard coming from the crankcase, proceed with step 18.
- If an air leak is **not heard**, one or more injector O-rings or oil rail O-rings are the cause of leak. If unable to tell which side is leaking, do test 16.4 Cylinder Head Isolation.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

18. Disconnect the compressed air supply from ICP system test assembly.

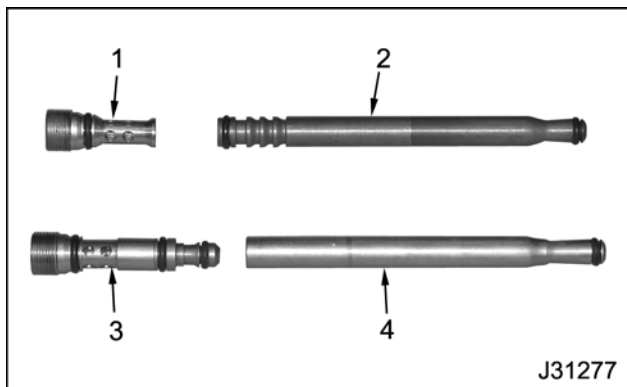


Figure 18 Crankcase-to-head tubes

1. Crankcase-to-head tube plug (Short)
2. Crankcase-to-head tube (Used with short rail plug)
3. Crankcase-to-head tube plug (Long)
4. Crankcase-to-head tube (Used with long rail plug)

19. Remove the questionable crankcase-to-head tube or tubes from the engine and inspect D-rings. Follow the procedures in the *Engine Service Manual*.

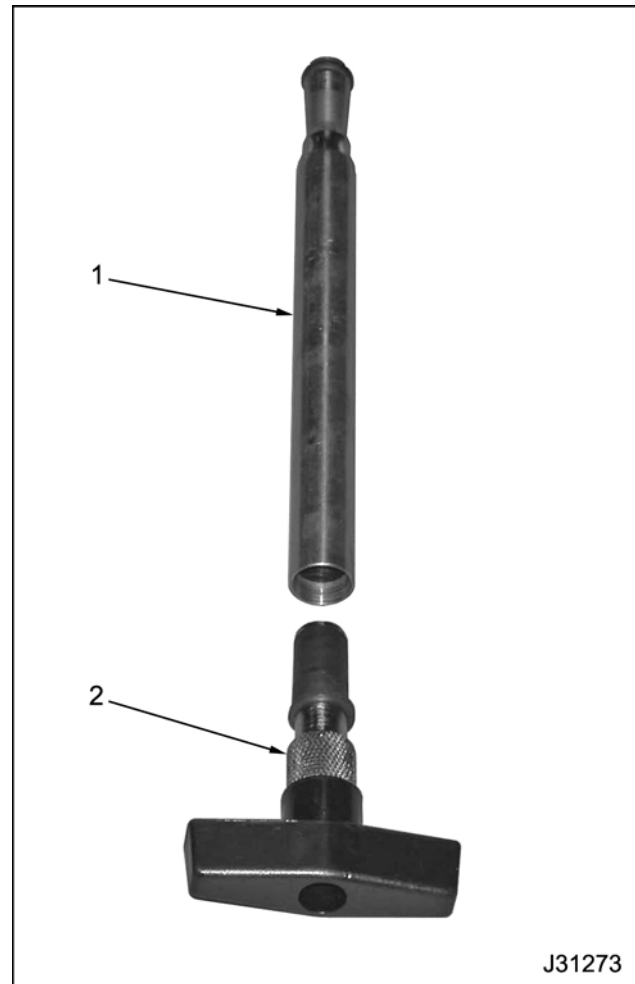


Figure 19 Crankcase-to-head tube and crankcase-to-head Tube Removal Tool

1. Crankcase-to-head tube
2. Crankcase-to-head Tube Removal Tool

NOTE: If crankcase-to-head tube is not attached to the leak test plug or sensor adapter, use ZTSE4694 crankcase-to-head tube removal tool to remove tube from crankcase.

20. Clean the crankcase-to-head tube and D-rings.

NOTE: Use mild cleaner to remove oil from D-rings. Dry D-rings and inspect.

- If D-rings are damaged, replace the crankcase-to-head tube assembly and retest.
- If D-rings are not damaged, install the crankcase-to-head tube or tubes and continue with step 21.

16. Low ICP System Pressure (cont.)

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

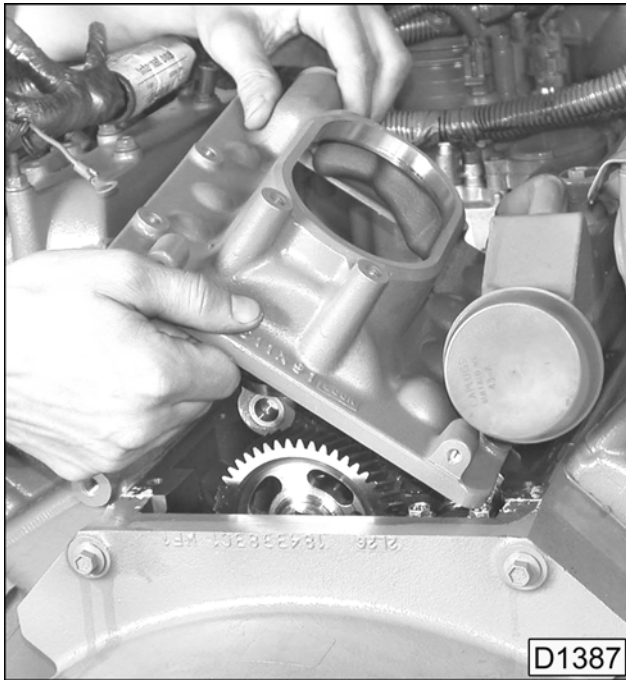


Figure 20 High-pressure pump cover

CAUTION: To avoid engine damage or high-pressure oil leaks, follow procedures in the *Engine Service manual* for removing the high-pressure pump cover.

21. Remove the high-pressure pump cover, following procedures in the *Engine Service Manual*.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

22. Connect the compressed air supply line to the ICP System Test Adapter.
23. Apply 689 kPa (100 psi) of pressure and open shutoff valve.
 - A faint air leak should be heard. Air should be passing through the IPR valve and returning to the crankcase when the IPR valve is not energized.
24. Use the Actuator Breakout Harness to apply B+ and ground to the IPR valve.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

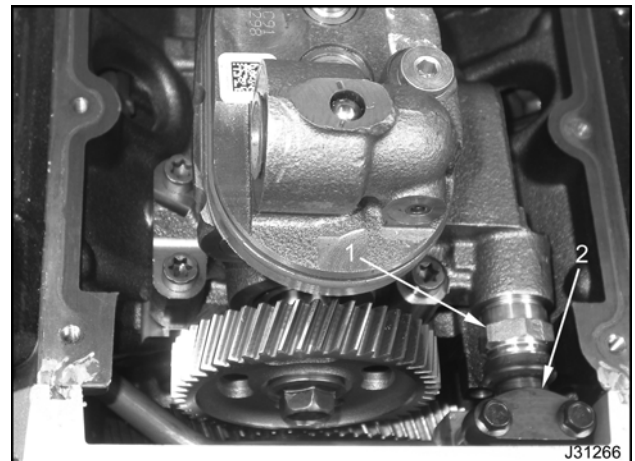


Figure 21 Possible leak areas in branch tube connection to the discharge port of high-pressure pump

1. Quick disconnect
2. Branch Tube Adapter

16. Low ICP System Pressure (cont.)

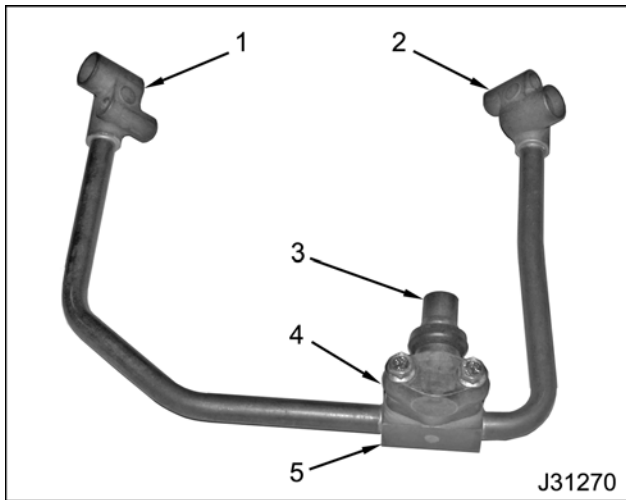


Figure 22 Possible leak areas in Branch Tube Assembly

1. Left branch tube block
 2. Right branch tube block
 3. Quick disconnect
 4. Branch Tube Adapter
 5. Center branch tube block
25. Check for air leaks in the Branch Tube Assembly connection to the discharge port of high-pressure pump and the Branch Tube Adapter.

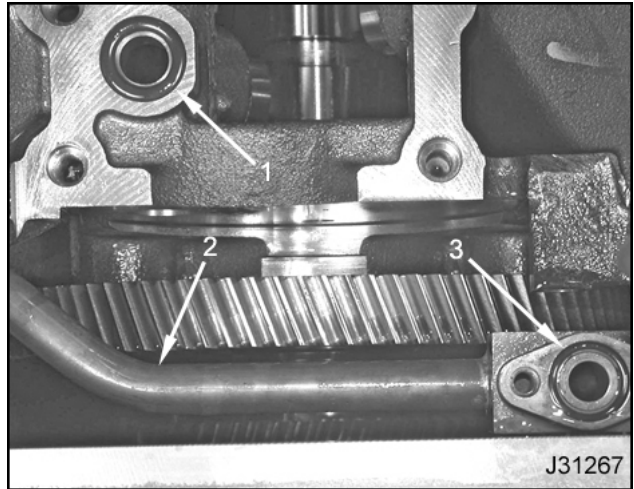


Figure 23 Possible leak areas under high-pressure pump

1. O-ring for high-pressure oil pump inlet
 2. Branch Tube Assembly
 3. O-ring for Branch Tube Adapter
26. Listen for air leaks in both O-ring areas under the high-pressure pump,
- If an air leak is not detected in the area under the high-pressure cover, but an air leak is heard, replace the Branch Tube Assembly.
 - If an air leak is located or detected, repair or replace as required.

16. Low ICP System Pressure (cont.)

16.4. Cylinder Head Isolation

NOTE: Before doing this test, inspect the D-rings for the ICP Leak Test Plug. Replace if worn, cracked or cut.

Depending on which rail is being tested, the complete test setup must be on the same side.

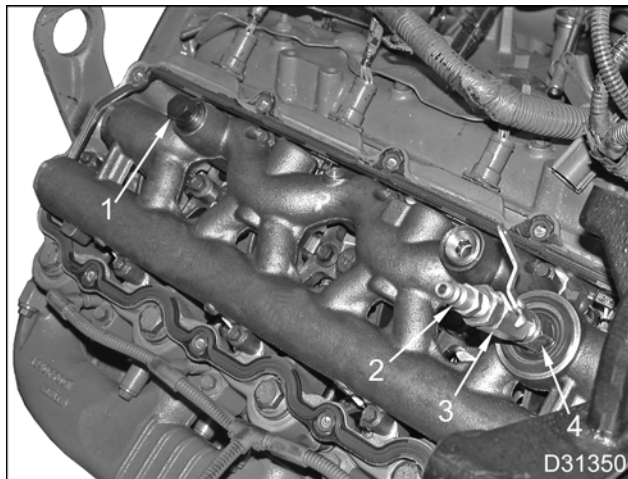


Figure 24 ICP Leak Test Plug and ICP System Test Adapter (Right cylinder head)

1. ICP Leak Test Plug
2. Air chuck
3. Shutoff valve
4. ICP System Test Adapter

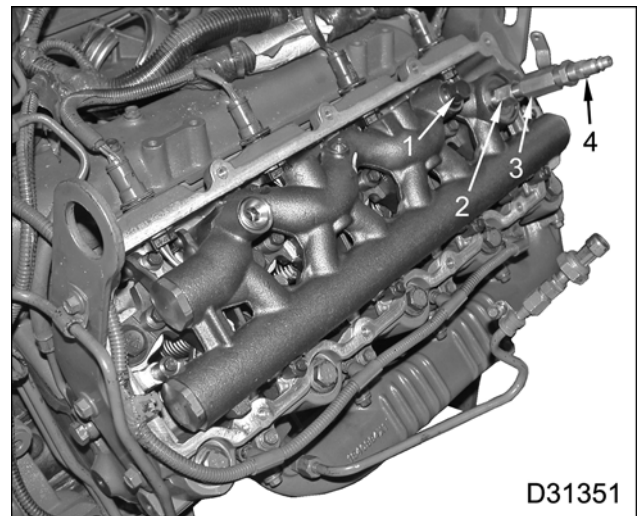


Figure 25 ICP Leak Test Plug and ICP System Test Adapter (Left cylinder head)

1. ICP Leak Test Plug
2. ICP System Test Adapter
3. Shutoff valve
4. Air chuck

1. Remove the crankcase-to-head tube plug from the rear of the oil rail. Install the ICP Leak Test Plug in this port.

NOTE: Understand and comply with the following:

- This will contain air flow to the oil rail and injectors.
- When crankcase-to-head tube plug is removed, the crankcase-to-head tube may still be attached. Remove tube from plug. Install tube to leak test plug for testing.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

- If the wrong diagnostic tool is used, a misdiagnosis will result.

16. Low ICP System Pressure (cont.)

2. Install ICP system test assembly (ICP System Test Adapter, shutoff valve, and air chuck) into ICP sensor port.

- ICP sensor removed from right cylinder head
- Plug removed from left cylinder head



WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

3. Connect compressed air supply line to air chuck.

NOTE: When air pressure is first applied, it may take up to 5 minutes before the leak can be heard. This allows the air pressure to displace the engine oil in the ICP system. Once the engine oil is displaced, an air leak can be heard almost immediately after applying air pressure.

4. Apply 689 kPa (100 psi) of pressure, open shutoff valve, and listen for an air leak.

5. Record results on Low ICP System Pressure Chart (Figure 33).

- If an air leak is not detected, the air leak may be coming from the crankcase or opposite cylinder head. Verify previous test results and repeat procedure for opposite cylinder head.
- If an air leak is detected, repair as needed and verify the integrity of the repairs.

16. Low ICP System Pressure (cont.)

16.5 High-pressure Pump

NOTE: Do this test only if Test 16.2 did not have leaks and EST Data List test had low ICP.

NOTE: Before doing this test, inspect the D-rings for the ICP Sensor Adapter and ICP Leak Test Plug. Replace if worn, cracked or cut.

! WARNING: To avoid serious personal injury, possible death or damage to the engine or vehicle, make sure the shutoff valve is closed.

1. Close shutoff valve in ICP system test assembly, before disconnecting compressed air supply.
2. Remove ICP system test assembly. (ICP System Test Adapter, shutoff valve, and air chuck)
3. Remove the left and right valve covers, following procedures in the *Engine Service Manual*.

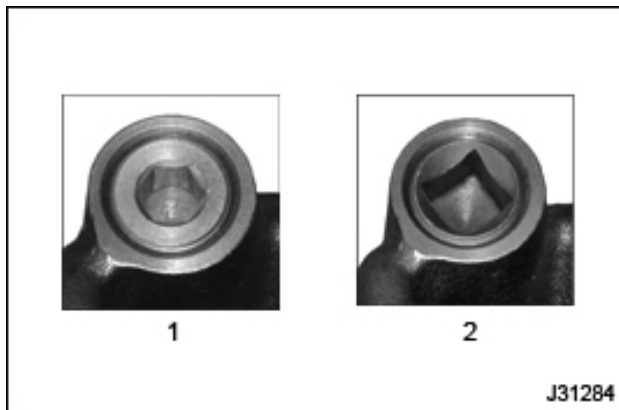


Figure 26 Crankcase-to-head tube plugs

1. New (hex head) long crankcase-to-head tube plug
2. Old (square head) short crankcase-to-head tube plug

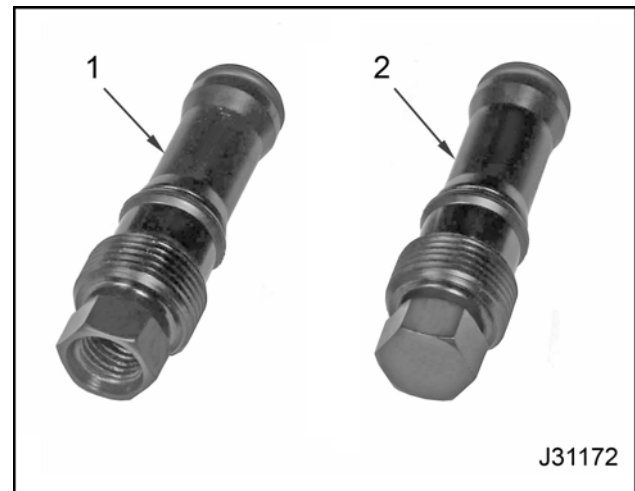


Figure 27 ICP sensor adapter and ICP leak test plug

1. ICP sensor adapter (threaded hex head).
2. ICP leak test plug (solid hex head).

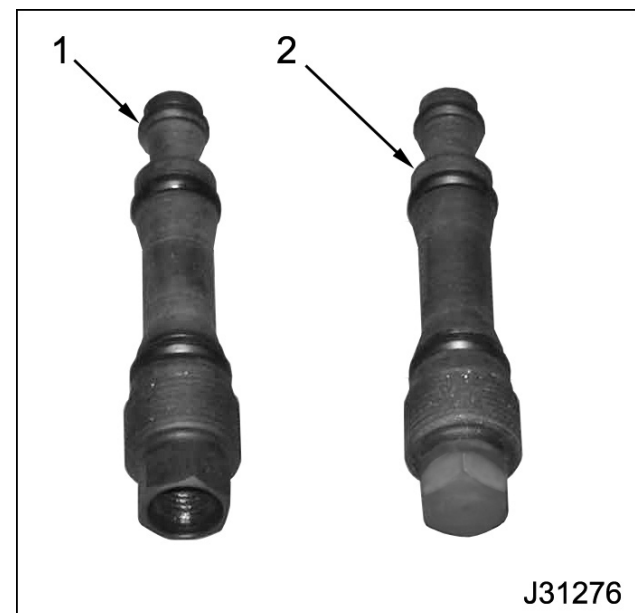


Figure 28 ICP Adapter/Plug Kit

1. ICP Sensor Adapter (Threaded hex head)
2. ICP Leak Test Plug (Solid hex head)

16. Low ICP System Pressure (cont.)

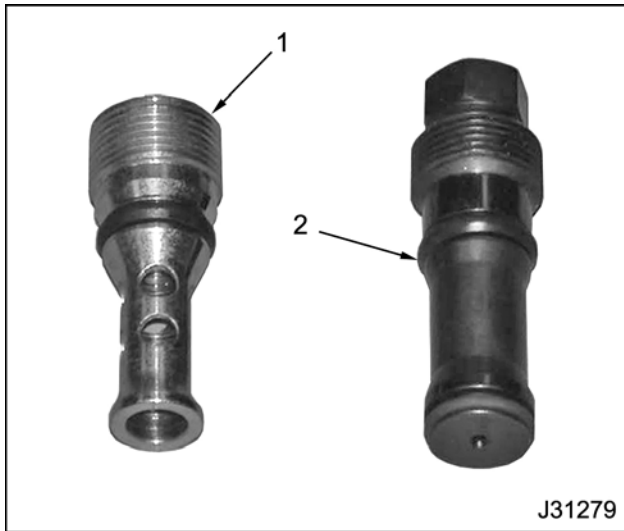


Figure 29 Crankcase-to-head tube plug and ICP Leak Test Plug

1. Crankcase-to-head tube plug
2. ICP Leak Test Plug (Solid hex head)

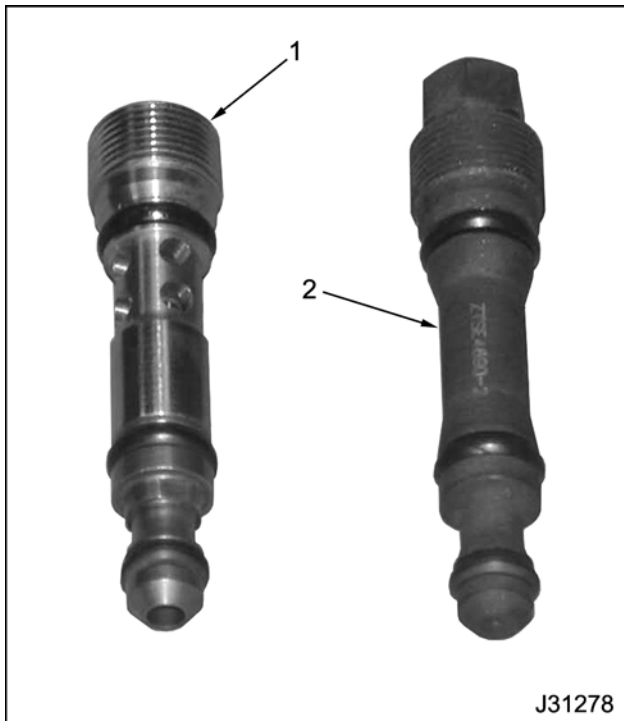


Figure 30 Crankcase-to-head tube plug and ICP Leak Test Plug

1. Crankcase-to-head tube plug
2. ICP Leak Test Plug

CAUTION: To avoid damage to the engine, make sure the crankcase-to-head tube plug (long or short) is installed with the correct crankcase-to-head tube.

4. Remove the crankcase-to-head tube plug in the rear of right side oil rail and install the ICP Sensor Adapter in this port.

NOTE: Understand and comply with the following:

- This will block oil flow to the right oil rail and injectors.
- When crankcase-to-head tube plug is removed, the crankcase-to-head tube may still be attached. Remove tube from plug. Install tube to ICP Sensor Adapter for testing.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

- If the wrong diagnostic tool is used, a misdiagnosis will result.

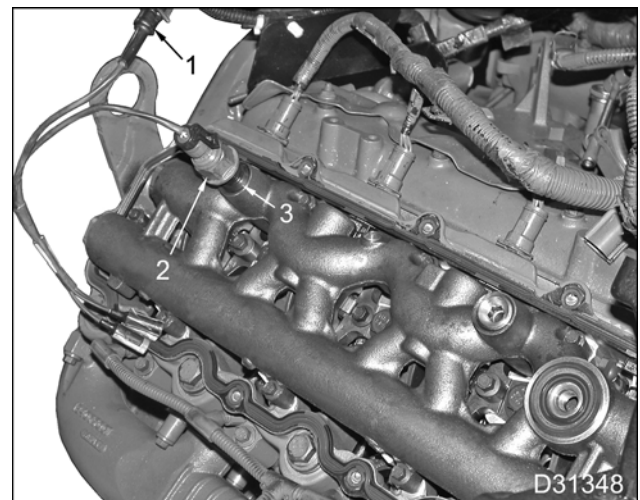


Figure 31 ICP sensor with ICP Sensor Adapter (Right cylinder head)

1. Pressure Sensor Breakout Harness
2. ICP sensor
3. ICP Sensor Adapter

16. Low ICP System Pressure (cont.)

5. Install ICP sensor into ICP Sensor Adapter.
6. Connect the engine wiring harness to the ICP sensor. Use the Pressure Sensor Breakout Harness as an extension, if needed.

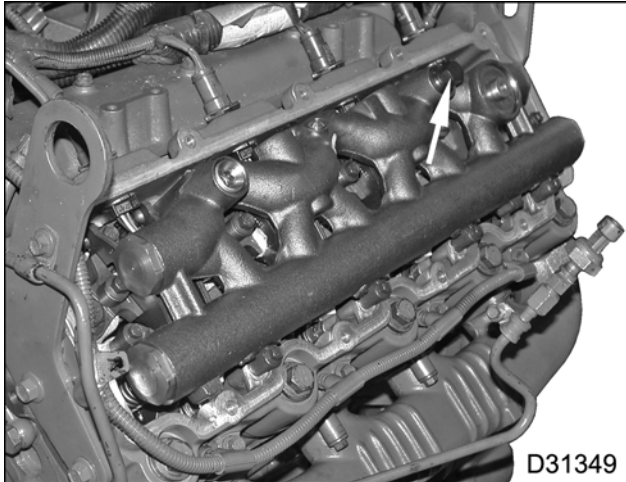


Figure 32 ICP Leak Test Plug (Left cylinder head)

7. Remove the crankcase-to-head tube plug from the rear of the left side oil rail. Install the ICP Leak Test Plug in this port.

NOTE: Understand and comply with the following:

- This will block oil flow to the left oil rail and injectors.
- When crankcase-to-head tube plug is removed, the crankcase-to-head tube may still be attached. Remove tube from plug. Install tube to leak test plug for testing.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

- If the wrong diagnostic tool is used, a misdiagnosis will result.

NOTE: Steps 4–7 block oil flow to both rails and all injectors; only the branch tube assembly, crankcase-to-head tube, and the high-pressure pump will be tested.

8. Use the Actuator Breakout Harness to apply B+ and ground to the IPR valve.

CAUTION: Do not leave the IPR valve energized longer than 120 seconds. This can damage the IPR valve.

! WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, comply with the following: While cranking the engine, the engine could start.

Before cranking the engine do the following:

- Set the parking brake.
- Put the transmission in neutral.
- Block the wheels.

If the engine starts, turn ignition switch to OFF and disconnect B+ or ground to the Actuator Breakout Harness.

When the ICP sensor is removed from the right side oil rail during testing, be sure all personnel are standing a safe distance from the right side of the engine.

- If D-rings on the test tools are worn, cracked or cut, oil can bypass D-rings and flow out the ICP sensor port.

9. Crank the engine and monitor ICP pressure.
10. Record results on Low ICP Pressure System Chart (Figure 33).
 - If unable to build the ICP pressure above 3.45 MPa (500 psi) (0.82 volts), replace the high pressure pump. Follow the procedure in the *Engine Service Manual*. Retest to verify repairs.

16. Low ICP System Pressure (cont.)

- If able to build ICP pressure above 3.45 MPa (500 psi) (0.82 volts), check previous test results. Remove the ICP Leak Test Plug from the left side oil rail and reinstall crankcase-to-head-tube plug. Continue with step 11.

CAUTION: To avoid damage to D-rings that could cause a high-pressure oil leak, lubricate the D-rings with clean engine oil before installing the crankcase-to-head tubes.

CAUTION: To prevent engine damage, it is recommended that the crankcase-to-head tubes be replaced, if removed. D-rings are not replaceable. If the crankcase-to-head tubes are to be reused, inspect each D-ring for cuts, abrasion, and twisting; do not reuse a crankcase-to-head tube having any of these conditions, because the tubes will leak.

11. Crank the engine and monitor the ICP pressure.

- If unable to build the ICP pressure above 3.45 MPa (500 psi) (0.82 volts), the problem is on left side. Do test 16.4 Cylinder head Isolation and check for leaks.
- If able to build ICP pressure above 3.45 MPa (500 psi) (0.82 volts), remove ICP Test Adapter from right side oil rail and reinstall crankcase-to-head-tube plug. Reinstall ICP sensor. Reconnect ICP sensor to engine wiring harness. Continue with step 12.

12. Crank the engine and monitor ICP pressure.

- If unable to build the ICP pressure above 3.45 MPa (500 psi) (0.82 volts), the problem is on right side. Do test 16.4 Cylinder head Isolation and check for leaks.
- If able to build pressure the engine will start and run. Install valve covers, following the procedures in the *Engine Service Manual*.

- Do only the following tests, if ICP was not to spec during the EST Data List test.
- Start and continue Test 16.1 System Function, if lube oil pressure is not a concern and terminals on the IPR valve and engine harness are not damaged or corroded.
- If either test result is yes for System Function, **do not do Tests 16.2 through 16.5 for low ICP.**

Low ICP test	Question	Result
16.1 System function	IPR connectors: Corroded, bent or pushed back pins Over 3.45 Mpa (500 psi) (0.82V)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No
16.2 IPR function	Audible air leak?	Unplugged B+ applied <input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
16.3 Under valve cover leaks	Audible air leak?	Cylinder Head
		Left Right
		<input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
		Crankcase
Left Right		
<input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No		
16.4 Cylinder Head isolation	Audible air leak?	Left Right
		<input type="checkbox"/> Yes <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No
16.5 High-pressure pump	Over 3.45 Mpa (500 psi) (0.82V)?	<input type="checkbox"/> Yes <input type="checkbox"/> No

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Figure 33 Low ICP System Pressure Chart