

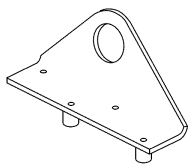
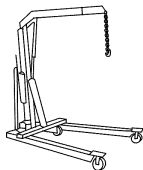
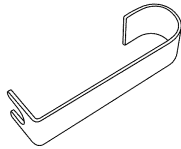
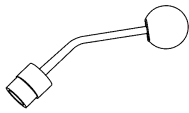
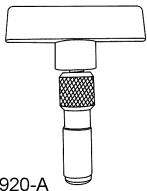
SECTION 303-01C Engine — 6.0L Diesel

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IN-VEHICLE REPAIR

Cylinder Head — LH

Special Tool(s)

 ST2697-A	Lifting Bracket, Cylinder Head 303-759
 ST1341-A	Heavy Duty Floor Crane 014-00071
 ST2861-A	Remover/ Installer Glow Plug Connector 303-1114
 ST2862-A	Release Tool, Injector Connector 303-1115
 ST2920-A	Remover, High Pressure Supply Tube 303-1164

Material

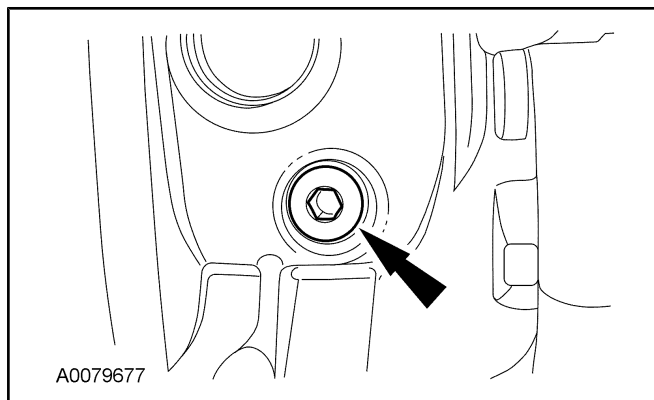
Item	Specification
SAE 15W-40 Super Duty Motor Oil	WSS-M2C171-D

Material(Continued)

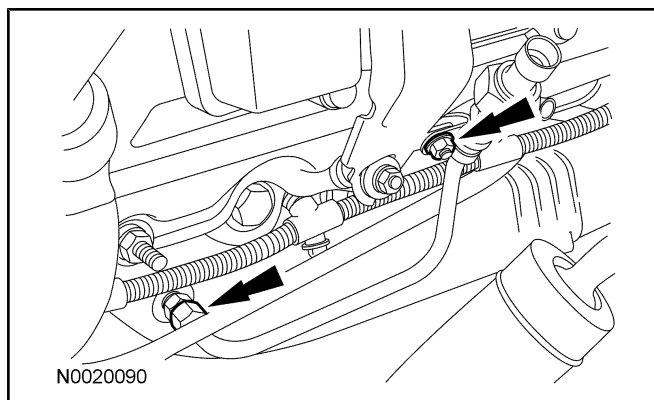
Item	Specification
XO-15W40-QSD (US); CXO-15W40-LSD12 (Canada); or equivalent	
High Temperature Nickel Anti-Seize Lubricant XL-2 (US); CXG-2-B (Canada)	ESE-M12A4-A
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02.
2. Drain the engine oil.
3. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
4. Remove the LH cylinder block coolant drain plug.

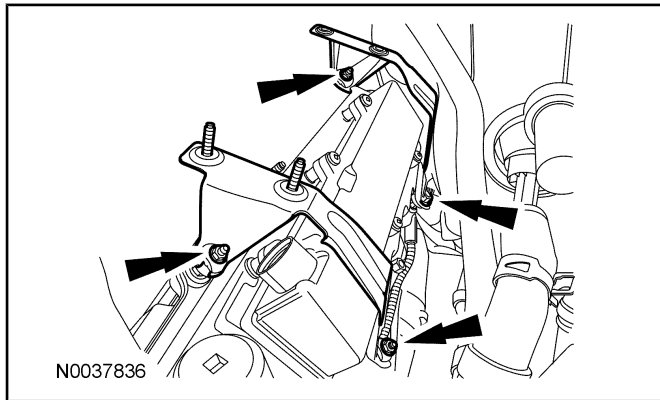


5. Disconnect the exhaust pressure (EP) sensor tube fitting at the exhaust manifold and remove the nut and the EP sensor tube.

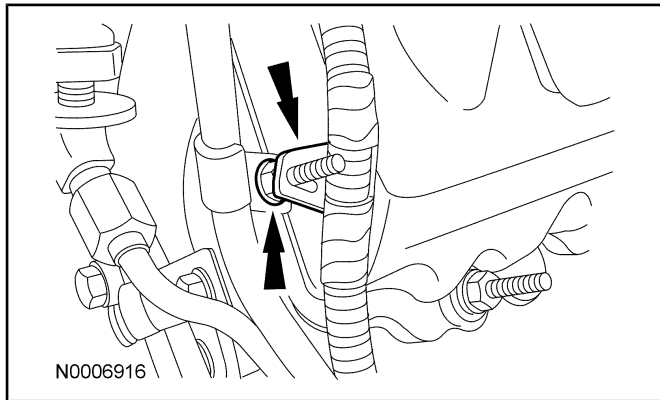


IN-VEHICLE REPAIR(Continued)

6. Remove the fuel injector control module mounting bracket.



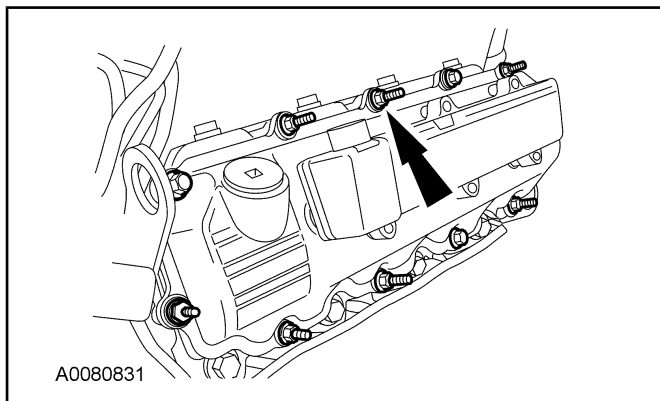
7. Disconnect the wire retainer and remove the nut and position the oil level indicator and tube aside.



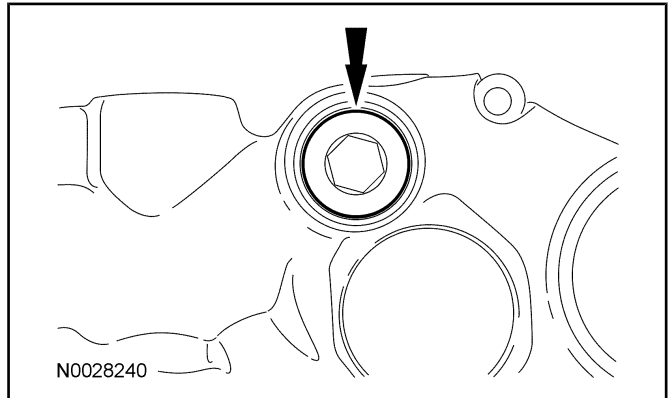
8. **NOTE:** Mark the position of the valve cover bolts for valve cover bolt installation.

Remove the bolts, stud bolts and the valve cover.

- Clean and inspect the valve cover gasket. Install a new gasket if necessary.

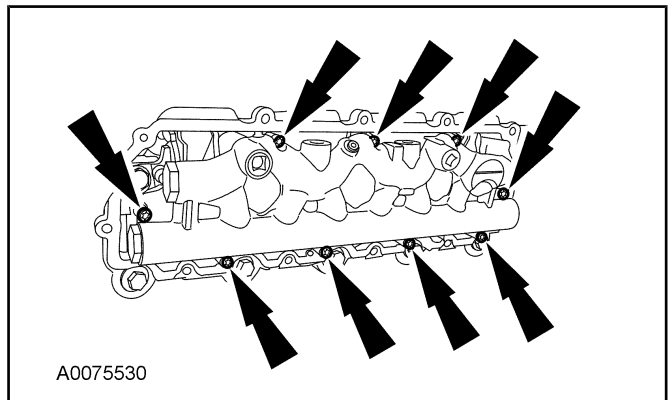


9. Remove the crankcase-to-head tube.



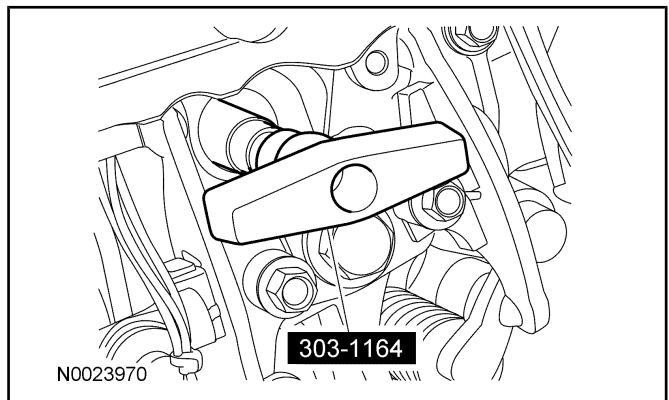
10. **NOTE:** Do not remove the oil rail end plugs or acoustic wave attenuator port fitting. Service parts are not available to support the components.

Remove the bolts and the high-pressure oil rail.



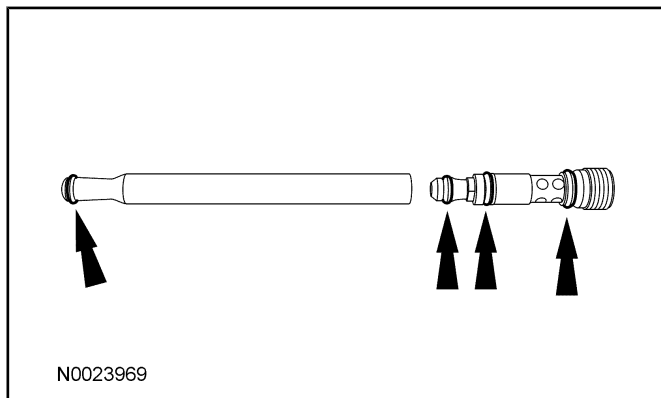
11. **NOTE:** Use a shop towel and metal brake parts cleaner to remove the oil residue prior to removing.

If the crankcase-to-head tube separated, using the special tool, remove the lower crankcase-to-head tube.



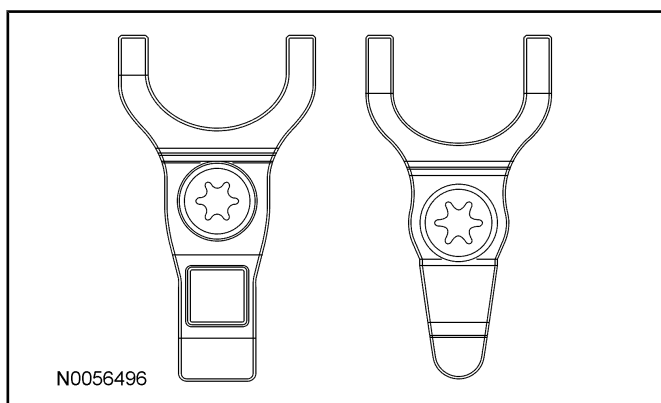
12. Inspect the D-ring seals for damage (nicks, cuts and gouges). If damaged, replace the crankcase-to-head tube.

IN-VEHICLE REPAIR(Continued)



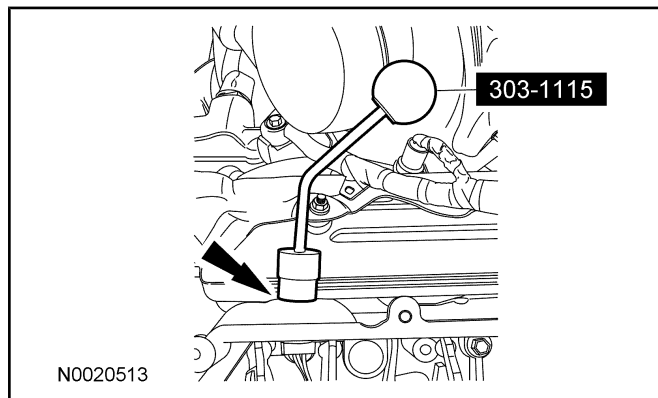
13. **NOTE:** Early build cylinder heads, head gaskets, cylinder block, rocker arm carriers and injector hold-down clamps are not interchangeable with late build engines. It is necessary to identify the head style prior to working on the cylinder heads. Early build heads are equipped with injector hold-down clamps with a square end and a T40 Torx® bolt. Late build heads have injector hold-down clamps with a tapered end and a T45 Torx® bolt.

Determine if the cylinder heads are early build (left frame of illustration) or late build (right frame of illustration).



14. **NOTICE:** Do not attempt to apply battery voltage to the fuel injector or damage to the fuel injector will occur.

Using the special tool, push the fuel injector electrical connector out of the rocker arm carrier.



15. Prior to removing the injector assembly, insert clean shop towels in the oil drain holes adjacent to each glow plug.
16. **NOTICE:** Failure to account for all snap rings or pieces prior to placing the vehicle back in service can cause engine damage. A missing snap ring can be ingested into the lube oil system causing severe engine damage.

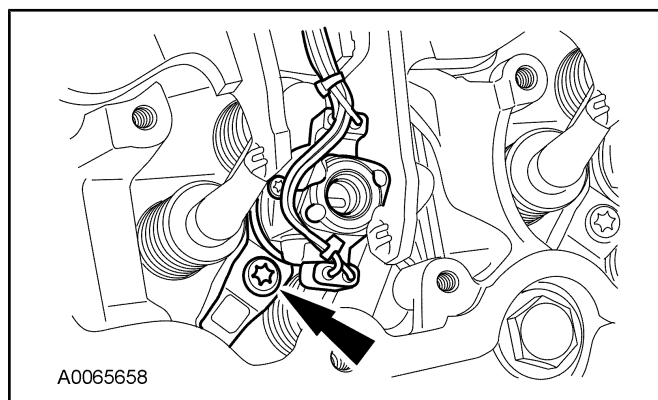
NOTICE: To prevent engine damage, do not use air tools to remove the fuel injectors. The snap ring that extracts the injector can dislodge and fall into the oil drain hole.

NOTE: There is no need to drain the fuel rail.

NOTE: If engine coolant is found in the combustion chambers, it may be necessary to install a new injector sleeve. For additional information, refer to Section 303-04C.

NOTE: The bolt is part of the fuel injector hold-down assembly.

Loosen the bolt and remove the bolt and fuel injector hold-down assembly and the fuel injector.



17. **NOTE:** If a snap ring or piece of a snap ring is missing from the injector hold-down assembly, it must be located prior to removing the shop towels.

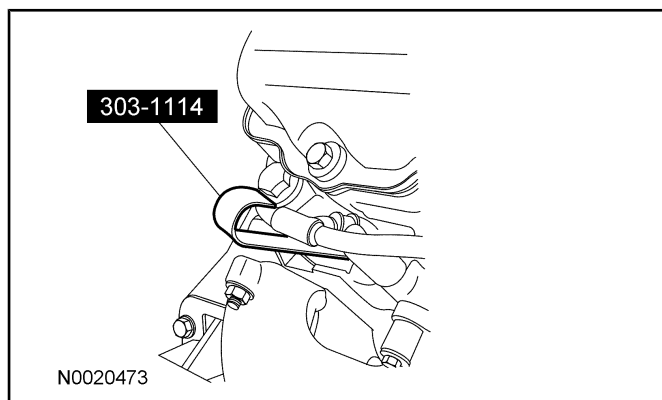
IN-VEHICLE REPAIR(Continued)

Remove the shop towels.

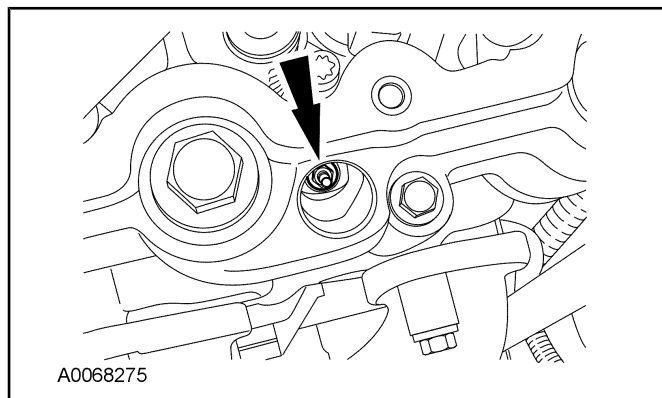
18. **NOTICE:** Do not pull on the glow plug wire or damage may occur.

NOTE: Only one glow plug connector shown.

Using the special tool, remove the glow plug harness and position aside.

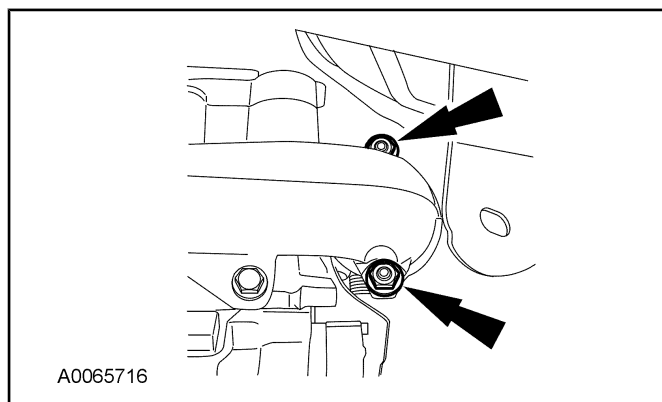


19. Remove the 4 glow plugs.



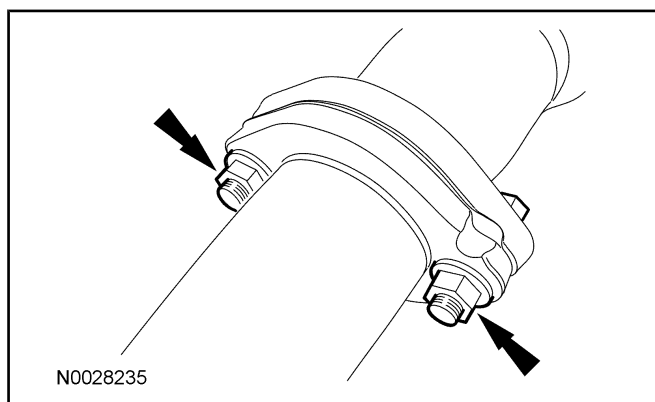
20. **NOTE:** LH shown, RH similar.

Remove the nuts and bolts from the turbocharger adapter pipe.



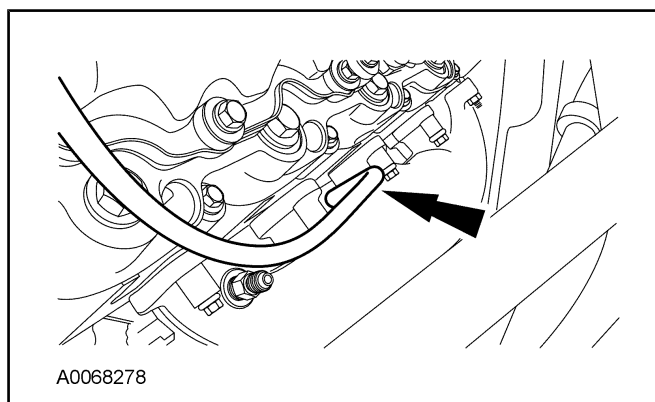
21. Position the turbocharger adapter pipe to gain access to the adapter pipe joint. Remove the bolts, separate the

adapter pipe joint and remove the gasket. Remove the 2 parts of the turbocharger adapter pipe.

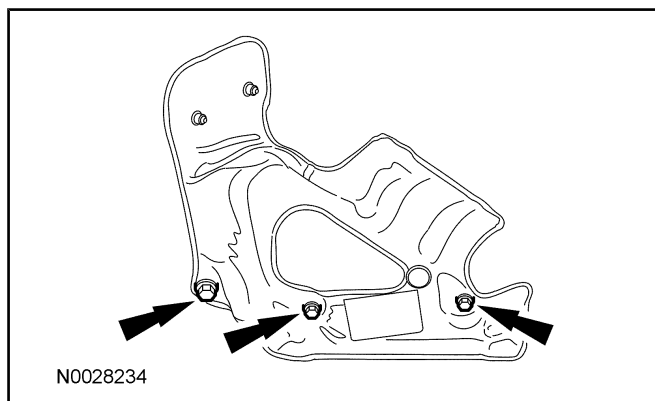


22. **NOTE:** Remove and discard the O-ring seal.

Remove the oil level indicator and tube.

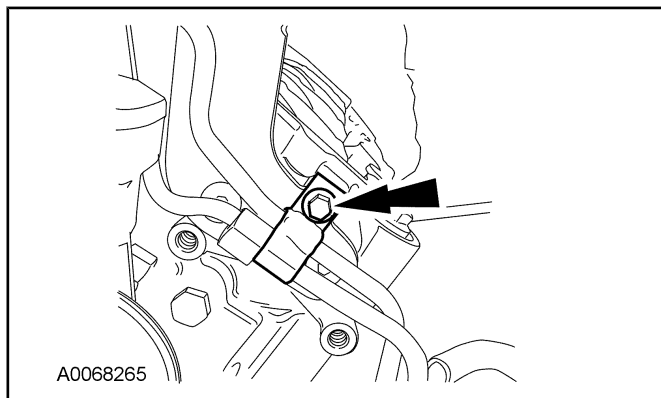


23. Remove the bolts and turbocharger heat shield.

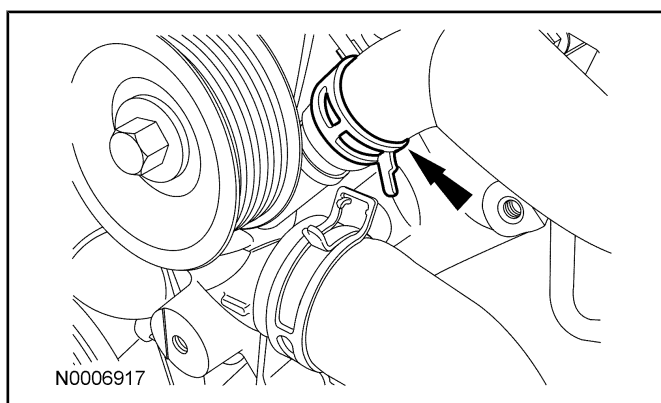


24. Remove the retaining bolt from the fuel tube bracket and position the fuel tubes aside.

IN-VEHICLE REPAIR(Continued)

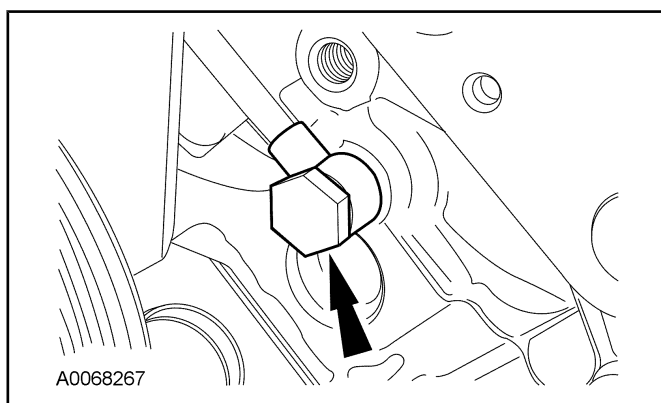


25. Disconnect the heater hose from the front cover and position aside.



26. **NOTE:** Remove and discard the sealing washers.

Remove the banjo bolt and the fuel tube.

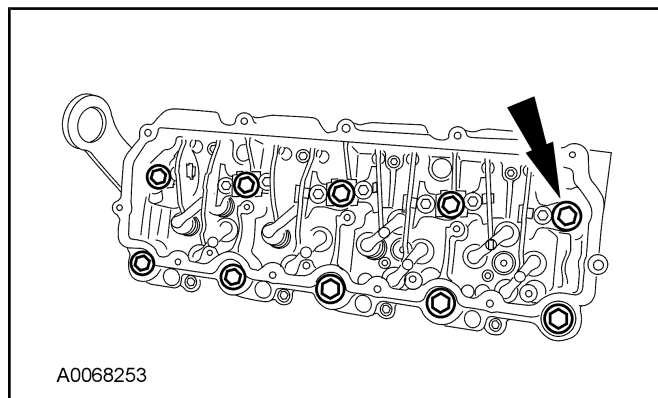


27. **NOTICE:** Make sure the insulation blanket is not damaged (torn, cracked or fabric separated from the metallic skin) when removing the lower rear cylinder head bolt. If the insulation blanket is damaged, the entire blanket must be replaced.

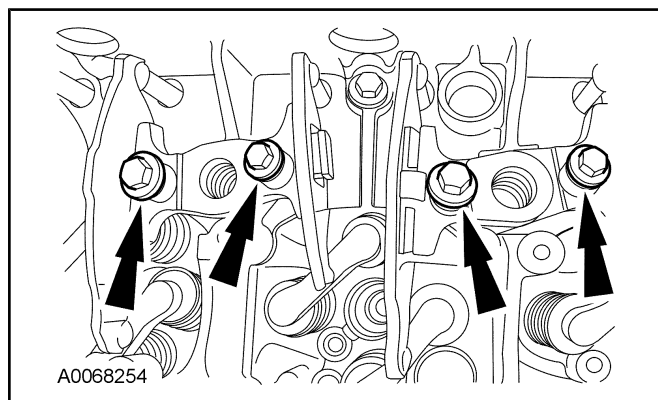
NOTE: It may be necessary to slightly compress or deform the insulation blanket to gain tool clearance to remove the lower rear cylinder head bolt.

NOTE: The back 2 cylinder head bolts cannot be removed from the head in vehicle. Raise these bolts and secure them in position, so they will clear the cylinder block deck as the head is removed.

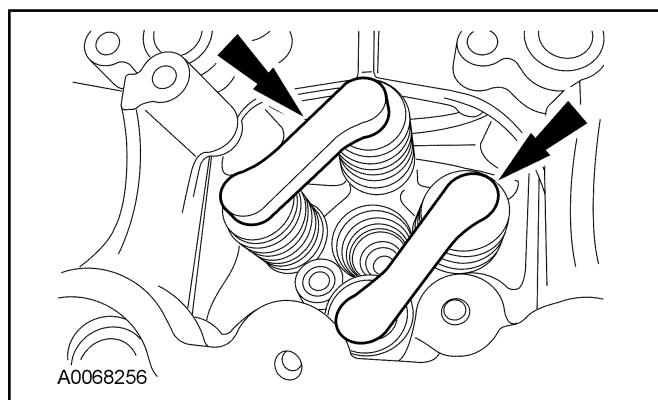
Remove and discard the inner cylinder head bolts.



28. Remove the 8 bolts and the rocker arm assemblies.



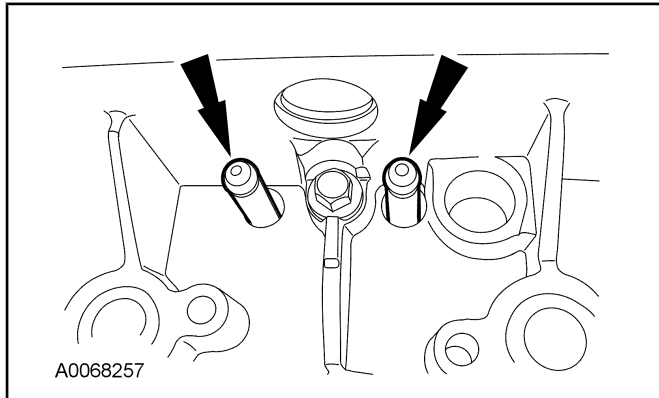
29. Mark the 8 valve bridges with a permanent marker and remove.



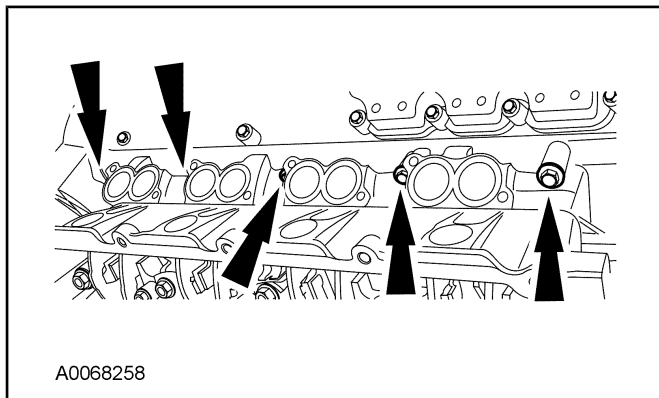
30. **NOTICE:** To prevent engine damage, keep the push rods in the order in which they were removed. Install all push rods back in their original positions.

Mark the location and remove the 8 push rods.

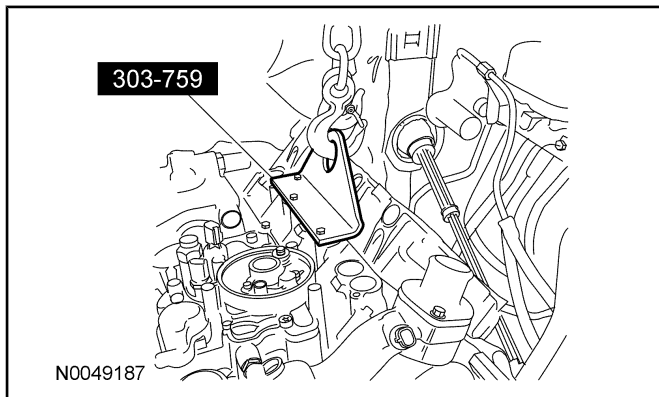
IN-VEHICLE REPAIR(Continued)



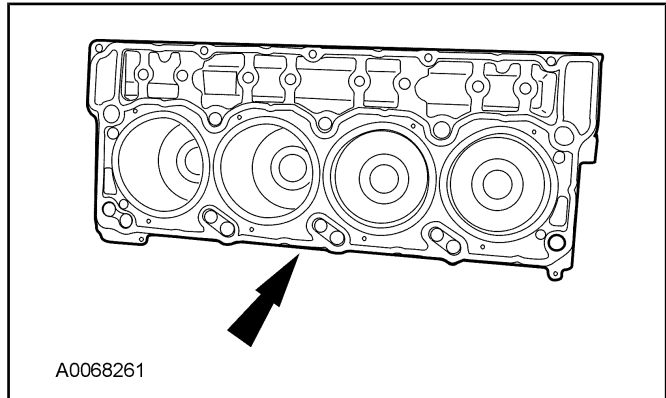
31. Remove the outer cylinder head bolts.



32. Install the special tool and the lifting crane. With the help of an assistant, remove the cylinder head from the vehicle.



33. Check for cylinder head distortion. For additional information, refer to Cylinder Head Distortion in this section.
34. Remove and discard the cylinder head gasket and dowels.
- Clean and inspect the gasket sealing surfaces.



35. Check for cylinder block distortion. For additional information, refer to Cylinder Block Distortion in this section.

Installation

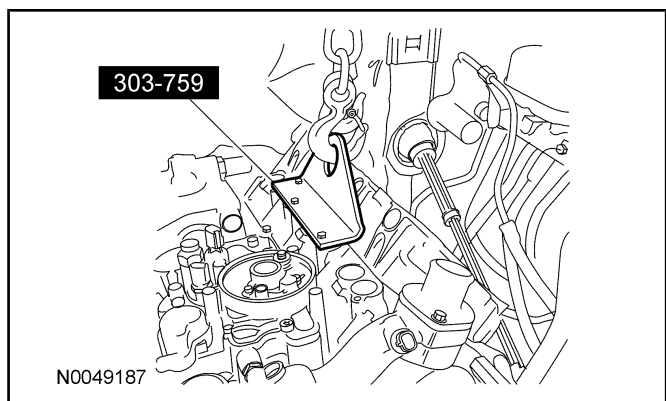
1. **NOTE:** Use care to avoid scratching the blue compound on the cylinder head gasket. Install the gasket with the part number facing upward and verify the 5 top holes and head gasket push rod holes line up.

Install the dowels and the cylinder head gasket.

2. **NOTE:** The back 2 cylinder head bolts cannot be installed into the head in vehicle. Lightly lubricate the threads of 2 new cylinder head bolts with clean engine oil. Position these bolts in the head and secure them in position, so they will clear the cylinder block deck as the head is installed.

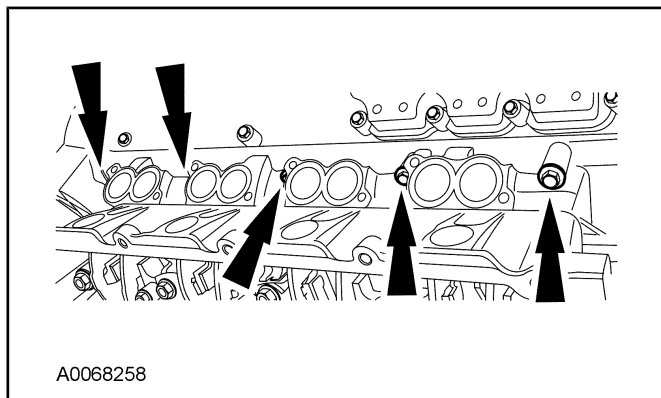
NOTE: Position the fuel tubes in place before the cylinder head is installed.

Using the special tools and with the help of an assistant, install the cylinder head on the engine. Remove the special tools.



3. Install the outer cylinder head bolts finger-tight.

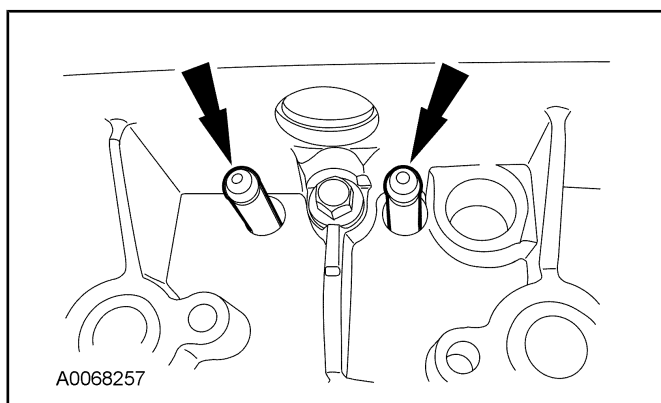
IN-VEHICLE REPAIR(Continued)



4. **NOTICE:** To prevent engine damage, keep the push rods in the order in which they were removed. Install all push rods back in their original positions.

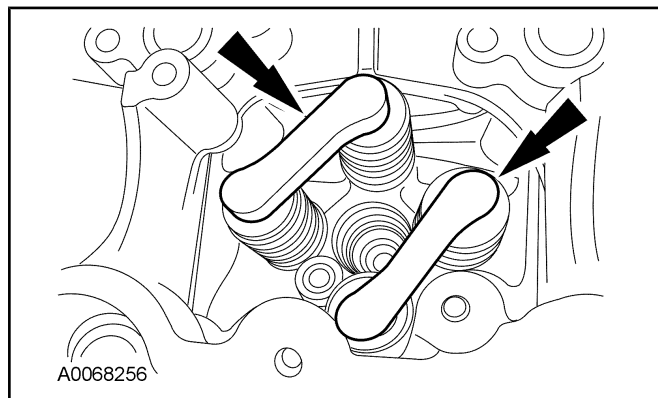
NOTE: On early build vehicles, higher mileage engines require push rods to be cleaned so the copper-colored end of the push rod can be identified and installed with the copper-colored end up. Push rods on late build vehicles and service push rods do not have a copper-colored end and can be installed with either end up.

Apply clean engine oil to each end of the push rods and insert them into their respective positions.



5. **NOTE:** Coat the end of each valve stem with clean engine oil.

Install the 8 valve bridges.

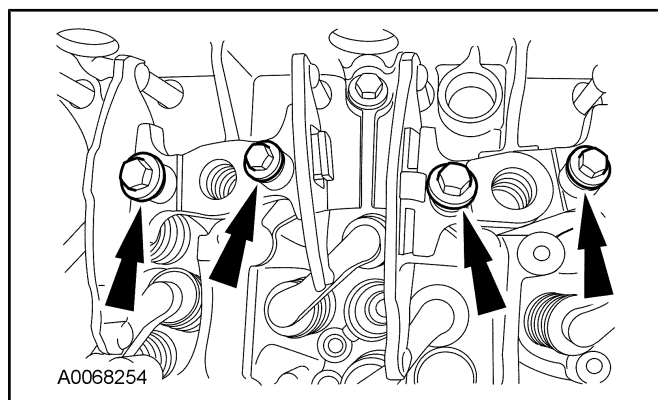


6. **NOTICE:** Rotate the crankshaft until the damper locating dowel notch is in the 6 o'clock position or engine damage can occur.

NOTE: Apply clean engine oil to the top center of each valve bridge.

Install the rocker arm assemblies and 8 bolts.

- Tighten to 31 Nm (23 lb-ft).



7. **NOTICE:** Using too much engine oil on the threads of the cylinder head bolts can cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads can affect the true torque value of the bolts.

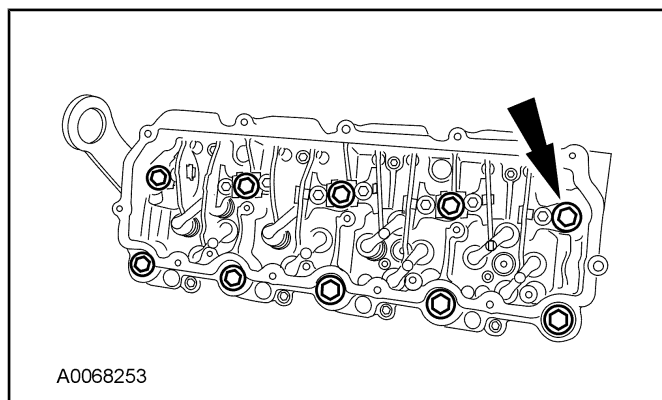
NOTICE: Make sure the insulation blanket is not damaged (torn, cracked or fabric separated from the metallic skin) when installing the lower rear cylinder head bolt. If the insulation blanket is damaged, the entire blanket must be replaced.

NOTE: It may be necessary to slightly compress or deform the insulation blanket to gain tool clearance to install the lower rear cylinder head bolt.

NOTE: Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

Install the 10 cylinder head retaining bolts finger-tight.

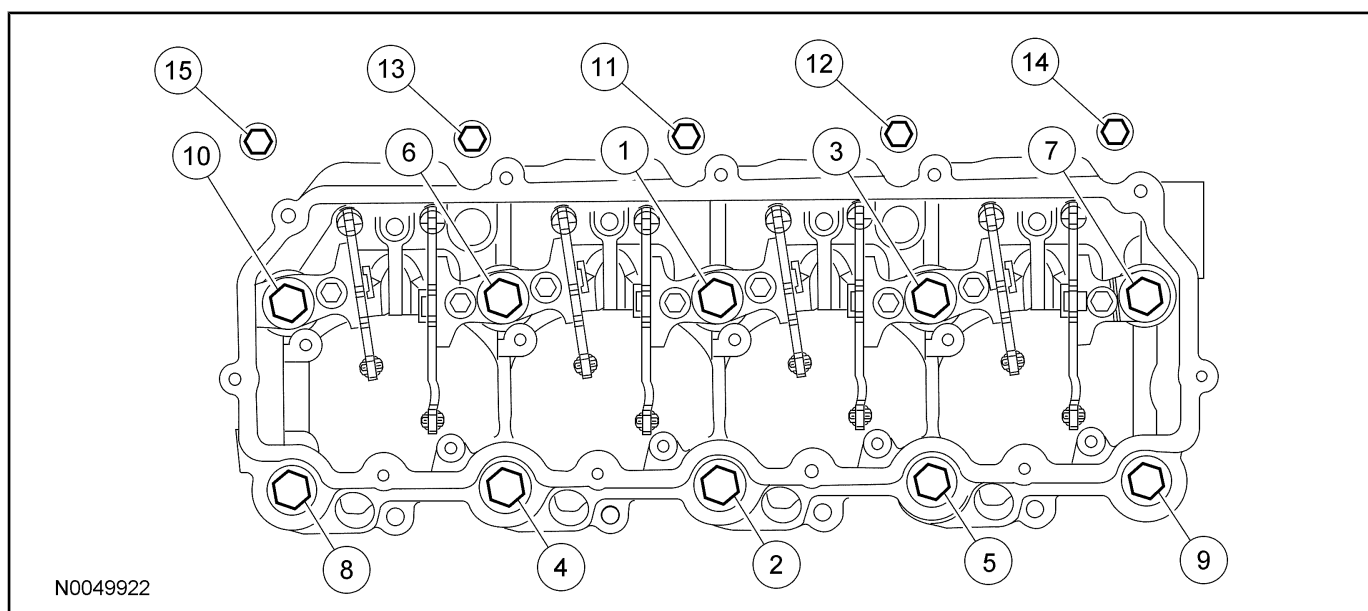
IN-VEHICLE REPAIR(Continued)



8. Tighten the cylinder head bolts in 7 stages in the sequence shown:

- Stage 1: Tighten bolts 1 through 10 to 88 Nm (65 lb-ft).

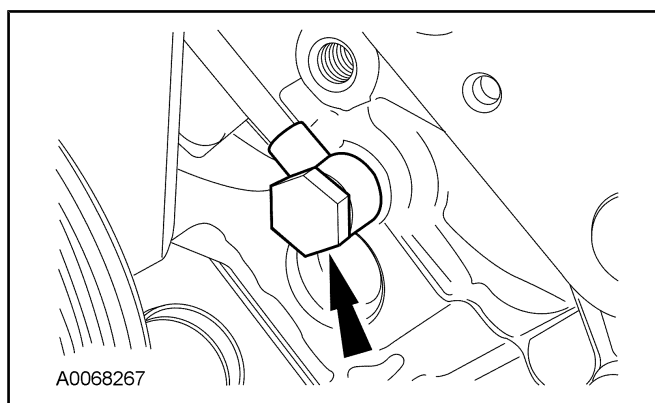
- Stage 2: Tighten bolts 1 through 10 to 115 Nm (85 lb-ft).
- Stage 3: Tighten bolts in sequence 1 through 10, 90 degrees.
- Stage 4: Tighten bolts in sequence 1 through 10, a second time, 90 degrees.
- Stage 5: Tighten bolts in sequence 1 through 10, a third time, 90 degrees.
- Stage 6: Tighten bolts 11 through 15 to 24 Nm (18 lb-ft).
- Stage 7: Tighten bolts 11 through 15 to 31 Nm (23 lb-ft).



9. **NOTE:** Install new sealing washers.

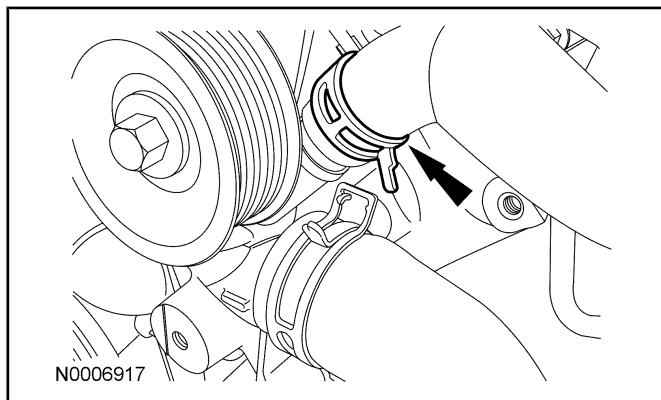
Install the fuel tube and the banjo bolt.

- For Viton® sealing washers, tighten to 25 Nm (18 lb-ft).
- For copper sealing washers, tighten to 38 Nm (28 lb-ft).



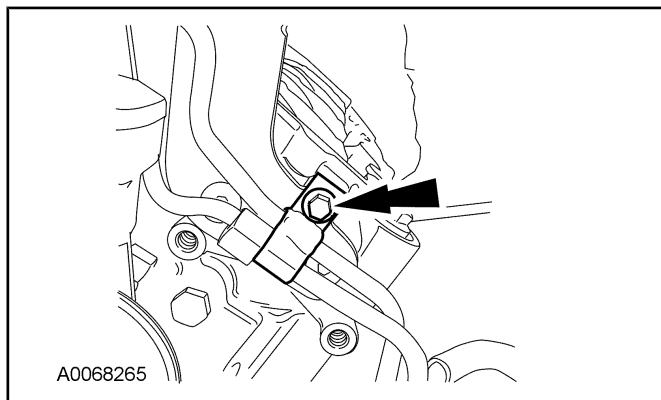
10. Connect the heater hose.

IN-VEHICLE REPAIR(Continued)



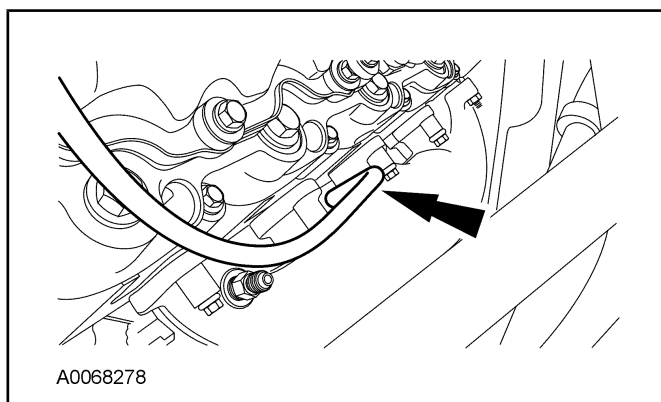
11. Position the fuel tubes and install the fuel tube bracket bolt.

- Tighten to 13 Nm (10 lb-ft).



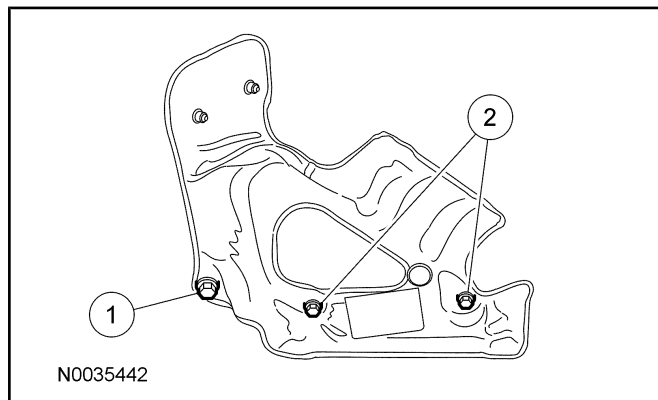
12. **NOTE:** Install a new O-ring seal and apply clean engine oil.

Install the oil level indicator and tube.



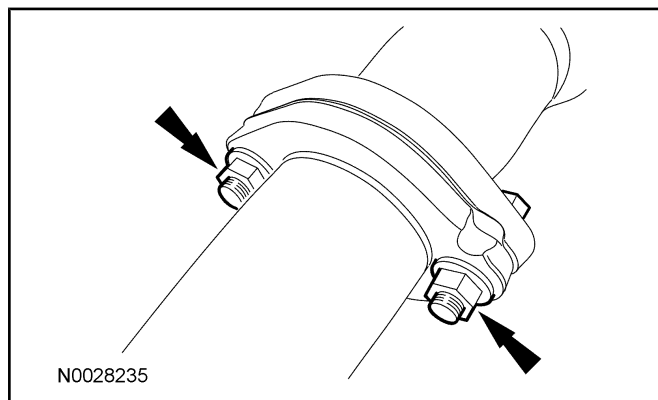
13. Position the turbocharger heat shield and install the 3 bolts.

- 1 Tighten to 49 Nm (36 lb-ft).
- 2 Tighten to 11 Nm (8 lb-ft).



14. Position the 2 parts of the turbocharger adapter pipe into the vehicle. Install the gasket, connect the adapter pipe joint and install the bolts. Position the turbocharger adapter pipe on the exhaust manifolds.

- Tighten to 27 Nm (20 lb-ft).

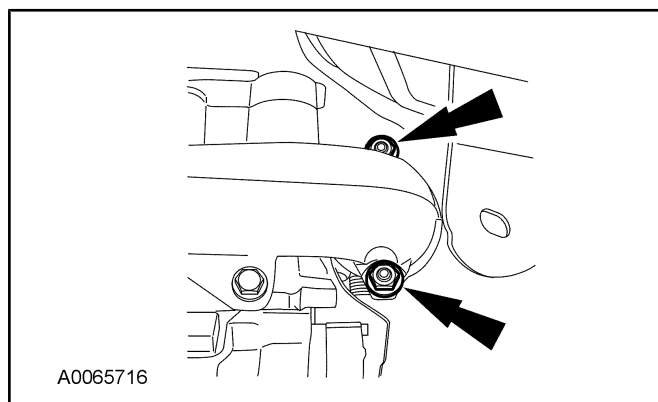


15. **NOTE:** Apply anti-seize lubricants to the bolt threads prior to installing the bolts.

NOTE: Do not tighten until after the turbocharger is installed.

Install the nuts and bolts in the adapter pipe.

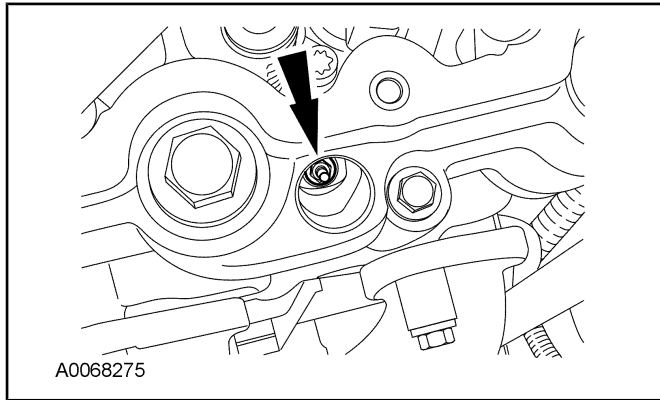
- Tighten to 27 Nm (20 lb-ft).



16. Install the 4 glow plugs.

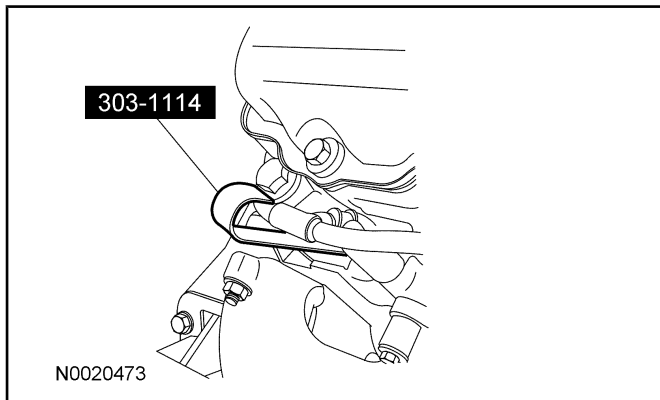
IN-VEHICLE REPAIR(Continued)

- Tighten to 19 Nm (14 lb-ft).



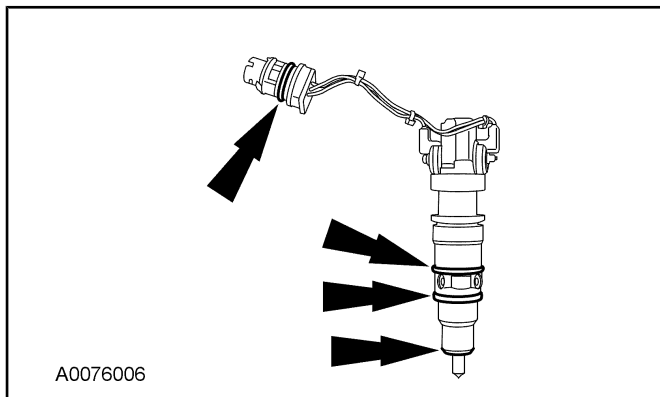
17. **NOTE:** Clean and apply clean engine oil to the O-ring seals prior to installing.

Using the special tool, install the glow plug harness.



18. **NOTICE:** If the fuel injector oil inlet D-shaped O-ring seal is damaged, a new fuel injector must be installed.

Install new O-ring seals and copper washer on the fuel injector. Lubricate the fuel injector and O-rings liberally with clean engine oil.

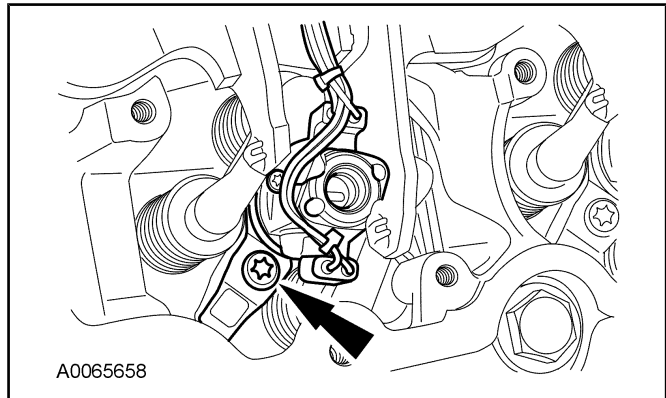


19. **NOTICE:** Failure to tighten the injector properly can lead to engine failure.

NOTICE: To prevent engine damage, do not use air tools to install the fuel injectors. The snap ring that extracts the injector can dislodge and fall into the oil drain hole.

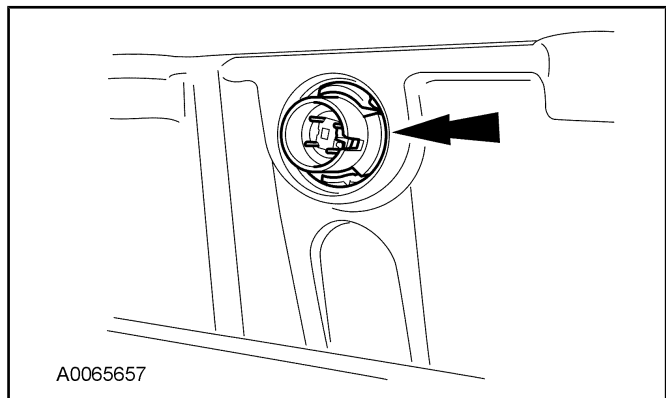
Assemble the fuel injector hold-down and bolt on the fuel injector and install the assembly.

- Early build vehicles (T40 Torx®), tighten to 33 Nm (24 lb-ft).
- Late build vehicles (T45 Torx®), tighten to 35 Nm (26 lb-ft).



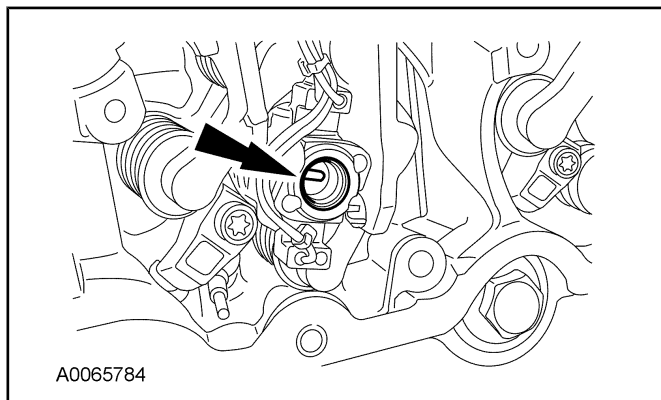
20. **NOTICE:** Make sure the injector wiring is clear of all moving parts or engine damage can occur.

Install the fuel injector electrical connector into the rocker carrier.



21. Apply engine oil to the top fuel injector O-ring seals.

IN-VEHICLE REPAIR(Continued)

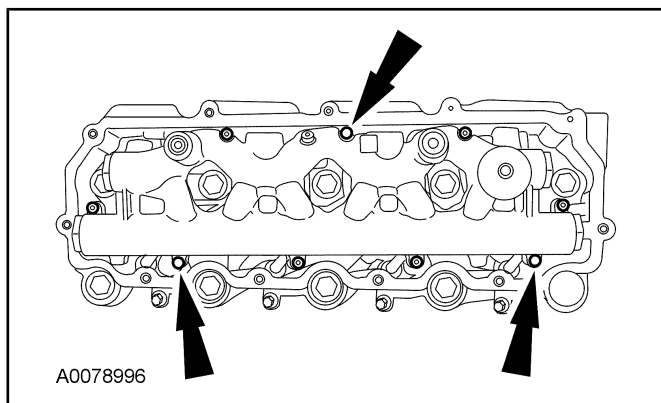


22. **NOTICE:** Using the bolts to push the high-pressure oil rail into the fuel injectors can damage the fuel injectors and high-pressure oil rail.

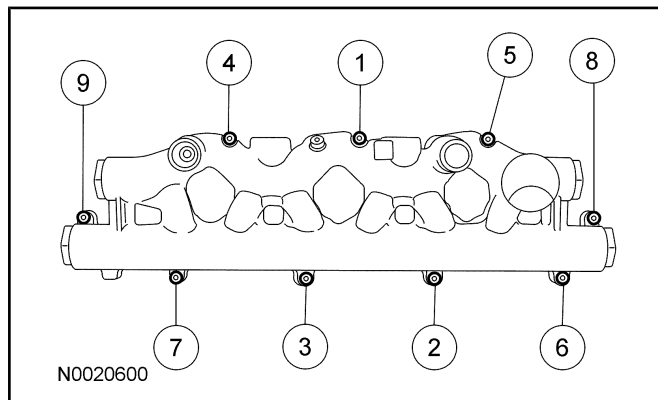
NOTE: Apply clean engine oil on the tubes prior to installing the high-pressure oil rail.

Position the oil rail on the fuel injectors.

- Place the oil rail on top of the carrier so that the 4 single ball tubes are engaging the injector lead angle.
- Insert 3 guide bolts, 2 on the ends of the straight side of the oil rail and 1 in the middle of the wavy side of the rail. Install the guide studs 6 to 7 turns.
- Manually press the oil rail into the fuel injectors.
- Make sure that the oil rail mounting feet are flat against the mounting surface.
- Loosely install the 6 bolts.

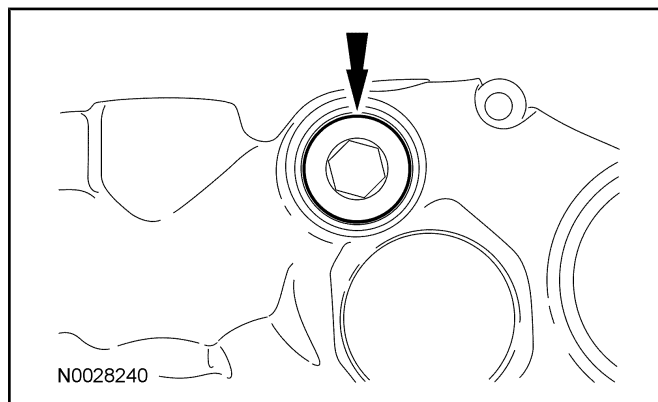


23. Remove the 3 guide bolts, install the remaining bolts and tighten the 9 bolts in the sequence shown.
- Tighten to 13 Nm (10 lb-ft).



24. Apply clean engine oil to the D-ring seals and reassemble the crankcase-to-head tube if necessary. Install the crankcase-to-head tube.

- Tighten to 82 Nm (60 lb-ft).

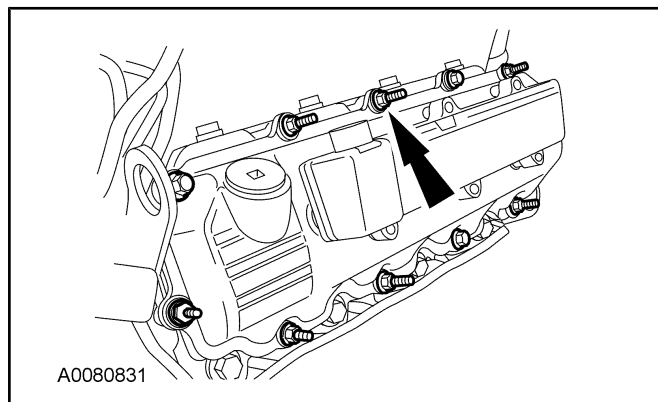


25. **NOTICE:** To prevent engine damage, do not use air-powered tools when installing the valve cover.

NOTE: Clean and inspect the valve cover gasket. Install a new gasket if necessary.

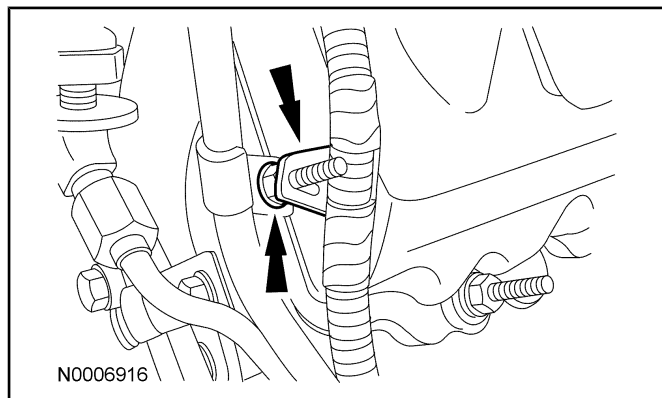
Position the valve cover gasket, the valve cover and install the stud bolts and the bolts.

- Tighten to 9 Nm (80 lb-in).



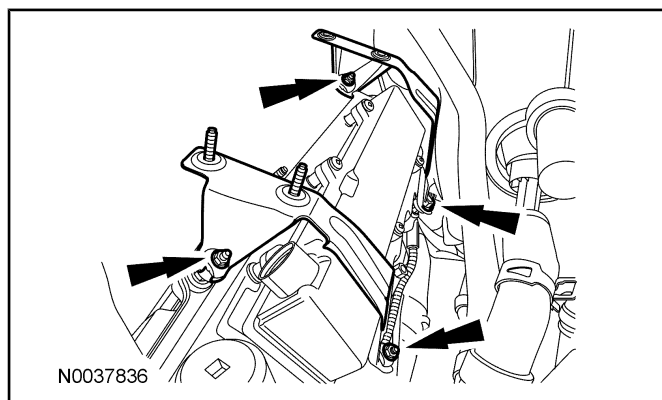
26. Position back the oil level indicator and install the nut. Connect the wire retainer.

IN-VEHICLE REPAIR(Continued)



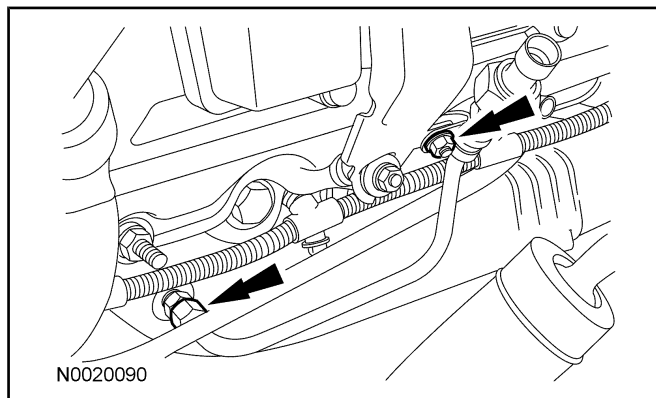
27. Install the fuel injector control module mounting bracket and the nuts.

- Tighten to 8 Nm (71 lb-in).



28. Position the EP sensor tube and connect the fitting at the exhaust manifold and install the nut.

- Tighten the EP sensor tube support bracket nut to 13 Nm (10 lb-ft).
- Tighten the EP sensor tube fitting at the exhaust manifold to 30 Nm (22 lb-ft).



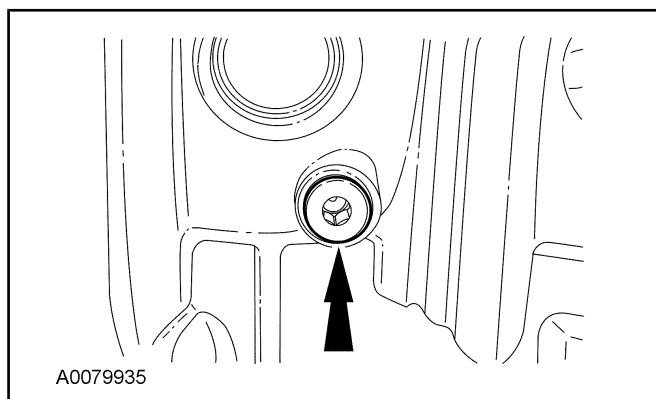
29. **NOTE:** Install a new oil filter.

Fill the crankcase with clean engine oil.

30. **NOTE:** Lightly lubricate the O-ring seal with clean engine oil before installing.

Install the cylinder block coolant drain plug.

- Tighten to 20 Nm (15 lb-ft).



31. Install the intake manifold. For additional information, refer to Intake Manifold in this section.