

**SECTION 303-01C Engine — 6.0L Diesel**

**CONTENTS**

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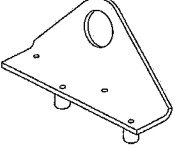
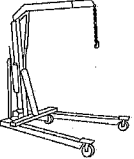

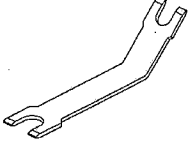
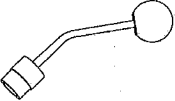
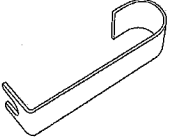
**IN-VEHICLE REPAIR**

Cylinder Head — LH .....

303-01C-2

**IN-VEHICLE REPAIR**  
**Cylinder Head — LH**

**Special Tool(s)**

 <p>ST2697-A</p>	<p>Lifting Bracket, Cylinder Head 303-759</p>
 <p>ST1341-A</p>	<p>Heavy Duty Floor Crane 014-00071</p>
 <p>ST2247-A</p>	<p>Quick Disconnect Tool 303-625</p>
 <p>ST2703-A</p>	<p>Disconnect Tool, Quick Release Coupling 303-755</p>
 <p>ST2862-A</p>	<p>Release Tool, Injector Connector 303-1115</p>
 <p>ST2861-A</p>	<p>Remover/Installer, Glow Plug Connector 303-1114</p>

**Material**

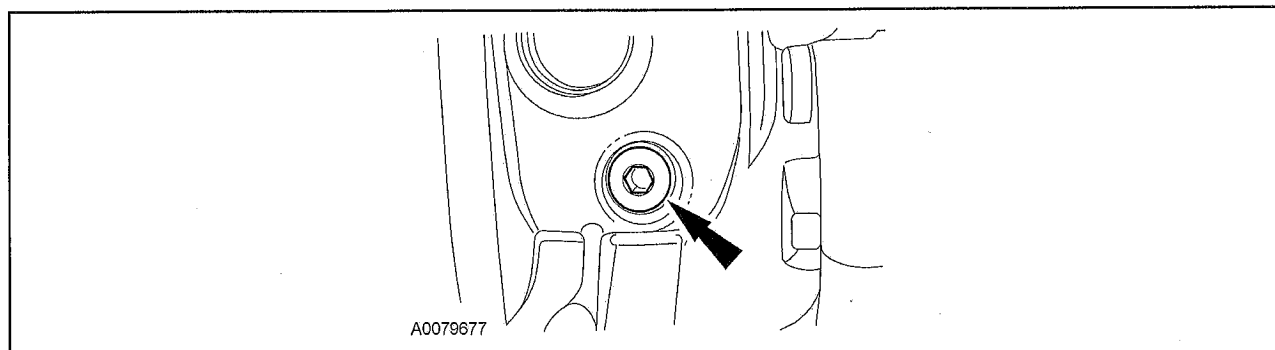
Item	Specification
SAE 15W-40 Super Duty Motor Oil XO-15W40-QSD or equivalent	WSS-M2C171-B

**IN-VEHICLE REPAIR (Continued)****Material (Continued)**

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2 or equivalent	ESE-M12A4-A
Metal Brake Parts Cleaner PM-4 (Canada CPM-4)	—

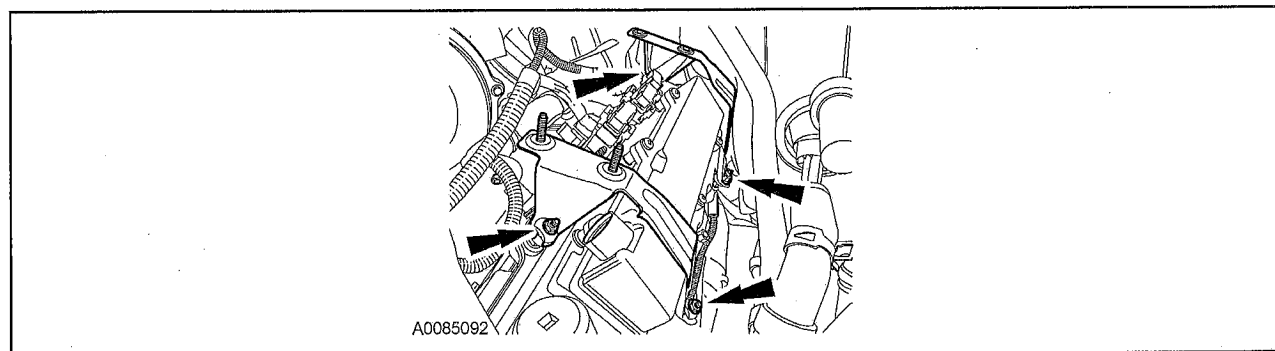
**Removal****All vehicles**

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 drain plug.



5. **NOTE:**  
Late build shown, early build similar.

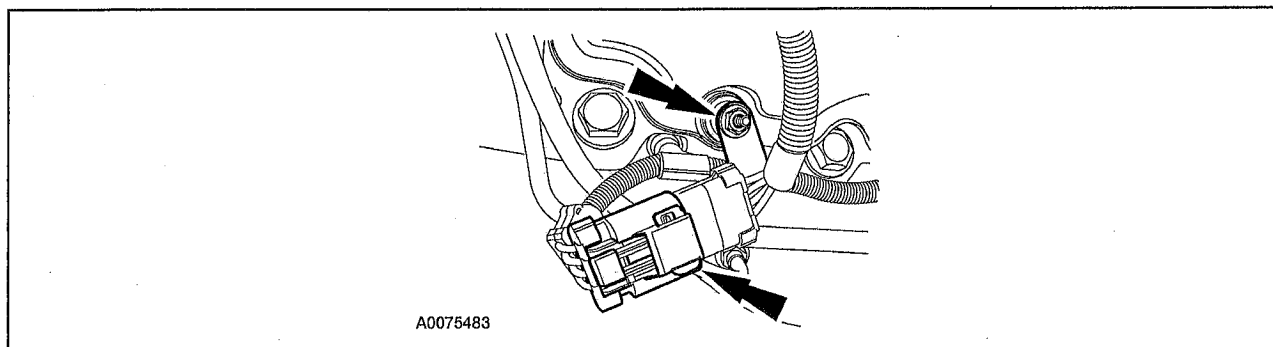
Remove the fuel injector control module mounting bracket.



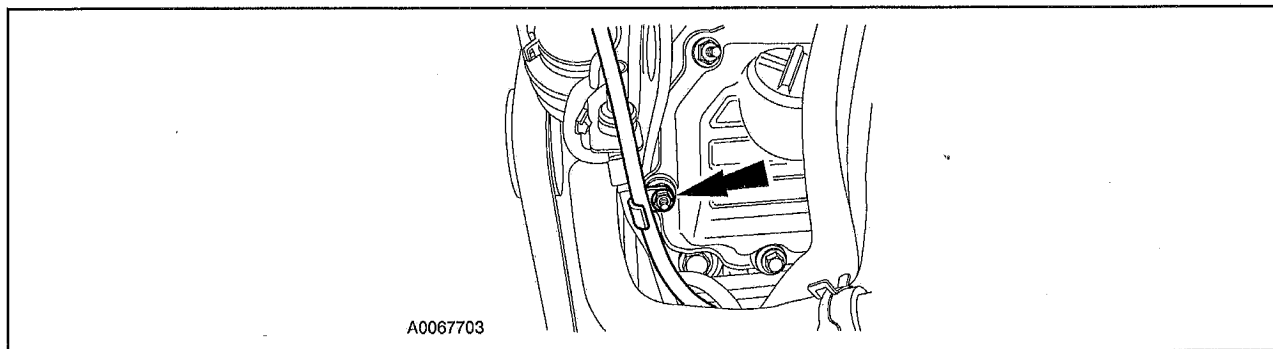
6. **NOTE:**  
Late build shown, early build similar.

Disconnect the glow plug connector and position aside.

## IN-VEHICLE REPAIR (Continued)



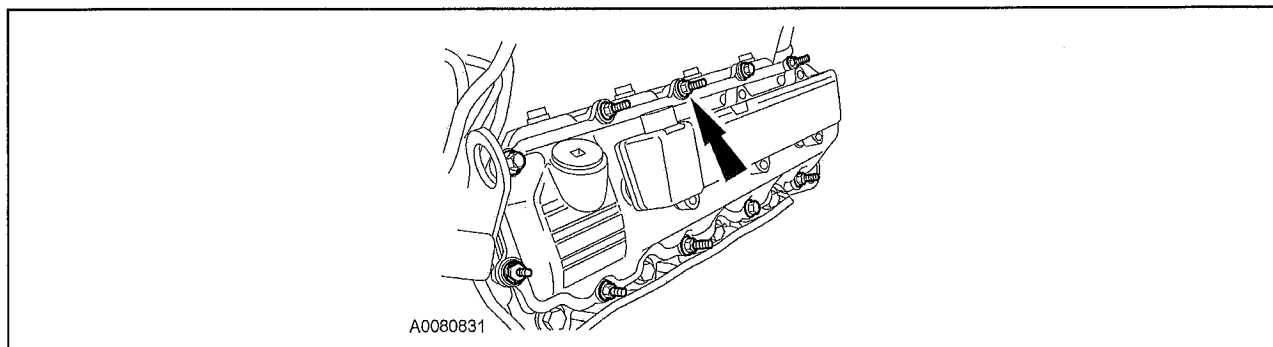
7. Remove the nut and position the oil level indicator and tube aside.



8. **NOTE:**  
Late build shown, early build similar.

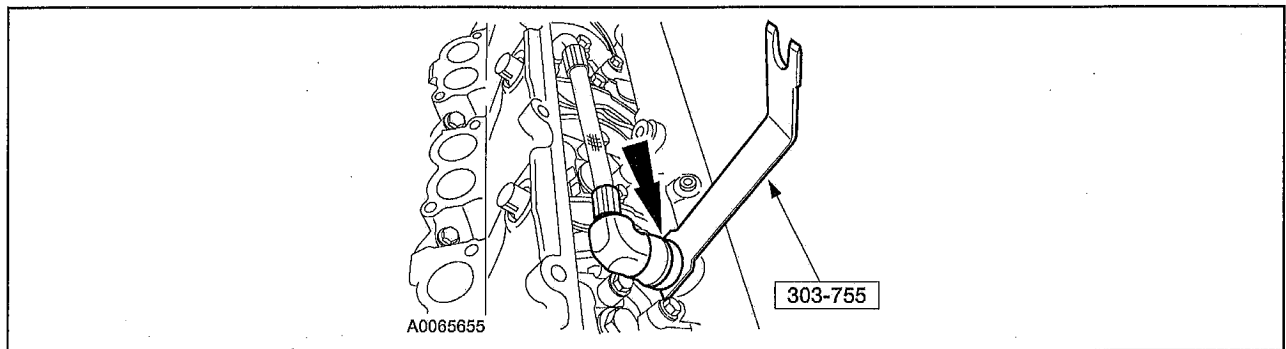
**NOTE:**  
Mark the position of the valve cover bolts for valve cover bolt installation.

Remove the eleven bolts and the valve cover. Remove the valve cover gasket.

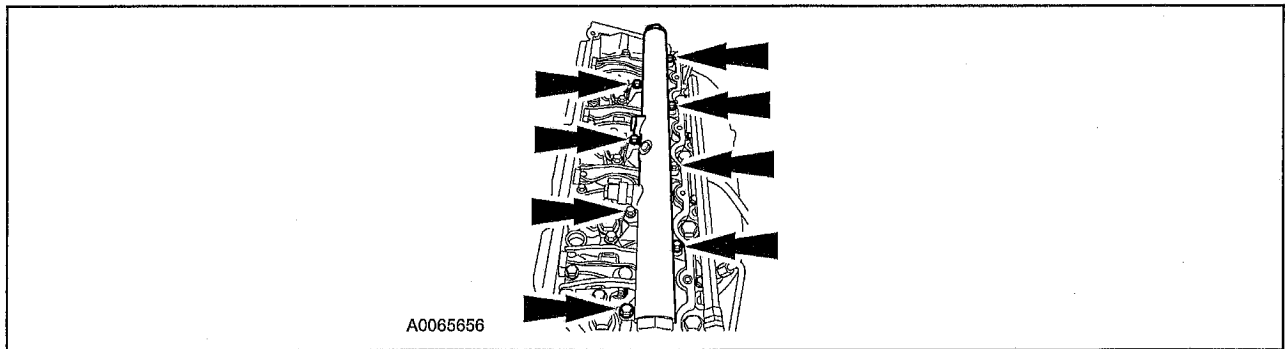
**Early build**

9. Disconnect the high-pressure oil rail supply line at the high-pressure oil rail.

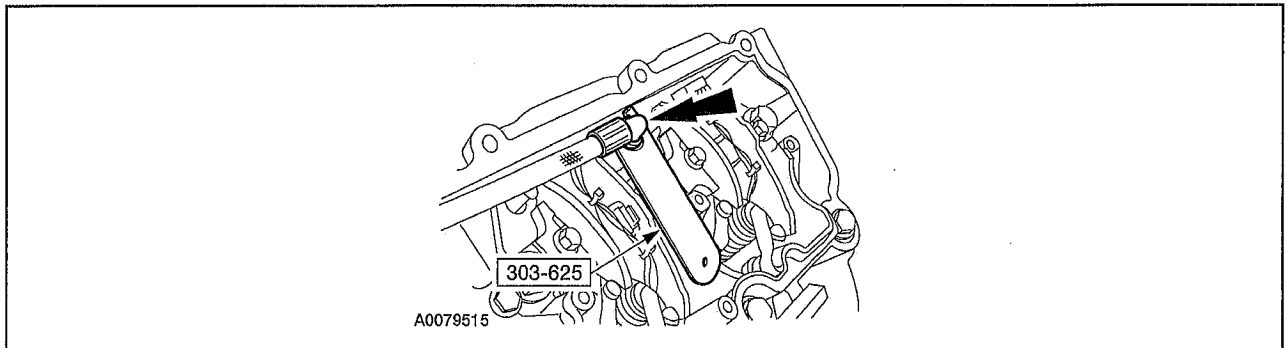
IN-VEHICLE REPAIR (Continued)



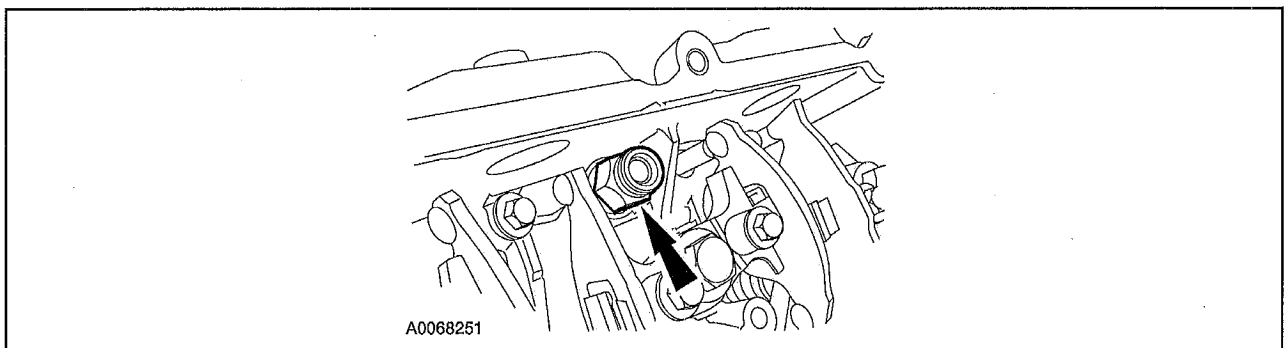
10. Remove the bolts and the high-pressure oil rail.



11. Disconnect and remove the high-pressure oil supply line.

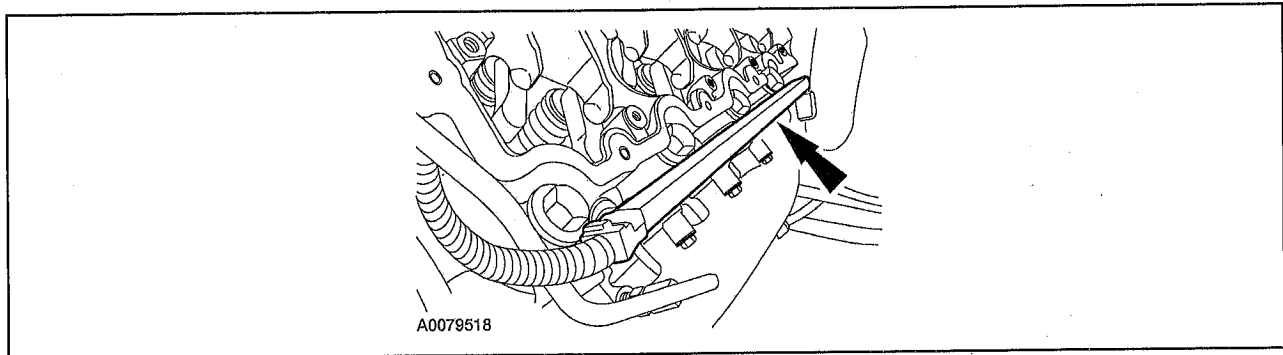


12. Remove and discard the crankcase-to-head tube assembly.



13. Remove the glow plug buss bar.

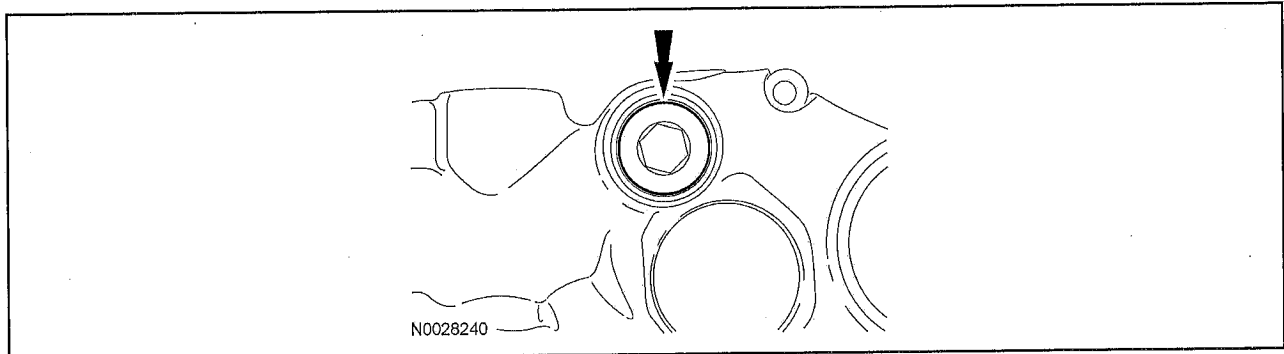
## IN-VEHICLE REPAIR (Continued)

**Two-piece head tube**

14. **NOTE:**  
Some engines may have been updated with a new two-piece crankcase-to-head tube. If the crankcase-to-head tube has been updated it will have a hex head.

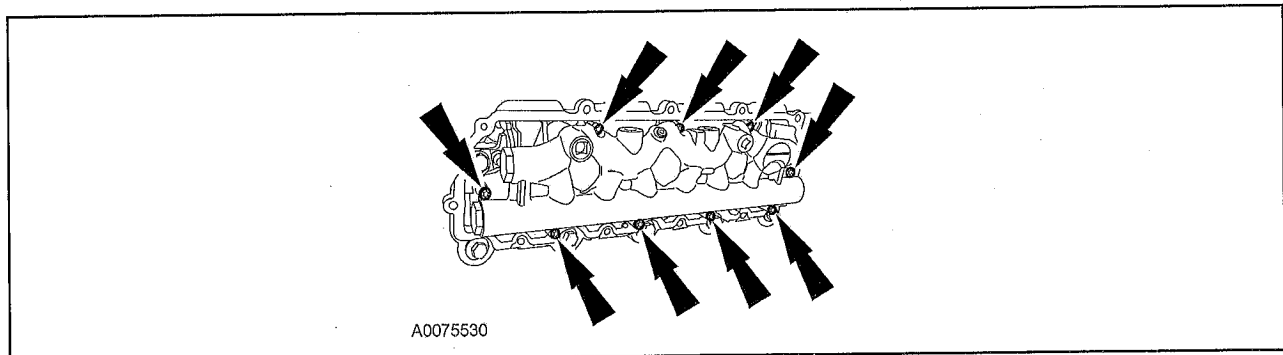
If the high-pressure oil rail has a hex head, remove the crankcase-to-head tube assembly.

- Remove and discard the O-ring seals.

**Late build**

15. **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.

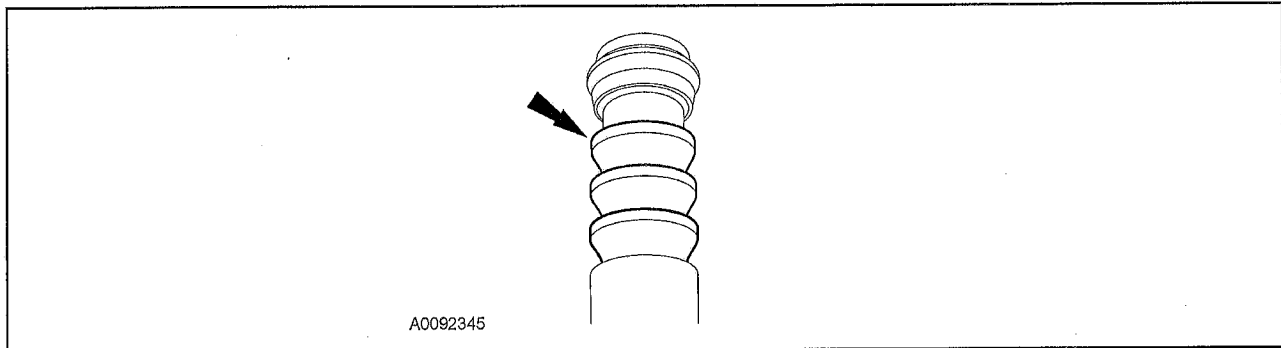
**One-piece head tube**

16. **NOTE:**  
The rings on the crankcase-to-head tube are to be used to pry the tube assembly from the branch tube assembly or the oil rail assembly.

Remove the crankcase-to-head tube assembly.

- Remove and discard the O-rings.

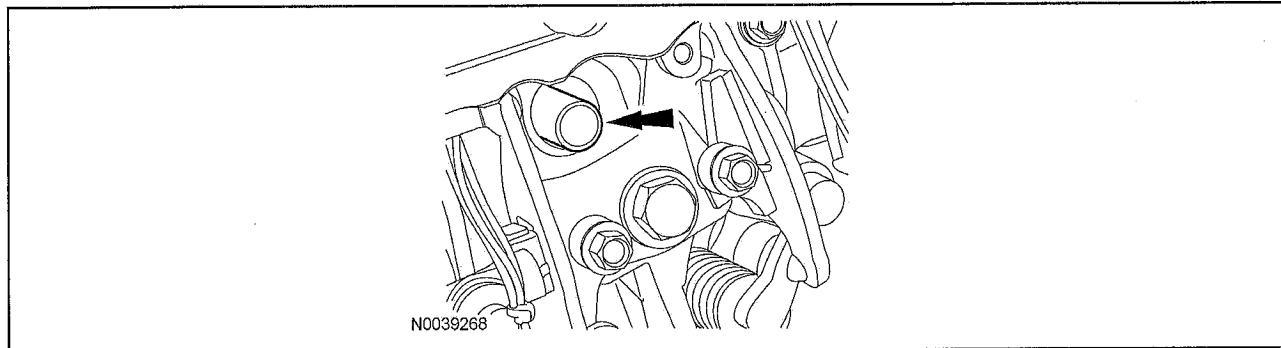
## IN-VEHICLE REPAIR (Continued)

**Two-piece head tube**

17. **NOTICE:**  
Use care not to deform the lower crankcase-to-head tube during removal. If the tube is damaged, a new tube must be installed.

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

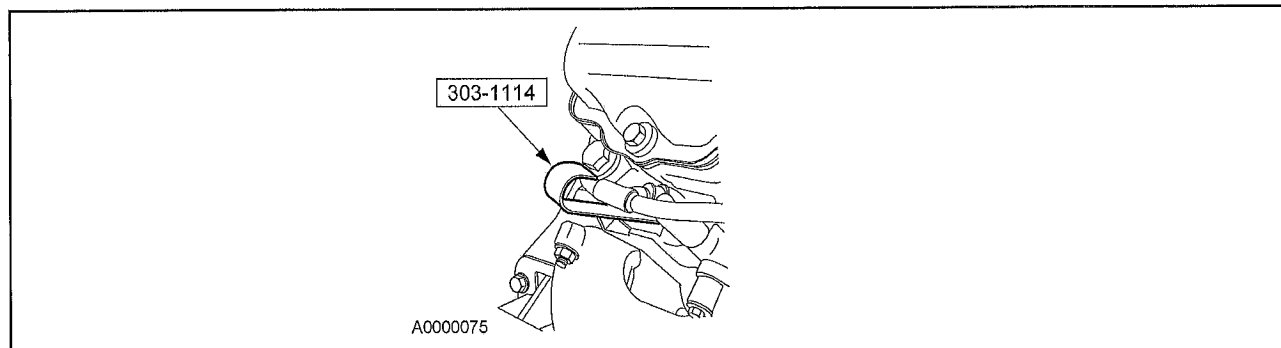
If the updated crankcase-to-head tube separated, using a pair of soft jawed pliers, remove the lower crankcase-to-head tube.

**Late build**

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

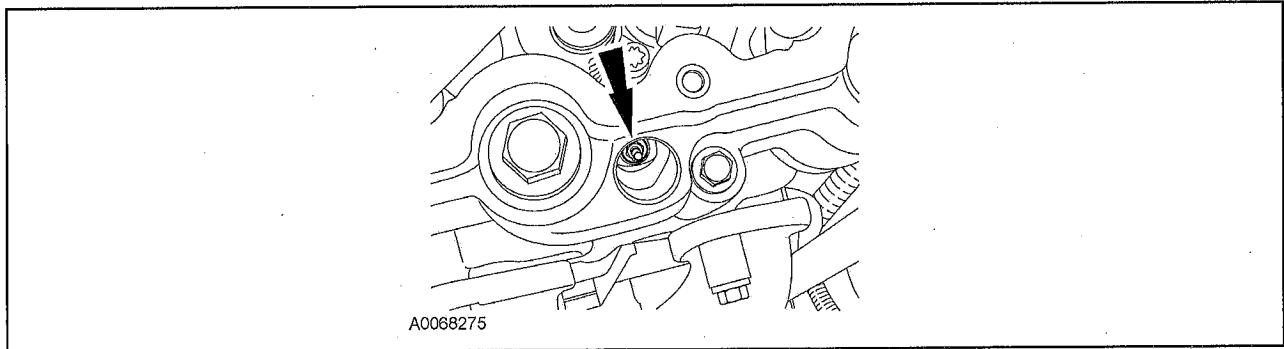
**NOTE:**  
Only one glow plug connector shown.

Using the special tool, remove the glow plug harness.

**All vehicles**

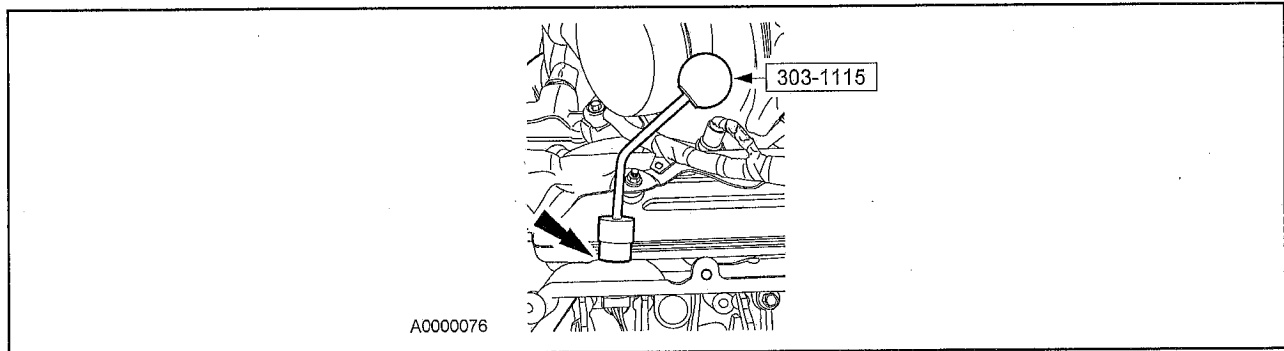
19. Remove the four glow plugs.

## IN-VEHICLE REPAIR (Continued)



20. **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.



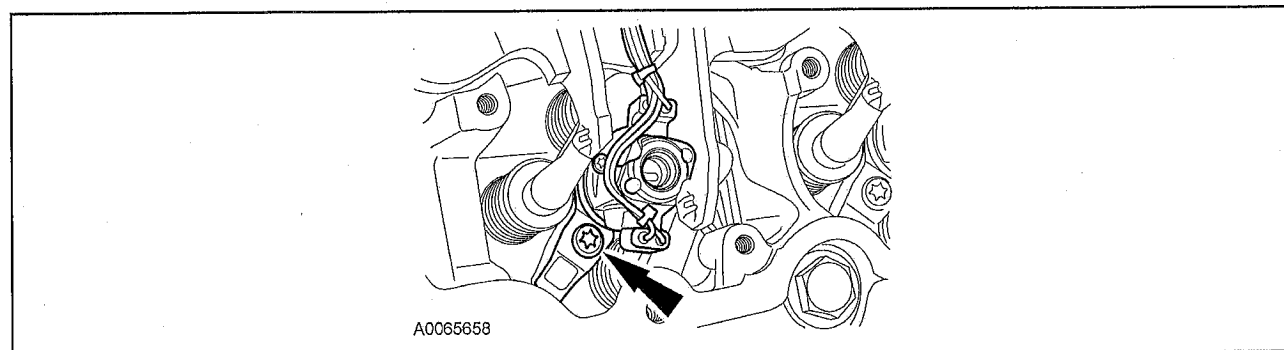
21. Prior to removing the injector assembly, insert clean shop towels in the oil drain holes adjacent to each glow plug.
22. **NOTICE:**  
Failure to account for all snap rings or pieces prior to placing the vehicle back in service can cause engine damage. A missing snap ring can be ingested into the 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 not any 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.

Remove the bolt, fuel injector hold down and fuel injector.



23. **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.

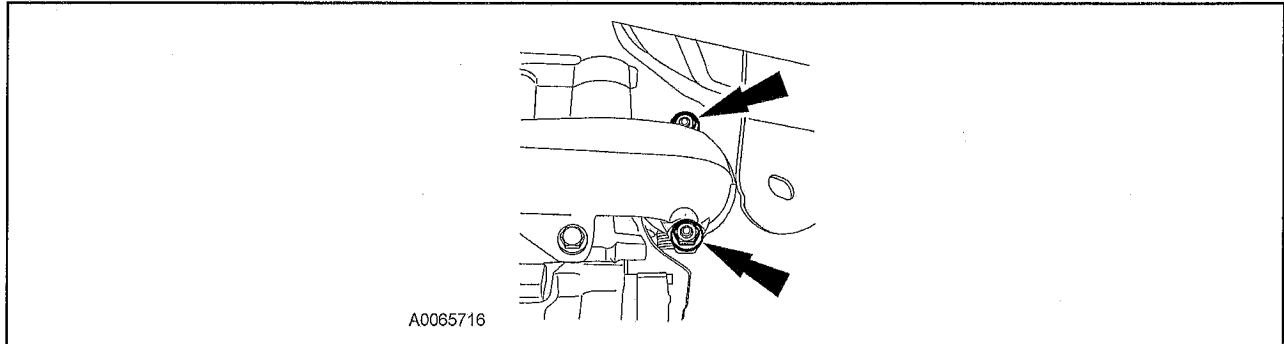


**IN-VEHICLE REPAIR (Continued)**

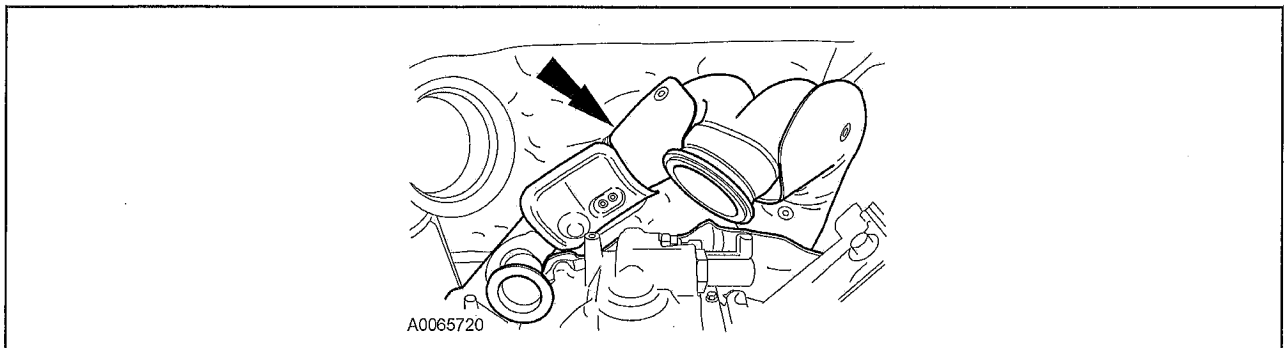
Remove the shop towels.

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

Remove the nuts and bolts from the turbocharger adapter pipe.

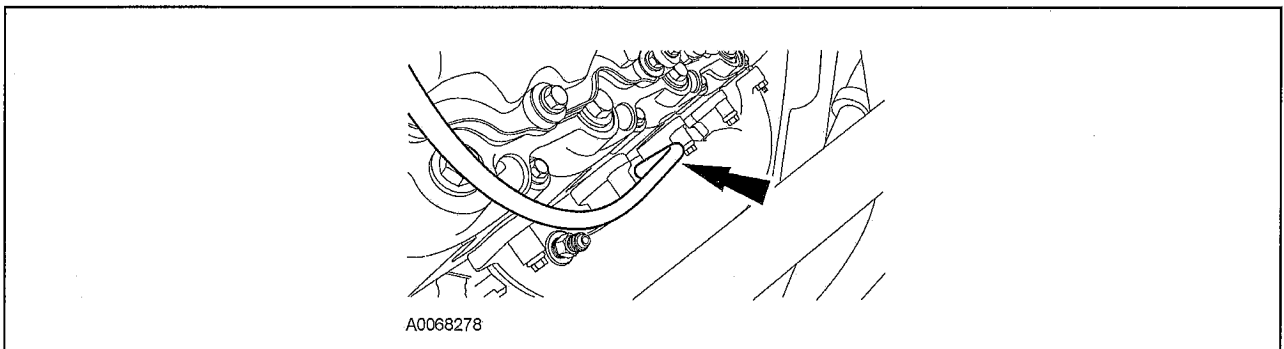


25. Remove the turbocharger adapter pipe.



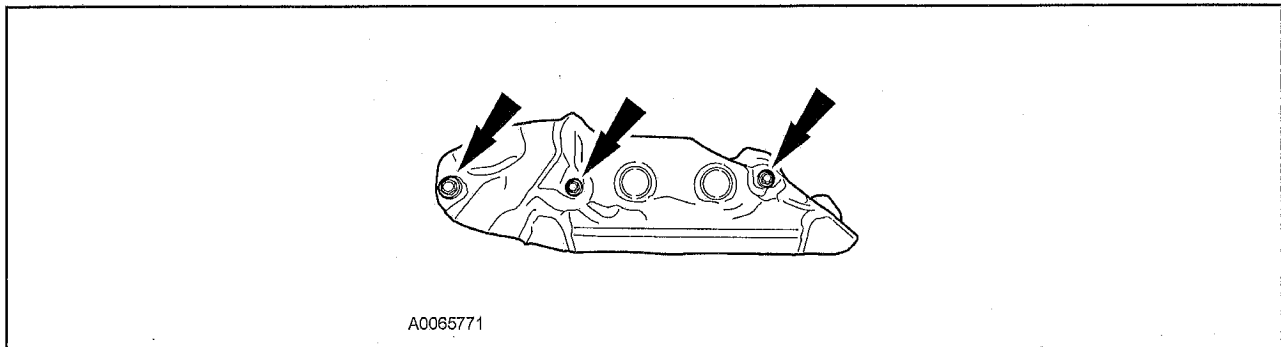
26. **NOTE:**  
Remove and discard the O-ring.

Remove the oil level indicator and tube.

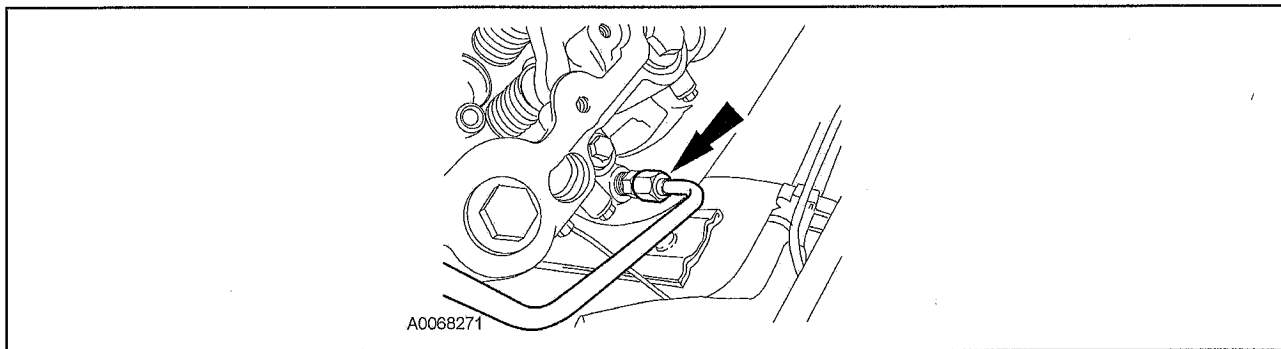


27. Remove the bolts and turbocharger heat shield.

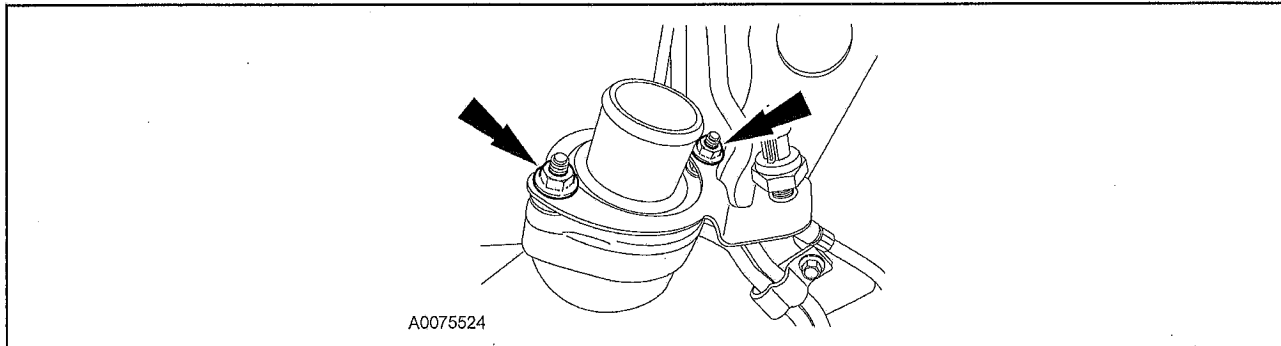
IN-VEHICLE REPAIR (Continued)



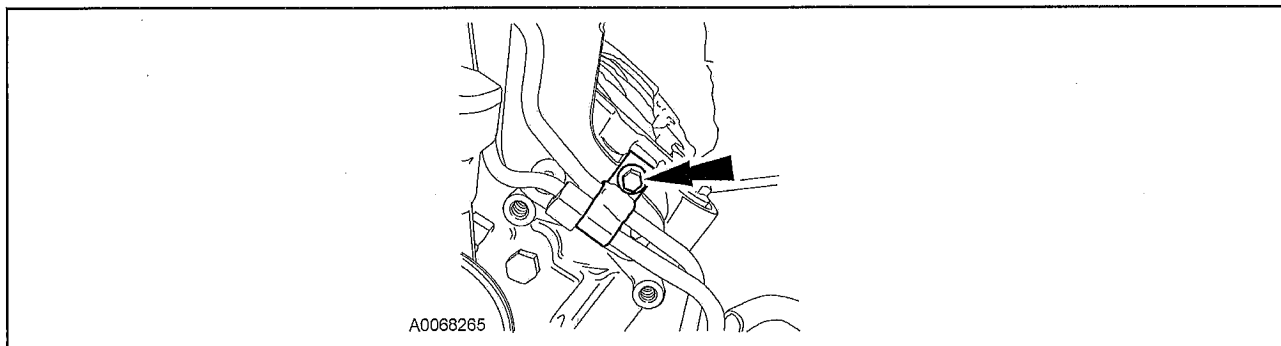
28. Disconnect the exhaust backpressure tube at the exhaust manifold.



29. Remove the retaining nuts. Remove the exhaust backpressure bracket assembly.

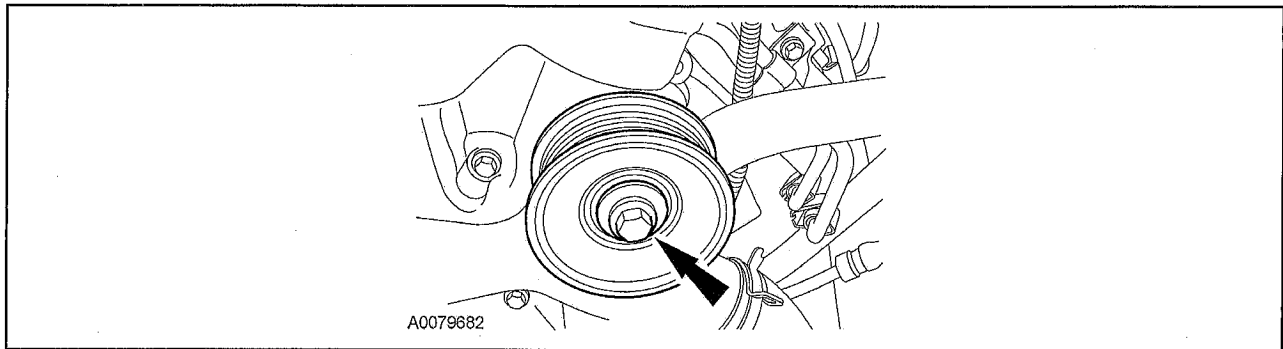


30. Remove the retaining bolt from the fuel tube bracket and position the fuel tubes aside.

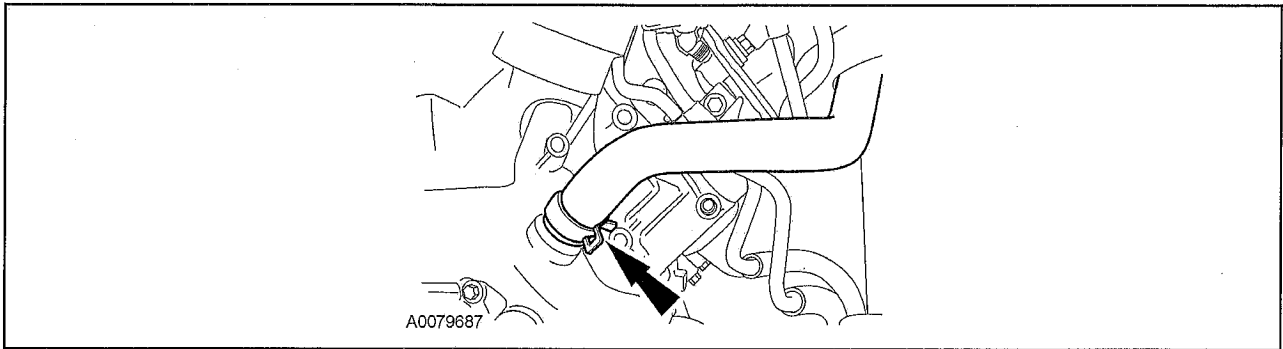


31. Remove the bolt and the idler pulley.

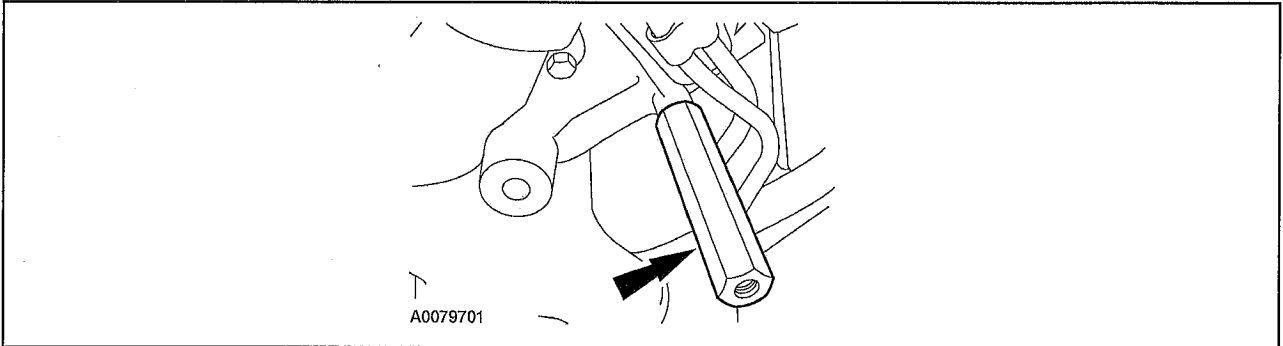
## IN-VEHICLE REPAIR (Continued)



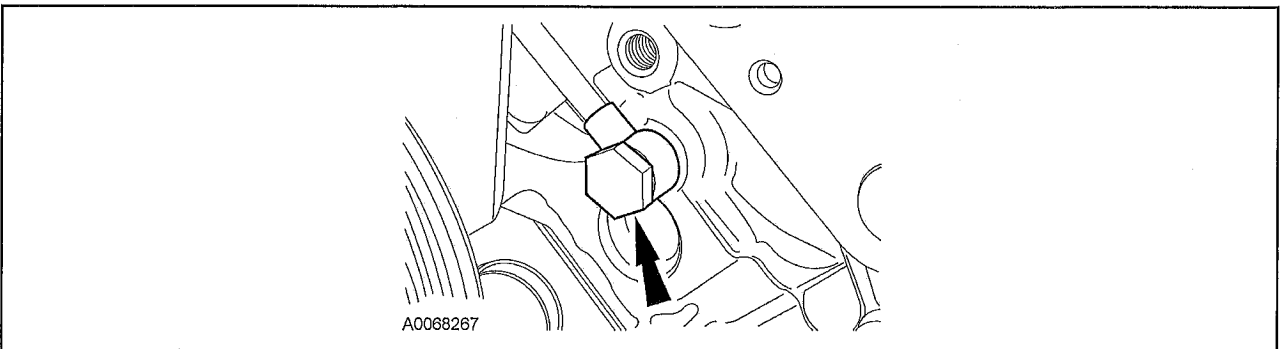
32. Disconnect the heater hose from the front cover and position aside.



33. Remove the fan shroud mounting stud.



34. **NOTE:**  
Remove and discard the sealing washers.  
  
Remove the banjo bolt and the fuel tube.



35. **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.

**IN-VEHICLE REPAIR (Continued)**

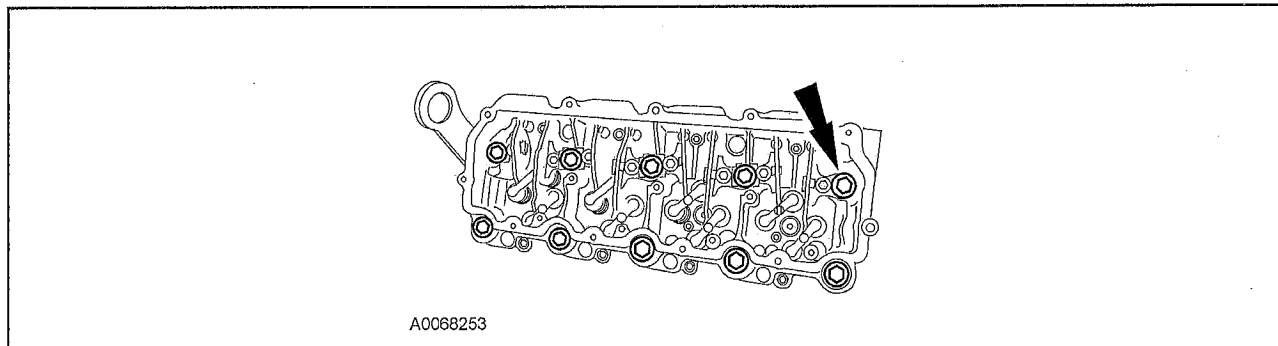
**NOTE:**

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

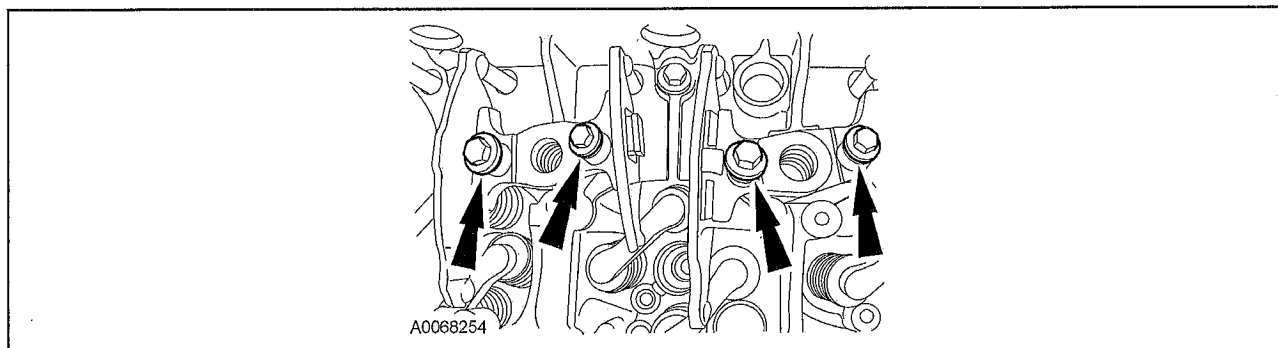
**NOTE:**

The back two 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.

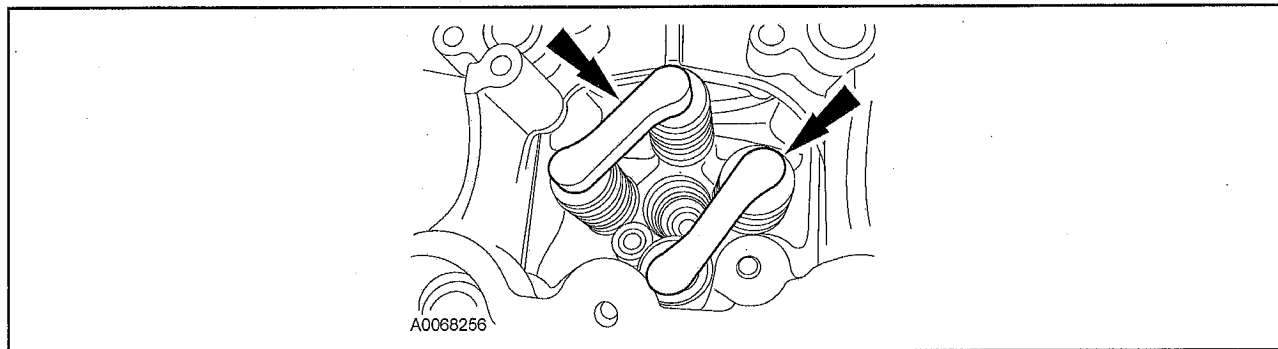
Remove and discard the inner cylinder head bolts.



36. Remove the eight bolts and the rocker arm assemblies.



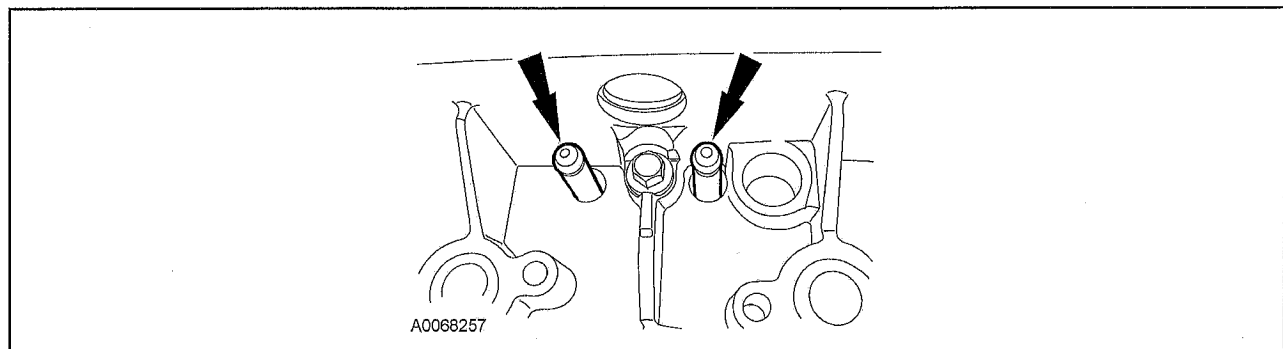
37. Mark the eight valve bridges with a permanent marker and remove.



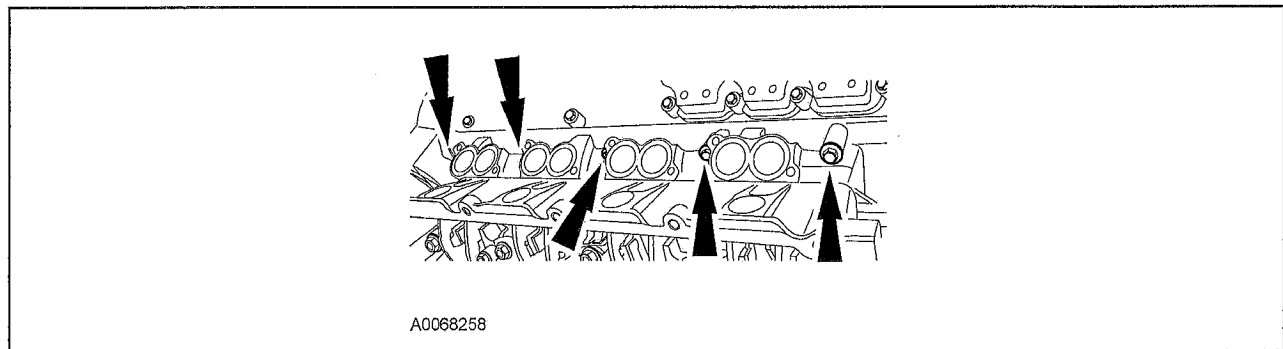
38. **NOTICE:**  
To prevent engine damage, keep the push rods in the order in which they were removed. Install all push rods back in their original positions.

Mark the location and remove the eight push rods.

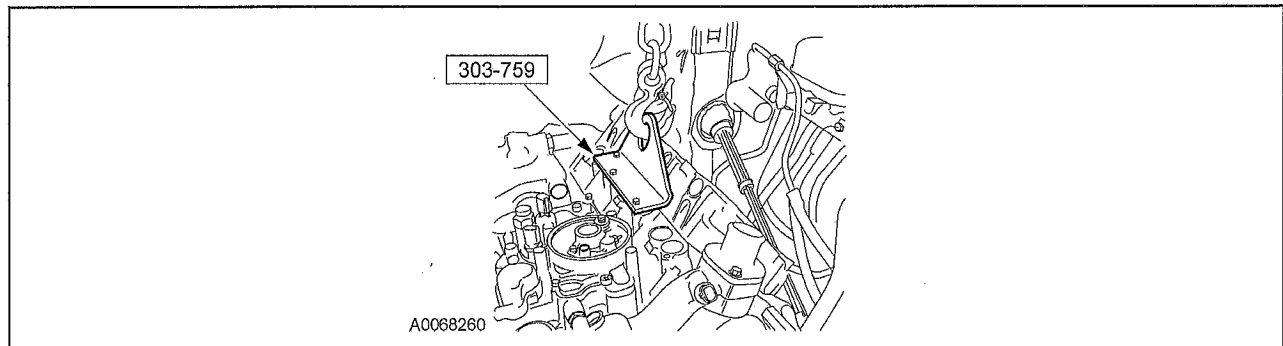
## IN-VEHICLE REPAIR (Continued)



39. Remove the outer cylinder head bolts.



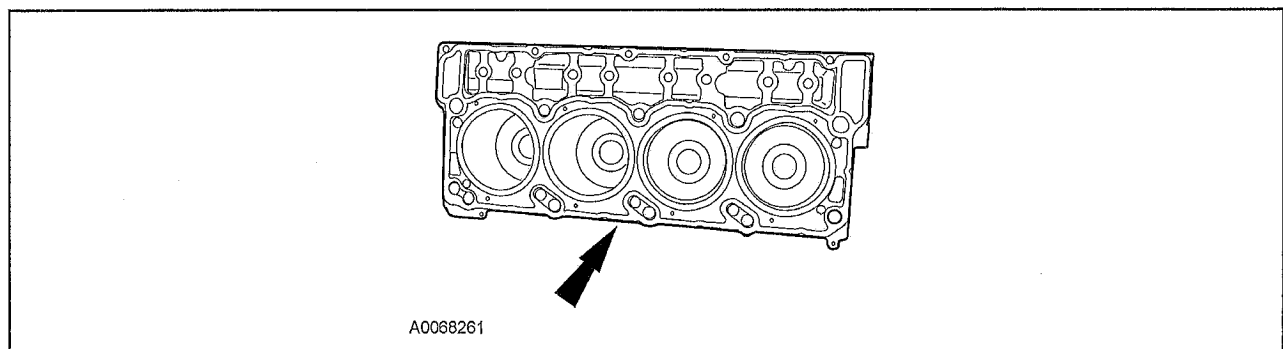
40. Install the special tool and the lifting crane. With the help of an assistant, remove the cylinder from the vehicle.



41. Check the cylinder head distortion. For additional information, refer to Cylinder Head Distortion in this section.

42. Remove and discard the cylinder head gasket and dowels.

- Clean and inspect the gasket sealing surfaces.



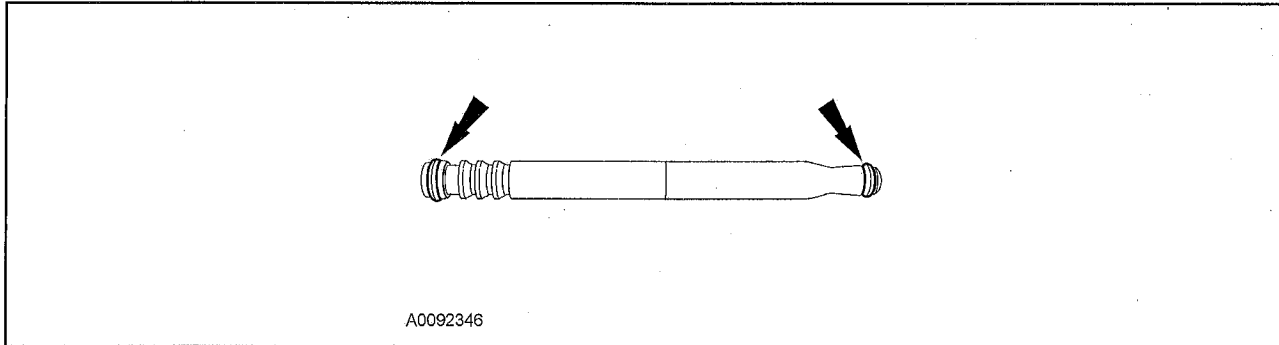
## Installation

### One-piece head tube

**IN-VEHICLE REPAIR (Continued)**1. **NOTICE:**

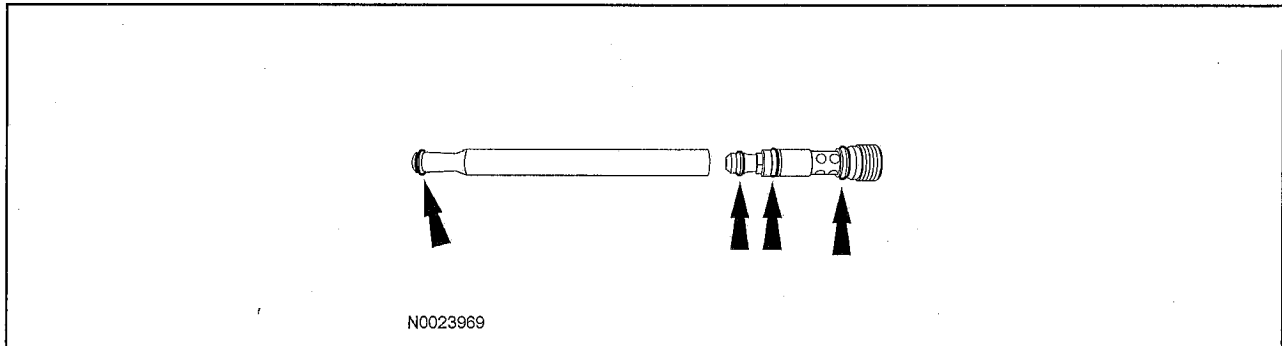
Install new D-ring seals on the crankcase-to-head tube. It requires several hours after installation for the D-ring seals to relax back to their original size. If the tube assembly is installed before the D-ring seals have relaxed, damage to the D-ring seals can occur.

Install new D-ring seals on each end of the crankcase to head tube assemblies.

**Two-piece head tube**2. **NOTICE:**

Install new D-ring seals on the crankcase-to-head tube. It requires several hours after installation for the D-ring seals to relax back to their original size. If the tube assembly is installed before the D-rings have relaxed, damage to the D-ring seals can occur.

Install new D-ring seals on the crankcase-to-head tube.

**All vehicles**3. **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 five top holes and head gasket push rod holes line up.

Install the dowels and the cylinder head gasket.

4. **NOTE:**

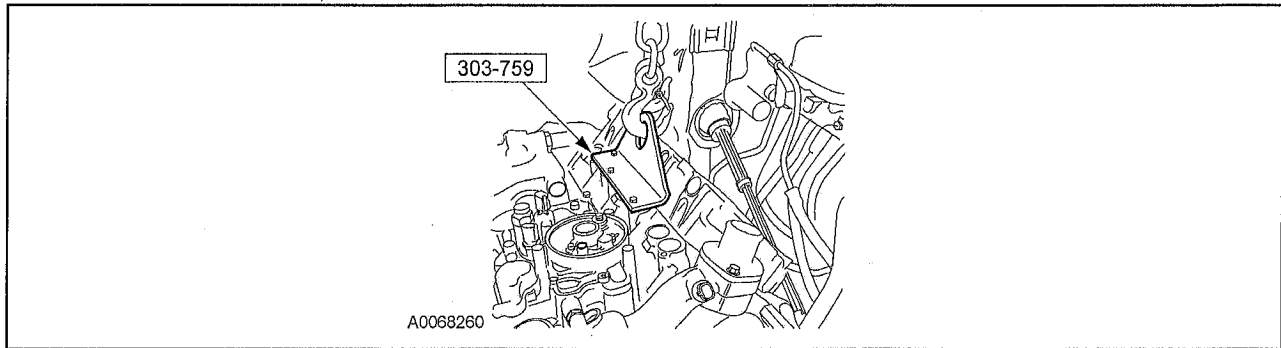
Position the fuel lines in place before the cylinder head is installed.

**NOTE:**

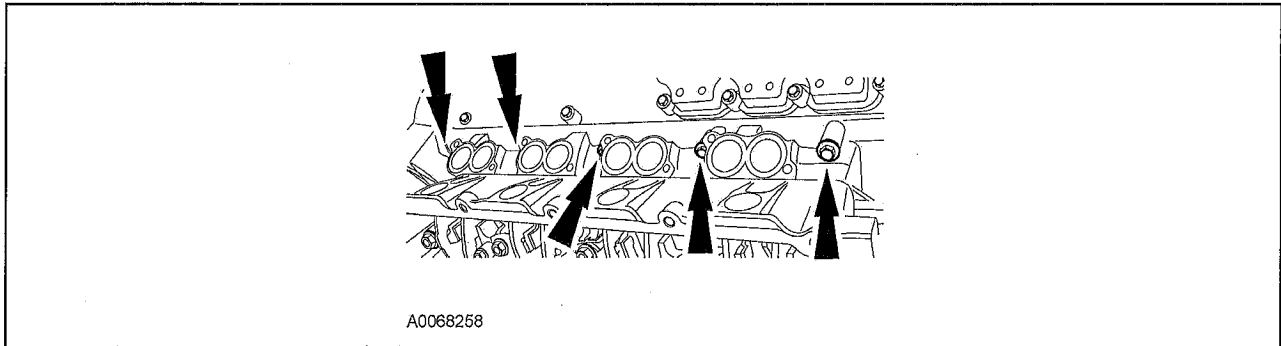
The back two cylinder head bolts cannot be installed into the head in vehicle. Lightly lubricate the threads of two new cylinder head bolts with clean engine oil. Position these bolts in the head and secure them in position so they will clear the cylinder block deck as the head is installed.

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

## IN-VEHICLE REPAIR (Continued)



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



6. **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.

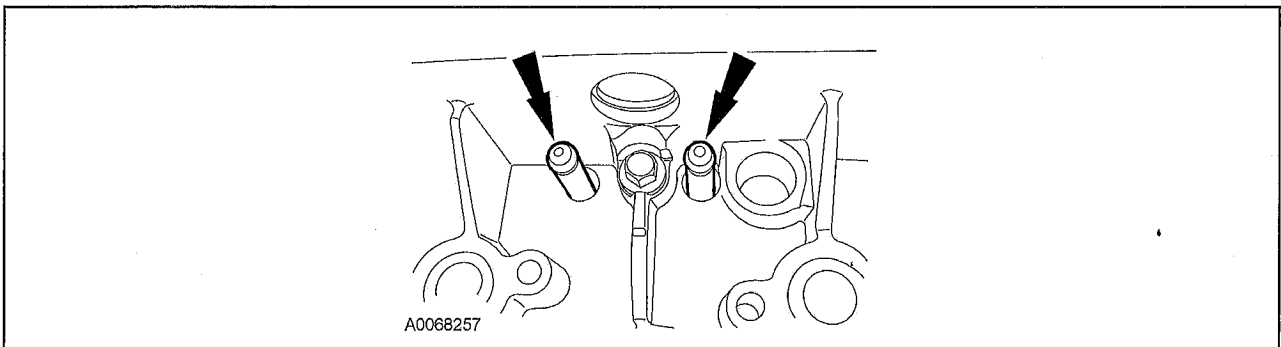
**NOTE:**

Higher mileage engines require push rods to be cleaned so the copper colored end of the push rod can be identified.

**NOTE:**

If a push rod has been replaced, it may not have a copper-colored end and can be installed with either end up.

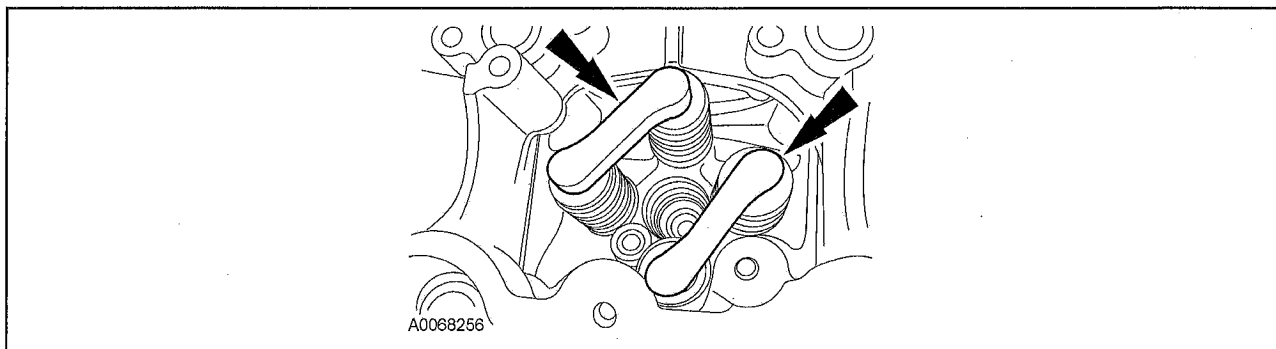
Apply clean engine oil to each end of the push rods. Insert them into their respective positions with the copper-colored end up.



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

Install the eight valve bridges.

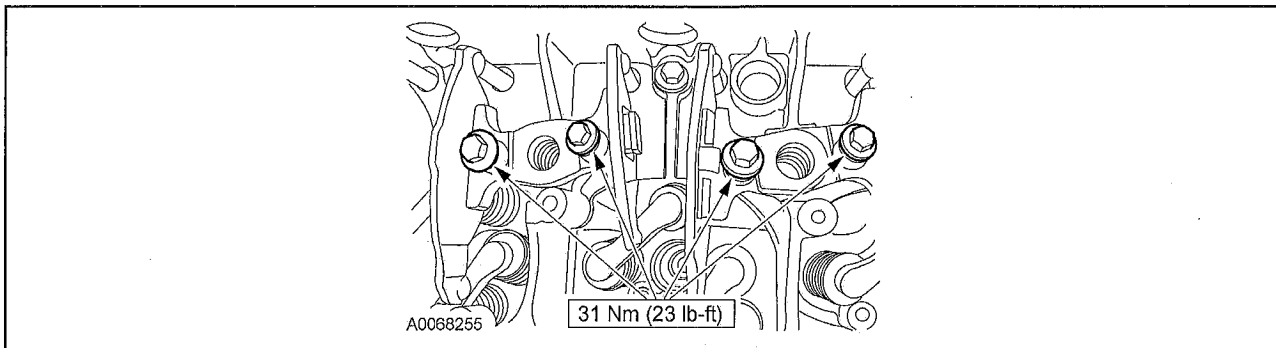
IN-VEHICLE REPAIR (Continued)



8. **NOTICE:**  
 Rotate the crankshaft until the damper locating dowel notch is in the six 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 eight bolts.



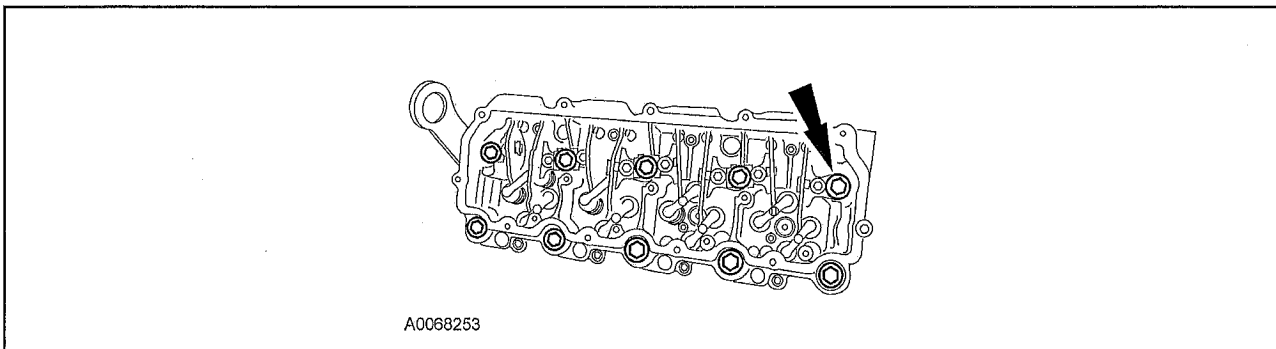
9. **NOTICE:**  
 Using too much engine oil on the threads of the cylinder head bolts can cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads can affect the true torque value of the bolts.

**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 new cylinder head retaining bolts finger-tight.

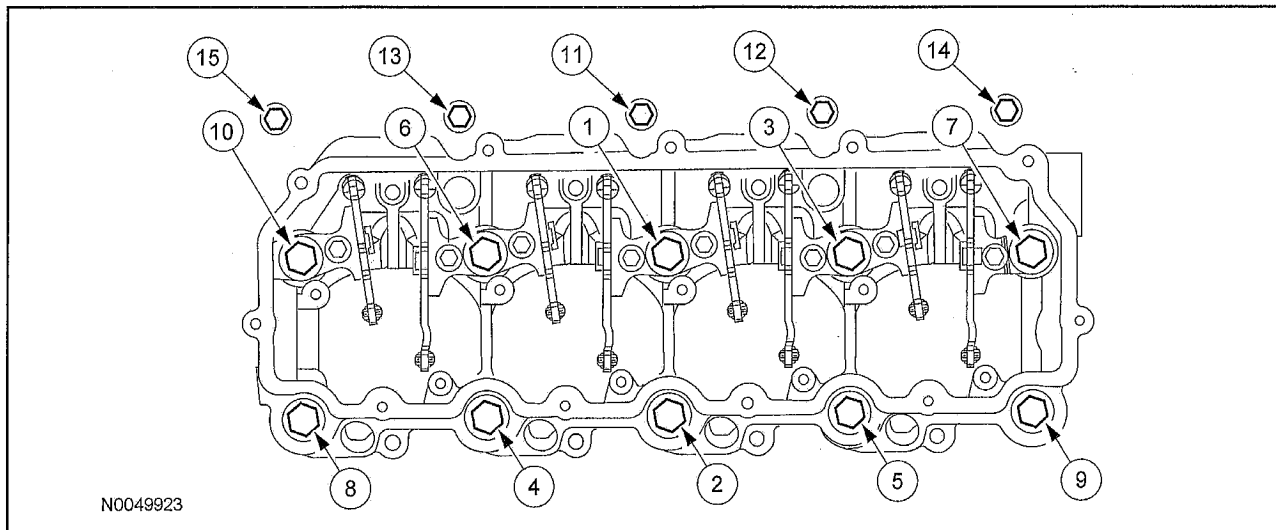


10. Tighten the head bolts in the following sequence.  
 1 Tighten bolts 1 through 10 to 88 Nm (65 lb-ft).



**IN-VEHICLE REPAIR (Continued)**

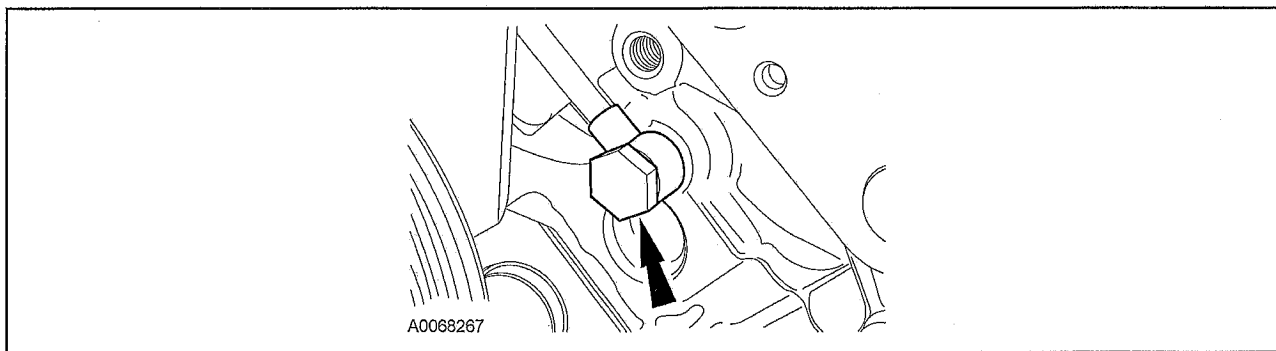
- 2 Tighten bolts 1 through 10 to 115 Nm (85 lb-ft).
- 3 Tighten bolts in sequence 1 through 10, clockwise 90 degrees.
- 4 Tighten bolts in sequence 1 through 10, a second time, clockwise 90 degrees.
- 5 Tighten bolts in sequence 1 through 10, a third time, clockwise 90 degrees.
- 6 Tighten bolts 11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



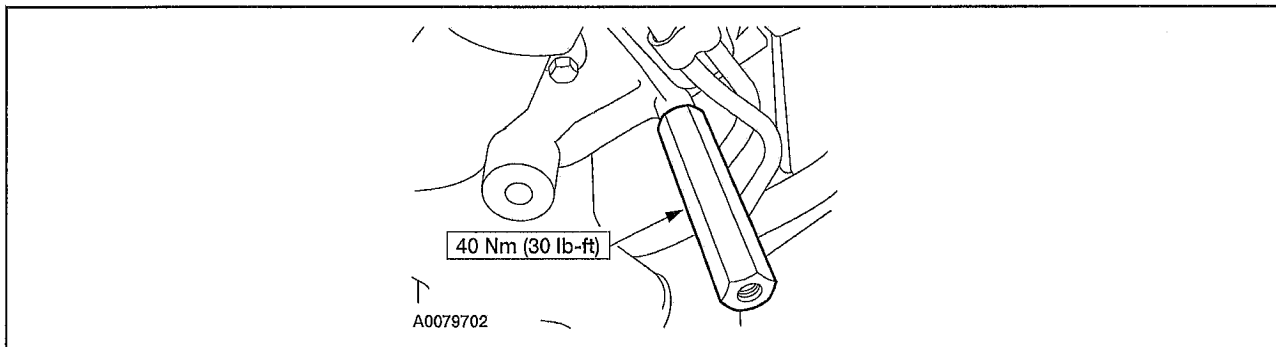
11. **NOTE:**  
Install new sealing washers.

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).

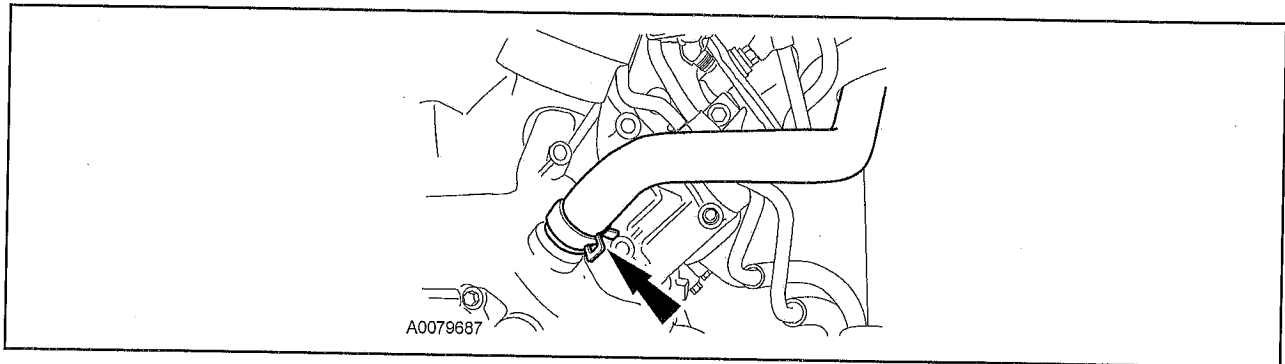


12. Install the fan shroud mounting stud.

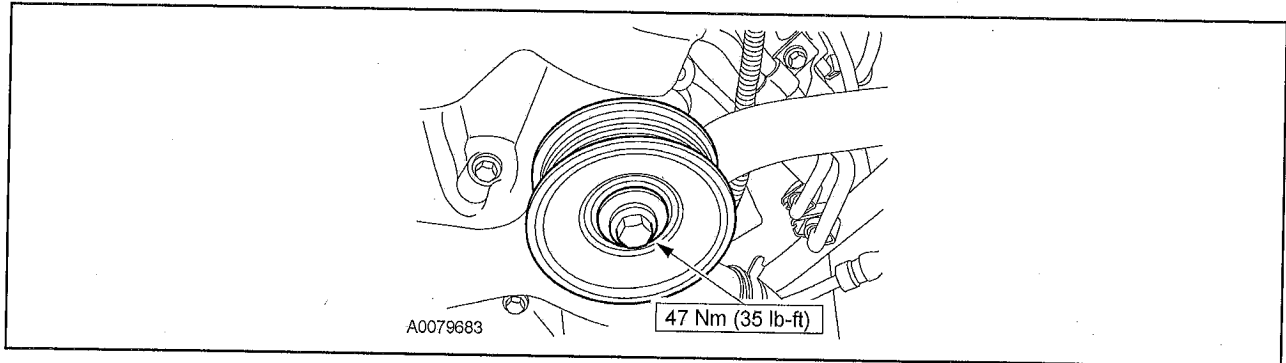


## IN-VEHICLE REPAIR (Continued)

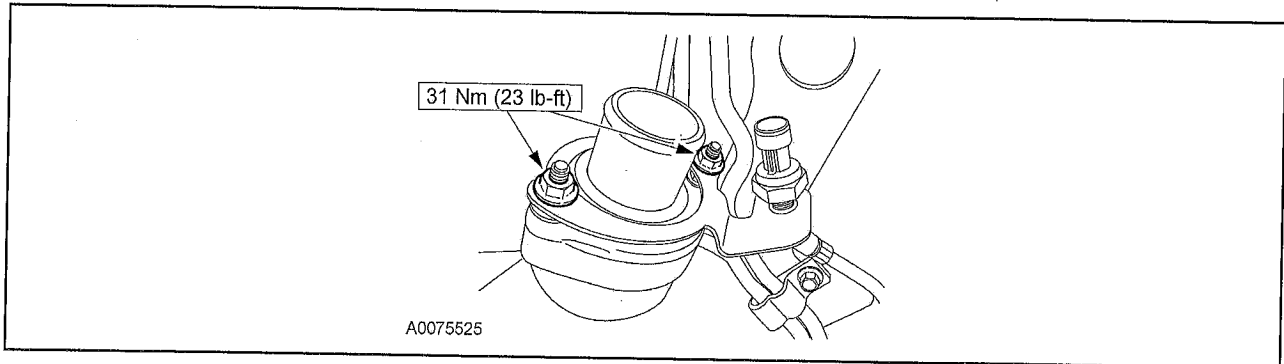
13. Position back and connect the heater hose.



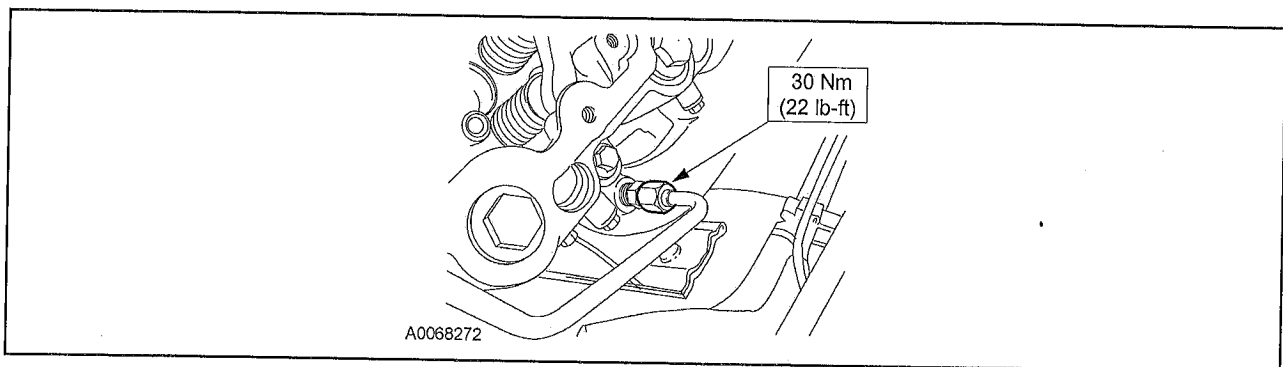
14. Install the idler pulley and bolt.



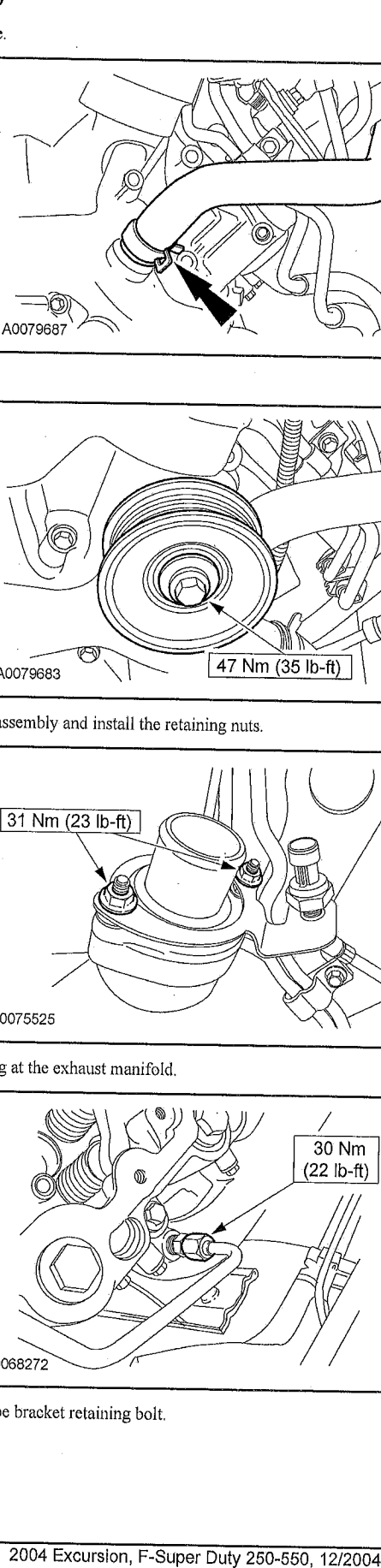
15. Position the exhaust backpressure bracket assembly and install the retaining nuts.



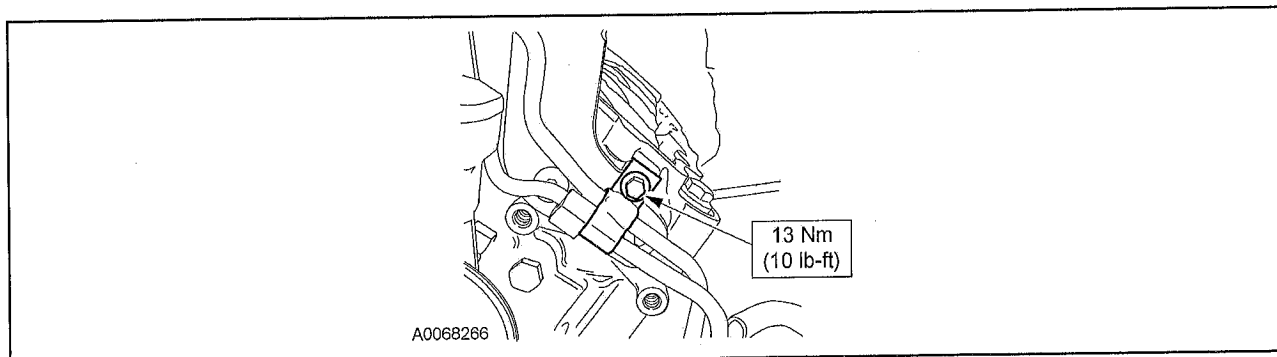
16. Tighten the exhaust backpressure tube fitting at the exhaust manifold.



17. Position the fuel tubes and install the fuel tube bracket retaining bolt.

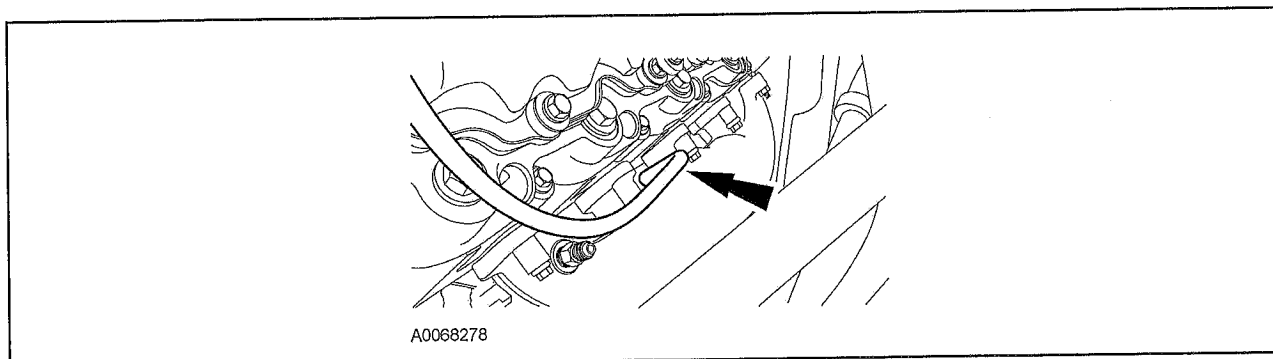


IN-VEHICLE REPAIR (Continued)

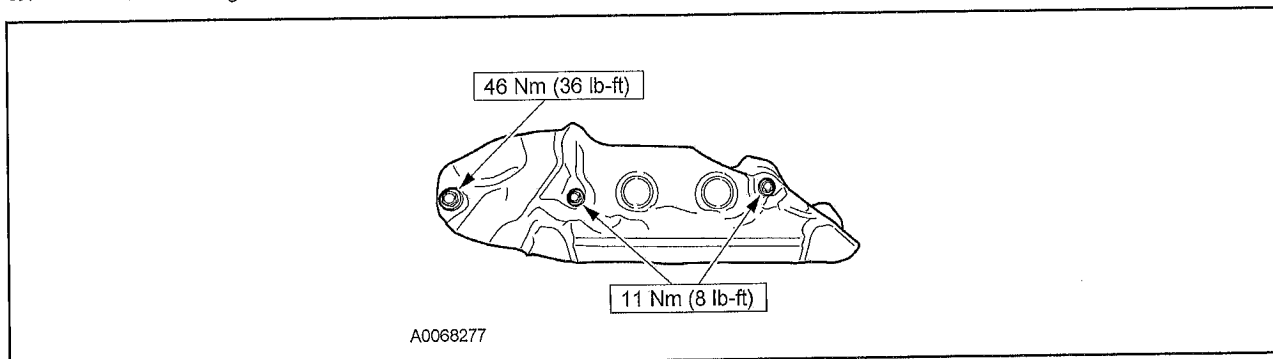


18. **NOTE:**  
Install a new O-ring and apply clean engine oil.

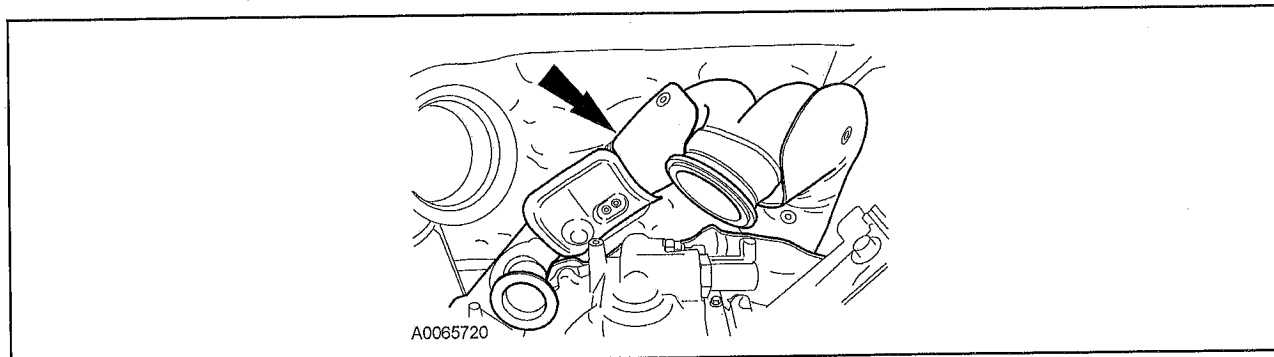
Install the oil level indicator and tube.



19. Install the turbocharger heat shield and bolts.



20. Position the turbocharger adapter pipe.

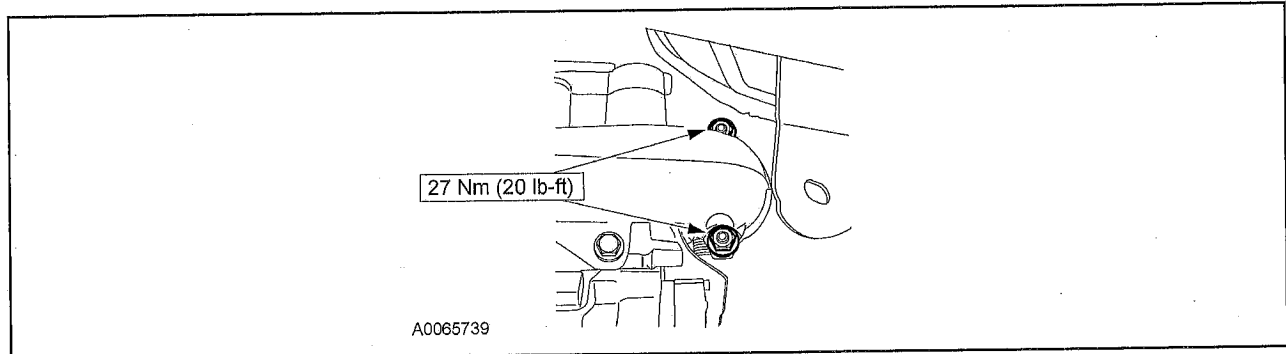


21. **NOTE:**  
Apply anti-seize lubricants to the bolt threads prior to installing the bolts.

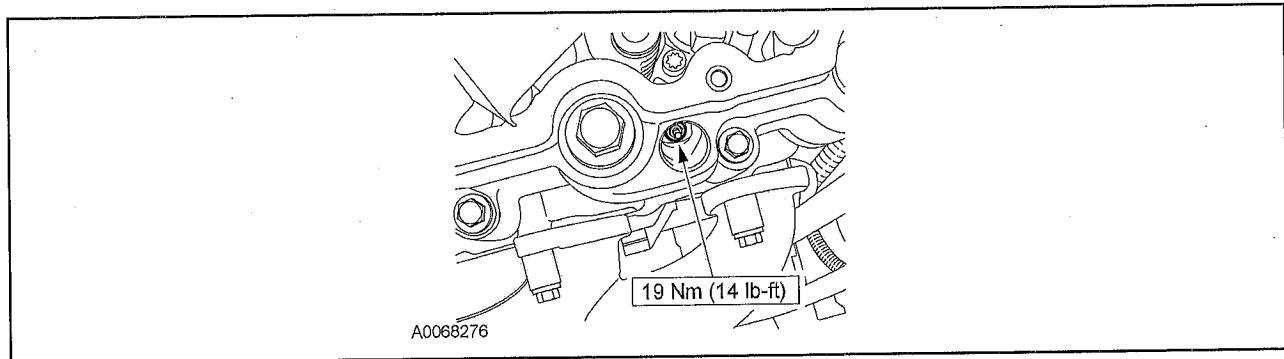
**IN-VEHICLE REPAIR (Continued)****NOTE:**

Do not tighten until after the turbocharger is installed.

Install the nuts and bolts in the adapter pipe.



22. Install the four glow plugs.

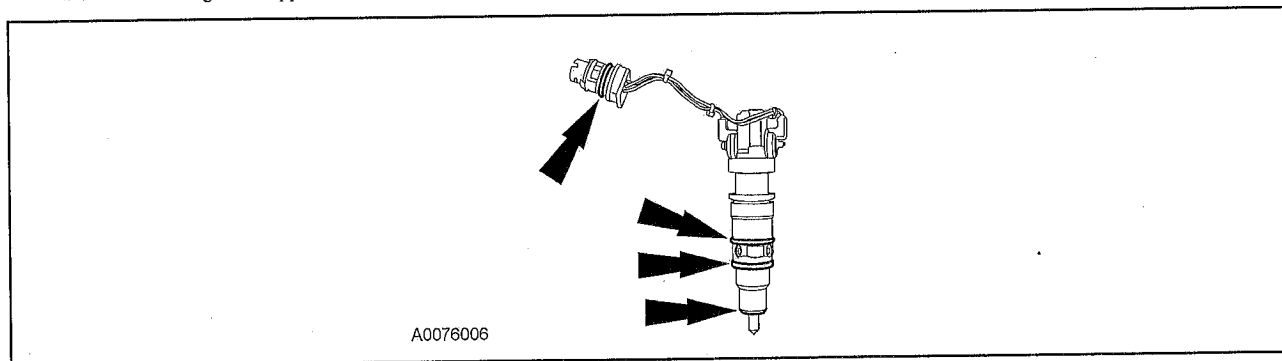


23. **NOTICE:**  
If the fuel injector oil inlet D-ring is damaged, a new fuel injector must be installed.

**NOTE:**

Lubricate the fuel injector and O-rings liberally with clean engine oil.

Install new O-rings and copper washer on the fuel injector.



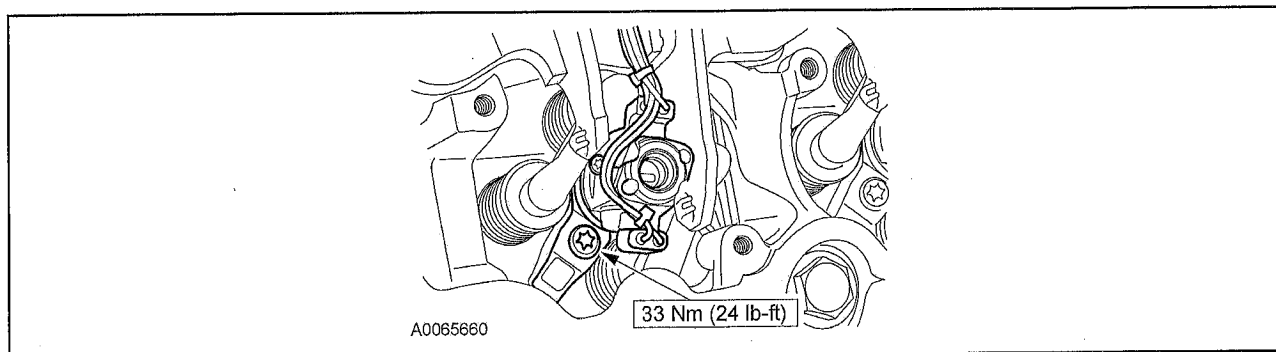
24. **NOTICE:**  
Failure to tighten the injector properly can lead to engine failure.

**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.

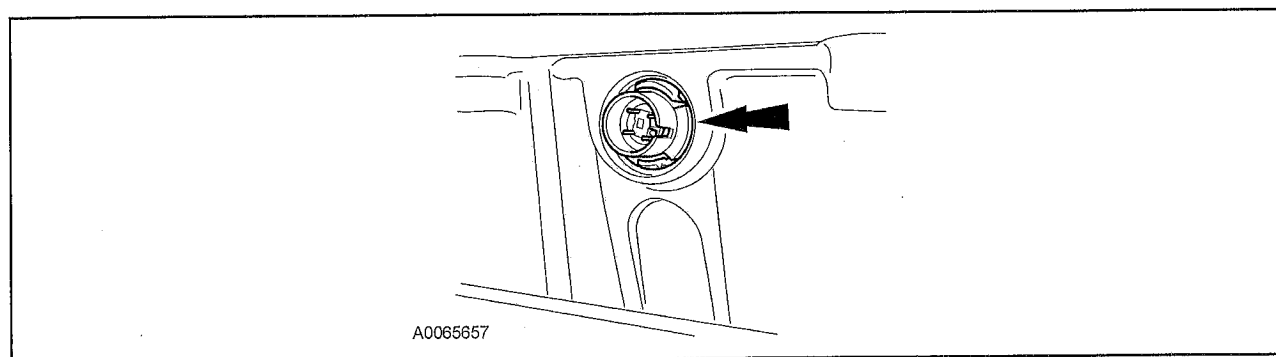
Install the fuel injector, fuel injector hold-down and bolt.

## IN-VEHICLE REPAIR (Continued)

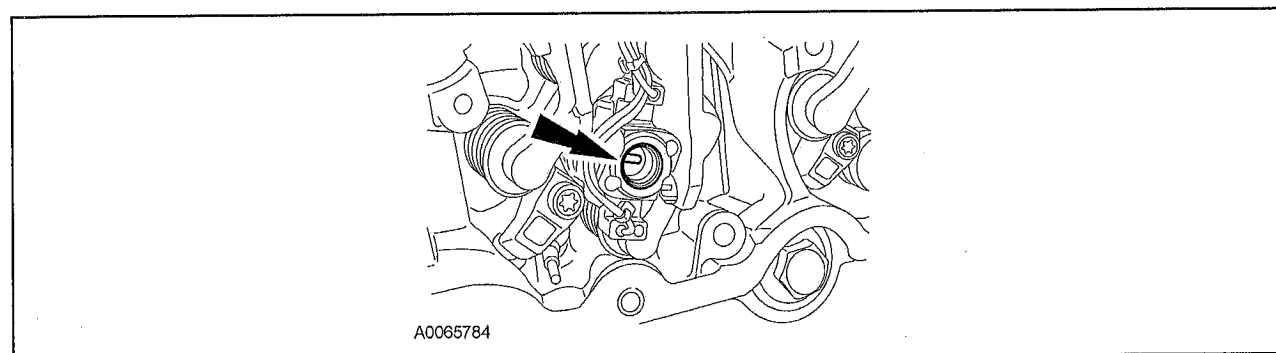


25. **NOTICE:**  
Make sure the injector wiring is clear of all moving parts or engine damage can occur.

Install the fuel injector electrical connector into the rocker carrier.



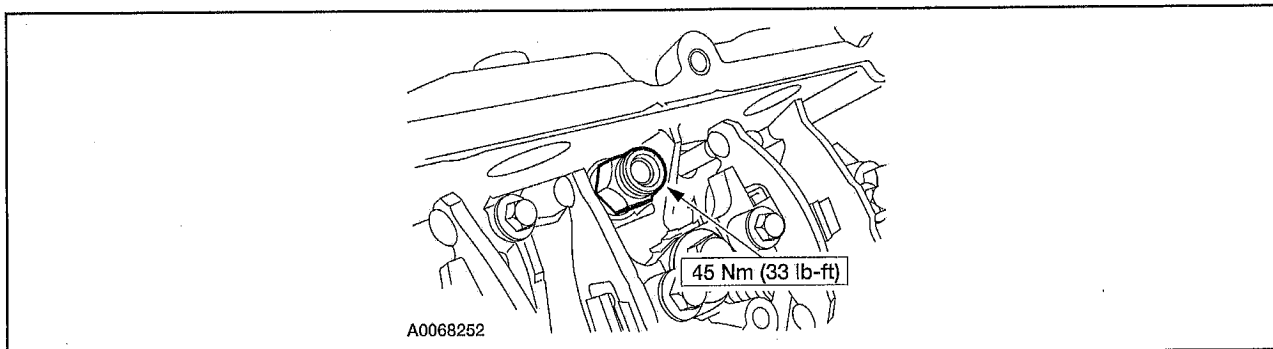
26. Apply engine oil to the top fuel injector O-rings.

**Early build**

27. **NOTE:**  
Install a new lower O-ring.

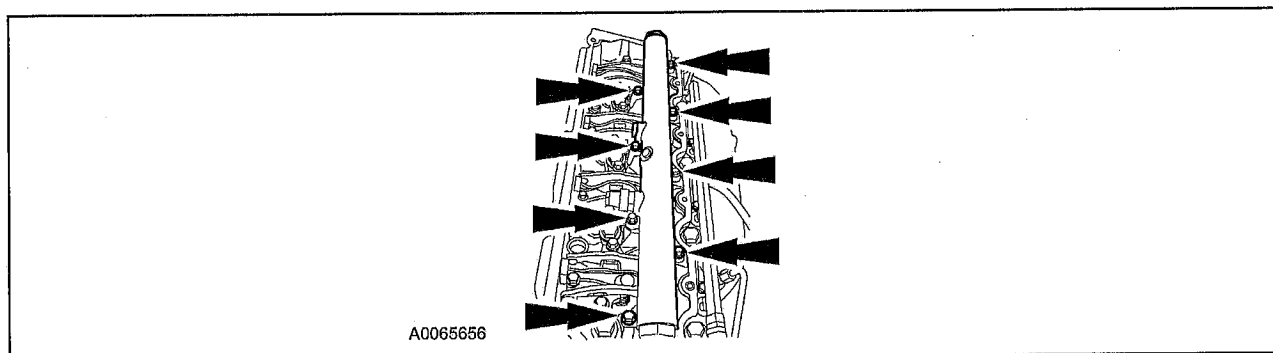
Install a new crankcase to head tube assembly.

IN-VEHICLE REPAIR (Continued)

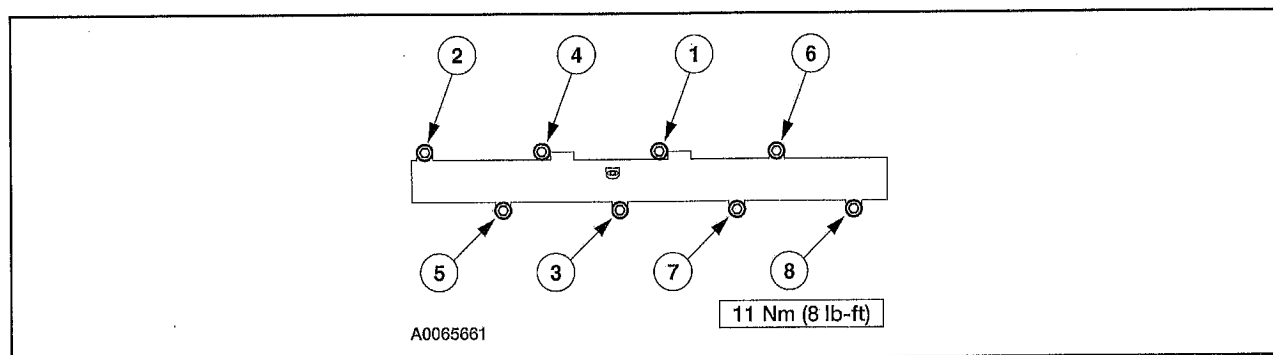


28. Install the high-pressure oil rail and bolts.

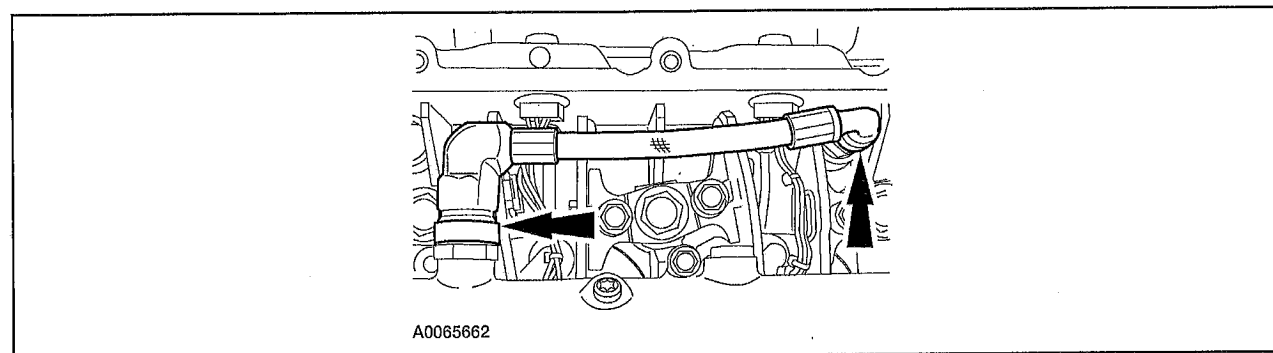
- Install the high-pressure oil rail.
- Install the bolts finger tight.



29. Tighten the bolts in the sequence shown.



30. Install the high-pressure oil line.

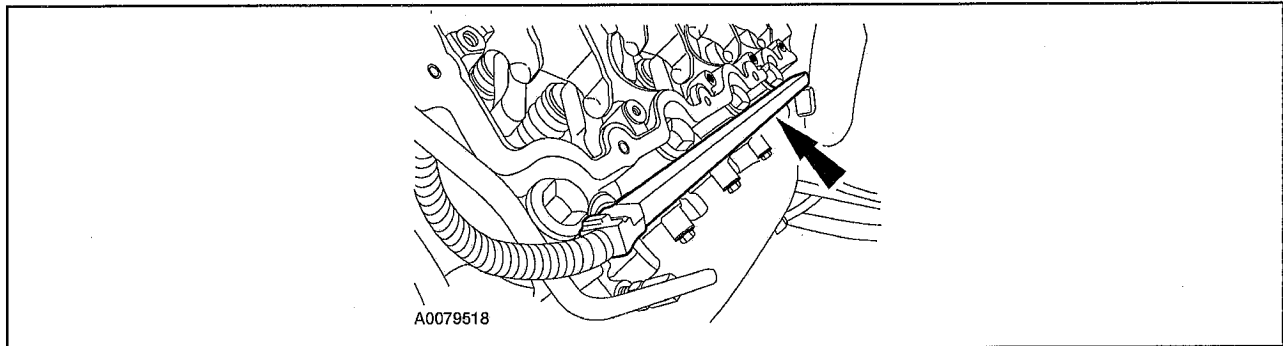


31. **NOTE:**  
Clean and inspect the O-rings and install new as necessary.

**IN-VEHICLE REPAIR (Continued)****NOTE:**

Apply clean engine oil to the O-rings before installing.

Install the glow plug buss bar.

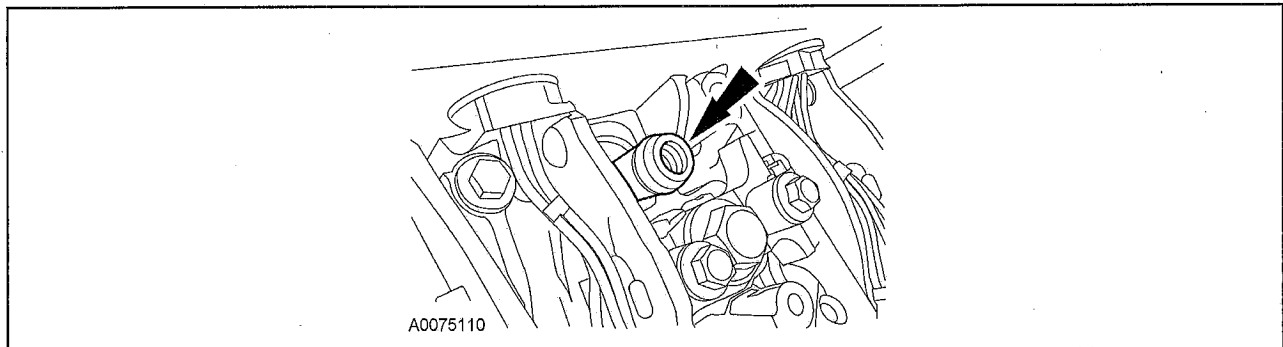
**One-piece head tube**32. **NOTICE:**

To prevent engine damage, check that the crankcase-to-head tube assemblies bottom out in the branch tube assembly. The oil rail, crankcase-to-head tube and the fuel injectors will not function correctly if the tube is not bottomed out.

**NOTE:**

Install new O-rings.

Apply clean engine oil and install the crankcase-to-head tube assembly.

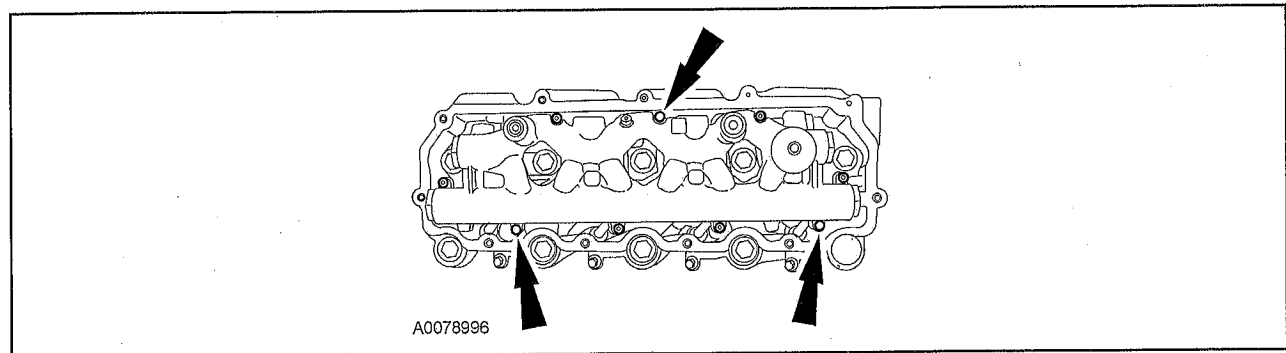
**Late build**33. **NOTE:**

Apply clean engine oil to the top fuel injector D-ring before installing the high pressure oil rail.

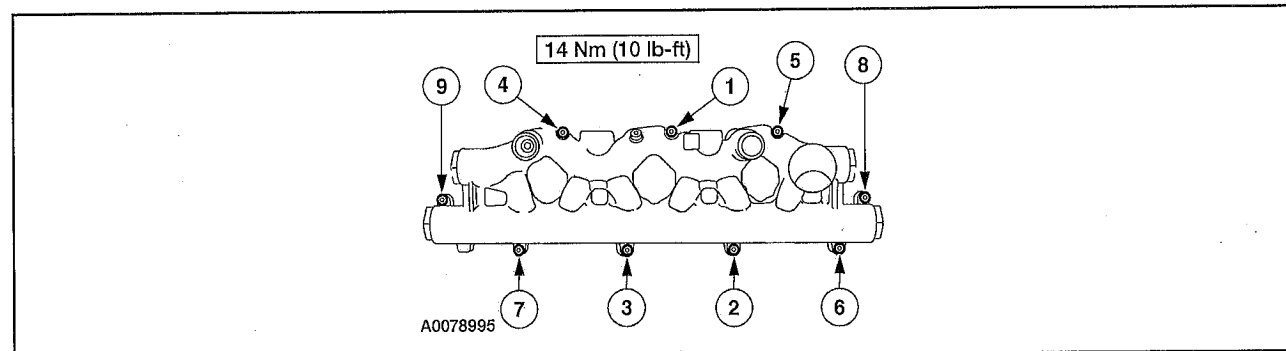
Position the oil rail on the fuel injectors.

- Place the oil rail on top of the carrier so that the four single ball tubes are engaging the injector lead angle.
- Insert three guide bolts, two on the ends of the straight side of the oil rail and one in the middle of the wavy side of the oil rail. Install the guide studs six to seven turns.
- Press the oil rail into the fuel injectors.
- Inspect that the oil rail mounting feet are flat against the mounting surface.
- Loosely install the six bolts.

## IN-VEHICLE REPAIR (Continued)

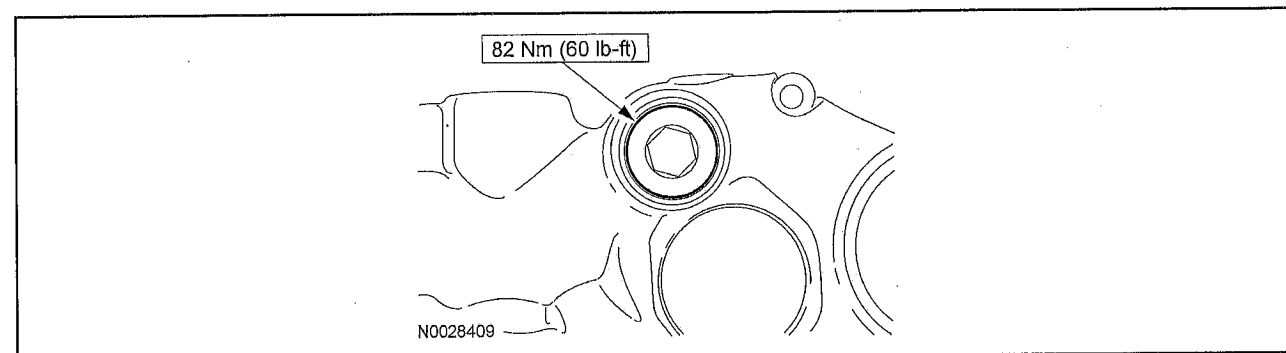


34. Install the oil rail retaining bolts.
- Remove the three guide bolts.
  - Loosely install the three remaining bolts.
  - Tighten the bolts in the sequence shown.

**Two-piece head tube**

35. **NOTE:**  
Apply clean engine oil to the crankcase-to-head tube prior to installation.

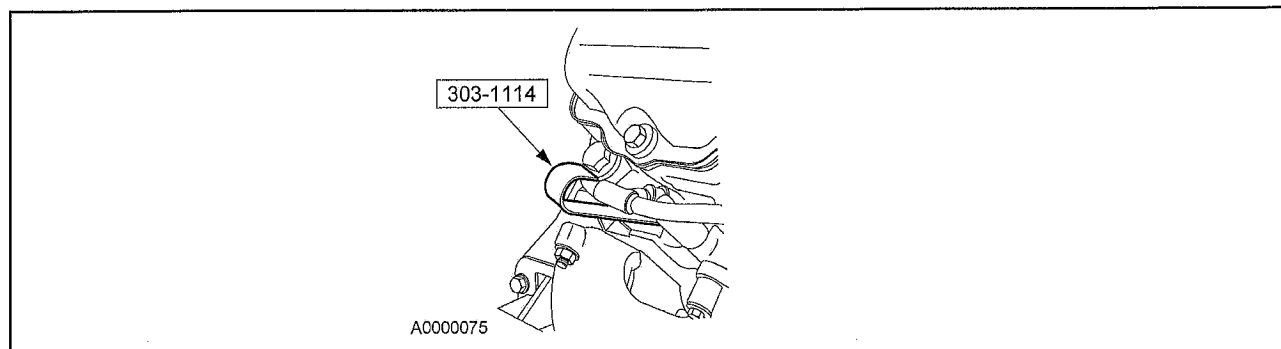
If equipped with an updated crankcase-to-head tube, install the crankcase-to-head tube assembly.

**Late build**

36. **NOTE:**  
Clean and apply clean engine oil to the O-rings prior to installing.
- Using the special tool, install the glow plug harness.



## IN-VEHICLE REPAIR (Continued)

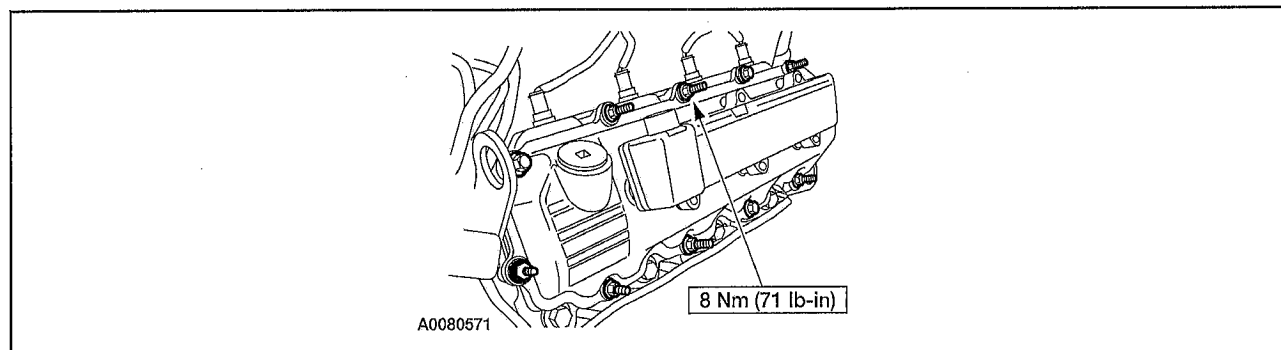
**All vehicles**

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

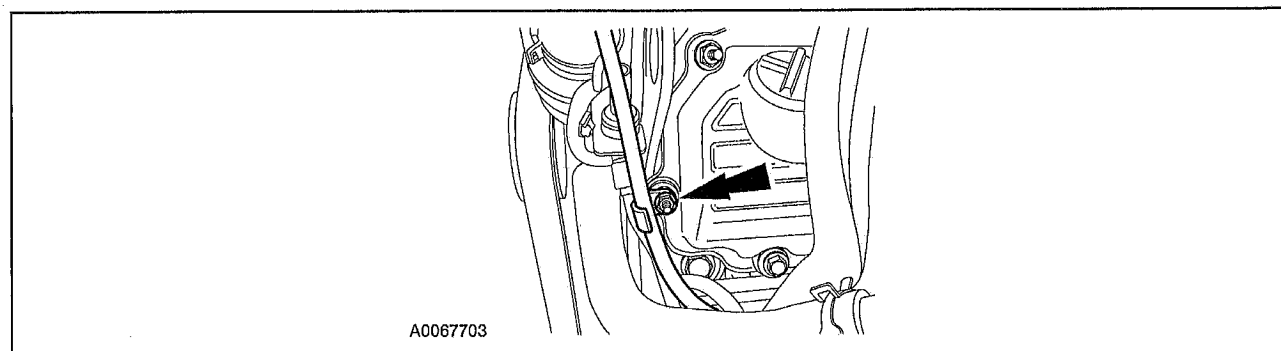
**NOTE:**  
Late build shown, early build similar.

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

Position the valve cover gasket. Install the valve cover and 11 bolts.



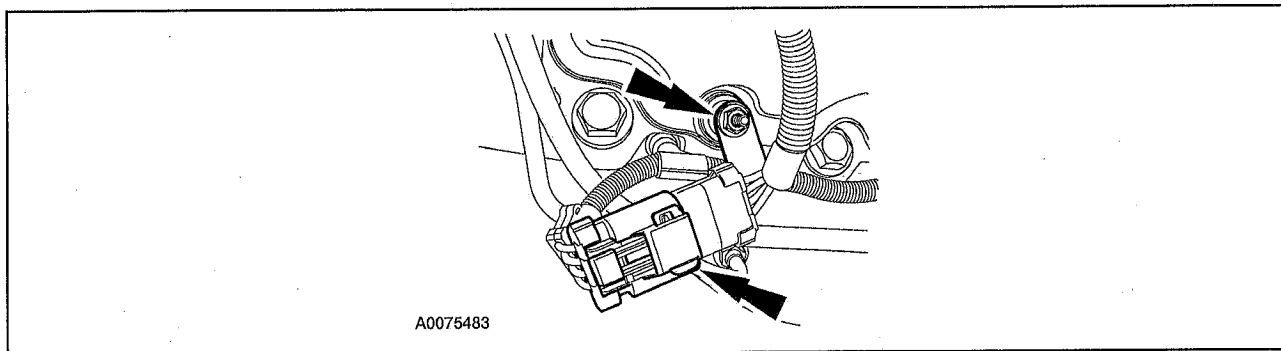
38. Position back the oil level indicator and install the nut.



39. **NOTE:**  
Late build shown, early build similar.

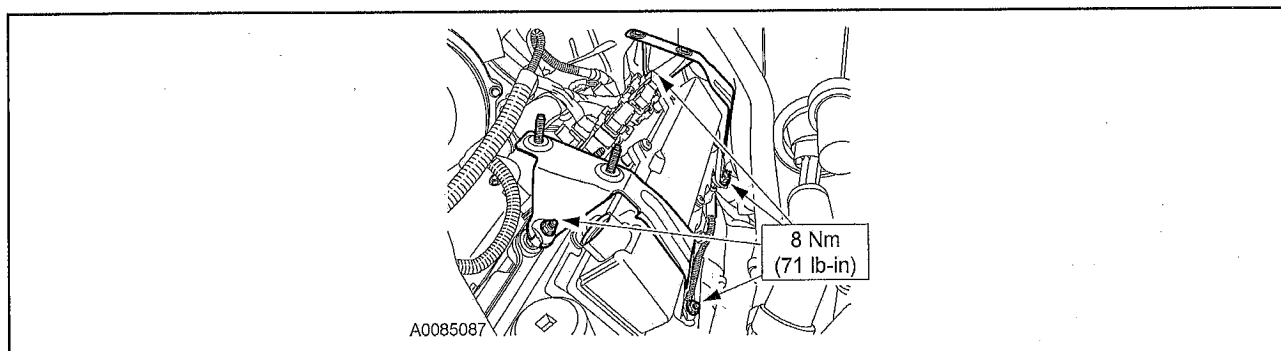
Connect the glow plug connector.

## IN-VEHICLE REPAIR (Continued)



40. **NOTE:**  
Late build shown, early build similar.

Install the fuel injector control module mounting bracket.

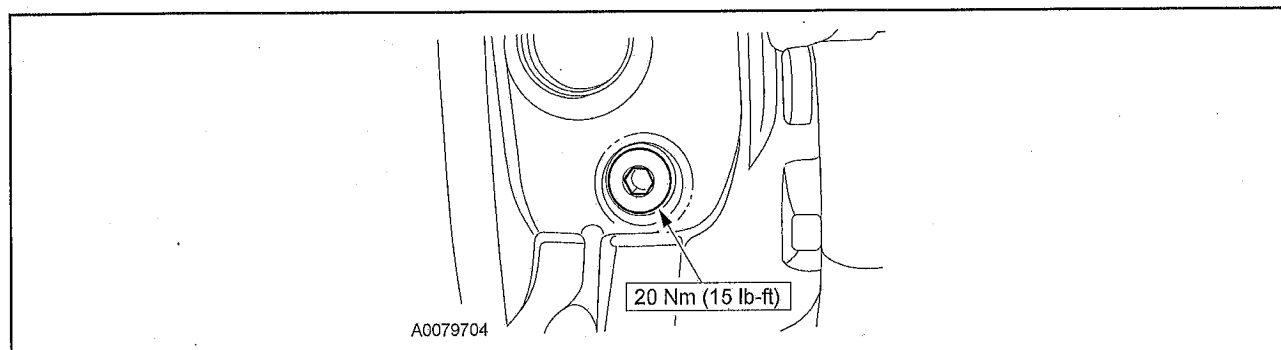


41. **NOTE:**  
Install a new oil filter.

Fill the crankcase with clean engine oil.

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

Install the cylinder block drain plug.



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