IN-VEHICLE REPAIR

Cylinder Head — LH

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.

**Late build vehicles**

5. To remove the exhaust pressure sensor tube assembly, remove the exhaust pressure sensor tube retaining nut and disconnect the exhaust pressure sensor tube fitting at the exhaust manifold.
IN-VEHICLE REPAIR (Continued)

All vehicles

6. Remove the fuel injector control module mounting bracket.

7. Disconnect the wire retainer. 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 11 bolts and the valve cover.
   - Clean and inspect the valve cover gasket. Install a new gasket if necessary.

Late build vehicles

9. Remove the crankcase-to-head tube assembly.
   - Remove and discard the D-ring seals.

All vehicles

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.
IN-VEHICLE REPAIR (Continued)

Early build vehicles

11. **NOTE:** The rings on the crankcase-to-head tube must 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 D-ring seals.

Late build vehicles

12. **WARNING:** 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 brake parts cleaner to remove the oil residue prior to removing.
   
   If the crankcase-to-head tube separated, using a pair of soft-jawed pliers, remove the lower crankcase-to-head tube.
   
   - Remove and discard the D-ring seal.

All vehicles

13. **WARNING:** 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.

14. Prior to removing the injector assembly, insert clean shop towels in the oil drain holes adjacent to each glow plug.
IN-VEHICLE REPAIR (Continued)

15. **CAUTION:** 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.

**CAUTION:** 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.

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

16. **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.

Remove the shop towels.

17. **CAUTION:** 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. Position the wiring harness aside.

18. Remove the four glow plugs.

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

Remove the nuts and bolts from the turbocharger adapter pipe.
IN-VEHICLE REPAIR (Continued)

Early build vehicles

20. Remove the turbocharger adapter pipe.

Late build vehicles

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 two parts of the turbocharger adapter pipe.

All vehicles

22. **NOTE:** Remove and discard the O-ring seal. Remove the oil level indicator and tube.

23. **NOTE:** Late build shown, early build similar. Remove the bolts and turbocharger heat shield.

Early build vehicles

24. Disconnect the exhaust pressure tube at the exhaust manifold.
25. Remove the retaining nuts. Remove the exhaust pressure bracket assembly.

All vehicles

26. Remove the retaining bolt from the fuel line bracket and position the fuel lines aside.

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

28. **NOTE:** Remove and discard the sealing washers. Remove the banjo fitting and the fuel line.

29. **CAUTION:** 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 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.
IN-VEHICLE REPAIR (Continued)

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

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

32. **CAUTION:** 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.

33. Remove the outer cylinder head bolts.

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

35. Remove and discard the cylinder head gasket and dowels.
   - Clean and inspect the gasket sealing surfaces.
IN-VEHICLE REPAIR (Continued)

Installation

All vehicles

1. **CAUTION:** 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.

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

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

2. **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.

3. **NOTE:** The back two 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 lines 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.

4. Install the outer cylinder head bolts finger-tight.
IN-VEHICLE REPAIR (Continued)

5. **CAUTION:** 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.

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

Install the eight valve bridges.

7. **CAUTION:** 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 eight bolts.
IN-VEHICLE REPAIR (Continued)

8. **CAUTION:** 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.

**CAUTION:** 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)

9. Tighten the head bolts in the following sequence.

1. Tighten bolts 1 through 10 to 88 Nm (65 lb-ft).
2. Tighten bolts 1, 3, 5, 7 and 9 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).

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

   Install the fuel line and the banjo fitting.
IN-VEHICLE REPAIR (Continued)

11. Position back and connect the heater hose.

![Diagram](image1)

12. Position the exhaust pressure bracket assembly and install the retaining nuts.

![Diagram](image2)

13. Tighten the exhaust pressure tube fitting at the exhaust manifold.

![Diagram](image3)

All vehicles

14. Position the fuel lines and install the fuel line bracket retaining bolt.

![Diagram](image4)

15. **NOTE:** Install a new O-ring seal and apply clean engine oil. Install the oil level indicator and tube.

![Diagram](image5)

16. **NOTE:** Late build shown, early build similar. Install the turbocharger heat shield and bolts.

![Diagram](image6)
17. Position the turbocharger adapter pipe.

20. Install the four glow plugs.

18. Position the two 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.

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

19. **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.
22. **CAUTION:** 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.

23. **CAUTION:** Failure to tighten the injector properly can lead to engine failure.

**CAUTION:** 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.

24. **CAUTION:** 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.

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

Early build vehicles

26. **CAUTION:** 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.

Apply clean engine oil and install the crankcase-to-head tube assembly.
IN-VEHICLE REPAIR (Continued)

All vehicles

27. **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 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.

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

Late build vehicles

29. **NOTE:** Apply clean engine oil to the crankcase-to-head tube prior to installing.

   Install the crankcase-to-head tube assembly.

All vehicles

30. **CAUTION:** 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. Install the valve cover and 11 bolts.
IN-VEHICLE REPAIR (Continued)

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

32. Install the fuel injector control module mounting bracket.

Late build vehicles

33. Connect the exhaust pressure sensor tube fitting to the exhaust manifold and install the exhaust pressure sensor retaining nut.

34. **NOTE:** Install a new oil filter.
   Fill the crankcase with clean engine oil.

35. **NOTE:** Lightly lubricate the O-ring seal with clean engine oil before installing. Install the cylinder block drain plug.

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