

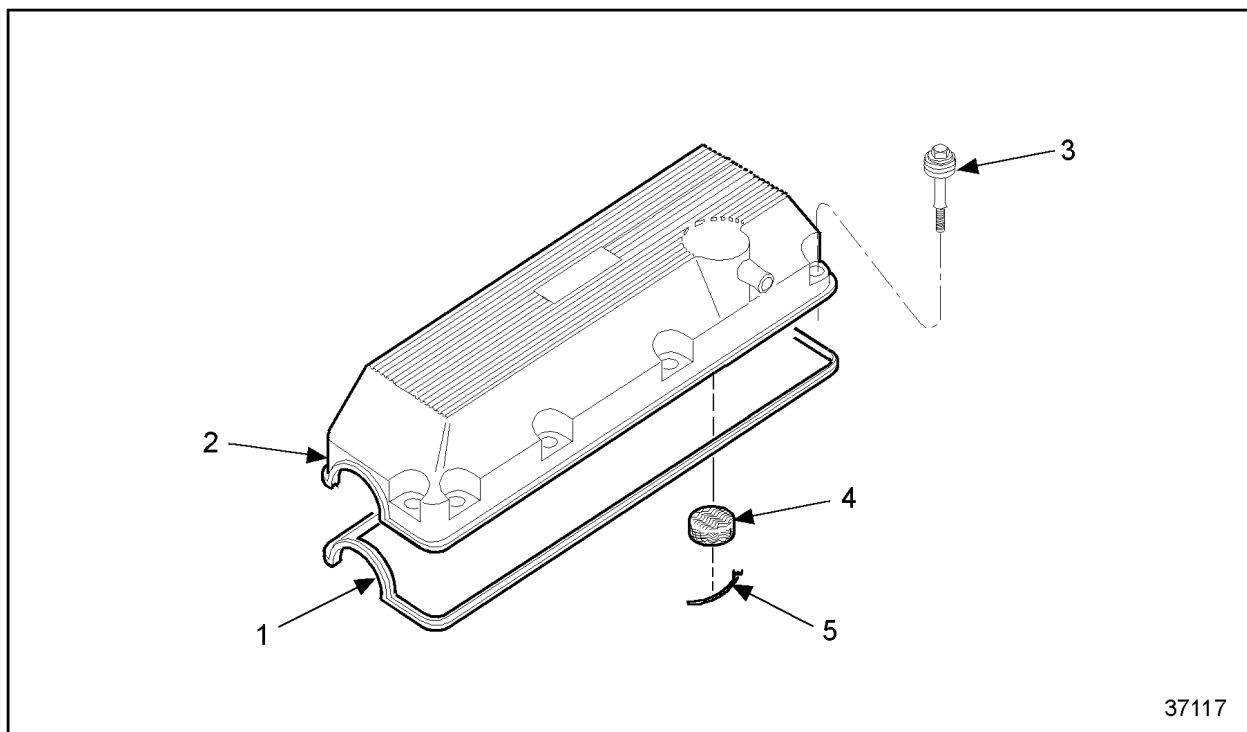
1.6 ROCKER COVER

The rocker cover completely encloses the valve and injector operating mechanism on top of the cylinder head (and in some cases an engine brake), including the overhead camshaft.

Depending on the installation, the rocker cover may be a one-piece, two-piece or three-piece design. See Figure 1-96, see Figure 1-97, see Figure 1-98, see Figure 1-99, see Figure 1-100 and see Figure 1-101.

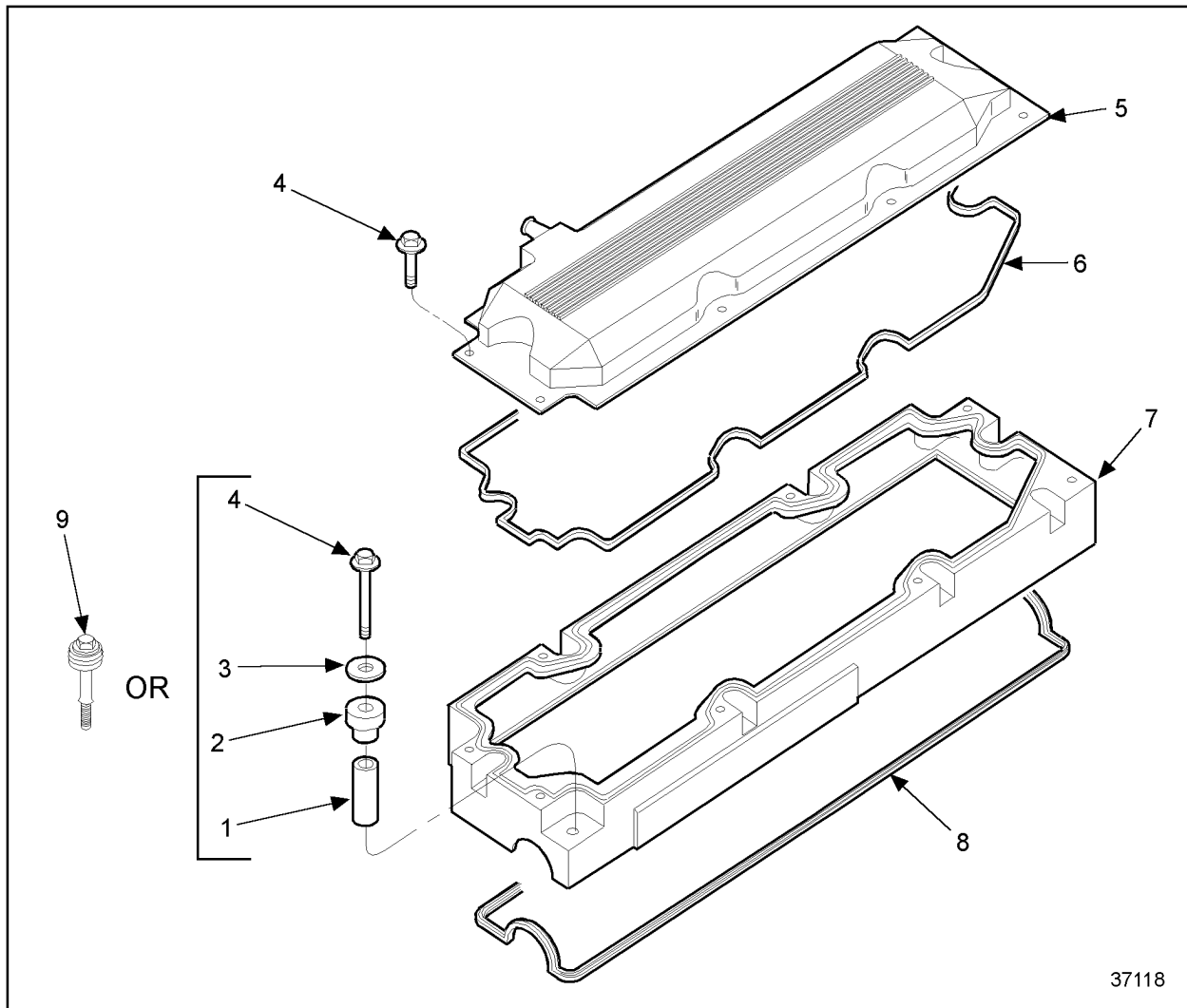
The one-piece rocker cover is molded of a sound-dampening, fiberglass-reinforced, synthetic material. It is internally ribbed to distribute the hold-down bolt clamp load for effective, full perimeter sealing. See Figure 1-96.

Effective July 1993, a breather baffle is installed on the low-profile aluminum rocker cover.



- | | |
|-----------------------|------------|
| 1. Gasket | 4. Element |
| 2. Rocker Cover | 5. Clip |
| 3. Bolt Assembly (10) | |

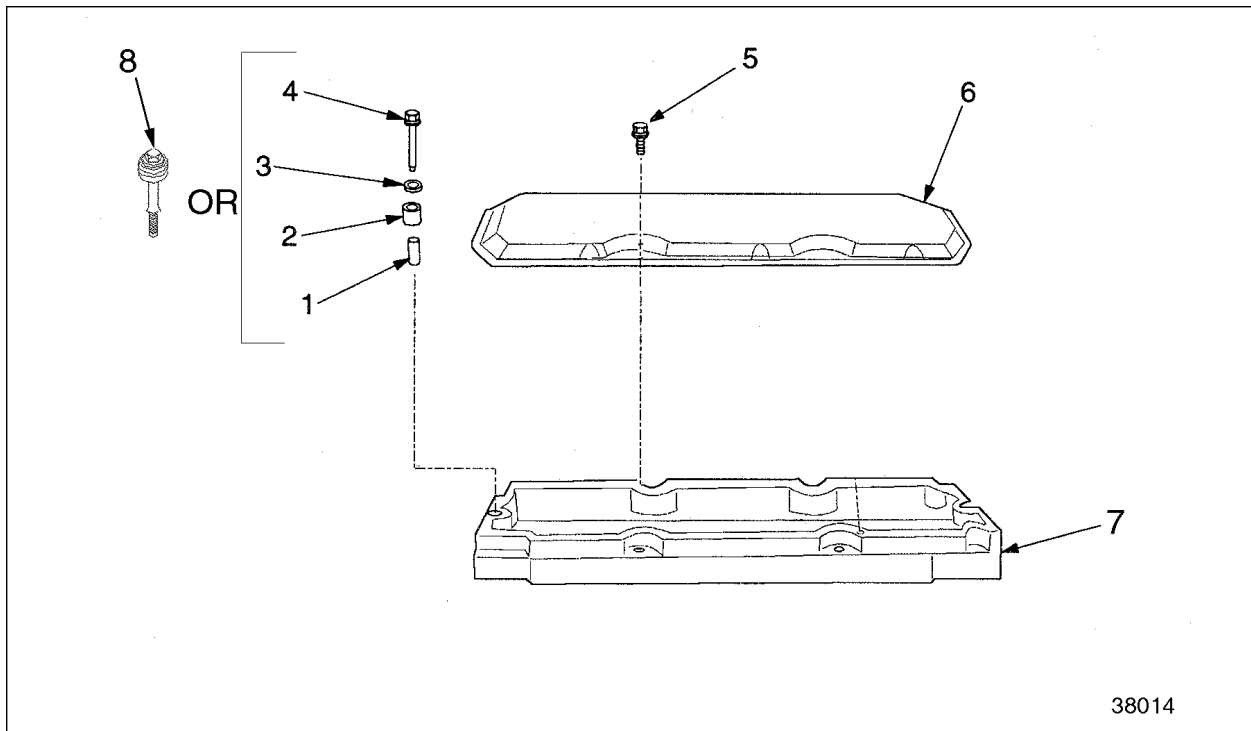
Figure 1-96 One-Piece Rocker Cover - Series 60 Diesel Engine



- 1. Limiting Sleeve
- 2. Isolator
- 3. Washer
- 4. Bolt
- 5. Rocker Cover Cap

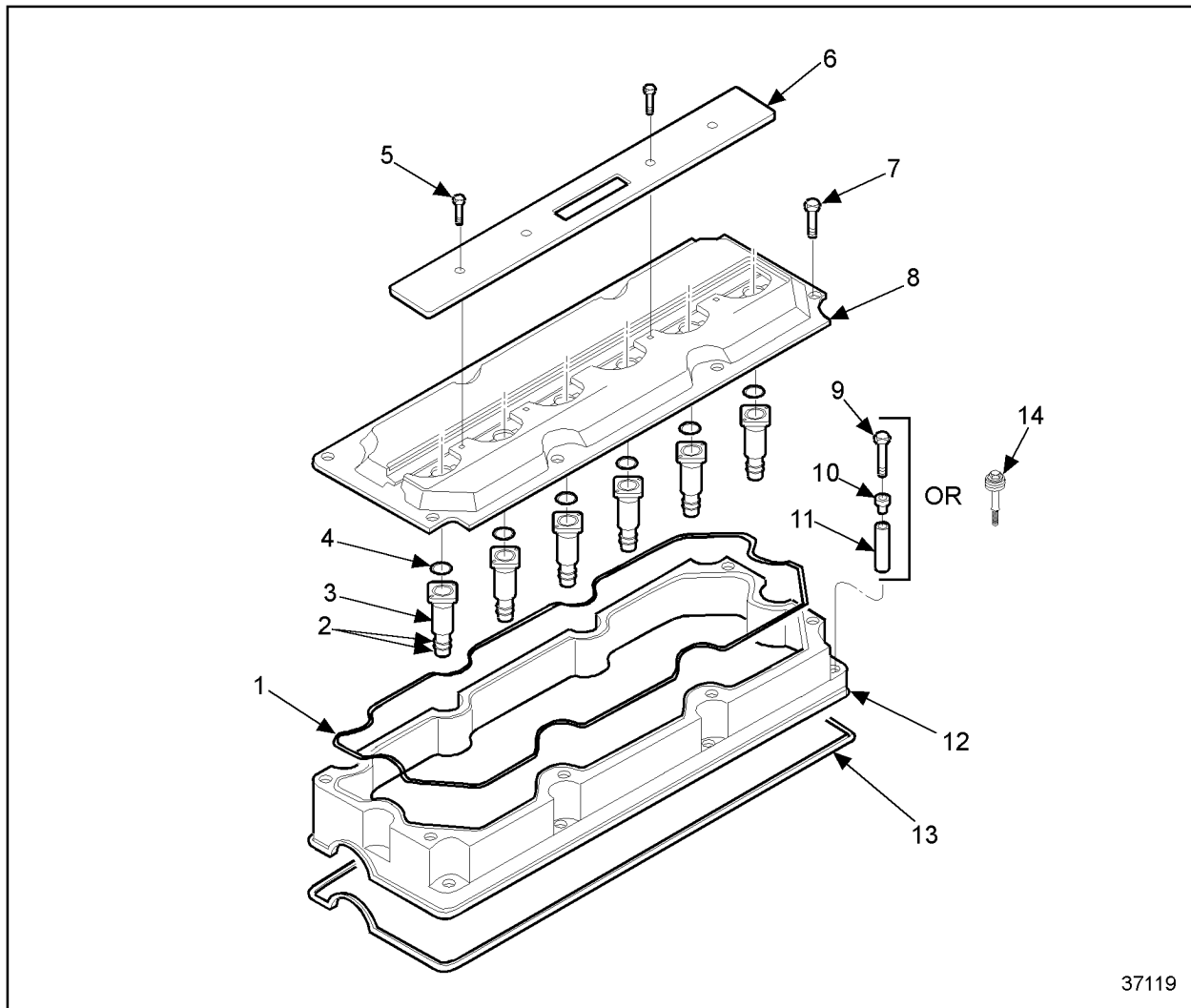
- 6. Diamond-Shaped Seal
- 7. Rocker Cover Base
- 8. Isolator Rim Seal
- 9. Bolt Assembly (10)

Figure 1-97 Two-Piece Rocker Cover - Series 60 Diesel Engine



- | | |
|--------------------|----------------------|
| 1. Limiting Sleeve | 5. Bolt |
| 2. Isolator | 6. Rocker Cover Cap |
| 3. Washer | 7. Rocker Cover Base |
| 4. Bolt | 8. Bolt Assembly |

Figure 1-98 Two-Piece Aluminum Rocker Cover - Pleasure Craft Marine Engine

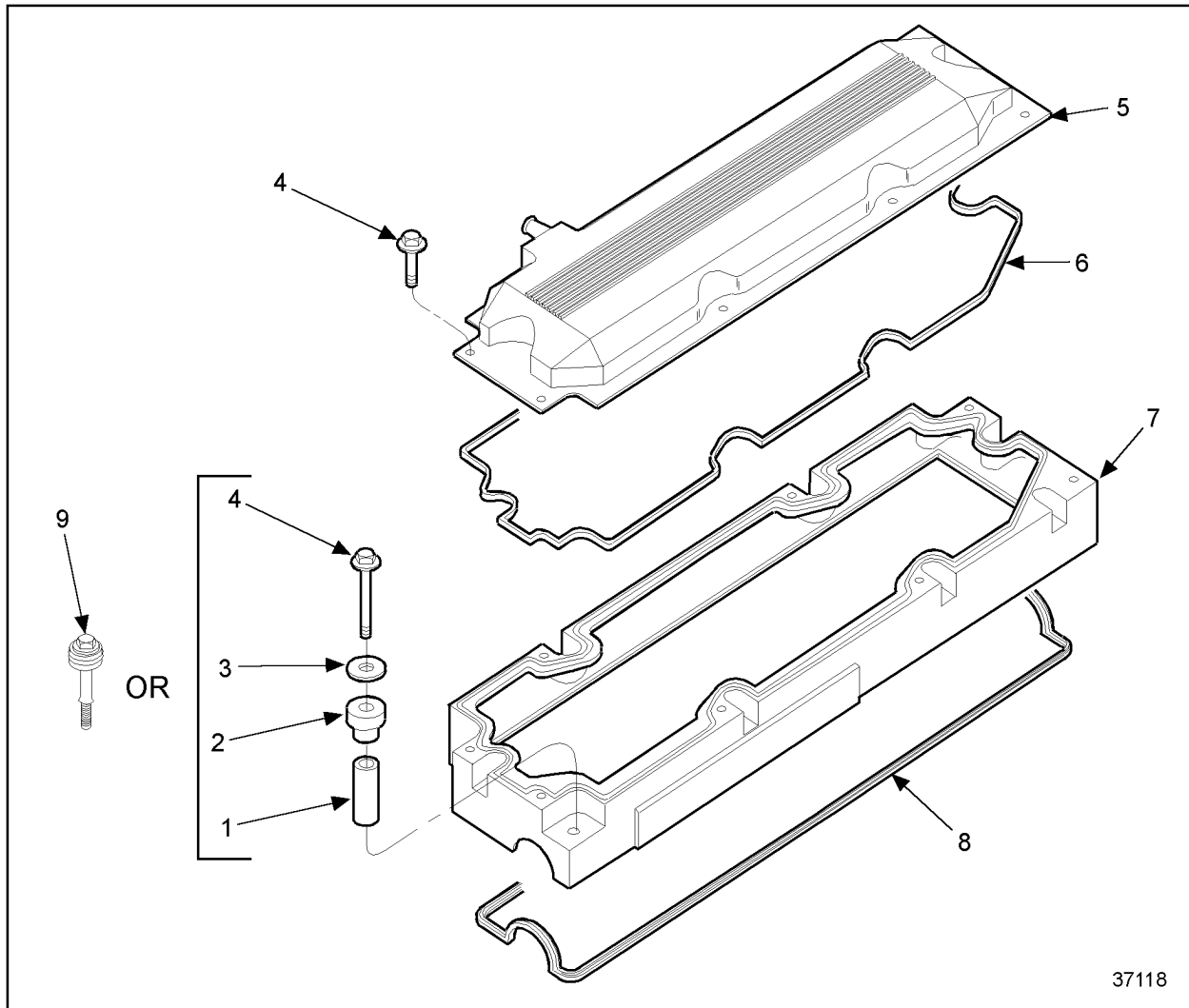


37119

- | | |
|--------------|--|
| 1. Gasket | 8. Cover |
| 2. Seal Ring | 9. Bolt |
| 3. Tube | 10. Isolator |
| 4. Seal Ring | 11. Spacer |
| 5. Screw | 12. Rocker Cover Base |
| 6. Cover | 13. Gasket |
| 7. Bolt | 14. Bolt Assembly (replaces 9, 10, 11) |

Figure 1-99 Two-Piece Rocker Cover - Series 60G Engine with Coil Over Plug Ignition

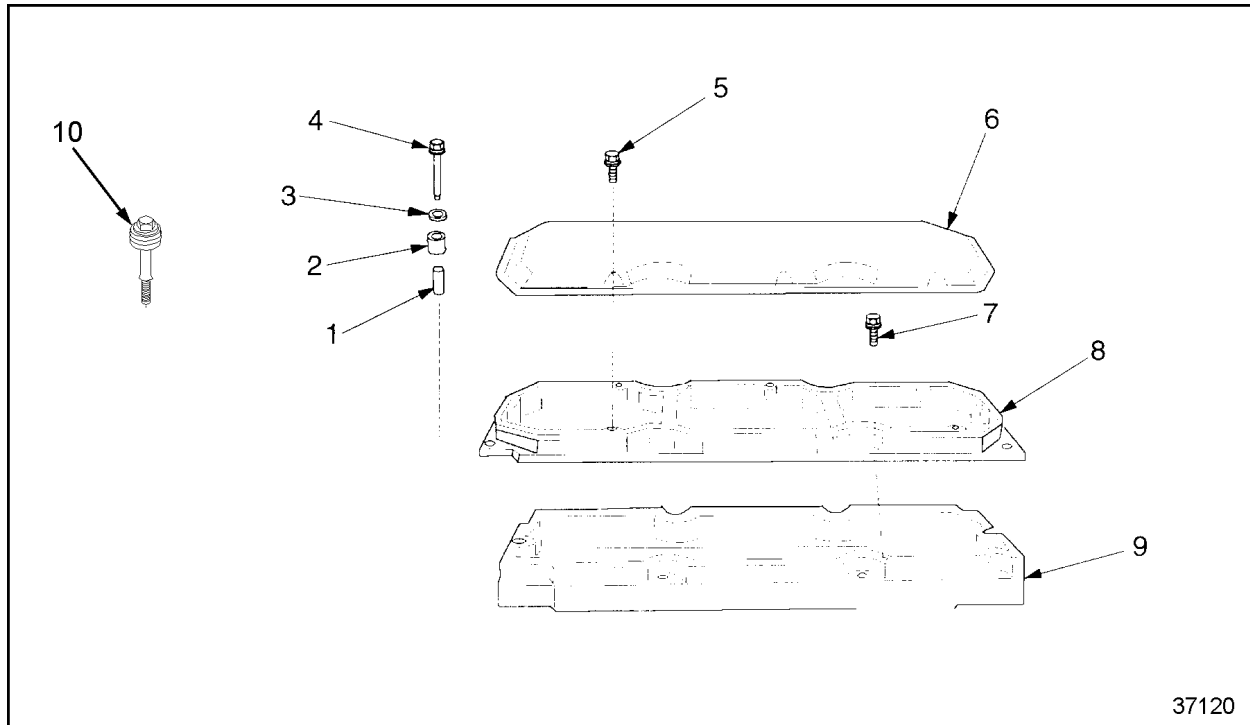
The two-piece rocker cover is constructed of cast aluminum. The top piece or cap is held in place by eight bolts and is removable for access to the valve, engine brake and fuel injector adjusting mechanisms. A one-piece diamond shaped perimeter seal is located in a groove in the rocker cover base and seals the cap to the base. See Figure 1-100.



- | | |
|---------------------|------------------------|
| 1. Limiting Sleeve | 6. Diamond-Shaped Seal |
| 2. Isolator | 7. Rocker Cover Base |
| 3. Washer | 8. Isolator Rim Seal |
| 4. Bolt | 9. Bolt Assembly (10) |
| 5. Rocker Cover Cap | |

Figure 1-100 Two-Piece Rocker Cover

The three-piece rocker cover is similar to the two-piece cover but with an additional intermediate cover and diamond seal and new cover cap. See Figure 1-101.



- 1. Limiting Sleeve
- 2. Isolator
- 3. Washer
- 4. Bolt
- 5. Bolt

- 6. Rocker Cover Cap
- 7. Bolt
- 8. Intermediate Cover
- 9. Rocker Cover Base
- 10. Bolt Assembly (10)

Figure 1-101 Three-Piece Alumium Rocker Cover

Two caps are available with the Series 60 diesel engines. One is for use with a Jake Brake, and one without a Jake Brake.

Only one cap is available with the Series 60G engines.

The rocker cover base is attached to the cylinder head using ten bolt/spacer/isolator assemblies. All rocker covers use a polyacrylic rim seal seated in a groove around the bottom edge of the rocker cover base to provide an effective oil seal. The one-piece and two-piece design rocker covers incorporate a crankcase ventilation breather outlet. The three-piece design and the Series 60G cap incorporate a combination filler/breather at the camshaft cover (gear case cover) position.

1.6.1 Repair or Replacement of Rocker Cover

To determine if repair is possible or replacement is necessary, perform the following procedure. See Figure 1-102.

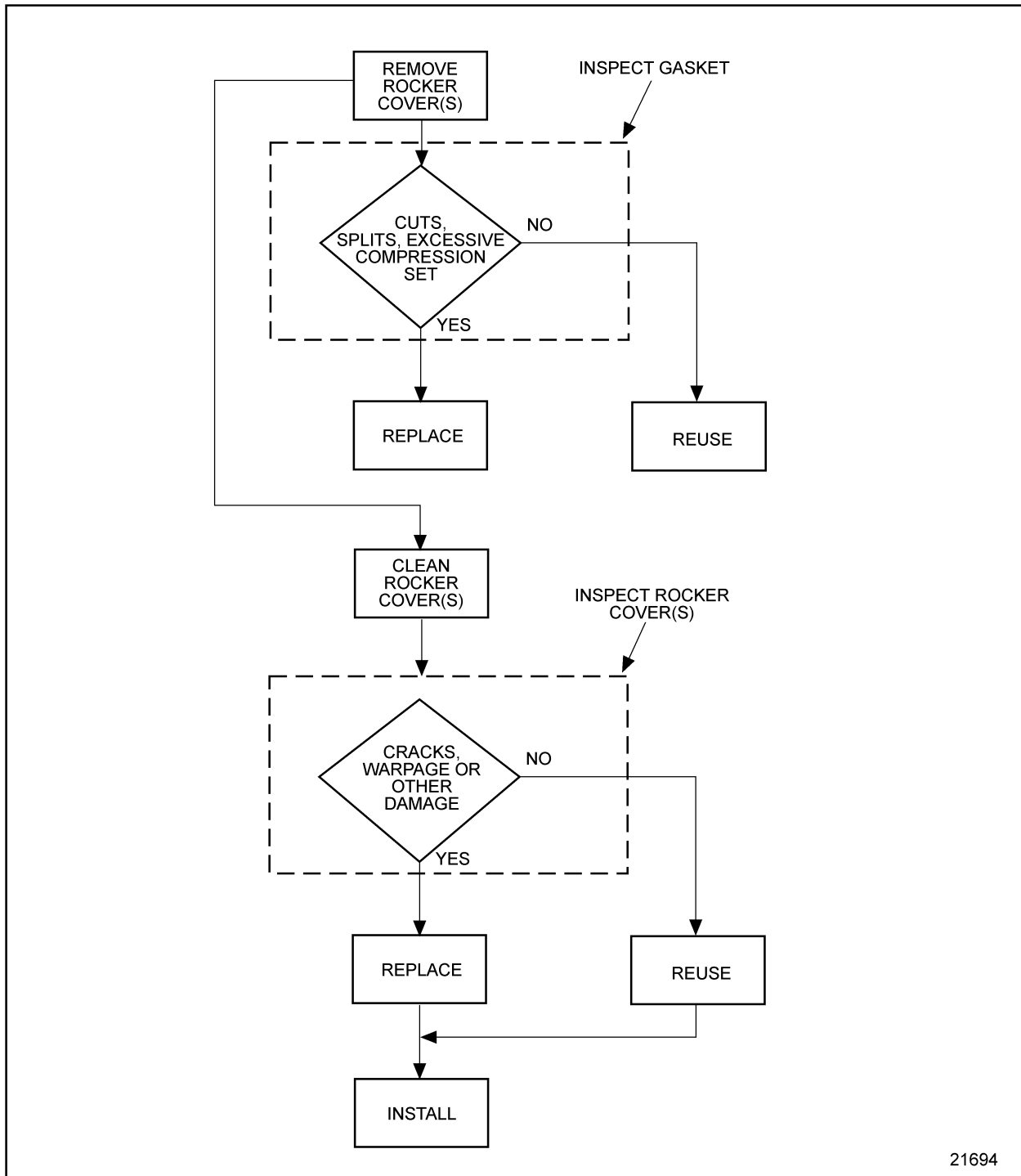


Figure 1-102 Flowchart for Repair or Replacement of Rocker Cover

1.6.2 Removal and Cleaning of One-Piece Rocker Cover For Diesel Engines Only

Preclean the rocker cover, especially around its seat on the head, and in the attaching bolt recesses, to keep dirt and debris out of the valve gear chamber.

Perform the following steps to remove the one-piece rocker cover:

1. Loosen the hold-down bolts until isolators can be pulled straight up from the cover.

NOTE:

It is not necessary to remove the bolt assemblies from the rocker cover.

NOTE:

Engines built after May 1999 use a one-piece bolt assembly. The rocker cover requires ten bolt assemblies to be used.

2. Lift the rocker cover straight up off the engine.

1.6.2.1 Cleaning and Inspection of the One-Piece Rocker Cover For Diesel Engines Only

Inspect the rocker cover as follows:

1. Remove the breather element and retainer clip.

NOTICE:
To avoid damaging the silicone isolators, do not clean them with mineral spirits, fuel oil or any petroleum based solvents.

2. Remove bolt assemblies and isolators and clean in detergent and water solution.
3. Remove gasket from rocker cover and clean the gasket and rocker cover. Remove old RTV sealant from the corners of the gasket and clean the gasket and rocker cover components in part cleaning solvent.

NOTE:

Pay special attention to the breather element. Clean thoroughly or replace as required.

**CAUTION**

To avoid personal injury when blow drying, wear adequate eye protection (safety glasses or face plate) and do not exceed 276 kPa (40 lb/in.²) air pressure.

4. Blow dry with compressed air.
5. Clean the breather recess in the rocker cover.
6. Check for damage. Replace as necessary.
7. Reinstall the breather element and retainer clip.

1.6.3 Removal and Cleaning of Two-Piece Rocker Cover For Diesel Engines Only

Preclean the two-piece rocker cover, especially around its seat on the head, and in the attaching bolt recesses, to keep dirt and debris out of the valve gear chamber.

Perform the following steps to remove the two-piece rocker cover:

1. Remove the eight screws that attach the rocker cover cap to the base.
2. Lift the cap off the base.
3. Loosen and remove the ten bolt and isolator assemblies that attach the base to the cylinder head.

NOTE:

Engines built after May 28, 1999 use a one-piece bolt assembly. The base requires ten bolt assemblies to be used.

4. Lift the base straight up off the cylinder head.

1.6.3.1 Inspection of Two-Piece Rocker Cover

Perform the following steps to inspect the two-piece valve rocker cover which has a removable breather housing:

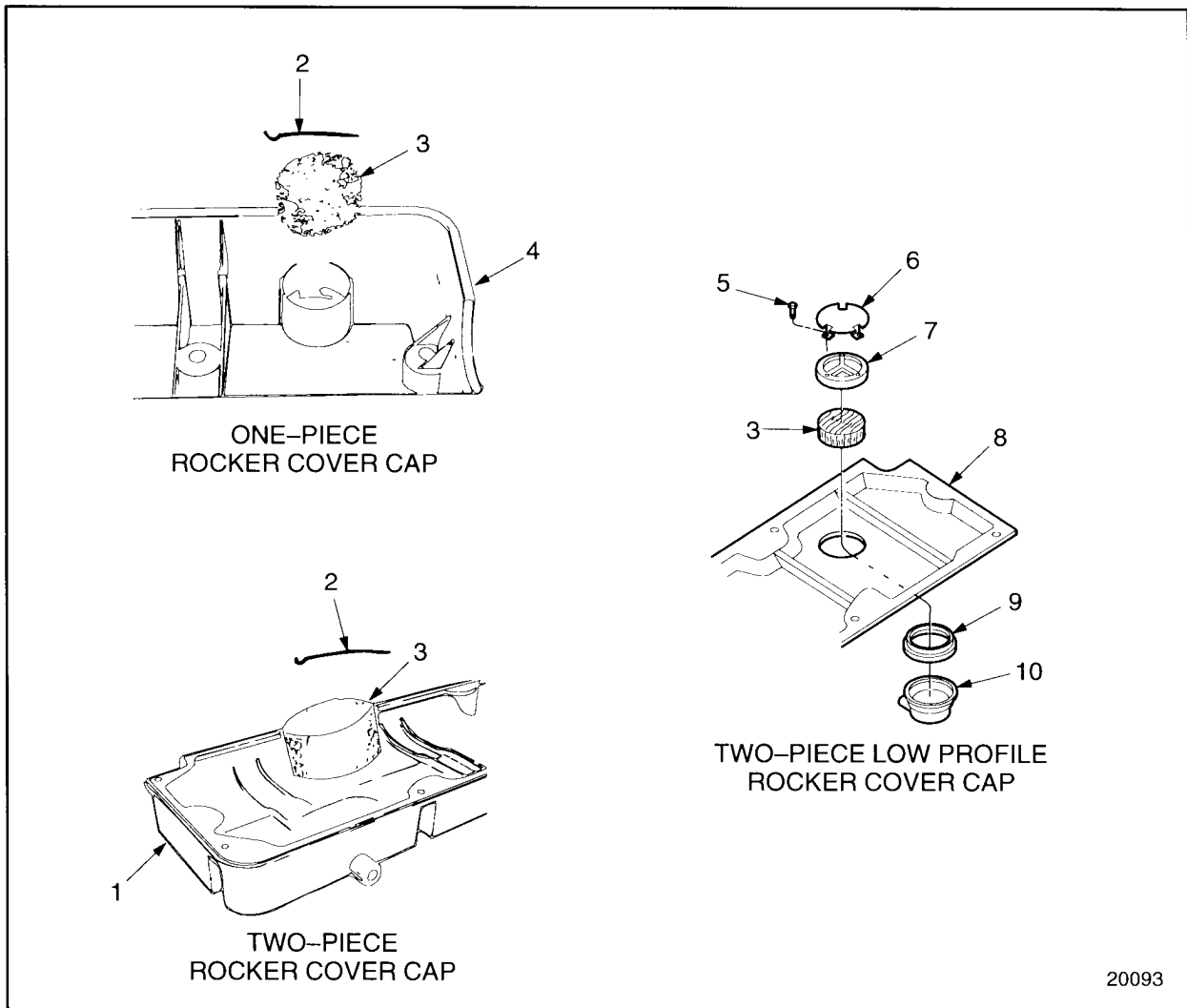
1. Remove the three screws and retainer that retains the breather housing.
2. Remove the breather housing, seal, and wire mesh element.
3. Wash the components in clean fuel oil.



CAUTION

To avoid personal injury when blow drying, wear adequate eye protection (safety glasses or face plate) and do not exceed 276 kPa (40 lb/in.²) air pressure.

4. Blow dry with compressed air.
5. Reassemble breather housing to valve cover cap. See Figure 1-103. Tighten the screws to 2.5 N·m (22 lb·in.) torque.



20093

- | | |
|---------------------------|---|
| 1. Two-Piece Rocker Cover | 6. Retainer Cover |
| 2. Retainer Clip | 7. Retainer |
| 3. Wire Mesh Element | 8. Two-Piece Low Profile Rocker Cover Cap |
| 4. One-Piece Rocker Cover | 9. Seal |
| 5. Screw | 10. Breather Housing |

Figure 1-103 Two-Piece Rocker Cover Assembly

1.6.4 Removal and Precleaning of Two-Piece Rocker Cover-Gas Engines with Coil Over Plug Ignition System Only

Preclean the rocker cover, especially around its base on the cylinder head and in the attaching bolt recesses to keep dirt and debris out of the valve gear chamber.

To remove the two-piece rocker cover:

1. Remove the ignition boots from the spark plug wells. Refer to section 15.3.1.
2. Lift the cap off the base leaving the six extension tubes in the cylinder head.
3. Blow any excess oil from the outside of the extension tube so that the oil will not enter the spark plug well when the extension tubes are removed.
4. Pull the six extension tubes from the cylinder head.
5. Loosen and remove the ten bolt/isolator assemblies that attach the base to the cylinder head.

NOTE:

Engines built after May 28, 1999 use a one-piece bolt assembly. The base requires ten bolt assemblies to be used.

6. Lift the base straight up off the cylinder head.

1.6.5 Removal and Cleaning of Three-Piece Rocker Cover

Preclean the three-piece rocker cover, especially around its seat on the head, and in the attaching bolt recesses, to keep dirt and debris out of the valve gear chamber.

Perform the following steps to remove the three-piece rocker cover:

1. Remove the eight screws that attach the rocker cover cap to the intermediate cover. See Figure 1-101.
2. Lift the cap off the intermediate cover.
3. Loosen and remove the eight bolts that attach the intermediate rail to the base.
4. Lift intermediate off the base.
5. Loosen and remove the ten bolt/isolator assemblies that attach the base to the cylinder head.

NOTE:

Engines built after May 28, 1999 use a one-piece bolt assembly.

6. Lift the base straight up off the cylinder head.

Before inspecting the rocker cover, clean the isolators as follows:

NOTICE:

To avoid damaging isolators, do not use solvents of any kind, or any petroleum distillates to clean them. The isolators can be cleaned with mild soap and water if necessary. Install new seals and isolators clean and dry.

1. Wash isolators with mild soap and water.

**CAUTION**

To avoid personal injury when blow drying, wear adequate eye protection (safety glasses or face plate) and do not exceed 276 kPa (40 lb/in.²) air pressure.

2. Be sure to completely dry seal grooves in the rocker cover with compressed air.
3. Use new seals (do not reuse old seals).


NOTE:

Exception — Inspect the lower rocker cover base-to-cylinder head gasket for damage and replace only if necessary.

1.6.5.1 Inspection of Three-Piece Rocker Cover

Inspect the three-piece valve cover as follows:

1. Wash the components in clean fuel oil.

 CAUTION
To avoid personal injury when blow drying, wear adequate eye protection (safety glasses or face plate) and do not exceed 276 kPa (40 lb/in.²) air pressure.

2. Blow dry with compressed air.
3. Clean the breather recess in the rocker cover.
4. Check for damage. Replace as necessary.

1.6.6 Disassembly of Rocker Cover

Disassemble the rocker cover as follows:

1. Disengage the clip that holds the crankcase vent breather element in the valve cover by pressing the center of the spring steel retaining clip outward and removing the straight end.
2. Rotate the clip upward to remove the curved end.
3. Remove the wire mesh element.

1.6.7 Pre-installation of Rocker Cover

Perform the following steps prior to installing the rocker cover:

NOTE:

Be sure the rocker cover grooves and the seals are clean and free of oil. A 50/50 detergent and water solution should be sprayed into the seal groove to ease installation of the seal.

1. Install the rocker cover seal in corners of the camshaft cap section (arch at each end of the valve cover) first. See Figure 1-104.

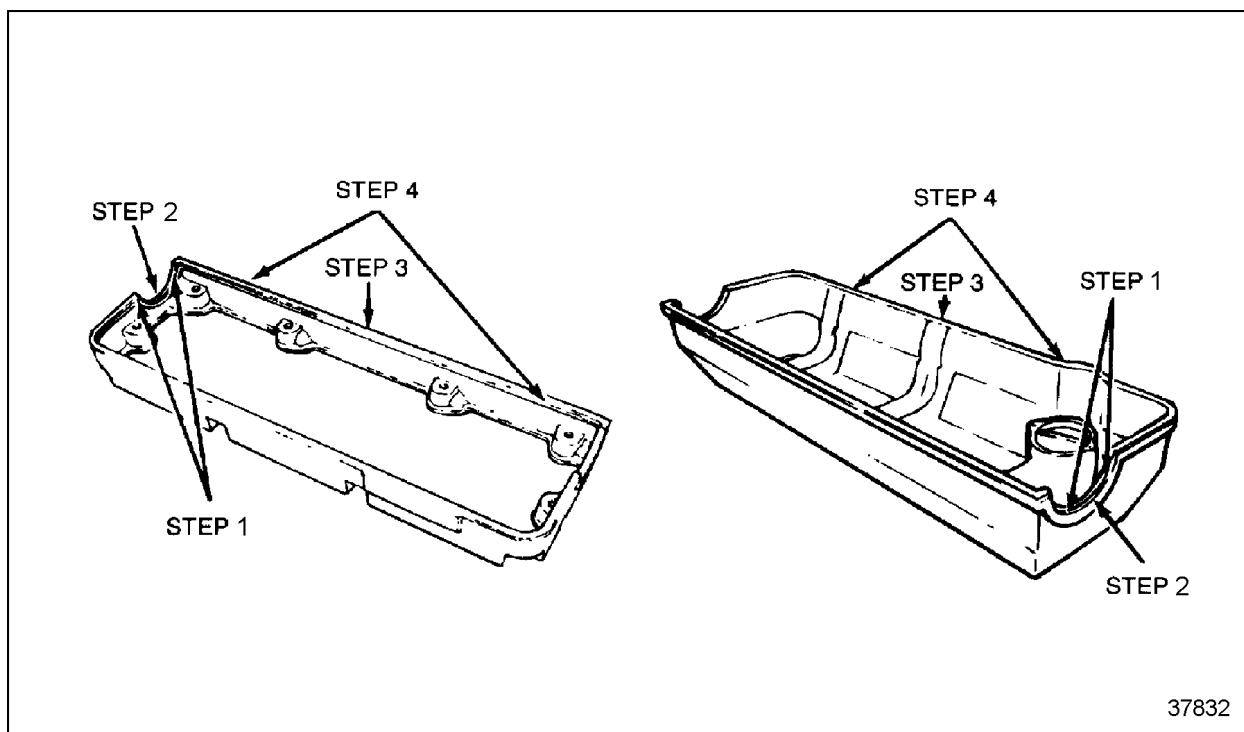


Figure 1-104 Rocker Cover Gasket Installation

2. Install the cam cap section, starting in the center, by pushing the seal into the groove at the top of the arch. Then install each section at its halfway point. Seat the seal completely around the arch. Be sure the corners are still firmly seated after the arch is completed. They should present a square corner parallel to the rocker cover rail. Repeat this procedure for the cam cap section on the other end.
3. Seat the gasket into the four outside corners of the rocker cover.
4. Install the long runs of the gasket starting in the center, by pushing the seal into the groove.

1.6.8 Installation of One-Piece Rocker Cover

Perform the following steps to install a one-piece rocker cover:

1. Position the rocker cover on the cylinder head, making sure the gasket is firmly seated in the rocker cover groove and has not rolled out of the groove.
2. Install the bolt assemblies, with isolators into their recesses in the rocker cover.
3. Torque the bolts using the pattern shown (see Figure 1-108), starting with the center bolts and working out, to 30–38 N·m (22–28 lb·ft) torque.

NOTE:

Engines built after May (28th for aluminum covers) 1999 use a one-piece bolt assembly. The rocker cover requires ten bolt assemblies to be used.

4. Install any other components that were removed for their procedure.
5. Start the engine and check for leaks.

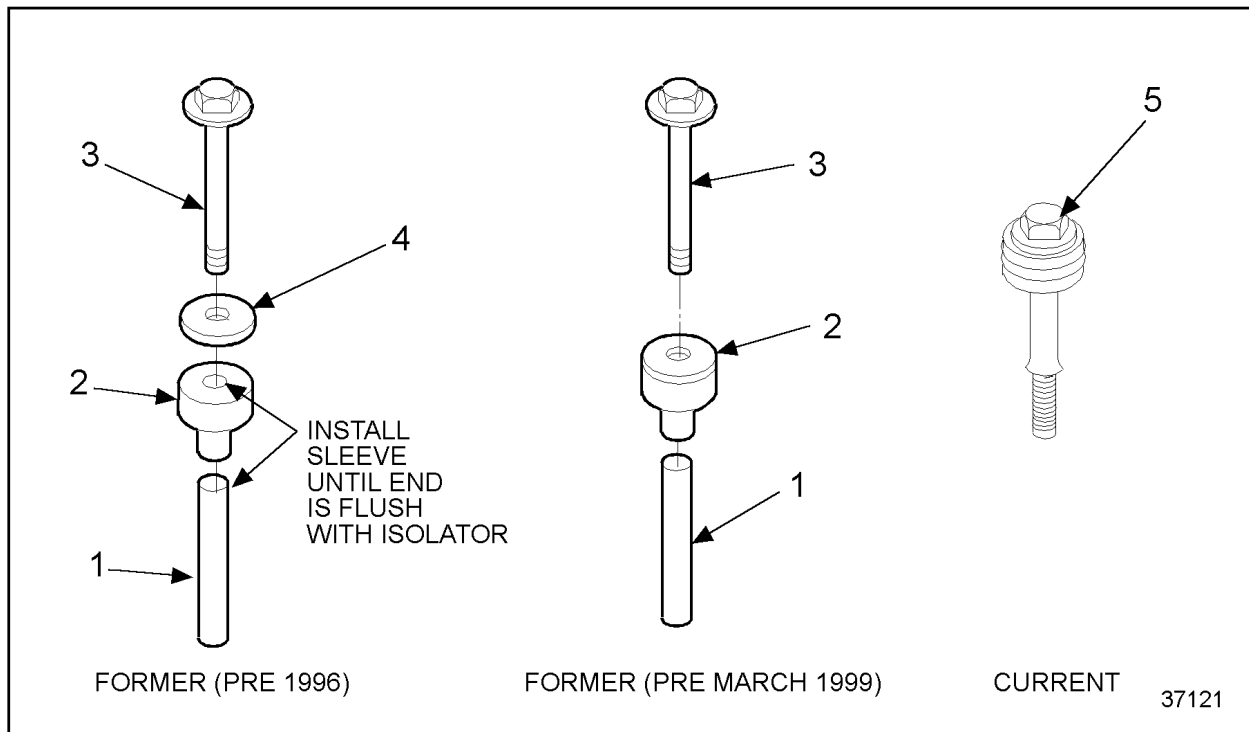
1.6.9 Installation of Two-Piece and Three-Piece Aluminum Rocker Covers

Perform the following steps to install a two or three-piece rocker cover for engines built prior to July 1999:

1. Position the rocker cover base on the cylinder head.
2. Lubricate the valve cover limiting sleeves with clean silicone spray. Insert the sleeves into the isolators until the end of the sleeve is flush with the isolator. See Figure 1-106.

NOTE:

Engines built after May 28, 1999 use a unitized bolt assembly. The rocker cover base requires ten bolt assemblies to be used.



1. Limiting Sleeve

2. Isolator

3. Bolt

4. Flat Washer

5. Unitized Bolt Assembly

Figure 1-106 Rocker Cover Base Hold-Down Hardware

3. Install the hold-down bolts, with washers installed, to the limiting sleeves.
4. Install the hold-down assemblies to the rocker cover base, and thread the bolts two to three threads into the cylinder head.

NOTE:

Use care when tightening the rocker cover base hold-down bolts that the injector wires do not get caught between the limiting sleeve and the cylinder head. See Figure 1-107.

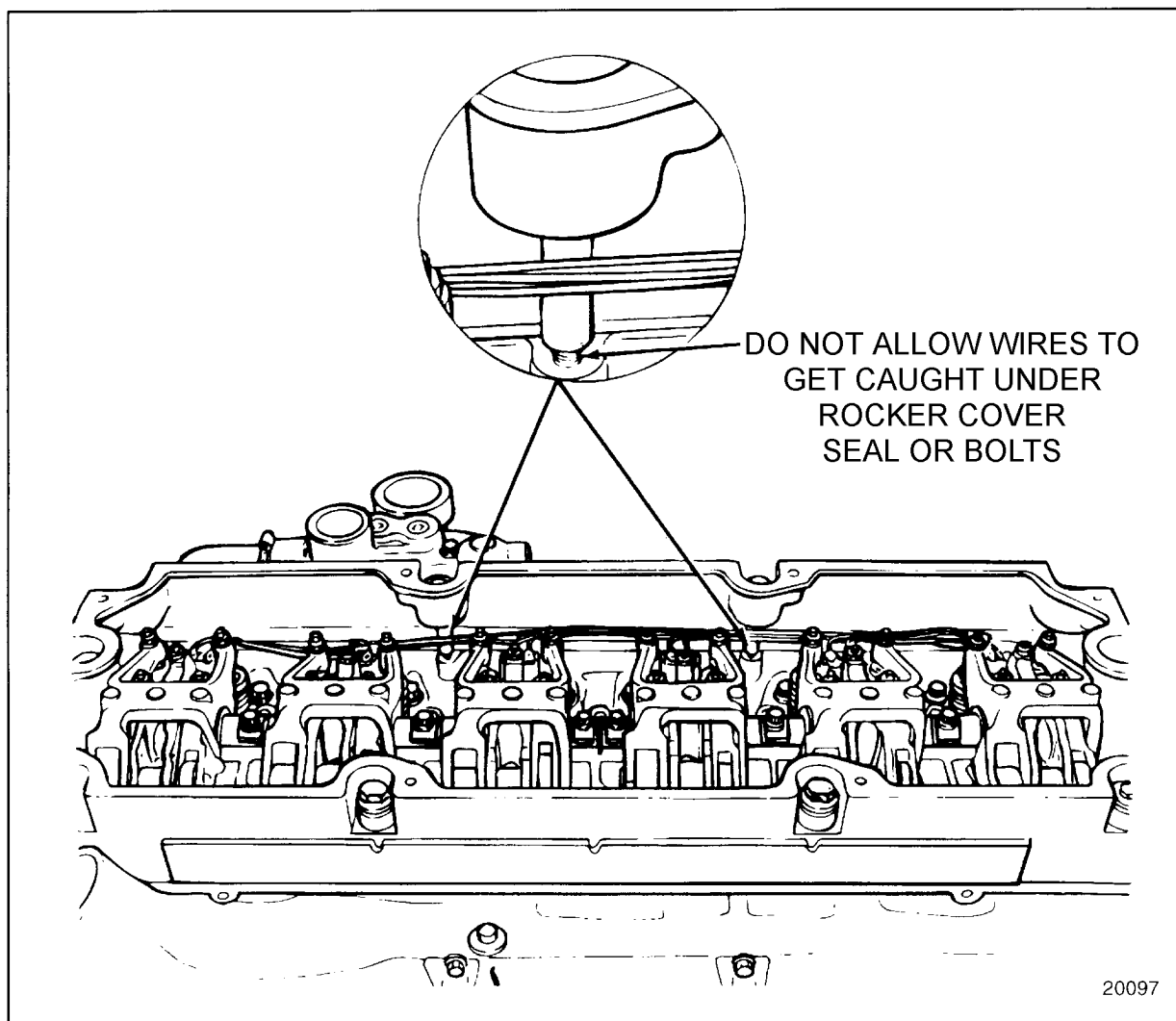


Figure 1-107 Rocker Cover Base Hold-Down Bolt Installation

5. Torque the ten rocker cover base hold-down bolts to 30-38 N·m (22-28 lb·ft). See Figure 1-108.

NOTE:

Torque the bolts in two stages, using half-torque values first.

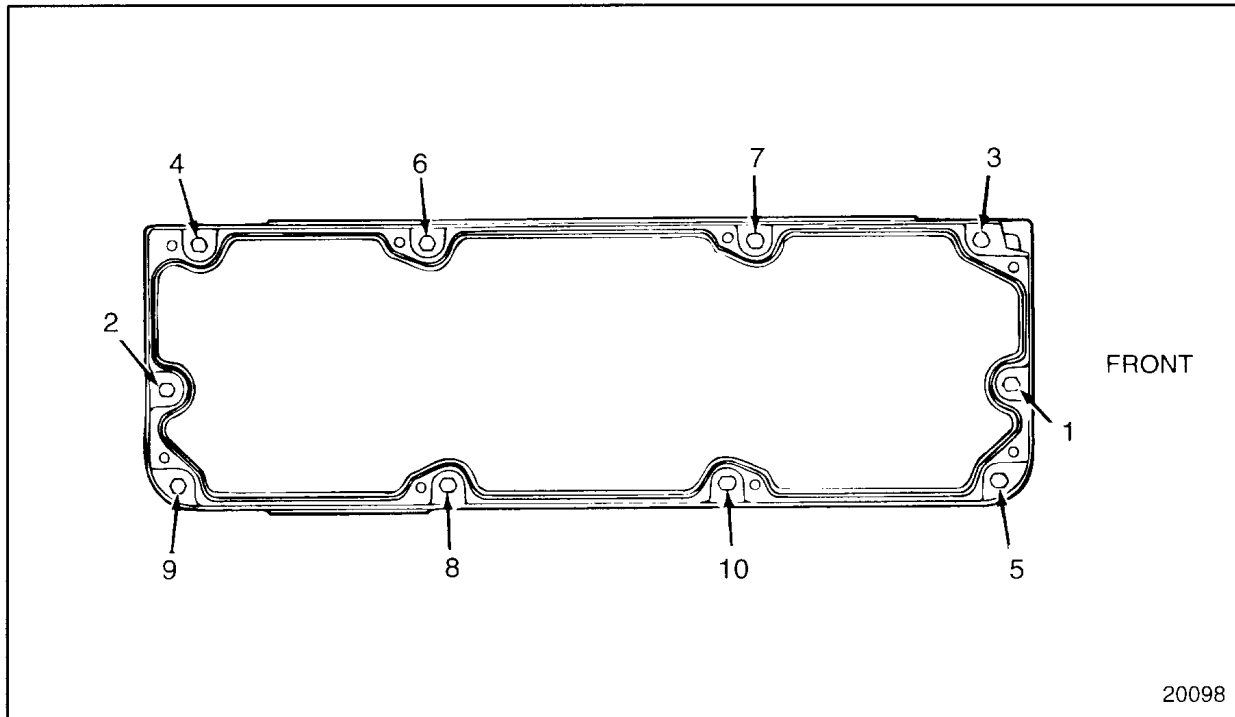


Figure 1-108 Rocker Cover Base Bolt Tightening Sequence

6. Be sure the groove in the top of the rocker cover base, and its mating, diamond-shaped seal are clean and dry. Install the diamond-shaped seal to the groove by pressing the seal into the groove. Use care not to stretch or twist the seal. The seal has a definite shape, and should be installed exactly as removed from the base. If the seal cannot be installed to its groove without bunching or looping, the seal is stretched and must be replaced. The same procedure applies to the intermediate cover diamond-shaped seal installation.
7. Install the rocker cover cap to the base. Install the eight screws that attach the cap to the base, and tighten to 22-25 N·m (16-18 lb·ft) torque using the torque sequence. See Figure 8-10. Tighten the bolts in two stages, using half-torque value first. The same procedure applies to the intermediate cover installation.

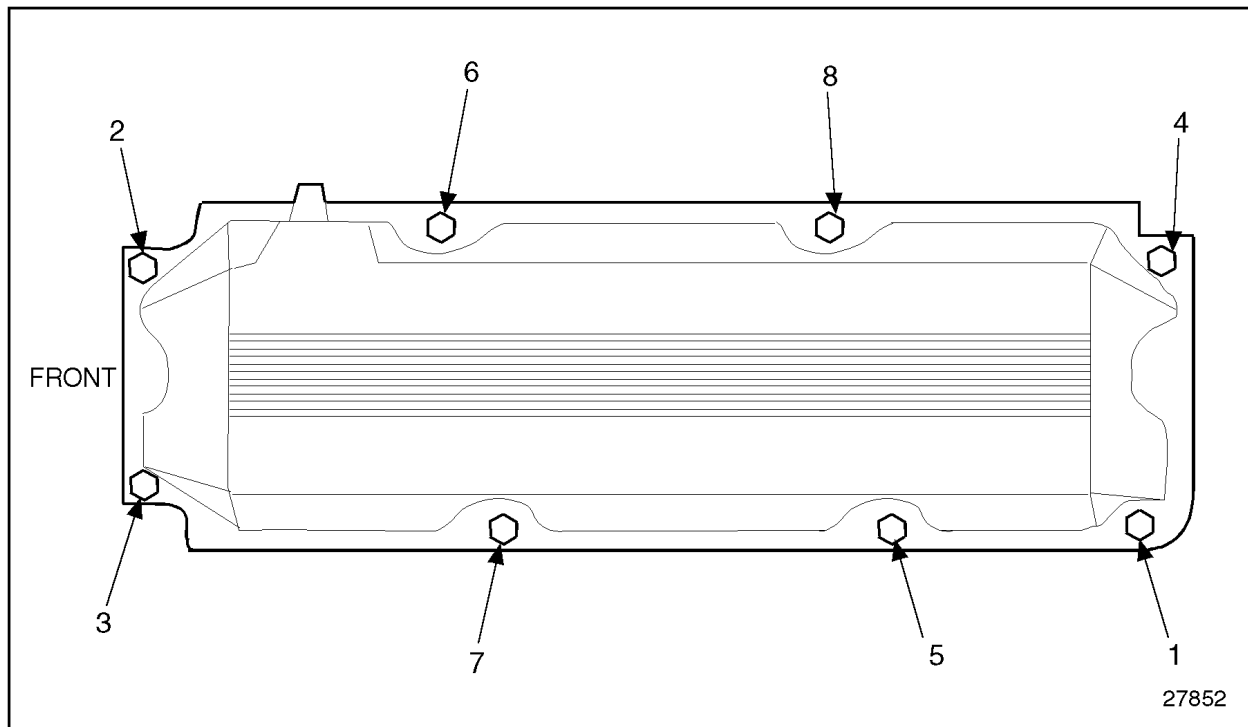


Figure 1-109 Rocker Cover Bolt Tightening Sequence

8. Install any other parts that were removed for this procedure.
9. Start the engine and check for leaks. Shutdown engine after checking for leaks.

1.6.10 Installation of the Two-Piece Rocker Cover Cap (Gas Engines with Coil Over Plug Ignition System Only)

Install the two-piece rocker cover cap as follows:

1. Clean any oil or dirt from the spark plug wells.
2. Insert the six extension tubes with O-rings in the cylinder head.
3. Orient the extension tubes so that twelve threaded holes are in a straight line. This will allow the coil mounting bolts to engage these holes after the rocker cover cap is installed.
4. Place the rocker cover cap on base without disturbing the extension tube seals. Loosely install the eight bolts that attach the cap to the base.
5. Insert the coils into the spark plug wells. Engage the coil mounting bolts into the extension tubes. Torque the bolts 13-16 N·m (10-12 lb·ft).
6. Tighten the eight rocker cover cap mounting bolts to 22-25 N·m (16-18 lb·ft).
7. Install the remaining ignition system parts. Refer to section 15.2.
8. Apply antiseize compound to the coil cover mounting screw holes to aid removal of these parts in the future.
9. Install any other parts that were removed for this procedure.
10. Start the engine and check for leaks. Refer to section 11.8.