

Unit Injector and Sleeve, Replacement
(Conical)
D11, D13, D16

Unit Injector and Sleeve, Replacement (Conical)



CAUTION

This bulletin describes important tools and procedure for injector and injector sleeve replacement. These tools and procedure replace all existing tools and procedures for conical sleeve replacement. If the procedure in this bulletin is not followed exactly, damage to the engine may result.

Failure to follow the procedure in this bulletin exactly may result in warranty claim denial.

Contents

- "Sleeve Identification", page 2
- "Conical Unit Injector and Sleeve Replacement", page 4

Note: Information is subject to change without notice.

Illustrations are used for reference only, and may differ slightly from the actual engine version. However, key components addressed in this information are represented as accurately as possible.

Service Procedures

2379-03-02-01

Unit Injector and Sleeve, Replacement (Conical)

You must read and understand the precautions and guidelines in Service Information, Function Group 20, "Engine Safety Practices" before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Special tools: 9990006, 9990013, 9990649, 9998252, 9998253, 85112740, 88800014, 88800283, 88800285, 88800288, 88800289, 88880010, 88880056, J42885, PT2900, DBT2V700

Sleeve Identification

Note: There are two types of injector sleeves used in Volvo engines, conical and flat copper. The conical sleeves are made of stainless steel. A washer is used with the flat copper sleeves. You must determine which type of sleeve is in the engine to know the proper tools to use for the replacement procedure.



W2056876

- A. Flat Injector
- B. Conical Injector

 **CAUTION**

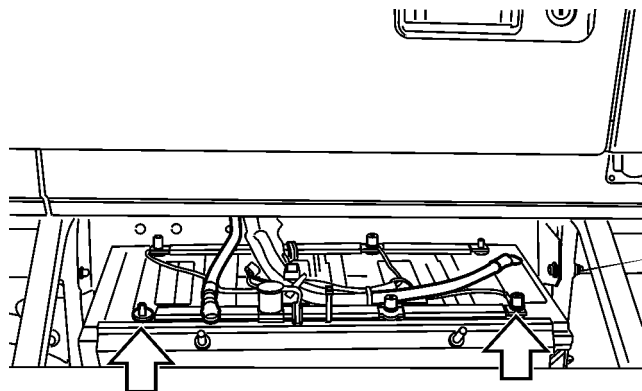
Conical and copper sleeves should not be mixed in the same engine. The same type of sleeve must be used in all six cylinders. Mixing sleeves can result in damage to the engine.



W204

Note: Whenever a new conical injector is installed, a new injector sleeve must also be installed.

Conical Unit Injector and Sleeve Replacement



W2003815

1

Apply the parking brake and place the shift lever in neutral.

2

Disconnect all cables from the negative (ground) battery terminals to prevent personal injury from electrical shock and prevent damage to electrical components.

3

Drain the coolant from the radiator and engine using the coolant extractor.

Note: An alternate method is to connect the drain hose to the drain fitting and drain the coolant.

DBT2V700, 9990649, 85112740

4

Clean around the fuel supply line fitting on the filter housing. Loosen the fuel line at the filter housing to allow fuel to drain from the cylinder head. Allow the fuel to drain into a suitable container.

5

Remove the valve cover from the engine. Refer to Group 211 for service procedure.

Note: Rotate the valve cover as needed, to clear the camshaft gear and damper.

Note: Dependent upon chassis, engine cover may need to be removed for clearance to remove valve cover.

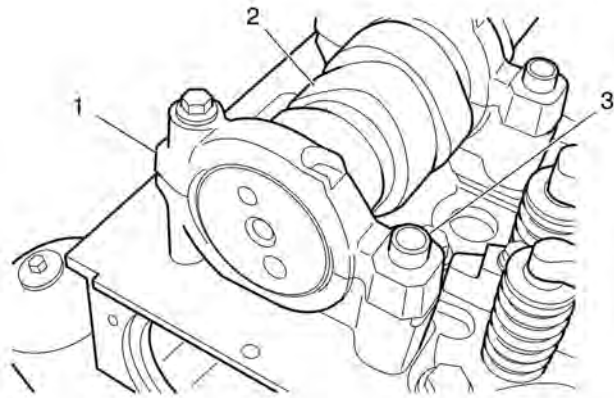
6

Remove the rocker arm shaft. Refer to Function Group 214 for service procedures.



CAUTION

The order of the rocker arm assembly must be maintained. Make certain the sets of four are kept together. Make certain the rocker arms are identified so they can be returned to their original positions on the shaft. Failure to heed this caution may result in severe engine damage.



W2005514

- 1 Camshaft Bearing Cap
- 2 Camshaft
- 3 Alignment Sleeve

7

Make sure the alignment sleeves remain in position on each bearing cap.

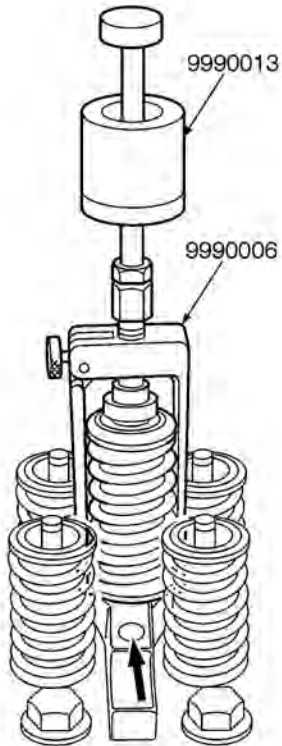
8

Mark the valve bridges so they can be installed in the same location during reassembly. Remove the valve bridges.

Note: Mark the location of the injectors for reinstallation. Injectors must be installed in the same cylinder as they were removed.

9

Thoroughly clean around the injectors that are to be removed. Remove the injector hold down bolt.



W2005170

10

CAUTION

Do not use excessive force on the injector with the slide hammer. If the injector is stuck in the sleeve, the puller can be damaged by the slide hammer.

Install the puller onto the injector. Position the puller fork in the groove on the injector and lock the arm using the thumb screw on the side. Secure the puller by screwing down the screw toward the inner cup of the injector. Install the slide hammer. Use reasonable force with the slide hammer to pull the injector free from the cylinder head.

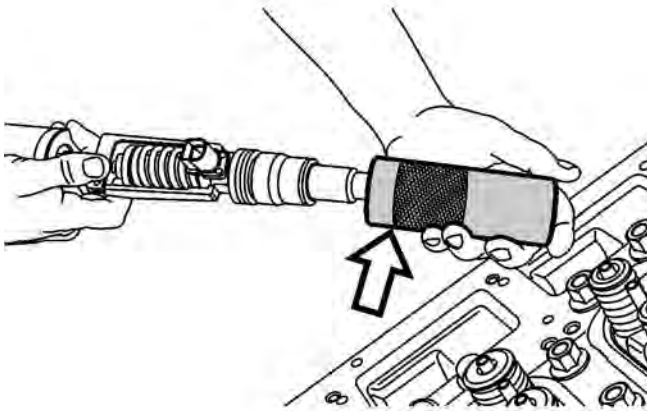
Note: Use care when removing the injector because the injector hold down is not secure and could fall off if not held in place.

9990006, 9990013

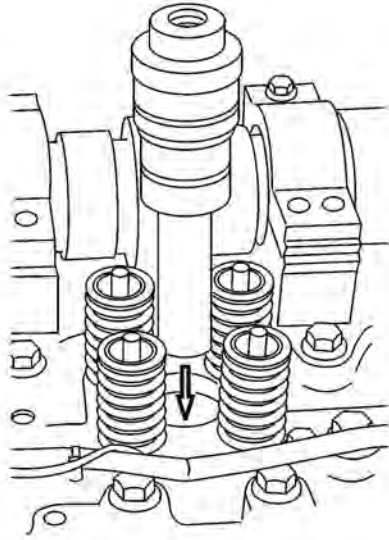
11

Install the protective sleeve over the injector to prevent damage.

9998249



W2005112



W2005172

12

If the injector sleeve is not being removed immediately, install the protective plug into the injector bore of the cylinder head to protect it from debris. Using compressed air, clean out the injector hold down bolt holes.

9998251

13

Install the protective sleeve from kit J42885. Use brush 88880056 to clean the injector sleeve.

Note: After cleaning the sleeve, carefully inspect the inside surface of the sleeve, especially the bottom surface. Any remaining contamination is unacceptable and must be removed. Also, if there is any indication of a discrepancy that raises concern about suitability of the sleeve for reuse, replace it with a new sleeve.

Note: When reinstalling the existing injector, it is acceptable to reuse the injector sleeve. When installing a new injector, a new injector sleeve must also be installed.

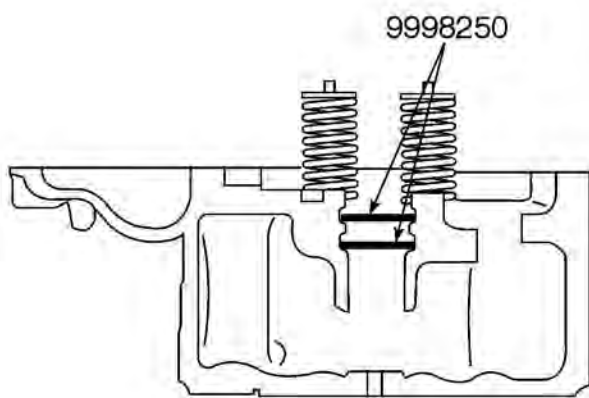
J42885, 88880056

14

Install two sealing rings to prevent dirt from entering the fuel gallery when the injector sleeve is removed.

Note: Two sealing rings are required to cover the fuel gallery.

9998250



W2005171

15

Install the flywheel turning tool. Turn the flywheel until the piston is at its lowest position in the cylinder. Confirm the piston is at the lowest position in the cylinder by using a 40 cm (16 inch) piece of straight stiff wire in the injector hole of the cylinder.

Note: This is to ensure that the injector sleeve tapping tool does not damage the piston due to tool length.

Note: Ensure the turning tool is well greased before attempting to turn the flywheel.

Note: If it is necessary to replace other injector sleeves, continue the procedure on pairs of companion cylinders (1 and 6, 2 and 5, 3 and 4). It is necessary to rotate the crankshaft and place each pair of companion cylinders at the lowest position in the cylinder.

88800014, or 9996956

16

Insert the 8.3 mm forming tap into the tap handle until it stops. Make sure a flat on the tap is aligned with the upper set screw. Tighten upper set screw first, then tighten lower set screw. Completely coat the forming tap with fresh, extreme pressure NLGI #2 grease or equivalent.

Note: Forming taps require extreme pressure grease due to the cold working process used to form threads.

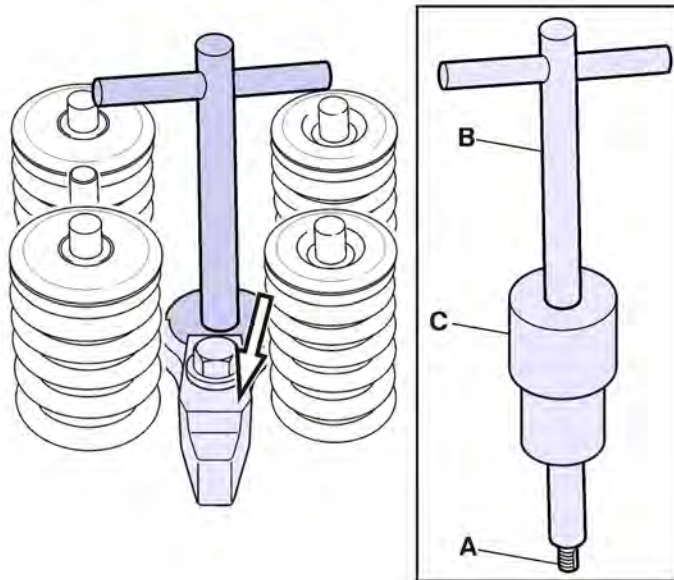


W2038611

 **CAUTION**

If the injector sleeve is not completely tapped through to the opening of the tip, an end piece of the tip can break off and fall into the cylinder during removal. These types of failures are not covered by warranty.

88800289, 9998252



T2055473

- A. 8.3 mm Forming Tap, 88800289
- B. Tap Handle, 9998252
- C. Sleeve Hold Down, 88800285

17

Note: Use bolt 8192804 to tighten the injector hold down yoke on the sleeve hold down (special tool number 88800285). Do not use the hold down screw from the engine because it is a limited use screw.

Position tap holder and sleeve hold down in the injector bore. Position the injector hold down yoke over the sleeve hold down and tighten bolt 8192804 to 80 ± 5 Nm (60 ± 4 ft-lb). Apply moderate downward force to get the tap started while turning the tap handle clockwise. Continue turning in the same direction, without reversing, until the injector sleeve is tapped all the way through. The shoulder of the tap handle should bottom on the injector sleeve. Ensure that the tap is completely through the injector sleeve.

CAUTION

If threads are not cut completely through the tip of the injector sleeve, the tip can break off and fall into the cylinder. This can result in damage to the cylinder, piston, valves or turbocharger. These types of failures are not covered by warranty.

9998252, 88800285, 88800289

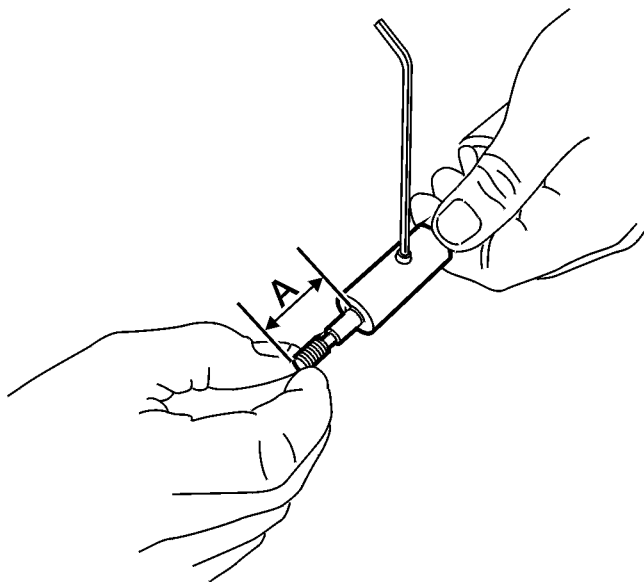
18

Remove bolt from the injector hold down yoke. Remove the injector hold down, sleeve hold down, tap and tapping tool.

19

Install the 8.3 mm extractor bolt into the end of the extractor tool. Adjust the bolt until it extends approximately 25 mm (1 inch) beyond the end of the tool (dimension A).

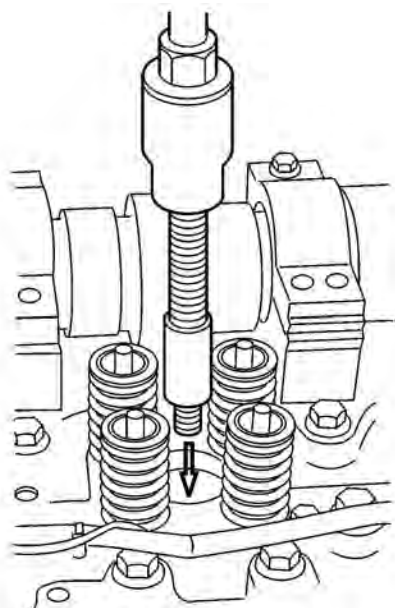
88800288, 9998253



W2003433

20

Tighten the set screw of the extractor tool to secure the bolt. Make sure that the set screw is seated against the flat part of the extractor bolt.



W2005079

21

CAUTION

Make sure the extractor bolt is threaded completely into the injector sleeve before attempting to remove it or the tip of the sleeve may break off as it is removed. This broken sleeve tip can seriously damage the piston, valves or turbocharger. These types of failures are not covered by warranty.

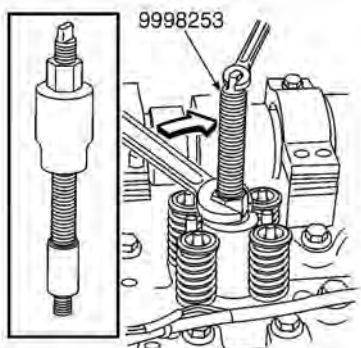
Lubricate the threads of the pulling screw on the puller. Lubricate under the face of the nut. Place the extractor tool with the bolt into the injector bore. Make sure the nut on the spindle is backed off so that the threaded end can be completely installed through the injector sleeve tip. Hand tighten until the bolt bottoms out in the sleeve.

Note: If it is necessary to replace other injector sleeves, continue the procedure on pairs of companion cylinders (1 and 6, 2 and 5, 3 and 4). It is necessary to rotate the crankshaft and place each pair of companion cylinders at the lowest position in the cylinder.

22

While holding the top of the tool stationary, turn the large nut clockwise to extract the injector sleeve.

Note: When the injector sleeve is removed, make sure that the extractor bolt is extended at least one thread beyond the injector sleeve. If not, make sure that no part of the injector sleeve has broken off and fallen into the cylinder.

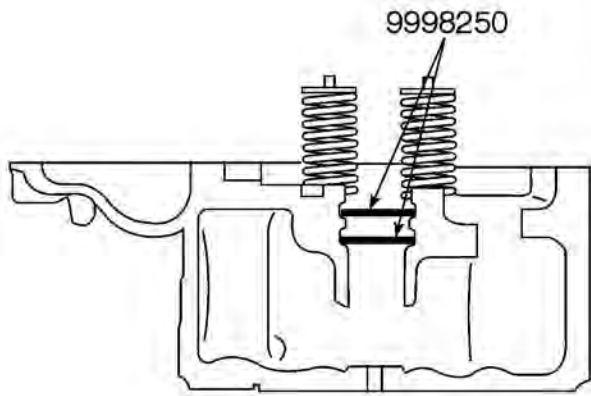


W2005442

CAUTION

Do not use air tools to remove injector sleeves, or damage to the injector bore can result.

9998253



W2005171

23

Remove the two sealing rings from the fuel passage. Using the chip vacuum, remove any remaining debris from the injector bore.

9998250, PT2900

24

Install the injector bore sealing tool, J-42885-25, to protect the fuel passage area and prevent debris from entering.

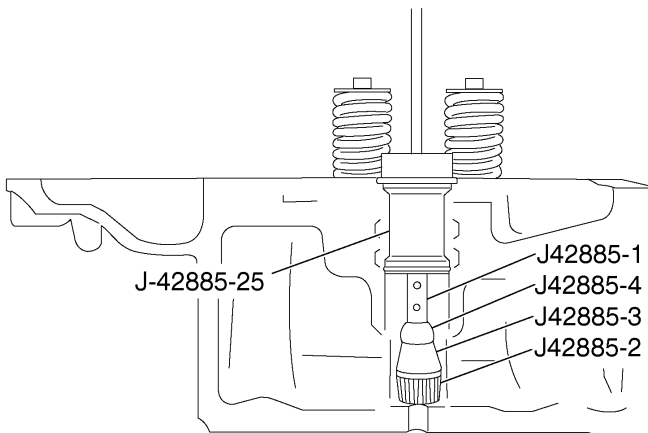
J-42885-25

25

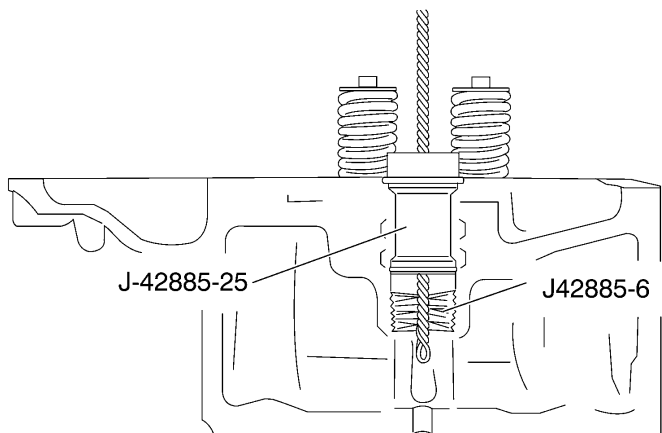
Using the cleaning kit, J42885, clean the injector sleeve seat of the cylinder head.

Note: The injector bore sealing tool must be used to prevent dirt from entering the fuel passage.

J42885-1, J42885-2, J42885-3, J42885-4, J-42885-25



W2006260



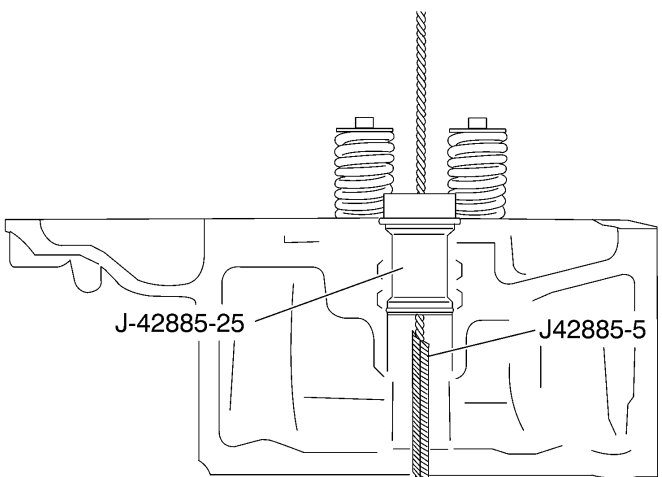
W2005616

26

Using the brush, clean the cylinder head injector bore walls for the injector sleeve.

Note: The injector bore sealing tool must be used to prevent debris from entering the fuel passage.

J42885-6, J42885-25



W2005617

27

Using the brush, clean the injector sleeve opening in the cylinder head.

Note: The injector bore sealing tool must be used to prevent debris from entering the fuel passage.

Note: When replacing the injector sleeves, it is important to check that the sleeve bore in the cylinder head is free from any carbon deposits or other residue (i.e., pieces of O-ring, etc.) before installing a new injector sleeve. Repeat cleaning if necessary.

J42885-5, J-42885-25

28

! WARNING

Do not attempt to blow away debris using compressed air. Doing so can result in eye injury.

Using the chip vacuum, remove all debris from the injector sleeve bore.

PT2900

29

Remove the injector bore sealing tool from the cylinder head. Using the chip vacuum, remove any remaining debris.

PT2900, J-42885-25

30

Ensure the piston is at the lowest position in the cylinder. If not, use the flywheel turning tool to place the piston at its lowest position.

Note: This is to ensure that the sleeve installation tool does not damage the piston due to tool length.

88800014, 9996956

31

Note: Make sure the sleeve bore surface in the cylinder head is clean and dry prior to paste being applied.

Before installing a conical sleeve, apply a 2-3 mm bead of Volvo approved sealing compound (part number 1161059) to the bottom of the injector sleeve.



T2048540

32

Note: Always use the new O-ring included in the sleeve kit.

Lubricate a new injector sleeve O-ring with clean coolant or soapy water. Install the O-ring on the injector sleeve and lubricate again with clean coolant or soapy water.

33

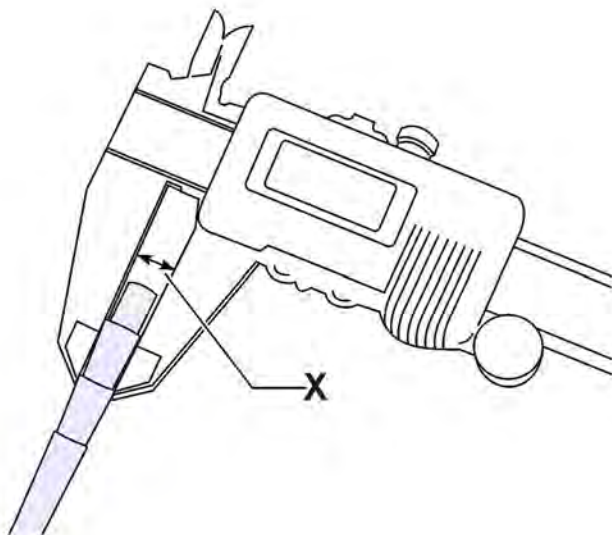
CAUTION

Failure to use the proper bit can result in the bit breaking off into the cylinder head. These types of failures are not covered by warranty.

Using calipers, measure the swedging bit to make sure that the proper swedging tool is used. Measurement should read 7.9 ± 0.05 mm. Also, verify that the swedging bit has four stages and the length is 120 mm.

Note: Swedging bit, 88880054, can be ordered as a spare part if the bit is worn or broken.

88880054



T2048537

X = 7.9 ± 0.05 mm



W2080611

Undamaged Installation Tool



W2080607

Damaged Installation Tool

34



CAUTION

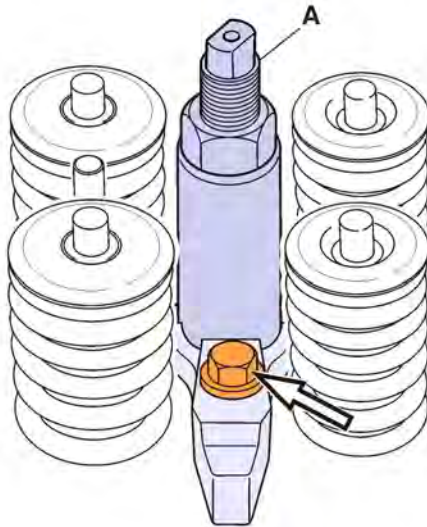
Inspect the installation tool around the sleeve mating surface to make sure it is clean and not damaged or distorted which may result in sleeve damage.

Before installing the sleeve on the installation tool, inspect the tool to ensure that it is the correct tool. Inspect and clean the tool sleeve mating surface to make sure it is free from dirt and debris. Always handle the tool with care and protect the conical surface from burrs and handling damage.



W2038612

Conical Sleeve Installation Tool, 88800283



T2055474

A. Installation Tool

35

CAUTION

Failure to loosen the swedging bit can result in the bit being twisted or broken.

Place the new injector sleeve on the installation tool. Thread the swedging bit completely into the flaring tool until it stops (finger tight). Loosen the swedging bit 180° before installing the tool in the cylinder head. Lubricate the swedging bit and the threads on the tool with fresh, extreme pressure NLGI #2 grease or equivalent.

Note: It may be necessary to install at least 8 mm (0.3 in) of spacers under the nut on the flaring tool to ensure that the swedging bit is pulled completely through the sleeve.

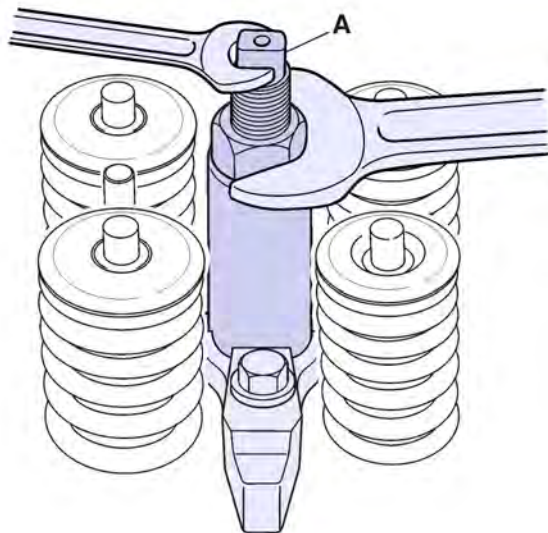
88800283

36

Carefully place the sleeve installation tool and new injector sleeve into the injector bore of the cylinder head. Carefully move the injector sleeve downward into the injector bore so that the swedging bit is guided into the injector tip bore in the cylinder head. Push downward on the installation tool using hand force to move the injector sleeve downward until it bottoms out on the injector sleeve seat in the bottom of the injector bore. Use the injector hold down yoke and bolt 8192804 to hold the tool in position. To ensure that the sleeve is bottomed in the cylinder head, tighten the bolt to 80 ± 5 Nm (60 ± 4 ft-lb).

Note: Remove any oil from the injector hold down bolt holes to avoid hydraulic lock for this step and when the injector is installed.

Note: Use bolt 8192804 to hold the tool in position. Do not use the hold down screw from the engine because it is a limited use screw.



T2055477

A. Installation Tool

37

Flare the injector sleeve by turning the nut clockwise while holding the spindle until the swedging bit has been pulled completely through the injector sleeve.



CAUTION

Failure to hold the spindle can result in a twisted or broken swedging bit.

38

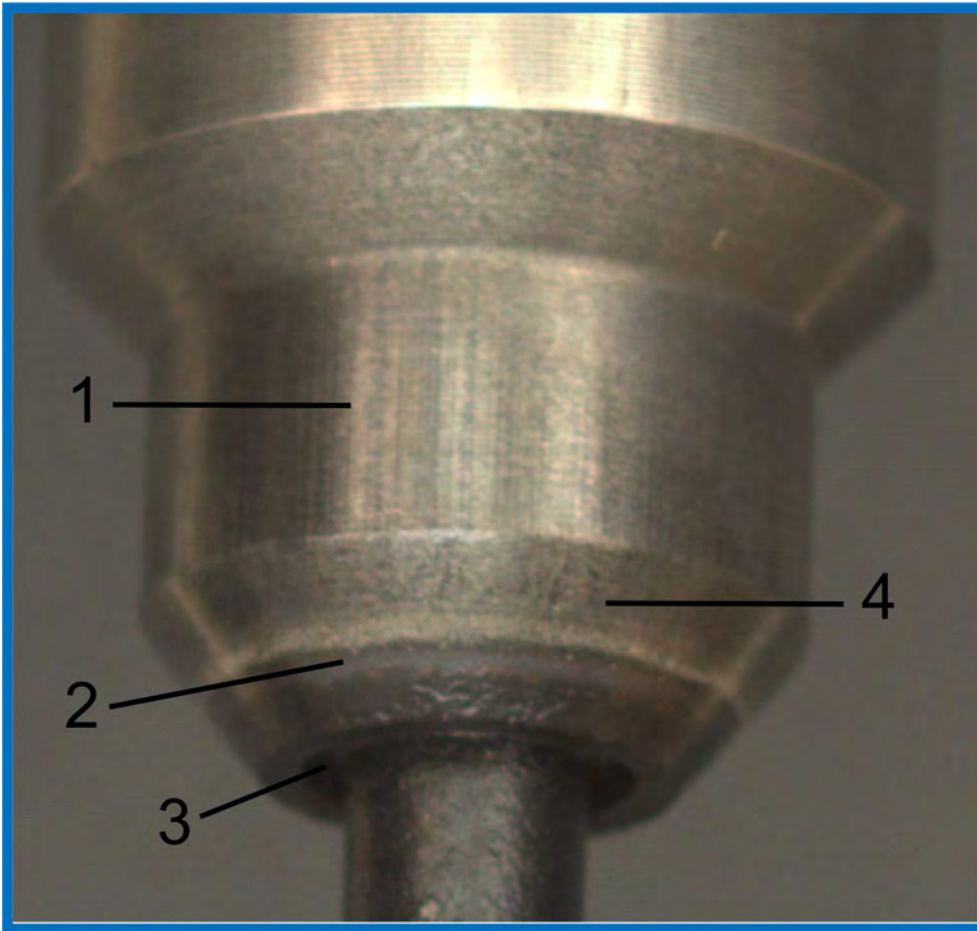
Remove sleeve installation tool from the injector bore.

Note: If the injector is not being installed immediately, install the protective plug into the injector bore to protect it from debris.

9998251

39

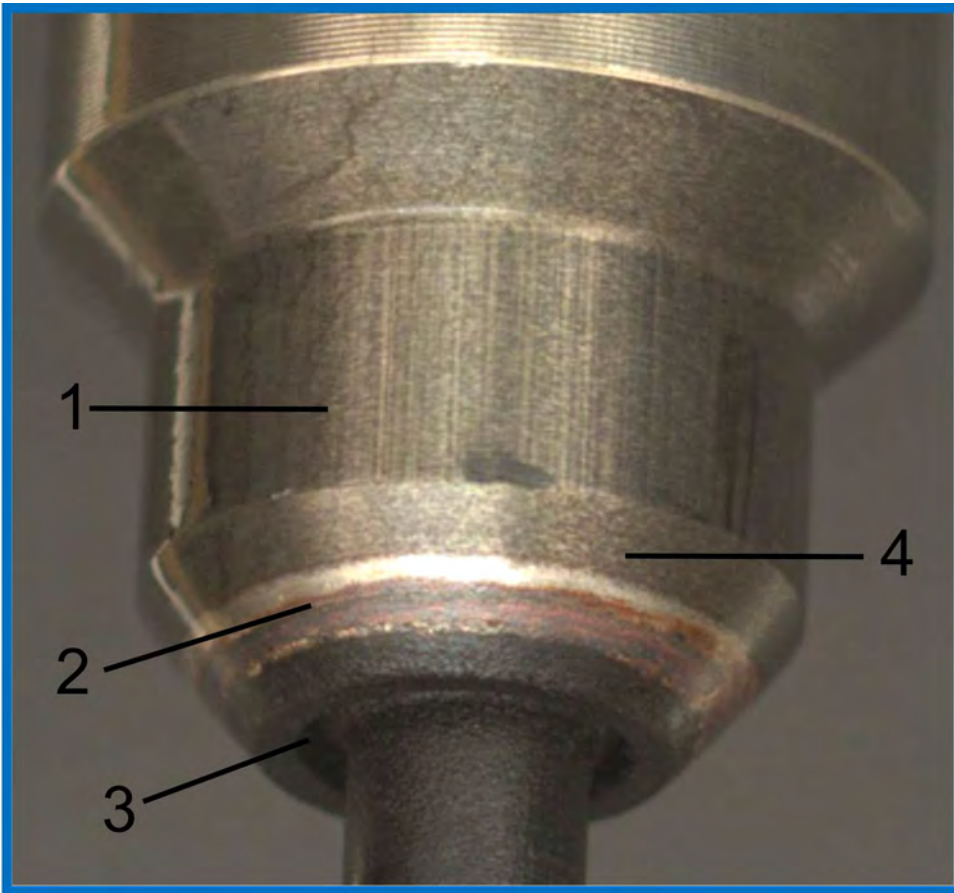
To help determine if an injector can be reused, the following pictures show examples of both reusable and not reusable injectors. Review the examples and compare the removed injectors to the examples shown. Look for signs of carbon deposits and soot above the sealing area caused by combustion gas leakage. Also look for signs of uneven and broad wear around the sealing ring area that can be caused by the injectors moving in the seats and letting combustion gas pass.



W2078381

Reusable Injector

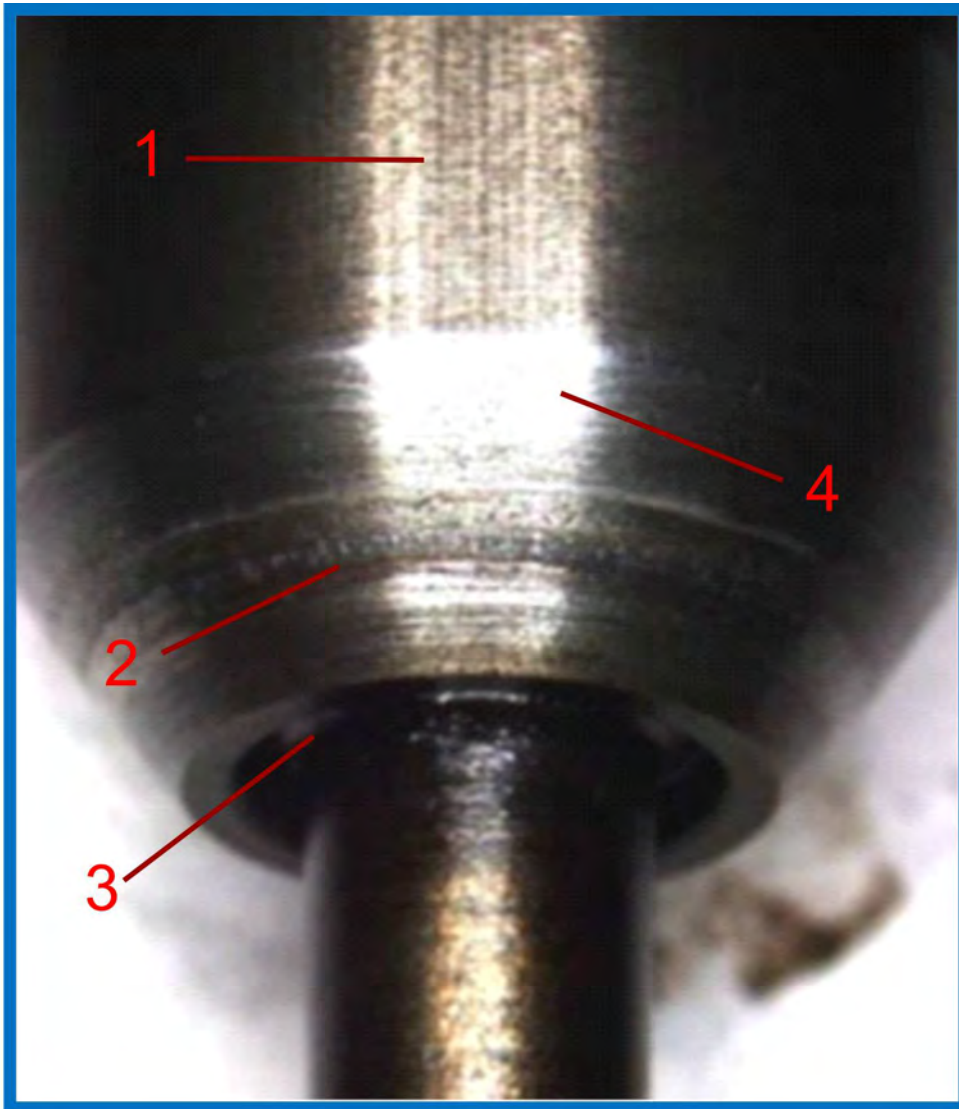
- 1 Non-contact area. Soot deposits are not visible and no combustion gas leakage shown.
- 2 Sealing area uniform, normal sealing ring shown.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, no severe wear shown or soot deposits visible.



W2080174

Reusable Injector

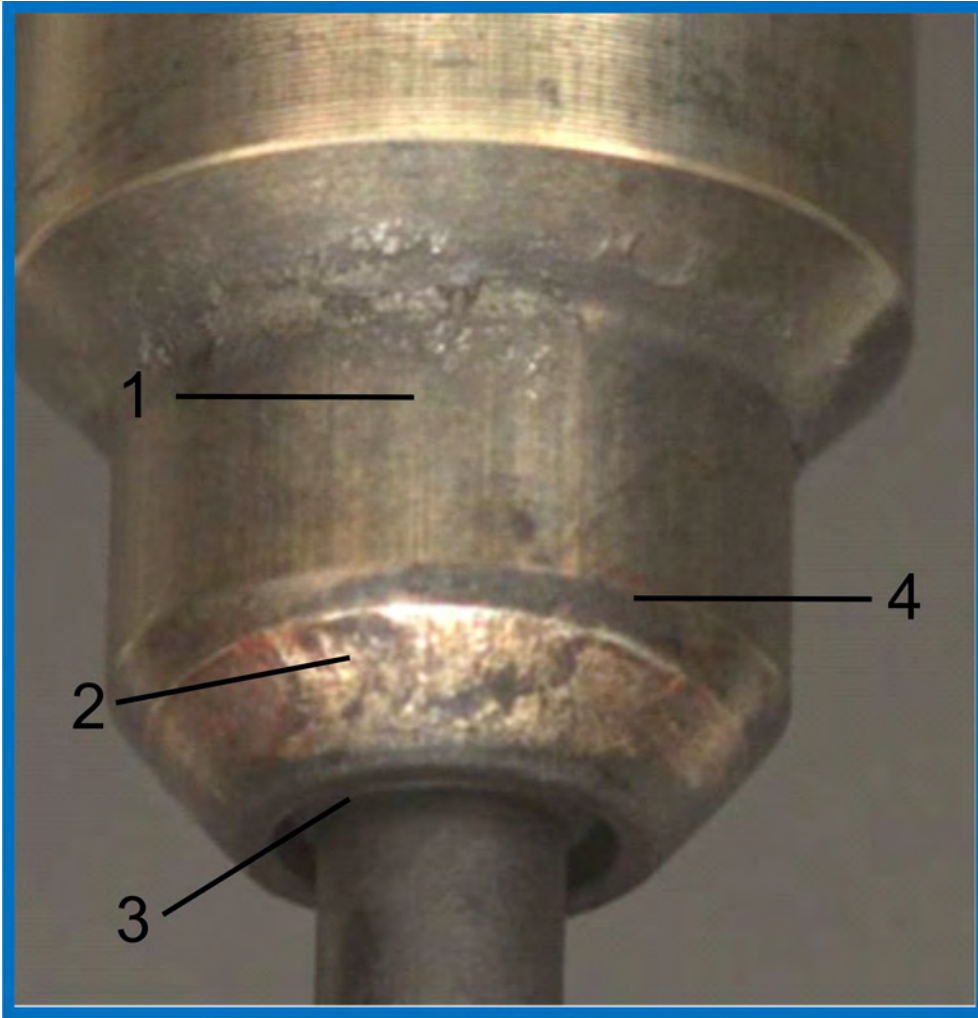
- 1 Non-contact area. Soot deposits are not visible and no combustion gas leakage shown.
- 2 Sealing area uniform, normal sealing ring shown.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, no severe wear shown or soot deposits visible.



W2080175

Reusable Injector

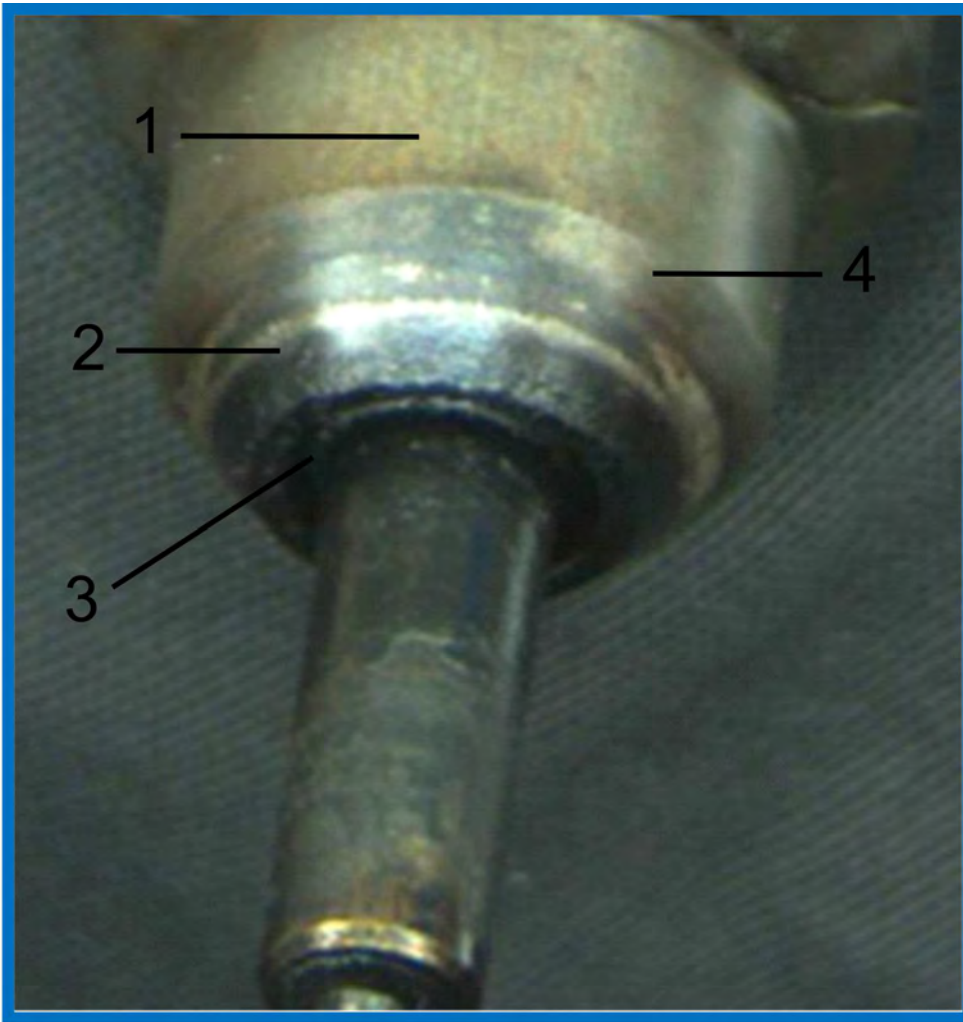
- 1 Non-contact area. Soot deposits are not visible and no combustion gas leakage shown.
- 2 Sealing area uniform, normal sealing ring shown.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, no severe wear shown or soot deposits visible.



W2078380

Not Reusable Injector

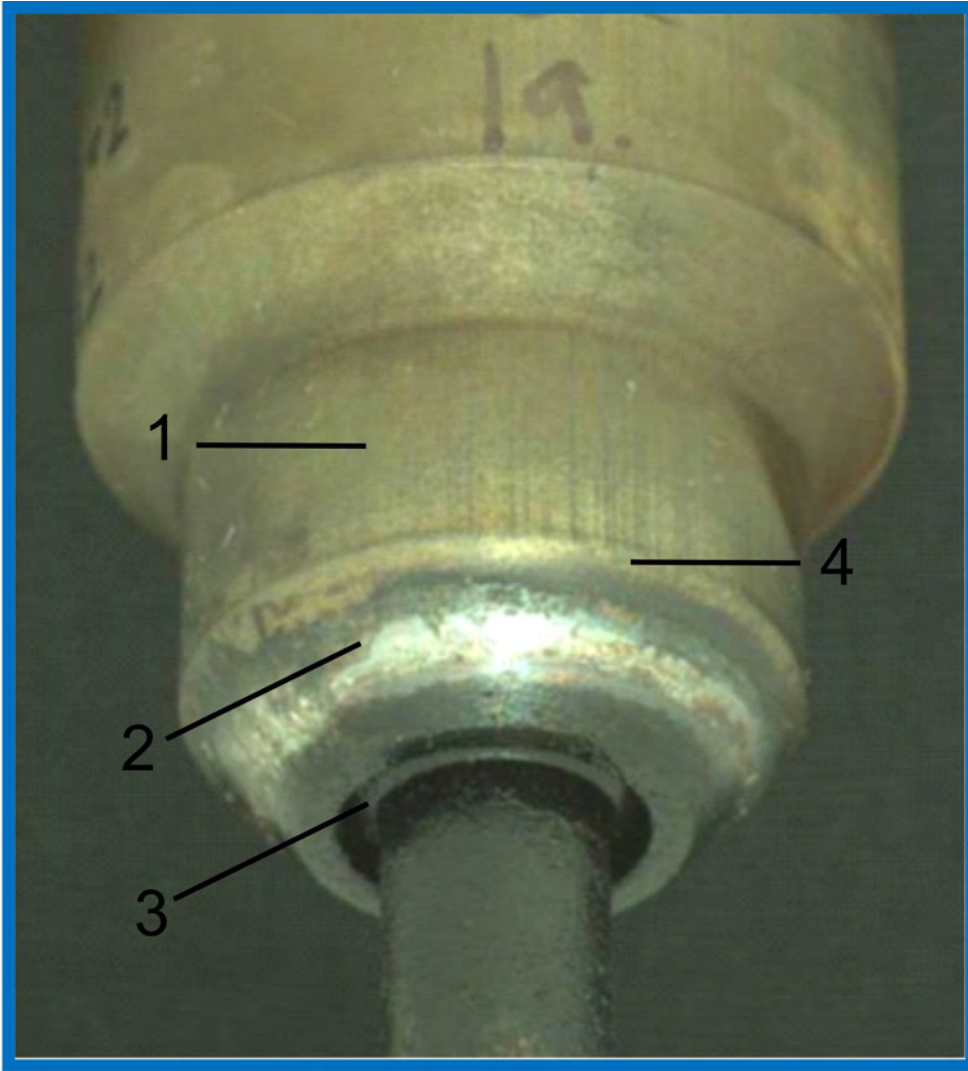
- 1 Non-contact area. Soot deposits are visible and combustion gas leakage shown.
- 2 Sealing area, very broad sealing ring showing injector movement.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, severe ring wear shown, soot deposits visible.



W2080177

Not Reusable Injector

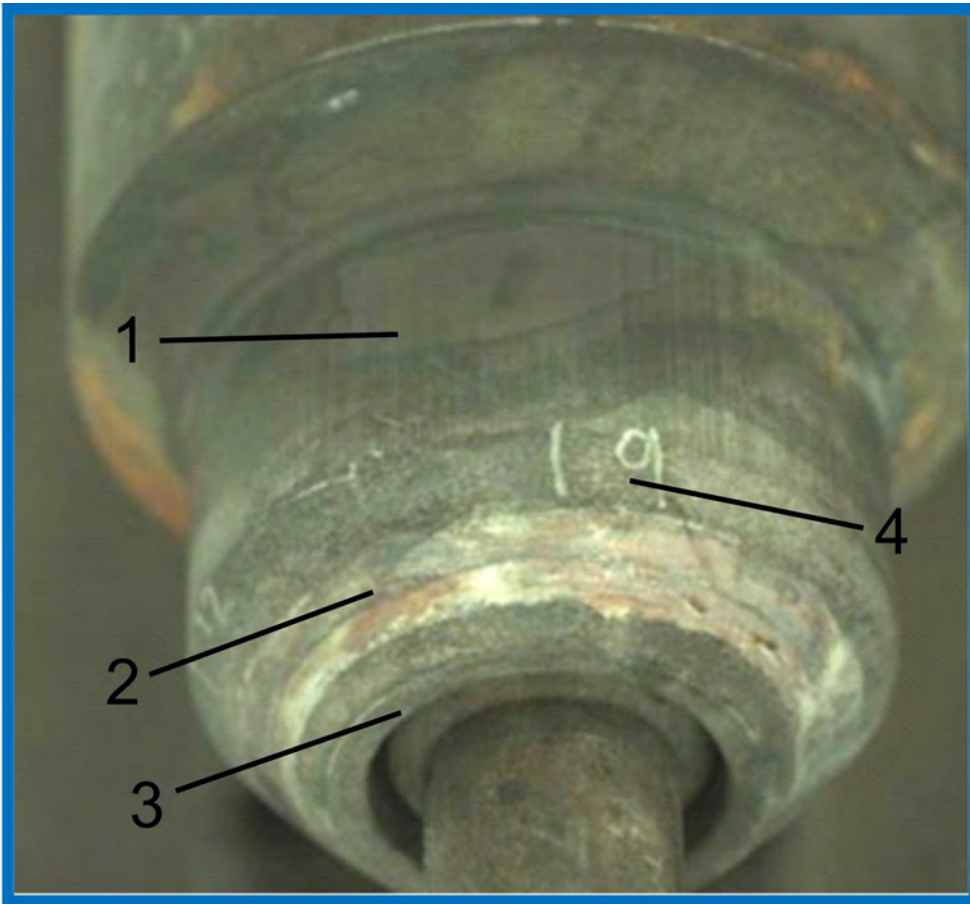
- 1 Non-contact area. Soot deposits are visible and combustion gas leakage shown.
- 2 Sealing area, very broad sealing ring showing injector movement.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, severe ring wear shown, soot deposits visible.



W2080181

Not Reusable Injector

- 1 Non-contact area. Soot deposits are visible and combustion gas leakage shown.
- 2 Sealing area, very broad sealing ring showing injector movement.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, severe ring wear shown, soot deposits visible.



W2080182

Not Reusable Injector

- 1 Non-contact area. Soot deposits are visible and combustion gas leakage shown.
- 2 Sealing area, very broad sealing ring showing injector movement.
- 3 Below the sealing area. Where combustion gases are present, it will normally be sooty.
- 4 Just above the sealing area, severe ring wear shown, soot deposits visible.



W2080152

DO NOT USE A WIRE WHEEL TO CLEAN INJECTORS



W2080151

40

If the injector can be reused, clean the cap nut seat surface of hard carbon deposits with a shop rag and diesel fuel. This is the only approved cleaning procedure. There are new injector cap coatings that can be damaged by improper cleaning methods.



CAUTION

Do not use a wire wheel to clean the cap nut seat surface. Only use a shop rag and diesel fuel to clean the cap nut seat surface. The use of excessive force must be avoided and can damage the seat surface resulting in an injector that cannot be reused.

41

After cleaning, inspect the injector nozzle cap nut seat surface for pitting or related damage. If there is pitting or other damage, the injector and sleeve can not be reused. If there is no pitting on the seat surface, the injector and sleeve can be reused. **The injector must be reinstalled in the same cylinder from which it was removed.**

Note: Pitting on surfaces other than the cap nut seat surface does not effect the function of the injector and is acceptable.



W2080149

- 1 Replace upper O-ring
- 2 Remove and discard lower O-ring

42

Before installing the new or reused injector, install a new upper O-ring (large diameter, violet) on the top injector groove only. If new injectors have O-rings installed on both top and bottom locations of the injector, remove the lower O-ring.

 **CAUTION**

Do **NOT** replace the lower O-ring (small diameter, violet). It has been determined that the lower O-ring is not required for conical injectors. The lower O-ring **MUST** be installed on flat injectors or damage to the engine may result.

43

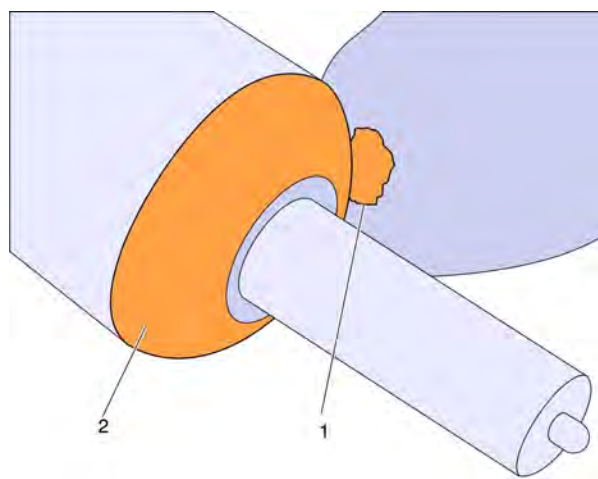
Lubricate the O-ring with clean engine oil.

44

 **CAUTION**

Any oil which may have pooled in the bottom of the injector yoke screw hole must be cleaned from the hole to avoid hydraulic lock when the screw is installed and tightened. Hydraulic lock would result in a lack of clamp load and/or a cylinder head cracked at the screw hole.

When reusing a hold down screw, clean the screw before installation. Apply a light coat of oil to the threads on the screw and to the underside of the screw head. Slip the injector hold down and screw onto the injector.



W2075816

- 1 Use finger to apply paste to injector
- 2 Graphite Paste

45



CAUTION

Do not get any hard particles on the injector sealing surfaces. Hard particles will prevent a good seal and damage to engine can result.

Note: Always wear gloves when applying graphite sealant paste.

Use a finger tip to apply a thin layer of graphite sealant paste (part number 85134750) all around the injector cap nut cone.

46

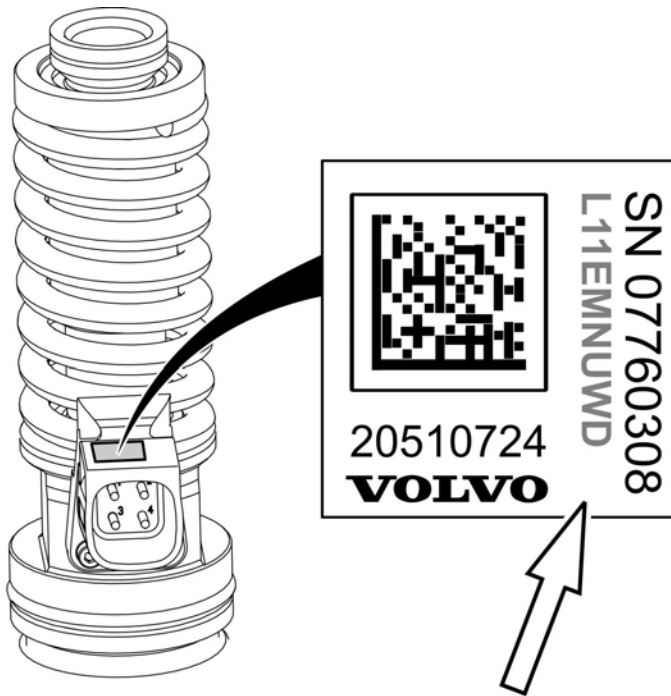
Center the injector between the valve springs and then push down on the injector using hand pressure to seat the O-ring. Clamp the injector in position with the injector hold down by tightening the injector hold down bolt. Tighten the injector hold down bolt using the following five step procedure:

- 1 Tighten 20 +5-0 Nm (15 +4-0 ft-lb).
- 2 Tighten 180 ±5 degrees angle of tightening.
- 3 Loosen the hold down bolt until torque is 10 to 15 Nm (7.0 to 11.0 ft-lb).

Note: This should be achieved by loosening with an angle of 100-110 degrees. Do not completely loosen the bolt to prevent components from moving after the previous seating process.

- 4 Tighten 20 +5-0 Nm (15 +4-0 ft-lb).
- 5 Tighten 90 ±5 degrees angle of tightening.

Note: The injector hold down bolt can be used only five (5) times. After the initial installation, every additional application of the five step injector hold down bolt tightening process requires that a punch mark be applied to the head of the bolt. After four (4) punch marks have been accumulated, the bolt cannot be reused again and must be replaced.



W2080146

47

When replacing injectors, the engine control module (ECM) must be programmed with the new injector's trim codes. The code is printed on top of the injector electrical connector. The programming is performed using Tech Tool and is necessary to ensure that engine timing and emission levels are correct.

Note: Due to the ECM self learning capability, it is necessary to reset learned ECM parameters after servicing some engine related components. This allows the ECMU to learn the new components behavior. After servicing is complete, perform the "Learned Data Reset" using Tech Tool. This is located in the Function Group 1 menu.

Note: If reinstalling an injector into the same location, reprogramming is not required.

48

Install the valve bridges onto the same cylinders as marked at disassembly. Lubricate the valve bridges and camshaft lobes with engine oil.

49

Install the rocker shaft. Refer to Group 214 for service procedures.

50

Adjust **all** of the valves and injectors. Refer to Group 214 for service procedures.

51

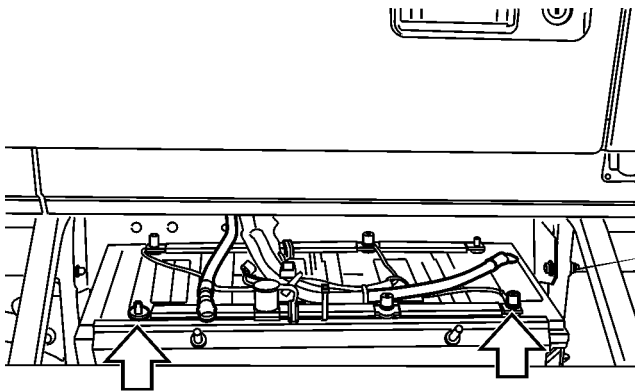
Install the valve cover on the cylinder head. Refer to Group 211 for procedure.

52

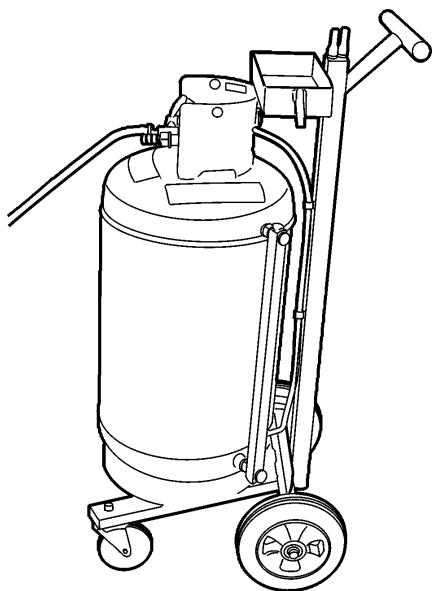
Secure the fuel supply line fitting at the fuel filter housing (loosened earlier to drain fuel from the cylinder head). Clean any fuel that remains around the fitting.

53

Install all previously removed cables to the ground (negative) battery terminals.



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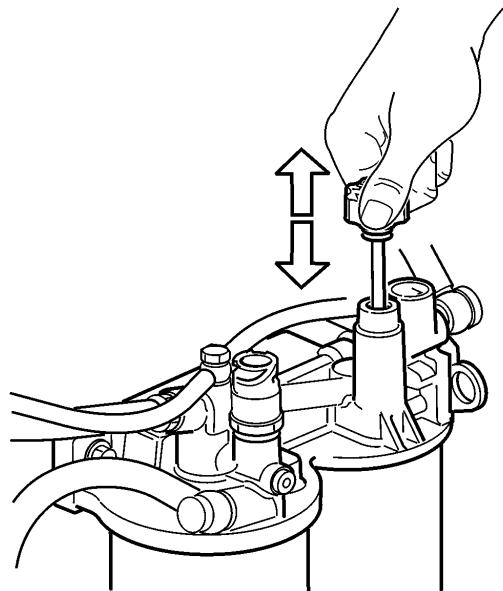


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54

Use coolant extractor to fill the system with approved coolant per specifications.

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Prime the fuel system by pumping the hand priming pump on the fuel filter housing until resistance is felt indicating that the system is full of fuel.

56

Start the engine and run until the engine clears and runs without stumbling. This procedure may need to be repeated once or twice to get the fuel system completely free of air.

Note: If the engine does not start on the first attempt, prime the fuel system again, and refer to the previous step. Engine priming may need to occur several times in order to get the engine to start.

57

Allow the engine to run at low idle for about 5 minutes. Check for any fuel leaks and correct if necessary.

Note: The engine speed should **not** be increased as any air pockets can be forced into the cylinder head which can result in the engine stopping.