

Fuel System

Section 5D - Fuel Injectors

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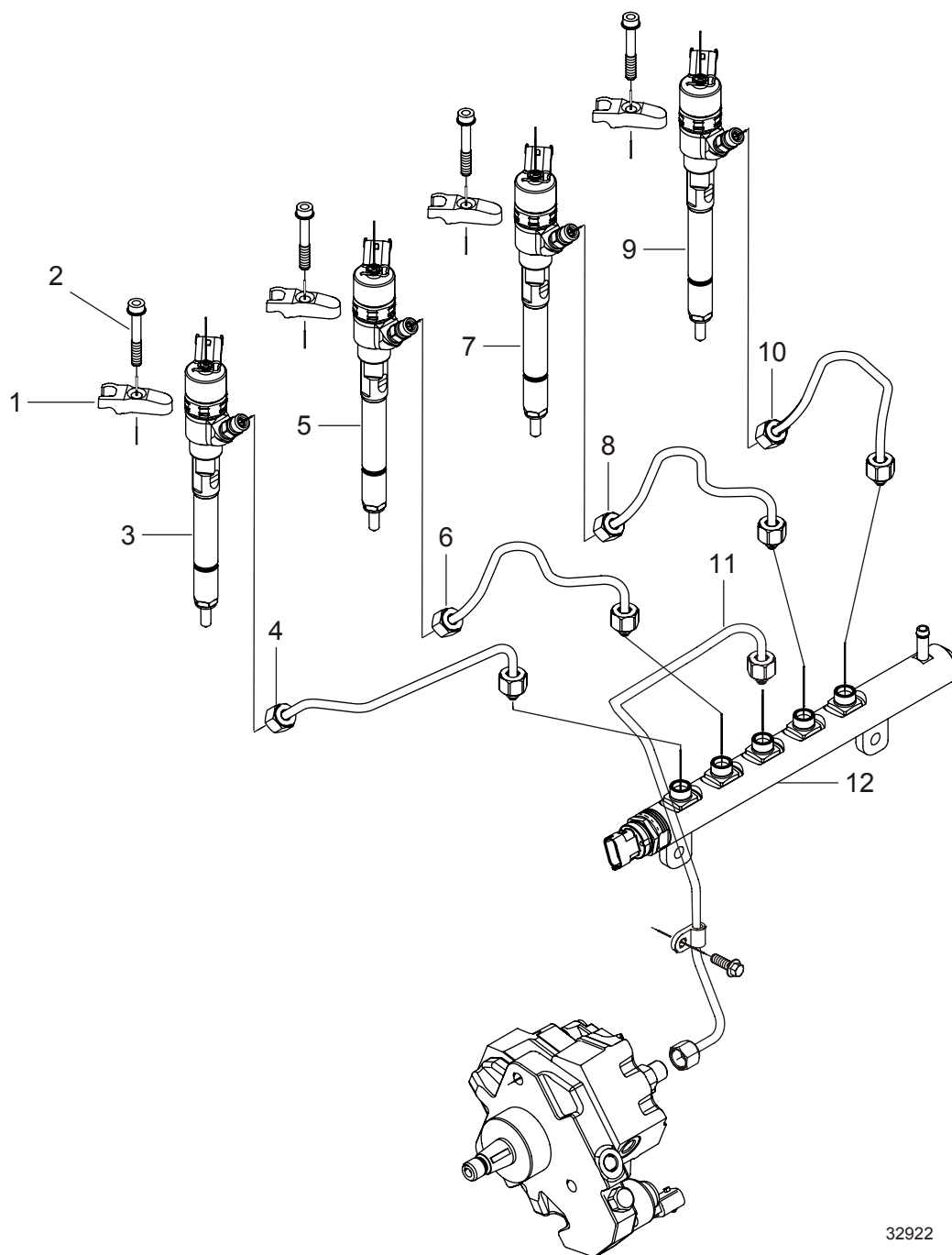
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Lubricant, Sealant, Adhesives

Tube Ref No.	Description	Where Used	Part No.
 80	SAE Engine Oil 30W	Injector O-ring seal	Obtain Locally

Notes:

Exploded View—Fuel Injectors and Related



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Exploded View—Fuel Injectors and Related

Ref. No.	Qty.	Description	Torque		
			Nm	lb-in.	lb-ft
1	4	Fuel injector clamp			
2	4	Fuel injector clamp screw	30	–	22
3	1	Fuel injector 1			
4	1	High pressure fuel line, Injector 1	See Section 5C—High Pressure Fuel Lines.		
5	1	Fuel injector 2			
6	1	High pressure fuel line, Injector 2	See Section 5C—High Pressure Fuel Lines.		
7		Fuel injector 3			
8	1	High pressure fuel line, Injector 3	See Section 5C—High Pressure Fuel Lines.		
9		Fuel injector 4			
10	1	High pressure fuel line, Injector 4	See Section 5C—High Pressure Fuel Lines.		
11	1	High pressure fuel supply line	See Section 5C—High Pressure Fuel Lines.		
12	1	Common rail			

Fuel Injector Repair and Service

The Robert Bosch Corporation has a worldwide network of authorized Bosch Service Dealers to service their products.

The high pressure fuel pump, common rail, and injectors must be sent to an authorized Bosch Service Center.

When shipping an injection pump to a service center for adjustments or repairs, the fuel return line hollow bolt must accompany the unit. The hollow bolt incorporates a calibrated sized orifice for proper pressure that is matched to the pump. The pump cannot be adjusted properly without the matched orifice.

Contact the Bosch distributor nearest you for the location of an authorized Bosch Service Center.

Fuel Injectors

Description

These electronically controlled diesel engines use a hole type injector nozzle and holder. In contrast to the previous throttling pintle nozzles, the electronically controlled injector must have its installed position and calibration specifications programed into the ECM.

Injector controlled fuel management includes:

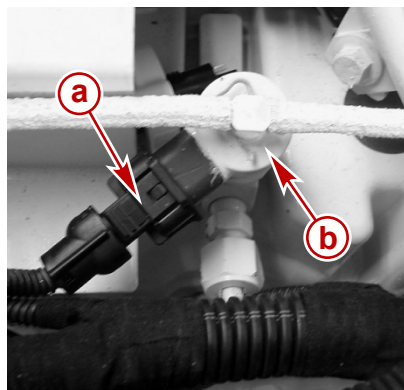
- Meter the injected fuel
- Manage and prepare the fuel spray in the cylinder
- Set the rate of fuel discharge
- Close off the injection system from the combustion process

Removal

⚠ CAUTION

Failure to release pressure from the fuel system will result in fuel spraying out, which can cause a fire or explosion. Allow the engine to cool completely and release all fuel pressure before servicing any part of the fuel system. Always protect eyes and skin from pressurized fuel and vapors.

1. Disconnect the injector harness connection.



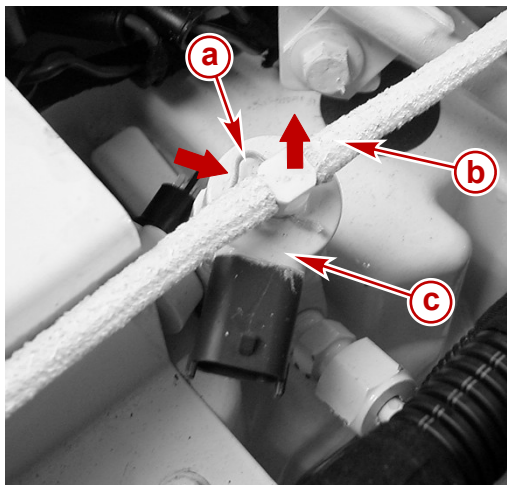
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- a** - Harness connector
b - Injector

IMPORTANT: If the injector is to be replaced, remove and retain the horseshoe clip for installation.

NOTE: The horseshoe retaining clips for the fuel injector return line can not be replaced as an individual part. If a clip is lost or damaged the entire return line assembly must be replaced to obtain a new clip.

2. Push in the retaining clip and pull up on the fuel injector return line.



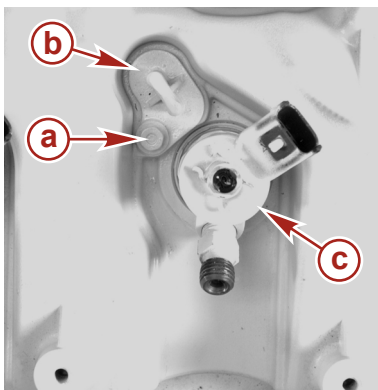
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- a** - Retaining clip
- b** - Injector return line
- c** - Injector

3. Clean around the fuel injectors, fittings, and pipes.
4. Remove the components necessary to gain access to the high pressure fuel lines. See the appropriate sections for procedures.
5. Remove the high pressure fuel lines. Refer to **Section 5C—Common Rail and Fuel Lines** for removal procedures.

IMPORTANT: The injectors can be removed without removing the valve cover by loosening the injector clamp screw and sliding the screw and clamp assembly away from the injector.

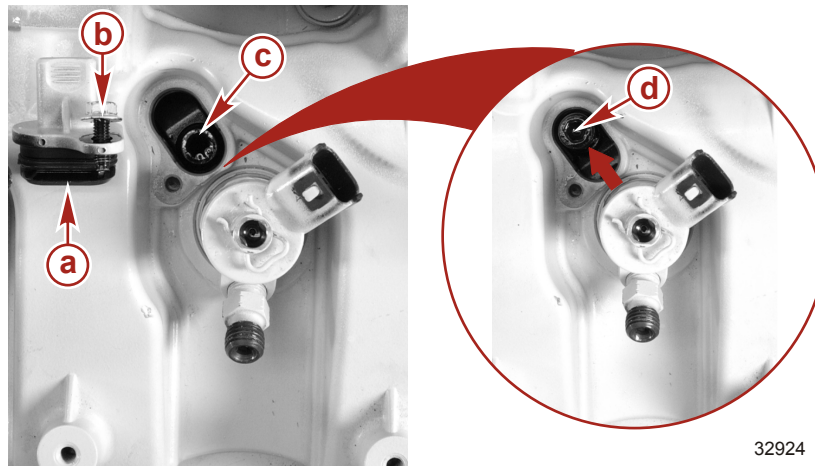
6. Remove the injector clamp cover.



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- a** - Injector clamp cover screw
- b** - Injector clamp cover
- c** - Fuel Injector

7. Loosen the injector clamp screw and washer.



- a** - Injector clamp cover
- b** - Injector clamp cover screw
- c** - Injector clamp screw in lock position
- d** - Injector clamp screw in unlocked position

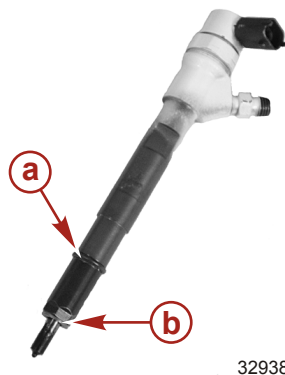
8. Using the screw, slide the injector clamp away from the injector.

IMPORTANT: To prevent injector nozzle from rusting, wet parts with diesel fuel before handling.

NOTE: To assist in removal, rotate the injector slightly clockwise and counterclockwise to break any seal formed by paint or corrosion. Repeat for each injector if required.

IMPORTANT: Note and mark the location of each injector for installation. The ECM is programmed with cylinder and injector-specific calibration information.

9. Withdraw the fuel injector from the bore together with its copper sealing washer and O-ring. Note and mark the injector with its location for installation.
10. Discard the copper sealing washer and O-ring.



- a** - O-ring
- b** - Copper sealing washer

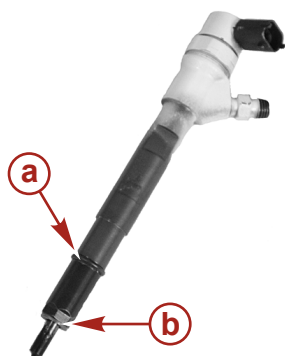
Inspection

1. Remove any injector seal that may have stayed in the head. Do not gouge or nick the injector seat.
2. Ensure that cylinder head injector bores are clean.

Installation

IMPORTANT: Ensure that the copper sealing washer is centered in the injector bore and fully seated on the cylinder head.

1. Place a new copper sealing washer on the injector.

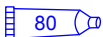


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a - O-ring groove

b - Copper sealing washer seat

2. Install a new O-ring seal in the groove on the injector. Lubricate the seal.

Tube Ref No.	Description	Where Used	Part No.
 80	SAE Engine Oil 30W	Injector O-ring seal	Obtain Locally

IMPORTANT: The ECM is programed with cylinder and injector specific calibration information. Install the injector in the same cylinder from which it was removed.

3. Point the fuel inlet adapter away from the valve cover and install the injector. Ensure that the injector O-ring seal is not damaged during installation.
4. Position the injector clamp and screw in the locked position.



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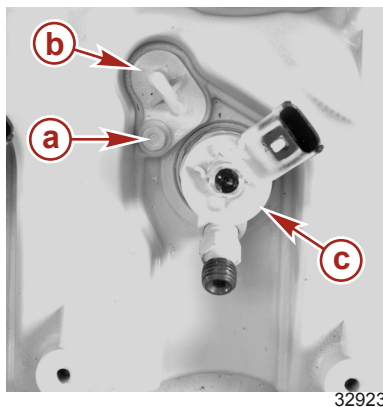
a - Injector clamp screw in unlocked position

b - Injector clamp screw in lock position

5. Tighten the injector clamp screw to specification.

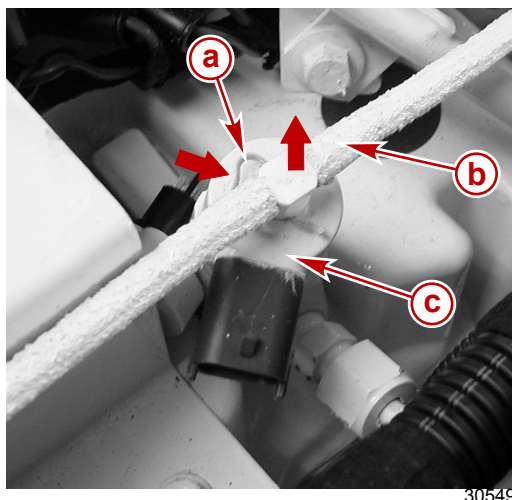
Description	Nm	lb-in.	lb-ft
Injector clamp screw	21.6	191	—

6. Install the injector clamp cover.



- a** - Injector clamp cover screw
- b** - Injector clamp cover
- c** - Fuel Injector

7. Install the high pressure fuel lines. Refer to **Section 5C—Common Rail and Fuel Lines** for installation procedures.
8. Check that the retaining clip is installed on the injector.
9. Push in on the retaining clip and install the fuel injector return line.



- a** - Retaining clip
- b** - Injector return line
- c** - Injector

10. Connect the injector harness connector.
11. If any of the injectors were replaced, use the CDS tool to calibrate the ECM to the new injector. See **ECM Injector Calibration**.

NOTICE

Without sufficient cooling water, the engine, the water pump, and other components will overheat and suffer damage. Provide a sufficient supply of water to the water inlets during operation.

⚠ WARNING

The fuel injection pump generates pressure in excess of 13790 kPa (2000 psi), which is high enough to penetrate or cut the skin. Do not use your fingers to feel for fuel leaks and wear personal protective equipment when servicing the fuel system.

12. Start the engine.

NOTE: *It is sometimes helpful to use compressed air to dry the area near fittings when checking for fuel leaks. Wear safety glasses.*

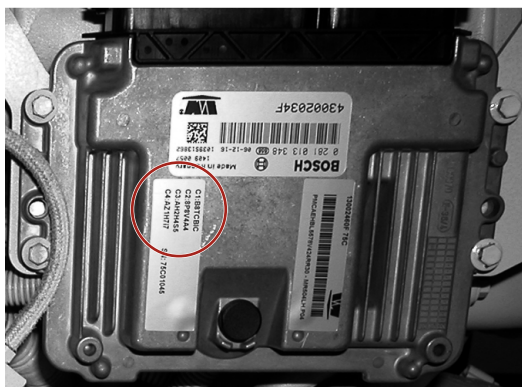
13. Check for fuel leaks while waiting for engine to reach normal operating temperature. Immediately stop the engine if leaks exist.

14. Repair as needed.

ECM Injector Calibration

IMPORTANT: Each injector is specifically calibrated to a specific cylinder. If the injector is not calibrated using the injector metering adjustment (IMA) code, the ECM will not recognize it, and the engine will not operate correctly.

Injectors that are supplied with the engine have the IMA code painted over during the assembly process. The codes are placed on a label and affixed to the back of the ECM for reference.



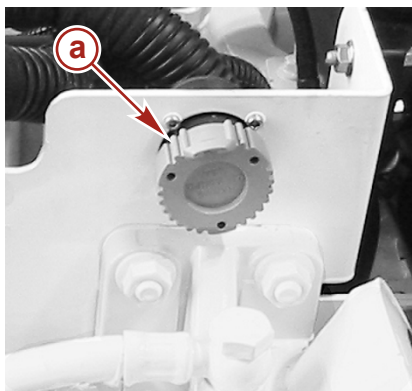
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ECM injector IMA label

New injectors come with a new label to update the IMA codes. Write down the IMA numbers for injectors that will not be replaced on the new label. Affix the new label to the back of the ECM for future reference.

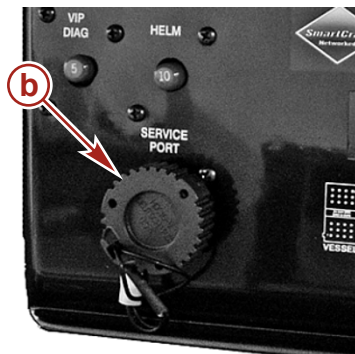
1. Check that each injector is properly installed and connected to the wiring harness.

2. Connect the CDS tool to the engine diagnostic connection port.



Engine Diagnostic Connector

a - Engine diagnostic port



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VIP Diagnostic Connector

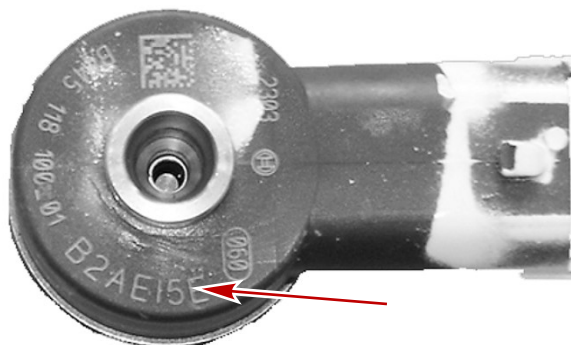
b - VIP diagnostic port

3. Turn the key switch to "ON" but do not start the engine.

IMPORTANT: The injector metering adjustment (IMA) code for new injectors is located on top of each injector.

NOTE: *Injector IMA codes for injectors that come with the engine are located on the back of the ECM.*

4. Follow the on screen instructions to calibrate each injector using the injector metering adjustment (IMA) code.



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New injector IMA code