

Common Rail Injector Installation Instructions & Information

Common Rail Injector General Information



Fuel may be returned at highly elevated temperatures. Wear safety glasses and protective gloves and clothing when performing this test. Avoid any contact with returned fuel.



The pressure within the fuel rail is extremely high. A high-pressure leak can penetrate the skin. Stand clear of the engine while it is running.



Be sure the fuel inlet and return valves are returned to the open position before cranking the engine. Engine damage can result if valves are in the wrong position when the engine is cranked or started. Environmental damage can also occur.

The fuel return manifold is located near the point at which the OEM connects the vehicle fuel drain line. To locate this manifold, follow the fuel drain lines from their source, (rail pressure relief valve, injector return, or high pressure injector pump return) to their termination point. The termination point will occur at the fuel return manifold.

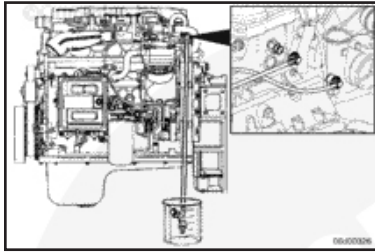
Refer to Procedure 006-999 in Familiarization section for further information.

An internal leak from either the high-pressure connector or the fuel injector will result in increased fuel return flow from the cylinder head. The single cylinder cut-out test will not be able to isolate this leak because it occurs before it reaches the control needle inside the injector. Because all injectors share the same pressurized fuel supply from the rail, all cylinders will share the loss of fuel equally.

Due to the varying engine configurations, the following steps have been established to cover a majority of engine configurations. The purpose of the following steps are to isolate and measure the injector return fuel drain flow. In some configurations this requires isolating the high pressure fuel pump and/or fuel rail pressure relief valve fuel drain flows.

Common Rail Injector Setup

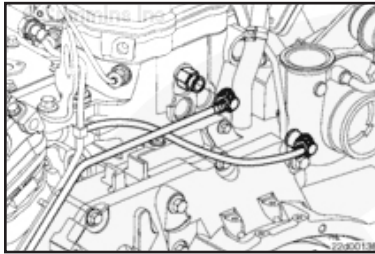
Low Mount Fuel Drain Manifold



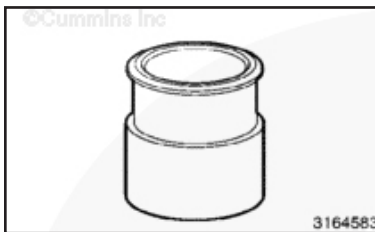
3.9L and 5.9L Engines Without EGR

These engines have a quick-disconnect fitting, with a white tang, in the fuel return port at the back of the cylinder head.

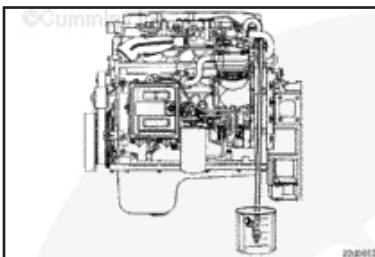
Check for excessive flow in the injector return circuit due to leakage.



Remove the quick-disconnect fuel line from the back of the cylinder head and attach the fuel pressure gauge adapter, Part Number 3164044.

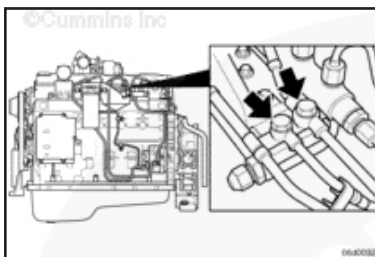


Install the quick-disconnect block-off fitting, Part Number 3164583, on the drain line removed from the cylinder head to prevent the back flow of fuel from the drain line.



Place the loose end of the fuel pressure gauge adapter tool into a graduated cylinder, Part Number 3823705.

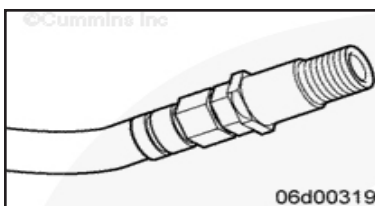
High Mount Fuel Drain Manifold with Two Banjo Fittings



5.9L Engines with EGR

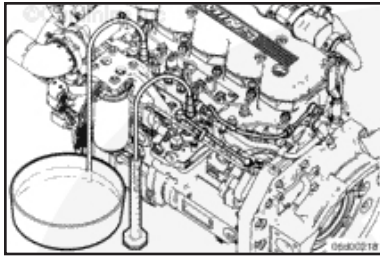
These engines have a banjo fitting in the fuel return port at the back of the cylinder head.

If the pressure relief valve fuel return flow measures zero, proceed with this procedure. If the pressure relief valve fuel return flow is not zero, refer to Procedure 006-061 for the reseating or replacement procedure.



The injector and the fuel rail pressure relief valve share the same return line. Therefore it is necessary to isolate the fuel rail pressure relief valve flow from the fuel injector return flow. Remove the banjo bolt from the fuel rail pressure relief valve. Install the pressure relief valve return flow hose, Part Number 3164617, in place of the banjo bolt.

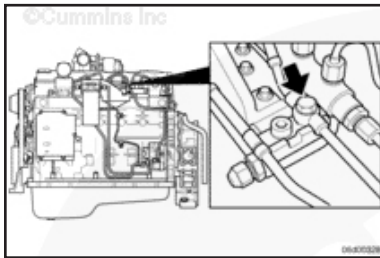
Drain any fuel into a drain pan.



Follow the fuel drain line from the back of the cylinder head to the fuel return manifold. Remove the banjo bolt from the fuel injector drain line at the fuel return manifold. Install the fuel drain hose, Part Number 3164618, in place of the banjo bolt.

Place the end of the fuel injector drain line fuel return flow hose in a graduated cylinder, Part Number 3823705, and collect return flow.

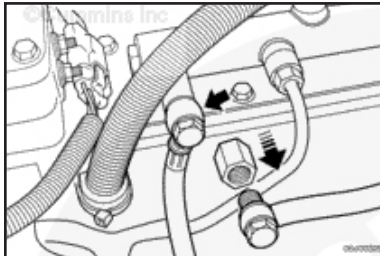
High Mount Fuel Drain Manifold with One Banjo Fitting



6.7 L Engines in Industrial Applications

These engines have a banjo fitting in the fuel return port at the back of the cylinder head.

If the pressure relief valve fuel return flow measures zero, proceed with this procedure. If the pressure relief valve fuel return flow is not zero, refer to Procedure 006-061 for the reseating or replacement procedure.

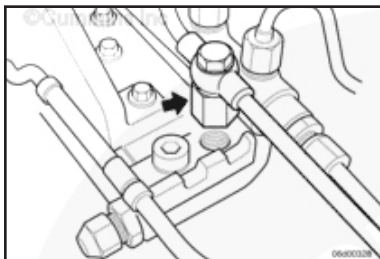


Isolation of the fuel rail pressure relief valve flow from the injector return flow requires the use of the fuel rail pressure relief valve flow tester kit, Part Number 4918295.

Remove the banjo bolt from the fuel rail pressure relief valve.

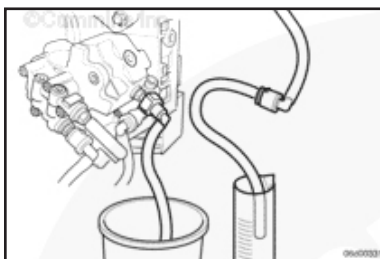
Install the fuel rail pressure relief valve fuel drain hose onto the pressure relief valve using the banjo bolt supplied in the tester kit.

Install the cap supplied in the pressure relief valve tester kit onto the existing banjo, to cap off the pressure relief valve fuel drain line.



Measurement of injector return flow requires the use of a fuel system leak tester, Part Number 4918354. The fuel system leak tester contains Part Numbers: 4918297, 4918433, and 4918434.

Remove the banjo bolt from the fuel drain line at the fuel return manifold. (This is the inline banjo fitting). Install a cap, Part Number 4918297, onto the banjo bolt to prevent fuel flow to the return manifold.

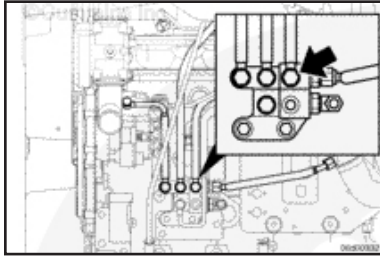


To prevent high pressure fuel pump return flow from entering the injector return flow, remove the fuel return line quick-disconnect on the injector pump.

Install a fuel drain hose with a female quick-disconnect, Part Number 4918434, onto the high pressure fuel pump and drain into a bucket.

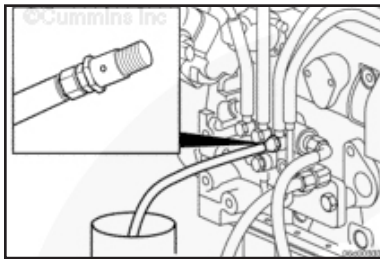
Insert a fuel drain hose with male quick-disconnect, Part Number 4918433, into the removed fuel drain line. Place the end of the fuel drain hose into a graduated cylinder, Part Number 3823705.

Marine Applications



NOTE: The fuel return manifold on marine engines is located on the side of the engine block, in front of the ECM.

Follow the fuel drain line from the injector return port at the back of the cylinder head to the fuel return manifold.

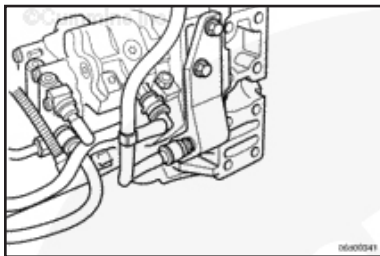


Remove the banjo bolt from the injector drain line at the fuel return manifold.

Insert a fuel drain hose, Part Number 3164618, in place of the banjo bolt.

Insert the end of the fuel drain hose into a graduated cylinder, Part Number 3823705, to measure injector return flow.

Gear Housing Fuel Drain



4.5L Industrial and Automotive Applications

It also applies to 6.7L automotive applications and some 6.7L industrial applications. These engines have a banjo fitting in the fuel return manifold at the back of the cylinder head and a combined fuel return manifold

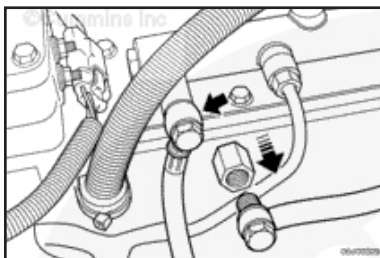
6.7L Engines in Industrial Applications

These engines have a banjo bolt fitting at back of cylinder head and one banjo bolt in fuel return manifold

If the pressure relief valve fuel return flow measures zero, proceed with this procedure. If the pressure relief valve fuel return flow is not zero, refer to Procedure 006-061 for the reseating or replacement procedure.

To measure the fuel injector return flow, it is necessary to isolate the fuel rail pressure relief valve flow.

NOTE: A banjo bolt or a quick-disconnect fitting can be present on the fuel rail pressure relief valve.

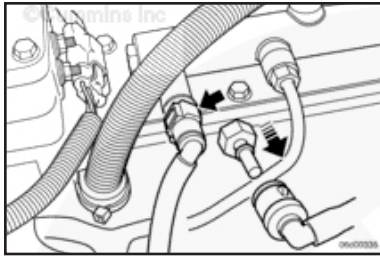


For engines with a banjo fitting on the fuel rail pressure relief valve, use the fuel rail pressure relief valve flow tester kit, Part Number 4918295.

Remove the banjo bolt from the fuel rail pressure relief valve.

Install the fuel rail pressure relief valve fuel drain hose onto the pressure relief valve using the banjo bolt supplied in the tester kit.

Install the cap supplied in the pressure relief valve tester kit onto the existing banjo, to cap off the fuel drain line.

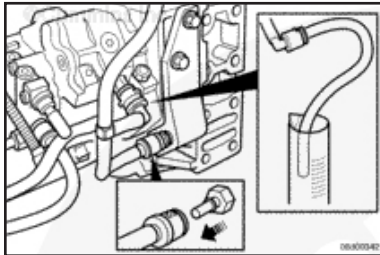


For engines with a quick-disconnect fitting on the fuel rail pressure relief valve, use a female quick-disconnect drain hose and a block-off fitting to isolate the fuel pressure relief valve flow.

Remove the quick-disconnect fitting from the pressure relief valve.

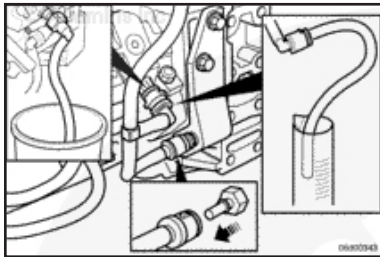
Install a pressure gauge adapter, Part Number 4918462, on the fuel rail pressure relief valve and drain into a bucket.

Install a quick-disconnect block-off fitting, Part Number 4918464, into the fuel drain line removed from the fuel rail pressure relief valve.



Remove the quick-disconnect fitting on the fuel drain line from the fuel return manifold.

Install a quick-disconnect block-off fitting, Part Number 4918464, into the fuel drain line to prevent fuel flow into the fuel return manifold.



To prevent high pressure fuel pump drain flow from entering the injector return flow, remove the fuel drain line from the high pressure fuel pump.

Install a fuel drain hose with female quick-disconnect, Part Number 4918434, onto the high pressure fuel pump and drain into a bucket.

Install a fuel drain hose with a male quick-disconnect fitting, Part Number 4918433, into the fuel drain line removed from the injector pump. This hose will be placed into a graduated cylinder, Part Number 3823705, to measure injector fuel return flow.

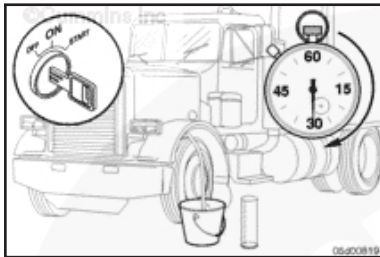
Common Rail Injector Initial Check



Fuel can be returned at highly elevated temperatures. Wear safety glasses and protective gloves and clothing when performing this test. To reduce the possibility of personal injury, avoid contact with returned fuel.



The pressure within the fuel rail is sufficient to penetrate the skin and cause serious personal injury. Wear gloves and protective clothing.



For marine applications, open fuel supply and return valves.

Start the engine. Start the INSITE™ electronic service tool Fuel Leakage Test and allow the injectors to get up to operating temperature for at least 1 minute. By allowing the injectors to get up to operating temperature, more accurate fuel flow measurements can be made.

This test elevates the fuel rail pressure.

With the fuel drain hose, Part Number 3164618 in a graduated cylinder, measure the injector drain flow for 1 minute.

Flow Specification: INSITE™ Fuel Leakage Test active	
4-cylinder	200 ml per minute [6.8 fl-oz per minute] maximum
6-cylinder	300 ml per minute [10.1 fl-oz per minute] maximum

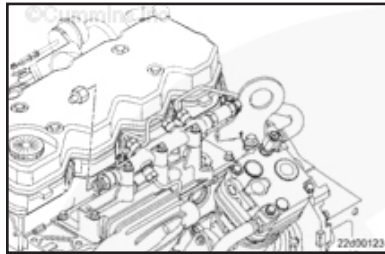
Flow Specification: Standard Idle Conditions (leak may not be detected)	
4-cylinder	120 ml per minute [4 fl-oz per minute] maximum
6-cylinder	180 ml per minute [6 fl-oz per minute] maximum

If the engine will **not** start, crank the engine and measure the amount of fuel returned from the injectors.

Flow Specification: Engine Cranking	
4 & 6 cylinder	90 ml per minute [3 fl-oz per minute] maximum
NOTE: Be sure not to overheat the starter.	

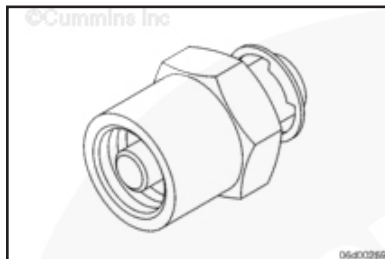
If fuel flow is greater than specification, it is necessary to perform the injector isolation test described below.

Common Rail Injector Test



Before attempting to isolate the leak, make sure that all the high pressure fuel connectors are tightened to the correct torque. Refer to Procedure 006-052. If a connector is not tightened to the proper torque, tighten the connector and perform the previous test again. If the injector return flow is greater than the specified flow rate, it is necessary to block off the fuel to one injector at a time to determine the location of the leak.

With the engine **not running**, remove the fuel injector supply line connecting the rail to cylinder number 1.



3.9L and 5.9L Engines

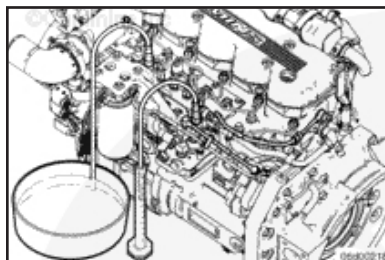
Install the injector leakage isolation tool, Part Number 3164325, on the rail where the number 1 cylinder fuel line connects.

Torque Value:	30 n.m	[26 ft-lb]
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4.5L and 6.7L Engines

Install the injector leakage isolation tool, Part Number 4918298, on the rail where the number 1 cylinder fuel line connects.

Torque Value:	35 n.m	[29 ft-lb]
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Repeat the leakage flow test with cylinder one blocked off and record the flow rate.

Install the fuel injector supply line. Refer to Procedure 006-051.

Repeat the leakage test with each cylinder blocked off.

Record the flow rate for each test.

The flow rate will decrease below the maximum specified flow when the cylinder with the leak is blocked.

The table represents the results from a leakage test with a leak present in cylinder number 5 injector or high pressure connector.

Leak Test Results						
Cylinder blocked	1	2	3	4	5	6
ml/minute [fl-oz/minute]	210 [7]	220 [7]	215 [7]	210 [7]	91 [3]	220 [7]

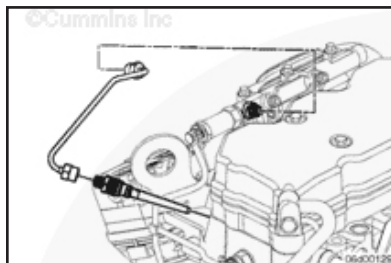
If this test is performed and there is not a significant change in fuel return flow while cutting out one injector, there may be a problem with more than one injector. Compare the fuel flow difference across all injectors. If there is more than one injector that caused a noticeable decrease in flow, those could be the injectors with the problems.

Another cause of this problem could be the customer is operating on fuels with lower viscosity than specified. Fuels with low viscosity will result in higher injector leakage and greater drain flow rates.

Common Rail Injector Removal



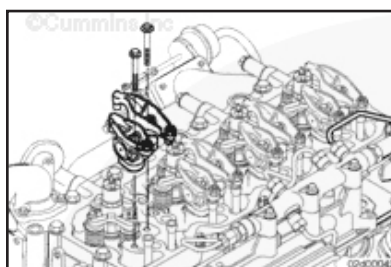
The fuel connector must be removed before removing the injector or damage to the connector will result.



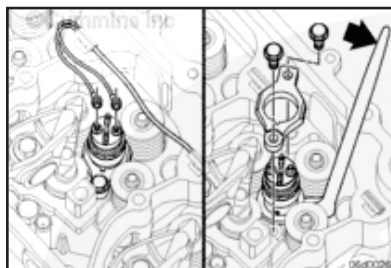
Remove the high-pressure fuel line from the fuel rail and high-pressure connector. Refer to Procedure 006-051.

Remove the high-pressure connector. Refer to Procedure 006-052.

Remove the rocker lever cover. Refer to Procedure 003-011.



Remove the exhaust rocker lever. Refer to Procedure 003-008.



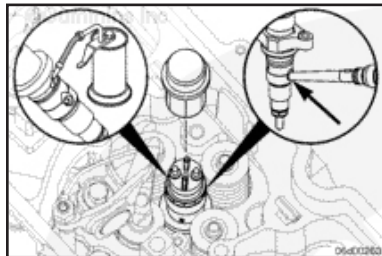
Disconnect the solenoid wires.

Remove the two injector hold-down capscrews and remove the injector hold-down clamp.

NOTE: The injector hold-down clamp is not removable on all engines. Use the injector remover, Part Number 3823024, to remove the injector from the cylinder head.

NOTE: A small heel pry bar can also be used to pry up the injector. Pry up the injector hold-down flange (part of the injector body just above the cylinder head casting).

Common Rail Injector Installation



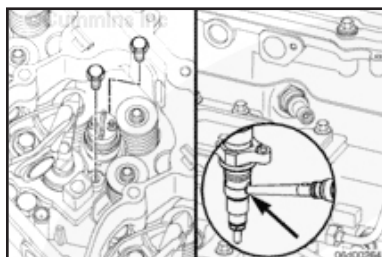
Make sure the injector bore is clean and that only one (1) sealing washer is installed on the injector nozzle.

The rounded edge of injector hold-down clamp is positioned toward the rocker levers. The fuel inlet hole on the injector faces the intake side of the engine.

NOTE: The injector hold-down is removable on some injectors. Lubricate the injector o-ring with clean engine oil.

Align the injector in the cylinder head in the proper orientation (fuel inlet toward the high-pressure fuel connector). Use the injector solenoid shipping cap, make sure the injector is seated in the injector bore.

NOTE: If the injector solenoid shipping cap is not used to install the injector, be careful that pressure is not placed on the wire terminals. Wire terminals could break off if they are used to push on the injector.



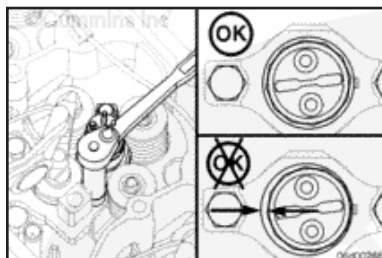
Install the injector hold-down and injector hold-down capscrews, but **do not** tighten. A new high pressure fuel connector **must be used** anytime an injector is replaced.

Install the high-pressure fuel connector making sure the end of the high-pressure fuel connector is in the injector inlet port.

Start the high-pressure fuel connector retaining nut and tighten partially.

Torque Value:	15 n.m	[133 in-lb]
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This is **not** the final torque for the high-pressure fuel connector retaining nut.



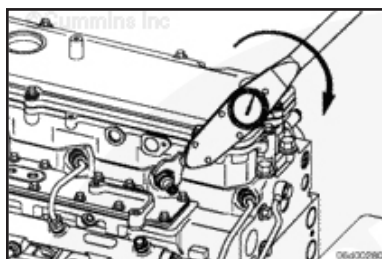
Tighten the injector hold-down capscrews. Make sure to tighten the hold-down capscrews evenly. Check to make sure the gap between the hold-down clamp and the injector is equally spaced around the injector body.

Torque value (3.9L and 5.9L):

Alternate between capscrews turning 90 degrees per turn until reaching 10 n.m [89 in-lb].

Torque value (4.5L and 6.7L):

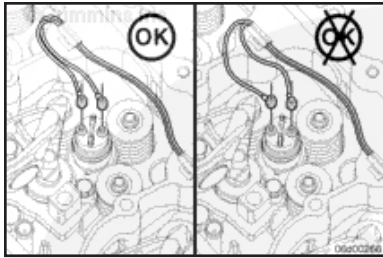
Alternate between capscrews turning 90 degrees per turn until reaching 8 n.m [71 in-lb]



CAUTION The injector solenoid terminals will yield and may malfunction if too much torque is applied. Do not over tighten.

Tighten the high-pressure fuel connector retaining nut.

Fuel Connector (Cylinder Head Mounted)	50 n.m	[34 ft-lb]
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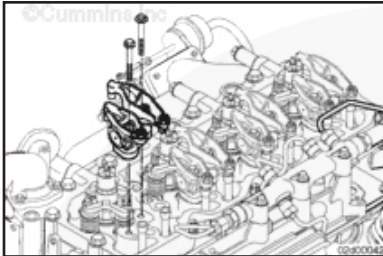


Connect and tighten the solenoid wires.

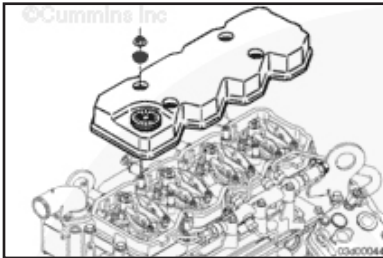
Torque Value:	1.5 n.m	[13 in-lb]
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Use service tool, Part Number 3823208, or a torque wrench.

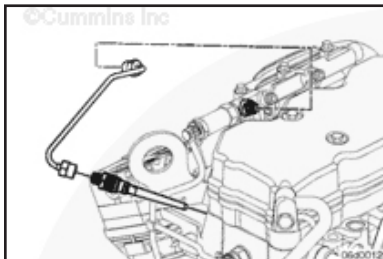
Be sure the solenoid wires can not make contact with the rocker levers when installed.



Install the exhaust rocker and adjust the exhaust valve lash. Refer to Procedure 003-008.

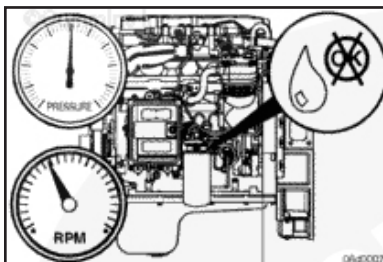


Install the rocker lever cover. Refer to Procedure 003-011.



Install the high-pressure fuel line from the fuel rail to the high-pressure connector. Refer to Procedure 006-051.

Common Rail Injector Finishing Steps



For Marine applications, open fuel supply and return valves. Operate the engine and check for leaks.