



Service Manual B3.9, B4.5, B4.5 RGT, and B5.9 Volume 2

SYMPTOM: COOLANT TEMPERATURE ABOVE NORMAL

Cause	Correction
Low Coolant Level	Add Coolant. Refer to Section
Collapsed Radiator Hose	
Engine Lubricating Oil Level is too High or Low	
Engine is Receiving too Much Fuel	
Dirty Engine (Exterior)	
Loose Fan Drive Belt	
Radiator Shut Opening Closed	
Temperature Sensor Faulty	
Thermostat Stuck Closed	
Water Pump Faulty	

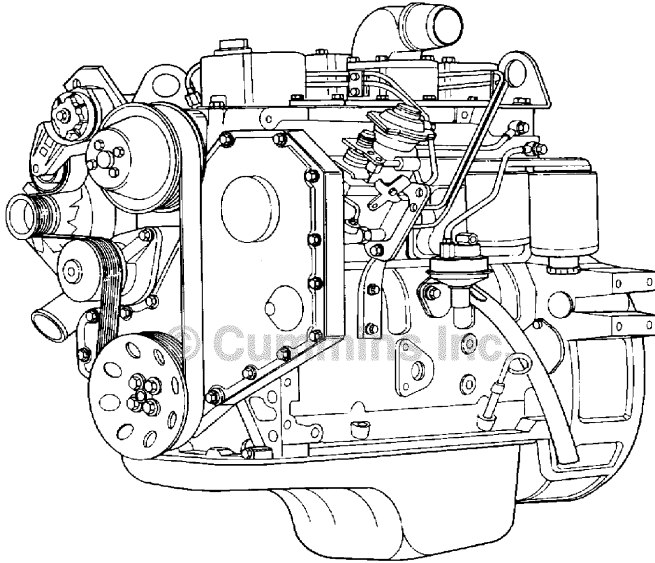
Continued

The illustration shows a circular temperature gauge with a needle pointing towards the right. Below the gauge are several wrenches of different sizes. In the foreground, there is a diagnostic tool with a screen displaying various engine parameters: Fuel/Lean, Inj./AC, Volts, Oil/Water, and Intake/Air. The tool has several cables and connectors attached to it.

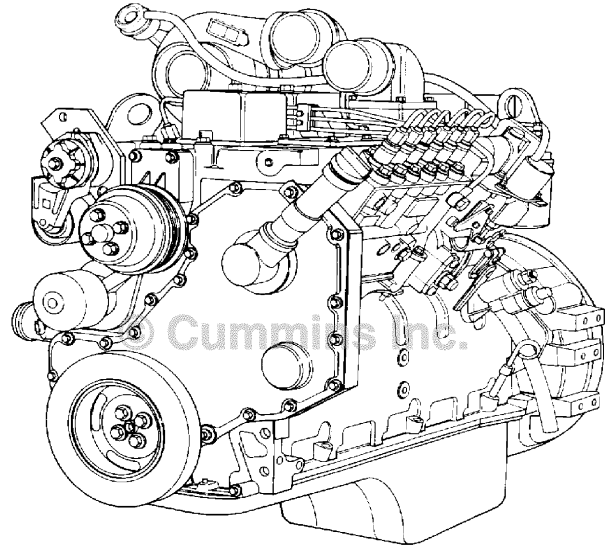




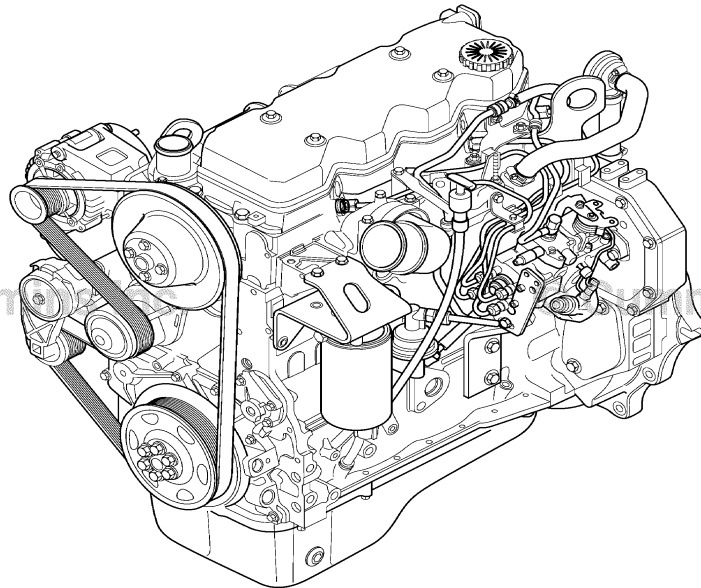
Service Manual
B3.9, B4.5, B4.5 RGT, and B5.9
Volume 2



B3.9 and B4.5



B5.9



B4.5 RGT

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Foreword

This manual contains instructions for troubleshooting and repairing this engine in the chassis, complete rebuild procedures and specifications. Disassembly, cleaning, inspection, and assembly instructions are included. A listing of accessory and component suppliers is located in Section M - Component Manufacturers. Suppliers can be contacted directly for any information not covered in this manual.

Read and follow all safety instructions. Refer to the WARNING in the General Safety Instructions in Section i - Introduction.

The manual is organized to guide a service technician through the logical steps of identifying and correcting problems related to the engine. This manual does not cover vehicle or equipment problems. Consult the vehicle or equipment manufacturer for repair procedures.

The repair procedures in this manual are based on the engine or component removed from chassis. Some rebuild procedures require the use of special service tools. Make sure the correct tools are used as described in the procedures.

When a specific brand name, number, or special tool is referenced in this manual, an equivalent product can be used in place of the recommended item.

A series of specific service manuals (for example: Troubleshooting and Repair, Specifications, and Alternative Repair) are available and can be ordered by contacting your local area Cummins Regional office. A Cummins Regional office listing is located in Service Literature (Section L).

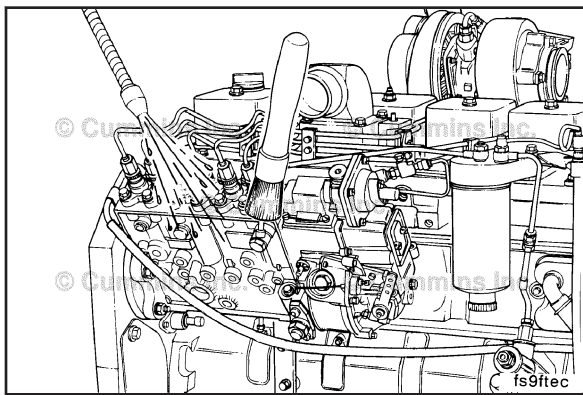
Cummins Inc. encourages the user of this manual to report errors, omissions, and recommendations for improvement. Please use the postage paid, pre-addressed Literature Survey Form in the back of this manual for communicating your comments.

The specifications and rebuild information in this manual is based on the information in effect at the time of printing. Cummins Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a Cummins Authorized Repair Location or call 1-800-DIESELS (1-800-343-7357) toll free in the U.S. and Canada.

The latest technology and the highest quality components are used to manufacture Cummins engines. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

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Plunger Lift Timing

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Do not allow any dirt, debris, or paint chips to enter the fuel system while it is open. If foreign material of any type is allowed into the pump, lines, or injectors during this process, it could result in an injection pump or fuel injector malfunction.

NOTE: This timing procedure can **only** be used on Bosch® P7100 fuel injection pumps.

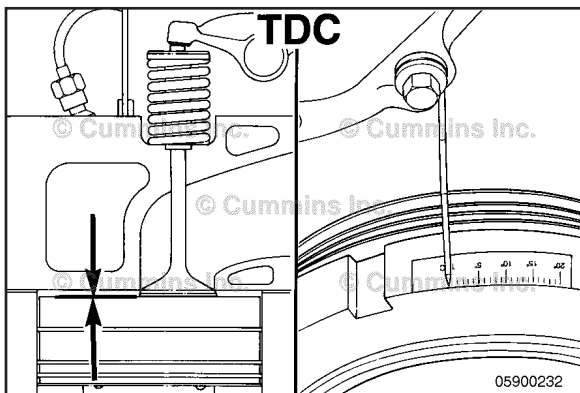
Plunger Lift Timing Kit, Part Number 3162853

The kit contains the following items:

- Dial indicator, Part Number 3824564
- Adapter, Part Number 3824565
- Special socket, Part Number 3824566
- Delivery valve seals, Part Number 3824567.

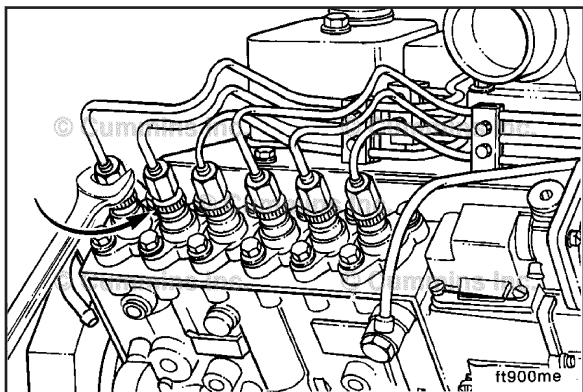
Step: 1

Thoroughly clean the engine and fuel system before attempting to remove any components. Pay special attention to the top of the fuel injection pump. Use compressed air to remove any water remaining on the fuel pump after the cleaning process.



Step: 2

Locate top dead center (TDC) of the compression stroke on cylinder Number 1. The following procedure uses the engine timing pin, but other alternate methods, such as the dropped valve method, can be used.



Step: 3

⚠ CAUTION ⚠

Do not bend the fuel lines. Bending the lines will cause line or injector failure.

If the injection lines have **not** already been removed, remove the Number 1 injection line.

Step: 4

⚠ WARNING ⚠

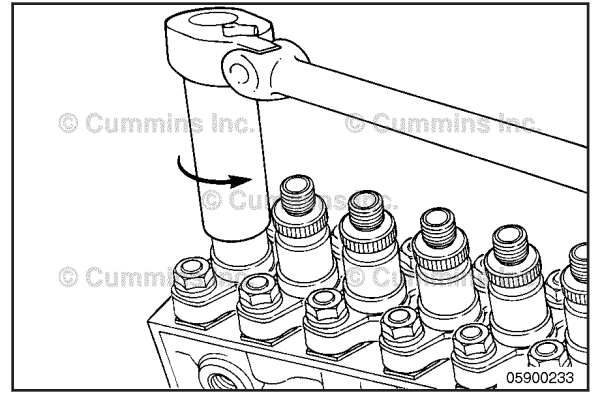
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause bodily injury.

⚠ CAUTION ⚠

Do not loosen the two barrel flange nuts located below the delivery valve holder. Loosening of these nuts will void the fuel injection pump warranty.

NOTE: There is an external o-ring on the holder to help prevent debris from getting into the pump; this can create a slight resistance as the holder is loosened.

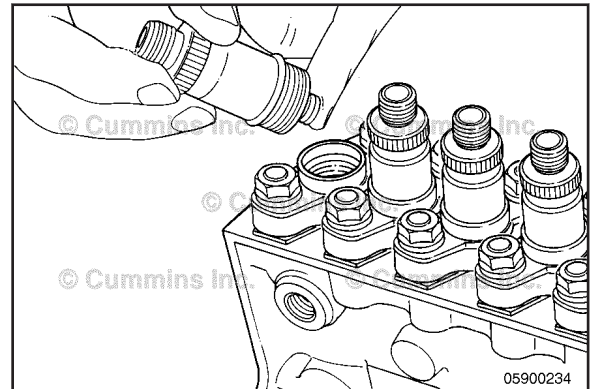
With the engine at TDC, loosen, but do **not** remove the front (Number 1) delivery valve holder using the special socket provided in the timing kit. Use compressed air to remove any paint chips from around the delivery valve holder. Remove the special socket prior to removing the delivery valve holder from the fuel injection pump.



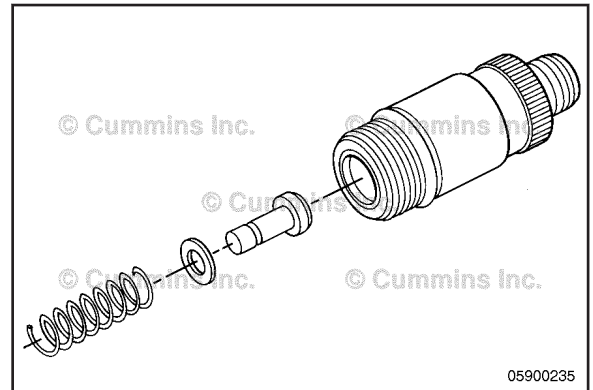
Step: 5

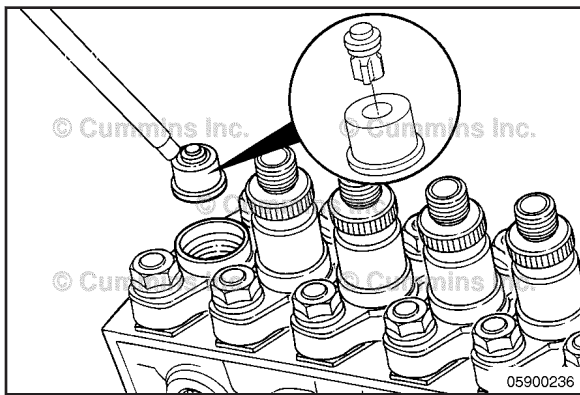
⚠ CAUTION ⚠

Use extreme care when removing the delivery valve holder and delivery valve components. Keep all parts together in the order in which they are removed from the fuel injection pump.



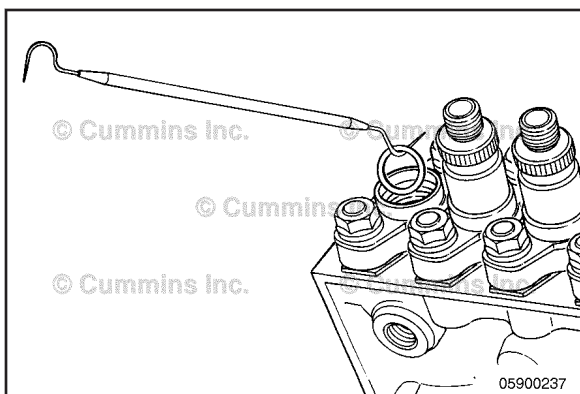
Remove the delivery valve holder by carefully tipping the holder outboard with one hand while using the other hand to hold the spring, fill piece, and any shims from slipping out of the holder. Place these as an assembly on a clean surface out of the way.





Step: 6

Using a magnet, remove the two-piece delivery valve assembly from the pump. Place these pieces on a clean surface with the delivery valve holder.



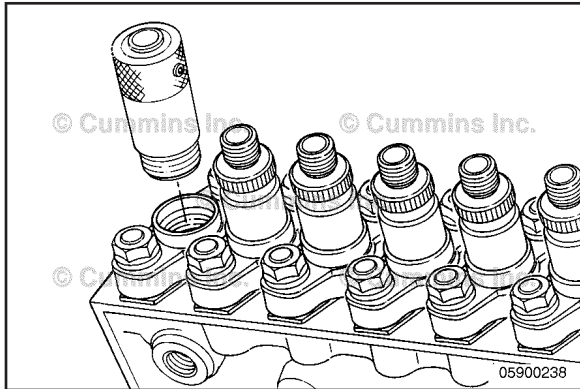
Step: 7

CAUTION

Do not scratch the top of the plunger/barrel assembly during gasket removal.

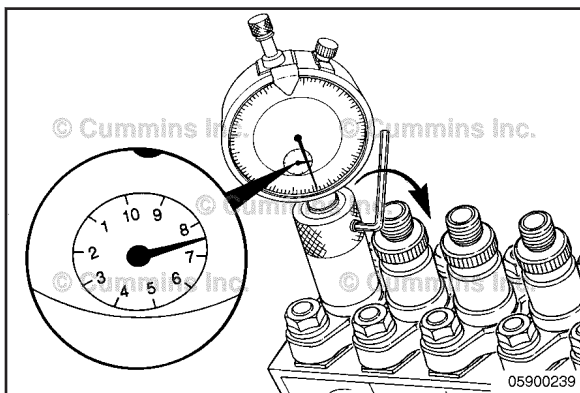
NOTE: The delivery valve gasket can be either bronze or steel, or on new injection pumps, there is often no gasket.

If the gasket is bronze, use a pick to remove it from the top of the pumping element; if the gasket is steel, use a pick or a magnet. Discard the used delivery valve gasket.



Step: 8

Install the dial indicator from the timing kit in place of the Number 1 delivery valve holder and tighten finger-tight.



Step: 9

Loosen the set screw on the dial indicator adapter, and install the dial indicator into the adapter. Position the dial indicator to read between 7.0 and 9.0 mm, and lightly tighten the set screw.



Overtightening the set screw will bind the dial indicator.

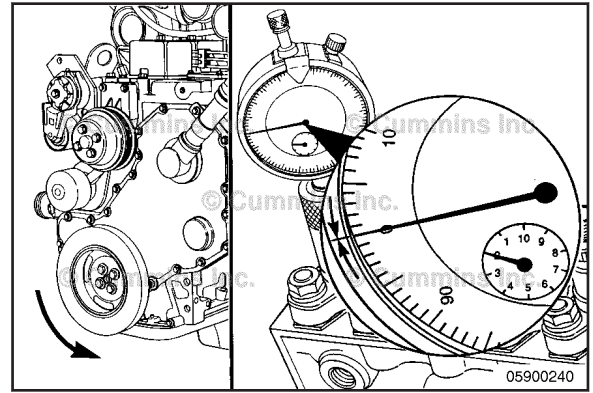
NOTE: The dial indicator is capable of measuring from 0 to 20.00 mm lift. The small inner dial is marked in increments of 1.00 mm; the large outer dial is marked in increments of 0.01 mm. One revolution of the outer dial is equal to 1.00 mm. The inner dial **only** indicates 0 to 10.00 mm, but will rotate twice as the indicator goes through the full range.

Step: 10

⚠CAUTION⚠

Be sure to disengage the timing pin before rotating the crankshaft to avoid damage to the timing pin.

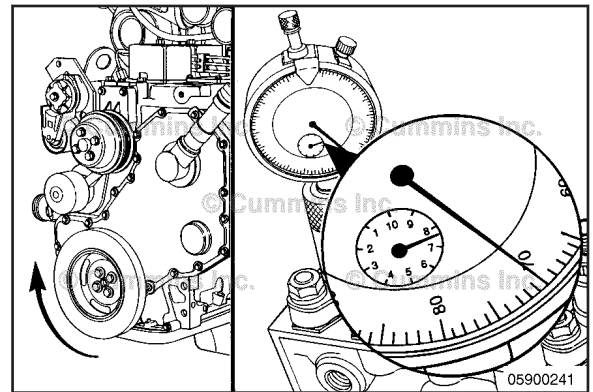
Use a barring tool to rotate the crankshaft in the direction opposite normal direction of crankshaft rotation (**counterclockwise** from front of the engine) 1/4 turn or until the dial indicator reading stops dropping. This is the inner base circle of the fuel injection pump camshaft. Zero "0" the indicator and note the reading on the small inner dial.



Step: 11

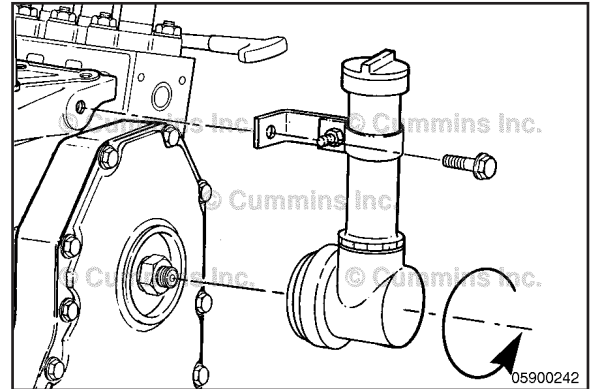
Rotate the crankshaft slowly to TDC in the direction of normal crankshaft rotation (**clockwise** from front of the engine).

The total lift **must** be within the specified lift for that CPL. The attached table lists the lift setting in millimeters (mm) that corresponds to the engine timing specification in degrees.



Step: 12

If a change in injection timing is required, remove the oil filler tube and adapter elbow or fuel injection pump gear access cap from the front of the gear housing.

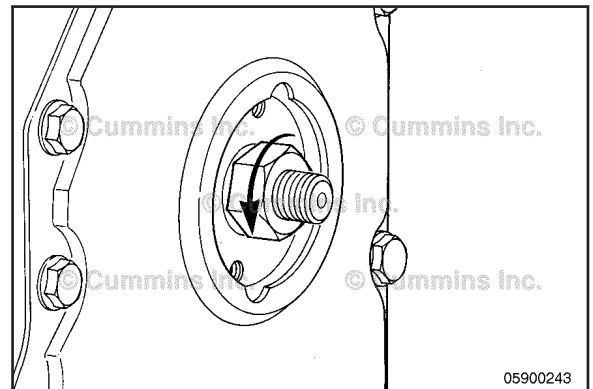


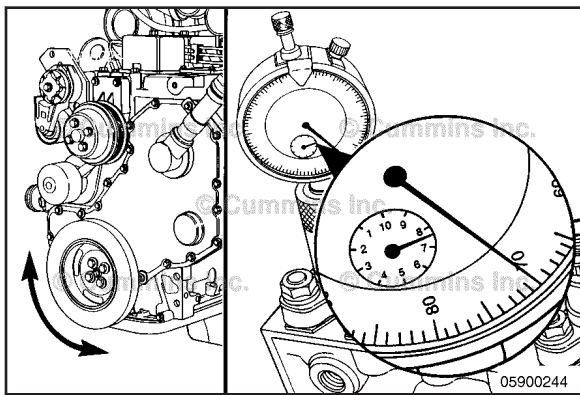
Step: 13

⚠CAUTION⚠

Be sure to disengage the timing pin before rotating the crankshaft to avoid damage to the timing pin.

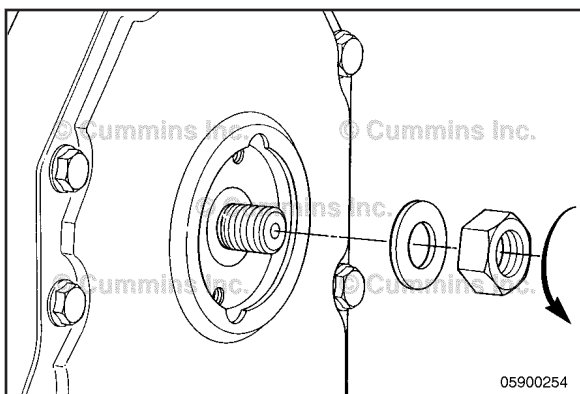
Loosen the injection pump shaft nut approximately 1/4 turn. The barring tool can be used to keep the crankshaft from rotating.





Step: 14

If the actual lift setting is **not** within specification, rotate the crankshaft to obtain the desired dial indicator setting (plunger lift).

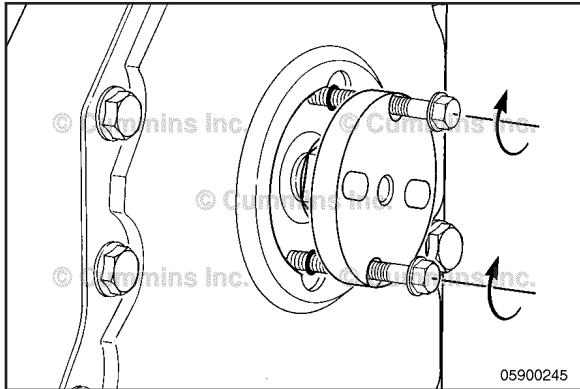


CAUTION

Do not allow the drive nut or washer to drop inside the engine gear cover. Disassembly of the engine will be required for retrieval.

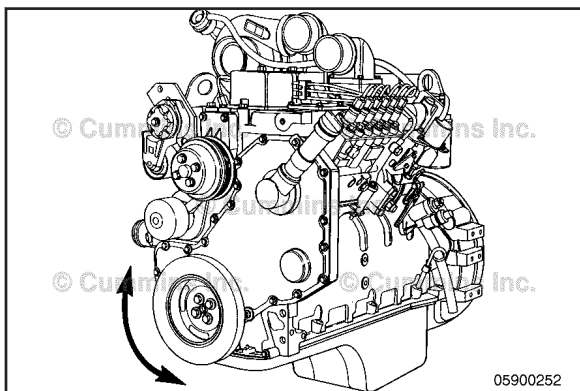
Remove the fuel injection pump driveshaft nut and lock washer.

Service Tip: Use a pointed object such as a metal awl and a magnet, to assist in the removal of the lock washer.



Step: 15

With the fuel injection pump positioned at the correct plunger lift setting, use the gear puller, Part Number 3824469, or equivalent, to pull the injection pump gear off the taper of the injection pump input shaft. Remove the gear puller.

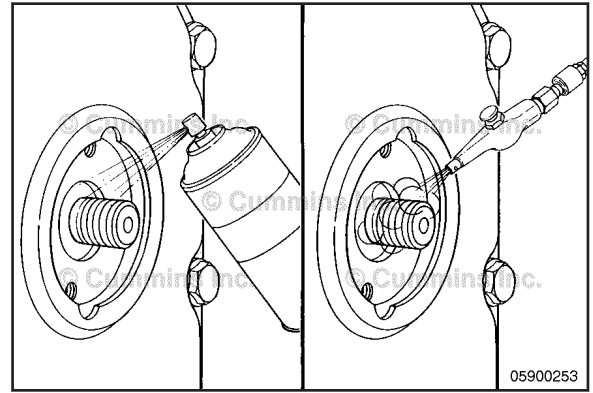


Step: 16

Rotate the crankshaft 20 degrees to 30 degrees opposite the direction of normal crankshaft rotation; then rotate the crankshaft back in the direction of normal crankshaft rotation to TDC. This step removes the backlash from the lower gear train.

Step: 17

Clean the fuel injection pump shaft and gear tapers with a residue-free cleaner (Cummins Part Number 3824510, or equivalent) by spraying into the gap between the shaft and gear. Dry the taper surfaces with compressed air. Failure to clean and dry the shaft and gear tapers thoroughly can result in a timing shift to the retarded side after the engine is started and run under load. This will result in low power, smoke, and rough running.



Step: 18

CAUTION

Be sure the timing pin is disengaged before the final tightening step to avoid damage to the timing pin.

Install the input shaft lock washer and nut. Use a 2-step tightening process to tighten the fuel injection pump gear nut.

Torque Value: 15 N•m [133 in-lb]

This will seat the shaft taper.

Hold the crankshaft from rotating (using the barring tool or other means) on the final step of the tightening sequence.

Torque Value: 165 N•m [122 ft-lb]

Step: 19

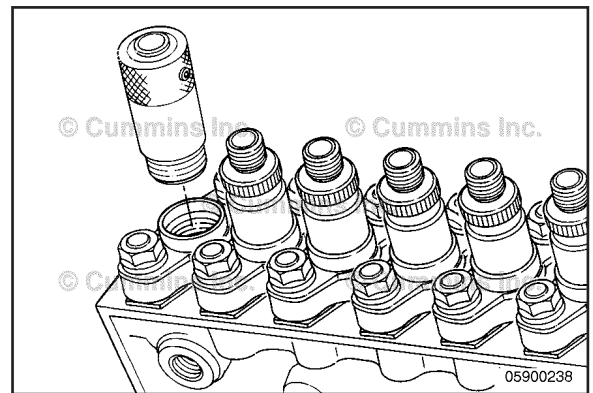
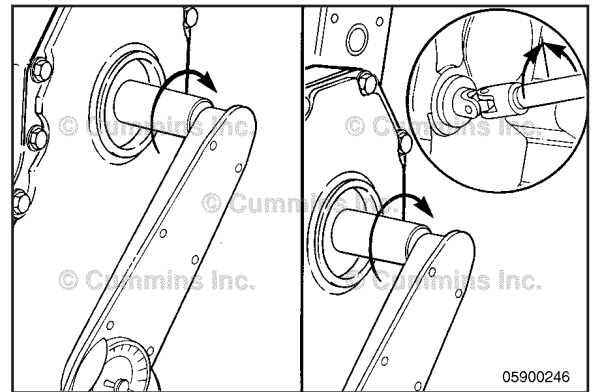
Repeat steps 10 and 11 to verify that the final timing setting is correct.

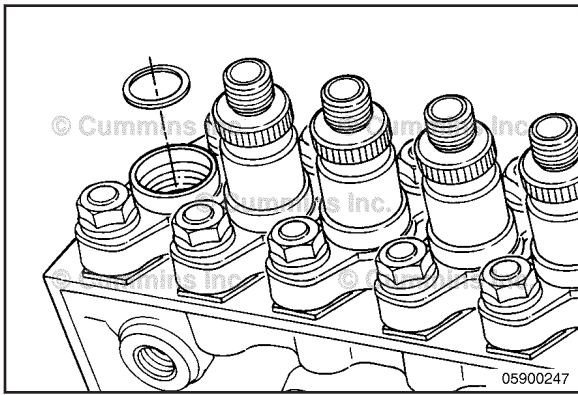
Step: 20

CAUTION

The following steps for installing and tightening the delivery valve and holder must be followed exactly. Improper installation will result in delivery valve damage or leaks.

Remove the dial indicator and adapter from the fuel injection pump.

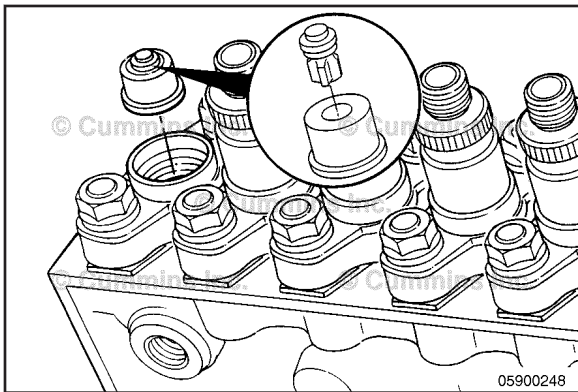




Step: 21

Inspect the fuel injection pump bore for debris. The bore **must** be free of debris.

If a gasket was removed from under the delivery valve, install a new delivery valve gasket (Cummins Part Number 3824567) into the fuel injection pump. Do **not** use a gasket if this is a pump with gasketless delivery valves. See attached list of pumps that have or do **not** have delivery valve gaskets.

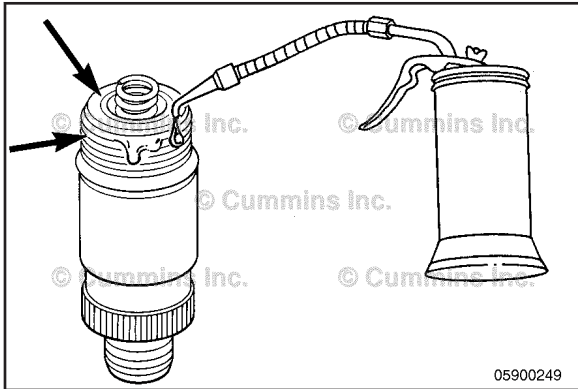


Step: 22

Clean the delivery valve parts with residue-free cleaner (Cummins Part Number 3824510, or equivalent) prior to reassembly.

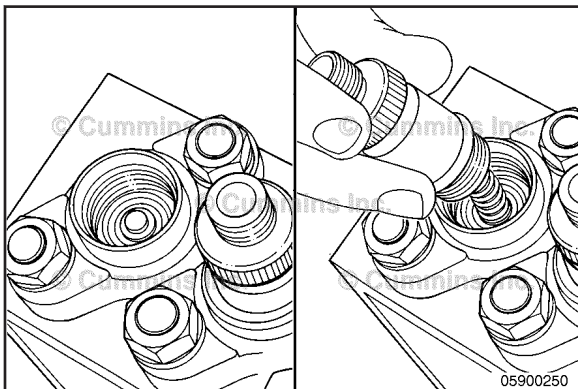


Install the delivery valve assembly.



Step: 23

Lubricate the threads and clamping surface of the delivery valve holder with a few drops of SAE 90 hypoid gear oil. Do **not** lubricate the delivery valve gasket or its seating area.



Step: 24

Install the delivery valve holder assembly, taking care **not** to displace the delivery valve spring, fill piece, or any shims.

Step: 25

⚠ WARNING ⚠

Keep hands and body parts away from the high-pressure fuel lines. Fuel coming from the high-pressure fuel lines is under extreme pressure and can cause serious injury by penetrating the skin.

Use step 1 to initially tighten the holder; then, in one motion, use step 2 for the final torque value.

Torque Value:

Step 1	40 N•m	[29 ft-lb]
Step 2	115 N•m	[85 ft-lb]

Install the remaining engine components removed during the TDC location or timing process. Leave the injector side of the high-pressure fuel lines loose to facilitate bleeding the air out of the system.

Crank the engine until fuel is observed at the injectors. Tighten the high-pressure lines at the injector. Start the engine, and vent one line at a time until the engine runs smoothly. Check for leaks.

