

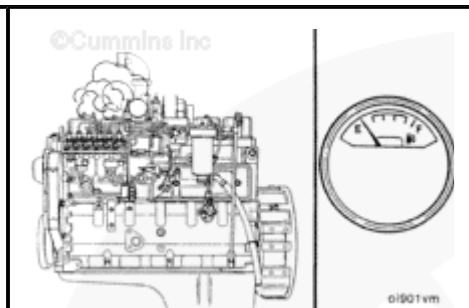
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## 005-037 Fuel Pump Timing

### General Information

Pump-to-engine timing is extremely critical. Pump timing that is off by **only** a few crankshaft degrees will cause:

1. Poor performance - starting and power.
2. Excessive smoke.
3. Poor fuel economy.

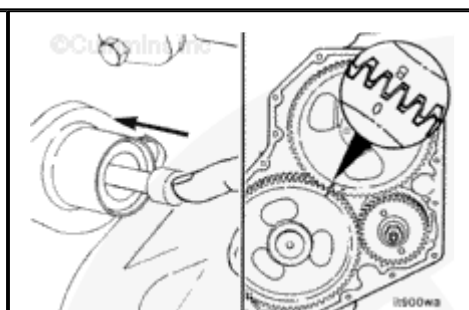


### Time

Engine pump timing begins with the timing of the fuel injection pump drive gear to the camshaft gear.

The first step is the location of TDC of the compression stroke for cylinder Number 1.

Then, depending on the engine configuration, an alpha character on the injection pump drive gear will possibly need to be aligned with the mark on the camshaft gear.



This table **must** be used to maintain proper fuel injection pump-to-engine timing. The Control Parts List (CPL) number from the engine dataplate and the Control Parts List Manual, Bulletin 3379133 or 4021327, **must** be used to determine whether the engine is certified, and if so, what year and regulating agency (EPA or CARB).

Given this information, use the following table to determine which letter on the fuel injection pump drive gear is aligned with the camshaft gear.

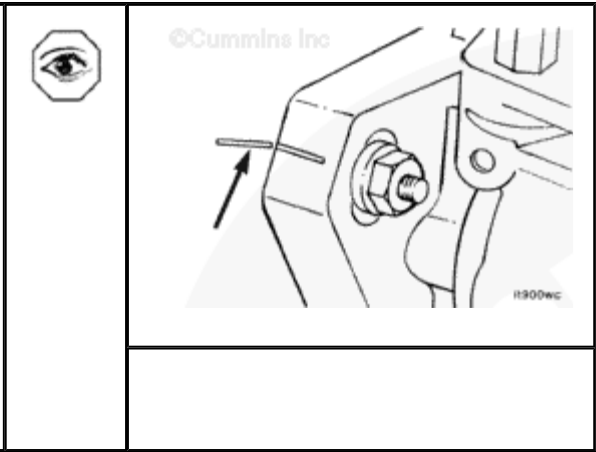
**NOTE: Timing mark alignment is not required for the Nippondenso EP-9 or Bosch® in-line drive gear.**

**NOTE: The timing mark is not required for Bosch® VE and DP210 used on Tier II Industrial engines. For these engines, vary timing by using the Timing Check procedure.**

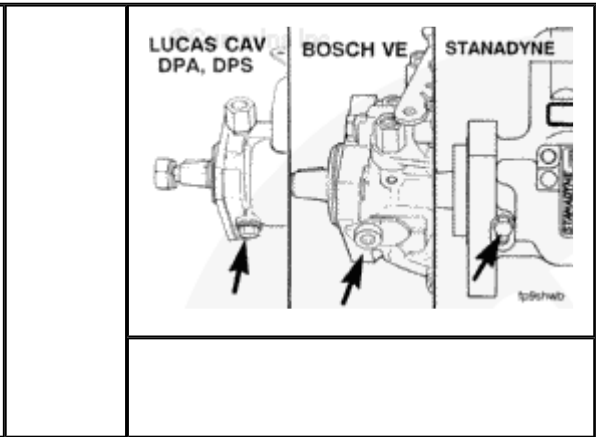
Letter on Pump Gear	Engine Model	Injection Pump	Certification
A	4B3.9, 4BT3.9	Stanadyne pump	Noncertified
A	4B3.9, 4BT3.9, 4BTA3.9	Lucas CAV DPA pump	All noncertified
B	4B3.9, 4BTA3.9	Bosch® VE	1986, 1987 EPA, All pre-1986, All noncertified
C	6BT5.9, 6BTA5.9	Bosch® VE	1986, 1987 EPA, All pre-1986, All noncertified, CPL 600
D	6B5.9, 6BT5.9	Stanadyne	Noncertified
D	6B5.9, 6BT5.9, 6BTA5.9	Lucas CAV DPA	All noncertified
E	6BT5.9, 6BTA5.9	Bosch® VE	1986, 1987, 1988, 1989, 1990, 1991, 1992 CARB
F	4BT3.9, 4BTA3.9	Bosch® VE	1986, 1987, 1988, 1989, 1990, 1991, 1992 CARB, 1988, 1989, 1990, 1991, 1992 EPA
G	6BTA5.9	Lucas CAV DPA	All Fire Pumps
H	<b>Not</b> used at this time	N/A	N/A

To verify that the fuel injection pump is timed correctly, first check the alignment marks on the pump flange and gear housing.

**NOTE: 1 mm of rotation past the timing mark will advance or retard (depending on direction of rotation) the pump timing by 1 degree.**

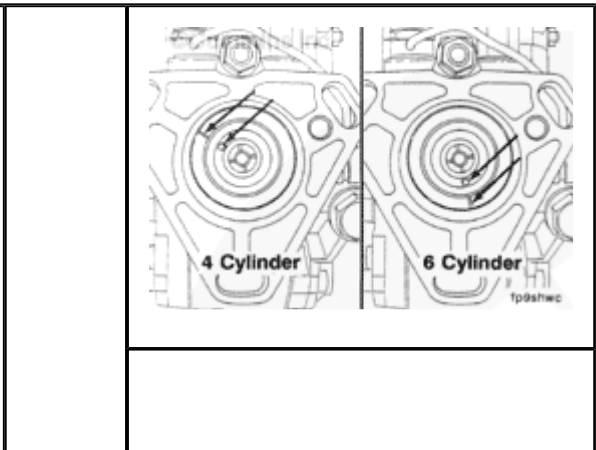


The Lucas CAV DPA, DPS, Delphi DP210, Stanadyne DB4, and the Bosch® VE fuel injection pumps all have a provision for locking the pump shaft at a position corresponding to top dead center for cylinder Number 1. New and reconditioned fuel injection pumps **must** be received with the shafts located in this position.



At the point of injection, the keyway of the shaft will align with the delivery valve receiving the injection and the illustrated hash mark on the seal housing.

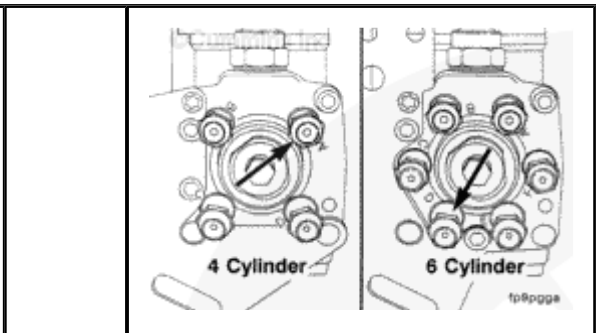
**NOTE: The illustrated mark is for reference only and must not be used for setting the fuel injection pump timing.**



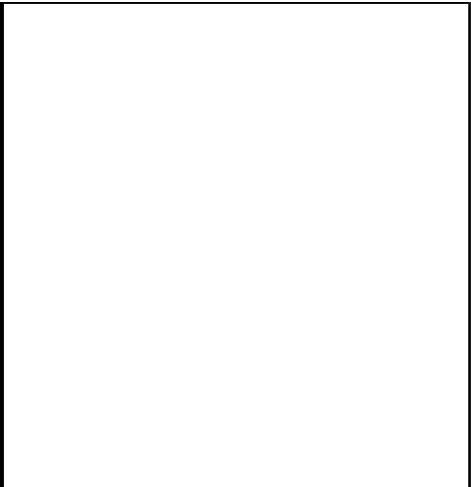
The Number 1 cylinder delivery valve is marked as illustrated.

Four cylinder = A

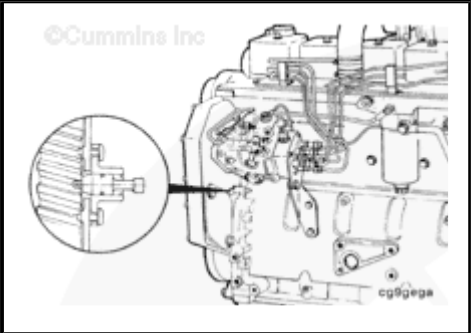
Six cylinder = D



Firing Order	
Four Cylinder	Six Cylinder
A = 1	D = 1
B = 3	E = 5
C = 4	F = 3
D = 2	A = 6
	B = 2
	C = 4



The engine is equipped with an engine timing pin to locate top dead center (TDC) for cylinder Number 1.

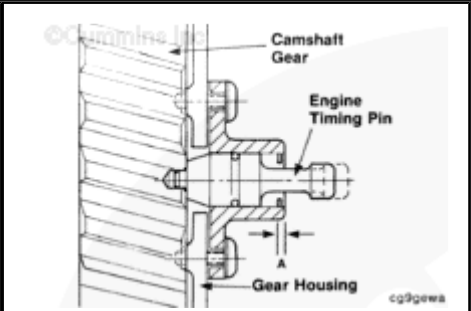


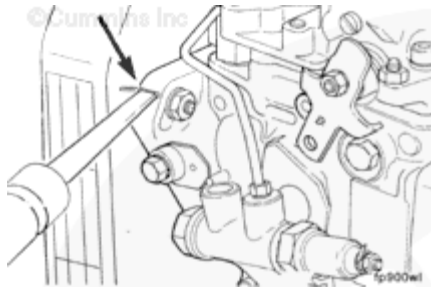
**CAUTION**

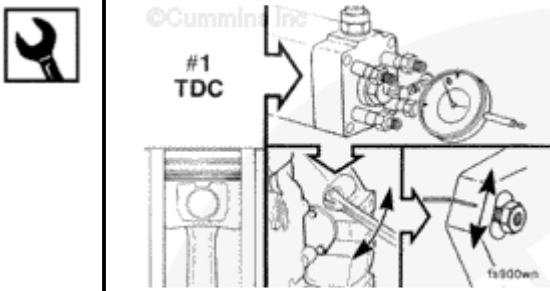
If the timing pin is incorrectly located on the gear housing, the pump will not be timed correctly.

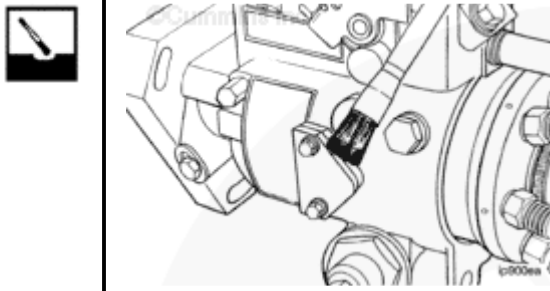
After precisely locating TDC for cylinder Number 1, the factory positions the timing pin assembly to the gear housing, using the timing pin and the hole in the camshaft gear. If the gear housing or timing pin assembly are removed, the same precision is required to relocate it.


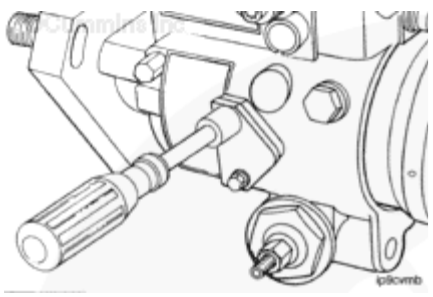
If the timing pin assembly is incorrectly located, reposition the timing pin.

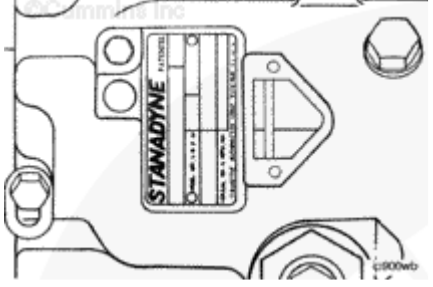



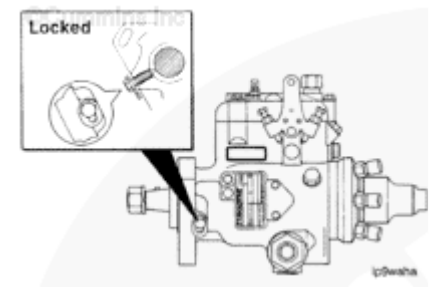
<p>The flange of a replacement pump <b>must</b> be marked to align with the mark on the gear housing after installation.</p> <p>During production, after the locked pump is fitted to the engine with cylinder Number 1 at top dead center (TDC), a mark is stamped on the gear housing and the pump flange. Thereafter, when these marks are aligned, the pump is correctly timed to the engine.</p> <p><b>NOTE:</b> The marks on the gear housing and the pump flange are unique to each engine.</p>	 <p>The diagram shows a close-up of the fuel injection pump assembly. An arrow points to a specific mark on the pump flange, which is being aligned with a corresponding mark on the gear housing. The text '©Cummins Inc' is visible in the top left corner of the diagram.</p>
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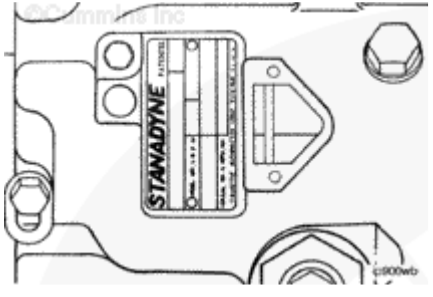
<p>See Service Tool Instruction, Bulletin 3400196 and Service Tool Catalog, Bulletin 3377710 to determine the appropriate Bosch® timing tool and adapter kit part numbers.</p> <p>A special indicator can be used to measure the position of the Bosch® VE fuel injection pump plunger to check pump timing.</p>	 <p>The diagram illustrates the use of a timing tool. On the left, a wrench icon is shown. The main diagram shows a timing tool being used to measure the position of the Bosch VE fuel injection pump plunger. The text '#1 TDC' is visible in the top left corner of the diagram, and '©Cummins Inc' is in the top left. The diagram is split into two parts, with the top part showing the tool being applied and the bottom part showing the measurement.</p>
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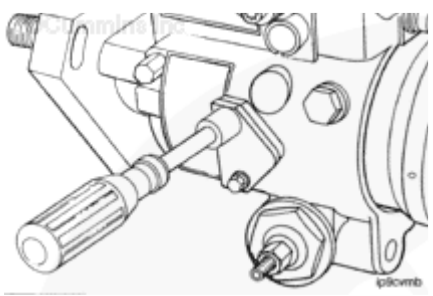
<p><b>Stanadyne DB4 Fuel Injection Pump Timing</b></p> <p>Clean all debris from around the fuel injection pump timing window cover.</p>	 <p>The diagram shows a close-up of the fuel injection pump assembly. A cleaning tool is being used to clean the timing window cover. The text '©Cummins Inc' is visible in the top left corner of the diagram.</p>
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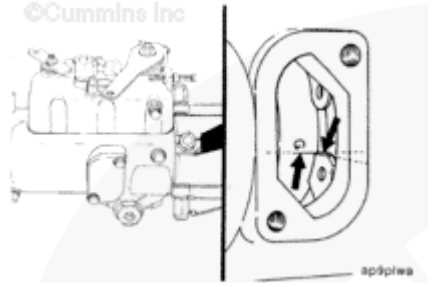
<p>Remove the fuel injection pump timing cover.</p>		
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<p>Rotate the fuel injection pump driveshaft in the direction of pump rotation to align the timing line on the weight retainer hub with the line on the cam ring.</p>		
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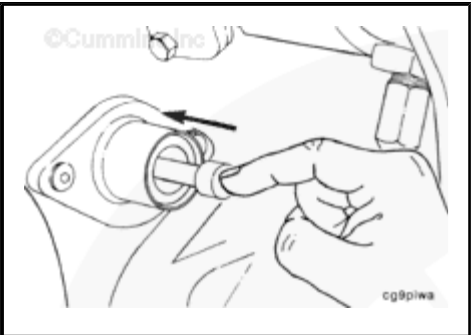
<p>Position the fuel injection driveshaft locking key plate in the locked position. Turn the locking screw in until contact is made with the driveshaft.</p> <p><b>Torque Value:</b> 11.9 n.m [105 in-lb]</p>		
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<p>Verify the timing marks are aligned after timing is locked.</p>		
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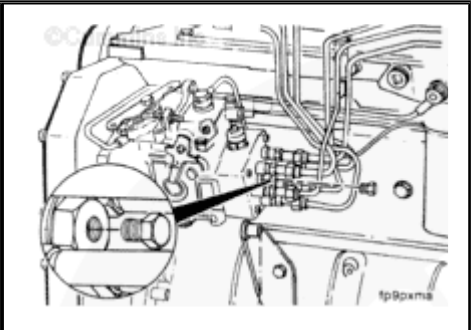
<p>Install the fuel injection pump timing cover.</p>		
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<p>CAV DPA/DPS Fuel Injection Pump Timing</p> <p>Correct timing of the Lucas CAV DPA/DPS fuel injection pump can be verified by removing the inspection plate.</p> <p><b>NOTE: Special equipment in an authorized shop is required to time the Lucas CAV DPA fuel injection pump precisely. However, for troubleshooting and in an emergency, visual alignment of the timing mark is close enough for the engine to run.</b></p> <p>Both of these checks are described in the fuel injection pump replacement. Refer to Procedure 005-012 (Fuel Injection Pumps, In-Line) in Section 5.</p> <p>Refer to Procedure 005-014 (Fuel Injection Pump, Rotary) in Section 5.</p> <p>Refer to Procedure 005-013 (Fuel Injection Pump, In-Line, Spill Port Timing) in Section 5 for installation of the timing pin.</p>		
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Timing Check - (Bosch® VE Pump)  
 Rotate the crankshaft to top dead center (TDC).



Remove the plug from the end of the pump.



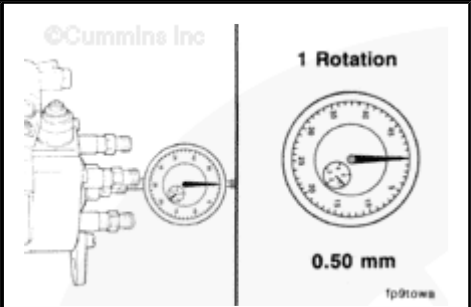
**CAUTION**  
 Do not bend the fuel lines. Doing so can result in fuel system failure.

See Service Tool Instruction, Bulletin 3400196 and Service Tool Catalog, Bulletin 3377710 to determine the appropriate Bosch® timing tool and adapter kit part numbers.

Install the timing indicator. Be sure to allow adequate travel for the indicator.

In order to install the timing indicator, it is often necessary to disconnect one or more of the fuel lines from the fuel pump.

**NOTE:** The indicator is marked in increments of 0.01 mm. 1 revolution of

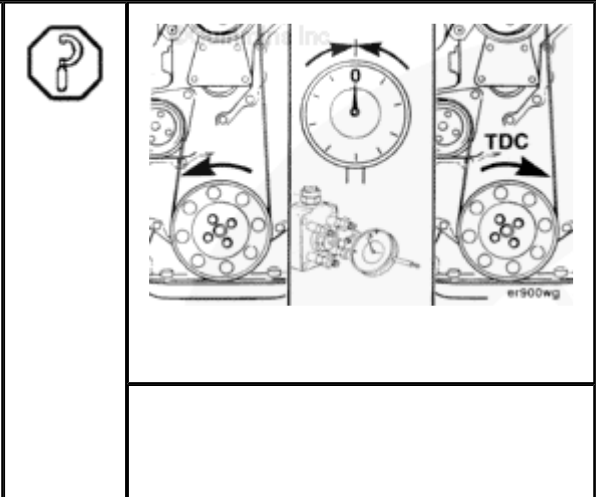




**the indicator needle is equal to 0.50 mm.**

Bar the crankshaft in the direction opposite engine rotation until the indicator needle stops moving. Adjust the indicator face to read 0.

Rotate the crankshaft back to top dead center (TDC), and count the number of revolutions of the indicator needle. The reading shown when the engine timing pin engages is the amount of plunger lift the pump has at that point.

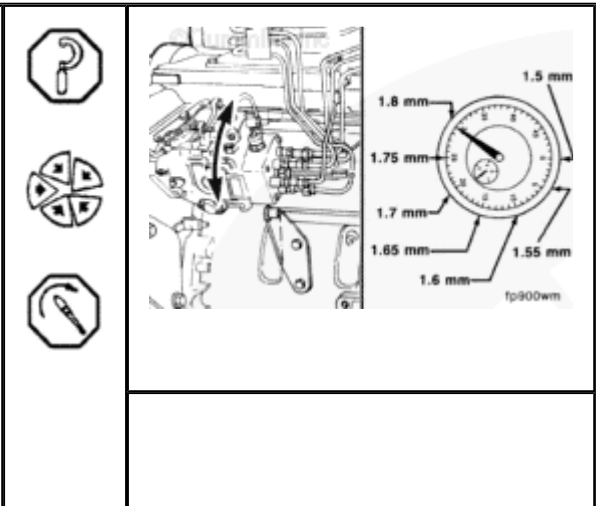


**Bosch® VE Pumps with Slotted Mounting Holes**

Rotate the pump on the mounting studs until the indicator reads the correct value for plunger lift. This illustration gives an example of the indicator readings for the various plunger lift values.

Tighten the flange mounting nuts.

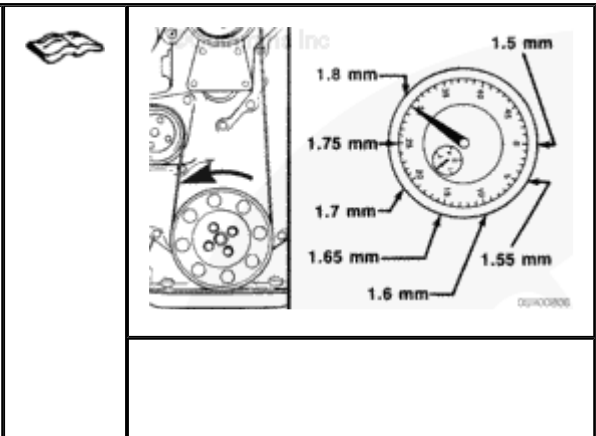
**Torque Value:** 24 n.m [18 ft-lb]


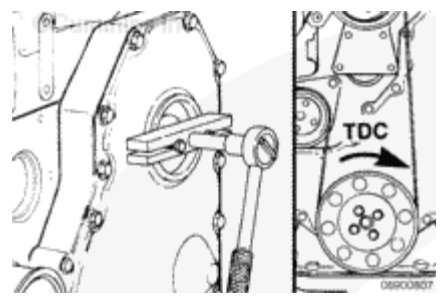



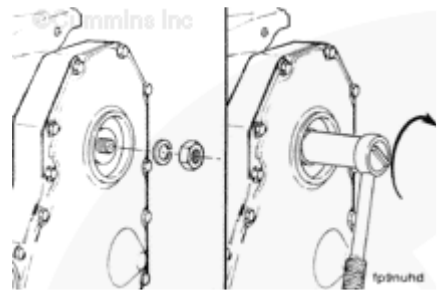
**Bosch® VE Pumps with Round Mounting Holes**


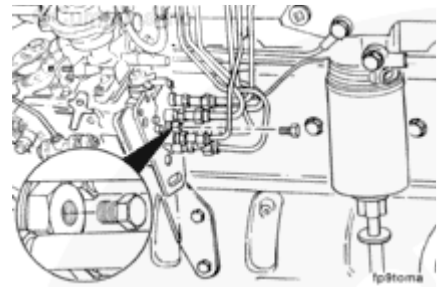
Rotate the engine until the plunger travel is at the desired location.

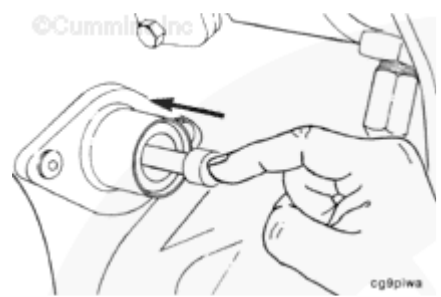
Lock the fuel pump. Refer to Procedure 005-014 (Fuel Injection Pump, Rotary) in Section 5.



<p>Separate the fuel pump drive gear from the pump shaft. Refer to Procedure 005-014 (Fuel Injection Pump, Rotary) in Section 5</p> <p>With the pump locked, rotate the engine back to TDC.</p>		
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<p>Torque the fuel pump drive nut. Refer to Procedure 005-014 (Fuel Injection Pump, Rotary) in Section 5.</p> <p>Unlock the fuel pump.</p> <p>Verify the correct timing has been achieved by measuring the static timing.</p>		
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<p>Remove the timing indicator. Install the plug.</p> <p><b>Torque Value:</b> 10 n.m [89 in-lb]</p>		
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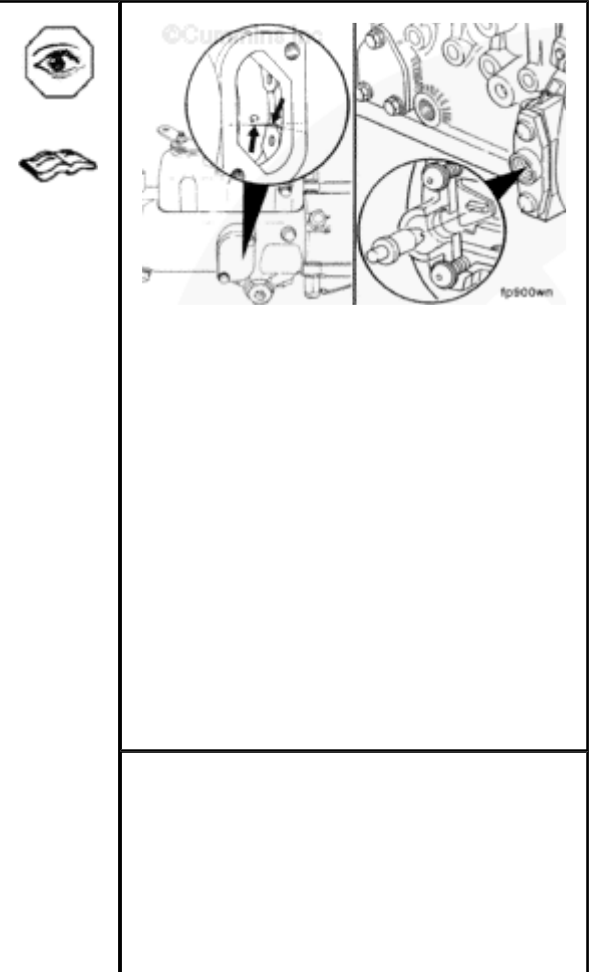
<p>Pump Timing - Lucas CAV DPA, Stanadyne DB4, Delphi DP210, Nippondenso EP-9, and Bosch® P7100</p> <p>Rotate the engine to top dead center (TDC).</p>		
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Correct timing of the Lucas CAV DPA and Stanadyne DB4 fuel injection pump can be verified by removing the timing window cover plate.

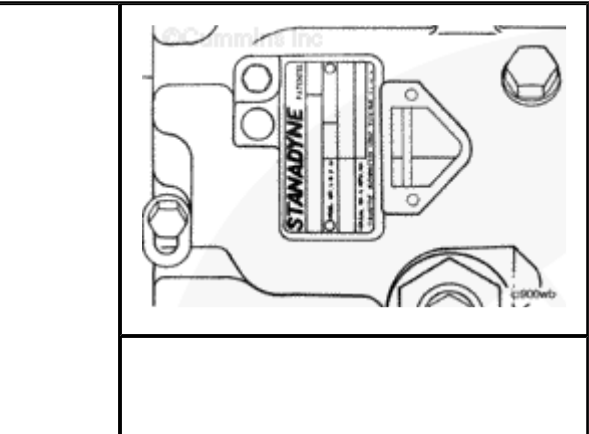
The Nippondenso EP-9 and Bosch® P-7100 fuel injection pumps are checked by removing the timing pin access plug and verifying the slot in the pin will fit over the timing tooth in the fuel injection pump.

**NOTE: Special equipment in an authorized shop is required to time the Lucas CAV DPA fuel injection pump precisely. However, for troubleshooting and in an emergency, visual alignment of the timing mark is close enough for the engine to run.**

To correct the timing on the Bosch® P-7100 and Nippondenso EP-9, see the replacement procedure for the respective pump.



Two injection pump timing marks are used on the Stanadyne DB4 for timing injection of fuel into the Number 1 cylinder. One mark is located on the governor weight retainer hub. The other is located on the internal cam ring. These two marks **must** be aligned at Number 1 cylinder top dead center (TDC).



On the Lucas CAV DPA, the correct timing letter can be located on the engine dataplate as shown.

The letter G indicated refers to the correct timing letter alignment as shown in the previous frame.




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**Last Modified: 22-Jun-2007**

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