

Troubleshooting Symptoms

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*Refer to "General Engine Noise Diagnostic Procedures" on Page T-71 for appropriate diagnostic procedures.

**Refer to "Driveability - General Information" on Page T-72.

Engine Specifications

General Engine Data

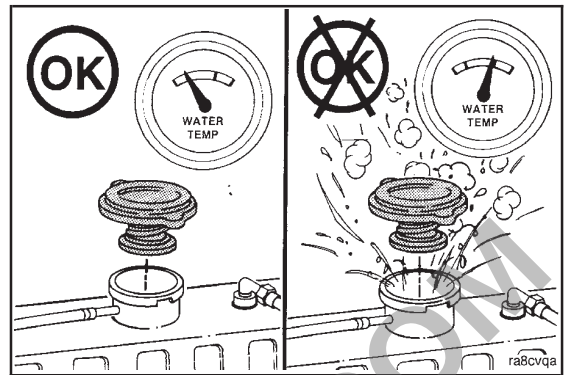
Metric (U.S. Customary)

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PREVIEW -

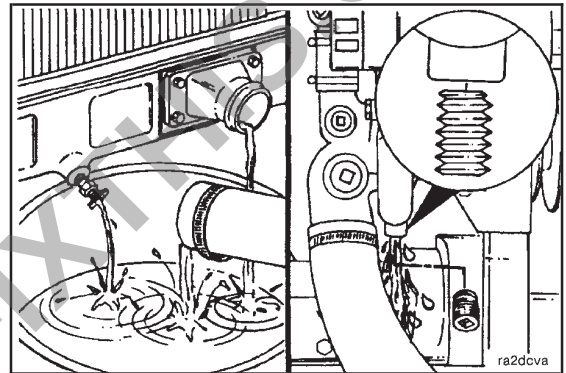
Warning: Wait until the coolant temperature is below 50°C [120°F] before removing coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.

Remove the radiator cap after the engine is cool.



Drain the cooling system as follows:

- Open the radiator draincock
- Remove the lower radiator hose
- Remove the pipe plug in the water pump body



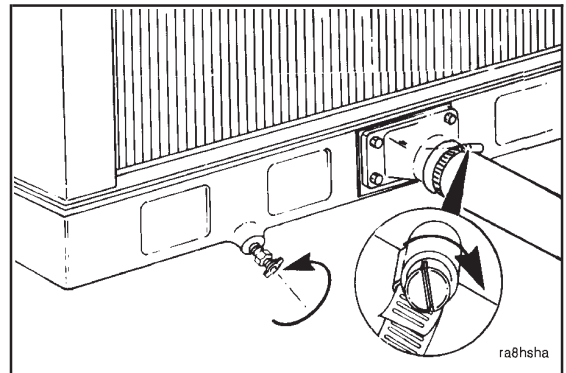
Cooling System, Fill (1-08)

Close the radiator draincock.

Install the lower radiator hose.

Tighten the hose clamp.

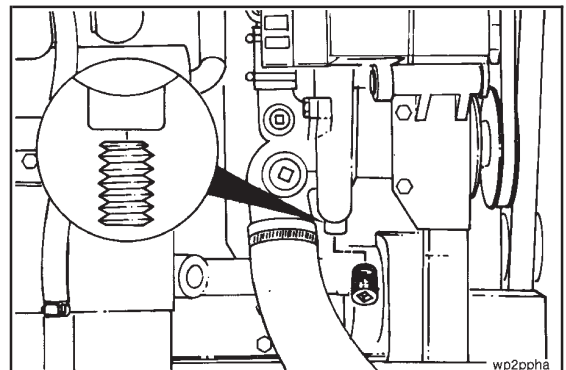
Torque Value: 5 N•m [40 in-lb]



Install the pipe plug in the water pump body.

Tighten the pipe plug.

Torque Value: 20 N•m [15 ft-lb]



Capscrew Markings and Torque Values (10-03)

⚠ Caution: When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

Most of the capscrews used on the L10 engine are metric. Some components, such as the air compressor and

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COOLANT LOSS (INTERNAL)

Cause	Corrections
Air Compressor Cylinder Head Cracked, Porous, or Gasket Leaking	Isolate air compressor and test for air in cooling system. Refer to Procedure 1-11.
OK ↓	
Aftercooler Leaking	Remove and pressure test aftercooler. Refer to Procedure 7-04.
OK ↓	
Lubricating Oil Cooler Leaking	Inspect lubricating oil cooler. Refer to Procedure 2-20.
OK ↓	
Cylinder Head Cracked/Porous or Cylinder Head Gasket Leaking	Test for air or combustion gases in cooling system. Refer to Procedure 1-11.
OK ↓	
Injector Sleeves Incorrectly Seated or Damaged	Test for air or combustion gases in cooling system. Refer to Procedure 1-11.
OK ↓	
Cylinder Liner Cracked/Porous or Seal Leaking	Check for cylinder liner and seal damage. Refer to Procedure 1-36.
OK ↓	
Cylinder Block Cracked or Porous	Check cylinder block. Refer to Procedure 1-36.

EXHAUST SMOKE UNDER LOAD - EXCESSIVE

Cause

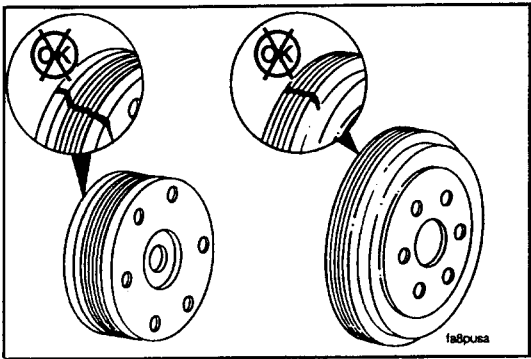
Corrections

Install Compuchek®, if available	Perform low power test, then cylinder performance test. Refer to "Compuchek® Operation Manual," Bulletin No. 3377550.
OK ↓	
Intake Air System Restricted	Check intake air restriction. Refer to Procedure 3-07.
OK ↓	
Turbocharger Wheel Rubbing	Inspect turbocharger. Refer to Procedure 3-11.
OK ↓	
Intake Air Leaks Between Turbocharger and Cylinder Head	Check for air leaks. Refer to Procedure 3-09.
OK ↓	
* Fuel Specifications Incorrect	Check fuel specifications. Refer to Reference 5-03.
OK ↓	
* Fuel Drain Line Restricted	Inspect fuel return system for loops, crimps, clamped points. Refer to Procedure 5-15.
OK ↓	
Injector Loose and Valve Adjusted Incorrectly	Adjust valves and injectors. Refer to Procedure 7-42.
OK ↓	
Engine is Receiving too Much Fuel	Check fuel pressure and fuel rate. Replace pump. Refer to Procedure 5-05 and 5-07.
OK ↓	

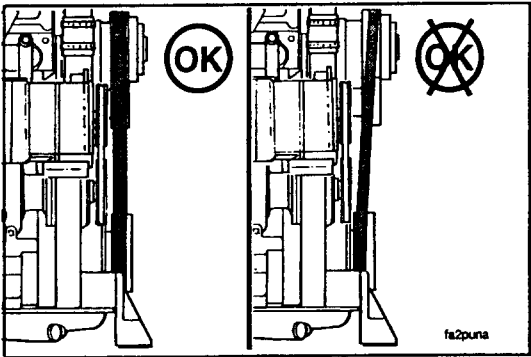
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* Compuchek® does **not** test for this cause.

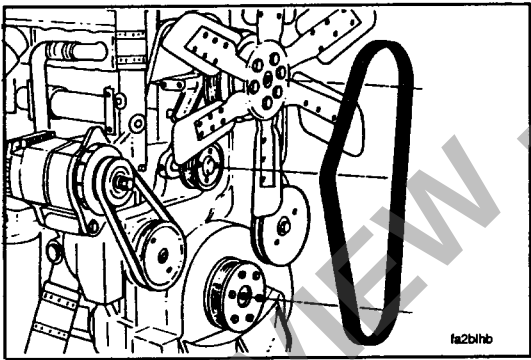
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Visually inspect pulleys for cracks or broken grooves. Replace if necessary. Refer to Procedures 1-25 and 1-26.

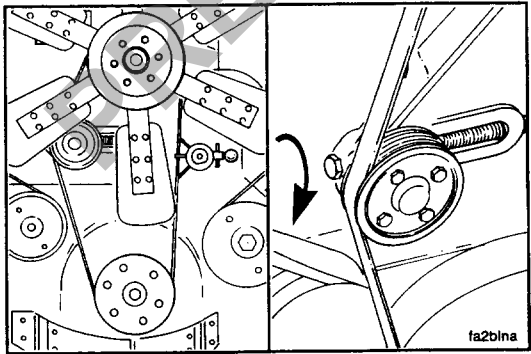


Visually inspect pulley alignment. Replace the idler and fan hub pulleys if they are **not** in alignment. Refer to Procedures 1-25 and 1-26.



Install

Install a new belt on the pulleys.



Use belt tension gauge, Part No. ST-1293, to measure the belt tension.

Turn the adjusting screw to adjust the belt tension.

Belt Tension		
Newtons		Pounds Force
890	New	200
360 to 710	Used	80 to 160

NOTE: A belt is considered used if it has been in operation 10 minutes or longer. If used belt tension is below the minimum value, tighten the belt to the maximum value. Replace the belt if it will **not** maintain correct tension.

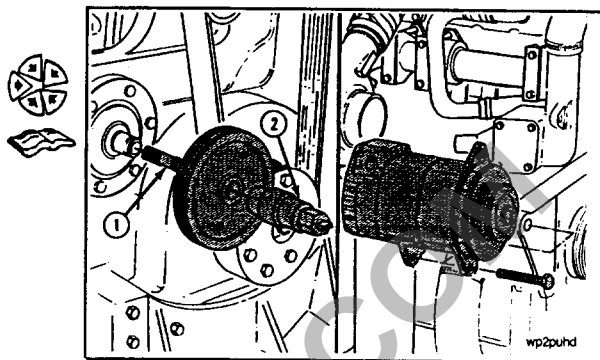
Pulley - Install

Use pulley pusher, Part No. 3376326, (2) and pulley pusher adapter, Part No. 3377401, (1) to install the pulley.

NOTE: The stamped steel pulley removed with puller adapter Part No. 3822616-1 **must** be installed with the deep dished side away from the engine.

Install the alternator. Refer to Procedure 6-10.

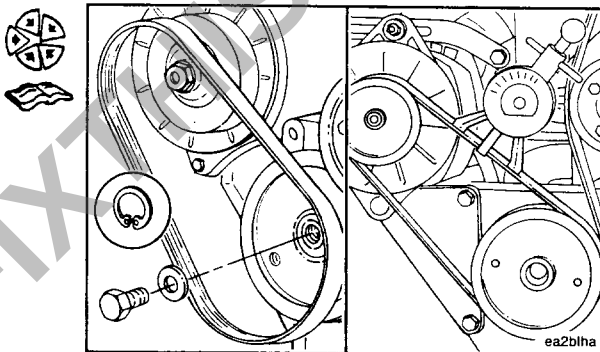
NOTE: Use pulley pusher adapter, Part No. 3376383, on earlier production engines.



Install the capscrew and washer or the snap ring in the groove at the end of the shaft. Tighten the capscrew (if used).

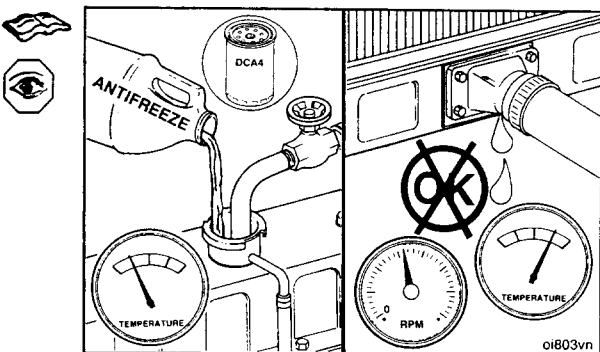
Torque Value: 115 N•m [85 ft-lb]

Install and adjust the alternator drive belt. Refer to Procedure 6-08.



Fill the cooling system. Refer to Procedure 1-08.

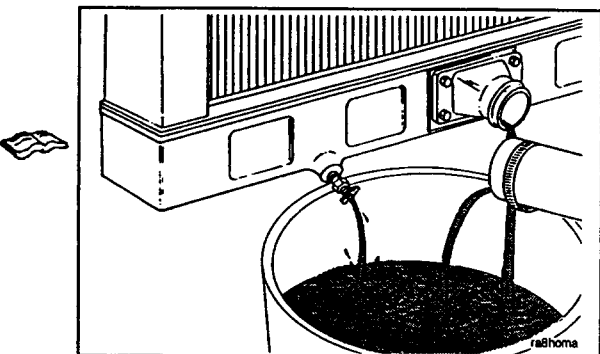
Operate the engine until it reaches a temperature of 80°C [180°F] and check for coolant leaks.



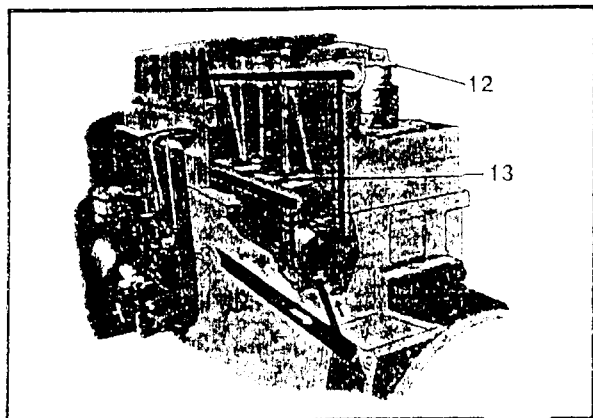
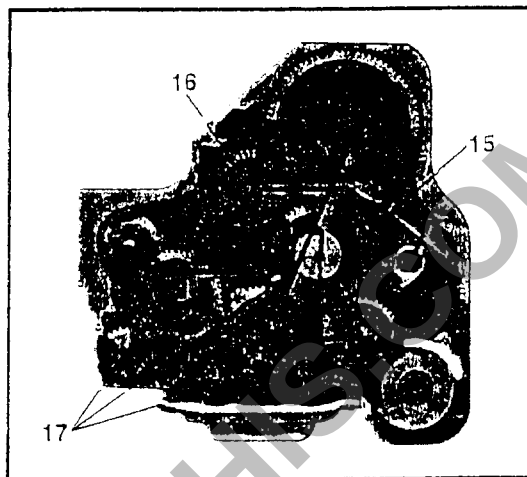
Water Heater Housing - Replace (1-32)

Remove

Drain the cooling system. Refer to Procedure 1-07.

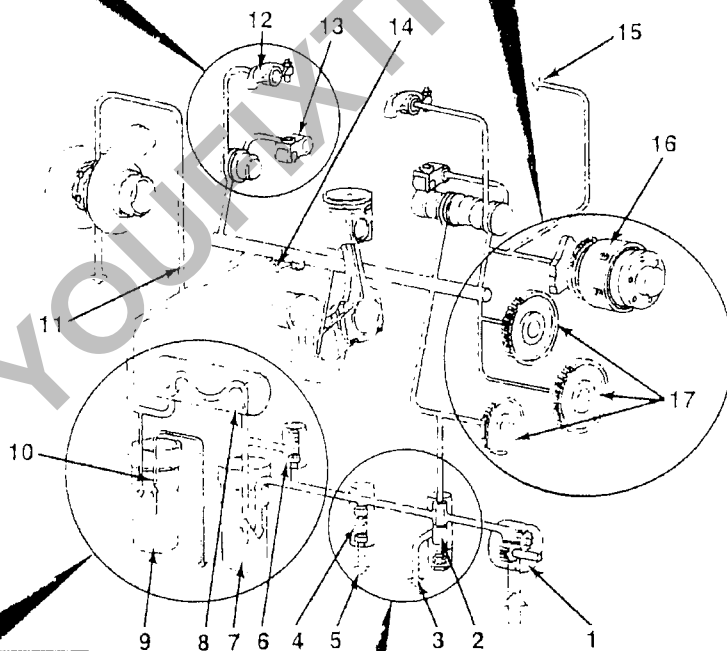
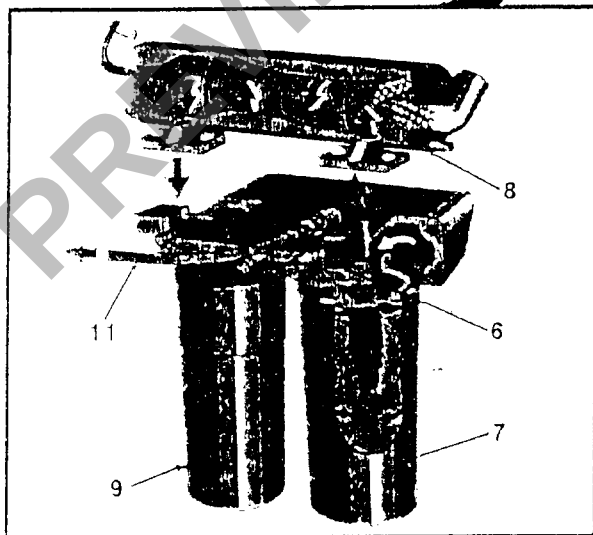
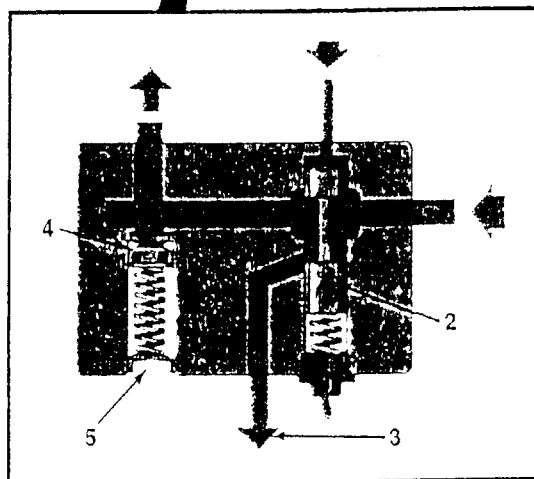


Lubricating Oil System Flow Diagrams (2-04)



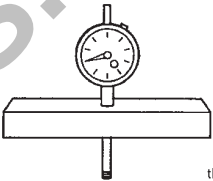
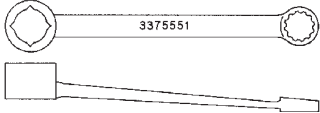
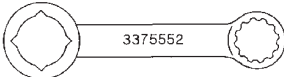
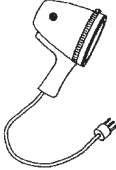
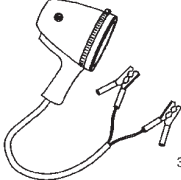
Lubrication Flow Schematic

1. Oil Pump
2. Pressure Regulator Valve
3. Oil Return to Pan
4. High Pressure Relief Valve
5. Oil Return to Pan
6. Full Flow Filter Bypass Valve
7. Full Flow Filter
8. Oil Cooler
9. Bypass Filter
10. Bypass Filtered Oil Return
11. Turbocharger Oil Supply
12. Rocker Lever
13. Cam Follower
14. Piston Cooling Nozzle
15. Accessory Drive/Air Compressor
16. Gear Driven Fan Clutch
17. Idler Gears

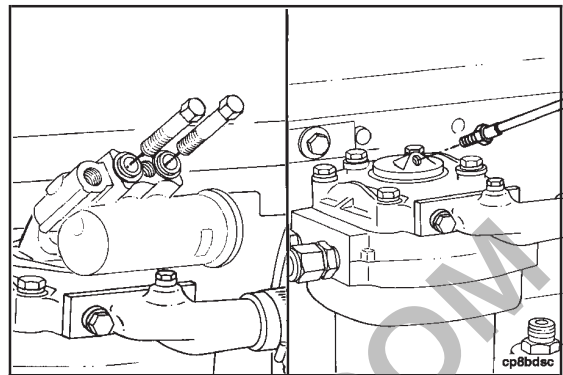


Combustion Air System - Service Tools (3-01)

The following special tools are recommended to perform procedures in Section 03. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Cummins Authorized Repair Location.

Tool No.	Tool Description	Tool Illustration
ST-537	Dial Depth Gauge Measure turbocharger axial motion.	 tb8togf
3375551	Torque Wrench Adapter Torque turbine housing capscrews.	
3375552	Torque Wrench Adapter Torque compressor housing capscrews.	
3376891	Flourescent Tracer Add to oil. Use with blacklight to find oil leaks.	 3376891
3377253	Black Light (AC) Inspect for oil or fuel leak.	 3377253
3377394	Black Light (DC) Inspect for oil or fuel leak.	 3377394

Install the air governor or air governor line to the unloader body and tighten.



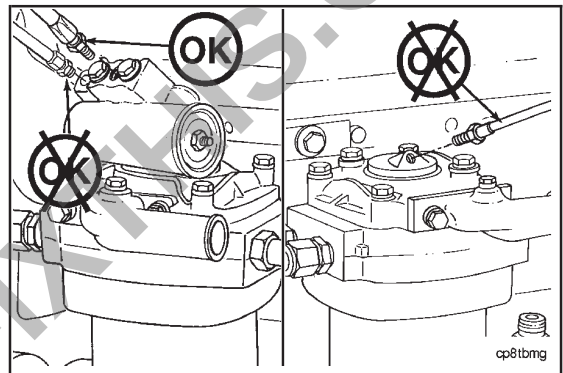
Air Governor - Check (4-08)

Air Compressor Pumps Continuously

NOTE: The illustrations shown will be of the single cylinder air compressor. Differences in procedures for one and two cylinder Cummins air compressors will be shown where necessary.

Remove the accessory air lines from the air governor unloader port.

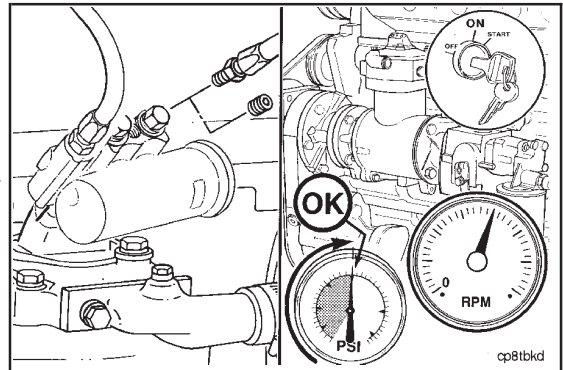
NOTE: Do **not** disconnect the line from the air compressor unloader valve. Do **not** disconnect the reservoir air line from the air governor.



Install pipe plugs in the air governor unloader ports where accessory air lines were removed.

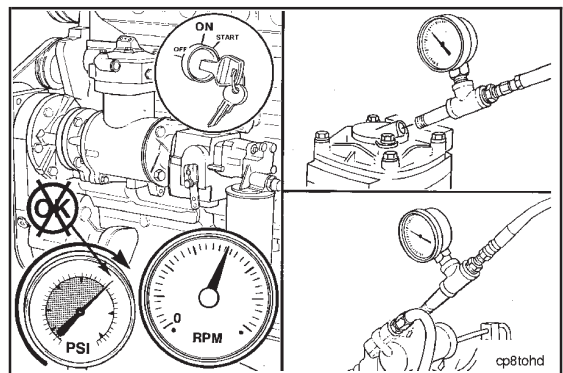
Operate the engine to activate the air compressor.

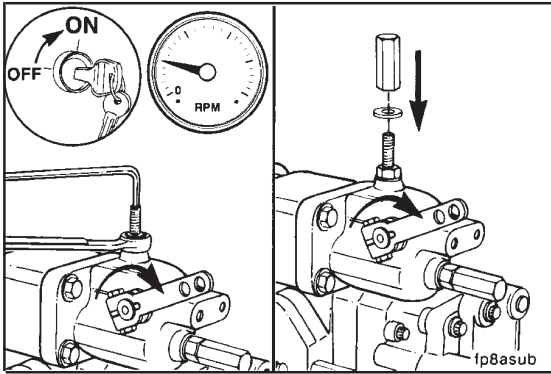
If the air compressor stops pumping (air pressure stops rising) at the governed air pressure, there is a leak in an accessory or an accessory air line. Refer to the equipment manufacturer's instructions for troubleshooting and repair.



If the air compressor does **not** stop pumping (air pressure continues to rise) at the governed air pressure, connect a regulated shop air pressure line to one of the following:

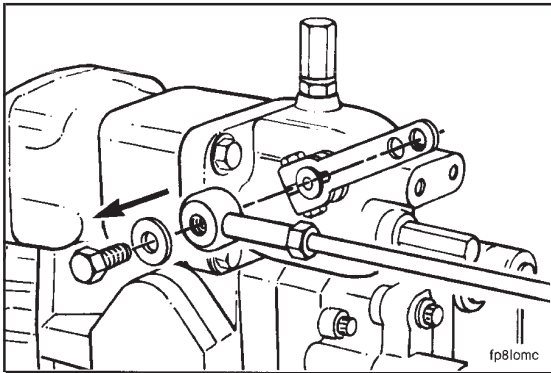
- The air compressor unloader valve port.
- One of the air governor unloader valve ports.





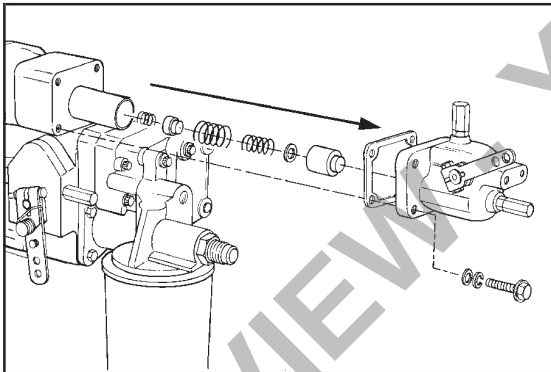
Start the engine. Hold the VS lever **clockwise** (in the high speed position). Adjust the screw to the correct RPM and tighten the jam nut.

Install a new copper washer and the lock nut.



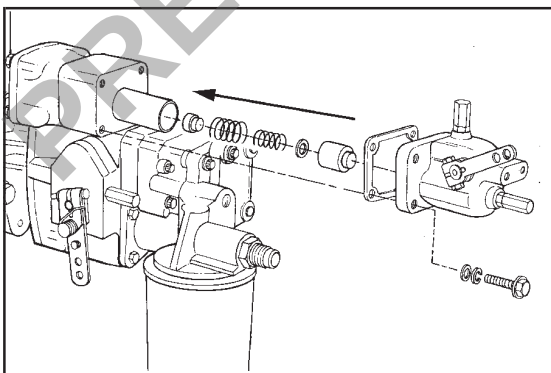
Variable Speed (VS) Governor - Idle Spring Removal

Remove the linkage from the VS throttle lever.



Remove the following parts:

- VS housing cover
- Gasket
- Throttle lever plunger
- High speed spring and the shims
- Plunger assist spring, if required
- Spring guide
- Idle spring

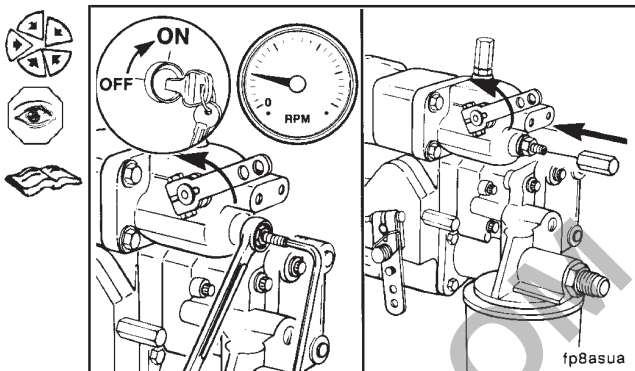


Install the following parts:

- Idle spring
- Spring guide
- High speed spring and the shims
- Plunger assist spring if required
- Throttle lever plunger
- New cover gasket
- VS housing cover

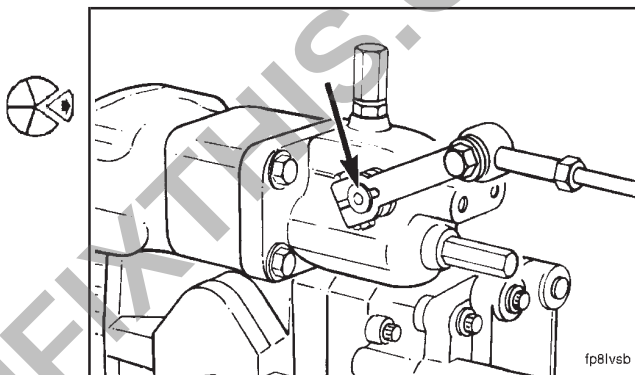
Install new copper washers between the jam nuts and the lock nuts. Install the jam nuts.

Check the governor speed adjustments. Refer to Procedure 5-05.



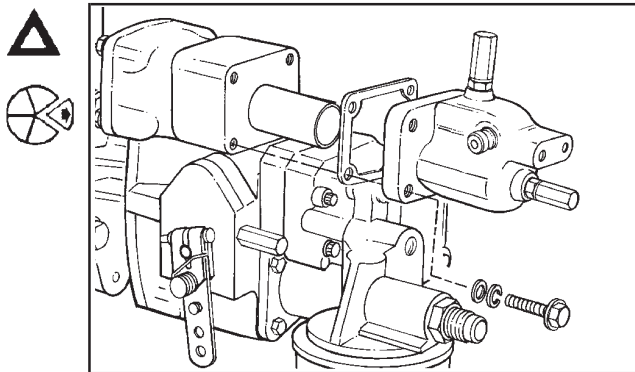
Variable Speed (VS) Throttle Shaft Leaking Fuel

Mark the angle of the VS throttle lever on the VS throttle shaft. Remove the VS throttle lever.

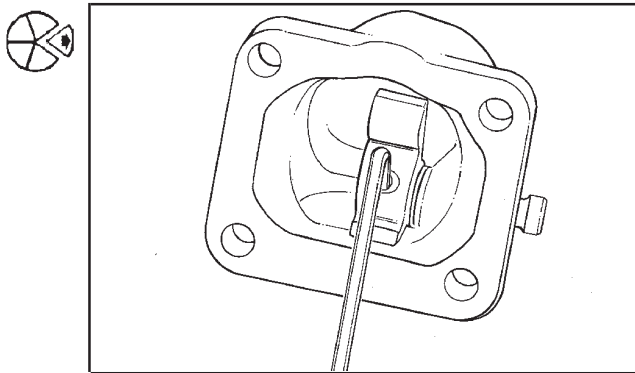


Caution: Make sure the components in the spring pack guide do not fall out when the cover is removed.

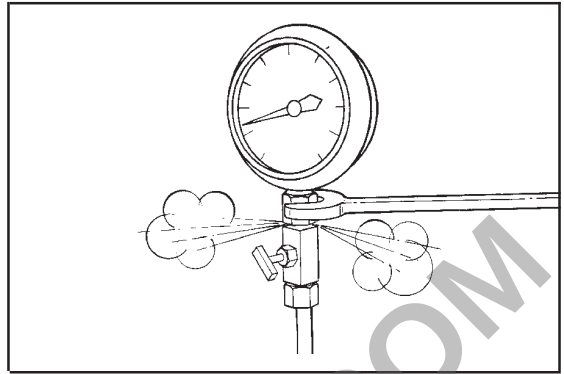
Remove the VS spring pack housing cover.



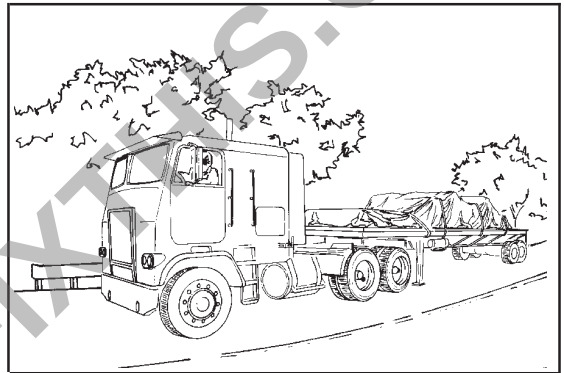
Loosen the set screw in the VS throttle stop.



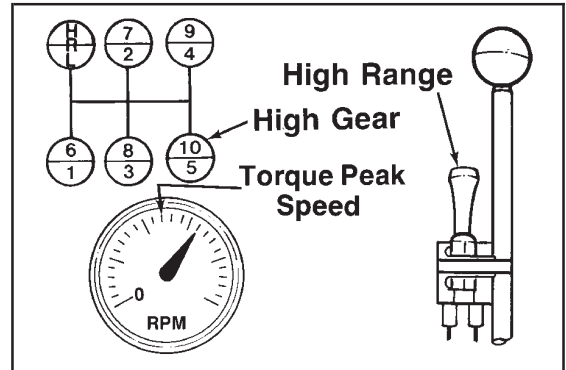
Make sure to remove all of air from the gauge and hose.



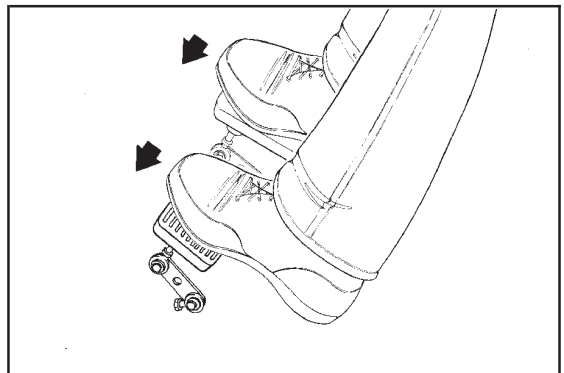
Drive the truck down a level road with a loaded trailer.



Drive the truck in high or top gear and above the torque peak speed to establish a target rail pressure.



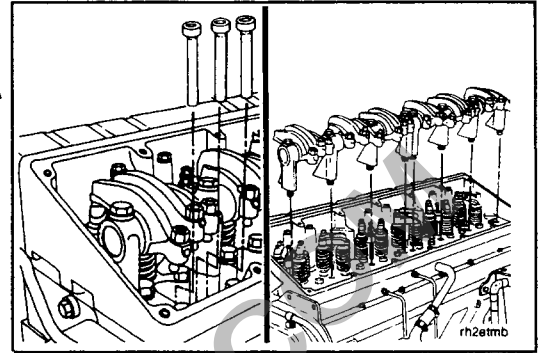
Engage the service brakes and put the throttle in wide open position.



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Remove the push rods. Refer to Procedure 7-07.

Remove the rocker levers. Refer to Procedure 7-05.

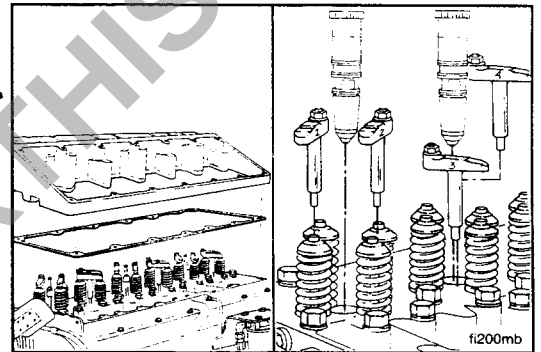


Remove the rocker lever housing. Refer to Procedure 7-06.

Remove the injectors. Refer to Procedure 5-06.

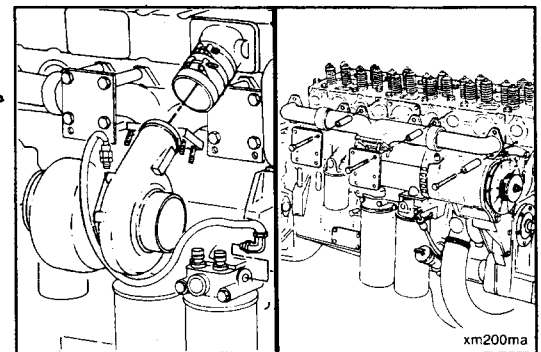
Remove the crossheads.

NOTE: Mark the position of the crossheads as they are removed. The crossheads **must** be installed in the same position when the engine is assembled.



Remove the turbocharger. Refer to Procedure 3-12.

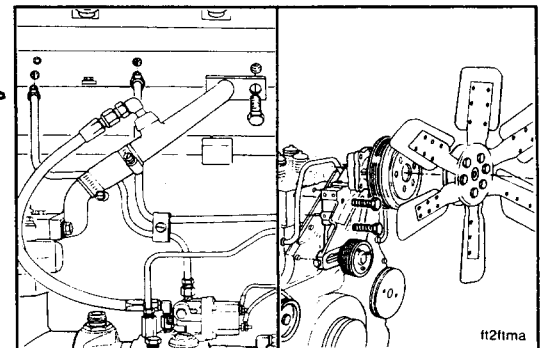
Remove the exhaust manifold. Refer to Procedure 7-08.

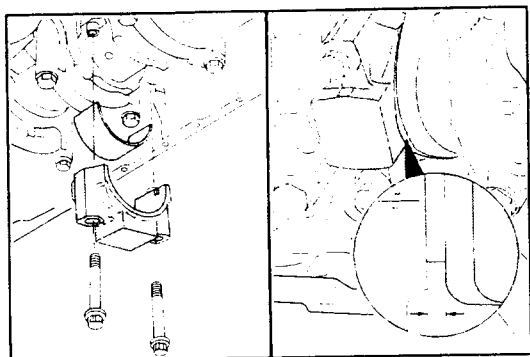


Disconnect the fuel lines and air compressor tube from the cylinder head.

Remove the fan and fan hub. Refer to Procedure 1-25.

Remove all the necessary brackets and clamps.





- Install the connecting rod caps.

Torque Value: Step 1 - 70 N•m [50 ft-lb]

Step 2 - 140 N•m [105 ft-lb]

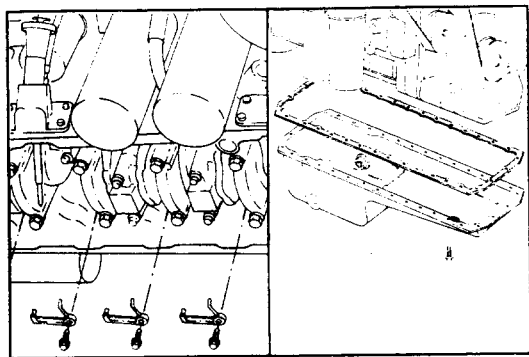
Step 3 - 210 N•m [155 ft-lb]

Step 4 - Loosen completely

Step 5 - Repeat steps 1 through 3

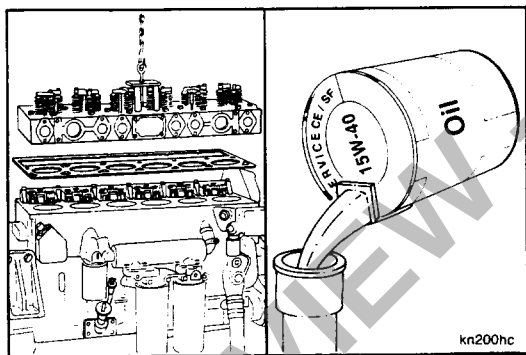
- Measure side clearance again.

NOTE: If the side clearance does **not** meet the specifications, the connecting rod **must** be replaced.



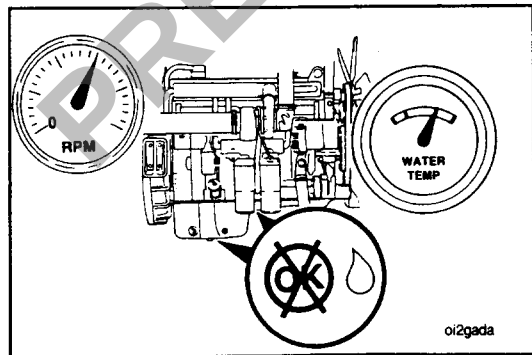
Install the piston cooling nozzles. Refer to Procedure 7-12.

Install the lubricating oil pan. Refer to Procedure 2-14.



Install the cylinder head. Refer to Procedure 7-09.

Fill the lubricating oil pan. Refer to Procedure 2-11.



Operate the engine to normal operating temperature and check for leaks.

Base Engine Components
L10

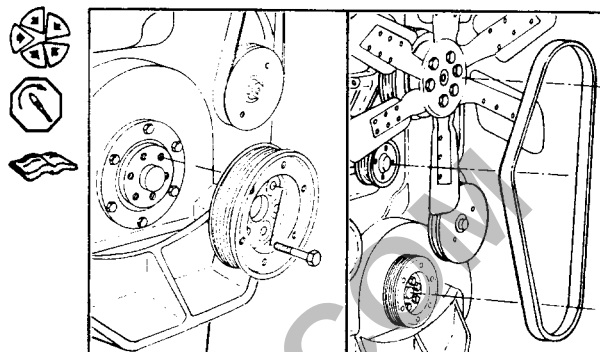
Seals, Front and Rear Crankshaft - Replace (7-21)
Page 7-95

Install the pulley and capscrews.

Tighten the capscrews in a star pattern.

Torque Value: 150 N•m [110 ft-lb]

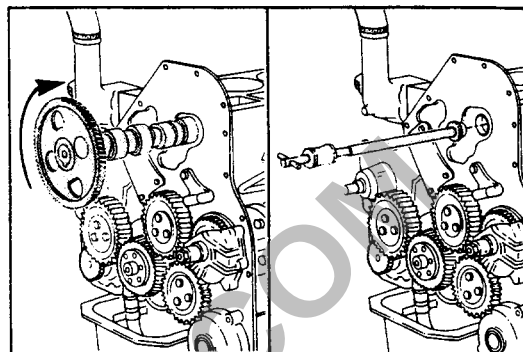
Install and adjust the fan drive belt. Refer to Procedure 1-20.



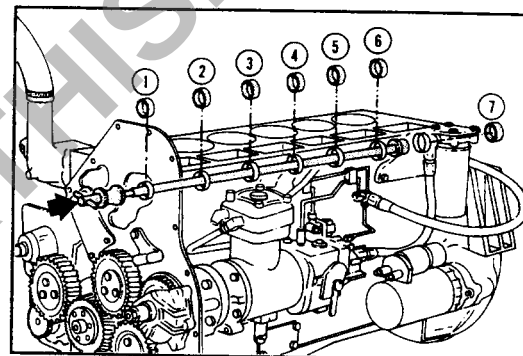
Remove the camshaft. Refer to Procedure 7-28.

Use camshaft bushing driver, Part No. ST-1228, and driver, Part No. 3376070, to remove the bushings.

Remove bushing number one first.

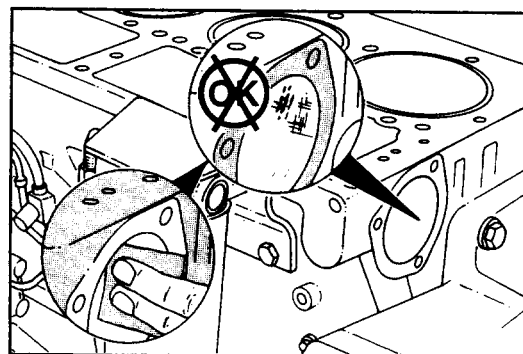


Remove the remaining six bushings in order from front to rear.



Clean and Inspect

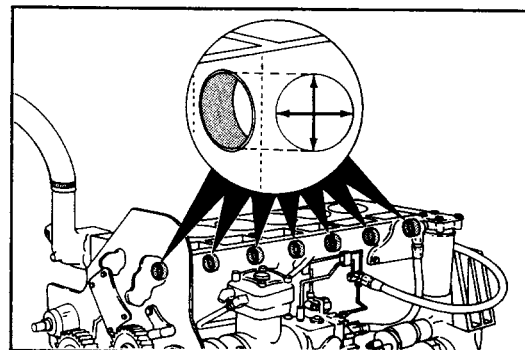
Use Scotch-Brite® 7448, or equivalent to remove burrs and clean the bushing bores.

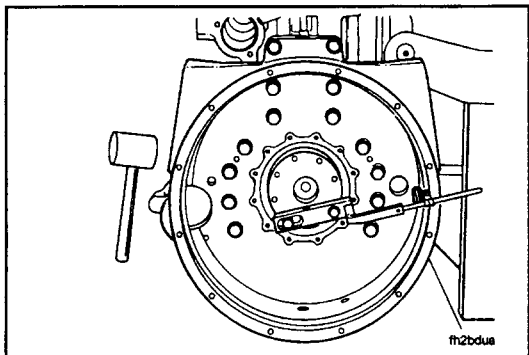


Measure the cylinder block camshaft bore inside diameter.



Camshaft Bore I.D.		
mm		in
76.987	MIN	3.0310
77.013	MAX	3.0320





Flywheel Housing Bore Alignment Maximum TIR

mm	SAE No.	in
0.31	00	0.012
0.25	0	0.010
0.25	1/2	0.010
0.20	1	0.008
0.20	2	0.008
0.20	3	0.008

If the maximum bore alignment **does not** meet the specifications, use a rubber hammer to move the housing in the necessary direction and repeat the measurement procedure.

NOTE: If the bore alignment will **not** meet the specifications or the bore is **not** round, the housing **must** be replaced.

Measure the Flywheel Housing Face Alignment



Caution: The tip of the gauge must not enter the capscrew holes or the gauge will be damaged.

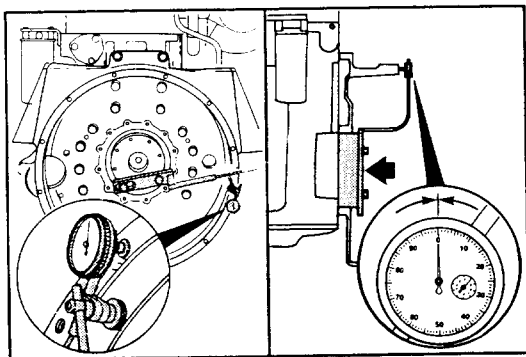
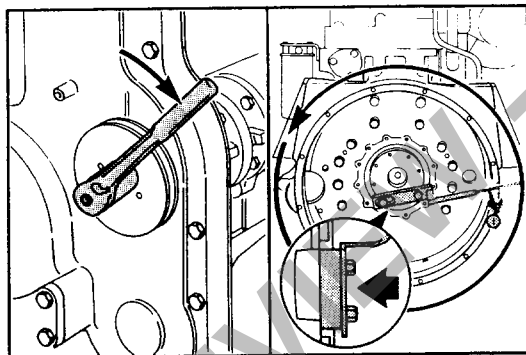


Install the contact tip of the dial indicator gauge against the flywheel housing face.



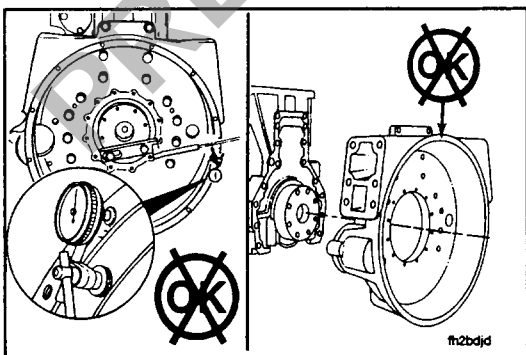
Push the crankshaft toward the front of the engine.

Adjust the dial indicator gauge to zero "0".



NOTE: Monitor the dial indicator gauge while turning the crankshaft.

Use the accessory drive shaft to rotate the crankshaft one complete revolution (360 degrees).



Flywheel Housing Face Alignment Maximum TIR

mm	SAE No.	in
0.31	00	0.012
0.25	0	0.010
0.25	1/2	0.010
0.20	1	0.008
0.20	2	0.008
0.20	3	0.008

NOTE: If the maximum face alignment **does not** meet the specifications the flywheel housing **must** be replaced.

Section 8 - Engine Testing ("In-Chassis")

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Fan Hub – Belt Driven (Refer to Procedure 1-25)

End Clearance		
mm		in
0.08	MIN	0.003
0.41	MAX	0.016

Idler Pulley – Fan Belt (Refer to Procedure 1-26)

End Clearance		
mm		in
0.05	MIN	0.002
0.25	MAX	0.010

Thermostat – Operating Temperature Range (Refer to Procedure 1-27)

Normal Position	Start to Open				Fully Open*		
	°C	Min	°F	°C	Max	°F	
Closed	80		177	83		182	94 202
* Maximum Open Distance - 9.52 mm [0.375 inch]							

• Optimized Aftercooling

Normal Position	Start to Open				Fully Open*		
	°C	Min	°F	°C	Max	°F	
Closed	78		173	80		177	91 197
* Maximum Open Distance - 2.54 mm [0.100 inch]							

Water Pump (Refer to Procedure 1-31)

Impeller Bore I.D.			Shaft O.D. at Impeller		
mm		in	mm		in
15.339	MIN	0.6039	15.389	MIN	0.6058
15.365	MAX	0.6049	15.402	MAX	0.6064

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