Troubleshooting and Repair Manual ISB and QSB5.9 Engines

U.S.A., Canada, Australia, New Zealand, and Puerto Rico



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General Safety Instructions

Important Safety Notice

⚠ WARNING ⚠

Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation or other bodily injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Make sure the work area surrounding the product is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do **not** work on anything that is supported ONLY by lifting jacks or a hoist. **Always** use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, fuel and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To prevent suffocation and frostbite, wear protective clothing and ONLY disconnect fuel and liquid refrigerant (freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.
- To avoid burns, be alert for hot parts on products that have just been turned off, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use ONLY genuine Cummins or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.

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Specifications

General Specifications

Horsepower (refer to engine dataplate)

Bore and Stroke ..... 102 mm [4.02 in] X 120 mm [4.72 in]

Displacement ..... 5.9 liters [359 C.I.D.]

Compression Ratio 16.5:1

Firing Order 1-5-3-6-2-4

Engine Weight (with standard accessories):
- Dry Weight ..... 458 kg [1010 lb]

Crankshaft Rotation (viewed from the front of the engine) ..... **Clockwise**

Valve Clearance:
- Intake ..... 0.025 mm [0.010 in]
- Exhaust ..... 0.051 mm [0.020 in]

NOTE: The ISB engine features a no-adjust overhead. The ISB valve train is designed such that adjustment of the valve lash is **not** required for normal service during the first 241,402 km [150,000 mi]. The valve train operates acceptably within the limits of 0.152- to 0.381-mm [0.006- to 0.015-in] intake valve lash and 0.381- to 0.762-mm [0.015- to 0.030-in] exhaust valve lash.

Fuel System

For performance and fuel rate values, refer to the Engine Data Sheet or the fuel injection pump for the particular model involved.

Engine Idle Speed ..... 700 to 1000 rpm

Maximum Fuel Inlet Restriction to Lift Pump ..... 20 kPa [6 in Hg]

Maximum Fuel Pressure at Fuel Filter Outlet (engine cranking) ..... 28 to 55 kPa [4 to 8 psi]

Minimum Fuel Pressure at Fuel Filter Inlet (engine running) ..... 55 to 117 kPa [8 to 17 psi]

Maximum Pressure Drop Across Fuel Filter ..... 34 kPa [5 psi]

Fuel Drain Line Maximum Restriction ..... 69 kPa [10 psi]

Fuel Inlet Maximum Temperature ..... 74°C [165°F]

Engine Minimum Cranking Speed ..... 150 rpm

Lubricating Oil System

Oil Pressure:
- Low Idle (minimum allowed) ..... 103 kPa [15 psi]
- At Rated Speed (minimum allowed) ..... 310 kPa [45 psi]

Regulated Pressure ..... 414 kPa [60 psi]

Oil Capacity of Standard Engine:
- Standard
  - Pan **Only** ..... 14.2 liters [15 qt]
  - Total System ..... 16.4 liters [17 qt]
- Deep Sump
  - Pan **Only** ..... 16.1 liters [17 qt]
  - Total System ..... 18.3 liters [19 qt]
- Oil Pan High - Low
  - Standard Pan ..... 12 to 14.2 liters [13 to 15 qt]
  - Deep Sump Pan ..... 14.2 to 16.1 liters [15 to 17 qt]

NOTE: Some applications use a slightly different lubricating oil pan capacity. Contact your local Cummins Distributor if you have questions.

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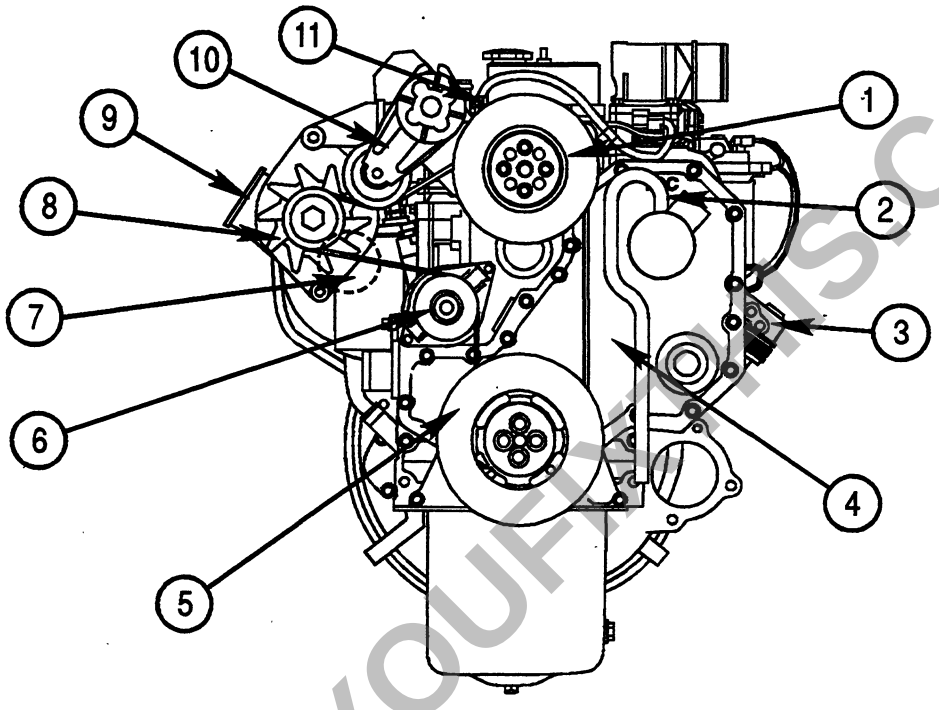
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Engine Diagrams

Engine Views

The following illustrations show the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

NOTE: The illustrations are **only** a reference showing a typical engine.



00900035

Front View

1. Fan pulley
2. Top dead center indication
3. Air compressor
4. Front gear cover
5. Vibration damper
6. Water pump
7. Turbocharger air inlet
8. Alternator
9. Turbocharger air outlet
10. Automatic belt tensioner
11. Coolant temperature sensor.

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Air Compressor Air Pressure Rises Slowly

This is symptom tree T004.

Cause	Correction
Air intake system restriction to air compressor is excessive	Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Procedure 010-031.
OK ⬇	
Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, and valves. Refer to Procedure 012-019 and the OEM service manuals.
OK ⬇	
Air governor is malfunctioning	Check the air governor for correct operation. Make sure the air governor is located less than 2 feet from the air compressor. Refer to the Master Repair Manual, Holset® Air Compressors, Bulletin No. 3666121, and the OEM service manual.
OK ⬇	
Carbon buildup is excessive in the air discharge line, check valve, or cylinder head	Check for carbon buildup. Replace the air compressor discharge line if necessary. Refer to Procedure 012-003. Check the turbocharger for oil leaks. Check the intake tube for oil. Refer to Procedures 010-040 and 010-049.
OK ⬇	
Air system component is malfunctioning	Check the operation of check valves, alcohol evaporators, air dryers, and other OEM-installed air system components. Refer to the manufacturer's instructions.
OK ⬇	
Unloader valve is malfunctioning	Check the unloader valve and unloader body seal. Refer to the Master Repair Manual, Holset® Air Compressor, Bulletin No. 3666121.
OK ⬇	
Air compressor intake or exhaust valve leaks air	Inspect the air compressor intake and exhaust valve assemblies. Refer to Procedure(s) 012-019.

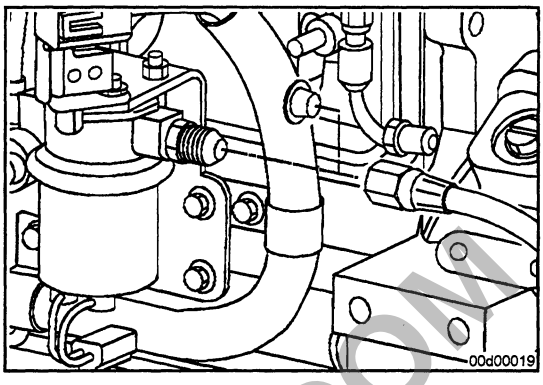
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Engine Removal (000-001)

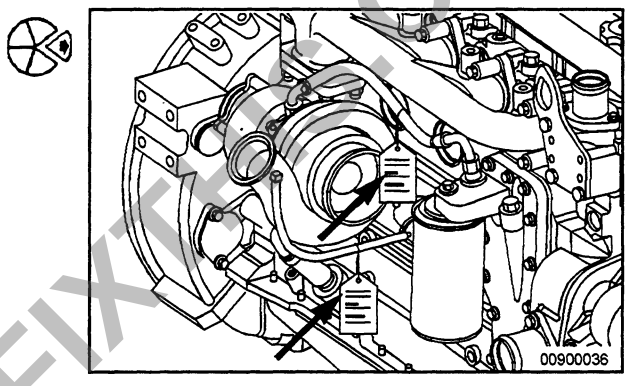
Initial Check (000-001-001)

Shut off and cap the fuel supply line.



Remove (000-001-002)

Place a tag on all hoses, lines, linkage, and electrical connections as they are removed to identify their locations.



Disconnect the battery cables, negative (-) cable first.

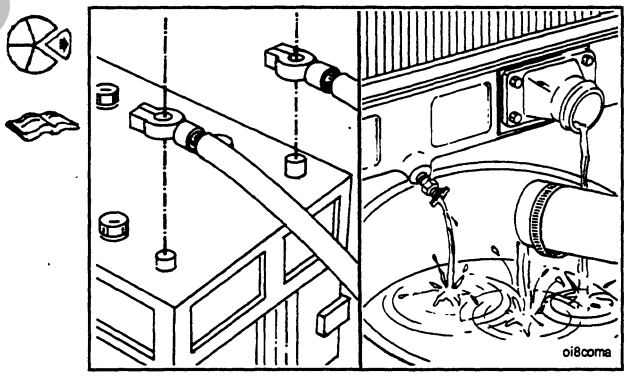
⚠ WARNING ⚠

Coolant is toxic. Keep away from pets and children. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

Wait until the temperature is below 50°C [120°F] to avoid personal injury from hot coolant.

Drain the engine coolant. Refer to Procedure 008-018.



⚠ WARNING ⚠

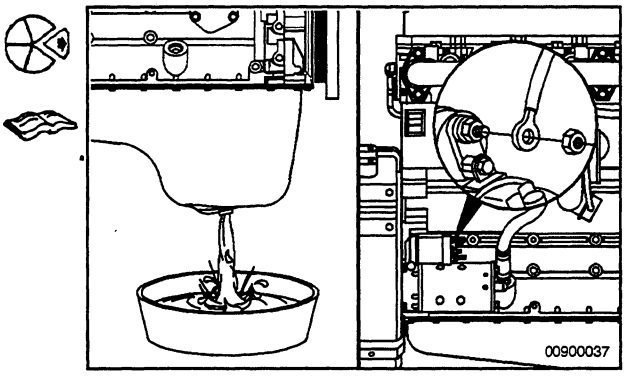
Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.

⚠ WARNING ⚠

Avoid direct contact of hot oil with your skin. Hot oil can cause personal injury.

Drain the lubricating oil. Refer to Procedure 007-025.

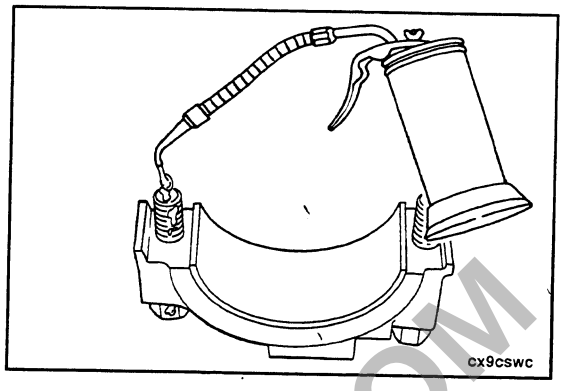
Disconnect the starter cable, engine ground straps, cab or chassis to engine hoses, tubing, electrical wires, wire harnesses, and hydraulic lines.



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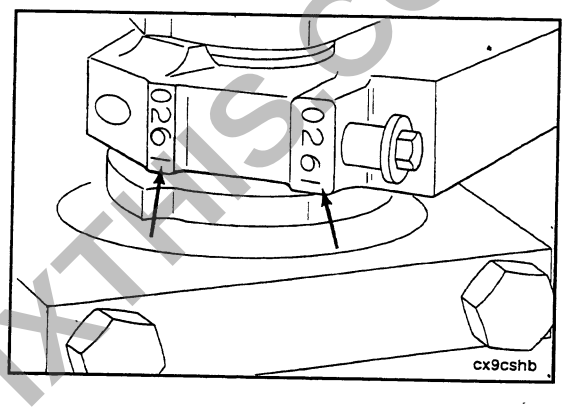
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Use clean 15W-40 engine oil to lubricate the threads and underside of the connecting rod capscrew head.



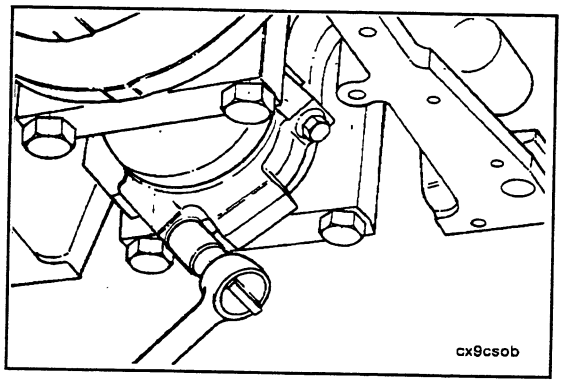
NOTE: The number stamped on the connecting rod and connecting rod cap at the parting line **must** match and be installed on the lubricating oil cooler side of the engine.

Install the connecting rod cap and capscrews to the connecting rod.



Alternately tighten the two capscrews.

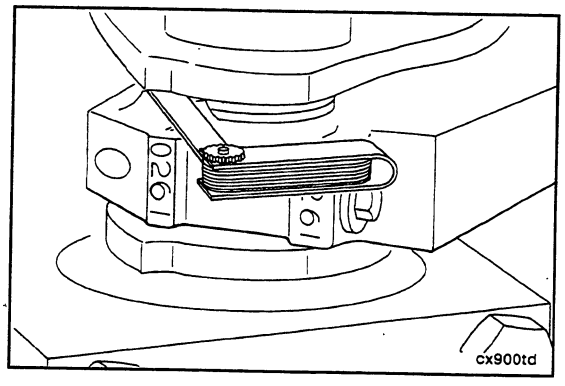
Torque Value: Step 1 30 N•m [22 ft-lb]
2 60 N•m [44 ft-lb]
3 Rotate 60 degrees clockwise



NOTE: Do **not** measure the clearance between two connecting rod caps.

Measure the side clearance between the connecting rod and crankshaft.

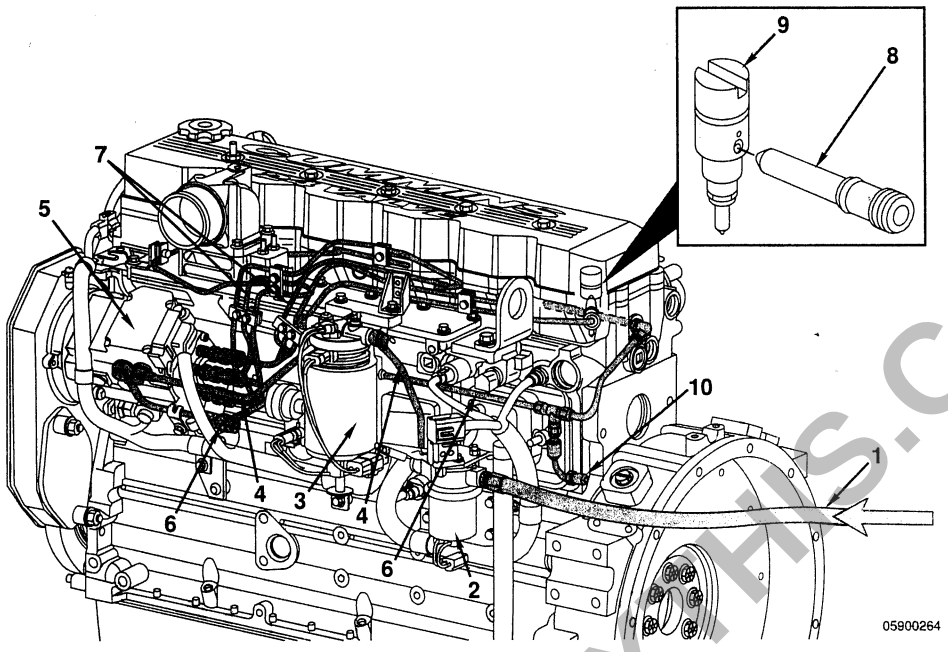
Connecting Rod Side Clearance Limits		
mm		in
0.10	MIN	0.004
0.33	MAX	0.013



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Flow Diagram, Fuel System



1. Fuel from Supply Tank
2. Electronic Lift Pump
3. Fuel Filter/Water Separator
4. Low-Pressure Supply Lines
5. Robert Bosch® VP44 Injection Pump
6. Fuel Drain Line
7. High-Pressure Supply Lines
8. Fuel Connector
9. Robert Bosch® Closed-Nozzle Injectors
10. Fuel Return to Supply Tank.

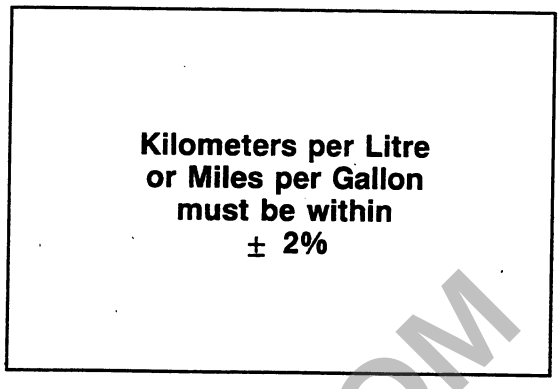
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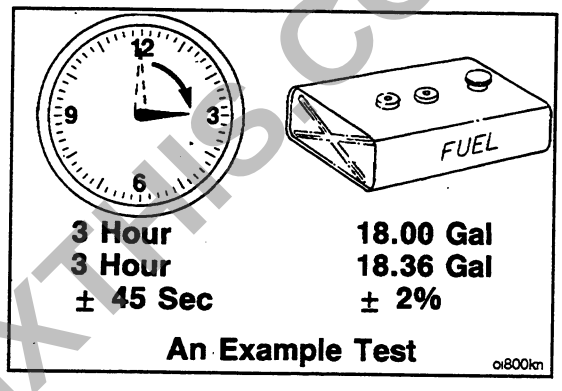
The fuel usage of the test truck between test drives **must** fall within a 2-percent range (e.g., 2.55 versus 2.60 km/liters [6.00 versus 6.12 mpg]).

The same range also applies between test drives of the control truck.

NOTE: The differences in traffic and driving practices can make the test drive fall out of the 2-percent range.

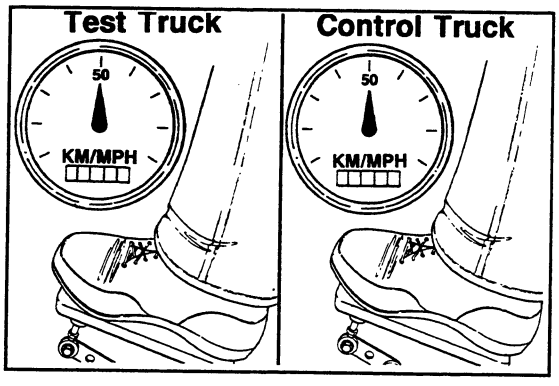


A minimum of three test drives that meet these conditions make a valid test. A single test drive is unreliable.



Use the same experienced drivers for all of the tests.

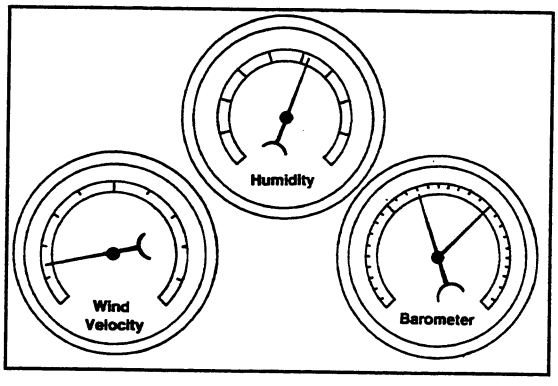
NOTE: The vehicle speeds **must** be representative of a typical operation.



During the test, record the following:

- Ambient temperature
- Humidity
- Barometric pressure
- Wind velocity
- Wind direction.

NOTE: Avoid testing under any extreme conditions.



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Oil Consumption

In addition to the information that follows, a service publication is available entitled Technical Overview of Oil Consumption, Bulletin No. 3379214.

Cummins Engine Company, Inc. defines "acceptable oil usage" as outlined in the following table.

ACCEPTABLE OIL USAGE									
ANY TIME DURING COVERAGE PERIOD									
ENGINE FAMILY	HRS PER QT	HRS PER LITER	HOURS PER IMPERIAL QUART	MILES PER QUART	MILES PER LITER	MILES PER IMPERIAL QUART	KM PER QUART	KM PER LITER	KM PER IMPERIAL QUART
A	10.0	10.6	12.0	400	425	475	650	675	775
4B	10.0	10.6	12.0	400	425	475	650	675	775
6B	10.0	10.6	12.0	400	425	475	650	675	775
6C	10.0	10.6	12.0	400	425	475	650	675	775
V/VT-378	4.0	4.3	5.0	-	-	-	-	-	-
V/VT-504	4.0	4.3	5.0	250	265	310	400	425	485
V/VT-555	4.0	4.3	5.0	250	265	310	400	425	485
L Series	4.0	4.3	5.0	250	265	310	400	425	485
M Series	4.0	4.3	5.0	250	265	310	400	425	485
N Series	4.0	4.3	5.0	250	265	310	400	425	485
V/VT/VTA-903	4.0	4.3	5.0	250	265	310	400	425	485
KT/KTA-19	3.0	3.2	3.75	200	210	250	320	340	390
V/VT/VTA28	2.0	2.1	2.5	-	-	-	-	-	-
KT/KTA38	1.5	1.6	1.8	-	-	-	-	-	-
KTA50	1.1	1.2	1.3	-	-	-	-	-	-

ACCEPTABLE OIL USAGE (Transit Bus, Shuttle Bus and School Bus)									
ANY TIME DURING COVERAGE PERIOD									
ENGINE FAMILY	HRS PER QT	HRS PER LITER	HOURS PER IMPERIAL QUART	MILES PER QUART	MILES PER LITER	MILES PER IMPERIAL QUART	KM PER QUART	KM PER LITER	KM PER IMPERIAL QUART
B	10.0	10.6	12.0	200	210	240	320	340	385
C	8.0	8.5	10.0	150	160	180	240	255	290
L, M, N	4.0	4.3	5.0	100	105	120	160	170	195

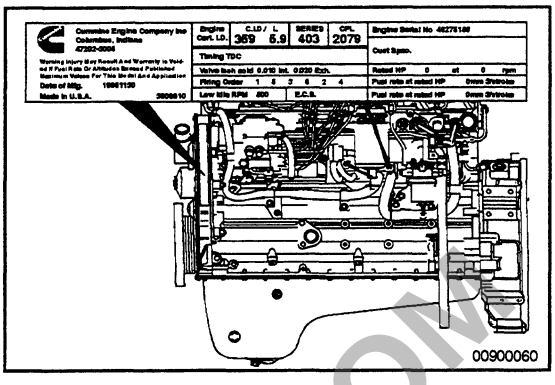
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Engine Identification

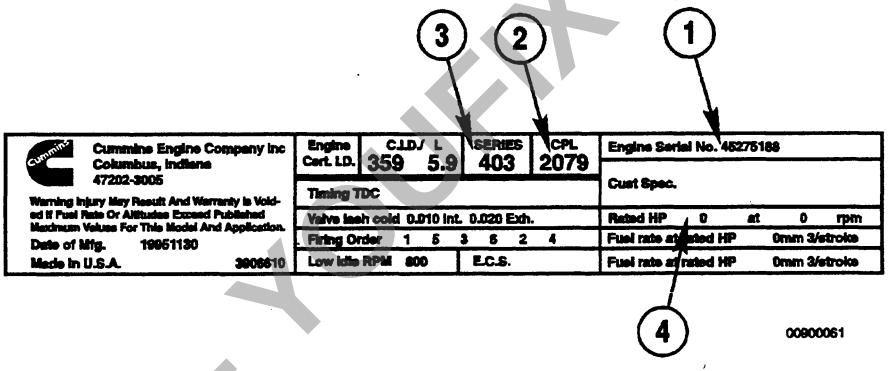
Engine Dataplate

The engine dataplate shows specific facts about your engine. The engine serial number and CPL provide data for ordering parts and service. The engine dataplate **must not** be changed unless approved by Cummins Engine Company, Inc.

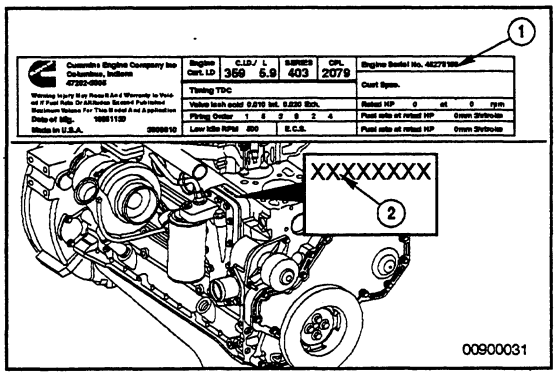


Have the following engine data available when communicating with a Cummins Authorized Repair Location. The information on the dataplate is **mandatory** when sourcing service parts.

1. Engine serial number
2. Control parts list (CPL)
3. Model
4. Horsepower and rpm rating.



NOTE: If the engine dataplate (1) is **not** readable, the engine serial number (2) can be identified on the engine block on top of the lubricating oil cooler housing. Additional engine information is available by reading the ECM dataplate.



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Weights and Measures - Conversion Factors

Quantity	U.S. Customary		Metric		From U.S. Customary To Metric Multiply By	From Metric To U.S. Customary Multiply By
	Unit Name	Abbreviation	Unit Name	Abbreviation		
Area	sq. inch	in^2	sq. millimeters	mm^2	645.16	0.001550
			sq. centimeters	cm^2	6.452	0.155
	sq. foot	ft^2	sq. meter	m^2	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kW-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.352	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kW	0.746	1.341
Pressure	pounds force per sq. inch	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613
	inches of water	in H_2O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H_2O	millimeters of water	mm H_2O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	°F	centigrade	°C	(°F-32) ÷1.8	(1.8 x °C) +32
Torque	pound force per foot	ft-lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in-lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers/hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in^3	liter	l	0.01639	61.02545
	cubic inch	in^3	cubic centimeter	cm^3	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	J	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kW-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kW-hr	0.746	1.341

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Foreword

This manual provides instructions for troubleshooting and repairing this engine in the chassis. Component and assembly rebuild procedures are provided in the engine shop manual. Refer to Section i - Introduction for instructions on how to use 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.

A series of specific service manuals (for example: Shop, Specifications, and Alternative Repair) are available and can be ordered by filling out and mailing the Literature Order Form located in Section L - Service Literature.

The repair procedures used in this manual are recommended by Cummins Engine Co., Inc. Some service procedures require the use of special service tools. Use the correct tools as described.

Cummins Engine Company, 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 are based on the information in effect at the time of printing. Cummins Engine Company, 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. These parts can be identified by the following trademarks:

Cummins® Cummins ReCon® HOLSET® Fleetguard® Premium Blue

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Engine Difficult to Start or Will Not Start (Exhaust Smoke)

This is symptom tree T043.

Cause	Correction
Fuel level low in the tank	Fill the supply tank.
OK	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF in the Troubleshooting and Repair Manual, ISB Fuel System, ISB Engine, Bulletin No. 3666194 for fault code troubleshooting.
OK	
Battery voltage is low	Check the electrolyte level (**not** maintenance-free batteries) in each cell. Add distilled water if necessary. Check the "eye" on the maintenance-free batteries. Refer to the OEM service manual. Replace batteries if necessary.
OK	
Air intake system restriction is above specification	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 010-031.
OK	
Starting aid is necessary for cold weather, or starting aid is malfunctioning	Check for correct operation of the starting aid. Refer to the manufacturer's instructions. Refer to Cold Weather Starting Aids in the Operation and Maintenance Manual, ISB Engine, Bulletin No. 3666170.
OK	
Fuel filter is plugged	Measure the fuel pressure before and after the fuel filter. Refer to Procedure 005-011.
OK	
Engine block heater is malfunctioning (if equipped)	Check the electrical sources and wiring to the cylinder block heater. Replace the block heater if necessary. Refer to the OEM service manuals.
OK	
Fuel pump overflow valve is malfunctioning	Check the overflow valve. Refer to Procedure 005-066 or 006-044.
OK	

(Continued)

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Intake Manifold Pressure (Boost) is Below Normal

This is symptom tree T097.

Cause	Correction
Air intake or exhaust leaks	Inspect the air intake and exhaust systems for air leaks. Refer to Procedure 010-024.
OK ↓	
Air intake system restriction is above specification	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 010-031.
OK ↓	
Charge air cooler (CAC) is restricted or leaking	Inspect the CAC for air restriction or leaks. Refer to Procedure 010-027.
OK ↓	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF in the Troubleshooting and Repair Manual, ISB Fuel System, ISB Engine, Bulletin No. 3666194 for fault code troubleshooting.
OK ↓	
Air compressor connection is loose or damaged	Check the connection between the manifold and the air compressor. Repair or replace if necessary.
OK ↓	
Exhaust system restriction is above specification	Check the exhaust system for restrictions. Refer to Procedure 011-009.
OK ↓	
Turbocharger is **not** correct	Check the turbocharger part number and compare it to the Control Parts List (CPL), Bulletin No. 3379133. Replace the turbocharger if necessary. Refer to Procedure 010-033.
OK ↓	
Turbocharger is worn or damaged	Check the turbocharger for damage. Measure the turbine and compressor wheel clearances. Refer to Procedure 010–038 and 010–047.
OK ↓	

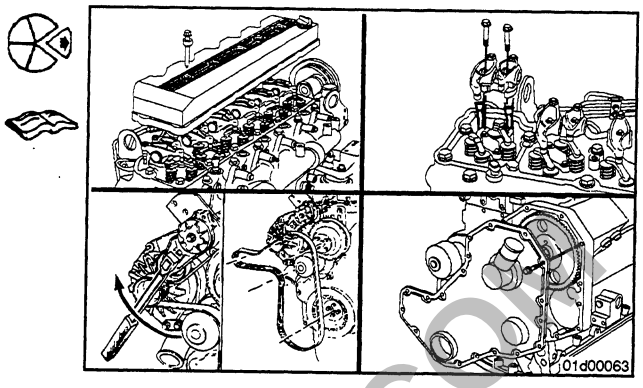
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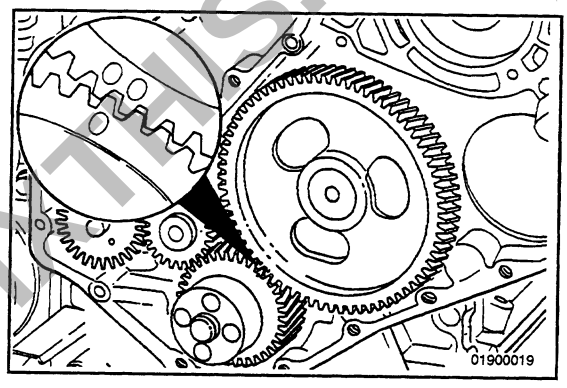
Camshaft (001-008)

Remove (001-008-002)

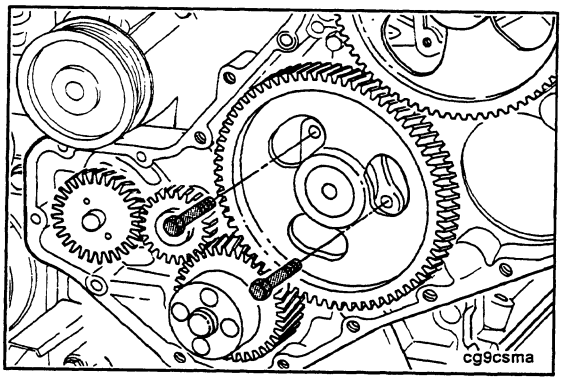


- Remove the rocker lever cover. Refer to Procedure 003-011.
- Remove the rocker levers. Refer to Procedure 003-008.
- Remove the push rods. Refer to Procedure 004-014.
- Remove the drive belt. Refer to Procedure 008-002.
- Remove the crankshaft pulley. Refer to Procedure 001-052.
- Remove the gear cover. Refer to Procedure 001-031.
- Raise the tappets. Refer to Procedure 004-015.

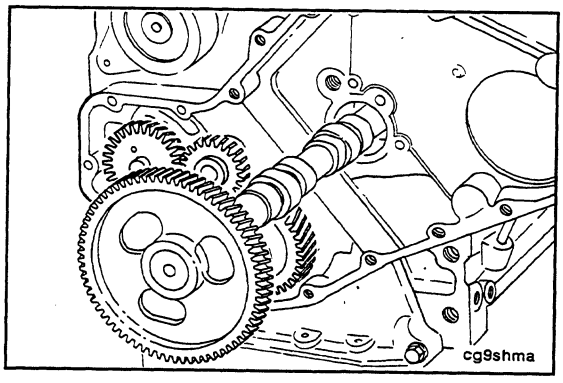
Rotate the crankshaft to align the crankshaft to camshaft timing marks.



Remove the capscrews from the thrust plate.

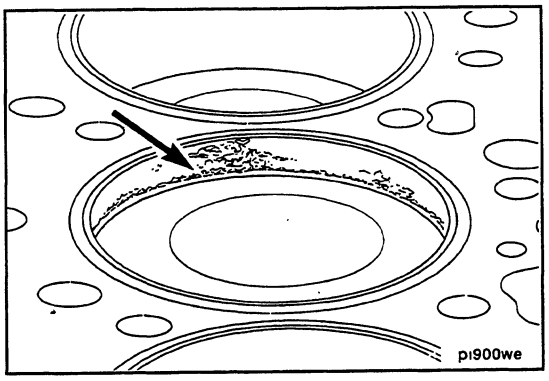


Remove the camshaft and thrust plate.

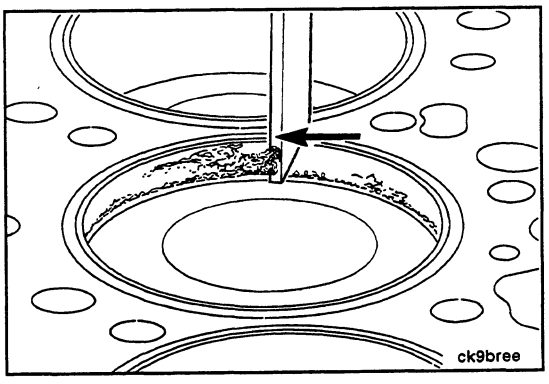


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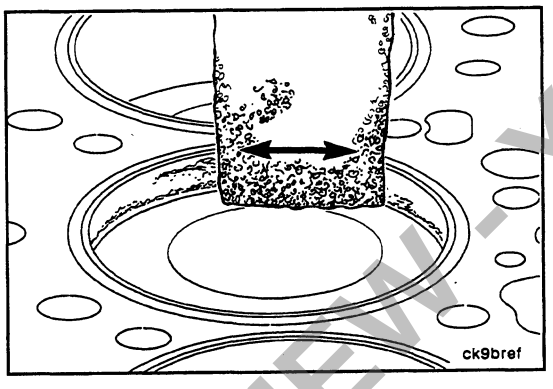
Rotate the crankshaft until the pistons are below the carbon deposits, which are found above the ring travel area.



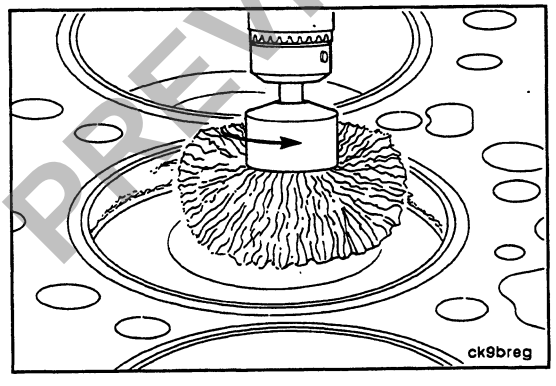
⚠ CAUTION ⚠

Do not damage the cylinder with the scraper.

Use a scraper or a blunt-edged instrument to loosen the carbon deposits.



Remove the remaining carbon with a Scotch-Brite cleaning pad, or equivalent.



⚠ WARNING ⚠

To prevent serious eye damage, wear eye protection during this operation.

⚠ CAUTION ⚠

Do not use the steel wire wheel in the piston travel area. Operate the wheel in a circular motion to remove the deposits.

An alternative method to remove the carbon ridge is to use a high-quality steel wire wheel installed in a drill or die grinder.

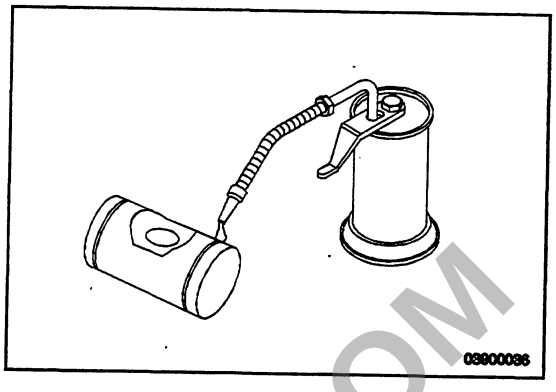
NOTE: An inferior quality wire wheel will lose steel bristles during operation, thus causing additional contamination.

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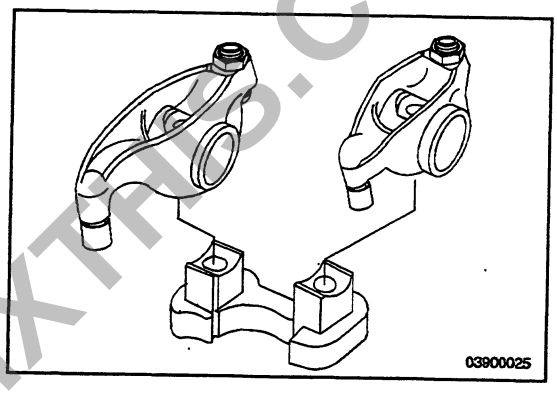
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Lubricate the rocker lever shafts with clean 15W-4O engine lubricating oil.

Install the rocker lever shafts into the rocker levers.

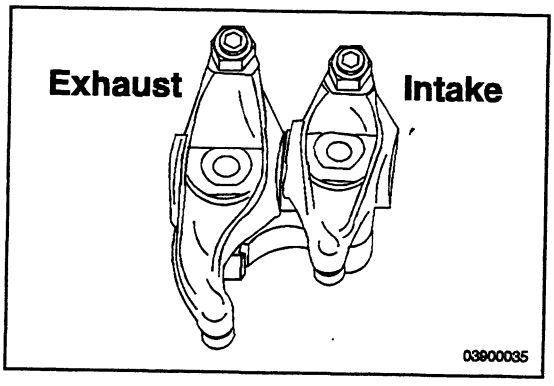


Position the rocker levers on the rocker pedestal.



⚠ CAUTION ⚠

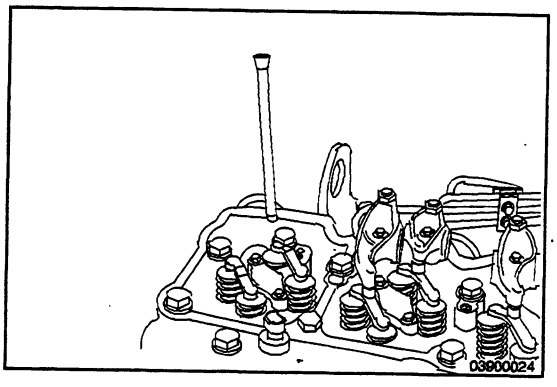
Be sure to assemble the intake and exhaust rocker levers in the correct location. Failure to do so will result in engine damage.



Install (003-008-026)

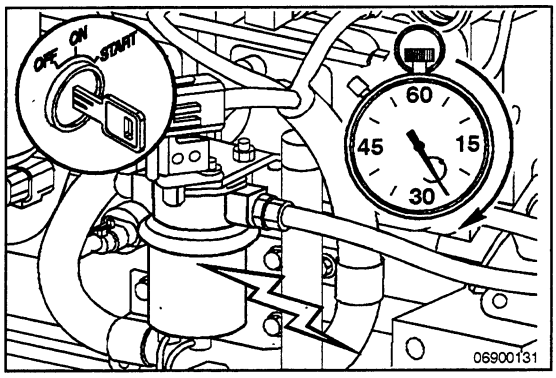
Install the crossheads in their original location and position.

Install push rods as marked during removal.



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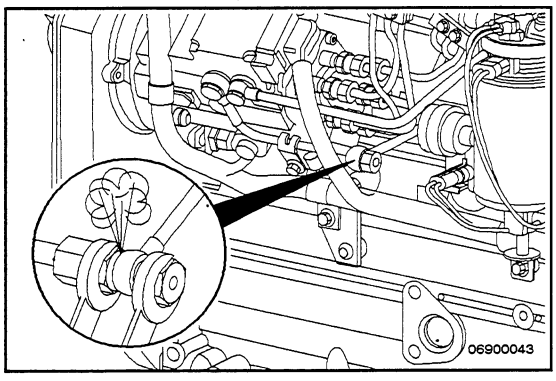
Air in Fuel (006-003)

Test (006-003-012)

The pressure relief valve on the VP44 fuel system creates a self-bleeding system during replacement of most of the supply-side components.

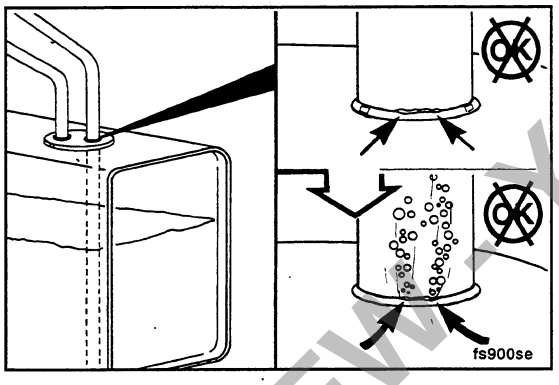
Generally, most of the air that enters the system during component replacement can be bled out by turning the fuel lift pump on for 25 seconds.

NOTE: To run the fuel lift pump for 25 seconds, crank the engine for a split second, and leave the key in the ON position.



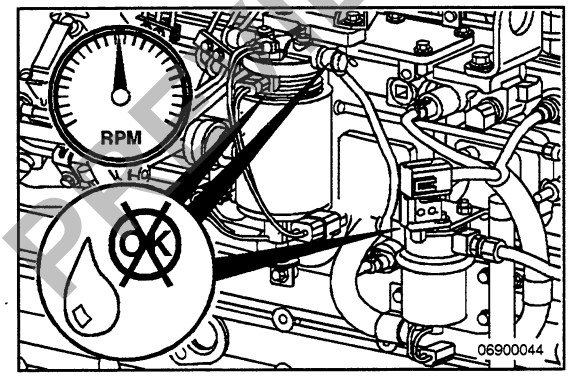
NOTE: If an excessive amount of air has entered the system, the system will need to be bled.

Loosen the return banjo fitting on the fuel drain line. Run the fuel lift pump until all the air has been bled. When all the air has been bled, retighten the fitting.



If air continues to bubble out of the system for several minutes, an air leak is present. A source from which air can enter the fuel system, which is often overlooked, is between the fuel filter and suction tube inlet in the tank. Fuel tanks that have the outlet fitting at the top will have a suction tube that extends to the bottom of the tank. Cracks or pin holes in the weld that join the tube to the fitting can let air enter the fuel system.

Make sure that all fittings from the fuel supply line on the tank to the inlet of the fuel lift pump are tight.



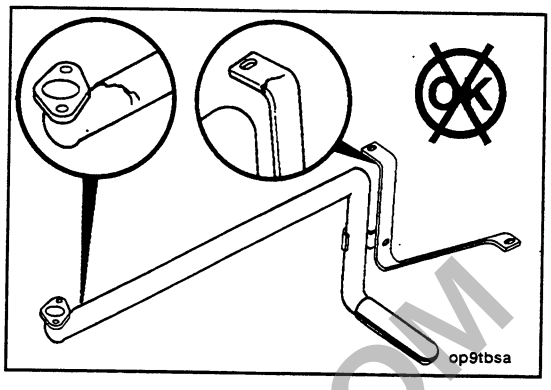
Since the fuel lift pump provides a positive pressure through the fuel filter and supply line to the fuel injection pump, loose connections or defective seals should show as a fuel leak, **not** as an air leak.

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Inspect for Reuse (007-035-007)

Inspect the suction tube for cracks.

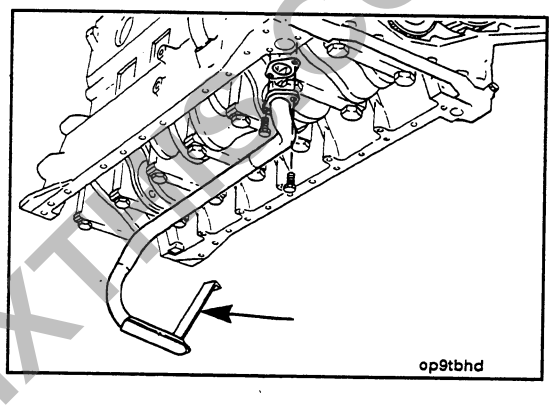


Install (007-035-026)

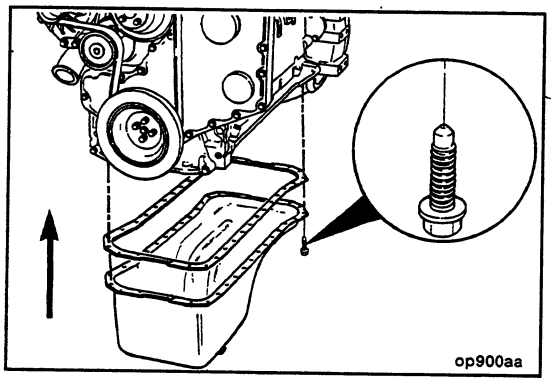
Install the lubricating oil suction tube gasket and suction tube.

Install and tighten the suction tube mounting capscrews.

Torque Value: 24 N•m [18 ft-lb]



Install oil pan and gasket. Refer to Procedure 007-025.

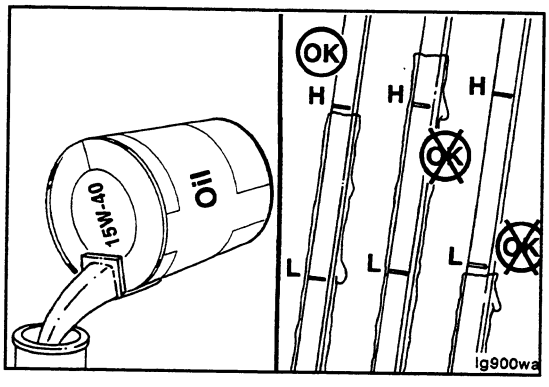


Fill (007-035-028)

Fill the engine with 15W-40 lubricating oil. Refer to Procedure 007-025.

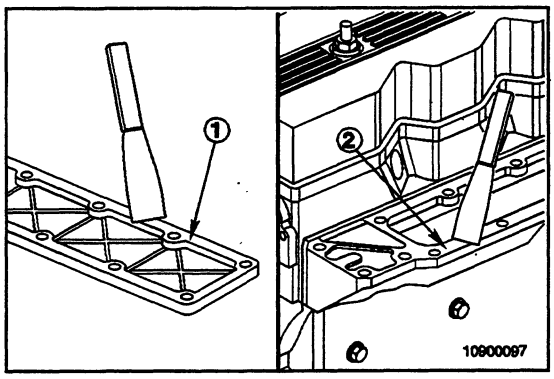
Operate the engine and check for leaks.

Stop the engine, and check the lubricating oil level with the dipstick.



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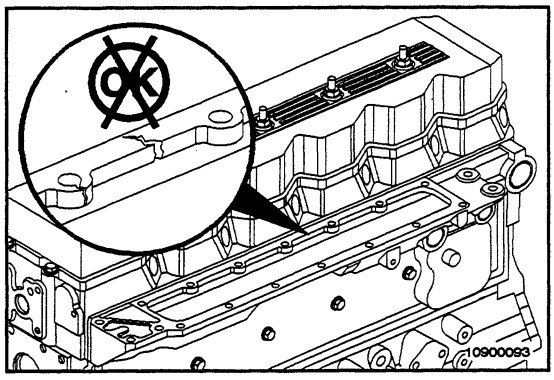
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Clean (010-023-006)

NOTE: Keep the gasket material and any other material out of the air intake.

Clean the sealing surfaces (1 and 2) with a putty knife and a clean rag.

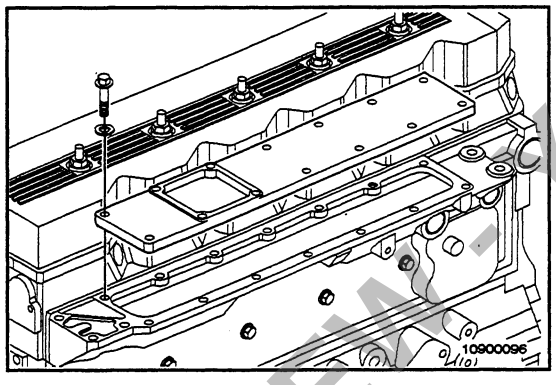


Inspect for Reuse (010-023-007)

Remove the tape.

Inspect the intake manifold for cracks or other damage.

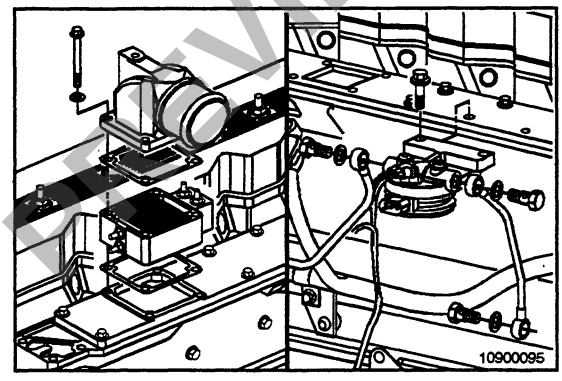
NOTE: When inspecting the intake manifold for oil or debris from an air system failure, also inspect the cylinder head for oil and debris.



Install (010-023-026)

Install the cover and a new gasket.

Torque Value: 24 N•m [18 ft-lb]



Install the fuel filter mount. Refer to Procedure 006-018.

Install the fuel filter head. Refer to Procedure 006-014 or 006-015.

Install the low-pressure fuel lines. Refer to Procedure 006-024.

Install the high-pressure fuel lines. Refer to Procedure 006-051.

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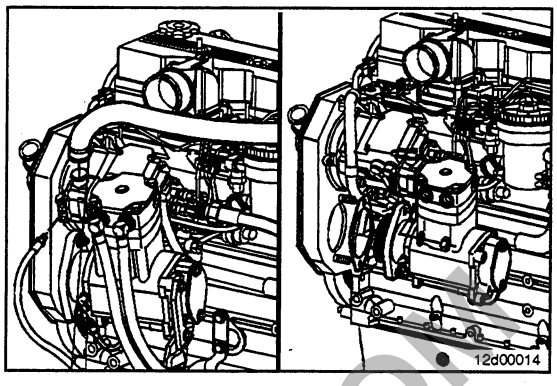
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Remove the air connections from the air compressor.

Remove the oil supply and return lines, if applicable.

Remove the air compressor support bracket and capscrews.

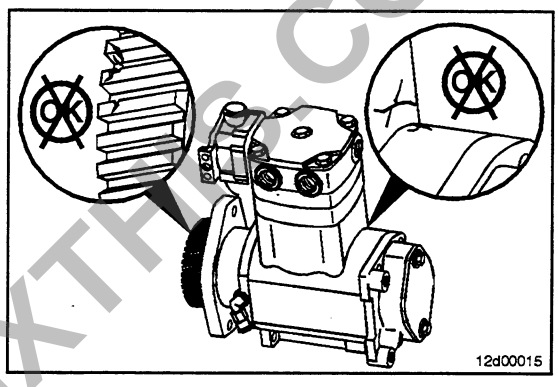
Remove the four capscrews and the air compressor.



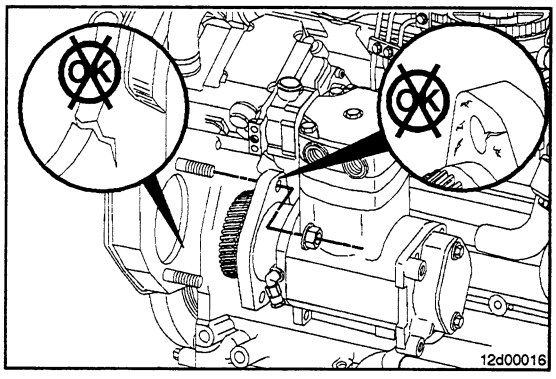
Inspect for Reuse (012-014-007)

Inspect the compressor housing for cracks or damage.

Inspect the drive gear for cracks or damaged.



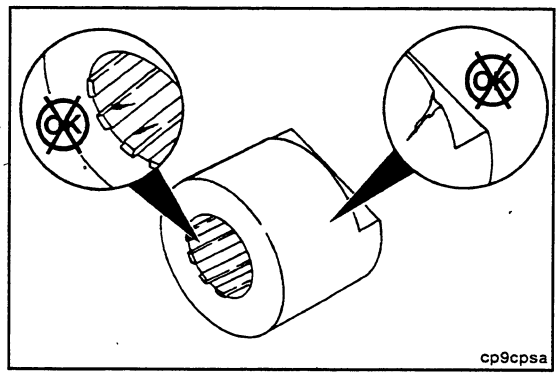
The gasket surfaces of the gear housing and air compressor **must** be clean and **not** damaged.



Power Steering Coupling (if applicable)

Inspect the coupling for wear or cracks.

Replace the coupling, if damaged. Refer to the OEM repair manual.

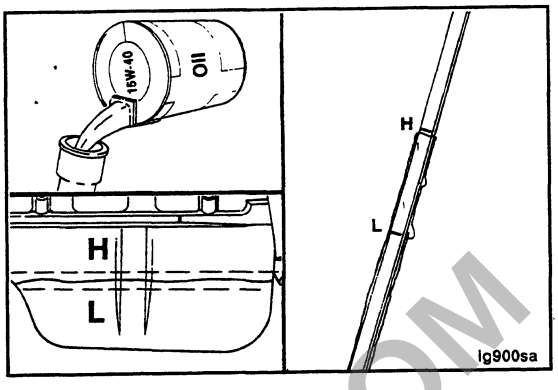


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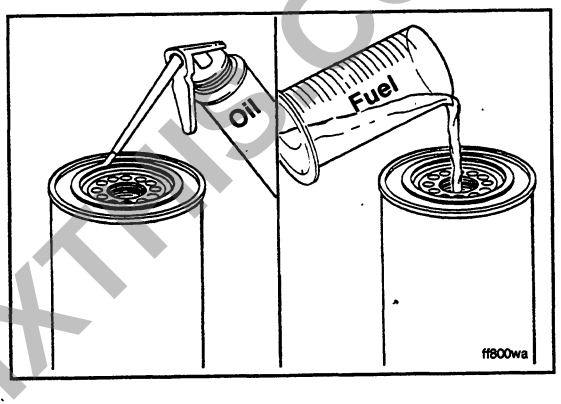
Allow the oil to drain into the oil pan, and measure the oil level with the dipstick.

Add oil, as necessary, to bring the level to the high level mark on the dipstick.



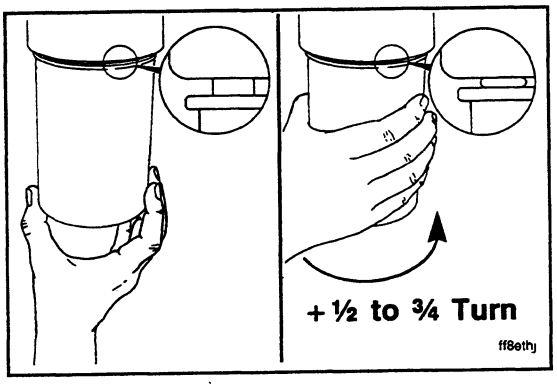
Lubricate the gasket on the fuel filter with clean 15W-40 oil.

Fill the fuel filter with clean fuel.



Screw the fuel filter onto the fuel filter head until the gasket contacts the fuel filter head surface.

Tighten the filter as specified by the manufacturer.



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