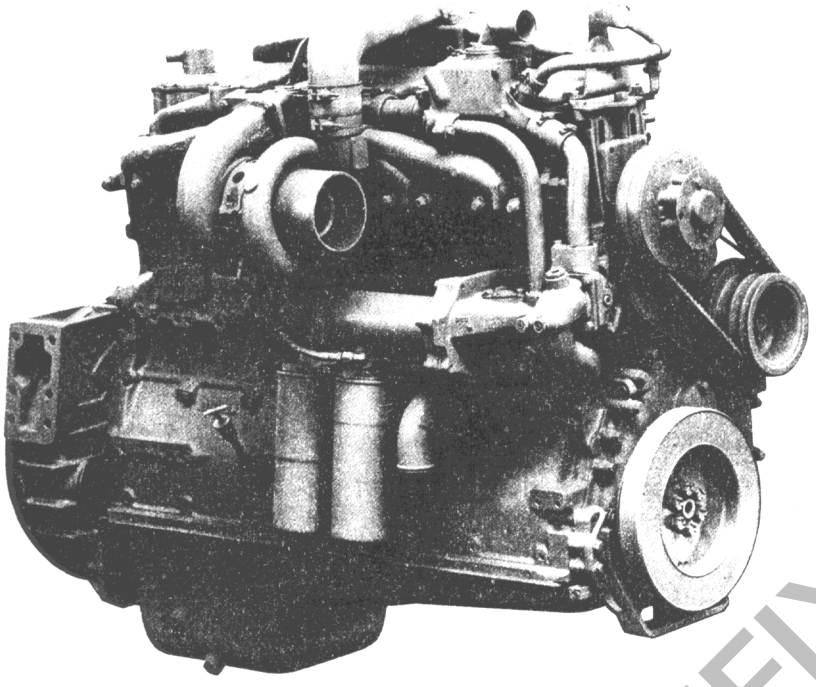
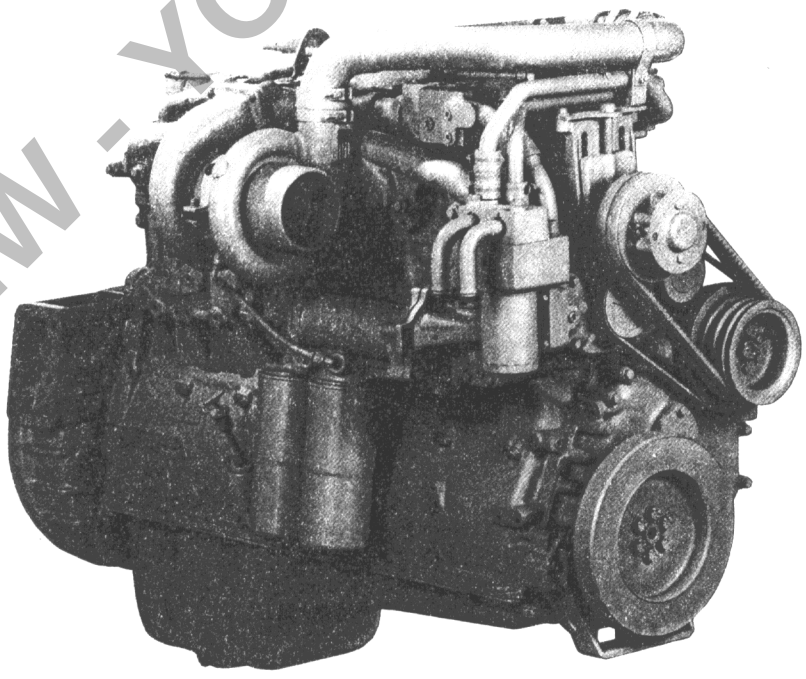
Troubleshooting and Repair Manual
Big Cam III and Big Cam IV, NT 855 Engines



Big Cam III



Big Cam IV

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Troubleshooting Symptoms

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*Refer to ″General Engine Noise Diagnostic Procedures″ on page 70 for appropriate diagnostic procedures.

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Engine Specifications

General Engine Data

Horsepower ..... 179 kw (240 BHP) to 354 kw (475 BHP)
Engine Speed@ Maximum Output
  Standard Rating (RPM) 2100
  Formula Rating (RPM) 1800
Bore and Stroke ..... 140 mm [5.5 in.] X 152 mm [6.0 in.]
Displacement ..... 14.0 liters [855 cu. in.]
Compression Ratio ..... 13.5:1 to 17.2:1
Firing Order 1-5-3-6-2-4
Engine Weight (With Standard Accessories)
  Dry Weight ..... 1126 kg [2480 lb.] to 1221 kg [2690 lb.]
  Wet Weight ..... 1180 kg [2600 lb.] to 1276 kg [2810 lb.]

Air Induction System

Maximum allowable turbocharged intake restriction ..... 64 cm H_2O [25 in. H_2O]
Maximum allowable naturally aspirated and Fleet 270 intake restriction ..... 51 cm H_2O [20 in. H_2O]

Lubrication System

Oil pressure at idle (minimum allowable) ..... 70 kPa [10 psi] minimum
At no load governed speed ..... 240-310 kPa [35-45 psi]
Oil capacity of standard engine:
  Bypass filter ..... 2.8 liters [0.75 U.S. gal.]
  Full flow filter ..... 3.5 liters [0.93 U.S. gal.]
  Combo filter ..... 3.9 liters [1.04 U.S. gal.]
  Oil pan capacity (high-low) ..... 36-28 liters [9.5-7.5 U.S. gal.]
Total system capacity including filters ..... 42 liters [11.0 U.S. gal.]

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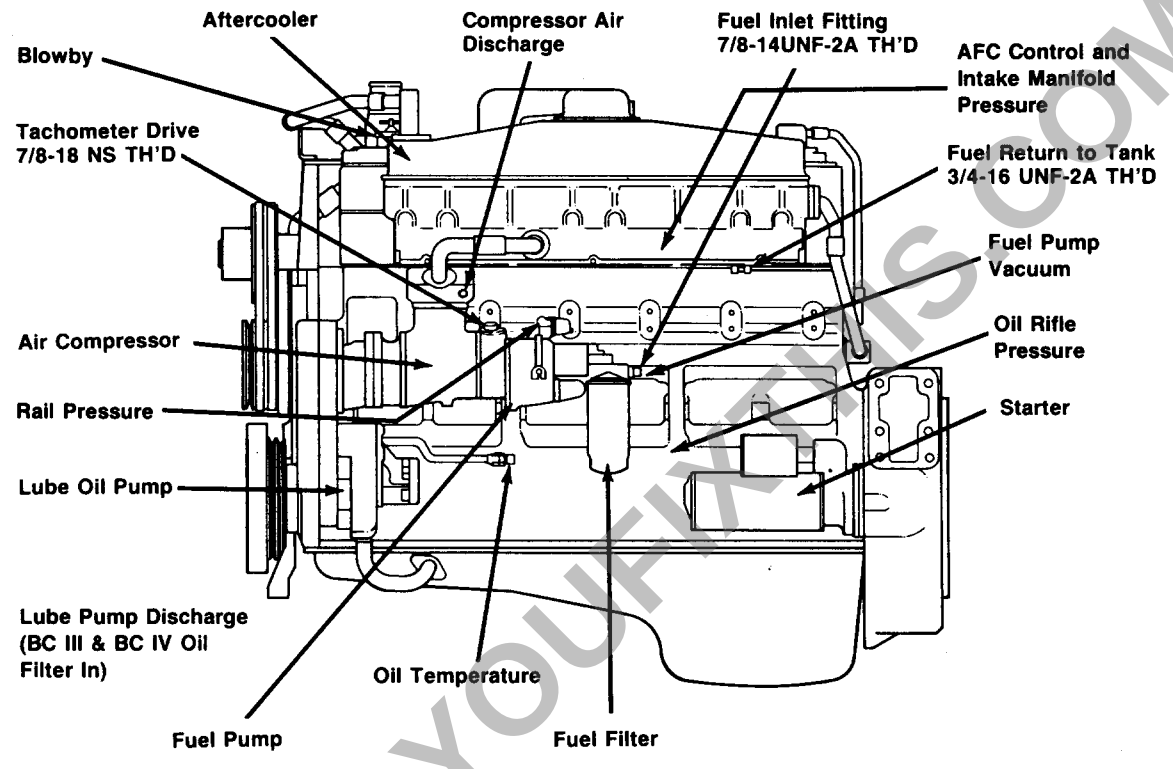
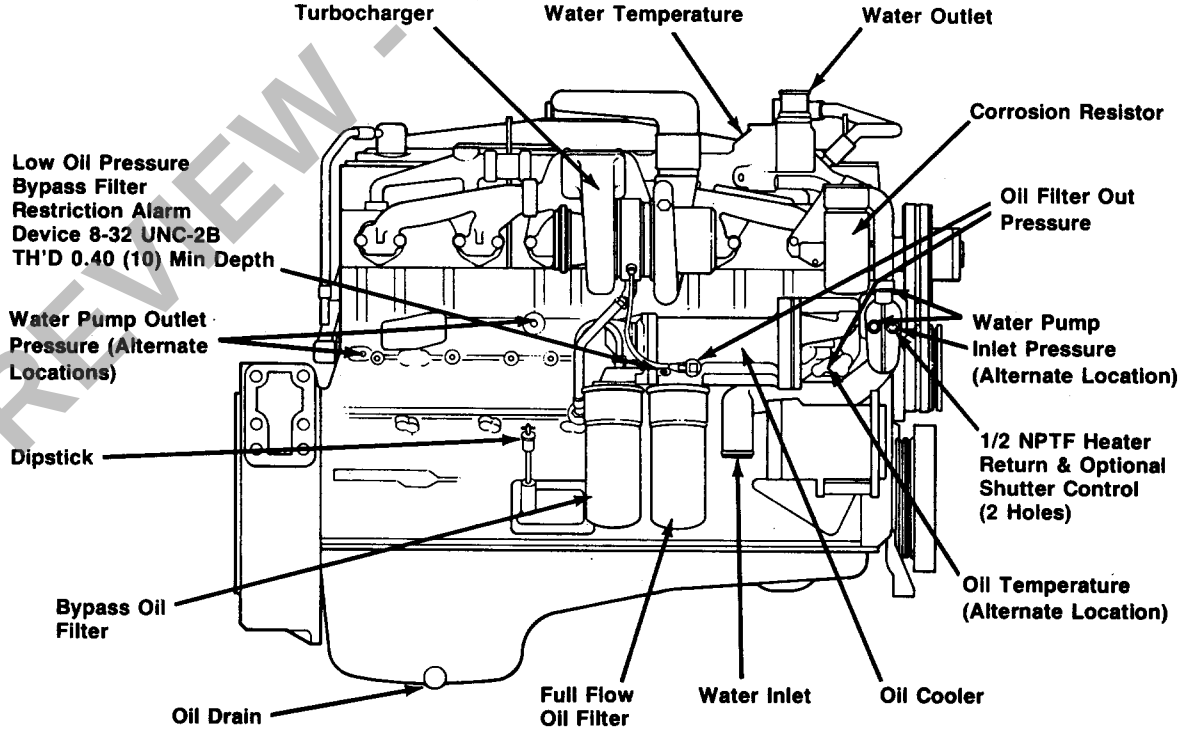
Engine Diagrams

The following drawings contain information about engine components, filter locations, drain points, and access locations for instrumentation and engine controls.

The information and configuration of components shown in these drawings are of a general nature. Some component locations will vary depending on applications and installations.

Conventional Aftercooling





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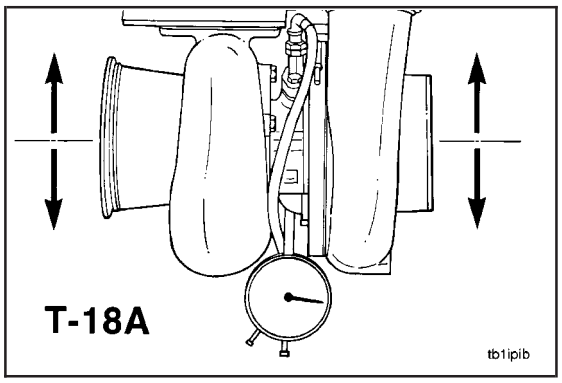
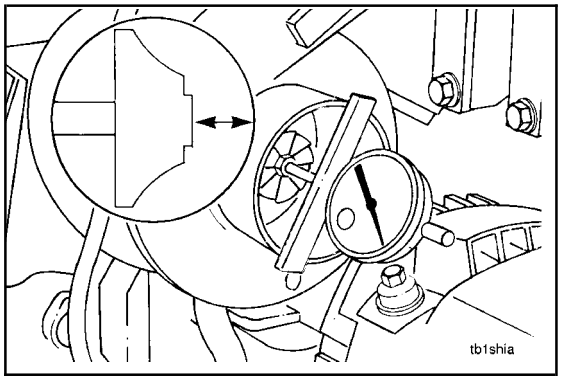


Turbocharger Model No.	Dimension Minimum	Maximum
T46B		
• Compressor Impeller	0.15 mm [0.006 in.]	0.45 mm [0.018 in.]
• Turbine Wheel	0.20 mm [0.008 in.]	1.09 mm [0.043 in.]
HT3B		
• Compressor Impeller	0.15 mm [0.006 in.]	0.45 mm [0.018 in.]
• Turbine Wheel	0.20 mm [0.008 in.]	0.53 mm [0.021 in.]
HT4B		
• Compressor Impeller	0.15 mm [0.006 in.]	0.46 mm [0.018 in.]
• Turbine Wheel	0.20 mm [0.008 in.]	0.53 mm [0.021 in.]
HC3		
• Compressor Impeller	0.20 mm [0.008 in.]	0.41 mm [0.016 in.]
• Turbine Wheel	0.28 mm [0.011 in.]	0.48 mm [0.019 in.]
T18A*		
• Compressor Impeller and Turbine Wheel	0.20 mm [0.008 in.]	0.45 mm [0.18 in.]

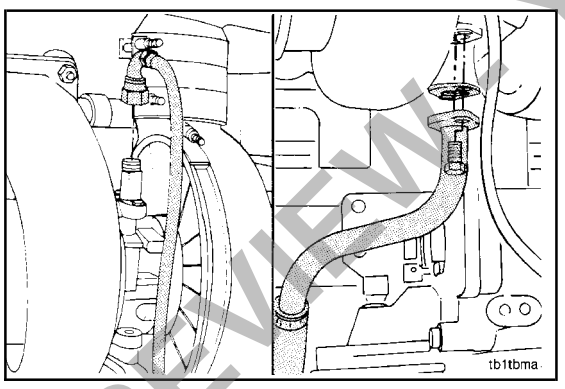
*Radial clearance on T18A **must** be measured with the dial indicator through the turbocharger oil drain hole.



1. Measure axial clearance (end to end).

   Rebuild or replace the turbocharger if axial clearance is greater than specified.

Turbocharger Model No.	Dimension Minimum	Maximum
T46B	0.15 mm [0.006 in.]	0.35 mm [0.014 in.]
HT3B	0.03 mm [0.001 in.]	0.10 mm [0.004 in.]
HT4B	0.05 mm [0.002 in.]	0.13 mm [0.005 in.]
HC3	0.03 mm [0.001 in.]	0.10 mm [0.004 in.]
T18A	0.10 mm [0.004 in.]	0.23 mm [0.009 in.]



Turbocharger - Replace (3-13)

Remove

1. Remove the oil supply and the oil drain tubes from the turbocharger.

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Required Service Tools - (1-00)

Cooling System

Procedure No.	Part No.	Description
1-09	3300846S	DCA4 Coolant Test Kit
	(Fleetguard®)	
	3375208	
	(Cummins)	
1-19	ST-1293	Belt Tension Gauge
1-20	ST-1138	Belt Tension Gauge
	ST-1274	Belt Tension Gauge
1-25	3377462	Optical Tachometer
	3377464	Reflective Tape (in optical tachometer, Part No. 3377462)
1-32	ST-1225	Thermostat Seal Mandrel
1-35	3377144	Internal Pipe Wrench
	3377387	Internal Pipe Wrench
1-38	3377291	Thermostat Seat Driver
1-40	3377414	Check Valve Driver

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Pipe Plug Torque Values - (10-03)

Size			Torque		Torque	
Thread	Actual Thread O.D.		In Aluminum Components		In Cast Iron or Steel Components	
in	mm	[in]	N•m	[ft-lbs]	N•m	[ft-lbs]
1/16	8.1	[0.32]	5	[45 in-lbs]	15	[10]
1/8	10.4	[0.41]	15	[10]	20	[15]
1/4	13.7	[0.54]	20	[15]	25	[20]
3/8	17.3	[0.68]	25	[20]	35	[25]
1/2	21.6	[0.85]	35	[25]	55	[40]
3/4	26.7	[1.05]	45	[35]	75	[55]
1	33.5	[1.32]	60	[45]	95	[70]
1-1/4	42.2	[1.66]	75	[55]	115	[85]
1-1/2	48.3	[1.90]	85	[65]	135	[100]

Capscrew Markings and Torque Values - (10-04)

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

SAE capscrews are graded according to the strength of the capscrew. They are marked on the head so the correct strength and torque value are known.

The table on the following page lists the capscrew markings and the correct value for the capscrew. SAE capscrews are identified by:

U.S. Customary (5/16 X 18 X 1 1/2)		
5/16	**18**	**1 1/2**
Major Thread Diameter in Inches	Number Threads per Inch	Length in Inches

Notes:

1. Always use the torque values listed on page 5 when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual. It is important to use the correct torque values for SAE grade 5 and 8 capscrews.
3. The torque values in the table are based on the use of lubricated threads.

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Section I - Introduction

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TURBOCHARGER LEAKS (ENGINE OIL OR FUEL)

Cause	Corrections
Turbocharger Turbine Seal Leak	Check turbine seal for leaks. Refer to Procedure 3-05.
OK ↓	
Excessive Engine Crankcase Gases (Blowby)	Check engine crankcase gases (blowby). Refer to Procedure 8-01.

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EXCESSIVE ENGINE NOISE *

Cause	Corrections
Fan Belt Malfunctioning (Too Tight, Loose, or Not in Alignment)	Check fan belt. Refer to Procedure 1-20.
OK ↓	
Fan Blades Damaged	Check fan. Refer to Procedure 1-24.
OK ↓	
Incorrect Turbocharger Installed	Check for correct turbocharger. Refer to Procedure 3-07.
OK ↓	
Excessive Valve or Injector Clearance	Check valve and injector adjustment. Refer to Procedure 7-04.
OK ↓	
Damaged Push Rod or Cam Follower	Check push rods and cam followers. Refer to Procedures 7-08, 7-13, and 7-15.
OK ↓	
Excessive Gear Train Backlash or Damaged Gear Teeth	Check gear backlash and gear teeth. Refer to Procedures 7-28, 7-35, and 7-37.
OK ↓	
Main or Connecting Rod Bearings Loose or Damaged	Refer to ‘‘Connecting Rod or Main Bearing Noise’’ Symptom Charts on pages 72 and 71, respectively.
OK ↓	
Piston Rings Broken or Worn	Refer to ‘‘Piston Noise’’ Symptom Chart on page 73.

*__Note:__ When troubleshooting engine noise problems, make sure the engine accessories (air compressor, fan clutch, or hydraulic pump) are **not** the cause of the noise. Refer to ″General Engine Noise Diagnostic Procedures″ on page 70.

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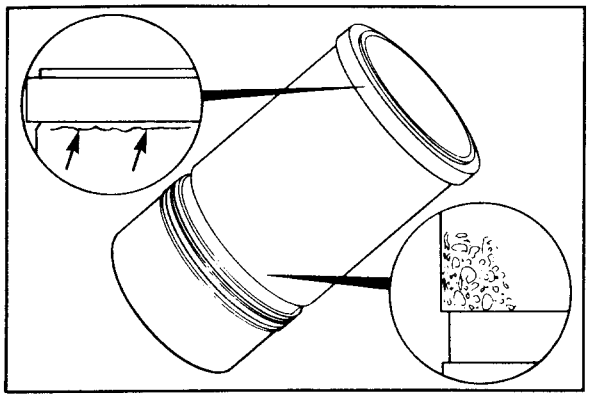
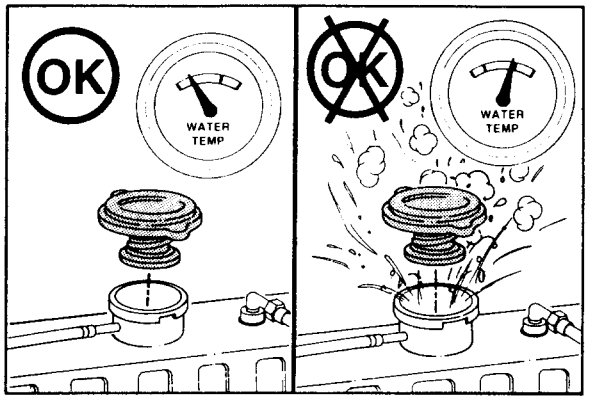
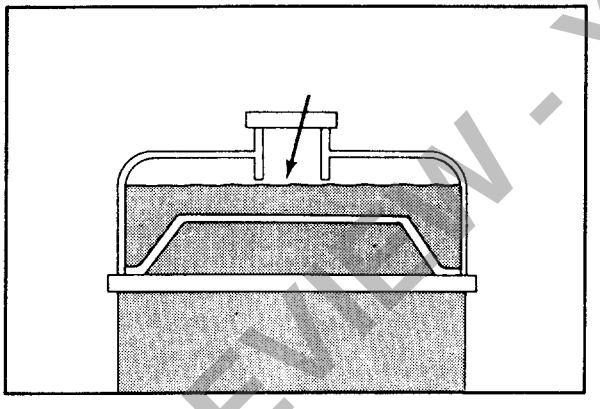


8. Inspect the liner for cracks or porosity. Refer to Section 7, Procedure 7-24.



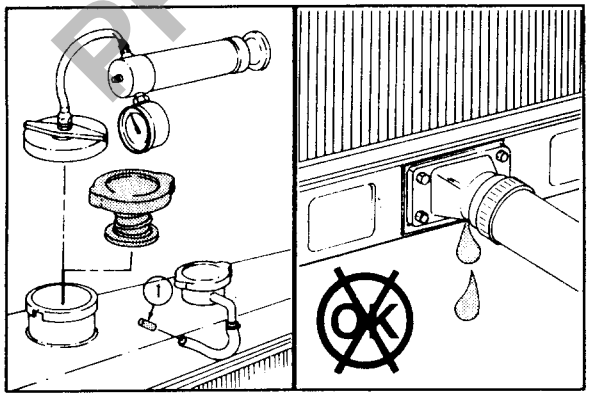
Cooling System - Pressure Test (1-12)

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



1. Check the coolant level and fill if necessary.

NOTE: If coolant is added, additional DCA4 (or equivalent) will be required. For the correct test kit to check DCA4 concentration, refer to Procedure 1-09.



2. If the radiator is equipped with a pressure relief valve, install a plug in the overflow tube (1).

Caution: Do not apply more than 140 kPa [20 psi] air pressure to the cooling system. The water pump seal may be damaged.

3. Install the pressure tester on the radiator fill neck or surge tank (if equipped), and apply 140 kPa [20 psi] maximum air pressure.

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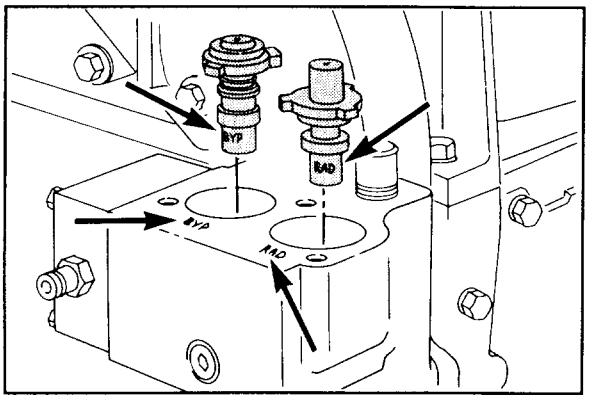


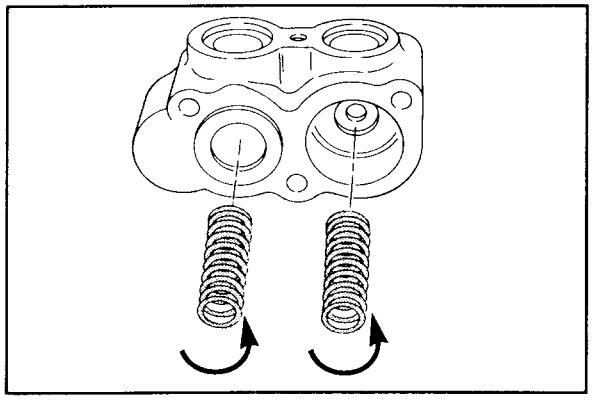
Install

Caution: The thermostats must be positioned in the correct bores so the thermostats will operate correctly. Failure to do so may cause engine damage. Refer to Step No. 1 below to identify the thermostats and the correct bore location.

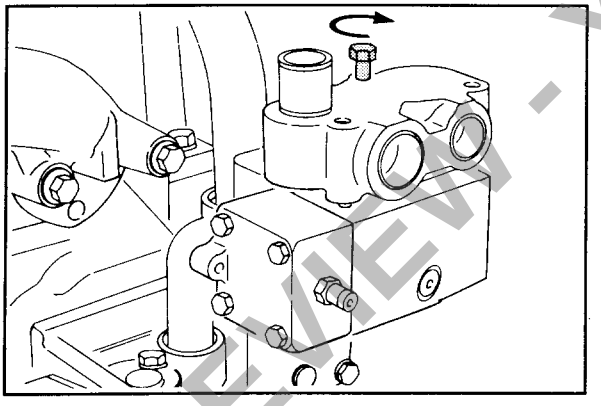
1. Install the cover gasket on the thermostat housing. Carefully install the thermostats into the correct bores. Each thermostat is marked as follows:

   • BYP (Bypass) • RAD (Radiator)

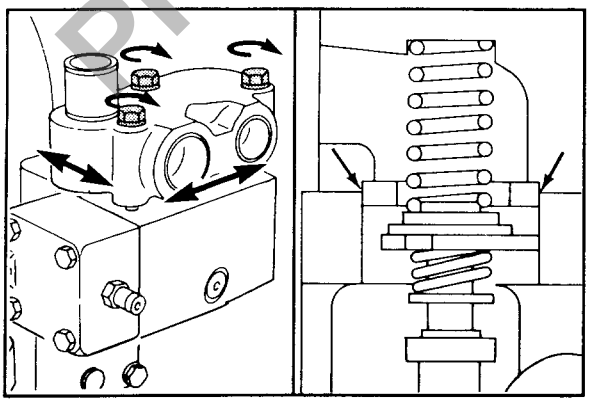
   The top of the cover gasket is also marked.



2. Twist the springs into the two bores in the cover. The springs are held in the cover by an interference fit of the springs in the bores.



3. Position the springs on top of the thermostats, and install the cover. Hold down the cover, and tighten the center capscrew until the cover is approximately 6.4 mm [0.25-inch] above the housing.



4. Move the cover back and forth until the protruding bypass seat drops into the bore. Tighten the capscrews alternately so the seat correctly enters into the bore. Tighten the capscrews to 45 N•m [35 ft-lbs] torque.

NOTE: The bypass seat **must** be in the bore before the cover is tightened.

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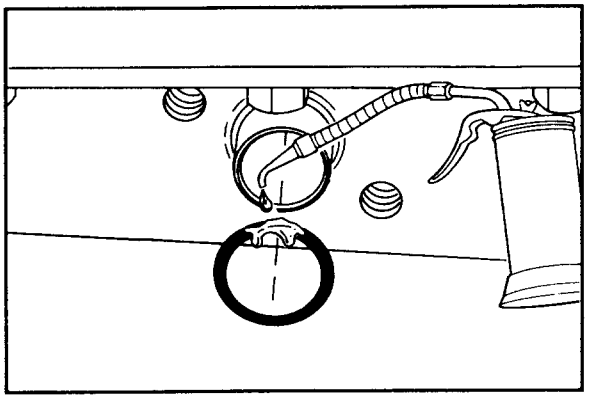
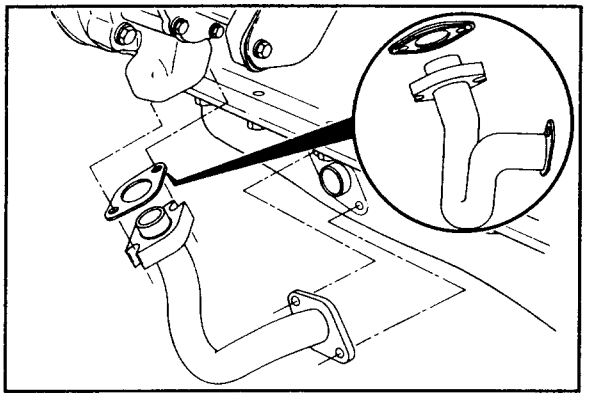
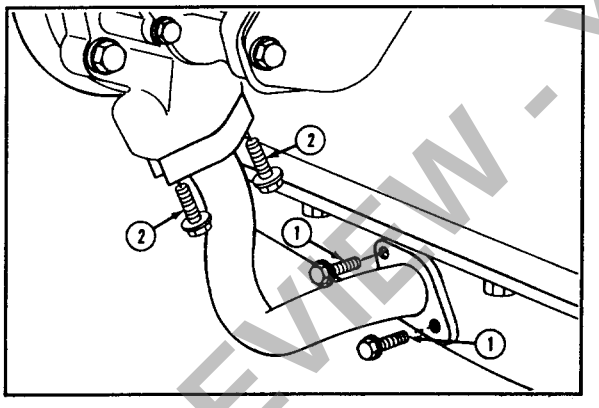


4. Install a new O-ring on the oil pan lubricating oil suction tube.
5. Use clean vegetable oil to lubricate the O-ring.

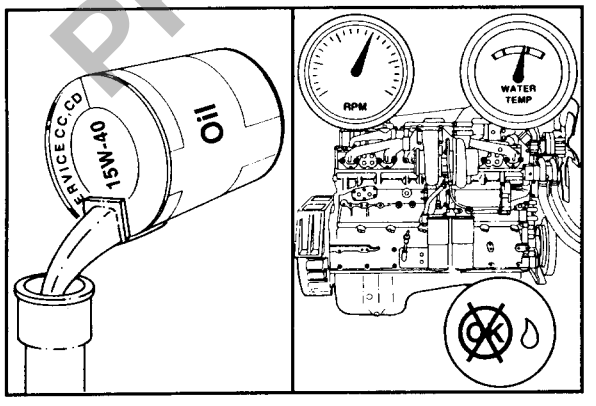


6. Loosely assemble the lubricating oil transfer tube, the flanges, the O-rings, the gaskets, and the mounting capscrews to the oil pan and the lubricating oil pump.

NOTE: The printed side of the mounting flange gasket on the oil transfer tube **must** be toward the flange.



7. Tighten the capscrews in the following sequence:
   - First, tighten the two capscrews (1) at the oil pan to 45 N•m [35 ft-lbs] torque.
   - Second, tighten the capscrews (2) at the lubricating oil pump to 45 N•m [35 ft-lbs] torque.



8. Fill the engine with clean 15W-40 oil. Refer to Reference 2-03 for engine capacity.
9. Operate the engine until the water temperature reaches 80°C [180°F], and check for oil leaks.

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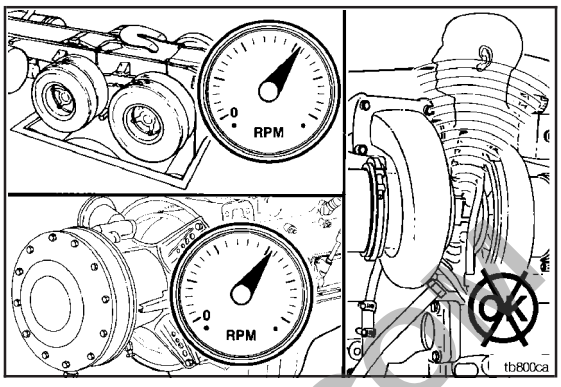
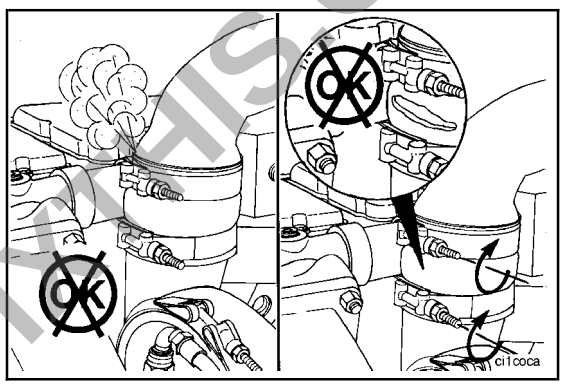
3. Operate the engine at full throttle and maximum load.
4. Listen for a ‘‘high pitch’’ noise from the turbocharger.



5. The noise can be caused by an air leak from the following:

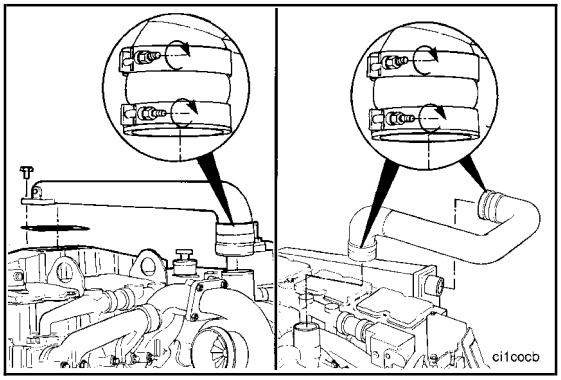
   a. Turbocharger to aftercooler air supply hose.

   - Inspect the hose for damage.
   - Tighten the hose clamps to 8 N•m [70 in-lb] torque.



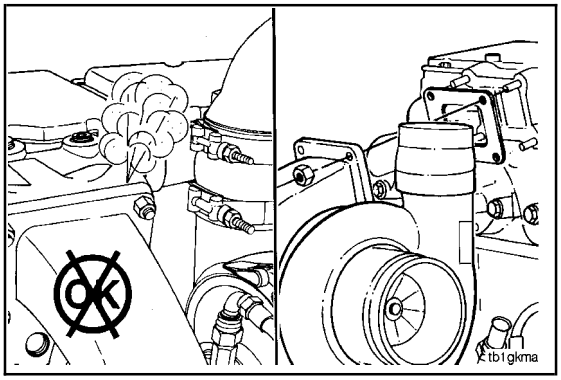
   b. Air crossover to aftercooler connection leakage.

   - Replace the air crossover gasket, and tighten the capscrews to 35 N•m [25 ft-lb] torque, (Big Cam III).
   - Tighten the hose clamps to 8 N•m [70 in-lb] torque, (Big Cam IV).



   c. Turbocharger to exhaust manifold mounting gasket.

   - Replace the gasket. Refer to Procedure 3-13.



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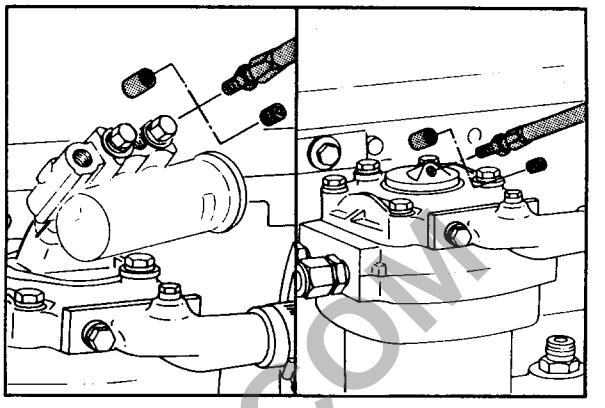
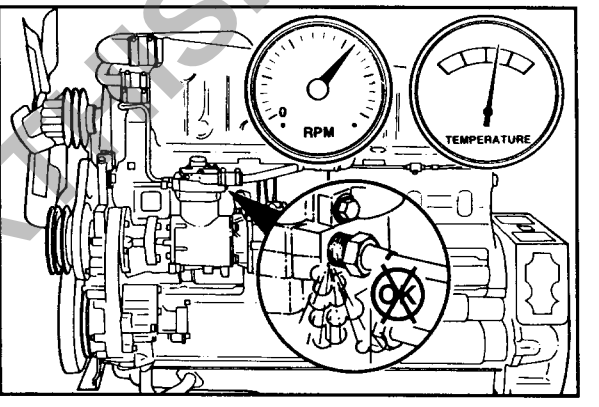
9. Remove the pipe plugs from the unloader ports used for accessory air lines.
10. Install and tighten the accessory air lines.
11. Connect the unloader valve.



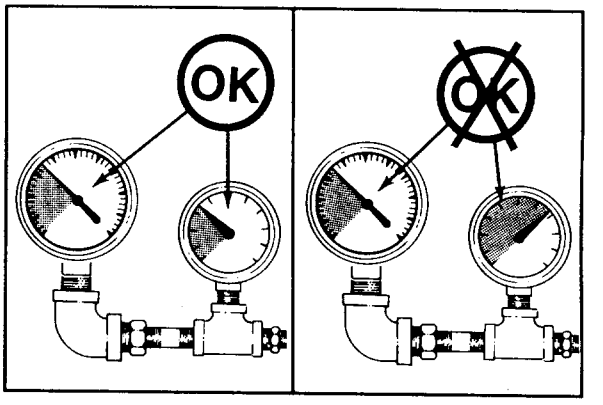
12. Operate the engine and check for air leaks.



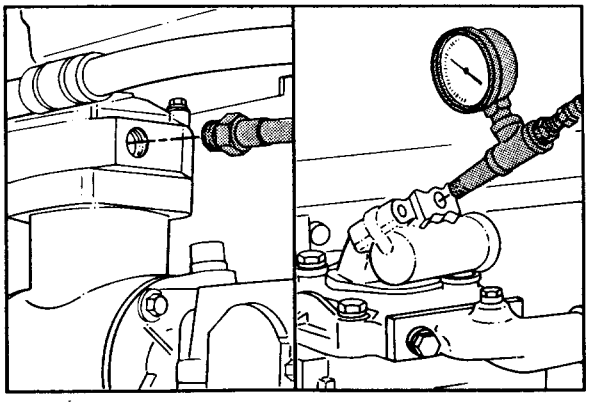
Lubricating Oil Usage, Air Compressor - Check (4-09)

NOTE: Be sure the air pressure gauge is accurate and the supply lines and fittings are in good condition before performing any air pressure checks. Use a master gauge of known accuracy to check the air pressure gauge.

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.



1. Remove the air discharge line from the air compressor.
2. Use a 690 kPa [100 psi] regulated shop air line to apply air pressure to the air governor unloader port.



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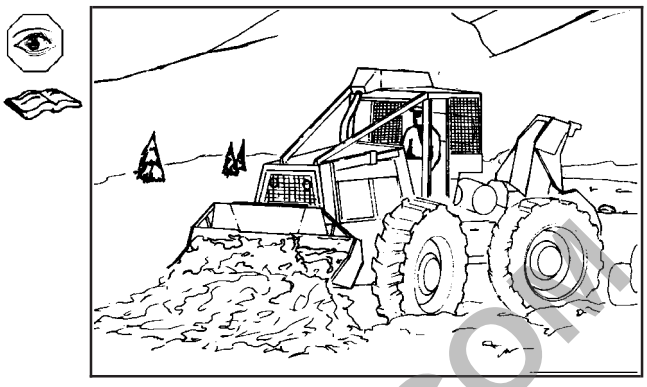
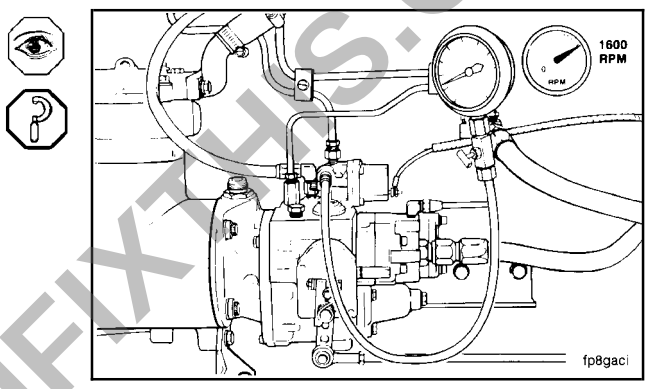
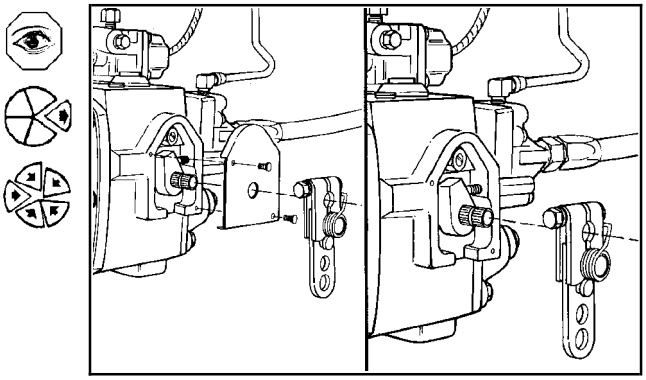
e. On off-road equipment, check the manufacturer's specifications for the time to accelerate to stall speed from idle. Refer to Procedure 5-19.



6. Check the AFC no-air rail pressure.



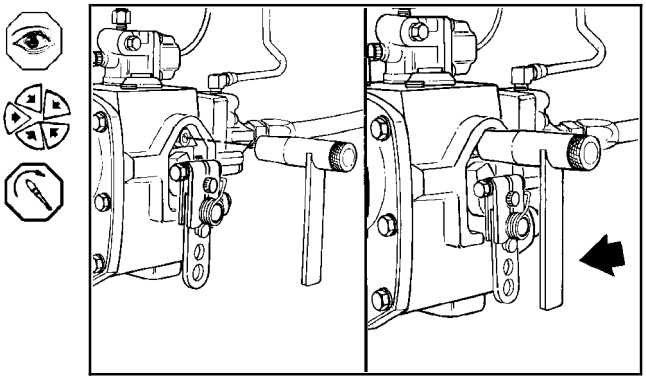
7. If the pressure is **not** within the specifications, remove the throttle lever from the fuel pump.
8. Remove the throttle cover plate.
9. Install the throttle lever.



10. Adjust the AFC no-air valve to the correct pressure with the AFC no air adjustment tool, Part No. 3375140.

NOTE: Turn the knurled knob **clockwise** to lower the pressure.

11. Tighten the lock nut on the AFC no-air valve to 3.4 to 5.1 N•m [30 to 45 in. lb.] torque.



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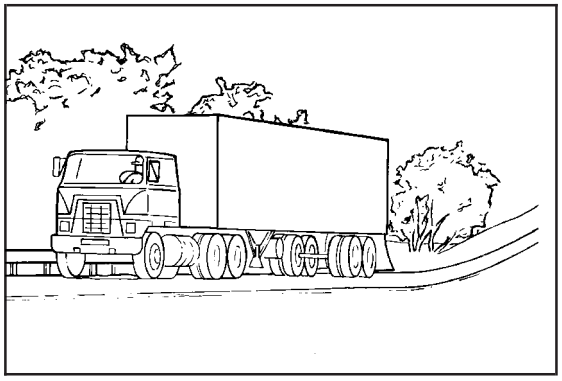
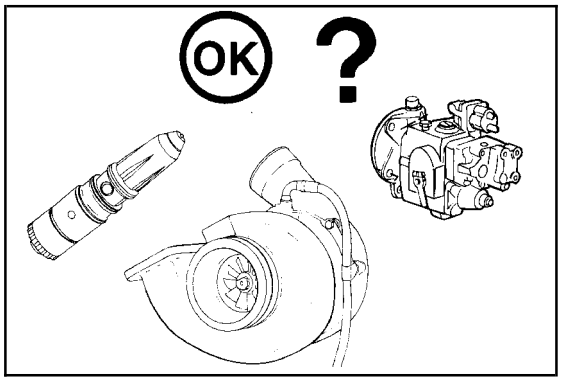
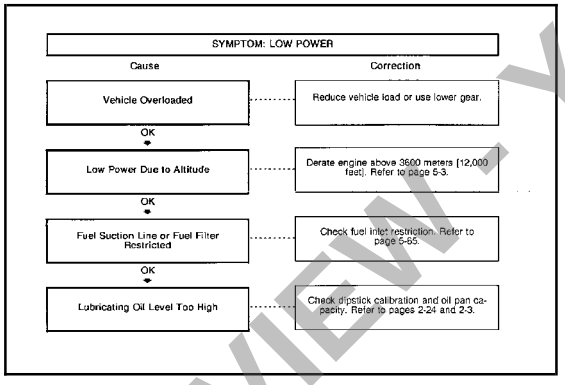


4. Low power or hesitation at bottom of hill after coasting?



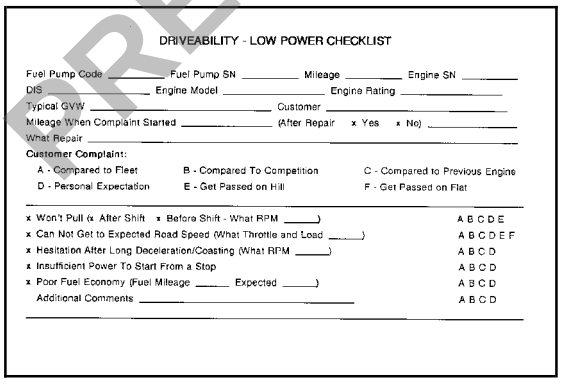
5. Are you sure the fuel system is at fault or something else?



SYMPTOM: LOW POWER

Cause	Correction
Vehicle Overloaded	Reduce vehicle load or use lower gear.
OK	
Low Power Due to Altitude	Derate engine above 3600 meters (12,000 feet). Refer to page 5-3.
OK	
Fuel Suction Line or Fuel Filter Restricted	Check fuel inlet restriction. Refer to page 5-65.
OK	
Lubricating Oil Level Too High	Check dipstick calibration and oil pan capacity. Refer to pages 2-24 and 2-3.

6. Before any disassembly, refer to the Low Power Troubleshooting Chart and the Low Power Check List on page 83.



DRIVEABILITY - LOW POWER CHECKLIST

Fuel Pump Code _____ Fuel Pump SN _____ Mileage _____ Engine SN _____
DIS _____ Engine Model _____ Engine Rating _____
Typical GVW _____ Customer _____
Mileage When Complaint Started _____ (After Repair x Yes x No) _____
What Repair _____

Customer Complaint:

A - Compared to Fleet B - Compared To Competition C - Compared to Previous Engine
D - Personal Expectation E - Get Passed on Hill F - Get Passed on Flat

x Won't Pull (x After Shift x Before Shift - What RPM _____)	A B C D E
x Can Not Get to Expected Road Speed (What Throttle and Load _____)	A B C D E F
x Hesitation After Long Deceleration/Coasting (What RPM _____)	A B C D
x Insufficient Power To Start From a Stop	A B C D
x Poor Fuel Economy (Fuel Mileage _____ Expected _____)	A B C D
Additional Comments _____	A B C D

7. The checks will confirm the complaint and determine whether it is the fuel system or something else.

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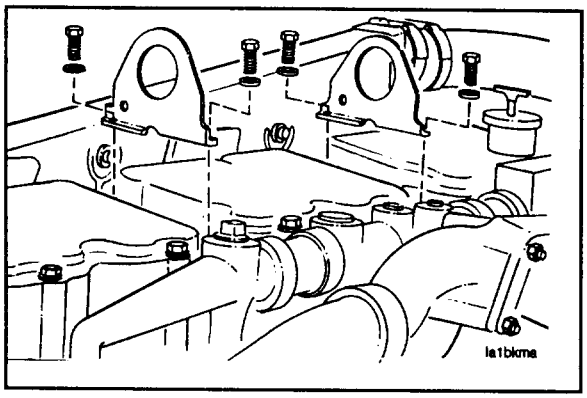
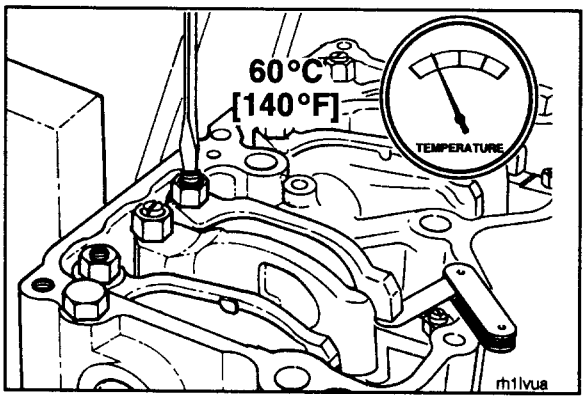


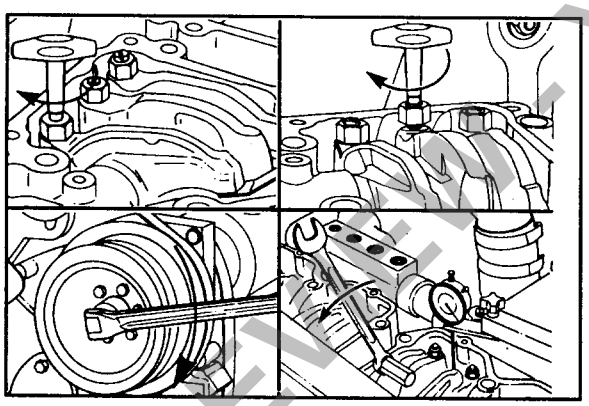
Install

1. Install the front bracket and two capscrews.
2. Install the rear bracket and two capscrews.
3. Tighten the capscrews to 80 N•m [60 ft-lbs] torque.

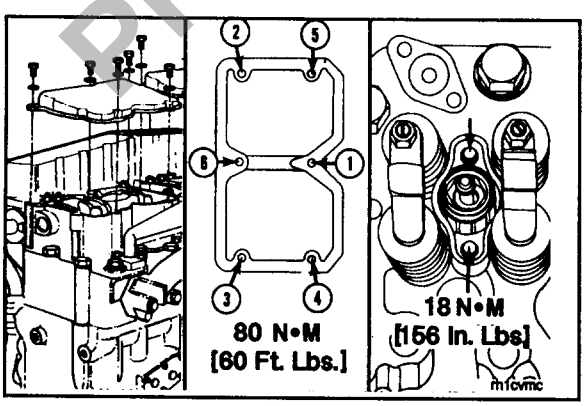


Crossheads, Valves and Injectors - Adjust (7-04)

1. All overhead (crosshead, valve, and injector) adjustments **must** be made when the engine is cold (any stabilized coolant temperature at 60°C [140°F] or below).



NOTE: After an engine rebuild or any major repair where the injector setting **must** be disturbed, set all of the valves and injectors. Once the adjustment procedure has been completed, continue through the crankshaft rotation and check (adjust if necessary) the injector adjustment on cylinders No. 2, No. 3, and No. 6. This takes care of any camshaft and rocker lever shaft deflection which may have occurred during the initial adjustment.



2. Remove the rocker housing cover. Refer to Procedure 7-02.
3. Tighten the rocker housing capscrews to 80 N•m [60 ft-lbs] torque. Refer to Procedure 7-09.
4. Alternately tighten the injector hold down capscrews to 18 N•m [156 in-lbs] torque.

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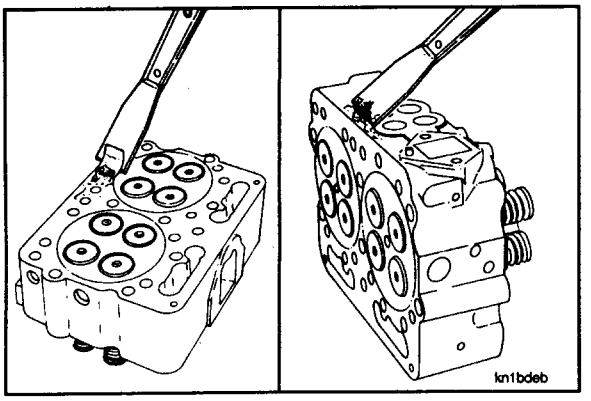
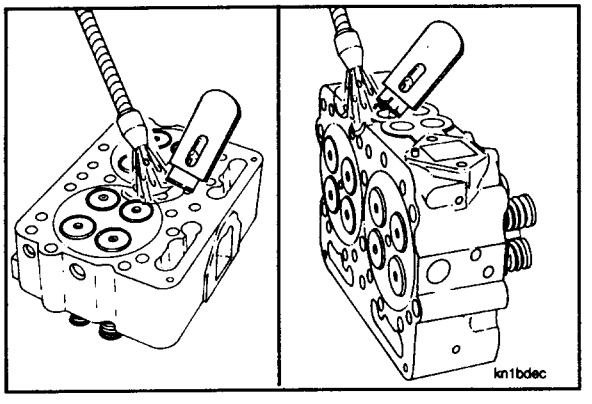
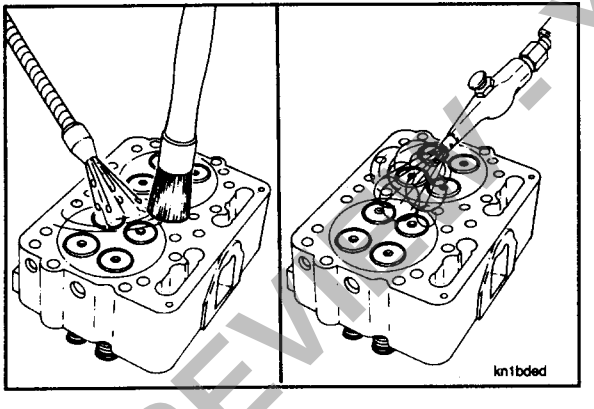


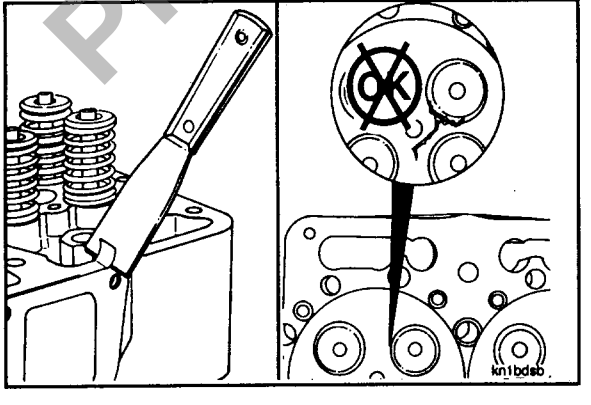
8. Use a gasket scraper to remove heavy dirt and debris from the cylinder head gasket surface and the exhaust manifold gasket surface.



9. Use a razor blade scraper and solvent to remove any remaining material from the cylinder head gasket surface and the exhaust manifold gasket surface.



10. Clean with solvent, and dry with compressed air.



11. Clean the rocker housing gasket surface on each cylinder head.

12. Visually inspect the cylinder heads for cracks or damage.

NOTE: If a crack in a cylinder head is suspected, pressure test the cylinder head. Refer to Procedure 7-12.

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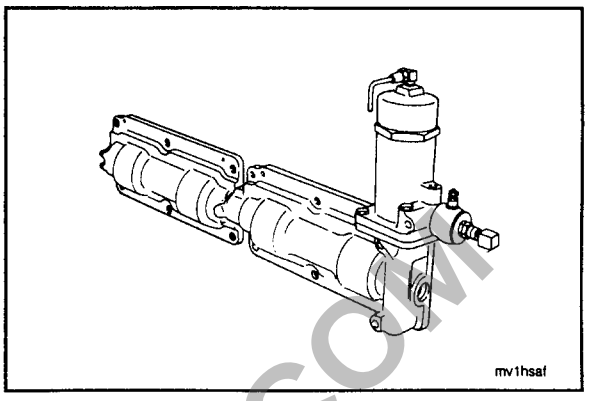
d. Install the shaft of the housing into the splined coupling as follows:

(1) Align the roll pin in the center housing with the slot in the front housing.

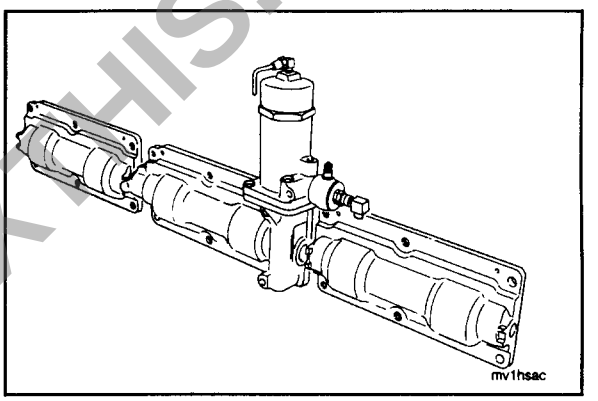
(2) Push the shaft into the coupling until the housing is against the rectangular seal.



e. Install the shaft of the rear housing into the actuator gear in the center housing as follows:

(1) Align the roll pin in the center housing with the slot in the rear housing.

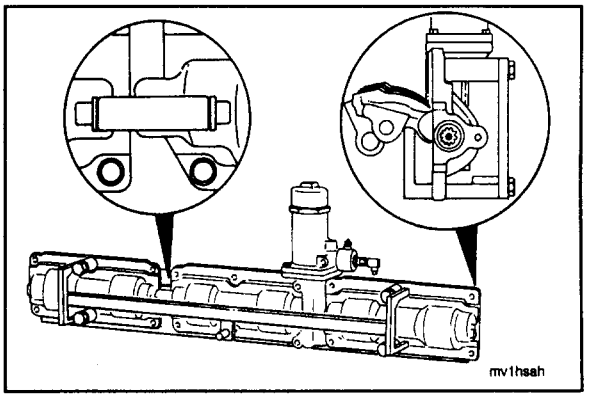
(2) Push the shaft into the gear until the housing is against the rectangular seal.



2. Install Part No. 3376028 Variable Timing Fixture and Part No. 3376209 Bracket to the cam follower assemblies.

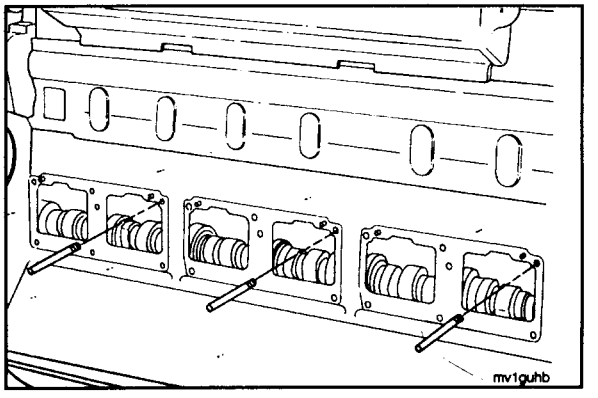
NOTE: The cam follower assembly installation tools hold the housings in alignment and the cam follower levers in an upward position.

3. Make sure the rectangular sealing rings are in the correct position.



4. Install three guide studs into the capscrew holes in the block.

NOTE: Install the guide studs to align with the top right hand capscrew hole in each cam follower housing.



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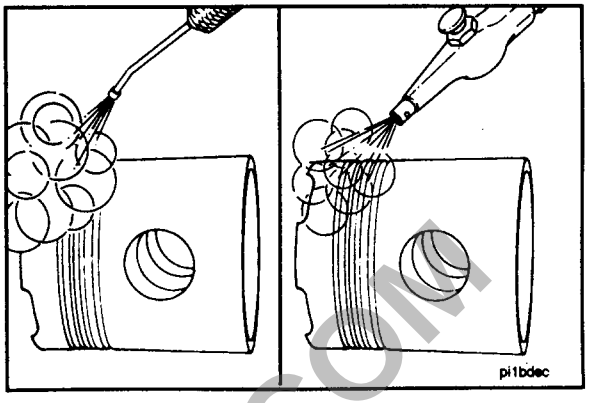
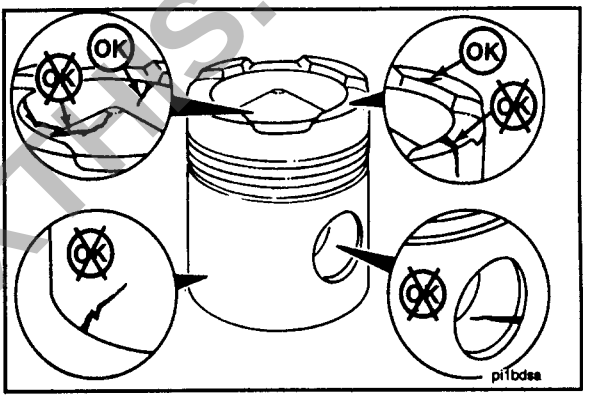
3. Steam clean the pistons, and dry with compressed air.



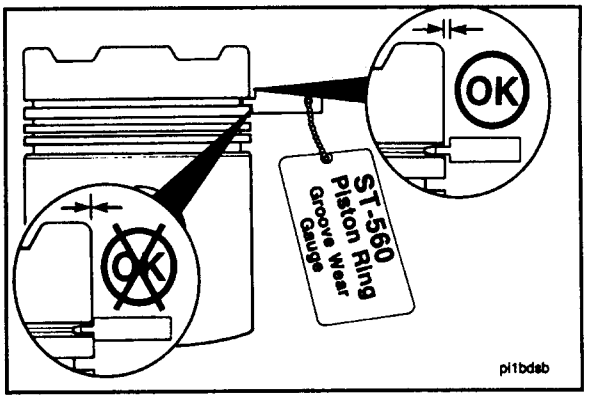
4. Visually inspect the piston bowl, pin bore, and skirt for cracks or damage.

NOTE: Do **not** use pistons with dome cracks larger than one-half (1/2) the rim width or with cracks which extend over the rim toward the ni-resist insert.



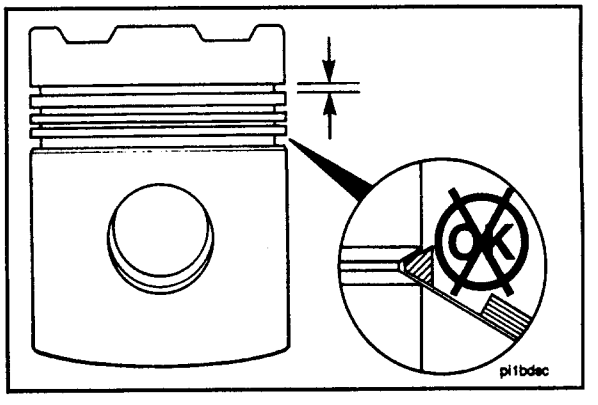
5. Use Part No. ST-560 Piston Ring Groove Wear Gauge to inspect the top and second grooves.

NOTE: The widest part (shoulder) of the tool **must not** come in contact with the piston. Replace the piston if the shoulder touches the piston.



6. Hold a new ring in the groove. Install a 0.152 mm [0.006-inch] feeler gauge. If the feeler gauge enters the groove without resistance, there is too much wear. Replace the piston.

NOTE: The ring groove can be inspected with a new ring and a feeler gauge.



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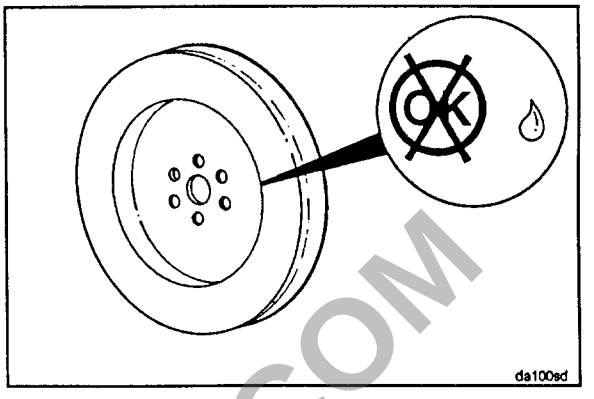
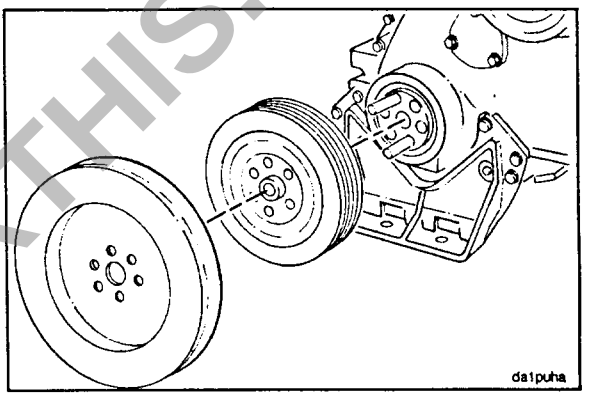
Caution: Wear protective gloves when handling parts that have been heated to prevent personal injury.

6. Remove the damper from the oven, and check for fluid leakage. If there is leakage, replace the damper.

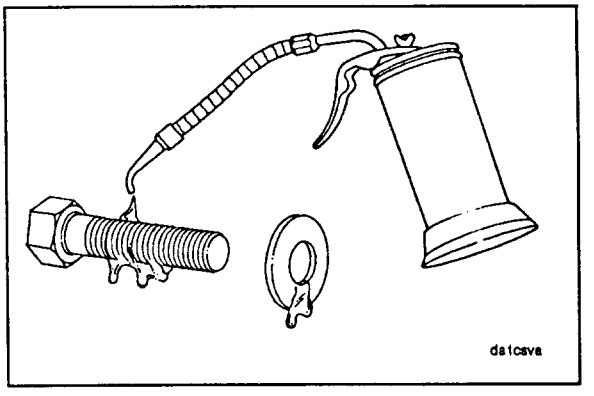


Install the Vibration Damper

1. Install two guide pins into the end of the crankshaft. Install the pulley and the vibration damper.

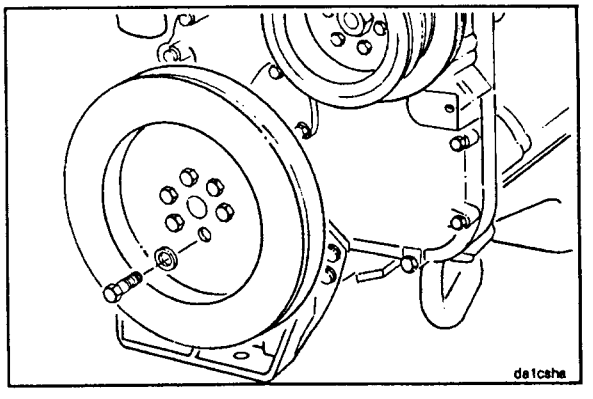


2. Lubricate the threads of the capscrews and the washer with a film of SAE 15W-40 oil.



3. Install the washers and the capscrews. Keep the crankshaft from rotating, and tighten the capscrews to the following torque values:

Capscrew Size	SAE Grade No.	N•m [ft-lb]
5/8-inch	8	260 [190]



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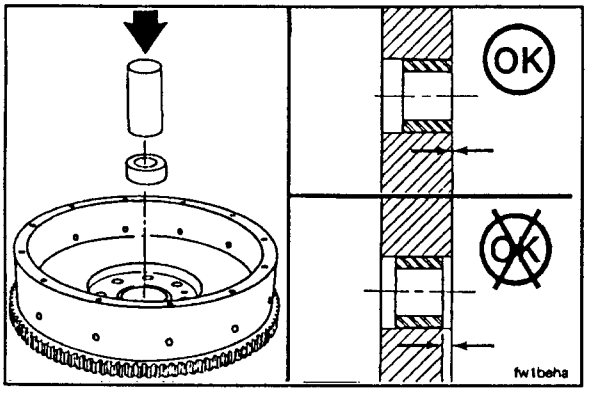
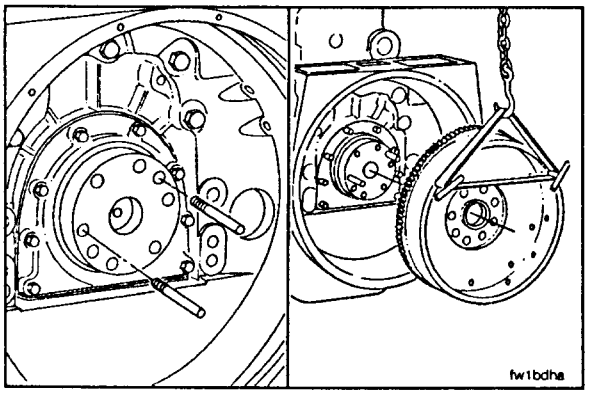


3. Use a mandrel and a hammer to install the pilot bearing.

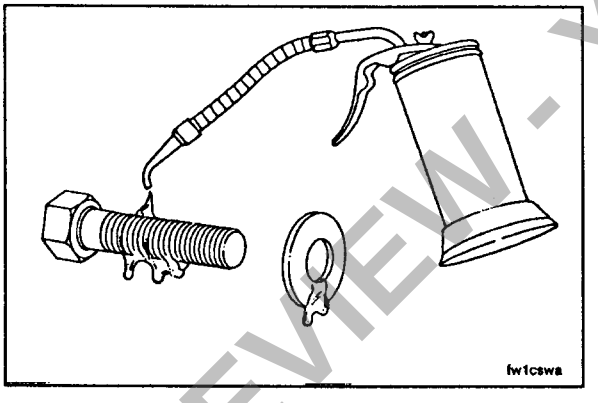
NOTE: The pilot bearing **must** be installed flush with the pilot bore surface.



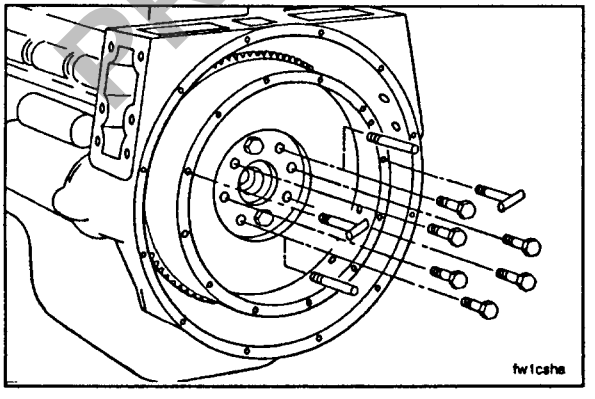
4. Install two 5/8 - 18 x 6-inch guide studs in the crankshaft flange.

Warning: Because this part weighs more than 23 kg [50 lbs], two people or a hoist will be required to lift the part to avoid personal injury.

5. Install the flywheel on the guide stud.



6. Lubricate the threads of the capscrews and the surface of the washers with 15W-40 lubricating oil.



7. Install the four capscrews.
8. Remove the "T-handles" and the guide studs.
9. Install the remaining two capscrews in the holes from which the guide studs were removed.
10. Tighten the capscrews in a star pattern to 270 N•m [200 ft-lbs] torque.

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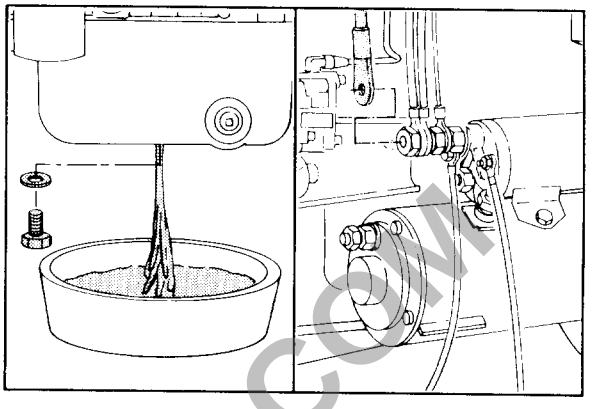
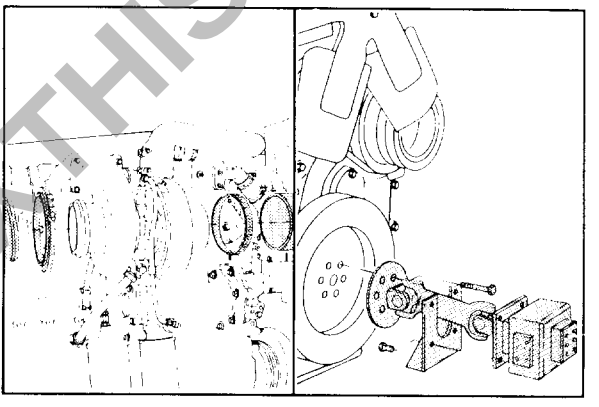
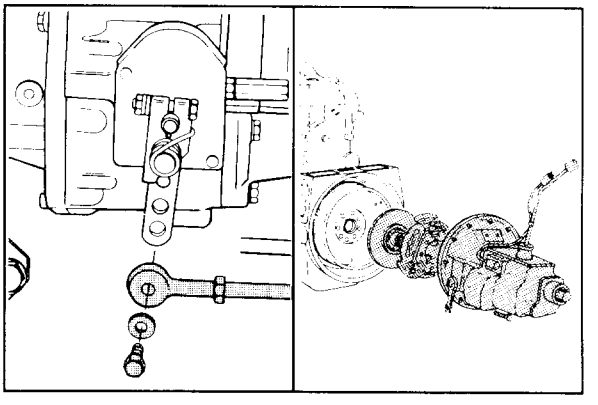
3. Drain the lubricating oil. Refer to Procedure 2-09.
4. Disconnect the starter cable, the engine ground straps, the cab or chassis to engine hoses, the tubing, the electrical wires, and the hydraulic lines.



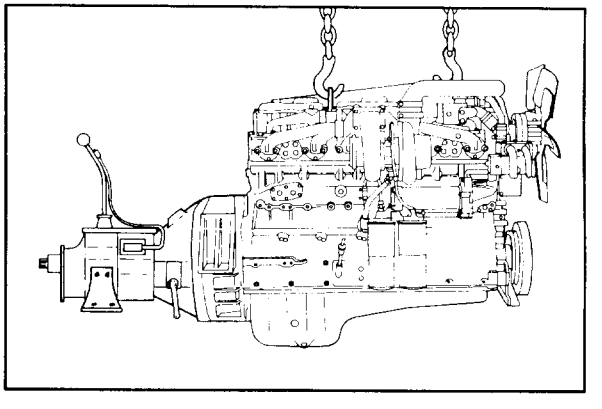
5. Disconnect the intake and the exhaust air pipes.
6. Disconnect all chassis mounted "engine driven" accessories.



7. Disconnect the throttle linkage from the fuel pump control lever.
8. Disconnect the drive units from the flywheel.



NOTE: If the rear engine mounts are attached to the transmission, it may be necessary to remove the engine and the transmission as an assembly.



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