

INTRODUCTION

Service Procedures and Tool Usage

Anyone using a service procedure or tool not recommended in this manual must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects. Individuals deviating in any manner from the instructions provided assume all risks of consequential personal injury or damage to equipment involved.

Also note that particular service procedures may require the use of a special tool(s) designed for a specific purpose. These special tools must be used in the manner described, whenever specified in the instructions.

DANGER

- 1. Before starting a vehicle, always be seated in the driver's seat, place the transmission in neutral, apply the parking brakes, and push in the clutch pedal. Failure to follow these instructions could produce unexpected vehicle movement, which can result in serious personal injury or death.***
 - 2. Before working on a vehicle, place the transmission in neutral, set the parking brakes, and block the wheels. Failure to follow these instructions could produce unexpected vehicle movement, which can result in serious personal injury or death.***
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DANGER

Engine-driven components such as Power Take-Off (PTO) units, fans and fan belts, driveshafts and other related rotating assemblies, can be very dangerous. Do not work on or service engine-driven components unless the engine is shut down. Always keep body parts and loose clothing out of range of these powerful components to prevent serious personal injury. Be aware of PTO engagement or nonengagement status. Always disengage the PTO when not in use.

DANGER

Do not work under a vehicle that is supported only by a hydraulic jack. The hydraulic jack could fail suddenly and unexpectedly, resulting in severe personal injury or death. Always use jackstands of adequate capacity to support the weight of the vehicle.

CAUTION

Before towing the vehicle, place the transmission in neutral and lift the rear wheels off the ground, or disconnect the driveline to avoid damage to the transmission during towing.

**REMEMBER,
SAFETY . . . IS NO ACCIDENT!**

INTRODUCTION

ABOUT THE MACK MP8 EURO 4 ENGINE [200 EA]

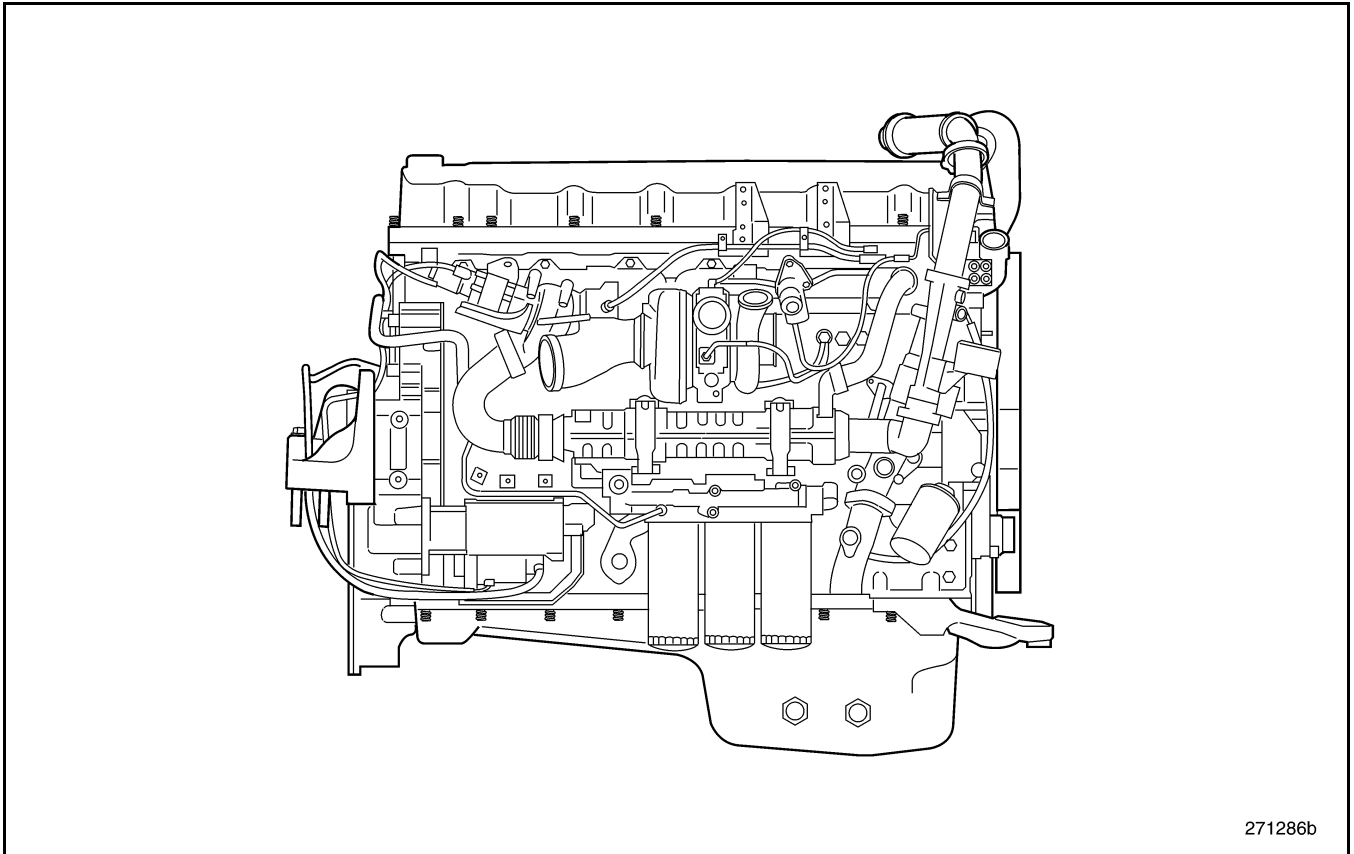


Figure 1 — MACK MP8 Engine — for Conventional Chassis

The MACK MP8 is a 13 liter (800 CID) engine with electronic unit injectors, a cooled Exhaust Gas Recirculation (EGR) system and the Holset Variable Geometry Turbocharger (VGT). The PowerLeash™ engine brake is optional. The engine conforms to Euro 4 emissions requirements.

The MP8 EGR system features reduced restriction plus enhanced efficiency and reliability. Its venturi system is easy to service.

The Holset VGT features fixed vanes with a sliding nozzle ring. The nozzle position is infinitely variable between open and closed. This design reacts quickly to exhaust pressure and controls inlet pressure more precisely. Reliability is enhanced by having fewer moving parts. Its actuator and bearing housing are water cooled and engine oil lubricated for greater durability.

A wide range of the current transmission offerings, including manual, automated manual and automatic, can be teamed with the MP8.

Diagnostic help can be found in the Premium/Volvo Tech Tool. In some markets the diagnostic tool is Premium Tech Tool (PTT) and in other markets the diagnostic tool is Volvo Tech Tool (VTT). Contact your local dealer for Tech Tool availability.

The engine weighs approximately 1200 kg (2646 lb.) dry (with air compressor, without oil, coolant, starter, fan, alternator and clutch). Its design includes a one-piece cylinder head, a single overhead camshaft, three rocker arms per cylinder, unit injectors and no pushrods. PowerLeash™ engine braking, requiring a fourth rocker arm, is optional. Monosteel™ steel pistons are made in one piece.

DESCRIPTION AND OPERATION

CYLINDER BLOCK

The cylinder block is made of cast iron. For increased cylinder block rigidity and noise and vibration reduction, a steel stiffener plate attaches to the bottom.

The main and piston lubricating channels are drilled longitudinally through the block. These are plugged at the front of the block. The main channel opens into a cast-in channel that supplies oil to the timing gears. The piston cooling channel is covered by the timing gear cover.

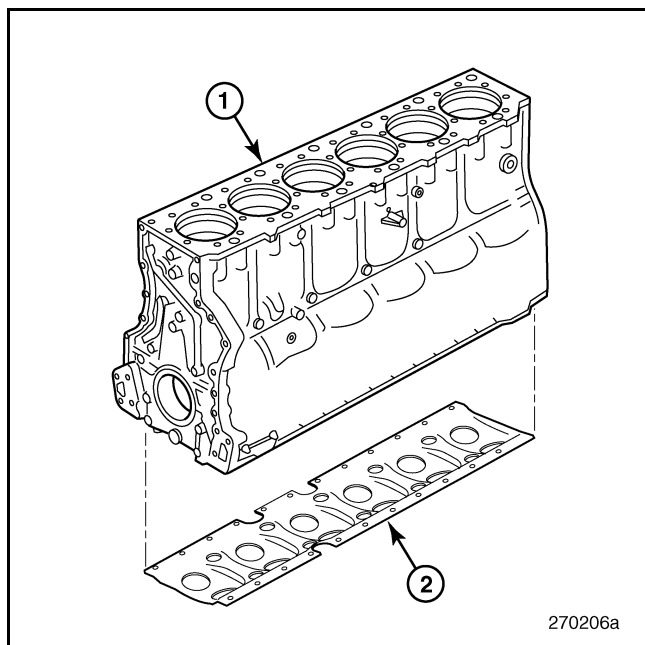


Figure 8 — Cylinder Block and Stiffener Plate

1. Cylinder Block

2. Block Stiffener Plate

Main bearing caps are made of nodular cast iron machined together with the cylinder block. Cast alignment slots in the block and tabs on the caps ensure proper alignment at installation. Each cap is marked with its location beginning with No. 1 at the front. Cap Nos. 4 and 7 are unique and are not numbered.

The block includes cylinder liners that contact the coolant directly (wet liners). The casting shape follows the contours of the cylinders to increase rigidity and reduce noise.

HEAD TO BLOCK ALIGNMENT

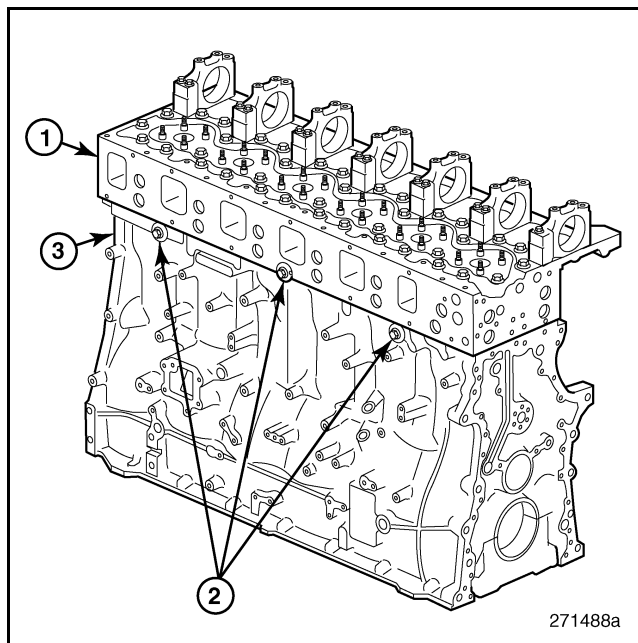


Figure 9 — Head to Block Alignment Screws and Washers

1. Cylinder Head
2. Alignment Screws and Washers

3. Cylinder Block

Three screws and washers installed at the side (two in the block and one in the head) align the head from side to side at assembly. Fore and aft, the head is aligned by contact with the timing gear mounting plate.

CAUTION

The head is aligned with the timing gear plate by screws passed through the plate into the head and tightened securely. It is extremely important to remove these screws before attempting to remove the cylinder head from the block. Failure to heed this caution may result in severe damage to the timing gear plate and other engine components.

DESCRIPTION AND OPERATION

The coolant pump contains an impeller, shaft seals, bearing and pulley which attach to the mounting plate. The bearing is a permanently lubricated combination roller and ball bearing. Between the shaft seals and the bearing, there is a ventilated space which leads into a duct behind the pulley. This allows internal leaks to be detected.

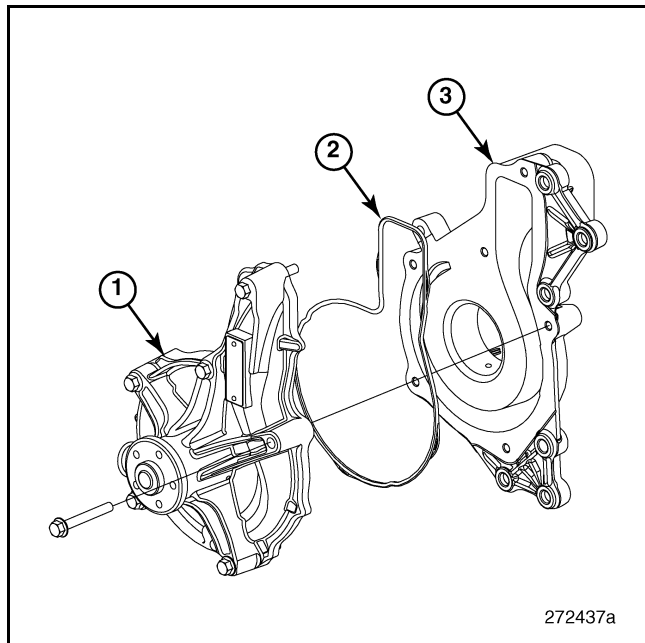


Figure 33 — Coolant (Water) System Components

1. Coolant Pump 2. Coolant Pump Seal	3. Coolant Pump Mounting Plate
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THERMOSTAT

This is a piston-type, full-flow thermostat with piston, bulb, seal and housing in a single assembly. Coolant flows continuously, either back to the pump, or to the radiator and back to the pump. It has lower pressure drop compared to other types. The thermostat is mounted in the front of the cylinder head.

ENGINE COOLING FAN

The cooling fan (Figure 34) runs via a viscous (N/A Australia) or air-operated drive through which fan speed is electronically controlled by the EECU. With precise EECU control, fan speed is continuously adjusted in response to several interrelated influences. This makes for efficient cooling with low fuel consumption.

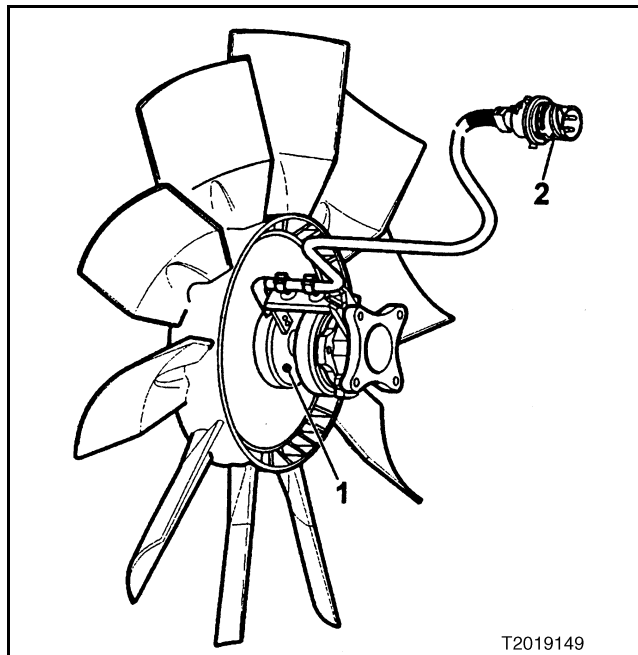


Figure 34 — Electronically Actuated Viscous Fan Drive Assembly (N/A Australia)

1. Solenoid Valve and Speed Sensor	2. Connector (to EECU)
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Engine Management System

ENGINE ELECTRONIC CONTROL UNIT (EECU)

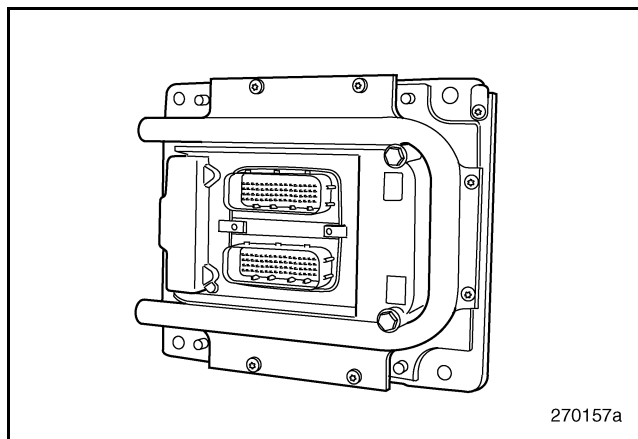


Figure 35 — EECU and Cooler

The engine management system module, also known as the Engine Electronic Control Unit (EECU), is located on the left side of the engine just below the inlet manifold. The EECU is cooled by fuel circulating through a plate attached to the cover of the unit. The fuel comes from the tank on its way to the fuel pump.

TROUBLESHOOTING

NOTE

If a large enough container cannot be obtained, the EGR cooler can be tested without being immersed in water by using the test plugs included with the kit, 88800216-5, to seal the gas outlet port. The EGR cooler core can then be filled with water and tested by applying air pressure to the coolant outlet port as shown in Figure 54. When using this technique, the cooler must be tested in the upright position.

To ease the installation of the test plug, coat the inside of the hose with a suitable O-ring lubricant.

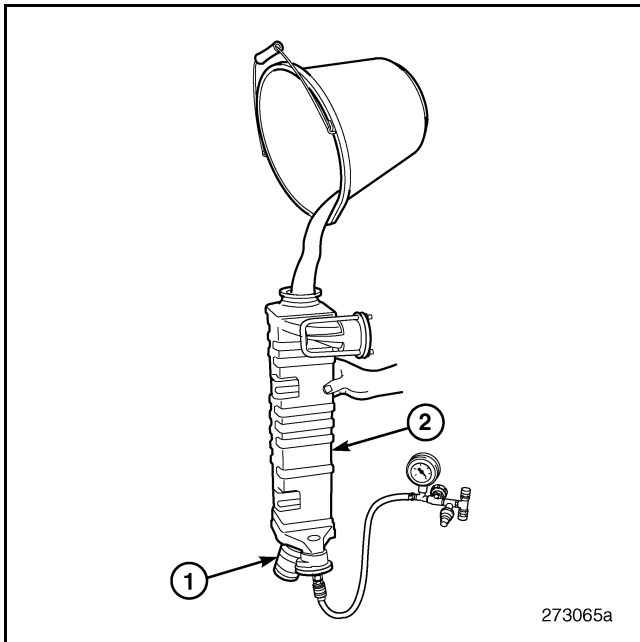


Figure 54 — Test with EGR Gas Outlet Port Plugged

- | | |
|--------------------------|---------------|
| 1. Test Plug, 88800216-5 | 2. EGR Cooler |
|--------------------------|---------------|

5. Apply air pressure (240 kPa [35 psi]) to the EGR cooler. Maintain the pressure for 15 minutes. If the EGR cooler is leaking internally, there will be a steady stream of bubbles coming from the gas inlet or outlet openings. If a steady stream of bubbles appears, replace the EGR cooler.

NOTE

If the cooler is being tested without being immersed in water, look inside the gas inlet port. If bubbles are seen, the cooler is leaking internally and must be replaced.

NOTE

A stream of bubbles seen coming from around the plugs in either of the coolant ports indicates that the O-rings may be damaged. If this is the case, remove the plugs, inspect the O-rings and replace as required.

6. Lift the EGR cooler out of the container and remove the pressure testing equipment.
7. Dump the water from inside the EGR cooler and then use compressed air to remove any remaining water from the cooler core and outer cover.

Engine Compression, Test (on Vehicle)

Verify suspected leaks in the cylinder head or block by pressure testing before replacing these. Do not use Magnaflux® inspections alone as replacement criteria.

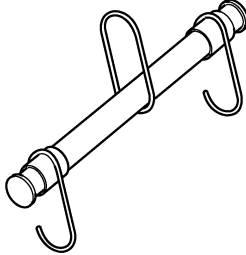
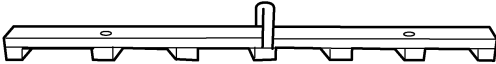
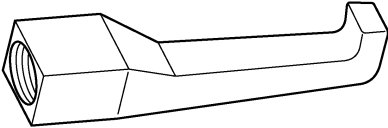
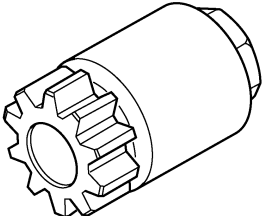
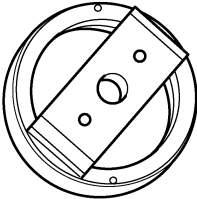
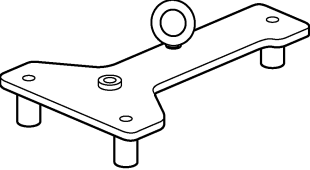
Before proceeding with the tests, look for coolant stains around the sealing plugs on the cylinder head. Check that the plugs are installed properly and in good condition.

1. Remove the cylinder head (valve) cover.

CAUTION

On engines fitted with PowerLeash™, secure the pistons in the rocker arms with rubber bands or tie straps so the pistons do not drop out when the rocker assembly is lifted. Pistons and rockers are matched together. Failure to heed this caution may result in severe component damage.

REPAIR INSTRUCTIONS, PART 1

Tool No.	Description	Image
85109034	Camshaft Lifting Bar (Essential)	 <p data-bbox="1339 520 1414 541">006835a</p>
85109250	Rocker Shaft Assembly Lifting Tool (Essential)	 <p data-bbox="1339 701 1414 722">006770a</p>
85109980	Camshaft Bearing Cap Removal Tool, use with slide hammer, 9990013	 <p data-bbox="1339 905 1414 926">006886a</p>
88800014	Flywheel Turning Tool (Essential)	 <p data-bbox="1339 1192 1414 1213">271485a</p>
88800021	Front Main Seal Remover/Installer (Essential)	 <p data-bbox="1339 1478 1414 1499">006774a</p>
88800188	Cylinder Head Lifting Tool (Essential)	 <p data-bbox="1339 1738 1414 1759">006923a</p>

REPAIR INSTRUCTIONS, PART 1

Block Stiffener Plate Removal

The inlet pipe with a front sump oil pan is longer than the one with a rear sump oil pan. Both the shorter and longer pipes attach to a bracket mounted on the stiffener frame and cylinder block.

1. Remove the support retaining fasteners and remove the pump inlet pipe. Remove and discard the seal ring.

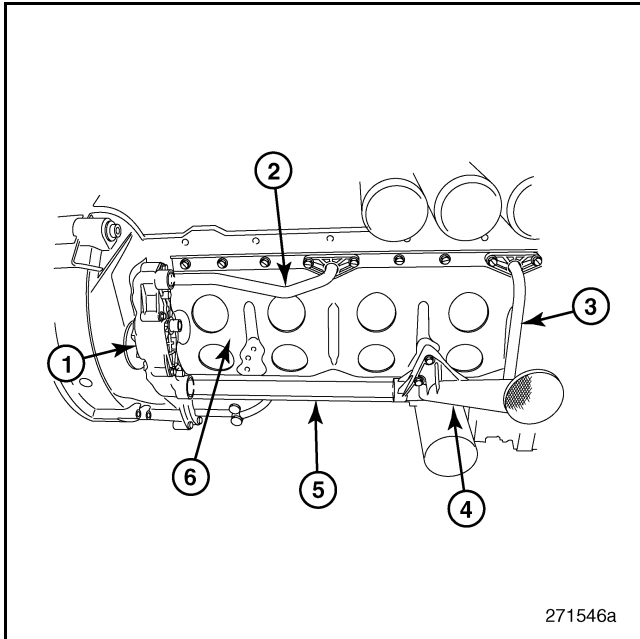


Figure 188 — Inlet, Outlet and Crossover Pipes (Front Sump Shown)

1. Oil Pump	4. Strainer
2. Pump Outlet Pipe	5. Pump Inlet Pipe
3. Crossover Pipe	6. Block Stiffener Plate

2. Remove the fasteners from the pump outlet (pressure side) pipe flange and remove the pipe from the engine. Remove and discard the seal rings.
3. Remove the fasteners from the crossover pipe flange and remove the pipe.

4. Remove the remaining fasteners securing the stiffener plate to the cylinder block.

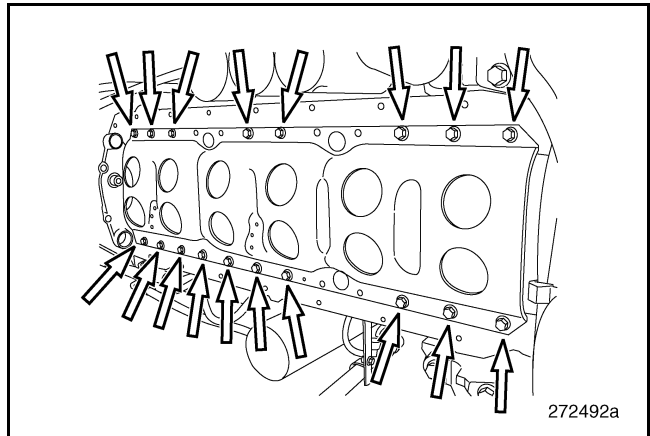


Figure 189 — Block Stiffener Plate

5. With the help of an assistant, remove the block stiffener plate.

Oil Pump Removal

[219 MU, 219 NT]

If the engine is not being completely disassembled for overhaul and only the oil pump is to be replaced, instructions are provided in a separate section entitled "OIL PUMP REPLACEMENT (IN CHASSIS)" for removing and installing the oil pump with the engine in the chassis.

1. If necessary for access to the oil pump mounting fasteners, rotate the crankshaft using flywheel turning tool, 88800014.
2. Remove the fasteners securing the oil pump to the No. 7 main bearing cap.

REPAIR INSTRUCTIONS, PART 1

Inlet and Exhaust Valve Removal

[213 NB]

GENERAL INFORMATION

The MP8 has a single cylinder head, valves in the head and a single overhead camshaft. The single rocker arm shaft rests on the inboard end of seven camshaft bearing caps. The seventh bearing cap also provides a connection for lubricant. The optional engine brake electronic oil control valve connects the oil passages in the head and rocker arm shafts.

A copper sleeve and washer lines the bottom of each injector port. An O-ring seals each sleeve. An opening in the right front corner receives the thermostat. There are three special screws and washers used to align the cylinder head, two in the block and one in the cylinder head. Valve seat counterbores are cut in the block side. Valve guides pressed into place project from the upper side.

A gallery delivers fuel to the injectors and fuel pressure regulator. The inlet manifold attaches to the left (driver's) side of the head; the exhaust manifold to the right side.

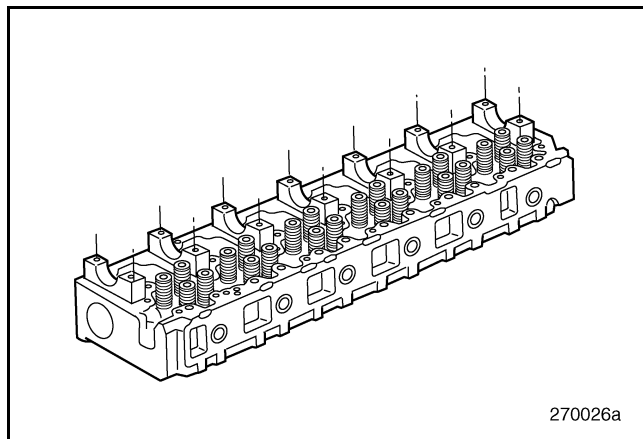


Figure 215 — Cylinder Head

REMOVAL PROCEDURE

1. Using the spring compressor, 9990210, compress a valve spring set to access the keepers.
2. Using a magnet, remove the keepers from the valve stem.
3. Remove the valve spring set.
4. Using a suitable tool, remove the valve stem seals.
5. Remove the valves.

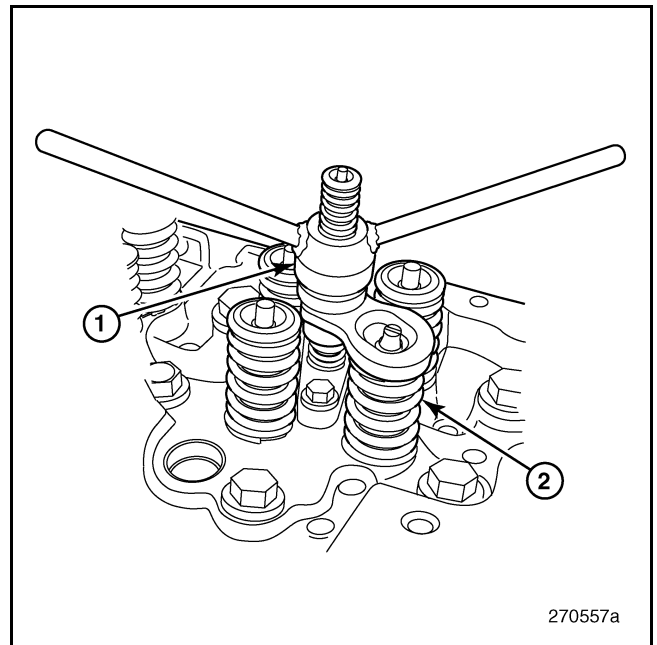


Figure 216 — Valve Spring Keeper Removal

- | | |
|---------------------------------------|-----------------|
| 1. Valve Spring Compressor
9990210 | 2. Valve Spring |
|---------------------------------------|-----------------|

Valve Stem Seals

For standardization, the valve guide and seal are used at the inlet locations as well as the exhaust locations.

REPAIR INSTRUCTIONS, PART 1

NOTE

The bearing shells should not be lubricated on the outside.

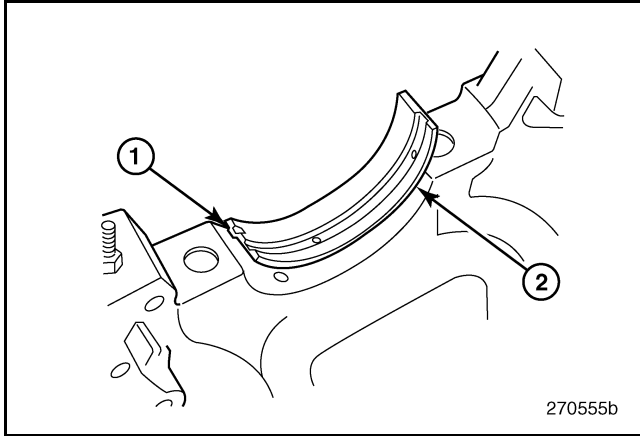


Figure 254 — Main Bearing (Upper)

- | | |
|-----------------|------------|
| 1. Locating Tab | 2. Bearing |
|-----------------|------------|

- Using the crankshaft lifting tool, J 49002, carefully position the crankshaft in the cylinder block.

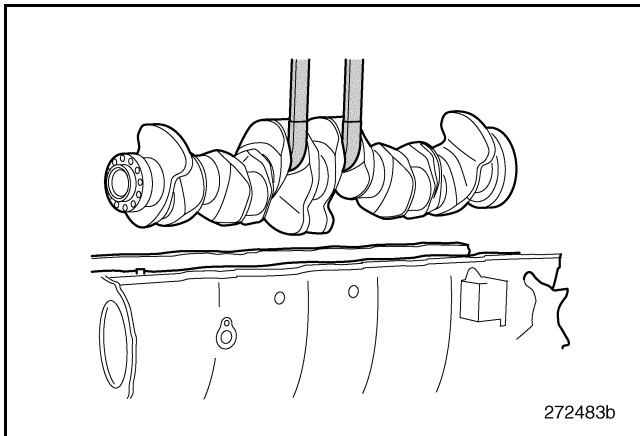


Figure 255 — Crankshaft Installation

Main Bearing Cap Installation

[212 HH]

- Clean the bore in the bearing cap and back of the lower bearing.
- Install the bearing in the bearing cap. The bearing must be installed dry.

NOTE

Lubricate the bearing insert surfaces with clean engine oil.

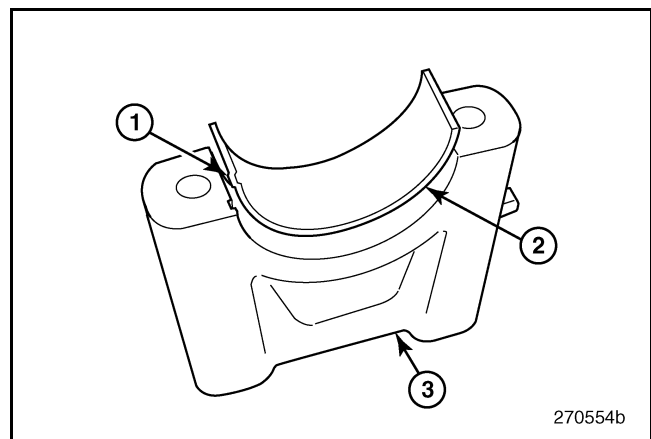


Figure 256 — Main Bearing Cap Installation (Lower)

- | | |
|-------------------|----------------|
| 1. Locating Tab | 3. Bearing Cap |
| 2. Bearing Insert | |

- Lubricate the threads of the fasteners with clean engine oil and insert in the caps.
- Position the No. 1 bearing cap over the No. 1 crankshaft journal and start the capscrews in the threaded holes in the cylinder block.

NOTE

Make sure the bearing caps are correctly fitted (see markings on the cap).

- Using a plastic mallet, tap the bearing cap down until it contacts the machined mounting surface.

REPAIR INSTRUCTIONS, PART 1

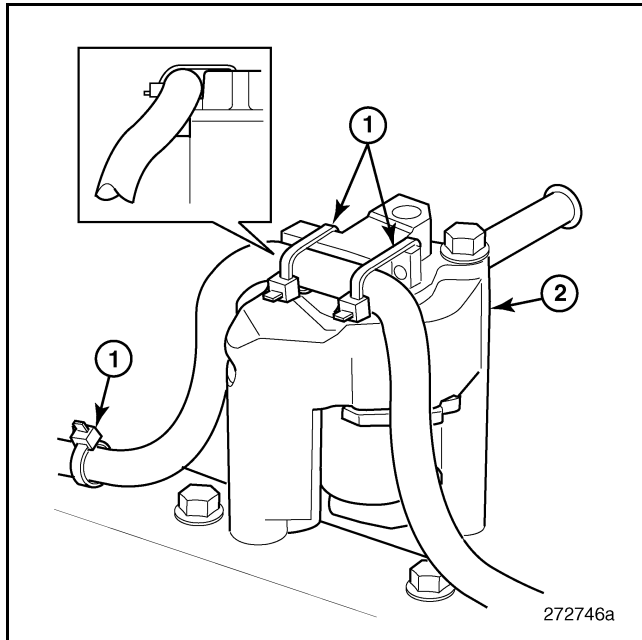


Figure 319 — Harness Routing Over Engine Brake Control Valve

1. Tie Straps

2. Control Valve

Flywheel Housing Installation

[211 HD]

Inspect the flywheel housing machined surfaces, bolt holes and pilot locations for cracks or wear. Replace the housing if cracks are evident.

1. Thoroughly clean the sealing area in the flywheel casing and the sealing surface against the crankshaft.
2. Apply an even 2 mm (5/64 inch) thick bead of MACK-approved sealant to the timing gear plate side of the flywheel housing according to the pattern shown. Sealant must also be applied to the intermediate bearing support in the flywheel housing.

NOTE

The flywheel housing must be installed within 20 minutes of the sealant being applied.

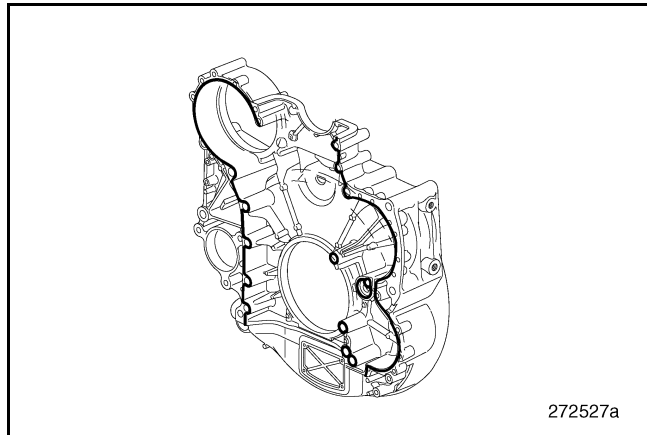


Figure 320 — Flywheel Housing Sealant Application Pattern

NOTE

Be sure to apply beads of sealant around the holes in the bosses as shown in the graphic.

Temporarily install guide pins in the two lower flywheel housing mounting holes in the timing gear plate/cylinder block.

3. Within 20 minutes of the application of the sealant, assemble the flywheel housing over the guide pins.
4. Insert and hand-tighten the attaching bolts. Remove the two guide pins and install the remaining bolts.

NOTE

If the engine was originally built with the longer idler gear bolts, the flywheel housing may need to be updated to block the idler gear bolt hole with a plug and washer from plug kit 21090322. Use the following procedure to thread the hole and install the plug:

- a. Using a 3/4-16 UNF x 11.5 tap, thread the hole indicated in Figure 321.
- b. Apply thread locking compound (Loctite® 277 or equivalent) to the threads of the plug.
- c. Insert the plug with washer and tighten according to specification.

REPAIR INSTRUCTIONS, PART 1

5. Secure the engine harness to the inlet manifold using P-clamps.
6. Install the electrical connector to the charge air temperature sensor located on the top of the inlet manifold and secure the harness with tie straps.

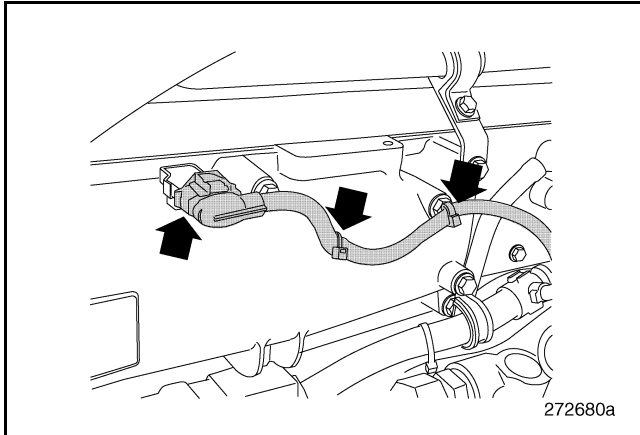


Figure 396 — Charge Air Temperature and Pressure (Boost) Sensor

7. Using a torque wrench, tighten the sensor according to specification.

EGR Mixer Installation

[214 HL]

NOTE

A redesigned single-piece mixer inlet tube (part No. 21153626) was implemented into production in September 2008, replacing the previous style brazed-end tube (part No. 20900934). The revised tube is available through the MACK Parts System and should be used if a replacement part is needed. Refer to SB214058.

1. Clean the forward sealing surface on the inlet manifold, air preheater or spacer, and EGR mixing chamber.
2. Position the EGR mixing chamber and inlet air preheater (if equipped), or spacer block with **new** gaskets onto the inlet manifold. Next, start the bolts to hold the assembly to the inlet manifold.

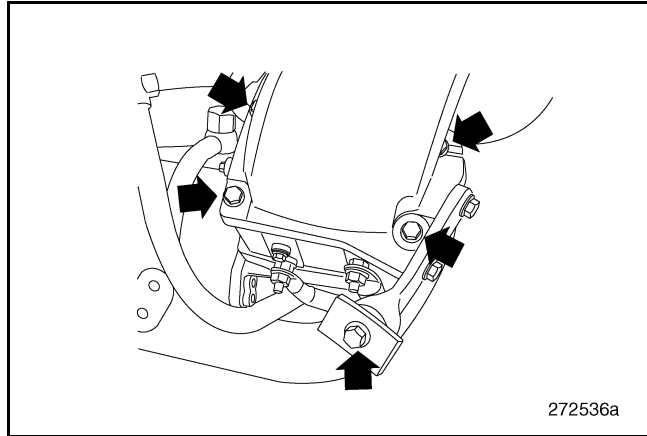


Figure 397 — EGR Mixing Chamber

3. Using a torque wrench, tighten the fasteners in a cross pattern according to specification.
4. Install the fan ring support bracket mounting fastener. Tighten the bolt according to specification.
5. If equipped, position and install the inlet air preheater relay bracket (with relay attached) to the mounting surface on the inlet manifold. Connect and secure the power and ground cables as marked at disassembly.

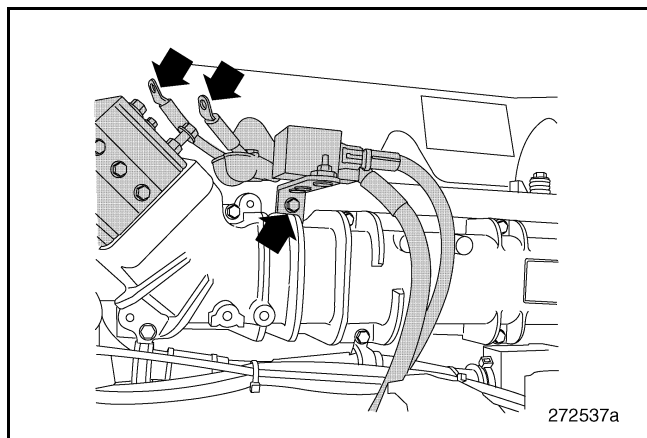


Figure 398 — Inlet Air Preheater Relay

REPAIR INSTRUCTIONS, PART 1

NOTE

To allow for chassis articulation in severe service applications, the fan ring rubber seal does not fit flush against the shroud on GU model chassis. A gap of 15–20 mm (0.59–0.79 inch) exists between the front face of the aluminum fan ring to the back face of the fan shroud.

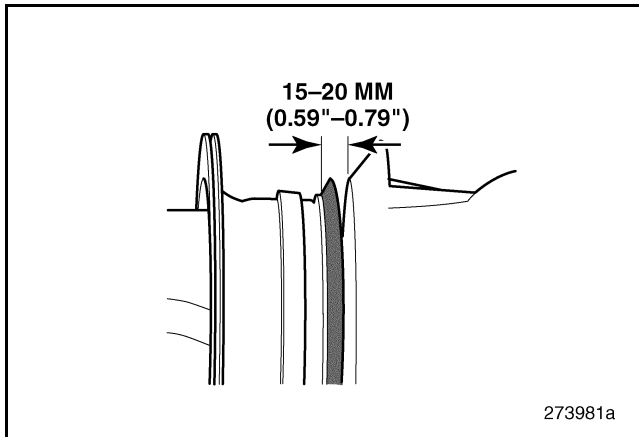


Figure 429 — Fan Ring-to-Shroud Clearance

22. Connect the fan actuator.
23. Connect the engine coolant temperature sensor.
24. Attach the charge air cooler outlet components.
25. Attach the charge air cooler inlet components.
26. Attach the coolant expansion tank.
27. Attach the lower radiator tube.
28. Connect the cab heater and fuel heater coolant return lines to the lower radiator tube.
29. Attach the upper radiator tube.
30. If the vehicle is equipped with air conditioning:
 - a. Connect the A/C compressor discharge hose.
 - b. Connect the A/C line at the receiver/dryer.
 - c. Connect the pressure switch on the receiver/dryer.
 - d. Connect the low pressure cutout switch.
 - e. Recharge the A/C system with refrigerant using refrigerant recovery and recycling equipment for R134A.
31. Install the inlet air system components including the filter.
32. Connect the inlet air heater if present.
33. Attach the oil and fuel filters and the coolant filter.
34. Close all drains and drain valves.
35. Connect all sensors and actuators.
36. Install the drive belts.
37. Add oil and coolant. If available, use the coolant extractor/injector when adding coolant.
38. Attach the hood, or lower the tilted cab.

REPAIR INSTRUCTIONS, PART 2

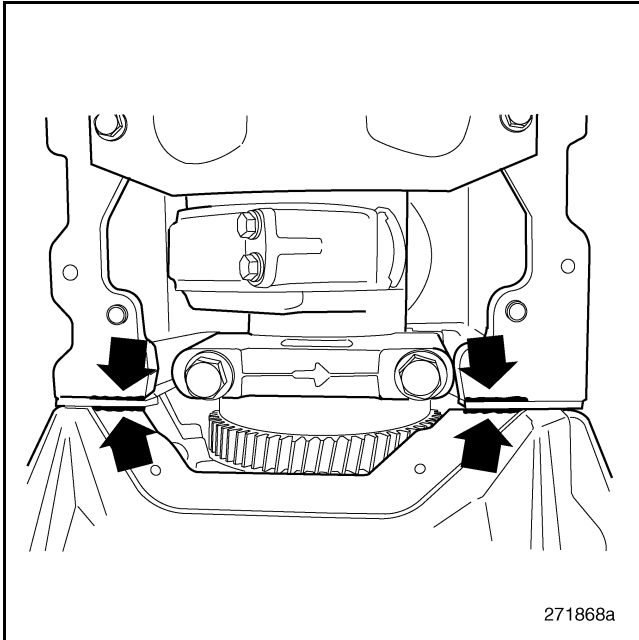


Figure 456 — Sealant Points — Flywheel Housing to Timing Gear Plate and Plate to Block

12. Apply a 2 mm (5/64 inch) bead of 342SX33 MACK-approved sealant to the seams between the flywheel housing and timing gear plate and between the mounting plate and the cylinder block.

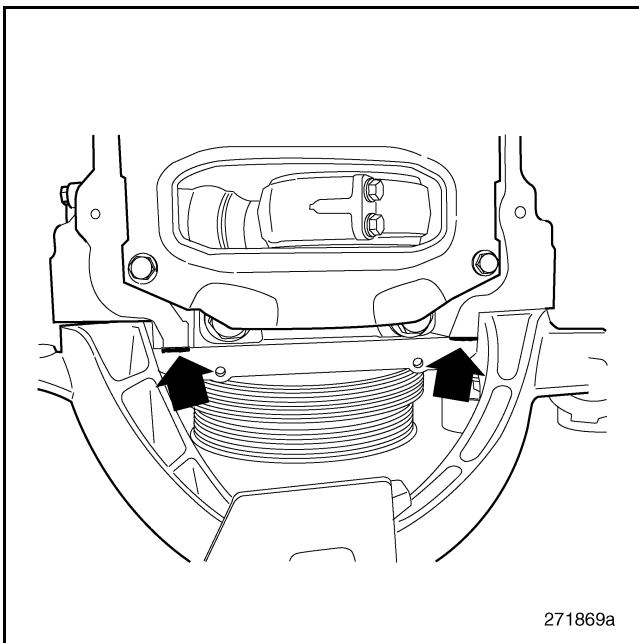


Figure 457 — Sealant Points — Front Seal Cover to Block

13. Apply a 2 mm (5/64 inch) bead of 342SX33 MACK-approved sealant to the seams between the front seal cover and the cylinder block.
14. Attach the oil pan to the cylinder block.
15. Using a torque wrench, tighten the screws in sequence according to specification.

CAUTION

Use a steel washer. Do not use a copper washer. Do not use an impact wrench to install the drain plug. Failure to heed this caution may result in property damage.

16. Install the drain plug.
17. Check system oil pressure through the pressure sensor port in the oil filter housing.

REPAIR INSTRUCTIONS, PART 2

7. Connect the actuator electrical connector to the engine harness connector. Install tie straps as needed to secure the harness.
8. Install all previously removed cables to the ground (negative) battery terminals.
9. Connect the VCADS *pro* PC or the Tech Tool to the vehicle diagnostic connector, and turn the vehicle ignition switch to the ON position.
10. Using VCADS *pro* or Tech Tool, command the actuator to the **Install** position. Turn OFF the ignition when done. The actuator is now ready for installation.

NOTE

Keep hands and obstructions away from the drive gear during installation. The actuator gear must not be moved or the calibration will not be successful.

11. Insert two **new** attaching screws diagonally in the SRA.

NOTE

Use **new** attaching screws and a **new** gasket when assembling the SRA on the turbocharger.

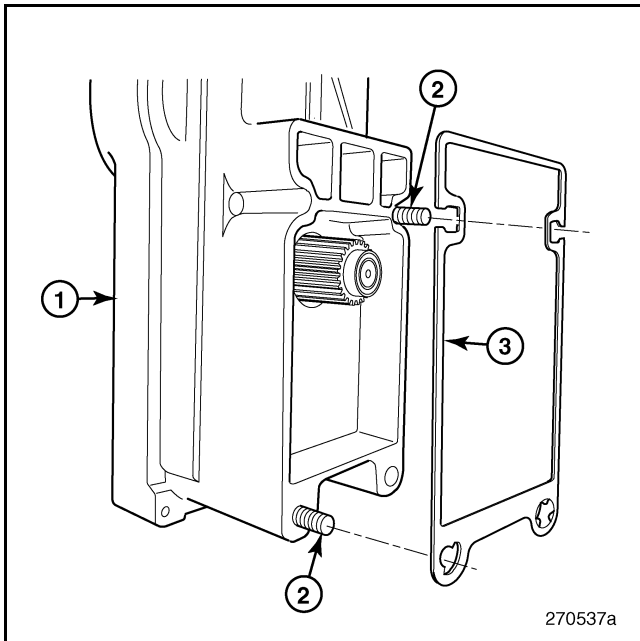


Figure 488 — Attaching SRA to Turbocharger

1. SRA Housing
2. Attaching Screws

3. Gasket

12. Assemble a **new** gasket on the protruding screws at the back of the actuator.
13. Carefully align the actuator with the turbocharger center housing and place the actuator in position on the turbocharger. Hand tighten the two attaching screws.

NOTE

Be careful to preserve the gear tooth alignment and the correct position of the gasket during assembly.

14. Install the remaining two **new** actuator screws.
15. Using a torque wrench, tighten the actuator mounting screws in two steps alternately in a diagonal pattern.
Step 1: 3 N•m (27 lb-in)
Step 2: 11 N•m (97 lb-in)
16. Connect the coolant lines to the SRA and using a torque wrench, tighten the coolant line connections to specification.

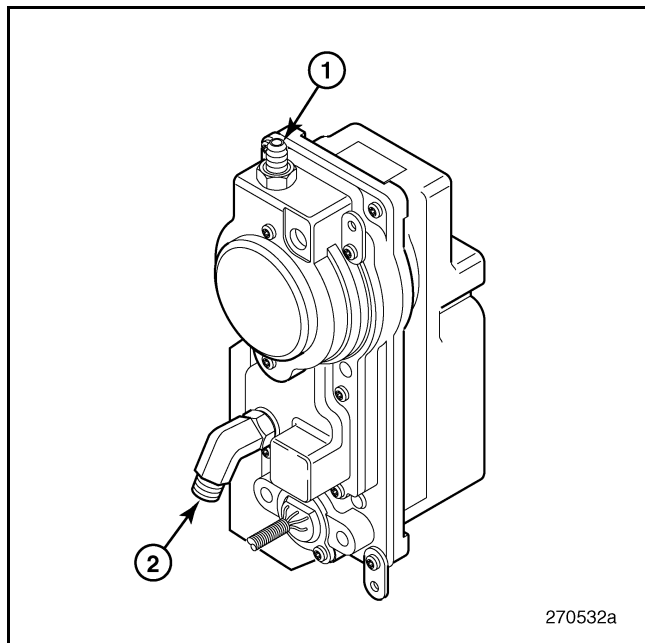


Figure 489 — SRA Coolant Connections

1. Coolant Return Port

2. Coolant Inlet Port

REPAIR INSTRUCTIONS, PART 3

1. Remove and flush the turbocharger oil supply line with a suitable, clean, non-flammable solvent.

SERVICE HINT

Allow solvent to run through the line to flush any debris, then blow the line dry with clean compressed air.

CAUTION

A turbocharger failure can result in debris contaminating the turbocharger oil supply line. It is EXTREMELY IMPORTANT to remove, flush and thoroughly clean the line prior to starting the engine. Failure to heed this caution may result in severe component and engine damage.

2. Reinstall the oil supply line.
3. Prime the lubrication system following the procedure described earlier in this section.
4. Following engine overhaul, use the diagnostic computer to calibrate the variable geometry turbocharger.

Cooling System

1. Check the cooling system. Make sure all plugs and coolant drain quick disconnects are installed and are tight.
2. Make sure the thermostat is installed.
3. Install a **new** coolant filter.
4. Fill the system with the recommended coolant.

NOTE

Make sure that all air is purged from the cooling system.

Fuel System

DANGER

Before working on or inspecting a vehicle, set the parking brake, place the transmission in neutral and block the wheels. Failure to heed this warning can result in unexpected vehicle movement and cause severe personal injury or death.

DANGER

To avoid potential fire hazard, do not service any part of the fuel system while smoking or in the presence of flames, sparks or hot surfaces, or when working on an operating engine. Failure to heed this warning can result in fire which can produce severe personal injury or death.

DANGER

Wear adequate protective clothing (face shield, heavy gloves, apron, etc.) when working on a hot engine to guard against burns from direct contact with hot fuel. Failure to heed this warning can result in severe personal injury or death.

WARNING

Do not work near the fan with the engine running. The engine fan can become active at any time without warning. Failure to heed this warning can result in severe personal injury.

WARNING

Before turning the ignition on, make sure no one is near the fan. Failure to heed this warning can result in severe personal injury.