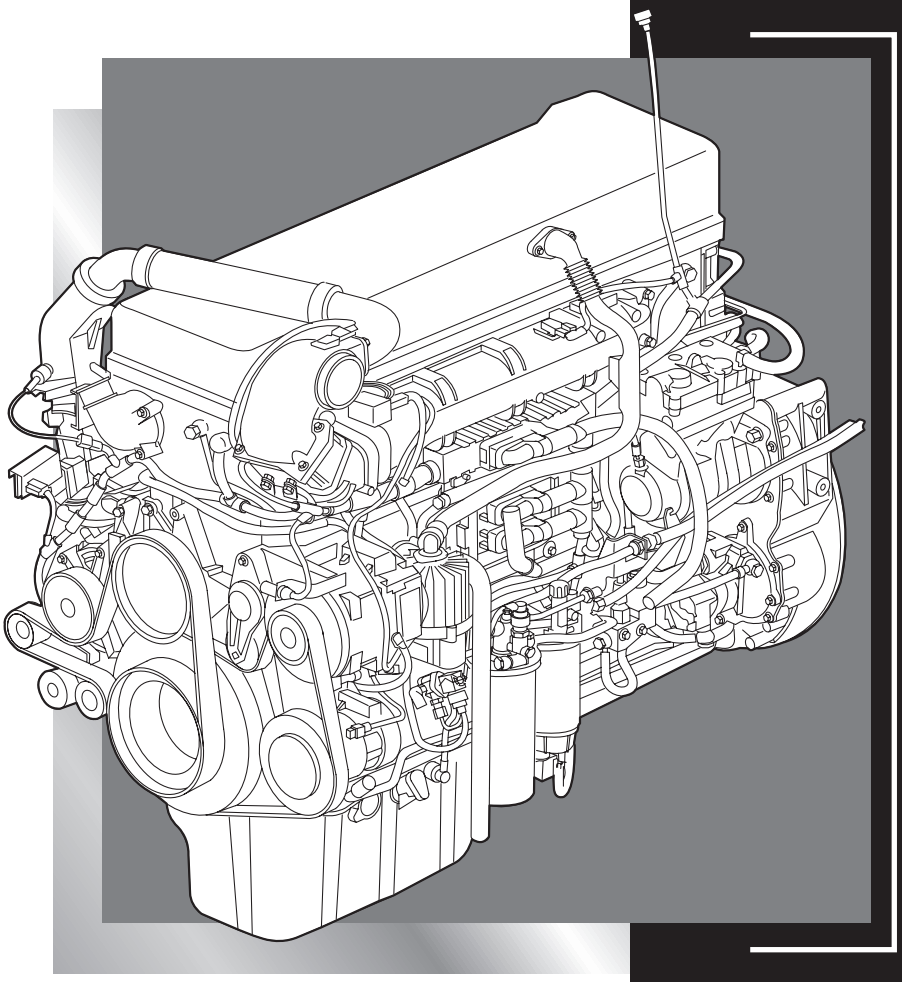


MACK® MP8 DIESEL ENGINE

SERVICE MANUAL

(EURO 4)

JULY 2009
(REVISED)
5-117

⚠ DANGER

Do NOT use starting fluid (ether) on engines equipped with an inlet manifold air heater element. An explosion could occur. Failure to heed this danger may result in severe personal injury or death.

Two optional fan drives are available: On/Off and electronically actuated. The electronically actuated viscous fan drive is precisely controlled by the Engine Electronic Control Unit (EECU).

NOTE

The electronically actuated fan drive is not available on vehicles manufactured for Australia.

Timing gears mount on the rear of the MP8 improving the flow of cooling air around the front. Special service instructions apply to the camshaft position sensor. The mounting plate, idler and camshaft gears are marked to facilitate proper installation. The air compressor drive gear meshes with the double idler instead of the auxiliary idler as on the MP7 engine.

Another feature of the MP8 is the rear engine power take-off (REPTO-ready) that is gear driven through the timing gear train. An optional PTO with drive gear, bearing and housing can be added at the factory.

The rocker arm shaft is held in place by camshaft bearing capscrews. There are special instructions for installing the camshaft bearing caps and the rocker arm shaft during service.

A stiffener plate fastens to the bottom of the cylinder block to ensure block strength and rigidity. The engine can be used with axle forward or axle back vehicles by virtue of optional oil pans. The engine fan is mounted high or low depending on vehicle configuration.

The MP8 uses unit injectors. The unit injector incorporates the pump, valve and injector. Its internal solenoids permit fast, precise control of fuel delivery into the cylinder. The unit injectors are encased by the valve cover and not exposed to the heat of exhaust system components.

Replacing injectors requires a specific procedure, and installation requires that the EECU be programmed to recognize replacement injectors. Cleaning injector bores requires a special tool.

An engine compression brake option on the MP8 engine assists deceleration and braking. The operation of the brake differs from earlier engine models. Working in conjunction with the exhaust cycle, the brake requires a camshaft with four cams per cylinder, two rocker arms for the exhaust valves, a bridge over the two exhaust valves, an electronic control valve and a wiring harness that includes the control valve. The exhaust valves are adjusted with shims.

Preventive maintenance is important to get the most from the MACK MP8 engine and to ensure many years of reliable, trouble-free operation. Refer to the current TS943 Maintenance and Lubrication manual for schedules and specifications.

Repair instructions in this manual deal with removal, installation, disassembly, assembly, setup and adjustments of MP8 components.

There are restrictions concerning the reuse of certain fasteners. Refer to current specifications bulletins and the **SPECIFICATIONS** section of this manual for detailed information.

OIL PAN

The oil pan is plastic or steel with a threaded plug for draining. The plastic pan has a groove in the mounting flange which accepts a molded elastomer gasket for a seal. The steel pan is sealed with a gasket on the oil pan flange. Twenty-two spring-loaded screws clamp the pan to the block.

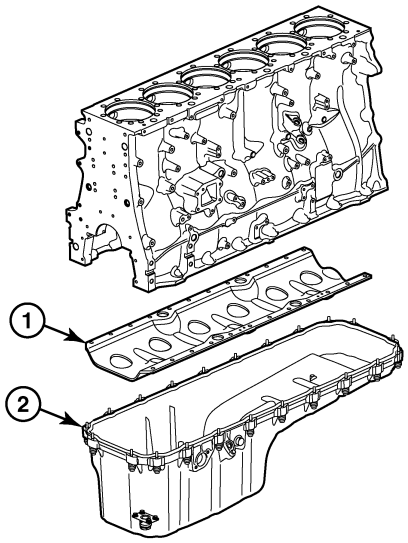


Figure 12 — Oil Pan and Stiffener Plate

1. Block Stiffener Plate	2. Oil Pan with Gasket

The oil pan includes an oil level/temperature sensor with connector. The filler tube and dipstick mounting ports are also components of the oil pan.

NOTE

Oil pans with the sump at the front or at the rear are available to accommodate axle forward or axle back chassis.

CRANKSHAFT

The crankshaft is drop forged steel and induction hardened. It has seven journals with replaceable bearings. Five oversized replacement bearing options are available to accommodate crankshaft regrinding.

The rear main cap (No. 7) includes an attaching point for the lube pump. Thrust washers to control axial movement straddle the central journal (cap No. 4). The remaining caps (Nos. 1–3, 5 and 6) are numbered to facilitate correct assembly.

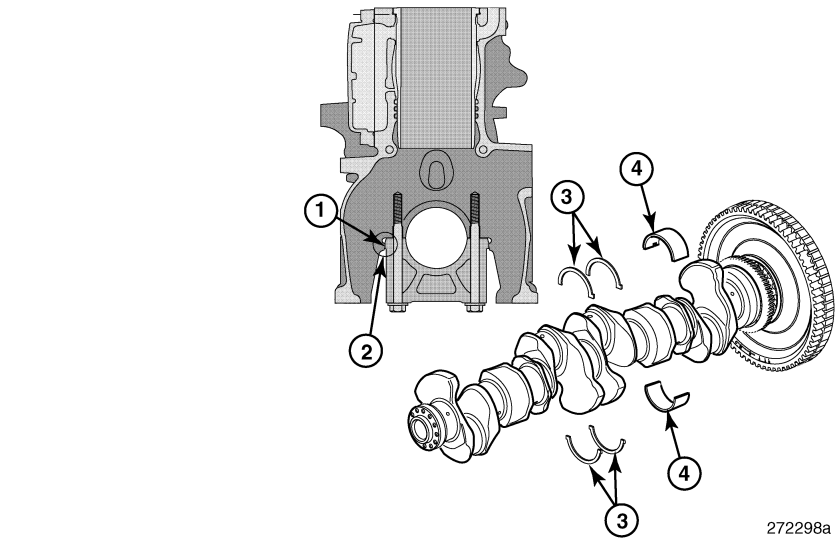


Figure 13 — Crankshaft, Bearings, Thrust Washers and Cap Alignment Tabs

1. Alignment Tab, Block 2. Alignment Tab, Cap	3. Thrust Washers 4. Upper and Lower Bearings

UNIT INJECTORS

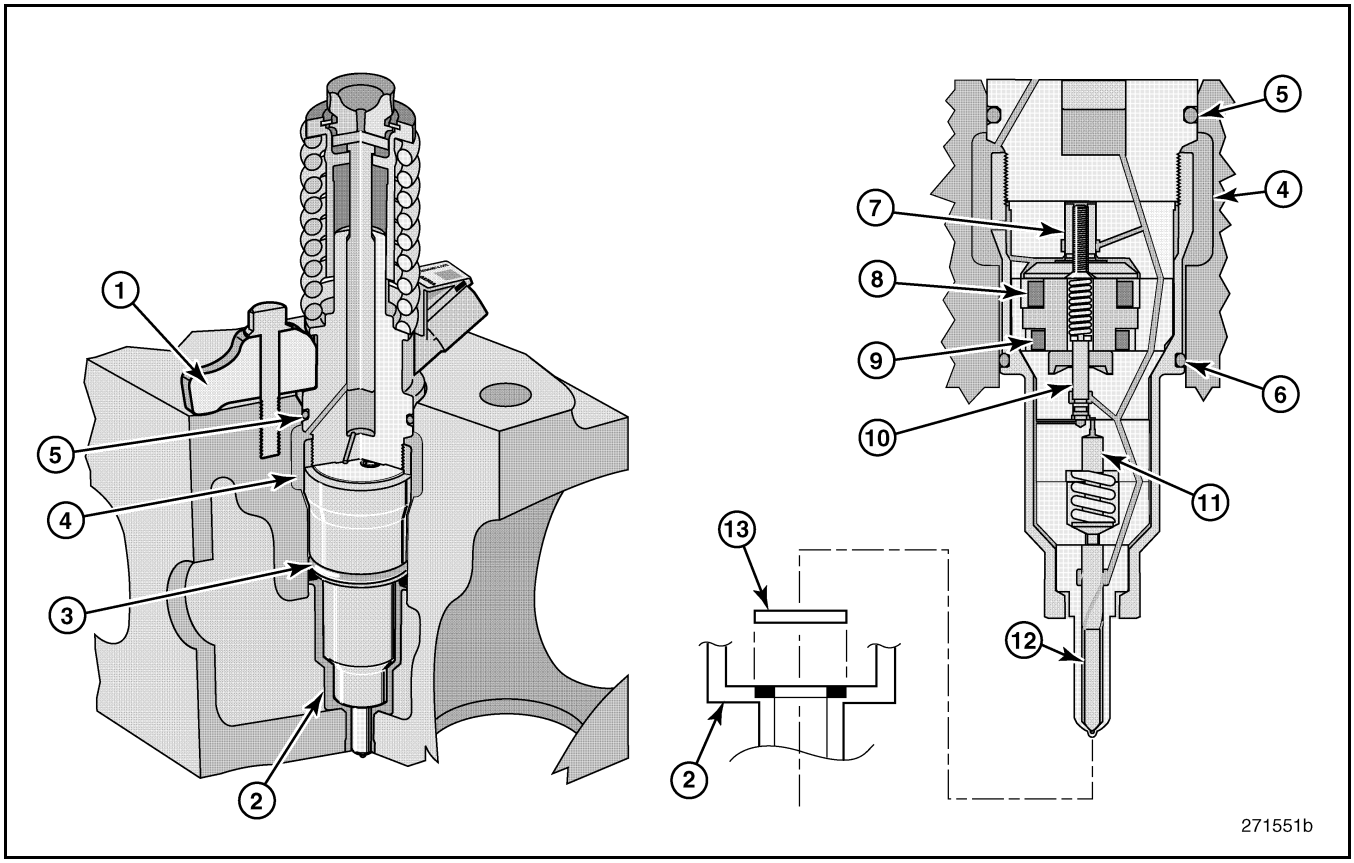


Figure 23 — Unit Injector Diagram

1. Injector Yoke	8. Solenoid Coil
2. Copper Sleeve	9. Solenoid Coil
3. O-Ring	10. Injector Valve
4. Fuel Gallery	11. Injector Piston
5. O-Ring	12. Injector Nozzle
6. O-Ring	13. Washer
7. Pressure Relief Valve	

This engine uses double solenoid unit injectors. Unlike systems that require separate components for delivering, pressurizing and injecting, this unit injector combines these functions. These injectors precisely control the fuel delivery because of the two solenoids. The solenoids, pump and nozzle are in a single body in close proximity to each other.

The injector is set in a pressurized fuel gallery where the fuel temperature is constant. Uniform fuel temperature means uniform quantity in each injection which means uniform power output from each cylinder.

The fuel pump pressurizes the gallery so that fuel rushes into each injector when it opens. Gallery pressure is regulated by a valve that delivers excess fuel back to the tank.

Copper sleeves, acting as coolant jackets, line the bottoms of the injector bores. Engine coolant circulates around these sleeves aiding the process of controlling injection temperature.

GLOSSARY OF TERMS

Atmospheric Pressure Sensor

A sensor incorporated into the EECU that detects atmospheric (barometric) pressure and relays this value to the EECU. This pressure is affected by altitude.

Carbon Monoxide (CO)

An odorless, colorless gas resulting from incomplete combustion of hydrocarbons; found in diesel truck exhaust; poisonous to humans and animals.

Compressor Discharge Temperature Sensor

Mounted between the turbocharger compressor housing and CAC, detects compressor discharge air temperature and relays this value to the EECU.

Cooled Exhaust Gas Recirculation (CEGR)

A system whereby a pre-determined amount of exhaust gas is diverted through a heat exchanger where it is cooled and sent to the inlet manifold for introduction into the combustion chambers. Adding the cooled exhaust gases to the combustible fuel and air mixture lowers the overall combustion temperatures for reduced formation of nitrogen oxides (NOx).

Electronic Unit Injector (EUI)

Controlled electronically by the EECU, there is one electronic unit injector for each cylinder of an engine. A unit injector incorporates the pump, the injector nozzle and two solenoids in a single body. Actuated by the camshaft via rocker arms with roller followers, electronic unit injectors offer precise fuel metering using a process called “rate shaping.”

Engine Electronic Control Unit (EECU)

A microprocessor-based controller usually mounted on the cylinder block. On the MP8 engine, a cooling plate mounts on the surface of the module. A tube on the plate conducts fuel drawn from the tank on its way to the pump before being pressurized. The fuel acts as the coolant. With the MACK V-MAC® IV system, the EECU controls fuel timing and delivery, exhaust gas recirculation, fan operation, engine protection functions and engine brake operation.

Exhaust Gas Recirculation (EGR)

A system whereby a pre-determined amount of exhaust gas is returned to the combustion chambers. Adding a small percentage of exhaust gas to the fuel/air mixture lowers the combustion temperature reducing the formation of nitrogen oxides (NOx).

Hydrocarbons (HC)

Chemical compounds composed only of carbon and hydrogen. Gasoline, diesel fuel and motor oil are all examples of a very large group of hydrocarbons. The largest source of hydrocarbons is petroleum.

Idler Gear

A gear running between a driving and a driven gear to make the driven gear rotate in the same direction as the driving gear.

Idler Tensioner

A belt tensioning device designed to maintain optimum tension under varying engine speeds and load.

Intake Air Temperature and Humidity Sensor

Mounted in the air intake between the air cleaner and the turbocharger compressor housing, detects outside air temperature and humidity and relays these values to the EECU.

Oxides of Nitrogen (NOx)

High temperatures and pressures of combustion produce oxides of nitrogen (NOx). When combustion temperature exceeds 1372°C (2,500°F), oxygen and nitrogen combine in large quantities to form NOx. By themselves, NOx emissions are no great hazard; however, when mixed with the right amount of HC in the air, NOx will combine in the presence of sunlight to form smog.

Poly-V Belt

A multi-ribbed belt design incorporated into the accessory drive belt and pulley arrangement at the front of the engine.

ENGINE SYMPTOM DIAGNOSIS [200 EA]

The Vehicle Management and Control (V-MAC IV) system monitors engine function and displays a code when a fault is detected. The code can be observed on the instrument panel or through an electronic diagnostic tool. An explanation of the fault codes can be found in VCADS, Guided Diagnostics or the Fault Code Manual, 8-218. Guided Diagnostics also includes symptom-based troubleshooting. To obtain Tech Tool, contact your local MACK dealer.

The Tech Tool provides complete system diagnostics. For more information, see manual 8-371 or the Tech Tool web site. Repair information is available in the respective engine service manuals and from the MACK Electronic Information System (EIS). EIS is easily accessed with Tech Tool.

Troubleshooting Technique

Talk to the vehicle operator. Learn how the engine operated before it failed. Ask about the maintenance schedule and the fuel, coolant and lubricant used. Begin by attempting to determine whether anything has happened recently that could point to the electrical system, but which is not related to the electronic control system.

Depending on the vehicle configuration, a problem may be caused, or influenced, by malfunctions in other vehicle components. Be sure to inspect for unusual conditions among the batteries, tires, axles, trailer, bodybuilder adaptations and other possibilities. Consult specific service information resources according to the conditions observed. Fuel waxing, for example, can cause symptoms easily mistaken for other engine problems.

If possible, recreate the problem in an environment similar to that described by the vehicle operator. Run the engine at the temperature at which the symptom occurred.

Engine problems can be electrical, mechanical or a combination of the two. Electrical and electronic problems will, for the most part, cause fault codes to be set in the V-MAC system.

Before Troubleshooting Begins

Before troubleshooting begins, observe all shop safety procedures.

Noise and Vibration

NORMAL VERSUS ABNORMAL

Noise is the name we give to vibration that irritates us through our ears. *Vibration* can be felt without being heard. Engine operation can cause vibration and noise throughout a vehicle that we regard as “normal.”

Abnormal noises and vibrations suggest that something is not working properly or is not assembled properly. A damaged driveshaft can cause abnormal vibration. A loose fastener allows two surfaces to rub or slap together causing unusual noise in response to the vibration.

Be sure to discuss noise and vibration issues with the driver. It is important to discover under what conditions these occur. Maybe a test drive will be necessary to familiarize yourself with the details of the driver's story. Even so, it will probably be necessary to start the diagnostic process with a guess as to the nature of the difficulty.

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.

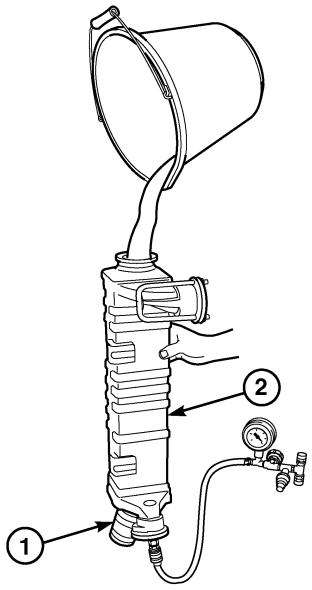


Figure 54 — Test with EGR Gas Outlet Port Plugged

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.

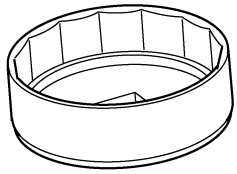
1. Remove the cylinder head (valve) cover.

⚠ 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.

LUBRICATION SYSTEM MAINTENANCE

Special Tool

Tool No.	Description	Image
9998487	Oil Filter Wrench (Available)	 006845a

Oil Level Check

When checking oil levels, the vehicle must be parked on level ground. Components must be filled to the correct level. DO NOT OVERFILL.

The best time to check oil level is while the engine is COLD (prior to starting at the beginning of the work day, or after the vehicle has sat approximately 2 hours). At normal operating temperature (engine oil temperature above 80°C [175°F]), oil level can be checked 15 minutes after shut down.

⚠ CAUTION

Failure to wait a sufficient amount of time (2 hours if engine oil temperature is below 80°C [175°F]) or 15 minutes if oil temperature is above 80°C [175°F]) will result in an inaccurate dipstick reading.

For accurate oil level readings, the dipstick must be inserted fully into the dipstick tube. The level must be close to the FULL line (at least between the LOW and FULL lines) on the dipstick, but must NOT exceed the FULL line.

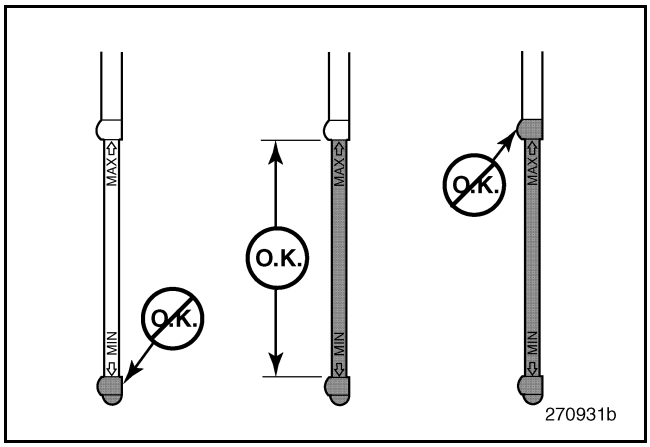


Figure 72 — Oil Level Check

NOTE

The fan assembly is heavy and difficult to handle. Obtain assistance to support it safely during removal.

15. Remove the fan assembly.

NOTE

If equipped with an electronically-controlled viscous fan, store the fan assembly face down (hub flange up) or vertically as shown to prevent fluid leaking from the assembly.

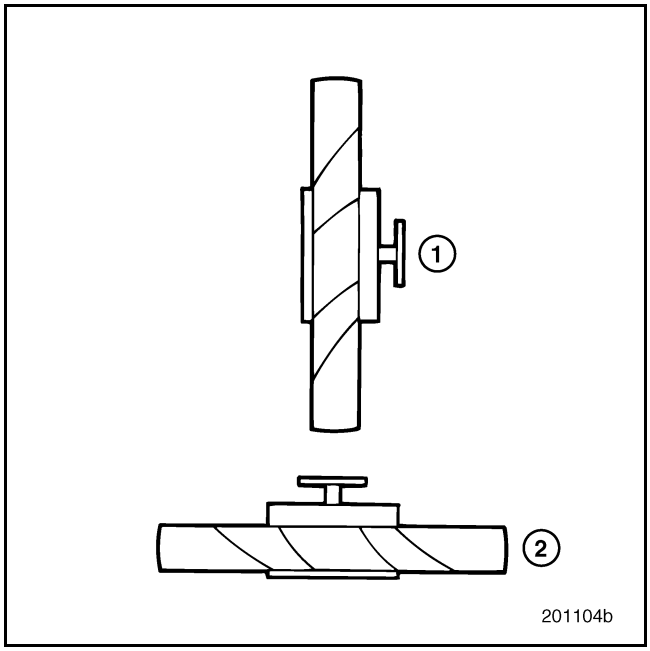


Figure 76 — Viscous Fan Drive Assembly Storage

1. OK to Store with Fan Blade in Vertical Position.	2. OK to Store with Fan Blade in Horizontal Position and Mounting Flange Up. Do Not Store with Mounting Flange Down.

16. If equipped, remove the exhaust bracket from the flywheel housing.

NOTE

Use a container to collect power steering fluid.

17. Remove the power steering hoses.
18. Disconnect the exhaust system from the turbocharger.
19. Disconnect electrical cables or wires connected to the starter.
20. Disconnect or remove all other items attached to the frame or cab that would prevent engine removal, such as:
    a. Clutch linkage
    b. Ground straps
    c. Electrical wiring
    d. Coolant tubing
    e. Air lines
    f. Fuel lines
    g. Hydraulic hoses or tubing
21. Remove the valve cover.

⚠ CAUTION

Cover the valve mechanism and gear train with a suitable c\loth or similar covering to prevent dirt and debris from entering the engine.

NOTE

Use a transmission jack to support the transmission when disconnected from the engine.

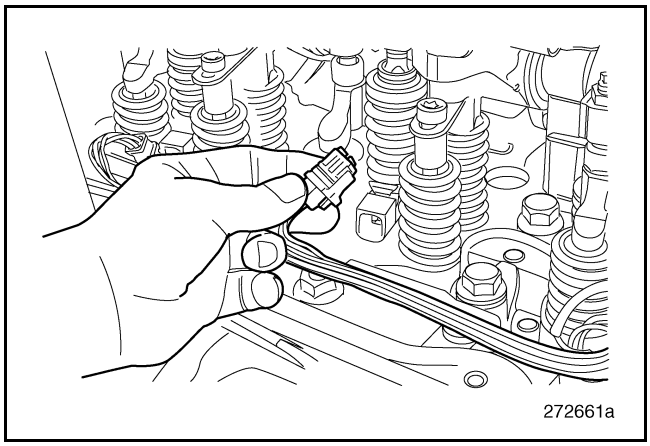


Figure 88 — Disconnecting Harness at Unit Injector

6. If so equipped, disconnect the harness from the engine brake control valve.

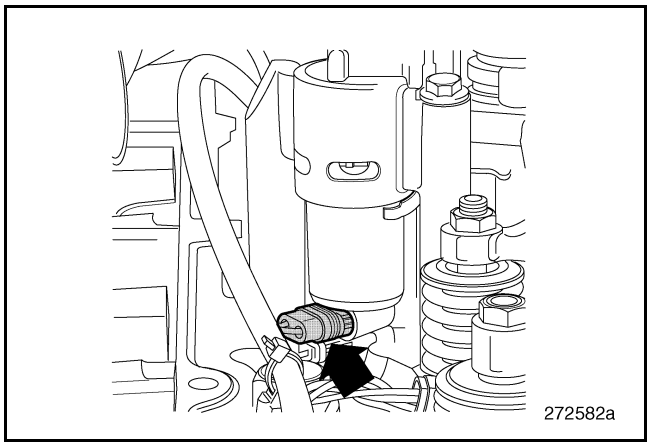


Figure 89 — Engine Brake Control Valve Terminal

7. Cut the cable ties holding the harness to the cylinder head and the engine brake control valve.
8. Carefully pull the harness through the hole at the front of the cylinder head and remove the harness from the engine.

Timing Gear Cover Removal [211 AA]

1. Disconnect the oil supply line at the EGR valve and at the flywheel housing. Remove the line from the engine.

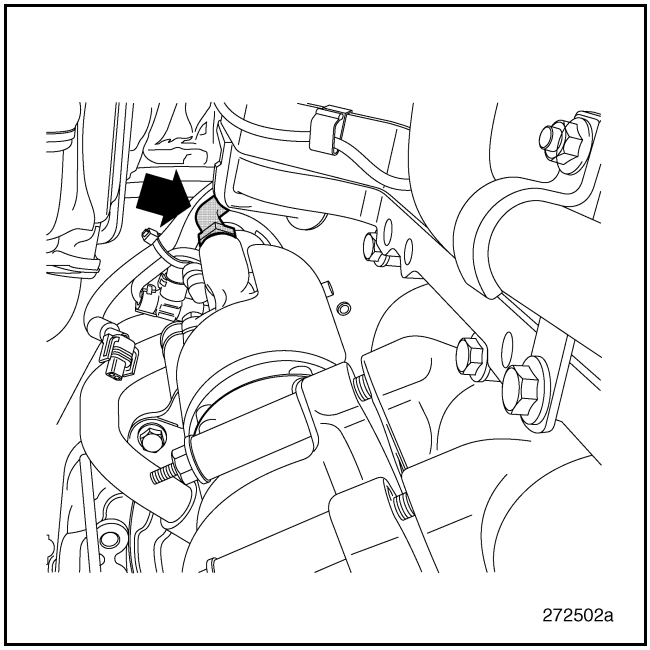


Figure 90 — EGR Valve Oil Supply Line

2. Remove the mounting fastener and remove the camshaft position sensor from the timing gear cover.
3. Remove all straps, P-clamps and other retainers used to restrain harnesses, oil lines and coolant tubes to the rear of the engine. This will allow the support bracket at the rear of the engine to be removed.

NOTE

- If an injector nozzle gasket (flat washer) had been used for the seal joint between the injector copper sleeve and the injector, discard the used gasket immediately after the injector is removed. A used gasket must not be reused. When the injector is removed, this gasket may come out attached to the injector or it may remain in the bottom of the injector sleeve.
- If the nozzle gasket (flat washer) is attached to the injector, loosen it with gentle prying from a thin flat gasket scrapper blade. If the gasket is in the bottom of the injector sleeve, initially attempt to remove it with a magnet. If this is unsuccessful, use a standard flat blade screwdriver with a long thin shank and narrow width blade to loosen the gasket. Locate the blade in the recess between the outside of the gasket and the injector sleeve. Use the blade to apply force on the outside of the gasket at different locations around the gasket. Continue this until the gasket separates from the sleeve.

10. If the injector is not being installed immediately, install the protective plug into the unit injector bore of the cylinder head to protect it from debris.

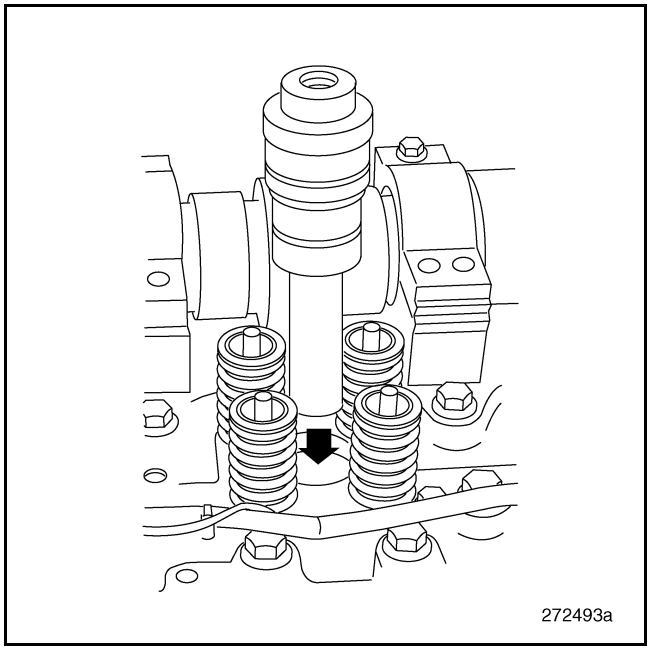


Figure 114 — Installing Injector Bore Protective Plug

11. Repeat the process to remove the remaining unit injectors.

Starter Removal

[272 DH]

The starter is held in place by nuts assembled over studs installed at the front right side of the flywheel housing.

⚠ WARNING

The starter is heavy. Do NOT attempt to remove the starter without the help of an assistant or the use of a suitable lifting device. Failure to heed this warning may result in personal injury and component damage.

1. If not already done, disconnect the wiring harness from the starter motor.
2. Loosen the nuts fastening the starter to the flywheel housing.

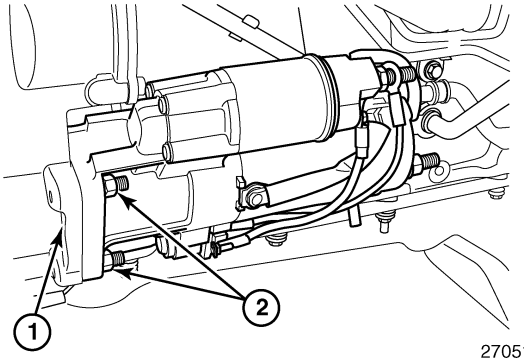


Figure 115 — Starter

1. Flywheel Housing	2. Attaching Nuts

3. With the help of an assistant or a lifting device, remove the starter from the engine.

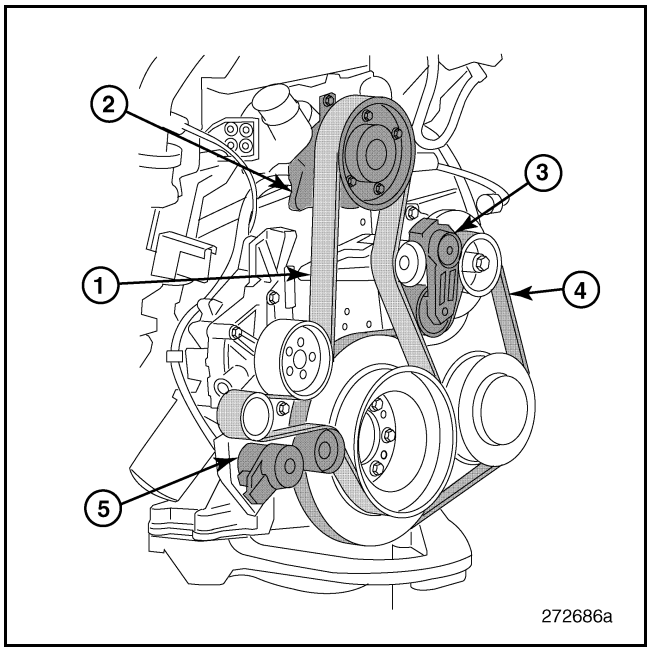


Figure 147 — Fan Hub and Accessory Drive System

1. Fan Drive Belt 2. Fan Hub Bracket 3. Accessory Drive Belt Tensioner	4. Accessory Drive Belt 5. Fan Drive and Coolant Pump Belt Tensioner

4. Remove the fasteners and fan hub bracket assembly.

EGR Mixer Removal

[214 HL]

1. If not already done, remove the fasteners and remove the inlet pipe (elbow) from the EGR mixer.

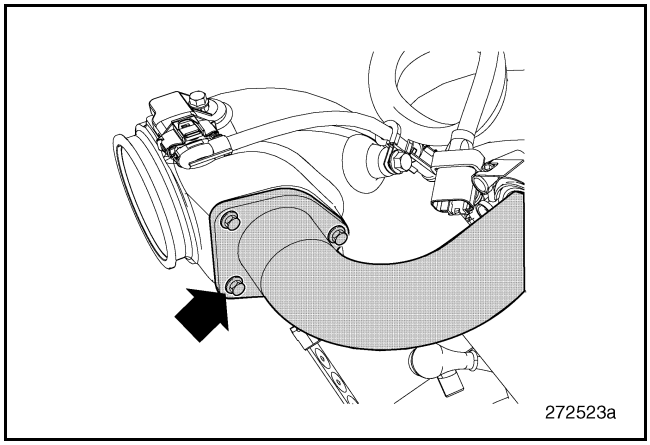


Figure 148 — EGR Mixer Inlet Pipe

2. Remove the fasteners and EGR mixer (including fan ring support bracket) and gasket from the spacer block or inlet air preheater, if so equipped.

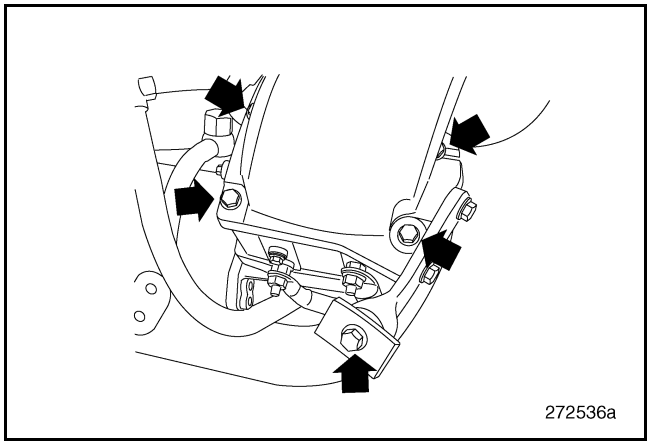


Figure 149 — EGR Mixer Fasteners

3. Remove the spacer block from the inlet air manifold. Or, if so equipped, remove all power and ground cables from the inlet air preheater and remove the preheater from the manifold.

Alternator and Refrigerant Compressor Removal

[271 CB, 264 DP]

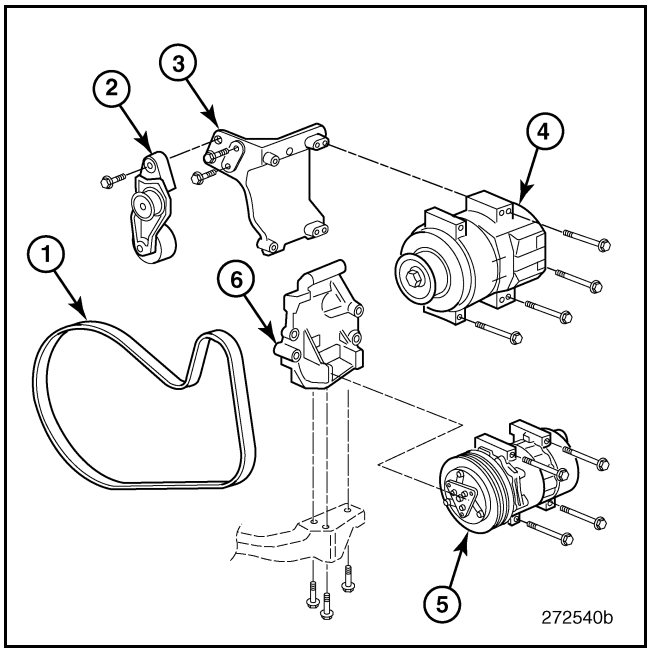


Figure 172 — Alternator and Refrigerant Compressor Mounting

1. Fan Belt 2. Tensioner 3. Alternator Mounting Bracket	4. Alternator 5. Refrigerant Compressor 6. Front Engine Support Mounting Bracket

NOTE

For this procedure, the engine is out-of-chassis, the fan drive and accessory drive belts are removed, the alternator harness wiring is disconnected, and the A/C compressor refrigerant lines are removed.

1. While supporting the alternator, remove the fasteners and remove the alternator from the upper mounting bracket.
2. While supporting the refrigerant compressor, remove the fasteners and remove the compressor from its mounting pads on the front engine support mounting bracket.
3. If necessary, remove the fasteners and remove the belt tensioner from the upper mounting bracket.
4. Remove the fasteners and remove the upper mounting bracket from the cylinder block.

NOTE

It is not necessary to remove the front engine support mounting bracket unless it is damaged and in need of replacement.

Thermostat and Cover Removal

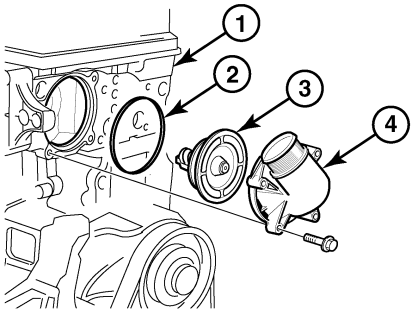


Figure 173 — Thermostat and Cover

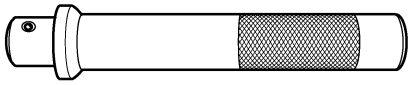
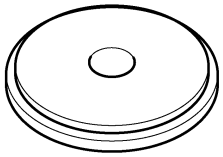
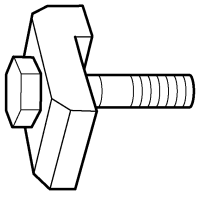
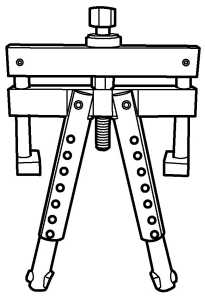
1. Cylinder Head 2. Sealing Ring	3. Thermostat 4. Thermostat Cover

1. Remove the fasteners, thermostat cover, thermostat and sealing ring.
2. Carefully clean the thermostat seat and all cylinder head-to-thermostat cover mating surfaces.

CYLINDER BLOCK RECONDITIONING [211 DB]

Tools and Equipment

SPECIAL TOOLS

Tool No.	Description	Images
9992000	Handle with Various Uses (fits 25 mm/1 inch hole) (Essential)	 006785a
9996599	Liner Installation Plate (Available)	 006792a
9996966	Liner Hold-Down Tool (Essential)	 006796a
PT-6435 or PT-6400-C	Cylinder Liner Puller (Available) **Note:** Alternate tools for liner removal — 9992955, 9996394, 9996395 and 9996645 in combination.	 006808a

3. Using a generous amount of clean engine oil on the wrist pin and rod bearing, press the wrist pin into the bore.
4. Insert a snap ring in the other wrist pin retaining groove.
5. Set the assembled piston aside in a clean location until it is needed.
6. Repeat steps 1 through 5 for each piston.

⚠ CAUTION

Connecting rod capscrews can only be re-used four times. Screw heads must be punched at each overhaul to indicate the number of times used. Failure to heed this caution may result in severe component damage.

A screw with four punch marks (A) must be replaced with a **new** screw.

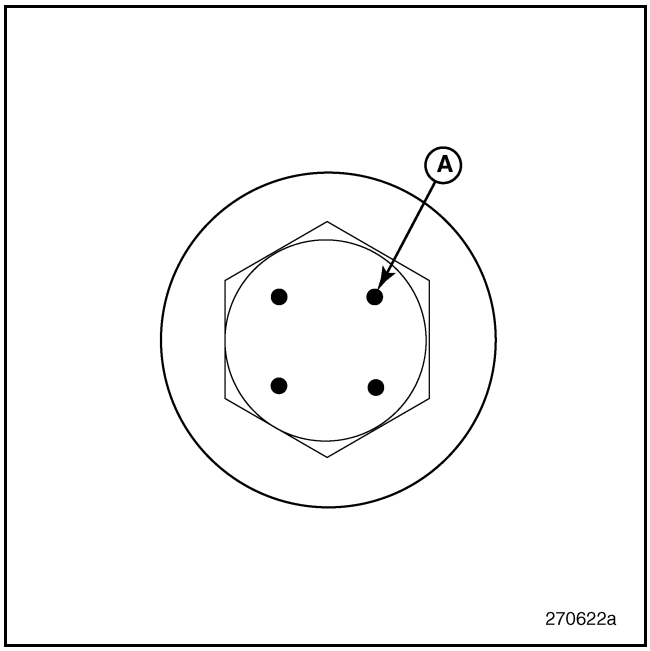


Figure 214 — Connecting Rod Screw with Maximum Punch Marks (Replace)

Used connecting rod screws must be lightly oiled on the threads and under the head. New screws are coated with phosphate and oil and must be assembled dry.

⚠ CAUTION

If the capscrews are incorrectly assembled or tightened to an incorrect torque, the assembly must be discarded. Failure to heed this caution may result in severe component damage.

10. Tighten the set screw of the extractor tool to secure the bolt. Make sure that the set screw is seated against the flat part of the extractor bolt.
11. Place the extractor tool with the bolt into the injector bore. Make sure the nut on the spindle is backed off so that the threaded end can be completely installed through the copper sleeve tip. Hand tighten until the bolt bottoms out in the sleeve.

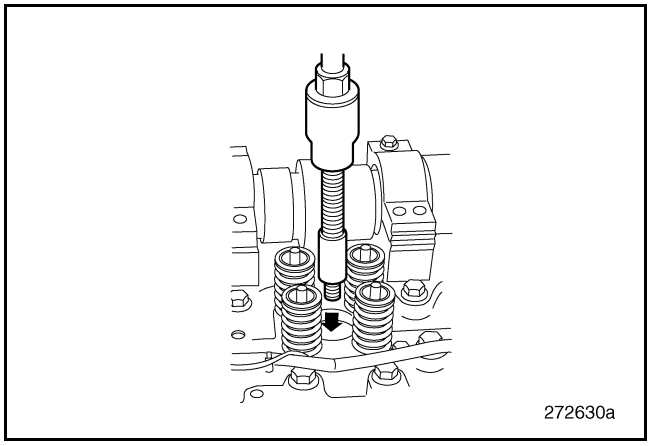


Figure 223 — Extractor Tool Installation

⚠ CAUTION

Make sure the extractor bolt is threaded completely into the copper sleeve before attempting to remove it or the tip of the sleeve may break off as it is removed.

12. Screw the injector sleeve removal tool, 9998253, completely into the injector sleeve and then back it out 1/2 turn. Remove the sleeve by turning the nut while holding the threaded shaft of the removal tool.

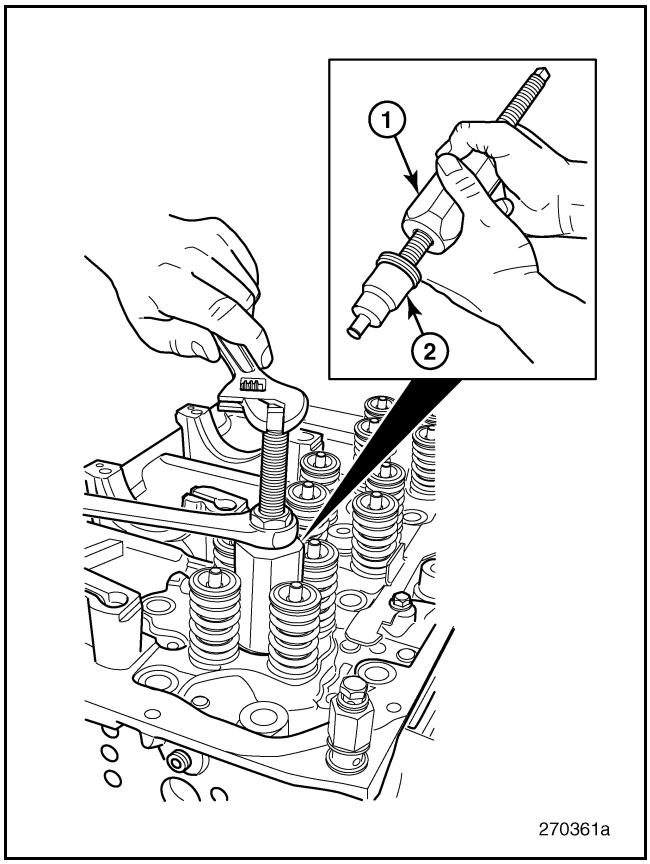


Figure 224 — Removing Injector Sleeve

1. Injector Sleeve Remover 9998253	2. Injector Sleeve

NOTE

When the copper sleeve is removed, make sure that the extractor bolt is extended at least one thread beyond the copper sleeve. If not, make sure that no part of the copper sleeve has broken off.

⚠ CAUTION

Do not use air tools to remove copper sleeves, or damage to the injector bore can result.

INSPECTION

1. Clean the camshaft thoroughly.

NOTE

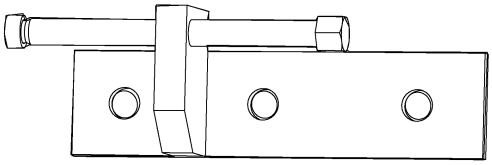
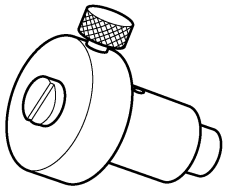
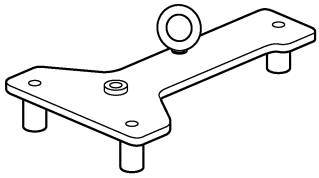
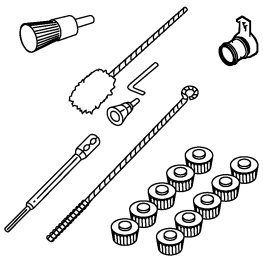
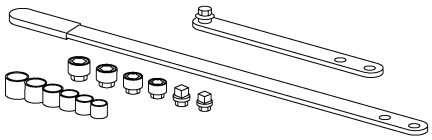
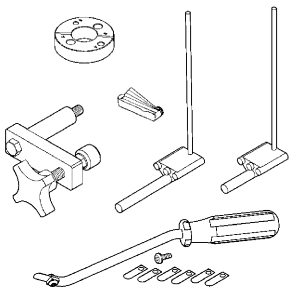
If any component displays cracking, pitting, scoring or excessive wear, replace it.

2. Inspect the camshaft, lobes and journals.
3. Inspect the camshaft gear.
4. Inspect the vibration damper.

CAMSHAFT GEAR INSTALLATION

The camshaft can be installed on a properly installed cylinder head before attaching the timing gear and vibration damper.

1. Using two or three attaching screws, loosely assemble the damper, gear and shaft.
2. Install the remainder of the screws loosely.
3. Tighten the screws according to the sequence specified in the ENGINE TORQUE SPECIFICATIONS section.

Tool No.	Description	Image
88800022	Cooling Duct Cover Installation Tool	 006893a
88800031	Camshaft Sensor Gauge (Essential)	 006804a
88800188	Cylinder Head Lifting Tool (Essential)	 006923a
J 42885	Injection Bore Cleaning Kit (Essential) **Note:** Alternate kit for injector cleaning — 9998599.	 006926a
J 44392	Belt Tensioner Release Tool	 272697a
J 44514-B	Engine Timing Kit (Essential)	 006889a

NOTE

Make sure that the crankshaft front cover and cylinder block flanges are thoroughly cleaned before applying the sealant.

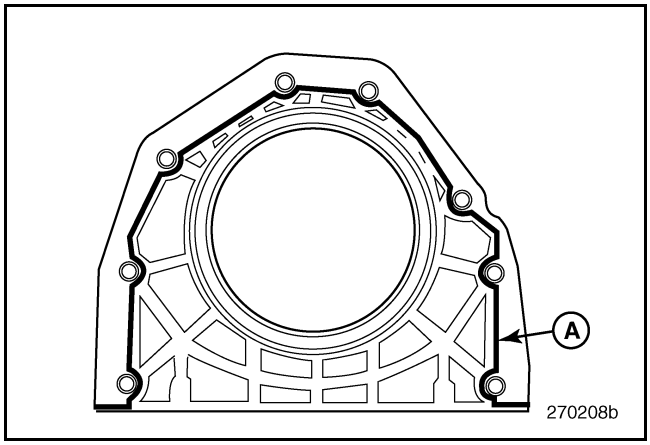


Figure 274 — Sealant Application Pattern — Crankshaft Front Seal Cover to Block

A. Apply sealant here.

3. Within 20 minutes of sealant application, install the front cover to the cylinder block. Center the crankshaft front cover against the crankshaft using the plastic ring.
4. Install the front cover. Note that there are two different types:

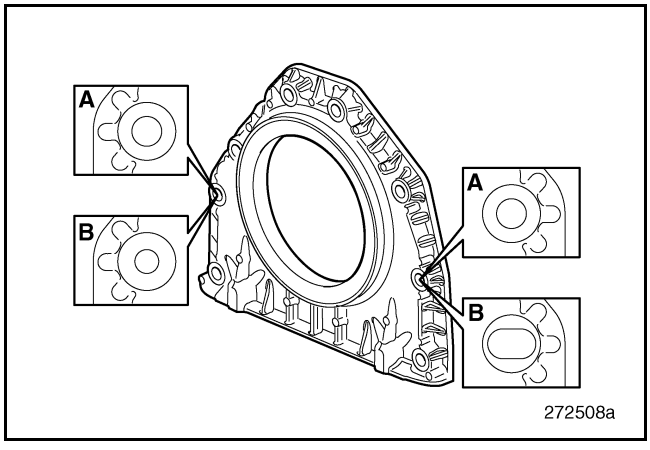


Figure 275 — Crankshaft Front Cover

- **For earlier type (A), the following installation instructions apply:**

  Install the bolts without tightening them. Using a straightedge rule, make sure the cover is flush with the lower edge of the cylinder block.

- **For later type (B), the following installation instructions apply:**

  Install the bolts in both bolt holes that align the cover to the correct position. Tighten by hand so that the cover is fixed. Install the remaining bolts.

NOTE

For the later type cover, the left-hand hole is smaller and the right-hand hole is oval. This change allows the later cover to be correctly aligned.

5. Using a torque wrench, tighten the screws in sequence according to specification.

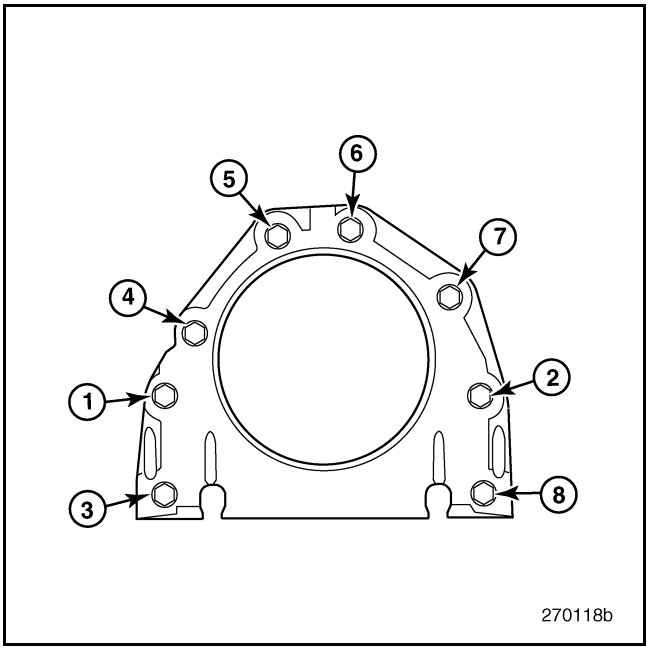


Figure 276 — Front Cover Torque Sequence

6. Remove the plastic ring from the crankshaft hub. Drive in the crankshaft seal with drift, 88800021, and handle, 9992000, until the drift bottoms against the crankshaft.

Unit Injector Installation

[221 GP]

NOTE

If a unit injector is reused, it must be fitted to the bore from which it was removed.

1. If not previously performed, install protective sleeve, J 42885-25, and clean the unit injector copper sleeve with the appropriate brush and extension.

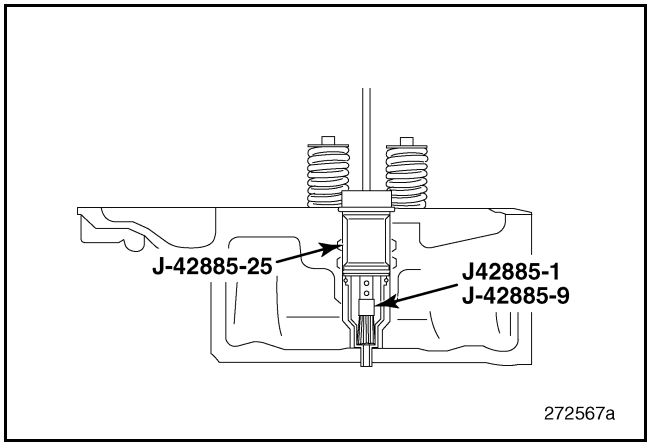


Figure 301 — Unit Injector Copper Sleeve Cleaning

NOTE

After cleaning the copper sleeve, carefully inspect the inside surface of the sleeve, especially the bottom surface where the injector seal is located. Any remaining contamination is unacceptable and must be removed. Also, if there is any indication of a discrepancy that raises concern about suitability of the sleeve for reuse, replace it with a **new** sleeve.

2. Before reusing an injector, cleaning is required to ensure suitability for reuse. Before doing any cleaning, the injector fuel inlet and outlet ports and the electrical connector opening must be covered to prevent contamination from the cleaning process. Also, there must be no lower O-ring installed in the injector. Refer to “UNIT INJECTOR CLEANING” on page 272 for further information.
3. Remove the bore protection sleeve, 9998251.

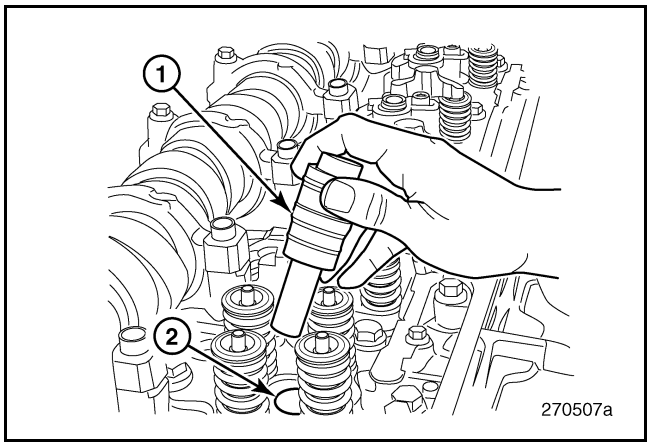


Figure 302 — Unit Injector Bore Protection Sleeve

1. Unit Injector Protection Sleeve, 9998251	2. Unit Injector Bore

4. Install **new** O-rings on the unit injector as follows:
   - Upper ring — large diameter, violet
   - Lower ring — small diameter, violet
5. Lubricate both O-rings and the cylinder head injector bore with clean engine oil.
6. Install a **new** injection nozzle gasket (flat washer) on the injector, using hand force to push it over the tip and down until it is fully seated against the bottom of the injector. DO NOT use grease or any other material to secure the gasket to the injector; the gasket must be installed dry. Three small projections (grippers) on the inside diameter of this gasket retain it to the injector during installation.

11. Check for proper flywheel-to-position sensor clearance using the sensor depth gauge to determine if shims are required for sensor depth. The flywheel position sensor clearance specification is 0.3–1.0 mm (0.0118–0.0393 in.).
    a. Rotate the engine using the flywheel turning tool until a tooth of the flywheel toothed wheel is aligned with the sensor bore.
    b. Insert the tool into the sensor bore until the outer part of the tool is fully seated against the flywheel housing.
    c. Loosen the thumb screw of the tool and push the inner part of the tool until it contacts a tooth of the toothed wheel.
    d. Tighten the thumb screw to secure the inner part of the tool.
    e. Carefully remove the tool from the flywheel sensor bore and observe the location of the steps between the inner and outer portions of the tool:
        - Both steps below the surface of the tool = no shims required.
        - One step below the surface of the tool = one shim required.
        - Both steps above the surface of the tool = two shims required.

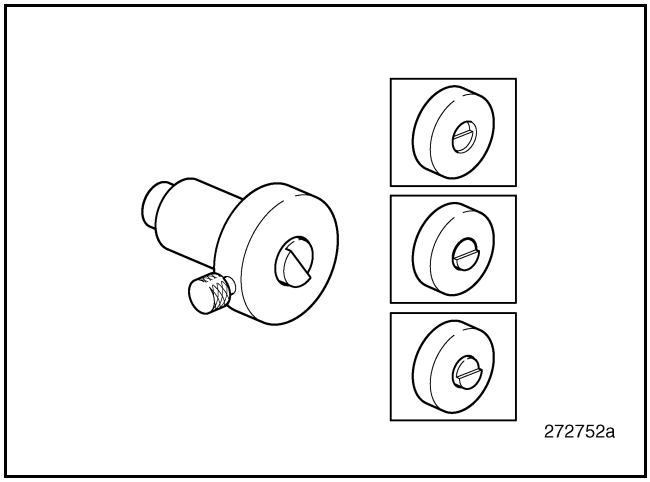


Figure 328 — Depth Sensor Gauge

12. Carefully install the flywheel position sensor with the appropriate shim(s) and **new** O-ring. Secure the sensor with a bolt tightened to specification and plug in the harness connection.

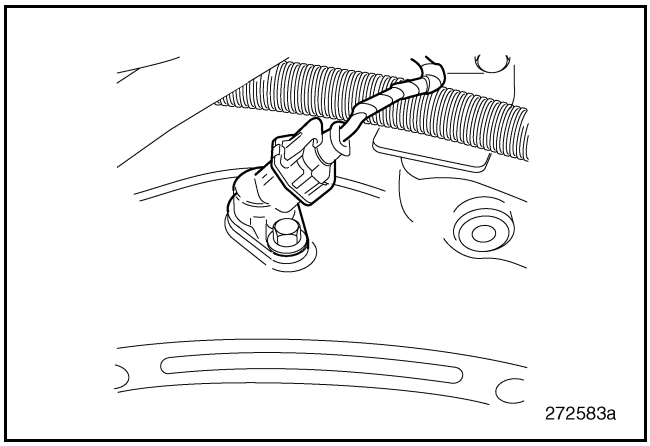


Figure 329 — Flywheel Position Sensor

Oil Pan Installation

[211 NB]

1. Apply a 2 mm (5/64 inch) bead of MACK-approved sealant at the seams between the flywheel housing and the timing gear plate. Also, apply a 2 mm (5/64 inch) bead of sealant at the seams between the timing gear plate and the cylinder block.

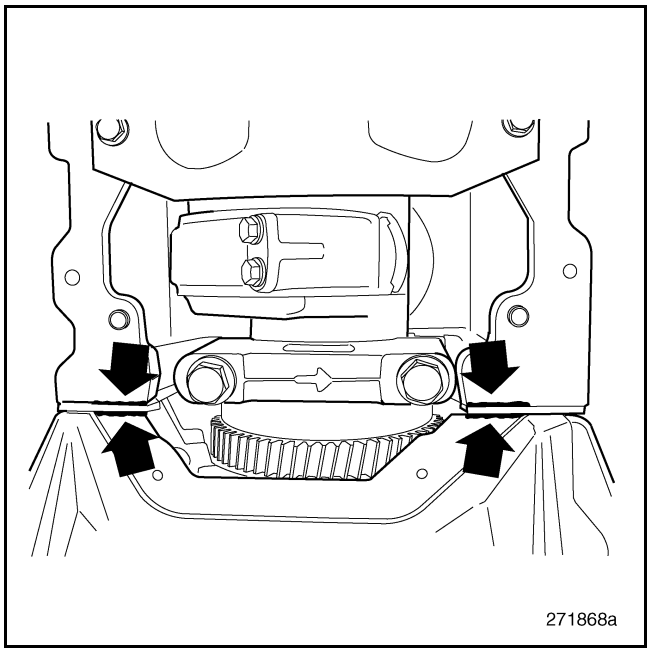


Figure 330 — Sealant Application for Oil Pan — Rear

2. Apply a 2 mm (5/64 inch) bead of MACK-approved sealant to the seam between the front seal cover and the cylinder block.

2. Install two alignment pins — to hold the gasket in place and to aid in the alignment of the housing.

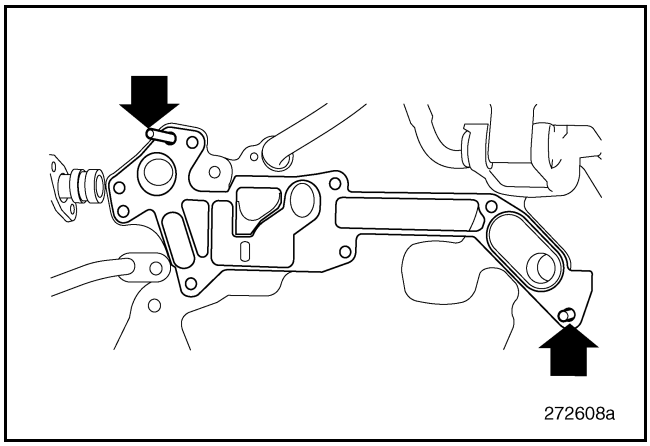


Figure 361 — Alignment Pins and Gaskets

3. Install the gasket to the cylinder block.
4. Install the oil filter housing onto the cylinder block and position the rear pipe. Tighten the fasteners according to specification.
5. Install the fasteners to the rear pipe in the oil filter housing. Tighten the fasteners according to specification.
6. Install the front pipe with **new** seals between the oil filter housing and the cooling duct cover.

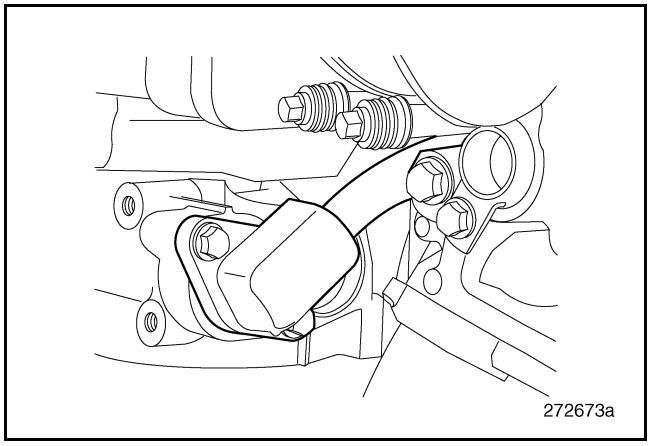


Figure 362 — Front Pipe Installation

7. Install all hard pipes (coolant and oil) to the cooling duct cover. Replace and lubricate all sealing O-rings. Also, replace sealing washers for the banjo fitting on the cooling duct cover. Tighten the banjo fittings according to specification.

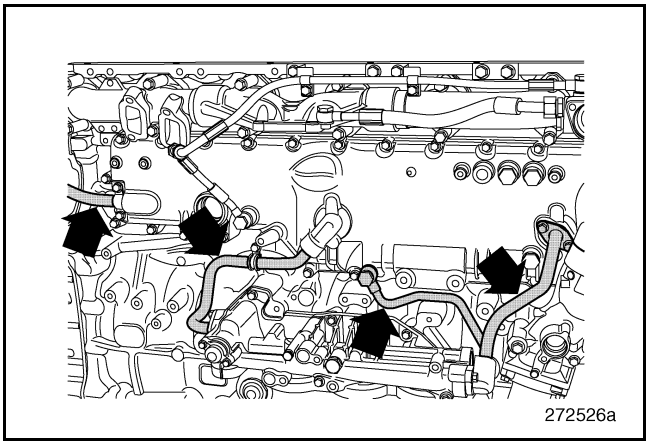


Figure 363 — Oil Cooler Hard Pipes

Exhaust Manifold Installation

[214 EG]

NOTE

The exhaust manifold mounting fasteners can be used five times unless the manifold is being replaced. If the manifold is being replaced, use **new** fasteners.

1. Clean the manifold mounting surface on the cylinder head.
2. Temporarily install an alignment pin at each exhaust manifold flange location on the cylinder head.

NOTE

This is done to hold the manifold while positioning the manifold gaskets for installation of the bolts and spacers.

Air Compressor Installation

[261 CK]

1. Install a **new** seal in the air compressor housing mounting flange.

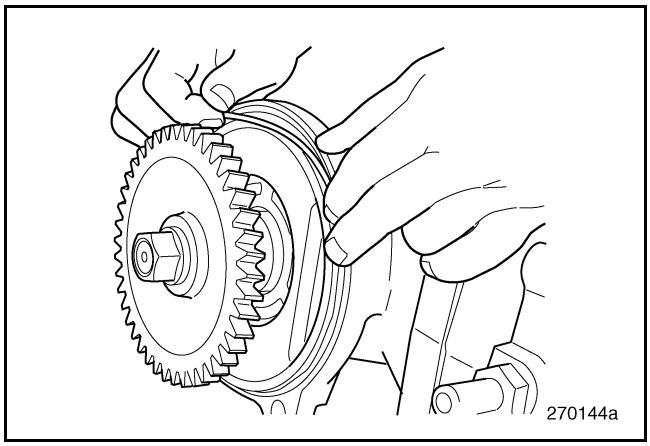


Figure 390 — Installing Air Compressor Mounting Seal

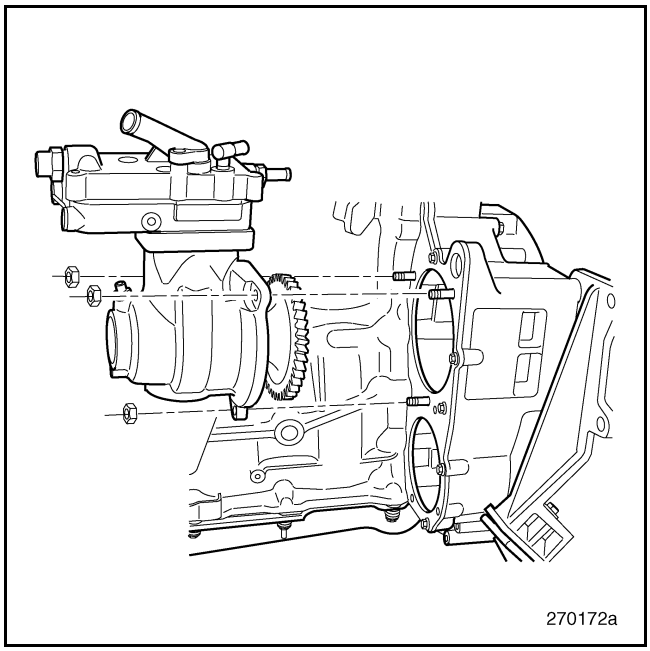


Figure 391 — Air Compressor Installation

2. Assemble the air compressor on the mounting flange of the timing gear plate.

3. Using a torque wrench, tighten the attaching nuts in two stages according to specification.

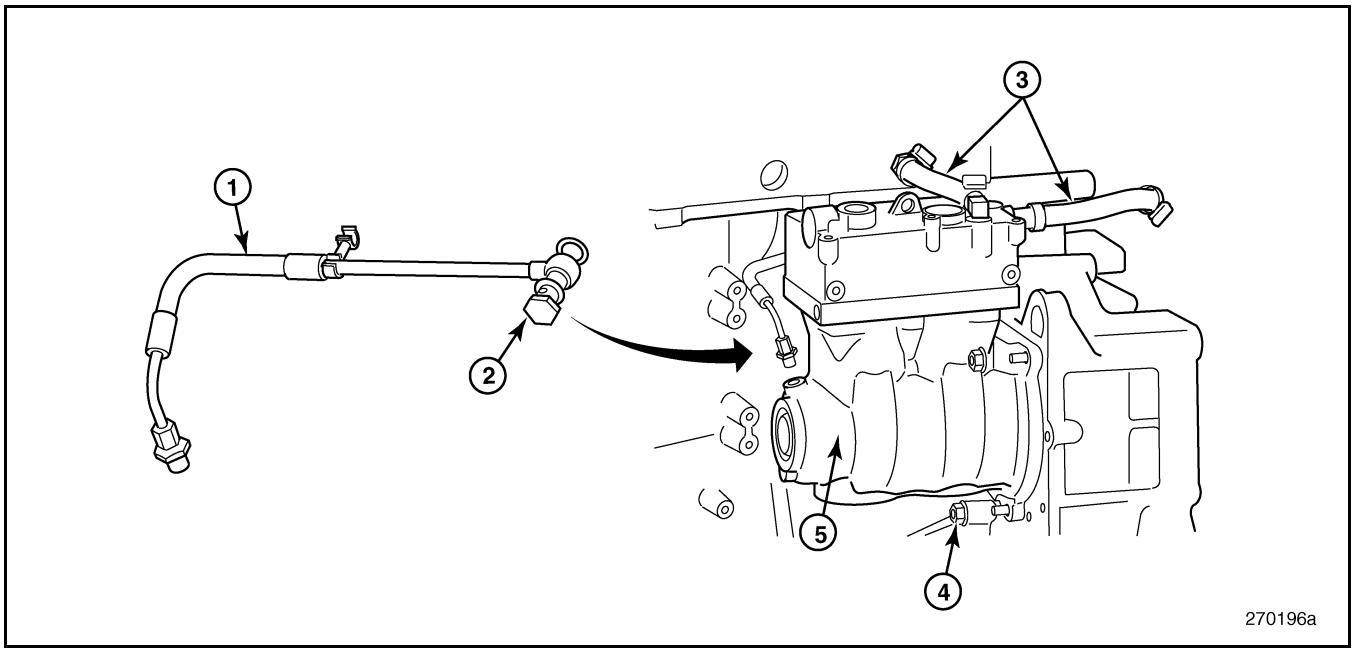


Figure 392 — Air Compressor Coolant and Lubrication Fittings

1. Lubrication Line 2. Banjo Fitting 3. Coolant Lines	4. Attaching Stud and Nut 5. Air Compressor

4. Install the coolant lines to the air compressor.

5. Install the lubrication lines to the air compressor.

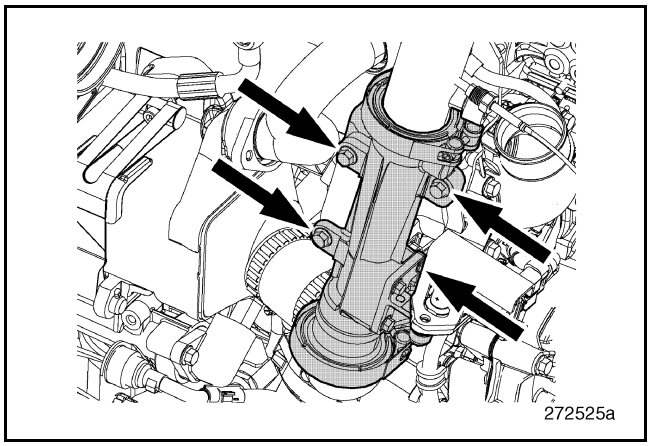


Figure 415 — Venturi Tube

3. Install the retainer strap and fasteners to secure the EGR venturi outlet pipe to the venturi tube mounting bracket.

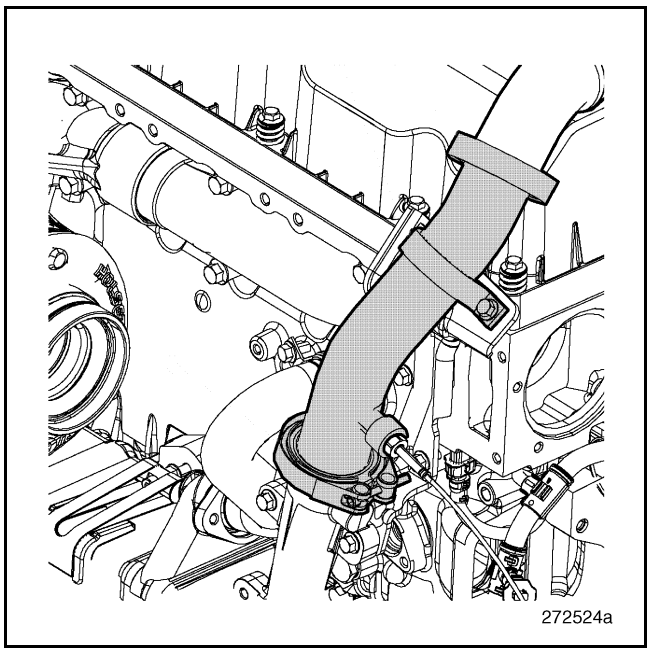


Figure 416 — EGR Venturi Outlet Pipe

4. Install a **new** hose and O-ring on the 90-degree elbow that connects the EGR cooler outlet to the venturi tube.
5. Position the 90-degree elbow with hose to the EGR cooler outlet. Tighten the clamps to secure.

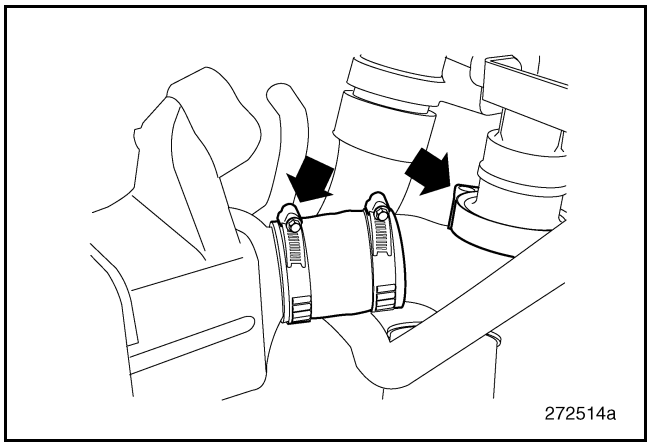


Figure 417 — EGR Cooler Outlet

6. Inspect the venturi tube V-band clamps for wear or damage, and replace as necessary. Position the V-band clamps to the venturi tube inlet and outlet. Lubricate the threads and V-inserts.
7. Tighten the clamps according to specification.

NOTE

Make sure the O-rings remain in place while positioning the pipe.

8. Install a **new** O-ring at the EGR mixer inlet and a **new** O-ring on the crossover pipe clamp flange.

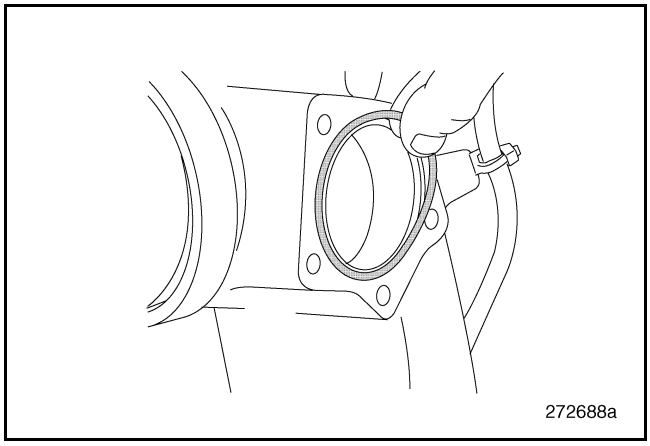


Figure 418 — Mixer Inlet O-Ring

IN-CHASSIS PART/COMPONENT PROCEDURES

This section presents standalone replacement operations which can be done in-chassis without a complete engine overhaul. These operations include:

- CAMSHAFT BEARING BRACKETS, REPLACEMENT
- OIL THERMOSTAT AND PRESSURE SAFETY VALVE REPLACEMENT
- CRANKSHAFT FRONT SEAL REPLACEMENT
- CRANKSHAFT REAR SEAL REPLACEMENT
- CRANKCASE VENTILATION (CCV) SEPARATOR REPLACEMENT
- OIL PUMP REPLACEMENT
- INJECTOR COPPER SLEEVE REPLACEMENT
- TURBOCHARGER SMART REMOTE ACTUATOR (SRA) REPLACEMENT
- UNIT INJECTOR CLEANING
- VALVE STEM HEIGHT MEASUREMENT PROCEDURE
- VALVE STEM SEAL REPLACEMENT

Due to the Engine Electronic Control Unit (EECU) self-learning capability, it is necessary to reset learned EECU parameters after servicing some engine-related components. This allows the EECU to learn the new component's behavior. After servicing is complete, perform the “Learned Data Reset” located in VCADS.

CAMSHAFT BEARING BRACKETS, REPLACEMENT (MACK MP8 ENGINE) [213 CJ]

This information covers guidelines when replacing factory or aftermarket camshaft bearing brackets (lower journals) on the MACK MP8 engine.

Preliminary Steps

The following components need to be removed for access to the camshaft bearing brackets:

- Valve Cover
- Compression Brake Solenoid Valve
- Rocker Arm Shaft
- Camshaft Assembly

General Information

Camshaft bearing journals are numbered 1–7, with matching upper and lower halves. Be sure to note and mark the corresponding journal numbers and install them in the correct sequence with matched upper and lower halves.

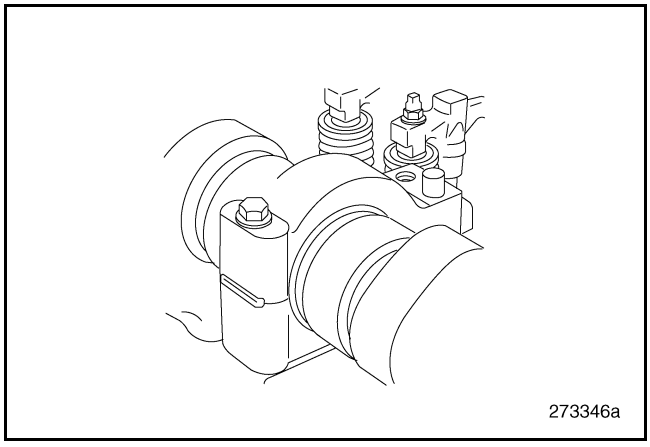


Figure 430 — Camshaft Bearing Bracket Installed

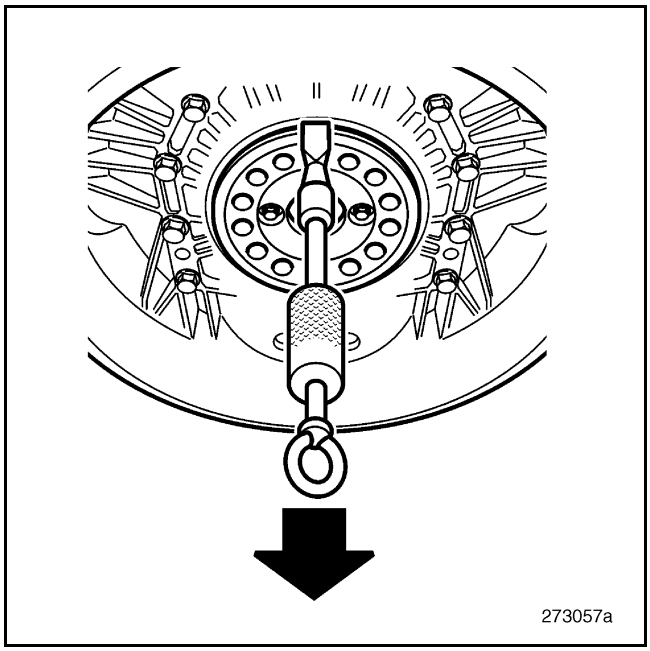


Figure 448 — Removing Crankshaft Rear Seal

6. Tap out the crankshaft rear seal.
7. Thoroughly clean the sealing surfaces of the flywheel, flywheel housing and crankshaft.

Teflon® Seal Installation

1. Install the plate and thrust screw part of tool, 9990166, to the crankshaft. Tighten the assembly screws securely.

NOTE

Make sure that the plate of the tool is positioned properly in the crankshaft internal guide and is flat against the crankshaft before tightening the screws.

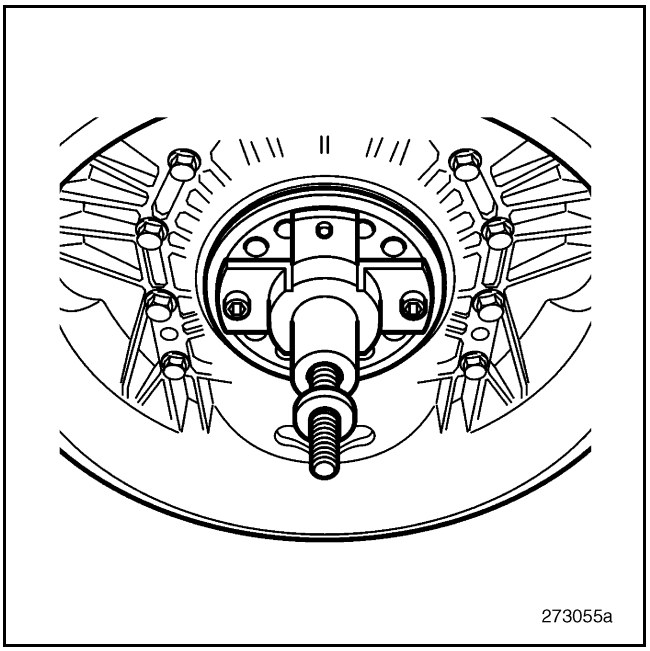


Figure 449 — Install Plate and Thrust Screw Assembly

2. Install the spacer, 88880013, of tool, 9990166, on the thrust screw.

NOTE

The spacer is important because it determines the installation depth of the crankshaft rear seal.

3. The sealing ring is supplied with a plastic installation ring that should be left in place during installation.

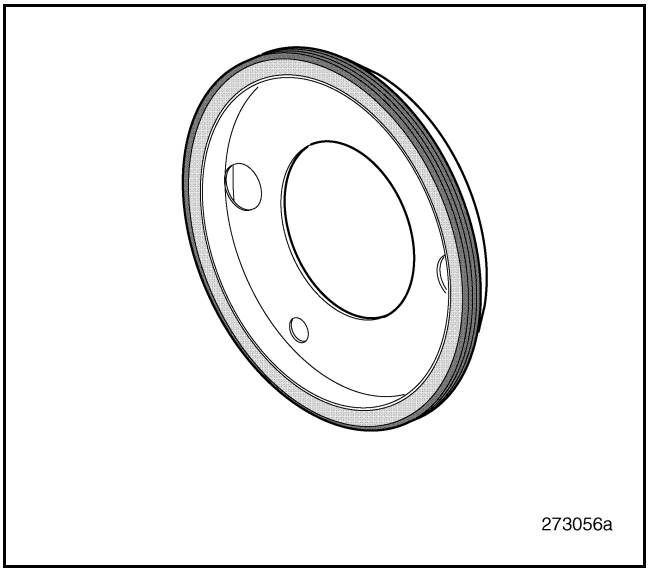


Figure 450 — Crankshaft Rear Seal

9. Install the extractor bolt into the end of the extractor tool. Adjust the bolt until it extends approximately 22 mm (0.9 inch) beyond the end of the tool (dimension A).

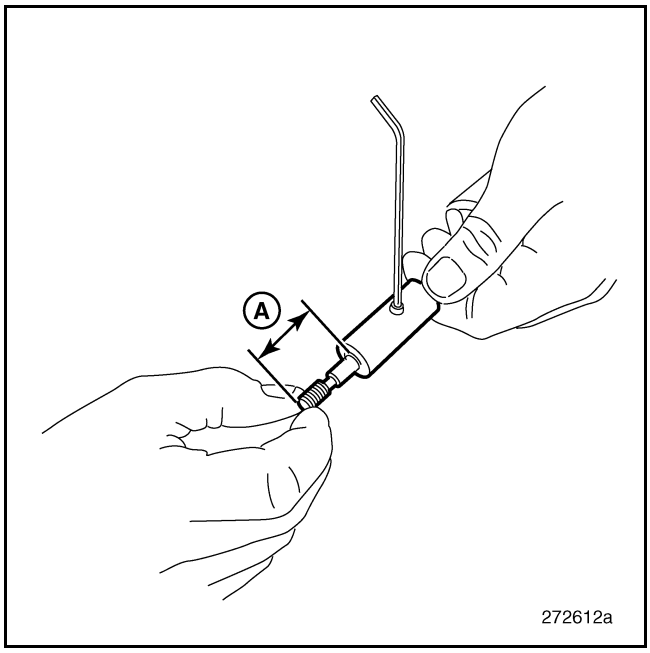


Figure 463 — Adjusting Copper Sleeve Extractor Bolt

10. Tighten the set screw of the extractor tool to secure the bolt. Make sure that the set screw is seated against the flat part of the extractor bolt.
11. Place the extractor tool with the bolt into the injector bore. Make sure the nut on the spindle is backed off so that the threaded end can be completely installed through the copper sleeve tip. Hand tighten until the bolt bottoms out in the sleeve.

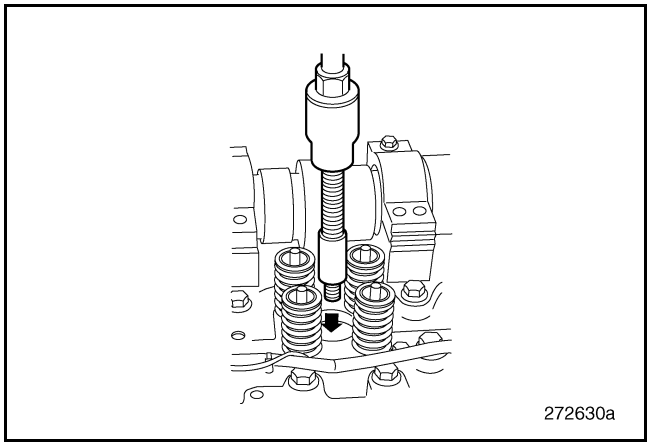


Figure 464 — Extractor Tool Installation

⚠ CAUTION

Make sure the extractor bolt is threaded completely into the copper sleeve before attempting to remove it or the tip of the sleeve may break off as it is removed. This broken sleeve tip can seriously damage the piston, valves or turbocharger.

12. While holding the top of the tool stationary, turn the large nut clockwise to extract the copper sleeve.

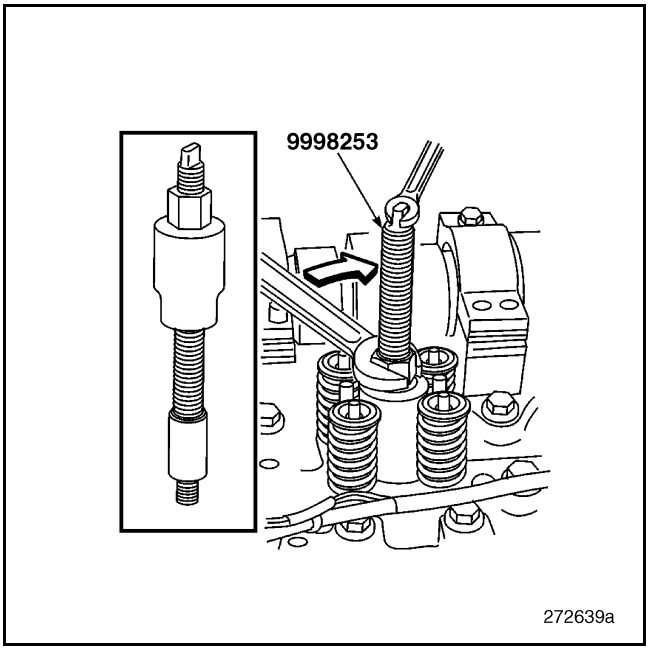


Figure 465 — Copper Sleeve Extraction

NOTE

When the copper sleeve is removed, make sure that the extractor bolt is extended at least one thread beyond the copper sleeve. If not, make sure that no part of the copper sleeve has broken off and fallen into the cylinder.

⚠ CAUTION

Do not use air tools to remove copper sleeves, or damage to the injector bore can result.

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.

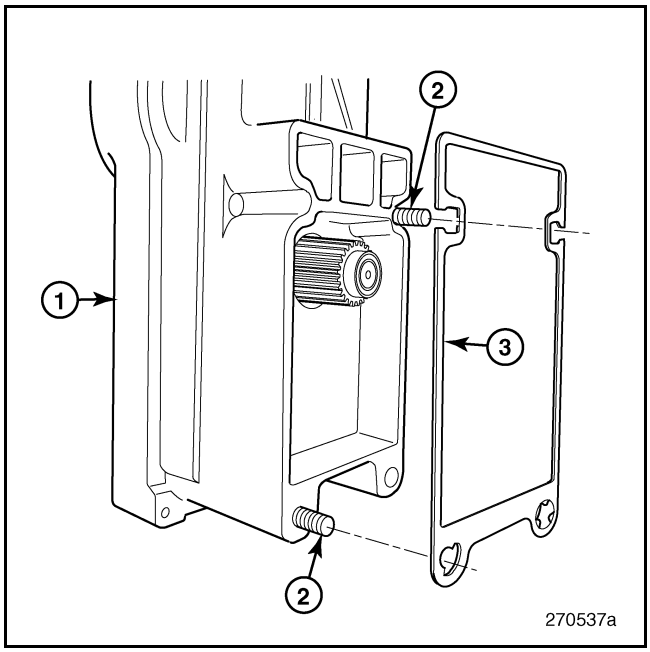


Figure 488 — Attaching SRA to Turbocharger

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.

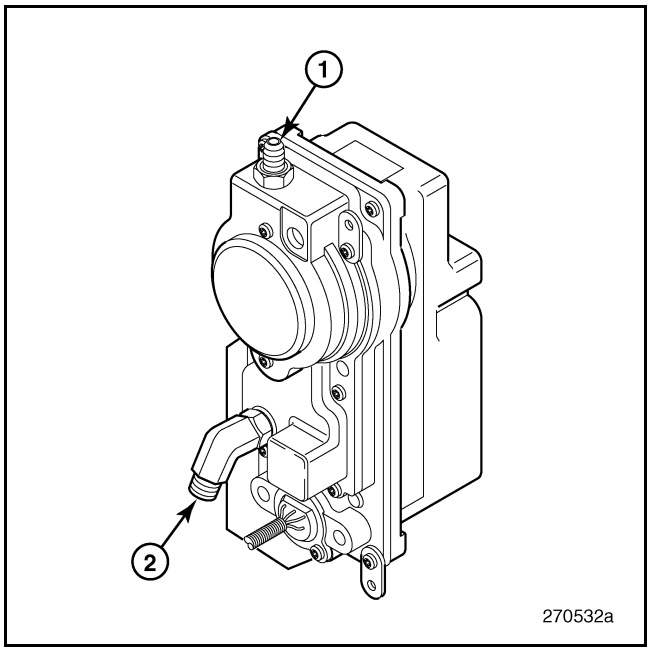


Figure 489 — SRA Coolant Connections

1. Coolant Return Port	2. Coolant Inlet Port

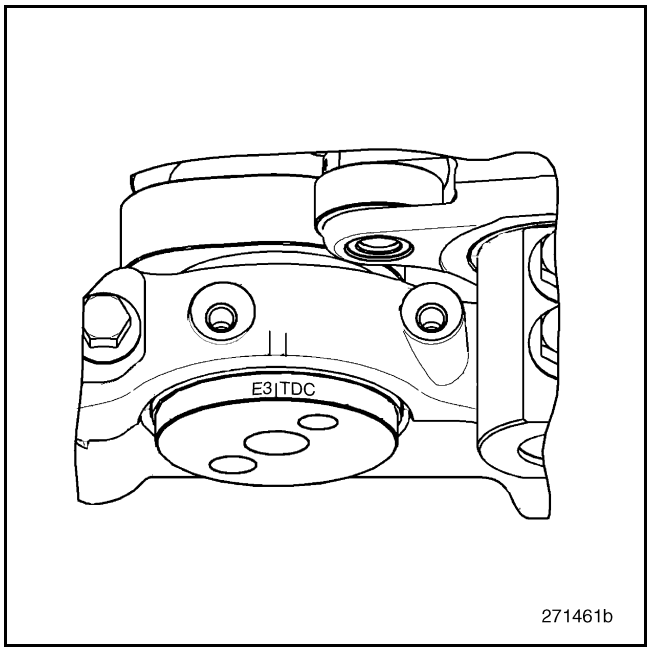


Figure 515 — Camshaft Positioning

7. Loosen and remove the eight screws securing the vibration damper and camshaft gear to the camshaft. Remove the damper from the camshaft, but do NOT remove the camshaft gear.
8. Install the gauge plate tool, J 44514-1A, using **Position B** of the gauge plate tool to secure the camshaft gear to the camshaft and loosely install the two retaining bolts.

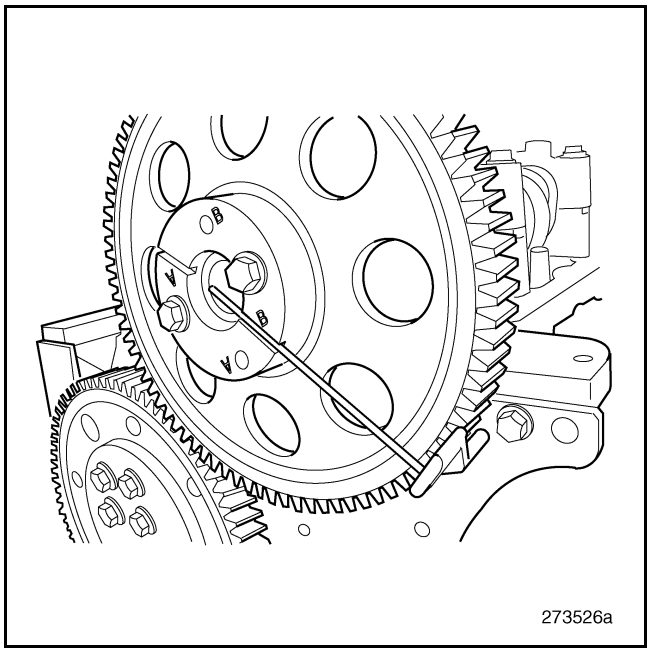


Figure 516 — Camshaft Gear Timing Mark Alignment

9. Insert the camshaft gear alignment tool, J 47450-1, into the hole in the timing gear plate while also engaging into the camshaft gear teeth and place the rod of the tool in the gauge plate slot. It may be necessary to rotate the camshaft slightly until this occurs. With the camshaft gear alignment tool properly positioned in the gauge plate slot, check that the camshaft TDC mark is still positioned between the two timing marks on the No. 1 camshaft bearing cap.
10. Remove the camshaft gear alignment tool, J 47450-1, from the camshaft gear.
11. Insert a 0.1 mm (0.004 inch) thickness gauge on the pressure side of the adjustable idler gear tooth and camshaft gear tooth by using feeler gauge holder J 44935 and J 44514-6 feeler gauge. Tighten the bolts on the adjustable idler gear by hand only.
12. Remove the feeler gauge from the gear teeth.
13. Install the J 44514-5 clamp assembly tool to the timing gear plate. Screw the hold-down against the adjustable idler gear so the adjustable idler gear does not rotate.

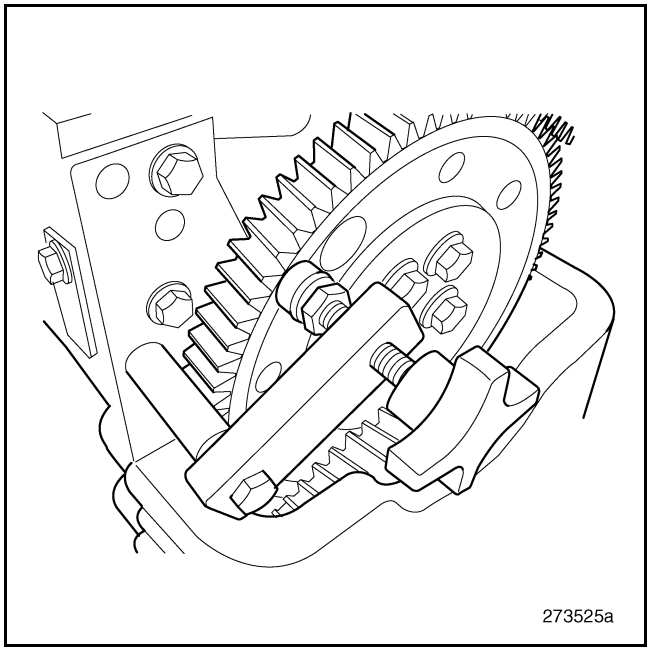


Figure 517 — Clamp Assembly Tool

MP8 ENGINE MECHANICAL SPECIFICATIONS (MP8 Euro 4 Engine)

Material and Dimensional Data

GENERAL DATA, WEIGHTS AND DIMENSIONS

Item	Specification
Engine Type	In-line, direct injection, diesel
Number of Cylinders	6
Displacement	13 L
Bore and Stroke	131 x 158 mm (5.16 x 6.22 in.)
Compression Ratio	16:1
Emissions Level	Euro 4
Fuel System	Electronic Unit Injector
Valve Actuation	Single Overhead Cam, 4 valves per cylinder
Aspiration	Variable Geometry Turbocharger with sliding nozzle ring
Power Cylinder	Wet sleeve; one-piece steel pistons
Electronic Controls	Electronic Management System (EMS)
Emission Control	Cooled EGR
Peak Power Ratings	265–368 kW (360–500 hp)
Peak Torque Ratings	1800–2400 N•m (1000–1500 lb-ft)
Weight, Dry	1200 kg (2646 lb.)
Firing Order	1–5–3–6–2–4
Length Overall	1366 mm (53.8 in.)
Width Overall	971 mm (38.2 in.)
Height Overall	1170 mm (46.1 in.)

COMPONENT FEATURES AND MATERIALS

Item	Description
Air Compressor	Flange mounted, oil lubricated, water cooled
Camshaft	Induction hardened, gear driven
Connecting Rods	Forged steel, cracked cap design
Coolant Conditioner	Spin-on type, disposable
Coolant Pump	Centrifugal rotor impeller, belt-driven
Crankshaft	Drop forged steel, induction hardened, seven main bearings
Cylinder Block	In-line six cylinder; wet, replaceable cylinder liners; cast iron, machined with bearing caps, stiffener plate added at bottom, timing gear plate added at rear
Cylinder Head	One-piece cast iron alloy; supports overhead camshaft, four valve system, unit injectors; replaceable cast iron valve guides with oil seals; replaceable steel valve seats; copper unit injector sleeves; integral fuel passages; integral thermostat housing

Cylinder Head

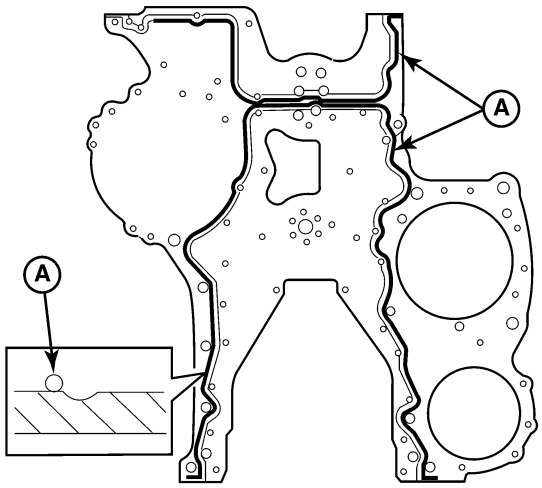


Figure 526 — Sealant Application Pattern — Head to Plate

Remove all old sealant before attempting to apply new sealant. Apply a 2 mm (5/64 inch) bead of 342SX33 MACK-approved sealant to the timing gear plate following the pattern shown. Attach the cylinder head to the timing gear plate within 20 minutes of applying the sealant.

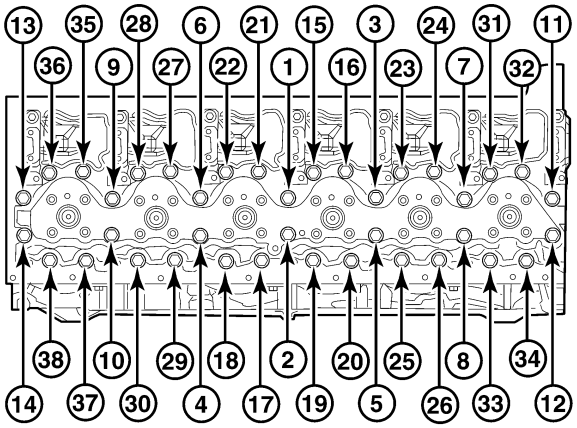


Figure 527 — Torque Sequence Screw Numbers — Head to Block

Discard screws with four marks when removed and substitute new screws. Tighten the screws in the order indicated by the numbers in the graphic.	
Step 1.	100 ±5 N•m (74 ±4 lb-ft)
Step 2. Verify	100 ±5 N•m (74 ±4 lb-ft)
Step 3. Angle tighten	120° ±5°
Step 4. Angle tighten	90° ±5°

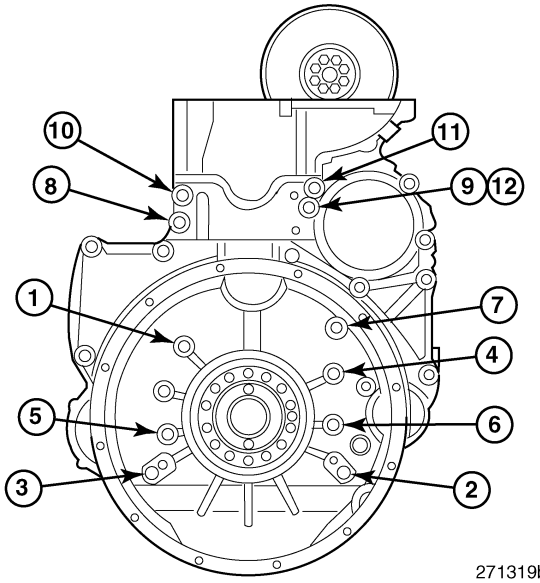


Figure 541 — Torque Sequence — M14 and M10 Screws (Housing to Plate and Block)

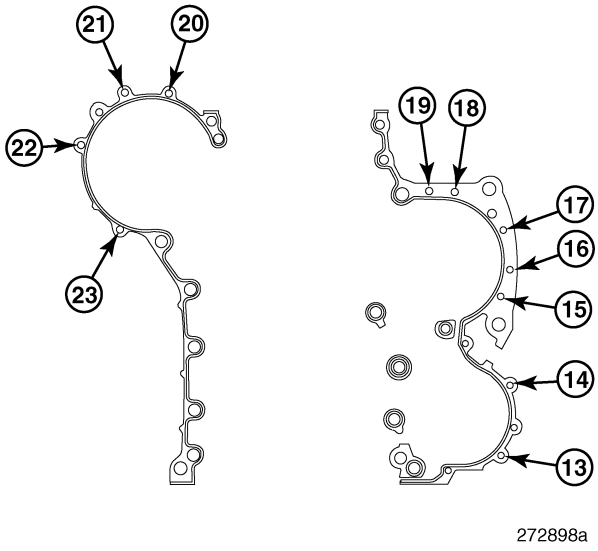


Figure 542 — Torque Sequence — M8 Screws (Plate to Housing)

Tighten the screws in the order indicated according to the following torque values.	
Step 1. M14, M10 and M8 screws	24 ±4 N•m (18 ±3 lb-ft)
Step 2. M14 screws, 1–8	140 ±20 N•m (103 ±15 lb-ft)
Step 3. M10 screws, 9–12	48 ±8 N•m (35 ±6 lb-ft)
Step 4. M8 screws, 13–23 (front of timing gear plate-to-flywheel housing)	24 ±4 N•m (18 ±3 lb-ft)

Low Pressure Fuel Circuit

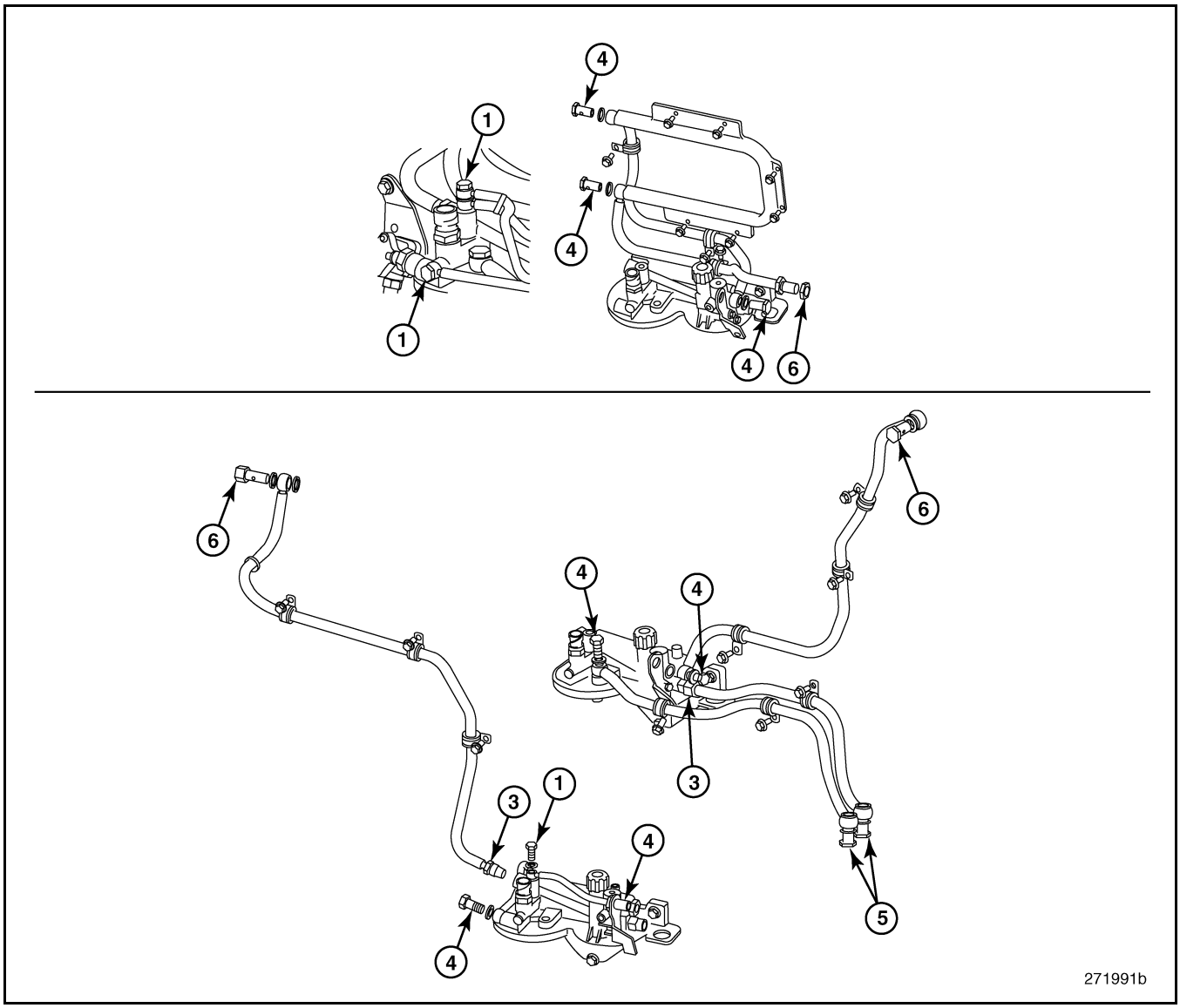
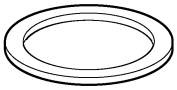
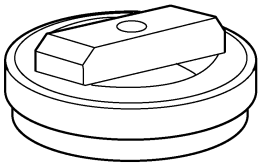
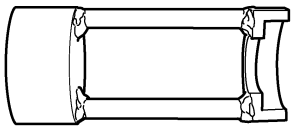
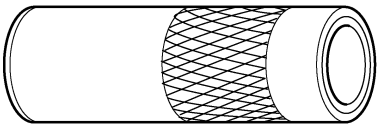
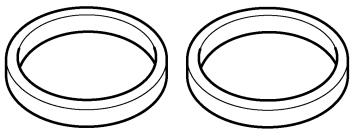
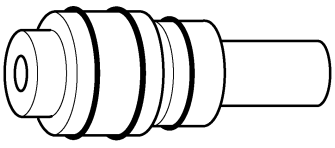
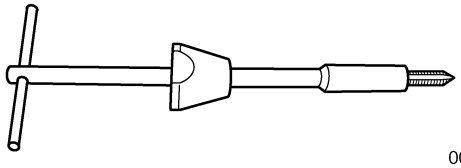


Figure 557 — Screw Number Identification for Torquing — Fuel Circuit

Filter Bracket Attaching Screws, M8 x 1.25	24 ±4 N•m (18 ±3 lb-ft)
No. 1	18 ±3 N•m (13 ±2 lb-ft)
No. 3	30 ±4 N•m (22 ±3 lb-ft)
No. 4	35 ±5 N•m (26 ±4 lb-ft)
No. 5	40 ±5 N•m (29.5 ±4 lb-ft)
No. 6	48 ±5 N•m (35 ±4 lb-ft)

Tool No.	Description	Image
9998170	Seal Spacer (Essential)	 006947a
9998238	Rear Main Seal Remover/Installer for neoprene type seals, use with 9992000 (Essential) **Note:** For Teflon® seals, use tools 9990166, 9990192 and 9996400.	 006780a
9998246	Valve Spring Compressor Adapter (Available)	 006797a
9998249	Unit Injector Protection Sleeve (Essential)	 006798a
9998250	Fuel Gallery Sealing Rings (Available)	 006799a
9998251	Unit Injector Bore Sealing Plug (Essential)	 006800b
9998252	Unit Injector Sleeve Tap (to thread nose of cup) (Essential) This tool comes with both M8 x 1.25 (part No. 9987009) and M9 x 1.25 (part No. 9809667) taps. Use the larger of the two taps, M9 x 1.25 (part No. 9809667), when servicing an MP8 engine.	 006801a