

V8 ENGINE - MAINTENANCE & REBUILD

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V8 ENGINE MAINTENANCE & REBUILD

GENERAL DESCRIPTION

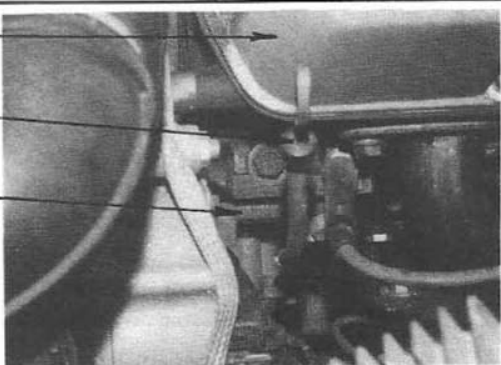
The 5.0 litre V8 is a High Output, Electronic Fuel injection, engine of 4988 CC capacity. It is a conventional cast iron 90° V8 engine, having a block mounted camshaft, over head valve, which operates the valves through push rods and rockers. The hydraulic valve lifters are non-adjustable.

ENGINE MAINTENANCE

Engine No. Location

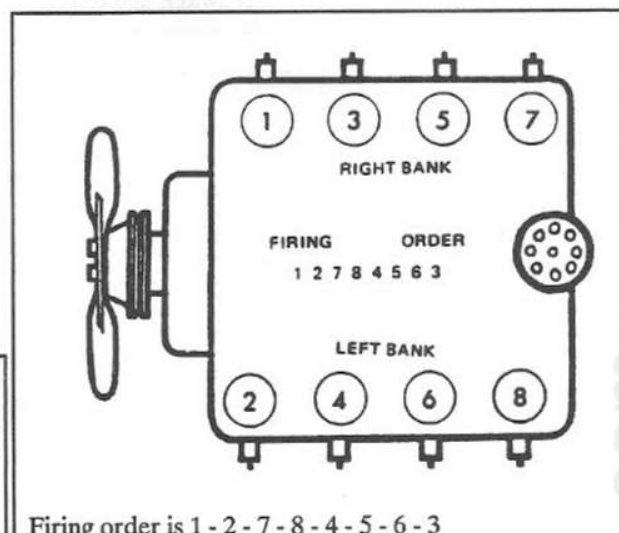
On the left hand side engine block casting near the front.

Rocker Cover
Dip Stick
Engine Number



Engine Firing Order

Firing order is 1 - 2 - 7 - 8 - 4 - 5 - 6 - 3

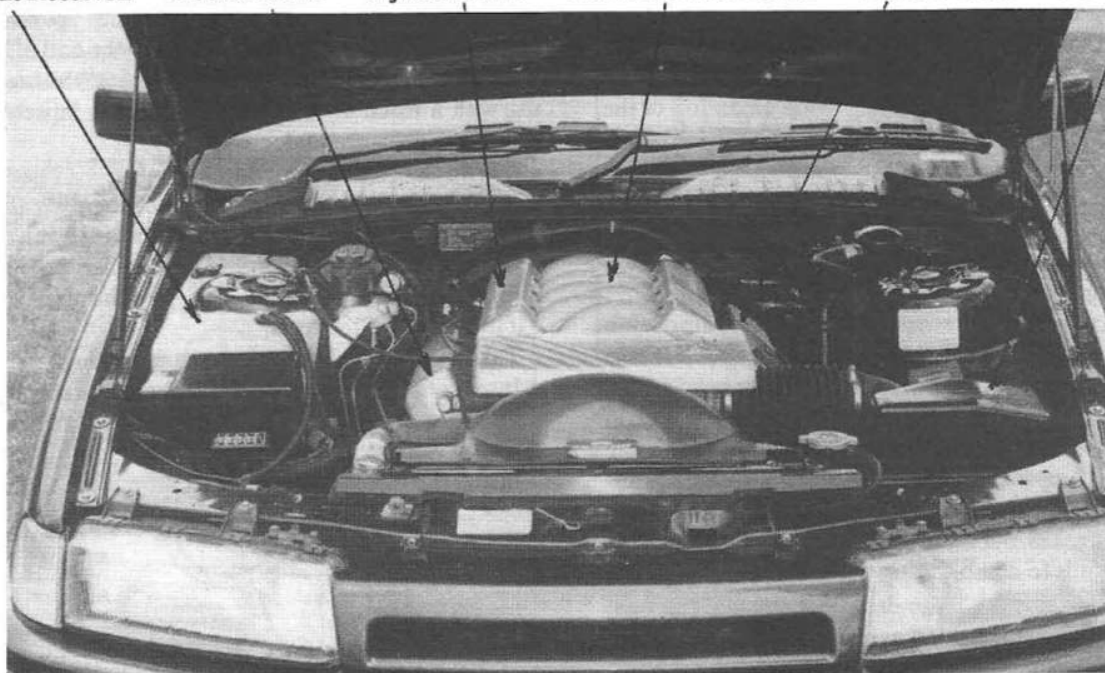


Firing order is 1 - 2 - 7 - 8 - 4 - 5 - 6 - 3

Compression Test

1. Make sure the engine sump oil is at the correct level. Run the engine until it is at normal operating temperature. Remove the spark plugs.

Coolant Reservoir Rocker Cover Injector Cover Intake Manifold Cover Rocker Cover Air Cleaner



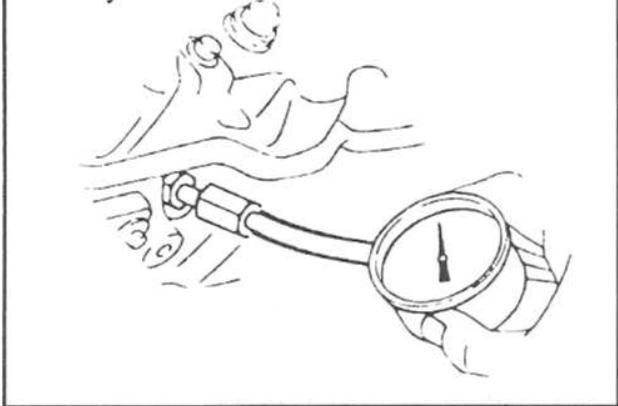
2. Remove the start relay adjacent to the battery. Attach an auxiliary starter switch between the battery and starter solenoid terminals of the relay socket.

* Ensure that the ignition switch is 'off' for the entire test.

3. Set the throttle plates and choke plate in the wide open position. Remove the spark plugs and install a compression guage in No. 1 cylinder. Crank the engine at least five pumping strokes, using an auxiliary starter switch and record the highest guage test.

4. Repeat the test on each cylinder to obtain the highest reading. Detach the auxiliary starter switch and refit the starter relay.

Remove the spark plugs and install a compression guage in No. 1 cylinder.



Test Conclusions

The test pressure should fall within the band specified and the compression of all cylinders should be uniform within 100 kPa.

Excessive deposits in the cylinder or wrong cylinder head on the engine is indicated by a reading of more than the allowable tolerance above normal.

A reading of more than the standard tolerance above average shows leakage at the cylinder head gasket, piston rings or valve or wrong cylinder head on the engine.

Squirt about one tablespoon of engine oil on top of the pistons if one or more cylinders read low. Repeat compression pressure check on these cylinders.

a. The piston rings are at fault if compression improves remarkably.

b. Valves are sticking or seating faulty if compression does not improve.

c. If two adjacent cylinders indicate low compression pressure and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders. Engine oil and/or coolant in the cylinders could result from this problem.

During a compression test, if the pressure fails to increase steadily and stays the same during the first two successive strokes, but increases higher on the succeeding strokes, or fails to climb during the entire test, it shows a sticking valve.

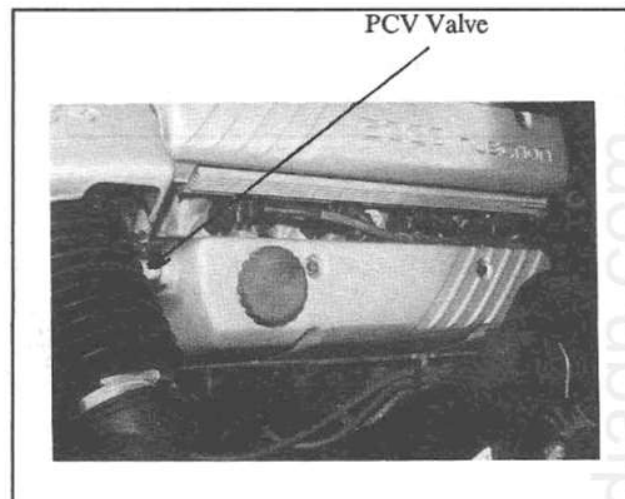
Positive Crankcase Ventilation System

Rough engine idle may indicate a malfunctioning positive crank-case ventilation system. Do not compensate for this faulty idle condition by detaching the crankcase ventilation system and/or making adjustments. The removal of the crankcase ventilation system from the engine will adversely alter the fuel economy and engine ventilation with resultant shortening of engine life.

Check PCV System Function

1. With the engine running-

(a) Take the PCV valve out from its mounting. A hissing air noise will occur as the air passes through the valve, if the valve is operating accurately and not plugged, and a strong vacuum should be felt when a finger is placed over the valve inlet. Check for vacuum leaks in the hose line and the connections whilst the finger is over the valve inlet.



(b) Install the PCV valve, and take out the crankcase are inlet hose at the air cleaner connection. Hold a small piece of stiff paper over the opening at the end of the inlet hose. The paper should be sucked against the hose opening with a force after adequate time has lapsed for the crankcase pressure to decrease.

2. With the engine stopped-

(a) Take the PCV valve out from its mounting and shake it. A metallic clicking noise will indicate the valve is free.

The system is operating and no further service is required if the ventilation system passes the above test.

If it fails any of the tests:

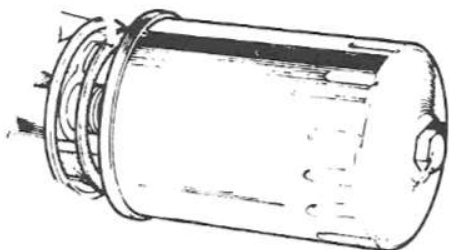
Take the PCV valve out from its mounting.

Inspect the hose from the valve for internal contamination, splits, cracks or deterioration. If serviceability is doubtful replace any hose.

Install the valve in its mounting.

Oil Filter Replacement

Oil Filter



Put a drip pan beneath the filter. Remove the filter from the adaptor fitting. Clean the filter adaptor recess and the gasket surface of the block.

Cover the gasket on the replacement filter with oil. Place the filter on the adaptor fitting. Hand tighten the filter until the gasket contacts the block face, then move it 3/4 turn.

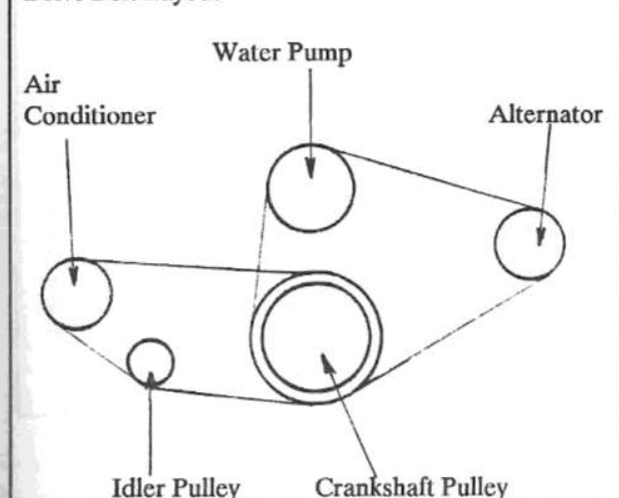
Run the engine at fast idle and inspect for oil leaks. If the oil leaks are visible repair the leakage. Check the oil level and add if required.

REPLACE DRIVE BELT and ADJUST BELT TENSION

Air Conditioner Drive Belt

1. Loosen air conditioning compressor drive belt idler pulley clamp nut, relieve the tension on the drive belt.
2. Remove the belt if belt is to be removed.

Drive Belt Layout



3. Install new drive belt (if applicable) on crankshaft, air conditioner and idler pulleys.

4. Use the idler pulley adjusting bolt to achieve specified belt tension, then tighten clamp nut to specified torque.

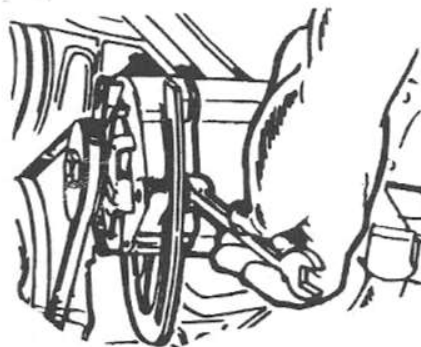
Air conditioner compressor belt tension

64kg New 43 kg used.

Idler pulley clamp nut torque 40-50Nm

Water Pump, Power Steering Pump & Alternator Drive Belt

Loosen alternator clamp nut

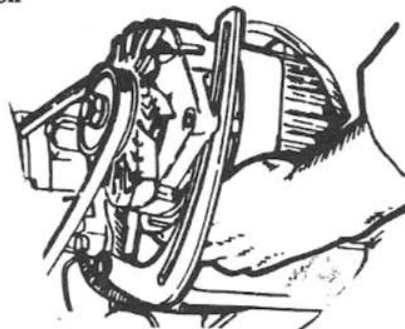


1. Loosen alternator clamp nut, relieve the tension on the drive belt.

2. Remove the belt if belt is to be removed.

3. Install new drive belt (if applicable) on crankshaft, power steering pump and water pump pulleys.

Use the alternator clamp bolt to achieve specified belt tension



4. Use the alternator clamp bolt to achieve specified belt tension, then tighten clamp nut to specified torque.

Power steering pump belt tension

57 kg New 34 kg Used

Power steering pump attaching bolts & nut 20-28 Nm

Alternator/water pump belt tension

57 kg New 34 kg Used

Alternator upper attaching bolt

and nut torque specification

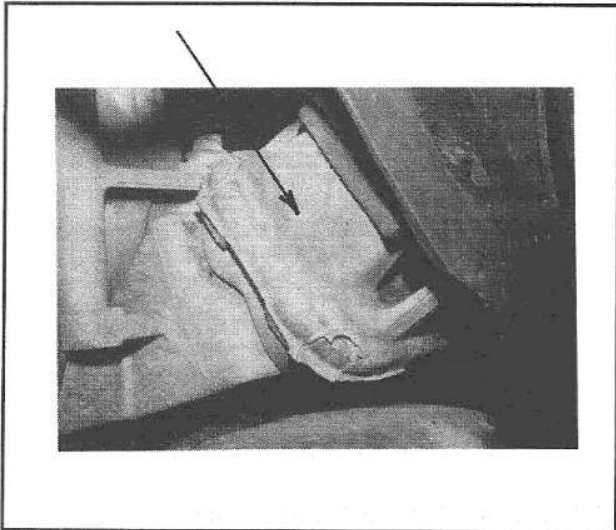
34-44 Nm

Alternator lower attaching bolt torque

12-16 Nm

Engine Front Supports**Remove**

1. Take the fan shroud out attaching screws. Support the engine using a jack with a block of wood to protect the oil pan.
2. Remove the engine mount to sub-frame retaining nuts. Remove the engine to transmission brace. (Right side only).
3. Remove the insulator bracket to engine bolts. Remove the insulator and bracket assemblies. Remove the insulator from the bracket.

**Install**

1. Assemble the insulator to the engine bracket. Place the assembly on the engine and install the securing bolts.
2. Make sure the engine mount studs are correctly placed in the sub-frame and install retaining nuts.

Engine mount to engine bracket nuts torque specification: 20-30Nm

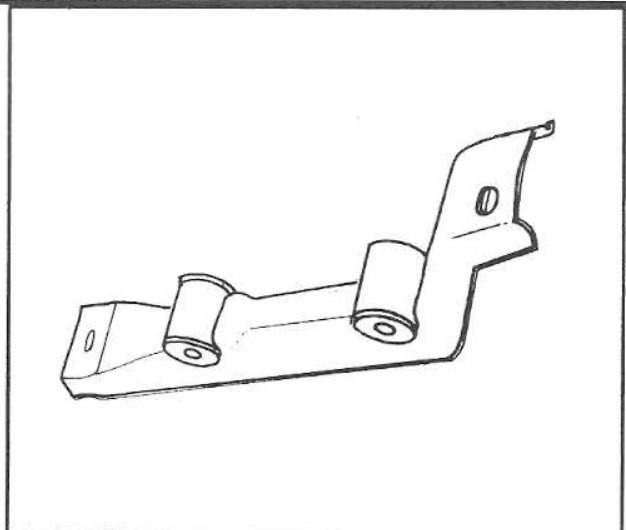
- All other engine mount nuts and bolts torque:** 35-45Nm
3. Remove the support from under the oil pan. Lower the vehicle and install shroud attaching screws.

Engine Rear Support**Remove**

1. Prop the transmission with a floor jack to ease weight from the supporting crossmember.
2. Take the retaining nuts and washers out, from the supporting crossmember, and remove the supporting crossmember.
3. Take the bolts and washers out which retain the engine rear support insulator assembly beneath the transmission. Take the insulator assembly out.

Install

1. Position the engine rear support insulator assembly in place under the transmission, and install the retaining bolts and washers.
2. Position the supporting crossmember and install the retaining washers and nuts.



Rear Engine mount bolts torque specification: 35-45Nm

3. Remove the supporting floor jack out.

Crankcase Ventilation System**Remove**

Remove the ventilation system closure tube from the throttle body and RH rocker cover.

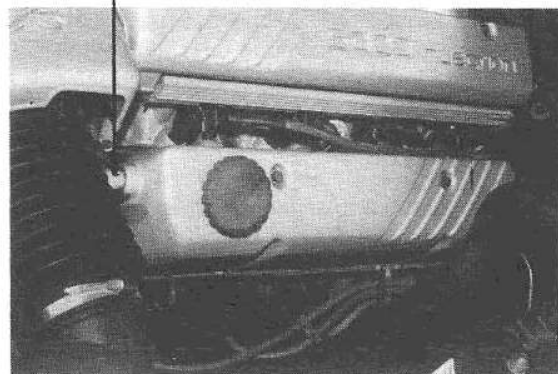
Pull the PCV valve out of the tube behind the throttle body at front of intake manifold. Detach the vent hose from the PCV valve and the throttle body, and the hose between the LH rocker cover and PCV valve.

Install

1. Insert the PCV valve into the tubes at the behind the throttle body in front of intake manifold. Connect the vent hose to the PCV valve and the throttle body, and the hose between the LH rocker cover and PCV valve.

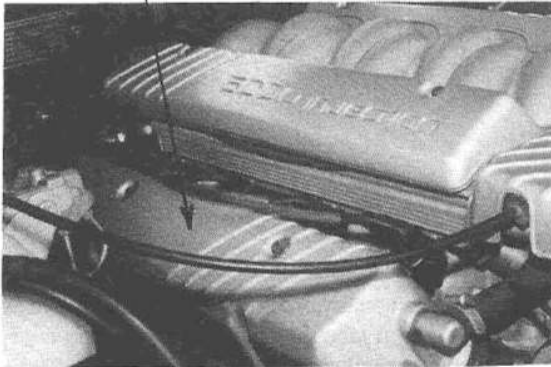
2. Start the engine and inspect for leaks.

Detach PCV tube from front of rocker cover.



Valve Rocker Arm Cover (Rocker Cover) and Rocker Arm Remove

Valve Rocker Arm Cover (Rocker Cover)



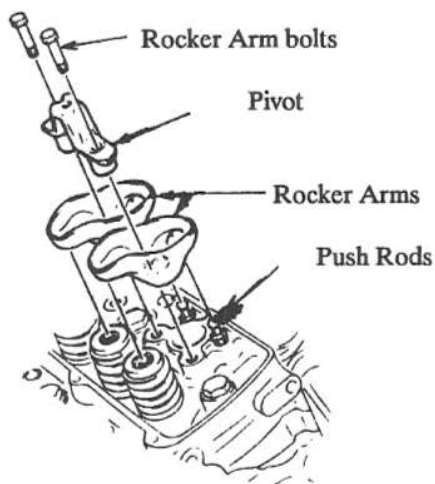
1. Detach the spark plug wires from the spark plugs using Spark Plug Wire Remover or equivalent. Do not pull on the wire. Remove the wires and bracket assembly from the rocker arm cover attaching stud and place the wires out of the way.

2. Remove rocker cover attaching bolts.

3. Remove a valve rocker arm cover from the RH cylinder head, detach breather tube from front of rocker cover. Remove the left side rocker arm cover detach the PCV valve tube from the front of the rocker cover.

4. Remove the valve rocker arm fulcrum bolts, fulcrum seat and rocker arm.

Remove the valve rocker arm fulcrum bolt, fulcrum seat and rocker arm.



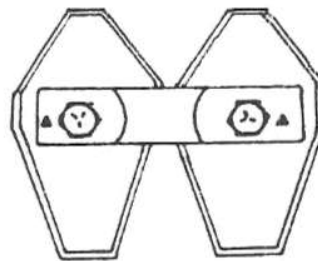
Install

Prior to installation, all rocker arms and fulcrum seats are to be lubricated with engine oil.

1. Place Multi-Purpose Grease to the top of the valve stem and underside of the fulcrum seats. Check the fulcrum bolts for damage.

2. Turn the crankshaft until the tappet is on the cam base circle (all the way down), and install the rocker arm, fulcrum seat and fulcrum bolt. Ensure the arrows on the rockers arms are positioned correctly. Tighten bolts to specified torque.

Ensure the arrows on the rockers arms are positioned correctly



Rocker Arm Pivot bolts torque specification: 25-32Nm.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Position a new service valve rocker cover gasket.

4. Position the cover(s) on the cylinder head(s). Then tighten the bolts to the specification. Install the crankcase breather tube in the RH cover and the PCV tube into the LH rocker cover.

Rocker Cover bolts torque specification: 8-10Nm.

5. Install upper intake manifold. Install the spark plug leads and bracket assembly on the rocker arm cover attaching stud. Connect the spark plug wires.

6. Start engine and inspect for leaks.

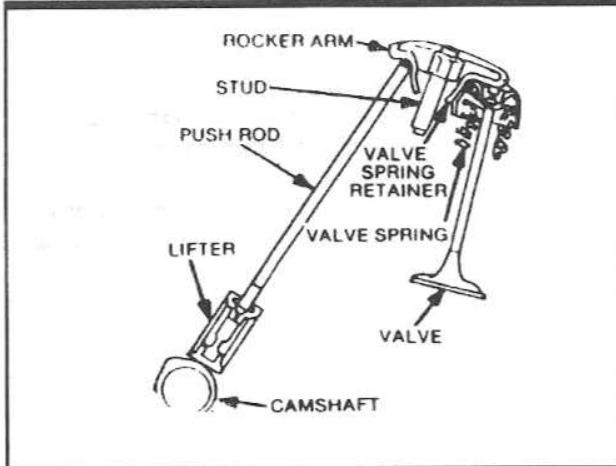
Valve Spring, Retainer and Stem Seal

Provided damage has not occurred, broken valve springs or damaged valve stem seals and retainers may be replaced without removing the cylinder head.

Remove

1. Take the valve rocker arm off and remove the applicable spark plug. Check that the piston is at the top of its stroke with both valves closed to prevent accidental dropping of the valve into the cylinder.

2. Install an air line with an adaptor in the spark plug hole and turn on the air supply. Failure of the air pressure to hold the valve(s) closed while performing the following steps is an indication of valve or valve seat damage and necessitates removal of the cylinder head.



3. Remove the valve rocker arm fulcrum bolts, fulcrum, rocker arm, fulcrum guide and push rods from the applicable cylinder and note their positions so they can be installed in their original positions.

4. Install the fulcrum bolt and position the Valve Spring Compressor. Compress the valve spring and remove the retainer collets, sleeve, spring retainer and valve spring. Remove and throw away the valve stem seal.

Install an air line with an adaptor in the spark plug hole.



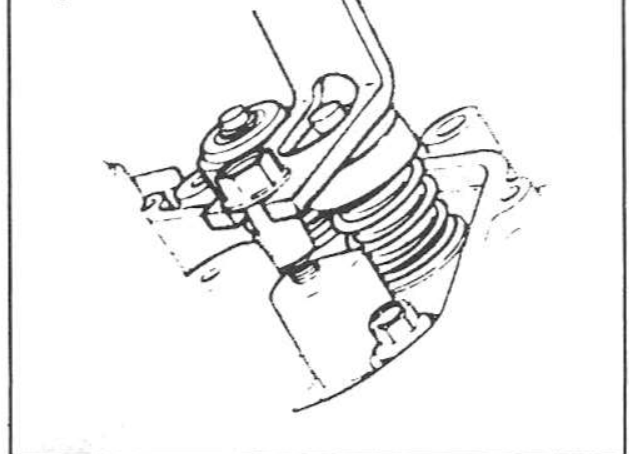
5. If the air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this from happening but will still allow enough travel to check the valve for binding.

Install

1. Take the air pressure out from the spark plug adaptor. Check the valve stem for damage. Turn the valve and check the valve stem tip for eccentric movement during turning. Move the valve up and down through normal travel in the valve guide and check the stem for binding. If the valve has been damaged, remove the cylinder head for service.

2. Apply engine oil to the valve stem if the condition of the valve is suitable and hold the valve closed. Apply the air pressure within the cylinder.

Install the fulcrum bolt and position the Valve Spring Compressor



3. Install new exhaust valve stem seals. Use Valve Stem Seal Installer Kit. Place the spring into position over the valve and install the valve spring retainer collets. Remove the compressor tool and fulcrum bolt.

4. Remove the air line and adaptor after turning the air pressure off. Install the spark plug and tighten to specification.

Spark Plug torque specification: 20-34Nm

5. Both ends of the push rods apply Multi-Purpose Grease. Install the push rods. To the tip of the valve stems apply the same grease or equivalent.

6. Apply Multi-Purpose Grease to the push rod socket, underside of the fulcrum seat and the valve pad of the rocker arm. Install the valve rocker arms, fulcrum seats and fulcrum bolts. Tighten bolts to specification.

Rocker Arm Pivot bolts torque specification: 25-32Nm.

7. Clean and install rocker arm cover using a new service gasket. If the RH cover was removed, install the closure tube. Install valve cover and tighten cover screws to specification.

Rocker Cover bolts torque specification: 3-6Nm.

8. Start the engine and inspect for leaks. Install intake manifold cover.

Exhaust Manifolds

Remove

Left Hand Manifold:

1. Remove exhaust manifold flange nuts. Remove the oxygen sensor wiring.

2. Detach spark plug leads.

3. Remove exhaust manifold retaining bolts, pull manifold from engine. Remove manifold to cylinder head gasket.

Install

1. Clean manifold and cylinder head mating surfaces. Position exhaust manifold and gasket to cylinder head.

2. Install retaining bolts and torque to specification. Replace the oxygen sensor wiring.

Exhaust Manifold nuts torque specification: 20-28Nm

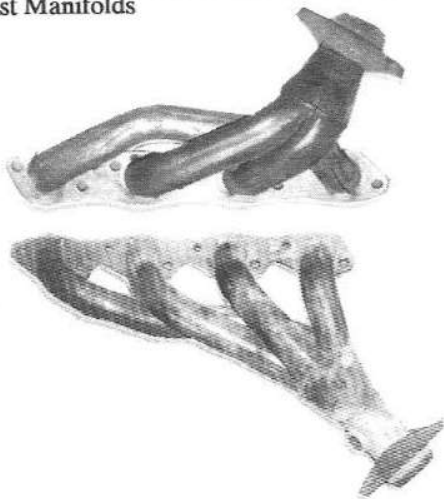
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3. Refit and connect spark plug leads.
4. Install exhaust pipe to exhaust manifold flange nuts and torque to specification.

Exhaust Pipe to Manifold torque spec: 15-35Nm

Exhaust Manifolds

*Right Hand Manifold:***Remove**

1. Detach battery leads and remove exhaust manifold flange nuts.
2. Detach the spark plug leads.
3. Remove exhaust manifold retaining bolts, withdraw manifold upwards from vehicle. Remove manifold to cylinder head gasket.

Install

1. Clean manifold and cylinder head mating surfaces. Position exhaust manifold and gasket to cylinder head.

2. Install retaining bolts and torque to specification.

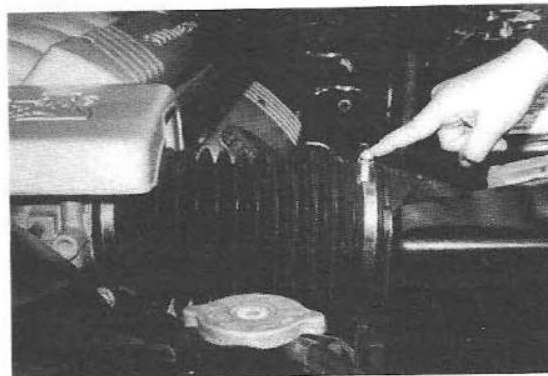
Exhaust Manifold nuts torque specification: 20-28Nm

3. Refit and connect spark plug leads.

4. Install exhaust pipe to exhaust manifold flange nuts and torque to specification. Reconnect battery leads.

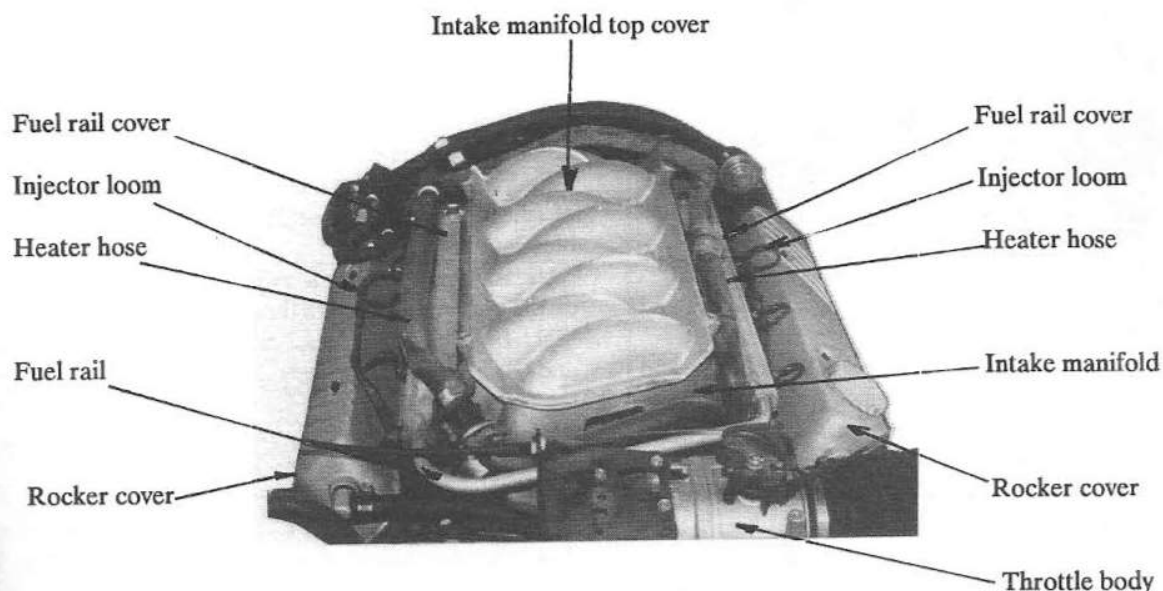
Exhaust Pipe to Manifold torque spec: 15-35Nm

Remove air cleaner to throttle body air intake tube.

**Intake Manifold****Remove**

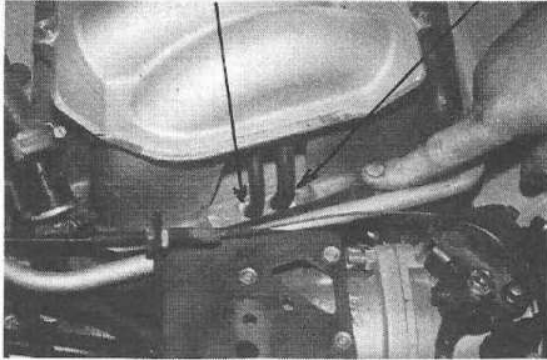
1. Detach battery and remove the intake manifold cover.
2. Remove air cleaner to throttle body air intake tube.
3. Detach accelerator, T.V. cable and cruise control cables.

Intake Manifold



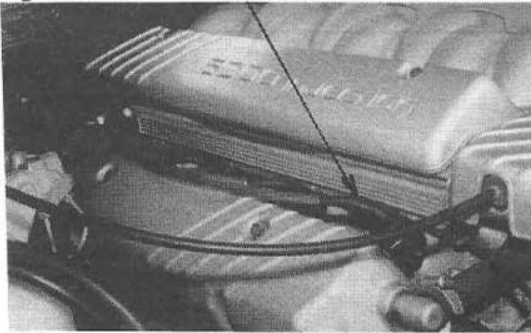
4. Drain engine coolant.
5. Detach coolant hose and coolant by-pass hose from intake manifold.
6. Detach breather PCV pipe from throttle body and valve rocker cover.
7. Detach ECM, MAT and temperature sensor wiring connectors, MAP & Fuel regulator vacuum hose from the intake manifold.

Detach ECM, MAT and temperature sensor wiring connectors, MAP & Fuel regulator vacuum hose from the intake manifold. Fuel regulator hose MAP hose



8. Detach carbon canister vacuum purge line.
9. Detach brake booster and heater vacuum hoses from rear of manifold.
10. Depressurise fuel rail, tag and disconnect fuel supply

Disconnect the fuel injector wiring connectors and wiring loom.



and return lines from the fuel pipe unions at fire wall.

11. Disconnect the fuel injector wiring connectors and wiring loom.
12. Disconnect the idle air control IAC motor, and throttle position sensor wiring connectors from the throttle body.
13. Remove the ignition coil assembly.
14. Remove the inlet manifold attaching bolts in the order shown and lift the manifold clear.

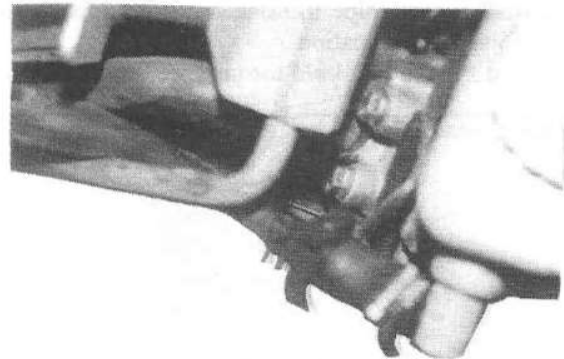
Install

1. Install the electrical sending units, if the intake manifold assembly was disassembled. Position the thermostat in the coolant outlet housing.

Engine coolant gauge sender 10 Nm

Fuel Rail

Right Rocker Cover



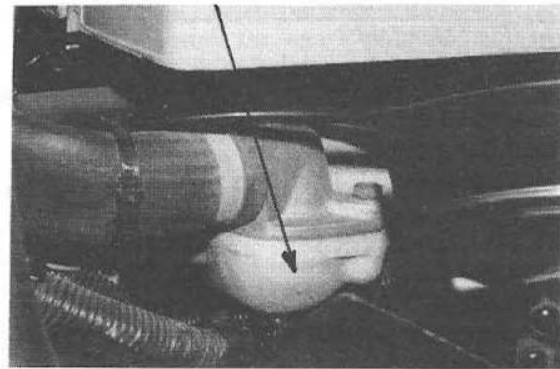
Temperature gauge sender unit Temperature sensor

ECM coolant temperature sensor 12 Nm

MAT (Manifold air temp.) sensor 14 Nm

2. Coat the thermostat gasket with Sealing Compound, and position it on the coolant outlet / thermostat housing.

Coolant outlet / thermostat housing



Install the coolant outlet housing and tighten bolts to specification.

Coolant Outlet housing bolts torque specification:
20-27Nm

3. Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block. Apply a 3.2 mm bead of silicone and rubber sealer to the parts shown in the illustration.

4. Place new seals on the cylinder block and new gaskets on the cylinder heads with the gaskets interlocked with the seal tabs. Check that "rear" on gasket faces rear of engine and the holes in the gaskets are aligned with the holes in the cylinder heads.

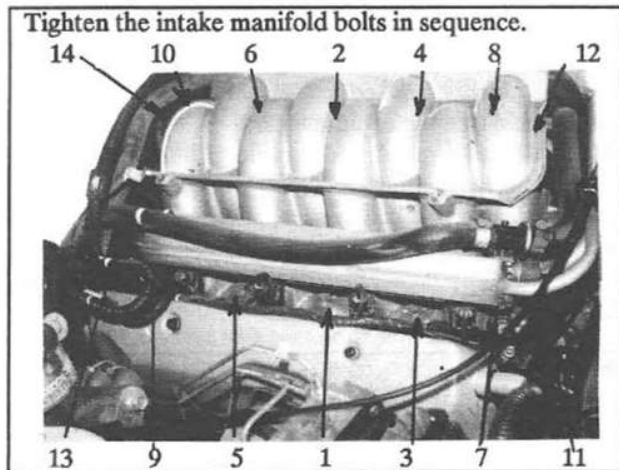
5. Apply 1.6 mm bead of sealer to the outer end of each intake manifold seal for the full width of the seal (four places).

*** This sealer sets up in 15 minutes, so it is important that assembly be completed quickly. Do not drip any sealer into engine valley.**

6. Use guide pins to ease installation, carefully lower the intake manifold into position on the cylinder block and cylinder heads. After the intake manifold is in place, run

a finger around the seal area to ensure the seals are in place. If the seals are not in place, remove the intake manifold and reposition the seals.

7. Make sure the holes in the manifold gaskets and manifold are in alignment. Remove guide pins. Install the intake manifold attaching bolts. Tighten the intake manifold bolts in sequence to specification.



Inlet Manifold securing bolt torque spec: 34-41 Nm.

8. Install throttle body to intake manifold if removed and tighten bolts to specification.

Throttle Body to Intake Manifold torque spec: 8-11Nm

9. Install the water pump bypass hose. Slide the clamp into position and tighten the clamp. Install hoses to heater tubes and tighten clamps.

10. Connect the radiator upper hose. Connect the heater hose at the intake manifold.

11. Connect fuel injector wiring harness connectors. Install the fuel lines.

12. Connect the PCV valve, the brake booster vacuum hose and all electrical wiring connectors removed during dismantle.

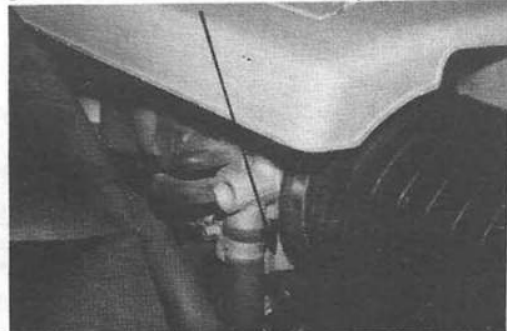
13. Connect all vacuum lines detached from the intake manifold plus lines to carbon canister.

14. Refill the cooling system adding the required amount of corrosion inhibitor.

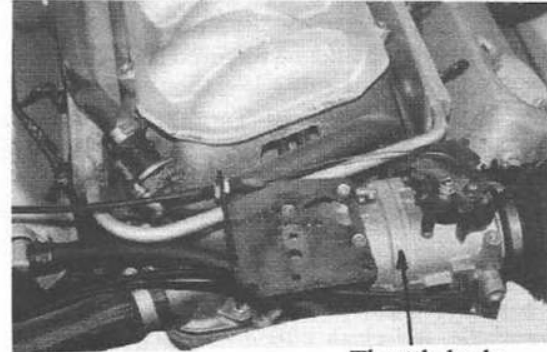
Replace covers (4) on to intake manifold and throttle body.



Idle air control IAC motor, and throttle position sensor wiring connectors on the throttle body.



Attach accelerator, T.V. cable and cruise control cables.



Throttle body

15. Connect accelerator, TV and cruise control cables.

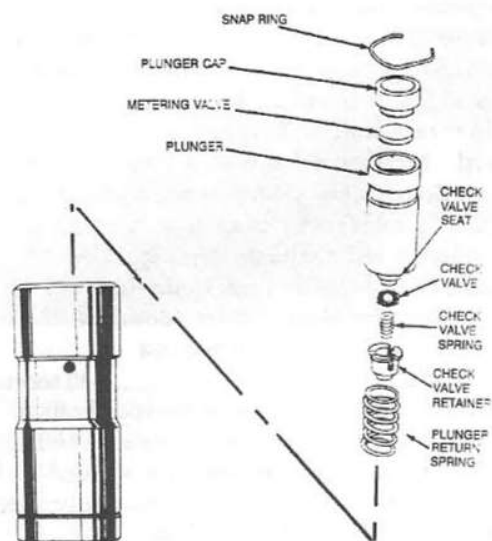
16. Install air cleaner to throttle body air intake tube.

17. Connect battery. Start engine, operate the engine at fast idle and check all hose connections and gaskets for leaks. Install intake manifold covers.

Hydraulic Valve Lifters

Prior to replacing a hydraulic valve lifter for noisy operation, check that the noise is not caused by improper valve

Hydraulic valve lifter



to rocker arm clearance or by worn rocker arms or push rods.

Remove

1. Remove the intake manifold and related parts as previously described.
2. Remove the valve rocker arm covers. Loosen the valve rocker arm fulcrum bolts.
3. Take the valve push rods out and identify them so that they can be installed in their original positions. Remove the lifter guide retainer.
4. Remove the retainer and lifter guide plates. Identify the guide plates so they may be installed in their original positions.
5. Remove the lifters by using a magnet and place them in a rack so that they can be installed in their original bores. If the lifters can not be removed from their bores due to excessive varnish, etc., it may be necessary to use a claw-type tool to remove them. Turn the lifter back and forth to loosen it from the gum or varnish that may have formed on the lifter.

Note: Keep the lifters in order of removal for installation in the original order. If the lifters are dismantled do not mix components as they become matched units.

Leakdown Testing

1. Dismantle and clean lifter to remove all traces of engine oil.

*** Do not mix parts from different lifters. Parts are select-fitted and are not interchangeable.**

*** Lifters cannot be checked with engine oil in them. Only testing fluids can be used.**

2. Place lifter in tester, with plunger facing upward. Pour hydraulic tester fluid into cup to a level that will cover lifter assembly. The fluid can be purchased from manufacturer of tester. Using kerosene or any other fluid will not provide an accurate test.

3. Place an 8.0 mm steel ball in plunger cap. Adjust length of ram so that pointer is 1.6 mm below starting mark when ram contracts tappet plunger, to facilitate timing as pointer passes Start Timing mark. Make sure that the scale is marked to correspond with 1.6 mm plunger travel.

4. Work lifter plunger up and down until lifter fills with fluid and all traces of air bubbles have disappeared.

5. Allow ram and weight to force lifter plunger downward. Measure exact time it takes for pointer to travel from Start Timing to Stop timing marks of tester. A tappet that is satisfactory must have a leakdown rate within minimum and maximum limits specified.

Hydraulic Lash Adjuster Leak Down Rate

(Time required for plunger to leak down 2.4 mm of travel with a 22 N load and test fluid in adjuster)

5-30 seconds

6. Replace the lifter if it is not within specification. It is recommended that if a flat lifter is replaced with a new lifter to install a new camshaft. There is no need to clean and disassemble the new lifters prior to testing because oil contained in the new lifters is test fluid.

8. Remove fluid from cup and bleed fluid from lifter by working plunger up and down. This step will aid in depressing lifter plungers when checking valve clearance.

Dismantle

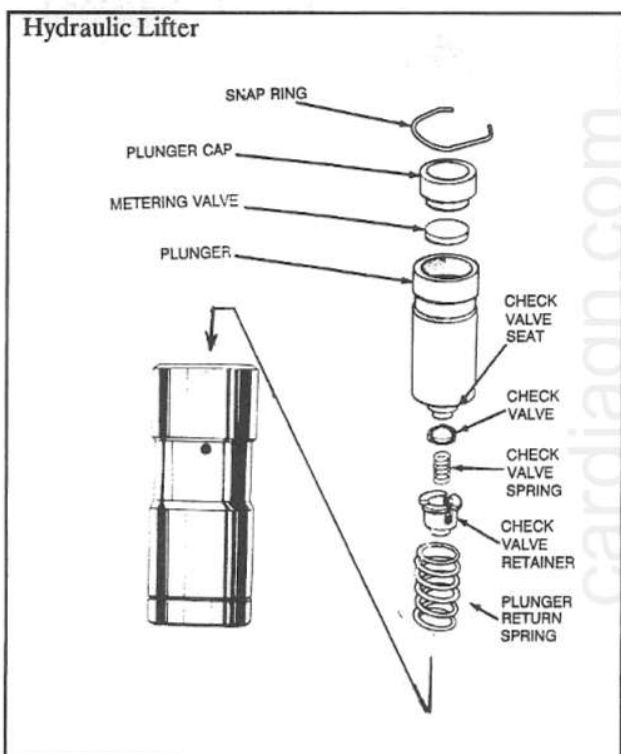
1. Remove push rod seat snap ring using a small, fine-bladed screwdriver.
2. Now that the retaining clip has been removed the plunger cap, metering valve and plunger should freely come out, with the force of the plunger spring.
3. If the components are stuck in the lifter body it will help if the lifter is soaked in a cleaning fluid solution, as this will help free the components.

4. Use a small screw driver to remove the valve retainer.

Clean and Inspection

Use a clean work bench area, if the components are contaminated the lifter will not function correctly.

Wash all components in a cleaning fluid solution and allow to air dry.



If the lifter body or plunger are showing signs of wear or damaged, the lifter should be replaced with a new lifter.

Assembly

1. Install the valve retainer to the plunger, as shown in the diagram. Use a screw driver to fit the retainer valve to the plunger.

2. Place the lifter vertically on the work bench, insert the plunger spring into the lifter.

3. Place the plunger into the top of the lifter body with the oil holes aligned. Use a fine nail or piece of wire, push the nail into the oil holes to unseat the steel ball inside the lifter, this will allow the plunger to be pushed all the way down into the lifter. Remove nail.

4. Install metering valve, plunger cap and snap ring.

Install

Prior to installation use engine oil to lubricate the lifter and bores.

1. Clean outside of lifters and install in the bores from which they were removed. If a new lifter is being installed, inspect the new lifter for a free fit in the bore in which it is to be installed. Lubricate the lifter and bore with engine oil prior to inserting it in the bore.

2. Install lifter guide plates in their original positions, then install guide plate retainer.

3. Install the push rods in their original position. Apply Multi-Purpose Grease or equivalent to the valve stem tips and the push rod ends.

4. Use engine oil to lubricate the rocker arms and fulcrum seats. Position the rocker arms over the push rods and install pivot bolts. Tighten to specification.

Rocker Arm Pivot bolt torque specification: 24-32Nm

5. Install the valve rocker arm covers with a new service gasket or equivalent where specified. Install the intake manifold and related parts.

Rocker Cover bolts torque specification: 3-6Nm.

6. Start the engine and check for leaks.

Cylinder Heads

Remove

1. Release the fuel pressure in the fuel lines as previously described in tune-up chapter.

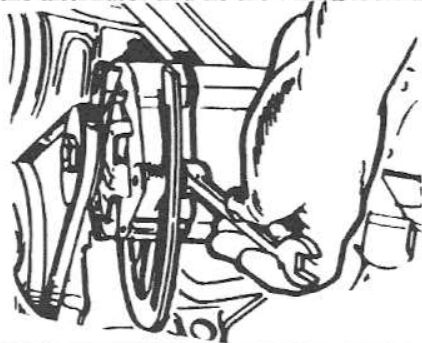
2. Remove earth cable from battery and battery to engine.

3. Remove the the power steering pump attaching bolts and power steering pump reservoir, place to one side with the hoses attached.

4. Remove the alternator and tie the wiring loom aside.

5. Empty the coolant by disconnecting the lower radiator

Remove the alternator and tie the wiring loom aside.



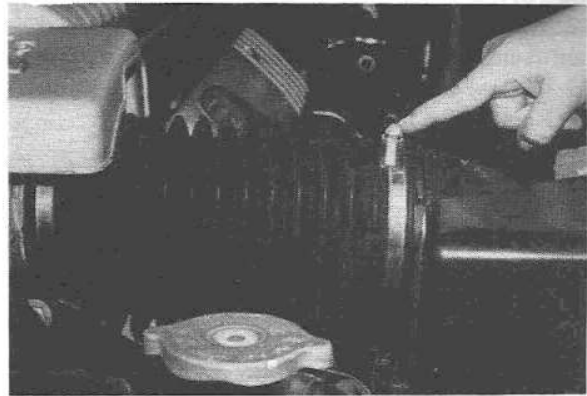
hose from the engine, then disconnect the upper hose.

6. Disconnect the coolant hoses from the right side of the engine compartment, label if necessary.

7. Remove the air ducting between the air cleaner and throttle body.

8. Remove the exhaust manifold bolts and leave the manifolds on the exhaust pipes.

Remove the air ducting between the air cleaner and throttle body



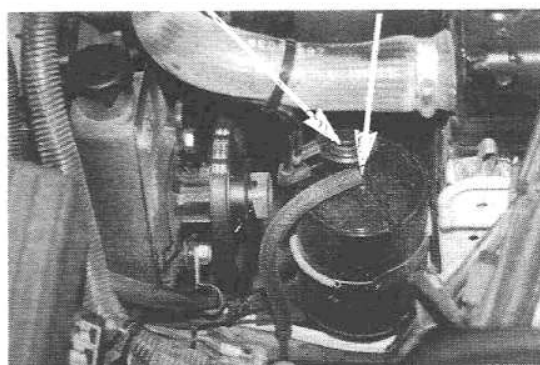
9. Disconnect the vacuum lines from the intake manifold including the canister purge lines from the throttle body.

Disconnect the vacuum lines from the intake manifold including the canister purge lines from the throttle body.
Canister Purge Hoses Right rocker cover breather



Carbon canister
Purge Valve

Return line to fuel tank



10. Detach the fuel feed and return lines at the injector rail and pressure regulator.

11. Detach the wiring & vacuum hoses from the sensors, the throttle positioner, injector loom, ignition coil, oil pressure sender, MAP vacuum hose, idle

control valve, MAT sensor. Label and tie these wiring looms to the back of the engine compartment.

12. Detach the kickdown cable, T.V. cable and cruise control cable if fitted.

13. Remove the coil assembly and spark plug leads.

14. Remove the intake manifold.

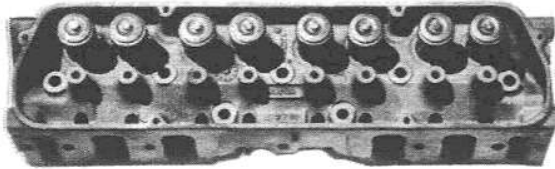
15. Remove the rocker cover.

16. Remove the rocker arms, pivots and push rods.

17. Remove the cylinder head studs, lift the heads clear of the cylinder block.

18. The cylinder heads assembly may now be taken apart as required on a clean bench.

The cylinder heads assembly may now be taken apart as required on a clean bench.



Install

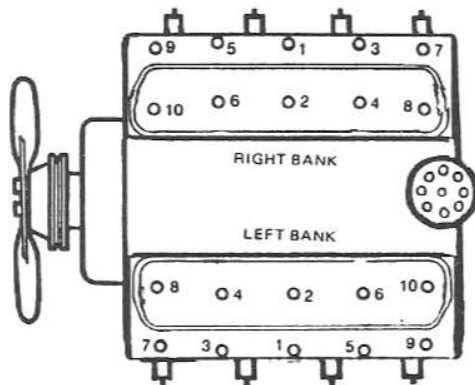
1. Clean the heads and block gasket surfaces. Inspect the flatness of the mating surfaces, if the head was removed for a gasket change.

3. Do not place sealer in the cylinder head gasket. Place the gasket over the dowels in the cylinder block. Make sure the "TOP" marking is on the up side of the gasket, if the gaskets have arrows stamp on them the arrow must point towards the rear of the engine.

4. Install the correct length head studs and tighten finger tight, coat the head studs with a lock tight sealant.

5. Tighten the head studs in the correct manner and to specified torque.

Tighten the head studs in the correct manner and to specified torque.

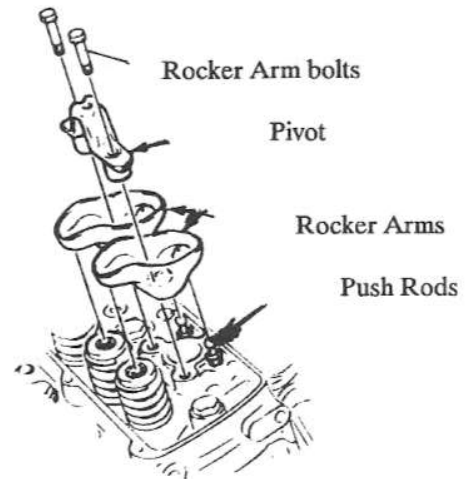


Step 1 - Head Stud Torque specification: 50-55Nm

Step 2 - Head Stud further tighten: 77-83Nm

6. Replace the push rods, rocker arms, pivots and pivot bolts, tighten to specification.

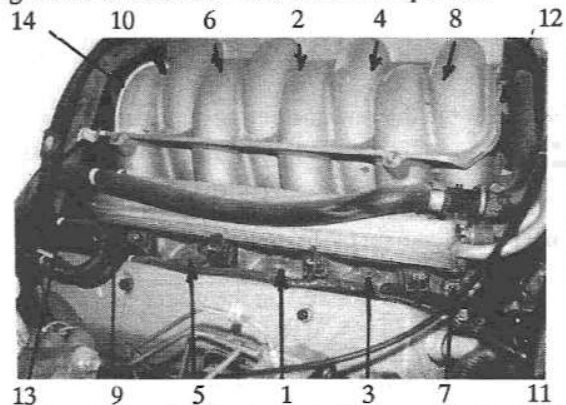
Replace the valve rocker arm, pivot bolt and rocker arm.



Pivot bolts torque specification: 24-32Nm

7. Install the intake manifold, tighten bolts to specification and in the correct order.

Tighten the intake manifold bolts in sequence.



Intake manifold bolts specified torque:

Step 1 - Head Stud Torque specification: 12-17Nm

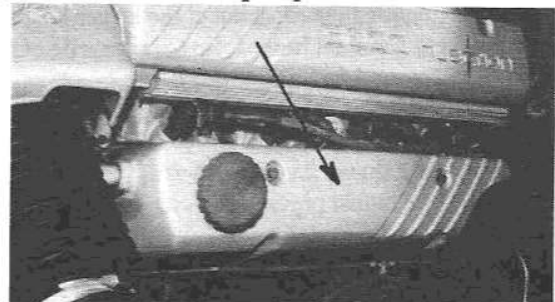
Step 2 - Head Stud further tighten: 34-41Nm

Step 3 - Head Stud torque specification: 34-41Nm

8. Install the rocker cover, tighten bolts to specification.

Install the rocker cover, tighten bolts to specification

Rocker Cover bolts torque specification: 3-6Nm.



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Rocker cover bolt torque specification: 3-6Nm

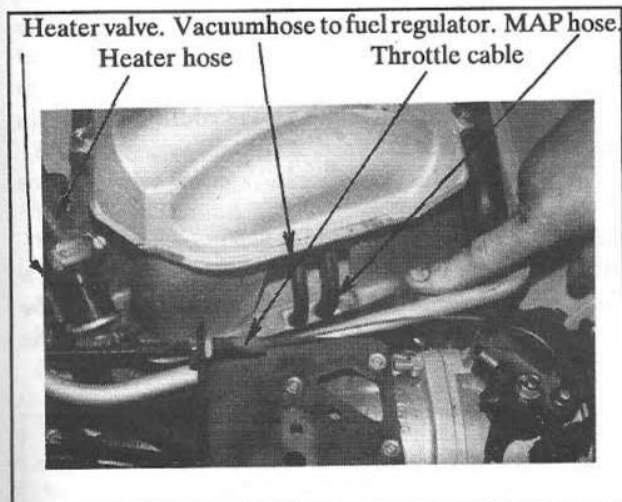
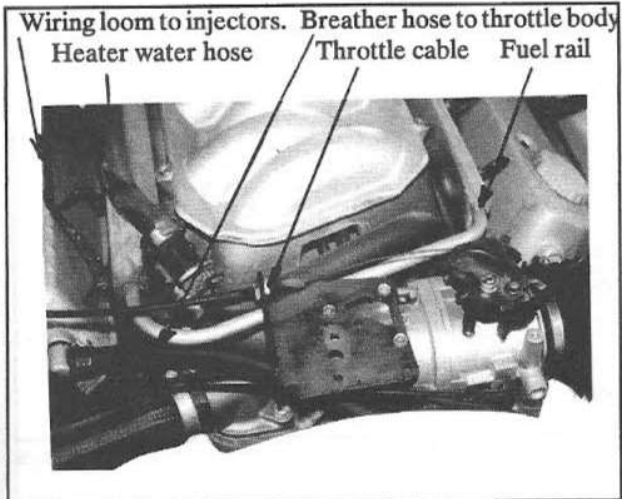
9. Lift the exhaust manifolds to the cylinder heads, fit studs and tighten to specification.

Exhaust Manifold torque specification: 27-34Nm

10. Replace the coil assembly and spark plug leads.

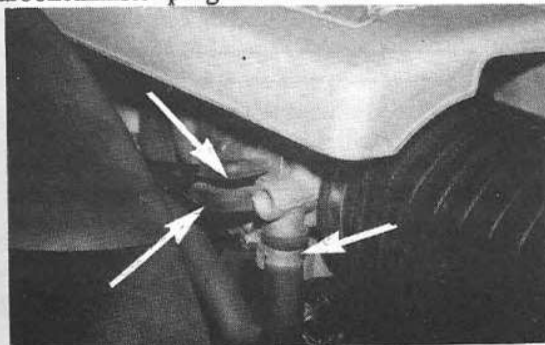
11. Refit the kickdown cable and cruise control cable if fitted.

12. Reposition the wiring to the sensors positioned in the



thermostat housing, the throttle positioner, injectors, ignition coil, oil pressure sender, MAP sensor, idle control

Carboncannister purge control hose



Carboncannister purge hose. Right valve cover breather

valve, MAT sensor. Take note of the labels used during removal.

13. Reconnect the vacuum lines to the intake manifold including the canister purge line. Connect the fuel feed and return lines at the throttle body and fuel rail, tighten clamps.

14. Replace the air ducting to the throttle body and air cleaner.

15. Connect the coolant hoses to the right side of the engine compartment.

16. Connecting the radiator hoses to the engine. Refill cooling system with specified coolant.

17. Replace the the power steering pump attaching bolts.

Power steering pump attaching bolts torque: 20-28Nm.

18. Install the alternator and the wiring loom.

19. Install the drive belt and tension as previously described.

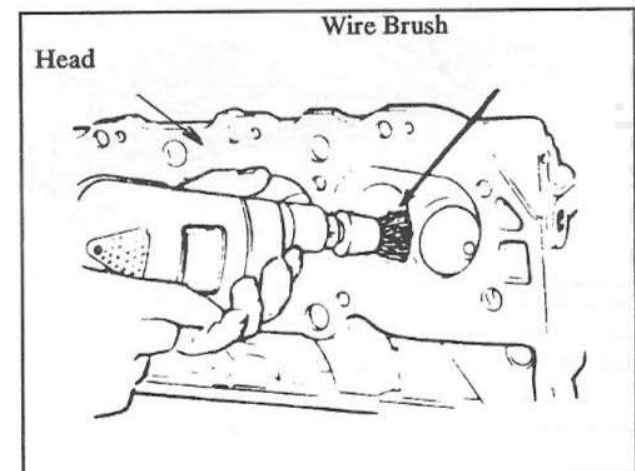
20. Connect earth cable to battery and battery to engine.

21. Start engine and test drive, check for any leaks.

Cylinder Head Rebuild

Clean

With the valves installed to protect the valve seats, take the deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to damage the cylinder head gasket surface. Clean the valve guide bores with a valve guide cleaning tool after the valves are removed. Use cleaning solvent to remove dirt, grease



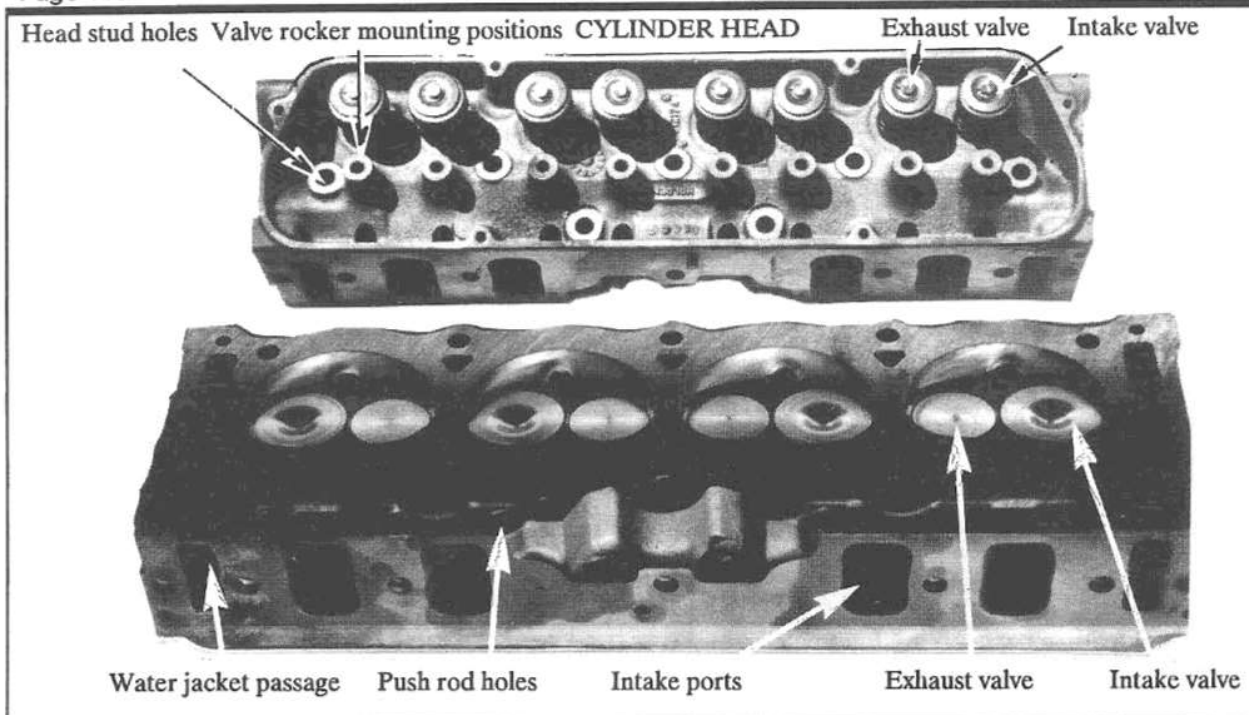
and other deposits and clean all bolt holes.

Using a fine wire brush or buffing wheel remove all deposits from the valves.

Inspect

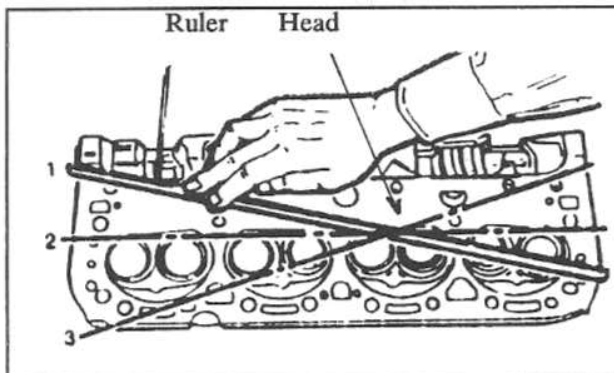
Inspect the cylinder heads for cracks, and inspect the gasket surface for burrs and nicks. Replace the head if it is cracked.

The following inspection procedures are for a cylinder head that is to be completely inspected. For individual repair operations, use only the pertinent inspection procedure.



Cylinder Head Flatness

When a cylinder head is removed because of gasket



leaks, check the flatness of the cylinder head gasket surface for conformance to specifications.

Cylinder Head flatness should be within: 0.10mm

Do not plane or grind off more than 0.25 mm, if it is required to refinish the cylinder head gasket surface.

Valve Rocker Arm Assembly

Clean

Clean all the parts completely and check that the oil passages are open.

Inspect

Check the rocker arm and pivot assembly is not damaged or badly worn. If the rocker arm is grooved, replace the rocker arm. Inspect the rocker pivot bolts for stripped or broken threads.

Valve Seat Runout

Inspect the valve seat runout by coating the face of a new or refaced valve with Prussian blue, placing the valve in

the valve seat and turn it back and forth several times about 1/8 turn.

Remove the valve and if the blue has not been transferred to the seat showing a full circle contact reface the seat.

Valve Seat Width

Measure the valve seat width. If the width is not within specifications reface the valve seats.

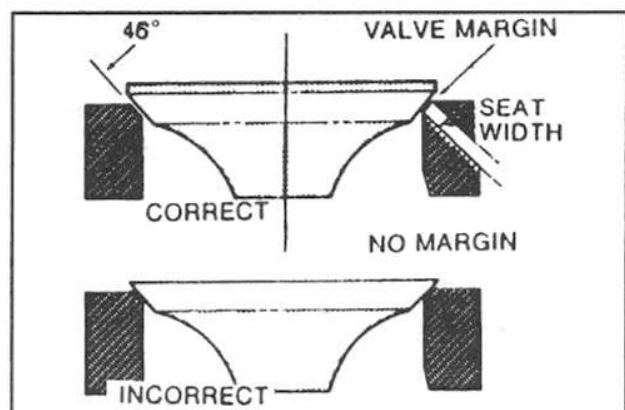
* Valve seat angles are 46° .

* Valve seat width:

Exhaust 1.10mm +/- .20mm

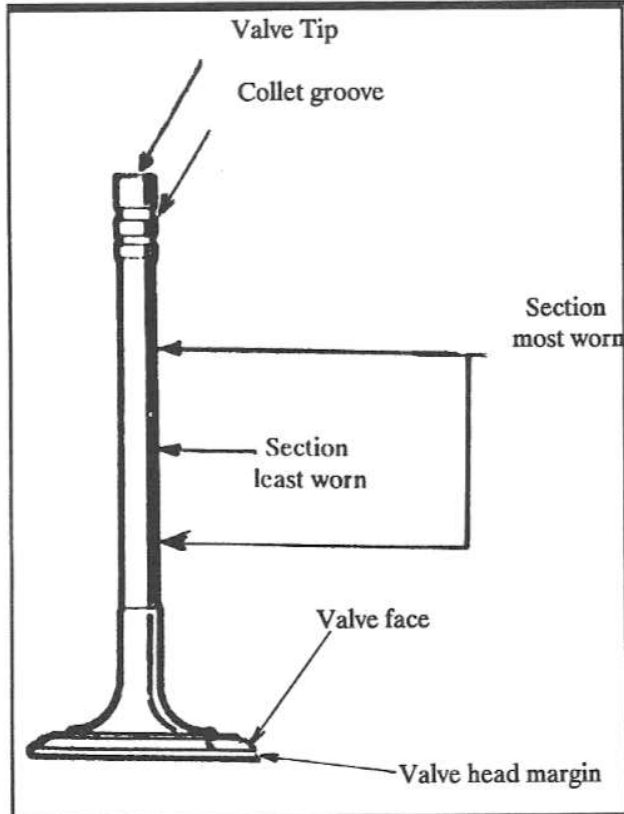
Intake 1.15mm +/- .20mm

Note: If the seat is too wide after grinding, it may be narrowed by using a 25° or 65° grinding stone. The 25° stone will lower the seat and the 65° stone will raise the seat.



Valves and Springs

Refer to diagram for inspection points. Check the valve face and the rim of the valve head for pits, grooves, scores or other defects. Check the stem for a bent shape and the



end of the stem for grooves or scores. Check the valve head for indications of burning, erosion, warpage and cracking. Faults such as minor pits, grooves, etc., may be eliminated by refacing the valve.

Replace valves that are severely ruined. Check the valve springs, valve spring retainers, locks and seals for faults.

Valve Face Runout

Valve face runout will become apparent when the valve is being refaced.

Minimum valve head margin thickness: .63mm

Valve face angle: 45°

Replace the valve if the valve face cannot be trued before the minimum valve head thickness is reached.

Valve Stem Clearance

Inspect the valve stem to valve guide clearance of each valve guide. With the cylinder head gasket face uppermost, slide a "new" inlet or exhaust valve as suitable into the guide to be checked until the end of the stem is flush with the top of the valve guide.

Install a dial indicator on the cylinder head gasket face so that the plunger can be placed on the edge of the valve head 90 degrees to the camshaft axis.

Move the valve head from side to side at right angles to the camshaft axis as far as the clearance will allow and note the indicator reading, whilst the dial indicator is in this position and the end of the valve stem flush with the top of the guide.

Maximum Clearance - Valve stem to Valve Guide:

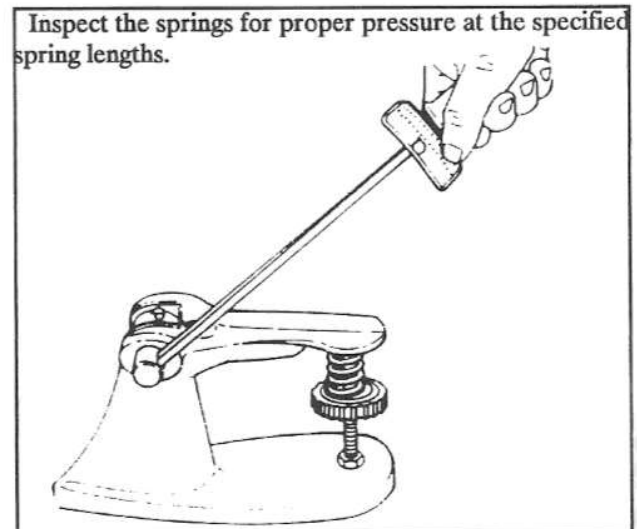
Intake - 0.025 - 0.068 mm

Exhaust - 0.025 - 0.068 mm

If the valve head deflection is not within specification for inlet or exhaust valves the guide in question is worn excessively and should be replaced or reamed out to accept a valve with an oversized stem.

VALVE SPRING PRESSURE

Inspect the springs for proper pressure at the specified spring lengths.



Maximum allowable variance in spring end length: 1.60 mm, while rotating spring on level desk.

Valve spring compressed height/load:

Valve spring height:

Spring 338 - 373 Nm (45.2 mm).

Free length:

Valve Spring length: 51.56mm.

Weak valve springs cause poor engine performance; thus if the pressure of any spring approaches the wear limit, replace the spring.

VALVE SPRING SQUARENESS

Using a steel square and surface plate, inspect each spring for squareness. On the surface plate, stand the spring and square on end. Slide the spring up to the square. Rotate the spring slowly and observe the space between the top coil of the spring and the square. Replace the spring if it is out of square more than 1.6 mm.

VALVES

Valve faults, such as minor pits, grooves, etc., can be removed. Replace any valves that are severely damaged, or if the face runout or stem clearance exceeds specifications.

Replace any defective part of the valve assembly and grease valve stems with a suitable Molybond before installing.

Valve Seat Repair

Refacing Valve Seats

Refacing of the valve seats should be closely coordinated with refacing of the valve so that the completed

seat and valve face will be concentric and the specified interference fit will be maintained. Check that the refacer grinding wheels are properly dressed.

Grind the valve seats to 46 degrees. Detach only enough stock to clean up pits, grooves, or to adjust the valve seat runout. Use a seat width scale to measure the seat width, after the seat has been refaced. If necessary narrow the seat to bring it within specifications.

Remove enough stock from the top edge and/or bottom edge of the seat to reduce the width specifications, if the valve seat width exceeds the maximum limit.

To remove stock from the top of the seats (lower seats), use a 25 degree angle grinding wheel and to remove stock from the bottom of the seats (raise the seats), use a 65 degree angle wheel.

The completed valve seat should contact the estimated centre of the valve face.

It is good practice to determine where the valve seat contacts the face. To do this, coat the seat with Prussian blue, then set the valve in place. Rotate the valve with light pressure. The contact is successful if the blue is transferred to the centre of the valve face. Lower the valve seat if the blue is transferred to the top edge of the valve face. Raise the valve seat if the blue is transferred to the bottom edge of the valve face.

Timing Cover Oil Seal

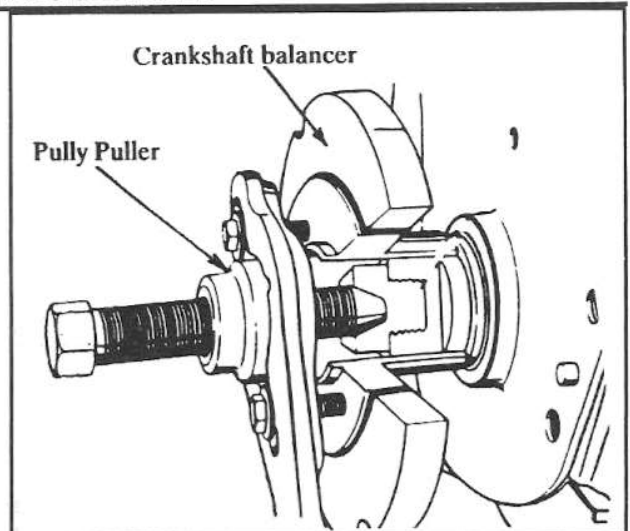
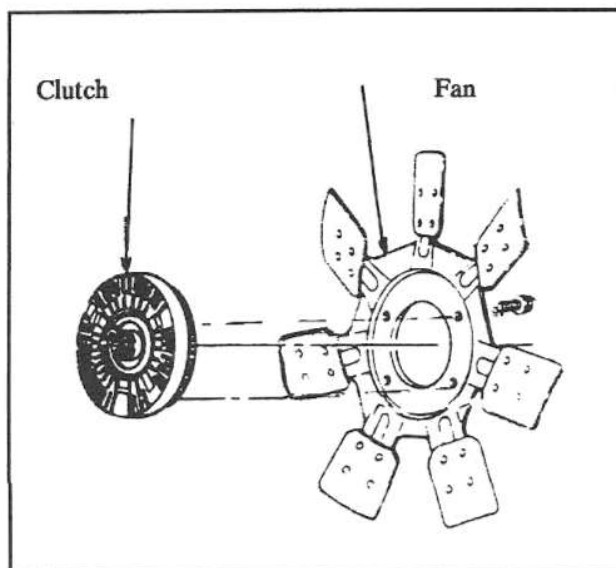
Remove

1. Remove the throttle body cover, air cleaner to throttle body air intake tube and air cleaner air intake duct.

2. Remove radiator and fan shroud mounting screws. Remove fan shroud.

Note: It may be necessary to drain and remove the radiator depending on the size of the crankshaft vibration damper remover to be used.

3. Remove the fan/clutch assembly from the water pump hub and all drive belts.



4. Remove the damper attaching bolt and washer. Install crankshaft Damper Remover or equivalent on the crankshaft vibration damper. Remove the vibration damper.

5. Place the Front Cover Seal Remover or equivalent onto the front cover plate over the front seal. Tighten the two through bolts to force the seal puller under the seal flange.

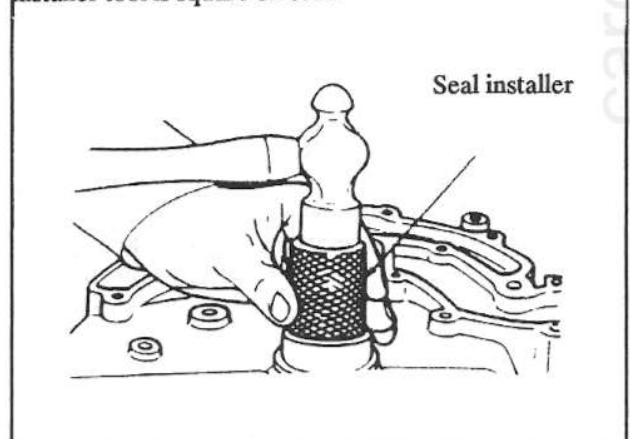
Alternately tighten the four puller bolts one-half turn at a time to pull the oil seal from the front cover.

Note: A fine screw drive could also be used to lever the seal out.

Install

1. Coat the new seal with engine oil, and place it onto the

If using hammer in type of seal installer make sure seal installer tool is square on seal.



Front Cover Seal Replacer. Place the sleeve and seal onto the end of the crankshaft and push it toward the engine until the seal starts into the front cover.

2. Place the installation screw, washer and nut onto the end of the crankshaft. Thread the screw into the crankshaft. Tighten the nut against the washer and installation sleeve to force the seal into the front cover plate. Remove the installation tool from the crankshaft.

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3. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply silicone seal to key way groove in damper prior to installing on crankshaft.

4. Line the crankshaft vibration damper keyway up with the key on the crankshaft. Install the vibration damper on the crankshaft. Install the bolt and washer. Tighten the bolt to specification.

Vibration Damper bolt torque spec: min 190Nm

5. Install the accessory drive belts as previously described.

6. Replace the fan/clutch assembly to the water pump hub and install the fan shroud.

7. Install air cleaner to throttle body air intake duct, battery earth cable. Install throttle body cover.

Timing Chain Cover, Timing Chain & Sprockets.

Remove

1. Disconnect the battery earth cable and drain the radiator.

2. Remove the throttle body cover, air cleaner to throttle body air intake tube. and air cleaner air intake duct.

3. Remove radiator and fan shroud mounting screws. Remove fan shroud.

Note: It may be necessary to remove the radiator depending on the size of the crankshaft vibration damper remover to be used. Or if the camshaft is to be removed.

4. Drain coolant by detaching lower radiator hose from water pump. Remove top radiator hose and by-pass hose.

5. Remove the fan/clutch assembly from the water pump hub and all drive belts.

6. Remove the alternator bracket attached to the timing chain cover.

7. Remove the damper attaching bolt and washer. Install crankshaft Damper Remover or equivalent on the crankshaft vibration damper. Remove the vibration damper.

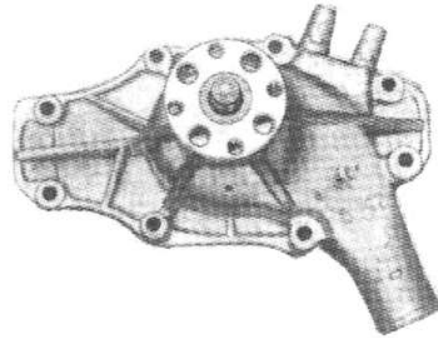
Note: Leave water pump attached to the front cover.

8. Remove the oil pan(ump)-to-cylinder front cover attaching bolts. Use a thin blade knife to cut the oil pan

gasket flush with cylinder block face prior to separating the cover from the cylinder block.

9. Remove the cylinder front cover and water pump attaching bolts remove as an assembly.

Remove the water pump



* Cover the front oil pan opening while the cover assembly is off to prevent foreign material from entering the pan.

10. If a new cover is to be installed, remove the water pump from the old cylinder front cover and install it on the new cover.

11. Throw away the cylinder front cover gasket.

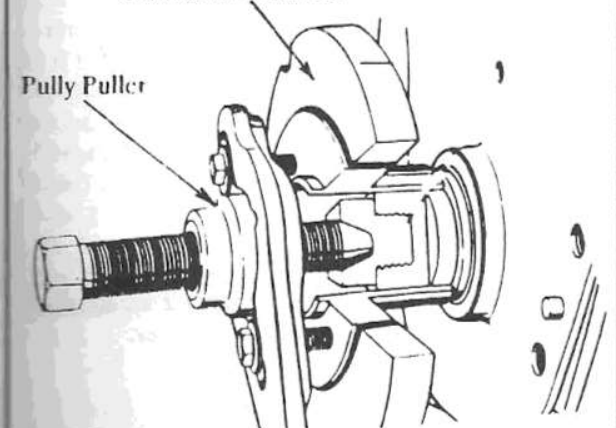
12. Turn the crankshaft until the timing marks on the sprockets are positioned as shown at T.D.C. No 1 cylinder on compression stroke. The alignment marks must be as shown.

13. Remove the bolt securing the eccentric spacer and camshaft sprocket to camshaft. Withdraw the crankshaft, camshaft sprockets and timing chain as an assembly. The crankshaft sprocket is a push fit on the crankshaft.

Install crankshaft damper remover, remove the vibration damper (Crankshaft Balancer).

Crankshaft balancer

Pully Puller



Timing chain silver links opposite timing marks

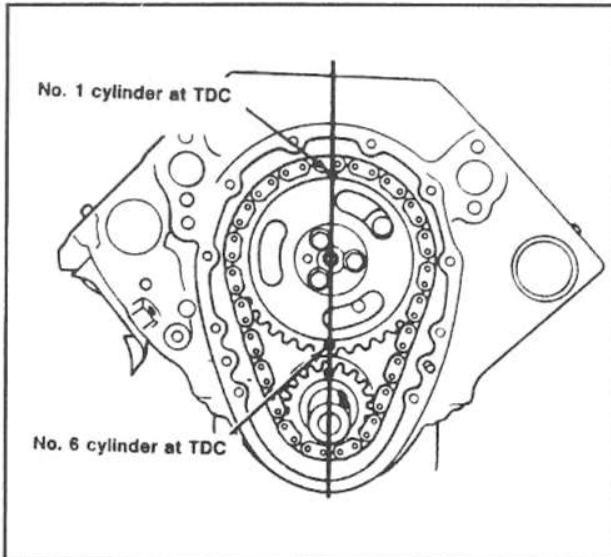


Timing marks

Note: Do not move the crankshaft after the camshaft sprocket, camshaft sprocket and timing chain has been removed.

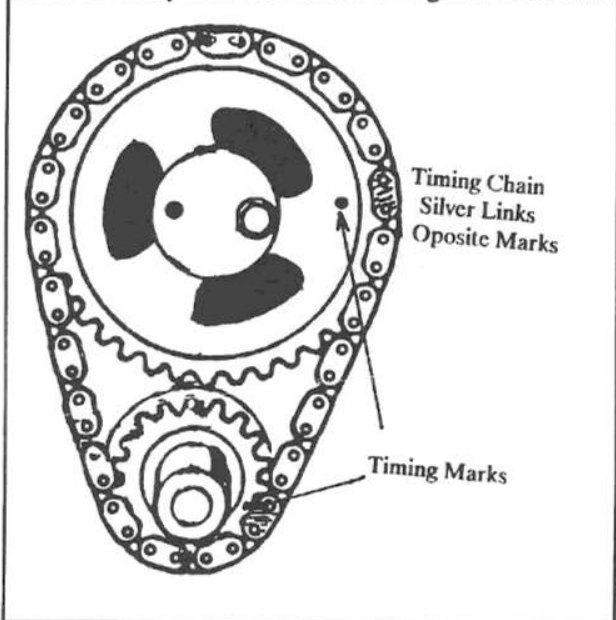
Install

1. The engine must be still at T.D.C. No 1 cylinder on compression stroke.



2. Place the sprockets and timing chain on the camshaft and crankshaft simultaneously. Check that the timing marks on the sprockets are positioned correctly in relation to the timing chain as shown.

Check that the timing marks on the sprockets are positioned correctly in relation to the timing chain as shown.



3. Install the eccentric spacer and camshaft sprocket. tighten the spacer bolt to specification.

Camshaft spacer bolt torque specification: 61-74Nm

4. Clean the cylinder front cover, oil pan and the block gasket surfaces. Install a new oil seal in the cylinder front cover. Lubricate the timing chain with engine oil.

5. Coat the gasket surface of the oil pan with sealer, cut and position the required sections of a new gasket on the oil pan, apply silicone sealer or equivalent at the corners. Install pan seal as required.

*** Gasket and Trim Adhesive or equivalent is recommended to hold the seals and gaskets in position during assembly.**

6. Coat the gasket surfaces of the block and cylinder front cover with Sealing Compound and position a new gasket on the block.

7. Position the timing chain cover on the cylinder block. To avoid seal damage or possible gasket mislocation take care when installing the cover. Install the cover to seal alignment pins, this will help to keep the gasket in the proper position.

8. It may be necessary to loosen the other sump bolts to fit the cover on correctly.

9. Coat the threads of the attaching bolts with oil resistant sealant with Teflon and install the bolts. Tighten the cover bolts to specification.

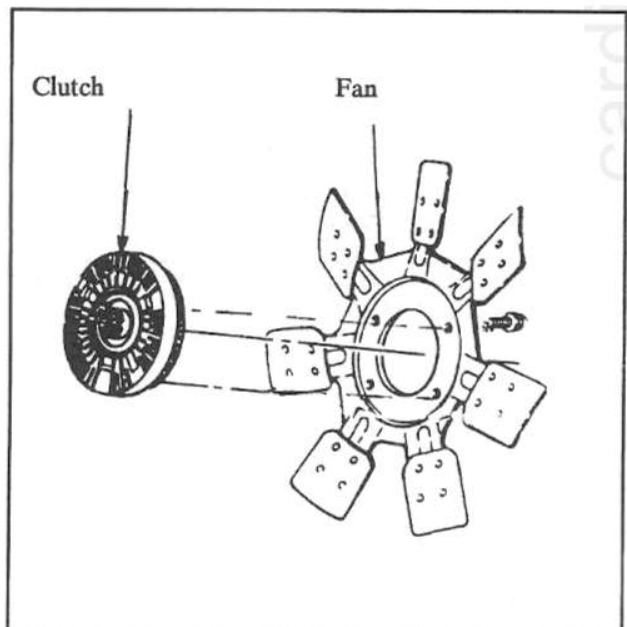
Timing Chain Cover attaching bolts: 23-30Nm

10. Align the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft and bolt, tighten to specification.

Vibration Damper bolt torque spec: min 190Nm

11. Install the accessory drive belts as previously described.

12. Replace the fan/clutch assembly to the water pump hub and install the fan shroud.



13. Install air cleaner to throttle body air intake duct, battery earth cable. Install throttle body cover.

CAMSHAFT.**Camshaft Lobe Lift**

Inspect the lift of each lobe in consecutive order.

* Make sure that the ignition is turned 'off' for the entire test.

1. Remove the rocker arm covers and the starter relay adjacent to the battery. Attach an auxiliary starter switch between the battery and starter solenoid terminals of the relay socket.

2. Place a dial indicator with a flat adaptor on the stylus so that the stylus contacts the rocker arm. Push the crankshaft over until the rocker arm is on the base circle of the camshaft lobe. The rocker arm will be in its lowest position.

3. Zero the dial indicator. Turn the crankshaft slowly until the rocker arm is in the fully raised position. Compare the total lift recorded on the indicator with the lift for all other lobes, if there appears excessive wear for one lobe replace the camshaft.

4. Turn the crankshaft until the indicator reads zero, to check the accuracy of the original indicator reading. The camshaft and the rocker arm operating on the worn lobe(s) must be replaced, if the lift on any lobe is below specified wear limits.

* Comparing the size of one camshaft lobe to another, with a micrometer or other measuring instrument, is not a satisfactory method of checking camshaft lobe lift, owing to tolerance on base circle radii. It is best to check with the camshaft out of the engine.

5. Take the dial indicator out and install the rocker cover.

Remove.

1. Remove the rocker arm covers as previously described.
2. Remove the intake manifold as previously described.
3. Remove the rocker arms, pivots, push rods and hydraulic lifters as previously described.
4. Remove the timing chain cover and timing chain as previously described.
5. Slide the camshaft out from the front of the engine.

Clean and Inspect

Clean the camshaft in solvent and wipe it dry. Check the camshaft lobes for scoring and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general area of the lobe toe. This pitting is not damaging to the operation of the camshaft, providing that the lobe lift is within specification.

Measure the camshaft journal diameter to check that the journals are within specification.

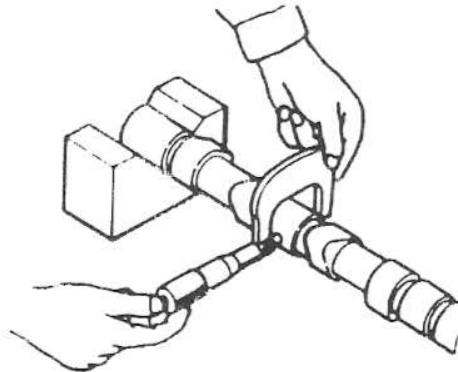
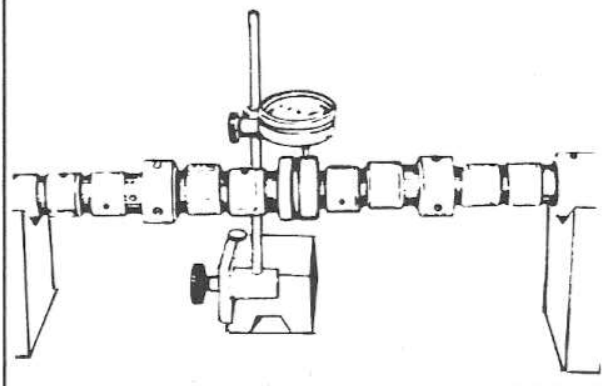
Camshaft Journal Diameter:

Nos 1 & 2	47.060-47.978mm
Nos 3 & 4	47.452-47.478mm
No 5	40.107-40.132mm

The lift of the camshaft lobes can be checked with the camshaft installed on V blocks.

Camshaft Journal Diameter:

Nos 1 & 2	47.060-47.978mm
Nos 3 & 4	47.452-47.478mm
No 5	40.107-40.132mm

**Camshaft Lobe Lift****Install**

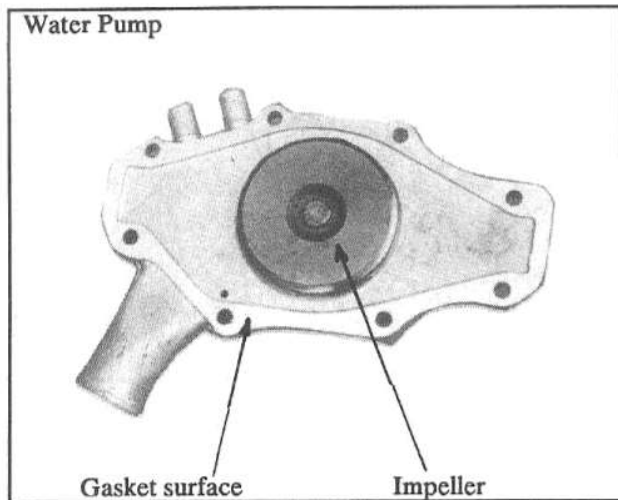
1. Oil the camshaft journals with engine oil and slide the camshaft carefully back into the cylinder block.
2. Replace the timing chain and cover as previously described.
3. Replace the rocker arms, pivots, push rods and hydraulic lifters as previously described.
4. Replace the intake manifold as previously described.
5. Replace the rocker arm covers as previously described.

Water Pump**Remove**

1. Disconnect the battery earth cable and drain the radiator.
2. Remove the throttle body cover, air cleaner to throttle body air intake tube, and air cleaner air intake duct.
3. Remove radiator and fan shroud mounting screws. Remove fan shroud.
4. Drain coolant by detaching lower radiator hose from water pump. Remove top radiator hose and by-pass hose.
5. Remove the fan/clutch assembly from the water pump hub and all drive belts.
6. Remove the alternator bracket attached to the timing chain cover.

7. Remove water pump retaining bolts and detach the water pump from the cylinder front cover. Remove and throw away water pump gasket.

Install



1. Remove all gasket material from the component mounting surfaces.

2. Place a new gasket, coated on both sides with silicone rubber sealant, or equivalent on the cylinder front cover.

3. Install the water pump and torque retaining bolts.

Water Pump retaining bolts torque spec: 17-22Nm

4. Install the water pump pulley and tighten the bolts to specification.

Water Pump Pulley attaching bolts torque: 17-22Nm

5. Install the drive belt and adjust the tension as previously described.

6. Connect the lower radiator hose and water pump bypass hose to the water pump.

7. Install top radiator hose.

8. Install the radiator shroud.

9. Replace the fan/clutch assembly to the water pump hub and install the fan shroud.

10. Install air cleaner to throttle body air intake duct, battery earth cable. Install throttle body cover.

11. Refill cooling system, adding required amount of glycol. Start engine and check for coolant leaks.

REAR MAIN OIL SEAL

Replace in Vehicle

1. Remove sump.

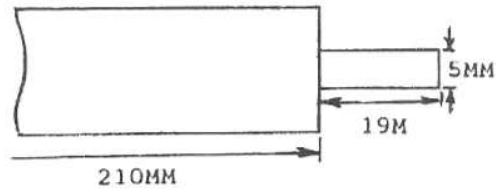
2. Remove rear main bearing cap.

3. Remove old seal from bearing cap and measure the length of the seal. Cut two pieces of new seal 2.0mm longer than the piece removed.

4. Use piece of oxy welding rod to make a tool as shown.

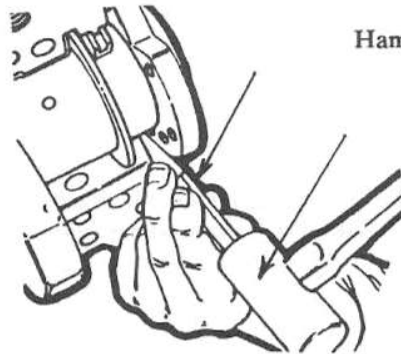
5. Force special tool up into old seal in engine block to push the old around in groove. With pliers grab the old seal, which is now partly out of seal groove and pull seal out.

Use piece of rod to make a tool as shown.



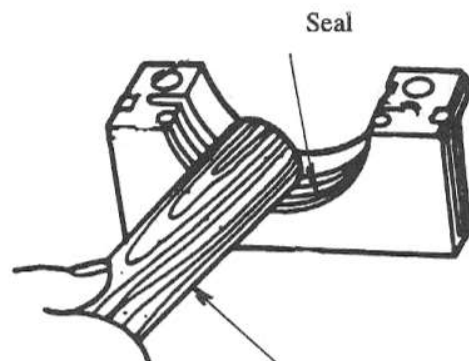
Special Tool

Hammer



6. Use a new cut seal, apply an adhesive (Holden's specification HN1539 type 4 or equivalent) to seal and force into seal groove packing the seal with special tool as in point 4. Cut seal still off at bearing mating surface once seal has fully filled seal groove.

Cut ends of seal level with bearing surface

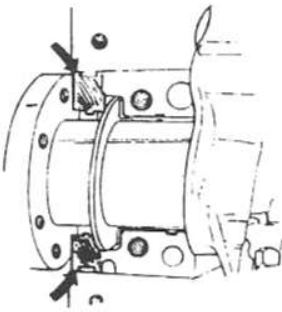


Hammer handle

7. Install another new half seal in bearing cap after applying the same type of cyanoacrylate adhesive as above in point number 6, to bearing cap seal groove. Roll seal into groove with wooden hammer handle.

8. Trim ends of seal flush with bearing cap surface. Apply a silastic type of sealant to the trimmed ends of the seal, this will help the seal to become oil proof.

Apply sealant as shown



9. Install rear main bearing cap and tighten bolts to specified torque.

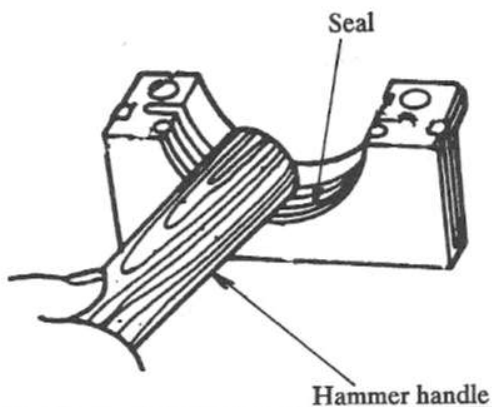
Rear main bearing cap bolt torque 81-95 Nm

10. Install engine sump.

REPLACE

1. Remove crankshaft, as described in this chapter.
2. Remove old rear main bearing oil seal from crankcase and rear main bearing cap. Clean seal groove.
4. Cut new seals 5.0mm longer than old seals removed.
5. Apply cyanoacrylate adhesive (Holden's specification HN1539 type 4 or equivalent) to bearing cap and crankcase seal grooves.

Cut ends of seal level with bearing surface



6. Install new seals in bearing cap and crankcase using a wooden hammer handle to roll in new seal. Trim seal ends level with bearing cap and crankcase. Apply sealant Holden's specification HN1373, such as, Silastic sealer RVT 159 Type 1, to cut ends of seal.

7. Apply thin bead of sealer to cap and mating surface on crankcase.

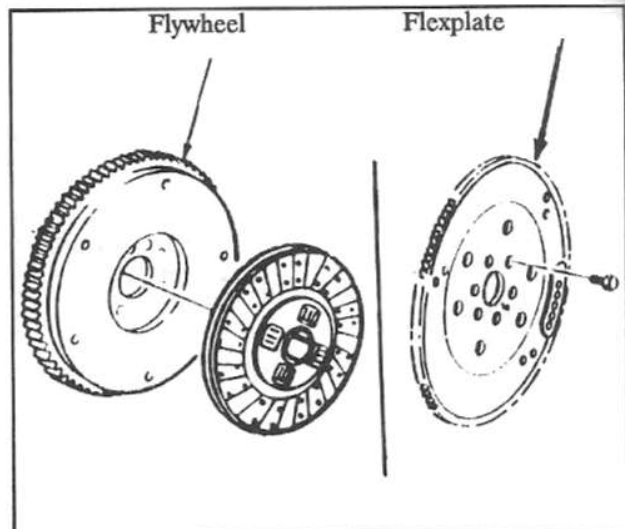
8. Install crankshaft.

9. Install rear main bearing cap and tighten bolts to specified torque.

Rear main bearing cap bolt torque 81-95 Nm

10. Install engine sump.

Flywheel/Flexplate



Remove

1. Remove the transmission, clutch pressure plate and disc, following the procedures in 'Clutch Chapter', on a manual shift transmission. Do not drain the transmission. On a vehicle with automatic transmission and converter housing following the procedure in 'Automatic Transmission'. Do not drain the transmission.

2. Remove the retaining bolts and remove the flywheel/flexplate.

Install

1. Use oil resistant Pipe Sealant with Teflon to coat the threads of the flywheel attaching bolts. Position the flywheel on the crankshaft flange. Install and tighten the bolts in sequence (across from each other) to specification.

Flywheel/Flexplate bolt torque spec: 81-88Nm

2. Install the clutch pressure plate, disc, and the transmission following the procedure in 'Clutch Chapter' on a manual shift transmission.

Install the converter housing and transmission following the procedure in 'Automatic Transmission' on a vehicle with automatic transmission. It is not necessary to adjust the transmission when it has been removed only for flywheel removal.

Clutch Spigot Bearing

Remove

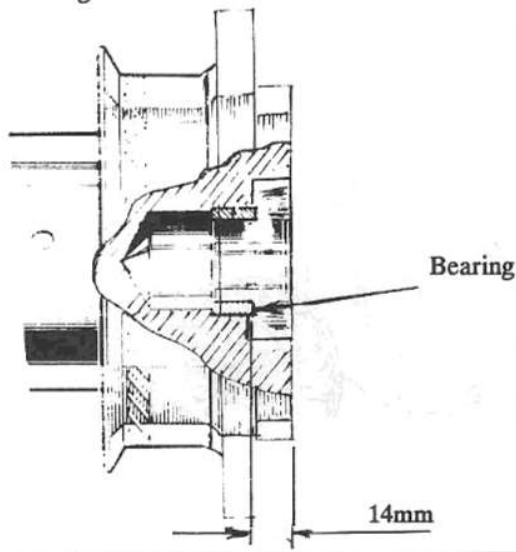
1. Remove the transmission, clutch pressure plate, and disc following the procedures in 'Clutch Chapter'.

2. Remove the pilot bearing with an expanding puller.

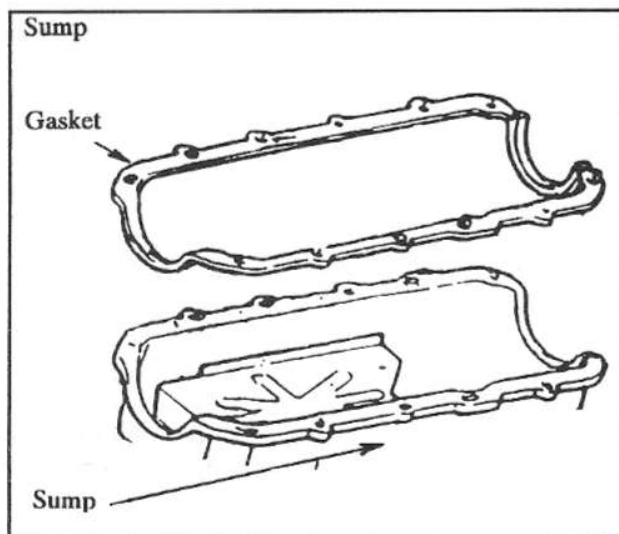
Install

Install the spigot bearing. Install the clutch pressure plate, disc and the transmission following the procedure in 'Clutch Chapter'.

* Press the adaptor into the crankshaft until the adaptor bottoms in the bore in the crankshaft. Do not change the location of the bearing in the adaptor.

Spigot Bearing**Sump (Oil Pan)****Remove**

1. Remove the oil level indicator (Dipstick) from the L.H. side of the oil pan.
2. Drain oil from sump.
3. Detach starter motor electrical connections. Remove the starter motor retaining bolts and remove the starter motor.
4. Install an engine support, raise the engine enough to relieve engine mount compression.
5. Remove the four front crossmember suspension sub-frame retaining nuts from the support bolts. As described in "Front Suspension Chapter". Lower crossmember.
6. Remove the power steering rack retaining bolts, detach the steering rack from the sub frame and support using wire ties. Remove the stabiliser bar to subframe bolts.
7. Clean around the oil pan to cylinder block joint, remove the oil pan attaching bolts and remove the oil pan.

Install

1. Clean the oil pan gasket surface on the cylinder block. Clean the oil pan and inspect for damage.
2. Apply sealer on parting line between engine block and rear main bearing cap.
3. Install the oil pan gasket to the cylinder block. Install the oil pan, ensure the gasket is not displaced and install the retaining bolts.

Sump Retaining bolts torque spec: 8-10 Nm.

4. Install drain plug into sump with a new seal.

Drain Plug torque specification: 20-27Nm

5. Refit the crossmember to frame and install hardware. Torque to specification. As described in "Front Suspension Chapter".

6. Install the stabiliser bar to the sub frame. Install the power steering rack to the sub frame. Install the four front crossmember to frame retaining nuts, as described in "Front Suspension Chapter".

7. Lower the engine, remove engine supports.

8. Refit starter motor and connect wiring. Install the oil level indicator.

9. Replace the dipstick (Oil level indicator).

10. Fill the sump with engine oil of specified amount and specified oil.

Oil Quality

Oil quality

SF or SG Engine Oil

Oil Capacity

V8

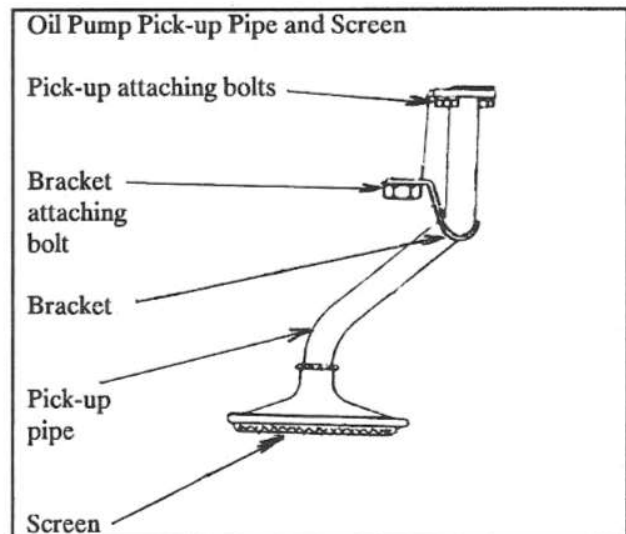
Oil pan capacity (less filter): 4.8 litres

Oil Filter Capacity: 0.3 litres

11. Start engine and inspect for leaks. Install intake manifold cover.

Oil Pump Pick-up Pipe and Screen**Remove**

1. Remove sump as described above.
2. Remove the 3 bolts attaching the tube and screen to the cylinder block.

Install

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1. Install the oil pump pick up tube and screen assembly and 3 bolts, tighten to specified torque.

Oil Pump Pick-up tube and screen torque spec:
8-11Nm

2. Install sump as described above.

3. Fill the sump with engine oil of specified amount and specified oil.

Oil Quality

Oil quality SF or SG Engine Oil

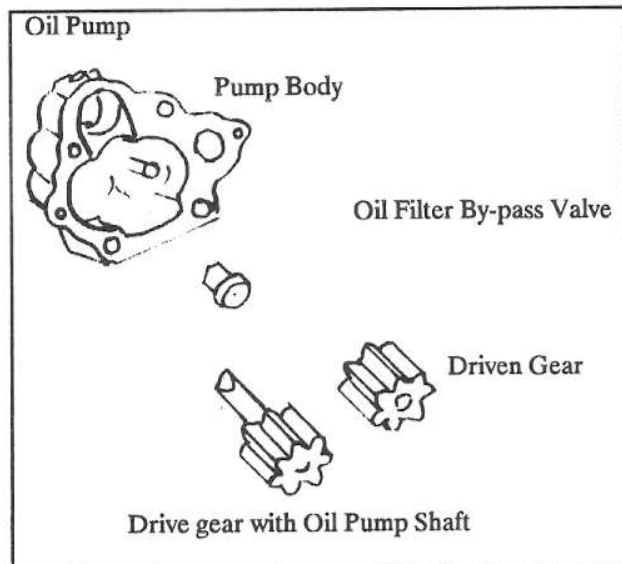
Oil Capacity

V8

Oil pan capacity (less filter): 4.8 litres

Oil Filter Capacity: 0.3 litres

4. Start engine and inspect for leaks. Install intake manifold cover.

Oil Pump**Remove**

1. Remove electrical connection to oil pump.
2. Remove oil filter.
3. Remove the 4 oil pump attaching bolts. Remove the oil pump.
4. Remove bolt type plug on side of filter section of pump body, spring and valve.
5. Remove the pump cover bolts and remove cover.
6. Mark gears with felt pen or scratch mark to help during assembly, remove gears.

Install

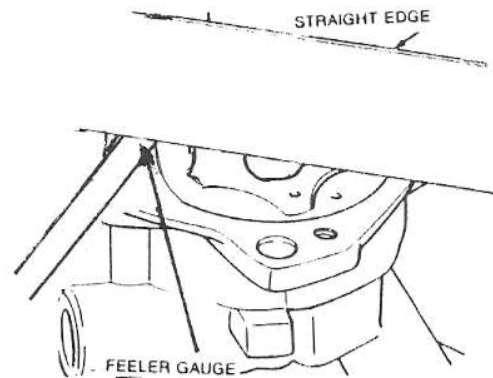
1. Clean and install pump gears aligning marks during removal.
2. Check gear clearance to pump with a straight edge and feeler gauge for specified clearance.

Gears should protude: 0.050-0.150mm

3. Check gear back lash for specified tolerance with a feeler gauge.

Gear Back lash: 0.230-0.380mm

Gears should protude: 0.050-0.150mm



4. Install pump cover and tighten the bolts to specification.

Pump Cover attaching bolts torque spec: 6-7Nm

5. Clean and install pump pressure valve, spring and plug, tighten plug to specification.

Oil Pressure Valve Plug torque spec: 34-41Nm

6. Clean gasket surfaces for oil pump and engine, coat a thin layer of gasket sealant to both surfaces and fix gasket to oil pump.

7. Install oil pump and tighten 4 attaching bolts to specification.

Oil Pump attaching bolts torque spec: 23-30Nm

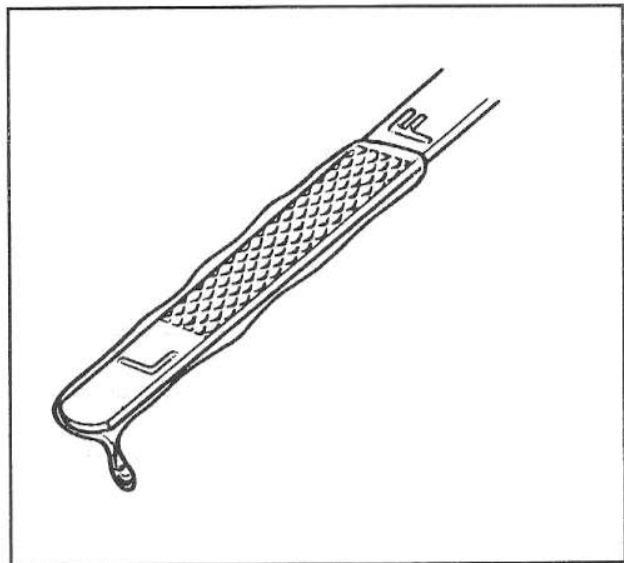
8. Replace oil pressure switch if it was removed, tighten to specification.

Oil Pressure Switch torque spec: 12-14Nm

9. Fit a new oil filter and seal. Tighten Seal till surfaces meet, then turn an extra 2/3 of a turn.

10. Install the oil pan and related parts.

11. Pour oil into engine, check oil level, start engine and check for oil leaks.

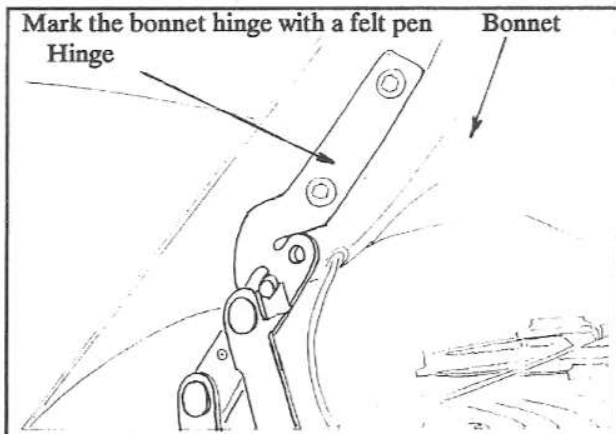


MAJOR REPAIRS & REBUILD

Engine

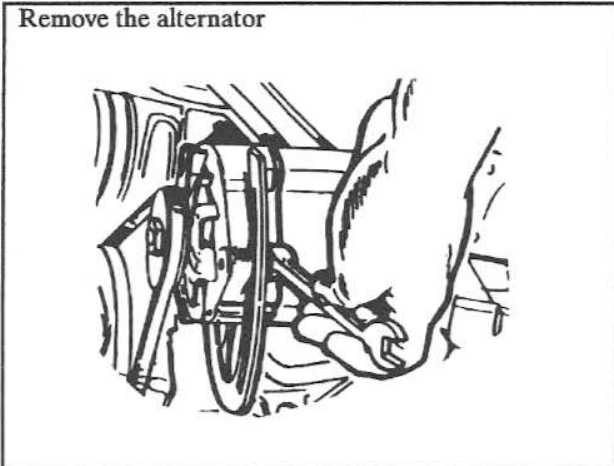
Remove

1. Install fender covers and remove the bonnet to enable the engine to be lifted out. Mark the bonnet hinge with a felt pen to help align the bonnet during installation.



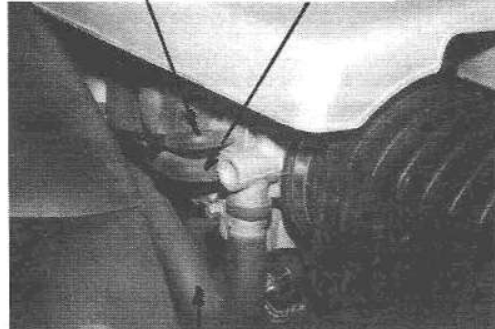
2. Release the fuel pressure in the fuel lines as previously described in tune-up chapter.
3. Remove earth cable from battery and battery to engine, also earth strap from ignition coil assembly.
4. Remove the the power steering pump attaching bolts and power steering pump reservoir, place to one side with the hoses attached.
5. Remove the alternator and tie the wiring loom aside.

Remove the alternator



6. Empty the coolant by disconnecting the lower radiator hose from the engine, then disconnect the upper hose.
7. Disconnect the coolant hoses from the right side of the engine compartment, label if necessary.
8. Remove the air ducting between the air cleaner and throttle body.
9. Remove the exhaust manifold bolts and leave the manifolds on the exhaust pipes.

Carbon Canister control purge line
Carbon Canister purge line

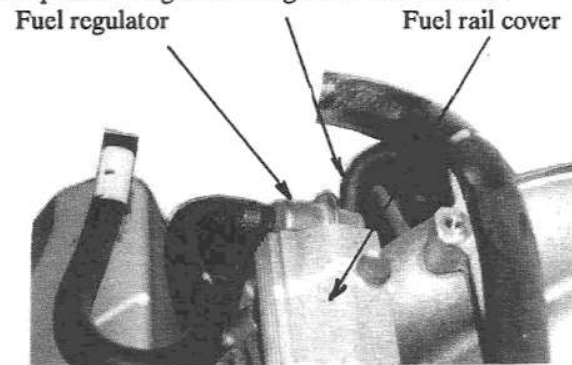


Right Rocker Cover breather hose

10. Disconnect the vacuum lines from the throttle body & intake manifold including the canister purge lines and brake booster pipe.

11. Detach the fuel feed and return lines at the injector rail and pressure regulator.

Detach the fuel feed and return lines to the injector rail and pressure regulator. Regulator vacuum hose



12. Detach the wiring from the sensors positioned in the thermostat housing, the throttle positioner, injectors, ignition coil block, oil pressure sender, MAP sensor, idle control valve, MAT sensor. Label and tie these wiring looms to the back of the engine compartment.

13. Detach the kickdown cable, TV cable and cruise control cable if fitted.

14. Detach the engine wiring loom connectors from the ECM located behind passenger side kick panel in the front section of the passenger compartment.

15. Remove wiring connectors from the transmission, automatic or manual.

16. Manual transmission vehicles, disconnect the clutch activating cable.

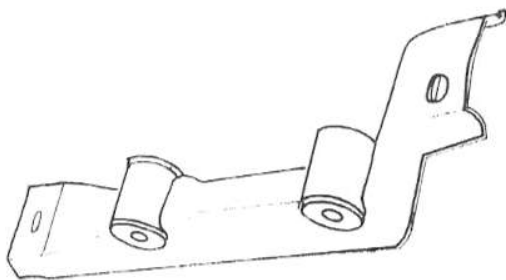
17. Automatic transmission vehicles, cable activated remove the cable, electrical activated transmission remove the wiring connectors.

18. Automatic transmissions remove the transmission fluid cooler tubes from the radiator.

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Rear transmission mount



19. Remove the rear transmission mount as previously described.

20. Remove the tail shaft as described in the "Tail Shaft and Universals chapter".

21. Install a lifting sling to the engine.

22. Take the weight of the engine and transmission assembly on the lifting sling and remove the front engine mount through bolts.

23. Raise the engine and transmission assembly from the vehicle.

24. Place the engine on a clean work area and separate the transmission from the engine.

Install

1. Bolt the engine and transmission together and tighten the bolts to specification.

Automatic Transmission:

Converter housing bolt to engine: 40-45 Nm

Crossmember bolt: 40-51 Nm

Crossmember brace bolt: 30-40 Nm

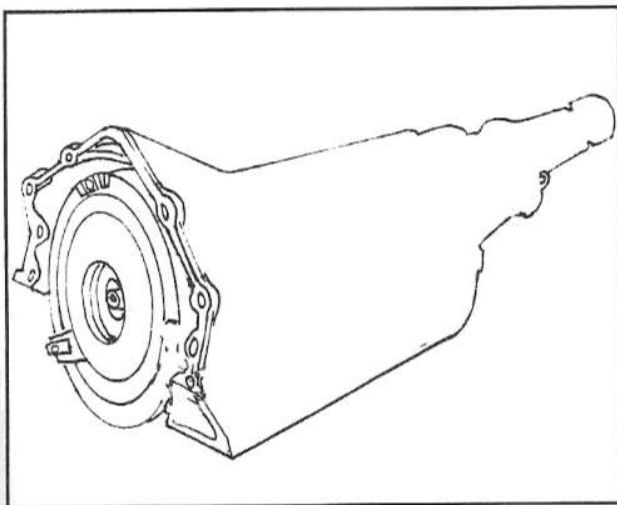
Torque converter to flex plate bolts: 40-45 Nm

TV cable to transmission screw: 8-10 Nm

Manual Transmission.

Case Cover to Transmission Case Attaching

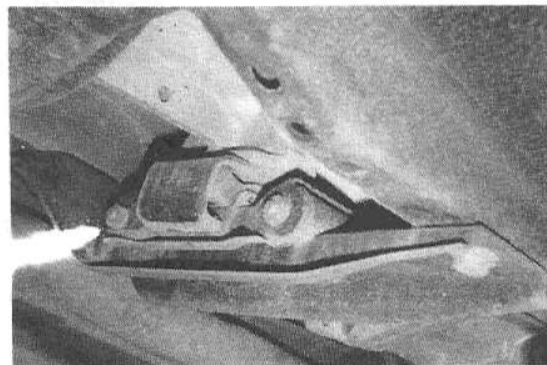
Bolt: 8 - 15Nm

**Transmission Extension to Transmission**

Case Attaching Bolt: 40 - 60Nm

2. Lift the engine and transmission assembly and lower into the vehicle.

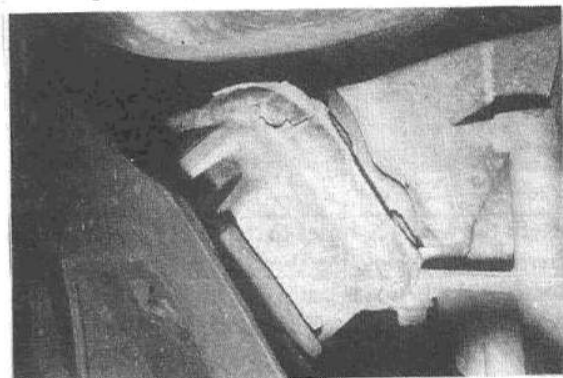
3. Replace the rear transmission mount as previously described.

Replace the rear transmission mount

Rear Crossmember to side frame bolt: 40-50Nm

Support to rear mounting nut: 20-25Nm

4. Replace the front engine mount as previously described.

Front engine mount

Engine mount to bracket cross member: 35-65Nm

Engine mount to cylinder block: 35-65Nm

5. Install the tail shaft as described in the Tail shaft and universals chapter.

6. Automatic transmissions install the transmission fluid cooler tubes to the radiator.

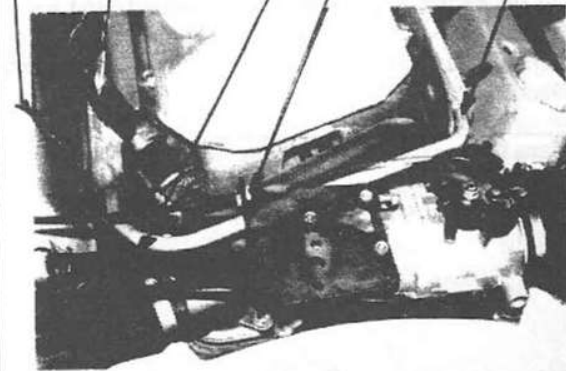
7. Automatic transmission vehicles, cable activated replace the cable, electrical activated transmission replace the wiring connectors.

8. Manual transmission vehicles, connect the clutch activating cable.

9. Replace wiring connectors to the transmission, automatic or manual.

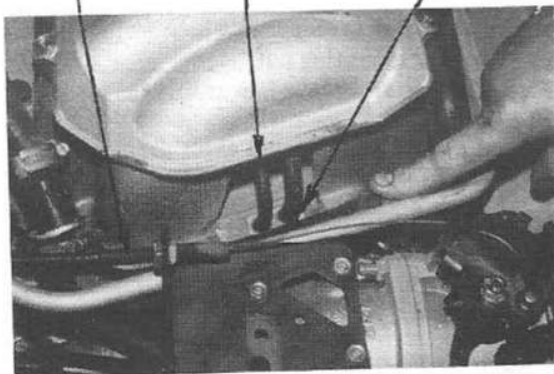
10. Refit the engine wiring loom connectors to the ECM located behind passenger side kick panel in the front section of the passenger compartment.

Wiring loom to injectors
Heater water hose
Breather hose to throttle body
Throttle cable
Fuel rail



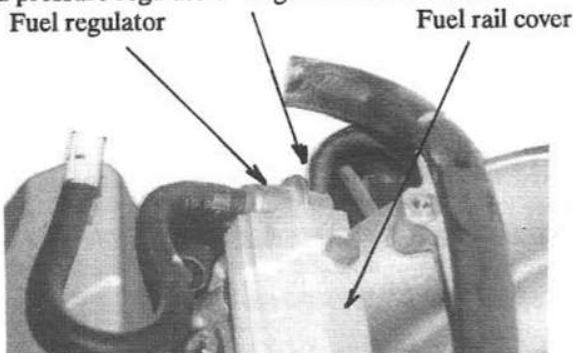
11. Install the kickdown cable and cruise control cable if fitted.

Throttle cable
Fuel regulator hose
MAP hose



12. Refit the wiring & hoses to the sensors positioned in the thermostat housing, the throttle positioner, injectors, ignition coil block, oil pressure sender, MAP sensor, idle control valve, MAT sensor. The labelled connectors (from removal) will help to identify the correct connectors.

Install the fuel feed and return lines to the injector rail and pressure regulator. Regulator vacuum hose

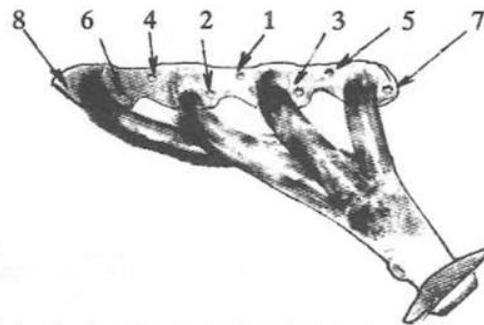


13. Install the fuel feed and return lines to the injector rail and pressure regulator.

14. Reconnect the vacuum lines to the intake manifold including the canister purge lines and brake booster pipe.

15. Install the exhaust manifolds and bolts to specified torque and in correct order.

Install the exhaust manifolds and bolts to specified torque and in correct order



Exhaust manifold torque specification: 40-60Nm

16. Replace the air ducting between the air cleaner and throttle body.

17. Reconnect the coolant hoses at the right side of the engine compartment.

18. Reconnecting the lower and upper radiator hoses to the engine. Refill the coolant system with specified coolant.

Refill the coolant system with specified coolant.



Specified Coolant: HN 2043, Eg Tectaloy Plus +

19. Replace the alternator and wiring loom connectors.

20. Replace the the power steering pump attaching bolts and power steering pump reservoir.

Power steering pump attaching bolts torque: 20-28Nm.

21. Replace the earth cable to battery and battery to engine, also earth strap to ignition coil assembly.

22. Install the bonnet, align the bonnet with felt pen marks to help aligning the bonnet to correct position.

Engine Dismantle and Assemble**Dismantle**

* Prior to beginning to dismantle, remove all wiring harnesses, emission control system, fuel system, ignition system, flywheel, rear cover plate and front end accessory drive components.

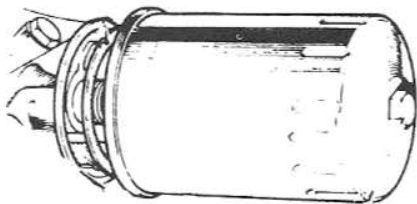
For more detailed information on any particular system, refer to the specific section in the suitable repair group.

With the engine placed on a work stand:

Dismantle

1. Drain the engine oil and remove the dipstick tube.
2. Take the exhaust manifolds off if fitted.
3. Remove the coil assembly, spark plug leads and spark plugs
4. Remove the oil filter, oil pressure sender unit.

Remove the oil filter, oil pressure sender unit and oil pump

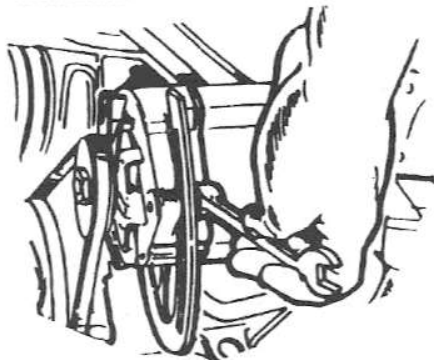


5. Remove the rocker arm covers and inspect the rocker arm pivots and arms.

6. Remove the drive belts and tensioner.

Remove the alternator assembly and mounting brackets

Alternator

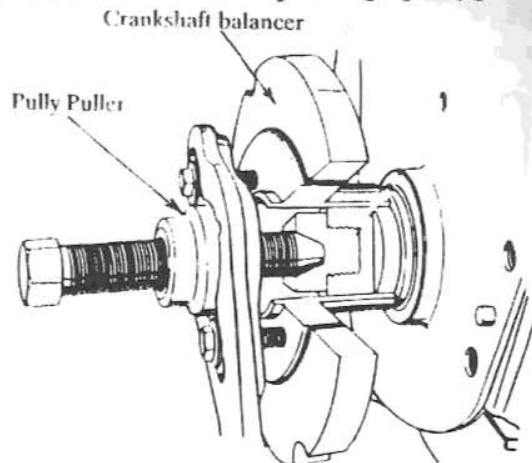


7. Remove the alternator assembly and mounting brackets.

8. Remove the the water pump.

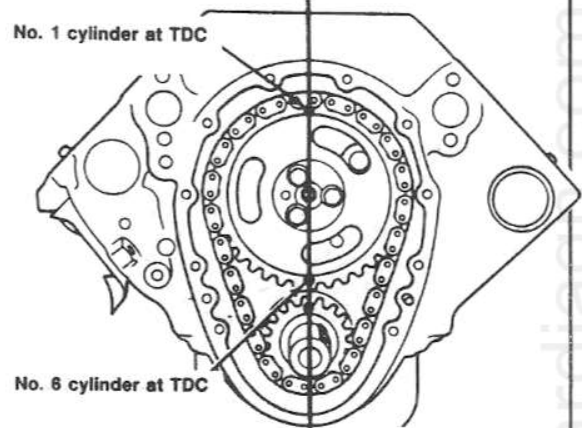
9. Remove the crankshaft damper using a pulley puller.

Remove the crankshaft damper using a pulley puller.



10. Remove the timing cover, hold the camshaft gear and loosen the camshaft gear bolt one half turn.

Align marks at No1 TDC on compression

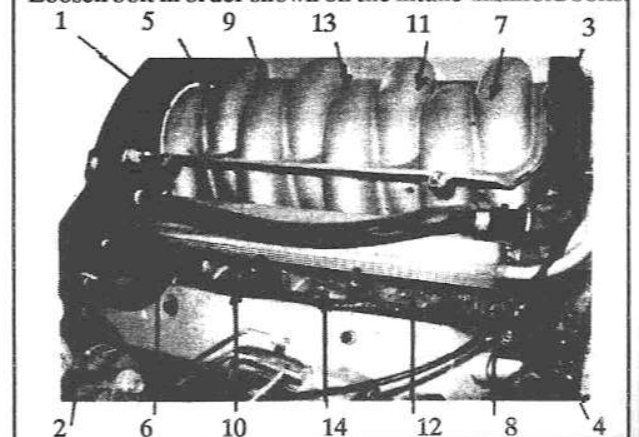


11. Remove the camshaft timing chain, gear and camshaft as described under camshaft section.

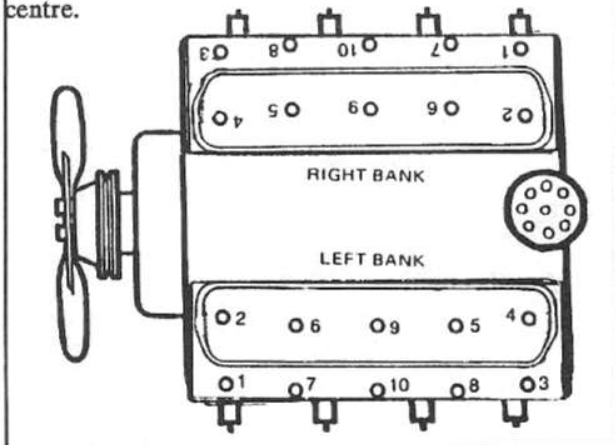
12. Remove the distributor.

13. Remove the intake manifold as described under intake manifold

Loosen bolt in order shown on the intake manifold bolts.

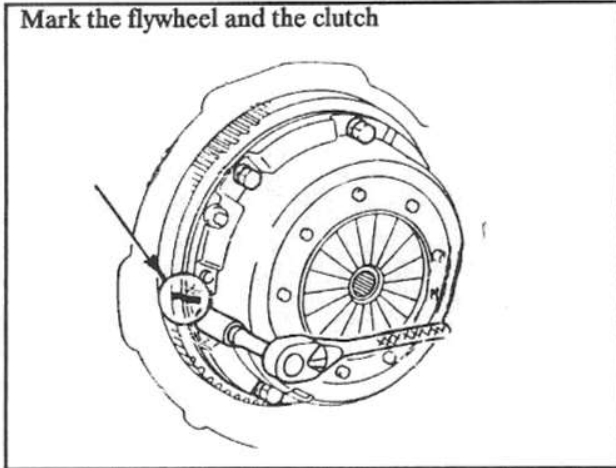


Loosening the bolts gradually from each end to the centre.



14. Remove the cylinder heads after loosening the bolts gradually from each end to the centre.

Mark the flywheel and the clutch



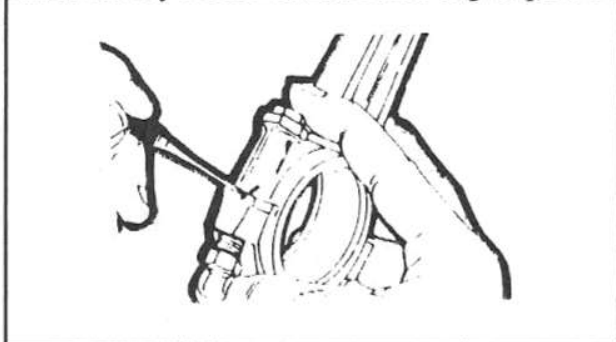
15. Mark the flywheel and the clutch, on a vehicle with a manual transmission, so that they may be replaced in the same relationship. Remove the clutch and pressure plates.

16. Remove the flywheel, clutch pilot bearing and the engine rear cover plate.

17. Remove the flywheel and cover plate for automatic transmission.

18. Remove the sump and throw away gaskets and seals. Remove the oil pump pickup strainer and pipe.

Check that all main and connecting rod bearing caps are marked so they can be installed in their original position.

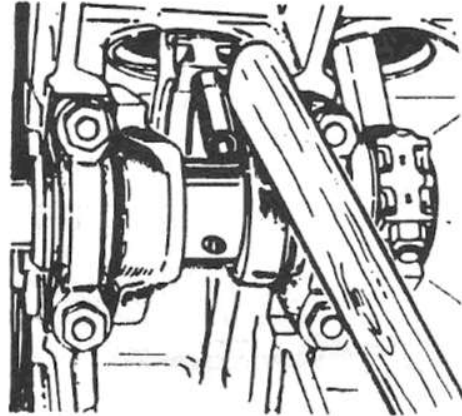


19. Check that all main and connecting rod bearing caps are marked so they can be installed in their original position. Turn the crankshaft until the connecting rod bearing to be removed is easily accessible.

20. Take the bearing inserts out from the connecting rods and caps. Remove the connecting rod bearing caps.

21. Install protective covers on the connecting rod bolts.

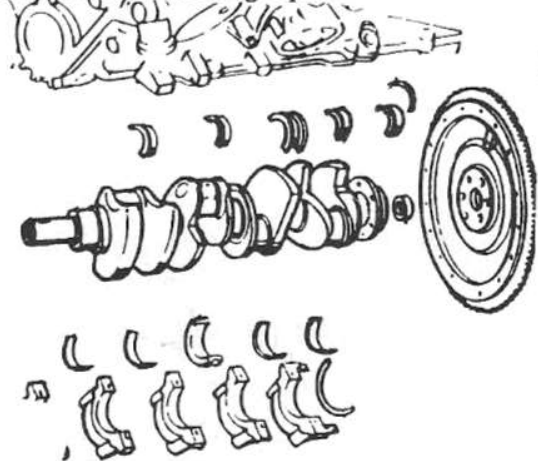
Install protective covers on the connecting rod bolts.



22. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of the hammer. Avoid damage to the crank shaft or the cylinder wall when removing the piston and connecting rod.

23. Remove the main bearing caps.

Remove the main bearing caps.



24. Remove the rear main bearing seals.

25. Lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces. Remove the main bearing inserts from the block and bearing caps.

Cylinder Block

Refinishing Cylinder Walls

Detach any ridges and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridges with a ridge cutter.

When removing ridges never cut into the ring travel area in excess of 0.8 mm.

Only when the walls have minor faults such as light scuffs or scratches, honing is recommended for refinishing. The quantity of metal that has to be removed will calculate the grade of hone to be used. If coarse stones are used to begin the honing operation, leave adequate material so that all hone marks can be removed with the finishing hone, which is used to gain the required piston clearance.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. Prior to any cylinder being refinished, all the main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the refinishing operation.

Refinish only the cylinder or the cylinders that require the refinishing. All pistons are the same weight, both standard and oversize, thus, various sizes of pistons can be used without upsetting engine balance.

To calculate the maximum oversize, refinish the cylinder with the most wear first. Replace the cylinder block, if the cylinder will not clean up when refinished to the maximum oversize piston size recommended.

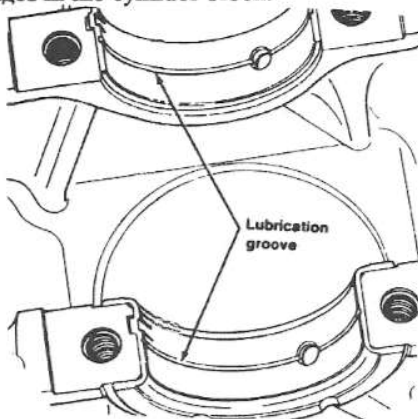
Assembly

Clean all segments, and clean all sealer and adhesive from all joining components.

1. Install the correct undersize bearings if the crankshaft main bearing journals have been refinished to a definite undersize. Check that the bearing bores are clean. Place the main upper arm bearing inserts in position in the bore with the tang fitting in the slot provided.

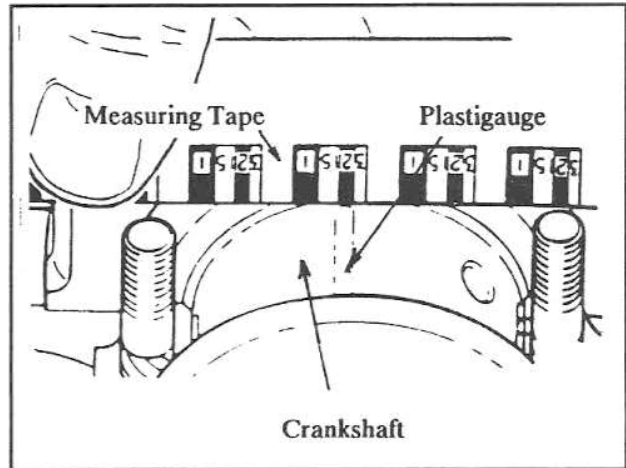
No. 3 upper main bearing incorporates the thrust bearing flanges in the cylinder block. Install the lower main bearing inserts in the bearing caps.

No. 3 upper main bearing incorporates the thrust bearing flanges in the cylinder block.



2. Lower the crankshaft into place. Do not damage the bearing surfaces.

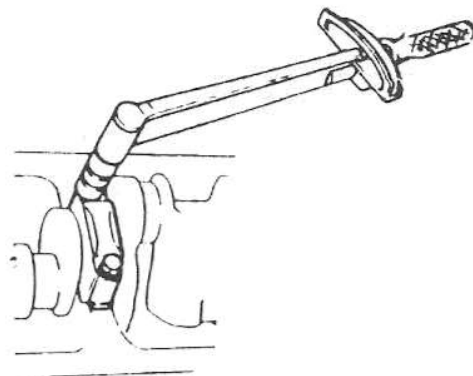
3. Inspect the clearance of each main bearing as described in "Main Bearing Replacement".



4. Apply a light coat of engine oil to the journals and bearings. Apply oil resistance sealer to the rear main bearing cap at the rear of the top mating surface.

Install the bearing caps. Check that the main bearing caps are installed in their original locations. Torque the bearing cap bolts to specification.

Torque the bearing cap bolts to specification.



Main bearing cap bolts specified torque: 81-95Nm

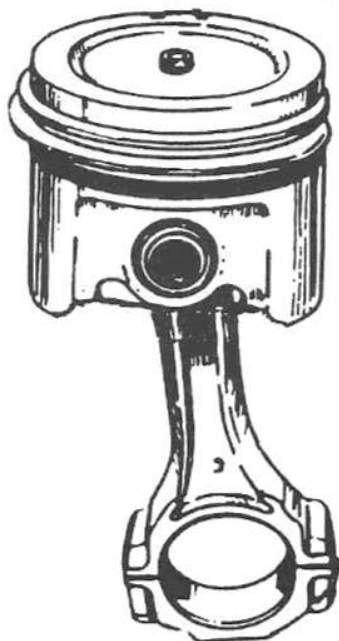
5. Install the rear main bearing oil seal with the help of special tools as described under Rear main bearing oil seal section

6. Inspect the crankshaft end play as described in "Rear main bearing seal" on page No 152.

7. Rotate the engine on the work stand. Oil the piston rings, pistons, and cylinder walls with light engine oil.

8. Check that the pistons are installed in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing caps should have been numbered from 1 - 8 when the engine was dismantled.

Piston and Connecting Rod Assembly

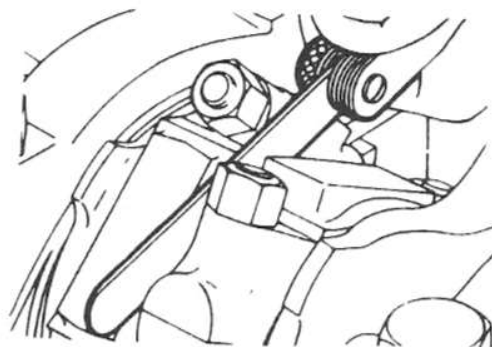


The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. New bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number if a connecting rod is ever transposed from one block or cylinder to another.



11. Inspect the clearance of each bearing following the procedure under 'Connecting Rod Bearings Replacement'.

Connecting rod side clearance: 0.203-0.356mm

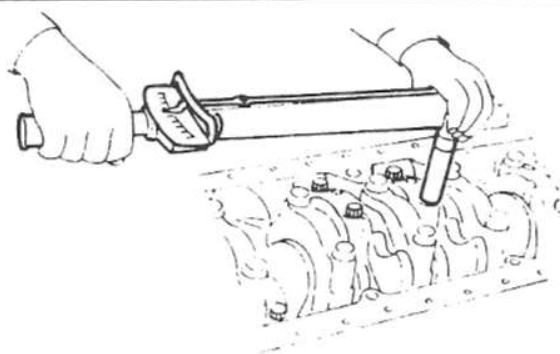


Connecting rod side clearance: 0.203-0.356mm

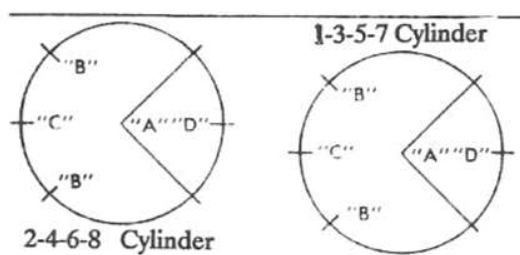
12. Apply a light coat of engine oil to the journals and bearings. Rotate the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Take the protection covers off.

13. Place the connecting rod cap on. Torque the nuts to specification.

Connecting rod cap bolt torque: 56-64Nm



Engine left Engine front Engine right



"A" Oil ring spacer gap
(Tang in hole or slot within arc)
"B" Oil ring rail gaps
"C" 2nd compression ring gap
"D" Top compression ring gap

9. Check that the ring gaps are properly spaced around the circumference of the piston.

10. Place a piston ring compressor on the piston and press the piston in with a hammer handle until the piston is below the surface of the cylinder block. Direct the connecting rods to avoid damaging the crankshaft journals. Place the piston with the arrow on the piston head toward the front of the engine.

13. Inspect the connecting rod side clearance on each crankshaft journal.

14. Install the oil pump pickup pipe and strainer.

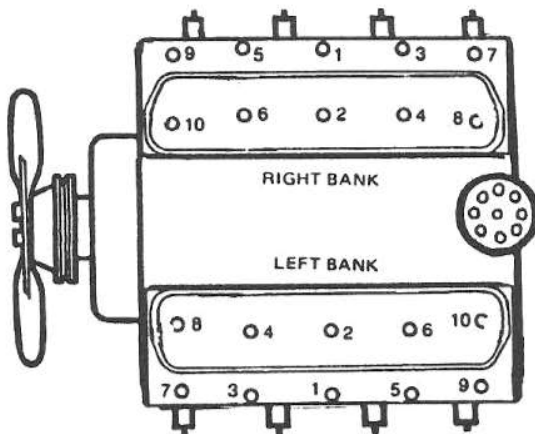
15. Install the sump and tighten bolts to specification.

Sump bolt torque specification: 8-10Nm

15. Install the cylinder head gaskets. Place the gasket over the dowels in the cylinder block. Make sure the "TOP" marking is on the up side of the gasket. There is sealant on the top of the gasket.

16. Install the cylinder heads as described under cylinder heads, tighten bolts to specified torque in correct order.

Tighten bolts to specified torque in correct order.



Step 1 - Head Stud Torque specification: 50-55Nm

Step 2 - Head Stud further tighten to: 77-83Nm

17. Install the camshaft as in camshaft section.

18. Install the timing chain cover with new gaskets as previously described.

19. Tighten the bolts for the cover then install and torque the bolts on the sump.

Timing Cover to Cylinder Block: 23-30Nm

20. Install the oil pump to the cylinder block.

Oil Pump to cylinder block torque spec: 23-30Nm

21. Install a new oil filter if the oil filter was removed.

Oil Filter tighten until surfaces meet plus 2/3 turn.

22. Replace the crankshaft balancer and bolt, torque bolt to specification.

Crankshaft Balancer bolt torque: 190Nm min

23. Install the water pump as previously described.

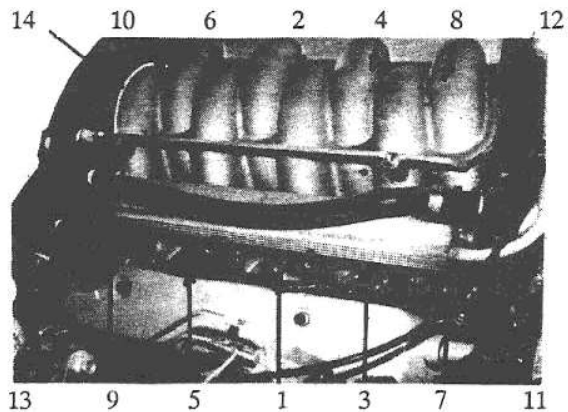
Water Pump to Timing Cover bolt torque spec: 17-22Nm

24. Install the hydraulic valve lifters into the same lifter position from which they were removed.

25. Install intake manifold and new gaskets, ensure that the gaskets fit correctly and apply sealant to the front and rear gasket seals as well as the intake manifold attaching bolts. Torque bolts to specified torque in the order shown in the diagram.

Intake manifold bolts specified torque: 34-41Nm.

Tighten the intake manifold bolts in sequence.



26. Reinstall the push rods, rocker assemblies in the order that they were removed.

Pivot bolts torque specification: 24-32Nm

27. Reinstall the rocker covers.

Rocker cover bolt torque specification: 8-10Nm

28. Install the clutch pilot bearing in the crankshaft on manual transmission vehicles. Install the clutch assembly on the flywheel using a suitable tool to align the disc.

29. Place lock tight sealer to the bolt threads and install the flywheel, tighten bolts to specified torque. Install the engine rear cover plate.

Flywheel / Flexplate bolt specifications: 74-88 Nm

30. Install the alternator assembly and mounting brackets.

Alternator Upper Attaching Nut And Bolt

Torque Specification: 34-44 Nm.

Alternator Attaching Bolt

Torque Specification: 12-16 Nm.

31. Install starter motor, tighten bolts to specification.

Starter Motor To Block Bolts: 40-60Nm

Starter Motor Brace To Block: 12-16Nm

32. Install the drive belt and tensioner. Adjust belt, turn the automatic adjuster idler pulley mounting stud to adjust tension.

Drive Belt Tension Specification:

57 kg new 34 kg used

33. Install the coil assembly, spark plug leads and spark plugs.

Spark Plug specified torque: 20-30Nm

34. Install the exhaust manifolds. Tighten the bolts to specification and in correct order.

Exhaust manifold torque specification: 24-34Nm

35. Install the dipstick tube.

36. Fill the engine with specified amount of engine oil.

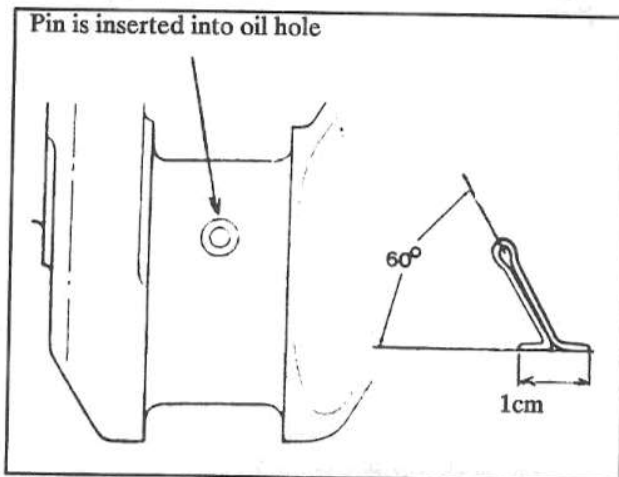
Oil capacity including Oil Filter: 4.8Litres

Main Bearing Replacement (Engine in Vehicle)**Remove**

1. Remove the oil level dip stick and the sump.
2. Remove the oil pickup pipe and strainer.
3. Remove one bearing at a time, leaving the other bearings securely fastened. Remove the main bearing cap to which new bearings are to be installed.

If the rear main bearing is removed care must be taken with the rear main seal. VN models replace the seal as the rear main cap is installed.

4. To remove the upper section of the bearing shell, place an appropriate flat headed pin or split as shown in the oil hole in the crankshaft.



* Care must be taken not to damaged the crankshaft.

Turn the crankshaft in the direction engine turns to force the bearings out of the block. Remove the pin. Clean the crankshaft journal.

5. Place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that the pin can be installed in the oil hole in the crankshaft. With the pin placed in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction to engine rotation until the bearing seats itself. Turn the the shaft back slightly to remove the pin.

Clean

Using solvent clean the bearing inserts and caps thoroughly, and dry them with compressed air. Do not scrape gum or varnish deposits from the bearing shells.

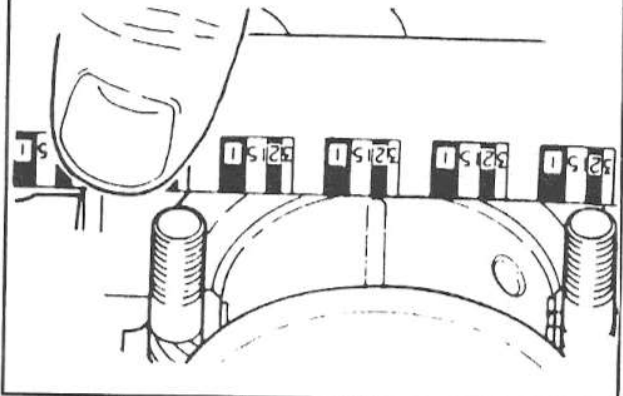
Inspect

Carefully inspect each bearing. Replace any bearings that have a scored, chipped or worn surface. The copper lead bearing base may be visible through the bearing overlay, although this does not mean that the bearing is worn. If the bearing clearance is within its limits it is not essential to restore the bearing. Inspect the clearance of bearings that seem to be suitable with Plastigage.

Install

1. Install the cap bearing and place a piece of Plastigage on the crankshaft journal full width of the bearing cap and about 5 mm off centre.

Do not turn the crankshaft while the Plastigage is in place.



2. Install the cap and torque the bolts to specifications.

Main Bearing cap bolt specified torque: 81-95Nm

Do not turn the crankshaft while the Plastigage is in place.

3. Take the cap off. Using the Plastigage scale, check the width of the Plastigage. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The variation between the two readings is the taper.

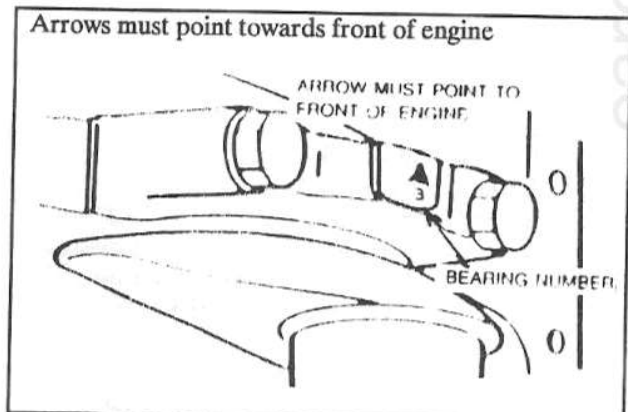
Clean all of the plastigage from the crankshaft journal.

4. If the clearance is more than specified, fit under size bearings.

Main Bearing clearance: .013-0.051mm

The bearing clearance must be within specified limits.

If the standard and 0.0254 mm undersize bearings do not bring the clearance within the desired limits, refinish the crankshaft journals; then install undersize bearings, make

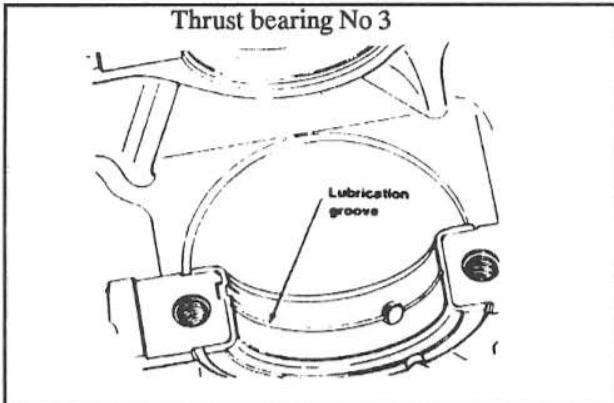


sure that the arrows on the bearing shells are pointing towards front of engine.

5. If the rear main bearings are replaced, replace the oil seal as featured under Rear Main Bearing Seal Replacement. Apply oil resistant sealer to the rear main bearing cap mating surface.

6. Apply a light coat of engine oil to the journal and bearings, then install the bearing cap.

7. Repeat the procedure for the remaining bearings that require replacement.



8. Check crankshaft end float by using a screw driver to move the the crankshaft forward and back. Place a feeler gauge between the No 3 bearing flange and the crankshaft, check that end float is within specification, if so replace No 3 bearing shells

Crankshaft End Float specification: 0.08-0.28mm

* The No. 3 main bearing incorporates the crankshaft thrust flanges.

9. Clean the oil pump inlet pipe screen and refit, tighten bolts to specification.

Oil pickup pipe attaching bolt specified torque: 8-10Nm

10. Install sump, tighten bolts to specification.

Sump attaching bolt specifcied torque: 8-10Nm

Connecting Rod Bearings (Engine in Vehicle)

Remove

1. Remove spark plugs.
2. Remove the oil level dip stick and the sump.
3. Remove the oil pickup pipe and strainer.
4. Rotate the crankshaft until the connecting rod is easy to work on. Detach the connecting rod cap and the bearing inserts from the rod and cap.

5. Check that the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause failure.

Clean

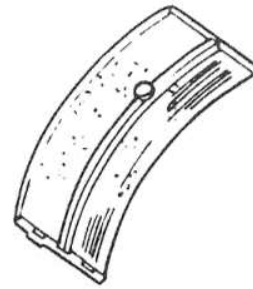
Using solvent clean the bearing inserts and caps thoroughly, and dry them with compressed air. Do not scrape gum or varnish deposits from the bearing shells.

Inspect

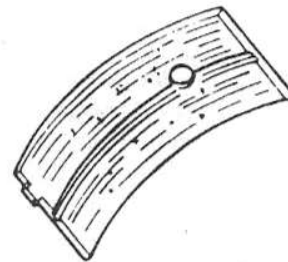
Carefully inspect each bearing. Replace any bearings that have a scored, chipped or worn surface. The copper lead bearing base may be visible through the bearing overlay, although this does not mean that the bearing is worn. If the bearing clearance is within its limits it is not essential to restore the bearing. Inspect the clearance of bearings that seem to be suitable with Plastigage.

Install

Tapered journal



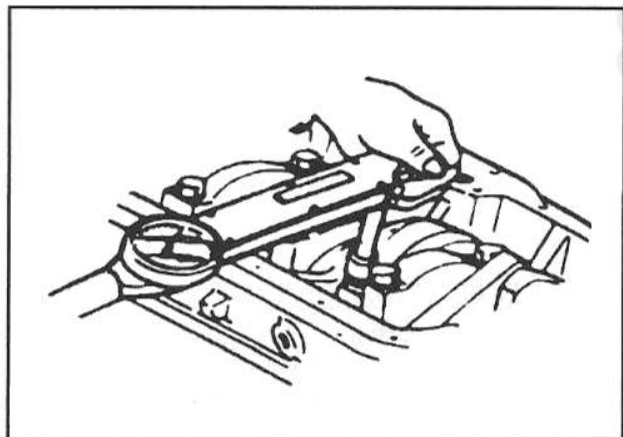
Lack of oil



1. Clean the crankshaft journal. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slot provided.

2. Pull the connecting rod assembly firmly onto the crankshaft journal.

3. Place a piece of Plastigage on the crankshaft journal, the full width of the cap and about 5 mm off centre.



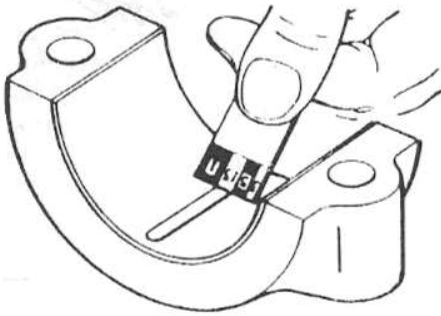
4. Place the cap and torque the connecting rod nuts to specification.

Connecting Rod Cap bolt specified torque: 20-30Nm

Do not turn the crankshaft while the Plastigage is in place.

5. Take the cap off. Use the plastigage scale and inspect the width of the plastigage. When inspecting the width of the Plastigage, inspect at the widest point in order to get

Use Plastigage to check clearance of bearing and crankshaft



minimum clearance. Inspect at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.

6. If the clearance is more than the specified limit, fit under size connecting rod bearing shells.

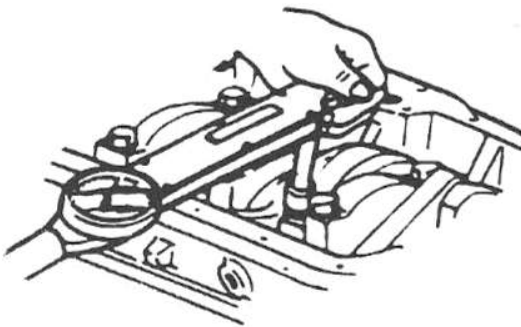
Connecting Rod Bearing clearance: 0.09mm

If the clearance is more than the specified limit, fit under size bearings. Bearing clearance must be within specified limits, replace crankshaft if necessary.

Clean all plastigage from crankshaft journal and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Tighten to specification.

Connecting Rod Bearing cap bolt specification:

56-64Nm



Connecting Rod Bearing cap bolt specification:

56-64Nm

7. Repeat the procedure for the remaining connecting rods that require new bearings and clean the oil pump inlet pipe screen.

8. Check connecting rod side clearance.

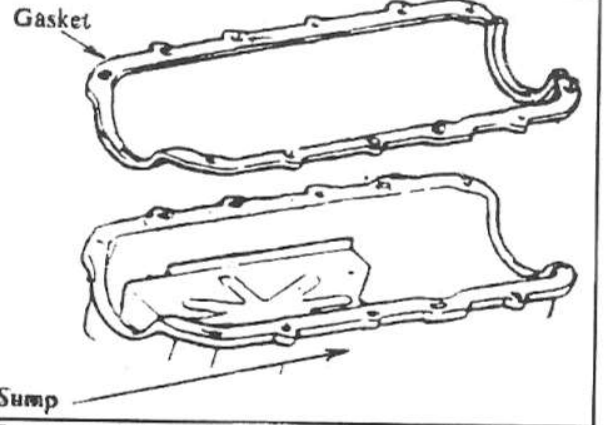
Connecting Rod side

clearance specification: 0.203-0.356mm

9. Clean the oil pump inlet pipe screen and refit, tighten bolts to specification.

Oil pickup pipe attaching bolt specified torque: 8-10Nm

10. Install sump, tighten bolts to specification.

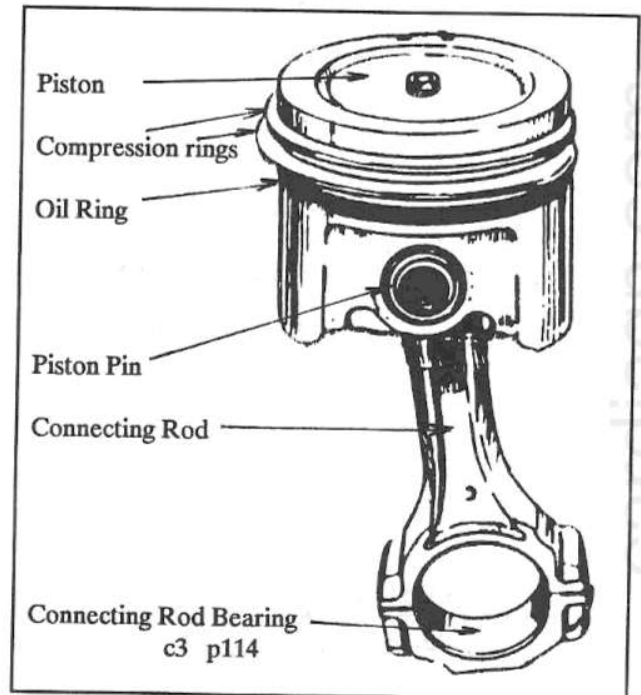


Sump attaching bolt specified torque: 8-12Nm

11. Install spark plugs and tighten to specification.

Spark Plug tightening specification: 20-30Nm

Piston and Connecting Rod Assemblies



Remove

1. Refer to 'Cylinder Head Removal' and remove the head and connecting parts.

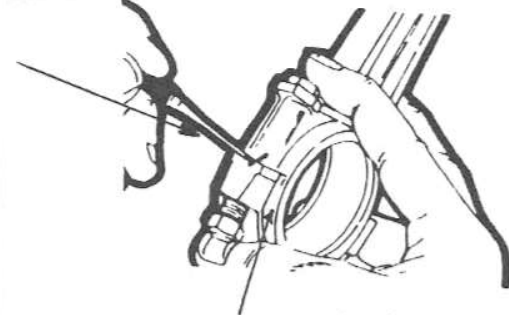
2. Take the oil pan and connecting parts out. Take the oil pump inlet tube and the oil pump out.

3. Rotate the crankshaft until the piston is at the bottom of its travel and put a cloth on the piston head to accumulate the cuttings. Take any ridge and/or deposits out from the upper end of the cylinder bores. Take the cylinder ridge out and using ridge cutter. Follow the instructions furnished by the tool manufacturer. Do not cut into the ring travel area in excess of 0.8mm when taking out ridges.

4. Check all the connecting rod caps are marked so that

Check all the connecting rod caps are marked so that they can be installed in their original positions.

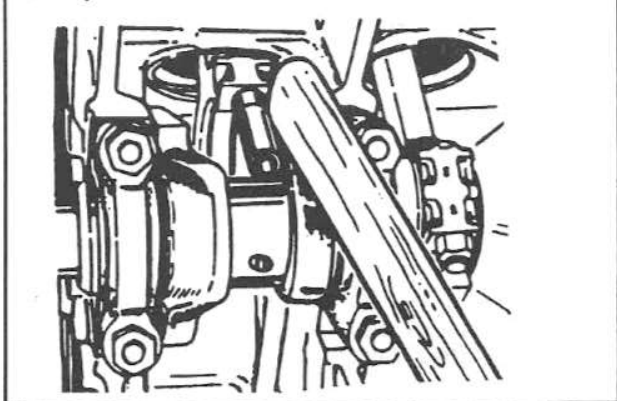
Etcher



Connecting rod and cap

they can be installed in their original positions. Take the connecting rod cap out.

Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer



5. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. Avoid damage to the crank pin or the cylinder wall when taking the piston and rod out, cover the rod bolt threads with tape or plastic tube.

Connecting Rods

Clean

Take the bearings out from the rod and cap. Identify the bearings if they are not to be used again. Using solvent clean the connecting rod, including the rod bore and the back of the inserts. Do not use a caustic cleaning solution. Using compressed air blow out all the passages.

Inspect

Inspect and check the connecting rods and related parts for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

Examine the I.D. of the connecting rod piston pin bore. Restore the connecting rod if the pin bore is not within specifications.

Piston Pin diameter: 22.995-23.000mm

Piston Pin clearance:

In piston: 0.010-0.20mm

In Connecting rod: 0.018-0.043mm

Restore defective connecting rod nuts and bolts.

If the connecting rod has been withdrawn from the piston it should be checked for bend or twist before assembling it to the piston. Connecting rods can be inspected for bend or twist while assembled to the piston.

Connecting Rod alignment:

Bend: 0.020mm per 25mm

Twist: 0.038 per 25mm

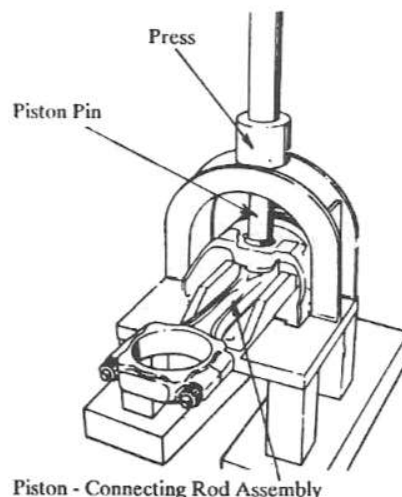
Check the connecting rods for bend or twist on a suitable alignment fixture. If the bend and/or twist exceeds specifications, the connecting rod must be straightened or replaced.

Dismantle

1. Take the bearing inserts out from the connecting rod and cap.

2. Mark the pistons and pins to secure assembly with the same rod and installation in the same cylinders from which they were removed.

Remove piston pin with a press.



3. Take the piston pin out from the piston and connecting rod with a press.

4. Remove the piston rings.

Pistons, Connecting Pins and Rings

Clean

Withdraw the deposits from the piston surfaces. Clean gum or varnish from the piston skirt, piston pins and rings with solvent. Do not use a caustic cleaning solution or a wire brush to clean pistons. Clean the ring grooves with a groove cleaner. Check the oil slots are clean.

Inspect

Check the pistons for fractures at the ring lands, skirt and pin bosses, and for scuffed, rough or scored skirts. If the lower inner portion of the ring grooves has a high step

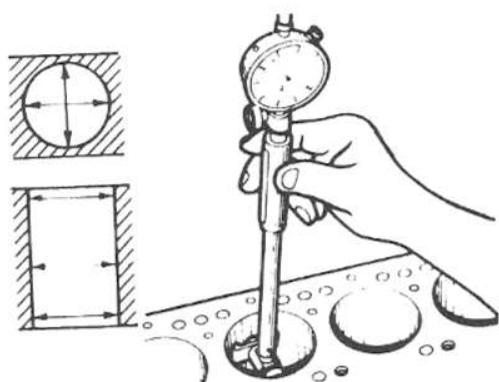
restore the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Detonation or pre-ignition are usually caused by spongy, eroded areas near the edge of the top of the piston. A bent connecting rod can cause a shiny surface on the thrust surface of the piston, offset from the centre line between the piston pin holes. Pistons that show signs of excessive wear, wavy ring lands or fractures or damage from detonation or pre-ignition replace.

By measuring the piston and bore diameters check for out of round and check the piston to cylinder bore clearance. At the centre of the piston pin bore measure the O.D. of the piston with micrometers and at 90 degrees to the pin bore axis.

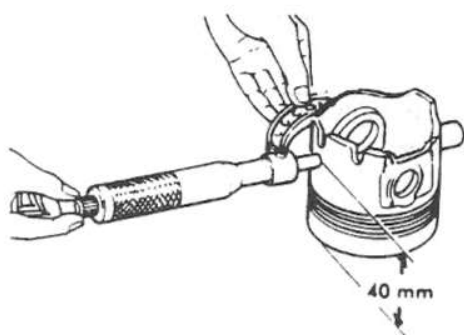
Cylinder Bore

Measuring piston bore



Standard Bore diameter: 101.60-101.676mm
Taper: 0.127 (new) 0.0127mm max
Out or round: 0.0762 (new) 0.0254mm max
Piston

Measuring piston diameter

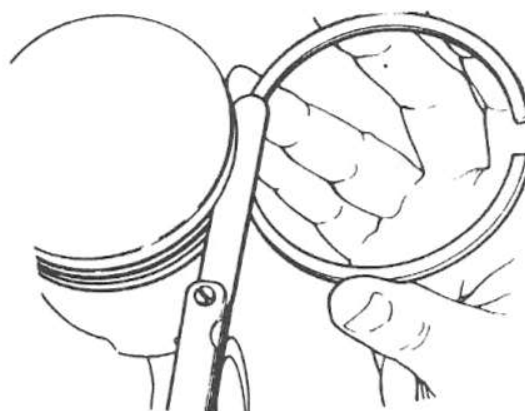


Piston standard size: 101.572-101.648mm
Available sizes: .254 and .508mm
Piston to Bore clearance: 0.20-0.036mm
 Inspect the ring side clearance following the procedure under Fitting Piston Rings.

Check piston ring side clearance

Piston Ring clearance:

Measuring piston ring clearance



Top Ring 0.039-0.079mm
Second Ring: 0.039-0.79mm
Oil Control Ring 0.028-0.206mm

Piston pins following showing signs of fracture, etching or wear replace. Inspect the piston pin fit in the piston and rod.

Piston Pin diameter: 22.995-23.000mm
Piston Pin clearance:
In piston: 0.010-0.20mm
In Connecting rod: 0.018-0.043mm

Inspect the O.D. of the piston pin and the I.D. on the pin bore in the piston. Replace any piston pin, or piston that is not within specifications.

Replace all rings that are scored, chipped or cracked.

Inspect the end gap and check for specification.

Compression Ring End Gap specification:

Measuring piston ring end gap Feeler gauge



Top ring: 0.254-0.635mm
Second ring: 0.254-0.635mm

It is good practice to always install new rings when overhauling an engine. Rings should not be transferred

5.0 LITRE V8 - MAINTENANCE & REBUILD

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from one position to another regardless of length of time in service.

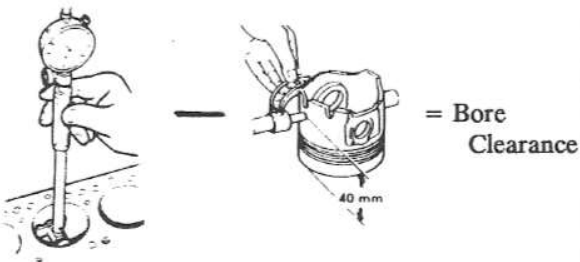
Check that the rings gaps are accurately spaced around the border of the piston. Install the piston with the arrow on the piston head toward the front of the engine.

Fitting Pistons

Pistons are obtainable in average sizes.

Follow the procedures in Cleaning and Inspection to measure the piston O.D. and cylinder bore I.D. The dimensions should be within specifications, and the piston to bore clearance (bore I.D. minus piston O.D.) must be within the specified limits.

Bore I.D. minus piston O.D = Bore clearance



Piston to Bore clearance: 0.20-0.036mm

Cylinder Bore

Standard Bore diameter: 101.60-101.676mm

Taper: 0.127 (new 0.0127)mm max

Out of round: 0.0762 (new 0.0254)mm max

Piston

Piston standard size: 101.572-101.648mm

Available sizes: .254 and .508mm

Piston to Bore clearance: 0.20-0.036mm

Refinish the cylinder if the correct clearance cannot be achieved.

Mark the piston when it has been placed for assembly in the cylinder to which it was adjusted.

New piston rings will give adequate service, if the taper, out-of-round and piston to cylinder bore clearance conditions of the cylinder bore are within specified limits.

Pistons are available in oversize of 0.254 and 0.508mm

Remove the cylinder wall gauge, if the new rings are to be positioned in a used cylinder that has not been refinished.

Clean the cylinder bore thoroughly.

1. Take a cylinder bore check, to calculate the size piston to be used. Follow the method used in Cleaning and Inspection.

2. Choose the proper size piston to provide the desired clearance, 0.020 - 0.036. Measure the piston diameter in line with centreline of the piston pin at 90 degrees to the piston pin axis.

3. Check that the piston and cylinder block are at room temperature (21 deg. C).

Allow the cylinder bore to cool and check that piston and bore are clean and dry prior to the piston fit check.

1. Choose the appropriate ring set for the size cylinder bore.

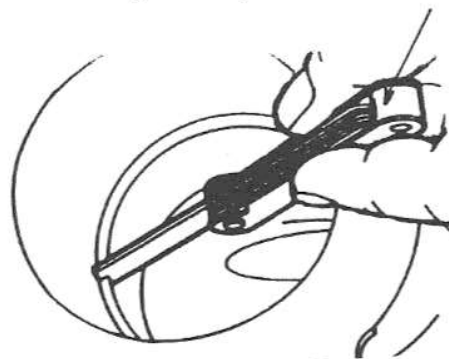
2. Place the ring in the cylinder bore in which it is going to be used and push the ring down into the bore area where normal ring wear is not encountered.

3. So that the ring is square with the cylinder wall, use the head of a piston to position the ring in the bore. Use caution to avoid damage to the ring or cylinder bore.

4. Using a feeler gauge measure the gap between the ends of the ring. Try another ring size if the ring gap is less or greater than the indicated limits.

Measure Ring End Gap

Feeler Gauge



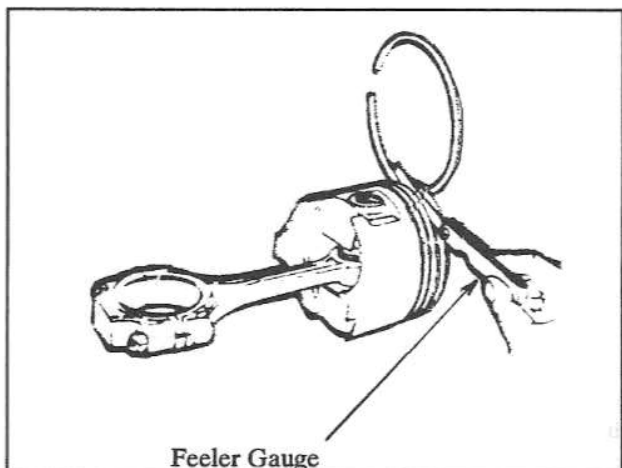
Compression Ring End Gap specification:

Top ring: 0.279-0.533mm

Second ring: 0.254-0.508mm

5. Using a feeler gauge, insert the gauge between the ring and its lower land to check the ring side clearance of the compression rings. The gauge should slide freely around the whole ring circumference without binding. Any wear that arises will form a step at the inner portion of the lower land. If the lower lands have high steps, the piston should be replaced.

Piston Ring clearance:



Top Ring 0.03-0.08mm

Second Ring: 0.03-0.08mm

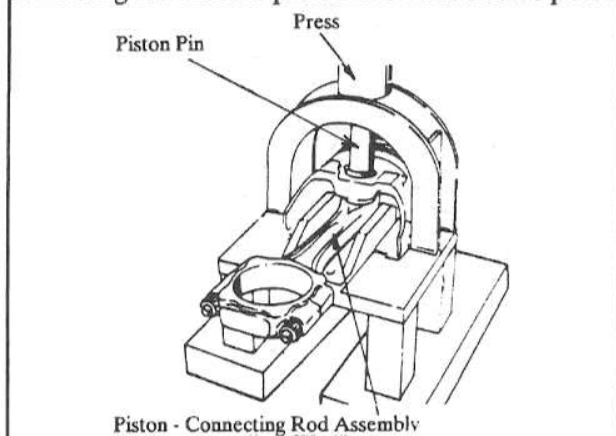
Assembly

Inspect the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.

The piston pin bore of a connecting rod and the diameter of the piston pin must be within regulations. Check that the connection of the attaching rod to the piston, assembled with the notch in the piston toward the front of the engine, the number stamped on the connecting rod and cap will be on the camshaft side of the engine (oil squirt hole in the connecting rod to the thrust side of the piston).

1. Place a light coat of engine oil to all parts.
2. Start the piston pin in the piston and connecting rod (this may require a light tap with a mallet). Using a press, force the piston pin through the piston and connecting rod until the pin is in the middle of the piston.

Using a press, force the piston pin through the piston and connecting rod until the pin is in the middle of the piston.



3. Inspect the end gap of the piston rings and it must be within regulations. Follow the instructions contained on the piston ring package and install the piston rings.

4. Inspect the ring side clearance of the compression rings with a feeler gauge.

5. Ensure the bearing inserts and bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

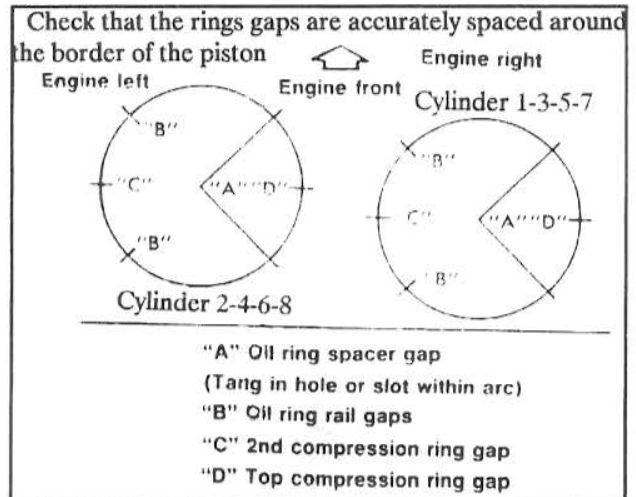
Install

1. Oil the piston rings, pistons and cylinder walls using light engine oil.

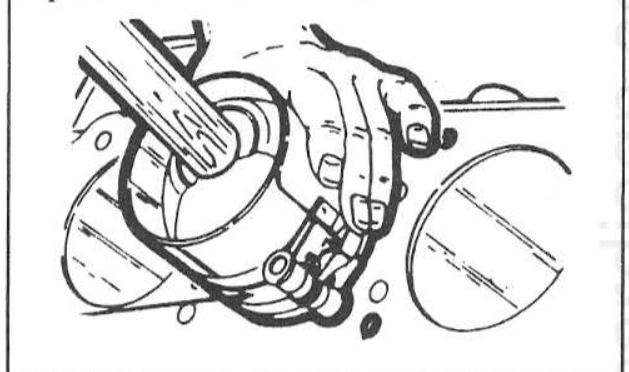
2. Check that the pistons are installed in their original cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing caps are numbered from 1-8 from removal if not stamped on the connecting cap. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. New bearings should be installed and the

connecting rod should be numbered to correspond with the new cylinder, if a connecting rod is ever taken from one block or cylinder to another.

4. Check that the rings gaps are accurately spaced around the border of the piston.



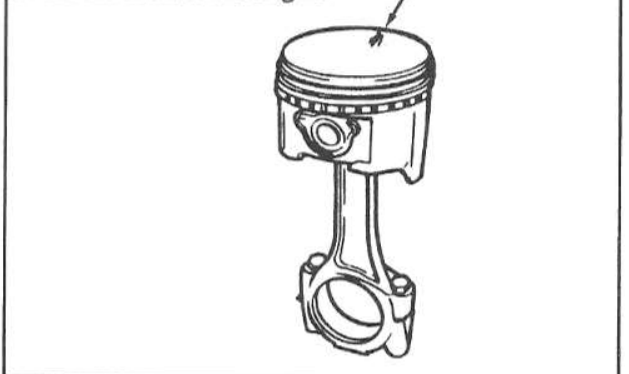
Install a piston ring compressor on the piston and push the piston in with a hammer handle

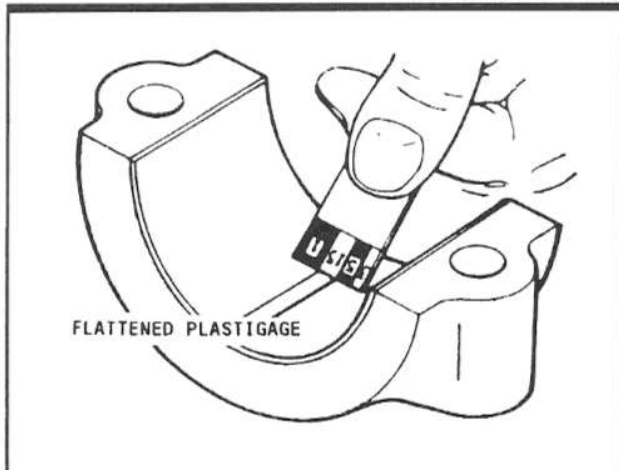


5. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is somewhat below the top of the cylinder.

6. Ensure to direct the connecting rods to avoid damaging the crankshaft journals. Install the piston with the arrow on the piston head toward the front of the engine.

Install the piston with the arrow on the piston head toward the front of the engine



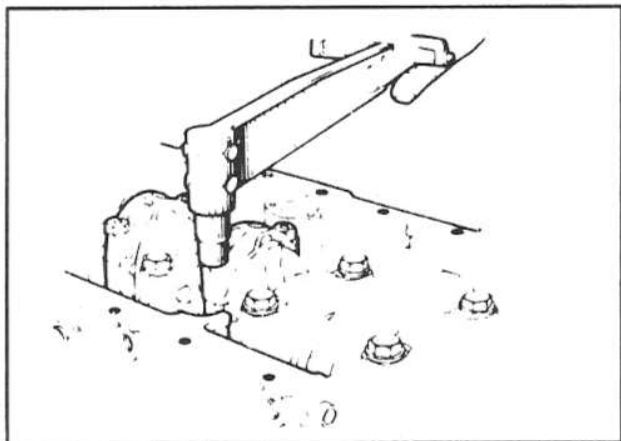


7. Inspect the clearance of each bearing follow the procedure under Connecting Rod Bearing Replacement section.

8. Apply a light coat of engine oil to the journals and bearings.

9. Rotate the crankshaft throw to the bottom of its stroke, then push the piston down until the connecting rod bearing seats on the crankshaft journal.

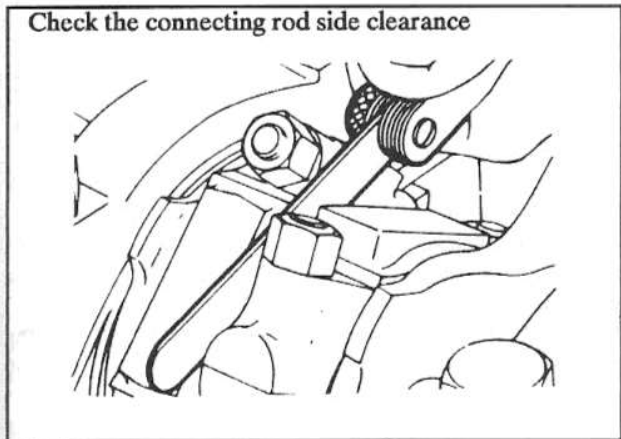
10. Install the connecting rod cap. Tighten connecting rod cap to specification.



Connecting Rod Bearing cap bolt torque spec: 56-64Nm

11. Check the connecting rod side clearance on each crankshaft journal.

Check the connecting rod side clearance



Connecting Rod side

clearance specification: 0.203-0.356mm

12. Install the oil pump inlet tube.

13. Install the oil pan and related parts. Install the cylinder head.

Crankshaft

Remove

1. Remove the timing cover and timing chain.

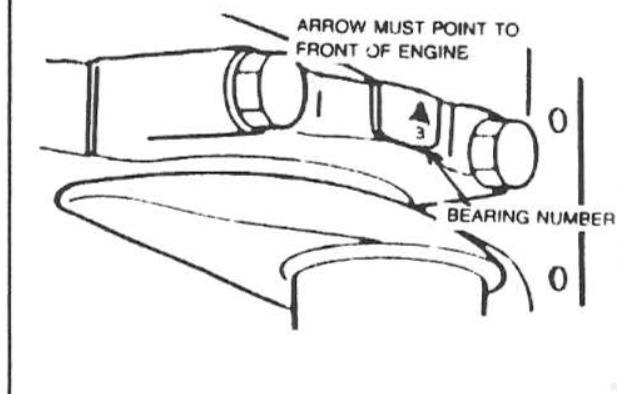
2. Remove the flywheel or flexiplate.

3. Remove the sump and gasket.

4. Remove the oil pump pickup pipe.

5. Check all bearing caps (main and connecting rod) are marked so that they can be installed in their original positions.

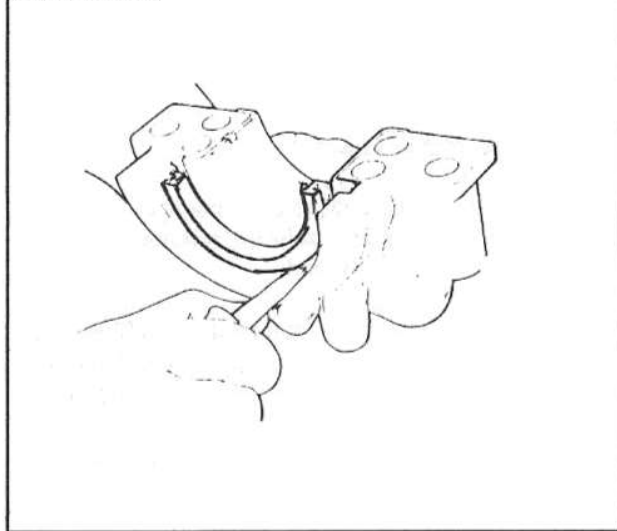
Check all bearing caps (main and connecting rod) are marked so that they can be installed in their original positions.



6. Take the connecting rod caps off. Install journal protection sleeves over the uncovered bolt threads, as each cap is taken off.

7. Take the main bearing caps out and remove the rear main bearing oil seal.

Remove the rear main bearing oil seal with a screw driver or knife blade.



5. Raise the crankshaft carefully out of the block so that the thrust bearing surfaces are not damaged, handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.

Crankshaft

Clean

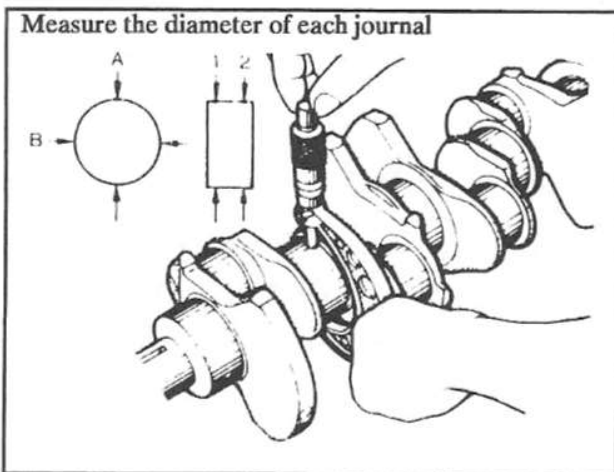
To avoid possible fractures or damage to the finished surfaces, handle the crankshaft with care. Use solvent to clean the crankshaft, then use compressed air to blow out all the oil passages.

Inspect

Check main and attaching rod journals for cracks, scratches, grooves or scores.

Measure the diameter of each journal in at least four places to determine out-of-round, taper or undersize.

Main Bearing Journal Diameter



Standard	53.950-53.975mm
Taper	.0254mm max.
Out-Of-Round	.0381mm max.

Connecting Rod Journal Diameter

Standard	57.117-57.147mm
Quality	.008mm max.
Out-Of-Round	.008mm max.

The clutch spigot bearing is placed into the bore of the crankshaft, on engines that use a manual shift transmission. The bearing and adaptor are serviced as an assembly.

Check the clutch spigot bearing for roughness, evidence of overheating, seal damage, or loss of lubricant. Replace it if any of these cases are found.

Repairs

Dress slight imperfections with an oil stone. If the journals are severely damaged or exceed the wear limit, they should be refinished to size for the next undersize bearing.

Refinishing Journals

Refinish the journal to give the correct clearance with the next undersized bearing. Restore the crankshaft, if the

journal will not clean up to give the correct clearance with the utmost undersized bearing available. Always copy the same journal shoulder radius that remained originally. Too small a radius will result in fatigue failure of the crankshaft. Too large of a radius will result in bearing failure due to radius ride of the bearing.

After refinishing the journals, chamfer the oil holes, then buff the journal with a No. 320 or 500 grit polishing cloth and engine oil. Crocus cloth may be used also as a polishing detergent.

Install

1. Remove the main inserts from the block and bearing caps.

2. Remove the connecting rod bearings inserts from the connecting rods and caps.

3. Install the correct undersize bearings, if the crankshaft main bearing journals have been refinished to a certain undersize.

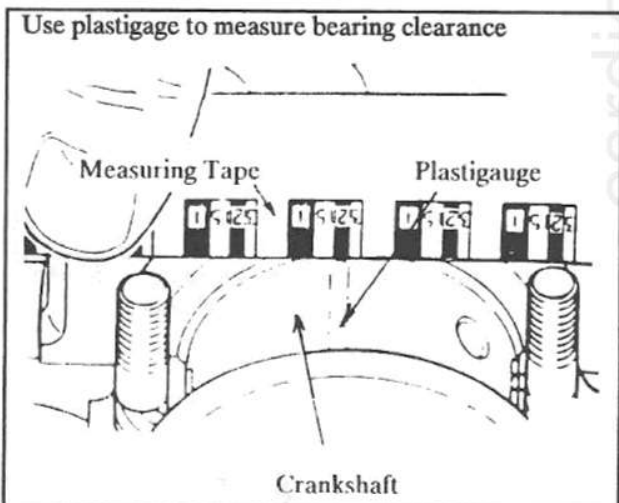
4. Check that the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

5. Put the upper main bearing inserts in place in the bores with the tang fitting in the slot supplied.

6. Install the lower main bearing inserts in the bearing caps.

7. Lower the crankshaft carefully into place and do not damage the bearing surfaces.

8. Inspect the clearance of each main bearing. Using a piece of Plastigage on the crankshaft journal the full width of the journal and about 5 mm of middle. Follow steps under Main Bearing Replacement.

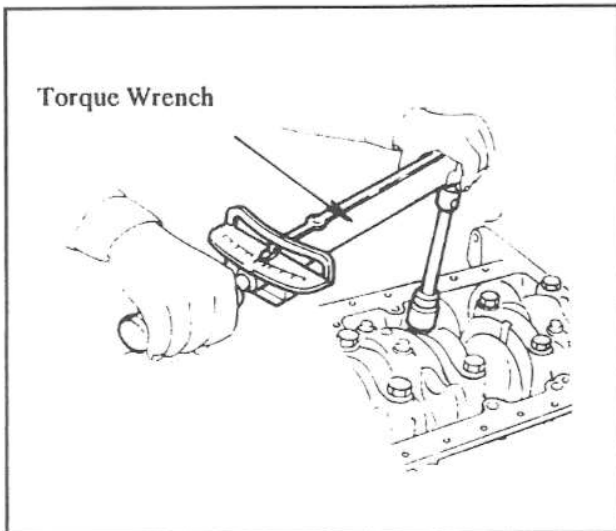


9. Place a light coat of engine oil to the journals and bearings.

10. Place a thin coat of oil resistant sealer to the rear main bearing cap at the rear top mating surface. Do not apply sealer to the area forward of the oil slinger groove. Install all the bearing caps.

* No. 3 main bearing incorporates the crankshaft thrust bearing.

11. Tighten the main bearing bolt to specification.



Main Bearing Cap Bolt specification: 117-127Nm

12. Push the crankshaft toward the rear of the engine. Install a dial indicator micrometer so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis.

Zero the dial indicator micrometer. Push the crankshaft forward and note the reading on the dial.

Crankshaft End float specification: 0.08-0.28mm

If the end play exceeds specification, replace the thrust bearing. If the end play is less than the lowest limit, inspect the thrust bearing faces for scratches, burrs, nicks or dirt.

13. With the dial indicator micrometer still located as for point 11, turn the crankshaft slowly to check that flange run out is within specification.

Crankshaft Rear Flange Runout spec: 0.05mm max.

13. Install the rear main bearing oil seal.

14. Install new bearing inserts in the connecting rods and caps.

15. Take the protection sleeves off from the bolts. Check the clearance of each bearing following the procedure under Connecting Rod Bearing Replacement. If the bearing clearances are to specification, place a light coat of engine oil to the journals and bearings.

Connecting Rod Bearing clearance:

New: 0.018-0.056mm

Used: 0.09mm max

16. Install the connecting rod cap and fit new nuts, tighten to specification.

Connecting Rod Cap bolt specification: 56-64Nm

17. Check the connecting rod side clearance on each connecting rod crankshaft journal.

Connecting Rod Side Clearance spec: 0.203-0.356mm

18. Install the timing chain, gears and sprockets, timing chain front cover as previously described.

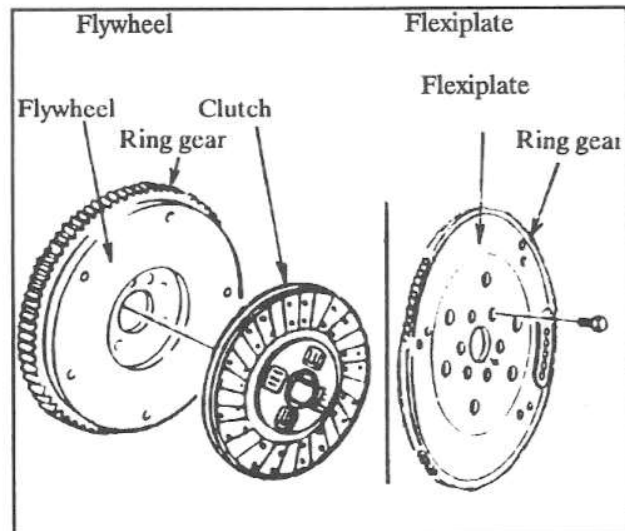
19. Install crankshaft sensor and crankshaft balancer pulley, following methods under Crankshaft sensor and balancer section.

20. Clean the oil pump pickup pipe, oil pump screen and install.

21. Install the sump as previously described. Tighten bolts to specification.

Sump attaching bolts: 8-10Nm

22. Install the flywheel/flexiplate on the crankshaft as previously described. Tighten bolts to specification.



Flywheel/flexiplate Attaching bolts: 74-88Nm

23 Install the clutch for manual transmission vehicles.

24. Install the oil level dipstick.

25. Install and adjust the drive belt.

PROBLEM SOLVING AND DIAGNOSIS

PROBLEM:

Engine will not crank.

POSSIBLE CAUSE:

Usually is in the starting system. If the system is not at fault, check for a hydrostatic lock or a seized engine.

PROBLEM:

Engine cranks normally but will not start.

POSSIBLE CAUSE:

The cause is probably in the ignition or the fuel system. Perform the following test to determine which system is at fault:

Detach a spark plug wire. Check the spark intensity.

If there is no spark or a weak spark at the spark plugs.

The cause is in the ignition system.

If the spark at the coil high tension lead is good, the cause is probably in the distributor cap, rotor or spark plug wires.

If there is no spark or a weak spark at the coil high tension lead, the cause is probably in the primary circuit, soil to distributor high tension lead, or the coil.

Check the distributor drive.

If there is a good spark at the spark plugs.

Check the ignition system. Check the spark plugs. For detailed Ignition System diagnosis refer to 'Ignition System'.

Fuel System

Check fuel system.

Engine

Mechanical failure in camshaft drive. Failed distributor drive.

PROBLEM:

Engine starts, but fails to keep running.

POSSIBLE CAUSE:

Fuel System

Check fuel system

Exhaust System

Exhaust system blocked.

Ignition System

Defective spark plugs. Leakage in the high tension wiring. Defective electronic control unit.

PROBLEM:

Engine runs, but misses.

POSSIBLE CAUSE:

Misses steadily at all speeds.

Remove ignition wire from one spark plug at a time, until all cylinders have been checked. Ground the spark plug wire removed.

Ignition System

If the miss is isolated in a particular cylinder, perform a spark test on the ignition lead of that cylinder.

If a good spark does not occur, the trouble is in the secondary circuit of the system. Check the spark plug wire and the distributor cap.

If a good spark does occur, check the spark plug. If the spark plug is not at fault, a mechanical component of the engine is probably at fault.

Engine

Intake manifold gasket leak.

Perform a manifold vacuum or compression test to determine which mechanical component of the engine is at fault.

Misses erratically at all speeds.

Exhaust System

Exhaust system restricted.

Ignition System

Defective secondary wiring, coil or spark plugs.

Defective electronic control unit.

High tension leakage across the coil, rotor or distributor cap.

Defective ignition switch.

Check fuel system.

Fuel System

Check fuel system.

Engine

Perform a manifold vacuum or compression test to determine which mechanical component of the engine is at fault.

Misses at idle only.

Ignition System

Defective coil, rotor, ignition wiring or spark plugs.

Engine

Valve clearance set too tight. Worn camshaft lobe(s).

Perform a manifold vacuum or compression test to determine which mechanical component of the engine is at fault.

Misses at high speed only.

Fuel System

Check fuel system.

Ignition System

Defective spark plugs.

Cooling System

Engine overheating.

Engine

Perform a manifold vacuum or compression test to determine which mechanical component of the engine is at fault.

PROBLEM:

Rough engine idle.

POSSIBLE CAUSE:

Fuel System

Check fuel system.

Ignition System

Fouled or improperly adjusted spark plugs.

Incorrect ignition timing. Spark plug misfiring.

Engine

Perform a manifold vacuum or compression test to determine which mechanical component is at fault.

PROBLEM:

Poor acceleration.

POSSIBLE CAUSE:

Ignition System

Incorrect ignition timing. Fouled or improperly adjusted spark plugs.

Fuel System

Check fuel system.

Brakes

Improper adjustment - too tight.

Transmissions

Clutch slippage (manual shift transmissions). Improper band adjustment (automatic transmission).

Converter One-Way Clutch (automatic transmissions).

5.0 LITRE V8 - MAINTENANCE & REBUILD

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Engine

Perform a manifold vacuum or compression test to determine which mechanical component of the engine is at fault.

PROBLEM:

Excessive fuel consumption.

POSSIBLE CAUSE:**Final Checks**

Fuel System

Ignition System

Check: Ignition timing, spark plug condition and adjustment, distributor spark advance operation.

Engine

Perform a manifold vacuum or engine compression test to determine which mechanical component of the engine is at fault. Check valve clearance.

Cooling System

Check the thermostat operation and heat range.

Transmission

Check band adjustment (automatic transmissions).

PROBLEM:

Engine Overheating.

POSSIBLE CAUSE:

Temperature sending unit and gauge.

Unit or gauge defective (not indicating correct temperature).

Engine

Cylinder head bolts not properly torqued. Incorrect valve clearance.

Low oil level or incorrect viscosity oil used.

Cooling System

Insufficient coolant. Cooling system leaks. Drive belt tension incorrect. Radiator fins obstructed. Thermostat defective. Thermostat improperly installed. Cooling system passage blocked. Water pump inoperative.

Ignition System

Incorrect ignition timing. Incorrect distributor advance.

Exhaust System

Restrictions in system.

PROBLEM:

Loss of coolant.

POSSIBLE CAUSE**Cooling System**

Leaking radiator or water pump. Loose or damaged hose connections. Radiator cap defective. Overheating.

Engine

Cylinder head gasket defective. Intake manifold to cylinder head gasket defective. Cylinder head or intake manifold bolts not properly torqued. Cylinder block core plugs leaking. Temperature sending unit leaking. Cracked cylinder head or block, or warped cylinder head or blocked water jacket hole in gasket.

Specifications**General Specifications**

Type	90° V8 OHV
Displacement	4922cc 5.0L
Number of Cylinders	8
Bore and Stroke	101.6 x 76.835
Firing Order	1-2-7-8-4-5-6-3
Compression ratio :	8.4:1
Power	165kW@4400RPM
Torque	365Newtonmeters@3600RPM

Cylinder Head

Maximum distortion:	0.10mm
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Valve Arrangement**Valve Stem to Guide Clearance**

Intake	0.025-0.068
Exhaust	0.025-0.068
Service Clearance	0.0140

Valve Head Diameter

Intake	49.28-49.53
Exhaust	40.64-40.89
Valve Seat Angle	46°
Valve Face Angle	45°

Valve Stem Diameter

Intake	8.661-8.679
Exhaust	8.66-8.68

Valve Springs**Compression Pressure N. @ Spec. Length (mm)**

Intake	338-373 @ 45.2
Exhaust	338-373 @ 45.2

Free Length (App.) (mm)

Intake	51.56
Exhaust	51.56

Hydraulic Lifter Leakdown Rate	10-50 Seconds
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Camshaft**Lobe Lift**

Intake including ramps opens 26° BTC for 314°
Exhaust including ramps opens 80° BBC for 314°
Intake excluding ramps opens 13° BTC for 268°
Exhaust excluding ramps opens 67° BBC for 268°

Journal Diameter

No. 1	47.960-47.978
No. 2	47.960-47.978
No. 3	47.452-47.470
No. 4	47.452-47.478
No. 5	40.107-40.132

Cylinder Block

Bearing Bore Diameter	62.006-62.027
Distributor Shaft Bearing Bore Diameter	11.494-11.534

Crankshaft and Flywheel

Main Bearing Journal Diameter	60.90-60.93
Out-of-Round max limit: new	0.0005mm/used 0.0254mm
Taper	max limit:
new 0.0005mm/used 0.0254mm	
Runout	Service Limit
0.03mm	

Connecting Rod Journal

Diameter	53.950-53.975
Out-of-Round max limit: new	0.013mm/used 0.0381mm

Connecting Rod Bearings

Clearance to Crankshaft - new	0.018-0.056mm
Allowable used	0.09mm
Main Bearings	
Clearance to Crankshaft - new	0.020-0.061mm
Allowable used	0.1mm

Cylinder Bore and Piston

Cylinder Bore	
Diameter	101.60-101.72
Surface Finish (RMS)	18-38
Out-of-Round Limit	0.038
Out-of-Round Service Limit	0.127
Taper Service Limit	0.254

Piston

Diameter	101.572-101.648
Piston-to-Bore Clearance	0.020-0.036

Piston Compression Ring Width

Top compression	1.956 - 1.981 mm
Second compression	1.956 - 1.981 mm

Piston Pin

Diameter	
Standard	23.5-23.55
Pin to Piston Clearance	0.0038-0.0064
Pin to Rod Clearance	Interference Fit

Piston Rings

Ring Width	
Compression (Top)	1.956-1.981
Compression (Bottom)	1.956-1.981
Side Clearance	
Compression (Top)	0.03-0.08
Compression (Bottom)	0.03-0.08
Oil Ring	Snug Fit
Service Limit	1.39 Max.
Ring Gap	
Compression (Top)	0.279-0.533
Compression (Bottom)	0.254-0.508
Oil Ring (Seal Rail)	0.381-1.397

Lubrication System

Oil Pump	
Oil Pressure Hot:	48kPa @ 500RPM
	275-414kPa @ 2000RPM
Oil Capacity (Litres) less filter	4.8litre
Oil Filter Capacity	0.3litre

Torque Specifications

Description	Nm
Throttle Body to Intake Manifold Attaching Nut	15-18
Camshaft Sprocket Gear to	
Camshaft Bolt	60 - 75
Camshaft Locator to	
Cylinder Block Bolt	70-80
Timing Chain Cover Bolts	11-15
Cylinder Head Bolt	
Step 1	50-55
Step 2	77-83
Damper to Crankshaft Bolt	190mim
Distributor Hold Down Bolt	20-27
Flywheel to Crankshaft Bolt	75-88
Intake Manifold to Cylinder Head Bolt	35-40
Connecting Rod Nut	55-65
Main Bearing Cap - Bolt	80-95
Oil Filter to Oil Pump:	
1/2 turn after gask contacts sealing surface	
Oil Pan Drain Plug	20-27
Oil Pan to Cylinder Block - Bolt	8-10
Oil Pump to Cylinder Block - Bolt	23-30
Rocker Arm Pivot bolt	24-32
Rocker Cover Bolt	8-10
Spark Plug: new	30-38
used	10-20
Exhaust Manifold to Cylinder Head Bolt	24-34
Exhaust Pipe to Exhaust Manifold Nuts	12-16
Fan to Fan Clutch	12-16
Fan Clutch to Water Pump Hub	27-36
Water Pump to Cylinder Bolck	23-30
Alternator Upper Bolts	33-44
Alternator Lower Bolts	12-16
Engine Mount to Engine Bracket	20-28
Engine Mount (other) bolts and nuts	34-46
Flywheel Housing to Engine Bolt	34-44