

ENGINE

SPECIFICATIONS

ENGINE ASSEMBLY

Type	4 cyl OHC
Bore	84 mm
Stroke	90 mm
Capacity	1955 cc
Compression ratio	8.7 : 1
Firing order	1-3-4-2

NOTE: Specifications regarding engine performance are listed in the Engine Tune-up section.

CYLINDER HEAD

Material	Alloy
Valve seat angle	45 deg
Warpage limit	0.05 mm

VALVES AND SPRINGS

Valve stem diameter:	
Inlet	7.970-7.985 mm
Exhaust	7.965-7.980 mm
Valve stem to guide clearance:	
Inlet	0.025-0.080 mm
Exhaust	0.030-0.100 mm
Valve face angle	45.5 deg
valve head minimum margin:	
Inlet	0.5 mm
Exhaust	1.0 mm
Valve spring free length	46.71 mm

CYLINDER BLOCK

Type	4 cyl in line
Bore diameter (std)	84.00-84.03 mm
Bore wear limit	0.25 mm

PISTONS AND RINGS

Pistons:	
Diameter (std)	83.975-84.005 mm
Clearance in cylinder bore	0.015-0.050 mm
Number of rings:	
Compression	2
Oil control	1
Clearance in piston groove	0.03-0.07 mm

Ring end gap:

No 1	0.28-0.50 mm
No 2	0.20-0.45 mm
Oil control	0.20-0.79 mm

CRANKSHAFT AND BEARINGS

Number of main bearings	5
Main bearing journal diameter	54.985-55.000 mm
Main bearing clearance:	
No 3	0.03-0.08 mm

Others	0.02-0.08 mm
Main bearing journal taper and ovality limit	0.02 mm
Crankshaft end float	0.02-0.30 mm
Crankpin diameter	47.985-48.000 mm
Crankpin bearing clearance	0.024-0.080 mm
Crankpin taper and ovality limit	0.02 mm
Connecting rod end float	0.016-0.30 mm

CAMSHAFT AND BEARINGS

Number of bearing journals	6
Journal diameter:	
No 1	46.459-46.475 mm
No 2	46.209-46.225 mm
No 3	45.959-45.975 mm
No 4	45.709-45.725 mm
No 5	45.459-45.475 mm
No 6	45.209-45.225 mm
Bearing clearance	0.025-0.100 mm
Camshaft end float	0.08-0.35 mm
End float taken at	Front of camshaft
Camshaft run out limit	0.04 mm

LUBRICATION

Pump type	Eccentric rotor (trochoid)
Driven by	Drive belt
Rotor to body clearance	0.1-0.20 mm
Rotor tip clearance	0.04-0.20 mm
Relief pressure	351-432 kPa
Minimum oil pressure at idle	30 kPa
Oil filter type	Full flow

TORQUE WRENCH SETTINGS

Cylinder head bolts	64 Nm
Camshaft housing bolts	6 Nm
Camshaft gear bolt	54 Nm
Manifold bolts and nuts	42 Nm
Main bearing bolts	58 Nm
Connecting rod nuts	49 Nm
Crankshaft pulley	108 Nm
Flywheel/drive plate bolts	77 Nm

1. ENGINE MECHANICAL TROUBLE SHOOTING

ENGINE MISSES AT IDLE SPEED

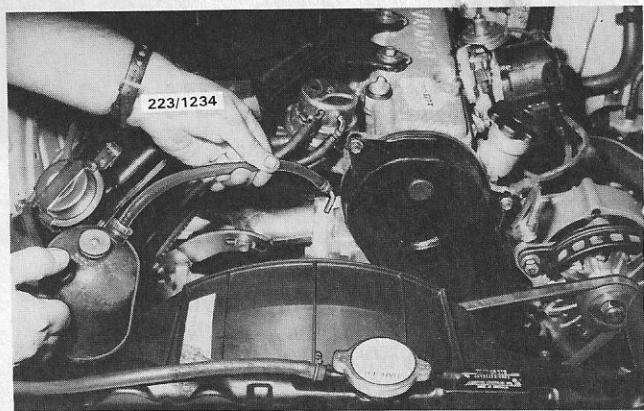
NOTE: Most causes of engine misfire can be traced to faults in the fuel or ignition systems. If reference to the Fuel System or Electrical System trouble shooting does not locate the fault, check the following faults and rectifications.

- (1) Air leak at inlet manifold gasket: If air leak is evident and cannot be rectified by torquing the manifold retaining nuts, renew the gasket. Check for cracks in the manifold.

(2) Broken or worn piston rings: Check cylinder compression and renew piston rings as necessary.

(3) Weak or broken valve springs: Remove rocker cover and check condition of valve springs. Renew as necessary.

(4) Burnt valves or valve seats in cylinder head: Check cylinder compression and overhaul cylinder head as necessary.



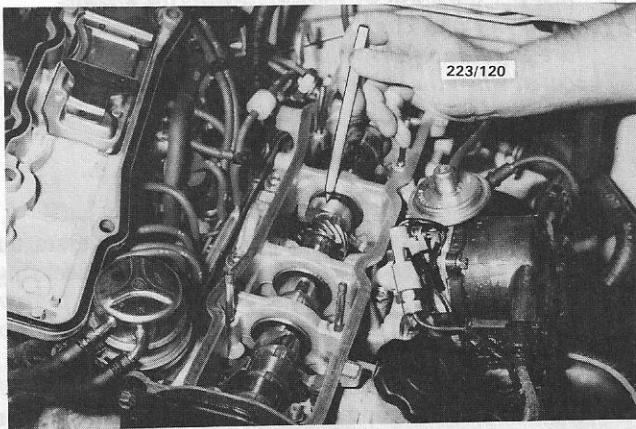
Air leaks at the inlet manifold can be checked by running oil around the suspect joint.

NOTE: Use a compression gauge and check the compression pressure in each cylinder as described in the Engine Tune-up section. If a low pressure reading is indicated in one or more cylinders remove the cylinder head for gasket and valve inspection. Should the gasket and valves prove satisfactory inspect the cylinder bores, pistons and rings.

Check for air leaks at the inlet manifold by applying oil around the manifold joints. If the oil can be seen or heard sucking into the manifold or excessive smoke begins to issue from the exhaust system, there is an air leak at the manifold joint.

NOISY VALVE OPERATION

(1) Weak or broken valve springs: Remove the



Camshaft lobe wear is a cause for noisy valve operation.

rocker cover and check condition of valve springs. Renew as necessary.

(2) Worn or damaged rocker arms and pivots: Renew any excessively worn parts.

(3) Defective hydraulic tappets: Renew hydraulic tappet assemblies.

(4) Worn valve guides: Overhaul cylinder head.

(5) Low oil pressure: Refer to Drop In Oil Pressure in this section.

NOTE: Check the oil pressure, valve springs, rocker gear and hydraulic tappets, in that order, prior to removing any part of the valve train for inspection. Cam lobe wear can also be a factor in noisy valve operation.

BIG END BEARING NOISE

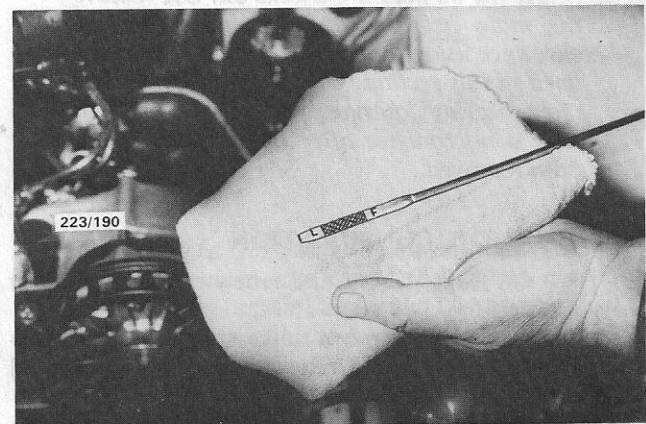
(1) Lack of adequate oil supply: Check engine oil level. Check condition of oil pump and pressure relief valve, renew oil filter.

(2) Low oil pressure: Check engine oil level, check pressure relief valve and spring.

(3) Thin oil or crankcase dilution with petrol or water: Change to correct oil grade, check and rectify source of oil dilution, check engine is not operating in overheat condition.

(4) Excessive bearing clearance: Renew the bearing shells and, if necessary, grind the crankshaft journals.

(5) Misaligned big end bearings: Align connecting rods and renew bearing shells.



Check the engine oil for correct level and dilution on the dipstick.

NOTE: Big end bearing noise is indicated by a metallic knock which is usually loudest at approximately 60 km/h with the throttle closed. The knock can be reduced or even eliminated by shorting out the spark plug on the offending cylinder. Before dismantling the engine to inspect the big ends check the engine oil for correct level and dilution on the dipstick. Also remove the oil pressure sender unit and connect an oil pressure gauge into the oil gallery to check out the oil pressure readings.

MAIN BEARING NOISE (APPARENT)

- (1) Loose flywheel: Tighten flywheel retaining bolts to specified torque.
- (2) Low oil pressure: Check bearing to journal clearance, check condition of oil pump and pressure relief valve, recondition oil pump as necessary.
- (3) Excessive crankshaft end float: Renew crankshaft thrust washers.
- (4) Crankshaft journals out of round and excessive bearing to journal clearance: Regrind journals, renew bearings (undersize).
- (5) Insufficient oil supply: Replenish oil in sump to correct level.

NOTE: Main bearing noise is indicated by a heavy but dull knock when the engine is under load. The knock can be confirmed by shorting out the spark plug adjacent to the offending bearing. The knock will be less audible or will even disappear when the plug is shorted. This test is best done with the engine running at a fast idle.

A loose flywheel is indicated by a thud or dull click when the ignition is switched off. It is usually accompanied by vibration.

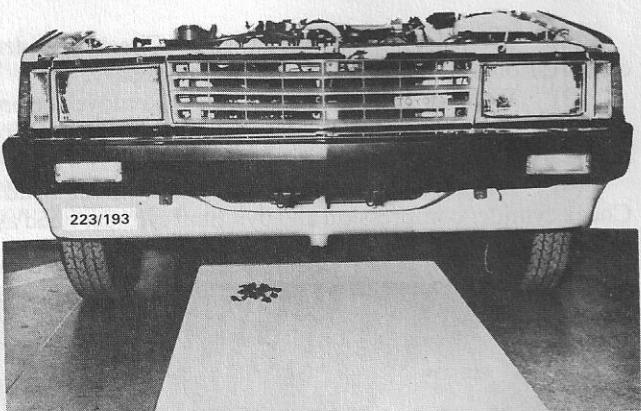
Crankshaft end float noise is indicated by a sharp rap at idle speed. The crankshaft can be readily checked out for excessive end float by levering the crankshaft backwards and forward.

If the oil pressure checks out OK remove the main bearing caps and assess bearing clearance using the Plastigage method as outlined in this section. Ovality and wear on the main bearing journals can only be checked with a micrometer after the crankshaft has been removed.

EXCESSIVE OIL CONSUMPTION

- (1) Oil leaks: Check and renew engine gaskets or seals as necessary.
- (2) Damaged or worn valve stem oil seals: Dismantle cylinder head and renew damaged or worn oil seals.
- (3) Excessive clearance, valve stem to valve guide: Renew valve guides.
- (4) Worn or broken rings: Renew piston rings on all pistons.
- (5) Rings too tight or stuck in grooves: Renew piston rings and clean out ring grooves.
- (6) Excessive wear in cylinder, pistons and rings: Recondition cylinders and renew pistons and rings.
- (7) Compression rings incorrectly installed, oil control rings clogged or broken: Renew piston rings.

NOTE: Before checking the engine for oil leaks the engine should be completely degreased and cleaned. Run the engine at operating temperature for a period and then visually check for oil leakage. By placing white



Run the engine over white paper to check for oil leaks.

paper on the floor directly beneath the engine any leak can be readily pinpointed.

Damaged or worn valve stem oil seals which allow oil to be drawn down past the valve stems into the combustion chambers can be diagnosed by allowing the engine to idle for a few minutes and then opening the throttle. If oil is being drawn down past the valve stems a heavy discharge of blue smoke will be seen at the tailpipe.

DROP IN OIL PRESSURE

- (1) Oil level low in sump: Check and replenish oil to full mark in sump.
- (2) Thin or diluted oil: Change to correct oil grade and rectify source of dilution.
- (3) Oil pump relief valve stuck or spring broken: Free up relief valve or renew broken relief valve spring.
- (4) Excessive bearing clearance: Renew bearing shells or recondition crankshaft journals as necessary.
- (5) Excessive wear of oil pump components: Renew or recondition oil pump.

NOTE: If the vehicle is not fitted with an oil pressure gauge remove the oil sender unit and connect a pressure gauge into the oil gallery. Check the oil pressure with the engine cold and hot. If the oil pump or relief valve are faulty low pressure will be indicated with the engine both hot and cold. However, if the bearings are at fault a fairly high pressure will be indicated when the engine is cold but a marked fall of in pressure will be noted when the engine is hot.

ENGINE WILL NOT ROTATE

- (1) Starter motor drive jammed: Remove starter motor, check and renew damaged drive or flywheel ring gear.
- (2) Engine overheated and seized: Remove and dismantle engine, check and renew damaged components, see following note.
- (3) Water in cylinder due to blown head gasket or cracked cylinder block or head: Remove cylinder head, if

gasket is blown check for cylinder block and head warp, reface if necessary. Renew cylinder head or cylinder block if cracked.

(4) Broken crankshaft, connecting rod, piston etc. due to overheating, fatigue, etc: Remove and dismantle engine, examine and renew components as necessary.

(5) Valve head broken off due to overheating, fatigue, etc: Remove cylinder head, check head, piston and cylinder bore for damage and repair or renew as necessary.

NOTE: Frequent jamming of the starter motor drive with the flywheel ring gear can be due to a bent starter armature shaft or damaged teeth on the drive or ring gear. With the starter motor removed the flywheel ring gear teeth can be examined through the starter motor mounting aperture. Replacement of the ring gear requires removal of the transmission and on manual transmission models removal of the clutch and flywheel. The checking for a bent armature shaft can be done by rotating the shaft by hand while the end is held in the close proximity to a fixed object.

Invariably when an engine seizes because of overheating due to lack of oil or water, damage is done to the bearings, pistons, etc. Although there may be instances where an engine will restart and run after it has cooled down and the oil and water replenished, it will generally be found that oil consumption increases, oil pressure drops and the engine will be noisier, depending upon the degree of damage.

When a cylinder head gasket blows allowing water into the cylinders, or compression loss between cylinders, it is essential that the gasket faces on the cylinder head and block be checked for warpage. Sufficient water can enter a cylinder because of a blown gasket, cracked cylinder head or block to prevent an engine from rotating. Normally this is preceded by difficult starting, misfiring, excessive steam from the exhaust and loss of water from the radiator. By removing the radiator cap and allowing the engine to fast idle, bubbles may be seen in the radiator filler neck, indicating a blown head gasket.

2. DESCRIPTION

The engine is a four cylinder overhead camshaft engine with an alloy cylinder head. The engine weight is reduced by using a hollow camshaft and crankshaft. The weight of the cylinder block is also reduced by using a ribbed construction.

The camshaft runs in six integral support bearings in the camshaft housing which in turn is mounted directly onto the cylinder head. Camshaft end float is controlled by a thrust plate mounted between the front journal and

the camshaft gear. The camshaft is driven by the crankshaft via a reinforced rubber belt and a camshaft timing gear.

The exhaust valve springs are fitted with rotators which rotate the valves to improve valve seat life. The rocker arms pivot on hydraulic tappet assemblies and the camshaft lobes bear directly onto the rocker arms. The hydraulic tappets provide automatic adjustment of the valves by maintaining the valve lash at zero.

The cylinder block is a ribbed construction and the crankshaft is supported in the block by five main bearings of the precision insert replaceable type. Crankshaft end float is controlled by thrust washers at the centre main bearing. Connecting rod bearings are also of the precision insert replaceable type.

The cast aluminium pistons are fitted with two compression rings and one oil control ring. The top of the piston is machined to give adequate valve to piston clearance.

The oil pump is of the twin rotor (trochoid) type. It is mounted directly to the front face of the cylinder block and is driven by the camshaft drive belt. The oil pump pressure relief valve is of the non adjustable, plunger and spring type, mounted in the oil pump body. The oil filter is the full flow disposable type.

The engine and transmission assembly is carried on three rubber bonded mountings situated on each side of the cylinder block and below the transmission extension housing.

3. ENGINE ASSEMBLY

Special Equipment Required:

To Remove and Instal - Suitable lifting tackle

TO REMOVE

NOTE: The following operation describes how to remove and instal the engine and transmission as an assembly, however, if required it is possible to remove and instal the engine separately.

- (1) Mark around the bonnet hinges with a soft lead pencil to ensure correct positioning on installation.
- (2) Remove the clips retaining the bonnet lining near the windscreens washer hose and disconnect the hose at the connector. Remove the bonnet retaining bolts and remove the bonnet.
- (3) Disconnect both battery terminals.
- (4) Drain the cooling system and remove the radiator as described in the Cooling System section.
- (5) Remove the air cleaner assembly as described in the Fuel System section. Mark and disconnect the necessary emission control hoses.
- (6) On vehicles fitted with air conditioning, remove the air conditioning compressor and secure the compressor to the vehicle body using wire.

NOTE: Do not attempt to disconnect the air conditioning hoses from the compressor as this will allow the gas to escape.

(7) Loosen the air pump adjusting and mounting bolts, push the air pump towards the cylinder block and remove the air pump drive belt.

(8) Loosen the alternator adjusting and mounting bolts, push the alternator towards the cylinder block and remove the alternator drive belt.

(9) Remove the nuts retaining the fan assembly to the fan bearing housing and remove the fan assembly and drive belt pulleys.

(10) Disconnect the brake servo unit vacuum hose from the inlet manifold.

(11) Loosen the hose clamps and disconnect the heater hoses from the rear of the engine.

(12) Open the throttle and disconnect the inner throttle cable from the throttle linkage on the carburettor. Loosen the outer cable locknuts and disconnect the throttle cable from the bracket.

(13) Disconnect the electrical connections from the starter motor and the alternator. Suitably tag the wires to assist in installation.

(14) Disconnect the fuel supply and return hoses from the fuel pump. Plug the hoses to prevent the loss of fuel and the ingress of dirt.

(15) Noting their installed positions, disconnect the remaining electrical wiring connectors from the engine and transmission. Pull on the connectors not the wires to prevent damage.

(16) Raise the front and rear of the vehicle and support on chassis stands.

(17) Disconnect the front exhaust support bracket,

remove the nuts securing the exhaust flange to the manifold and disconnect the engine pipe from the exhaust manifold.

(18) On manual transmission models, remove the centre console as described in the Body section. Remove the screws and plate retaining the gear shift lever boot. Remove the diaphragm retaining snap ring and ease the diaphragm and boot up the shift lever to reveal the 'E' clip retaining the conical spring. Remove the 'E' clip from above the conical spring and release the retaining tab of the pivot ball seat. Unscrew the ball seat from the gear shift housing and withdraw the shift lever.

(19) On automatic transmission models, disconnect the selector rod from the gear shift lever under the vehicle.

(20) Remove the engine sump and transmission drain plugs and drain the lubricant from both assemblies.

(21) Where applicable, remove the clutch slave cylinder retaining bolts and tie the slave cylinder to a convenient position on the underbody.

(22) Remove the propeller shaft from the vehicle as described in the Manual Transmission section.

(23) Remove the retaining bolt and clamp and withdraw the speedometer cable from the transmission.

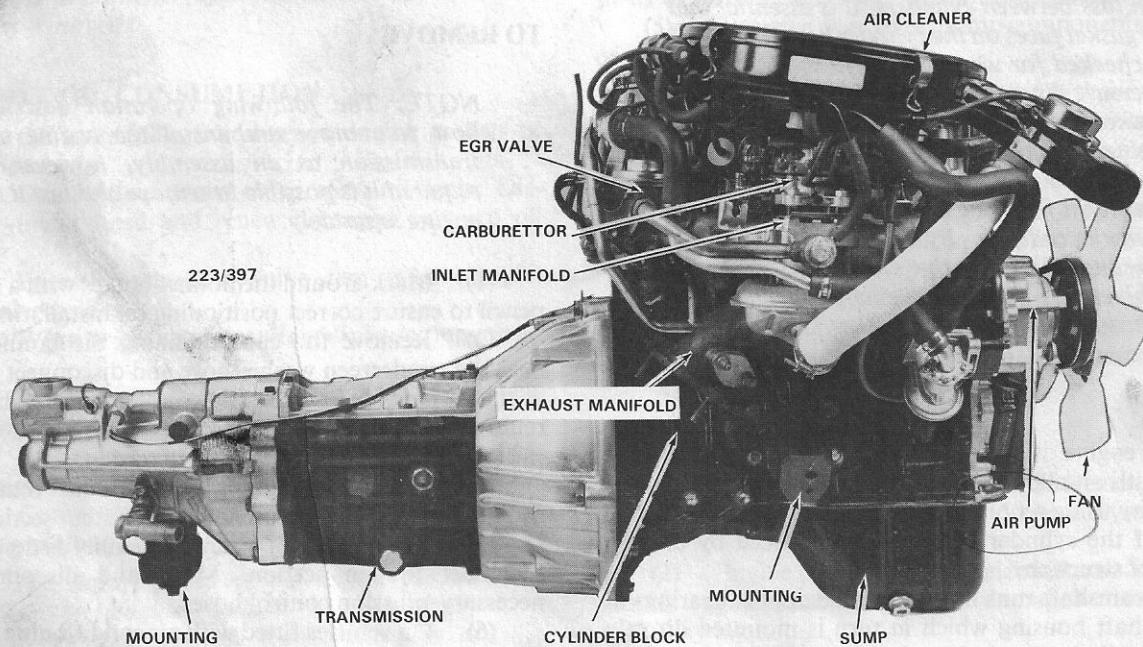
(24) Interpose a block of wood between the transmission and a jack and take the weight of the engine and transmission assembly.

(25) Remove the rear crossmember to mounting retaining bolts.

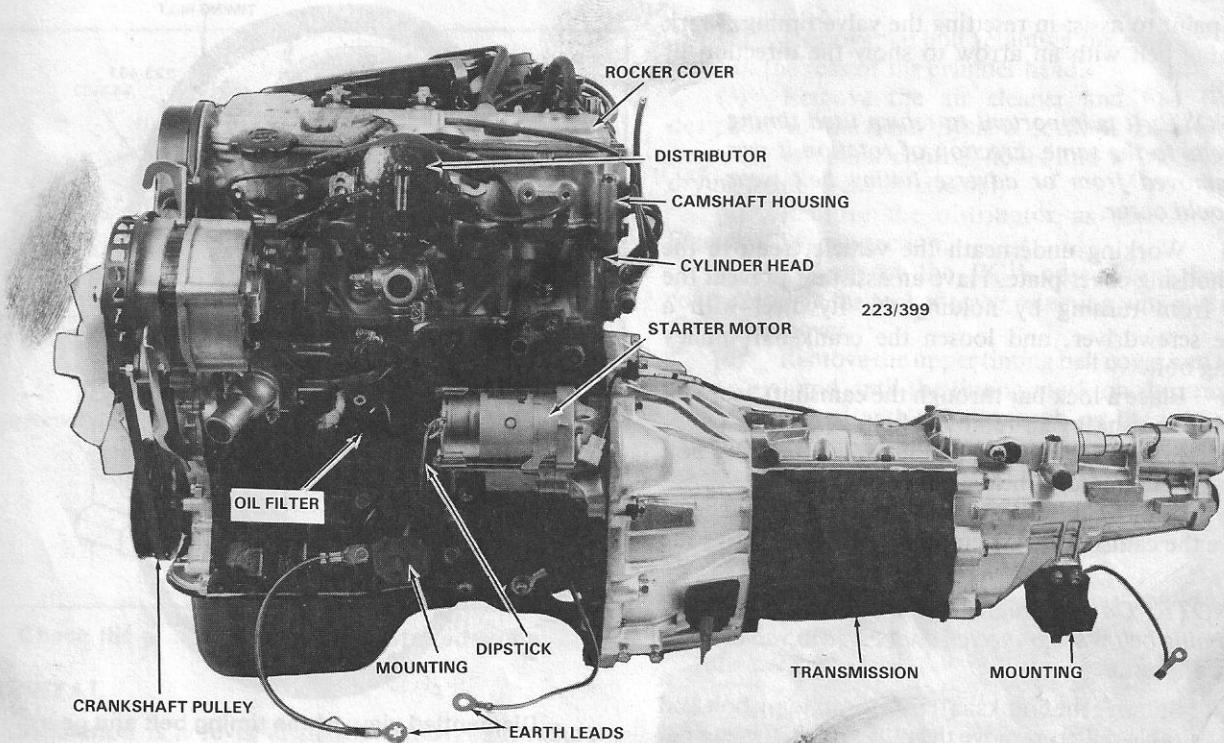
(26) Remove the crossmember to underbody retaining bolts and remove the crossmember.

(27) Instal suitable lifting tackle to the engine and take the weight of the engine assembly.

(28) Remove the front engine mounting to vehicle frame securing bolts, nuts and washers.



Right hand side view of engine and 5 speed manual transmission assembly.



Left hand side view of engine and 5 speed manual transmission assembly.

NOTE: It may be necessary to remove the engine mountings to gain clearance to allow the engine to be removed.

(29) Check around the engine and transmission assembly to ensure that nothing will foul on removal and also that all relevant items have been disconnected.

(30) Gradually raise the engine with the front tilted upwards to clear the body and at the same time lowering the transmission on the jack until the transmission assembly can be lifted clear of the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Instal the engine assembly loosely, instal all the engine mounting nuts, bolts and washers before the full weight of the engine is taken by the mountings, then tighten the mounting nuts and bolts.

(2) Instal a new manifold flange gasket.

(3) Fill the engine and transmission with the correct quantity and grade of lubricant.

(4) Fill the cooling system as described in the Cooling System section.

(5) Start and run the engine until it reaches normal operating temperature and check for fuel, oil and water leaks.

4. TIMING BELT AND GEARS

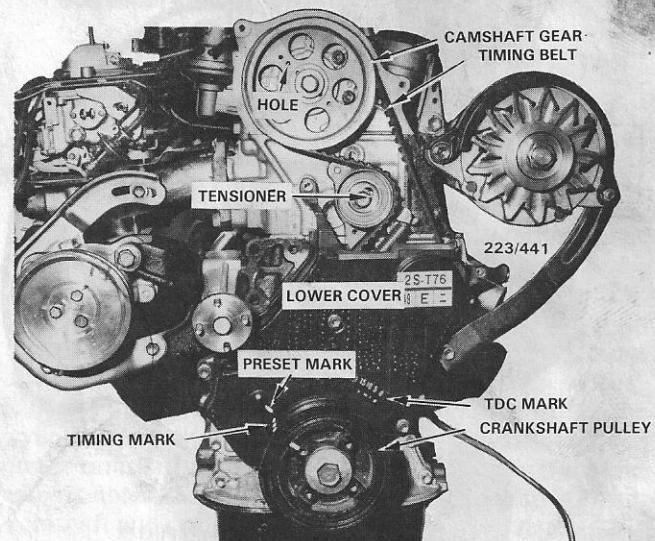
TO REMOVE

- (1) Disconnect the negative battery terminal.
- (2) Remove the alternator, air pump and air conditioner drive belts if installed.

(3) Remove the nuts retaining the fan assembly to the fan bearing housing and remove the fan and drive belt pulleys.

(4) Remove the bolts retaining the upper timing belt cover and remove the cover.

(5) Remove the spark plugs and turn the engine by hand until the mark on the crankshaft pulley is aligned with the preset mark on the lower timing cover. Mark the timing belt, camshaft gear and thrust plate with quick



Front view of the engine with upper timing cover removed and the timing marks aligned with the preset marks.

drying paint to assist in resetting the valve timing. Mark the timing belt with an arrow to show the direction of rotation.

NOTE: It is important to return used timing belts to the same direction of rotation it was removed from or adverse timing belt wear could occur.

(6) Working underneath the vehicle, remove the clutch housing cover plate. Have an assistant prevent the engine from turning by holding the flywheel with a suitable screwdriver, and loosen the crankshaft pulley retaining bolt.

(7) Place a lock bar through the camshaft gear and loosen the camshaft gear retaining bolt.

(8) Remove the timing belt tensioner securing bolt and spring and remove the tensioner.

(9) Remove the timing belt from the camshaft gear. Remove the camshaft gear retaining bolt and remove the gear.

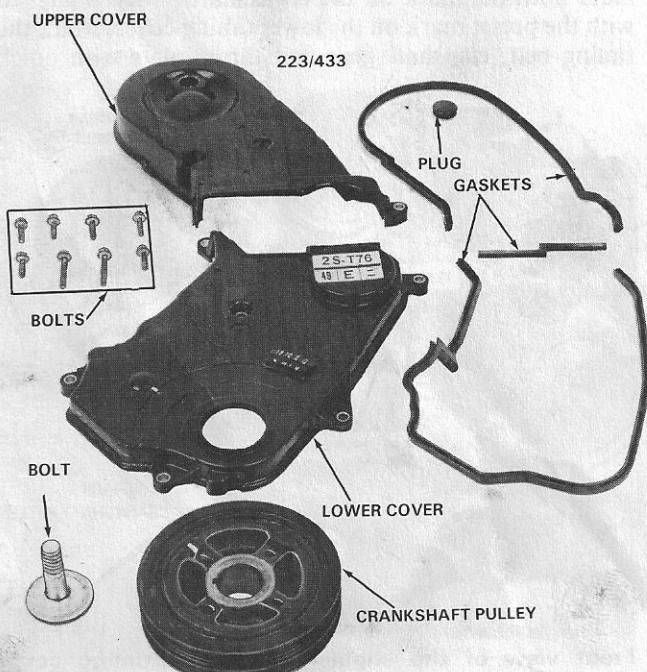
NOTE: Do not rotate the engine while the timing belt is disconnected as damage to valves could result.

(10) Remove the crankshaft pulley retaining bolt and using a suitable puller, remove the pulley from the engine.

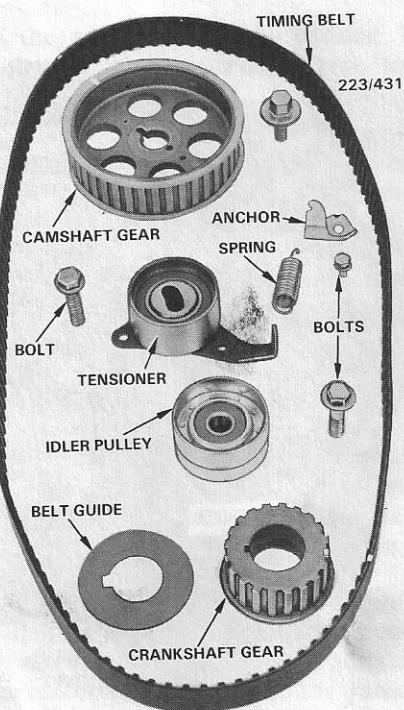
(11) Remove the lower timing belt cover retaining bolts and remove the cover and timing belt from the engine.

(12) Withdraw the crankshaft gear and belt guide from the front of the crankshaft.

NOTE: The crankshaft gear may be tight on its drive key and may require levering or tapping off. Take care not to damage the gear on removal.



View of the timing covers and associated components.



Dismantled view of the timing belt and gears.

TO CHECK AND INSPECT

(1) Wash all components in cleaning solvent and lay out on clean paper for inspection.

NOTE: Do not wash the timing belt, timing gears, tensioner or idler pulley, keep these components free of oil and grease. Wipe the components with a cloth if required.

(2) Inspect the timing belt for damage or wear. Check the belt thoroughly for peeling, cracking, or hardening of the rubber. Check to ensure that the belt is not oil contaminated. Replace the belt and check for oil leaks if any of the above conditions are evident.

NOTE: It is good practice to replace the timing belt if the engine has done more than 50,000 km.

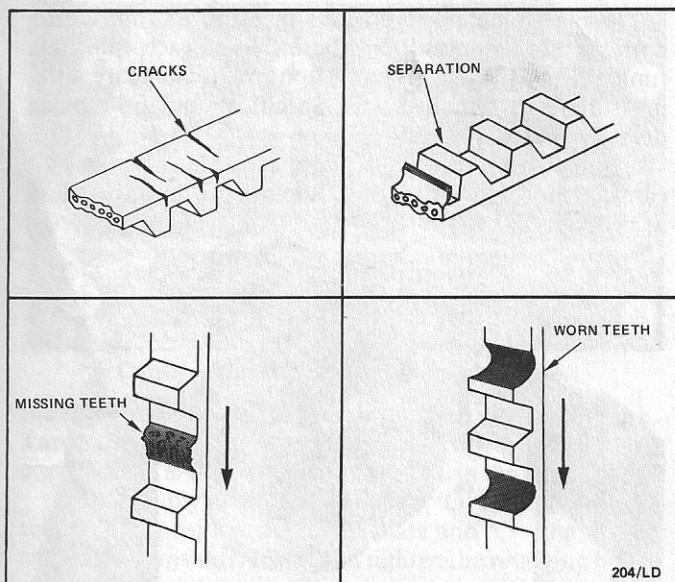
(3) Check the crankshaft gear for wear ensuring that the drive key is serviceable. Renew worn components as necessary.

(4) Check the camshaft gear for wear ensuring that there are no nicks or damage on the teeth. Renew worn components.

(5) Inspect the timing belt tensioner for looseness or wear ensuring that the bearing is serviceable. Check that the tension spring is not broken or stretched by comparing against a new spring.

(6) Check the water pump for signs of leakage or unservicability in accordance with the instructions laid down in the Cooling System section. Renew or replace as required.

(7) Check the oil pump, water pump, tensioner and idler pulley for smoothness of operation.



Check the timing belt for the illustrated faults.

TO INSTAL

Installation is a reversal of the removal procedure with attention to the following points:

(1) Instal the crankshaft and camshaft gears and instal the timing belt over the gears and pulleys. If the old timing belt is to be used, ensure that the arrow marked on the belt is facing the direction of rotation.

(2) Instal the timing belt guide and lower cover with gasket. Instal the crankshaft pulley and align the timing mark on the crankshaft pulley with the preset mark on the lower cover.

(3) Align the hole in the camshaft gear with the preset mark on the camshaft thrust plate.

(4) Release the timing belt tensioner half a turn and turn the engine 90 deg by hand until the timing mark on the crankshaft pulley is aligned with the tdc mark on the lower cover.

With the engine at this position, align the hole in the camshaft timing gear with the tdc mark on the camshaft thrust plate.

(5) Turn the engine two revolutions by hand, recheck the valve timing and reset if necessary.

NOTE: It is important that the valve timing is correctly set or engine damage could result.

(6) Instal the upper timing belt cover with gaskets, fan assembly, drive belts and spark plugs.

5. CAMSHAFT, ROCKER ARMS AND TAPPETS

Special Equipment Required:

To Inspect - Dial guage, straight edge and suitable micrometers

TO REMOVE

(1) Disconnect the negative battery terminal.

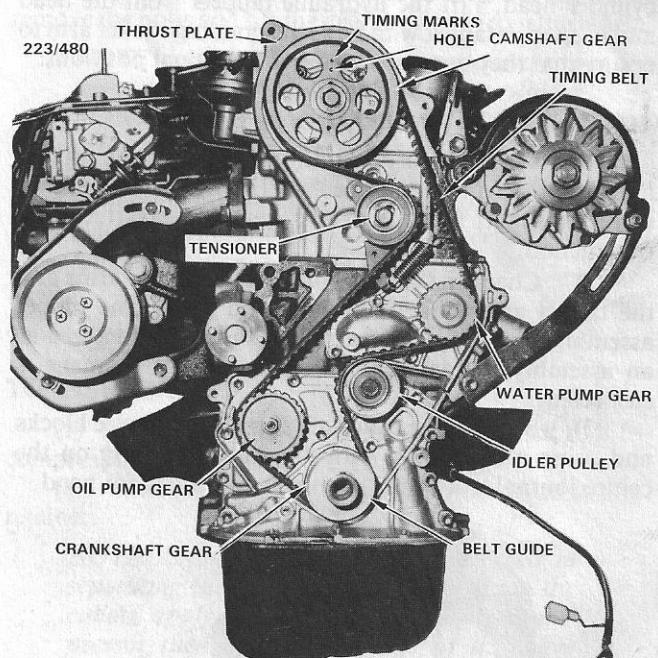
(2) Remove the bolt retaining the emission control pipes to the rear of the cylinder head.

(3) Remove the air cleaner and fuel pump as described in the Fuel System section. Disconnect the necessary emission control hoses and mark with quick drying paint to aid in assembly.

(4) Remove the distributor as described in the Electrical System section.

(5) Disconnect the PCV hose from the rocker cover, remove the rocker cover retaining nuts and remove the rocker cover.

(6) Remove the upper timing belt cover and turn the engine by hand until the timing mark on the crankshaft pulley is aligned with the tdc mark on the lower cover. Mark the positions of the timing belt and gears to aid assembly. Loosen the belt tensioner securing bolt, relock the tensioner in the fully off position and remove the belt from the camshaft gear.



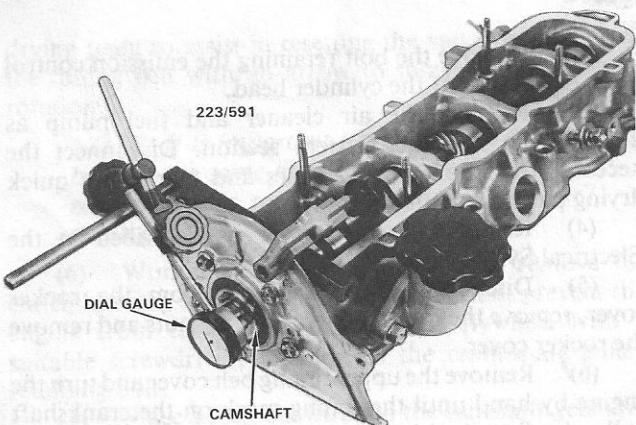
Front view of engine with timing covers removed showing the valve timing marks on tdc.

(7) Place a lock bar through the camshaft gear, loosen then remove the retaining bolt and remove the camshaft gear.

(8) Loosen the camshaft housing retaining bolts in the reverse order to the tightening sequence and remove the camshaft housing.

(9) Using a dial gauge mounted to the front of the cylinder head, lever the camshaft backwards and forwards in the camshaft housing to check the end play. If the end play is not within Specifications, check the thrust plate, camshaft and camshaft housing for wear and renew parts as necessary.

(10) Remove the camshaft thrust plate retaining bolts and remove the thrust plate. Remove and discard the oil seal and 'O' ring.



Checking the camshaft end play.

(11) Withdraw the camshaft from the front of the cylinder head.

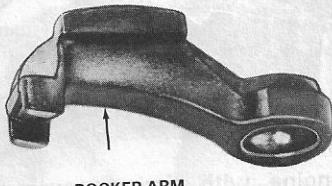
(12) Number the rocker arms and lift them from the cylinder head. Lift the hydraulic tappets from the head and keep each tappet with its corresponding rocker arm to ensure that they are assembled in the original positions.

TO CLEAN AND INSPECT

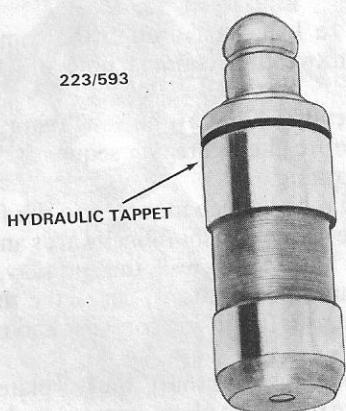
(1) Wash all parts with a suitable cleaning solvent and blow dry with compressed air. Ensure that all oil ways in the camshaft housing and rocker arms are free from obstruction.

(2) Check the camshaft lobes, the rocker arms and the tappet assemblies for pitting and wear. The tappet assemblies are non-serviceable and should be renewed as an assembly if wear is apparent or internal damage is suspected.

(3) Support the camshaft at each end on vee blocks and using a dial gauge with its plunger bearing on the centre journal, rotate the camshaft and check for bend.



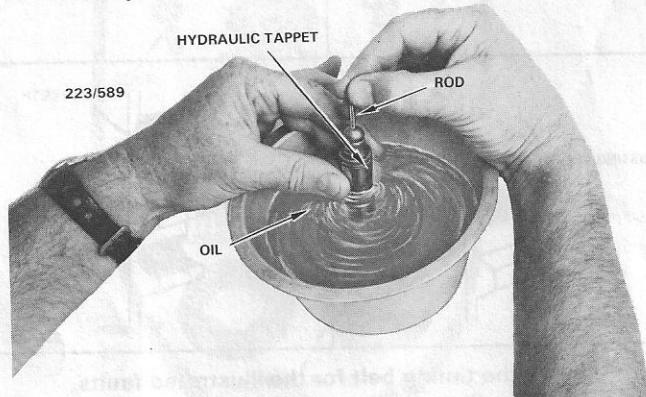
ROCKER ARM



Dismantled view of a hydraulic tappet and rocker arm.

Using suitable micrometers measure the outside of each camshaft journal and the inside of each camshaft tunnel in the camshaft housing. Compare the measurements obtained with Specifications and replace defective parts as necessary.

(4) Check the thrust plate, camshaft housing and camshaft for wear or scoring. Replace the defective parts as necessary.

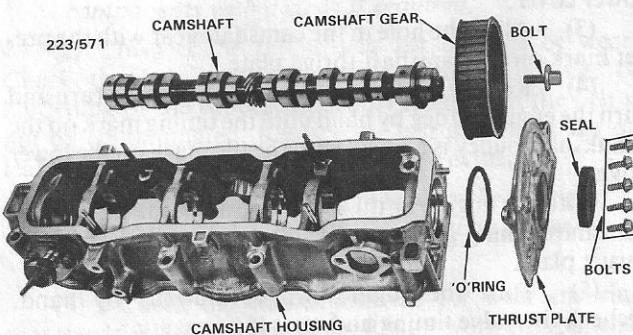


Bleeding the hydraulic tappets.

(5) Insert a steel rod through the plunger hole in the end of a hydraulic tappet and the other end into clean engine oil. Push the plunger valve with the rod several times until all the air has been bled out.

Measure the plunger travel after bleeding and if it exceeds 0.5 mm, replace the hydraulic tappet.

Repeat this procedure with all of the hydraulic tappets.



Dismantled view of camshaft housing.

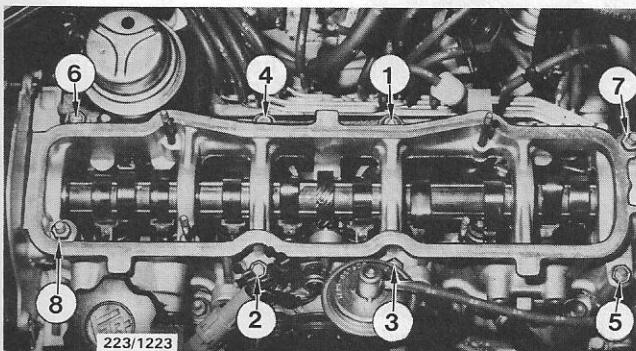
TO INSTALL

Installation is a reversal of the removal procedure with attention to the following points:

(1) Instal the hydraulic tappets and rocker arms to their original positions on the cylinder head.

(2) Apply clean engine oil to the camshaft bearings and camshaft journals. Insert the camshaft into position taking care not to damage the bearings with the edges of the cam lobes or journals.

(3) Lubricate the lip of a new oil seal and position the seal squarely in the thrust plate. Ensure that the lip of



Camshaft housing tightening sequence.

the seal faces towards the inside of the camshaft housing. Tap around the edge of the seal with a soft faced hammer until the seal is fully seated in the recess in the thrust plate.

(4) Apply engine oil to a new 'O' ring and the oil seal lip and position the thrust plate and 'O' ring on the end of the camshaft. Instal and tighten the retaining bolts.

(5) Fit the camshaft gear to the camshaft, ensuring it is correctly located. Tighten the gear retaining bolt to Specifications.

(6) Clean the mating surfaces of the camshaft housing and cylinder head, instal the gasket to the cylinder head and fit the camshaft housing to the cylinder head.

(7) Clean the threads of the retaining bolts and instal the bolts finger tight.

(8) Tighten the bolts in the correct sequence in three steps to Specifications. Do not overtighten as the gasket could be damaged.

(9) Instal the timing belt ensuring that the valve timing is correctly set as described under the heading Timing Belt and Gears in this section.

(10) Instal the remaining components, referring to the relevant sections if required, start the engine and check for oil leaks.

6. CYLINDER HEAD

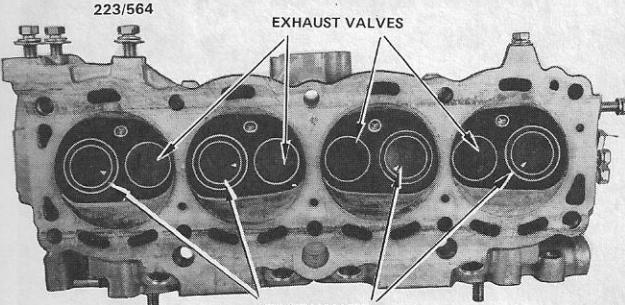
Special Equipment Required:

To Dismantle and Assemble – Valve spring compressor

To Inspect – Dial gauge and straight edge

TO REMOVE

(1) Disconnect the negative battery terminal.



View of the cylinder head showing the valve arrangement.

(2) Remove the timing belt, camshaft housing, rocker arms and hydraulic tappets as previously described.

(3) Drain the coolant from the radiator as described in the Cooling System section. Remove the bolt retaining the front heater pipe bracket to the cylinder head and disconnect the rear heater hose, by-pass hose and top radiator hose from the engine.

(4) Remove the bolt retaining the alternator to the cylinder head. Drain the oil from the engine sump as described in the Lubrication and Maintenance section.

(5) Remove the manifolds from the vehicle as described in this section under Inlet and Exhaust Manifolds.

(6) Mark and disconnect the vacuum hoses from the two BSV units at the rear of the cylinder head.

(7) Loosen the cylinder head bolts in the reverse order of the tightening sequence, backing off each bolt a quarter of a turn at a time. When all of the bolts are loose, remove the bolts and lift the cylinder head from the block.

NOTE: If difficulty is experienced in separating the cylinder head from the cylinder block, place a block of wood against the cylinder head manifold flange and sharply tap the block of wood upwards. Never wedge screwdrivers or similar tools between the cylinder head and the cylinder block to dislodge the cylinder head.

(8) Remove the cylinder head gasket from the cylinder block.

TO DISMANTLE

(1) Use a suitable valve spring compressor tool to compress the valve spring.

(2) Remove the two collets from the valve spring retainer.

NOTE: Should difficulty be experienced in separating the valve spring retainer from the collets, apply light pressure to the spring compressor then sharply tap edge of the valve spring retainer with a soft faced hammer.

(3) Release the spring compressor and remove the valve rotator or retainer and the spring and seat.

(4) Remove the valve stem seal.

(5) Using a warding file, remove any burrs from the valve stem to ensure that the valve guide is not damaged as the valve is withdrawn.

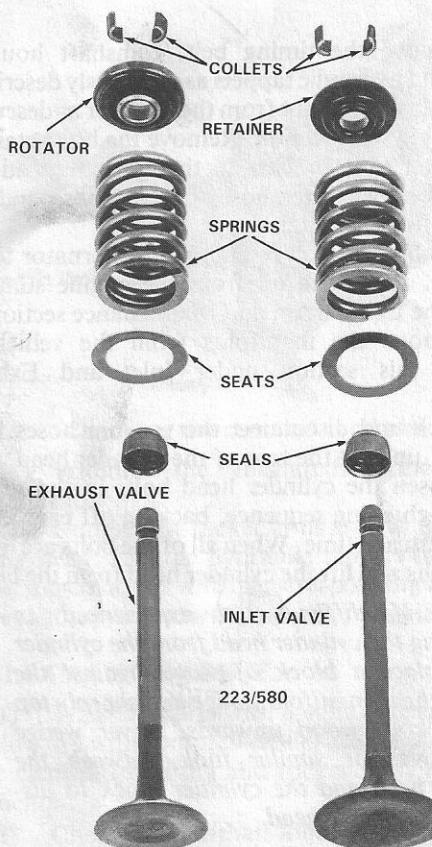
(6) Remove the valve and place it with the other components of the valve assembly in a suitable rack or tray to ensure that they are installed to their original position during assembly.

(7) Repeat the removal procedure with the remainder of the valves.

TO CLEAN AND INSPECT

(1) Clean the valves thoroughly of carbon deposits and discard any valve that is cracked or burnt.

(2) Inspect the exhaust valve stem tips for rotation



Dismantled view of valve and spring components.

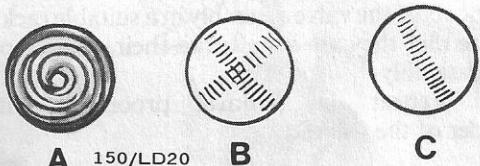
patterns. Rotators are incorporated in the exhaust valve spring caps which cause the valves to rotate during operation. This rotation helps prolong valve face and seat life.

(3) Reface each valve head to the specified angle, refer to Specifications and reface each valve stem flat and true on a suitable valve refacing machine.

If a valve head thickness has been reduced to less than 1.0 mm for the exhaust valve and 0.5 mm for the inlet valve after the refacing operation, then the valve concerned should be renewed.

(4) Measure the valve stem to guide clearance with a dial gauge. This is done by 'rocking' the valve back and forth in the valve guide and noting the greatest reading on the dial gauge.

If the clearance is outside Specifications then the valve guides will have to be renewed and new valves fitted. This is best left to an engine reconditioning shop.

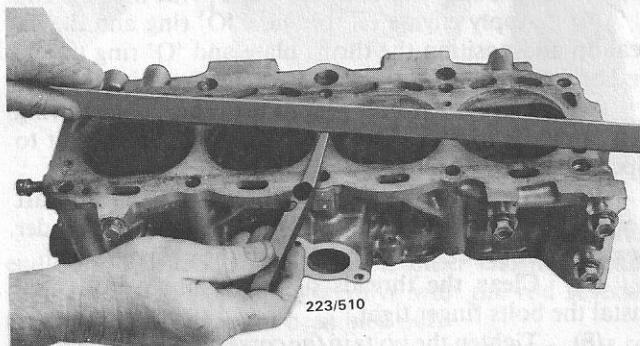


Exhaust valve stem tip rotation markings. A = proper tip marking — rotator operating correctly. B = partial rotation marking — renew rotator. C = no rotation marking — renew rotator.

(5) Remove the carbon deposits from the combustion chambers, the cylinder head face and the valve throats. Check the condition of the valve seats and if necessary, recut the valve seats with a valve cutter to the recommended angle.

NOTE: If the valve seats in the cylinder head are worn, cracked or recessed excessively then new inserts will have to be installed. This is best left to an engine reconditioning shop who has the necessary specialised equipment.

(6) With a steel straight edge and feeler gauge, check along and across the cylinder head for warping. If the cylinder head is found to be warped in excess of Specifications it will be necessary to have its surface ground to return it to a serviceable condition.



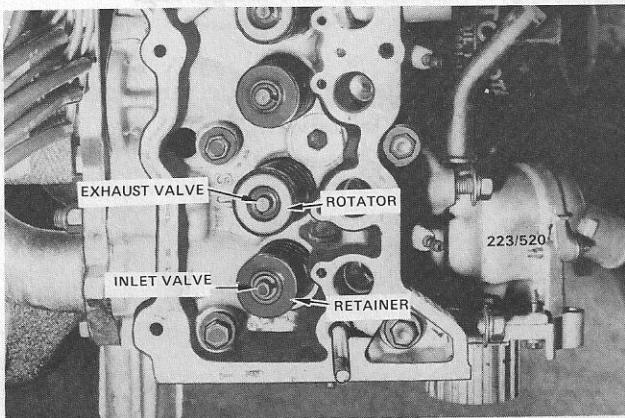
Checking the cylinder head face for warpage.

(7) Check the cylinder head face and combustion chambers for cracks and burn marks. Inspect the water transfer holes in the cylinder head for corrosion.

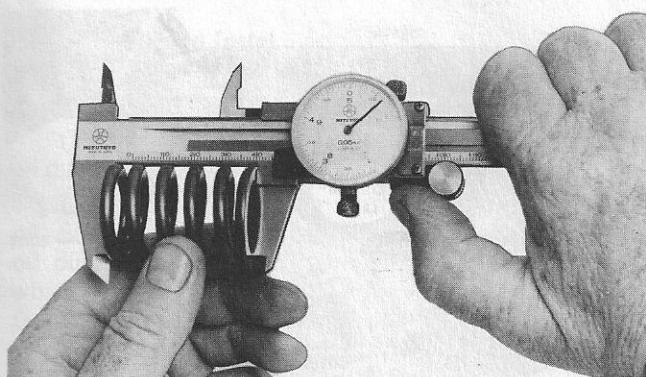
(8) Measure the valve springs free length and compare with Specifications. Also check the squareness of the springs. Renew springs that are suspect or prove to be unserviceable.

(9) Lap the valves to the valve seats with a lapping compound. Apply a smear of Prussian Blue to the valves after lapping and check the valves on their respective seats to ensure that a true and concentric seating has been obtained.

Ensure that all traces of valve lapping compound is



View of the valve gear showing valve retainer on inlet valve and rotator on exhaust valve.



Checking the free length of the valve spring.

washed from the valves and the combustion chambers.

(10) Ensure that all traces of old gasket are removed from the cylinder head face and the manifold faces.

TO ASSEMBLE

Assembly is a reversal of the dismantling procedure with attention to the following points:

(1) Lubricate all component wear surfaces with clean engine oil before assembly to ensure adequate lubrication when starting.

(2) Using a suitable tubular drift, carefully tap the valve stem seals onto the valve guides. Ensure that the seals are squarely on the valve guides and are pushed fully down.

(3) Use care when installing the valves to prevent damage to the seals.

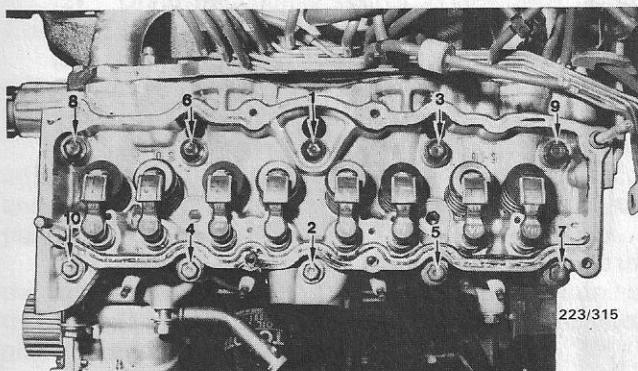
(4) Ensure that the valve retaining collets are installed to their correct positions, as noted during the dismantling procedure and that they are fully seated in the valve stem groove before releasing the valve spring compressor.

(5) Ensure that the valve rotators are fitted to the exhaust valves and the spring retainers are fitted to the inlet valves.

TO INSTAL

Installation is a reversal of the removal procedure with attention to the following points:

(1) Ensure that the mating faces of the cylinder block and the cylinder head are perfectly clean.



Cylinder head bolt tightening sequence.

(2) Do not use any gasket sealing compound when installing the cylinder head gasket.

(3) Instal the cylinder head gasket and cylinder head to the cylinder block and tighten the cylinder head bolts to the specified torque in three stages, in the sequence as shown in the illustration.

(4) Instal the hydraulic tappets, rocker arms, cam-shaft housing and the timing belt as described under the appropriate headings in this section.

(5) Instal the inlet and exhaust manifolds as described under the appropriate heading.

(6) After completing the installation, fill the cooling system as described in the Cooling System section.

(7) Fill the engine with the correct grade and quantity of engine oil.

(8) Start and run the engine, check for coolant and oil leaks.

7. ENGINE SUMP AND OIL PUMP

ENGINE SUMP

To Remove and Instal

(1) Raise the front of the vehicle and support on chassis stands.

(2) Using a suitable container, remove the sump plug and drain the engine oil.

(3) Instal and tighten the sump plug.

(4) Remove the engine splash shield from under the front of the engine.

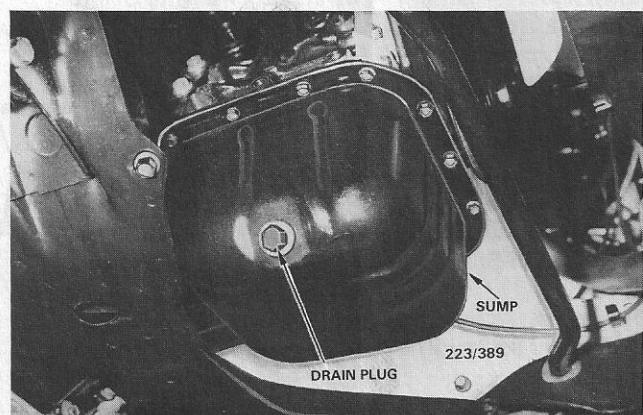
(5) Remove the stabiliser bar as described in the Front Suspension section.

(6) Interpose a block of wood between the clutch housing and a jack and take the weight of the engine.

(7) Remove the bolts and nuts retaining the front engine mountings to the vehicle crossmember and jack up the engine.

(8) Remove the sump retaining bolts and nuts and withdraw the sump from the vehicle.

NOTE: It may be necessary to use wedges to dislodge the sump. Ensure that the sump or oil pump is not damaged during this operation.



Installed view of the sump.

(9) Remove the bolts retaining the oil pick-up to the engine, remove the pick up and the 'O' ring.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Clean all traces of sealant from the sump and engine block.

(2) Thoroughly wash the sump, both inside and outside removing all traces of sludge, carbon deposits or metal particles.

(3) Wash the oil pump screen and clean if necessary with a wire brush and blow dry with compressed air after cleaning.

(4) Instal the oil pick up with a new 'O' ring and instal the retaining bolts.

(5) Coat the mating surfaces of the sump and engine block with a suitable sealant.

(6) Place the sump in position and instal the retaining nuts and bolts finger tight. Tighten the nuts and bolts securely in a diagonal sequence.

(7) Lower the engine into position, instal the engine mounting nuts and bolts and tighten when the full weight of the engine assembly is taken by the mountings.

(8) Instal the stabiliser bar and splash shield.

(9) Fill the sump with the recommended quantity and grade of oil.

(10) Start the vehicle and check for oil leaks. Rectify as necessary.

OIL PUMP

To Remove and Dismantle

(1) Remove the sump and oil pick up as previously described.

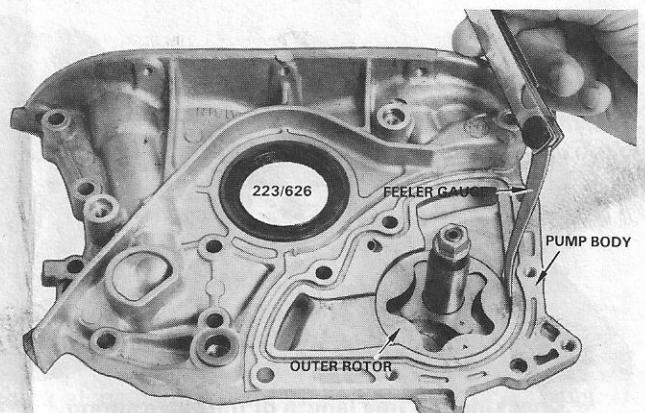
(2) Remove the timing belt as described in this section under the heading Timing Belt and Gears.

(3) Withdraw the crankshaft gear and key from the crankshaft.

(4) Remove the oil pump retaining bolts.

(5) Using a soft faced hammer, gently tap the oil pump from the inside to separate it from the cylinder block and remove the oil pump.

(6) Hold the oil pump drive gear in a vice equipped with soft jaws, remove the retaining nut and withdraw the gear from the shaft.



Measuring the outer rotor to body clearance.

(7) Remove the retaining bolts and separate the two halves of the oil pump body. Note the marks on the rotors and remove the inner and outer rotors.

(8) Remove the snap ring retaining the pressure relief valve in the oil pump body and remove the retainer, spring and piston from the body.

(9) Using a suitable drift, drive the rotor shaft oil seal and crankshaft oil seal from the oil pump.

To Check and Inspect

(1) Thoroughly clean the oil pump components in a suitable solvent, blow dry with compressed air and temporarily assemble the rotors in the oil pump body.

(2) Measure the inner to outer tip clearance. See Specifications. If clearance exceeds Specifications, renew the rotor set.

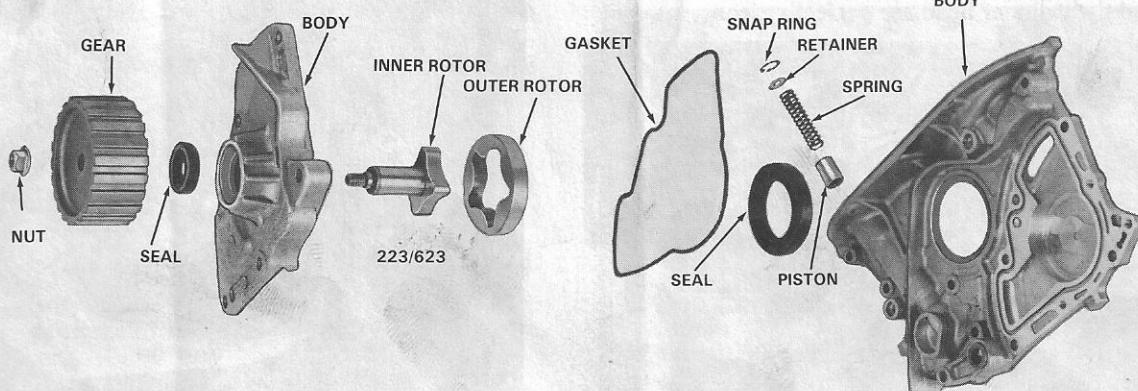
(3) Measure the outer rotor to the oil pump body clearance. If the clearance exceeds Specifications, renew the rotor set or oil pump body.

(4) Check the pressure relief valve spring for weakness and breakage.

(5) Check the relief valve for wear and ensure that the oilways are clear.

(6) Thoroughly clean the oil pick up and screen with a wire or bottle brush.

(7) Blow the oil pick up and screen clean with compressed air.



Dismantled view of the oil pump.

To Assemble and Instal

Assembly and installation is a reversal of the removal operations with attention to the following points:

(1) Lubricate all components sparingly with engine oil during assembly.

(2) Instal a new rotor shaft oil seal and crankshaft oil seal with the seal lips facing inwards, to the front of the oil pump body. The seal should bottom in the recess, which when measured should be equal to a depth of 1 mm from the edge of the oil pump.

(3) Instal the relief valve piston, spring and retainer into the oil pump body and instal the snap ring.

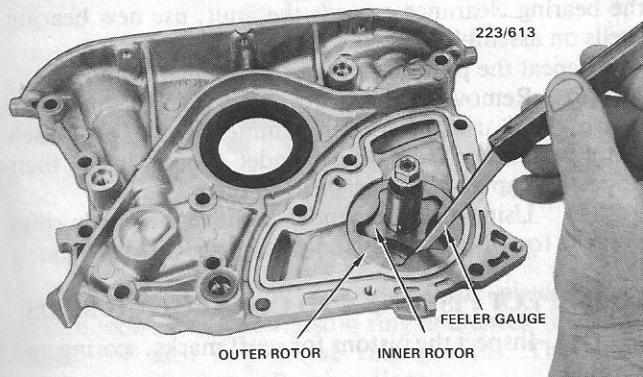
(4) Instal the outer rotor with the marks up into the oil pump body and using a new gasket, assemble the two halves of the oil pump body.

(5) Instal the oil pump to the cylinder block using a new gasket and instal the retaining bolts.

(6) Instal the oil pick up and sump as previously described.

(7) Instal the timing belt and set the valve timing as described under Timing Belt and Gears in this section.

(8) Fill the engine with the recommended quantity and grade of engine oil.



Measuring the rotor tip clearance.

8. INLET AND EXHAUST MANIFOLDS

TO REMOVE AND INSTAL

(1) Disconnect the negative battery terminal.

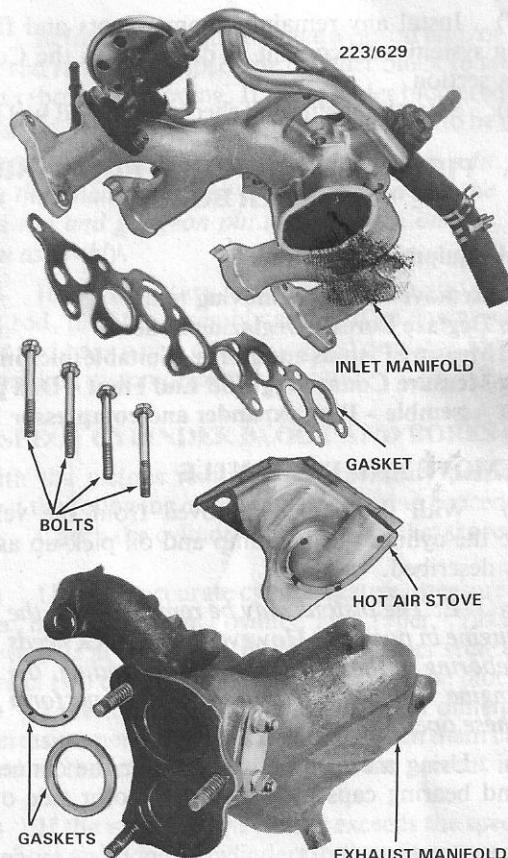
(2) Drain the cooling system as described in the Cooling System section.

(3) Remove the air cleaner and carburettor as described in the Fuel System section. Disconnect the PCV and brake servo hoses from the inlet manifold.

(4) Loosen the air pump mounting bolt, remove the adjusting bolt retaining the air pump to the inlet manifold and remove the air pump drive belt. Disconnect the air pump delivery hose from the air pump and check valve.

(5) Remove the bolts retaining the inlet manifold to the exhaust manifold. Remove the nuts and bolts retaining the inlet manifold to the cylinder head and lift the inlet manifold and hot air stove from the vehicle.

(6) Remove the nuts retaining the exhaust flange to the exhaust manifold, remove the exhaust pipe front



Dismantled view of the inlet and exhaust manifold assemblies.

support bracket and disconnect the exhaust pipe from the exhaust manifold.

(7) Remove the exhaust manifold mounting bolts and nuts and remove the exhaust manifold from the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Check the mounting faces of the manifolds for warpage and examine both manifolds for cracks. Renew or surface grind as necessary.

(2) Using new gaskets on all mating surfaces, instal the exhaust manifold and loosely instal the nuts and bolts retaining the exhaust manifold to the cylinder head and the exhaust flange.

(3) Instal the inlet manifold and hot air stove, and loosely instal the nuts and bolts retaining the inlet manifold to the cylinder head and to the exhaust manifold.

(4) Torque the inlet and exhaust manifold nuts and bolts to Specifications. Fully tighten the bolts securing the inlet manifold to the exhaust manifold and the exhaust flange nuts.

(5) Connect the PCV and brake servo hoses and instal the carburettor and air filter as described in the Fuel System section.

(6) Instal the air pump adjusting bolt. Instal and adjust the air pump drive belt and connect the delivery hose to the air pump and check valve.

(7) Instal any remaining components and fill the cooling system with coolant as described in the Cooling System section.

(8) Start the engine and check for air and fuel leaks.

9. PISTONS, CONNECTING RODS AND CYLINDER BORES

Special Equipment Required:

To Remove - Ridge removing tool

To Deglaze Bores - Deglazing hone

To Measure Pistons and Bores - Suitable micrometers

To Measure Connecting Rod End Float - Dial gauge

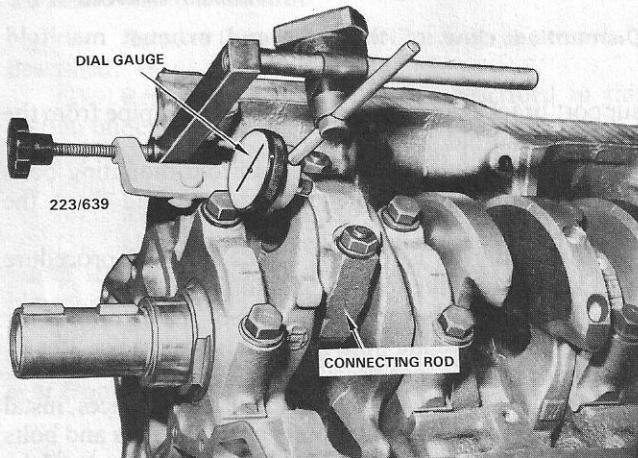
To Assemble - Ring expander and compressor

TO REMOVE AND DISMANTLE

(1) With the engine removed from the vehicle, remove the cylinder head, sump and oil pick-up as previously described.

NOTE: The pistons may be removed with the engine in position. However if the block needs reborning or the crankshaft needs grinding, the engine will have to be removed to perform these operations.

(2) Using a centre punch, number the connecting rods and bearing caps on the starter motor side of the engine.



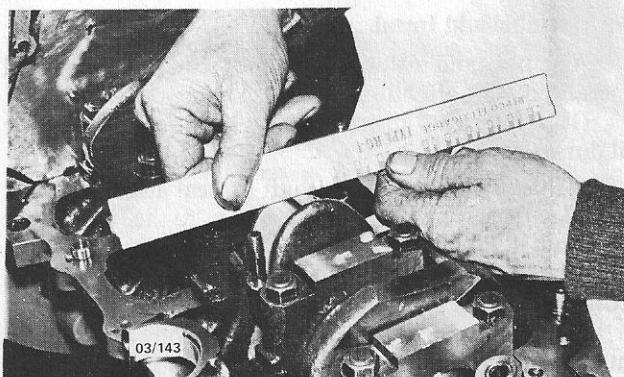
Checking connecting rod end float with a dial gauge.

NOTE: The bearing caps are marked 1, 2 or 3, which is not the location number but to denote the size of standard bearing used. Ensure that the bearings corresponding with this number are used.

(3) Check the end float of each connecting rod with a dial gauge. If the end float is not within Specifications, renew the connecting rod.

(4) Using a ridge removal tool, remove the ridge from the top of each cylinder bore where necessary.

(5) With number one cylinder at the bottom of its stroke, remove the bearing cap nuts and bearing cap.



Measuring the compressed Plastigage with the scale provided. Illustrative photo only.

Wipe the bearing shell and the exposed part of the crankshaft journal with a piece of lint free cloth, insert a piece of Plastigage across the journal, then instal the bearing cap and torque the nuts to Specifications.

Remove the nuts and cap, and measure (with the scale on the packet) the spread width of the Plastigage to determine the bearing clearance.

Compare the measurement to Specifications and if the bearing clearance exceeds the limit, use new bearing shells on assembly.

Repeat the procedure on the remaining cylinders.

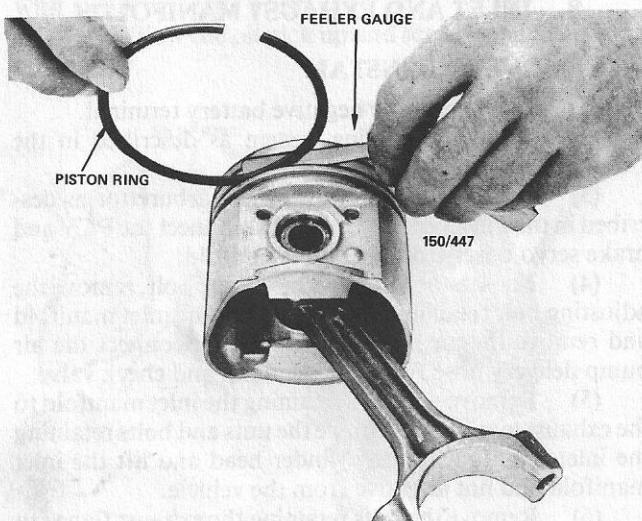
(6) Remove each bearing cap in turn keeping them in order and, using a wooden hammer handle, push each piston assembly from the cylinder block. Instal their respective cap and bearing shells to them.

(7) Using a ring expander, remove the piston rings over the top of the piston and discard the piston rings.

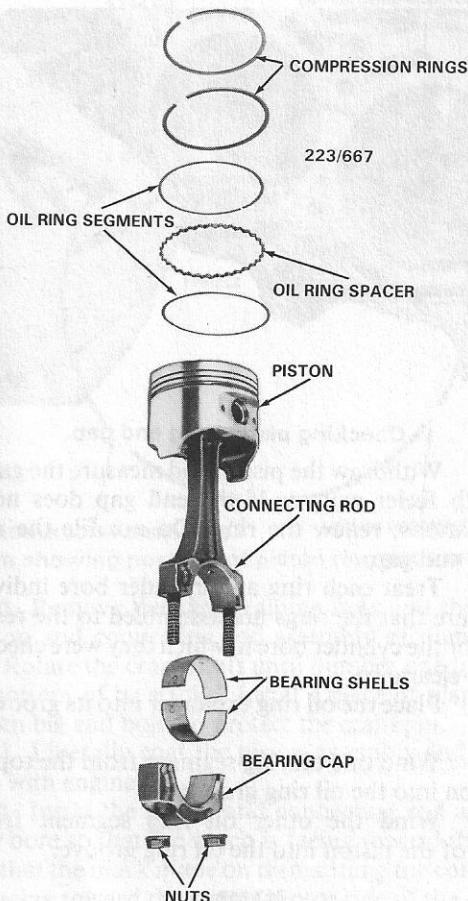
TO INSPECT PISTONS AND CONNECTING RODS

(1) Inspect the pistons for scuff marks, scoring and burning.

(2) Clean all traces of carbon from the piston crowns and using a piece of broken ring, clean out the ring grooves.



Checking piston ring to groove clearance.

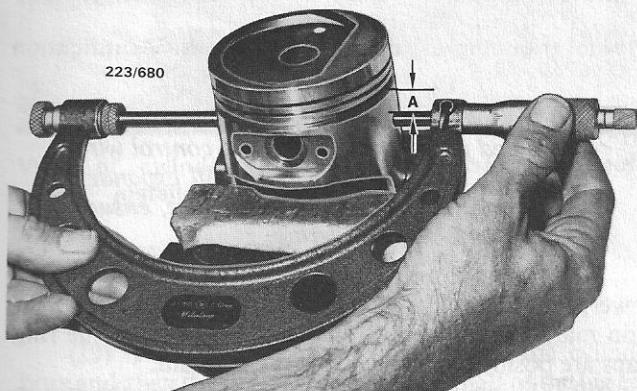


Piston and connecting rod components.

(3) Inspect the ring grooves of the pistons for excessive wear. Use a new piston ring and check the side clearance of each ring in the ring grooves. The side clearance must be within Specifications.

(4) Measure each piston skirt at a point 28 mm below the bottom of the oil ring groove and at right angles to the gudgeon pin axis. Renew the piston if the diameter does not meet Specifications.

(5) Inspect each pair of bearing cap shells for wear. If one or more pairs of the bearing shells are worn on the outer edge it is possible the connecting rod is bent.



Measuring the piston diameter. Distance A = 28 mm.

(6) Before proceeding to have a piston and/or connecting rod renewed, inspect the cylinder block to see if it requires reboring or honing. If the cylinder block requires reboring it is obvious that new pistons will have to be used.

NOTE: The gudgeon pin is an interference fit in the small end of the connecting rod and the piston and gudgeon pin are available only as an assembly.

(6) If it is necessary to renew a piston and/or connecting rod, take the assembly along to an engine reconditioner and have a new connecting rod or piston installed to the original piston or connecting rod.

TO INSPECT CYLINDER BLOCK AND BORES

With the pistons removed as previously described, carry out the following checks and measuring procedures.

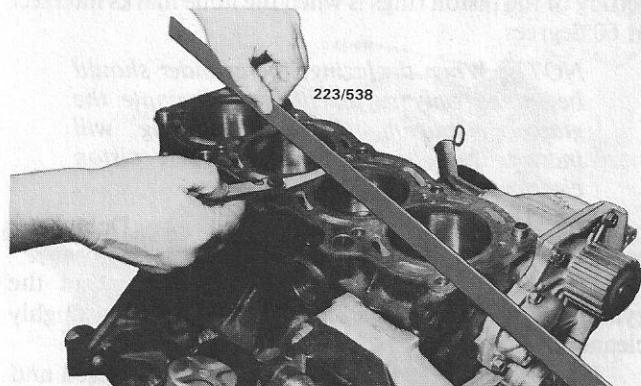
(1) Check the cylinder bores for cracks, scores and scuffs.

(2) Using an accurate cylinder gauge, measure each cylinder bore for wear, ovality and taper. Take the measurements at the upper, middle and lower sections of the bore in two directions, along and across the block.

(3) Take the minimum and maximum dimensions of the measurements. The difference between them can be regarded as the nominal amount of wear present in the bore.

(4) If the wear in any cylinder exceeds the specified limit, rebore and hone all cylinders to the nearest specified oversize for pistons and rings.

NOTE: The cylinder that is most worn will be the one that determines which oversize is applicable.



Checking the cylinder block face for warpage.

(5) With a straight edge and feeler gauge, check the top face of the cylinder block for warpage using the same procedure described for the cylinder head. See Specifications for warpage limits.

NOTE: If the top of the block is distorted beyond Specifications completely dismantle the engine and have the block machined.

(6) Thoroughly clean the block with a suitable solvent and compressed air, paying particular attention to the oil ways. Inspect the block for cracks and damage.

TO CHECK PISTON CLEARANCE

(1) Using an accurate cylinder measuring gauge, measure and note the diameter of each bore as previously described.

(2) Measure each piston skirt at a point 28 mm below the bottom of the oil ring groove and at right angles to the gudgeon pin axis.

(3) The difference between the bore and the piston skirt measurements is the piston clearance. If the clearance exceeds Specifications then renew the piston or bore and hone the cylinder, whichever is necessary.

(4) Cylinders that have been reamed and honed to take the appropriate oversize pistons should have the clearance checked in the manner described.

NOTE: Standard pistons are graded into sizes and identified by a letter on the piston crown. They are for use in the standard bores.

TO DEGLAZE CYLINDER BORES

Cylinder bores that are fit for further service with original pistons but require re-ringing should be deglazed with a hone.

(1) Use a surfacing hone with 280 grit stones for deglazing.

NOTE: When deglazing cylinder bores with the crankshaft installed, plenty of clean rag should be placed over the crankshaft to keep abrasive materials from entering the oil ways.

(2) Move the hone up and down the cylinder walls sufficiently fast enough to achieve a cross hatch pattern.

The cross hatch pattern most satisfactory for correct setting of the piston rings is when the hone marks intersect at 60 degrees.

NOTE: When deglazing, the cylinder should be honed only sufficiently to eliminate the glazed condition. Excessive honing will increase bore size and thus increase piston clearance.

(3) Use only honing oil for lubrication. Do not use engine oil, transmission oil, mineral spirits or kerosene.

(4) When honing is completed, ensure that the cylinder bore, crankcase area and oil ways are thoroughly cleaned.

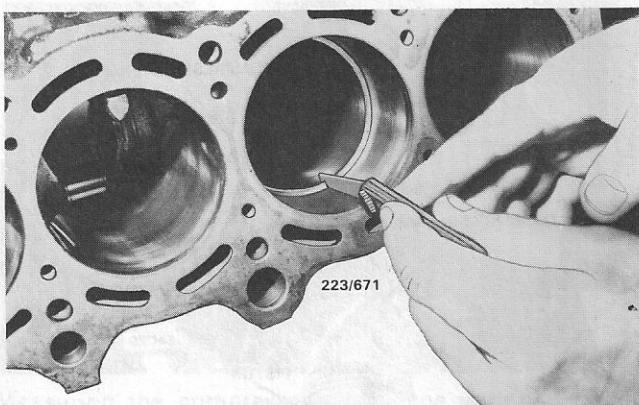
(5) After the cylinder block has been cleaned and dried, wipe the bores with a lint free cloth then smear them with engine oil to prevent rusting.

TO FIT NEW PISTON RINGS AND INSTAL

Once the correct piston and bore relationship has been determined and the pistons cleaned or renewed as necessary, proceed as follows:

(1) Select a set of rings to suit the bore, standard or oversize, whichever is necessary.

(2) Place a ring into number one cylinder bore and using an inverted piston push the ring down into the bottom of the cylinder bore.



Checking piston ring end gap.

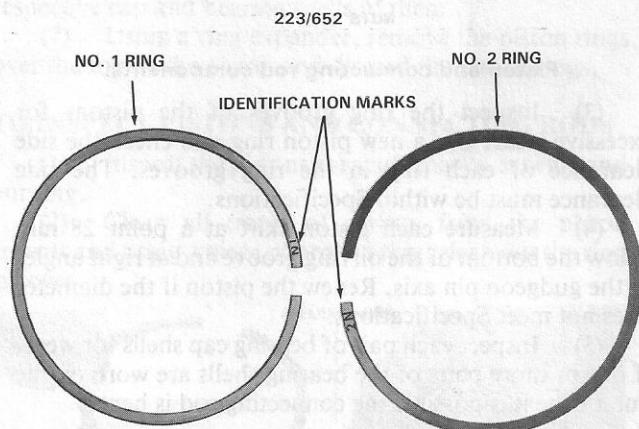
(3) Withdraw the piston and measure the gap in the ring with feeler gauges. If the end gap does not meet Specifications, renew the ring. Do not file the rings to increase end gap.

(4) Treat each ring and cylinder bore individually and ensure that the rings are assembled to the respective piston for the cylinder bore in which they were checked for end gap clearance.

(5) Place the oil ring expander into its groove in the piston.

(6) Wind one oil ring segment from the top end of the piston into the oil ring groove.

(7) Wind the other oil ring segment from the bottom of the piston into the oil ring groove.



View of the compression rings showing the identification marks.

NOTE: The ends of the oil ring expander are prevented from overlapping by a control wire built into the expander. If the oil expander used does not contain a control wire, ensure that the ends do not overlap.

(8) Using a piston ring expanding tool, instal the lower, then upper compression rings with the identification marks uppermost on the ring. Ensure that the ring gaps are positioned as shown in the diagram.

(9) Using the same procedure, instal the piston rings to the remaining pistons.

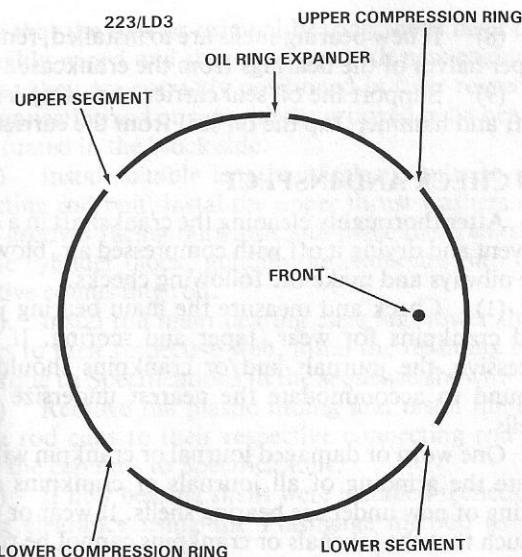
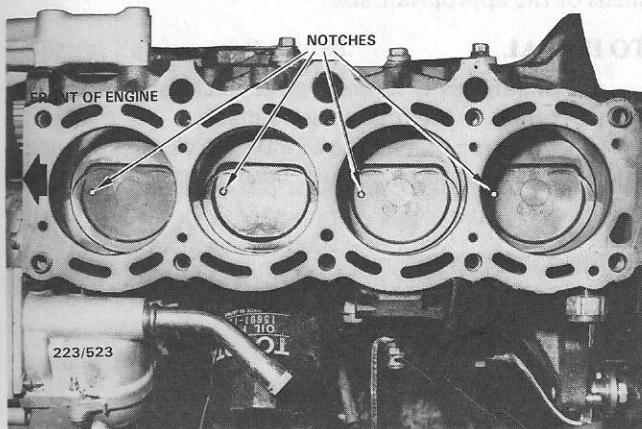


Diagram showing position of piston ring gaps on piston.

(10) Remove the cap retaining nuts and the cap of the piston and connecting rod assembly of number one piston. Rotate the crankshaft until number one journal is at the bottom of its stroke. Instal a piece of plastic tube over both big end bolts to protect the crankpin.

(11) Liberally coat the piston assembly and big end bearing with engine oil.

(12) Instal the piston and connecting rod assembly into the bore so that the notch is facing toward the front. Ensure that the mark made on dismantling the connecting rod is facing toward the starter motor side of the cylinder block. Instal a suitable piston ring compressor over the piston and compress the rings into their grooves.



View of cylinder block showing pistons correctly installed with notches facing the front.

NOTE: Connecting rod and piston assemblies must be replaced in the cylinders from which they were removed during dismantling.

(13) Push the piston assembly down the cylinder bore and align the connecting rod upper half of the big end bearing on the crankshaft crankpin.

NOTE: If on dismantling it was found that new bearing shells were needed, place them into the connecting rod and cap before installing the cap to the connecting rod.

(14) Remove the plastic tube from the big end bolts and instal the big end bearing cap and bearing half. Instal the retaining nuts and tighten to the specified torque.

(15) If new bearing shells were installed recheck the bearing clearance as previously described.

(16) With the bearing clearance as specified instal the remaining pistons in the same manner.

(17) With all connecting rods torqued to Specifications, instal the associated components by referring to the various sections and instal the engine assembly in the vehicle as previously described.

10. CRANKSHAFT AND BEARINGS

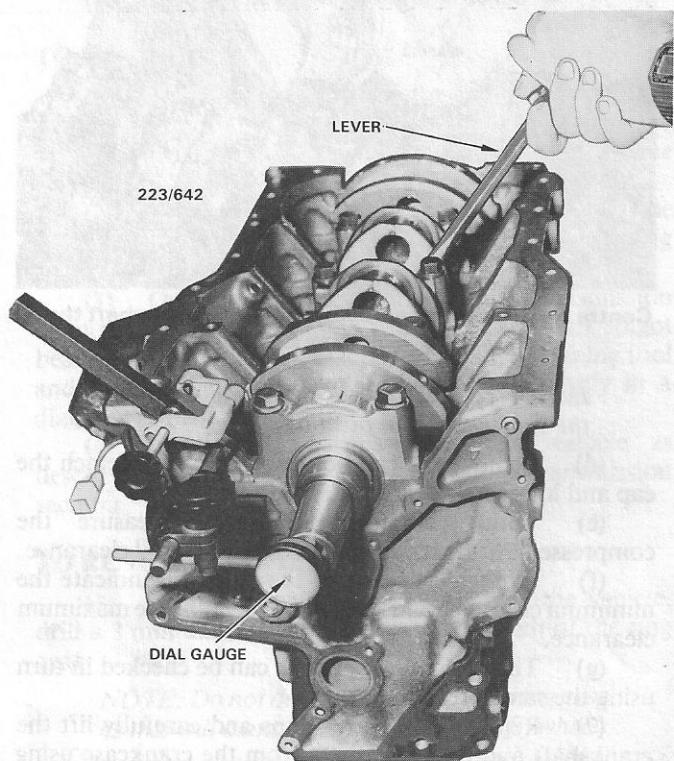
Special Equipment Required:

To Remove Crankshaft Pulley - Suitable puller
To Check End Float - Dial gauge
To Measure Journals - Micrometer

TO REMOVE

(1) With the engine assembly removed from the vehicle, refer to the appropriate sections and remove the sump, oil pump and flywheel/drive plate.

(2) Remove the crankshaft rear oil seal carrier assembly retaining bolts and remove the assembly rearwards from the crankshaft and cylinder block.



Measuring crankshaft end float.

(3) Ensure that all main bearing and connecting rod bearing caps are numbered to ensure correct assembly.

(4) Remove the connecting rod nuts and caps, keeping them in order and push each piston and connecting rod slightly into the bore without pushing the piston from the bore.

(5) Check the crankshaft end float clearance by inserting a feeler gauge between the shaft and the centre main bearing or by mounting a dial gauge with its plunger against one end of the shaft.

Push the crankshaft rearwards into contact with the front edge of the thrust plate at the centre main bearing, zero the dial gauge, then lever the shaft forward to determine the clearance.

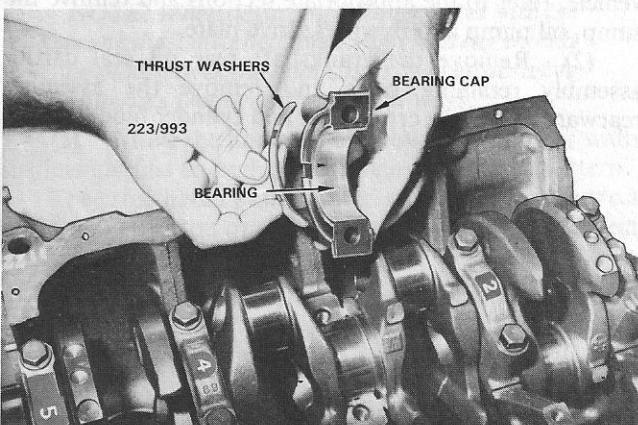
If the clearance exceeds Specifications then renew the centre main bearing thrust washers assembly.

(6) Check the main bearing clearance by the Plastigage method as follows:

(a) Remove the bearing cap and with a piece of lint free cloth, wipe the journal and bearing clean.

(b) Position a piece of Plastigage the approximate length of the bearing width and slightly off centre, onto the bearing surface of the crankshaft journal.

(c) Instal the bearing cap and tighten the cap bolts to the specified torque.



Centre main bearing removed showing crankshaft thrust washers.

IMPORTANT: Do not rotate the shaft while the Plastigage is in position.

(d) Remove the cap bolts and carefully detach the cap and lower half bearing.

(e) With the Plastigage scale, measure the compressed Plastigage strip to determine the oil clearance.

(f) The widest point of the strip will indicate the minimum clearance and the narrowest point the maximum clearance.

(g) The remaining bearings can be checked in turn using the same procedure.

(7) Remove all bearing caps and carefully lift the crankshaft and thrust washers from the crankcase using care not to dislodge or damage the upper halves of the main bearing shells if they are to be used again.

(8) If new bearing shells are to be installed, remove the upper halves of the bearings from the crankcase.

(9) Support the oil seal carrier and using a suitable drift and hammer, tap the oil seal from the carrier.

TO CHECK AND INSPECT

After thoroughly cleaning the crankshaft in a suitable solvent and drying it off with compressed air, blow out all the oilways and make the following checks.

(1) Check and measure the main bearing journals and crankpins for wear, taper and scoring. If wear is excessive, the journals and/or crankpins should be reground to accommodate the nearest undersize bearing shells.

One worn or damaged journal or crankpin will necessitate the grinding of all journals or crankpins and the fitting of new undersize bearing shells. If wear or damage is such that the journals or crankpins cannot be reground to take any one range of the available undersize bearings, then the crankshaft will have to be renewed.

NOTE: There are three sizes of standard bearings available. Each bearing shell is marked 1, 2 or 3 and must correspond with the same number marked on the engine block sump gasket surface at the right hand rear corner of the block.

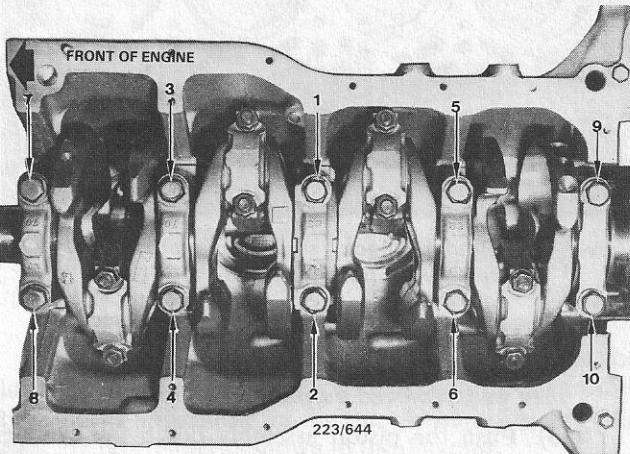
(2) Check the centre main bearing thrust plates for pitting or wear. If pitting or wear is evident renew the thrust plates which should bring the crankshaft end float back to Specifications.

(3) Even when the main bearing clearance has been found to be satisfactory, inspect the bearing shells for scores, flaking and pitting. Renew as necessary with new shells of the appropriate size.

TO INSTAL

Installation is a reversal of the removal procedure with attention to the following points:

(1) Ensure that all the oilways are clear and that all journals and crankpins have been thoroughly wiped.



Main bearing tightening sequence.

Ensure that the new or original bearing shells have been thoroughly wiped and then smeared with new engine oil and that they are correctly positioned in their respective web, connecting rod or cap with the grooved main bearing shell situated in the block side.

(2) Instal suitable lengths of plastic tube to each connecting rod bolt, instal the upper thrust washers with the oil grooves facing outwards and place the crankshaft into the cylinder block, guiding the crankpins into their respective connecting rod.

(3) Instal the main bearing caps and lower thrust washers to their respective web, instal the retaining bolts and torque to Specifications in the sequence shown.

(4) Remove the plastic tubing and instal the connecting rod caps to their respective connecting rod and torque the cap nuts to Specifications.

(5) If new bearing shells were installed recheck the bearing clearance using the Plastigage method as previously described.

(6) Coat the outside edge of a new rear engine oil seal with a suitable sealant, smear the sealing lip sparingly with engine oil and instal the oil seal to the seal carrier using a suitable installation tool and hammer. On installation the lip must be towards the engine and the outer face of the seal flush with the carrier.

(7) Ensure that the mating surfaces of the cylinder block and carrier are clean and coat both sides of a new gasket with a suitable type sealant. Place the gasket and the carrier into position and instal and securely tighten the carrier retaining bolts.

(8) Instal the oil pump, oil pick-up and sump and instal the engine to the vehicle as previously described.

11. FLYWHEEL/DRIVE PLATE

Special Equipment Required:

To Renew Ring Gear – Suitable heat source

TO REMOVE AND INSTAL

(1) Remove the transmission from the vehicle as described in the Manual or Automatic Transmission sections, whichever is applicable.

(2) On manual transmission models, mark the flywheel and the clutch pressure plate cover to ensure correct assembly.

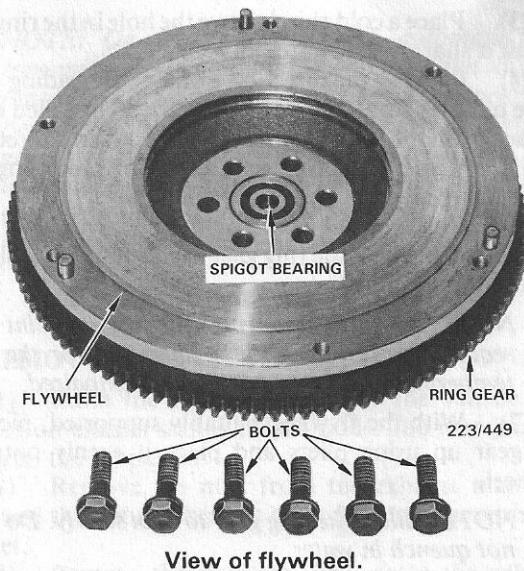
Progressively loosen and remove the pressure plate retaining bolts.

Lift the pressure plate off the flywheel and remove the pressure plate and clutch plate.

Using a dial gauge check the run-out of the clutch face contacting surface of the flywheel. If the run-out exceeds 0.3 mm both on and off the crankshaft, renew the flywheel.

(3) Suitably mark the flywheel or drive plate so that the unit can be installed in the original position on the crankshaft. Remove the retaining bolts.

(4) Lift the flywheel or drive plate from the engine.



TO CHECK AND INSPECT

(1) Inspect the clutch face contacting surface of the flywheel for cracks or excessive scoring.

(2) Inspect the ring gear teeth for damage, cracks or wear. The ring gear on manual transmission models can be renewed separately from the flywheel, but on automatic transmission models the complete drive plate must be renewed.

(3) Inspect the drive plate bolt holes for elongation which is caused by loose retaining bolts.

(4) Inspect the drive plate for cracks.

TO INSTAL

Installation is a reversal of the removal procedure with attention to the following points:

(1) Coat the threads of the flywheel drive plate retaining bolts with Loctite or similar adhesive sealant.

(2) Align the marks made on dismantling on the flywheel/drive plate and instal and tighten the retaining bolts to Specifications.

(3) On vehicles fitted with manual transmission align the clutch driven plate with the crankshaft spigot bearing using a spare input shaft or a clutch aligning tool and tighten the pressure plate bolts progressively in a diagonal sequence.

(4) Instal the transmission to the vehicle as described in the Manual or Automatic Transmission sections.

TO RENEW FLYWHEEL RING GEAR

(1) With the flywheel removed from the vehicle, drill a 3 mm diameter hole between two teeth of the ring gear.

NOTE: Do not drill right through the ring gear as this will damage the flange on the flywheel.

(2) Secure the flywheel, with the drilled hole uppermost, in a vice fitted with soft jaws.

(3) Place a cold chisel above the hole in the ring gear and hit it sharply to split the ring gear.

(4) Observe the direction of the teeth leading edges of the old ring gear. The new gear must be installed to the flywheel with the teeth leading edges in the same direction.

(5) Remove the ring gear, clean the mounting face on the flywheel and remove any burrs.

(6) Polish a few spots of the new ring gear with emery cloth and heat the ring gear evenly until the polished spots turn dark blue.

NOTE: Do not heat the ring gear past the point required to achieve a dark blue color or the tempering of the gear teeth will be impaired.

(7) With the flywheel suitably supported, pick the ring gear up using pliers and place it evenly onto the flywheel.

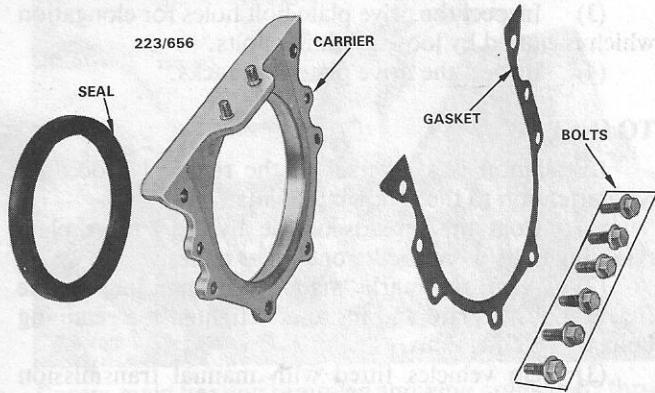
NOTE: Allow the ring gear to cool slowly. Do not quench in water.

12. CRANKSHAFT OIL SEALS

REAR CRANKSHAFT OIL SEAL

To Remove and Instal

(1) On automatic transmission models, remove the transmission from the vehicle as described in the Automatic Transmission section.



Dismantled view of crankshaft rear oil seal components.

On manual transmission models, remove the transmission as described in the Manual Transmission section.

(2) Remove the clutch assembly and flywheel or the drive plate as described under the previous heading in this section.

(3) Remove the bolts securing the crankshaft oil seal carrier to the rear of the cylinder block and remove the carrier rearwards from the block and crankshaft.

(4) Support the oil seal carrier and using a suitable drift and hammer, tap the oil seal from the carrier.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Coat the outside edge of a new carrier oil seal with a suitable sealant, smear the sealing lip sparingly with

engine oil and instal the oil seal to the carrier with a suitable installation tool and hammer.

On installation the oil seal lip must face towards the engine and the outer face of the seal flush with the carrier.

(2) Ensure that the mating surfaces of the cylinder block and carrier are clean and coat both sides of a new gasket with a suitable type sealant. Place the gasket and the carrier into position and instal and tighten the carrier retaining bolts.

FRONT CRANKSHAFT OIL SEAL

To Remove and Instal

The front crankshaft oil seal is installed in the oil pump body. The renewal of the oil seal is described in this section under the heading Sump and Oil Pump.

13. ENGINE MOUNTINGS

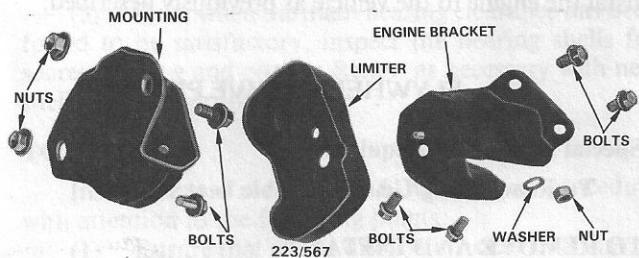
TO REMOVE AND INSTAL - FRONT

(1) Raise the front of the vehicle and support on chassis stands. Remove the engine splash shield.

(2) Interpose a wooden block between the engine sump and a jack and take the weight of the front of the engine assembly.

(3) Remove the nuts and bolts retaining the relevant engine mounting to the front crossmember and jack the engine assembly up slightly.

NOTE: Do not jack the engine too far as it could stretch hoses or cables.



Dismantled view of front engine mounting.

(4) Remove the nuts that attach the engine mounting to the cylinder block mounting bracket and lift the mounting and limiter from the engine compartment.

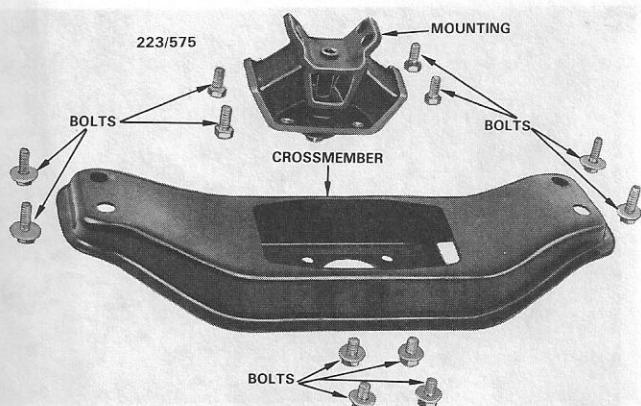
Installation is a reversal of the removal procedure with attention to the following points:

(1) Check the mounting for damage, deterioration or oil contamination. Engine mountings that are oil soaked should be renewed and the cause of the oil leak rectified to ensure a normal working life for the new mounting concerned.

(2) Allow the full weight of the engine assembly to bear on the mountings before finally tightening the mounting to crossmember bolts.

TO REMOVE AND INSTAL - REAR

(1) Raise the front and rear of the vehicle and support on chassis stands.

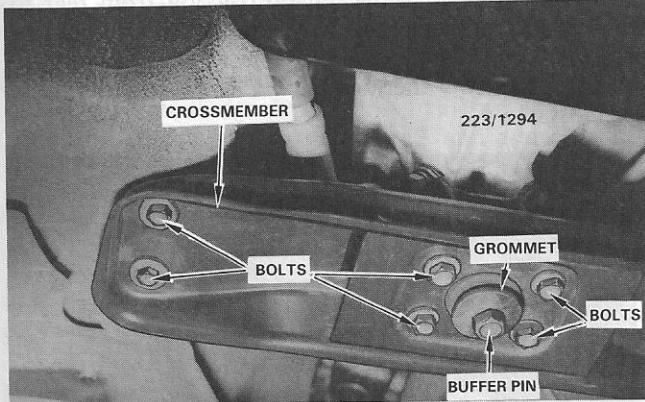


Dismantled view of rear engine mounting components.

- (2) Place a jack under the transmission to take the weight of the engine and transmission assembly.
- (3) Remove the transmission rear crossmember to mounting bolts.
- (4) Remove the bolts which attach the rear transmission crossmember to the underbody and lower the crossmember.
- (5) Remove the bolts which attach the rear mounting to the transmission extension housing and remove the mounting.

Installation is a reversal of the removal procedure with attention to the following points:

- (1) Check the mounting for damage, deterioration or oil contamination. Engine mountings that are oil soaked should be renewed and the cause of the oil leak rectified to ensure a normal working life for the new mounting concerned.
- (2) Ensure that the mounting is centralised and that the engine and transmission weight is taken on the mounting before finally tightening the mounting securing bolts.



Installed view of the rear crossmember and engine mounting.

NOTE: On vehicles fitted with automatic transmission, ensure that the buffer pin is centralised in the grommet to give a clearance between the buffer pin and the grommet. If the grommet is in contact with the buffer pin, loosen the bolts retaining the crossmember and the mounting and manoeuvre the cross-member until a clearance is obtained.

14. EXHAUST SYSTEM

TO REMOVE AND INSTALL

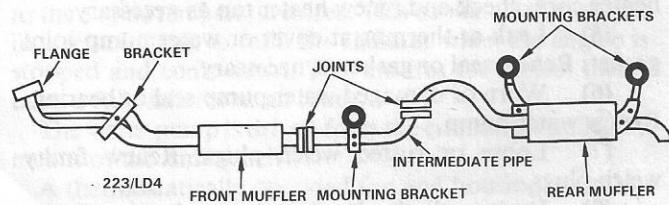
- (1) Raise the front and rear of the vehicle and support on chassis stands placed under the rear jacking points on the sill panels.
- (2) Remove the nuts from the exhaust manifold studs and the nut and bolt on the exhaust to transmission bracket.
- (3) Remove the nuts and bolts from the exhaust system joints behind the front muffler and in front of the rear muffler. Remove the front pipe and muffler from the vehicle.

NOTE: Vehicles fitted with automatic transmission may have an extra mounting rubber supporting the engine pipe.

- (4) Unhook the mounting rubbers from the front and rear of the rear muffler and in front of the rear axle.
- (5) Manoeuvre the rear muffler and intermediate pipe around the rear axle assembly and remove it from the vehicle.
- (6) Carefully inspect the exhaust system and discard any components which are cracked, worn or corroded.

Installation is a reversal of the removal procedure with attention to the following points:

- (1) Clean any carbon build up off the exhaust flange and joint and renew the gaskets.
- (2) Instal all components and check the system for correct positioning.
- (3) Tighten the exhaust flange and the joints and run the engine to check for exhaust leaks.



Schematic diagram of the exhaust system. Manual transmission.