2.5 LITER 4-CYLINDER

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engine may be identified from the Vehicle Identification Number (VIN) stamped on a metal tab located on top of instrument panel at lower left of windshield. VIN number code also appears on pad at right front of cylinder block below cylinder head. Engine unit and code number label is found on timing cover, and engine code stamping is found on pad at left rear of cylinder block below cylinder head. The VIN number contains 17 digits. The 8th digit identifies the engine and the 10th digit estabilishes the model year.

Engine Code

Engine	Code
2.5L (151") EFI	R

ENGINE REMOVAL

See Engine Removal at end of ENGINE Section.

CYLINDER HEAD & MANIFOLDS

INTAKE MANIFOLD

Removal – 1) Remove air cleaner, PCV valve and hose. Drain cooling system. Disconnect all electrical connections, fuel lines and vacuum lines from EFI assembly.

2) Disconnect throttle linkage, transaxle downshift linkage and cruise control linkage, if equipped, and remove EFI assembly. Remove bell crank and throttle linkage brackets and position aside.

3) Remove heater hose at intake manifold. Remove upper generator bracket and ignition coil. Remove intake manifold-to-cylinder head bolts and remove intake manifold.

Installation – 1) Install manifold and gasket on cylinder head. Start all bolts and finger tighten only.

2) Torque manifold-to-cylinder head bolts using torque sequence shown in *Fig. 1*. Reverse removal procedure to complete installation

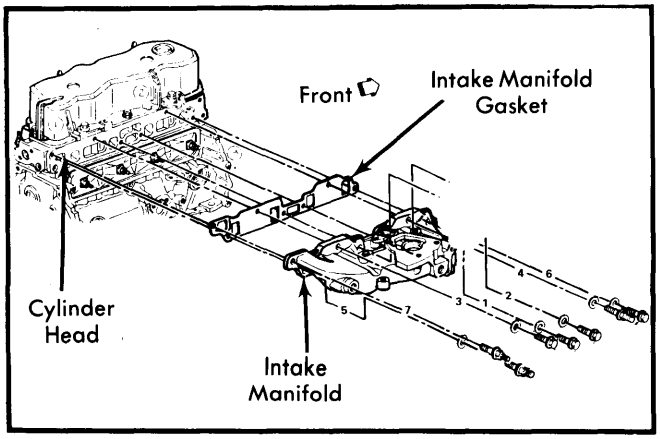

Fig. 1 Intake Manifold Tightening Sequence

EXHAUST MANIFOLD

Removal – 1) Remove air cleaner and EFI preheat tube. Remove torque strut rod bolts at radiator support panel and at cylinder head.

2) If equipped with A/C, remove compressor from mounting bracket and position aside, leaving refrigerant lines connected. Remove engine mount bracket from cylinder head. Raise vehicle on hoist and disconnect exhaust pipe at manifold. Remove exhaust manifold bolts and remove manifold.

Installation – 1) Install manifold and gasket on cylinder head. Start all bolts and finger tighten only.

2) Torque manifold-to-cylinder head bolts using torque sequence shown in *Fig. 2*. Reverse removal procedure to complete installation.

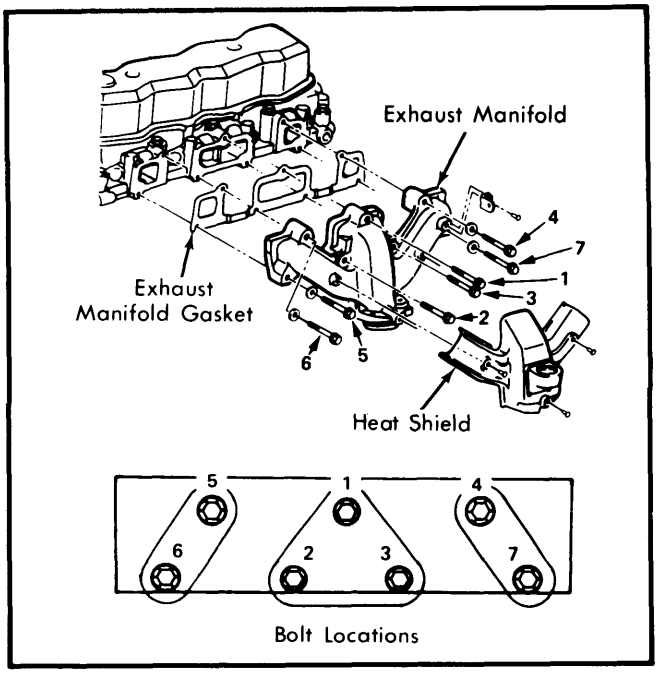

Fig. 2 Exhaust Manifold Tightening Sequence

CYLINDER HEAD

Removal – 1) Drain cooling system and remove air cleaner. Remove intake and exhaust manifolds as previously described.

2) Remove alternator bracket-to-cylinder head bolts. If equipped with A/C, remove compressor from mounting brackets and position aside, leaving refrigerant lines connected. Disconnect all electrical connections and vacuum lines at cylinder head.

3) Disconnect upper radiator hose. Disconnect spark plug wires and remove spark plugs. Remove rocker arm cover and back off rocker arm bolts. Pivot rocker arms to clear push rods and remove push rods. Remove cylinder head bolts and remove cylinder head. Place on 2 wood blocks to prevent damage.

Installation – 1) Make sure gasket surfaces are clean of foreign matter and free of nicks. Install a new gasket in position over dowel pins on cylinder block. Carefully install cylinder head over dowel pins and gasket.

NOTE – *Make sure all cylinder head bolt threads are clean and oiled. (If the threads are dirty correct torque cannot be achieved).*

2) Coat heads and threads of cylinder head bolts with sealing compound. Install all cylinder head bolts and finger tighten only. Gradually tighten bolts following the sequence in *Fig. 3*. Reverse removal procedure to complete installation.

2.5 LITER 4-CYLINDER (Cont.)

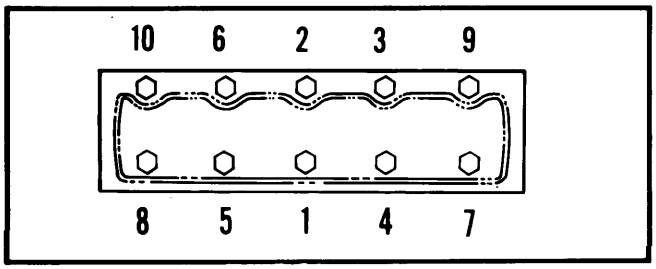

Fig. 3 Cylinder Head Tightening Sequence

VALVES

VALVE ARRANGEMENT

I-E-I-E-E-I-E-I

VALVE GUIDE SERVICING

Valve guides are integral with head. When measuring valve stem-to-guide clearance, check diameter of valve stem in 3 places; top, center and bottom. Exhaust valves have tapered stems and are .001" (.025 mm) larger at top of stem than at valve head end. If valve stem-to-guide clearance is excessive, ream guide to next size oversize. Service valves are available in standard, .003" (.076 mm) and .005" (.127 mm) oversize.

VALVE STEM OIL SEALS

An "O" ring type seal is installed on lower groove of valve stem on all valves. A teflon type oil seal is installed on guide of intake valves only, in addition to "O" ring type. A light coat of oil on stem will help prevent twisting of the "O" ring type seal during installation.

VALVE SPRINGS

Removal – 1) Remove rocker arm cover. Remove rocker arms on cylinder to be serviced, also remove spark plugs. Install air hose adapter to spark plug hole and apply air pressure.

2) With rocker arms removed, reinstall rocker arm bolt. Using spring compressor tool (J-5892-A or equivalent), compress valve spring and remove valve locks. Remove tool, retainer, oil shield, spring and oil seals.

Installation – Reverse removal procedure to complete installation.

VALVE SPRING INSTALLED HEIGHT

Installed height of valve spring should be 1.69" (42.926 mm). Measure spring height from surface of cylinder head pad to underside of spring retainer. If installed height exceeds specifications, install spacer(s) below spring to reduce height to specifications.

HYDRAULIC VALVE LIFTERS

If hydraulic valve lifters are being removed, mark or identify lifters to ensure that they are installed in original positions. Lifters are serviced as complete assemblies only and parts are not interchangeable between lifters. If lifter is damaged or worn, complete lifter must be replaced. Check camshaft mating surface for wear, and if present, replace camshaft. If lifters are disassembled for cleaning and/or inspection, reassemble and test with a leakdown tester according to manufacturer's instructions. Discard lifters not within specifications. Lifter leakdown rate is 12-90 seconds with a 50 lb. load.

NOTE – *New lifters are packaged in a plastic coating which must be removed and lifter leakdown test performed before installing lifter.*

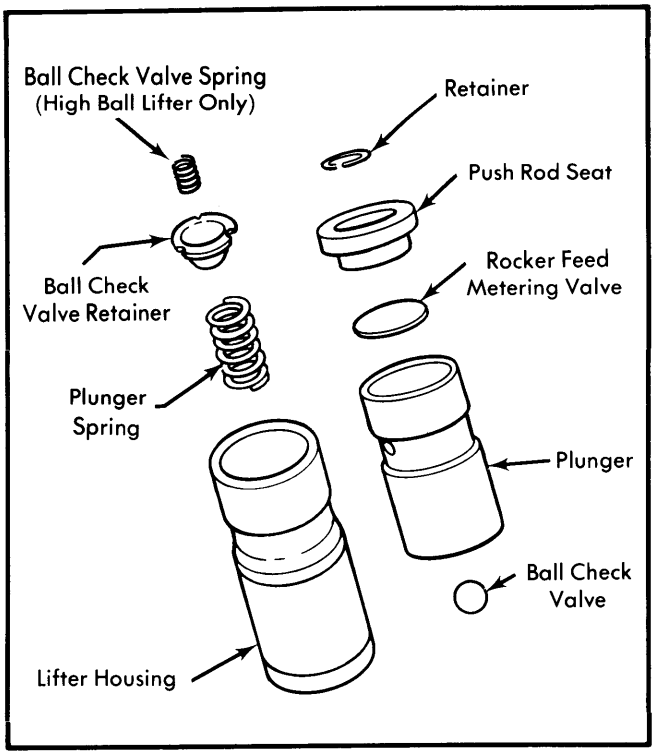

Fig. 4 Exploded View of Hydraulic Lifter Assembly

PISTONS, PINS & RINGS

OIL PAN

See Oil Pan Removal at end of ENGINE Section.

PISTON & ROD ASSEMBLY

NOTE – *New pistons must be installed in same cylinders for which they were fitted. Install used pistons in same cylinders from which they were removed.*

NOTE – *Piston should be at bottom of stroke and covered with a cloth to collect cuttings.*

Removal – 1) With cylinder head and oil pan removed, use a ridge reamer to remove any ridge or deposits from upper end of cylinder bore.

2) Check connecting rod and piston for proper identification and mark if necessary. Remove bearing cap. Remove piston and rod assembly through top of cylinder block, making sure not to damage cylinder wall or crankshaft journal.

Installation – 1) Lightly coat cylinder bores and pistons with engine oil. Ensure ring gaps are evenly spaced and marked side of compression ring is facing upward.

2) Install ring compressor tool on piston, ensuring ring gap spacing does not change. Using hammer handle, gently tap piston assembly into correct cylinder bore making sure not to damage bore, piston or rings.

2.5 LITER 4-CYLINDER (Cont.)

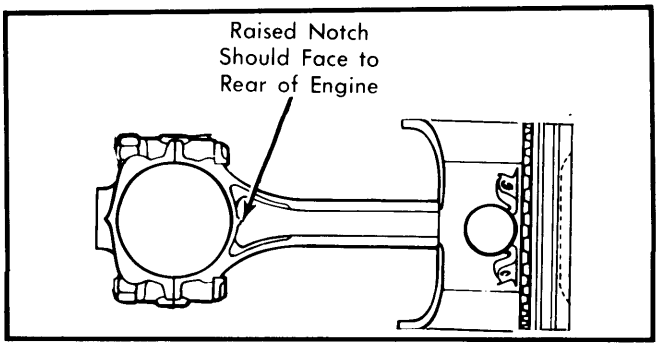

Fig. 5 Making Sure Connecting Rod and Piston Assembly are Properly Indexed

NOTE – *Notch or notches in top of piston faces front of engine. Raised notch on side of rod at bearing end should be opposite notches in piston when installed. See Fig. 5.*

3) Install bearing caps and tighten nuts. Reverse removal procedure to complete installation.

FITTING PISTONS

Measure piston skirt perpendicular to piston pin (with pin removed) at sizing point 1 $^{13}/_{16}$" from top of piston. Measure cylinder bore at sizing point 2 $^{1}/_{4}$" from top of cylinder block, parallel and at right angle to centerline of crankshaft. If cylinder bore measurements differ by .0005" (.0127 mm), bore cylinder block to next size oversize. Make sure both piston and cylinder block are at normal room temperature (70°F or 21°C) when fitting. Pistons are available in standard size and .005" (.127 mm), .010" (.254 mm), and .030" (.762 mm) oversizes.

PISTON PINS

Pins are press fit in piston. Oversize pins are available, piston and rod must be reamed for correct fit. Remove and install piston pins using arbor press and suitable adapters.

CRANKSHAFT & ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

NOTE – *Precision bearings are used in this engine and shimming is not acceptable for adjustment. Never file or grind connecting rods or caps when fitting bearings.*

Connecting Rod Bearings – 1) After ensuring rod and cap are marked for cylinder identification, remove rod cap. Use Plastigage method to check bearing clearance. Place Plastigage across full width of bearing journal, parallel to crankshaft. Install rod cap and torque nuts to 32 ft. lbs. Remove rod cap and determine amount of clearance by measuring width of compressed Plastigage at widest point.

2) Bearings must be replaced if clearance is not within specifications. New bearings are available in standard, .001" (.025 mm), .002" (.050 mm) and .010" (.254 mm) undersize. Use a micrometer to check for out-of-round condition on crankshaft journals.

3) If journals are more than .0005" (.013 mm) out-of-round, crankshaft must be replaced or reconditioned. When all bearings are checked and/or replaced and checked once more, tap each rod lightly (parallel to crankpin). Rod clearance between rod cap and side of crankpin should be .006-.022" (.16-.56 mm).

NOTE – *If clearance cannot be brought within specifications with service bearings, grind crankshaft to next undersize. If already ground to maximum undersize, replace crankshaft.*

Main Bearings – 1) If bearings are being checked with engine in vehicle, crankshaft must be supported to take up clearance between upper bearing half and crankshaft. Support crankshaft at both ends and ensure that all bearing caps, other than the one being checked, are tightened to specifications.

2) Start with rear main bearing cap and work forward. Remove main cap and use Plastigage method to check bearing clearance. Place Plastigage across full width of bearing journal, parallel to crankshaft. Install main cap and torque bolts to 70 ft. lbs.

3) Remove main cap and determine amount of clearance by measuring width of compressed Plastigage at widest point. Bearings must be replaced if clearance is not within specifications. New bearings are available in standard, .001" (.025 mm), .002" (.050 mm) and .010" (.254mm) undersize. Replace upper and lower inserts as a unit.

4) Use a micrometer to check for out-of-round condition on crankshaft journals. If journals are more than .0005" (.013 mm) out-of-round, crankshaft must be replaced or reconditioned. If within specifications, coat bearings with oil and install main caps. When all bearings are checked and/or replaced and checked once more, check thrust bearing alignment.

THRUST BEARING ALIGNMENT

Make sure all main bearing caps are installed with arrows pointing toward rear of engine. Force crankshaft to the extreme front position. Measure end play at front end of No. 5 main bearing using feeler gauge. End play should be .0035-.0085" (.0889-.2159 mm). Rotate crankshaft to ensure there is no excessive drag.

REAR MAIN BEARING OIL SEAL

NOTE – *Rear main bearing oil seal can be removed and installed without removal of oil pan or crankshaft.*

Removal – 1) Remove transaxle assembly. On manual transaxle, remove pressure plate and clutch disc. Remove flywheel.

2) Remove rear main bearing oil seal by prying it out with a screwdriver taking care not to scratch crankshaft.

Installation – 1) Coat new seal with engine oil and install with lip toward engine. Ensure that seal is firmly in place.

2) Install flywheel. On manual transaxle, install pressure plate and clutch disc. Install transaxle assembly.

CAMSHAFT

ENGINE FRONT COVER

Removal – 1) Remove engine drive belts. Remove center hub and slide hub and pulleys from crankshaft.

2.5 LITER 4-CYLINDER (Cont.)

2) Remove alternator lower bracket. Remove front engine mount-to-cradle nuts. Install suitable engine support fixture tool and raise engine. Remove engine-to-mount bolts and remove support bracket and mount as an assembly.

3) Remove 2 oil pan-to-front cover screws and front cover-to-block screws. Pull front cover slightly forward to allow cutting of oil pan front seal. Using a sharp knife or suitable cutting tool, cut pan seal flush with engine block on both sides. Remove front cover.

Installation – 1) Clean mating surfaces of engine block and front cover. Cut tabs off new oil pan front seal. *See Fig. 6.* Install seal on front cover, pressing tips into holes provided in cover. Apply silicone sealer (or equivalent) to joint at oil pan and engine block.

2) Install centering tool (J-23042 or equivalent) in front cover seal. Install front cover to block , install and partially tighten 2 oil pan-to-front cover screws.

3) Install front cover-to-block screws and tighten. Remove centering tool. Reverse removal procedure to complete installation.

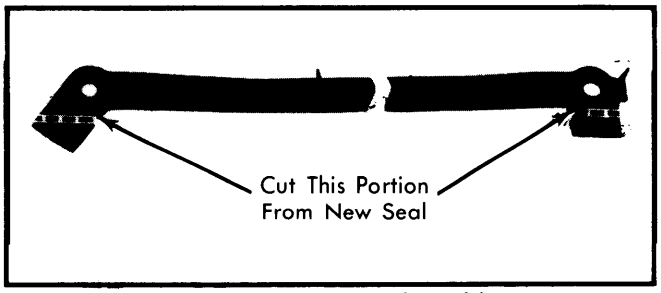

Fig. 6 Oil Pan Front Seal Modification

FRONT COVER OIL SEAL

Removal – Remove engine drive belts. Remove right front inner fender splash shield. Remove center hub bolt and slide hub and pulleys from crankshaft. Using large screwdriver, pry oil seal from front cover.

NOTE – *Use care in removing oil seal. Do not bend sheet metal timing chain cover.*

Installation – 1) Install new seal with lip toward rear of engine. Drive seal into place using seal driver tool (J-23042 or equivalent). Coat oil seal contact area of balancer with engine oil.

2) Position hub on crankshaft and slide into position until it bottoms against crankshaft gear. Install center bolt and tighten. Install pulley-to-hub bolts using sealing compound (Drylock No. 299 or equivalent) and tighten. Reverse removal procedure to complete installation.

CAMSHAFT & TIMING GEAR

Removal – 1) Remove engine from vehicle and install on engine stand. Remove rocker arm covers. Loosen rocker arm bolts and pivot rocker arms aside. Remove push rods. Remove intake manifold. Remove push rod cover and remove valve lifters. Remove distributor and fuel pump.

2) Remove alternator, lower alternator bracket and front engine mount bracket assembly. Remove oil pump drive shaft and gear assembly. Remove front pulley hub and timing gear cover. *See Fig. 7.*

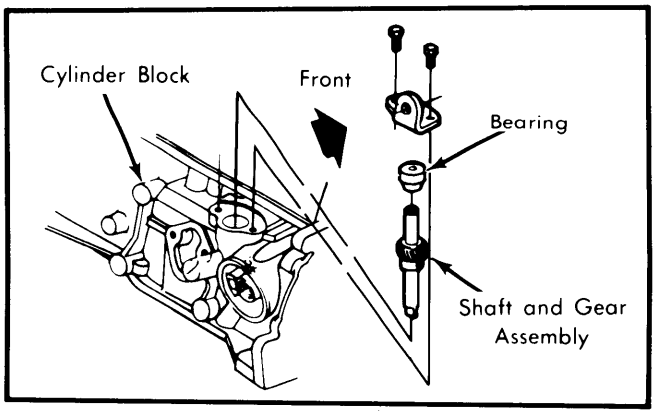

Fig. 7 Removing Oil Pump Drive Shaft

3) Remove the camshaft thrust plate retaining screws by working through holes in camshaft gear. *See Fig. 8.* Remove camshaft and gear assembly by pulling it through front of block. Use care not to damage camshaft bearings.

NOTE – *Camshaft timing gear is pressed onto camshaft. When removing, ensure that Woodruff key does not damage camshaft.*

Installation – 1) Install gear spacer ring and thrust plate over end of camshaft, and install Woodruff key in shaft keyway.

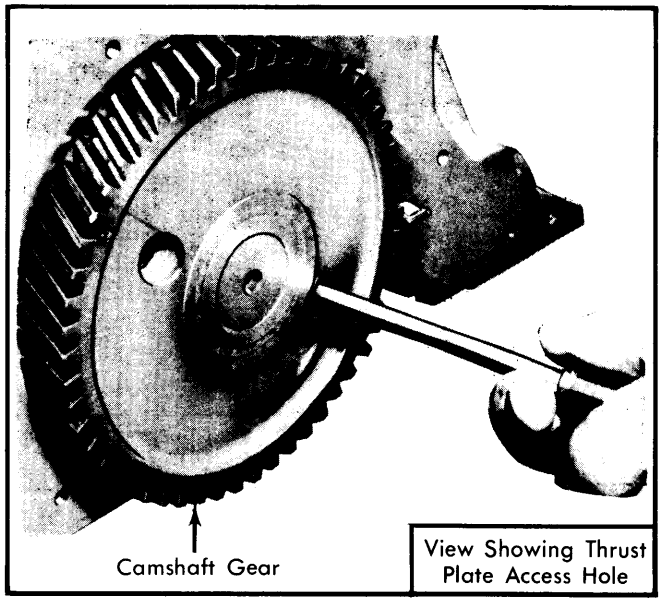

Fig. 8 Removing Thrust Plate Screw with Screwdriver Inserted Through Timing Gear

2) Install camshaft gear and press it onto camshaft until it bottoms against gear ring spacer ring. Measure the end clearance of thrust plate, it should be .0015-.0050" (.038-.127 mm). If less than .0015" (.038 mm), replace spacer ring. If more than .0050" (.127 mm), replace thrust plate.

3) Coat camshaft journals with engine oil and install camshaft in engine block being careful not to damage camshaft bearings. Align timing marks by rotating camshaft and crankshaft until valve timing marks on gear teeth will line up.

4) Engine is now timed in the No. 4 cylinder firing position. Install 2 camshaft thrust plate screws and tighten. Reverse removal procedure to complete installation.

2.5 LITER 4-CYLINDER (Cont.)

CAMSHAFT BEARINGS

Removal – With engine, flywheel and camshaft removed, drive out expansion plug from rear camshaft bearing by driving out from inside. Using bearing removal tool (J-21473-1 or equivalent), drive out front bearing toward rear and rear bearing toward front. Install extension tool (J-21054-1 or equivalent), and drive center bearing out toward rear.

Installation – 1) Install bearings using reverse procedure, ensuring that oil holes line up in camshaft and engine block.

2) Install front camshaft bearing so that bearing is recessed about 1/8" into engine block. This will allow for lubrication of timing gears. Reverse removal procedure to complete installation.

ENGINE OILING

ENGINE OILING

Crankcase Capacity – 3 quarts with or without oil filter change.

Oil Filter – Full flow type. Change oil filter at every oil change.

Normal Oil Pressure – 36-41 psi at 2000 RPM.

Pressure Regulator Valve – Located in oil pump body. Not adjustable.

ENGINE OILING SYSTEM

Engine lubrication is accomplished through a gear type pump which picks up oil from the oil pan sump, pumps it through the full flow oil filter and into oil passage which runs along the right side of the block and intersects the lifter bosses. Oil is then routed to the camshaft and crankshaft bearings through smaller drilled passages. Oil is supplied to the rocker arms through the hydraulic lifters which feed oil up the push rod tubes to the rocker arms. Bypass valves are located in the pickup screen, oil filter mounting and oil pump to allow for any clogged or restricted conditions. Many internal engine parts have no direct oil feed and rely on gravity or splash oil from other direct feed components. Oil returns to the oil sump through oil return holes in cylinder head and block. *See Fig. 9.*

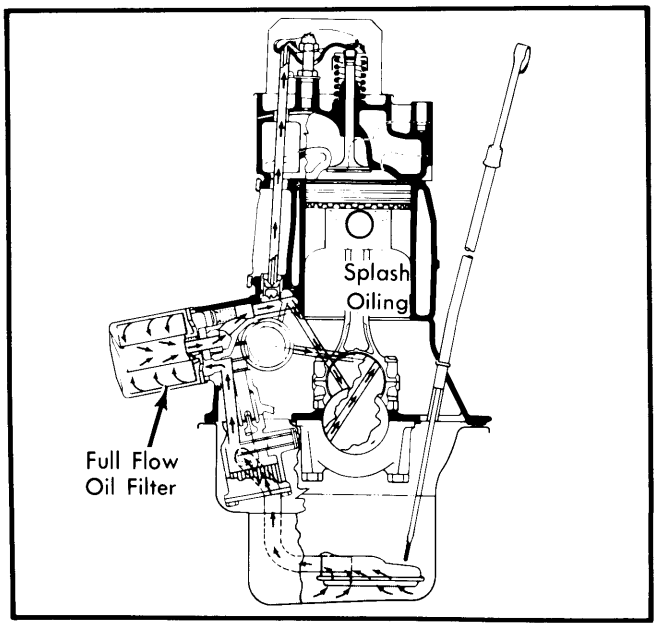

Fig. 9 Engine Oiling System

OIL PUMP

Oil pump is located in oil sump, oil pan must be removed for access, *See Oil Pan Removal at end of ENGINE Section.* Remove 2 flange bolts and nut from main bearing cap bolt and remove pump and screen as an assembly. Do not disturb oil pickup pipe on screen or body. Disassemble pump and inspect for excessive wear or cracks. Replace pump as a unit if parts are defective. *See Fig. 10.*

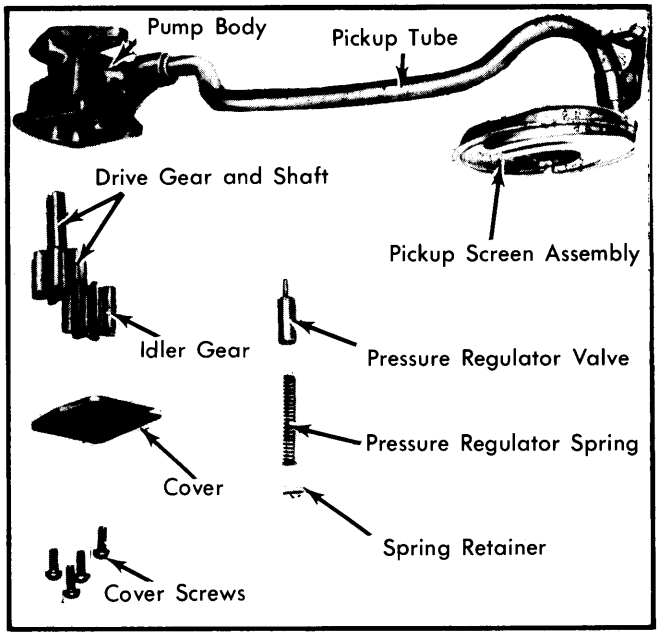

Fig. 10 Exploded View of Oil Pump Assembly

ENGINE COOLING

WATER PUMP

Removal – Disconnect negative battery cable and remove all accessory drive belts. Remove water pump attaching bolts and remove water pump.

Installation – 1) If installing new water pump, transfer pulley from old pump. Clean all sealing surfaces.

2) Apply a 1/8" bead of suitable sealer to the water pump and tighten attaching bolts.

3) Install all accessory drive belts and connect negative battery cable.

NOTE – *For further information on cooling system capacities and other cooling system components, see appropriate article in ENGINE COOLING SYSTEMS section.*

2.5 LITER 4-CYLINDER (Cont.)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke		Displ.	
				in.	mm	in.	mm	cu. ins.	cc
2.5L (151")	90@4000	134@2400	8.2:1	4.00	101.60	3.00	76.20	151	2500

VALVES

Engine & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
2.5L (151")							
Int.	1.72 (43.69)	45°	46°	.035-.075 (.889-1.90)	.3418-.3425 (8.682-8.699)	.0010-.0027 (.0254-.0686)	.406 (10.312)
Exh.	1.50 (38.10)	45°	46°	.058-.097 (1.473-2.464)	.3418-.3425 (8.682-8.699)	.0010-.0027① (.0254-.0686)	.406 (10.312)

① — Measured at top of guide. Bottom is .0020-.0037" (.050-.094 mm)

PISTONS, PINS, RINGS

Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Rings In. (mm)	End Gap In. (mm)	Side Clearance In. (mm)
2.5L (151")	①.0025-.0033 (.0635-.0838)	.0002-.0004 (.0050-.0102)	②	1	.010-.022 (.254-.559)	.0015-.0030 (.038-.076)
				2	.010-.027 (.254-.686)	.0015-.0030 (.038-.076)
				3	.015-.055 (.381-1.397)	.0015-.0030 (.038-.076)

① — Top clearance — Bottom clearance is .0017-.0041" (.043-.104 mm).
② — Interference fit.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm) ①	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
2.5L (151")	2.300 (58.42)	.0005-.0022 (.013-.056)	No. 5	.0035-.0085 (.0889-.2159)	2.000 (50.80)	.0005-.0026 (.013-.066)	.006-.022 (.16-.56)

① — Maximum out-of-round permissible is .0005" (.013 mm).

2.5 LITER 4-CYLINDER (Cont.)

ENGINE SPECIFICATIONS

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
2.5L (151″)	.....	78-86@1.66 (35-39@42.20)	122-180@1.25 (55-82@31.75)

CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm) ①	Lobe Lift In. (mm)
2.5L (151″)	1.869 (47.473)	.0007-.0027 (.0178-.0686)	.398 (10.109)

① – End play is .0015-.0050″ (.038-.127 mm).

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N·m)
Cylinder Head Bolts	① 85 (115)
Connecting Rod Nuts	32 (44)
Main Bearing Cap Bolts	70 (95)
Flywheel-to-Crankshaft Bolt	44 (60)
Harmonic Balancer Bolt	200 (260)
Intake Man.-to-Cyl. Head Bolts	29 (40)
Exhaust Man.-to-Cyl. Head Bolts	44 (60)
Front Cover Bolts	7 (10)
Camshaft Thrust Plate Screws	7 (10)
Oil Pan Bolts	4 (6)
Oil Pump-to-Block Bolts	22 (30)
Oil Pump Cover Bolts	10 (14)
Rocker Arm Bolts	20 (27)
Rocker Arm Cover Bolts	6 (8)
Water Pump-to-Block Bolts	25 (34)
Fuel Pump-to-Block Bolts	18 (25)
Push Rod Cover-to-Block Bolts	7 (10)

① – Requires thread sealer.