

1.8 LITER 4-CYLINDER DIESEL

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engine may be identified from the Vehicle Identification Number (VIN) stamped on a metal plate located on top of instrument panel at lower left of windshield. VIN number code also appears as part of production or unit number stamped on pad at left rear side of engine, below exhaust manifold. The VIN contains 17 digits. The 8th digit identifies the engine and the 10th digit establishes the model year.

Engine Code	
Engine	Code
1.8L (111") Diesel	D

ENGINE REMOVAL

See *Engine Removal* at end of ENGINE Section.

CYLINDER HEAD & MANIFOLD

INTAKE MANIFOLD

Removal – 1) Disconnect negative battery cable. Disconnect vent and fresh air hoses. Remove fuel separator. Disconnect electrical connectors, accelerator linkage and glow plug wires.

2) Remove injector lines at pump and injectors. Remove injection line, hold down clamps and remove lines. Remove glow plug line at head. If equipped with power steering, remove belt, idler pulley and bracket. Remove upper front dust cover, front cover bracket and intake manifold bolts. Remove intake manifold.

Installation – Thoroughly clean all gasket mating surfaces. Place new gasket over mounting studs and install intake manifold. Tighten bolts. Reverse removal procedures to complete installation. If equipped with power steering, adjust belt tension.

EXHAUST MANIFOLD

Removal – Disconnect negative battery cable. Raise vehicle and disconnect exhaust pipe from exhaust manifold. Remove power steering belt, if equipped. Remove flex hose, power steering pump and exhaust manifold bolts. Remove manifold.

Installation – Clean all gasket mating surfaces. Place new gasket on mounting studs. Install manifold and tighten bolts evenly and alternately starting at center and working outward. Reverse removal procedure for remaining components. Adjust power steering belt tension, if equipped.

CYLINDER HEAD

Removal – 1) Disconnect negative battery cable. Drain cooling system. Remove cam cover and timing belt. Remove camshaft. Remove glow plug resistor wire and injection lines. Remove fuel leak-off hose.

2) Disconnect exhaust pipe at manifold. Remove oil feed at rear of head. Disconnect upper radiator hose. Remove head

bolts. Remove cylinder head with exhaust and intake manifolds.

Installation – 1) Clean all gasket mating surfaces. Clean bolt holes in cylinder block and bolt threads. Place new gasket over dowel pins with "TOP" side of gasket up. Apply engine oil to threads and seating face of bolts, then install and tighten bolts in sequence shown in Fig. 1.

2) Install camshaft and rocker arm assembly. Loosen adjusting screws so that entire rocker arm assembly is held in a free state. Install timing belt. Connect upper radiator hose, oil feed at rear of head and exhaust manifold.

3) Install fuel leak-off hose and injector lines. Install glow plug resistor wire. Adjust valve clearance. Install rocker arm cover. Refill engine coolant.

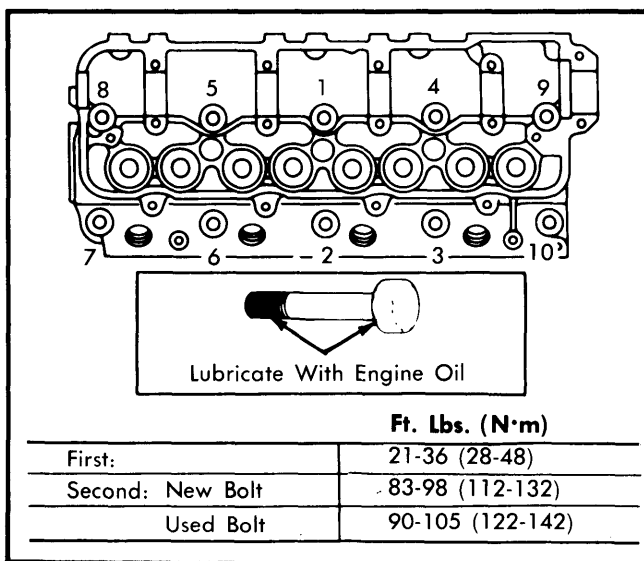


Fig. 1 Cylinder Head Tightening Sequence

VALVES

VALVE ARRANGEMENT

I-E-I-E-I-E-I-E (Front to Rear).

VALVE GUIDE SERVICING

Check amount of wear in valve guide to determine clearance between valves. Guides can be driven out with driver tool (J-26512) fitted against valve guide from lower face of cylinder head. To install, apply engine oil to outer circumference of guide. Set driver tool (J-26512) to guide and drive guide into position from upper face of cylinder head using a hammer. See Fig. 2. Valve guide should always be replaced together with valve as a set.

VALVE SEAT INSERTS

Check amount of valve seat depression from lower face of cylinder head to valve face using a depth gauge with a valve fitted into cylinder head. See Fig. 3. If necessary, insert can be removed by arc-welding excess metal around inner face of insert, allowing it to cool, then prying it out with a screwdriver. To install, press a new insert into the bore using a bench press. After installation, grind finish the seating face with a seat grinder carefully noting the seating angle, contact width and depression. Lap the valve seat as the final step.

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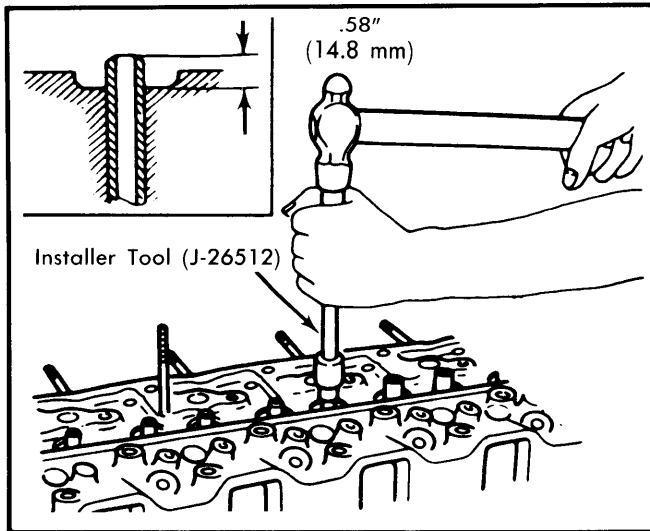


Fig. 2 Valve Guide Installation

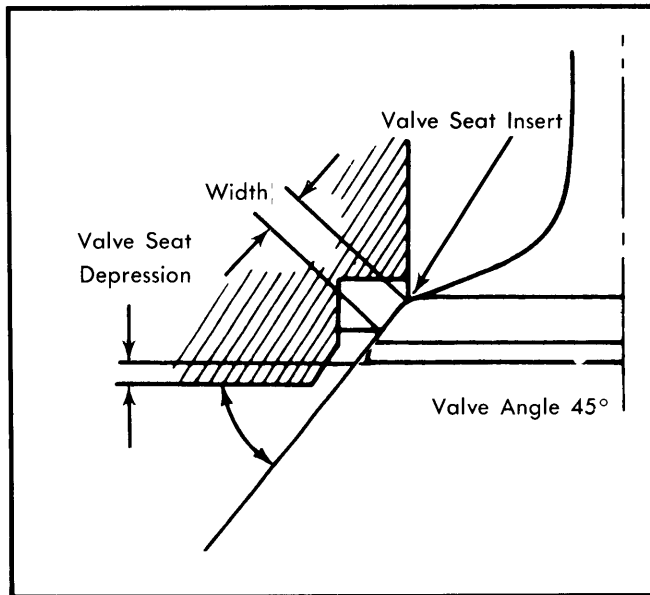


Fig. 3 Checking Valve Seat Depression

ROCKER ARM ASSEMBLY

Removal — Disconnect negative battery cable. Remove rocker arm cover. Remove rocker arm shaft bracket bolts and nuts by loosening them in sequence shown in Fig. 4. Remove rocker arm shaft bracket and rocker arm assembly. Loosen bolts and remove rocker arms.

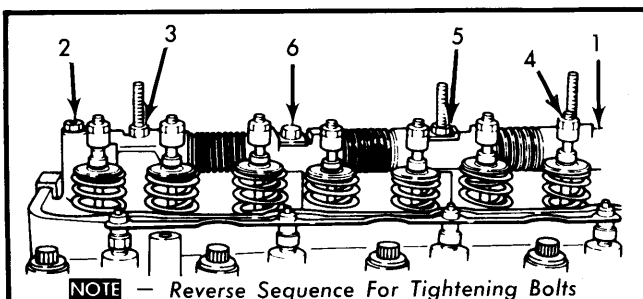


Fig. 4 Rocker Arm Bracket Bolt Loosening Sequence

Inspection — Inspect rocker arm shaft for runout. Support shaft on "V" blocks at ends and check runout with dial indicator. Replace shaft if runout exceeds .015" (.4 mm). Measure shaft diameter with outside micrometer at four locations. If shaft diameter is less than .0812" (20.35 mm), replace it. Measure inside diameter of rocker arms. If rocker arm-to-shaft clearance is greater than .0078" (.2 mm), replace either arms or shaft. Check face of rocker arms for wear. If wear or damage is considerable, replace rocker arm.

Installation — Coat rocker arm shaft, rocker arms and valve stem end caps with clean engine oil. Install rocker arm assembly and tighten bolts in reverse sequence of that shown in Fig. 4. Adjust valves. Install rocker arm cover.

VALVE CLEARANCE ADJUSTMENT

- 1) Check that rocker arm bolts and nuts are properly tightened. Rotate crankshaft until No. 1 or No. 4 cylinder is at TDC on compression stroke.
- 2) Adjust the valves indicated in Fig. 5. Rotate crankshaft one revolution and adjust remaining valves.

Cylinder Number	1	2	3	4
Valves	I E	I E	I E	I E
Step 1	○ ○	○		○
Step 2			⊙ ⊙	⊙ ⊙

I — Intake Valve
E — Exhaust Valve

Fig. 5 Valve Adjustment Sequence

Valve Clearance Adjustment	
Application	Specification In. (mm)
Intake Valves010" (25 mm)
Exhaust Valves014" (35 mm)

COMBUSTION (SWIRL) CHAMBERS

Removal — Insert a .12-.20" (3-5 mm) round bar into the nozzle holder fitting hole so it touches the combustion chamber. Using a hammer, drive out the chambers.

Installation — Install lock ball into groove in combustion chamber. Drive the chamber into the cylinder head by aligning the lock ball with groove in head. Press chamber into position by applying 9920-11,025 lbs. (44,125-49,040 N) pressure using a bench press with a piece of metal fitted against the chamber face for protection. After installation, grind the face of the chamber flush with cylinder head.

VALVE SPRINGS/VALVE STEM OIL SEALS

Removal — Remove rocker arm cover, rocker arm shaft and bracket assembly. Rotate engine to TDC for cylinder being serviced. Remove valve stem end caps. Compress valve spring using compressor tool (J-29760). Remove valve collets, valve spring upper seat and valve springs. Remove valve stem oil seal and valve spring lower seat.

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Inspection — Measure valve spring free height. Replace valve springs if measurements exceed limits in chart. Place valve spring on flat surface and check for squareness. Replace if valve spring is more than .04" (1 mm) out of square. Check valve spring tension with a spring tester. Replace springs if measurement exceeds limits in chart.

Valve Spring Free Height	
Application	Specification In. (mm)
Outer Spring	
Nominal Height	1.8465 (46.9)
Limit For Use	1.7874 (45.4)
Inner Spring	
Nominal Height	1.7835 (45.3)
Limit For Use	1.7244 (43.8)

Valve Spring Tension	
Application	Specification Lbs. (N)
Outer Spring (Compressed to 1.614"-41 mm)	
Standard Value	32-37 (143-165)
Limit	30 (137)
Inner Spring (Compressed to 1.516"-38.5 mm)	
Standard Value	19-22 (83-96)
Limit	17 (74)

Installation — 1) Lubricate valve stem and valve spring lower seat with clean engine oil. Install new seal over valve stem and onto valve guide. Check that projection on inner face of oil seal fits into groove in valve guide.

2) Install inner and outer springs and upper seat. Compress valve springs with compressor tool (J-29760) and install valve spring retainers. Remove tool and inspect to ensure that retainers are fully seated in valve stem groove.

3) Apply clean engine oil to valve stem end caps and install end caps. Reinstall rocker arm shaft and bracket assembly. Adjust valves. Install rocker arm cover.

PISTON, PINS & RINGS

OIL PAN

See *Oil Pan Removal* at end of *ENGINE* Section.

PISTON & ROD ASSEMBLY

Removal — 1) With timing belt, cam cover, rocker arm assembly, camshaft, cylinder head and oil pan removed, remove carbon deposits from upper part of cylinder wall with a scraper.

2) Remove connecting rod cap nuts. Remove bearing and cap. Remove piston and connecting rod by pushing on edge of rod with hammer handle or piece of wood. Remove with rod parallel with cylinder bore. Do not damage rod bearing.

Installation — 1) Apply clean engine oil to bearing surfaces and outer edge of piston and rings. Be sure rod bearing projections are fitted to recess in rod and cap.

2) With ring gaps set correctly, See Fig. 6, use piston installer to push piston into cylinder until connecting rod is contacting crank pin. Notch on piston must face front of engine. Use a piece of wood to push piston fully into bore.

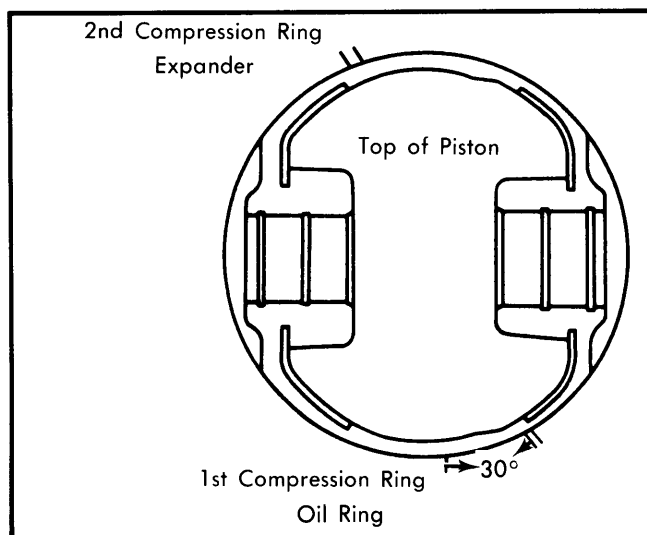


Fig. 6 Piston Ring Gap Location

3) Install connecting rod bearing cap by aligning it with cylinder number mark on connecting rod. See Fig. 7. Apply engine oil to threads and seating face of nuts, then install and tighten nuts. Check that crankshaft turns smoothly. Reverse removal procedures for remaining components.

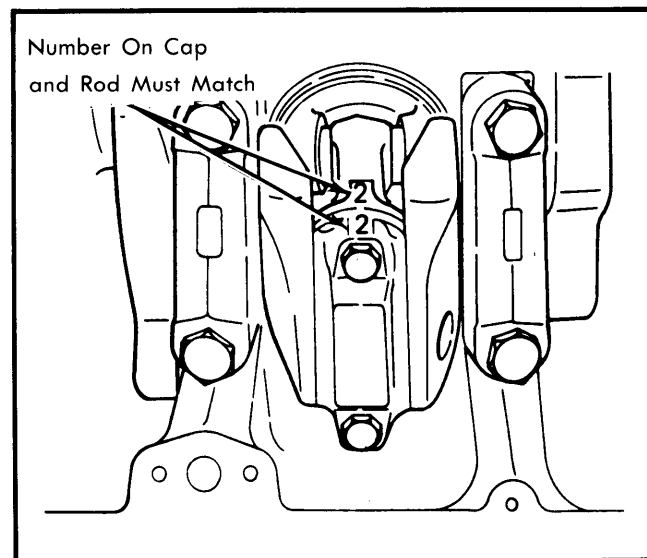


Fig. 7 Connecting Rod Bearing Cap Installation

FITTING PISTONS

Measure diameter of piston at point below piston head in direction at right angle to piston pin, with an outside micrometer. Measure cylinder bore diameter at lower section

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where amount of wear is smallest. Compare clearance. If clearance exceeds .0002-.0017" (.005-.045 mm), replace pistons with new ones. Oversize pistons are available in .020" (.50 mm) and .040" (1 mm).

PISTON PINS

Visually inspect for wear or scoring. Measure pin outside diameter and piston pin hole. If clearance exceeds .0019" (.05 mm), replace pin. Piston pin can be inserted into piston with hand pressure, after coating with engine oil. Install snap rings into slots in pin hole with snap ring installer.

PISTON RINGS

Install piston rings in sequence of coil expander, oil ring, 2nd compression ring and 1st compression ring. Oil compression rings should be installed with "N" mark facing up. The ends of coil expander should be opposite oil ring gap.

CRANKSHAFT & ROD BEARINGS

CONNECTING ROD & MAIN BEARINGS

1) Wipe crankshaft journals and crankpins to remove oil. Install bearings on cylinder block and mount crankshaft in position carefully. Turn crankshaft 30° to ensure good bearing contact.

2) Position Plastigage over crankshaft journal in direction in line with axis of crankshaft, so that it covers entire width of bearing. Install bearing cap and tighten to 75 ft. lbs. (101 N·m). Do not turn crankshaft with Plastigage installed.

3) Remove bearing cap and check width of Plastigage against scale printed on package. If clearance of main bearings is more than .0027" (.068 mm), replace bearings. If connecting rod clearance is more than .0027" (.068 mm), replace bearings.

CRANKSHAFT END PLAY

Install bearings on block and position crankshaft over bearings. Install thrust bearing in position on both sides of No. 3 journal. Move crankshaft fully endwise and check clearance between crankshaft and thrust bearing. If clearance exceeds .0117" (.3 mm), replace thrust bearings.

REAR MAIN BEARING OIL SEAL

Removal — Remove transmission. If equipped with manual transmission, remove clutch assembly. Remove flywheel. Pry off the oil seal with a screwdriver.

Installation — Apply clean engine oil to lipped portion and fitting face of new oil seal. Install seal in No. 5 crankshaft bearing using suitable installer tool (J-29818). Apply Loctite or equivalent, to threads of new bolts and install flywheel and tighten bolts in a diagonal sequence. Reverse removal procedures for remaining components.

CRANKSHAFT FRONT OIL SEAL

Removal — Disconnect negative battery cable. Drain coolant. Remove radiator and timing belt. Remove center bolt attaching hub and washer. Using puller (J-24420-A), remove hub from

crankshaft. Remove crankshaft gear from crankshaft using same puller tool. Pry out oil seal using screwdriver.

Installation — Apply clean engine oil to lipped portion and fitting face of front seal and install seal retainer using installer tool (J-26587). Install flange in crankshaft. Align pulley groove with key and install pulley on crankshaft using same installer tool. Align hub groove with crankshaft key and install center bolt and tighten. Install timing belt and reverse removal procedures for remaining components.

CONNECTING ROD BUSHINGS

Connecting rod bushing should have a maximum clearance of .0019" (.05 mm) between bushing and piston pin. Bushing can be removed and installed using suitable tool (J-29765). Align the bushing hole with connecting rod hole after installation. Finish the bushing bore with a pin hole grinder.

CAMSHAFT

LOWER DUST COVER

Removal & Installation — Disconnect negative battery cable. Remove nuts attaching cooling fan and remove fan, pulley and belt. Remove damper pulley attaching bolts and remove pulley. Remove dust cover attaching bolts and remove dust cover. To install, reverse removal procedures.

DAMPER PULLEY

Removal & Installation — Disconnect negative battery cable. Raise vehicle. Loosen alternator and disengage belt. Remove damper pulley. To install, reverse removal procedures.

TIMING BELT

Removal — 1) Disconnect negative battery cable. Drain cooling system. Remove fan shroud, fan belt and pulley. Remove upper dust cover. See Fig. 8. Disconnect bypass hose.

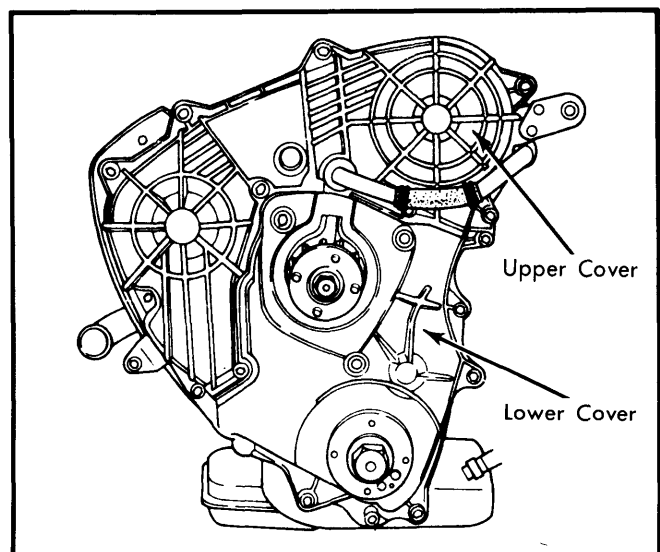


Fig. 8 Timing Belt Dust Covers

2) With No. 1 piston at TDC, check that setting mark on injection pump gear is in alignment with front plate. Align gear using a 8 mm X 1.25 mm bolt placed in hole in gear and front plate. Remove cam cover.

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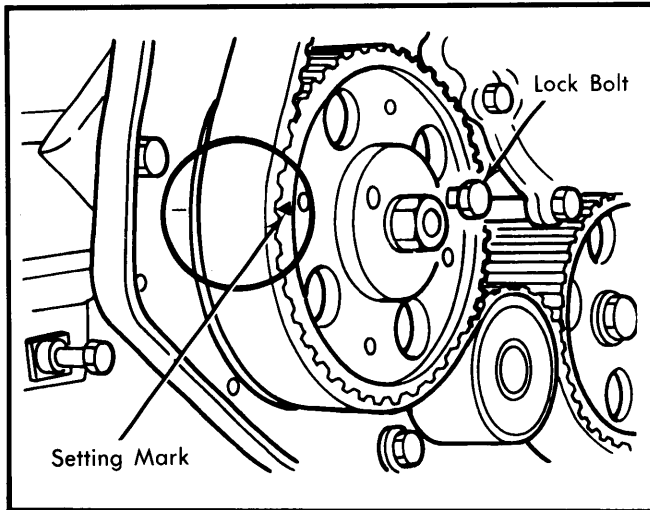


Fig. 9 Injector Gear Setting Mark

3) Install fixing plate (J-29761) to slot in rear of camshaft to prevent camshaft from rotating. Remove damper pulley. Be sure No. 1 cylinder is at TDC. Remove lower dust cover and timing belt holder.

4) Remove tension spring behind front plate next to injection pump. See Fig. 10. Loosen tension pulley and plate bolts, then remove timing belt.

Installation – **1)** Remove bolt attaching camshaft gear. Install puller (J-22888) and remove cam gear. Reinstall cam gear loosely so it can be turned by hand. Install timing belt, noting the following:

- Belt should be properly tensioned between pulleys.
- Cogs on belt and pulley should engage properly.
- Crankshaft should not be turned.
- Concentrate belt looseness on tension pulley, depress tension pulley with finger and install tension spring.

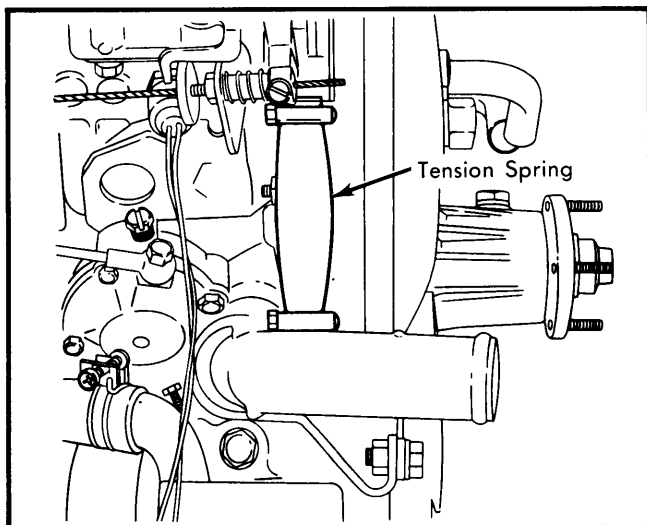


Fig. 10 Timing Belt Tensioner Spring

2) Finger tighten tensioner bolts. Tighten camshaft pulley bolt. Remove injection pump gear lock bolt. Remove fixing plate on end of camshaft.

3) Install damper pulley on hub and check that No. 1 cylinder is at TDC. Check that mark on injection pump pulley is in alignment with mark on plate. Fixing plate should fit smoothly into slot at rear of camshaft, then remove plate.

4) Loosen tensioner pulley and plate bolts. Concentrate looseness of belt on tensioner, then tighten bolts in sequence shown in Fig. 11. Belt tension should be checked at a point between camshaft gear and injection pump gear using tool (J-29771).

5) Remove damper pulley and install belt holder in position away from timing bolt. Install bypass hose, dust covers and damper pulley. Install cooling fan, belt and pulley. Install fan shroud. Refill system with coolant and connect battery.

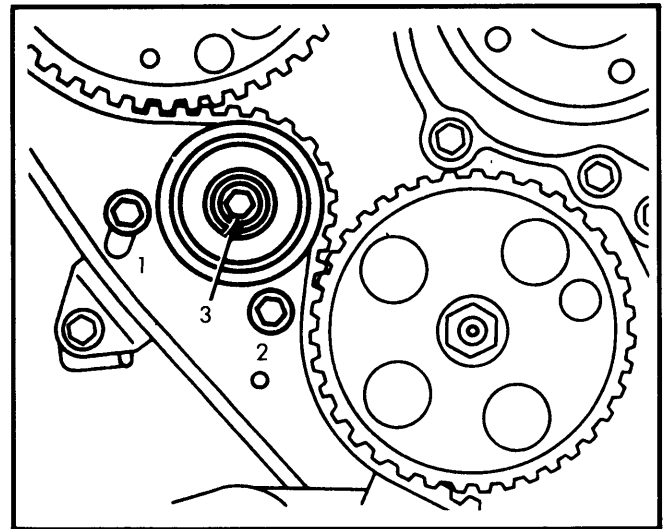


Fig. 11 Tensioner Pulley Bolt Tightening Sequence

CAMSHAFT

Removal – **1)** Remove cam cover and timing belt. Remove plug. Place fixing plate (J-29761) onto slit at rear of camshaft to hold it in place. Remove camshaft pulley bolt and pulley using remover tool (J-22888). Remove rocker arms and shaft.

2) Remove bolts attaching front head plate, and remove plate. Remove camshaft bearing cap attaching bolts and remove bearing caps with cap side bearings. Remove camshaft oil seal and remove camshaft.

Inspection – Check camshaft journal diameter with micrometer. If diameter is less than 1.09" (27.8 mm) replace camshaft. Measure cam lobe height. If height is less than 1.44" (36.6 mm), replace camshaft. Check runout with dial indicator. If more than .04" (1. mm), replace camshaft.

Installation – **1)** Apply clean engine oil to camshaft and cylinder head journals. Install camshaft and new oil seal. Apply suitable liquid gasket to cylinder head fitting face of No. 1 camshaft bearing cap.

2) Install rocker arm shaft assembly and tighten bolts in sequence shown in Fig. 4. Leave rocker arm adjusting screws loose. Install front head plate.

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3) Reinstall timing belt. Adjust valve clearance. Install rocker arm cover.

ENGINE OILING

Crankcase Capacity – 6 qts. with filter change.

Oil Filter – Change at first oil change and every second oil change thereafter.

Normal Oil Pressure – 64 psi at 5000 RPM.

OIL PUMP

Disassembly – Pulley, vane and rotor can be separated from oil pump body by removing attaching screws. See Fig. 12.

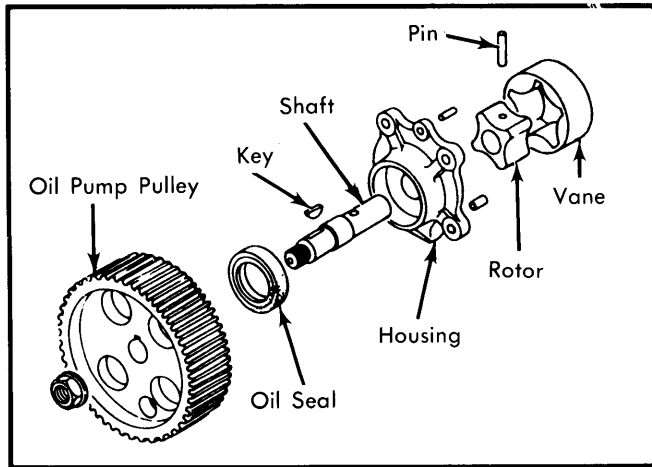


Fig. 12 Exploded View of Oil Pump Assembly

Reassembly – Apply engine oil to vane and install with taper side turned to cylinder body. Apply engine oil to "O" ring and install into groove in housing. Apply engine oil to rotor and install. Install pump body together with pulley and tighten attaching screws.

ENGINE COOLING

WATER PUMP

Removal – Disconnect negative battery cable. Drain cooling system. Remove fan shroud, fan and drive belt. Remove damper pulley, dust cover and bypass hose at pump. Remove attaching bolts and remove water pump.

Installation – Clean all gasket mating surfaces. Install new gasket on pump and install pump. Tighten bolts. Reverse removal procedures for remaining components. Refill system with coolant, connect battery, start engine and check for leaks.

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

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N·m)
Camshaft Bearing Cap Bolts	15-22 (20-30)
Camshaft Pulley Bolt	45 (61)
Connecting Rod Cap Nuts	65 (88)
Crankshaft Center Bolt	110 (149)
Cylinder Head Bolts ^⓪	
First Step	21-36 (28-48)
Second Step	
New Bolts	83-98 (112-132)
Used Bolts	90-105 (122-142)
Damper Pulley Bolts	15 (20)
Exhaust Manifold Bolts	15 (20)
Flywheel Bolts	40 (54)
Intake Manifold	30 (40)
Injector Lines	15-22 (20-30)
Main Bearing Cap Bolts	65-72 (88-97)
Oil Pump Bolts	15 (20)
Rocker Arm Bolts	20 (17)
Tensioner Pulley	
Center Bolt	54 (73)
Side Bolts	15 (20)
Water Pump Bolts	15 (20)

^⓪Coat threads of bolt with engine oil before installation.

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
1.8L	68@5000	53@2000	22.0:1	3.31	84	3.23	82	111	1800

General Motors 4 Engines

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ENGINE SPECIFICATIONS (Cont.)

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)
1.8L Intake	1.531-1.535 (38.9-39)	45°	45°	.047-.059 (1.19-1.49)	.3128-.3134 (7.946-7.961)	.0015-.0028 (.039-.071)	.378 (9.6)
Exhaust	1.335-1.339 (33.9-34.0)	45°	45°	.047-.059 (1.19-1.49)	.3126-.3132 (7.94-7.955)	.0018-.0030 (.045-.077)	.398 (10.1)

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS							
Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm)	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
1.8L	2.2019 (55.928)	.0015-.0031 (.039-.080)	No. 3	.0024-.0094 (.06-.24)	1.925-1.926 (48.89-48.92)	.0016-.0032 (.004-.008)

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm)	Side Clearance In. (mm)
1.8L	.0006-.0014 (.015-.035)	.00008-.00047 (.002-.012)	.00031-.00079 (.008-.020)	No. 1	.0078-.0157 (.20-.40)	.0035-.0049 (.0889-.1244)
				No. 2	.0078-.0157 (.20-.40)	.0015-.0019 (.0381-.0482)
				No. 3	.0078-.0157 (.20-.40)	.0012-.0027 (0304-.0685)

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs.@In. (Kg.@mm)	
		Valve Closed	Valve Open
1.8L Intake	5.21 (132.5)	19-21@1.52 (8.6-9.5@38.6)	54-62@1.14 (24.5-28.1@29)
		32-27@1.61 (14.5-16.7@40.8)	100-116@1.24 (45.3-52.6@31.5)
Exhaust	5.21 (132.5)	19-21@1.52 (8.6-9.5@38.6)	56-64@1.12 (25.4-29@28.5)
		32-37@1.61 (14.5-16.7@40.8)	104-119@1.22 (47.1-53.9@30.9)

CAMSHAFT			
Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
1.8L	1.1004-1.101 (27.95-27.96)	.0008-.0035 (.0203-.0889)