

Mazda Engines

808 & B-1600 4 CYLINDER

GENERAL SPECIFICATIONS										
Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
1976 808	77.6	1272	1x2-Bbl.	.....	.....	9.2:1	2.87	73	2.99	76
808 & B1600	96.8	1586	1x2-Bbl.	.....	.....	8.6:1	3.07	78	3.27	83

ENGINE IDENTIFICATION

Engine number on the 1586 cc engine is stamped on cylinder block directly behind dipstick. Engine number on the 1272 cc is stamped on right side of block below distributor.

Application	Engine	Code
808 Mizer	1272 cc	TCH
808	1586 cc	NA
B-1600 Pickup	1586 cc	NA

ENGINE

Removal, 1272 cc - 1) Remove hood and engine under cover. Drain cooling system and crankcase. Remove battery and air cleaner. Disconnect accelerator and choke cable at carburetor. Disconnect fuel lines at fuel pump, and heater hose at intake manifold. Disconnect primary wire and coil lead from distributor.

2) Disconnect wires from temperature sending unit, oil pressure switch and starter. Disconnect reverse light wiring connector. Remove starter. Disconnect hoses and expansion tank from radiator. Remove radiator. Disconnect heater outlet hose from engine. Remove bolt attaching front exhaust pipe clamp to clutch housing.

3) Disconnect alternator wiring. Remove bolt securing lower radiator hose clip to body. Remove cover plate from clutch housing. Support transmission with a jack and remove nuts and bolts attaching transmission to engine.

4) Install a lifting sling to engine lifting brackets, then attach a lifting hoist. Remove engine mount attaching nuts and bolts. Raise engine slightly. Pull engine forward until it clears the clutch shaft, then lift engine from vehicle.

Installation - To install, reverse removal procedure.

Removal, 1586 cc - 1) Remove hood and engine under cover. Drain cooling system and crankcase. Remove battery. Disconnect vacuum sensing tubes and air hose from air control valve on 808 models. Disconnect primary wire and coil lead from distributor. Disconnect condenser wire at coil on B-1600 models. Disconnect coupler and "B" terminal wire from alternator.

2) Disconnect oil pressure switch wire and engine ground wires. Disconnect wire coupler at front (B1600) or rear (808) of cylinder head. Remove radiator hoses and separate radiator cowl from radiator. On 808 models equipped with automatic transmission, disconnect transmission fluid lines at

radiator. Remove attaching bolts, then remove radiator and cowl. Remove hot air hose. Remove air pump and canister-to-air cleaner hoses on B1600 models. Remove check valve-to-air valve hose.

3) Remove attaching bolt or nut from air cleaner body and remove air cleaner assembly. Disconnect distributor vacuum tubes and remove check valve from inlet manifold on B1600 models. Disconnect choke wire and throttle linkage from carburetor, then disconnect fuel lines at carburetor. Disconnect wires from temperature sending unit and from carburetor solenoid.

4) Disconnect heater hoses from inlet manifold. Disconnect reverse light wiring coupler from under intake manifold. On 808 models disconnect vacuum sensing pipe (for power brake unit) from intake manifold and disconnect accelerator switch wiring. On 808 Calif. models, disconnect vacuum sensing tubes from three-way solenoid, and disconnect hose from vacuum amplifier.

5) On all models, disconnect starting motor wires and remove starter. Disconnect exhaust pipe from exhaust manifold (except 808 Calif. models) or from thermal reactor (808 Calif. models). Remove clutch cover plate and stays. Remove nuts and bolts attaching transmission-to-engine and support transmission with a jack.

6) Remove engine mount attaching nuts and bolts. Install a lifting sling to engine lifting brackets, then attach a lifting hoist and raise slightly. Pull engine forward until clear of clutch shaft, then lift engine from vehicle.

Installation - To install, reverse removal procedure.

CYLINDER HEAD

Removal - 1) Remove engine lifting brackets from cylinder head. Remove exhaust manifold or thermal reactor along with port liners and gaskets. Disconnect ignition wires at spark plugs and vacuum control tube at distributor. Remove lock nut, then remove distributor from cylinder head.

2) Disconnect hoses and remove air pump with bracket. Remove water pump fan and pulley. Disconnect hose from ventilation valve at intake manifold. Disconnect anti-afterburn valve hose on 808 models. Remove attaching bolts, then remove intake manifold and carburetor as an assembly.

3) Remove rocker arm cover, gasket, and oil seals. Install ring gear brake tool (49 0118 271A) to flywheel to prevent flywheel from rotating. Remove lock nut and washer, then slide distributor drive gear from camshaft. Remove camshaft sprocket lock nut. Remove cylinder head-to-front cover attaching bolt.

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4) On 1272 cc 808 models, remove blind cover from timing chain cover and install chain tensioner guide (49 1975 260), to prevent slipper head of tensioner from popping out. Loosen, in steps, cylinder head bolts in the reverse of tightening sequence and then remove bolts. Remove rocker arm assembly. Carefully pull camshaft to rear and remove from sprocket and cylinder head.

5) Remove camshaft sprocket. **CAUTION** — Timing chain should be lifted up to prevent chain tensioner slipper head from disengaging which will cause difficulty in chain tension adjustment upon reassembly. Remove camshaft bearings from cylinder head. Remove cylinder head and gasket.

Installation — 1) Install camshaft sprocket to timing chain and position on top of chain guide strip and chain vibration damper. **NOTE** — Ensure matching marks on chain and sprocket are aligned. Install new cylinder head gasket, then position cylinder head while aligning dowels.

2) Install camshaft bearings to cylinder head and to bearing caps. Lubricate bearing surfaces with engine oil. Carefully install camshaft to sprocket while aligning keyway and fit journals to respective bearings. Position rocker arm assembly on

cylinder head. **NOTE** — Ensure that the flat surface of ball on each rocker arm is facing down.

3) Install cylinder head bolts and tighten, in steps, according to sequence shown in Fig. 1. Install cylinder head-to-front cover bolt. Install and tighten camshaft lock nut, then bend tab of lock washer. Install distributor drive gear, tighten nut and bend lock washer.

4) Carefully press top of chain guide strip, using a lever, through opening of cylinder head. Tighten guide strip attaching screws. Adjust timing chain tension. See *Timing Chain Adjustment*. Install remaining components in reverse of removal procedure.

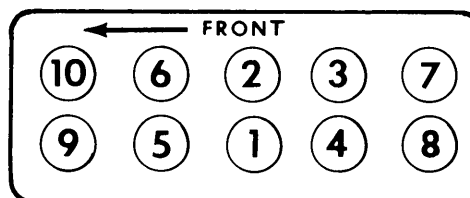


Fig. 1 Tightening Sequence for Cylinder Head

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)
1272 cc Intake	1.4173 (35.99)	45°	45°	.055 (1.4)	.314-.317 (7.98-8.05)	.0007-.0021 (.018-.053)	.....
Exhaust	1.2205 (31.00)	45°	45°	.055 (1.4)	.314-.317 (7.98-8.05)	.0007-.0023 (.018-.058)	.....
1586 cc Intake	1.6536 (42.00)	45°	45°	.055 (1.4)	.314-.317 (7.98-8.05)	.0007-.0021 (.018-.053)	.....
Exhaust	1.2992 (32.99)	45°	45°	.055 (1.4)	.314-.317 (7.98-8.05)	.0007-.0023 (.018-.058)	.....

- ① — Specification is $\pm .0039$ " (.099 mm).
 ② — Wear limit is .008" (.20 mm).

VALVE ARRANGEMENT

Right Side — All Intake.

Left Side — All Exhaust.

VALVE GUIDE SERVICING

Remove worn valve guide, using valve guide removal/installation tool and hammer. Install new guide until ring on guide just touches cylinder head. Install new valve seal onto valve guide using a seal pusher tool (42 0223 160B).

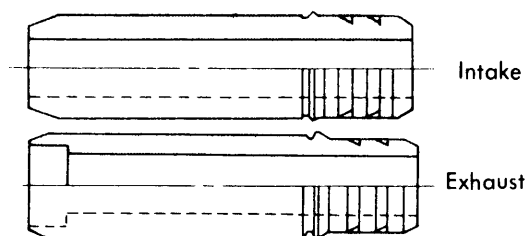


Fig. 2 Valve Guide Assemblies

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
1272 cc	Inner	1.449 (36.8)	20.9 @ 1.26 (9.5 @ 32.0)
	Outer	1.587 (40.3)	43.7 @ 1.319 (19.8 @ 33.5)
1586 cc	Inner	1.449 (36.8)	20.9 @ 1.26 (9.5 @ 32.0)
	Outer	1.469 (37.3)	31.4 @ 1.339 (14.25 @ 34.0)

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VALVE SPRING REMOVAL

Remove all carbon from inside combustion chamber. Using a suitable valve spring compressor, compress valve springs and remove taper sleeves, upper spring seat, valve springs and lower spring seat. If necessary, valve can now be removed.

NOTE — Mark components for reinstallation, as they are disassembled.

VALVE SPRING INSTALLED HEIGHT

With valve springs removed, inspect for corrosion or damage and replace as necessary. Using suitable valve spring tester, measure free length and fitting pressure.

ROCKER ARM ASSEMBLY

1) With rocker arm assembly removed and disassembled, inspect all components for wear or damage. The standard clearance between rocker arm bore and shaft on 1272 cc is, .0008-.0029" (.020-.074 mm), and on 1586 cc is, .0011-.0032" (.028-.081 mm). If measured clearance is beyond .004" (.102 mm), replace rocker arm or shaft.

2) Reassemble and install rocker shaft while noting the following: Intake and exhaust rocker arm shaft supports are interchangeable. Intake side uses two rocker shafts. On intake side, end of shaft with longer distance between oil hole and shaft end face each other. Center bearing cap oil hole faces toward intake side.

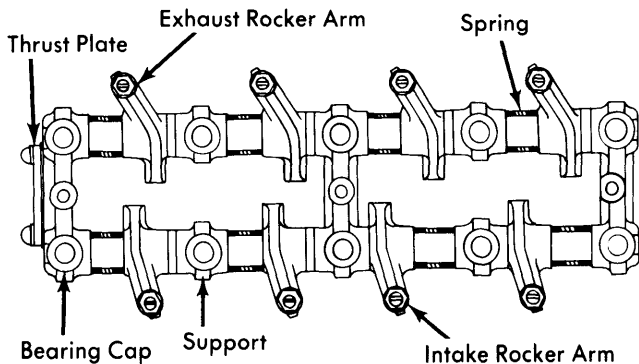


Fig. 3 1272 cc Rocker Arm Assembly

3) When installing the oil distribution pipe make sure the oil ejection hole faces camshaft. After pipe is installed press "O" ring into hole for pipe on center bearing cap. When installing rocker arm assembly make sure flat surface on ball of each rocker arm faces downward. Align dowels and install assembly to cylinder head. Before tightening cylinder head bolts, offset each exhaust rocker arm .040" (1 mm) from valve stem center.

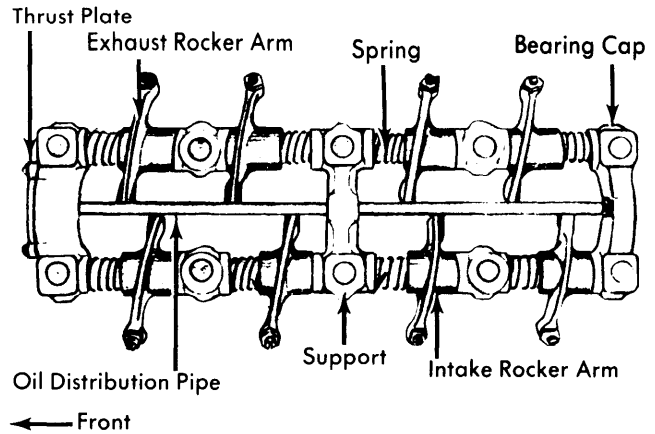


Fig. 4 1586 cc Rocker Arm Assembly

VALVE CLEARANCE ADJUSTMENT

To adjust clearance, loosen lock nut and insert feeler gauge between rocker arm and valve stem. Turn adjusting screw until proper clearance is obtained.

NOTE — Before adjusting, ensure flat surface of ball on rocker arm is facing downward.

Valve Clearance Specifications

Application	Intake In.(mm)	Exhaust In.(mm)
1272cc		
Valve side .....	.010 (.25)	.012 (.30)
Camshaft side .....	.007 (.18)	.009 (.22)
1586 cc		
Valve side .....	.012 (.30)	.012 (.30)
Camshaft side .....	.009 (.22)	.009 (.22)

PISTONS, PINS, RINGS						
Engine	PISTONS		PINS		RINGS	
	Clearance In. (mm)	① Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm)	Side Clearance In. (mm)
1272 cc & 1586 cc	.0021-.0026 (.057-.066)	-.0006 to +.0002 (-.014 to +.005)	.0004-.0012 (.01-.03)	No. 1	.008-.016 (.2-.4)	.0014-.0028 (.035-.070)
				No. 2	.008-.016 (.2-.4)	.0012-.0025 (.030-.064)
				Oil	.008-.016 (.2-.4)	.0012-.0024 (.030-.062)

① — In some instances it may be necessary to heat piston to insert pin.

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OIL PAN REMOVAL

Raise vehicle and drain crankcase. Remove under cover and clutch release cylinder bolts, and let cylinder hang. Remove clutch cover plate. Remove oil pan and gasket. To install, reverse removal procedure.

PISTON & ROD ASSEMBLY

Removal — Remove oil pan, cylinder head, and oil pump. Make sure connecting rod caps are marked so they may be replaced in their original positions, then remove rod caps. Push piston and rod assembly out top of cylinder. Take care not to damage bearing journal.

Installation — Oil piston rings, pistons, and cylinder walls with engine oil. Place piston rings approximately 120° apart so gap is not on thrust side or piston pin side. Install a ring compressor onto piston without disturbing position of rings. Install piston and rod assembly into its original bore. Make sure "F" mark on piston is facing front of engine. Install rod caps and tighten rod bolts. Install oil pump, oil pan, and cylinder head.

FITTING PISTONS

1) Cylinder bore can be measured using a cylinder gauge. Measurement must be taken at three depths and two angles as shown in illustration. Difference between maximum and minimum values is actual wear. If cylinder bore wear is .006" (.15 mm) or more, all cylinders must be honed or rebored. If cylinder is honed or rebored, oversize pistons and rings are available in .010" (.25 mm), .020" (.50 mm), .030" (.75 mm), and .040" (1.00 mm) oversizes.

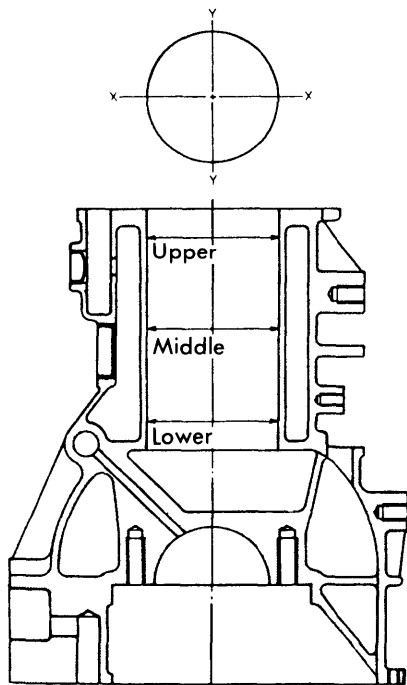


Fig. 5 Points for Measuring Cylinder Bore

2) Carefully inspect pistons and replace those severely damaged due to scoring, scratching or burning. Measure

pistons at points A, B & C, as shown in Fig. 6 using a micrometer. If piston is not within specifications, replace piston and rebore cylinder.

Standard Piston Specifications

Application	Diameter In. (mm)
1272 cc	
A	2.8718-2.8726 (72.948-72.956)
B	2.8722-2.8730 (72.959-72.967)
C	2.8590-2.8598 (72.649-72.657)
1586 cc	
A	3.0683-3.0691 (77.935-77.955)
B	3.0705-3.0713 (77.991-78.011)
C	3.0583-3.0591 (77.681-77.701)

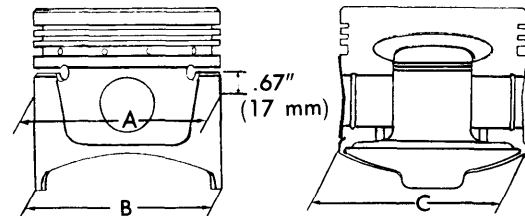


Fig. 6 Points for Measuring Piston

PISTON PIN REPLACEMENT

1) Remove piston pin circlips. Using suitable piston pin removal tool, extract piston pin. If pin is hard to remove, heat piston assembly.

2) Check fit of piston pin in connecting rod bushing. Fit should be .0004-.0012". If tolerance is exceeded, replace bushing.

3) To replace connecting rod bushing, press out worn bushing and install new one; ensure connecting rod and bushing oil holes align. Using suitable tool, finish ream new bushing. Correct fit is hand push, light resistance.

4) Begin reassembly by replacing piston pin circlip. Place connecting rod in piston so oil hole on connecting rod and piston index mark "F" are in relation. See Fig. 7. Using suitable piston pin installation tool, seat piston pin. Install second circlip.

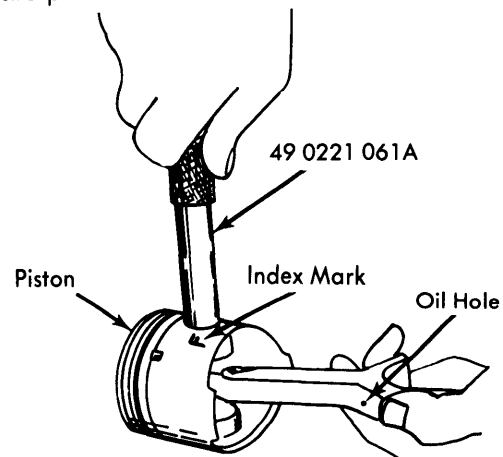


Fig. 7 Installing the Piston Pin

Mazda Engines

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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)
1272 cc	2.4780-2.4786 (62.941-62.956)	.0012-.0024 (.030-.061)	No. 5	.003-.009 (.08-.23)	1.7693-1.7699 (44.940-44.955)	.0011-.0029 (.028-.074)	.004-.008 (.10-.20)
1586 cc	2.4780-2.4786 (62.939-62.954)	.0012-.0024 (.030-.061)	No. 5 (.102-.203)	.003-.009 (.08-.23)	2.0842-2.0848 (52.939-52.954)	.0011-.0030 (.028-.074)	.004-.008 (.10-.20)

MAIN & CONNECTING ROD BEARINGS

- 1) Remove engine and oil pan. Check main and connecting rod bearing clearances using Plastigage method. If measured value exceeds correct clearance, bearing must be replaced.
- 2) Using a micrometer, measure diameter of connecting rod and main bearing journals. If wear is more than .0020" at any journal, crankshaft must be ground to fit .010", .020" or .030" undersize bearings.
- 3) Using a dial indicator, check crankshaft for out-of-round. Maximum allowable out-of-round is .0012" (.030 mm).
- 4) Fit five upper main bearings to cylinder block and lower bearings to caps. Install thrust washer halves to cylinder block with oil grooved surface facing crankshaft thrust side. Fit new oil seal at rear of crankshaft. Insert side seals on both sides of rear main bearing cap. Install main bearing caps. No. 1 through No. 4 bearing caps are marked for correct installation, No.5 may or may not be indexed.
- 5) Insert connecting rod assembly into cylinder as previously described. Fit upper bearing to rod and over crankshaft. Fit lower bearing to rod cap and install cap. Tighten all bolts to specifications. **NOTE** — Ensure engine is free to turn.
- 6) End play is compensated for by thrust washers placed at No. 5 main bearing. Check crankshaft end play using a dial indicator. End play must not exceed .012", if it does thrust washers must be replaced. Thrust washers are available in .010", .020" & .030" oversizes.

CAMSHAFT				
Engine	Journal Diam. In. (mm)	Clearance In. (mm)Ⓢ	Lobe Lift In. (mm)	
1272 cc	Front	1.6516-1.6522 (41.950-41.966)	.0014-.0030 (.035-.076)	.....
	Center	1.6504-1.6510 (41.920-41.936)	.0026-.0042 (.065-.106)	.....
	Rear	1.6516-1.6522 (41.950-41.966)	.0014-.0030 (.035-.076)	.....
1586 cc	Front	1.7695-1.7701 (44.946-44.961)	.0007-.0027 (.019-.069)	.....
	Center	1.7691-1.7697 (44.936-44.951)	.0011-.0031 (.029-.079)	.....
	Rear	1.7695-1.7701 (44.946-44.961)	.0007-.0027 (.019-.069)	.....

Ⓢ — End play is .001-.007" (.025-.178 mm).

CAMSHAFT REMOVAL

NOTE — Lift timing chain upward to prevent the slipper head of chain tensioner from coming out, and causing difficulty in adjusting the timing chain.

- 1) Remove valve cover. Install ring gear brake tool (49 0118 271A) to the flywheel. Remove lock nut and washer, and slide distributor drive gear from camshaft. Remove lock nut from camshaft sprocket.
- 2) Remove the bolt that attaches timing chain cover to cylinder head. Remove cylinder head bolts in reverse of tightening sequence. Lift out rocker arm assembly. Pull camshaft rearward and remove sprocket. Carefully remove camshaft. If necessary camshaft bearings can be removed at this time.

CAMSHAFT BEARING REPLACEMENT

- 1) Inspect cam face and journals, ensuring they are not worn or scored. Using a micrometer, measure cam height. Standard cam height is: 1272 cc intake and exhaust is 1.7369" (44.116 mm), and 1586 cc intake is 1.7605" (44.715 mm) and exhaust is 1.7592" (44.682 mm). If measured value differs from standard specification by more than .008" (.20 mm), replace camshaft.
- 2) Measure diameter of camshaft bearing journals. If wear is more than .002" (.051 mm) above maximum standard diameter, camshaft must be ground to accept .010", .020" or .030" undersize bearings.

- 3) Inspect camshaft bearing clearances using Plastigage method. If standard clearances are exceeded, replace bearings. If new bearings are properly fitted, correct clearance can be obtained without filing, shimming or scraping.

- 4) Using a dial indicator, check camshaft out-of-round. Camshaft must not exceed .0012" (.030 mm) out-of-round.

- 5) Check camshaft end play using a feeler gauge. Standard clearance is .001-.007" (.025-.178 mm). If wear limit of .008" (.20 mm) is exceeded, replace thrust plate.

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (BTDC)	Close (ALDC)	Open (BLDC)	Close (ATDC)
1272 cc	13°	50°	57°	6°
1586 cc	13°	54°	57°	10°

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TIMING CHAIN

Removal – 1) Remove cylinder head and oil pan with engine removed from vehicle. Remove front cover and gaskets, then remove oil thrower from crankshaft. Remove chain tensioner, guide strip, and vibration damper.

2) Remove oil pump sprocket lock nut and washer. Remove crankshaft sprocket, oil pump drive chain, and oil pump sprocket. Remove crankshaft spacer, timing chain and crankshaft sprocket. Remove key and spacer from crankshaft.

Installation – 1) On 1272 cc models, install timing chain guide strip, but do not tighten attaching screws. Install vibration damper. On all models, install spacer and key onto crankshaft. Place timing chain on crankshaft and camshaft sprockets with index marks aligned.

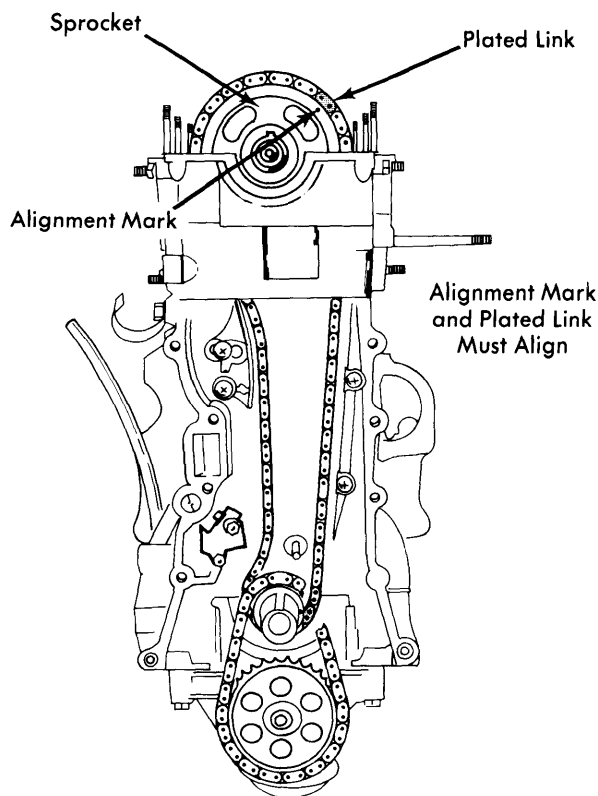


Fig. 8 Alignment Marks of Timing Chain & Sprockets

2) Align crankshaft and its sprocket keyway, then fit sprocket onto crankshaft. Install crankshaft spacer. Fit key on oil pump

shaft. Install oil pump drive chain onto oil pump and crankshaft sprockets, align keyway and install assembly onto crankshaft and oil pump shafts.

3) On 1272 cc models, tighten oil pump sprocket nut and bend tab of lockwasher. Install oil baffle plate a spacer onto crankshaft. On all other models, check the slack of oil pump drive chain. If slack exceeds .157" (4 mm), install adjusting shims between cylinder block and oil pump body. Tighten oil pump sprocket nut and bend tab of lockwasher.

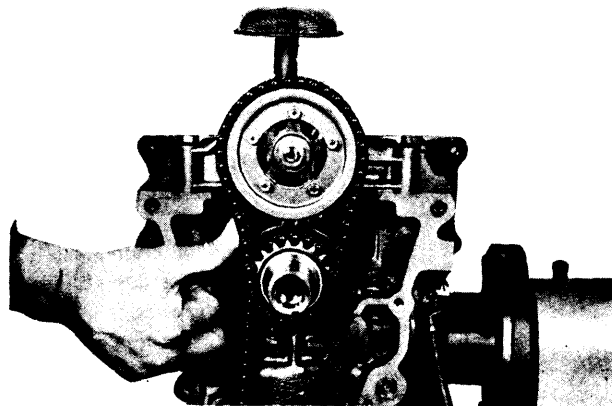


Fig. 9 Checking Oil Pump Chain Slack (1586 cc Engine Only)

4) Compress snubber spring of chain tensioner fully and insert a plate to retain tensioner in this position. Install chain tensioner to cylinder block. On 1586 cc models, install chain vibration damper and tighten attaching screws. Install chain guide strip, but do not tighten attaching screws at this time. Install oil deflector and seal into front cover. Install oil thrower on crankshaft with the edge facing forward.

5) On all models, fill oil seal lip with grease and install front cover. Install oil pan and gasket. Position camshaft sprocket and chain on top of chain guide strip and chain vibration damper. Install gasket and cylinder head to block. **NOTE** – Make sure matching marks on chain and sprockets are aligned. Install camshaft and bearings to cylinder head.

6) Install rocker arm assembly. Tighten cylinder head bolts. Rotate crankshaft in direction of rotation slightly. Press top of chain guide strip with a lever through opening in cylinder head, then tighten guide strip attaching screws through holes in front cover. Remove plate installed in chain tensioner and tensioner will be properly set. Install remaining components in reverse of removal procedure.

ENGINE OILING

ENGINE OILING SYSTEM

Oil is circulated under pressure by a rotor type pump. The pump is mounted on cylinder block inside the oil pan and is driven by crankshaft.

Crankcase Capacity – Approximately 3.2 quarts.

Oil Pressure – 50-64 psi (3.5-4.5 kg/cm²) @ 3000 RPM.

Oil Filter – Full flow cartridge.

Pressure Regulator Valve – Nonadjustable.

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ENGINE OILING (Cont.)

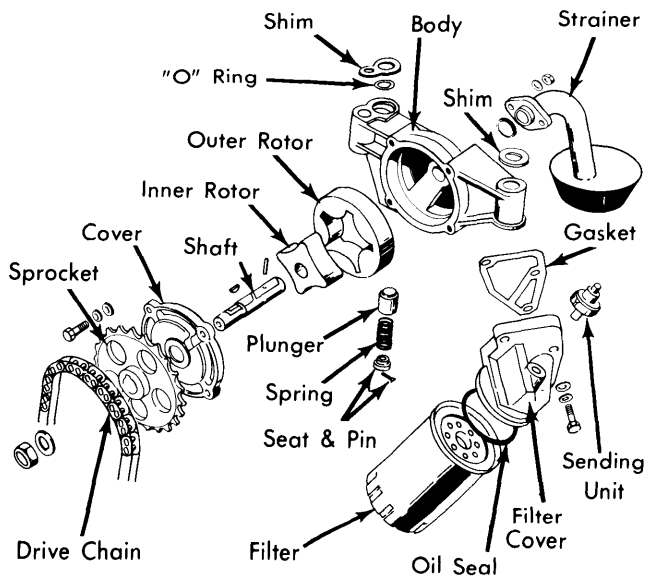


Fig. 10 1586 cc Oil Pump Assembly

Oil Pump Specifications

Application	Clearance In. (mm)
Rotor-to-Rotor .....	.002-.006 (.051-.152)
Rotor-to-Body .....	.006-.010 (.152-.254)
End Play .....	.002-.004 (.051-.102)

OIL PUMP

- 1) Check clearance between lobes of rotors with a feeler gauge. If clearance exceeds .010", replace both rotors.
- 2) Inspect clearance between outer rotor and pump body, using a feeler gauge. Maximum clearance is .012".
- 3) To check rotor ends, place a straightedge across pump body and measure clearance between rotor and straight edge, using a feeler gauge. Then place straightedge across cover and measure clearance between straight edge and cover. end play exceeds .006", replace pump cover.

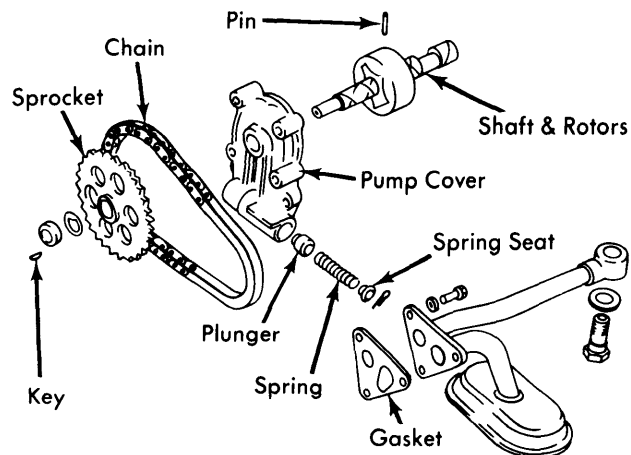


Fig. 11 1272 cc Oil Pump Assembly

ENGINE COOLING

WATER PUMP

NOTE — It may be necessary to remove radiator.

Remove bolts mounting fan and pulley to water pump. Remove nuts and bolts holding water pump to timing chain cover. Remove alternator bracket and water pump.

Cooling System Capacity — 1272 cc 5.9 qts., 1586 cc 7.9 qts., B1600 models 6.8 qts.

Thermostat — Begins to open at 180°F (82°C) and is fully open at 203°F (95°C).

Radiator Cap — 13 psi.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
1272 cc	
Cylinder Head	
Cold	47-51 (6.5-7.0)
Hot	51-54 (7.0-7.5)
Main Bearing Cap	43-47 (6.0-6.5)
Connecting Rod Cap	29-33 (4.0-4.5)
Oil Pump Sprocket	22-25 (3.0-3.5)
Camshaft Sprocket	51-58 (7.0-8.0)
Crankshaft Pulley	80-87 (11.0-12.0)
Distributor Drive Gear	51-58 (7.0-8.0)
Intake Manifold	14-19 (1.9-2.6)
Exhaust Manifold	12-17 (1.6-2.3)
1586 cc	
Cylinder Head	
Cold	56-60 (7.7-8.3)
Hot	69-72 (9.5-10.0)
Main Bearing Cap	61-65 (8.4-9.0)
Connecting Rod Cap	36-40 (5.0-5.5)
Oil Pump Sprocket	22-25 (3.0-3.5)
Camshaft Sprocket	51-58 (7.0-8.0)
Crankshaft Pulley	101-108 (14.0-14.9)
Distributor Drive Gear	51-58 (7.0-8.0)
Intake Manifold	14-19 (1.9-2.6)
Exhaust Manifold	16-21 (2.2-2.9)