

1971-73 MAZDA 616, B-1600 & 808 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
1971-72 616	96.8	1586	1x2 Bbl.	104@6000	106@3500	8.6:1	3.07	78	3.27	83
1972-73 B-1600&808	96.8	1586	1x2 Bbl.	.....	.....	8.6:1	3.07	78	3.27	83

► CHANGES, CAUTIONS, CORRECTIONS

See "Engine Notes" at end of article.

ENGINE REMOVAL

1) Disconnect battery, drain cooling system and crankcase. Disconnect all necessary electrical leads, water hoses, and vacuum lines. Remove exhaust manifold insulator (616 only) and disconnect exhaust pipe.

2) Remove air cleaner and disconnect carburetor linkage and fuel inlet line. Remove radiator and then remove radiator shroud.

3) Using suitable jack, support transmission, remove starter, clutch shield, and bolts mounting engine to transmission. Install suitable hoist and take weight of engine. Remove engine mount nuts. Pull engine forward and lift from vehicle. To install, reverse removal procedure.

INTAKE MANIFOLD

Removal — Remove air cleaner and disconnect all necessary electrical connections, water hoses, vacuum lines and carburetor linkage. Remove intake manifold retaining bolts and remove intake manifold with carburetor.

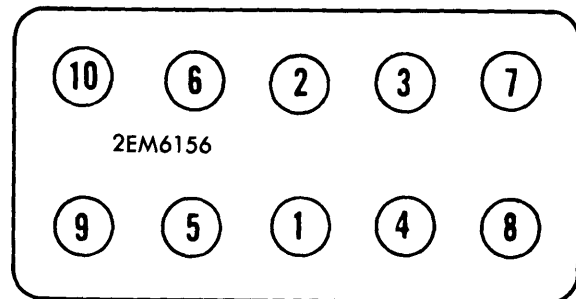
Installation — Make sure gasket surfaces are clean, use new gasket and reverse removal procedure to install intake manifold.

CYLINDER HEAD

Removal — 1) Remove valve cover and gasket. Remove lock nut and washer, and slide distributor drive gear off of camshaft. Using a suitable wrench (49 0164 631A), remove lock nut from camshaft sprocket.

2) Remove cylinder head bolts in reverse of tightening sequence. Remove rocker arm assembly. Pull rearward on camshaft, separating camshaft from sprocket. **NOTE** — Pull up on timing chain and sprocket and keep tight to prevent chain tensioner from sliding out of position. Remove cylinder head and gasket.

Installation — Make sure gasket surfaces are clean. To install cylinder head, reverse removal procedure. Tighten cylinder head bolts in sequence shown in illustration. Make sure camshaft and sprocket are correctly installed. See *Timing Chain replacement*.



← FRONT

CYLINDER HEAD TIGHTENING SEQUENCE

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)	
1971-72 616	Int.	1.6497-1.6575 (41.9-42.1)	45°	45°	.083 (2.1)	.3162-.3168 (8.030-8.045)	.0007-.0021 (.081-.053)	.....
	Exh.	1.2953-1.3031 (32.9-33.1)	45°	45°	.055 (1.4)	.3160-.3168 (8.025-8.045)	.0007-.0023 (.018-.058)	.....
1972-73 B-1600&808	Int.	1.6497-1.6575 (41.9-42.1)	45°	45°	.055 (1.4)	.3162-.3168 (8.030-8.045)	.0007-.0021 (.018-.053)
	Exh.	1.2953-1.3031 (32.9-33.1)	45°	45°	.055 (1.4)	.3160-.3168 (8.025-8.045)	.0007-.0023 (.018-.058)

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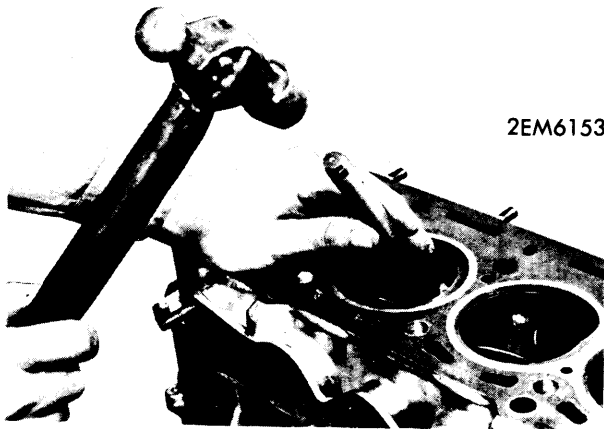
VALVE ARRANGEMENT

Right Side — All Intake.
 Left Side — All Exhaust.

VALVE GUIDE SERVICING

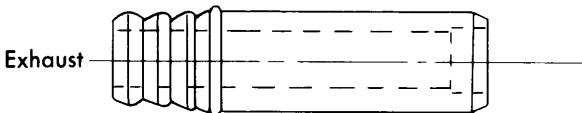
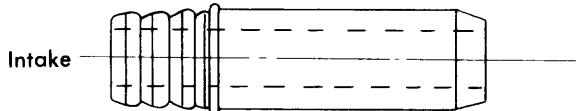
Remove worn valve guide, using suitable tool (49-0221-251A) and hammer. Install new guide, using same tool, until ring on guide just touches cylinder head.

NOTE — Intake and exhaust valve guides differ as shown in illustration.



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REMOVING VALVE GUIDE



2EM6161

INTAKE & EXHAUST VALVE GUIDES

VALVE STEM OIL SEALS

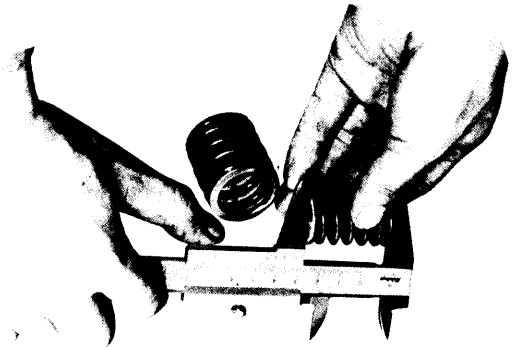
Valve stem oil seals are installed on valve guide before valve or valve springs are installed. Pry off old seal and install new seal using a suitable tool (49 0223 160A).

VALVE SPRINGS

Removal — With cylinder head removed, compress valve springs with a suitable valve spring compressor and remove keepers. Release valve spring compressor and remove upper spring retainer, springs and lower spring seats.

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE (LBS.) Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
1971-72 616	Inner	31.5@1.339 (14.3@34.0)	.....
	Outer	20.9@1.280 (9.5@32.5)	.....
1972-73 B-1600 & 808	Inner	31.4@1.339 (14.2@34.0)	.....
	Outer	20.9@1.260 (9.5@32.0)	.....

Installation — Measure valve spring free length with a set of Vernier calipers. If spring free length for inner spring is less than 1.425" (36.2 mm) or less than 1.406" (35.7 mm) for outer springs, springs must be replaced. To install valve springs, reverse removal procedure.



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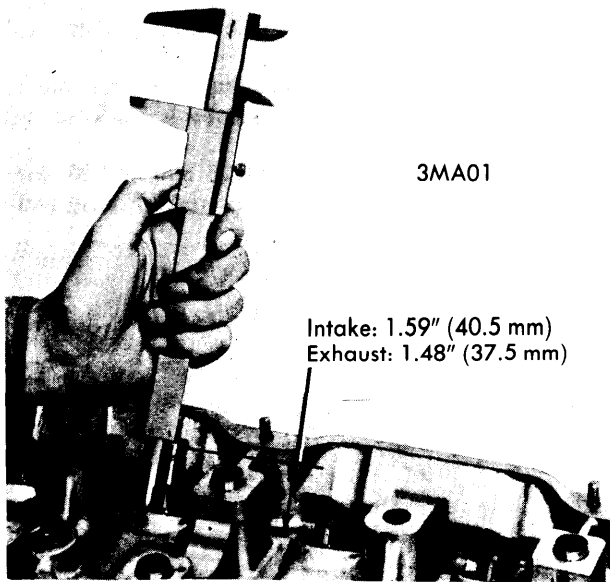
MEASURING FREE LENGTH

VALVE SPRING INSTALLED HEIGHT

1) If valve seats have been ground or valves refaced, valve stem may protrude too much from top of cylinder head, causing valve spring installed height to be incorrect. With valve pulled fully up into seat, measure distance from spring seat to top of valve stem with a set of Vernier calipers.

2) Specified distance for intake valves is 1.59" (40.5 mm) and for exhaust valves is 1.48" (37.5 mm). If measurement is .020" (.5 mm) less than specifications, washers of suitable thickness must be installed under valve springs to obtain correct height. If measurement exceeds .059" (1.5 mm) less than specification, valve or cylinder head must be replaced.

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Intake: 1.59" (40.5 mm)
Exhaust: 1.48" (37.5 mm)

CHECKING VALVE SPRING INSTALLED HEIGHT

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 is .0011-.0032". If measured clearance is beyond .004", replace rocker arm or shaft.

2) Reassemble and install rocker shaft, noting the following: Intake and exhaust rocker arm shaft supports are interchangeable; intake side uses two rocker shafts; on intake side, longer distances between oil hole and shaft end face each other. Before tightening cylinder head bolts, offset each exhaust rocker arm .040" from valve stem center.

VALVE CLEARANCE ADJUSTMENT

To adjust valve 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	Exhaust
Valve Side		
616.....	.012"	.012"
B-1600 & 808.....	.012"	.012"
Camshaft Side		
616.....	.010"	.010"
B-1600 & 808.....	.009"	.009"

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit	Rod Fit	Rings	End Gap In. (mm)	Side Clearance In. (mm)
1971-73	.0022-.0028 (.057-.072)	-.0002 to +.0006 (-.05 to +.014)	.0004-.0012 (.01-.03)	1	.006-.016 (.2-.4)	.0014-.0028 (.035-.070)
				2 & 3	.008-.016 (.2-.4)	.0012-.0025 (.030-.064)

OIL PAN REMOVAL

NOTE — Manufacturer recommends removing engine before taking off oil pan.

Invert engine and withdraw oil pan mounting bolts. Scrape contact surfaces clean before installing new gasket and oil pan.

PISTON & ROD ASSEMBLY

1) To remove piston and rod assembly, extract bolts from connecting rod and withdraw bearing caps. Using a wooden hammer handle, force piston and connecting rod assembly out top of cylinder block.

2) To install assembly, reverse removal procedure noting the following: Place piston rings approximately 120° apart (gap not on thrust side or piston pin side). Ensure piston and connecting rod assembly is inserted through top of cylinder, with index mark "F" facing front of engine.

PISTON PIN REPLACEMENT

1) Remove piston pin circlips. Using suitable tool (49-0223-061), extract piston pin. If pin is hard to remove heat piston.

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

3) To replace connecting rod bushing, press out worn bushing and install new one; ensure connecting rod and bushing holes align. Using suitable tool, 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 illustration). Using suitable tool (49-0223-061), seat piston pin. Install second circlip.

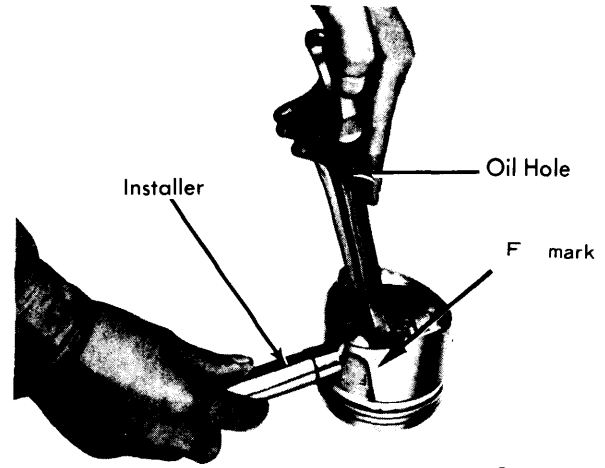
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FITTING PISTONS

1) Standard pistons and cylinders are graded into three classes according to diameter of piston and cylinder bore. Each is stamped with an "A", "C" or is unmarked. Standard clearance is obtained by combining pistons and cylinders with same marks.

2) Using a cylinder bore gauge, measure cylinder at top of ring travel and at bottom of ring travel. If wear exceeds .006", cylinder must be rebored. If clearance between piston and cylinder exceeds .006", cylinder must be rebored and oversize pistons installed. Pistons and rings are available .010" (.25 mm), .020" (.50 mm), .030" (.75 mm), and .040" (1.0 mm) oversize.

3) If old pistons are being installed, inspect pistons for burning or scoring. Remove all carbon from ring grooves using a suitable groove cleaner. Check side clearance of rings in grooves with a feeler gauge. If clearance is excessive, replace pistons or rings. Check ring end gap at bottom of ring travel, using a feeler gauge.



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PISTON ASSEMBLY

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)
1971-72 616	① ①	.0012-.0024 (.031-.061)	No.5	.0031-.0095 (.080-.242)	2.0842-2.0848 (52.94-52.95)	.0011-.0030 (.027-.077)	.004-.008 (.11-.21)
1972-73 B-1600	2.4780-2.4786 (62.94-62.95)	.0012-.0024 (.031-.061)	No.5	.003-.009 (.08-.24)	2.0842-2.0848 (52.94-52.95)	.0011-.0030 (.027-.077)	.004-.008 (.11-.21)
1972-73 808	2.4780-2.4786 (62.94-62.95)	.0012-.0024 (.031-.061)	N0.5	.003-.009 (.08-.04)	2.0842-2.0848 (52.94-52.95)	.0011-.0030 (.027-.077)	.004-.008 (.11-.21)

① — For these specifications, see Main and Connecting Rod Bearings.

MAIN & CONNECTING ROD BEARINGS

Main Bearings (616) — Standard main bearings are manufactured in three thickness class sizes designated by a color code on bearing. Crankshaft main bearing journal and bearing housing in cylinder block are manufactured in two class sizes, designated by a color code. Correct bearing clearance is obtained by combining correct class of bearing, journal and housing bore, as outlined in the following chart.

Bearing Clearance Color Code

Housing Bore	Bearing Journal	Main Bearing	Clearance Inches (mm)
Brown.....	Green.....	Green.....	.0013-.0023 (.032-.059)
Brown.....	Brown.....	Yellow.....	.0014-.0024 (.035-.061)
Green.....	Green.....	Brown.....	.0012-.0023 (.031-.059)
Green.....	Brown.....	Green.....	.0013-.0024 (.032-.061)

Main Bearing (All) — 1) Measure main bearing journal diameter with a micrometer. If journal wear exceeds .002" (.05 mm), crankshaft must be ground and undersize bearings installed. Check crankshaft runout with a dial indicator positioned on center main bearing journal. If runout exceeds .0012" (.03 mm), crankshaft must be straightened or replaced.

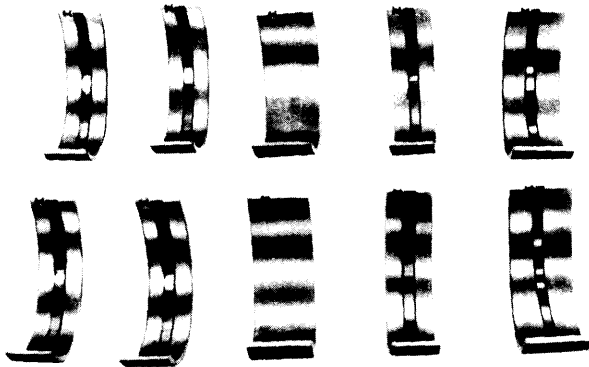
2) Check main bearing clearance using the Plastigage method. If clearance exceeds specifications, crankshaft must be ground and undersize bearings installed. Bearings are available .010" (.25 mm), .020" (.50 mm), and .030" (.75 mm) undersize.

Connecting Rod Bearings (All) — 1) Measure connecting rod bearing journal with a micrometer. If journal wear exceeds .002" (.05 mm), crankshaft must be ground and undersize bearings installed. Check connecting rod side play with a feeler gauge.

2) Check connecting rod bearing clearance using the Plastigage method. If clearance exceeds specifications, crankshaft must be ground and undersize bearings installed. Bearings are available .010" (.25 mm), .020" (.50 mm), and .030" (.75 mm) undersize.

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NOTE — Main bearings are classified into three types according to shape (see illustration).



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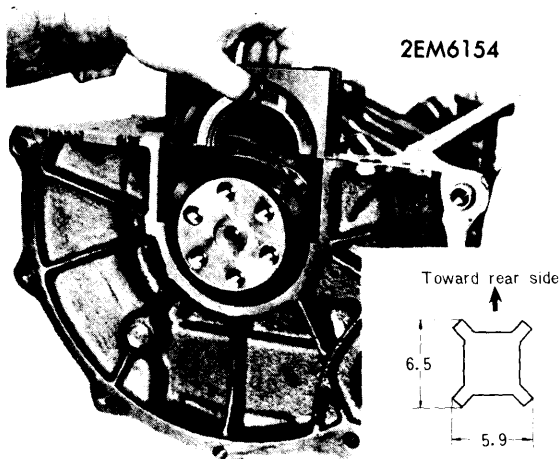
MAIN BEARINGS

THRUST BEARING ALIGNMENT

Check crankshaft end play with a dial indicator or a feeler gauge. If end play exceeds .012" (.03 mm), oversize thrust washers must be installed. Thrust washers are available .010" (.25 mm), .020" (.50 mm), and .030" (.75 mm) oversize. Install thrust washers with oil grooves toward crankshaft.

REAR MAIN BEARING OIL SEAL

Rear main bearing oil seal is held in place by rear main bearing cap. Lubricate lip of seal and install on seal contact surface at rear of crankshaft. Position side seals in main bearing cap correctly (see illustration). Install thrust washer halves correctly and install and tighten rear main bearing cap.



INSTALLING REAR MAIN BEARING CAP & SIDE SEALS

FRONT ENGINE COVER & SEAL

Install new seal in cover whenever cover is removed. Before installing cover, make sure oil slinger is installed on crankshaft, with edge of slinger toward cover. Oil contact lip of seal and install oil deflector and seal in cover. Using new gasket, coated with sealer, install front engine cover on engine. Cut excess gasket off at oil pan and cylinder head surface.

CAMSHAFT			
Engine	Journal Diam.	Clearance	Lobe Lift
1971-72 616	① 1.7695-1.7701 (44.94-44.96)	.0007-.0027 (.019-.069)	③ 1.7605 (44.71)
	② 1.7691-1.7697 (44.93-44.95)		④ 1.7592 (44.68)
1972-73 B-1600&808	① 1.7695-1.7701 (44.94-44.96)	① .0007-.0027 (.019-.069) ② .0011-.0031 (.029-.079)	③ 1.7605 (44.71)
	② 1.7691-1.7697 (44.93-44.95)		④ 1.7592 (44.68)

- ① — Journal No. 1 & 3. ③ — Intake Lift.
② — Journal No. 2. ④ — Exhaust Lift.

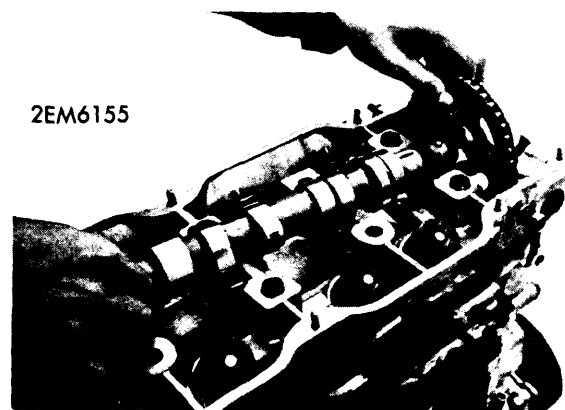
CAMSHAFT

Removal — 1) Remove valve cover. Remove lock nut and washer, and slide distributor gear off camshaft. Install a suitable tool to prevent engine from turning and remove camshaft sprocket nut using a suitable wrench (49 0164 631A).

2) Remove cylinder head bolts in reverse order of tightening sequence. Lift off rocker arm assembly. Pull camshaft rearward and separate from camshaft sprocket. Pull up on camshaft sprocket to ensure that timing chain stays tight against chain tensioner. Remove camshaft.

3) Check camshaft lobe lift with a micrometer. If lobe is worn more than .008" (.20 mm), camshaft must be replaced. Check camshaft runout with a dial indicator positioned on center journal. If runout exceeds .0012" (.03 mm), camshaft must be straightened or replaced.

Installation — To install camshaft, reverse removal procedure. Tighten cylinder head bolts in sequence shown in illustration. See *Cylinder Head*. Make sure timing chain and sprocket is correctly installed. See *Timing Chain*.



REMOVING CAMSHAFT

CAMSHAFT BEARINGS

With camshaft removed, measure journal diameter with a micrometer. If journals are worn more than .002" (.05 mm), camshaft journals must be ground and undersize bearings in-

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stalled. Bearings are available .010" (.25 mm), .020" (.50 mm), and .030 (.75 mm) undersize. If old bearings are being installed, carefully check for scoring or flaking. See illustration to ensure bearings are installed in correct position.

Cap Side



Cylinder Head Side

CAM BEARINGS

2EM6159

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (BTDC)	Close (ABDC)	Open (BBDC)	Close (ATDC)
1971-73 All	13°	54°	57°	10°

TIMING CHAIN & SPROCKETS

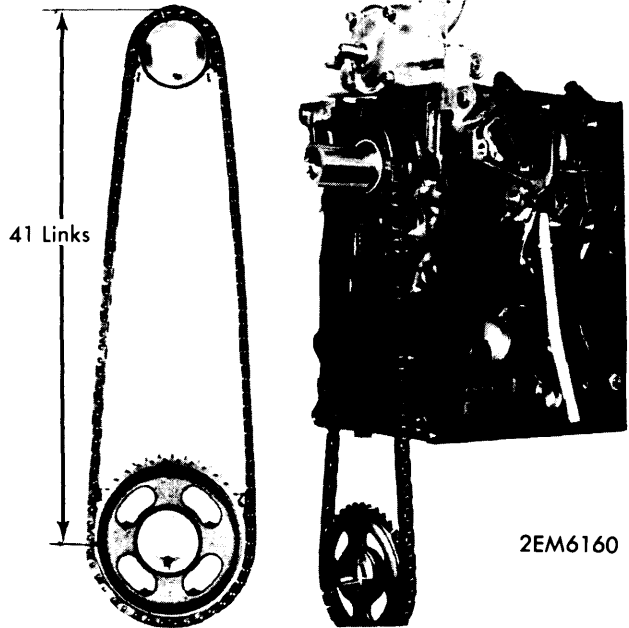
Removal - 1) With engine removed, remove crankshaft pulley. Remove oil pan and front engine cover. Remove oil deflector and slinger. Remove chain tensioner, slipper blade and chain damper.

2) Remove oil pump drive chain and sprockets. See *Oil Pump*. Remove camshaft as previously outlined. See *Camshaft*. Pull crankshaft sprocket off crankshaft and remove timing chain and both sprockets. Remove key and spacer from crankshaft.

Installation - 1) Install spacer and key in crankshaft. Position timing chain on crankshaft and camshaft sprockets with index marks on sprockets 41 chain links apart (see illustration). Install spacer on crankshaft and install chain tensioner, slipper blade and damper.

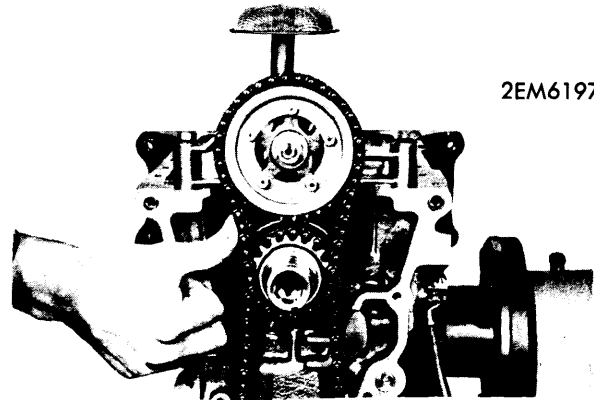
2) Install oil pump and drive chain. See *Oil Pump*. Install oil deflector and seal in front engine cover. See *Front Engine & Cover*.

3) Inspect chain for damage or broken links. Inspect sprockets for worn or chipped teeth. Check chain tensioner, slipper blade and vibration damper for wear or damage. Replace any components as necessary.



SPROCKET ALIGNMENT

2EM6160



OIL PUMP CHAIN TENSION

2EM6197

ENGINE OILING

Crankcase Capacity - Approximately 4 quarts.

Normal Oil Pressure - 50-64 psi at 3,000 RPM.

Oil Filter - Fill-flow, disposable canister type.

Pressure Regulator Valve - Nonadjustable.

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.

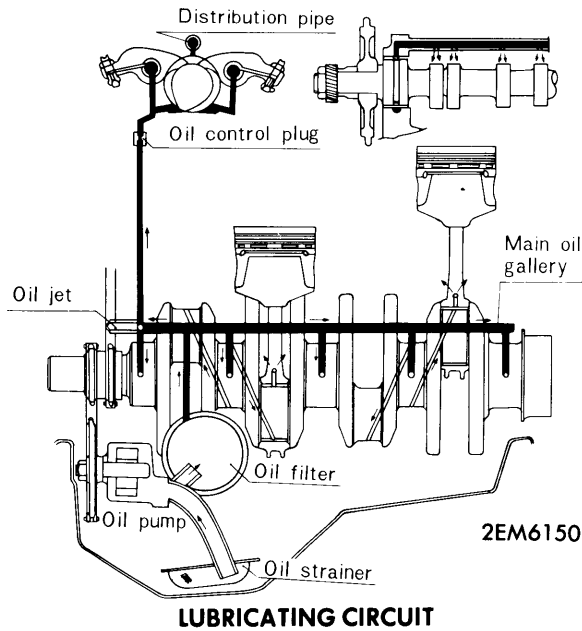
OIL PUMP

Removal & Disassembly - 1) With front engine cover removed, remove oil pump sprocket lock nut and washer. Remove oil pump sprocket, crankshaft sprocket and chain. Remove oil strainer and "O" ring. Remove oil pump retaining bolts, oil pump, "O" ring and adjusting washers.

2) Remove four bolts securing oil pump cover to pump body and remove cover. Remove inner and outer rotors. Remove cotter pin and withdraw pressure regulator valve spring retainer, spring and plunger.

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ENGINE OILING (Cont.)



2) Check clearance between rotor lobes with a feeler gauge. If clearance exceeds .010" (.25 mm), replace both rotors. Check clearance between outer rotor and pump body with a feeler gauge. If clearance exceeds .012" (.30 mm), replace rotor and pump body.

3) Check rotor end play by placing a straight edge across pump body and measuring clearance between straight edge and rotors with a feeler gauge. Now place straight edge on pump cover and measure clearance with a feeler gauge. If total end play exceeds .006" (.15 mm), face cover by grinding to reduce end play.

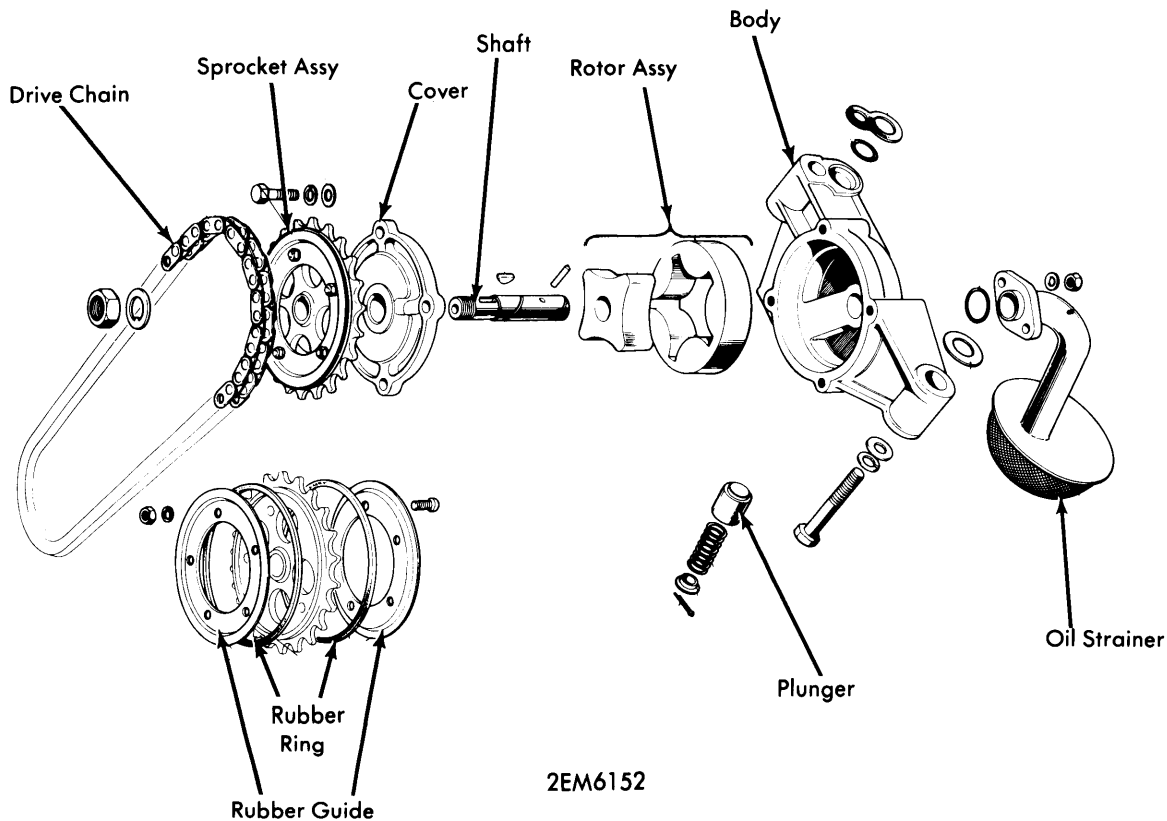
Assembly & Installation - 1) Lubricate all oil pump components with motor oil. Reverse disassembly procedure to assemble oil pump. To install oil pump reverse removal procedure. Install new "O" rings.

2) Check oil pump chain tension by pushing in on side of chain with thumb and measure amount of slack. If slack exceeds .160", oil pump must be removed and thicker spacer washers installed between oil pump and cylinder block.

Oil Pump Specifications

Application	Clearance
Rotor-to-Rotor .....	.002-.006" (.05-.15 mm)
Rotor-to-Body .....	.006-.010" (.15-.25 mm)
Rotor End Play .....	.002-.004" (.05-.10 mm)

Inspection - 1) Thoroughly clean all components in a suitable solvent. Blow dry all components with compressed air. Inspect all components for wear or damage. Replace any components as necessary.



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ENGINE COOLING

Cooling System Capacity — All 616 models, 7.4 qts. All B-1600 and 808 models, 6.8 qts.

Thermostat — Thermostat begins to open at 180°F and is fully open at 203°F.

WATER PUMP

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.

NOTE — It may be necessary to remove radiator.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Cylinder Head	
Cold	58 (8.0)
Hot	71 (9.8)
Main Bearings	63 (8.7)
Connecting Rod Caps	
616.....	32 (4.4)
B-1600 & 808	38 (5.3)
Oil Pump Sprocket.....	24 (3.3)
Camshaft Sprocket	55 (7.6)
Distributor Drive Gear	55 (7.6)
Crankshaft Pulley	87 (12.0)
Intake Manifold.....	17 (2.3)
Exhaust Manifold	15 (2.0)
Oil Filter	15 (2.0)

ENGINE NOTES

► **ALL PRODUCTION MODELS AS OF 5/1/73 — ROCKER ARM CHANGE** — If rocker arm noise becomes excessive, there is a possibility that hard chrome rocker arm-to-camshaft sliding surface has become prematurely worn or separated from rocker arm. A new modified rocker arm is available from factory. Rocker arms are two distinct types, one for exhaust valves and one for intake valve. Care should be taken not to mix these rocker arms upon installation. New rocker arms can be installed on old rocker arm shaft, providing shaft is not worn or damaged.

► **ALL PRODUCTION MODELS AS OF 1/8/73 — REAR MAIN BEARING OIL SEAL CHANGE** — All production models as of January 8, 1973 (and some earlier models) are equipped with a new improved rear main bearing oil seal. New seal is equipped with threaded groove behind seal contact surface. New seal is interchangeable with old seal.