F 6 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
1974	236.7	3878	1x2-Bbl.	138@4000	213@2200	7.8-1	3.54	90	4.00	101.6

ENGINE IDENTIFICATION

Engine number is stamped on left side of cylinder block below ignition coil. First digit indicates engine type.

Application	Engine Code
3878 cc	F

ENGINE REMOVAL

1) Disconnect battery and drain cooling system. Remove hood, radiator grille and hood lock support rod. Disconnect hood lock from radiator support and remove radiator support. Disconnect heater and radiator hoses and remove radiator.

2) Disconnect all necessary wiring and fuel lines. Remove fuel filter assembly and air cleaner. Disconnect rod end of high and low shift rod from shift link lever. Disconnect throttle rod, choke rod, and accelerator rod from carburetor.

3) Remove vacuum hose connection on intake manifold and remove check valve of transfer front drive controller. Disconnect exhaust pipe from manifold and parking brake cable from intermediate lever. Disconnect front propeller shaft from transfer output front shaft flange.

4) Remove engine and transmission undercovers. Disconnect high and low shift rod from transfer high and low shift inner lever. Remove high and low shift link lever and high and low shift rod. Remove clutch release cylinder assembly from engine mount rear bracket.

5) Loosen clamp screws and disconnect vacuum hoses from transfer diaphragm cylinder. Remove front drive indicator switch and disconnect speedometer drive cable from transmission. Disconnect rear propeller shaft from transmission.

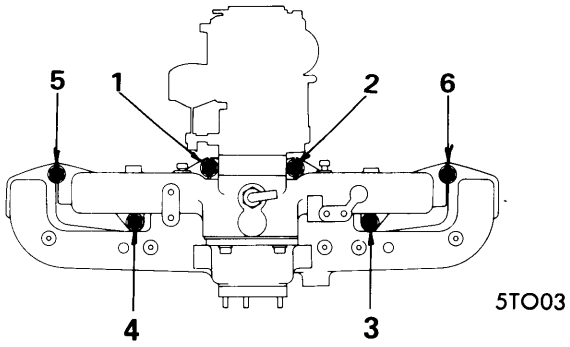
6) Disconnect gear shifting rod and gear selecting rod from gear shift outer lever and gear select outer lever. Remove nuts at front and rear engine mounts. Using suitable hoist, move engine up and forward to remove. To install, reverse removal procedure.

INTAKE & EXHAUST MANIFOLDS

Removal – 1) Disconnect battery and remove air cleaner. Disconnect throttle rod, choke rod, accelerator wire, vacuum line, and fuel line from carburetor.

2) Disconnect magnetic valve wire from ignition coil terminal and remove carburetor assembly. Disconnect exhaust pipe from exhaust manifold. Remove manifold nuts, manifolds and gaskets.

Installation – Clean all gasket surfaces and install new gasket. Install cylinder head and tighten bolts gradually in sequence shown. Reverse removal procedure for remaining components.



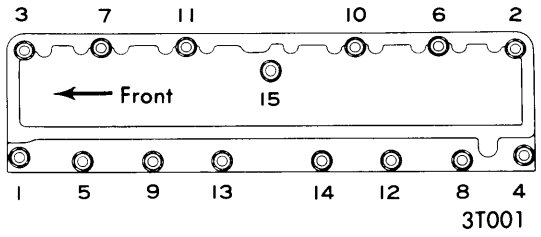
MANIFOLD TIGHTENING SEQUENCE

CYLINDER HEAD

Removal – 1) Disconnect battery, drain cooling system and remove air cleaner. Remove intake and exhaust manifolds. See *Intake & Exhaust Manifolds*. Remove bolts attaching oil filler tube to rocker arm cover and remove rocker arm cover.

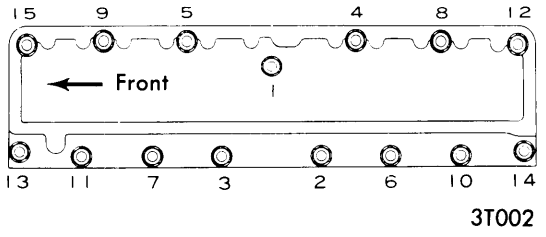
2) Disconnect all necessary wiring, radiator and heater hoses. Remove ignition coil from cylinder head. Remove rocker arm assembly support retaining nuts and bolts and remove rocker arm assembly.

3) Remove push rods and keep in order for proper installation. Loosen cylinder head bolts gradually in sequence shown and remove cylinder head.



CYLINDER HEAD LOOSENING SEQUENCE

Installation – Thoroughly clean all gasket surfaces and install new gaskets. Install manifold assembly and gradually tighten bolts working from center out. Install remaining components in reverse of removal procedure.



CYLINDER HEAD TIGHTENING SEQUENCE

F 6 CYLINDER (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)
F Engine							
Intake	1.81 (46.0)	45°	45°	.059 (1.4)	.3138-.3144 (7.970-7.985)	.0010-.0026 (.025-.060)	.....
Exhaust	1.48 (37.5)	45°	45°	.083 (2.1)	.3134-.3140 (7.960-7.975)	.0014-.0028 (.035-.070)	.....

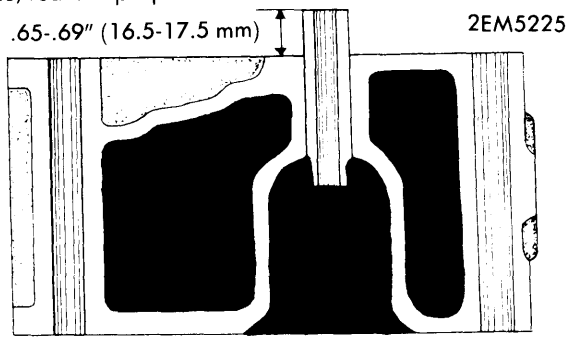
VALVE ARRANGEMENT

E-I-I-E-E-I-I-E-E-I-I-E (front to rear).

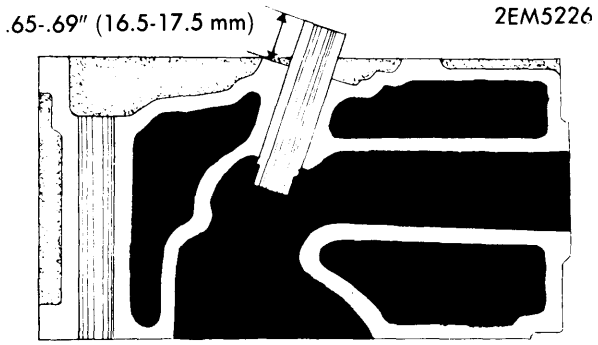
VALVE GUIDE SERVICING

1) Check clearance between valve stems and valve guides. If clearance exceeds .004" (.10 mm) for intake or .005" (.12 mm) for exhaust, replace valve and/or valve guide.

2) To replace valve guide, drive valve guide toward top of cylinder head using suitable tool (09201-60010). Using same tool, install new valve guide from top of cylinder head. Valve guide should extend .65-.69" (16.5-17.5 mm) above cylinder head surface. Intake valve guide length is 2.23" (54 mm) and exhaust valve guide is 2.32" (59 mm). After installing new guide, ream to proper clearance.



VALVE GUIDE INSTALLATION (INTAKE)

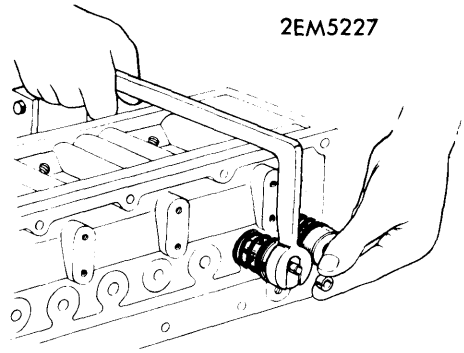


VALVE GUIDE INSTALLATION (EXHAUST)

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE (LBS.) Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
F Engine	2.028 (51.5)	71.7@1.693 (32.5@43.0)	.....

VALVE SPRINGS

Removal – Using suitable valve spring compressor, compress valve spring and remove valve spring retainer locks. Release compressor and remove spring retainer, spring, valve stem oil seal and spring seat. Remove valve.



REMOVING VALVE SPRINGS

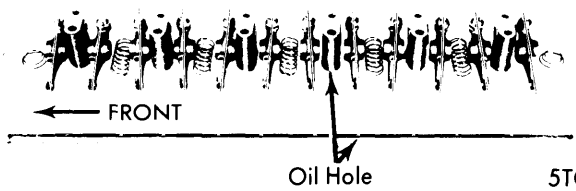
Installation – Insert valve into valve stem guide, and install valve spring seat, valve spring, valve stem oil seal and valve spring retainer onto valve stem. Compress valve spring using suitable valve spring compressor and install valve spring retainer locks. Make sure retainer locks seat properly in valve stem groove.

VALVE SPRING INSTALLED HEIGHT

After assembling valve, check installed height of valve spring by measuring from spring seat to point where spring contacts oil shield or spacer. Installed height of both intake and exhaust valve springs should be 1.693 (43.0 mm). Check squareness of springs by placing spring on flat surface next to steel square. Squareness should be within .079" (2.0 mm).

ROCKER ARM ASSEMBLY

1) Check rocker arm and shaft for damage or wear. Clearance between rocker arm bushing and shaft limit is .004". If clearance is excessive, replace bushing and ream to .0003-.0018" clearance. When replacing bushing make sure oil hole in bushing lines up with oil hole in rocker arm.



ROCKER ARM ASSEMBLY

F 6 CYLINDER (Cont.)

2) Install rocker arms, springs and rocker shaft supports onto valve rocker shaft, then install valve rocker shaft lock springs. *NOTE – There are two types of rocker arms and two types of rocker supports. Rocker support with oil hole is installed in the fourth position. Boss of rocker supports should face forward.*

VALVE CLEARANCE ADJUSTMENT

1) Set No. 1 piston at TDC of compression stroke and align timing mark with pointer. Adjust valves 1,2,3,5,7 and 9 (as numbered from front).

2) Rotate crankshaft one complete turn and again align timing mark with pointer. Adjust remaining valves 4,6,8,10,11 and 12.

Valve Clearance Specifications

Valve	Clearance (Hot) In. (mm)
Intake	.008 (.20)
Exhaust	.014 (.35)

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)
F Engine	.001-.002 (.03-.05)	Press Fit	.....	No. 1	.008-.016 (.20-.40)	.0012-.0028 (.03-.07)
				No. 2	.006-.014 (.15-.35)	.0008-.0024 (.02-.06)
				No. 3	.006-.014 (.15-.35)	.0008-.0024 (.02-.06)
				No. 4	.006-.014 (.15-.35)	.0008-.0026 (.020-.065)

OIL PAN

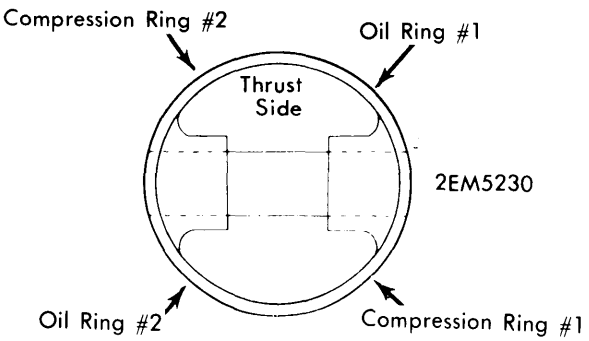
Removal – Remove engine undercovers, and remove flywheel side and undercover. Remove front propeller shaft. Drain oil, remove oil pan attaching bolts and oil pan.

Installation – Thoroughly clean all gasket mating surfaces. Apply liquid sealer onto both oil pan gasket surfaces, install oil pan and tighten bolts. Reverse removal procedure for remaining components.

PISTON & ROD ASSEMBLY

Removal – With cylinder head and oil pan removed, remove connecting rod caps and remove bearings. Push piston and rod assembly up through cylinder block. Mark all components with cylinder numbers for correct reassembly.

Installation – 1) Apply oil to piston and piston rings. Position piston ring gaps as shown in illustration. Using suitable ring compressor, install piston and rod assembly through top of cylinder. Make sure mark on piston faces front.



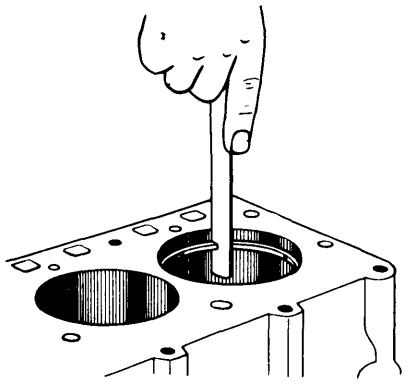
PISTON RING GAP SPACING

2) Replace connecting rod bearings and connecting rod caps. Tighten connecting rod bearing cap nuts and lock with cotter pins. Rotate crankshaft to make sure bearings are not too tight.

FITTING PISTONS

1) Measure cylinder bores and pistons to be fitted. Measure piston with micrometer at bottom of skirt at right angles to piston pin. If clearance is excessive, bore all cylinders for oversize pistons.

2) Measure piston ring end gaps in cylinder. If cylinder has not been bored, check gap with ring in lowest part of cylinder. If gap is less than specified, correct with file. Check clearance of piston ring in ring groove. Always install rings with marks facing upward.



MEASURING PISTON RING GAP

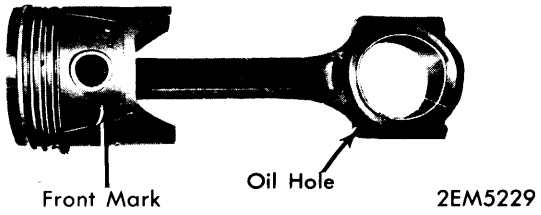
PISTON PINS

Removal – Remove piston pin bolt and push out piston pin from piston and connecting rod. Mark all parts for correct reassembly.

F 6 CYLINDER (Cont.)

Inspection – Check piston pin fit by pressing in pin with thumb with piston heated to 100-140°F. If fit is loose, replace both piston and piston pin.

Installation – Heat piston to 100-140°F for approximately five minutes. Position piston and connecting rod so that when piston faces front, oil hole in connecting rod faces camshaft side. Push pin into assembly and center pin in piston. Center connecting rod between piston pin bosses and tighten piston pin bolt.



PISTON & ROD 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)
F Engine							
No. 1	2.6366-2.6378 (66.97-67.00)	.0012-.0018 (.035-.045)	No. 3	.002-.006 (.06-.16)	2.1252-2.1260 (53.98-54.00)	.0008-.0024 (.020-.060)	.004-.009 (.11-.23)
No. 2	2.6957-2.6968 (68.47-68.50)	.0012-.0018 (.035-.045)					
No. 3	2.7547-2.7559 (69.97-70.00)	.0012-.0018 (.035-.045)					
No. 4	2.8138-2.8150 (71.47-71.50)	.0012-.0018 (.035-.045)					

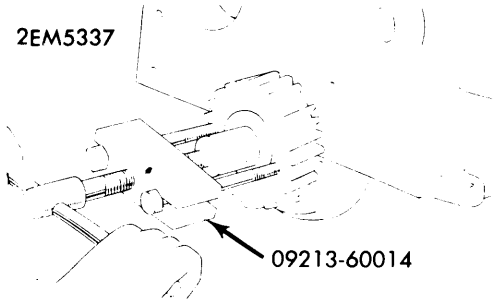
MAIN & CONNECTING ROD BEARINGS

1) Thoroughly clean crankshaft and blow out oil passages with compressed air. Check crankshaft for runout with a dial indicator on second or third main bearing journal. If runout exceeds .004" (.10 mm), straighten or replace crankshaft.

2) Check main and connecting rod bearing journals for taper or out-of-round. If taper or out-of-round exceeds .0012" (.03 mm), crankshaft must be ground to next undersize.

3) Main and connecting rod bearing clearance is checked by the Plastigage method. If clearance exceeds .004" (.10 mm) and cannot be corrected with .002" (.05 mm) undersize bearings, crankshaft must be reground to next undersize. Bearings are available .010", .020", .030" and .040" (.25, .50, .75, 1.00 mm) undersize.

NOTE – An oil hole is provided in upper half of main bearing. Make sure to install bearing with oil hole in cylinder block bore. Check for correct oil hole alignment.



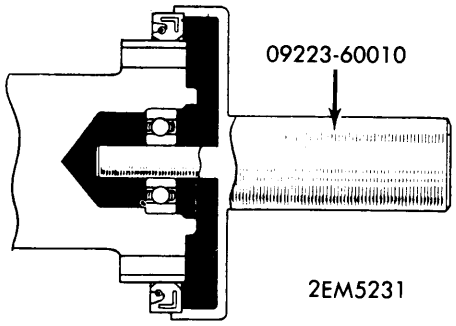
CRANKSHAFT TIMING GEAR REMOVAL

THRUST BEARING

Check crankshaft end play at No. 3 main bearing. If clearance exceeds .012" (.3 mm), replace crankshaft bearings.

CRANKSHAFT REAR OIL SEAL

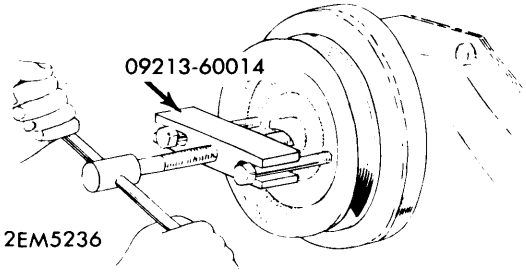
To install oil seal without disassembling crankshaft, pry out oil seal with a screwdriver. Use crankshaft rear oil seal replacer tool (Tool 09223-60010) to drive new oil seal into place.



REAR OIL SEAL INSTALLATION

ENGINE FRONT COVER REMOVAL

1) Drain cooling system and remove upper and lower radiator hoses. Remove bolts holding radiator to radiator support. Remove radiator upward using care not to damage radiator.



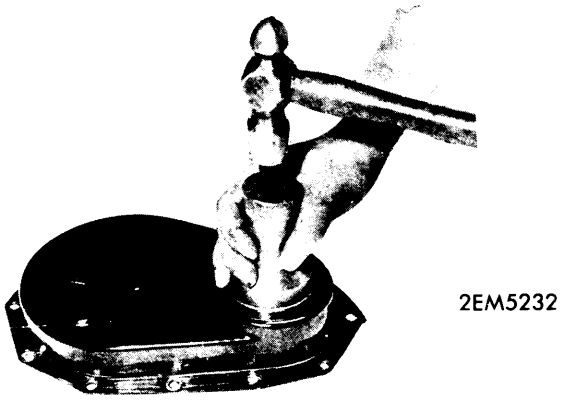
CRANKSHAFT PULLEY REMOVAL

F 6 CYLINDER (Cont.)

2) Remove fan belt. Remove crankshaft pulley using suitable puller (09213-60014). Remove bolts and remove timing gear cover and gasket. To install, reverse removal procedure.

FRONT COVER OIL SEAL REPLACEMENT

Pry old oil seal out using screwdriver. Install new oil seal so that open end of seal is towards inside of timing gear cover. Drive seal in place with suitable tool (Transmission Rear Bearing Replacer Tool 09309-12010, or Rear Wheel Bearing Replacer Tool 09515-35010).



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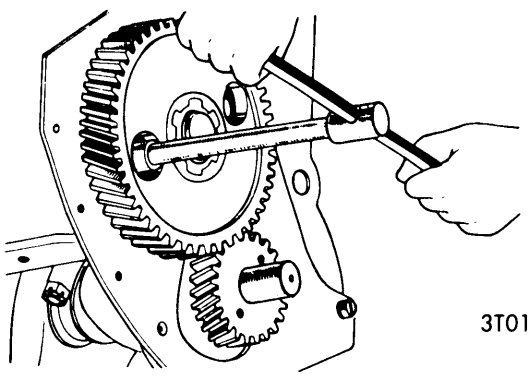
FRONT OIL SEAL INSTALLATION

CAMSHAFT			
Engine	**Journal Diam. In. (mm)**	**Clearance In. (mm)**	**Lobe Lift In. (mm)**
F Engine			
No. 1	1.8880-1.8888 (47.955-47.975)	.001-.003 (.025-.075)	.....
No. 2	1.8289-1.8297 (46.455-46.475)		
No. 3	1.7699-1.7707 (44.955-44.975)		
No. 4	1.7108-1.7116 (43.455-43.475)		

CAMSHAFT REMOVAL

Remove timing gear cover and gasket. Slide out oil slinger from crankshaft. Remove two bolts retaining camshaft thrust plate onto cylinder block by working through holes in camshaft timing gear. Remove camshaft by pulling out through front of block. Use care not to damage camshaft bearings or journals.



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CAMSHAFT REMOVAL

NOTE — Ensure timing gear oil nozzle is positioned to direct oil onto timing gears. Stake into place with a punch.

CAM HEIGHT

Measure height of cam. If height is less than following specified limits, camshaft must be replaced.

Cam Height Specifications

Application	Normal In. (mm)	Minimum In. (mm)
Intake	1.512 (38.41)	1.496 (38.0)
Exhaust	1.509 (38.33)	1.492 (37.9)

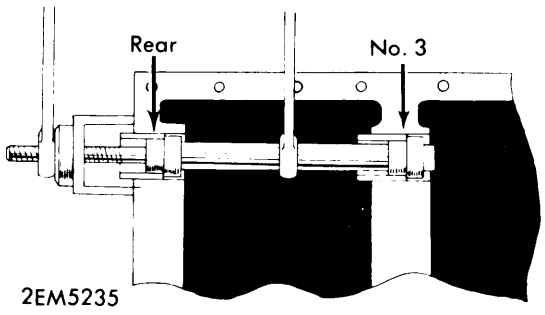
CAMSHAFT BEARING REPLACEMENT

1) Inspect camshaft journals and bearings for wear or damage. If runout exceeds .004" (.10 mm) or taper exceeds .002" (.05 mm), grind camshaft for next undersize bearings or replace camshaft. Check that clearance does not exceed .006" (.15 mm). Bearings are available in standard, .005", .010", .020", .030" and .040" (.125, .25, .50, .75, 1.00 mm) undersizes.

2) Drive out camshaft rear expansion plug from cylinder block. Remove front and No. 2 bearing using Camshaft Bearing Remover (Tool 09215-60010). Place front and second bearing adapters against rear of respective bearing, and place replacer against front part of cylinder block.

3) Insert replacer shaft into the three parts, and screw in retainer nut onto replacer shaft. Hold slotted part of shaft with wrench to prevent shaft from turning. By screwing in retainer nut with another wrench, the front and No. 1 bearing will be pulled out to the front.

4) Remove No. 3 and rear bearing towards rear of block using tool in same manner as for front and No. 3 bearing. When installing new bearings, make sure that oil holes of bearing match up with oil holes in cylinder block.



2EM5235

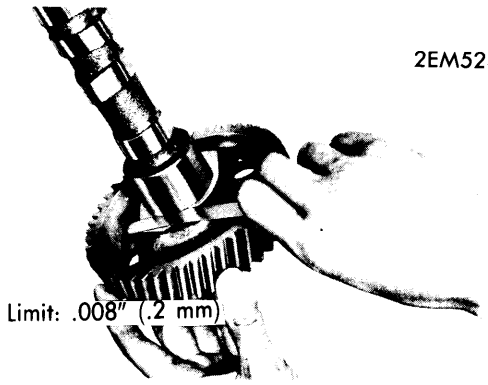
CAMSHAFT BEARING REMOVAL (NO. 3 & REAR)

5) When new bearings have been installed, measure to obtain proper clearance. Only a very light cut is required to ream bearings to proper size. Coat rear expansion plug with sealer and reinstall plug in block.

CAMSHAFT END THRUST

Measure end thrust with feeler gauge. Clearance should be .003-.006". If clearance exceeds .008", replace camshaft thrust plate.

F 6 CYLINDER (Cont.)



MEASURING CAMSHAFT END THRUST

CAMSHAFT TIMING GEAR REMOVAL

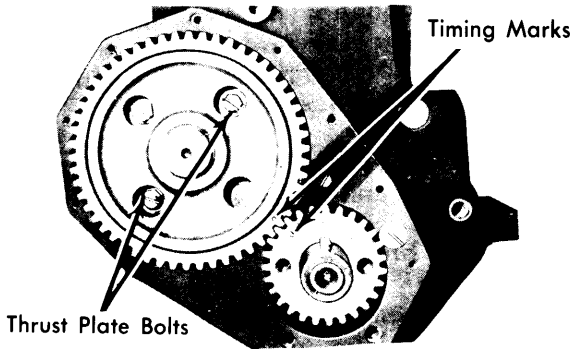
Remove camshaft and remove camshaft snap ring. Support thrust plate on the spacer, and press out shaft from gear. To assemble gear, place thrust plate on camshaft and make sure Woodruff key is seated in keyway. Support camshaft at back of front journal and press on gear. Install snap ring.

VALVE TIMING				
	INTAKE		EXHAUST	
Engine	Open (BTDC)	Close (ABDC)	Open (BBDC)	Close (ATDC)
F Engine	17°	53°	55°	15°

VALVE TIMING

1) With crankshaft timing gear installed on crankshaft, oil camshaft journals and bearings and insert camshaft. Align mating mark on camshaft timing gear with mark on crankshaft timing gear and push camshaft into position.

2) Tighten camshaft thrust plate retaining bolts to 14.5 ft. lbs. Check to make sure that gear backlash is .002-.005". Replace camshaft gear or crankshaft gear if backlash exceeds .008".



TIMING MARK ALIGNMENT

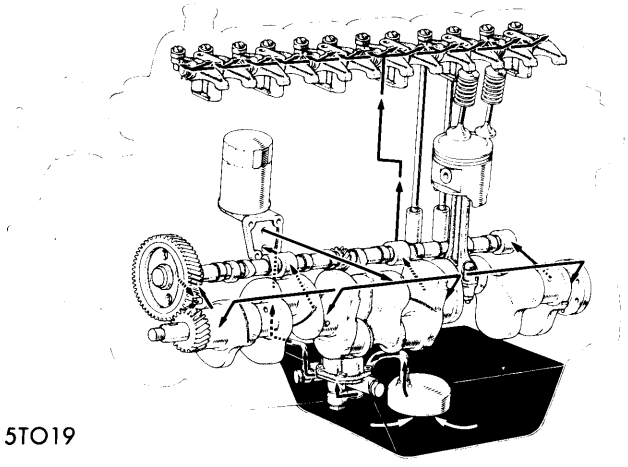
ENGINE OILING

Crankcase Capacity – 7.4 qts. Add 1.0 qts. with filter.

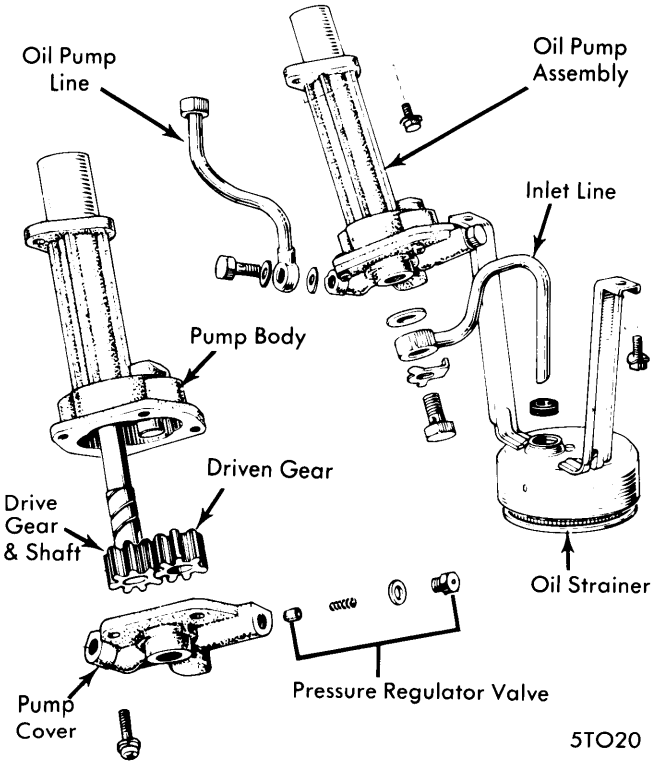
Oil Filter – Full flow cartridge type with integral relief valve.

Normal Oil Pressure – Pressure maintained at 44-50 psi by safety valve in oil pressure regulator.

Pressure Regulator – Located in oil pump, non-adjustable.



ENGINE OILING SYSTEM



OIL PUMP ASSEMBLY

F 6 CYLINDER (Cont.)

ENGINE OILING (Cont.)

ENGINE OILING SYSTEM

Forced feed system insures positive lubrication through oil holes and galleries in engine block.

OIL PUMP REPLACEMENT

1) Remove engine front undercover, engine floor pan. Remove flywheel side cover and flywheel housing undercover. Remove front propeller shaft. Drain engine oil.

2) Remove oil pan. Remove oil strainer and loosen union nuts on oil pump pipe. Remove lock wire and oil pump retaining bolt and remove oil pump and pipe.

3) Straighten union bolt lock washer and remove union bolt, lock washer, gasket, and oil pump inlet pipe from oil pump cover. Remove cover and slide out oil pump driven gear and oil pump drive gear together with oil pump shaft.

4) Inspect gears and housing and check clearance between gear tip and pump body. The clearance should be .001-.004". Replace gear if clearance exceeds .0079". Make sure that backlash does not exceed .037".

5) Measure end clearance between gears and pump cover. The clearance should be .0012-.003". Replace gears or pump assembly if clearance exceeds .006".

ENGINE COOLING

Thermostat – Wax pellet type, begins to open at 166-173°F and is fully opened at 182-191°F.

Coolant Capacity – Approximately 17.7 qts.

WATER PUMP REMOVAL

1) Drain cooling system and remove alternator adjusting bar. Remove fan, fan pulley and fan belt. Loosen hose clamps, disconnect radiator lower hose and by-pass hose from water pump.

2) Remove water pump retaining bolts, and remove water pump and gasket. To install, reverse removal procedure using new water pump gasket. Adjust fan belt tension to .28-.40" deflection.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Cylinder Head	83-98 (11.5-13.5)
Piston Pin Bolt	39-51 (5.4-7.0)
Connecting Rod Bearing Caps	35-55 (4.8-7.6)
Crankshaft Main Bearing Caps	
Front, No. 2 & No. 3	90-108 (12.5-15)
Rear	76-94 (10.5-13)
Camshaft Thrust Plate Bolts	15 (2.0)
Timing Gear Cover	12 (1.6)
Oil Pump Bolt	7-12 (1.0-1.6)
Oil Pan Bolts	4-9 (0.6-1.2)
Valve Rocker Shaft Bolts & Nuts	
10 mm Bolts & Nuts	25-30 (3.4-4.1)
8 mm Bolts	14-22 (2.0-3.0)
Manifold Nuts	14-22 (2.0-3.0)
Flywheel Bolts	47-53 (6.5-7.3)
Clutch Cover Bolts	22 (3.0)
Clutch Housing Bolts	58 (8.0)