

4.9L 6-CYLINDER ENGINE

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engine is identified by a letter code, eighth digit of Vehicle Identification Number, located inside windshield on left upper side of instrument panel. The VIN number is also located on the Safety Compliance Certification Label located on left door lock pillar.

Engine Identification Codes	
Application	VIN Code
4.9L (300")	E

ENGINE REMOVAL

See *Engine Removal* at end of *ENGINE* Section.

CYLINDER HEAD & MANIFOLD

INTAKE MANIFOLD

Removal – 1) Remove air cleaner, disconnect choke cable and accelerator cable or rod at carburetor. Remove accelerator retracting spring.

2) Remove kick-down rod retracting spring (vehicles with automatic transmission), remove accelerator rod bellcrank assembly.

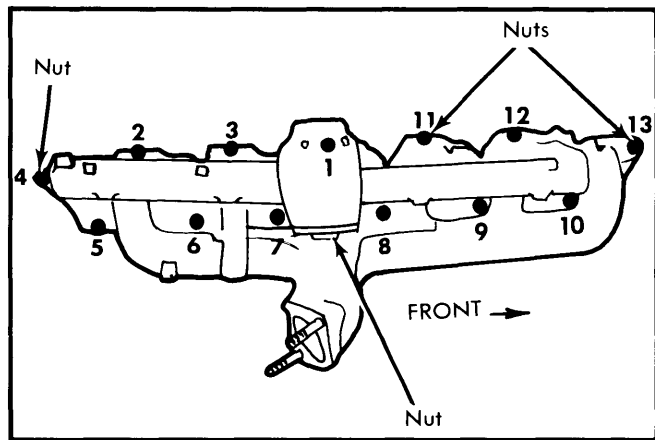


Fig. 1 Intake & Exhaust Manifold Tightening Sequence

3) Disconnect and label all vacuum lines at carburetor. Disconnect fuel inlet line at carburetor. Disconnect muffler inlet pipe from exhaust manifold. Disconnect crankcase vent hose clamp at manifold inlet tube and remove hose. Disconnect power brake vacuum line, if equipped.

4) Remove bolts and nuts retaining both manifolds to cylinder head. Lift manifold assemblies from engine. Remove and discard gaskets. Separate manifolds by removing nuts joining both pieces. Discard gaskets between manifolds.

Installation – 1) Clean joining surfaces of cylinder head and manifolds. If one of the manifolds is to be replaced remove tube fittings from discarded part and install on new part as required, also install new studs in replacement part.

2) If intake manifold and exhaust manifold have been separated, coat mating surfaces lightly with graphite grease, and position exhaust manifold over studs on intake manifold. Install lock washers and nuts, then tighten finger tight. Install new intake manifold gasket.

3) Coat mating surfaces lightly with graphite grease, place manifold assemblies in position against cylinder head. Make sure gaskets have not become dislodged. Install attaching washers, bolts and nuts. Torque bolts and nuts to specification in sequence shown in *Fig. 1*. If intake and exhaust manifolds were separated, tighten nuts joining both parts.

4) Position new gasket on muffler inlet pipe and connect inlet pipe to exhaust manifold. Torque nuts to specifications. Connect crankcase vent hose to intake manifold inlet tube, and position hose clamp.

5) Connect accelerator cable to carburetor and install retracting spring. Connect choke cable to carburetor. Install bellcrank assembly and kickdown rod retracting spring on models with automatic transmission. Adjust transmission control linkage as necessary. Install air cleaner, adjust engine idle speed and idle fuel mixture.

CYLINDER HEAD

Removal – If cylinder head is to be replaced, disassemble and transfer all valves, springs, rocker arms, etc. to new cylinder head. Clean and inspect all components, reface valves and check valve guide clearances before assembling used parts to new cylinder head. To remove cylinder head from engine block, proceed as follows:

1) Drain cooling system and remove air cleaner. Remove PCV valve from rocker cover, and disconnect vent tube at intake manifold inlet tube. Disconnect and remove carburetor fuel inlet line. Disconnect and label all vacuum lines at carburetor. Disconnect choke cable at carburetor and position choke cable and housing to one side.

2) Remove accelerator cable retracting spring, and disconnect accelerator cable from carburetor. On vehicles with automatic transmission, disconnect kickdown rod at carburetor. Disconnect upper radiator hose and heater hose at coolant outlet elbow. Remove coil bracket retaining bolt and position coil to one side.

3) Disconnect muffler inlet pipe from exhaust manifold, and discard inlet pipe gasket. Remove rocker arm cover, loosen rocker arm stud nuts, and rotate rocker arms to one side. Remove and identify push rods in sequence, permitting reinstallation in original locations. Disconnect spark plug wires at spark plugs.

4) Remove cylinder head bolts and attach lifting eyes to cylinder head. Position a floor crane or other suitable lifting device and attach lifting sling to eyes. Raise cylinder head and manifold assembly from engine.

CAUTION – Do not pry between cylinder head and block when freeing head assembly as gasket surface may be damaged.

Installation – 1) Clean cylinder head and cylinder block gasket surfaces. Clean gasket surfaces on exhaust manifold and muffler inlet pipe.

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- 2) If cylinder head was removed for head gasket replacement, check flatness of block and head gasket surfaces, then position new gasket over dowel pins on cylinder block.
- 3) Install lifting eyes on cylinder head in previous locations used to detach head assembly. Use suitable hoist to lift cylinder head over block, lowering carefully until head assembly is properly positioned on block and dowel pins. Remove hoist and lifting eyes.
- 4) Coat threads of head bolts with engine oil and install bolts. Tighten cylinder head bolts, in steps, in sequence shown in Fig. 2. Reverse removal procedure to install remaining components.

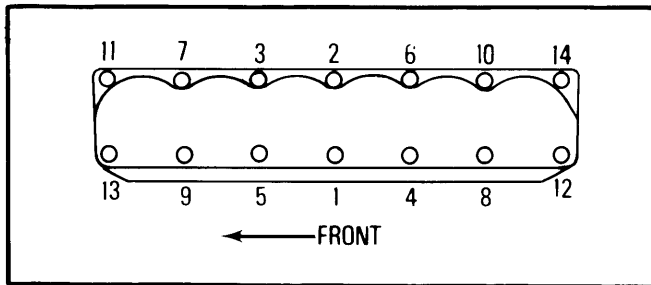


Fig. 2 Cylinder Head Tightening Sequence

VALVES

VALVE ARRANGEMENT

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

VALVE GUIDE SERVICING

To ream valve guides (for installation of valves with oversize stems), always use reamers in proper sequence and reface valve seat after valve guide has been reamed. Reamers are available .003" oversize with standard diameter pilots; .015" oversize with .003" oversize pilot; .030" oversize with .015" oversize pilot.

NOTE - Always break sharp corner (ID) at top of valve guide after reaming.

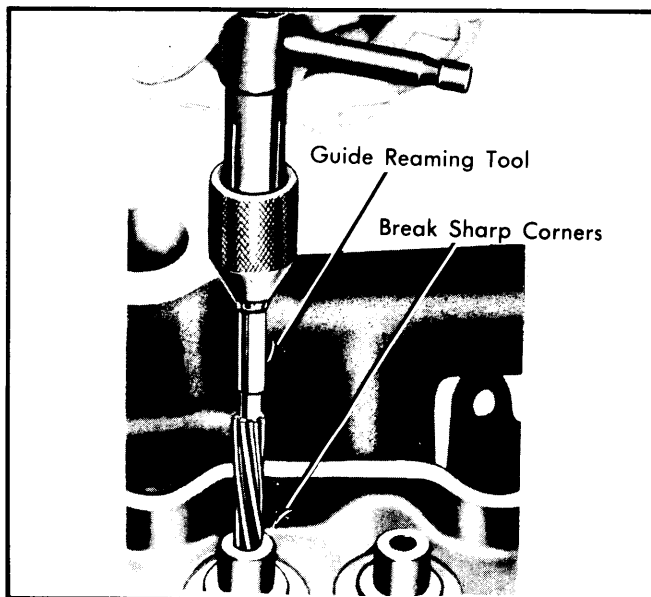


Fig. 3 Reaming Valve Guides

VALVE STEM OIL SEALS

Cup type teflon oil seals are used on valves. Install cupped side down, below upper spring retainer.

VALVE SPRINGS

Removal - 1) Remove air cleaner, accelerator cable retracting spring, and disconnect accelerator and choke cables at carburetor. Remove PCV valve from rocker arm cover, and remove rocker arm cover.

2) Remove spark plug from cylinder to be serviced. Crank engine to position cylinder on TDC after compression stroke. Install an air line and adapter to spark plug hole and apply air pressure.

3) Remove rocker arm stud nut, fulcrum seat, rocker arm, and push rod. Install a spring compressor to compress spring; then remove valve locks. Remove tool, spring retainer, valve spring and valve stem seal.

CAUTION - Do not remove air pressure until all components are reinstalled.

Installation - 1) Install new valve stem seal, position spring over valve and install spring retainer. Apply lubriplate to fulcrum seat and socket. Install retainer locks.

NOTE - Closed end of spring faces cylinder head.

2) Install push rod, rocker arm, fulcrum seat and stud nut. Adjust valve clearance. Remove air line and adapter, then install spark plug. Install rocker arm cover with new gasket and PCV valve. Connect accelerator cable, choke cable and accelerator cable retracting spring. Install air cleaner.

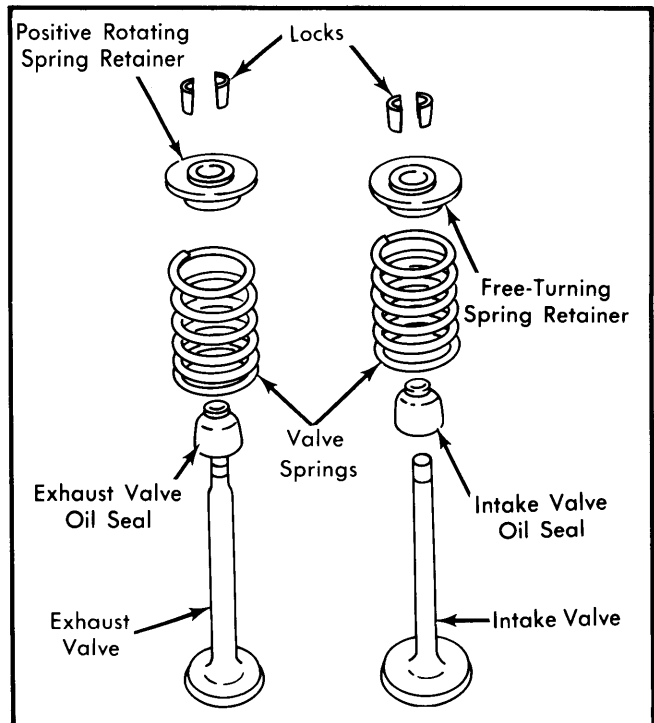


Fig. 4 Exploded View of Valve Assemblies

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VALVE SPRING INSTALLED HEIGHT

1) Check valve springs for squareness using steel square and surface plate. Stand spring against edge of square and rotate spring slowly observing space between top coil of spring and square. If spring is out of square more than $\frac{3}{4}$ " , spring must be replaced.

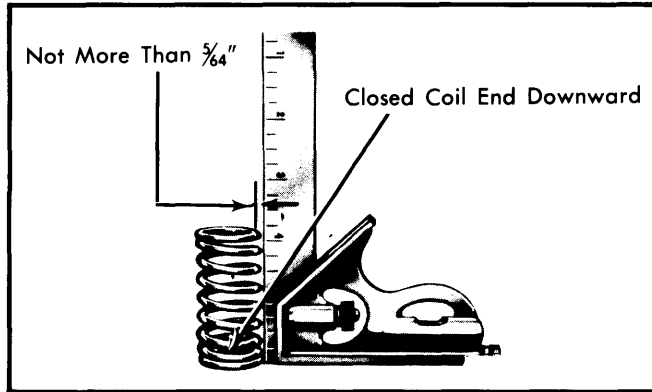


Fig. 5 Checking Valve Spring Squareness

2) Measure assembled height of valve spring from surface of cylinder head spring pad to underside of spring retainer using dividers. Check divider against scale, if assembled height of spring is greater than specified height, install necessary .030" spacers between cylinder head spring pad and valve spring to bring assembled height to recommended dimensions.

CAUTION — Do not install spacers unless necessary to meet specifications. Excess use of spacers will result in overstressing of valve spring assembly, and will overload camshaft lobes, causing possible spring breakage and/or camshaft wear.

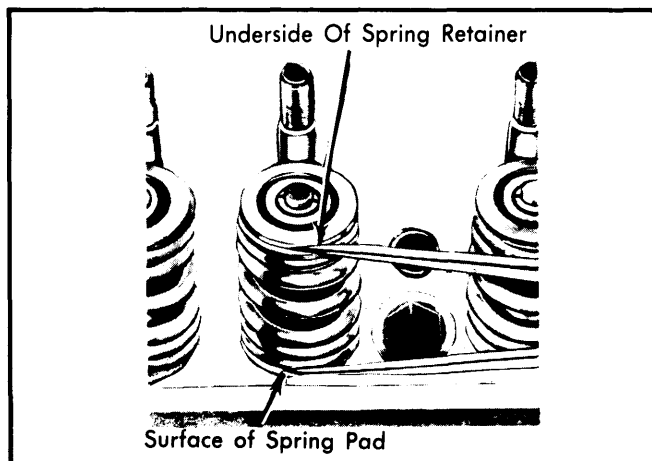


Fig. 6 Checking Valve Spring Height

Valve Spring Installed Height Specifications

Application	Intake Valve	Exhaust Valve
4.9L	$1\frac{1}{16}$ - $1\frac{23}{32}$ "	$1\frac{9}{16}$ - $1\frac{19}{32}$ "

ROCKER ARM STUDS

Removal — 1) Use suitable stud pulling tool kit (T79T-6527-A) to facilitate removal of faulty studs. Follow instructions of manufacturer for proper use.

2) If rocker arm stud was broken off flush with stud boss, use suitable screw extractor to remove broken stud.

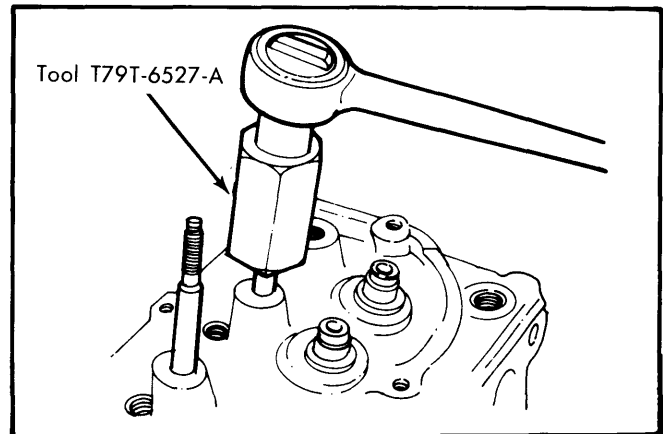


Fig. 7 Removing Rocker Arm Stud

Installation — 1) Replacement studs may be pressed into head using suitable stud replacement tool (T79T-6527-B). Align stud and replacement tool with stud bore and tap sliding driver on tool until tool contacts stud boss, indicating stud is installed to proper height.

2) If rocker arm stud being replaced was loose, check rocker stud bore diameter. If not within specification (.3685-.3695 Std.), ream stud bore using proper reamer (or reamers in sequence) for selected oversize stud. Studs are available in oversizes of .006", .010" and .015". Install rocker arm stud using same replacement tool as for standard size stud.

CAUTION — Make sure metal particles from reaming process of stud bore do not enter valve area.

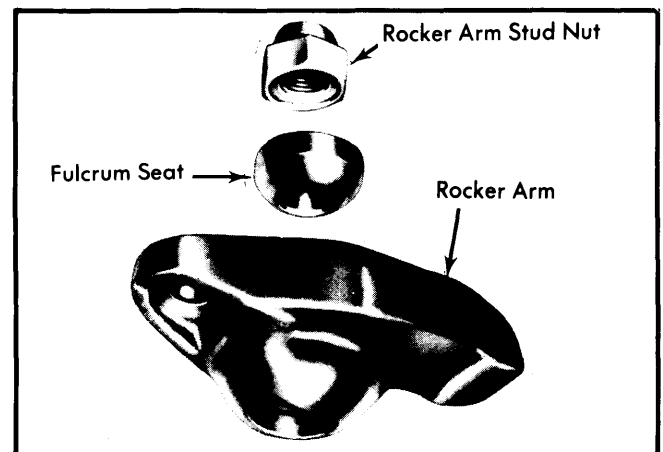


Fig. 8 Rocker Arm Assembly

Ford 6 Engines

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HYDRAULIC VALVE LIFTER ASSEMBLY

Lifters should be serviced as an assembly only. Parts are not interchangeable. Leak down rate on all lifters is 10-15 seconds at 1/16" plunger travel using suitable lifter leak down testing device. Replace lifter assembly if any sign of malfunction is noticed.

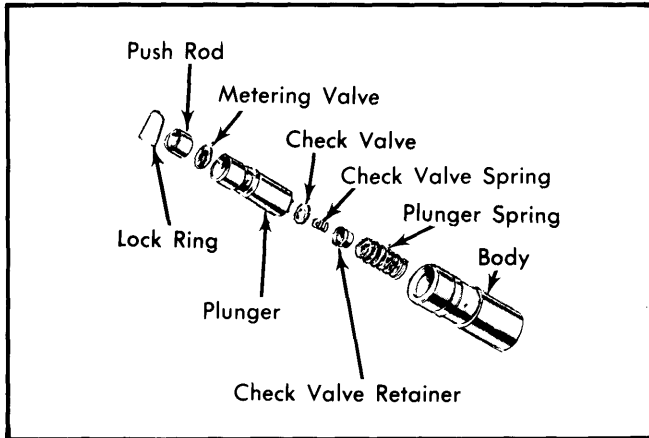


Fig. 9 Exploded View of Hydraulic Lifter

HYDRAULIC VALVE LIFTER ADJUSTMENT

- 1) Make two chalk marks on crankshaft pulley spaced approximately 120° apart, which together with timing marks, will divide damper pulley into three equal parts. Rotate crankshaft until number one piston is on TDC at end of compression stroke.
- 2) Adjust intake and exhaust valve clearance for number one cylinder by loosening rocker arm stud nut until there is end clearance in push rod, then tighten nut to just remove all push rod to rocker arm clearance (determined by rotating or moving push rod with fingers as nut is tightened).
- 3) When push rod to rocker arm clearance has been eliminated, tighten stud nut an additional one turn to place hydraulic lifter piston in desired range.

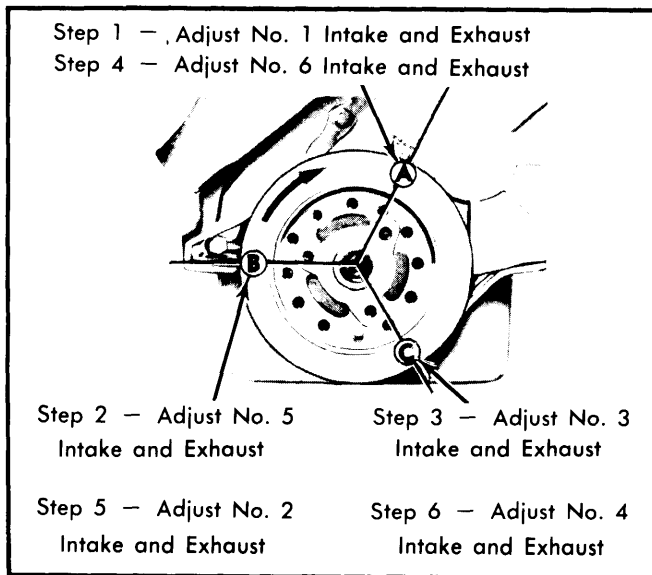


Fig. 10 Crankshaft Pulley Marking for Valve Clearance Adjustment

4) Repeat procedure for remaining set of valves, turning engine with auxiliary starter switch 1/3 turn at a time, in direction of rotation, while adjusting valves in firing order sequence of 1-5-3-6-2-4.

5) Start engine and check for rough engine idle or noisy lifters. Valve clearance set too tight will cause rough idle and valve clearance set too loose will cause noisy lifters. Readjust if necessary.

Collapsed Lifter Clearance

Application	Allowable	Desired
4.9L100-.200"	.125-.175"
Red		3.9982-3.9988"
Blue		3.9994-4.0000"
.003" Oversize		4.0008-4.0014"

PISTONS, PINS & RINGS

OIL PAN

See Oil Pan Removal at end of ENGINE Section.

PISTON & ROD ASSEMBLY

NOTE — Following procedures are performed with oil pan and oil pump removed.

Removal — 1) Turn crankshaft until piston to be removed is at bottom of stroke. Place cloth or shop towel lightly soaked with oil on head of piston to collect metal cutting from cylinder ridge.

2) Remove any ridge and deposits from upper end of cylinder bore using suitable ridge cutter. Follow instructions furnished by tool manufacturer.

CAUTION — Never cut into ring travel area in excess of 1/32" when removing ridges.

3) Make sure all connecting rod caps are marked to the appropriate pistons to ensure installation in original locations. Remove connecting rod cap.

4) Push connecting rod and piston out of top of cylinder using handle end of a hammer. Avoid damage to crankshaft journal or cylinder wall when removing piston and rod.

Installation — 1) Oil piston rings, piston, and cylinder wall with light engine oil. Install piston into original cylinder making sure ring gaps are spaced properly on piston as shown in Fig. 12. Install a ring compressor on piston.

2) Insert rod and piston assembly into cylinder bore and guide rod over crankshaft journal. Tap piston into cylinder bore us-

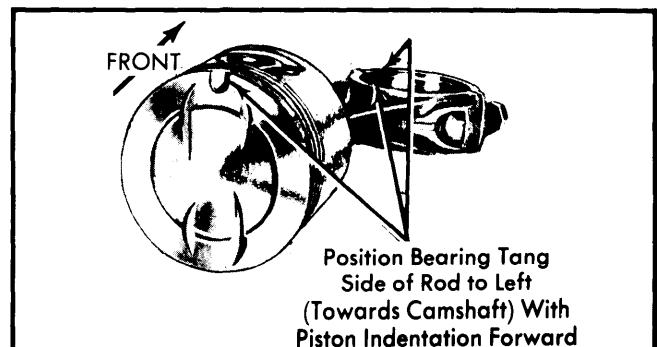


Fig. 11 Piston and Connecting Rod Assembly

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ing wooden handle tool until rod seats on crankshaft journal, install and tighten rod cap. Repeat procedure for each piston removed.

NOTE — Indentation on piston top must be installed towards front of engine.

FITTING PISTONS

Measure piston at centerline of piston pin bore 90° to pin bore axis. Measure cylinder bore at right angle to centerline of crankshaft, below ring travel. Piston-to-bore clearance should be as shown in Pistons, Pins & Rings table. Check Piston Size Code Chart to determine correct size. Make sure both piston and cylinder block are at normal room temperature (70°F) when fitting.

Piston Size Code Chart	
Code	Size
Red	3.9982-3.9988"
Blue	3.9994-4.0000"
.003" Oversize	4.0008-4.0014"

PISTON PINS

Removal — Using arbor press and pin removal tool T68P-6135-A, press piston pin from piston and connecting rod.

Installation — Start piston pin in piston and connecting rod. Using arbor press and suitable tool (T65L-6135-C), press piston pin through piston and connecting rod until pin is centered in connecting rod.

FITTING RINGS

1) Position ring in the cylinder bore that it will be used in. Push ring down to point in bore where ring wear is not encountered. Use head of piston to position ring squarely in bore.

2) Measure gap between ends of ring using feeler gauge, if not to specification, substitute another ring set until rings are within specification.

NOTE — Use care to avoid damage to ring or cylinder bore.

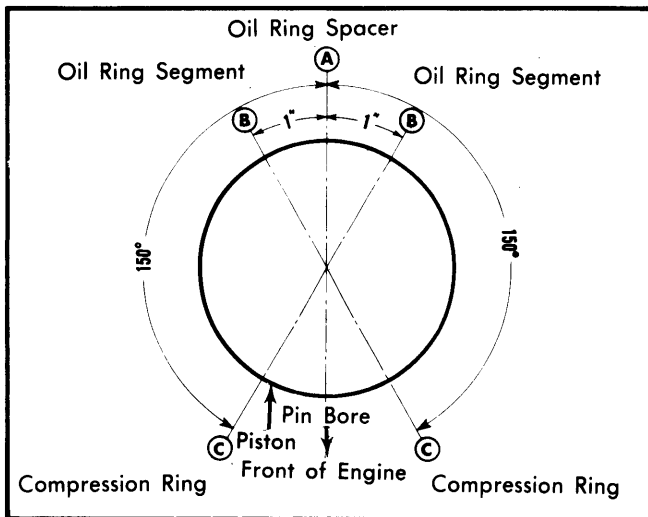


Fig. 12 Correct Spacing for Piston Rings

CRANKSHAFT & ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

NOTE — Following procedures are performed with oil pan and oil pump removed.

Connecting Rod Bearings — After ensuring rod caps are marked for cylinder identification, remove rod caps (with crankshaft journal of cylinder to be checked at bottom of throw). Use Plastigage method to check for proper clearances. New bearings are available in standard, .001" and .002" undersize. Selective fitting is required on each rod. A standard bearing half may be used in combination with a .001" undersize or a .002" undersize with a .001" undersize. Coat bearing surfaces with oil, install rod cap and tighten. Rotate crankshaft after bearing replacement to ensure that bearings are not too tight.

Main Bearings — 1) Mark main bearing caps for identification before removal. Remove bearing caps and upper half of main bearing. Rotate crankshaft slowly in direction of engine rotation to force upper half of bearing out.

NOTE — Replace one bearing at a time, leaving other bearings secured until ready to be changed.

2) Determine crankshaft bearing journal clearance using Plastigage method. When checking main bearings, place jack under counterweight adjoining bearing being checked. Place Plastigage on bearing surface over full width of cap and about ¼" off center. Install cap and tighten to specified tightness. Remove cap and check with gauge provided. New bearings are available in standard, .001" and .002" undersize.

3) To install upper main bearing, lubricate bearing with engine oil and place plain end of bearing over shaft on locking tang side of block. Insert bearing and rotate crankshaft in opposite direction of engine rotation until bearing tang is seated. Install bearing cap and tighten.

THRUST BEARING ALIGNMENT

Install thrust bearing cap after all other main caps have been tightened. Install thrust bearing cap with bolts finger tight. Pry crankshaft forward against thrust surface of upper half of bearing. Hold crankshaft forward and pry thrust bearing cap to rear. This will align thrust surfaces of both halves of bearing. Retain forward pressure on crankshaft and torque cap bolts to specifications.

REAR MAIN BEARING OIL SEAL

NOTE — The seal may be replaced without removing crankshaft on this engine. If oil seal is being replaced at same time as rear main bearing replacement, engine must be removed from vehicle.

Removal — Loosen all main bearing cap bolts and lower crankshaft slightly but do not exceed 1/32". Remove rear main bearing cap and seal by punching two holes in rear oil seal with an awl and install sheet metal screws in each hole. Use two large screwdrivers and pry against both screws at the same time. Use caution to avoid damaging the crankshaft or oil seal surface.

Installation — Install seal using installing tool T65L-701-A (or equivalent) making sure undercut (lip) side of seal is toward front of engine. Press seal into place until it contacts cylinder block surface. Inspect seal for possible damage.

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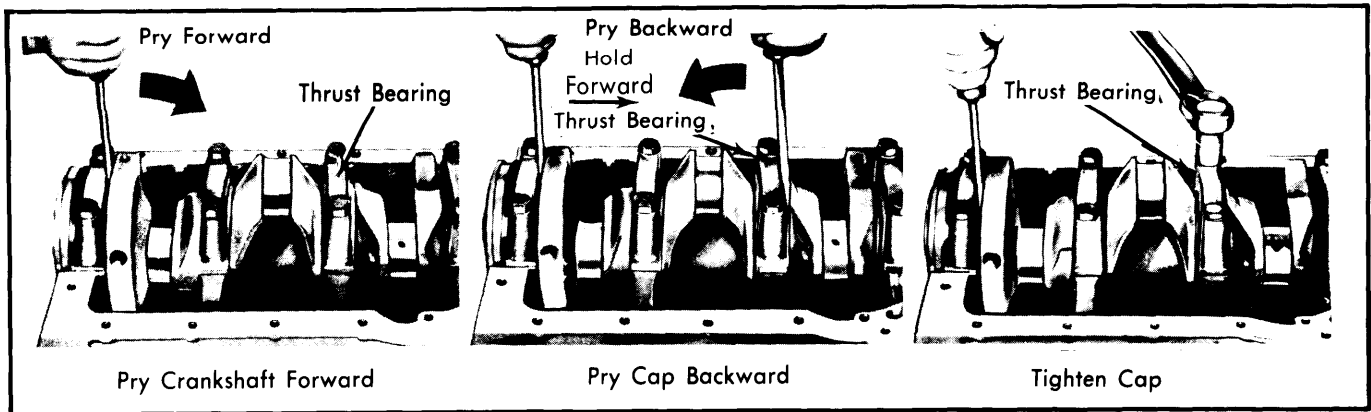


Fig. 13 Aligning Thrust Bearing

CAMSHAFT

ENGINE FRONT COVER

Removal — Drain cooling system and crankcase, then remove radiator. Remove alternator adjusting arm bolt, drive belt, and then swing adjusting arm to one side. Remove crankshaft damper. Remove oil pan, oil pump screen and inlet tube assembly. Remove front cover and gasket.

Installation — Replace front cover oil seal. Install an alignment tool into bore of front cover, then install cover, gasket, and alignment tool to engine. Install and tighten front cover attaching bolts. Install remaining components in reverse of removal procedure.

FRONT COVER OIL SEAL

Removal & Installation — With front cover removed from engine, drive oil seal out of cover using suitable pin punch. Clean out recess in cover. Coat new seal with grease and drive in seal until seal is fully seated in front cover recess. Check seal after installation to see that spring is properly positioned in seal.

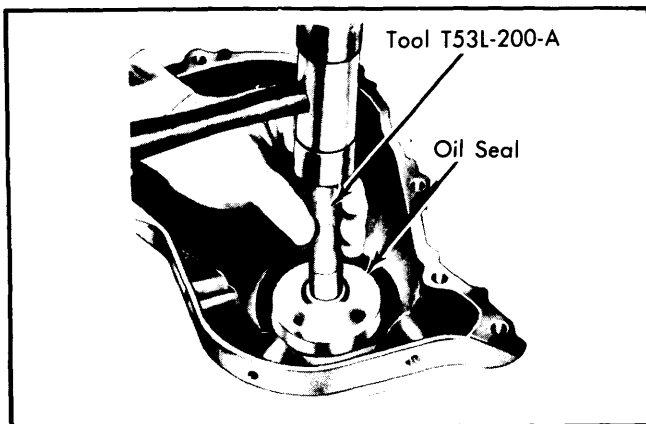


Fig. 14 Installing Front Cover Oil Seal

TIMING GEARS

Removal & Installation — 1) Drain cooling system and crankcase. Remove front engine cover as previously outlined. Check camshaft end play with dial indicator. End play should not exceed .009". Clearance should be between .001-.007".

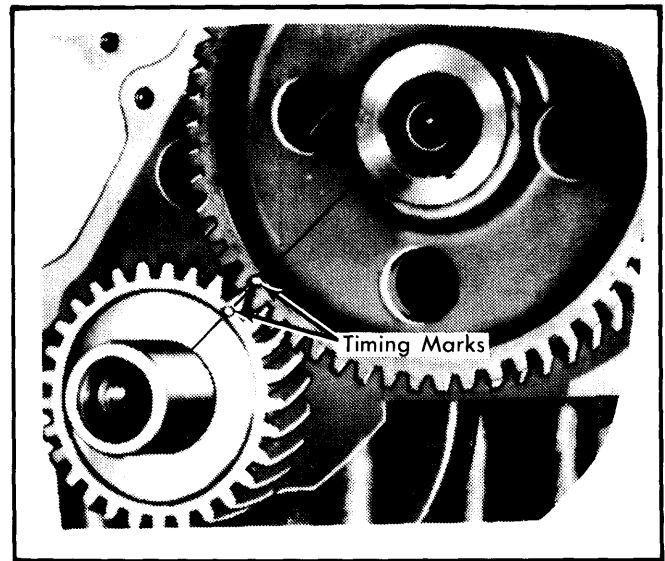


Fig. 15 Aligning Timing Marks

Crank engine over until timing marks are aligned as shown in Fig. 15. Use a gear puller to remove camshaft and crankshaft gears.

2) Ensure that key and spacer are properly installed. Align gear keyway with key and install camshaft gear and crankshaft gear. Check that timing marks line up on camshaft and crankshaft gears. Install front cover and related components.

CAMSHAFT

Removal — Drain cooling system and crankcase. Remove radiator, valve lifters, front cover, oil pump and oil pan. Disconnect fuel lines at fuel pump, remove fuel pump attaching bolts, and position fuel pump to one side. Disconnect wires and vacuum line to distributor, then remove distributor. Turn crankshaft to align timing marks. Remove camshaft thrust plate screws, then carefully remove camshaft taking care not to damage camshaft lobes.

Installation — Coat camshaft lobes with Lubriplate and coat journals with engine oil. Assemble key, spacer and thrust plate to camshaft. Align gear keyway with key and install gear as an assembly. Be sure timing marks are aligned and tighten thrust plate attaching screws. Replace oil seal in front cover. Reverse removal procedures for remaining components.

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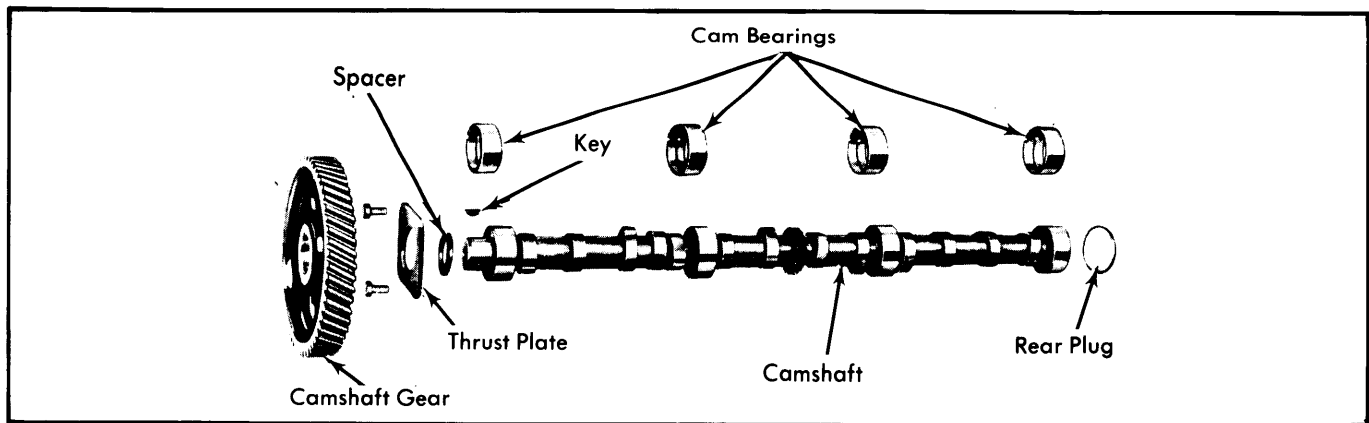


Fig. 16 Exploded View of Camshaft Assembly

CAMSHAFT BEARINGS

Removal & Installation — Remove engine from vehicle and remove flywheel. Remove camshaft and rear bearing bore plug. Remove crankshaft and push pistons to top of cylinders. Using a driver-puller tool (T65L-6250-A), remove camshaft bearings. Position new bearings at bearing bores and press into place while noting the following: Oil holes in bearings must be aligned with oil holes in cylinder block. Front bearing must be installed below front face of cylinder block at a distance of .020-.035".

CAMSHAFT END THRUST

With engine front cover removed, push camshaft toward rear of engine and install dial indicator so indicator point is on camshaft sprocket cap screw. Zero the dial indicator. Position large screwdriver between camshaft sprocket and block. Pull camshaft forward and then release. If dial indicator reading is not within specifications, replace thrust plate.

CAM LOBE LIFT

Remove rocker arm cover, stud nut, fulcrum seat and rocker arm. Check lift of each lobe in consecutive order. Using a dial indicator, position point on end of push rod and in same plane as push rod movement. Rotate crankshaft until lifter and push rod are at lowest position and zero dial indicator. Rotate crankshaft slowly until push rod is in fully raised position. Check that total lift recorded with indicator is within specifications. Maximum allowable lift loss is .005". If lift on any lobe is below specifications, camshaft and valve lifter operating on worn lobes must be replaced.

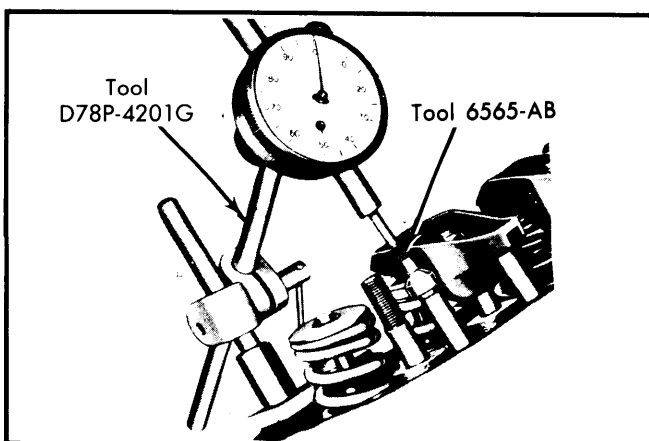


Fig. 17 Checking Camshaft Lobe Lift

ENGINE OILING

Crankcase Capacity — Capacity is 5 quarts. Add one quart with filter change.

Oil Filter — Replace filter at first oil change, then every second oil change thereafter.

Normal Oil Pressure — Oil pressure at 2000 RPM should be 40-60 psi.

Pressure Regulator Valve — Located in pump body. Nonadjustable.

ENGINE OILING SYSTEM

Oil supply is picked up from pan by oil pump which routes oil through filter element to passages in block supplying crankshaft bearings, camshaft bearings, and lifters. Oil is moved up to top of engine by means of push rods from the lifters. Rocker arms are lubricated in this fashion. Oil is returned to pan through drain holes in head assembly which lead back down to oil pan.

Timing Gears — Lubricated by splash method from oil pan.

Oil Filter — Full flow externally mounted type located on left side of engine. Filter has integral by-pass valve and anti-drain back diaphragm. Filter is disposable, throw-away type.

OIL PUMP

Removal & Disassembly — Remove oil pan, oil pump attaching bolts and oil pump from engine. Remove oil inlet tube cover attaching screws and cover. Remove inner rotor and shaft assembly, remove outer race. Drill small hole into oil pressure relief spring valve chamber cap, insert self-threading sheet metal screw into cap and pull from chamber. Remove spring and plunger.

Reassembly — 1) Clean, inspect and oil all parts thoroughly. Install relief plunger, spring and new cap. Stake cap into position. Install outer race, inner rotor and shaft with identification marks facing bottom of pump.

NOTE — Inner rotor, shaft and outer race are serviced as an assembly.

2) Install cover and tighten attaching bolts to specifications. Position oil inlet tube on oil pump, install new gasket and tighten attaching bolts to specifications. Submerge inlet port in oil and rotate shaft until oil flows from outer port.

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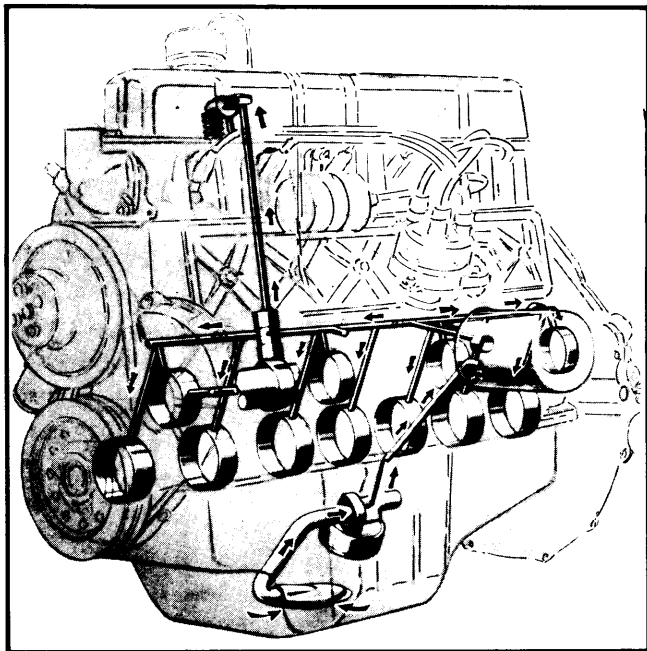


Fig. 18 Engine Oiling System

Oil Pump Specifications	
Application	Specification
Relief Valve Spring Tension	20.6-22.6 lbs.@2.490"
Shaft-to-Housing Clearance	.0015-.0030"
Relief Valve Clearance	.0015-.0030"
Rotor Assembly End Clearance	.004" Max.
Outer Race-to-Housig Clearance	.001-.013"

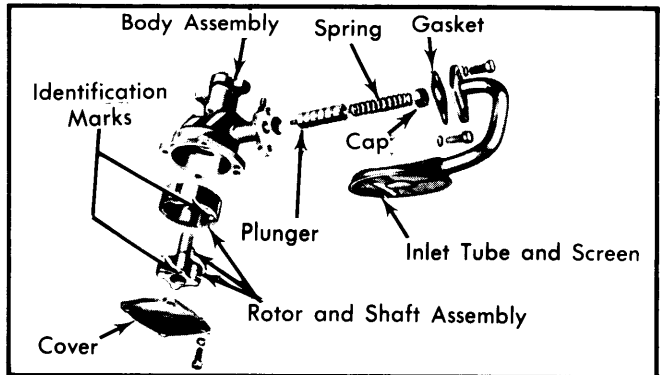


Fig. 19 Disassembled View of Oil Pump

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS							
Year	Displ. Cu. Ins.	Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore	Stroke
1981	300"	1-Bbl.	8.9:1	4.00"	3.98"

VALVES							
Engine & Valve	Head Diam.	Face Angle	Seat Angle	Seat Width	Stem Diameter	Stem Clearance	Valve Lift
4.9L							
Int.⓪	1.772-1.790"	44°	45°	.060-.080"	.3416-.3423"	.0010-.0027"	.403"
Exh.⓪	1.551-1.569"	44°	45°	.070-.090"	.3416-.3423"	.0010-.0027"	.403"

⓪ — Do Not remove more than .010" from end of stem.

VALVE SPRINGS			
Engine	Free Length	PRESSURE (LBS.)	
		Valve Closed	Valve Open
4.9L			
Int.	1.99"	76-85@1.700"	187-207@1.300"
Exh.	1.87"	77-85@1.580"	182-202@1.180"

CAMSHAFT			
Engine	Journal Diam.	Clearance	Lobe Lift
4.9L	2.017-2.018"	⓪.001-.003"	Ⓜ.2490"

⓪ — End play is .001-.007".

Ⓜ — Intake and exhaust have same lift.

Ford 6 Engines

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ENGINE SPECIFICATIONS (Cont.)

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance	Piston Fit	Rod Fit	Rings	End Gap	Side Clearance
4.9L	.0014-.0022"	.0002-.0004"	Interference Fit	1	.010-.020"	.0019-.0036"
				2	.010-.020"	.002-.004"
				3	.010-.035"	Snug

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS							
Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam.	Clearance	Thrust Bearing	Crankshaft End Play	Journal Diam.	Clearance	Side Play
4.9L	2.3982-2.3990"	.0008-.0015"	No. 5	.004-.008"	2.1228-2.1236"	.0008-.0015"	.006-.013"

TIGHTENING SPECIFICATIONS	
Application	Ft. Lbs.
Cylinder Headⓐ	85
Manifold-to-Cylinder Head	
Intake	22-32
Exhaust	28-33
Oil Pickup Tube	10-15
Main Bearing Caps	60-70
Connecting Rod Caps	40-55
Vibration Damper	130-150
Flywheel	75-85
Rocker Arm Nut	17-23
Engine Front Cover	12-18
Rocker Arm Cover	4-7
Oil Pan-to-Block	10-15
Water Pump	12-18
Oil Pump	10-15
Camshaft Thrust Plate	9-12

ⓐ — Tighten cylinder head bolts in three steps as follows:
 Step One — 55 ft. lbs.; Step Two — 65 ft. lbs.; Step Three — 85 ft. lbs.