# FOX 4 CYLINDER

## ENGINE CODING

### ENGINE IDENTIFICATION

Engine number is stamped on distributor side of engine block, just above the fuel pump. Number prefix indicates engine/transmission application as follows:

| Application | Engine Code |
|---|---|
| 1.6 Liter Calif. | YG |
| 1.6 Liter Fed. | YK,YH |
| Man. Trans. | XK |
| Auto. Trans. | ET |

## ENGINE & CYLINDER HEAD

### ENGINE

NOTE – *Leave all fuel injection lines connected to components.*

1) Disconnect battery ground cable. Loosen clutch adjusting nut and remove clutch cable. Disconnect electrical plug connector and pressure regulator lines. Remove vacuum hoses, ignition and emission control systems from intake manifold. Remove cold start valve, pull out injectors and remove accelerator cable.

2) Disconnect electrical wires at: ignition coil, fan motor, radiator thermo switch, alternator and oil pressure switch. Drain and remove radiator and radiator grille. Remove starter and exhaust pipe nuts.

3) On vehicles with air conditioning, remove intake air duct, radiator, radiator grille and cooling fan. Remove condenser (do not loosen or remove air conditioner hoses) and hang up with wire. Remove air filter, intake air distributor, EGR valve, horn and A/C Compressor.

4) Remove front engine mount and lower mounting bolts at engine block. Remove flywheel guard. On automatic transmission vehicles, remove torque converter cover and torque to drive plate bolts. Support transmission with floor jack or stand.

5) Using suitable engine sling (tool No. US1105) lift engine and transmission, until transmission housing contacts steering drive. Adjust jack or stand to make contact with transmission. Remove upper mounting bolts at engine block. Pry engine and transmission apart and remove intermediate plate.

6) On manual transmission vehicles, engine must be turned and lifted, to prevent damage to transmission main shaft, clutch and body. On automatic transmissions models lift engine straight out. Secure torque converter with suitable tool (tool No. 32-200).

**Installation** – To install engine, reverse removal procedure. Check that torque converter is fully seated on one-way clutch, and can be easily turned by hand. Check that all engine mounts are free of strain, realign if necessary.

### CYLINDER HEAD

**Removal & Installation** – 1) Disconnect battery ground cable. Drain coolant system and disconnect hoses which are connected to cylinder head. Disconnect exhaust pipe and electrical wires. Disengage accelerator linkage and disconnect at holder. Loosen alternator tensioner and remove camshaft drive belt and "V" belt.

2) Loosen head bolts in reverse of tightening sequence (See *Fig. 1*). To install, place head gasket with word "top" facing cylinder head. Position cylinder head on gasket and install bolts. Tighten bolts, in steps, in sequence shown in *Fig. 1*. Reinstall remaining components and retime camshaft. Retighten head bolts after 1000 miles.

NOTE – *On some models 11 mm cylinder head bolts with 12 mm polygon socket heads have been installed in place of 10 mm hexagon socket head bolts. Torque new head bolts to 55 ft lb (7.5 mkg), then tighten ¼ turn more. New head bolts do not have to be retorqued after 1000 miles.*

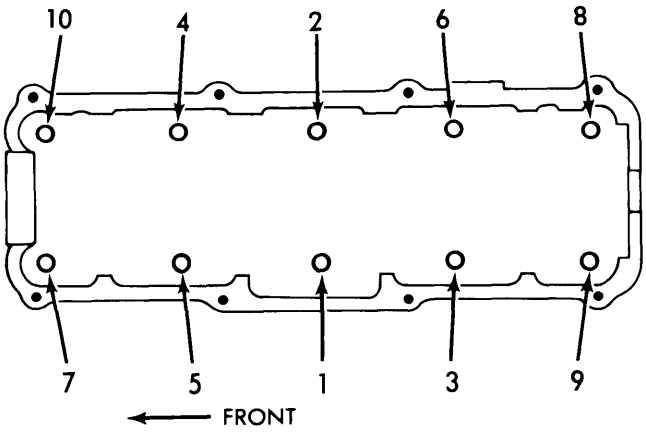


***Fig. 1 Cylinder Head Tightening Sequence***

## VALVES

### VALVE ARRANGEMENT

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

### VALVE GUIDE SERVICING

1) Before taking measurements, clean valve guides with a cleaning broach. To measure, attach a suitable device with a dial indicator (VW 689/1) to mounting surface of cylinder head. Insert a new valve into valve guide until stem is flush with end of guide. Rock valve against dial indicator and check amount of guide-to-stem clearance. Maximum valve rock should not exceed .039" (1.0 mm) for intake valves, and .051" (1.3 mm) for exhaust valves.

2) Use suitable press and adaptor (10-206) to remove and install valve guides. Press worn guides out from combustion chamber side. Coat new guide with oil and press into cold cylinder head from camshaft side. Do not use more than 1 Ton of pressure or guide shoulder may break. Ream guide by hand to proper size.

### VALVE STEM OIL SEALS

NOTE – *Valve stem seal, may be removed with cylinder head installed on vehicle.*

## FOX 4 CYLINDER (Cont.)

1) With camshaft removed, remove spark plug, turn crankshaft until piston is at BTC. Install pressure hose (tool No. VW 653) in spark plug hole and apply constant pressure.

2) Remove valve keepers and spring with compressor (VW 541). Lift seal off valve stem with seal remover (10-218). Slide plastic sleeve on valve stem, lubricate seal and push in place with installing tool (10-204).

### VALVE SPRINGS

With tappets removed, install suitable valve spring compressor (Tool No. 10-210). Compress springs and remove valve keepers and collar. Lift out valve springs. To install, reverse removal procedure.

### MECHANICAL VALVE LIFTER ASSEMBLY

With camshaft and tappet discs removed, lift out tappets. Inspect for wear or damage, replace as necessary. Oil tappet lightly and replace in original position.

### VALVE CLEARANCE ADJUSTMENT

1) Adjust valve clearances in firing number order (1-3-4-2). Rotate camshaft until number four cylinder valves overlap and measure number one cylinder valve clearances. Clearance is measured with engine warm. With a feeler gauge, measure clearance of each cylinder in turn and note clearance. If clearance is within .002" (.05 mm) of specifications, no adjustment is necessary.

2) Determine thickness of tappet disc installed. Using tappet clearance previously noted, calculate required thickness of disc needed to achieve proper tappet clearance. Tappet discs are available in .0019" (.05 mm) increments, from .1181" (3.0 mm) to .1673" (4.25 mm). Thickness is stamped on bottom side of tappet disc.

3) Special tools (tool No. VW 546 and US 4476) are required to remove tappet clearance discs. Rotate camshaft so cams of one cylinder overlap and cams of cylinder to be changed no longer rest on tappets. Rotate tappet until openings are at 90° angles to camshaft. Install tool No. VW 546 to depress tappets. Using tool No. US 4476, grasp tappet disc through opening in side of tappet and rotate out from under camshaft. Install proper disc and remove tool No. VW 546. Repeat procedure until all tappets are adjusted.

**Valve Clearances**

| Application | In. (mm) |
|---|---|
| Intake | |
| Hot | .008-.012 (.20-.30) |
| Cold | .006-.010 (.15-.25) |
| Exhaust | |
| Hot | .016-.020 (.41-.51) |
| Cold | .014-.018 (.36-.46) |

NOTE – *Cold settings are given for reference as initial settings after engine rework. Final adjustments are to be made with engine at operating temperature.*

## PISTONS, PINS & RINGS

### OIL PAN

Drain engine oil. Attach a suitable lifting device to engine, and apply supporting tension to engine. Remove auxiliary bolts (alternately), then remove left and right engine mounts. Unscrew oil pan bolts and remove pan. When installing, gasket is installed dry, and oil pan bolts are to be tightened in a criss-cross pattern.

### PISTON & ROD ASSEMBLY

1) Before removing connecting rods, mark rod and cap for proper reinstallation. Remove rod bolts and caps and carefully push piston and rod assembly out top of cylinder.

2) On reassembly of piston and rod assemblies, cast bosses on rod and cap, as well as locating projections of bearing inserts face toward intermediate shaft. All connecting rods must be of same weight class. Weight class numbers are stamped on bottom of connecting rod caps. Using a suitable ring compresser, install piston and rod assemblies with arrow on crown of piston facing forward.

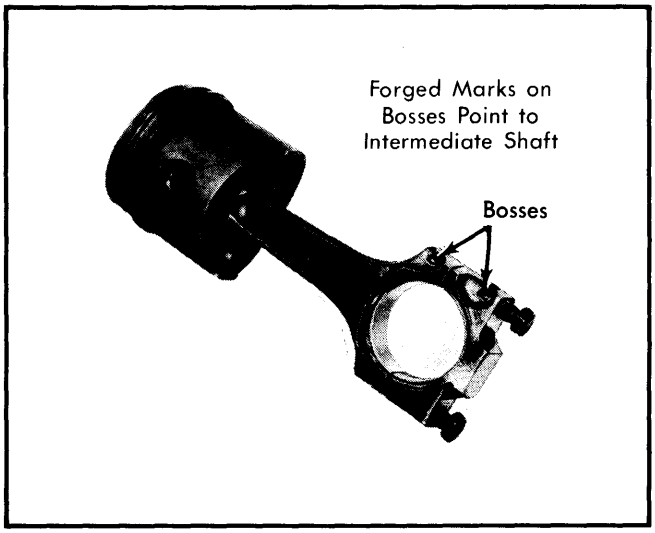


*Fig. 2 Location of Connecting Rod Bosses*

### FITTING PISTONS

1) Measure cylinder at three points: .39" (10 mm) from top and bottom, and at center of cylinder bore. Take measurements in line with thrust face and at 90° to thrust face.

2) Measure pistons at .63" (16 mm) from bottom of piston skirt (measuring at 90° to pin bore). Combining this measurement with measurement of corresponding cylinder bore, if piston-to-cylinder clearance exceeds .003" (.08 mm), oversize pistons must be installed.

3) Place piston rings squarely in top of cylinder bore (above ring ridge) and measure end gap; replace as necessary. Measure ring side clearance; replace rings and/or pistons if clearance exceeds .006" (.15 mm). Install rings on piston with end gaps 120° offset to each other and stamped word "TOP" on rings facing upward.

## FOX 4 CYLINDER (Cont.)

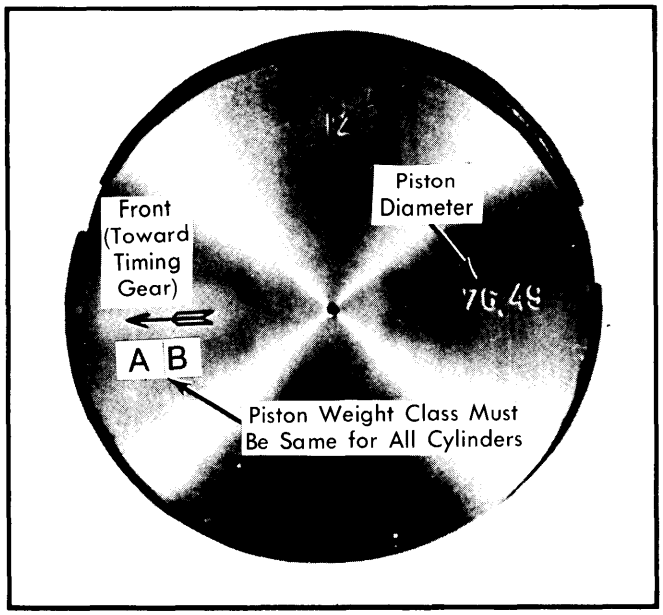


*Fig. 3 Piston Markings*

### PISTON PINS

Use pin-drift to lift circlip from piston groove. Use tool (VW 207c) to remove and install piston pins. If pins are too tight it may be necessary to warm pistons to about 140°F (60°C) for removal and replccement.

## CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

### MAIN & CONNECTING ROD BEARINGS

1) Push crankshaft toward one end and measure crankshaft end play at No. 3 (thrust) bearing. Main bearing caps are stamp-numbered "1" to "5" (front to rear) and must return to original positions upon reassembly. Measure end play of connecting rods. Remove rod and main bearing caps and check bearing clearance, using Plastigage method.

2) Measure crankshaft journals with a micrometer to determine if crankshaft is out-of-round. Maximum ovality permissible is .0012" (.03 mm). Install main inserts with bearing half having oil groove into block. Lubricate bearings and install caps.

**Crankshaft Journal Diameters**

| Size | Main Bearing Inches (mm) | Connecting Rod Inches (mm) |
|---|---|---|
| Std. | 2.124(53.95) | 1.809(45.95) |
| 1st US | 2.114(53.70) | 1.799(45.70) |
| 2nd US | 2.104(53.45) | 1.789(45.45) |
| 3rd US | 2.094(53.20) | 1.779(45.20) |

### REAR MAIN BEARING OIL SEAL

Rear main bearing oil seal may be replaced with engine in vehicle, if transmission and flywheel are removed. Carefully pry oil seal from crankcase. Install guide tool (2003/2A) on crankshaft and press seal into position as far as possible by hand. Press seal in until properly seated with installing tool (2003/1).

### INTERMEDIATE SHAFT OIL SEAL

Press seal out of flange. Using suitable tool (Tool No. 10-203), press new seal into flange until it is flush.

### FRONT MAIN BEARING OIL SEAL

1) Front main bearing oil seal may be replaced with engine in vehicle. Remove license plate, radiator grille and camshaft belt guard. Rotate crankshaft to TDC. Use a screwdriver to lock crankshaft from turning (through opening in transmission case). Remove pulley bolt. Loosen camshaft belt tensioner and alternator adjuster. Remove both belts.

2) Pry seal out of front cover with extractor tool (10-219). Using installation tool (10-203), press new seal into position, first level with cover, and finally to installed depth of 3/32" (2 mm) below cover lip. To install remaining components, reverse removal procedure and check valve timing.

## CAMSHAFT

### TIMING BELT

1) Remove radiator grille. Loosen alternator mounting bolts and remove "V" belt. Remove camshaft belt guard. Loosen mounting nut of camshaft belt tensioner arm and remove tension from belt. Slide belt forward off camshaft sprocket.

2) Install new belt and adjust tensioner arm until belt can be turned 90° with thumb and index finger at a point midway between camshaft sprocket and intermediate sprocket. Check valve timing.

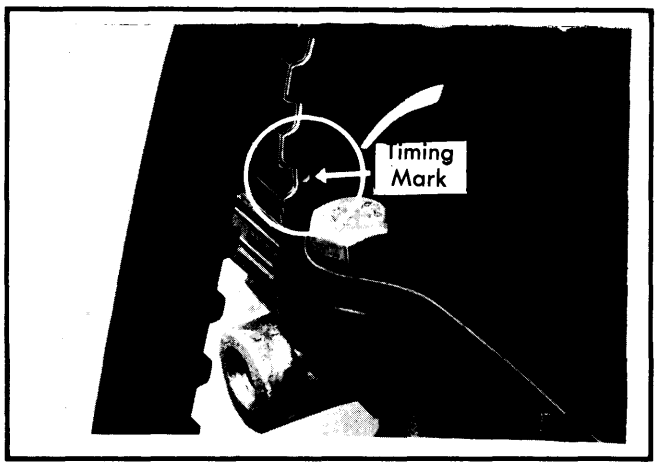


*Fig. 4 Camshaft Drive Sprocket Timing Mark Alignment*

### CAMSHAFT

Remove bearing caps 5, 1 and 3. Diagonally loosen bearing caps 2 and 4 in steps, remove caps and lift out camshaft. To in-

## FOX 4 CYLINDER (Cont.)

stall, lubricate bearing surfaces and reverse removal procedures. Tighten bearing caps 2 and 4 diagonally, then tighten remaining cap nuts.

CAUTION – *Bearings must be installed in proper order and off center position. Bearing cap numbers may not always be on same side.*

### VALVE TIMING

Turn camshaft sprocket until punch mark on rear of camshaft sprocket is in alignment with rocker cover gasket on left side of engine. Turn crankshaft pulley and intermediate shaft sprocket until notch on pulley is aligned with punch mark on intermediate shaft sprocket. Slide camshaft belt in place and adjust tension as previously described.

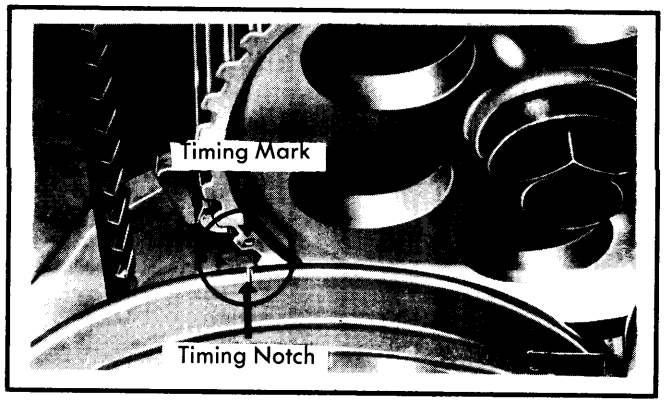


*Fig. 5 Intermediate Shaft Sprocket Aligned with TDC Mark on Crankshaft Pulley*

### ENGINE OILING

**Crankcase Capacity** – 3.2 qts. with filter.

**Oil Filter** – Replaceable spin-on type.

**Normal Oil Pressure** – 28 psi at 2000 RPM with oil temperature 176°F (80°C).

### ENGINE OILING SYSTEM

Oiling system is a pressure feed system. A gear type oil pump lifts oil from oil pan and pressure feeds it to crankshaft journals, camshaft bearings and intermediate shaft. Other parts of system receive oil mist or splash for lubrication.

### OIL PUMP

Remove oil pan and two oil pump mounting bolts. Pull pump straight down and out of engine. Remove two pump cover bolts and separate cover from pump body. Ensure that oil pump gear backlash is .002-.008" (.05-.20 mm). Check that rotor end clearance is not more than .006" (.15 mm). Remove pump drive shaft and gears. Bend up metal edges and remove filter screen. To assemble, reverse disassembly procedure.

### ENGINE COOLING

**Cooling System Capacity**
Without expansion chamber – 6½ qts.
With expansion chamber – 7qts.

**Thermostat**

Opens at – 176° F (80° C)

**Radiator Cap** – 14 psi.

**Cooling Fan** – Cut-in 194-203°F (90-95°C). Cut-out 185-194°F (85-90°C).

### WATER PUMP

1) Drain coolant and remove alternator. Remove camshaft belt guard, hose clamps and pump hoses. Remove water pump mounting bolts and lift out pump by turning slightly.

2) Remove pulley and pump body mounting screws. Separate pump assembly from housing. To reassemble, reverse diassembly procedure using new gasket and pump-to-block seal.

### ENGINE SPECIFICATIONS

**GENERAL SPECIFICATIONS**

| Year | Displ. | | Carburetor | HP at RPM | Torque (Ft. Lbs. at RPM) | Compr. Ratio | Bore | | Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|
| | cu. ins. | cc | | | | | in. | mm | in. | mm |
| 1978 | 97 | 1588 | Fuel Inj. | ①78@5500 | ..... | 8.0:1 | 3.13 | 79.5 | 3.15 | 80.0 |

①Calif. – 76 HP.

**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) |
|---|---|---|---|---|---|---|---|
| 1588 cc | | | | | | | |
| Intake | 1.338 (34) | 45° | 45° | .079 (2.0) | .314 (7.97) | ..... | ..... |
| Exhaust | 1.220 (31) | 45° | 45° | .094 (2.4) | .313 (7.95) | ..... | ..... |

## FOX 4 CYLINDER (Cont.)

### ENGINE SPECIFICATIONS (Cont.)

| VALVE SPRINGS | | | |
|---|---|---|---|
| Engine | Free Length In. (mm) | PRESSURE Lbs. @ In. (kg @ mm) | |
| | | Valve Closed | Valve Open |
| 1588 cc | | | |
| Inner | ..... | ..... | 46-51@.72 (21-23@18.3) |
| Outer | ..... | ..... | 96-106@.92 (44-48@22.3) |

| PISTONS, PINS, RINGS | | | | | | |
|---|---|---|---|---|---|---|
| Engine | PISTONS | PINS | | RINGS | | |
| | Clearance In. (mm) ① | Piston Fit In. (mm) | Rod Fit In. (mm) ③ | Rings | End Gap In. (mm) ④ | Side Clearance In. (mm) ⑤ |
| 1588 cc | .0012 (.031) | ② | .0011-.0034 (.028-.088) | Comp. | .012-.017 (.30-.43) | .0008-.002 (.02-.05) |
| | | | | Oil | .010-.016 (.25-.40) | .0008-.002 (.02-.05) |

① — Wear limit .003" (.07 mm). ② — Push fit at 140°F (60°C). ③ — Wear limit .004" (.12 mm).
④ — Wear limit .039" (1.0 mm). ⑤ — Wear limit .006" (.15 mm).

| CRANKSHAFT MAIN & CONNECTING ROD BEARINGS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Engine | MAIN BEARINGS | | | | CONNECTING ROD BEARINGS | | |
| | Journal Diam. In. (mm) | Clearance In. (mm) ① | Thrust Bearing | Crankshaft End Play In. (mm) ② | Journal Diam. In. (mm) | Clearance In. (mm) ③ | Side Play In. (mm) |
| 1588 cc | 2.124 (53.95) | .001-.003 (.028-.088) | No. 3 | .003-.007 (.07-.17) | 1.809 (45.95) | .001-.003 (.028-.088) | .015 (.40) |

① — Limit .007" (1.7 mm). ② — Limit .015" (.37 mm). ③ — Limit .004" (.12 mm).

### TIGHTENING SPECIFICATIONS

| Application | Ft. Lbs. (mkg) |
|---|---|
| Head Bolts (In Steps) | |
| Cold | 54 (7.5) |
| Warm | 62 (8.5) |
| Main Bearing Caps | 47 (6.5) |
| Connecting Rod Caps | 33 (4.5) |
| Flywheel (Use Loctite) | 54 (7.5) |
| Intermediate Shaft Sprocket | 58 (8.0) |
| Crankshaft Pulley | 58 (8.0) |
| Oil Pan Bolts | 6 (0.8) |
| Exhaust Manifold | 17 (2.3) |
| Intake Manifold | 18 (2.5) |
| Camshaft Bearing Caps | 15 (2.0) |
| Camshaft Sprocket | 58 (8.0) |
| Oil Pressure Switch | 9 (1.3) |