

## RABBIT (DIESEL) 4 CYLINDER

### ENGINE CODING

#### ENGINE IDENTIFICATION

Engine coding for Volkswagen Diesel engines is CK. Engine identification is stamped on left side of block on machined pad near number three cylinder.

### ENGINE, CYLINDER HEAD & MANIFOLDS

#### ENGINE

**NOTE** — Manufacturer recommends removal of engine-transaxle as a unit.

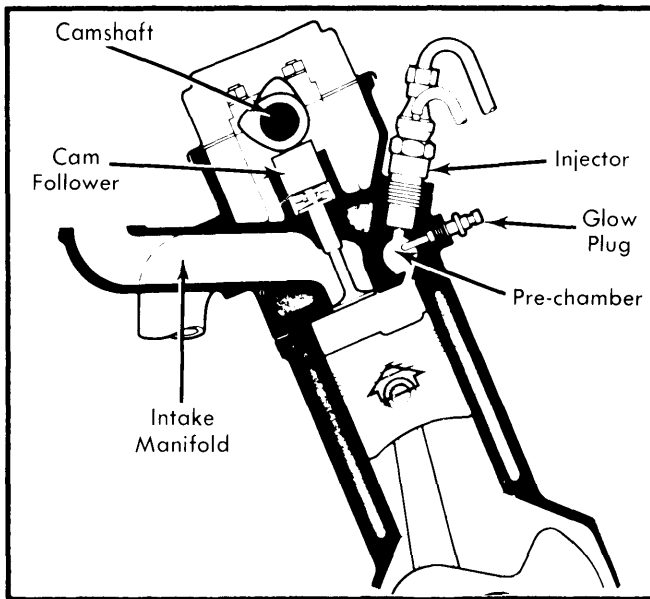


Fig. 1 End View of VW Diesel Engine

**Removal** — 1) Disconnect battery ground strap, open heater valve and drain all coolant. Remove radiator with fan, remove alternator and detach fuel filter from body.

2) Detach fuel supply and return lines from injection pump. Disconnect cold start cable, accelerator cable, and cable bracket from pump. Disconnect wires from oil pressure switch, temperature sensor, stop control, glow plugs, starter and back-up light switch.

3) Remove entire front transaxle mounting. Detach clutch cable and conduit from transaxle. Remove shift linkage relay shaft and detach from lever at rear. From underneath car, remove exhaust pipe supports, then remove nuts holding exhaust pipe to manifold. Remove rear transaxle mount.

4) Attach suitable sling to engine and lift slightly. Remove drive shafts at flanges from transaxle. Remove right engine mounting, then lift engine carefully to avoid damage to body, wires and cables.

5) Rotate crankshaft so that disassembly mark on flywheel is aligned with timing pointer. Remove cover plate over drive shaft flange. Remove engine/transmission mounting bolts and separate engine from transaxle.

**NOTE** — Do not allow either engine or transaxle to be supported by transmission mainshaft. Damage could result to clutch, push rod or mainshaft if a strain is placed on them.

**Installation** — To install, reverse removal procedures noting that recess in flywheel is level with clutch hub and drive shaft flange. Install left transaxle mounting loosely first, then complete alignment and assembly procedure.

#### CYLINDER HEAD & MANIFOLDS

**NOTE** — Cylinder head may be removed and installed with engine in car.

**Removal** — 1) Remove air cleaner and ducting, then drain cooling system. Remove camshaft drive belt. Unbolt thermostat housing from water pump. Disconnect battery ground strap.

2) Disconnect accelerator cable from injection pump. Detach fuel lines at injectors by unscrewing unions. Disconnect wire from glow plug bus, temperature sending wire and any other wires which could interfere with removal of cylinder head.

3) Remove nuts holding exhaust pipe to manifold and unbolt exhaust pipe support from engine/transaxle assembly. From underneath car, remove bolts and nuts holding exhaust manifold to cylinder head, then remove manifold from head. Disconnect coolant hoses from head and remove any other hoses which may interfere with head removal.

4) Remove cylinder head cover bolts and retaining plates. Carefully lift off cover and gasket. Loosen head bolts beginning at outer ends and work toward center. Lift off head and remove injectors and glow plugs to prevent damage while working on head.

5) Remove combustion chamber inserts by placing drift through injector hole and tapping out with hammer. Prior to installation, pre-chamber inserts must be reinstalled. When replacing injectors, new heat shields must be used between each injector and cylinder head. Remove old heat shield and place new shield in position with recess upward, towards injector. Tighten injector to 50 ft. lbs. (7.0 mkg).

**Installation** — 1) Clean gasket surface and ensure that cylinder head and block are not warped. Maximum distortion of .004" (.010 mm) is allowed. If installing on original piston and block assembly select a new head gasket that has the same marks as the original.

2) To determine proper gasket, measure projection of piston above block when at TDC. Select proper gasket from following table:

#### Available Cylinder Head Gaskets

Piston Projection in Inches (mm)	Gasket Thickness in Inches (mm)	Identification Notches
.017-.025 (.43-.63)	..... .051 (1.30)	..... 2
.025-.032 (.63-.82)	..... .055 (1.40)	..... 3
.032-.036 (.82-.92)	..... .059 (1.50)	..... 4
.036-.040 (.92-1.02)	..... .063 (1.60)	..... 5

Gasket must be installed with word "OBEN" facing up.

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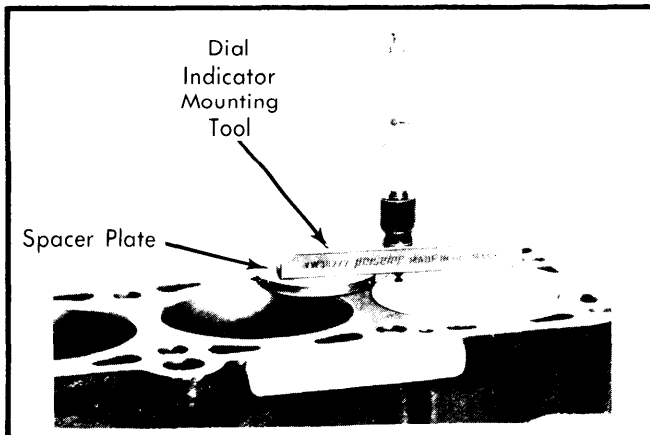


Fig. 2 Measuring Piston Projection

**CAUTION** — Due to the aluminum construction of the head, do not use metal brushes or scrapers to clean gasket sealing surface or combustion chambers. Use solvent and wooden or plastic scrapers to remove foreign material. Do not mar piston tops when cleaning cylinder block. Ensure that all bolt holes and cylinder bores are absolutely free of debris prior to installing head or bolts.

3) Lower head carefully onto gasket using two of the outermost bolts and washers to keep gasket and head aligned with block. Tighten head bolts in the sequence shown, first to 22 ft. lbs. (3.0 mkg), then to 43 ft. lbs. (6.0 mkg) and finally to 61 ft. lbs. (8.5 mkg). Complete installation in reverse order of removal.

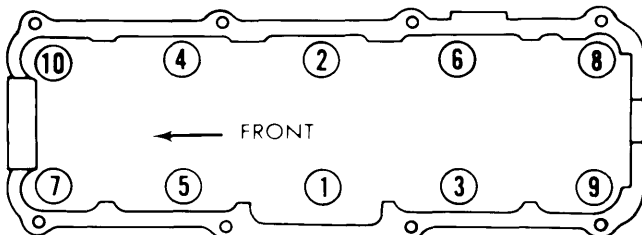


Fig. 3 Cylinder Head Tightening Sequence

### VALVES

#### VALVE ARRANGEMENT

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

#### VALVE GUIDE SERVICING

1) To check for wear, insert NEW valve in clean valve guide until stem end is flush with spring end of guide. Use dial indicator to check that no more than .051" (1.3 mm) lateral (rocking) movement is indicated at valve head when moved back and forth against indicator.

2) Prior to replacing worn guides, check that head is not cracked and that valve seats can be refaced. Press out old guides and coat new guides with oil. Press new guides in up to shoulder but do not use more than one ton of pressure once shoulder is seated. Hand ream guides to proper uniform diameter of .315-.316" (8.013-8.035 mm).

#### VALVE STEM SEALS AND SPRINGS

**NOTE** — It is possible to replace valve springs and seals with head installed provided camshaft and tappets are removed. Piston of cylinder concerned must be at top dead center position.

Use suitable spring compressor to depress spring and retainer. Remove keepers, then remove retainer and springs. Remove stem seal. Use protective sleeve over valve stem and install new seal. Complete assembly in reverse order of disassembly.

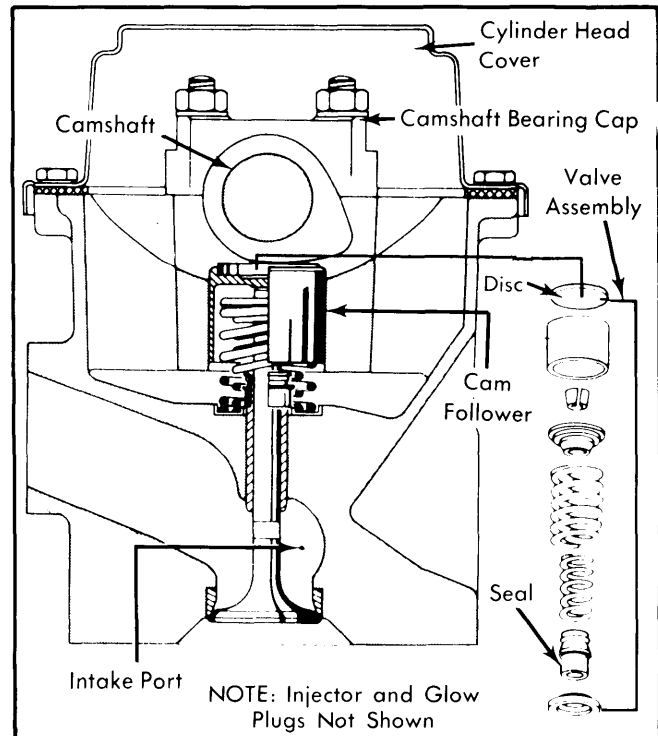


Fig. 4 View of Valve and Camshaft

#### VALVE CLEARANCE ADJUSTMENT

1) Engine should be near operating temperature (coolant at about 95°F (35°C)). Rotate crankshaft so that cam lobes for No. 1 cylinder (curb side) point upward. Check intake and exhaust clearance between heel of cam lobe and follower.

2) Use crankshaft pulley to rotate crankshaft 180° at a time and check No. 3, No. 4, and No. 2 clearance. If clearances are not within specifications, use thinner or thicker adjusting discs to increase or decrease clearance.

**NOTE** — Do not turn engine by camshaft pulley. Use crankshaft pulley with wrench or put vehicle in 4th gear and push to move crankshaft/valve train.

3) Twenty-six different thicknesses of discs are available in increments of .0019" (.05 mm) from .1181" (3.0 mm) to .1673" (4.25 mm). To install, turn crankshaft about ¼ turn past TDC and press cam follower down with suitable tool (VW 546). Remove old disc with special pliers (VW 10-208) and insert new disc with etched thickness marking toward cam follower.

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### Valve Clearance Specifications

Application	In. (mm)
Intake	
Hot .....	.008-.012 (.20-.30)
Cold .....	.006-.010 (.15-.25)
Exhaust	
Hot .....	.016-.020 (.40-.50)
Cold .....	.014-.018 (.35-.45)

**NOTE** — Cold settings are given for reference as initial settings to be used during cylinder head rework. Final adjustments are made at normal operating temperatures and should be checked after 600 miles of operation.

### PISTONS, PINS & RINGS

#### OIL PAN

Due to transverse suspension of engine ahead of front suspension, oil pan may be removed simply by removing mounting bolts. Oil pump may inspected or removed and replaced with pan off. It is recommended that any further repairs be accomplished with engine removed from car.

#### PISTON & ROD ASSEMBLY

**Removal** — Mark cylinder number on crown of each piston. If necessary, mark arrows pointing toward front of block on piston crowns. Remove rod cap bolts and force piston out top of cylinder using wooden hammer handle. Mark rods and bearing caps for proper installation.

**NOTE** — If ridge at top of cylinder prevents piston removal, use ridge reamer prior to further disassembly. DO NOT force piston out of cylinder.

**Installation** — Turn crankshaft so No. 1 journal is at BDC. Install piston/rod assembly until ring compressor contacts block. Guide rod over journal and use wooden handle of hammer to push piston into cylinder. Repeat with No. 4 piston and rod assembly ensuring that tabs on bearing halves engage notches in respective rod and cap. Tighten caps on rods 1 and 4, then rotate crankshaft 180° and install No. 2 and No. 3 piston/rod assemblies.

#### PISTON PINS

**Removal** — Use needle-nose pliers to remove circlips. Press out pin and remove piston, noting direction piston is fitted to rod.

**Installation** — Check piston/pin fit for thumb push fit. Connecting rod/pin wear limit is .0015" (.04 mm). Connecting rod may be rebushed and honed to proper size if required. If pin is too loose in piston, replace both pin and piston.

#### FITTING PISTONS

1) Measure cylinder at three points: 3/8" (10 mm) from top and bottom, and at center of bore. Measure in line with and at 90° to thrust face. Cylinder wear limit is .0015" (.04 mm) beyond standard dimensions and/or out of round. If limits are exceeded, cylinders must be honed and new pistons fitted.

2) Measure pistons 5/8" (15 mm) from bottom of skirt 90° to pin bore. Subtract this measurement from that of corresponding cylinder bore and note piston-to-cylinder clearance. If clearance exceeds .0028" (.07 mm), oversize pistons must be installed.

3) Place each piston ring squarely into bottom of cylinder about 5/8" (15 mm) and measure end gap. Measure ring side gap in pistons. Install properly fitted rings on pistons with end gaps offset 120° from each other (start with oil ring gap to rear). The word "TOP" on each ring must face upward.

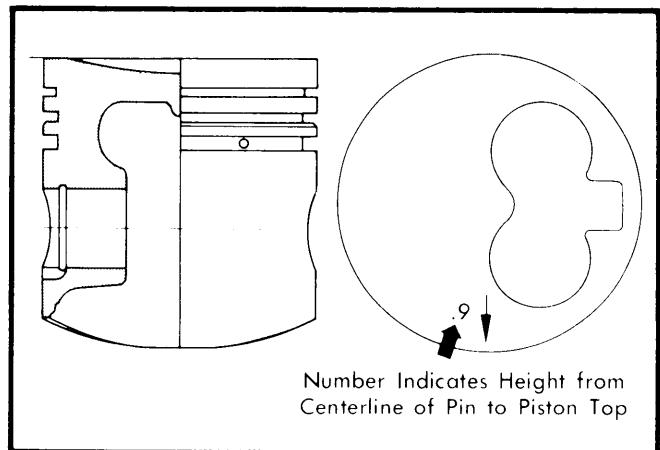


Fig. 5 Side and Top View of Diesel Piston

**NOTE** — In case any pistons require replacement, new pistons must be of same weight class. Unmarked pistons must be within 10 grams of weight of other installed pistons. Replacement piston rods must also be installed in sets of four from the same weight group.

### CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

#### MAIN & CONNECTING ROD BEARINGS

1) Push crankshaft toward one end and measure end play at No. 3 (thrust) bearing. Main bearing caps are numbered "1" to "5" with "1" at drive belt end and "5" at flywheel end. Measure connecting rod end play (side play). Check all bearing clearances by the Plastigage method.

2) Measure crankshaft journals to determine size and any out-of-round. Maximum allowable out of round is .0012" (.03 mm). Install main inserts with bearing half having oil groove into block. Lubricate bearings and install caps in original positions.

#### Crankshaft Journal Diameters

Size	Main Bearing In. (mm)	Con. Rod. Bearing In. (mm)
Standard .....	2.126 (54.00)	1.81 (46.00)
1st US .....	2.116 (53.75)	1.80 (45.75)
2nd US .....	2.106 (53.50)	1.79 (45.50)
3rd US .....	2.096 (53.25)	1.78 (45.25)

## RABBIT (DIESEL) 4 CYLINDER (Cont.)

### REAR MAIN BEARING OIL SEAL

**NOTE** — Rear main bearing oil seal may be replaced with engine in vehicle. Transmission and flywheel must be removed.

Insert screwdriver between crankshaft flywheel flange and inside lip of oil seal. Pry oil seal out. Install guide sleeve tool 2003/2A (or equivalent) over crankshaft flange. Start new oil seal into recess in carrier. Remove guide sleeve then fit drive plate 2003/1 (or equivalent) and seat seal by tightening flywheel bolts in plate.

### FRONT MAIN BEARING OIL SEAL AND INTERMEDIATE SHAFT OIL SEAL

**NOTE** — Diesel engine intermediate shaft rotates counterclockwise and utilizes a different seal than the gas engine. Arrow pointing counterclockwise on seal indicates correct application for Diesel model.

Remove camshaft belt and crankshaft sprocket. Pry seal from carrier carefully to avoid damage to carrier. Use tool 10-219 or equivalent to remove seal. Use suitable installing tool (10-203 or equivalent) and press new seal into carrier until flush with front of carrier. Remove steel driving sleeve from carrier and use aluminum part of tool to drive seal further in until it is recessed .080" (2 mm) from front of seal carrier.

**NOTE** — Same procedures are used for intermediate shaft seal except that intermediate shaft sprocket is removed. Seal is pressed in only until flush with carrier.

### CAMSHAFT

#### TIMING BELT

**NOTE** — Sprockets do not have to be removed to replace drive belt.

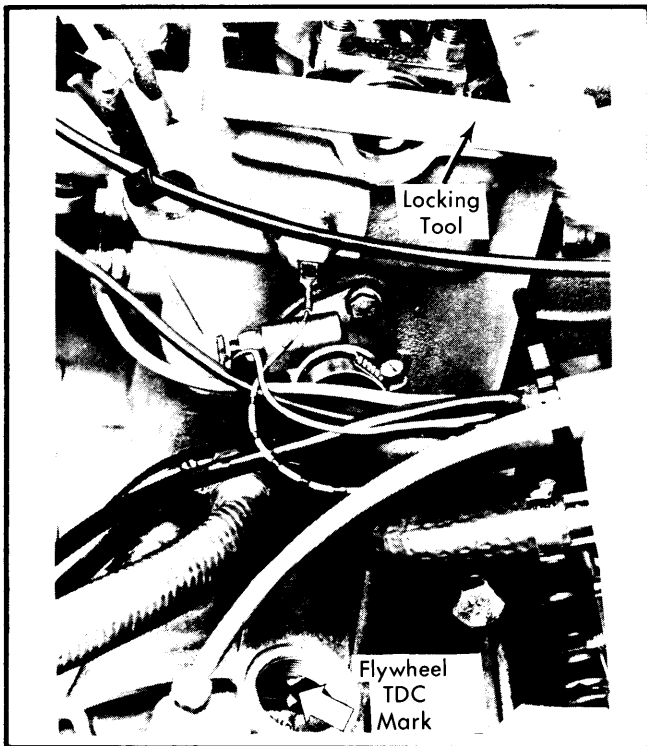


Fig. 6 Flywheel TDC Mark and Camshaft Locking Tool

**Removal** — Loosen alternator and remove V-belt, then remove crankshaft V-belt pulley. Remove air cleaner and ducting. Remove drive belt cover and cylinder head cover. Remove timing plug on top of bell housing and rotate crankshaft to No. 1 cylinder at TDC with both No. 1 cam lobes pointed upward. Using tool 2065 (or equivalent), lock camshaft in position. Lock injection pump in position with special pin (2064) and loosen tensioner. Remove drive belt toward right side of car.

**Installation** — Assure that flywheel is aligned with TDC mark. Loosen camshaft bolt 1/2 turn and tap camshaft gear loose from camshaft. Ensure that injection pump marks are aligned and install drive belt. Tension belt by turning tensioner to right until scale reads 12 to 13 on VW 210 tool. Tighten camshaft sprocket bolt to 32 ft. lbs. (4.5 mkg). Turn crankshaft two turns in direction of engine rotation, strike belt with rubber hammer between camshaft sprocket and injection pump sprocket. Recheck belt tension and replace remaining components.

### CAMSHAFT

**Removal** — With camshaft drive sprocket and cylinder head cover removed, loosen bearing caps in following sequence: 5, 1, and 3, then loosen caps 2 and 4 diagonally. Bearing caps are numbered front (sprocket end) to rear (flywheel end).

**Inspection** — 1) Number and remove cam followers, then reinstall camshaft using only end (1 and 5) bearing caps. Check axial play of camshaft with dial indicator. If play exceeds .006" (.15 mm), either head or camshaft is worn and must be replaced.

2) To measure camshaft bearing clearance, install caps one at a time and check with either a dial indicator or Plastigage. Check camshaft runout by installing shaft between centers and applying dial indicator at center bearing journal. Runout must not exceed .0004" (.01 mm) when camshaft is rotated.

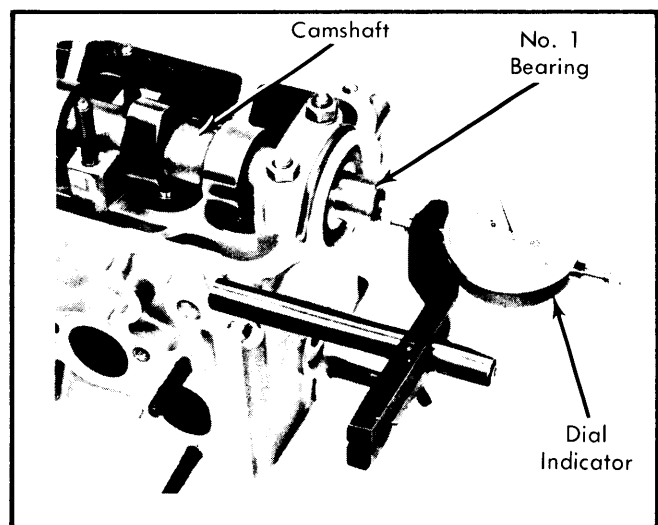


Fig. 7 Measuring Camshaft Endplay

3) Inspect cam lobes, followers, and all bearing surfaces. Ensure that all oil passages are clean. Replace any components showing signs of pitting, galling or signs of seizure.

# Volkswagen Engines

## RABBIT (DIESEL) 4 CYLINDER (Cont.)

**Installation** — Lightly lubricate all components for assembly. Install cam followers in original bores with matching adjusting discs. Place camshaft and number 2 and 4 bearing caps in position. Gradually tighten all four bearing cap nuts until camshaft is fully seated, then install caps 5, 3, and 1. Use tool 10-203 (or equivalent) to install front oil seal and complete installation in reverse order of removal.

### VALVE TIMING

See *TIMING BELT* procedures in this article.

### INJECTION PUMP TIMING

See *ADJUSTING INJECTION PUMP TIMING* in *BOSCH DIESEL INJECTION* section.

### ENGINE OILING

**Crankcase Capacity** — 3.7 quarts with filter change; 3.2 quarts without filter change.

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

**Normal Oil Pressure** — 28 psi @2000 RPM (normal operating temperature).

### ENGINE OILING SYSTEM

Gear type oil pump provides oil for pressure feed to crankshaft journals, camshaft bearings, and intermediate shaft. A larger, heavy-duty oil filter and revised oil pump drive are used in the Diesel. Other lubrication characteristics are similar to the spark ignition engines.

### OIL PUMP

**Removal** — Drain oil and remove oil pan. Remove pump mounting bolts and pump along with pick-up tube. Install in vise and remove pick-up tube.

**Inspection** — Check oil pump gear backlash with feeler gauge. Clearance should be between .002-.008" (.05-.20 mm). Measure pump gear end play using machinist's square and feeler gauge for .006" (.15 mm) clearance or less. If specifications are exceeded, replace gears or pump.

**Installation** — To install, assure that all mating surfaces are clean, install gaskets and reverse removal procedure.

### ENGINE COOLING

**Cooling System Capacity** — 6.8 U.S. quarts.

**Thermostat** — Begins to open at 176°F (80°C) and is fully open at 200°F (94°C). Radiator fan thermo switch causes fan to operate above 194°-203°F (90°-95°C) and switch off at 185°-194°F (85°-90°C) and below. Radiator relief pressure should be 13-15 psi.

**CAUTION** — Never drain the coolant while the engine is hot. Cylinder head or engine block could warp if not allowed to cool prior to draining.

### WATER PUMP

**NOTE** — Front portion of water pump (shaft, seals, bearing, and housing) can be replaced separately. To do this, camshaft drive belt and sprockets must be removed. To avoid removing drive belt, remove water pump as an assembly.

**Removal** — Drain cooling system. Disconnect battery ground strap and unplug alternator wires. Remove alternator. Disconnect thermostat housing and hoses from water pump. Remove bolts holding pump to engine block and remove pump.

**Installation** — To install, reverse removal procedure and use new "O" ring in recess in pump mounting flange.

**NOTE** — Do NOT use sealer between water pump mounting flange and engine block.

## 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
1977 Diesel	89.7	1471	Fuel Inj.	48@5000	58@2500	23.5:1	3.012	76.5	3.150	80.00

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)
1977 Diesel Intake	1.338 (33.9)	45°	45°	.079 (2.0)	.314 (7.98)	.051 (1.30)	.....
Exhaust	1.220 (31.0)	45°	45°	.095 (2.4)	.313 (7.95)	.051 (1.30)	.....

## RABBIT (DIESEL) 4 CYLINDER (Cont.)

### ENGINE SPECIFICATIONS (Cont.)

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)
Diesel	.001 (.03)	Push Fit	.0004-.0008 (.01-.02)	Comp.	.012-.018 (.30-.45)	.0008-.002 (.02-.05)
				Oil	.010-.016 (.25-.40)	.0008-.002 (.02-.05)

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)
Diesel	2.126 (54)	.0011-.0033 (.02-.088)	No. 3	.014 .37	1.81 (46)	.0011-.0035 (.028-.088)	⊙.014 (.37)

⊙ - Wear Limit

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
Diesel Inner	.....	46-51 @ .719 (21-23 @ 18.3)	.....
	Outer	96-106.875 43.5-48 @ 22.3	.....

CAMSHAFT			
Engine	Journal Diam. In. (mm)	Clearance In. (mm) ⊙	Lobe Lift In. (mm)
Diesel	.....	.0008-.002 (.02-.05)	.....

⊙ - End play .006" (.1 mm)

TIGHTENING SPECIFICATIONS	
Application	Ft. Lbs. (mkg)
Timing Belt Tensioner Lock Nut .....	32 (4.5)
Intermediate Sprocket Bolt .....	32 (4.5)
Crankshaft Sprocket Bolt .....	58 (8.0)
Water Pump Pulley Bolts .....	14 (2.0)
Crankshaft Pulley Bolts .....	14 (2.0)
Main Bearing Cap Bolts .....	47 (6.5)
Flywheel-to-Crankshaft Bolts .....	54 (7.5)
Connecting Rod Cap Bolts .....	32 (4.5)
Camshaft Sprocket Bolt .....	32 (4.5)
Camshaft Bearing Cap Nuts .....	14 (2.0)
Cylinder Head Bolts	
Cold .....	61 (8.5)
Hot .....	68 (9.5)
Manifolds-to-Cylinder Head .....	18 (2.5)
Oil Pump Mounting Bolts .....	14 (2.0)
Oil Pan Bolts .....	14 (2.0)
Fuel Injectors in Head .....	50 (7.0)
Fue Injector Line Unions .....	18 (2.5)
Fuel Injection Pump Mounting Bolts .....	18 (2.5)