4000 & 5000 5-CYLINDER

ENGINE CODING

ENGINE IDENTIFICATION

Engine number is stamped on left side of block near control pressure regulator.

Engine Identification Codes

Application	Code
2144 cc	
Federal CIS	WD
Calif. CIS	WE
Turbo	WK

ENGINE & CYLINDER HEAD

ENGINE

Removal (5000) – **1)** Disconnect battery ground cable. Remove coolant expansion tank cap. Disconnect hose from bottom of expansion tank and drain. Place temperature lever in "COLD" position if vehicle is equipped with air conditioning.

2) Disconnect coolant hoses and drain coolant. DO NOT disconnect any fuel lines. Remove control pressure regulator, cold start valve, and fuel injectors. Loosen air duct and vacuum hoses from throttle valve assembly. Remove air cleaner cover with filter.

3) Pull hood latch cable guide from bracket. Remove radiator cowl, shroud, electric fan and radiator. On air conditioned vehicles, remove grille and tilt condenser outward.

4) Remove power steering pump, leaving hoses connected. Remove vacuum amplifier, ignition coil and EGR control valve. Remove windshield washer and power steering reservoirs from holders. Remove distributor cap, rotor and ignition wires.

5) Remove circlip to remove throttle cable (manual transmission). Remove throttle push rod (automatic transmission). Disconnect electrical connections on distributor. Disconnect wiring to oil pressure and water temperature senders.

6) Remove air conditioning compressor, leaving hoses connected. Tie back compressor with wire. Remove exhaust pipe from manifold and from transmission bracket. Remove front engine mount, starter and alternator.

7) Remove torque converter mounting bolts (automatic transmission) from drive plate, doing so through starter mounting hole. Remove lower engine-to-transmission bolts. Install transmission support tool (VW 785/1). Remove upper engine-to-transmission bolts.

8) Remove left engine bracket and loosen right engine bracket from engine mount. With engine lifting device securely attached, lift engine until "V" belt pulley is behind grille opening. Lift transmission with support tool. Detach engine from transmission.

9) Lift engine upward, turning front of engine toward right as engine is lifted. Remove engine, using care that all wires, hoses and vacuum lines are free. Mount engine on stand (VW 540).

Installation – **1)** To install engine, reverse removal procedure, noting the following: Tighten starter cable, so cable cannot touch engine. Metal lip of gasket between exhaust manifold and exhaust pipe faces exhaust pipe. Adjust power steering pump, alternator, and air conditioning compressor belt tension.

2) Attach vacuum hoses to EGR control valve with straight adapter installed to EGR valve and angled adapter to vacuum amplifier. Refill coolant expansion tank. Adjust accelerator cable.

3) Tighten engine mounting bolts with engine running at idle speed.

Removal (4000) – **1)** Disconnect battery ground cable. Open heater control valve fully. Open cap on coolant expansion tank and drain coolant. Remove engine-to-transmission bolt holding coolant pipe. Remove upper coolant hose from pipe on left side of engine.

2) Remove upper radiator cover and upper radiator hose from engine. Remove vacuum hose at brake booster and at cruise control unit. Remove power steering pump and place in cowl.

3) Detach coolant hose at thermostat housing. Disconnect wires from oil pressure switch and control pressure regulator. Remove throttle push rod and control pressure regulator, leaving fuel lines connected.

4) Remove remaining coolant hose. Remove alternator adjusting bolt and mounting bolt and place alternator into lower radiator cover. Remove alternator bracket from engine block and remove front stop.

5) Loosen clamps and remove air duct. Disconnect plugs from frequency valve and ground point. Remove distributor vacuum unit hoses. Disconnect plugs at cold start valve, auxiliary air regulator and throttle switch. Remove coil high tension wire at ignition coil.

6) Pull out fuel injectors and remove cold start valve. Leave all fuel lines connected, protecting injectors and valve with caps. Remove fuel distributor with air flow sensor plate. Disconnect fuel feed and return lines. Pull PCV valve hose from valve cover.

7) Loosen upper air filter housing clips and housing bolt. Disconnect oxygen sensor, thermo switch, thermo-time switch, temperature sending unit, and ignition distributor connectors.

8) On air conditioned vehicles, remove coolant hoses at oil cooler. Remove heater hoses. Remove hose flange from engine block and remove cover for right engine mount. Loosen left and right engine mounts. Detach ground strap from mounting bracket. Remove upper engine-to-transmission bolts, leaving one easy-to-reach bolt installed.

9) Loosen "V" belt adjusting bolts for air conditioner compressor. Disconnect wire from oil temperature switch. Remove compressor clamping bolt, bracket from engine block, and wire from compressor clutch. Remove upper compressor mounting bolt and wire compressor out of way, leaving hoses connected.

10) Disconnect starter cables. Remove both front subframe bolts. Remove exhaust pipe attaching nuts from manifold. Remove bolt from exhaust pipe support. Remove starter.

4000 & 5000 5-CYLINDER (Cont.)

11) Working through starter mounting hole, remove 3 torque converter mounting bolts from drive plate. Remove lower engine-to-transmission bolts. Unhook shift rod clip. Install transmission support tool (VW 785/1).

12) Attach engine sling (US 9019 and US 1105) to engine. Adjust support bar to contact transmission. Remove upper engine-to-transmission bolt, left in earlier. Lift engine slightly and pry engine away from transmission. Continue to lift engine, while turning it toward the left.

13) Use care when guiding engine out of engine compartment. Be sure all wires, hoses, and vacuum lines have been removed. Secure torque converter so it does not fall out. Mount engine on stand (VW 540).

Installation – To install engine, reverse removal procedure, noting the following: Attach starter cable so that it does not touch engine, causing a short circuit. Align exhaust system and refill coolant tank. Tighten engine mounting bolts while engine is running at idle speed.

CYLINDER HEAD

Removal – **1)** Disconnect battery ground strap and drain cooling system. Disconnect coolant hoses from head and exhaust pipe from manifold. Remove electrical and vacuum leads from distributor. Disconnect accelerator linkage, fuel and vacuum lines and air filter from manifold.

2) Remove valve cover and timing belt cover. Rotate crankshaft so that number 1 cylinder is at TDC on firing stroke. Remove drive belt sprocket from camshaft, but do NOT separate from timing belt. Loosen head bolts in reverse order of tightening sequence and lift off head.

Installation – **1)** Install head gasket DRY (no adhesive) with part number facing upward. Guide pins may be used at opposite corners of head to ease alignment. Be sure cylinder head and block mating surfaces are clean.

2) Install head using only polygon cylinder head bolts. Install bolts 9 and 11 to center head, then tighten bolts in sequence shown in *Fig. 1*.

NOTE – *Do not retorque polygon cylinder head bolts after first 1,000 miles nor after first 1,000 miles following repairs.*

3) Complete assembly in reverse order of removal and ensure that all timing marks are properly positioned.

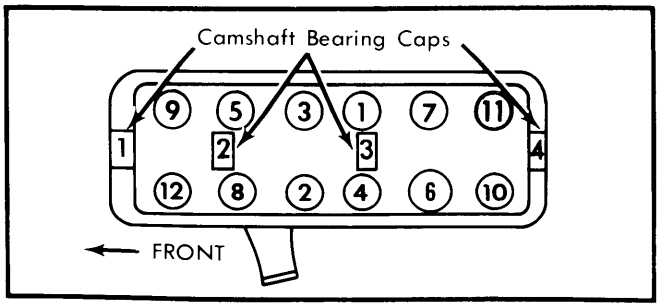

Fig. 1 Tighten Cylinder Head in Sequence Shown (Loosen in Reverse Order)

CAMSHAFT

DRIVE (TIMING) BELT

Remove "V" belts and take off drive belt cover. Engine should be in number 1 cylinder firing position (TDC). Loosen water pump bolts and turn pump counterclockwise to loosen belt. Install new belt and adjust by turning water pump clockwise to tighten. Ensure that valve timing is correct. Belt is properly adjusted when it can just be twisted 90° with thumb and index finger between camshaft and water pump sprockets.

CAMSHAFT

Diagonally loosen bearing caps 2 and 4 and remove caps. Diagonally loosen bearing caps 1 and 3 and remove caps. Remove camshaft from head. When installing, caps must be installed in original position. Lubricate bearings and journals and install caps with off-center position properly aligned. See *Fig. 2*. Tighten caps 2 and 4 diagonally and then caps 1 and 3.

CAUTION – *Front oil seal must not be installed beyond flush position or oil return will be blocked.*

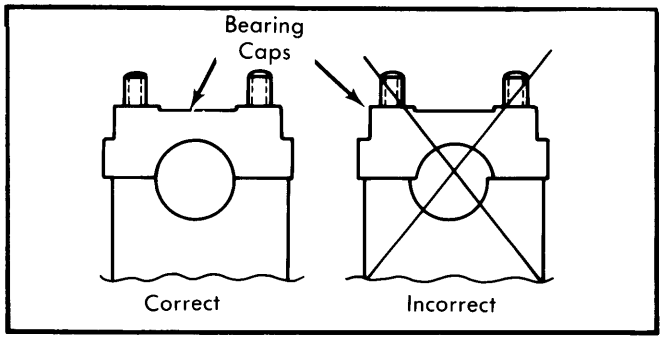

Fig. 2 Camshaft Bearing Caps with Proper Off-Center Position

VALVE TIMING

Rotate crankshaft until notch on "V" belt pulley aligns with mark on oil pump housing (engine out of vehicle) or TDC "O" mark on flywheel aligns with lug cast on clutch housing (engine installed). Fully loosen drive belt tension by loosening and turning water pump clockwise. Turn camshaft sprocket so that punch mark on rear aligns with valve cover gasket (upper edge of belt cover) on left side of engine. Install and adjust belt by turning water pump counterclockwise to tighten.

VALVES

VALVE ARRANGEMENT

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

VALVE GUIDE SERVICING

1) With head disassembled, insert new valve and check for wear with dial indicator. See *Fig. 3*. If wear exceeds .039" (1.0 mm) for intake, or .051" (1.3 mm) for exhaust valve, guides should be replaced.

4000 & 5000 5-CYLINDER (Cont.)

2) Press worn guides out of head from combustion chamber side with suitable tool (10-206). Coat new guides with oil and press into cold head from camshaft side. Press guides in as far as they will go, but DO NOT use more than 1 ton pressure once shoulder is seated. Ream guide by hand to proper size.

VALVE STEM OIL SEALS

NOTE – *Valve stem seals may be replaced with cylinder head installed on vehicle.*

With camshaft and followers removed, remove spark plug and turn crankshaft until piston of cylinder concerned is at BDC position. Install pressure hose (VW 653/3) in spark plug hole and apply low pressure air to keep valve seated. Remove valve springs with compressor (VW 451/1 or 2036) and lift off seal with pliers (10-218). Place seal protector over valve stem, lubricate seal and push seal in place with installing tool (10-204).

VALVE SPRINGS

With camshaft and followers removed, compress spring with suitable tool (US 1020 and 1020/1 or 2037) and remove valve locks (keepers). Lift off valve springs. If required, valve spring seats may be removed using pliers (10-218). To install, reverse removal procedure.

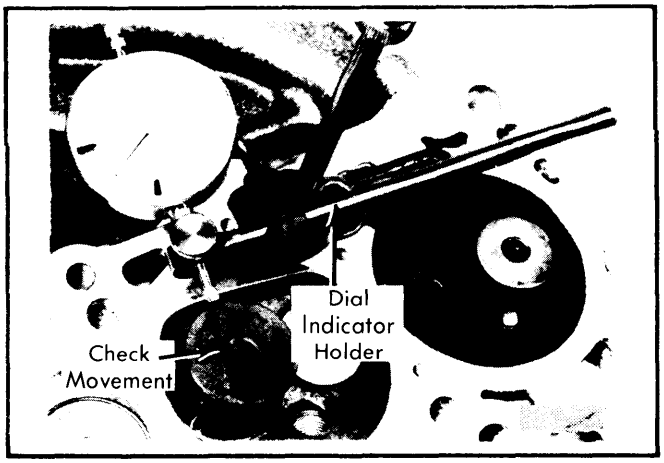

Fig. 3 Checking Valve Guide for Wear

CAM FOLLOWERS (TAPPETS)

With camshaft removed, lift off followers and adjusting discs. Inspect for wear or damage and replace as necessary.

NOTE – *Cam followers and valve system components must be kept in order and installed in original positions. Coat with oil when installing.*

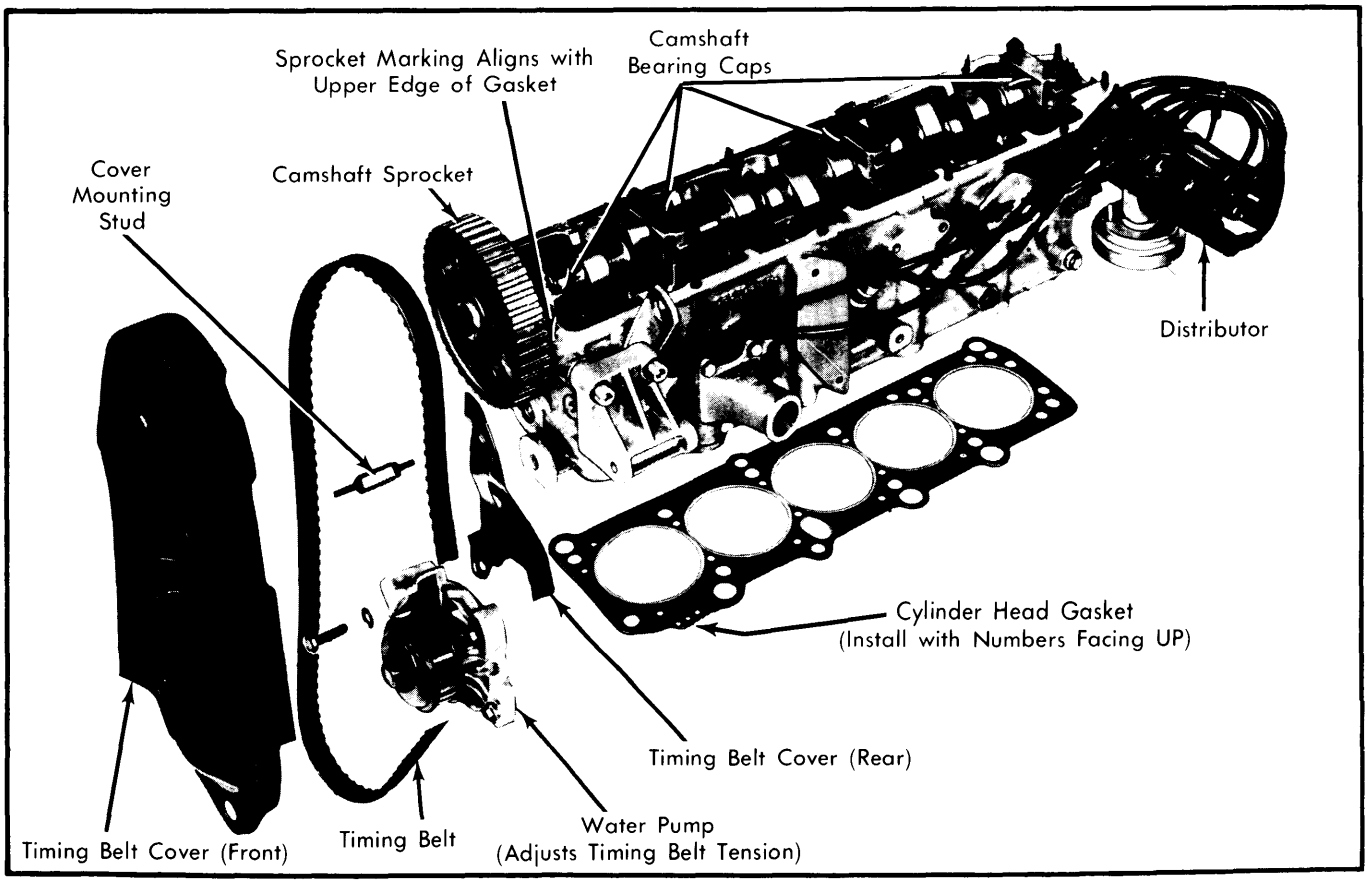

Fig. 4 Cylinder Head and Camshaft Assembly with Drive (Timing) Belt and Cover

4000 & 5000 5-CYLINDER (Cont.)

VALVE CLEARANCE ADJUSTMENT

1) Disconnect accelerator linkage and remove valve cover. Turn crankshaft so that both cam lobes of cylinder to be adjusted point upward. Check valve clearances between cam and follower in firing order (1-2-4-5-3). If clearance is greater than .002" (.05 mm) from specifications, select thicker or thinner disc.

2) To replace valve adjusting disc, use follower depressor tool (VW 548) to press follower down, then remove adjusting disc with tool (10-028 or US4476). Insert appropriate disc and recheck clearance. Discs are available in .0019" (.05 mm) increments from .1181" (3.0 mm) to .1673" (4.25 mm). Thickness is etched on bottom of disc; discs should be assembled with etched mark toward follower (DOWN).

Valve Clearances

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

NOTE – *Cold settings are given for reference as initial setting after engine rework. Final adjustments are to be made after engine is warm (at least 95°F or 35°C), and checked again after 1000 miles.*

PISTONS, PINS & RINGS

OIL PAN

Removal & Installation – Oil pan may be removed while engine is installed. Remove 2 front bolts in subframe and drain engine oil. Turn flywheel so that recesses point down and remove both rear pan bolts. Remove remaining pan bolts and lower pan from engine. To install, use new pan gasket and tighten pan bolts in a criss-cross pattern.

PISTON & ROD ASSEMBLY

Removal & Installation – Note that rod cap and rod are marked for proper installation. Remove cap nuts and push piston/rod assembly out of cylinder from bottom. When assembling, note that arrow on piston top points to crankshaft pulley (front of engine). Valve detents will be at left side of block. Raised casting marks on connecting rod and cap must face oil filter side of engine and point toward timing gear (front of engine).

FITTING PISTONS

1) Measure cylinder at 3 points: 3/8" (10 mm) from top and bottom, and at center of bore. Measure in line with and at 90° to thrust face. Wear limit is .003" (.08 mm).

NOTE – *Do not measure when block is mounted in repair stand with adapter VW 540 due to possible distortion.*

2) Measure pistons 3/8" (10 mm) from bottom of piston skirt, 90° to pin bore. Subtract this measurement from that of corresponding cylinder bore and note piston-to-cylinder clearance. If clearance exceeds .003" (.08 mm), oversize pistons must be installed.

3) Place each piston ring squarely into bottom of cylinder about 5/8" (16 mm) and measure end gap. Reading should be .010-.020" (.25-.50 mm). Measure ring side clearance in pistons using a feeler gauge. Ring clearance should be .0008-.0030" (.02-.08 mm) with a wear limit of .004" (.1 mm)

4) Install rings on pistons with "TOP" mark facing piston crown. Recessed edge on outside of center ring must face toward piston pin. Oil scraper ring with spring can be placed in either way. Ring gaps should be spaced 120° apart. Use suitable compressor (US 1008 A) and install piston and rod assemblies.

PISTON PINS

Removal & Installation – Use pin type drift to pry circlip from pin boss. Press out pin with suitable driver (VW 207 C). If pin is too tight, heat piston to approximately 140° F (60° C) prior to removal. Assemble piston and connecting rod assembly so that arrow on piston top faces forward when installed. Use new circlips to retain pins.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

Check crankshaft end play at number 4 main bearing with feeler gauge. Check main and connecting rod bearing clearance using Plastigage method. Main bearings are numbered 1 through 6 with 1 at drive belt end and 6 at flywheel end. Install bearing shells with lubrication grooves in block and shells without grooves in bearing caps. All bearing shells must be installed in original position if they are not being replaced. Use new connecting rod cap nuts.

Crankshaft Journal Diameters

Size	Main Bearing In. (mm)	Connecting Rod In. (mm)
Standard	2.283 (58.00)	1.811 (46.00)
1st US	2.273 (57.75)	1.801 (45.75)
2nd US	2.264 (57.50)	1.791 (45.50)
3rd US	2.254 (57.25)	1.781 (45.25)

NOTE – *Bearing clearance may be checked with engine installed in vehicle. DO NOT turn crankshaft when checking with Plastigage.*

CRANKSHAFT REAR OIL SEAL

Removal & Installation – With flywheel removed, use tool (2086) to pry old seal from sealing flange. Coat lips and outer edge of new seal with oil push seal into position by hand, then use installing tool (2003/1) to press in until properly seated.

CRANKSHAFT FRONT OIL SEAL

Removal & Installation – With front crankshaft pulley removed, pry old seal from housing using puller (2086). Coat seal lip and outer edge lightly with oil and start into position. Use pulley bolt and tool (2080 A) to press seal in until seated.

4000 & 5000 5-CYLINDER (Cont.)

ENGINE OILING

Crankcase Capacity – All models 4.3 US quarts (4.8 US quarts with filter change).

Oil Filter – Replaceable, spin-on type.

Normal Oil Pressure – 14 psi (.98 kg/cm²) at idle speed or 85 psi (5.98 kg/cm²) at 5500 RPM measured with oil temperature at 176°F (80°C).

OIL PUMP

1) Gear type pump is mounted at front of engine, driven by crankshaft with oil suction pipe extending into oil pan. To remove, loosen pulley bolt, take off timing belt cover, loosen water pump bolts and turn pump counterclockwise, and remove front "V" belt pulley and drive belt sprocket. Drain engine oil and remove oil pan and oil suction pipe.

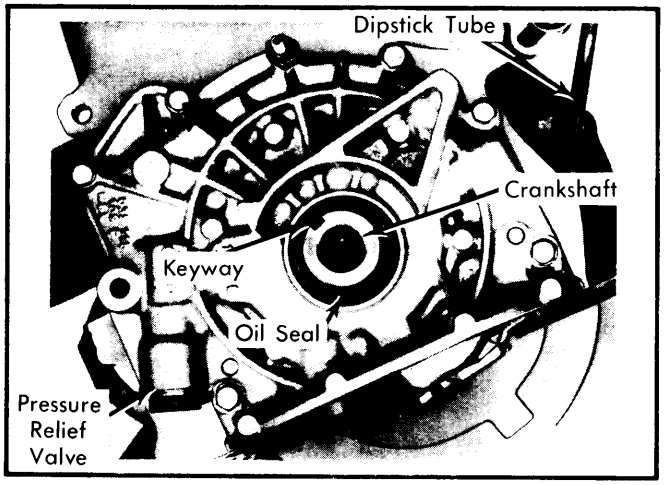

Fig. 5 Engine Oil Pump with Crankshaft Oil Seal

2) Unbolt pump and remove from front of engine. Inspect end cover, housing and gears for wear or scoring. Replace pump gears in pairs only, with triangle marking toward end cover (rear). To install, reverse removal procedure.

ENGINE COOLING

Cooling System Capacity – 9 U.S. quarts.

Thermostat – Begins to open at 194° F (90° C). Opening ends at 216° F (102° C).

Expansion Tank Cap – Relief valve opens at 17-19 psi (1.20-1.33 kg/cm²).

Radiator – Cross flow type with electric cooling fan and coolant expansion tank. Fan cuts in at 194-203° F (90-95° C) and cuts off at 185-194° F (85-90° C). Switch controlling fan is located in radiator. On air conditioned vehicles, temperature switch in supply hose controls compressor. It cuts in at 223-232° F (106-111° C) and cuts off at 244-253° F (118-123° C).

WATER PUMP

Water pump is driven by timing belt and is mounted at lower left front of engine block. To remove, drain cooling system and remove timing belt cover. Loosen and remove water pump mounting bolts. Remove pump and check for wear. To install, use new "O" ring and reverse removal procedure. Add coolant mixture until tank is full and replace cap. Run engine until cooling fan turns on. Check coolant level and top off if necessary.

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
1981										
Turbo	130.8	2144	Fuel Inj.	130@5400	142.0@3000	7.0:1	3.13	79.5	3.40	86.4
Others	130.8	2144	Fuel Inj.	103@5300	112.4@4000	8.0:1	3.13	79.5	3.40	86.4

VALVES

Engine & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm) ①	Valve Lift In. (mm)
2144 cc							
Intake	1.496 (38.0)	45°	45°	.079 (2.0)	.314 (7.97)	.039 (1.0)	.....
Exhaust	1.220 (31.0)	45°	45°	.094 (2.4)	.313 (7.95)	.051 (1.3)	.....

① – Maximum allowable clearance.

4000 & 5000 5-CYLINDER (Cont.)

ENGINE SPECIFICATIONS (Cont.)

PISTONS, PINS, RINGS

Engine	PISTONS Clearance In. (mm)	PINS		RINGS		
		Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm) ②	Side Clearance In. (mm) ③
2144 cc	.001-.003 (.025-.080)	①	.....	All	.010-.020 (.25-.50)	.0008-.003 (.02-.08)

① – Push fit at 140°F (60°C). ② – Wear limit .040" (1.0 mm). ③ – Wear limit .004" (.1 mm).

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)
2144 cc	2.283 (58.00)	.0006-.003② (.016-.075)	No. 4	.003-.007 (.07-.08)	1.811 (46.00)	.0006-.002① (.015-.620)	.016 (.40)

① – Wear limit .005" (.12 mm).
② – Wear limit .006" (.16 mm).

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N·m)
Head Bolts	
Step 1	29 (40)
Step 2	43 (60)
Step 3	①54 (75)
Main Bearing Cap	47 (65)
Connecting Rod Cap	36 (50)
Flywheel (Drive Plate) Loctite	54 (75)
Crankshaft Pulley	235 (350)
Intake Manifold	18 (25)
Camshaft Bearing Cap	14 (20)
Camshaft Sprocket	58 (80)
Engine Mounting Bolts	33 (45)

① – After 3rd step, tighten polygon socket head bolts 1/4 turn (90°) past specified torque DO NOT retighten after 1,000 miles.