5000 5 CYLINDER DIESEL

ENGINE CODING

ENGINE IDENTIFICATION

Engine number is stamped on a raised pad at the top of the block on the left side between number 2 and 3 cylinder.

Application	Code
1986 cc	CN

ENGINE & CYLINDER HEAD

ENGINE

NOTE – *Engine is removed from car with hood and transmission remaining installed.*

Removal – 1) Disconnect battery ground strap and remove air cleaner. Remove front grille and cover plates under engine/transmission. Detach and lay aside windshield washer reservoir and hydraulic fluid reservoir. Drain cooling system and disconnect water hoses attached to engine.

2) Remove power steering pump with hoses connected and lay aside. If equipped with A/C, loosen condenser and tilt outward. Remove auxiliary radiator. Disconnect wiring harness, overheating fuse connector, temperature sender wire, and wires connected to starter.

3) Remove upper part of fuel filter and loosen fuel return pipe on injection pump. Detach accelerator cable and disconnect idle speed control cable from injection pump lever. Remove right engine mount cover plate and remove front engine mount from crossmember. If equipped with A/C, remove compressor from engine leaving hoses attached.

4) Remove alternator mounting bracket and remove exhaust pipes from manifold and transmission bracket. Remove body ground strap and lower engine/transmission bolts. Remove flywheel cover plate from transmission and install supporting tool (VW785/1) with slight preload. Install engine lifting tool (US 1105 or equivalent).

5) Loosen right engine bracket from engine mount and remove left engine bracket. Lift engine/transmission up until transmission housing touches steering housing. Turn disc of supporting tool until it touches transmission housing and remove upper engine/transmission bolts.

6) Pry engine/transmission apart and turn engine to right while lifting. Turn engine 90° so that left side of engine is toward front of car and lift out. Use caution not to damage transmission main shaft, clutch and body.

Installation – To install engine, reverse removal procedures and note that metal lip on exhaust manifold flange gasket must face exhaust pipe. After installing upper transmission/engine bolts, remove supporting tool (VW785/1). It is recommended that engine mountings be tightened 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 feed pipes from injectors and disconnect wire to glow plug feed. Disconnect temperature sender wire and any other wires which could interfere with removal of cylinder head.

2) Remove valve cover and front timing belt cover. Remove vacuum pump "V" belt at rear of engine. Remove injection pump belt cover and set crankshaft to TDC on number 1 cylinder. Align marks on flywheel/clutch housing and injection pump sprocket mounting plate.

3) Lock injection pump sprocket in position with tool (2064). Hold vacuum pump pulley and injection pump drive sprocket with tool (3036) and remove retaining bolt. Remove "V" belt pulley and injection pump sprocket along with drive belt. Note number and position of spacer washers on "V" belt pulley.

4) Remove front camshaft sprocket and timing belt but DO NOT separate sprocket from belt. Loosen and remove head bolts in reverse order of tightening sequence. Lift off cylinder head with camshaft installed.

Installation – 1) Ensure that mating surfaces of engine block and cylinder head are clean. Use gasket with same identification notches as original if installing on original piston and block assembly. To determine proper gasket for new assemblies, measure piston height above top surface of engine block and select gasket from following table:

Available Cylinder Head Gaskets

Piston Projection in Inches (mm)	Gasket Number	Identification Notches
.026-.031 (.67-.80)	069 103 383	1
.032-.035 (.81-.90)	069 103 383A	2
.036-.040 (.91-1.02)	069 103 383B	3

2) Install guide pins in right front and left rear cylinder head bolt holes and place DRY gasket in position with numbers facing UP. Do NOT use sealer. Install head bolts and tighten in 3 steps in the sequence illustrated as follows: Step 1 – 29 ft. lbs. (4.0 mkg); Step 2 – 43 ft. lbs. (6.0 mkg); Step 3 – 54 ft. lbs. (7.5 mkg) plus an additional ¼ turn (90°).

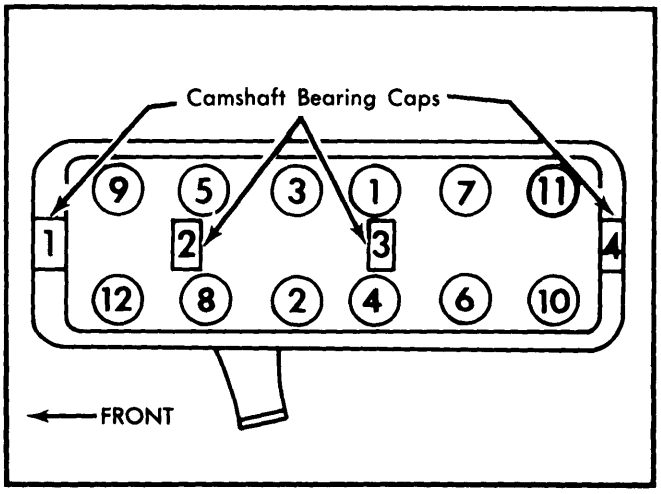

Fig. 1 Cylinder Head Tightening Sequence (Loosen in Reverse Order)

5000 5 CYLINDER DIESEL (Cont.)

CAMSHAFT

TIMING BELTS

Removal – 1) Remove alternator "V" belt and outer half of vacuum pump pulley and "V" belt. Remove drive belt covers and cylinder head cover. Set crankshaft at TDC on No. 1 cylinder and align marks on flywheel/clutch housing and injection pump sprocket mounting plate.

2) Lock injection pump sprocket with pin (2064) and hold inboard half of vacuum pump pulley and injection pump drive sprocket with tool (3036). Remove center retaining bolt and pulley half along with pump sprocket and injection pump drive belt.

3) Lock camshaft with tool (2065 A) and loosen drive belt by loosening water pump. Remove crankshaft pulley, camshaft drive belt and drive belt sprocket.

Installation – 1) Ensure that crankshaft is still at TDC on No. 1 cylinder and install injection pump drive sprocket with drive belt. Tighten injection pump drive retaining bolt until it is just possible to turn sprocket on camshaft by hand. Check belt tension and adjust by moving mounting plate and injection pump.

2) Tighten drive sprocket bolt and remove setting pin from injection pump. Attach crankshaft pulley, camshaft drive belt and camshaft sprocket. Tension belt by moving water pump. To complete installation, reverse removal procedure.

NOTE – *Belt should be tensioned so that scale on tool (VW 210) reads 12 to 13. Tension may also be checked by twisting belt 90° between pulleys using thumb and index finger. If belt twists more than 90°, tension is too loose. If belt will not twist 90°, tension is too tight.*

CAMSHAFT

To check camshaft end play, camshaft followers must be removed and camshaft free of tension. Check for maximum end play of .006" (.15 mm) with dial indicator. To remove camshaft, first remove camshaft drive belt and injecton pump drive belt. Remove outer bearing caps (1 and 4) first, loosen nuts of caps 2 and 3 alternately and diagonally, and lift off cam shaft. To install, reverse removal procedures, installing bearing caps 2 and 3 first, then caps 1 and 4.

VALVE TIMING

See TIMING BELT procedures in this article.

INJECTION PUMP TIMING

1) To check injection pump timing, set crankshaft to TDC on No. 1 cylinder. Align marks on flywheel/clutch housing and injection pump sprocket/mounting plate. Loosen cold start cable clamp screw nearest to lever and turn clamp 90°. *Do NOT loosen clamp screw at end of cable.*

2) Install dial indicator with adaptor on injection pump cover with .10" (2.5 mm) preload between plunger and pump shaft. Slowly turn crankshaft counterclockwise until indicator stops moving, then zero the dial indicator with about .04" (1 mm) preload.

3) Turn crankshaft clockwise so TDC mark is aligned with reference mark. Dial indicator should show lift of .033" (.85 mm). If necessary, loosen injection pump bolts and turn pump to set .033" (.85 mm) lift. Tighten mounting bolts and turn clamp on cold start device cable back 90° to tension cable. Tighten screw. Remove dial indicator and replace plug on injection pump.

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 in guide which has been cleaned of carbon deposits. With end of stem flush with end of guide, check back and forth travel of head with dial indicator. Maximum reading for intake and exhaust valve is .051" (1.3 mm).

2) Before replacing worn guides, ensure that valve seats can be refaced and that head is not cracked. Use tool (10-206) and press worn guides out from combustion chamber side. Oil new guides and press in up to shoulder from camshaft side. DO NOT use more than 1 ton pressure or guide shoulder may break. Ream guides by hand and reface valve seats.

VALVE STEM OIL SEALS

Removal & Installation – 1) Seals may be replaced with cylinder head installed or removed from engine. Remove camshaft drive belt and injection pump drive belt. Remove camshaft and cam follower. Turn crankshaft until piston of cylinder concerned is at TDC. Remove valve springs, allowing valve to rest on piston crown.

2) Using special pliers (10-218), pull valve stem seals off. To install new seal, slide plastic sleeve from gasket set onto valve stem. Lubricate new seal and place in installer tool (10-204). Push seal carefully onto valve guide and reverse removal procedure.

VALVE SPRINGS

Removal & Installation – 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. Valve spring seats may be removed with pliers (10-218) if required. To install, reverse removal procedure.

CAM FOLLOWERS (TAPPETS)

Removal & Installation – With camshaft removed, lift off followers and adjusting discs. Mark all components for installation in original position and inspect for wear or damage. To install, coat with oil and replace in original position.

VALVE CLEARANCE ADJUSTMENT

1) With cylinder head cover removed, turn crankshaft so that cam lobes of cylinder to be checked point upward. Check for specified clearance. If not within tolerances given, replace adjusting disc to mid-point of clearance range. Adjusting discs are available in .0019" (.05 mm) increments from .1181" (3.0 mm) to .1673" (4.25 mm).

5000 5 CYLINDER DIESEL (Cont.)

2) To replace disc, turn crankshaft so piston is NOT at TDC so that valves do not contact pistons when cam followers are pressed down. Use follower depressor tool (2078) to press follower down, then remove adjusting disc with tool (10-208 or US 4476). Insert required disc with etched marking downward (toward cam follower).

3) Rotate crankshaft so that lobes point upward and recheck clearance. Start and run engine until coolant temperature is warmed to approximately 95°F (35°C) and recheck clearance.

NOTE – *Valve clearances must be checked and adjusted after 1000 miles following cylinder head, camshaft or valve replacement or grinding.*

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.*

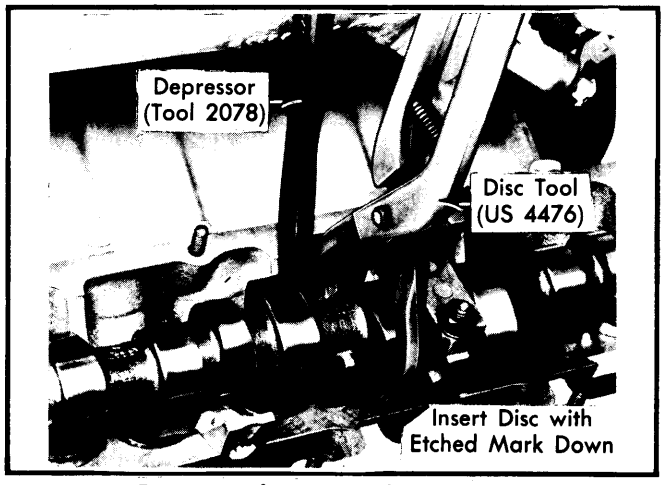

Fig. 2 Adjusting Valve Clearance

COMBUSTION CHAMBER INSERTS

Removal & Installation – Remove injector and glow plug with cylinder head on suitable work surface. Place drift through injector hole and knock insert out. Clean combustion chamber and drive new insert into position. Chamber is held in position by groove and retainer. Install new heat shield when installing injector.

NOTE – *Defective injectors can cause violent knocking noises which sound like faulty bearings. If this occurs, run engine at idle and loosen injection pipe unions one at a time until knocking stops. Injector is defective if knocking stops when pipe is loosened.*

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.

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 .027" (.07 mm).

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

2) Measure pistons at 9/16" (15 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 .027" (.07 mm), oversize pistons must be installed.

3) Place each piston ring squarely into bottom of cylinder about 9/16" (15 mm) and measure end gap. Measure ring side clearance in pistons with feeler gauge. Compression ring clearance should be .002-.003" (.05-.08 mm) with a wear limit of .008" (.2 mm). Oil ring clearance should be .001-.002" (.03-.05 mm) with a wear limit of .006" (.15 mm).

4) Install rings on pistons with "TOP" mark facing piston crown. Ring gaps should be spaced 120° apart. Use suitable compressor (US 1008 A or equivalent) and install piston/rod assemblies.

PISTON PINS

Removal & Installation – Use pin type drift to pry circlip from pin boss. Press out pin with suitable driver (10-508). If pin is too tight, heat piston to approximately 140°F (60°C) prior to removal. Assemble piston/connecting rod assembly so that arrow on piston top faces forward when assembly is correctly installed. Use new circlips to retain pins.

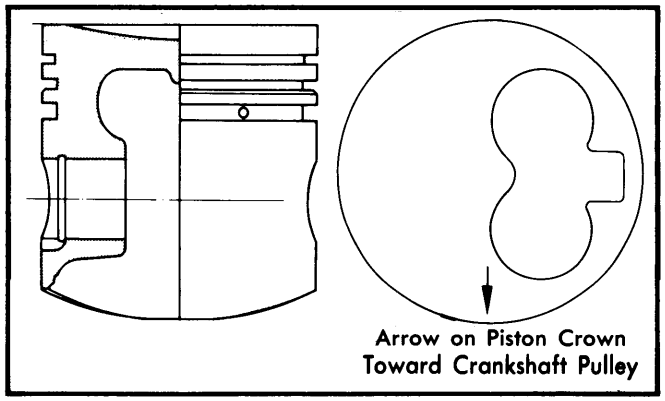

Fig. 3 Side and Top View of Diesel Piston

5000 5 CYLINDER DIESEL (Cont.)

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.

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) to press seal in until seated.

NOTE – *When installing crankshalt pulley bolt, coat threads and contact surface of bolt head with Loctite 573 or equivalent.*

ENGINE OILING

Crankcase Capacity – 5.3 quarts with filter; 4.8 quarts without filter change.

Oil Filter – Replaceable spin-on type filter is mounted on right side of engine block.

Normal Oil Pressure – 28 psi @2000 RPM with engine at normal operating temperature.

OIL PUMP

Gear crescent type pump is mounted at front of engine, driven by crankshaft with oil suction pipe extending to oil pan.

Removal – Remove front crankshaft pulley and "V" belts. Remove camshaft drive belt and cover. Drain engine oil and remove oil pan and oil suction pipe. Unbolt pump and remove from engine.

Installation – Ensure that driving dog on crankshaft engages pump gear properly and reverse removal procedure. Align drive belt sprocket with Woodruff key and apply Loctite 573 (or equivalent) to threads and contact surface of pulley bolt before installing.

ENGINE COOLING

Cooling System Capacity – 9.9 quarts.

Thermostat – Opens at 188°F (87°C).

Expansion Tank Cap – Relieves pressure at 17-19 psi.

Radiator – Diesel models use a main and an auxiliary radiator, both cross flow type, and a coolant expansion tank. An electric cooling fan is actuated by a thermoswitch at temperatures above 200°F (93°C) and turned off at lower temperatures.

WATER PUMP

Removal & Installation – Allow engine to cool, then drain cooling system. Remove "V" belts, timing belt and drive belt covers. See *TIMING BELT* procedures in this article. Remove retaining bolts and water pump. To install, use new "O" ring on pump and reverse removal procedure.

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
1979	121.2	1986	Fuel Inj.	67@4800	117.22@3000	23.0:1	3.01	76.5	3.40	86.4

VALVES In. (mm)

Engine & Valve	Head Diam.	Face Angle	Seat Angle	Seat Width	Stem Diameter	Stem Clearance	Valve Lift
5 Cyl. Diesel							
Intake	1.417 (36.0)	45°	45°	.078 (2.0)	.314 (7.97)	.051 (1.3)	.....
Exhaust	1.220 (31.0)	45°	45°	.096 (2.4)	.313 (7.95)	.051 (1.3)	.....

5000 5 CYLINDER DIESEL (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) ①	Side Clearance In. (mm) ②
5-Cyl. Diesel	.011-.027 (.03-.07)	Push Fit	.....	Upper	.012-.020 (.3-.5)	.002-.004 (.06-.09)
				Center	.012-.020 (.3-.5)	.002-.003 (.06-.08)
				Oil	.010-.016 (.25-.40)	.001-.002 (.03-.06)

① — Wear limit .040" (1.0 mm). ② — Wear limit .008" (.2 mm).

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS In. (mm)

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)
5-Cyl. Diesel	2.34 (59.96)	.0006-.006 (.016-.16)	No. 4	.003-.010 (.07-.25)	1.88 (47.76)	.0005-.002 (.015-.06)	.016 (.40)

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Head Bolts (Cold Only)	
Step 1	29 (4.0)
Step 2	43 (6.0)
Step 3	54 (7.5) plus 90°
Camshaft Bearing Caps	14 (2.0)
Main Bearing Caps	47 (6.5)
Connecting Rod Caps	33 (4.5)
Flywheel (Use Loctite)	54 (7.5)
Crankshaft Pulley (Use Loctite)	250 (35.0)
Oil Pan Bolts	14 (2.0)
Oil Pump Mounting Bolts	7 (1.0)
Oil Pump Pickup Tube	7 (1.0)
Timing Belt Cover	7 (1.0)
Cylinder Head Cover	7 (1.0)
Water Pump Mounting Bolts	14 (2.0)
Camshaft Sprocket Bolt	
Front	33 (4.5)
Rear	72 (10.0)
Exhaust Manifold	18 (2.5)
Exhaust Manifold Flange	22 (3.0)
Intake Manifold	22 (3.0)
Injectors	51 (7.0)
Injector Pipes	18 (2.5)
Engine Mounting Bolts	33 (4.5)
Engine to Transmission	43 (6.0)