

**1.8L 4-CYL
Article Text**

1985 Volkswagen Golf
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ARTICLE BEGINNING

1985 ENGINES
Volkswagen 1.8L In-Line 4-Cylinder

Cabriolet, Golf, GLI, GTI, Jetta, Quantum

*** PLEASE READ THIS FIRST ***

NOTE: For engine repair procedures not covered in this article, see **ENGINE OVERHAUL PROCEDURES - GENERAL INFORMATION** article in the **GENERAL INFORMATION** section.

ENGINE CODING

ENGINE IDENTIFICATION

Stamped engine identification number is on machined pad at left side of engine block near ignition distributor. Letter prefix is engine identification code.

ENGINE IDENTIFICATION CODES TABLE

Application	Engine Code
1.8L In-Line 4-Cylinder	
Cabriolet & Scirocco	JH
Golf & Jetta	GX
GLI & GTI	HT
Quantum	JN

ENGINE, MANIFOLDS & CYLINDER HEAD

ENGINE

Removal (Longitudinally Mounted)

NOTE: When removing longitudinally mounted engines, separate engine from transmission before lifting it from engine compartment.

1) Disconnect battery ground strap. Open radiator cap and set heater control to "WARM" position. Disconnect power steering pump from engine and place to side with hoses attached. Drain coolant by disconnecting and removing all hoses at engine end of hose. Leaving fuel lines connected, remove cold start valve, warm-up regulator, fuel injectors and airflow sensor assembly as necessary. Plug injector sockets and cap injectors. Secure all fuel components to right inner fender wall.

2) Disconnect all wiring from radiator fan motor, thermo time switch and any components attached to engine. Remove radiator assembly with shroud and fan attached. Disconnect accelerator and clutch cables as necessary. Remove upper nut from left engine mount. Remove front engine mount. On models without A/C, proceed to step 4).

3) On models with A/C, remove A/C drive belt by loosening nuts on outer portion of crankshaft pulley. Remove 2 upper and 3 lower compressor mounting bracket bolts. Place compressor and bracket to side with hoses and wiring attached. Remove horn bracket, throttle valve housing and auxiliary air regulator as necessary. Remove condenser and place to side with hoses attached.

4) Disconnect exhaust pipe at manifold. Remove starter motor. Remove all nuts from right engine mount. Remove bellhousing

dust plate. On models with A/T, disconnect torque converter from drive plate by removing 3 bolts through starter opening. Hold transmission up from underneath with Transmission Support Bar (VW 785/1B). Tighten hanger bar plate against transmission with slight tension.

5) Attach lifting device to engine. Lift engine slowly until all engine mounts are clear. Remove right engine mount. Readjust hanger bar plate against transmission. Remove remaining upper bolts holding engine to transmission. Separate engine from transmission. Lift engine, turning it so that body is cleared.

NOTE: Lift engine carefully to avoid damage to transmission mainshaft, clutch and body. On models with A/T, secure torque converter to transmission so that it cannot fall out.

Installation (Longitudinally Mounted)

1) To install engine, reverse removal procedure. Use molybdenum disulfide grease on clutch release bearing and transmission mainshaft. DO NOT lubricate release bearing guide sleeve. Place intermediate plate on locating dowels at rear of block, using grease to hold plate in place.

2) Carefully guide engine into vehicle and attach to transmission, while keeping weight off engine mounts. Tighten lower bolts that attach engine to transmission. Remove transmission support bar and lower engine into position on mounts. Replace all self-locking nuts on engine mounts. Install and tighten remaining bolts holding transmission to engine.

3) Recharge A/C system. Final tightening of engine mounts and subframe bolts is done after engine is installed and running at idle speed. Adjust throttle and clutch cables. Adjust A/C belt tension with shims between pulley halves. Fill cooling system and ensure that radiator cooling fan cycles.

Removal (Transversely Mounted)

NOTE: When removing transversely mounted engines, lift engine and transmission from engine compartment as unit.

1) Remove battery from vehicle. Disconnect drive axles from transmission flanges. Secure inner axle ends to body with wire. Remove springs holding together swivel joint of exhaust system. On models with power steering, remove pump and fluid reservoir with hoses attached. Secure pump and reservoir to cross member with wire.

2) Remove radiator grille. On models with A/C, remove front trim panel and lower apron. Disconnect wiring at compressor and radiator fan shroud. Remove compressor and alternator drive belts. Disconnect condenser from crossmember and radiator, leaving hoses and ducting attached.

3) Disconnect vacuum hoses from idle boost valve. Remove air filter housing and airflow sensor assembly and place on radiator, leaving all fuel lines attached. Remove compressor from engine with hoses attached. Secure compressor and condenser out of way with wire.

NOTE: When moving A/C parts that have hoses connected, use care to avoid kinking or squashing lines.

4) Open coolant reservoir cap and drain coolant by removing all coolant hoses. Disconnect wiring from radiator fan motor, thermo time switch and headlights. Disconnect hood release cable from latch and apron. Remove radiator assembly with fan motor and shroud. Disconnect all wiring from electrical components that are attached to engine.

5) On vehicles with M/T, disconnect wiring from transmission switches, upshift indicator vacuum switch and starter. Disconnect clutch and speedometer cables from transmission. Plug speedometer

cable opening. Disconnect gearshift rods from shifter bellcrank and remove bellcrank bracket. On vehicles with A/T, disconnect battery cable from starter and CIS-E wiring harness. Disconnect accelerator and selector lever cables from levers and mounts with selector lever in "PARK".

6) On all models, disconnect accelerator cable at throttle valve linkage and mounting bracket. DO NOT disconnect throttle linkage. Remove cold start valve, warm-up valve and all injectors from engine, leaving all fuel lines connected. Plug injector socket openings and cap injector tips. Disconnect all vacuum, vent and preheat hoses.

7) Attach engine lifting device to 2 lifting eyes located at each end of cylinder head. Apply slight tension to lifting device with hoist. Remove rear engine mount. Disconnect transmission mount. Remove through bolt from front mount. Lift engine/transmission assembly slowly while turning unit slightly to clear front mount.

Installation (Transversely Mounted)

1) To install, reverse removal procedure. Observe all tightening specifications. Make sure engine/transmission assembly clears drive axles during lowering process. Connect rear engine mount, transmission mount and front mount in sequence. ALL engine supports must be aligned with mount bushings before any mount bolts are tightened.

2) Connect and adjust accelerator cable, shift linkage, clutch linkage and headlight alignment as necessary. Make sure that all electrical components are reconnected correctly and wiring harnesses are properly routed. Check and adjust exhaust system alignment if necessary. Fill cooling system and make sure that cooling fan cycles properly.

CYLINDER HEAD & MANIFOLDS

Removal

1) Disconnect battery ground strap. Detach and remove air intake boot. If equipped, remove cold start valve, fuel injectors and control pressure regulator with lines connected. Plug injector seats and cap nozzles on fuel injectors and cold start valve.

2) Drain coolant from engine and disconnect any coolant hoses attached to cylinder head. Label and disconnect all vacuum, air and ventilation hoses attached to cylinder head and intake manifold.

3) Label and disconnect all electrical and ignition wiring attached to cylinder head and intake manifold. Disconnect wire attached to oxygen sensor in exhaust manifold. Remove all drive belts. Remove alternator bracket from cylinder head. Remove upper timing belt cover. Remove cam cover.

4) Remove water pump pulley. Disconnect exhaust pipe from manifold. Disconnect throttle cable. If equipped, remove cruise control servo and linkage. Position No. 1 piston on TDC after compression stroke. Ensure that flywheel timing mark is on 0° (TDC).

5) Loosen timing belt tensioner. Remove timing belt from camshaft sprocket. Loosen head bolts in reverse order of tightening sequence. See Fig. 1. Remove cylinder head with manifolds attached.

CAUTION: If any head bolt(s) require replacement, new polygon head bolts must be replaced in COMPLETE sets only. Polygon head bolts do NOT require retorque subsequent to repairs.

Installation

1) Clean all gasket mating surfaces. Use straightedge to check cylinder head surface for warping. Cylinder head must be resurfaced if distortion exceeds .004" (.10 mm).

2) Minimum thickness of cylinder head after surfacing is 5.22" (132.6 mm). This dimension is measured from head gasket surface

of cylinder head to machined surface of head where camshaft cover gasket sits.

3) Make sure cylinder head bolt holes in block are clean and dry. Place dry cylinder head gasket on cylinder block with word "OBEN" ("TOP") facing upward. Use no sealant on head gasket.

CAUTION: To avoid valve/piston contact damage during installation of head, turn crankshaft counterclockwise about 90° from TDC.

4) Install cylinder head with manifolds. Install head bolts Nos. 8 and 10 to align cylinder head. Install remaining head bolts. Polygon stretch head bolts must be sequentially tightened in 3 stages with engine cold. Tighten head bolts in proper sequence. See Fig. 1.

5) First tightening step is to 29 ft. lbs. (40 N.m). Second step is to 43 ft. lbs. (58 N.m). Third step is to turn bolts 180° (1/2 turn) further in 1 continuous movement or 2 separate 90° (1/4 turn) movements. Install remaining components in reverse order of removal. Ensure valve timing is correct. Install timing belt and adjust tension.

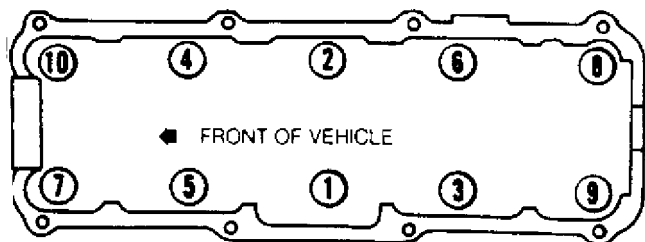


Fig. 1: Cylinder Head Bolt Tightening Sequence
Tighten polygon stretch bolts in 3 stages.

CAMSHAFT

TIMING BELT COVER

Removal & Installation

Outer cover consists of upper and lower parts. Inner (against block) timing belt cover is one piece. Remove all drive belts. Remove crankshaft and water pump pulleys. Remove outer covers. Install in reverse order of removal.

TIMING BELT

CAUTION: Never use camshaft sprocket attaching bolt to turn engine as timing belt could be stretched.

Removal

1) Remove all drive belts, crankshaft pulley and vibration damper. Remove upper and lower timing belt outer covers. Remove camshaft cover from cylinder head. Turn crankshaft to position No. 1 piston at TDC compression. Make sure that distributor housing and flywheel timing marks are correct. See Fig. 2.

2) Loosen timing belt tensioner to relieve tension on timing belt. Slide timing belt off sprockets. Do not allow camshaft, crankshaft or intermediate sprockets to turn when removing timing belt.

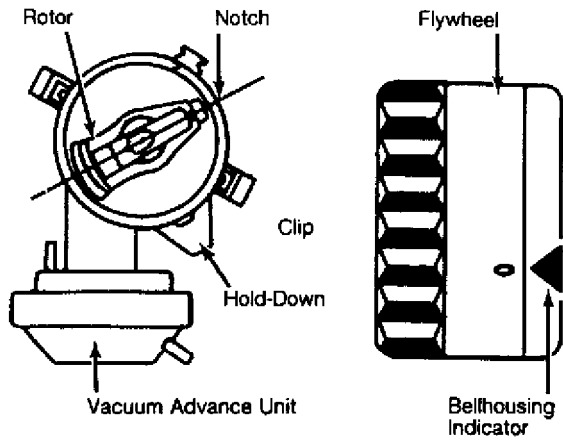


Fig. 2: Distributor & Flywheel TDC Alignment Points

Installation & Valve Timing

1) Set crankshaft at point just before TDC compression for No. 1 cylinder. Place timing belt on crankshaft and intermediate shaft sprockets. Install crankshaft pulley and tighten all 4 bolts. Align mark on crankshaft pulley with mark on intermediate shaft sprocket at No. 1 TDC. See Fig. 3.

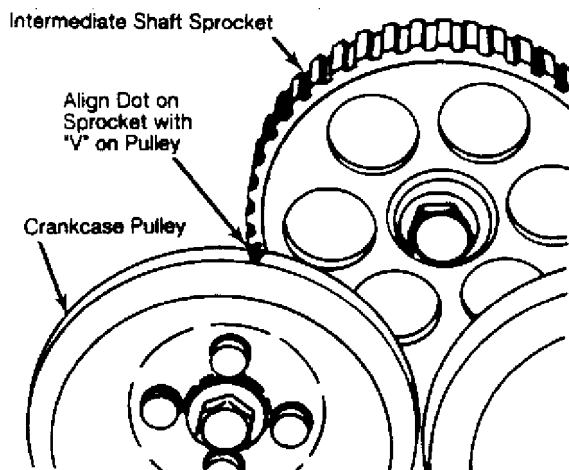


Fig. 3: Aligning Intermediate Shaft & Crankshaft
Rotate intermediate shaft and crankshaft to align marks.

2) Position camshaft so mark on back of sprocket is in line with upper edge of timing belt rear cover. See Fig. 4. Both lobes for No. 1 cylinder should point upward at 45° from camshaft follower so both valves are closed. Install timing belt on camshaft sprocket.

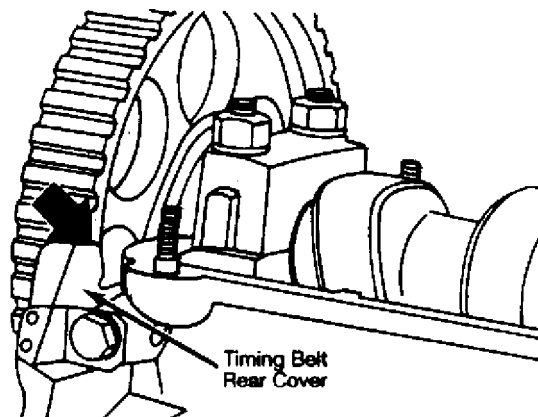


Fig. 4: Setting Camshaft Timing Mark
Align sprocket notch or dot with edge of belt rear cover.

3) Adjust timing belt tension by turning tensioner adjusting hex clockwise against belt. Make sure shaft timing marks have not moved. Tighten tensioner lock nut and check tension of timing belt at point midway between camshaft sprocket and intermediate sprocket. See Fig. 5.

4) Belt has correct tension when it can be twisted 90° with

thumb and finger pressure. Rotate engine by hand through 2 revolutions in clockwise direction. Check all timing marks. If belt tension and valve timing are correct, install remaining components.

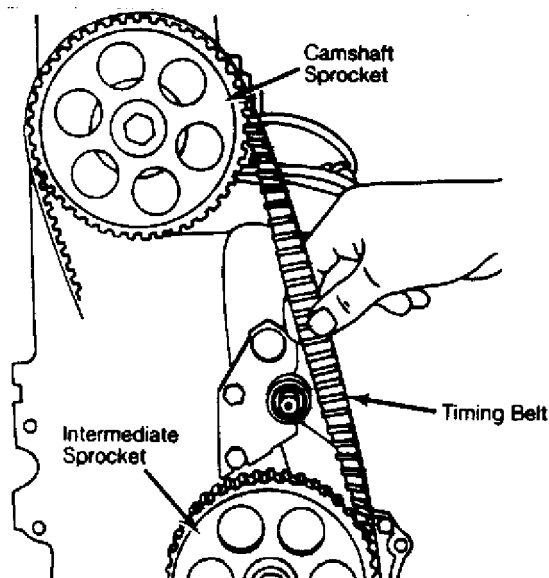


Fig. 5: Adjusting Timing Belt Tension
Correctly adjusted belt will twist 90° with finger pressure.

CAMSHAFT OIL SEAL

Removal

1) Remove upper timing belt cover. Position No. 1 piston on TDC of compression stroke. Loosen tensioner pulley to relieve tension on timing belt. Remove camshaft sprocket and Woodruff key from camshaft. Reinstall sprocket mounting bolt with washer. Use Seal Extractor (2085) to remove oil seal.

2) Extend inner portion of seal extractor 2 turns. Lock inner portion in place with set screw. Lubricate threaded end of extractor. Push end of extractor into seal as far as possible. Loosen set screw and turn inner part of puller against camshaft until seal is pulled out.

Installation

1) Install protective sleeve of Seal Installer (10-203) over camshaft. Coat seal lips with oil. Push seal over sleeve and into position.

2) Using seal installer, press seal into bearing cap recess until flush. Install remaining components in reverse order of removal. Check that valve timing and belt tension are correct before starting engine.

CAMSHAFT

Removal

1) Remove upper timing belt cover. Remove camshaft cover. Turn crankshaft to TDC on cylinder No. 1 on compression stroke. Loosen timing belt tensioner to relieve tension on timing belt. Remove timing belt from camshaft sprocket. Remove camshaft sprocket and Woodruff key.

2) If necessary, mark positions of camshaft bearing caps with No. 1 at front and No. 4 at rear of cylinder head. Remove bearing caps No. 1 and No. 3. Slowly loosen nuts on bearing caps No. 2 and No. 4. Nuts must be removed alternately and diagonally. Remove bearing caps and lift out camshaft.

Identification

Stamped number "026" or letter "A" is found between intake and exhaust lobes of No. 1 cylinder on camshaft. On camshafts with "A" stamp, stamped number "026" may be found between lobes of No. 3

cylinder. Base circle of camshaft, measured between intake lobes of No. 2 and No. 3 cylinders, is 1.34" (34.0 mm).

Installation

1) Before installing camshaft, lubricate camshaft journals and bearing surfaces in cylinder head and caps. Install camshaft. Make sure that oil spray jet orifice is at 90° to camshaft. Install caps No. 2 and No. 4. Make sure caps are not misaligned. See Fig. 6.

2) Tighten caps evenly in alternate and diagonal pattern. Install caps No. 1 and No. 3. Tighten all cap nuts evenly to 14 ft. lbs. (20 N.m). Install remaining components in reverse order of removal. Make sure valve timing and belt tension are correct before starting engine.

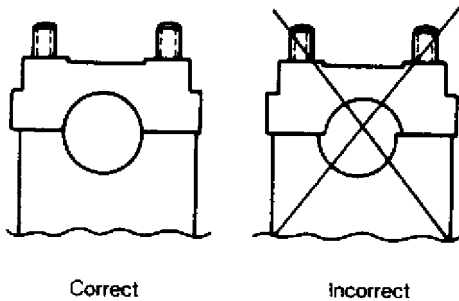


Fig. 6: Checking Camshaft Bearing Cap Alignment
Tighten bearing cap nuts to 14 ft. lbs. (20 N.m).

WEAR MEASUREMENTS

CAUTION: Hydraulic valve lifters are always stored with contact face down. This applies to new lifters or to lifters removed for engine repairs. Lifters will take about 30 minutes to leak down after installation. Do NOT start engine during leak-down period as internal engine damage will occur.

End Play

1) Remove camshaft and valve lifters. Keep lifters in order for reassembly. Place lifters on clean surface with contact faces down. Remove sprocket and oil seal from camshaft. Reinstall camshaft without lifters or seal as any tension on camshaft will make measurement inaccurate. Use only caps No. 1 and No. 5.

2) Attach dial indicator with tip on end of camshaft at 90° to end face of camshaft. Push camshaft rearward and zero dial indicator. Push camshaft forward to record maximum movement. If end play exceeds .006" (.15 mm), check camshaft thrust flange and bearing cap for wear. Replace worn components.

Radial Play

1) Remove camshaft and valve lifters. Keep lifters in order for reassembly. Place lifters on clean surface with contact faces down. Remove sprocket and oil seal from camshaft. Clean bearing caps, bearing seats and camshaft journals.

2) Place camshaft on cylinder head. Make sure that no lobes touch valves or valve spring retainers. Place Plastigage on camshaft journals parallel to length of camshaft. Install bearing caps in correct position and tighten cap nuts. DO NOT rotate camshaft with Plastigage installed.

3) Remove bearing caps and measure radial play. Wear limit for camshaft radial play is .004" (.10 mm). If wear limit is exceeded, repeat measurement with new camshaft installed. If wear limit is still exceeded with new camshaft in place, cylinder head must be replaced.

INTERMEDIATE SHAFT

END PLAY

Using dial indicator, measure intermediate shaft end play. Maximum end play is .010" (.25 mm). Remove distributor prior to removing intermediate shaft.

OIL SEAL

If oil seal replacement is necessary, remove oil seal flange and press out seal. Lubricate new seal lips with oil. Install oil seal flange with oil return hole at bottom edge. Use Seal Installer (10-203) to press seal into place.

VALVES

VALVE ARRANGEMENT

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

VALVE GUIDE SERVICING

Inspection

1) Make sure valve guides are clean and clear of debris. Attach dial indicator and Adapter Fixture (VW 387 or US 4420A) to mounting surface of cylinder head. Insert new valve into valve guide. Use correct valves in respective guides. End of valve stem must be flush with upper end of valve guide.

2) Tip of dial indicator must rest against side of valve head. Rock valve back and forth against tip of dial indicator. Maximum reading on dial indicator is .039" (1.0 mm) for intake valves and .051" (1.3 mm) for exhaust valves. Only replace guides in heads that have valve seats that can be resurfaced.

Removal

Use press and Valve Guide Drift (10-206) to remove valve guides. Press valve guides out of head from combustion chamber side.

Installation

Coat new guide with oil. Press guide into cold cylinder head from camshaft side of head, using valve guide drift. Do not use more than 1 ton of pressure after guide shoulder touches head as shoulder may break off. Ream guide with Hand Reamer (10-215) and cutting oil.

VALVE & VALVE SEAT SERVICING

NOTE: Manufacturer states that exhaust valves must NOT be refaced with machinery and that exhaust valves should be lapped in ONLY by hand.

1) If valves are to be reused, measure valves for minimum dimensions. Minimum intake valve stem diameter is .314" (7.97 mm). Minimum exhaust valve stem diameter is .313" (7.95 mm). Minimum overall length of valve (from face to tip of stem) is 3.58" (90.9 mm) for intake valves and 3.57" (90.7 mm) for exhaust valves.

2) In HT and MG engines, minimum face diameter of intake valves is 1.56" (40.00 mm). In all other engines, minimum face diameter of intake valves is 1.50" (38.0 mm). Minimum face diameter of exhaust valves is 1.30" (33.0 mm) for all engines.

3) Both intake and exhaust valve seats are cut at 45° angle. Using 30° cutter, narrow intake seat to .079" (2.00 mm) and exhaust seat to .094" (2.39 mm). In HT and MG engines, intake valve seat diameter limit is 1.543" (39.2 mm). In all other engines, intake valve seat diameter limit is 1.464" (37.19 mm). Exhaust valve seat diameter limit is 1.275" (32.39 mm) in all engines.

4) To establish limit for cutting valve seats (dimension "y"), measure distance "X" between end of valve stem and upper edge of cylinder head (where camshaft cover gasket rests). See Fig. 7. Insert valve into guide and hold tightly against seat.

5) Measure distance "X". Subtract minimum dimension "X" from measured distance "X". Result is maximum cut allowed (dimension "y") for refacing valve seats. In all engines, minimum dimension "X" is 1.33" (33.8 mm) for intake valves and 1.34" (34.1 mm) for exhaust valves.

6) If minimum dimension "X" is greater than measured distance "X", cylinder head MUST be replaced. If minimum dimension is not observed, hydraulic valve lifters may not function properly.

NOTE: Be sure to remove all traces of grinding compound from valves and guides after valves have been lapped into seats.

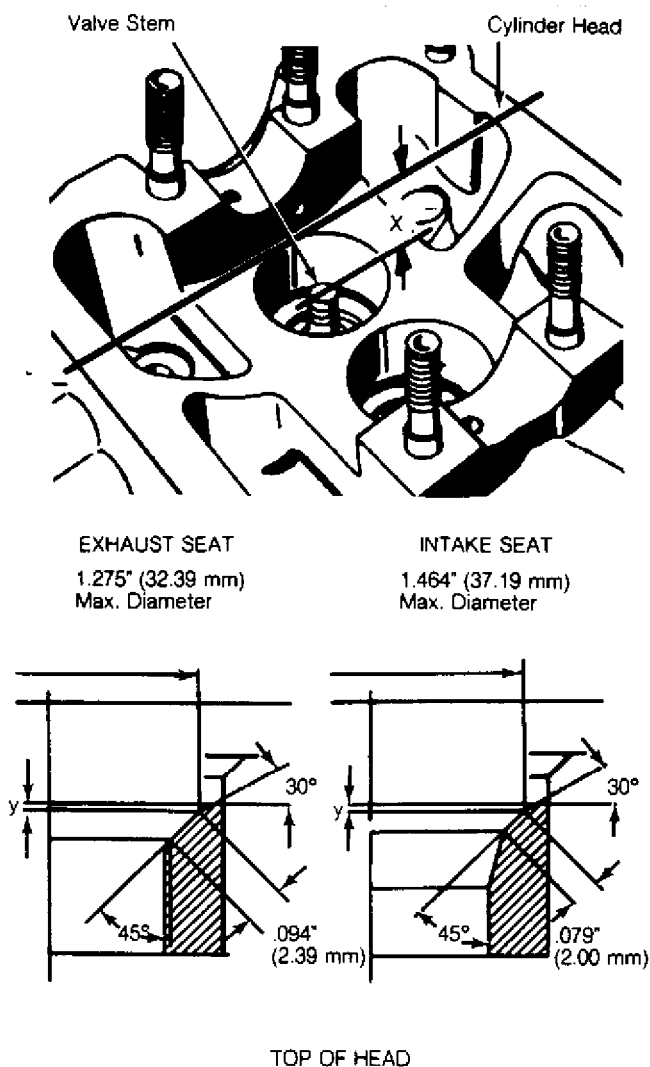


Fig. 7: Measuring Refacing Limit Of Valve Seat
 Minimum dimension "X" is 1.33" (33.8 mm) for intake and 1.34" (34.1 mm) for exhaust.

VALVE STEM OIL SEALS

NOTE: Valve stem oil seals may be replaced with cylinder head installed on vehicle.

Removal

1) Remove camshaft and valve lifters. Keep lifters in order for reassembly. Place hydraulic lifters on clean surface with contact faces down. Remove spark plug and place piston of cylinder being serviced at bottom of stroke (BDC). Install air hose and Adapter (VW 653/3) in spark plug hole and apply air pressure.

CAUTION: Engine may rotate due to air pressure if piston is not at

true BDC. Keep hands clear of belts and pulleys.

2) Do not remove air pressure until valve spring components have been reassembled. Compress valve springs with Valve Spring Compressor (VW 541). Remove keepers, dual valve springs and both spring seats. Remove seal from valve stem.

Installation

Slide plastic protective sleeve onto valve stem. Failure to use sleeve may result in edge of valve stem tip cutting lip of seal. Excessive oil consumption and smoking will occur if seal is damaged. Lubricate new seal and push into place with Seal Installer (10-204). Install remaining components in reverse order of removal. Make sure valve timing is correct.

CAUTION: Hydraulic valve lifters are always stored with contact face down. This applies to new lifters or to lifters removed for engine repairs. Lifters will take about 30 minutes to leak down after installation. Do NOT start engine during leak-down period as internal engine damage will occur.

VALVE SPRINGS

Dual valve springs may be replaced with cylinder head installed on vehicle. To replace valve springs, use removal and installation procedure explained in VALVE STEM OIL SEALS. Both inner and outer valve springs must be replaced together if either is bad.

HYDRAULIC VALVE LIFTERS

Inspection

1) Hydraulic valve lifters are neither repairable nor adjustable. Any worn, damaged or noisy lifter must be replaced as complete assembly. Some occasional valve/lifter noise is normal immediately after starting engine.

2) Run engine until radiator cooling fan has cycled at least once. Hold engine at steady 2500 RPM for 2 minutes. Allow engine speed to return to idle. If lifter is still noisy, replace it.

3) Remove camshaft cover. Turn engine by crankshaft bolt until both camshaft lobes of cylinder to be checked point upward. Push down on lifters with wooden stick. If lifter can be compressed more than .004" (.1 mm), it must be replaced.

4) If hydraulic valve lifters are removed for engine repairs, keep them in correct order for reassembly. Store lifters on clean surface with contact surface facing down (upside down compared to installed position).

CAUTION: Hydraulic valve lifters are always stored with contact face down. This applies to new lifters or to lifters removed for engine repairs. Lifters will take about 30 minutes to leak down after installation. Do NOT start engine during leak-down period as internal engine damage will occur.

PISTONS, PINS & RINGS

OIL PAN

Removal

Drain engine oil. Attach lifting device or Support Bar (10-222) to engine. Raise engine slightly to support engine weight. If equipped, remove cover plate under engine. Remove both front bolts of subframe. Pull front end of subframe down to clear oil pan. Unbolt and remove oil pan.

Installation

Install oil pan with new gasket. Do NOT use any adhesive on gasket. Install oil pan bolts and tighten in diagonal pattern. Install subframe and cover plate, if equipped. Remove support bar from engine.

PISTON & ROD ASSEMBLY

NOTE: All connecting rods must be in same weight class. Connecting rods of same weight class are only available in sets of 4.

Removal

1) Remove cylinder head, oil pan and oil pump. Place piston to be removed at bottom of cylinder and cover with cloth to collect metal cuttings. Using ridge reamer, remove ridge or deposit from upper end of cylinder bore.

2) Before removing piston and rod from engine, mark piston, rod and rod cap as to cylinder and position. This will ensure that reassembly position is correct. Remove rod cap and carefully push piston and rod out top of cylinder. Loosely install rod cap on rod so rod caps and rods do not become interchanged.

Installation

1) Cover rod bolts with hose or tape to avoid damaging rod journals on crankshaft. Coat cylinder bore, piston and rings with engine oil. Ensure ring gaps are spaced 120° apart and install ring compressor on piston.

2) Make sure that ring position does not change. Install piston and rod in correct bore, with arrow on piston head pointing toward front of engine. Forged casting marks on rod and cap must face toward intermediate shaft.

FITTING PISTONS

Identification

Recess depth on face of piston varies depending upon engine application. On HT and MG engines, recess depth is .173" (4.4 mm). On all other engines, recess depth is .319" (8.1 mm).

Sizing

1) Take 3 cylinder bore measurements with inside micrometer or cylinder bore gauge. Take 1 set of measurements at 90° to crankshaft centerline. Take second set of measurements in line with crankshaft centerline. Measuring points should be at point 3/8" from top of bore, at middle of bore and at point 3/8" from bottom of bore.

NOTE: Do not measure cylinder bore when block is on engine stand as block could be distorted. Resulting measurements would be inaccurate.

2) Difference between sets of measurements at same point is cylinder out-of-round. Maximum cylinder out-of-round is .0016" (.04 mm). If cylinder bore measurements vary from top to bottom, taper of bore may be excessive. If out-of-round or taper is excessive, block must be honed or bored to next oversize. Maximum deviation allowed from nominal dimensions, as shown in PISTON & CYLINDER DIMENSIONS table, is .003" (.08 mm).

3) If cylinder bore is within limit for out-of-round, measure piston diameter at 90° to piston pin bore, about 9/16" (15 mm) from bottom of piston skirt. Compare this measurement with measurement of corresponding cylinder bore. If taper is such that piston skirt clearance is excessive, block must be honed or bored to next oversize.

4) Clearance between piston and cylinder wall should be

.001" (.03 mm) for new parts. Wear limit for clearance between piston and cylinder wall is .003" (.08 mm). Install oversize pistons if wear limit is exceeded. Pistons are available in oversizes of 81.23 mm and 81.48 mm. Pistons have 4-digit number marked on face, which gives diameter in millimeters.

PISTON & CYLINDER DIMENSIONS TABLE

Size	Piston Diameter	Cylinder Bore
Standard	80.98 mm	81.01 mm
1st Over	81.23 mm	81.26 mm
2nd Over	81.48 mm	81.51 mm

FITTING RINGS

1) Place piston rings squarely into cylinder bore about .59" (15 mm) from bottom of bore. Using feeler gauge, measure ring end gap. End gap should be .012-.018" (.30-.45 mm) for new compression rings. End gap should be .010-.016" (.25-.40 mm) for new oil scraper rings. Maximum end gap is .04" (1.0 mm) on all rings.

2) With rings installed on piston, use a feeler gauge to measure ring side clearance. Take measurement around entire circumference of piston, between top of ring and ring land. New parts should have side clearance of .0008-.002" (.02-.05 mm). Wear limit for side clearance is .006" (.15 mm).

3) Install rings on piston with "TOP" mark facing upward. Recessed edge on outside of center ring must face piston pin (down). Ring end gaps should be spaced 120° apart when piston is installed.

PISTON PIN REPLACEMENT

Removal

Remove circlip from pin bore groove. Use Piston Pin Drift (VW 222a or VW 207c) to remove and install piston pins. If pins are very tight, warm pistons to 140° F (60° C).

Installation

Assemble connecting rod to piston. Arrow on piston head and forged casting beads on connecting rod must face toward front of engine when assembly is installed. Use piston pin drift to install piston pin. Pin, piston and rod bushing should have interference fit. Install circlip into pin bore groove.

CRANKSHAFT & ROD BEARINGS

MAIN BEARINGS

1) Five main bearings are numbered front to rear. Main bearing caps must NEVER be interchanged. Always measure main bearing clearances 1 at a time.

2) Use Plastigage method for measuring bearing clearances. Clean any oil film from bearing shells and crankshaft journals before measuring clearance. Main bearing clearance with new parts should be .001-.003" (.03-.08 mm). Wear limit for main bearing clearance is .007" (.17 mm).

3) When replacing bearings, install bearing halves with lubrication grooves into cylinder block. Plain bearing halves are installed in main bearing caps. Make sure locating tangs butt against each other when installed. Lubricate crankshaft journal and bearings prior to installing bearings.

CONNECTING ROD BEARINGS

1) Always measure connecting rod bearing clearances 1 at a time. Use Plastigage method for measuring bearing clearances. Clean oil film from bearing shells and crankshaft journals before measuring clearance.

2) Connecting rod bearing clearance should be .0011-.0034" (.028-.088 mm) with new parts. Wear limit for connecting rod bearing clearance is .005" (.12 mm). Using feeler gauge, measure clearance between side of connecting rod and face of crankshaft counterweight. Wear limit for connecting rod side clearance is .015" (.37 mm).

3) Install connecting rod stretch bolts. Install bearings and rod cap. Make sure that bearing tangs are correctly located so that they butt against each other. Lubricate contact surface of rod nuts and tighten evenly to 22 ft. lbs. (30 N.m). Tighten both nuts additional 90° (1/4 turn).

CRANKSHAFT END PLAY

Use a feeler gauge to check crankshaft end play. Insert feeler gauge between No. 3 main bearing (thrust bearing) and crankshaft thrust face. With new parts, end play should be .003-.007" (.07-.17 mm). Wear limit for end play is .010" (.25 mm). Original thrust bearing uses plain shell with 4 separate washers while replacement thrust bearings have attached collar.

CRANKSHAFT REAR OIL SEAL

Removal

If engine is in vehicle, remove transmission. Remove flywheel/flex plate, noting position of shim if used. Use Flywheel Lock (10-201) to hold flywheel/flex plate when loosening and tightening bolts. Carefully pry oil seal from seal flange.

Installation

1) Coat new seal lips with oil. Place Centering Sleeve (2003/2A) on crankshaft and start seal into place. Using Seal Installer (2003/1), press in seal until seated.

2) On models with flex plate (A/T), measure distance from back of block to face of flex plate (converter side) with intermediate plate removed. Distance must be 1.20-1.26" (30.5-32.1 mm), measured from lower left corner of block (high point). If distance is too small, install shim between end of crankshaft and flex plate.

3) Install intermediate plate, making sure it is located on dowel sleeves. Chamfered side of washer faces flex plate during installation. On all models, bolts with NO shoulder are tightened to 55 ft. lbs. (75 N.m). Bolts with shoulder should be replaced with new bolts and tightened to 74 ft. lbs. (100 N.m). Install remaining components.

CRANKSHAFT FRONT OIL SEAL

Removal

1) Remove all drive belts. Remove upper timing belt cover. Set No. 1 piston on TDC after compression stroke. Remove crankshaft pulley. Install Locking Retainer (3099) and loosen bolt that holds timing belt sprocket to crankshaft. Remove water pump pulley.

2) Remove lower timing belt cover. Loosen timing belt tensioner. Remove timing belt and drive sprocket. Install Allen head bolt from Seal Installer (3083) in end of crankshaft. Remove seal using Seal Extractor (2085) guided by bolt from installer.

Installation

1) Slide sleeve from Seal Installer (3083) onto crankshaft.

Slide new seal over sleeve after dipping seal in fresh engine oil. Place thrust sleeve from installer over guide sleeve.

2) Press seal into place with thrust sleeve and Allen head bolt until seal is fully seated. Install crankshaft timing belt sprocket, making sure keyed lug on sprocket is fitted to machined groove in crankshaft. Use locking retainer to hold crankshaft.

3) Use oil to coat threads of bolt which secures timing belt sprocket to crankshaft. Install bolt and tighten to 148 ft. lbs. (200 N.m). Install remaining components. Make sure valve timing and timing belt tension are correct.

ENGINE OILING

ENGINE OILING SYSTEM

Oiling system is 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 lubrication by drainage or splash method.

CRANKCASE CAPACITY

Capacity is 3.7 quarts (3.5L) without filter replacement; 4.3 quarts (4.0L) with filter replacement.

NORMAL OIL PRESSURE

Minimum oil pressure is 29 psi (2.0 kg/cm²) at 2000 RPM, with oil temperature of 176° F (80° C). Specification is for 20W/20 type engine oil.

OIL PUMP

Removal & Disassembly

Remove oil pan. Remove oil pump attaching bolts and lower pump away from engine. Remove pump pick-up bolts. Separate pickup from pump body. Remove strainer cover from pick-up tube and clean strainer.

Inspection

1) With oil pump gears installed in pump housing, insert feeler gauge between drive gear and driven gear teeth (where teeth mesh). Measure pump gear backlash. Maximum backlash is .002-.008" (.05-.20 mm).

2) Place straightedge over pump housing. Insert feeler gauge between pump gears and straightedge. Maximum end play of gears is .006" (.15 mm).

Reassembly & Installation

Assemble pump in reverse order of disassembly. Prime oil pump prior to installing. Install pump in reverse order of removal procedures. Make sure engine has oil pressure after starting.

ENGINE COOLING

CAUTION: Coolant/water mixture should be used at all times. Only ethylene glycol based (phosphate-free) antifreeze may be used, as it protects aluminum/iron engines from corrosion.

WATER PUMP

Removal & Disassembly

1) Set heater control on dash to warm (partially opens

heater control valve). Remove cap from expansion tank. Disconnect wiring and remove thermo-time switch from coolant flange on left side of head. Drain coolant. Remove alternator and drive belt.

2) Remove coolant hoses at pump housing. Remove water pump pulley. Remove bolts holding pump housing against engine block. Remove pump assembly. Unbolt and separate impeller portion from pump housing.

Reassembly & Installation

1) To reassemble, reverse disassembly procedure. Use new gasket between pump and housing. When installing pump assembly, use new "O" ring between pump housing and engine block. Open heater control valve fully. Add coolant to expansion tank until coolant comes out of thermo time switch opening on coolant flange.

2) Reinstall thermo time switch and connect wiring. Fill expansion tank 3/4" above full mark. Start and run engine until radiator cooling fans cycles on and off. Check coolant level. Fill expansion tank if necessary. Make sure coolant circulates (thermostat opens).

NOTE: For information on cooling system capacities and other cooling system components, see appropriate article in **ENGINE COOLING SYSTEMS** section.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

AA

Application	Ft. Lbs. (N.m)
Camshaft Bearing Cap Nut	14 (20)
Camshaft Sprocket Bolt	58 (80)
Connecting Rod Cap Nut	(1) 22 (30)
Crankshaft Pulley Nut	14 (20)
Crankshaft Sprocket Bolt	148 (200)
CV Joint-to-Flange	33 (45)
Cylinder Head Bolt (Engine Cold)	
Step 1	29 (40)
Step 2	43 (60)
Step 3	Plus 180° (1/2 Turn)
Engine-to-Transmission Bolt	
M10	33 (45)
M12	54 (75)
Engine/Transmission-to-Body	
Longitudinally Mounted Unit	
Front Mount-to-Body	18 (25)
Side Mounts-to-Subframe	25 (35)
Transversely Mounted Unit	
Front Mount-to-Body Bolt	
Front	51 (70)
Rear	25 (35)
Front Mount-to-Trans. Bolt	33 (45)
Front Mount Through Bolt	36 (50)
Rear Mount-to-Bushing Bolt	18 (25)
Rear Mount-to-Engine Bolt	18 (25)
Rear Mount Through Bolt	58 (80)
Trans. Mount-to-Bushing Bolt	43 (60)
Trans. Mount Bushing-to-Body	18 (25)
Exhaust Pipe-to-Manifold Nut	25 (35)
Flywheel-to-Crankshaft Bolt (2)	
Without Shoulder	55 (75)
With Shoulder (3)	74 (100)

Intermediate Shaft Sprocket Bolt	58 (80)
Main Bearing Cap Bolts	47 (65)
Manifold Fasteners (M8)	18 (25)
Power Steering Pump-to-Bracket Nut	14 (20)
Timing Belt Tensioner Nut	33 (45)
Torque Converter-to-Drive Plate Bolt	
Longitudinally Mounted	14 (20)
Transversely Mounted	22 (30)

(1) - Plus 90° (1/4 turn) after reaching specified torque.

(2) - Use locking compound.

(3) - Always use new bolts.

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ENGINE SPECIFICATIONS

GENERAL ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS TABLE

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Application	In. (mm)
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Cabriole

Displacement

Cubic Inches	109
Liters	1.8

Fuel System

CIS-E Fuel Injection

HP @ RPM

90 @ 5500

Torque Ft. @ RPM

100 @ 3000

Compression Ratio

8.5:1

Bore

3.19 (81.0)

Stroke

3.40 (86.4)

GLT & GTI

Displacement

Cubic Inches	109
Liters	1.8

Fuel System

CIS-E Fuel Injection

HP @ RPM

100 @ 5500

Torque Ft. @ RPM

105 @ 3000

Compression Ratio

10.0:1

Bore

3.19 (81.0)

Stroke

3.40 (86.4)

Golf & Jetta

Displacement

Cubic Inches	109
Liters	1.8

Fuel System

CIS-E Fuel Injection

HP @ RPM

85 @ 5250

Torque Ft. @ RPM

96 @ 3000

Compression Ratio

9.0:1

Bore

3.19 (81.0)

Stroke

3.40 (86.4)

Quantum

Displacement

Cubic Inches	109
Liters	1.8

Fuel System

CIS-E Fuel Injection

HP @ RPM

88 @ 5500

Torque Ft. @ RPM

109 @ 3000

Compression Ratio

8.5:1

Bore

3.19 (81.0)

Stroke	3.40 (86.4)
Scirocco	
Displacement	
Cubic Inches	109
Liters	1.8
Fuel System	CIS-E Fuel Injection
HP @ RPM	90 @ 5500
Torque Ft. @ RPM	100 @ 3000
Compression Ratio	8.5:1
Bore	3.19 (81.0)
Stroke	3.40 (86.4)

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VALVE SPECIFICATIONS

VALVE SPECIFICATIONS TABLE

AA

Application	In. (mm)
Intake (GX/JN)	
Head Diam.	1.496 (38.00)
Face Angle	45°
Seat Angle	45°
Seat Width079 (2.01)
Stem Diameter314 Min. (7.97)
Stem Clearance
Valve Lift
Intake (HT/JH)	
Head Diam.	1.575 (40.00)
Face Angle	45°
Seat Angle	45°
Seat Width079 (2.01)
Stem Diameter314 Min. (7.97)
Stem Clearance
Valve Lift
Exhaust	
Head Diam.	1.300 (33.00)
Face Angle	45°
Seat Angle	45°
Seat Width094 (2.40)
Stem Diameter313 Min (7.95)
Stem Clearance
Valve Lift

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PISTONS, PINS & RINGS SPECIFICATIONS

PISTONS, PINS & RINGS SPECIFICATIONS TABLE

AA

Application	In. (mm)
Pistons	
Clearance	(1) .0011 (.028)
Pins	
Piston Fit	(2)
Rod Fit	Interference
Rings	
Ring No.	All
End Gap	(3) .012-.018 (.30-.46)
Side Clearance	(4) .0008-.0020 (.020-.050)

- (1) - Wear limit is .003" (.07 mm).
- (2) - Light press fit at 140°F (60°C).
- (3) - Wear limit is .040" (1.02 mm).

(4) - Wear limit is .006" (.15 mm).

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CRANKSHAFT MAIN & CONNECTING
ROD BEARINGS SPECIFICATIONS

CRANKSHAFT MAIN & CONNECTING
ROD BEARINGS SPECIFICATIONS TABLE

AA

Application In. (mm)

1.8L

Standard Size

Main Bearings

Journal Diam.	(1)	2.124-2.125	(53.96-53.98)
Clearance	(2)	.001-.003	(.03-.07)
Thrust Bearing			No. 3
Crankshaft End Play	(3)	.003-.007	(.07-.17)

Connecting Rod Bearings

Journal Diam.	(1)	1.880-1.881	(47.76-47.78)
Clearance	(4)	.0011-.0034	(.028-.088)
Side Play015 Max.	(.38)

1st Under Size

Main Bearings

Journal Diam.		2.114-2.115	(53.71-53.73)
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Connecting Rod Bearings

Journal Diam.		1.871-1.872	(47.51-47.53)
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2nd Under Size

Main Bearings

Journal Diam.		2.104-2.105	(53.46-53.48)
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Connecting Rod Bearings

Journal Diam.		1.860-1.861	(47.26-47.28)
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3rd Under Size

Main Bearings

Journal Diam.		2.095-2.096	(53.21-53.23)
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Connecting Rod Bearings

Journal Diam.		1.851-1.852	(47.01-47.03)
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(1) - Out-of-round limit is .001" (.03 mm).

(2) - Wear limit is .007" (.17 mm).

(3) - Wear limit is .010" (.25 mm).

(4) - Wear limit is .005" (.12 mm).

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END OF ARTICLE