

# 1.8L 4-CYL 8-VALVE & 1.8L 4-CYL 16-VALVE

## Article Text

1986 Volkswagen Scirocco

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### ARTICLE BEGINNING

1986 VOLKSWAGEN ENGINES

1.8L 8-Valve & 1.8L 16-Valve 4-Cylinder

Cabriolet, GLI, Golf, GTI, Quantum, Scirocco

#### \* 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 8-Valve 4-Cylinder	
Cabriolet .....	JH
Golf & Jetta .....	GX
GLI & GTI .....	RD
Quantum .....	JN
Scirocco .....	JH
1.8L 16-Valve 4-Cylinder	
Scirocco .....	PL

### 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. 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 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 with Transmission Support Assembly (3147 and 10-222A). 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 automatic transmission, secure torque converter to transmission so that it cannot fall out.

#### Installation

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 attaching engine to transmission. Remove transmission support bar and lower engine into position on mounts. Replace 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 transaxle from engine compartment as a unit. The intake manifold must be removed on Scirocco 16-valve engines prior to engine removal.

1) Remove battery from vehicle. Disconnect drive axles from transaxle flanges. Secure inner drive 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 crossmember 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 flattening lines.

4) Open coolant reservoir cap and drain coolant by removing 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 manual transaxle, disconnect wiring from transaxle mounted 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.

6) On vehicles with automatic transaxles, 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".

7) 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 injectors from engine, leaving all fuel lines connected. Plug injector socket openings and cap injector tips. Disconnect all vacuum, vent, and preheat hoses.

8) 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 transaxle mount. Remove through bolt from front mount. Lift engine/transaxle assembly slowly while turning unit slightly to clear front mount.

#### Installation

1) To install, reverse removal procedure. Make sure engine/transaxle assembly clears drive axles during lowering process. Connect rear engine mount, transaxle 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 all electrical components are connected 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. On Scirocco 16-valve engine, remove upper half of intake manifold. See Fig. 6.

4) On all models, 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 camshaft cover.

5) 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 of compression stroke. Ensure that flywheel timing mark is on "0" (TDC).

6) 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) On Scirocco 16-valve engine, minimum thickness of cylinder head after surfacing is 4.65" (118.1 mm). This dimension is measured from cylinder head gasket surface to machined surface of head where cylinder head bolt sits.

3) On all others, minimum thickness of cylinder head after surfacing is 5.22" (132.6 mm). This dimension is measured from cylinder head gasket surface to machined surface of head where camshaft cover gasket sits.

4) On all models, 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.

5) 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.

6) First tightening step is to 29 ft. lbs. (40 N.m). Second step is to 44 ft. lbs. (60 N.m). Third step is to turn bolts 180 degrees (1/2 turn) further in one continuous movement or in 2 separate 90 degree (1/4 turn) movements. Install remaining components in reverse order of removal. Ensure valve timing is correct. Install timing belt and adjust tension.

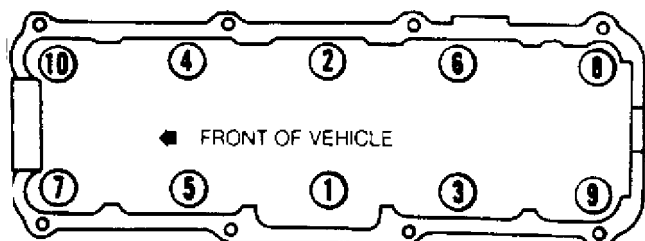


Fig. 1: Cylinder Head Bolt Tightening Sequence  
Courtesy of Volkswagen United States, Inc.

### CAMSHAFT

#### TIMING BELT COVER

#### Removal & Installation

Outer cover consists of upper and lower parts. See Fig. 2. Inner (against block) timing belt cover is one piece. Remove all drive belts. Remove crankshaft and water pump pulleys. Remove outer covers. To install, reverse removal procedure.

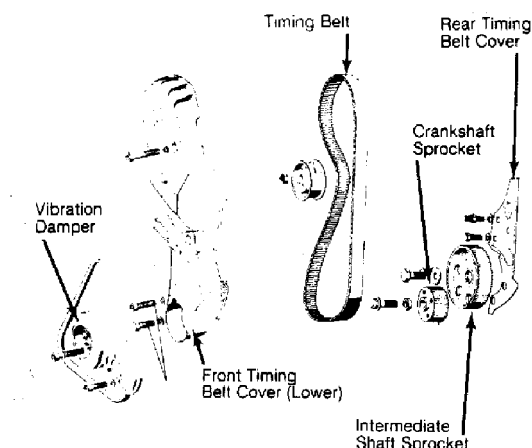


Fig. 2: Scirocco 16-Valve Timing Belt Cover  
& Timing Belt Assembly  
Courtesy of Volkswagen United States, Inc.

## 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. On Scirocco 16-valve engine, remove upper half of intake manifold.

2) On all models, remove camshaft cover from cylinder head. Turn crankshaft to position No. 1 piston at TDC of compression stroke. Make sure distributor housing and flywheel timing marks are correctly aligned.

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

### Installation

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 TDC. See Fig. 3.

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 degrees from camshaft follower so both valves are closed. Install timing belt on camshaft sprocket.

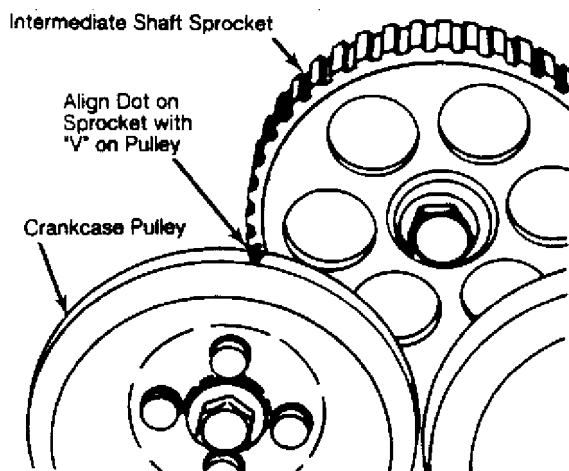


Fig. 3: Aligning Intermediate Shaft & Crankshaft  
Courtesy of Volkswagen United States, Inc.

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 degrees 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.

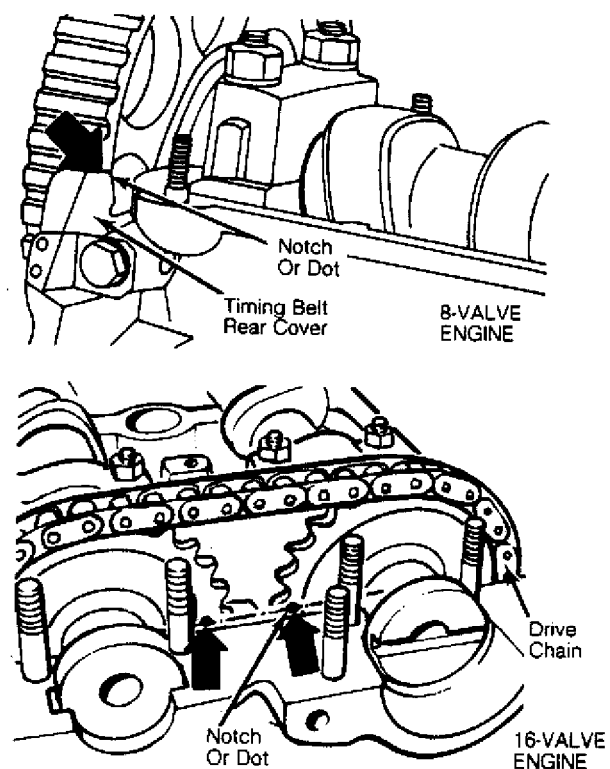


Fig. 4: Setting Camshaft Timing Marks  
 Courtesy of Volkswagen United States, Inc.

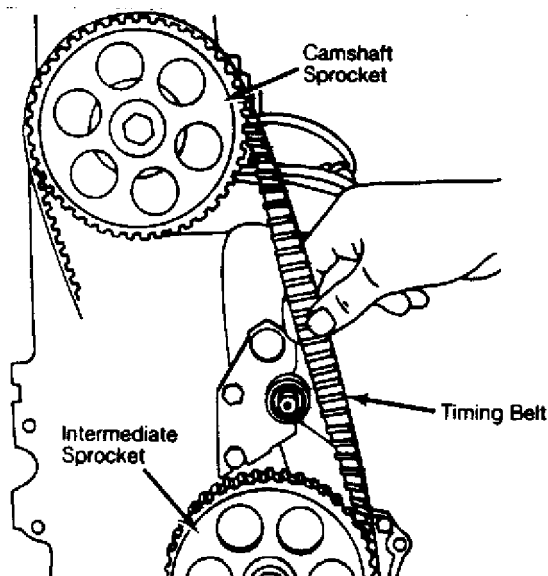


Fig. 5: Adjusting Timing Belt Tension  
 Courtesy of Volkswagen United States, Inc.

#### 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 (if equipped).

2) Reinstall sprocket mounting bolt with washer. Use Seal Extractor (2085) to remove oil seal. Extend inner portion of seal extractor 2 turns. Lock inner portion in place with set screw.

3) 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. Using seal installer, press seal into bearing cap recess until flush.

2) On Scirocco 16-valve engine, the use of Bolt (10-203/1)

is also required. Install remaining components in reverse order of removal. Ensure valve timing and belt tension are correct before starting engine.

## CAMSHAFT

### Removal

1) Remove upper timing belt cover. On Scirocco 16-valve engine, remove intake manifold upper half. On all models, remove camshaft cover. Turn crankshaft to position cylinder No. 1 on TDC of compression stroke.

2) Loosen timing belt tensioner to relieve tension on timing belt. Remove timing belt from camshaft sprocket. Remove camshaft sprocket and Woodruff key (if equipped).

3) On all models except Scirocco 16-valve engine, 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 camshaft.

4) On Scirocco 16-valve engine, remove bearing caps No. 5 and No. 7 as well as drive chain end cap from intake camshaft. See Fig. 6. Slowly loosen nuts on bearing caps No. 6 and No. 8. Nuts must be removed alternately and diagonally.

5) Remove bearing caps No. 1 and No. 3 as well as end caps from intake camshaft. Slowly loosen nuts on bearing caps No. 2 and No. 4. Nuts must be removed alternately and diagonally. Remove bearing caps, camshafts, and drive chain. See Fig. 6.

### Identification

1) On all models except Scirocco 16-valve engine, a stamped number "026" or letter "A" ("G" on GTI and Jetta GLI) is found between intake and exhaust lobes of No. 1 cylinder on camshaft.

2) On camshafts with letter "A" or "G", 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. On all models except Scirocco 16-valve engine, install camshaft. Make sure that oil spray jet orifice is at 90 degrees to camshaft.

2) Install caps No. 2 and No. 4. Make sure caps are not misaligned. Tighten caps evenly in an alternate and diagonal pattern. Install caps No. 1 and No. 3. Tighten all cap nuts evenly to 14 ft. lbs. (20 N.m).

3) On Scirocco 16-valve engine, install camshafts and drive chain as an assembly. Ensure timing marks on camshaft are aligned. See Fig. 4. Tighten intake camshaft bearing caps No. 6 and No. 8 evenly in an alternate and diagonal pattern to 11 ft. lbs. (15 N.m).

4) Install remaining intake camshaft bearing caps and tighten to 11 ft. lbs. (15 N.m). Tighten exhaust camshaft bearing caps No. 2 and No. 4 evenly in an alternate and diagonal pattern to 11 ft. lbs. (15 N.m). Install remaining exhaust camshaft bearing caps and tighten to 11 ft. lbs. (15 N.m).

5) Install camshaft sprocket and tighten bolt to 48 ft. lbs. (65 N.m). On all models, install remaining components in reverse order of removal. Make sure valve timing and belt tension are correct before starting engine.

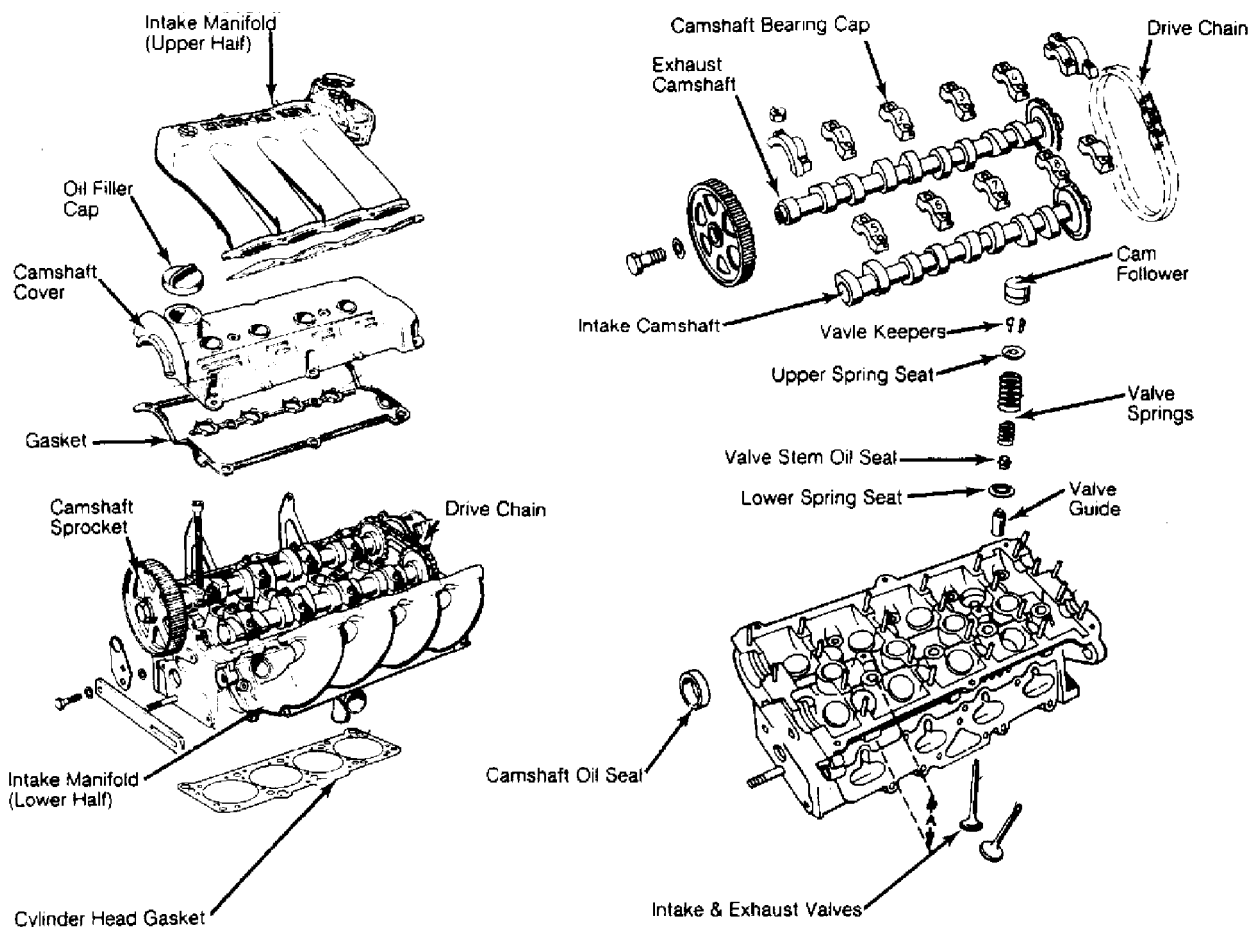


Fig. 6: Exploded View of Scirocco 16 Valve Cylinder Head Assembly  
 Courtesy of Volkswagen United States, Inc.

### CAMSHAFT INSPECTION

**CAUTION:** Hydraulic valve lifters are always stored with contact faces (camshaft side) 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(s) 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(s) without lifters or seal as any tension on camshaft(s) will make measurement inaccurate. Use only outermost camshaft bearing caps (No. 1 and No. 5 on 8-valve cylinder head).

2) Attach dial indicator with tip on end of camshaft at 90 degrees 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(s) 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(s) 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

Remove distributor prior to removing intermediate shaft. See Fig. 8. Measure intermediate shaft end play. Maximum end play is .010" (.25 mm).

### 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

Scirocco (16 Valve) - Exhaust valves are on exhaust manifold side of head. Intake valves are on intake manifold side.  
All Others - E-I-E-I-I-E-I-E (Front-to-rear).

### VALVE GUIDES

#### Inspection

1) Make sure valve guides are clean and clear of debris. Attach dial indicator and 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 .04" (1.0 mm) for intake valves and .05" (1.3 mm) for exhaust valves.

**CAUTION:** Replace valve guides in only those heads that have valve seats that can be resurfaced.

#### Removal

On Scirocco 16-valve engine, use press, Valve Guide Drift (3121), and Support (30-23) to remove valve guides. On all others, use press and Valve Guide Drift (10-206) to remove valve guides. Press valve guides out of head from combustion chamber side.

#### Installation

1) Coat new guide with oil. Press guide into cold cylinder head from camshaft side of head, using valve guide drift. On Scirocco 16 valve engine, the use of Valve Guide Backing Plate (3123) is also required. Do not use more than one ton of pressure after guide shoulder touches head as shoulder may break off.

2) On Scirocco 16-valve engine, ream guide with Hand Reamer (3120) and cutting oil. On all others, ream guide with Hand Reamer (10-215 or US 4412 on 4000S) and cutting oil. Reface valve seats.

## VALVE & VALVE SEAT SERVICING

1) If valves are to be reused, measure valves for minimum dimensions. See VALVES specification table at end of article. On

Scirocco 16-valve engine, minimum overall length of valve (from face to tip of stem) is 3.76" (95.5 mm) for intake valves and 3.87" (98.2 mm) for exhaust valves.

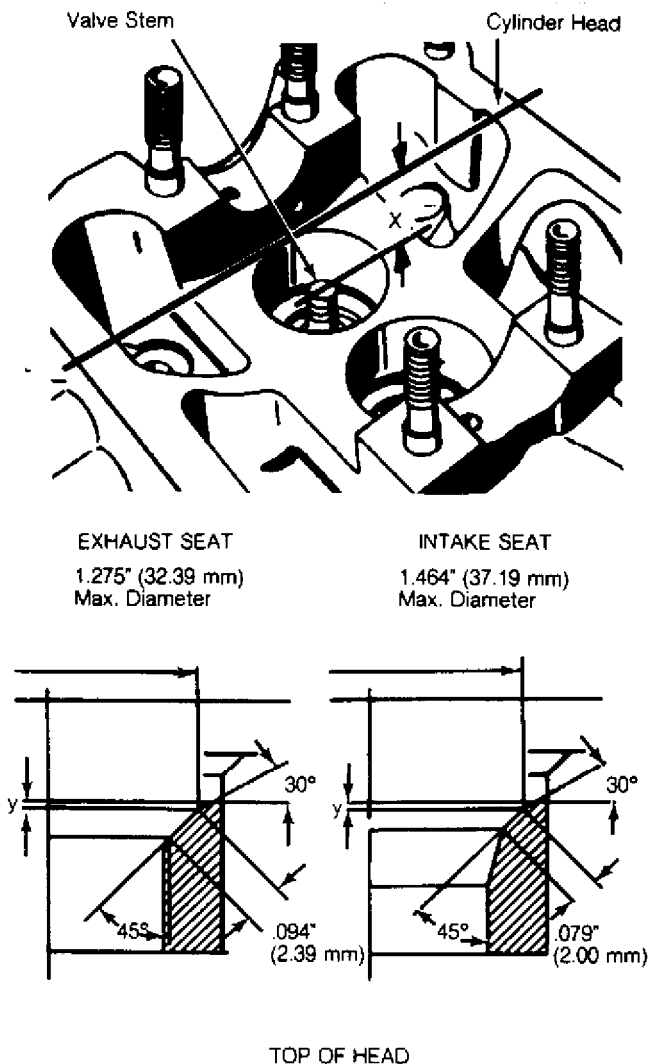
2) On all others, minimum overall length of valve is 3.58" (90.9 mm) for intake valves and 3.57" (90.7 mm) for exhaust valves. To establish limit for cutting valve seats (dimension "Y"), measure distance "X" between end of valve stem and upper edge of cylinder head. See Fig. 7.

3) Insert valve into guide and hold tightly against seat. Measure distance "X". Subtract minimum dimension "X" from measured distance "X". Result is maximum cut allowed (dimension "Y") for refacing valve seats.

4) On Scirocco 16-valve engine, minimum dimension "X" is 1.35" (34.4 mm) for intake valves and 1.37" (34.7 mm) for exhaust valves. On all others, minimum dimension "X" is 1.33" (33.8 mm) for intake valves and 1.34" (34.1 mm) for exhaust valves.

5) 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:** On Scirocco 16-valve engine, both intake and exhaust valves must NOT be refaced on a machine. Valves should be lapped in ONLY by hand. On all others, exhaust valves must NOT be refaced on a machine. Exhaust valves should be lapped in ONLY by hand. 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**  
Courtesy of Volkswagen United States, Inc.

#### Removal

1) Remove camshaft and valve lifters. Keep lifters in order for installation. 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).

2) On Scirocco 16-valve engine, install air hose and Adapter (US 1106) in spark plug hole and apply air pressure. On all others, 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.

3) Do not remove air pressure until valve spring components have been reassembled. Install Adapter (2036) and install to studs. Compress valve springs with Valve Spring Compressor (VW 541/1 and VW541/5) on Scirocco 16-valve engine.

4) Compress valve springs with Valve Spring Compressor (VW 541/1) on all others. Remove keepers, dual valve springs and both spring seats. Remove seal from valve stem.

#### Installation

1) 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.

2) Lubricate new seal and push into place with Seal Installer (3129) on Scirocco 16-valve engine. Use Seal Installer (10-204) on all other models. 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, go to next step.

3) On Scirocco 16-valve engine, remove upper half of intake manifold. See Fig. 6. On all models, remove camshaft cover. Turn engine crankshaft until both camshaft lobes of cylinder to be checked point upward. Push down on lifter with wooden stick. If lifter can be compressed more than .004" (.10 mm), it must be replaced.

4) If hydraulic valve lifters are removed for engine repairs, keep them in correct order for installation. 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

#### 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.

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

#### 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 degrees 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. Recess depth is .319" (8.1 mm).

#### Sizing

1) Take 3 cylinder bore measurements with inside micrometer or cylinder bore gauge. Take one set of measurements at 90 degrees 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. 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 degrees to piston pin bore, about 13/32" 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 3.198" (81.23 mm) and 3.208" (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	
	In. (mm)		In. (mm)	
Standard	3.188	(80.98)	3.189	(81.01)
1st Over	3.198	(81.23)	3.199	(81.26)
2nd Over	3.208	(81.48)	3.209	(81.51)

FITTING RINGS

1) Place piston rings squarely into cylinder bore about 19/32" 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 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" (.020-.050 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 degrees 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 140ø F (60ø 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. See Fig. 8. Main bearing caps must NEVER be interchanged. Always measure main bearing clearances one 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 one at a time. Use Plastigage method for measuring bearing clearances. Clean oil film from bearing shells and crankshaft journals before measuring clearance.

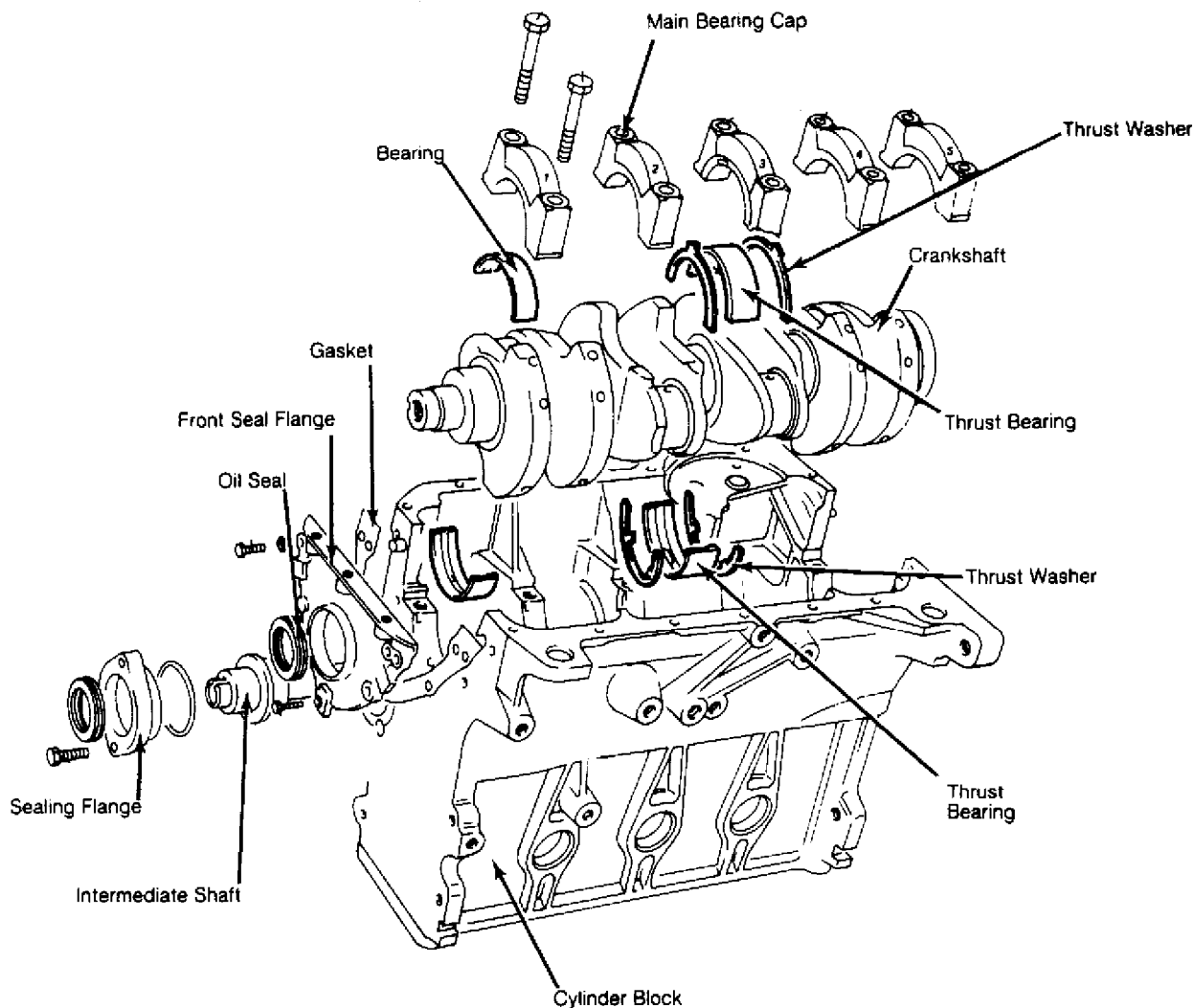
2) Connecting rod bearing clearance should be .0011-.0034" (.028-.088 mm) with new parts. Wear limit for connecting rod bearing clearance is .005" (.12 mm). Using feeler gauge, measure clearance between side of connecting rod and face of crankshaft counterweight. Wear limit for connecting rod side clearance 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 an additional 90 degrees (1/4 turn).

## CRANKSHAFT END PLAY

1) 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).

2) 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.



**Fig. 8: Scirocco 16-Valve Engine Intermediate Shaft, Crankshaft & Main Bearing Assembly**  
 Courtesy of Volkswagen United States, Inc.

#### 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, 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 of 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

On Cabriolet, Golf, and Scirocco, crankcase capacity is 3.7 quarts (3.5L) without oil filter replacement. Capacity is 4.3 quarts (4.1L) with filter replacement.

On Jetta, GTI, and GLI, crankcase capacity is 4.2 qts. (4.0L) without oil filter replacement; 4.7 qts. (4.4L) with filter replacement.

On Quantum, crankcase capacity is 3.2 quarts (3.0L) without oil filter replacement; 3.6 quarts (3.4L) with filter replacement.

### NORMAL OIL PRESSURE

Minimum oil pressure is 29 psi (2.0 kg/cm<sup>2</sup>) 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" position (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 cycle on and off. Check coolant level. Fill expansion tank if necessary. Make sure coolant circulates (thermostat opens).

**NOTE:** For further information on cooling systems, see ENGINE COOLING section.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS TABLE

AA

Application	Ft. Lbs. (N.m)
<b>Camshaft Bearing Cap Nuts</b>	
8 Valve .....	14 (20)
16 Valve .....	11 (15)
<b>Camshaft Sprocket Bolt</b>	
8 Valve .....	58 (80)
16 Valve .....	48 (65)
Connecting Rod Cap Nut .....	(1) 22 (30)
Crankshaft Pulley Nut .....	14 (20)
Crankshaft Sprocket Bolt .....	148 (200)
CV Joint-to-Flange .....	33 (45)
<b>Cylinder Head Bolt (Engine Cold)</b>	
Step 1 .....	29 (40)
Step 2 .....	44 (60)
Step 3 .....	(2)
<b>Engine-to-Transmission Bolts</b>	
M10 .....	33 (45)
M12 .....	54 (75)
<b>Engine/Transmission-to-Body</b>	
<b>Longitudinally Mounted Unit</b>	
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 (3)	
Without Shoulder .....	55 (75)
With Shoulder (4) .....	74 (100)
Intermediate Shaft Sprocket Bolt	
8 Valve .....	58 (80)
16 Valve .....	48 (65)
Main Bearing Cap Bolts .....	47 (65)
Manifold Fasteners	
8 Valve .....	18 (25)
16 Valve .....	15 (20)
Power Steering Pump-to-Bracket Nut .....	14 (20)
Timing Belt Tensioner Nut .....	33 (45)
Torque Converter-to-Drive Plate Bolt	
Longitudinally Mounted .....	14 (20)
Transversly Mounted .....	22 (30)

- (1) - Turn nuts an additional 90 degrees (1/4 turn) after reaching specified torque.
- (2) - Turn bolts 180 degrees (1/2 turn) further in one continuous movement. Two separate 90 degree (1/4 turn) movements may also be used.
- (3) - Use locking compound.
- (4) - Always use new bolts.

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## ENGINE SPECIFICATIONS

### GENERAL ENGINE SPECIFICATIONS

#### GENERAL SPECIFICATIONS TABLE

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Application	In.(mm)
<b>Cabriolet</b>	
Displacement	
Cu. In. ....	109
Liters .....	1.8
Fuel System .....	CIS-E Fuel Inj.
HP @ RPM .....	90 @ 5500
Torque Ft. @ RPM .....	100 @ 3000
Compr. Ratio .....	8.5:1
Bore	
In. (mm) .....	3.19 (81.0)
Stroke	
In. (mm) .....	3.40 (86.4)
<b>GLT &amp; GTI</b>	
Displacement	
Cu. In. ....	109
Liters .....	1.8
Fuel System .....	CIS-E Fuel Inj.

HP @ RPM	.....	102 @ 5250
Torque Ft. @ RPM	.....	110 @ 3250
Compr. Ratio	.....	10.0:1
Bore		
In. (mm)	.....	3.19 (81.0)
Stroke		
In. (mm)	.....	3.40 (86.4)
Golf & Jetta		
Displacement		
Cu. In.	.....	109
Liters	.....	1.8
Fuel System	.....	CIS-E Fuel Inj.
HP @ RPM	.....	85 @ 5250
Torque Ft. @ RPM	.....	96 @ 3000
Compr. Ratio	.....	9.0:1
Bore		
In. (mm)	.....	3.19 (81.0)
Stroke		
In. (mm)	.....	3.40 (86.4)
Quantum		
Displacement		
Cu. In.	.....	109
Liters	.....	1.8
Fuel System	.....	CIS-E Fuel Inj.
HP @ RPM	.....	88 @ 5500
Torque Ft. @ RPM	.....	101 @ 3000
Compr. Ratio	.....	8.5:1
Bore		
In. (mm)	.....	3.19 (81.0)
Stroke		
In. (mm)	.....	3.40 (86.4)
Scirocco		
Displacement		
Cu. In.	.....	109
Liters	.....	1.8
Fuel System	.....	CIS Fuel Inj.
HP @ RPM	.....	123 @ 5800
Torque Ft. @ RPM	.....	120 @ 4250
Compr. Ratio	.....	10.0:1
Bore		
In. (mm)	.....	3.19 (81.0)
Stroke		
In. (mm)	.....	3.40 (86.4)

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VALVE SPECIFICATIONS

VALVE SPECIFICATIONS TABLE

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Application	In. (mm)
Intake (GX/JN)	
Head Diam.	..... 1.496 (38.00)
Face Angle	..... 45ø
Seat Angle	..... 45ø
Seat Width	..... .079 (2.01)
Stem Diameter	..... .314 Min. (7.97)
Stem Clearance	..... ..
Valve Lift	..... ..
Intake (PL)	
Head Diam.	..... 1.260 (32.00)
Face Angle	..... 45ø
Seat Angle	..... 45ø
Seat Width	..... .065 (1.65)

Stem Diameter	.....	.274 Min. (6.97)
Stem Clearance	.....	...
Valve Lift	.....	...
Exhaust (PL)		
Head Diam.	.....	1.102 (28.00)
Face Angle	.....	45ø
Seat Angle	.....	45ø
Seat Width	.....	.070 (1.80)
Stem Diameter	.....	.273 Min (6.94)
Stem Clearance	.....	...
Valve Lift	.....	...
Intake (JH/RD)		
Head Diam.	.....	1.575 (40.00)
Face Angle	.....	45ø
Seat Angle	.....	45ø
Seat Width	.....	.079 (2.01)
Stem Diameter	.....	.314 Min. (7.97)
Stem Clearance	.....	...
Valve Lift	.....	...
Exhaust (All Others)		
Head Diam.	.....	1.300 (33.00)
Face Angle	.....	45ø
Seat Angle	.....	45ø
Seat Width	.....	.094 (2.40)
Stem Diameter	.....	.313 Min (7.95)
Stem Clearance	.....	...
Valve Lift	.....	...

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PISTONS, PINS & RINGS SPECIFICATIONS

PISTONS, PINS & RINGS SPECIFICATIONS TABLE

Application	In.(mm)
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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 140øF (60øC).
- (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

Application	In.(mm)
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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 Play .....	.015 Max. (.38)
1st U/Size	
Main Bearings	
Journal Diam. ....	2.114-2.115 (53.71-53.73)
Connecting Rod Bearings	
Journal Diam. ....	1.871-1.872 (47.51-47.53)
2nd U/Size	
Main Bearings	
Journal Diam. ....	2.104-2.105 (53.46-53.48)
Connecting Rod Bearings	
Journal Diam. ....	1.860-1.861 (47.26-47.28)
3rd U/Size	
Main Bearings	
Journal Diam. ....	2.095-2.096 (53.21-53.23)
Connecting Rod Bearings	
Journal Diam. ....	1.851-1.852 (47.01-47.03)

- (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