**ARTICLE BEGINNING**

**1999-2000 ENGINES**
**Volkswagen 2.0L 4-Cylinder**

**Beetle, Cabrio, Golf, GTI, Jetta**

*** 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 IDENTIFICATION**

**On models Cabrio, Golf, GTI and Jetta, engine identification number is stamped on a machined pad on left side of engine block, above crankcase breather. See Fig. 1 or 2. On Beetle, Golf and Jetta, engine identification number is located on left side of cylinder block, near transmission.**

**ENGINE CODES**

| Application | Engine Code |
|---|---|
| 2.0L Cabrio, Golf, GTI & Jetta | ABA |
| 2.0L Beetle, Golf, Jetta | AEG |

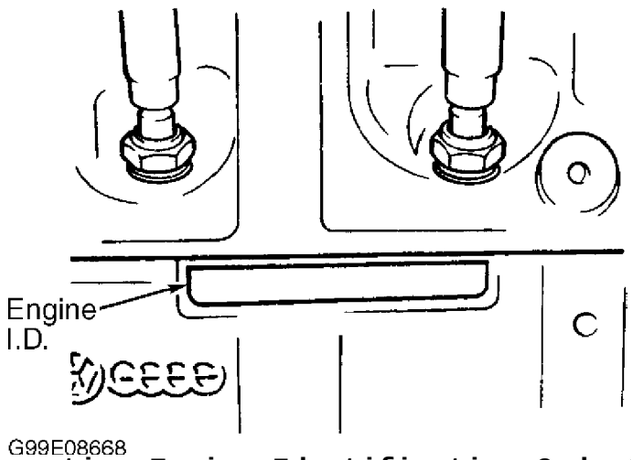


**Fig. 1: Locating Engine Identification Code (2.0L (ABA))**
**Courtesy of Volkswagen United States, Inc.**

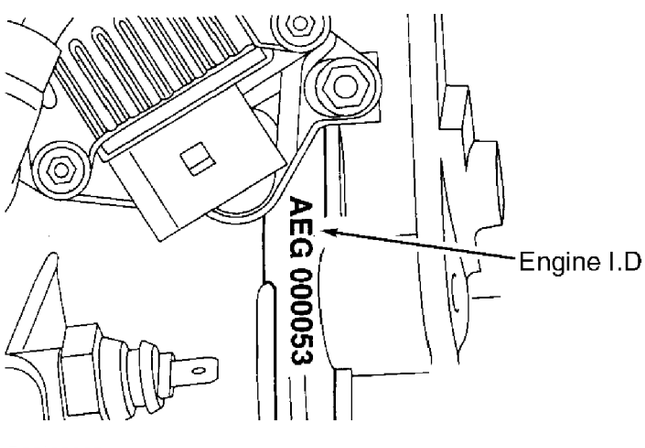


**Fig. 2: Locating Engine Identification Code (2.0L (AEG))**
**Courtesy of Volkswagen United States, Inc.**

## ADJUSTMENTS

### VALVE CLEARANCE

**Engine is equipped with hydraulic lifters. Adjustment is not necessary. Valve noise during startup is considered normal.**

## TROUBLE SHOOTING

**NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.**

## REMOVAL & INSTALLATION

### * PLEASE READ THIS FIRST *

**NOTE: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle.**

**NOTE: For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Place mating marks on other major assemblies before removal.**

**WARNING: Radio/cassette or radio/CD player is equipped with an anti-theft protection circuit. Whenever battery is disconnected, radio will go into anti-theft mode. When battery is reconnected, radio will display CODE, and will be inoperative until proper code number is entered. Obtain security code before disconnecting battery.**

### FUEL PRESSURE RELEASE

**Remove fuel pump relay (located in fuse/relay panel). Crank engine for 5 seconds. Turn ignition switch off. Reinstall fuel pump relay.**

### RADIATOR

**NOTE: Obtain radio anti-theft code before disconnecting battery.**

**Removal & Installation (Cabrio, Golf, GTI, Jetta & Passat - ABA Engine)**

**1) Disconnect and remove battery. Drain engine coolant by disconnecting coolant hose from thermostat housing. Disconnect radiator hoses. Disconnect fan harness connectors. Remove headlights. Remove radiator mounting bolts.**

**2) On vehicles equipped with A/C, remove air cleaner. Remove A/C line retaining clamps. DO NOT disconnect hoses. Separate condenser from radiator and move radiator forward.**

**3) On all vehicles, remove radiator. To install, reverse removal procedure. Fill cooling system. Adjust headlights.**

**Removal & Installation (Beetle)**

**1) Remove center undercar tray. Drain coolant from radiator. Remove front inner fenders. Remove fender bolts from inside of fender. See Fig. 3. Remove lower fender bolts. Remove screws from rear of fender. Remove 3 screws from under front of bumper cover. Remove 16 screws under hood attaching fenders and bumper cover to vehicle. With a helper, remove front fenders and bumper cover as an assembly.**

**2) Disconnect hood latch cable. Remove upper bumper bolt on each side and install Special Tools (3411). See Fig. 4. Remove upper panel bolts and remaining bumper bolts. Slide entire lock carrier**

assembly out on special tools.

3) Disconnect radiator hoses. Disconnect radiator mounted switch harness connectors. Remove radiator mounting bolts. See Fig. 5. On vehicles equipped with A/C, remove A/C line retaining clamps. DO NOT disconnect hoses. Fasten condenser to lock carrier before removing radiator. On all vehicles, remove radiator. To install, reverse removal procedure. Fill cooling system. Adjust headlights.

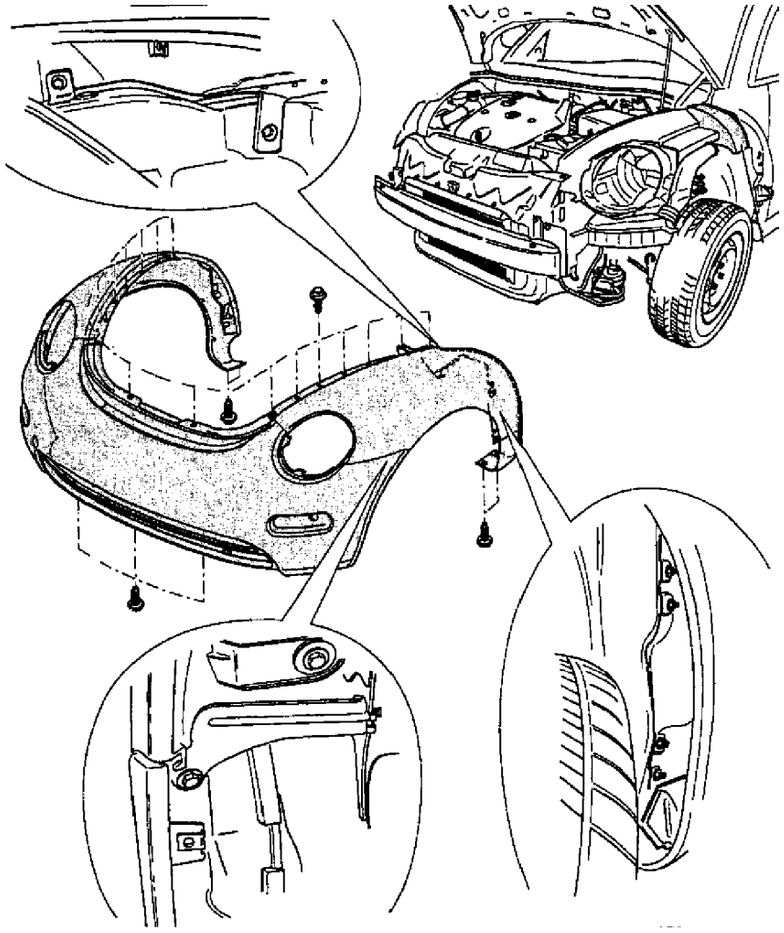

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**Fig. 3: Removing Front Fenders & Bumper Cover**
**Courtesy of Volkswagen United States, Inc.**

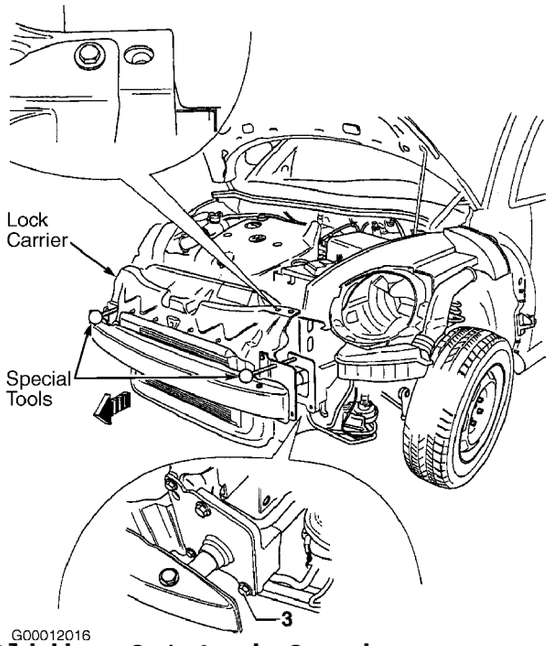


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**Fig. 4: Sliding Out Lock Carrier**
**Courtesy of Volkswagen United States, Inc.**

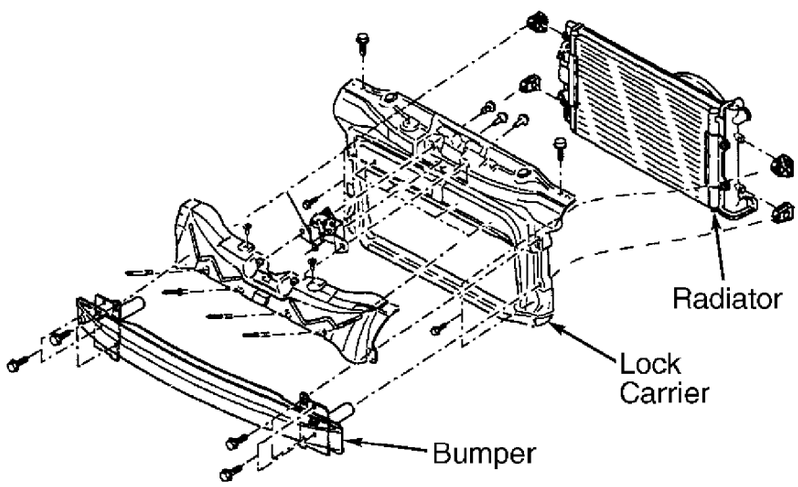


**Fig. 5: Exploded View Of Lock Carrier**
**Courtesy of Volkswagen United States, Inc.**

ENGINE

**NOTE: Engine is removed from vehicle with transaxle attached.**

**Removal (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) Disconnect and remove battery. Drain engine coolant by disconnecting coolant hose from thermostat housing. Remove intake air duct. Disconnect all electrical connectors, cables and hoses that interfere with engine removal.**

**2) On vehicles equipped with A/C, it is not necessary to discharge A/C system. Remove receiver-dryer mounting bolts. DO NOT disconnect hoses from receiver-dryer. Remove accessory drive belt. Remove radiator with fan and condenser attached. Set radiator/condenser assembly in front of engine mount. Remove A/C compressor with hoses attached and set aside with radiator/condenser assembly. DO NOT stress refrigerant hoses.**

**3) On all models, remove front bumper/grille assembly. Disconnect power steering pump with bracket and set aside. DO NOT disconnect power steering hoses. Remove axle shafts from transaxle. See FWD AXLE SHAFTS article in DRIVE AXLES. Leave fuel lines connected and remove cold start injector and warm-up regulator.**

**4) Remove fuel injectors. Remove rear engine mount. Remove complete transaxle mount. Disconnect exhaust pipe from exhaust manifold. On M/T models, disconnect clutch cable. Attach Engine Sling (2024A) to engine. On A/T models, remove crankshaft pulley and water pump pulley. Install engine sling on engine lift hooks. Carefully raise engine and transaxle out of vehicle. Separate transaxle from engine.**

**Removal (Beetle, Golf & Jetta - AEG Engine)**

**1) Disconnect and remove battery. Relieve fuel pressure. See FUEL PRESSURE RELEASE. Remove engine cover. Remove power steering reservoir from battery tray with hoses attached and secure aside. Disconnect fuel supply and return hoses from fuel rail.**

**2) Remove air cleaner. Disconnect shift linkage from transmission. On M/T models, remove slave cylinder. On all models, remove engine undercover. Drain engine coolant from radiator. Drain engine coolant from engine by disconnecting coolant hose from oil cooler.**

**3) Remove accessory drive belt. Remove cooling fan on right side of vehicle (if equipped). Remove power steering hose brackets. Remove power steering pump with hoses attached and set aside.**

**4) On vehicles equipped with A/C, it is not necessary to discharge A/C system. Remove refrigerant hose brackets. Remove A/C compressor with hoses attached. Secure A/C compressor aside to prevent**

**stressing hoses.**

**5) Disconnect any hoses interfering with engine/transmission removal. Remove secondary air injection pump. Disconnect any electrical connectors necessary for engine/transmission removal. Remove torque rod from transmission.**

**6) Remove axle shafts from transmission. See FWD AXLE SHAFTS article in DRIVE AXLES. Remove exhaust pipe from exhaust manifold. Remove coolant hose bracket under engine block. Support engine/transmission assembly with suitable jack.**

**7) Remove engine mount-to-engine bolts. Remove transmission mount-to-transmission bolts. Carefully lower engine/transmission assembly. Ensure power steering hoses clear transmission. Separate transmission from engine.**

**Installation (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) To install, reverse removal procedure. Engine alignment adjustment is necessary whenever engine is removed or mounts are loosened. To adjust, loosen through-bolt on engine mount. Loosen transaxle mount bolts. Loosen front engine mount and bracket.**

**2) Lightly rock engine and transaxle to allow position to shift as necessary. Evenly tighten mount bolts in reverse order of loosening. Fill fluids to proper level. Adjust clutch pedal (if equipped). Tighten all bolts and nuts to specification. See TORQUE SPECIFICATIONS.**

**Installation (Beetle, Golf & Jetta - AEG Engine)**

**1) To install, reverse removal procedure. Ensure engine/transmission assembly are aligned. Engine/transmission are aligned when there is .39" (10.0 mm) distance between top engine mount and engine mount bracket. See Fig. 6.**

**2) On A/T models, use NEW lock washer on shift cable. On all models, adjust all cables as necessary. Fill fluids to proper level. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS.**

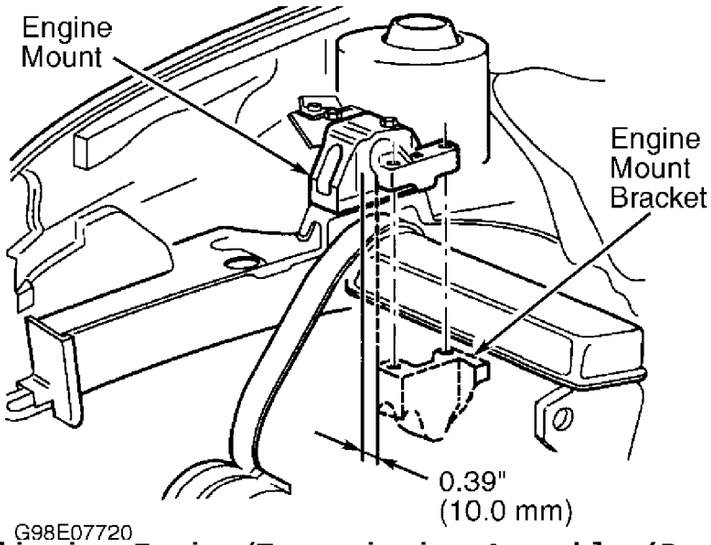


**Fig. 6: Aligning Engine/Transmission Assembly (Beetle, Golf & Jetta - AEG Engine)**
**Courtesy of Volkswagen United States, Inc.**

INTAKE MANIFOLD (UPPER & LOWER)

**Removal and installation procedures are not available from manufacturer. See TORQUE SPECIFICATIONS.**

CYLINDER HEAD

**CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.**

**Removal (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) Allow engine to cool. Label and disconnect electrical connectors and vacuum hoses. Disconnect throttle, cruise and kickdown cables. Leave fuel lines connected and remove cold start injector and warm-up regulator.**

**2) Remove fuel injectors. Remove crankcase breather pressure regulating valve. Remove upper part of intake manifold. Remove cylinder head cover (rocker arm cover). Remove timing belt. See TIMING BELT. Disconnect exhaust pipe from exhaust manifold.**

**3) Ensure pistons are NOT at TDC. Remove timing belt inner cover. Remove cylinder head bolts in reverse sequence of installation. See Fig. 7. Replace cylinder head bolts after loosening or removing.**

**NOTE: Cracks between valve seats or between valve seat and spark plug threads are considered acceptable by manufacturer. The maximum allowable size for cracks is .02" (.5 mm) wide or less for ABA engine or .01" (.3 mm) or less for AEG engine.**

**Removal (Beetle, Golf & Jetta - AEG Engine)**

**1) Allow engine to cool. Disconnect negative battery cable. Remove engine cover. Release fuel pressure. See FUEL PRESSURE RELEASE. Drain engine coolant from radiator. Drain engine coolant from cylinder block by disconnecting coolant hose from oil cooler.**

**2) Disconnect fuel hoses from fuel rail. Remove air cleaner. Disconnect throttle cable from Throttle Valve Control Module (TVCM). Disconnect hoses and electrical connector from TVCM. Remove upper intake manifold-to-lower intake manifold front bolts.**

**3) Disconnect hoses from intake manifold, secondary air injection valve and fuel pressure regulator (as necessary). Remove warm air deflector bolts. Disconnect hoses from fuel pressure regulator. Disconnect electrical connectors from fuel injectors and camshaft position sensor.**

**4) Remove hoses from secondary air injection pump. Disconnect spark plug wires from spark plugs. Remove accessory drive belt and tensioner. Remove upper timing belt cover. Ensure pistons are NOT at TDC. Remove timing belt tensioner. Remove timing belt from camshaft pulley. See TIMING BELT.**

**5) Disconnect exhaust pipe from exhaust manifold. Remove valve cover. Loosen cylinder head bolts in reverse order of tightening sequence. See Fig. 7. Remove cylinder head.**

**Inspection (All Models)**

**Thoroughly clean all gasket mating surfaces. Check cylinder head for warpage. Maximum warpage is .004" (.100 mm). Check minimum cylinder head height and replace cylinder head (if necessary). See CYLINDER HEAD table under ENGINE SPECIFICATIONS.**

**NOTE: DO NOT reuse antifreeze after replacing cylinder block, cylinder head, head gasket, radiator and/or heater core.**

**CAUTION: If camshaft or cam followers are changed, and cam followers are charged with oil, allow 30 minutes for followers to bleed down before starting engine. Pistons may strike valves, resulting in bent valves.**

**Installation (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**CAUTION: Ensure cylinder head bolt holes are clean and free of oil or coolant. Hydrostatic lock may occur when tightening cylinder head bolts**

**1) Install Guide Pins (3070) into bolt holes No. 8 and 10. Install NEW head gasket on cylinder block with part number facing up.**

DO NOT use any type of sealant. Ensure pistons are NOT at TDC.

2) Carefully position cylinder head on block. Install 8 remaining head bolts finger tight. Remove guide pins with Extractor (3070). Install remaining head bolts finger tight.

3) Tighten cylinder head bolts in sequence to specification. See Fig. 7. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS. Fill radiator with NEW coolant. Fill all fluids to proper level.

Installation (Beetle, Golf & Jetta - AEG Engine)

1) Position piston No. 1 to TDC. Rotate crankshaft counterclockwise slightly.

2) Install Guide Pins (3450/2A) into bolt holes No. 7 and 9. See Fig. 7. Install NEW head gasket on cylinder block with part number facing up. Install cylinder head. Install 8 remaining cylinder head bolts finger tight.

3) Using Guide Pin Extractor (3450/3), remove guide pins. Install remaining cylinder head bolts finger tight. Tighten cylinder head bolts in sequence to specification. See Fig. 6. See TORQUE SPECIFICATIONS.

4) To complete installation, reverse removal procedure. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS. Fill radiator with NEW coolant. Fill all fluids to proper level.

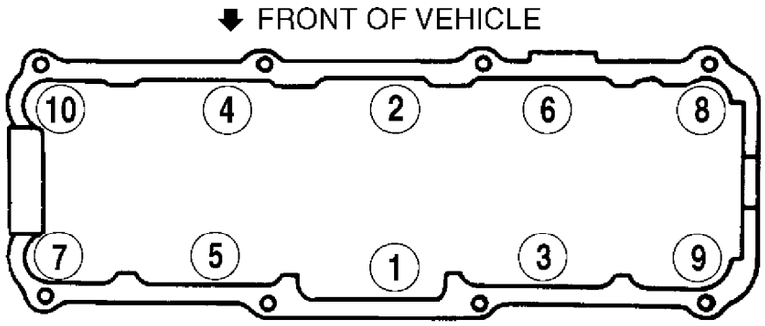


Fig. 7: Cylinder Head Bolt Tightening Sequence
Courtesy of Volkswagen United States, Inc.

## FRONT COVER OIL SEAL

CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.

Removal & Installation (Cabrio, Golf, GTI & Jetta - ABA Engine)

1) Remove timing belt. See TIMING BELT. Using Crankshaft Holder (3099), remove timing belt drive pulley. Rotate inner part of Oil Seal Extractor (2085) outward 2 turns and tighten set screw.

2) Use bolt from Seal Installer (3083) as guide in center of oil seal extractor. Insert bolt through oil seal extractor and thread bolt all the way into crankshaft. Lubricate threaded area of extractor and push in as far as possible. Loosen set screw and turn inner part of extractor until oil seal is removed.

3) Lubricate lip of new seal. Place guide sleeve from Seal Installer (3083) onto crankshaft. Push oil seal over guide sleeve. Press seal completely into position. To complete installation, reverse removal procedure.

Removal & Installation (Beetle, Golf & Jetta - AEG Engine)

1) Remove timing belt. See TIMING BELT. Using Crankshaft Holder (3415), remove timing belt drive pulley. Install timing belt drive pulley bolt finger tight. Rotate inner part of Oil Seal

**Extractor (3203) outward 9 turns and tighten set screw.**

**2) Lubricate threaded area of Seal Extractor (3203). Thread seal extractor into seal as far as possible. Loosen set screw and turn inner part of extractor until oil seal is removed.**

**3) Lubricate lip of new seal. Place guide sleeve from Seal Installer (2080-A) onto crankshaft. Push oil seal over guide sleeve. Using Seal Installer (3266), press seal completely into position. To complete installation, reverse removal procedure.**

TIMING BELT

**CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.**

**Removal (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) Remove accessory drive belt. See Fig. 8. Remove drive belt tensioner pulley and lever. Remove upper timing belt cover. Remove crankshaft pulley and idler pulley. Remove water pump pulley.**

**2) Remove lower belt cover. If timing belt is to be reused, mark direction of rotation on belt. Rotate crankshaft clockwise until No. 1 piston is at TDC of compression stroke and TDC mark on flywheel and bellhousing are aligned.**

**3) Ensure camshaft pulley "O.T." alignment mark is aligned with mark on drive belt guard. Loosen timing belt tensioner. Remove timing belt.**

**CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.**

**Removal (Beetle, Golf & Jetta - AEG Engine)**

**1) Remove engine cover and undercover on right side. Remove accessory drive belt and tensioner. Set piston No. 1 to TDC. Remove upper timing belt cover. Support engine and remove front engine mount.**

**2) Remove crankshaft pulley. Remove center and lower timing belt covers. Raise engine slightly. Remove front engine mount bracket. If timing belt is to be reused, mark direction of rotation on belt.**

**3) Loosen timing belt tensioner nut. Remove timing belt. See Fig. 8. Rotate crankshaft counterclockwise slightly to ensure pistons are not at TDC.**

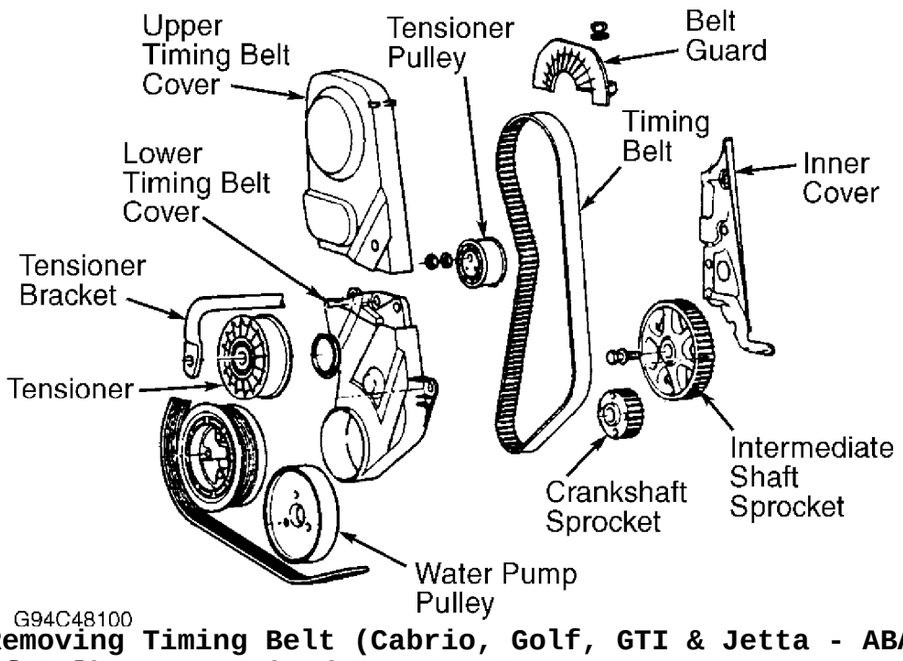


**Fig. 8: Removing Timing Belt (Cabrio, Golf, GTI & Jetta - ABA Engine) Courtesy of Volkswagen United States, Inc.**

**Installation (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) Place crankshaft at TDC by aligning flywheel (M/T) or**

drive plate (A/T) TDC marks. Remove distributor cap. Rotate intermediate shaft until rotor is pointed at No. 1 cylinder mark. See Fig. 9. Align mark on camshaft sprocket with mark on belt guard. See Fig. 10.

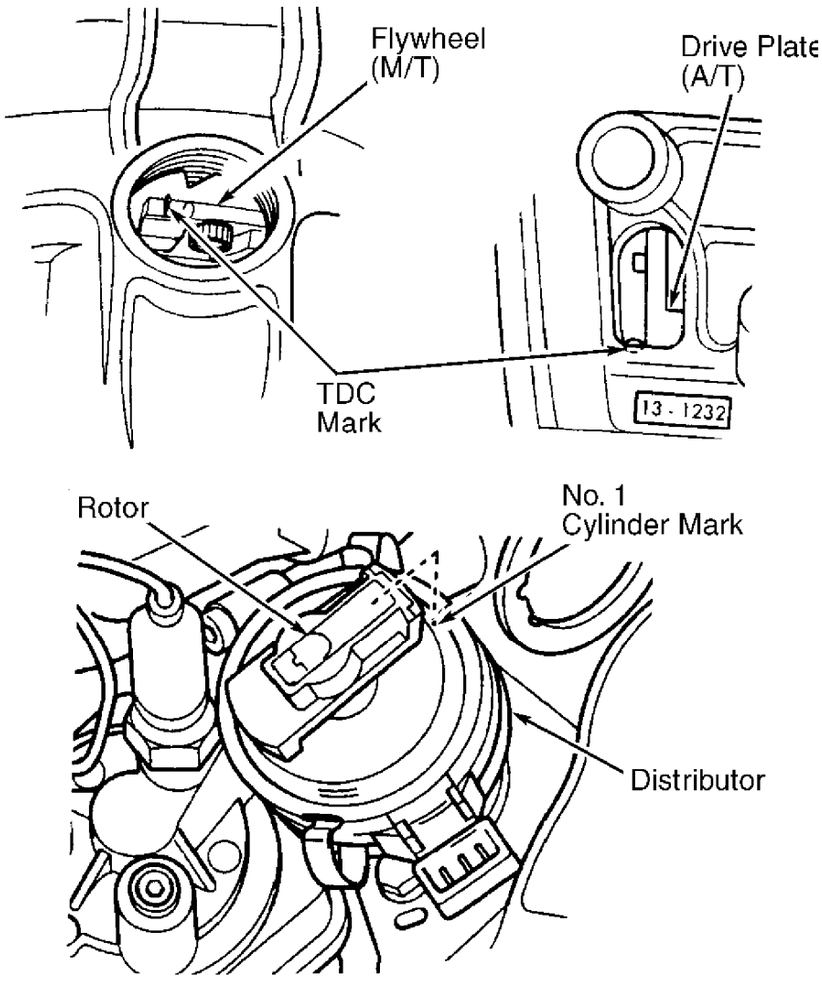


**Fig. 9: Aligning Crankshaft & Distributor Timing Marks (Cabrio, Golf, GTI & Jetta - ABA Engine)**
**Courtesy of Volkswagen United States, Inc.**

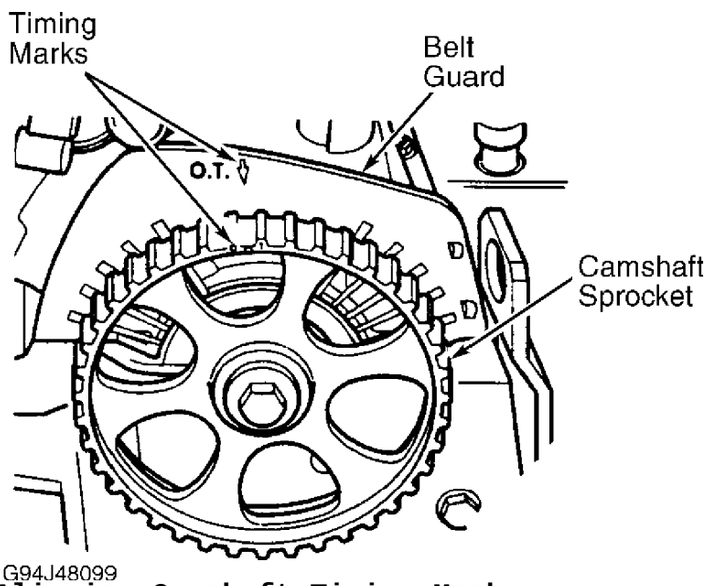


**Fig. 10: Aligning Camshaft Timing Marks**
**Courtesy of Volkswagen United States, Inc.**

2) Install timing belt around crankshaft, intermediate shaft and camshaft sprockets. Install drive belt tensioner. Rotate tensioner clockwise to tension timing belt. Tighten tensioner mounting bolt to

specification. See TORQUE SPECIFICATIONS.

3) Rotate engine 2 times and check belt tension. It must be possible to twist timing belt 90 degrees with thumb and forefinger half-way between camshaft and intermediate shaft sprockets. See Fig. 11. Adjust tension as necessary. To complete installation, reverse removal procedure.

**Installation (Beetle, Golf & Jetta - AEG Engine)**

1) Ensure pistons are NOT at TDC. Align camshaft timing marks. See Fig. 10. Install timing belt on timing belt drive pulley and water pump pulley. Install engine mount bracket.

2) Install center and lower timing belt covers. Install crankshaft pulley. Set piston No. 1 to TDC. Install engine mount. Ensure camshaft timing mark is still aligned. Install timing belt on camshaft sprocket and tensioner.

3) Manufacturer recommends tensioning timing belt with engine warm. Using Wrench (T-10020), rotate tensioner counterclockwise until arrow mark on tensioner aligns with notch. See Fig. 12.

4) Rotate crankshaft clockwise 2 revolutions. Ensure timing marks are still aligned. Ensure tensioner marks align. To complete installation, reverse removal procedure. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS.

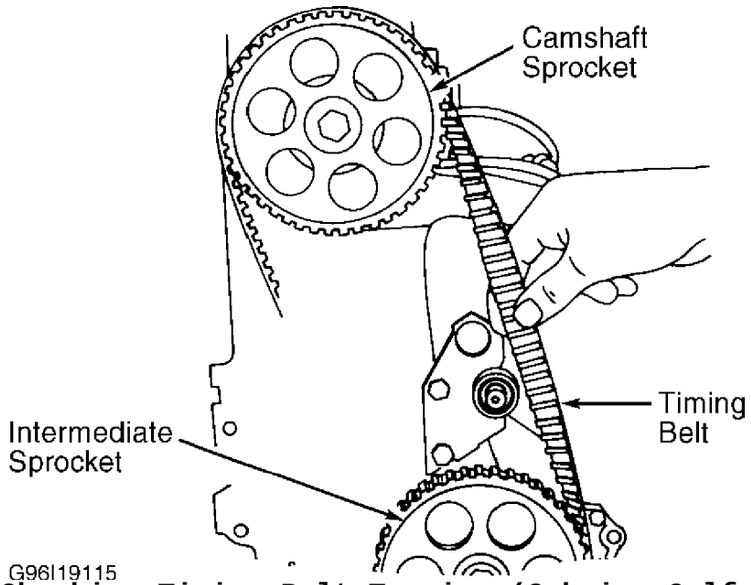


**Fig. 11: Checking Timing Belt Tension (Cabrio, Golf, GTI & Jetta - ABA Engine)**
**Courtesy of Volkswagen United States, Inc.**

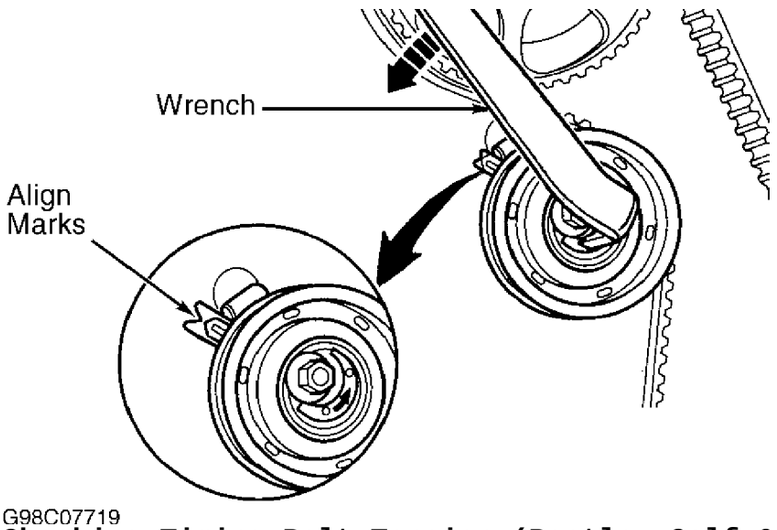


**Fig. 12: Checking Timing Belt Tension (Beetle, Golf & Jetta - AEG Engine)**
**Courtesy of Volkswagen United States, Inc.**

CAMSHAFT OIL SEAL

**CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.**

**Removal**

**1) Remove upper timing belt cover. Place crankshaft at TDC with No. 1 cylinder on compression stroke. Remove timing belt from camshaft sprocket. Remove camshaft sprocket bolt. On ABA Engine, use Counter Support (3415), to hold camshaft sprocket. On AEG Engine, use Camshaft Holder (3036) to hold camshaft sprocket. Remove camshaft sprocket. Remove Woodruff key.**

**2) Install camshaft sprocket bolt and washer until washer is tight against camshaft. Rotate inner part of Oil Seal Extractor (2085) outward 2 turns and tighten set screw. See Fig. 13. Lubricate threaded area of extractor and push in as far as possible. Loosen set screw and turn inner part of extractor until oil seal is removed.**

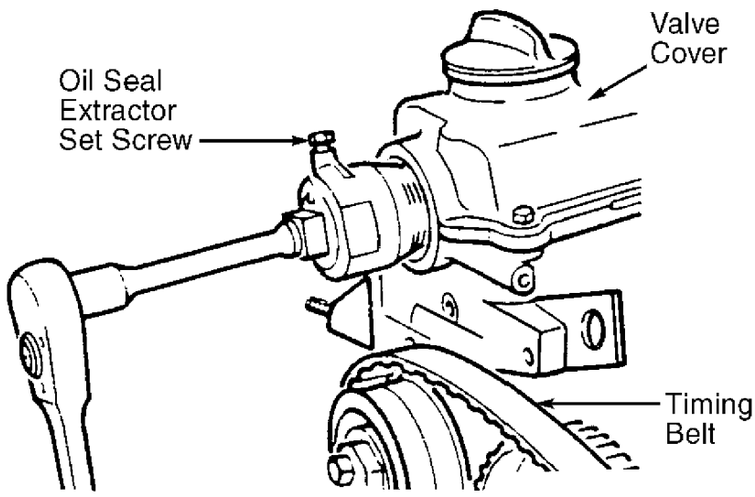


**Fig. 13: Removing Camshaft Oil Seal**
**Courtesy of Volkswagen United States, Inc.**

**Installation**

**Coat new seal lips lightly with engine oil. Using Installer (10-203), install seal until flush. To complete installation, reverse removal procedure.**

CAMSHAFT

**CAUTION: DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.**

**Removal**

**remove camshaft pulley, See step 1) under CAMSHAFT OIL SEAL in REMOVAL & INSTALLATION. Remove valve cover. Loosen and remove camshaft bearing caps No. 1, 3 and 5 evenly. See Fig. 14. Loosen camshaft bearing caps No. 2 and 4 evenly, in a crisscross pattern. Remove camshaft bearing caps. Lift camshaft from cylinder head.**

**Inspection**

**Check camshaft bearing oil clearance. See CAMSHAFT table under ENGINE SPECIFICATIONS. If oil clearance is not within specification, install new camshaft and recheck clearance. If clearance still exceeds specification, replace cylinder head. Check camshaft end play with cam followers removed and first and last bearing caps installed.**

**CAUTION: If cam followers are charged with oil, allow 30 minutes for**

followers to bleed down before starting engine. Pistons may strike valves, resulting in bent valves.

Installation

1) Place camshaft in cylinder head. Ensure lobes for No. 1 cylinder are pointed upward. See Fig. 14. Install camshaft bearing caps. Camshaft bearing caps are offset from center. Ensure camshaft bearing caps are installed correctly.

2) Tighten camshaft bearing caps No. 2 and 4 evenly in a crisscross pattern to specification. See TORQUE SPECIFICATIONS. Tighten camshaft bearing caps No. 1, 3 and 5 evenly to specification.

3) To complete installation, reverse removal procedure. If cam followers are charged with oil, allow 30 minutes for followers to bleed down before starting engine.

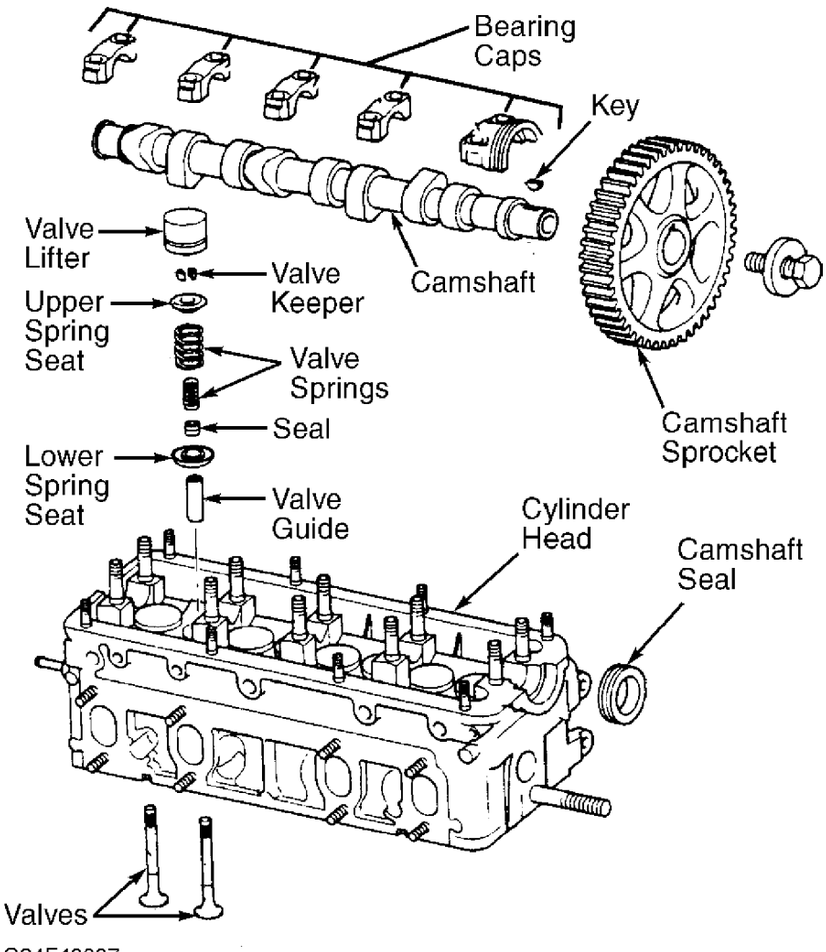


**Fig. 14: Identifying Cylinder Head Components**
**Courtesy of Volkswagen United States, Inc.**

## INTERMEDIATE SHAFT

**NOTE:** It may be necessary to remove engine in order to remove intermediate shaft. Procedure for ABA Engine is not available from manufacturer.

**CAUTION:** DO NOT turn crankshaft or camshaft with timing belt removed. Valve damage may result.

Removal & Installation

1) Remove timing belt. See TIMING BELT. Mark distributor assembly for installation reference and remove distributor assembly.

2) Ensure intermediate shaft end play does not exceed .010" (.25 mm). Remove intermediate shaft sprocket. Remove intermediate shaft seal flange. Remove intermediate shaft. Replace seal (if necessary). See Fig. 17. To install, reverse removal procedure.

REAR CRANKSHAFT OIL SEAL

**NOTE: Rear crankshaft oil seal and retaining flange must be replaced as an assembly.**

**Removal & Installation**

**Remove flywheel/flexplate and discard bolts. For A/T, see appropriate REMOVAL & INSTALLATION article in TRANSMISSION SERVICING. For M/T, see appropriate article in CLUTCHES. See Fig. 17. Remove retaining flange and seal assembly. Replace flange and seal assembly as a unit. To complete installation, reverse removal procedure. Install NEW flywheel/flex plate bolts.**

WATER PUMP

**CAUTION: Coolant/water mixture should be used at all times. Use only ethylene glycol based (phosphate-free) coolant.**

**Removal & Installation (Cabrio, Golf, GTI & Jetta - ABA Engine)**

**1) Disconnect negative battery cable. Turn heater control to HOT position. Drain cooling system. Remove accessories and brackets (as necessary).**

**2) Label and remove coolant hoses from water pump. Remove water pump pulley. Remove bolts and remove water pump assembly. To install, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS.**

**Removal & Installation (Beetle, Golf & Jetta - AEG Engine)**

**1) Drain engine coolant. Remove accessory drive belt and tensioner. Remove timing belt upper and center covers. See TIMING BELT . Remove timing belt from water pump sprocket only.**

**2) Remove timing belt inner guard. Cover timing belt with shop towel. Remove water pump mounting bolts. Remove water pump. DO NOT allow coolant to spill on timing belt.**

**3) To install, reverse removal procedure. Use NEW "O" ring. To install timing belt, see TIMING BELT. Tighten all fasteners to specification. See TORQUE SPECIFICATIONS. Fill engine with coolant.**

OIL PAN

**1) Remove lower insulation tray. Drain engine oil. Remove oil pan and bell housing bolts. Remove oil pan using rubber hammer if necessary. Remove sealant from cylinder block and oil pan. Ensure surfaces are free from grease and oil.**

**2) To install, apply 2-3 mm thick silicone bead around sealing surface of oil pan. Immediately install oil pan and lightly tighten oil pan bolts. Ensure oil pan is flush with cylinder block. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Allow sealer to dry for 30 minutes before installing engine oil.**

## OVERHAUL

CYLINDER HEAD

**NOTE: Cracks between valve seats or between valve seat and spark plug threads are considered acceptable by manufacturer. The maximum allowable size for cracks is .02" (.5 mm) wide or less for ABA engine or .01" (.3 mm) or less for AEG engine.**

**Cylinder Head**

**Clean all gasket mating surfaces. Check cylinder head for warpage. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.**

**Valve Stem Oil Seals**

**Valve stem oil seals may be replaced with cylinder head installed. On ABA engine, install seals using Valve Seal Driver (10-204). On AEG engine, install valve seals using Valve Seal Driver (3129).**

**Valve Springs**

**On AEG engine, remove valve spring using Lever (VW541-1A) and Press Piece (VW 541/5). On ABA engine, information is not available from manufacturer.**

**Valve Guides**

**1) Using dial indicator, check valve stem-to-guide clearance. See CYLINDER HEAD table under ENGINE SPECIFICATIONS. To replace valve guide, press guide out from camshaft side. Replacement valve guides have shoulder on camshaft end. Press replacement guides out from combustion chamber side.**

**2) Lubricate new valve guides with oil. Using Valve Guide Installer (3121), press valve guide in cold cylinder head as far as guide will go from camshaft side. DO NOT exceed one ton pressure. Using Valve Guide Reamer (3120), ream guides to proper stem-to-guide clearance. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.**

**Valve Seats**

**1) Check valve seats before any other cylinder head service. Insert valve and hold firmly against valve seat. Measure distance between valve stem tip and valve cover surface. See Fig. 15.**

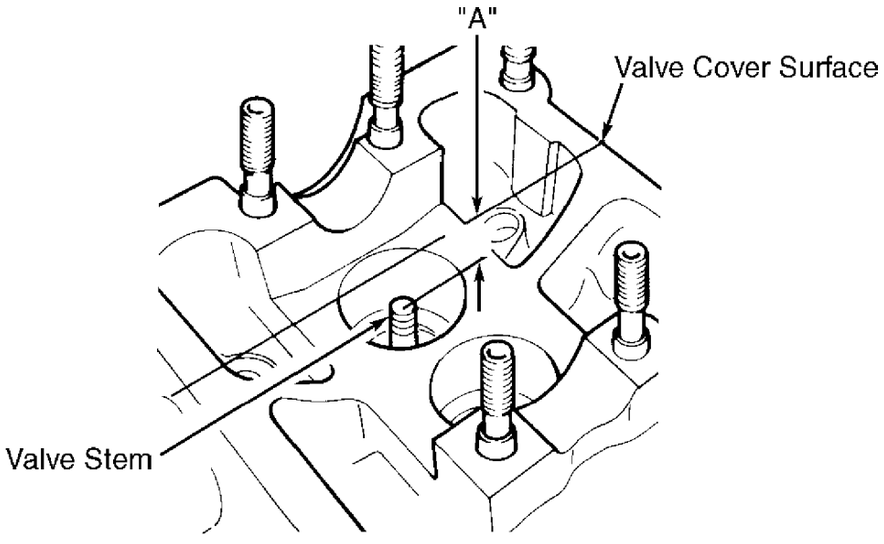


**Fig. 15: Measuring Valve Installed Height**
**Courtesy of Volkswagen United States, Inc.**

**2) This measurement determines installed valve height. Subtract measured distance from minimum specification. See MINIMUM VALVE INSTALLED HEIGHT table.**

**MINIMUM VALVE INSTALLED HEIGHT**

| Application | In. (mm) |
|---|---|
| Intake Valve | 1.331 (33.80) |
| Exhaust Valve | 1.343 (34.10) |

**3) The difference is maximum refacing allowable for valve and seat. If valve installed height is less than specification, replace**

**cylinder head assembly. If valve installed height is too low or too high, cam followers will not work correctly.**

**Valves**

**Measure valve stem diameter and valve margin. If not within specification, replace valves. DO NOT reface valves with machine. Lap valves by hand only. Replace as necessary. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.**

VALVE TRAIN

**Lifters (Cam Followers)**

**Test lifters by pushing then downward with a suitable wooden dowel with camshaft lobe pointing up. If lifter can be pushed downward more than .004" (.10 mm) on ABA engines, and .007" (.20 mm) on AEG engines, replace lifters. Lifters must be replaced as a set.**

**CAUTION: If lifters are charged with oil, allow 30 minutes for followers to bleed down before starting engine. Pistons may strike valves, resulting in bent valves.**

CYLINDER BLOCK ASSEMBLY

**Piston & Rod Assembly**

**1) Ensure piston, connecting rod and rod caps are marked with matching cylinder number prior to removal. Ensure engine front arrow is marked on top of piston and front mark exists on rod and cap. See Fig. 16. Pistons and rods are to be replaced in sets of 4. Rod cap bolts and nuts must be replaced after removing or loosening.**

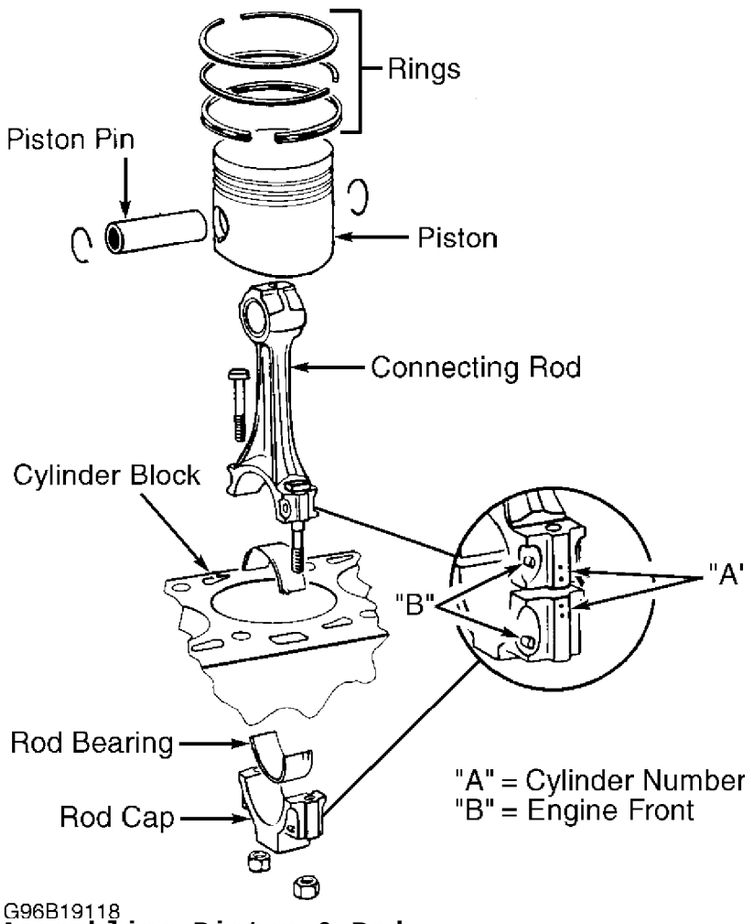


**Fig. 16: Assembling Piston & Rod**
**Courtesy of Volkswagen United States, Inc.**

**2) Mark piston in relation to pin. Remove circlips from ends of pin bore. Use Piston Pin Replacer/Installer (VW 222A) to remove and install piston pin. If pin is too tight, heat piston to 140øF (60øC).**

Ensure rod is properly positioned with piston. See Fig. 16.

### Fitting Pistons

Measure clearances with cylinder block supported on work bench. Check clearance of piston-to-cylinder bore. Piston diameter is stamped on top of piston in millimeters.

**PISTON-TO-CYLINDER BORE DIMENSIONS**

| Size | Piston Diameter (1) - In. (mm) | Cylinder Bore - In. (mm) |
|---|---|---|
| **AEG Engine** | | |
| Standard | 3.246 (82.465) | 3.248 (82.51) |
| 1st Oversize | 3.266 (82.965) | 3.268 (83.01) |
| **ABA Engine** | | |
| Standard | 3.247 (82.49) | 3.248 (82.51) |
| 1st Oversize | 3.257 (82.74) | 3.258 (82.76) |
| 2nd Oversize | 3.267 (82.99) | 3.268 (83.01) |

(1) - New pistons have graphite coating that wears away. For used piston, subtract .0007" (.020 mm) for AEG engine, or .0006" (.015 mm) for ABA engine, from piston diameter.

### Piston Rings

Measure ring end gap. Measure ring side clearance with piston. If not within specification, replace as necessary. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS. Install rings on piston with TOP mark facing upward. Recessed edge on outside of center ring must face piston pin (down). Position ring gaps on piston at 120-degree intervals. See Fig. 16.

### Rod Bearings

Mark rod caps for reinstallation. Use Plastigage to measure bearing oil clearance. Tighten connecting rod nuts to 22 ft. lbs. (30 N.m) when measuring oil clearance. DO NOT turn additional 90 degrees. Measure connecting rod side play. Replace or machine as necessary. See appropriate CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS. Lubricate bolt threads when installing connecting rod caps. Tighten evenly to specification in several steps. See TORQUE SPECIFICATIONS.

### Crankshaft & Main Bearings

Main bearing caps are marked with matching journal for installation in original position. See Fig. 17. Use Plastigage to measure oil clearance. Tighten main bearing cap bolts to 48 ft. lbs. (65 N.m) when measuring oil clearance. DO NOT turn additional 90 degrees. Measure crankshaft end play. See THRUST BEARING.

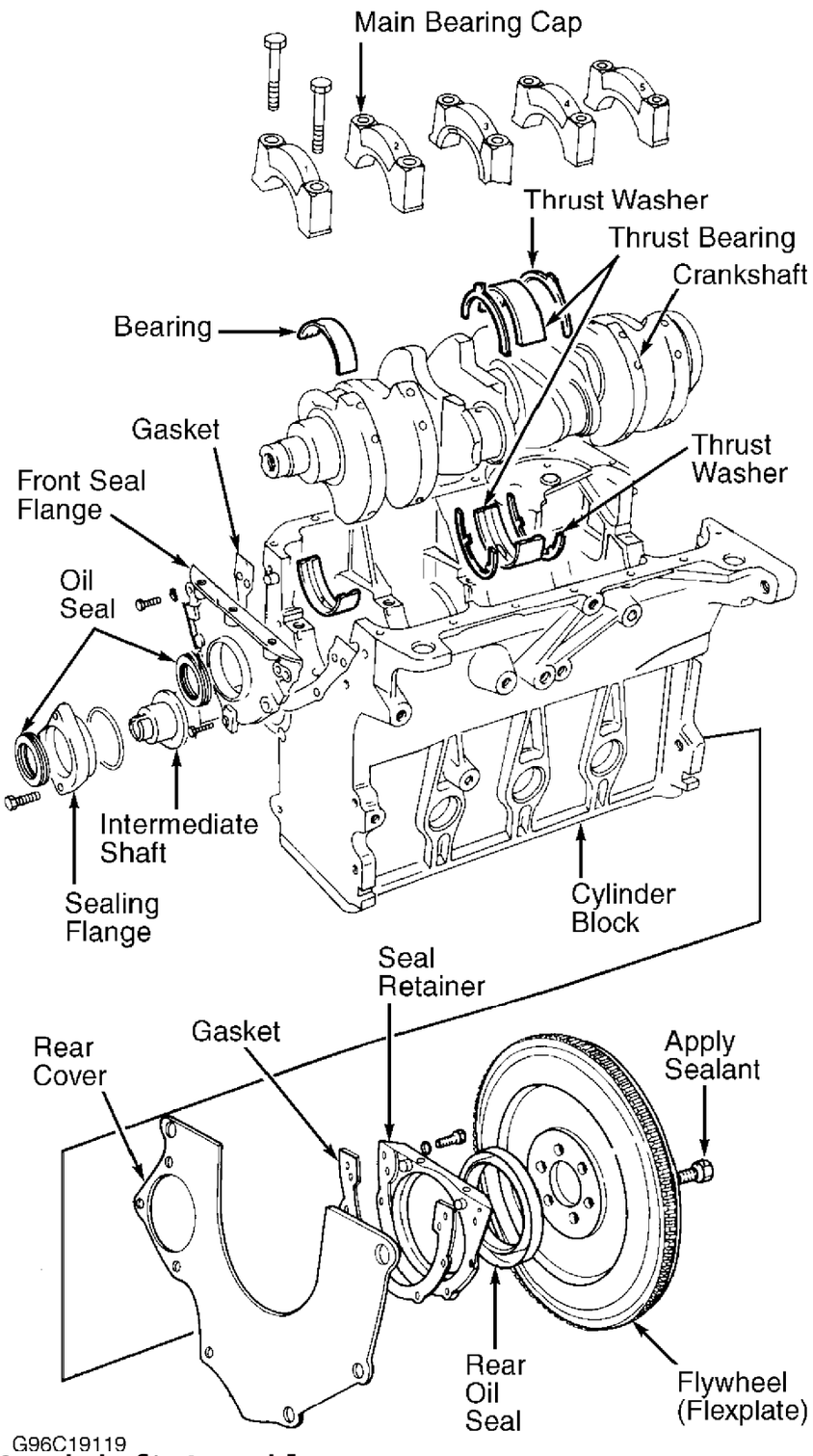


**Fig. 17: Crankshaft Assembly**
**Courtesy of Volkswagen United States, Inc.**

**Thrust Bearing**

**Insert feeler gauge between No. 3 main bearing and crankshaft thrust face to measure end play. See Fig. 17. Replace thrust bearing as necessary. See appropriate CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.**

**Cylinder Block**

**Measure cylinder block while supported on work bench. Check cylinder bore for wear, out-of-round and taper. Check cylinder block for warpage. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS.**

## ENGINE OILING

### ENGINE LUBRICATION SYSTEM

**Crankcase Capacity**
**See CRANKCASE CAPACITY table.**

**CRANKCASE CAPACITY**

| Application | Qts. (L) |
|---|---|
| Without Filter Replacement | 3.7 (3.5) |
| With Filter Replacement | 4.2 (4.0) |

**Oil Pressure**
**Check oil pressure with engine at normal operating temperature. Minimum oil pressure at idle is 29 psi (2.0 kg/cmý). Minimum oil pressure at 2000 RPM is 43 psi (3.0 kg/cmý).**

## OIL PUMP

**NOTE: Oil pump removal and installation procedure for Beetle, Golf and Jetta is not available from manufacturer.**

**Removal & Installation**
**Remove oil pan. Remove oil pump attaching bolts and remove oil pump assembly. To install, reverse removal procedure.**

**Inspection**
**Check oil pump backlash and oil pump axial play. If not within specification, replace oil pump assembly. See OIL PUMP SPECIFICATIONS table.**

**OIL PUMP SPECIFICATIONS**

| Application | In. (mm) |
|---|---|
| ABA Engine | |
| Backlash | |
| New | .002 (.05) |
| Service Limit | .008 (.20) |
| Axial Play Limit | .006 (.15) |
| AEG Engine | (1) |

**(1) - Information is not available from manufacturer.**

## TORQUE SPECIFICATIONS

**TORQUE SPECIFICATIONS**

| Application | Ft. Lbs. (N.m) |
|---|---|
| A/C Bracket-To-Engine Bolt | |
| ABA Engine | 22 (30) |
| AEG Engine | 33 (45) |
| Axle Shaft-To-Transaxle Drive Flange Bolt | |
| ABA Engine | 33 (45) |
| AEG Engine | 30 (40) |
| Camshaft Bearing Cap Bolt | 15 (20) |
| Camshaft Drive Gear Bolt | |
| ABA Engine | 59 (80) |
| AEG Engine | 74 (100) |
| Connecting Rod Bearing Cap Nut (1) | |
| Step 1 | 22 (30) |

| | |
|---|---|
| Step 2 | Additional 90 Degrees |
| Crankshaft Main Bearing Cap Bolt (1) | |
| Step 1 | 48 (65) |
| Step 2 | Additional 90 Degrees |
| Crankshaft Timing Sprocket Bolt (1) | |
| Step 1 | 66 (90) |
| Step 2 | Additional 90 Degrees |
| Cylinder Head Bolt (1) | |
| Step 1 | 30 (40) |
| Step 2 (ABA Engine) | (2) 44 (60) |
| Step 3 | Additional 90 Degrees |
| Step 4 | Additional 90 Degrees |
| Driveplate (A/T) (1) | |
| Step 1 | 22 (30) |
| Step 2 | 44 (60) |
| Step 3 | Additional 90 Degrees |
| EGR Tube Nuts | 22 (30) |
| Engine Front Cover | |
| ABA Engine | 18 (25) |
| AEG Engine | 11 (15) |
| Engine Mounts | |
| ABA Engine | |
| Front Mount-To-Bracket | 41 (55) |
| Front Mount-To-Transmission Bracket | 41 (55) |
| Left Rear Mount-To-Bracket | 44 (60) |
| Left Rear Mount-To-Body | 22 (30) |
| Left Rear Mount Bracket-To-Transmission | 18 (25) |
| Right Rear Mount-To-Body | 18 (25) |
| Right Rear Mount-To-Engine Bracket | 18 (25) |
| Right Rear Mount-To-Bracket | 37 (50) |
| AEG Engine | |
| Front Engine Mount-To-Body | |
| Long Bolts (1) | |
| Step 1 | 30 (40) |
| Step 2 | Additional 90 Degrees |
| Short Bolt | 18 (25) |
| Front Engine Mount-To-Engine Bracket (1) | |
| Step 1 | 44 (60) |
| Step 2 | Additional 90 Degrees |
| Transmission Mount-To-Body | |
| Long Bolts (1) | |
| Step 1 | 30 (40) |
| Step 2 | Additional 90 Degrees |
| Short Bolt | 18 (25) |
| Transmission Mount-To-Transmission (1) | |
| Step 1 | 44 (60) |
| Step 2 | Additional 90 Degrees |
| Torque Rod-To-Transmission (1) | |
| Step 1 | 30 (40) |
| Step 2 | Additional 90 Degrees |
| Torque Rod-To-Body (1) | |
| Step 1 | 15 (20) |
| Step 2 | Additional 90 Degrees |
| Engine Mount Carrier-To-Frame Bolt | 37 (50) |
| Engine-To-Transaxle 10-mm Bolt | |
| ABA Engine | 44 (60) |
| AEG Engine | 33 (45) |
| Engine-To-Transaxle 12-mm Bolt | 59 (80) |
| Exhaust Manifold-To-Cylinder Head Bolt & Nut | 18 (25) |
| Exhaust Pipe-To-Manifold Nut | 30 (40) |
| Exhaust Pipe-To-Support Bracket Bolt | 18 (25) |
| Flywheel-To-Crankshaft (1) | |
| Step 1 | 44 (60) |

| | |
|---|---|
| Step 2 | Additional 90 Degrees |
| Intake Manifold | |
| Lower | 18 (25) |
| Upper | 15 (20) |
| Intermediate Shaft Sprocket Bolt | 59 (80) |
| Knock Sensor | 15-18 (20-25) |
| Oil Pan Bolt | |
| ABA Engine | 15 (20) |
| AEG Engine | 11 (15) |
| Oil Pump Cover (ABA Engine) | |
| Long Bolt | 15 (20) |
| Short Bolt | (3) |
| Oil Pump Bolts (AEG Engine) | 11 (15) |
| Oil Pump Sprocket (AEG Engine) | 15 (20) |
| Oil Pump Chain Tensioner Bolt (AEG Engine) | 11 (15) |
| Oil Pan Drain Plug | 22 (30) |
| Pressure Plate-To-Flywheel Bolt (1) | |
| Step 1 | 22 (30) |
| Step 2 | Additional 90 Degrees |
| Starter Mount Bolt | 40 (60) |
| Timing Belt Tensioner Nut | |
| ABA Engine | 33 (45) |
| AEG Engine | 15 (20) |
| Torque Converter-To-Drive Plate Bolt | |
| ABA Engine | 22 (30) |
| AEG Engine | 44 (60) |
| Water Pump Housing-To-Engine Bolt | |
| ABA Engine (1) | |
| Step 1 | 15 (20) |
| Step 2 | Additional 90 Degrees |
| AEG Engine | 11 (15) |
| Water Pump Pulley Bolt (ABA Engine) | 18 (25) |

| | INCH Lbs. (N.m) |
|---|---|
| Piston Oil Jet Nozzle | 89 (10) |
| Transaxle/Engine Cover Plate Bolt | 89 (10) |
| Valve Cover Retaining Nut | 89 (10) |
| Water Pump-To-Housing (ABA Engine) | 89 (10) |

(1) - Use NEW bolts.
(2) - On AEG Engine, perform steps 1, 3 and 4.
(3) - Tighten bolt to 89 INCH lbs. (10 N.m).

## ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

**GENERAL SPECIFICATIONS**

| Application | Specification |
|---|---|
| Displacement | 121 Cu. In. (2.0L) |
| Bore | 3.25" (82.5 mm) |
| Stroke | 3.65" (92.8 mm) |
| Compression Ratio | |
| ABA Engine | 9.0:1 |
| AEG Engine | 10.0:1 |
| Fuel System | CIS-E Motronic SFI |

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS (ABA ENGINE)

**CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS (ABA ENGINE)**

| Application | In. (mm) |
|---|---|
| **Crankshaft End Play** | |
| Standard | .003-.007 (.07-.17) |
| Service Limit | .010 (.25) |
| **Main Bearings** | |
| Journal Diameter | |
| Standard (Nominal) | 2.1260 (54.000) |
| Maximum | 2.1269 (54.023) |
| Minimum | 2.1243 (53.957) |
| 1st Undersize (Nominal) | 2.1161 (53.749) |
| Maximum | 2.1170 (53.772) |
| Minimum | 2.1145 (53.708) |
| 2nd Undersize (Nominal) | 2.1063 (53.500) |
| Maximum | 2.1071 (53.520) |
| Minimum | 2.1047 (53.459) |
| 3rd Undersize (Nominal) | 2.0965 (53.251) |
| Maximum | 2.0973 (53.271) |
| Minimum | 2.0949 (53.210) |
| Journal Out-Of-Round | (1) |
| Journal Taper | (1) |
| Oil Clearance | |
| Standard | .0008-.0024 (.02-.06) |
| Service Limit | .007 (.17) |
| **Connecting Rod Bearings** | |
| Journal Diameter | |
| Standard (Nominal) | 1.8819 (47.800) |
| Maximum | 1.8828 (47.823) |
| Minimum | 1.8803 (47.760) |
| 1st Undersize (Nominal) | 1.8720 (47.550) |
| Maximum | 1.8729 (47.572) |
| Minimum | 1.8704 (47.508) |
| 2nd Undersize (Nominal) | 1.8622 (47.300) |
| Maximum | 1.8631 (47.323) |
| Minimum | 1.8610 (47.270) |
| 3rd Undersize (Nominal) | 1.8524 (47.051) |
| Maximum | 1.8533 (47.074) |
| Minimum | 1.8510 (47.015) |
| Journal Out-Of-Round | (1) |
| Journal Taper | (1) |
| Oil Clearance | |
| Standard | .002-.012 (.05-.31) |
| Service Limit | .015 (.37) |

**(1) - Information is not available from manufacturer.**

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS (AEG ENGINE)

**CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS (AEG ENGINE)**

| Application | In. (mm) |
|---|---|
| **Crankshaft End Play** | |
| Standard | .003-.009 (.07-.23) |
| Service Limit | .012 (.30) |
| **Main Bearings** | |
| Journal Diameter (Beetle) | |
| Standard (Nominal) | 2.1260 (54.000) |
| Maximum | 2.1266 (54.017) |
| Minimum | 2.1245 (53.963) |
| 1st Undersize (Nominal) | 2.1161 (53.750) |

| | |
|---|---|
| Maximum | 2.1168 (53.767) |
| Minimum | 2.1147 (53.713) |
| 2nd Undersize (Nominal) | 2.1063 (53.500) |
| Maximum | 2.1070 (53.517) |
| Minimum | 2.1048 (53.463) |
| 3rd Undersize (Nominal) | 2.0965 (53.250) |
| Maximum | 2.0971 (53.267) |
| Minimum | 2.0950 (53.213) |
| Journal Diameter (Golf & Jetta) | |
| Standard | |
| Maximum | 2.1253 (53.983) |
| Minimum | 2.1245 (53.963) |
| 1st Undersize | |
| Maximum | 2.1154 (53.733) |
| Minimum | 2.1146 (53.713) |
| 2nd Undersize | |
| Maximum | 2.1056 (53.483) |
| Minimum | 2.1048 (53.463) |
| 3rd Undersize | |
| Maximum | 2.0957 (53.233) |
| Minimum | 2.0949 (53.213) |
| Journal Out-Of-Round | (1) |
| Journal Taper | (1) |
| Oil Clearance | |
| Standard | .0004-.0016 (.010-.040) |
| Service Limit | .0059 (.150) |
| **Connecting Rod Bearings** | |
| Journal Diameter (Beetle) | |
| Standard (Nominal) | 1.8819 (47.800) |
| Maximum | 1.8828 (47.823) |
| Minimum | 1.8803 (47.760) |
| 1st Undersize (Nominal) | 1.8720 (47.550) |
| Maximum | 1.8729 (47.572) |
| Minimum | 1.8704 (47.508) |
| 2nd Undersize (Nominal) | 1.8622 (47.300) |
| Maximum | 1.8631 (47.323) |
| Minimum | 1.8610 (47.270) |
| 3rd Undersize (Nominal) | 1.8524 (47.051) |
| Maximum | 1.8533 (47.074) |
| Minimum | 1.8510 (47.015) |
| Journal Diameter (Golf & Jetta) | |
| Standard | |
| Maximum | 1.8810 (47.778) |
| Minimum | 1.8802 (47.758) |
| 1st Undersize | |
| Maximum | 1.8711 (47.528) |
| Minimum | 1.8703 (47.508) |
| 2nd Undersize | |
| Maximum | 1.8613 (47.278) |
| Minimum | 1.8605 (47.258) |
| 3rd Undersize | |
| Maximum | 1.8514 (47.028) |
| Minimum | 1.8507 (47.008) |
| Journal Out-Of-Round | (1) |
| Journal Taper | (1) |
| Oil Clearance | |
| Standard | .0004-.0024 (.010-.060) |
| Service Limit | .0047 (.120) |

**(1) - Information is not available from manufacturer.**

**CONNECTING RODS**

| Application | In. (mm) |
|---|---|
| Bore Diameters | (1) |
| Center-To-Center Length | (1) |
| Side Play | |
| Standard | .0020-.0122 (.05-.31) |
| Service Limit | .015 (.37) |

**(1) - Information is not available from manufacturer.**

PISTONS, PINS & RINGS

**PISTONS, PINS & RINGS**

| Application | In. (mm) |
|---|---|
| Pistons | |
| Clearance | .0016 (.040) |
| Standard Diameter (1) | 3.247 (82.49) |
| 1st Oversize (1) | 3.257 (82.74) |
| 2nd Oversize (1) | 3.267 (82.99) |
| Pins | |
| Diameter | (2) |
| Piston Fit | (2) |
| Rod Fit | (2) |
| Rings | |
| No. 1 & 2 | |
| End Gap | |
| Standard | .007-.016 (.20-.40) |
| Service Limit (ABA Engine) | .039 (1.00) |
| Service Limit (AEG Engine) | .031 (.80) |
| Side Clearance (ABA Engine) | |
| Standard | .001-.002 (.02-.05) |
| Service Limit | .006 (.15) |
| Side Clearance (AEG Engine) | |
| Standard | .002-.004 (.06-.09) |
| Service Limit | .008 (.20) |
| No. 3 (Oil) | |
| End Gap | |
| Standard | .010-.020 (.25-.51) |
| Service Limit (ABA Engine) | .039 (1.00) |
| Service Limit (AEG Engine) | .031 (.80) |
| Side Clearance | |
| Standard | .001-.002 (.02-.05) |
| Service Limit | .006 (.15) |

**(1) - Measurement includes graphite coating. For new pistons, subtract 0.0006" (0.015 mm) from piston diameter.**
**(2) - Information is not available from manufacturer.**

CYLINDER BLOCK

**CYLINDER BLOCK**

| Application | In. (mm) |
|---|---|
| Cylinder Bore | |
| Standard Diameter | 3.248 (82.51) |
| 1st Oversize | 3.258 (82.76) |
| 2nd Oversize | 3.268 (83.01) |

| | |
|---|---|
| Maximum Taper | .0016 (.040) |
| Maximum Out-of-Round | .001 (.03) |



## VALVES & VALVE SPRINGS

| Application | Specification |
|---|---|
| **Intake Valves** | |
| Face Angle | 45ø |
| Head Diameter | 1.549-1.561" (39.35-39.65 mm) |
| Length | 3.616" (91.85 mm) |
| Minimum Margin | (1) |
| Stem Diameter | .272" (6.92 mm) |
| Valve Stem Installed Height (Minimum) | 1.33" (33.8 mm) |
| **Exhaust Valves** | |
| Face Angle | 45ø |
| Head Diameter | 1.289-1.301" (32.75-33.05 mm) |
| Length | 3.588" (91.15 mm) |
| Minimum Margin | (1) |
| Stem Diameter | .272" (6.92 mm) |
| Valve Stem Installed Height (Minimum) | 1.34" (34.1 mm) |

**(1) - DO NOT machine valves; hand lap only.**



## CYLINDER HEAD

| Application | Specification |
|---|---|
| Cylinder Head Height (Minimum) | 5.220" (132.6 mm) |
| Maximum Warpage | .004" (.100 mm) |
| **Valve Seats** | |
| Intake Valve | |
| Seat Angle | 45ø |
| Seat Width | .079" (2.00 mm) |
| Exhaust Valve | |
| Seat Angle | 45ø |
| Seat Width | .094" (2.40 mm) |
| **Valve Guides** | |
| Intake Valve | |
| Valve Guide Installed Height | (1) |
| Valve Stem-To-Guide | |
| Oil Clearance | (2) .040" (1.00 mm) |
| Exhaust Valve | |
| Valve Guide Installed Height | (1) |
| Valve Stem-to-Guide | |
| Oil Clearance | (2) .051" (1.30 mm) |

**(1) - Valve guide shoulder flush with cylinder head.**
**(2) - New valve installed in cylinder head. Dial indicator used to measure valve wobble in guide.**



## CAMSHAFT

| Application | In. (mm) |
| --- | --- |
| **Journal Diameter** | |
| **Standard** | **1.024 (26.00)** |
| **Undersize** | **1.014 (25.75)** |
| **End Play** | **.006 (.150)** |
| **Runout** | **.0004 (.010)** |
| **Oil Clearance (Maximum)** | **.004 (.10)** |

END OF ARTICLE