

## 3.8 LITER V8

### ENGINE CODING

#### ENGINE IDENTIFICATION

Identification number is located on tag attached to engine crankcase. First six digits of code are used to identify engine, as follows:

#### ENGINE IDENTIFICATION

Application	Chassis Type	Engine Code
380 SEC .....	126.043 .....	116.963
380 SL .....	107.045 .....	116.962
380SEL .....	126.033 .....	116.963

### ENGINE, MANIFOLDS & CYLINDER HEADS

#### ENGINE

##### Removal

1) Remove engine hood. Drain cooling system. Disconnect and remove battery and frame. Remove air conditioning system and remove pipe set at compressor.

2) Disconnect and remove all water hoses. Remove all vacuum, fuel and electrical lines leading to engine. On model 126, remove exhaust pipe at manifold. On all other models, remove exhaust system. Remove right drag link end from ball-stud.

3) On all models, drain power steering reservoir and disconnect hoses. Remove TDC test socket, and remove cable from TDC transmitter. Remove engine shock absorbers.

4) Attach hoist to engine. Remove engine mount bolts. Remove rear engine carrier with engine mount. Remove driveshaft.

5) Remove transmission linkages at transmission. Lift engine/transmission assembly at a 45° angle, and carefully remove from vehicle. Separate engine from transmission assembly.

##### Installation

1) Ensure that oil cooler and all hoses have been flushed and are free from contamination. Replace engine mounts and components as required.

2) Reverse removal procedure to complete installation. Recharge air conditioning system, and check for leaks.

#### INTAKE MANIFOLD

##### Removal & Installation

1) Disconnect negative battery cable. Partially drain coolant at cylinder block drain plug. Disconnect injection lines and fuel lines. Pull off air lines.

2) Remove bearing bracket from throttle linkage and bearing bracket from longitudinal regulating shaft. Pull off connecting cables and plug. Disconnect vacuum lines from automatic transmission and brake power unit.

3) Remove cooling system hoses. Remove intake manifold attaching bolts, and remove intake manifold toward the rear. Clean intake manifold and check flange surfaces for warpage with straightedge. To install, reverse removal procedure.

#### EXHAUST MANIFOLD

##### Removal & Installation

Disconnect negative battery cable. Disconnect exhaust pipe from manifold and exhaust gas return line at 90° fitting. Remove exhaust manifold retaining bolts and exhaust manifold. To install, reverse removal procedure.

#### CYLINDER HEAD

##### Removal

1) Remove left and right cylinder block drain plugs, and drain cooling system. Remove air cleaner and battery. Remove fuel line and injectors. Disconnect fuel injection linkage.

**NOTE:** Do not remove cylinder head until engine has cooled down. Special Allen wrenches are required for cylinder head bolt removal and replacement.

2) Remove intake manifold. Remove transmission fluid filler pipe from attachment at cylinder head. Remove alternator and mounting bracket. Remove distributor and power steering pump with mounting bracket.

3) Disconnect exhaust pipe from manifold and exhaust gas return line at 90° fitting. Remove chain tensioner and slide rails. Mark camshaft sprocket and timing chain position for assembly reference.

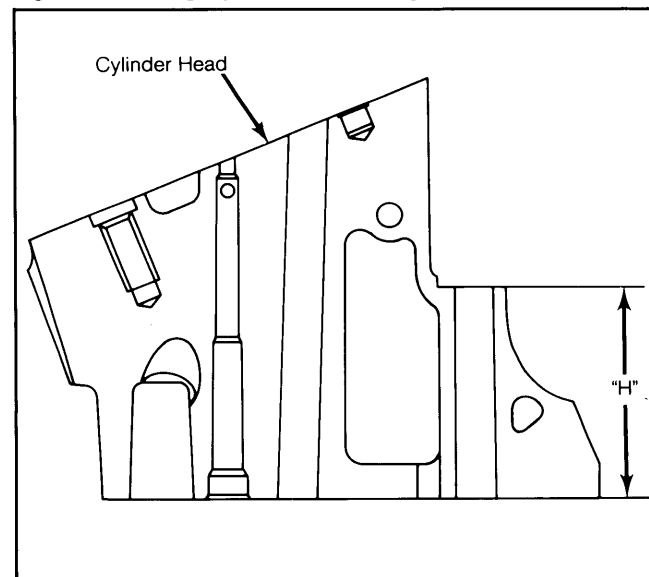
4) Remove sprocket from camshaft. Using Allen wrenches, remove head bolts in reverse of tightening sequence. See Fig. 2. Lift off cylinder head.

##### Inspection

1) Check cylinder head for warp with a straightedge and feeler gauge. Maximum warp in longitudinal direction is .003" (.08 mm). Maximum warp in transverse direction is 0".

2) If cylinder head must be resurfaced, check reference point to determine amount of material to be removed. See Fig. 1. Minimum dimension of "H" is 2.352" (59.75 mm).

**Fig. 1: Checking Cylinder Head Height**



Minimum dimension of "H" is 2.352" (59.75 mm).

# Mercedes-Benz Engines

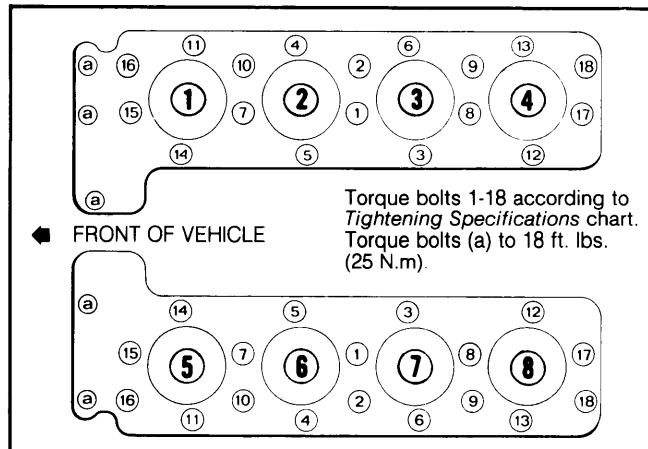
## 3.8 LITER V8 (Cont.)

### Installation

1) Ensure that all mating surfaces are clean and install new cylinder head gasket. Tighten cylinder head bolts. See Fig. 2.

2) To complete installation, reverse removal procedure. Run engine until normal operating temperature is reached. Slightly loosen head bolts individually, then retighten.

**Fig. 2: Cylinder Head Tightening Sequence**



Loosen cylinder head bolts in reverse order.

## CAMSHAFT

### FRONT MAIN BEARING OIL SEAL

#### Removal

Remove radiator, drive belts, and fan. Remove crankshaft hub bolt and pull off hub. Carefully pry out oil seal with a screwdriver.

#### Installation

Fill seal with MP grease prior to installation. Press in seal using sleeve (110 589 07 61 00). To complete installation, reverse removal procedure.

## TIMING CHAIN

### Removal & Installation

1) A split link timing chain is available for repairs without dismantling engine. Remove spark plugs and camshaft covers. Remove air cleaner adapter. Remove chain tensioner. Cover chain guard with cloth and grind open both pins of a link in the timing chain.

2) Remove old link and insert new split link with new chain attached. Turn crankshaft slowly in normal direction while feeding new chain in, and old chain out. Ensure that chain does not slip on sprockets and install master (split) link from rear so that retainer will be at front of engine.

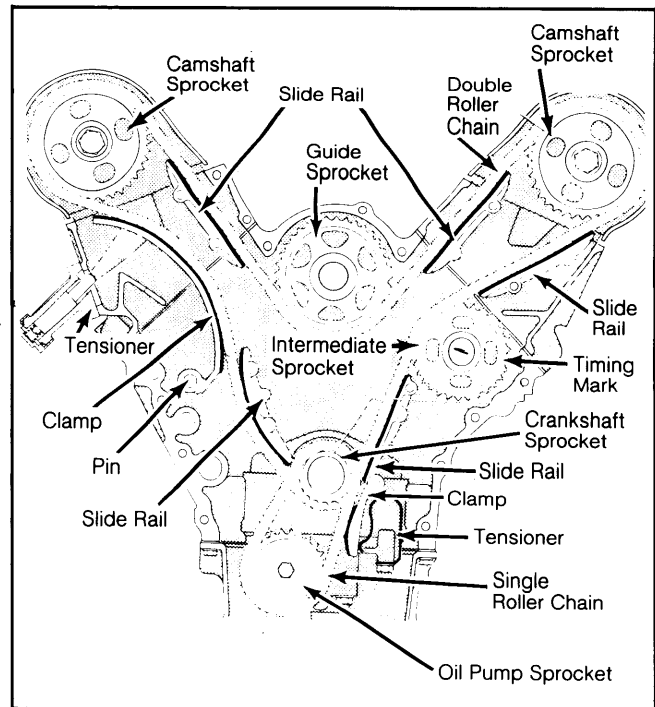
3) Install link spring lock with closed end facing direction of rotation. Rotate crankshaft through one complete revolution and check that all timing marks still agree. To complete installation, reverse removal procedure.

## CHAIN TENSIONER

1) Remove 3 bolts fastening tensioner. Remove chain tensioner.

2) To check tensioner, place vertically in container of oil so that oil covers flange. Actuate plunger

**Fig. 3: Timing Chains and Sprockets**



When installing new chain, ensure that chain does not slip on sprockets.

to fill tensioner with oil. After filling and bleeding, plunger should release compression very slowly and evenly.

3) To install, use new gasket and tighten bolts evenly. Pressure pin of tensioner must press against lug of timing rail.

## VALVE TIMING

1) Remove camshaft covers. Remove rocker arms and valve clearance adjusting shim from No. 1 and No. 6 intake valves. Install valve adjusting screws (116 050 11 20) in place of adjusting shims. Install rocker arms.

2) Turn crankshaft in direction of normal rotation until No. 1 cam lobe is straight up. Adjust screw so rocker arm just touches the base circle of the cam.

3) Attach dial indicator so that pointer rests vertically on valve spring retainer. Pin should have .118" (3 mm) preload and dial should be set to zero.

4) Rotate engine in direction of normal rotation, until pointer moves .0787" (2 mm), leaving a preload of .039" (1 mm). Value on vibration damper should be 16°. Repeat test for No. 6 intake valve.

5) If timing requires correction, install an offset Woodruff key or new chain. Keys are available in 4 offsets providing corrections of 4°, 6 1/2°, 8°, and 10°. After adjusting valve timing, install hydraulic lifters and adjust for proper base setting.

## CAMSHAFT & BEARINGS

### Removal

1) Remove cylinder head covers. Remove rocker arms. If rocker arms and camshafts are not replaced, install all parts in original position.

2) Set No. 1 piston to TDC of compression stroke. Woodruff key in camshaft must point up. Remove oil pipe.

## 3.8 LITER V8 (Cont.)

3) Mark relative position of camshaft sprockets and timing chain. Remove camshaft sprockets. Remove camshaft bearings and camshaft as an assembly.

### Inspection

Check camshaft runout. Maximum camshaft runout is .001" (.025 mm) measured at center journal.

### Installation

1) Assemble bearings on camshaft. Note that smooth bearing journals must fit in bearings with an oil groove, and camshaft journals with an oil groove must fit in bearings without an oil groove.

2) Place camshaft and bearing assembly on head. Note that outer screw of left camshaft rear bearing must be inserted in bearing prior to mounting due to interference from brake unit. Oil pipe connections on bearings must be replaced to ensure proper oil pressure.

3) Tighten camshaft bearing mounting bolts, and check that camshaft rotates freely. Mount compensating washer so that both inner and outer notches align with Woodruff key in camshaft. Assemble sprockets to camshaft so that white color faces camshaft and timing marks are aligned.

4) Install rocker arms and check basic clearance of lifters. See *Adjusting Lifters to Base Setting*. To complete installation, reverse removal procedure.

**NOTE:** If new rocker arms or camshaft are replaced, both rocker arms and camshaft must be replaced. Camshaft journals may be reground and undersize bearings installed.

## DISTRIBUTOR DRIVE GEAR

### Removal

1) With engine front cover removed, disconnect slide rails as needed and timing chain tensioners.

2) Remove chain from intermediate sprocket and pull sprocket from engine. Use puller to extract bushing from crankcase and cover.

### Installation

1) Press new bushings in position so that lubricating groove is at bottom. Lubricate bushings and install intermediate sprocket.

2) Note that mark on sprocket must align with mark on crankcase with number 1 cylinder at TDC position on its compression stroke. To complete installation, reverse removal procedure.

## VALVES

### VALVE ARRANGEMENT

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

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

### ROCKER ARMS

1) Rocker arms are individually mounted on the 16 valves, without use of a shaft. They are in constant contact with the camshaft, thrust plates above the valve stems, and hydraulic valve lifters. To remove, compress spring on each valve using compressor (123 589 03 61 00). Mark each arm for installation in original position.

**NOTE:** Whenever it is necessary to install either new rocker arms or camshaft, both rocker arms and camshaft must be replaced. Camshaft journals may be reground and undersize bearings installed.

2) Rocker arms should have a chamfer behind ball socket (lifter end). Do not use rocker arms unless they have this chamfer.

3) Whenever camshaft is replaced, new rocker arms must also be installed. Likewise, when new rocker arms are installed, replace the camshaft, as well. When making replacements, check base setting of hydraulic valve lifters using test gauge (100 589 04 23 00).

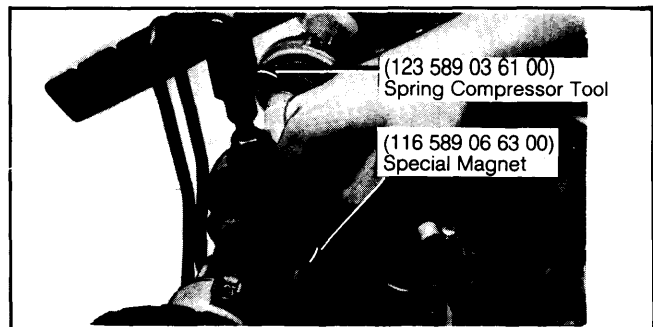
4) Correct, as required, using new adjusting shims. Shims are available in increments of .35 mm from 3.7 mm to 5.8 mm. See *Adjusting Lifters to Base Setting*.

## VALVE SPRINGS & STEM SEALS

### Removal

Using spring compressor (123 589 03 61 00) remove rocker arms. Lift out adjusting shim and, using special magnet (116 589 06 63 00), remove valve keepers. Remove spring retainer, valve springs, valve stem seals, and rotocaps.

Fig. 4: Removing Valve Keepers

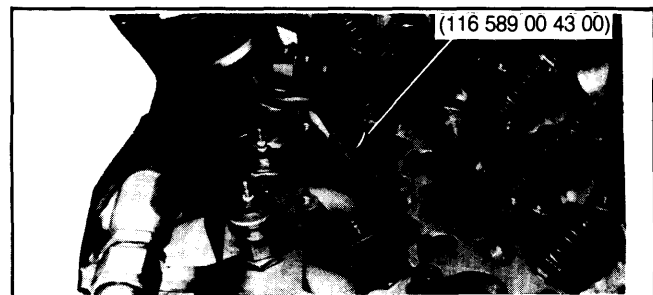


Use special magnet (116 589 06 63 00) to remove valve keepers.

### Installation

Replacement valve stem seals are supplied in a kit which includes assembly sleeves. Place sleeve over stem and install lubricated seal with installing tool. Install remaining components in reverse order of removal.

Fig. 5: Installing Valve Stem Seals



## VALVE GUIDE SERVICING

1) With cylinder head removed, clean bores of valve guides. Inspect valve guides for wear. Inner diameter of inlet and exhaust guides should be .354-.355" (9.000-9.015 mm). If guide is worn, replace with new guide.

2) With mandrel, drive or press worn guide from combustion chamber side of cylinder head. Inspect valve guide bore in cylinder head and ream to accept next oversize guide.

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## 3.8 LITER V8 (Cont.)

3) Press fit of standard valve guide in cylinder head is .0003-.0008" (.008-.020 mm). Press fit of oversize valve guide is .0004-.0009" (.011-.024 mm).

4) Heat cylinder head to approximately 174°F (80°C) and cool valve guide. Coat guide bore with oil and using mandrel, seat new guide in bore.

**NOTE:** Be sure snap ring is properly installed. Recheck valve guide clearance and that valve moves freely in guide.

### VALVE SEAT

1) Check valve guide prior to removing seat ring. See *Valve Guide Servicing*. If seat is worn, carefully remove it by machining with a valve seat ring turning tool.

2) Thoroughly clean the receiving bore, and check its diameter. If diameter is within specifications, install a new valve seat ring of the same size. Standard intake bore size is 1.617-1.618" (41.090-41.100 mm). Standard exhaust bore size is 1.575-1.615" (40.000-41.016).

3) If diameter is not within specifications, machine bore to next oversize. Press fit of standard and oversize valve seats in cylinder head is .003-.004" (.074-.100 mm).

4) To install, heat cylinder head in water to approximately 140°F (60°C). Place pre-cooled seat ring into bore. To position seat ring, lightly tap ring, using a mandrel and hammer.

5) Machine valve seat to correct width and correct for runout. Do not machine rounded bead on lower part of valve seat. Valve seat runout should not exceed .0016" (.04 mm).

### HYDRAULIC VALVE LIFTERS

**NOTE:** Always keep hydraulic valve lifters in an upright position. Rocker arms and lifters must be reinstalled in original locations. When checking and adjusting lifter settings, crank engine for 30 seconds with starter contact switch.

To check hydraulic lifter performance, press on rocker arm at lift end with valves in closed position. If pressure bleeds off too rapidly, replace faulty lifter(s). If lifters are removed, they should be stored in an upright position and reinstalled in original location.

### ADJUSTING LIFTERS TO BASE SETTING

1) When replacing hydraulic lifters, camshaft, or rocker arms, basic position of lifter must be checked. Rotate engine so that cam lobe of element to be checked is in the upright position and install test gauge (100 589 04 23 00).

2) Set measuring pin of gauge through rocker arm hole so that it rests on ball pin of lifter. Basic position is correct when red groove of pin is aligned with measuring edge of tool.

3) If groove is below measuring edge, a plus (+) deviation is indicated, requiring a thinner shim. Entire groove showing above measuring edge indicates a minus (-) deviation, and requires a thicker shim.

4) To correct setting, remove rocker arm and shim. Install thinner or thicker shim as required. Install rocker arm. Repeat measuring procedure. Position is correct when center of measuring groove aligns with edge of gauge.

## PISTONS, RINGS & PINS

### OIL PAN

#### Removal (Model 107)

Remove radiator, and shroud. Remove front axle assembly. Remove A/C compressor and mounting bracket. Remove supporting angle bracket between pan and transmission. Remove oil pan bolts and lower oil pan along with dipstick guide tube from engine.

#### Installation

To install, apply grease to clean mating surfaces and install new gasket. Reverse removal procedure to complete installation.

#### Removal (Model 126)

1) Remove A/C compressor and mounting bracket from engine. Remove drive belt tensioning pulley. Unbolt and remove oil pan lower half. Remove oil pump drive sprocket and mounting bolts. Remove oil pump.

2) Remove oil pan upper half retaining bolts, and remove upper pan. Remove engine mount bolts. Loosen both engine shock absorbers. Remove radiator shell. Lift engine until oil pan can be removed.

#### Installation

To install, ensure that all mating surfaces are clean and apply thin layer of grease. Use new gasket and install oil pan upper half. To complete installation, reverse removal procedure.

### PISTON & ROD ASSEMBLY

#### Removal

1) With cylinder head and oil pan removed, remove connecting rod nuts and bearing caps. Push piston and rod assembly out top of cylinder. Use care not to damage any bearing surface, during removal procedure.

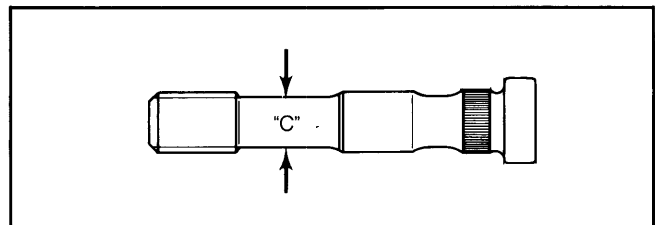
2) Remove piston pin snap ring and push out piston pin. Retain all components in proper order for reassembly.

#### Inspection

1) Check connecting rod bolt diameter at point "C". See Fig. 6. Minimum diameter at "C" is .315" (8.0 mm). Replace bolt if less than specification.

2) Press old bolts out of connecting rod. Press new bolts in at approximately 5 tons (4588 kg).

**Fig. 6: Checking Connecting Rod Bolt Diameter**



Minimum diameter at "C" is .315" (8.0 mm).

#### Installation

1) Check rings for end gap and side clearance. Replace if not within specifications. Lubricate piston pins and connecting rod bushings. Push in piston pin (do not heat piston), and insert snap rings.

2) Stagger ring gaps on piston and fit ring compressor. Install piston and rod assembly with arrow on piston facing toward front of engine.

3) Install rod caps, matching code numbers to and facing rod numbers. Tighten rod cap nuts and check all clearances.

## 3.8 LITER V8 (Cont.)

### FITTING PISTONS

Measure cylinder bores at top, bottom and center of bore in at least 2 directions. If greater than .004" (.10 mm) from standard, cylinders must be bored and new pistons fitted.

### CYLINDER BORE SPECIFICATIONS

Application	In. (mm)
Standard .....	3.6220-3.6228 (92.0-92.02)
1st Oversize .....	3.6417-3.6425 (92.50-92.52)
2nd Oversize .....	3.6614-3.6622 (93.0-93.02)

### PISTON RINGS

1) Check rings for end gap and side clearance. Stagger ring gaps on piston and fit ring compressor. Install piston and rod assembly with arrow on piston facing toward front of engine.

2) Install rod caps, matching code numbers to and facing rod numbers. Check connecting rod bolts. See *Piston & Rod Assembly*. Tighten connecting rod cap nuts.

### PISTON PINS

#### Removal

Piston pins are retained with snap rings in pistons. To remove pins, remove circlips and press out pins.

#### Installation

To install, ensure that arrow on piston crown faces front (timing chain end) and that bearing retaining notch in connecting rod faces toward outside of engine. Lubricate pin and push into piston and rod assembly by hand. Do not heat piston. Install snap rings.

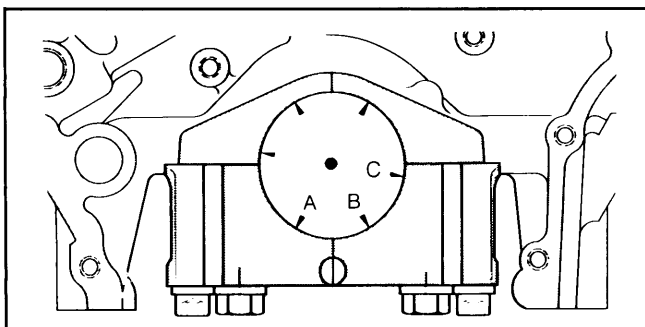
## CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

### MAIN & CONNECTING ROD BEARINGS

1) Mount main bearing cap to cylinder block without bearings in place. Measure inside diameter at 3 locations. See *Fig. 7*. Be sure cap is properly positioned when taking reading. Offset bearing caps can be moved into center position by lightly tapping them with a plastic hammer.

2) All 3 measurements should agree. If basic bores exceed specifications, remove .008" (.02 mm) from contact surfaces, using a surface plate.

**Fig. 7: Location for Measuring Main Bearing Bore Diameter**



Be sure cap is properly positioned, when taking reading.

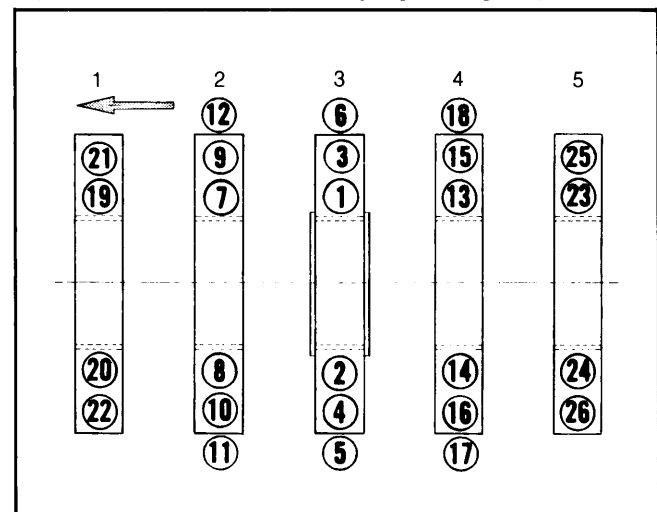
3) Measure main bearing and connecting rod bearings at front and rear to check for taper. If beyond .0006" (.015 mm), remove excess material from one side of bearing cap, using surface plate.

4) Use proper bearing shells to match measurements obtained. Several overlapping bearing sizes are available. Fit bearing halves into bearing bore and tighten bolts.

5) Measure inner diameter of bearings and outer diameter of journals. Difference in measurements should be within bearing clearance specifications. If not, change bearing shell halves.

6) When proper clearance is calculated, clean and oil all parts and install crankshaft. Tighten main cap bolts according to sequence. See *Fig. 8*.

**Fig. 8: Crankshaft Main Bearing Tightening Sequence**



Tighten bolts in 2 steps.

7) With crankshaft properly installed, check for free rotation and for proper end play. Install connecting rods.

### THRUST BEARING ALIGNMENT

Use a feeler gauge to check crankshaft end play. Insert feeler gauge between No. 3 main bearing (thrust bearing) and crankshaft thrust face. Crankshaft end play should be .004-.009" (.10-.23 mm).

### REAR MAIN BEARING OIL SEAL

#### Removal

Remove transmission and flex plate. Pry out oil seal. Clean sealing surfaces. Check crankshaft surface for scoring. Oil seal with sealing lip offset inward is available in case of scored crankshaft.

#### Installation

1) Lubricate lip of seal, and place seal into position in rear engine cover. Place conical sleeve (116 589 03 43 00) over crankshaft end and place cover in position. Do not damage pan gasket.

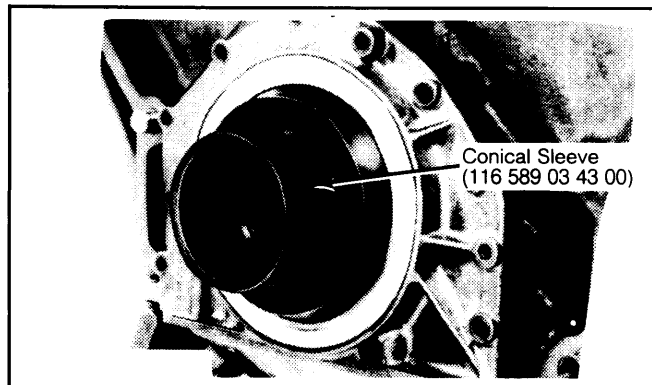
2) Before installing flex plate, check diameter of neck-down bolts. Diameter of bolt at section closest to shoulder must not be less than .366" (9.3 mm). If so, replace all bolts. Install flex plate.

**NOTE:** Flex plate can only be mounted in one position due to offset of 1 of the 8 fastening bolts.

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## 3.8 LITER V8 (Cont.)

**Fig. 9: Installing Rear Cover and Seal**



Seal can be installed, without removing rear engine plate.

### ENGINE OILING

#### CRANKCASE CAPACITY

8.5 qts. (8.0L) with filter.

#### OIL FILTER

Disposable cartridge type.

#### NORMAL OIL PRESSURE

7.1 psi (.5 kg/cm<sup>2</sup>) at idle; 42.6 psi (3.0 kg/cm<sup>2</sup>) at 3000 RPM.

#### BY-PASS VALVE

Valve is located in crankcase and enters into main oil gallery. When filter becomes contaminated, valve will open and oil will enter in an unfiltered state.

#### ENGINE OILING SYSTEM

Lubrication is provided by a gear type oil pump directly driven by crankshaft. Oil is picked up through a strainer from lower portion of oil pan and forced to oil filter through a gallery in timing casing.

After passing through filter, oil flows to center main gallery, to crankshaft and through rod bearings up

rods to piston pin bushing. Oil galleries run to cylinder head, valve assemblies and to camshafts. Circuit also oils timing chain tensioner.

#### OIL PUMP

##### Removal

Remove oil pan, as previously outlined. Oil pump is chain driven and must have sprocket and chain removed prior to pump removal. Remove 4 oil pump mounting bolts. Slide pump off drive shaft..

##### Installation

Mount oil pump on sprocket. The clamping sleeve in sprocket should enter cutout of drive shaft. Install oil pump.

**NOTE:** When tightening pump retaining bolt, lock tensioning spring of chain tensioner with a screwdriver.

### ENGINE COOLING

#### COOLING SYSTEM CAPACITY

15.8 qts. (14.9L)

#### THERMOSTAT

Opens at 162-169°F (72-76°C). Thermostat is located in water pump housing. When installing ensure ball-valve is mounted at highest point.

#### WATER PUMP

##### Removal

Disconnect all necessary water hoses and any remaining components from water pump housing. Remove distributor, and 8 water pump mounting bolts. Remove pump from vehicle.

##### Installation

Clean gasket mating surfaces, and install water pump with new gasket. To complete installation, reverse removal procedure.

### ENGINE SPECIFICATIONS

#### GENERAL SPECIFICATIONS

Year	DISPLACEMENT		Fuel System	HP@RPM	Torque Ft. Lbs.@RPM	Compr. Ratio	BORE		STROKE	
	Cu. In.	Liters					In.	mm	In.	mm
1981	234	3.8	Fuel Inj.	155@4750	196@2750	8.3:1	3.46	88	3.11	78.9

#### VALVES

Engine Size & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
3.8L Intake	1.5433 (39.2)	45°	45°	.051-.078 (1.3-2.0)	.3523-.3531 (8.95-8.97)	.003 (.075)	.....
Exhaust	1.4606 (37.1)	45°	45°	.059-.079 (1.5-2.0)	.3523-.3531 (8.94-8.96)	.003 (.075)	.....

# Mercedes-Benz Engines

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## 3.8 LITER V8 (Cont.)

### ENGINE SPECIFICATIONS (Cont.)

#### PISTONS, PINS, RINGS

Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Ring No.	End Gap In. (mm)	Side Clearance In. (mm)
3.8L	.0008-.0012 (.020-.030)	.0001-.0005 (.002-.012)	.0003-.0007 (.007-.018)	No. 1	.012-.018 (.30-.45)	.002-.003 (.050-.080)
				No. 2	.014-.022 (.35-.55)	.0016-.0030 (.040-.070)
				Oil	.010-.016 (.25-.40)	.0012-.0020 (.030-.060)

#### CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm)	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
3.8L	2.517-2.518 (63.95-63.96)	.0012-.0028 (.045-.084)	.....	.004-.009 (.10-.24)	2.045-2.046 (51.95-51.96)	.001-.002 (.030-.060)	.009-.015 (.220-.380)

#### CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
3.8L <sup>1</sup>			
No. 1	1.376-1.377 (34.96-34.98)	.001-.002 (.03-.06)	.....
No. 2 & 3	1.935-1.936 (49.16-49.18)	.001-.002 (.030-.060)	.....
No. 4 & 5	1.943-1.944 (49.36-49.38)	.001-.002 (.030-.060)	.....

<sup>1</sup> - Standard end play is .003-.006" (.070-.143 mm).

#### VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (Kg @ mm)	
		Valve Closed	Valve Open
3.8L	Inner	24.7@1.3 (11.2@33)	50.7@846 (23@21.5)
	Outer	67.24@1.65 (30.5@42)	194@1.2 (88@30.5)

#### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Cylinder Head Bolts	
Cold Step 1 .....	22 (30)
Cold Step 2 .....	44 (60)
Warm Step 3 .....	44 (60)
Camshaft Bracket Bolts .....	37 (50)
Camshaft Sprocket Bolts .....	74 (100)
Connecting Rod Bolts .....	133 (45)
Main Bearing Caps	
Large Bolts .....	72 (98)
Small Bolts .....	47 (64)
Crankshaft Hub Bolt .....	199-243 (270-330)
Oil Pressure Relief Valve .....	29 (39)
Flywheel (Drive Plate) .....	<sup>1</sup> 25 (35)
Hydraulic Valve Lifters .....	36 (49)
Chain Tensioner Nut .....	80 (109)

<sup>1</sup> - After torque values are achieved, torque an additional 90-100°.

#### VALVE TIMING

Engine	INTAKE		EXHAUST	
	Open (ATDC)	Close (ABDC)	Open (BBDC)	Close (BTDC)
3.8L	16°	15°	16°	17°