

## 528i, 633CSi & 733i 6-CYLINDER

### ENGINE CODING

#### ENGINE IDENTIFICATION

Engine serial number is same as chassis serial number. Engine serial number is stamped in crankcase above starter.

### ENGINE, CYLINDER HEAD & MANIFOLDS

**NOTE** — Transmission (manual or automatic) must be removed prior to removing engine.

#### MANUAL TRANSMISSION

**Removal** — 1) Remove exhaust system and support brackets from vehicle. Pull up boot from shift lever, remove circlip and pull shift lever up and out. Disconnect propeller shaft at output flange after compressing rubber coupling with compressing strap (261012).

2) Remove center support bearing and pull propeller shaft from transmission. Remove heat shield and clutch slave cylinder. Remove speedometer cable and disconnect backup light switch connection. Disconnect transmission from clutch housing. Support engine at front, remove transmission crossmember and transmission.

**Installation** — To install, reverse removal procedure. When installing drive shaft, push center support bearing forward .08" (2 mm) to preload bracket and tighten nuts.

#### AUTOMATIC TRANSMISSION

**Removal** — 1) Disconnect exhaust system and remove support brackets. Disconnect accelerator cable at transmission and take off of counterholder. Drain transmission and remove filler tube. Plug filler tube opening and disconnect oil cooler lines at transmission. Remove web from bottom of drive shaft tunnel and disconnect wire harness to transmission.

2) Rotate torque converter and remove 4 bolts securing converter to drive plate. Disconnect shift rod from lever. Disconnect drive shaft coupling at rear of transmission and loosen threaded coupling at rear of center support bearing.

3) Remove center support bearing and pull drive shaft down and out to remove. Disconnect speedometer cable and backup light connection. Remove transmission crossmember, allowing engine oil pan to rest on front axle crossmember.

4) Place a jack under transmission and remove ground strap. Separate transmission from engine, making sure torque converter stays in housing in transmission. Remove transmission.

**Installation** — Reverse removal procedures and note that center support of torque converter is below edge of transmission. Push center support forward .08" (2 mm) to preload center bearing and tighten nuts. Adjust accelerator cable lever.

#### ENGINE

**Removal** — 1) Drain cooling system and disconnect battery ground cable. Remove hood and radiator. Remove air cleaner with fuel injection air volume control unit. Remove distributor

cap and secondary wiring. Disconnect vacuum line from distributor and primary wires from ignition coil.

2) Disconnect fuel feed hose at fuel filter, vapor hose at charcoal filter, and vacuum hoses from brake booster. Disconnect all remaining coolant and fuel hoses from engine. Remove engine ground cable and disconnect plug from fuel injection control unit. Pull control harness into engine compartment from glove box.

3) Mark for identification and disconnect all remaining electrical connections to engine. Detach air conditioner compressor (if equipped) and suspend from wire. Do NOT disconnect hoses. Disconnect wires from starter and alternator. Detach power steering pump from engine, leaving hoses connected.

4) Disconnect accelerator linkage from engine and remove nuts from engine mounts. Remove protective cover from under engine. Attach a hoist to lifting holes at front and rear of engine. On manual transmission models, push back rubber boot on slave cylinder, remove circlip and pull slave cylinder out toward front. Remove throw-out bearing lever and bearing from clutch housing.

5) On all models, gradually lift engine and turn as necessary to clear vehicle. If disassembling engine, mount on engine support tool and adapter (00 1 500 and 11 0 130).

**Installation** — On manual transmission models, lubricate contact surfaces of throw-out-bearing lever with suitable lubricant. To install engine on all models, reverse removal procedures. Ensure that all hoses, lines and electrical connections are restored to original position.

#### INTAKE MANIFOLD

**NOTE** — Throttle housing, air collector and intake pipes may be separated individually.

**Removal** — 1) Disconnect battery ground cable and remove cylinder head cover. Disconnect throttle linkage and detach throttle housing from collector, leaving water hose connected.

2) Mark for identification and remove hoses, lines and wires from intake system. Detach support bracket and press away from collector. Detach collector from intake pipes and remove collector.

**Installation** — Use all new gaskets and reverse removal procedure. Ensure that all hoses, lines and electrical connections are installed in correct locations.

#### CYLINDER HEAD

**Removal** — 1) Disconnect battery ground cable and drain cooling system. Remove air cleaner, spark plug wire tube and valve cover. Disconnect fuel line at fuel pump.

2) Disconnect all fuel and vacuum lines, along with all wiring from injection system and cylinder head. Disconnect accelerator linkage.

3) Remove upper front cover. See *Engine Front Cover & Oil Seal*. Bend back lock tabs and remove camshaft sprocket bolts and sprocket. Remove timing chain tensioner plug, spring and piston. Disconnect water hoses at base of intake manifolds.

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4) Disconnect exhaust pipes. Remove cylinder head bolts and install aligning pins to keep rocker arm shafts from moving. Remove cylinder head.

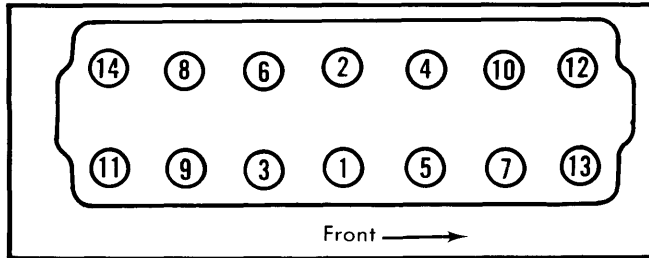


Fig. 1 Cylinder Head Tightening Sequence

**Installation** – 1) Ensure that there is no oil or fluid in recesses of block and insure that all mating surfaces are clean. Install new head gasket ensuring that openings for coolant flow are aligned. Install head and tighten head bolts in 3 steps in sequence illustrated. See *Tightening Specifications*.

**NOTE** – Never loosen bolts during tightening sequence; turn only in tightening direction.

2) Install camshaft sprocket and timing chain. See *Timing Chain Replacement*. Install valve cover and complete installation in reverse order of removal. Retighten cylinder head bolts after engine has been run and allowed to cool to approximately 100°F (38°C).

## CAMSHAFT

### ENGINE FRONT COVER AND OIL SEAL

**Upper Front Engine Cover** – 1) Remove distributor cap and valve cover. Remove thermostat housing and thermostat. Rotate crankshaft until number one cylinder is at TDC of compression stroke. Distributor rotor should point at notch in distributor.

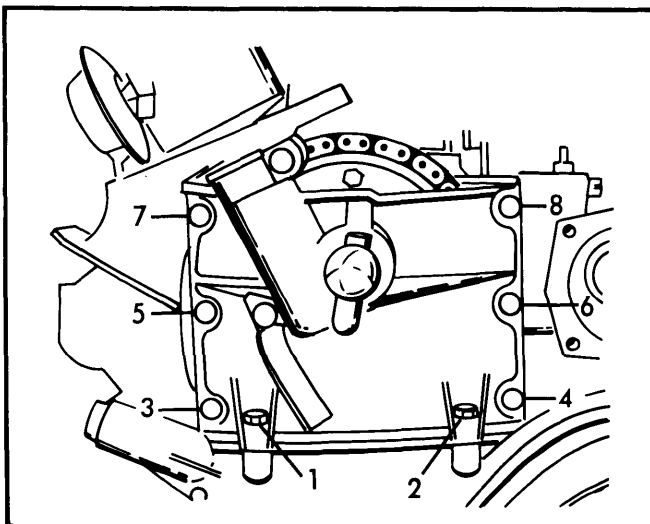


Fig. 2 Upper Front Cover Tightening Sequence

2) Disconnect vacuum lines to distributor. Loosen pinch bolt on distributor mounting and pull out distributor. Remove guard

and upper timing cover bolts. Take off cover with distributor drive gear.

3) To install, thoroughly clean all mating surfaces, fill bores of timing cover with Dirco (or equivalent) sealer, replace cord seal around distributor drive gear, and replace cover with new gasket and sealer. Turn distributor rotor counterclockwise so that rotor tip is about 1½" (38 mm) from notch in distributor housing and guide distributor into position. Note that vacuum advance unit is aligned approximately 90° to valve cover when installed properly.

4) Lightly tighten bolts one and two (see illustration), then tighten remaining bolts to specification in sequence shown in illustration. Tighten bolts one and two to specification. To install remaining components, reverse removal procedure.

**Lower Front Engine Cover** – 1) Remove upper front engine cover as previously outlined. Remove timing chain tensioner piston, fan clutch and crankshaft pulley. Remove lower front engine cover.

2) Replace oil seal. To install cover, reverse removal procedure. Thoroughly clean mating surfaces and use new gasket with sealer. Tighten bolts to specification.

**NOTE** – Oil seal can be replaced without removing lower front engine cover.

**Timing Case Cover Oil Seal** – 1) Remove lower flywheel cover and install suitable ring gear lock. Remove fan housing and all drive belts. Unscrew crankshaft nut and remove vibration damper with hub. Pry out radial seal.

2) Pack lips of new radial seal with grease. Press seal in with installing tool (11 1 280). Install components in reverse order of removal and remove lock on flywheel.

## CAMSHAFT

**Removal** – 1) Cylinder head must be removed from engine. Remove coolant hose. Loosen bolts holding oil distribution line to rocker arm supports and remove line. Loosen all valve adjustments to maximum clearance position.

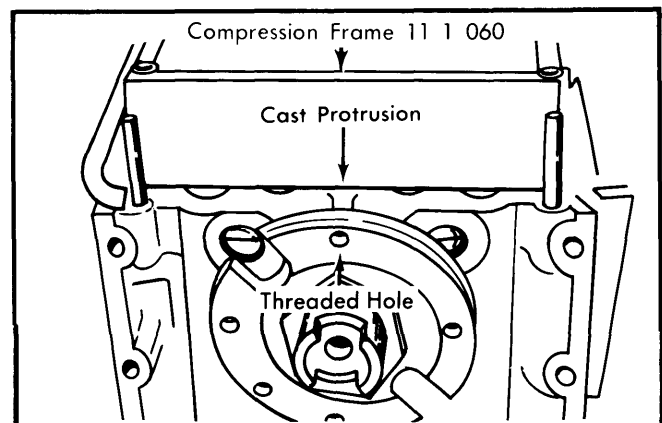


Fig. 3 Position of Camshaft with No. 6 Valves in Overlap Position

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2) Rotate camshaft from TDC position of No. 1 cylinder toward intake approximately .59" (15 mm) and install compression tool (11 1 060). Tighten exhaust side nuts on tool to stop, then intake side nuts. Remove camshaft retaining bolts and pull out camshaft.

**Installation** — 1) Install camshaft in head and tighten thrust plate bolts. Cam must turn easily without excess end play. Turn camshaft to No. 6 overlap position as illustrated and remove compression tool.

2) Install oil line so that oil bores will give off spray between rocker arms and cams of intake and exhaust valves. Ensure that seals are used between line and rocker supports as well as under head of attaching bolts. Continue assembly in reverse order of removal.

### CAMSHAFT END PLAY

Check camshaft end play with a feeler gauge. If end play exceeds .001-.007" (.03-.18 mm), replace camshaft thrust plate.

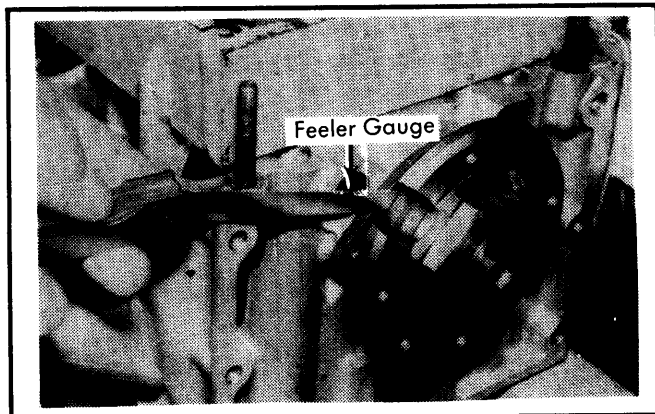


Fig. 4 Checking Camshaft End Play with Feeler Gauge

### TIMING CHAIN REPLACEMENT

1) Rotate crankshaft until number one cylinder is at TDC of compression stroke. Rotor should point to notch in distributor. Remove front engine covers as previously outlined. Mark front side of timing chain for installation.

2) Bend over lock tabs and remove camshaft sprocket with timing chain. If mileage of vehicle exceeds 30,000 miles, replace timing chain. Replace sprockets if worn or damaged.

3) To replace crankshaft sprocket, remove oil pan, oil pump chain and sprocket, and crankshaft Woodruff key. Pull off sprocket with puller (11 2 000). To install, reverse removal procedure and adjust oil pump chain tension.

4) To install timing chain, reverse removal procedure, making sure number one cylinder is at TDC of compression stroke. Line up tapped hole in sprocket hub with cast protrusion in cylinder head and install timing chain and sprocket.

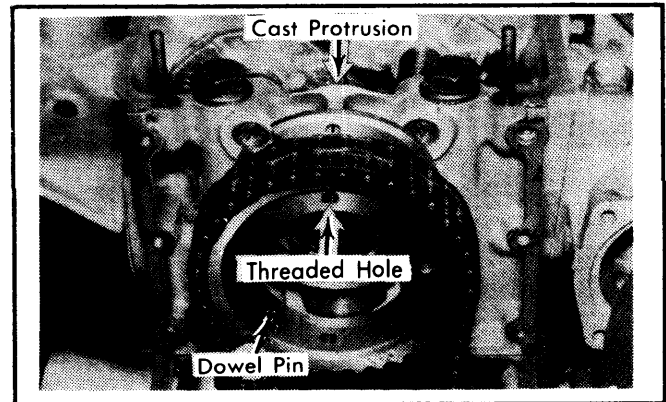


Fig. 5 Camshaft, Sprocket and Timing Chain Alignment for Installation

### TIMING CHAIN TENSIONER

1) Remove tensioner plug, spring and piston. Check length of spring and piston assembly. Length of spring should be 6.122" (155.5 mm). Piston assembly length should be 2.441" (62.0 mm)

2) Check piston with compressed air to see if air vent slots (see illustration) are plugged. Clean slots if air does not pass through. When assembling piston, do not block air vents with disc.

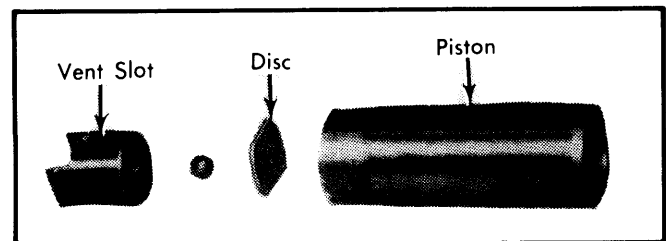


Fig. 6 Timing Chain Tensioner Components

3) Install piston, spring with conical end toward plug and slightly tighten plug. Fill oil well full of oil and remove valve cover to vent air from piston. Move tensioning rail back and forth until oil comes out at plug. Tighten plug and reverse removal procedure to install remaining components.

## VALVES

### VALVE ARRANGEMENT

**Left Side** — Intake valves.

**Right Side** — Exhaust valves.

### ROCKER ARM ASSEMBLY

1) Remove camshaft. See *Camshaft Removal*. Push rocker arms and thrust rings against springs and remove circlips from front rocker arm shafts.

2) Remove two countersunk rocker arm shaft locking bolts next to number one bearing bore of camshaft. Install a suitable

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removing tool (No. 11 3 060) in shaft and pull out of cylinder head. Remove rocker arms, thrust rings, springs and disc.

3) Check rocker arms and shaft for excessive play. Normal shaft diameter should be at least .609" (15.466 mm) and maximum bushing bore in rocker arms should not exceed .611" (15.518 mm). Check cam follower pads on rocker arms for wear and security. If loose, replace rocker arms.

4) Install spring, disc, rocker arm and thrust ring. Install rocker arm shafts and adjust so that recesses in shafts are aligned with cylinder head bolt holes in cylinder head.

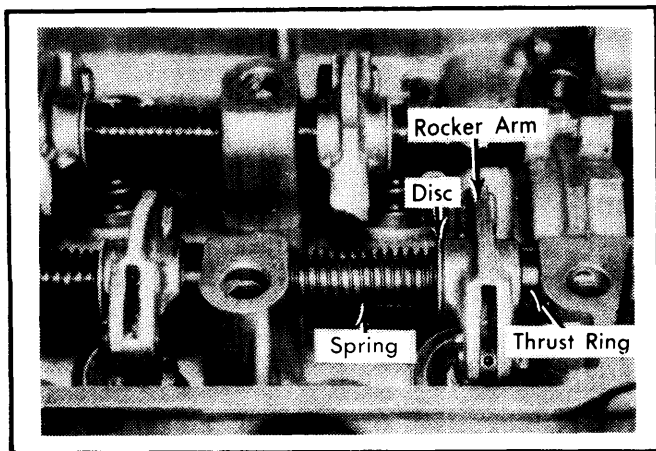


Fig. 7 Installed View of Rocker Arm Assembly

5) To disassemble rear rocker arm assemblies, remove rear cover on cylinder head. Use same procedure for rear shafts as used for front. Install self sealing discs on bolts for rear cover plate and use Cabritol sealer on plate gasket.

### VALVE GUIDE SERVICING

1) With valve removed, check inside diameter of valve guide. If size exceeds specifications, drive guide out through combustion chamber with a suitable driver (No. 11 1 100).

2) Check size of valve guide bore in cylinder head. If size exceeds .5519" (14.018 mm), an oversize guide must be installed. If guide or bore condition warrant, the following sizes of guides are available for service replacement: .5551" (14.10 mm), .5591" (14.20 mm), and .5630" (14.30 mm).

3) Guides require a .0006-.0019" (.015-.044 mm) press fit in cylinder head with head heated to 430-480°F (220-250°C). Ream head bores according to guide size being installed.

4) Using suitable driver (No. 11 1 120), drive guide into cylinder head from top until top of guide protrudes .591" (15.0 mm) for standard guide, or .531" (13.5 mm) for modified guide. Ream valve guide until correct clearance with valve is obtained.

### VALVE SPRING

With rocker arms and shafts removed, compress valve spring with suitable tool (11 1 060) and remove keepers. Remove valve spring and retainer and check spring free length. Check

compressed length and pressure in a suitable tester. Replace defective springs and assemble with paint stripe (tight coil end) against head. Install retainer and keepers.

### VALVE STEM OIL SEALS

To replace valve stem oil seals, use guide or tape over stem grooves to prevent damage to new seals. Lubricate seal and press into position with suitable tool (11 1 130).

### VALVE CLEARANCE ADJUSTMENT

Remove valve cover and turn crankshaft so that No. 1 cylinder is at TDC on firing stroke. Assure that engine temperature is cool (max. 95°F, 35°C) and use feeler gauge to check clearance between valve and adjusting eccentric. Clearance for both intake and exhaust valves should be .010-.012" (.25-.30 mm). To adjust clearance, loosen nut on rocker arm and rotate eccentric.

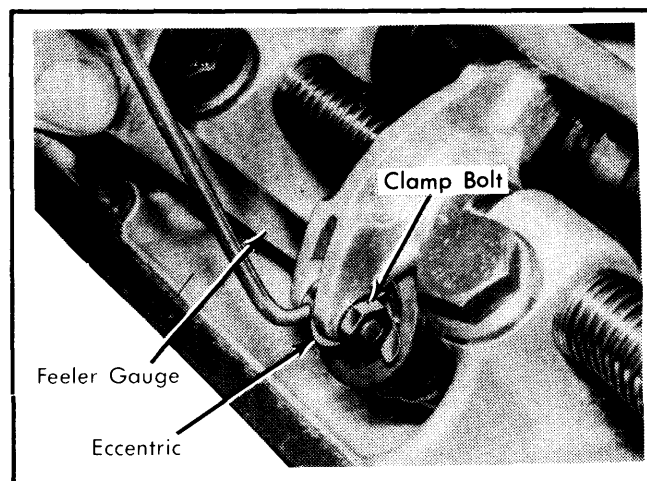


Fig. 8 Valve Clearance Adjustment Procedure

## PISTONS, PINS & RINGS

### OIL PAN

**Removal** – Drain engine oil and remove wires from oil level switch (if equipped). Remove power steering pump but do NOT disconnect hoses. Remove alternator and loosen mounting pad bolts enough to allow access to pan bolts. Remove bottom rear bolt of mounting pad and unscrew pan bolts. Turn crankshaft so that No. 6 connecting rod is above crankcase sealing surface and remove pan. On 733i, it may be necessary to detach engine mounts and lift engine slightly.

**Installation** – To install, use new gaskets and apply sealer to all junctions of block, pan and end covers. To complete installation, reverse removal procedure.

### PISTON & ROD ASSEMBLY

With cylinder head, oil pan and oil pump removed, remove connecting rod cap. Push piston and rod assembly up and out through top of block. To install, ensure that ring gaps are offset 120° to each other. Apply ring compressor and insert bearing halves in rod and cap. Install with arrow on piston top facing timing chain. Assemble cap to rod with numbers matching and tighten cap.

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### PISTON PIN REPLACEMENT

1) With piston and rod assembly removed, remove circlips from piston pin hole in piston. Drive out piston pin and separate piston from connecting rod. Thoroughly clean and inspect rod and piston.

#### Piston Pin Class Designation

Application	Pin Diameter In. (mm)
White .....	.8660-.8661 (21.997-22.000)
Black .....	.8659-.8660 (21.994-21.997)
Blue .....	.8661-.8663 (22.000-22.005)

2) Pistons and pins are installed as a matched set only. Pin class may be coded by white or black marking for standard or blue for oversize pins.



Fig. 9 View Showing Connecting Rod Cap Installation

3) Classes of pins and pistons must not be interchanged. If piston or pin is replaced, it must be replaced with one of a corresponding class and weight. Weight classification is designated by a "+" or "-" stamped in top of piston.

4) Check pin-to-piston clearance, if clearance exceeds that specified and pin is not worn, replace piston. Check pin-to-rod clearance, if clearance exceeds that specified, depending on pin class, new bushing must be installed.

5) Press out old bushing and install new one with split in bushing rotated 90° from oil hole in connecting rod. Drill through oil hole in connecting rod. Ream bushing to specified clearance with piston pin.

6) If connecting rod is replaced, replace with rod which is within 4 grams of rod being replaced. Position piston on connecting rod with arrow on piston facing in same direction as oil hole in connecting rod. Lubricate and install piston pin and circlips.

### FITTING PISTONS

1) With piston removed and disassembled from connecting rod, measure diameter of piston. Measure with micrometer positioned 90° from pin hole and at a point measured from bottom of piston skirt. (Distance "A" in Fig. 10.)

**NOTE** — Distance depends on engine and manufacturer of pistons.

Application	Manufacturer	Distance "A"
528i .....	Mahle .....	.630" (16.0 mm)
528i .....	KS .....	.947" (24.05 mm)
633CSi, 733i .....	Mahle .....	1.024" (26.0 mm)
633CSi, 733i .....	KS .....	1.340" (34.05 mm)

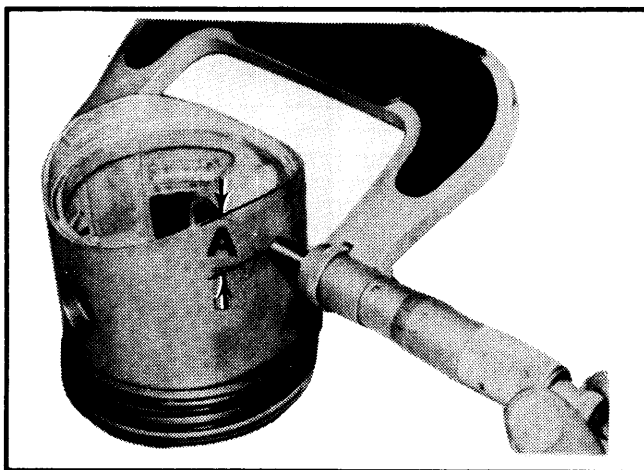


Fig. 10 Measuring Piston Diameter

2) Measure inside diameter of bore in crankcase. If clearance exceeds specification, crankcase must be bored for next oversize piston. Pistons are available in .010" (.25 mm) and .020" (.50 mm) oversize.

3) Check piston ring side clearance and end gap. If new rings are installed, install with word "TOP" stamped in ring toward top of piston.

### CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

#### MAIN & CONNECTING ROD BEARING SERVICE

1) With engine removed, remove clutch, flywheel, cylinder head, oil pan and timing chain. See *Timing Chain Replacement*. Remove rear main bearing oil seal mount.

2) Remove pistons and connecting rods. Remove main bearing caps and lift out crankshaft. Thoroughly clean and inspect crankshaft. Blow out oil passages with compressed air.

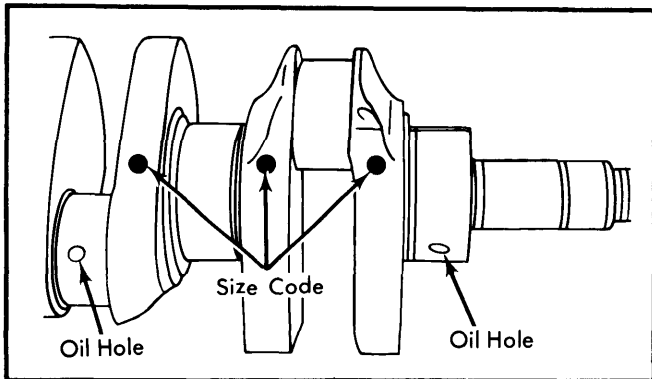
3) Main bearing journals are manufactured in 2 standard sizes. Sizes are designated by a colored dot on crankshaft balance weight next to individual journal. See Fig. 11.

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4) Check main and connecting rod bearing clearance using Plastigage method. If clearance will not meet specifications when installing new bearings, it will be necessary to exchange crankshaft. Crankshaft is tenifer treated and may only be reground at the factory.

5) Install bearing halves in crankcase and bearing caps. Lubricate crankshaft bearing journals and install crankshaft in crankcase.

**NOTE** — In the event of a crankshaft of a different color code than the crankcase, use one blue and one red bearing shell for each journal. Make sure that all red or all blue shells are installed facing up and the remaining color facing down.

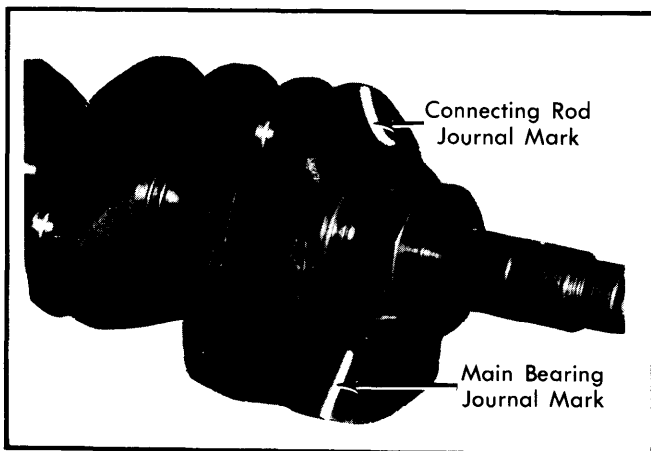


**Fig. 11 Crankshaft Color Code Markings**

6) Install bearing caps with numbers on caps running from one through six in order from front to rear. Install caps with bearing locks on same side as bearing locks in crankcase.

7) Tighten caps to specifications. Check crankshaft end play. See *Thrust Bearing Alignment*. To install remaining components, reverse removal procedure.

**NOTE** — Crankshafts which have been ground undersize are marked with painted stripes. See Fig. 12.



**Fig. 12 View Showing Crankshaft Undersize Markings**

Application	Crankshaft Journal Sizes	In. (mm)
Connecting Rod		
Standard	.....	1.888-1.889 (47.97-47.99)
1 paint stripe	.....	1.852-1.853 (47.72-47.74)
2 paint stripes	.....	1.851-1.852 (47.48-47.49)
3 paint stripes	.....	1.850-1.851 (47.22-47.24)
Main Bearings (Red Code)		
Standard	.....	2.361-2.362 (59.98-59.99)
1 paint stripe	.....	2.324-2.325 (59.73-59.74)
2 paint stripes	.....	2.323-2.324 (59.48-59.49)
3 paint stripes	.....	2.322-2.323 (59.23-59.24)
Main Bearings (Blue Code)		
Standard	.....	2.361-2.362 (59.98-59.99)
1 paint stripe	.....	2.324-2.325 (59.72-59.73)
2 paint stripes	.....	2.323-2.324 (59.47-59.48)
3 paint stripes	.....	2.322-2.323 (59.22-59.23)

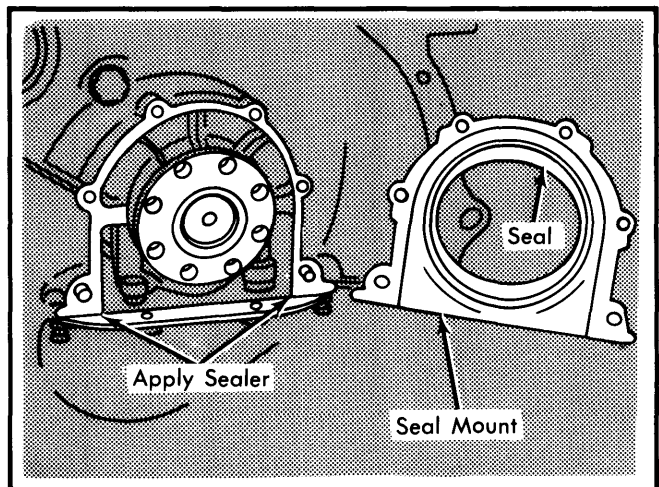
### THRUST BEARING ALIGNMENT

Check axial play prior to disassembly by attaching dial indicator to block and moving flywheel to front and rear. If play exceeds .007" (.174 mm), check and replace main bearings as required.

### REAR MAIN BEARING OIL SEAL REPLACEMENT

**NOTE** — To replace rear main bearing oil seal in vehicle, transmission must be removed.

- 1) Remove clutch and flywheel and drain engine oil. Remove bolts securing oil pan to rear main bearing oil seal mount.
- 2) Pry oil pan down at area around seal mount, taking care not to damage gasket. Remove bolts securing seal mount to crankcase and remove mount.



**Fig. 13 Installing Crankshaft Rear Oil Seal**

3) Pry old seal from mount and install new one using driver and adapter (00 5 500 and 11 1 260). Use guide (11 2 213) when replacing mount to prevent damage to seal. Pack seal lips with grease and apply Atmosit (or equivalent) sealer to junction of oil pan and seal mount. Reverse removal procedure to complete installation.

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### ENGINE OILING

#### ENGINE OILING SYSTEM

Full pressure oil system, utilizing a chain driven Eaton type oil pump, a full flow filter and a pressure regulator valve.

**Crankcase Capacity** – 6 quarts including filter.

**Oil Filter** – Full-flow, paper element type.

**Normal Oil Pressure** – 7-28 psi (.5-2.0 kg/cm<sup>2</sup>) at idle and 71 psi (5.0 kg/cm<sup>2</sup>) at max. RPM.

**Pressure Regulator Valve** – Mounted in oil pump. See *Oil Pump Removal*.

#### OIL PUMP

1) Remove oil pan, front engine covers and timing chain as previously outlined. Remove oil pump drive sprocket and chain. Remove oil pump.

2) Remove pressure regulator plug, spring and piston. Remove pump cover and thoroughly clean and inspect all components. Check clearance between inner and outer rotors. If clearance exceeds maximum specified, replace rotors.

3) Check clearance between outer rotor and pump body and clearance between rotor sealing face and mating surface of pump body and pump cover. If either clearance exceeds maximum specified, replace pump body.

4) Remove sprocket flange using puller (00 8500). Install flange so that distance between sprocket side of flange and sealing side of inner rotor is 1.744±.004" (44.3±.10 mm).

5) Check free length of regulator spring, if less than specified, replace spring. To assemble pump, reverse removal procedure. Attach oil pump to crankcase and install sprocket and chain. Chain should slightly depress when pushed in with thumb.

6) If chain depresses more than recommended, remove pump and install shims between pump and crankcase mounting points. Make sure oil holes line up on front shim. Rear shim

must be same thickness as front. To install remaining components, reverse removal procedure.

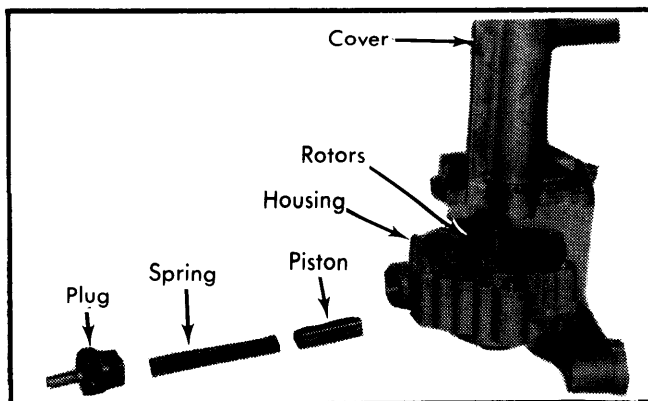


Fig. 14 View of Oil Pump Assembly

#### Oil Pump Specifications

Application	Measurement In. (mm)
Rotor-to-Rotor Clearance	.005-.008 (.12-.20)
Rotor-to-Housing Clearance	
Radial	.006-.011 (.150-.275)
Axial	.0014-.0037 (.035-.095)
Regulator Spring Free Length	2.677 (67.99)

### ENGINE COOLING

#### WATER PUMP

Remove clutch fan, pulley, side bar and connecting hose. Remove water pump. To install, reverse removal procedure. Use new gaskets and sealer.

**Thermostat** – Opens at 176°F (80°C).

**Cooling System Capacity** – 12.7 qts.

### ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS										
Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
1981										
528i	170	2788	Fuel Inj.	169 @ 5500	166 @ 4500	8.2:1	3.386	86	3.150	80
633CSi	196	3210	Fuel Inj.	177 @ 5500	192 @ 4000	8.4:1	3.504	89	3.386	86
733i	196	3210	Fuel Inj.	177 @ 5500	195 @ 4000	8.4:1	3.504	89	3.386	86

# BMW Engines

## 528i, 633CSi & 733i 6-CYLINDER (Cont.)

### ENGINE SPECIFICATIONS (Cont.)

VALVES							
Engine & 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)
2788 cc & 3210cc Intake	1.811 (46.0)	45°30'	45°	.063-.079 (1.6-2.0)	.3134-.3140 (7.960-7.975)	.0010-.0022 (.025-.055)	.....
Exhaust	1.496 (38.0)	45°30'	45°	.079-.095 (2.0-2.4)	.3128-.3134 (7.945-7.960)	.0016-.0027 (.040-.070)	.....

VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
2788 cc & 3210 cc	①1.712 (43.5)	64±2.5@1.480 (29±1.2@37.6)	154±6@1.122 (70±2.8@28.5)

① — Some springs are 1.811" (46.0 mm), depending on manufacturer.

PISTONS, PINS, RINGS						
Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit In. (mm)	Rings	End Gap In. (mm)	Side Clearance In. (mm)
2788 cc & 3210 cc	.0018 (.045)	0-.0002 (0-.005)	①.0002-.0005 (.005-.013) ②.0003-.0006 (.008-.016)	No. 1	.012-.020 (.30-.50)	③.002-.004 (.06-.09)
				No. 2	.008-.016 (.20-.40)	③.001-.002 (.03-.06)
				Oil	.010-.016 (.25-.40)	③.0008-.002 (.02-.06)

① — White color code.

② — Black color code.

③ — Mahle specifications shown; For KS, No. 1 .002-.004" (.06-.09 mm), No. 2 .002-.003" (.04-.07 mm), Oil .001-.002 (.03-.06 mm).

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)
2788 cc & 3210 cc Red Code	2.3614-2.3618 (59.98-59.99)	.0012-.0028 (.030-.070)	No. 4	.0033-.0069 (.085-.174)	1.8888-1.8894 (47.975-47.991)	.0009-.0027 (.023-.069)	.....
Blue Code	2.3610-2.3614 (59.97-59.98)	.0012-.0027 (.030-.068)					

## 528i, 633CSi & 733i 6-CYLINDER (Cont.)

### ENGINE SPECIFICATIONS (Cont.)

CAMSHAFT				
Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)	
2788 cc & 3210 cc	1.3764-1.3770 (34.96-34.98)	.0013-.0029 (.034-.075)	.2802 (7.12)	
				No. 1
				No. 2
				No. 3
No. 4	1.7304-1.7310 (43.95-43.97)			
	1.7704-1.7710 (44.97-44.98)			
	1.8094-1.8100 (45.96-45.97)			

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (BTDC)	Close (ABDC)	Open (BBDC)	Close (ATDC)
2788 cc	①	7°	51°	7°
	②	18°	62°	18°
3210 cc	①	14°	54°	14°
	②	26°	66°	26°

- ① - With .020" (.51 mm) clearance between heel of camshaft and rocker pad.  
 ② - With .014" (.37 mm) clearance between heel of camshaft and rocker pad.

### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N·m)
Cylinder Head Bolts ①	
1st Stage .....	26-32 (34-44)
2nd Stage .....	49-52 (67-71)
3rd Stage .....	56-59 (77-81)
Main Bearing Bolts .....	42-45 (57-62)
Rod Cap Nuts .....	38-41 (51-56)
Camshaft Thrust Plate .....	101-108 (137-147)
Upper Front Engine Cover .....	7-8 (9-11)
Lower Front Engine Cover .....	7-8 (9-11)
Timing Chain Tensioner Plug .....	22-29 (30-40)
Rocker Arm Clamp Bolt .....	7-8 (9-11)
Flywheel Bolts ② .....	72-83 (98-113)
Crankshaft Pulley Nut .....	318-333 (432-451)
Oil Pump Regulator Plug .....	26-30 (35-40)
Camshaft Oil Line Hollow Bolt .....	8-9 (11-13)

- ① - With engine cool - Max. 95°F (33°C).  
 ② - Coat threads with Loctite.