

# BMW Engines

## 1966-73 BMW 1600 & 2002 4 CYLINDER

GENERAL SPECIFICATIONS										
Year	Displ.		Carburetor	HP at RPM	Torque (Ft. Lbs. at RPM)	Compr. Ratio	Bore		Stroke	
	cu. ins.	cc					in.	mm	in.	mm
<b>1602</b> 1966-71	95.99	1573	1x1-Bbl.	96@5800	91@3000	8.6-1	3.307	84	2.795	71
<b>1602ti</b> 1967	95.99	1573	2x2-Bbl.	.....	.....	....	3.307	84	2.795	71
<b>2002 &amp; A</b> 1968-72	121.44	1990	1x1-Bbl.	113@5800	115@3500	8.5-1	3.504	89	3.150	80
1973	121.44	1990	1x1-Bbl.	113@5800	115@3500	8.3-1	3.504	89	3.150	80
<b>2002ti</b> 1967-72	121.44	1990	2x2-Bbl.	135@5800	123@3000	9.3-1	3.504	89	3.150	80
<b>2002tii</b> 1972	121.44	1990	⓪	147@5800	130@4500	10-1	3.504	89	3.150	80
1973	121.44	1990	⓪	147@5800	130@4500	9.0-1	3.504	89	3.150	80

⓪ — Kugelfisher mechanical fuel injection.

### ENGINE IDENTIFICATION

Engine number is located on rear left side of crankcase. Model number is stamped next to engine number.

#### 1602 Serial No.

<b>Saloon</b>	<b>Saloon (USA)</b>	<b>Saloon (Re. L.)</b>
2511 .....	2515 .....	2512

#### 2002 Serial No.

2551 .....	2552 .....	2553
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#### 2002A Serial No.

2556 .....	2558 .....	2557
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#### 2002ti Serial No.

2554 .....	-	-
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### ENGINE REMOVAL

**All Models Except 2002tii** — 1) Remove air cleaner hoses and tubes. Remove air cleaner. Disconnect ground leads from battery and engine. Remove alternator and starter positive cables.

2) On 2002A models, disconnect cables from choke and thermo-start valve. Disconnect plug from starter lock.

3) Remove radiator. Disconnect fuel line at fuel pump. Disconnect wire from thermometer sensor. Remove vacuum line with non-return valve from union. Disconnect heater hose from intake manifold.

4) Disconnect return spring, clamp spring and control rod on carburetor from support on firewall. Loosen clamp and pull out choke cable.

5) On 2002A models, disconnect return spring and pull rod. Lift out retainer from torsion shaft on carburetor and remove torsion shaft.

6) Disconnect oil pressure switch wire from distributor. Remove distributor cap and wires from cylinder head. Remove intermediate shaft and push rod.

7) Check clutch throw-out arm free travel. It should have .67-.75" (17-19 mm) of play measured at push rod. If free play is less than .197" (5 mm) replace clutch. On 2002 and 2002ti models, pull back collar and remove circlip. Remove clutch slave cylinder by pulling out towards front of engine.

8) On 2002A models, remove "C" washer and disconnect selector rod from lever.

9) Remove exhaust pipe support from transmission. Disconnect exhaust pipe from manifold. Remove attaching nuts and disconnect propeller shaft at transmission. Loosen attaching bolts at propeller shaft center bearing.

*NOTE — To avoid the problem of loud booming noises coming from exhaust pipe after installation, use the following sequence of mounting: Attach exhaust pipe to manifold. Loosen retaining plate mounting bolts and press exhaust pipe support (tension free) against exhaust pipe. Tighten retaining plate to transmission and support. Tighten support to exhaust pipe.*

10) Attach suitable lifting hoist to engine. Remove crossmember. Disconnect speedometer cable and back-up light wires.

11) Loosen nut on right engine mount. Remove windshield washer reservoir. Lower transmission and lift engine out of vehicle to the right. To install, reverse removal procedures.

**2002tii** — 1) Disconnect negative battery lead. Remove transmission. Disconnect leads from alternator. Remove radiator and air cleaner.

2) Disconnect negative lead from battery box. Disconnect fuel hose from injector pump and wire from thermo-time switch. Remove fuel filter from front panel.

3) Disconnect vacuum hose air distribution manifold. Disconnect lead from start valve and clamps on cylinder head.

4) Disconnect accelerator linkage and starter cable. Remove heater and overflow hoses from cylinder head. Disconnect fuel overflow hose.

5) Remove wires from distributor and oil pressure switch. Pull induction transmitter from coil. Remove distributor cap and rotor.

6) Attach suitable lifting hoist to engine. Remove windshield washer reservoir. Remove right and left engine mounting nuts. Disconnect harness cable clamp near left engine mount. Lift engine out of vehicle. To install, reverse removal procedures.

### INTAKE MANIFOLD REMOVAL

**1602, 2002 & 2002A** — 1) Drain cooling system, remove air cleaner and disconnect choke cable. Disconnect accelerator

## 1966-73 BMW 1600 & 2002 4 CYLINDER (Cont.)

linkage and vacuum hoses at carburetor and intake manifold. On 2002A, disconnect leads from thermostat valve and choke cover. Remove torsion shaft from carburetor.

2) Disconnect fuel line at fuel pump and lead for remote thermometer sensor. Remove water hoses at manifold flange. Remove dipstick tube and heater hoses from intake manifold.

3) Remove intake manifold from cylinder head. To install, reverse removal procedures.

**2002tii Flexible Manifolds** – 1) Remove air cleaner housing. Disconnect fuel hose, cold start wire and vacuum hose. Loosen clamps and remove all intake-to-air distribution manifold hoses.

2) Unhook return spring. Remove injection pipe from No. 1 cylinder. Remove injection valve.

*NOTE* – Hold up at pipe connection when loosening union nut.

3) Remove bolts from bracket on throttle valve stub. Disconnect vacuum line and air auxiliary hose. Remove injection pipe from No. 4 cylinder.

4) Remove nuts attaching air distribution manifold to cylinder head and lift off manifold. To install, reverse removal procedures.

*NOTE* – Hold up at pipe connection when loosening union nut.

**2002tii Rigid Manifolds** – 1) Remove air cleaner housing and disconnect fuel line, starter valve connector and vacuum hose. Remove fuel return hose, second vacuum hose and auxiliary air hose.

2) Remove bolts attaching throttle valve assembly to stabilizer bracket. Disconnect air distribution manifold from support brackets. Remove rigid manifolds at bottom, from intake pipes. Lift out air induction manifold complete with throttle valve assembly and manifolds, while pressing support brackets away from throttle valve assembly and manifolds. To install, reverse removal procedure.

**1602ti & 2002ti Front Manifold** – 1) Drain cooling system. Remove air cleaner housing and bearing block. Disconnect pull rod, fuel line and vacuum hose. Remove support for dipstick tube.

2) Disconnect remote thermometer sensor wire. Remove water hoses at pipe flange and dipstick from tube. Remove water pipe flange and intake manifold complete with carburetor. To install, reverse removal procedures.

**1602ti & 2002ti Rear Manifold** – Remove bearing block. Disconnect fuel line and pull rod. Remove intake manifold complete with carburetor. To install, reverse removal procedures.

### CYLINDER HEAD REMOVAL

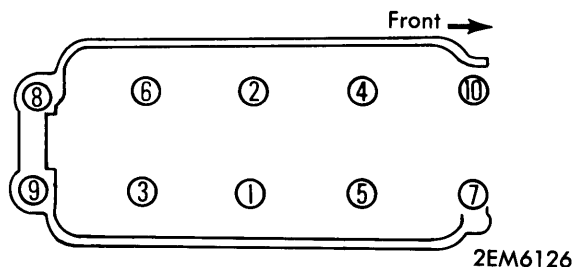
**Removal** – 1) With intake manifolds removed, disconnect breather tube from valve cover. Disconnect battery ground strap and fuel line from fuel pump.

2) Disconnect oil pressure switch wire. Remove distributor cap, high tension lead to coil and water hose from cylinder head.

3) Remove upper timing gear cover. Set No. 1 piston to TDC. Then distributor rotor points to notch in distributor body. Remove piston from chain tensioner and camshaft sprocket from camshaft.

4) Remove exhaust pipe support from transmission and exhaust pipe from manifold. Unscrew head bolts and lift off head.

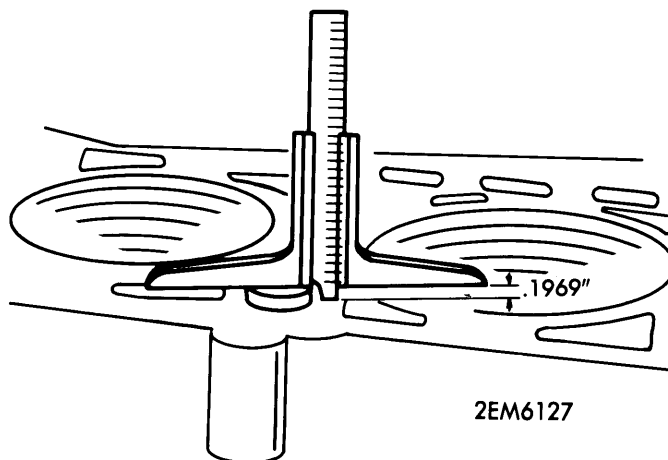
**Installation** – 1) Check guide bushings to see that they protrude .197" above cylinder block (see illustration). Install head gasket, coating two corners near camshaft sprocket with sealing compound.



CYLINDER HEAD TIGHTENING SEQUENCE

*NOTE* – A 2002 cylinder head gasket may not be used on either 2002ti or 2002tii, but a 2002ti gasket may be used on a 2002. Embossed digits "E12" identify late style cast iron head.

2) Install cylinder head and tighten bolts to specifications (see illustration). Reverse removal procedures for remaining components.



CYLINDER HEAD LOCATING BUSHING

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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)	
1602 & ti	Int.	1.636 (42)	45°20'	45°	.071 (1.8)	.3134-.3140 (7.96-7.975)	.0010-.0022 (.025-.055)	.....
	Exh.	1.378 (35)	45°20'	45°	.087 (2.2)	.3128-.3134 (7.945-7.96)	.0016-.0028 (.040-.070)	.....
2002, ti & tii	Int.	1.732 <sup>Ⓢ</sup> (44)	45°20'	45°	.071 (1.8)	.3134-.3140 (7.96-7.975)	.0010-.0022 (.025-.055)	.....
	Exh.	1.496 (38)	45°20'	45°	.087 (2.2)	.3128-.3134 (7.945-7.96)	.0016-.0028 (.040-.070)	.....

Ⓢ - 1.811" (46 mm) for "E12" Cast Iron Head.

### VALVE ARRANGEMENT

Left Side - All intake.

Right Side - All exhaust.

### VALVE GUIDE SERVICE

1) Check valve guide for wear. Press out guide toward combustion chamber. Measure guide bore in cylinder head, if it exceeds .5505" ream cylinder head and fit oversize guide.

2) Heat cylinder head to 428-482°F. Press in new guide from combustion chamber side until tapered groove end protrudes .591" above camshaft side of cylinder head. Ream guide to proper I.D.

#### Valve Guide Specifications

Valve Guide O.D.	Cylinder Head I.D.
Std. .5528" (14.04 mm)	.5508" (13.99 mm)
O.S. .5568" (14.14 mm)	.5548" (14.09 mm)
O.S. .5607" (14.24 mm)	.5587" (14.19 mm)
O.S. .5646" (14.34 mm)	.5626" (14.29 mm)

### VALVE STEM OIL SEALS

1) Remove valve keepers, spring collar and spring. Slide old oil seal off of guide and valve stem.

2) Wrap valve stem with cellophane tape to prevent damage to oil seal. Slide new oil seal, large diameter downward, onto valve guide until it engages tapered groove.



2EM6128  
VALVE STEM OIL SEAL INSTALLATION

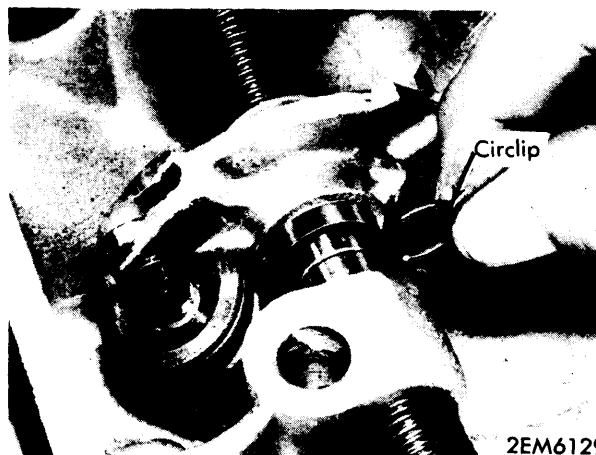
VALVE SPRINGS			
Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (kg @ mm)	
		Valve Closed	Valve Open
All	1.713 (43.5)	64@1.480 (29@37.6)	154@1.122 (70@28.5)

### VALVE SPRING SERVICE

Remove valve keepers and collar. Check spring for wear or fatigue. Replace worn springs with green marked springs only. Install spring, collar and keepers.

### ROCKER ARM ASSEMBLY

Removal - 1) With camshaft removed, push back thrust ring and rocker arm so rocker shaft circlip may be removed (see illustration). Remove distributor mounting flange.

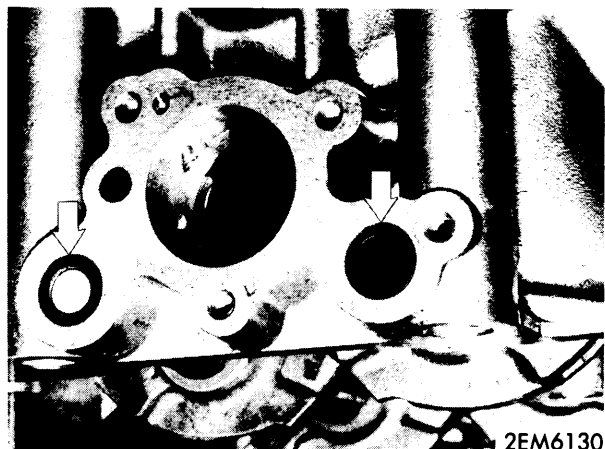


2EM6129  
ROCKER SHAFT CIRCLIP LOCATION

2) Drive out rocker shafts with a punch. Remove rocker arms, springs and thrust rings.

NOTE - Rocker shaft on intake side is open at rear. Exhaust rocker shaft is plugged.

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REAR EXHAUST ROCKER SHAFT PLUG

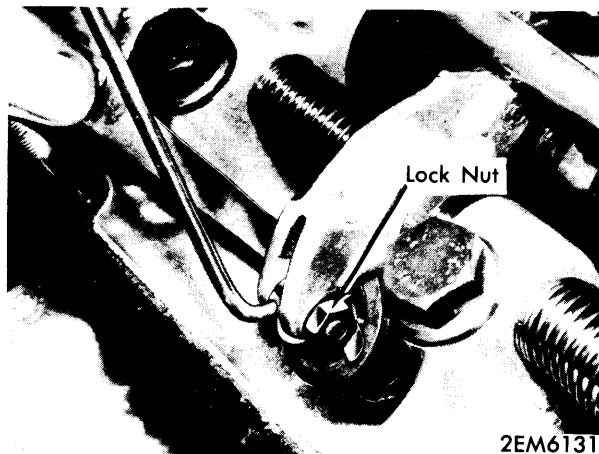
3) Replace rocker arms with loose slide pads.

**NOTE** — Two styles of rocker arms are available. Old style rocker arm without bushing and slide pad .472" wide. Rocker shaft oil hole faces downward. New style rocker arm with bushing and slide pad .433" wide with two rocker shaft oil holes horizontal.

**Installation** — Replace springs, rocker arms and thrust rings. Insert rocker shafts and align shafts so locating pins may be installed. Replace rocker shaft circlips.

### VALVE CLEARANCE ADJUSTMENT

Adjust valves in firing order sequence of 1-3-4-2 at TDC of compression stroke. Using a feeler gauge between rocker eccentric and valve stem, set clearance to .008-.010" (.20-.25 mm) with engine hot or .006-.008" (.15-.20 mm) with engine cold. Loosen nut on rocker eccentric, insert a rod in hole in eccentric and rotate until proper clearance is achieved (see illustration).



TAPPET ADJUSTMENT

### PISTONS, PINS, RINGS

Engine	PISTONS	PINS		RINGS		
	Clearance In. (mm)	Piston Fit In. (mm)	Rod Fit	Rings	End Gap In. (mm)	Side Clearance In. (mm)
1602 & 2002ti	.0016 (.04)	.00004-.0002 (.001-.005)	①	No.1	.0118-.0177 (.30-.45)	.0006-.0011 (.015-.029)
				No.2	.0118-.0177 (.30-.45)	.0005-.0010 (.012-.026)
				No.3	.0098-.0157 (.25-.40)	.0004-.0010 (.011-.025)
2002, A & tii	.0016 (.04)	.00004-.0002 (.001-.005)	①	No.1	.0118-.0177 (.30-.45)	.0006-.0011 (.015-.029)
				No.2	.0079-.0157 (.20-.40)	.0005-.0010 (.012-.026)
				No.3	.0098-.0157 (.25-.40)	.0004-.0010 (.011-.025)

① — Color coded white .00012-.00039" (.003-.010 mm) and color coded black .0002-.00047" (.005-.012 mm).

### OIL PAN REMOVAL

With engine installed, remove stabilizer bar and drain engine oil. Remove bolts from oil pan. Remove nuts from both engine mounts and lift engine slightly. Rotate No. 4 piston to TDC and slide oil pan forward and out. Coat crankcase ends where timing cover and rear main bearing cover join crankcase with sealing compound before reassembly.

### PISTON & ROD ASSEMBLY

1) With oil pan and cylinder head removed, rotate crankshaft to BDC of piston and rod assembly to be removed. Remove

connecting rod nuts and bearing cap, push assembly out top of engine. Replace worn or damaged parts as necessary.

2) Place rings on piston with marking "TOP" facing upward and end gap 180° apart. Install piston with arrow facing forward and oil hole in wrist pin end of connecting rod facing timing chain. Connecting rod and bearing cap numbers must match, with No. 1 rod nearest timing chain.

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### FITTING PISTONS

Piston crowns are marked with arrow for direction of installation and a "+", "-" or no sign to show weight classification. All pistons should have same weight mark. Measure piston and cylinder diameter to determine clearance (see specifications). Measure piston diameter at 90° to wrist pin bore near bottom of piston skirt, see following table for distance from bottom of piston.

**CAUTION** — There are two types of pistons. Type with an "A" stamped at bottom of piston is for early style head with normal combustion chamber and type with "B" stamped at bottom is for late style "E12" cast iron cylinder head with hemispherical combustion chamber.

#### Piston Measuring Location

Piston Type	Distance From Bottom
Mahle	
1602.....	.656" (16.70 mm)
2002.....	.630" (16.00 mm)
2002tii.....	.650" (16.05 mm)
KS	
1602.....	.965" (24.50 mm)
2002.....	.632" (16.05 mm)
2002tii.....	.919" (23.35 mm)
Nural	
1602.....	.433" (11.00 mm)
2002.....	.626" (15.90 mm)

### Piston Diameters

Grade Letter	1602 In. (mm)	2002 In. (mm)
Standard		
A.....	3.3055 (83.96)	3.5024 (88.96)
B.....	3.3059 (83.97)	3.5027 (88.97)
C.....	3.3063 (83.98)	3.5031 (88.98)
Intermediate		
A.....	3.3087 (84.04)	3.5055 (89.04)
B.....	3.3090 (84.05)	3.5059 (89.05)
C.....	3.3094 (84.06)	3.5063 (89.06)
Oversize .010" (.25 mm)		
A.....	3.3153 (84.21)	3.5122 (89.21)
B.....	3.3157 (84.22)	3.5126 (89.22)
C.....	3.3161 (84.23)	3.5130 (89.23)
Oversize .020" (.50 mm)		
A.....	3.3252 (84.46)	3.5220 (89.46)
B.....	3.3256 (84.47)	3.5224 (89.47)
C.....	3.3260 (84.48)	3.5228 (89.48)

### PISTON PIN REPLACEMENT

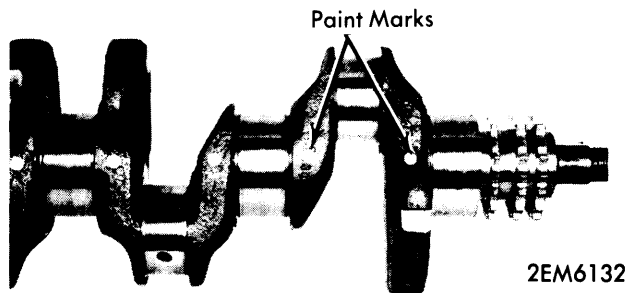
- 1) Remove circlips and push out wrist pin. Check for wear in piston and connecting rod. If rod bushing is worn, press out old bushing and press in new bushing with ends 90° to oil hole.
- 2) Wrist pins come in two diameters, white coded wrist pin with "W" stamped on piston crown or black coded wrist pin with "S" stamped on piston crown.
- 3) Drill oil holes in bushing and ream bushing diameter to specifications. Wrist pin is a light push fit in bushing. Install piston and wrist pin on connecting rod and replace circlips.

### CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

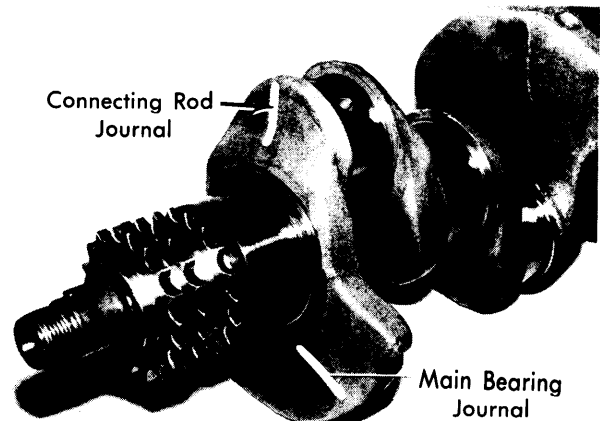
Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam. In. (mm)	Clearance In. (mm)	Thrust Bearing	Crankshaft End Play In. (mm)	Journal Diam. In. (mm)	Clearance In. (mm)	Side Play In. (mm)
All							
Red	2.1646-2.1650 (54.98-54.99)	.0012-.0028 (.030-.070)	Center	.0033-.0069 (.85-.174)	1.8888-1.8894 (47.975-47.991)	.0009-.0027 (.023-.069)	.....
Blue	2.1642-2.1646 (54.97-54.98)						

### MAIN BEARING SERVICE

Plastigage method is used to determine connecting rod and main bearing journal clearances. Standard or undersize crankshafts are marked red or blue. Color coded inserts must agree with crankshaft color code (see illustration). The following table shows color code and undersizes available:



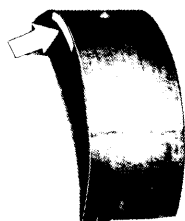
ORIGINAL CRANKSHAFT MARKS (Red or Blue)



UNDERSIZE CRANKSHAFT MARKS

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Paint Mark



2EM6134

### BEARING INSERT CODING (Red or Blue)

#### Main Bearing Journal Diameter

Undersize	In. (mm)
Std. Red.....	2.1646-2.1650 (54.98-54.99)
Std. Blue.....	2.1642-2.1646 (54.97-54.98)
Stage 1 Red.....	2.1547-2.1551 (54.73-54.74)
Stage 1 Blue.....	2.1544-2.1547 (54.72-54.73)
Stage 2 Red.....	2.1449-2.1453 (54.48-54.49)
Stage 2 Blue.....	2.1445-2.1449 (54.47-54.48)
Stage 3 Red.....	2.1350-2.1354 (54.23-54.24)
Stage 3 Blue.....	2.1347-2.1350 (54.22-54.23)

#### Connecting Rod Journal Diameter

Undersize	In. (mm)
Standard.....	1.8888-1.8894 (47.975-47.991)
Stage 1.....	1.8789-1.8796 (47.725-47.741)
Stage 2.....	1.8691-1.8697 (47.475-47.491)
Stage 3.....	1.8592-1.8599 (47.225-47.241)

### THRUST BEARING ALIGNMENT

Attach a dial indicator to crankcase with shaft touching flywheel. Move flywheel in and out to determine endplay of crankshaft. If endplay is excessive, replace center main bearing inserts.

### REAR MAIN BEARING OIL SEAL SERVICE

With flywheel removed, unscrew six attaching bolts from rear crankshaft seal holder. Carefully run a knife blade between seal holder and oil pan gasket to break seal. Remove seal holder and press out old seal, press in new seal. Coat oil pan gasket at either side with sealing compound and replace seal holder.

### ENGINE FRONT COVER & OIL SEAL

- 1) Remove radiator and loosen alternator adjusting brackets. Remove fan belt. Partially loosen cover plate on transmission.
- 2) Using suitable tool (6069), lock flywheel ring gear. Unscrew nut from pulley hub and remove pulley. Using a suitable puller, extract oil seal and replace with new seal.
- 3) Remove bolts attaching timing cover. Insert a knife blade between cover and oil pan gasket to break seal. Lift off timing cover. To install, reverse removal procedures.

Paint Mark



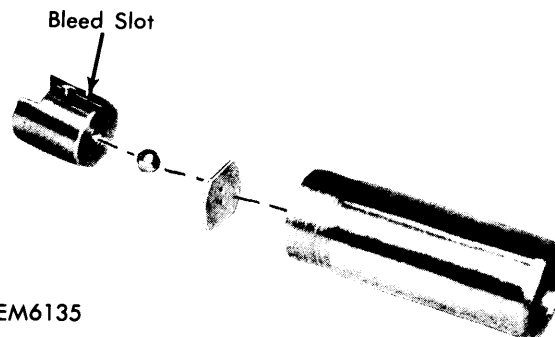
CAMSHAFT			
Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
All			
No.1	1.376-1.377 (34.96-34.98)	.0013-.0030 (.034-.075)	.2764 (7.02)
No.2	1.652-1.653 (41.96-41.98)		
No.3	1.691-1.692 (42.96-42.98)		

### TIMING CHAIN REPLACEMENT

- 1) Remove cylinder head, oil pan and water pump. Remove cover plate on transmission. Lock flywheel with suitable tool (6069).
- 2) Unscrew nut on pulley hub and remove pulley. Remove alternator and mounting brackets. Remove timing cover.
- 3) Mark direction of timing chain rotation if original chain is to be reinstalled. If new chain is installed, replace timing sprockets. To install, reverse removal procedures.

### TIMING CHAIN TENSIONER SERVICE

- 1) Unscrew tensioner plug and remove piston and spring. **CAUTION** — Tensioner plug is under high spring pressure, use care when removing plug.
- 2) Press piston out of sleeve. Remove ball bearing and perforated disc. Clean all parts thoroughly.
- 3) Reassemble sleeve, perforated disc, ball bearing and piston, making sure perforated disc does not block bleed slots (see illustration).



2EM6135

### CHAIN TENSIONER PISTON ASSEMBLY

- 4) Install piston in tensioner body. Place spring with tapered end facing tensioner plug. Screw tensioner plug slightly into tensioner body. Fill oil pocket with engine oil and move tensioner rail back and forth until oil comes out around plug threads. Tighten tensioner plug.

### CAMSHAFT REMOVAL

- 1) Remove cylinder head from engine. Loosen clamp screw and withdraw distributor. Remove camshaft sprocket and camshaft oil pipe. Remove fuel pump and partly pull out fuel pump plunger.

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2) Adjust tappet eccentrics to largest possible clearance. Using suitable compression frame (No. 6025-1 & CS 2000), preload rocker arms. Check endplay between guide plate and camshaft. Remove guide plate and carefully slide out camshaft.

3) Check camshaft and bearings for wear or damage. Install camshaft with mark facing upward and guide pin hole facing downward.

### VALVE TIMING

Rotate engine to TDC of No. 1 piston. Position camshaft so that timing mark on camshaft flange is straight up and locating pin

hole is straight down. Without moving crankshaft or camshaft, install camshaft sprocket so that it engages locating pin hole in camshaft flange.

VALVE TIMING				
Engine	INTAKE		EXHAUST	
	Open (BTDC)	Close (ABDC)	Open (BBDC)	Close (ATDC)
All ①	18°	66°	66°	18°

① - With .011" clearance between cam base circle and rocker pad.

### ENGINE OILING

**Crankcase Capacity** - 4.5 qts. with filter.

**Oil Filter** - Full-flow, replace 4,000 miles.

**Normal Oil Pressure** - 56.9 psi @ 4,000 RPM.

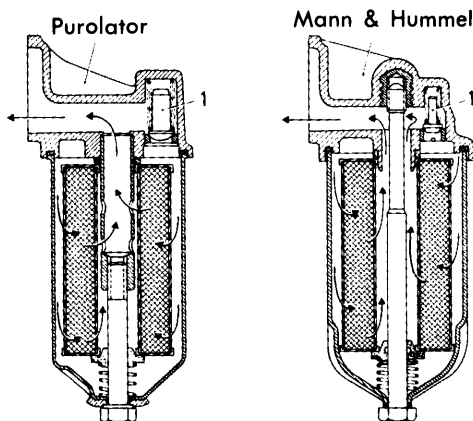
**Pressure Regulator Valve** - Non-adjustable.

### ENGINE OILING SYSTEM

A chain driven gear or rotor type oil pump pressure feeds oil to a full-flow oil filter. From oil filter, oil is fed through passages to all moving parts of engine.

### OIL FILTERS

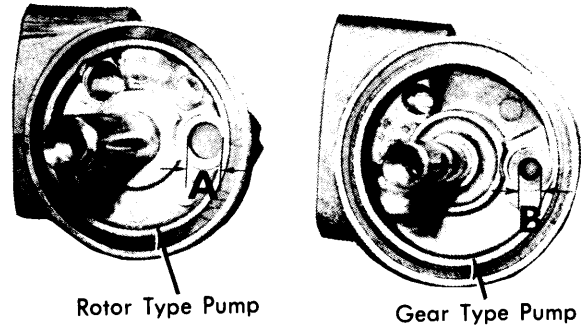
Three types of oil filters are used. They can not be interchanged without changing filter mounts. There is a Purolator, Mann & Hummel and a replaceable element type. Pressure relief valve is located in filter mounting on Purolator and Mann & Hummel filters. Replaceable filter has valve incorporated in filter element (see illustration).



2EM6137

### OIL FILTERS

A - .4724"  
B - .2756"

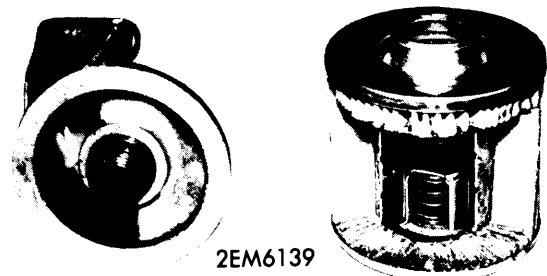


Rotor Type Pump

Gear Type Pump

2EM6138

### OIL FILTER MOUNTS



2EM6139

### REPLACEABLE OIL FILTER ELEMENT

### OIL PUMP

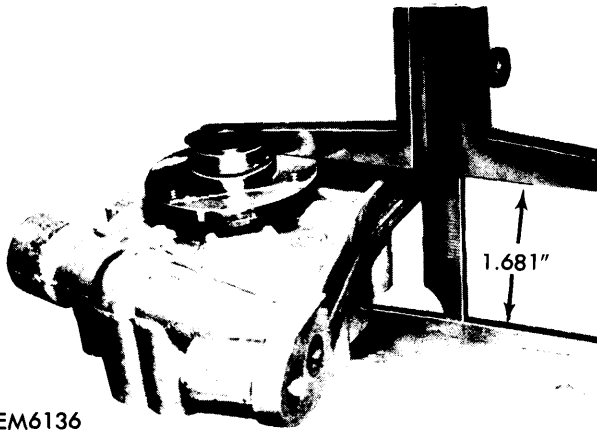
1) Remove oil pan and oil pump sprocket. Remove bolts attaching pump pick-up. Remove two bolts mounting pump to crankcase and lift out pump.

2) Unscrew union and remove spring and plunger from pump body. Remove pick-up tube and cover from pump body.

3) Measure clearance between outer rotor-to-pump body, rotor-to-rotor and rotor face-to-pump body flange (see specifications).

## 1966-73 BMW 1600 & 2002 4 CYLINDER (Cont.)

### ENGINE OILING (Cont.)



2EM6136

FAN HUB INSTALLATION MEASUREMENT

4) Using suitable puller, remove drive flange from rotor shaft. Press drive flange on new rotor shaft to a distance of 1.681" between flange and rotor face (see illustration). To install, reverse removal procedures.

*NOTE* — When installing compensating plate between oil pump and crankcase make sure oil hole is in proper position.

### Oil Pump Specifications

Application	In. (mm)
Rotor-to-Housing Clearance .....	.0014-.0037 (.035-.095)
Inner-to-Outer Rotor Clearance.....	.0047-.0079 (.12-.20)
Cover-to-Rotor Clearance.....	.0039-.0059 (.10-.15)
Pressure Relief Spring (Free Length) .....	2.68 (68)

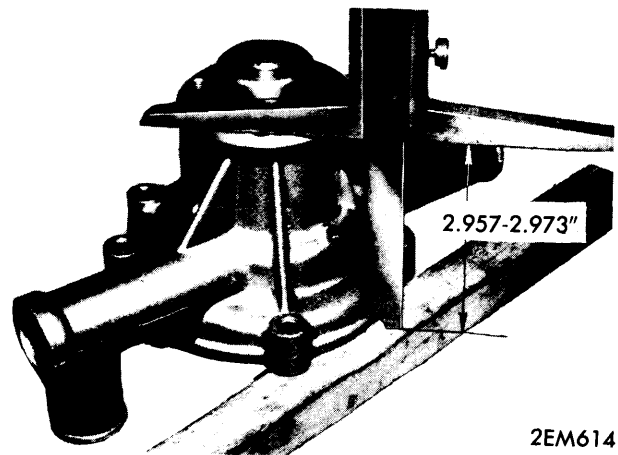
### ENGINE COOLING

Thermostat — Opens at 176°F.

Cooling System Capacity — 7.3 qts.

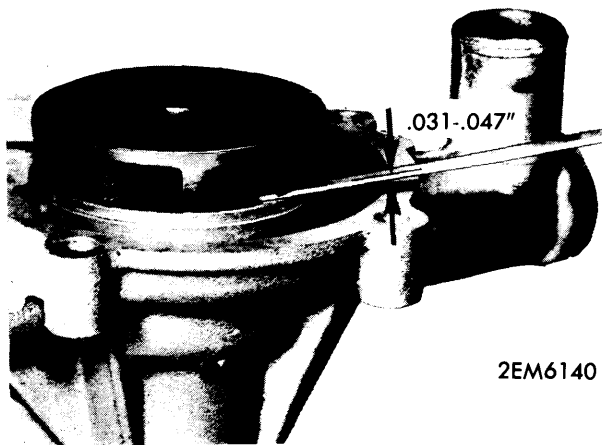
#### WATER PUMP

- 1) Loosen alternator bracket. Remove fan and drive belt. Loosen hose clamps and remove water pump.
- 2) Using a suitable puller, remove fan hub from impeller shaft. Extract circlip and spacer ring from front of pump.
- 3) Press impeller off shaft and pump bearing out of housing. Drive friction seal out of housing and lift out cover ring.
- 4) Replace any worn or damaged parts. Using Loctite AVV, press impeller onto shaft until there is clearance of .031-.047" between impeller and pump face (see illustration).



2EM6141

FAN HUB INSTALLATION



2EM6140

WATER PUMP IMPELLER INSTALLATION

- 5) Press fan hub onto pump shaft until a distance of 2.957-2.973" between hub flange and pump face (see illustration). To install, reverse removal procedures.

### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Cylinder Head Studs.....	①
Main Bearing Caps.....	42-46 (5.8-6.3)
Connecting Rods.....	37-41 (5.2-5.7)
Flywheel-to-Crankshaft ② .....	76-83 (10.5-11.5)
Rocker Set Screw .....	7-8 (.9-1.1)
Oil Pan .....	7-8 (.9-1.1)
Camshaft Oiler (Hollow Bolt) .....	8-9 (1.1-1.3)
Crankshaft Pulley .....	101-108 (14-15)
Fuel Pump.....	7-10 (1-1.4)
Timing Cover .....	7-18 (.9-2.5)

- ① — Tighten in three steps at operating temperature, 25-32 (3.5-4.5), 43-47 (6.0-6.5) and 52-56 (7.3-7.7) Ft. Lbs. (mkg).
- ② — To be fitted with Loctite red, No. 41 and activator "T".