

11 Engine

Type 318 I/A - US - E 30:

11 00 006	Diagnosis with BMW Service Tester	see nominal value microfiche
039	Compression of all cylinders - check	11 - 2
050	Engine - remove and install	11 - 3
091	Engine - exchange	11 - 6
11 12 000	Cylinder head cover - remove and install	11 - 6
100	Cylinder head - remove and install	11 - 7
101	Cylinder head gasket - replace	11 - 10
561	Valve guide - replace (valve removed)	11 - 11
595	Valve guide - check for wear	11 - 11
600	Valve guide - ream	11 - 11
607	Valve seats and valves - machine (cylinder head disassembled)	11 - 11
719	Cylinder head mating surface - grind (cylinder head disassembled)	11 - 12
729	Cylinder head - check for cracks in water test (cylinder head disassembled)	11 - 12
11 13 010	Oil pan upper section - remove and install / replace	11 - 13
020	Oil pan lower section - remove and install / replace	11 - 13
11 14 100	Timing case cover, upper - remove and install / seal	11 - 13
120	Timing case cover, lower - remove and install / seal	11 - 14
141	Radial oil seal in lower timing case cover - replace	11 - 15
605	Radial oil seal in clutch end cover - replace	11 - 15
11 21 000	Crankshaft - remove and install	11 - 16
120	Crankshaft pulley - remove and install	11 - 17
501	Crankshaft - replace (crankshaft removed)	11 - 18
531	Crankshaft main bearing shells - replace (engine disassembled)	11 - 18b
571	Pilot bearing in crankshaft - replace	11 - 19
11 22 000	Flywheel - remove and install	11 - 20
051	Drive plate for torque converter - replace	11 - 20
541	Starter gear ring - replace	11 - 20
11 24 521	Connecting rods - replace (pistons removed)	11 - 21
571	Connecting rod bearing shells - replace (engine disassembled)	11 - 21

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Type 318 I/A – US – E 30:

11 25 000	Piston – remove and Install	11 - 22
651	Piston rings of one piston – replace (piston removed)	11 - 23
11 31 000	Camshaft – remove and Install	11 - 24
051	Timing chain – replace	11 - 25
061	Timing chain sprocket set – replace (timing chain removed)	11 - 25
090	Timing chain tensioner piston – remove and Install	11 - 26
601	Timing chain tensioning and guide rails – replace (timing chain removed)	11 - 26
11 33 020	Rocker arm shafts – remove and Install	11 - 27
031	Rocker arms – replace	11 - 28
11 34 004	Valve clearance – adjust	11 - 28
509	Valves (all) – check for leaks (camshaft removed)	11 - 28
550	Valves – remove and Install (rocker arm shafts removed)	11 - 29
	Engine oil circuit	11 - 30
11 40 000	Engine oil pressure – check	11 - 31
11 41 000	Oil pump – remove and Install	11 - 31
151	Oil pump drive chain – replace	11 - 31
512	Oil pump – overhaul (oil pump removed)	11 - 32
11 42 020	Full flow oil filter – remove and Install / seal	11 - 33
021	Full flow oil filter – replace	11 - 33
11 51 000	Water pump – remove and Install	11 - 33
502	Water pump – overhaul	11 - 34
11 52 000	Fan – remove and Install	11 - 35
020	Fan coupling – replace	11 - 35
11 53 000	Coolant thermostat – remove and Install	11 - 35
11 78 010	Oxygen sensor function – check	11 - 36
510	Oxygen sensor – replace	11 - 37

11 Engine

BMW M 3 — Engine S 14 Z

11 00 039	Compression of all cylinders — check	11 - 51
050	Engine — remove and install	11 - 52
11 12 000	Cylinder head cover — remove and install	11 - 53
100	Cylinder head — remove and install	11 - 53a
595	Valve guide — check for wear (valve removed)	11 - 54
600	Valve guide — ream out (valve removed)	11 - 54
607	Valve seats and valves — machine (valves removed)	11 - 54
719	Cylinder head sealing surface — grind (cylinder head disassembled)	11 - 55
729	Cylinder head — check for cracks in water test (cylinder head disassembled)	11 - 55
11 13 010	Oil pan upper section — remove and install	11 - 55a
020	Oil pan lower section — remove and install	11 - 55a
11 14 105	Radial oil seal in distributor housing — replace	11 - 56
120	Timing case cover, lower — remove and install/seal	11 - 56
141	Radial oil seal in lower timing case cover — replace	11 - 58
605	Radial oil seal in clutch end cover — replace	11 - 58
11 21 000	Crankshaft — remove and install	11 - 59
120	Crankshaft pulley — remove and install	11 - 60
501	Crankshaft — replace (crankshaft removed)	11 - 61
531	Crankshaft main bearing shells — replace (engine disassembled)	11 - 61 b
571	Pilot bearing in crankshaft — replace	11 - 62
11 22 000	Flywheel — remove and install	11 - 63
541	Starter gear ring — replace	11 - 63

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BMW M 3 – Engine S 14 Z

11 24 521	Connecting rod – replace (piston removed)	11 - 64
571	Conrod bearing shells – replace (engine disassembled)	11 - 64
11 25 000	Piston – remove and install (engine removed)	11 - 65
651	Piston rings of one piston – replace	11 - 66
11 31 000	Camshaft – remove and install (cylinder head removed)	11 - 67
051	Timing chain – replace	11 - 70
061	Timing chain sprockets – replace (timing chain removed)	11 - 71
090	Timing chain tensioner piston – remove and install	11 - 72
11 34 004	Valve clearance – adjust	11 - 73
509	Valves – check for leaks	11 - 73
550	Valves – remove and install (cylinder head removed)	11 - 74
11 40 000	Engine oil pressure – check	11 - 75
11 41 000	Oil pump – remove and install	11 - 75
151	Oil pump drive chain – replace	11 - 76
11 42 021	Full flow oil filter – replace	11 - 77
11 43 101	Guide tube for oil dipstick – replace	11 - 78
11 51 000	Water pump – remove and install	11 - 78
11 52 000	Fan – remove and install	11 - 79
020	Fan clutch – replace	11 - 79
11 53 000	Coolant thermostat – remove and install	11 - 79

11 Engine

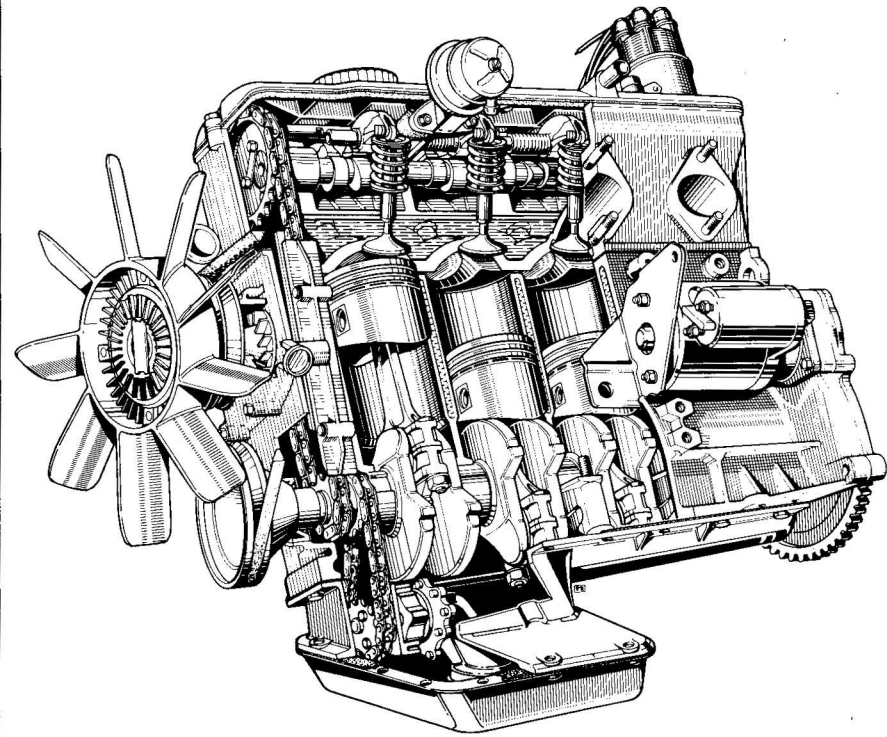
M 20 B 25 / B 27:

11 00 039	Compression of all cylinders – check	11 - 101
050	Engine – remove and install	11 - 102
050	Engine – remove and install (since 1988 models)	11 - 104a
091	Engine – exchange	11 - 104
11 11 160	Bearings for oil pump drive shaft – replace	11 - 105
11 12 000	Cylinder head cover – remove and install	11 - 105
100	Cylinder head – remove and install	11 - 106
100	Cylinder head – remove and install	11 - 108a
101	Cylinder head gasket – replace	11 - 109
240	Radial oil seal in end cover – replace	11 - 109
561	Valve guide – replace (valve removed)	11 - 110
595	Valve guide – check for wear	11 - 110
600	Valve guide – ream out	11 - 110
607	Valve seats and valves – machine (cylinder head disassembled)	11 - 111
719	Cylinder head mating surface – grind (cylinder head disassembled)	11 - 111
729	Cylinder head – check for cracks in water test (cylinder head disassembled)	11 - 111
11 13 000	Oil pan – remove and install	11 - 112
11 14 175	Front end cover – remove and install	11 - 112
180	Radial oil seals in front end cover – replace	11 - 113
605	Radial oil seal in clutch end cover – replace	11 - 113
11 21 000	Crankshaft – remove and install	11 - 114
501	Crankshaft – replace (crankshaft removed)	11 - 115

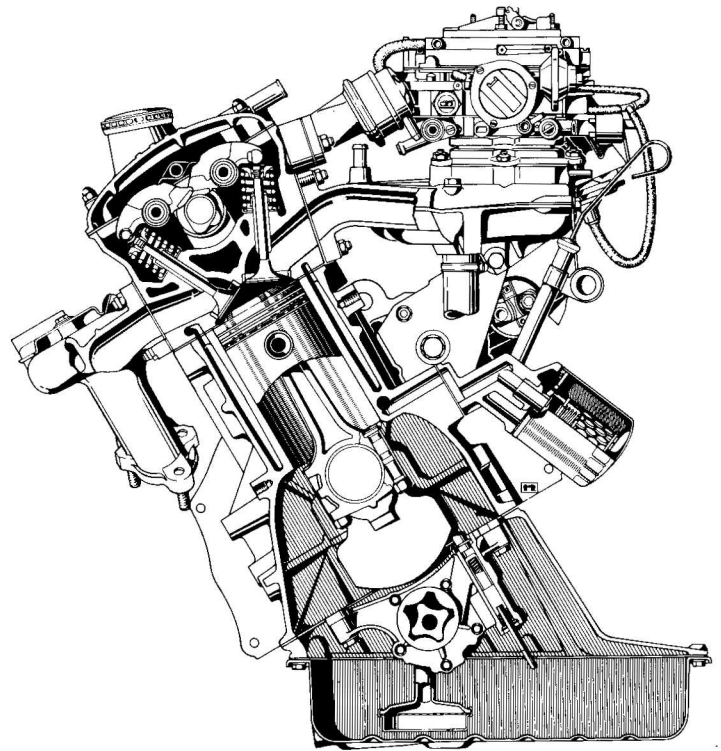
11 Engine

M 20 B 25 / B 27:

11 21 531	Crankshaft main bearing shells – replace (engine disassembled)	11 - 115b
571	Pilot bearing in crankshaft – replace	11 - 116
11 22 000	Flywheel – remove and install	11 - 117
051	Torque converter drive plate – replace	11 - 117
541	Starter gear ring – replace	11 - 117
11 23 010	Vibration damper – replace	11 - 118
031	Vibration damper hub – replace	11 - 118
11 24 421	Connecting rods – replace (pistons removed)	11 - 119
571	Connecting rod bearing shells – replace (engine disassembled)	11 - 119
11 25 000	Piston – remove and install	11 - 120
651	Piston rings of one piston – replace (piston removed)	11 - 121
11 31 000	Camshaft – remove and install	11 - 122
110	Toothed drive belt – replace	11 - 123
11 33 020	Rocker arm shafts – remove and install	11 - 124
031	Rocker arms – replace	11 - 125
11 34 004	Valve clearance – adjust	11 - 125
509	Valves – check for leaks (camshaft removed)	11 - 125
550	Valves – remove and install	11 - 126
11 35 020	Intermediate shaft – remove and install	11 - 126
	Engine oil circuit	11 - 127
11 40 000	Engine oil pressure – check	11 - 128
11 41 000	Oil pump – remove and install	11 - 129
110	Pressure relief valve – remove and install	11 - 130
11 42 021	Full flow oil filter – replace	11 - 130
11 43 101	Guide tube for oil dipstick – replace	11 - 130
11 51 000	Water pump – remove and install	11 - 130
502	Water pump – overhaul (water pump removed)	11 - 131
11 52 000	Fan – remove and install	11 - 132
020	Fan coupling – replace	11 - 132
11 53 000	Coolant thermostat – remove and install	11 - 132
080	Coolant temperature sender – replace	11 - 132
11 78 010	Oxygen sensor – check	11 - 133
510	Oxygen sensor – replace	11 - 134

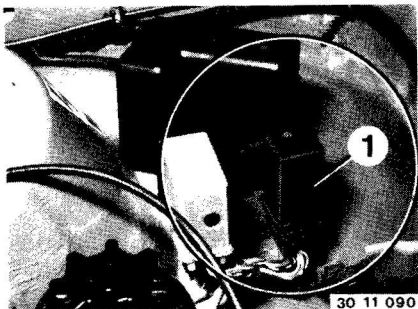


BMW 318 i - M 10 B 18



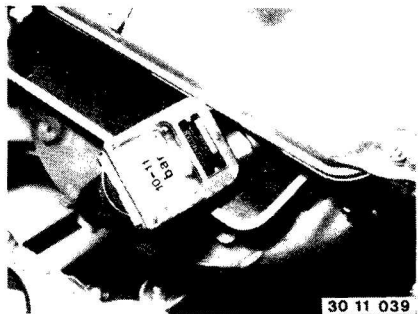
11 00 039 CHECKING COMPRESSION OF
ALL CYLINDERS

Pull off relay (1) to avoid spill because of constant ejection of fuel injectors while operating the starter.



30 11 090

Pull off plug on transistor ignition (TCI) control unit.
Unscrew spark plugs.
Check compression*.
Installation:
Tightening torque**.



30 11 039

* See Specifications

** See Specifications of Gr. 12

11 00 050 REMOVING AND INSTALLING ENGINE

Remove transmission s. Gr. 23/24
Detach power steering pump.
Pressure hoses remain connected.

Installation:

Tighten drive belt and check tightness with Special Tool 11 5 020.

Unscrew bolts (1).
Remove bolts (2).

Unscrew bolt and remove compressor.
Refrigerant hoses remain connected.

Installation:

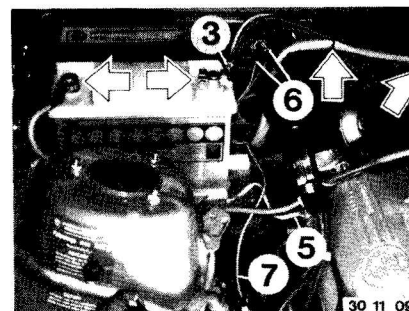
Tighten drive belt and check tightness with Special Tool 11 5 020.

Remove radiator 17 11 000.
Disconnect prop and gas pressure spring and apply Special Tool 51 2 120.

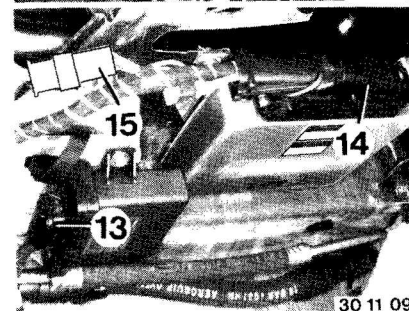
Important!
Use locks (1).

Installation:

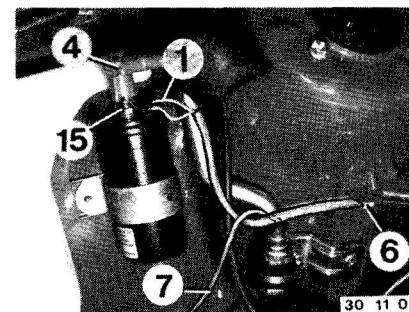
Insert plastic part (2).



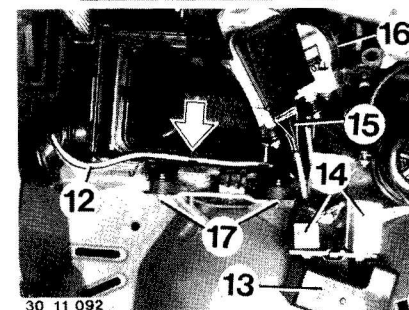
Disconnect battery ground and positive leads.
Disconnect wire (3).
Unscrew ground wire (5).
Open wire straps.
Pull off plug (6) on temperature sensor.
Disconnect plug (7) for oxygen sensor.



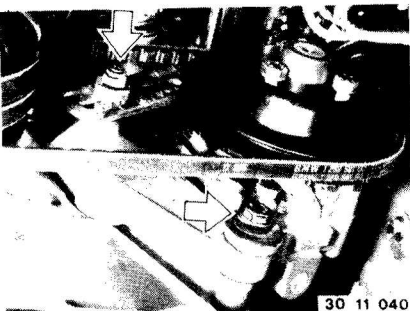
Remove trim in glove box.
Pull off plug (13) on idle control unit and plug (14) on L-Jetronic control unit.
Disconnect wire (15).
Push out wire harness into engine compartment.



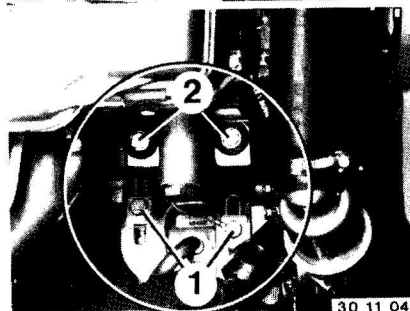
Pull off wire (4) on ignition coil and disconnect wires (1 and 15).
Take wires out of clips (6).
Disconnect wire (7).



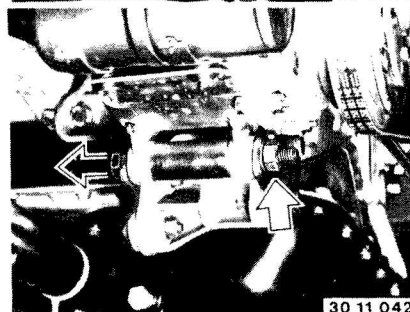
Disconnect wire (12).
Lift off cap (13) and remove relay (14).
Pull off plug (15).
Open hose strap (16).
Loosen nuts (17) and take off air cleaner.



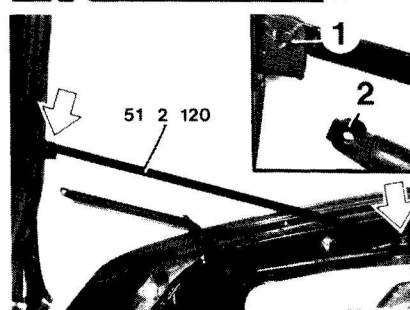
30 11 040



30 11 041



30 11 042



20 11 206

30 11 097

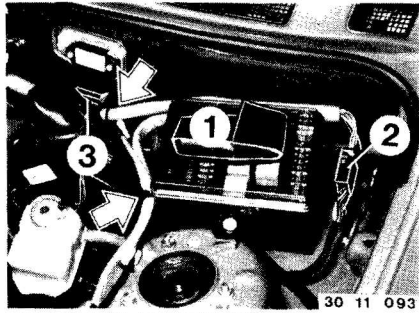
30 11 098

30 11 091

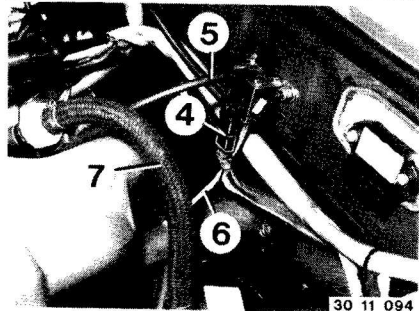
30 11 092

51 2 120

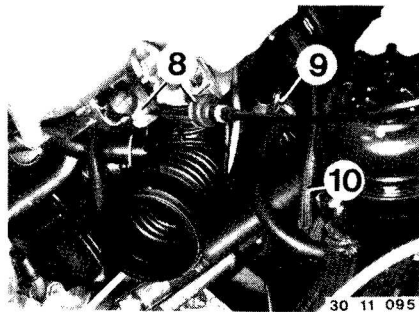
11-4



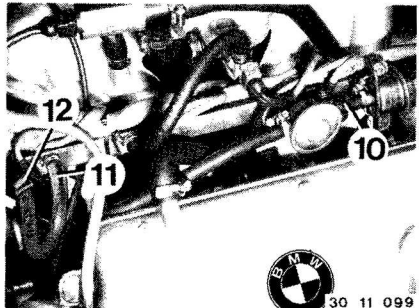
Lift off cap (1).
Lift out and disconnect plug (2).
Take off rubber guard on ignition control unit.
Pull off plug (3).
Loosen wire straps.



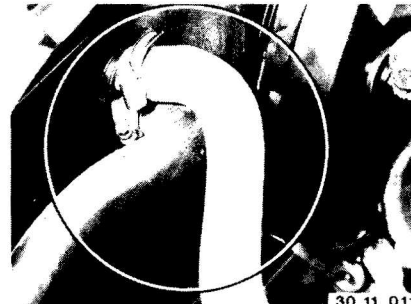
Pull off plug (4) and vacuum hoses (5 and 6).
Disconnect vacuum hose (7).
Installation:
Hose (5) to distributor.
Hose (6) to intake manifold.



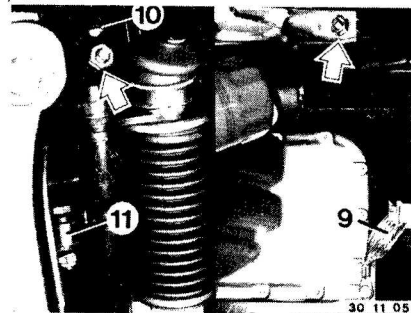
Disconnect throttle cable (8).
Unscrew bracket (9) and hose (10).
Installation:
Adjust throttle cable 35 41 421.



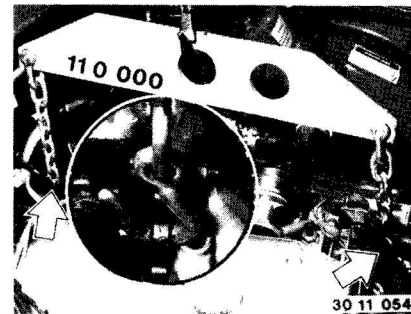
Unscrew fuel hoses (10 and 11).
Unscrew bracket (12).



Disconnect water hoses.

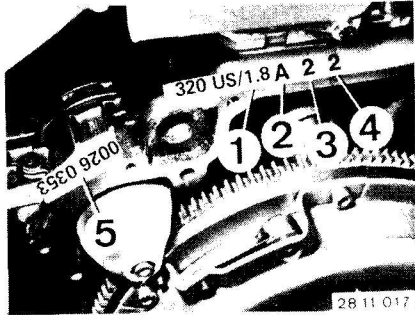


Unscrew ground strap (5) and both engine mounts.
Unscrew engine damper (11).
Installation:
Insert guide pin (10) in bore of axle carrier.
Tightening torque*.



Attach Special Tool 11 0 000 on front and rear ends of engine and lift out engine.
Installation:
Adjust ignition timing 12 11 004.
Adjust engine idle speed/CO 13 00 054.

* See Specifications



11 00 091 INSTALLING EXCHANGE ENGINE

Remove engine 11 00 050.
Exchange Engine Identification on Crankcase:
1 = Type designation****
2 = "A" for exchange or "N" for new
3 = Manufacturing month
4 = Manufacturing year (1982)

Stamp engine number (5).

Knock in supplied oil dipstick guide tube (see 11 43 101) and transfer parts from old engine to exchange engine.

Fill engine with oil***.

Important!

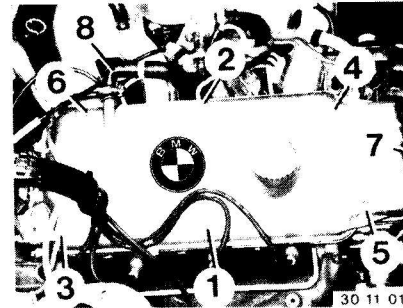
On cars with an automatic transmission the pilot bearing must be installed in crankshaft (see 11 21 571).

Install engine.

If necessary, adjust ignition timing 12 11 004.

Adjust engine idle speed/CO 13 00 054.

Run engine warm.



11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

Detach hose (8).
Remove cylinder head cover.

Installation:

Tighten nuts and bolts in order of 1 through 7.
Tightening torque*.

Also bolt holder for ignition lead.
Check gasket, replacing if necessary.

*** See Service Information of Gr. 00

**** See BMW Technik of Gr. 11

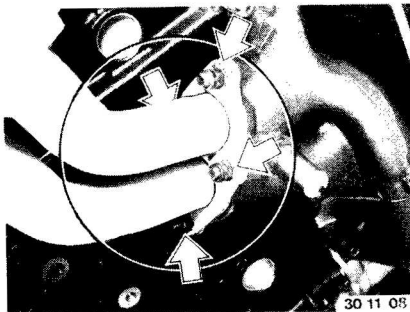
* See Specifications

11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

Unscrew exhaust pipes on exhaust manifold and pipe clamp on transmission.

Installation:

Check gasket, replacing if necessary.
Coat studs with "CRC" copper paste**.
Replace self-locking nuts.
Tightening torque*.

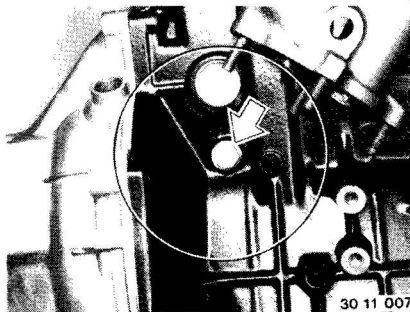


30 11 05

Disconnect battery ground lead.
Unscrew bolt and drain coolant.

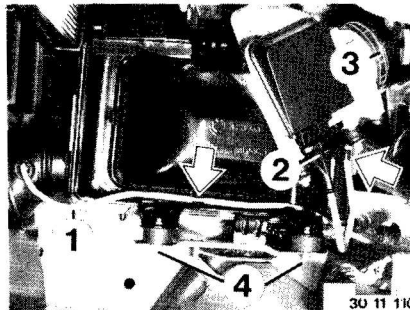
Installation:

Pour in coolant*** and bleed cooling system 17 00 039.
Replace engine oil***.



30 11 007

Disconnect wire (1).
Pull off plug (2).
Unscrew hose strap (3).
Unscrew nuts (4) and remove air cleaner.

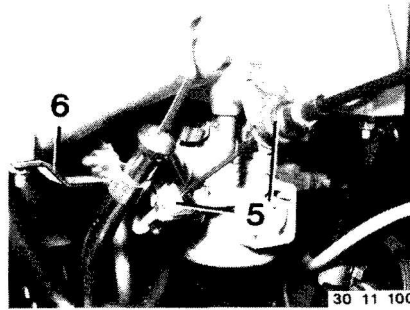


30 11 110

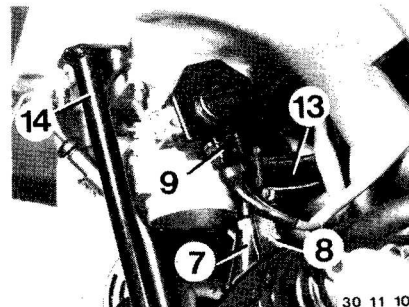
Disconnect throttle cable (5).
Unscrew bracket (6).

Installation:

Adjust throttle cable, see 35 41 421.

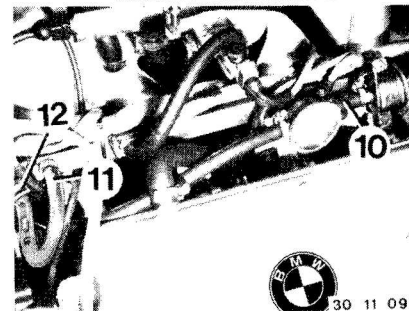


30 11 100



30 11 101

Disconnect water hoses (7 and 8).
Pull off plug (9).
Pull off vacuum hose (13).
Unscrew support (14).

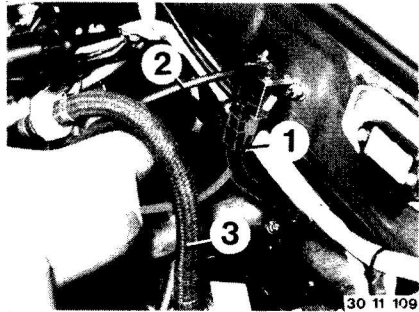


30 11 099

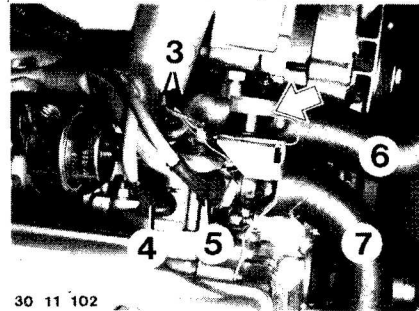
Disconnect fuel hoses (10 and 11).
Unscrew bracket (12).

* See Specifications
** Source: HWB
*** See Service Information of Gr. 00

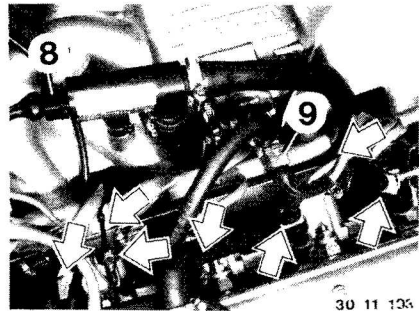
11-8



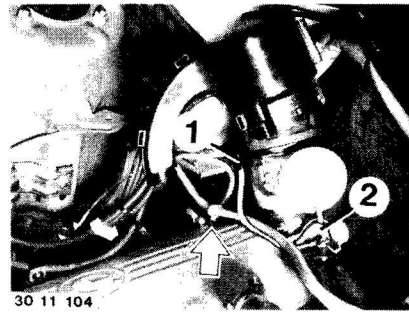
Pull off vacuum hose (1) for intake manifold and vacuum hose (2) for distributor. Disconnect vacuum hose (7).



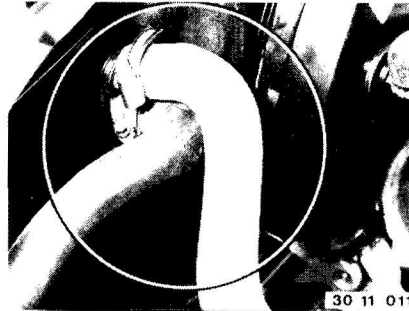
Disconnect diagnosis plug. Pull off plugs (3 ... 5). Disconnect wires on alternator. Disconnect coolant hoses (6 and 7).



Pull off plugs (8 and 9). Disconnect plug on starter. Pull off plugs on fuel injectors and open wire straps.

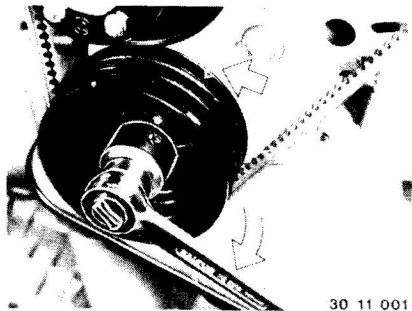


Remove distributor cap and pull off spark plug caps. Pull off plugs (1 and 2). Disconnect wire harness.



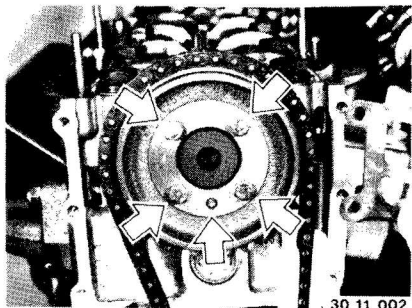
Disconnect coolant hoses.

11-9



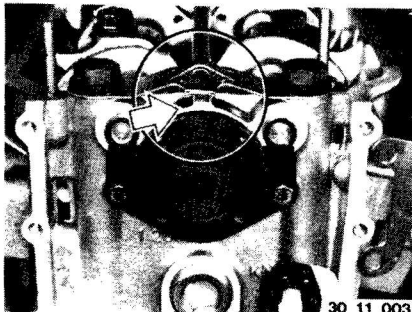
30 11 001

Remove upper timing case cover — see 11 14 100.
 Remove distributor — see 12 11 060.
 Turn cylinder no. 1 to TDC.
 Cast boss is then aligned with notch in pulley.



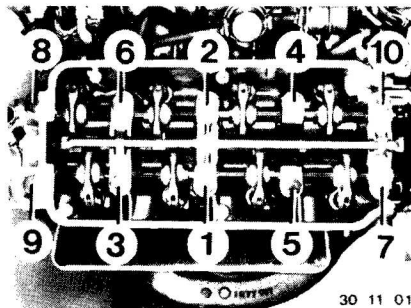
30 11 002

Remove chain tensioner piston — see 11 31 090.
 Remove sprocket.
Caution!
 Never turn the engine after removing the timing chain.
Installation:
 Install timing chain that bore for the dowel pin faces down.
 Tightening torque*.



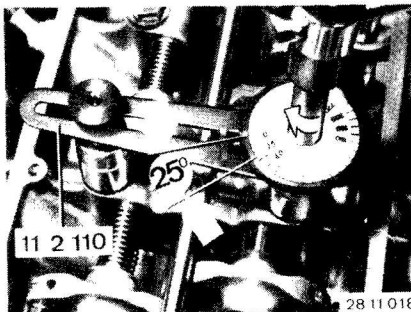
30 11 003

Installation:
 Turn camshaft to align notch in the camshaft flange with the cast boss on the cylinder head prior to mounting the cylinder head.
 Cylinder no. 1 is set to TDC.
 The timing chain is also installed in this position.



30 11 013

Unscrew cylinder head bolts in order of 10 through 1 and lift off the cylinder head.
Installation:
 Keep oil out of cavities, since otherwise bolts tightened with correct torque might not exert sufficient pressure on the cylinder head and, in addition, the crankcase could crack.
 Clean cylinder head bolts.
 Give threads and bearing surfaces of bolt heads a light coat of oil.
 Replace cylinder head gasket — see 11 12 101.



28 11 018

Tighten bolts in order of 1 through 10 to correct torque in three steps*.
 Adjust valve clearance, see 11 34 004.
 Adjust ignition timing, see 12 11 004.
 Adjust engine idle speed and CO, see 13 00 054.
 Tighten cylinder head bolts in the 3rd step (cylinder head cover removed again after running the engine warm) to the correct torque angle* with Special Tool 11 2 110 regardless of the engine temperature.
Note:
 Cylinder head bolts need not be retightened after 1,000 km (600 miles).

* See Specifications

* See Specifications

11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head 11 12 100.
Clean sealing surfaces on cylinder head and crankcase with a sealant remover** and a hard wood scraper.
Check levelness with a standard steel ruler, grinding cylinder head sealing surface if necessary — see 11 12 719.

Installation:

Only use original cylinder head gaskets, the holes and openings of which for the coolant are matched precisely.

A gasket of original thickness or a 0.3 mm (0.012") thicker gasket, to prevent reduction in combustion chamber size, can be installed on a ground cylinder head.

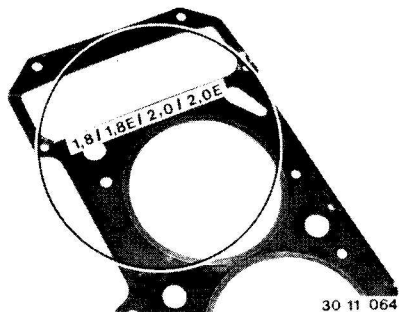
Identification:

Stamped codes:

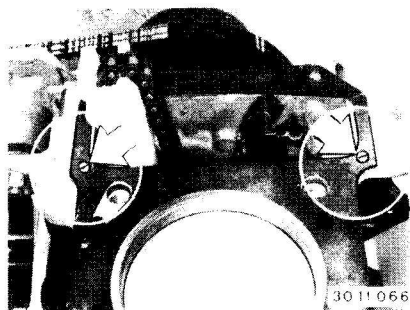
1.8 / 1.8E / 2.0 / 2.0E.

Important!

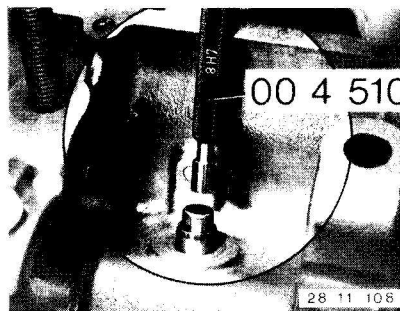
Coat bores with a brush-on universal sealant/ Three Bond Silicone 1207** before installation of the timing case cover.



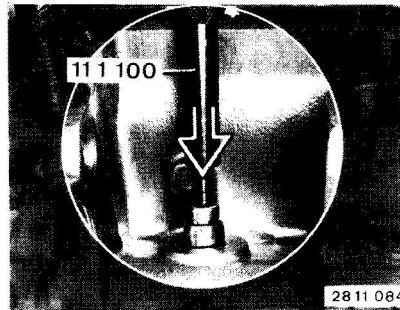
30 11 064



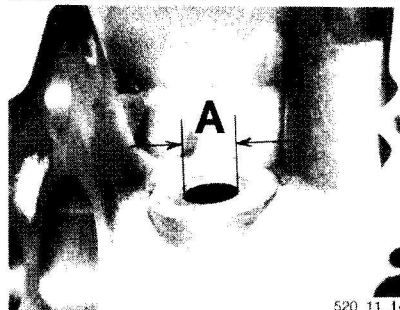
30 11 066



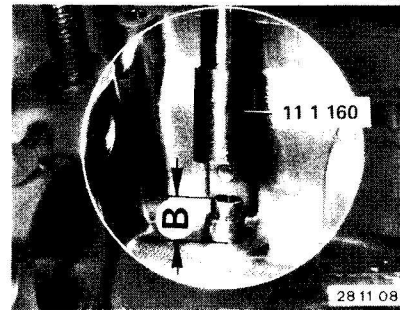
28 11 108



28 11 084



520 11 141



28 11 085

11 12 561 REPLACING VALVE GUIDES — Valves Removed —

Check wear* of valve guides with Special Tool 00 4 510.

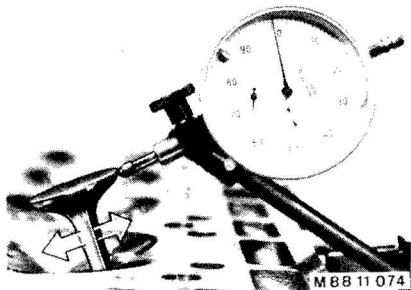
If the permissible wear limit is exceeded, drive out valve guide (cold) into combustion chamber with Special Tool 11 1 100.

Inspect bore (A) in the cylinder head with Special Tool 00 4 520.
If the permissible diameter is exceeded, ream out the bore with standard reamers and install an oversize* valve guide.

Heat* cylinder head.
Drive valve guide into cylinder head from the camshaft side with Special Tool 11 1 160.
Stepped end of valve guide faces camshaft.
Important!
Bore in special tool determines protrusion B* of the valve guide.
Ream out the valve guide to the specified inside diameter* with Special Tool 00 4 500.
Machine valve seat — see 11 12 607.

** Source: HWB

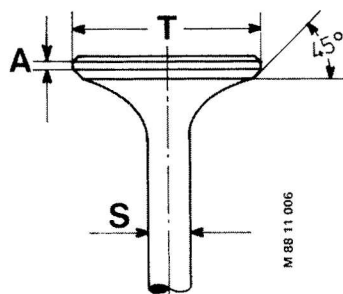
* See Specifications



11 12 595 CHECKING VALVE GUIDE FOR WEAR

— Valve Removed —

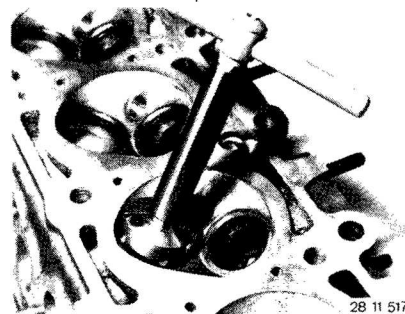
To measure, insert a new valve that its shaft end is flush with the valve guide. Apply dial gage and measure tilt clearance. Max. permissible tilt clearance*.



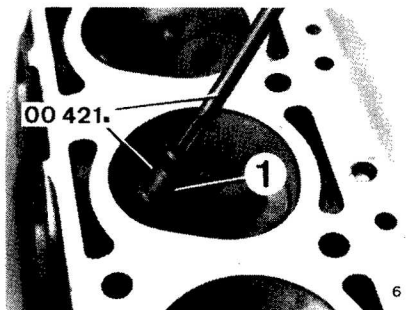
11 12 607 MACHINING VALVE SEATS AND VALVES

— Valves Removed —

The valve has to be replaced, if minimum edge thickness A* cannot be held.



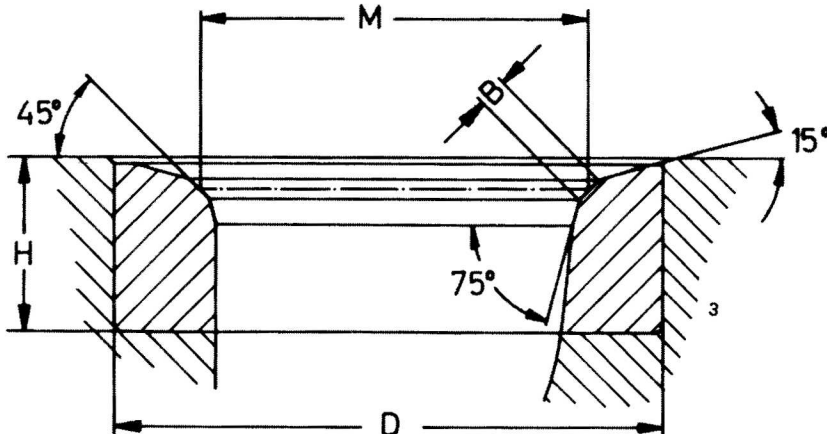
Produce valve seat diameter M* and valve seat width B* by machining the correction angles*, after machining the valve seat angle*. Grind in valves with grinding paste and check for leaks — see 11 34 509.



11 12 600 REAMING OUT VALVE GUIDE

— Valve Removed —

In case of excessive play between the valve guide and valve stem, see 11 12 595, ream out the valve guide and install a valve with a larger stem diameter "S"*. The valve seat must also be machined, see 11 12 607, in conjunction with this. Press guide pad (1) on to valve seat and ream out the valve guide from the combustion chamber end — turning down the reamer once.



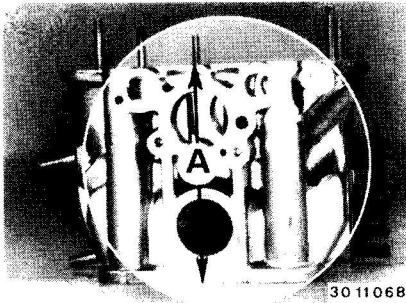
* See Specifications

* See Specifications

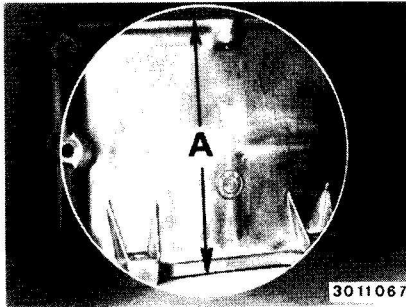
11 12 719 GRINDING CYLINDER HEAD SEALING SURFACES — CYL. HEAD DISASSEMBLED —

When grinding cylinder head mating surface, not more than 0.3 mm (0.012") may be taken away from total cylinder head thickness $A = 129 \pm 0.1$ mm (5.079 \pm 0.004"). Install a 0.3 mm (0.012") thicker gasket on a ground cylinder head (also refer to 11 12 101).

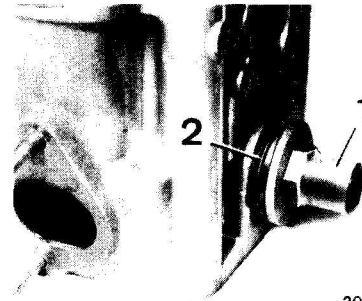
Upper timing case cover must be ground accordingly after grinding cylinder head.



30 11 068



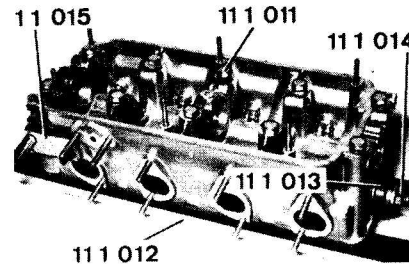
30 11 067



20 11 050

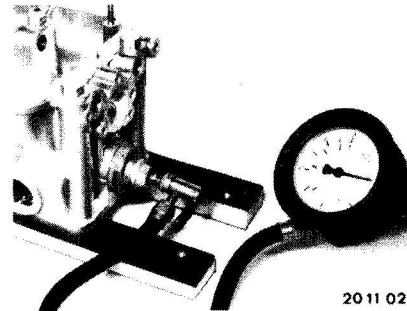
11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST — CYL. HEAD DISASSEMBLED —

Unscrew bolt (1).
Installation:
Replace seal (2).



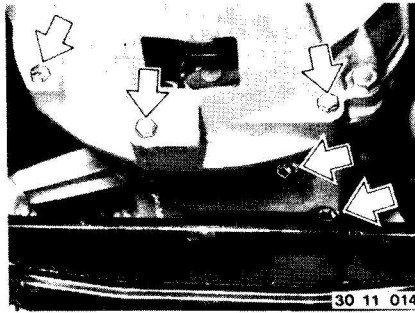
20 11 027

Mount rails 11 1 012 on cylinder head with bolts 11 1 011.
Plug off water circuit on cylinder head with Special Tools 11 1 015, 11 1 013 and 11 1 014.



20 11 028

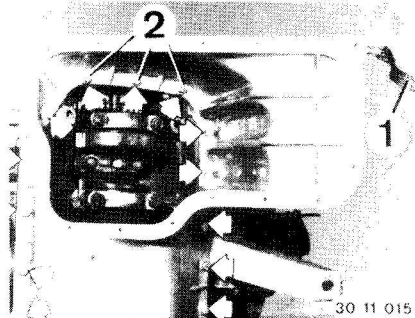
Apply compressed air to cylinder head.
Test pressure: 4.5 bar (64 psi).
Place cylinder head in water bath and check for cracks.
Note:
If necessary, relax water bath with a detergent.



11 13 010 REMOVING AND INSTALLING OR REPLACING UPPER OIL PAN SECTION

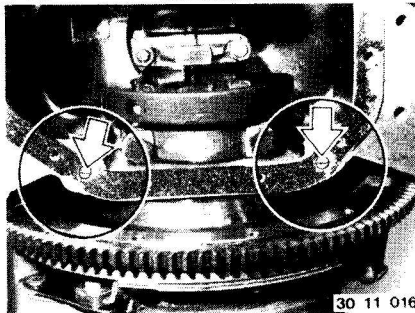
Pull out oil dipstick.
Detach oil pan lower section 11 13 020.
Remove oil pump 11 41 000.
Unscrew reinforcement plate.

30 11 014



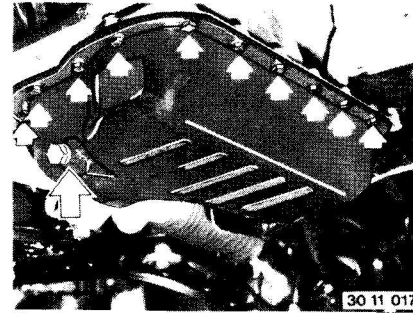
Unscrew ground strap (1).
Unscrew oil pan bolts and remove upper oil pan section.
Installation:
Install bolts (2) with Loctite No. 270**.

30 11 015



Installation:
Clean sealing surfaces.
Replace oil pan gasket.
Coat mating surfaces on timing case cover and end cover with a brush-on universal sealing compound**.

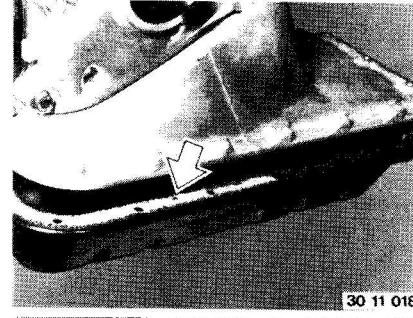
30 11 016



11 13 020 REMOVING AND INSTALLING OR REPLACING LOWER OIL PAN SECTION

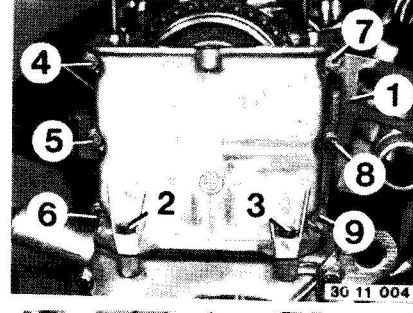
Drain engine oil.
Unscrew oil pan bolts.
Installation:
Add engine oil***.

30 11 017



Take off oil pan.
Installation:
Replace gasket.

30 11 018

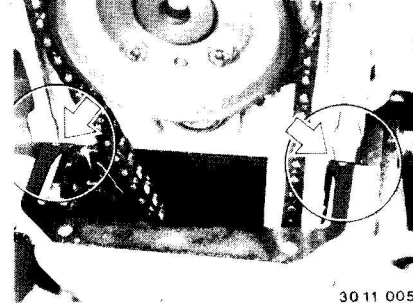


11 14 100 REMOVING AND INSTALLING/ SEALING UPPER TIMING CASE COVER

Remove cylinder head cover 11 12 000.
Unscrew bracket (1).
Unscrew timing case cover.

Installation:
Tighten bolts (2 and 3) only finger tight.
Then tighten bolts (4 ... 9) in order to final torque and finally tighten bolts (2 and 3) to correct torque.
Replace gasket and install with grease.

30 11 004



Important!
Pack bores with a brush-on universal sealing compound** before installing the timing case cover.
If applicable, replace a damaged cylinder head gasket – see 11 12 000.

30 11 005

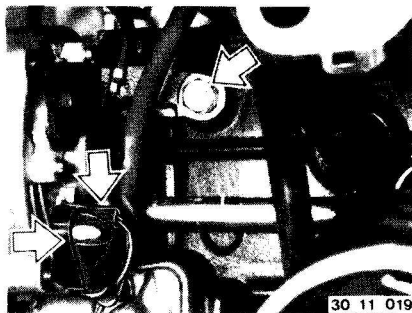
** Source: HWB

** Source: HWB

*** See Service Information of Gr. 00

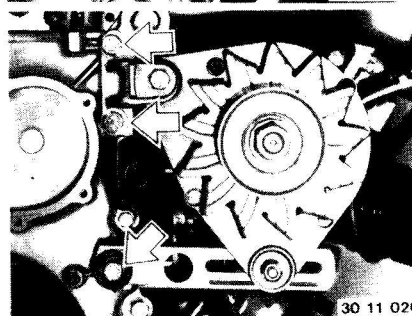
11 14 120 REMOVING AND INSTALLING/ SEALING LOWER TIMING CASE COVER

Disconnect battery ground lead.
Remove upper timing case cover 11 14 100.
Disconnect wires on alternator.
Unscrew bolt on engine block.



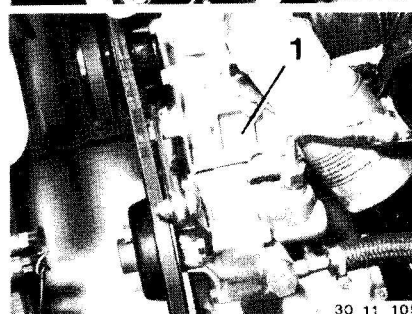
30 11 019

Unscrew alternator with console and
tensioning bar



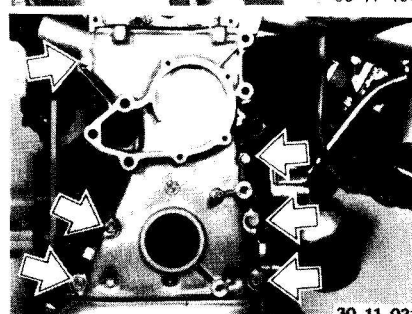
30 11 020

Loosen drive belt.
Unscrew bracket (1)
Pressure hoses remain connected
Installation
Tighten drive belt and check tightness with
Special Tool 11 5 020

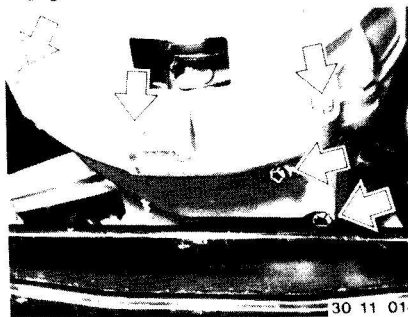


30 11 105

Remove water pump 11 51 000.
Remove crankshaft pulley 11 21 120.
Remove piston for chain tensioner 11 31 090.
Unscrew remaining bolts on timing case
cover.

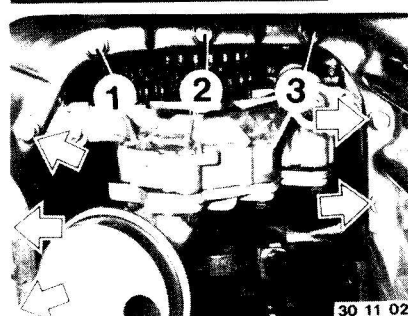


30 11 021



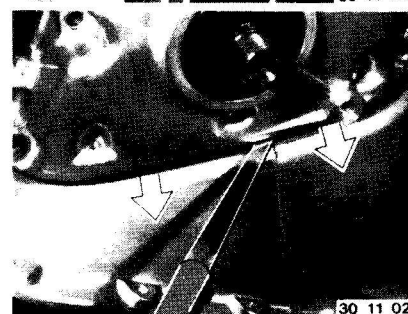
30 11 014

Unscrew reinforcement plate.
Unscrew lower oil pan section — see 11 13 020.



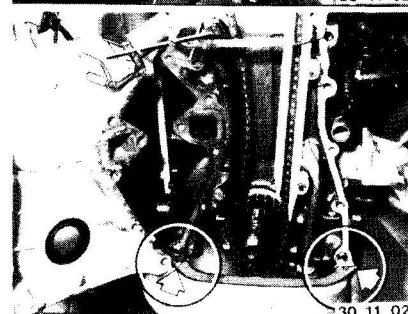
30 11 022

Unscrew bolts (1 ... 3).
Loosen remaining oil pan bolts.
Installation:
Install bolts (1 ... 3) with Loctite No. 270**.



30 11 023

Pry oil pan gasket off of timing case cover
carefully with a knife.
If oil pan gasket is damaged, remove oil pan
— see 11 13 000.



30 11 024

Remove timing case cover.
Installation:
Coat mating surfaces between oil pan and
crankcase with a brush-on universal sealing
compound**.
Important!
Holder for tensioning piston must extend into
the oil pocket.

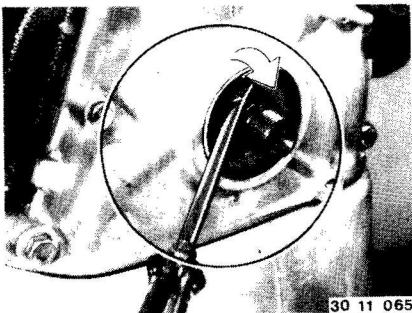
** Source: HWB

11-15

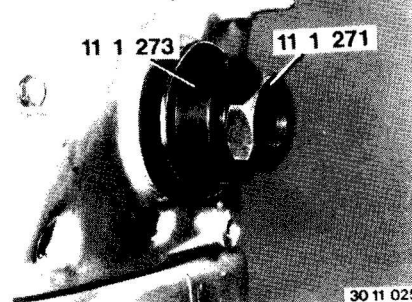
11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

Remove crankshaft pulley 11 21 120.
Lift out radial oil seal with a screwdriver.

Lubricate sealing lip of radial oil seal with oil.
Press in radial oil seal flush with Special Tools
11 1 273 and 11 1 271.



30 11 065



30 11 025

11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER — Transmission Removed —

Remove flywheel 11 22 000.
Drain engine oil.
Loosen oil pan bolts.
Loosen gasket in area of end cover/oil pan joint
carefully with a knife.
Unscrew end cover.
Press radial oil seal out of end cover.

Installation:

Replace gasket.
If oil pan gasket was damaged, remove oil pan
11 13 000.

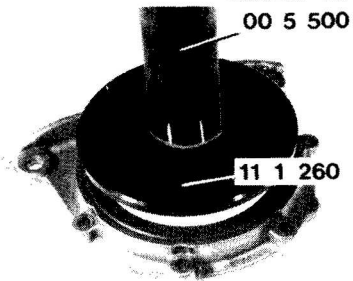
Coat end cover/oil pan joint with a brush-on
universal sealing compound**.
Use Special Tool 11 2 213 to avoid damage on
radial oil seal.

Press in radial oil seal with Special Tools
11 1 260 and 00 5 500.

Press in new radial oil seal 1 to 2 mm (0.039 to
0.079") deep, in contradiction to the standard
seal which was installed flush.
Lubricate sealing lip with oil.



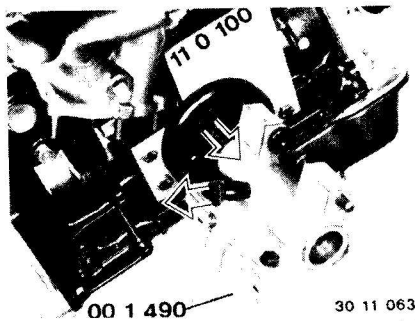
30 11 026



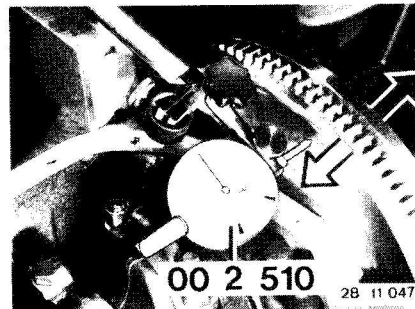
30 11 027

11 21 000 REMOVING AND INSTALLING CRANKSHAFT

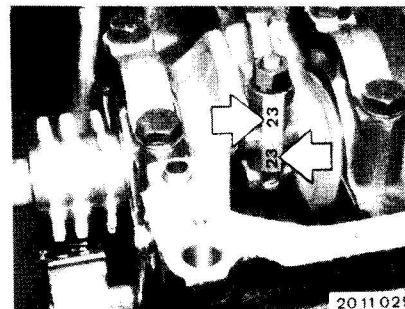
Remove engine 11 00 050.
 Unscrew engine mounts.
 Mount crankcase on assembly stand 00 1 490 with Special Tool 11 0 100.



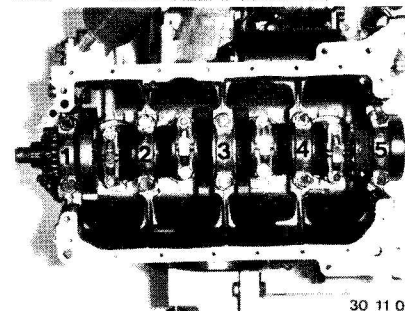
Remove clutch 21 21 000.
 Remove cylinder head 11 12 100.
 Remove timing chain 11 31 051.
 Remove oil pump 11 41 000.
 Check axial play* before removing the crankshaft.
 Check/replace thrust bearing, if maximum permissible play is exceeded.



Remove flywheel 11 22 000.
 Unscrew end cover.
Installation:
 Replace gasket.
 Use Special Tool 11 2 213 to avoid damage to the radial oil seal.
 Cut off gasket on the oil pan sealing surface.



Unscrew conrod bearing caps.
Installation:
 Replace conrod bearing shells and measure conrod bearing play, see 11 24 571.
 The pairing code (0 ... 99) must be the same on the connecting rod and cap.
 Tightening torque*.

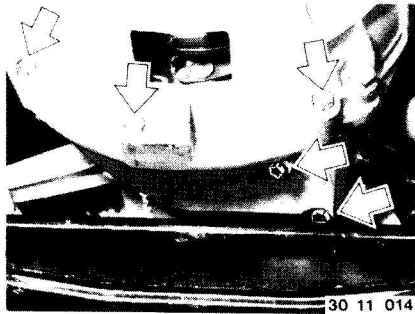


Unscrew crankshaft bearing caps and lift out the crankshaft.
Installation:
 Bearing cap no. 1 is on the sprocket end.
 Install bearing shells and check bearing play, see 11 21 531.
Installation:
 Measure axial play with the crankshaft installed – loosen thrust bearing no. 3 again.
 Center the thrust bearing by applying knocks from a plastic hammer on the front and rear ends of the crankshaft.
 Tighten thrust bearing again to correct torque.
 Measure axial play*.

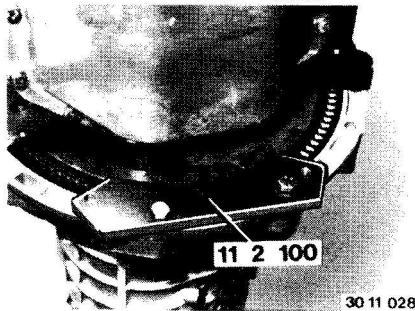
Clean the oil and water bores again thoroughly to remove casting sand, if the crankcase is replaced.

11 21 120 REMOVING AND INSTALLING PULLEY ON CRANKSHAFT

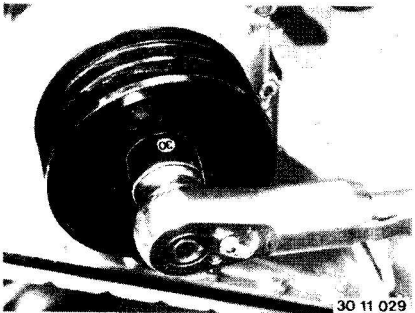
Detach reinforcement plate.



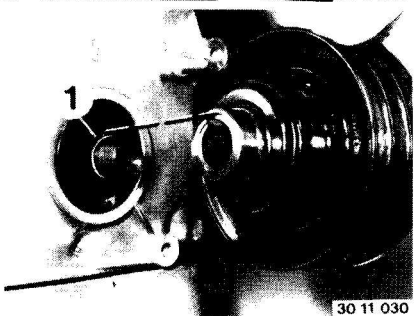
Hold flywheel with Special Tool 11 2 100.



Unscrew nut on pulley.
Pull off pulley.
Installation:
Tightening torque*.



Installation:
Check that woodruff key (1) is positioned
correctly.



* See Specifications

11 21 501 REPLACING CRANKSHAFT - Crankshaft Removed -

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.

Crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

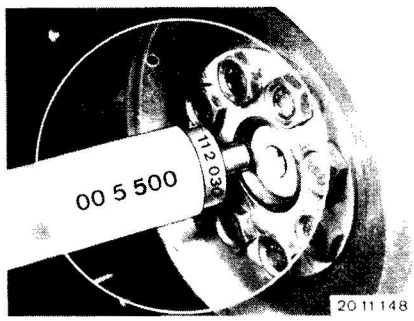
Installation:
Heat sprocket to max. 200° C (390° F) for installation.

Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

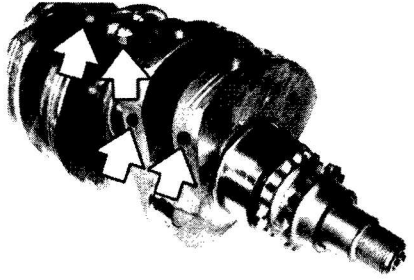
Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

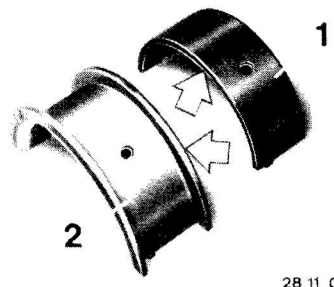
* See Specifications



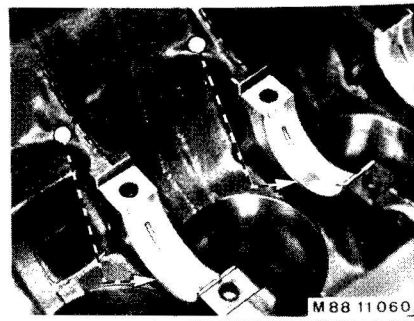
20 11 148



28 11 167



28 11 053



M 88 11 060

Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

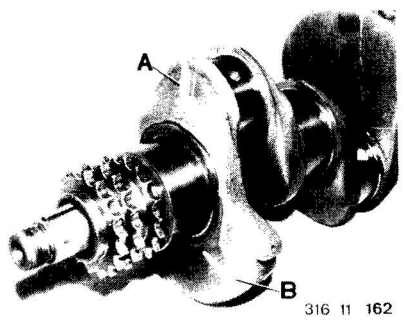
Replacement crankshafts are only supplied with bearing shells of double classification. A crankshaft is marked with red or blue paint because of the main bearing journal tolerances.

- 1 = Bearing shell 1-2-4-5
- 2 = Bearing shell 3 (pilot bearing)

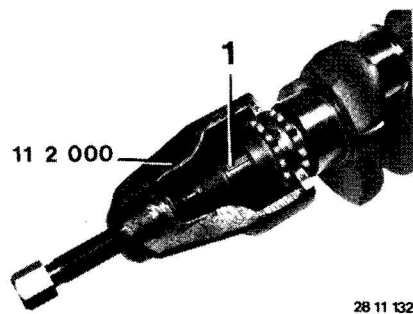
The color code is located on the side of a bearing shell.

Check the ground size of main bearing journals.

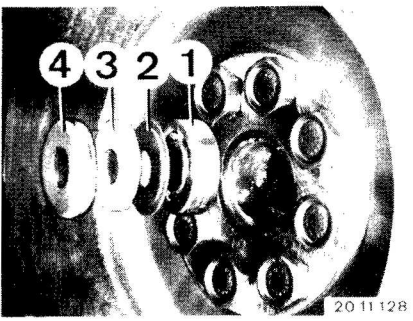
Installing Instructions:
Only place bearing shells with "red" marks in the crankcase (regardless of the old color code mark on the crankcase). Install bearing shells in bearing caps depending on the color code of the crankshaft main bearing journals - "red" or "blue".



316 11 162

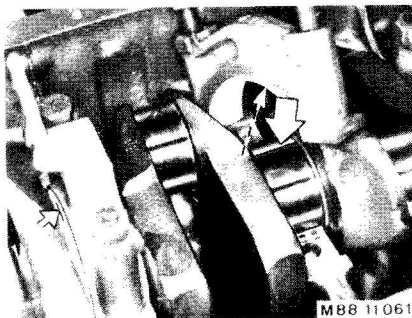


28 11 132



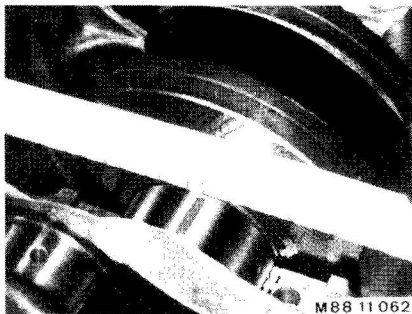
20 11 128

11-18a



Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

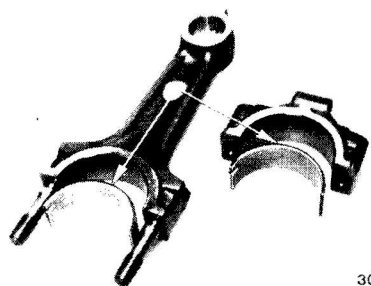
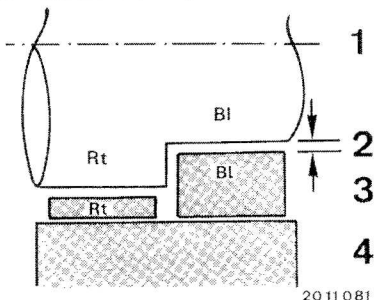


Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.

Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

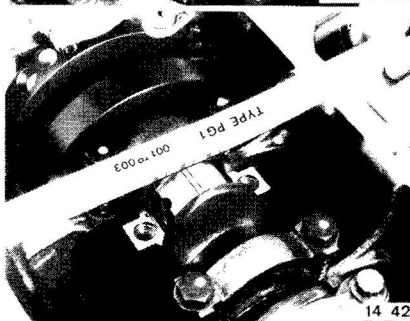
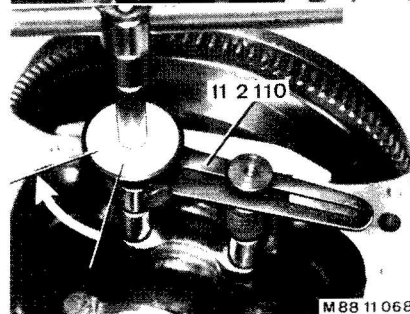
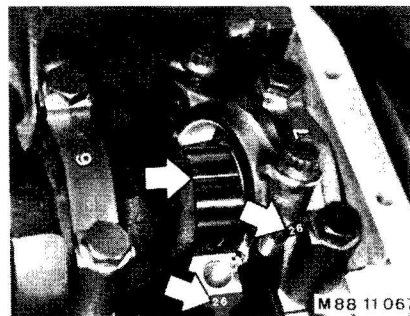
- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter



Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod for a pertinent crankshaft ground size.

Only install the red bearing shells of a pertinent ground size supplied with a replacement crankshaft.

* See Specifications



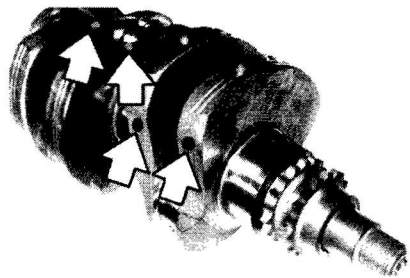
Place Type PG 1 Plastigage on a crankshaft wiped clean of oil in BDC position.
Connecting rods and caps are marked with the same pair number (0 ... 99). All pair numbers are located on one side in an engine.
Mount conrod caps.
Tightening torque:
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

Important!
Do not turn connecting rods or the crankshaft.
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.
Replace conrod bolts for final installation and tighten the conrod bearing caps.
Tightening torque*.

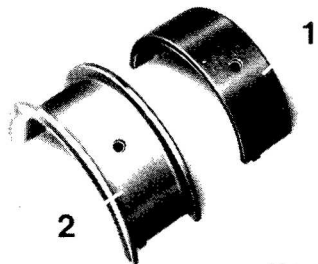
* See Specifications

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS - Engine Disassembled -

A crankshaft is marked with red or blue paint depending on main bearing journal tolerances.



28 11 167

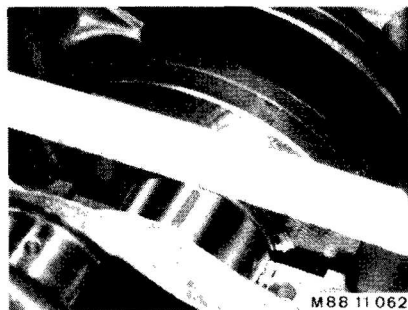


28 11 053

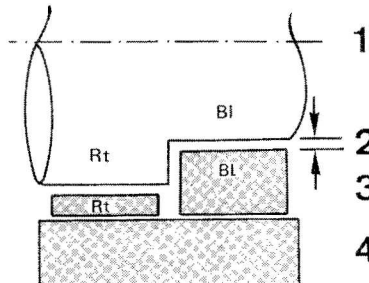
- 1 = Bearing shell 1-2-4-5
- 2 = Bearing shell 3 (pilot bearing)

Color code mark is located on the side of a bearing shell.

Check ground size of main bearing journals.



M88 11 062



20 11 081

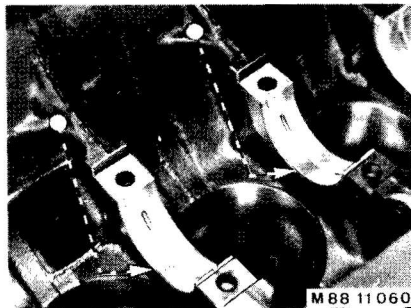
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.

Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness*

Double Classification Color Codes:

Rt = red
Bl = blue

- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter

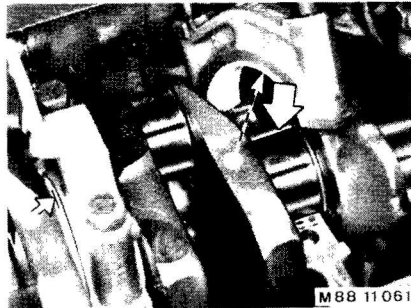


M88 11 060

Install bearing shells in crankcase with same color code as the dot of paint on the console.

Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.

Install bearing shells in bearing caps with the same color code as for the crankshaft.



M88 11 061

Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*. Do not turn the crankshaft.

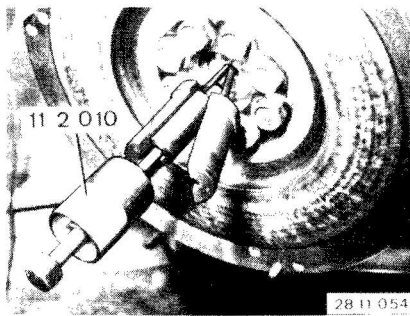
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications

* See Specifications

11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

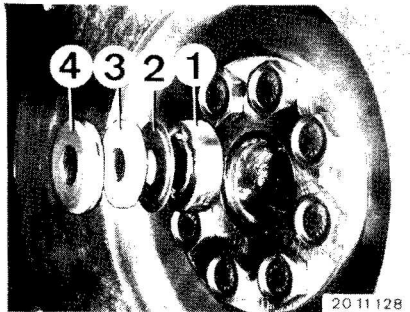
Remove clutch 21 21 000.
Pull out ball bearing with Special Tool
11 2 010.



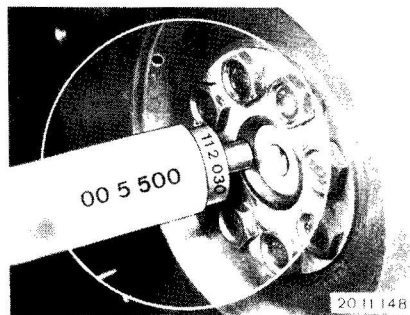
Installed Order:

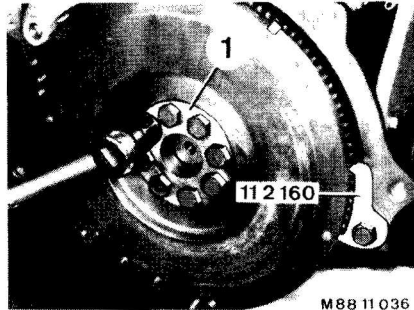
- 1 Ball bearing
- 2 Cover
- 3 Felt ring
- 4 Capsule

Install cover (2) with stamp facing out.



Pack bore in crankshaft with approx. 1 gram
of lubricating grease.
Drive in pilot bearing with Special Tools
11 2 030 and 00 5 500.

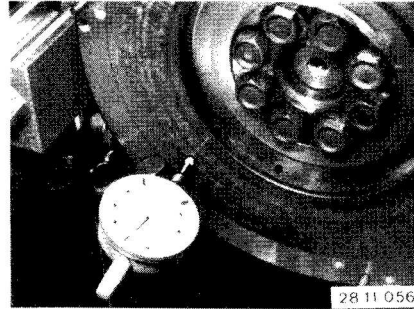




M 88 11 036

11 22 000 REMOVING AND INSTALLING FLYWHEEL

Remove clutch 21 21 000.
 Hold flywheel with Special Tool 11 2 160.
 Unscrew bolts and take off the flywheel.
Installation:
 Clean the tapped bores.
 Use washer (1).
 Replace and install new expansion bolts with Loctite No. 270**.
Important!
 Only coat threads of the bolts.
 Tightening torque*.

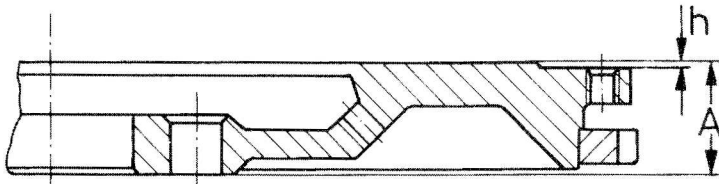


28 11 056

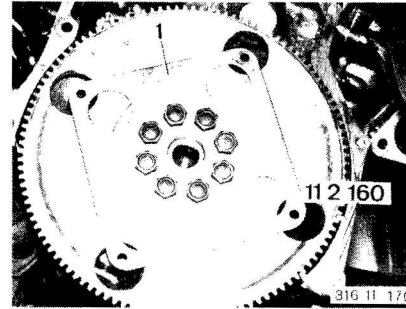
Check axial runout* of flywheel.

The friction surface may be machined to minimum thickness A*.
 If grinding the friction surface reduces the distance "h" to zero, the flange surface (distance "h") has to be machined.

M 88 11 072



* See Specifications
 ** Source: HWB



316 11 170

11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

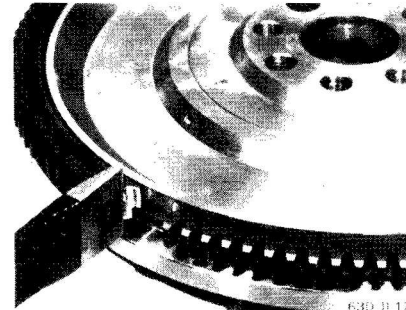
Remove transmission 24 00 020.
 Hold flywheel with Special Tool 11 2 160.
 Unscrew expansion bolts.
 Replace drive plate (1).
Installation:
 Clean the tapped bores.
 Replace and install the new expansion bolts with Loctite No. 270**.
Important!
 Only coat threads of the bolts.
 Tightening torque*.



630 11 170

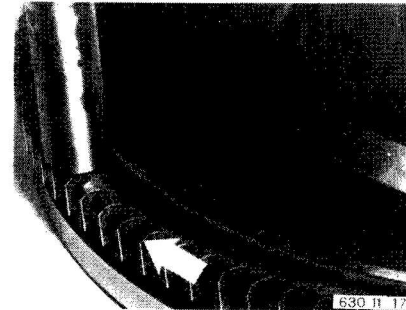
11 22 541 REPLACING STARTER GEAR RING

Drill a 6 mm (0.236") diameter hole about 8 mm (0.315") deep below a tooth gap to make breaking the gear ring easier.



630 11 171

Break the gear ring with a chisel applied at the drilled point.



630 11 172

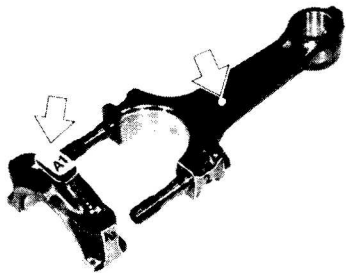
Installation:
 Heat a new starter gear ring to 200 ... 230° C (395 ... 445° F), checking the temperature with a thermocolor pencil.
 Tooth bevel faces the engine.
 Move on starter gear ring to fit firmly all around with a brass mandrel.

* See Specifications
 ** Source: HWB

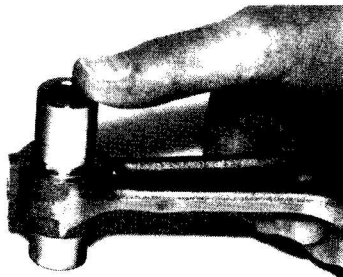
11 24 521 REPLACING CONNECTING RODS — PISTONS REMOVED —

Important!

Only install connecting rods of same weight class in one engine.
Weight class is stamped in machined conrod cap surface or indicated by a color code.
Connecting rods may not be machined.



28 11 275

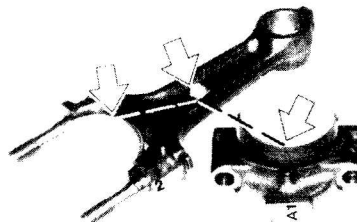


316 11 178

Piston pin must slide through conrod bushing under light pressure.
Install conrod bearing shells 11 24 571.

11 24 571 REPLACING CONNECTING ROD BEARING SHELLS —ENGINE DISASSEMBLED—

Install conrod bearing shells in connecting rods and conrod bearing caps.
Shells with Double Classification:
Install red or blue conrod bearing shells according to color code on connecting rod.
Important!
Check machined size (conrod bearing diameter).



28 11 305

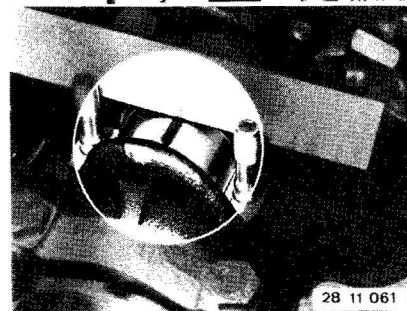


28 11 306

In BDC position place Plastigage Type PG 1 on a crankshaft wiped clean of oil.
Connecting rods and conrod bearing caps are marked with identical pair codes (0 ... 99).
Pair codes must always be on one side in an engine.
Mount conrod bearing caps.
Tightening torque*.
Source for Plastigage:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

Important!

Don't turn connecting rods or crankshaft.
Take off bearing caps.
Read bearing play* on supplied scale by measuring width of flattened Plastigage.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.
For final installation, replace conrod bearing cap bolts and tighten bearing caps.
Tightening torque*.



28 11 061

11 25 000 REMOVING AND INSTALLING PISTON

Remove engine and take off cylinder head, oil pan and oil pump.
Take off conrod bearing cap and press out piston with connecting rod upwards.
Important!
Mark installed position of connecting rod to crankshaft, if it is not necessary to replace conrod bearing shells.

Remove circlip (1).
Press out piston pin.
Installation:
Piston pins and pistons are matched and must not be mixed up.
Important!
If there is excessive play between piston pin and conrod bushing (sounds like acceleration knock), check conrod bushing diameter, replacing connecting rod or bushing.

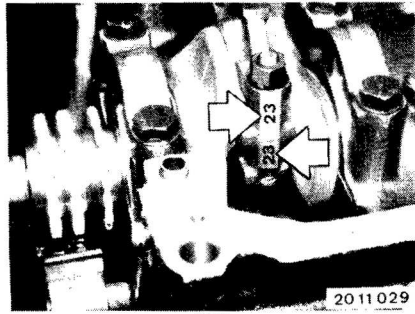
Only install piston of same make and same weight class.
Weight class is stamped with "+" or "-" in piston crown.
Check machined size (piston diameter).
Identifications:

Type	E*	Piston Cone Height mm (in.)	Diameter mm (in.)
318 i	9.3	6.9 (0.272)	89 (3.504)
318 i	9.0	3.6 (0.142)	89 (3.504)

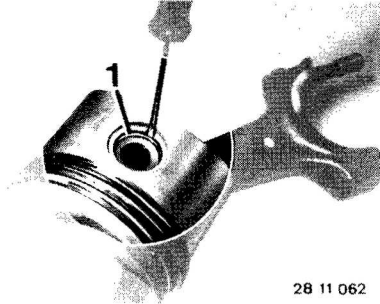
Check piston installed clearance*.

Model	Make	Checkpoint mm (in.)
318 i	Mahle	14.00 (0.551)
	KS	30.85 (1.215)
	Alcan	15.5 (0.610)

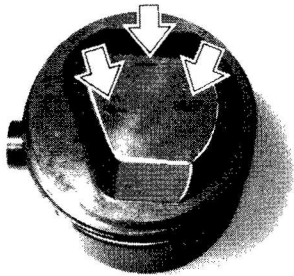
* See Specifications



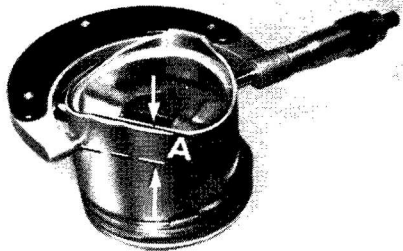
20 11 029



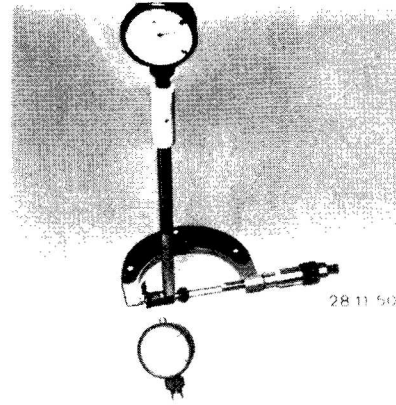
28 11 062



30 11 032



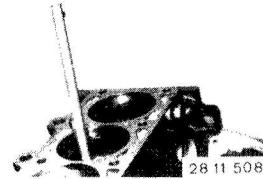
28 11 064



28 11 502

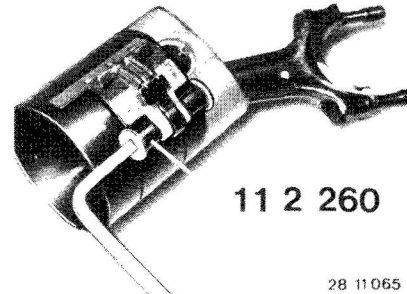
Set internal gauge to zero with measured piston diameter on the micrometer.

Measure cylinder bore at bottom, center and top in forward and rotating directions with the internal gauge.
Check piston installed clearance*.



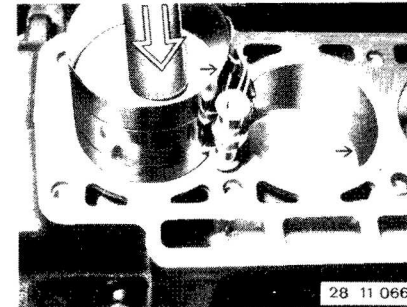
28 11 508

Lubricate piston and piston rings with oil.
Offset piston ring end gaps 120° to each other.
Compress piston rings with Special Tool 11 2 260.



11 2 260

28 11 065



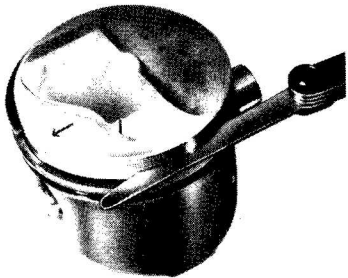
28 11 066

Install piston that arrow faces timing chain.
Install connecting rod 11 24 521.

* See Specifications

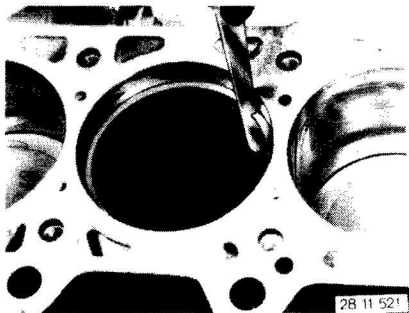
11 25 651 REPLACING PISTON RINGS OF ONE PISTON — PISTON REMOVED —

Measure side clearance* of piston rings.



28 11 067

Remove piston rings and measure end clearance*.

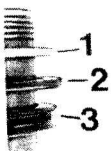
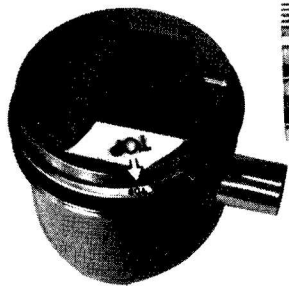


28 11 521

Installation:

Install piston rings that word "TOP" faces piston crown.

- 1 Plain compression ring
- 2 Tapered face ring
- 3 Bevelled oil control ring

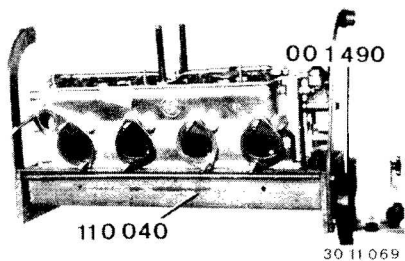


28 11 068

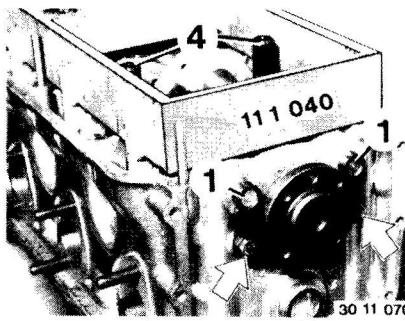
* See Specifications

11-24

11 31 000 REMOVING AND INSTALLING CAMSHAFT



Remove cylinder head 11 12 100.
Mount cylinder head on Special Tool 11 1 040.

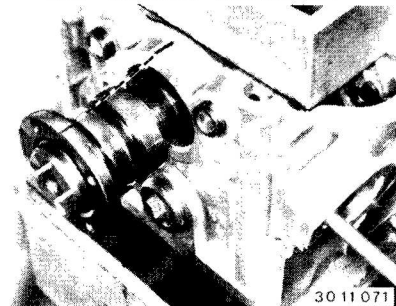
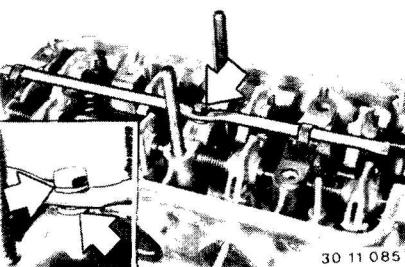


Insert dowel pins (4) and unscrew guide plate.
Installation:
Replace loose plug (1) and install with Loctite No. 270*.
Camshaft should still turn easily after installation of the guide plate.

Detach oil line.

Installation:

Check installed position of seals.
Tightening torque*.



Pull out camshaft carefully.

Installation:

Turn camshaft before releasing the special tool until notch on camshaft flange is aligned with cast boss on cylinder head.

Camshaft Identification:
2 = 264° standard version.

Adjust valve clearance of all valves to maximum value.

Mount Special Tool 11 1 040 and press down rocker arms.

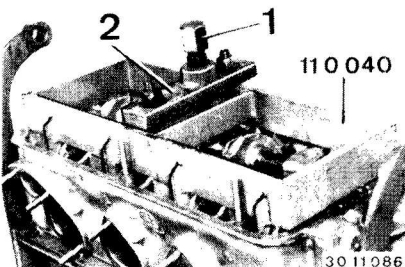
Important!

Clamping bolt (1) is off-center.

To prevent contact between valve heads, mount clamp (2) that the short end faces exhaust manifold.

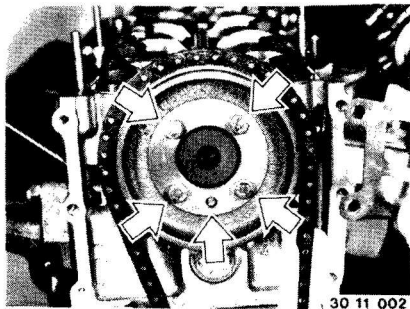
Installation:

Adjust valve clearance 11 34 004.



* See Specifications

* Source: HWB

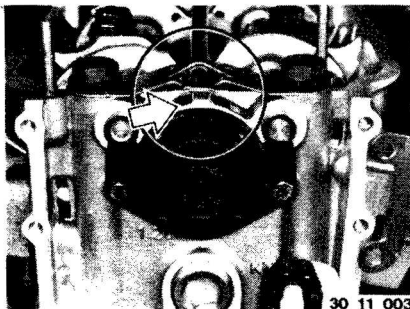


11 31 051 REPLACING TIMING CHAIN

Remove upper timing case cover 11 14 100.
Remove lower timing case cover 11 14 120.
Set cylinder no. 1 to TDC.
Detach sprocket.

Important!

Never crank engine when timing chain has been removed.

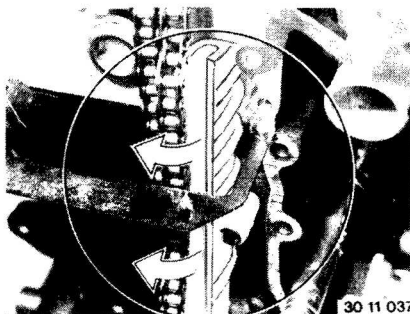


Installation:

Position timing chain that notch in camshaft flange is aligned with cast boss on cylinder head.

Cylinder no. 1 is at TDC.

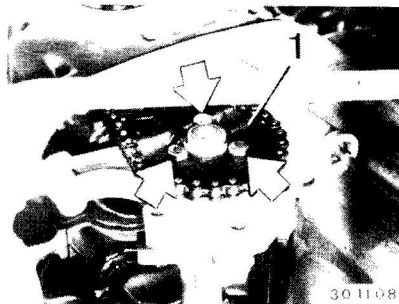
Tightening torque*.



Take timing chain off of bottom sprocket and remove carefully from guide rail.

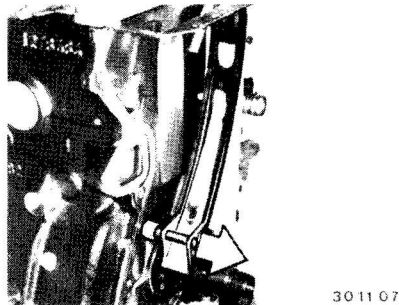
Note:

Timing chain is pre-stretched.

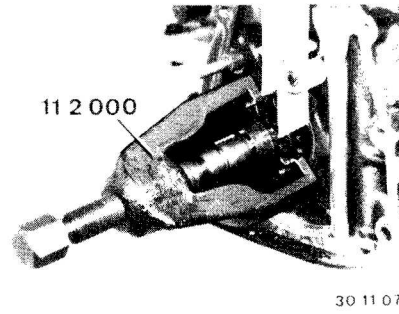


11 31 061 REPLACING SET OF SPROCKETS - TIMING CHAIN REMOVED -

Remove oil pan 11 13 000.
Detach sprocket (1) on oil pump.
Remove chain.



Remove lock and swing in and remove tensioning rail.



Pull off sprocket with Special Tool 11 2 000.

Installation:

Heat sprocket for installation: max. 200° C (390° F).

Tighten oil pump chain, see 11 41 000.

11 31 090 REMOVING AND INSTALLING CHAIN TENSIONER PISTON

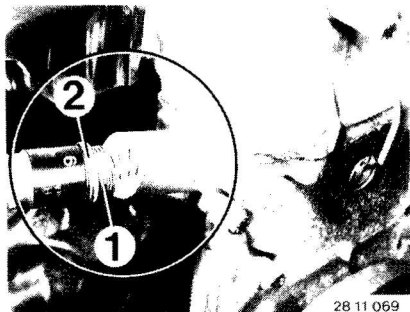
Unscrew plug (1).
Caution!
 Strong spring force.
 Remove spring and piston.
Installation:
 Replace seal (2).

Installation:
 Check spring length*.
 Tapered end of coil spring faces plug.

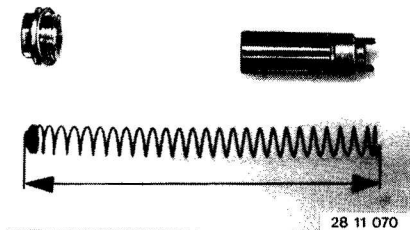
Checking Piston:
 Check free movement of ball (3) by shaking.
 Check function of valve by blowing air
 – in direction A = closed and
 – in direction B = opened.
 If applicable, drive valve (4) out of sleeve (5)
 and clean.
 Make sure vent slots (6) are not clogged.

To bleed piston, remove cylinder head cover
 11 12 000.
 Loosen plug (1) and move tensioning rail (6)
 back and forth until oil runs out at plug (1) and
 resistance can be felt.
Points Causing Unusual Chain Noise:
 a) Piston bled insufficiently.
 b) Piston seized.
 c) Vent slots clogged.
 d) Ball valve in piston malfunctions.
 e) Spring force excessive or insufficient.

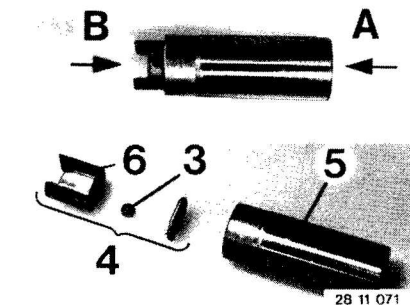
* See Specifications



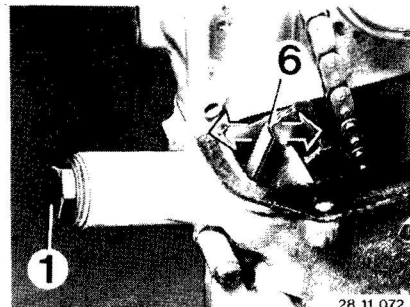
28 11 069



28 11 070



28 11 071



28 11 072

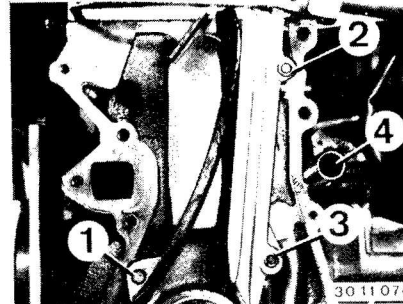
11 31 601 REPLACING TENSIONING RAIL/ GUIDE RAIL – TIMING CHAIN REMOVED –

Remove circlips (1 ... 3).
 Disconnect water pipe (4) on holder.

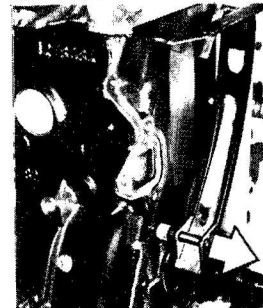
Swing in and remove tensioning rail.

Pull off guide rail on bottom bearing pin.

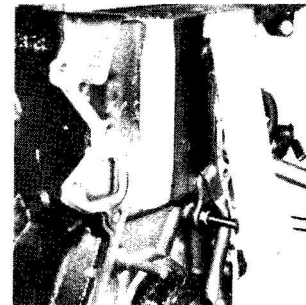
Swing guide rail aside and remove.



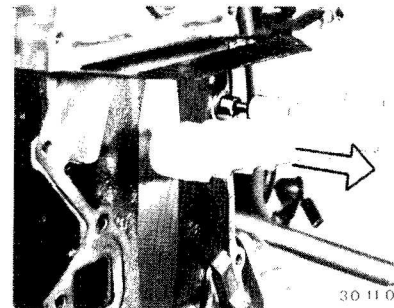
30 11 074



30 11 072



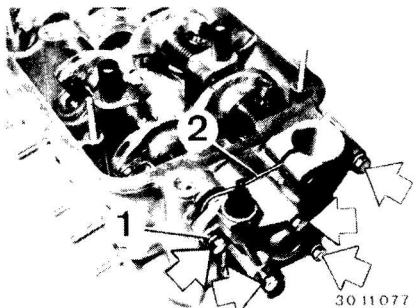
30 11 075



30 11 076

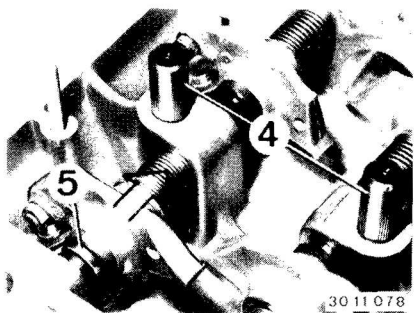
11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

Remove camshaft 11 31 000.
Detach distributor flange.
Installation:
Replace seal (1) and gasket (2).



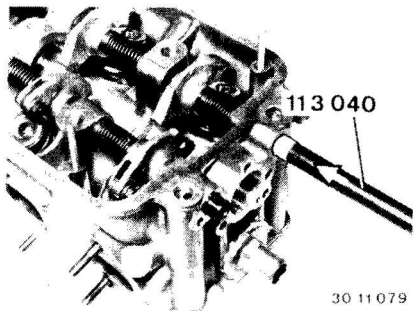
30 11 077

Slide back rocker arms and thrust rings.
Remove circlips (5).
Remove dowel pin (4).

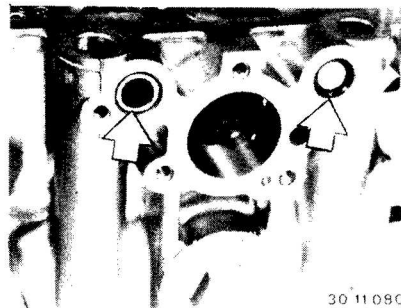


30 11 078

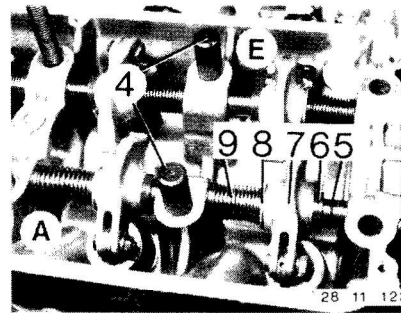
Drive out rocker arm shafts with Special Tool
11 3 040.
Installation:
Replace worn shafts.



30 11 079



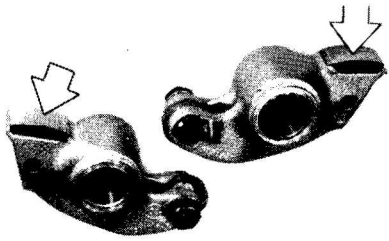
30 11 080



28 11 123

Important!
Rear end of rocker arm shaft on intake side is open.
Rocker arm shaft on exhaust side must be closed.
Install loose or replace missing plugs with Loctite No. 270*.

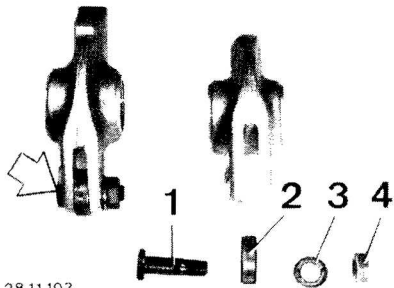
Installed Order:
Spring (9), washer (8), rocker arm (7), thrust ring (6) and snap ring (5).
A = Exhaust side
E = Intake side
Align rocker arm shafts that cylinder head bolts fit in openings.
Insert dowel pins (4).
Important!
The new, short springs (9) may be installed mixed with the conventional, long springs (9).



11 33 031 REPLACING ROCKER ARMS

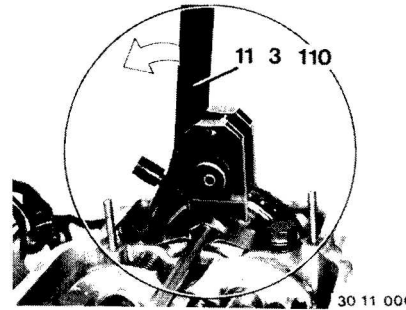
Remove rocker arms 11 33 020.
 Replace worn rocker arms or rocker arms with loose slides.
 Loose slides will be noticed as excessively loud valve noise.

28 11 102



28 11 103

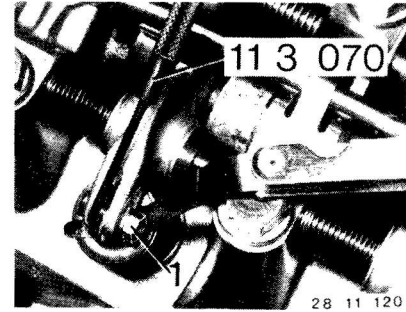
Transfer setscrew (1), eccentric (2), washer (3) and nut (4) to new rocker arm.
 Replace a worn eccentric.
Important!
 Setscrew and nut have M 6 x 0.75 fine threads.
 Bore faces out and thick side down.
 Bevelled side of setscrew faces tab on rocker arm.



30 11 006

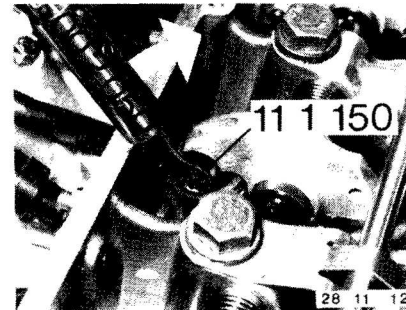
11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover 11 12 000.
 Crank engine with Special Tool 11 3 110.



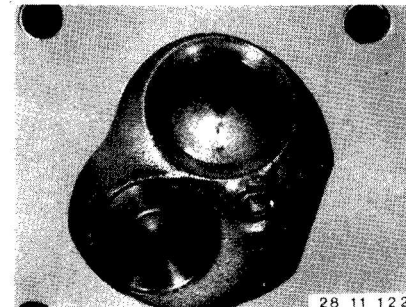
28 11 120

Adjusting order is same as firing order (1-3-4-2) in compression top dead center (TDC).
 Adjust valve clearance* between valve and eccentric after loosening nut (1).



28 11 121

Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
 Tightening torque*.



28 11 122

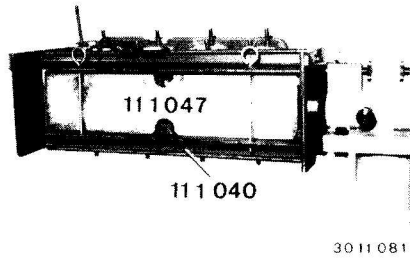
11 34 509 CHECKING ALL VALVES FOR LEAKS - CAMSHAFT REMOVED -

Spark plugs remain installed.
 Fill combustion chamber with gasoline outdoors or indoors while conforming with fire prevention measures.
 If gasoline runs past the valves, inspect valves and valve seats.
 Remove and install valves 11 34 550.
 Machine valve seats 11 12 607.

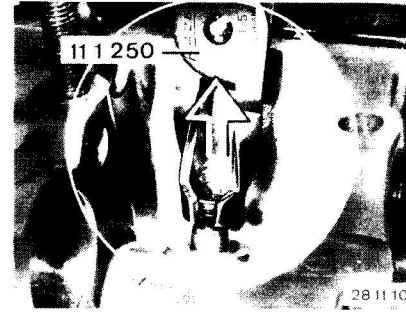
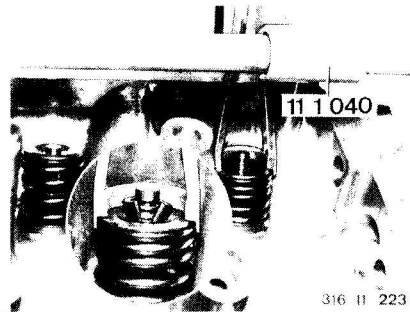
* See Specifications

11 34 550 REMOVING AND INSTALLING VALVES — Rocker Arm Shafts Removed —

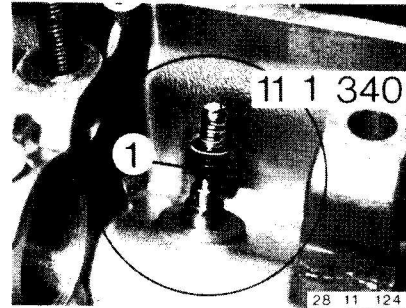
Place tray 11 0 047 in assembly stand 11 1 040.



Press down the valve springs with Special Tool 11 1 040 and remove valve collets.



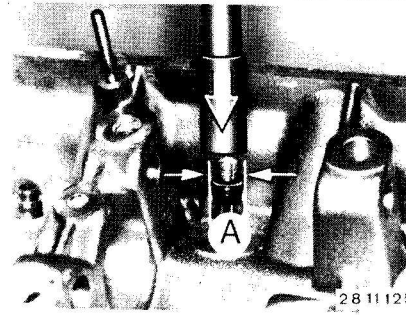
Pull off valve stem seal with Special Tool 11 1 250.



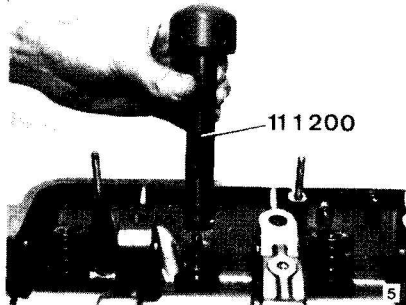
Insert valve.
Use Special Tools 11 1 340 to avoid damage on the valve stem seal.

Lubricate valve stem seal (1) with oil and install.

Source for Special Tool Sleeves:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

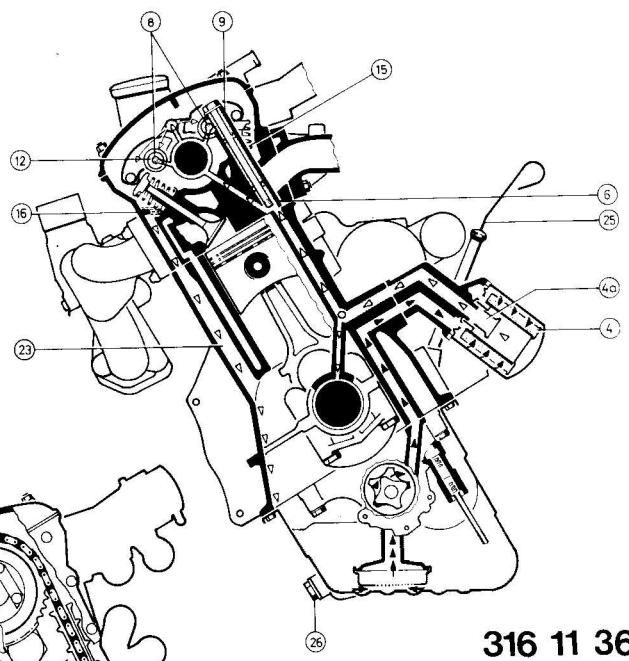
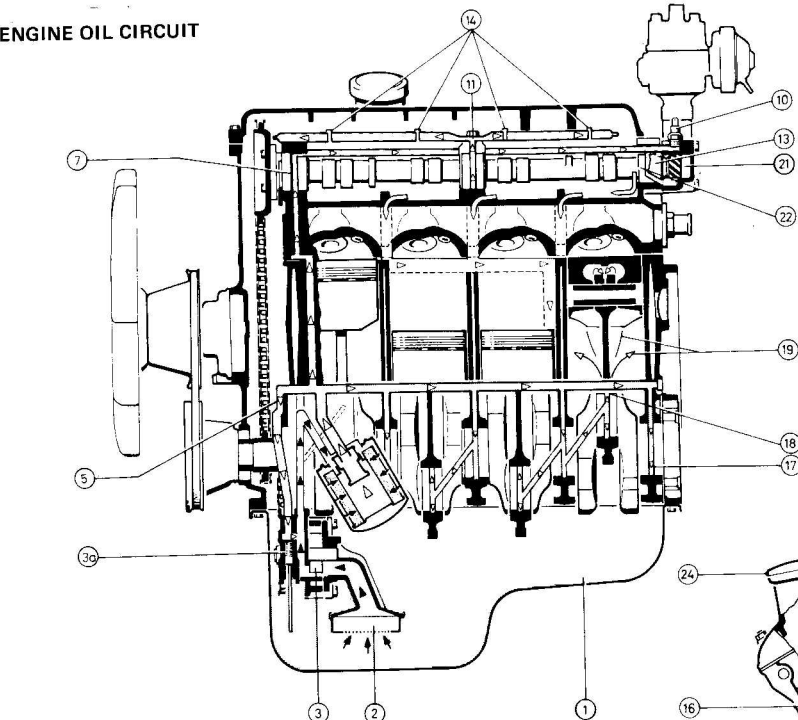


Press on valve stem seal against stop, using Special Tool 11 1 090 for seals with dia. A = 14 ± 0.2 mm (0.551 ± 0.008 "') or Special Tool 11 1 070 for seals with dia. A = 14.3 ± 0.2 mm (0.563 ± 0.008 "').

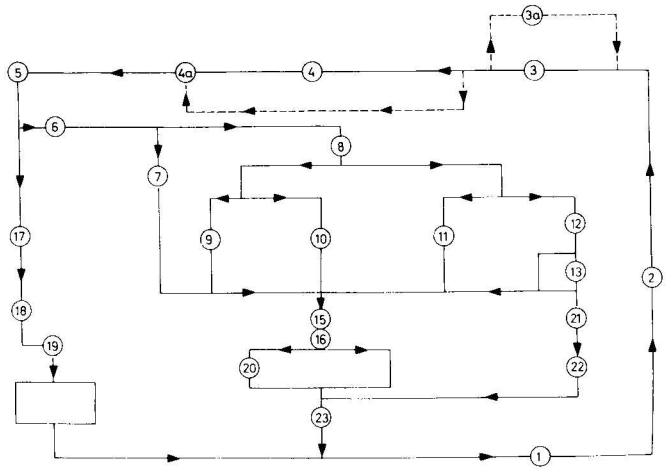


The new, improved valve stem seals (inside grooving) are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters — for 7/8 mm ($0.276/0.315$ "') valve stem seals.

ENGINE OIL CIRCUIT

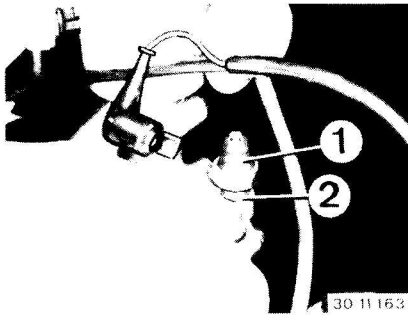


316 11 362



- | | | | | | |
|---|----------------|----|--------------------------------------|----|-----------------------------|
| ▲ | Unfiltered oil | 1 | Oil pan | 14 | Oil spray tube |
| △ | Filtered oil | 2 | Intake with filter screen | 15 | Valve guide |
| | | 3 | Oil pump | 16 | Overflow from cylinder head |
| | | 3a | Pressure relief valve | 17 | Crankshaft bearings |
| | | 4 | Oil filter | 18 | Conrod bearings |
| | | 4a | Safety valve | 19 | Spray oil |
| | | 5 | Main distribution bore | 20 | Pocket/chain lubrication |
| | | 6 | Oil bore in cylinder head | 21 | Oil sump/distributor drive |
| | | 7 | Camshaft bearings | 22 | Overflow bore |
| | | 8 | Rocker arm shaft | 23 | Oil drain bore |
| | | 9 | Rocker arm bearings (intake valves) | 24 | Oil filler neck |
| | | 10 | Oil pressure transmitter | 25 | Oil dipstick |
| | | 11 | Camshaft bearings | 26 | Oil drain plug |
| | | 12 | Rocker arm bearings (exhaust valves) | | |
| | | 13 | Camshaft bearings | | |

11-31

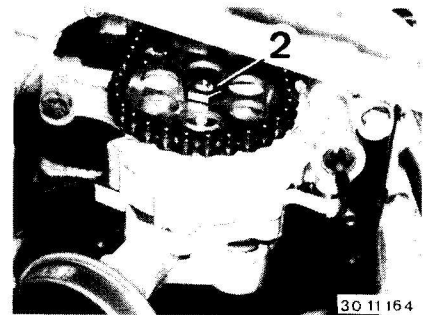


11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check seal (2), replacing if necessary.

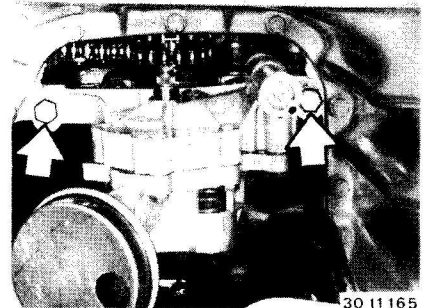


Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW service test unit.
Check oil pressure*.

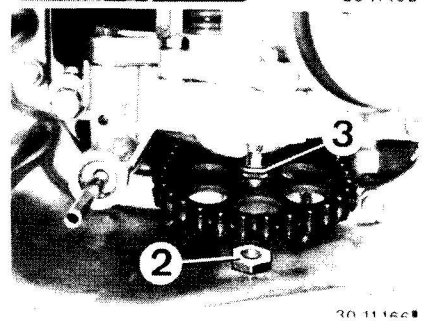


11 41 000 REMOVING AND INSTALLING OIL PUMP

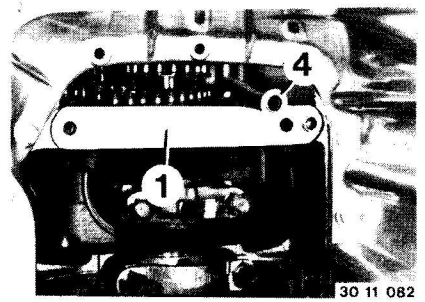
Unscrew oil pan bottom section 11 13 020.
Unscrew nut (2) and take off sprocket.



Unscrew oil pump.



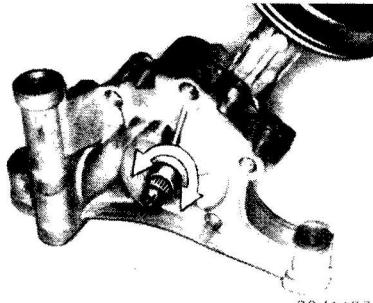
Installation:
Install shim (3).
Check tightening torque* of nut (2).



Installation:
Check installed position of O-ring (4) between housing and vacuum line.
Chain Tightness:
Adjust chain tightness with shim (1) that chain gives at middle under light thumb pressure.
Check position of oil bore in shim.

* See Specifications

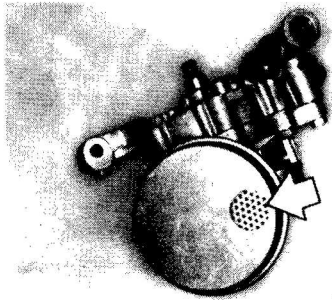
* See Specifications



30 11167

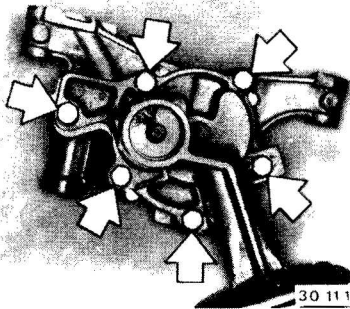
Checking and Servicing:
Turn drive shaft to check whether oil pump runs easily.

Clean oil filter screen.



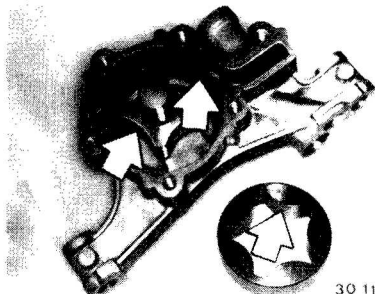
30 11168

Disassemble oil pump.

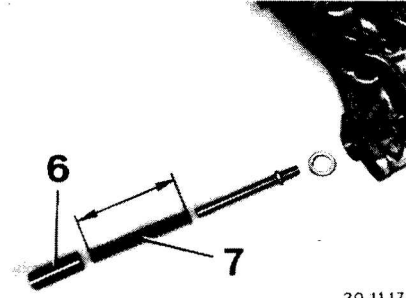


30 11169

Check oil pump for wear
— Scoring in body
Wear on rotors

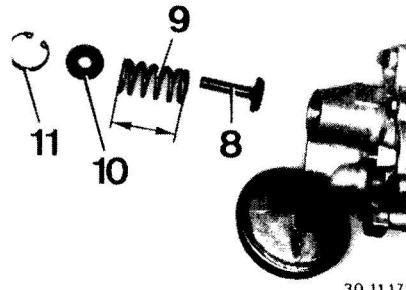


30 11170



30 11171

The pressure relief valve is located in the main bore and regulates the engine oil pressure*, see 11 40 000.
Check whether piston (6) runs easily.
Check length of spring (7) = 68 mm (2.677").

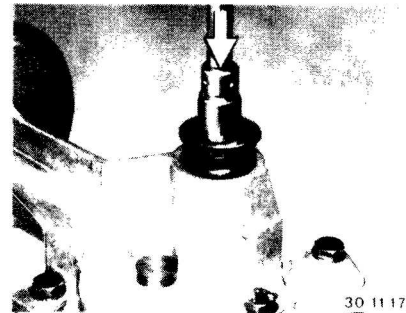


30 11172

The 8 bar (114 psi) overload valve regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check fit of piston (8).
Check length of spring (9) = 44 ± 0.4 mm (1.732 \pm 0.016").

Installation:

Press in spring (9) and washer (10) with a wrench socket and install circlip (11).



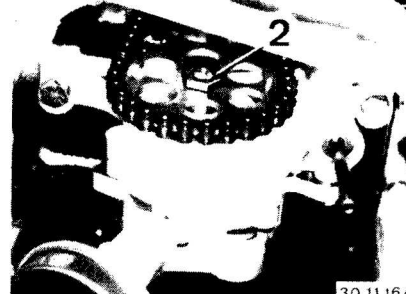
30 11173

11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Remove oil pan bottom section 11 13 020.
Remove timing chain 11 31 051.
Unscrew nut (2) and take off sprocket.

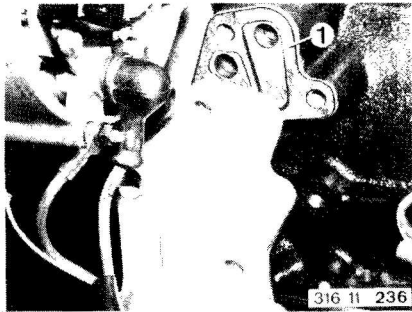
Installation:

Check sprockets for wear.
Adjust chain tightness, see 11 41 000.
Chains with green mark are longer than chains with a red mark.
Tightening torque*.



30 11164

* See Specifications



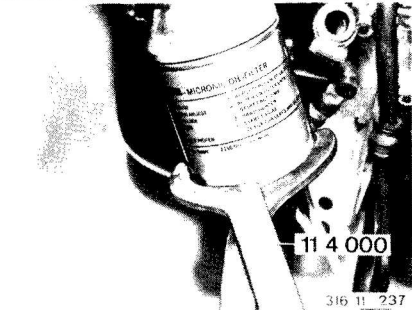
316 11 236

11 42 020 REMOVING AND INSTALLING/ SEALING COMPLETE FULL FLOW OIL FILTER

Unscrew full flow oil filter on crankcase.

Installation:

Replace gasket (1).



11 4 000

316 11 237

11 42 021 REPLACING FULL FLOW OIL FILTER

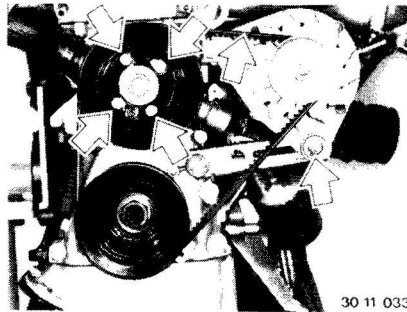
Unscrew filter with Special Tool 11 4 000.

Installation:

Lubricate gasket with a light coat of oil. Screw on oil filter by hand until the gasket touches – then tighten the filter by hand with a one half turn.

Pour in oil, start the engine and check oil level and for leaks.

If the engine no longer builds up oil pressure after replacing the oil filter cartridge, stop the engine, loosen the filter about 90°, start the engine and tighten the filter again after oil has run out briefly (bleeding procedure).



30 11 033

11 51 000 REMOVING AND INSTALLING WATER PUMP

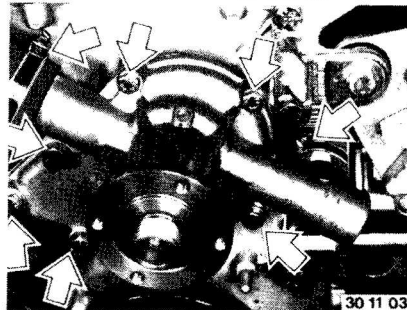
Remove fan 11 52 000.

Loosen alternator.

Remove pulley and drive belt.

Installation:

Tighten drive belt 12 31 299.



30 11 034

Loosen hose clamps.

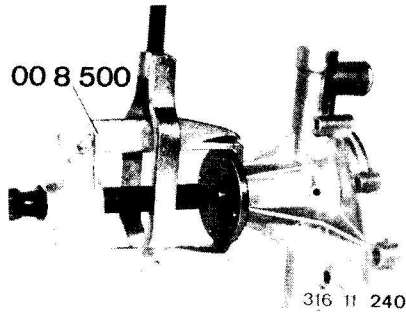
Unscrew water pump.

Installation:

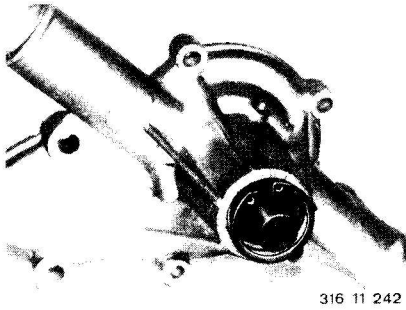
Replace gasket.

11 51 502 OVERHAULING WATER PUMP

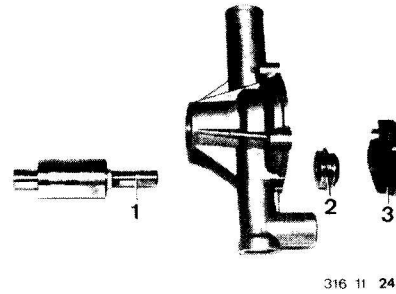
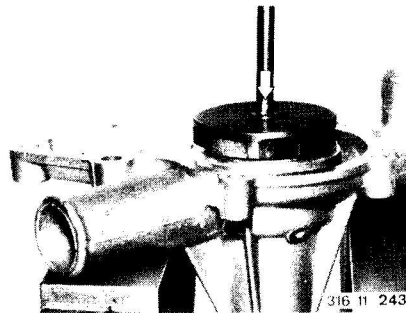
Pull off hub with Special Tool 00 8 500 from Kukko.



Remove circlip.



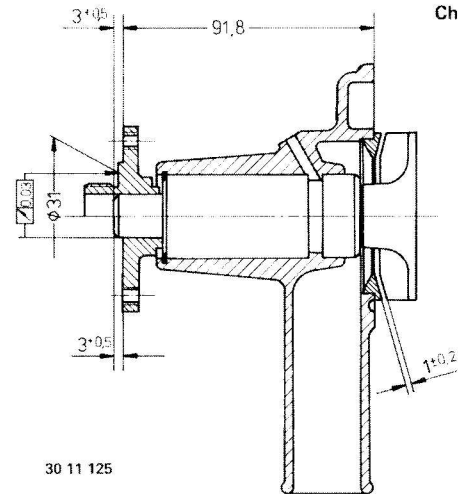
Press out water pump bearing.



Replace bearing (1) and seal (2).
Check impeller (3), replacing if necessary.

Installation:

Press in bearing (1) against stop.
Press on impeller (3).



Check dimensions after assembling.

11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).

Important!
Left-hand threads – nut turned clockwise to unscrew.

Tightening torque*.

Installation:

Tighten fan with Special Tool 11 5 040. 40 Nm (29 ft. lbs.) tightening torque is equal to a setting of 30 Nm (22 ft. lbs.) on the torque wrench.

11 52 020 REPLACING FAN COUPLING

Remove fan – see 11 52 000.

Reasons for replacing clutch:

- a) Hub has seized – fan of stopped engine can not be turned or hard to turn.
- b) Fan coupling has axial play or radial play or is losing oil.

Check switching points* with a Vibro-card**. Unscrew fan mounting bolts and take off the fan coupling.

* See Specifications

** See Workshop Equipment Catalog

11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain coolant.
Loosen hose clamps.
Remove thermostat.

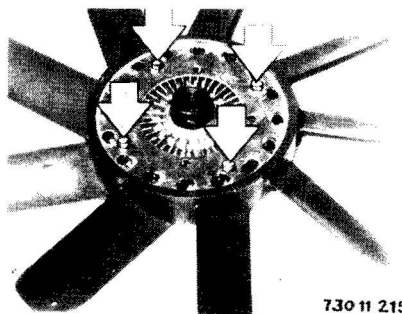
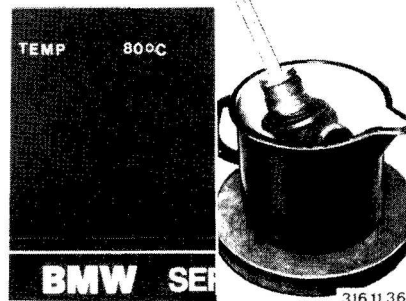
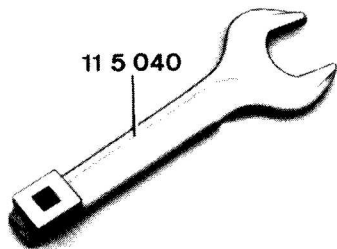
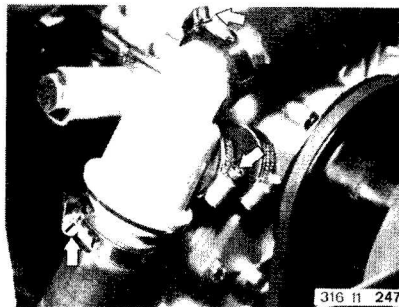
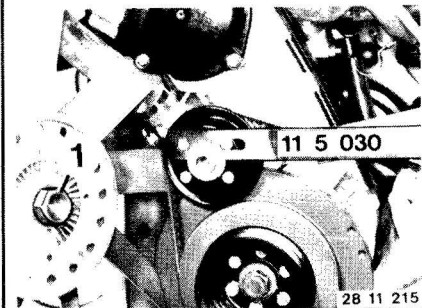
Installation:

Bleed cooling system – see 17 11 000.

Checking Thermostat:

Place thermostat in a water bath and heat the water.

Check opening temperature* and opening travel with a steel ruler. Opening travel = 8 ± 1 mm (0.315 \pm 0.039").



11 78 010 CHECKING OPERATION OF
OXYGEN SENSOR

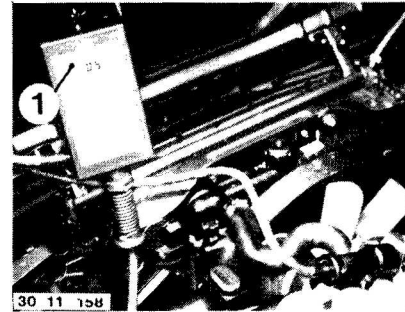
Run engine approx. 30 seconds at a speed of 3,000 rpm before checking.
If checking is not finished after about 5 minutes, heat oxygen sensor by running engine approx. 30 seconds at 3,000 rpm again.

Connect mixture control unit 12 6 400 on the diagnosis plug.

Oxygen sensor is okay, if the LED (1) flashes at least every 3 seconds after waiting approx. 10 seconds.

LED Does Not Flash (Oxygen Sensor Not Operating):

- Oxygen sensor is dirty (oil/soot) or does not have correct operating temperature = 350° C (662° F).
- Heat oxygen sensor again by running engine at fast speed.



11-37

11 78 510 REPLACING OXYGEN SENSOR

- Do not clean oxygen sensors or let them come in contact with lubricants.
- Only use Anti-Seize** for the threads.
- Cover oxygen sensors when undercoating the car.

Until 1984 Models:

Oxygen sensor must be replaced at intervals of 30,000 miles.

The "O₂ SENSOR" sign, however, only comes on after the first 30,000 miles.

Disconnect plug (2).

Unscrew oxygen sensor (1).

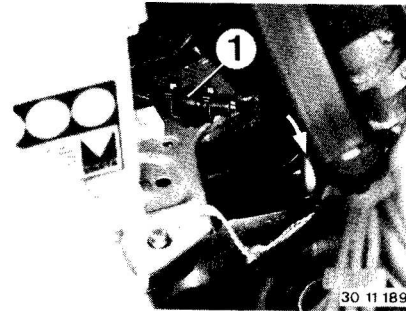
Installation:

Coat threads with Anti-Seize**.

Unscrew screw (3).

Push cover on display unit to the right and lift off.

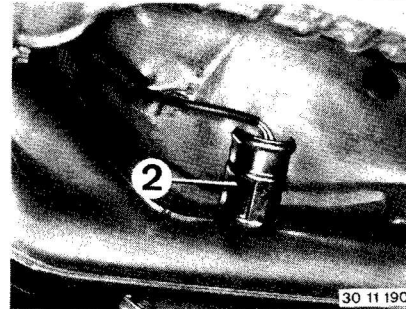
Remove lamp (4) for "O₂ SENSOR" sign by bending off.



Since 1985 Models:

The heated oxygen sensor has to be replaced at intervals of 50,000 miles -- there is no sign or indicator lamp. Disconnect plug (1).

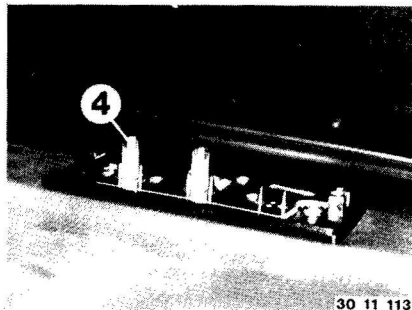
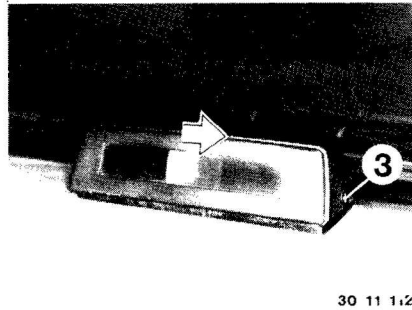
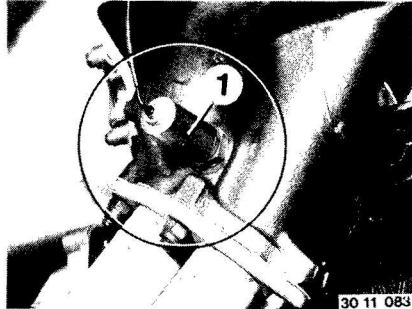
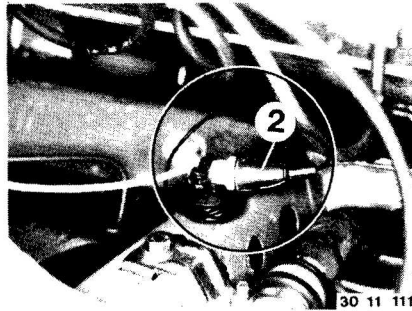
Pull off plate (2).

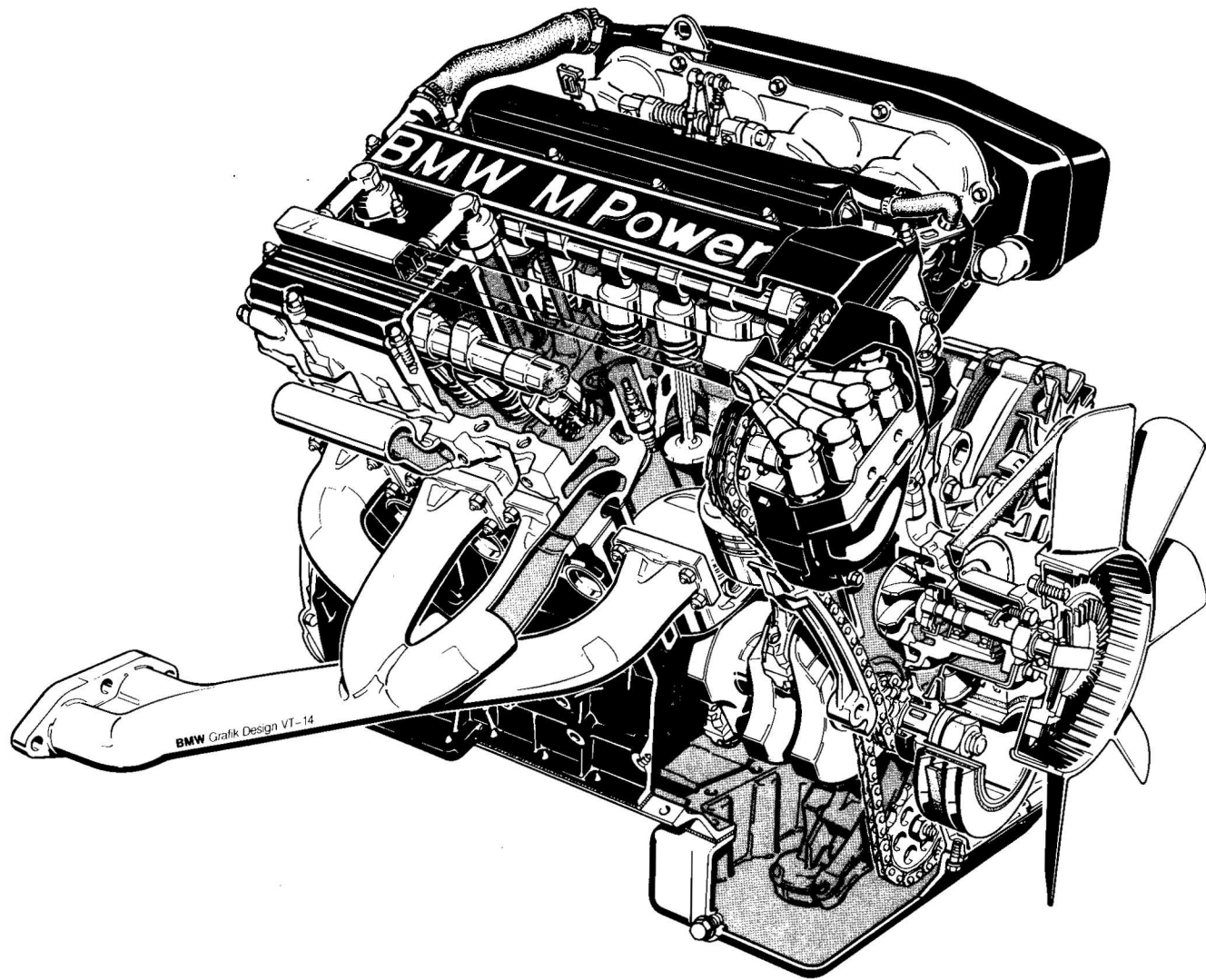


Unscrew oxygen sensor (3).

Installation:

Coat threads with Anti-Seize**.

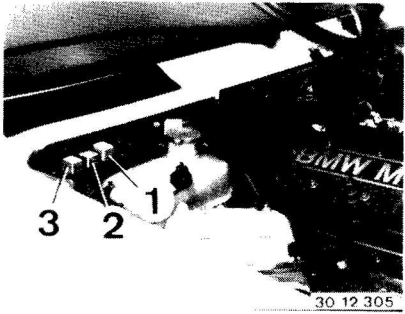




BMW M 3 – Engine S 14 Z

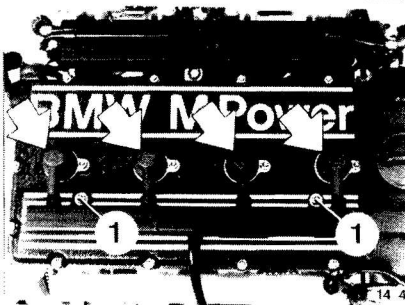
11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

Unscrew trim panel and pull off master relay (2).



30 12 305

Unscrew nuts (1) on ignition lead tube and pull off spark plug connectors.

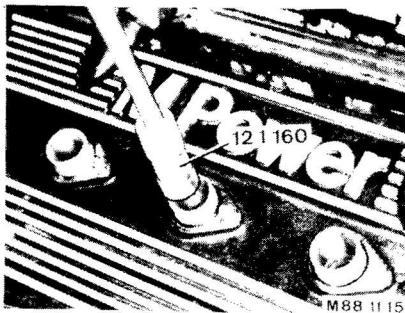


14 4

Unscrew spark plugs with Special Tool 12 1 160.

Installation:

Tightening torque: 20 Nm (14.5 ft. lbs.).



12 1 160

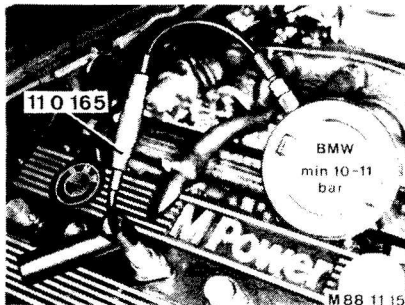
M88 11 151

Screw in Special Tool 11 0 165 and connect compression tester.

Press down accelerator pedal and operate starting motor so long, until compression no longer rises.

Values of all cylinders must not deviate by more than 0.5 bar (7 psi).

Nominal value: 10 to 11 bar (145 to 155 psi).



11 0 165

BMW
min 10-11
bar

M88 11 152

11 00 050 REMOVING AND INSTALLING ENGINE

Disconnect battery ground lead.
 Remove transmission — see Group 23.
 Remove splash guard.
 Drain coolant on engine and radiator.
Installation:
 Fill and bleed cooling system — see Group 17.

Loosen hose clamp (1) and hose clamp for intake hose (next to radiator).
 Pull off hoses.
 Pull off plugs (2 and 3) and place leads aside.
 Loosen nuts (4 and 5) and remove air cleaner.

Disconnect accelerator cable (1) and cruise control cable (2).
 Unscrew nuts (3) on holder and lay cables with holder aside.
 Unscrew nut (4).
 Pull off clamp and lift out vacuum hose (5) in the brake booster.

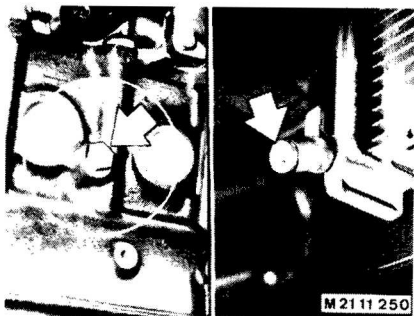
Loosen hose clamp (1) and pull off hose on intake manifold.
 Unscrew nut (2) on intake manifold brace.

Loosen hose clamp (1) and pull off hose.
 Unscrew nuts and take off intake manifold.
Installation:
 Check O-rings, replacing if necessary.
 Tightening torque: 9 Nm (6.5 ft. lbs.).

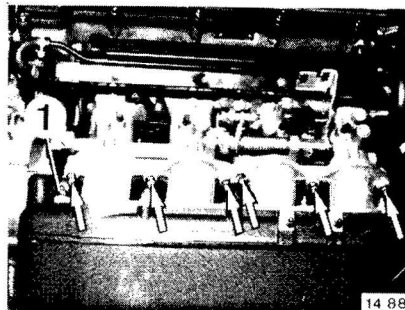
Loosen hose clamps (1 and 2) and pull off hoses on coolant expansion tank.
 Unscrew nut (3) and take off ground strap.

Pull off ignition lead (1) on ignition coil.
 Pull off plugs (2 and 3).
 Unscrew nut (4) and lay lead aside on opposite end of engine.

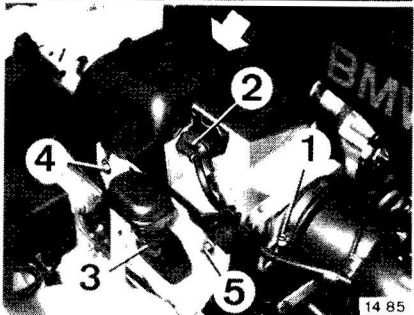
Disconnect leads (1 and 2) on alternator.
 Unscrew nuts (3 and 4) and take off leads



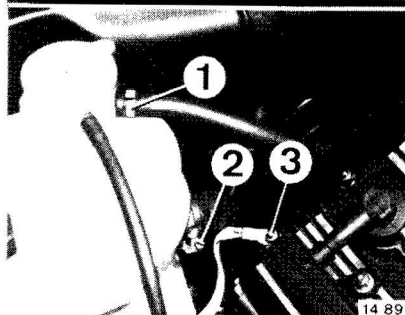
M 21 11 250



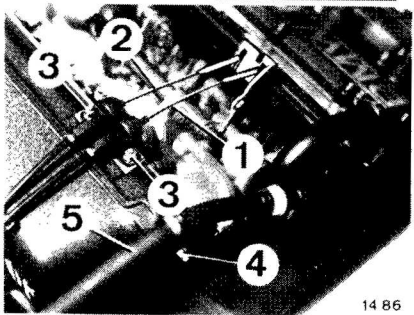
14 88



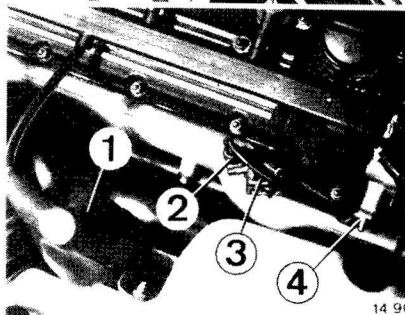
14 85



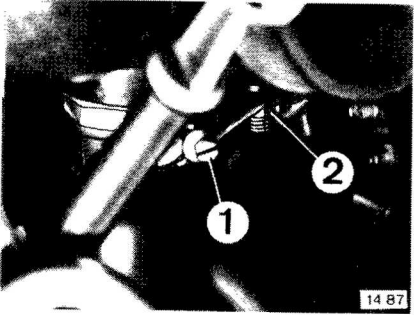
14 89



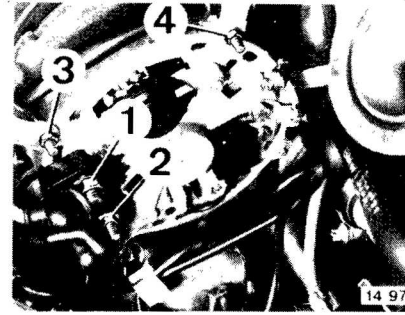
14 86



14 90

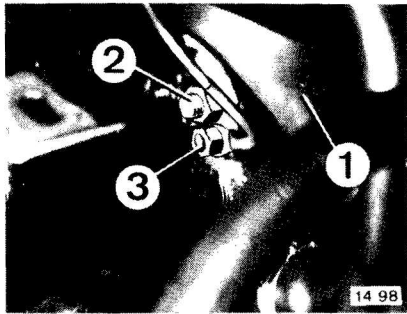


14 87

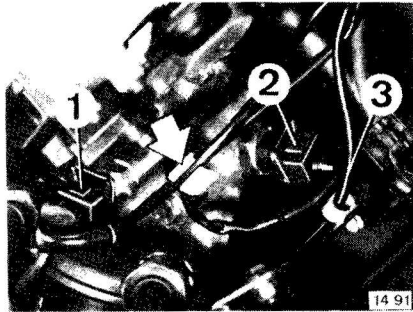


14 97

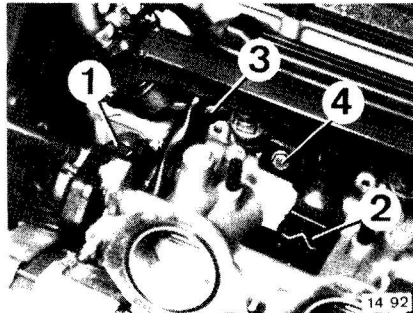
11-52a



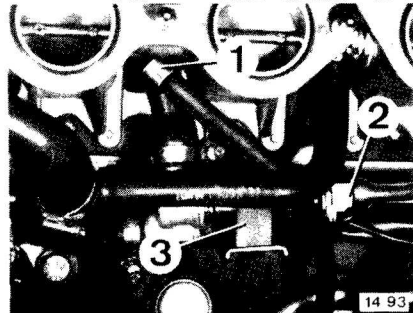
Unscrew cover (1).
Disconnect leads (2 and 3) on starter.



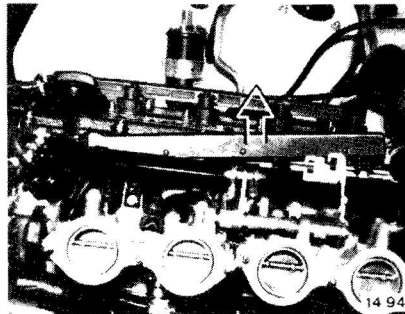
Pull off plugs (1 and 2) and unclip leads in holder.
Disconnect lead (3) on oil pan (pull off plug and unscrew holder) and remove lead from above.



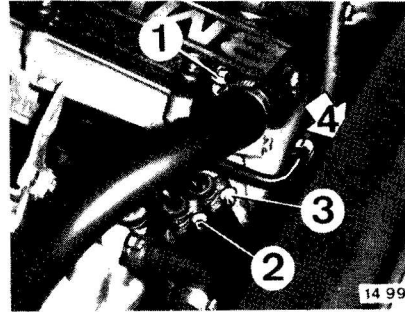
Pull off plugs (1 and 2).
Pull off vacuum hose (3) on pressure regulator.
Unscrew screw (4) and take off lead with holder.



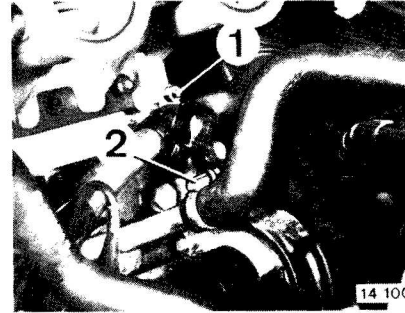
Pull off vacuum hose (1) and pull out of intake manifold brace.
Pull off plug (2).
Lift out rubber retainer (3).
Place idle speed control aside and take engine wire harness located behind out of holders.



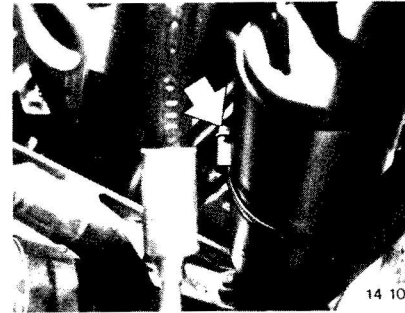
Pull off plug plate on fuel injectors and lay aside past the pressure regulator.



Loosen clamp (1) and pull off bleeder hose.
Unscrew fuel pipes (2 and 3) on injection pipe.
Disconnect heater hose (4) on cylinder head.
Installation:
Don't mix up pipes (2 and 3).

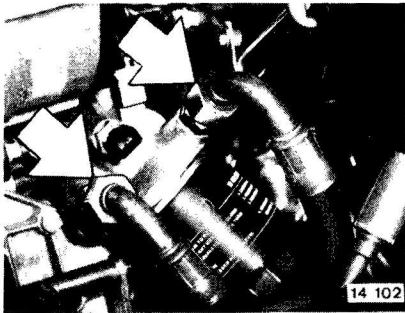


Loosen clamp (1) and place engine wire harness aside.
Loosen hose clamp (2) and pull off heater hose.

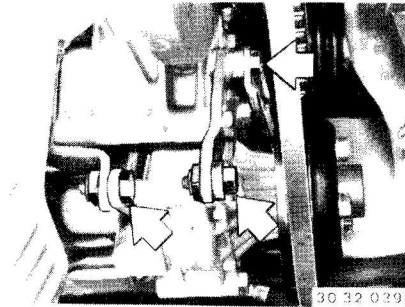


Loosen clamp and place carbon canister aside (hoses can remain connected).

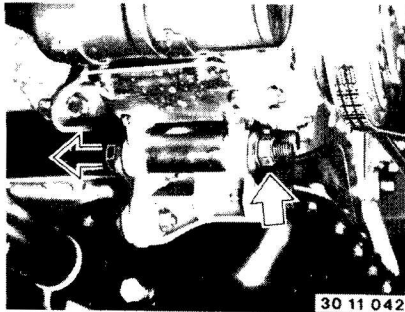
11-52b



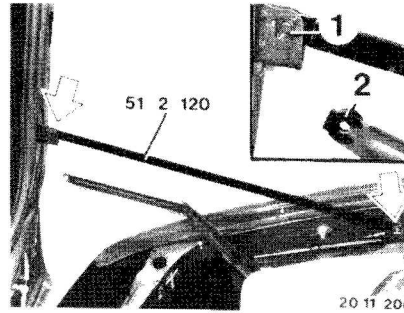
Unscrew both oil cooler pipes on oil filter housing.
Remove fan — see 11 52 000.
Remove radiator — see Group 17.
Disconnect ground lead on oil pan.
Installation:
Tightening torque for oil cooler pipe coupling nuts = 35 Nm (25 ft. lbs.).



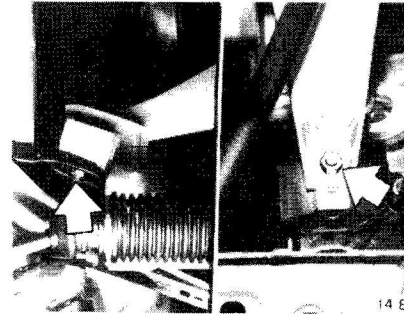
Unscrew power steering pump on holder (hydraulic lines remain connected) and suspend from wire aside.
Installation:
Check drive belt tightness with Special Tool 11 5 021.



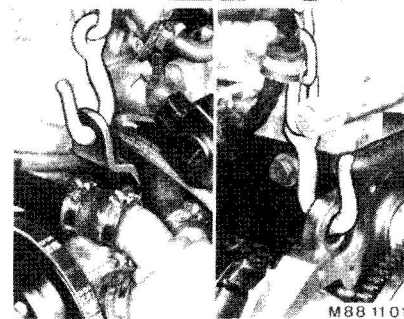
Unscrew A/C compressor on holder (refrigerant hoses remain connected) and suspend from wire aside.
Installation:
Check drive belt tightness with Special Tool 11 5 021.



Disconnect support arm and gas pressure prop and install Special Tool 51 2 120 to hold the engine hood.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



Unscrew engine mounts on front axle carrier.
Left — Unscrew at top.
Loosen at bottom.
Right — Loosen at top.
Unscrew at bottom
Installation:
Tightening torque: 45 Nm (32.5 ft. lbs.).



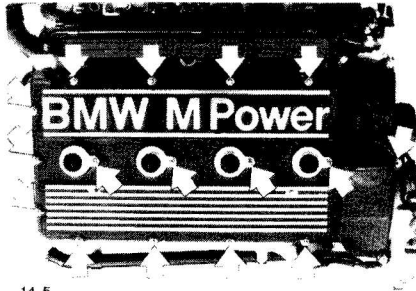
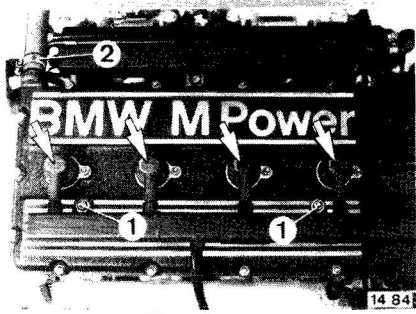
Connect Special Tool 11 0 000 on engine and lift out engine.

11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

Unscrew nuts (1).
Pull off spark plug connectors.
Take off ignition lead tube.
Loosen hose clamp (2) and pull off bleeder
hose.

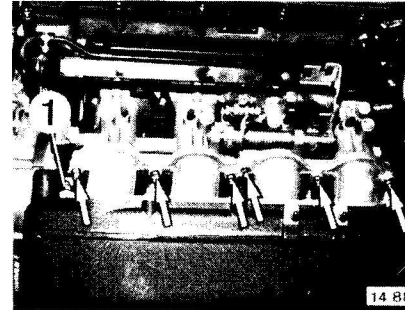
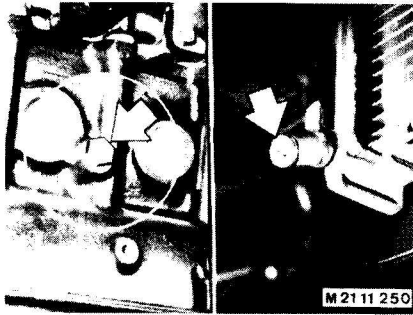
Unscrew nuts and take off cylinder head
cover.

Installation:
Check gaskets, replacing if necessary.

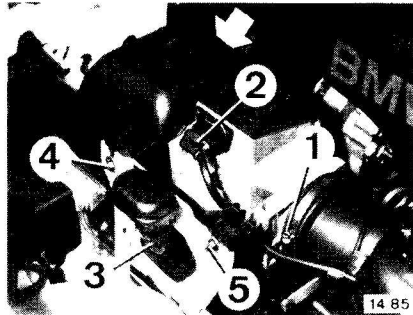


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

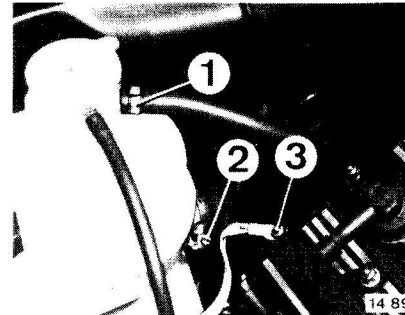
Disconnect battery ground lead.
Remove splash guard.
Drain coolant on engine and radiator.
Installation:
Fill and bleed cooling system — see Group 17.



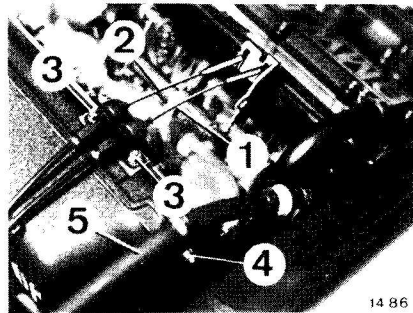
Loosen hose clamp (1) and pull off hose.
Unscrew nuts and take off intake manifold.
Installation:
Check O-rings, replacing if necessary.
Tightening torque: 9 Nm (6.5 ft. lbs.).



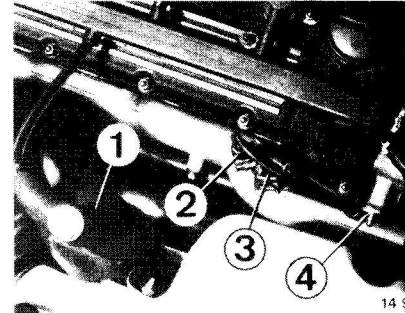
Loosen hose clamp (1) and hose clamp for intake hose (next to radiator) and pull off hoses.
Pull off plugs (2 and 3) and lay leads aside.
Loosen nuts (4 and 5) and remove air cleaner.



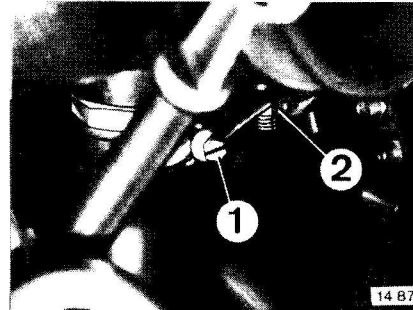
Loosen hose clamps (1 and 2) and pull off hoses on coolant expansion tank.
Unscrew nut (3) and take off ground strap.



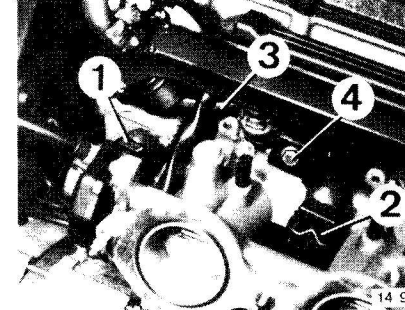
Disconnect accelerator cable (1) and cruise control cable (2).
Unscrew nuts (2) on holder and place cables with holder aside.
Unscrew nut (3), pull off clamp and lift vacuum hose (4) out of brake booster.



Pull off ignition lead (1) on ignition coil.
Pull off plugs (2 and 3).
Unscrew nut (4) and place lead on opposite end of engine.

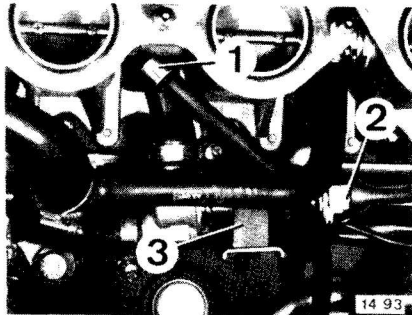


Loosen hose clamp (1) and pull hose off of intake manifold.
Unscrew nut (2) on intake manifold brace.

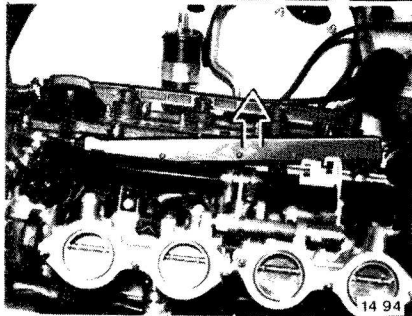


Pull off plugs (1 and 2).
Pull vacuum hose (3) off of pressure regulator.
Unscrew screw (4) and take off lead with holder.

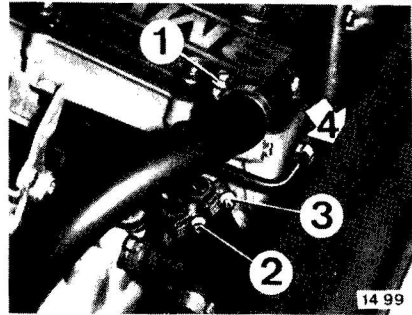
11-53b



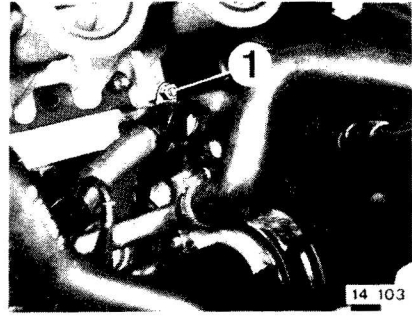
Pull off vacuum hose (1) and plug (2).
Lift out rubber retainer (3), place idle speed control aside and disconnect engine wire harness located behind on the holder.



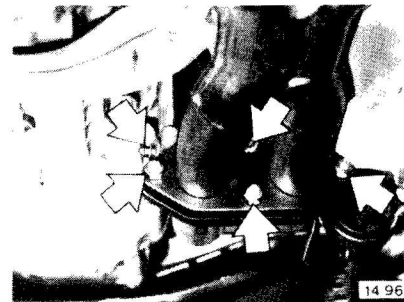
Pull off plug plate on fuel injectors and place aside past the pressure regulator.



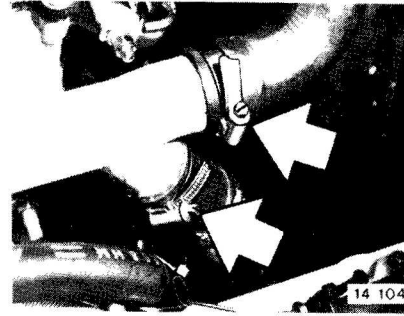
Loosen clamp (1) and pull off bleeder hose.
Unscrew fuel pipes (2 and 3) on injection tube.
Disconnect heater hose (4) on cylinder head.
Installation:
Don't mix up pipes (2 and 3).



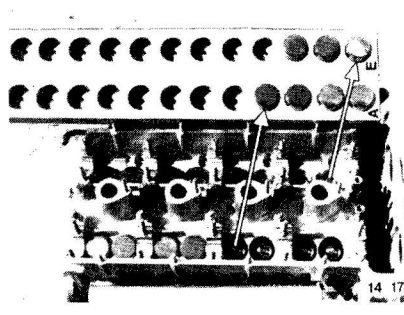
Loosen clamp (1) and pull off of cylinder head.



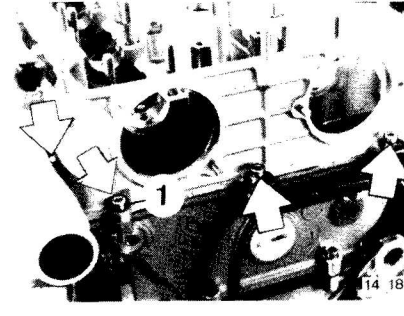
Unscrew flange bolts.
Disconnect plug for oxygen sensor.
Installation:
Replace gaskets.
Replace self-locking nuts.
Tightening torque: 50 Nm (36 ft. lbs.).



Loosen hose clamps and pull off radiator hoses.

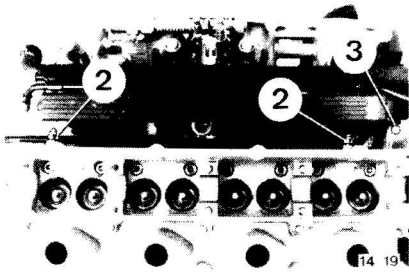


Remove camshaft — see 11 31 000.
Pull out tappets and place in Special Tool 11 3 030 (tray).
Installation:
Install tappets in same position.

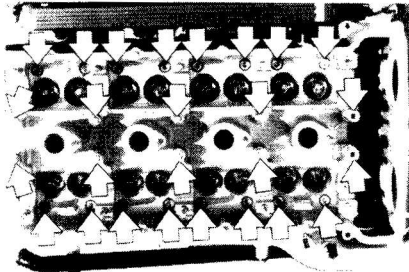


Unscrew bolts.
Installation:
Longer bolt (1) is used to lock the shaft for the upper tensioning rail.

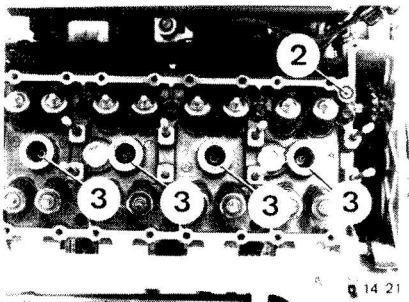
11-53c



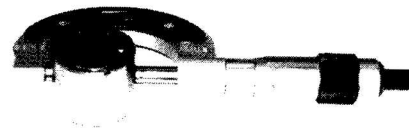
Remove pipe (2).
Unscrew bolt (3).



Remove timing case.



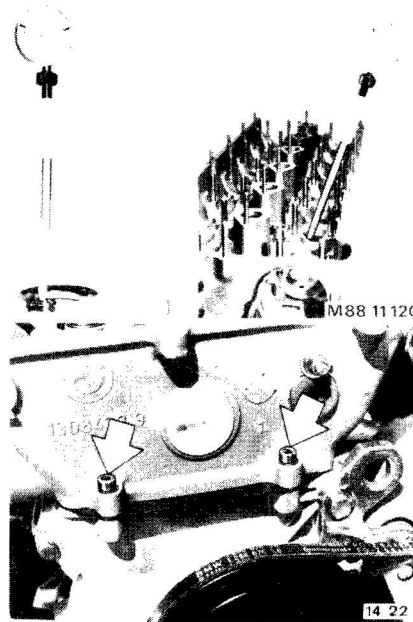
Installation:
Replace O-ring (2) in oil bore.
Check O-rings (3), replacing if necessary.
Coat sealing surfaces with Three Bond 12 07**.
Tighten bolts uniformly.
Tightening torque:
M 7 = 15 + 2 Nm (11 + 1 ft. lbs.)
M 8 = 21 + 1 Nm (15 + 0.5 ft. lbs.)



M 88 11 119

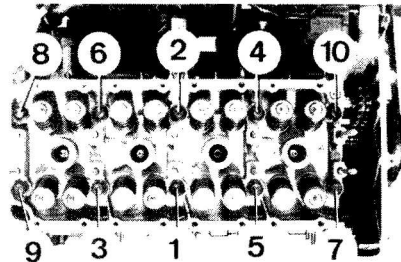
Measure tappet clearance:
Measure tappet diameter with a micrometer.

** Source of Supply: HWB



Set internal calipers to zero on the micrometer with the measured tappet diameter.
Measure tappet bore diameter.
Compare measured tappet clearance with the specified clearance.
Tappet clearance/installed clearance:
0.0025 to 0.066 mm (0.0001 to 0.0026").

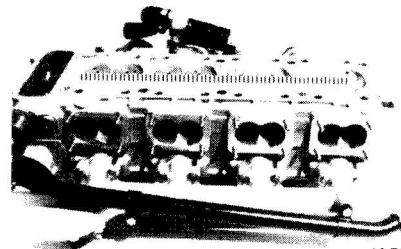
Unscrew bolts.



14 23

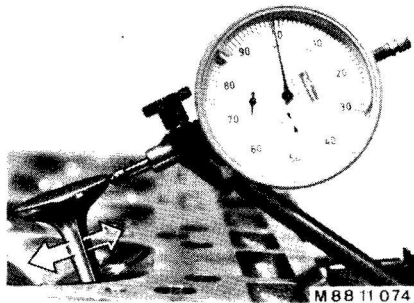
Unscrew cylinder head bolts in order of 10 to 1 and lift off the cylinder head.

Installation:
Clean holes in crankcase and cylinder head bolts — lubricate cylinder head bolts with oil.
Clean sealing surfaces on cylinder head and crankcase thoroughly — using a gasket remover** and hard wood scraper.
Check levelness with a standard steel ruler.
Replace cylinder head gasket.
Check arrangement of tensioning rails while mounting the cylinder head.
Tighten bolts in order of 1 to 10 in three steps.
Step 1: 50 + 2 Nm (36 + 1 ft. lbs.)
Step 2: 80 + 2 Nm (58 + 1 ft. lbs.)
Wait 15 minutes!
Step 3: 100 + 2 Nm (72 + 1 ft. lbs.)



14 72

** Source of Supply: HWB



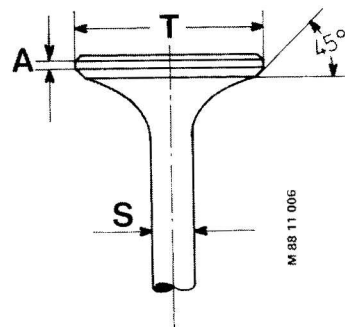
M 88 11 074

11 12 595 CHECKING VALVE GUIDE FOR WEAR

— Valve Removed —

To measure, insert a new valve that end of valve stem is flush with valve guide. Mount the dial gage and measure tilt play. Max. permissible tilt play:

Intake valve 0.65 mm (0.025")
 Exhaust valve 0.80 mm (0.031")



M 88 11 006

11 12 607 MACHINING VALVE SEATS AND VALVES

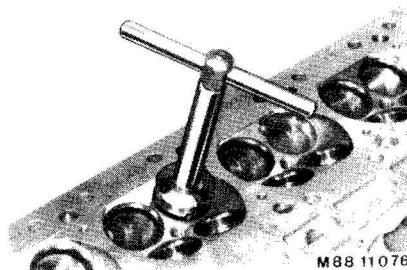
— Valves Removed —

Valve must be replaced, if minimum edge thickness "A" is not held.

"A" Intake valve 0.50 mm (0.020")
 "A" Exhaust valve 0.95 mm (0.037")
 "T" Intake valve 37 ± 0.1 mm
 (1.457 ± 0.004")
 "T" Exhaust valve 32 ± 0.1 mm
 (1.260 ± 0.004")

After machining the valve seat angle (45°), produce valve seat diameter V and valve seat width B by machining correction angles (35°/60°). Grind in valves with grinding paste and check for leaks — see 11 34 509.

"V" Intake valve 36.6 + 0.1 mm
 (1.441 + 0.004")
 "V" Exhaust valve 31.4 + 0.1 mm
 (1.236 + 0.004")
 "B" Intake valve 1.2 + 0.1 mm
 (0.047 + 0.004")
 "B" Exhaust valve 1.4 + 0.1 mm
 (0.055 + 0.004")



M 88 11 076

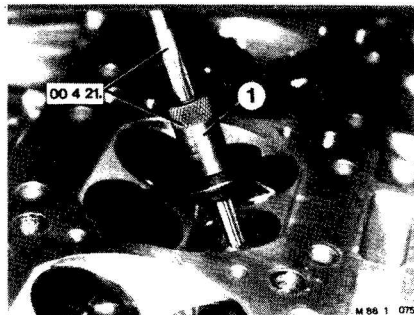
11 12 600 REAMING OUT VALVE GUIDE

— Valve Removed —

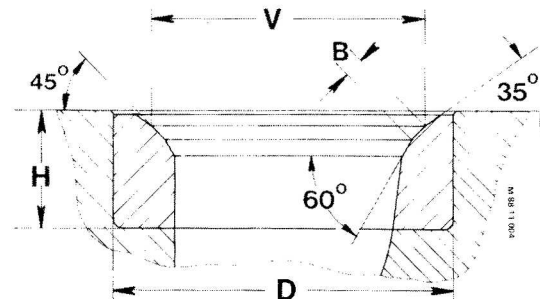
If there is excessive play between the valve guide and valve stem, see 11 12 595, ream out the valve guide and install an oversize valve with stem diameter "S" = 7.1 or 7.2 mm (0.279 or 0.283").

The valve seat must then also be machined — see 11 12 607.

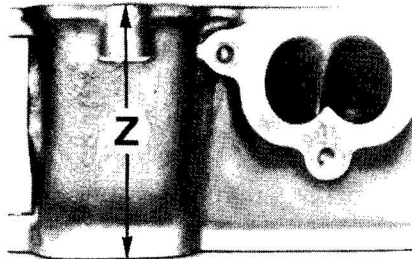
Press guide (1) against the valve seat and ream out the valve guide from the combustion chamber end — turn down the reamer once.



M 88 1 075



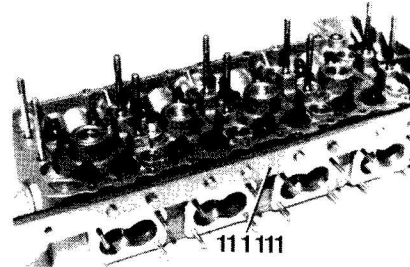
M 88 11 006



M88 11 077

11 12 719 GRINDING CYLINDER HEAD SEALING SURFACE
 — Cyl. Head Disassembled —

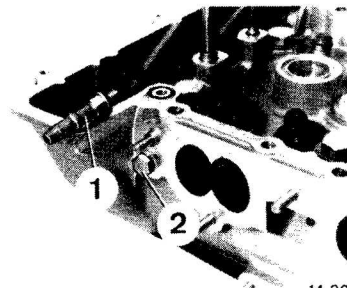
Approval has not yet been given for grinding cylinder heads.
 The cylinder head may be cleaned by wheting on a surface plate.



11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST
 — Cyl. Head Disassembled —

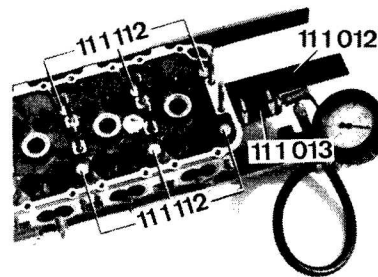
Bolt on Special Tool 11 1 111.

14 29



Unscrew connector (1).
 Plug opening with bolt (2) -- copper bolt from M 30 exhaust manifold.

14 30



Bolt on Special Tools 11 1 012 with Special Tools 11 1 112.
 Install Special Tool 11 1 113.
 Apply air pressure to cylinder head— 2 bar (28 psi) testing pressure — place cylinder head in a water bath and check for cracks.

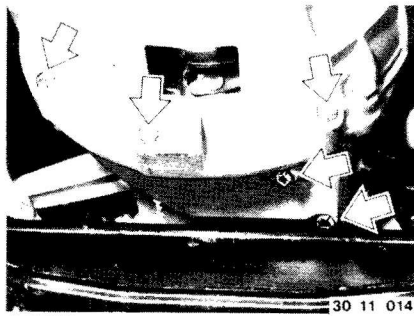
Note:
 If necessary, relax the water bath with a detergent.

14 31

11-55a

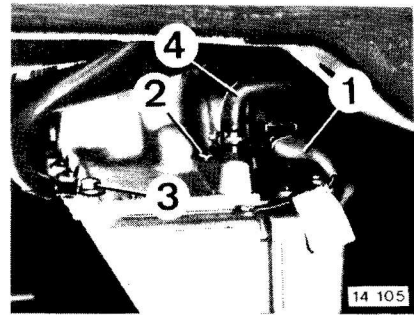
11 13 010 REMOVING AND INSTALLING OIL PAN UPPER SECTION

Pull out oil dipstick.
Remove oil pan lower section — see 11 13 020.
Remove oil pump — see 11 41 000.
Remove reinforcement plate.



30 11 014

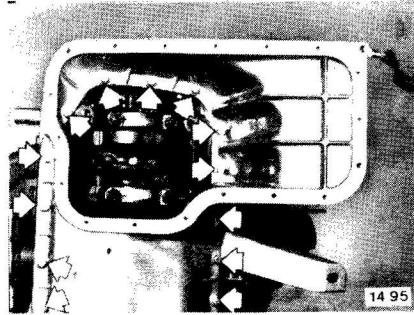
Disconnect plug (1).
Unscrew holder (2) and ground lead (3).
Loosen clamp and pull off bleeding hose (4).



14 105

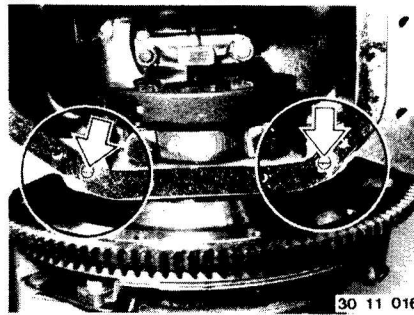
Unscrew oil pan bolts and remove oil pan upper section.

Installation:
Tightening torque: 10 Nm (7 ft. lbs.).



14 95

Installation:
Clean sealing surface.
Replace oil pan gasket.
Coat joint on timing case cover and end cover with a brush-on universal sealing compound**.

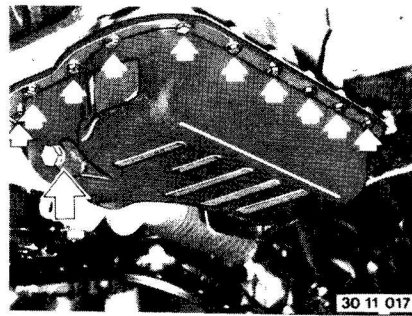


30 11 016

** Source of Supply: HWB

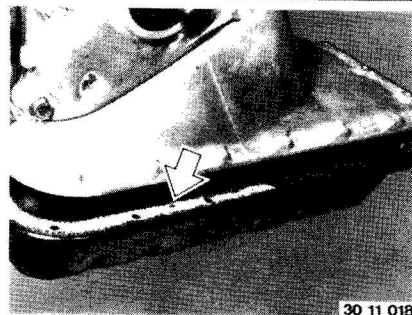
11 13 020 REMOVING AND INSTALLING OIL PAN LOWER SECTION

Remove splash guard.
Drain engine oil.
Unscrew oil pan bolts.
Installation:
Pour in engine oil***.
Tightening torque:
Oil drain plug = 33 Nm (24 ft. lbs.)
Oil pan bolts = 10 Nm (7 ft. lbs.)



30 11 017

Take off oil pan.
Installation:
Replace gasket.

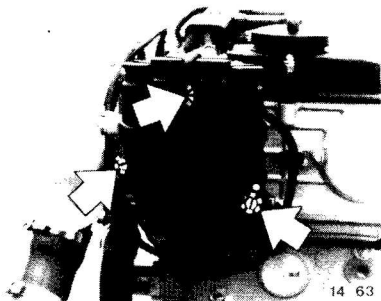


30 11 018

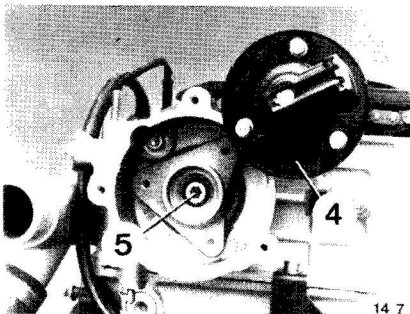
*** See Service Information of Gr. 00

11 14 105 REPLACING RADIAL OIL SEAL IN DISTRIBUTOR HOUSING

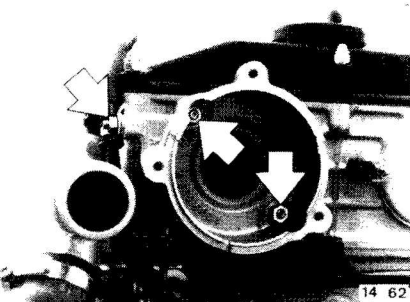
Unscrew ignition lead tube.
Remove distributor cap.



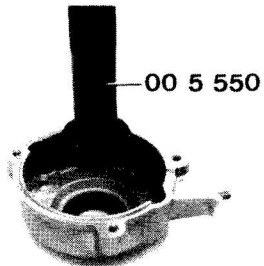
Unscrew distributor rotor (4).
Unscrew adapter (5).



Unscrew distributor housing.
Installation:
Check O-ring, replacing if necessary.



Lift out radial oil seal.
Drive in new radial oil seal with Special Tool
00 5 550.
Lubricate sealing lip with oil.

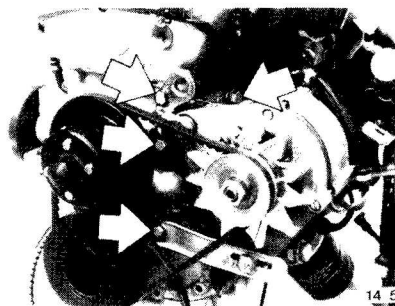


11 14 120 REMOVING AND INSTALLING/ SEALING LOWER TIMING CASE COVER

Disconnect battery ground lead.
Remove air cleaner with air flow sensor.

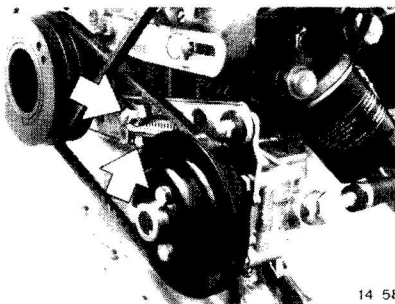
Unscrew alternator.

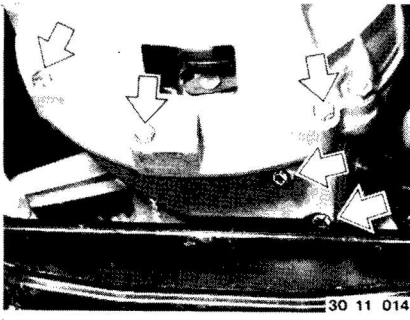
Installation:
Tighten drive belt and check tightness with
Special Tool 11 5 020.



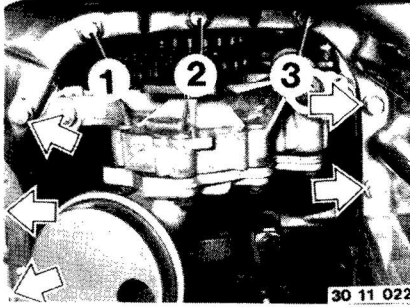
Unscrew power steering pump.
Hoses remain connected.

Installation:
Tighten drive belt and check tightness with
Special Tool 11 5 020.

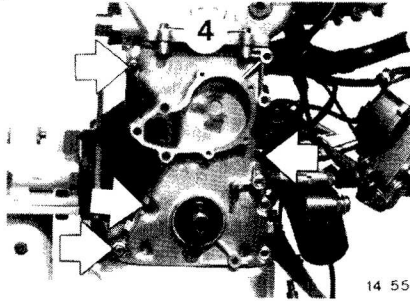




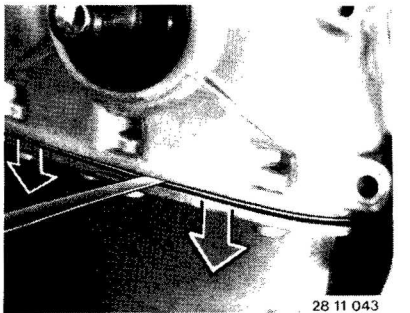
Unscrew reinforcement plate.
Remove lower oil pan section — see 11 13 020.



Unscrew and remove bolts (1 ... 3).
Loosen remaining oil pan bolts.
Installation:
Install bolts (1 ... 3) with Loctite No. 270**.



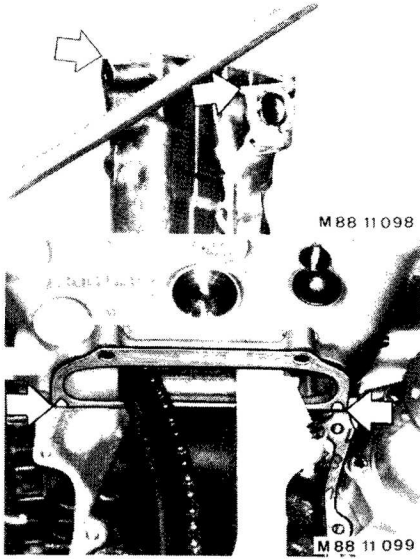
Remove water pump — see 11 51 000.
Remove pulley on crankshaft — see 11 21 120.
Remove piston for chain tensioner — see 11 31 090.
Unscrew bolts (4).
Unscrew remaining bolts on timing case cover.



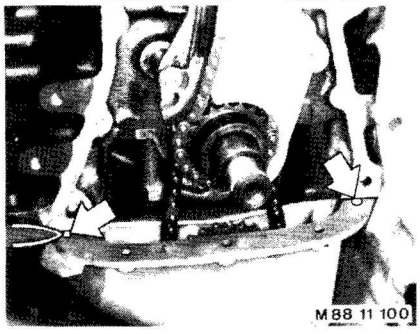
Loosen oil pan gasket on timing case cover carefully with a knife.
If oil pan gasket is damaged, remove oil pan and replace gasket — see 11 13 000.



Take off timing case cover.
Installation:
Break upper edges with a file.
Coat sealing surfaces with Three Bond Silicone 1207**.

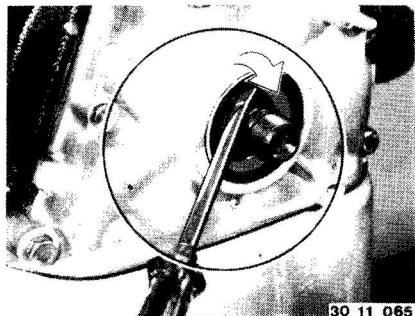


Installation:
Install new gaskets, coat with Three Bond Silicone 1207** and cut off ends.
Coat mating surfaces with Three Bond Silicone 1207**.
Guide in cover uniformly.



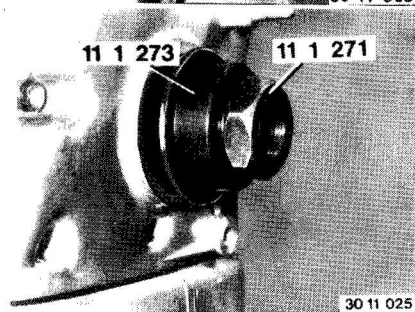
** Source: HWB

** Source: HWB



11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

Remove pulley on crankshaft — see 11 21 120.
Lift out radial oil seal with a screwdriver.

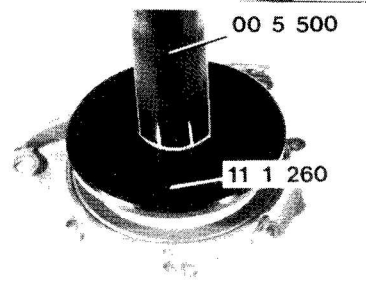


Lubricate sealing lip of radial oil seal with oil.
Press in radial oil seal flush with Special Tools
11 1 273 and 11 1 271.



11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER — Transmission Removed

Remove flywheel — see 11 22 000.
Drain engine oil.
Loosen oil pan.
Loosen gasket in area of end cover/oil pan joint
carefully with a knife.
Remove end cover.
Press radial oil seal out of end cover.

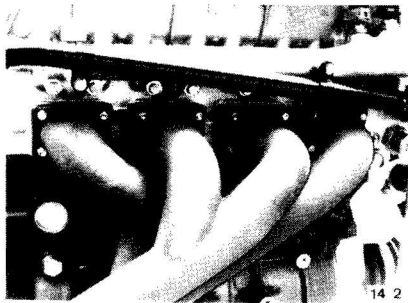


Installation:

Replace gasket.
Remove oil pan — see 11 13 000 — if oil pan
gasket was damaged.
Coat end cover/oil pan joint with Three Bond
Silicone 1207**.
Use Special Tool 11 2 213 to avoid damaging
the radial oil seal.
Add engine oil***.
Use Special Tools 11 1 260 and 00 5 500 to
press in the radial oil seal.
Press in new radial oil seal with approx. 1 to 2
mm (0.039 to 0.079") offset toward the inside
in contradiction to the standard seal, which was
installed flush.
Lubricate sealing lip with oil.

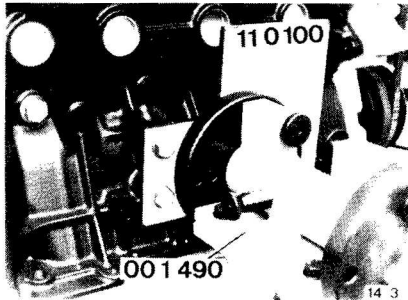
** Source: HWB

*** See Service Information of Gr. 00

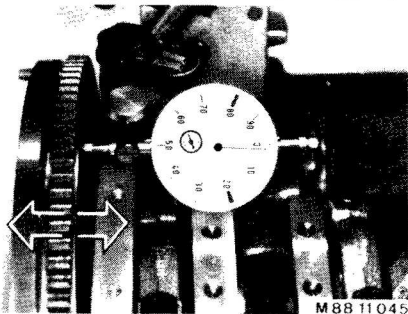


11 21 000 REMOVING AND INSTALLING CRANKSHAFT

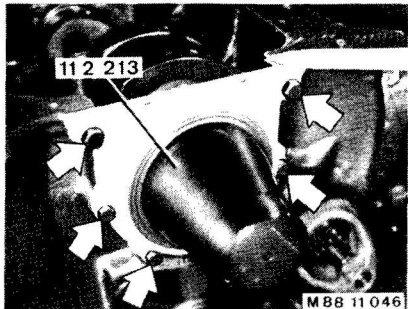
Remove engine — see 11 00 050.
 Remove exhaust manifold.
Installation:
 Replace gaskets.
 Tightening torque: 9 to 10 Nm (6.5 to 7.0 ft. lbs.).



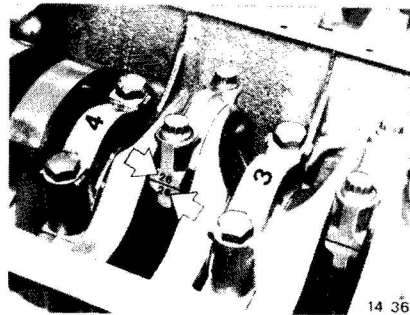
Unscrew engine mounts.
 Mount crankcase on Special Tool 00 1 490 with help of Special Tool 11 0 100.



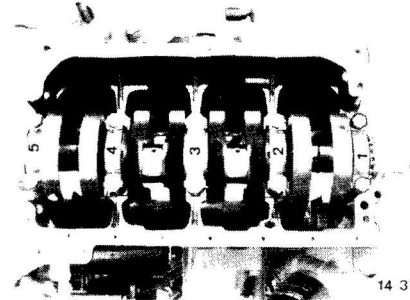
Remove clutch — see 21 21 000.
 Remove cylinder head — see 11 12 100.
 Remove timing chain — see 11 31 051.
 Remove oil pump — see 11 41 000.
 Measure axial play before removing the crankshaft.
 Nominal value: 0.085 to 0.174 mm (0.0033 to 0.0068").
 Check/replace thrust bearing, if maximum permissible play is exceeded.



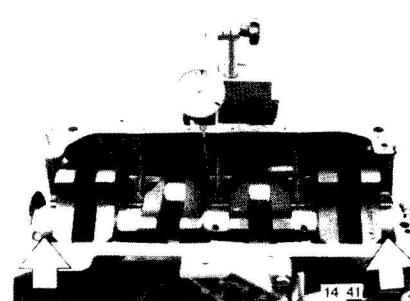
Remove flywheel — see 11 22 000.
 Unscrew end cover.
Installation:
 Replace gasket.
 Use Special Tool 11 2 213 to avoid damaging the radial oil seal.
 Cut off gasket along oil pan sealing surface.



Unscrew conrod bearing caps.
Installation:
 Replace conrod bearing shells and measure conrod bearing play — see 11 24 571.
 Pair code (0 ... 99) must be the same on connecting rods and conrod bearing caps.



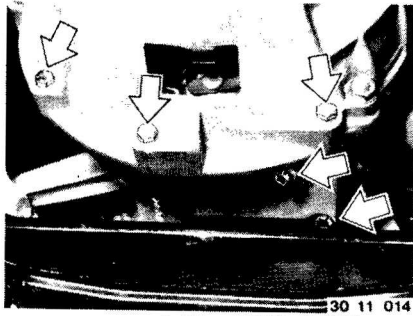
Unscrew crankshaft bearing caps and lift out the crankshaft.
Installation:
 Bearing cap no. 1 is on the sprocket end.
 Install bearing shells and check the bearing play — see 11 21 531.
Installation:
 Measure axial play with installed crankshaft — loosen thrust bearing no. 3 again.
 Center the thrust bearing by applying knocks on the front and rear ends of the crankshaft with a plastic hammer.
 Tighten thrust bearing as specified.
 Measure axial play.
 Nominal value: 0.085 to 0.174 mm (0.0033 to 0.0068").
 If the crankcase is replaced, clean oil and water bores again thoroughly to remove casting sand.



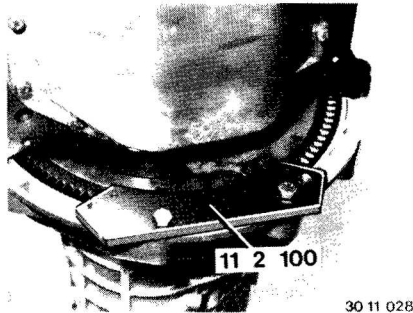
Checking Runout:
 Install bearing shells 1 and 5.
 Apply dial gage on center bearing and measure the runout while turning the crankshaft.
 Nominal value: max. 0.1 mm (0.004").

11 21 120 REMOVING AND INSTALLING PULLEY ON CRANKSHAFT

Unscrew reinforcement plate.



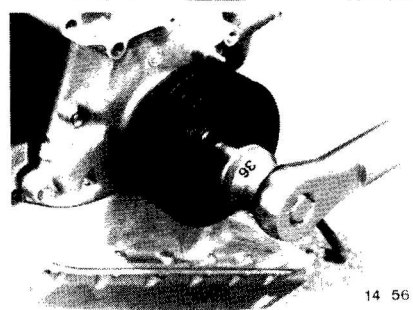
Hold flywheel with Special Tool 11 2 100.



Unscrew nut on pulley
Pull off pulley.

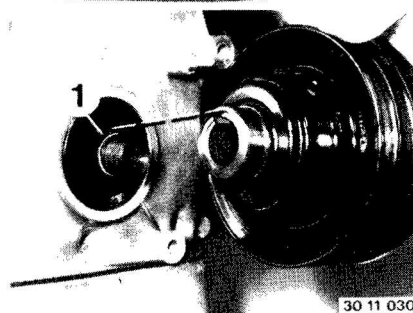
Installation:

Tightening torque*.



Installation:

Check for correct installed position of
woodruff key (1).

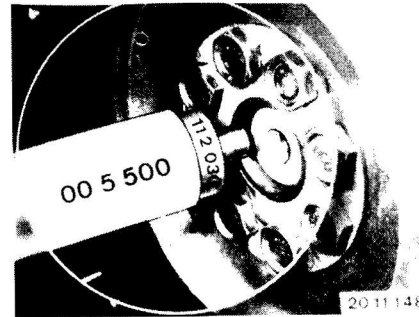


* See Specifications

11 21 501 REPLACING CRANKSHAFT - Crankshaft Removed -

Note:

A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.



20 11 148

Crankshaft is surface treated and may only be reground in the factory.

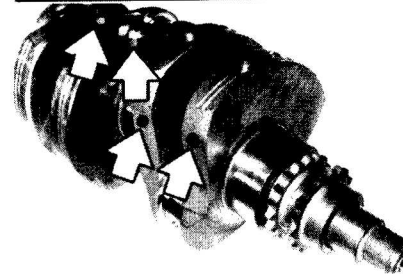
Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

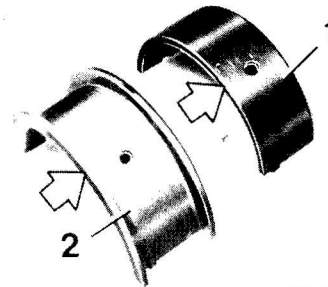
Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

Installation:
Heat sprocket to max. 200° C (390° F) for installation.



28 11 167



28 11 053

Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

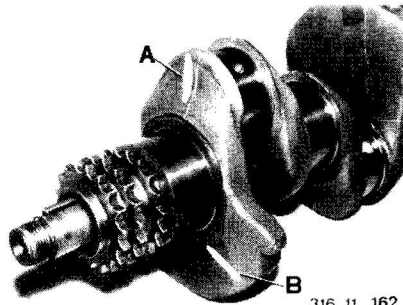
Replacement crankshafts are only supplied with bearing shells of double classification. A crankshaft is marked with red or blue paint because of the main bearing journal tolerances.

1 = Bearing shell 1-2-4-5
2 = Bearing shell 3 (pilot bearing)

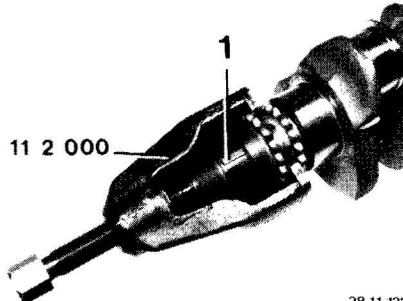
The color code is located on the side of a bearing shell.

Check the ground size of main bearing journals.

Installing Instructions:
Only place bearing shells with "red" marks in the crankcase (regardless of the old color code mark on the crankcase).
Install bearing shells in bearing caps depending on the color code of the crankshaft main bearing journals - "red" or "blue".



316 11 162



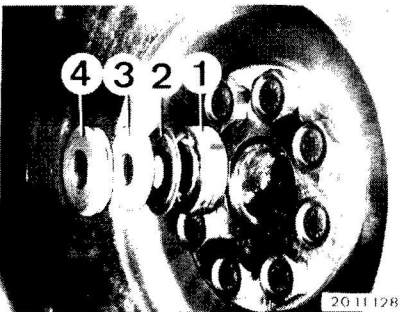
28 11 132

Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

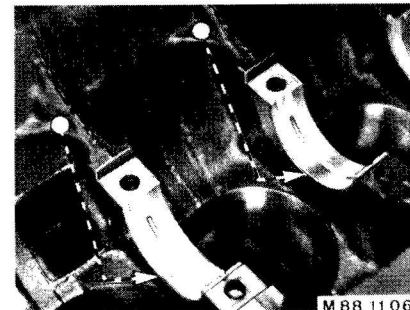
Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

* See Specifications

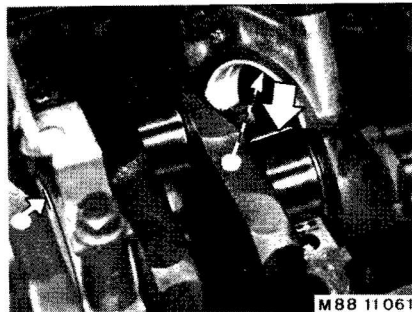


20 11 128



M 88 11 060

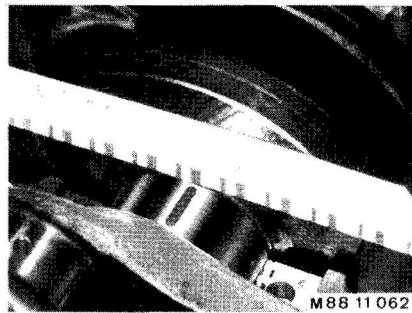
11-61a



M88 11 061

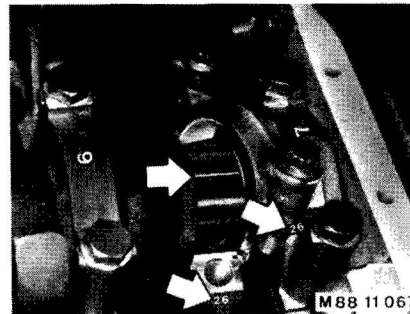
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



M88 11 062

Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



M88 11 067

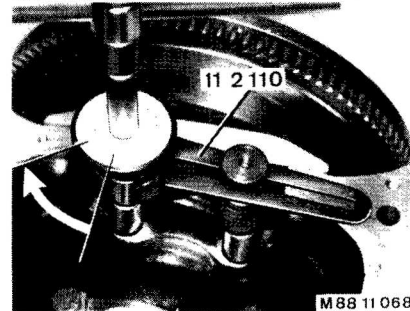
Place Type PG-1 Plastigage on conrod bearing journals wiped clean of oil in BDC position.
Mount conrod caps – pair codes and grooves of bearing shells are on the outside.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

Tighten bolts (use old conrod bolts).
Do not turn the crankshaft.
Remove conrod bearing caps.

Tightening Torque of Conrod Bolts:
Step 1 10 Nm (7 ft. lbs.)
Step 2 30 Nm (22 ft. lbs.)
Step 3 60' + 2' torque angle
Conrod bearing play: 0.024 to 0.064 mm (0.0009 to 0.0025").

Installation:
Use new conrod bolts for final installation.

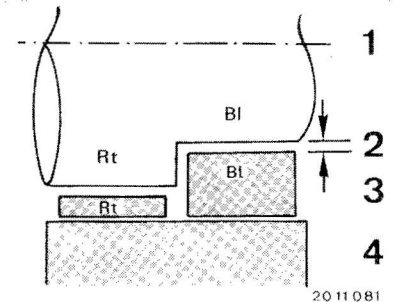


M88 11 068

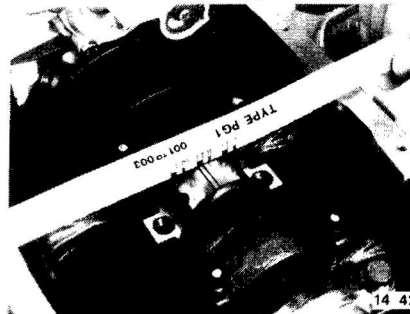
**Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness***

Double Classification Color Codes:
Rt = red
Bl = blue

- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter



2011 081

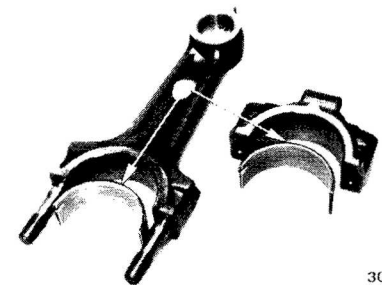


14 42

Check conrod bearing play by measuring width of the flattened Plastigage with help of the supplied scale.

Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod for a pertinent crankshaft ground size.

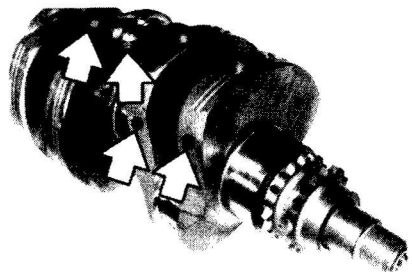
Only install the red bearing shells of a pertinent ground size supplied with a replacement crankshaft.



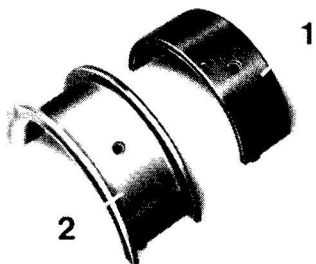
11-61b

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS - Engine Disassembled -

A crankshaft is marked with red or blue paint depending on main bearing journal tolerances.



28 11 167



1

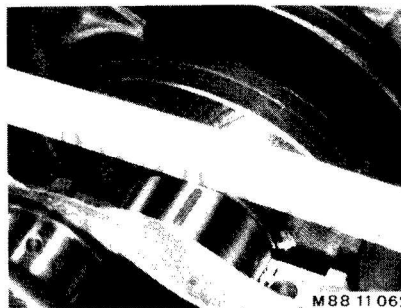
2

28 11 053

- 1 = Bearing shell 1-2-4-5
- 2 = Bearing shell 3 (pilot bearing)

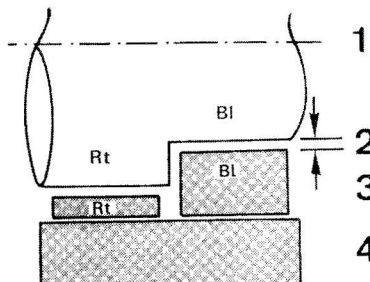
Color code mark is located on the side of a bearing shell.

Check the ground size of main bearing journals.



M 88 11 062

Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.

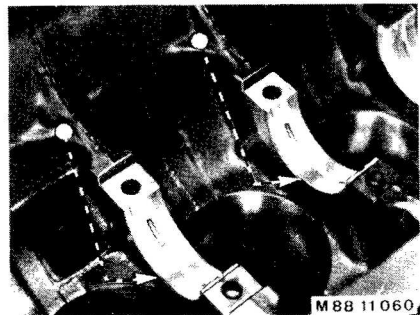


20 11 081

Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter

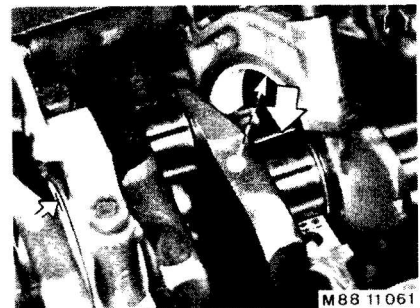


M 88 11 060

Install bearing shells in crankcase with same color code as the dot of paint on the console.

Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.

Install bearing shells in bearing caps with the same color code as for the crankshaft.



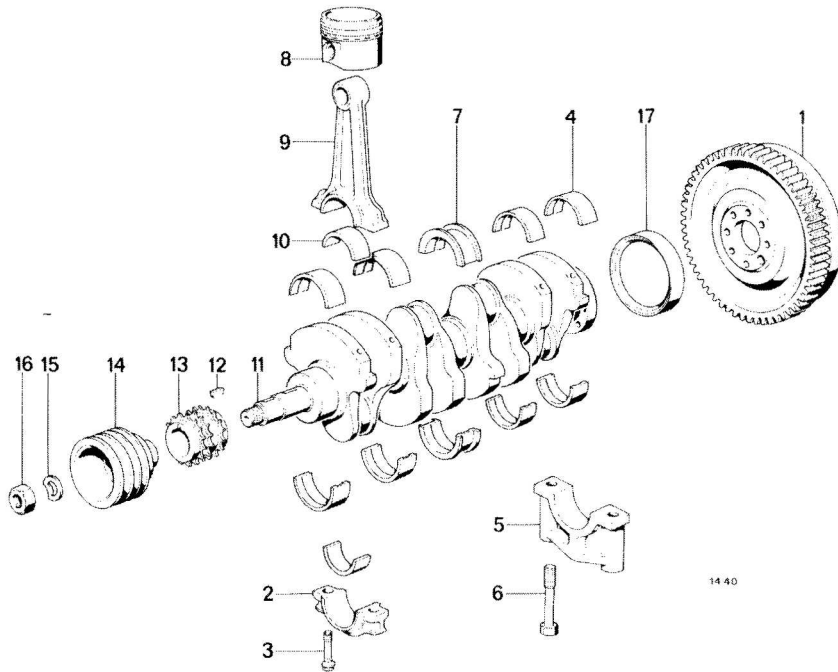
M 88 11 061

Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

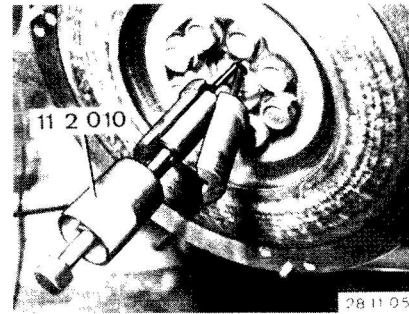
* See Specifications

* See Specifications



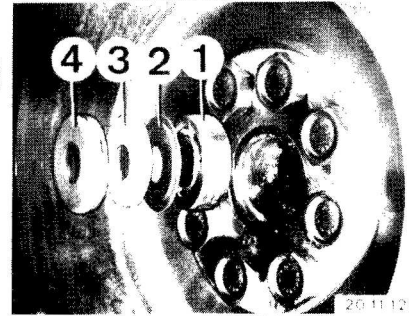
Crankshaft Survey

- | | |
|-------------------------|-------------------------|
| 1 Flywheel | 9 Connecting rod |
| 2 Conrod cap | 10 Conrod bearing shell |
| 3 Conrod bolt | 11 Crankshaft |
| 4 Main bearing shell | 12 Woodruff key |
| 5 Main bearing cap | 13 Sprocket set |
| 6 Main bearing cap bolt | 14 Vibration damper |
| 7 Thrust bearing | 15 Washer |
| 8 Piston | 16 Nut |
| | 17 Radial oil seal |

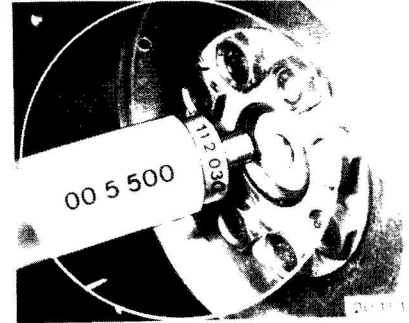


11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

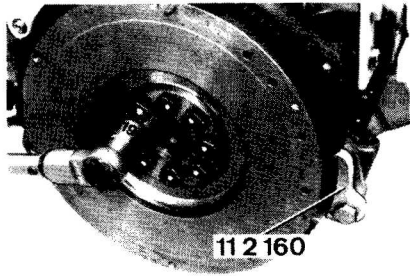
Remove clutch – see 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.



Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).
Install cover (2) with the embossment facing out.



Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease.
Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



11 22 000 REMOVING AND INSTALLING FLYWHEEL

Remove clutch — see 21 21 000.
 Hold flywheel with Special Tool 11 2 160.
 Unscrew bolts and take off the flywheel.

Installation:

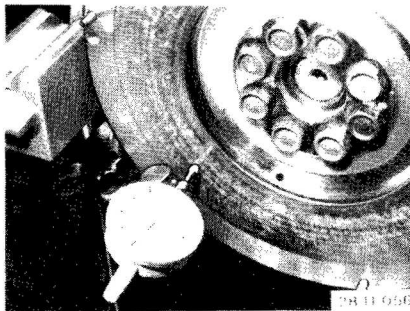
Clean tapped bores.

Install new expansion bolts with Loctite No. 270**.

Tightening torque: 105 ± 4 Nm (76 ± 3 ft. lbs.).

11 2 160

14 32



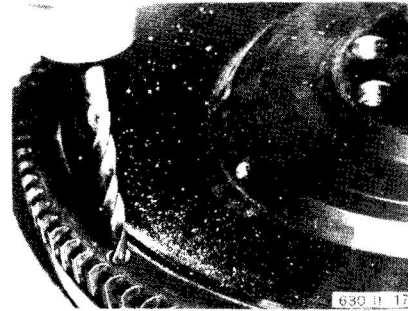
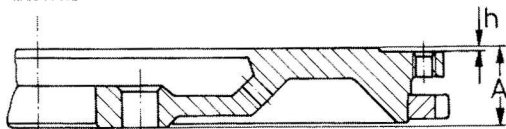
Check axial runout of flywheel.
 Nominal value: max. 0.1 mm (0.004").

14 32

Friction surface may be machined to the minimum distance $A = 29.1 - 0.1$ mm ($1.146 - 0.004$ ").

If machining the friction surface reduces distance "h" to zero, the flange surface has to be machined.

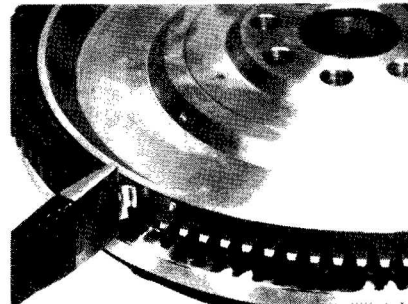
M 88 11 072



11 22 541 REPLACING STARTER GEAR RING

Drill a 6 mm (0.236") diameter hole approx. 8 mm (0.315") deep below a tooth gap to make breaking the gear ring easier.

630 11 173



Break gear ring at drilled point with a chisel.

630 11 173



Installation:

Heat new starter gear ring to 200 ... 230° C (395 to 445° F).

Measure temperature with a thermo-color pencil.

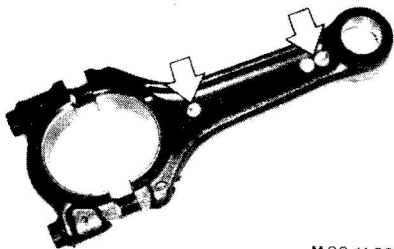
Tooth bevel faces the engine.

Knock on starter gear ring to fit firmly all around with a brass mandrel.

630 11 172

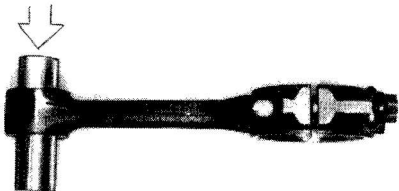
11 24 521 REPLACING CONNECTING RODS

— Pistons Removed —



M88 11 064

Only install connecting rods of same weight class in one engine. Weight class is shown on the connecting rod by a certain number and color of paint dots. Connecting rods may not be machined.

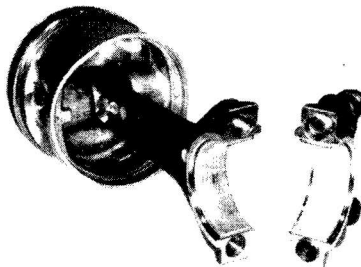


M88 11 065

Piston pin must slide through the conrod bushing under light pressure. Install conrod bearing shells — see 11 24 571.

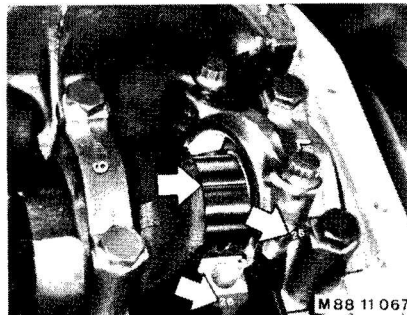
11 24 571 REPLACING CONROD BEARING SHELLS

— Engine Disassembled —



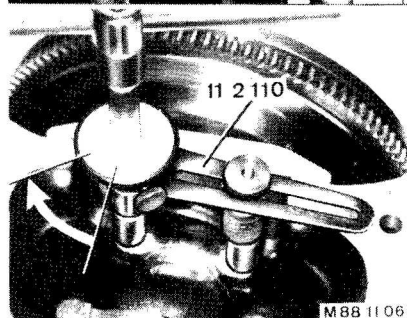
M88 11 066

Install one each yellow bearing shell in connecting rod and conrod cap or one blue bearing shell in connecting rod and one red bearing shell in conrod bearing cap. Check the machined size (conrod bearing dia.).



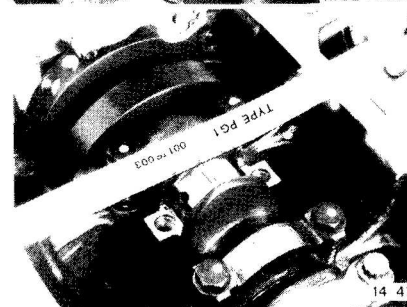
M88 11 067

Place Type PG-1 Plastigage on conrod bearing journal wiped clean of oil in BDC position. Mount conrod bearing cap — code and grooves of bearing shells on exhaust side. Source of Plastigage: CARTOOL Alfred-Brehm-Str. 5 D-8070 Ingolstadt



M88 11 068

Tighten bolts — use old conrod bolts. Don't turn the crankshaft. Remove conrod bearing cap. Measure width of flattened Plastigage to check the conrod bearing play, with help of the supplied scale.



14 42

Correct bearing play by installing new bearing shells or bearing shells with different machined size or different color code. Replace conrod bolts for final installation. Conrod bolt tightening torque:
 Step 1 10 Nm (7 ft. lbs.)
 Step 2 30 Nm (22 ft. lbs.)
 Step 3 60 + 2° torque angle
 Conrod bearing play: 0.024 to 0.064 mm (0.0009 to 0.0025").

11 25 000 REMOVING AND INSTALLING PISTONS

— Engine Removed —

Remove cylinder head — see 11 12 100.
Remove oil pump — see 11 41 000.
Remove conrod bearing cap and press out piston with connecting rod upwards.

Remove circlip (1).
Press out piston pin.

Installation:

Piston pin is matched with piston and must not be mixed up.

Installation:

Pairing code and grooves of bearing shells are on the exhaust side.
Install circlip (1) with gap facing down.

Only install pistons of same make and same weight class.

Weight class is specified on piston crown with "+" or "-".

Identification:

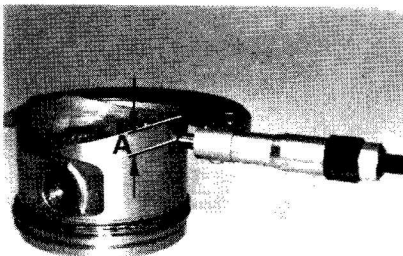
Engine	E	Diameter
S 14	10.5	93.4 mm (3.677")

Check the machined size (piston diameter)*.

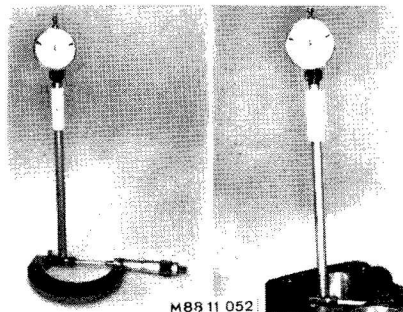
* See Specifications

Measuring Piston Installed Clearance:
Measure piston diameter* at checkpoint "A" with a micrometer.

Engine	Make	Checkpoint "A"
S 14	Mahle	6 mm (0.236")



M88 11 051



M88 11 052

Set internal calipers to zero on the micrometer with the measured piston diameter.

Measure cylinder bore diameter at bottom, center and top with the internal calipers in forward and turning directions.

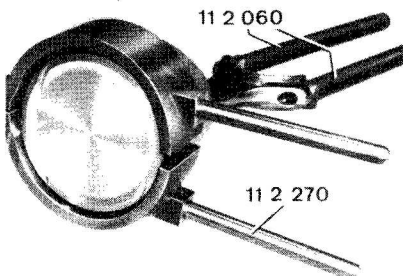
Compare measured piston installed clearance with specified piston installed clearance/max. total wear play.

Installed clearance: 0.03 to 0.06 mm (0.0012 to 0.0024").

Max. permissible total wear play: 0.15 mm (0.006").

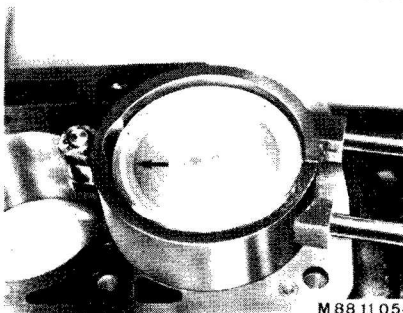
Bolt Special Tool 11 2 060 on connecting rod. Lubricate piston and piston rings with oil. Offset piston ring end gaps by 120° to each other.

Compress piston rings with Special Tool 11 2 270 ...



M88 11 053

... install piston that arrow faces timing chain. Turn pertinent conrod bearing journal to BDC for installation of piston.

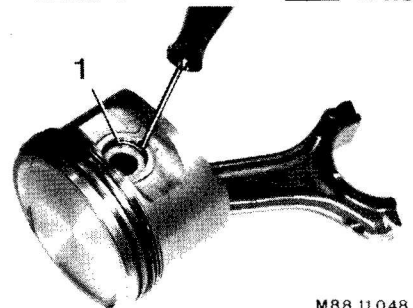


M88 11 054

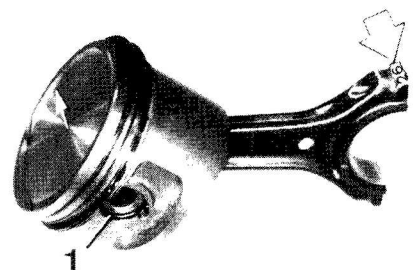
* See Specifications



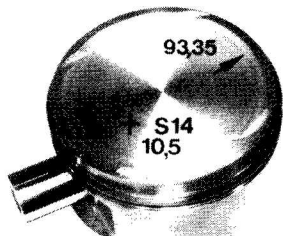
14 363



M88 11 048



M88 11 049



14 67

11 25 651 REPLACING PISTON RINGS OF ONE PISTON — Piston Removed —

Remove piston rings with a piston ring
pliers.

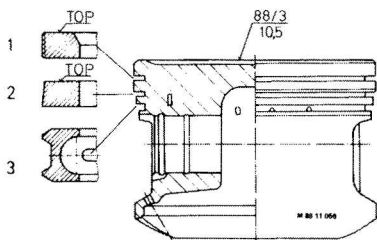


M 88 11 055

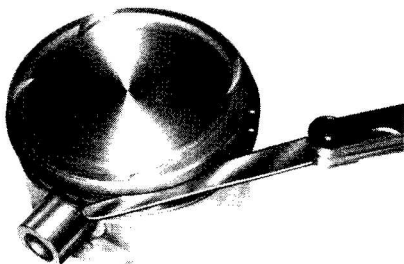
Installation:

Install piston rings with "TOP" facing the
piston crown.

- 1 Plain compression ring
- 2 Bevelled face compression ring
- 3 Oil scraper ring with rubber lined spring



Measure side clearance*.



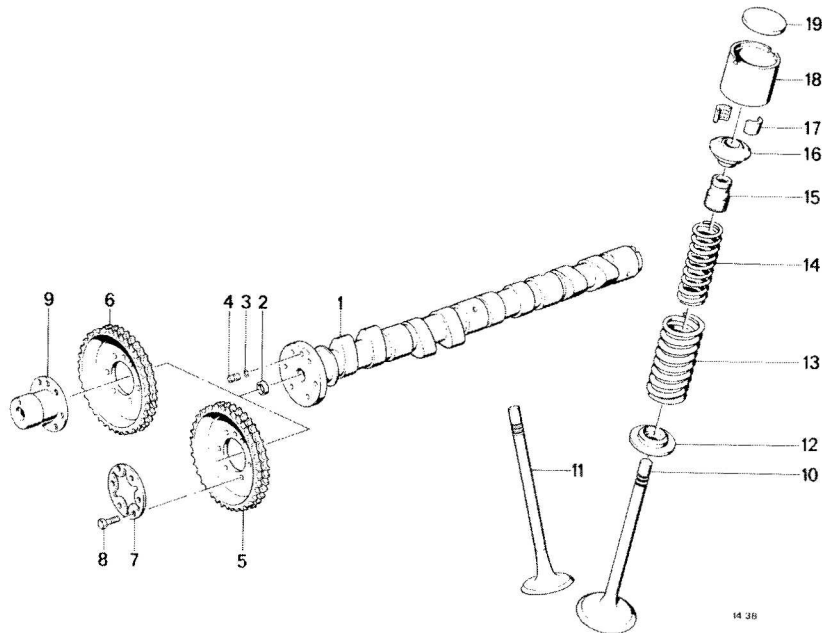
M 88 11 057

Measure end clearance*.



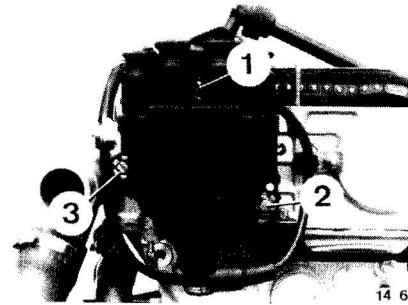
M 88 11 058

* See Specifications



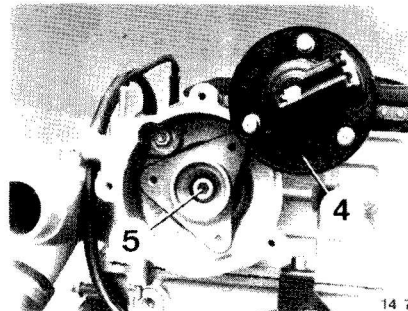
Valve Timing

- 1 Camshaft 248°
- 2 Plug for oil bore in camshaft
- 3 Lockwasher
- 4 Dowel pin
- 5 Sprocket - intake "E"
- 6 Sprocket - exhaust "A"
- 7 Lockplate
- 8 Hexagon head screw M 6 x 16
- 9 Adapter for distributor rotor
- 10 Intake valve - 37 mm (1.457") dia.
Oversize valves with larger stem diameters are available
- 11 Exhaust valve - 32 mm (1.260") dia.
Oversize valves with larger stem diameters are available
- 12 Spring retainer, lower
- 13 Valve spring, outside - 41 mm (1.614") long
- 14 Valve spring, inside - 38.5 mm (1.516") long
- 15 Valve stem seal
- 16 Valve spring retainer, upper
- 17 Valve collet
- 18 Tappet
- 19 Shims from 3.00 to 4.25 mm (0.118 to 0.167")



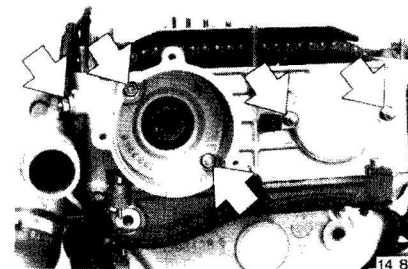
11 31 000 REMOVING AND INSTALLING CAMSHAFT

Remove cylinder head cover - see 11 12 000. Unscrew bolts (1 ... 3) and take off distributor cap.



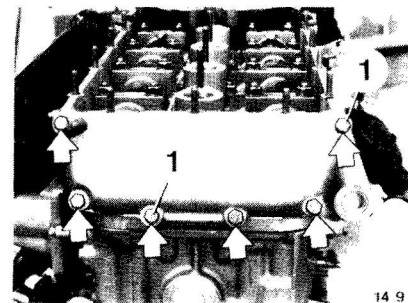
Unscrew distributor rotor (4). Unscrew adapter (5).

Installation:
Tightening torque: 23 ± 1 Nm (16.5 ± 0.5 ft. lbs.).



Unscrew and remove distributor housing, and plugs.

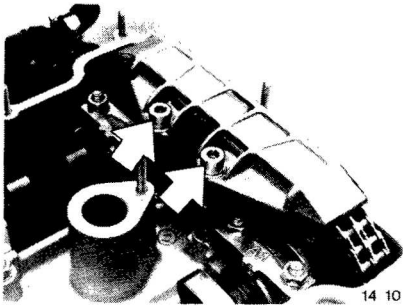
Installation:
Check O-rings, replacing if necessary.



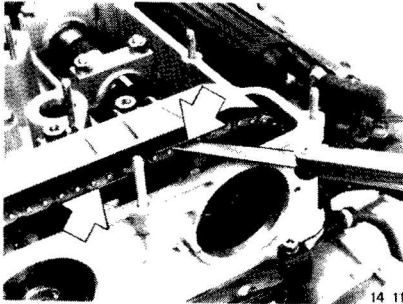
Remove end cover.

Installation:
Replace gasket.
Use longer bolts in bores with a dowel sleeve (1).

Unscrew guide rail.

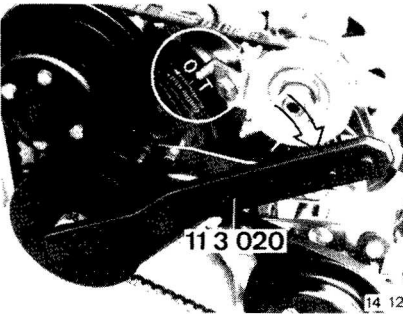


Installation:
Center guide rail with a feeler gage.



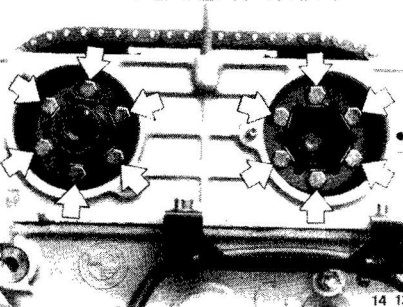
Turn crankshaft with Special Tool 11 3 020 to position cylinder no. 1 to TDC – cylinder no. 4 overlaps.

Caution!
Never crank the engine after removing the timing chain.

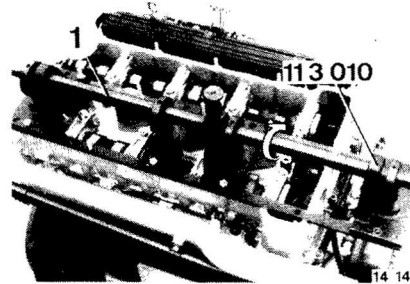


Remove chain tensioner – see 11 31 090. Open lockplates and unscrew sprockets.

Installation:
Tightening torque: 9 + 1 Nm (6.5 + 0.5 ft. lbs.).

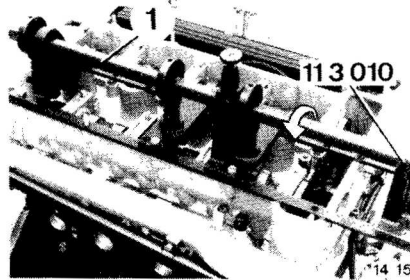


Mount Special Tool 11 3 010 on timing case. Turn shaft (1) up to the arrest – camshaft is held down for removal of bearing caps. Unscrew camshaft bearing caps.

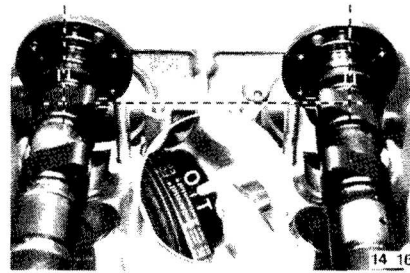


Loosen the arrest and relax the camshaft. Remove Special Tool 11 3 010. Mark camshafts "E" or "A" and remove.

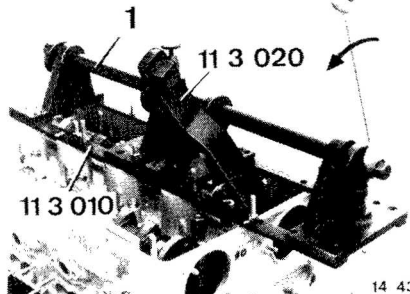
Installation:
Camshafts are identical for exhaust and intake sides. Install an used camshaft in the same direction.

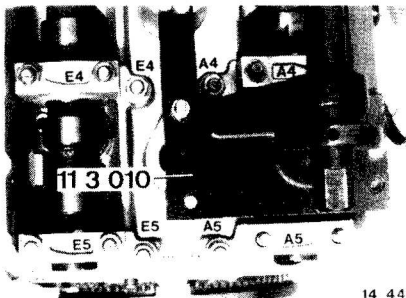


Installation:
Turn crankshaft to TDC. Install camshaft that one each groove faces up and inward – TDC position.



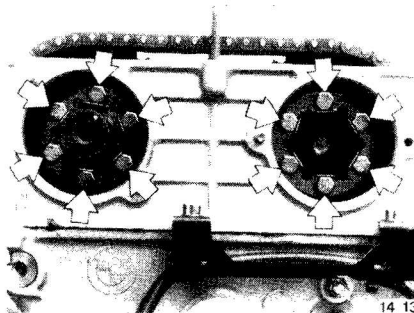
Mount Special Tool 11 3 010 on timing case. Hold camshaft in TDC position with Special Tool 11 3 020 and turn shaft (1) up to the arrest – camshaft is held down for installation of bearing caps.





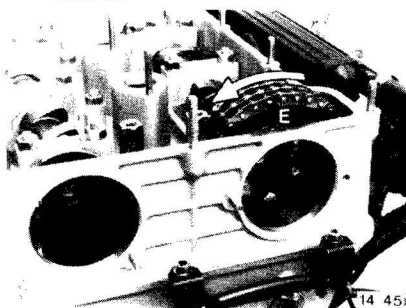
14 44

Install camshaft bearing caps on timing case according to lettering.
Tightening torque: 22 ± 2 Nm (16 ± 1.5 ft. lbs.).



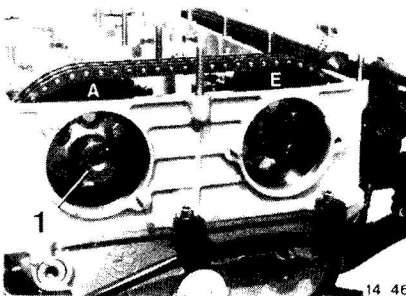
14 13

Lock sprocket mounting bolts with a lockplate.
Adjust valve clearance -- see 11 34 004.



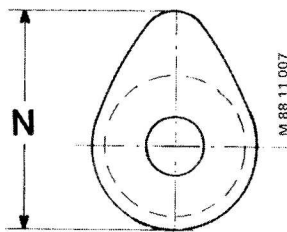
14 45

Tighten the timing chain in opposite direction of engine rotation and mount on the intake side sprocket "E" first.
Install lockplate and bolt down the sprocket.
Tightening torque: $9 + 1$ Nm ($6.5 + 0.5$ ft. lbs.).

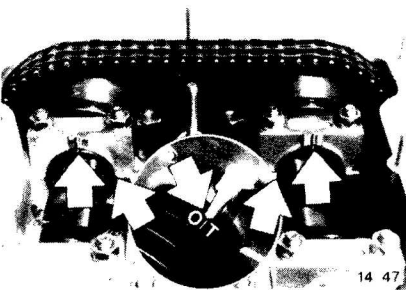


14 46

Installation:
Install exhaust side sprocket "A".
Install adapter (1).
Install lockplate and bolt down the sprocket.
Tightening torque: $9 + 1$ Nm ($6.5 + 0.5$ ft. lbs.).



Cam distance "N"
Nominal value: 43.713 mm (1.721")

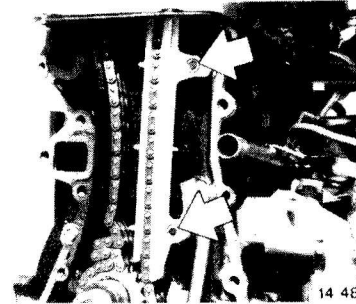
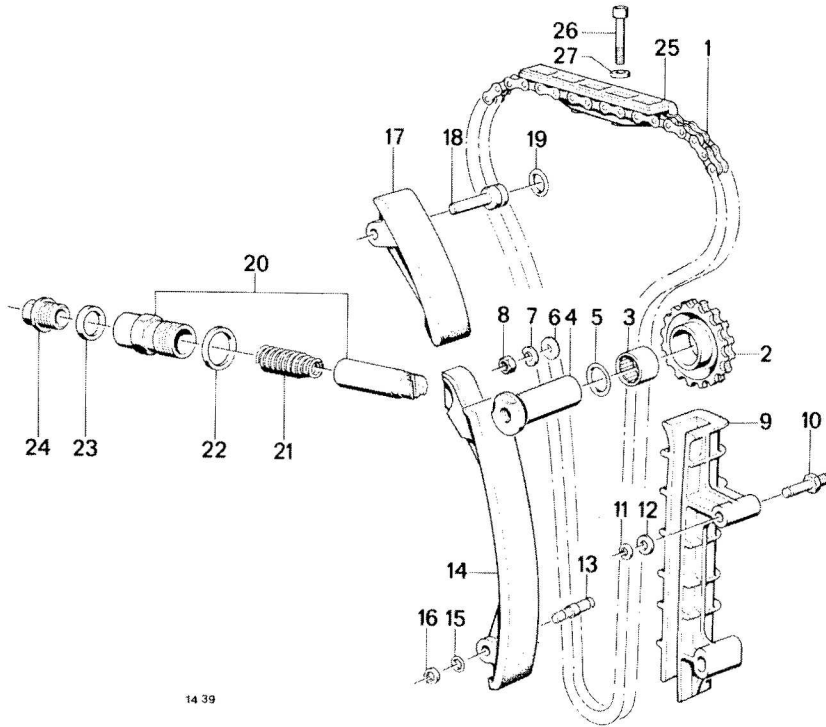


14 47

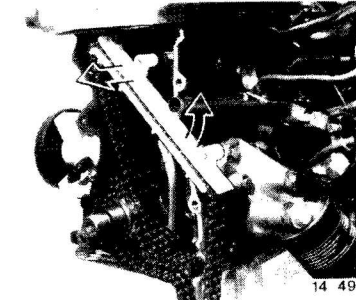
Install chain tensioner -- see 11 31 090.
Turn engine once in direction of rotation and recheck the timing.
- Crankshaft at TDC
- One each camshaft groove faces in
- One each camshaft groove faces cast boss on bearing cap

11 31 051 REPLACING TIMING CHAIN

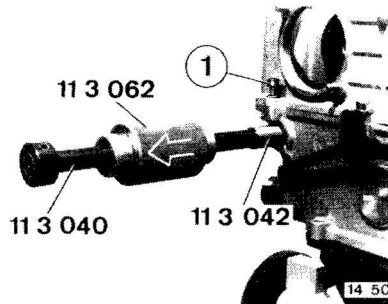
Remove lower timing case cover — see 11 14 110.
 Remove sprockets on camshafts — see 11 31 000.



Remove lockwashers.



Pull guide rail forward and swing aside.
 Remove timing chain.
Installation:
 Timing chain is pre-stretched.



11 31 ... REMOVING AND INSTALLING UPPER TENSIONING RAIL

Remove timing chain — see 11 31 051.
 Unscrew bolt (1) partially.
 Screw on Special Tools 11 3 040, 11 3 042 and 11 3 062.
 Knock out the shaft.
Installation:
 Check O-ring, replacing if necessary.
 Check tensioning rail arrangement!

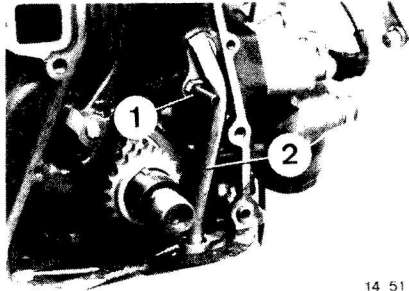
Valve Timing

- | | |
|--|--|
| 1 Double-row timing chain | 15 Lockwasher |
| 2 Sprocket (guide wheel) | 16 Circlip |
| 3 Needle sleeve | 17 Tensioning rail, upper (chain removed) |
| 4 Shaft | 18 Shaft bolt |
| 5 O-ring | 19 O-ring |
| 6 Washer | 20 Chain tensioner piston and cylinder (matched) |
| 7 Spring washer | 21 Spring |
| 8 Hexagon nut | 22 Seal |
| 9 Guide rail | 23 Seal |
| 10 Shaft bolt | 24 Plug |
| 11 Lockwasher | 25 Guide rail |
| 12 Washer | 26 Bolt |
| 13 Shaft bolt | 27 Washer |
| 14 Tensioning rail, lower (head removed) | |

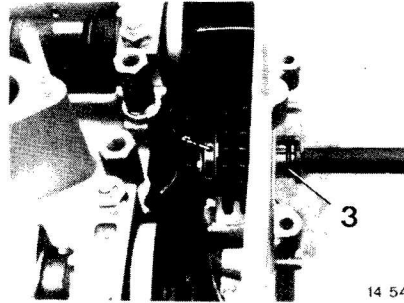
11 31 061 REPLACING SPROCKET SET — Timing Chain Removed —

Remove oil pump drive chain — see 11 41 151.
Unscrew shaft bolt (1) and take off oil pipe (2).

Installation:
Check O-rings, replacing if necessary.



14 51

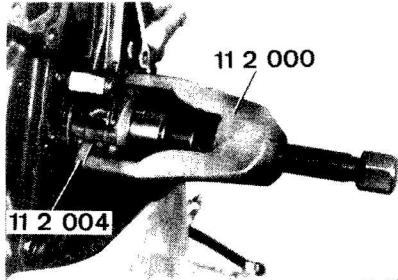


14 54

Installation:
Replace O-ring (3).
Drive in shaft partially with bore facing up.
Slide on the guide sprocket.
Drive in shaft against the stop.

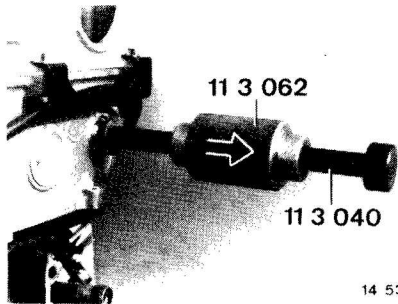
Pull off sprocket with Special Tools 11 2 000 and 11 2 004.

Installation:
Heat sprocket to max. 200° C (390° F) for installation.
Tighten oil pump drive chain — see 11 41 000.



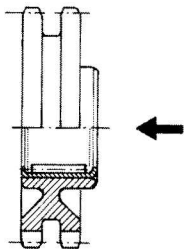
14 52

Mount Special Tools 11 3 040 and 11 3 062 on shaft of guide sprocket.
Knock out the shaft.

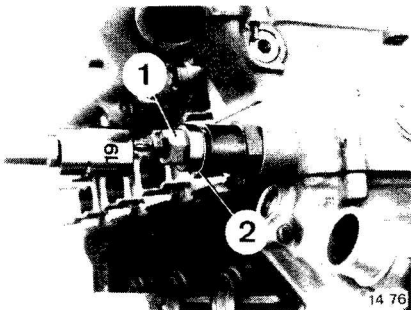


14 53

Installation:
Check needle sleeve in sprocket, replacing if necessary.
Press in needle sleeve in forward driving direction of car.
Forward and pressing-in direction for needle sleeve.



14 1



11 31 090 REMOVING AND INSTALLING PISTON FOR CHAIN TENSIONER

Unscrew plug (1).

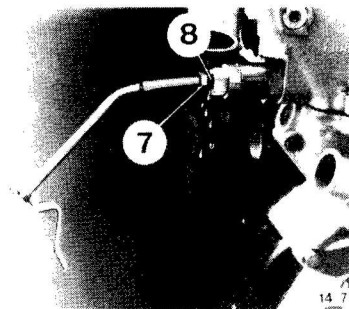
Caution!

Strong spring pressure.

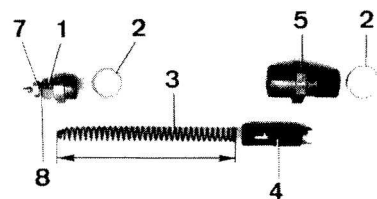
Remove spring (3) and piston (4).

Installation:

Replace seal (2).



Unscrew nipple (7) – replace O-ring (8) if necessary.
Add engine oil, until oil runs out of nipple (7).
Tighten nipple (7).



Installation:

Check length of spring (3).

Nominal value: 159 ± 0.5 mm

(6.260 ± 0.020 ").

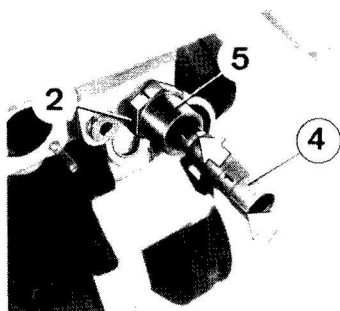
Conically wound end of spring faces plug (1).

Tightening torque for:

– plug (1) 40 ± 2 Nm (29 ± 1.5 ft. lbs.)

– cylinder (5) 50 ± 2 Nm (36 ± 1.5 ft. lbs.)

14 77



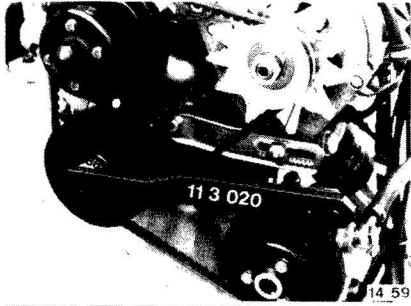
Piston (4) and cylinder (5) are matched* – code 1 or 2.

Only install parts with same code.

Install cylinder with groove facing back (as seen looking forward in car) and position with groove facing up.

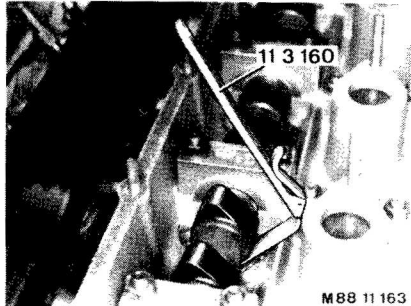
Guide piston opening into tensioning rail.

14 78

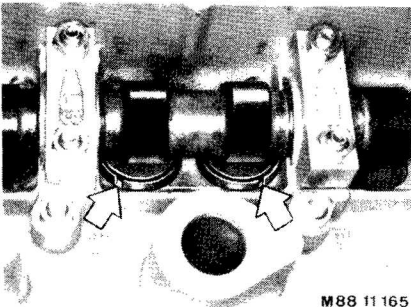


11 34 004 ADJUSTING VALVE CLEARANCE

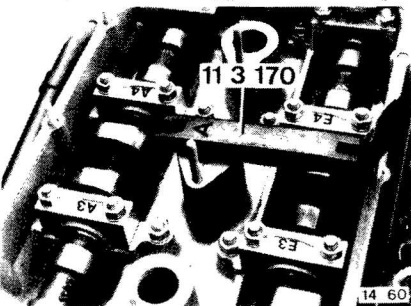
Remove cylinder head cover — see 11 12 000.
Crank engine with Special Tool 11 3 020.



Measure valve clearance of cams facing up.
Compare measured valve clearance with the specified valve clearance.
Nominal values:
0.26 to 0.35 mm (0.010 to 0.014") — cold*
0.31 to 0.40 mm (0.012 to 0.016") — warm*

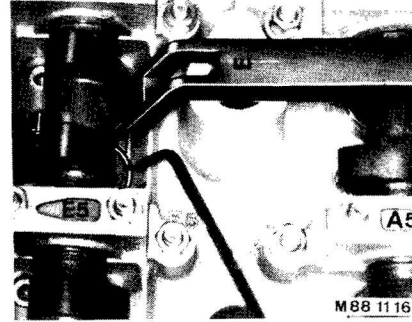


Turn openings of tappets as shown in picture in case measured valve clearance is not within specified tolerances.

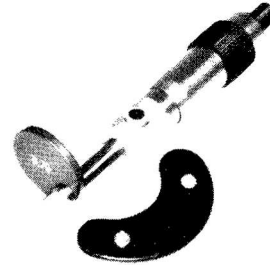


Guide in Special Tool 11 3 170 according to camshaft "A" or "E" and press tappets down.

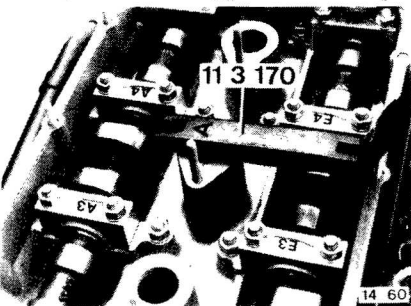
* See Specifications



Blow out valve shim with compressed air.



Measure thickness of removed valve shim.
Install shim of required thickness with the lettering facing down.



11 34 509 CHECKING VALVES FOR LEAKS — Cylinder Head Removed —

Spark plugs remain screwed in.
Fill combustion chamber with gasoline outdoors or indoors with conformance of fire prevention regulations.
Valves and valve seats must be inspected, if gasoline runs past the valve heads.
Remove valves — see 11 34 550.
Machine valve seats — see 11 12 607.

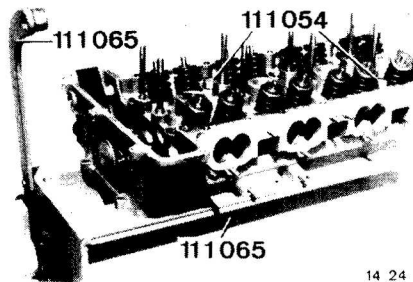
11 34 550 REMOVING AND INSTALLING VALVES

— Cylinder Head Removed —

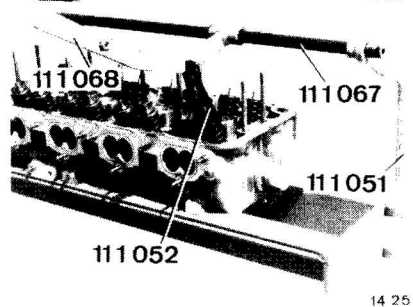
Unscrew spark plugs.
Mount cylinder head on Special Tool 11 1 065 with Special Tools 11 1 054.

Installation:

Tightening torque for spark plugs:
 $20 \pm 5 \text{ Nm}$ ($14.5 \pm 3.5 \text{ ft. lbs.}$).

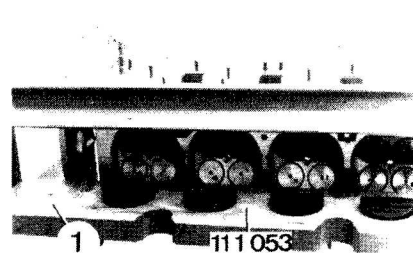


14 24



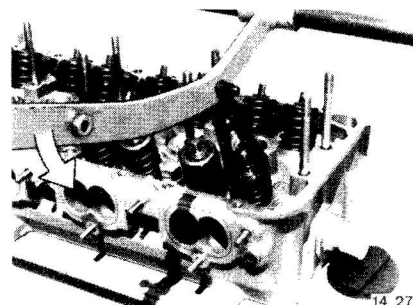
14 25

Screw on Special Tool 11 1 051.
Mount Special Tools 11 1 068, 11 1 052 and 11 1 067.



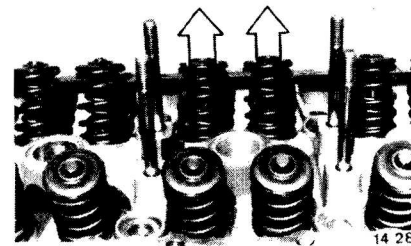
14 26

Place Special Tool 11 1 053 (tray) in the assembly stand — pull out rubber part (1)!



14 27

Compress valve springs and remove valve collets.

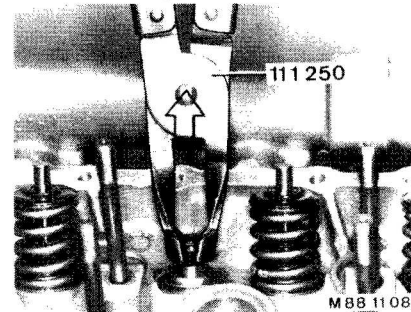


14 28

Remove upper spring retainer and double spring set.
Take tray out of assembly stand and pull out valve.

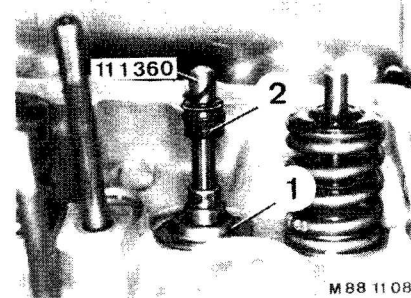
Installation:

Lubricate valve guide and valve stem with oil.



M88 11 087

Pull off valve stem seal with Special Tool 11 1 250.
Check valve guide for wear — see 11 12 595.

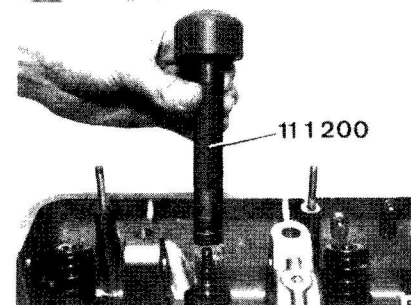


M88 11 088

Install valve and insert Special Tool 11 1 053 (tray).

Insert lower spring retainer (1).
Use Special Tool 11 1 360 to avoid damaging the valve stem seal.
Lubricate valve stem seal (2) with oil and install.

Source for Special Tool Sleeves
CARTOOL
Alfred-Brehm Str. 5
D-8070 Ingolstadt



5

Press on valve stem seal with Special Tool 11 1 200 by hand.
Special Tool 11 1 200 has two diameters — for 7 and 8 mm (0.275 and 0.315") valve stem seals.

11 40 000 CHECKING ENGINE OIL PRESSURE

Remove air cleaner with air flow sensor.
Pull off plug on oil pressure switch.
Unscrew oil pressure switch (1).

Installation:

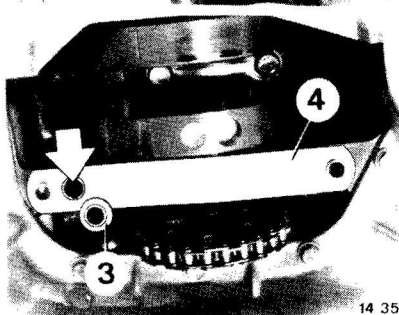
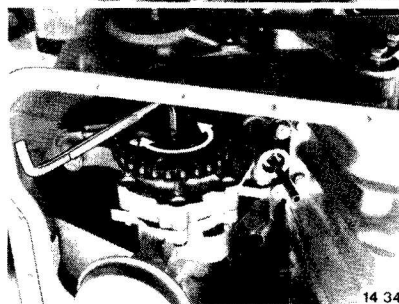
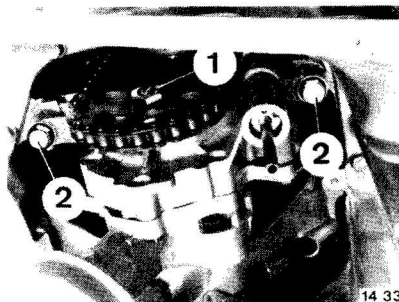
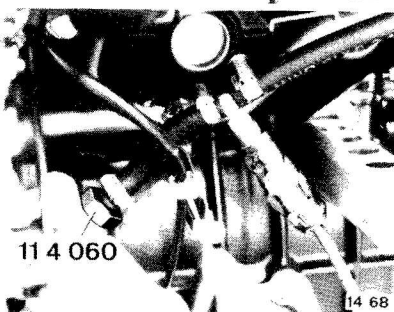
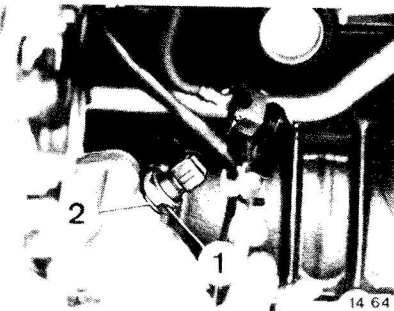
Check seal (2), replacing if necessary.

Screw in Special Tool 11 4 060.

Connect 10 bar (142 psi) pressure tester of BMW Service Tester.

Install air cleaner.

Measure oil pressure*.



11 41 000 REMOVING AND INSTALLING OIL PUMP

Remove lower oil pan section — see 11 13 020.
Unscrew nut (1) and take off sprocket.
Unscrew bolts (2).

Installation:

Push on sprocket with mounted oil pump.

Tightening torque of nut:

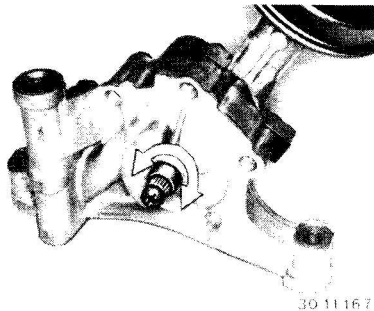
25 to 30 Nm (18 to 22 ft. lbs.).

Installation / Chain Tightness:

Check installed position of O-ring (3) between housing and pressure pipe.

Adjust chain tightness with shim (4) in such a manner, that chain gives under light thumb pressure.

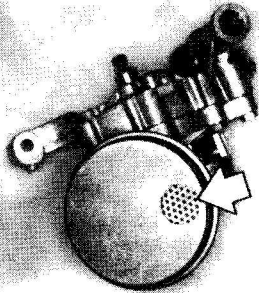
Check position of oil bore in shim.



Testing and Servicing:
Check whether oil pump runs easily by turning the drive shaft.

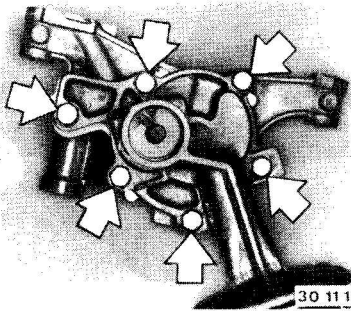
30 11 167

Clean oil filter screen.



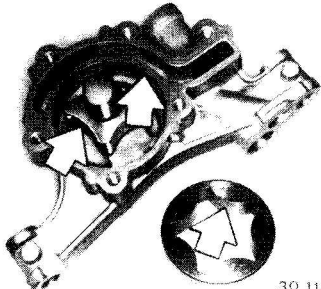
30 11 168

Disassemble oil pump.

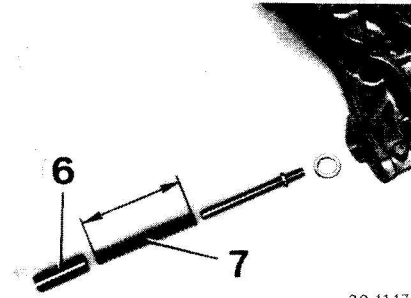


30 11 169

Check oil pump for wear.
– Scoring in body
– Wear on rotors

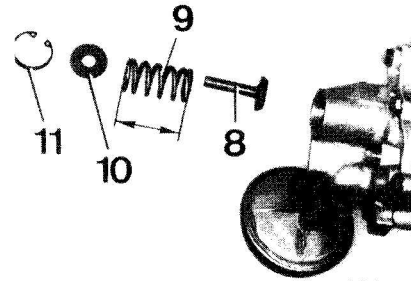


30 11 170



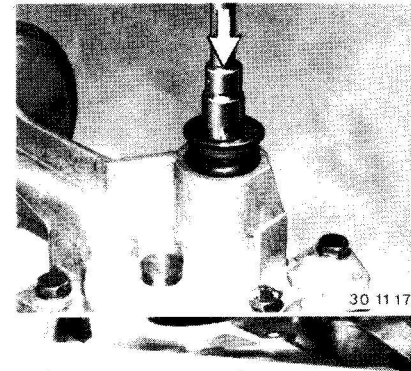
30 11 171

The pressure safety valve is located in the main bore and regulates the engine oil pressure* – see 11 40 000.
Check whether piston (6) moves easily.
Check length of spring (7) = 68 mm (2.677").



30 11 172

Pressure safety valve (8 bar = 114 psi) regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check seat of piston (8).
Check length of spring (9) = 44 ± 0.4 mm (1.732 ± 0.016 ").



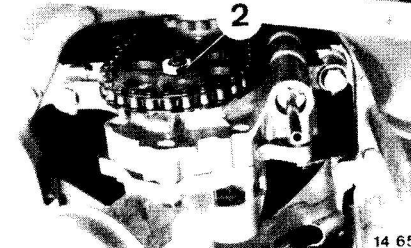
30 11 173

Installation:
Press in spring (9) and washer (10) with a wrench socket and install clip (11).

11 41 151 REPLACING OIL PUMP DRIVE CHAIN

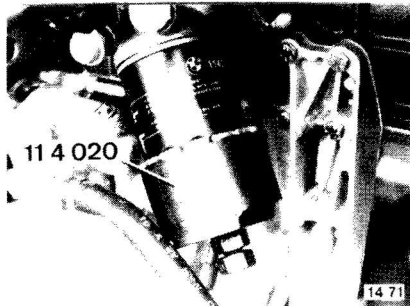
Remove lower oil pan section – see 11 13 020.
Remove timing chain – see 11 31 051.
Unscrew nut (2) and take off sprocket.

Installation:
Check sprockets for wear.
Adjust chain tightness – see 11 41 000.
Chains with green code are longer than chains with a red code.
Tightening torque: 25 to 30 Nm (18 to 22 ft. lbs.)



14 65

* See Specifications



11 42 021 REPLACING FULL FLOW OIL FILTER

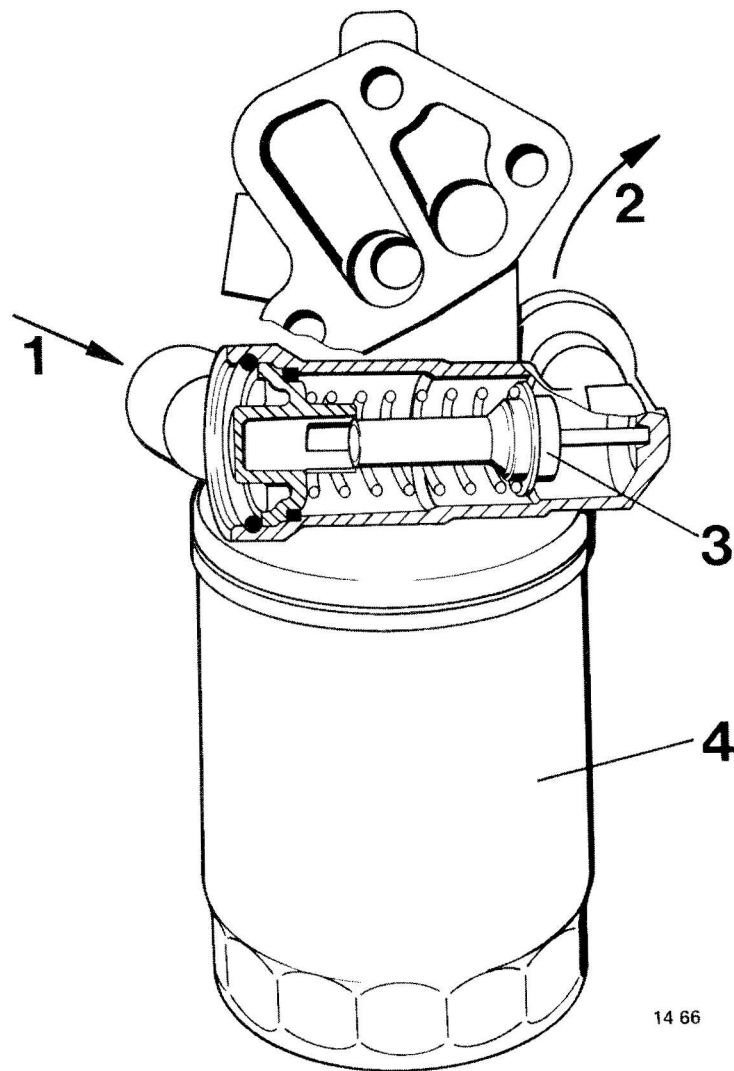
Unscrew filter with Special Tool 11 4 020.

Installation:

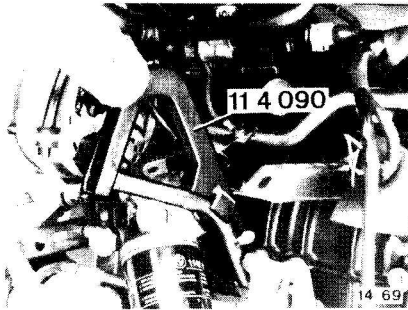
Lubricate gasket with light coat of oil. Tighten oil filter by hand until the gasket bears on surface – then tighten filter by hand one half turn more.

Add oil, start engine and check oil level as well as for leaks.

If engine no longer builds up oil pressure after replacement of the oil filter cartridge, stop the engine, turn the filter cartridge approx. 90° and tighten it again after starting the engine and waiting until a small amount of oil escapes from the filter (bleeding procedures).

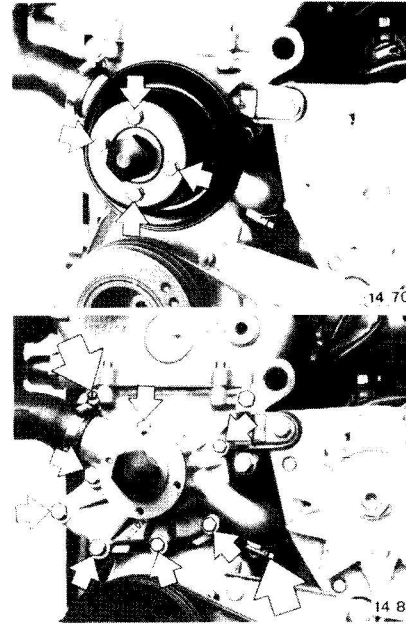


- 1 From oil cooler
- 2 To oil cooler
- 3 Temperature regulator – switches off oil cooler as of approx. 95° C (203° F)
- 4 Oil filter



11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Install guide tube with Loctite No. 270** and drive in against the stop.



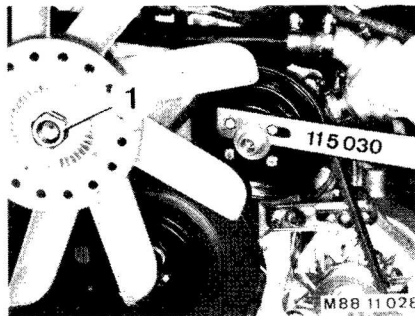
11 51 000 REMOVING AND INSTALLING WATER PUMP

Drain coolant.
 If applicable, remove fan cowl and fan – see 11 52 000.
 Take off drive belt and remove pulley.
Installation:
 Add coolant***.
 Tighten drive belt – check tightness with Special Tool 11 5 020.

Loosen hose clamps.
 Remove water pump.
Installation:
 Replace gasket.

** Source: HWB

*** See Service Information of Gr. 00



11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).

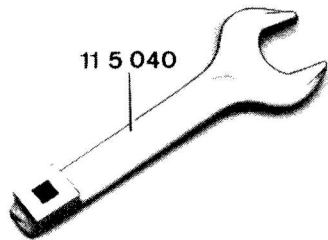
Important!

Left-hand threads – nut must be turned clockwise to unscrew.

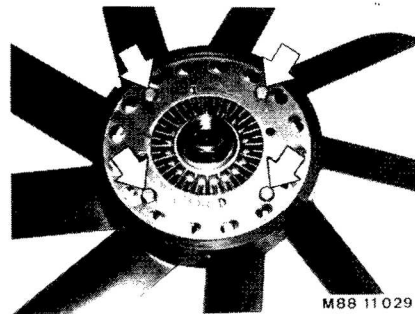
Tightening torque: 40 + 10 Nm (29 + 7 ft. lbs.).

Installation:

Tighten fan with Special Tool 11 5 040. The 40 Nm (29 ft. lbs.) tightening torque is equal to a 30 Nm (22 ft. lbs.) setting on the torque wrench.



30 11 193



11 52 020 REPLACING FAN CLUTCH

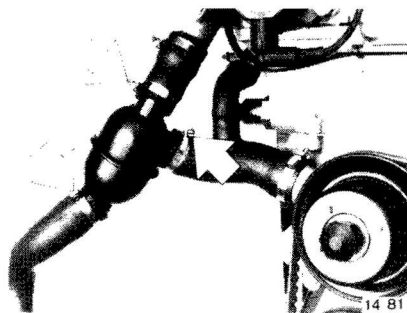
Remove fan – see 11 52 000.

Fan clutch must be replaced, if

- a) hub has seized – fan of stopped engine cannot be turned or is hard to turn –,
- b) fan clutch has axial or radial play, or is losing oil.

Check switching points* with a Vibrocard***

Unscrew fan mounting bolts and take off the fan clutch.



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

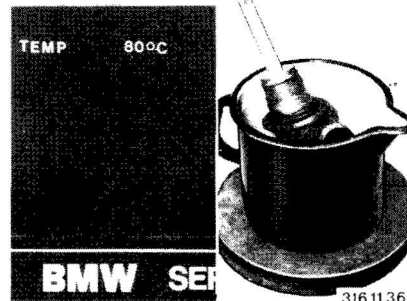
Drain coolant.

Loosen hose clamps.

Remove thermostat.

Installation:

Bleed cooling system – see 17 11 000.



Checking Thermostat:

Place thermostat in water and heat the water. Measure temperature at which thermostat begins to open and the opening distance with a steel ruler.

Opening temperature / travel:

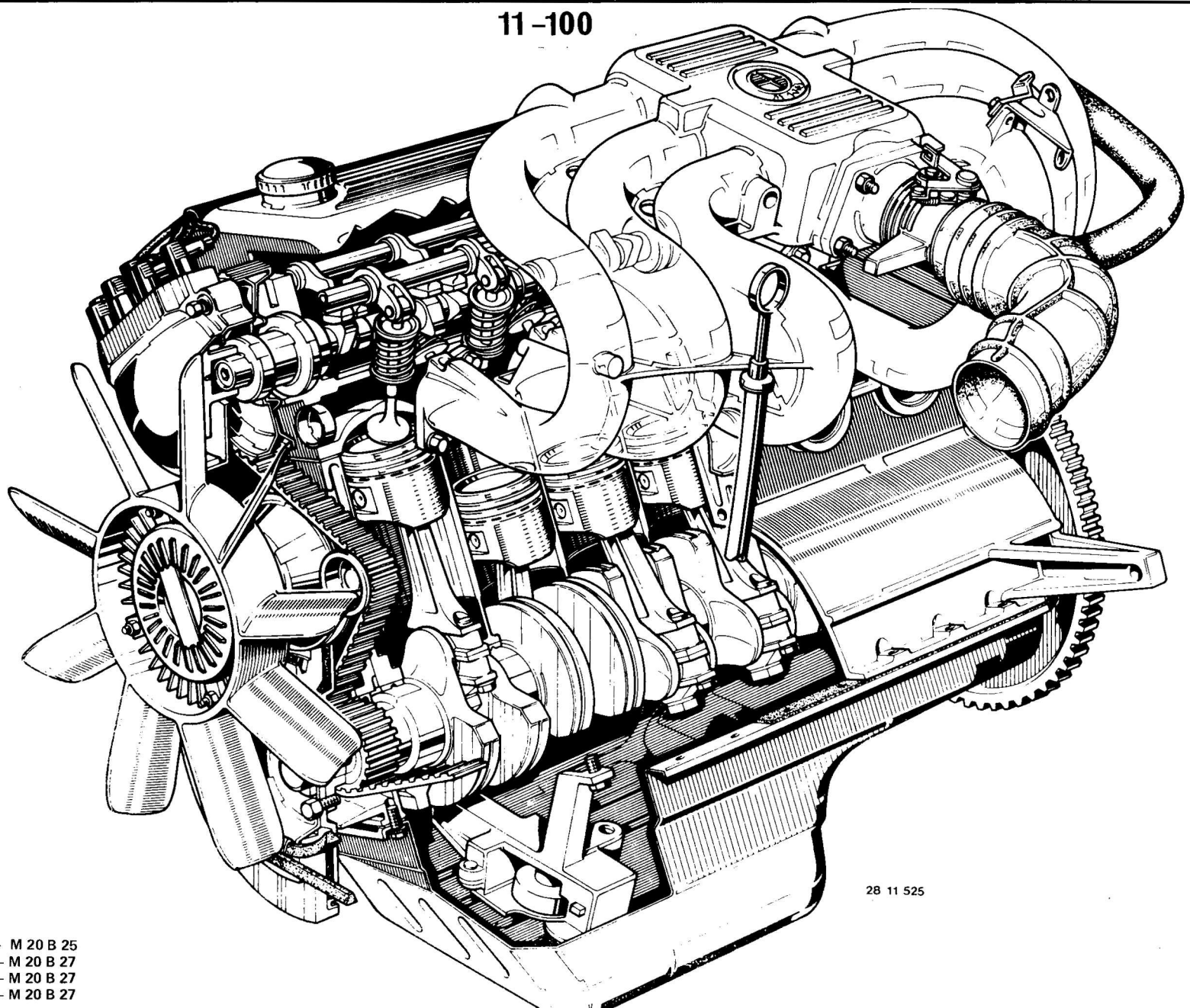
$80 \pm 2^{\circ} \text{C}$ ($176 \pm 3^{\circ} \text{F}$) / 0.1 mm (0.004").

Testing temperature / travel:

95°C (203°F) / 8 mm (0.315").

* See Specifications

*** See Workshop Equipment Catalog

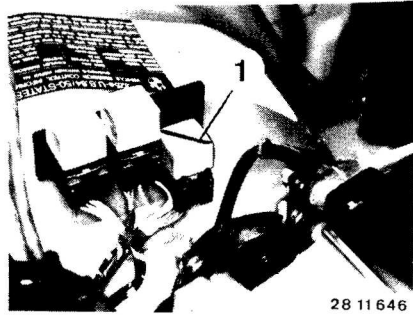


28 11 525

- BMW 325 i - M 20 B 25
- BMW 325 - M 20 B 27
- BMW 325 e - M 20 B 27
- BMW 325 es - M 20 B 27

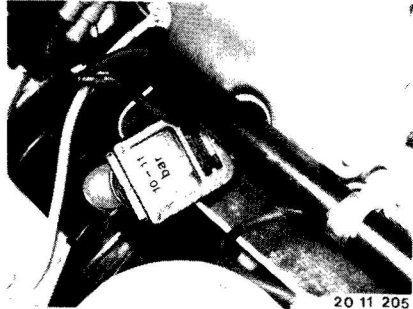
11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

Pull off main relay (1).



28 11 646

Unscrew spark plugs.
Test compression*.
Installation:
Tightening torque**.



20 11 205

* See Specifications

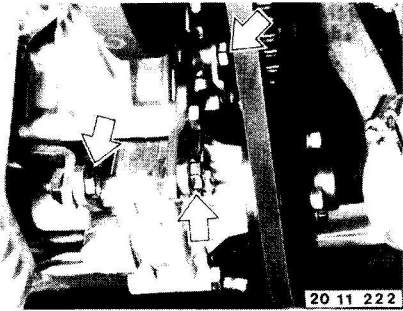
** See Specifications of Gr. 12

11 00 050 REMOVING AND INSTALLING ENGINE

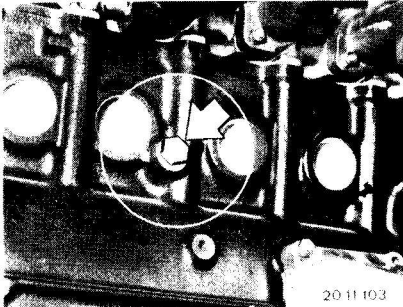
Remove transmission — see Group 23 or 24.
 Unscrew power steering pump.
 Hoses remain connected.

Installation:

Tighten drive belt and check tightness with Special Tool 11 5 020.



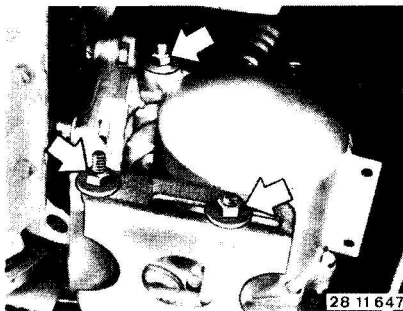
Unscrew bolt and drain coolant.
 Remove radiator — see 17 11 000.



Unscrew compressor.
 Refrigerant hoses remain connected.

Installation:

Tighten drive belt and check tightness with Special Tool 11 5 020.



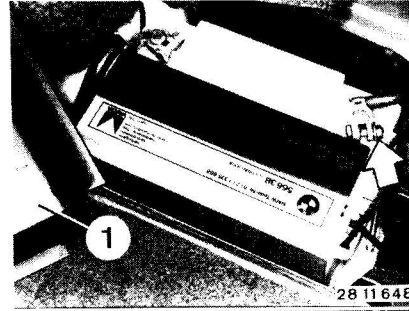
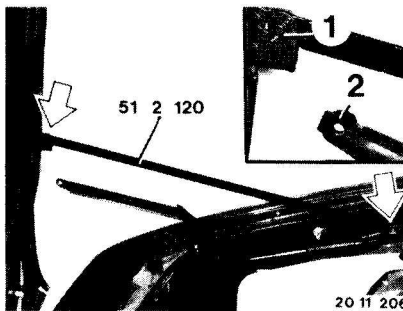
Disconnect support and gas pressure props.
 Prop engine hood with Special Tool 51 2 120.

Caution!

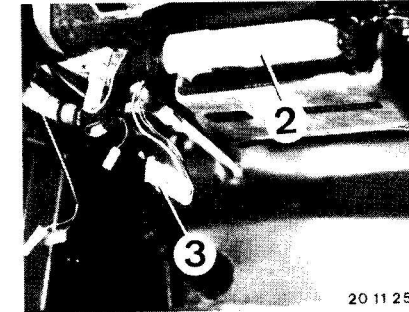
Use locks (1).

Installation:

Insert plastic part (2).



Unscrew cover and disconnect battery ground lead.

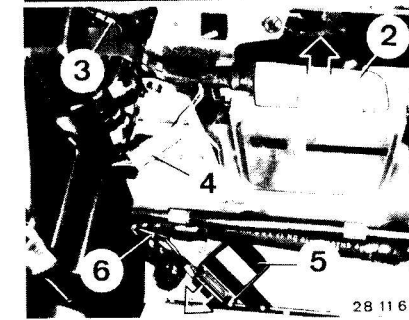


M 20 B 25:

Take off trim panel in glove box.

Pull off plug (2) on control unit and disconnect plug (3).

Cars with Automatic Transmission:
 Disconnect plug for main wire harness.

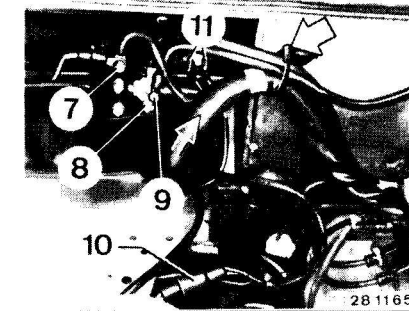


M 20 B 27:

Take off trim panel in glove box.

Pull off plug (2) on control unit and disconnect plugs (3 and 4).

Unscrew idle control unit (5) and pull off plugs.
 Cars with Automatic Transmission:
 Disconnect plug (6) for main wire harness.



All Models:

Disconnect wires (7 ... 9).

Lift out and disconnect plug (10) for oxygen sensor.

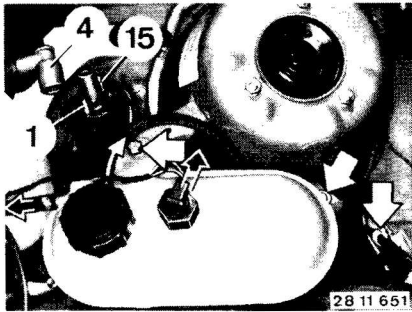
Pull off plug (11) on temperature sensor.

Loosen wire straps and pull out wire harness into engine compartment.

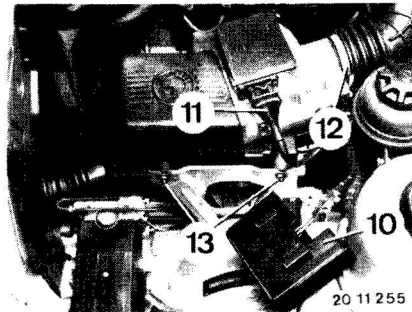
Installation:

7 = Engine electrics

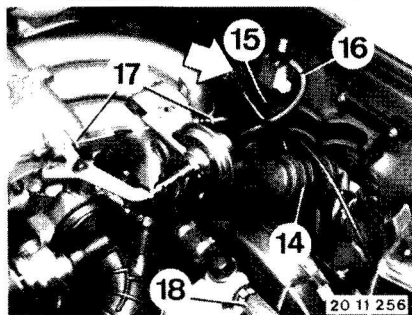
9 = Car electrics



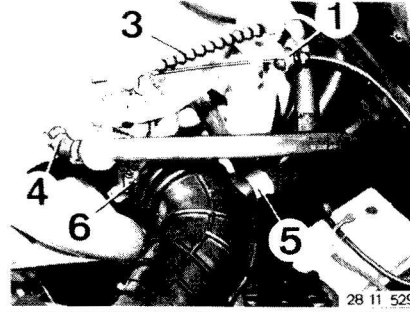
Remove coolant expansion tank.
 Pull off wire (4) on ignition coil.
 Disconnect wires (1 and 15).
 Disconnect wire harness.
Installation:
 Use new squeeze-hose clamp.



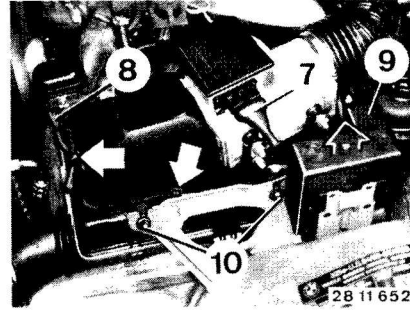
M 20 B 25:
 Lift out relay (10).
 Loosen clamp (12).
 Pull off plug (11).
 Disconnect wire harness.
 Unscrew nuts (13) and remove air cleaner
 with air flow sensor.



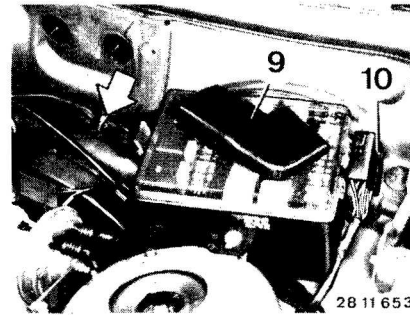
Lift out and disconnect plug (14).
 Disconnect wire harness.
 Pull off vacuum hoses (15 and 16).
 Disconnect accelerator cable (17).
 Cars with Cruise Control:
 Disconnect cruise control cable.
 Pull off vacuum hose (18).
Installation:
 Adjust accelerator cable — see 35 41 421.
 Adjust cruise control cable — see Group 65.
 Use a new squeeze-hose clamp.
 Screw-on plug (14) engages in final position.



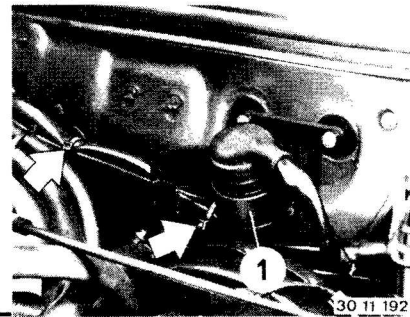
M 20 B 27:
 Disconnect accelerator cable (1) and cruise
 control cable (3).
 Pull off vacuum hose (4) and hose (5).
 Loosen clamp (6).
Installation:
 Adjust accelerator cable — see 35 41 421.
 Adjust cruise control cable — see Group 65.



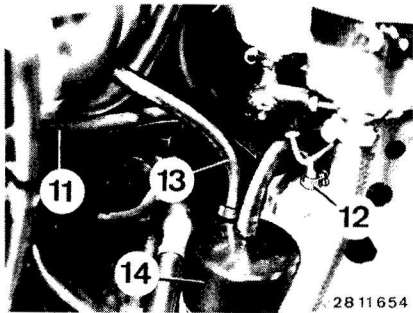
Pull off plugs (7 and 8).
 Lift out relay (9).
 Disconnect wire harness.
 Unscrew nuts (10) and remove air cleaner
 with air flow sensor.



Up to 1985 Models:
 Pull off cap (9) and disconnect plug (10).
 Disconnect wire harness.

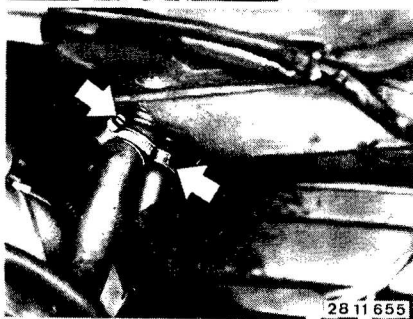


Since 1986 Models:
 Lift out and disconnect plug (1).
 Disconnect wire harness.
Installation:
 The screw-on plug engages in final position.



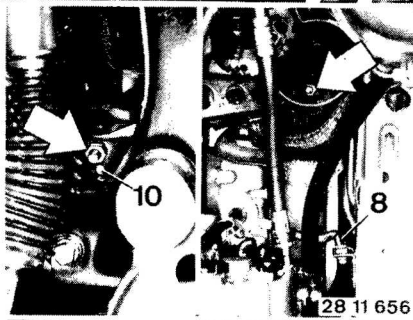
All Models:
 Unscrew fuel lines (11 and 12).
 Pull off hose (13) and unscrew filter (14).
Installation:
 Use a new squeeze-hose clamp.

28 11 654



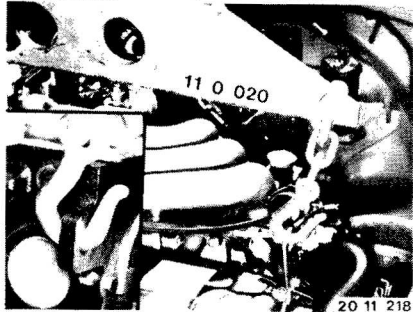
Disconnect water hoses for heater.

28 11 655



Unscrew ground strap (8) and both engine mounts.
Installation:
 Insert guide pin (10) in bore of axle carrier.
 Tightening torque*.

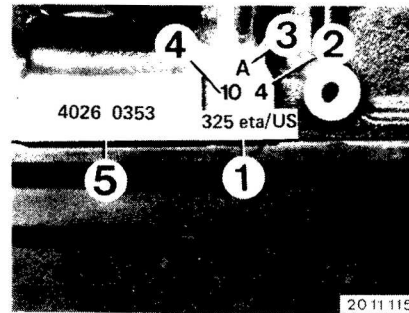
28 11 656



Apply Special Tool 11 0 020 and lift out the engine.
Installation:
 Adjust engine idle speed and CO level — see 13 00 054.

20 11 218

* See Specifications



20 11 115

11 00 091 EXCHANGING ENGINE

Remove engine — see 11 00 050.
 Exchange Engine Identification on the Crankcase:
 1 = Type designation/displacement*
 2 = Year of manufacture (1984)
 3 = "A" for exchange or "N" for new engine
 4 = Month of manufacture

Stamp engine number (5).

Drive in supplied oil dipstick guide tube (see 11 43 101) and transfer parts from old engine to exchange engine.
 Fill exchange engine with oil**.
Important!
 Remove pilot bearing in crankshaft, see 11 21 571, if car has an automatic transmission.

Install engine.
 Adjust ignition timing — see 12 11 004.
 Adjust engine idle speed and CO level — see 13 00 054.

* See BMW Technik and Service Information of Group 11

** See Service Information of Group 00

11 00 050 REMOVING AND INSTALLING ENGINE — Since 1988 Models —

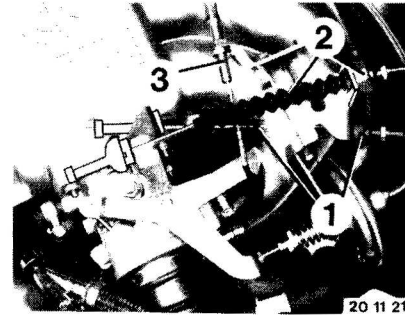
Disconnect battery ground lead.
Cars with Power Steering:
Unscrew power steering pump.
Hoses remain connected.

Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

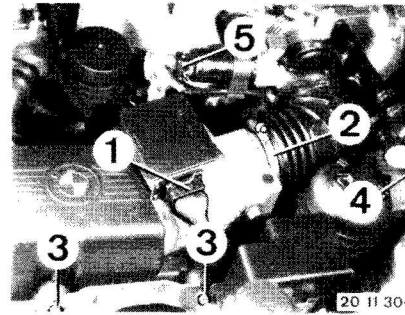
Unscrew plug and drain coolant.
Remove radiator — see 17 11 000.
Remove fan — see 11 52 000.

Cars with Air Conditioner:
Unscrew compressor.
Hoses remain connected on compressor.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

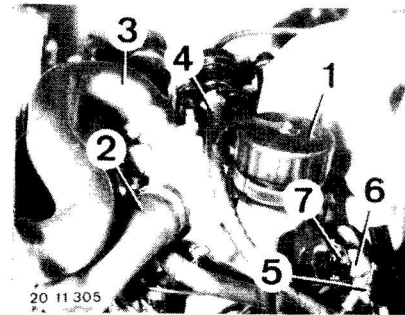
Disconnect prop and gas pressure spring, and insert Special Tool 51 2 120 to hold the engine hood.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



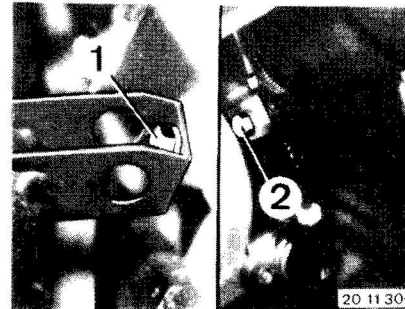
20 11 219



20 11 304



20 11 305



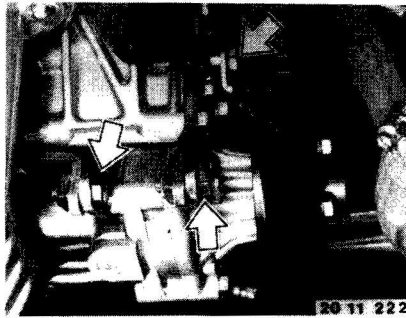
20 11 306

Disconnect accelerator cable (1).
Cars with Cruise Control:
Disconnect cruise control cable (2).
Cars with Automatic Transmission:
Disconnect throttle cable (3).
Installation:
Adjust accelerator cable — see Gr. 35.
Adjust cruise control cable — see Gr. 65.
Adjust throttle cable — see Gr. 24.

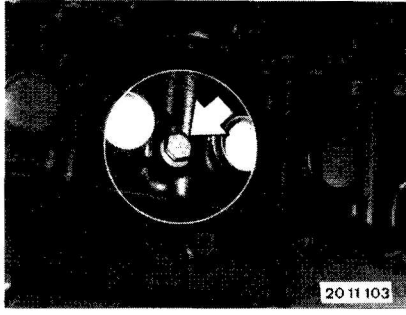
Pull off plug (1).
Loosen clamp (2).
Unscrew nuts (3) and lift out air cleaner with air flow sensor.
Pull off hose (4).
Pull off plug (5).

Disconnect diagnosis plug (1).
Disconnect hoses (2 and 3).
Unscrew fuel pipe (4).
Unscrew holder (5).
Loosen clip for fuel hose.
Disconnect plugs (6 and 7).
Unscrew holder for guide tube (oil dipstick).

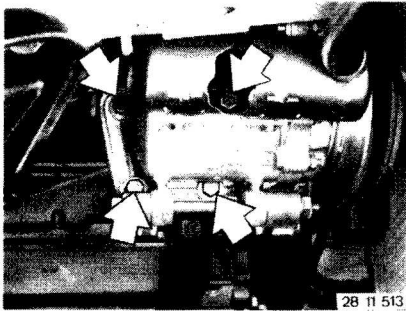
Unscrew bolts (1 and 2) for water pipe and take off water pipe.



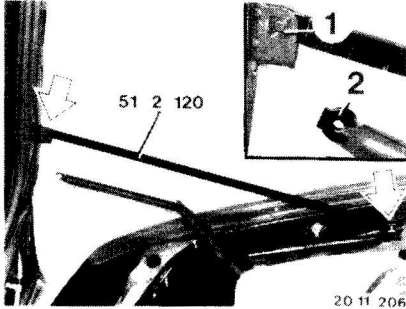
20 11 222



20 11 103

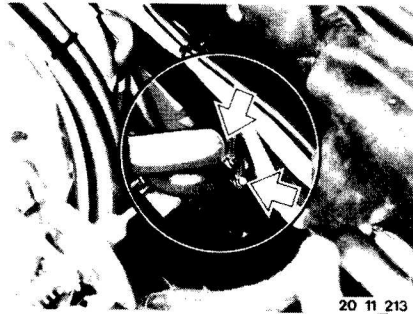


28 11 513



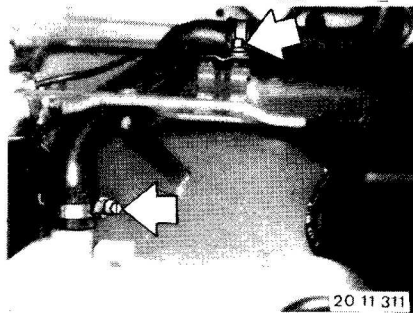
20 11 206

Disconnect water hoses for heater.



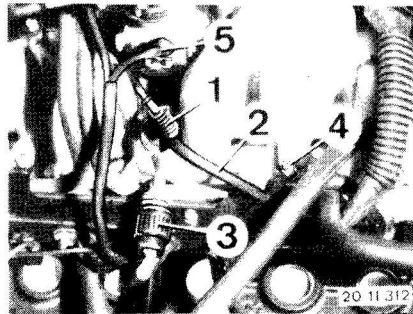
20 11 213

Disconnect coolant hose.



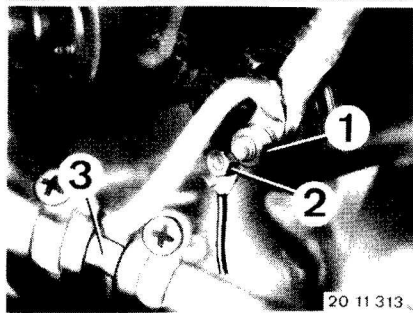
20 11 311

Pull off plug (1).
Pull off fuel hose (2).
Pull off plug (3).
Unscrew bolt (4).
Pull off plug (5).



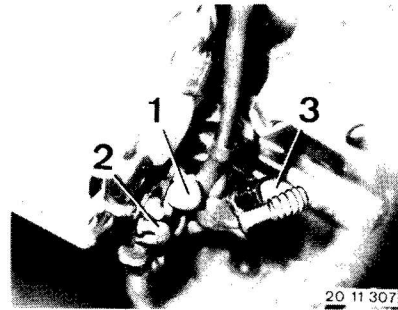
20 11 312

Disconnect leads (1 and 2) on starter and lift out starter.
Disconnect fuel pipe (3).



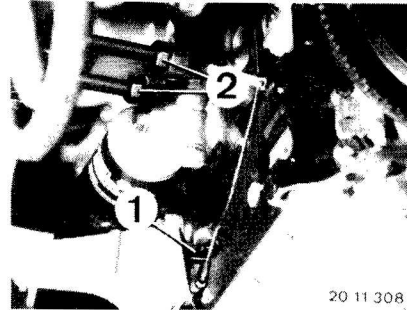
20 11 313

Pull off rubber caps (1 and 2) and unscrew leads on alternator.
Disconnect plug (3).



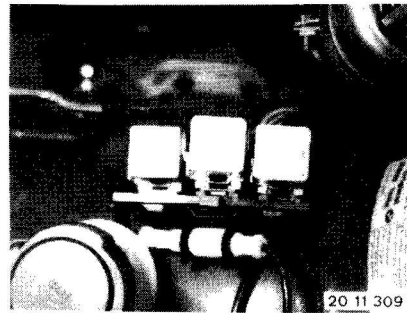
20 11 307

Pull off ignition leads on ignition coil.
Pull off plug (1) on oil pressure switch.
Loosen lead holding clip underneath the distributor and pull out leads to left side of engine.
Disconnect pipes (2) for oil cooler.
Installation:
Check gaskets, replacing if necessary.
Tightening torque*.



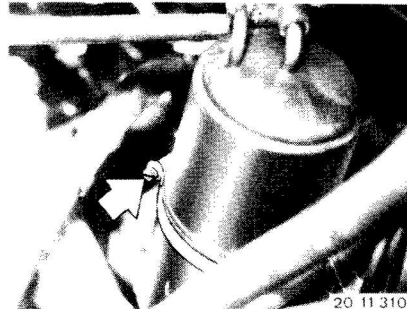
20 11 308

Take off relay box cover.
Lift out relay with socket and lay on engine together with wire harness.



20 11 309

Loosen clamp and remove carbon canister.
Place electric lead plate aside past the oil dipstick guide tube.

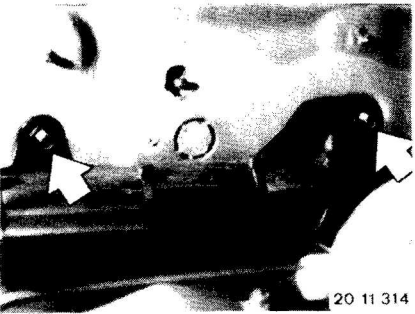


20 11 310

* See Specifications

11-104 c

Unscrew bolts.



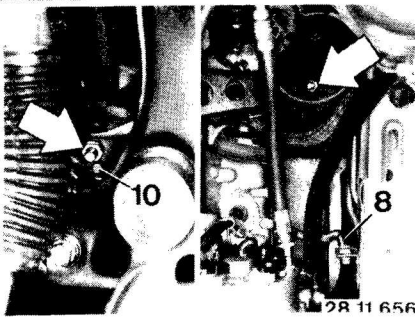
20 11 314

Unscrew ground strap (8) and both engine mounts.

Installation:

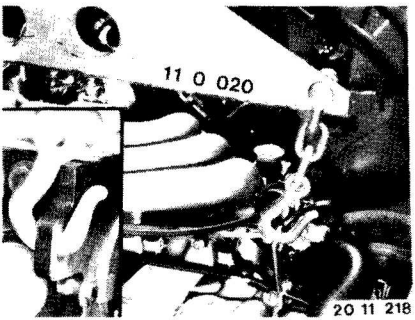
Guide mandrel (10) into bore on axle carrier.

Tightening torque*.



28 11 656

Connect Special Tool 11 0 020 on front and rear ends of engine, and lift out engine.



20 11 218

* See Specifications

11 11 160 REPLACING BEARINGS FOR OIL PUMP DRIVE SHAFT

Remove oil pump — see 11 41 000.
Unscrew screw (1) and lift off cover (2).

Remove gear wheel (3).
Installation:
Open end of gear wheel shaft faces down.
Check seal (4), replacing if necessary.

Drive out needle bearing from bottom to top with Special Tool 11 1 310.

Installation:
Lubricate needle bearing with grease.
Drive in needle bearing against stop with Special Tool 11 1 300.

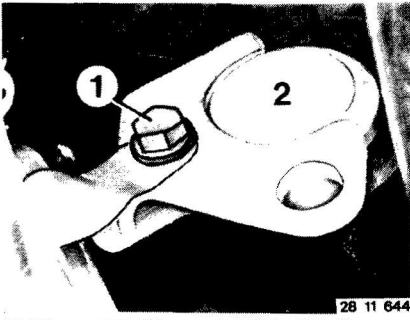
11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

M 20 B 25:
Unscrew support (1).

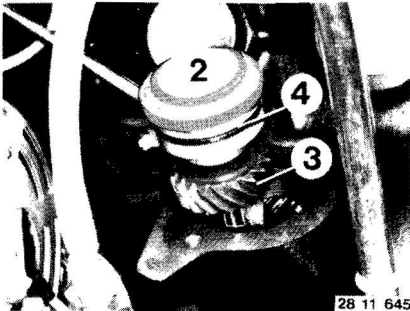
M 20 B 27:
Pull off plugs (11 and 12) and unscrew holder (13).
Unscrew support (14).

All Models:
Disconnect hose (9).
Unscrew nuts (1 ... 8) and take off cover.
Installation:
Check gasket, replacing if necessary.
Mount the ground strap with nut (6).
Tighten nuts in order of 1 through 8.
Tightening torque*.

* See Specifications



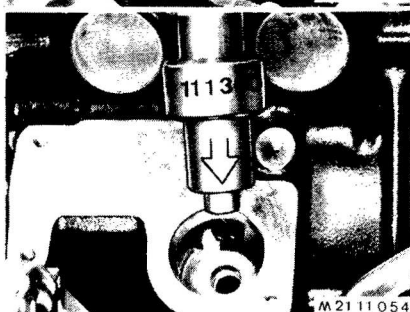
28 11 644



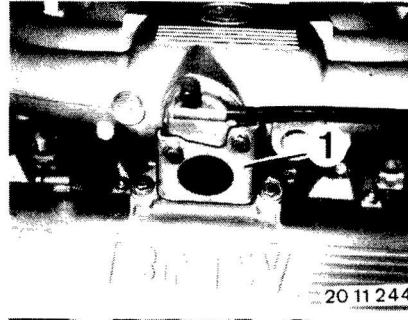
28 11 645



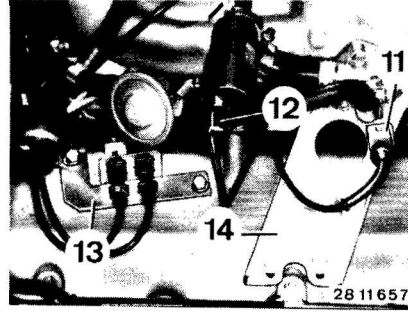
M 21 11 173



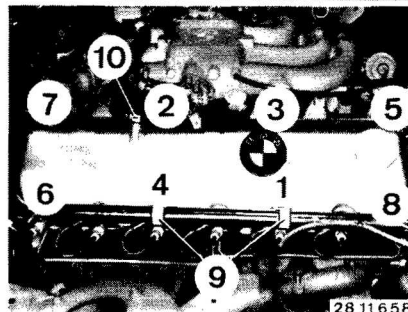
M 21 11 054



20 11 244



28 11 657



28 11 658

11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

Unscrew exhaust pipes on exhaust manifolds and pipe clamp on transmission.

Installation:

Check gaskets, replacing if necessary.
Coat studs with "CRC copper paste"***.
Replace self-locking nuts.
Tightening torque*.

Unscrew plug and drain coolant.
Disconnect battery ground lead.

Installation:

Pour in coolant*** and bleed cooling system — see 17 00 039.
Replace engine oil***.

Disconnect accelerator cable (1) and cruise control cable (2).

Installation:

Adjust accelerator cable — see 35 41 421.
Adjust cruise control cable — see Group 65.
Cars with Automatic Transmission:
Disconnect throttle cable (3).

Installation:

Adjust throttle cable — see Group 24.

Take off diagnosis plug (1).

Disconnect water hoses (2 ... 6).

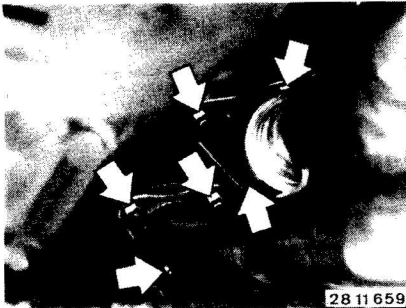
Pull off fuel hose (7).

Unscrew bracket (8).

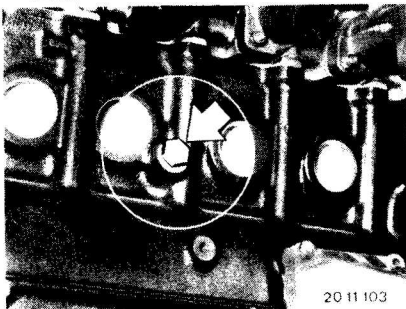
* See Specifications

** Source: HWB

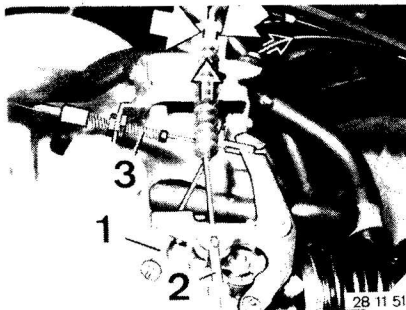
*** See Service Information of Gr. 00



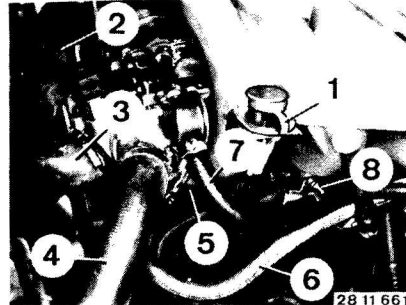
28 11 659



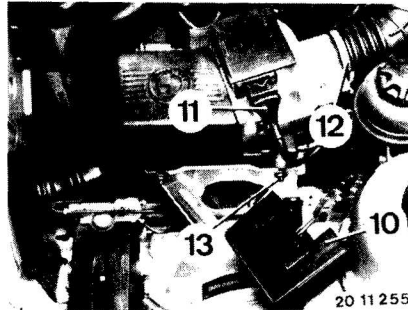
20 11 103



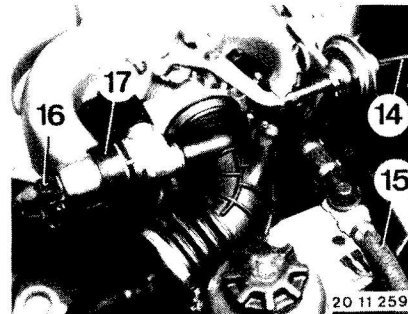
28 11 514



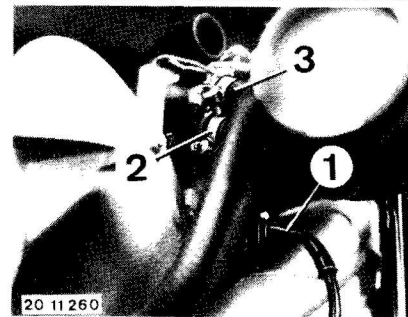
28 11 661



20 11 255



20 11 259



20 11 260

M 20 B 25:

Lift out relay (10).

Pull off plug (11).

Loosen clamp (12).

Disconnect wire harness.

Unscrew nuts (13) and remove air cleaner with air flow sensor.

Pull off hose (15).

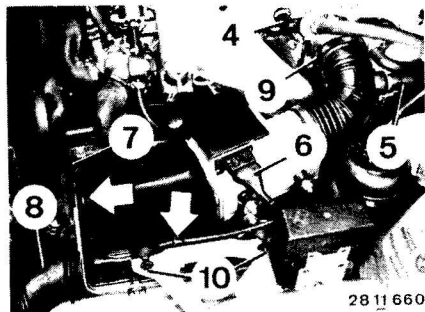
Pull off plug (16) and remove idle speed positioner (17).

Cars with Four Wheel Drive:

Pull off hose (14).

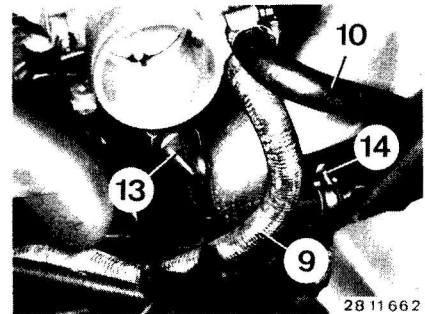
Pull off plug (1).

Disconnect hoses (2 and 3).



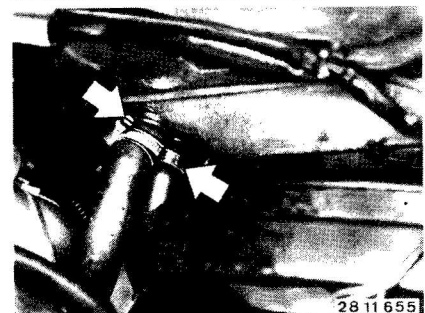
M 20 B 27:
 Pull off vacuum hose (4) and hose (5).
 Pull off plugs (6 and 7) and disconnect wire harness.
 Pull out hose (8) and loosen hose clamp (9).
 Unscrew nuts (10) and remove air cleaner with air flow sensor.

28 11 660



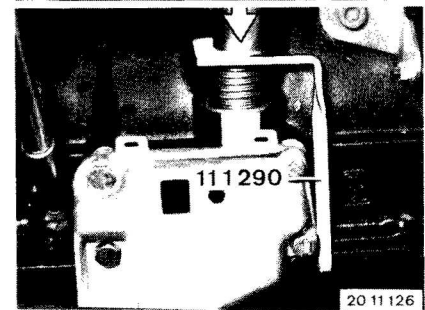
Disconnect hoses (9 and 10).
 Pull off plug (13).
 Unscrew bracket (14).

28 11 662



All Models:
 Disconnect water hoses for heater.

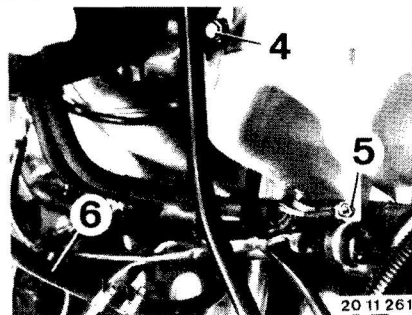
28 11 655



Press down vent tube and lock with Special Tool 11 1 290.

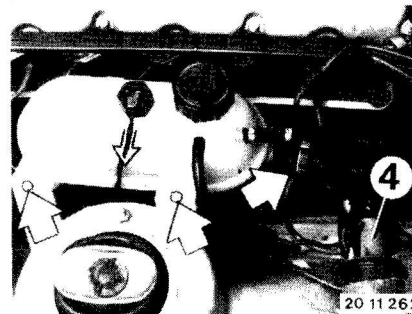
Installation:
 Check seal, replacing if necessary.
 Check for correct fit of vent tube after removing Special Tool 11 1 290.

20 11 126



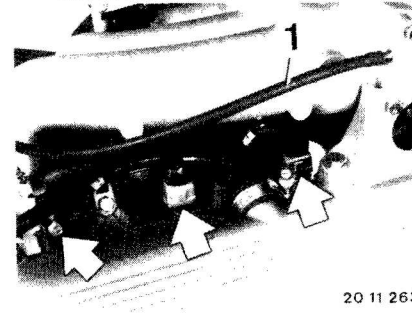
Unscrew oil dipstick tube (4).
 Unscrew holder (5).
 Disconnect fuel hose (6).

20 11 261



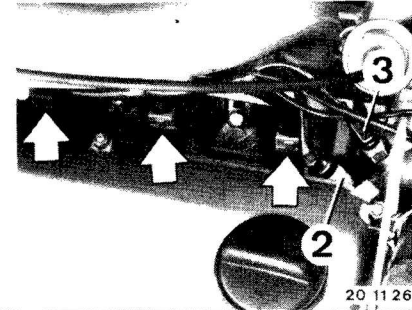
Pull off wire (4) on ignition coil.
 Take off coolant expansion tank.

20 11 262



M 20 B 25:
 Pull off plugs on fuel injectors (4/5/6) and pull out wire harness.
Cars with Four Wheel Drive:
 Pull off hose (1).

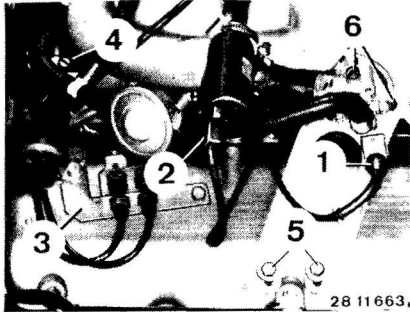
20 11 263



Pull off plugs (2 and 3).
 Pull off wire on oil pressure switch.
 Pull off plugs on fuel injectors (1/2/3).
 Disconnect wire harness and pull in to the left side.

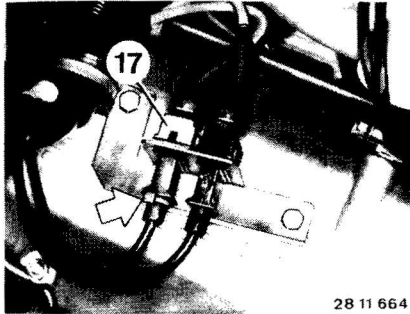
20 11 264

11-107a



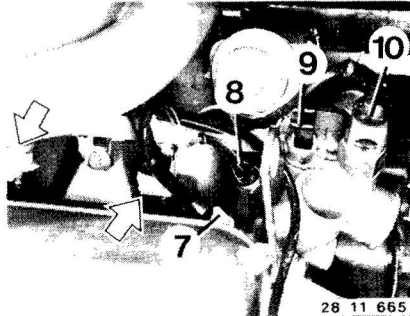
M 20 B 27:
 Pull off plugs (1 and 2).
 Unscrew bracket (3).
 Pull off fuel hose (4).
 Unscrew support (5) with flange (6).
 Pull off plugs on fuel injectors (4 ... 6).
Installation:
 Replace gasket if necessary.

28 11 663.



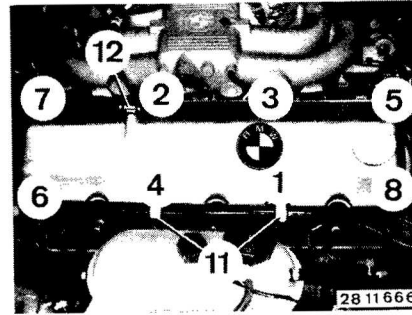
Installation:
 Connect DME plugs for reference mark and speed transmitter signals in such a manner, that gray plug (17) is connected with plug having a ring for identification.

28 11 664



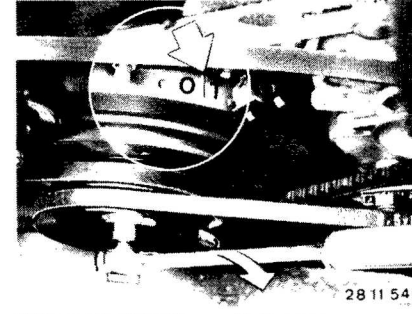
Pull off plugs on fuel injectors (1 ... 3) as well as plugs (7 ... 10).
 Pull off wires on oil pressure switch.
 Disconnect and pull in wire harness to the left side.

28 11 665.



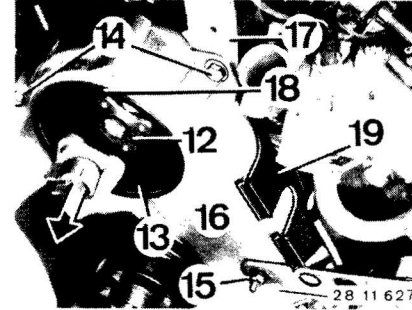
All Models:
 Pull off wire (4) on ignition coil.
 Pull off spark plug connectors.
 Unscrew ignition lead tube (11).
 Disconnect vent hose (12).
 Unscrew nuts (1 ... 8) and take off cylinder head cover.
Installation:
 Check gasket, replacing if necessary.
 Tighten nuts in order of 1 through 8.

28 11 666



Turn crankshaft to set cylinder no. 1 to TDC (valves of cylinder no. 6 overlap).
 Take off distributor cap.

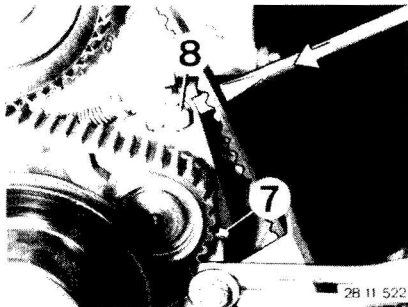
28 11 546



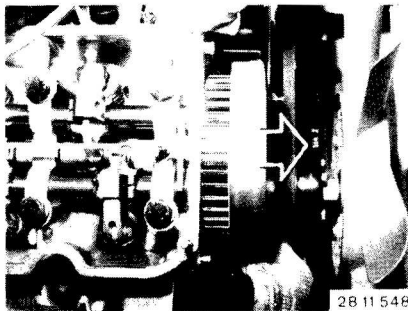
Unscrew distributor rotor.
 Unscrew adapter (12).
 Remove cover (13).
 Unscrew bolts (14).
 Unscrew nut (15).
 Remove protective cover (16).
Installation:
 Screw on holder (17).
 Check rubber ring (18).
 Insert rubber cover (19).

28 11 627.

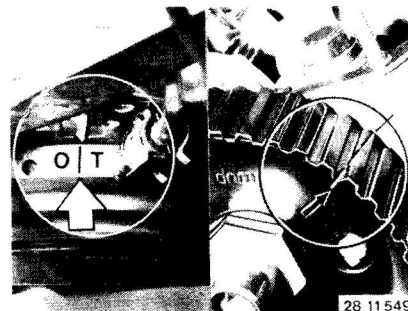
11-108



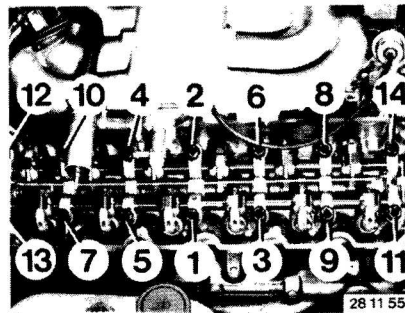
Loosen bolts (7 and 8).
Press in tensioning roller.
Tighten bolt (6).



Take off drive belt on camshaft sprocket.
Caution!
Never crank engine after removing drive belt.
Installation:
Always replace drive belt – see 11 31 110.



Installation:
Before installing the cylinder head, turn the camshaft that mark on camshaft sprocket is facing mark on cylinder head.
Cylinder no. 1 is in TDC.
Also install the drive belt in this position.



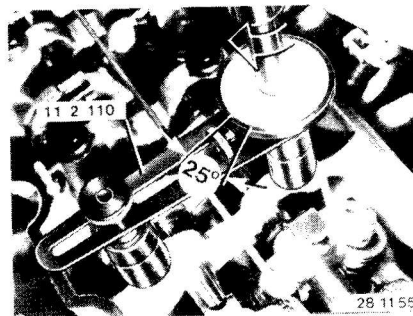
Unscrew bolts in order of 14 through 1 and take off the cylinder head.

Installation:

Keep oil out of cavities, since otherwise bolts tightened with correct torque might not exert sufficient pressure on the cylinder head and, in addition, the crankcase might be cracked. Clean cylinder head bolts.

Lubricate threads and bearing surfaces of bolt heads with a light coat of oil.

Replace cylinder head gasket – see 11 12 101.



Tighten bolts in order of 1 through 14 in three steps.

Tightening torque*.

Adjust valve clearance – see 11 34 004.

Adjust engine idle speed and CO level -- see 13 00 054.

Tighten cylinder head bolts in the 3rd step (cylinder head cover removed again after running engine warm) to torque angle with Special Tool 11 2 110 regardless of the engine temperature.

Note:

Cylinder head bolts need not to be retightened after 1,000 km (600 miles).

* See Specifications

11 - 108 a

11 12 100 REMOVING AND INSTALLING CYLINDER HEAD — SINCE 1988 MODELS —

Disconnect battery ground lead.
Disconnect plug for oxygen sensor.
Unscrew exhaust pipes on exhaust manifolds and holder on transmission.

Installation:

Check gaskets, replacing if necessary.
Coat studs with copper paste "CRC"***.
Replace self-locking nuts.
Tightening torque*.

Unscrew plug and drain coolant.

Installation:

Pour in coolant*** and bleed cooling system
— see 17 00 039.
Replace engine oil***.

Disconnect accelerator cable (1).

Cars with Cruise Control:

Disconnect cruise control cable (2).

Cars with Automatic Transmission:

Disconnect throttle cable (3).

Installation:

Adjust accelerator cable — see Gr. 35.

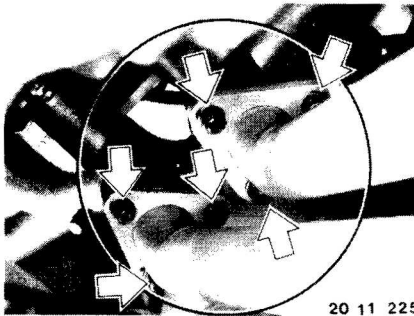
Adjust cruise control cable — see Gr. 65.

Adjust throttle cable — see Gr. 24.

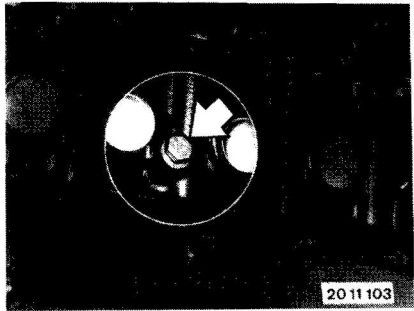
* See Specifications

** Source of Supply: HWB

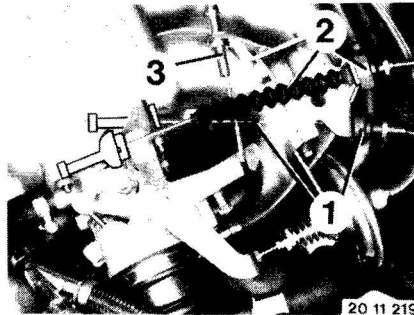
*** See Service Information of Gr. 00



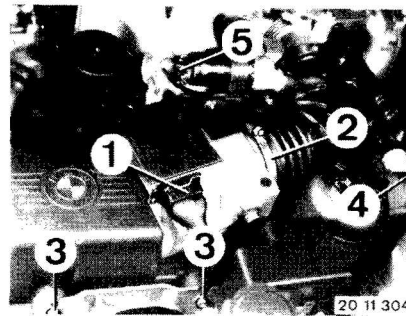
20 11 225



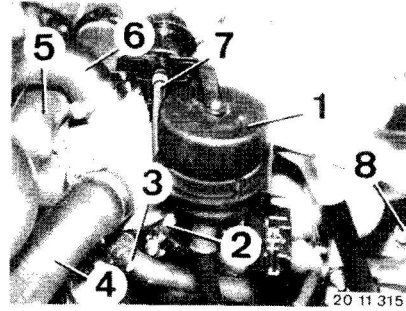
20 11 103



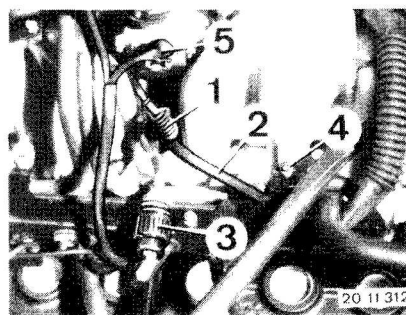
20 11 219



20 11 304



20 11 315



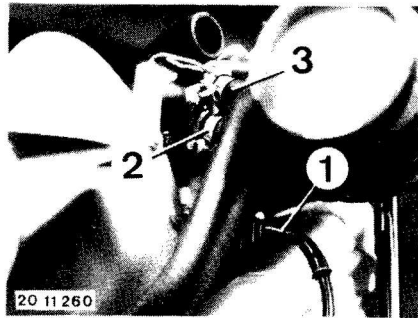
20 11 312

Pull off plug (1).
Loosen clamp (2).
Unscrew nuts (3) and lift out air cleaner with air flow sensor.
Pull off hose (4).
Pull off plug (5).

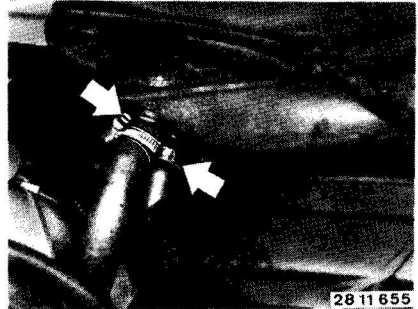
Remove diagnosis plug (1).
Disconnect hoses (2 ... 6).
Disconnect fuel hose (7).
Unscrew holder (8).

Pull off plug (1).
Pull off fuel hose (2).
Disconnect plug (3).
Unscrew bolt (4).

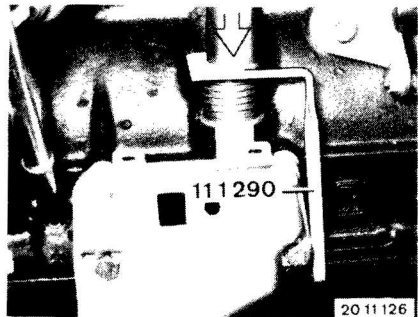
11-108 b



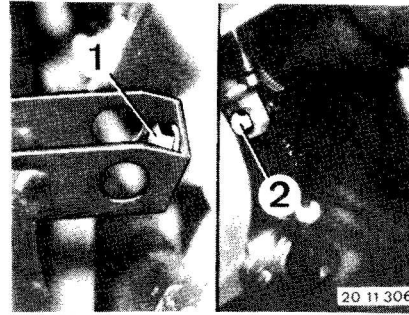
Pull off plug (1).
Disconnect hoses (2 and 3).



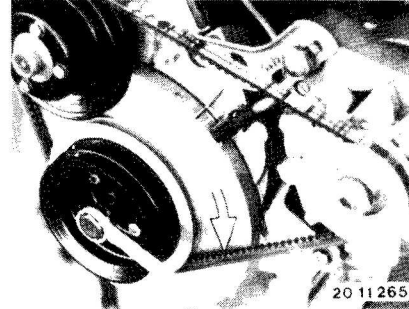
Disconnect water hoses for heater.



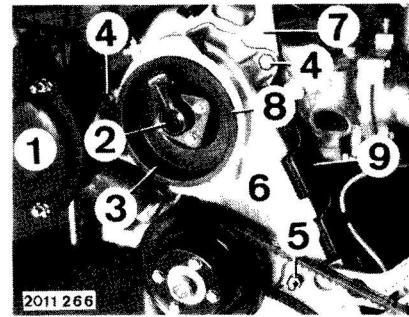
Press down and arrest breather tube with Special Tool 11 1 290.
Installation:
Check seal, replacing if necessary.
Check for correct seating of breather tube after removal of Special Tool 11 1 290.



Pull ignition leads off of ignition coil.
Remove fan -- see 11 52 000.
Unscrew water pipe bolts (1 and 2) and take off water pipe.

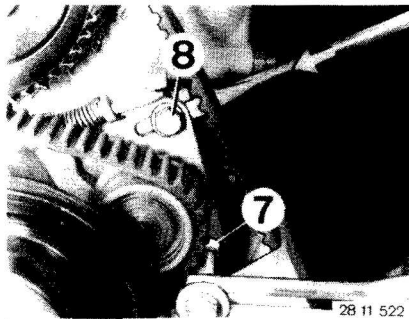


Remove cylinder head cover -- see 11 12 000.
Turn crankshaft to have cylinder no. 1 in TDC and overlapping valves in cylinder no. 6.

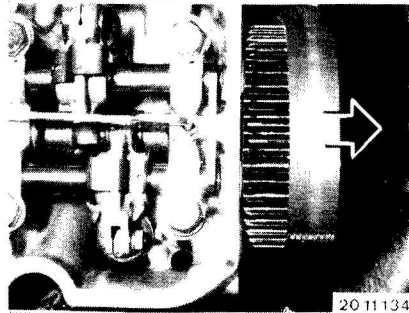


Unscrew distributor cap (1).
Unscrew distributor rotor (2).
Remove cover (3).
Unscrew bolts (4).
Unscrew nut (5).
Remove protective cover (6).
Take off wire clip underneath the distributor and place leads in front of pulley.
Installation:
Screw on holder (7).
Check rubber ring (8).
Install rubber cover (9).

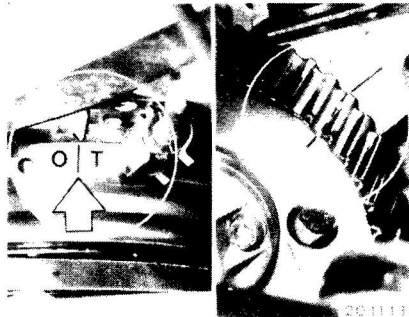
11 - 108 c



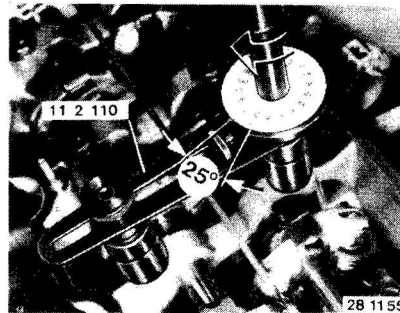
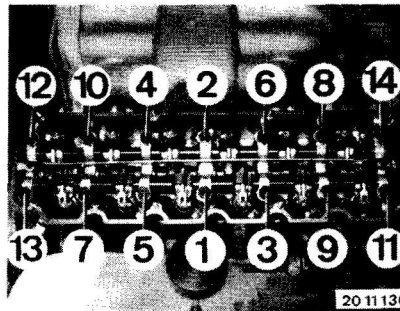
Loosen bolts (7 and 8).
Press in tensioning roller and tighten bolt (8).



Take drive belt off of camshaft sprocket.
Caution!
Never crank engine after removing drive belt.
Installation:
Always replace an used drive belt, regardless of the driven miles, each time the tensioning roller is loosened***.
Replace drive belt — see 11 31 110.



Installation:
Turn camshaft to have mark on camshaft sprocket facing mark on cylinder head prior to mounting the cylinder head.
Cylinder no. 1 is in TDC.
Drive belt is also installed in this position.



Unscrew bolts in order of 14 through 1 and take off cylinder head.
Installation:
Keep oil out of cavities since otherwise bolts tightened with specified torque might not exert sufficient pressure on the cylinder head and, in addition, the crankcase might be cracked.
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with a light coat of oil.
Replace cylinder head gasket — see 11 12 101.

Tighten bolts in order of 1 through 14 in three steps.
Tightening torque*.
Adjust valve clearance — see 11 34 004.
Adjust ignition timing — see 12 11 004.
Adjust engine idle speed and CO level — see 13 00 054.
In the third step (cylinder head cover removed again after running the engine warm), tighten the cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature.
Note:
Cylinder head bolts do not have to be tightened again after 1,000 km (600 miles).

*** See Service Information of Gr. 11

* See Specifications

11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head — see 11 12 100.
Clean sealing surfaces on cylinder head and crankcase — using sealant remover** and a hard wood scraper.
Check levelness with a standard steel ruler, grinding the cylinder head sealing surface if necessary — see 11 12 719.

Installation:

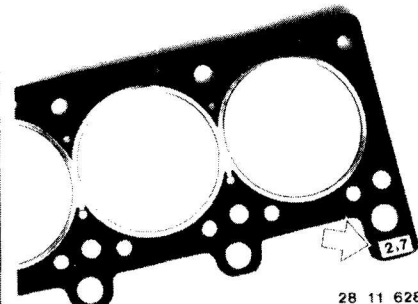
Only use original cylinder head gaskets, of which the openings for coolant are matched precisely.

Engine	Stamped Code
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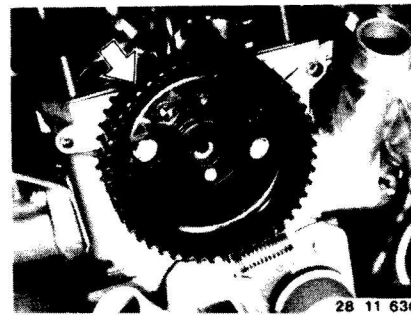
M 20 B 25	2.5
M 20 B 27	2.7

Important!

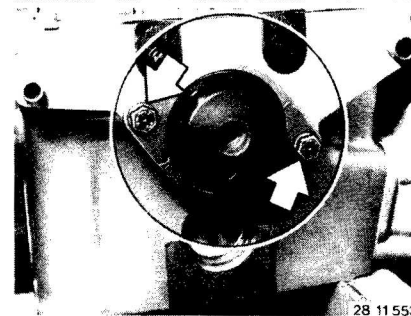
A 0.3 mm (0.012") thicker gasket must be installed after grinding the cylinder head to prevent reduction in combustion chamber size.



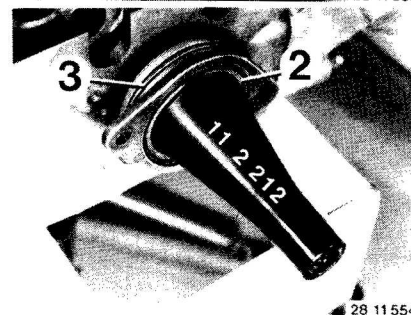
28 11 628



28 11 630



28 11 553



28 11 554

11 12 240 REPLACING RADIAL OIL SEAL IN END COVER

Remove drive belt — see 11 31 110.
Take off sprocket.

Note:

Always replace drive belt — see 11 31 110.

Unscrew cover.

Replace radial oil seal (2) and round cord seal (3).

Installation:

Use Special Tool 11 2 212 to install the cover.

11 12 561 REPLACING VALVE GUIDE — Valve Removed —

Check wear* of valve guide with Special Tool 00 4 300.

Drive out valve guide (cold) into the combustion chamber with Special Tool 11 1 330.

Inspect bore in cylinder head with Special Tool 00 4 530.

If permissible diameter A is exceeded, ream out the bore with a standard reamer and install an oversize* valve guide.

Heat* cylinder head.

Drive valve guide into the combustion chamber from the camshaft side with Special Tool 11 1 320.

Stepped end of valve guide faces the camshaft.

Important!

The bore in the special tool determines the installed depth B = 14.5 ± 0.5 mm (0.571 ± 0.020 ").

Ream out valve guide to 7 mm H 7 diameter with Special Tool 00 4 200.

Machine valve seats, see 11 12 607.

* See Specifications

11 12 595 CHECKING VALVE GUIDE FOR WEAR — Valve Removed —

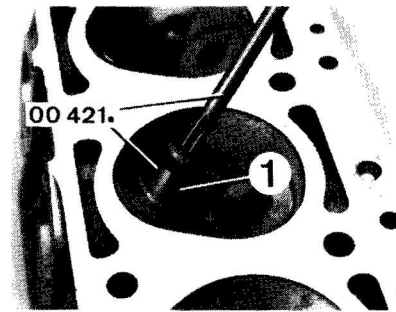
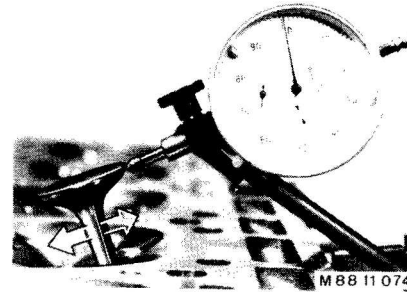
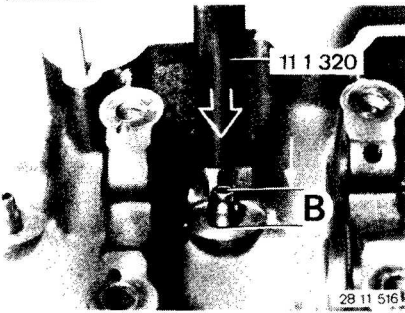
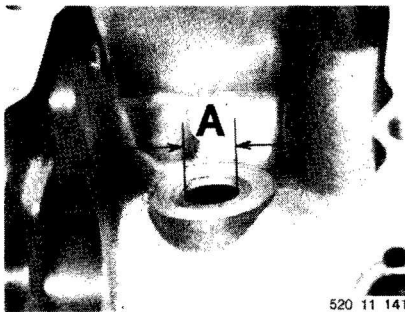
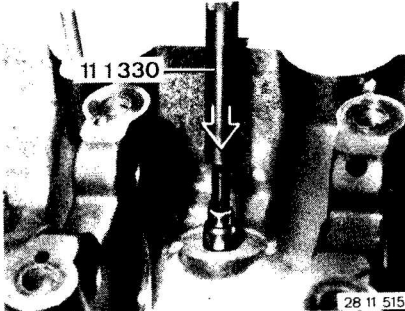
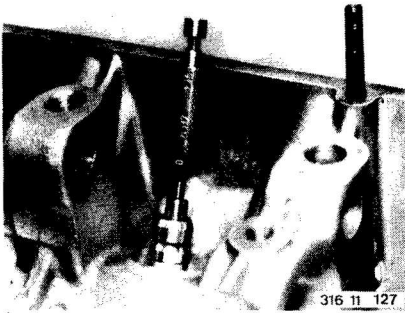
To measure, insert a new valve that its stem end is flush with the valve guide. Apply dial gage and measure the tilt clearance. Max. permissible tilt clearance*.

11 12 600 REAMING OUT VALVE GUIDE — Valve Removed —

If there is excessive play between the valve guide and valve stem, see 11 12 595, ream out the valve guide and install a valve with a larger stem diameter "S"*.

The valve seat must then also be machined in conjunction with this, see 11 12 607. Press guide pad (1) on to valve seat and ream out valve guide from the combustion chamber end — turning down the reamer once.

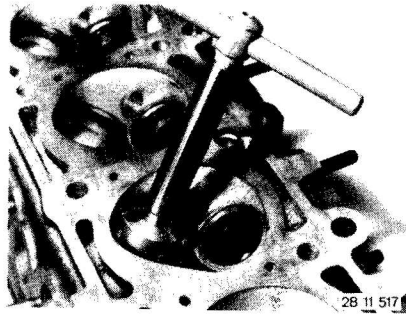
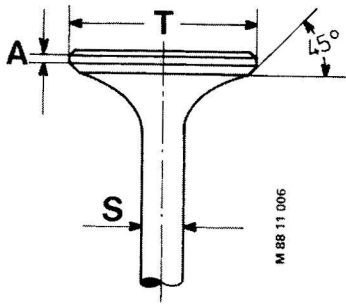
* See Specifications



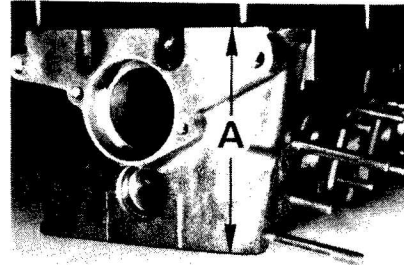
11 12 607 MACHINING VALVE SEATS AND VALVES

— Valves Removed —

The valve has to be replaced, if the minimum edge thickness A^* cannot be held.



Produce the valve seat diameter M^* and valve seat width B^* by machining correction angles* after machining the valve seat angle*. Grind in valves with grinding paste and check for leaks, see 11 34 509.



11 12 719 GRINDING CYLINDER HEAD SEALING SURFACE

— Cylinder Head Disassembled —

The original total thickness (A) of the cylinder head is 125.1 ± 0.1 mm (4.925 ± 0.004 "') and not more than 0.3 mm (0.012 "') may be ground off.

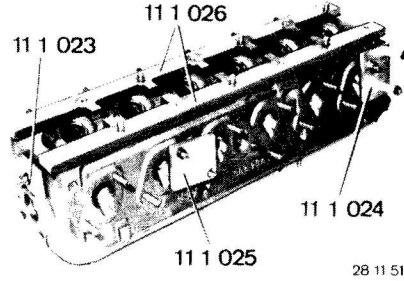
Use a 0.3 mm (0.012 "') thicker gasket on a reground cylinder head (also refer to 11 12 101)

28 11 518

11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST

Mount Special Tools 11 1 026 on the cylinder head, using cylinder head bolts.

Close off water circuit on the cylinder head with Special Tools 11 1 023, 11 1 024 and 11 1 025.



28 11 519

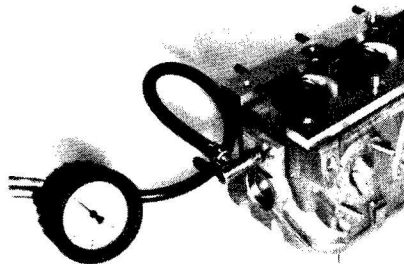
Apply compressed air on cylinder head.

Pressure: 4.5 bar (64 psi).

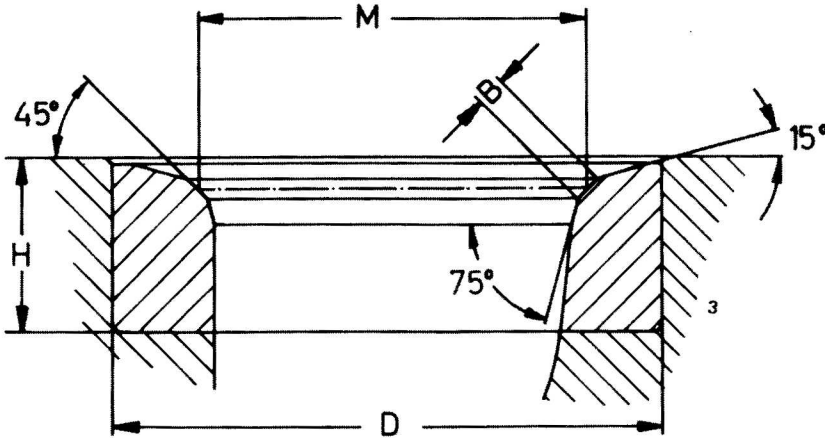
Place cylinder head in a water bath and check for cracks.

Note:

If necessary, relax water bath with a detergent.



28 11 520



11 13 000 REMOVING AND INSTALLING OIL PAN

Lift out and disconnect plug.

Drain oil.

Installation:

Add engine oil***.

28 11 667

Unscrew steering gear on front axle carrier, see 32 11 ...

Unscrew cover/reinforcement plate.

28 11 668

Unscrew oil pan.

Unscrew oil pump and remove oil pan.

Installation:

Insert oil pump drive shaft, see 11 41 000.

Replace gasket.

28 11 572

Installation:

Clean sealing surfaces.

Coat joint surfaces on timing case covers and end cover with a brush-on universal sealing compound**.

28 11 573

** Source: HWB

*** See Service Information of Gr. 00

11 14 175 REMOVING AND INSTALLING FRONT END COVER

Remove radiator, see Group 17.

Remove toothed drive belt 11 31 110.

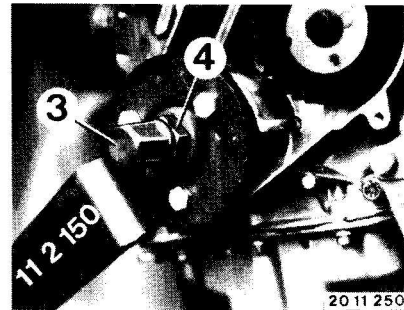
Single-piece Hub/Toothed Belt Sprocket:
Hold sprocket with Special Tool 11 2 150.

Unscrew bolt (3).

Take off collar (4).

Installation:

Tightening torque*.

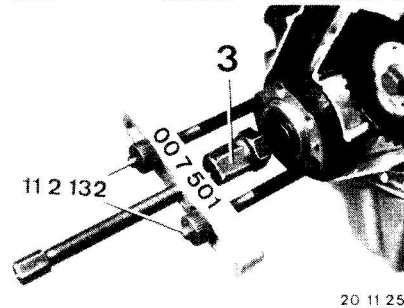


Screw in bolt (3) about 3 turns.

Pull hub/toothed belt sprocket off of the crankshaft with Special Tools 00 7 501 and 11 2 132.

Important!

Woodruff key.



Two-piece Hub/Toothed Belt Sprocket:

Screw in bolt (3).

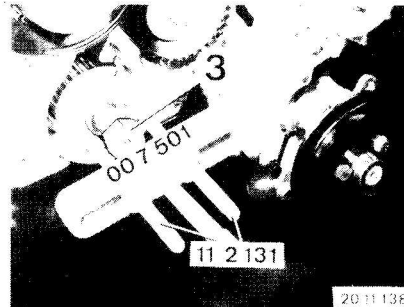
Pull toothed belt sprocket off of the crankshaft with Special Tools 00 7 501 and 11 2 131.

Important!

Woodruff key.

Installation:

Mount sprocket that the stepped side faces forward.



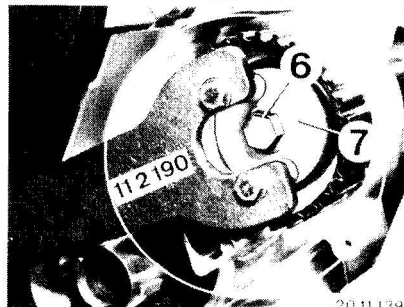
Hold sprocket of intermediate shaft with Special Tool 11 2 190.

Unscrew bolt (6).

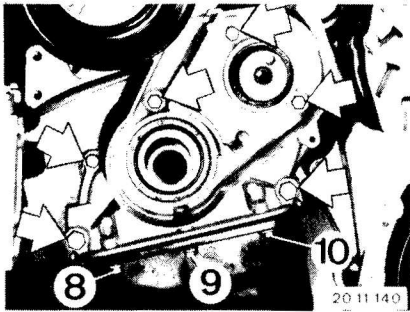
Take off washer and sprocket.

Installation:

Guide centering pin (7) into bore.



* See Specifications

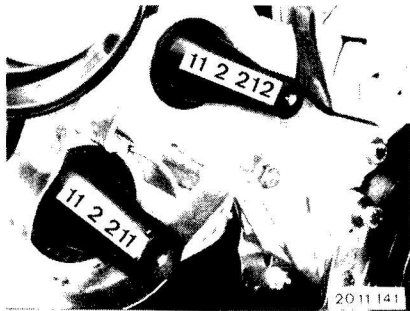


Unscrew bolts (8 ... 10).
Only loosen the other oil pan bolts.
Loosen oil pan gasket on end cover carefully with a knife.

Take off cover.

Installation:

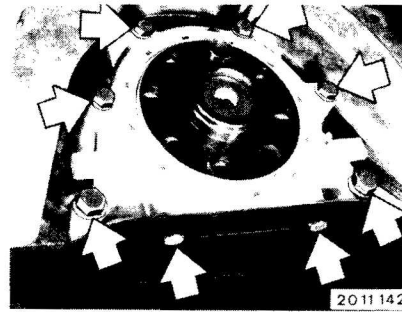
If oil pan gasket was damaged, remove oil pan and replace gasket – see 11 13 000.
Coat bores of oil pan gasket with a brush-on universal sealing compound/Three Bond Silicone 1207**.
Replace gasket.



Check radial oil seals, replacing if necessary.

Important!

Always use Special Tools 11 2 211 (crankshaft) and 11 2 212 (intermediate shaft) for installation of the end cover.



11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER Transmission Removed

Remove flywheel 11 22 000.

Unscrew oil pan/end cover bolts.

Only loosen the other oil pan bolts.

Loosen oil pan gasket on end cover carefully with a knife.

If oil pan gasket was damaged, remove oil pan and replace gasket – see 11 13 000.

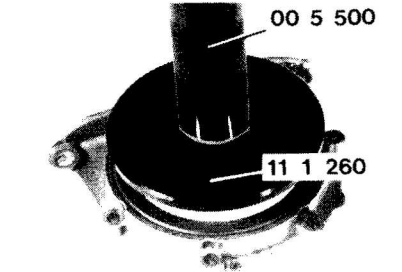
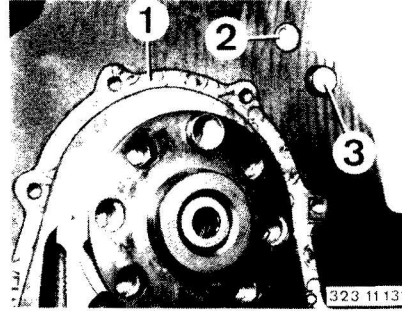
Take off end cover.

Replace gasket (1).

Important!

Check cover (2) of main oil bore for leaks, replacing with a new plug (3) if necessary.

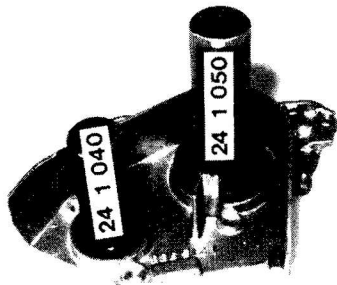
Install plug with Loctite No. 270**.



Press in the radial oil seal with Special Tools 11 1 260 and 00 5 500.

Press in the new radial oil seal approx. 1 to 2 mm (0.039 to 0.079") deeper, in contradiction to the standard seal which had been installed flush.

Lubricate sealing lip with oil.



11 14 180 REPLACING RADIAL OIL SEAL IN END COVER

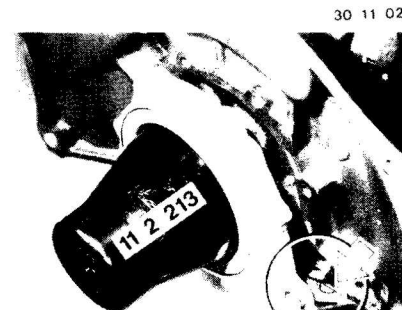
Remove end cover 11 14 175.

Press radial oil seals out of the cover.

Press in radial oil seals with Special Tools 24 1 050 and 24 1 040.

Press in the new radial oil seals approx. 1 to 2 mm (0.039 to 0.079") deeper, in contradiction to the standard seal which had been installed flush.

Lubricate sealing lips with oil.



Coat end cover/oil pan joint with a brush-on universal sealing compound / Three Bond Silicone 1207**.

Use Special Tool 11 2 213 to avoid damage on the radial oil seal.

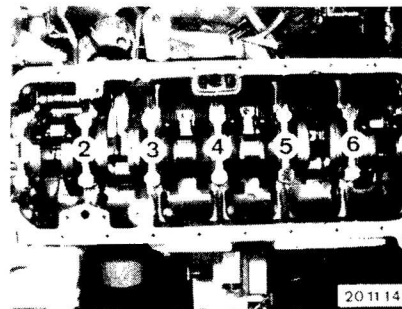
11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove the engine 11 00 050.
Mount engine block in assembly stand 00 1 490 with Special Tool 11 0 120.

Remove the clutch 21 21 000.
Take off the cylinder head 11 12 100.
Remove front end cover 11 14 175.
Remove the oil pump 11 41 000.
Check axial play* before removing the crankshaft.
Check / replace the thrust bearing, if the maximum permissible play is exceeded.

Remove flywheel 11 22 000.
Take off the end cover.
Installation:
Replace the gasket.
Use Special Tool 11 2 213 to avoid damage on the radial oil seal.
Cut off gasket on the oil pan sealing surface.

Unscrew the conrod bearing caps.
Installation:
Replace conrod bearing shells and measure the conrod bearing play, see 11 24 571.
The pairing code (0 to 99) must be the same on the connecting rods and caps.



Remove crankshaft bearing caps and lift out the crankshaft.

Installation:

Do not mix up the bearing caps.
Bearing cap no. 1 is on the drive belt end.
Bearing no. 6 is the thrust bearing.
Install bearing shells and check the bearing play, see 11 21 531.

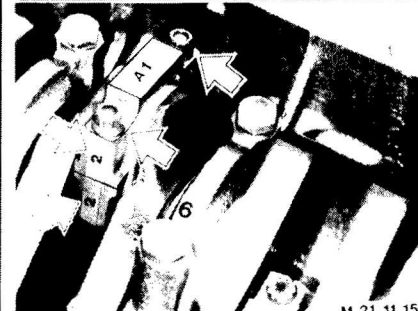
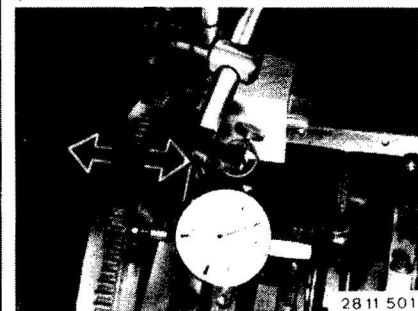
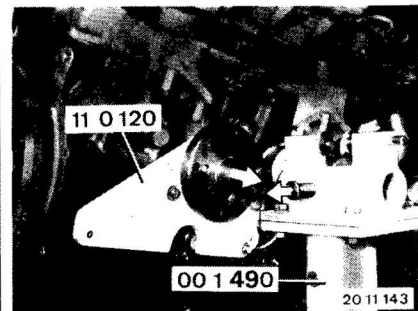
Installation:

Measure axial play with the crankshaft installed – loosen thrust bearing no. 6.

Center the thrust bearing by applying knocks from a plastic hammer on the front and rear ends of the crankshaft.

Tighten the thrust bearing to specifications. Measure the axial play*.

If the crankcase is replaced, clean the oil and water bores again thoroughly to remove casting sand.



* See Specifications

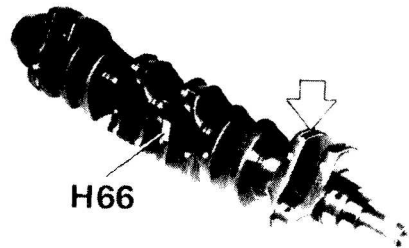
* See Specifications

11 21 501 REPLACING CRANKSHAFT - Crankshaft Removed -

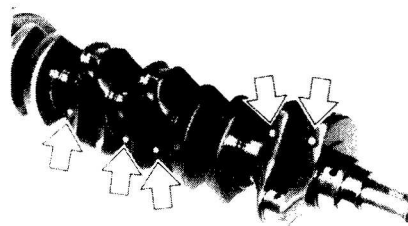
Note:

A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings. Crankshaft Identification:

Engine	Stroke	Grooves	Code
M 20 B 20	66.0 mm	1	U
M 20 B 23	76.8 mm	-	V
M 20 B 25	75.0 mm	3	X
M 20 B 27	81.0 mm	2	W



28 11 307



28 11 30E

Crankshaft is surface treated and may only be reground in the factory.

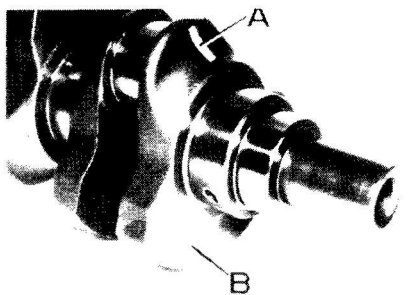
Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)

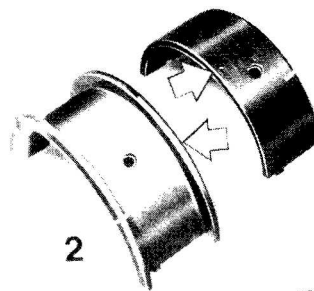
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Main Bearing Journal (B)

1 paint stripe Size 1 *
2 paint stripes Size 2 *



M21 11 023



28 11 053

1 = Bearing shell 1-2-3-4-5-7
2 = Bearing shell 6 (pilot bearing)

The color code is located on the side of the bearing shell.

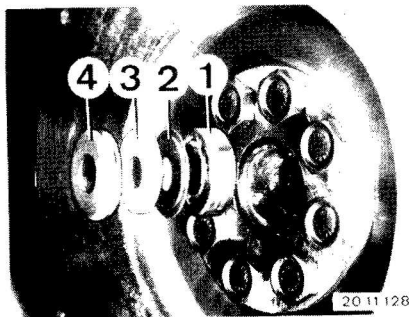
Cars with Manual Transmission:

Install pilot bearing for the transmission main shaft.

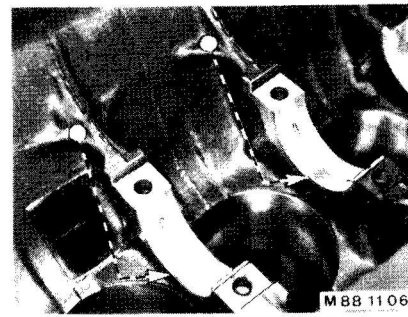
Installed Order:

Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

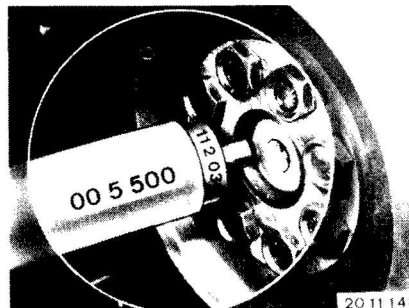


20 11 128

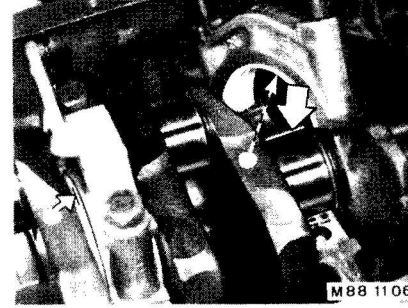


M88 11 060

Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



20 11 148



M88 11 061

Installing Instructions:

Only place bearing shells with "yellow" marks in the crankcase (regardless of the old color code mark on the crankcase).

Install bearing shells in bearing caps depending on the color code of the crankshaft bearing journals - "yellow-green-white".

Install crankshaft.

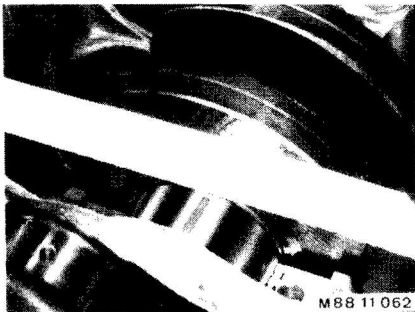
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:

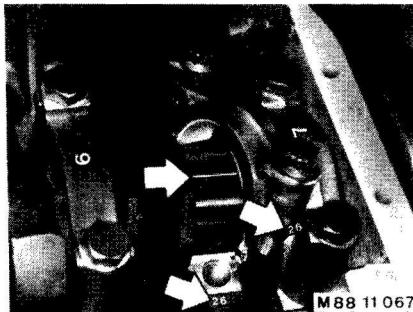
CARTOOL
Alfred-Jrehm-Str. 5
D-8070 Ingolstadt

* See Specifications

* See Specifications



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



Place Type PG-1 Plastigage on crankshaft wiped clean of oil in BDC position and mount the bearing caps that all grooves are on one side.
The pair number (0 ... 99) must be the same on connecting rods and caps.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingoistadt

Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness*

Triple Classification Color Codes:

Ge = yellow

Gn = green

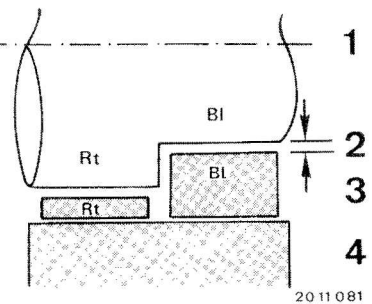
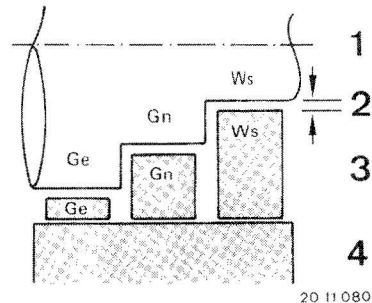
Ws = white

Double Classification Color Codes:

Rt = red

Bl = blue

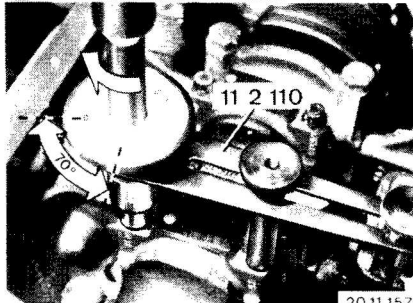
- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter



Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod or crankshaft for a pertinent ground size.

Only install the red bearing shells of a pertinent ground size for a replacement crankshaft.

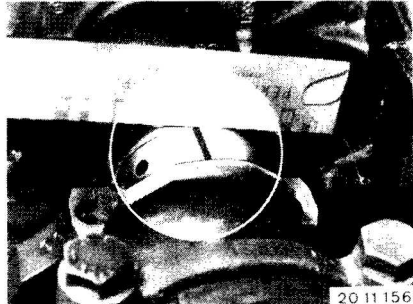
* See Specifications



Tighten bolts in two steps (use old conrod bolts).
Step 1 20 Nm (14.5 ft. lbs.)
Step 2 70° torque angle

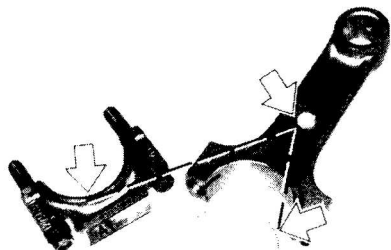
Important!
Do not turn the connecting rods or crankshaft.

Remove bearing caps.



Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.
Replace conrod bolts for final installation and tighten the conrod caps in two steps (see above).

* See Specifications



11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS - Engine Disassembled -

Crankshaft bearing shells with the following color codes for a pertinent ground size had been installed standard.

- Double classification: red/blue (old color code)
- Triple classification: yellow/green/white (new color code)

- 1 = Bearing shell 1-2-3-4-5-7
- 2 = Bearing shell 6 (pilot bearing)

Color code mark is located on the side of a bearing shell.

Install bearing shells in crankcase with same color code as the dot of paint on the console.

Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.

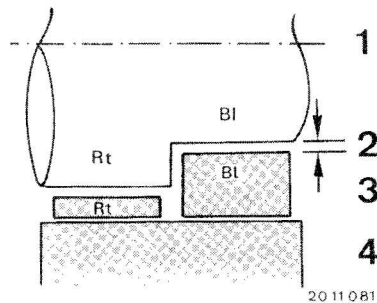
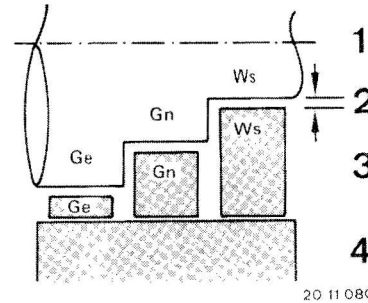
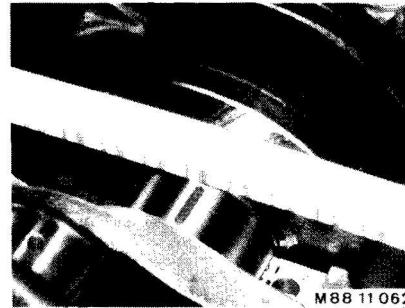
Install bearing shells in bearing caps with the same color code as for the crankshaft.

Install crankshaft.

Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



Remove bearing caps. Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale. Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.

Survey of Color Code/Shaft Diameter/
Bearing Shell Thickness*

Triple Classification Color Codes:

Ge = yellow

Gn = green

Ws = white

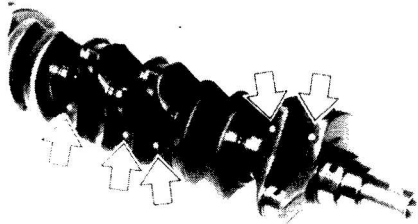
Double Classification Color Codes:

Rt = red

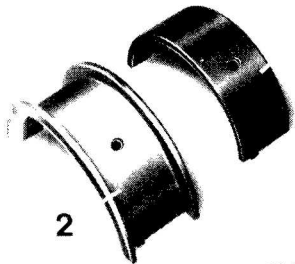
Bl = blue

- 1 Crankshaft diameter
- 2 Bearing play
- 3 Bearing shell thickness
- 4 Console diameter

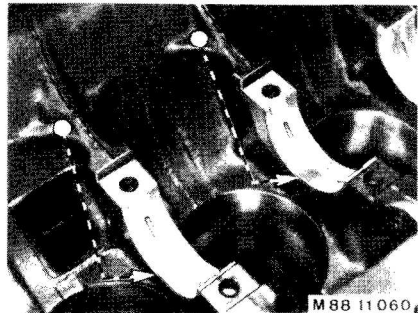
* See Specifications



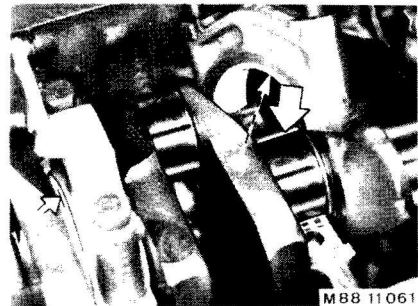
28 11 306



28 11 053



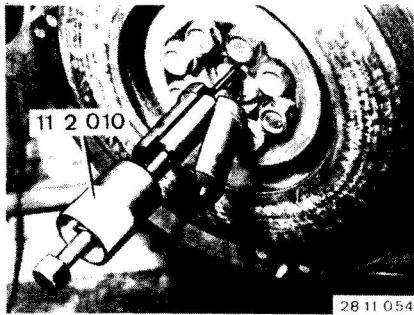
M88 11 060



M88 11 061

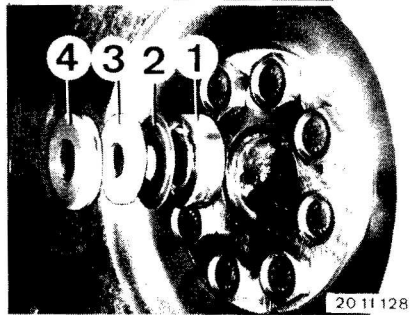
11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch disc 21 21 000.
Pull out ball bearing with Special Tool
11 2 010.



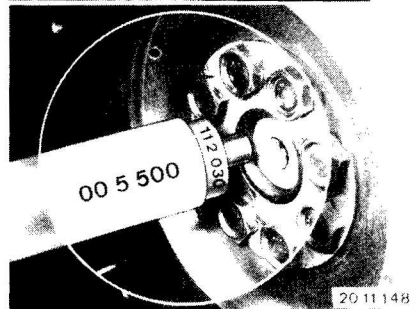
28 11 054

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and
capsule (4).
Install cover (2) with embossment facing out



20 11 128

Pack bore in crankshaft with approx. 1 gram
of lubricating grease.
Drive in pilot bearing with Special Tools
11 2 030 and 00 5 500.



20 11 148

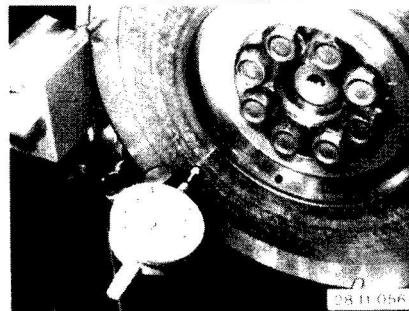
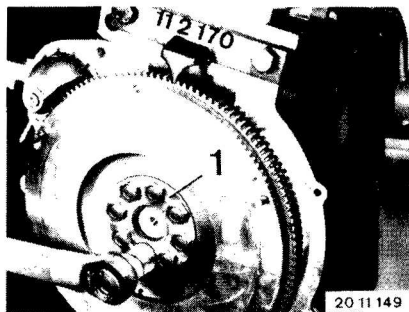
11 22 000 REMOVING AND INSTALLING FLYWHEEL

Remove clutch — see 21 21 000.
 Hold flywheel with Special Tool 11 2 170.
 Unscrew bolts and take off flywheel.
Installation:
 Clean tapped bores.
 Insert ring (1).
 Replace and install expansion bolts with Loctite No. 270**.
 Tightening torque*.

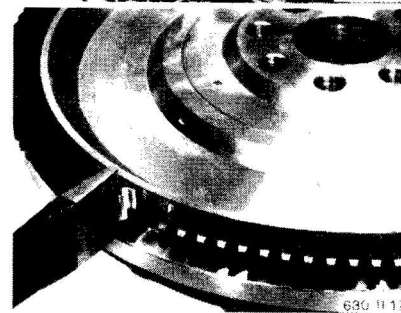
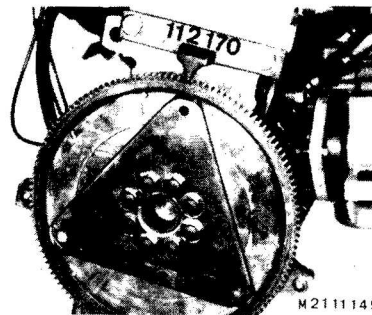
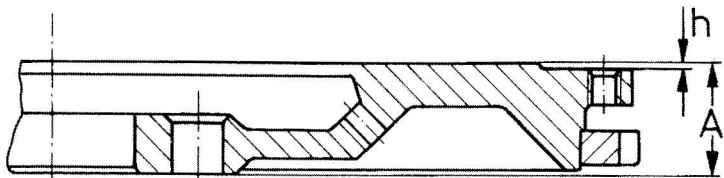
Check flywheel for axial runout*.

Friction surface may be machined to minimum distance A*.
 If machining the friction surface reduces distance "h" to zero, the flange surface (distance "h") has to be machined.
 The friction surface of a double-mass flywheel cannot be machined.

* See Specifications
 ** Source: HWB



M 88 11 072



11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

Remove transmission — see Group 24.
 Hold flywheel with Special Tool 11 2 170.
 Unscrew bolts and take off flywheel.
Installation:
 Clean tapped bores.
 Replace and install expansion bolts with Loctite No. 270**.
 Tightening torque*.

11 22 541 REPLACING STARTER GEAR RING

Drill a 6 mm (0.236") dia, hole about 8 mm (0.315") deep underneath a tooth gap to make breaking the gear ring easier.

Break the starter gear ring at drilled point with a chisel.

Installation:
 Heat new starter gear ring to 200 ... 230° C (395 to 445° F), checking temperature with a thermo-color pencil.
 Tooth bevel faces the engine.
 Drive on starter gear ring to fit tight all around with a brass mandrel.

* See Specifications
 ** Source: HWB

11 23 010 REPLACING VIBRATION DAMPER

M 20 B 27:

Take drive belts off of alternator, power steering pump and, if applicable, compressor for air conditioner.

Installation:

Tighten drive belts and check tightness with Special Tool 11 5 020.

M 20 B 25:

Remove fan — see 11 52 000.

Take drive belt off of alternator, power steering pump and, if applicable, air conditioner compressor.

Unscrew pulley on water pump.

Installation:

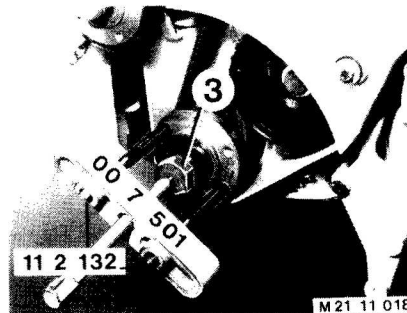
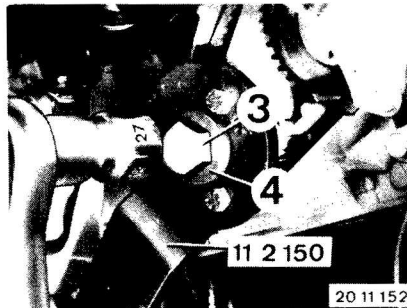
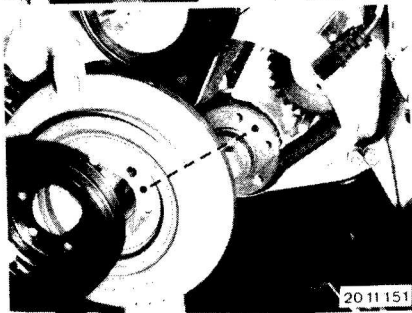
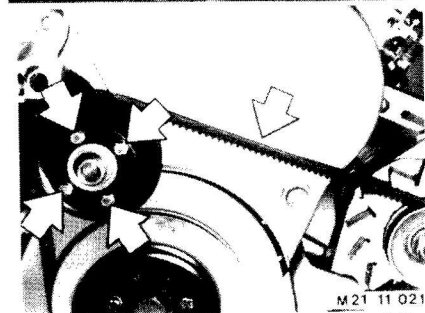
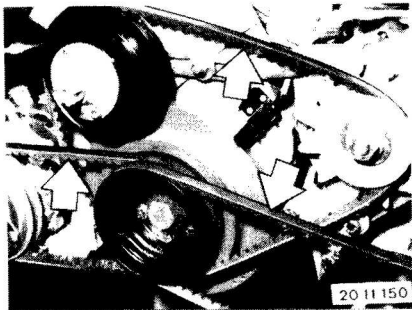
Tighten drive belt and check tightness with Special Tool 11 5 020.

All Models:

Take pulley and vibration damper off of hub.

Installation:

Centering pin must be in bore of vibration damper.



11 23 031 REPLACING HUB FOR VIBRATION DAMPER

Two Piece Hub/Pulley:

Remove radiator — see 17 11 000.

Remove vibration damper — see 11 23 010.

Hold hub with Special Tool 11 2 150.

Unscrew bolt (3).

Take off collar (4).

Installation:

Tightening torque*.

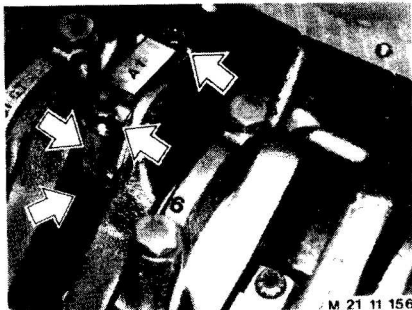
Screw in bolt (3) about three turns.

Pull hub off of crankshaft with Special Tools 00 7 501 and 11 2 132.

Unscrew bolt (3).

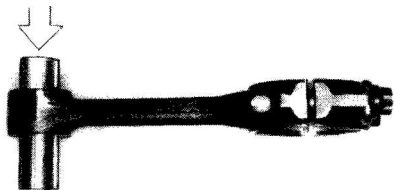
11 24 521 REPLACING CONNECTING RODS — Pistons Removed —

Important!
Only use connecting rods of the same weight group in one engine.
The weight group is stamped in the machined conrod bearing cap surface.
Connecting rods may not be machined!
Check length of connecting rods!



M 21 11 156

The piston pin must slide through the conrod bushing under light pressure.

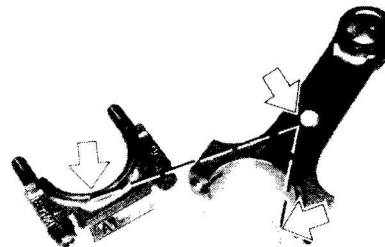


M88 11 065

11 24 571 REPLACING CONNECTING ROD BEARING SHELLS — Engine Disassembled —

Install the conrod bearing shells in the rods and caps.
Double Classification:
Install red or blue conrod bearing shells according to the color code on the connecting rods.

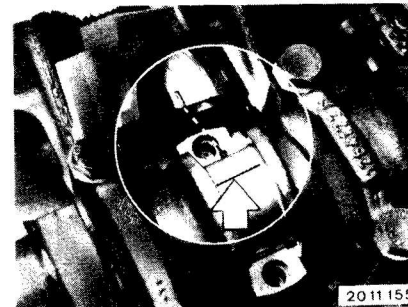
Important!
Check machined size (conrod bearing diameter).



M 21 11 154

Turn to BDC, place Type PG-1 Plastigage on crankshaft wiped clean of oil and mount conrod bearing caps that grooves are on one side. The pairing code (0 to 99) must be the same on the connecting rod and cap.

Source for Plastigage:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt / West Germany



20 11 155

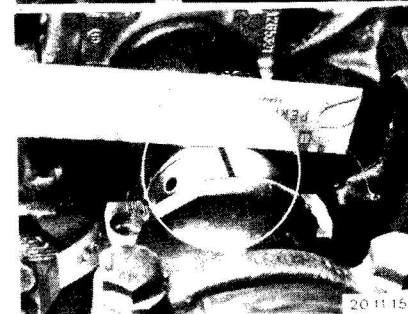
Tighten the bolts in two steps (use the old conrod bolts).

1st step 20 Nm (14.4 ft. lbs.)

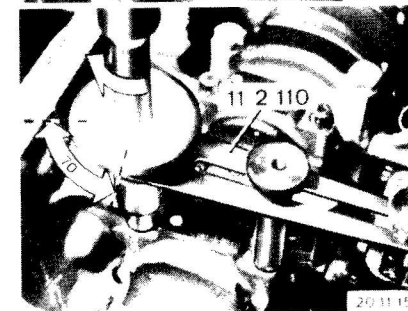
2nd step 70° torque angle

Important!
Don't turn the connecting rods or crankshaft. Take off the bearing caps. Read the bearing play* from the width of the flattened Plastigage with help of the supplied scale.

Correct the bearing play by installing new bearing shells, bearing shells of different machined size or with a different color code. Replace the conrod bolts for final installation and tighten the conrod bearing caps in two steps (see above).



20 11 156



20 11 157

* See Specifications

11 25 000 REMOVING AND INSTALLING PISTON

Remove engine.

Take off cylinder head, oil pan and oil pump. Remove connecting rod bearing cap and press out the piston with connecting rod upwards.

Important!

Mark installed position of connecting rod to the crankshaft, if connecting rod bearing shells do not have to be replaced.

Remove circlip (1). Press out piston pin.

Installation:

Piston pin is matched with piston and must not be mixed up.

Important!

If the clearance between the piston pin and conrod bushing is excessive (which will sound like acceleration knock), check the conrod bushing diameter and replace the connecting rod or bushing if necessary.

Only install piston of same make and same weight class.

Weight class is stamped with "+" or "-" in piston crown.

Important!

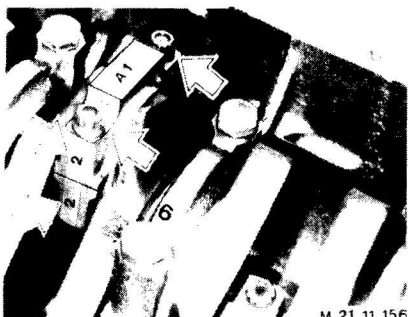
Check machined size (piston diameter)*.

Type	E*	Piston Bowl	Diameter
M 20 B 27	9.0	3.5 mm (0.138")	84 mm (3.307")
M 20 B 25	8.8	4.4 mm (0.173")	84 mm (3.307")

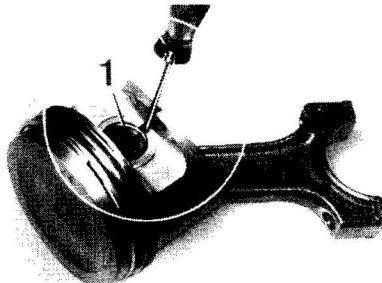
Check piston installed clearance*

Type	Make	Checkpoint A
Pistons with total height: 68.7 mm (2.705")		
M 20 B 27	Mahle	8 mm (0.315")
	KS	14 mm (0.551")
Pistons with total height: 77.7 mm (3.059")		
M 20 B 27	Mahle	23 mm (0.905")
	KS	23 mm (0.905")
Pistons with total height: 73.6 mm (2.898")		
M 20 B 25	Mahle	9 mm (0.354")

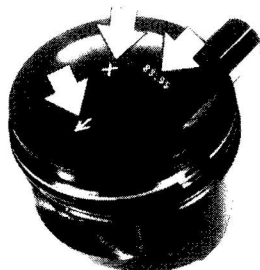
* See Specifications



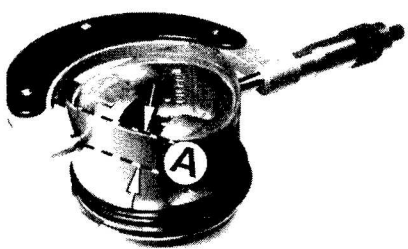
M 21 11 156



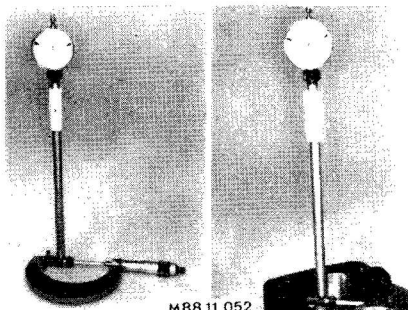
28 11 504



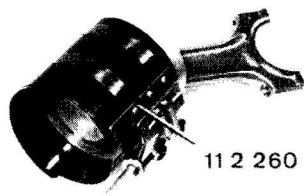
28 11 505



28 11 506



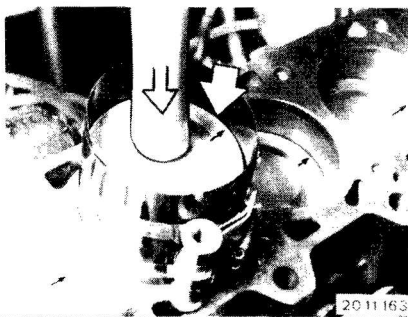
M 88 11 052



11 2 260

Set internal calipers on micrometer to zero with the measured piston diameter. Measure the cylinder bore at bottom, middle and top in radial and axial directions with the internal calipers. Compare the measured piston installed clearance with the specified piston installed clearance/ permissible total wear clearance.

Lubricate the piston and piston rings with oil. Offset piston ring end gaps by 120° to each other. Compress piston rings with Special Tool 11 2 260.



20 11 162

Install the piston that the arrow faces the drive belt. Install the connecting rod — see 11 24 521.

20 11 163

* See Specifications

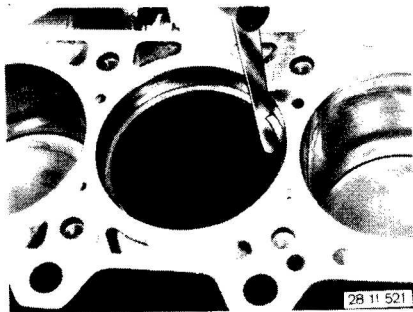
11 25 651 REPLACING PISTON RINGS
OF ONE PISTON
— PISTON REMOVED —

Measure side clearance* of piston rings.



28 11 509

Remove piston rings and measure end clearance*.

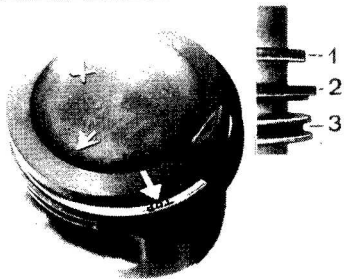


28 11 521

Installation:

Install piston rings that word "TOP" faces piston crown.

- 1 Plain compression ring
- 2 Taper face ring
- 3 Oil scraper ring

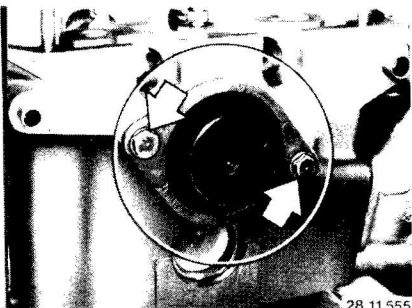


28 11 510

11-122

11 31 000 REMOVING AND INSTALLING CAMSHAFT

Remove rocker arm shafts — see 11 33 020.
Unscrew end cover.



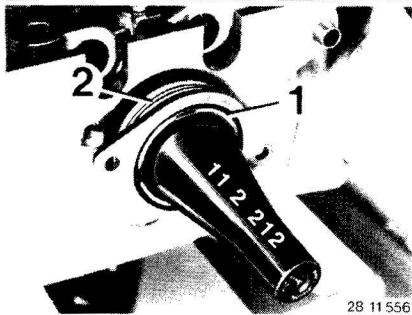
28 11 555

Check radial oil seal (1) and round cord seal (2), replacing if necessary.

Installation:

Use Special Tool 11 2 212 for installation of the end cover.

Check axial clearance*.

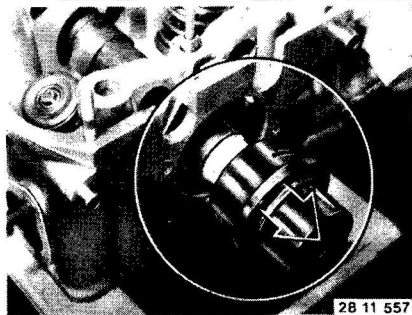


28 11 556

Pull out the camshaft.

Camshaft Identification:

Type	Degrees	Code
M 20 B 25	260	K
M 20 B 27	236	B



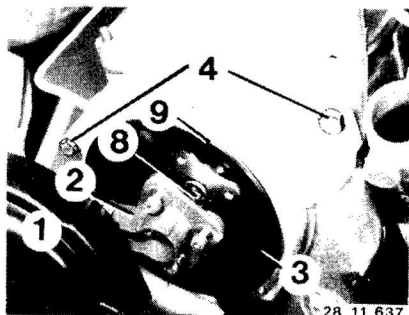
28 11 557

* See Specifications

11 31 110 REPLACING DRIVE BELT

Important!

Always replace an used drive belt, regardless of the driven miles, with a new one each time the tensioning roller is loosened***.



28 11 637

Unscrew distributor cap (1).
Unscrew distributor rotor (2).

Older Version:

Unscrew adapter (8).

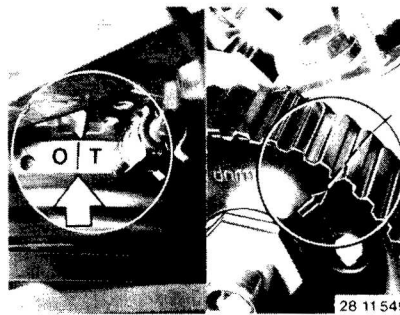
Remove cover (3).

Unscrew bolts (4).

Installation:

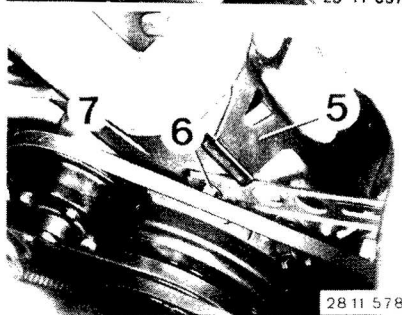
Check seal (9), replacing if necessary.

Tightening torque*.



28 11 549

Turn crankshaft to have TDC in cylinder no. 1 (arrow on camshaft sprocket facing mark on cylinder head).
Remove vibration damper – see 11 23 010.



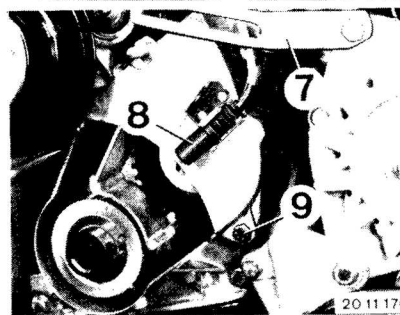
28 11 578

Take off rubber guard (5).

Unscrew nut (6).

Remove cover (7).

Re-install adapter (8).



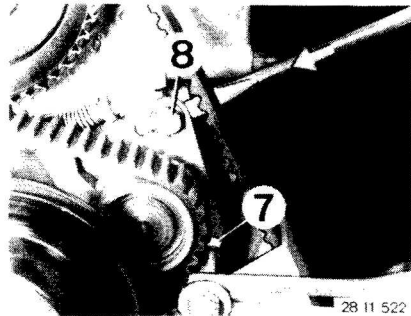
20 11 170

Two Piece Hub/Sprocket:
Remove hub for vibration damper – see 11 23 031.
Swing away tensioning bar (7).
Lift out TDC sender (8).
Unscrew bolt (9) and take off cover.

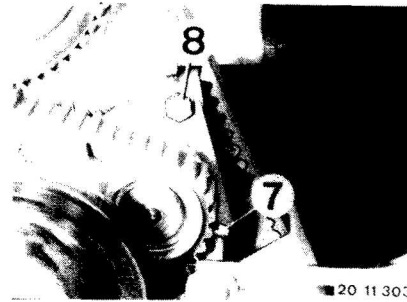
* See Specifications

*** See Service Information of Gr. 11

11-123 a

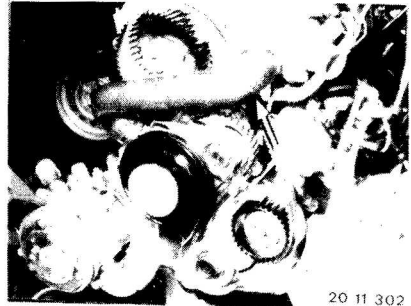


Loosen bolts (7 and 8).
Press in tensioning roller.
Tighten bolt (8).
Take off drive belt.



Tightening Drive Belt:

- Loosen bolt (8) again (spring force must move the tensioning roller).
- Crank engine once in running direction up to the TDC mark (drive belt tightens itself).
- Check timing (mark on camshaft sprocket must be precisely aligned with mark on cylinder head with crankshaft turned to TDC).
- Bolt down tensioner (tighten bolt (8) first and then bolt (7)).



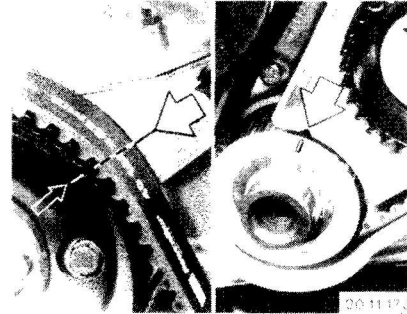
Installation:

There are different drive belt versions.

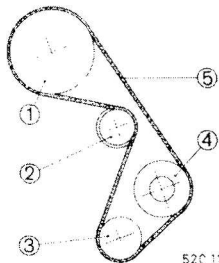
1. For sprockets with square profile:
 - A. Square profile with 111 teeth
 - B. Square profile with 110 teeth ("Z 127") with modified woodruff key and tensioning roller marked "Z 127".

2. For sprockets with oval profile:
 - A. Oval profile with 128 teeth
 - B. Oval profile with 127 teeth ("Z 127") and tensioning roller marked "Z 127".

Versions A must be converted to B***.
Install toothed drive belt in opposite direction of engine rotation, starting on the crankshaft sprocket.



Install a label with the date and mileage on the cylinder head cover after completion of work.



520 11 186

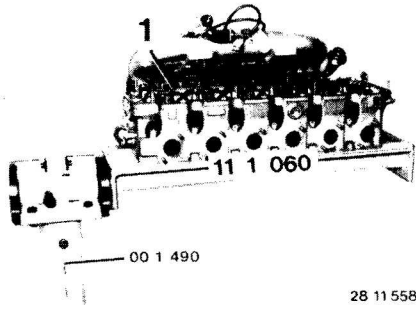
Toothed Drive Belt Layout:

- 1 Camshaft sprocket
- 2 Tensioning roller
- 3 Crankshaft sprocket
- 4 Intermediate shaft sprocket
- 5 Toothed drive belt

*** See Service Information of Gr. 11

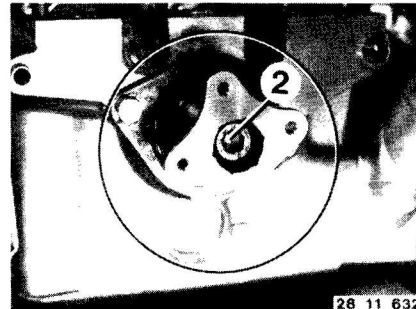
11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

Remove cylinder head 11 12 100.
Set up Special Tool 11 1 060 on Special Tool
00 1 490 and mount cylinder head with one
cylinder head bolt.



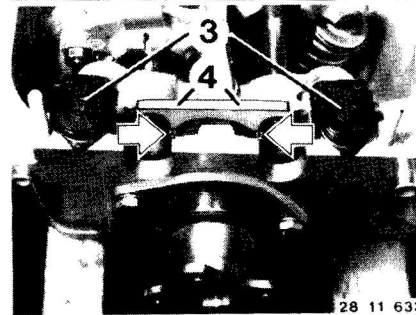
28 11 558

Mount adapter (2) again.
Adjust valve clearance of all valves to greatest
value.



28 11 632

Remove front and rear plugs (3).
Remove guide plate (4).
Installation:
Guide plate (4) must fit in grooves of rocker
arm shafts.

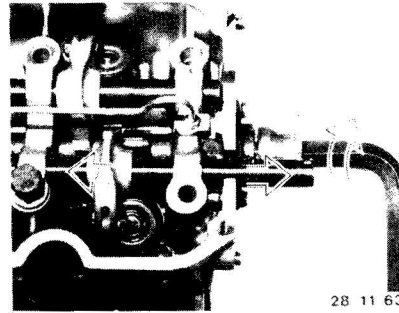


28 11 633

Remove spring clamps.
Installation:
Straight surfaces of spring clamps must fit in
grooves of rocker arm shafts.

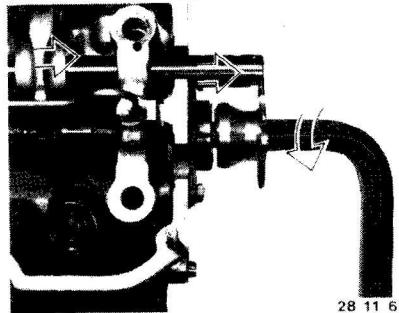


28 11 561



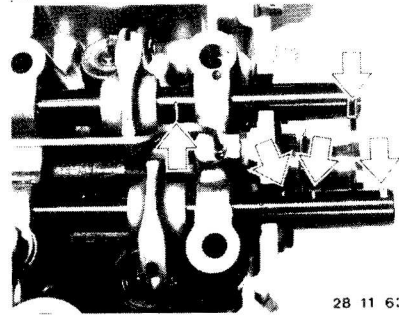
28 11 634

Remove rocker arm shafts.
1) Exhaust Side:
Cylinder no. 6 must overlap.
Push in rocker arms of cylinder no. 1 and turn
camshaft on adapter to intake side until rocker
arms (all) are relaxed.
Pull out rocker arm shaft.



28 11 635

2) Intake Side:
Turn camshaft on the adapter to exhaust side
and move rocker arms until all rocker arms are
relaxed.
Pull out rocker arm shaft.
Replace worn (scored) rocker arm shafts and
rocker arms.

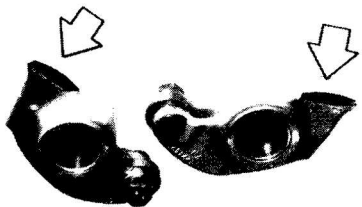


28 11 636

Installation:
Install rocker arm shafts that large oil bores
face down to valve guides and small oil bores
as well as grooves for guide plate face in.

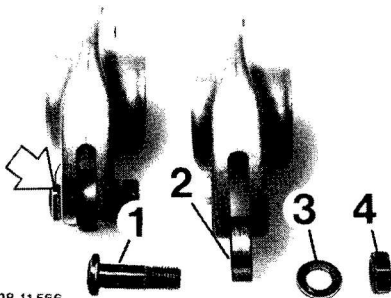
11 33 031 REPLACING ROCKER ARMS

Remove rocker arm shafts 11 33 020.
 Replace worn rocker arms or rocker arms with loose guides.
 Loose guides will be noticed as excessively loud valve noise.

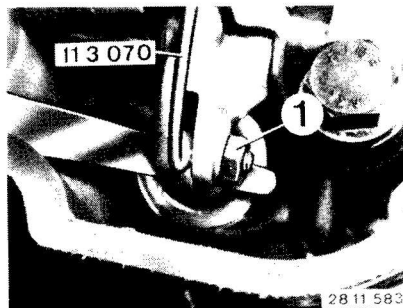


28 11 565

Transfer screw (1), eccentric (2), washer (3) and nut (4) to new rocker arm.
 Replace a worn eccentric.
Important!
 Screw and nut have M 6 x 0.75 fine threads.
 Bore faces out and thick side down.
 Bevelled surface of screw faces tab on rocker arm.



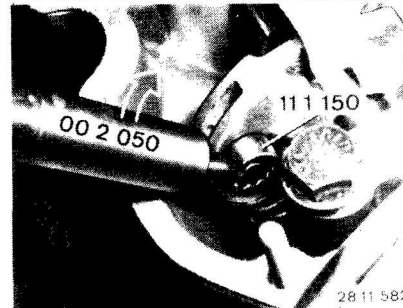
28 11 566



28 11 583

11 34 004 ADJUSTING VALVE PLAY

Remove cylinder head cover 11 12 000.
 Crank engine with a wrench socket on the crankshaft (vibration damper).
 Adjusting order is same as the firing order (1 5 3 6 2 4) in compression top dead center (TDC).
 Adjust valve clearance* between valve and eccentric after loosening nut (1).

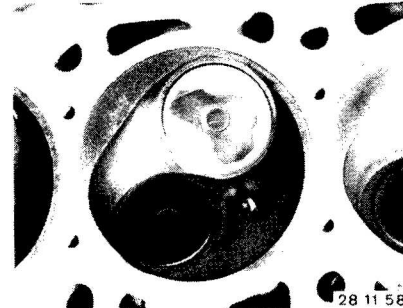


28 11 582

Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
 Tightening torque*.

11 34 509 CHECKING ALL VALVES FOR LEAKS - CAMSHAFT REMOVED -

Spark plugs remain installed.
 Fill combustion chamber with gasoline outdoors or indoors with strict conformance with fire prevention regulations.
 If the gasoline runs past the valve heads, check valves and valve seats.
 Remove and install valves 11 34 550.
 Machine valve seats 11 12 607.



28 11 580

* See Specifications

11 34 550 REMOVING AND INSTALLING VALVES

Remove rocker arm shafts 11 33 020.
Place tray 11 1 066 in assembly stand 11 1 060.

Unscrew intake.

Installation:

Replace gaskets.



Install valve.
Always use Special Tool 11 1 350 to avoid damage on the valve stem seal.
Lubricate valve stem seal (1) with oil and install.

Source for Special Tool Sleeves:

Cartool
Alfred-Brehm-Str. 5
D- 8070 Ingolstadt / West Germany

"Goetze" Seals:

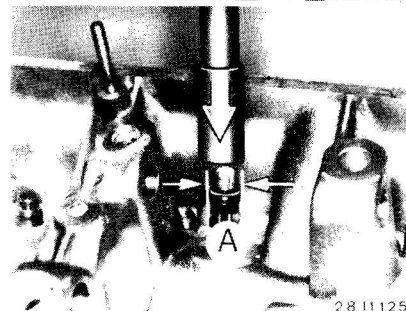
Press on the valve stem seal to fit tight with Special Tool 11 1 140.

Dia. A = 12.8 mm (0.504").

"Elring" Seals:

Press on the valve stem seal to fit tight with Special Tool 11 1 080.

Dia. A = 13.5 mm (0.531").



Press down the valve springs with Special Tool 11 1 060 and remove the valve collets.

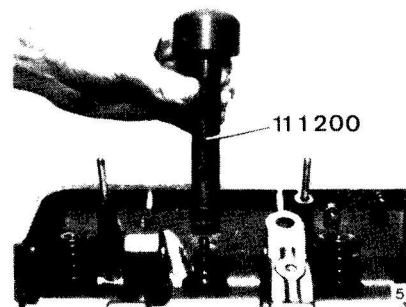
Remove the upper spring retainer, valve springs and lower spring retainer.

Take the tray out of the assembly stand and pull out the valve.

Installation:

Only use valve springs with same color code, wire gage size and length.

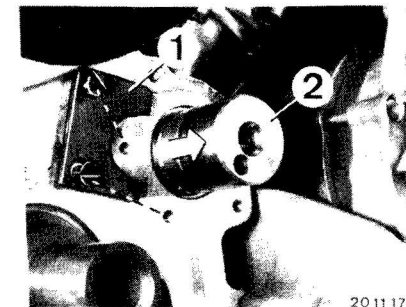
Lubricate valve guide and valve stem with oil.



The new, improved valve stem seals (internal grooving) are pressed on by hand with Special Tool 11 1 200.

Special Tool 11 1 200 has two diameters -- for 7/8 mm (0.276/0.315") valve stem seals.

Pull off valve stem seal with Special Tool 11 1 250.



11 35 020 REMOVING AND INSTALLING DISTRIBUTOR INTERMEDIATE SHAFT

Remove fuel pump 13 31 030.

Remove distributor 12 11 060.

Remove front end cover 11 14 175.

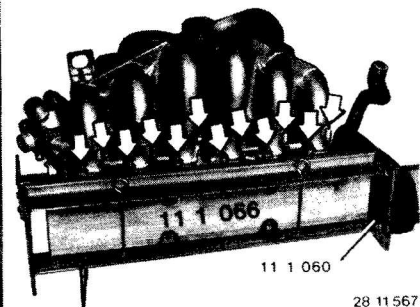
Remove guide plate (1).

Pull out the intermediate shaft (2).

Installation:

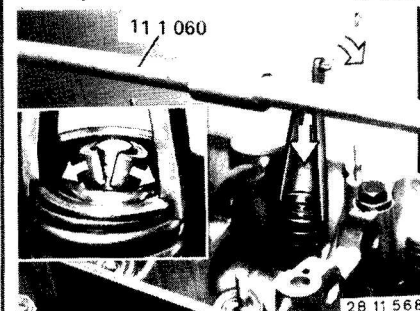
Check sprocket, replacing the intermediate shaft if necessary.

The bearings in the crankcase cannot be replaced.



11 1 066

28 11 567

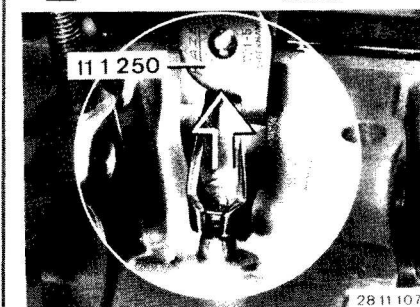


11 1 060

28 11 568



28 11 569



11 1 250

28 11 107

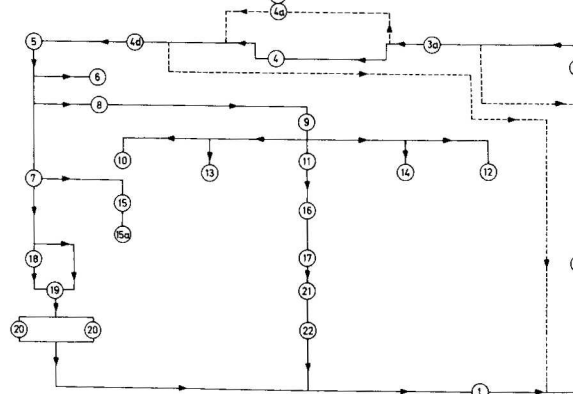
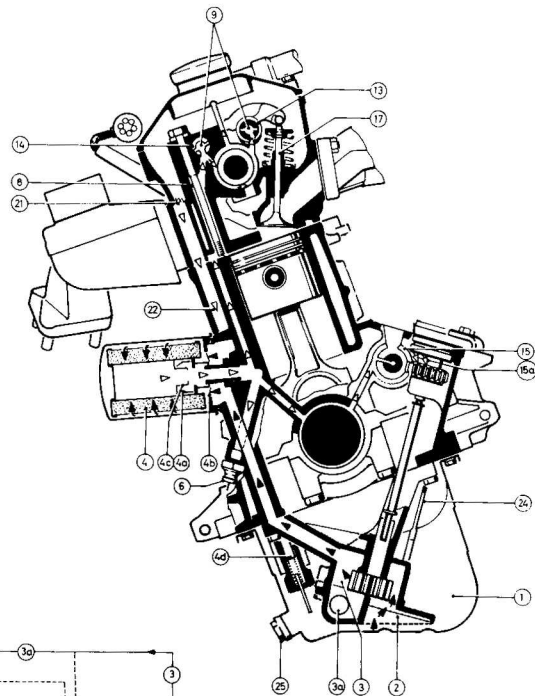
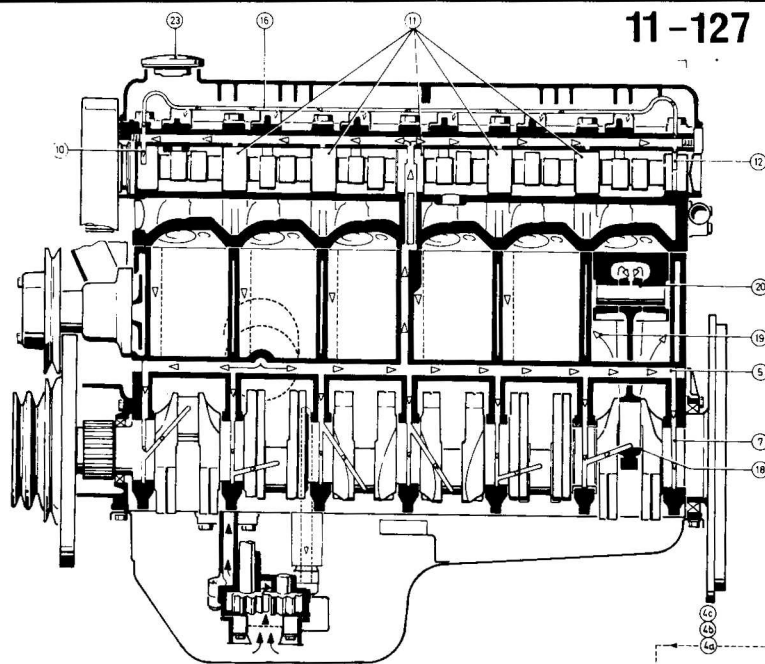
520 11 252

28 11 125

11 1 200

5

20 11 178



◀ unfiltered oil
 ▲ filtered oil

ENGINE OIL CIRCUIT

- 1 Oil pan
- 2 Intake with filter screen
- 3 Oil pump
- 3 a Pressure relief valve
- 4 Oil filter
- 4 a Safety valve (oil filter)
- 4 b Check valve — unfiltered side) prevents draining of oil filter
- 4 c Check valve — filtered side) when engine is stopped
- 4 d Pressure relief valve

- 5 Main distribution bore
- 6 Transmitter for oil pressure ind. lamp
- 7 Crankshaft bearings
- 8 Oil bore in cylinder head
- 9 Hollow rocker arm shaft
- 10 Front camshaft bearing
- 11 Camshaft bearing
- 12 Rear camshaft bearing
- 13 Rocker arm bearing (intake valve)

- 14 Rocker arm bearing (exhaust valve)
- 15 Intermediate shaft bearings
- 16 Oil line for cams
- 17 Valve guide
- 18 Connecting rod bearings
- 19 Spray oil
- 20 Piston pin / cylinder wall
- 21 Overflow from cylinder head

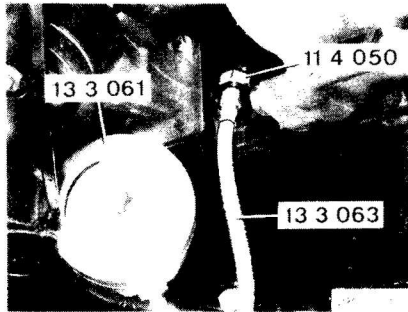
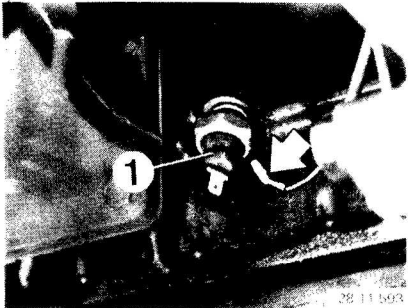
- 22 Oil return
- 23 Oil filler neck
- 24 Oil dipstick
- 25 Oil drain plug

11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).

Installation:

Check gasket, replacing if necessary.

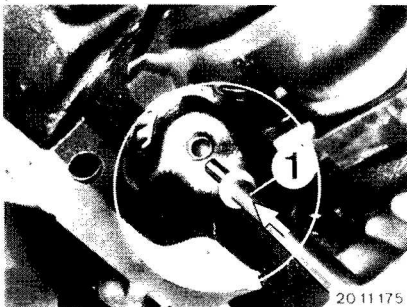
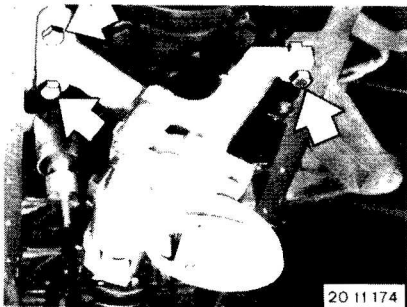


Screw in Special Tool 11 4 050 (adapter).
Connect Special Tools 13 3 063 (hose) and
13 3 061 (pressure tester).
Check oil pressure*.

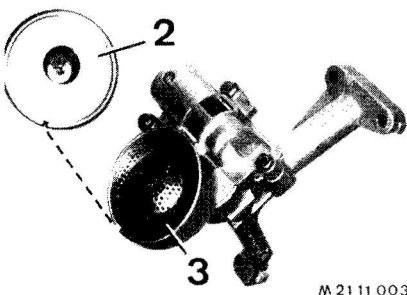
* See Specifications

11 41 000 REMOVING AND INSTALLING OIL PUMP

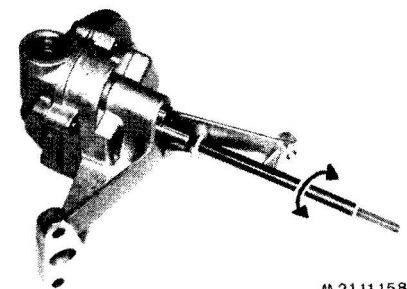
Remove oil pan 11 13 000.
Unscrew oil pump.



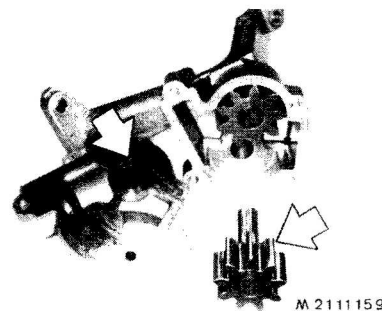
Installation:
Guide in drive shaft (1).
Replace bearing, see 11 11 160.



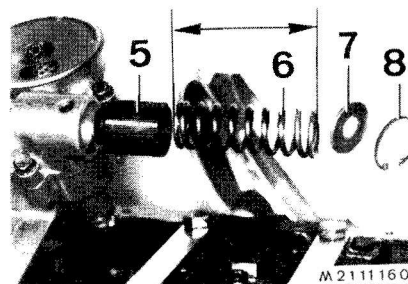
Testing and Servicing:
Unscrew cover (2) and clean oil filter screen (3).



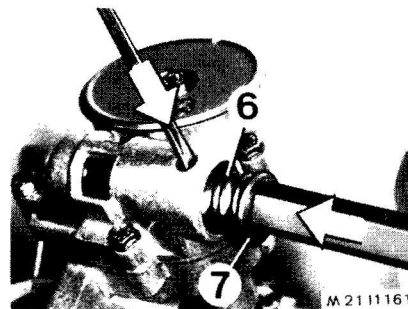
Check whether gears turn easily by turning the drive shaft.



Unscrew oil pump cover and check oil pump for wear.
– Scoring in body/cover
– Wear on gears



The overload valve regulates oil pressure in front of the oil filter and prevents oil filter leakage.
Check that piston (5) moves easily.
Check length of spring (6) = 44 ± 0.2 mm (1.732 ± 0.008 "').



Installation:
Press in and hold spring (6) and washer (7) with a screwdriver.
Install circlip (8).

11 41 110 REMOVING AND INSTALLING PRESSURE RELIEF VALVE

The pressure relief valve is installed in the main bore and regulates the engine oil pressure* after the oil filter.
Remove oil pan 11 13 000.
Unscrew pressure relief valve.
Take off the sleeve (1).

11 42 020 REPLACING FULL FLOW OIL FILTER

Unscrew filter with Special Tools 11 4 020/ 11 4 650.

Installation:

Give gasket a light coat of oil.
Screw on the oil filter by hand until the gasket touches — then tighten by hand with one half turn.
Add oil, start engine and check oil level and for leaks.

If the engine no longer builds up oil pressure after replacement of the oil filter cartridge, stop the engine, loosen the filter cartridge by approx. 90° and start the engine.
Tighten the filter again after oil has run out briefly (bleeding procedure).

11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Install the guide tube with Loctite No. 270** and drive it in against the stop.

* See Specifications
** Source: HWB

11 51 000 REMOVING AND INSTALLING WATER PUMP

Drain coolant.

Remove distributor cap (1).
Remove distributor rotor (2).
Unscrew adapter (3).
Remove cover (8).
Unscrew bolts (4).
Remove fan 11 52 000.

Installation:

Pour in coolant and bleed the cooling system 17 00 039.
Check seal (9), replacing if necessary.

Remove pulley.

Unscrew nut (4) and take off the drive belt.
Lift out rubber part (5) and pull out the protective cover (6).

Installation:

Tighten the drive belt and check the tightness with Special Tool 11 5 020.

Compress the spring and clamp the pin with Special Tool 11 5 010.

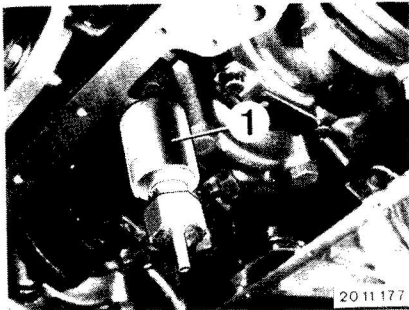
Installation:

Check installed position of the pin to the water pump.

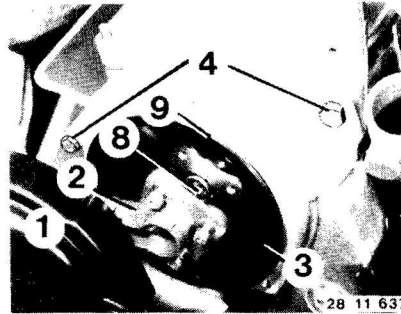
Disconnect coolant hoses (7 and 8).
Remove the water pump.

Installation:

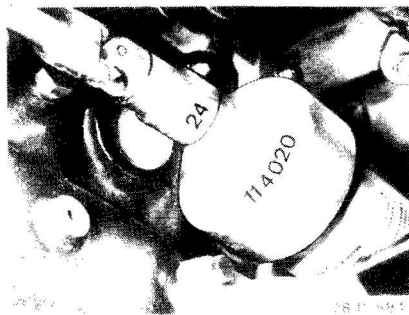
Replace the gasket.



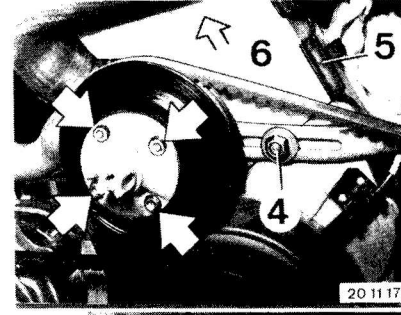
20 11 177



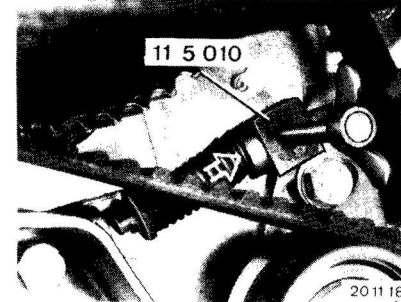
28 11 637



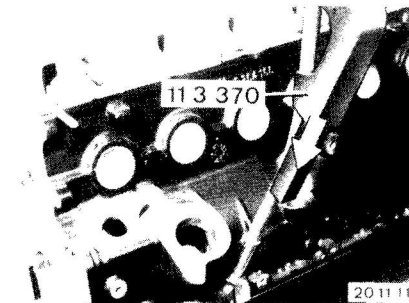
28 11 177



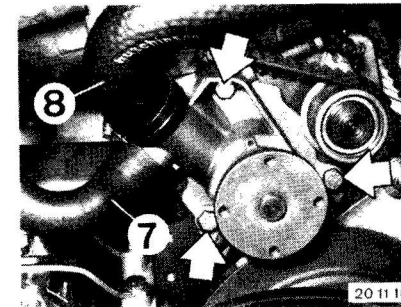
20 11 179



20 11 180



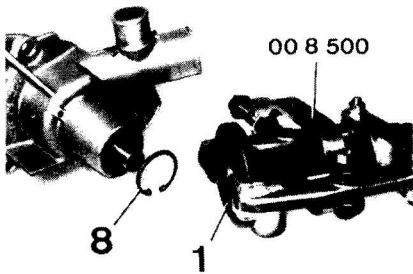
20 11 116



20 11 181

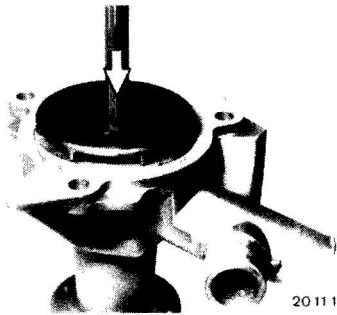
11 51 502 OVERHAULING WATER PUMP — WATER PUMP REMOVED —

Pull off hub (1) with Special Tool 00 8 500.
Remove circlip (8).



20 11 182

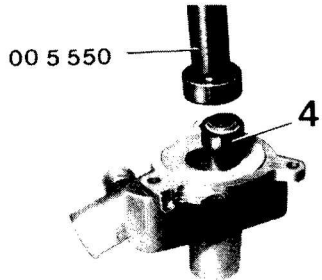
Press out water pump bearing.



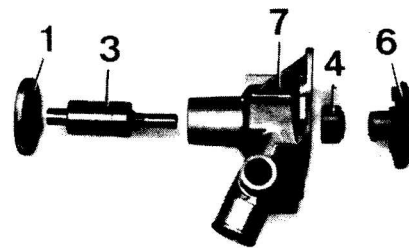
20 11 184

Drive out seal (4).

Installation
Press in seal (4) with Special Tool 00 5 550.



20 11 185



20 11 186

Replace bearing (3) and seal (4).
Check impeller (6), replacing if necessary.

1 = hub

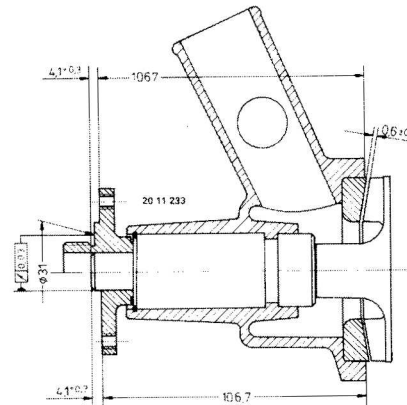
7 = Water pump body

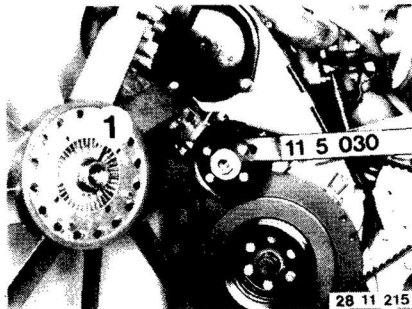
Installation:

Press in bearing (3) against stop.

Press on impeller (6).

Check dimensions after assembling.





11 52 000 REMOVING AND INSTALLING FAN

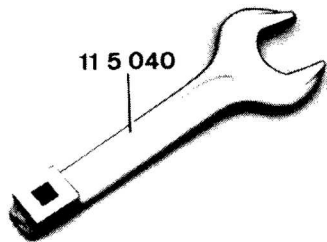
Temperature Dependent Visco Fan Clutch:
Hold pulley with Special Tool 11 5 030 and unscrew the coupling nut (1).

Important!

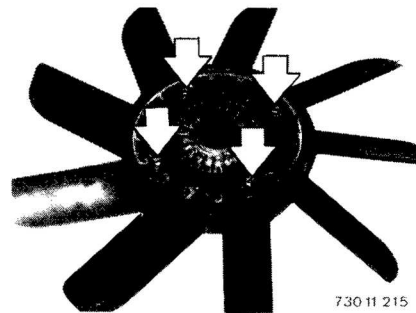
Left-hand threads – nut must be turned clockwise to unscrew.
Tightening torque*.

Installation:

Tighten fan with Special Tool 11 5 040. The 40 Nm (29 ft. lbs.) tightening torque is equal to a 30 Nm (22 ft. lbs.) setting on the torque wrench.



30 11 193



11 52 020 REPLACING FAN CLUTCH

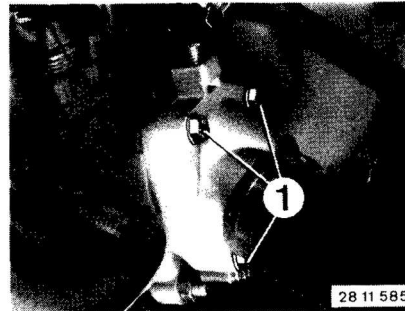
Remove fan – see 11 52 000.

Reasons for Replacing the Fan Clutch:

- a) Hub has seized – fan of stopped engine cannot be turned or is hard to turn.
- b) Fan clutch has axial/radial play or is losing oil.

Check the switching points* with a Vibrocard***.

Unscrew the fan mounting bolts and take off the fan clutch.



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain some of the coolant.
Unscrew cover (1).

Installation:

Bleed the cooling system – see 17 00 039.

Remove thermostat.

Installation:

Clamp on the thermostat faces out.

Replace rubber ring (2).

Since 1986 Models:

New thermostat housing:

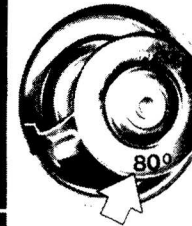
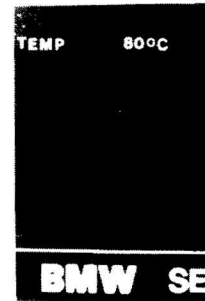
Install thermostat no. 1 713 040 (smaller valve seat diameter).



Checking Thermostat:

Check whether opening temperature agrees with the value in the Specifications.

Check opening temperature in a hot water bath and compare value with the stamped opening temperature value.



20 11 190

11 53 080 REPLACING TEMPERATURE TRANSMITTER

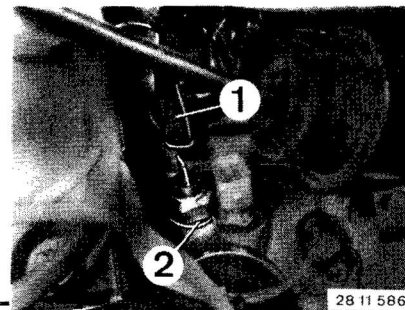
Pull off wire (1).

Unscrew the transmitter.

Installation:

Replace seal (2).

Bleed the cooling system – see 17 00 039.



* See Specifications

*** See Workshop Equipment Catalog

11 78 010 CHECKING FUNCTION OF OXYGEN SENSOR

M 20 B 27 Up To 1987 Models:

Unscrew plug (1).

Screw in Special Tool 13 0 100 and connect Special Tool 12 0 090.

Connect BMW Service Tester.

Measure CO level.

Specifications: 0.2 to 1.2 % by volume.

See 13 00 054 for additional information.

Pull off and plug vacuum hose (1) on pressure regulator.

CO level will rise briefly and then be regulated back to the original value immediately — oxygen sensor works.

Faulty:

Check power supply of oxygen sensor via relay to the wiring diagram

See Group 13 for additional information.

M 20 B 25 Since 1987 Models:

M 20 B 27 Since 1988 Models:

A. Heating Test

Disconnect oxygen sensor plug. Connect ohmmeter on terminals 3 and 4 (facing oxygen sensor).

Measure resistance.

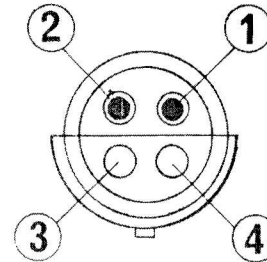
Specifications: < 5 ohms.

1 = Plug for sensor voltage —

2 = Plug for sensor voltage +

3 = Terminal for sensor heating

4 = Terminal for sensor heating



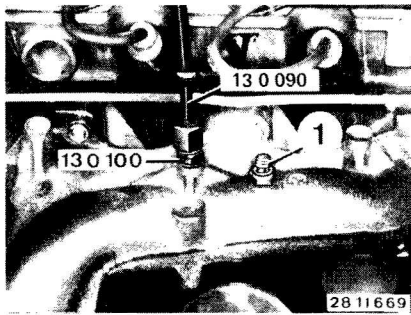
32 11 1

B. Signal Voltage Test

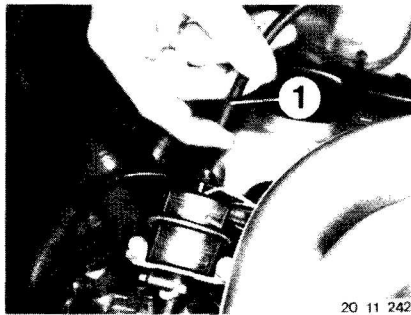
Check "oxygen sensor voltage" in scope of DME self-diagnosis by calling oxygen sensor voltage.

Value will be measured at idle speed with the oxygen sensor connected and oxygen sensor control switched on (approx. 1 to 2 minutes after starting the engine) and should be between 0.02 and 0.85 volts.

The oxygen sensor is not working if a constant voltage of 0.45 volts is measured (oxygen sensor or power supply lead faulty).



28 11 669



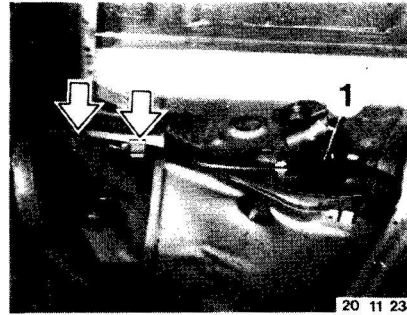
20 11 242

11-134

11 78 510 REPLACING OXYGEN SENSOR

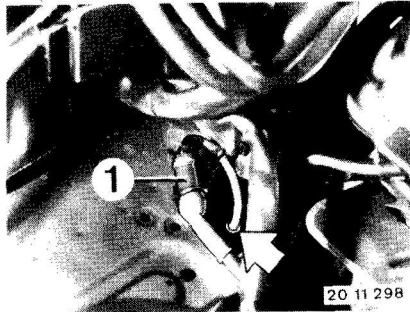
- Do not clean oxygen sensors or let them come in contact with lubricants.
- Only use AntiSeize** on threads.
- Cover oxygen sensors when undercoating the car.

The heated oxygen sensor has to be replaced at intervals of 50,000 miles.

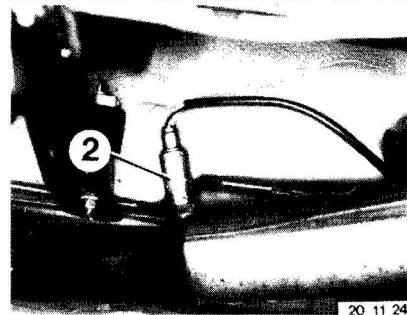


M 20 B 27:
Disconnect plug (1).
Lift out leads.

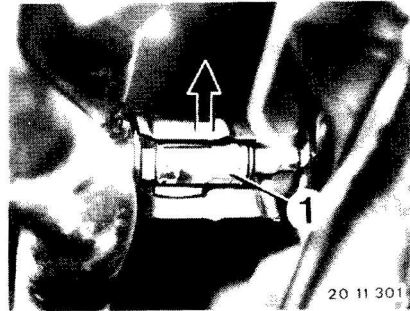
Installation:
Seal plug (1) with an universal sealing compound for protection against spray water.



M 20 B 25:
Disconnect plug (1).
Lift leads out of clip.



Unscrew oxygen sensor (2).



Pull off cover and remove oxygen sensor (1).

All Models:
Installation:
Coat threads with Anti-Seize** and tighten the oxygen sensor with Special Tool 11 7 020. Tightening torque*.

* See Specifications
** Source: HWB