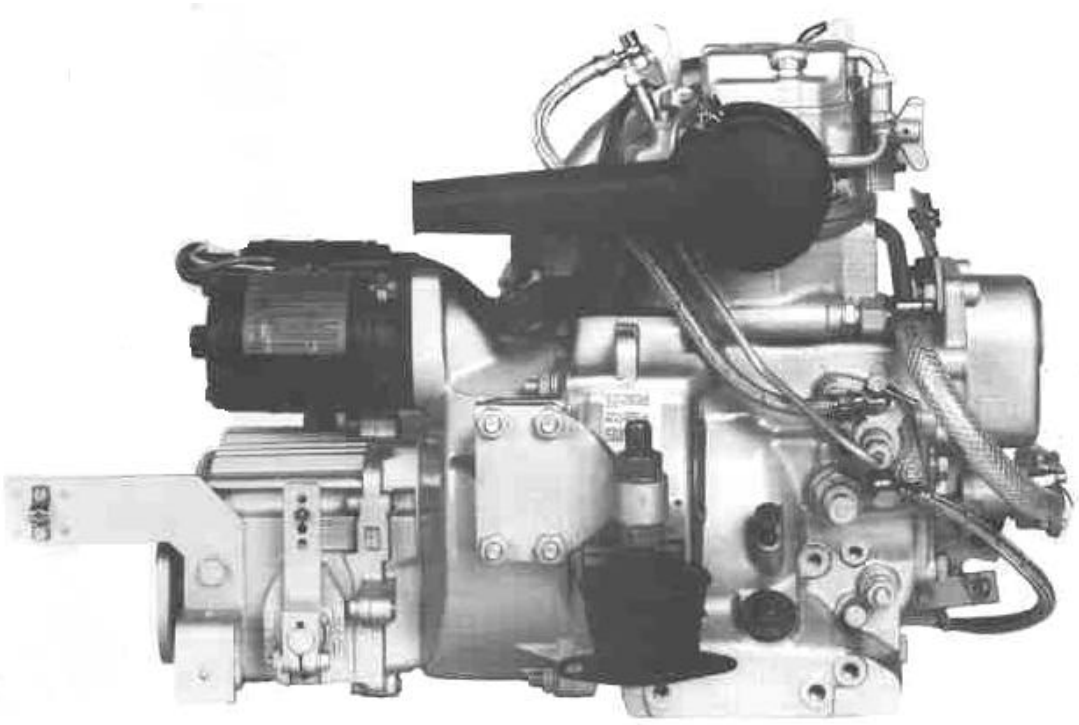
Workshop Manual

BMW D7



BMW Marine

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BMW D7 Marine Engine

A four-stroke diesel engine with direct injection and open-circuit cooling system. The Neoprene impeller of the coolant pump is driven directly from the crankshaft. Electric starter and flywheel alternator are standard equipment. The injection system is fitted with automatic bleeding.

Notes on Use

This workshop manual describes complete procedures for dismantling, overhaul and assembly of the BMW D7 marine engine.

If only part of the procedure is to be carried out (e.g. small repairs or replacement of gaskets, oilseals) the remainder can be ignored.

The relevant technical data is provided with each section. General specifications are found on page iii.

Assembly is generally a reversal of removal procedure. Special attention, however, should be paid to "notes on assembly".

Checking and adjustment procedures, where applicable, are to be found at the end of the relevant section.

Technical data

Capacity	280cc / 17.1 cu.in.
Bore x stroke	73 mm x 67 mm / 2.87 in x 2.64 in
Max. power	4.5 kw / 6 bhp @ 3600 rpm
Compression ratio	22 : 1
Dry weight with gearbox	68 kg / 150 lbs
Gearbox reduction	forward 2.7:1, reverse 1.9:1
Max. installation angle	15^{o}

Specifications

Fuel	Diesel oil, DIN 51601/USA #2
Lubricating oil, engine	HD-API CC/CD
gearbox	Hurth ATF Dexron - ZF SAE 20 W 20
Oil capacity, engine	2 litres / 3.5 pints UK / 4.4 pints US
gearbox	0.4 litres / 0.7 pints UK / 0.85 pints US
Fuel filter	BMW 13 32 1 328 270
Air filter	BMW 13 71 1 329 269
Injector	Bosch
Injection pressure	135 + 8 bar
Injection pump	Bosch PFR 1 K 70 A 343/II
Starter motor	Bosch 0.8 kw
Generator	14V 350W 25A
Battery	12V 60 Ah
Gearbox	Hurth HBW5 - ZF Bw 3

Adjustment data

Injection ends	11.5^{o} - 12.5^{o} BTDC
Valve clearances, cold	0.15 mm / .006 in.

Torque settings

	Nm	kpm	Remarks
Cylinder head nuts M 8	40	4.0	Use permanently elastic sealing compound (e.g. Atmosit) on the stud screws in the oil space!
Connecting rod screws	40	4.0	Oil threads and screw head insert lightly
Counter weight screws	22	2.2	Oil threads and screw head insert lightly
M 6 hex nut for the mounting of the injector	10	1.0	
Flywheel bolts M 10	70	7.0	
Injection pump delivery valve	40	4.0	
M 6 hex head screw for fastening bearing cover retaining yoke on the flywheel side	10	1.0	
Nozzle nut	85	8 - 9	

List of Special Tools D7

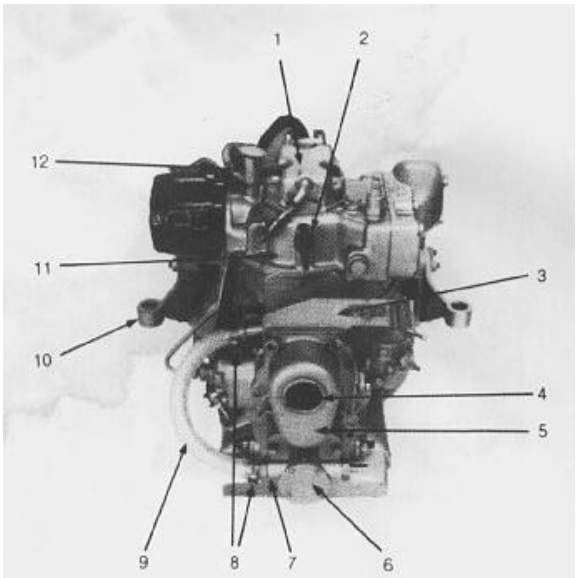
BMW Part No.	Description
74 64 1 333 525	To refit ball hub
74 64 1 333 526	To refit crankshaft gear
74 64 1 333 513	Crankshaft installation tool
74 64 1 333 514	Puller for valve lifter shaft
74 64 1 333 515	Tool for crankshaft removal
74 64 1 333 516	Tool for camshaft needle bearing installation
74 64 1 333 517	Wrench for injection adjuster
74 64 1 333 527	Crankshaft gear puller
74 64 1 333 535	Tool for adjustment of injection pump
74 64 1 333 528	Tool for injection adjuster
74 64 1 333 536	Multi purpose extractor
74 64 1 333 529	Auxiliary wrench for cable connector
74 64 1 333 530	Sleeve 27 - 36 mm internal extractor
74 64 1 333 531	Counter support-internal extractor
74 64 1 333 537	Allen socket with center pin 8 mm
74 64 1 333 538	Allen socket with center pin 10 mm
74 64 1 333 539	Clamping holder to grind valve-valveseat
74 64 1 333 540	Allen wrench 6 mm elongated
74 64 1 333 518	Auxillary bush-oil seal
74 64 1 333 519	Punch - needle bearing camshaft
74 64 1 333 520	Socket 13 mm (long size)
74 64 1 333 541	Allen socket 6 mm
74 64 1 333 521	Retaining bracket for cylinder
74 64 1 333 542	Press-in mandrel-valve guide 7 mm Ø
74 64 1 333 532	Hand reamer 7 mm Ø H 7 for valve guide
74 64 1 333 543	Flare nut wrench 17/19 mm
74 64 1 333 522	Special tool for governor spring
74 64 1 333 523	Box wrench 10mm
74 64 1 333 524	Piston ring clamp
74 64 1 333 544	Measuring device for bumping clearance
74 64 1 333 545	Testing device for injection equipment
74 64 1 333 546	Dial gauge 1/100 mm
74 64 1 333 547	Torque wrench 1 - 140 NM
74 64 1 333 534	Guiding pin 7 mm Ø (valve reseating tool)
74 64 1 333 548	Handle for valve reseating tool
74 64 1 333 549	Piston ring pliers
74 64 1 333 550	Allen socket 8 mm
74 64 1 333 551	Valve reseating tool 42.5 mm Ø
74 64 1 333 552	Gudgeon pin extractor

BMW Marine Diesel Engine D7

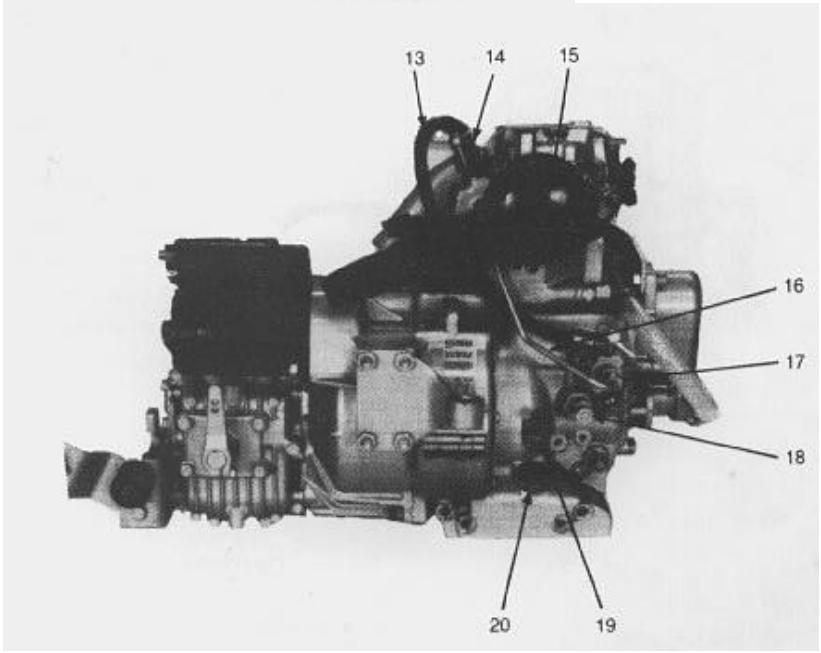
Description:

Water cooled single cylinder four stroke producing 4.5 kW (DIN) (6 Hp)

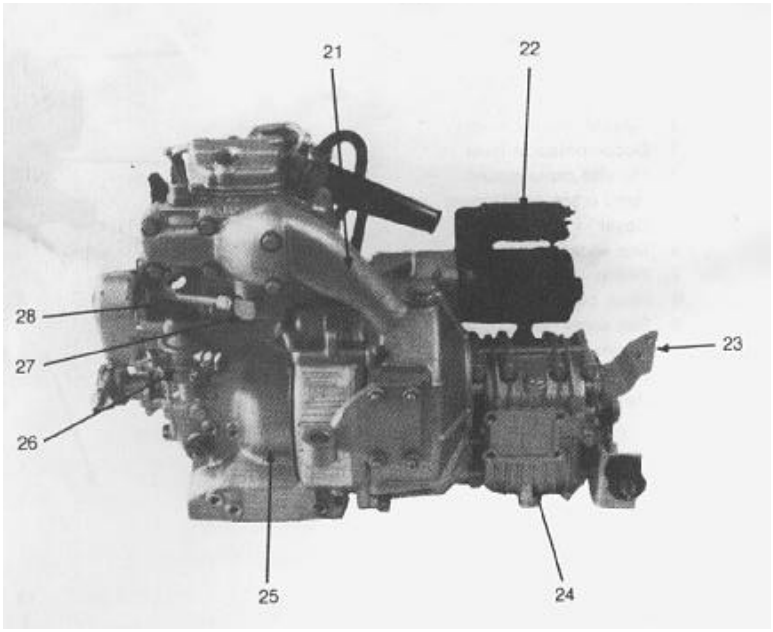
1. Cylinder head cover
2. Decompression lever
3. Throttle cable mount
4. Hand crank attachment
5. Cover
6. Sea water pump
7. Fitting
8. Hose clips
9. Sea water hose
10. Engine mounts
11. Cylinder head
12. Metering device



13. Fuel return hose
14. Injector
15. Air filter
16. Fuel injection pipe
17. Injection pump
18. Throttle
19. Dipstick
20. Oil filler screw



21. Exhaust
22. Starter
23. Retainer yoke
24. Gear box
25. Crankcase
26. Fuel pump
27. Fitting
28. Sea water pipe



CAUTION

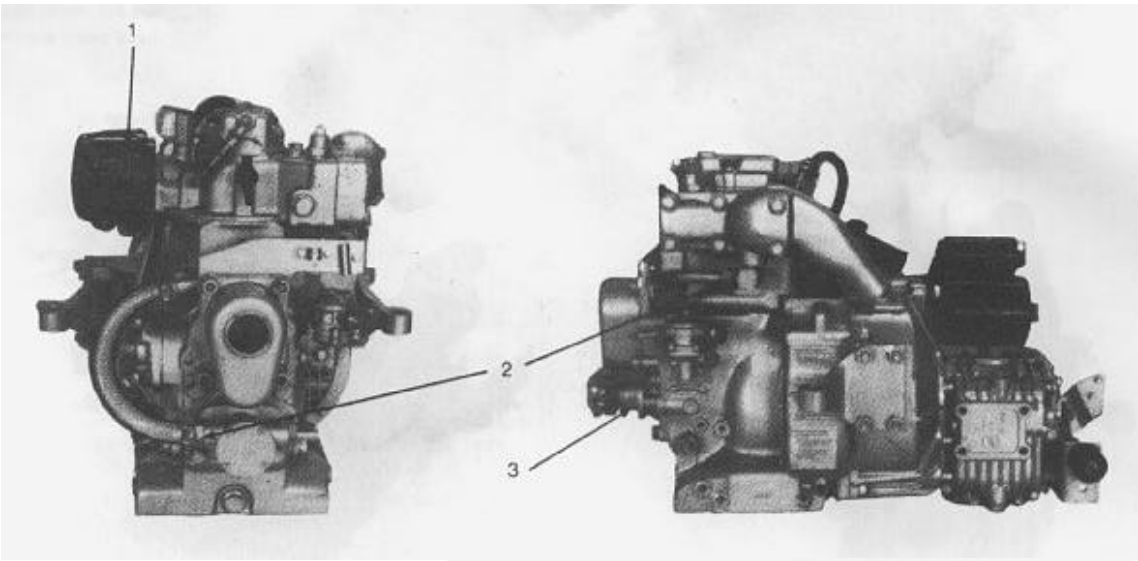
To avoid damage to engine parts, always
use special tools as shown in the illustrations.
The tools to be used fit only in the position shown.

Removing cylinder head and cylinder

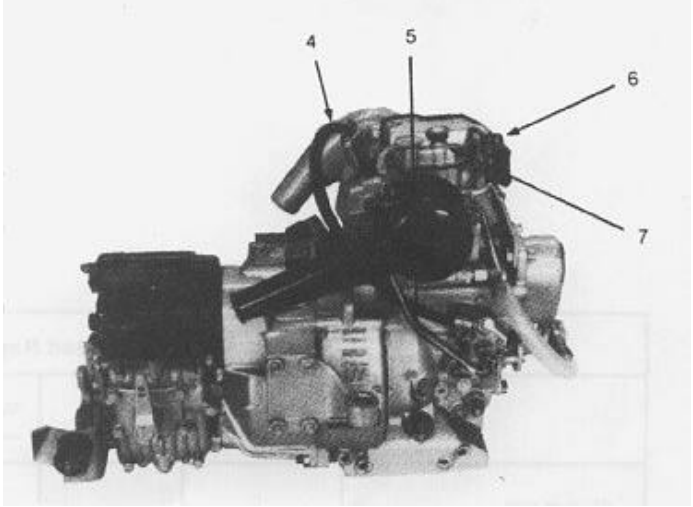
- Remove air filter (1)
- Loosen sea water pipe from exhaust manifold and water pump and remove (2) + (3)

CAUTION

Cover all openings in the fuel system



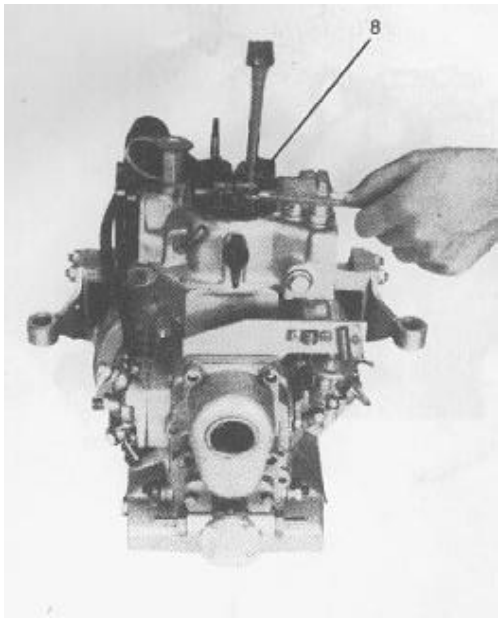
- Disconnect fuel return hose from injector and remove (4)
- Disconnect fuel injection pipe from injector and injection pump and remove (5)
- Remove clip of crankcase vent hose (6), unscrew both nuts of the rocker cover and remove the rocker cover with gasket (7)

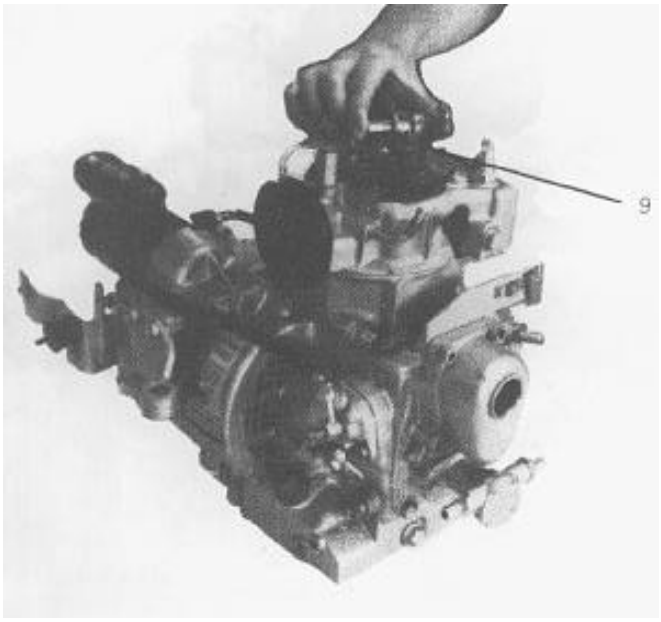


Detach
Disassemble
Remove

Air filter, seawater hose, fuel overflow hose, cylinder head vent hose clip, cylinder head cover with gasket, rocker shaft with rockers, pushrods

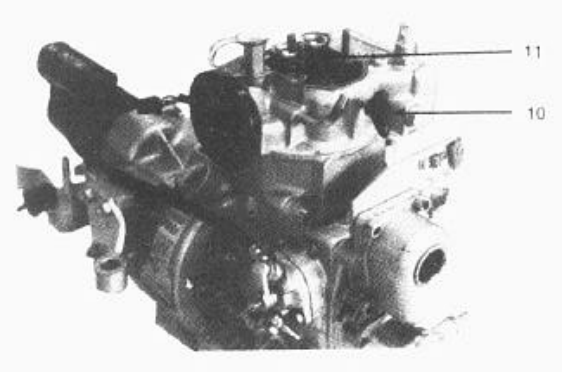
- Remove rocker shaft with bushing and retainer yoke and remove rockers (8) and (9)
- Pull out both pushrods





Cylinder Head Repair Data				
	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Rocker arms shaft dia.	mm	18 $^{-0.027}$	0.05	
Rocker arm internal dia.	mm	18 $^{+0.024}_{+0.006}$	0.05	After press fitting
Rockaer arm radius	mm	8	No flats	
Valve seat angle	^{o}	45		

Detach Rocker shaft with rockers, pushrods
Disassemble
Remove



- Remove decompression lever from the underside of the cylinder head (10)
- Unscrew the M10 nut and unscrew stud bolt.
- Remove the spring
- Remove retaining pin with pointed pliers
- Unscrew inner clamping sleeve on gear segment and remove shaft and gear segment.
- Remove valves & valve springs (11)
- Press down the spring retainers

WARNING

Danger of injury due to spring retainers and valve keys popping out.

- Loosen both key halves while applying pressure from below and remove with pointed pliers.
- Remove cap and washer from under the valve spring
- Remove valve
- Press out the valve guides from below

NOTE

When pressing in the new valve guides, when parts are cold note minimum force of 1000 N (approx 100 kp)

- Ream the valve guides
- Rework leaky valve seats with a 45^{o} valve seat cutter. Mill only enough to remove spots from valve seats.
- Reseat valves using auxiliary tool
- No 74 64 1 333 539

The valves should sit back as measured from the seating surface of the cylinder head, according to the following table:

Repair Data Valves				
Cylinder Head	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Valve clearance cold	mm	0.15		
Intake valve stem dia	mm	7 -0.04 -0.05	0.05	
Exhaust valve stem dia	mm	7 -0.05 -0.04	0.05	
Intake valve disc dia	mm	30.5		
Exhaust valve disc dia	mm	30.5		
Valve sit back max	mm	0.70		CAUTION! Valve sit back may not be less than 0.45 mm as otherwise the danger exists that the valve disc hits the piston.
Valve sit back min	mm	0.45		
Valve guide bore	mm	7 +0.09 0		
Outer diameter	mm	10 +0.023 +0.029	0.05	The sealing surface of the cylinder head can be reworked to a maximum of 0.5 mm if the sit back of 0.7 mm is exceeded due to valve seat milling.
Valve guide bore in cylinder head	mm	10 +0.0011		
Valve guide press in force	kp	100		With the cylinder head cold.

Table: Valve sit back

Remove cylinder head and pull off cylinder (12)

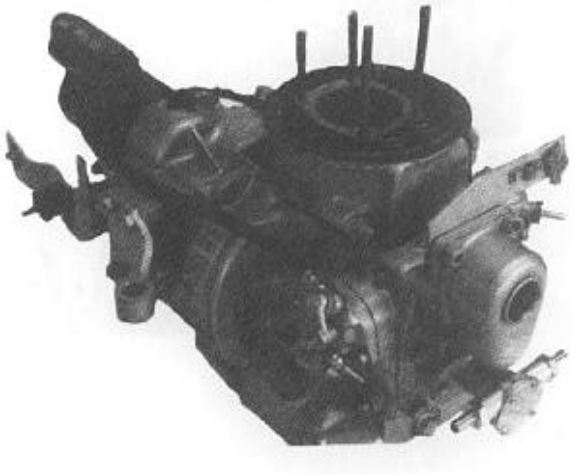
The cylinder head is unusable in the following cases:

- Sealing surface fouled or damaged i.e. uneven
- Clean the sealing surface and re-grind, observing the tolerances
- Valve seats worn out or no longer suitable for re-facing.
- Cracks in the valve seats in the cylinder head

NOTE
Measure cylinder bore with a cylinder indicator

In the following cases, the cylinder is unusable:

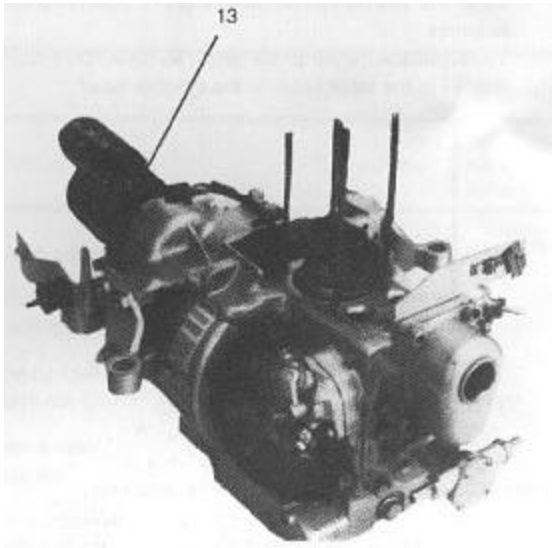
- Seize marks are found in the bore
- Scratches are present
- Wear exceeds 0.15 mm



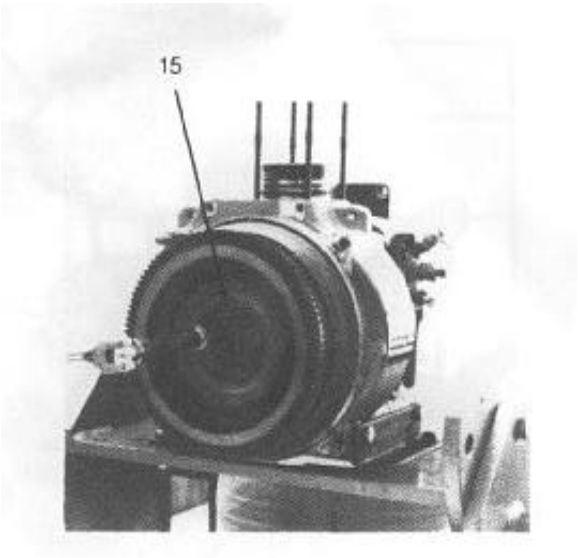
Repair Data Cylinder				
Cylinder	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Bore dia	mm	73 + 0.01	0.15	
Roughness Ra	μ	1.0 – 1.2		
Oversizes	mm	+ 1		

Remove Unusability of cylinder head/cylinder
Detach Cylinder head, cylinder

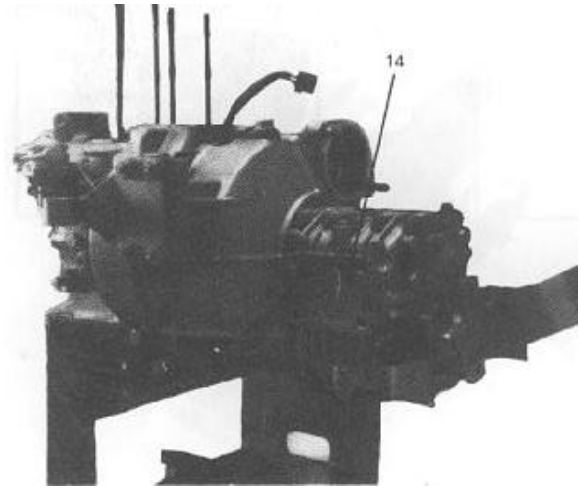
Remove starter (13)

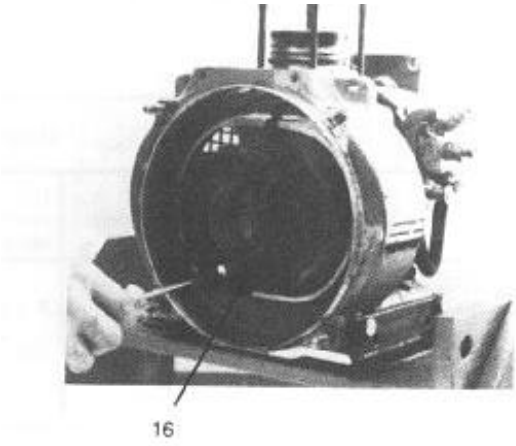


- Remove attaching clamp of the cable to the stator and remove starter
- Remove the four cyclinder screws M 10 and remove the flywheel (15) and (16)



Remove gearbox (14) complete with flywheel cover.

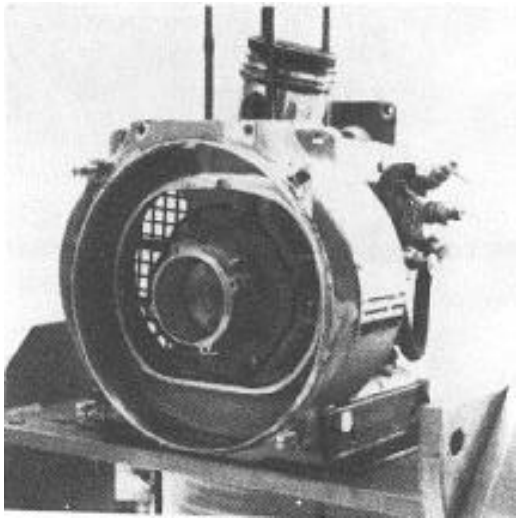




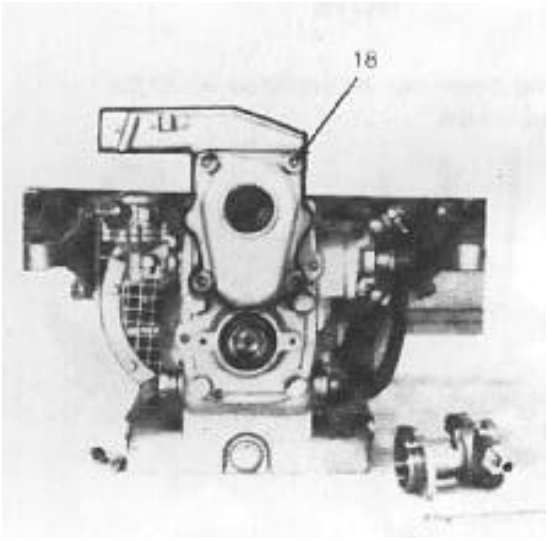
NOTE

- After loosening the four M6 hex screws, remove the bearing cover with locking plate and the sealing ring located on the inner face (17)

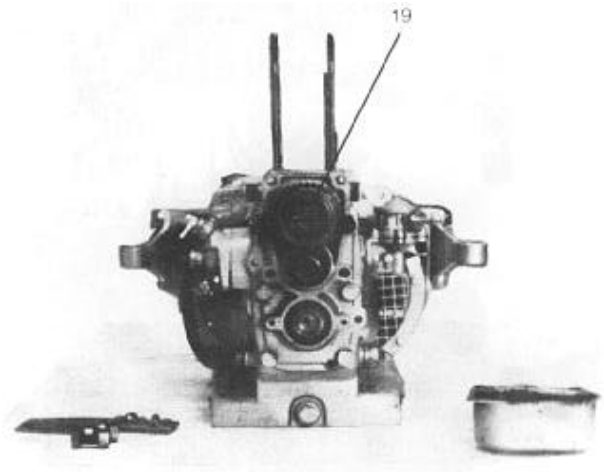
Bearing cover can be replaced when the engine is cold

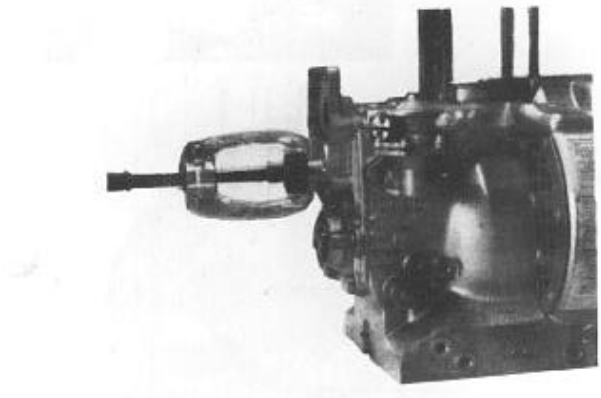


- Remove screws from cover of timing gear cover and take off the cover (18)

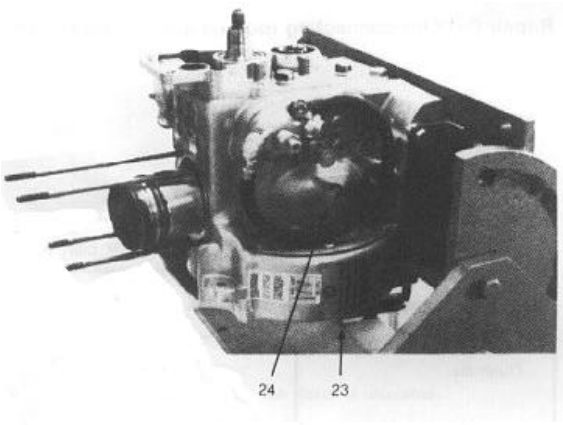


- Remove hand crank mechanism (19) with extractor tool No 666 332 00

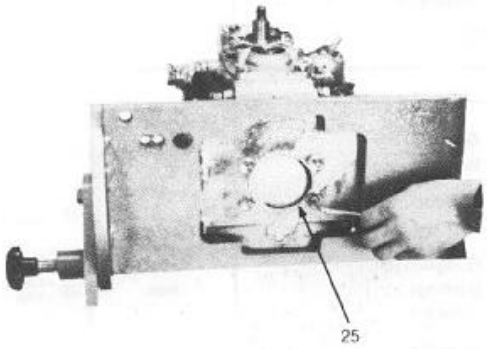




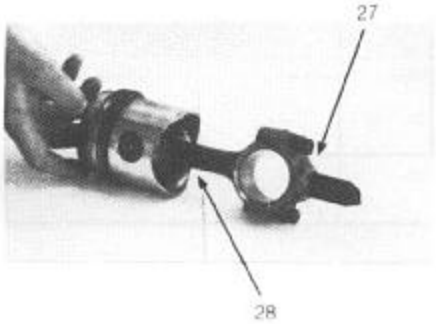
- Turn the engine on to the flywheel side (23) and remove dipstick (24)

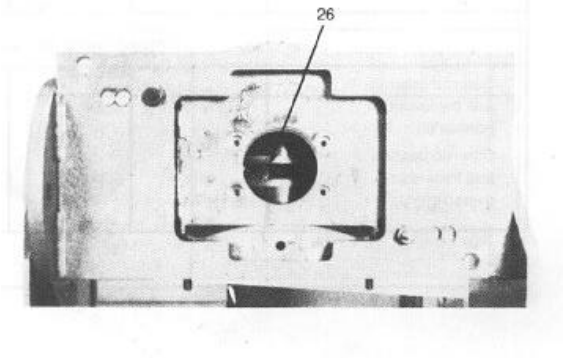


- Remove cover and O-ring from crankcase on the engine bottom (25).



- Unscrew the two connecting rod screws (26).
- Take out connecting rod cap with oil pick-up (27) from below and piston and connecting rod (28) from top.



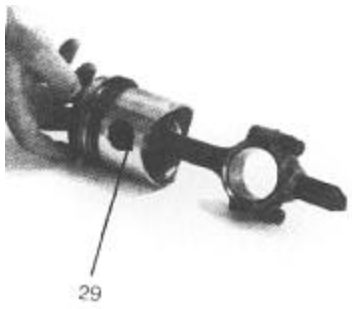


Repair Data for con-rod bearing and con-rod				
Con-rod bearing	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Outer dia	mm	46		Minimum bearing play = 0.040-0.076mm when new
Inner dia	mm	42 $^{+0.016}_{-0.026}$	see table on page 17	max wear to 0.15mm
Width	mm	26.5		
Undersize	mm	41.5	see table on page 17	
Con-rod bearing wall thickness normal(W)	mm	1.998 $^{+0.02}$	Total play after wear: max 0.15mm	
Con-rod bearing wall thickness oversize(WU)	mm	2.248 $^{+0.02}$		
Con-rod				
Gudgeon pin bushing bore dia	mm	28 $^{+0.013}_{0}$		
Con-rod bearing bore dia	mm	46 $^{+0.010}_{-0.006}$		
Gudgeon pin bushing: outer dia	mm	28 $^{+0.048}_{+0.035}$		
inner dia – loose	mm	25 $^{+0.082}_{+0.068}$	0.20	
- installed	mm	25 $^{+0.020}_{+0.007}$		
Thread con-rod bolts		M8		

Note

Heat piston to remove piston pin

- Remove the gudgeon pin snap rings and press out the gudgeon pin by hand while the parts are still warm (29).

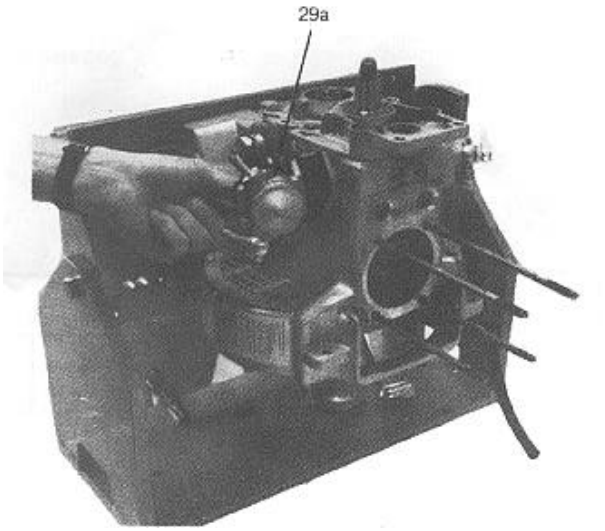


In the following cases, the piston is unusable:
- ring land between the rings broken
- piston scuffed
- ring groove worn out
- and cracked

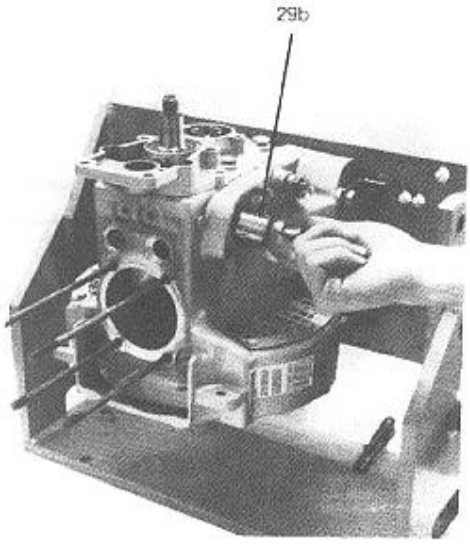
Piston rings are unusable when the gap is too big

Repair Data				
Piston	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Piston dia	mm	72.96		
Oversize	mm	+1.00		
Overall length	mm			82mm
Piston ring gap (new condition)	mm	0.25 – 0.4	Up to 2.00	

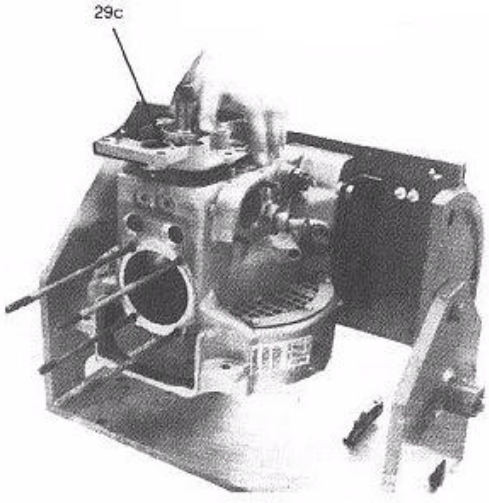
- Remove fuel pump (29a)



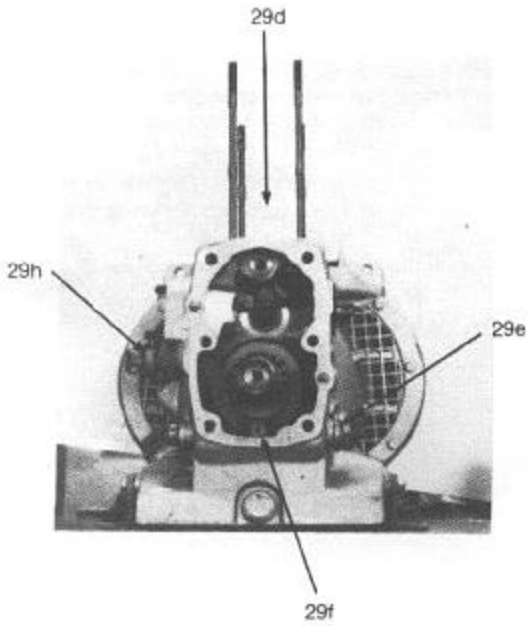
- Remove pump plunger (29b)

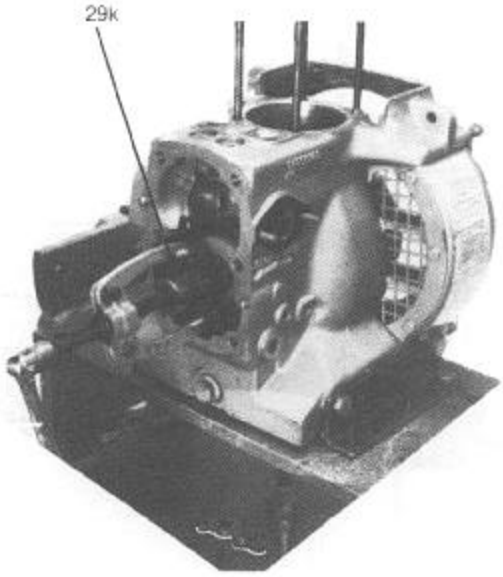


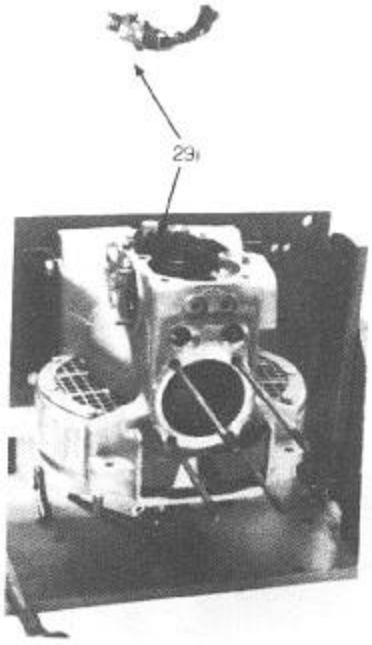
- Unscrew the three M16 hex nuts and remove timing gear cover (29c)



- Bring engine into the horizontal position, as shown in Fig (29d)
- Remove gear from crankshaft using extractor tool (29k)
- Loosen M6 hex nut (29f) on the regulator lever and pull out locking pin with pointed pliers
- Unscrew both M10 hex nuts (29e) from regulator shaft.
- Remove regulator shaft together with round nut, spring washer, sealing ring and friction disc.
- Unscrew M8 hex nut. Withdraw eccentric bolt with cap plate and sealing ring
- Loosen M20 hex nut. Remove start filling (29h) with sealing ring.
- Pull out clamping sleeve, using pointed pliers.
- Withdraw regulator lever with regulator spring (29i)
- Turn engine on flywheel side.





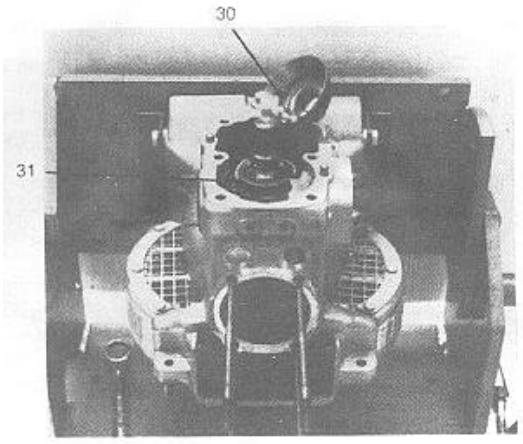


Repair Data for Regulator Spring Washers			
Maximum rpm	No of balls	Regulator Spring BMW Part No	Wire Dia
3600/160	4	13 41 1 329 652	2.6

- Remove ball sleeve with sliding disc taking care that no balls fall out (30)

Ball hub and spacer washer (31) remain on crankshaft. Detach these parts only when removing the crankshaft.

- Turn the engine block into the horizontal position.

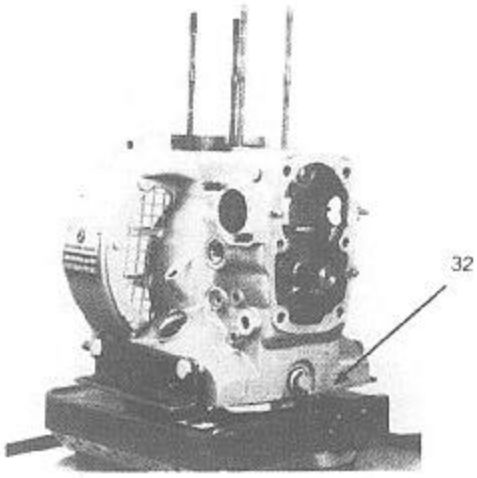


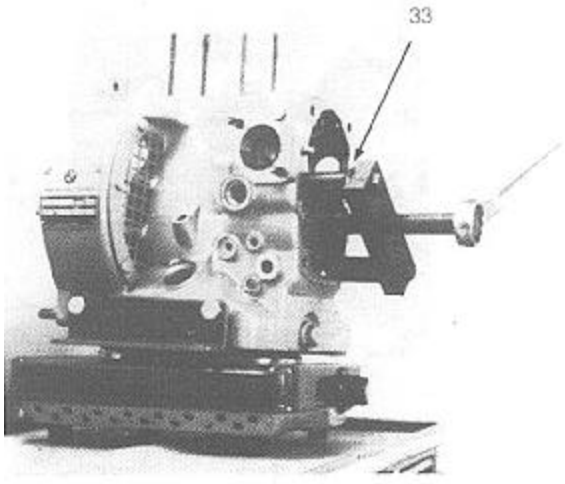
Removing the crankshaft

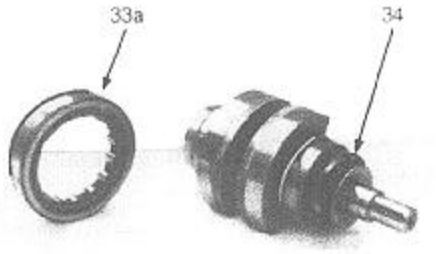
NOTE

It is essential that all plastic parts such as oil filler cover and cold start cover are removed

- Heat the crankcase on a heating plate to between 80 and 100° C (32)
- Press out the crankshaft with extractor tool (33) 74 64 1 333 515
- Press off the roller bearing on timing side (33a)
- Press off straight roller bearing together with spacer washer and drive dog hub (34)





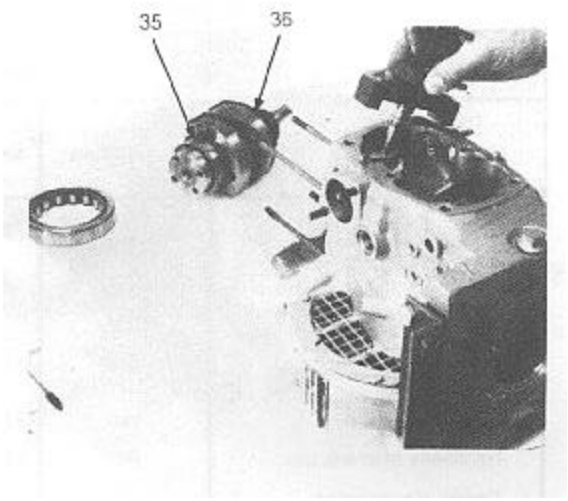


The outer race of the straight roller bearing on the timing gear side remains in the crankcase and can be removed with the aid of a press

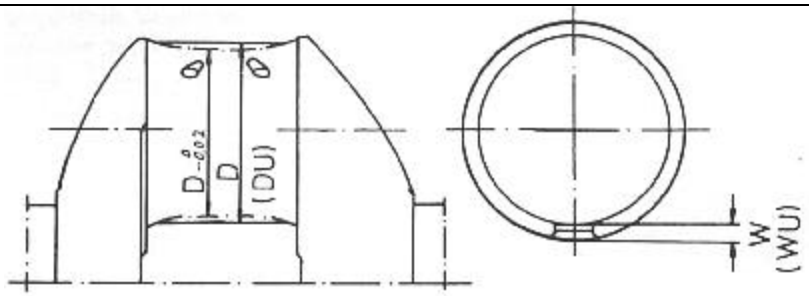
In order to remove the bearing rings which have been shrunk on to the crankshaft (35) heat the crankshaft on a heating plate or with a sufficiently large gas burner rapidly to about 70 to 80° C

After removal of the M8 cylinder head screws, remove the counterweights (36).

Set the crankshaft on a solid support and loosen bearing race by a blow to the crankshaft.



Repair Data for Crankshaft Crank Pins



Crank pins must not become convex upon regrinding. A concave shape of from 0.01 to 0.02 mm in diameter in the mid portion of length is allowable.

Crank pin nominal diameter (D)	42 $^{-0.060}_{+0.074}$	mm	Total play when worn out max 0.15mm
Crank pin diameter undersize (DU)	41.5 $^{-0.060}_{-0.074}$	mm	

Table: Repair data for crankshaft

Repair Data for Crankshaft				
Crankshaft	Dimension	D7 nominal values	Max. allowable wear (mm)	Remarks
Crank pin dia	mm	42.0 $^{-0.060}_{-0.070}$	Total play 0.15 max	Max allowable crank pin out-of-round 0.05mm
End float	μ	0.3		
Crankshaft crank pin width	mm	33.0 $^{+0.068}_{0}$		
Radii on crank pin	mm	3.0		
Hardness of crank pin	RC	50-55		
Depth of hardening of crank pin	mm	1.1-1.5		
Diameter of ball hub (regulator)	mm	29.0 $^{+0.021}_{0}$		
Diameter of ball sleeve	mm	28.0 $^{-0.020}_{-0.041}$		
Diameter of gear on crankshaft	mm	22.0 $^{+0.048}_{+0.035}$		
Regrinding of crankpin	mm	0.5	Grinding finish see page 17	Hardness at least 48 RC
Axial play	mm	0.3-0.4		