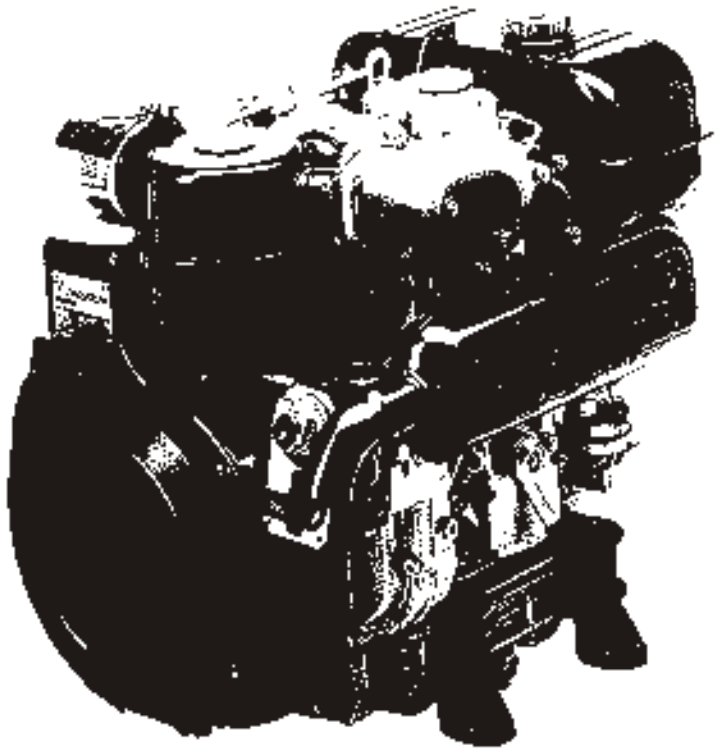
WORK SHOP MANUAL

12LD 435-2
12LD 435-2/B1
12LD 475-2

LOMBARDINI
intermotor SLANZI
SERVICE

CHARACTERISTICS OF MODELS 12LD435-2, 12LD435-2/B1, 12LD475-2

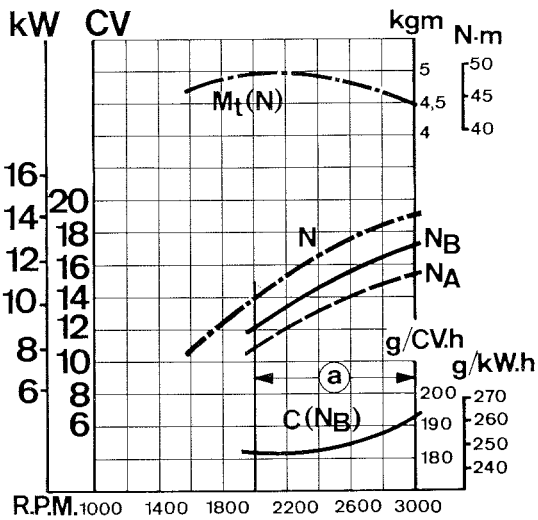


ENGINE TYPE			12LD435-2	12LD435-2/B1	12LD475-2
Number of cylinders		N.	2	2	2
Bore		mm	86	86	90
Stroke		mm	75	75	75
Displacement		cm³	871	871	954
Compression ratio			18,0:1	18,0:1	18,0:1
R.P.M.			3000	3600	3000
	N DIN 70020 - 80/1269/CEE - ISO 1585		14	14,7	15,8
Power kW	NB DIN 6270		12,7	13,2	14,85
	NA DIN 6270		11,4	12,0	13,53
Max. torque		Nm	49 @ 2000	49 @ 2000	57 @ 2100
Max. torque at 3rd p.t.o.		Nm	25	25	25
Specific fuel consumption *		g/kW•h @ r.p.m.	260 @ 3000	280 @ 3600	245 @ 3000
Tank capacity		l.	7	7	7
Oil consumption **		Kg/h	0,020	0,020	0,025
Oil sump capacity		l.	2.5	2.5	2.5
Dry weight		Kg.	80	80	80
Combustion air volume at 3000 r.p.m.		l./1'	1050	1250 ***	1150
Cooling air volume at 3000 r.p.m.		l./1'	13300	16200 ***	15500
Max. permissible driving shaft axial load in both directions		Kg.	300	300	300
	momentary	α	35°	35°	35°
Max. inclination	lasting up to 1 h.	α	25°	25°	25°
	permanent	α	****	****	****

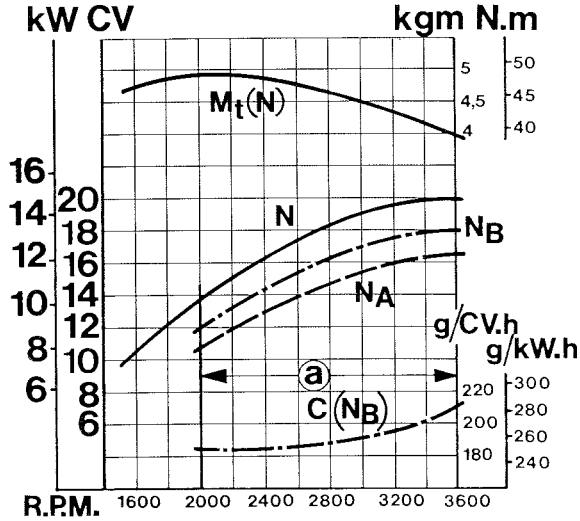
* Referred to max. NB power
** At 3000 r.p.m.
*** At 3600 r.p.m.
**** Depending on the application

CHARACTERISTIC POWER, TORQUE AND SPECIFIC CONSUMPTION CURVES

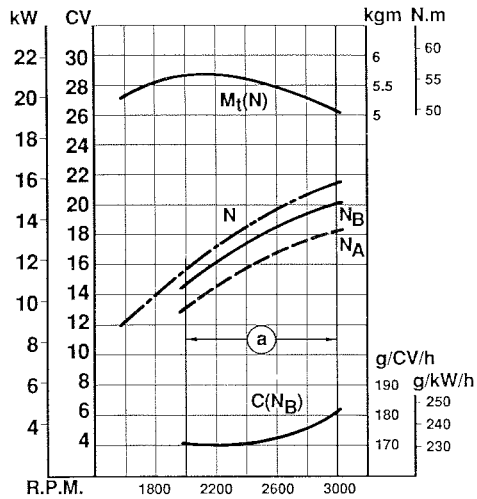
12LD435-2



12LD435-2/B1



12LD475-2



N (80/1269/CEE - ISO 1585) AUTOMOTIVE RATING: Intermittent operation with variable speed and variable load.
N_B (ISO 3046 - 1IFN) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty operation with constant speed and variable load
N_A (ISO 3046 - 1ICXN) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: Continuous heavy duty with constant speed and constant load.
M_N Torque curve (N curve) - **M_B** (N_B curve) - **M_A** (N_A curve).
C Specific fuel consumption curve

The above power values refer to an engine fitted with an air cleaner and standard muffler; after run-in and at the environmental conditions of 20°C and 1 bar.
Max. power tolerance is 5%. Power decreases by approximately 1% every 100 m altitude and by 2% every 5°C above 25°C.

MAINTENANCE

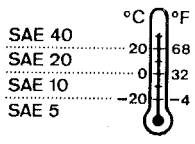
OPERATION	COMPONENT		INTERVAL (HOURS)								
				10	50	125	250	500	1000	2500	5000
CLEANING	(OIL BATH) AIR CLEANER (*)			●							
	FEED PUMP FILTER						●				
	HEAD AND CYLINDER FINS (*)						●				
	FUEL TANK								●		
	INJECTORS							●			
	INTERNAL OIL FILTER								●		
CHECK	LEVEL	AIR CLEANER OIL		●							
		CRANKCASE OIL		●							
		BATTERY FLUID			●						
	DELIVERY VALVE TIGHTNESS							●			
	VALVE AND ROCKER ARM CLEARANCE							●			
	INJECTOR SPRAY PATTERN							●			
REPLACEMENT	OIL	AIR CLEANER (**) (***)		●							
		CRANKCASE (***)			△		●				
	OIL FILTER CARTRIDGE				△		●				
	FUEL FILTER CARTRIDGE						●				
	DRY AIR CLEANER CARTRIDGE		(○)								
OVERHAUL INSPECTION	PARTIAL (****)									●	
	COMPLETE										●

(*) Under special working conditions clean daily.
(**) Under extremely dusty conditions clean every 4-5 hours.
(***) See recommended oil type.
(****) Includes checking cylinders, piston rings, guides, springs, grinding valve seats, scaling heads and cylinders as well as checking injection pump and injectors.
(○) When clogging indicator shows the need for replacement.
△ First replacement

RECOMMENDED OIL TYPE

AGIP DIESEL SIGMA S SAE 30-40, specification MIL-L-2104 C
ESSOLUBE D3, specification MIL-L-2104 D and UNIFARM specification MIL-L-2104 C
In countries where AGIP and ESSO products are not available use diesel engine oil API SERVICE CD or a similar type complying with the military specification MIL-L-2104 C and MIL-L-2104 D.

Suggested oil grades



CAPACITIES (LITERS)

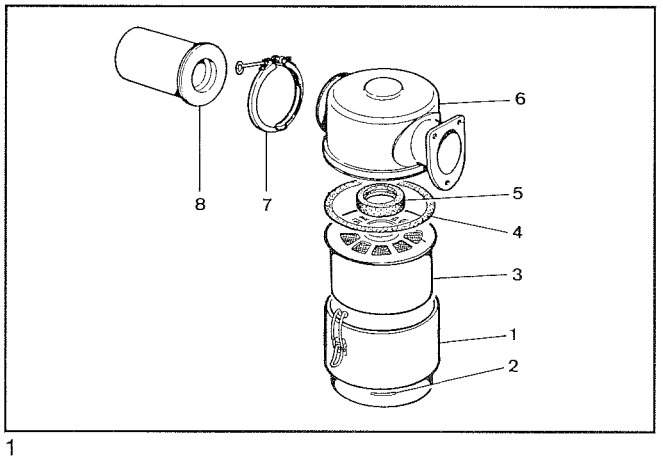
Standard fuel tank	10,0
Standard oil sump	2,8
Air cleaner oil tank	0,3

As for filters, tanks and special crankcases please refer to LOMBARDINI instructions.

MAIN TORQUE SPECIFICATIONS			
POSITION	Picture No.	Diameter and pitch mm	Torque Nm
Connecting rod	31	8x1,25	40
Injection pump delivery valve union	59/61	18x1,5	40
Rocker arm cover	5	8x1,25	20
Center main bearing support	36	8x1,25	25
Intake manifold	—	8x1,25	25
Exhaust manifold	—	8x1,25	20
Air shroud	—	6x1,0	6
Accelerator cover	—	6x1,0	10
Oil filter housing	53	6x1,0	12,5
Internal oil filter cover	50 Nr. 16	6x1,0	10
Hydraulic pump flange	46 Nr. 5	8x1,25	25
Camshaft gear	44	10x1,5	60
Oil pump gear	51	10x1,5	35
Starting motor	76	10x1,5	45
Rocker arm shaft	9	8x1,25	25
Gear cover plate	—	8x1,25	25
Engine mounting foot	—	10x1,5	40
Fuel feeding pump	58	8x1,25	25
Injection pump	61	8x1,25	25
Oil pump	51	8x1,25	20
Nozzle holder	66 Nr. 9	6x1,0	10
Oil pan	—	8x1,25	28
Main bearing support, gear case side	33	8x1,25	25
Main bearing support, flywheel side	34	8x1,25	25
Center main bearing support	35	10x1,5	30
Hydraulic pump gear support	46 Nr. 7	8x1,25	25
Governor fork support	—	8x1,25	25
Fuel tank bracket	—	8x1,25	40
Cylinder head	11	10x1,5	50
Flywheel	3	16x1,5	180

DISASSEMBLY AND REASSEMBLY

Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions. Always use original LOMBARDINI spare parts for proper repair operations.
All dimensions in mm.



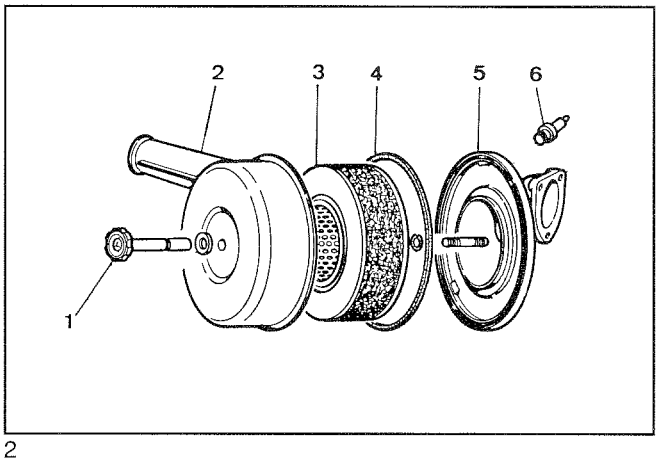
1

Oil-bath air cleaner

Check gaskets and replace if necessary.
Check that flange weld is free of porosity or defective spots.
Carefully clean bowl and filtering element with Diesel oil and blow through with compressed air.
Top up with engine oil to the mark.
When refitting tighten nuts at 25 Nm.
See page 3 for periodic maintenance details.

Components:

1 Bowl
2 Oil level mark
3 Filtering element
4 Seal ring
5 Internal seal ring
6 Cover
7 Clamp
8 Prefilter

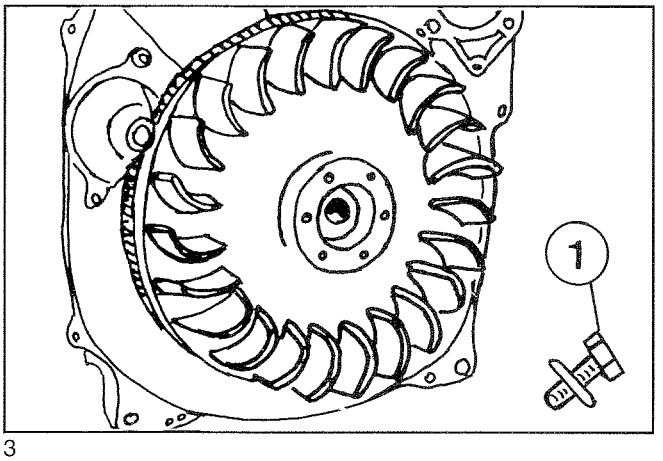


2

Dry air cleaner

1 Hand wheel
2 Cover
3 Cartridge
4 Seal ring
5 Bracket
6 Clogging indicator

Note: Replace cartridge immediately when indicator shows that is clogged.



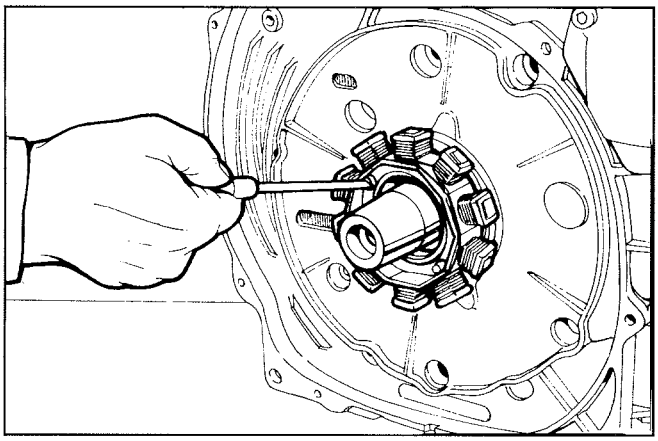
3

Flywheel

Remove flywheel with puller (part. No. 7271-3595-048).
Check starter ring gear and tapered crankshaft mating surfaces.
When refitting tighten bolt to 180 Nm.

Note: To replace starter ring gear heat it up to 200 ÷ 250°C and rapidly drive it onto the flywheel.

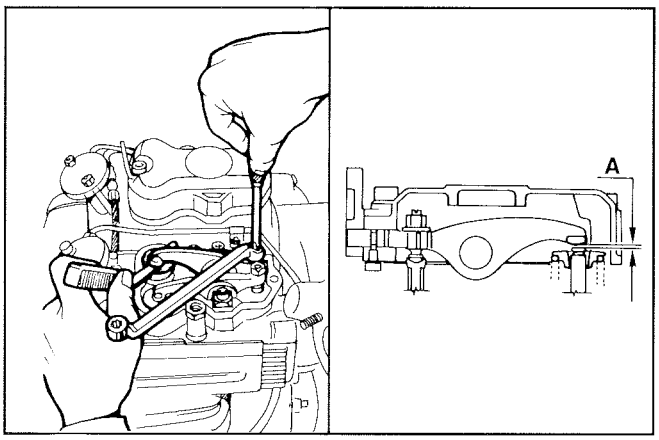
Attention: Unscrew bolt 1 clockwise.



4

Alternator

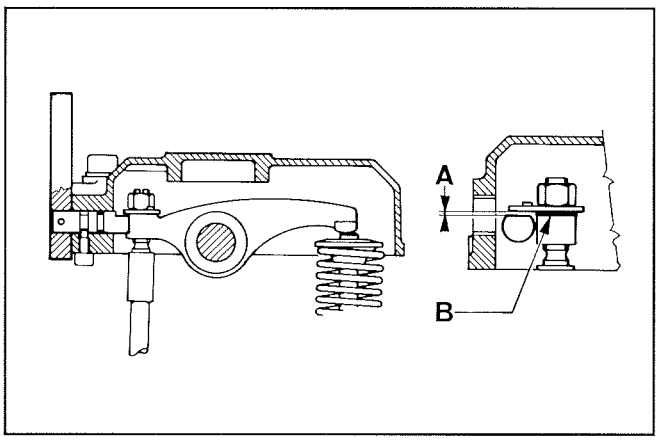
Remove stator and place it inside the rotor to prevent metal particles from being attracted by the magnets.
When refitting tighten rotor screws and stator bolts at 10 Nm.
See page 19, 20 for alternator characteristics.



5 6

Valve / rocker arm clearance

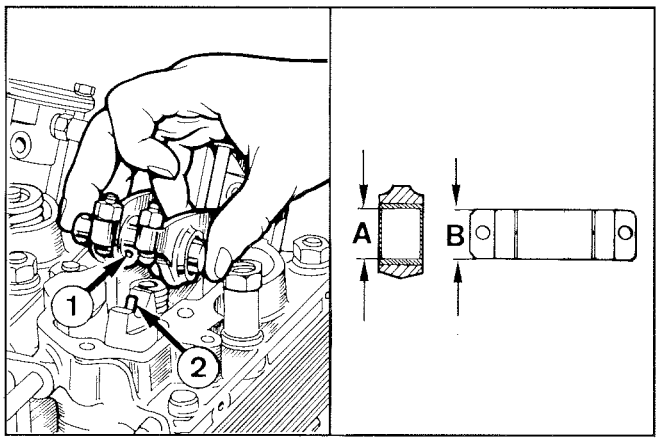
Remove rocker arm cover and check gaskets for breakage.
Setting should be performed when the engine is cold: bring each cylinder piston to top dead center on the compression stroke and set clearance **A** at 0.15 ÷ 0.20 mm.
When refitting tighten cover screws to 20 Nm.



7

Compression release (optional)

Bring piston to top dead center on the compression stroke.
Unscrew rocker arm cover side plug and measure clearance **A**. It must be 0.30 ÷ 0.40 mm.
For setting purposes remove rocker arm cover, unscrew lock nut and set clearance **A**, by adding or removing shims under steel plate (point **B**).

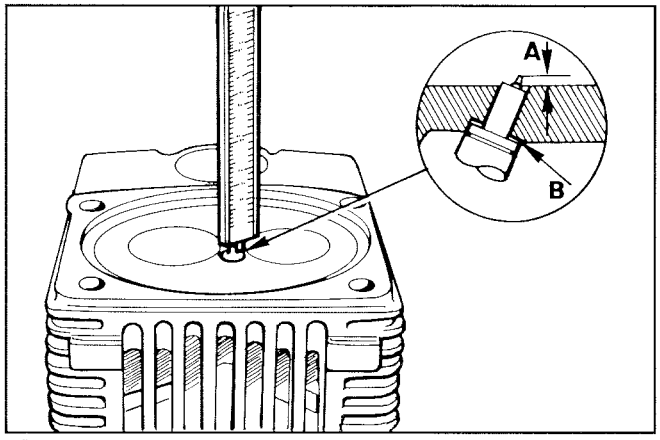


8 9

Rocker arm assembly

Components:
1 Bore
2 Lubrication tube

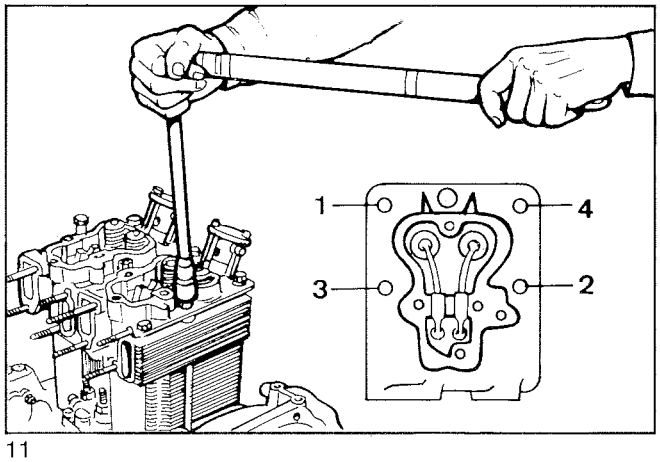
Dimensions (mm):
A = 18.032 ÷ 18.050
B = 17.989 ÷ 18.000
If clearance (A-B) exceeds 0.135 mm. replace shaft and rocker arms.
When refitting check that lubrication tube perfectly matches with the journal bore.
Tighten screws to 25 Nm.



10

Injector projection

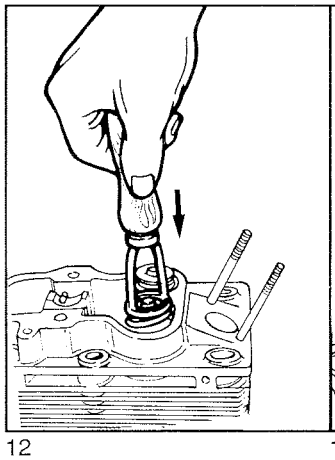
The end of nozzle **A** should project 3.0 ÷ 3.5 mm. from the cylinder head plane.
Adjust injector projection by means of copper shims **B** measuring 1.5 and 1.00 mm. in thickness.



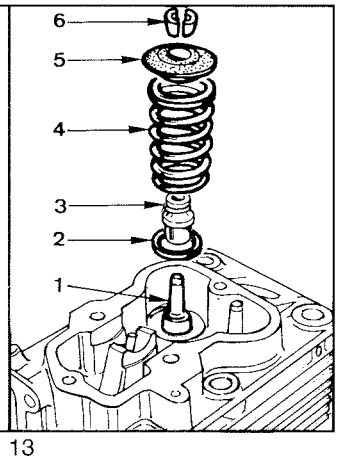
11

CYLINDER HEAD

Do not remove it when hot to avoid deformation.
If cylinder head is deformed level it off by removing a maximum of 0.3 mm.
When refitting tighten only if sure that rocker arm lubrication tube is well inside its holes and that both heads are in line by fitting the inlet and exhaust manifolds before tightening the cylinder head nuts.
Always replace copper head gasket: see page 7 for choosing the right thickness.
Progressively tighten nuts in the **1, 2, 3, 4** sequence at 50 Nm.



12

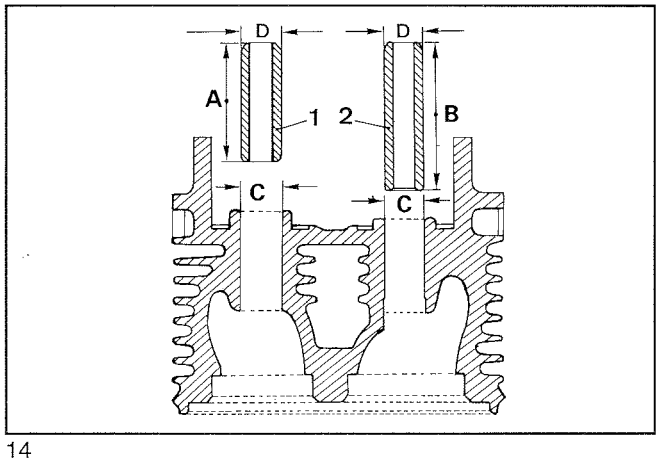


13

Valves

Components:
1 Intake valve
2 Spring seat
3 Valve stem oil seal
4 Spring
5 Retainer
6 Half collets
To remove half collets firmly press down as shown in the figure.

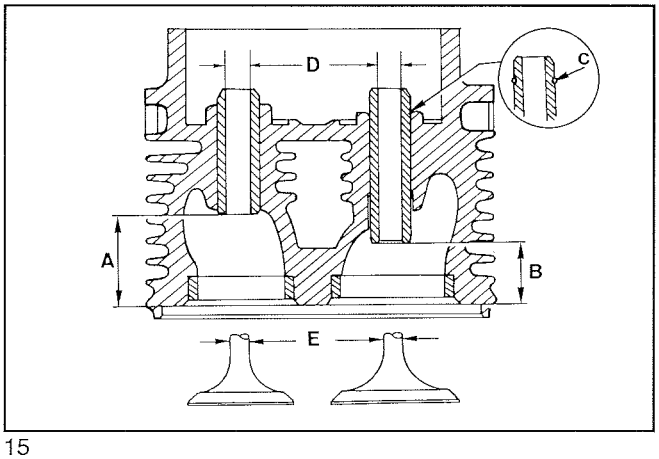
Note: Valve stem oil seal, **3** must be fitted to the intake valve only.



14

Valve guides and valve guide housings

Starting from engine No. 2883619 intake and exhaust valve guides are both made of phosphoric cast iron.
Components:
1 = Exhaust valve guide
2 = Intake valve guide
Dimensions (mm):
A = 42,0
B = 48,5
C = 14,000 ÷ 14,018
D = 14,050 ÷ 14,060
Valve guides with outside diameter increased by 0.5 mm. are also available; in such cases valve guide bore **C** should also be increased by 0.5 mm.



15

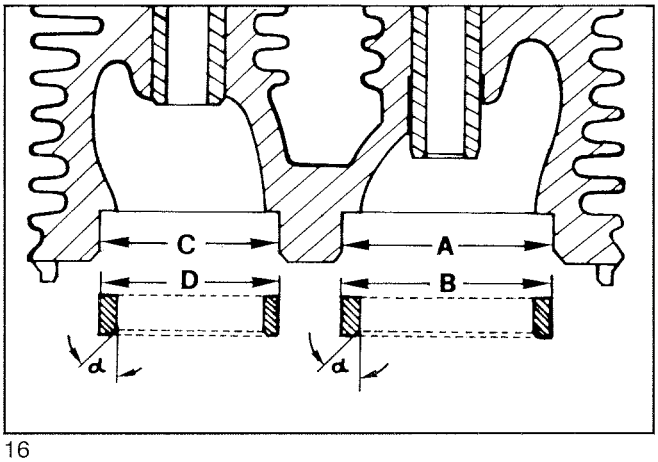
Valve guide insertion

Heat cylinder head up to 160 ÷ 180°C
Press guides considering the **A** and **B** distances from the head plane.
Dimensions (mm):
A = 30.80 ÷ 31.20
B = 24.80 ÷ 25.20
C = 20.3 ÷ 20.7

Note: If guides are seated with stop ring **C**, first locate the ring in place and then position guides without considering **A** and **B**.

Dimensions and clearance between guides and valves (in mm)

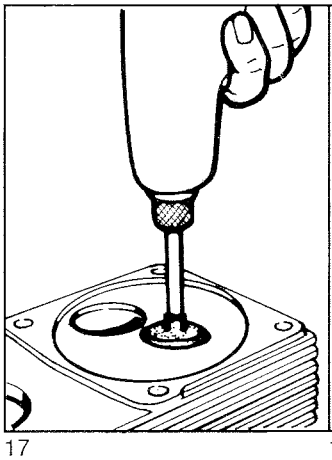
D = 8.030 ÷ 8.045
E = 7.985 ÷ 8.000
(D-E) = 0.030 ÷ 0.060 **(D-E)** limit of wear = 0.15



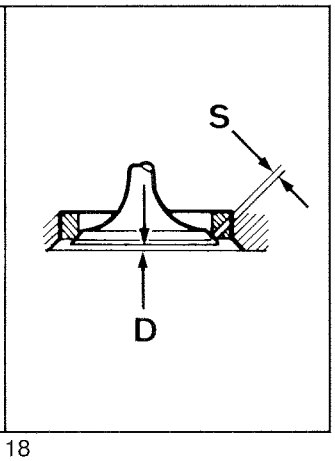
16

Valve seats and housings

Dimensions (mm.):
A = 40.000 ÷ 40.016 (intake valve housing dia.)
B = 40.120 ÷ 40.140 (intake valve seat dia.)
C = 34.000 ÷ 34.016 (exhaust valve housing dia.)
D = 34.120 ÷ 34.140 (exhaust valve seat dia.)
Press valve seats into the housings and cut α at 45°



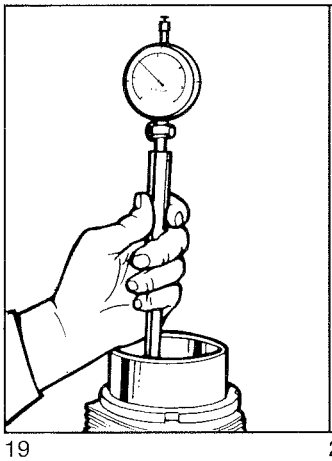
17



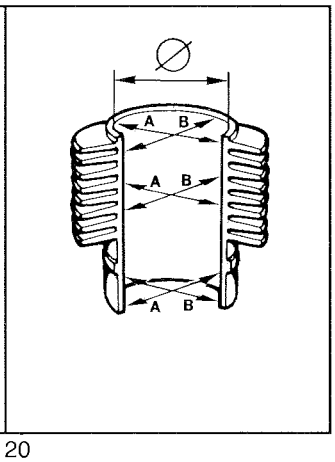
18

Valve seat grinding

After cutting grind valve seats with fine emery paste in oil suspension.
The sealing surface **S** should not exceed 2 mm.
Valve recess after grinding **D** = 0.75 ÷ 1.25 mm; maximum worn limit 1.65 mm.



19



20

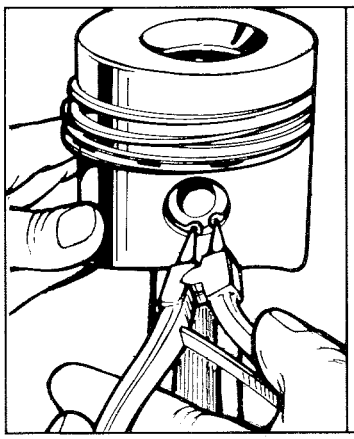
CYLINDER

Measure diameter size between two diametrically opposed points at three different heights.
For 12LD435-2 and 12LD435-2B1 ∅ = 86,00 ÷ 86,02 mm (new)
For 12LD475-2 ∅ = 90,00 ÷ 90,02 mm. (new)
In case wear exceeds 0.10 mm, bore the cylinder and fit oversize piston and rings. In case of less wear replace piston rings only.

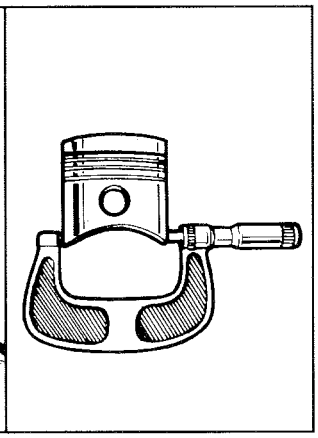
Cylinder roughness

Inclination of the machined cross-hatch should range between 45° and 55°; the cross-hatch should be uniform and clear in both directions. Mean roughness should range between 0.5 and 1 μm. The entire surface of the cylinder which contacts piston rings should be honed.

Warning: Do not use emery cloth on the cylinder or attempt to create the the cross-hatch by hand motion.



21



22

PISTON

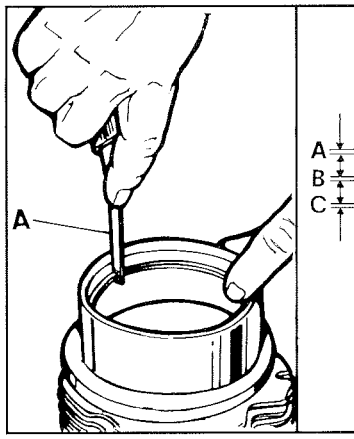
Remove circlips and remove piston pin.
Remove piston rings and clean grooves.
Measure diameter at 12 mm (like drawing) from the bottom of the piston.

Diameter in mm (new)
12LD435-2 and 12LD435-2B1 = 85,920 ÷ 85,940
12LD475-2 = 89,925 ÷ 89,940

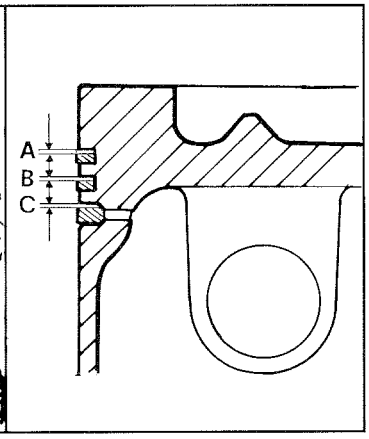
Note: Oversize pistons of 0.5 and 1.0 mm are available.

Piston weight

Weigh pistons when replacing them in order to avoid unbalance.
The difference in weight should not exceed 6 g.



23



24

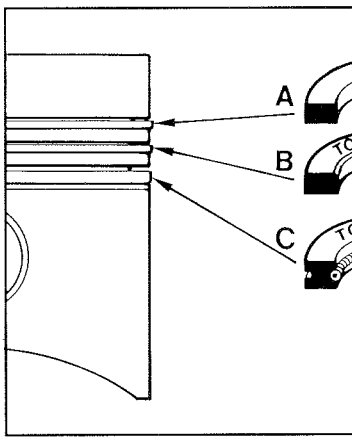
Piston rings - End gaps (mm)

Place piston rings squarely into the unworn part of the lower cylinder and measure the end gap.

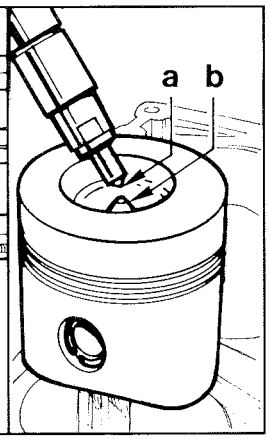
A = 0,30 ÷ 0,50 (new)

Piston rings - Clearence between groves

A = 0,060 ÷ 0,065 limit of wear = 0,12
B = 0,030 ÷ 0,035 limit of wear = 0,07
C = 0,020 ÷ 0,025 limit of wear = 0,05



25



26

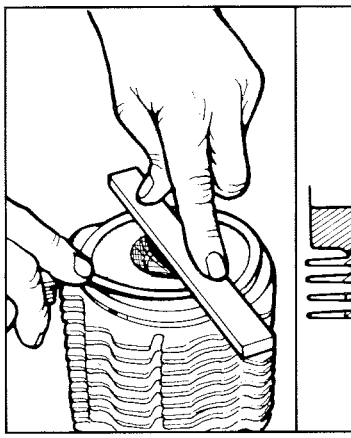
Piston rings - Fitting sequence

A = 1° Chromium-plated ring
B = 2° Torsional (internal tapered) ring
C = 3° oil control ring

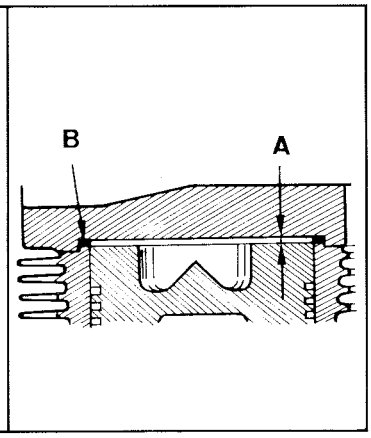
Note: Before fitting the piston into the cylinder stagger the ring gaps at 120°.

Piston - Refitting

Connect piston to connecting rod in a way that the combustion chamber centre **b** is at right angle under nozzle tip **a**.
Lubricate piston pin and introduce it into the piston by exerting pressure with your thumb.
Check that both circlips are well inside their seats.



27

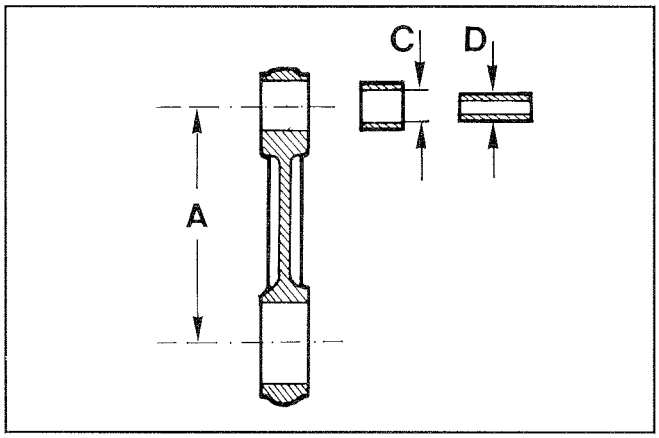


28

Piston clearance

A = Piston clearance
B = Copper head gasket

A (0.65 ÷ 0.70 mm) is determined by placing the piston at top dead center and measuring with a feeler gauge and straight edge, the distance the piston is below or above the cylinder face. A copper gasket (available in various thicknesses) is them selected to ensure the clearance is correct.
Gaskets are available in the following thicknesses 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95 mm.

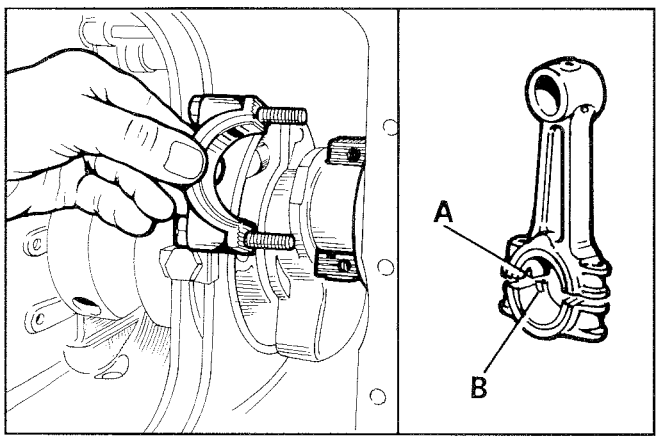


29

Connecting rod small end bushing

Dimensions and clearance (mm):
A = 117.95 ÷ 118.05
C = 22,015 ÷ 22,025 (with machined bushing in place)

D = 21,995 ÷ 22,005
(**C-D**) = 0,010 ÷ 0,030
(**C-D**) limit of wear = 0.070



30

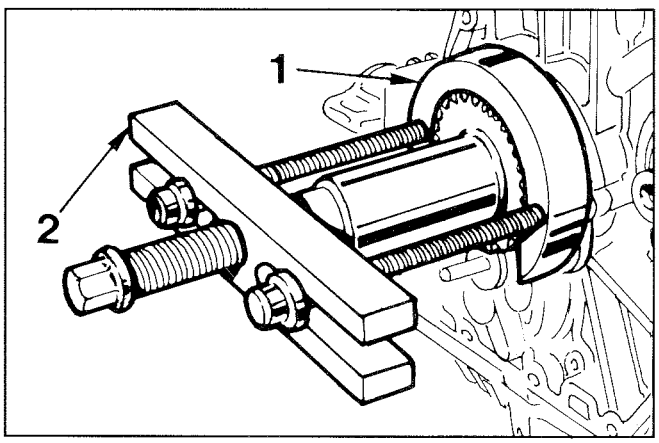
31

Connecting rod big end bearing

Both centering notches **A** and **B** must be on the same side when refitting.
Tighten bolts to 40 Nm.
See page 12 for dimensions.

Connecting rod weight

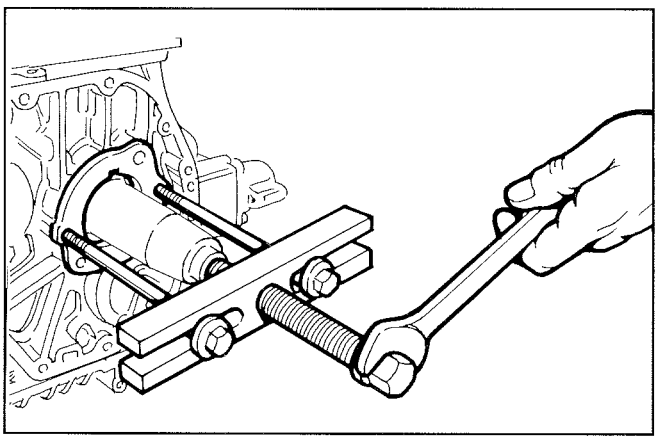
Weigh connecting rods when replacing them in order to avoid unbalance. The difference in weight should not exceed 10 g.



32

Crankshaft timing gear

Use tool **1** (Part No. 7560-4000-052) and puller **2** (Part No. 7271-3595-048) to remove the gear.

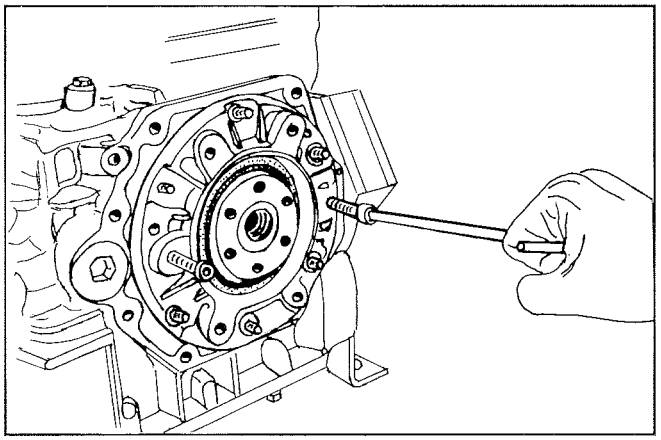


33

Main bearing support, gear side

Remove main bearing by means of two M8x1.25 screws with fully threaded length of 40 mm or a puller (Part No. 7271-3595-048).

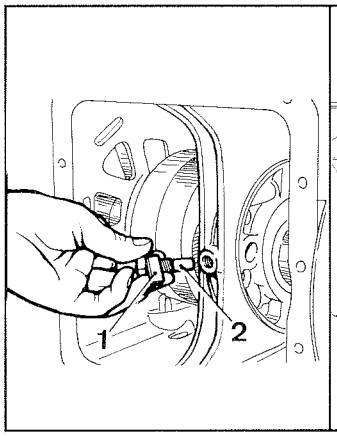
Note: To avoid deformation it is not recomended to replace the bearing bushing, complete assembly's of bushing and support are available in standard, 0.25 mm and 0.50 mm undersize configurations as spare parts.
See page 12 for dimensions.



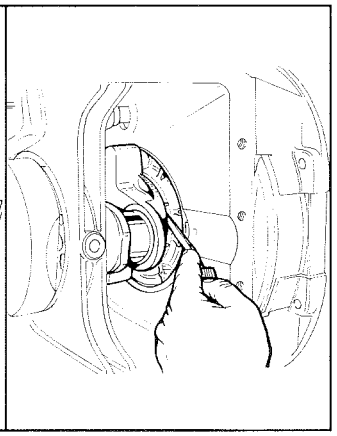
34

Main bearing support, PTO-Side

Remove it by means of two M8x1.25 screws with fully threaded length of 40 mm.
Check oil seal ring and replace if warped, hardened or worn-out.
When refitting, tighten nuts to 25 Nm.
See page 12 for dimensions.



35



35a

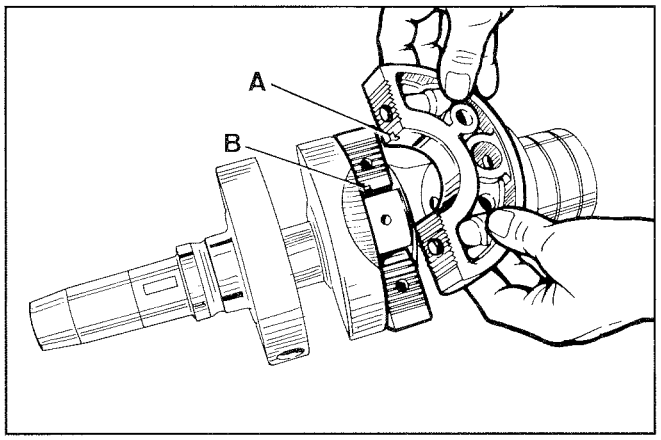
CRANKSHAFT

Center main bearing support, locating bolt.

Straighten plate **1** and unscrew bolt **2** before removing crankshaft.
When refitting, tighten screw **2** to 30 Nm.

Crankshaft end play

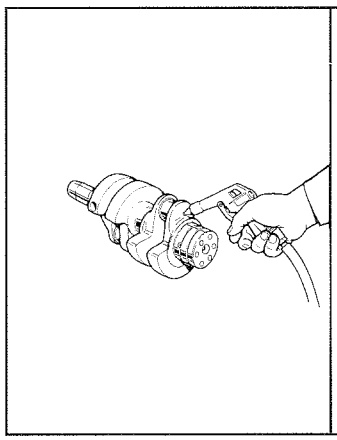
When refitting crankshaft check end play be means of a feeler gauge; this value should be 0.08 ÷ 0.38 mm and can be set by changing the thickness of gasket **A** which is located on the flywheel-side main bearings.
Gaskets with thickness of 0,30 and 0,50 mm can be supplied.



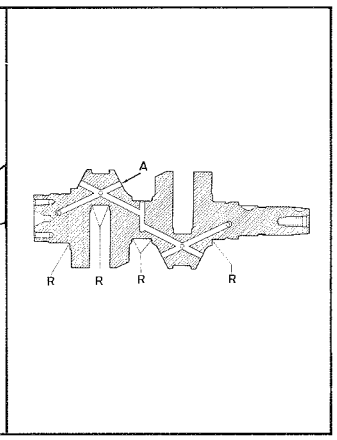
36

Crankshaft center main bearing support

When refitting, both centering notches **A** and **B** must be located on the same side.
Tighten screws to 25 Nm.
See page 12 for dimensions.



37



38

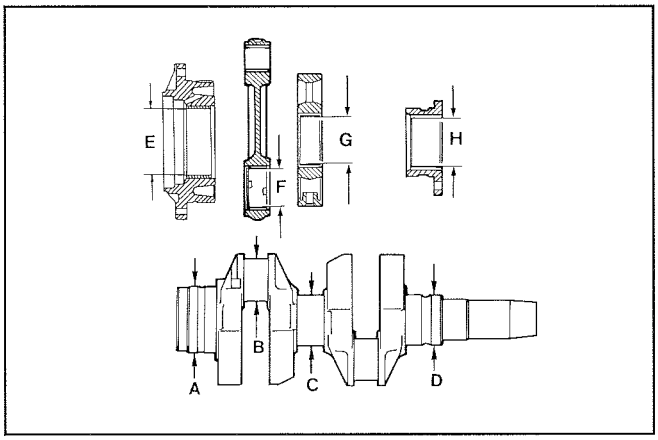
Crankshaft lubrication ducts

Remove plugs, clean duct **A** with a pointed tool and blow in compressed air.
Replace the plugs, and check for sealing.

Crankshaft journal radii

The radius **R** connecting journals to shoulders is 2.8 ÷ 3.2 mm.

Note: When grinding main journals or crank pins restore the **R** value to original specification.



39

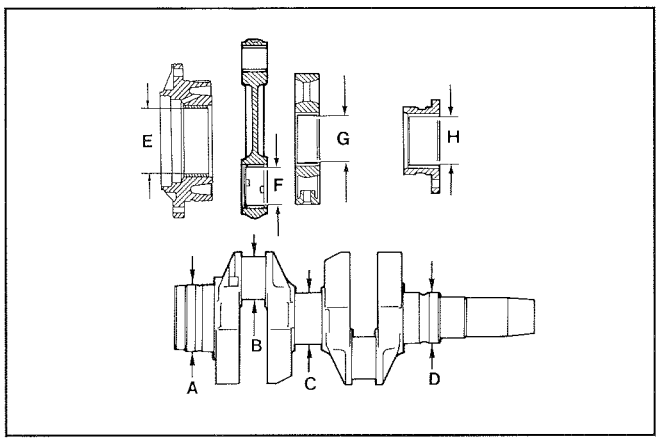
Main journal and crank pin diameter (mm)
Main bearing and connecting rod big end bearing inside diameter

Dimensions (mm):

E =	72.070 ÷ 72.090	**A** =	71.981 ÷ 72.000
F =	40.045 ÷ 40.076	**B** =	40,004 ÷ 40,020
G =	55.404 ÷ 55.435	**C** =	55,340 ÷ 55,350
H =	55.000 ÷ 55.020	**D**	3 54.931 ÷ 54.950

The above dimensions refer to driven in or tightened bearings.

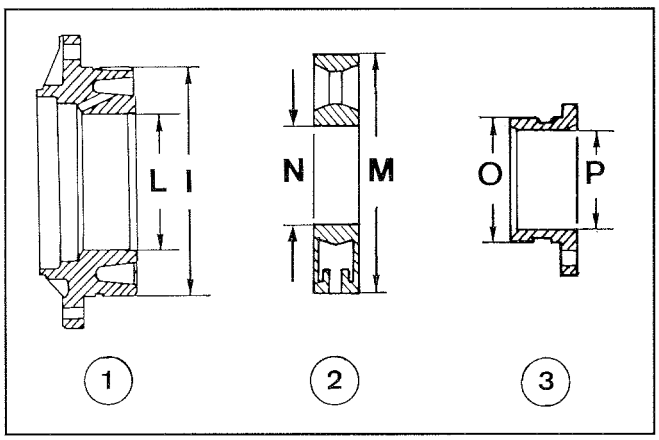
Note: Both main bearings and connecting rod big end bearings are available with inside diameter size measuring 0.25 and 0.50 mm less than the standard version.



40

Clearance between main journals/crank pins and connecting rod bearings (mm)

(**E-A**) =	0.070 ÷ 0.109;	limit value = 0.195
(**F-B**) =	0.025 ÷ 0.072;	limit value = 0.150
(**G-C**) =	0.051 ÷ 0.095;	limit value = 0.190
(**H-D**) =	0.050 ÷ 0.089;	limit value = 0.180



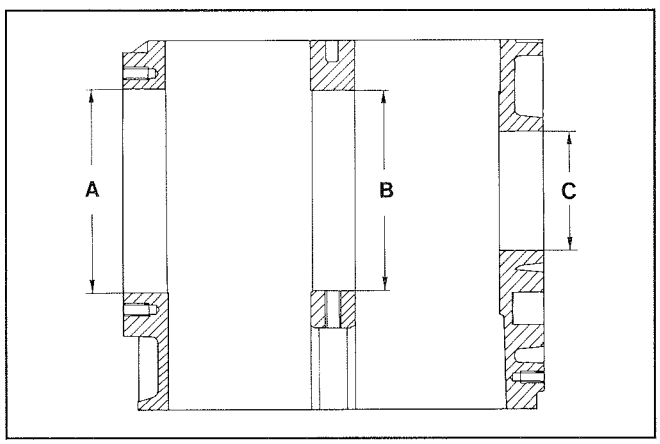
41

Main bearing supports

1 PTO-side
2 Central
3 Gear side

Dimensions (mm):

I =	130.000 ÷ 130.020
L =	76.980 ÷ 77.020
M =	128.000 ÷ 128.018
N =	59.074 ÷ 59.092
O =	75.990 ÷ 76.010
P =	60.000 ÷ 60.020

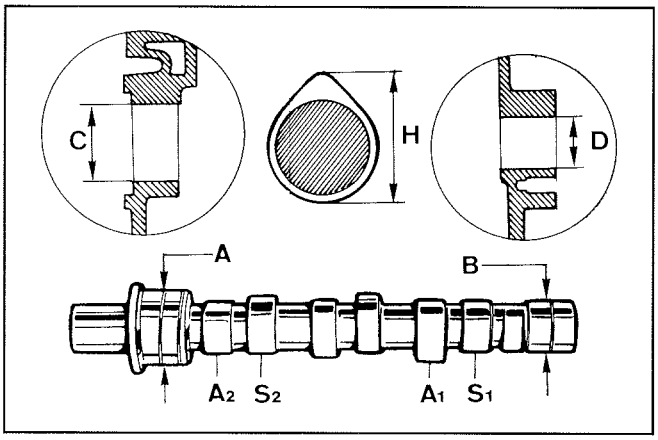


42

Main bearing housings

Dimensions (mm):

A =	130.000 ÷ 130.020
B =	128.000 ÷ 128.020
C =	76.000 ÷ 76.020



43

Dimensions of camshaft journals and housings (mm)

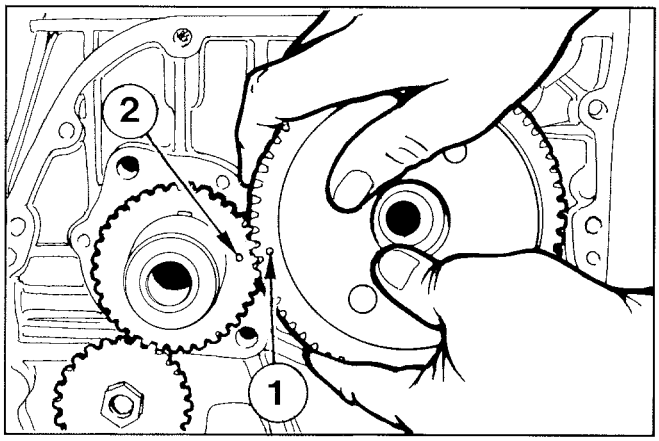
A = 41.940 ÷ 41.960
B = 27.940 ÷ 27.960
C = 42.000 ÷ 42.025
D = 28.000 ÷ 28.020

Clearance (mm)

(**C-A**) = 0.040 ÷ 0.085; (**C-A**) limit value = 0.160
(**D-B**) = 0.040 ÷ 0.080; (**D-B**) limit value = 0.150

How to measure intake/exhaust cam height

A_1 = 1st cylinder intake cam A_2 = 2nd cylinder intake cam
S_1 = 1st cylinder exhaust cam S_2 = 2nd cylinder exhaust cam
Exhaust and intake cams feature the same height **H** = 33,62 ÷ 33,65.
Replace camshaft if **H** is 0.1 mm below the given value.



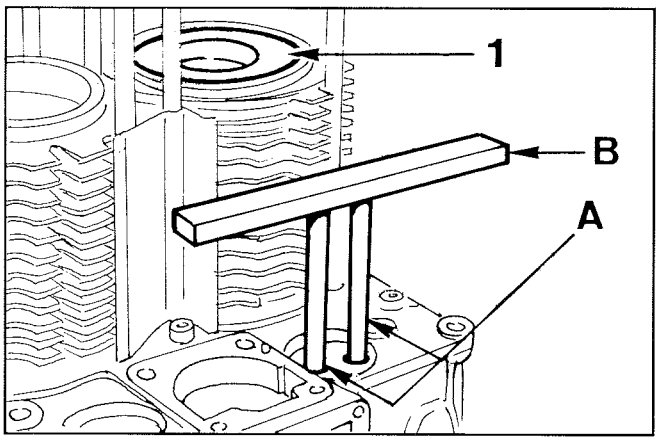
44

Camshaft timing

Fit camshaft gear by making timing mark **1** coincide with timing mark **2** on the crankshaft timing gear.
Tighten camshaft bolt to 60 Nm.

Camshaft end play

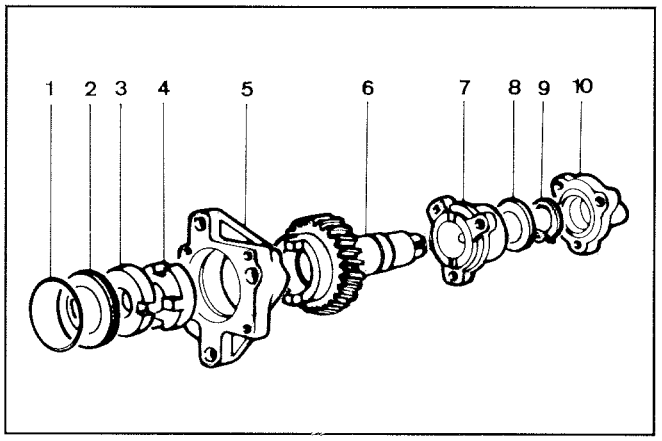
End play should be 0.10 ÷ 0.26 mm; check by means of a dial gauge pushing or pulling camshaft as required.



45

Valve timing without considering timing marks

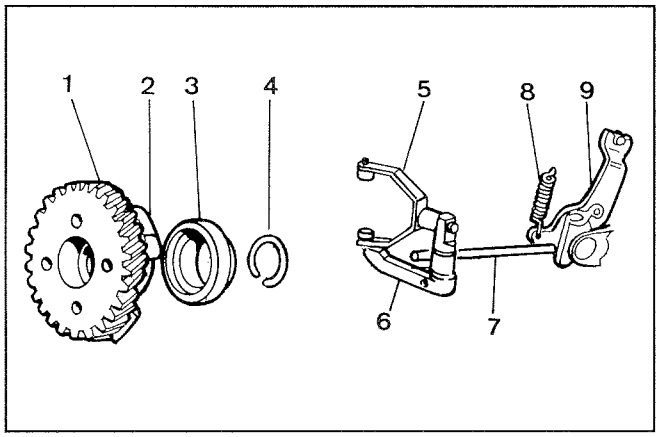
Locate piston 1 (on flywheel side) at the top dead centre.
Position two small cylinders **A** of the same height onto the tappets. Rotate camshaft stopping when cylinder 1 tappets are in overlap position (intake open, exhaust closed).
By means of ruler **B** check that tappets are at the same height.
Engage camshaft gear with crankshaft gear.



46

Hydraulic pump p.t.o. (1P)

Components:
1 Seal ring
2 Centering ring
3 Coupling
4 Half coupling
5 Flange
6 Gear
7 Bracket
8 Thrust washer
9 Stop ring
10 Cover
The maximum torque is 27 Nm corresponding to 7,64 kW at 3000 r.p.m..



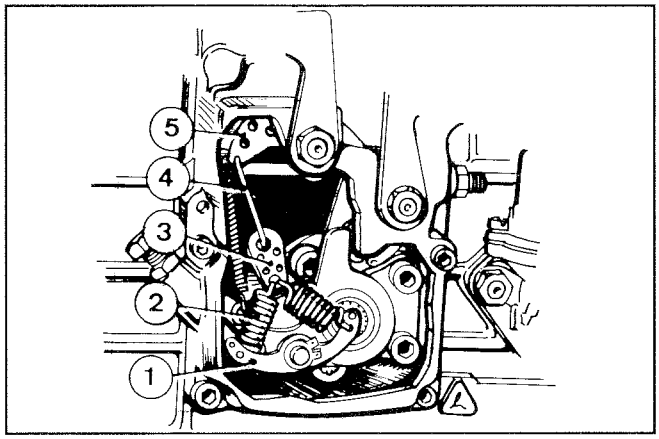
47

Mechanical speed governor

Components:

1 Gear
2 Weight
3 Mobile bell
4 Stop ring
5 Yoke
6 Lever
7 Drive rod
8 Governor spring
9 Rack control lever

Weights are moved to the periphery by the centrifugal force and thus axially shift a mobile bell connected to the injection pump rack control lever by a linkage. A spring placed under tension by the accelerator control offsets the weights centrifugal force. Balance between the two forces keeps speed at an almost constant level in spite of load variations. See page 17 for timing.

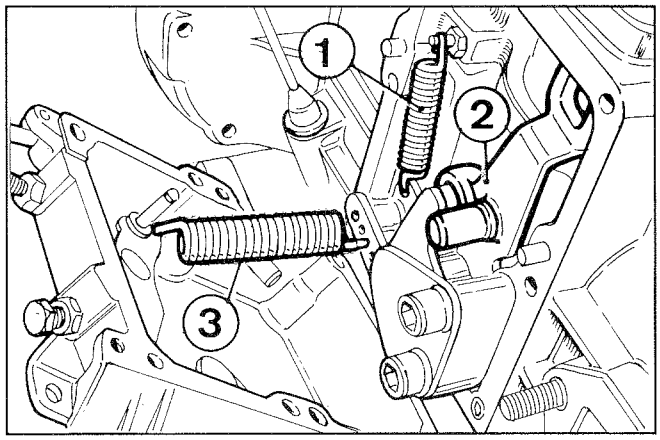


48

Governor springs with rocker arm

Components:

1 Rocker arm for spring anchoring
2 Governor springs
3 Plate
4 Link
5 Lever



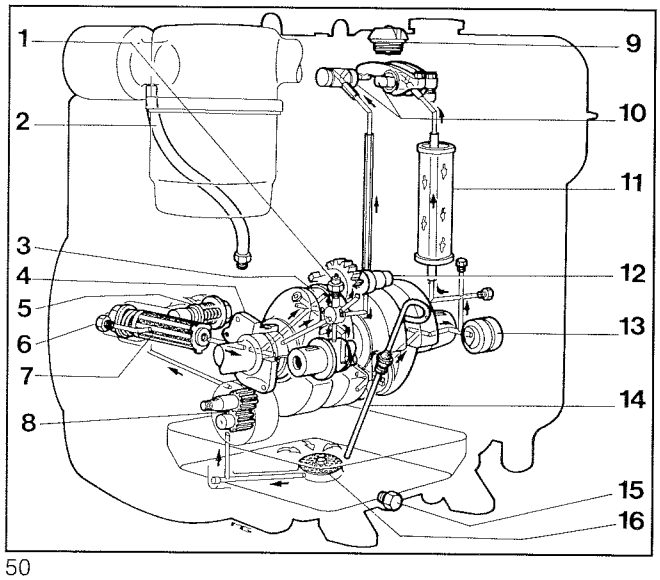
49

Spring for extra fuel supply at starting

Components:

1 Extra fuel spring
2 Injection pump control yoke
3 Governor spring.

The device is operated automatically: when the engine is stopped spring **1** acts on injection pump control yoke **2** providing maximum fuel delivery, until the engine starts and the governor controls the injection pump rack.



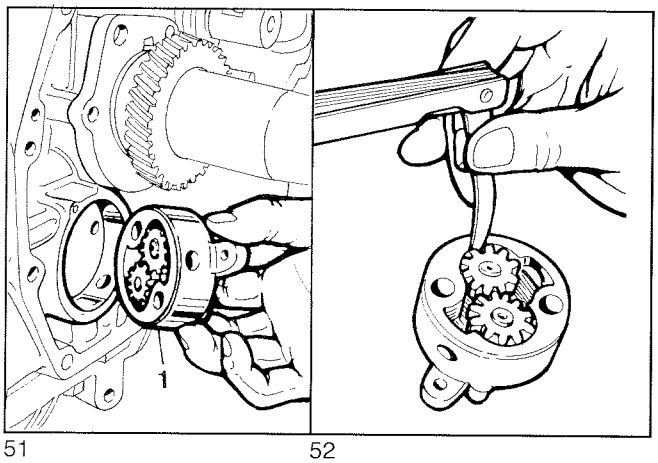
50

Components:

1 Oil pressure switch
2 Breather
3 Connecting rod big end bearing
4 Crankshaft main bearing, gear side
5 Oil pressure relief valve
6 Fitting for pressure gauge
7 Cartridge filter
8 Oil pump
9 Oil fill plug
10 Rocker arm shifts
11 Pushrod protection tube
12 Hydraulic pump gear
13 Camshaft journal on flywheel side
14 Oil dipstick
15 Drain plug
15Internal filter

Oil pressure check

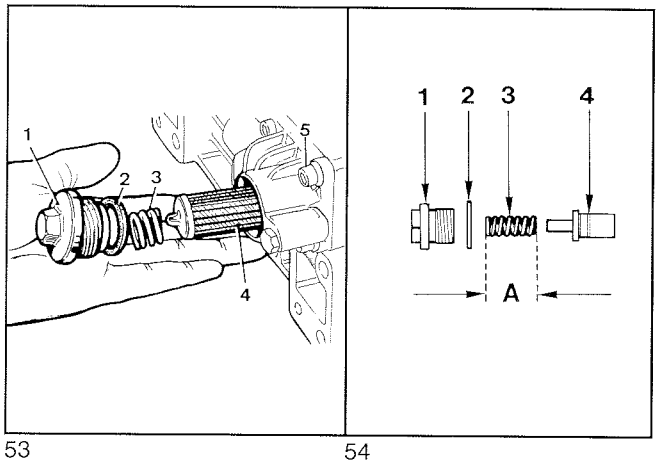
Once the engine is filled with oil and fuel; connect a 10 bar pressure gauge to the oil filter fitting.
Start the engine and check pressure as a function of the oil temperature



51 52

Oil pump

Check that gear teeth are intact and that clearance between gear edge and pump body does not exceed 0.15 mm.
Further more check that control shaft is free to rotate with end float not exceeding 0.15 mm.
Oil pump delivery at 3000 r.p.m. is 9 liters/min.



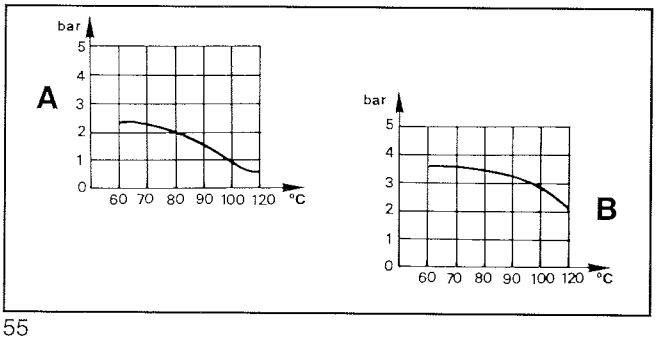
53 54

Oil filter cartridge (internal)

Components:
1 Plug
2 Seal ring
3 Spring
4 Cartridge
Features:
Type of filtration: 70 μ
By-pass valve opening pressure: 0.60 ÷ 0.75 bar.
Max. working pressure: 4.5 bar.

Oil pressure relief valve

Components:
1 Plug
2 Gasket
3 Spring
4 Valve
A = 37 mm
Carefully clean all components and check spring **A** length.



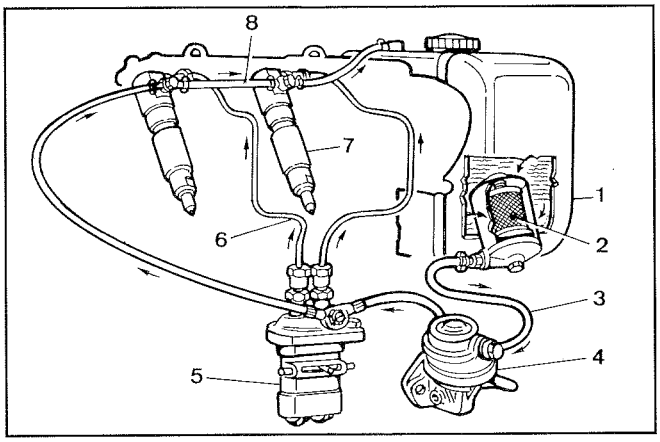
55

Oil pressure curve at idling speed (A)

The curve is obtained at the oil filter level with constant engine speed of 1200 r.p.m. in no-load conditions and at a room temperature of +25°C.
Pressure is given in bar and temperature in centigrade.

Oil pressure curve at full speed (B)

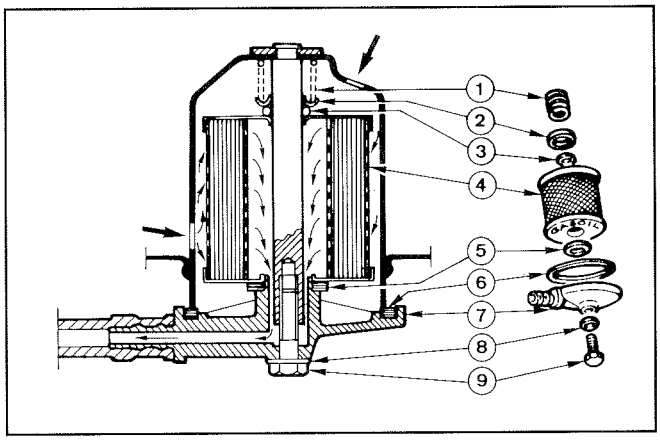
The curve is obtained at the oil filter level with engine working at 3000 r.p.m.
Pressure is given in bar and temperature in centigrade.



56

Fuel feeding/injection circuit

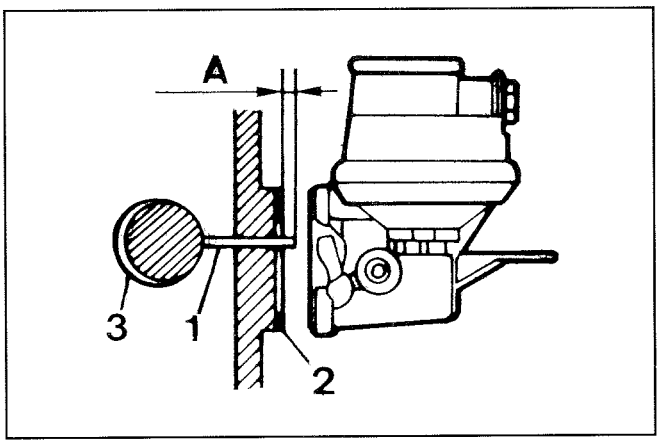
Components:
1 Tank
2 Filter
3 Fuel feeding tube
4 Fuel feeding pump
5 Injection pump
6 Injection line
7 Injector
8 Injector leak off line and self bleeding system



57

Fuel filter (inside fuel tank)

Components:
1 Spring
2 Disc
3 Ring
4 Cartridge
5 Gasket
6 Gasket
7 Cap
8 Ring
9 Bolt



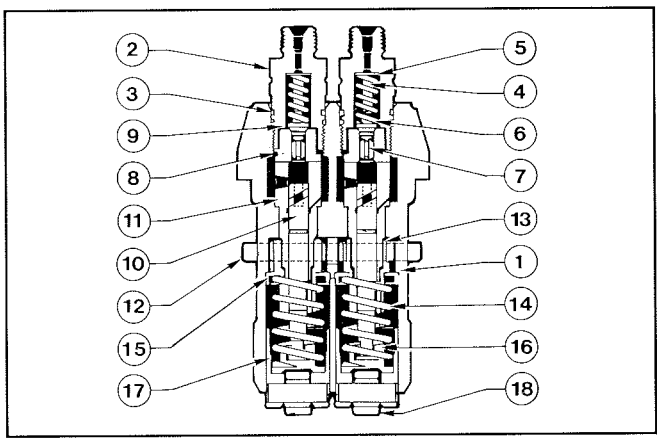
58

Fuel feeding pump drive rod protrusion

Components:
1 Drive rod
2 Gasket
3 Camshaft eccentric

Drive rod **A** protrudes 0.8-1.2 mm from the crankcase; it can be adjusted by means of gaskets.
Gaskets are supplied in the following thicknesses: 0.50, 0.80 and 1.0 mm.

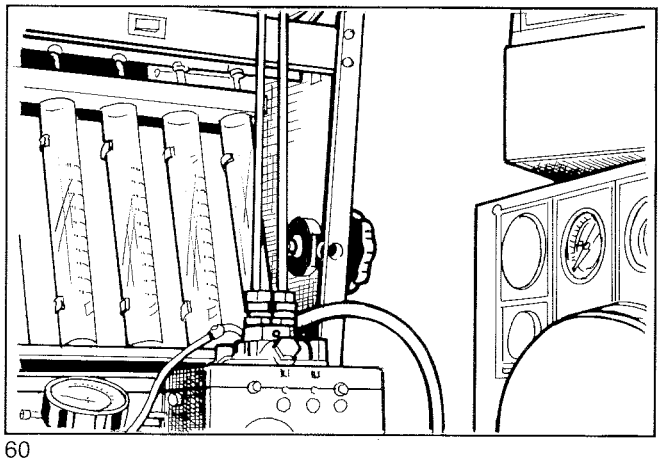
Note: This setting is performed when the rod is on the base of the cam lobe (i.e. minimum protrusion).



59

Injection pump

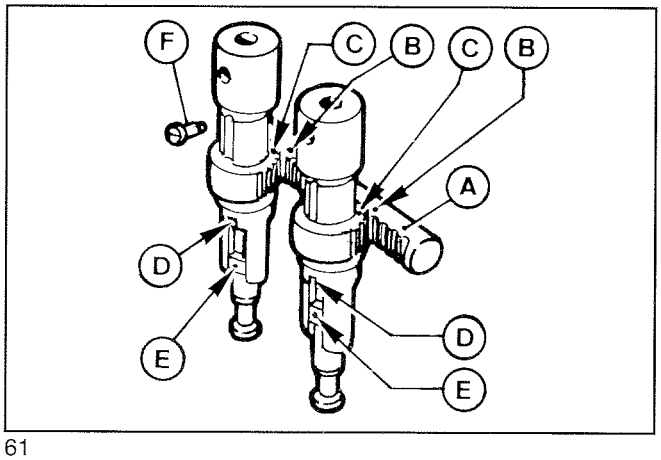
Components:
1 Pump body
2 Fitting
3 Seal ring
4 Filler
5 Shim
6 Spring
7 Delivery valve
8 Seat
9 Gasket
10 Plunger
11 Barrel
12 Rack rod
13 Sector gear
14 Spring
15 Upper retainer
16 Lower retainer
17 Tappet
18 Tappet roller



60

Test data for injection pump delivery

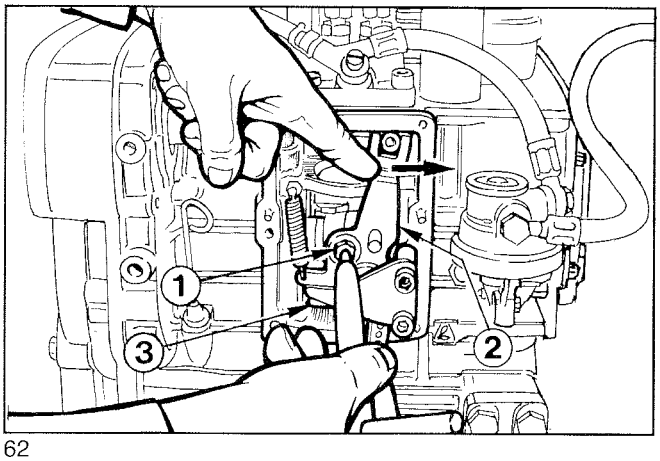
Control rod max. force	Rod stroke from max deliv. point	R.P.M.	Delivery	Max. plunger difference
Newton	mm		mm^3 • stroke	mm^3 • stroke
0,50	10	1500	23 ÷ 26	3
	13	500	4 ÷ 8	3
	0	150	57 ÷ 65	—
	10	500	10 ÷ 14	3



61

How to reassemble injection pump components

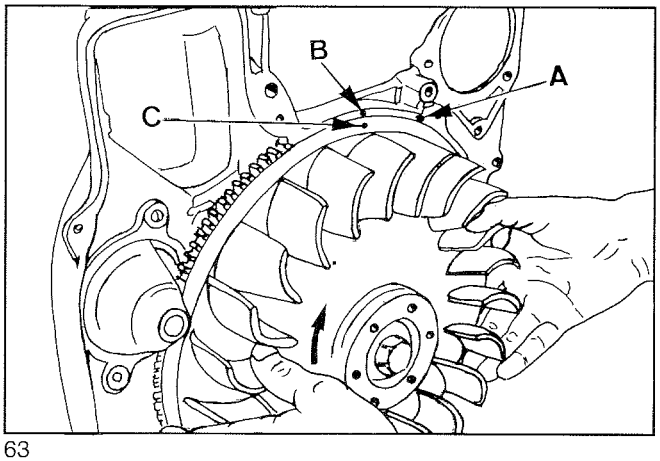
After replacing the worn-out components, reassemble the pump as follows:
Introduce sector gears into the pump body by making reference points **C** match with the **B** points on the rack.
Fix barrels with the eccentric screws **F** on the pump body.
Fit valves with seats, springs, fillers and delivery unions tightening them at 3.5 ÷ 4 Kgm.
Fit plungers by making reference points **E** match with the sector gear **D** points.
Fix retainers and springs; lock tappet with special stop.
Check that both plungers have the same delivery by performing the necessary measurements at the test bed; if delivery is not the same set screw **F**.



62

Injection pump/mechanical speed governor timing

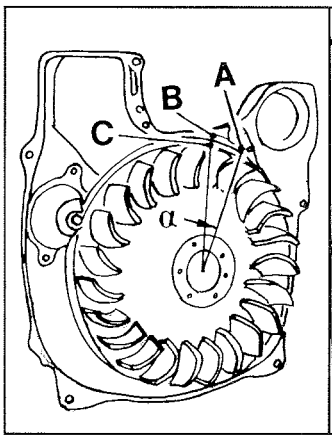
Loosen screw **1**
Move injection pump lever **2** to maximum delivery (to the right).
Check that drive rod **3** closes the speed governor; keeping lever **2** pressed to the right the drive rod should have no clearance.
Tighten screw **1**.



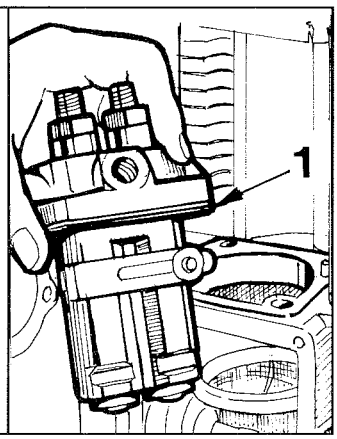
63

Static injection timing

Disconnect injection line cylinder **1** making sure not to loosen the pump delivery union. Attach the timing tool. (Spare part. no. 1460.024).
Top up the tank checking that fuel level is at least 10 cm above checking device.
Adjust injection pump rack rod half stroke.
Turn the flywheel according to the engine direction of rotation and check that fuel reaches the checking device.
Repeat this last operation during compression proceed slowly and stop immediately when the fuel is seen to pass through the checking device hole; bring flywheel back by 5 mm; this is the so-called static injection timing.



64



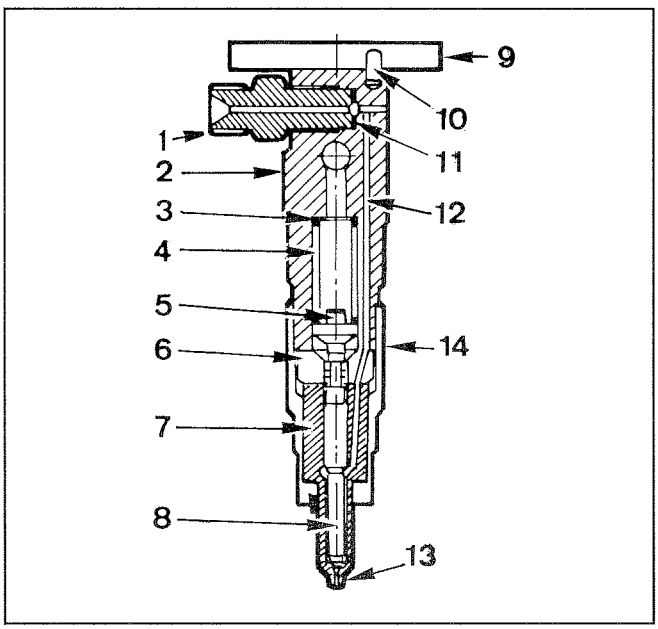
65

Injection timing reference marks on crankcase and flywheel

A = Piston reference mark at the top dead centre
B = Injection timing reference mark compared to **A**
A ÷ B = Distance in mm.
C = Piston reference mark in injection timing position.
α = Reference angle in degrees.

Engine type	(A ÷ B) mm	α
12LD 435-2	67,6	26°
12LD 435-2/B1	67,6	26°
12LD 475-2	54,6	21°

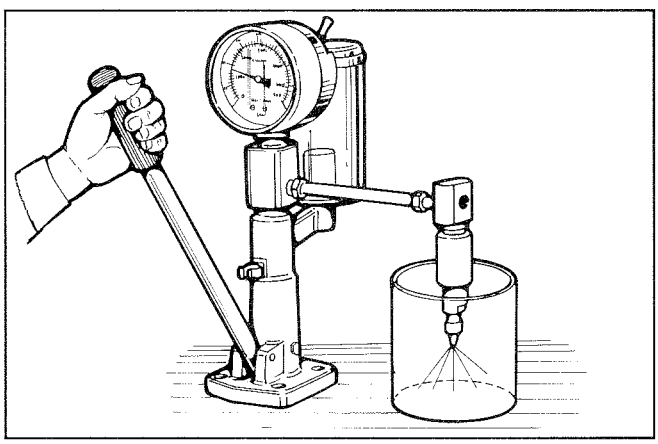
Note: By adding or removing a 0.1 mm shim under the pump **C** is delayed or advanced by approximately 3 mm.



66

INJECTOR

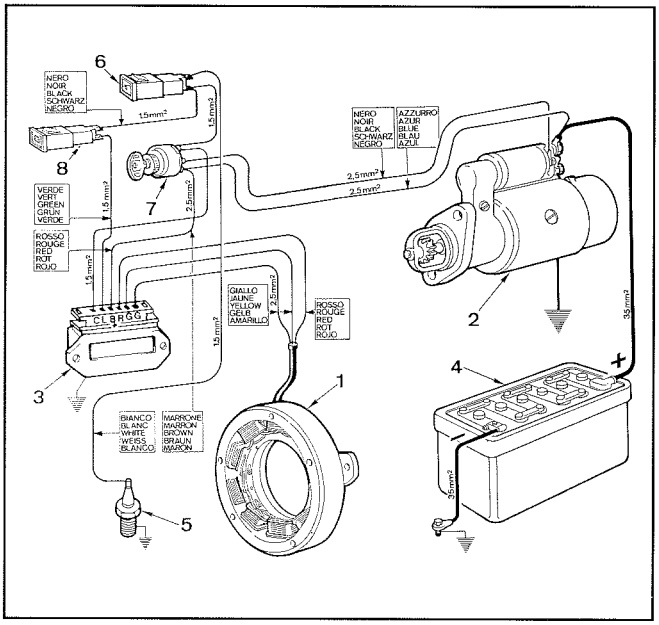
Components:
1 Intake fitting
2 Nozzle holder
3 Shim
4 Spring
5 Pressure rod
6 Intermediate flange
7 Nozzle
8 Needle valve
9 Fixing flange
10 Taper pin
11 Gasket
12 System duct
13 Sump



67

Injector setting

Conect injector to a hand pump and check that setting pressure is 210 ÷ 220 bar; make the required adjustments, if any, by changing the shim over the spring.
When replacing the spring, setting should be performed at a 10 bar greater pressure (220 ÷ 230 bar) to allow for bedding during operation.
Check needle valve sealing by slowly moving hand pump until approximately 180 bar.
Replace nozzle in case of dripping.



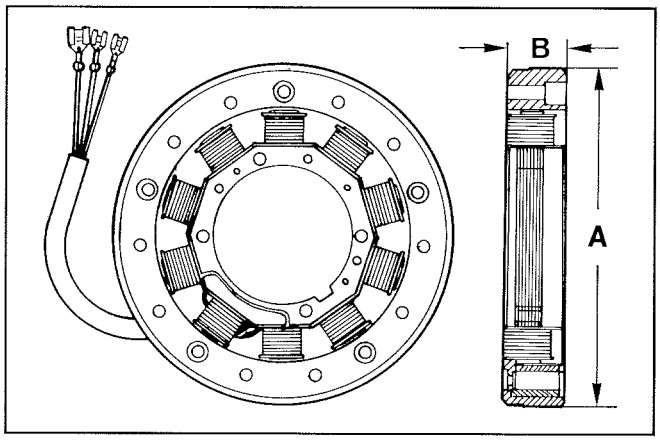
68

Electrical starting layout with battery charging light

Components:

1 Alternator
2 Starting motor
3 Voltage regulator
4 Battery
5 Pressure switch
6 Oil pressure warning light
7 Key switch
8 Battery charging light

Note: Battery, which is not supplied by Lombardini, should feature 12 V voltage and capacity not below 70 Ah.

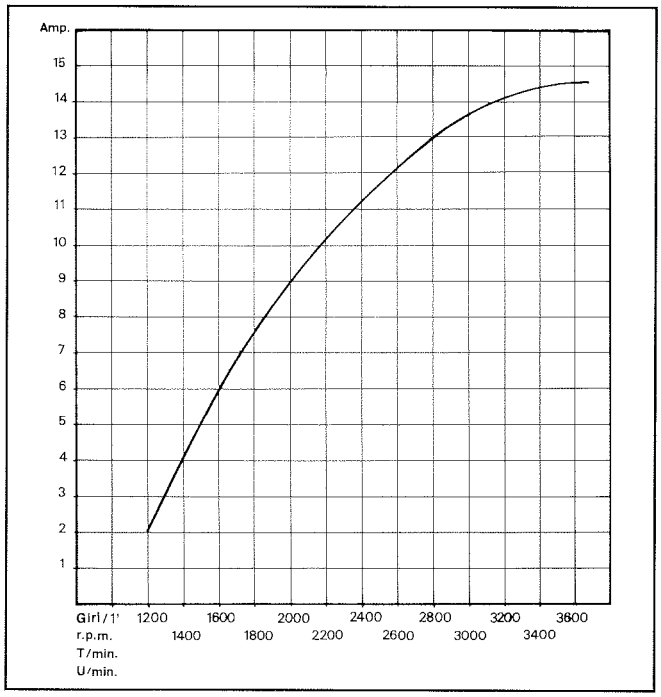


69

12.5 V, 14 A Alternator

Features a fixed armature winding mounted on the air shroud bracket. The rotating permanent magnet inductor is located in the fan spindle.
Dimensions (mm):
A = 158.80 ÷ 159.20
B = 27.50 ÷ 27.90

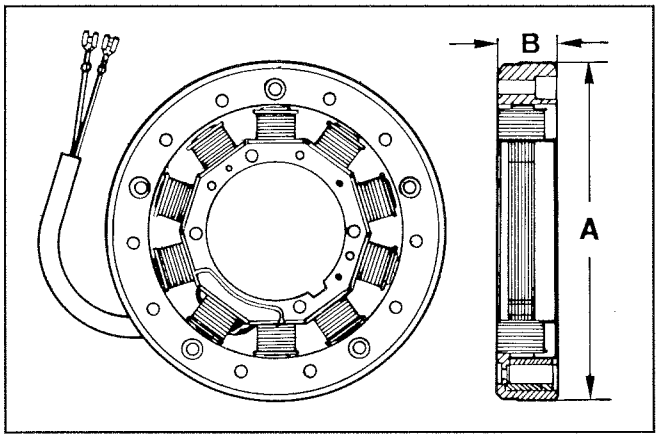
Note: Clearance between armature winding and inductor (air gap) should be 0.48 ÷ 0.60 mm.



70

Alternator battery charger curve (12.5 V, 14A)

The curve was obtained at room temperature of +25°C with 12.5 V battery voltage



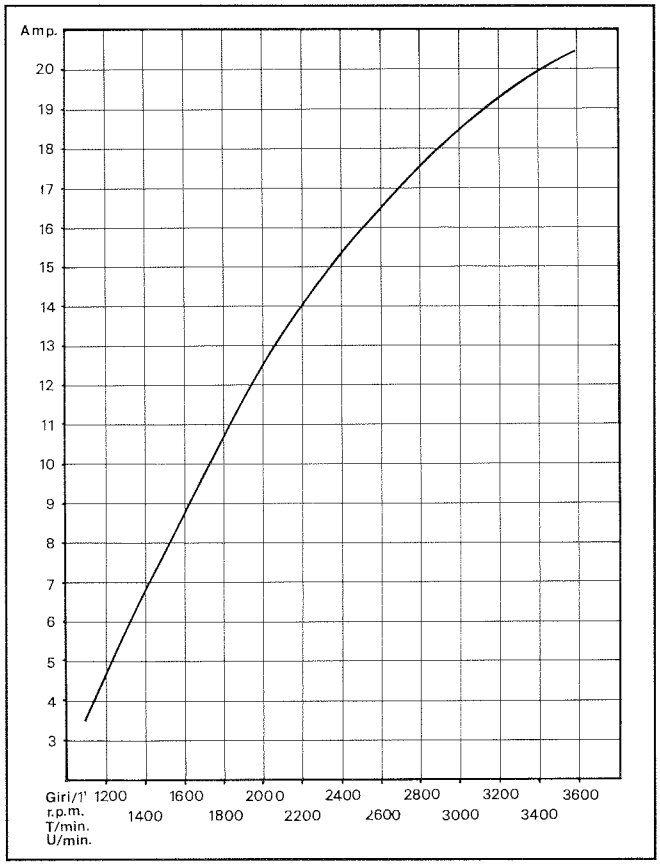
71

OPTIONAL ELECTRIC EQUIPMENT

12 V, 18A Alternator

Only two yellow cables are at output.
Dimensions (mm):
A = 158.80 ÷ 159.20
B = 27.50 ÷ 27.90

Note: Clearance between armature winding and inductor (air gap) must be 0.48 ÷ 0.60 mm.



72

Alternator battery charger curve (12 V, 18 A)

This curve is obtained at +25°C with 12.5 V battery voltage.

VOLTAGE REGULATOR

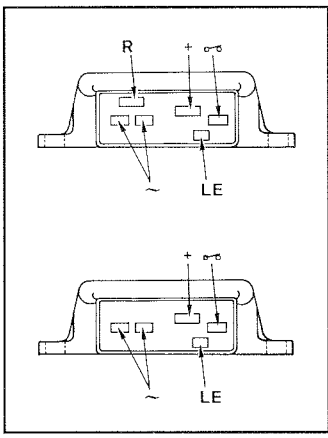
Type LOMBARDINI, supplied by SAPRISA and DUCATI: Voltage 12 V, max. current 26A. References for SAPRISA connections with the corresponding DUCATI connections.

SAPRISA	DUCATI
~	G
R	R
+	B
LE	L
⊶	C

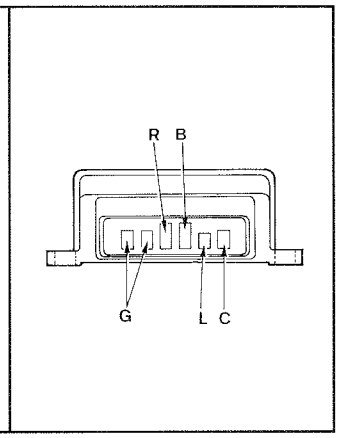
To avoid wrong connections 3 different sizes are supplied.

SAPRISA	DUCATI	CONNECTION SIZE (mm)	
		WIDTH	THICKNESS
~	G	6.25	0.8
R	R	9.50	1.2
+	B	9.50	1.2
LE	L	4.75	0.5
⊶	C	6.25	0.8

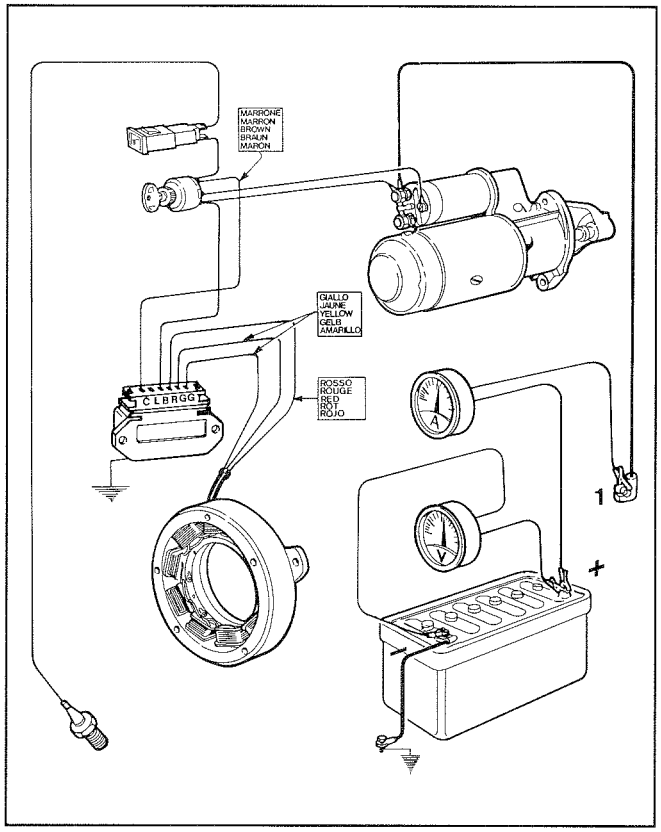
The voltage regulator fits to both circuits with and without battery charging light; in the latter case connections LE (SAPRISA) and L (DUCATI) are not used.



73



74

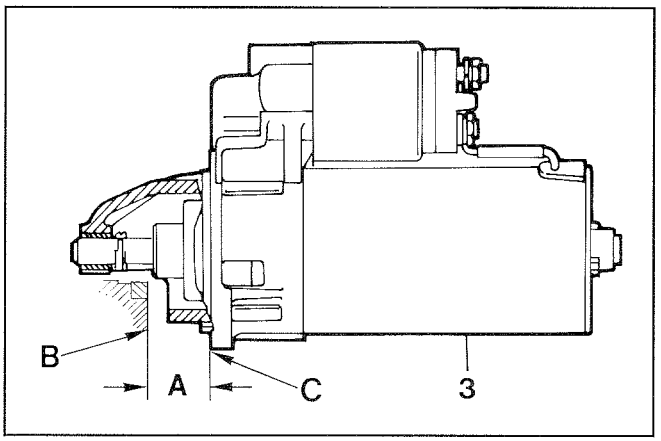


75

How to check voltage regulator for proper operation

Check that connections correspond to the layout.
Disconnect the terminal from the battery positive pole.
Connect a d.c. voltmeter between the two battery poles.
Fit an ammeter between the positive pole and the corresponding cable **1** terminal.
Start a couple of times until battery voltage drops below 13 V.
When battery voltage reaches 14.5 V the ammeter current suddenly drops down to almost zero.
Replace regulator if recharge current is zero with voltage below 14 V.

Warning: When the engine is running do not disconnect battery cables or remove the key from the control panel.
Keep regulator away from heat sources since temperatures above 75°C might damage it.
No electric welding on engine or application.

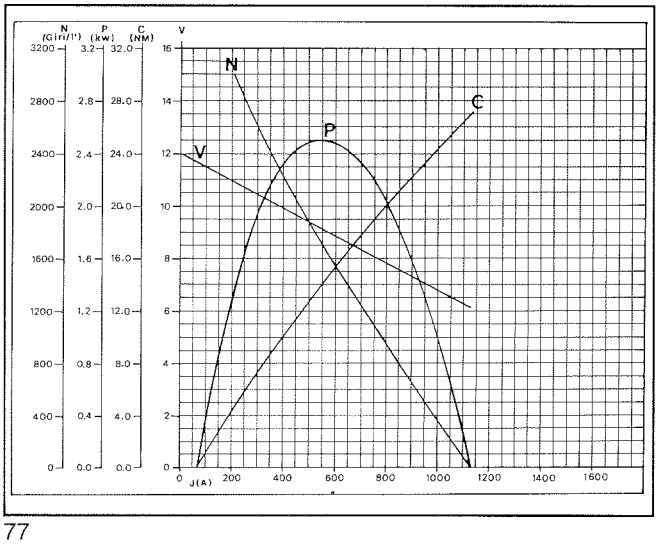


76

Starting motor type Bosch DWL 12 V, 1.7 kW

A = 29.5 ÷ 31.5 mm
B = Ring gear plane
C = Flange plane

Warning: Flywheel should not project from ring gear plane **B**.

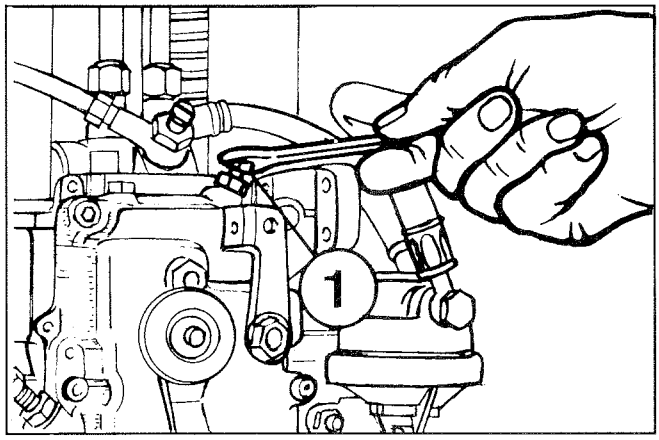


77

Characteristic curves for starting motor type Bosch DWL 12 V, 1.7 kW

Curves were obtained at the temperature of + 20°C with 88 Ah battery.

V = Motor terminal voltage in Volt
P = Power in kW
C = Torque in N/m
N = Motor speed in r.p.m.
J (A) = Absorbed current in Ampere.

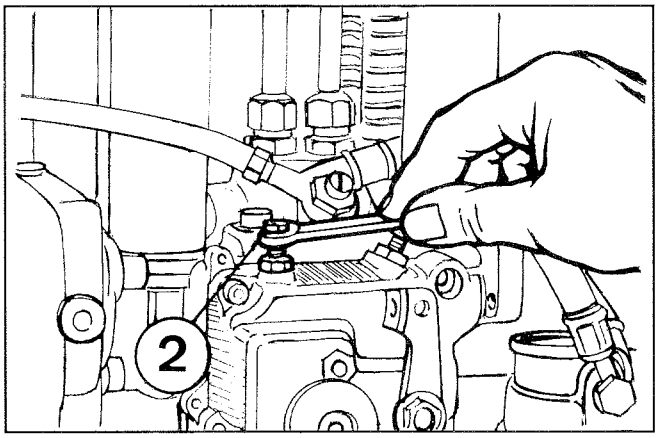


78

SETTINGS

1) Idling speed setting in no-load conditions

After filling with oil and fuel, start the engine and let it warm up for 10 minutes.
Adjust idling speed at 1200 ÷ 1300 r.p.m. by turning setscrew **1**; then tighten lock nut.

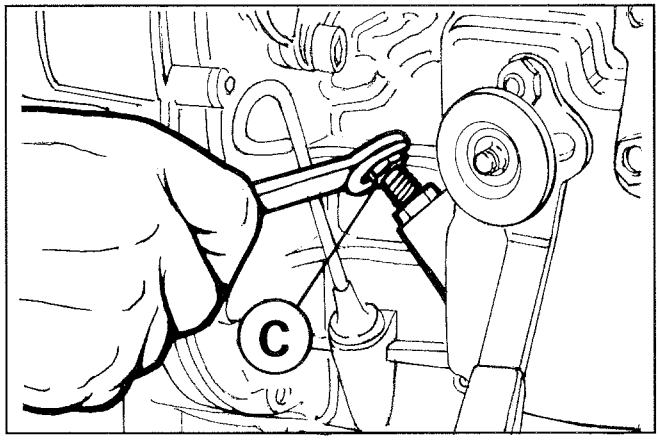


79

2) Full speed setting in no-load conditions (standard)

After setting idle speed turn screw **2** and set full speed in no-load conditions at 3200 r.p.m.; then tighten lock nut.

Note: When the engine reaches the pre-set power full speed stabilizes at 3000 r.p.m.

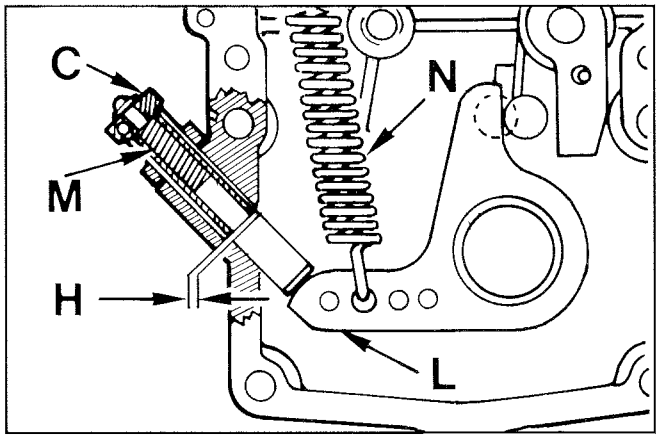


80

Injection pump delivery setting

This setting should be performed at the torque dynamometer. If not, setting is only approximate.
The following steps are required:
Loosen delivery limiting device **C** by 5 turns.
Bring engine to full speed in no-load conditions i.e. 3200 r.p.m.. Tighten limiting device until the engine shows a drop in r.p.m..
Unscrew limiting device **C** by 1½ turn. Tighten lock nut.

Note: If the engine, under full load, generates too much smoke tighten **C**; if no smoke is observed at the exhaust and the engine cannot reach its full power unscrew **C**.

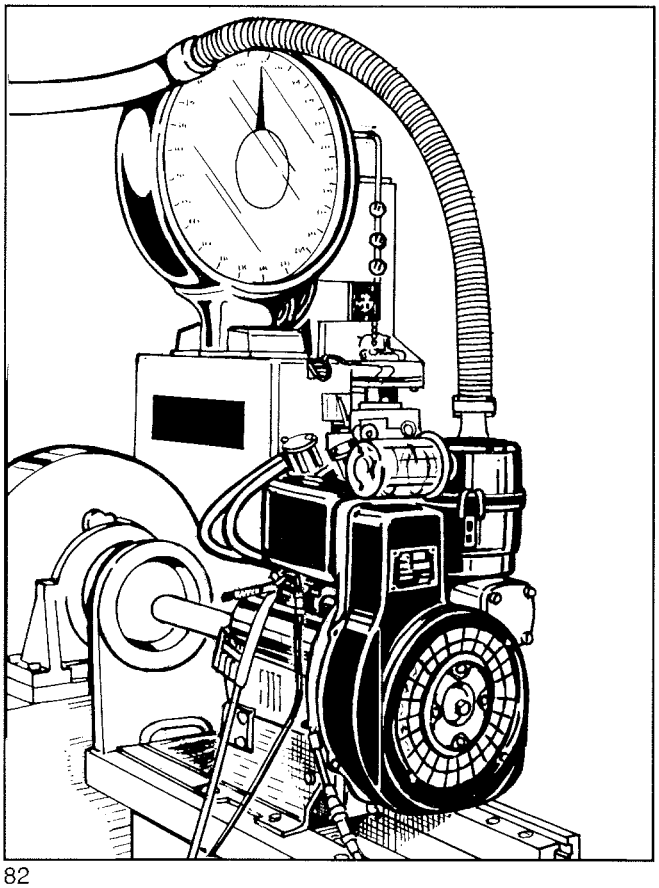


81

Injection pump delivery limiting and extra fuel device

Limiting device **C** limits the injection pump maximum delivery. It also acts as a torque setting device since spring **N** opposes the resistence of spring **M** inside the cylinder through lever **L**.
The torque setting device allows lever **L** to move over stroke **H** corresponding to 0.15 ÷ 0.25 mm.
This consequently increases injection pump delivery with torque reaching its peak value.

Note: In generator sets and power welders, the torque setting device acts as a delivery limiter only. It therefore does not feature spring **M** or stroke **H**.



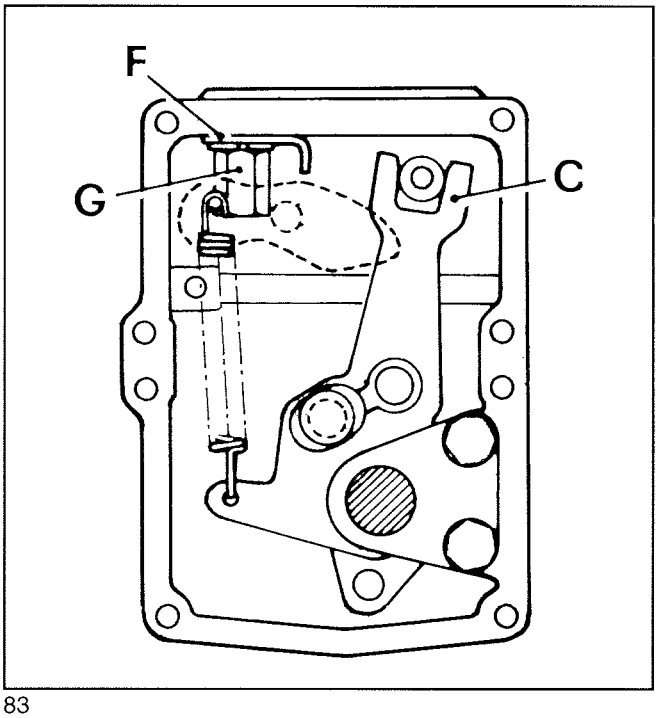
82

Injection pump delivery setting with engine at the torque dynamometer

1) Bring engine to idling speed
2) Unscrew delivery limiting device **C** (see page 22)
3) Bring engine to the power and r.p.m. required by the manufacturer of the device.
4) Check that consumption falls within the table specifications (see below). If consumption is not as indicated change balance conditions at the torque dynamometer by varying the load and adjusting the governor.
   Under stable engine conditions check consumption again.
5) Tighten limiting device **C** until the engine r.p.m. decreases.
   Lock the limiting device by means of lock nut.
6) Release brake completely and check at what speed the engine becomes stable.
   Speed governor should comply with the requirements of the class indicated by the manufacturer of the device.
7) Stop the engine
8) Check valve clearance when the engine has cooled down.

Required settings (as most commonly applies)

Engine	R.P.M.	Power kW (HP)	Specific fuel consumption *	
			Time (sec.) per 100 cm³	g/kWh (g/HPh)
12LD435-2	3000	N 13.97 (19)	74-76	290-282 (213 ÷ 208)
		NB 12.72 (17.3)	91-93	259-254 (191 ÷ 186)
12LD435-2/B1	3600	N 14.7 (20)	66-68	309-300 (227 ÷ 221)
		NB 13.23 (18)	78-80	291-283 (214 ÷ 208)
12LD475-2	3000	N 15.8 (21.5)	73-75	260-253 (191 ÷ 186)
		NB 14.85 (20.2)	82-84	246-240 (181 ÷ 177)

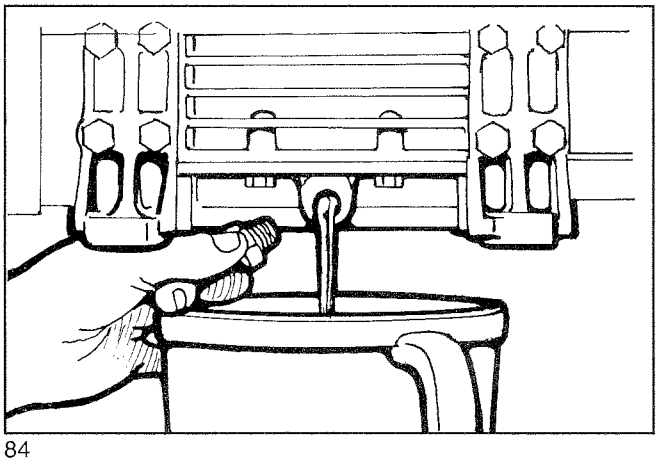


83

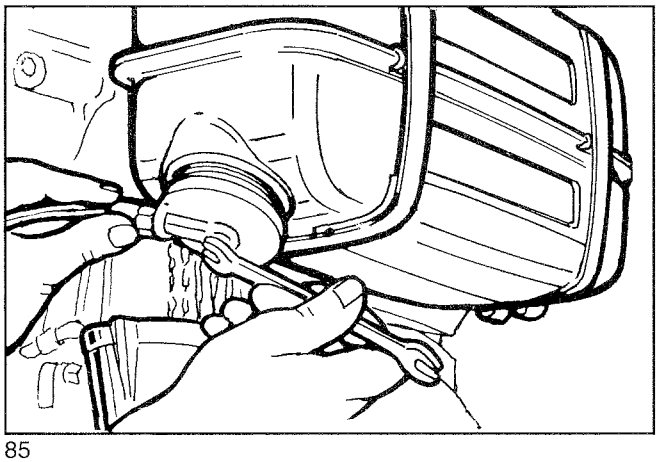
Stop setting

1) Completely turn lever **C** counterclockwise and keep it in this position. Retainer **F** should not be in contact with lever **C**.
2) Unscrew nut **G** and bring retainer **F** in contact with lever **C**
3) Push retainer **F** so that lever **C** is moved backwards clockwise by 1.0 ÷ 1.5 mm.
4) Lock retainer **F** by screwing nut **G**

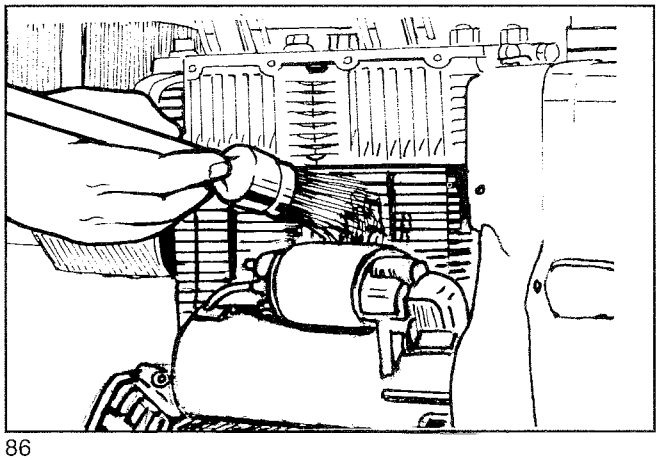
Note: Under these conditions no damage can be caused to the injection pump rack rod stops by sudden impacts due to the available electric stops.



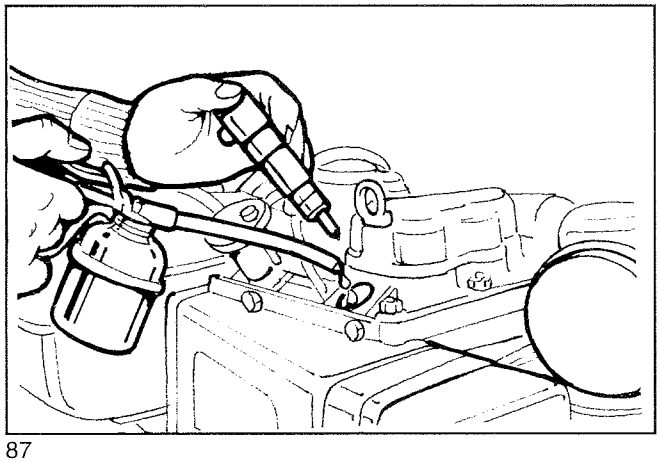
84



85



86



87

STORAGE

Prepare engines as follows for storage over 30 days:

Temporary protection (1 ÷ 6 months).

- Let engine work at idling speed in no-load conditions for 15 minutes.
- Fill crankcase with protection oil MIL-1-644-P9 and let engine run at 3/4 full speed for 5 ÷ 10 minutes.
- When engine is warm empty oil pan and fill with standard new oil.
- Remove fuel tube and empty the tank.
- Remove fuel filter, replace cartridge if dirty and refit.
- Carefully clean cylinder fins, heads and fan.
- Seal all openings with tape.
- Remove injectors, pour a spoonful of oil type SAE 30 into the cylinders and rotate manually to distribute the oil. Refit injectors.
- Spray oil type SAE 10W into exhaust and intake manifolds, rocker arms, valves, tappet etc. Grease all unpainted parts.
- Loosen belt.
- Wrap the engine in a plastic film.
- Store in a dry place, if possible not directly on the soil and far from high voltage electric lines.

Permanent protection (over 6 months)

The following is recommended apart from the above instructions:

- For the lubrication and injection system as well as for moving parts use rustproof oil type MIL-L-21260 P10, grade 2, SAE 30 (Ex. ESSO RUST - BAN 623 - AGIP, RUSTIA C. SAE 30). Let the engine run with rustproof oil and drain any excess.
- Coat external unpainted surfaces with antirust type MIL-C-16173D, grade 3 (Ex. ESSO RUST BAN 398 - AGIP, RUSTIA 100/F).

How to prepare the engine for operation

- Clean engine outside
- Remove protections and covers.
- Remove antirust by an appropriate solvent or degreaser.
- Remove injectors, fill with standard oil, turn crankshaft by a few revolutions, remove oil pan and drain the protective oil.
- Check injectors, valve clearance, belt tension, head tightening, oil filter and air cleaner for proper setting. If the engine is stored over a long period of time (over 6 months) check one of the bushings for corrosion.