WORK SHOP MANUAL

5LD825-2
5LD825-3
5LD825-3/T
5LD825-4
5LD930-3
5LD930-4

LOMBARDINI

SERVICE

This manual contains the most important information for the repair of LOMBARDINI air-cooled, direct injection Diesel engines type 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD825-4, 5LD930-3, 5LD930-4.
This information has been updated until 01.01.91.

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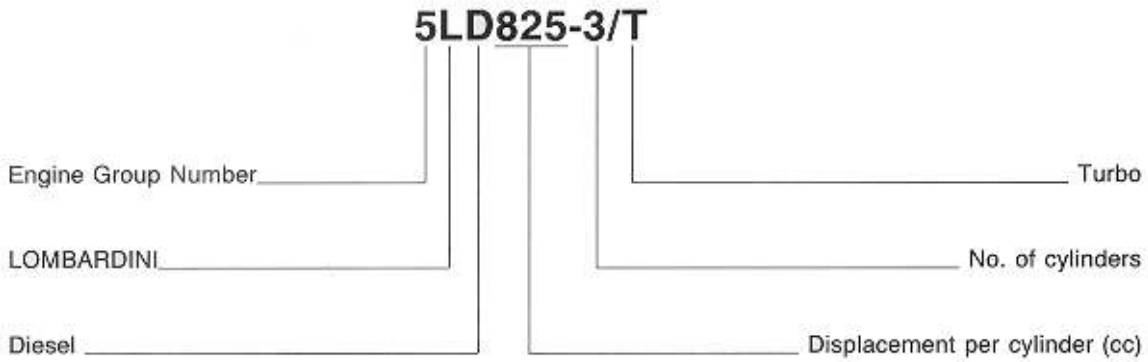
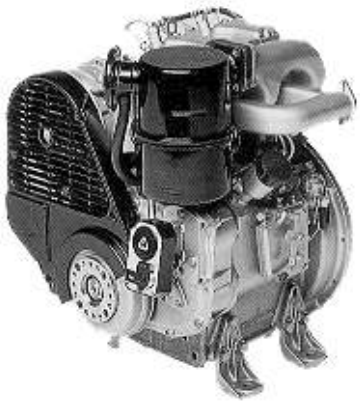
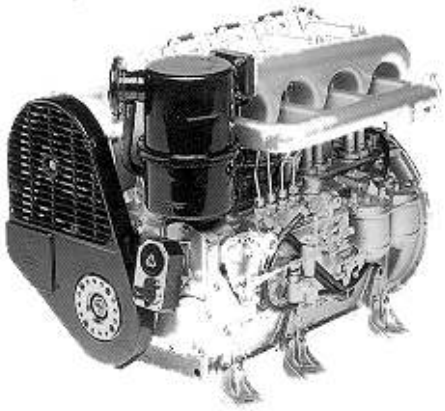
MODEL NUMBER AND ENGINE IDENTIFICATION



Once you have identified the model number you can identify the engine by means of the Ser. No. indicated on the name-plate applied to the blower stator and the crankcase.

CHARACTERISTICS OF MODELS 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD825-4, 5LD930-3, 5LD930-4





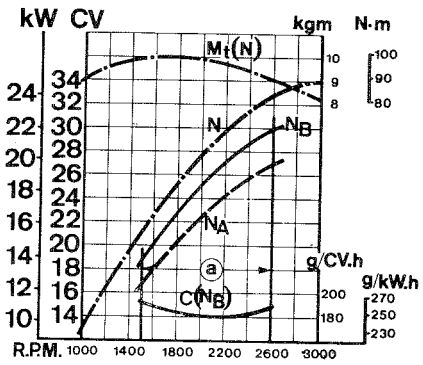
ENGINE TYPE		5LD825-2	5LD825-3	5LD825-3/T	5LD825-4	5LD930-3	5LD930-4
Number of cylinders	Nb	2	3	3	4	3	4
Bore	mm	100	100	100	100	106	106
Stroke	mm	105	105	105	105	105	105
Displacement	cm^3	1649	2474	2474	3299	2780	3706
Compression ratio		17,4:1	17,4:1	17,4:1	17,4:1	17,4:1	17,4:1
R.P.M.		—	—	2600	2600	—	—
N DIN 70020		25,0/34,0 @ 3000	38,0/51,7 @ 3000	44/60	48,5/66,0	39,7/54,0 @ 2600	53,0/72,0 @ 2600
Power kW/HP NB DIN 6270		25,0/30,0 @ 2600	33,0/45,0 @ 2600	40,8/55,5	44,0/59,8	35,3/48,0 @ 2300	47,4/64,5 @ 2300
NA DIN		19,9/27,0 @ 2600	29,8/40,5 @ 2600	37/50,4	39,3/53,5	32,3/44,0 @ 2300	44,5/60,5 @ 2300
Max. torque	Nm Nm	99 @ 1700	146 @ 1700	191 @ 1700	194 @ 1800	170 @ 1600	215 @ 1700
Max. torque at 3rd p.t.o.	Nm	49	49	49	49	49	49
Fuel consumption at max. NB power	l/h	6,8	10,3	9,3	13,5	10,0	13,6
Oil consumption	Kg/h	0,034	0,050	0,050	0,066	0,054	0,070
Oil sump capacity	l.	3,50	5,50	5,50	7,00	6,30	8,00
Dry weight	Kg.	210	255	260	310	270	310
Combustion air volume at 2600 r.p.m.	l./min.	1790	2680	4320	3580	3000	4016
Cooling air volume at 3000 r.p.m.	l./min	31200	49200	49200	54000	49000	54000
Max. permissible crankshaft axial load in both directions	Kg.	300	300	300	300	300	300
Max. inclination momentary	α	35°	35°	35°	35°	35°	35°
Max. inclination lasting up to 1 h.	α	25°	25°	25°	25°	25°	25°
Max. inclination permanent	α	★	★	★	★	★	★

★ Depending on the application

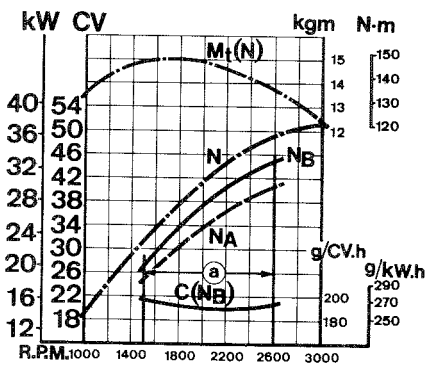
Note: For engines of the 670 series which are no longer produced the repair instructions are the same as for the engines shown in the table.

CHARACTERISTIC POWER, TORQUE AND SPECIFIC CONSUMPTION CURVES

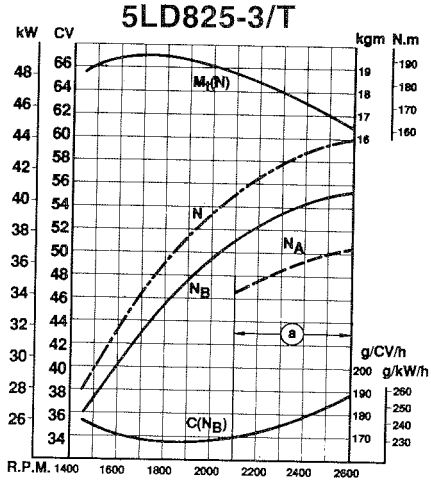
5LD825-2



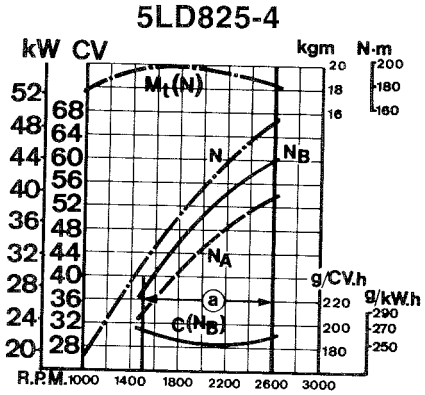
5LD825-3



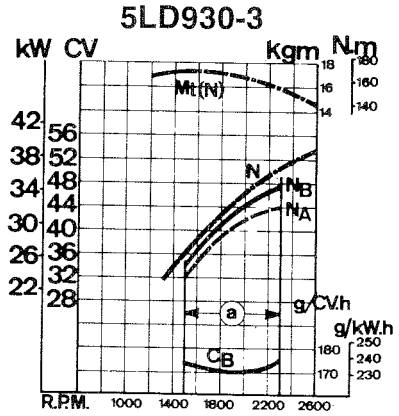
5LD825-3/T



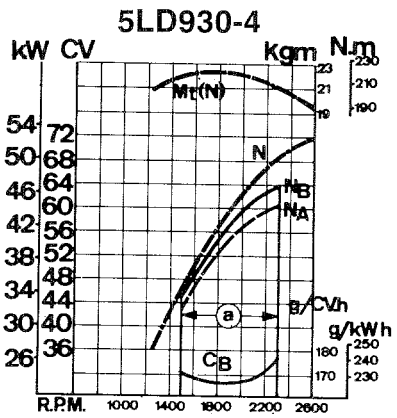
5LD825-4



5LD930-3



5LD930-4



N (DIN 70020) AUTOMOTIVE RATING: intermittent operation with variable speed and variable load.
N_B (DIN 6270) RATING WITH NO OVERLOAD CAPABILITY: continuous light duty operation with constant speed and variable load.
N_A (DIN 6270) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: continuous heavy duty with constant speed and constant load.

The above power values refer to an engine fitted with air cleaner and standard muffler, after testing 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 20°C.

$C(N_B)$: Specific fuel consumption at N_B power
Mt : Torque at N power
ⓐ : Range of application for continuous operation. In case of application outside this range please contact LOMBARDINI.

MAINTENANCE

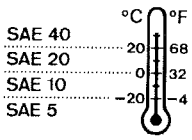
OPERATION	COMPONENT		INTERVAL (HOURS)								
				10	50	125	250	500	1000	2500	5000
CLEANING	AIR CLEANER			●							
	FUEL FEED PUMP FILTER						●				
	HEAD AND CYLINDER FINS (*)						●				
	OIL COOLER FINS						●				
	FUEL TANK								●		
	INJECTORS							●			
	INTERNAL OIL FILTER									●	
CHECK	LEVEL	AIR CLEANER OIL		●							
		CRANKCASE OIL		●							
		BATTERY ELECTROLYTE			●						
	FAN BELT TENSION					●					
	VALVE AND ROCKER ARM CLEARANCE							●			
	INJECTOR CALIBRATION							●			
REPLACEMENT	OIL	AIR CLEANER (**)		●							
		CRANKCASE			△		●				
	OIL FILTER				△		●				
	FUEL FILTER						●				
	DRY AIR CLEANER ELEMENT		(***)								
	FAN BELT							●			
OVERHAUL INSPECTION	PARTIAL (****)									●	
	COMPLETE										●

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

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
5LD825-2, 5LD825-3, 5LD825-3/T, 5LD930-3 16
5LD825-4, 5LD930-4 29

Standard oil sump
5LD825-2 3,5
5LD825-3, 5LD825-3/T 5,5
5LD825-4 7
5LD930-3 6,3
5LD930-4 8,0

Air cleaner bowl 0,5

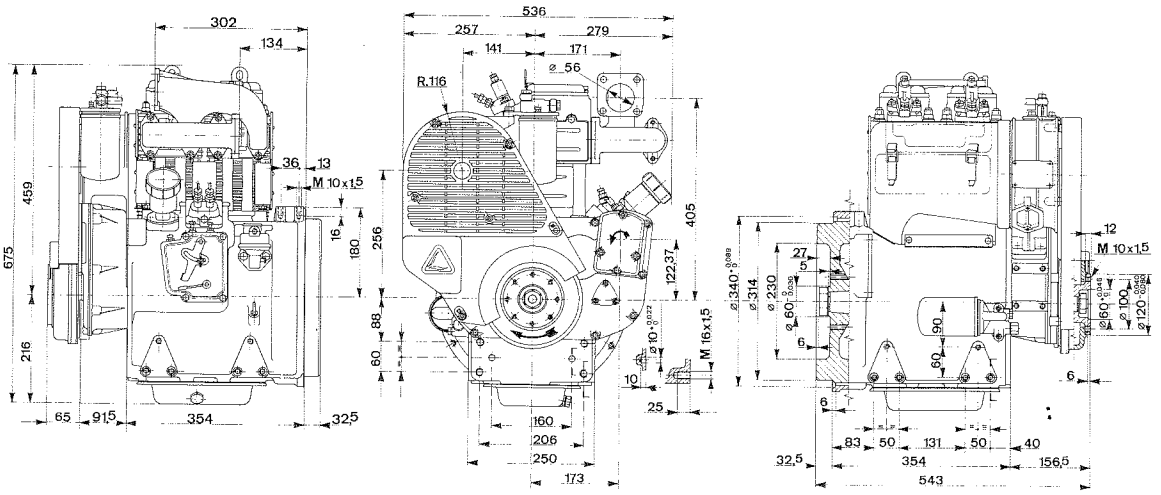
POSSIBLE CAUSES AND TROUBLE SHOOTING

The following table contains the possible causes of some failures which may occur during operation. Always perform the simplest checks before removing or replacing any part.

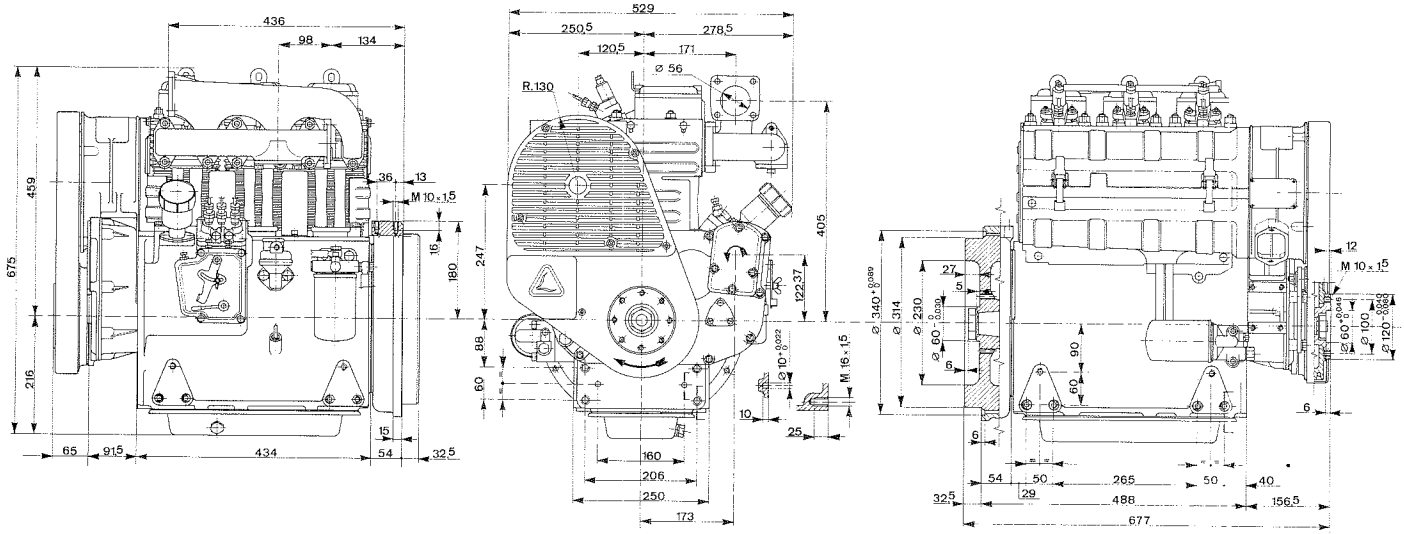
	POSSIBLE	TROUBLE									
		Engine does not start	Engine starts but stops	No acceleration	Non-uniform speed	Black smoke	White smoke	Low oil pressure	Oil level rising	Excessive oil consumption	Oil and fuel dripping from exhaust
FUEL SYSTEM	Clogged fuels lines	●									
	Clogged fuel filter	●	●	●							
	Entrainment	●	●	●							
	Clogged tank breather	●	●	●							
	Faulty feed pump	●	●								
	Stuck injector	●									
	Stuck injection pump valve	●									
	Injector not set at proper pressure					●					
	Excessive plunger blow-by								●		
	Injection pump rack sticking	●		●	●						
	Wrong injection pump delivery setting			●		●					
LUBRICATION	Oil level too high				●		●			●	
	Stuck pressure relief valve							●			
	Wrong pressure relief valve setting							●			
	Worn-out oil pump							●			
	Air entrainment							●			
	Faulty pressure gauge or switch							●			
	Clogged oil suction pipe							●			
ELECTRIC SYSTEM	Battery dis-charged	●									
	Wrong or inefficient cable connection	●									
	Defective starter switch	●									
	Defective starter	●									
MAINTE-NANCE	Clogged air filter	●		●		●					
	Excessive idle operation						●				●
	Incomplete running-in						●				
	Engine overloaded			●		●					
SETTINGS/REPAIR	Advanced injection	●									
	Retarded injection					●					
	Incorrect governor linkage adjustment	●			●						
	Broken or loose governor spring			●							
	Idle speed too low		●							●	●
	Worn-out or stuck piston rings						●			●	●
	Worn-out cylinders						●			●	●
	Worn-out valve guides	●					●			●	●
	Worn-out main bearings and connecting rod bearings							●			
	Governor linkage not freely operating	●	●		●						
	Crankshaft not turning freely					●					

OVERALL DIMENSIONS

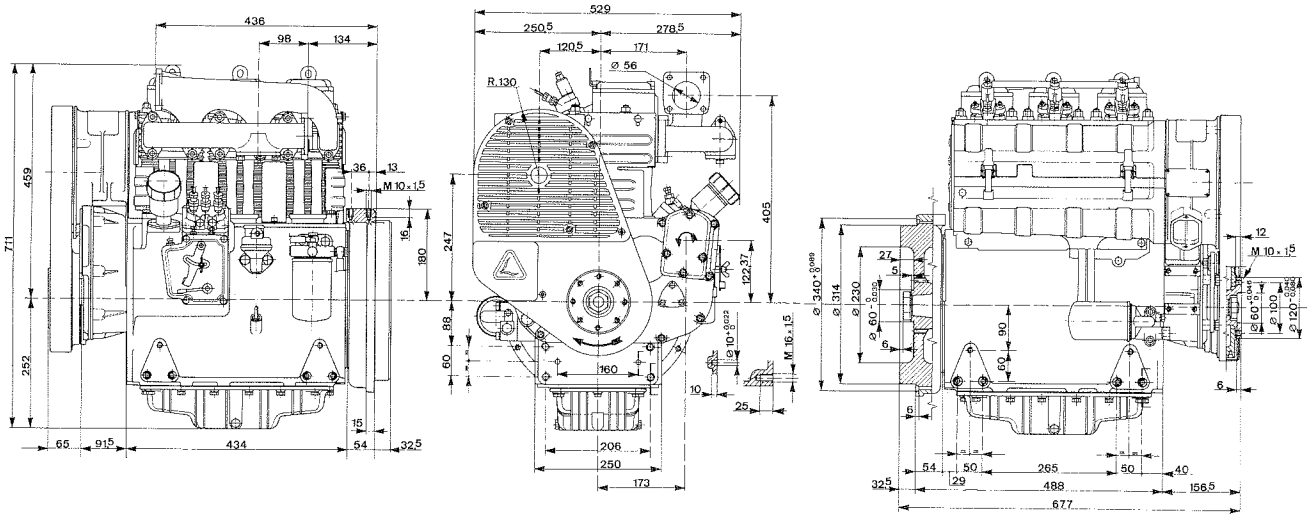
5LD825-2



5LD825-3

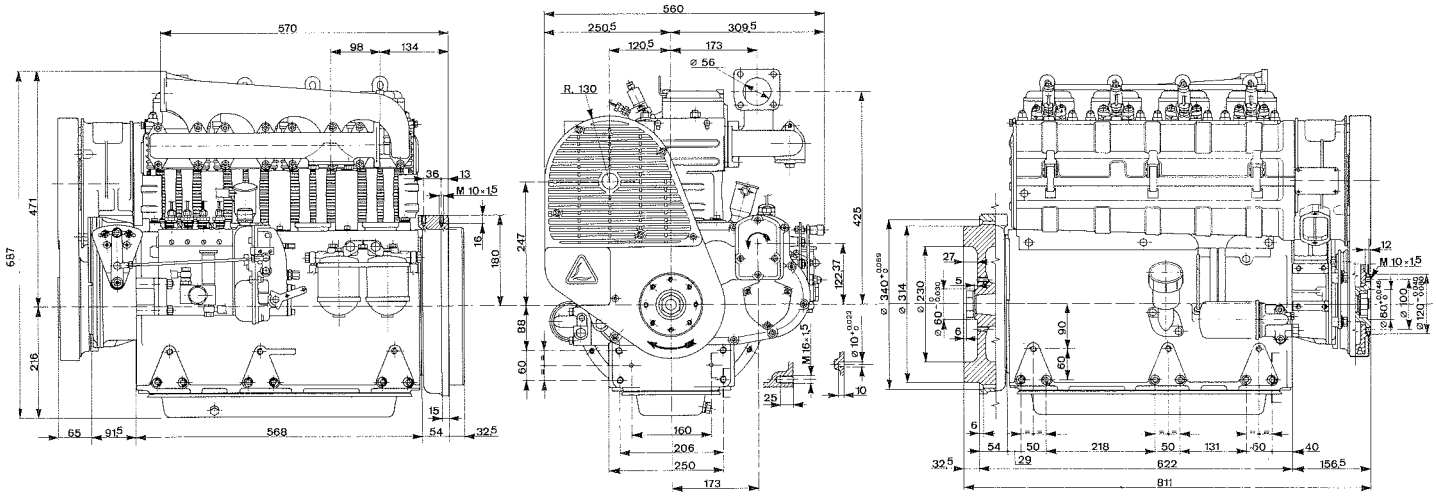


5LD930-3

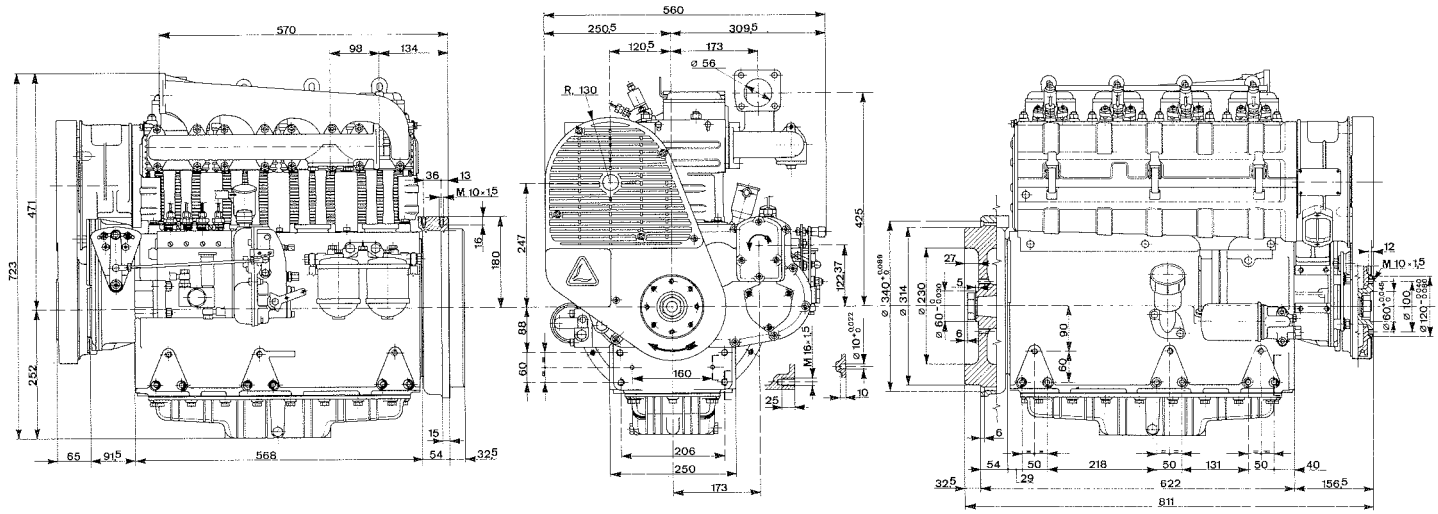


OVERALL DIMENSIONS

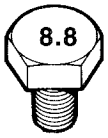
5LD825-4



5LD930-4



MAIN TORQUE SPECIFICATIONS			
POSITION	Diameter and pitch mm	Torque	
		Kgm	Nm
Injection pump union	18x1,5	4	39
Crankcase bell	10x1,5	5	49
Rocker arm cover	8x1,25	2	18
Central main bearing support	10x1,5	5	49
Intake and exhaust manifolds	8x1,25	2,5	24,5
Gear box cover	8x1,25	2,5	24,5
Oil sump	8x1,25	2,5	24,5
Oil pump body	8x1,25	2,5	24,5
Oil pump body (connecting bolt)	14x1,5	3,5	34
External oil filter	8x1,25	3	29
Oil pick-up	8x1,25	3	29
Oil pick-up (connecting bolt)	8x1,25	3	29
Camshaft gear	22x1,5	20	196
Crankshaft gear	40x1,5	50	490
Idler gear	14x1,5	14	137
Oil pump gear	12x1,5	5,5	54
Speed governor gear	14x1,5	8	78
Injector	8x1,25	2	18
Splined sleeve for 4-cylinder Bosch injection pump	12x1,5	6	59
Starting motor	10x1,25	4,5	44
Engine foot	12x1,25	8	78
Fuel feeding pump	8x1,25	2,2	21
Injection pump	8x1,25	2,5	24,5
Crankshaft pulley	27x2	45	441
Fuel banjo bolt	12x1,5	2,5	24,5
Gearbox	8x1,25	2	18
Central main bearing support	10x1,5	5	49
Main bearing support, flywheel side	8x1,25	3	29
Oil drain plug	14x1,5	4	39
Connecting rod	10x1,5	5	49
Cylinder head	12x1,5	9	88
Flywheel	20x1,5	35	343

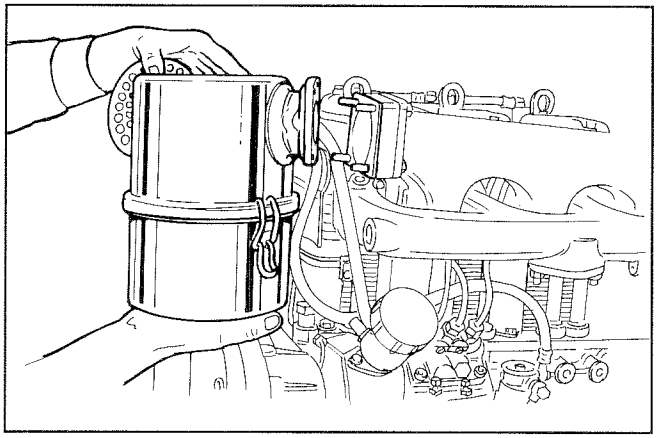
STANDARD BOLT TORQUE SPECIFICATIONS						
DESCRIPTION						
Diameter x Pitch (mm)	High-carbon steel		Alloy steel		Special alloy steel	
	Nm	Kgm	Nm	Kgm	Nm	Kgm
4x0.70	3.6	0.37	5.1	0.52	6	0.62
5x0.80	7	0.72	9.9	1.01	11.9	1.22
6x1.00	12	1.23	17	1.73	20.4	2.08
7x1.00	19.8	2.02	27.8	2.84	33	3.40
8x1.25	29.6	3.02	41.6	4.25	50	5.10
9x1.25	38	3.88	53.4	5.45	64.2	6.55
10x1.50	52.5	5.36	73.8	7.54	88.7	9.05
12x1.75	89	9.09	125	12.80	150	15.30
14x2.00	135	13.80	190	19.40	228	23.30
16x2.00	205	21.00	289	29.50	347	35.40
18x2.50	257	26.30	362	37.00	435	44.40
20x2.50	358	36.60	504	51.50	605	61.80
22x2.50	435	44.40	611	62.40	734	74.90
24x3.00	557	56.90	784	80.00	940	96.00

USE OF SEALANTS

POSITION	TYPE OF SEALANT
Tank anti-vibration mounting	Loctite 270
Oil pump fastening nut or union	Loctite 270
Crankshaft thread for pulley lock	Loctite 270
Oil filter nipple	Loctite 270
Oil filter center plate nipple	Loctite 270
Bearing lubrication nipple, flywheel side	Loctite 270
Cylinder head stud	Loctite 270
Main bearing stud	Loctite 270
Engine bell stud	Loctite 270
Injection pump mounting	Loctite 638
Fuel feeding pump stud	Loctite 270
Blower mounting stud	Loctite 270
Starting motor stud	Loctite 270
Oil piping seal plate stud	Loctite 270
Main bearing support, flywheel side	Silicone dow corning P3-7091
Crankshaft pulley (blower drive)	Loctite 270
Rocker arm journal screw	Loctite 270
Crankshaft and camshaft plug screw	Loctite 270
Timing gear cover and gear housing	Loctite 270
Gear housing/crankcase	Arexon seal glue
Gear housing / gear cover	Arexon seal glue
Crankcase / speed control plane	Arexon seal glue

DISASSEMBLY AND REASSEMBLY

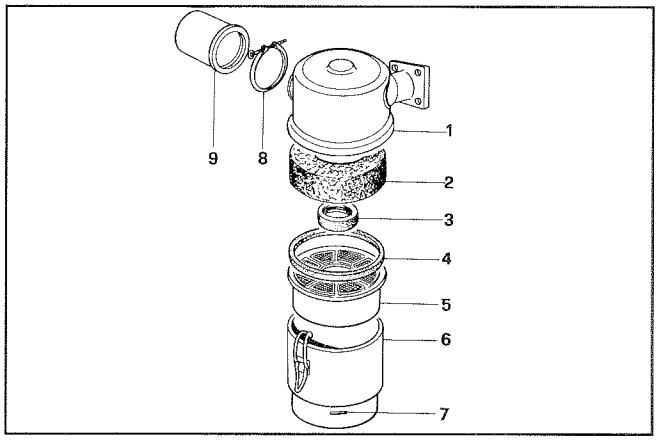
Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions.
Always use original LOMBARDINI spare parts for proper repair operations.



1

Oil-bath air cleaner (standard)

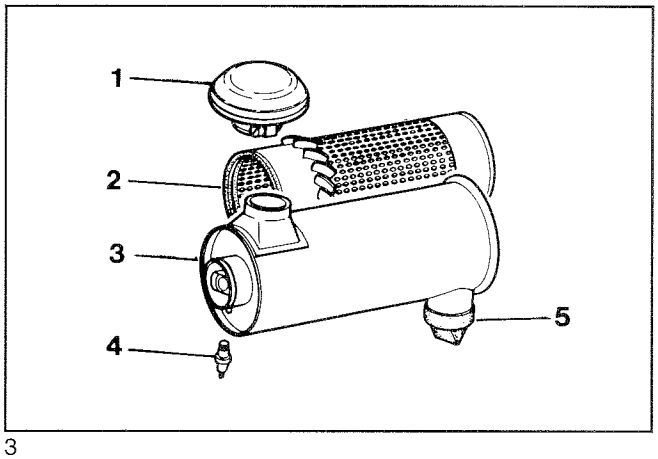
Check gaskets and replace them if damaged.
Check that flange pipe weldings are free of porosity.
Carefully clean bowl and filtering element using Diesel fuel and blow with compressed air.
Fill bowl with engine oil up to the mark.
When reassembling tighten nuts to 25 Nm.
See Page 8 for periodical cleaning operations and oil replacement.



2

Oil-bath air cleaner components

1 Cover
2 Polyurethane filtering element
3 Inner seal
4 Outer seal
5 Metal filtering element
6 Bowl
7 Oil level mark
8 Strap
9 Pre-filter



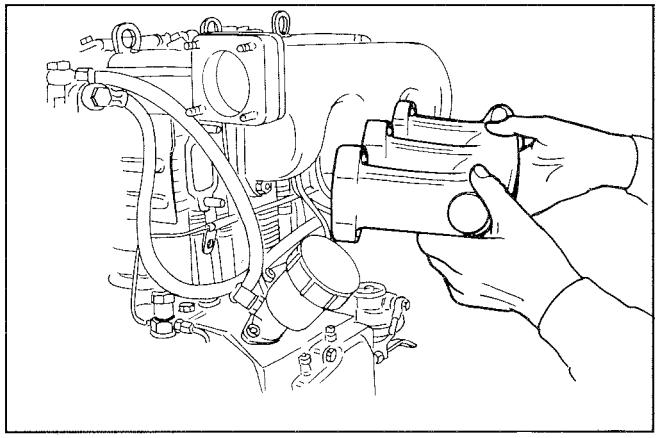
3

Dry air cleaner (for 5LD825-3/T)

This component is only fitted to 5LD825-3 models with Turbo Charger.

Components:
1 Cap
2 Cartridge
3 Body
4 Clogging indicator
5 Outlet

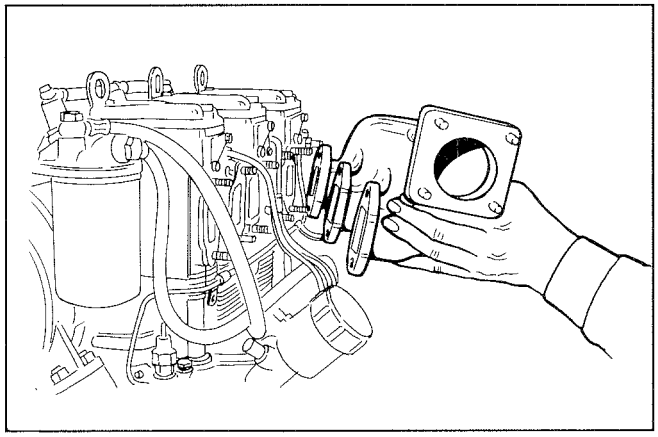
Note: See page 8 for cartridge replacement.



4

Exhaust manifold

Check deposits and clean if necessary.
To avoid flange breakage before tightening nuts check that heads are in line.
Replace gaskets. Tighten nuts to 25 Nm.

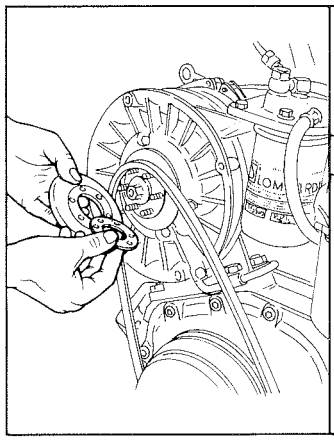


5

Intake manifold

Check that flanges are flush and that the manifold is clean inside.
Before reassembling check that heads are in line.
Replace gaskets. Tighten nuts to 25 Nm.

Note: In case of low temperature starting we can supply a manifold with the possibility of fitting a glow plug for air-preheating or a thermal starting device.



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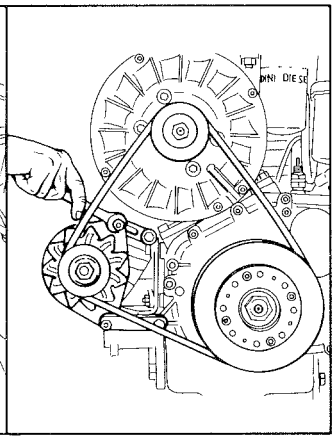
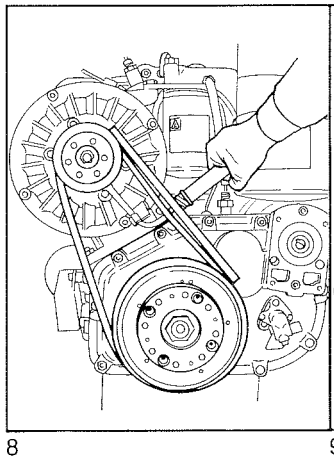


7

Fan control belt

Remove the belt guard bolts and the nuts attaching the pulley.
Remove "V" - belt and check for wear.
See page 8 for periodic maintenance details.



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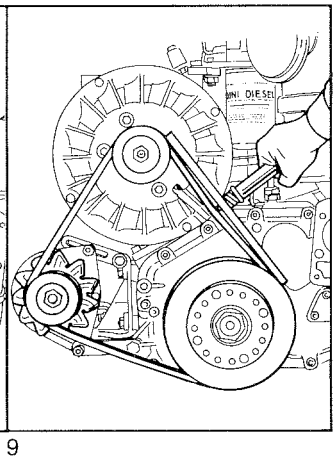


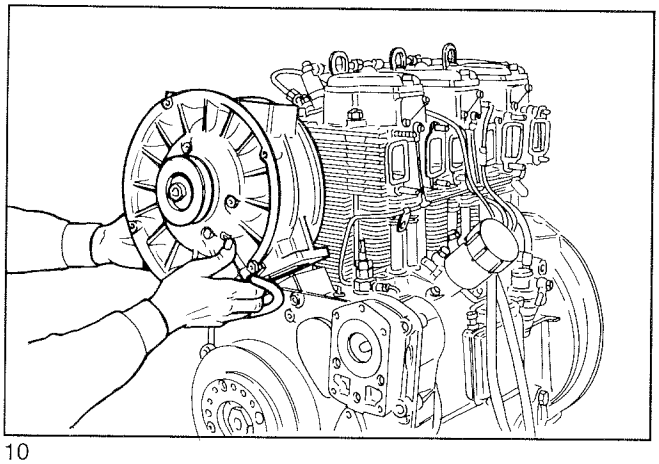
9

Belt tension adjustment

Belt tension can be adjusted by adding or removing the spacers located between the half-pulleys, see Fig. 6. Spacers are 0.5, 1.0 and 2.0 mm. thick.
Engines with external alternator come with mounting featuring a slotted hole and an adjustment bolt. See fig. 7.

Tension check

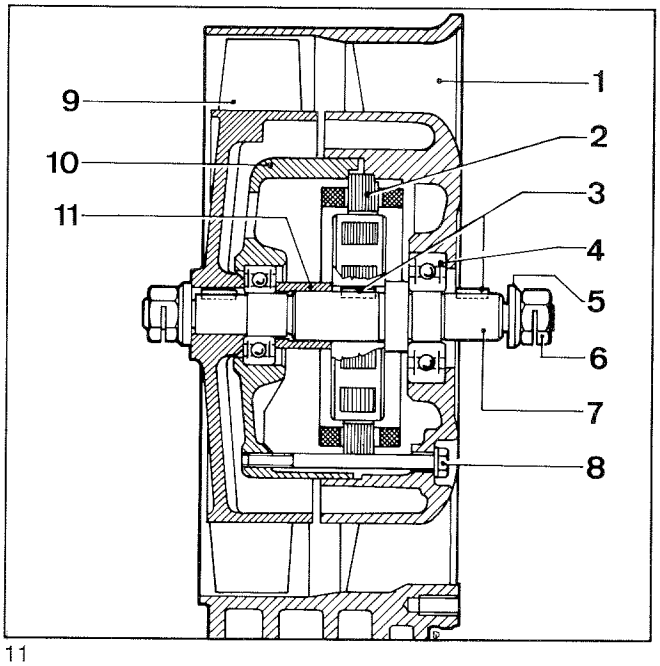
A 100 N force halfway between the pulleys should cause the belt to deflect 10 ÷ 15 mm.



10

Blower assembly

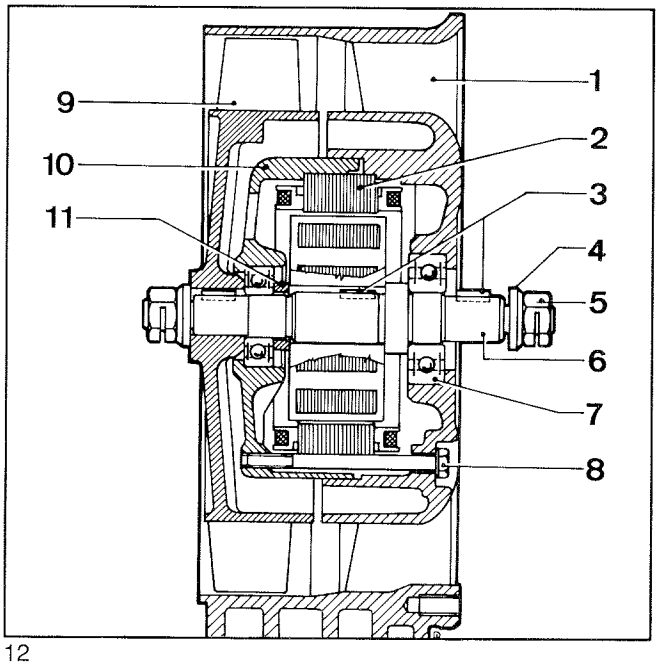
A 14A or 21A alternator is housed inside the blower.
See page 53 for the alternator technical data.
See page 6 for the cooling air volume.



11

Blower assembly components with 14A alternator

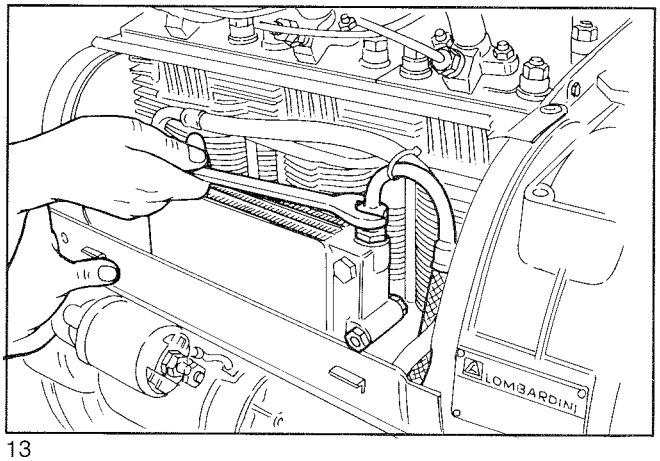
1 Housing
2 14A alternator
3 Key
4 Ball bearing
5 Washer
6 Nut
7 Shaft
8 Bolt
9 Fan
10 14A alternator bell
11 Spacer



12

Blower assembly components with 21A alternator

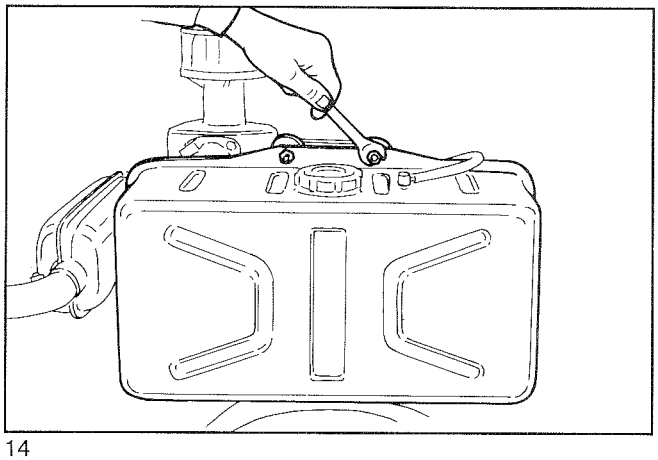
1 Housing
2 21A alternator
3 Key
4 Washer
5 Nut
6 Shaft
7 Bearing
8 Bolt
9 Fan
10 21A alternator bell
11 Spacer



13

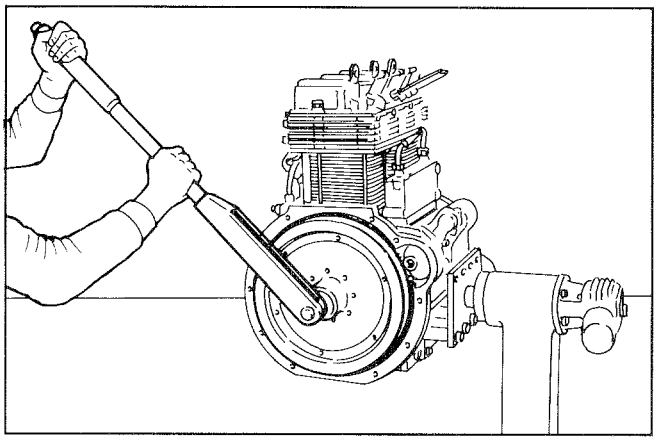
Oil cooler

When cleaning cylinders every 250 hours also clean oil cooler with Diesel fuel and dry with compressed air.
Max. working pressure: 10 bar.


14

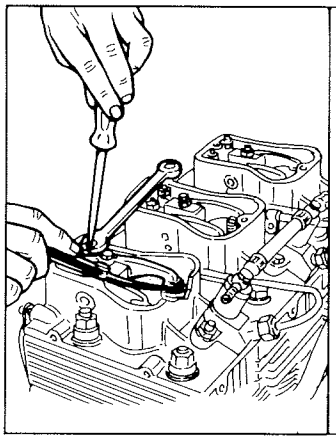
Tank

Disconnect fuel lines.
Completely empty the tank and check that no impurities are found inside.
Check that breather cap is not clogged.
See page 8 - Refuelling - for tank capacity.

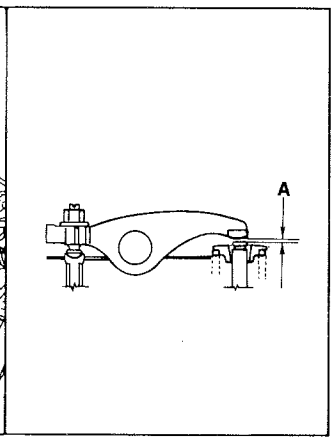

15

Flywheel

Loosen the bolt which attach the flywheel to the crankshaft. To replace starter ring gear, heat to 300°C for 15 ÷ 20 minutes. Drive it onto the flywheel carefully checking that it perfectly fits onto the seat.
Let cool slowly. When refitting tighten bolt to 35 Nm and always replace the lock.



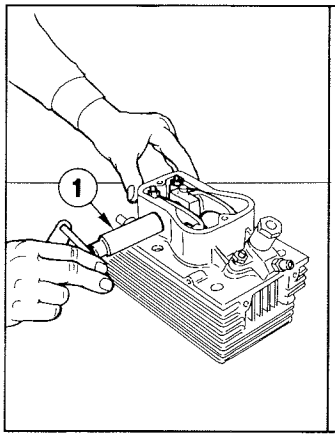
16



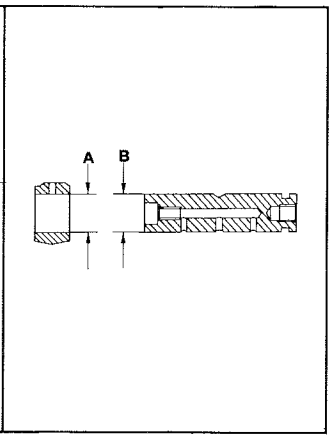
17

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 the top dead center on the compression stroke and set clearance **A** at 0.25 ÷ 0.30 mm.
When refitting tighten cover screws to 20 Nm.



18

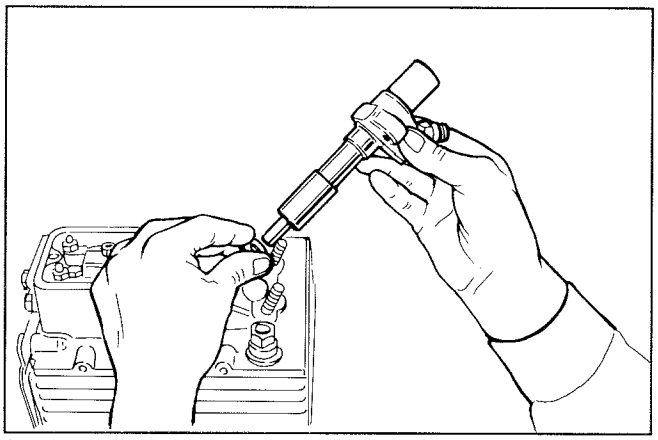


19

Rocker arm assembly

Dimensions (mm)
A = 18.032 ÷ 18.050
B = 17.989 ÷ 18.000
(A-B) = 0.032 ÷ 0.061 **(A-B)** limit value = 0.13

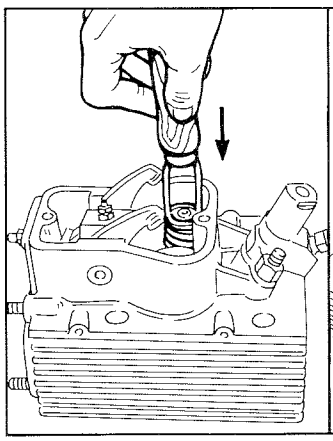
Use tool with Ser. No. 7276-3595-040 to remove rocker arm pin.



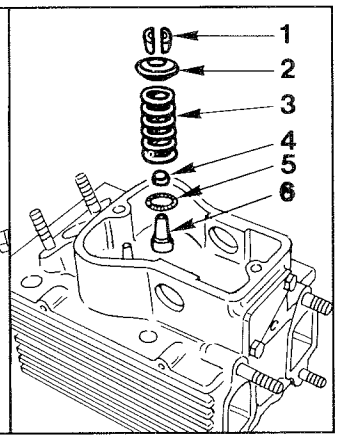
20

Injector

Check calibration pressure, see Fig. 149.
When refitting check that it correctly protrudes from the cylindrical head plane, see Fig. 32.
Tighten the fixing nuts to 20 Nm.



21

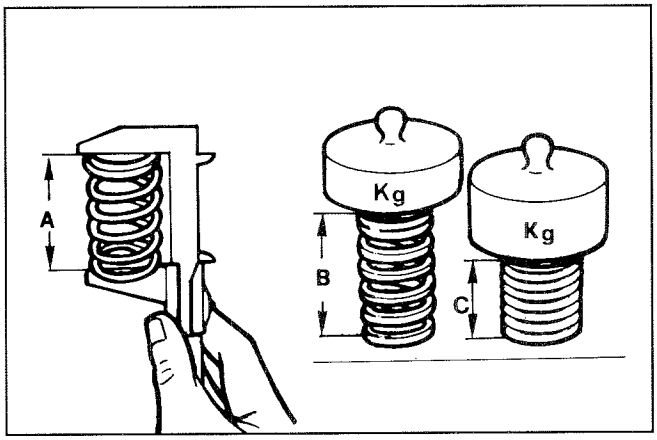


22

Valves

1 Half collets
2 Spring seat
3 Spring
4 Stem steal (in intake valves only)
5 Cap
6 Intake valve

To remove half collets place a shim under valve head and press firmly as shown in the Figure.

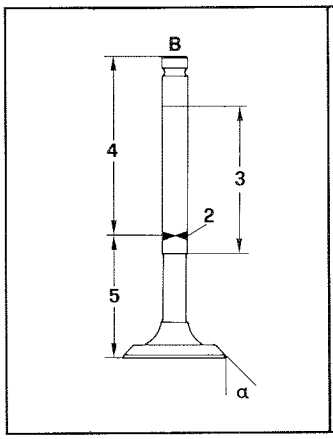


23

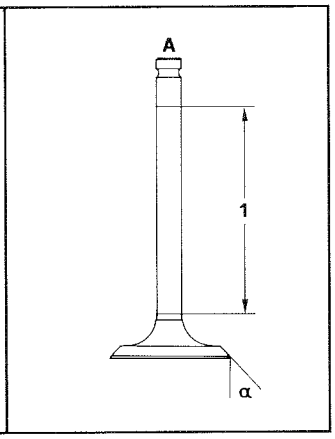
Valve spring

The same spring is fitted to the exhaust and intake valves.
Measure free length with a caliper.
Using a spring gauge check that the spring length under two different loads corresponds to the values below:

Free length **A** = 55.4 mm
Length **B** compressed by a 27 Kg weight = 37 mm
Length **C** compressed by a 42.5 Kg weight = 26.4 mm



24



25

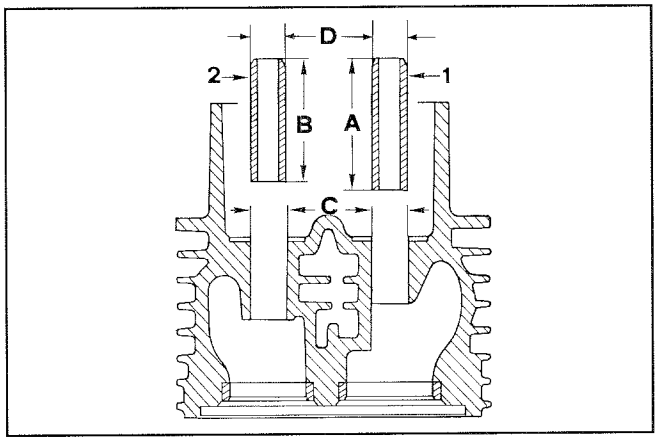
Valve material

Intake valve A

Material: X 45 Cr Si 8 UNI 3992
1 Chromium-plated portion
α 45°15' ÷ 45°25'

Exhaust valve B

Shaft and head are made of two different materials
2 Welded portion
3 Chromium-plated portion
4 Portion made of X 45 Cr Si 8 UNI 3992
5 Portion made of X 70 Cr Mn Ni N 216 UNI 3992
α 45°15' ÷ 45°25'



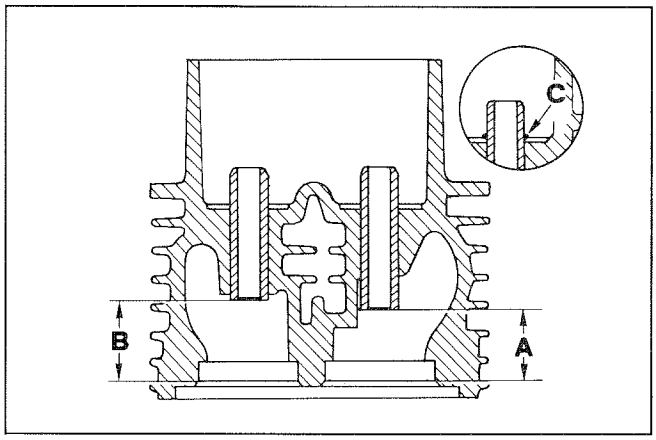
26

Valve guides and valve guide housings

1 Intake valve guide
2 Exhaust valve guide

Dimensions (mm)
A = 54.99 ÷ 55.02
B = 50.98 ÷ 51.02
C = 15.00 ÷ 15.018
D = 15.06 ÷ 15.07

Note: Valve guides with outside diameter increased by 0.5 mm. are available as spares; in this case valve guide bore **C** should also be increased by 0.5 mm.



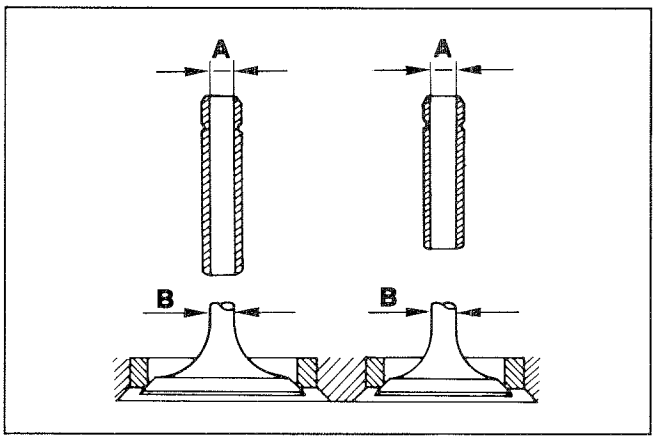
27

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 = 29.80 ÷ 30.20
B = 33.80 ÷ 34.20

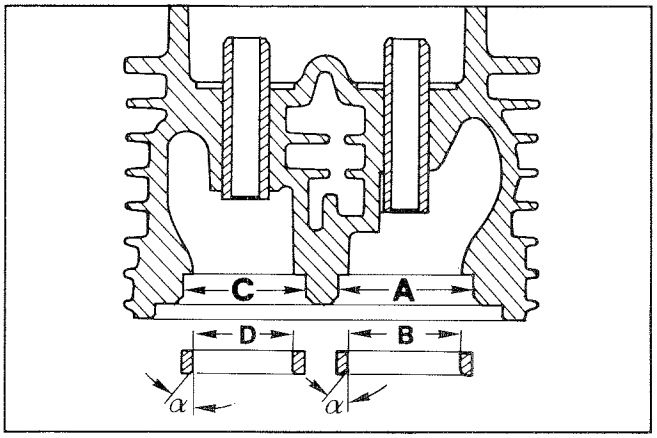
Note: If guides are seated with stop ring **C**, first locate the ring in place and them position guides without considering **A** and **B**.



28

Dimensions and clearance between guides and valves (mm)

A = 9.030 ÷ 9.060 (with guide in place)
B = 8.985 ÷ 9.000
(A-B) = 0.030 ÷ 0.075
(A-B) limit value = 0.150

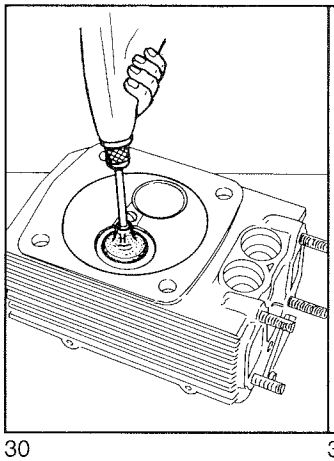


29

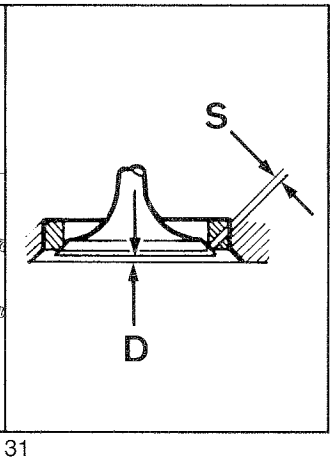
Valve seats and housings

Dimensions (mm)
A = 43.99 ÷ 44.02
B = 44.12 ÷ 44.14
C = 39.99 ÷ 40.02
D = 40.12 ÷ 40.14

Drive valve seats into their bores and cut α at 45°.



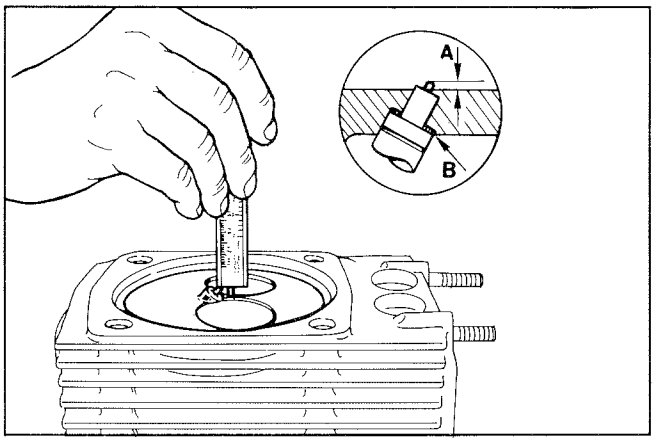
30



31

Valve seat grinding

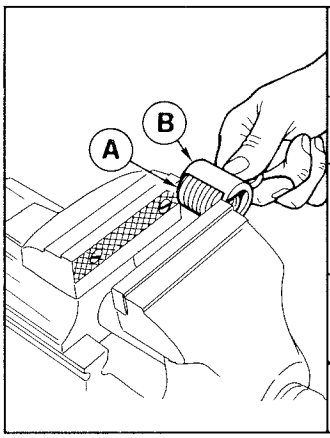
After cutting, lap valve seats with fine lapping compound.
The sealing surface **S** should not exceed 2 mm.
Valve recess **D** after grinding should be 0.75 ÷ 1.25 mm, limit value 1.65 mm.



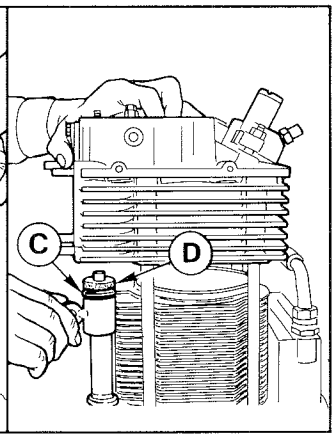
32

Injector projection

The end of nozzle **A** should project 4.5 ÷ 5 mm. from the cylinder head plane.
Adjust injector projection by means of copper shims **B** measuring 0.50, 1.00 and 1.50 mm in thickness.



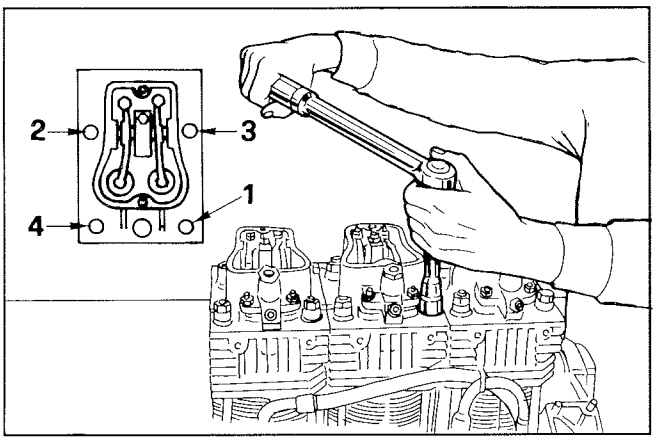
33



34

Pushrod tube spring

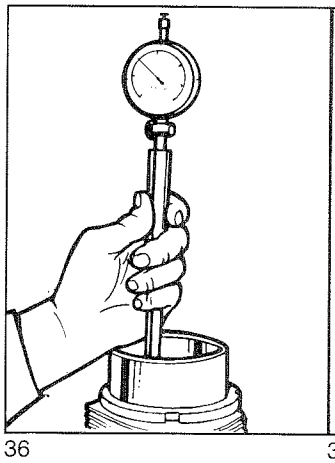
Introduce spring **A** into tool **B** (Ser. No. 7672-1460-008) of both tubes.
Install gasket to head using some grease for adhesion.
Fit head making sure that washer **C** and rubber ring **D** of each tube perfectly fit into their seats.



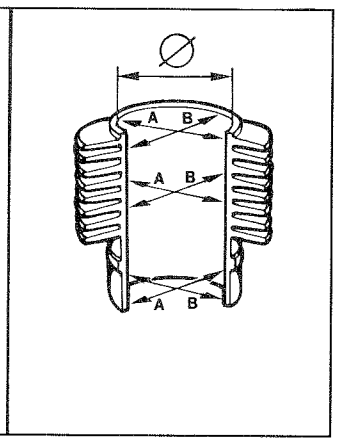
35

Head tightening

To prevent intake and exhaust manifold flanges from breaking align heads before tightening.
Progressively tighten to 90 Nm in the **1, 2, 3** and 4 sequence.
Remove tools **B** as shown in fig. 33.



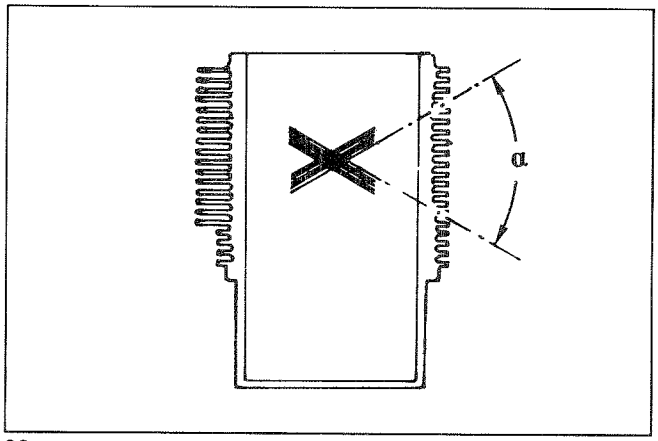
36



37

CYLINDER

Set bore gauge to zero with a calibrated ring.
Measure diameter size at **A** and **B** at three different heights as shown in the Fig.
If wear exceeds the max. given value by 0.08 mm, bore the cylinder to the next oversize.
For diameter sizes see below.

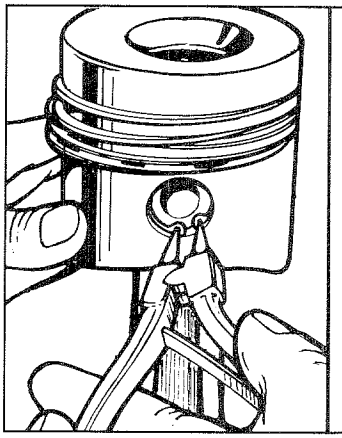


38

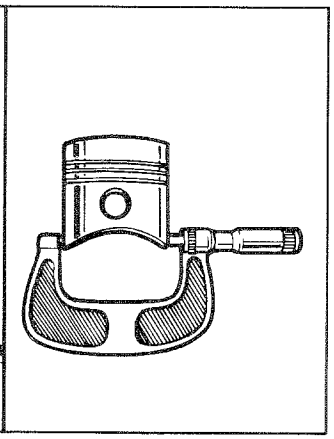
Cylinder roughness

The inclination of the cross hatch α should be 45° ÷ 55°; cross hatch should be uniform and consistent in both directions.
Mean roughness should range between 0.1 and 1 μm.
The cylinder surface which contacts piston rings should be honed using a bead type hone.

Warning: Do not hand-grind the cylinder inner surface using emery cloth.



39



40

PISTON

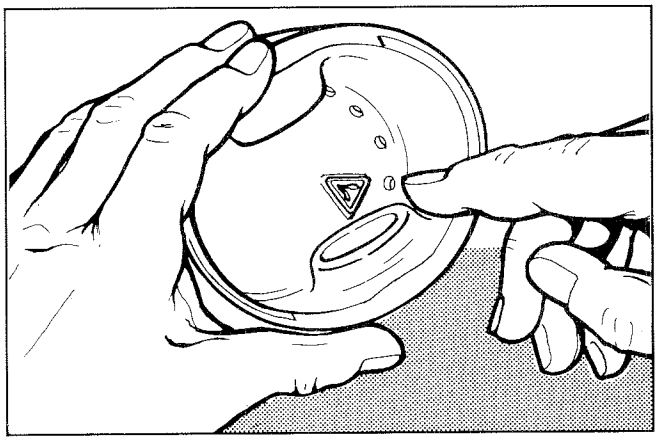
The piston is of the hypereutectic type which reduces clearance between piston and cylinder, thereby decreasing oil consumption.
Measure diameter size at a distance of 12 mm. from the skirt bottom.

Piston and cylinder dimensions (mm)

Engine	Cylinder Dia.	Piston Dia.	Clearance
5LD825-2 5LD825-3 5LD825-3/T 5LD825-4	100.00 ÷ 100.02	99.90 ÷ 99.92	0.08 ÷ 0.12
5LD930-3 5LD930-4	106.00 ÷ 106.02	105.90 ÷ 105.92	0.08 ÷ 0.12

Piston availability:

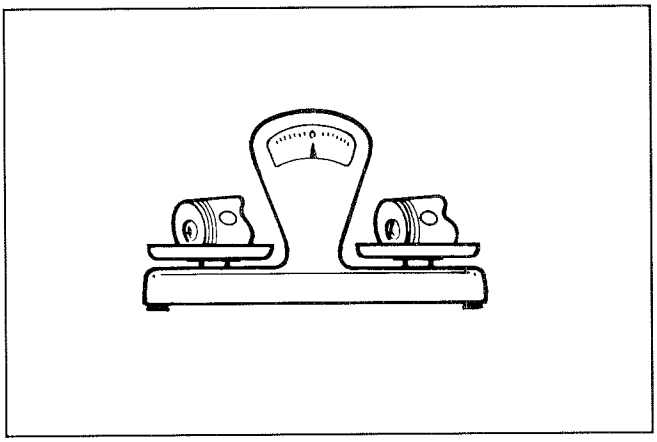
Pistons are available both with nominal diameter and with diameter size increased by 0.50 and 1.00 mm; the oversize indication is shown on the piston crown.



41

Checking that piston is an original part

When replacing the piston or any other engine component always check that the original spare part is available.
The logo confirming that the part is an original is stamped inside.
For diameter size check see Fig. 40.



42

Piston weight

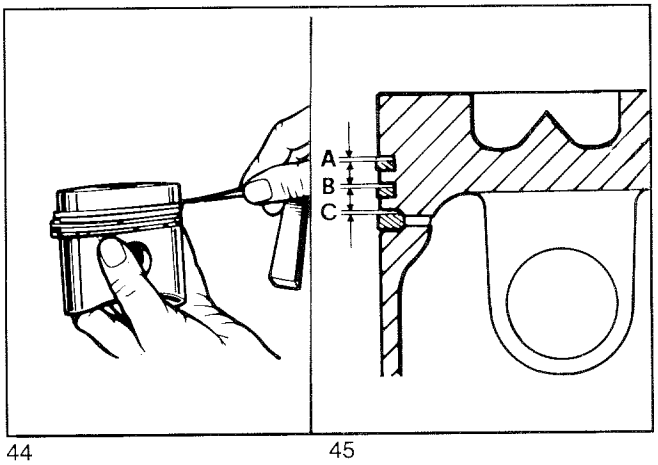
Weigh pistons when replacing them in order to avoid unbalance.
The difference in weight should not exceed 6 g.

43

Piston rings - End gaps (mm)

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

1st chromium-plated ring	**A** = 0.35 ÷ 0.55
2nd torsional ring	**A** = 0.30 ÷ 0.45
3rd oil control ring	**A** = 0.25 ÷ 0.40



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45

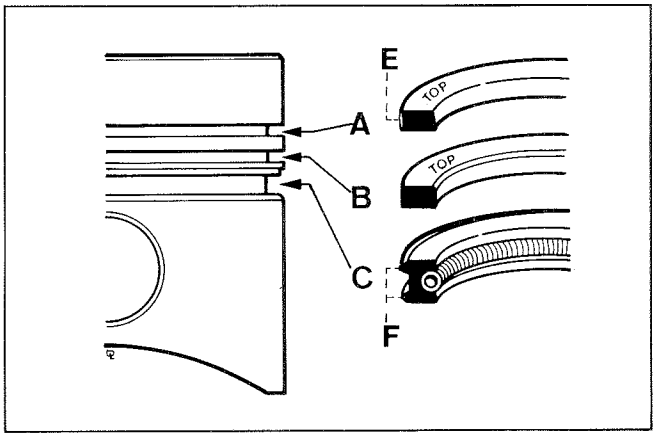
Piston rings - Clearance between grooves (mm)

For 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD825-4

A = 0.07 ÷ 0.11; limit value = 0.20
B = 0.05 ÷ 0.09; limit value = 0.16
C = 0.04 ÷ 0.08; limit value = 0.15

For 5LD930-3, 5LD930-4

A = 0.060 ÷ 0.100; limit value = 0.19
B = 0.110 ÷ 0.147; limit value = 0.21
C = 0.040 ÷ 0.050; limit value = 0.18



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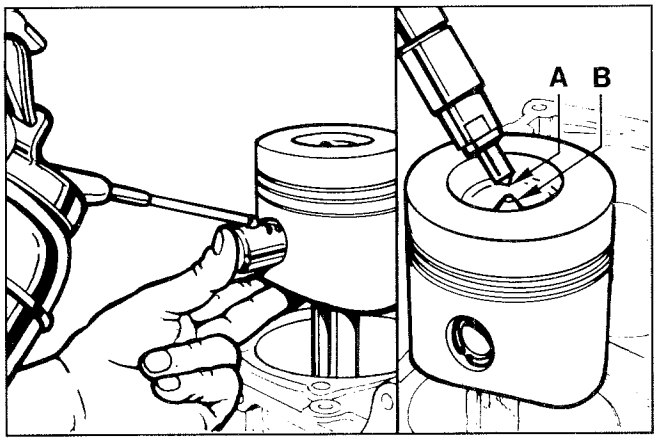
Piston rings - Fitting sequence

A = 1st chromium-plated ring
B = 2nd torsional tapered ring
C = 3rd oil control ring
E = Chromium-plated portion
F = Chromium-plated portion

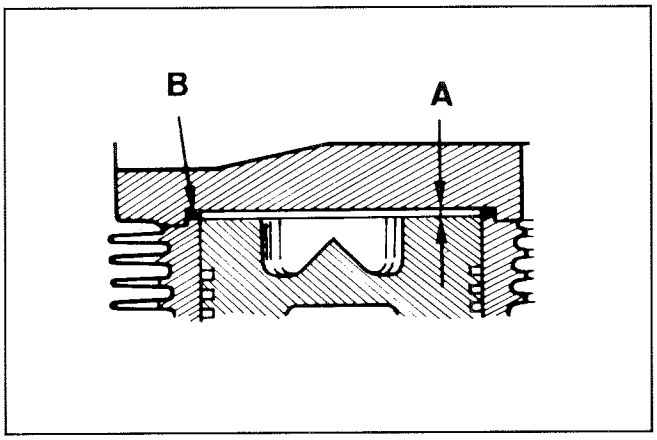
Note: If TOP or any similar reading is stamped on the upper portion of a piston ring, this is the surface which should face upwards.



48 49

Piston - Refitting

Connect piston to connecting rod in a way that the combustion chamber **B** is centered under nozzle tip **A**.
Lubricate piston pin and introduce it into the piston by exerting pressure with your thumb.
Check that both circlips are properly seated.

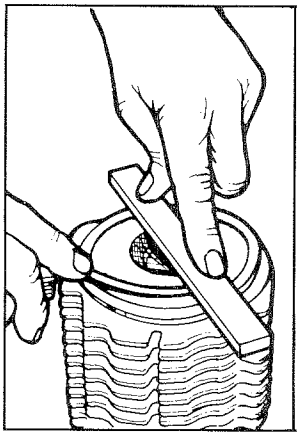


50

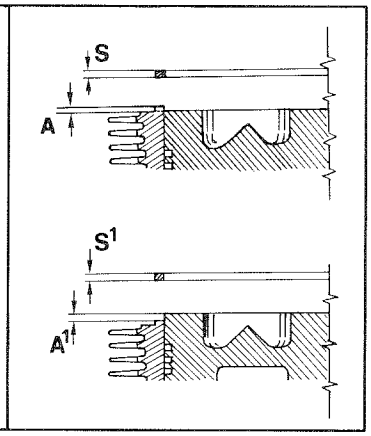
Piston clearance

A = Piston clearance
B = Copper head gasket

The thickness of head gasket **B** determines clearance **A** which should be = 0.85 ÷ 1 mm.
Gaskets are available in the following thicknesses: 0.70, 0.80, 0.90, 1.00 and 1.10 mm.



51



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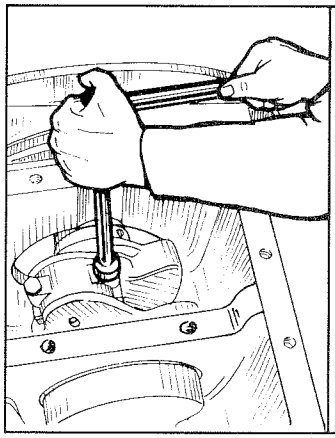
Selection of head gasket thickness with clearance of 0.85 ÷ 1.00 mm

A Distance between piston and cylinder plane (piston under cylinder plane)
S Gasket thickness referred to **A**.

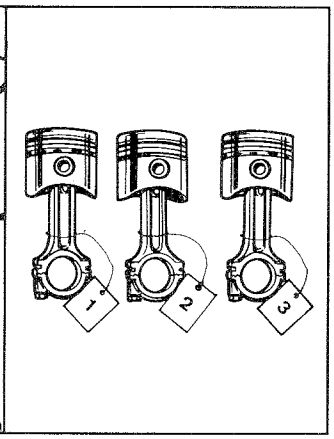
A (mm) =	0.20	0.15	0.10	0.05	0
S (mm) =	0.70	0.80		0.90	

A_1 Distance between cylinder plane and piston (piston above cylinder plane)
S_1 Gasket thickness referred to A_1.

A_1 (mm) =	0	0.05	0.10	0.15	0.20
S_1 (mm) =	0.90	1.00		1.10	



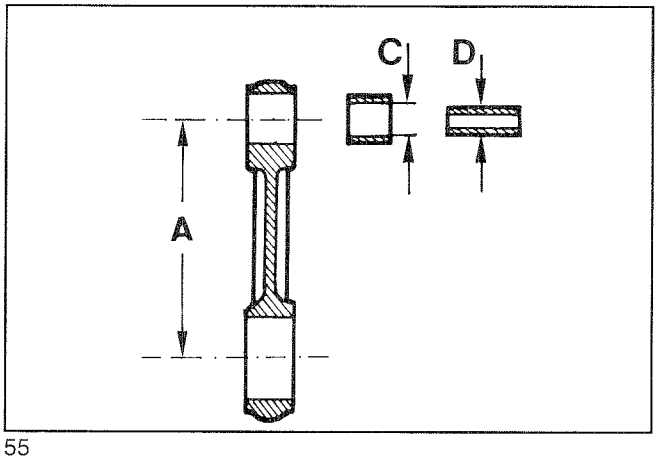
53



54

CONNECTING ROD

Remove oil pan and oil pick-up tube.
Remove the connecting rods and make the checks described below.
The connecting rod/piston assemblies should be fitted back into original cylinders; apply reference marks to avoid mistakes.
See fig. 58 for tightening the connecting rod big end bearing.

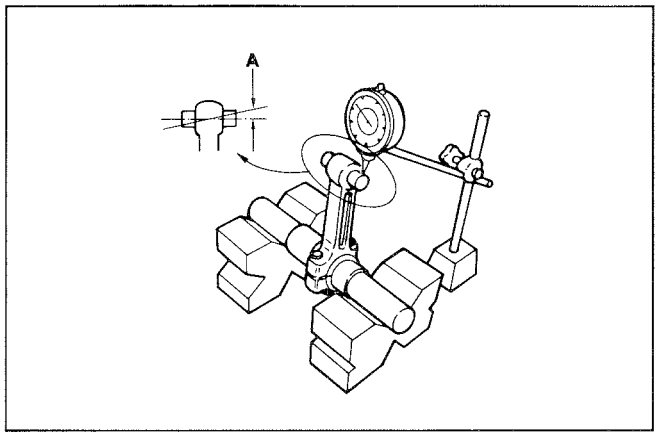


55

Connecting rod, small end bearing pin

Dimensions and clearance (mm)
A = 162.95 ÷ 163.05
C = 32.020 ÷ 32.030 (with bearing already in place and bored)
D = 31.995 ÷ 32.000
(C-D) = 0.020 ÷ 0.035
(C-D) limit value = 0.070

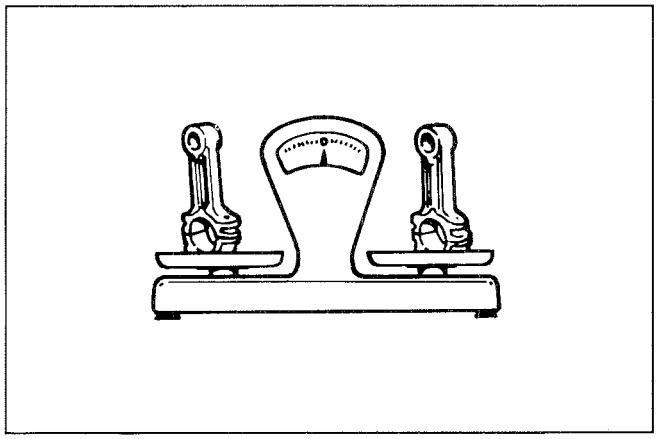
Note: The connecting rod small end bushing is supplied with **A** machining allowance of 0.3 ÷ 0.5 mm on the inside diameter; reaming is therefore required after fitting.



56

Connecting rod alignment

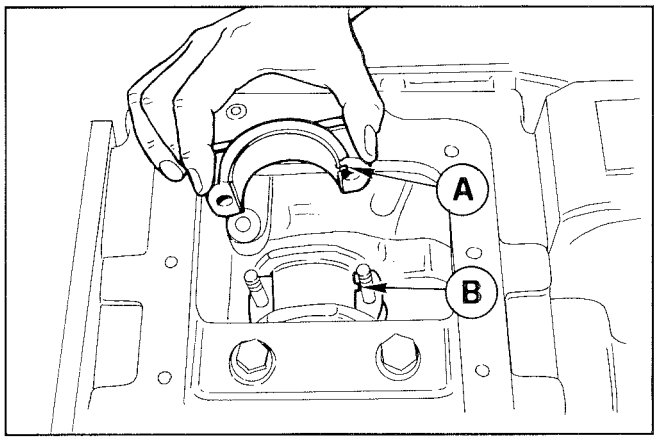
Check axial alignment; mis-alignment **A** = 0.02 mm; limit value 0.05 mm.
Moderate warpage may be corrected by gradually working with a press.



57

Connecting rod weight

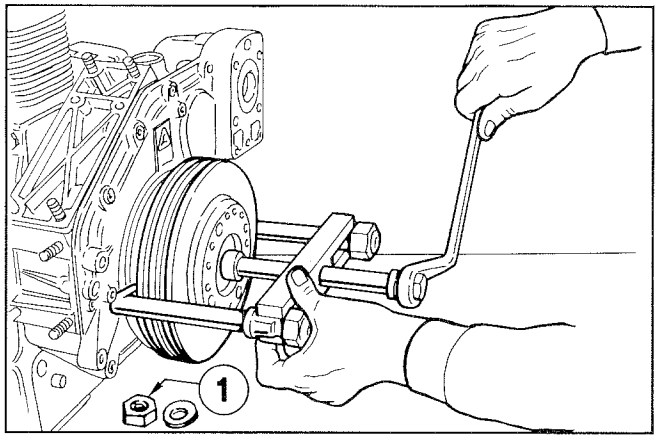
Weigh connecting rods when replacing them in order to avoid unbalance. Difference in weight should not exceed 10 g.



58

Connecting rod big end bearing

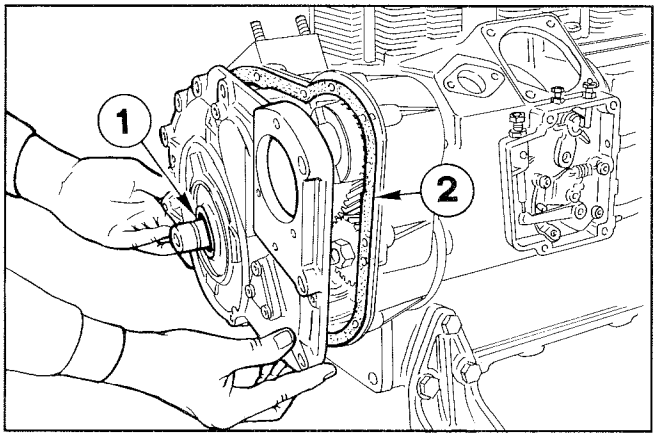
Both centering notches **A** and **B** must be on same side when refitting.
Tighten nuts to 50 Nm.
See fig. 83 for connecting rod big end bearing inside diameter.



59

Crankshaft pulley

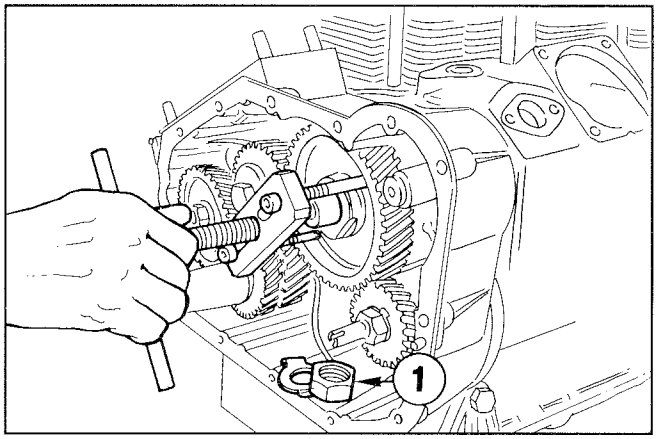
Loosen nut **1** by turning counterclockwise.
Remove pulley with a puller. When re-fitting tighten nut **1** to 441 Nm.
The pulley of engines type 5LD825-2 features a diameter of 194 mm while the other engines of the series have a 193 mm diameter.
See fig. 146 for injection timing reference marks.



60

Timing cover

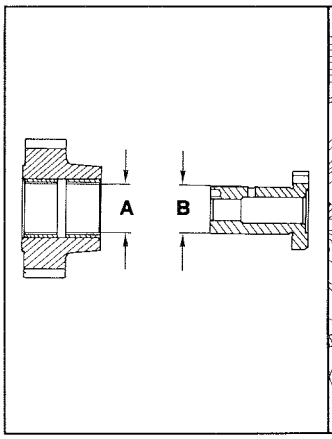
Loosen screws and remove cover.
When refitting tighten screws to 25 Nm.
Check oil seal **1** for wear; replace it if hardened, damaged or warped.
Replace gasket **2**.



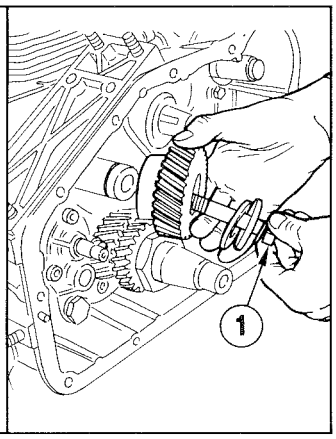
61

Camshaft gear

Loosen nut **1** by turning it clockwise.
When refitting tighten nut to 196 Nm.
See fig. 94 and 95 for timing reference marks.



62

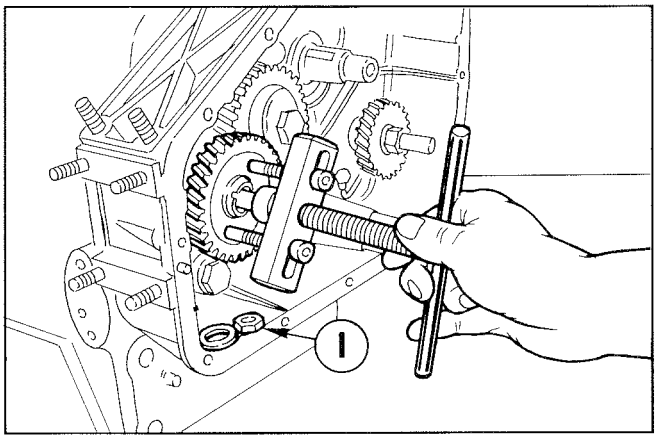


63

Idler gear and support

Dimensions and clearance (mm)
A = 30.000 ÷ 30.033
B = 29.980 ÷ 29.959
(A-B) = 0.020 ÷ 0.074
(A-B) limit value = 0.15

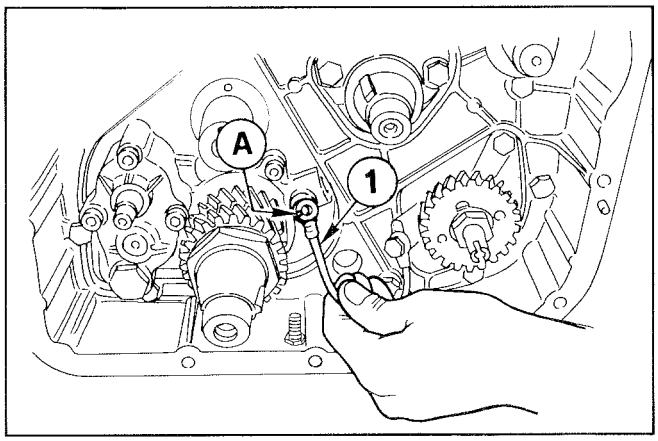
Idler gear **2** features two bearings of the same type; check for wear.
When refitting tighten screw **1** to 137 Nm.
See fit. 94 for timing reference marks.



64

Oil pump gear

Loosen nut **1** and remove oil pump gear with a puller.
When refitting tighten nut **1** to 54 Nm.

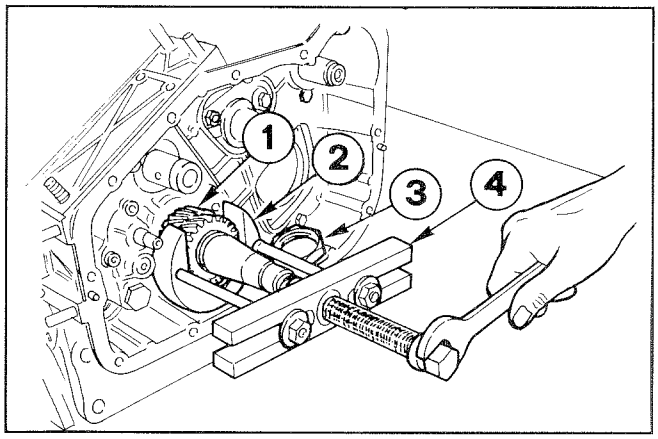


65

Speed governor lubricating tube

In the **A** position tube **1** features an opening through which oil passes and lubricates the gears.

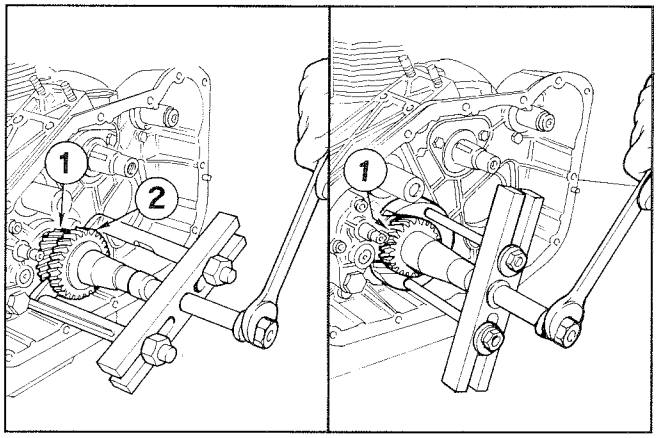
Note: In engines type 5LD825-4 and 5LD930-4 the speed governor is built in the injection pump and tube **1** is not available.



66

Timing gear for 5LD825-2

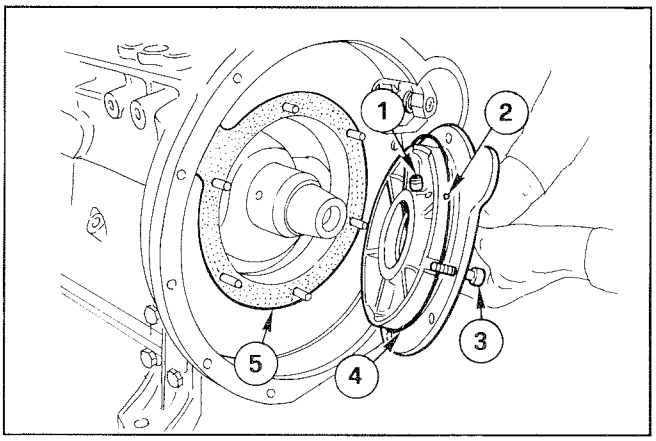
Gear **1** consists of both the timing gear and the oil pump drive gear. To remove the gear use special tool **2** with part. no. 7276-4000-032 and puller **4** with part. no. 7271-3595-048.
When refitting heat gear up to 180°C and tighten nut **3** to 490 Nm.



67 68

Timing gear for 5LD825-3, 5LD825-3/T, 5LD930-3, 5LD825-4 and 5LD930-4

In this case timing gear **1** is separate from oil pump gear **2** .
Remove gear **2** with a type puller and gear **1** with the same tool as the one used in fig. 66.
When refitting heat both gears up to 180°C and tighten nut **4** to 490 Nm.

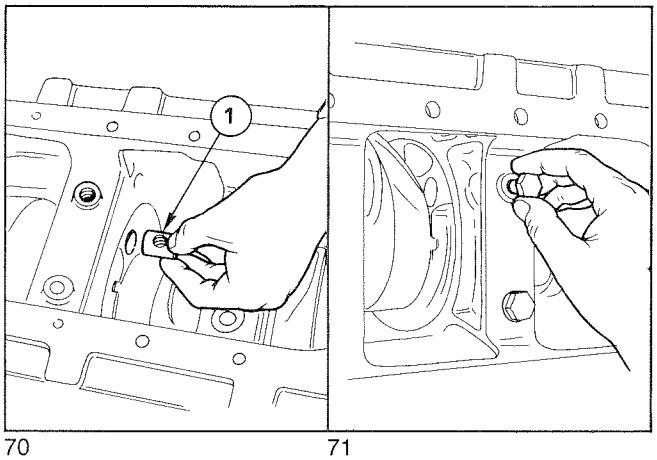


69

Main bearing support, flywheel side

Components:
1 = Nozzle
2 = Camshaft lubrication hole
3 = Fastening screw
4 = O-ring seal
5 = Gasket

See fig. 84 for dimensions.

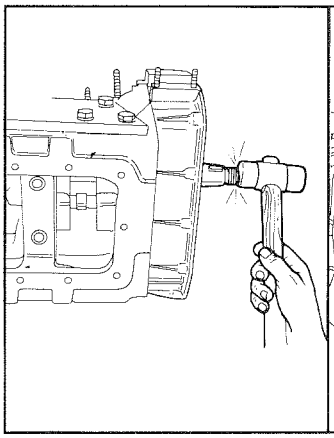


70 71

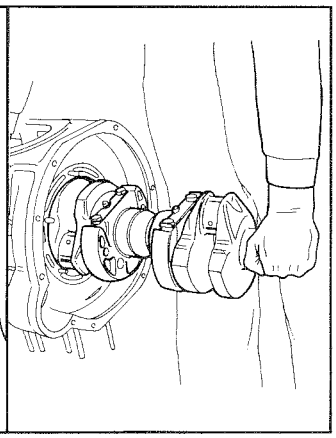
CRANKSHAFT

Center main bearing support, locating bolts

Before pulling the crankshaft remove the center support locating bolts.
When refitting turn supports as required to insure alignment corresponding nut **1** as shown in the Figure.
When refitting tighten bolts to 50 Nm.



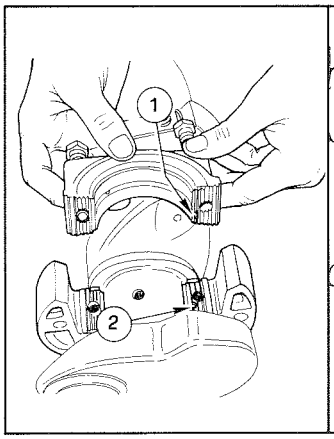
72



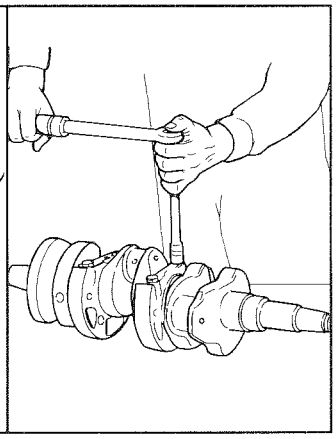
73

Crankshaft removal

To pull out the crankshaft tap lightly on the gear side end using a copper-headed hammer.
When refitting align center main bearing supports so that the locating bolt hole coincides with the crankcase hole.



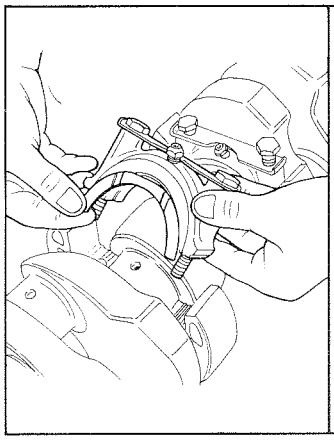
74



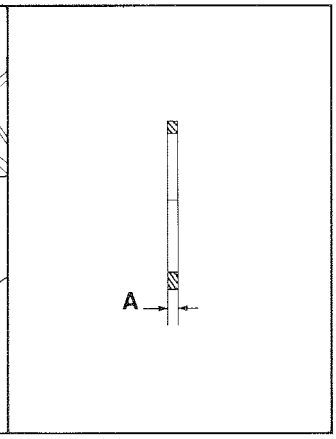
75

Crankshaft center main bearing supports

Fit the support collar so that the centering notches of bearings **1** and **2** are located on the same side.
Tighten bolts to 50 Nm.



76



77

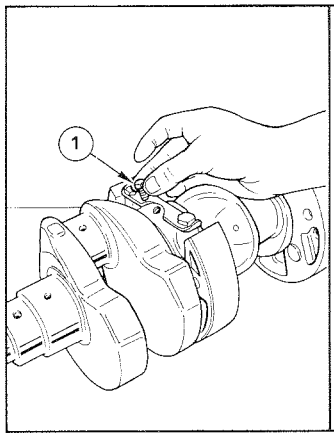
Thrust ring

Fit the two thrust half-rings as shown in the diagram; spread some grease in their seats to prevent them from moving during assembly.

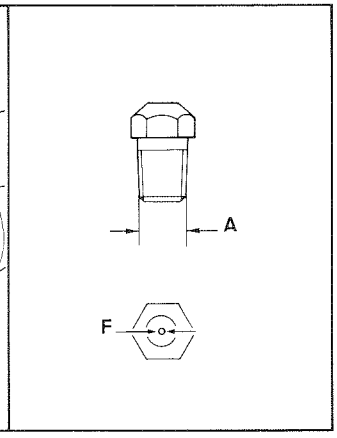
Dimensions (mm)
A = 2.31 ÷ 2.36

Replace if wear exceeds the minimum value by 0.15 mm.

Note: Oversize thrust rings are not available.



78



79

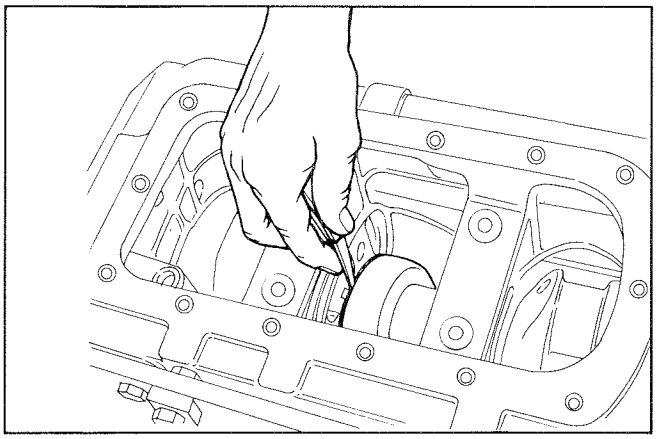
Oil sprayer

Each main bearing support comes with an oil jet which lubricates and cools the piston.

Dimensions
A = 1/8'' gas, tapered (thread type)
F = 1.00 ÷ 1.06 mm (nozzle hole)

Specifications:
Opening pressure = 1.3 ÷ 1.7 bar

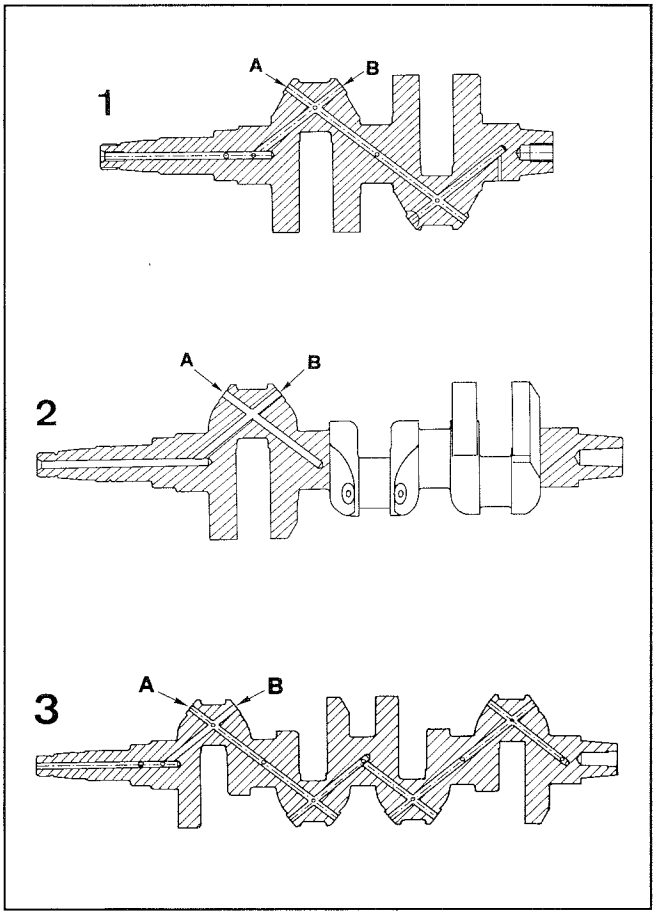
Note: In engines of the old series which do not feature oil jets do not fit hypereutectic pistons with 3 rings.



80

Crankshaft end play

Check crankshaft end play after refitting the crankshaft and fastening the bearing supports. Its value should be 0.05 ÷ 0.4 mm.

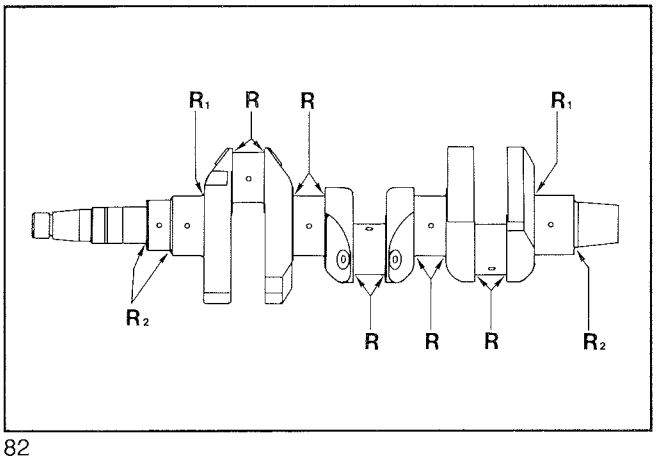


81

Crankshaft lubrication ducts

1 For 5LD825-2
2 For 5LD825-3, 5LD825-3/T, 5LD930-3
3 For 5LD825-4, 5LD930-4

Remove plugs from ducts **A** and **B** of each crank throw, clean and blow with compressed air.
Push plugs back in place and check for sealing.

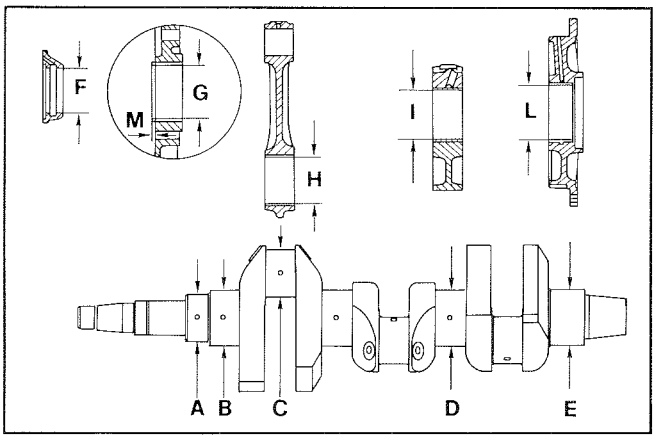


82

Crankshaft journal radius (mm)

R = 3.35 ÷ 3.45
R1 = 2.9 ÷ 3.1
R2 = 3.0

Note: When grinding main journal or crank pins restore the **R** value of the radius.



83

Main bearing and connecting rod big end bearing inside diameter
Main journal and crankpin diameter
Clearance between main journals/crank pins and connecting rod bearings

When locating the bearing on the timing side make sure that it protrudes from the crankcase plane by a value of **M** (2 mm).

Dimensions (mm)

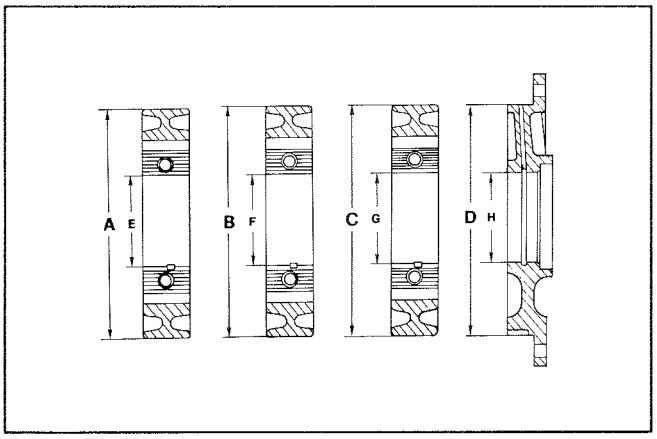
A = 54.990 ÷ 55.000
B = 64.960 ÷ 64.980
C = 55.340 ÷ 55.353
D = 64.960 ÷ 64.980
E = 64.960 ÷ 64.980
F = 55.050 ÷ 55.080*
G = 65.040 ÷ 65.070
H = 55.404 ÷ 55.435
I = 65.050 ÷ 65.070
L = 65.050 ÷ 65.070

Clearance (mm)

(F-A) = 0.05 ÷ 0.09 — **(F-A)** limit value = 0.15
(G-B) = 0.06 ÷ 0.11 — **(G-B)** limit value = 0.18
(H-C) = 0.05 ÷ 0.10 — **(H-C)** limit value = 0.17
(I-D) = 0.07 ÷ 0.11 — **(I-D)** limit value = 0.18
(L-E) = 0.07 ÷ 0.11 — **(L-E)** limit value = 0.18

Bearing availability: Main bearings and connecting rod big end bearings are supplied with nominal inside diameter as well as with inside diameter size decreased by 0.25 or 0.50 mm.

* Oil pump collar diameter.

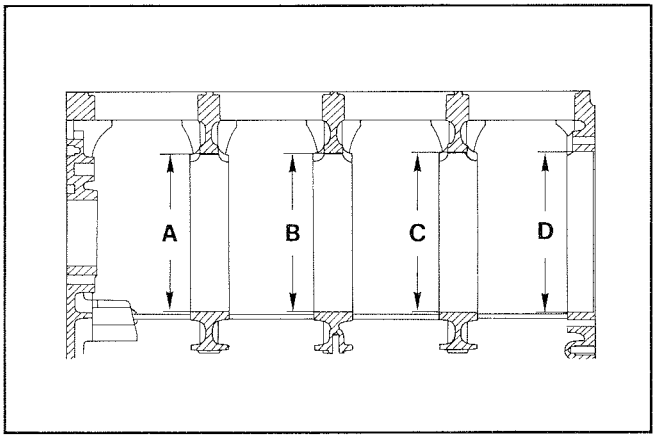


84

Main bearing supports

Dimensions (mm)

A = 176.000 ÷ 176.020
B = 177.000 ÷ 177.020
C = 178.000 ÷ 178.020
D = 179.000 ÷ 179.020
E, F, G = 68.720 ÷ 68.730
H = 70.000 ÷ 70.020

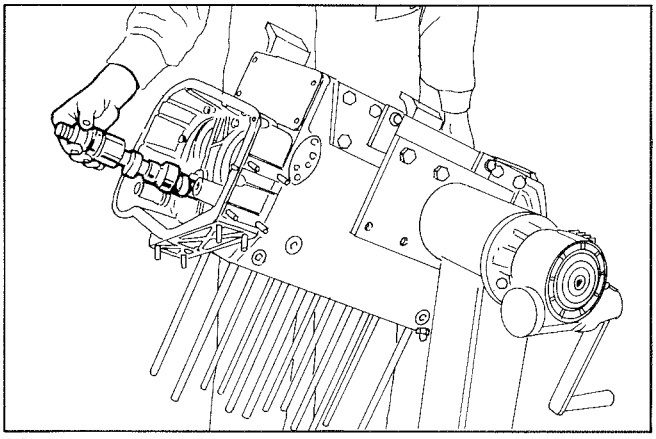


85

Main bearing housings

Dimensions (mm)

A = 176.000 ÷ 176.020
B = 177.000 ÷ 177.020
C = 178.000 ÷ 178.020
D = 179.000 ÷ 179.020

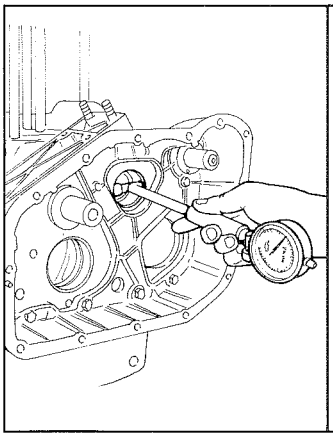


86

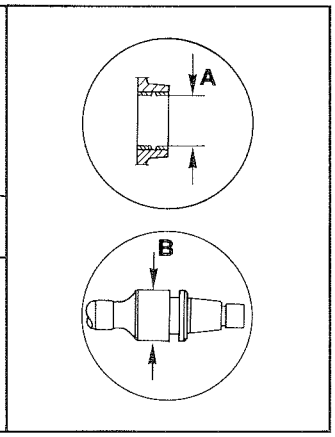
CAMSHAFT

Camshaft removal

To pull out the camshaft tilt the engine as shown: in this position the pushrod tappet is not in contact with the camshaft thus making its removal possible.



87



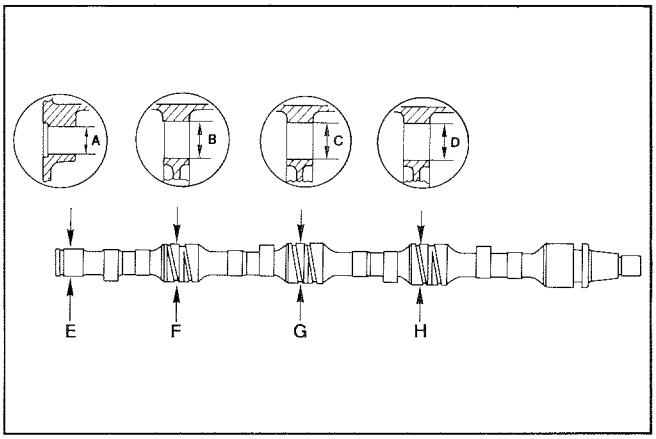
88

Camshaft bearing and journal inside diameter

Dimensions (mm)

A = 48.005 ÷ 48.025 (standard)
B = 47.940 ÷ 47.960
(A-B) = 0.045 ÷ 0.085 **(A-B)** limit value = 0.16

The camshaft bearing is supplied both with standard inside diameter and with diameter size decreased by 0.25 or 0.50 mm.
The bearing with standard inside diameter is also available with oversize outside diameter increased by 1 mm.



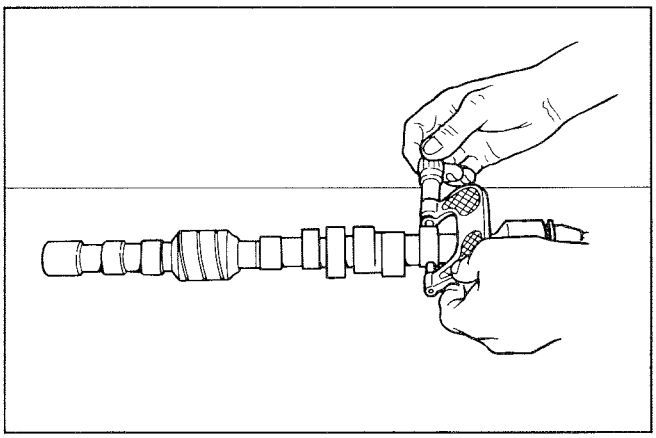
89

Dimensions of camshaft journals and bores for 5LD825-4 and 5LD930-4 (mm)

A = 30.000 ÷ 30.025
B = 42.000 ÷ 42.025
C = 44.000 ÷ 44.025
D = 46.000 ÷ 46.026
E = 29.910 ÷ 29.930
F = 41.920 ÷ 41.940
G = 43.920 ÷ 43.940
H = 45.930 ÷ 45.950

Clearance (mm)

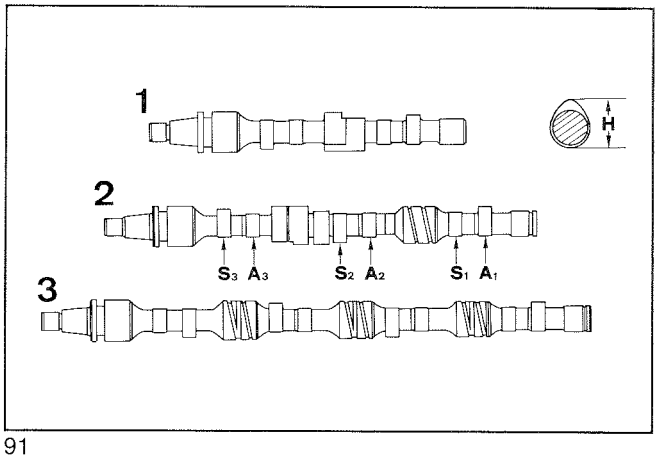
(A-E) = 0.070 ÷ 0.115 **(A-E)** limit value = 0.17
(B-F) = 0.060 ÷ 0.105 **(B-F)** limit value = 0.16
(C-G) = 0.060 ÷ 0.105 **(G-C)** limit value = 0.16
(D-H) = 0.050 ÷ 0.095 **(D-H)** limit value = 0.15



90

Intake/exhaust cam height measurement

Measure this height with an outside micrometer.



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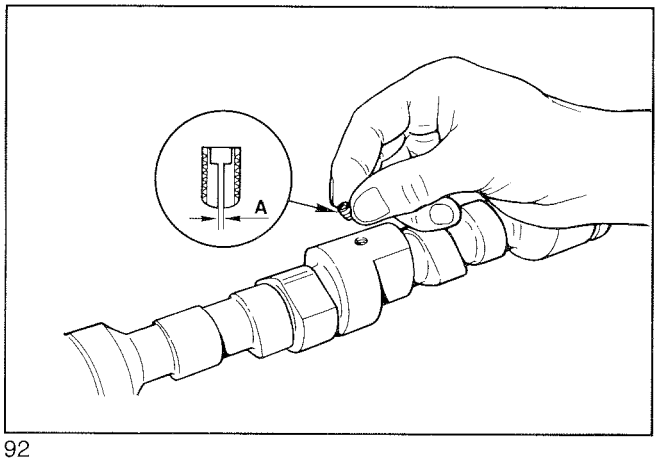
Intake/exhaust cam height

1 Camshaft, 5LD825-2
2 Camshaft, 5LD825-3, 5LD825-3/T, 5LD930-3
3 Camshaft, 5LD825-4, 5LD930-4

A_1, A_2, A_3 and **S_1, S_2 and S_3** are the intake and exhaust lobes of the first, second and third cylinder respectively.

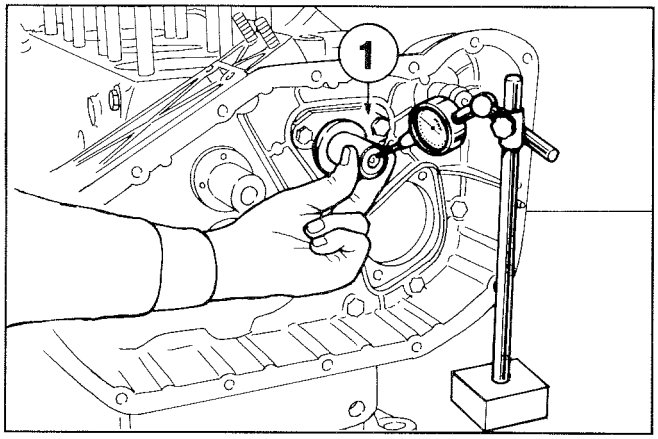
Intake and exhaust lobes feature the same height **H** in all engines of the series.
H = 34.3 ÷ 34.4 mm.
Replace camshaft if, due to cam wear, the minimum given value for **H** is exceeded.



92

Camshaft plugs

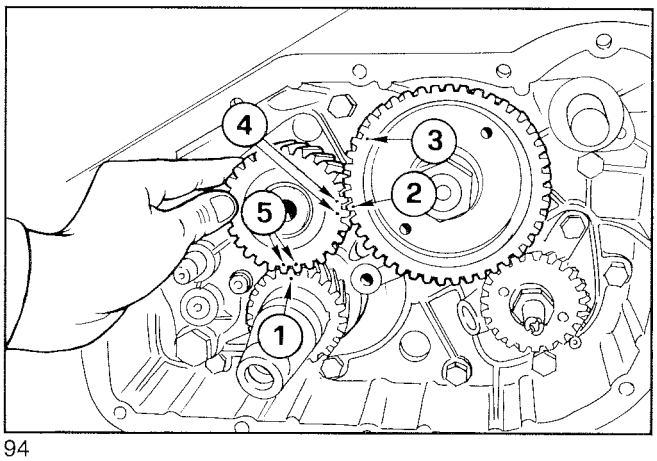
To carefully clean the camshaft inside it is necessary to remove the lubrication duct plugs; check that hole **A** (1.5 mm dia.) of the injection pump cam plug is not clogged.
When refitting apply a drop of Loctite 270 on the plug threads.



93

Camshaft end play

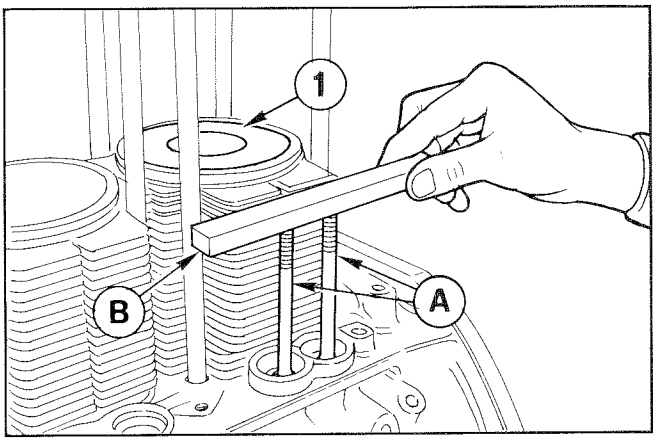
Check camshaft end play after removing cylinder heads, injection pumps and fuel feed pump from the engine.
Tighten cover **1** screw to 25 Nm.
Place the dial gauge on the camshaft front part; push and pull camshaft as required.
Camshaft end play should be 0.40 ÷ 0.70 mm.



94

Camshaft timing

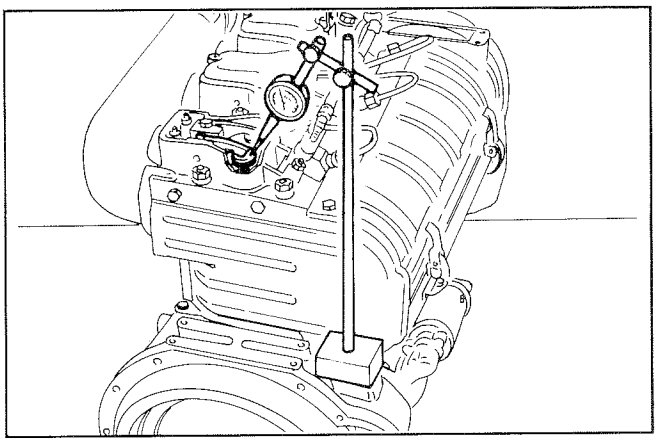
Fit idler gear by making timing marks **5** coincide with timing marks **1** of the crankshaft. Furthermore, timing marks **4** should coincide with timing marks **2** of the camshaft gear.
The three timing gears are the same for all engines of the series. However, for the timing of 5LD825-4 and 5LD930-4 timing mark **3**, instead of **2**, should coincide with timing mark **4** of the idler gear.



95

Valve timing without considering timing marks

Locate piston 1 (on flywheel side) at the top dead center. 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.
Place oil pump gear between timing and camshaft gear.



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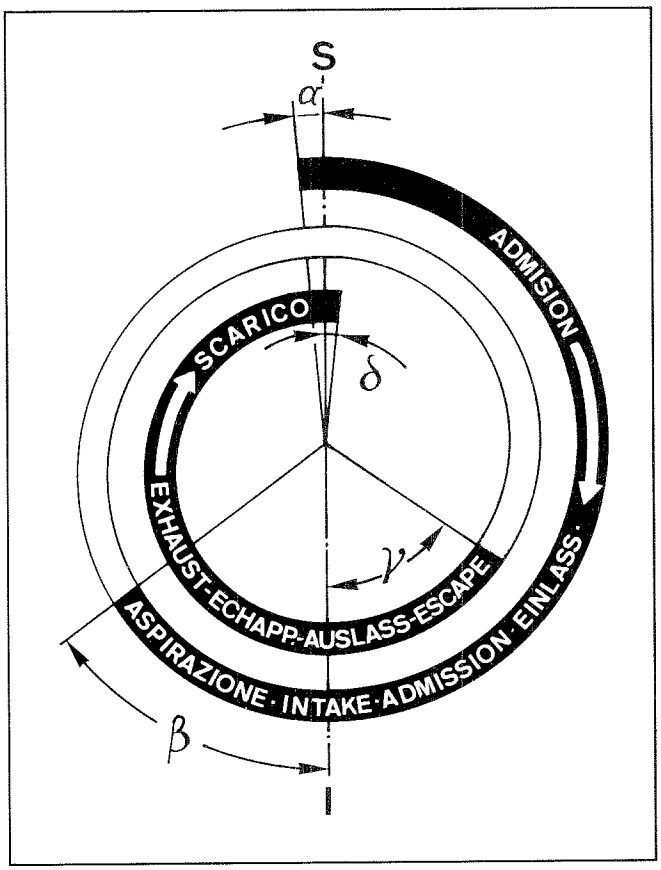
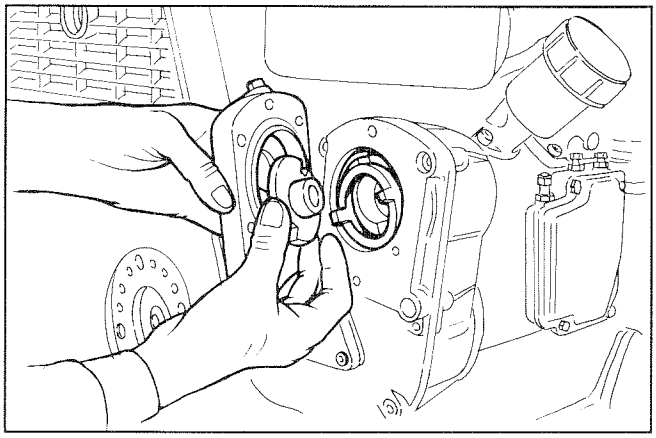
Valve timing check

Check valve timing at the crankshaft. The values shown are checked at the flywheel circumference (with flywheel) of 314 mm diameter (each degree corresponds to 2.74 mm).
Set valve clearance at 0.65 ÷ 0.70 mm (after checking restore the value at 0.25 ÷ 0.30 mm).
Set dial gauge on intake valve to a zero value; by rotating the crankshaft according to the normal direction of rotation measure α (intake valve opening advance referred to top dead center **S**) and β (intake valve closing delay referred to bottom dead center **I**).
Follow the same procedure for exhaust valves checking γ (exhaust valve opening advance) and δ (exhaust valve closing delay).

α = 4°
β = 36°
γ = 36°
δ = 4°



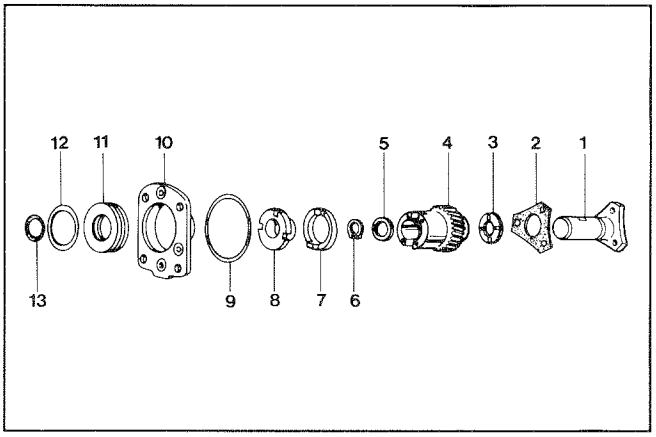
97



98

Hydraulic pump p.t.o.

A hydraulic pump of group 1 or 2, type Bosch, can be installed on the gear side **A**, 3rd p.t.o.
The max. obtainable torque is 49 Nm.
The engine/pump r.p.m. ratio is 1:1.

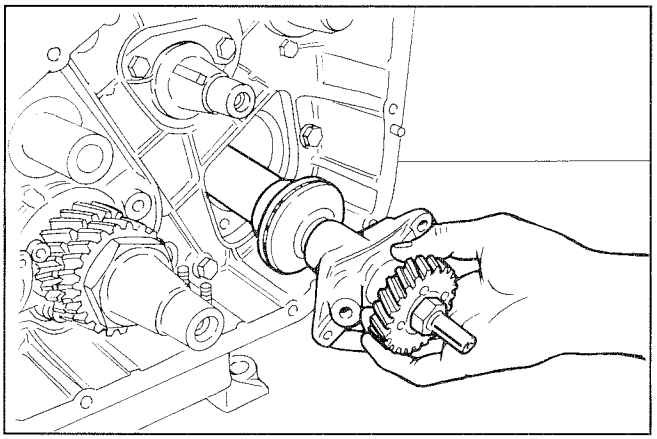


99

Hydraulic pump 3rd p.t.o., group 2

Components:

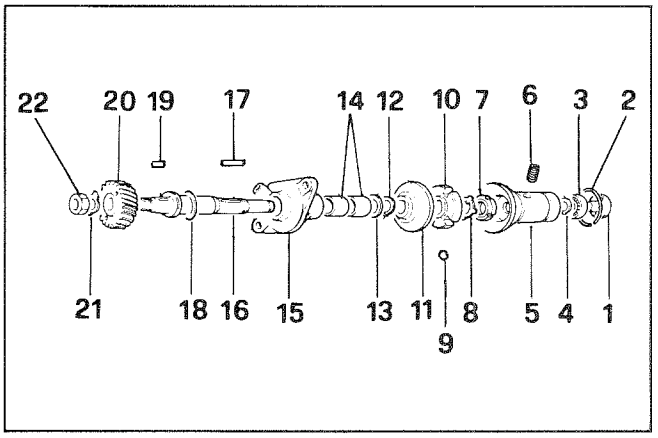
1 Shaft
2 Gasket
3 Thrust ring
4 Gear
5 Washer
6 Circlip
7 Intermediate drive
8 Driven flange
9 Seal ring
10 Pump support
11 Centering ring
12 Seal ring
13 Seal ring



100

Speed governor

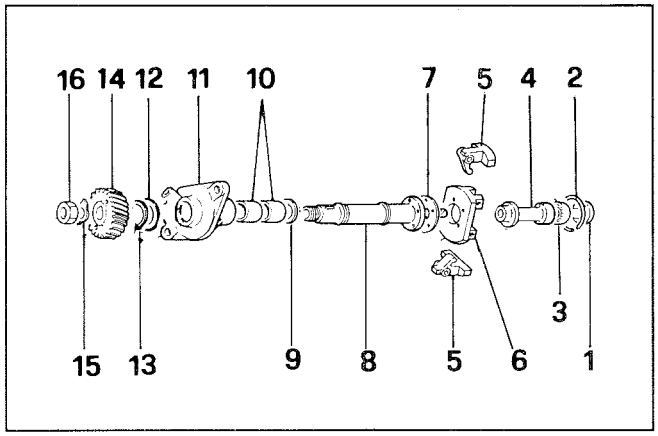
Ball-type (standard) and weight-type speed governors for generating sets are fitted to engine types 5LD825-2, 5LD825-3, 5LD825-3/T and 5LD930-3.
In engine type 5LD825-4 and 5LD930-4 the speed governor is built in the injection pump.



101

Ball-type speed governor (standard)

1 Thrust Plate
2 Snap ring
3 Ball bearing
4 Snap ring
5 Mobile bell
6 Screw
7 Ring nut
8 Lock
9 Ball
10 Collar
11 Bell
12 Circlip
13 Thrust ring
14 Bearings
15 Speed governor support
16 Shaft
17 Key
18 Thrust ring
19 Key
20 Gear
21 Lock
22 Nut

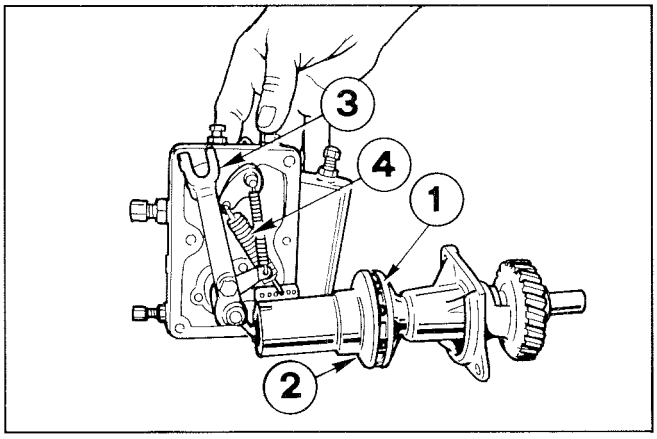


102

Weight-type speed governor for generating sets

Components:

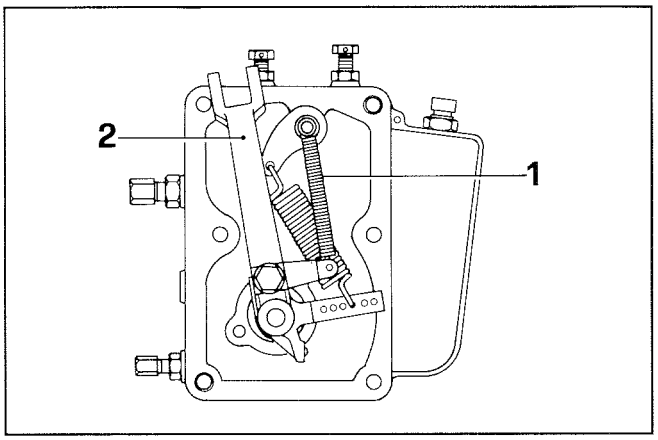
1 Thrust plate
2 Snap ring
3 Ball bearing
4 Spool
5 Weights
6 Weight support
7 Plate
8 Shaft
9 Thrust ring
10 Bearings
11 Speed governor support
12 Ring
13 Circlip
14 Gear
15 Lock plate
16 Nut



103

Speed governor operation

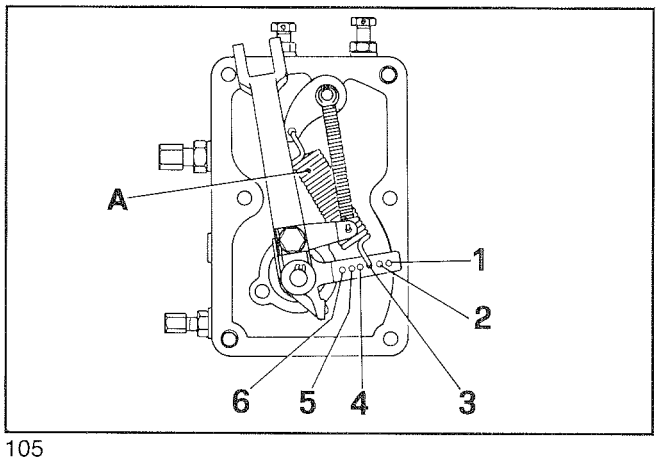
Balls **1** are moved to the periphery by the centrifugal force and thus axially shift the mobile bell **2** and the injection pump control lever **3**. Spring **4**, placed under tension by the throttle control lever, offsets the balls centrifugal force. Balance between the two forces keeps speed at an almost constant level in spite of load variations.



104

Spring for extra fuel supply at starting

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



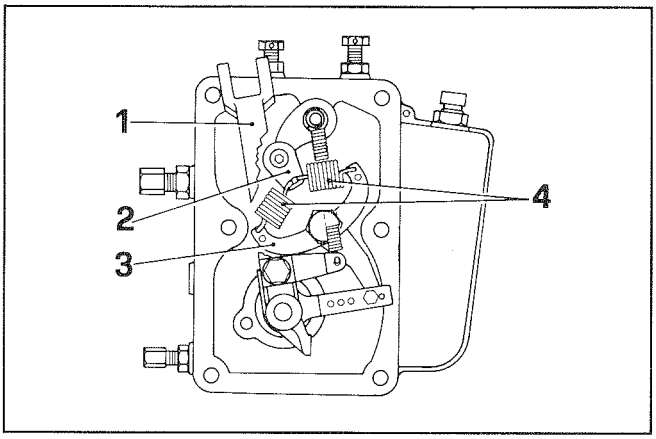
105

Speed governor spring hook-up

Depending on the engine r.p.m. setting spring **A** should be hooked to one of the holes shown in the Figure.
Spring **A** is available in two types: one for engines set at 1500 to 1800 r.p.m. (generating sets with weight-type speed governor) and one for engine settings between 2200 and 3000 r.p.m. (with ball-type speed governor).

With weight-type governor:
Hole No. 5 for engine settings at 1500 r.p.m.
Hole No. 4 for engine settings at 1800 r.p.m.

With ball-type governor:
Hole No. 5 for engine settings at 1500 r.p.m.
Hole No. 4 for engine settings at 1800 r.p.m.
Hole No. 4 for engine settings at 2200 r.p.m.
Hole No. 3 for engine settings at 2600 r.p.m.
Hole No. 2 for engine settings at 3000 r.p.m.

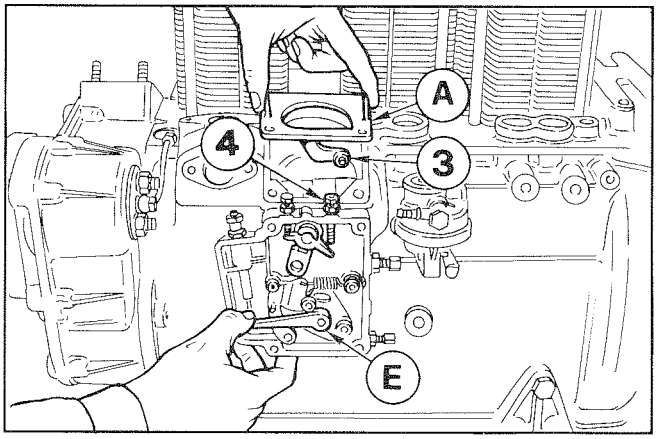


106

Speed governor springs with rocker yoke

Components:
1 Injection pump delivery control lever
2 Spring anchoring plate
3 Rocker yoke
4 Springs

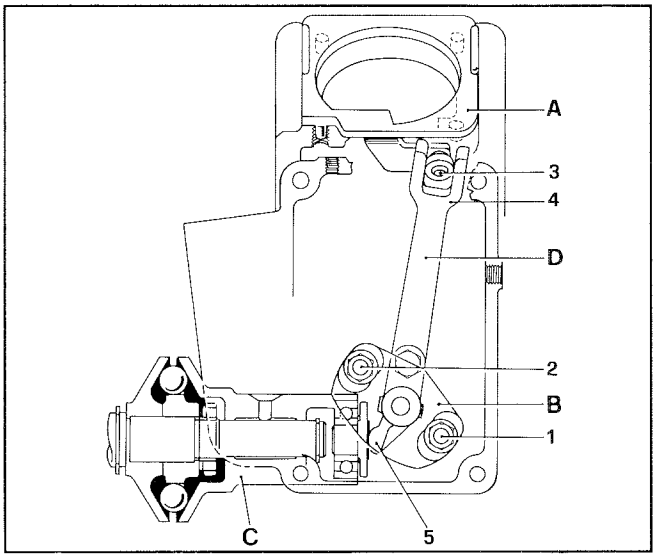
The system consists of two springs hooked to a rocker yoke and thus makes it possible to limit r.p.m. changes to a minimum when operating at idle speed.



107

Tool for speed governor to injection pump adjustment, 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD930-3

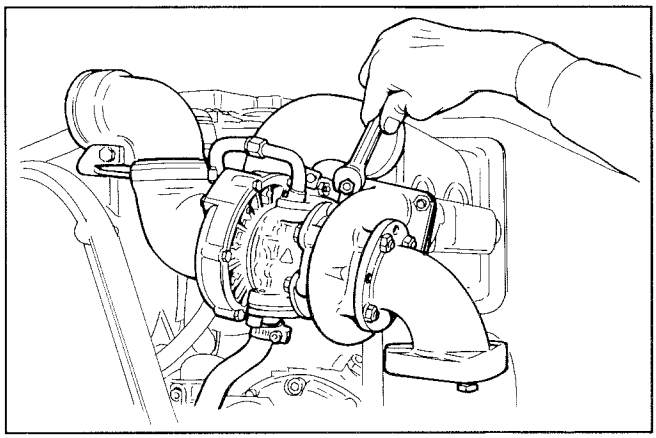
Two type are available:
Ser. No. 2003-004 for 5LD825-2
Ser. No. 2003-005 for 5LD825-3, 5LD825-3/T, 5LD930-3
See below for adjusting maximum injection pump delivery with speed governor.



108

Speed governor timing with injection pump for 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD930-3

— Loosen nuts **1** and **2** .
— Turn support **B** counterclockwise.
— Introduce tool **A** into the injection pump housing so that pawl **3** matches with yoke **4**. The injection pump control lever **D** is thus in full delivery position.
— Turn support **B** clockwise until the end of lever **D** closes the mobile bell of speed governor **C** in position **5** .
— Tighten nuts **1** and **2**; at the end of this operation tool **A** should start moving.


109

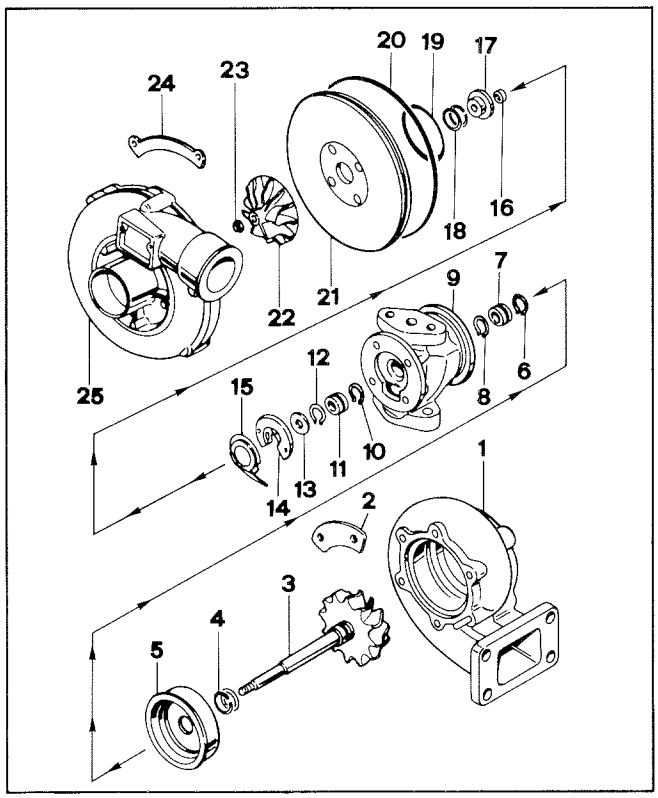
Turbocharger

Warning notes for operation:

Avoid full loading at start-up-allow engine to warm-up.
After a prolonged phase of full-load operation it is recommmended to let the engine idle in no-load conditions before it is shut off.

Warning notes for maintenance:

The turbocharger requires no special maintenance. Yet, certain precautions should be taken when performing maintenance operations on the engine (ex.: setting valve clearance).
Remove the turbocharger connecting piping, clean carefully before refitting. Before refitting the turbocharger to the engine pour clean engine oil into the bearing housing.

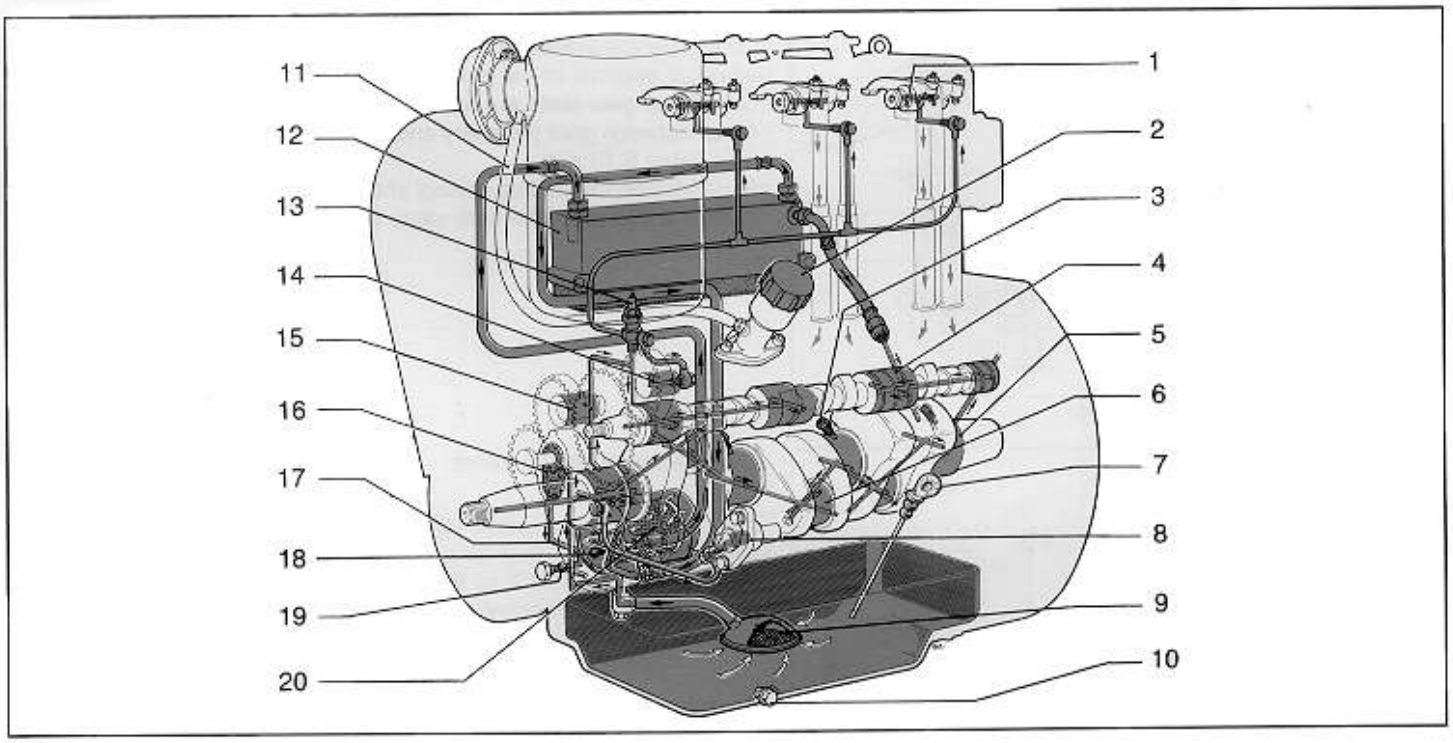


110

Turbocharger components:

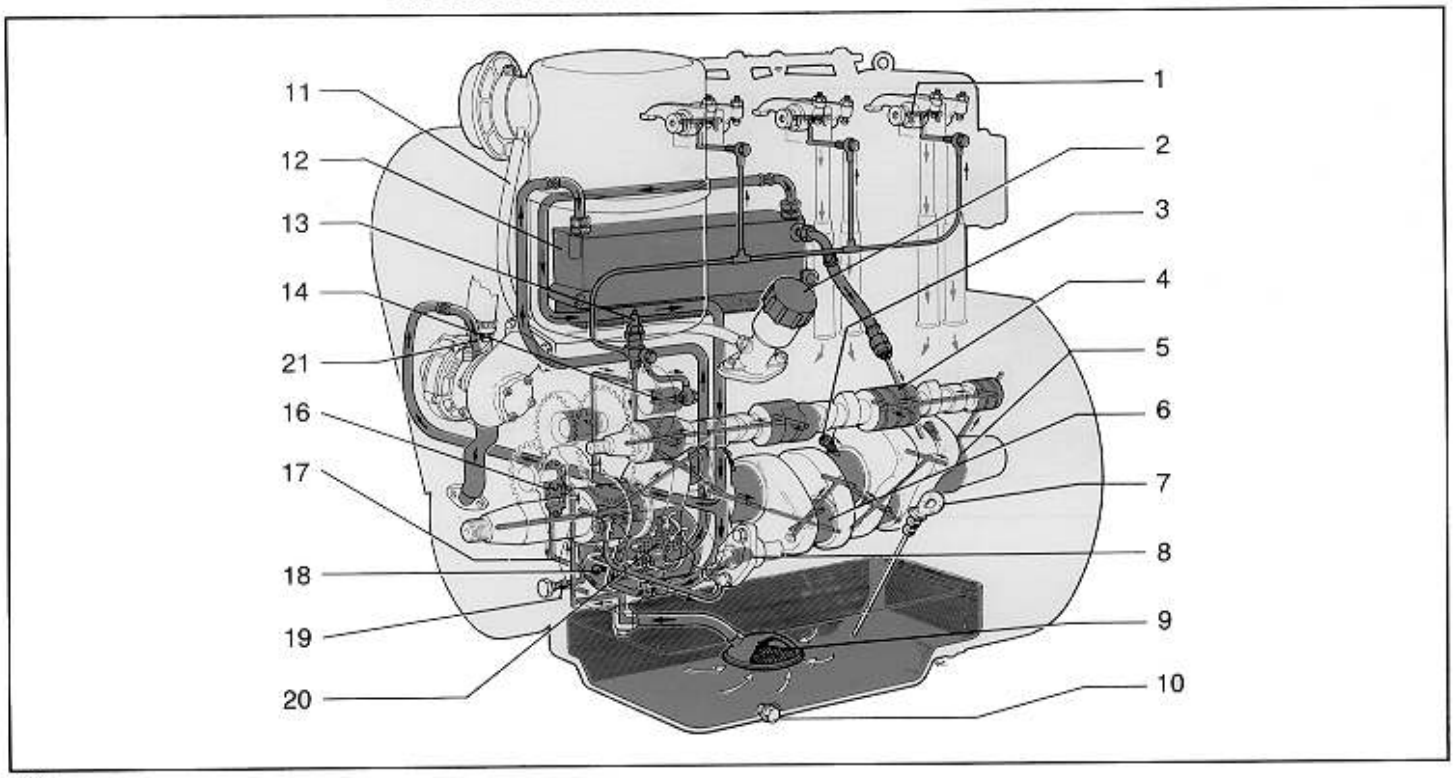
1 Turbine casing
2 Spring ring on turbine side
3 Rotor
4 Spring rings
5 Heat guard
6 Circlip
7 Bearing
8 Circlip
9 Bearing support
10 Circlip
11 Bearing
12 Circlip
13 Thrust washer
14 Axial bearing
15 Oil baffle
16 Spacer
17 Seal bushing
18 Spring rings
19 O-ring seal
20 O-ring seal
21 Center plate
22 Turbocharger impeller
23 Shaft nut
24 Spring ring on turbocharger side
25 Turbocharger casing

LUBRICATION SYSTEM LAYOUT FOR 5LD825-3, 5LD930-3



111

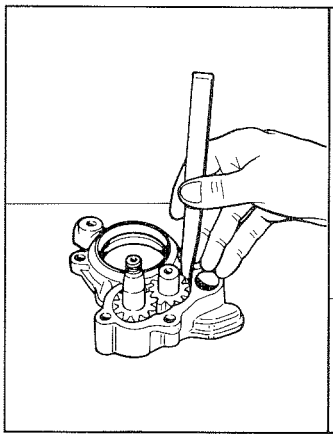
LUBRICATION SYSTEM LAYOUT FOR 5LD825-3/T



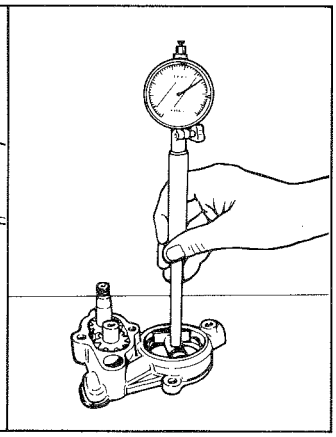
112

Components:

1) Rocker arm journal - 2) Oil fill cap - 3) Nozzle - 4) Camshaft journal - 5) Crankshaft journal - 6) Rod journal - 7) Oil dipstick - 8) Speed governor shaft - 9) Oil pick-up - 10) Drain plug - 11) Breather pipe - 12) Oil cooler - 13) Pressure switch - 14) Hydraulic pump support shaft - 15) Idler gear shaft - 16) Oil pump - 17) Pump delivery side - 18) By-pass valve - 19) Pressure relief valve - 20) Filter - 21) Turbocharger inlet.



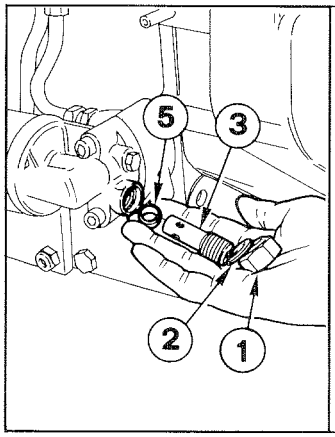
113



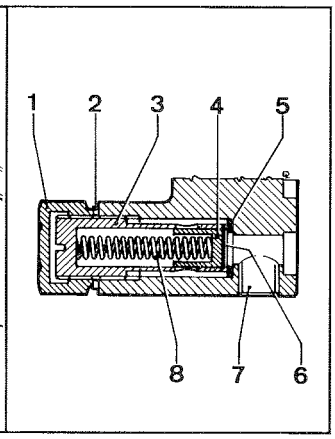
114

Oil pump

Includes the crankshaft collar; see fig. 83 for collar inside diameter.
Oil pumps are available in two versions: one for 5LD825-2 and one for all other engines of the series.
Check that gear teeth are not cracked, chipped or pitted and that clearance between gear periphery and pump body is 0.041 ÷ 0.053 mm with limit value 0.10 mm.
Furthermore, check that control shaft is free to rotate with end float of 0.040 ÷ 0.090 mm with limit value of 0.170 mm.



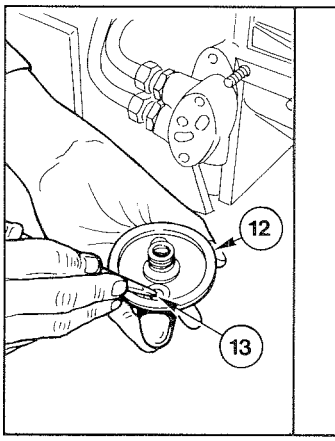
115



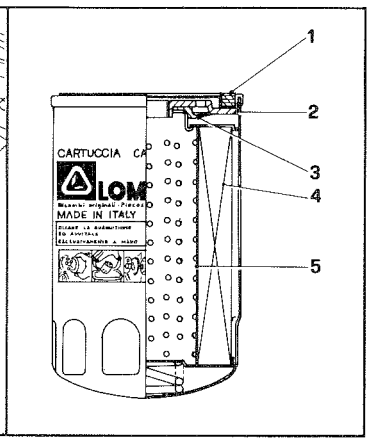
116

Oil pressure relief valve

Components:
1) Cap - **2)** Copper gasket - **3)** Adjustment - **4)** Piston - **5)** Rubber gasket - **6)** Ring - **7)** Hole for pressure switch connection - **8)** Spring
When refitting screw **3** so that it touches gasket **5** .
Do not tighten excessively since gasket **5** might break causing an oil pressure drop in the system.



117



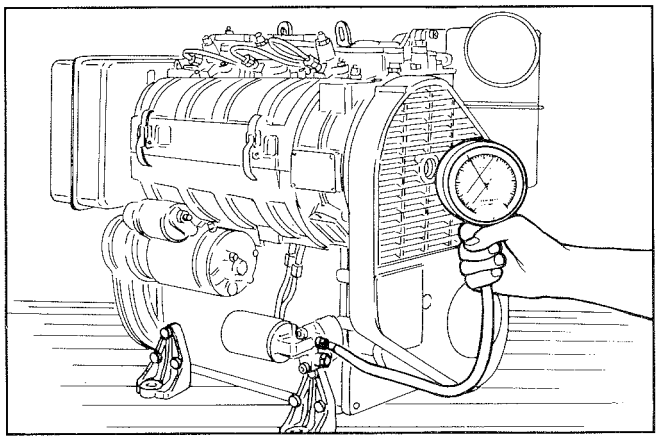
118

Oil filter

1 Gasket
2 Plate
3 Check valve
4 Baffle
5 Filtering element

Cartridge characteristics:
Filtering rate: 2 μm
Filtering area: 1830 cm²

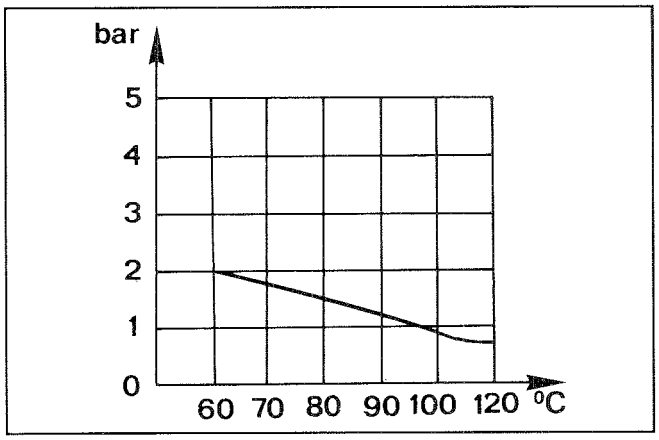
Clean by-pass valve **13**, blow with compressed air and check sealing properties.



119

Oil pressure check

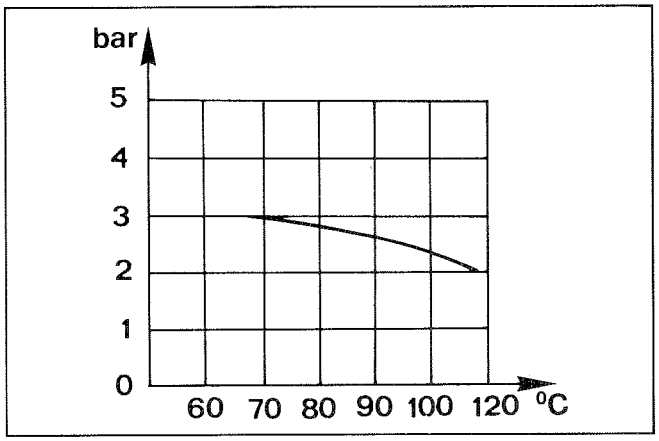
Fill with oil and fuel; connect a 10 bar pressure gauge to the oil filter fitting.
Start the engine and check pressure as a function of the oil temperature.



120

Oil pressure curve at idling speed

The curve is obtained at the oil filter with constant engine speed of 1200 r.p.m. in no-load conditions.
Pressure is given in bar and temperature in centigrades.
The curve represents the pressure min. value while its max. value is 5 bar.

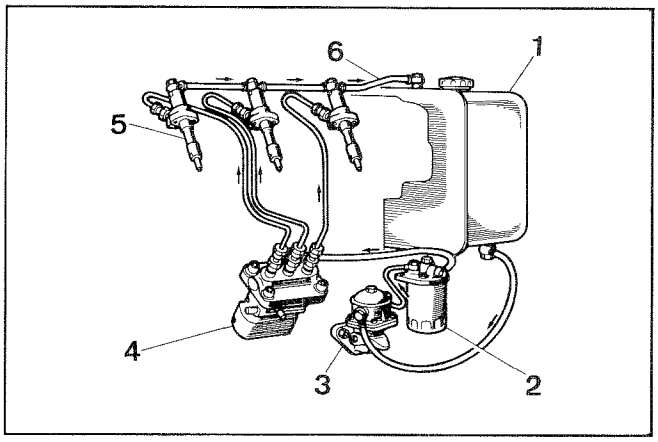


121

Oil pressure curve at full speed

The curve is obtained at the oil filter with engine operating at 3000 r.p.m. at the **N** power. Pressure is given in bar and temperature in centrigrades.
The curve represents the pressure min. value while its max. value is 5 bar.

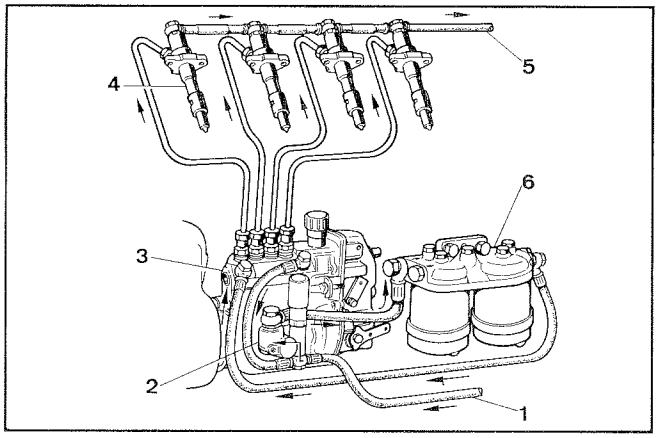
Note: After engine running-in the lube oil max. temperature should be lower than the sum of room temperature plus 95°C.



122

Fuel feeding/injection system for 5LD825-3, 5LD825-3/T, 5LD930-3

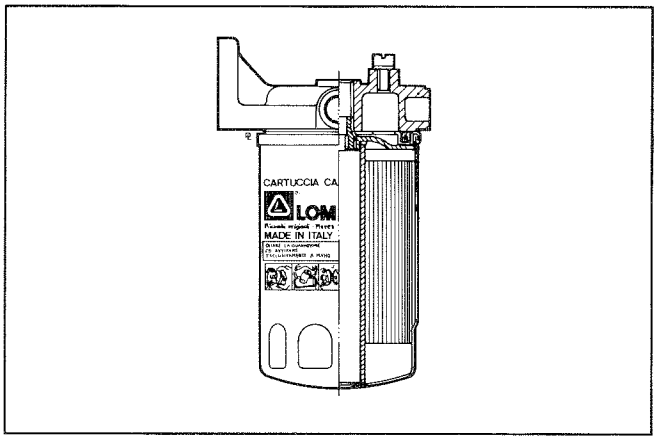
Components:
1 Tank
2 Filter
3 Fuel feeding pump
4 Injection pump
5 Injector
6 Injector leakoff line



123

Fuel feeding/injection system for 5LD825-4 and 5LD930-4

Components:
1 Tank connection hose
2 Fuel feeding pump
3 Injection pump
4 Injector
5 Injector leakoff line
6 Filter



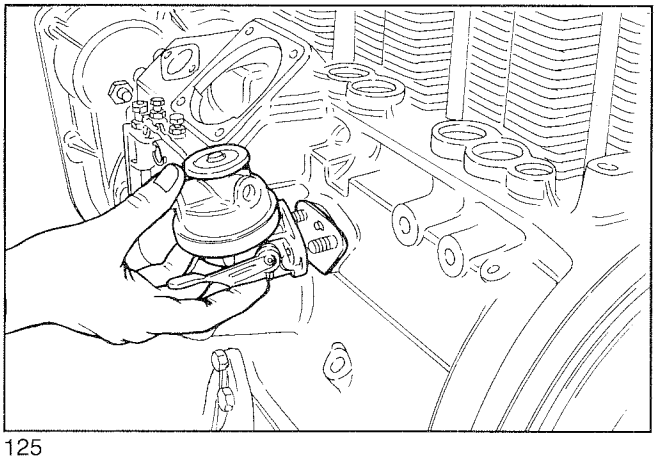
124

Fuel filter

For 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD930-3

Cartridge characteristics:

Filtering area:	5000 cm²
Filtering rate:	2 ÷ 3 µm
Max. working pressure:	4 bar



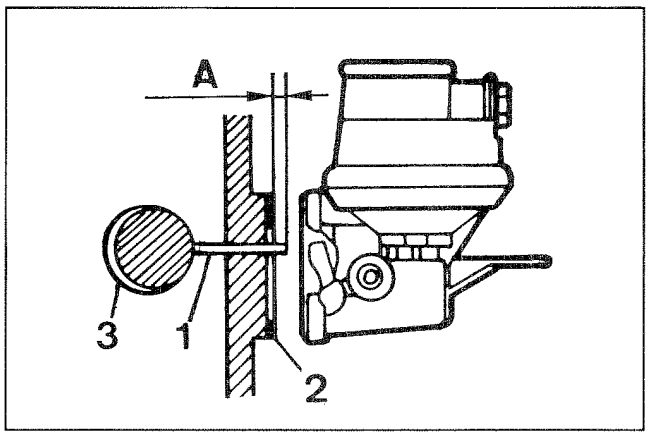
125

Fuel feeding pump

The fuel feeding pump is of the diaphragm type operated by a camshaft eccentric through a drive rod. It features an external lever for manual operation.

Characteristics: when the engine control eccentric rotates at 1500 r.p.m. minimum delivery is 64 l/h while self-regulation pressure is 0.4 ÷ 0.5 bar.

Note: In engines type 5LD825-4 and 5LD930-4 the fuel feeding pump is built in the injection pump.

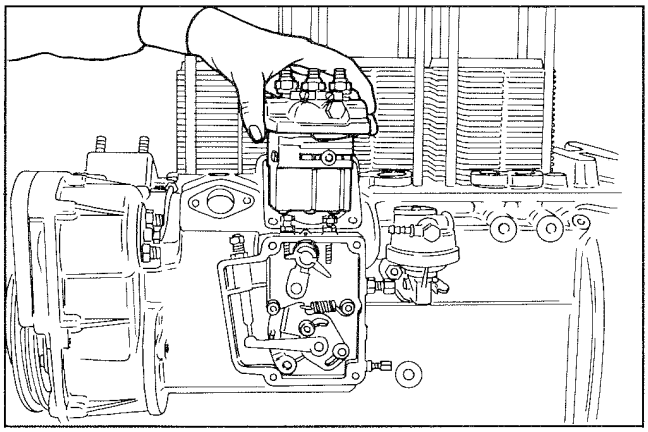


126

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; 1.00 mm.
Drive rod length is 38.95 ÷ 39.05 mm.

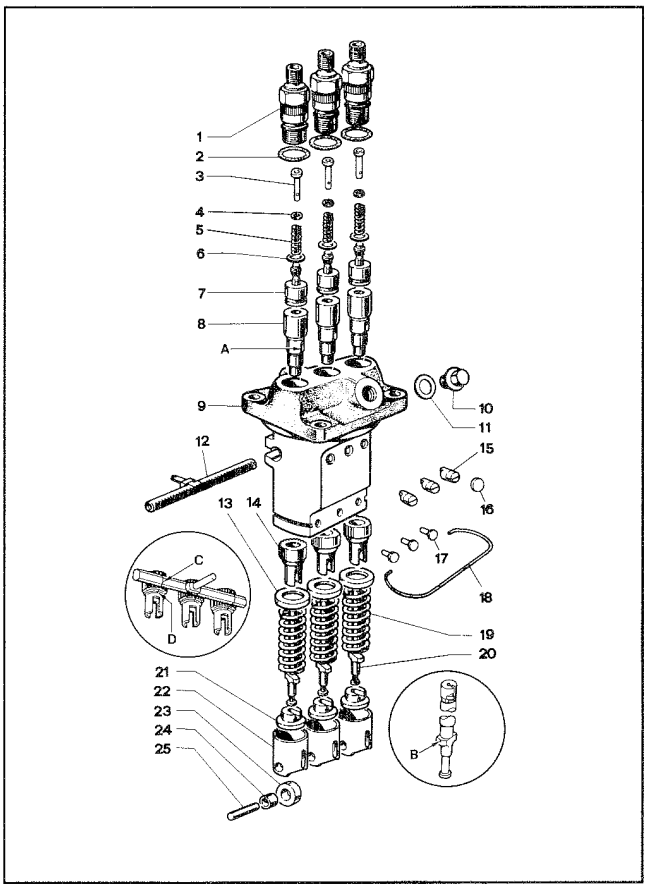
Note: This operation must be carried out when drive rod **1** is not on camshaft eccentric **3**, as shown in the figure.



127

Injection pump for 5LD825-3

In engines type 5LD825-2 the injection pump is of the same type but features one plunger less.
In engines type 5LD825-3/T and 5LD930-3 the injection pump is of the same type but features plungers of different diameter size, see fig. 130 and 131.
For engines type 5LD825-4 and 5LD930-4 see page 48 or 49.



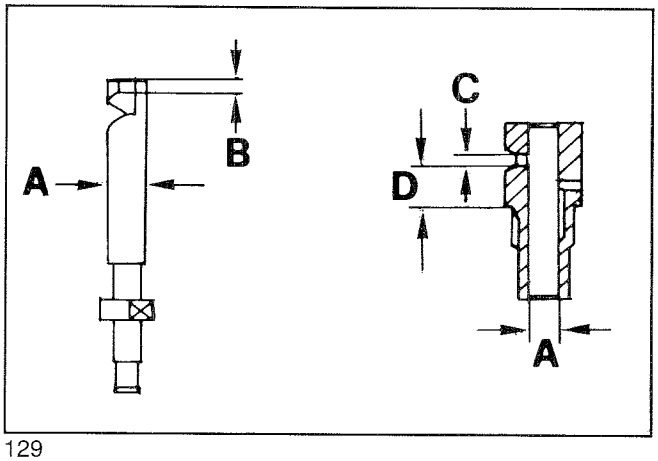
128

Injection pump components

1 Delivery union
2 O-ring seal
3 Filler
4 Shim
5 Spring
6 Gasket
7 Delivery valve
8 Barrel
9 Case
10 Plug
11 Gasket
12 Rack rod
13 Spring cup
14 Sector gear
15 Eccentric
16 Plugnut
17 Stop pin
18 Retainer
19 Spring
20 Plunger
21 Spring retainer
22 Tappet
23 Roller
24 Bushing
25 Roller pin

Reassembly

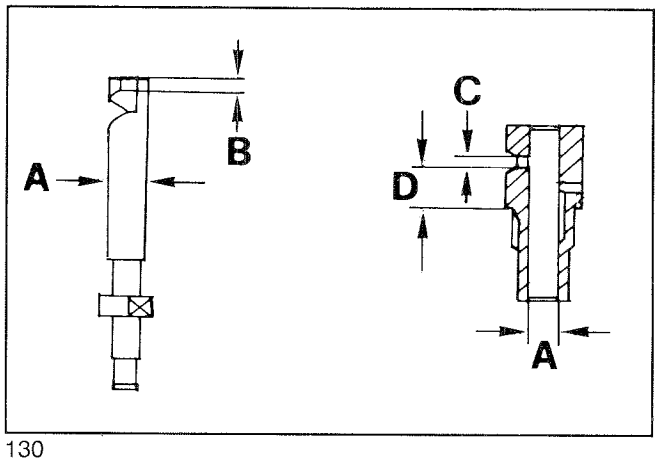
Fit eccentrics **15**, then cylinders **8** so that groove **A** matches with the corresponding eccentric; continue fitting in reverse numerical order starting from delivery valve **7** . Place rack rod **12** at its mid-stroke, then fit sector gear **14** in such a way that mark **D** on each sector gear matches with **C** on the rack rod.
Continue reassembly: when plunger **20** is inserted, mark **B** should be located on the side of eccentric **15**. Follow the same procedure for the remaining plungers. Once reassembly is completed tighten delivery unions **1** to 40 Nm and equalize plunger delivery on a test bench by adjusting eccentrics **15**.



129

Barrel and plunger for 5LD825-2

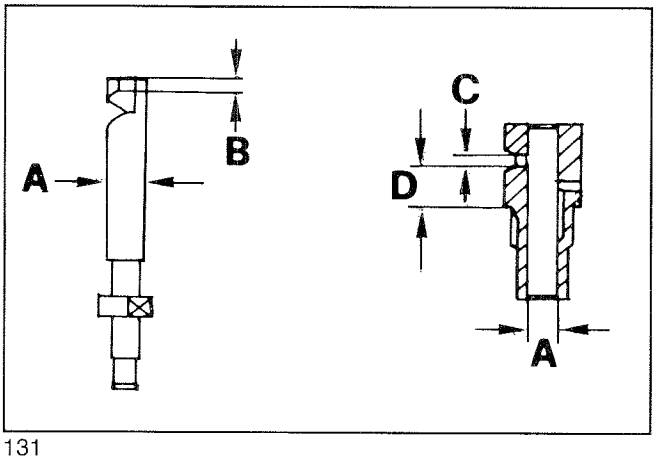
Dimensions (mm)
A = 7.000 (nominal diameter)
B = 2.250 ÷ 2.550
C = 3.000
D = 7.225 ÷ 7.275



130

Barrel and plunger for 5LD825-3

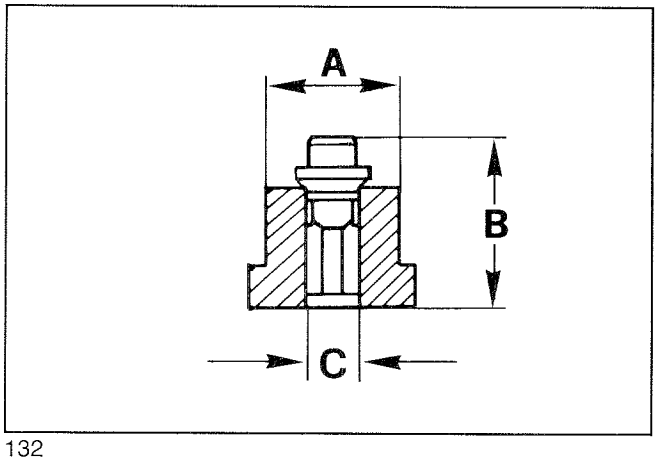
Dimensions (mm)
A = 7.500 (nominal diameter)
B = 2.250 ÷ 2.550
C = 3.000
D = 7.225 ÷ 7.275



131

Barrel and plunger for 5LD930-3, 5LD825-3/T

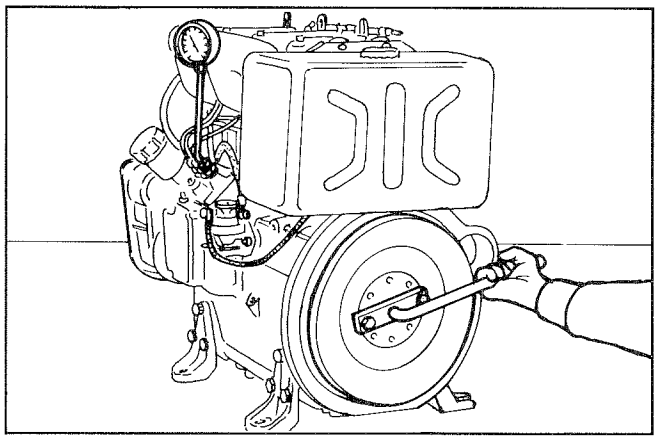
Dimensions (mm)
A = 8.000 (nominal diameter)
B = 2.800 ÷ 3.000
C = 3.500
D = 7.225 ÷ 7.275



132

Injection pump delivery valve (same for all engines of the series)

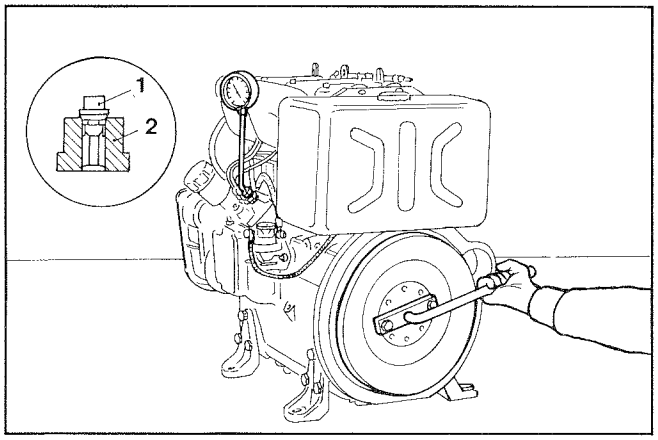
Dimensions (mm)
A = 12.80
B = 16.20
C = 5.00
The volume displaced by the delivery valve is 25 mm^3.



133

Checking barrel and plunger for internal leakage

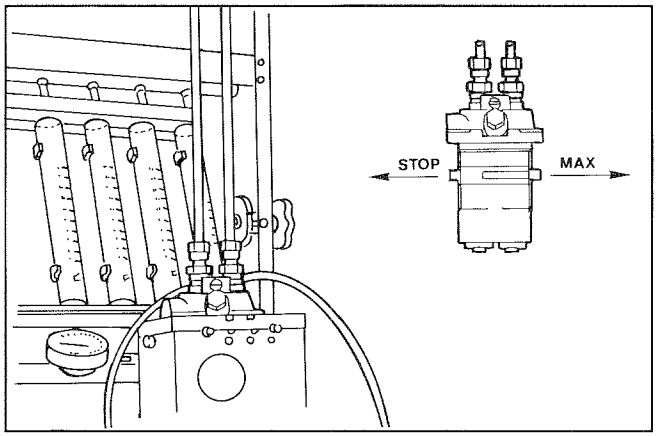
This operation is for trouble shooting only since pressure changes depend on the pumping speed.
Connect the delivery union with a 600 bar pressure gauge with safety valve.
Adjust rack at half-stroke. Turn flywheel in normal direction of rotation so that the plunger puts the circuits under pressure.
Replace plunger if the displayed pressure is below 300 bar.
Repeat the same operation for all plungers.



134

Checking injection pump delivery valve sealing

Components:
1 Valve
2 Seat
Adjust pump rack at half-stroke.
Turn flywheel in normal direction of rotation so that the plunger puts the circuit under pressure.
During this operation the displayed pressure will gradually reach a peak followed by a sudden drop which corresponds to valve closing.
Pressure drop should be 30 ÷ 50 bar. Replace tha valve if pressure drop is below this value. Repeat the same operation for all plungers.
Tighten delivery union to 35 ÷ 40 Nm.



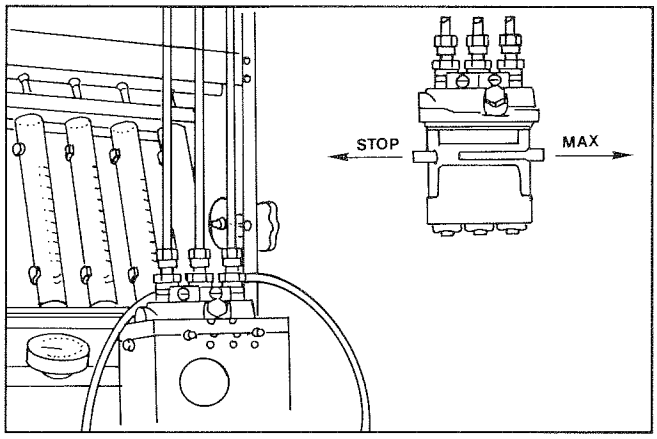
135

Injection pump delivery testing for 5LD825-2 - Pump type Lombardini/Omap and Lombardini/Stanadyne

Test data

Control rod max. force	Rod stroke from max. delivery	Camshaft r.p.m.	Delivery	Max. plunger difference
Newton	mm	r.p.m.	mm³/stroke	mm³/stroke
0,50	10	1500	27 ÷ 37	4
	0	150	75 ÷ 90	*
	*	500	10	4

* Neglectable value.



136

Injection pump delivery testing for 5LD825-3 - Pump type Lombardini/Omap and Lombardini/Stanadyne

Test data

Control rod max. force	Rod stroke from max. delivery	Camshaft r.p.m.	Delivery	Max. plunger difference
Newton	mm	r.p.m.	mm³/stroke	mm³/stroke
0,60	10	1500	40 ÷ 55	5
	0	150	100 ÷ 120	*
	*	500	10	5

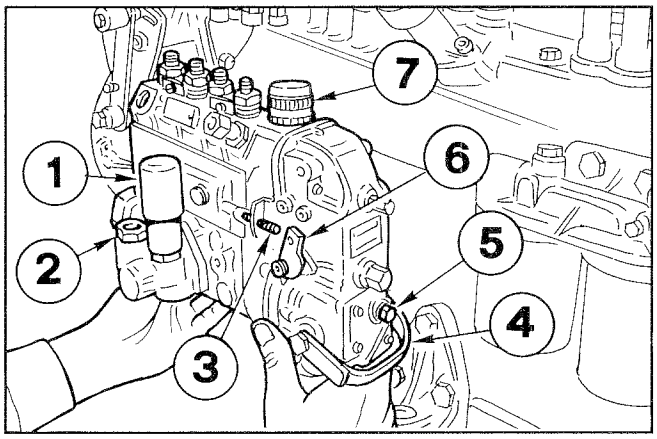
* Neglectable value.

Injection pump deliveri testing for 5LD825-3/T, 5LD930-3 - Pump type Lombardini/Omap and Lombardini/Stanadyne

Test data

Control rod max. force	Rod stroke from max. delivery	Camshaft r.p.m.	Delivery	Max. plunger difference
Newton	mm	r.p.m.	mm³/stroke	mm³/stroke
0,60	10	1300	60 ÷ 80	6
	0	150	135 ÷ 170	*
	*	500	10	6

* Neglectable value



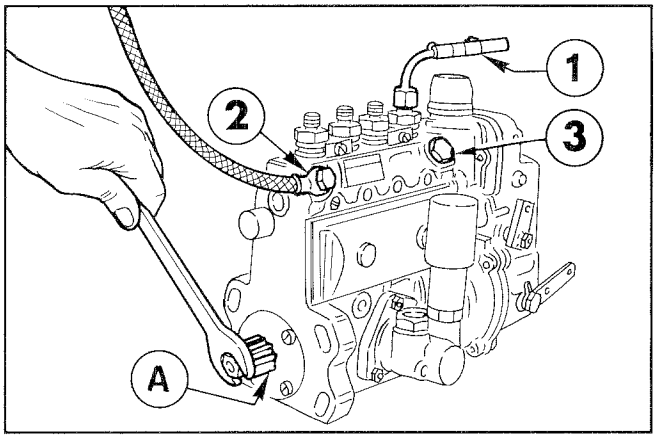
137

Injection pump for 5LD825-4, 5LD930-4 - Pump type Bosch PES

Includes injection pump camshaft, speed governor and feeding pump. Two versions are available: one for engines set at 2600 r.p.m. and one for engines set at 1500 r.p.m.

Components:
1 Fuel feeding pump
2 Fuel feeding pump connection
3 Max. speed setscrew
4 Stop lever
5 Oil plug
6 Control lever
7 Oil fill plug

Note: Contact the Bosch service organization for overhaul.

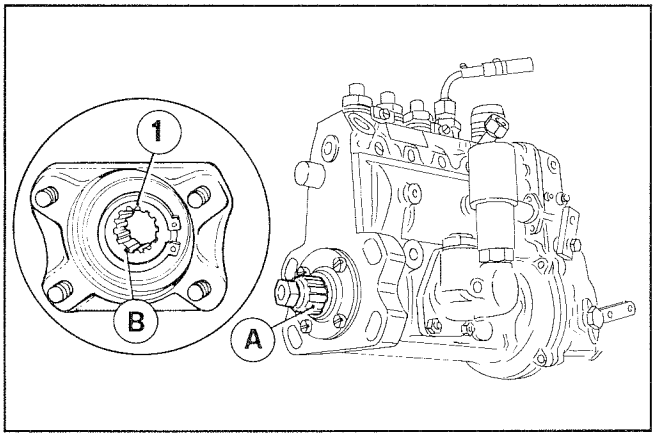


138

Injection pump preparation for reassembly to the engine - Pump type Bosch PES

If the injection pump is removed from the engine, it should be timed with the engine, at replacement.

— Fit testing device **1** to the delivery union which connects the first cylinder (on the flywheel side).
— Connect union **2** with a hose and a tank; temporarily close hole **3** with a plug and feed the pump with Diesel oil.
— Turn the injection pump camshaft counterclockwise and stop as soon as Diesel begins to flow out of the testing device; check that groove **A** is in the same position as shown in the figure.

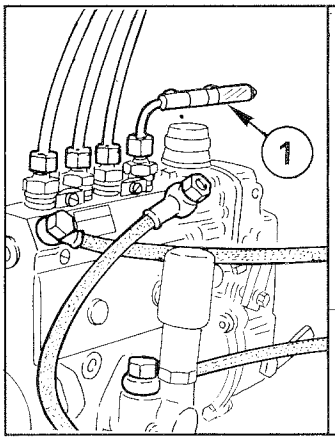


139

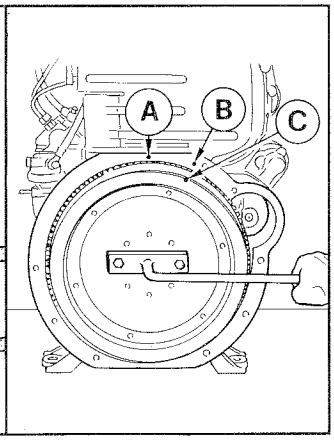
Injection pump reassembly to the engine - Pump type Bosch PES

Before fitting the pump to the engine make sure that the injection timing reference marks of the first cylinder on the flywheel coincide. See fig. 141 (**C** matches with **B** during 1st cylinder compression). The pump hub should fit to sleeve **1** making sure that groove **A** engages with tooth **B**.

Fix the pump to the engine and connect feed piping.



140



141

Static injection timing

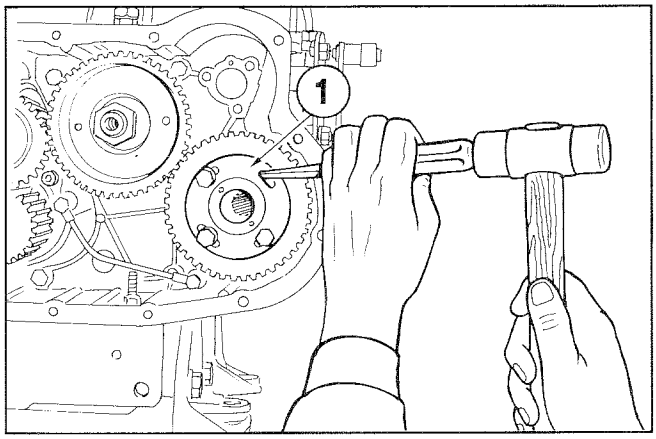
Fill tank checking that the fuel level is at least 10 cm. above testing device **1**, otherwise operate the fuel feeding pump.

Accelerate injection pump. Turn flywheel according to the engine direction of rotation (counterclockwise) and check that fuel reaches the testing device.

Repeat this operation: during the 1st cylinder compression stroke operate slowly and stop immediately after seeing the fuel move through the testing device hole; bring flywheel back 5 mm: this is the statil injection timing.

If **C** coincides with **B** timing is perfect, otherwise see below.

Note: For flywheel and pulley injection timing values see fig. 145 and 146.



142

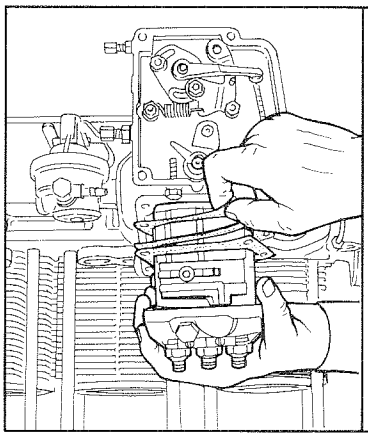
Injection timing corrections with injection pump type Bosch PES

Flange 1 of the splined sleeve features four slotted holes. Injection timing can be corrected by loosening the four bolts.

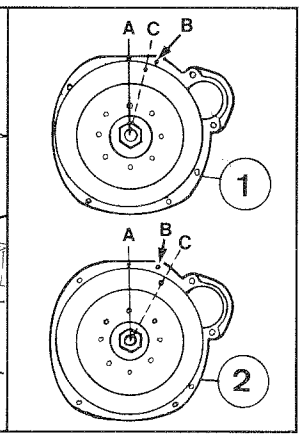
Injection is advanced by rotating the flange counterclockwise and delayed by rotating the flange clockwise.

Minor corrections can be obtained also by rotating the pump: loosen the four nuts which fix it to the engine and also the Diesel fuel pipe unions.

Injection is advanced by rotating the pump counterclockwise and delayed by rotating the flange clockwise.



143



144

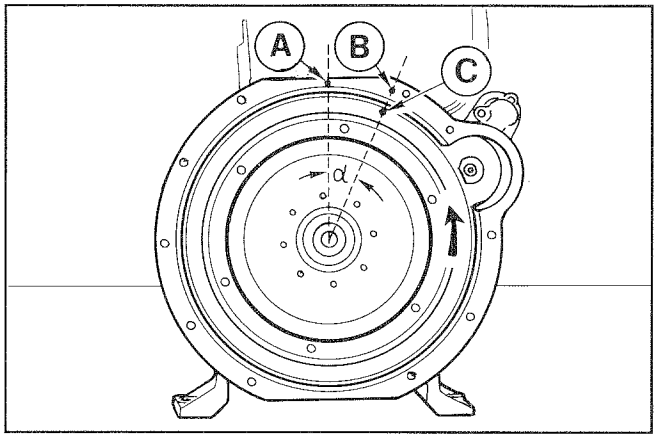
Static injection timing correction for 5LD825-2, 5LD825-3, 5LD825-3/T, 5LD930-3

If reference mark **C** does not match with **B** follow examples **1** and **2** .

1 Example of late injection timing: remove shims under the pump to make **C** match with **B**.

2 Example of early injection timing: add shims under the pump to make **C** match with **B**.

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



145

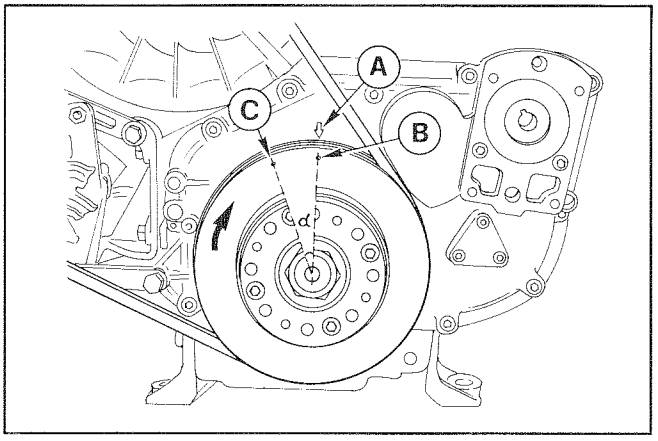
Static injection timing reference marks on crankcase and flywheel

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

Engine type	**(A ÷ B)** mm	α
5LD825-2 **5LD825-3** **5LD825-3/T** **5LD930-3**	63 ÷ 68.5	23° ÷ 25°
5LD825-4* **5LD930-4***	68.5 ÷ 74	25° ÷ 27°

Values given in mm have been reported at the periphery of a flywheel with dia. 314 mm.

* For engine settings from 1500 to 2300 r.p.m. injection timing on the flywheel is 60.5 ÷ 66 mm (22° ÷ 24°)



146

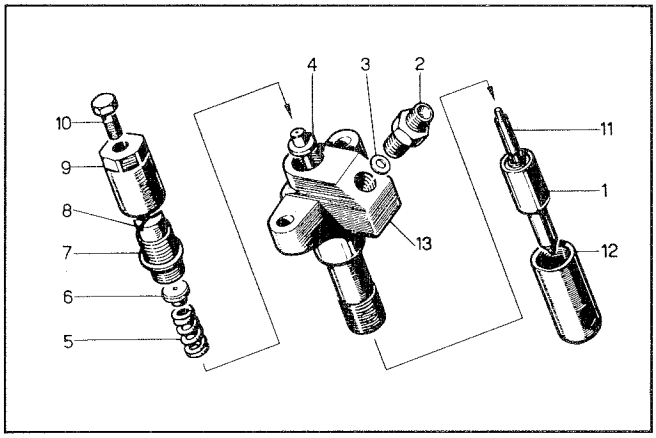
Injection timing reference marks on the pulley and the gear cover

A = Gear cover reference arrow at top dead center.
B = Piston reference mark in injection position
C = Piston reference mark: when it matches with **A** it is at top dead center
α = Reference angle in degrees

Engine type	**(A ÷ C)** mm	α
5LD825-2 **5LD825-3** **5LD825-3/T** **5LD930-3**	38.7 ÷ 42.1	23° ÷ 25°
5LD825-4* **5LD930-4***	42.1 ÷ 45.5	25° ÷ 27°

Values given in mm have been reported at the periphery of a pulley with dia. 193 mm.

* For engine settings from 1500 to 2300 r.p.m. injection timing on the flywheel is 37 ÷ 40 mm (22° ÷ 24°)

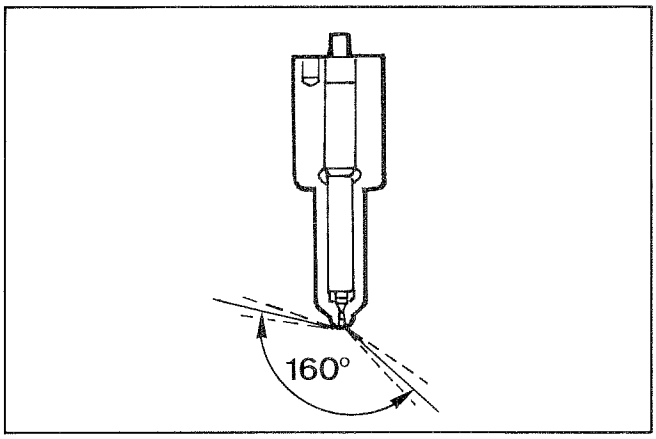


147

Injector

Components:

1 Nozzle
2 Inlet fitting
3 Gasket
4 Pressure rod
5 Spring
6 Spring seat
7 Gasket
8 Calibration union
9 Cap
10 Leakoff line
11 Needle
12 Cup
13 Nozzle holder



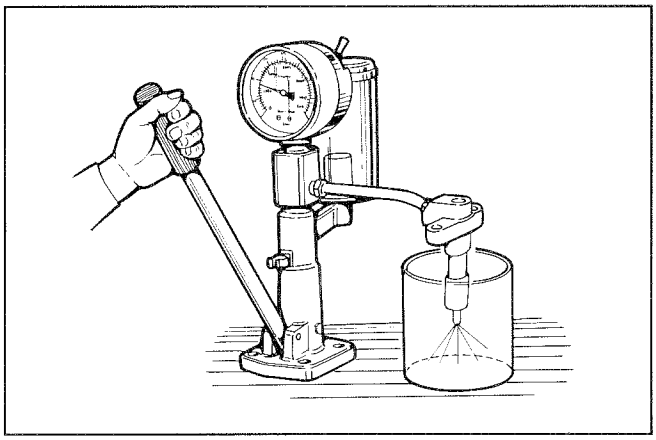
148

Nozzle

Features:

Hole number and diameter = 4x0.28 mm
Spray angles = 160°
Needle valve elevation = 0.20 ÷ 0.22 mm
Hole length = 0.6 mm
Sump dia. and length = 1.2x1.97 mm

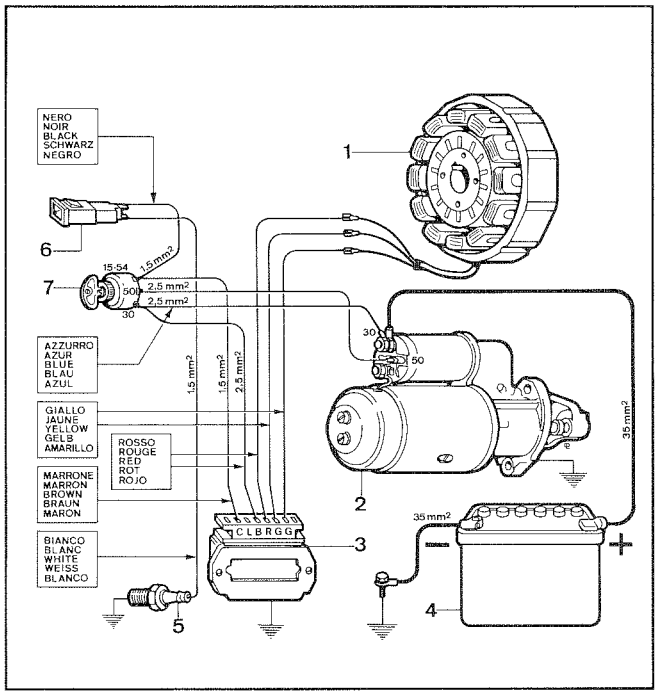
Clean nozzle tip with a brass brush.
Check that holes are not obstructed using a mandrel with steel wire with 0.28 mm dia.
When refitting tighten ring nut to 7 kgm.



149

Injection setting

Connect injector to a hand pump and check that setting pressure is 210 ÷ 220 bar; make the required adjustments, if any, by changing spring tension via union **8**, see fig. 147.
When replacing the spring, setting should be performed at a 10 bar greater pressure (220 ÷ 230 bars) 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.

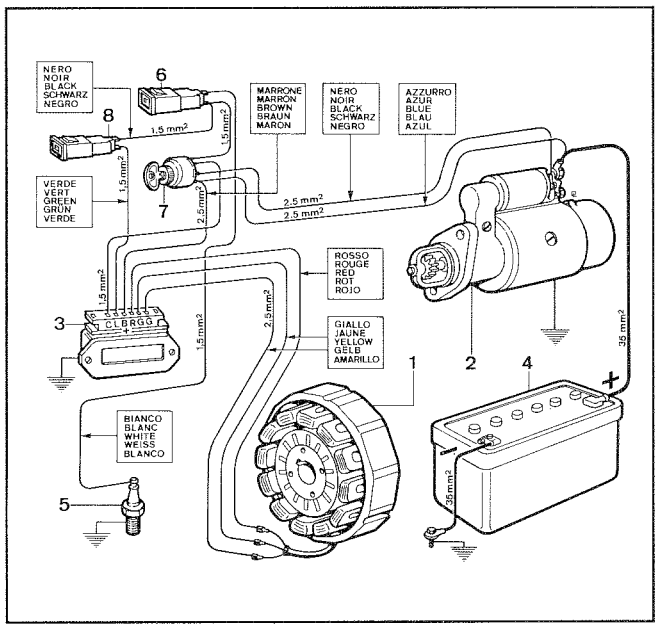


150

ELECTRIC SYSTEM

Electrical starting layout without battery charging light

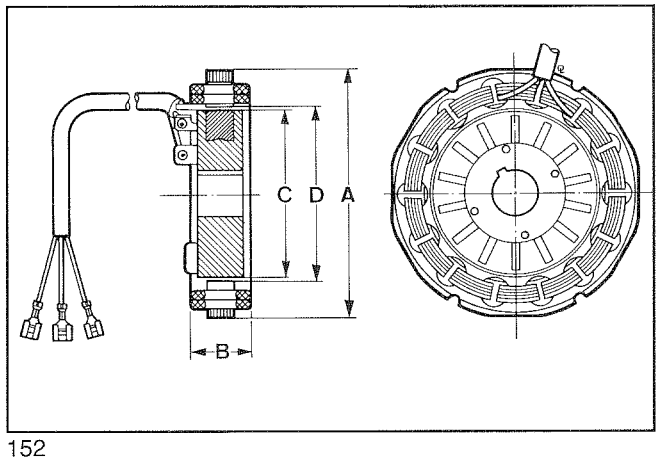
Components:
1 Alternator
2 Starting motor
3 Voltage regulator
4 Battery
5 Pressure switch
6 Oil pressure warning light
7 Key switch



151

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



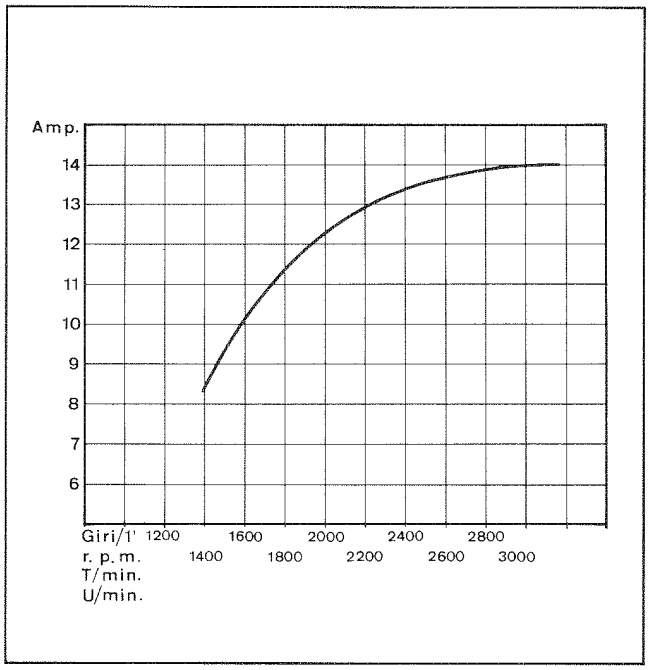
152

12.5 V, 14 A Alternator

Features a fixed armature winding housed in the blower housing. The rotating permanent magnet inductor is located on the fan spindle.

Dimensions (mm):
A = 111.701 ÷ 111.788
B = 31.000 ÷ 33.500
C = 76.226 ÷ 76.300
D = 77.400 ÷ 77.474

Note: Clearance between armature winding and inductor (air gap) should be 0.55 ÷ 0.63 mm.

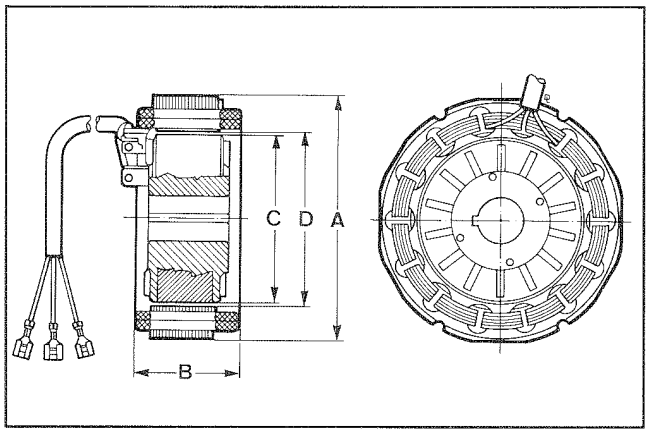


153

Alternator battery charging curve (12.5 V, 14 A)

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

Note: The r.p.m. shown in the table refers to the engine crankshaft.



154

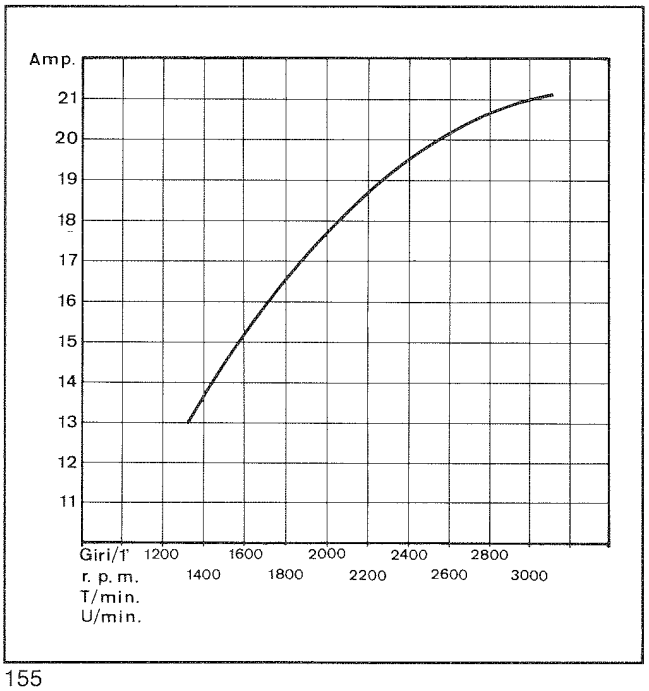
12 V, 21 A Alternator

Features a fixed armature winding housed in the blower housing. The rotating permanent magnet inductor is located on the fan spindle.

Diameter size mm.

A = 111.701 ÷ 111.788
B = 49.500 ÷ 52.000
C = 76.226 ÷ 76.300
D = 77.400 ÷ 77.474

Note: Clearance between armature winding and inductor (air gap) should be 0.47 ÷ 0.63 mm.

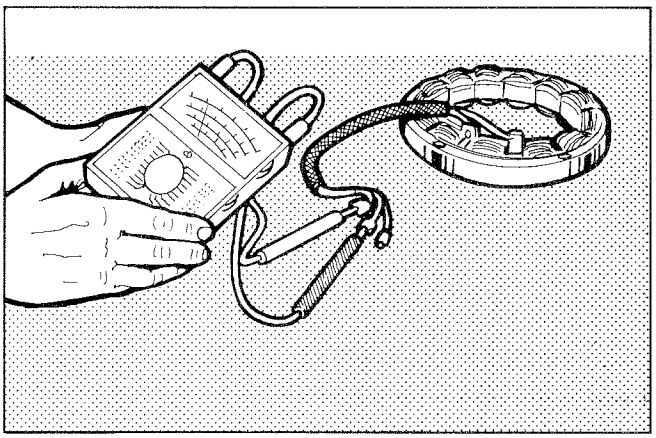


155

Alternator battery charger curve (12 V, 21 A)

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

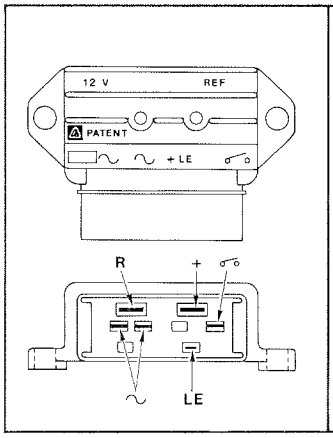
Note: The r.p.m. shown in the table refers to the engine crankshaft.



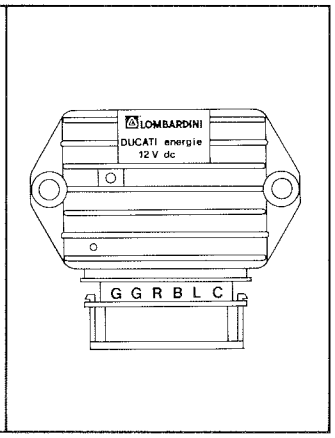
156

Checking for cable continuity

Check that stator windings have no unsoldered connection, burnt areas or grounded wires.
Using an ohmmeter check for continuity between the red cable and the two yellow ones.
Furthermore, check that they are insulated from the ground.
This check can be performed with alternator fitted to the engine.



157

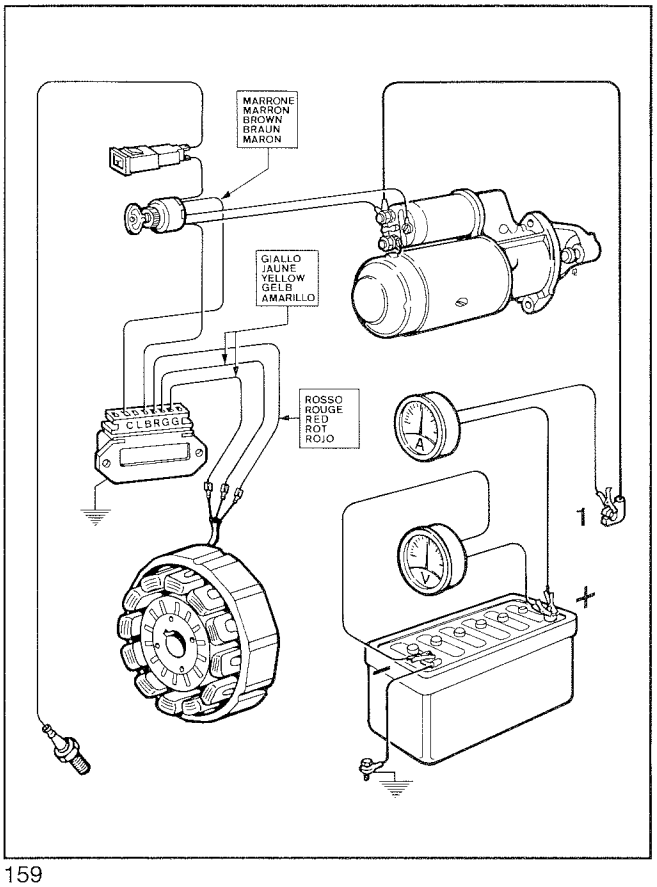


158

Voltage regulator

Type LOMBARDINI, supplied by AETSA SAPRISA, NICSA and DUCATI: Voltage is 12 V, maximum current 26 A.
May be used in systems with and without battery charger.
To avoid wrong connections 3 different tab sizes are supplied.

AETSA, SAPRISA NICSA	DUCATI	TAB SIZE mm	
		WIDTH	THICKNESS
~	G	6,35	0,8
R	R	9,50	1,2
+	B	9,50	1,2
LE	L	4,75	0,5
	C	6,35	0,8

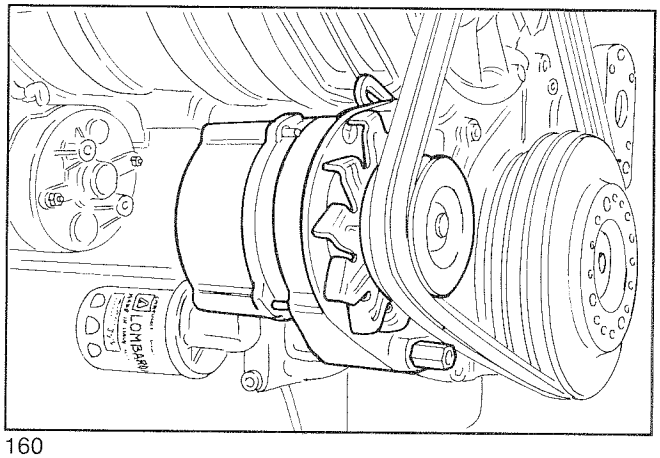


159

Checking 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 a d.c. ammeter between the positive pole and the corresponding cable 1 terminal.
The ammeter should be suitable for reading the required value (14A) and for withstanding the starting motor peak absorption (400 ÷ 450 A).
Start a couple of times until battery voltage drops below 13 V.
When battery voltage reaches 14.5V the ammeter current should drop 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 temperature above 75°C might damage it.
No electric welding on engine or application.

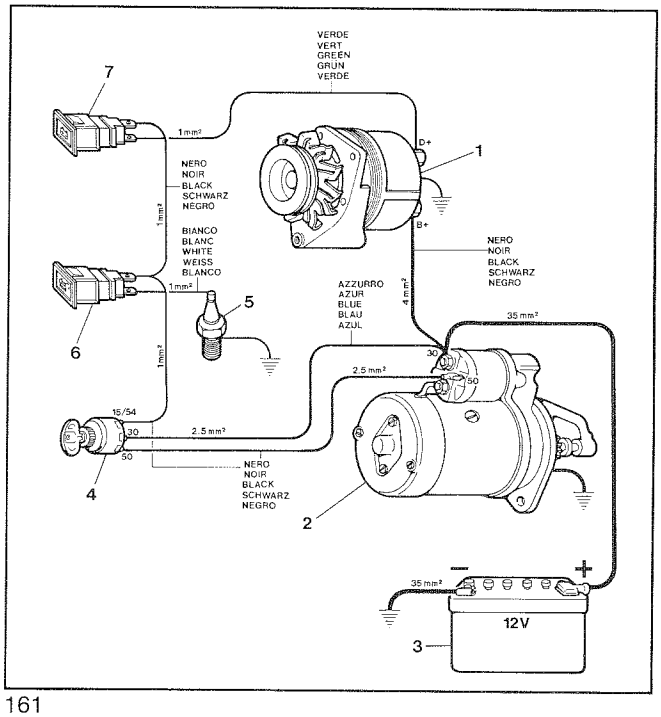


160

Alternator type Bosch G1, 14 V, 33 A (optional)

The alternator is of the claw-pole rotor type with built-in voltage regulator. The rotating motion is conveyed by the engine through a "V" - belt and sheave.

Features: 12V rated voltage. Max. current 33A at 7000 alternator r.p.m. RH direction of rotation.

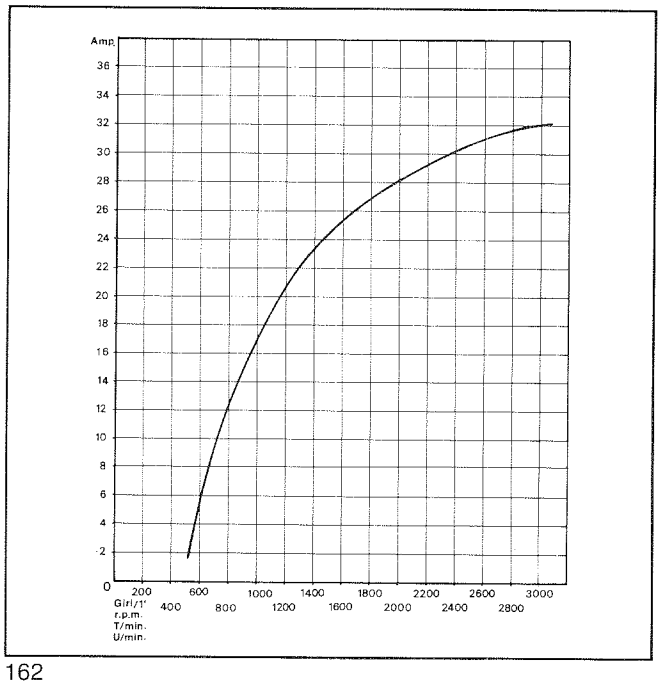


161

Alternator type Bosch G1, 14 V, 33 A layout

Components:

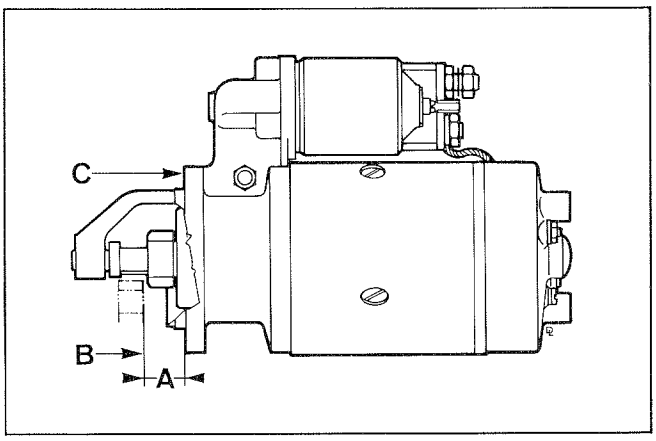
1 Alternator
2 Starting motor
3 Battery
4 Key switch
5 Pressure switch
6 Oil pressure warning light
7 Battery charging light



162

14V, 33A Bosch G1 alternator battery charger curve

The curve was obtained at room temperature of +25°C.
Battery terminal voltage is 12.5 V.
The r.p.m. shown on the table refers to the engine crankshaft.



163

STARTING MOTOR

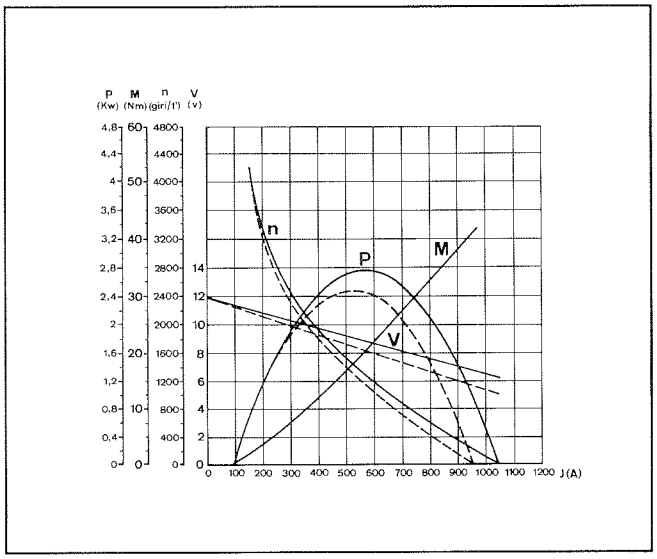
Bosch type JF (R) 12 V, class 2.5

RH direction of rotation

A = 23÷24 mm
B = Ring gear plane
C = Flange plane

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

Note: Contact **A** Bosch Service Center for any type of repair.

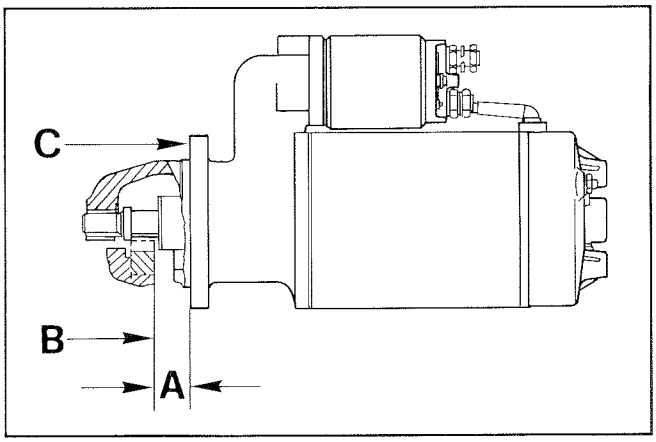


164

Characteristic curves for starting motor type Bosch JF (R) 12 V

Curves were obtained at room temperature of +20°C with 88 Ah batteries.

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



165

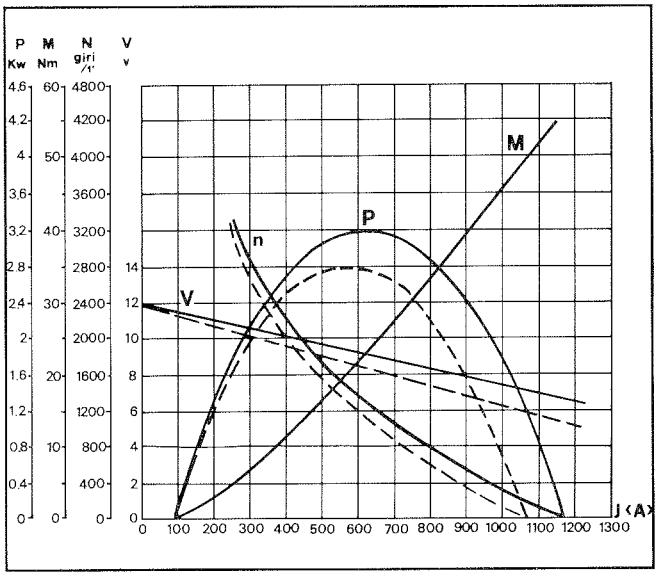
Bosch type JF 12 V, class 3

RH direction of rotation

A = 23÷25 mm
B = Ring gear plane
C = Flange plane

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

Note: Contact **A** Bosch Service Center for any type of repair.

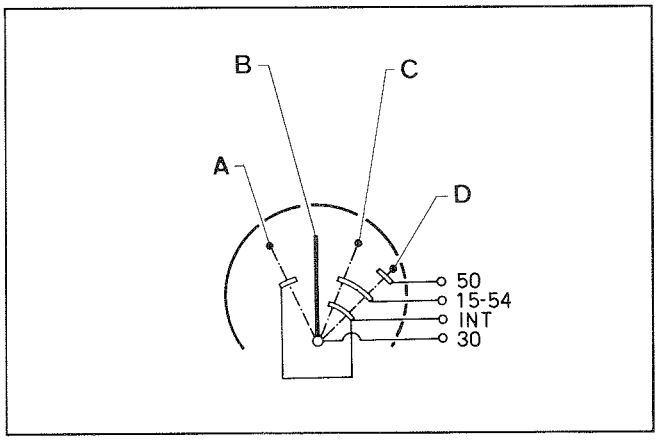


166

Characteristic curves for starting motor type Bosch JF class 3

Curves were obtained at room temperature of +20°C with 88 Ah batteries.

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.



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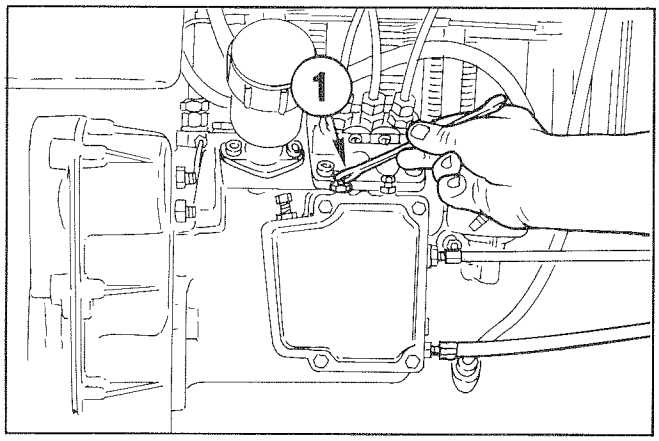
Key switch

A = Accessory
B = Stop
C = Run
D = Start



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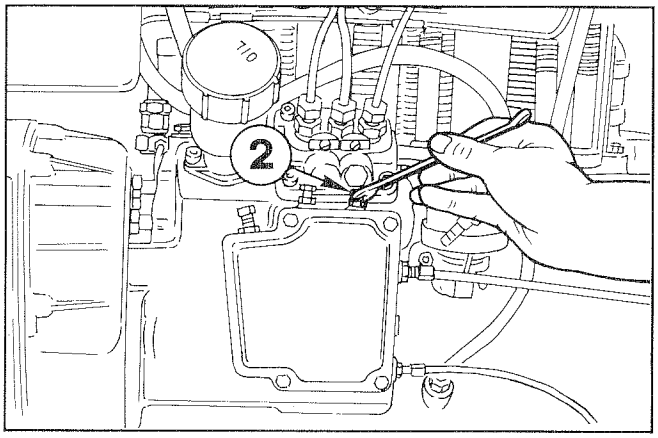
SETTINGS

1 Idling speed setting in no-load conditions (standard)

After filling with oil and fuel, start the engine and warm up for 10 minutes. By turning setscrew **1** adjust idling speed at 1000 ÷ 1200 r.p.m. for 5LD825-2; at 900 ÷ 1000 r.p.m. for 5LD825-3, 5LD825-3/T and 5LD930-3.



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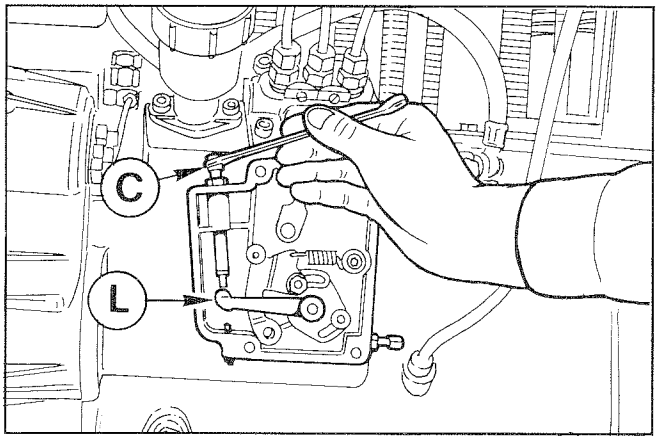
2 Full speed setting in no-load conditions (standard)

After setting idle speed turn screw **2** and set full speed in no-load conditions at 2780 r.p.m.; then tighten lock nut.

Note: When the engine reaches the pre-set power full speed stabilizes at 2600 r.p.m.



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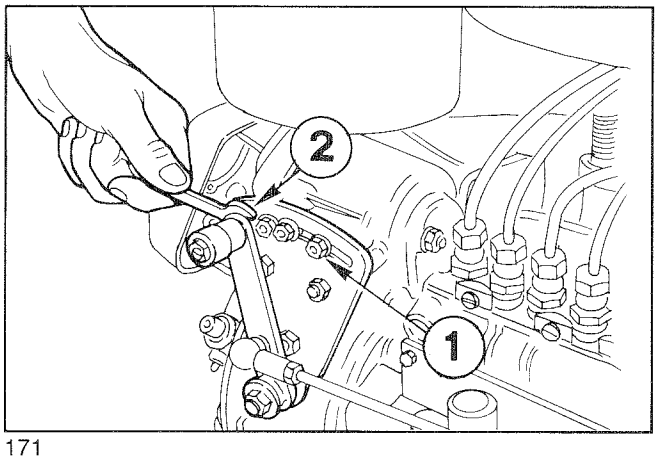
Injection pump delivery setting

This setting should be performed on a torque dynamometer. If not, setting is only approximate.
Loosen delivery limiting device **C** by **5** turns.
Bring engine to full speed in no-load conditions i.e. 2780 r.p.m. Tighten limiting device **C** until it slightly touches lever **L** .
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** .



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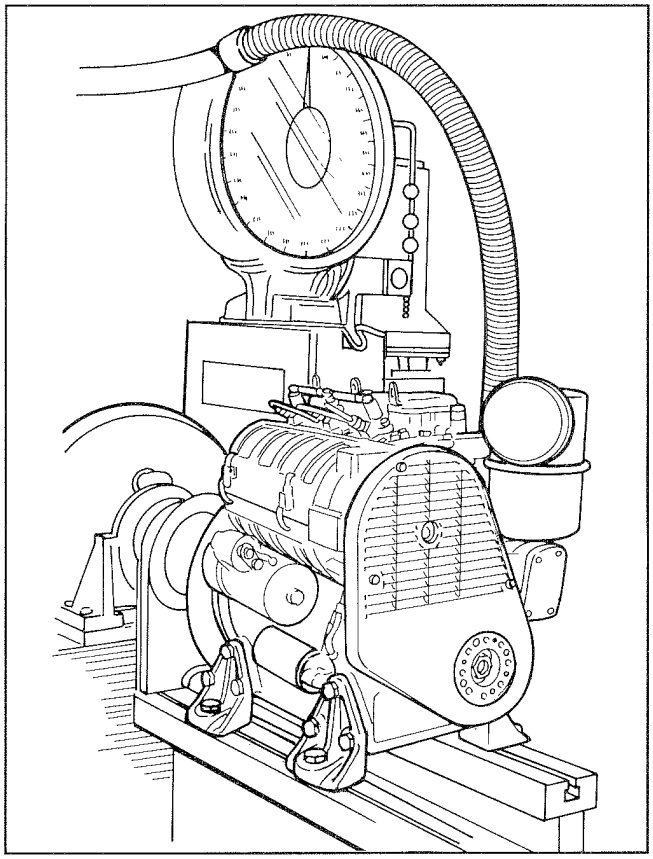
Standard idling and full speed setting for 5LD825-4 and 5LD930-4

Set idling speed in no-load conditions at 850 ÷ 950 r.p.m. by means of setscrew **1**.
Set full speed in no-load conditions at 2700 r.p.m. by means of screw **2**.



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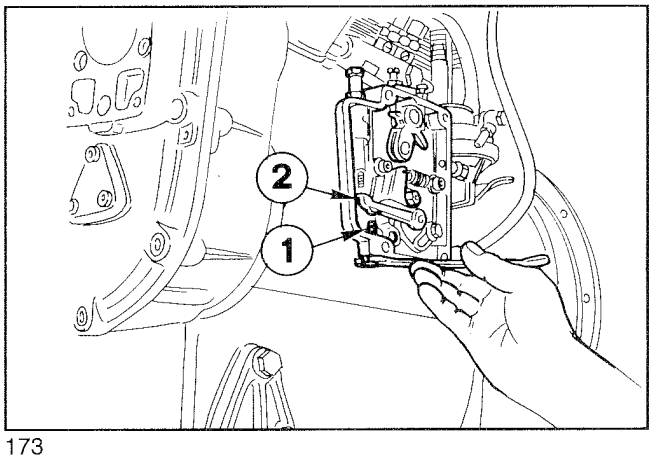
Injection pump delivery setting with engine on the torque dynamometer

1) Bring engine to idling speed
2) Unscrew delivery limiting **C** (see fig. 170)
3) Bring engine to the power and r.p.m. required by the manufacturer.
4) Check that fuel 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.
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	Specific fuel consumption *			
		kW	Time (sec.) per 100 cm³	g/kW H	Time (sec.) per 200 cm³	g/kW H
5LD825-2	2600	N 24	—	—	89 ÷ 93	266/279
5LD825-2	2600	NB 22,1	—	—	100 ÷ 104	260/270
5LD825-2/L	1500	NB 13,6	84 ÷ 87	251/261	—	—
5LD825-3	2600	N 36	—	—	59 ÷ 62	266/280
5LD825-3	2600	NB 33	—	—	64 ÷ 68	265/281
5LD825-3/L	1500	NB 20,2	56 ÷ 59	250/264	—	—
5LD825-4	2600	N 49	—	—	46 ÷ 49	246/261
5LD825-4	2600	NB 44,2	—	—	52 ÷ 55	246/260
5LD825-4/L	1500	NB 28	—	—	83 ÷ 86	247/257
5LD930-3	2600	N 39,7	—	—	60 ÷ 63	238/252
5LD930-3	2300	NB 35,3	—	—	69 ÷ 73	231/245
5LD930-4	2600	N 53	—	—	45 ÷ 47	238/252
5LD930-4	2300	NB 47	—	—	52 ÷ 55	231/245
5LD930-3/TL	2200	N 36,8	—	—	68 ÷ 72	224/238



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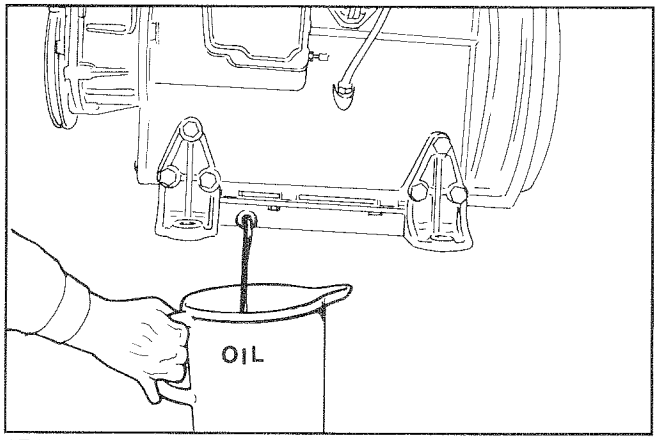
Stop setting

When the engine has reached full speed in no-load conditions tighten screw **1** until about 4 mm from lever **2** .
Lower lever **2** down to screw **1** until the engine stops.
Loosen screw **1** by 1/4 turn and lock with lock nut.



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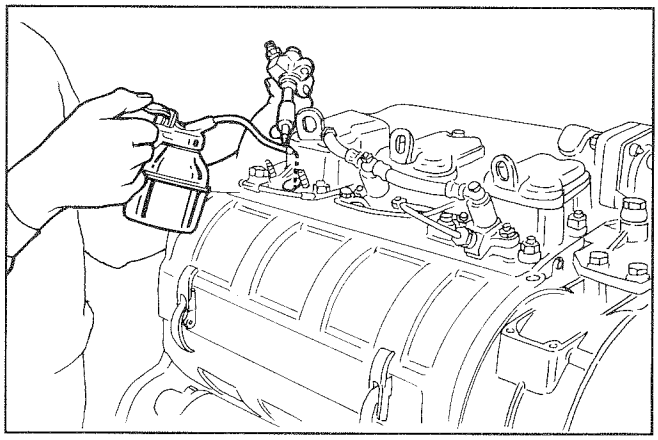
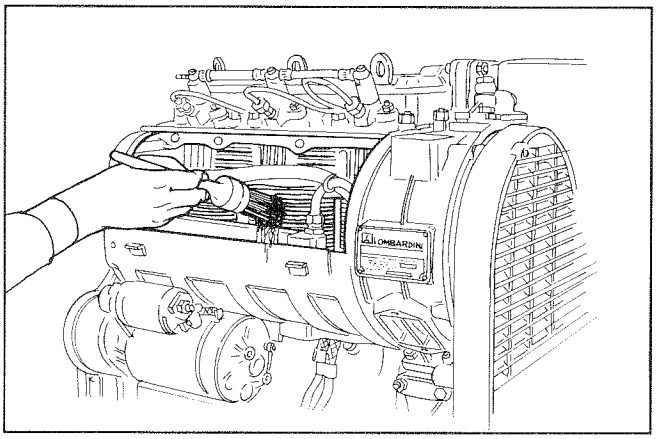

175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STORAGE

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.
- Stop engine and drain oil.
- Fill crankcase with protection oil MIL-1-644-P9 and let engine run 3/4 full speed for 5 ÷ 10 minutes.
- When engine is warm empty oil pan and fill with standard new oil.
- Remove fuel pipe and empty the tank.
- Remove fuel filter, replace gasket 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)

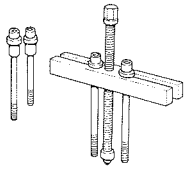
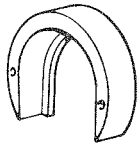
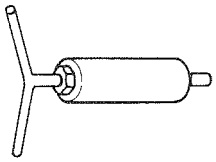
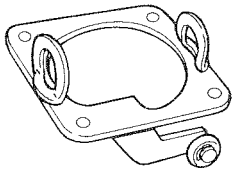
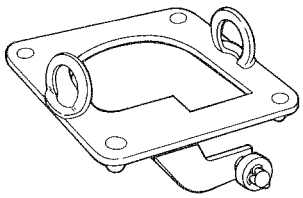
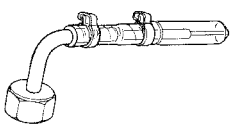
The following is recommended apart from the above instructions:

- 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 injector, pour in a small amount of standard engine oil, turn crankshaft by a few revolutions, remove the oil pan and drain 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.

SPECIAL EQUIPMENT

	DESCRIPTION	SER. NO.
	Flywheel puller	7271-3595-048
	Yoke for timing control gear extraction	7276-4000-032
	Rocker arm pin extractor	7276-3595-040
	Valve spring assembly tool	7672-1460-008
	Injection pump lever timing gauge for 5LD825-2	7276-2003-004
	Injection pump lever timing gauge for 5LD825-3, 5LD825-3/T, 5LD930-3	7277-2003-005
	Testing device for injection pump static timing	7271-1460-024