WORK SHOP MANUAL

CHD series engines, p.no 1-5302.345

LDW 1503 CHD
LDW 2004 CHD
LDW 2004/T CHD

3rd edition

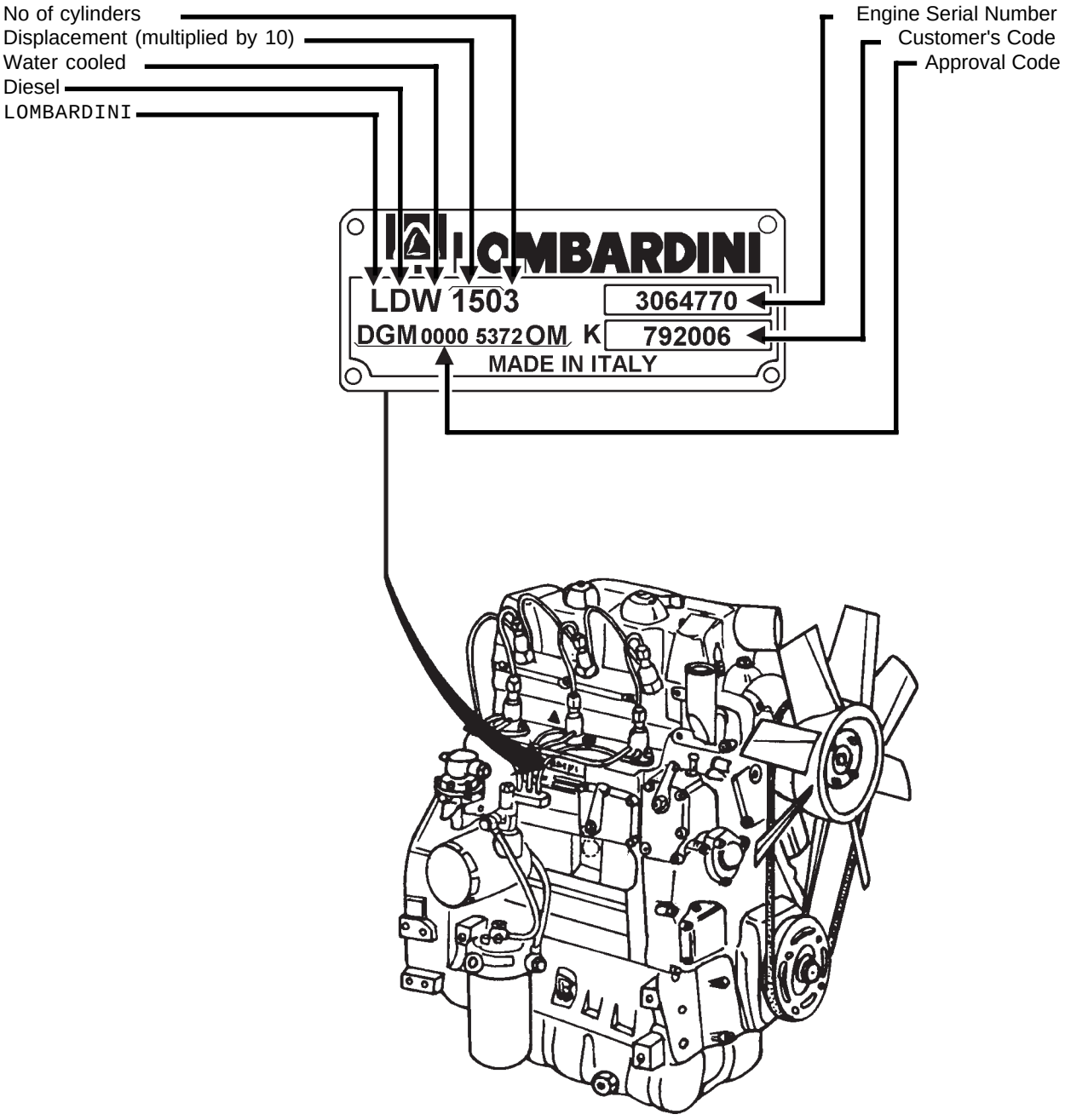
LOMBARDINI intermotor SLANZI
SERVICE

INTRODUCTION

This manual contains very important information for the repair of LOMBARDINI water-cooled indirect injection Diesel engines type LDW 1503, LDW 2004 and LDW 2004/T: updated August 01, 1996.

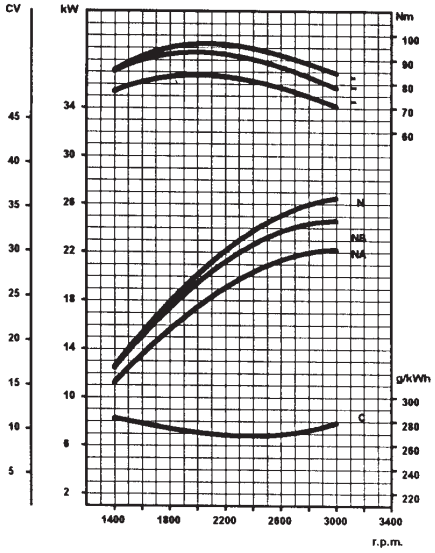
INDEX

MODEL NUMBER **ENGINE IDENTIFICATION**

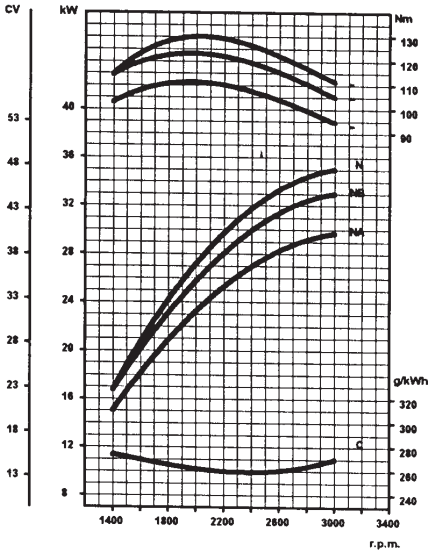


CHARACTERISTICS POWER, TORQUE AND SPECIFIC CONSUMPTION CURVES

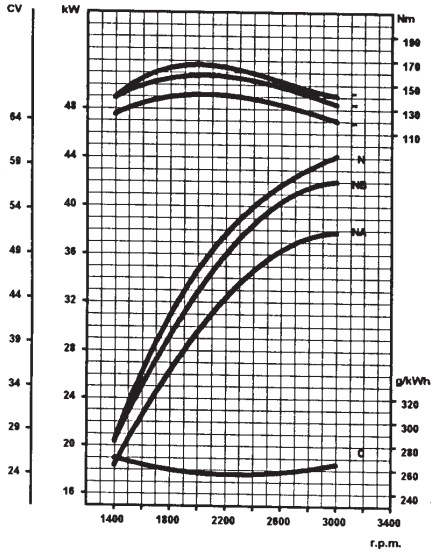
LDW 1503



LDW 2004



LDW 2004/T



N (80/1269/CEE - ISO 1585) AUTOMOTIVE RATING: intermittent operation with variable speed and variable load.
NB (ISO 3046 - 1 IFN) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty operation with constand speed and variable load.
NA (ISO 3046 - 1 ICXN) CONTINUOUS RATING WITH OVERLOAD CAPABILITY: continuous heavy duty with constant speed and constant load.
MN Torque curve (N curve) - MB (NB curve) - MA (NA curve). ().
C: Specific fuel consumption curve (**NB** curve)

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

MAINTENANCE

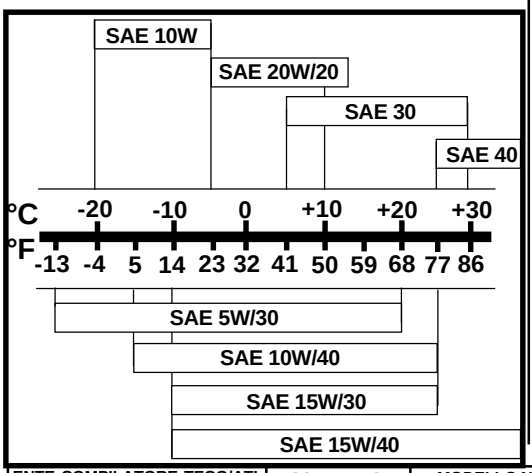
OPERATION	COMPONENT		INTERVAL (HOURS)								
				10	50	125	250	500	1000	2500	5000
CLEANING	OIL-BATH AIR CLEANER (*)			●							
	FUEL TANK								●		
	INJECTORS								●		
	RADIATOR FINS		(°°°)								
	OIL PICK-UP STRAINER									●	
CHECK	LEVEL	AIR CLEANER OIL		●							
		CRANKCASE		●							
		BATTERY FLUID				●					
	RADIATOR FINS			●							
	ALTERNATOR BELT TENSION							●			
	VALVE AND ROCKER ARM CLEARAN.							●			
	INJECTOR CALIBRATION								●		
	DRY AIR CLEANER			●							
REPLACEMENT	OIL	AIR CLEANER (*) (**)			●						
		CRANKCASE (**)			□	●					
	ANTIFREEZE		(°)								
	OIL FILTER CARTRIDGE						●				
	FUEL FILTER CARTRIDGE				□		●				
	DRY AIR CLEANER CARTRIDGE		(°°)								
	ALTERNATOR BELT								●		
OVERHAUL INSPECTION	PARTIAL (***)									●	
	COMPLETE										●

□ First replacement
* Under special working conditions clean daily
* Under extremely dusty conditions clean every 4-5 hours.
** See recommended oil type
**** Includes checking cylinders, piston rings, guides, springs, grinding valve seats, scaling heads and cylinders as well as checking injection pump and injectors.
(°) Every two years or after 1000 hours of operation.
(°°) When clogging indicator shows the need for replacement.

RECOMMENDED OIL TYPE

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

Suggested oil grades



RECOMMENDED ANTIFREEZE

AGIP ANTIFREEZE. Antifreeze and protective fluid to be mixed with water.
The cooling mixture freezing point depends upon the concentration of the product in water: at -15°C concentration is 30%, at -20°C,-25°C, -30°C and -35°C, it is 35%,40%,45% and 50% respectively.
In any case a 50% mixture is always recommended for general purposes.

CAPACITIES (Liters)

Standard oil sump

-	LDW 1503	LDW 2004 LDW 2004/T	LDW 2004 LDW 2004/T
-	with dyn.bal. with filter	no dyn.balan. with filter	
max. level	4.4	5.3	6.4
min. level	2.3	3.6	3.6

Cooling system

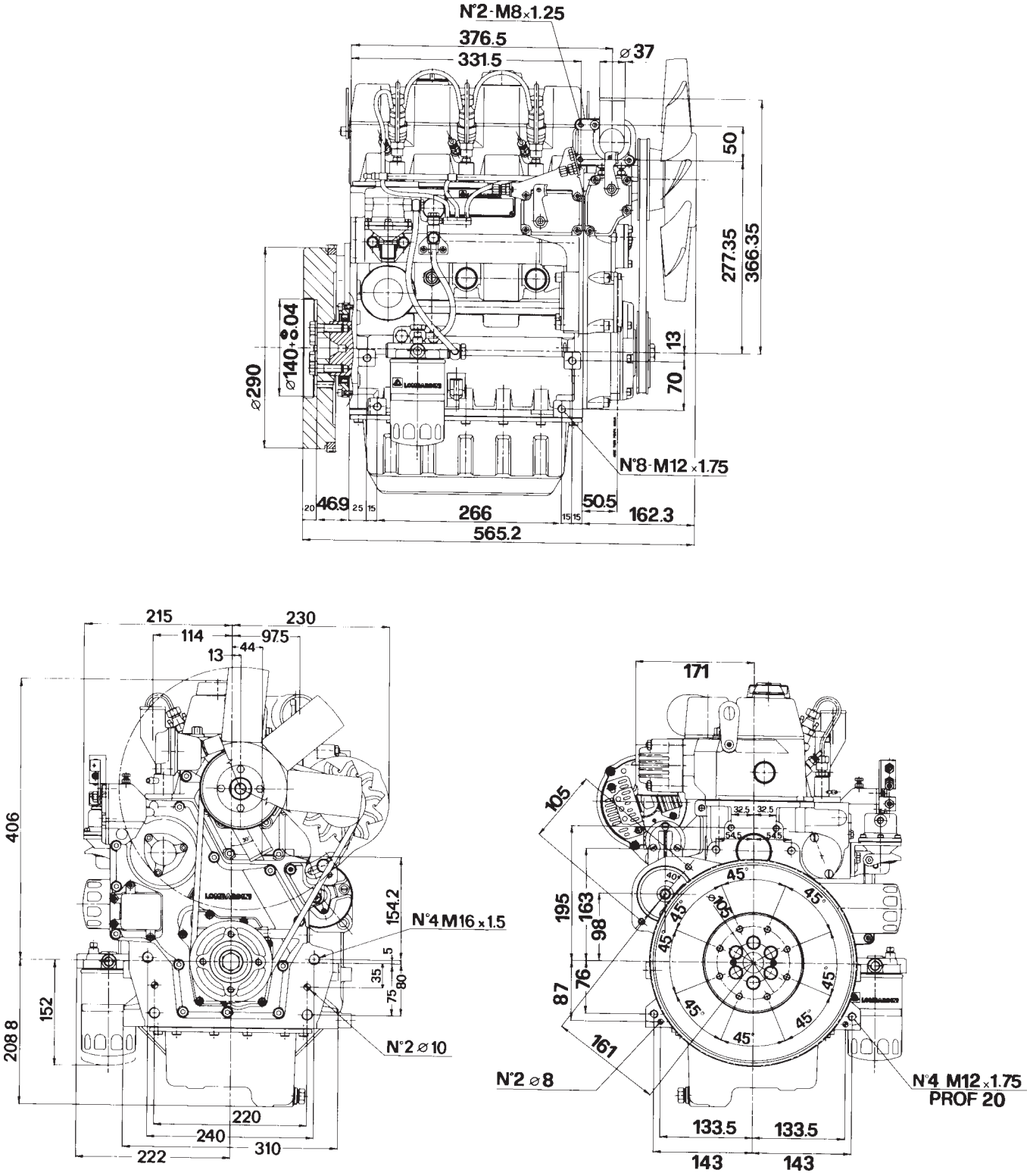
	LDW 1503	LDW 2004 LDAW 2004/T
with expansion tank	7.5	8.5
no expansion tank	6.5	7.5

POSSIBLE CAUSES AND TROUBLE SHOOTING

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

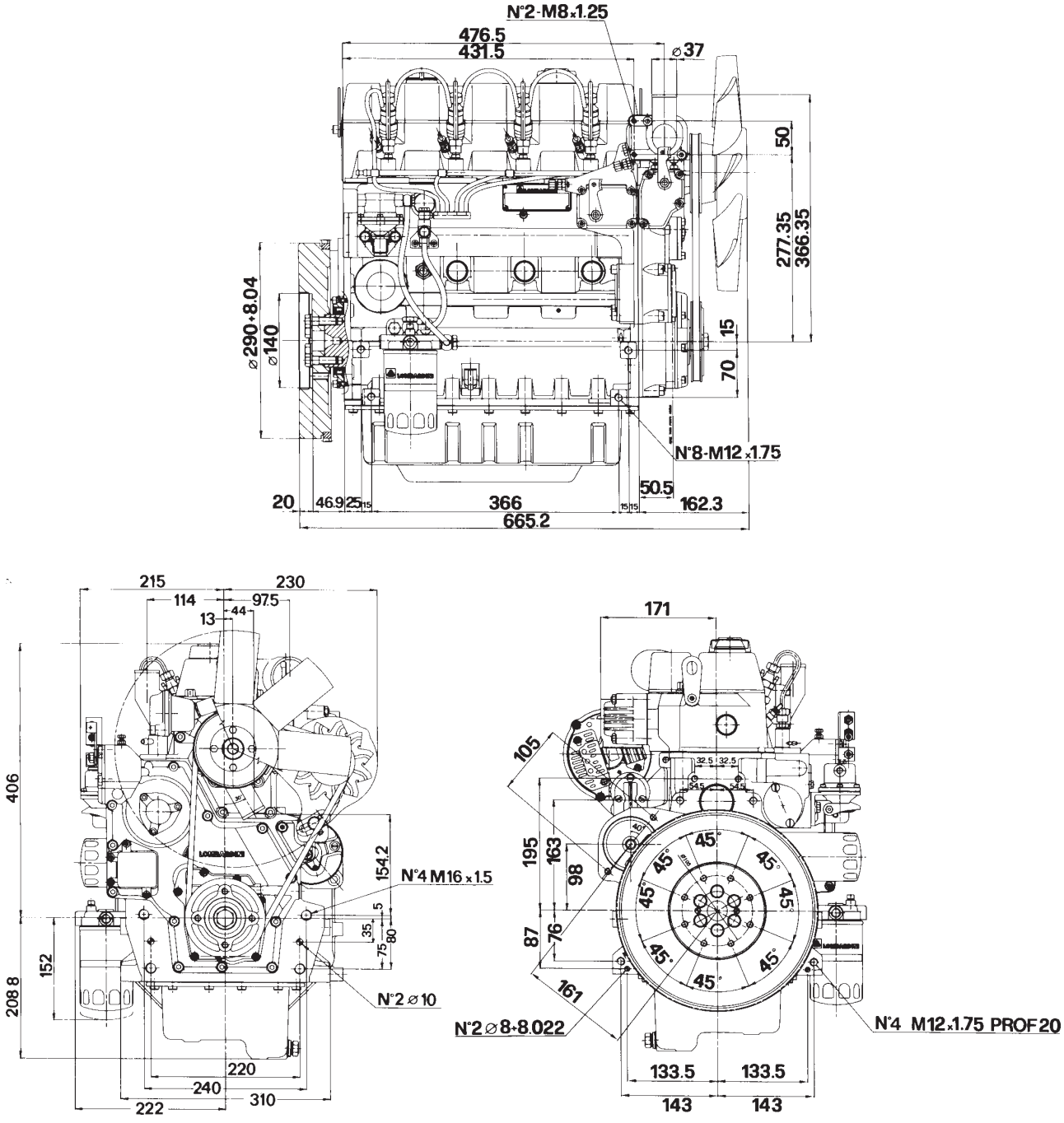
	POSSIBLE CAUSE	TROUBLE										
		Engine does not start	Engine starts but stops	No acceleration	Non-uniform speed	Black smoke	White smoke	Too low oil pressure	Increase oil level	Excessive oil consumption	oil and fuel dripping from exhaust	Coolant overheating
FUEL CIRCUIT	Clogged pipings	●										
	Clogged fuel filter	●	●	●								
	Air inside fuel circuit	●	●	●								
	Clogged tank breather	●	●	●								
	Faulty feed pump	●	●									
	Stuck injector	●										
	Stuck injection pump valve	●										
	Wrong injector setting					●						
	Excessive plunger blow-by								●			
	Sticking injection pump rack	●		●	●							
	Wrong injection pump setting			●		●						
LUBRICATION	Too high oil level				●		●			●		
	Stuck pressure relief valve							●				
	Worn oil pump							●				
	Air inside oil suction pipe							●				
	Faulty pressure gauge or switch							●				
	Clogged oil suction pipe							●				
ELECTRIC SYSTEM	Burnt preheating glow plug fuse	●										
	Defective glow plug control box	●										
	Battery dis-charged	●										
	Wrong or inefficient cable connection	●										
	Defective starter swich	●										
	Defective starter	●										
MAINTE-NANCE	Clogged air filter	●		●		●						
	Excessive idle operation						●				●	
	Incomplete running-in						●					
	Engine overloaded			●		●						●
SETTINGS/REPAIRS	Advanced injection	●										
	Retarded injection					●						
	Incorrect governor linkage adjustment	●			●							
	Broken or loose governor spring			●								
	Too low idle-speed		●							●	●	
	Worn-out or stuck piston rings						●			●	●	●
	Worn-out cylinders						●			●	●	
	Worn-out valve guides						●			●	●	
	Sticking valves	●										
	Worn-out bearings							●				
	Governor linkage not freely operating	●	●		●							
	Crankshaft not turning freely					●						
	Damaged cylinder head gasket								●			●

OVERALL DIMENSIONS LDW 1503



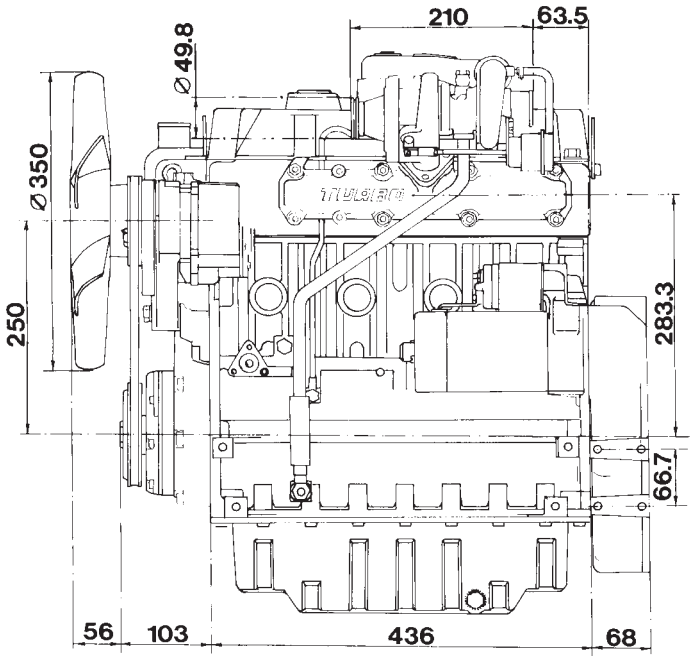
Note : Dimensions shown in mm

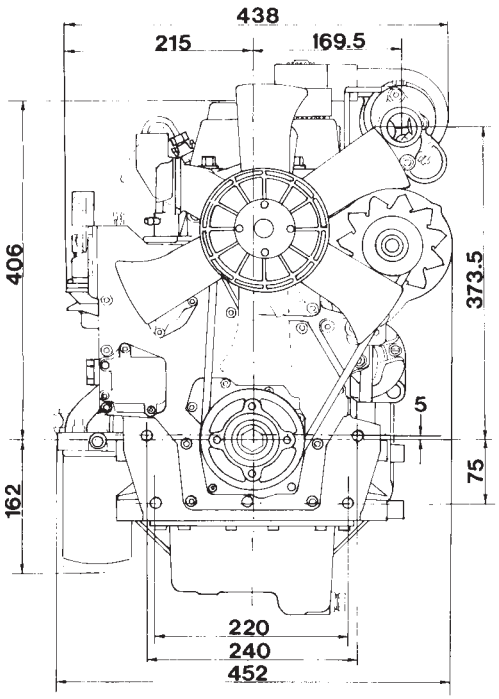
OVERALL DIMENSIONS 2004

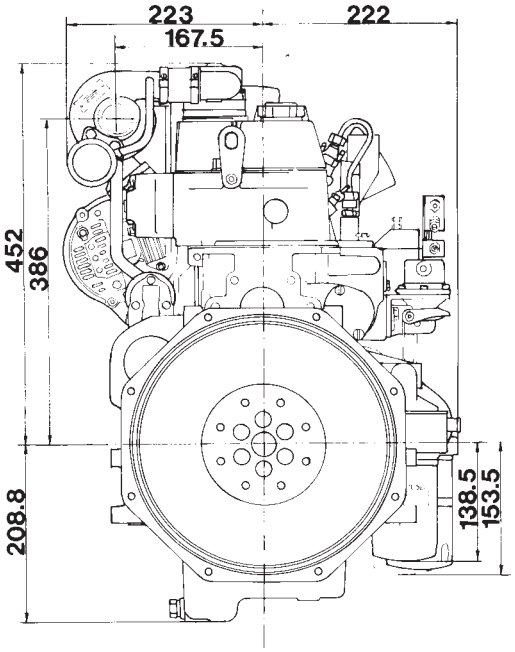


Note : Dimensions shown in mm

OVERALL DIMENSIONS 1204/T



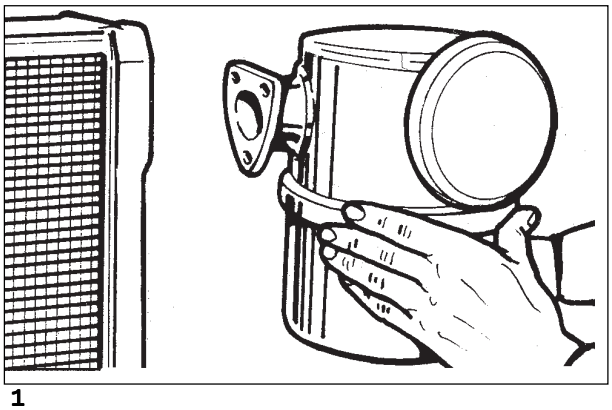




Note : Dimensions shown in mm

DISASSEMBLY AND REASSEMBLY

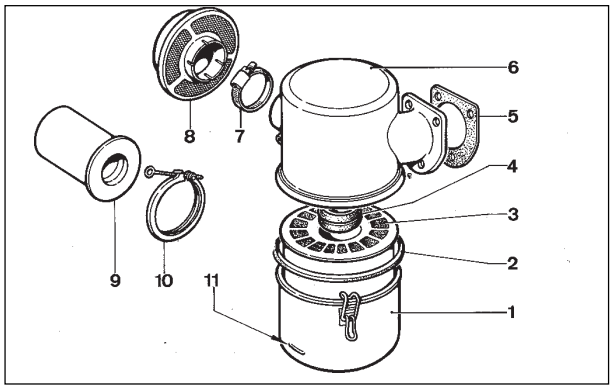
Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions. Always use original LOMBARDINI spare parts for repair operations.



1

Oil-bath air cleaner (optional)

Check gaskets and replace if necessary.
Check that flange welds are free of porosity or defective spots.
Carefully clean bowl and filtering element with Diesel fuel and dry with compressed air.
Top up engine oil to the mark (see below).
When refitting tighten nuts to 24.5 Nm
See page 5 for periodic cleaning and oil replacement.

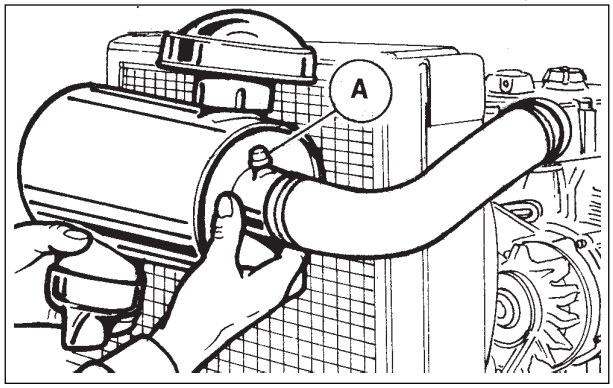


2

Oil-bath air cleaner components

1 Bowl
2 Outer seal ring
3 Filtering element
4 Inner seal ring
5 Gasket
6 Cover
7 Cap clamp
8 Cap
9 Centrifugal pre-filter
10 Centrifugal pre-filter clamp
11 Oil level mark

Note: Centrifugal pre-filter 9 is fitted upon request.

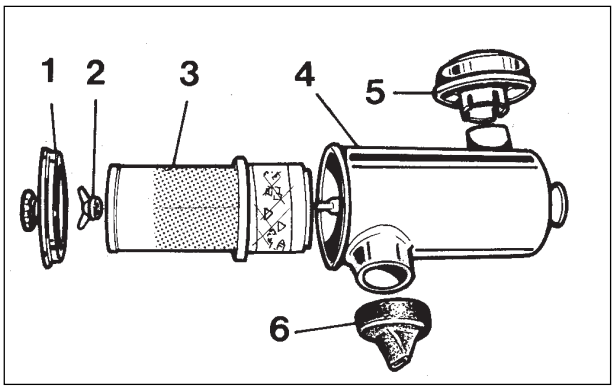


3

Dry air cleaner (optional)

A = Fitting to accomodate clogging indicator

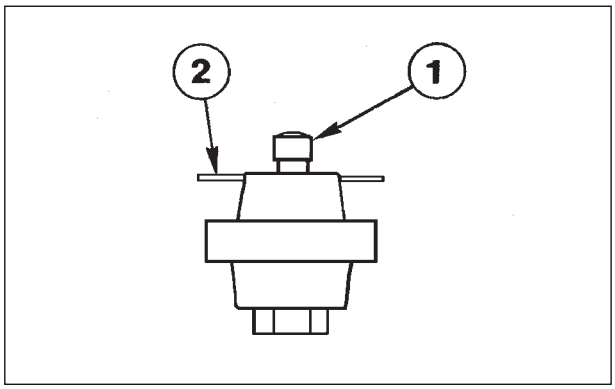
See page 5 for maintenance details and cartridge replacement.



4

Dry air components

1 Cover
2 Nut
3 Filter element
4 Body
5 Cap
6 Vacuator valve

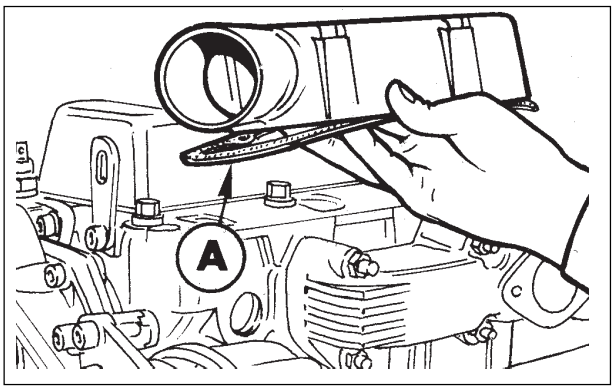


5

Air filter restriction switch

Components:
1 Reset button
2 Connection

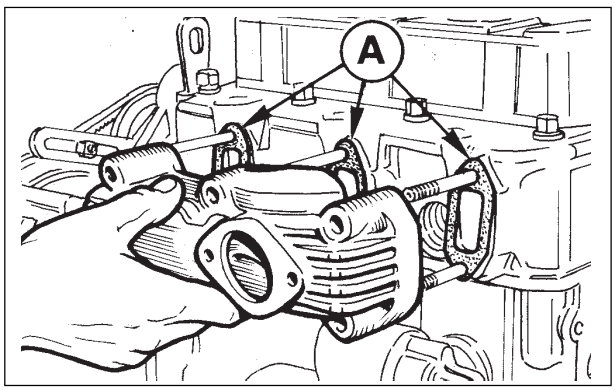
Note: There are two types: one for an aspirated engine and one for a supercharged engine.
Setting for aspirated engine (LDW 1503,LDW 2004)= 600/650 mm column of water.
Setting for supercharged engine (LDW 2004/T= 370/420 mm column of water.



6

Intake manifold

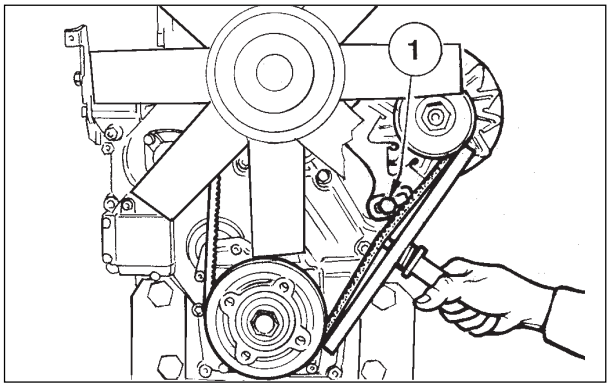
The sealing surface should be clean, smooth and free of any scoring.
Replace gasket **A.**
Tighten nuts to 25 Nm.



7

Exhaust manifold

Check that the sealing surface is smooth and that the inside is free of carbon deposits.
Replace gasket **A**.
Tighten nuts to 25 Nm.

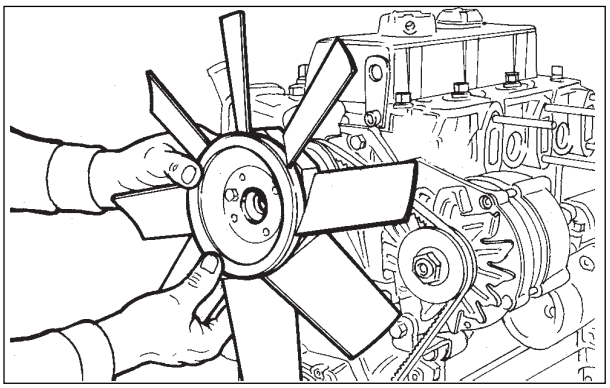


8

"V" belt

The "V" belt is of the Pirelli
Sectoflex AV 10D type.
Outside length 990 mm

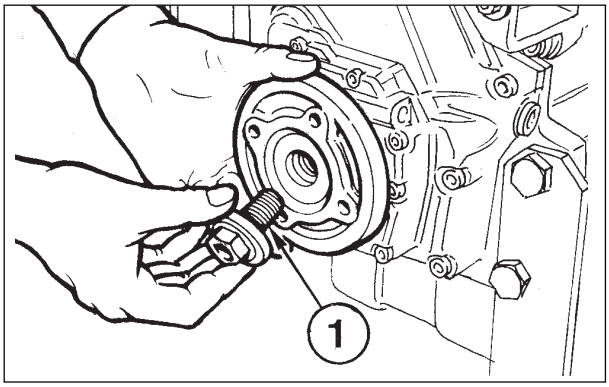
Tension adjustment:
Adjustments are made by means of scew **1**; stretch belt so that a 100 Nm load located half-way between the two pulleys causes a 10/15mm flexure.



9

Cooling fan

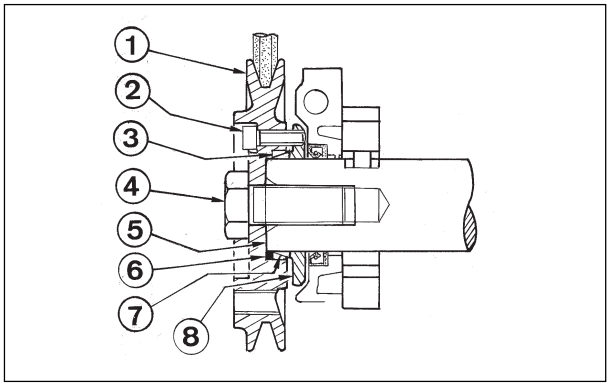
Take off the fan and check that all blades are not damaged; if any are damaged, replace the entire fan.
See page 56 for cooling air volume.



10

Driving pulley

This pulley drives the alternator and the water pump. It also represents the second engine p.t.o. which allows 100% power (axial) for the models LDW 1503 and 70% of the power for models LDW 2004 and 2004/T.
Bolt 1 can be loosened by turning clockwise. When refitting tighten this bolt to 350 Nm.

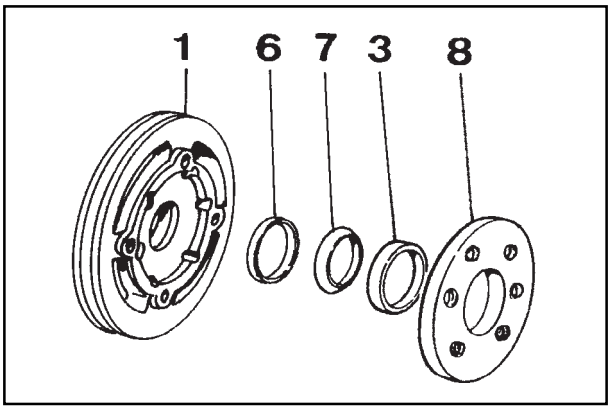


11

"Ringfeder" Rings on LDW 2004, LDW 2004/T

From the second p.t.o. of the engines LDW 2004 and LDW 2004/T it is possible to take off 3/4 of the power.
If you want to take off all the power it is necessary to mount the Ringfeder rings on the driving shaft spigot.

1 Appropriate pulley
2 Screw M6x1
3 Ringfeder ring
4 Screw M16x1.5
5 Driving shaft spigot
6 Shoulder ring
7 Inner Ringfeder ring
8 Fixing flange

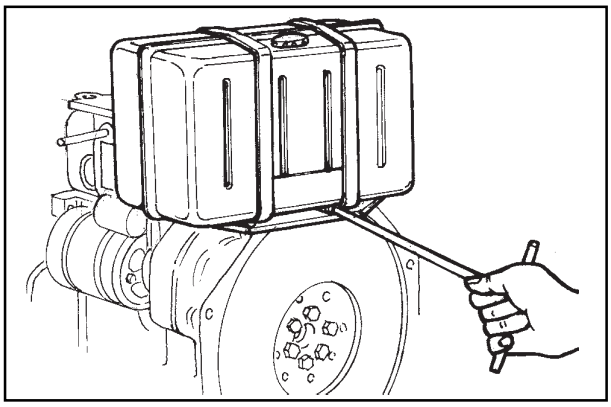


12

"Ringfeder" rings, disassembly

Refer to figures **11** and **12.** Clean and oil with engine oil the parts involved in assembly. Insert the shoulder ring **6**, outer ringfeder ring and inner ringfeder ring into the pulley **1**. Oil the screws **2** especially at the base of the head. Lightly tighten flange **8** by means of the screws **2** in the sequence: after tightening the first screw, the second one will be the opposite one, after tightening the third screw the fourth one will be the opposite one, etc. Fit the assembled pulley onto the driving shaft spigot. Tighten screw **4** to 352 Nm.

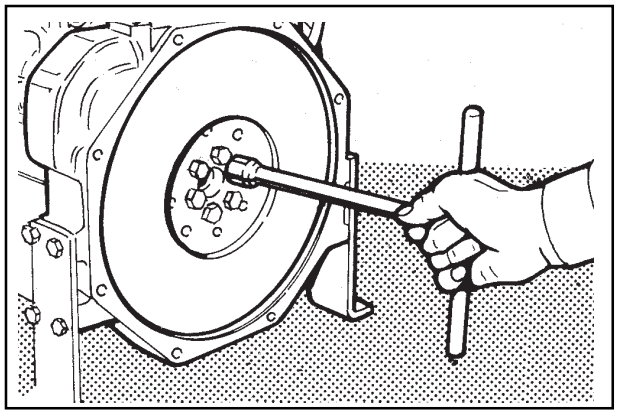
Tighten screws **2** in three phases.
1 Phase: 4/6 Nm
2 Phase: 12 Nm
3 Phase: check the tightening torque of the screws in the sequence they were tightened in.



13

Tank (optional)

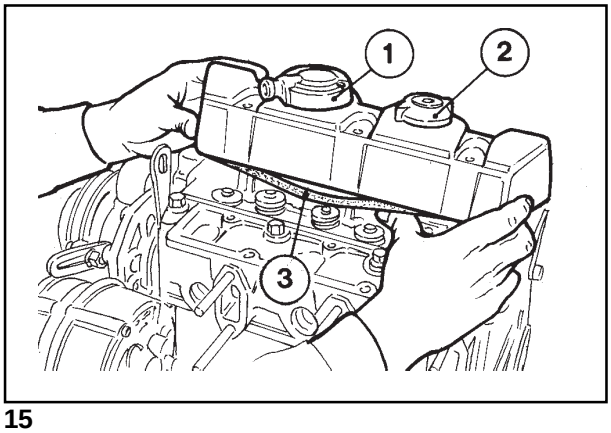
Remove fuel line and loosen clamp screws.
Completely empty the tank and check that no impurities are found inside.
Check that cap breather hole is not clogged.



14

Flywheel

Remove the bolts which attach the flywheel to the engine shaft; when refitting tighten to 140 Nm after checking that the locating pin is in its seat.
To remove the starter ring gear, it is recommended to cut it into several portions with an iron hacksaw and then use a chisel; to replace starter ring gear slowly heat to 300°C for 15/20 minutes.
Drive the gear onto the flywheel checking that it perfectly rests against the shoulder. Let it cool down slowly.

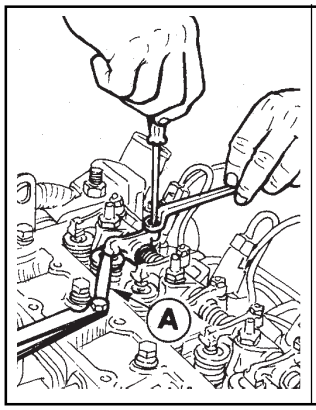


15

Rocker arm cover

Components
1 - Breather cap
2 - Oil fill cap
3 - Gasket

A small filtering element is located inside cap **1** with the purpose of separating oil from the venting vapors; check filtering element state and clean if necessary.
Replace gasket **3.**



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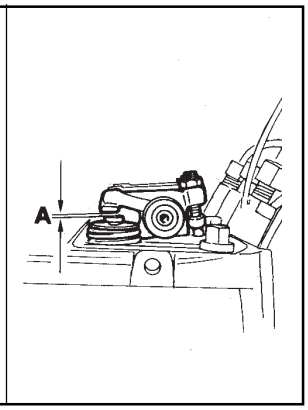
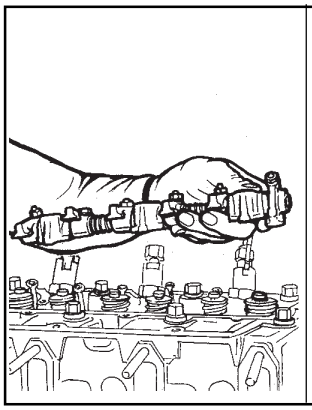


17

Valve/rocker arm clearance

Setting should be performed when the engine is cold.
Bring each cylinder piston to top dead center on the compression stroke and set clearance A at 0.15 mm for both the intake and exhaust valve.



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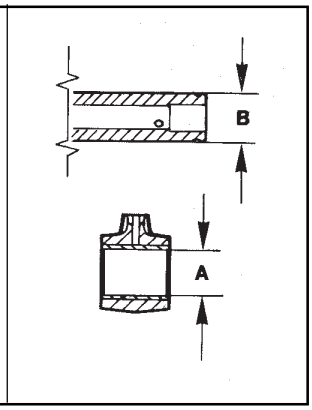
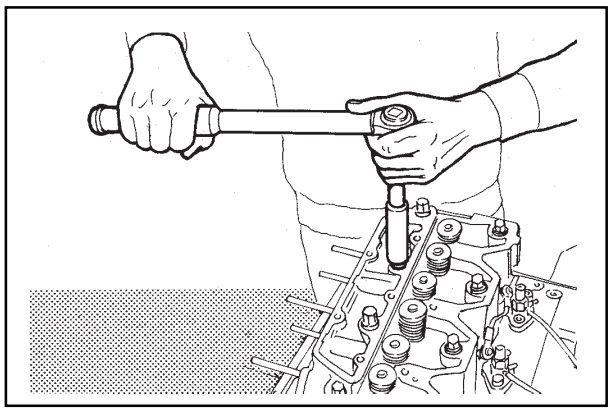


19

Rocker arm assemly

Loosen the screws which fasten the assembly to the head; when refitting tighten to 50 Nm.
The journal has a bore inside for lubrication purposes but is closed by two plugs at the ends. Check journal and rocker arm bushings for wear.
Remove the two end plugs and carefully clean the bore inside; when refitting apply a drop of Loctite 270 onto the threads.

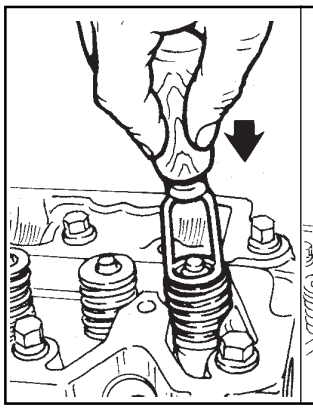
Dimension (mm):
A = 14,032/14,050 with bushing fitted to the rocker arm and reamed
B = 13,982/14,000
(**A-B**) = 0,03/0,07 (**A-B**) limit value = 0,14



20

Cylinder head

Do not remove when hot to avoid deformation.
Check cylinder head plane using a metal straight edge and thickness gauge; if warpage exceeds 0.10 mm, level off by removing a maximum 0.20 mm.
See fig. 52,53 and 54 for cylinder head tightening.



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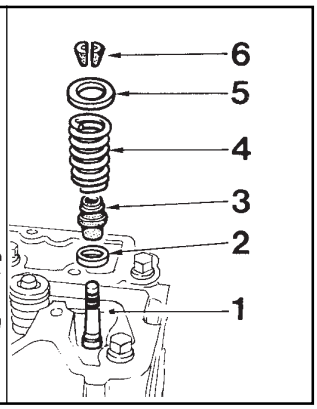


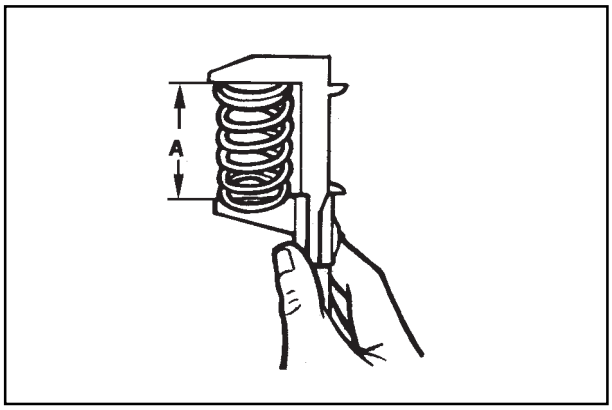
22

Valve removal

Components:

1 - Valve
2 - Lower spring seat
3 - Valve guide seal (for intake only)
4 - Spring
5 - Spring cap
6 - Cotters

To remove the cotters firmly press down as shown in the figure.

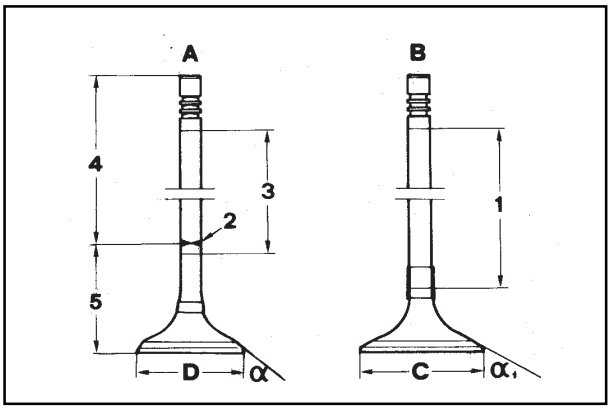


23

Valve spring

Measure free length with a gauge.

Free length **A** = 52 mm.



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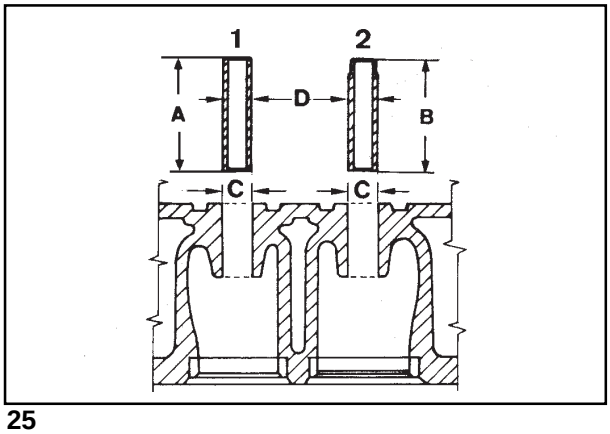
Valve material

Exhaust valve **A** :Valve stem and valve 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
a = 45°30'/45°45'
D = 35,30/35,50 mm

Intake valve **B**
Material: X 45 Cr Si 8 UNI 3992
1 Chromium-plated portion
a = 60°30'/60°45'
C = 40,30/40,50 mm

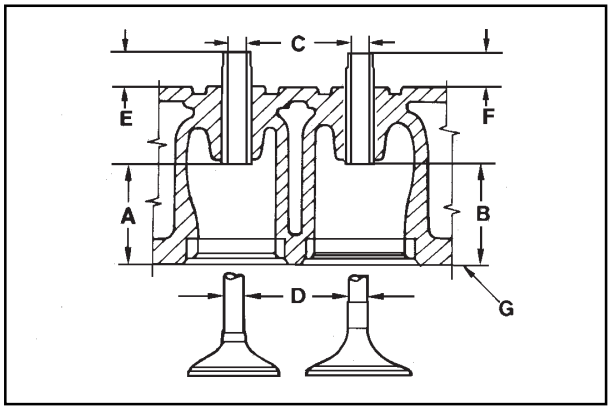


25

Valve guides and cylinder head

Intake and exhaust valve guides are both made of gray cast iron with pearlitic and phosphoric matirx.
Dimensions (mm)
A = 38,00
C = 12,020/12,038
D = 12,048/12,058

Valve guides with outside diameter D increased by 0.5 mm are available; in such case valve guide bore C should also be increased by 0.5



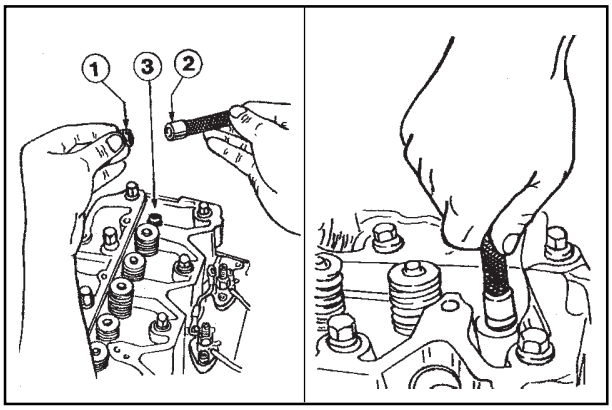
26

Valve guide insertion

Press guides considering the A and B distances from the lower head plane g or, alternatively, the E and F values.

Dimensions (mm):
A,B = 36,8/37,2
C = 7,020/7,035
D = 6,985/7,000
E = 10,5/11,0
F = 6,5/7,0

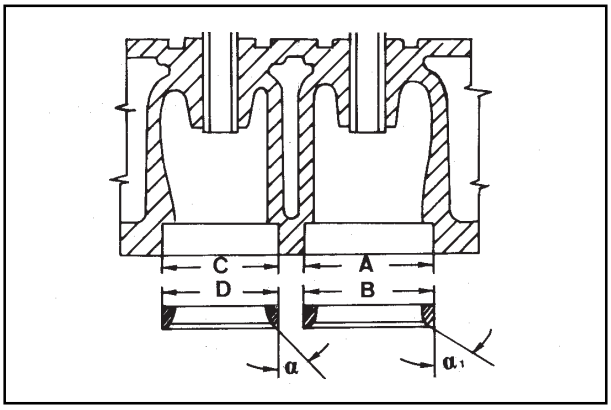
Clearance (mm)
(C-D) = 0,020/0,065 **(C-D)** limit value = 0,130



27 28

Oil seal in the valve guide, disassembly

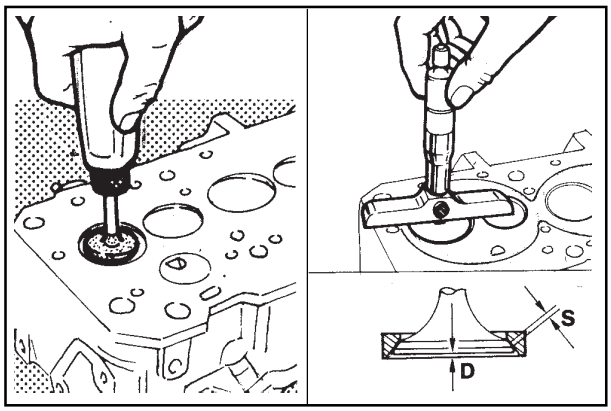
To prevent the seal **1** warping when mountig the valve guide **3** put it into the tool **2** part no. 7107-1460-047 and proceed as shown in the figure, making sure the seal **1** reaches its stop.



29

Valve seats and bore

Dimensions (mm):
A = 41.5000/41.520
B = 41.575/41.590
C = 36.500/36.520
D = 36.575/36.590
a = 44.53' / 45°
a1 = 59.53' / 60°
Press valve seats into the bore and cut as a function of **a** and **a**1



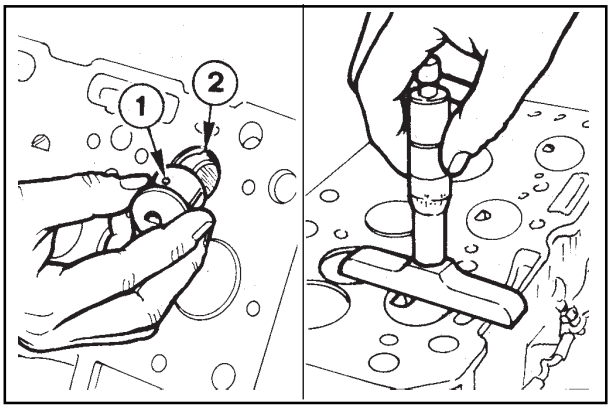
30 31

Valve recess and sealing surfaces

After cutting, cap valve seats with fine lapping compound.
S = Sealing surface width on exhaust side
S1 = Sealing surface width on intake side
D = Valve recess with reference to the head plane
Dimensions (mm)

Tipo motore	S	S1	D
LDW 1503 **LDW 2004** **LDW 200/T**	1.27/1.55	1.20/1.60	0.75/1.00

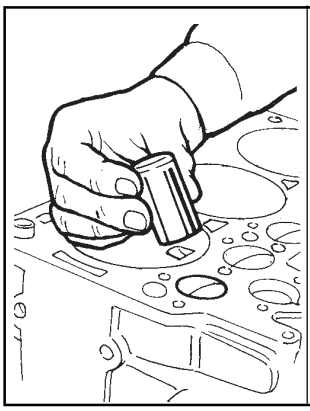
S and **S1** worn limit = 2.00 mm
D worn limit = 1.3 mm



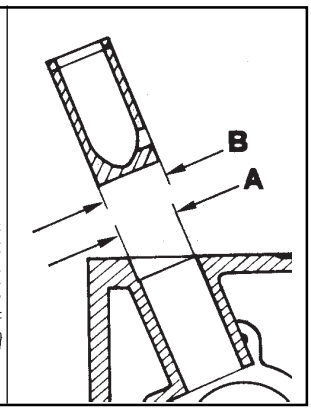
32 33

Precombustion chamber

To remove the precombustion chamber tap with a punch on the injector housing side. Replace it because it might undergo warpage during removal.
Introduce precombustion chamber by making dowel 1 match with notch 2.
Press uniformily.
The clearance allowance between the precombustion chamber and its bore on the cylinder head is equal to 0.05 mm.
Using a depth gauge check that the precombustion chamber plane protrusion does not exceed 0.04 and does not receed over 0.02 mm from the head plane level.



34

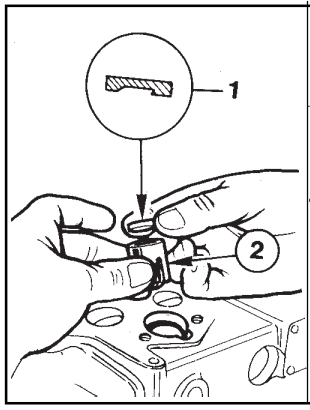


35

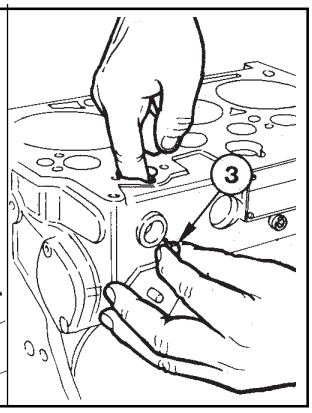
Tappet

Dimensions (mm):
A = 24.50/24/56
B = 24.46/24.48
(A-B) = 0.02/0.06 **(A-B)** limit value = 0.10

Nota: If tappet is worn out along diameter B replace it. No oversize tappets are available. If tappet/camshaft surface is worn - replace



36

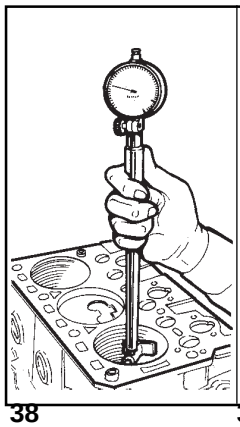


37

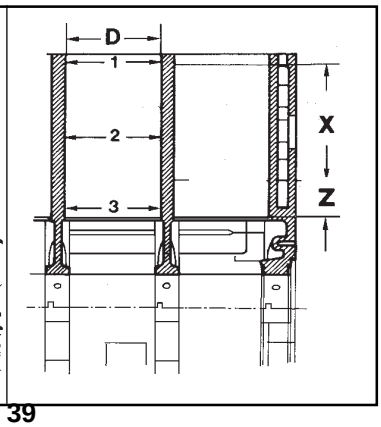
Injection pump follower

Introduce the follower into its housing and manually turn screw 3 until it matches with notch 2.
Before locking screw 3 check that the follower is allowed to freely move in the vertical position using your finger.
Space 1 should be introduced into the pushrod with the flat surface facing upwards

Note: Screws **3** are of the same length except for the one on the distribution side inside the shorter stop cover, take care not to replace it with one of the longer ones.



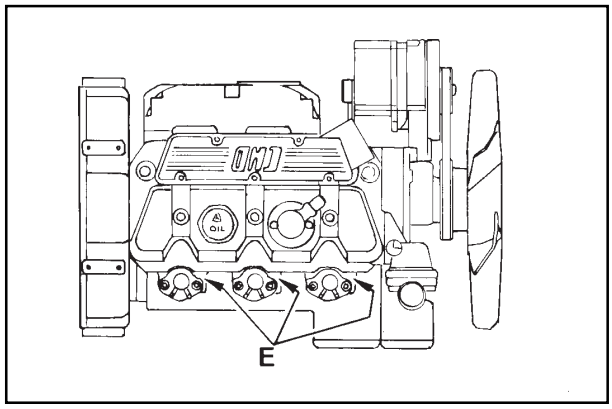
38



39

Cylinders

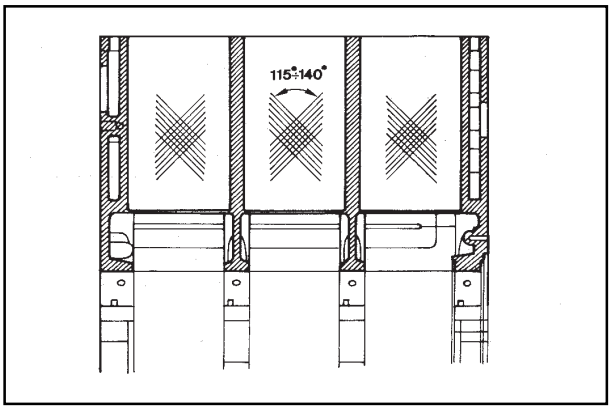
Reset dial gauge with a calibrated ring. Check diameter size D at 1, 2 and 3; repeat the same operation at the same places after turning the dial gauge by 90°. Check for wear in the X area where piston rings are located.
Dimensions (mm):
LDW 1503
LDW 2004 **D** = 88.00/88.01 wear limit = 88.100
LDW 2004/T
The above diameter sizes refer to class A cylinders which match with pistons of the same class (See page 18 fig. 44,45).
To check clearance with the matching piston measure the diameter size at Z along the axis which runs at right angles to the driving shaft.



40

Cylinders, class

The references of the classes of pistons **(A,B,C,R)** are given inside the piston, fig. 45, whereas those of the cylinders are at the position shown by **E.**

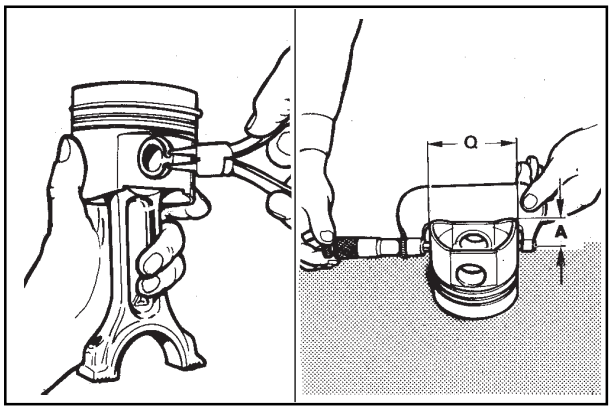


41

Cylinder roughness

The inclination of the cross-hatched marks left by machining should range between 115°-!40°; they should be uniform and clearly visible in both directions.
Average roughness should range between 0.5 and 1 **m m** .
The cylinder surface which comes into contact with the piston rings should be machine honed with the plateau system.

Warning: Manual grinding of the cylinder inner surface using an emery cloth is not allowed.



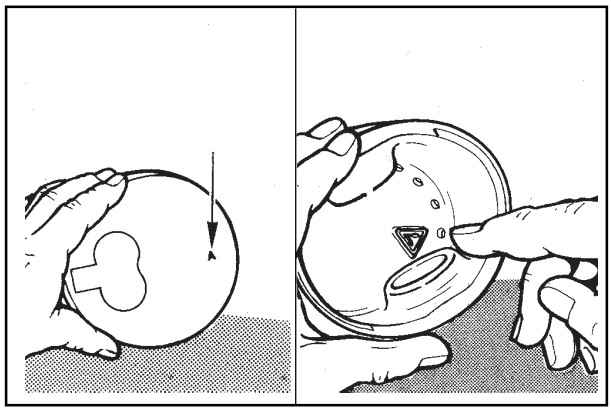
42

43

Piston

Remove circlips and piston pin.
Remove piston rings and clean grooves.
Measure diameter Q at the A distance from the bottom of the skirt (A = 12 mm)
In case of diameter wear exceeding 0.05 mm of the minimum given value replace piston and rings.

Nota : The oversizes are 0.50 and 1.00 mm. The LDW 2004/T piston differs from that of the LDW 2004 in its cooling sprayer passage niche and an insert in the slot of the first ring.



44

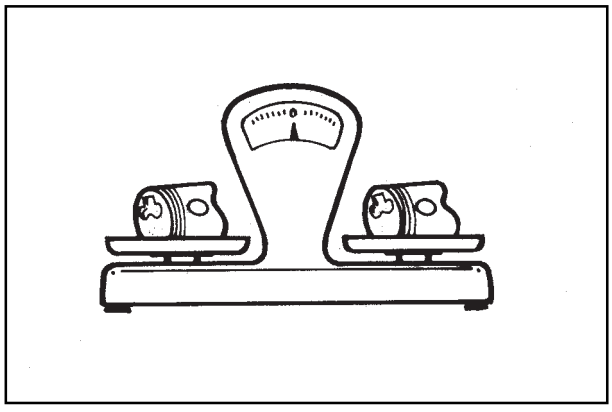
45

Piston classes and logo

Depending on their diameter size pistons are subdivided into class A,B,C or R; such reference letters are stamped inside the piston together with the logo.

Note: The class **R** piston rings are oversized with respect to those of class **A, B** and **C.**
Dimensions (mm)

Engine	Class	Cylinder Ø	Piston Ø	Clearance
LDW 1503	A	88.00/88.01	87.96/87.967	
LDW 2004	B	88.01/88.02	87.97/87.977	0.033/0.050
LDW 2004/T	C	88.02/88.03	87.98/87.987	
	R	88.10/88.11	88.06/88.067	



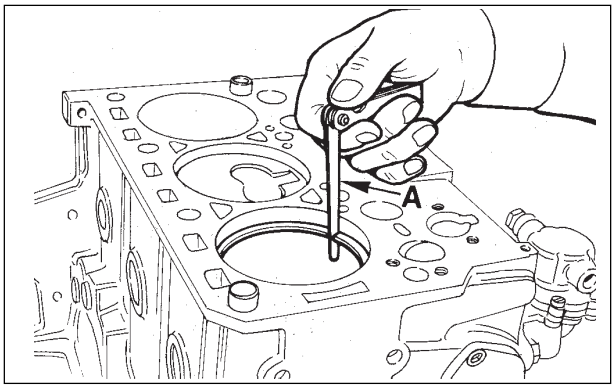
46

Piston availability

Pistons with standard diameter value are available only in class **A** and **R**.
Oversize pistons of 0.50 and 1.00 are supplied in the **A** class only.

Piston weight

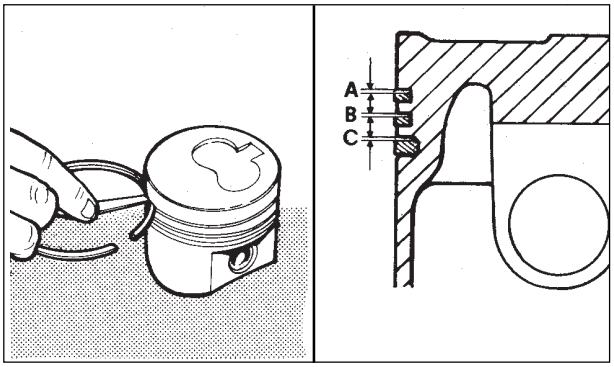
Weigh the pistons when replacing them in order to avoid unbalance.
The difference in weight should not exceed 6 g.



47

Piston rings - End gaps (mm)

Place piston rings into the cylinder and measure end gap **A.**
1st ring **A** = 0.30/0.50
2nd ring **A** = 0.30/0.50
3rd ring **A** = 0.25/0.50

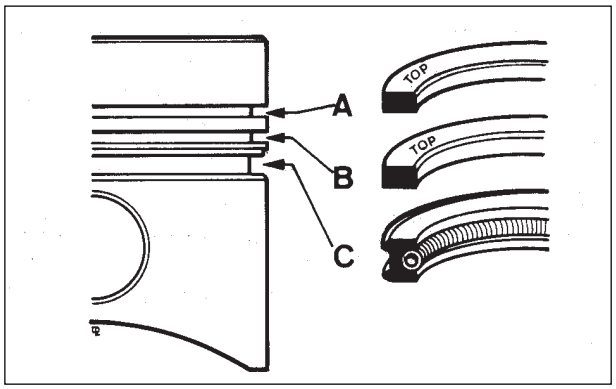


48 49

Piston rings - Clearance between grooves (mm)

For LDW 1503 and LDW 2004
A = 0.09/0.12
B = 0.06/0.10
C = 0.05/0.08

For LDW 2004/T
A = ---
B = 0.07/0.10
C = 0.05/0.08



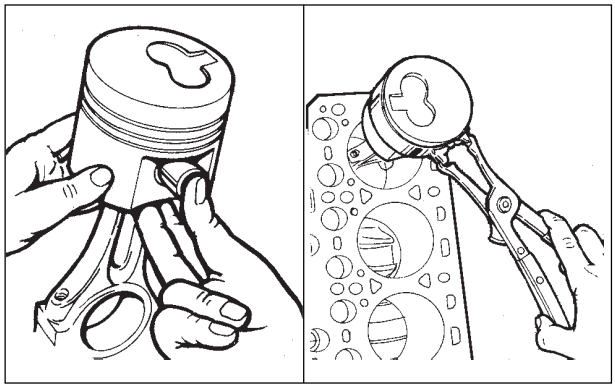
50

Piston rings - Fitting sequence

A = 1st (chromium - plate, internal tapered, torsional) ring *
B = 2nd (internal tapered, torsional) ring
C = 3rd (chromium-plated oil control ring

***** The first ring in the LDW 2004/T engine is different, it has a trapezoidal cross-section.

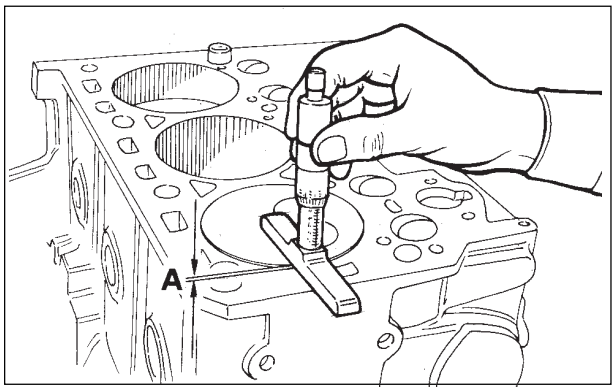
Note: In case an inscription is visible on the segment surface fit that surface upwards.



51 52

Piston - Refitting

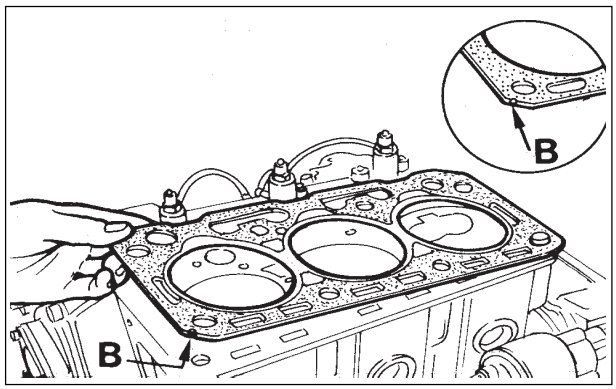
Connect piston to connecting rod after lubricating piston pin and introducing it by exerting pressure with your thumb.
Position the two piston pin ciclips and check that they are well inside their seats. Using a ring compressor introduce the piston into the cylinder with combustion chamber facing the injection pump side.



53

Piston position and clearance

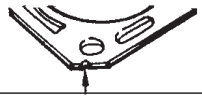
To obtain a clearance of 0.67/0.90 mm measure protrusion A of all pistons from the cylinder plane and consider the A value of the most protruding piston (see below).
Perform this measurement along the engine axis.



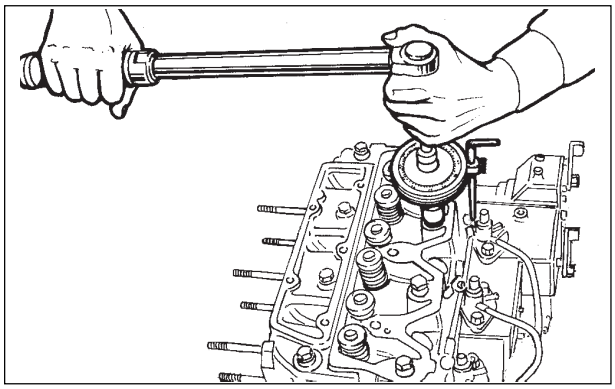
54

Cylinder head gasket

At B the gasket shows small semi-circular notches indicating thickness. Choose the most suitable gasket considering that each A value in the table corresponds to no notch, one notch and two notches on the gasket.

A mm	No.of notches	Resulting clearance mm
0.60/0.83		0.67/0.90
0.84/0.98		0.67/0.84
0.99/1.10		

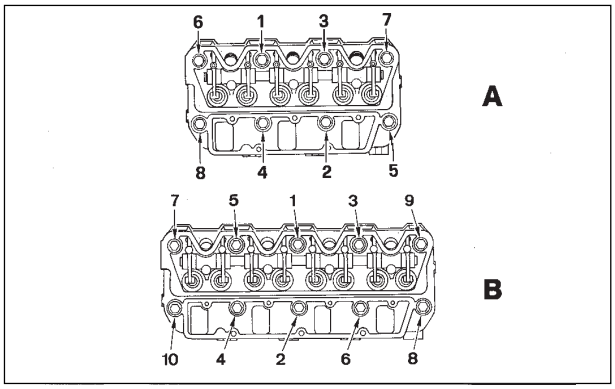
Note: The notches shown above protrude from the cylinder head plane; you can thus determine the gasket thickness before taking down the head.



55

Cylinder head tightening

Use a torque wrench (fitted with tool for angular tightening).
The head should not be re-tightened after engine testing.
It is recommended to replace the screws depending on their stretching caused by their tightening.
The length of the screws is 126.40/126.60 mm, if they have stretched by 2 mm replace them.



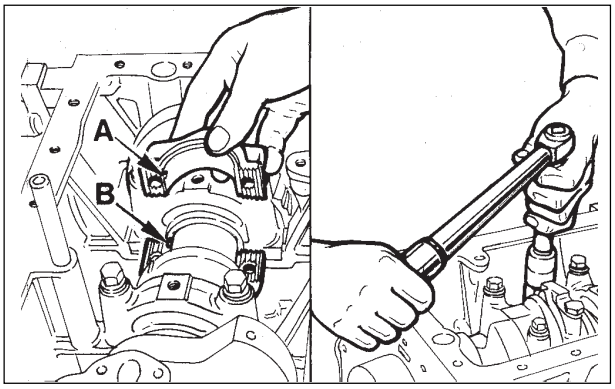
56

Cylinder head tightening steps

A = For LDW 1503
B = For 2004, 2004/T

Following the number sequence shown in the figure bolts shuld be tightened in four susequent steps with the following torque values:

1st step = 40 Nm
2nd step = 70 Nm
3rd step = 100 Nm
4th steps = Rotate wrench by 180° (in two steps 90°+90°)



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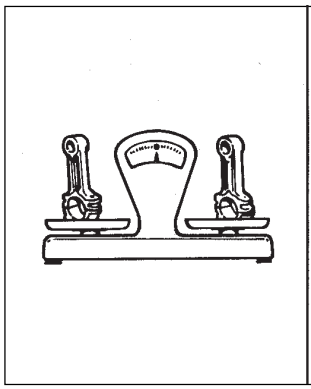
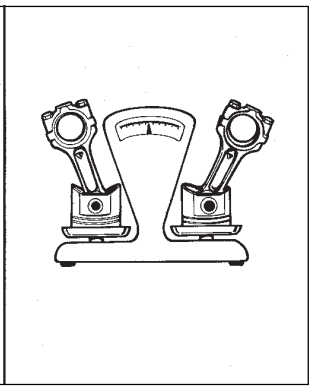
Connecting rod

Remove oil pan and oil pump suction pipe.
Dsconnect the connecting rod from the engine shaft and perform the following checks:
When refitting both centering notches A and B should be located on the same side.
Tghten the connecting rod big end bolts to 70 Nm.



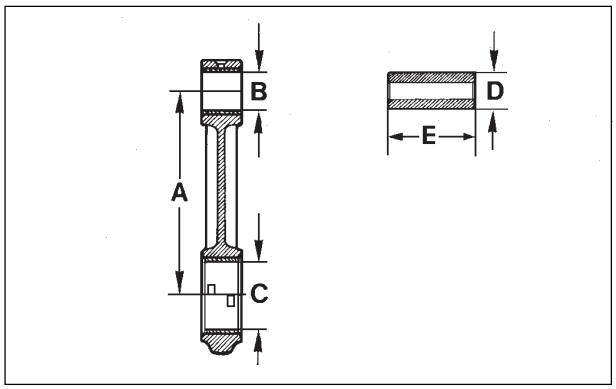
59



60

Connecting rod weights

Weigh connecting rods before replacing them in order to avoid unbalance.
The difference in weight should not exceed 10 g.
Connecting rod, piston and piston pin can also be weighed in a preassembled state but the difference in weigt should not exceed 14 g.



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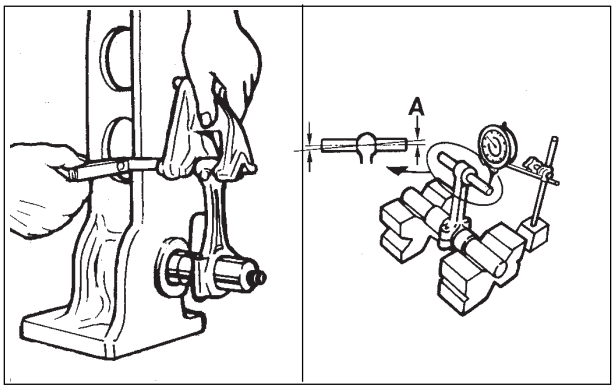
Connecting rod and piston pin

Dimensions mm
A = 144.98/145.02
B = 28.02/28.03 (with reamed bushing in place)
C = 50.035/50.066 (with shell bearings in place and tightened to 70 Nm).
D = 27.995/28.000
E = 62.3 **E** (per LDW 2004/T) = 65.8
(B-A) = 0.02/0.03 **(B-A)** limite = 0.06

Note: The connecting rod big end shell bearings are supplied in either standard or with this value decreased by 0.25 and 0.50 mm respectively.



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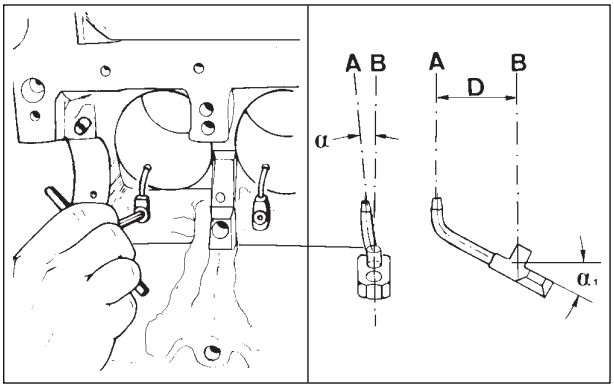
Connecting rod alignment

Use a surface plate gauge or a dial gauge as shown in the figure.
Checked for axis alignment; axial mis-alignment A = 0.02 mm; maximum limit 0.05 mm.
Moderate warpage may be corrected by gradually working with a press.



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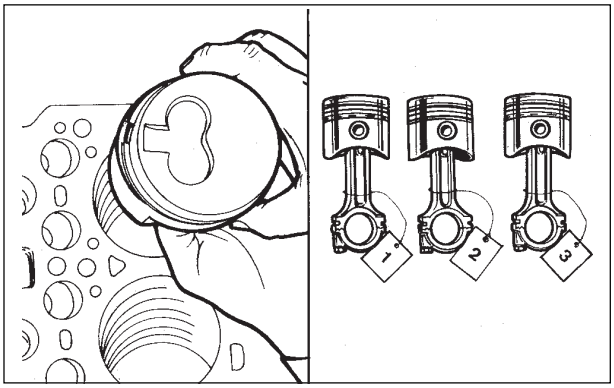
Piston cooling sprayer

This is assembled on turbo engines LDW 2004/T.
Blow on it with compressed air and check that there are no impurities inside.
Reassemble it back into place making sure you maintain axis alignment **A** of the spray with respect to axis **B** shown in the fugure. Anyway the correct position is ensured by the fixing screw.

a = 3°
a1 = 28°
D = 28 mm.



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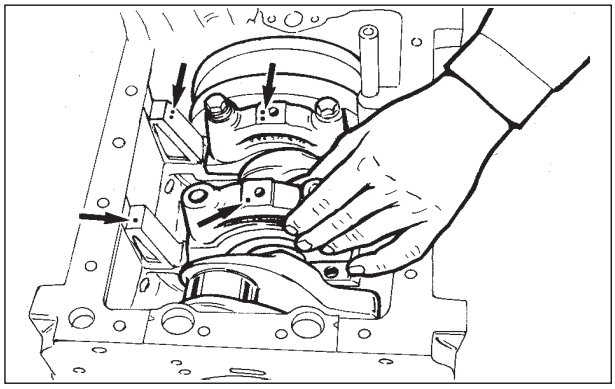
Connecting rod/piston assemlies

The three connecting rod/piston assemblies should be fitted back into their original cylinders. Mark them with references to avoid mistake.

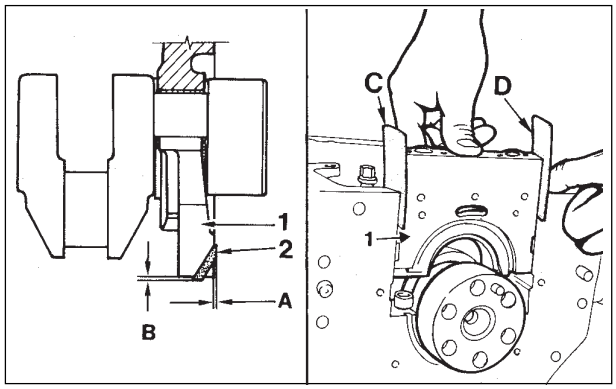
Note: The custom at LOMBARDINI is to consider the cylinder on the flywheel side as the first cylinder.



68

Center main bearings

Center main bearing caps are marked with 1 point, 2 points or 3 points.
The same reference marks are given on the crankcase.
Match caps with the same points and on the same side; comunque fare riferimento alle due tacche di centraggio dei semicuscinetti della bronzina che si devono trovare dallo stesso lato.



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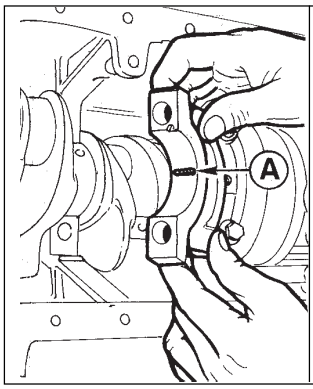
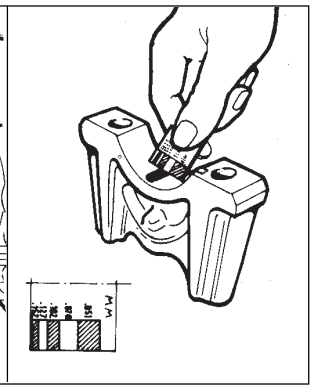
Front and rear main bearing caps

When refitting rear main bearing cap 1, replace lateral rubber gaskets 2 considering that A and B should protrude 0.5/1.0 mm from the crankase; cut any excess portion.
Follow the same procedure for the front main bearing cap.
To introduce the bearing caps into the crankcase place two plates C and D measuring 0.1 mm in thickness between the surfaces.
Tighten bolts to 120 Nm.



71



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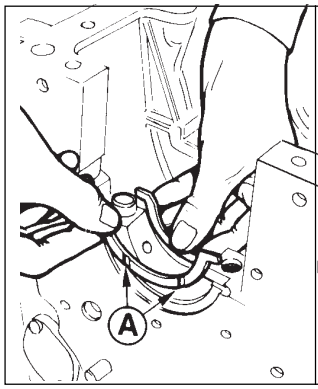
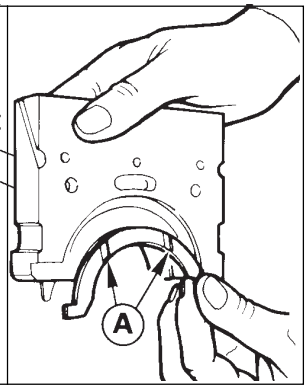
To check clearance between main bearings and journals

Use "Perfect Circle Plastigage" A and position it with a few drops of oil at the center of the half bearing; tighten bolts to 12o Nm.
Determine clearance by measuring the squeezed portion of the plastigage with the indexed scale supplied.
For clearance between main journals, connecting rod big end journals and the corresponding bearings see page 26 fig 84.

Note: When replacing bearings make sure that the lower half is kept separate from the upper one.



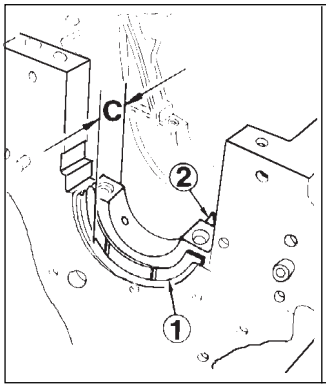
73



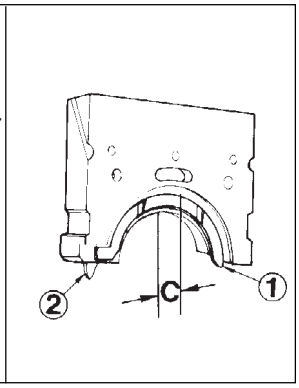
74

Thrust bearings

Apply some grease to make sure that the halves remain in their seats.
Halves should be fitted with grooves A as shown in the figure.
Thrust bearing thickness = 2.31/2.36 mm; oversize halves with thickness increased by 0.1 and 0.2 mm are available as spares.



75



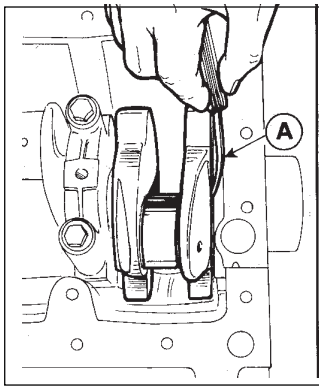
76

Thrust bearing, oversizes

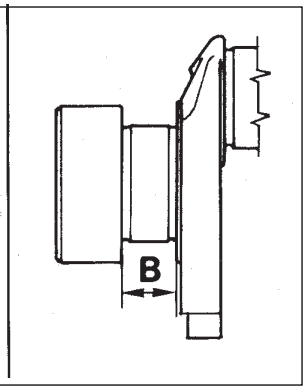
Dimensions (mm)	A*	C	B**
Standard	27.77/27.92	28.00/28.05	0.08/0.28
1st Oversize	27.97/28.12	28.20/28.25	
2nd Oversize	28.07/28.22	28.30/28.35	
3rd Oversize	28.17/28.32	28.40/28.45	

* **A** of fig. 77
** **B** of fig. 78

Grinding **B** according to the above table, following half-rings can be assembled:
1st Oversize. Half-rings 1 and 2, on both the support sides +0.10 mm.
2 nd Oversize. Half-rings 1 and 2 , on one support side +0.10 mm and on the other side +0.20 mm.
3 rd Oversize. Half-rings 1 and 2, on both the support sides +0.20 mm.



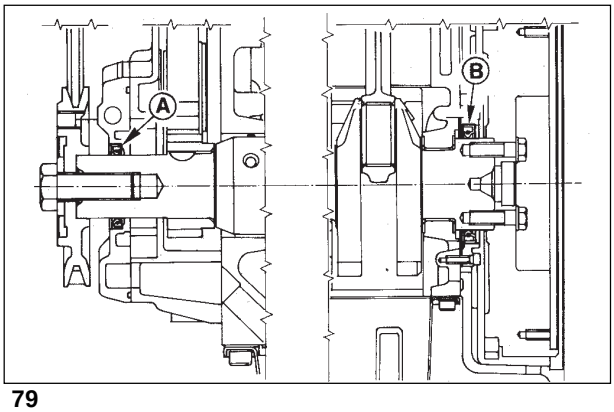
77



78

Crankshaft end play

After tightening main bearings measure the end play **A** between the crankshaft shoulder on the flywheel side and main bearing halves.
A = 0.08/0.28 mm
B = 28.00/28.05 mm
If the end play does not fall within the given values check **B** and possibly fit the oversize thrust bearings.



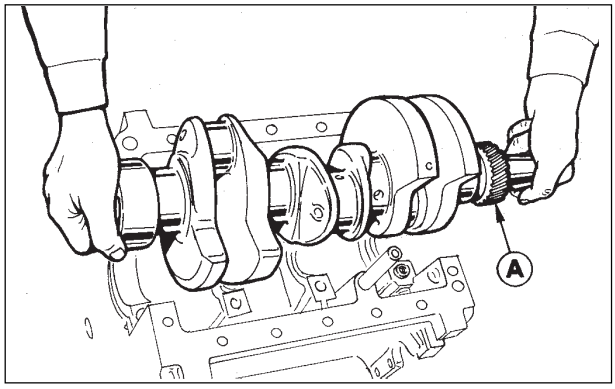
79

Crankshaft front and rear oil seal

The front oil seal **A** is located in the oil pump cover while the rear oil seal ring **B**, is positioned in the flange on the flywheel side.
Replace seals if warped, hardened or damaged.
In case of replacement:
- Carefully clean the seat.
- Soak the seal in engine oil for approximately half an hour.
- Fill the inside with grease and lubricate and sealing lip with thick oil.
- Drive the seal into its seal exerting a uniform pressure over the entire front area.

Note:The crankshaft, to avoid its wear, is hardened in the ring working areas. The rings in this case are made of red siliconic material.
Engines of recent production have rings in "Viton" material and are brown coloured.
In this case crankshaft are not hardened in this area.
As a consequence red rings cannot be assembled at the place of brown rings; these last however can be assembled on both crankshafts.

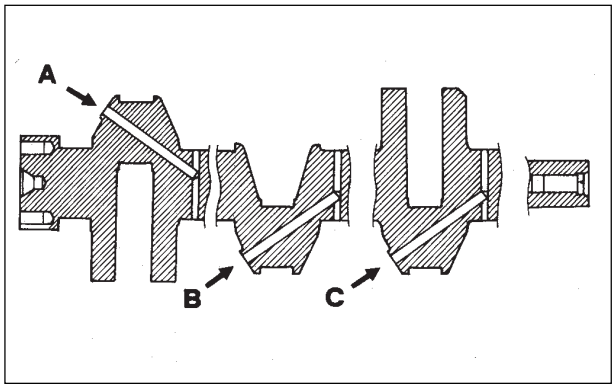
Warning: in case of room temperature below -35°C seals could become damaged.



80

Crankshaft timing gear

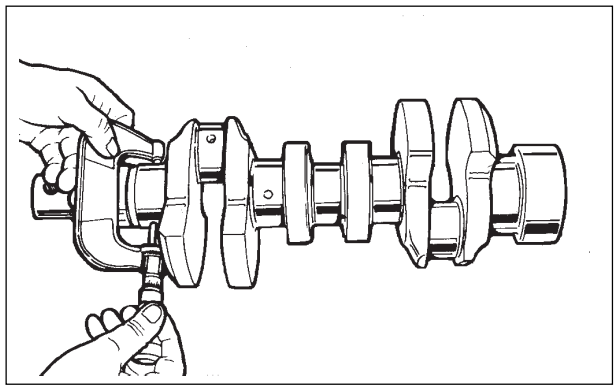
The following steps are required to remove timing gear A.
To remove use a bearing puller.
To refit first heat it up to 180°-200°C and then drive it in position.



81

Crankshaft lubrication ducts

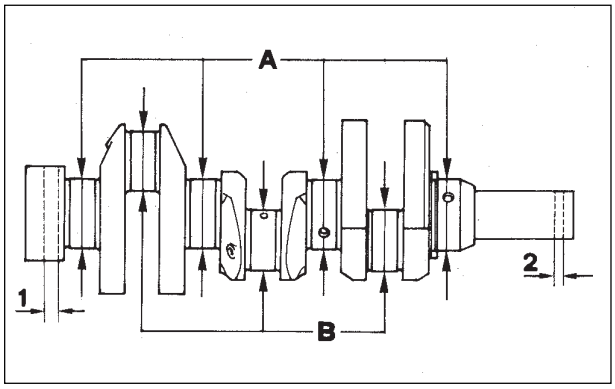
Dip crankshaft into a petroleum bath.
Remove plugs and clean ducts A, B and C with a pointed tool. Finally blow with compressed air.
Re-place plugs using a calking tool and check for sealing.



82

Checking main journals and crank pins

Use an outside micrometer gauge.

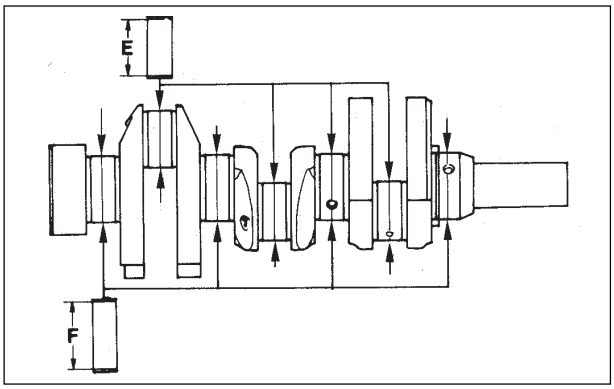


83

Main journal and connecting rod big end journal diameter

Dimensions (mm)
A = 57.980/58.000
B = 49.989/50.000

The crakshaft is made of spheroidal graphite cast iron hardened at the level of the oil seal rings 1 and 2. Hardness 55 hrc, hardening depth 0.5/1.5 mm.



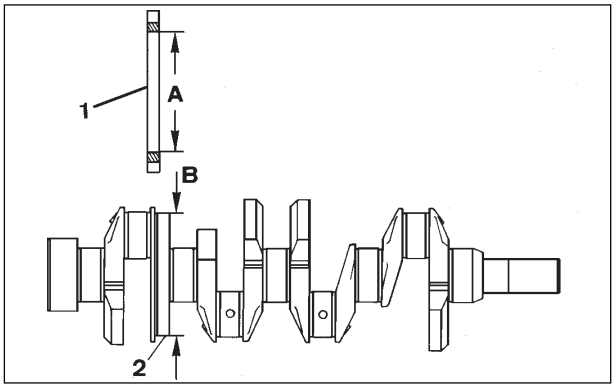
84

Main bearing and connecting rod big bearing inside diameter

Dimensions (mm)
E = 50.035/50.066
F = 58.041/58.091
The above dimensions refer to tightened berings.

Clearance between bearings and corresponding journals (mm).
(E-B) = 0.035 ¸ 0.077 **(E-B)** worn limit = 0.150
(F-A) = 0.041 ¸ 0.111 **(F-A)** worn limit = 0.200
See fig. 71 and 72 for checking procedures.

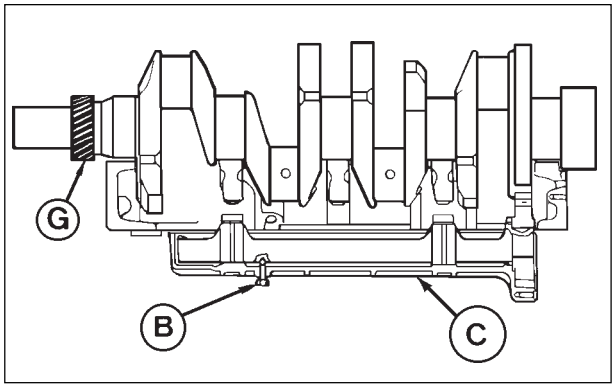
Note: Both main bearing and connecting rod big end bearings are available with inside diameter measuring 0.25 and 0.50 mm. less than standard.



85

Crankshaft for LDW 2004, LDW 2004/T

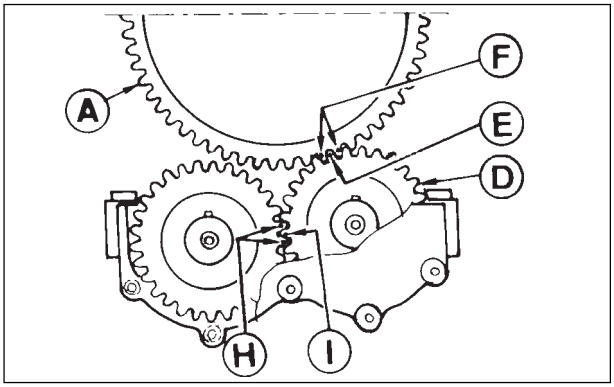
The main bearing and connecting rod big end bearing inside diameter is the same as for model LDW 1503.
In addition, the crankshaft comes with seat for the control gear of the counter-rotating shaft dynamic balancer.
Components:
1 Control gear for counter-rotating shafts
2 Seat for the control gear of counter-rotating shafts
Dimensions (mm):
A = 132.00/132.03 **B** = 132.07/132.09
To replace the gear heat it up to 180°/200°C.
Locate it into its seat so that the timing reference marks on the teeth are found on the flyweel side.



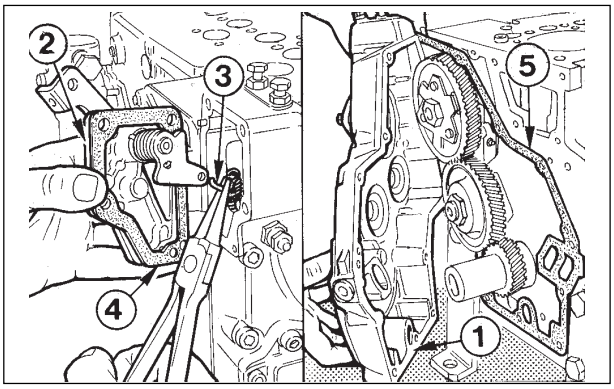
86

Dynamic balancer (on request) - Adjustment of clearance between teeth D and ring gear A

Follow figures 86 and 87.
Screw the screw **B** into support **C** taking care to centre the hole in the mass of the gear **D** to lock it.
Fit the mass assembly under the crankcase so that the tooth with reference **E** goes between the teeth with references **F.**
Fix the mass assembly with the four M10 screws to the crankcase, provisionally tightening it to 40 Nm.
By making the driving shaft turn, check the clearance between the ring gear **A** and the gear of mass **D**; set a comparator with the feeler on one tooth of the timing system control gear **G;** by turning the driving shaft a little way check the clearance which must be 0.026/ 0.067.
If the clearance measured does not come within the values given, repeat the operation placing the 0.05 mm shims provided for adjustment between the support **C** and the crankcase.
When mounting the balancer, lubricate the bushings with Molikote then couple the two masses, taking into account the references **H** and **I.**
Permanently fix the support **C** to the crankcase by tightening the screws to 50 Nm plus one turn of the wrench clockwise through 45°.
The four screws will have to be mounted with a few drops of Loctite 242.



87

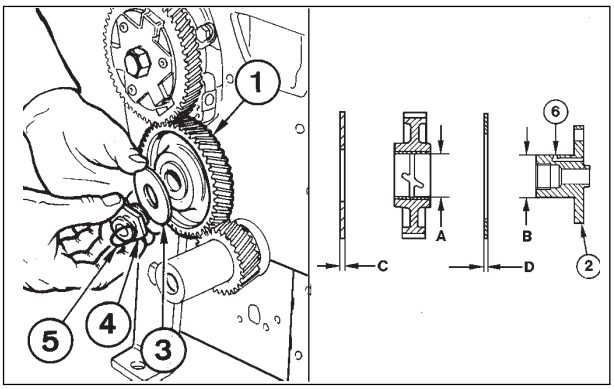


88 89

Front cover

To remove front cover **1** bring the 1st cylinder to the top dead center, remove throttle cover **2** and release spring **3.**
When refiting replace gasket **4** and **5;** tighten front cover **1** to 25 Nm.

I

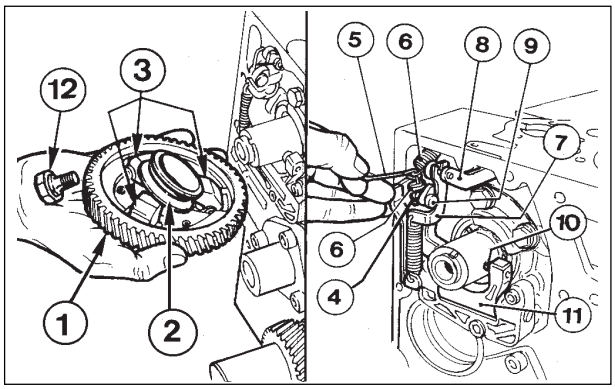


90 91

dler gear and hub

Components:
1 Idle wheel **2** Hub
3 Thrust washer **4** Fitting
5 Oil seal ring **6** Bushing lubrication hole
Dimensions (mm):
A = 36.00/36.02
B = 35.959/35.975
C = 1.95/2.05
D = 0.96/1.00
Clearance (mm):
(A-B) = 0.025/0.061 **(A-B)** worn limit = 0.120
End play = 0.10/0.30 limit = 0.6

Note: Unscew fitting **4** clockwise and when refitting it to 200 Nm.

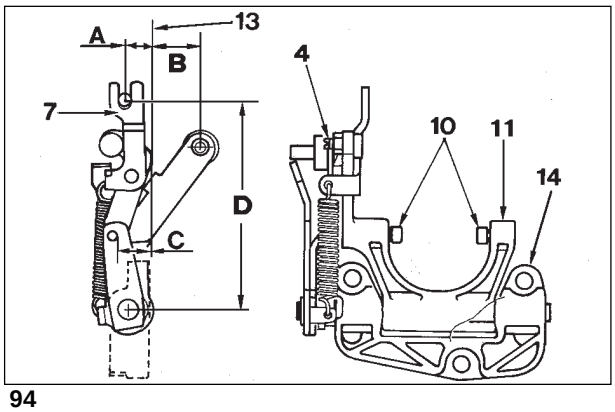


92 93

Speed governor

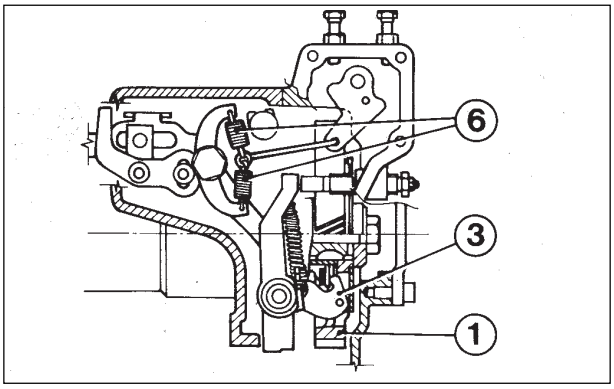
Components:
1 Gear
2 Bell
3 Counterweights
4 Adjusting screw
5 Throttle control rod
6 Governor spring
7 Control yoke for injection pump delivery rod
8 Injection pump delivery rod
9 Yoke **7** adjustement eccentric
10 Bushing
11 Lever
12 Bolt

Yoke **7** is pre-set through screw **4** and eccentric **9.** Do not unscrew, (see below).
When refitting camshat gear **1** tighten bolt **12** to 80 Nm.



94

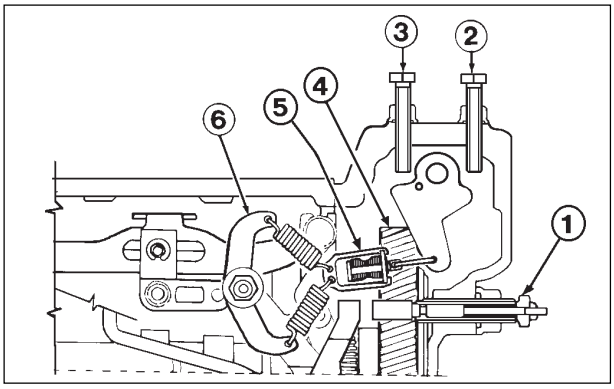
Dimensions for injection pump delivery control yoke adjustement
A = 10.8 **C** = 13.4 **D** = 88
Components:
4 Adjusting screw
7 Control yoke for injection pump delivery rod
10 Bushing
11 Lever
13 Reference and mounting plane for support **14**
14 Lever Support
Note: If, when adjusting, screw **4** is unintentionally loosened adjust yoke **7** considering the dimensions **A, C** and **D.**
In case of replacement lever **11** is supplied complete with pre-set yoke **7**.



95

Speed governor counterweights and springs

Counterweights **3** inside the camshaft gear come in two dimensions: for engines in the 2200 to 3000 rpm setting range and engines in the 1500 to 1800 rpm setting range.
For settings other than the standard one (3000 rpm) different springs 6 are used.

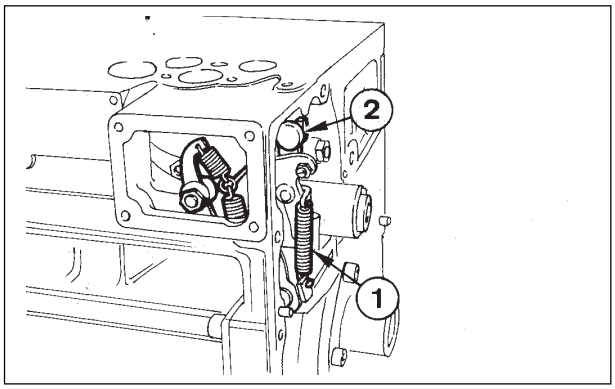


96

Frame with idling speed governor spring

Engines for applications requiring a certain power capacity at low speeds are fitted with the frame **5** complete with the idling speed spring which allows satsifying the above described requirements without the engine tending to stop.

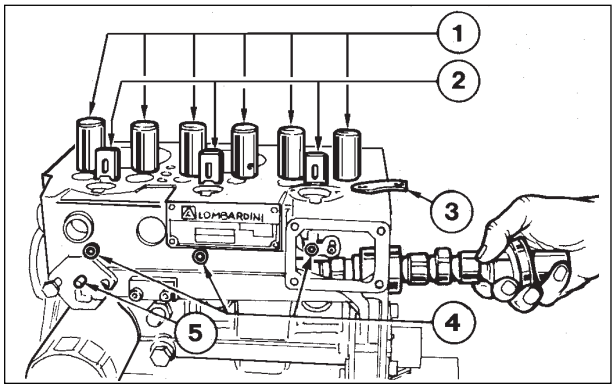
Components:
1 Adapter
2 Top speed adjustment.
3 Idling speed adjustment
4 Camshaft gear and speed governor
5 Frame for idling speed spring
6 Rocker arm with speed governor springs.



97

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 lever **2** providing maximum fuel delivery until the governor starts operating.



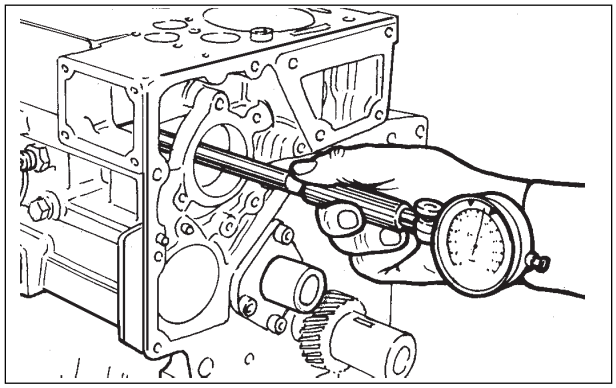
98

Camshaft

Camshaft removal

To remove camshaft first remove valve tappets **1**, injection pump follower **2,** bearing stop plate **3** and fuel pump control rod **5.**

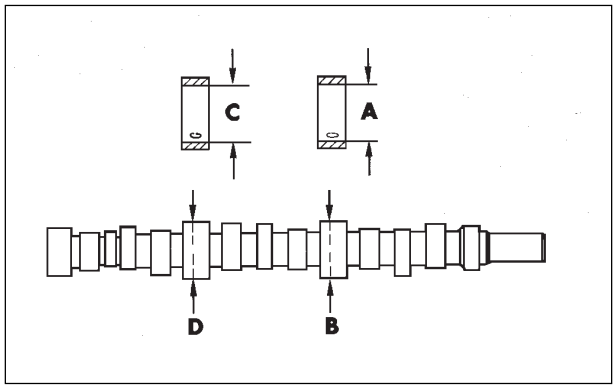
Note: To remove follower **2** loosen screw **4** by three or four turns.



99

Checking camshaft bushing internal diameter

Use a bore gauge.
If the diameter size does not correspond to the given value remove the bushings using the special tool (fig. 102 and 103) and replace.



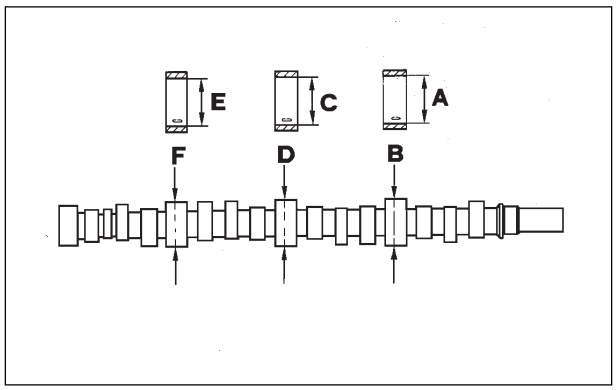
100

Camshaft journals and bushings in model LDW 1503

Dimensions (mm):
A = 43.000/43.025
B = 42.94/42.96
C = 42.000/42.025
D = 41.94/41.96

Clearance (mm):
(A-B) = 0.04/0.085 worn limit 0.16
(C-D) = " " " " "

Note: A and **C** values refer to driven in and bored bushings.

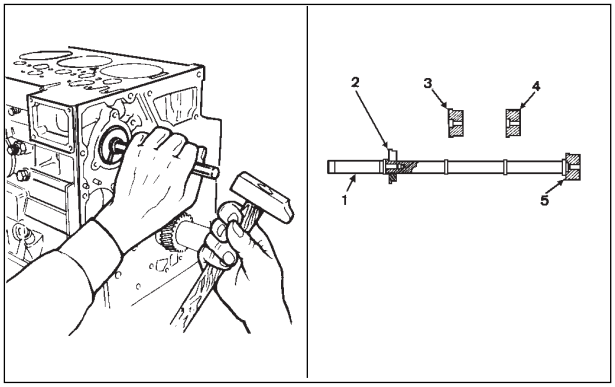


101

Camshaft journals and bushings in models LDW 2004, LDW 2004/T

Dimensions:
A = 44.000/44.025
B = 43.94/43.96
C = 43.000/43.025
D = 42.94/42.96
E = 42.000/42.025
F = 41.94/41.96

Clearance (mm)
(A-B) = 0.040/0.085 worn limit 0.16
(C-D) = 0.040/0.085 worn limit 0.16
(E-F) = 0.040/0.085 worn limit 0.16

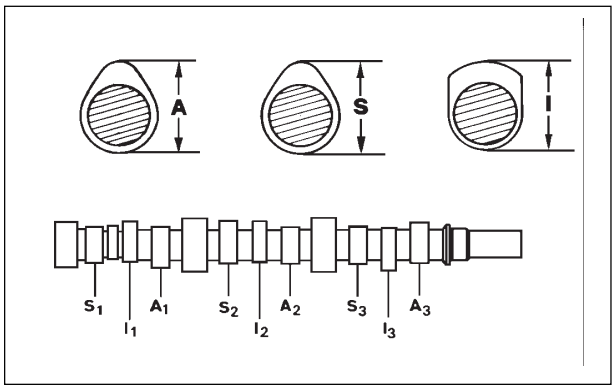


102 103

Camshaft bushing replacement

Tool part No.7104-1460-021
Components:
1 Mandrel
2 Centering bushing
3 Bushing diam. 44 mm
4 Bushing diam. 43 mm
5 Bushing diam. 42 mm

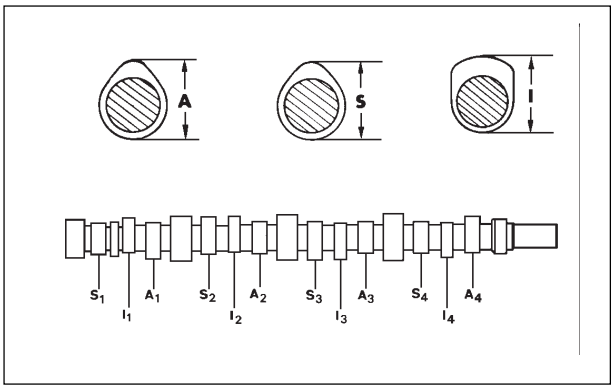
Note: Before driving in the bushing, position it in such a way that the lubricating hole maiches with the hole in the crankcase.



104

Intake, exhaust and injecton cam height for model LDW 1503

Dimensions (mm)
A = 36.058/36.12 **S** = 35.62/35.68 **I** = 33.85/33.90
A,S and **I** have a worn limit of 0.4
A1 =1st cylinder intake cam
S1 = 1st cylinder exhaust cam
I1 = 1st cylinder injection cam
A2 = 2nd cylinder intake cam
S2 =2nd cylinder exhaust cam
I2 = 2nd cylinder injection cam
A3 = 3rd cylinder intake cam
S3 = 3rd cylinder exhaust cam
I3 = 3rd cylinder injection cam

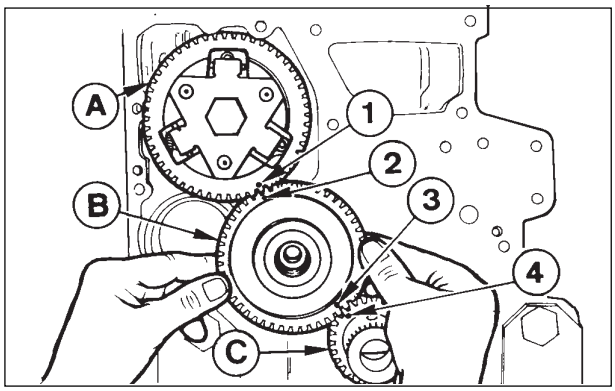


105

Intake, exhaust and injection cam height for models LDW 2004, LDW 2004/T

Dimensions LDW 2004
A = 36.058/36.12 **S** = 35.62/35.68 **I** = 33.85/33.90
Dimensions LDW 2004/T
A = 35.54/35.60 **S** = 35.24/ 35.30 **I** = 33.85/ 33.90

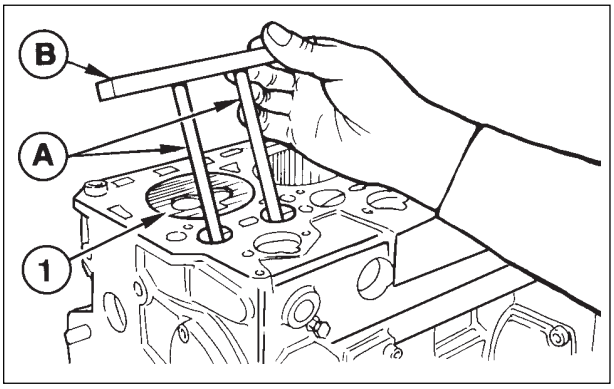
A1 = 1st cylinder intake cam **A3** = 3rd cylinder intake cam
S1 = 1st cylinder exhaust cam **S3** = 3rd cylinder exhaust cam
I1 = 1st cylinder injection cam **I3** = 3rd cylinder injection cam
A2 = 2nd cylinder intake cam **A4** = 4th cylinder intake cam
S2 = 2nd cylinder exhaust cam **S4** = 4th cylinder exhaust cam
I2 = 2nd cylinder injection cam **I4** = 4th cylinder injection cam



106

Camshaft timing

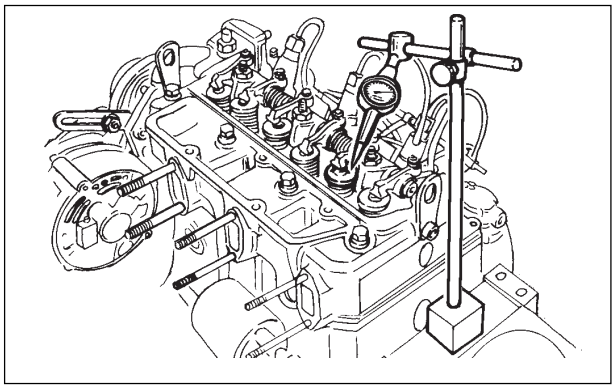
Fit idler gear B by making timing mark **2** coincide with timing mark **1** on the camshaft control gear **A** and mark **3** with **4** on the timing gear **C.**



107

Valve timing without considering timing marks

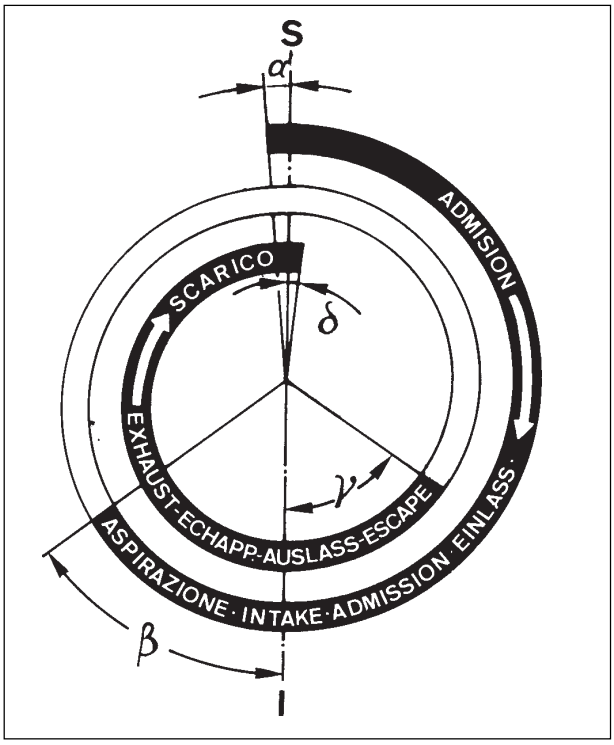
Locate piston 1 (on flywheel) at the top dead center. Position two small rods A of the same length onto the tappets.
Rotate camshaft stopping when cylinder 1 tappets are in overlap position (intake open exhaust closed).
Using the straight edge B check that rods A are at the same length.
Engage idler gear with camshaft and timing gear.



108

Valve timing check

Check valve timing at the crankshaft.
The values shown are checked at the flywheel circumference (with flywheel diameter of 290 each degree corresponds to 2.53 mm).
Set valve clearance at 0.65-0.70 mm (after checking reset the value to 0.15 mm).
Set dial gauge on intake valve to a zero value; by rotating the crankshaft according to its direction of rotation you can measure **a** (intake valve opening advance referred to top dead center **S**) and **b** (intake valve closing delay referred to bottom dead center **I**).
Follow the same procedure for exhaust valves checking **g** (exhaust valve opening advance)and **d** (exhaust valve closing delay).



109

Timing angles for checking puposes
(valve clearance = 2 mm)

a = 14° after **S** (corresponding to 35 mm on the flywheel)
b = 6° after **I** (corresponding to 15 mm on the flywheel)
g = 17° before **I** (corresponding to 43 mm on the flywheel)
d = 15° before **S** (corresponding to 38 mm on the flywheel)

Timing angles for operating purposes
(valve clearance 0.15 mm)

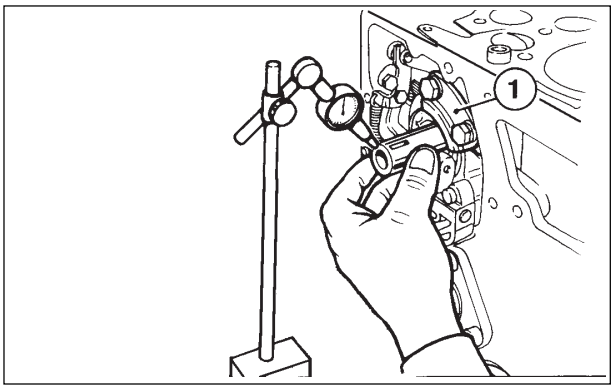
a = 14° before **S** (corresponding to 35 mm on the flywheel)
b = 34° after **I** (corresponding to 85 mm on the flywheel)
g = 46° before **I** (corresponding to115 mm on the flywheel)
d = 14° after **S** (corresponding to 35 mm on the flywheel)

Timing angles for checking purposes LDW 2004/T
(valve clearance 2 mm)

a = 15° after **S** (corresponding to 38 mm on the flywheel)
b = 21° after **I** (corresponding to 52 mm on the flywheel)
g = 31° before **I** (corresponding to 77 mm on the flywheel)
d = 13° before **S** (corresponding to 32 mm on the flywheel)

Timing angles for operating purposes LDW 2004/T (valve clearance 0.15 mm)

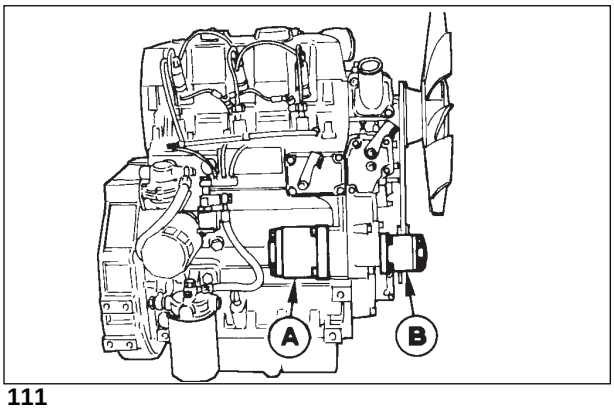
a = 12° before **S** (corresponding to 30 mm on the flywheel)
b = 48° after **I** (corresponding to 120 mm on the flywheel)
g = 58° before **I** (corresponding to 145 mm on the flywheel)
d = 14° after **S** (corresponding to 35 mm on the flywheel)



110

Camshaft end play

Check camshaft end play after removing the cylinder head, the injection and the fuel pumps from the engine. Check that plate 1 is tightened.
Position the dial gauge on the camshaft front surface; push and pull the camshaft.
Maximum end play should be o.oo8 mm (ball bearing end play).

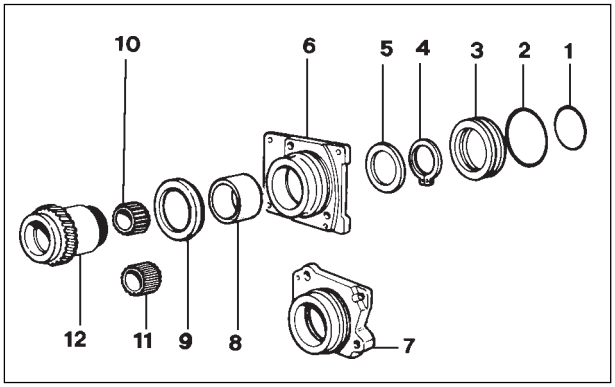


111

Hydraulic pump p.t.o.

A = 3rd p.t.o. with hydraulic pump Gr 2.
B = 4th p.t.o. with hydraulic pump Gr 1

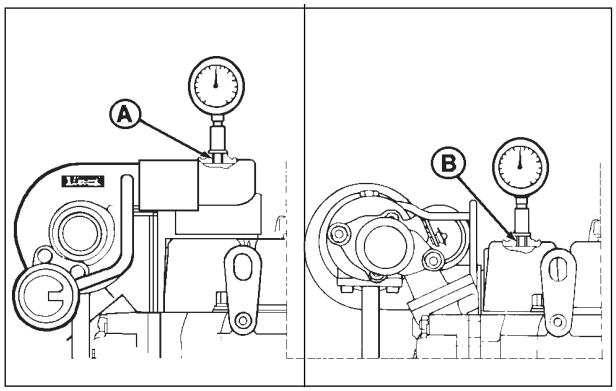
Hydraulic pumps of either GR 1 or GR 2 type can be fitted, even simultaneously, on the erd and 4th p.t.o. provided the resulting power does not exceed 12.27 kW which equals a torque of 40 Nm.
The gear ratio between engine r.p.m. and 3rd and 4th p.t.o. is 1:1.



112

GR 1 and GR 2 hydraulic pump 3rd p.t.o.

1 O-R
2 O-R
3 Center ring
4 Circlip
5 Thrust washer
6 GR 2 hydraulic pump flange
7 GR 1 hydraulic pump flange
8 Bushing
9 Trust washer
10 GR 2 hydraulic pump drive gear
11 GR 1 hydraulic pump drive gear
12 Control gear

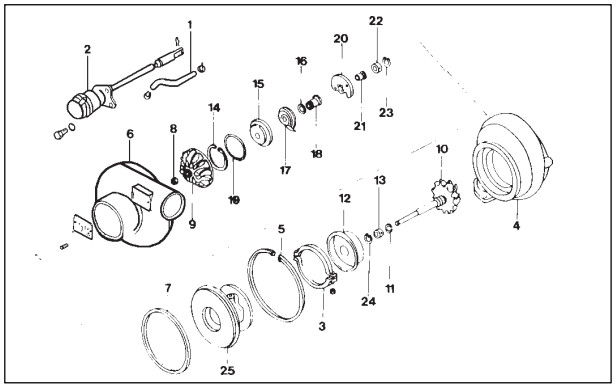


113 114

Turbocharger

It is installed on the engine in two versions: with air intake on the flywheel side and with air intake on the fan side.

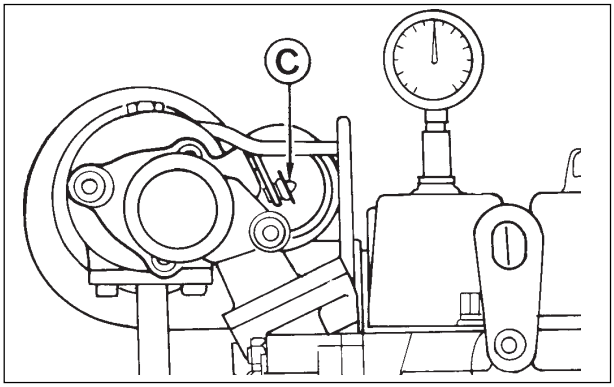
To control the supercharge air pressure, screw the pressure gauge into the M8 holes **A** and **B** both for the version with air intake on flywheel side (fig. 113) and for air intake on fan side (fig.114)



115

Turbocharger components

1 Flexible hose
2 Actuator
3 Collar
4 Turbine body
5 Snap ring
6 Compressor volute
7 Thickness
8 Nut
9 Lock nut
10 Shaft with turbine
11 Segment
12 Flame shield
13 Bearing
14 Snap ring
15 Thickness
16 Segment
17 Oil deflector
18 Thrust block sleeve
19 O-ring
20 Thrust block bearing
21 Thrust block ring
22 Bearing
23 Snap ring
24 Snap ring
25 Bearing support



116

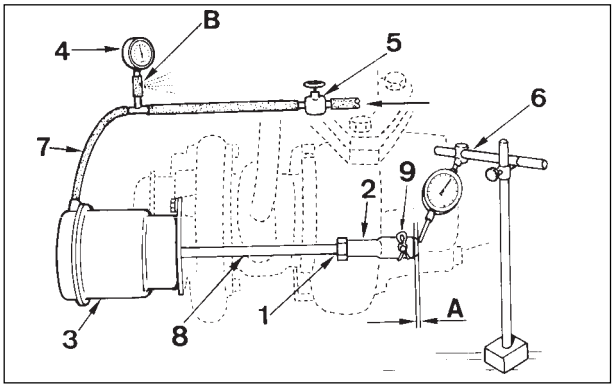
Turbocharger Testing

Get a pressure gauge with scale from zero to 2 bar, connect it according to fig, 113 and 114.

Start up the engine, warm it up for a few minutes, then take it to 3000 rpm at the power NB.

The supercharge air pressure value to be measured is 89/93 KPa (0.89/0.93 bar).

If the setting pressure does not come within the required value it is necessary to adjust the stroke of the valve control rod **C** (Wastegate), see below.

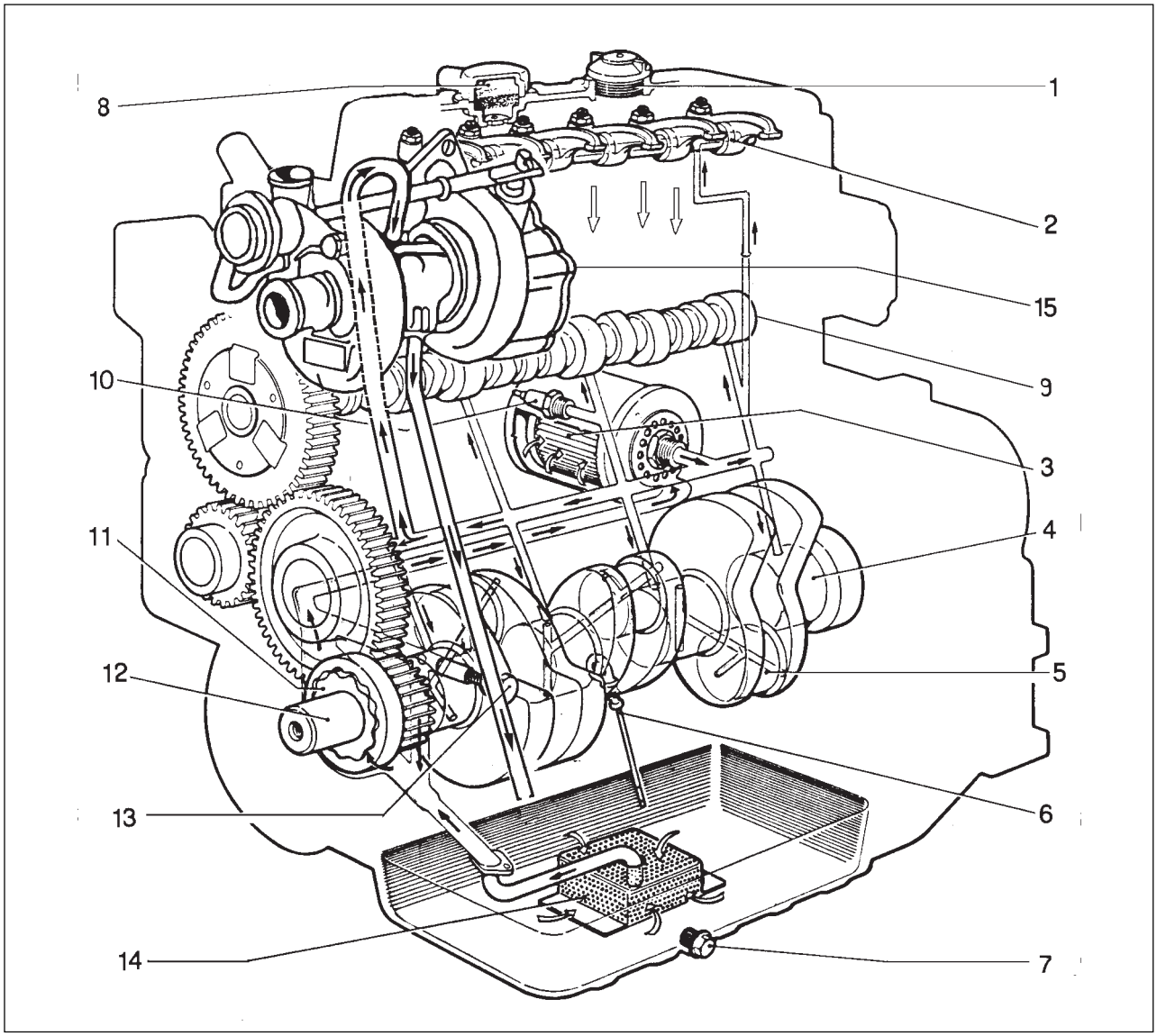


117

Checking actuator setting - "Waste gate" valve control rod stroke adjustment

This test must be done with the engine stationary.
Disconnect pipe **7** from the compressor side.
Using a **T** coupling, connect up with a pressure gauge **4** (scale from zero to 2 bar) and with the compressed air mains pipe complete with reduction unit **5.**
The mains air pressure must be 1.5/2.0 bar. Make a hole **B** diameter 1.5 mm in the pressure gauge pipe where part of the air will escape which has the purpose of stabilizing the pressure in the pressure gauge.
Use the reduction unit **5** to send air to the actuator so as to make terminal **2** of **A** move forward (A = 1 mm).
Position a comparator **6** so that the feeler rests on the terminal **2.**
The pressure read on the pressure gauge must be 830/890 mm Hg (1.11/1.19 bar). If the pressure is lower than the given value, proceed as follows.
Unscrew the lock nut **1.**
Remove the split pin **9** and disconnect the rod **8**. Keeping the rod stationary, screw the terminal **2** to reach the setting pressure. While the terminal is rotating the rod must undergo no twisting.

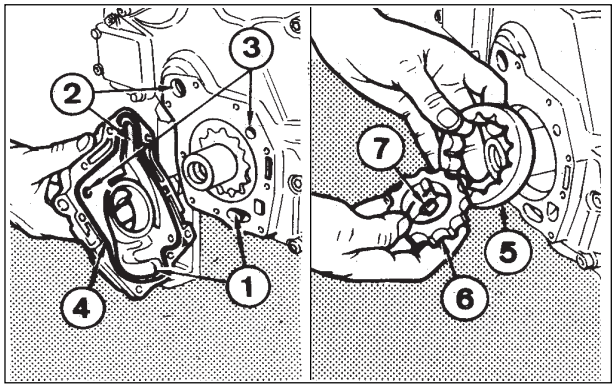
LUBRICATION SYSTEM LAYOUT



118

Components:

1) Oil fill cap
2) Rocker arm shaft
3) Oil filter
4) Main journal
5) Connecting rod journal
6) oil dipstick
7) Drain plug
8) Breather
9) Camshaft
10) Oil pressure switch
11) Oil pump
12) Crankshaft
13) Oil pressure adjusting valve
14) Oil pick-up screen
15) Turbocharger, only on LDW 2004/T.



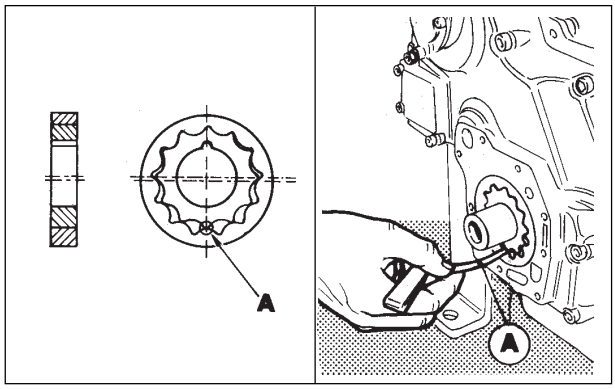
119 120

Oil pump

Components:

1 Suction port
2 Delivery port
3 Oil pressure adjusting Valve port
4 Gasket
5 External rotor
6 Internal rotor
7 Key

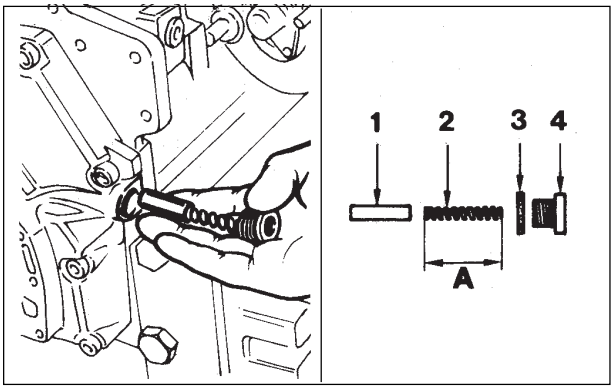
The oil pump is driven by the crankshaft via key 7. Rotor 6 is locked in the circumferential but not in the axial direction. This allows the shaft to move axially while rotors 5 and 6 are prevented from damaging the pump sealing surfaces.
Oil pump capacity = 24.5 litres/min. at a pressure of 4.5/4.75 bar (engine speed 3000 rpm, oil temperature 38/42°C).



121 122

Oil pump rotor clearance

Measure clearance **A** between the teeth located along the axis of the
keyway (as shown in the figure); its value is 0.150 mm; worn limit clearance 0.280 mm.



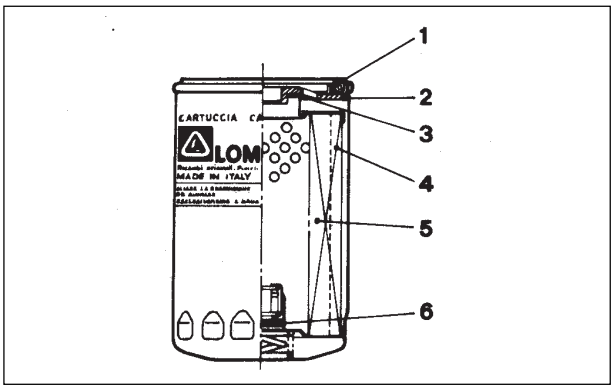
123 124

Oil pressure adjusting valve

Components:
1 Valve
2 Spring
3 Gasket
4 Plug

Dimensions (mm):
A = 45.5/46.0

Blow compressed air into the valve seat and carefully clean all components; using a caliper measure the length of spring **A**.

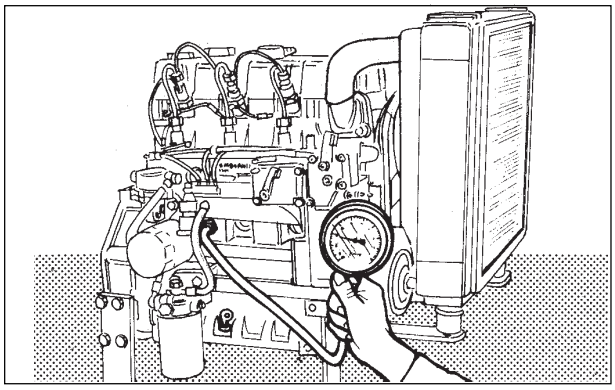


125

oil filter cartridge

Components:
1 Gasket
2 Plate
3 Gasket
4 Blade
5 Filtering material
6 By-pass valve

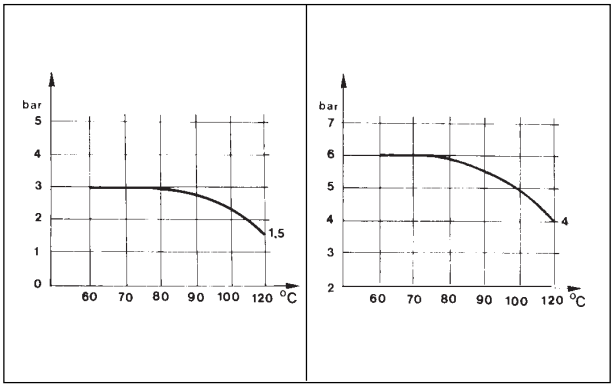
Specifications:
Max. working pressure = 7 bar
Max. explosion pressure = 20 bar
Low temperature limit = -35°C
By-pass valve setting = 2.1/2.8 bar
Total filtering surface = 2000 cm2
Degree of filtration = 15 µm



126

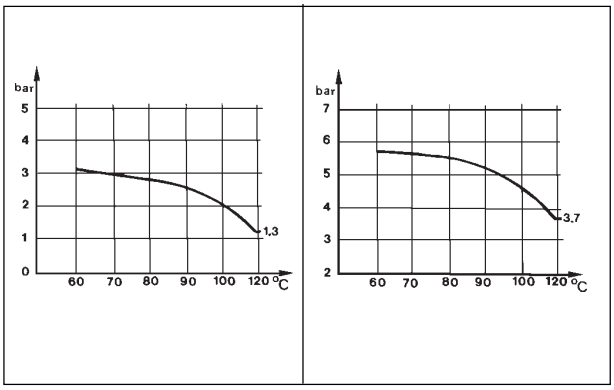
Oil pressure check

On completing assembly, fill with engine oil and fuel; connect a 10 bar pressure gauge to the pressure switch fitting.
Start the engine and check pressure as a function of the oil temperature (see below).



127 128

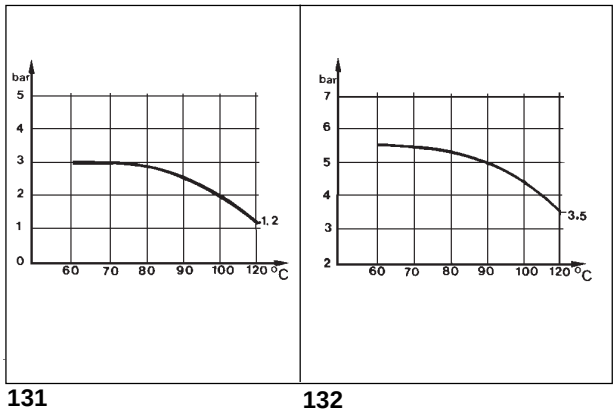
Oil pressure curve for LDW 1503
.Fig. 127 - The curve is obtained at the oil filter level constant engine speed of 850 rpm in no-load conditions.
Fig. 128 - The curve is obtained at the oil filter level with engine working at 3000 rpm at the N power.



129 130

Oil pressure curve for LDW 2004

.Fig. 129 - The curve is obtained at the oil filter level constant engine epeed of 850 rpm in no-load conditions.
Fig. 130 - The curve is obtained at the oil filter level with engine working at 3000 rpm at the N power.



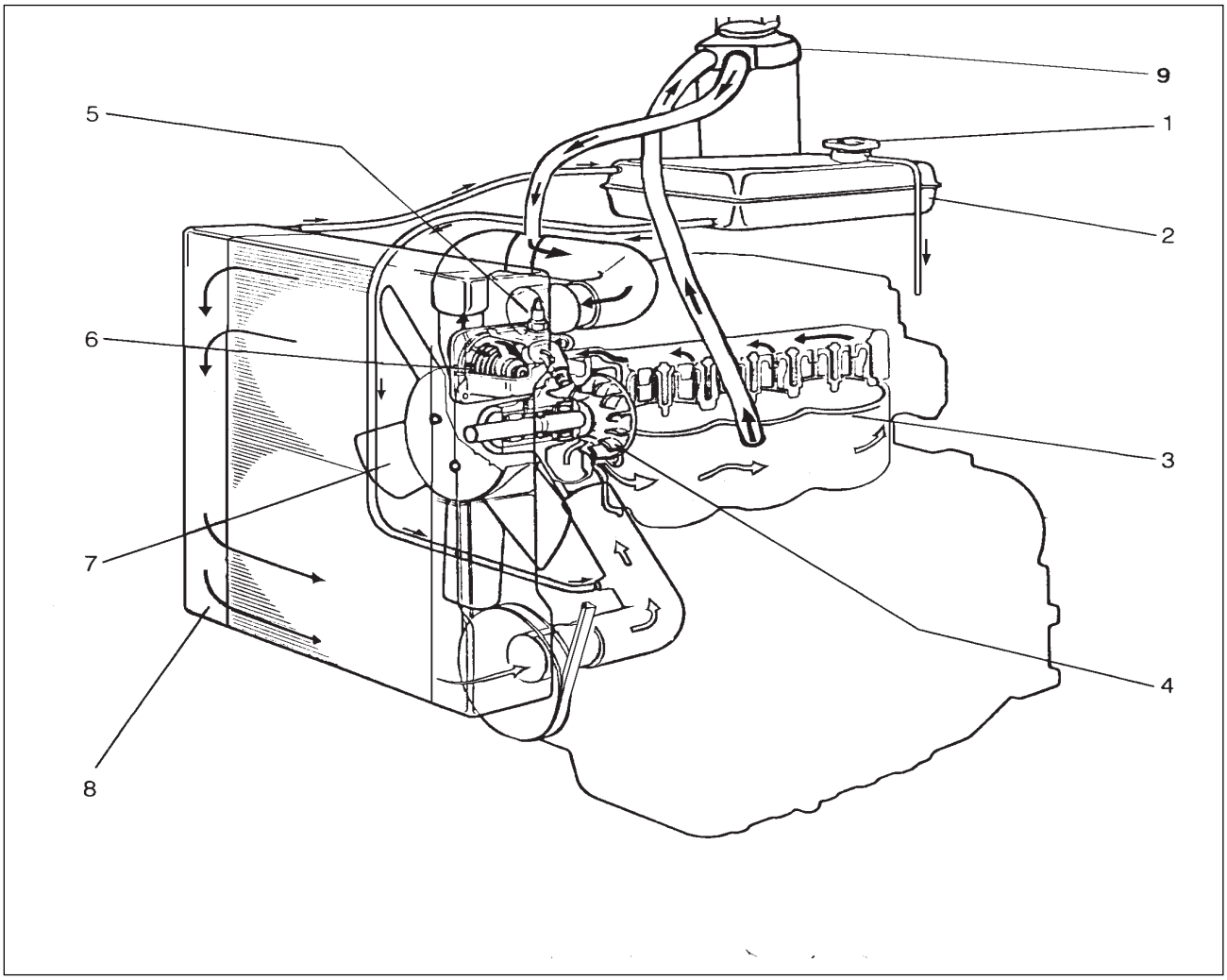
131 132

Oil pressure curve for LDW 2004/T

.Fig. 131 - The curve is obtained at the oil filter level constant engine epeed of 850 rpm in no-load conditions.
Fig. 132 - The curve is obtained at the oil filter level with engine working at 3000 rpm at the N power.

Note:
The max lubrication oil temperature must be lower than the sum: ambient temperature + 95°C.

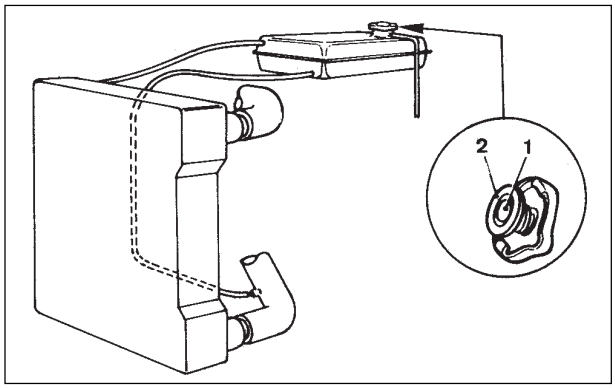
COOLING SYSTEM



133

Components:

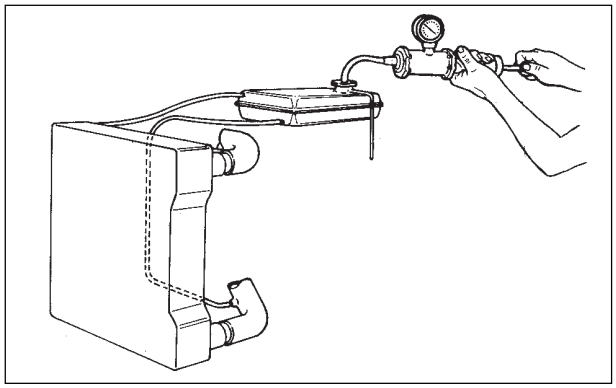
1) Coolant fill cap
2) Expansion tank
3) Cylinder block
4) Circulating pump
5) Coolant temperature warning lamp
6) Thermostat
7) Fan
8) Radiator
9) Heat exchanger, only on LDW 2004/T.



134

Expansion tank and cap

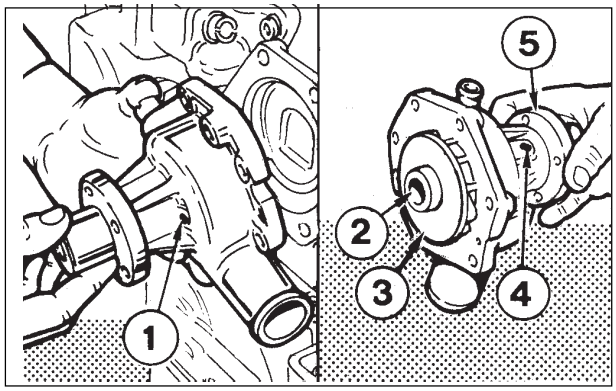
The expansion tank is separated from the radiator and is fitted with a coolant fill cap. The cap comes with vacuum valve 1 and pressure relief valve 2.
The pressure relief valve opens at a pressure of 0.7 bar.



135

Checking for cooling system leaks
Remove the cap from the expansion tank and check coolant level.
Replace the cap with one fitted with portable hand air pump coupling as shown in the figure.
Compress air at a pressure of 1 bar for approximately 2 minutes.
Check that no leaks occur.

Note: In normal conditions clean radiator fins every 250 hours. In adverse conditions, clean as necessary.
Replace coolant as specified on page 5.

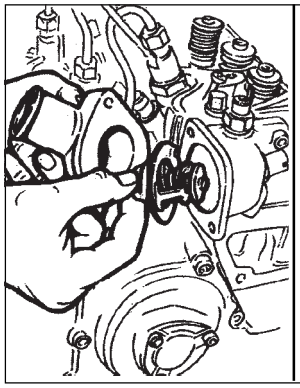


136

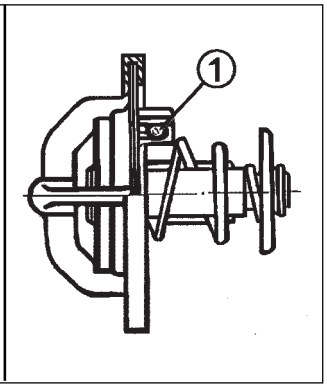
137

Coolant circulating pump

Impeller 3 and hub 5 are fitted to the shaft by press fit.
To remove the impeller, screw the M 18x1.5 bolt into bore 2.
To remove that shaft take 4 which locks the bearing to the pump body.
A seal is located on the shaft between the bearing and the impeller.
In case of worn-out seal, coolant leaks from hole 1.
LDW 1503 and LDW2004:
The ratio between the pump and engine rpm = 1:1.2
Pump delivery at 3000 rpm is 70 liters/min.
LDW 2004/T:
The ratio between the pump and engine rpm = 1:1.5
Pump delivery at 3000 rpm is 116 liters/min.



138

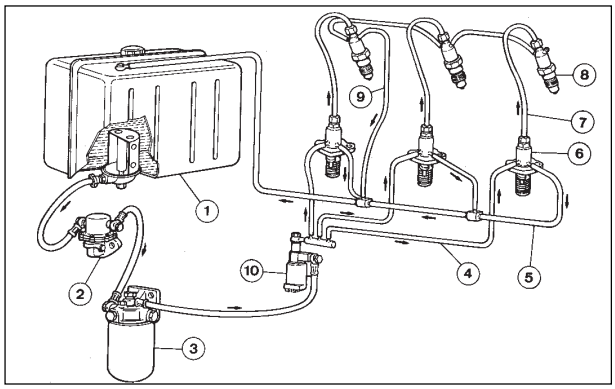


139

Thermostat

1 - Air valve

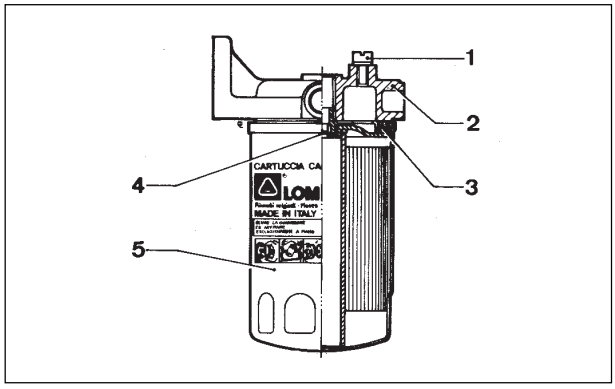
Specifications:
Opening temperature: 77°/81°C
Max. stroke at 94°C = 7.5 mm
Coolant flow rate with thermostat and valve in closed position = 15 Liters/h.



140

Fuel feeding/injection circuit

Components:
1 - Tank
2 - Fuel feeding pump
3 - Fuel filter
4 - Fuel feeding tube
5 - Return tube
6 - Injection pump
7 - High pressure tube
8 - Injector
9 - Injector return tube
10 - Solenoid valve



141

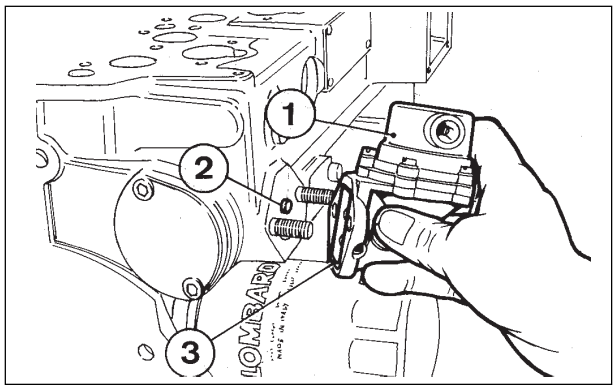
Fuel filter

Components:
1 - Drain screw
2 - Cover
3 - Seal
4 - Fitting
5 - Cartridge

Cartridge specifications

Filtering paper:	PF [illegible]04
Filtering area:	5000 cm2
Filtering degree:	2/3 m
Max. working pressure:	4 bar

See page 5 for maintenance details.



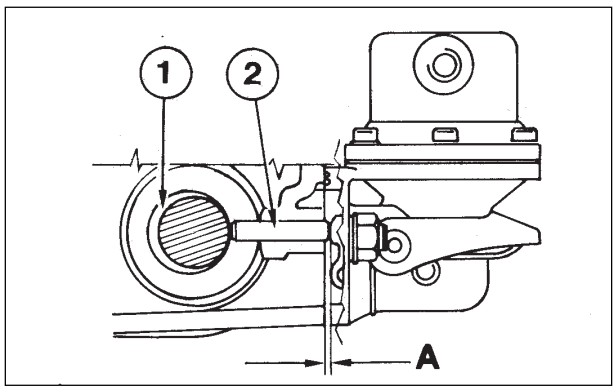
142

Fuel feeding pump
Components:
1 - Feeding pump
2 - Push rod
3 - Seal ring

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

Characteristics:

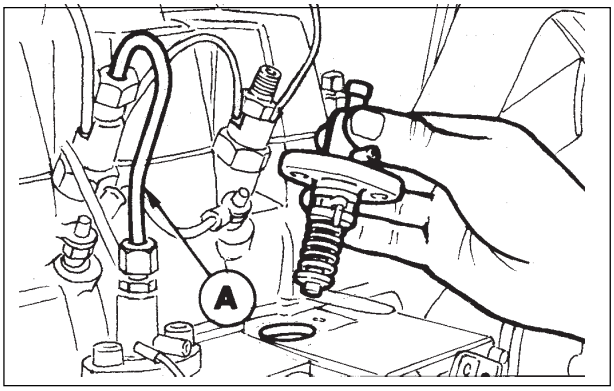
When the control eccentric rotates at 1500 rpm minimum delivery is 64 l/h while self-regulation pressure is 5/6 m water column.



143

Fuel feeding pump drive rod protrusion

Push rod 2 shows a protrusion A of 1.5/1.9 mm from the crankcase plane. Check this value with eccentric 1 at the lowest point.
Push rod length = 32.5/32.7 mm.
Check push rod length and replace push rod if size is inadequate.

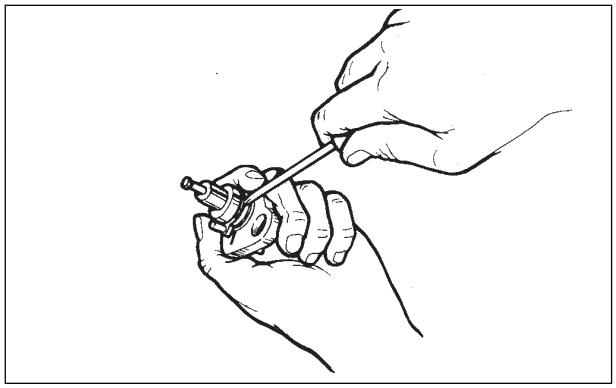


144

Injection pump

The injection pump of a simplified **Q** type has been designed by LOMBARDINI for installation on engines of the **CHD** series**: LDW 1503, LDW 2004, LDW 2004/T**.
The injection system includes three or four separate pumps each of which feeds a cylinder.
Located on the crankcase at the level of the corresponding cylinder, pumps are directly operated by the camshaft. All high pressure tubes **A** feature the same shape and dimensions.

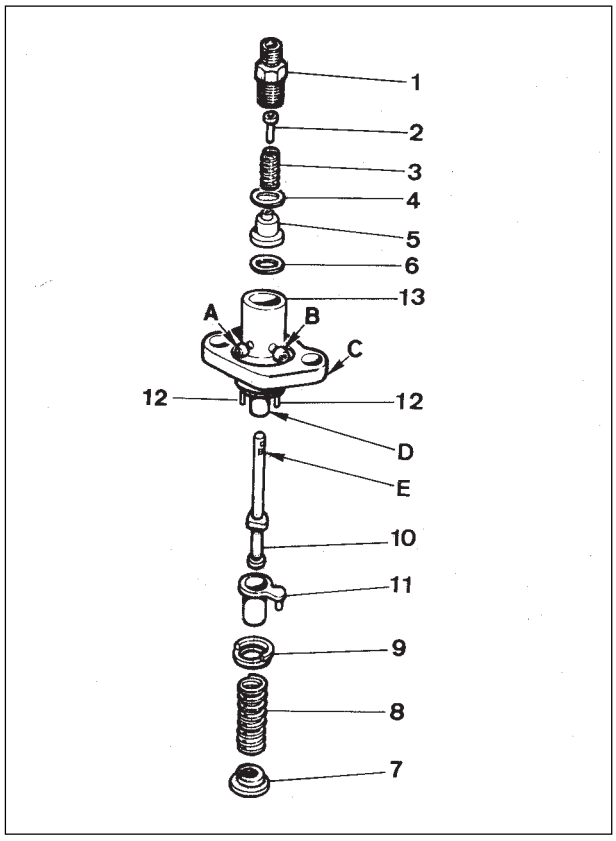
Note: The diameter of the pumping element of the injection pump of the LDW 2004/T engine is larger, see Fig. 157.



145

Injection pump disassembly

Release the spring from the cap and remove the plunger.
Two pins keep the upper cap connected to the pump body; pry with a tool between the pump body and the cap.



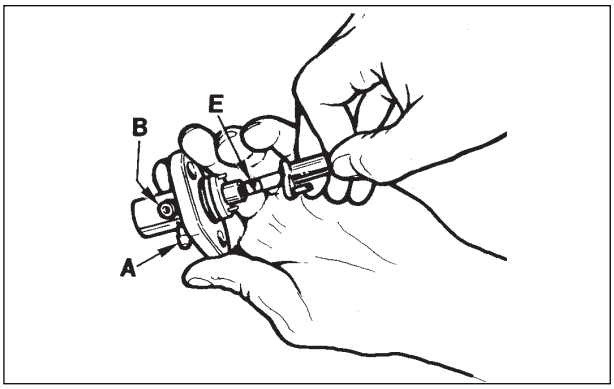
146

Injection pump components

1 Delivery union
2 Spacer
3 Spring
4 Gasket
5 Delivery valve
6 Gasket
7 Cap
8 Spring
9 Upper cap
10 Plunger
11 Lever
12 Pin
13 Body

A Fuel feed union
B Fuel dischrge union
C Pump flange
D Barrel
E Fuel control helix

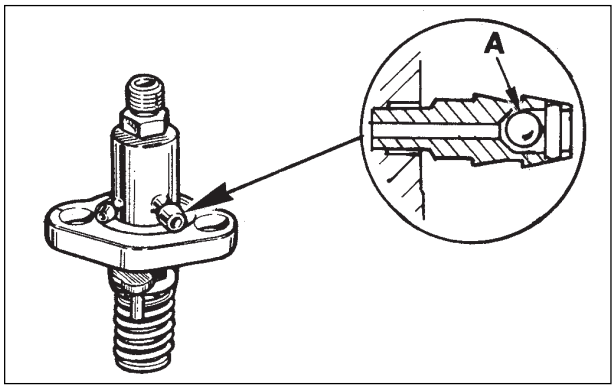
Note: Union **A and B,** flange **C** and barrel **D** form an integral part of the pump body.



147

How to reassemble injection pump components

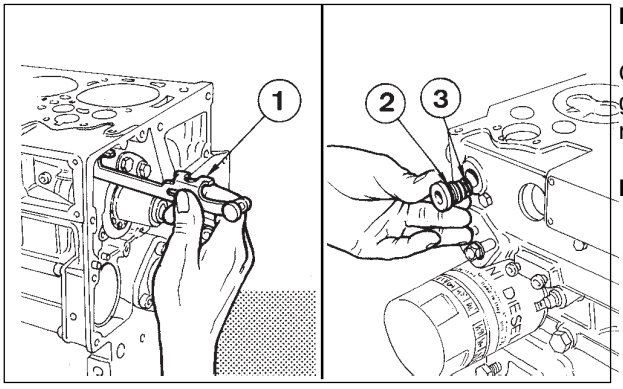
Fit the plunger with helix **E** directed towards the discharge union **B**; if it is erroneously fitted with spiral facing the fuel feed union **A** the injection pump will not operate (thus the possibility of the engine overspeeding is completely ruled out); complete reassembly following fig. 146 and 147.
Tighten delivery union to 35 Nm.



148

Injection pump non-return valve

The discharge union is fitted with a non-return valve **A;** this valve improves injection by bleeding the air inside the fuel and stops the engine immediately after the stop device is operated.

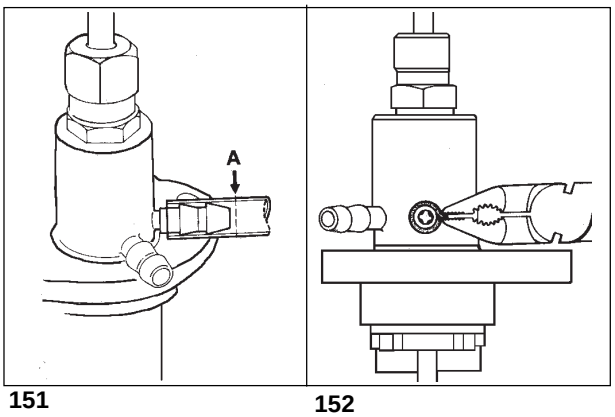


149 150

Injection pump control rod

Control rod **1**, operated by the throttle and controlled by the speed governor, controls the injection pump. Ring nut **2** keeps rod **1** in the required position by means of groove **3.**

Note: Do not unscrew ring nut **2** before removing rod **1.**



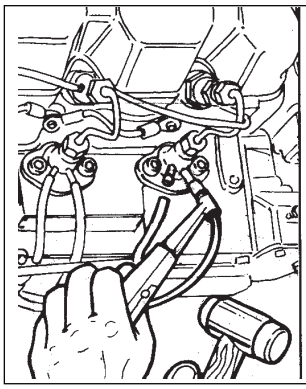
151 152

How to remove injection pump feeding tubes

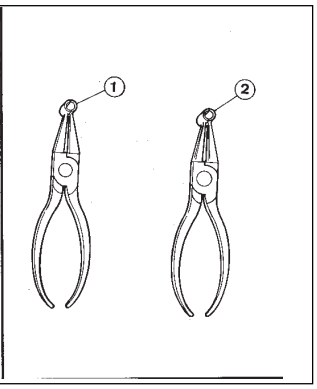
Cut the nylon tube at A.
Remove the portion left inside the union using pliers. Deform the nylon tube without damaging the union seals as shown in the figure.

Warning:

Cutting the pipe in the opposite direction to the arrow A (horizontally) damages the pump coupling with consequent leakage of fuel.



153

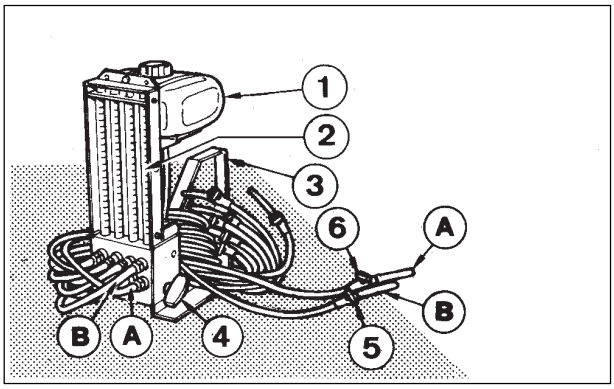


154

How to reassemble injection pump feeding tubes

1 Pliers for 6 mm diam. tubes - Part No. 7104-1460-022
2 Pliers for 8 mm diam. tubes - Part No. 7104-1460-023

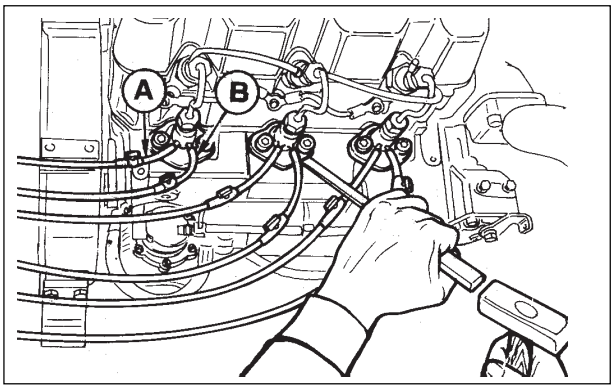
Feeding and discharge tubes are made of nylon; they fit into the injection pump unions by exerting pressure and using special pliers and a plastic hammer.



155

Instrument for equalizing injection pump delivery - Part No. 7104-1460-090
Components:
1 Tank
2 Test tube
3 Support
4 Handle
5 Injection pump discharge tube cut-off valve
6 Injection pump intake tube-off valve
A Tube for connection to injection pump intake union
B Tube for connection to injection pump discharge union

- Remove feed tubes from all injection pumps and fit the instrument tubes making sure that each pump has its own intake and discharge tubes; with reference for figures 155 and 156 connect the instrument **A** with the engine **A** and the instrument **B** with the engine **B**.
  Proceed in a similar manner with the other pumps.
- Open valves **5** and **6** of each tube and completely fill with clean Diesel fuel.
- Start the engine and carry out the test at 2000 rpm in no-load conditions; the maximum equalization error between the test tubes should not exceed 2 cm^3 /1 min.

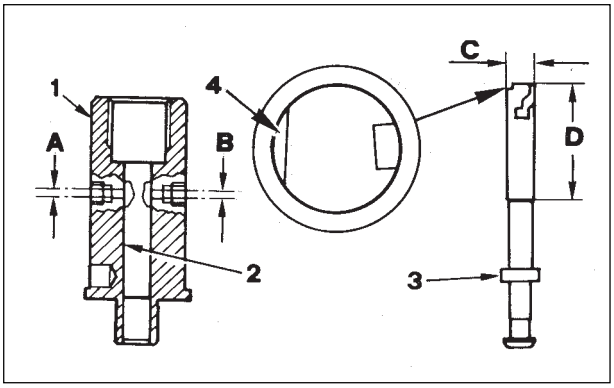


156

Injection pump delivery equalization.
Once instrument with Part No.7104-1460-020 has been connected and filled with fuel, locate it at least 20 cm. above the injection pump level. Bring the engine to 2000 rpm in no-load conditions. Cut off fuel supply from the engine by turning handle **4** Fig 155. Then check test tube levels. If a level is lower than the others reduce delivery of the corresponding pump. Bearing in mind that the pump flange screw bores are slot-shaped do as follows: loosen the screws fixing the pump to the crankcase by 1/4 turn.
With drift and hammer tap so that the pump body is allowed to slightly rotate. Delivery increases by turning clockwise and decreases by turning counterclockwise. Tighten screws to 25 Nm. Any time an injection pump is replaced delivery equalization should be performed.

Note: A reference notch is located between the pump flange and its mounting on the crankcase. If one or more pumps are disassembled and reassembled do as follows:

- Leave the shims for injection timing setting under each pump unchanged.
- Each pump should be reassembled in its own housing. Align the delivery reference notches located on the pump flange with those on the crankcase.

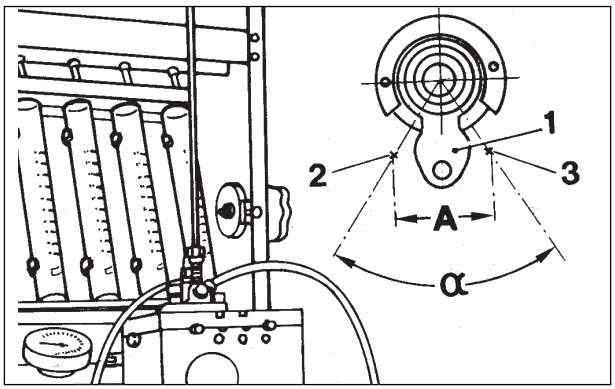


157

Injection pump P. No. 6590-249 - Plunger and barrel assembly

Components:
1 Pump body **2** Barrel **3** Plunger
4 Retardation notch
Dimensions (mm):
A = 2.00/2.03 **B** = 1.50/1.53 **C** = 6.00
D = 26.00 **E** = 0.47/0.50

Note: Barrel 2 forms an integral part of the pump body 1. For this reason both the barrel and plunger 3 should not be replaced. When checking static injection timing refer to retardation notch 4.
The new injection pump Part No. 6590-267 has a pumping element of the same size but has no retardation notch.
The injection pump Part No. 6590-251 mounted on the LDW 2004/T has a pumping element of diameter **C** of 7 mm and has no retardation notch.



158

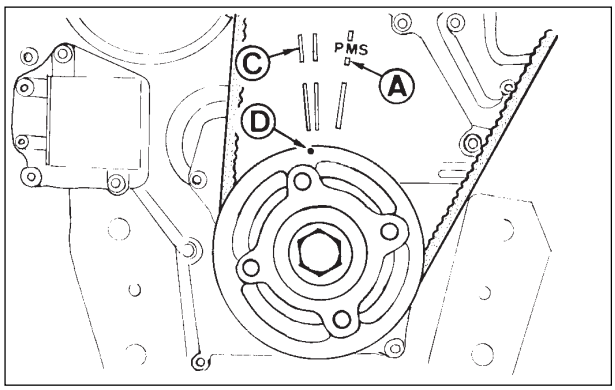
Checking injection pump delivery
1 Delivery adjustment rod
2 Rod 1 stop position
3 Rod 1 max. delivery position
A = 18.5/19.5 mm (rod max. stroke)
a= 66° (rod max. rotation)

Test data of injection pump P.No 6590-267 for LDW 1503, LDW 2004

Control rod max. force	Rod stroke from max. delivery point	Camshaft rpm	Delivery
Newton	mm	rpm	mm3/stroke
0.35	9	1500	30/40
	9	500	25/35
	0	150	56/66

Test data of injection pump P.No. 6590-251 for LDW 2004/T

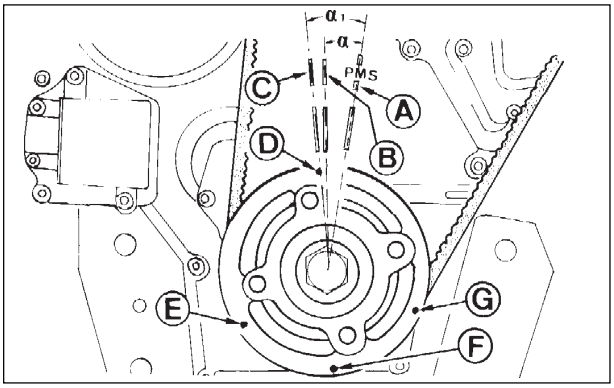
Control rot max. force	Rod stroke from max.delivery point	Camshaft rpm	Delivery
Newton	mm	rpm	mm3/stroke
0.35	9	1500	40/48
	9	500	20/28
	0	150	58/64



159

Checking low pressure injection timing

Fill the tank and connect it to the inlet pipe **4** of the injection pump fig. 161. Check that the level of fuel in the tank is at least 20 cm above the injection pump. If this is not possible, excite the solenoid valve by means of the starter key and operate the supply pump.
Disconnect the outlet pipe **3** fig. 161 and introduce a metal wire making it protrude by approximately 1 cm to check dripping.
Put all the injection pumps in the stop position by using the appropriate lever.
By turning the driving pulley in the direction of rotation of the engine (clockwise), take the 1st cylinder to the TDC of compression, go back by 1/4 of a turn, see below.

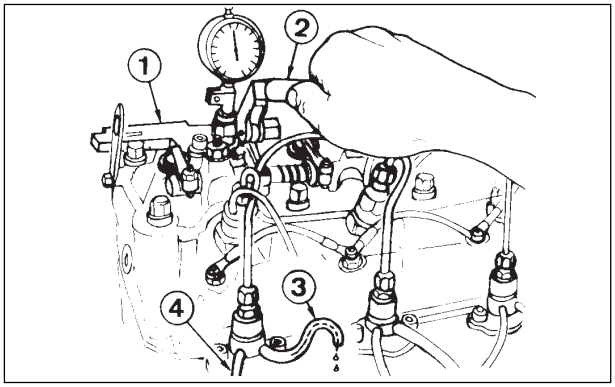


160

Fuel will be seen to come out of the outlet pipe **3** of the injection pump.
Slowly turn the pulley clockwise, taking care to stop as soon as fuel stops dripping: this is the static injection timing.
If the TDC reference of the pulley of the 1st cylinder **D** does not coincide with **C** (standard injection timing reference fig. 160) remove the injection pump and replace the pad with one of the right thickness, fig.161.
Proceed in the same manner with the other pumps, bearing in mind that TDC references of every cylinder are given on the pulley, fig.160.

Note: Changing the thickness **B** by 0.1 mm fig 163 (or the thickness of the seal of the old system) changes timing by approximately **1** degree.

Injection timing and top dead centre references of cylinders LDW 1503, LDW 2004, LDW 2004/T (fig. 160)
A = TDC on timing system cover
B = Injection timing reference with respect to the TDC for adjustments under 2400 rpm, **a** = 10°/12°.
C = Injection timing reference (standard) with respect to the TDC for adjustments from 2400 to 3000 rpm, **a**1 = 12°/14°; for LDW 2004/T from 2400 to 3000 rpm, **a** = 7°, for adjustments under 2400 rpm, **a** = 3/5°



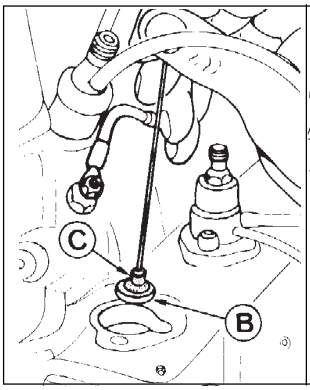
161

References on the pulley (fig 160)
D = TDC of the 1st cylinder LDW 1503, of the 1st and 4th cylinder LDW 2004 and LDW 2004/T
E = TDC of the 2nd cylinder LDW 1503
F = TDC of the 3rd and 2nd cylinder LDW2004, LDW 2004/T
G = TDC of the 3rd cylinder LDW 1503.

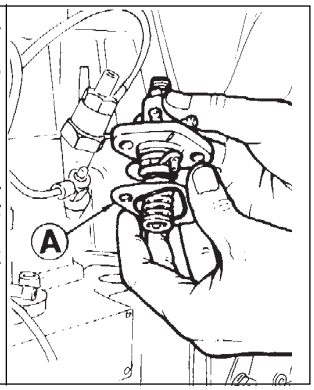
Injection timing control in low pressure making reference to lowering the piston with respect to the TDC.
When it is not possible to access the pulley due to a lack of space inside the application, it is possible to cotnrol the injection timing by using the tool 1 Part No. 7107-1560-075 fig. 161 with the advantage of obtaining more exact values than the above described control.
Remove the rocker arm cap, intake manifold and mount tool **1** as in the figure.
Put all the injection pumps in the stop position by using the appropriate lever.
Take the piston to TDC; by operating lever **2,** take the intake valve into contact with the piston and zero the comparator.
Turn the pulley anticlockwise by 1/4 of a turn, then again clockwise proceeding very slowly, observing the dripping of pipe **3** fig. 161 taking care to stop as soon as the fuel stops dripping. This is the injection timing also according to what is described in fig.160.
By using the lever **2** check the lowering of the piston with respect to the TDC, making reference to the table on the left, note that the standard injection timing for the LDW 1503, LDW 2004 con **a**= 13° corrisponds to lowering the piston 1.405 mm.
The table shows lowering the piston referring to the injection timings of the other cylinders, fig. 160.
To correct the injection timing replace the thickness of the pad inside the injection tappets, fig. 163 or the shim under the injection pump of the old system.
fig 164.

a	LDW 1503 LDW 2004 LDW 2004/T (mm)
15°	1.866
14°	1.627
13°	1.405
12°	1.198
11°	1.008
10°	0.834
9°	0.676
8°	0.534
7°	0.409
6°	0.301
5°	0.209

162



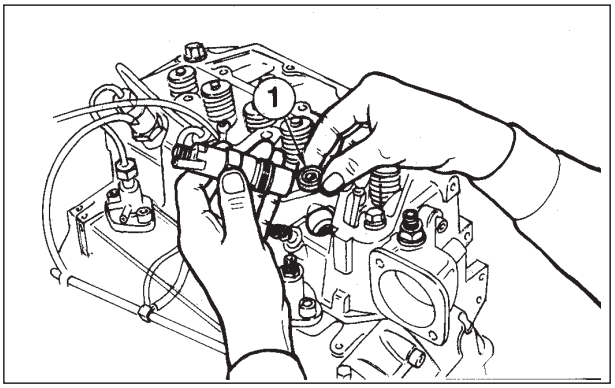
163



164

Injection timing correction by changing the pad thickness

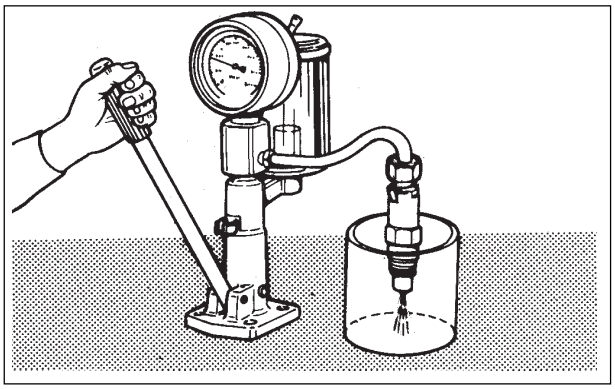
The new system comprises a single seal **A** under the flange of the injection pump and moreover has the purpose of ensuring a seal against any oil leakage.
In addition to the thickness of the seal **A** the injection timing is determined by the thickness of the pad inside the injection tappet.
To remove the pad **B** use a rod with a sucker **C** or a magnet at its end.
The spare pads supplied have 8 different thicknesses (from 4.0 to 4.7 mm) and the value of the thickness is stamped on the bottom of the pad.



165

Injector

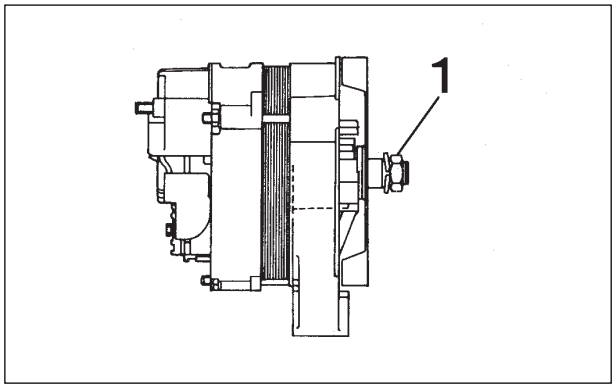
Whenever maintenance operations are carried out on the injector clean the seal ring and replace it if not in proper condition.
Introduce seal ring 1 into the injector housing with the sealing surface facing upwards (see figure).
See page 5 for maintenance intervals.
Fix injector to the head tightening to 70 Nm.



166

Injector setting

Connect injector to a hand pump and check that setting pressure is 140/150 bar; Make the required adjustments, if any, by changing the shim over the spring. Eleven different shims are available as spares with size from 1 to 2 mm.
When replacing the spring, setting should be performed at a 10 bar greater pressure(160 bar) to allow for bedding during operation.
Checke needle valve sealing by slowly moving the hand pump until approximately 120 bar per 10 seconds.
Replace nozzle in case of dripping.

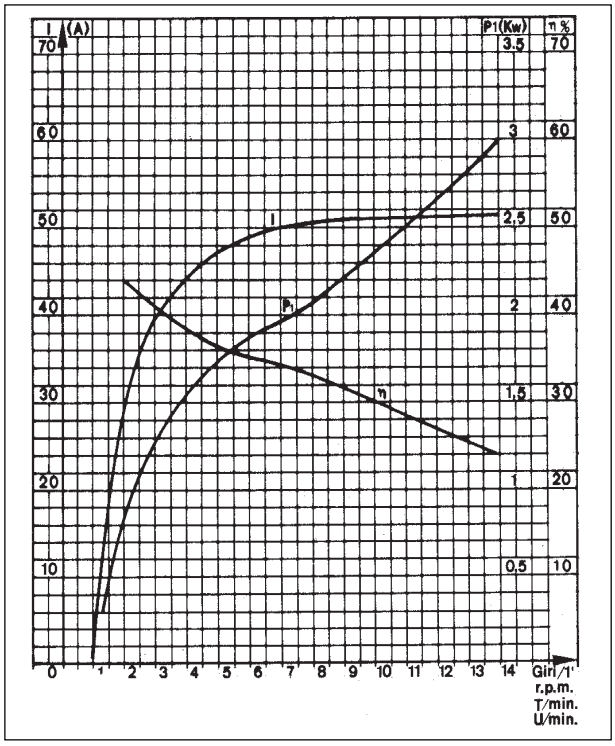


167

Alternator type Marelli AA 125 R 14V 45A

Characteristics:
Rated voltage = 14V
Rated current = 45A
Max. speed = 14000 giri/1'
Peak speed (max 15 min) = 15000 rpm
Bearing on control side = 6203.2z
Bearing on manifold side = 6201-2z/C3
Voltage regulator = RTT 119 AC
RH direction of rotation.

Note: Lube the two bearings with high temperature grease.
Tighten the nut **1** to 60 Nm.
The alternator has a **W** terminal for a speed indicator.

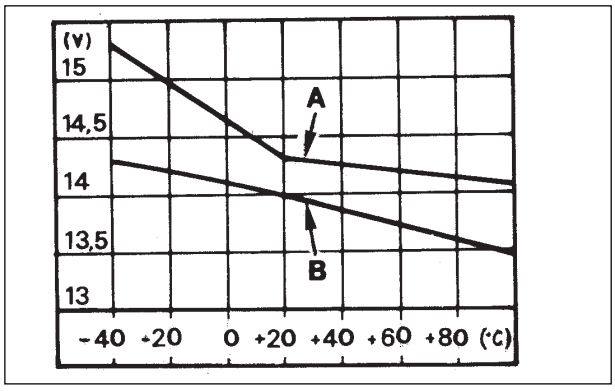


168

Characteristic curves for alternator type Marelli AA 125 R 14V 45A

The curves have been detected with electronic voltage regulator after thermal stabilization at 25°C; test voltage 13.5 V.
P1 = Power in kW
I = Current in Ampere
h = Alternator efficiency

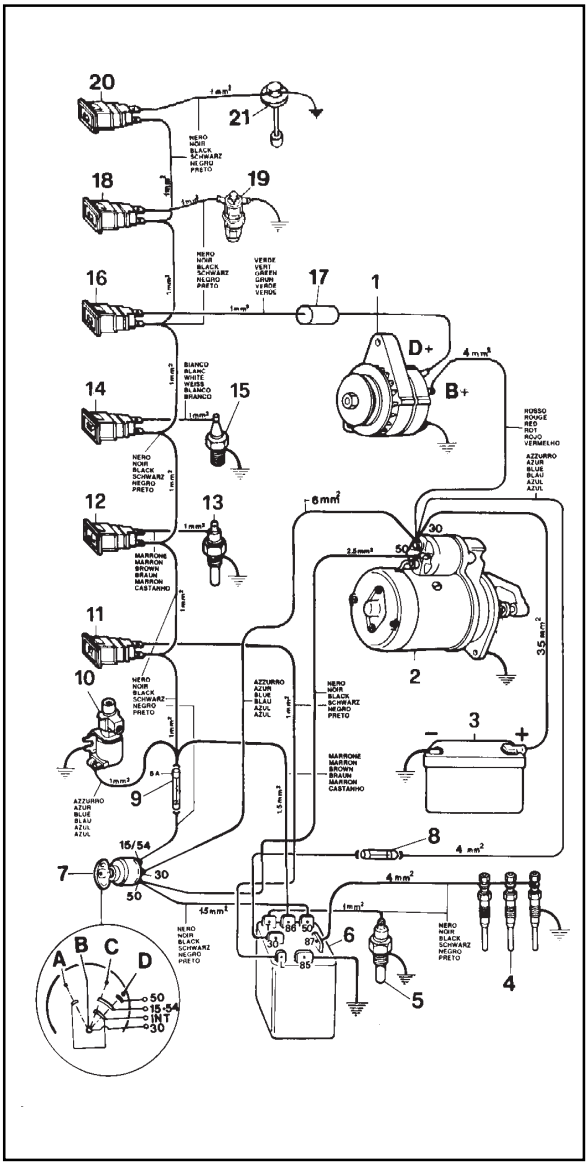
Note: The alternator rpm is equal to to the rpm shown in the table multiplied by 1000.
Ratio between engine/alternator rpm = 1:1.8



169

Characteristic voltage curve for regulator type RTT 119 AC

The electronic voltage regulator is built into the alternator.
The curve changes depending on temperature.
A = Max. voltage curve
B = Min. voltage curve



170

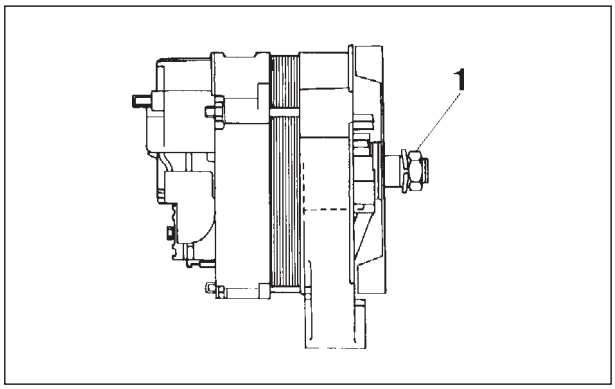
12V Electric wiring -Marelli 14V - 45A

1 Alternator
2 Starter Motor
3 Battery (See below for sizing details)
4 Glow Plugs
5 Thermistor (Glow Plug Controller Circuit)
6 Glow Plug Controller / Timer
7 Key Switch
8 System Fuse, 50A (LDW 1503), 80A (LDW 2004,2004/T).
9 Fuse (Accessory)- 5A
10 Fuel Valve
11 Glow Plug Indicator Lamp
12 Coolant High Temperature Lamp
13 Coolant High Temperature Switch (N.O.)
14 Oil Pressure (Low) Lamp
15 Oil Pressure Switch (N.C.)
16 Alternator Charging Lamp (Off if Charging)
17Diode
18 Air Filter High Restriction Indicator
19 Air Filter Restriction Switch (N.O.)
20 Low Fuel Level Lamp
21 Low Fuel Level Switch (N.O.)

A Accessory
B Off Position
C On Position
D Starting Position

Note: This electric starting diagram holds for both 45A and 65A alternators.
Battery 3 is not supplied by LOMBARDINI.
Anyhow, for installation we recommend a battery for all the range of engines with the following particulars, see following table.

Engine Model	Starter Rating (Kw)	Normal Ambient Conditions		Extreme Ambient Conditions	
		Amp-Hours @ 20 hours Rating	Maxim.Battery Amps @ -18° C	Amp-Hours @ 20 hours Rating	Maxim.Battery Amps @ -18° C
LDW 1503	2.2	88	330	110	450
	3	110	450	143	570
LDW 2004	2.2	88	330	110	450
	3	110	540	143	570
LDW 2004/T	2.2	88	330	110	450
	3	110	540	143	570



171

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Rated current = 45A
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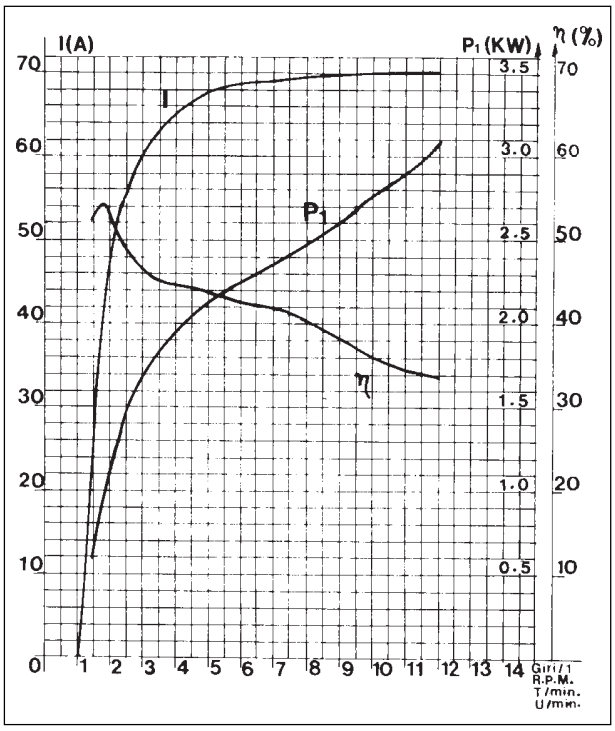
Bearing on control side = 6203.2z
Bearing on manifold side = 6201-2z/C3
Voltage regulator = RTT 119 AC
RH direction of rotation.

Note: Lube the two bearings with high temperature grease.
Serrare il dado **1** a 60 Nm.
The alternator has a **W** terminal for a speed indicator.

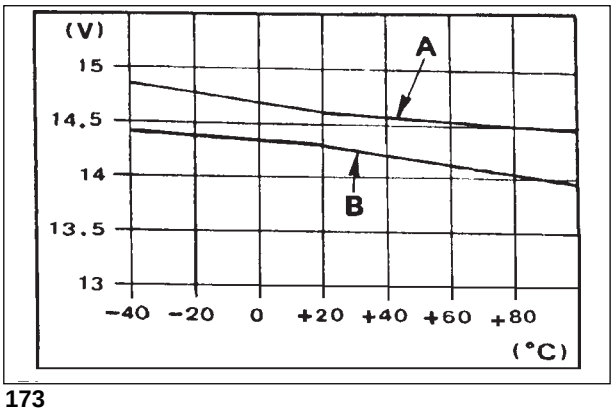


172

Characteristic curves for alternator type Marelli AA 125 R 14V 65A

The curves have been detected with electronic voltage regulator after thermal stabilization at 25°C; test voltage 13.5 V.
P1 = Power in kW
I = Current in Ampere
h = Alternator efficiency

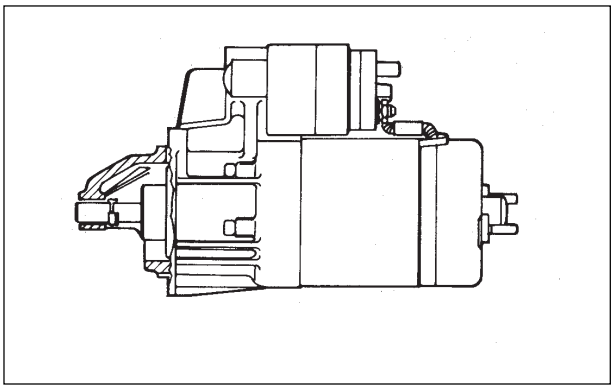
Note: The alternator rpm is equal to the rpm shown in the table multiplied by 1000.
Ratio between engine/alternator rpm = 1:1.8



173

Characteristic voltage curve for regulator type RTT 119 AC

The electronic voltage regulator is built into the alternator.
The curve changes depending on temperature.
A = Max. voltage curve
B = Min. voltage curve

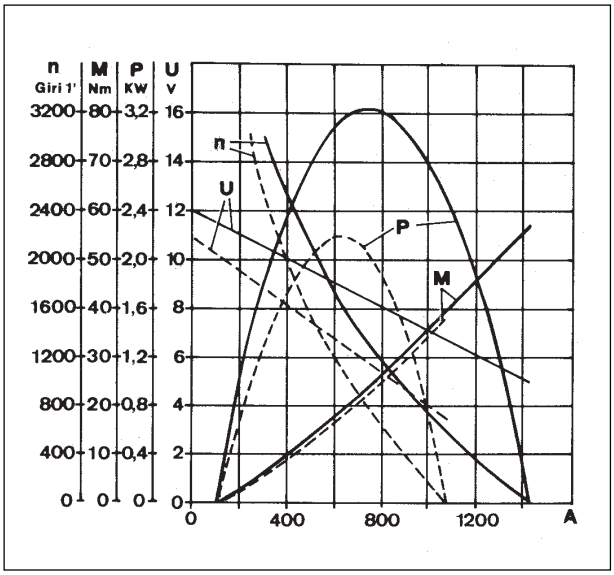


174

Starting Motor

Bosch type EV 12V 2.2 Kw
RH direction of rotation.

Note: Apply to a Bosch service center for any tipe of repair.

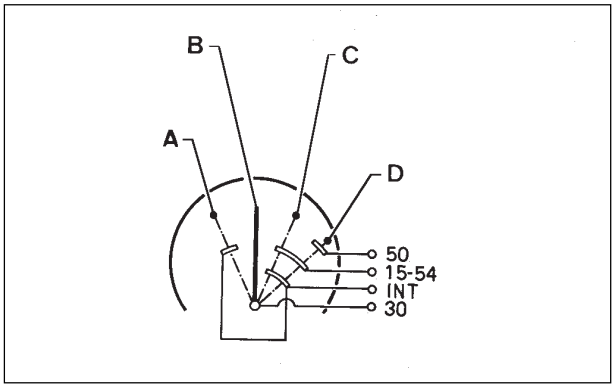


175

Characteristic curves for starting motor type Bosch EV 12V 2.2 kW

The solid lines were obtained at a temperature of +20°C; the dotted lines were obtained at a temperature of -20°C.Battery type 110 Ah 450A.

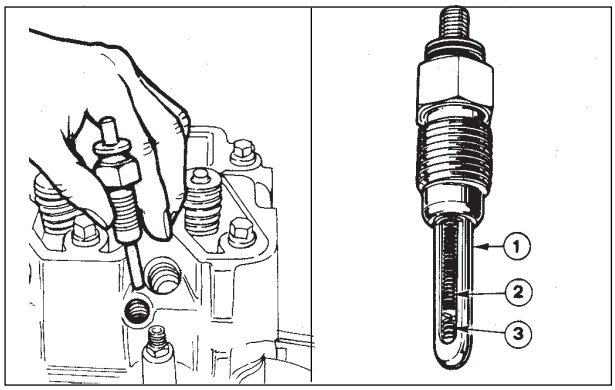
U = Motor terminal voltage in Volt
n = Motor speed in rpm.
A =Absorbed current in Ampere
P =Power in kW
M = Torque in Nm



176

Key switch electrical layout

A = Accessory
B = Off position
C = On position
D = Starting position

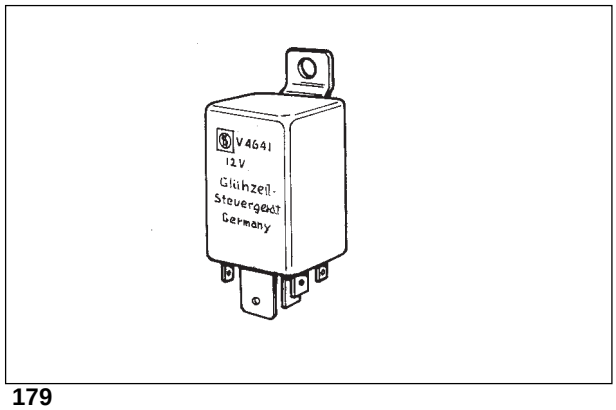


177 178

Pre-heating glow plug

Characteristics:
Nominal voltage = 12.5V
Current = 12/14A after 5 seconds
Sheath surface temperature = 850°C after 5 seconds

Components:
1 Sheath
2 Regulation filament
3 Heating filament
Installation torque 20 Nm.



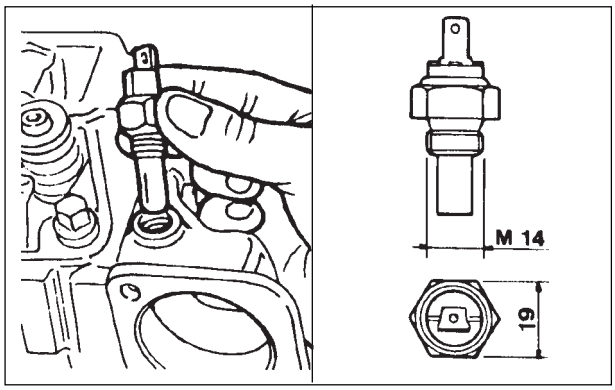
179

Glow plug controller relay with coolant temperature sensor
To avoid white smoke generation at cold start-up, post-heating is maintained for approximately 5 sec. after starting.

Transducer		Heating time in seconds		
Resistance (ohm)	Temp.fluid °C	Pre-heating	Post-heating	*
7000	-20	23.5/29.5		
2400	0	13.5/16.5		4/7
1000	+20	8.5/10.5		
460	+40	6.0/8.0		
£ 320	+50	no heating		

4/7

***** Time the operator has available before starting up the starter motor.

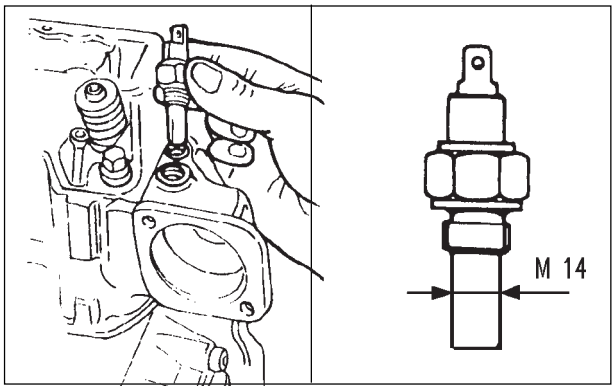


180 181

Temperature sensor (Thermistor)

The thermistor is located on the thermostat housing, adjacent to the high coolant temperature switch. The thermistor must be installed in the thermostat housing in the port located nearest to the cylinder head. (See the figure to the left)

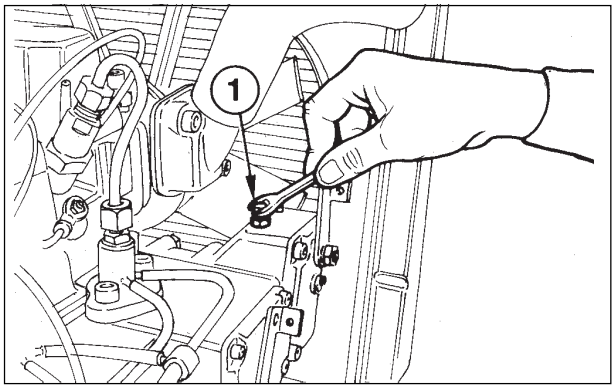
Characteristic:
Working range = 30/50°C
Voltage = 6/24 V
Max. temperature = 150°c
Max. installation torque = 30 Nm.



182 183

Coolant high temperature lamp switch
Characteristics:
Single-pole circuit, normally open
Supply voltage: 6/24V
Absorbed power: 3W
Circuit closing temperature: 107/113°C
When refitting tighten to 25 Nm.

Note: As an alternative to the thermostat, on request the thermistor for an electrical thermometer can be fitted with the following characteristics:
Power supply voltage = 6/24 V
Resistance: at 60°C = 600/470 **W**; at 90°C = 215 **W**; at 120°C = 93/73 **W**.



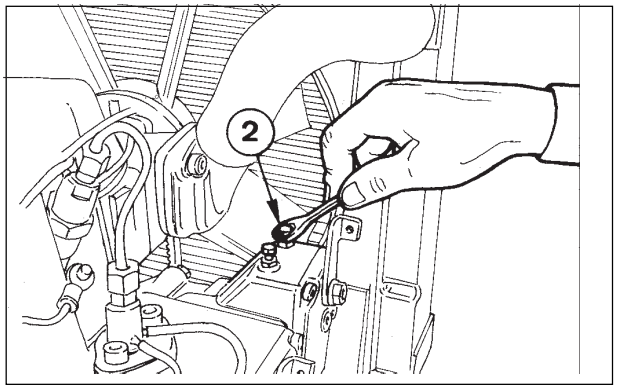
184

Settings

Idling speed setting in no-load conditions (standard)

After filling with oil, fuel and coolant, start the engine and warm up for 10 minutes.
Adjust idling speed at 850.950 rpm by turning screw **1** then tighten lock nut.

Note: Speed decreases when loosening scew **1** and increases when tightening it.

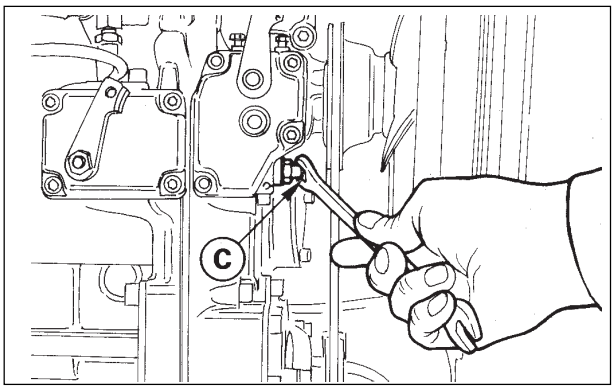


185

Full speed setting in no-load conditions (standard)

After setting idle speed turn screw **2** and set full speed in no-load conditions at 3200 rpm; then tighten lock nut.
When the engine reaches the pre-set power, full speed stabilizes at 3000 rpm.

Nota: Speed increases when loosening scew **2** and decreases when tightening it.

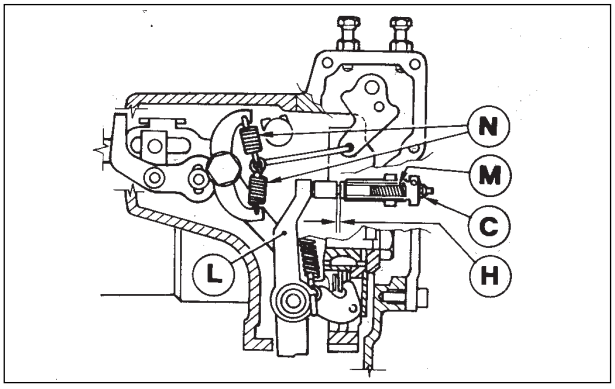


186

Standard injection pump delivery setting without torque dynamometer

Injection pump delivery setting should be performed with engine on a dynamometer; if not, setting will only be approximate.
In any case, do as follows:
Loosen delivery limiting device **C** by 5 turns.
Bring engine to max. rpm in no-load conditions i,e. 3200 rpm.
Tighten limiting device **C** until the engine rpm decreases.
Unscrew limiting device **C** by 1 1/2 turn.
Tighten lock nut.

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

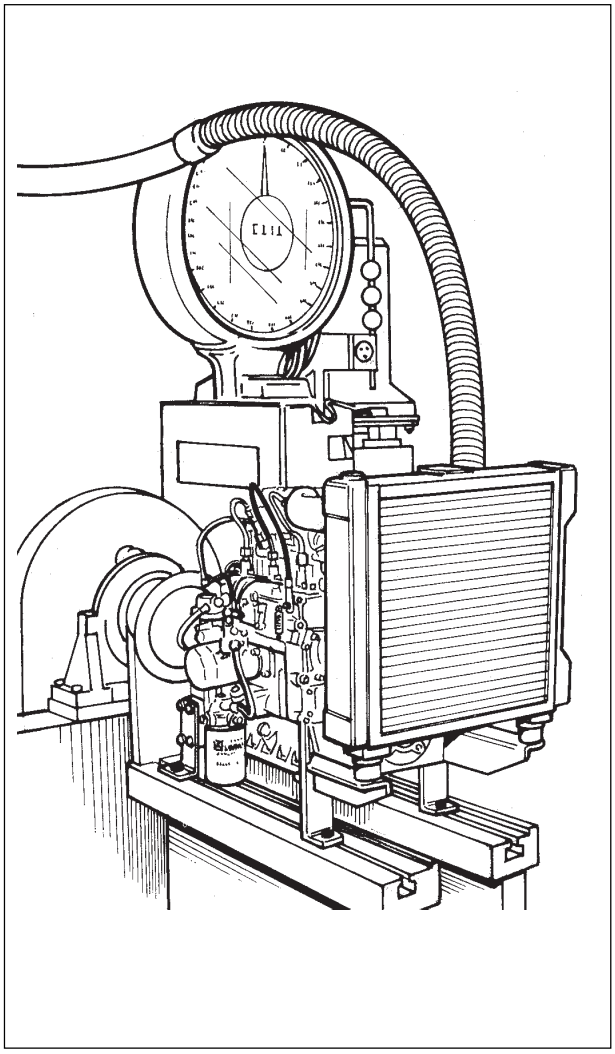


187

Injection pump delivery limiting and torque adjusting device

Limiting device **C** has the function of limiting the injection pump maximum delivery
The same device acts as torque adjusting device since springs **N** act on lever **L** and thus oppose the resistance of spring **M** contained in the barrel.
The torque limiting device allows lever **L** to have a stroke **H** of 1.0/ 1.1 mm: this increases the injection pump delivery while torque reaches its peak.

Note: In application for generating sets and motor welding units the torque adjusting device only acts as delivery limiting device without spring **M** and stroke **H.**



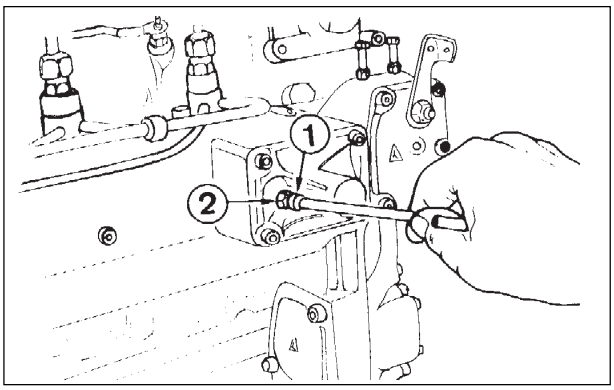
188

Injection pump delivery setting

1) Bring engine to idling speed
2) Unscrew delivery limiting device **C** (see fig. 186)
3) Bring the engine to the power and rpm required by the manufacturer of the device.
4) Check that fuel consumption falls withing 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 rpm decreases. Lock the limiting device by means of lock nut.
6) Check for torque increase at the given rpm if required.
7) Release brake completely and check at what speed the engine becomes stable
   Speed governor should comply with the requirements of the class indicated by the manufacturer of the device.
8) Stop the engine.
9) Check valve clearance when engine has cooled down.

Standard settings

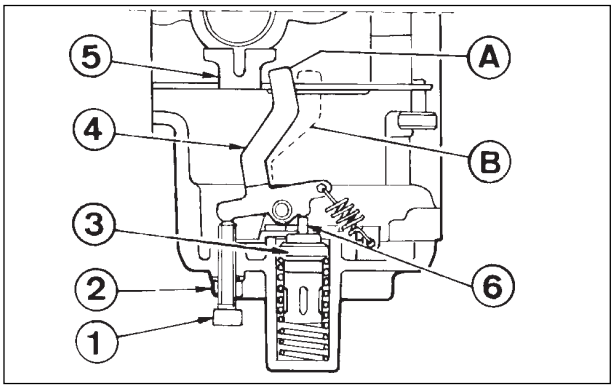
Engine	rpm	Power *	Specific fuel consumption	
		Kw	time, seconds for 100 cc	gr/Kw.h
LDW 1503	3000	24.56	43/46	280
LDW 2004	3000	32.72	32/34	270
LDW 2004/T	3000	42	26/27	265



189

Fuel limiting device
(fig. 189 e 190)

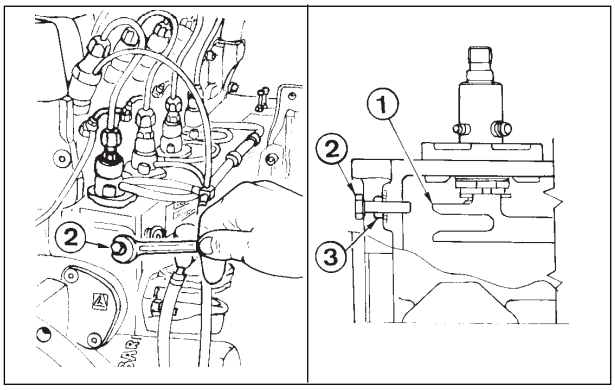
When starting up the engine the fuel limiting device has the aim of preventing excessive smoke at the exhaust.
Use the delivery adjustment rod of the injection pumps **5** Fig.190 in a constant manner when ambient temperature is above 15°C.
As the temperature gradually falls, this device gradually lessens its action to then exclude it at zero degrees.



190

Fuel limiting device adjustment
(fig189 e 190)

- Take the engine to the setting speed and power
- Loosen the lock nut **2.**
- Unscrew the screw **1** (to bring lever **4** close up to rod **5**) until the engine speed tends to decrease.
- Screw the screw down by at most 1/2, 3/4 of a turn so as to distance lever **4** from rod **5** by 1.2/1.8 mm.
  Screw down the lock nut **2**.
- When the temperature falls under zero degrees, lever **A** turns (pin **6** of the thermostat **3** comes back in) to go into position **B**
  thereby allowing rod **5** to go into the supplement position.

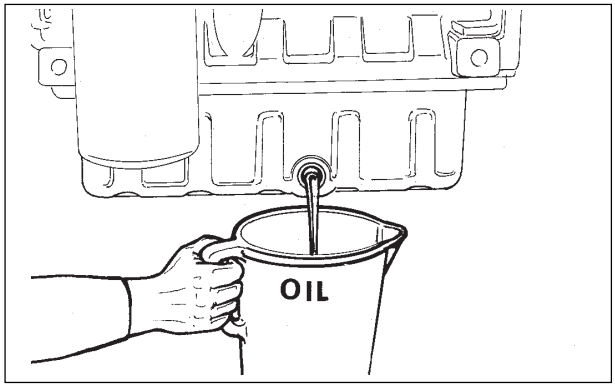


191 192

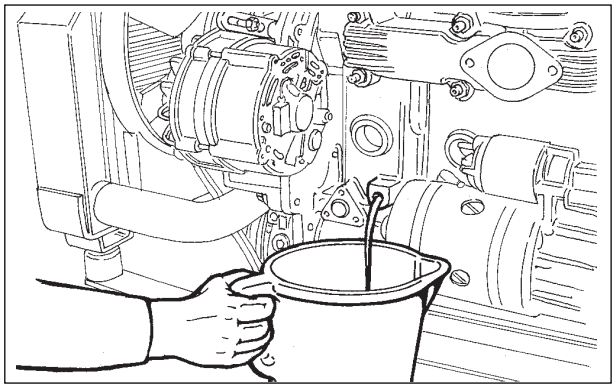
Stop setting

- Unscrew the screw **2**
- Move rod **1** fully to the left**.**
- Screw down screw **2** to touch rod **1**.
- Continue screwing screw **2** by 1/2 turn.
- Lock nut **3**.

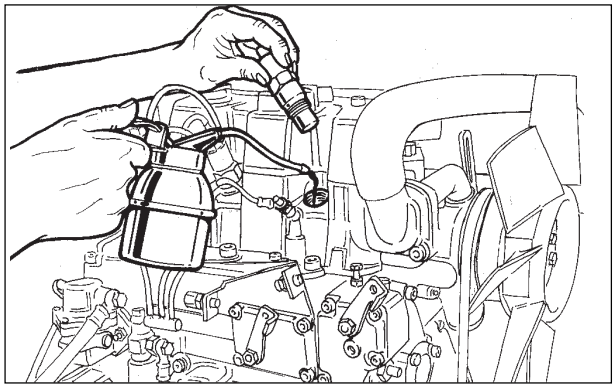
Note: In these conditions the injection pump delivery control limit stops cannot be damaged by violent impact caused by operation of any electro-stops that may be fitted.



193



194



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Storage

Prepare engines as follows for storage over 30 days

Temporary protection (1/6 months)

- Let engine run at idling speed in no-load conditions for 15 minutes.
- Fill crankcase with protection oil MIL-1-644-P9 and let engine run at 3/4 full speed for 5/10 minutes.
- When engine is warm empty oil pan and fill with standard new oil.
- Remove fuel tube and empty the tank
- Remove fuel filter, replace cartridge if dirty and refit.
- Carefully clean cylinder fins, heads and fan.
- Seal all openings with tape.
- Remove injectors, pour a spoonful of oil type SAE 30 into the cylinders and rotate manualy 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).
- Change the antifreeze liquid after two years.

How to prepare the engine for operation

- Clean engine outside
- Remove protections and covers
- Remove antirust by an appropriate solvent or degreaser.
- Remove the intake manifold, pour engine oil close to the valves, turn the driving shaft a few turns, then remove the pan and drain off the oil containing the protective element dissolved in it.
- Check injectors, valve clearance, belt tension, head tightening, oil filter and air cleaner for proper setting.

SPECIFICATIONS LDW 1503, LDW 2004, LDW 2004/T

TIPO MOTORE			LDW 1503	LDW 2004	LDW 2004/T
Cylindres		N.	3	4	4
Borte		mm	88	88	88
Stroke		mm	85	85	85
Displacement		Cm^3	1551	2068	2068
Compression ratio			22:1	22:1	22:1
R.P.M.			3000	3000	3000
Power KW NB	N 80/1269/CEE-ISO 1585-DIN 70020		26.4	35	44.1
	ISO 3046 - 1 IFN - DIN 6270		24.6	33	42
	NA ISO 3046 - 1 ICXN - DIN 6270		22.2	29.6	37.8
Max. torque *		Nm @ RPM	95.4@2100	128@2100	165.7@2000
Max. torque 3rd + 4th p.t.o.		Nm @ RPM	39.2@3000	39.2@3000	39.2@3000
Specific fuel consumption **		gr/KW.h @ RPM	268@2300	260@2300	256@2200
Oil consumption ***		Kg/h	0.024	0.032	0.032
Dry weight		Kg	155	190	195
Combustion air volume at 3000 r.p.m.		l./min.	2326	3100	3900
Cooling air volume at 3000 r.p.m.		l./min.	95.830	128.330	180.000
Max. permissible driving shaft axial load in both directions		Kg.	300	300	300
Max inclination	Max. 60 seconds	a	35°	35°	35°
	Lasting up to 30 seconds	a	25°	25°	25°
	Permanent	a	****	****	****
Firing Order			1-3-2	1-3-4-2	1-3-4-2

* Referred to max. N power
** Referred to max. NB power
*** At NA power
**** Depending on the application

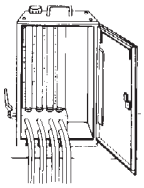
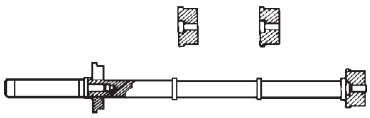
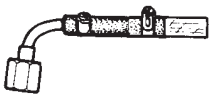
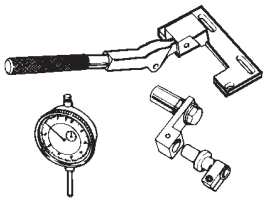
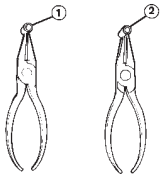
MAIN TORQUE SPECIFICATIONS

POSITION	Diam.and pitch mm	Torque Nm	Sealant Loctite, type
Connecting rod	10x1.5	70	
Diesel fuel union bolts	14x1.5	40	
Flywheel housing	10x1.5	50	
Preheating glow plug	12x1.25	20	
Roker arm cover	8x1.25	20	
Main bearing cap	12x1.25	120	
Intake manifold	8x1.25	25	
Exhaust manifold	8x1.25	25	
Throttle cover	6x1	10	
Oil pump cover	6x1	10	
1P hydraulic pump flange cover	6x1	10	
Oil pressure indicator	12x1.5	35	
Camshaft gear	10x1.5	80	270
Injector	24x2	70	
Starting motor	10x1.5	45	
Front engine foot	16x1.5	196	
Engine foot on bell	10x1.5	40	
Oil pan	8x1.25	25	
Feed pump stud bolts	8x1.25	-	270
Drive puly	16x1.5	352	
Oil filter nipple	UNF 3/4	-	270
Injection pump union	12x1.5	35	
Intermediate thrust block union	22x1.5	150	270
Injection pump union	12x1.5	25	
Water recirculation unions	14x1.5	-	554
Engine mounting bracket	12x1.75	50	
Rocker arm assembly	10x1.5	50	
Tank bracket	8x1.25	30	
Crankcase lubrication port plug	14x1.25	-	554
Water drain plug	14x1.5	40	
Oil drain plug	14x1.5	50	
Air bleed plug under oil sump	14x1.5	40	
Head (see fig. 55 - 56)			
High pressure injection line	12x1.25	24,5	
Air bleed tube under oil sump	12x1.5	35	270
Flywheel	12x1.25	140	

STANDARD BOLT TORQUE SPECIFICATIONS

DESCRIPTION						
Diameter per Pitch (mm)	R ³ 800 N/mm2		R ³ 1000 N/mm2		R ³ 1200 N/mm2	
	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

SPECIAL TOOLS

	DESCIPTION	Part No.
	Fuel delivery equalization tool. Allows the adjustment of individual unit injector fuel delivery.	7104-1460-090
	Glass column for fuel delivery equalization tool.	7104-1460-072
	Camshaft bushing replacement tool	7104-1460-021
	Static timing tool	7271-1460-024
	T.D.C. determination fixture.	7107-1460-75
	Pliers for injection pump feeding tubes ① For tube diam. 6 mm ② For tube diam. 8 mm	① 7104-1460-022 ② 7104-1460-023

NOTE

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