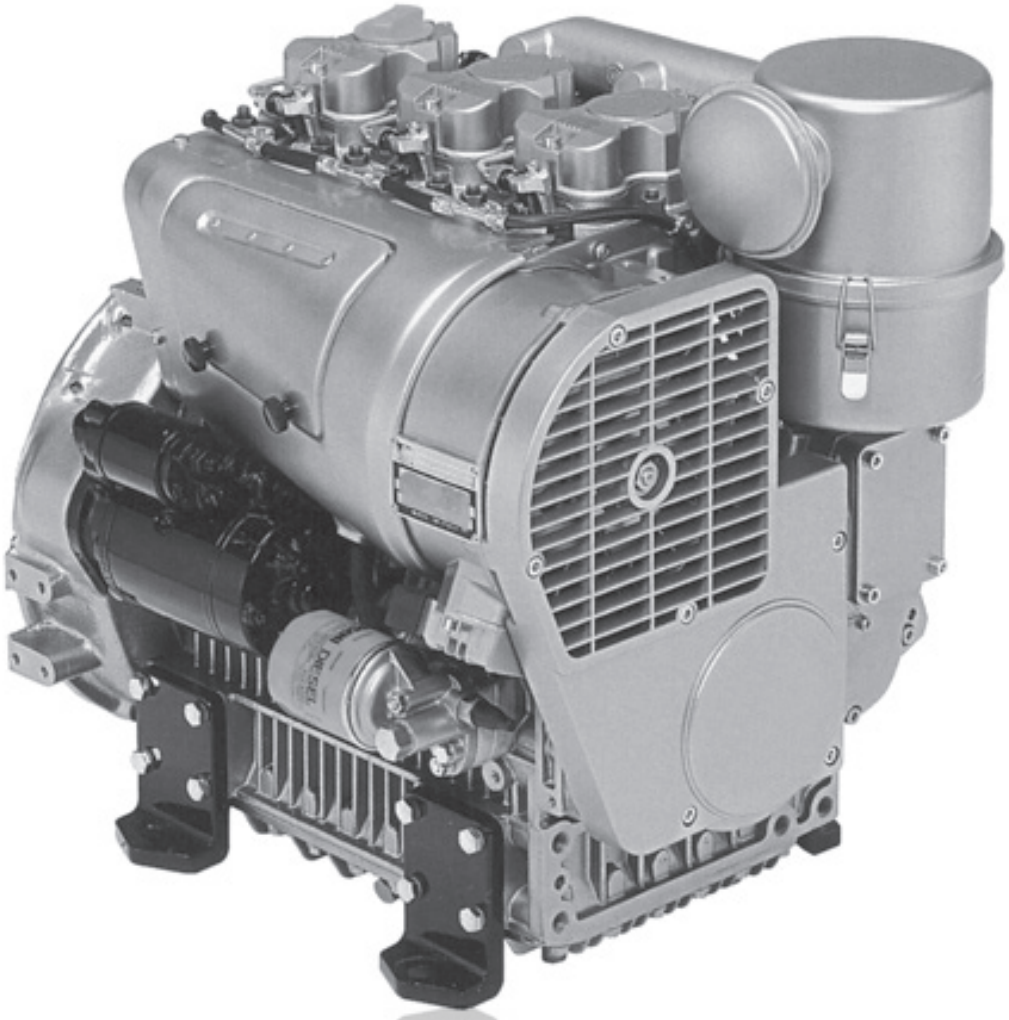
# 11 LD 625-3 / 626-3

WORKSHOP MANUAL



LOMBARDINI
A KOHLER COMPANY

**REGISTRATION OF MODIFICATIONS TO THE DOCUMENT**

Any modifications to this document must be registered by the drafting body, by completing the following table.

| Drafting body | Document code | *Model N°* | Edition | *Revision* | Issue date | Review date | *Endorsed* |
|---|---|---|---|---|---|---|---|
| Tech-Pubs | ED0053022960 | 50510 | ***6°*** | ***5*** | 1-89 | 21.05.2019 | |

## Manual's purpose

This manual contains the instructions needed to carry out a proper maintenance of the engine, therefore it must always be available, for future reference when required.
Safety pictograms can be found on the engine and it is the operator's responsibility to keep them in a perfectly visible place and replace them when they are no longer legible.
Information, description and pictures in this manual reflect the state of the art at the time of the marketing ofengine.
However, development on the engines is continuous.Therefore, the information within this manual is subject to change without notice and without obligation.
**Lombardini Srl** reserves the right to make, at any time, changes in the engines for technical or commercial reasons.
These changes do not require **Lombardini Srl** to intervene on the marketed production up to that time and not to consider this manual as inappropriate.
Any additional section that **Lombardini Srl** will deem necessary to supply some time after the main text shall be kept together with the manual and considered as an integral part of it.
The information contained within this manual is the sole property of **Lombardini Srl** As such, no reproduction or replication in whole or part is allowed without the express written permission of **Lombardini Srl**

***Original instructions translated from the Italian language***

Data reported in this issue can be modified at any time by **Kohler Engines** .

## PREFACE

Every attempt has been made to present within this use and maintenance, accurate and up to date technical information.
However, development on the ***Lombardini*** series is continuos.
Therefore, the information within this manual is subject to change without notice and without obligation.
Carefully read and follow all instructions in this booklet as well as all those provided with the equipment on which this engine is used.
The information contained within this service manual is the sole property of ***Lombardini***.
As such, no reproduction or replication in whole or part is allowed without the express written permission of ***Lombardini***.

Information presented within this manual assumes the following the person or persons performing service work on ***Lombardini*** series engines:

1 - is properly trained and equipped to safely and professionally perform the subject operation;
2 - possesses adequate hand and ***Lombardini*** special tools to safely and professionally perform the subject service operation;
3 - has read the pertinent information regarding the subject service operations and fully understands the operation at hand.

- For spare parts and after sale assistance contact authorized service centers.
- For any spare parts order please specify following details: ENGINE TYPE AND SERIAL NUMBER - Version (K) - on the engine name plate
- The complete and updated list of authorized ***Kohler*** service centers can be found on our web site: ***www.kohlerengines.com*** & ***www.lombardinigroup.it/dealer-locator***
- Pls contact Service Centers for special applications.

## GENERAL SERVICE MANUAL NOTES

**1.** Use only genuine repair parts. Failure to use genuine parts could result in sub-standard performance and low longevity.

**2.** All data presented are in metric format:
. dimensions are presented in millimeters (**mm**),
. torque is presented in Newton-meters (**Nm**),
. weight is presented in kilograms (**kg**),
. volume is presented in liters or cubic centimeters (**cc**)
. pressure is presented in barometric units (**bar**).

**3.** To ensure safe operation please read the following statements and understand their meaning.
Also refer to your equipment manufacturer's manual for other important safety information.

This manual contains safety precautions which are explained below.

***Danger*** Warning is used to indicate the presence of a hazard that can cause severe personal injury, death, or substantial property damage if the warning is ignored.

***Important*** This indicates particularly important technical information that should not be ignored.

***Warning*** Caution is used to indicate the presence of a hazard that will or can cause minor personal injury or property damage if the caution is ignored.

## GLOSSARY AND TERMINOLOGY

For clarity, here are the definitions of a number of terms used recurrently in the manual.

- **Cylinder number one:** is the timing belt side piston .
- **Rotation direction:** anticlockwise «viewed from the flywheel side of the engine».

# 11 LD 625-3 / 626-3
# ENGINE
## with advance variator

## Safety regulation

GENERAL NOTES

- Lombardini engines are built to provide safe and longlasting performances, but in order to obtain these results it is essential that the maintenance requirements described in the manual are observed along with the following safety recommendations.
- The engine has been built to the specifications of a machine manufacturer, and it is his responsibility to ensure that all necessary action is taken to meet the essential and legally prescribed health and safety requirements. Any use of the machine other than that described cannot be considered as complying with its intended purpose as specified by Lombardini, which therefore declines all responsibility for accidents caused by such operations.
- The following instructions are intended for the user of the machine in order to reduce or eliminate risks, especially those concerning the operation and standard maintenance of the engine.
- The user should read these instructions carefully and get to know the operations described. By not doing so he may place at risk his own health and safety and that of anyone else in the vicinity of the machine.
- The engine may be used or mounted on a machine only by personnel suitably trained in its operation and aware of the dangers involved. This is particularly true for standard and, above all, special maintenance work. For special maintenance contact personnel trained specifically by Lombardini. This work should be carried out in accordance with existing literature.
- Lombardini declines all responsibility for accidents or for failure to comply with the requirements of law if changes are made to the engine's functional parameters or to the fuel flow rate adjustments and speed of rotation, if seals are removed, or if parts not described in the operating and maintenance manual are removed and reassembled by unauthorized personnel.

***Danger***

- In addition to all other machine specifications, ensure that the engine is in a near horizontal position when starting. If starting manually, ensure that the necessary operations can be performed without any risk of striking against walls or dangerous objects. Rope starting (except for recoil rope starting) is not permitted even in emergencies.
- Check that the machine is stable so that there is no risk of it overturning.
- Get to know the engine speed adjustment and machine stop operations.
- Do not start the machine in closed or poorly ventilated environments. The internal combustion process generates carbon monoxide, an odourless and highly toxic gas, so spending too long a time in an environment where the engine discharges its exhaust products freely can lead to loss of consciousness and even death.
- The engine may not be used in environments containing flammable materials, explosive atmospheres or easily combustible powders, unless adequate and specific precautions have been taken and are clearly stated and certified for the machine.
- To prevent the risk of fire, keep the machine at a distance of at least one metre from buildings or other machines.
- Children and animals must be kept at a sufficient distance from the machine to prevent any danger resulting from its operation.
- Fuel is flammable, so the tank must be filled only when the engine is turned off. Dry carefully any fuel that may have spilled, remove the fuel container and any cloths soaked in fuel or oil, check that any sound-absorbing panels made of porous material are not soaked with fuel or oil, and make sure that the ground on which the machine is located has not absorbed fuel or oil.
- Before starting, remove any tools that have been used for carrying out maintenance work to the engine and/or the machine and check that any guards removed have been replaced. In cold climates it is possible to mix kerosene with the diesel fuel to make the engine easier to start. The liquids must be mixed in the tank by pouring in first the kerosene and then the diesel fuel. Consult Lombardini technical office for mixture proportions. Petrol may not be used because of the risk of it forming flammable vapours.
- During operation the surface of the engine reaches temperatures that may be dangerous. Avoid in particular all contact with the exhaust system.
- The liquid cooling circuit is under pressure. Do not carry out any checks before the engine has cooled down, and even then open the radiator cap or the expansion tank cautiously. Wear protective clothing and glasses. If there is an electric fan, do not approach the engine while it is still hot as the fan may come on even when the engine is not running. Clean the cooling system with the engine turned off.
- While cleaning the oil bath air filter, check that the oil is disposed of in such a way as not to harm the environment. Any filtering sponges in the oil bath air filter should not be soaked with oil. The cyclone pre-filter cup must not be filled with oil.
- Since the oil must be emptied out while the engine is still hot (approx. 80°C), particular care should be taken in order to avoid burns. In any case make sure that oil does not come into contact with your skin because of the health hazards involved.
- Fuel vapours are highly toxic, so fill up only in the open air or in well ventilated environments.
- During operations which involve access to moving parts of the engine and/or removal of the rotary guards, disconnect and insulate the positive cable of the battery so as to prevent accidental short circuits and activation of the starter motor.
- Check the belt tension only when the engine is turned off.

***Important***

- To start the engine follow the specific instructions provided in the engine and/or machine operating manual. Do not use auxiliary starting devices not originally installed on the machine (e.g. Startpilot systems which utilise ether etc.)
- Before carrying out any work on the engine, turn it off and allow it to cool down. Do not perform any operation while the engine is running.
- Check that the discharged oil, the oil filter and the oil contained in the oil filter are disposed of in such a way as not to harm the environment.
- Close the fuel tank filler cap carefully after each filling operation. Do not fill the tank right up to the top, but leave sufficient space to allow for any expansion of the fuel.
- Do not smoke or use naked flames while filling.
- Take care when removing the oil filter as it may be hot.
- The operations of checking, filling up and replacing the cooling

liquid must be carried out with the engine turned off and cold. Take particular care if liquids containing nitrites are mixed with others not containing these compounds as this may give rise to the formation of nitrosamines which are a health hazard. The cooling liquid is polluting, so dispose of in a manner that does not damage the environment.

- In order to move the engine simultaneously use the eyebolts fitted for this purpose by Lombardini. These lifting points are however not suitable for the entire machine, so in this case use the eyebolts fitted by the manufacturer.

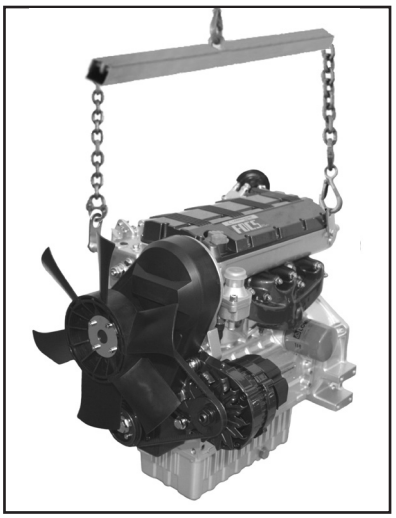
**California Proposition 65**
**WARNING**

*Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.*

## Regulations for lifting the engine

Important

Before removing the engine from the vehicle on which it is installed, disconnect the power supply, detach the fuel and coolant supply, and all connections including the mechanical ones.
Attach the engine to a suitable lifting device (lifting beam).
To move the engine simultaneously use the eyebolts installed, these lifting points are not suitable for the entire machine, then use the eyebolts installed by the manufacturer.
Before lifting, make sure the weight is correctly balanced by checking its barycentre.
Close all engine openings accurately (exhaust, intake, etc.), then wash the outside and dry with a jet of compressed air.
The bracket of the lifting points have been designed to lift the engine only. They are not intended nor approved to lift additional weights.
Do not use different methods to lift the engine than those described herein. In case different methods are used, no warranty shall be granted for any consequential damage.
Use protective gloves when handling the engine



## GENERAL SAFETY DURING OPERATING PHASES

- The procedures contained in this manual have been tested and selected by the manufacturer's technical experts, and hence are to be recognised as authorised operating methods.
- A number of procedures must be carried out with the aid of equipment and tools that simplify and improve the timing of operations.
- All tools must be in good working condition so that engine components are not damaged and that operations are carried out properly and safely.
- It is important to wear the personal safety devices prescribed by work safety laws and also by the standards of this manual.
- Holes must be lined up methodically and with the aid of suitable equipment. Do not use your fingers to carry out this operation to avoid the risk of amputation.
- Some phases may require the assistance of more than one operator. If so, it is important to inform and train them regarding the type of activity they will be performing in order to prevent risks to the health and safety of all persons involved.
- Do not use flammable liquids (petrol, diesel, etc.) to degrease or wash components. Use special products.
- Use the oils and greases recommended by the manufacturer.
- Do not mix different brands or combine oils with different characteristics.
- Discontinue use of the engine if any irregularities arise, particularly in the case of unusual vibrations.
- Do not tamper with any devices to alter the level of performance guaranteed by the manufacturer.

## SAFETY AND ENVIRONMENTAL IMPACT

Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment.
Procedures for identifying the extent of the impact on the environment must consider the following factors:

- Liquid waste
- Atmospheric emissions
- Waste management
- Use of raw materials and natural resources
- Soil contamination
- Regulations and directives regarding environmental impact

In order to minimise the impact on the environment, the manufacturer now provides a number of indications to be followed by all persons handling the engine, for any reason, during its expected lifetime.

- All packaging components must be disposed of in accordance with the laws of the country in which disposal is taking place.
- Keep the fuel and engine control systems and the exhaust pipes in efficient working order to limit environmental and noise pollution.
- When discontinuing use of the engine, select all components according to their chemical characteristics and dispose of them separately.

## *Information and safety signals*

| DANGER | *Accidental Starts!* |
|---|---|
|  | **Accidental Starts can cause severe injury or death.** Disable engine by disconnecting negative (-) battery cable. |
| Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows: 1) Disconnect negative (-) battery cable from battery. | |

| DANGER | *Rotating Parts!* |
|---|---|
|  | **Rotating Parts can cause severe injury.** Stay away while engine is in operation. |
| Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the engine with covers, shrouds, or guards removed. | |

| DANGER | *Lethal Exhaust Gases!* |
|---|---|
|  | **Carbon Monoxide can cause severe nausea, fainting or death.** Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area. |
| Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area. | |

| DANGER | *Hot Parts!* |
|---|---|
|  | **Hot Parts can cause severe burns.** Do not touch engine while operating or just after stopping. |
| Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running, or immediately after it is turned off. Never operate the engine with heat shields or guards removed. | |

| DANGER | *Explosive Fuel!* |
|---|---|
|  | **Fuel can cause fires and severe burns.** Do not fill the fuel tank while the engine is hot or running. |
| Fuel is flammable and its vapors can ignite. Store fuel only in approved containers, in well ventilated, unoccupied buildings. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use fuel as a cleaning agent. | |

| DANGER | *Explosive Gas!* |
|---|---|
|  | **Explosive Gas can cause fires and severe acid burns.** Charge battery only in a well ventilated area. Keep sources of ignition away. |
| Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries. Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or fuel vapors are present. | |

| DANGER | *High Pressure Fluid Puncture!* |
|---|---|
|  | **High Pressure Fluids can puncture skin and cause severe injury or death.** Do not work on fuel system without proper training or safety equipment. |
| Fuel system is to be serviced only by properly trained personnel wearing protective safety equipment. Fluid puncture injuries are highly toxic and hazardous. If an injury occurs, seek immediate medical attention. | |

| CAUTION | *Electrical Shock!* |
|---|---|
|  | **Electrical Shock can cause injury.** Do not touch wires while engine is running. |
| Never touch electrical wires or components while the engine is running. They can be sources of electrical shock. | |

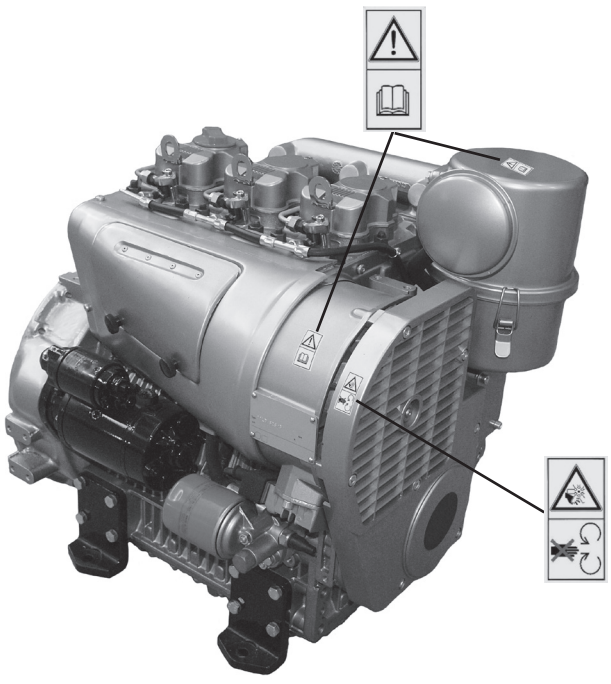
## *Explanation of the safety pictograms that can be found on the engine or in the Workshop manual*

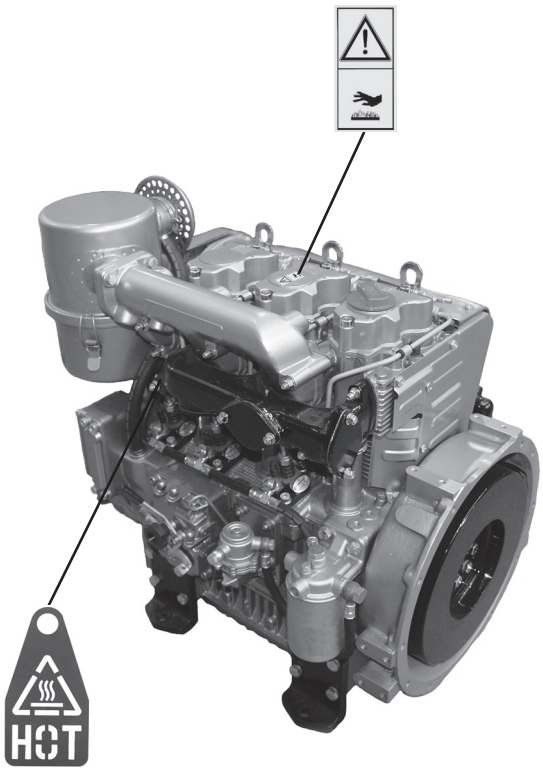
| | |
|---|---|
|  | - Read the Operation and Workshop manual before performing any operation on the engine |
|  | - High temperature components<br>- Danger of scalding |
|  | - Presence of rotating parts<br>- Danger of entangling and cutting |
|  | - Presence of explosive fuel<br>- Danger of fire or explosion |
|  | - Presence of steam and pressurized coolant<br>- Danger of scalding |

| | |
|---|---|
|  | - Use protective gloves before carrying out the operation |
|  | - Use protective glasses before carrying out the operation |
|  | - Use sound absorbing protections before carrying out the operation |
|  | - Electric shock<br>- Danger of severe scalding or death |
|  | - Fluids under high pressure<br>- Danger of fluids penetration |
|  | - Lethal exhaust gas<br>- Danger of poisoning or death |

## *Indications regarding the points on the engine where the safety pictograms are placed*

- Ensure the good condition of safety *pictograms*.
- If the safety signs are damaged and / or illegible, you must replace them with other originals and place them in the positions shown below.
- For cleaning use a cloth, water and soap.





## POSSIBLE CAUSES AND TROUBLE SHOOTING

**THE ENGINE MUST BE STOPPED IMMEDIATELY WHEN:**

**1)** - The engine rpms suddenly increase and decrease
**2)** - A sudden and unusual noise is heard
**3)** - The colour of the exhaust fumes suddenly darkens
**4)** - The oil pressure indicator light turns on while running.

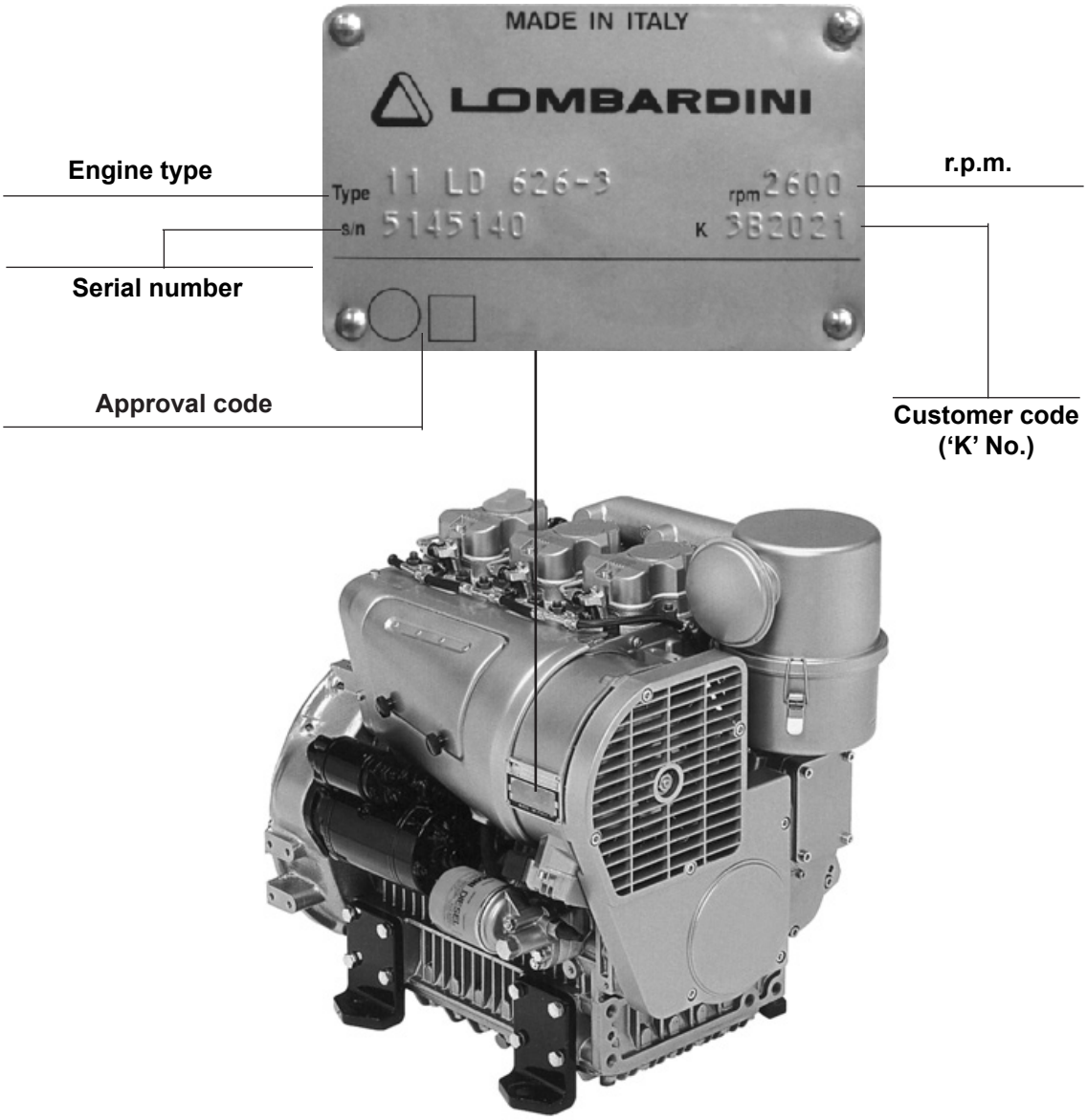
***TABLE OF LIKELY ANOMALIES AND THEIR SYMPTOMS***

The following table contains the possible causes of some failures which may occur during operation.
Always perform these 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 | Overheats | Inadequate performance | Excessive oil consumption | High noise level |
| FUEL CIRCUIT | Obstructed fuel line | ■ | ■ | | ■ | | | | | ■ | | |
| | Fuel filter clogged | ■ | ■ | ■ | ■ | | | | | ■ | | |
| | Air or water leaks in fuel system | ■ | ■ | ■ | ■ | | | | | ■ | | |
| | The tank cap vent hole is clogged | ■ | ■ | | | | | | | | | |
| | No fuel | ■ | ■ | | ■ | | | | | | | |
| ELECTRIC SYSTEM | Discharged battery | ■ | | | | | | | | | | |
| | Cable connection uncertain or incorrect | ■ | | | | | | | | | | |
| | Faulty starting switch | ■ | | | | | | | | | | |
| | Faulty starting motor | ■ | | | | | | | | | | |
| MAINTENANCE | Clogged air filter | | | ■ | ■ | ■ | | | | ■ | | |
| | Excessive idle operation | | | | | | ■ | | | | ■ | |
| | Incomplete run-in | | | | | | ■ | | | | ■ | |
| | Overloaded engine | | | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ |
| | Non-conforming engine oil | | | | | | | | | | ■ | |
| SETTINGS REPAIRS | Incorrect governor linkage adjustment | | | | ■ | | | | | | | |
| | Governor spring broken or unhooked | | ■ | ■ | ■ | | | | | | | |
| | Low idle speed | | ■ | | | | | | | | | |
| | Rings worn or sticking | ■ | | | ■ | | ■ | | ■ | ■ | ■ | |
| | Worn cylinder | ■ | | | ■ | | ■ | | ■ | ■ | ■ | |
| | Worn main con rod-rocker arm bearings | | | | ■ | | | ■ | ■ | ■ | ■ | |
| | Badly sealed intake valve | ■ | | | | | | | ■ | ■ | ■ | |
| | Head tightening nuts loose | ■ | | | | | | | | | | ■ |
| | Damaged cylinder head gasket | | | | | | | | ■ | ■ | ■ | ■ |
| | Excessive valve-rocker arm clearance | | | | | | | | | ■ | | ■ |
| | No clearance between valves and rocker arms | ■ | | | | | | | | | | |
| | Valves sticking | | | | | | | | | | | ■ |
| | Defective timing system | | | | | | | | | | | ■ |
| | Bent rods | | | ■ | ■ | ■ | | | ■ | ■ | | ■ |

| POSSIBLE CAUSE | | TROUBLE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Engine does not start | Engine starts but stops | No acceleration | Non-uniform speed | Black smoke | White smoke | Too low oil pressure | Overheats | Inadequate performance | Excessive oil consumption | High noise level |
| INJECTION | Damaged injector | ■ | | | | ■ | ■ | | | ■ | | ■ |
| | Injection pump valve damaged | ■ | | | | | | | | | | |
| | Injector not adjusted | ■ | | | | | | | | | | |
| | Faulty fuel feeding pump | ■ | ■ | ■ | ■ | | | | | ■ | | |
| | Hardened pump control rod | | | ■ | ■ | | | | | | | |
| | Broken or loose supplementary start-up spring | ■ | | | | | | | | | | |
| | Worn or damaged pumping element | | | | ■ | ■ | | | | ■ | | |
| | Incorrect tuning of injection components (delivery balancing advance) | ■ | ■ | | ■ | ■ | | | ■ | ■ | | |
| | | | | | | ■ | | | | | | |
| LUBRICATION CIRCUIT | Extra fuel control level sticking | | | | ■ | | ■ | | ■ | | ■ | |
| | Oil level too high | | | | | | | | ■ | | | |
| | Oil level low<br>Oil pressure valve blocked or dirty | | | | | | | ■ | | | | |
| | Oil pressure regulator not adjusted | | | | | | | ■ | | | | |
| | Worm oil pump | | | | | | | | ■ | | | |
| | Oil sump suction line clogged | | | | | | | | ■ | | | |
| | Faulty pressure gauge or pressure switch | | | | | | | ■ | | | | |
| | Blocked draining pipe | | | | | | | ■ | | | | |
| COOLING CIRCUIT | Worn or broken blower belt | | | | | | | | ■ | | | |
| | Cooling circuit clogged | | | | | | | | ■ | | | |

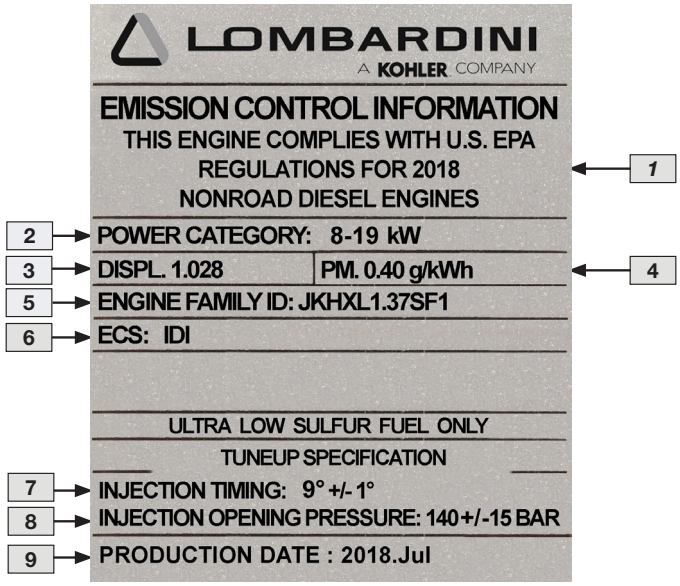
## MANUFACTURER AND MOTOR IDENTIFICATION DATA




Compilation example

**Plate for EPA regulations placed on the air-shroud**

1) Model year
2) Power category, kW
3) Engine displacement
4) Particulate emission limit (g/kWh)
5) Engine family ID
6) Emission Control System = ECS
7) Injection timing (BTDC)
8) Injector opening pressure (bar)
9) Production date (example 2018.Jul)



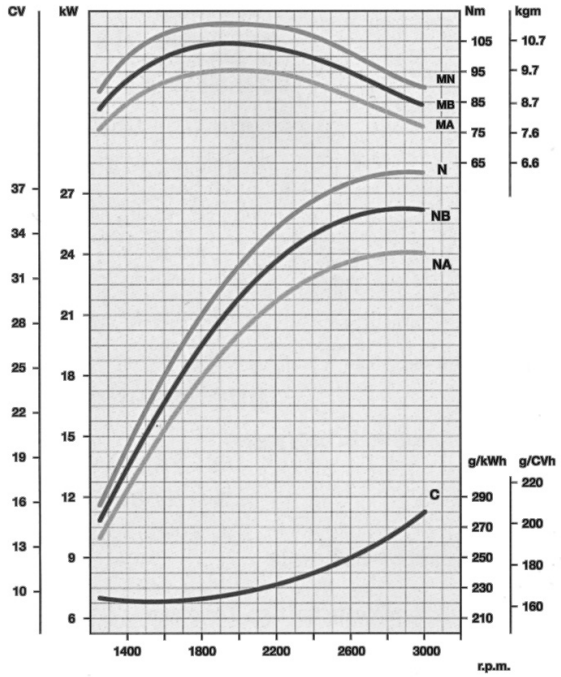
## TECHINICAL SPECIFICATIONS

| ENGINE TYPE | | | 11LD 625-3 | 11LD 626-3 |
|---|---|---|---|---|
| Number of cylinders | | N. | 3 | 3 |
| Bore | | mm | 95 | 95 |
| Stroke | | mm | 88 | 88 |
| Displacement | | Cm³ | 1870 | 1870 |
| Compression ratio | | | 17:1 | 17:1 - 20:1❐ |
| R.P.M. | | | 3000 | 3000 |
| Power kW/HP | N (80/1269/CEE) ISO 1585 | kW/CV | 28/38 | 30,8/42 |
| | NB ISO 3046 IFN | kW/CV | 26/35,4 | 28,6/39 |
| | NA ISO 3046 ICXN | kW/CV | 24/32,7 | 26,3/35,8 |
| Max. torque | | Nm/kgm | 104/10,6 @2000 | 114,5/11,7 @2000 |
| Max. torque at 3rd p.t.o. at 3200 r.p.m. | | kW/CV | 13/17,7 | 13/17,7 |
| Max. torque at 4th p.t.o. at 3200 r.p.m. | | kW/CV | 7,98/10,8 | 7,98/10,8 |
| Specific fuel consumption * | | g/CV.h - g/kW.h | 190/258.5 | 184/250 |
| Tank capacity | | l. | 15 | 15 |
| Oil consumption ** | | kg/h | 0,017 | 0,017 |
| Oil sump capacity | | l. | 5 | 5 |
| Dry weight | | kg | 170 | 170 |
| Combustion air volume at 3000 r.p.m. | | l./min' | 2400 | 2400 |
| Cooling air volume at 3000 r.p.m. | | l./min' | 38000 | 38000 |
| Max. permissible driving shaft axial load in both directions | | kg | 300 | 300 |
| Max. inclination | momentary | α | 35° | 35° |
| | lasting up to 1 h. | α | 25° | 25° |
| | permanent | α | **** | **** |
| Firing Order | | | 1 - 3 - 2 | 1 - 3 - 2 |

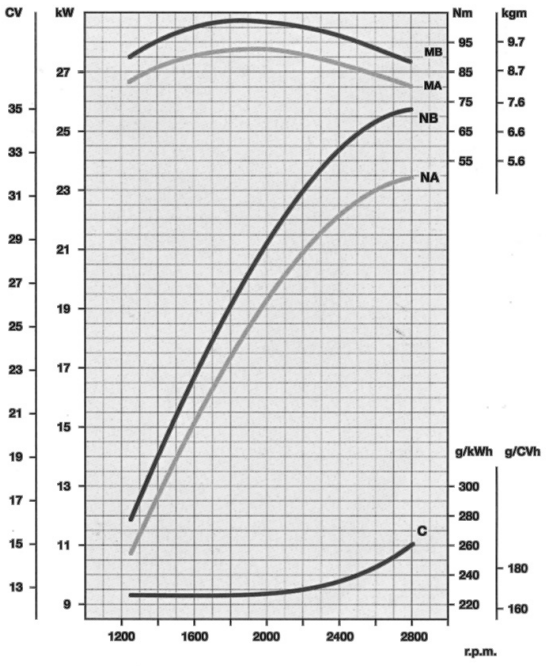
❐ Only for 97/68 CE and EPA approved engines
* Referred to max. N power
** Referred to max. NB power
*** At NA power
**** Depending on the application

## PERFORMANCE DIAGRAMS

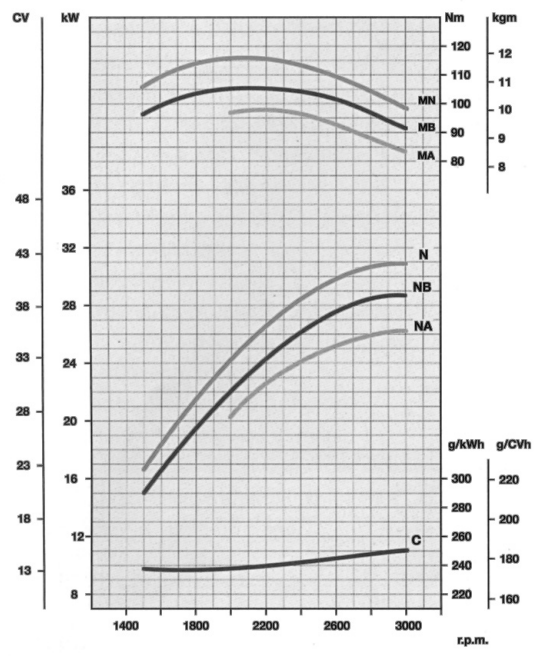
### 11 LD 626-3 NR @ 3000 r.p.m.



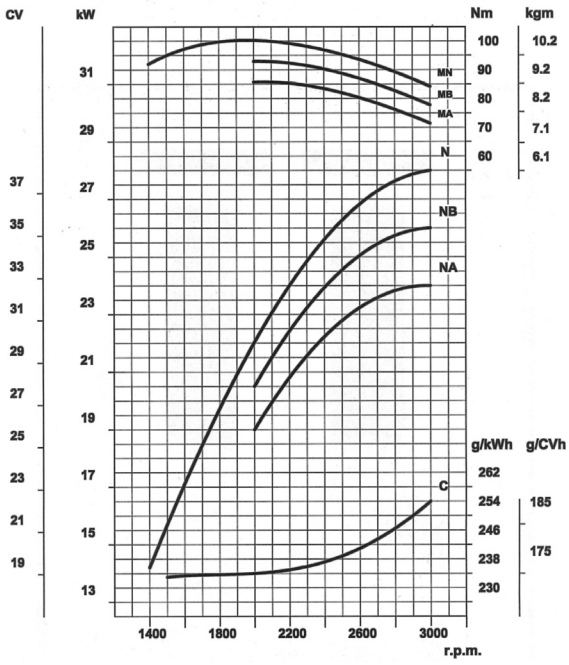

### 11 LD 626-3 B2 NR @ 2800 r.p.m.




### 11 LD 626-3 @ 3000 r.p.m.

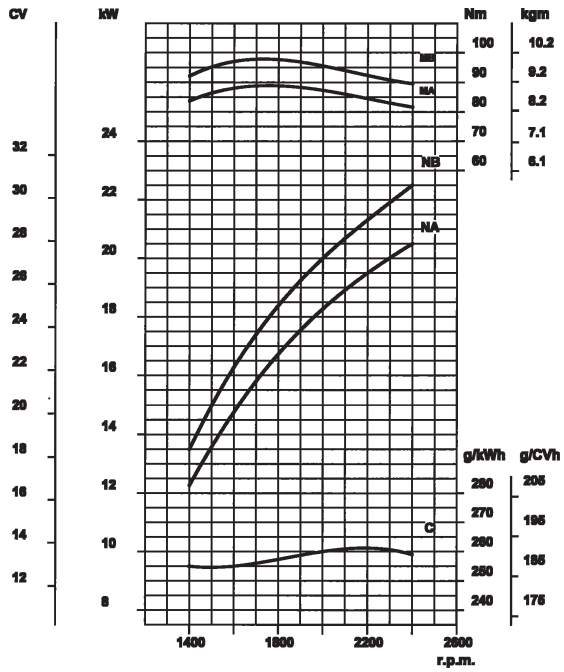



### 11 LD 625-3 @ 3000 r.p.m.

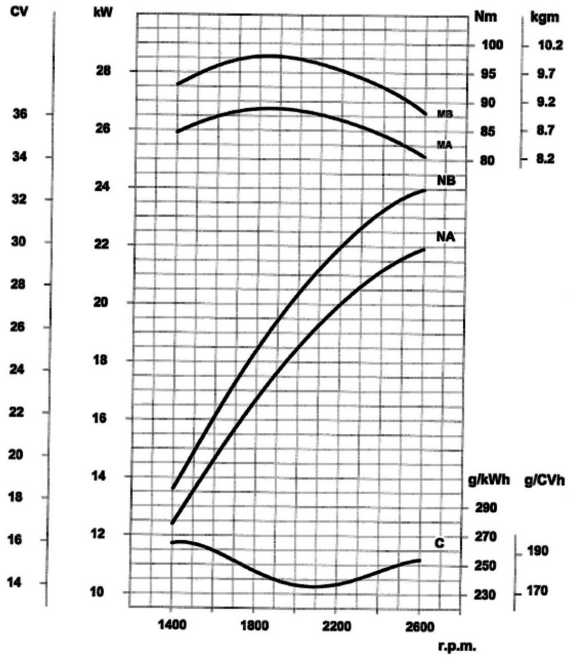


**11 LD 625-3 / 626-3 EPA**

**@ 2400 r.p.m.**




**@ 2600 r.p.m.**




**N (80/1269/EEC - ISO 1585) - AUTOMOTIVE RATING:** Intermittent operation with variable speed and variable load.
**NB (ISO 3046 - 1 IFN) - RATING WITH NO OWERLOAD CAPABILITY:** continuos ligth duty operation with constant speed and variable load.
**NA (ISO 3046 - 1 ICXN) - CONTINUOS RATING WITH OVERLOAD CAPABILITY:** continuos heavy duty with constant speed and constant load.

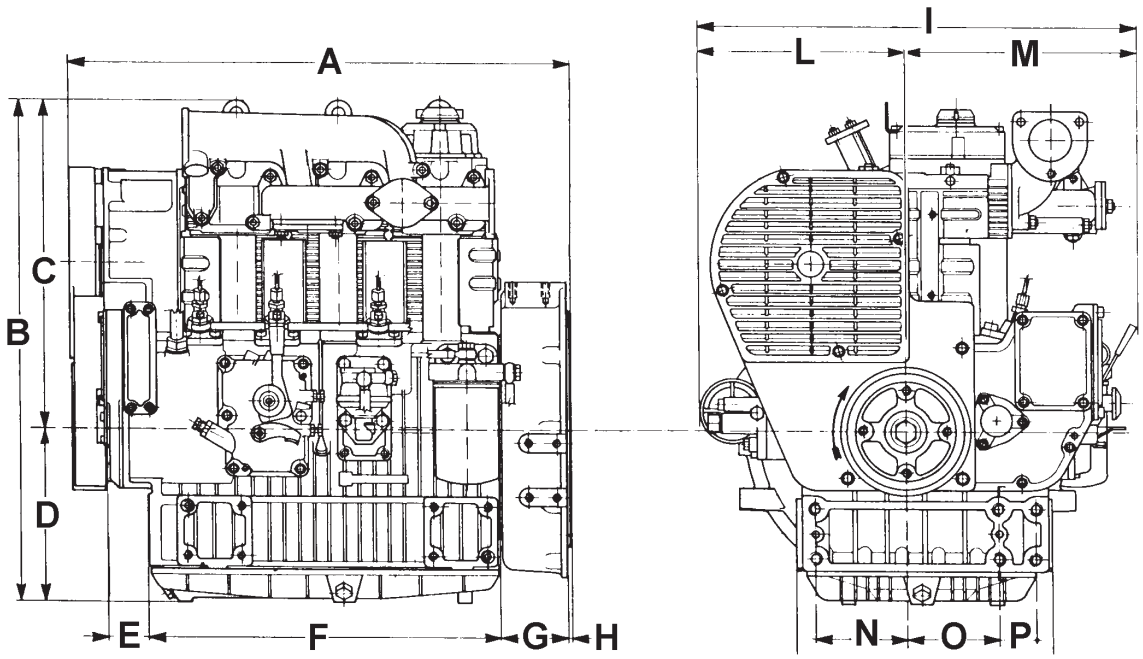
**MN** Torque at **N** power.
**MB (NB curve)**
**MA (NA curve).**
**C** Specific fuel consumption at **NB** power.

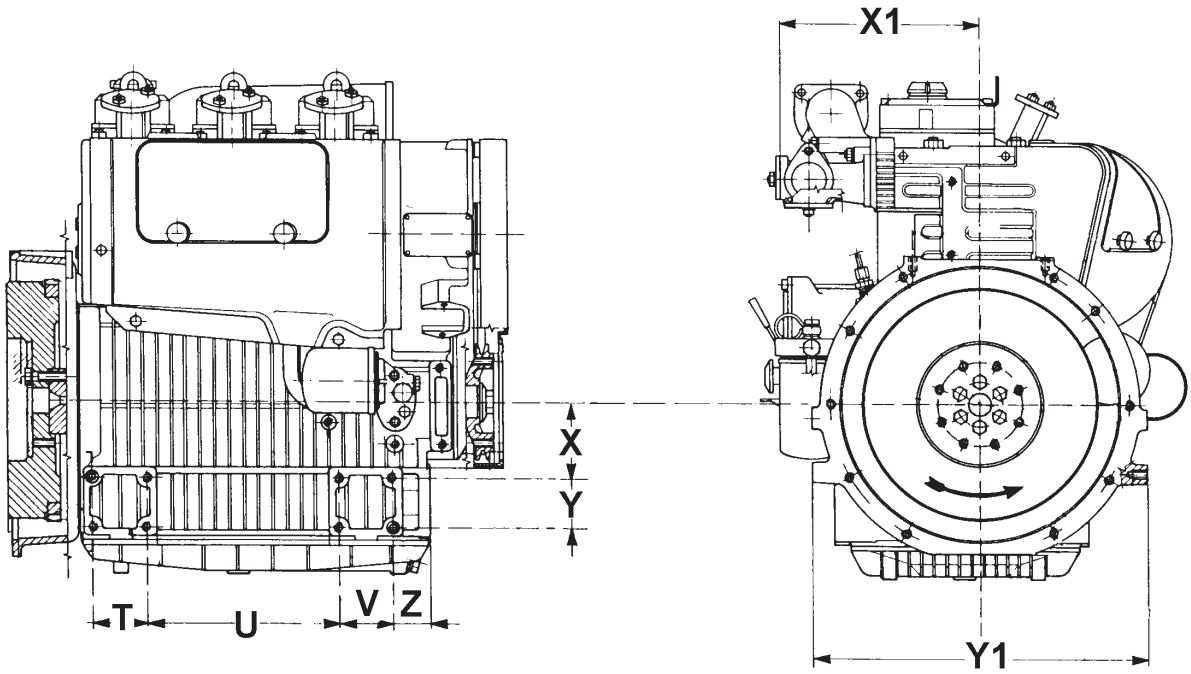
The above power values refer to an engine fitted with air cleaner and standard muffler, after testing and at the environmental conditions of 20°C and 1 bar.
Max. power tolerance is 5%. Power decreases by approximately 1% every 100 m di altitude and by 2% every 5°C above 25°C.

***Important***
**Non-approval by Lombardini for any modifications releases the company from any damages incurred by the engine.**

***Note:*** Consult LOMBARDINI for power, torque curves and specific consumptions at rates differing from those given above.

## OVERALL DIMENSIONS




| DIMENSION mm | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | 601 | **D** | 212 | **G** | 82 | **L** | 247 | **O** | 110 | **R** | 173 | **U** | 230 | **X** | 94 | **X1** | 237 |
| **B** | 612 | **E** | 47 | **H** | 4 | **M** | 278 | **P** | 45 | **S** | 305 | **V** | 65 | **Y** | 60 | **Y1** | 400 |
| **C** | 400 | **F** | 421 | **I** | 525 | **N** | 110 | **Q** | 132 | **T** | 65 | **Z** | 46 | | | | |

**Note :** Dimensions shown in mm

## ROUTINE ENGINE MAINTENANCE

***Important***

**Failure to carry out the operations described in the table may lead to technical damage to the machine and/or system**

## *EXTRAORDINARY MAINTENANCE*

| AFTER THE FIRST 50 WORKING HOURS | Engine oilreplacement. | Oil filter replacement. |
|---|---|---|

## *ORDINARY MAINTENANCE*

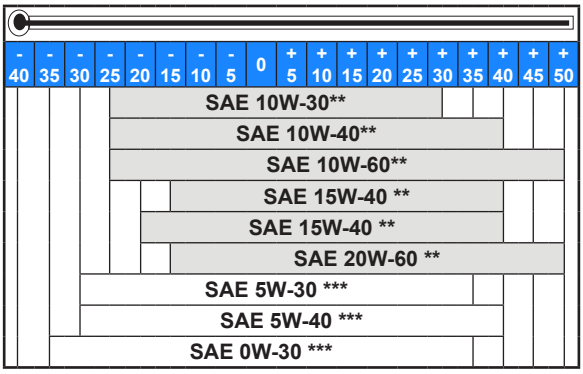
| OPERATION DESCRIPTION | | FREQUENCY x HOURS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 10 | 125 | 250 | 500 | 1000 | 2500 | 5000 |
| CHECK | LEVEL ENGINE LUBRICANT | | ■ | | | | | | |
| | DRY AIR CLEANER | (***) | ■ | | | | | | |
| | OIL BATH AIR CLEANER | | ■ | | | | | | |
| | BLOWER BELT TENSION | | | ■ | | | | | |
| | VALVE/ROCKER ARMS CLEARANCE ADJUSTMENT | | | | | ■ | | | |
| | SETTING AND INJECTORS CLEANING | | | | | ■ | | | |
| | FUEL PIPES | | ■ | | | | | | |
| | RUBBER INTAKE HOSE (AIR FILTER – INTAKE MANIFOLD) | | | | ■ | | | | |
| | ENGINE OIL RADIATOR CLEANING (IN THE APPLICATIONS WHERE IT IS PRESENT) | | | | | | | ■ | |
| | FUEL TANK CLEANING | | | | | | ■ | | |
| | COOLING SYSTEM CLEANING | | | | ■ | | | | |
| REPLACEMENT | ENGINE LUBRICANT | (*) | | | ■ | | | | |
| | OIL FILTER | (*) | | | ■ | | | | |
| | FUEL FILTER | (*) | | | ■ | | | | |
| | BLOWER BELT | (**) | | | | ■ | | | |
| | FUEL PIPES | | | | | | ■ | | |
| | RUBBER INTAKE HOSE (AIR FILTER – INTAKE MANIFOLD) | (**) | | | | | ■ | | |
| | DRY AIR CLEANER EXTERNAL CARTRIDGE | (***) | AFTER 6 CHECKS WITH CLEANING | | | | | | |
| | DRY AIR CLEANER INTERNAL CARTRIDGE | (***) | AFTER 3 CHECKS WITH CLEANING | | | | | | |
| OVERHAUL INSPECTION | PARTIAL OVERHAUL | | | | | | | ■ | |
| | TOTAL OVERHAUL | | | | | | | | ■ |

**(*) - In case of low use: every year.**
**(**) - In case of low use: every 2 years.**
**(***) - The period of time that must elapse before cleaning or replacing the filter element depends on the environment in which the engine operates. The air filter must be cleaned and replaced more frequently in very dusty conditions.**

## LUBRICANT

### SAE Classification

In the SAE classification, oils differ on the basis of their viscosity, and no other qualitative characteristic is taken into account.
The first number refers to the viscosity when the engine is cold (symbol W = winter), while the second considers viscosity with the engine at régime.
The criteria for choosing must consider, during winter, the lowest outside temperature to which the engine will be subject and the highest functioning temperature during summer.
Single-degree oils are normally used when the running temperature varies scarcely.
Multi-degree oil is less sensitive to temperature changes.




SAE- Grade

*** Semi-synthetic base*
**** Synthetic base*

### International specifications

They define testing performances and procedures that the lubricants need to successfully respond to in several engine testing and laboratory analysis so as to be considered qualified and in conformity to the regulations set for each lubrication kind.
**A.P.I** : ( American Petroleum Institute )
**MIL** : Engine oil U.S. military specifications released for logistic reasons
**ACEA** : European Automobile Manufacturers Association
Tables shown on this page are of useful reference when buying a kind of oil.
Codes are usually printed-out on the oil container and the understanding of their meaning is useful for comparing different brands and choosing the kind with the right characteristics.
Usually a specification showing a following letter or number is preferable to one with a preceding letter or number.

### *ACEA Regulations - ACEA Sequences*

| LIGHT DUTY DIESEL ENGINES | |
|---|---|
| *B1* | Low-viscosity, for frictions reduction |
| *B2* | Standard |
| *B3* | High performances (indirect injection) |
| *B4* | High quality (direct injection) |

| HEAVY DUTY DIESEL ENGINES | |
|---|---|
| *E2* | Standard |
| *E3* | Heavy conditions (Euro 1 - Euro 2 engines ) |
| *E4* | Heavy conditions (Euro 1 - Euro 2 - Euro 3 engines ) |
| *E5* | High performances in heavy conditions (Euro 1 - Euro 2 - Euro 3 engines ) |

### API / MIL Sequences

| API | CH-4 | CG-4 | CF-4 | CF-2 | CF | CE | CD | CC |
|---|---|---|---|---|---|---|---|---|
| MIL | | | L- 46152 D / E | | | | | |

## PRESCRIBED LUBRICANT

| | | |
|---|---|---|
| **SAE 15 W 40** | specifications | **API CF 4**<br>**ACEA B2 - E2**<br>**MIL - L-2104 D/E** |

In the countries where AGIP products are not available, use oil API SJ/CF for Diesel engines or oil corresponding to the military specification MIL-L-2104 D/E.
For a temperature of -10°C an oil with a **5W40** viscosity is recommended. For a temperature of -15°C an oil with a **0W30** viscosity is recommended.

| 11 LD 625/3 - 626/3 ENGINES OIL CAPACITY | | |
|---|---|---|
| **OIL VOLUME AT MAX LEVEL (OIL FILTER INCLUDED)** | Litres | **5,5** |
| **OIL VOLUME AT MAX LEVEL (WITHOUT OIL FILTER)** | Litres | **5** |

**Danger – Attention**

- The engine may be damaged if operated with insufficient lube oil. It is also dangerous to supply too much lube oil to the engine because a sudden increase in engine rpm could be caused by its combustion.
- Use proper lube oil preserve your engine. Good quality or poor quality of the lubricating oil has an affect on engine performance and life.
- If inferior oil is used, or if your engine oil is not changed regularly, the risk of piston seizure, piston ring sticking, and accelerated wear of the cylinder liner, bearing and other moving components increases significantly.
- Always use oil with the right viscosity for the ambient temperature in which your engine is being operated.
- The used engine oil can cause skin-cancer if kept frequently in contact for prolonged periods.
- If contact with oil cannot be avoided, wash carefully your hands with water and soap as soon as possible.
- Do not disperse the oil in the ambient, as it has a high pollution power.

## FUEL SPECIFICATIONS

***Danger***

- **To avoid explosions or fire outbreaks, do not smoke or use naked flames during the operations.**
- **Fuel vapours are highly toxic. Only carry out the operations outdoors or in a well ventilated place.**
- **Keep your face well away from the plug to prevent harmful vapours from being inhaled.**
- **Dispose of fuel in the correct way and do not litter as it is highly polluting.**

To achieve optimum performance of the engine, use good quality fuel with certain characteristics:

Cetane number (minimum 51): indicates the ignition quality.
A fuel with a low cetane number may cause problems when starting from cold and have a negative effect on combustion.
Viscosity (2.0/4.5 centistokes at 40°C): this is the resistance to flow and performance may decline if not within the limits.
Density (0.835/0.855 Kg/litre): a low density reduces the power of the engine, and density that is too high increases performance and opacity of the exhaust
Distillation (85% at 350°): this is an indication of the mixture of different hydrocarbons in the fuel.
A high ratio of light hydrocarbons may have a negative effect on combustion.
Sulphur (maximum 0.05% of the weight): high sulphur content may cause engine wear.
In those countries where diesel has a high sulphur content, it is advisable to lubricate the engine with a high alkaline oil or alternatively to replace the lubricating oil recommended by the manufacturer more frequently.

| PRESCRIBED LUBRICANT | |
|---|---|
| Fuel with low sulphur content | **API CF4 - CG4** |
| Fuel with high sulphur content | **API CF - CD - CE** |

The countries in which diesel normally has a low sulphur content are: Europe, North America and Australia.

**Fuels for low temperatures**

It is possible to run the engine at temperatures below 0°C using special winter fuels.
These fuels reduce the formation of paraffin in diesel at low temperatures.
If paraffin forms in the diesel, the fuel filter becomes blocked interrupting the flow of fuel.

| | | | | |
|---|---|---|---|---|
| **Fuel can be:** | **-** | **Summer** | **up to** | **0°C** |
| | **-** | **Winter** | **up to** | **-10°C** |
| | **-** | **Alpine** | **up to** | **-20°C** |
| | **-** | **Arctic** | **up to** | **-30°C** |

**For all fuel types, the cetane number cannot be lower than 51.**

**Aviation kerosene and RME fuels (biofuels)**

The only Aviation fuels that may be used in this engine are: JP5, JP4, JP8 and JET-A if 5% oil is added.
For more information on Aviation fuels and Biofuels (RME, RSME) please contact the Lombardini applications department.

| Capacities standard fuel tank | Litres | 15 |
|---|---|---|
| As for filters, tanks and special crankcases please refer to LOMBARDINI instructions. | | |

## RECOMMENDATIONS FOR DISASSEMBLING AND ASSEMBLING

***Important***
**To locate specific topics, the reader should refer to the index.**

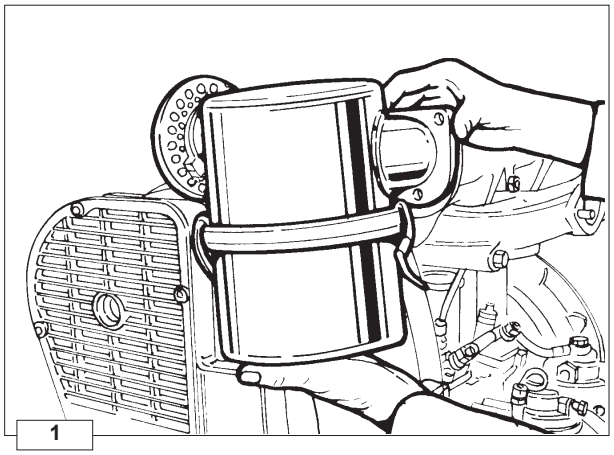
- Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions.
- Always use original LOMBARDINI spare parts for proper repair operations.
- The operator must wash, clean and dry components and assemblies before installing them.
- The operator must make sure that the contact surfaces are intact, lubricate the coupling parts and protect those that are prone to oxidation.
- Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
- For safety and convenience, you are advised to place the engine on a special rotating stand for engine overhauls.
- Before proceeding with operations, make sure that appropriate safety conditions are in place, in order to safeguard the operator and any persons involved.
- In order to fix assemblies and/or components securely, the operator must tighten the fastening parts in a criss-cross or alternating pattern.
- Assemblies and/or components with a specific tightening torque must initially be fastened at a level lower than the assigned value, and then subsequently tightened to the final torque.

## RECOMMENDATIONS FOR OVERHAULS AND TUNING

***Important***
**To locate specific topics, the reader should refer to the index.**

- Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
- The operator must comply with the specific measures described in order to avoid errors that might cause damage to the engine.
- Before carrying out any operation, clean the assemblies and/or components thoroughly and eliminate any deposits or residual material.
- Wash the components with special detergent and do not use steam or hot water.
- Do not use flammable products (petrol, diesel, etc.) to degrease or wash components. Use special products.
- Dry all washed surfaces and components thoroughly with a jet of air or special cloths before reassembling them.
- Apply a layer of lubricant over all surfaces to protect them against oxidation.
- Check all components for intactness, wear and tear, seizure, cracks and/or faults to be sure that the engine is in good working condition.
- Some mechanical parts must be replaced *en bloc*, together with their coupled parts (e.g. valve guide/valve etc.) as specified in the spare parts catalogue.

***Important***
**During repair operations, when using compressed air, wear eye protection**.

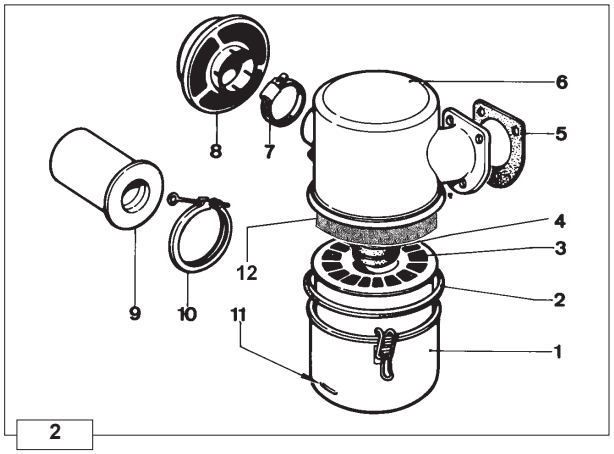

1

**Oil-bath air cleaner**

***Important***
**Do not blow the paper filter element with compressed air to clean.**

***Warning***
**Check gaskets and replace as necessary.**
**Check that flange welds are free of defective spots.**

❍ When reassembling, tighten the fastening nuts of the air filter to the intake manifold to 25 Nm.



2

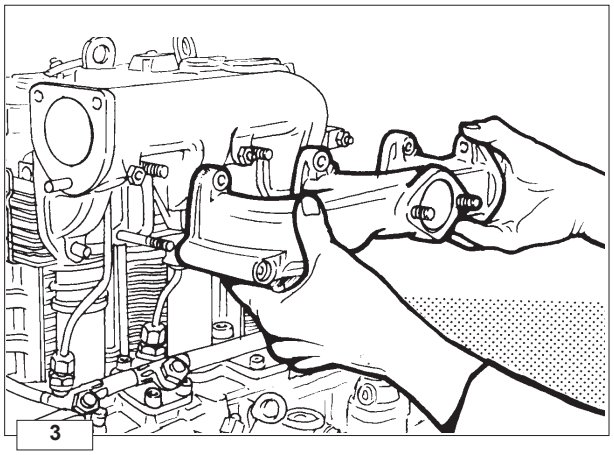
**Oil-bath air cleaner components**

***Warning***
**Replace if irreparably clogged.**

**1** Bowl
**2** External seal ring
**3** Lower filtering element
**4** Internal seal ring
**5** Gasket
**6** Cover
**7** Cover clamp
**8** Cap
**9** Centrifugal pre-filter
**10** Centrifugal pre-filter clamp
**11** Oil level mark
**12** Upper filtering element (polyurethan sponge)

***Note:*** Thoroughly clean the lower tank and the metal filter element using diesel fuel then blow compressed air into them.
The upper filter element in polyurethane foam is cleaned by washing it in soapy water; after washing, dry completely using compressed air.

➲ After cleaning refill the engine oil tank up to the indicated level.
See page 21 for the maintenance or replacement instructions.

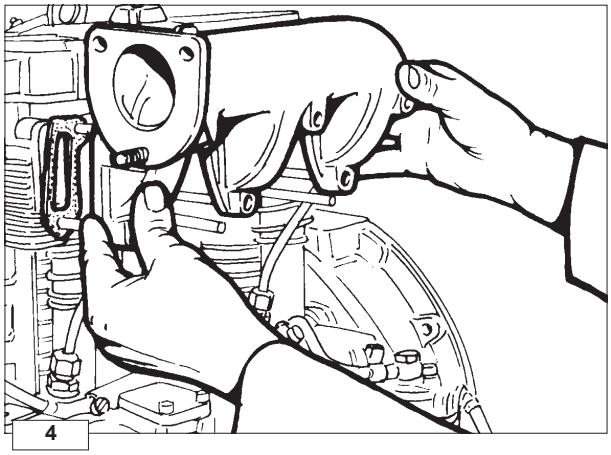

3

**Exhaust manifold**

***Important***
**Allow the exhaust manifold to cool before demounting it in order to prevent scorching and burns.**

Make sure that the inside is properly clean and is free from cracks or breakage.
Always replace the seals between the manifold and the exhaust pipes.

❍ When assembling, tighten the nuts in sequence and gradually before the final torque to 20 Nm.

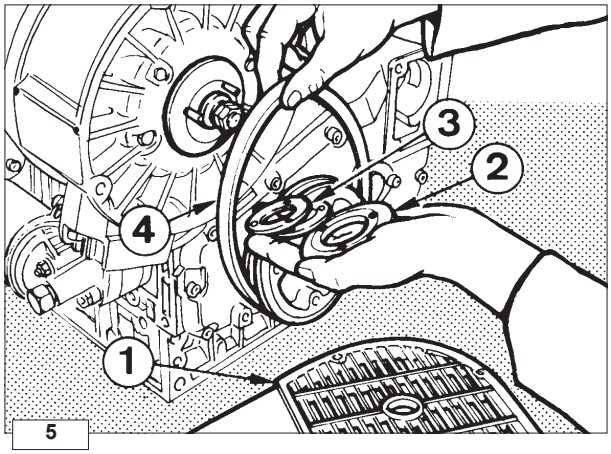

4

**Intake manifold**

Before reassembling the manifold check the levelness of the flanges.
Always replace the seals between the manifold and the intake pipes.

❍ Tighten the nuts gradually to 25 Nm.

***Note:*** In case of low temperature starting we can supply a manifold with provision for a glow plug for air preheating.



5

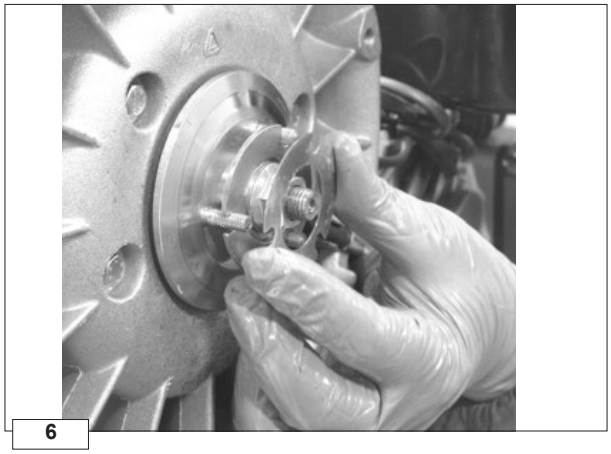
**Blower belt alternator**

*Components:*

**1** Guard
**2** Pulley
**3** Spacers
**4** 'V'-belt

Unscrew the fastening screws of the belt guard and remove it, then take out the nuts on the three stud bolts on the half-pulley.
Remove the V belt and check for wear.

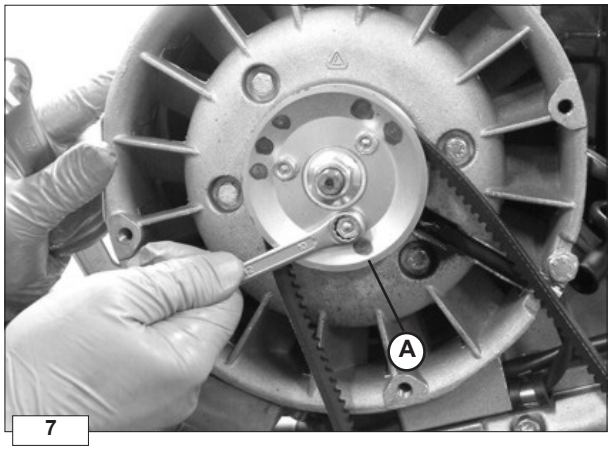
➲ See page 21 for periodic maintenance details.


6

**Belt tension adjustment**

***Important***
**Check the belt tension only when the engine is not running**

The belt tension is adjusted by adding (to reduce tension) or removing (to increase tension) spacers between the half-pulleys.
Spacers are available in thicknesses of 0.5, 1 and 2 mm.

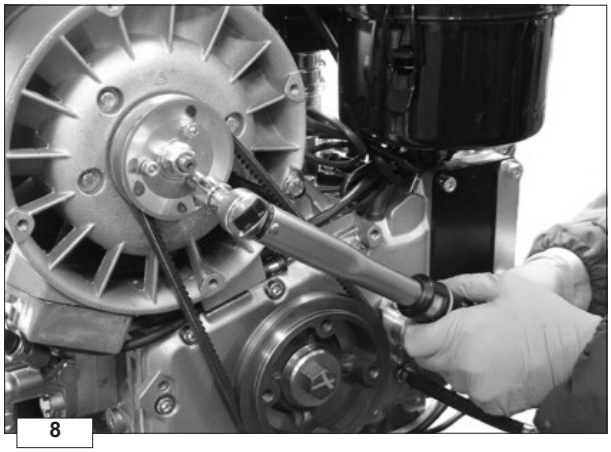


7

**Half-pulley - Reassembly**

***Important***
**The three stop nuts of the half-pulley should never be tightened simultaneously.**

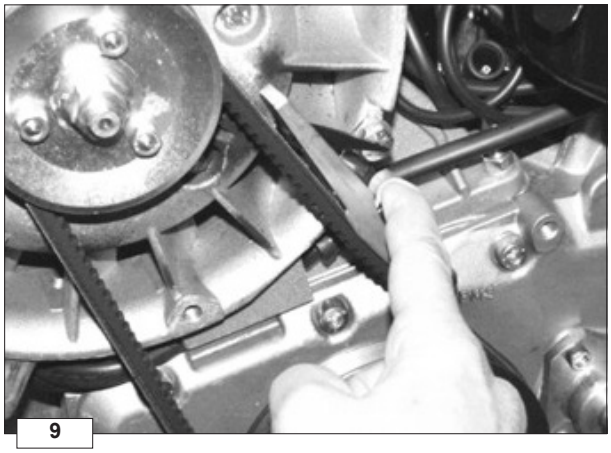
Turn the pulley so that, whenever you tighten a nut, this is in the position indicated **A** in the figure 7.
Tightening should be carried out gradually.


8

**Blower belt alternator - Reassembly**

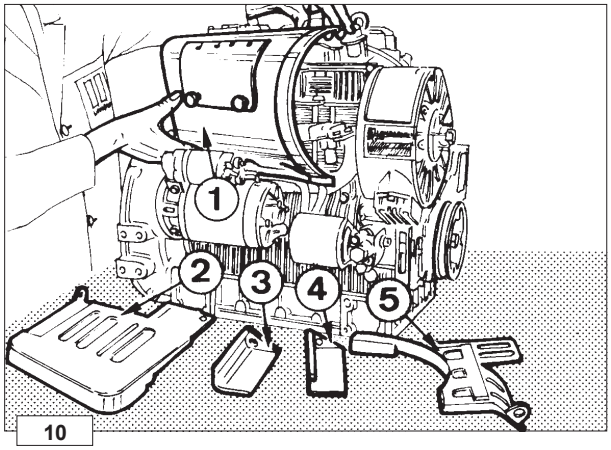
❍ The half-pulley fastening nuts must be tightened using the torque wrench to a final torque of 10 Nm.

Again during this phase the nut must be in position **A** when tightened as in fig. 7 – page 28.


9

**Tension check**

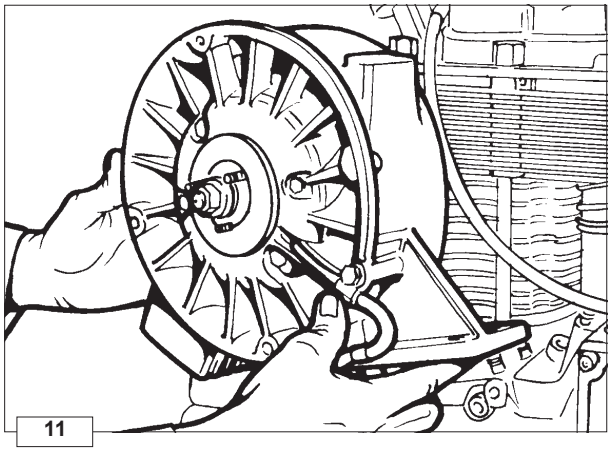
A 4 Kg load located halfway between the pulleys should cause the belt to bend 5 ÷ 15 mm.
The correct belt tension can also be checked with special tools that are available on sale.



10

**Air shroud and baffles - Disassembly**

The air shroud **1** and the baffles **2**, **3**, **4**, **5** are shaped in such a way as to direct the flow of air onto the cylinders in order to cool them.
As the shroud is completely covered in noise-absorbent material, it also has the function of reducing the amount of noise generated by the blower fan and vibrations.

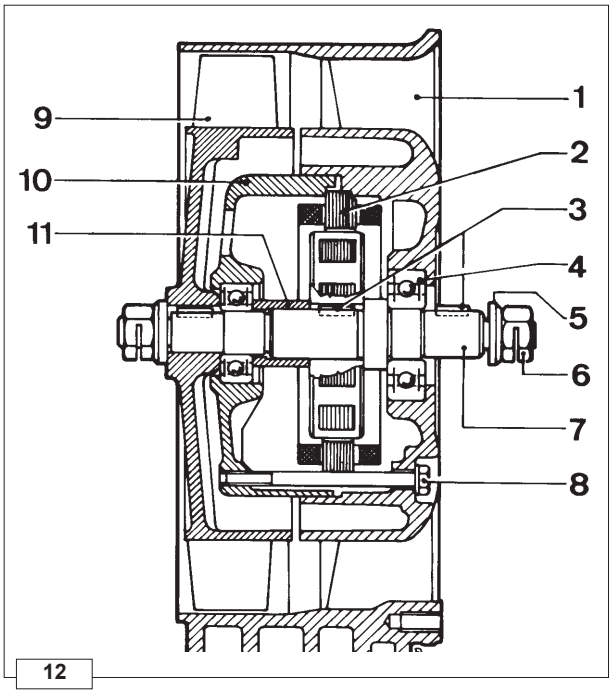

11

**Blower assembly**

***Danger***
**Before demounting the cooling fan, disconnect the positive battery cable to prevent accidental short-circuits which could consequently energize the starter motor.**

The plate and tension regulator are fixed to the outside of the blower fan stator.
A 14 A or 21 A alternator is housed inside the stator.

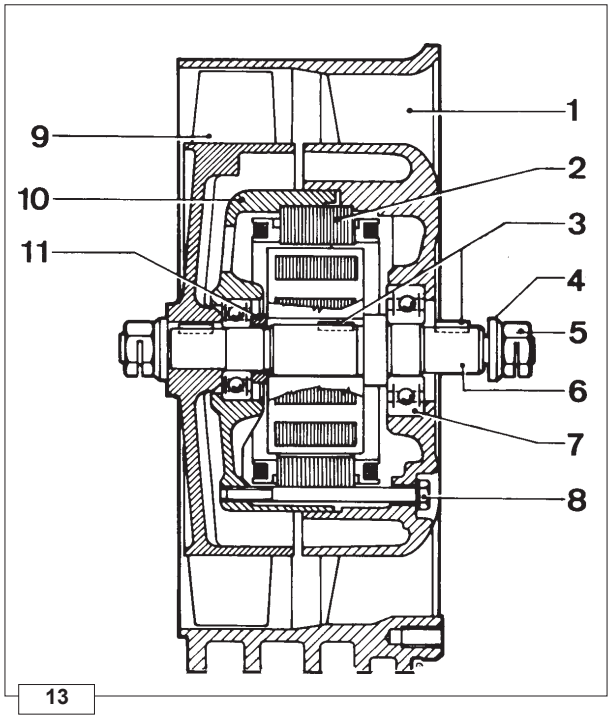
➲ See page 66 - 71 for the alternator technical data.
➲ See page 17 for the cooling air volume.



12

**Blower assembly components with 14 A alternator**

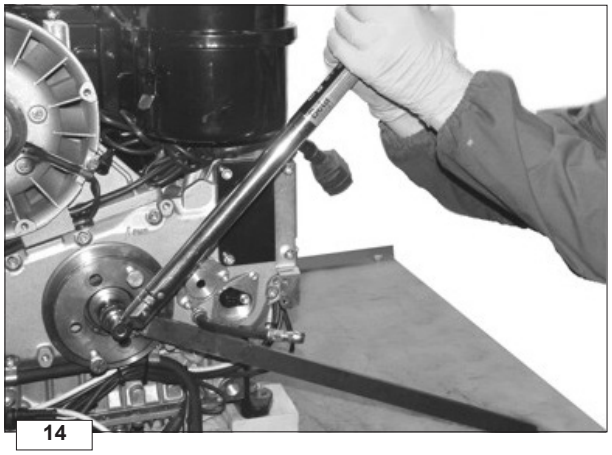
**1** Housing
**2** 14 A alternator
**3** Key
**4** Ball bearing
**5** Washer
**6** Nut
**7** Shaft
**8** Bolt
**9** Fan
**10** 14 A alternator bell
**11** Spacer



13

**Blower assembly components with 21 A alternator**

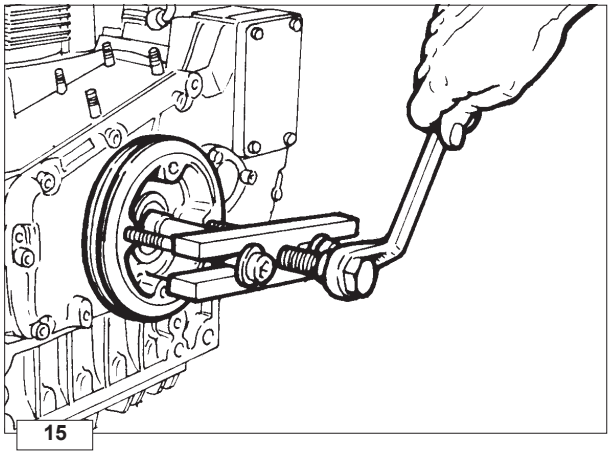
**1** Housing
**2** 21 A alternator
**3** Key
**4** Washer
**5** Nut
**6** Shaft
**7** Bearing
**8** Bolt
**9** Fan
**10** 21 A alternator bell
**11** Spacer


14

**Blower control pulley - Disassembly**

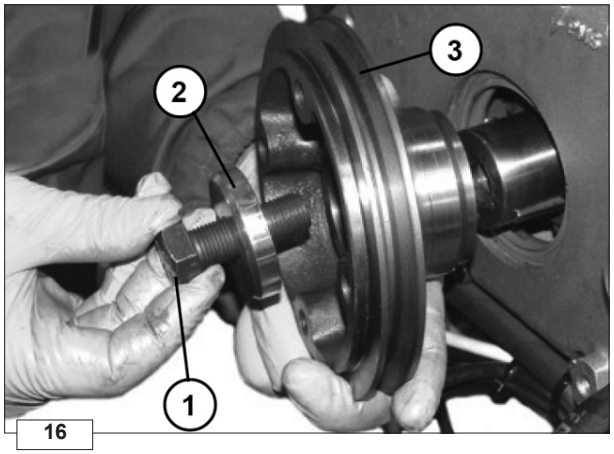
The blower control pulley is installed on and is driven by the crankshaft.
To disassemble the pulley unscrew the left-handed bolt (clockwise) after blocking the crankshaft.

❍ When reassembling, tighten the bolt using a torque wrench to a torque of 300 Nm.


15

**Crankshaft pulley**

Remove the pulley using extractor serial no. 1460.200.

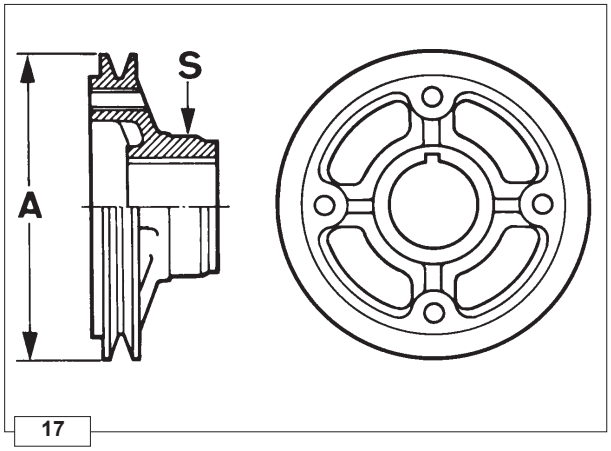


16

*Components:*

**1** Left-handed bolt
**2** Washer
**3** Blower control pulley

***Note:*** It is only possible to check crankshaft axial clearance after tightening the pulley.



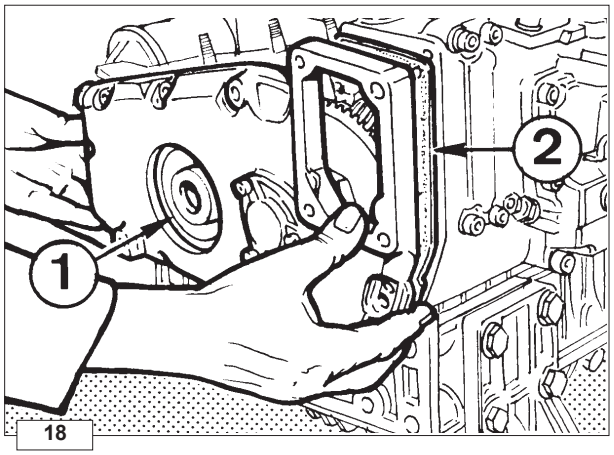
17

**Blower control pulley diameter**

There are three pulleys with different diameters **A** which take account of engine settings:

| | |
|---|---|
| **A** = 142 mm | ( from 2401 to 3000 r.p.m. ) |
| $\mathbf{A_1}$ = 147 mm | ( from 2001 to 2400 r.p.m. ) |
| $\mathbf{A_2}$ = 163 mm | ( from 1500 to 1800 r.p.m. ) |

Check **S** surface in contact with oil seal ring and, if necessary, rub with a fine grain emery cloth.



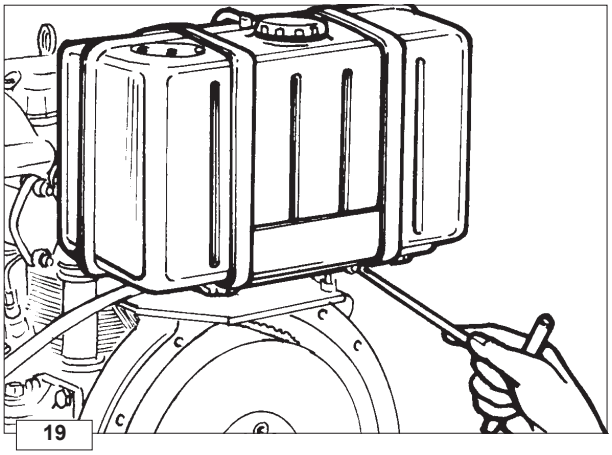
18

**Timing cover**

Loosen the screws and remove the cover.

❍ When refitting tighten screws at 25 Nm.

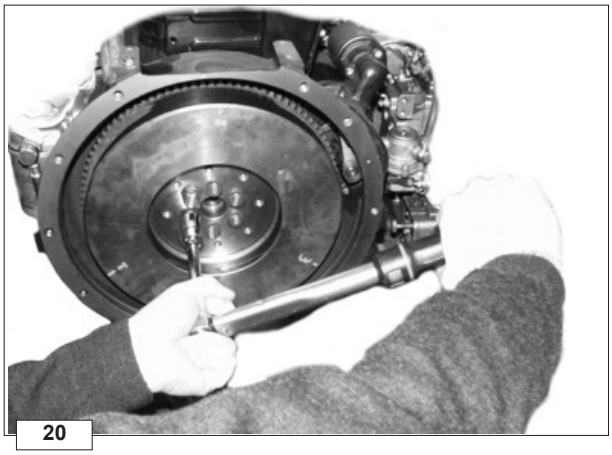
Check oil seal ring **1** and replace if warped, hardened or worn-out. Replace gasket **2**.


19

**Tank**

***Danger***
**Do not smoke or use naked flames during the demounting operations as these could cause explosions or fire outbreaks.**
**Fuel fumes are highly toxic. Only carry out the operations outdoors or in a well ventilated place.**
**Keep your face well away from the filler cap or you could inhale harmful fumes. Dispose of fuel in the correct way as it is highly polluting. Do not litter.**

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

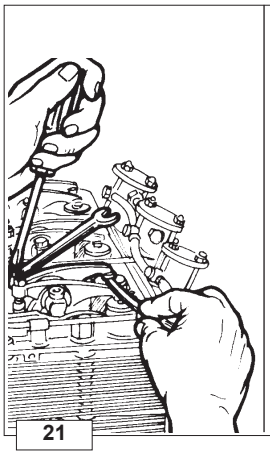

20

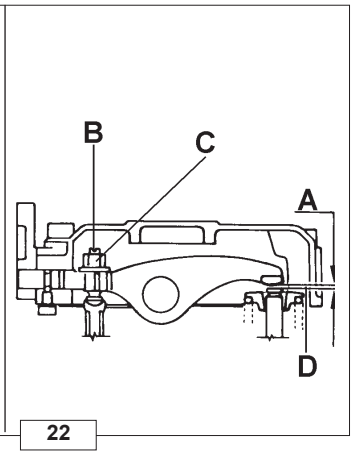
**Flywheel**

***Danger***
**During the demounting phases, pay particular attention to prevent the flywheel from dropping as this could seriously injure the operator.**
**Wear protective goggles when removing the flywheel ring.**

Remove the bolts which attach the flywheel to the crankshaft.
To replace starter ring gear heat it up to 300°C for 15 ÷ 20 minutes. Drive it onto the flywheei caretully checking that it perfectly fits into its seat.
Let it cool down slowly.

❍ When reassembling gradually tighten the fastening screws to 140 Nm on the crankshaft using a torque wrench.


21

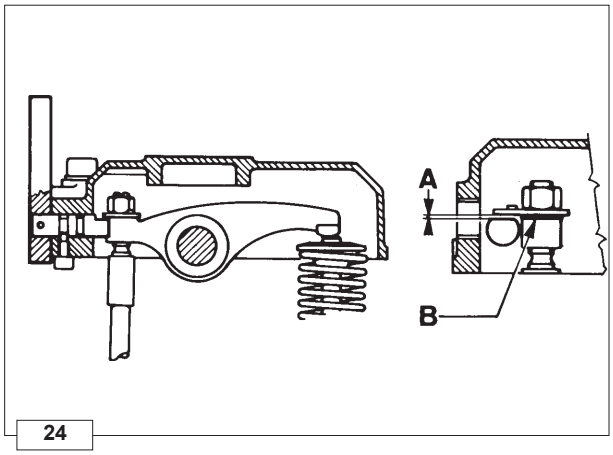


22

**Valve / rocker arm clearance**

***Warning***
**Make settings when the engine is cold.**

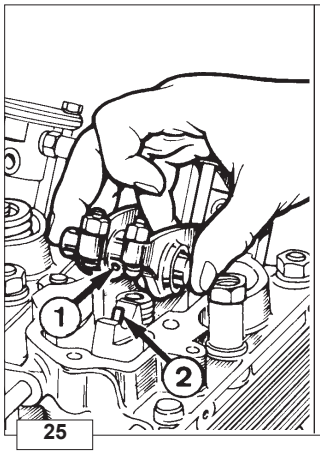
Remove the rocker arm covers and make sure the seals are intact, otherwise replace them. Bring the cylinder piston that is to be adjusted to the compression top dead centre.
Loosen the fastening nut **C**, insert the thickness gauge **D** between the rocker arm and the top of the valve stem, then, using a cross-head screwdriver turn the adjusting screw **B** to set clearance.
Tighten the fastening screw **C** and check valve clearance **A** again to ensure that it is between 0,15 and 0,2 mm for intake and 0,3 ÷ 0,35 mm for exhaust.
❍ When refitting tighten cover screws to 20 Nm.
If necessary place a 0,30 or 0,40 mm shim at **B**.



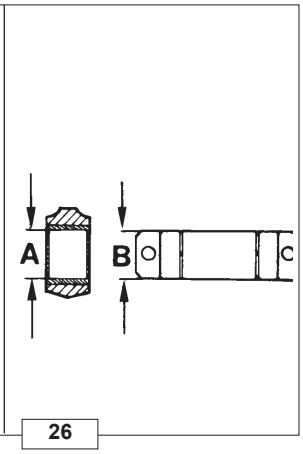
24

**Compression release (optional)**

Bring piston to top dead center on the compressìon stroke.
Unscrew rocker arm cover side plug and measure clearance **A** should be 0,30 ÷ 0,40 mm.



25



26

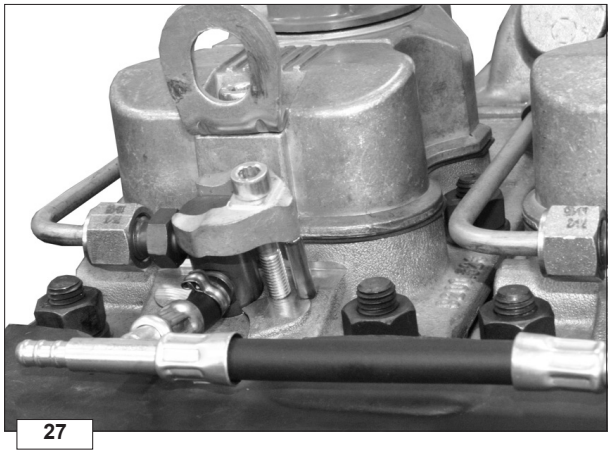
**Rocker arm assembly**

Components: **1** Rocker arm axle lubrication hole
**2** Lubrication tube

| Ref. | Dimensions (mm) |
|---|---|
| A | 18.032 ÷ 18.050 |
| B | 17.989 ÷ 18.000 |

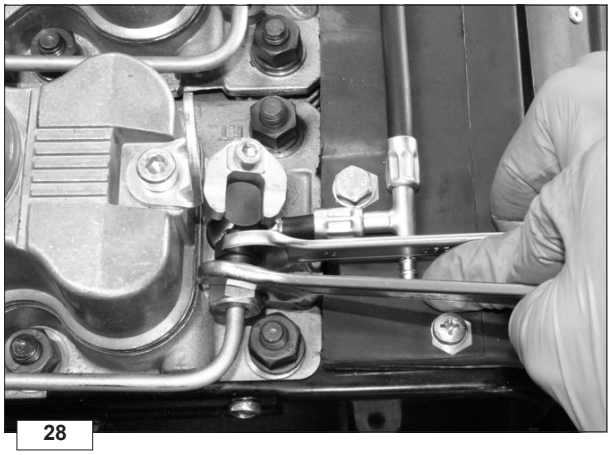
Replace the axle and the rocker arm if clearance (**A-B**) is greater than 0,135 mm.
When refitting check that lubrication tube **2** perfectly fits into centering bore **1**.

❍ Tighten screws at 25 Nm.

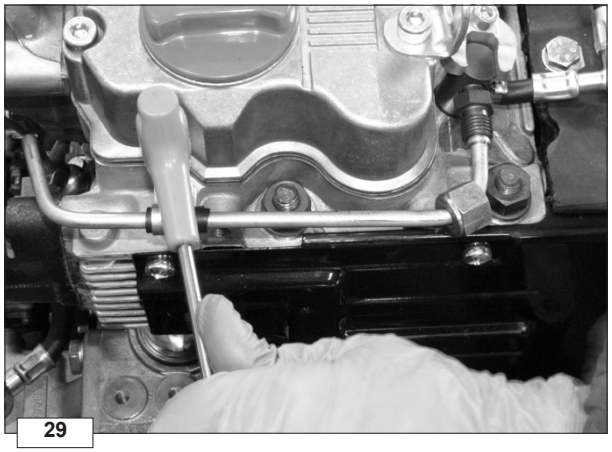

27

**Disassembling size P injector**

The injector is attached to the cylinder head via a forked bracket.

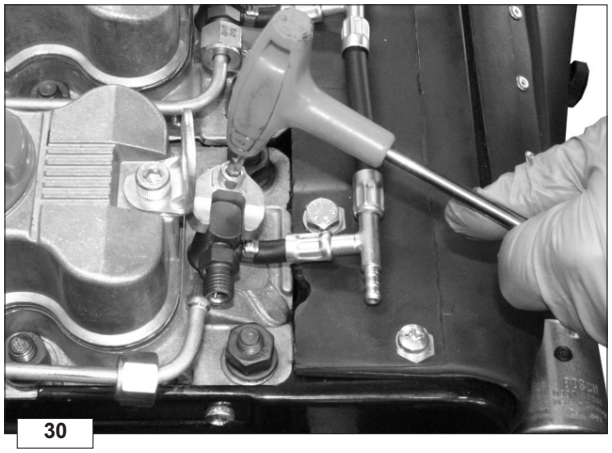

28

To release the injector union from the high-pressure pipe, use two box wrenches (14 and 17 mm).



29

Unscrew the screw fastening the clamp of the high-pressure pipe using a 4 mm hexagon screwdriver.

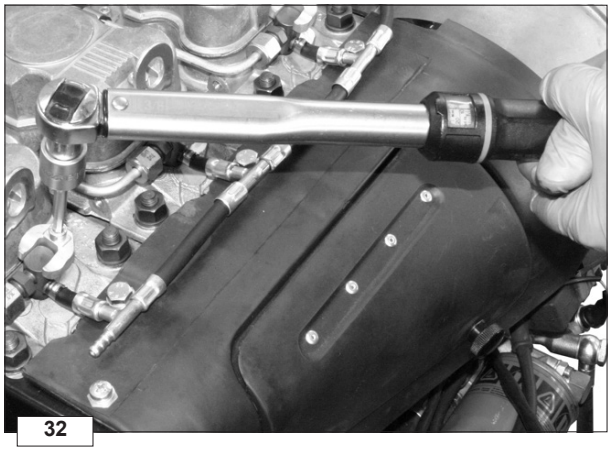


30

Remove the forked bracket fixing the injector to the cylinder head using a 5 mm hexagon screwdriver (see photo 29 - 30).

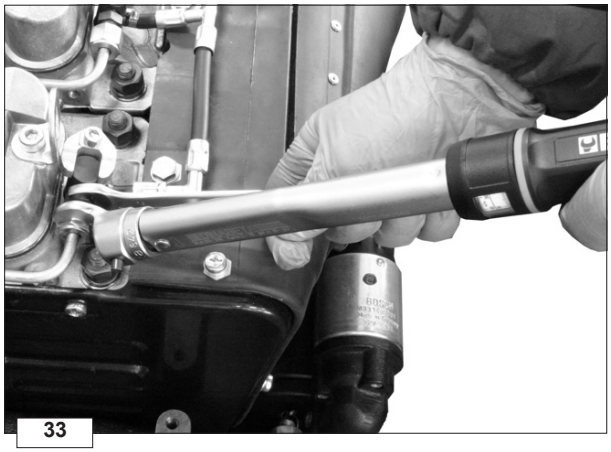
31

These operations are necessary when checking injector calibration or when replacing it.

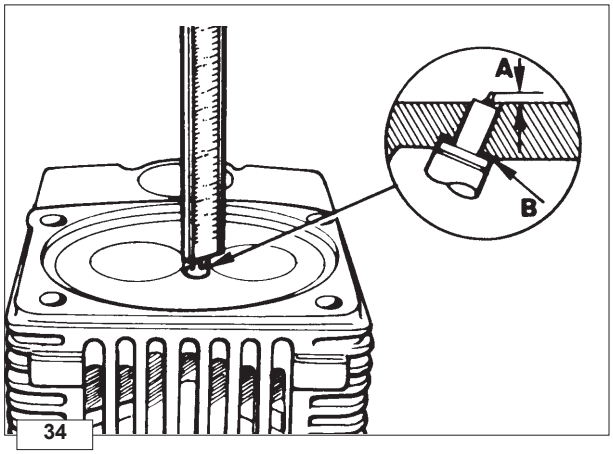


32

❍ The fixing bracket screws must be tightened to 10 Nm using a torque wrench.


33

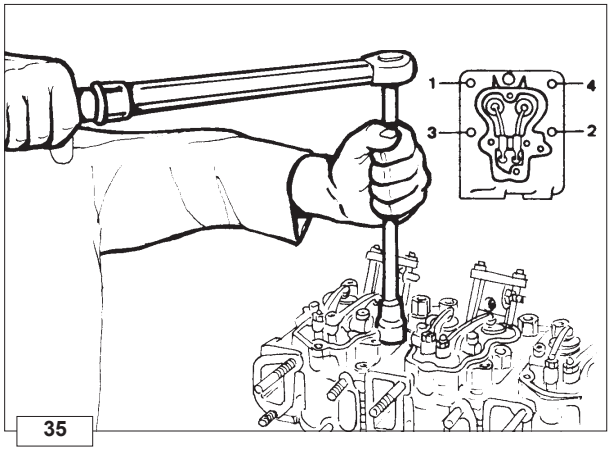
❍ The high-pressure pipe union must be tightened to the injector union to 20 ÷ 25 Nm using a torque wrench.



34

**Injector protrusion**

It is only possible to check injector protrusion with the cylinder head disassembled.
The end of the nozzle must be 3 ÷ 3,5 mm with respect to the head surface **A**.
Protrusion is adjusted by adding or removing copper seals **B** which are supplied at a thickness of 0,5 and 1 mm.



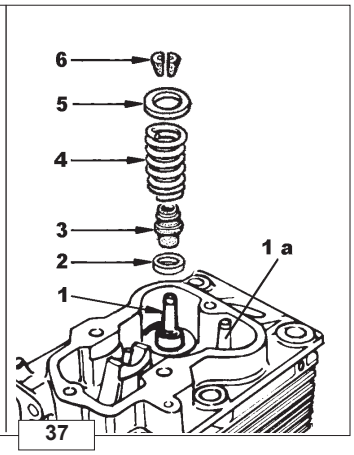
35

**Cylinder Head**

***Warning***
**Do not demount or remount while hot as this could lead to deformations.**

If the head surface is distorted, grind it by removing up to 0.3 mm thickness. When reassembling, before tightening, make sure that the rocker arm lubrication hose is firmly lodged into holes. The cylinder heads must be tightened with the exhaust or intake manifold mounted to keep them lined up. Always replace the copper seal between the cylinder head and the cylinder that determines clearance volume; see page 40 for the choice of thickness. See page 32 for how to mount the spring on the tappet rod protection pipe.
❍ The cylinder head fastening nuts must be tightened gradually to 55 Nm and in the sequence **1**, **2**, **3**, **4**; see fig. 38.


36



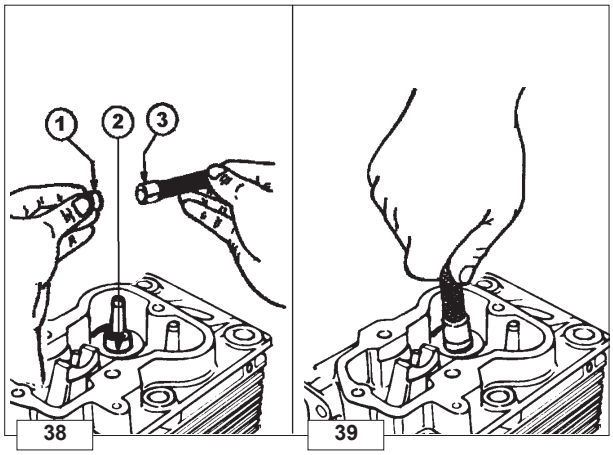
37

**Valves**

*Components:*

**1** Intake valve
**1a** Exhaust valve
**2** Lower spring collar
**3** Valve stem sealing ring
**4** Spring
**5** Upper spring collar
**6** Three-groove half collets

Te remove half collets firmly press down the special tool 1460 - 113 as shown in the figure 36.

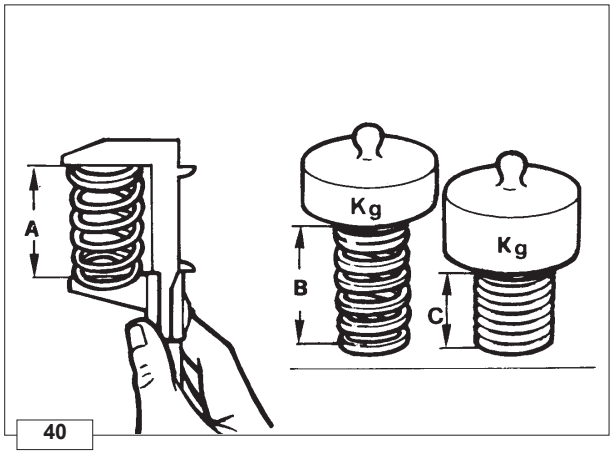


38

39

### Valve stem sealing rings - Reassembly

Lubricate the inside of the sealing ring with Molikote BR2 Plus and insert them all the way onto the guides using tool 1460 – 108.
To prevent deformation of the sealing ring **1** as it is inserted onto the valve guide **2** insert it onto tool **3**.
Lubricate valve stem with the same type of grease; insert the valves into the guides rotating them particularly as they enter the sealing ring.

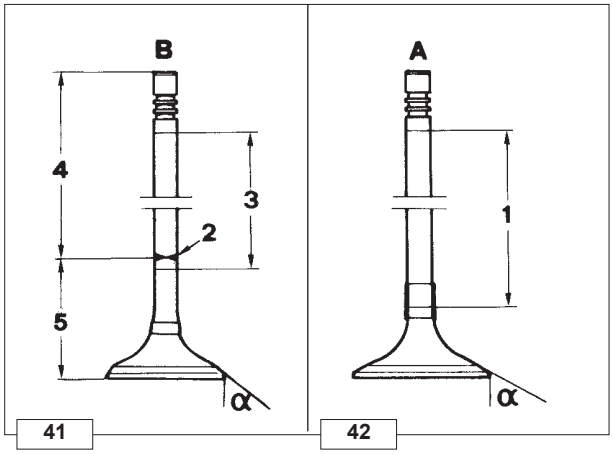


40

### Valve springs

Measure free length with a gauge.
Using a spring tester check that the spring length under two different loads corresponds to the values below:

Free length **A** = 52 mm
Length **B** compressed by a 21 Kg weight = 34.8 mm
Length **C** compressed by a 32 Kg weight = 25.8 mm.



41



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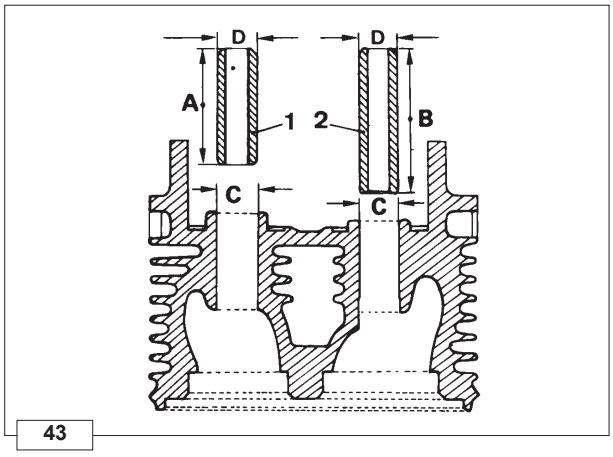
### Valve material

**Intake valves A**
- Material: X 45 Cr Si 9 - 3 UNI EN 10090
**1** = Chromium-plated portion
**α** = 45°15' ÷ 45°25'

**Exhaust valve B**
Shaft and head are made of 2 different materials.
**2** = Welded portion
**3** = Chromium-plated portion
**4** = Portion made of X 45 Cr Si 9 - 3 UNI EN 10090
**5** = Portion made of X 53 Cr Mn Ni N 21 - 9 UNI EN 10090
**α** = 45°15' ÷ 45°25'



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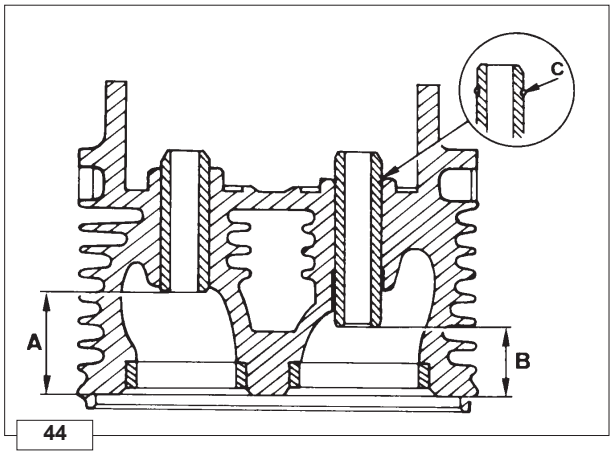
### Valve guides and cylinder head housings

Intake and exhaust valve guides are both made of phosphoric cast iron.
*Components:* **1** = Exhaust valve guide
**2** = Intake valve guide

| Ref. | Dimensions (mm) |
|---|---|
| A | 42.00 |
| B | 48.00 |
| C | 14.00 ÷ 14.018 |
| D | 14.045 ÷ 14.056 |

Valve guides with outside diameter increased by 0,5 mm are also available; in such cases valve guide bore **C** should also be increased by 0,5 mm.



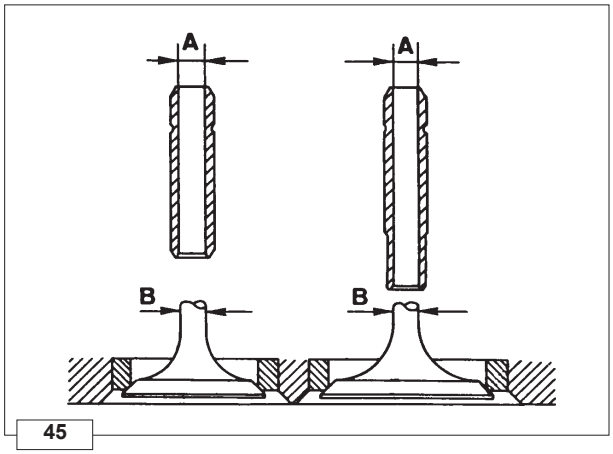
44

### Valve guide insertion

Heat cylinder head up to 160 ÷ 180°C.
Thread guides considering the **A** e **B** distances from the head plane.

| Ref. | Dimensions (mm) |
|---|---|
| A | 30.80 ÷ 31.20 |
| B | 24.80 ÷ 25.20 |

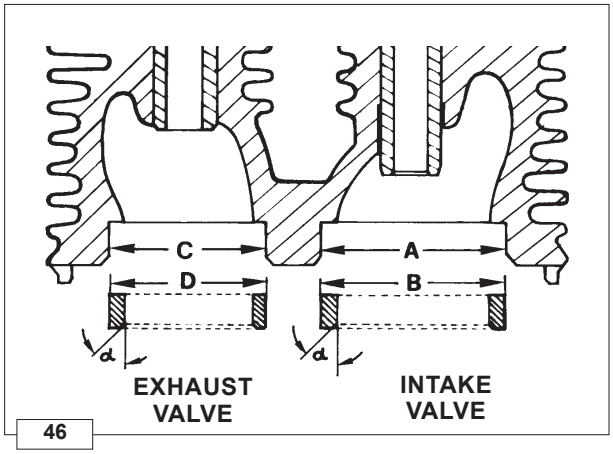
***Note:*** If the guides are supplied with the housing for the lock ring **C**, insert the ring, then drive the guides until the lock ring is stopped without worrying about **A** and **B**.



45

### Dimensions and clearance between guides and valves

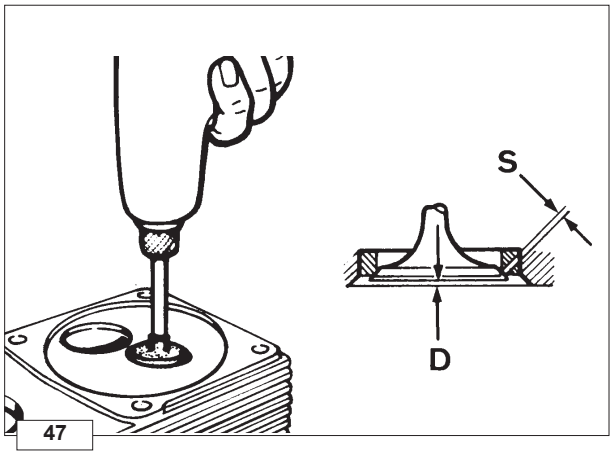
| Ref. | Dimensions (mm) | Clearance (mm) | Limit value (mm) |
|---|---|---|---|
| A | 8.025 ÷ 8.040 | 0.025 ÷ 0.055 | 1.15 |
| B | 7.985 ÷ 8.000 | | |



46

### Valve seats and housings

| Ref. | Dimensions (mm) |
|---|---|
| A | 40.000 ÷ 40.016 |
| B | 40.120 ÷ 40.140 |
| A | 34.000 ÷ 34.016 |
| B | 34.120 ÷ 34.140 |



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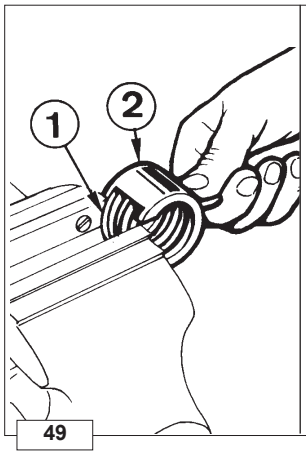
### Valve seat lapping

After cutting, lap valve seats with fine emery paste in oil suspension.
The sealing surface **S** should not exceed 2 mm.

**Valve recess after grinding**

| Ref. | Dimensions (mm) | Limit value (mm) |
|---|---|---|
| D | 0.75 ÷ 1.25 | 1.65 |



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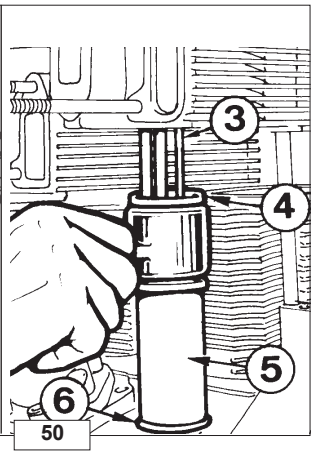


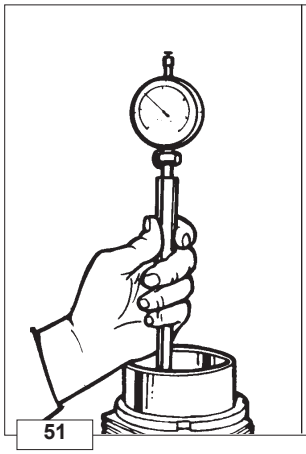
50

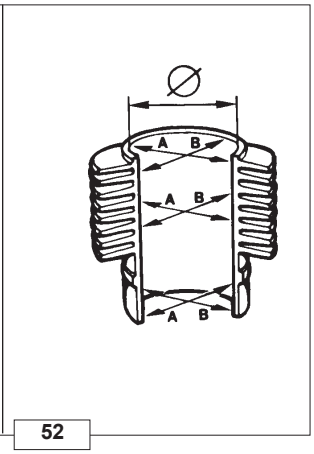
**Pushrod tube spring fitting**

*Components:*

**1** Spring
**2** Tool Part No 1460-009
**3** Rocker arm lubrication tube
**4** Gasket
**5** Pushrod tube
**6** Gasket

To mount the spring **1** on the tappet rod protection pipe **5** insert it into the tool **2** with the help of a vice.
Make sure that the rocker arm lubrication hose **3** and the seals **4** and **6** are fully in place.


51



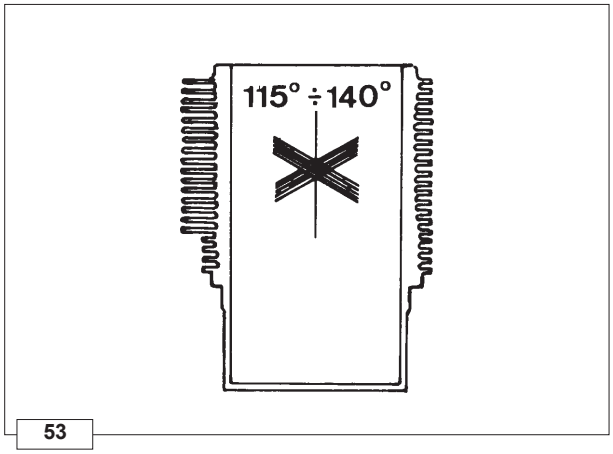
52

**Cylinder**

Measure diameter sìze between two diametrically opposed points at three different heights.

| Ref. | Ø Cylinder (mm) |
|---|---|
| 11 LD 625-3/626-3 | 95,00 ÷ 95,03 |

In case wear exceeds 0,10 mm, bore the cylinder and fit oversize piston and rings.
In case of less wear replace piston rings only.



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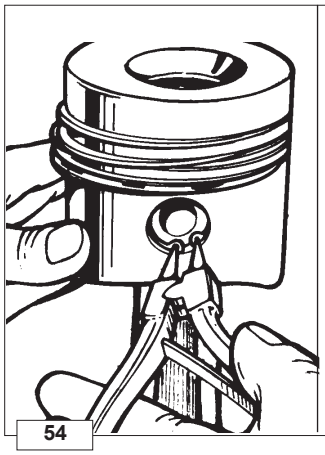
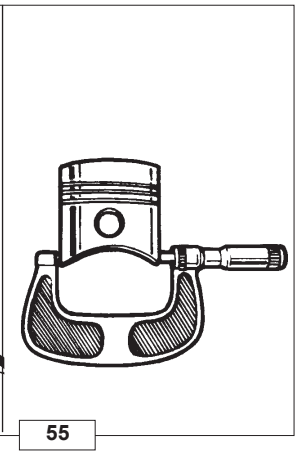
**Checks and cyiinder roughness**

The cylinder should show no blowholes or porosities.
Seal both ends of cylinder and pressurize with compressed air at 4 bar for 30 sec.
Fins must be intact.
Cross hatch pattern must range between 115° ÷ 140°: they must be uniform and clear in both directions.
Average roughness should range between 0,5 and 1 µm.


54


55

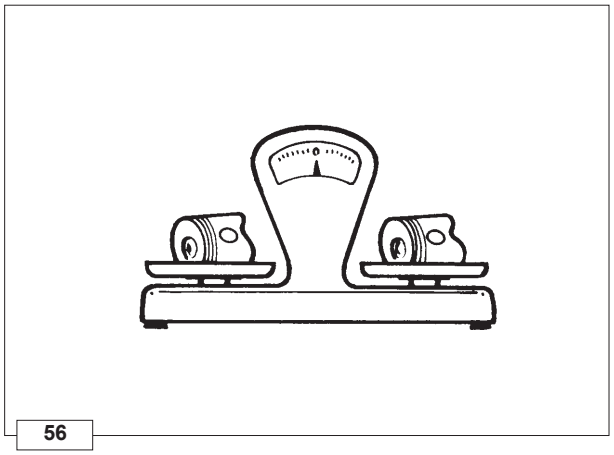
**Piston**

Remove the Sieger stop rings and extract the pin.
After removing the snap rings from the piston, clean the grooves if necessary.
Measure the diameter at 2 mm from the base using an external micrometer.

| Ref. | Ø Piston (mm) |
|---|---|
| 11 LD 625-3/626-3 | 94.92 ÷ 94.95 |

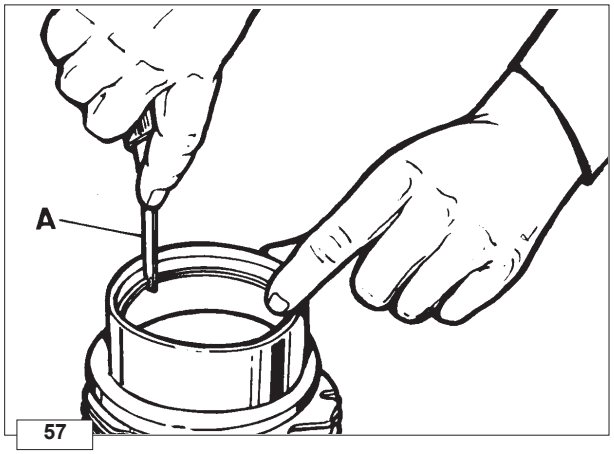
Replace the piston and the snap rings if the diameter of the wear is greater than 0,05 mm of the minimum value prescribed.

***Note:*** Oversize pistons of 0,5 and 1,0 mm are available.


56

### Piston weight

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



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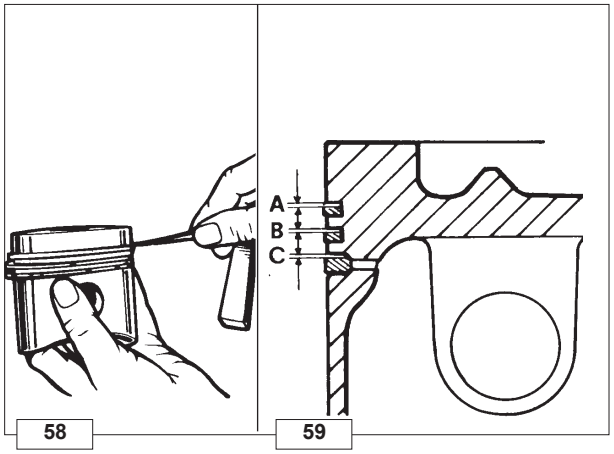
### Metal snap rings - End gaps

Insert the snap rings in the lower part of the cylinder, then measure the distance between the tips.

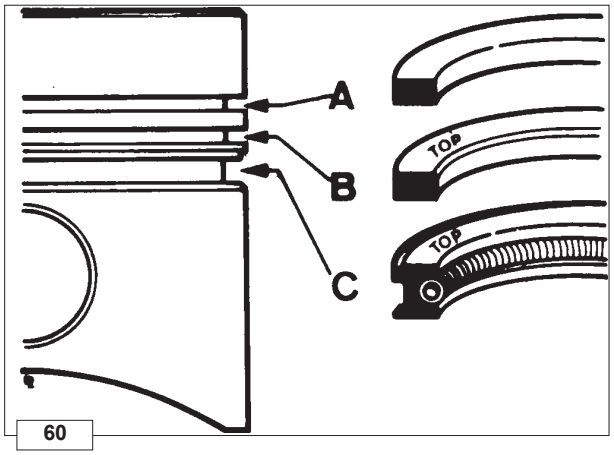
| | | | 11 LD 625-3 626-3 | Limit value |
|---|---|---|---|---|
| 1° | Compression snap ring (chrome-plated) | A | 0.40 ÷0.50 | 1 mm |
| 2° | Snap ring (conical internal torsional) | A | | |
| 3° | Ring (oil scraper) | A | 0.25 ÷ 0.50 | |



58 59

### Metal snap rings - Piston grooves

| Ref. | Dimensions (mm) | Limit value (mm) |
|---|---|---|
| A | 0,07 ÷ 0,11 | 0,20 |
| B | 0,05 ÷ 0,09 | 0,16 |
| C | 0,04 ÷ 0,08 | 0,15 |



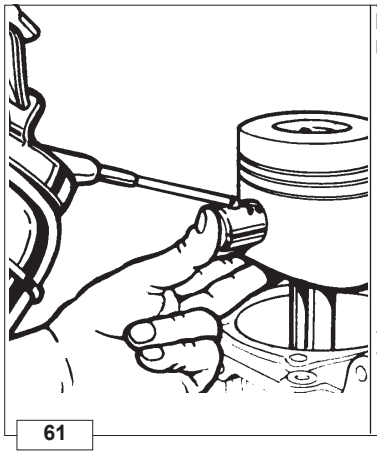
60

### Metal snap rings - Fitting sequence

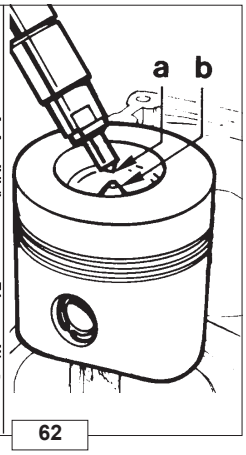
**A** = Compression snap ring (chrome-plated)
**B** = Snap ring (conical internal torsional)
**C** = Ring (oil scraper)

***Note:*** before inserting the piston in the cylinder, rotate snap rings so that cuts are misaligned by 120° from one to the next.

***Important***
**Assemble the segments with TOP facing the piston crown.**



61



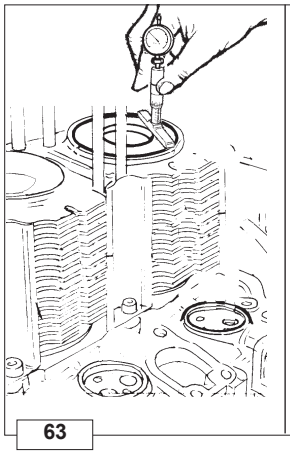

62

## Piston - Refitting

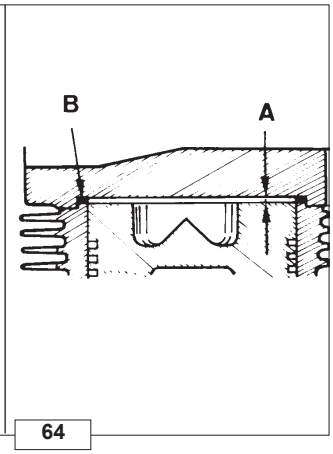
***Warning***

**Lubricate the following parts with oil before mounting: the piston pin, the piston, the cylinder and the big-end bearing**

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



63




64

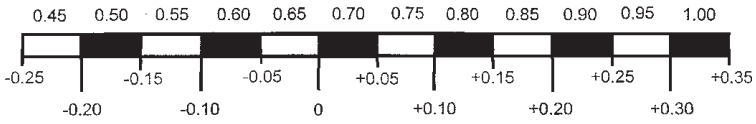
## Piston clearance

**A** = Clearance volume is 0,65 ÷ 0,7 mm for size **S** injectors and 0,55 ÷ 0,6 mm for size **P** injectors
**B** = Copper seal with various thicknesses

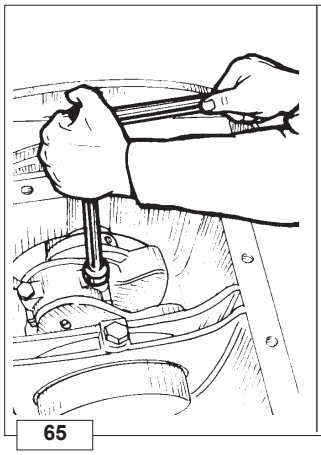
The piston crown in the **TDC** (top dead centre) position may vary, and extend or be short of the upper surface of the cylinder.
Use a dial indicator to measure the positive or negative difference between the two surfaces (piston crown and upper cylinder surface) and use a suitable thickness copper gasket **B** for the cylinder head to adjust the clearance volume **A** between the cylinder head and the piston crown, and which must be between 0,65 and 0,7 mm for size S injectors and 0,55 ÷ 0,6 mm for size **P** injectors.

The table below shows how to choose the most suitable cylinder head copper seal according to the position of the piston in relation to the upper surface of the cylinder.

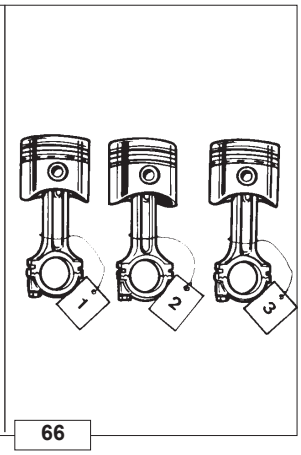
**Seal thickness**




**Position**



65




66

## Connecting rod

***Warning***

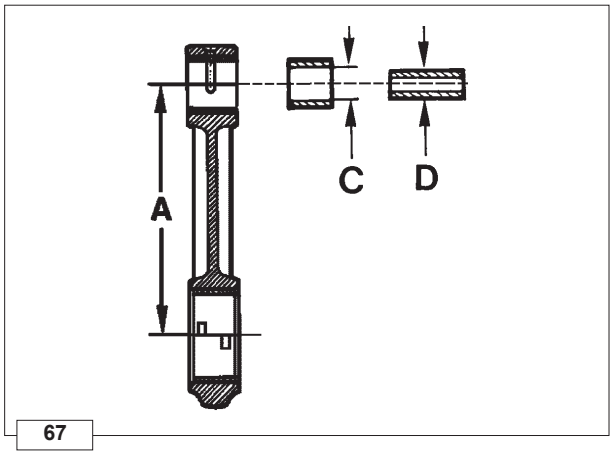
**When remounting the big-end bearings, remember to thoroughly clean the parts and generously lubricate them to prevent seizure when the engine is started up for the first time**

Remove the oil sump and internal oil filter.
Remove connecting rocis and check as follows.

***Important***

**All connecting rod/piston units should be fitted back into the corresponding cylinders; mark them to avoid mistakes.**

➲ See page 41 fig. 71 for specifications as to the tightening of the connecting rod big end bearing.

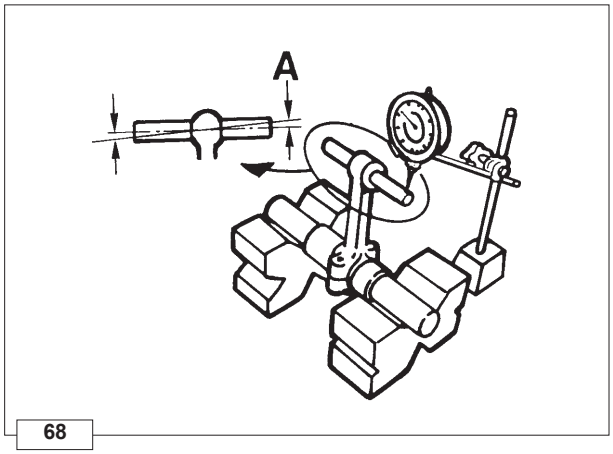


67

### Connecting rod small end bearing and pin

| Ref. | Dimensions (mm) | Clearance (C-D) (mm) | Limit value (C-D) (mm) |
|---|---|---|---|
| A | 141.95 ÷ 142.05 | | |
| B | 25.020 ÷ 25.030 | 0.020 ÷ 0.035 | 0.070 |
| C | 24.995 ÷ 25.000 | | |

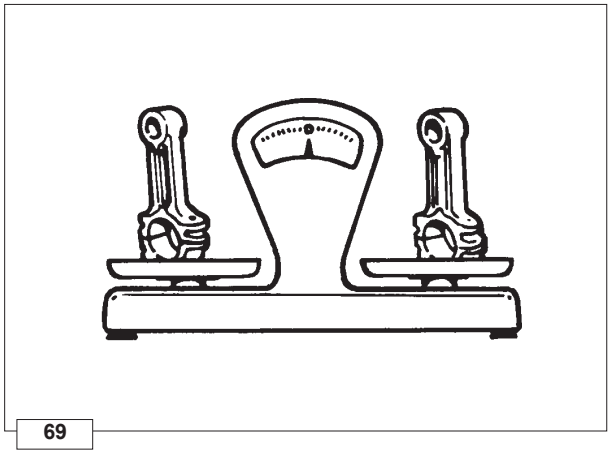
* with driven and machined bearing.
When refitting the bearing of the connecting rod small end, as you drive in, make sure that the lubrication hole on the connecting rod coincides with the hole on the bearing.



68

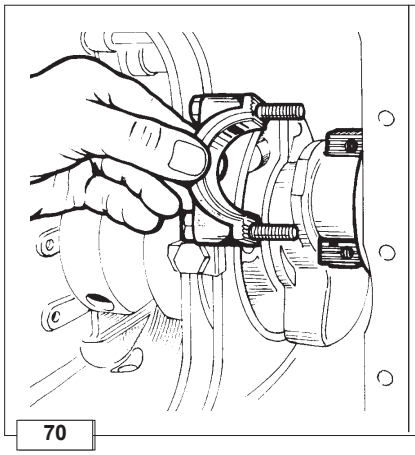
### Connecting rod alignment

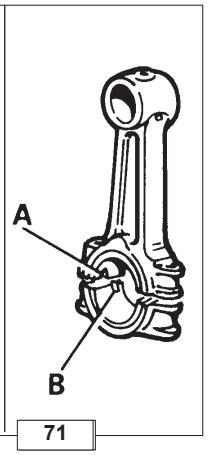
Check alignment of small end and big end bearing bores using fitted mandrels; axial mis-alignment **A** = 0,02 mm; maximum limit 0,05 mm.
Moderale warpage may be corrected by gradually working with a press.


69

### Connecting rod weight

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


70



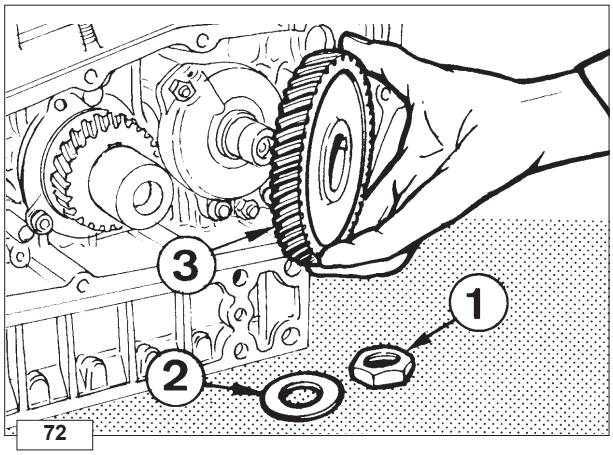
71

### Connecting rod big end bearing

Both centering notches **A** and **B** must be on the same side when refitting.

❍ Tighten bolts at 40 Nm.

➲ See page 45 for dimensions.



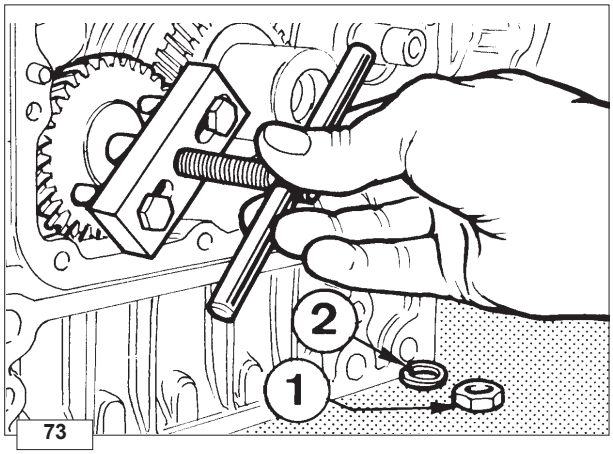
72

**Camshaft gear**

Remove nut **1** and washer **2**. Then remove camshaft gear **3**.
The cylindrical type of coupling makes gear removal easier since no puller is required.

❍ Tighten nut **1** at 25 Nm.

➲ See Page 48 for timing.

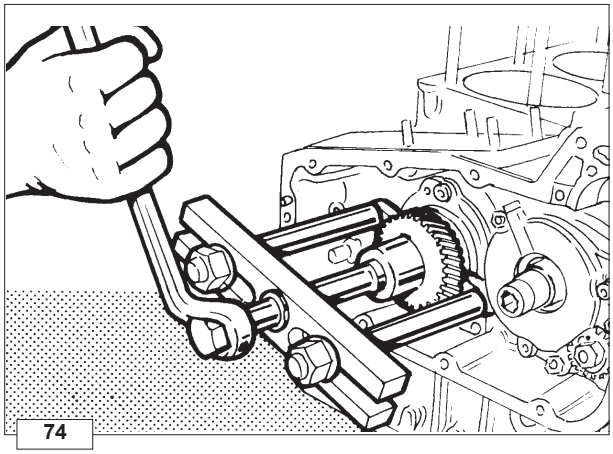


73

**Oil pump gear**

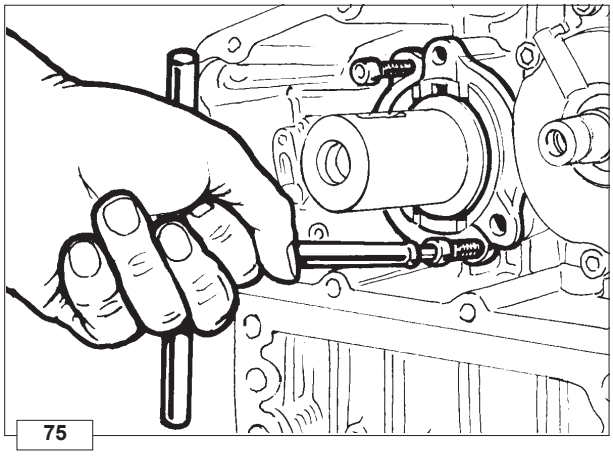
Remove nut **1** and washer **2**. Then remove oil pump gear using a puller with two M 8x1,25 bolts (length: 60 mm).

❍ Tighten the nut at 35 Nm.


74

**Timing gear**

The timing gear can be easily pulled out thanks to the cylindrical type of coupling.
However, if resistance is felt use a bearing puller.

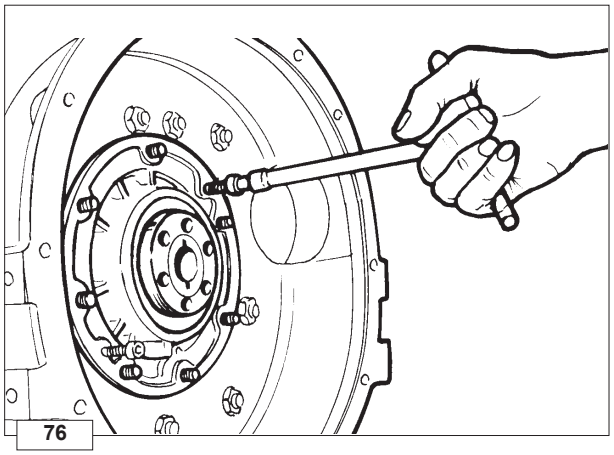

75

**Main bearing support, gear side**

Remove crankshaft key and thrust bearing.
Loosen the three fixing bolts and remove the main bearing support on gear side using two M 8x1,25 screws with fully threaded length of 60 mm.

***Note***: To avoid distortion it is not recommended to repiace the bearing bushing.
Complete assemblies of bushing and support are available in standard, 0,25 and 0,50 mm undersíze configurations as spare parts.

❍ When refitting tighten screws at 25 Nm.

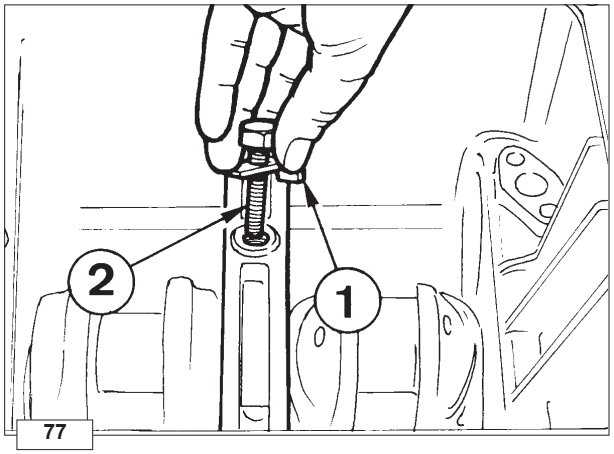

76

**Main bearing support, flywheel side**

Loosen nuts and extract main bearing support using two M 8x1.25 screws with fully threaded length of 40 mm.
Check oil seal ring and replace if warped, hardened or worn-out.

❍ When refitting tighten nuts at 25 Nm.

➲ See Page 45 for dimensions.

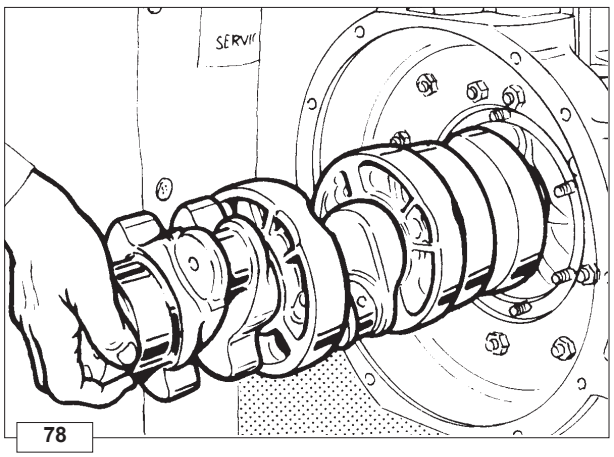


77

**CRANKSHAFT**

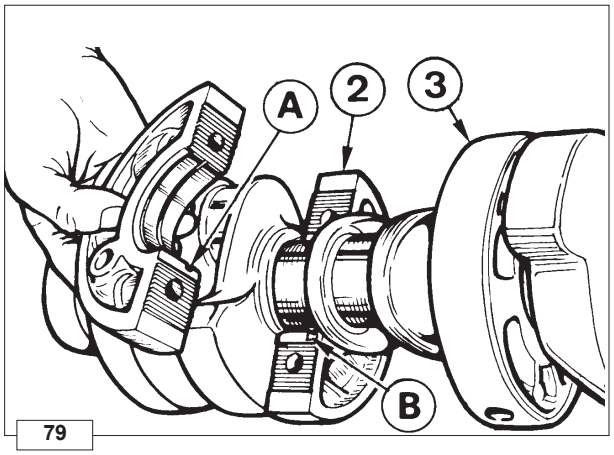
**Center main bearing support, locating bolts**

Before removing the crankshaft, straighten the safety stop **1** and unscrew the bolts **2** of the central main bearings.


78

**Crankshaft removal**

To pull out the crankshaft tap lightly on the gear side end using a copperheaded hammer.
When refitting align center main bearing supports so that the locating bolt holes coincide with the crankcase holes.

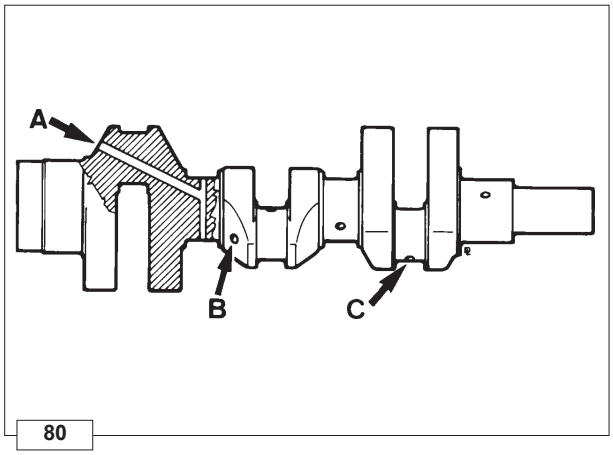


79

**Crankshaft center main bearing supports**

Main bearing supports **2** and **3** have a different diameter size (see page 40 for dimensions).
When refitting, both centering notches **A** and **B** must be located on the same side.

❍ Tighten screws at 30 Nm.

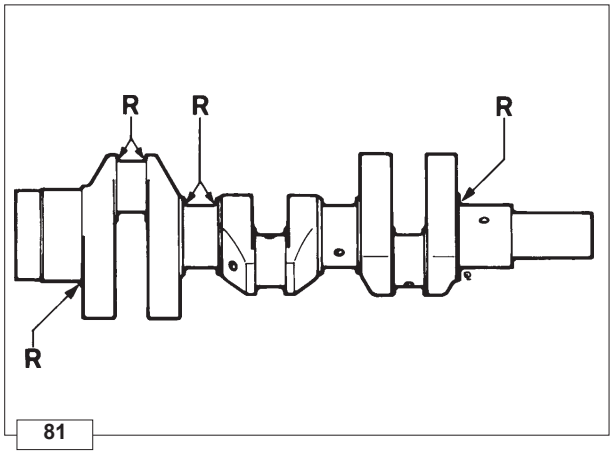


80

### Crankshaft lubrication ducts

***Important***
**During repair operations, when using compressed air, wear eye protection.**

Remove the caps, clean ducts **A**, **B** and **C** using a drill bit with the same diameter and blow with compressed air.
After cleaning, replace the new caps in their seats and make sure they are sealed.

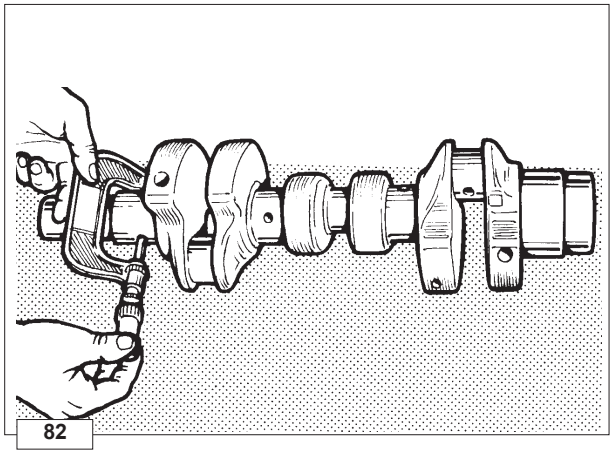


81

### Crankshaft journal radius

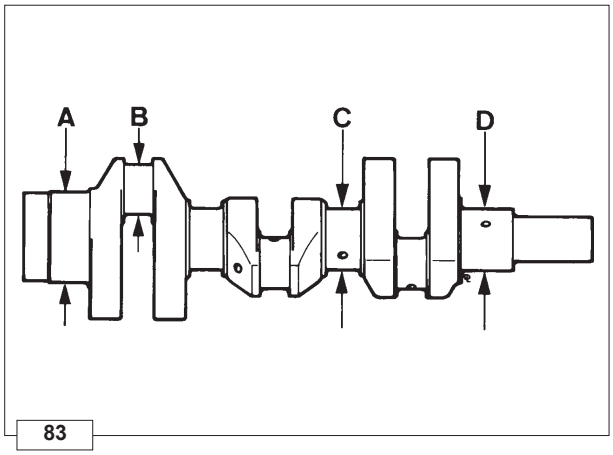
The radius **R** connecting journal to shoulders is 2,8 ÷ 3,2 mm.

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


82

### Checking main journals and crank pins

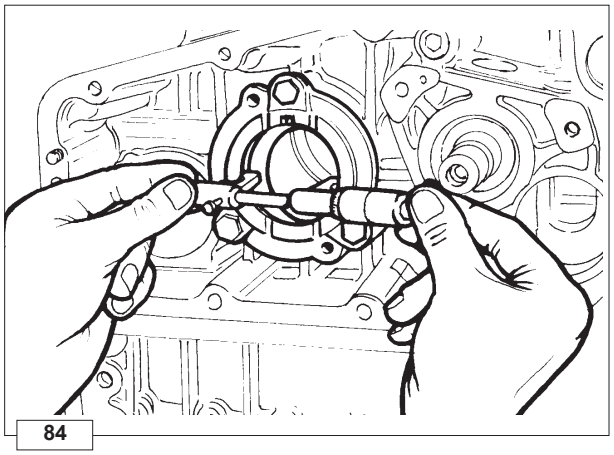
Use an outside micrometer gauge.



83

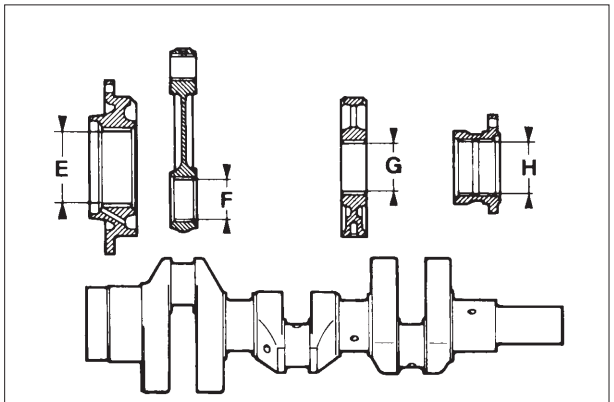
### Main journal and crank pin diameter

| Ref. | Dimensions (mm) |
|---|---|
| A | 80.781 ÷ 80.800 |
| B | 45.500 ÷ 45.516 |
| C | 55.350 ÷ 55.370 |
| D | 54.931 ÷ 54.950 |


84

### Diameter of main bearings

Use an inside micrometer to measure the inside.



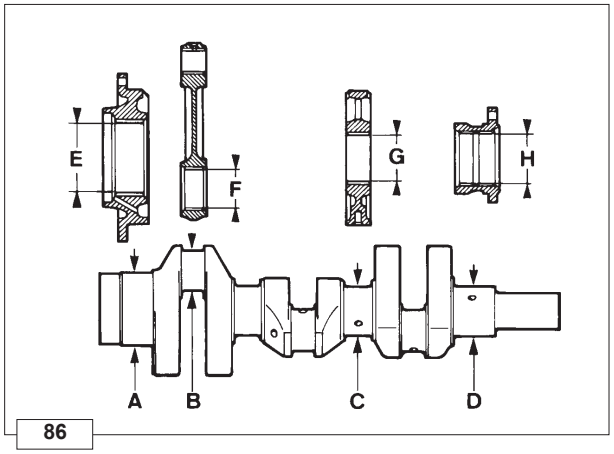
85

### Main bearing and connecting rod big end bearing inside diameter

| Ref. | Dimensions (mm) |
|---|---|
| E | 80,870 ÷ 80,890 |
| F | 45,548 ÷ 45,578 |
| G | 55,430 ÷ 55,460 |
| H | 55,000 ÷ 55,020 |

The above dimensions refer to driven in or tightened bearings.

***Note:*** Both main bearings and connecting rod big end bearings are available with inside diameter size measuring 0,25 and 0,50 less than the standard version.



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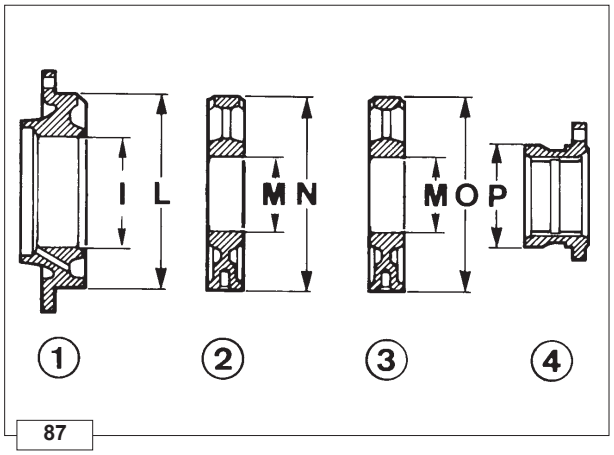
### Clearance between main journals/crank pins and connecting rod bearings

| Ref. | Dimensions (mm) | Limit value (mm) |
|---|---|---|
| E-A | 0,070÷0,109 | 0,195 |
| F-B | 0,032÷0,078 | 0,150 |
| G-C | 0,060÷0,110 | 0,195 |
| H-D | 0,050÷0,089 | 0,180 |



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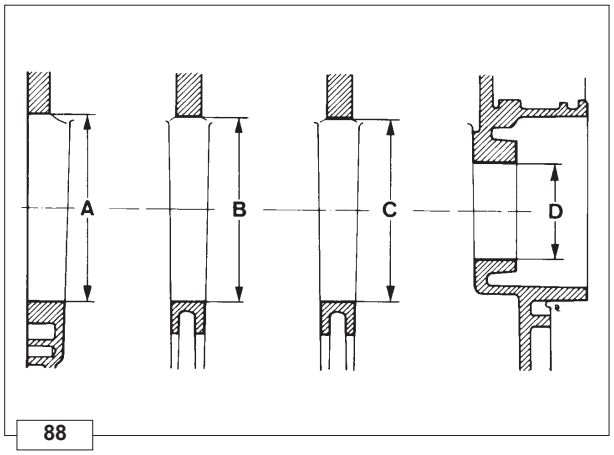
### Main bearing supports

**1** Flywheei side
**2** 1st central
**3** 2nd central
**4** Gear side

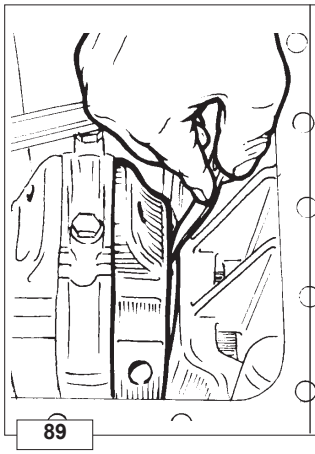
| Ref. | Dimensions (mm) |
|---|---|
| I | 85,785 ÷ 85,815 |
| L | 152,000 ÷ 152,020 |
| M | 60,000 ÷ 60,020 |
| N | 150,000 ÷ 150,020 * |
| O | 148,000 ÷ 148,020 * |
| P | 77,990 ÷ 78,010 |

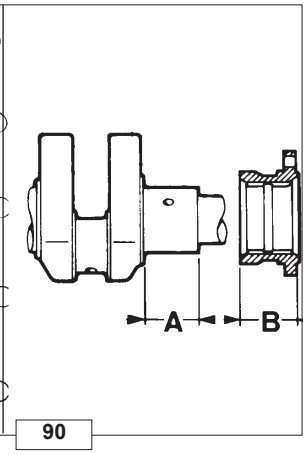


88

**Main bearing housings**

| Ref. | Dimensions (mm) |
|---|---|
| A | 150.000 ÷ 150.020 |
| B | 152.000 ÷ 152.020 |
| C | 148.000 ÷ 148.020 |
| D | 78.000 ÷ 78.020 |


89

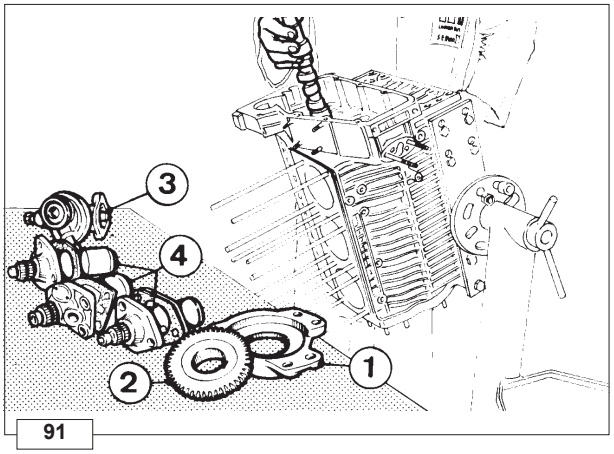


90

**Crankshaft end play**

| Ref. | Dimensions (mm) |
|---|---|
| A | 48.200 ÷ 48.250 |
| B | 47.950 ÷ 48.000 |

Check crankshaft end play after refitting the crankshaft pulley and tightening its nut at 300 Nm; the crankshaft end play is equal to 0,20 ÷ 0,30 mm and is not adjustable. If this value cannot be obtained check **A** and **B**, and possibly replace the parts whose size is inadequate.



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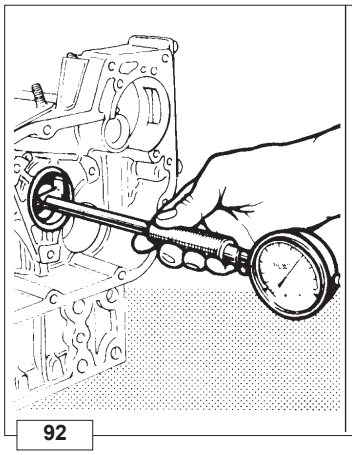
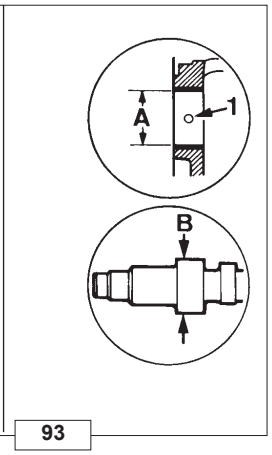
## CAMSHAFT

**Camshaft removal**

To pull out the camshaft simply remove bell **1**, gear **2**, fuel feeding pump **3**, injection pumps **4** and tilt the engine; in this position the cam followers is not in contact with the camshaft thus making its removal possible.


92



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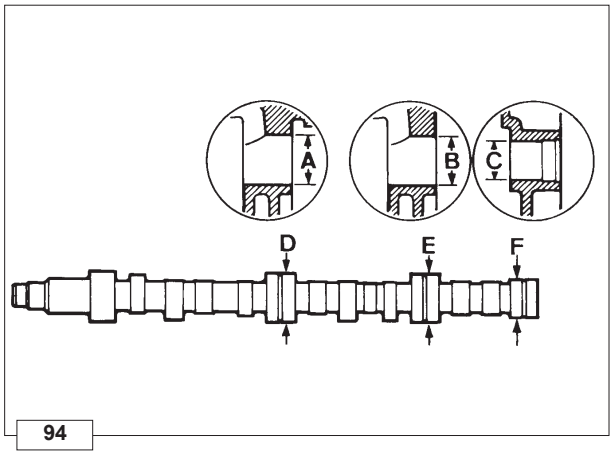
**How to measure camshaft bearing and journal inside diameter**

| Ref. | Dimensions (mm) | Clearance (mm) | Limit value (mm) |
|---|---|---|---|
| A | 44.000 ÷ 44.025 | 0.040 ÷ 0.085 | 0.170 |
| B | 43.940 ÷ 43.960 | | |

Measure **A** using an internal dial indicator and **B** with an external micrometer.
When repiacing the bearing make the lubrication hole **1** match with the corresponding crankcase bore.



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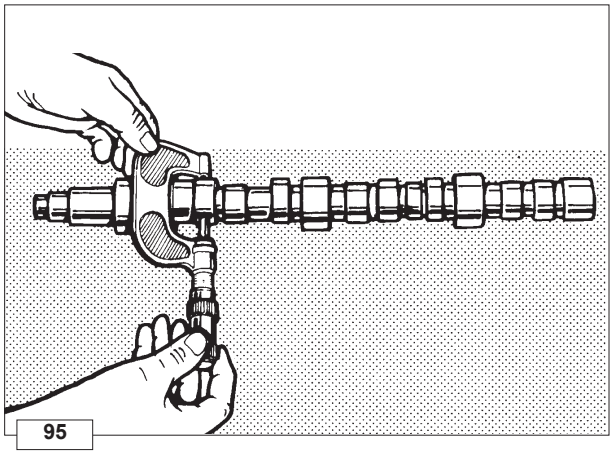
### Dimensions of camshaft journals and housings

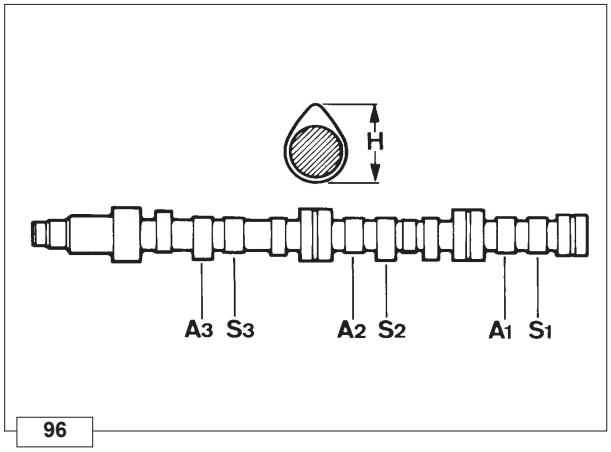
| Ref. | Dimensions (mm) |
|---|---|
| A | 42.000 ÷ 42.025 |
| B | 41.000 ÷ 41.025 |
| C | 33.200 ÷ 33.220 |
| D | 41.940 ÷ 41.960 |
| E | 40.940 ÷ 40.960 |
| F | 33.140 ÷ 33.160 |

| Ref. | Cleatance (mm) | Limit value (mm) |
|---|---|---|
| A-D | 0.040 ÷ 0.085 | 0.170 |
| B-E | | |
| C-F | 0.040 ÷ 0.085 | 0.160 |


95

### Checking intake/exhaust cam height

Use an outside micrometer gauge to measure camshaft lobe height.



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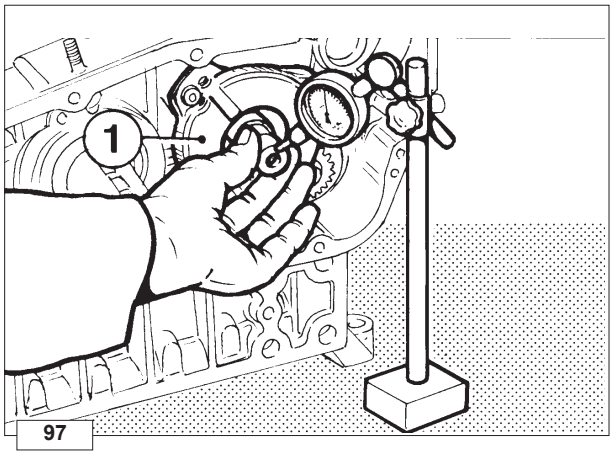
### Intake/exhaust cam height

**A1**= 1st cylinder intake cam
**S1** = 1st cylinder exhaust cam
**A2** = 2nd cylinder intake cam
**S2** = 2nd cylinder exhaust cam
**A3** = 3rd cylinder intake cam
**S3** = 3rd cylinder exhaust cam
**H** = 33,65 ÷ 33,55 for engines EPA 97/68 CE

Exhaust and intake cams feature the same height **H**.
Replace camshaft if **H** is 0.1 mm below the given value.

**Note**: Engines 11LD 625/3 - 626/3, in the slow speed version (1500 ÷ 2000 r.p.m.) features a camshaft with **H** = 33,765 ÷ 33,865 mm.



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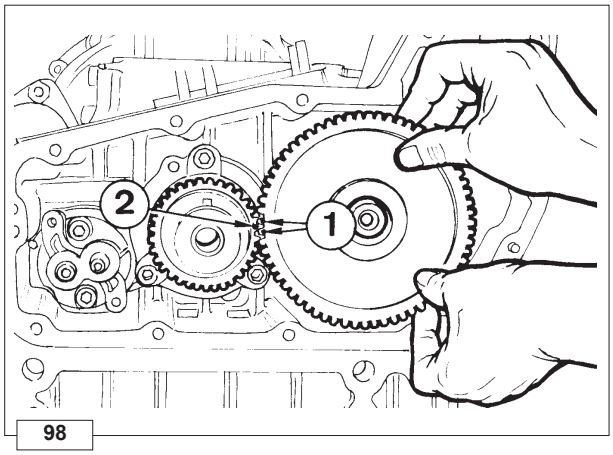
### Camshaft end play

Check camshaft end play after removing cylinder head, injection pump and fuel feed pump from the engine.

❍ Check that the three cover **1** screws are tightened at 25 Nm.

Place the dial gauge on the camshaft gear outer part; push and pull same gear as required.
Camshaft end play should be 0,15 ÷ 0,30 mm.



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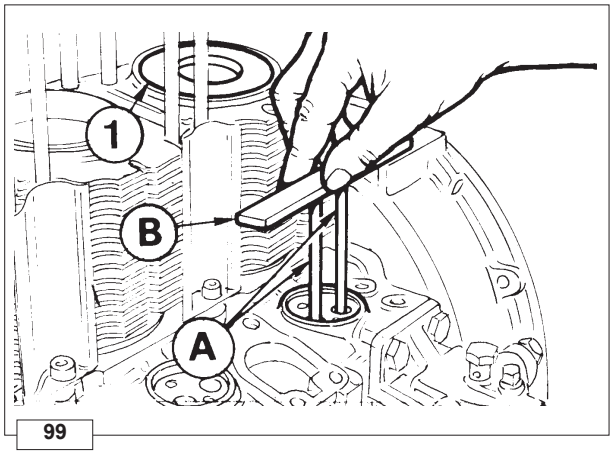
**Camshaft timing**

Fit camshaft gear by making timing mark **2** coincide with timing marks **1**.

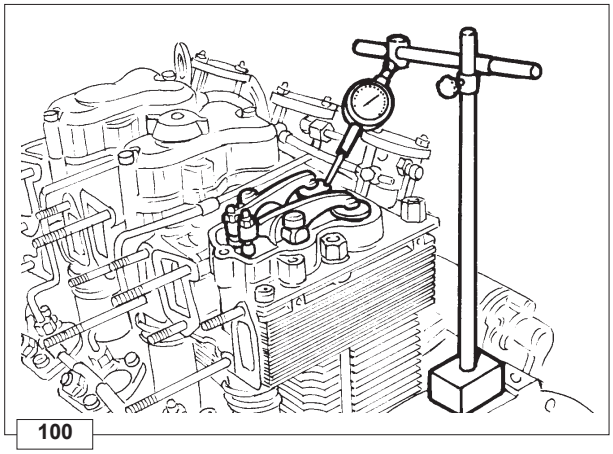
❍ Tighten camshaft bolt at 250 Nm.



99

**Valve timing without considering timing marks**

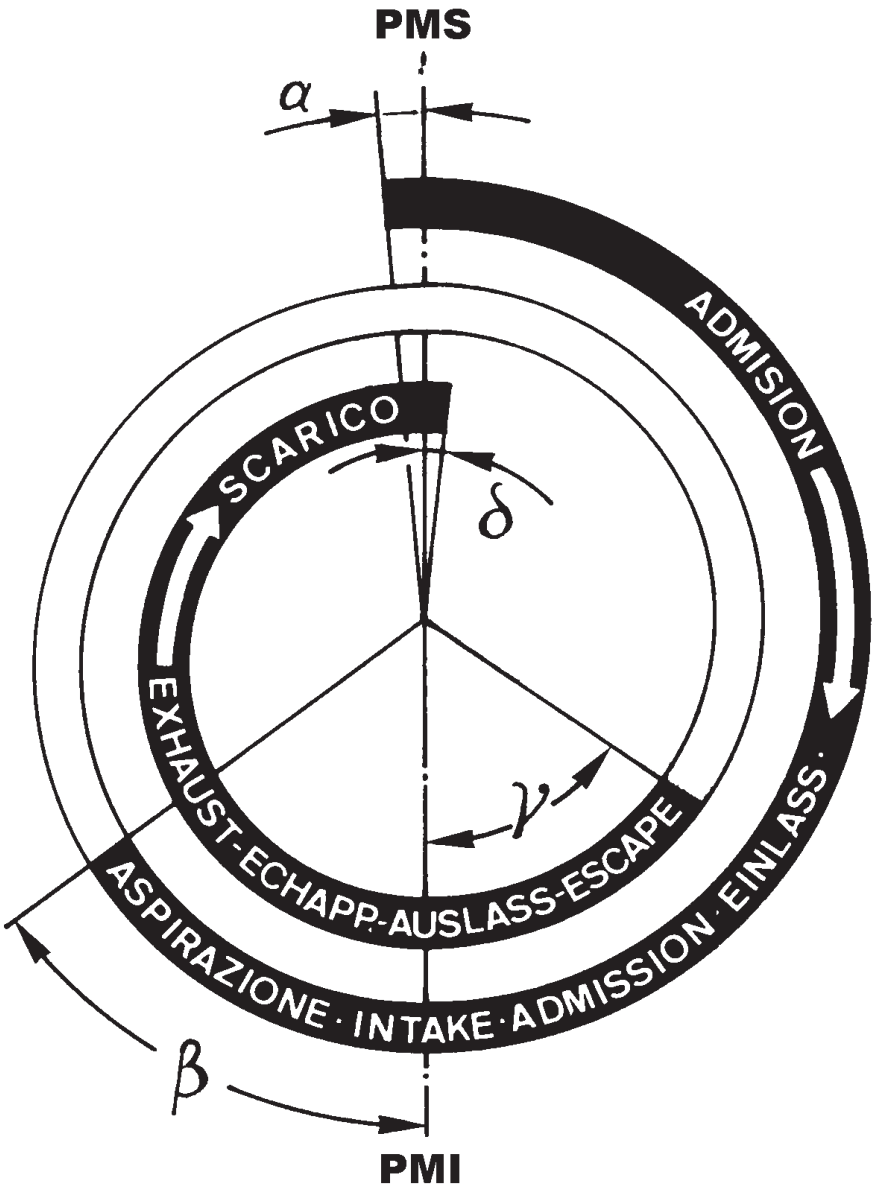
Locate piston **1** (on flywheel side) at the top dead center. Position two small cylinders **A** of the same height onto the tappets.
Rotate camshaft stopping when cylinder **1** tappets are in overlap position (intake open, exhaust closed).
By means of ruler **B** check that tappets are at the same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


100

**Valve timing check**

Check using an index plate suitable for reading angles, integral with the crankshaft. Readings are taken in degrees.
Set valve clearance at 0,65 ÷ 0,70 mm (after checking restore the value al 0,15 ÷ 0,20 mm). Set dial gauge on intake valve to a zero value; by rotating the driving shaft according to its direction of rotation you can measure $\alpha$ (intake valve opening advance referred to top dead centre **PMS**) and **ß** (intake valve closing delay referred to bottom **1** dead centre).

Follow the same procedure for exhaust valves checking $\gamma$ (exhaust valve opening advance) and $\delta$ (exhaust valve closing delay).

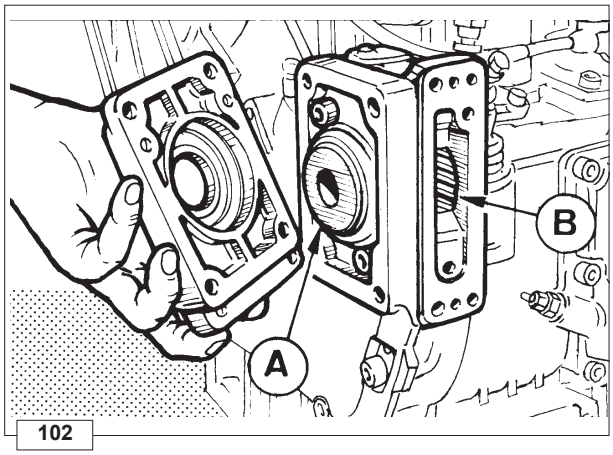



**Legend**

**S =** piston at top dead center
**I =** piston at bottom dead center
α = intake valve open
β = intake valve closed
γ = exhaust valve open
δ = exhaust valve closed

**Value expressed in degrees of the timing angles. (valves clearance = 0.65 ÷ 0.70 mm)**

| | | | |
|---|---|---|---|
| α = | open | 2° | before P.M.S. |
| β = | close | 34° | after P.M.I. |
| γ = | open | 34° | before P.M.I. |
| δ = | close | 2° | after P.M.S. |



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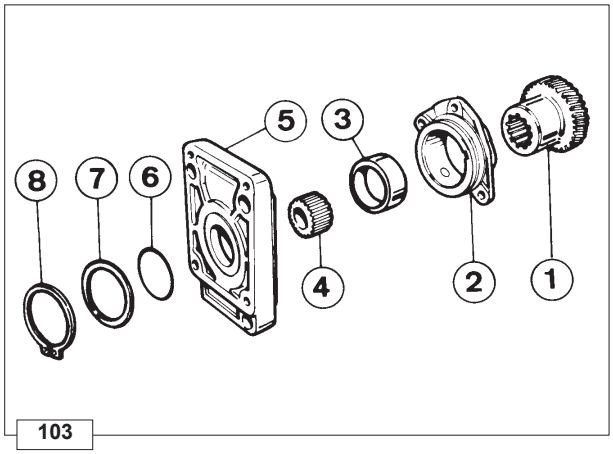
**Hydraulic pump p.t.o. group 1**

A hydraulic pump of group 1 or 2 can be installed on the gear side **A**, 3rd p.t.o.
A group 1 hydraulic pump can be installed at the 4th p.t.o. **B**.



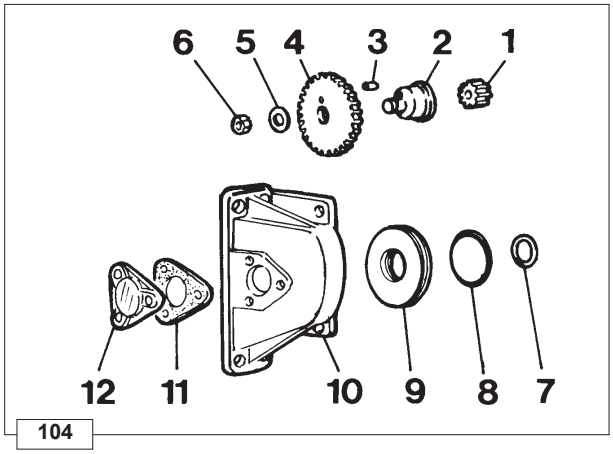
103

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

*Components:*

**1** Gear
**2** Gear support
**3** Bearing
**4** Drive
**5** Flange
**6** Washer
**7** Seal ring
**8** Circlip

A max torque of 39,6 Nm can be obtained from this p.t.o.



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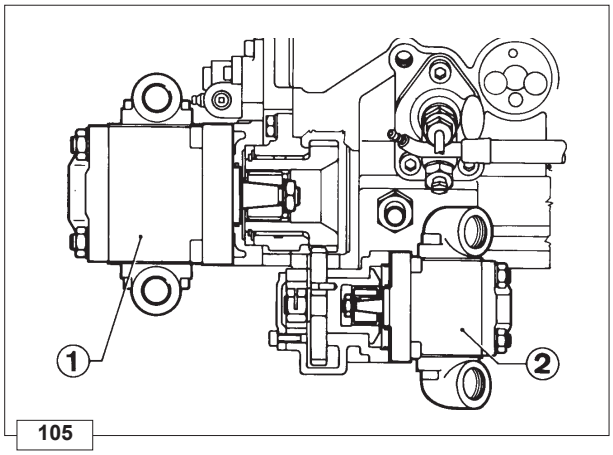
**Hydraulic pump 4th p.t.o., group 1**

*Components:*

**1** Drive
**2** Control shaft
**3** Pin
**4** Gear
**5** Washer
**6** Nut
**7** Seal ring
**8** Seal ring
**9** Centering ring
**10** Bracket
**11** Gasket
**12** Cover

A max. torque of 243 Nm can be obtained from this p.t.o.

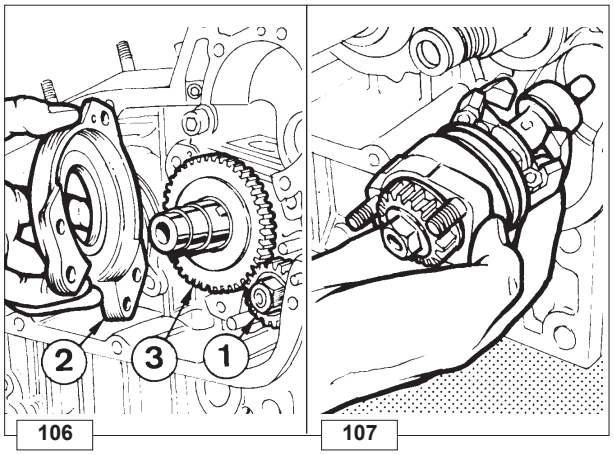


105

**Use of 3rd and 4th p.t.o.**

**1** Hydraulic pump, group 2, mounted at 3rd p.t.o.
**2** Hydraulic pump, group 1, mounted at 4th p.t.o.

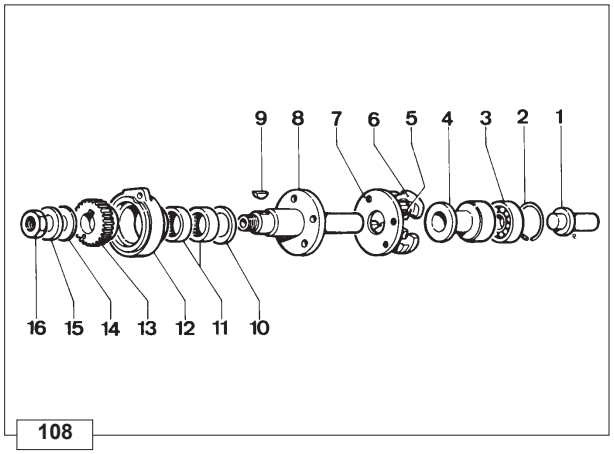
Total power obtainable from 3rd and 4th plo. is 13 kW ( 17.7 HP).
Ratio for both p.t.o. compared to the engine r.p.m. is 1:1 for 4th PTO is 1 : 1,067 for 3th PTO.




106 107

## Mechanical speed governor

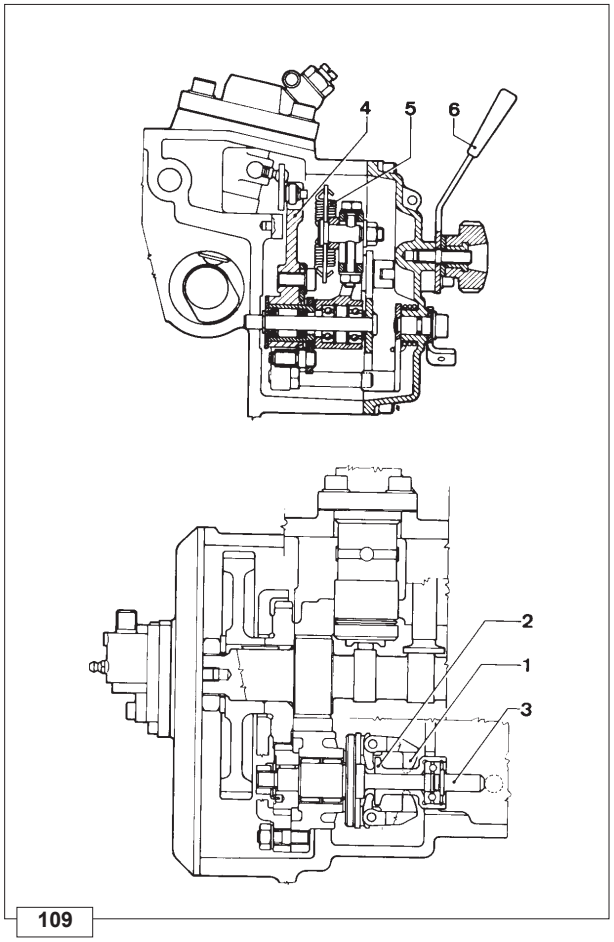
The governor (with centrifugal weights) is housed inside the crankcase and is controlled by a camshaft gear.
To remove speed governor **1** remove camshaft bell **2** and speed governor control gear **3**.




108

## Mechanical speed governor components (standard)

**1** Drive rod
**2** Stop ring
**3** Bearing
**4** Washer
**5** Pin
**6** Weights
**7** Weight support
**8** Shaft
**9** Key
**10** Thrust washer
**11** Bearings
**12** Shaft support
**13** Gear
**14** Spring washer
**15** Flat washer
**16** Nut

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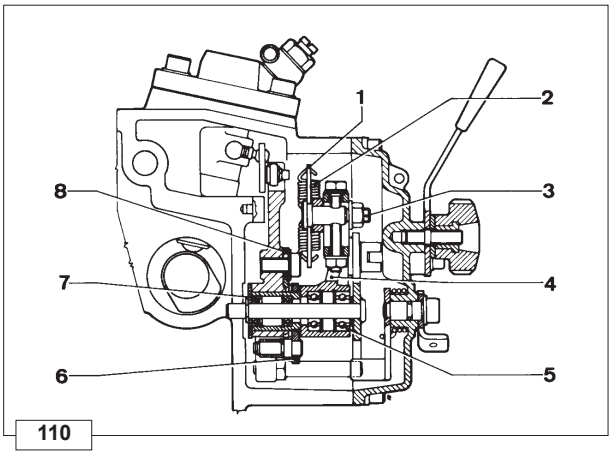
## Mechanical speed governor operation (standard)

Weights **1** are moved to the periphery by the centrifugal force and thus axially shift the washer **2** and the drive rod **3** which, by means of a linkage, move injection pump control lever **4**.
The governor springs **5** placed under tension by the accelerator control lever **6** offset the weights **1** centrifugal force.
Balance between the two forces keeps speed at an almost constant level in spite of load variations.

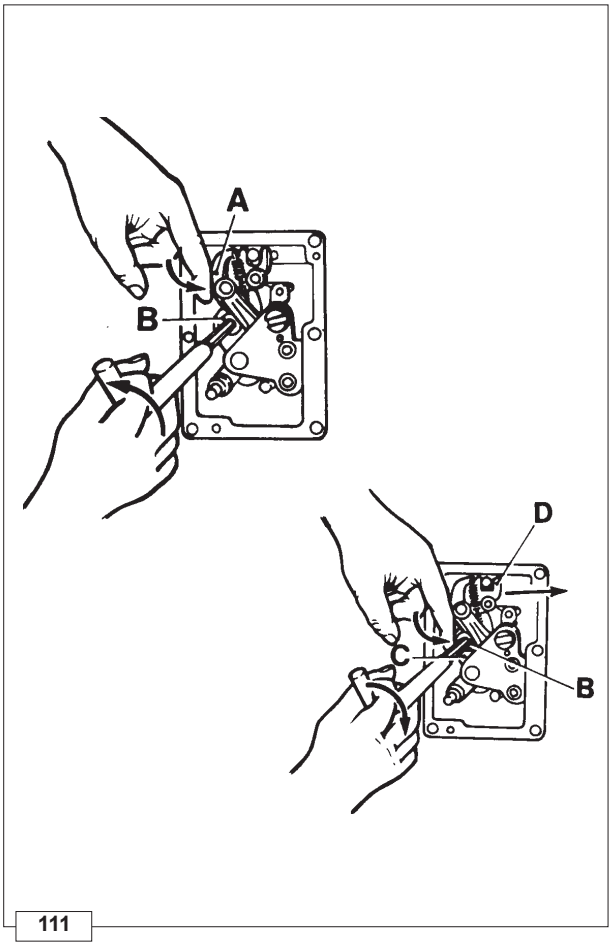



110

**Mechanical speed governor components for special generating sets**

**1** Spring anchoring rocker arm
**2** Governor springs
**3** Journal
**4** Governor control lever
**5** Governor control lever ball bearing
**6** Lever
**7** Bearing
**8** Plate

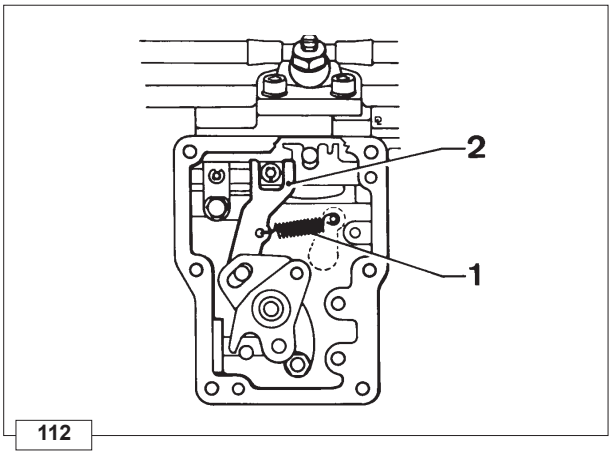
***Note:*** Two types of governor springs **2** are available: one for full speed regulation at 1500 r.p.m. and the other for full speed regulation at 1800 r.p.m.; in this case governor weights are heavier.




111

**Mechanical speed governor setting**

Lift finkage **A**.
Loosen screw **B**.
Push lever **C** to the right and check that speed governor weights are closed.
Shift injection pump delivery control yoke **D** to the right (for maximum delivery).
Tighten screw **B**.

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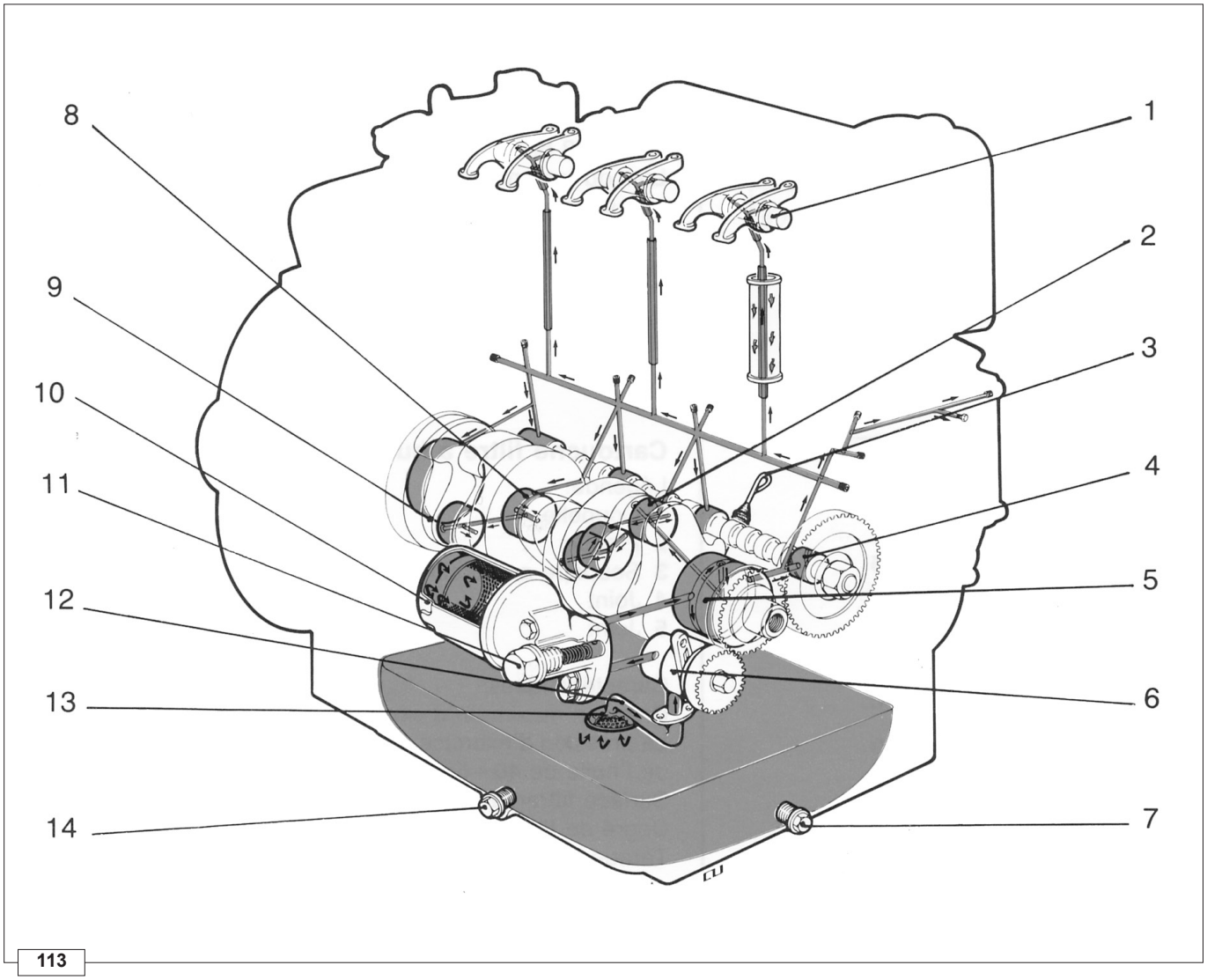
**Spring for extra fuel supply at starting**

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

***Danger***

**The engine can be damaged if allowed to operate with insufficient oil. It is also dangerous to add too much oil because its combustion may lead to a sharp increase in the rotation speed.**
**Use suitable oil in order to protect the engine.**
**Nothing more than lubrication oil can influence the performances and life of an engine.**
**Use of an inferior quality oil or failure to regularly change the oil will increase the risk of piston seizure, will cause the piston rings to jam and will lead to rapid wear on the cylinder liner, the bearings and all other moving parts.**
**Engine life will also be notably reduced.**
**The oil viscosity must suit the ambient temperature in which the engine operates.**

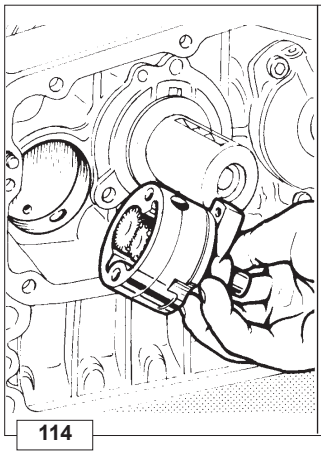
**Old engine oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time.**
**If contact with the oil is unavoidable, you are advised to wash your hands with soap and water as soon as possible.**
**Dispose of old oil in the correct way as it is highly polluting.**

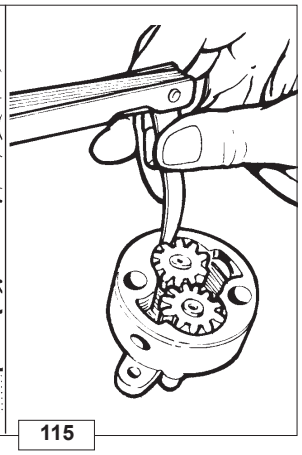



113

*Components:*

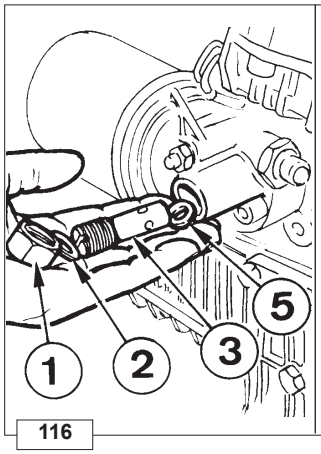
**1)** Rocker arm shaft
**2)** Connecting rod big end bearìng
**3)** Oil dipstick
**4)** Camshaft
**5)** Crankshaft journal
**6)** Oil pump
**7)** Drain plug
**8)** Crankshaft main journal
**9)** Crankshaft
**10)** Cartridge filter
**11)** Oil pressure relief valves
**12)** Pump intake pipe
**13)** Internal strainer
**14)** Drain plug


114

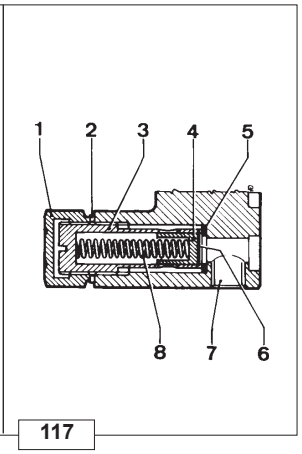

115

## Oil pump

Check that gear teeth are intact and that clearance between gear edge and pump body is 0,041 ÷ 0,053 mm with limit value 0,10 mm. Furthermore check that control shaft is tree to rotate with end float of 0,040 ÷ 0,090 mm with limit value of 0,170 mm.
Oil pump delivery at 3000 r.p.m. is 18 liters/min.



116



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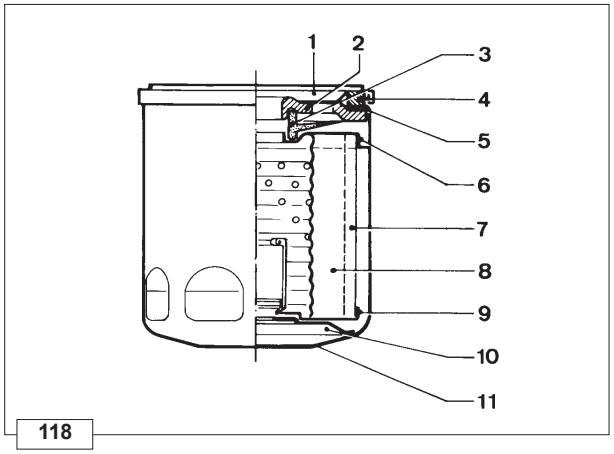
## Oil pressure relief valve

Components:

**1** Plug
**2** Copper gasket
**3** Bushing
**4** Piston
**5** Rubber gasket
**6** Ring
**7** Hole for pressure switch connection
**8** Spring

**Note**: Blow-by at an oil temperature of 40 ÷ 50°C and pressure of 3 bar should be less than 1 l/min.
When refitting screw bushing **3** so that it touches gasket **5**.
Do not tighten excessively since gasket **5** might break causing an oil pressure drop in the system.



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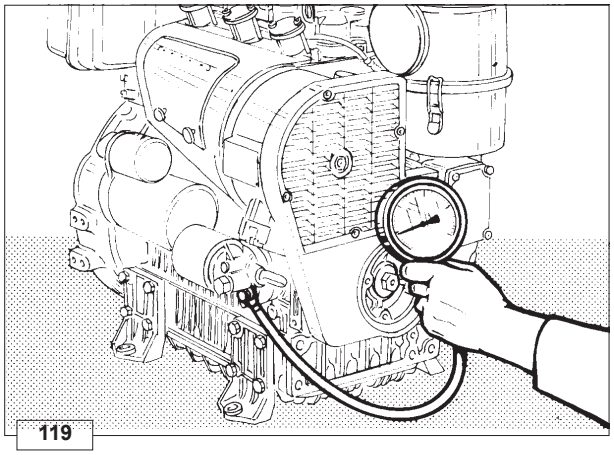
## Oil filter cartridge

Components:

**1** Retainer
**2** Plate
**3** Valve
**4** Gasket
**5** Gasket
**6** Upper cover
**7** Blade
**8** Filtering element
**9** Assembly
**10** Belleville washer
**11** Tank

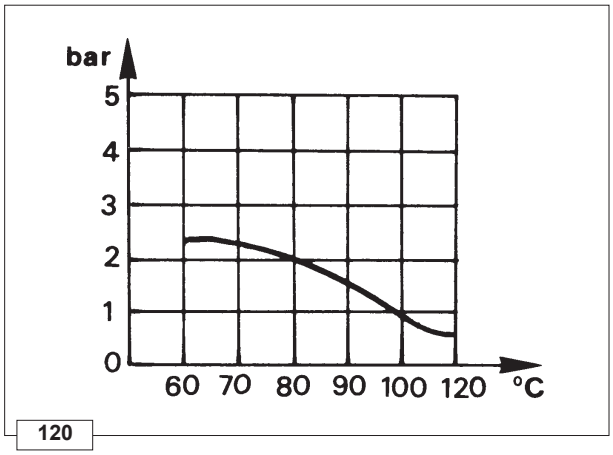
**Characteristics**:

Max. working pressure .....13 bar
Filtering area.....955 $cm^2$
Type of filtration .....20 µm
By-pass valve opening pressure .....1,4 ÷ 1,8 bar.


119

## Oil pressure check

Once the engine is fitted fill with oil and fuel, connect a 10 bar pressure gauge to the oil filter fitting.
Start the engine and check pressure as a function of the oil temperature (see page. 55).



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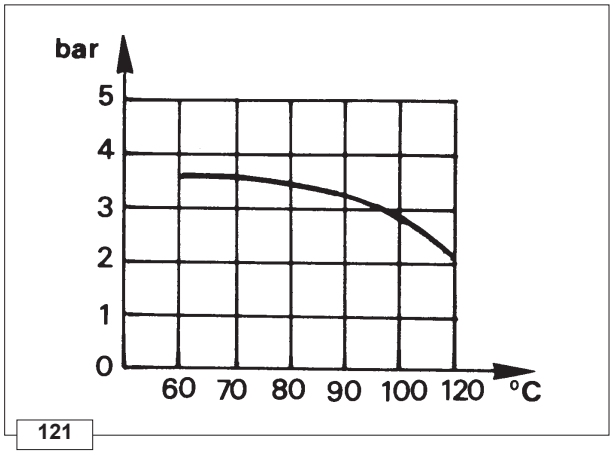
**Oil pressure curve at idling speed**

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



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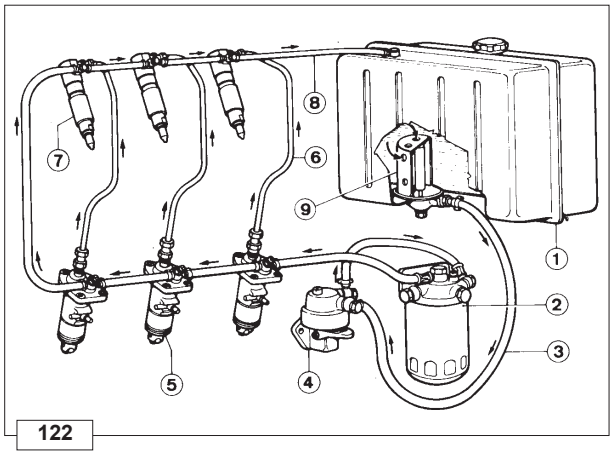
**Oil pressure curve at full speed**

The curve is obtained at the oil filter level with engine working al 3000 r.p.m. al the N power. Room temperature is +25°C.
Lube oil peak temperature should be below 120°C for engines without oil cooler and below 110°C for engines with oil cooler. Pressure is given in bar and temperature in centigrades.

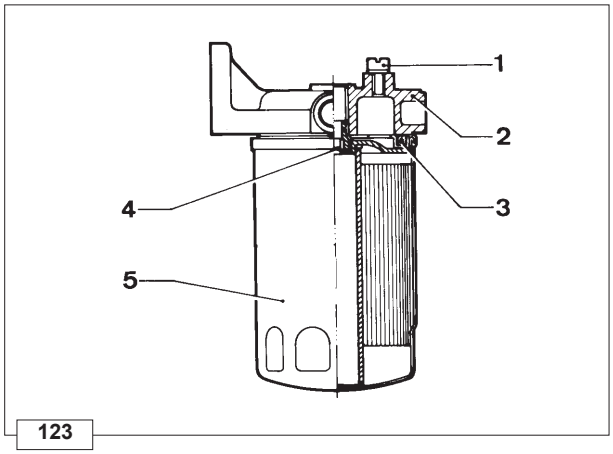


122

## Fuel feeding/injection circuit

*Components:*

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



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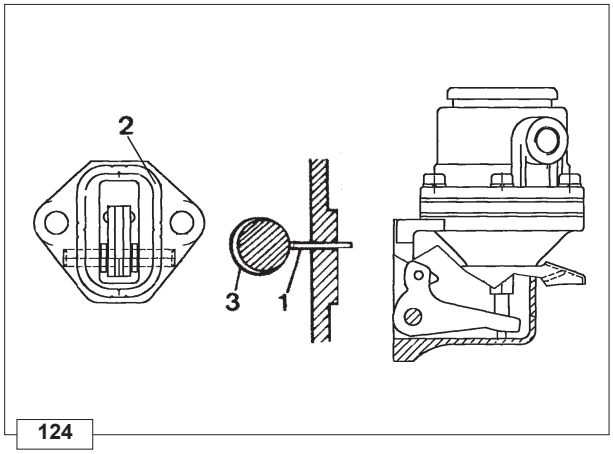
## Fuel filter

*Components:*
**1** Bleeder
**2** Cap
**3** Seal element
**4** Union
**5** Cartridge

*Cartridge characteristics:*
Filtering paper.....PF 904
Filtering area.....5000 cm2
Degree of filtrafion .....2 ÷ 3 µm
Max.,working pressure:..... 4 bar

➲ See page 21 for periodical maintenance details.



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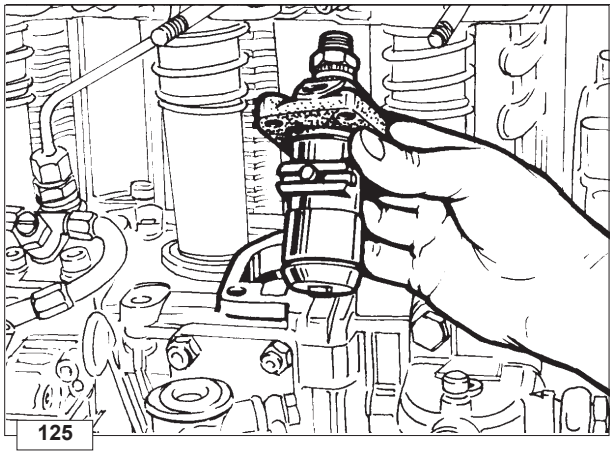
## Fuel feeding pump

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

*Components:*

**1** Drive rod : shelf 1,470 ÷ 2,070 mm
**2** Gasket
**3** Camshaft eccentric

*Characteristics:* when the control eccentric rotates at 1500 r.p.m. minimum delivery is 64 l/h while self-regulation pressure is 4 ÷ 5 m water column.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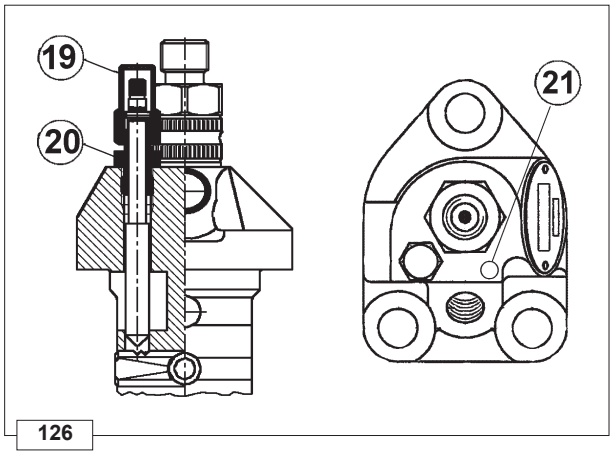
## Injection pump

The Bosch injection system consists of three pumps each feeding one cylinder.
The pumps mounted on the crankcase, corresponding to their proper cylinder, are directly operated by the camshaft.

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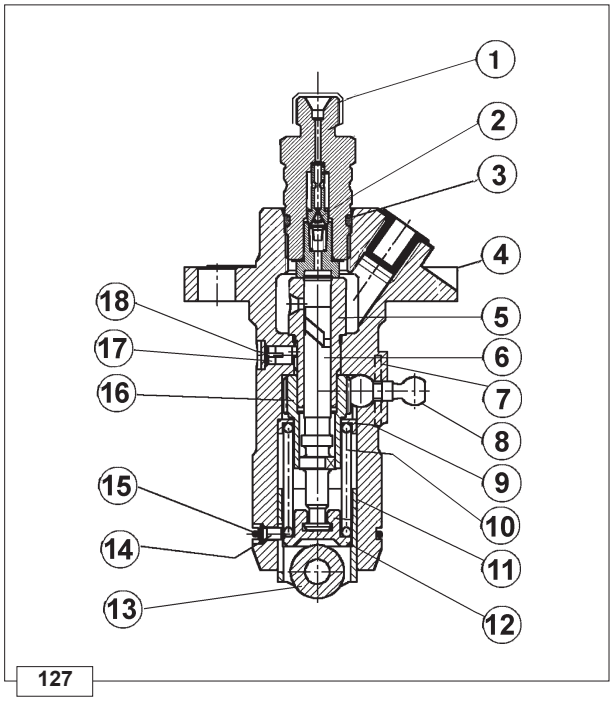
**19** Threaded plug
**20** Adjustment rod locking device
**21** Area in which the pump delivery class is stamped

In this engine the injection pumps are preset by the manufacturer who supplies them stamped with alphabetical classes (A, Ax, B, Bx, C, Cx or D) for standard and 97/68 EC engines, while for EPA2 engines the classes are numerical (5, 6, 7, 8, 9, 10, 11, 12, 13 and 14).
The adjustment rod is locked via the bayonet device.

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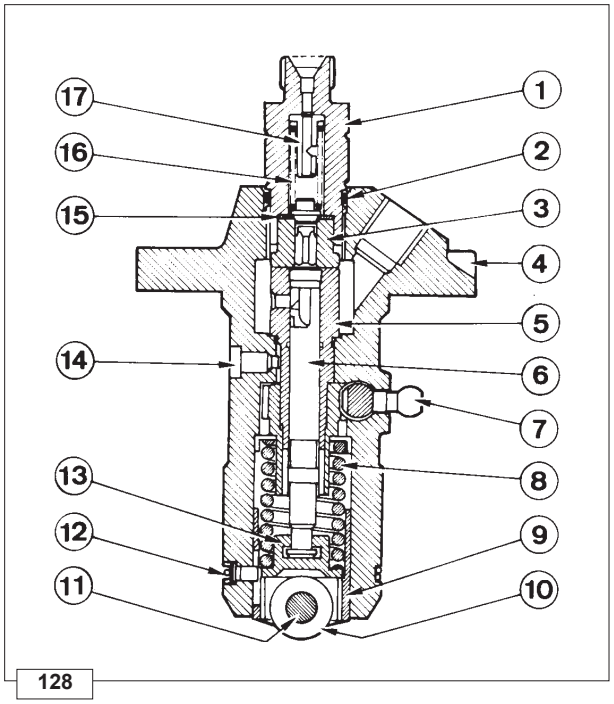
**Injection pump only for EPA engines**

**1** Delivery union
**2** PRV valve
**3** O-Ring
**4** Pump housing
**5** Pumping piston
**6** Pumpung plunger
**7** Elastic pin
**8** Rack rod
**9** Superior retainer
**10** Spring tappet
**11** Tappet body
**12** Inferior retainer
**13** Roller
**14** Journal guide tappet
**15** Elastic pin
**16** Adjustment hose
**17** Plunger stop pin
**18** Cap

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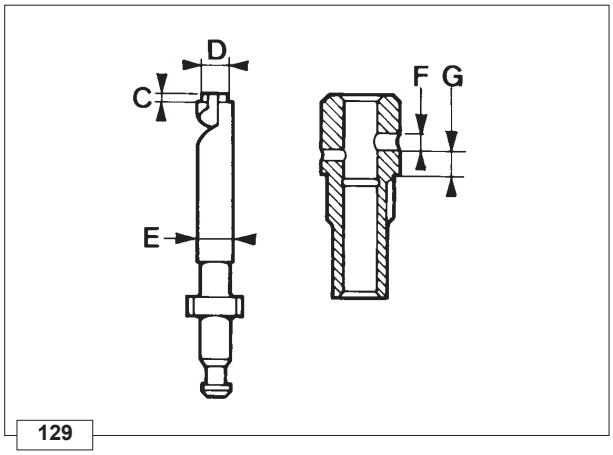
**Injection pump only for standard and 97/68 Ce engines**

**1** Delivery union
**2** Rubber ring
**3** Delivery valve
**4** Pump housing
**5** Piston
**6** Plunger
**7** Rack rod
**8** Spring
**9** Tappet body
**10** Roller
**11** Journal
**12** Pin
**13** Spring retainer
**14** Eccentric
**15** Copper gasket
**16** Spring
**17** Filler

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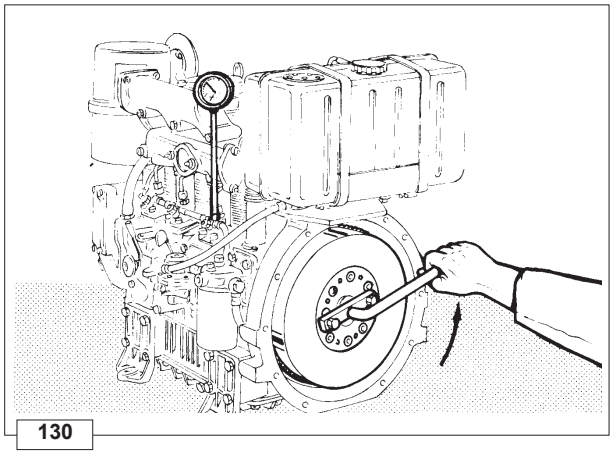
**Plunger**

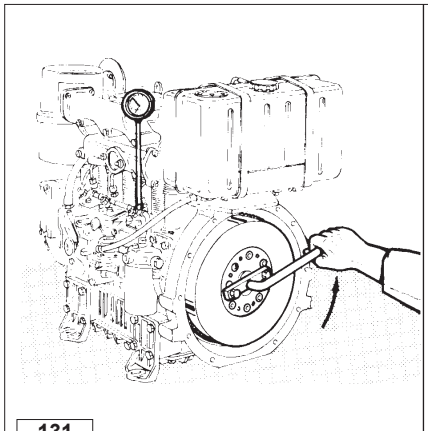
| Ref. | Dimensions (mm) |
|---|---|
| C | 1,000 ÷ 1,100 |
| D | 7,445 ÷ 7,455 |
| E | 7,500 |
| F | 3,000 ÷ 3,025 |
| G | 7,225 ÷ 7,275 |



130

**How to check plunger and barrel for internal leakage**

This operation is only diagnostic since pressure changes depend on the pumping speed.
Connect the delivery union with a 600 bar pressure gauge with safety valve.
Adjust rack rod at half-stroke.
Turn flywheel according to its direction so that the plunger puts the circuit under pressure.
Replace plunger if the displayed pressure is below 300 bar.
Repeat the same operation for the other plungers.



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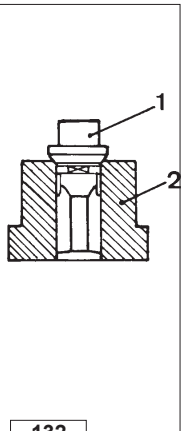


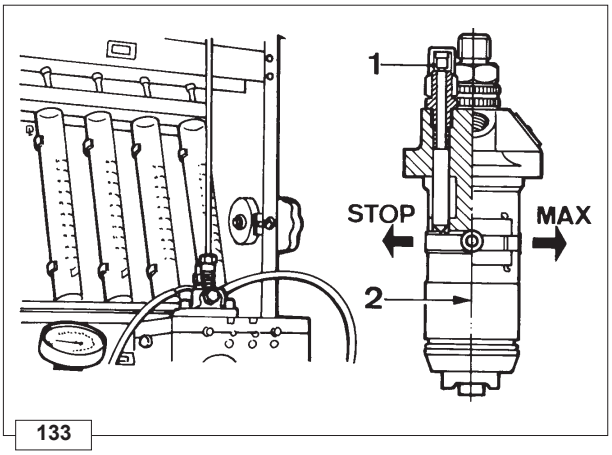

132

**How to check injection pump delivery valve sealing**

*Components:*

**1** Valve
**2** Seat

Adjust pump rack at half-stroke.
Turn flywheel according to its direction of rotation so that the plunger puts the circuit under pressure.
During this operation the displayed pressure will gradually reach a peak followed by a sudden drop which corresponds to valve closing.
Pressure drop should be 30 ÷ 50 bar.
Replace the valve if pressure drop is below this value.
Repeat the same operation for the other two pumps.



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**Test data for injection pump delivery at the test bench for standard and 97 / 68 CE engines**

**1** Rack rod lock to be removed after pump fitting to the engine
**2** Injection pump axis

***Test data:***

| Control rod max. force (N) | Rod stroke from pump axis (mm) + towards max - towards stop | Camshaft r.p.m. | Delivery mm³/stroke |
|---|---|---|---|
| 0,45 | - 2 | 500 | 3 ÷ 4 stamped A<br>4 ÷ 5 stamped Ax<br>5 ÷ 6 stamped B<br>6 ÷ 7 stamped Bx<br>7 ÷ 8 stamped C<br>8 ÷ 9 stamped Cx<br>9 ÷ 10 stamped D |
| | - 2 | 1500 | 27,5 ÷ 30,5 |
| | max | 150 | 90 ÷ 100 |

The above test data refer to pump with plunger dia. of 7,500 mm.

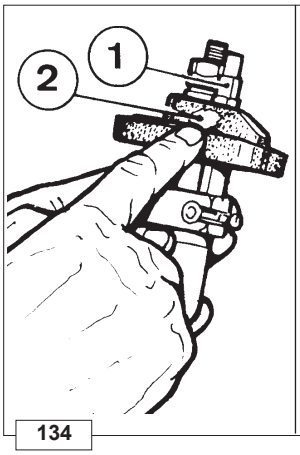
**Test data for injection pump delivery at the test bench only for EPA engines**

***Test data:***

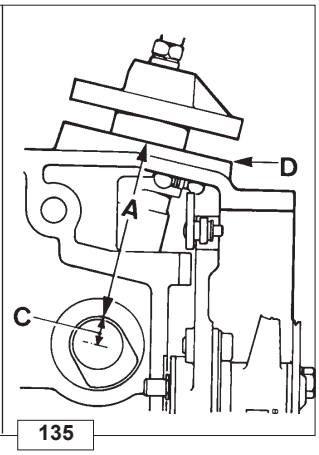
| Control rod max. force (N) | Rod stroke from pump axis (mm) + towards max - towards stop | Camshaft r.p.m. | Delivery mm³/stroke |
|---|---|---|---|
| 0,45 | 0 | 500 | 3 ÷ 4 stamped A<br>4 ÷ 5 stamped Ax<br>5 ÷ 6 stamped B<br>6 ÷ 7 stamped Bx<br>7 ÷ 8 stamped C<br>8 ÷ 9 stamped Cx<br>9 ÷ 10 stamped D |
| | 0 | 1500 | 38 ÷ 40 |
| | max | 150 | 90 ÷ 100 |

The pump class is indicated by the full delivery value * at 1 mm³/ stroke from 5 to 14.
Plunger diameter size: 7,500 mm.

***Note:*** All pumps are tested and set in order to obtain the same delivery at full speed.
After the tests carried out at idle speed pumps are subdivided into classes marked with references in letters or numbers.
These reference marks are very clearly stamped on the upper pump body.
If replacing, make sure that the new pumps have the same references (letters or numbers) as the previous ones.




134




135

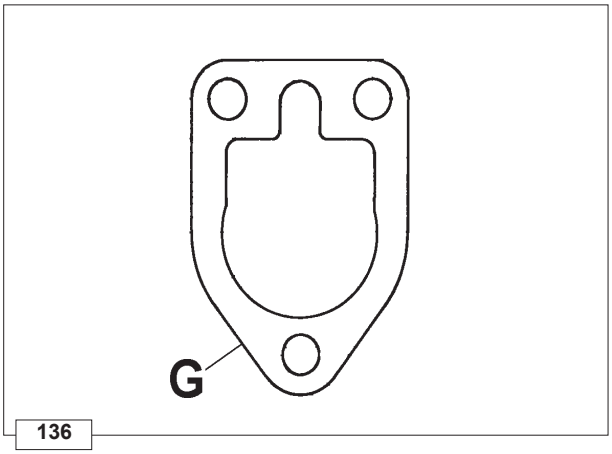
## Injection pump replacement

**1** Rack rod lock
**2** Reference mark pump class

**A** = 82.80 mm
**C** = Injection cam radius
**D** = Injection pump support

***Important***
**Whe replacing this type of injection pump check that the new one has a same reference mark as the old one.**
**The reference marks of injection pumps must be the same.**

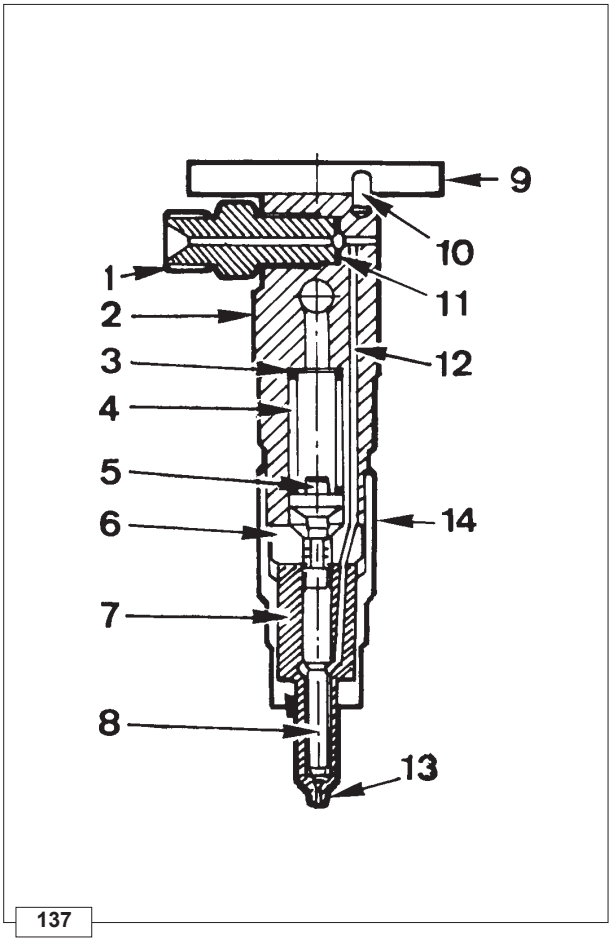
Replace as follows:




136

❍ Fit pump into the crankcase and tighten screws at 25 Nm.

Remove lock **1** and check that rack rod is free to move.
If pump removal is required fit lock **1** to its original position: the rack rod centre should coincide with the pump axis (see fig. 126).
When replacing the crankcase or the camshaft preserve the same distance **A** between **D**, injection pump support, and **C**, injection cam radius; add shims **G** on **D** to obtain the right **A** value if required.
Seals **G** are supplied with different thicknesses: 0,05 – 0,1 – 0,3 and 0,5 mm.

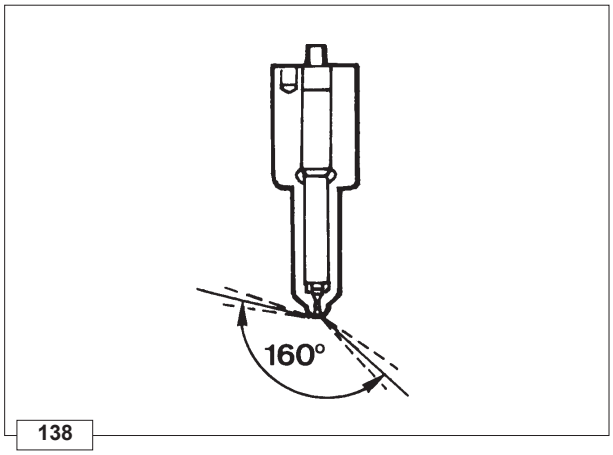



137

## Size S injector

*Components:*

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




138

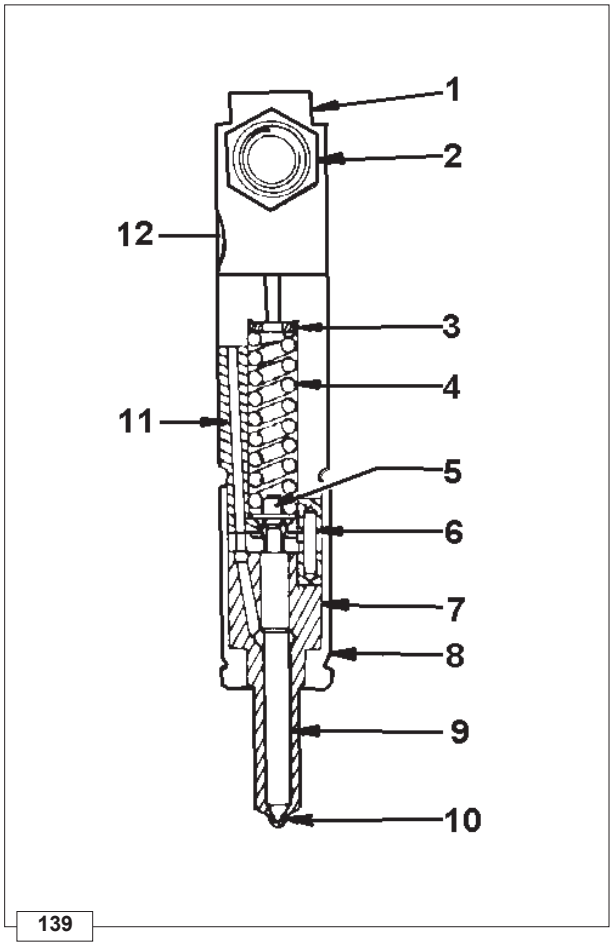
**Size S nozzle**

*Features:*

Hole number and diameter.....4x0,28 mm
Jet angles .....160°
Needle valve elevation .....0,20 ÷ 0,22 mm
Hole length .....0,7 mm
Sump diameter and length .....1x1,5 mm

Clean nozzle tip with a brass brush.
Check that holes are not obstructed using a mandrel with steel wire with 0,28 mm diam.

❍ When refitting tighten ring nut at 70 Nm.



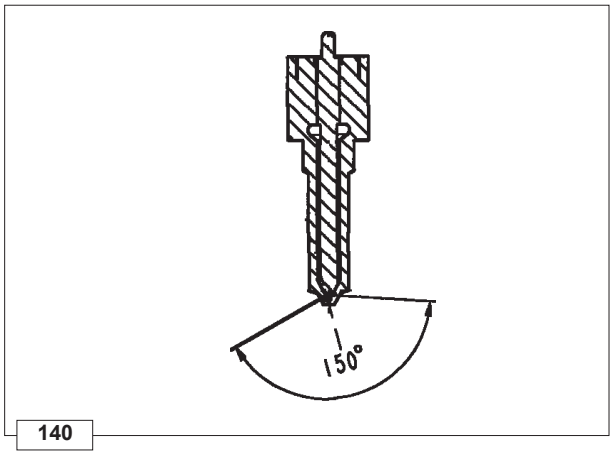

139

**Size P injector**

*Components:*

**1** Injector housing
**2** Intake fitting
**3** Shim
**4** Spring
**5** Pressure rod
**6** Taper pin
**7** Nozzle
**8** Cup
**9** Needle valve
**10** Sump
**11** System duct
**12** Overflow pipe

❍ When refitting tighten ring **8** nut at 50 Nm.




140

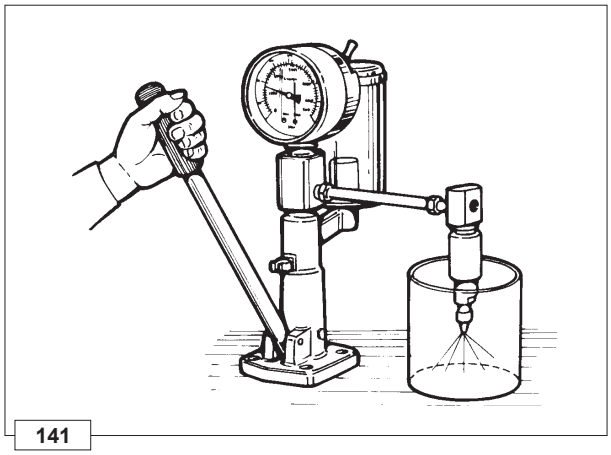
**Size P nozzle**

*Features:*

Hole number and diameter..... 5 x 0,23 mm.
Jet angles ..... 150°.
Needle valve elevation ..... 0,200 ÷ 0,205 mm
Hole length ..... 1 mm
Sump diameter and length ..... 2 x 2,5 mm

Clean nozzle tip with a brass brush.
Check that holes are not obstructed using a mandrel with steel wire with 0,23 mm diam.

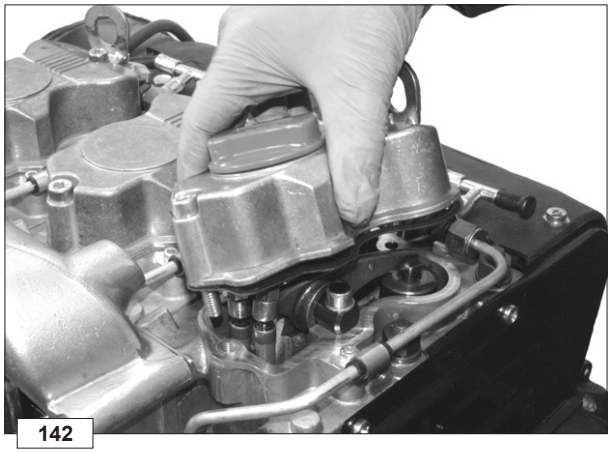
❍ When refitting tighten ring nut at 55 ÷ 65 Nm.



141

### Injector setting

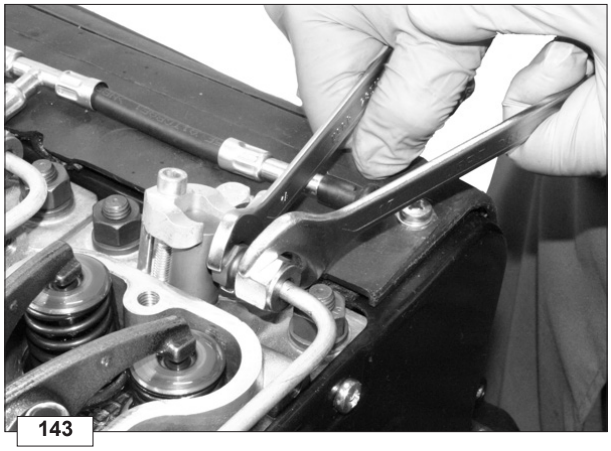
Connect injector to high pression pump and check that setting pressure is 210 ÷ 220 bar for size S injector and 245 ÷ 255 bar for size P injector.
To change injector setting replace the shim over the spring.
When replacing the spring, setting should be performed at a 10 bar greater pressure to allow for bedding during operation.
Check needle valve sealing by slowly moving hand pump until approximately 180 bar.
Replace nozzle in case of dripping (only for size S injectors).



142

### (Static) Injection timing

Remove the rocker arm cover.

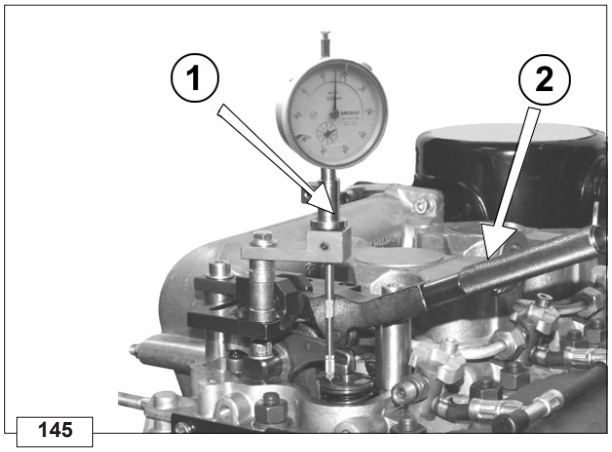


143

Use a 14 mm box wrench to lock the injector union and a 17 mm box wrench to loosen the union of the injector pump high-pressure pipe.

144

Use a 19 mm box wrench to lock the injection pump union and a 17 mm box wrench to loosen the union of the injector pump high-pressure pipe.

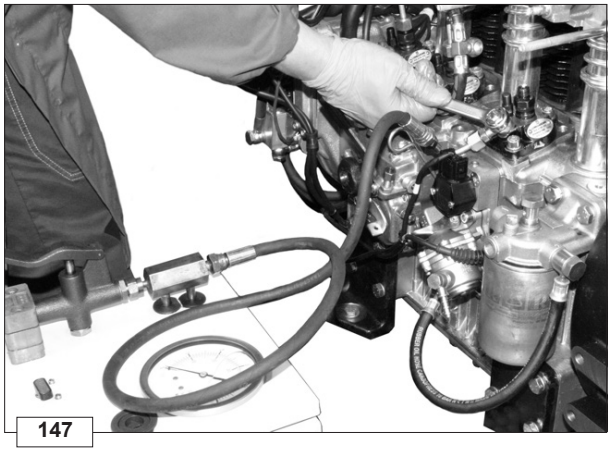


145

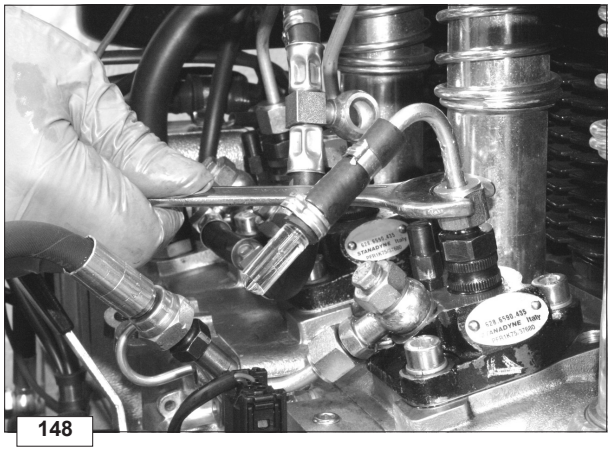
Assemble tool serial no. 1460 - 266 made up of lever **2** serial no. 1460 - 275, of a dial indicator **1** serial no. 1460 - 274 inserted in a dial indicator holder serial no. 1460 - 270.
The function of lever **2** is to reduce the effort required against the resistance of the spring when the valve lowers and comes into contact with the piston crown near the top dead centre.
The dial indicator tracer **1** rests against the upper spring bearing ring of the valve.
To sum up, as pressure is placed on lever **2** the valve goes into contact with the piston since the dial indicator **1** is applied to the valve, allowing to know precisely every movement of the piston from and towards the **TDC**, which is very important for the following operation.


146

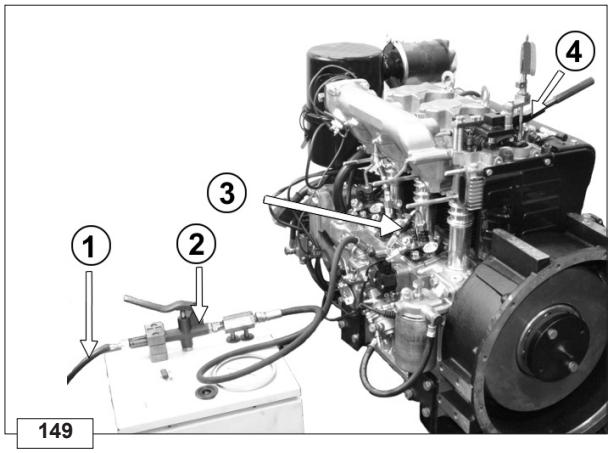
Unscrew the fuel supply union for the injection pump of the cylinder which is to be worked on.


147

To the injection pump connect the high-pressure pump serial no. 1460 - 273 supplied by a tank whose fuel level is at least 100 mm above the injection pump.


148

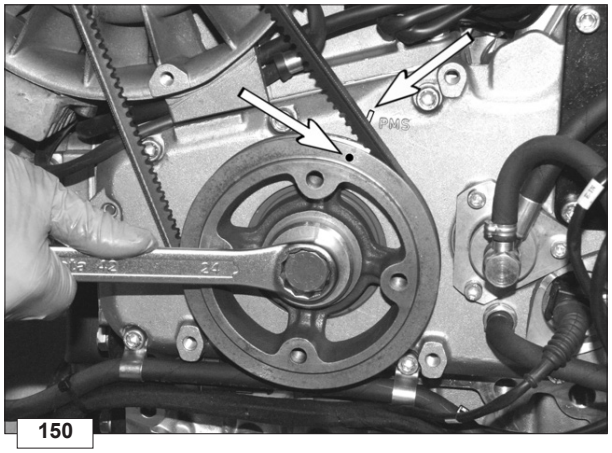
Insert the capillary tester serial no. 1460 - 024 onto the injection pump union where the high-pressure pipe is usually connected from the pump to the injector.



149

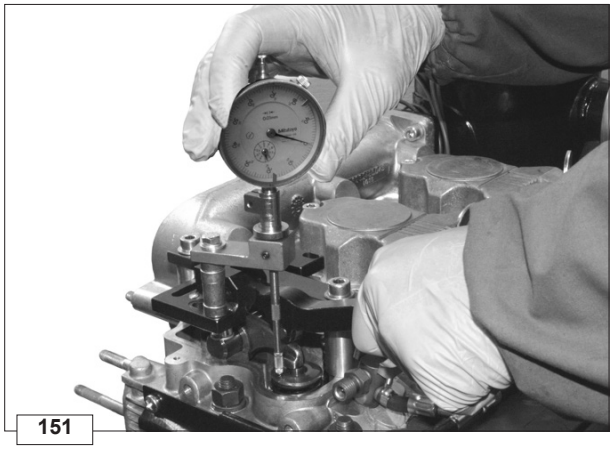
*Components:*

**1** Fuel supply pipe from the tank
**2** High-pressure pipe
**3** Capillary tester
**4** Valve-lowering lever with dial indicator showing piston movement

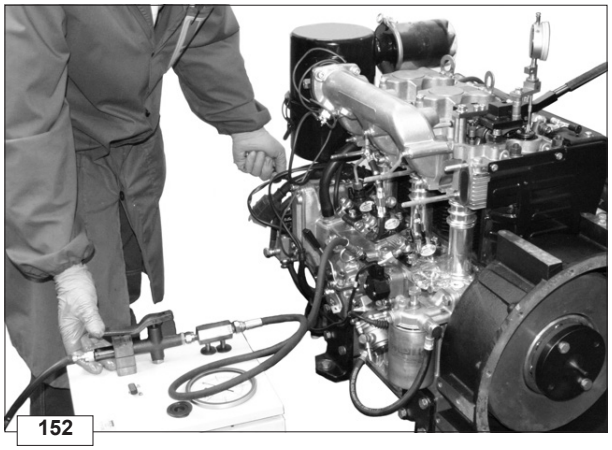


150

Rotate the crankshaft clockwise on the timing belt side and position the relevant cylinder piston at top dead centre.


151

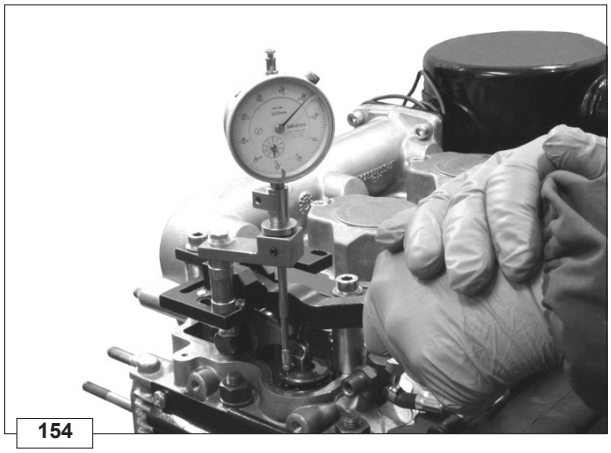
Press the lever to bring the valve into contact with the piston crown.
By joggling back and forth clockwise and anticlockwise, find the dead centre via the dial indicator and then reset to zero.


152

Rotate the crankshaft anticlockwise until diesel starts to flow out from the capillary when the high-pressure lever is pressed.
Change direction of rotation of the crankshaft to clockwise from the timing belt side.
Press the high-pressure lever and rotate the crankshaft until fuel stops flowing from the capillary.


153

The capillary tube shows when the fuel is flowing out, thanks to its small transparent slot.


154

After finding the delivery start point (when fuel stops flowing from the capillary), press the lever and use the dial indicator to check how many millimetres the piston has moved from the top dead centre.
Check static injection advance using the conversion table from millimetres to degrees.
If it is necessary to change static advance add the seals **G** in figure 129 (to delay) or remove the seals **G** in figure 129 (to advance) from between the injection pump surface and the crankcase surface.
The same operation must be performed for each cylinder.

**Table static advance values for engines with P size injectors**

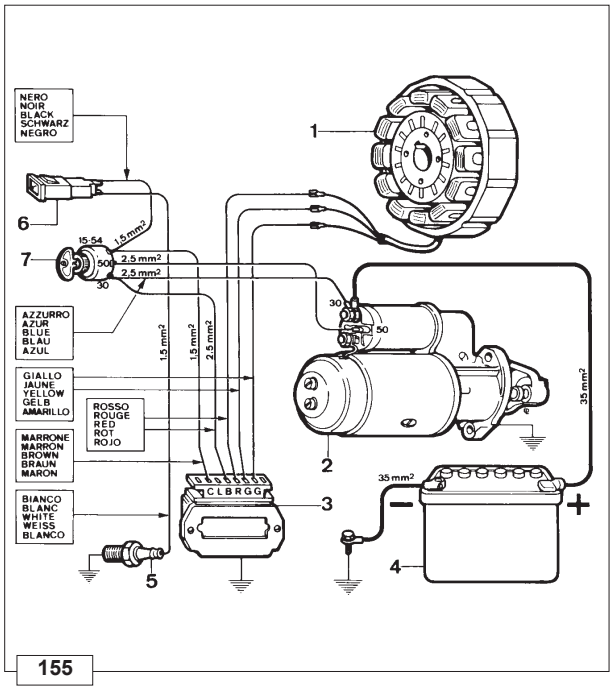
| | R.p.m. | α | Piston lowering (mm) |
|---|---|---|---|
| 97-68 CE | 2400 | 9° ± 1° | 8° --> 0.56<br>9° --> 0.71<br>10° --> 0.87 |
| | 2500 ÷ 2800 | 8° ± 1° | 7° --> 0.43<br>8° --> 0.56<br>9° --> 0.71 |
| | 3000 | 9° ± 1° | 8° --> 0.56<br>9° --> 0.71<br>10° --> 0.87 |
| EPA | 2400 ÷ 2800 | 5° ± 1° | 4° --> 0.14<br>5° --> 0.22<br>6° --> 0.32 |

**Table static advance values for engines with S size injectors**

| R.p.m. | α | Piston lowering (mm) |
|---|---|---|
| 1500 ÷ 2200 | 14° ± 1° | 13° --> 1.47<br>14° --> 1.71<br>15° --> 1.96 |
| 2201 ÷ 3000 | 16° ± 1° | 15° --> 1.47<br>16° --> 1.71<br>17° --> 1.96 |

**Conversion table from degrees into millimetres**

| α | (mm) |
|---|---|
| 0° | 0.00 |
| 1° | 0.01 |
| 2° | 0.04 |
| 3° | 0.08 |
| 4° | 0.14 |
| 5° | 0.22 |
| 6° | 0.32 |
| 7° | 0.43 |
| 8° | 0.56 |
| 9° | 0.71 |
| 10° | 0.87 |
| 11° | 1.06 |
| 12° | 1.26 |
| 13° | 1.47 |
| 14° | 1.71 |
| 15° | 1.96 |
| 16° | 2.22 |
| 17° | 2.51 |
| 18° | 2.81 |
| 19° | 3.12 |
| 20° | 3.45 |



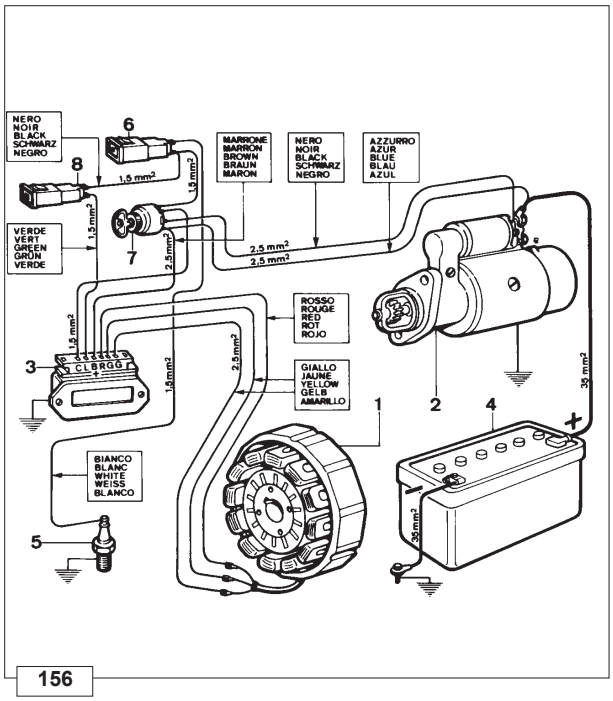

155

**Standard electric equipment**

**Electric starting layout without battery charging light**

*Components:*

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



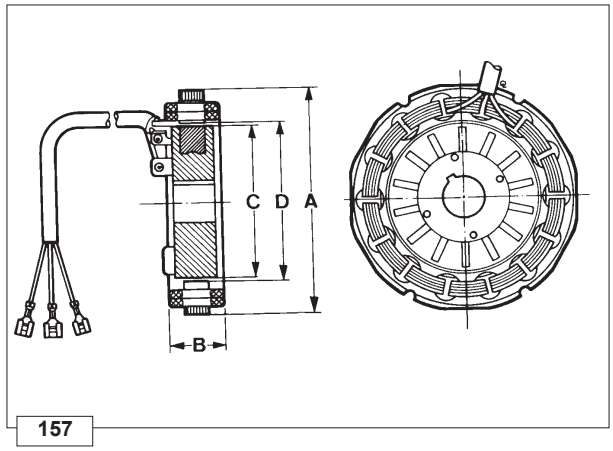

156

**Electrical starting layout with battery charging light**

*Components:*

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

***Note:*** Battery, which is not supplied by Lombardini, should feature a 12V voltage.
When choosing battery capacity please consider environmental conditions: 66 Ah are recommended down to -10°C and 88 Ah are recommended below -15°C; in any case do not use a battery with greater capacity than 110 Ah.



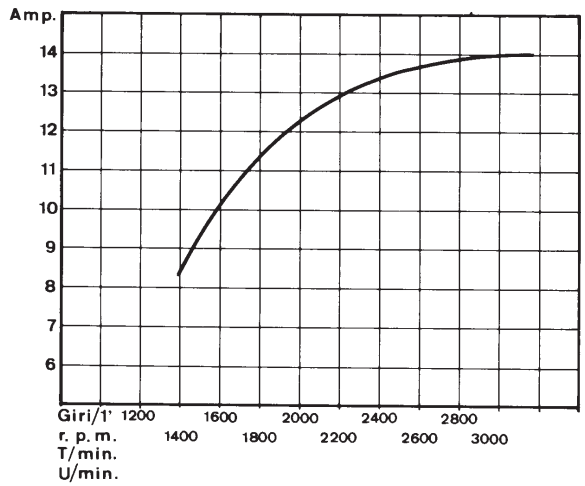

157

**12,5 V, 14 A Alternator**

Features a fixed armature winding, housed in the bell inside the blower stator. The rotating permanent magnet inductor is located in the fan spindle. See page 28.

| Ref. | Dimensions (mm) |
|---|---|
| A | 111,701 ÷ 111,788 |
| B | 31,000 ÷ 33,500 |
| C | 76,226 ÷ 76,300 |
| D | 77,400 ÷ 77,474 |

***Note:*** Clearance between armature winding and inductor (air gap) should be 0,55 ÷ 0,63 mm.

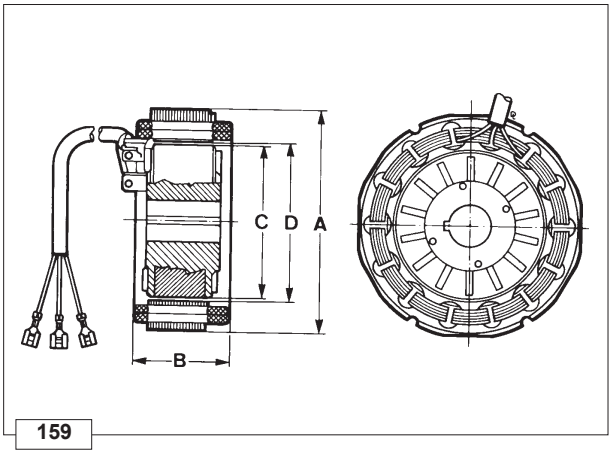



158

**Alternator battery charger curve (12.5 V, 14A)**

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

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



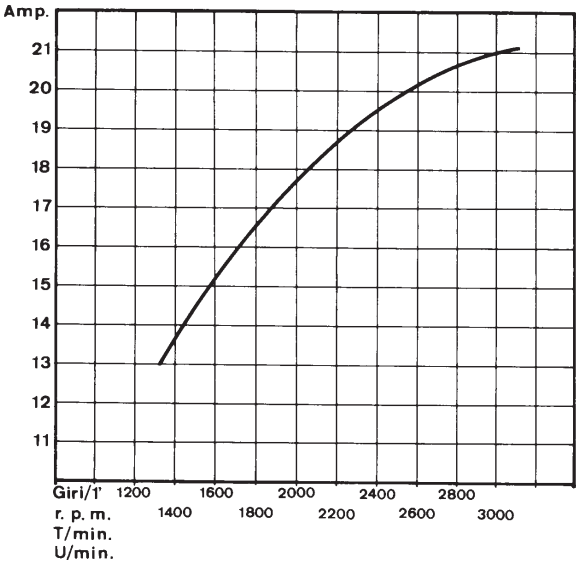

159

**12 V, 21 A Alternator**

Features a fixed armature winding housed in the bell inside the blower stator.The rotating permanent magnet inductor is located in the fan spindle. See page 24.

| Ref. | Dimensions (mm) |
|---|---|
| A | 111,701 ÷ 111,788 |
| B | 49,500 ÷ 52,000 |
| C | 76,226 ÷ 76,300 |
| D | 77,400 ÷ 77,474 |

***Note:*** Clearance between armature winding and inductor (air gap) should be 0,47 ÷ 0,63 mm.

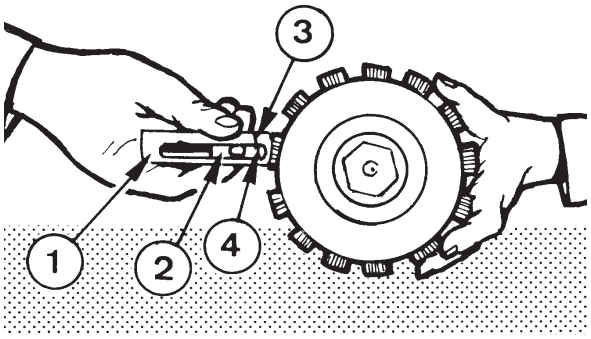



160

**Alternator battery charger curve (12 V, 21 A)**

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

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



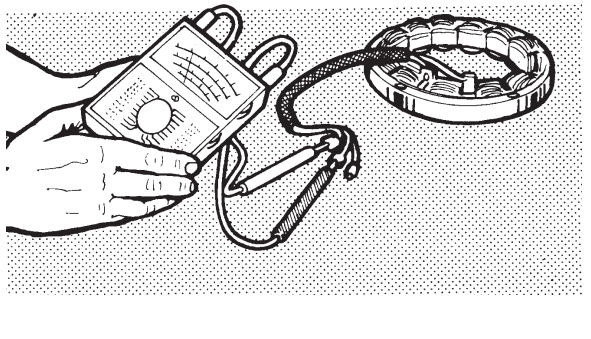

161

**Magnetization checking tool (Part No. 7000-9727-001)**

*Components:*

**1** Casing
**2** Slider
**3** Casing reference line
**4** Slider reference line

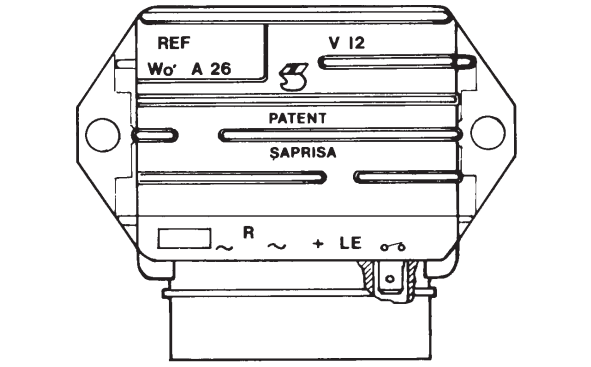
Rest the tool end horizontally onto the magnetic poles.
Hold sfider so that its reference line coincides with the casing reference line.
Release slider: if no attraction occurs the rotor is demagnetized; therefore replace alternator.



162

**Checking for cable continuity**

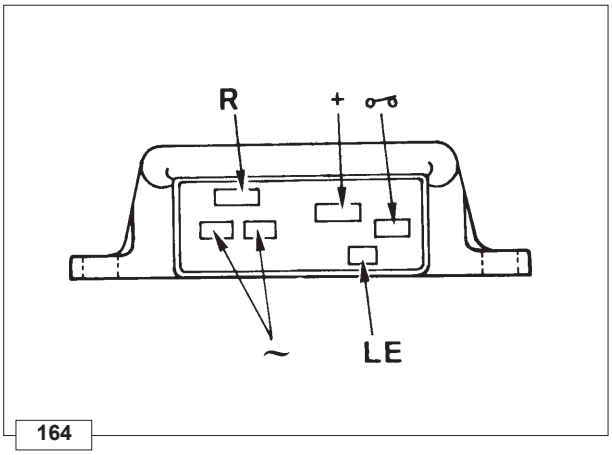
Check that stator windings have no unsoldered connections, burnt areas or grounded wires.
Using an ohmmeter check for continuity between the red cable and the two yellow ones.
Furthermore, check that they are insulated from the ground.




163

**Voltage regulator**

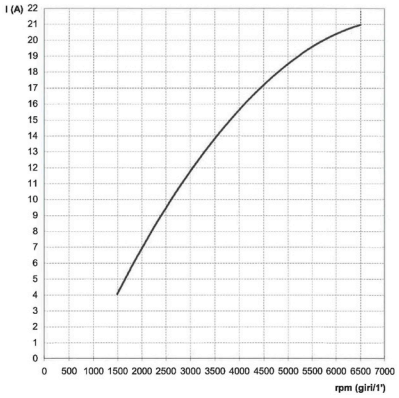
Supplied by SAPRISA : Voltage 12 V, max. current 26A.




164

To avoid wrong connections 3 different sizes are supplied.

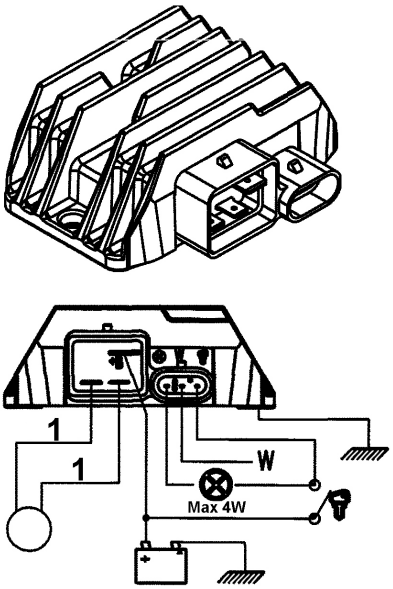
| Ref. | Connection size (mm) | |
|---|---|---|
| | Width | Thickness |
| ~ | 6.25 | 0.8 |
| R | 9.50 | 1.12 |
| + | 9.50 | 1.12 |
| LE | 4.75 | 0.5 |
| ⊶ | 6.25 | 0.8 |




165

**Charge curve of the alternator 12 V, 21 A with voltage regulator 24V - 26A.**

Detected after thermal stabilization at 20 ° C and constant voltage 24V

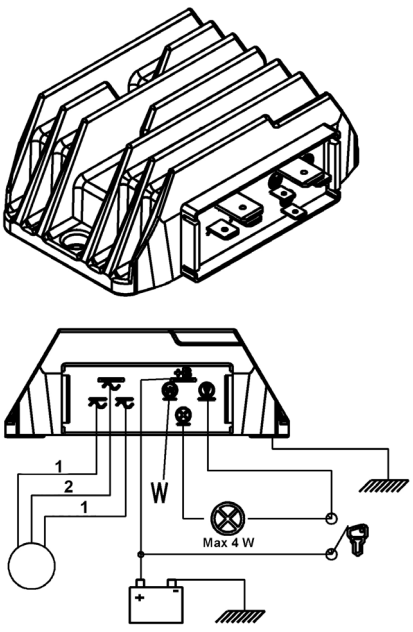



166

**Voltage regulator**

Supplied by SAPRISA : Voltage 24 V, max. current 26 A.

1 - Yellow

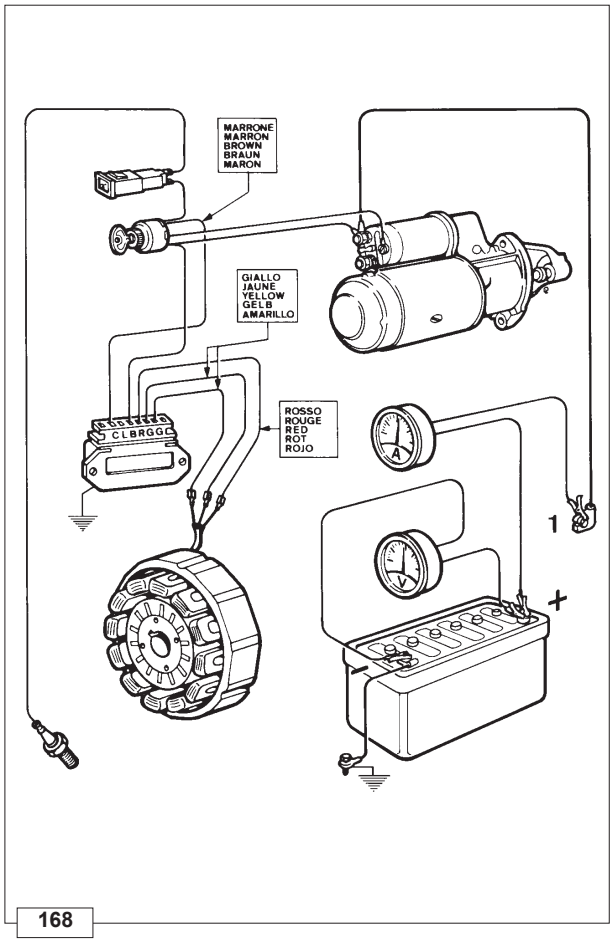



167

**Voltage regulator**

Supplied by SAPRISA : Voltage 24 V, max. current 26 A.

1 - Yellow
2 - Red

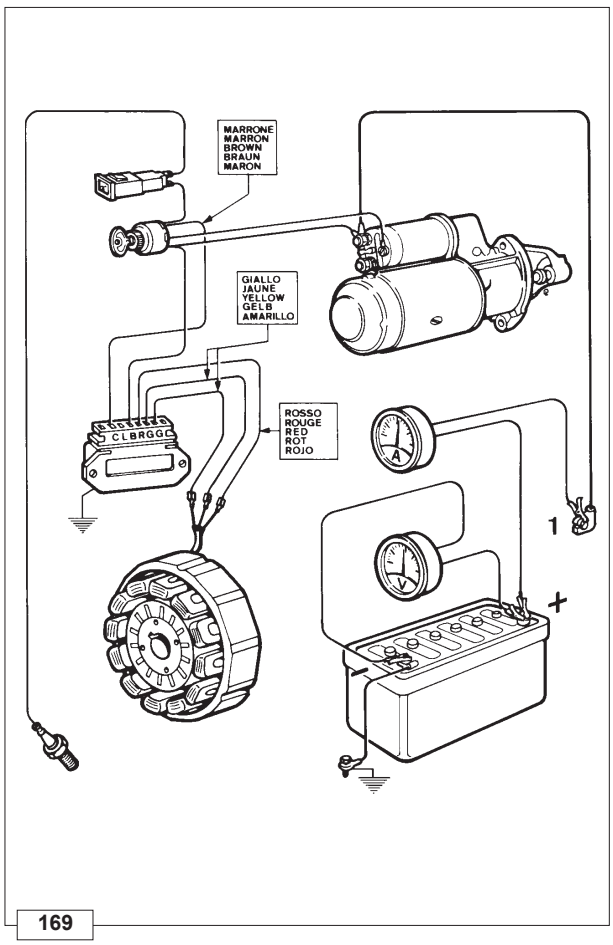



168

**How to check voltage regulator 12V for proper operation**

Check that connections correspond to the layout.
Disconnect the terminal from the battery positive poie.
Connect a d.c. voltmeter between the two battery poles.
Fit an ammeter between the positive pole and the corresponding cable **1** terminal.
The ammeter should be suitabie for reading the required value (14 or 21 A) and for withstanding the starting motor peak absorption (400 ÷ 450 A).
Start a couple of times until battery voltage drops below 13 V.
When battery voltage reaches 14,5 V the ammeter current suddeniy drops down to almost zero.
Replace regulator if recharge current is zero with voltage below 14 V.

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

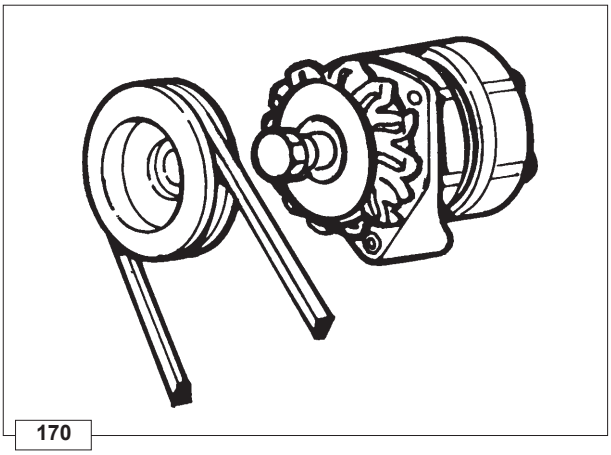



169

**How to check voltage regulator 24V for proper operation**

Check that connections correspond to the layout.
Disconnect the terminal from the battery positive poie.
Connect a d.c. voltmeter between the two battery poles.
Fit an ammeter between the positive pole and the corresponding cable **1** terminal.
The ammeter should be suitabie for reading the required value 26 A and for withstanding the starting motor peak absorption (400 ÷ 450 A).
Start a couple of times until battery voltage drops below 13 V.
When battery voltage reaches 25,5 V the ammeter current suddeniy drops down to almost zero.
Replace regulator if recharge current is zero with voltage below 24,5 V.

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

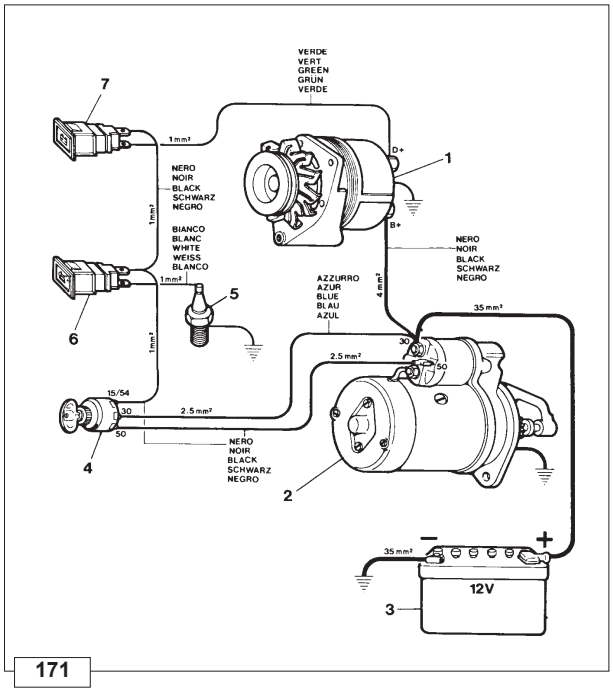


170

**Alternator type Bosch G1 14 V, 33 A**

The alternator is ot the claw-pole rotor type with built-in voltage re-guiator.
The rotating motion is conveyed by the engine through a 'V' belt and sheave.

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

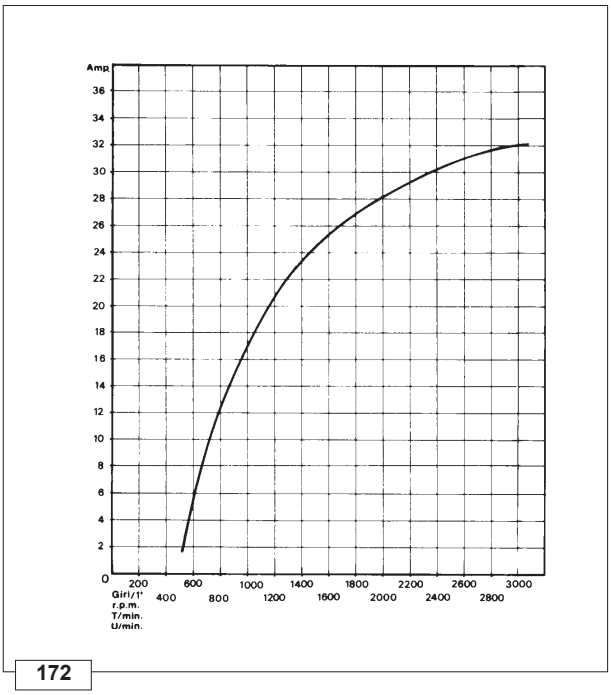



171

**Alternator type Bosch Gil 14 V, 33 A layout**

*Components:*

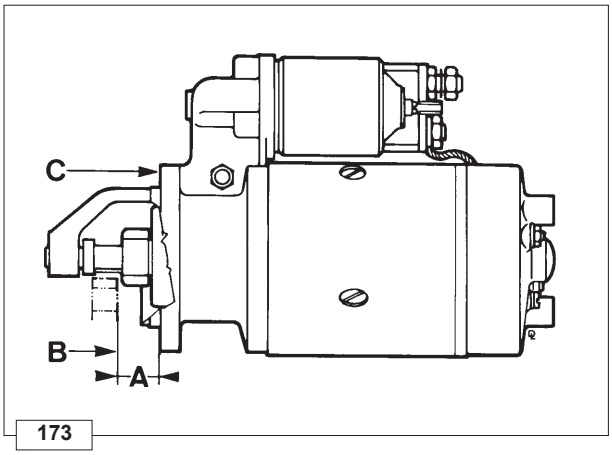
**1** Alternator
**2** Starting motor
**3** Battery
**4** Key switch
**5** Pressure switch
**6** Oil pressure warning light
**7** Battery charging light




172

**14 V, 33 A Bosch G1 alternator battery charger curve**

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




173

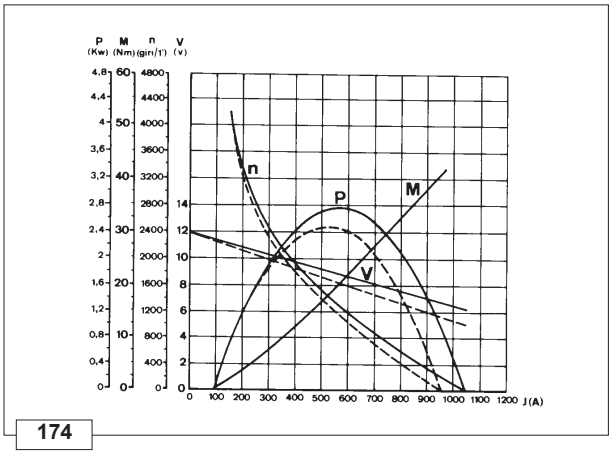
**Starting motor type Bosch JF (R) 12 V, class 2.5 12V**

RH direction of rotation

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

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

***Note:*** Apply to Bosch Service Centers for any type of repair.

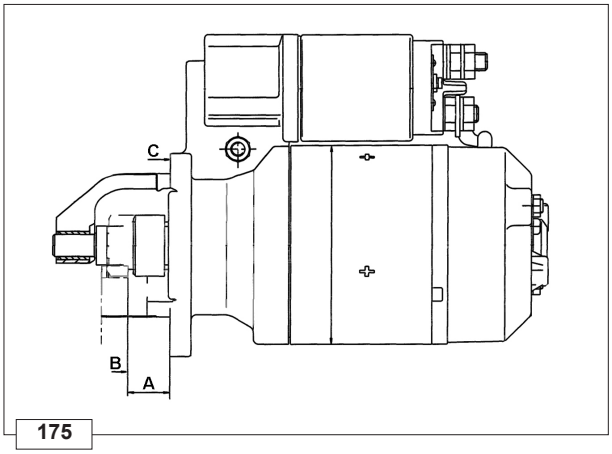



174

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

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

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




175

**Starting motor type 24V.**

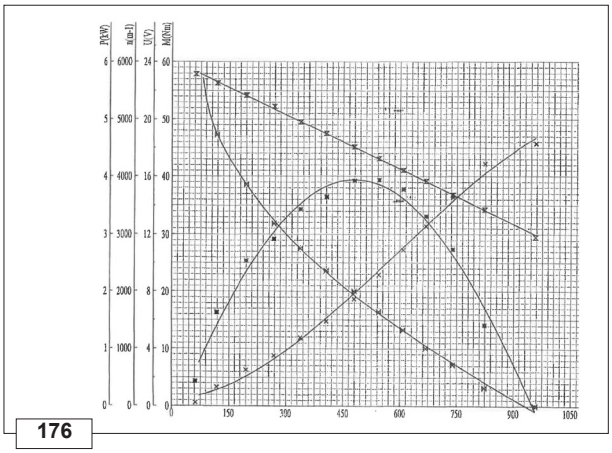
**Type Iskra JF (R) 24V o Bosch**

RH direction of rotation

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

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

***Note:*** Apply to Iskra Service Centers for any type of repair.

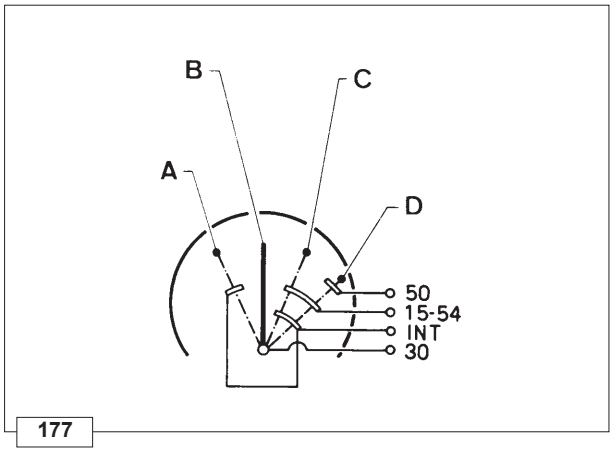


176

**Characteristic curves for starting motor type ISKRA 24V 2.8 kW**

Curves were obtained at room temperature of +23.4°C

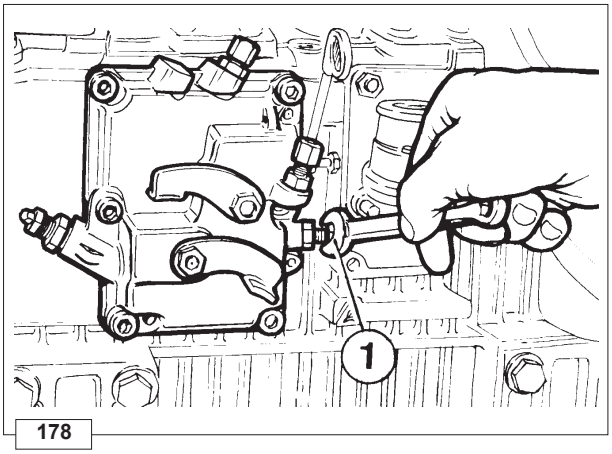
**U(V)** = Motor terminal voltage in Volt
**P** = Power in kW
**M** = Torque in N/m
**N** = Motor speed in r.p.m.




177

**Starting motor layout**

**A** = Parking lights
**B** = Stop
**C** = Run
**D** = Start

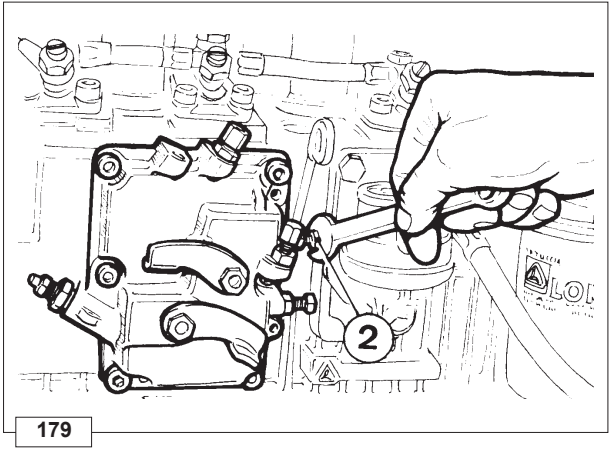



178

## Settings

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

After filling with oil and fuel, start the engine and let it warm up for 10 minutes. Adjust idling speed at 800 ÷ 900 r.p.m. by turning setscrew **1**; then tighten lock nut.

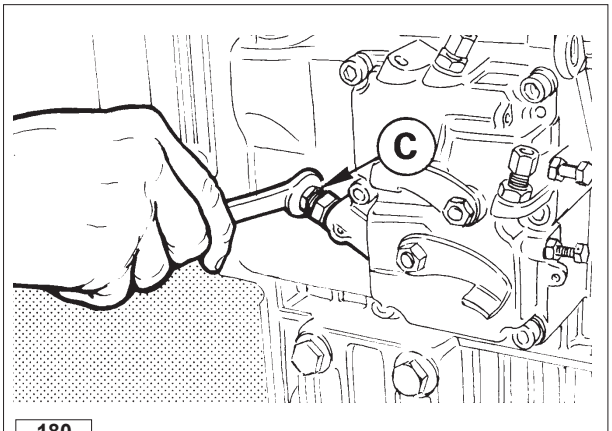



179

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

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

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

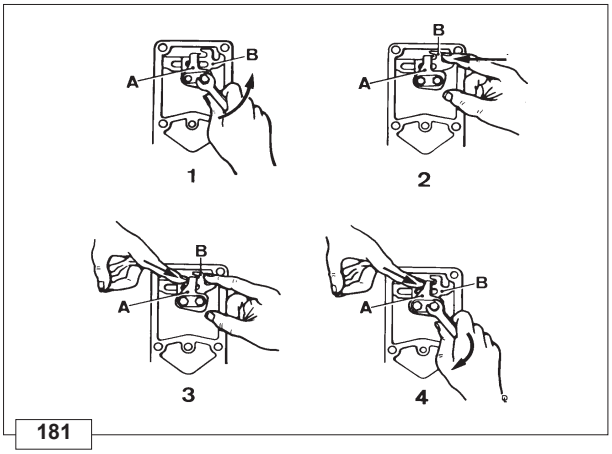



180

### Injection pump delivery setting

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

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




181

### Stop setting

Remove fuel feeding pump and cover.

**1)** Loosen both bolts fixing plate **A**.
**2)** Push injection pump **B** control rod to the right and keep it in this position.
**3)** Push plate **A** to the right until it touches rod **B** and stop.
**4)** Release rod **B** and push plate **A** to the right so that rod **B** has a stroke of 1 mm.
Tighten both bolts.

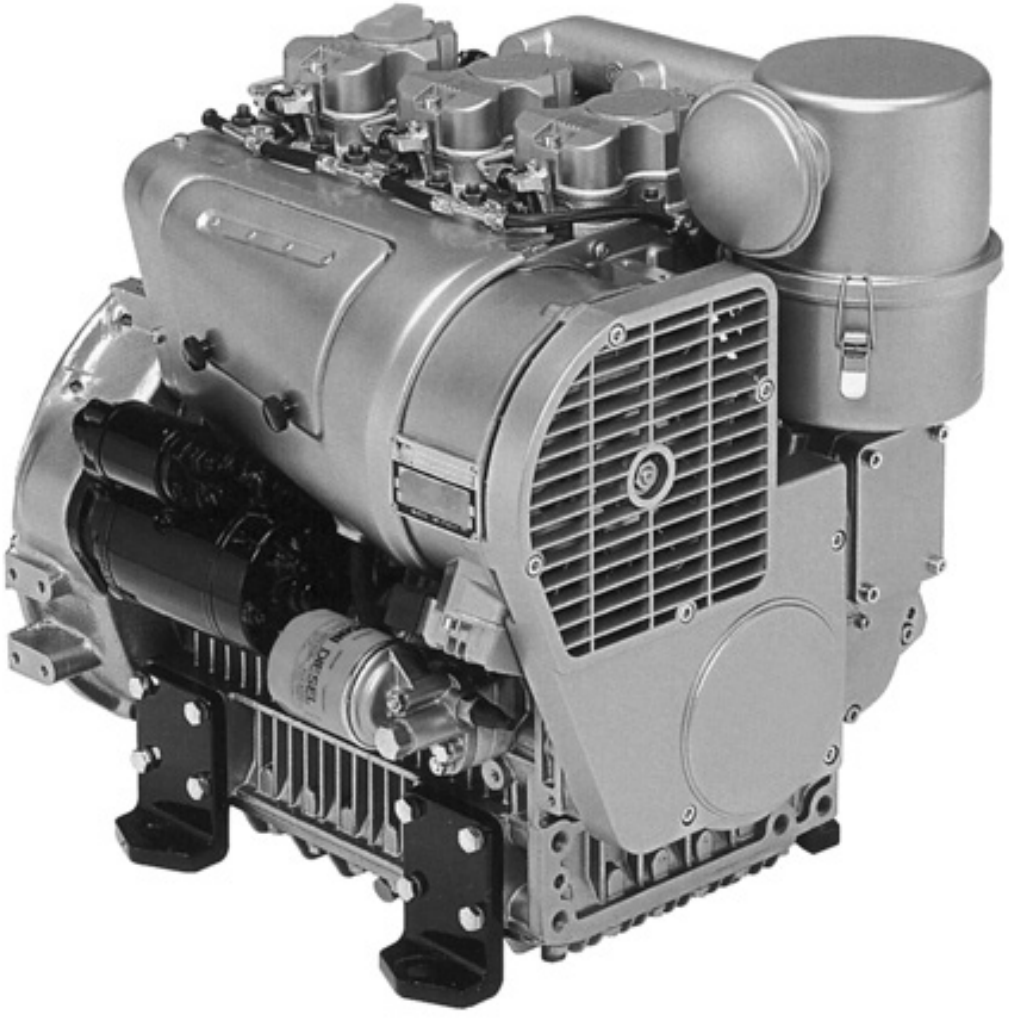
**Note**: Under these conditions no damage can be caused to the injection pump rack rod stops by sudden impacts due to the available control solenoids.

# 11 LD

# 625-3 / 626-3

# ENGINE

## with advance variator



## INJECTION TIMING DEVICE OPERATION

In order to meet EPA tier 2 limits, the engine 11LD 625-3 / 626-3 has been equipped with a variable injection timing device.
The system consists of an electro–hydraulic actuated mechanical device, that allows changing the injection timing by rotating the camshaft against its driving gear.
The change takes place using the oil whose pressure is regulated by a pair of electric valves, which allow a rotation between 0 and 4.5°. The maximum variation of the injection timing is 4.5° (camshaft degrees).
Oil is taken from the engine oil circuit and its pressure acts on a sort of hydraulic piston that moves from one side to the other. The hydraulic plunger is attached on the inside by means of a straight groove and on the outside via a spiral-shaped groove. Thus movement from left to right (or vice versa) causes rotation from the driving gear and the camshaft.
In other words, the plunger translates and, at the same time, rotates and thus varying the angular position of camshaft that is connected to it.
The gear timing variation is managed by an ECU which receives electric signals from two speed sensors, the temperature sensor and the load sensor, which reads the position of the injection pump control.
The ECU memory contains the maps of the injection timing variation strategies.

Fig. A_1. Injection timing device: in "Resting position"

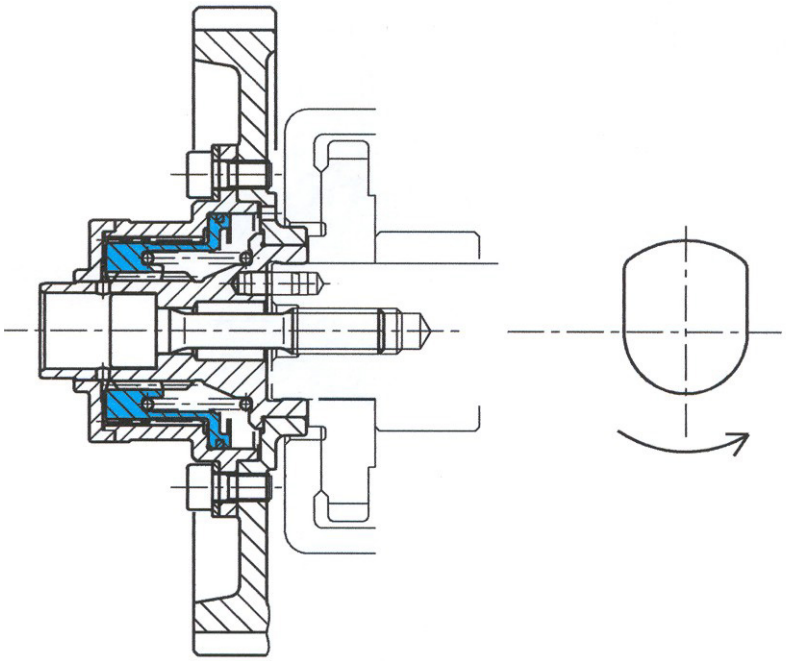


Fig. A_2. Injection timing device: during actuation of an advance (max value 4.5°).
The oil (yellow) goes into the system and moves the plunger (blue) that activates the camshaft anticlockwise.

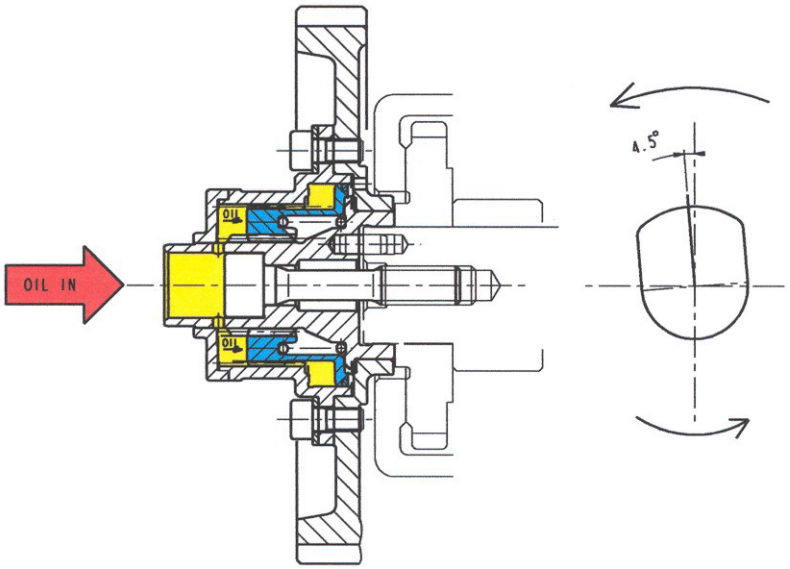
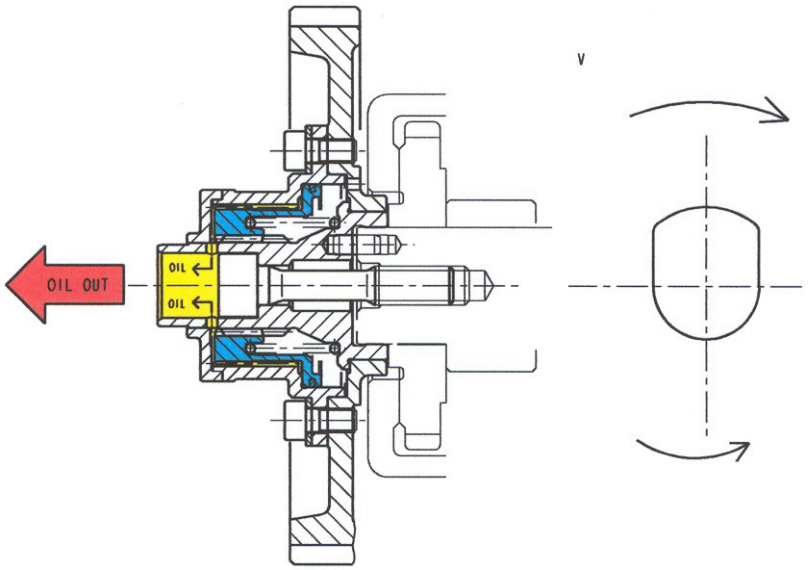
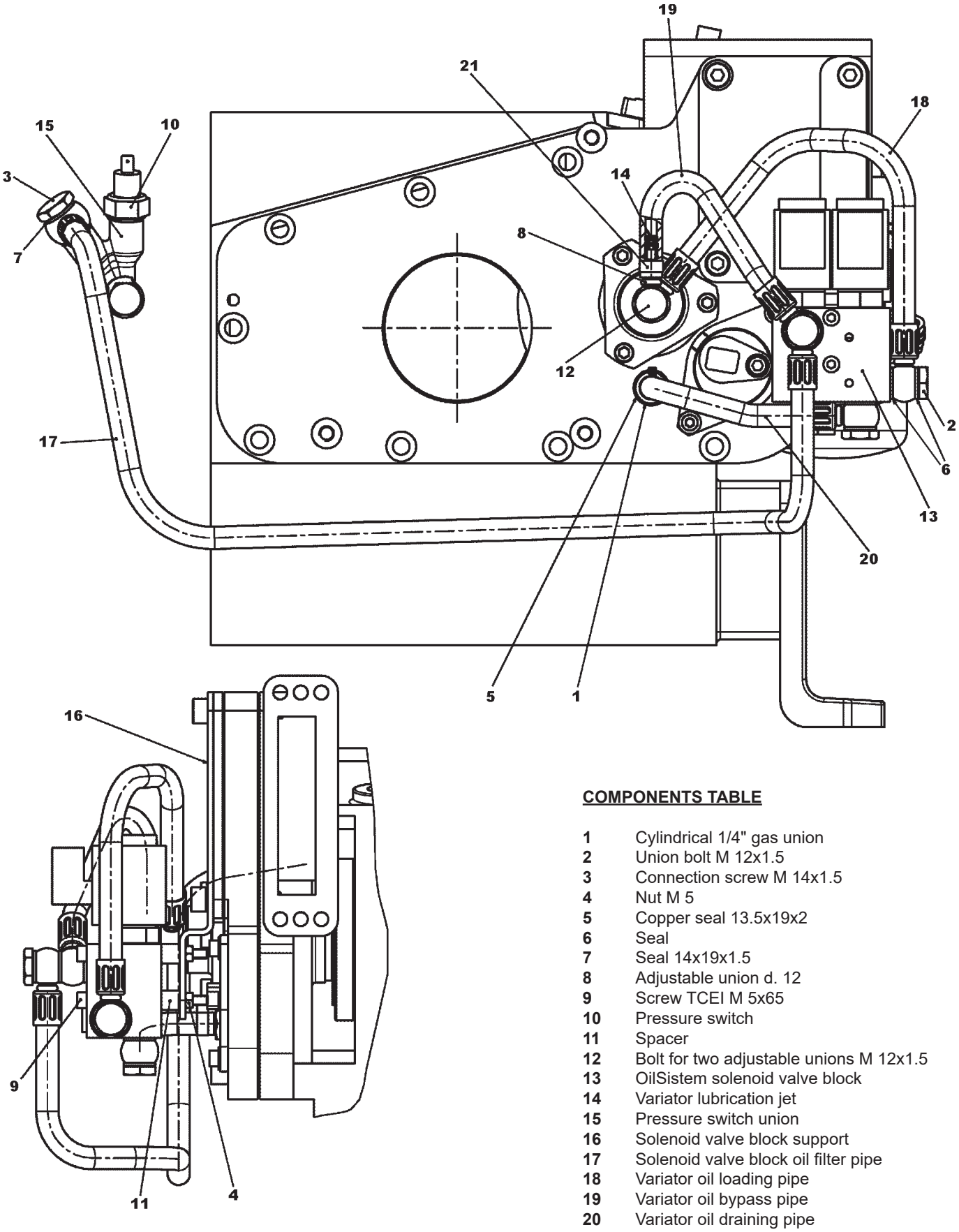



Fig. A_3. Injection timing device: moving from actuation of an advance to resting position.
The oil (yellow) goes out and releases the spring to move the plunger (blue), which in turn activates the camshaft clockwise.



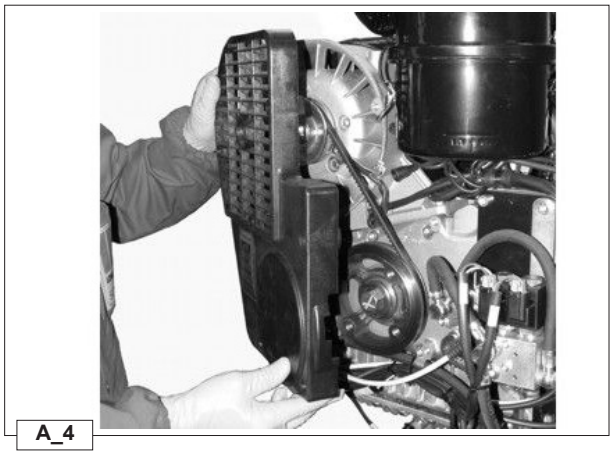

Our system is able to actuate any intermediate advance, regulating the oil pressure. When the set level is reached, the oil exerts the right force to compress the spring at the right height to move the plunger appropriately, thus achieving the required rotation (angular advance).

## Solenoid valve assembly diagram



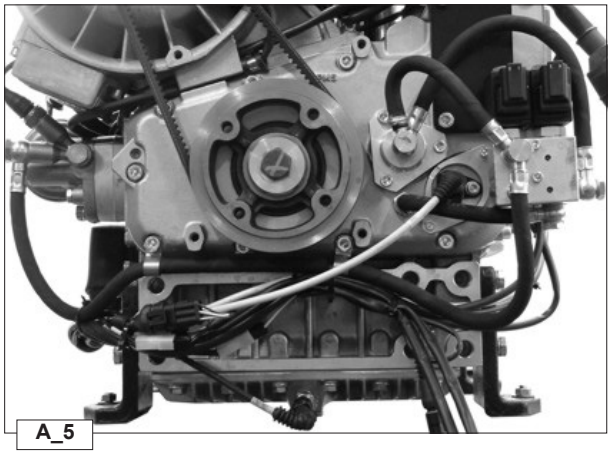

### COMPONENTS TABLE

| | |
|---|---|
| **1** | Cylindrical 1/4" gas union |
| **2** | Union bolt M 12x1.5 |
| **3** | Connection screw M 14x1.5 |
| **4** | Nut M 5 |
| **5** | Copper seal 13.5x19x2 |
| **6** | Seal |
| **7** | Seal 14x19x1.5 |
| **8** | Adjustable union d. 12 |
| **9** | Screw TCEI M 5x65 |
| **10** | Pressure switch |
| **11** | Spacer |
| **12** | Bolt for two adjustable unions M 12x1.5 |
| **13** | OilSistem solenoid valve block |
| **14** | Variator lubrication jet |
| **15** | Pressure switch union |
| **16** | Solenoid valve block support |
| **17** | Solenoid valve block oil filter pipe |
| **18** | Variator oil loading pipe |
| **19** | Variator oil bypass pipe |
| **20** | Variator oil draining pipe |
| **21** | "OTECO clic 66" clamp |



A_4

After loosening the screws, remove the alternator belt guard.



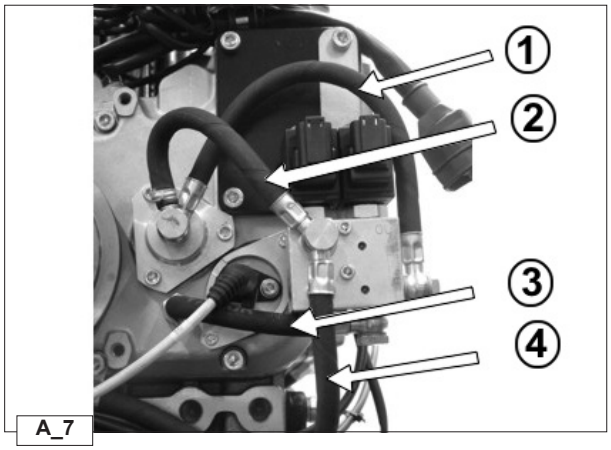
A_5

Overall view of variator speed sensor and hydraulic circuit.

A_6

**Components:**

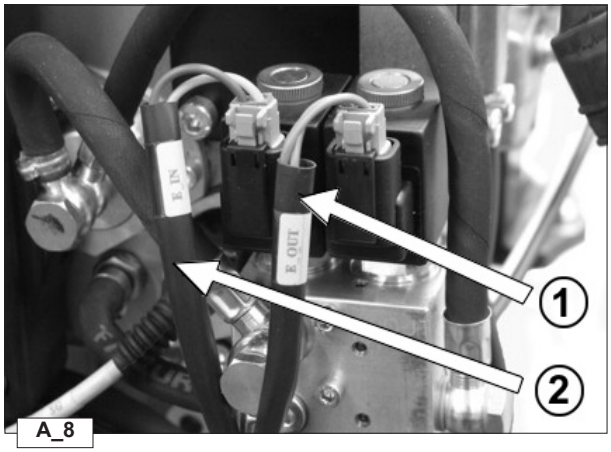
**1** Pressure switch
**2** Pressure switch union
**3** Solenoid valve block oil filter pipe




A_7

**Components:**

**1** Variator oil loading pipe
**2** Variator oil bypass pipe
**3** Variator oil draining pipe
**4** Solenoid valve block oil filter pipe



A_8

Components:

**1** Variator load solenoid valve
**2** Variator unload solenoid valve

***Important***
**Do not invert cables during reassembly.**


A_9

To remove connectors, press the stop tabs and draw upwards.


A_10

➲ Refer to page 78 to identify the pipes.

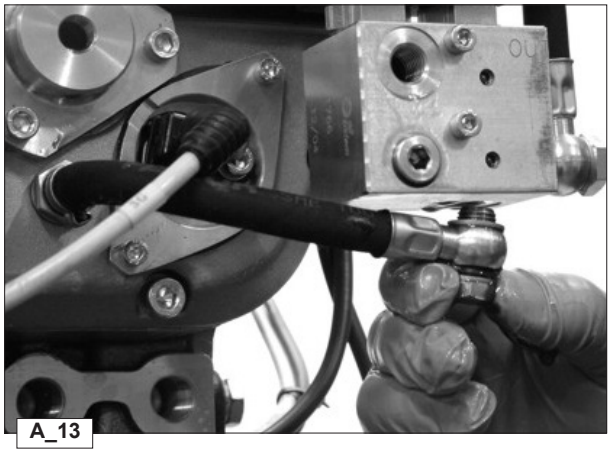
Loosen the union screw of pipes **17** and **19**.


A_11

On the opposite end of the block of pipe **19** is the variator lubrication jet attached to the pipe by a click clamp.

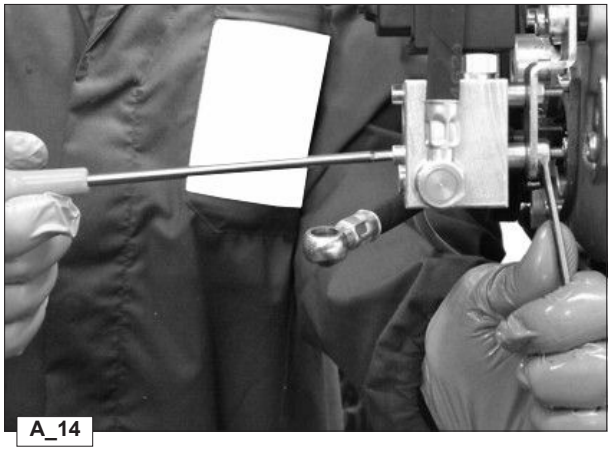
A_12

Variator lubrication jet complete with banjo union.



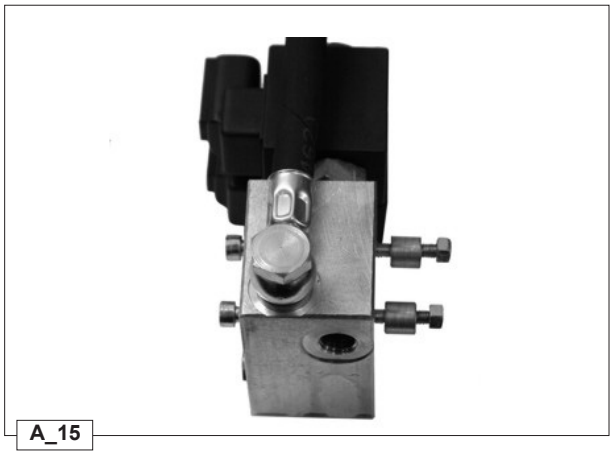
A_13

Unscrew the union of variator oil discharge pipe **20**.



A_14

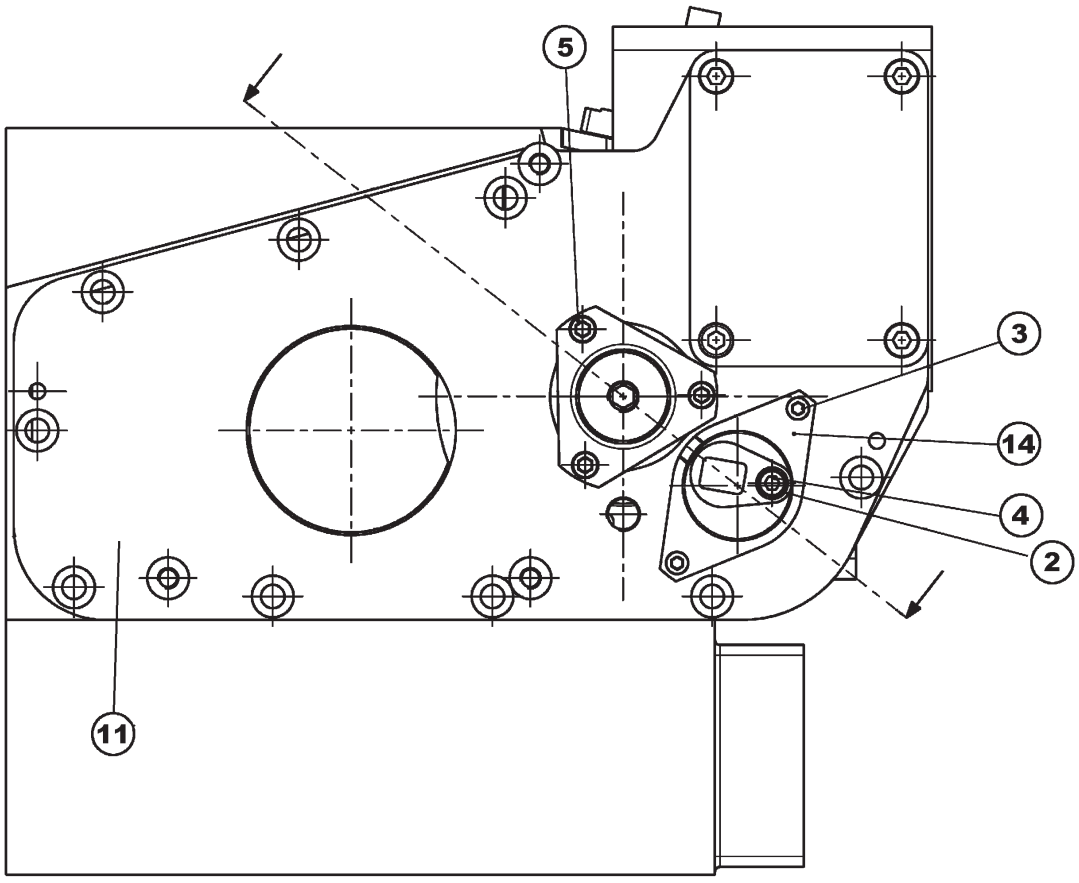
To remove the solenoid valve block from the support bracket, unscrew the two screws M 5.

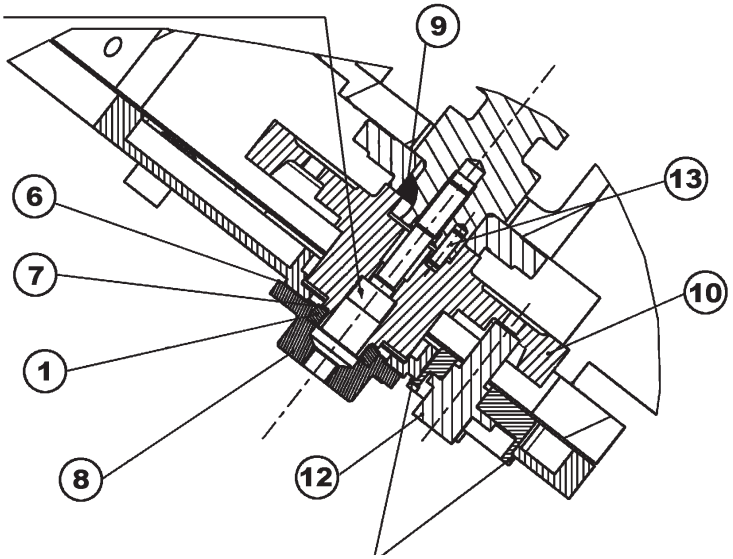


A_15

View of the unassembled solenoid valve block with two spacers between the block and the bracket.

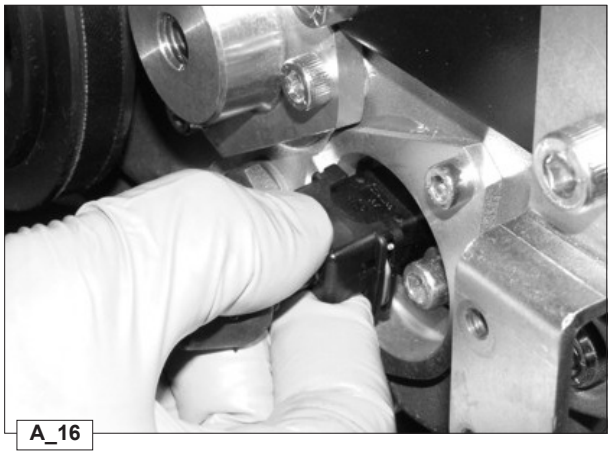
## Speed sensor and variator assembly diagram



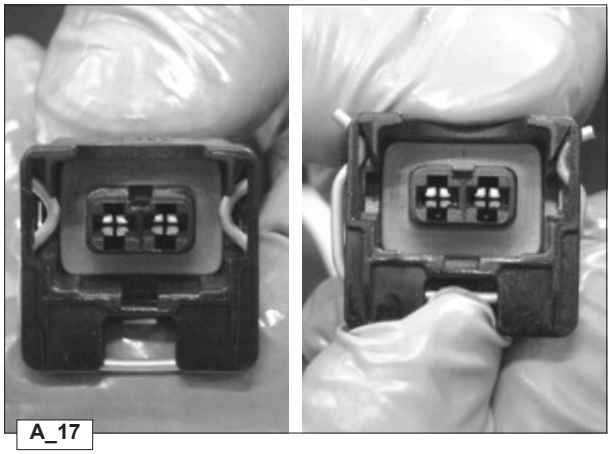

### COMPONENTS TABLE

| | |
|---|---|
| **1** | Oil seal ring 20x30x7 |
| **2** | Washer 6x12xSp1 |
| **3** | Screw TCEI M 5x10 |
| **4** | Screw TCEI UNI 5931 M 6x10 |
| **5** | Screw TCEI UNI 5931 M 6x14 |
| **6** | Lid seal (rev. counter) |
| **7** | Oil seal support ring |
| **8** | Variator oil bush |
| **9** | Special tab for variator |
| **10** | Advance variator device |
| **11** | Timing cover side cover for variator |
| **12** | Speed and phase sensors |
| **13** | Cylindrical pin 5x16 |
| **14** | Speed sensor support |

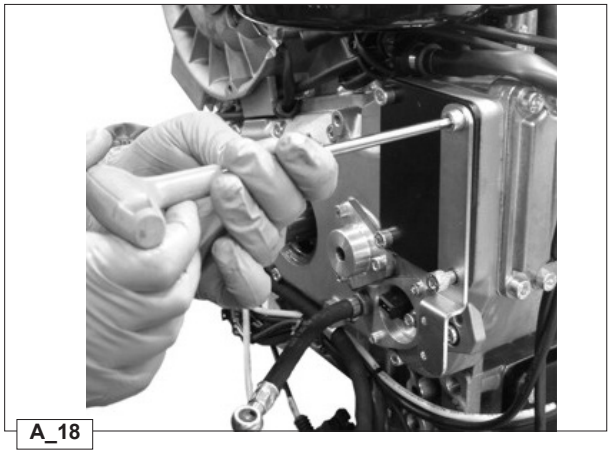


A_16

To remove the speed sensor cable connector press the spring as shown in figures **A_16** and **A_17** and draw upwards.

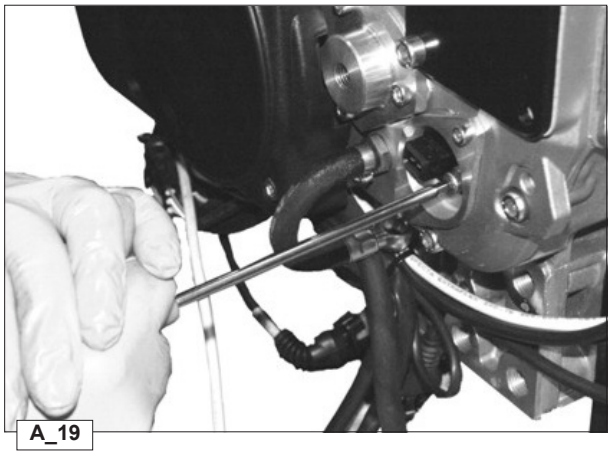


A_17



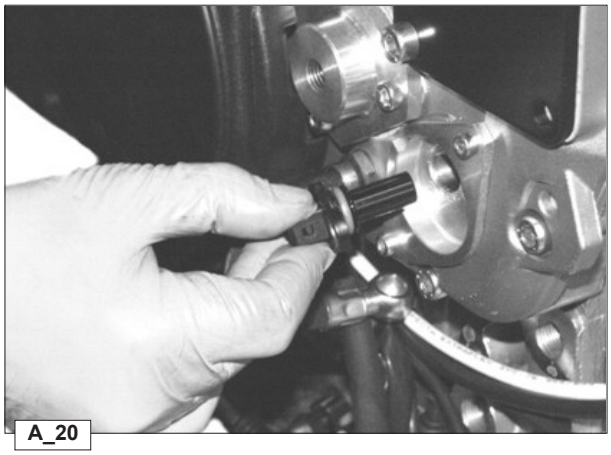
A_18

Loosen the two screws M8 to disassemble the solenoid valve support bracket.



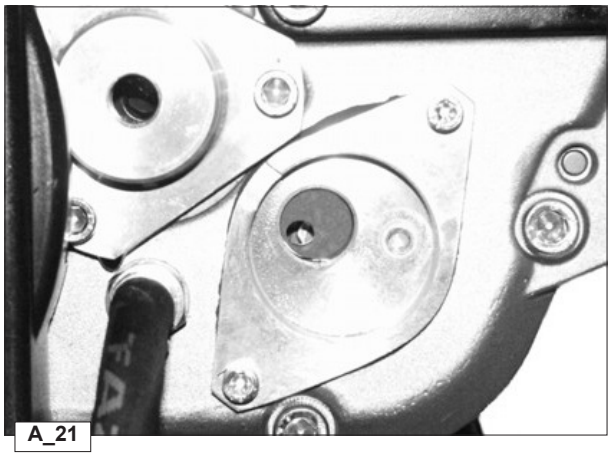
A_19

Loosen screw M6 to remove the speed sensor from its support.



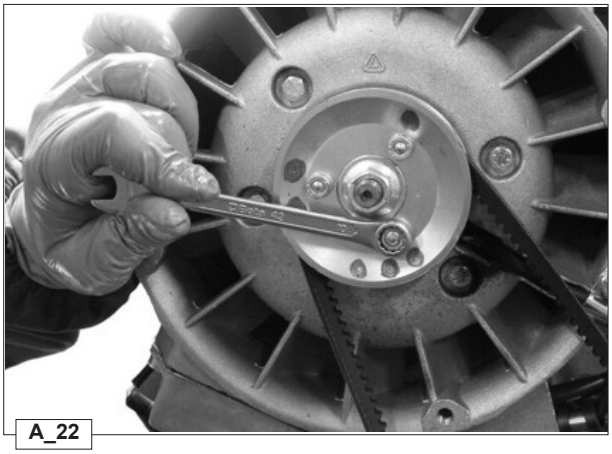
A_20

Draw he speed sensor outwards, being careful not to damage the rubber seal ring.



A_21

View of speed sensor housing.

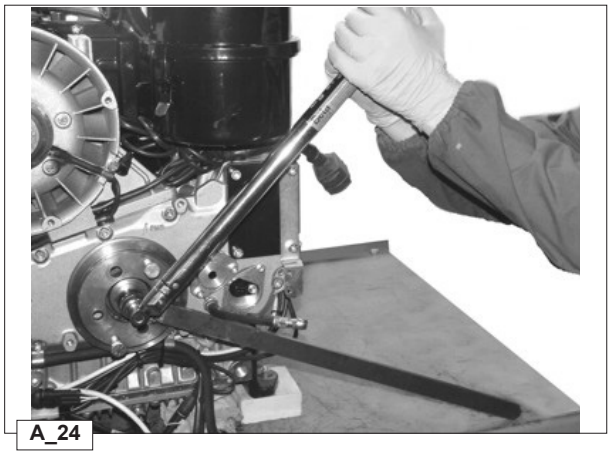


A_22

**Blower belt alternator - Disassembly**

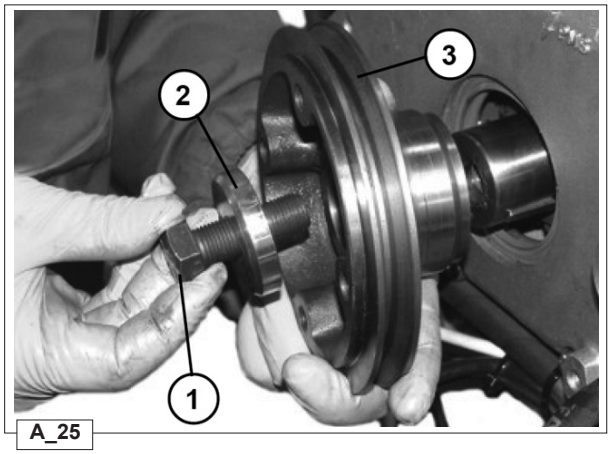
➲ See page 28-29.

A_23


A_24

**Blower control pulley - Disassembly**

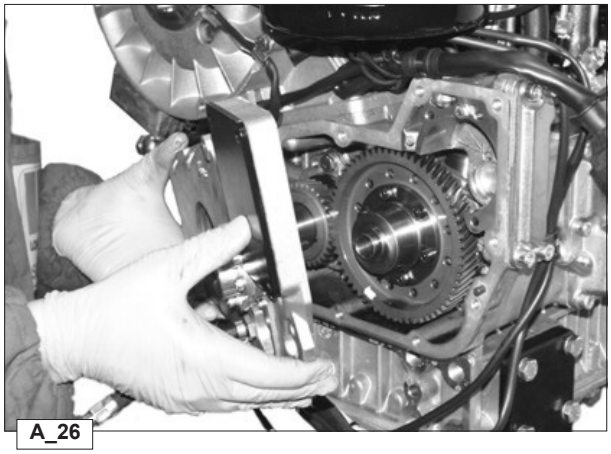
➲ See page 28-29.



A_25

*Components:*

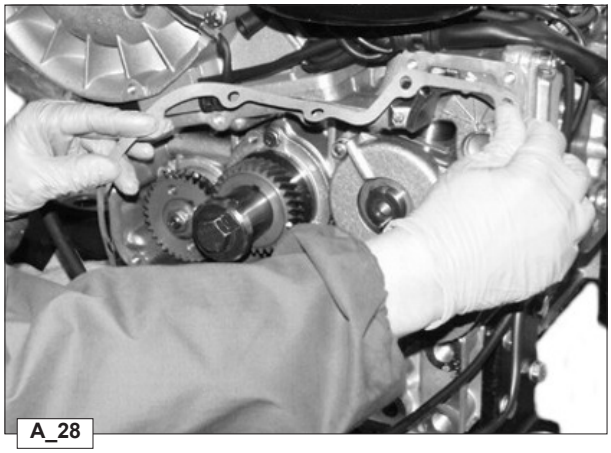
**1** Left-handed bolt
**2** Washer
**3** Blower control pulley


A_26

After loosening the screws, remove the timing cover.


A_27

Pay attention to the oil seal support ring when disassembling the timing cover.


A_28

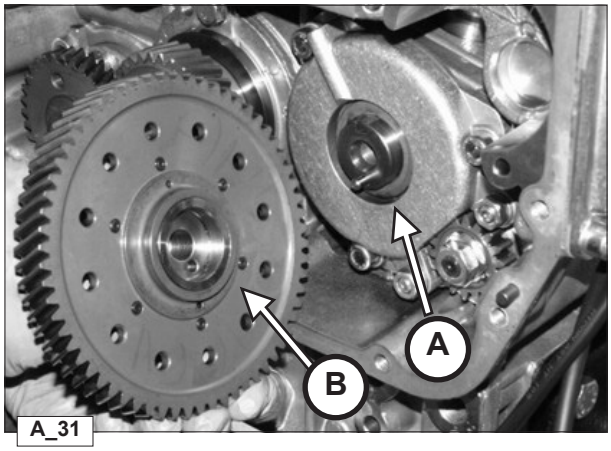
Remove the timing cover seal.


A_29

Unscrew screws M10 on the variator to the camshaft.


A_30

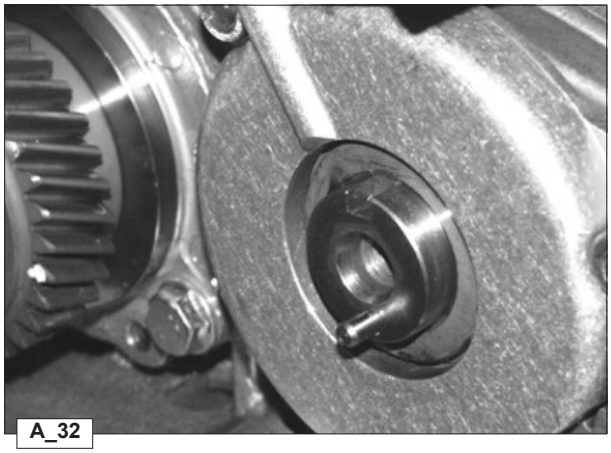
Remove screw M10.



A_31

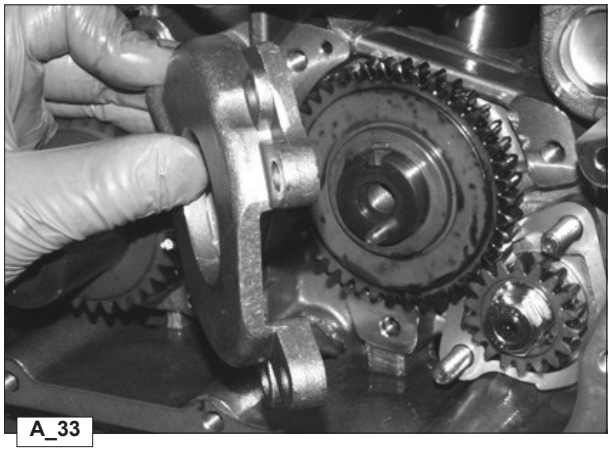
Remove the variator.
The figure shows the camshaft pin for correct variator timing.

**A** Cylindrical pin Ø 5x16
**B** Pin housing



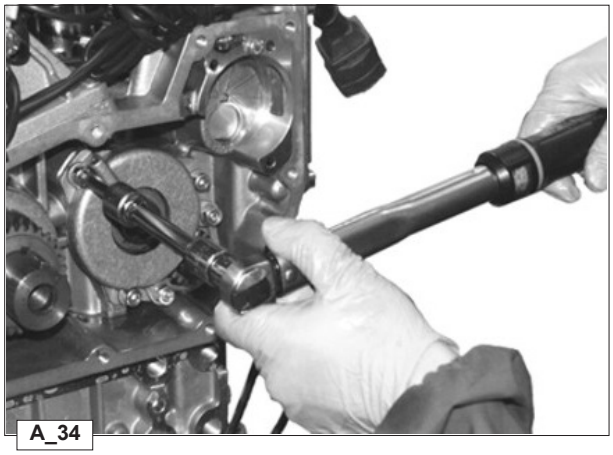
A_32

View of the camshaft ends with pin inserted.



A_33

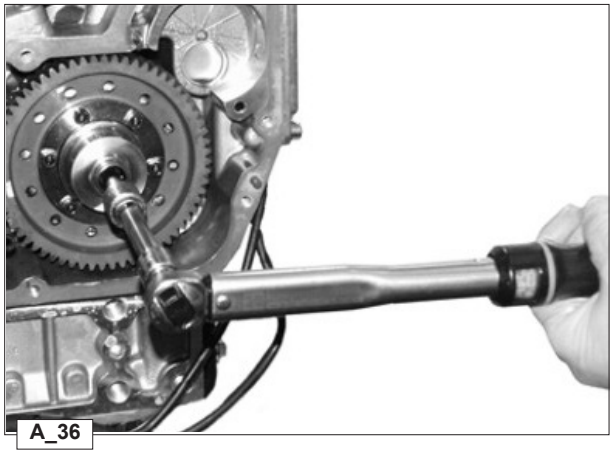
Remove the shoulder housing of the idle gear that drives the speed governor.


A_34

❍ After refitting the housing tighten the screws to 20 Nm using a torque wrench.

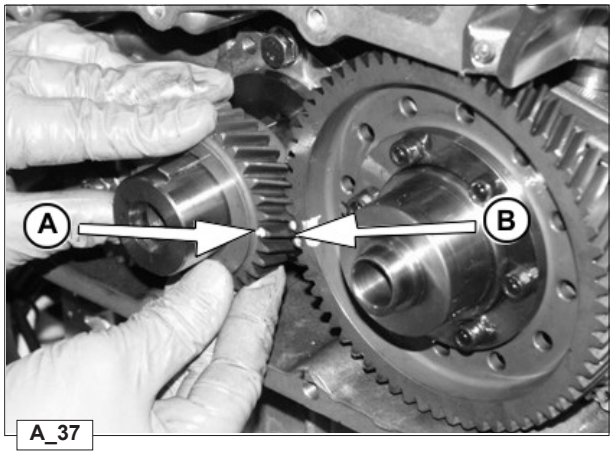

A_35

Remove the distribution control gear from the crankshaft.


A_36

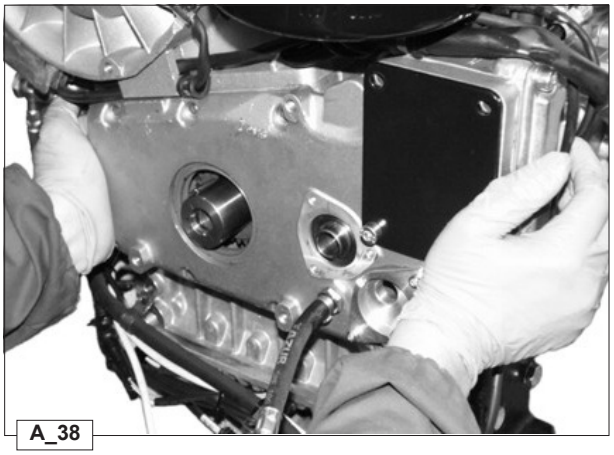
Assemble the variator onto the end of the camshaft taking care to properly insert the timing pin into place and ensuring that the variator comes into contact with the surface of the speed governor idle gear.

❍ Tighten screw M10 to 65 Nm using a torque wrench.

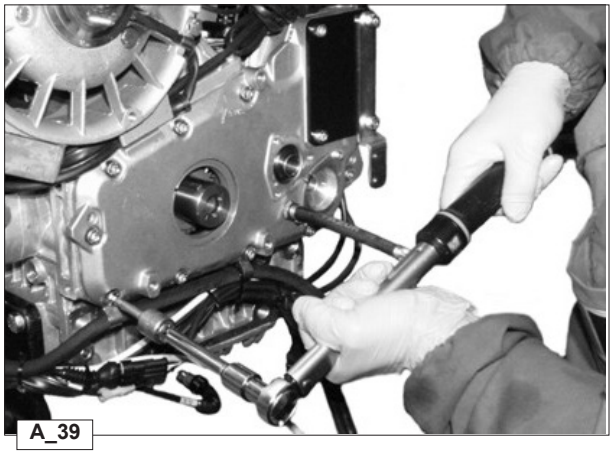


A_37

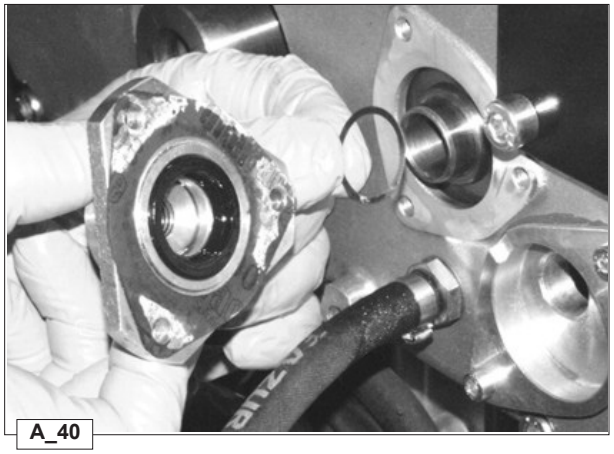
Assemble the timing control gear onto the crankshaft so that reference mark **A** is lined up with the two reference marks **B** on the idle gear installed on the camshaft.


A_38

Replace the timing cover, placing a new seal and lining up with the two centring pins.

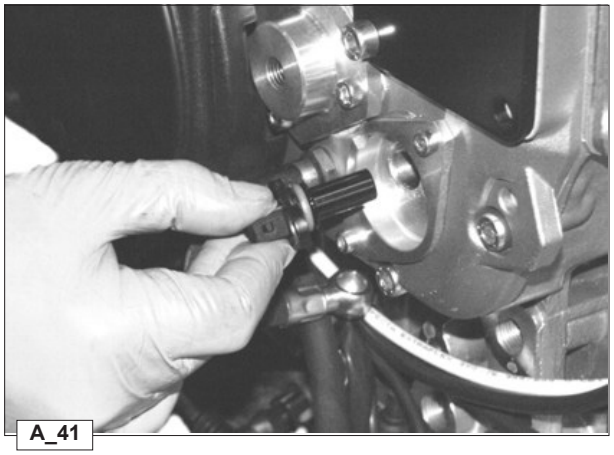

A_39

❍ Tighten the screws to a 25 Nm torque.

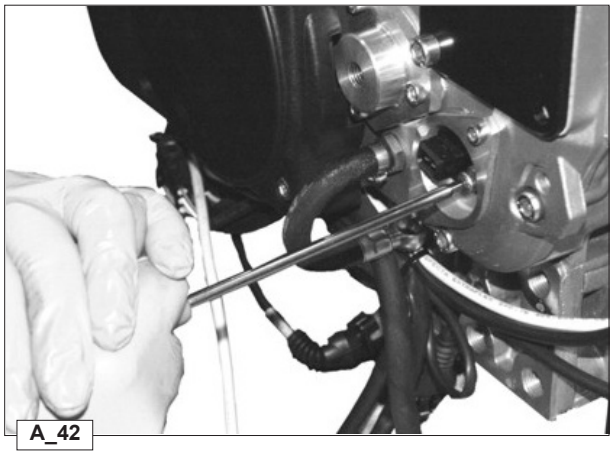

A_40

Refit the oil feed bushing to the variator, placing the oil seal support ring in between.
Replace the seal.

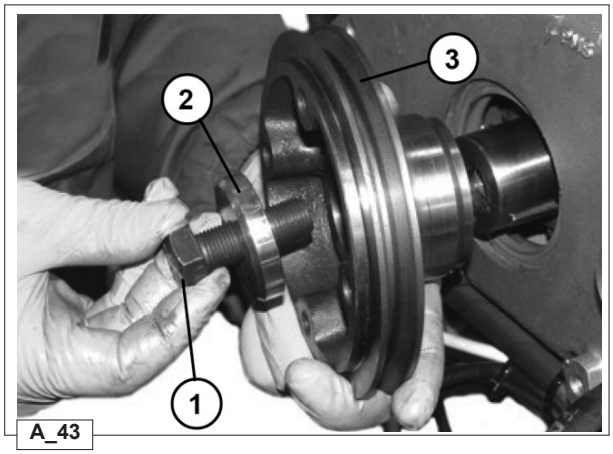
❍ Tighten the three screws M6 to an 8 Nm torque.


A_41

Replace the speed sensor taking care not to damage the O-ring.


A_42

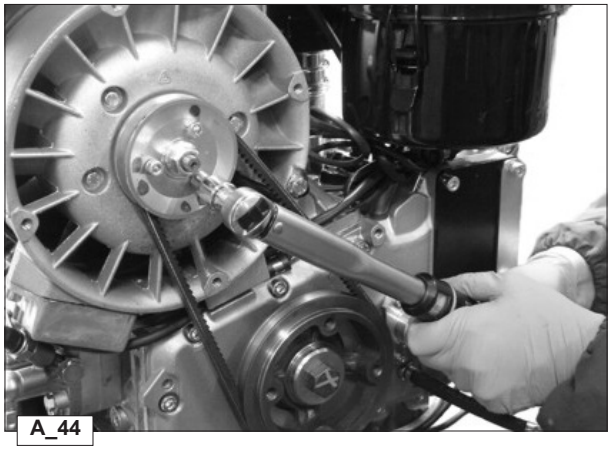
❍ Attach the sensor using screw M6 to a torque of 8 Nm.



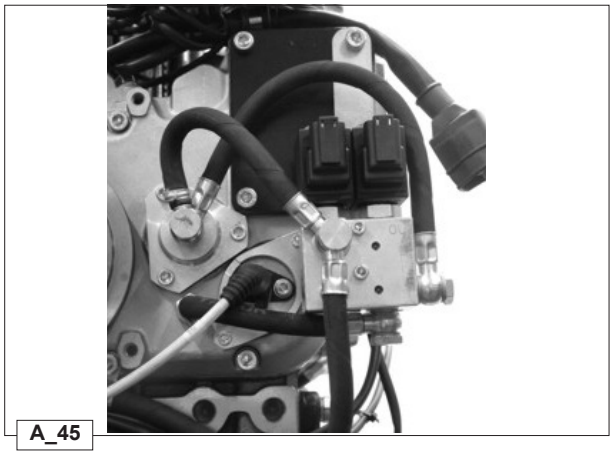
A_43

Reassemble the blower control pulley onto the crankshaft.

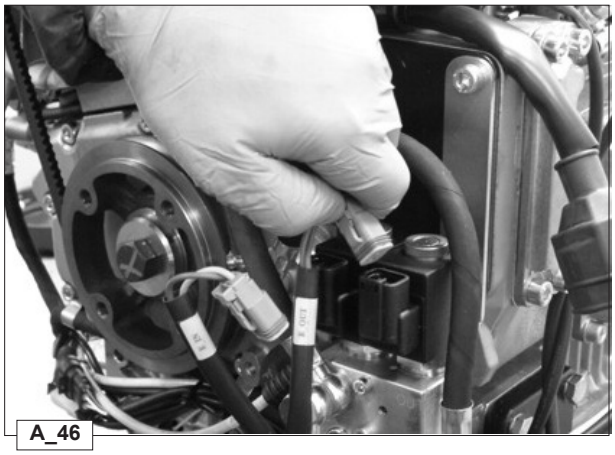
❍ Tighten the left-handed fastening bolts to torque of 300 Nm.


A_44

➲ Replace and check the belt tension, see page 29.

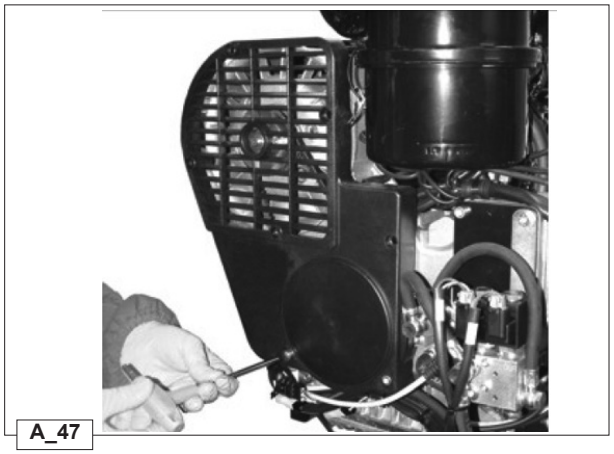

A_45

Replace the variator circuit oil pipes. If in doubt consult the diagram on page 78.



A_46

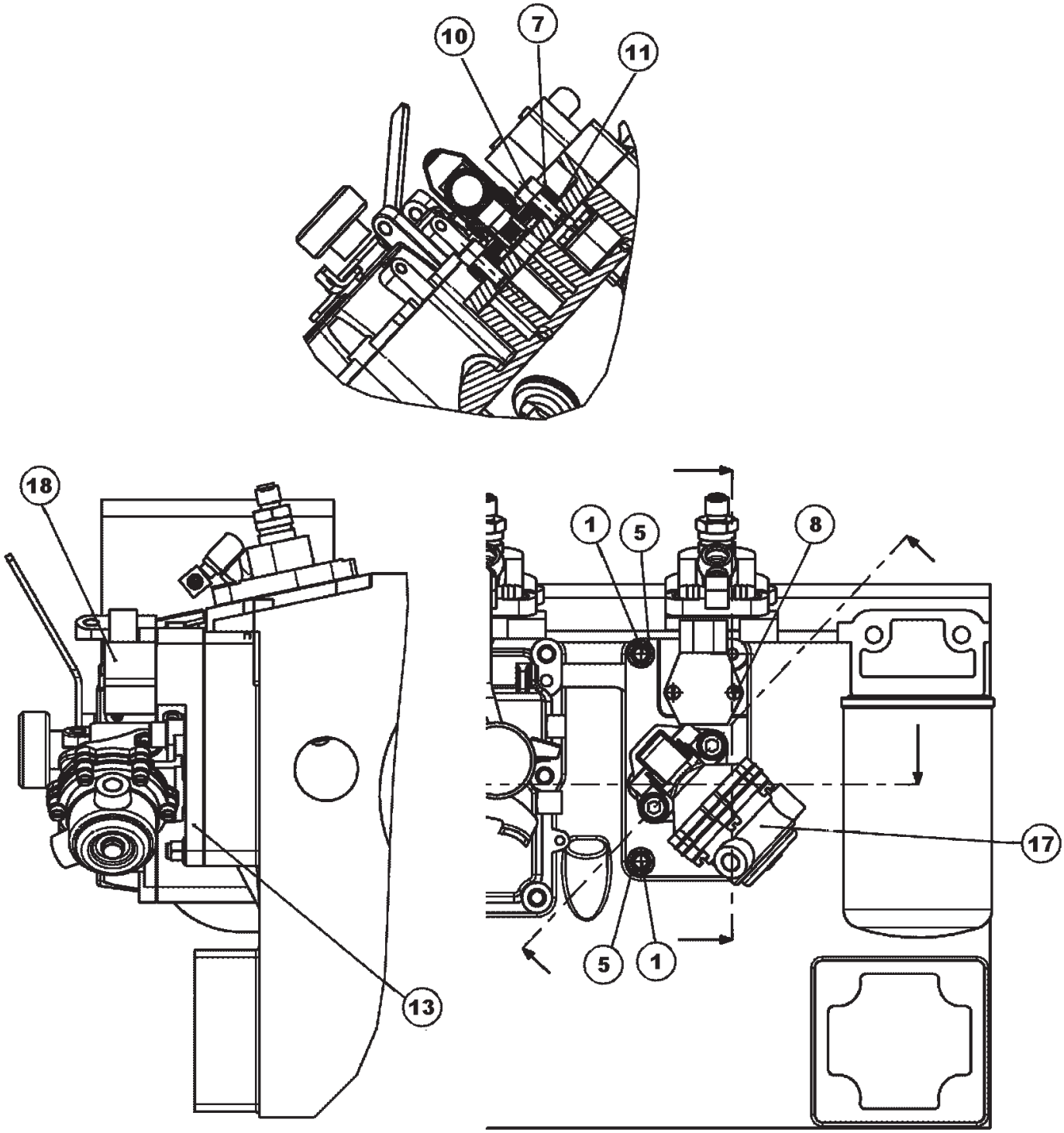
Insert the solenoid valve connectors following the references (**IN** and **OUT**) shown on the cables and on the solenoid valve block.

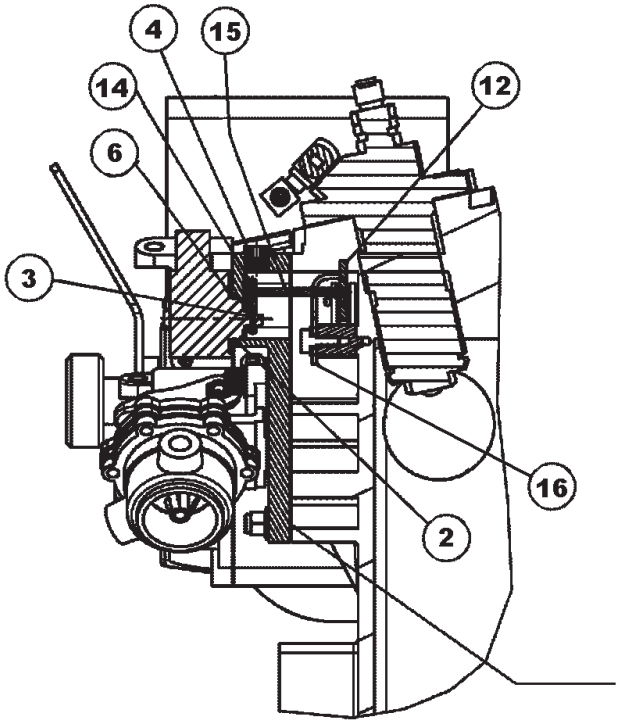


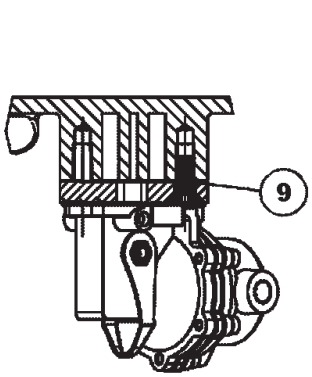
A_47

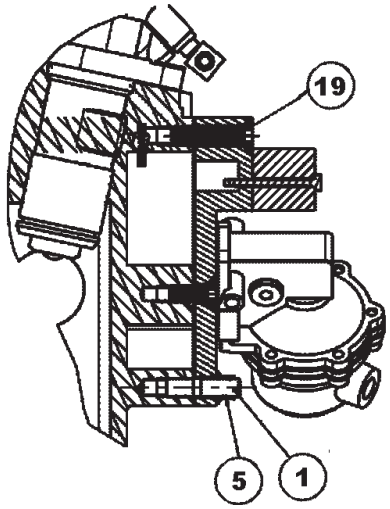
❍ Replace the built guard and tighten to 15 Nm.

## Angular position sensor and AC pump assembly diagram





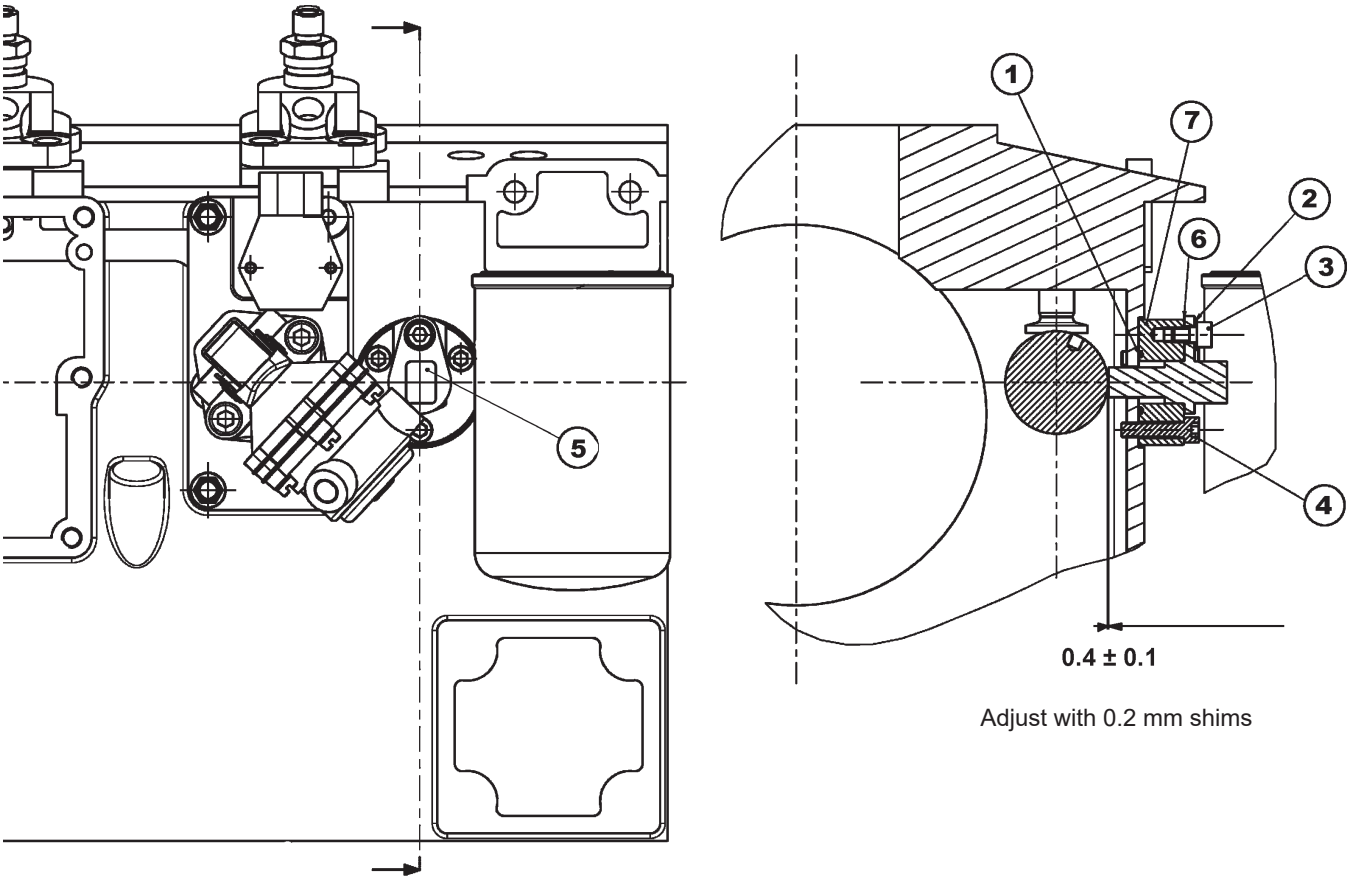




**COMPONENTS TABLE**

| | |
|---|---|
| **1** | Stud bolt M8x20 |
| **2** | Silicone O-ring |
| **3** | Snap pin 2x10 |
| **4** | Conical screw STEI M 10x1.5 |
| **5** | Self-locking flanged hex nut |
| **6** | Copper washer |
| **7** | Crinkled spring washer |
| **8** | Screw TCEI UNI 5931 M 4x35 |
| **9** | Screw STEI M 8x20 |
| **10** | Fuel supply pump |
| **11** | Screw TCEI M 8x18 |
| **12** | Fuel supply pump seal |
| **13** | Sensor pump connection rod |
| **14** | AC pump and angular position sensor cover |
| **15** | Sensor control lever |
| **16** | Connecting pin between rod and sensor |
| **17** | Discharge stop plate |
| **18** | Angular position sensor |
| **19** | Flathead screw |

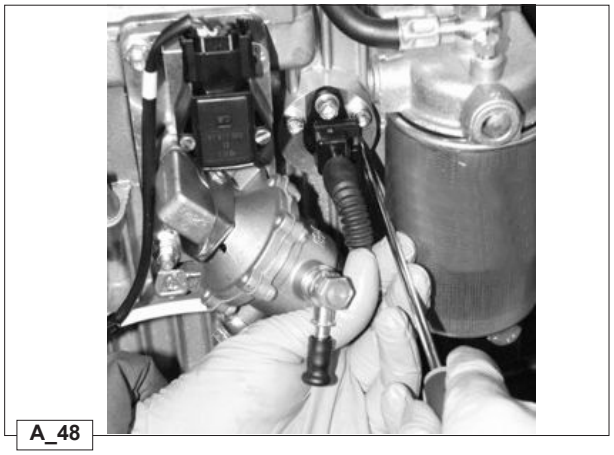
## Phase sensor assembly diagram



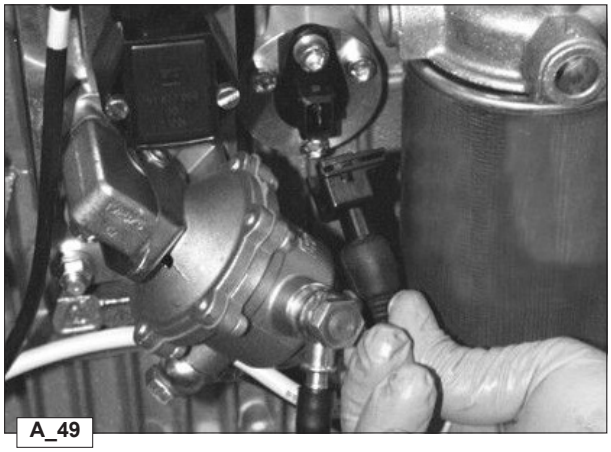

Adjust with 0.2 mm shims

### COMPONENTS TABLE

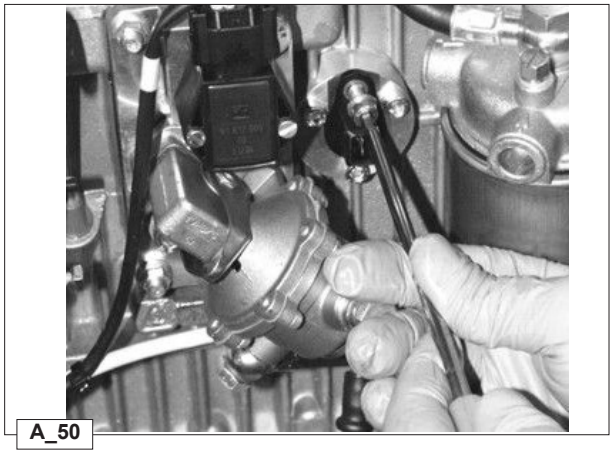
**1** Silicone O-ring
**2** Washer 6x12xSp1
**3** Screw TCEI UNI 5931 M 6x10
**4** Screw TCEI UNI 5931 M 6x25
**5** Speed and phase sensors
**6** Phase sensor air gap adjustment shim
**7** Phase sensor support


A_48

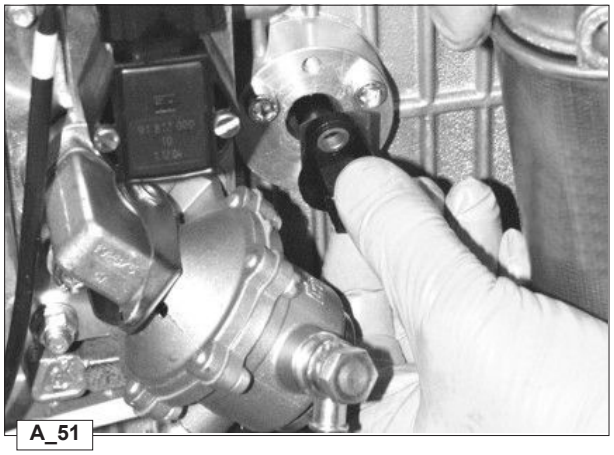
To assemble the phase sensor connector press the locking spring.


A_49

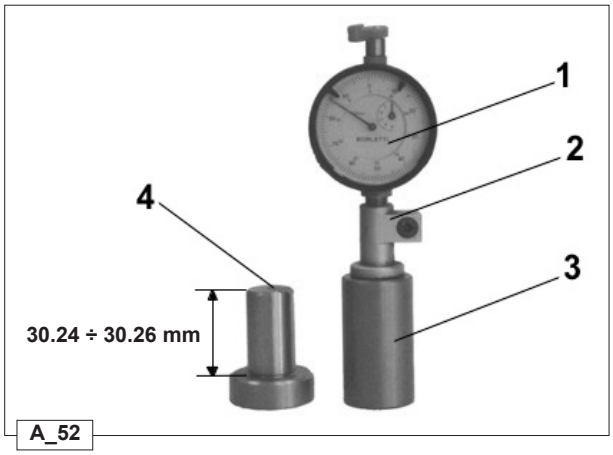
Remove the connector from the sensor.


A_50

❍ Loosen screw M6. When refitting, tighten to 8 Nm.


A_51

Remove the sensor from the support taking care not to damage the O-ring.



A_52

**Components:**

**1** Dial indicator
**2** Support for dial indicator
**3** Sensor control gauge measurement: 30,24 ÷ 30,26 mm
**4** Control master measurement: 30,24 ÷ 30,26 mm for sensor gauge

If replacing the phase sensor, check the length of the sensor pin using the tool in figure A_52.
Check by measuring the distance between magnetic end and the sensor support surface (30,24 ÷ 30,26 mm).


A_53

**Resetting the dial indicator**

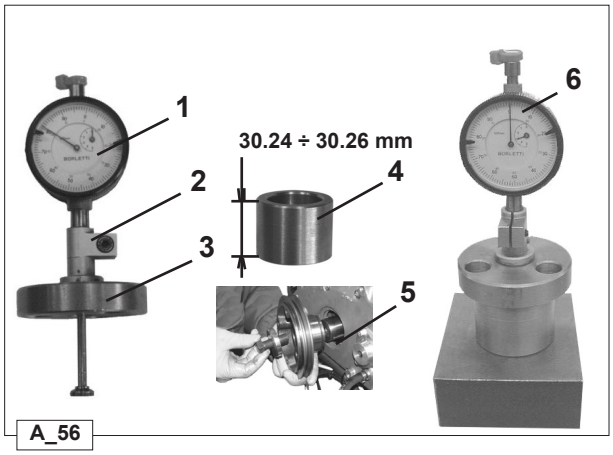
Assemble the dial indicator **1** onto support **2**.
Attach the support with the dial indicator to the gauge **3**.
Insert the master **4** into the gauge **3** and reset the dial indicator.


A_54

**Sensor test**

Remove the master **4** from the gauge **3**; insert the phase sensor and check that the sensor falls within tolerance measurements of 30,015 ÷ 30,035 mm.
See fig. A_53 -A_ 54.

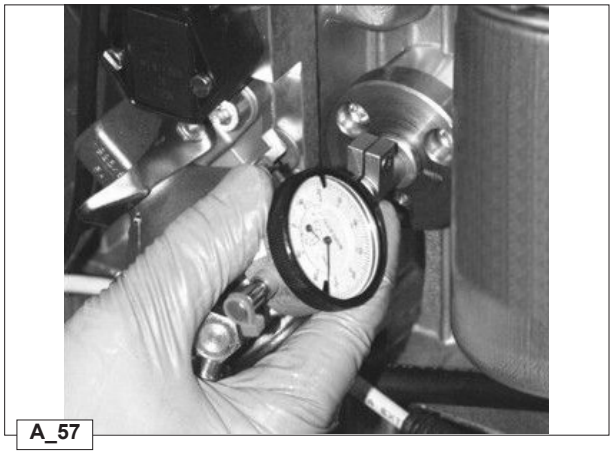

A_55



A_56

**Resetting the dial indicator**

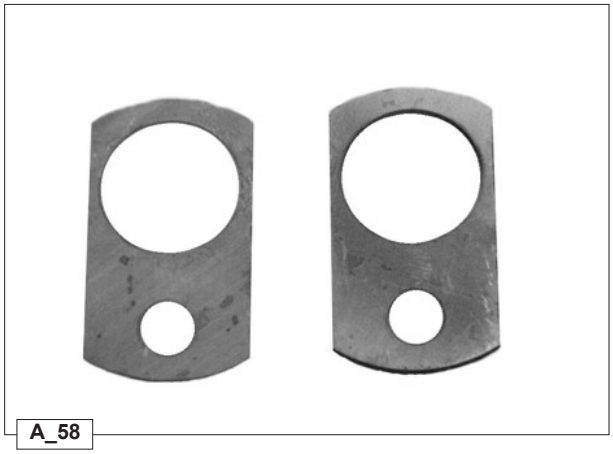
Components:
**1** Dial indicator
**2** Support for dial indicator
**3** Camshaft sensor support surface control gauge measurement: 30,24 ÷ 30,26 mm
**4** Resetting master measure: 30,24 ÷ 30,26 mm for gauge
**5** Resetting reference base
If replacing the sensor, camshaft or engine block via the tool see figure 56.
Make sure that the support surface of the sensor on the camshaft support measures 30,24 ÷ 30,26 mm. Assemble the dial indicator **1** in the support **2**. Insert the support **2** complete with dial indicator **1** into the gauge **3**. Set the master **4** and reset the dial indicator while resting on the base **5** as in **6**.


A_57

**Measuring the depth between the sensor support and the camshaft**

Insert the gauge complete with dial indicator onto the sensor support and attach using the three screws.
Make sure the measurements taken are within the specific tolerance limits 30.24 ÷ 30.26 mm.

❍ The three screws for the phase sensor support screws must be tightened to 8 Nm using a torque wrench.

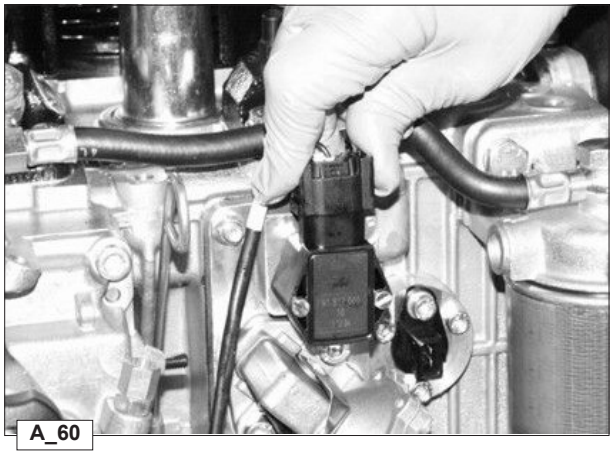

A_58

**Air gap adjustment**

The air gap is adjusted using shims measuring 0,2 mm in thickness which are placed between the sensor surface and its support.
The air gap must be between 0,3 and 0,5 mm (see phase sensor assembly diagram page 94).
When adjusting the air gap with shims, it is important to consider any difference between the measurements taken (length of the sensor pin and depth between the sensor support surface and the camshaft) and specifications.

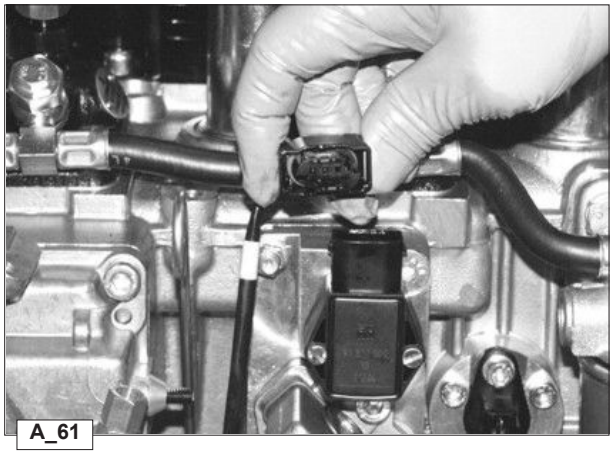

A_59

Example of where to insert the air gap adjustment shims.

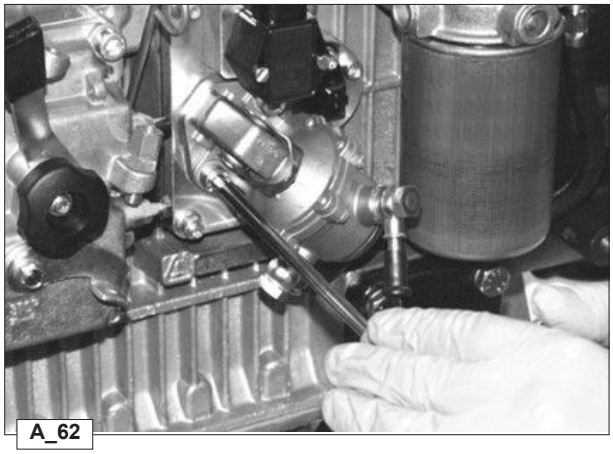


A_60

Remove the connector from the position sensor on the injection pump control rod.



A_61



A_62

Unscrew the two screws to disassemble the fuel pump;

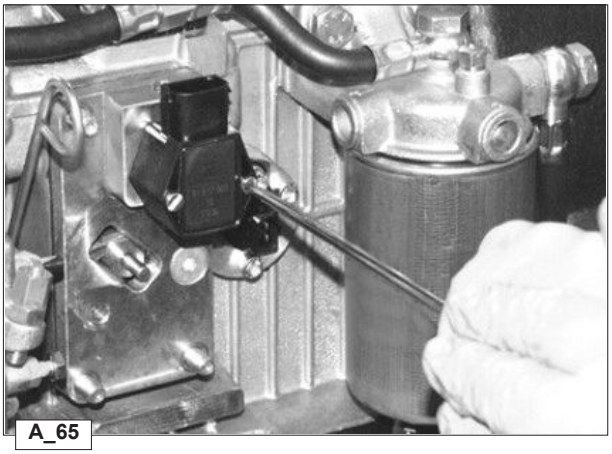
❍ when refitting, tighten the flathead screws, the nuts and hexagonal-head screws to 25 Nm.

A_63

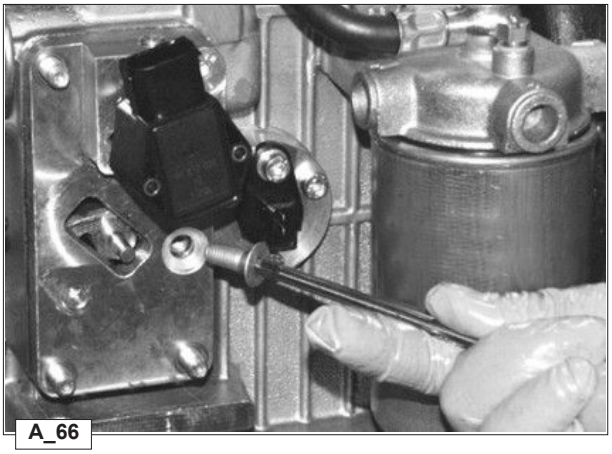
When reassembling, replace the sealing gasket.


A_64

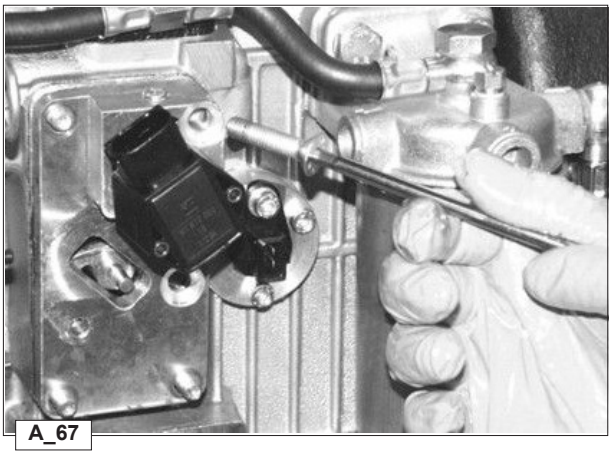
Remove the conical inspection plug.


A_65

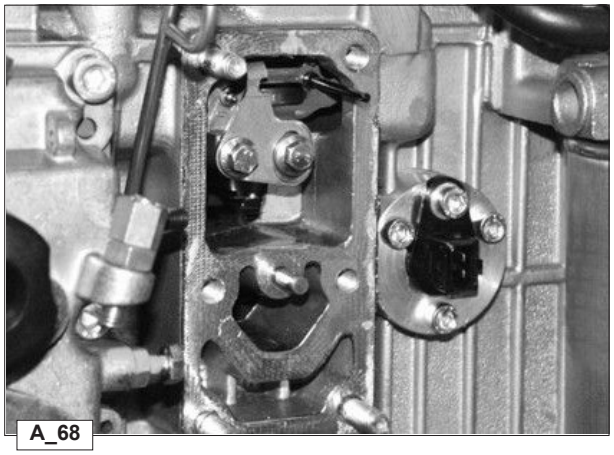
Unscrew the two screws to disassemble the injection pump rod position sensor.


A_66

Remove the three flanged nuts and the flathead screw.

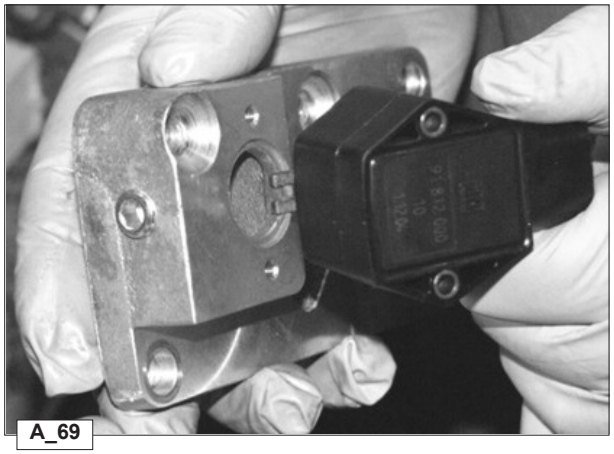

A_67

Unscrew the last screw (flathead) after rotating the sensor anticlockwise.



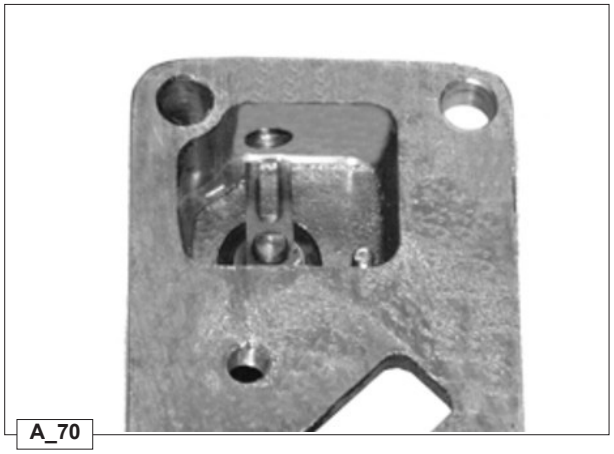
A_68

Remove the cover supporting the sensor and the fuel pump.



A_69

Rotate the position sensor shaft to direct the fork on the side opposite the connector.

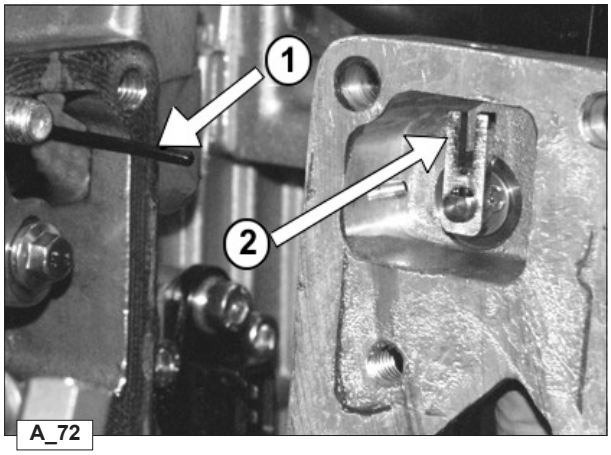


A_70

Insert the fork into the slot in the support.
Rotate the sensor body 180°, keeping the fork in the position shown in figure A _70.

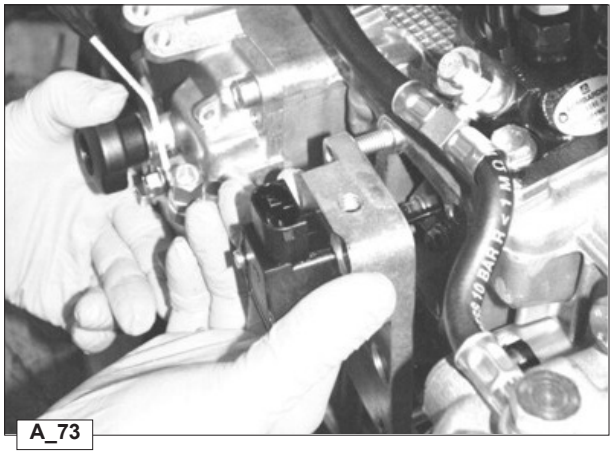
A_71

Tighten only one screw on the position sensor to keep it in the right position.

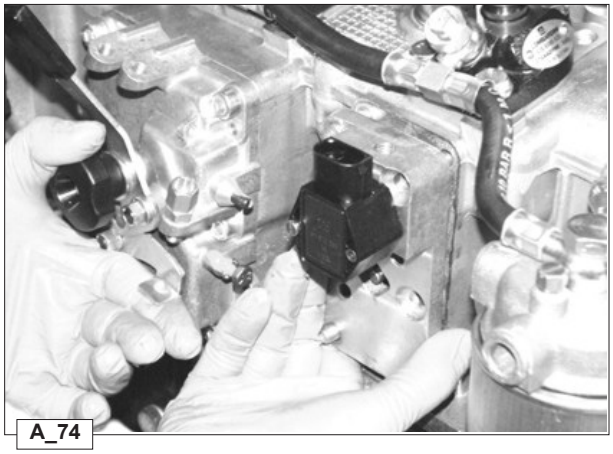


A_72

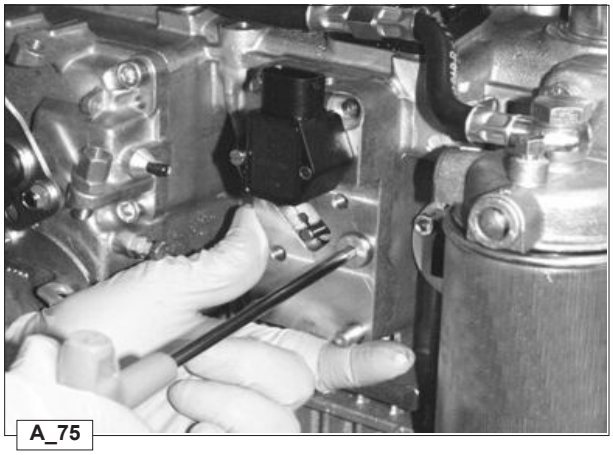
Set the cover against the crankcase so that the injection pump rod drive pin **1** is inserted between the two prongs of the fork **2**.


A_73

Look through the upper inspection hole on the cover to make sure that the pin **1** is correctly inserted into the fork **2**.

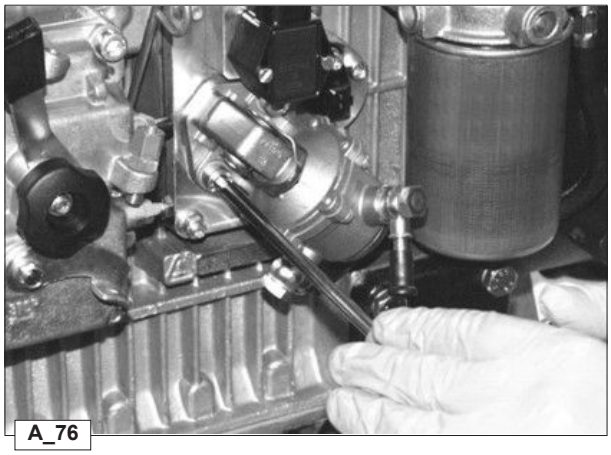

A_74

Operate the stop control lever repeatedly to make sure the system is running smoothly.


A_75

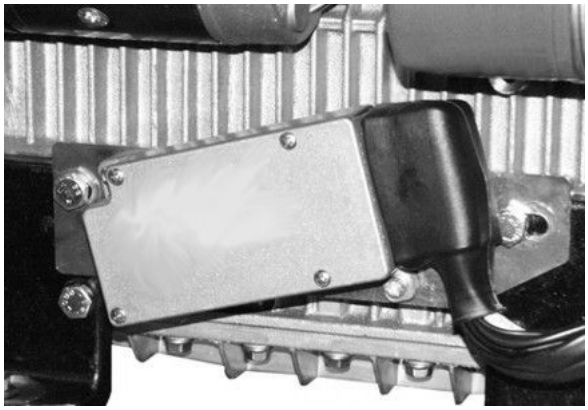
Replace the screws and nuts in the cover in the opposite order to when they were removed and

❍ tighten to 25 Nm.



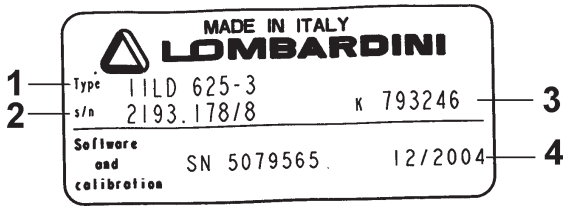
A_76

Refit the fuel pump after replacing the seal; tighten the screws to 25 Nm.



A_77

Correct assembly position of the control unit that runs the engine variator.



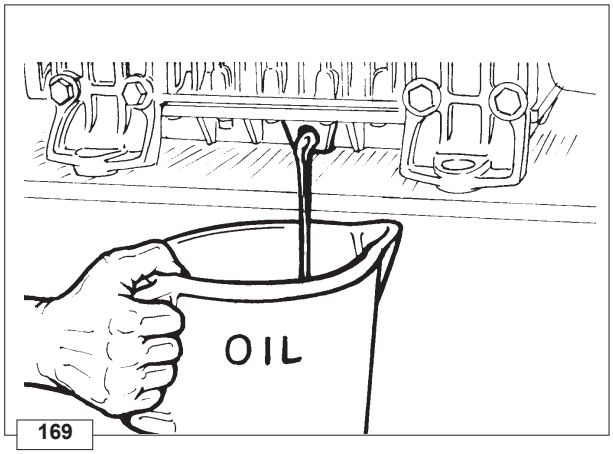

A_78

**Example of adhesive plate on the control panel**

**1** Engine type
**2** Control panel serial number
**3** Version number (form **K**)
**4** SN plus engine serial number plus date

**When the engines are not used for more than 3 months, they must be protected by the measures described below:**

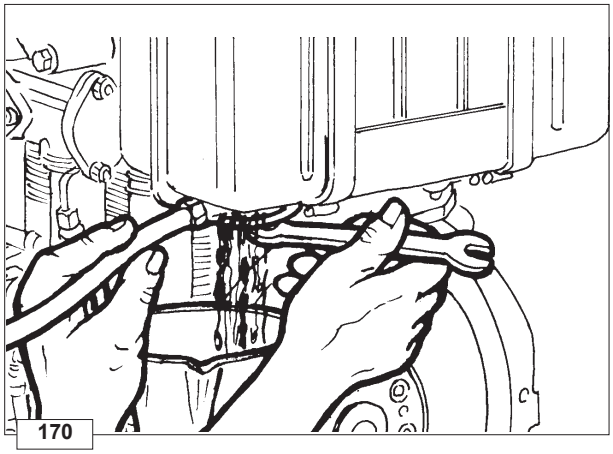
## STORAGE



169

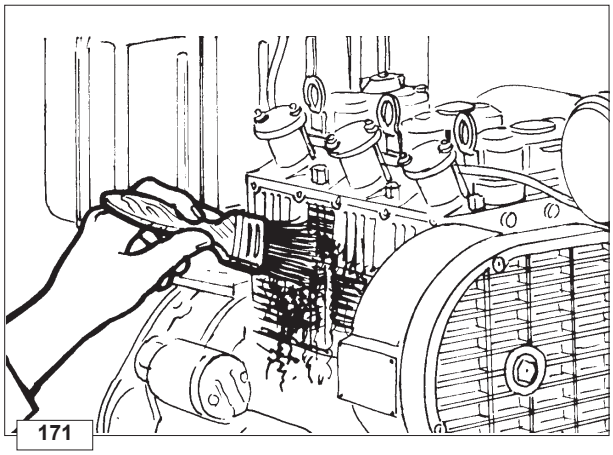
**External engine protection:**

- Start the engine and heat it.
- Remove the drain plug and let the oil flow completely.
- Replace the oil filter with a new one (screw manually the new filter).
- Clean the oil drain plug and after having assembled a new gasket, tighten it.
- Carry out the oil refilling to the upper level of the rod, using AGIP RUSTIA C (for Countries in which this product is not available find an equivalent product on the market).
- Start for about 10 minutes and verify any possible oil leakage, then stop the engine.


170

**Injection systems protection:**

- Empty the fuel tank.
- Replace the fuel filter with a new one.
- Carry out the filling of fuel using 10% of AGIP RUSTIA NT special additives.
- After having performed the air bleeding, start the engine, verify any possible fuel leakage, then stop the engine.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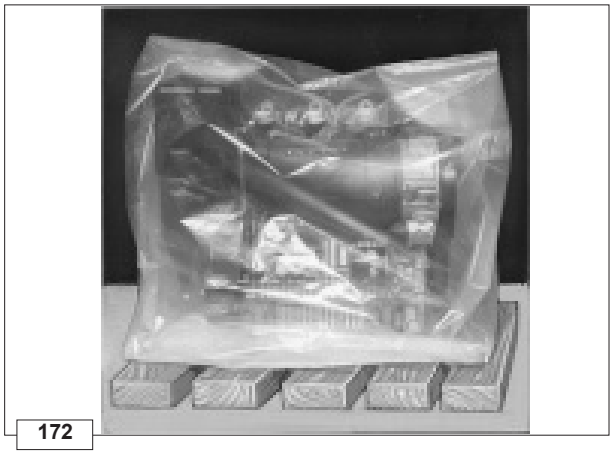
**External engine protection:**

- Clean carefully cylinder cooling system fins and the blowing fan.
- Loosen the drive belt of the blowing fan.
- Protect the external non-painted surfaces with AGIP RUSTIA 100/F.
- Seal with adhesive tape the intake and exhaust systems
- Coat the engine with a nylon or plastic sheet.
- Keep in a dry place. If possible not in direct contact with the ground and away from high voltage electric lines.

## PROCEDURES TO BE CARRIED OUT BEFORE START THE ENGINE



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- Remove all protections and coverings.

- Remove the rust preventer from the external part of the engine by means of adequate products (solvent or degreaser).

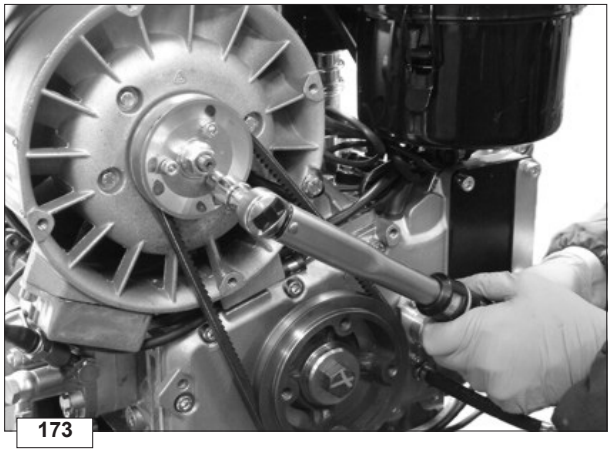
- Tension the blower timing belt.

- Disassemble the injectors and introduce, by means of a bowl, motor oil on the piston crown ( no more than 2 cc for every cylinder).

- Remove valve covers and spray motor oil on the valves, then turn the crankshaft manually for a few revolutions.

- Start the engine and heat it for about 10 minutes.

- Remove the drain plug and let the protective oil flow completely.



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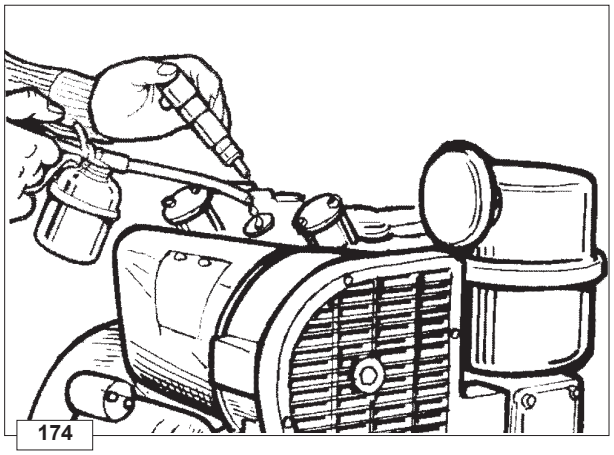
- Reinsert the drain plug.

- Carry out motor oil refilling to the upper level of the rod using the oil recommended by the manufacturer for a normal engine operation.



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## MAIN TORQUE SPECIFICATIONS

| COMPONENT | Diameter and pitch ( mm ) | Torque Nm | Sealants |
|---|---|---|---|
| Tank bracket vibration dampers | 8x1,25 | 25 | Loctite 270 |
| Connecting rod | 8x1 | 40 | |
| Injection pump delivery valve union | 18x1,5 | 40 | |
| Bell flywheel side | 10x1,5 | 50 | |
| Central support collar | 8x1,25 | 25 | |
| Intake manifold | 8x1,25 | 25 | |
| Exhaust manifold | 8x1,25 | 25 | |
| Air shroud | 8x1,25 | 15 | |
| Throttle control cover | 8x1,25 | 25 | |
| Rocker arm cover | 8x1,25 | 20 | |
| Timing cover | 8x1,25 | 25 | |
| Cover hydraulic pump flange 1P | 8x1,25 | 25 | |
| Oil pump casing | 8x1,25 | 25 | |
| Blower pulley nuts | 6x1 | 10 | |
| Oil pump nut or union | 8x5 | 25 | Loctite 270 |
| Oil pump gear threading | | | Loctite 270 |
| Tank bracket gasket | | | LoctiteIS 495 |
| Air filter | | 25 | |
| Oil filter | 8x1,25 | 25 | |
| Internal oil filter | 8x1,25 | 25 | |
| Hydraulic pump flange | 8x1,25 | 25 | |
| Nozzle cup | | 70 | |
| Blower assembly | 8x1,25 | 25 | |
| Camshaft gear | 24x2 | 250 | |
| Oil pump gear | 10x1,5 | 35 | |
| Timing gear | 10x1,5 | 40 | |
| Injector (cylinder head fastening nuts for S size, screw for P size) | | 10 | |
| Injection pump control lever | 8x1,25 | 25 | |
| Starting motor | 10x1,5 | 45 | |
| Oil radiator nipple | 16x1,5 | 45 | Loctite 270 |
| Oil filter cartridge nipple | 8x1,25 | 25 | Loctite 270 |
| Rocker arm pin | 8x1,25 | 25 | |
| Governor control external lever pin | 8x1,25 | 10 | |
| Stop control external lever pin | 8x1,25 | 10 | |
| Engine mounting foot | 10x1,5 | 40 | |
| Injector stud bolt | 8x1,25 | 25 | |
| Starter motor stud bolt | 8x1,25 | 25 | |
| Fuel feeding pump | 8x1,25 | 25 | |
| Blower housing stud | 10x1,5 | 12 | Loctite 270 |
| Main bearing support fixing stud bolt, flywheel side | 8 | 25 | Loctite 270 |
| Head stud | 12 | 86 | Loctite 270 |
| Crankcase stud bolt | 8x1,25 | 8-10 | Loctite 270 |
| Injection pump | 8 | 25 | Loctite 270 |

## MAIN TORQUE SPECIFICATIONS

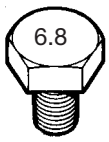
| COMPONENT | Diameter and pitch ( mm ) | Torque Nm | Sealants |
|---|---|---|---|
| Oil sump | 10 | | Loctite 270 |
| Belt guard | 8x1,25 | 25 | |
| Blower crankshaft pulley | 16x1,5 | 250 | |
| Fan pulley | 12x1,5 | 40 | |
| Fuel filter union | 14x1,5 | 40 | |
| Fuel pump union | 10x1 | 12 | |
| Radiator union | 14x1,5 | 40 | |
| Injector high pressure pipe union | 12x1,5 | 20-25 | |
| Speed governor support shaft | 8x1,25 | 22 | |
| Main bearing support, gear case side | 8x1,25 | 25 | |
| Main bearing support, flywheel side | 8x1,25 | 25 | |
| Center main bearing support | 10x1,5 | 30 | |
| Hydraulic pump gear support | 8x1,25 | 25 | |
| Governor control internal lever support | 8x1,25 | 25 | |
| Fuel tank bracket | 8x1,25 | 25 | |
| Drain plug | 14x1,5 | 50 | |
| Cylinder head | 10x1,5 | 55 | |
| Camshaft axle housing screws | | 25 | |
| Flywheel | 12x1,25 | 140 | |

| USE OF SEALANTS ONLY FOR ENGINES WITH VARIATOR | |
|---|---|
| **POSITION** | **SEALANTS** |
| Pump cover C | Loctite 5205 |
| Speed sensor support | Loctite 209079 |
| Phase sensor support fastening screws | Loctite 242 |
| Speed sensor support fastening screws | Loctite 242 |

***Table of tightening torques for standard screws (coarse thread)***

| Resistance class (R) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Quality/ Dimensions |  4.6 |  4.8 |  5.6 |  5.8 |  6.8 |  8.8 |  10.9 |  12.9 |
| Diameter | R>400N/mm² | | R>500N/mm² | | R>600N/mm² | R>800N/ mm² | R>1000N/ mm² | R>1200N/ mm² |
| | Nm | Nm | Nm | Nm | Nm | Nm | Nm | Nm |
| M3 | 0,5 | 0,7 | 0,6 | 0,9 | 1 | 1,4 | 1,9 | 2,3 |
| M4 | 1,1 | 1,5 | 1,4 | 1,8 | 2,2 | 2,9 | 4,1 | 4,9 |
| M5 | 2,3 | 3 | 2,8 | 3,8 | 4,5 | 6 | 8,5 | 10 |
| M6 | 3,8 | 5 | 4,7 | 6,3 | 7,5 | 10 | 14 | 17 |
| M8 | 9,4 | 13 | 12 | 16 | 19 | 25 | 35 | 41 |
| M10 | 18 | 25 | 23 | 31 | 37 | 49 | 69 | 83 |
| M12 | 32 | 43 | 40 | 54 | 65 | 86 | 120 | 145 |
| M14 | 51 | 68 | 63 | 84 | 101 | 135 | 190 | 230 |
| M16 | 79 | 105 | 98 | 131 | 158 | 210 | 295 | 355 |
| M18 | 109 | 145 | 135 | 181 | 218 | 290 | 405 | 485 |
| M20 | 154 | 205 | 193 | 256 | 308 | 410 | 580 | 690 |
| M22 | 206 | 275 | 260 | 344 | 413 | 550 | 780 | 930 |
| M24 | 266 | 355 | 333 | 444 | 533 | 710 | 1000 | 1200 |
| M27 | 394 | 525 | 500 | 656 | 788 | 1050 | 1500 | 1800 |
| M30 | 544 | 725 | 680 | 906 | 1088 | 1450 | 2000 | 2400 |

***Table of tightening torques for standard screws (fine thread)***

| Resistance class (R) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Quality/ Dimensions |  4.6 |  4.8 |  5.6 |  5.8 |  6.8 |  8.8 |  10.9 |  12.9 |
| Diameter | R>400N/mm² | | R>500N/mm² | | R>600N/mm² | R>800N/ mm² | R>1000N/ mm² | R>1200N/ mm² |
| | Nm | Nm | Nm | Nm | Nm | Nm | Nm | Nm |
| M 8x1 | 10 | 14 | 13 | 17 | 20 | 27 | 38 | 45 |
| M 10x1 | 21 | 28 | 26 | 35 | 42 | 56 | 79 | 95 |
| M 10x1,25 | 20 | 26 | 24 | 33 | 39 | 52 | 73 | 88 |
| M 12x1,25 | 36 | 48 | 45 | 59 | 71 | 95 | 135 | 160 |
| M 12x1,5 | 38 | 45 | 42 | 56 | 68 | 90 | 125 | 150 |
| M 14x1,5 | 56 | 75 | 70 | 94 | 113 | 150 | 210 | 250 |
| M 16x1,5 | 84 | 113 | 105 | 141 | 169 | 225 | 315 | 380 |
| M 18x1,5 | 122 | 163 | 153 | 203 | 244 | 325 | 460 | 550 |
| M 18x2 | 117 | 157 | 147 | 196 | 235 | 313 | 440 | 530 |
| M 20x1,5 | 173 | 230 | 213 | 288 | 345 | 460 | 640 | 770 |
| M 20x2 | 164 | 218 | 204 | 273 | 327 | 436 | 615 | 740 |
| M 22x1,5 | 229 | 305 | 287 | 381 | 458 | 610 | 860 | 1050 |
| M 24x2 | 293 | 390 | 367 | 488 | 585 | 780 | 1100 | 1300 |
| M 27x2 | 431 | 575 | 533 | 719 | 863 | 1150 | 1600 | 1950 |
| M 30x2 | 600 | 800 | 750 | 1000 | 1200 | 1600 | 2250 | 2700 |

For reference check the specific tools manual, cod. ED0053030770-S, to be found at:

http://iservice.lombardini.it

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