VECTOR SERIES

Industrial application

VECTOR 8

Technical and Repair manual

This publication describes the characteristics, data and correct methods for repair operations on each component of the vehicle.

If the instructions provided are followed and the specified equipment is used, correct repair operations in the programmed time will be ensured, safeguarding against possible accidents.

Before starting to perform whatever type of repair, ensure that all accident prevention equipment is available and efficient.

All protections specified by safety regulations, i.e.: goggles, helmet, gloves, boot, etc. must be checked and worn.

All machining, lifting and conveying equipment should be inspected before use.

Publication edited by
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20010 Pregnana Milanese
Milano (Italy)
Print **P2D32V001E** - 1st Ed. 04.2006

Produced by:

SATIZ msx INTERNATIONAL

B.U. TECHNICAL PUBLISHING
Iveco Technical Publications
Lungo Stura Lazio, 15/19
10156 Turin - Italy

PRELIMINARY REMARKS

Manuals for repairs are split into Parts and Sections, each one of which is marked by a numeral; the contents of these sections are indicated in the general table of contents.
The sections dealing with things mechanic introduce the specifications, tightening torque values, tool lists, assembly detaching/reattaching operations, bench overhauling operations, diagnosis procedures and maintenance schedules.
The sections (or parts) of the electric/electronic system include the descriptions of the electric network and the assembly's electronic systems, wiring diagrams, electric features of components, component coding and the diagnosis procedures for the control units peculiar to the electric system.
The manual uses proper symbols in its descriptions; the purpose of these symbols is to classify contained information. In particular, there have been defined a set of symbols to classify warnings and a set for assistance operations.

SYMBOLS - WARNINGS

Danger for persons

Missing or incomplete observance of these prescriptions can cause serious danger for persons' safety.

Danger of serious damage for the assembly

Failure to comply, both fully or in part, with such prescriptions will involve serious damage to the assembly and may sometimes cause the warranty to become null and void.

General danger

It includes the dangers of above described signals.

Environment protection

Moreover, it describes the correct actions to be taken to ensure that the assembly is used in such a way so as to protect the environment as much as possible.

NOTE It indicates an additional explanation for a piece of information.

GENERAL WARNINGS

Warnings shown cannot be representative of all danger situations possibly occurring. Therefore, it is suggested to contact immediate superiors where a danger situation occurs which is not described.

Use both specific and general-purpose toolings according to the prescriptions contained in respective use and maintenance handbooks. Check use state and suitability of tools not subjected to regular check.

The manual handling of loads must be assessed in advance because it also depends, besides weight, on its size and on the path.

Handling by mechanical means must be with hoisters proper as for weight as well as for shape and volume. Hoisters, ropes and hooks used must contain clear indications on maximum carrying capacity acceptable. The use of said means is compulsorily permitted to authorised personnel only. Stay duly clear of the load, and, anyhow, never under it.

In disassembling operations, always observe provided prescriptions; prevent mechanical parts being taken out from accidentally striking workshop personnel.

Workshop jobs performed in pairs must always be performed in maximum safety; avoid operations which could be dangerous for the co-operator because of lack of visibility or of his/her not correct position.

Keep personnel not authorised to operations clear of working area.

You shall get familiar with the operating and safety instructions for the assembly prior to operating on the latter. Strictly follow all the safety indications found on the assembly.

Do not leave the running assembly unattended when making repairs.

When carrying out work on the assembly lifted off the ground, verify that the assembly is firmly placed on its supporting stands, and that the manual/automatic safety devices have been actuated in the event that the assembly is to be lifted by means of a hoist.

When you have to operate on assemblies powered by natural gas, follow the instructions contained in the document, as well as all the specific safety standards provided for.

Only remove radiator cap when the engine is cold by cautiously unscrewing it in order to let system residual pressure out.

Inflammable fuel and all inflammable fluids and liquids must be handled with care, according to what contained on harmful materials 12-point cards. Refuelling must be performed outdoors with the engine off, avoiding lit cigarettes, free flames or sparks in order to prevent sudden fires/bursts. Adequately store inflammable, corrosive and polluting fluids and liquids according to what provided by regulations in force. Compulsorily avoid to use food containers to store harmful liquids. Avoid to drill or bore pressurised containers, and throw cloths impregnated with inflammable substances into suitable containers.

Worn out, damaged or consumable parts must be replaced by IVECO Motors original spares.

During workshop activity, always keep the work place clean; timely clear or clean floors from accidental liquid or oil spots. Electric sockets and electric equipment necessary to perform repair interventions must meet safety rules.

GENERAL WARNINGS

Put on, where required by the intervention, garments and protections provided in accident prevention rules; contact with moving parts can cause serious injuries. Use suitable, preferably tight-fitted garments, and avoid to use jewels, scarves, etc.

Do not leave the engine in motion at workshop locations not provided with a pipe to scavenge exhaust gas outside.

Avoid to breathe fumes coming from heating or from paint welding because they can cause damages to health; operate outdoors or in suitably ventilated areas. Put on proper inspirator if paint powder is present.

Avoid contact with hot water or steam coming from the engine, radiator and pipings because they could cause serious burns. Avoid direct contact with liquids and fluids present in vehicle systems; where an accidental contact has occurred, refer to 12-point cards for provisions to make.

Clean the assemblies and carefully verify that they are intact prior to overhauling. Tidy up detached or disassembled parts with their securing elements (screws, nuts, etc.) into special containers.

Check for the integrity of the parts which prevent screws from being unscrewed: broken washers, dowels, clips, etc. Self-locking nuts with an insert made of nylon must always be replaced.

Avoid contact of rubber parts with diesel oil, petrol or other not compatible substances.

Before washing under pressure mechanical parts, protect electric connectors, and central units, if present.

Tightening screws and nuts must always be according to prescriptions; IVECO Motors commercial and assistance network is available to give all clarifications necessary to perform repair interventions not provided in this document.

Before welding:

- ❑ Disconnect all electronic central units, take power cable off battery positive terminal (connect it to chassis bonding) and detach connectors.
- ❑ Remove paint by using proper solvents or paint removers and clean relevant surfices with soap and water.
- ❑ Await about 15 minutes before welding.
- ❑ Equip with suitable fire resistant protections to protect hoses or other components where fluids or other materials flow which may catch fire easily on welding.

Should the vehicle be subjected to temperatures exceeding 80°C (dryer ovens), disassemble drive electronic central units.

The disposal of all liquids and fluids must be performed with full observance of specific rules in force.

GENERAL WARNINGS ON THE ELECTRIC SYSTEM

If an intervention has to be made on the electric/electronic system, disconnect batteries from the system; in this case, always disconnect, as a first one, the chassis bonding cable from batteries negative terminal.

Before connecting the batteries to the system, make sure that the system is well isolated.

Disconnect the external recharging apparatus from the public utility network before taking apparatus pins off battery terminals.

Do not cause sparks to be generated in checking if the circuit is energised.

Do not use a test lamp in checking circuit continuity, but only use proper control apparatuses.

Make sure that the electronic devices wiring harnesses (length, lead type, location, strapping, connection to screening braiding, bonding, etc.) comply with IVECO Motors system and are carefully recovered after repair or maintenance interventions.

Measurements in drive electronic central units, plugged connections and electric connections to components can only be made on proper testing lines with special plugs and plug bushes. Never use improper means like wires, screwdrivers, clips and the like in order to avoid the danger of causing a short circuit, as well as of damaging plugged connections, which would later cause contact problems.

To start up the engine, do not use fast chargers. Start up must only be performed with either separate batteries or special truck.

A wrong polarisation of supply voltage in drive electronic central units (for instance, a wrong polarisation of batteries) can cause them to be destroyed.

Disconnect the batteries from the system during their recharging with an external apparatus.

On connecting, only screw up connector (temperature sensors, pressure sensors etc.) nuts at prescribed tightening torque.

Before disconnecting the junction connector from an electronic central unit, isolate the system.

Do not directly supply electronic central units servo components at nominal vehicle voltage.

Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Once the intervention on the electric system has been completed, recover connectors and wiring harnesses according to original arrangement.

NOTE Connectors present must be seen from cable side. Connectors views contained in the manual are representative of cable side.

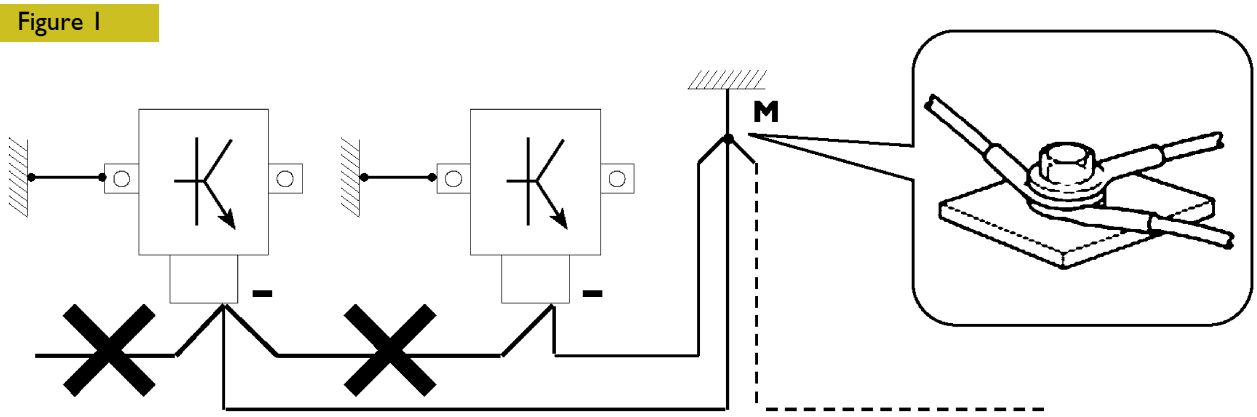
Bonding and screening

Negative leads connected to a system bonded point must be both as short and possible and "star"-connected to each other, trying then to have their centering tidily and properly made (Figure 1, re. M).

Further, following warnings are to be compulsorily observed for electronic components:

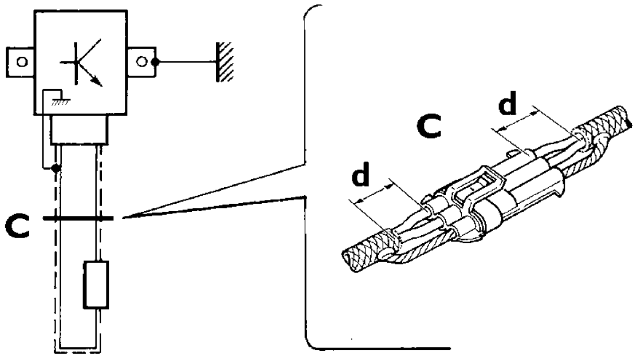
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative terminal.
- Analog bonding (sensors), although not connected to battery negative system/terminal bonding, must have optimal isolation. Consequently, particularly considered must be parasitic resistances in lugs: oxidising, clinching defects, etc.
- Screened circuits braiding must only electrically contact the end towards the central unit entered by the signal (Figure 2).
- If junction connectors are present, unscreened section **d**, near them, must be as short as possible (Figure 2).
- Cables must be arranged such as to result to be parallel to reference plane, i.e. as close as possible to chassis/body structure.

Figure 1



1. NEGATIVE CABLES "STAR" CONNECTION TO SYSTEM BONDING **M**

Figure 2



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2. SCREENING THROUGH METALLIC BRAIDING OF A CABLE TO AN ELECTRONIC COMPONENT – **C.** CONNECTOR **d.** DISTANCE → 0

OPTIONAL ELECTRICAL AND MECHANICAL PARTS INSTALLATIONS

Assemblies shall be modified and equipped with additions - and their accessories shall be fitted - in accordance with the assembling directives issued by IVECO Motors.
It is reminded that, especially about the electric system, several electric sockets are provided for as series (or optional) sockets in order to simplify and normalise the electrical intervention that is care of preparation personnel.

It is absolutely forbidden to make modifications or connections to electric central units wiring harnesses; in particular, the data interconnection line between central units (CAN line) is to be considered inviolable.

CONVERSIONS BETWEEN THE MAIN UNITS OF MEASUREMENT OF THE INTERNATIONAL SYSTEM AND MOST USED DERIVED QUANTITIES

Power

1 kW = 1.36 metric HP
1 kW = 1.34 HP
1 metric HP = 0.736 kW
1 metric HP = 0.986 HP
1 HP = 0.746 kW
1 HP = 1.014 metric HP

Torque

1 Nm = 0.1019 kgm
1 kgm = 9.81 Nm

Revolutions per time unit

1 rad/s = 1 rpm x 0.1046
1 rpm = 1 rad/s x 9.5602

Pressure

1 bar = 1.02 kg/cm^2
1 kg/cm^2 = 0.981 bar
1 bar = 10^5 Pa

Where accuracy is not particularly needed:

- Nm unit is for the sake of simplicity converted into kgm according to ratio 10:1

1 kgm = 10 Nm;

- bar unit is for the sake of simplicity converted into kg/cm^2 according to ratio 1:1

1 kg/cm^2 = 1 bar.

Temperature

0° C = 32° F
1° C = (1 x 1.8 + 32) ° F

VECTOR 8 ENGINES

PREFACE TO USER'S GUIDELINE MANUAL

Section 1 describes the VECTOR engine illustrating its features and working in general.

Section 2 describes the type of fuel feed.

Section 3 relates to the specific duty and is divided in four separate parts:

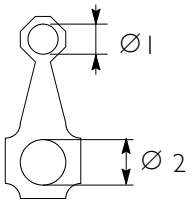
1. Mechanical part, related to the engine overhaul, limited to those components with different characteristics based on the relating specific duty.
2. Electrical part, concerning wiring harness, electrical and electronic equipment with different characteristics based on the relating specific duty.
3. Maintenance planning and specific overhaul.
4. Troubleshooting part dedicated to the operators who, being entitled to provide technical assistance, shall have simple and direct instructions to identify the cause of the major inconveniences.

Sections 4 and 5 illustrate the overhaul operations of the engine overhaul on stand and the necessary equipment to execute such operations.

SPECIAL REMARKS

Diagrams and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with, (see next page) instead of giving descriptions of some operations or procedures.

Example



Ø 1 = housing for connecting rod small end bush

Ø 2 = housing for connecting rod bearings

Tighten to torque
Tighten to torque + angular value

SYMBOLS - ASSISTANCE OPERATIONS

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Visual inspection Fitting position check
	Measurement Value to find Check
	Equipment
	Surface for machining Machine finish
	Interference Strained assembly
	Thickness Clearance
	Lubrication Damp Grease
	Sealant Adhesive
	Air bleeding
	Replacement Original spare parts

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
	Pressure
>	Oversized Higher than.... Maximum, peak
<	Undersized Less than.... Minimum
	Selection Classes Oversizing
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

UPDATING

Section	Description	Page	Date of revision

SECTION 1

General specifications

CORRESPONDENCE BETWEEN TECHNICAL CODE AND COMMERCIAL CODE

Technical Code	Open Commercial Code
FVAE2885X*F100	VECTOR 8 TE2
FVAE2884A*B201	-
FVAE2884A*B200	-
FVKE2887A*A200	-

LUBRICATION

The forced feed lubrication is produced by the following components:

- ❑ oil pump with rotors, housed in the rear part of the crankcase inside the sump.
  It is driven by a helical toothed gear fitted on the crankshaft.The pump casing contains an oil pressure regulation valve.
- ❑ water/oil heat exchanger.
- ❑ oil filter mounting equipped with:
  - oil pressure regulation valve;
  - by-pass valve for excluding blocked oil filter;
  - cartridge oil filter.

OPERATING PRINCIPLE

The (forced type) lubrication of the engine is produced by means of an oil pump fastened to the rear part of the crankcase and driven by the crankshaft through an intermediate gear.

This pump draws in oil from the sump and sends it to the water/oil heat exchanger, to the filter assembly and, later on, to the oil distribution ducts in the crankcase; the pressure of the oil is controlled by the pressure valve at the filter inlet.

The oil heat exchanger is the type with flat pipes that comes into contact with the coolant.

The oil is directed, from the two oil distribution ducts, positioned lengthwise in the crankcase, to lubricate the crankshaft bearings and the camshaft and to cool the piston through calibrated jets.

Other ducts direct the oil to each of the heads to lubricate the timing components.

The oil flow rate is managed by two pressure relief valves (4) (one per bank) which close when the oil pressure reaches minimum values (engine idling) in order to protect the bearings and other engine components.

The components fitted in the front and rear sections of the engine are lubricated by oil sprayed by special jets .

The crankshafts for the turbines are suitably lubricated by two pipes coming from the crankcase and the drainage goes directly to the sump.

The return oil from the various components is collected in the oil sump.

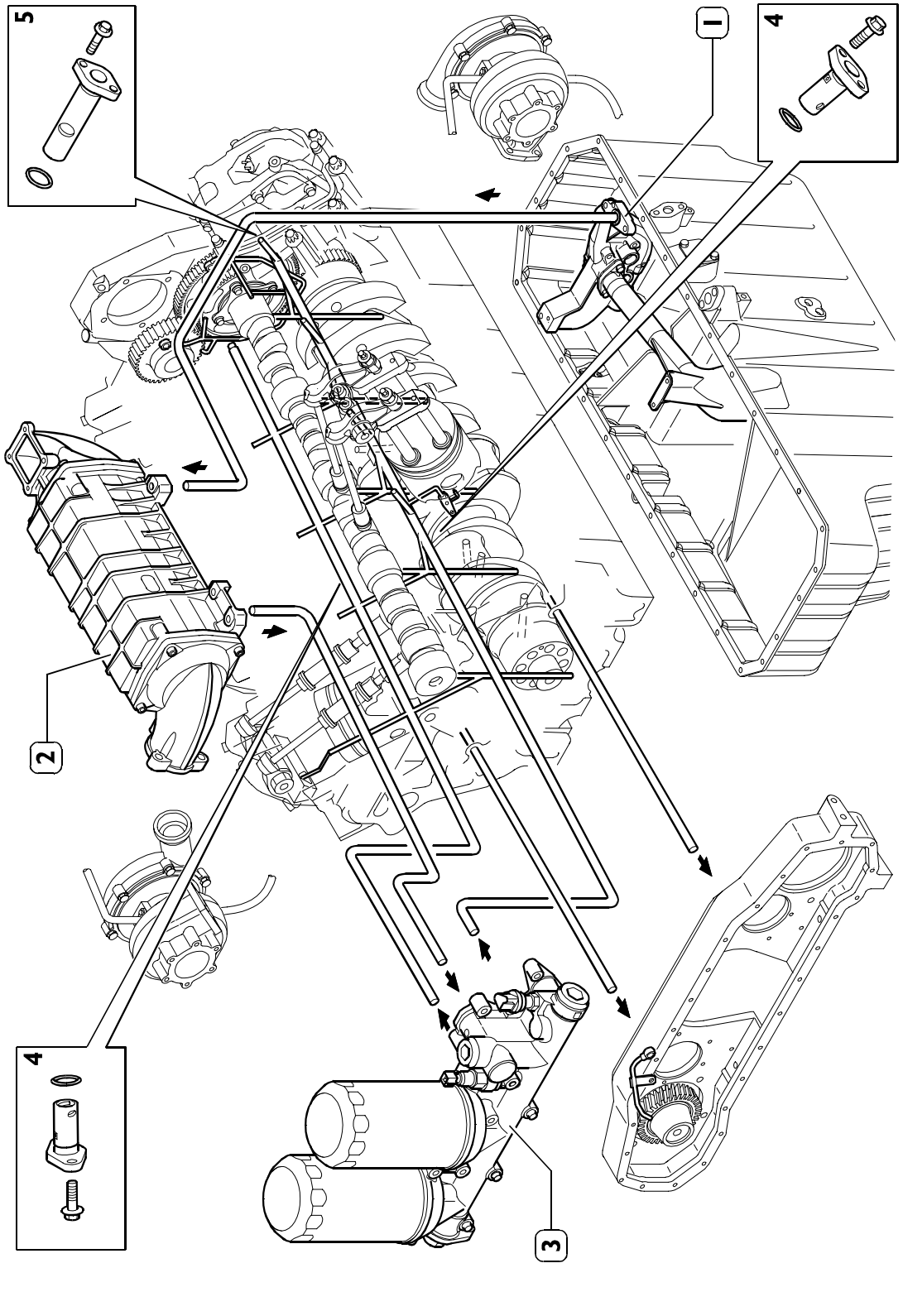
The oil is filtered by means of two cartridge filters with a paper filter element operating in series.

The opening pressure of the oil filter safety valve is 3.4 ± 0.3 bar.

The theoretical starting temperature pressure for the engine lubrication pressure regulation valve (5) is around 5 bar.

The opening pressure for the piston lubrication pressure regulation valves (4) is around 2.65 bar.

Figure 3



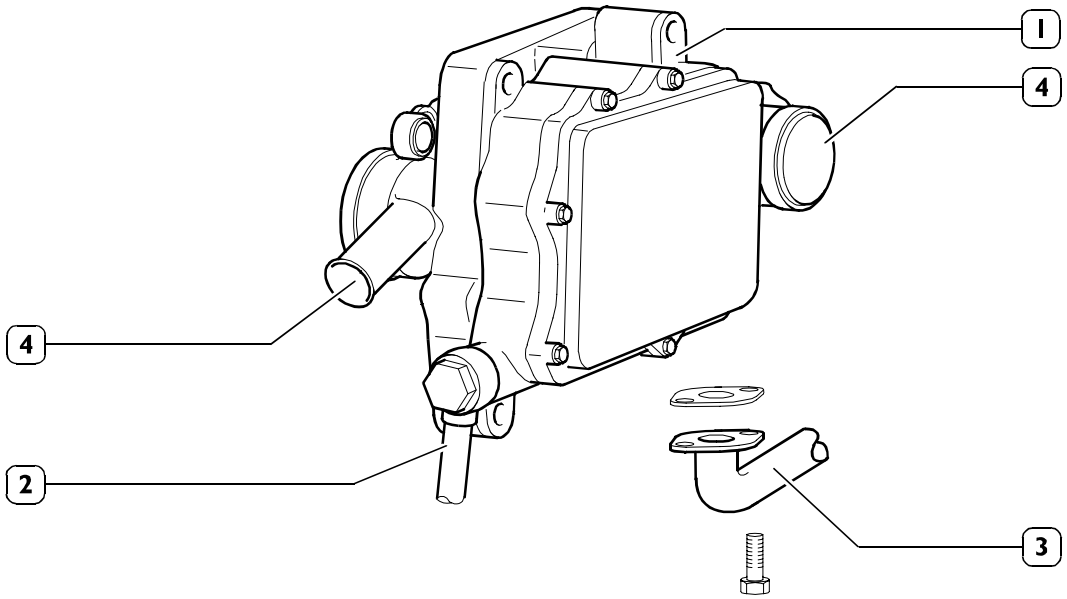
1. Oil pump - 2. Water/oil heat exchange - 3. Oil filter support - 4. Relief pressure valve (piston cooler) - 5. Relief pressure valve (Engine oil pressure system).

Oil vapour recirculation - blow-by filter

The oil vapours produced by the lubrication of the moving parts are directed via the pipe (3) and then are collected and filtered in the blow - by (1).

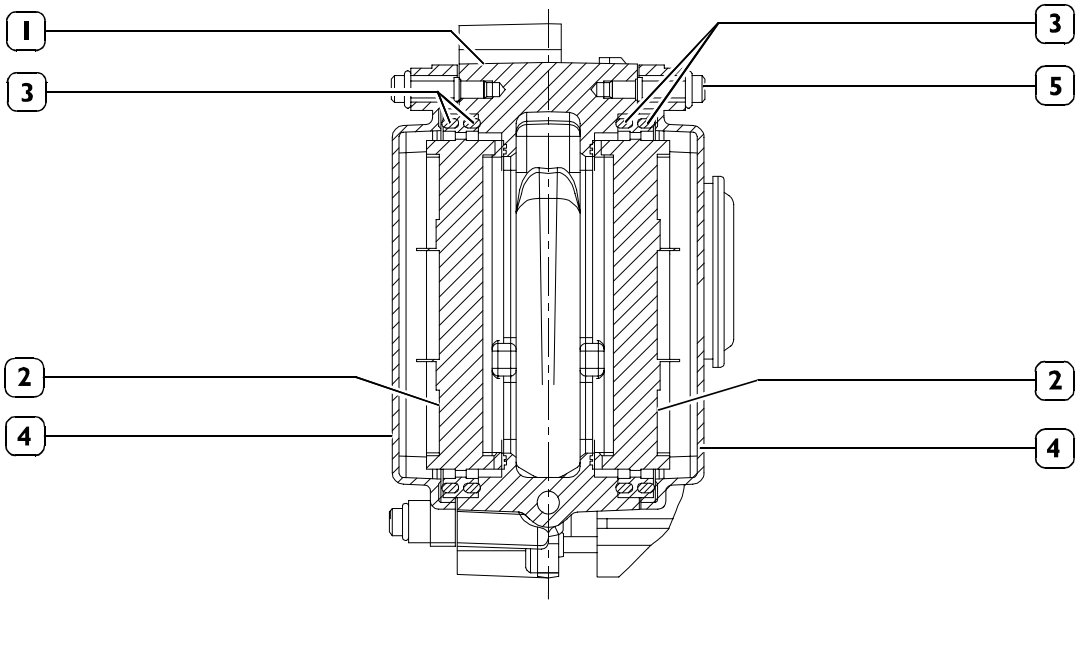
In the blow-by, some of the vapours condense and return to the oil sump via the pipe (2), whilst the remaining vapours are recirculated in the intake.

Figure 4



1. Blow-by filter - 2. Sump drainage pipe - 3. Oil vapour inlet - 4. Gas outlet

Figure 5



1. Blow-by filter casing - 2. Filter - 3. Gasket - 4. Cover - 5. Cover fixing bolts

The blow-by comprises two filtering layers (2), a casing (1) and two gaskets (3) which ensure the seal between the casing and the two covers (4).

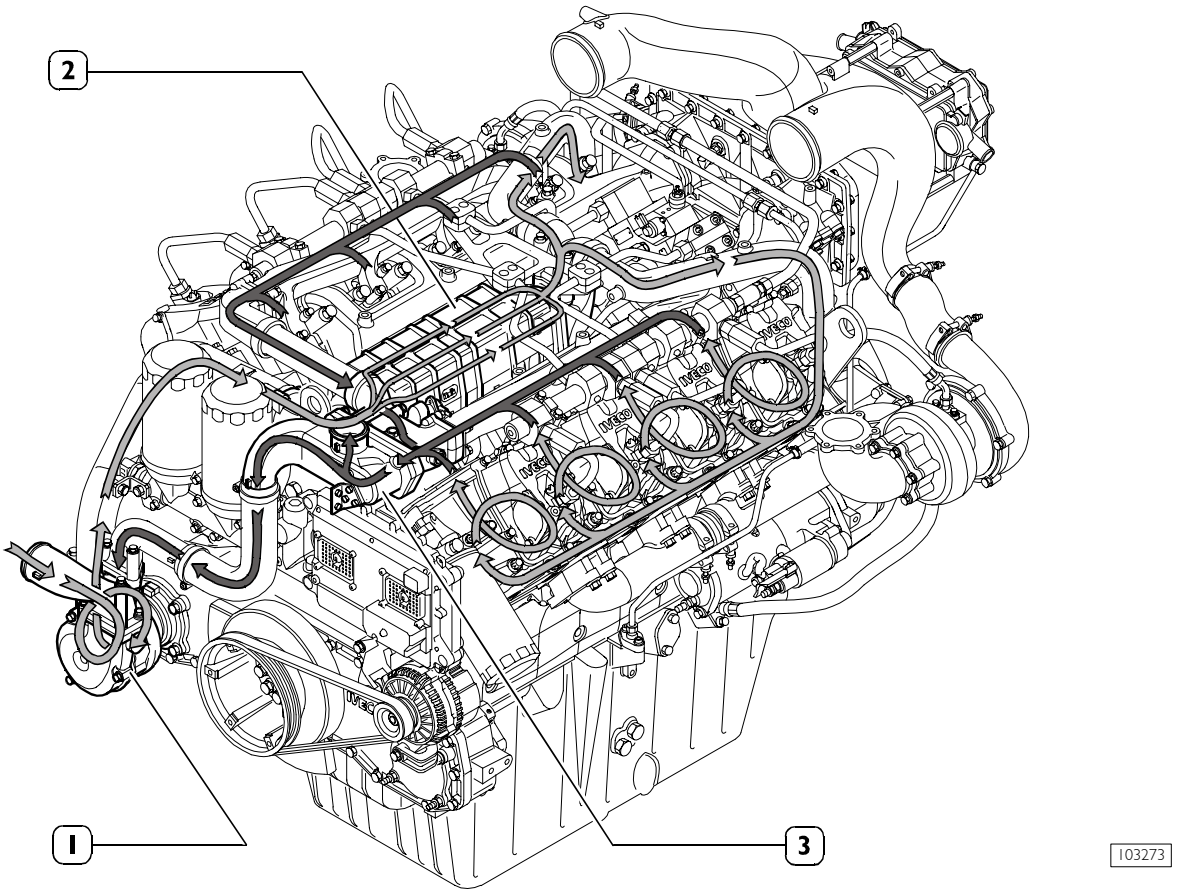
ENGINE COOLING

The cooling system is reponsible for cooling the engine casing and the engine lubrication oil inside the heat exchanger (2).

From the circulation pump (1), the coolant is sent to the heat exchanger (2) where the engine lubrication oil is cooled. From here the coolant reaches the engine block and, after having cooled the cylinders, is sent to the thermostat casing.

Depending on the temperature, the coolant is either recirculated by the water pump (1) or sent to the radiator.

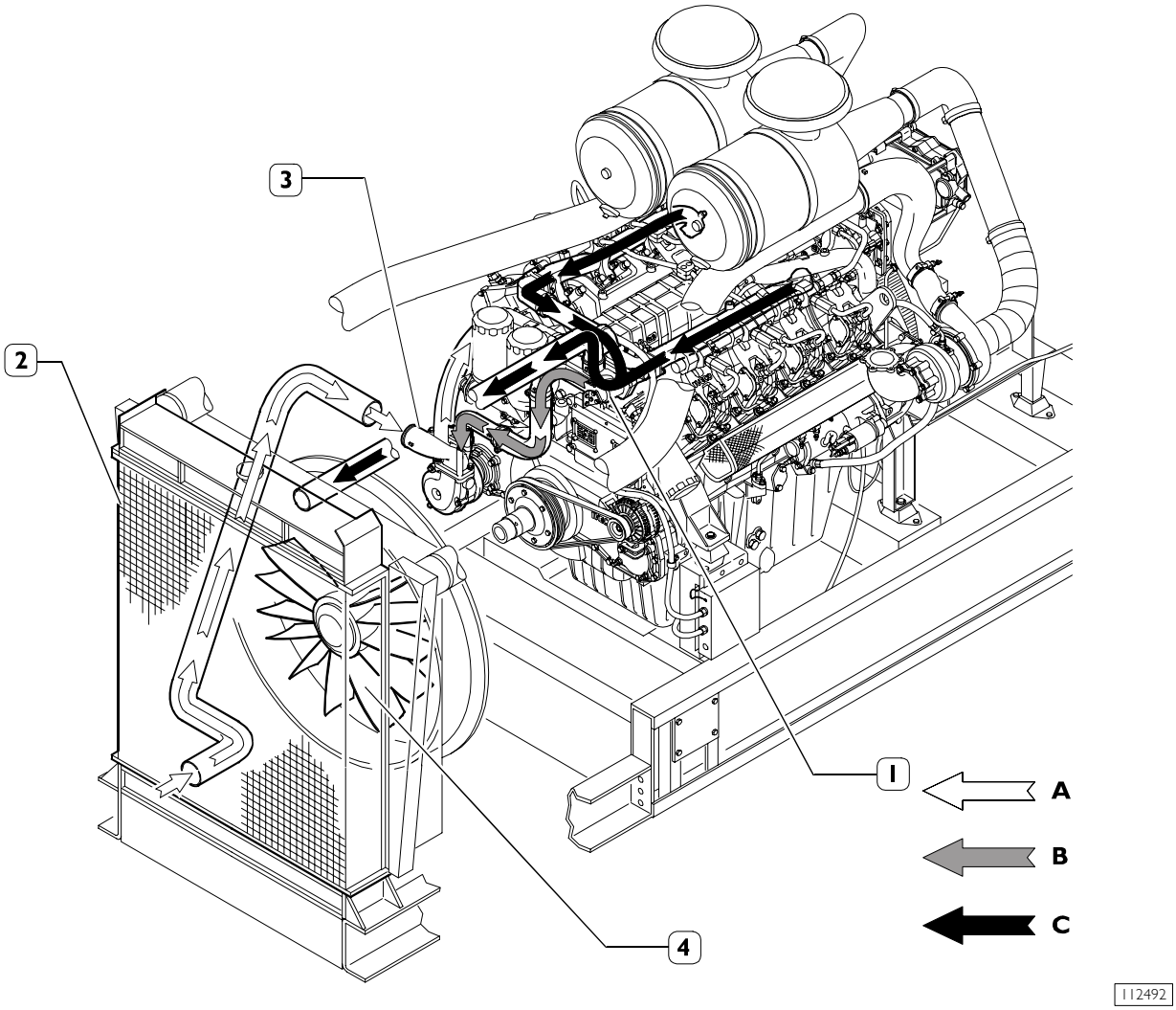
Figure 6



1. Circulation pump - 2. Engine lubrication water/oil heat exchanger - 3. Thermostat casing

COOLING SYSTEM ASSEMBLY

Figure 7



1. Thermostat casing - 2. Radiator - 3. Coolant circulation pump - 4. Cooling fan.

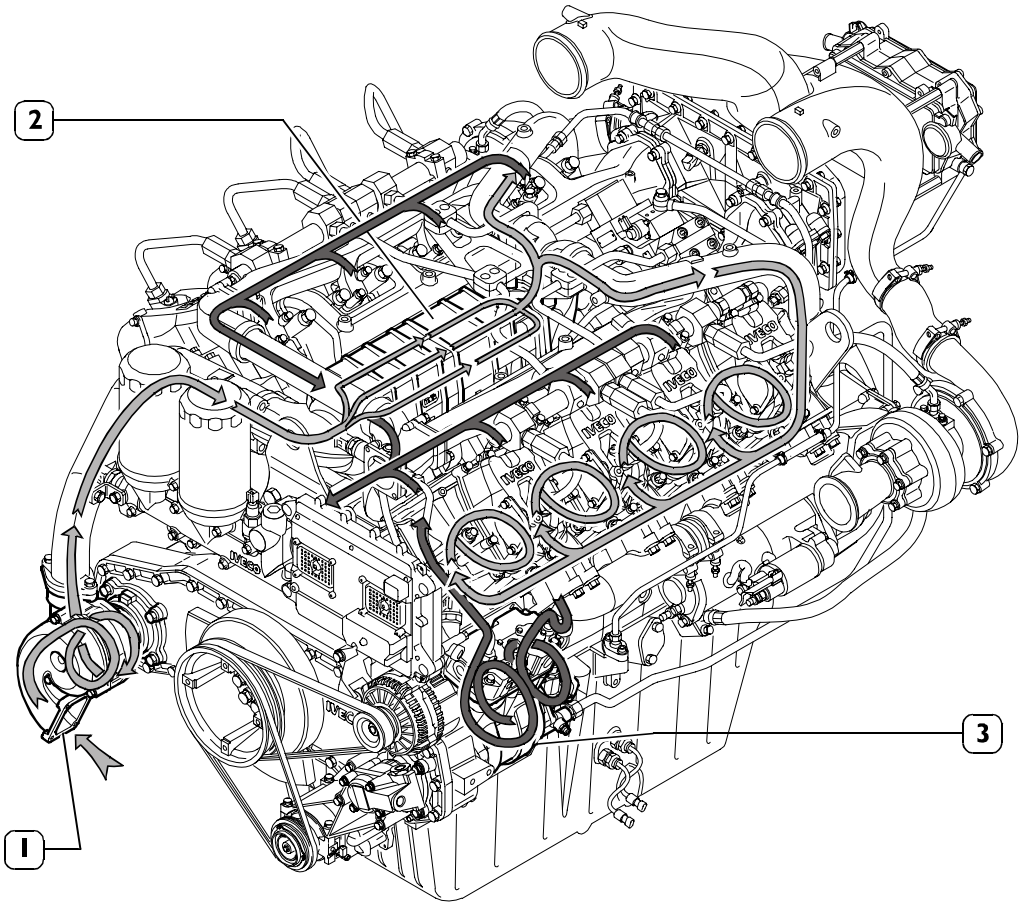
A Coolant coming from the cooling radiator being drawn into the pump.

B Coolant coming from the engine block passing through the thermostat casing (temperature < 70°C) sent to the circulation pump.

C Coolant coming from the engine block passing through the thermostat casing (thermostat valve opening temperature around 70°C, complete travel 85°C) to the cooling radiator.

VARIANT FOR APPLICATIONS WITH BRAKE AIR COMPRESSOR

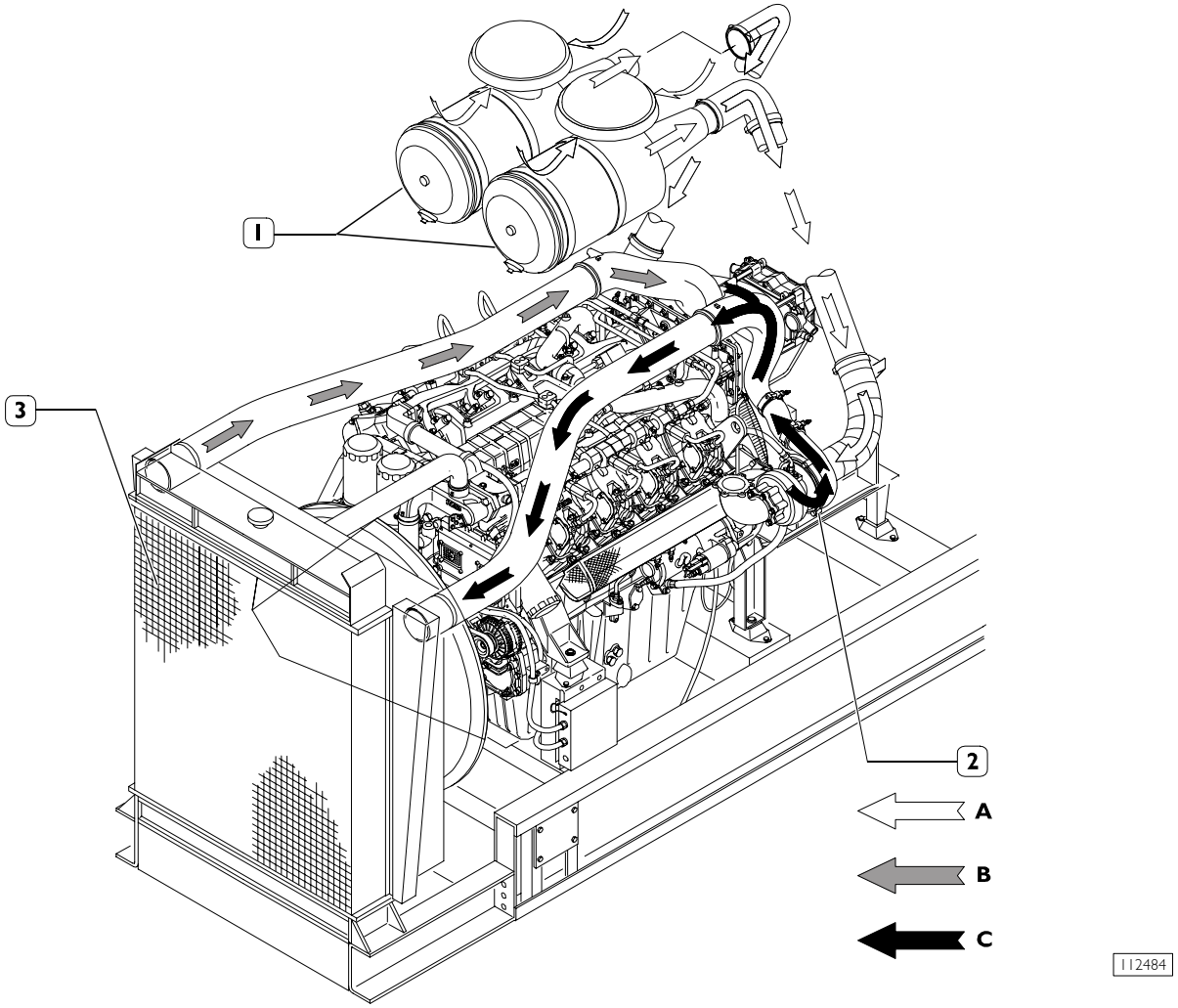
Figure 8



Rif.	Description
1	Circulation pump
2	Engine lubrication water/oil heat exchanger
3	Air system compressor (for DRAGON applications)

AIR/AIR INTERCOOLER SYSTEM (DRAGON, G-DRIVE AND GRIFFON APPLICATIONS)

Figure 9



1. Air filter - 2. Turbochargers - 3. Heat exchanger (air/air intercooler)

A Air drawn in by the filters and sent to the turbochargers.

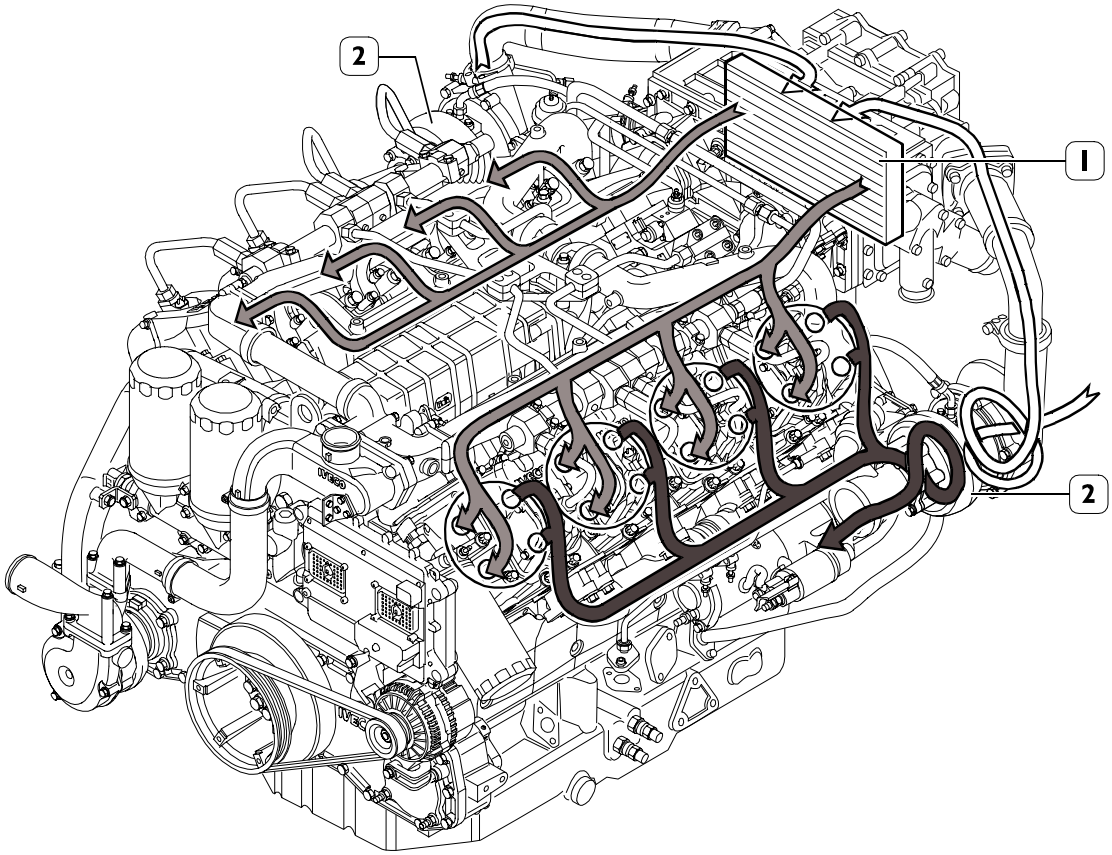
B Air drawn in from the heat exchanger (air/air intercooler) to the main intake manifold and from there to the bank intake manifolds.

C Hot supercharing air coming from the two turbines to the heat exchanger (air/air intercooler).

The system has been designed to lower the temperature of the supercharing air before it is sent to the cylinders.
The air is drawn in and filtered by means of two dry filters and introduced inside the turbochargers.
The air is compressed, with a consequent increase in temperature and, after having been collected in a single pipe, it is sent to the intercooler.
This heat exchanger, which the flow of air produced by the fan fastened axially and driven by the crankshaft comes into contact with, cools the compressed air and sends it, via the pipe, to the main manifold and from there to the two intake manifolds, located on each bank.
On versions for cold climates, there are two pre-heating heaters on the main manifold designed to assist engine starting at low temperatures (ambient temperature up to - 25°C).
Heater voltage: 24V DC
Peak current: 240 ± 50°
Stabilization current: 83 ± 12A.
Together with the above mentioned heaters, these versions also have a resistance for heating the engine lubrication oil and a fuel heater on the diesel pre-filter.

AIR / WATER INTERCOOLER SYSTEM (SPRINKLER APPLICATIONS)

Figure 10



Intake air and hot compressed air

Cold compressed air

Exhaust

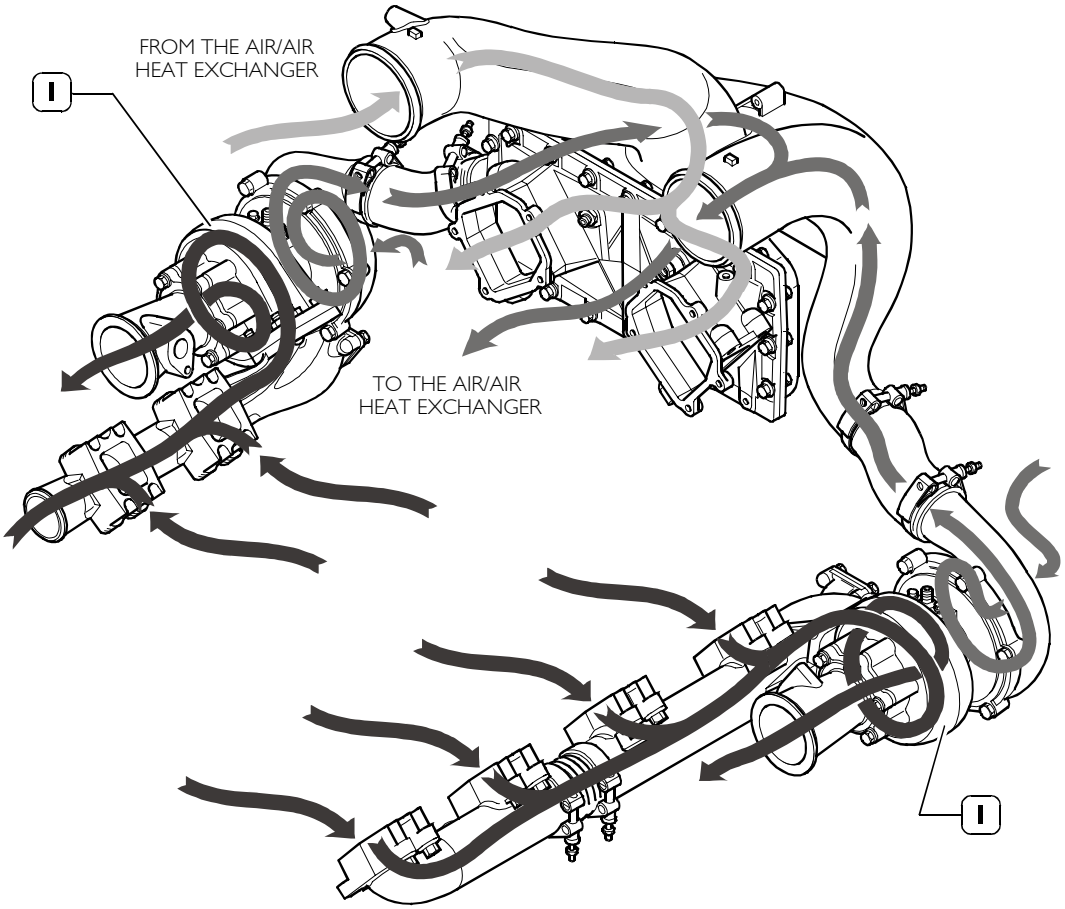
1. Heat exchanger (air/water intercooler) - 2. Turbochargers

SUPERCHARGING

The exhaust fumes are directed to the turbocharger (1) which rotates the section which draws in the air from the filters and compresses it (with a consequent increase in temperature).

The hot compressed air is directed to the inside of the heat exchanger (air/air intercooler) in which it is cooled and sent to the intake manifolds and to the inlet valves.

Figure 11



SECTION 2

Fuel

HIGH–PRESSURE ELECTRONIC INJECTION FUEL SYSTEM (COMMON RAIL)

General Information

Reducing emissions and fuel consumption requires a high level of precision and high injection pressures.

The common rail system makes it possible to inject fuel at pressures of up to 1600 bar, while the injection precision, obtained with an electronic control module (ECM), (also called electronic control unit, ECU) optimises the operation of the engine, limiting emissions and consumption.

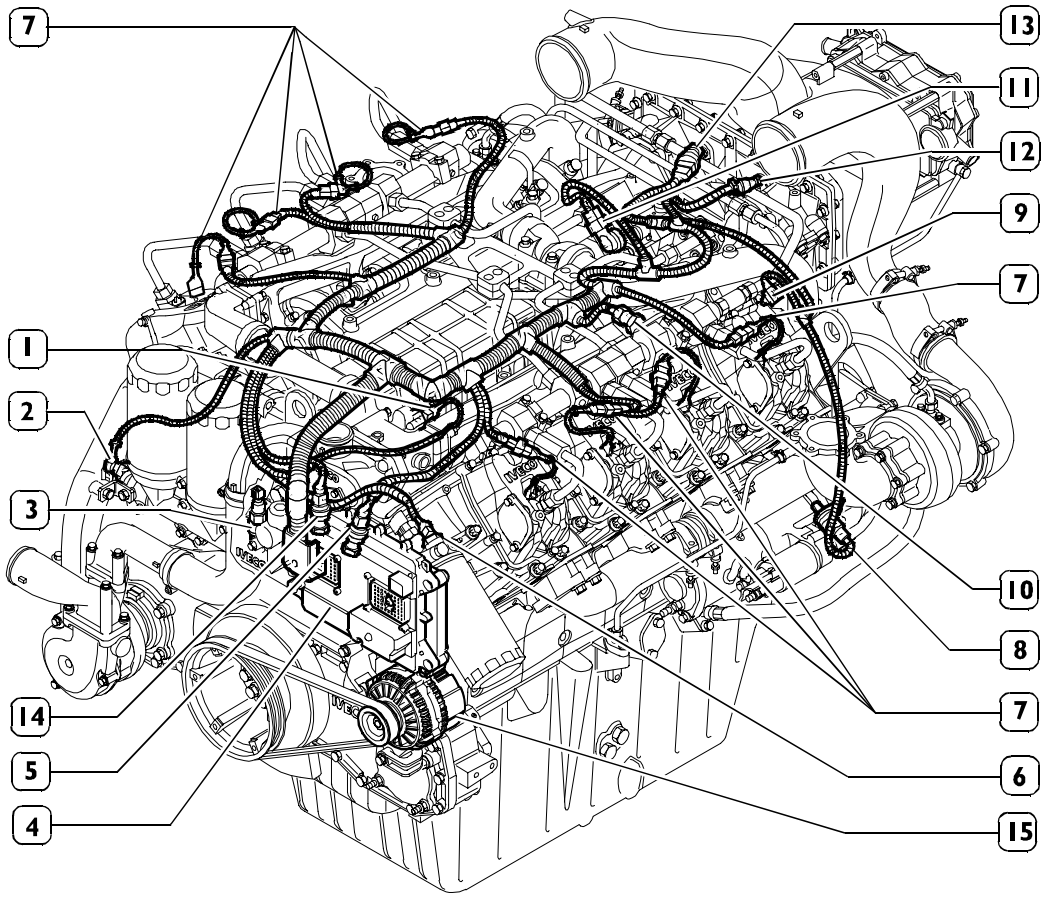
Description of the system

The system is composed of the electrical system and the fuel system.

Electrical system

The control unit governs the engine via the sensors on the engine.

Figure 1



1. Engine coolant temperature sensor – 2. Engine oil temperature sensor – 3. Oil filter clogging sensor – 4. ADEM III engine control module – 5. Atmospheric pressure sensor – 6. Fuel temperature sensor – 7. Electro–injectors – 8. Engine speed/timing sensor on crankshaft – 9. Engine speed/timing sensor on camshaft – 10. Common rail fuel pressure sensor – 11. Common rail high pressure control solenoid valve, also called pulse wide modulation (PWM) or M–Promp valve – 12. Intake air temperature sensor after intercooler – 13. Intake air pressure sensor – 14. Engine oil pressure sensor – 15. Alternator

Pressure sensors

The pressure sensors are used to notify the electronic control unit of the oil pressure values (reference 3, Figure 1), the atmospheric pressure (reference 5, Figure 1) and the turbo outlet air pressure (reference 13, Figure 1).

Temperature sensors

These are NTC type sensors and are used to notify the electronic control unit of the operating temperatures of the engine coolant (reference 1, Figure 1), the engine oil (reference 2, Figure 1), the fuel (reference 6, Figure 1) and the heat exchanger outlet air (reference 12, Figure 1).

Rpm sensors (timing sensor)

This is an inductive type sensor and is located on the camshaft (reference 9, Figure 1).

It produces signals obtained by means of the magnetic flow lines which close through the ports in the gear fitted on the camshaft. The signal produced and sent to the electronic control unit allows the latter to calculate the moment of injection. The sensor should be fitted by tightening it to a torque of 28 ± 7 Nm

Engine rpm sensors

This is an inductive type sensor and is located on the engine flywheel (reference 8, Figure 1).

It produces signals obtained through the magnetic flow lines which close via the ports in the actual flywheel. The electronic control unit uses these signals to detect the various engine speeds.

Engine oil level sensors

This is a sensor used to signal a low oil level in the sump.

OPERATION

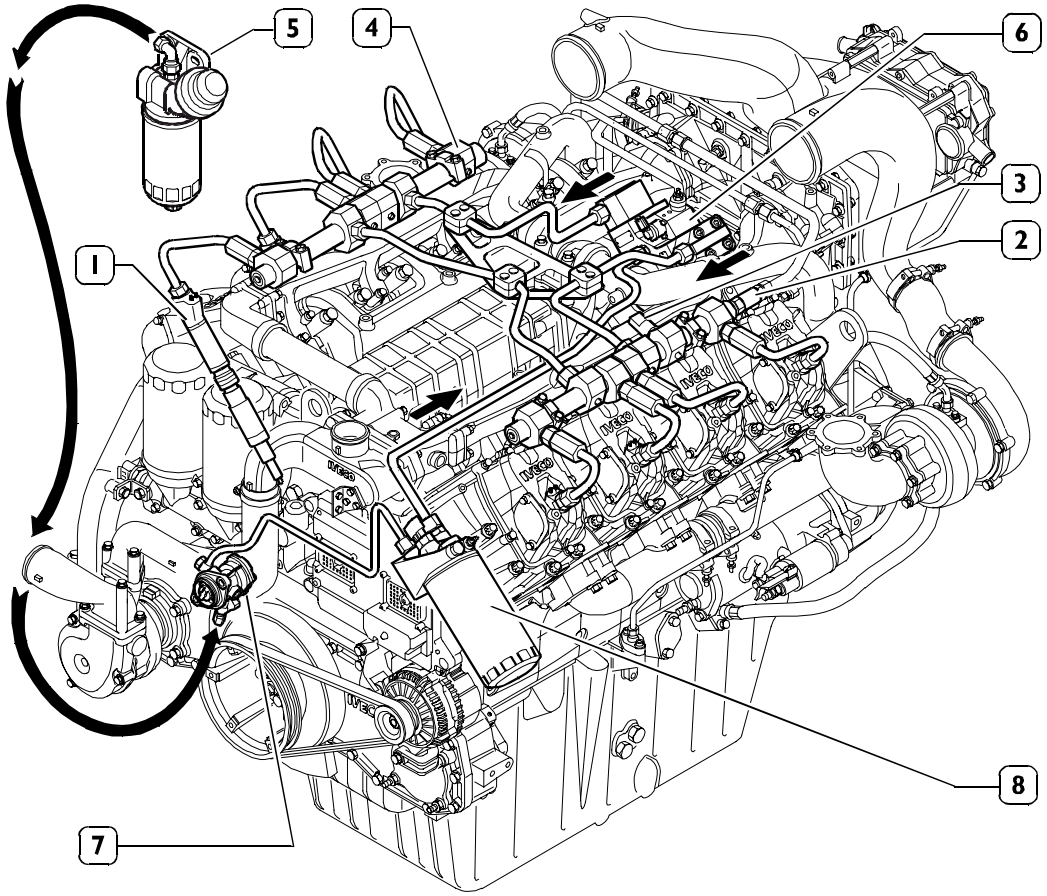
The fuel system consists of a low pressure part and a high pressure part.

The low pressure pump (LPP) (no.7) is located on the left side of the engine and it sucks the fuel from the fuel tank.

The fuel drawn in by the low pressure pump enters the pre-filter (5) where the water and the larger particles of impurities, that may be present, are separated out.
This filter is equipped with a heater element (on certain applications) used to increase the temperature of the fuel in low temperature conditions. There is also a mechanical pump on the pre-filter that is used to prime the circuit. On reaching the low pressure pump, the fuel is sent for filtering to the filter or filters depending on the applications (8). The pump pressure is maintained at 5 bar.

The high pressure system is a common rail system consisting of a high pressure pump and 8 injectors, which is electrically controlled by an ECM.

Figure 2



1. Electro–injector – 2. Common rail – 3. Pressure sensor – 4. Common rail pressure relief valve – 5. Fuel pre-filter – 6. High–pressure pump – 7. Low–pressure pump – 8. Fuel filter.

The fuel system is composed of a low–pressure circuit and a high–pressure circuit.

The high–pressure circuit is composed of the following pipes:

- ❑ pipe connecting the high–pressure pump outlet to the common rail;
- ❑ pipes connecting the electro–injectors to the common rail.

The low–pressure circuit is composed of the following pipes:

- ❑ fuel suction pipe from the tank to the pre–filter equipped with a priming pump, fuel pre–heating element and clogging sensor;
- ❑ pipes supplying the mechanical low–pressure fuel pump;
- ❑ pipe from the low pressure pump to the fuel filter/filters;
- ❑ pipes which supply the high pressure pump from the filter/filters;

The fuel system is completed by the fuel return circuit from the common rail, injectors and high–pressure pump.

Figure 3

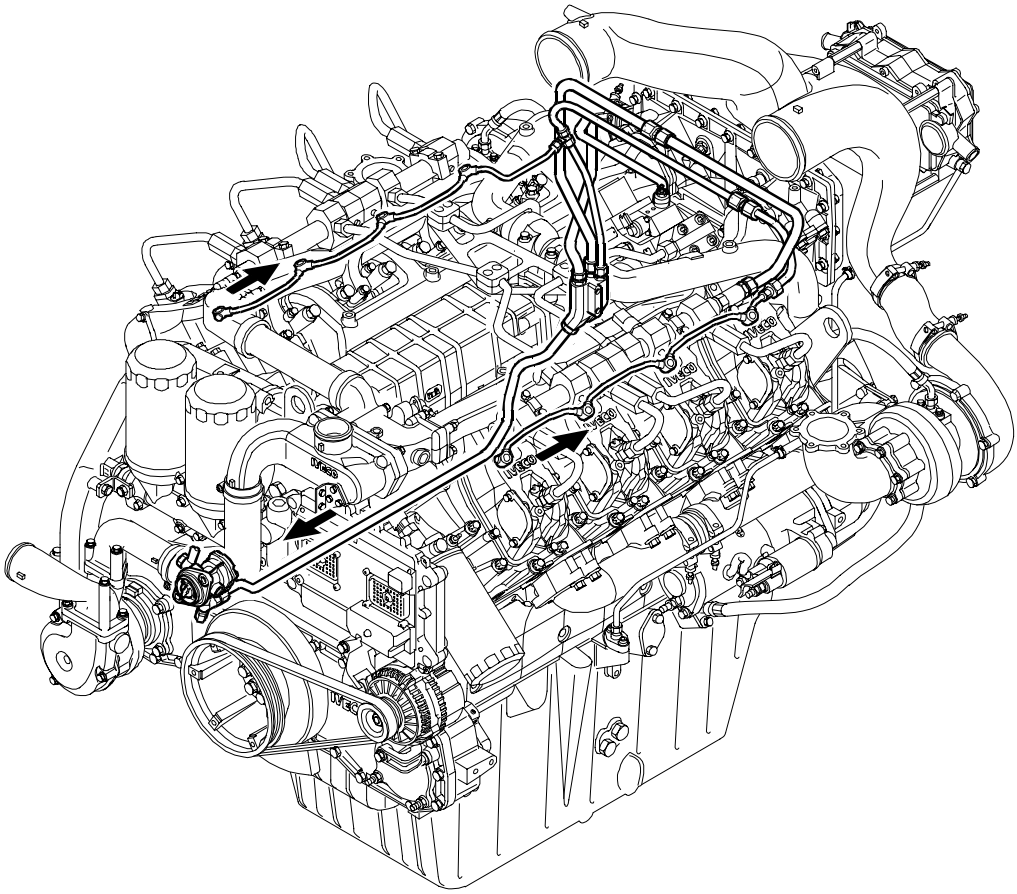


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DIAGRAM SHOWING PIPES FOR G-DRIVE / SPRINKLER APPLICATIONS

Figure 4

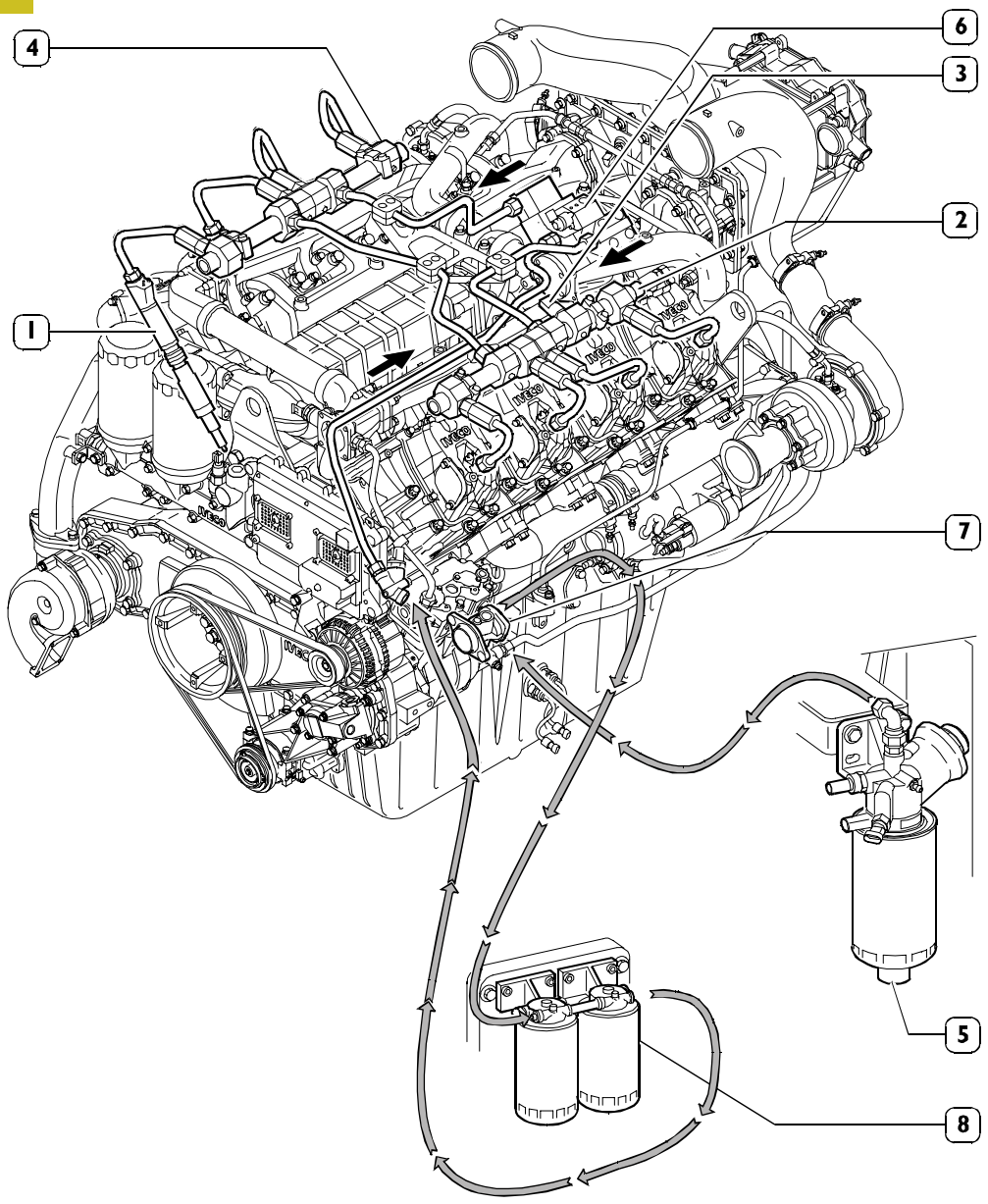
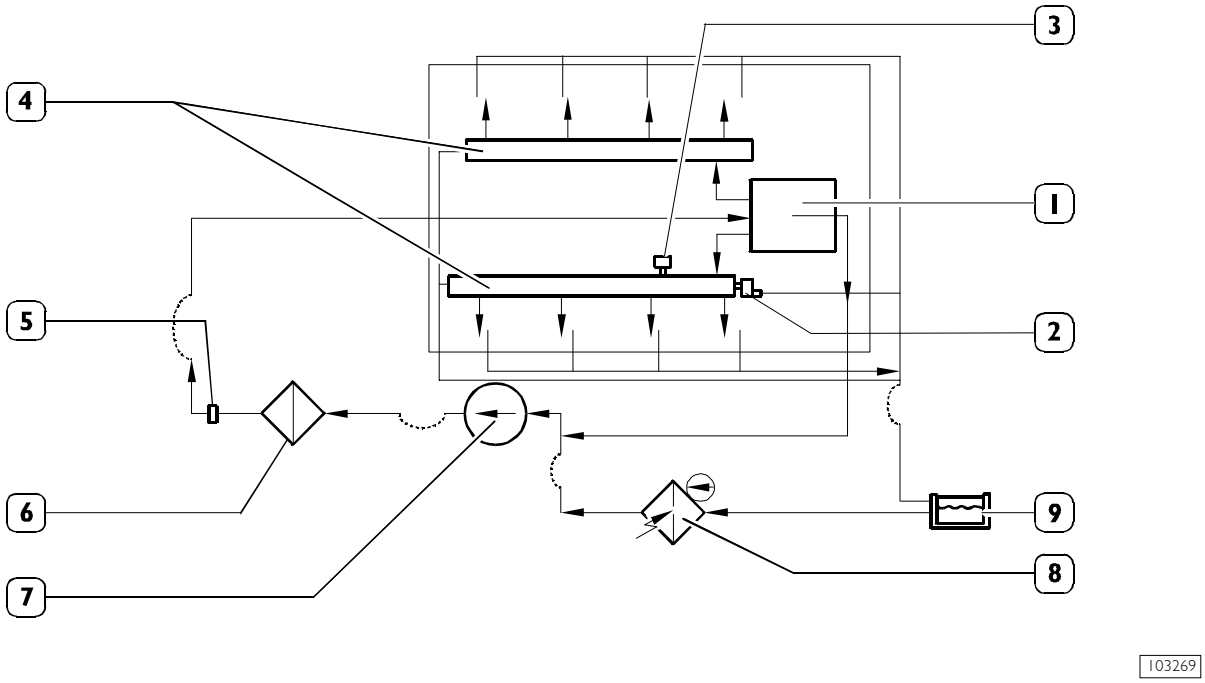


DIAGRAM SHOWING PIPES FOR DRAGON / GRIFFON APPLICATIONS

Rif.	Description
1	Injector
2	Common rail pressure relief valve
3	Pressure sensor
4	Common rail
5	Diesel pre-filter
6	High pressure pump
7	Low pressure pump
8	Fuel filters (depending on the application)

Fuel system diagram

Figure 5



1. High–pressure pump – 2. Rail pressure valve – 3. Pressure sensor – 4. Common rail – 5. Clogging sensor on fine fuel filters – 6. Fuel filter/s (*) – 7. Low–pressure pump – 8. Pre–filter with pre–heating element and priming pump – 9. Fuel tank.

* The number of fuel filters depends on the application.

The fuel drawn from the tank (9) is sent to the pre–filter (8) and from here to the low–pressure pump (7).

From the pump (7), the fuel reaches the fuel filter/s (6) and from there it goes to the high pressure pump (1).

The pressure relief valve fitted on the high–pressure pumps inlet side, keeps the inlet pressure at a constant level of 5 bar, so the M–Promp (high–pressure regulator) receives a constant flow of fuel in order to work properly.

The M–Promp valve located upstream from the high–pressure pump, governs the necessary flow to the high pressure pump allowing only the fuel necessary to maintain the pressure in the rail, improving energy efficiency and limiting system heating.

The high–pressure pump (1) takes the fuel up to a pressure of 1600 bar, depending on the engine conditions.

From the high–pressure pump the fuel is directed through the rails (4) to the electro–injectors.

The excess flow from the injectors and from the over pressure valve is collected and sent through pipes to the fuel tank.

The high–pressure pump drainage (excess fuel) is re–circulated by a pipe going directly to the low–pressure pump.

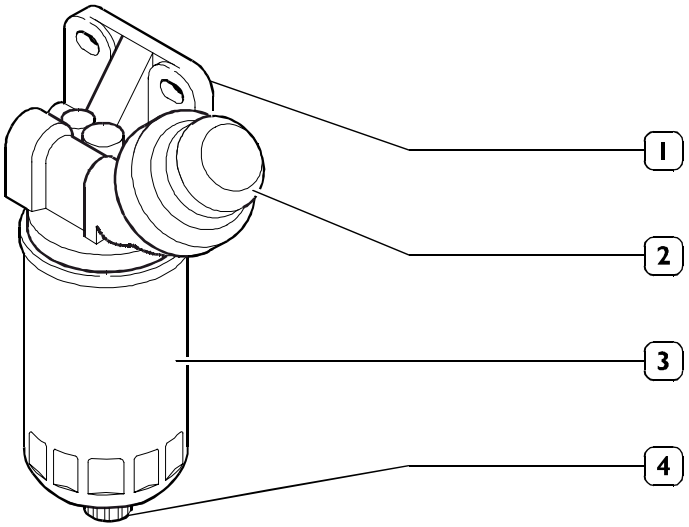
Main mechanical components of the fuel system

Fuel pre-filter for G-DRIVE and SPRINKLER applications

The fuel pre–filter, a water separation type, has the water sensor (4) at the base of the cartridge (3) to indicate if there is water in the fuel.

The manual priming pump (2) is located on the filter mounting (1).

Figure 6



103268

1. Filter support – 2. Manual priming pump and system bleed – 3. Fuel pre–filter cartridge – 4. Water sensor

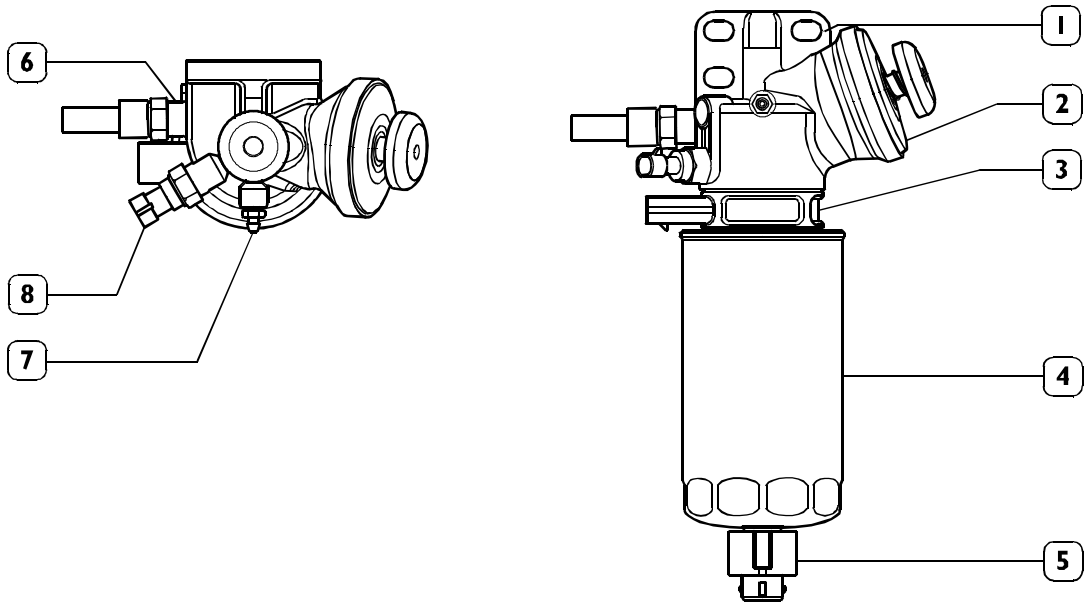
Fuel pre-filter for DRAGON and GRIFFON applications

The high water separation type fuel pre-filter has a sensor (5) at the base of the cartridge (4) that signals the presence of water to be drained.

There is a manual priming pump (2) and an air breather jet (7) on the filter mounting (1).

There is a heater (3) on the mounting for heating the diesel, an intake with a rapid connector (6) for the return pipe from the tank and a temperature sensor (8).

Figure 7



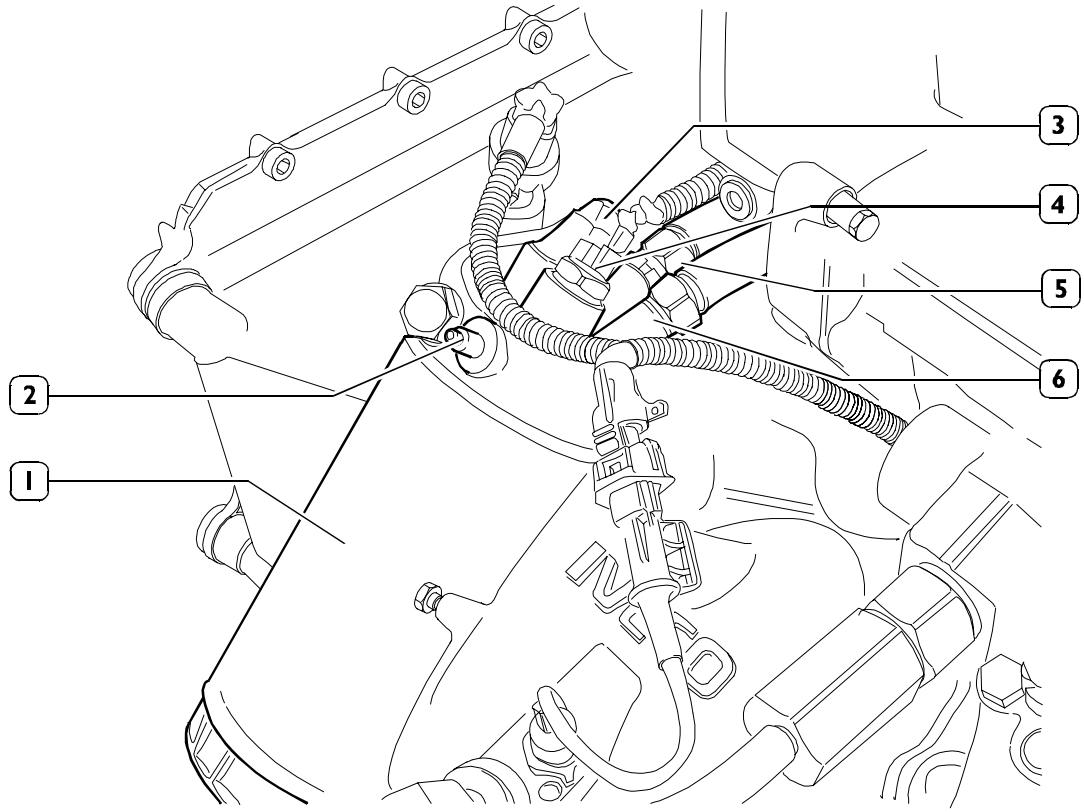
1. Filter mounting – 2. Manual priming pump and system bleed – 3. Heater –
4. Fuel pre-filter cartridge – 5. Water in fuel presence sensor – 6. Attachment with rapid pipe connector –
7. System breather jet – 8. Temperature sensor

Fuel filter for G-DRIVE and SPRINKLER applications

The fuel filter (1) is fitted in the circuit between the high pressure pump and the low pressure pump behind the engine management control unit.

The bleed screw (2), the diesel pressure sensor (3) and the diesel temperature sensor (4) are located on the mounting.

Figure 8



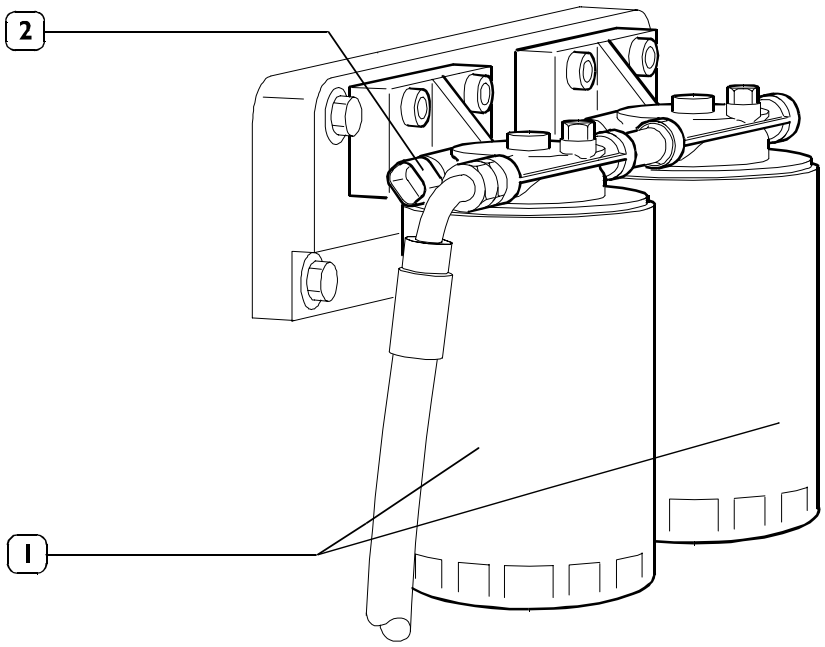
1. Fuel filter – 2. System bleed screw – 3. Diesel pressure sensor – 4. Diesel temperature sensor – 5. Filter diesel inlet – 6. Diesel outlet from the filter to the high pressure pump.

Fuel filters for DRAGON and GRIFFON applications

The fuel filters (1) are located in the circuit between the low pressure pump and the high pressure pump.

The bleed screws and the filter blockage sensor (2) are located on the mounting.

Figure 9



1. Filter cartridges – 2. Filter blockage sensor

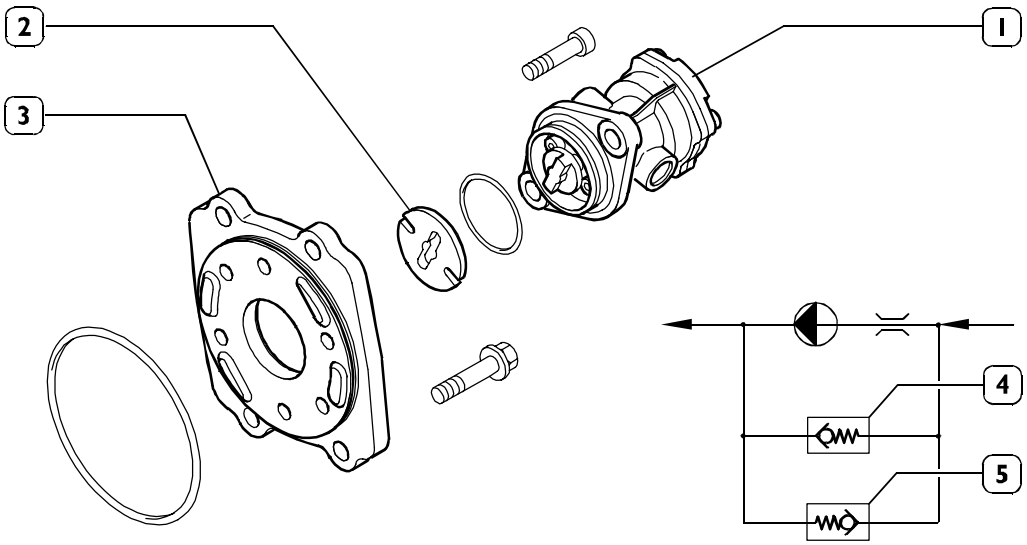
Low pressure pump for G-DRIVE, and SPRINKLER applications

The low pressure pump (1) (LPP) is fitted on the rear of the gear casing through the flange (3).

It receives power through the coupling (2) which meshes with the front teeth of the pump gear for the engine cooling circuit.

It has the task of pumping the fuel at low pressure to the high pressure pump.

Figure 10



1. Mechanical low pressure pump – 2. Pump control coupling (LPP) – 3. Flange – 4. Safety valve – 5. By-pass valve (Components 4 and 5 are housed inside the pump).

Main specifications

Safety valve (4):

- Valve opening pressure: . . . . . 9,5 bar
- Maximum pressure: . . . . . 12 bar

By-pass valve (5):

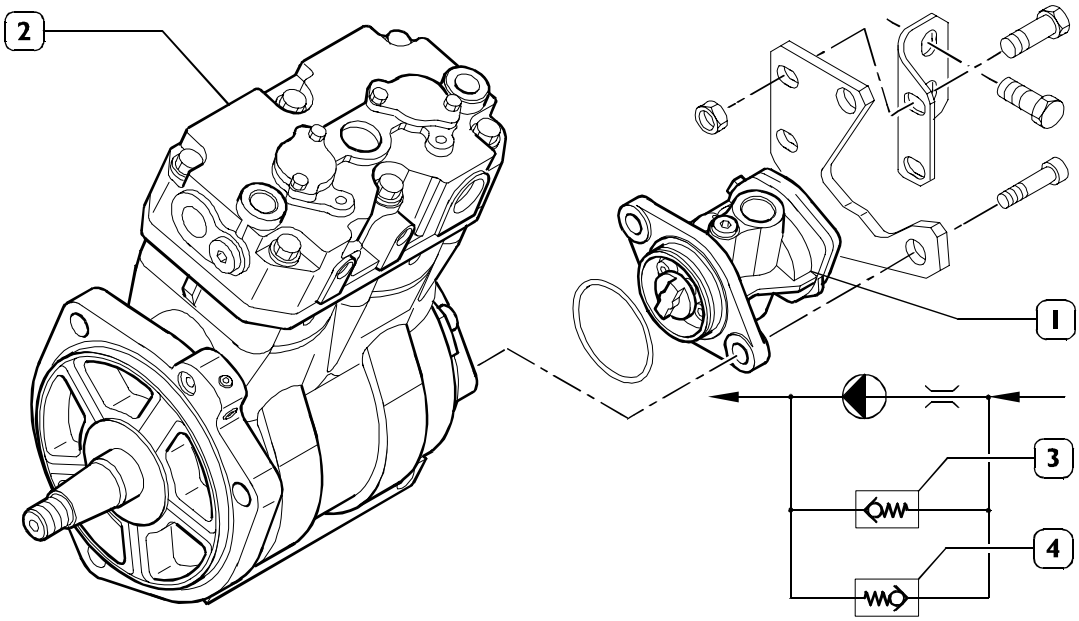
- Valve opening pressure: . . . . . 1,5 bar

Low pressure pump for DRAGON applications

The mechanical low pressure pump (1) is fitted axially behind the braking system air compressor (2), if fitted. Otherwise, it is fitted directly on the rear part of the gear casing.

It has the task of pumping fuel at low pressure to the high pressure pump.

Figure 11



1. Mechanical low pressure pump – 2. Braking system air compressor – 3. Safety valve – 4. By-pass valve (Components 3 and 4 are housed inside the pump).

Main specifications

Safety valve (4):

- Valve opening pressure: . . . . . 9,5 bar
- Maximum pressure: . . . . . 12 bar

By-pass valve (5):

- Valve opening pressure: . . . . . 1,5 bar

High–pressure pump

The high–pressure pump (1) is located in the centre of the V–block and is secured to the rear gear housing of the engine.

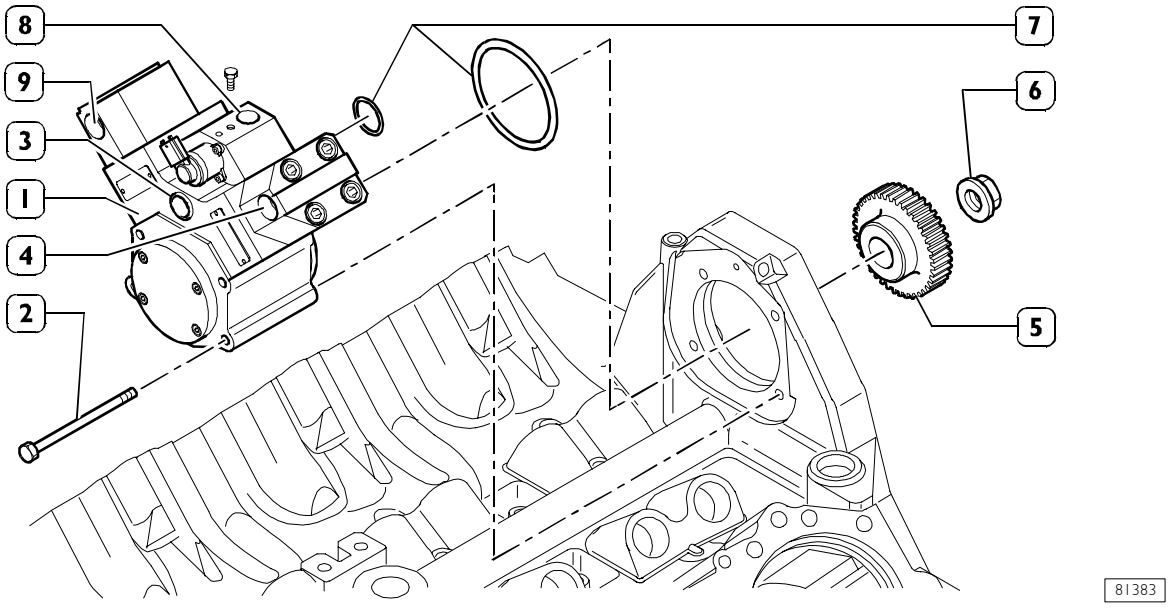
Drive is provided by gears directly from the camshaft.

It receives the supply to the inlet (3) and, after compressing it, delivers it to the rails via outlets (4) and (9).

At the top there is an outlet (8) for draining off excess fuel to go to the low–pressure pump to be re–circulated to the high pressure pump.

The pump's gear (5) is attached onto the pump's shaft directly and secured by the nut (6). (350 torque; 300 Nm with the screwdriver with final take off at 350 Nm with dynamometric wrench).

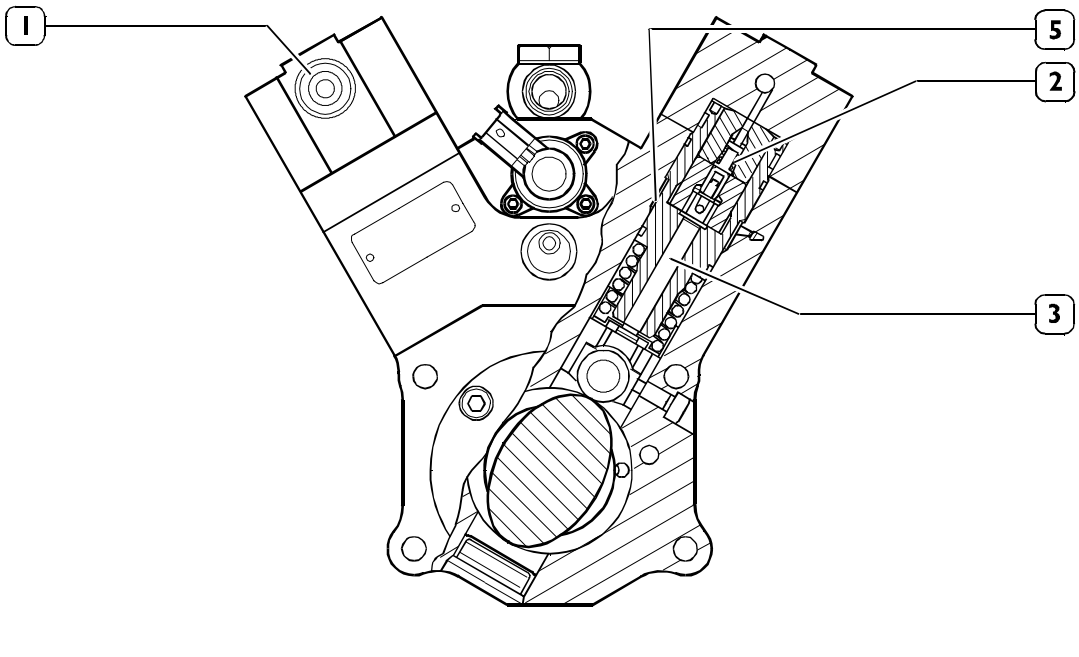
Figure 12



1. High–pressure pump – 2. Fixing screws – 3. Fuel inlet – 4. and 9. Outlet to Common Rail – 5. Pump gear – 6. Fixing nut – 7. Seal – 8. Outlet for draining off excess fuel.

High pressure pump operating principle

Figure 13



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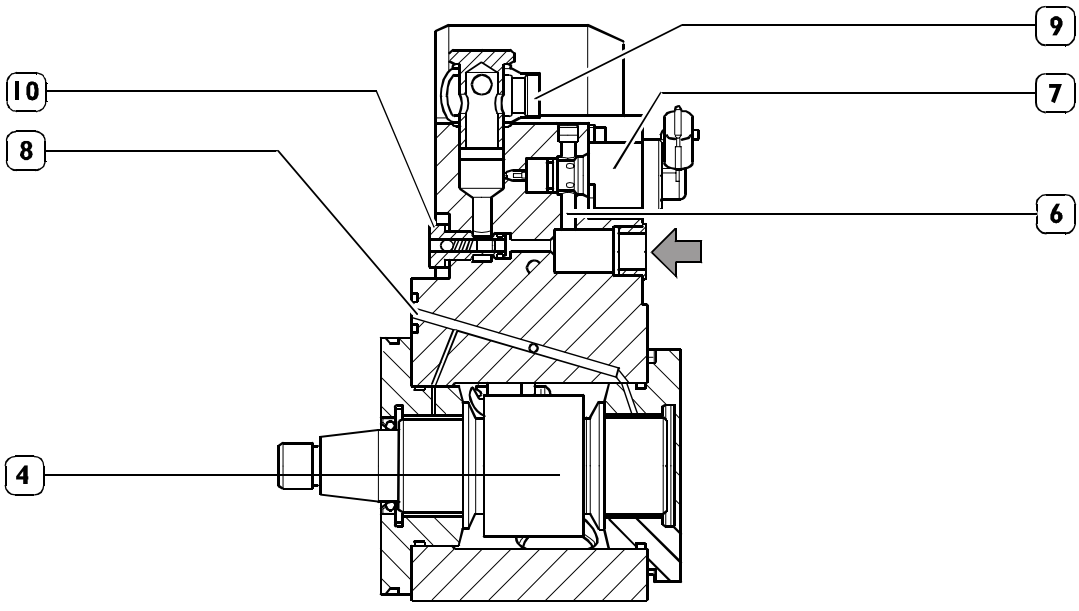

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1. Outlet for supply to the rail – 2. Rail supply valve – 3. Pumping element – 4. Pump shaft – 5. Pumping supply duct – 6. Pressure regulator supply duct – 7. Pressure regulator (M-promp) – 8. Lubrication oil inlet – 9. Fuel return to the low pressure pump – 10. Relief valve regulated to 5 bar

The pumping element (5) is oriented on the cam on the pump shaft.

In the suction phase, the pumping element is fed through the supply line (3). The amount of fuel to send to the pumping element is decided by the pressure regulator (7).

Depending on the command received from the control unit, the pressure regulator will control the flow of fuel to the pumping element. During the compression phase of the pumping element, the fuel pressure opens the common rail delivery valve (2), before going out the outlet (1).

The pump shaft supports are lubricated through the ducts (oil channels) (8).

The pressure regulator (7) decides the amount of fuel with which to supply the pumping elements; any excess fuel flows out through the duct (9).

The pressure relief valve (10), has the function of keeping a constant inlet pressure at 5 bar for the pressure regulator.

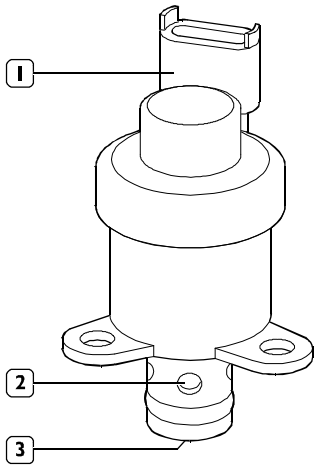
High pressure regulator

Located at the high–pressure pump inlet, on the low–pressure system, it controls the flow of fuel to the high–pressure pump according to the commands received from the electronic control unit (ECU).

If there is no command signal, the pressure regulator is normally open, so the high–pressure pump is in the condition of maximum delivery.

The control unit sends the regulator a command signal to control the fuel flow to the high–pressure pump.

Figure 14



1. Electrical connector – 2. Fuel outlet – 3. Fuel inlet

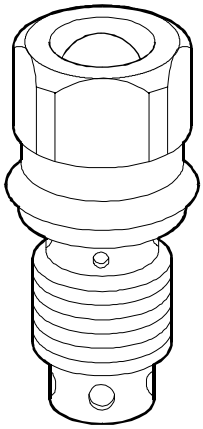
Pressure relief valve 5 bar

Mounted in parallel with the pressure regulator, its function is to keep the pressure at the regulator inlet constant, which is necessary for the system to work properly.

When the pressure at the inlet of the regulator exceeds 5 bar, the relief cylinder (8, Figure 16), will begin to open in order to lead the additional fuel to the outlet.

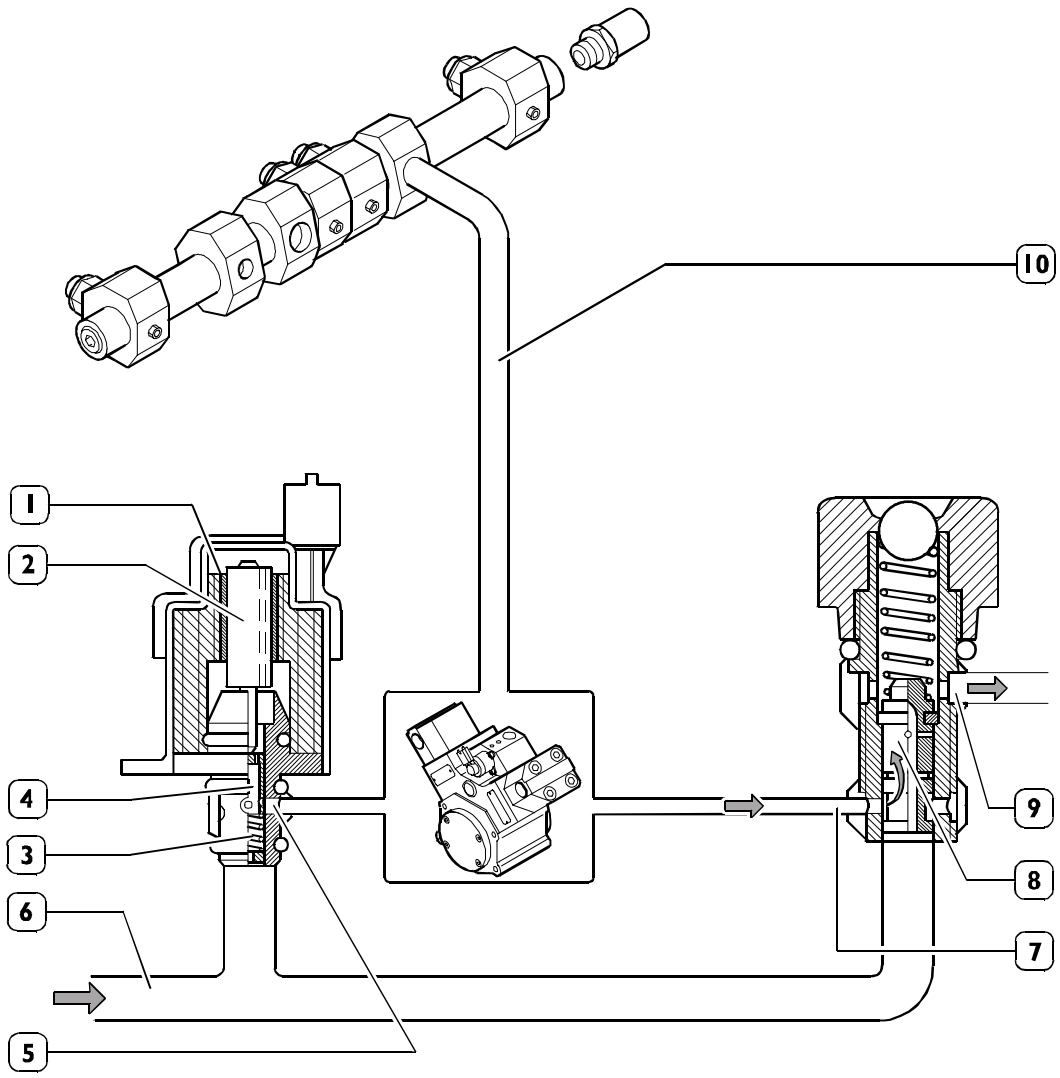
Depending on the fuel flow required, with the pressure regulator partially closed, the cylinder moves into a dynamically balanced position such as to ensure a constant pressure of 5 bar at the regulator inlet.

Figure 15



Pressure regulator and 5 bar pressure relief valve at max. fuel delivery

Figure 16



1. Coil – 2. Core – 3. Pre–loading spring – 4. Shutter – 5. High–pressure pump supply – 6. Fuel inlet (from the filter) – 7. Fuel return from the high–pressure pump – 8. Cylinder for opening outlet line – 9. Fuel outlet – 10. Fuel delivery

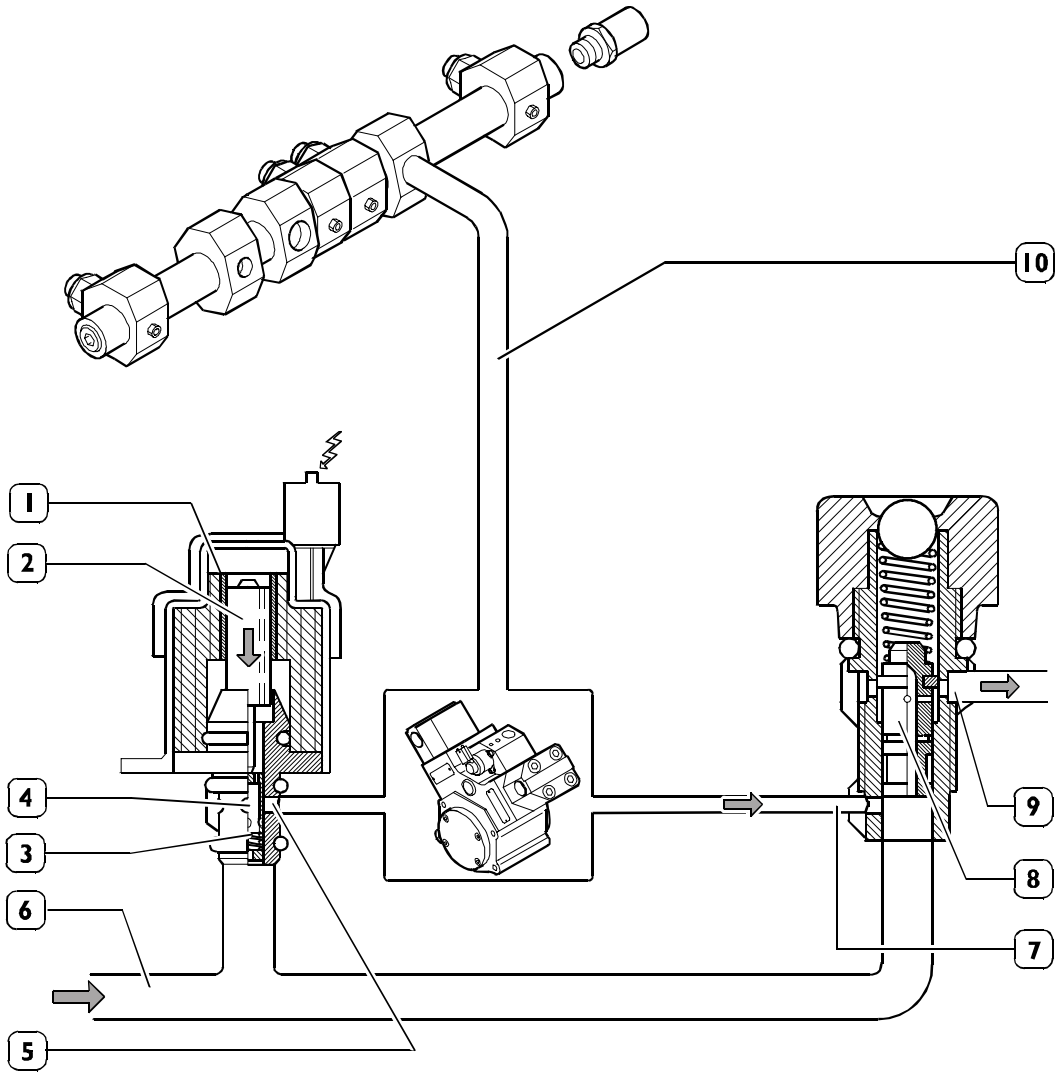
When the coil (1) of the regulator is not energised, the core (2) is in the rest position due to the pre–loading spring (3). The shutter (4) is in the position of maximum delivery and the HPP will provide the rail with max. pressure.

The clearance between the internal parts in the high pressure pump permits fuel leakage, which is used to lubricate the pump. This excess fuel is sent towards the pressure relief valve.

The cylinder (8) in the pressure relief valve will then move into a balanced position and there it will maintain the pressure in the low pressure line at 5 bar.

Pressure regulator and 5 bar pressure relief valve in regulation mode

Figure 17



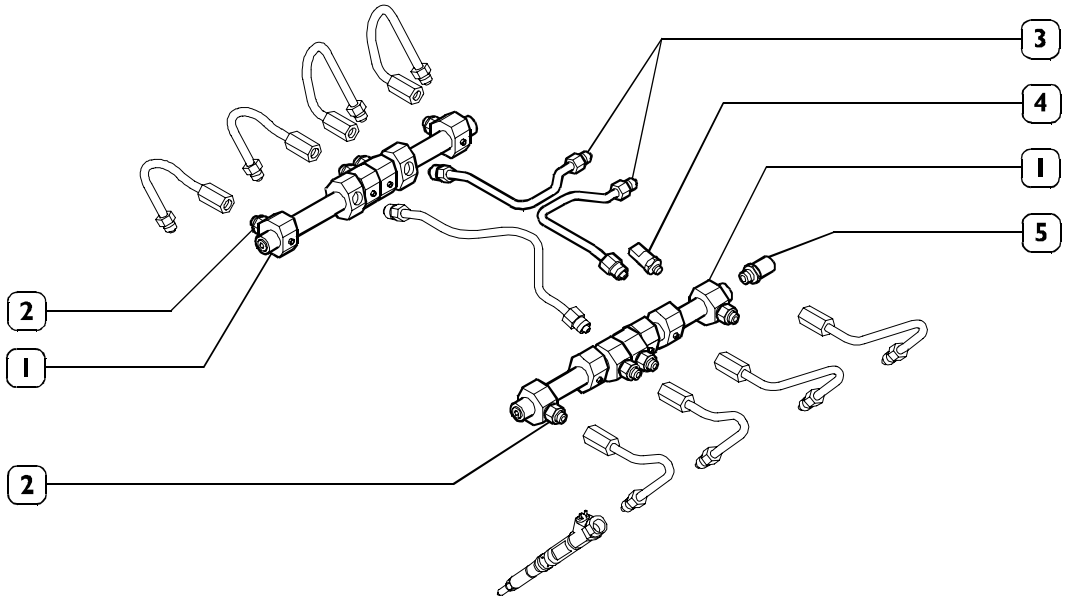
1. Coil – 2. Core – 3. Pre–loading spring – 4. Shutter – 5. High–pressure pump supply – 6. Fuel inlet (from the filter) – 7. Fuel return from the high–pressure pump – 8. Cylinder for opening outlet line – 9. Fuel outlet – 10. Fuel delivery

When the PWM is in regulation mode the coil (1) is energised (between 0–1600mA depending on the pressure required by the ECM) and the core (2) is moving the shutter (4) towards the closing position in order to limit the fuel flow to the HPP and thereby reducing the fuel pressure in the rail.

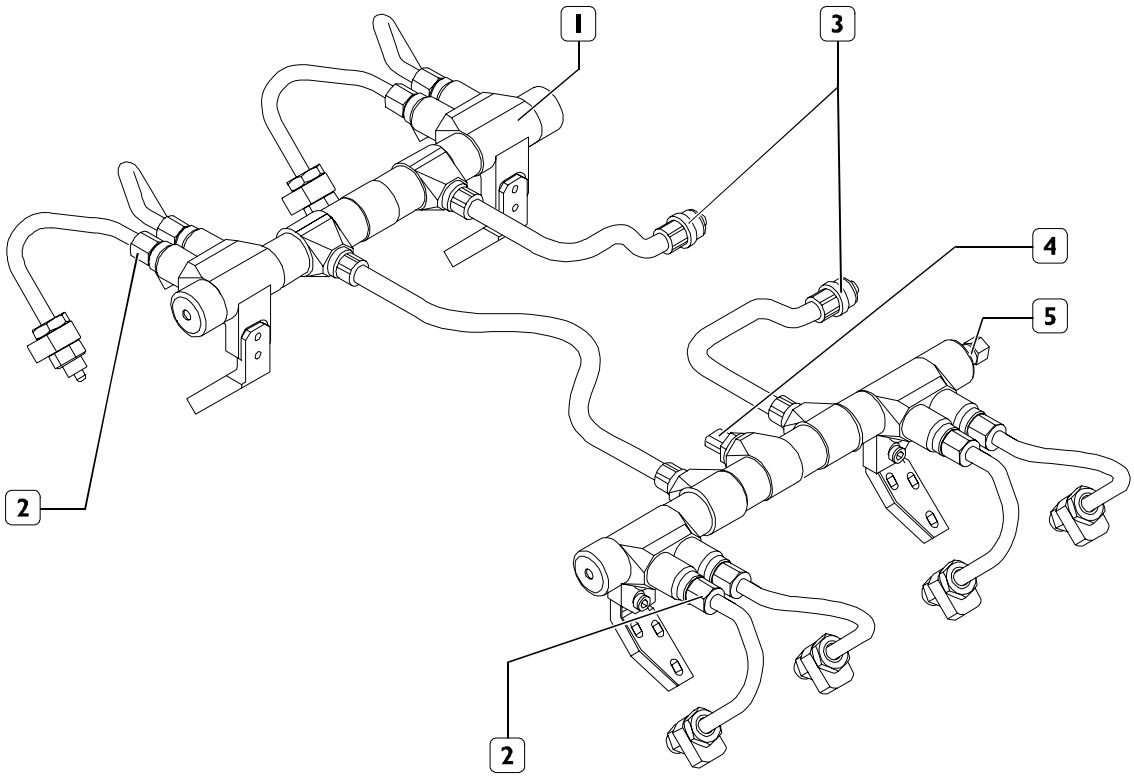
The cylinder (8) in the pressure relief valve will move into a balance position and there it will maintain the pressure in the low pressure line at 5 bar.

Rail (pressure accumulator)

Figure 18



RAIL FOR G-DRIVE / DRAGON / SPRINKLER APPLICATIONS



RAIL FOR GRIFFON APPLICATION

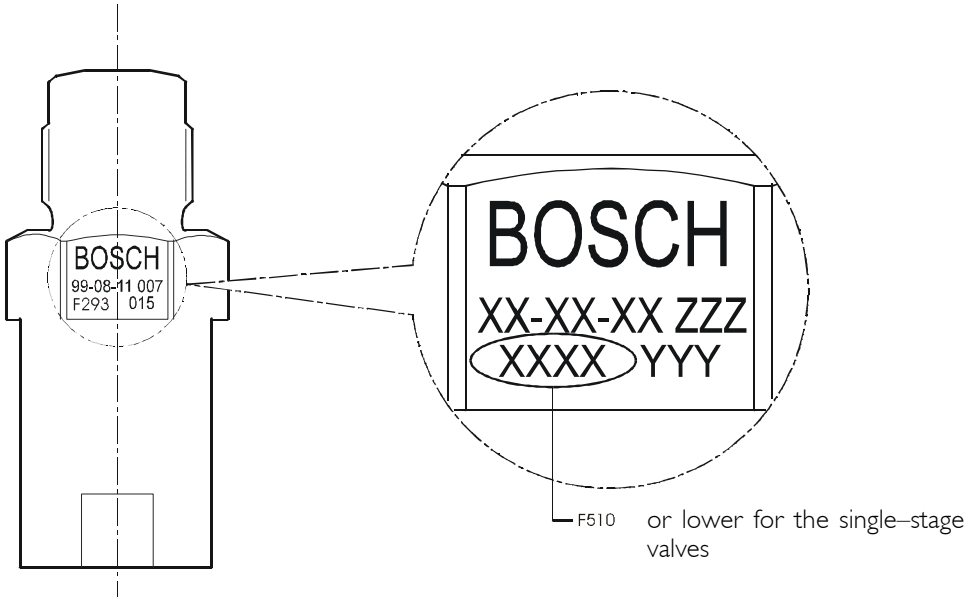
1. Common rail (one for each row) – 2. Flow limiters – 3. Fuel inlet from the high–pressure pump (one for each common rail) – 4. Pressure sensor – 5. Pressure relief valve (one on the right–hand rail)

Single–stage pressure relief valve (item 5, Figure 18)

Fitted at one end of the rail, its function is to protect the system's components if any malfunctioning of the rail pressure sensor or of the pump pressure regulator causes an excessive increase in the pressure of the high–pressure system.

The valve is a mechanical type and when the pressure in the high–pressure system reaches 1850 bar the valve opens to run fuel off into the outlet line and accordingly reduce the pressure to acceptable values.

Figure 19



Single–stage pressure relief valve (item 4, Figure 18)

Fitted at one end of the rail, its function is to protect the system's components if any malfunctioning of the rail pressure sensor or of the pump pressure regulator causes an excessive increase in the pressure of the high–pressure system.

The valve is a mechanical type and when the pressure in the high–pressure system reaches 1850 bar the valve opens to run fuel off into the outlet line and accordingly reduce the pressure to acceptable values.

Flow limiters (item 2, Figure 18)

Located on the fuel outlet unions from the common rail, they protect the engine and vehicle in the event of larger fuel leakage after the flow limiter (e.g. a jammed open nozzle) or external leakage (e.g. damage in high–pressure pipes).

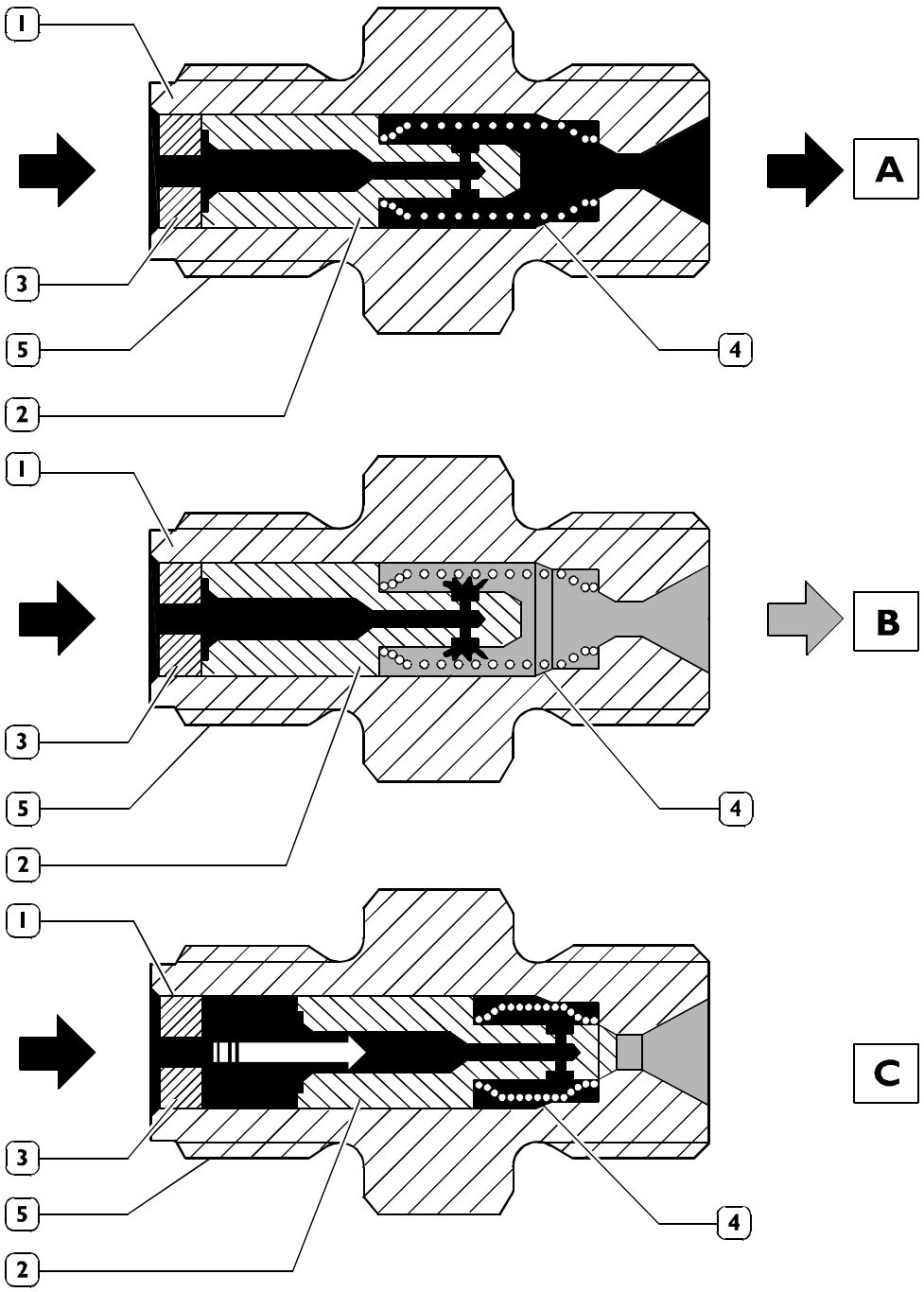
Under this circumstance, cut off the fuel to the cylinder in question.

To reset the flow limiter it is necessary to stop the engine in order to zero the rail pressure.

However, if the cause of it switching on is not removed, the same fault will occur the next time the engine is started.

If the leakage is considerable, it will be impossible to restart the engine due to the lack of pressure in the rail.

Figure 20



1. Body - 2. Piston - 3. Fuel inlet - 4. Spring - 5. Part bolted onto the common rail

A The flow of fuel from the common rail to the injectors takes place via the ports in the small diameter of the piston.

In normal conditions, the pressure of the fuel is exerted on both sides of the piston, maintained by the spring in the opening position

B If there is a substantial loss in pressure downstream of the limiter, the inlet pressure becomes predominant and moves the piston to the opposite side, obstructing the outlet of the fuel.

C Limiter with piston in outlet closed position.

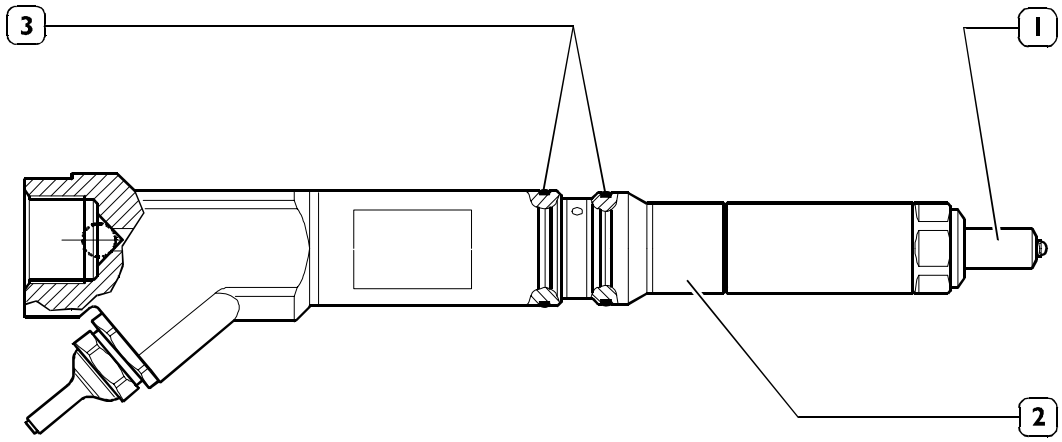
Electro–injector

The high–pressure pump keeps the delivery fuel pressure constantly high, irrespective of the phase and the cylinder that must receive the injection and it accumulates the fuel in the common rail and piping to all the electro–injectors.

At the electro–injector inlet there is therefore always fuel available at the injection pressure calculated by the engine's electronic control unit (ADEM III).

When the solenoid valve of an electro–injector is energized by the electronic control unit, fuel taken directly from the rail is injected into the relevant cylinder.

Figure 21



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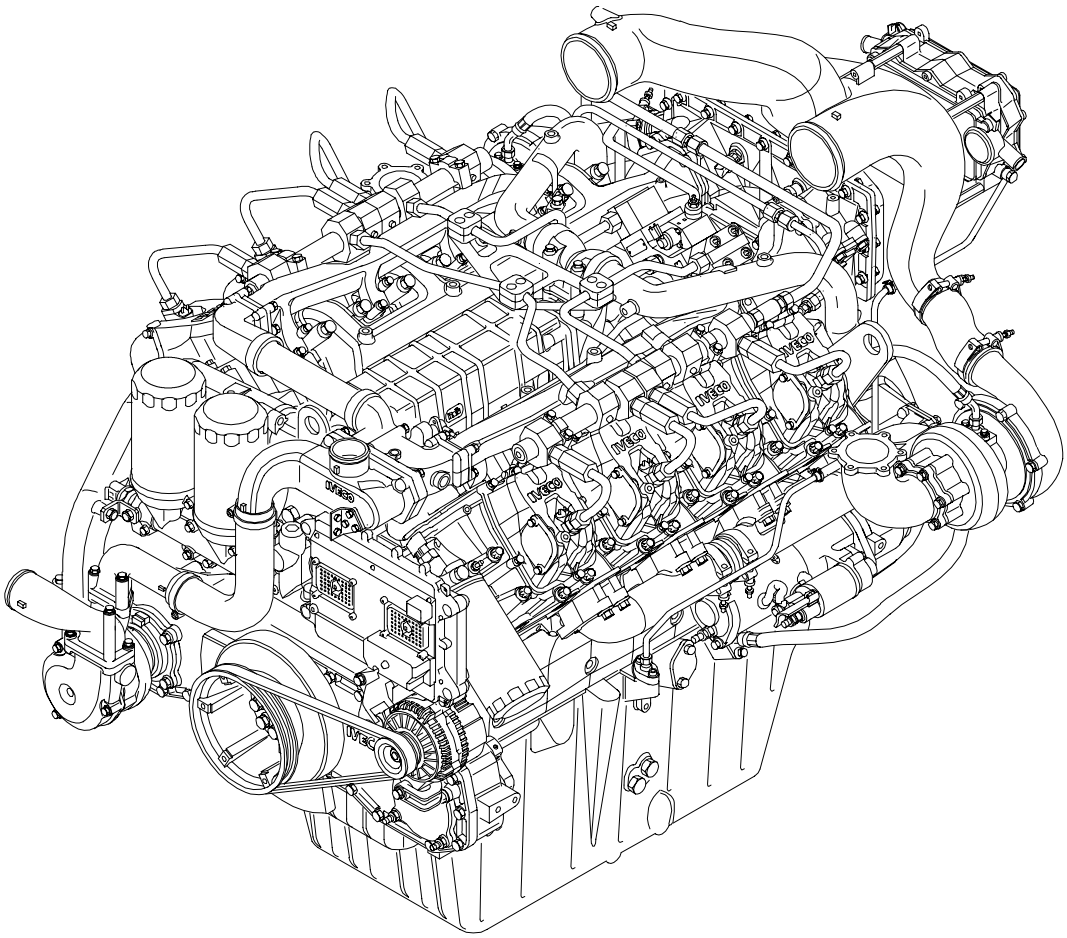
1. Nozzle – 2. Electro–injector – 3. Seals

SECTION 3
Industrial application

GENERAL SPECIFICATIONS

Figure 1



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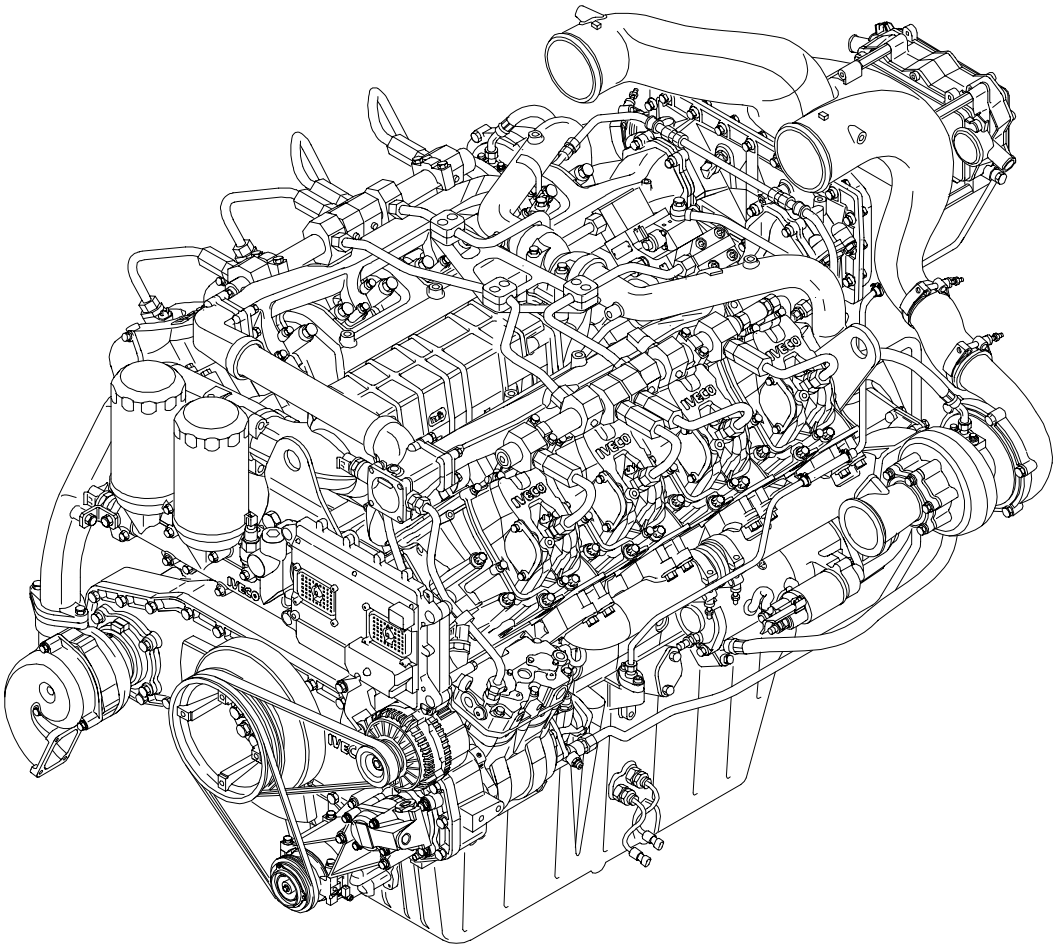
G-DRIVE application

Figure 2



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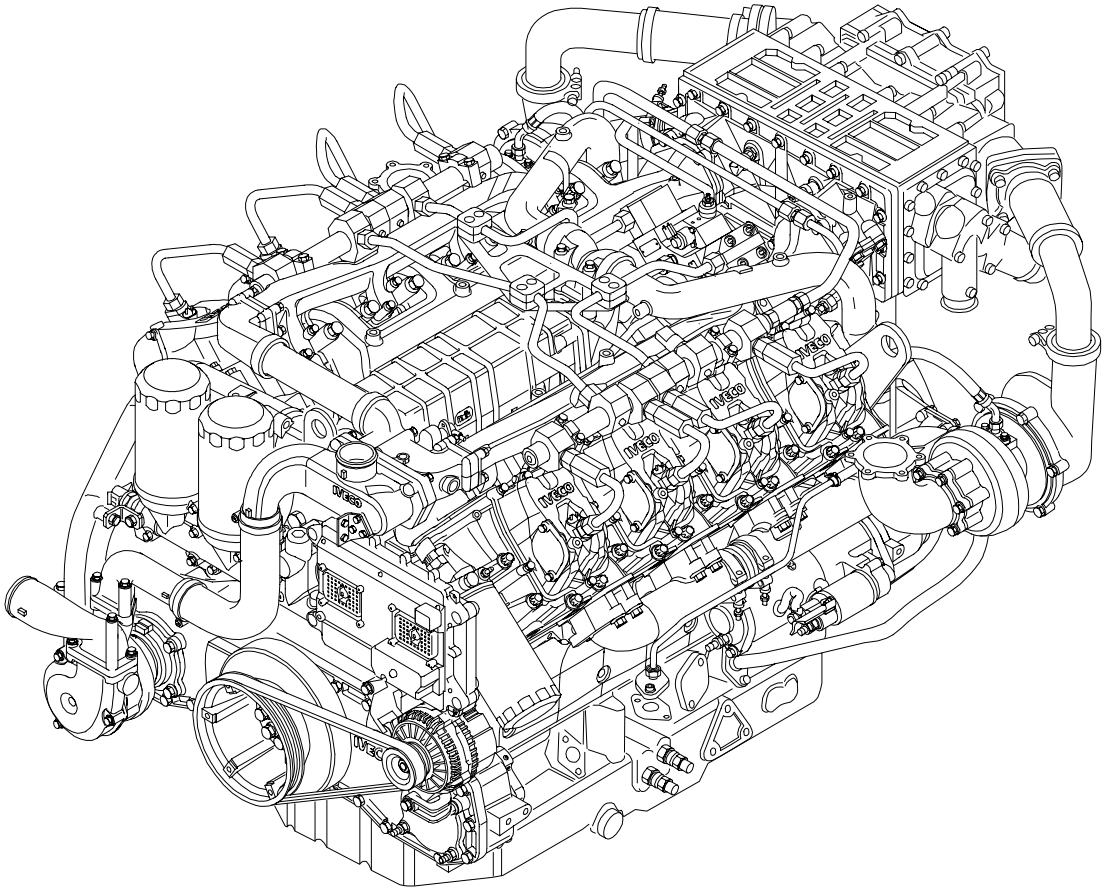
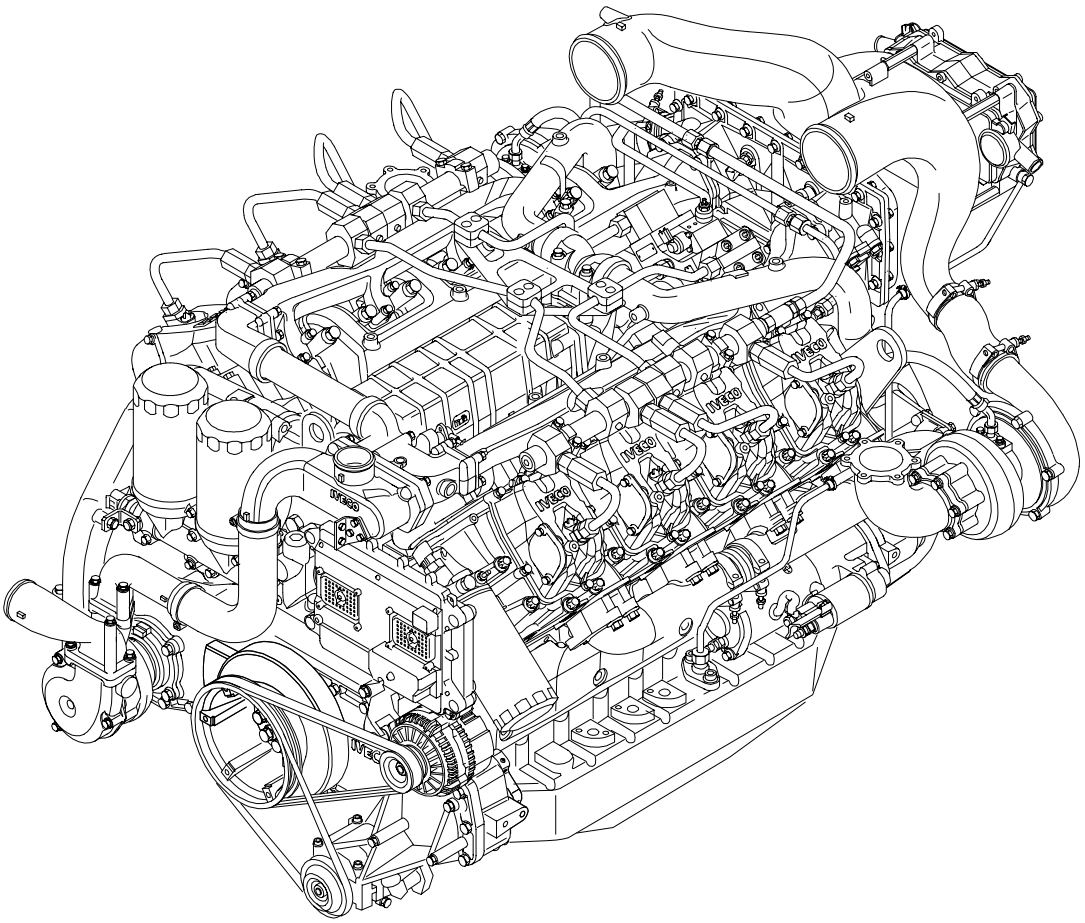
DRAGON application

Figure 3



SPRINKLER application

Figure 4



GRIFFON application

VECTOR engines feature a 4 stroke diesel cycle with supercharging with 8 cylinders in two banks at 90°.

They have high pressure injection fuelling (common rail) and are entirely electronically driven in order to optimise the working process in accordance to the operation, limiting as much as possible the pollution emissions and consumption.

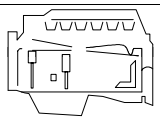
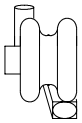
NOTE Data, features and performances are valid only if the setter fully complies with all the installation prescriptions provided by Iveco Motors.

Furthermore, the users assembled by the setter shall always be in conformance to couple, power and number of turns based on which the engine has been designed.

The section herein described is composed or four sections:

- ❑ Section of mechanical overhaul prescribed in accordance to the engine's specific duty, illustrating all necessary operation to remove and assembly the external components of the engine, including cylinder heads, gearbox of the timing system and of the front part cover;
- ❑ Electrical section, describing the connections to the different components of the engine control module and of the sensors assembled to the engine;
- ❑ Diagnosis section;
- ❑ Section of preventive maintenance operations, providing instructions for the execution of the main operations.

Clearance data - 8 cyl.

	Type		VECTOR 8			
			FVAE2885 X*F100	**FVAE2884 A*B201**	**FVAE2884 A*B200**	**FVKE2887 A*A200**
ϱ	Compression ratio		16 : 1			
	Max. output	kW (HP) rpm	560 (760) 2100	- - -	745 (1000) 2200	680 (920) 2100
	Max. torque	Nm (kgm) rpm	3200 (320) 1400÷1700	- - -	3960 (396) 1400÷1700	3200 (320) 1500
	Loadless engine idling	rpm	> 800	-	600 ± 25	-
	Loadless engine peak	rpm	< 2300	-	2350 ± 25	-
	Bore x stroke		145 x 152			
	Displacement	cm^3	20080			
	**TURBOCHARGING**		with intercooler			
	Turbocharger type		HOLSET HX55		KKK-K31	HOLSET HX55
	**LUBRICATION**		Forced by gear pump, relief valve single action oil filter			
	Oil pressure (warm engine)					
	- idling	bar	4.0			
	- peak rpm	bar	Up to 6.5			
	COOLING		By coolant			
	Water pump control		Through an idler gear			
	Thermostat					
	- start of opening	°C	70 ± 2			
 15W40 ACEA E3 ACEA E5	**FILLING**					
	engine sump	liters	80			

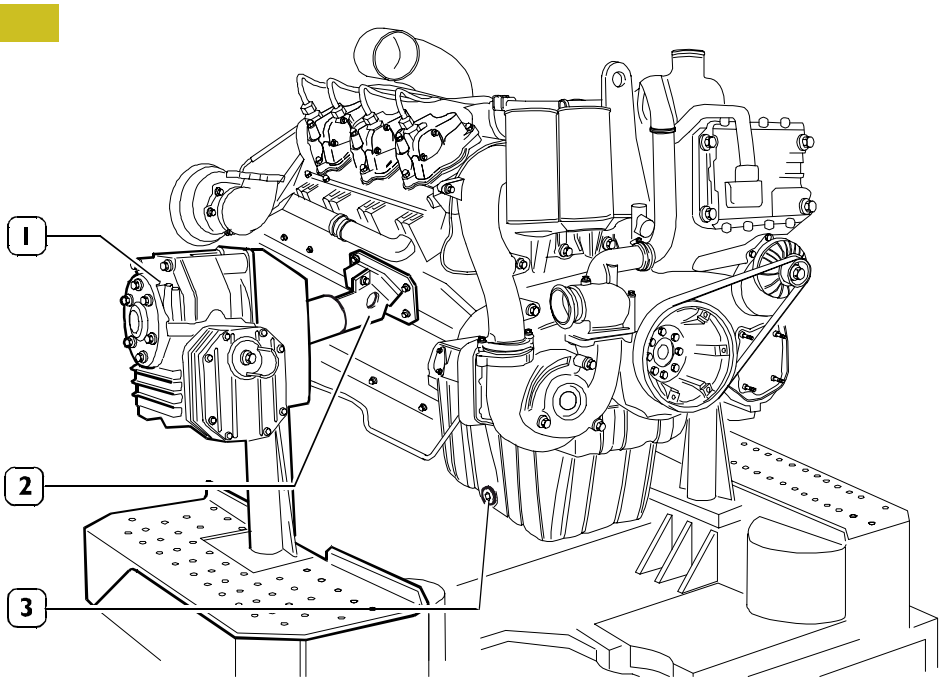
NOTE Data, features and performances are valid only if the technician fully complies with all the installation requirements provided by Iveco Motors.

Furthermore, the use of the unit after overhaul showd conform to the original specified power and engine rev/min for which the engine has been designed.

PART ONE -
MECHANICAL COMPONENTS

ENGINE OVERHAUL

Figure 1



Preface

NOTE All operations of Engine disassembly operations as well as overhaul operations must be executed by qualified technicians provided with the specific tooling and equipment required.

The following information relates to the engine overhaul operations only for what concerns the different components customising the engine, according to its specific duties.

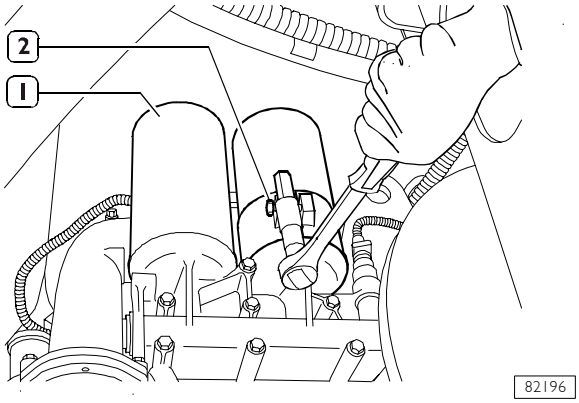
In section "General overhaul", all the operations of engine block overhaul have been contemplated. Therefore the above mentioned section is to be considered as following the part hereby described.

Dismantling

- ❑ Remove the protective grilles from the exhaust manifolds and from the turbochargers from the engine.
- ❑ Remove the dipstick complete with guide pipe from the sump.Also remove the oil filler.
  Seal appropriately to prevent particles of dirt from entering.
- ❑ Secure the engine to the rotary stand 99322230 (1) with the brackets 99361011 (2); drain off the lubrication oil from the engine sump through the plug (3).

Handle all components very carefully. Do not put your fingers between different components. Always wear recommended protective clothing such as goggles, gloves, safety shoes and protective headgear.

Figure 2



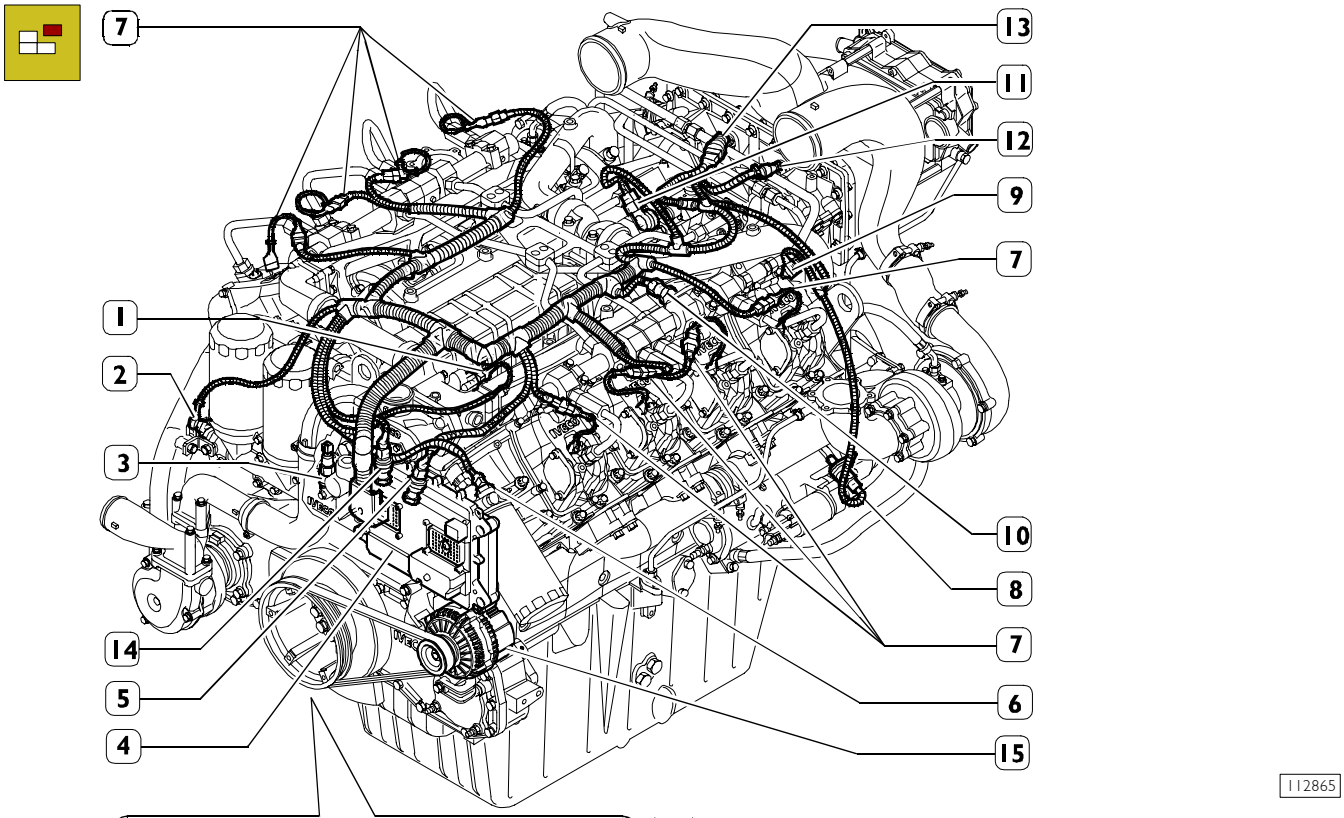
- ❑ Remove the oil filters (1) using the special tool 99368501 (2).

NOTE Before disassembling, place under the filter a basin of suitable capacity.

Improper waste disposal is a threat for the environment. Potentially hazardous waste includes lubricants, fuels, coolants, filters and batteries.

- Use watertight containers when draining off fluids. Never use containers for foodstuffs or beverages that can lead people to drink from them.
- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

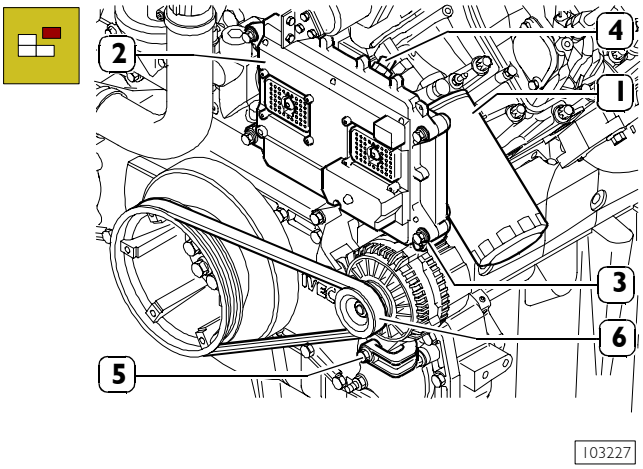
Figure 3



❑ Remove the engine wiring: disconnect the wiring from coolant temperature sensor (1), sensors (2 and 14), XJ2 connector from ADEM III (4), atmospheric pressure sensor (5), fuel temperature sensor (6), electro injector (7), engine speed sensor (8), timing system speed sensor (9), common rail fuel pressure sensor (10), common rail high pressure control solenoid valve (11), turbo–blower air temperature sensor (12) and air pressure sensor in the intercooler (13).

NOTE The oil filter blockage sensor (3) and the alternator (15) are not connected to the engine lead.

Figure 4



❑ Remove the diesel filter (1) using tool 99360091.

NOTE On the DRAGON and GRIFFON applications, the fuel filters are fitted in a remote position.

❑ Remove the ADEM III engine management control unit (2) from its mounting undoing the bolts for the flexible mountings (3).

❑ Remove the atmospheric pressure sensor (4) from the support.

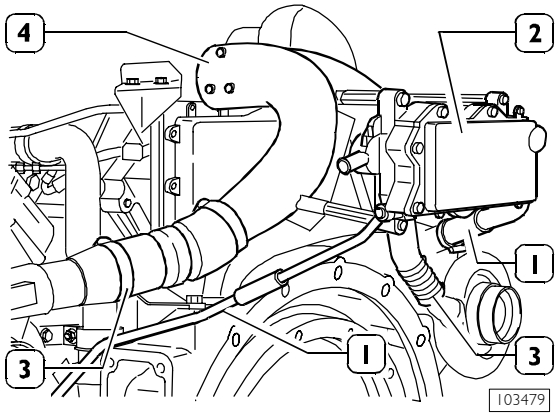
❑ If present on the application, remove the flexible belt (16) and the air conditioning compressor (17).

❑ Completely undo the screw (5) and release the belt (6).

❑ Remove the alternator complete with bracket.

❑ Remove the control unit support complete with diesel filter mounting.

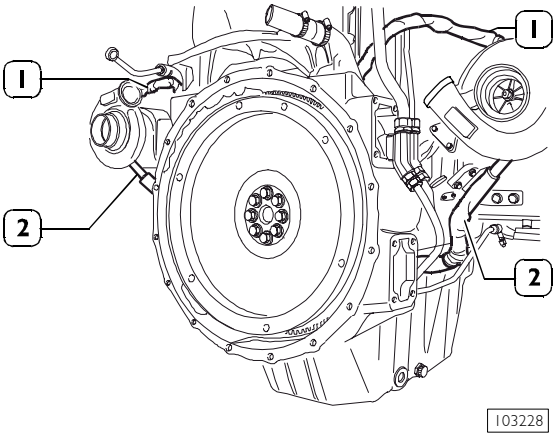
Figure 5



- ❑ Remove the pipes (1) to the blow-by filter (2) from the flywheel side.
- ❑ Undo the 4 bolts fixing the filter casing to the air intake manifolds from the turbocharger body to the heat exchanger (air/air intercooler) removed previously together with the air filters.
- ❑ Loosen the bands (3) on both sides of the hoses near the turbochargers.
- ❑ Undo the bolts from underneath the bracket above the flywheel to release the manifold (4). Remove the manifold securing it appropriately.

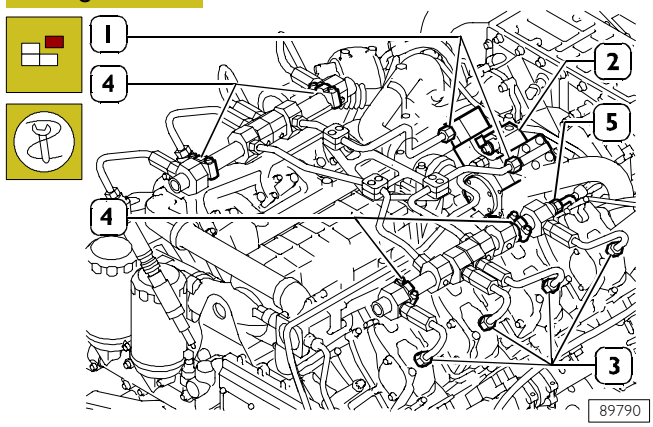
NOTE After having checked the cleanliness inside the manifold, seal the three ends to preserve it. Check the wear of the hoses in the case of obvious signs of cracks or if there is a loss in the normal flexibility replace them.

Figure 6



- ❑ Remove the lubrication pipes from both turbines: disconnect the oil intake pipe (1) from the crankcase at the top flange on the body of the turbo–blower and the exhaust pipe (2) from the bottom of the body of the turbo–blower and from the seat on the sump.
- ❑ Also remove the oil pipes at the sump from the blow-by filter removed previously.
- ❑ Remove the band fastening the pipe on the flywheel casing and then undo it from the flange on the engine sump.

Figure 7

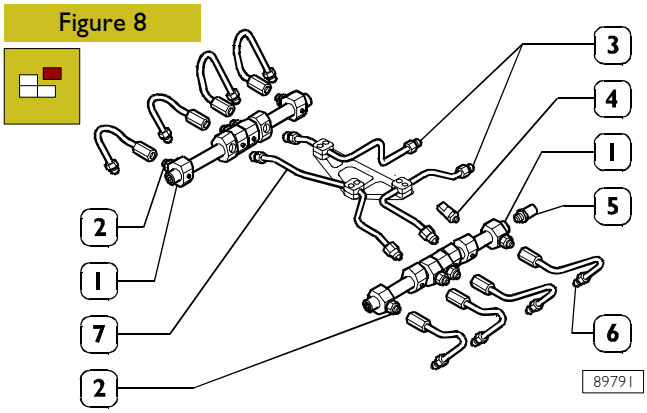


- ❑ Loosen the rail check u-bolt (4) fixing screws.
- ❑ Disassemble the assembly of the delivery pipes (1) from the high pressure pump (2) and the ones on the electro-injectors;
  unscrew the washers (3) with a 99368506 wrench.
- ❑ Remove the rail assembly
- ❑ Disassemble the diesel fuel exhaust pipes from the overpressure valve rail (5).

NOTE Plug all the pipes in order to prevent possible contamination. Unscrew the fittings seeing to protect the seal surfaces.

NOTE If it is hard to disassemble, loosen the washers of the electro-injector supply pipes on the rail side, of the compensation pipes between the rail and the rail side supply.

Figure 8



RAIL ASSEMBLY FOR G-DRIVE / DRAGON / SPRINKLER APPLICATIONS
Common rail (1), flow limiting device (2), delivery pipes to the rail from the high pressure pump (3), pressure sensor (4), overpressure valve (5).

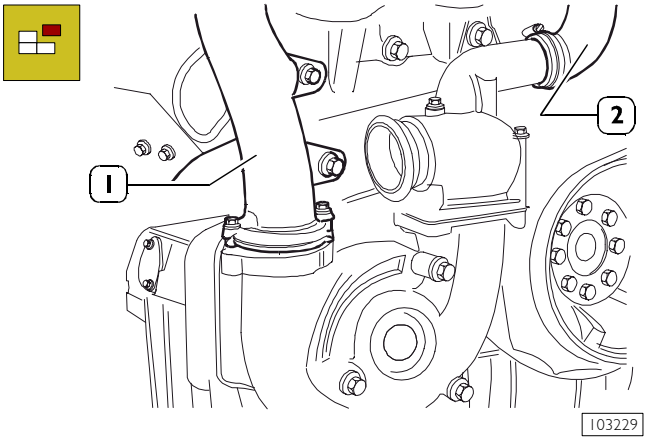
NOTE The RAIL assembly for GRIFFON applications is shown on page 21 of the section 2.

On the bench separate the pipes that are between the rail and the support. Check the conditions of the thread seal conic surfaces. Plug all pipes in order to prevent contamination

NOTE If there is a malfunction with components (2), (4) or (5), replace the rail assembly (1).

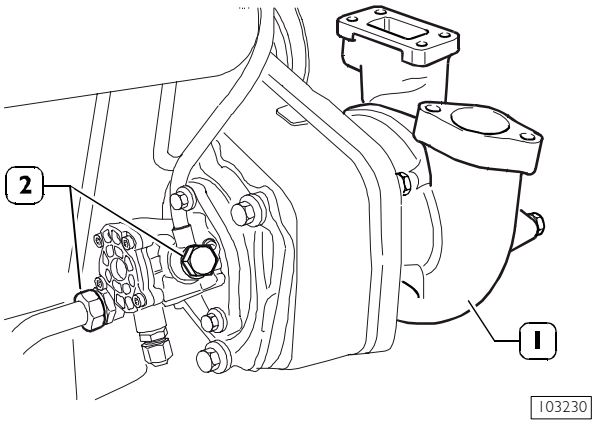
- ❑ Remove all the diesel return pipes: those of the injectors and the one from the high–pressure pump.

Figure 9



❑ Remove the pipe (1) which connects the pump to the water/oil heat exchanger fitted between the two banks and remove the hose (2) between the thermostat body and the elbow connector on the pump.

Figure 10



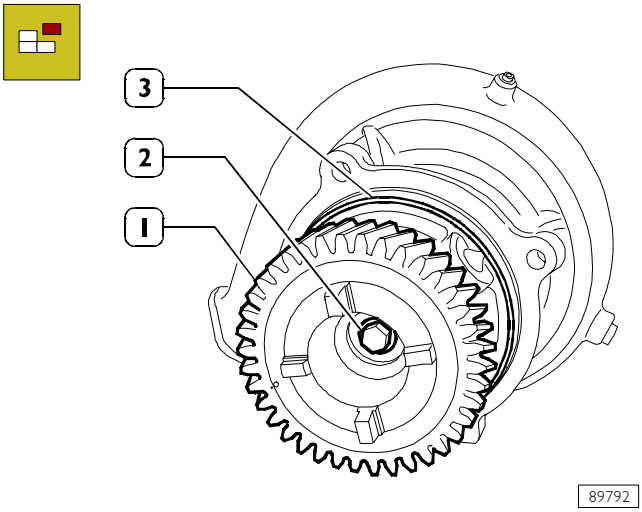
❑ Support the cooling pump (1) and undo the four fixing nuts.
Thoroughly release the pump assembly for the inlet pipes.

❑ Disconnect the pipes (2) from the rear of the gear casing.

NOTE Seal the pipes and the connectors on the pump.

Fully drain off the coolant contained in the cooling pump.

Figure 11



❑ Inspect the hydraulic pump and especially the state of wear of the teeth of the driving gear (1) (both those receiving motion from the gearbox and the front teeth transmitting motion to the pump of the primary cooling circuit).

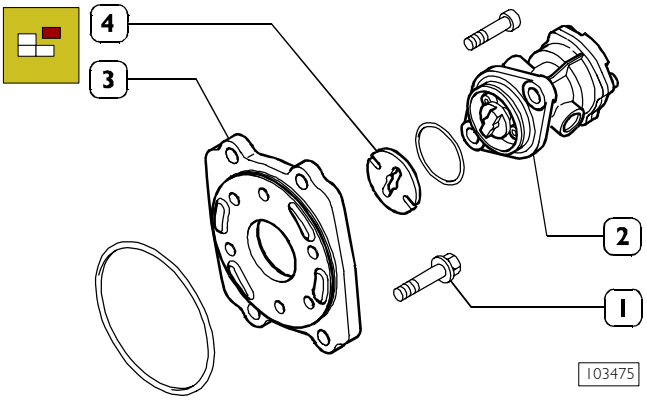
❑ Replace if there is excessive gear wear: lock gear (1) rotation properly and loosen screw (2). Disassemble the gear and set the screw aside.

NOTE The gear has a left-hand locking screw.

NOTE The hydraulic sealing of the pump is assured by a gasket (3). If the same pump is used again replace the above mentioned seal before reassembly.

For G-DRIVE, GRIFFON and SPRINKLER applications

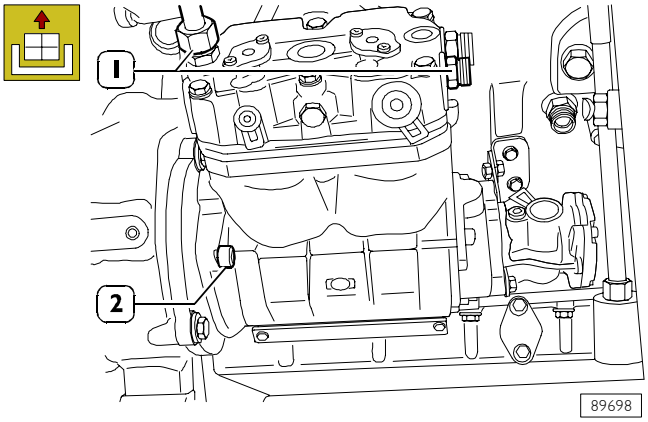
Figure 12



- ❑ Unscrew the three screws (1) fixing the support to the gearbox and remove the the low–pressure supply pump (2).
- ❑ On the bench, go ahead and remove the support (3) and separate the low–pressure supply pump (2); in addition, remove the coupling drive (4).

For DRAGON applications

Figure 13

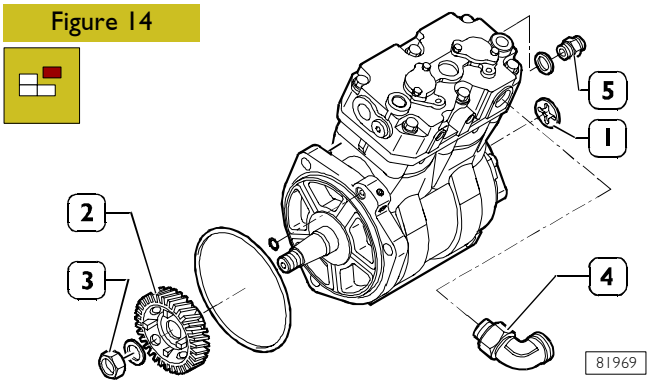


- ❑ Disconnect the coolant connecting pipes (1).

NOTE It is advisable to plug both the pipes and the ports on the compressor that has to be shipped for overhaul.

- ❑ Unscrew the fixing screws of brakets (13, Figure 15)
- ❑ Unscrew the screws (2, Figure 13) fixing the compressor on the spacer.

Figure 14

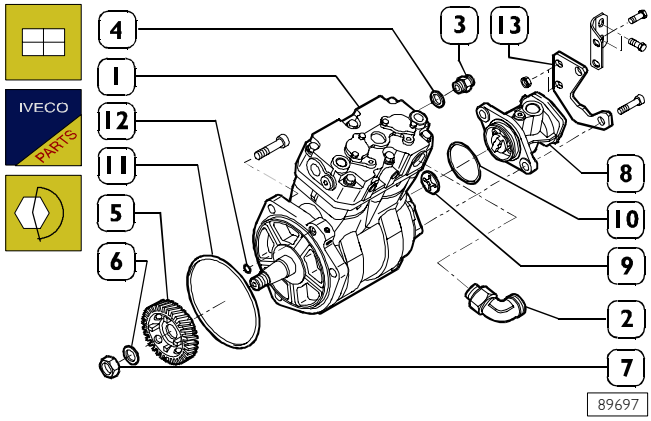


- ❑ Take the compressor to the workbench and separate the low-pressure pump (if not previously removed).

NOTE Recover the universal joint (1), checking its state of wear.

- ❑ After firmly securing the compressor in a vice, remove the gear (2) by unscrewing the nut (3) and using a specific extractor. In addition, remove the fittings (4) and (5).

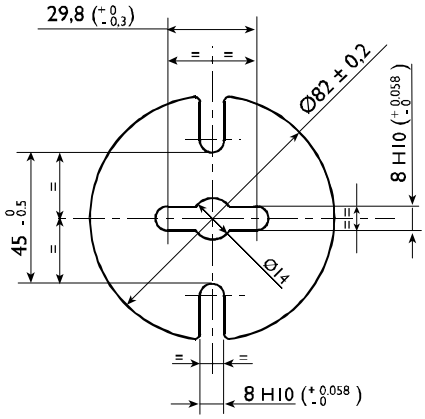
Figure 15



- ❑ Unscrew the screw (13) that fixing the LPP (8) to air compressor.
- ❑ Divide the LPP (8) from air compressor and recover coupling drive (9) and O-ring (10).

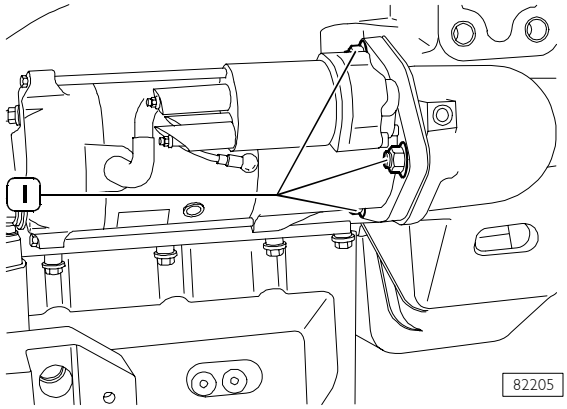
For all applications

Figure 16



- ❑ Check the state of wear of the coupling drive and its coupling with the low–pressure pump spindle.

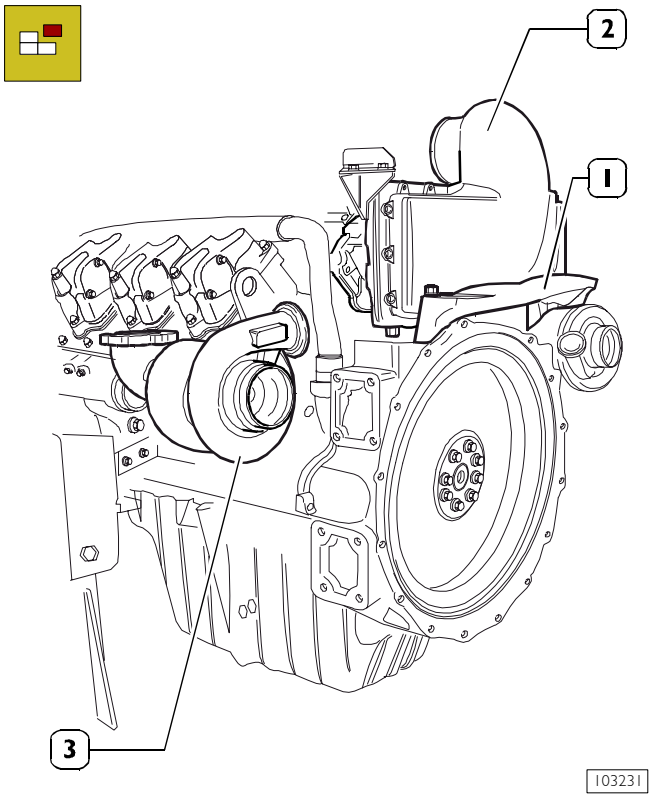
Figure 17



- ❑ Remove the starter motor by unscrewing the three nuts (1).

For G-DRIVE, DRAGON and GRIFFON applications

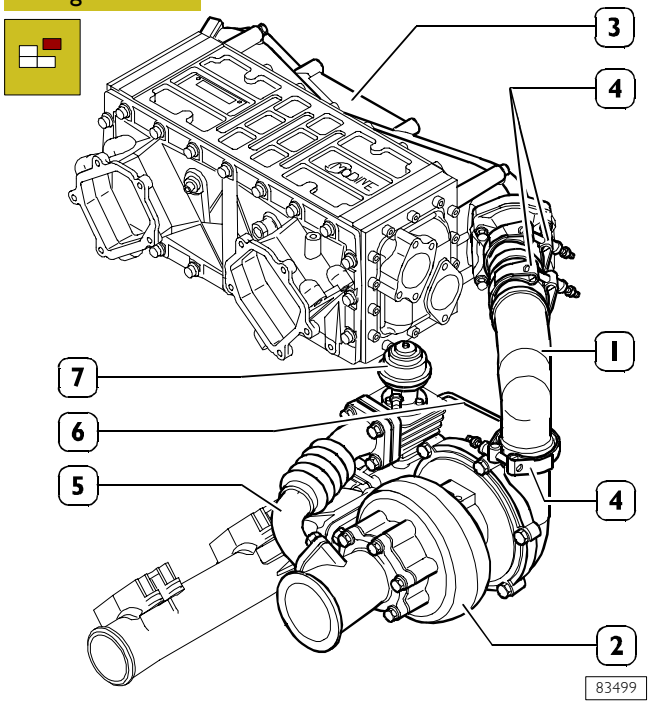
Figure 18



- ❑ Remove the bracket (1) for the flywheel and intercooler casing (2).
- ❑ Undo the nuts fixing the turbocharger (3) to the exhaust manifold.
- ❑ Then repeat this procedure for the second turbo–blower.

For SPRINKLER applications

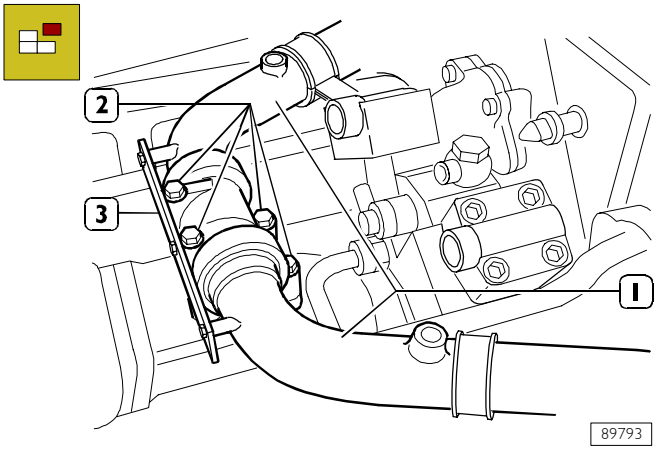
Figure 19



- ❑ Remove the manifold (1) between the turbo–blower (2) and the intercooler (3), loosening the clamp (4) on the manifold and on the turbo–blower .
- ❑ Remove the exhaust pipe (5) between the waste gate valve (7) and the pipe of the turbo–blower.
- ❑ Remove the air pipe (6) between the turbo–blower and the waste gate valve (7).
- ❑ Lastly, unscrew the nuts fixing the turbo–blower to the exhaust manifold.
- ❑ Then remove the cooling pipes of the waste gate valve (7) and detach it from the exhaust manifold.
- ❑ Then repeat this procedure for the second turbo–blower.

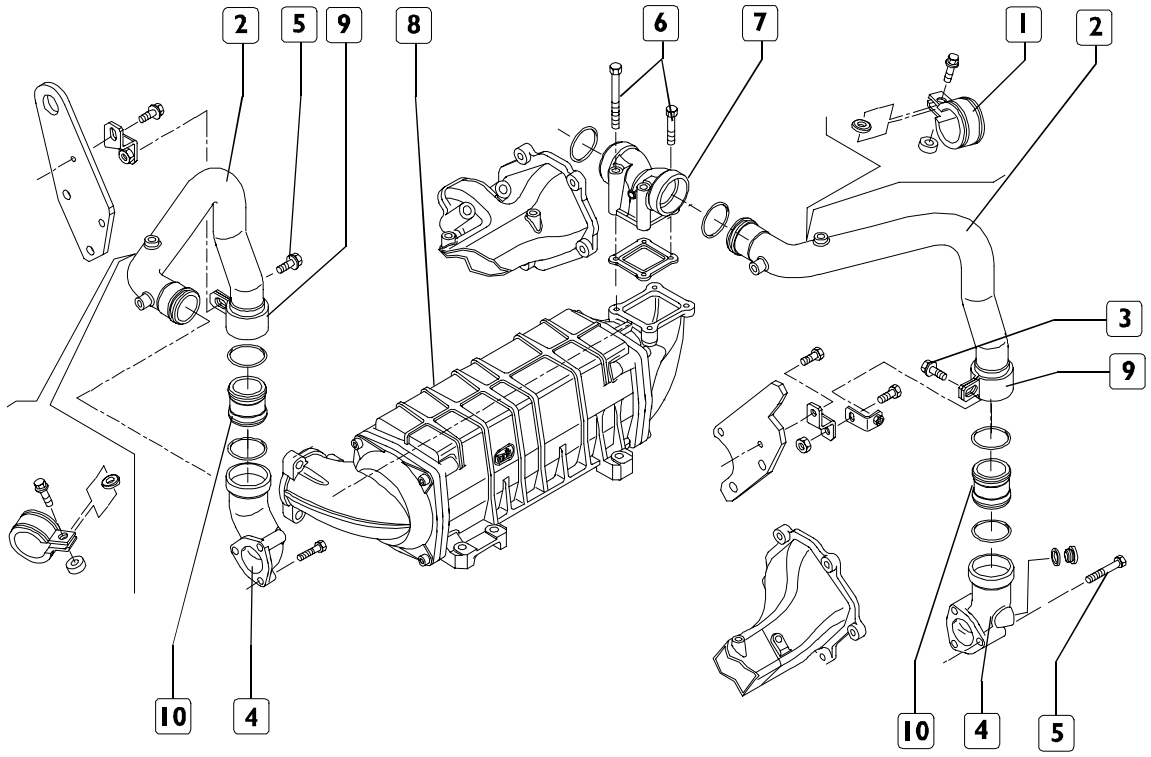
For all applications

Figure 20



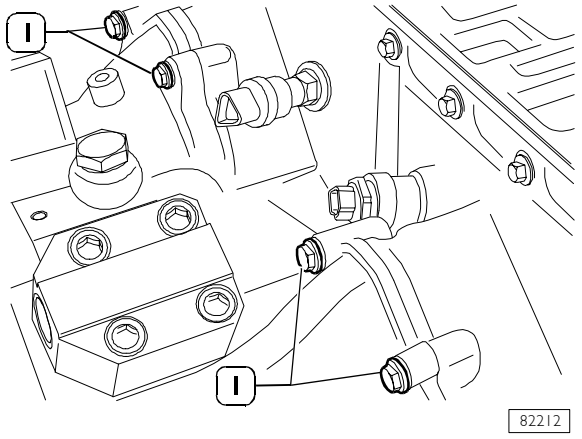
- ❑ Disassemble the junction plate (3) of the cooling pipes (1) and the three way fitting on the exchanger.
- ❑ Then disassemble the cooling pipes (1), the three way fittings by loosening the screws (2) and the fitting on the inlet of the main bearings.

Figure 21



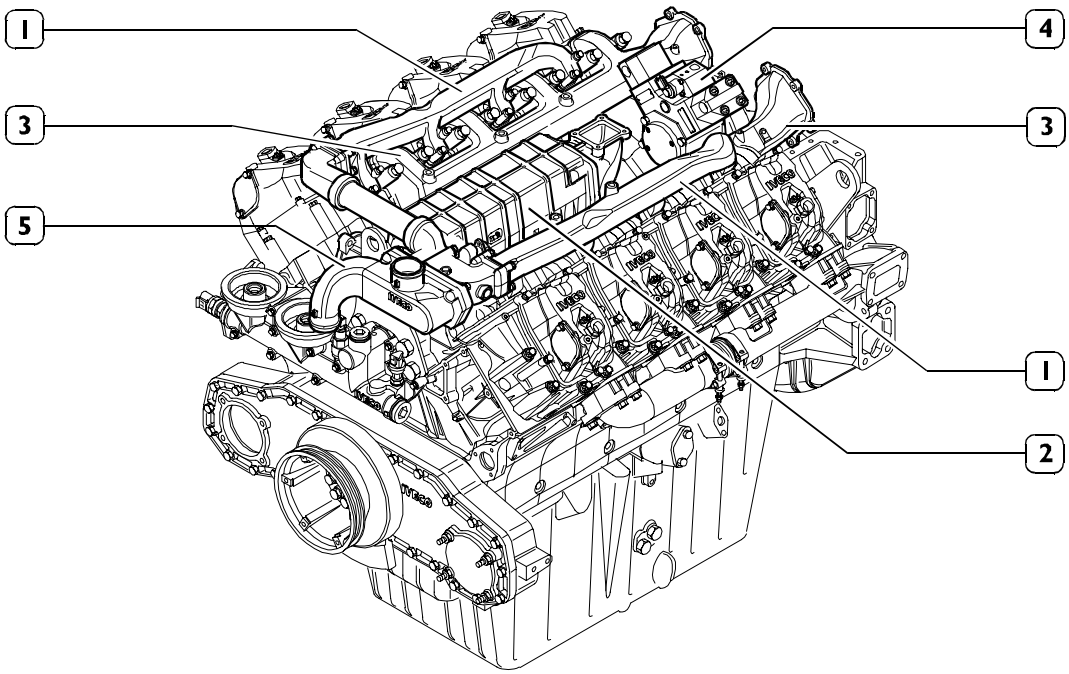
❑ Proceed as follows:
Undo the screws of the collars (1) securing the pipes (2) to the intake ducts.
Undo bolts (3) securing fastening collars (9) that join pipes (2) to fittings (4) on the engine blocks by means of gaiters (10).
Undo the screws (5) fixing the couplings (4) on the main bearings and at the top unscrew the screws (6) fixing the three–way coupling (7) on the oil/water cooler (8) of the engine oil.

Figure 22



❑ Unscrew the 10 screws (1) fastening the intercooler to the air intake manifolds.

Figure 23



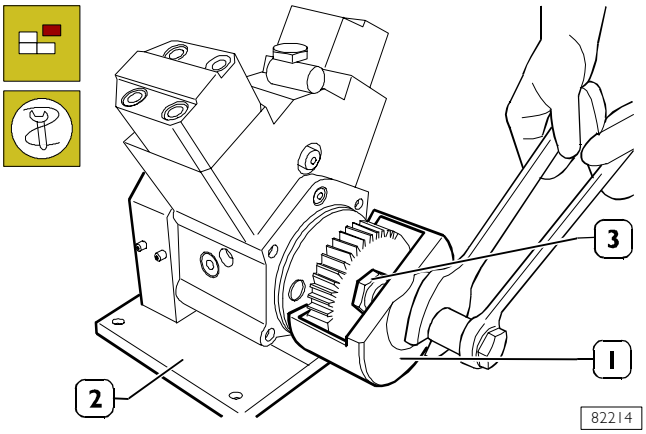
- ❑ Unscrew the fixing screws and remove the water outlet pipes (1) from the heads.
- ❑ Remove the thermostat casing (5).

NOTE Separate the screws appropriately, marking their placement to facilitate assembly.

- ❑ Then remove the engine water/oil cooler (2), unscrewing the M10 x 40 mm screws (three on both sides).
- ❑ Remove the diesel supply pipe from the high–pressure pump (the coupling has been removed together with the ADEM III control unit support).
- ❑ Remove the diesel recovery piping.
- ❑ Remove the intake manifolds (3), remove the gaskets and remove the high pressure pump (4) from the flywheel casing complete with gear.

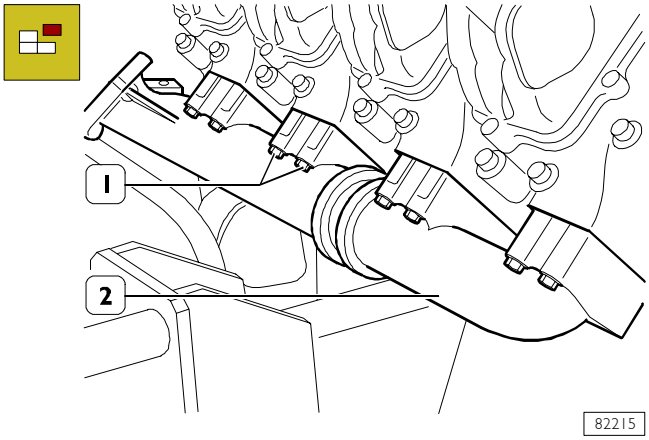
NOTE Separate the screws appropriately, marking their placement to facilitate assembly.

Figure 24



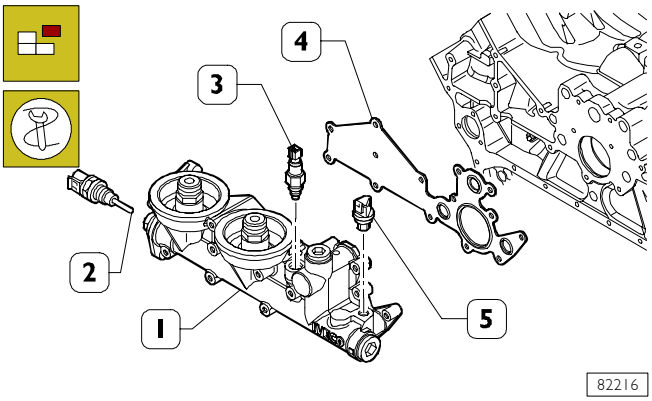
- ❑ Remove the driving gear with the aid of tools 99368516 (1), 99368517 (2) that permit unscrewing the M24 x 1.5 nut (3).

Figure 25



- ❑ Unscrew the screws (1) and remove the exhaust manifolds (2) on both sides comprehensive of seals.

Figure 26

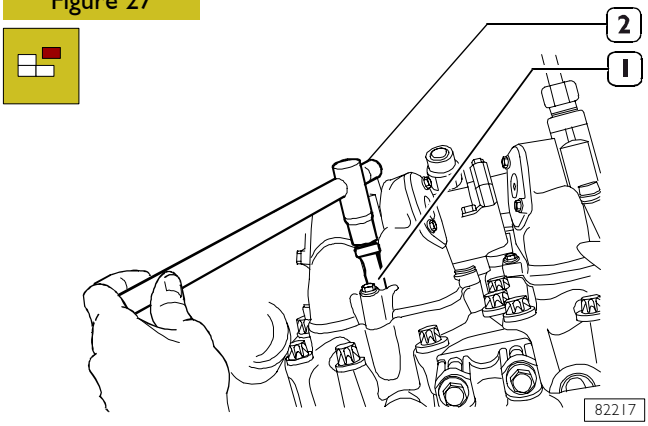


❑ From the front side disassemble the engine oil filter supports (1) including the oil temperature transmitters (2), the pressure sensor (5), the seal (4) and the filter clog sensor (3).

❑ Remove the remaining diesel pipe from the LPP to the filter mounting (the two components have already been removed previously)

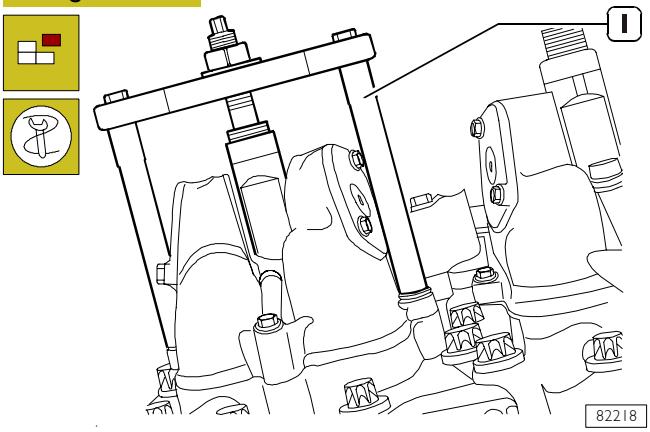
NOTE If necessary, replace the worn parts. Always change the seals in the assembly phase.

Figure 27



❑ Remove the electro–injectors. Using the wrench (2), unscrew the screw (1) of the fixing bracket.

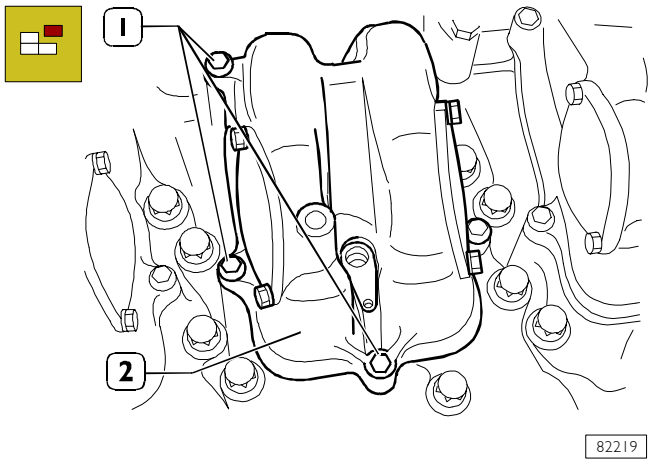
Figure 28



❑ Fit the tool 99368505 (1) and the wrench for extracting the electro–injector.

NOTE Always change the O–ring in the assembly phase. Lubricate the O-rings with vaseline before installating

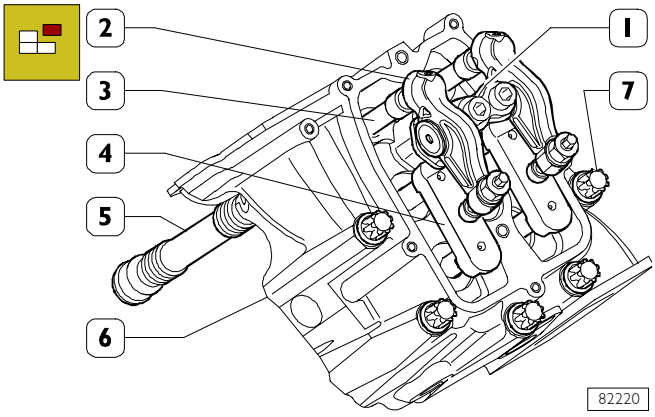
Figure 29



❑ Unscrew the fixing screws (1) and remove the tappet cover (2). Repeat this operation for all the covers.

NOTE Note down the position of the tappet covers in relation to the heads so as to fit them in the positions they had with the first assembly.

Figure 30

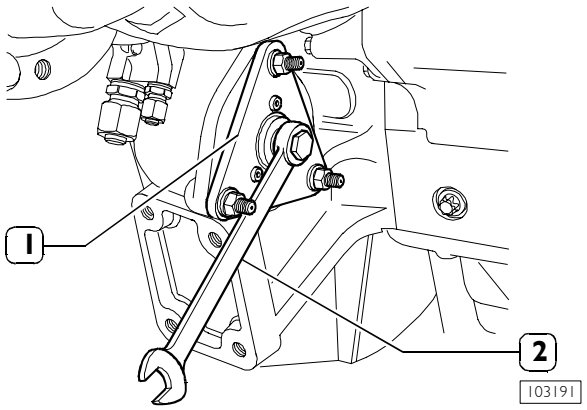


❑ Remove the rocker arms (2) from the support (1), taking out the circlips and seals on both sides of the support. Extract the rods (3) from their seat on the heads and the jumpers (4).

❑ Unscrew the fixing screws (7) and remove the head (6). Remove the cases (5) protecting the valves.

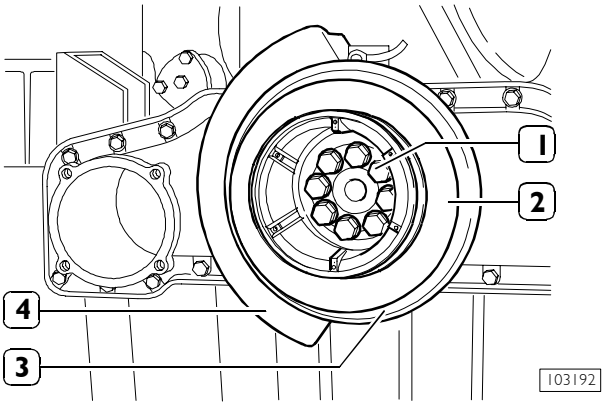
NOTE The screws (7) fixing the head on the crankcase have different sizes:
M15x170
M15x185
Mark them so as to facilitate the assembly phase.

Figure 31



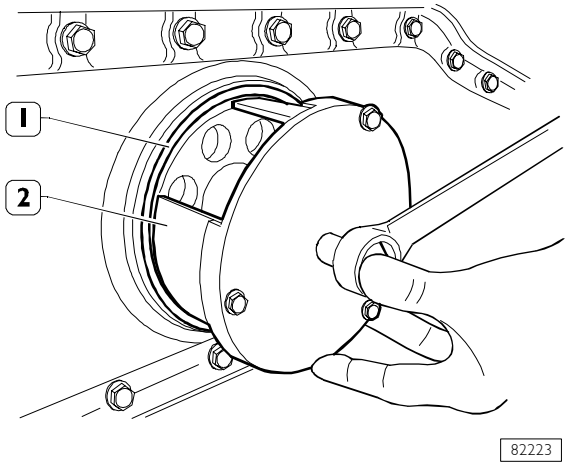
❑ Fit tool 99368502 (1) and place the fixed spanner (2) as shown in the diagram to prevent the rotation of the flywheel during the dismantling of the pulley and the damper flywheel on one side and the actual flywheel on the other.

Figure 32



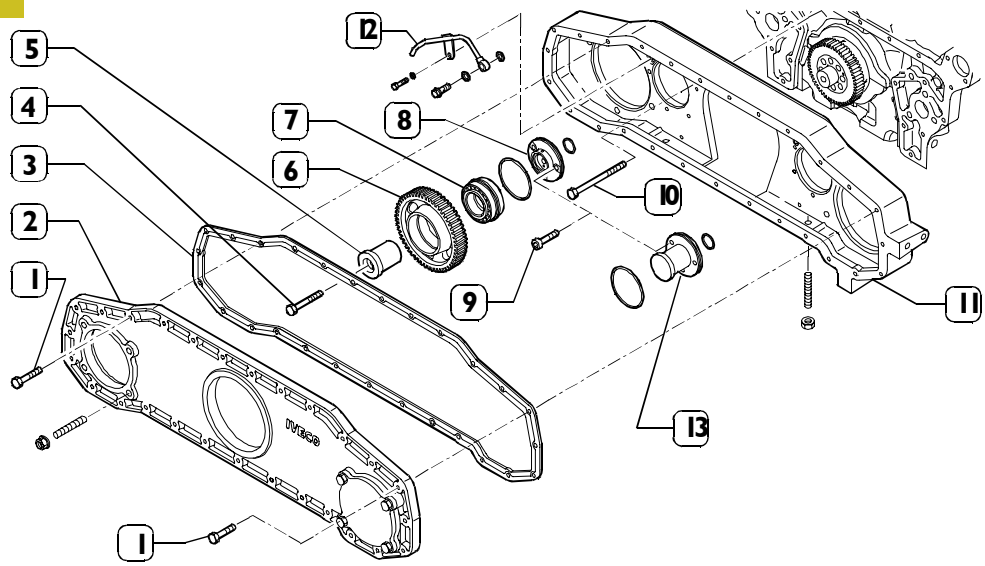
❑ At the front, undo the 8 botls (1) and remove the pulley (2), the damper flywheel (3) and the counter-weight (4).

Figure 34



❑ Remove the oil seal (1) using the tool 99368514 (2).

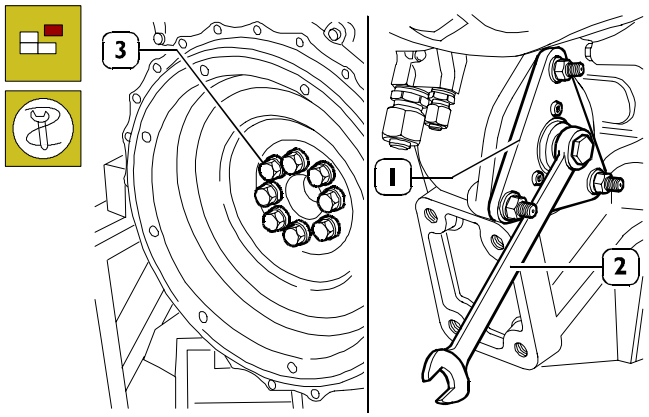
Figure 33



❑ Undo the M8 bolts (1) and remove the cover (2) for the gear casing. Remove the gasket (3).
❑ Remove the duct (12).
❑ Unscrew the screw (4), remove the shaft (5) and the gear (6) with the bearing (7).

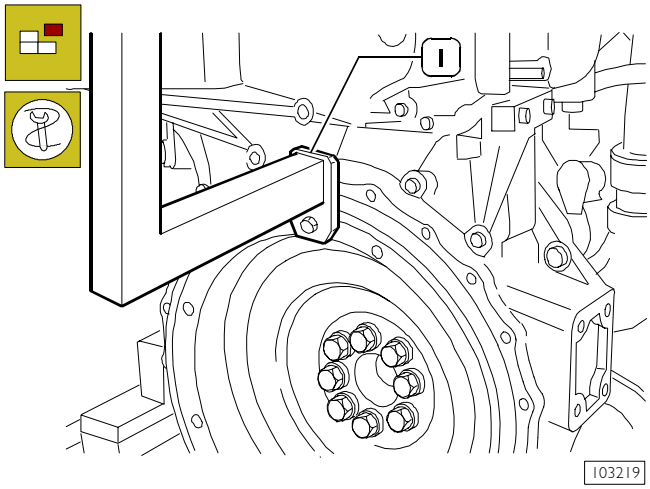
❑ Rotate the engine and remove the oil sump.
❑ Remove the engine lubricating oil pump with the suction cup.
❑ Undo the bolt (10) securing the gear casing (11) to the cylinder block/crankcase; after having removed the gear casing, undo the bolt (9) and remove the spacers (8) and (13) complete with O-rings.

Figure 35



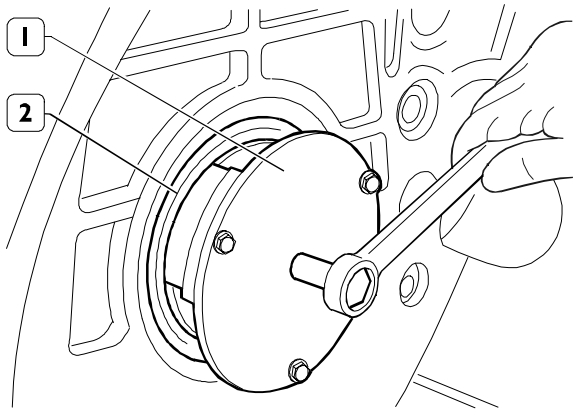
❑ From the inside of the flywheel box prevent flywheel rotation by using rotation tool 99368502 (1) and fixed wrench (2). Then loosen screws (3).

Figure 36



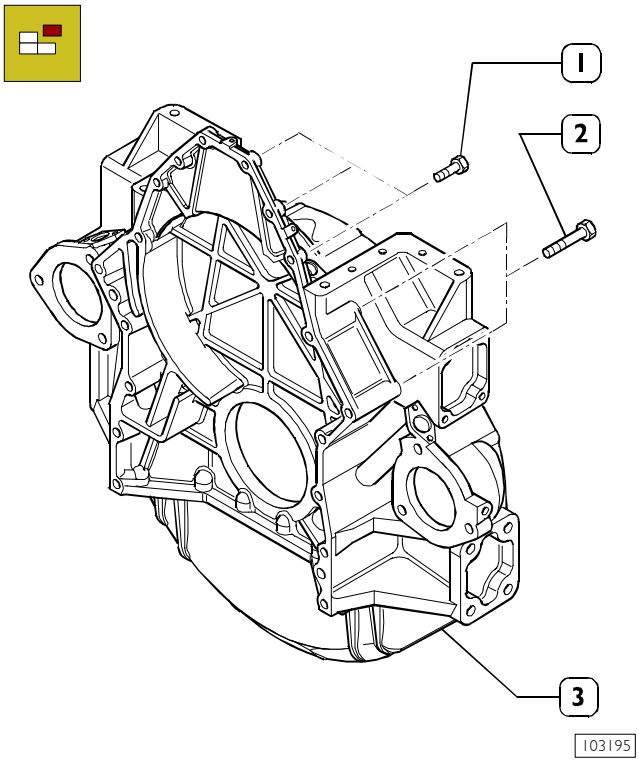
❑ Fit the supporting tool 99368533 (1) for disassembling and assembling the flywheel. Go ahead and unscrew the flywheel fixing screws. Remove washer and engine flywheel assembly.

Figure 37



❑ Fit the tool 99368513 (1) and extract the rear oil seal (2).

Figure 38



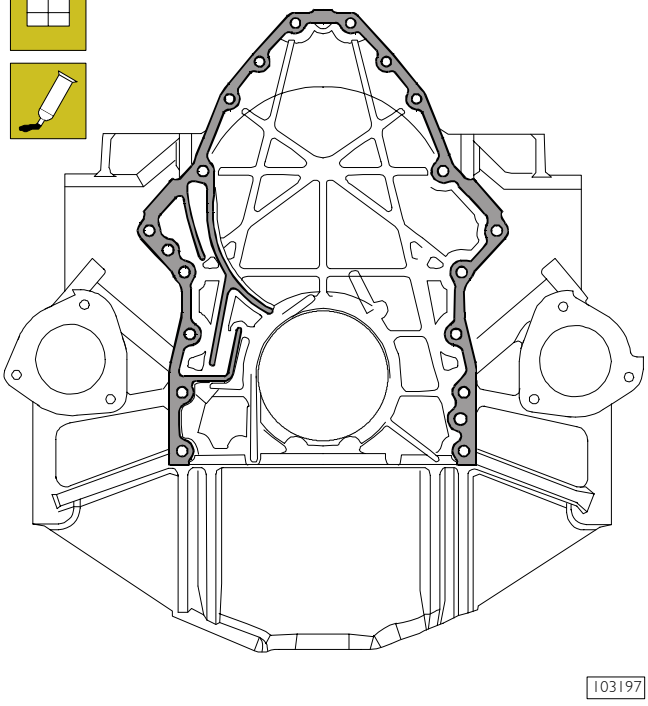
❑ Unscrew the screws (1), (2) and (3) after suitably slinging the flywheel cover casing (4). Detach the flywheel cover casing from the crankcase.

NOTE Mark the position of the screws (1), (2)
Screws (1): M12x35 mm 6 bolts tot.
Screws (2): M14x90 mm 12 bolts tot.

Installation of components for the application
Fitting the flywheel cover housing

❑ Carefully clean the contact sides between the crankcase and the flywheel cover housing, removing any remains of sealant with a scraper.

Figure 39



103197

❑ Form a bead of IVECO 2992692 sealant as shown in the figure.

A perfect seal is only obtained by carefully cleaning the surface to seal.

Smear the case with IVECO SEAL 2992692 to obtain a bead of a few mm diameter.

It shall be uniform (no clots), without air bubbles, thin areas or discontinuities.

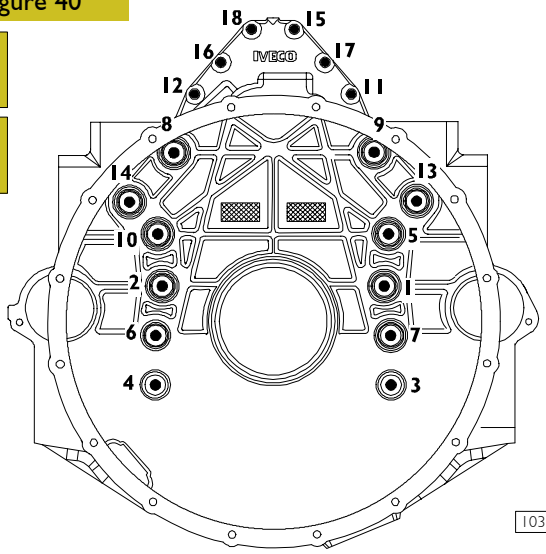
Any imperfection shall be corrected as soon as possible.

Avoid using excess material to seal the joint.

Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joint shall be assembled immediately (10–20 minutes).

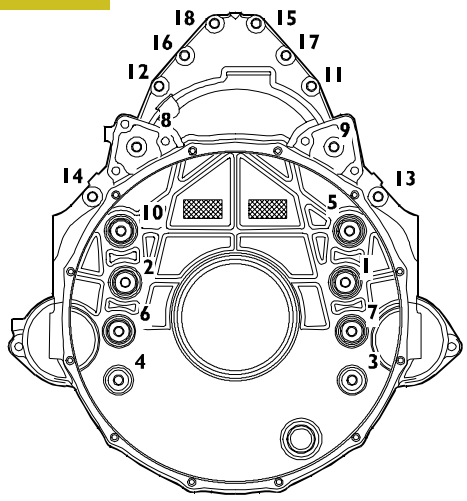
Figure 40



103198

DIAGRAM SHOWING TIGHTENING ORDER FOR BOLTS FIXING FLYWHEEL COVER CASING ON G-DRIVE APPLICATION

Figure 41



83507

DIAGRAM SHOWING TIGHTENING ORDER FOR BOLTS FIXING FLYWHEEL CASING COVER FOR GRIFFON, DRAGON and SPRINKLER APPLICATIONS

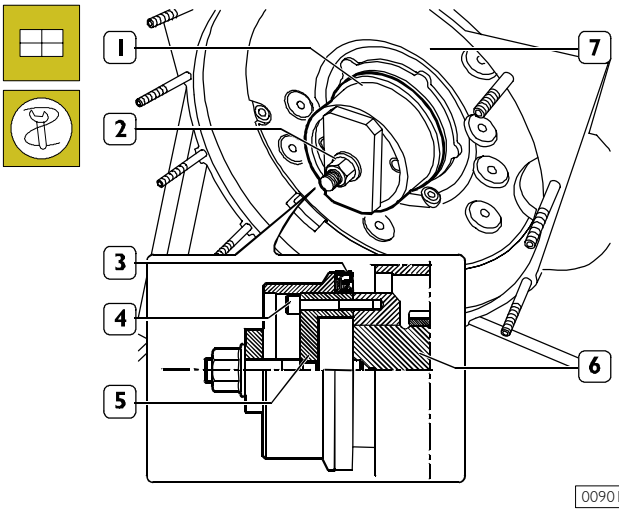
❑ Refit the housing (1) to the engine block and screw the fastening screws in the same position found at removal and tighten them to the following torque values in the sequence shown in the figure:

M12x1.75x45	torque 89 to 105 Nm	G-DRIVE Application
M14x2x90	torque 135 to 165 Nm	
M12x1.75x45	torque 89 to 105 Nm	GRIFFON, DRAGON and SPRINKLER Applications
M14x2x90	torque 135 to 165 Nm	
M14x2x110	torque 135 to 165 Nm	

NOTE Make sure you put the screws in the seats from where they were taken. There are screws of different lengths as well as different sizes.

Fitting the rear oil seal

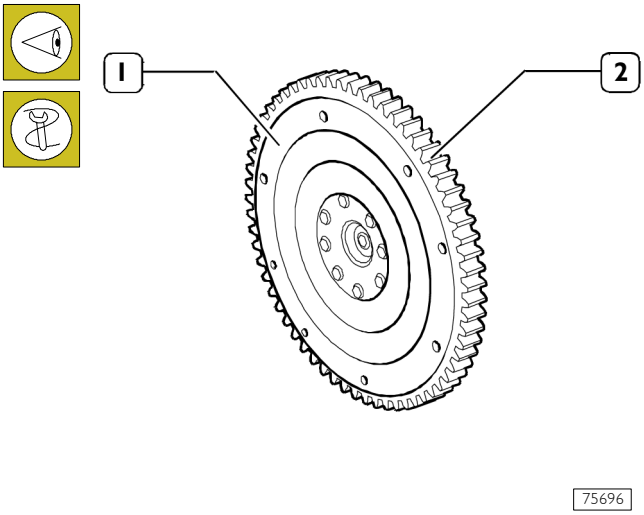
Figure 42



❑ Apply tool 99368511 part (6) to the rear output shaft tang (5), secure it with screws (4) and fit the new sealing ring (3).
Position part (1) on part (5), screw nut (2) until completing sealing ring (3) fitting into flywheel housing (7).

ENGINE FLYWHEEL

Figure 43

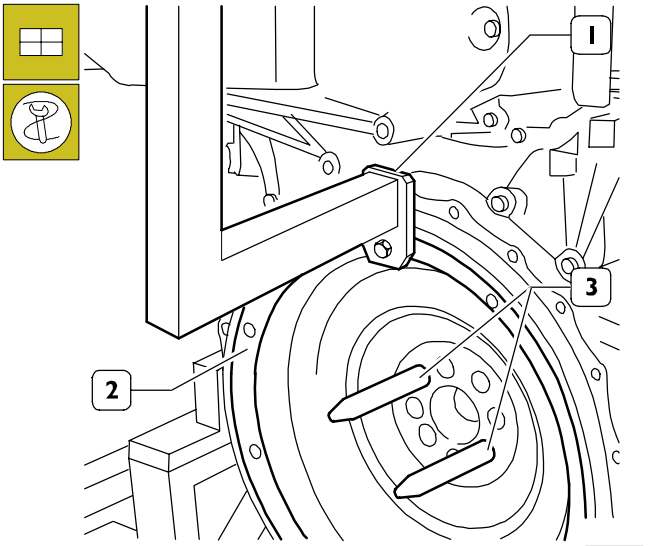


NOTE Check the important measurements depending on the application.

❑ Check the condition of the teeth for the ring gear (2). If the teeth are broken or very worn, remove it from the engine flywheel (1) using an ordinary drift and fit the new ring gear, heated previously to a temperature of 150°C for 15' P 20'; the bevel on the inner diameter of the ring gear should be facing the engine flywheel.

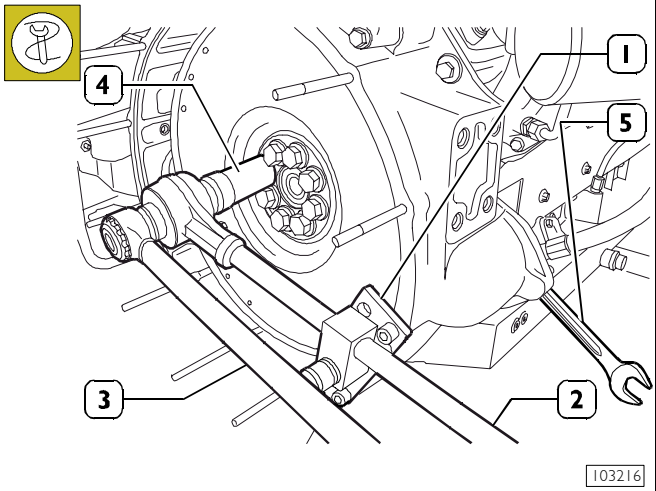
Fitting the engine flywheel

Figure 44



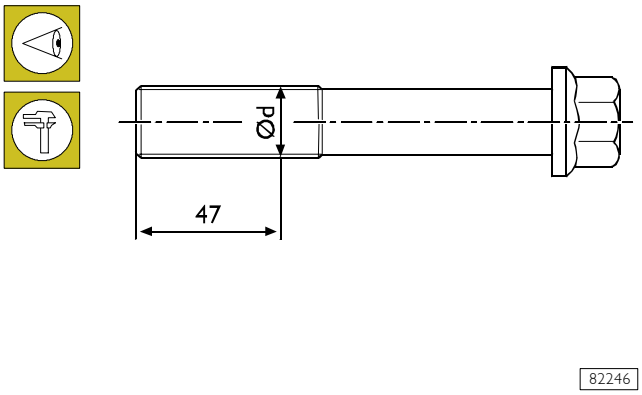
❑ Screw the pins 99367019 (3) onto the crankshaft and fit the flywheel (2) with tool 99368533 (1) and a suitable lift.

Figure 45



❑ Stop engine shaft rotation with tool 99368502: the fixed wrench (5) keeps the flywheel in position preventing its rotation. Assemble tool 99368546 (1) and tighten the fixing screws that were previously lubricated with "UTDM" oil up to the prescribed torque by using torque multiplier 99389816 (2), dynamometric wrench 99389818 (3) and bush wrench 99367016 (4); for angular closure use tool 99395216 (2).

Figure 46



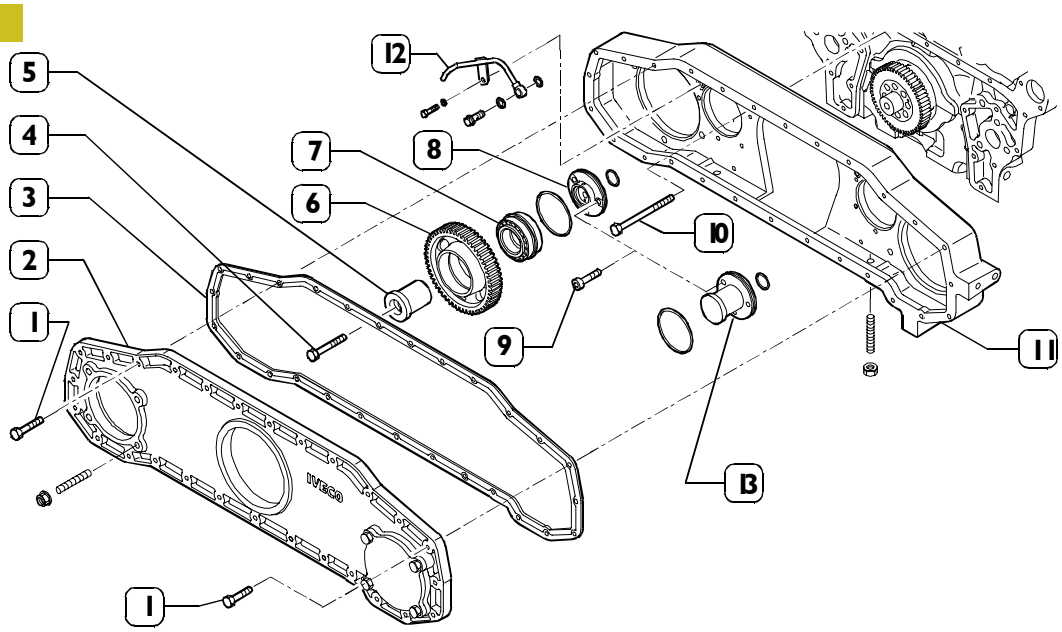
NOTE If the screws turn out to have been removed previously, check the stated diameter: if the diameter "d" turns out to be < 23.5 mm.

Tightening: pre–torque + angle

Pre–torque = 350 Nm
Angle 120°
Torque 910 to 1600 Nm

Fitting the gearbox

Figure 47

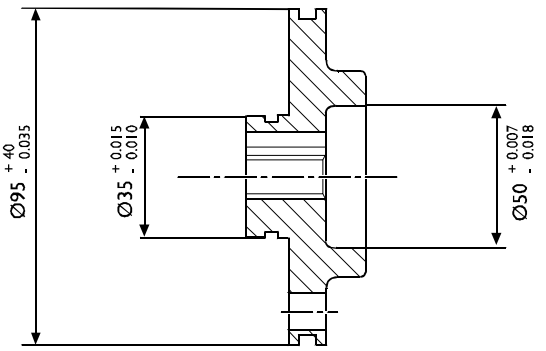


103193

❑ Check the dimensions of the parts removed, examining their state of wear.

NOTE Replace all the seals and O-rings.

Figure 48



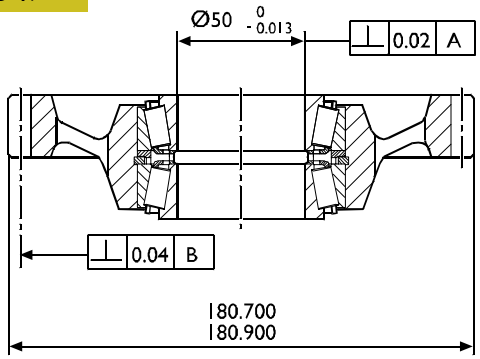
82248

❑ Check the spacer (8, Figure 47): check the state of wear of the zones of contact with the shaft (5) and the dimensions as shown in the figure.

❑ Insert the new O–rings in their seats on the spacer (1) and, with the aid of a drift, go ahead with assembly on the crankcase.

❑ Tighten the spacer fixing screws to the prescribed torque: M10x1.5x25 mm cheese–headed screws: 45 to 50 Nm. Lubricate the screws with "UTDM" oil or alternatively with engine oil.

Figure 49



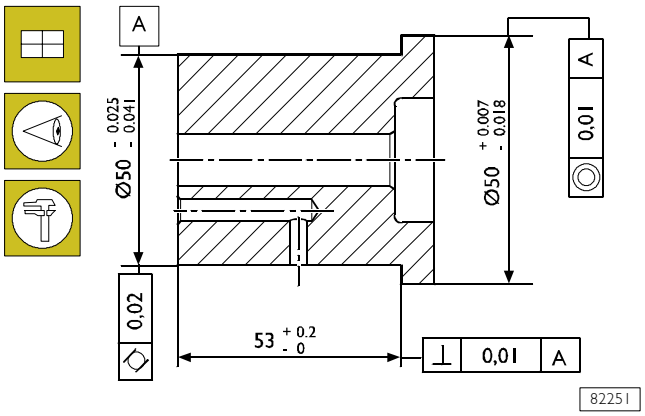
82250

❑ In addition, check the state of wear of both the bearings and the gears. If there is noisiness or clear seizure of the gears, replace them.

❑ Check the state of wear of the teeth of the gears and the contact surface between the inside of the bearing and the shaft.

NOTE The conical roller bearings and the gear are supplied as spares already fitted.
The gear has the following dimensions:
-outer diameter 180, 700 P 180,900 mm;
-No. of teeth 34.

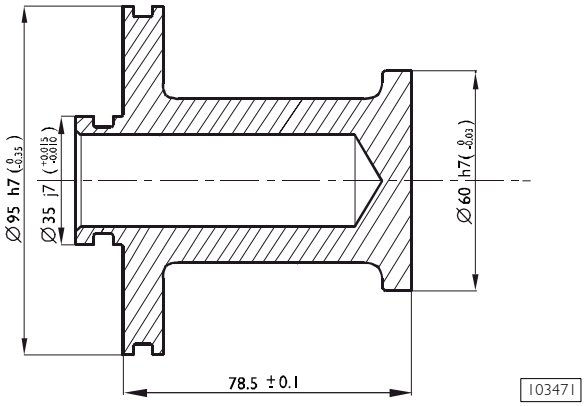
Figure 50



- ❑ Check the state of the contact surface of the shaft and its dimensions. Blow compressed air into the bearing lubrication passage to remove any debris.
- ❑ After applying a bead of IVECO 45500318 sealant onto the contact surface of the crankcase with the gearbox, position the box.
  Tighten the fixing screws to the prescribed torque: M8x1.25: 22–27 Nm
- ❑ Then fit the gear complete with conical roller bearings on the shaft and fit the assembly in place on the spacer fitted previously on the engine block. Tighten the bolt fixing the shaft to the spacer to the recommended torque: hexagonal head bolts M12x1.75x80 mm: 73 P 80 Nm.Before tightening, lubricate the bolt with UTDM oil or, alternatively, with engine oil.

NOTE Replace all the seals.

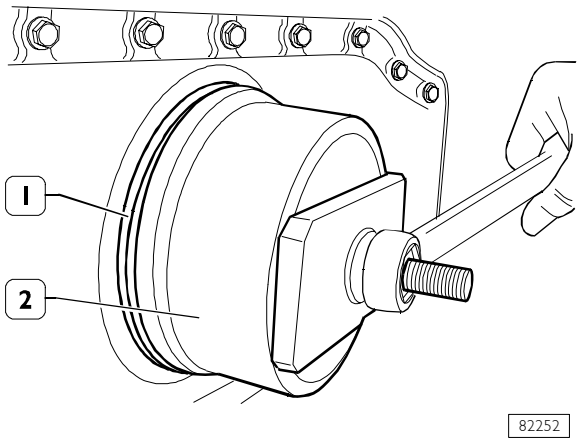
Figure 51



- ❑ On the opposite side, fit the shaft illustrated in the diagram. The idler gear should not be present.
- ❑ Take the new flat gasket out of the package and put it in its seat on the gearbox cover.
- ❑ Fit the cover together with the gasket on the gearbox. Tighten the screws to the prescribed tightening torque. M8x1.25x30mm hexagonal–head screw: 22–27 Nm.

NOTE If the studs fitting the cooling pump and the sump have been removed from the cover and from the gear casing, proceed with fitting them.

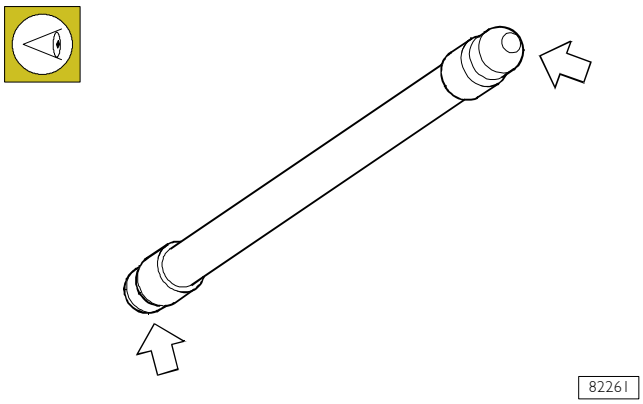
Figure 52



- ❑ Fit the seal (1) in its seat on the gearbox with the aid of tool 99368512.

RODS

Figure 53

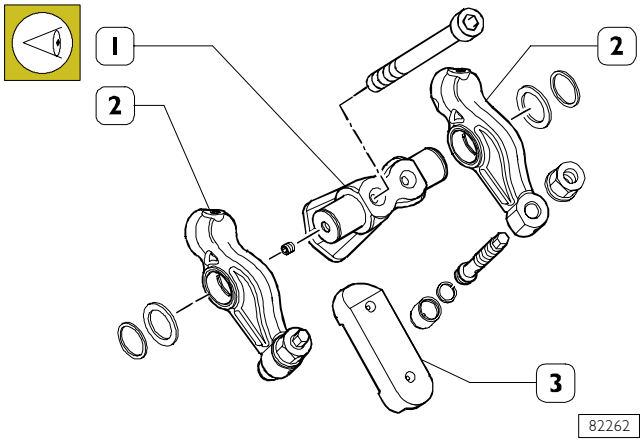


The valve pushrods must be free from distortion; the cup seatings for the adjustment screws and the ball ends locating in the tappets (arrowed) must not show any signs of seizing or wear; if they do, replace the rods.

Pushrods for inlet and exhaust valves are identical and therefore interchangeable.

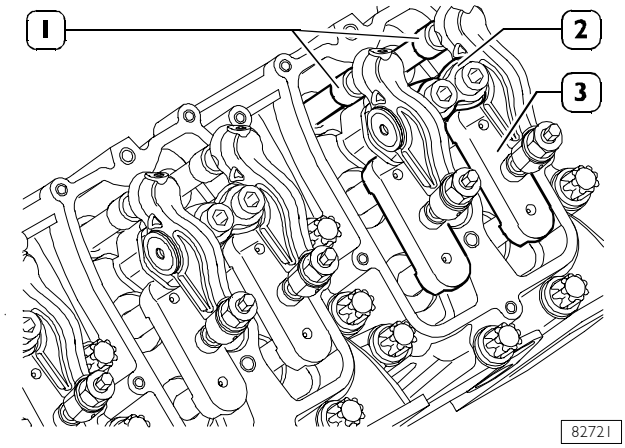
ROCKER ARM ASSEMBLY
ROCKER ARMS
JUMPERS
ROCKER ARM SUPPORT ROCKERS

Figure 54



- ❑ Check that the rocker arms (2), jumpers (3) and support (1) show no sign of wear, scoring or seizure.
  Riscontrando anomalie, sostituire i particolari interessati.
- ❑ Check that the plug is assembled on the end of each rocker–arm holding shaft.

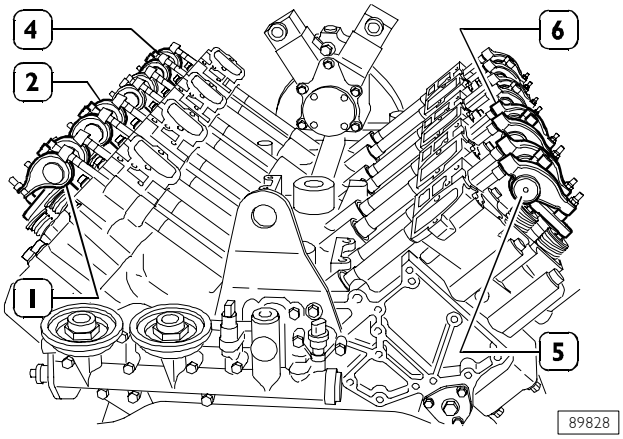
Figure 56



- ❑ Install rods (1), rocker arm supports (2) with rocker arms and bridges (3).

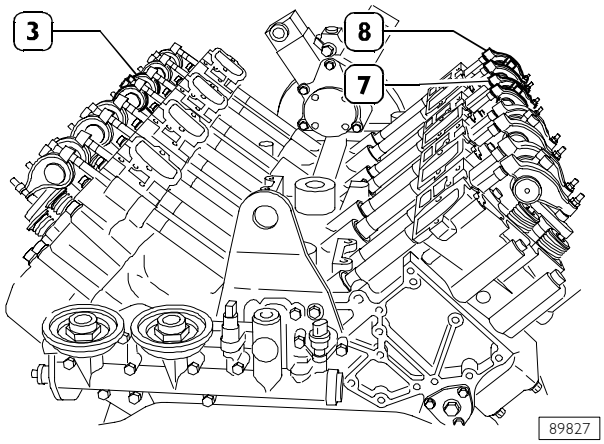
NOTE Make sure that the bevelled side of the fall plate is turned towards the inside of the engine.

Figure 55



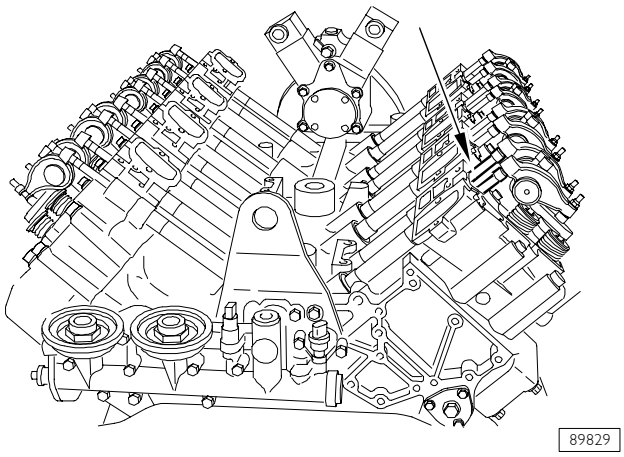
- ❑ Make sure that cylinder 1 is in the firing order and that cylinder 6 is balanced, then assemble rocker–arm units 1-2-4-5 and 6.
- ❑ Check that the contact between the register and the plate is centred and that the rods can turn freely.

Figure 57



- ❑ Unscrew the three fixing nuts of the cover of the box that covers the flywheel (on the opposite side of the starting motor). Insert tool 99368502 in order to turn the engine flywheel and fix it with the nuts of the cover that has been removed.
- ❑ Turn the engine clockwise for 360°, then assemble rocker–arm units 3-7 e 8.
- ❑ Check that the contact between the register and the plate is centred and that the rods can turn freely.

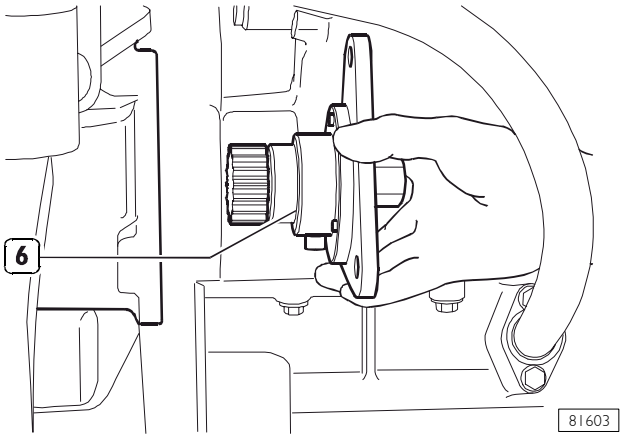
Figure 58



- ❑ Apply the 20 ÷ 120 Nm torque wrench with the 1/2" square connection to the wrench 99389813 to lock bolts M12x1,75 to a torque of 80 ÷ 89 Nm.
- ❑ After the rocker–arm control rods (1) have been assembled check that they are properly inserted in the tappet seats and then lubricate then with engine oil in the area in which the rod slides.

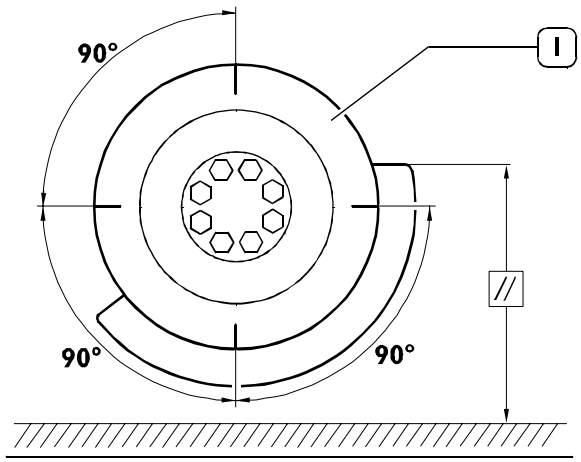
Adjusting operating clearance between valves and rockers

Figure 59



- ❑ Undo the three nuts fixing the flywheel cover casing cover (side opposite the starter motor). Fit tool 99368502 (6) with pinion 99368547 to rotate the engine flywheel and secure it using the nuts for the cover removed.
- ❑ After fitting the 24 mm ratchet wrench on the back of tool 99368502, turn the engine flywheel until we obtain the required cylinder balancing (the 4 valves are at the same height).

Figure 60



83505

- ❑ To obtain cylinder no.1 or no.6 in T.D.C. conditions it is necessary to position the damping flywheel as indicated in the picture. For the following balancing/adjustments it is recommended to trace some marks on the flywheel (1), placed at 90° one from the other (see picture).
- ❑ After obtaining this condition of balancing we move on to adjust the valves in the following order:

Figure 61

FIRST STEP

1	3	7	2	BALANCING
6	5	4	8	ADJUST

81605

Figure 62

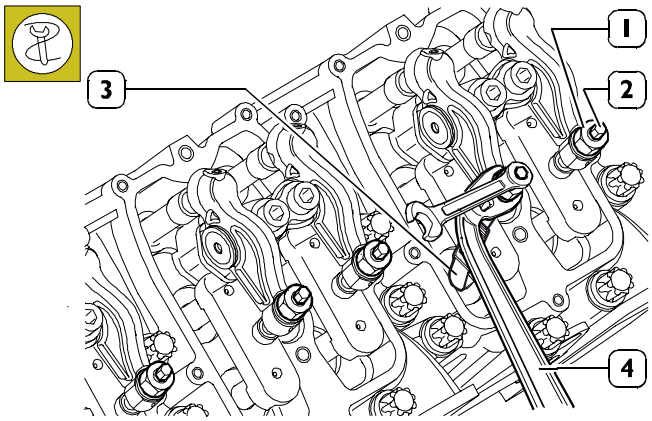
SECOND STEP

6	5	4	8	BALANCING
1	3	7	2	ADJUST

81606

- ❑ To make the adjustment, proceed as illustrated here:

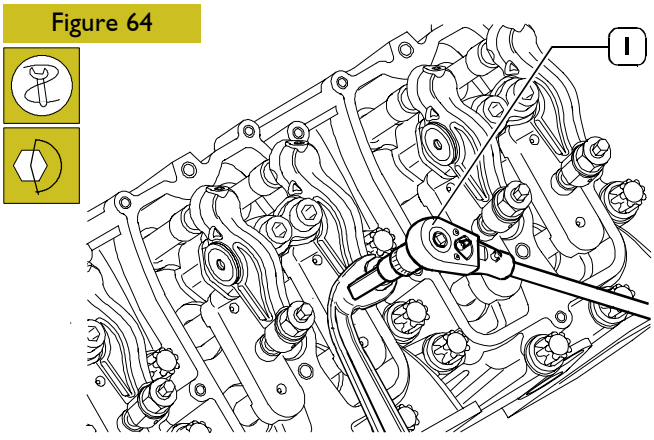
Figure 63



82722

- ❑ Using the wrench 99368503 (4), loosen the check nut (1) of the adjuster screw (2).
- ❑ Insert the tappet feeler gauge (0,50 mm) 99368545 (3).
- ❑ With wrench, screw or unscrew the adjuster screw (2).
- ❑ Check that the tappet feeler gauge (3) can slide with a slight amount of friction.
- ❑ Keeping the adjuster screw still (2), use wrench 99368503 (4) to lock the check nut (1) of the adjuster screw.

Figure 64

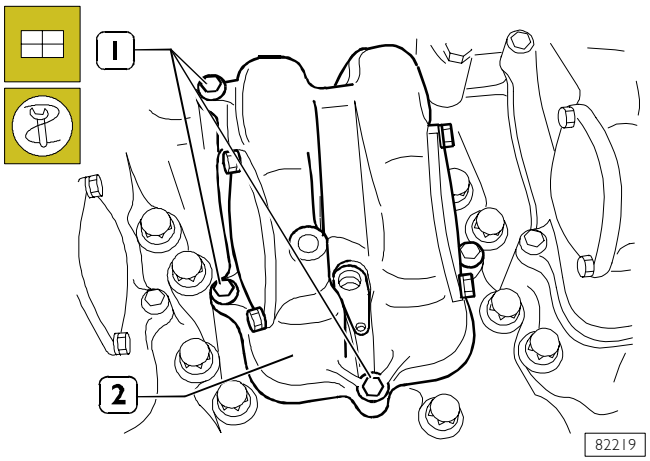


82723

- ❑ Apply the 10 – 60 Nm torque wrench with the 3/8" square connection 99389831 (1) to the wrench 99368503 to lock the nut (1, Figure 63) to a torque of 34 to 44 Nm.
- ❑ Adjust the clearance between all valves and all rockers.
- ❑ Extract the tool for turning the flywheel and close the flywheel cover.

Fitting the cylinder head tappet covers

Figure 65



- ❑ Position a new gasket.
- ❑ Fit the tappet cover (2) on the head.
- ❑ Insert the cover fixing screws (1) and tighten them to a torque of 20–24Nm.

NOTE The cover fixing screws have different lengths:
M8x1.25x40 front screws (three per cover)
M8x1.25x25 rear screws (two per cover)

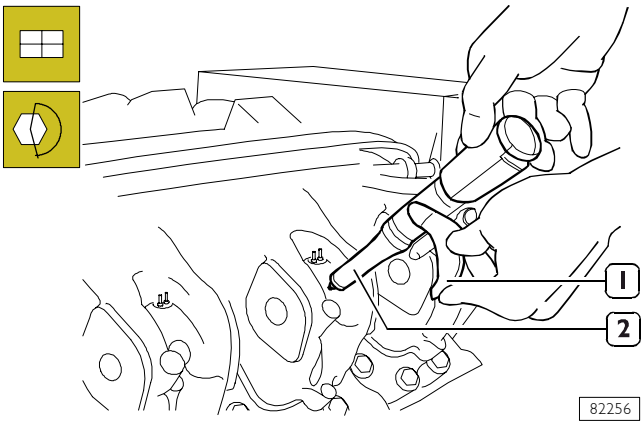
- ❑ If the side inspection covers have been removed, fit on both sides of the tappet cover together with the gasket.

NOTE Always change the seal.

- ❑ Tighten the screws of the inspection covers to a torque of 7–10 Nm.

Fitting the injectors

Figure 66



- ❑ Clean the injector seat (1) thoroughly and fit the injector complete with mounting bracket (2) in its seat pressing it until it clicks and is correctly inserted.
- ❑ Screw down the M10x1.5x70mm injector fixing screw to a torque of 32÷36 Nm.
- ❑ Fit all the electro–injectors.

NOTE Always change the O–ring in the assembly phase. Lubricate the O-rings with vaseline before fitting.

LUBRICATION

The engine is lubricated by a gear pump driven by the crankshaft.

There is a safety valve located on the oil filter mounting which starts opening at 3.4 ± 0.3 bar.

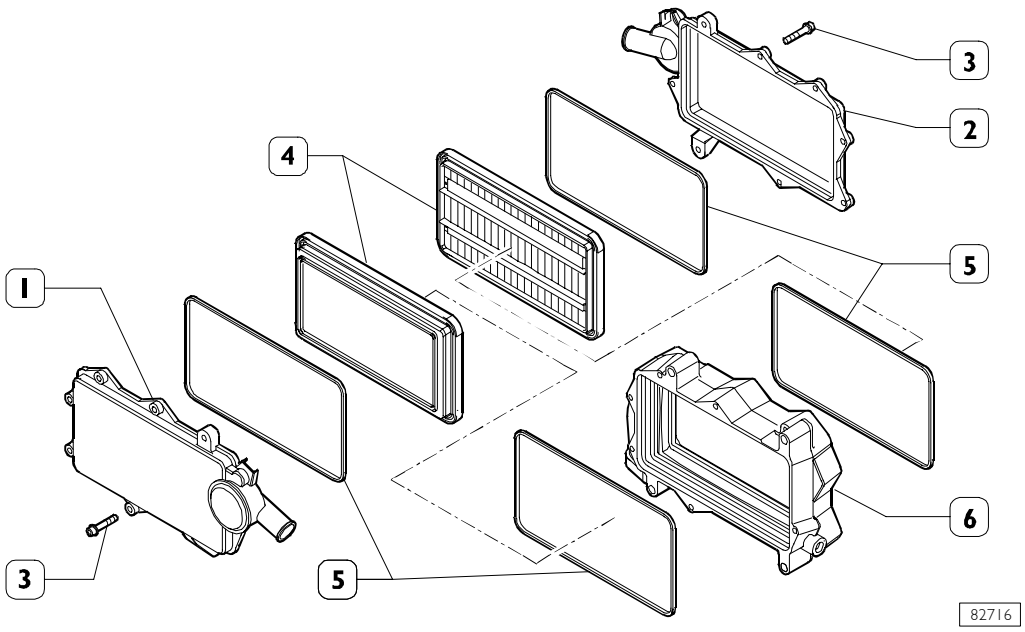
Lubricating pressure with oil at 110 °C:

- ❑ max pressure up to 6.5 bar
- ❑ min pressure 4.0 bar

The oil vapours that form inside the engine during operation are directed into a condenser (blow-by filter) where some of them are condensed and recirculated again and some of them are directed via two pipes to the intake.

The oil vapour condenser needs a periodical overhaul.

Figure 67

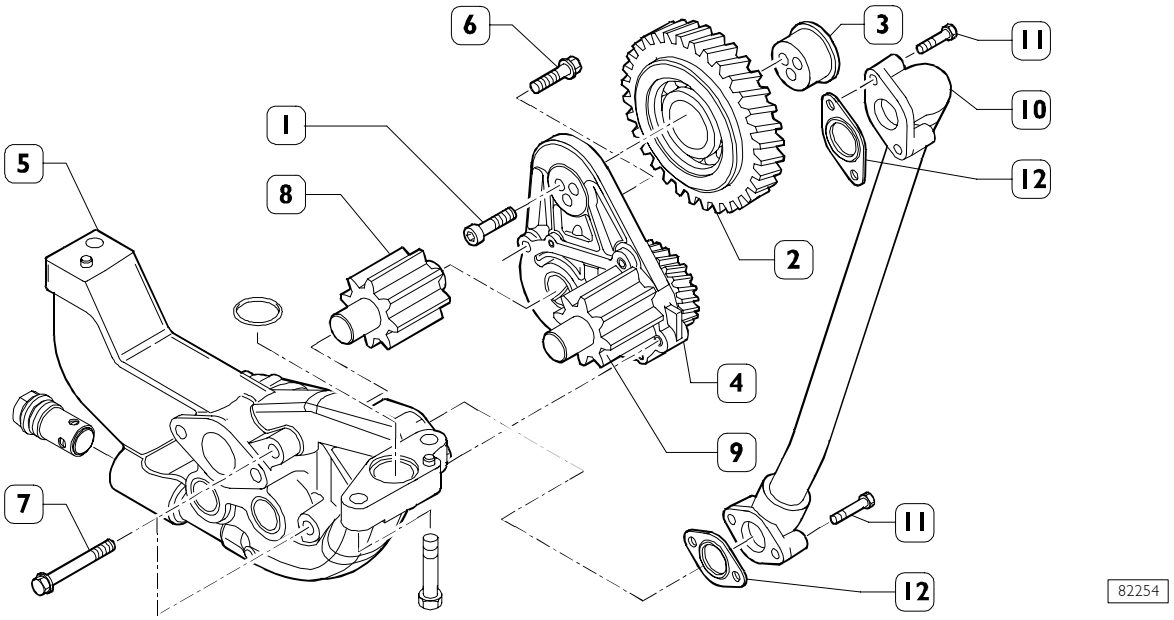


- ❑ Remove the covers (1) and (2) by unscrewing the screws (3).
- ❑ Change the filtering parts (4) and the gaskets (5).
- ❑ Carefully clean the blow–by filter body (6) and the covers.

engine oil is a pollutant. Protect your skin suitably against contact with engine oil.

Oil pump

Figure 68



- ❑ Check the pump casing and the external gears. If there are any visible signs of deterioration (cracks in the casing or gear teeth worn too much), change the whole part.
- ❑ Overhaul by unscrewing the screws (1) and removing the gear (2) together with the ball bearing and pin (3).
- ❑ Check the bearing and the sliding surfaces of the internal cage of the bearing and of the pin (3) work properly.
- ❑ Then separate the pump cover (4) from the casing (5). Unscrew the two screws (6) M8x30mm from the top of the cover and the two screws (7) M8x80mm from the casing side.
- ❑ Check the state of wear of the internal gears (8) and (9). In addition, check the gear (9) fitted stably on the cover (4) turns freely.

NOTE Wear or poor rotation of the gear (9) require changing the cover assembly (4) + (9) + (2) +(3) supplied as spare parts already fitted.

The cover assembly also includes the bushing in which the gear spindle (8) turns.

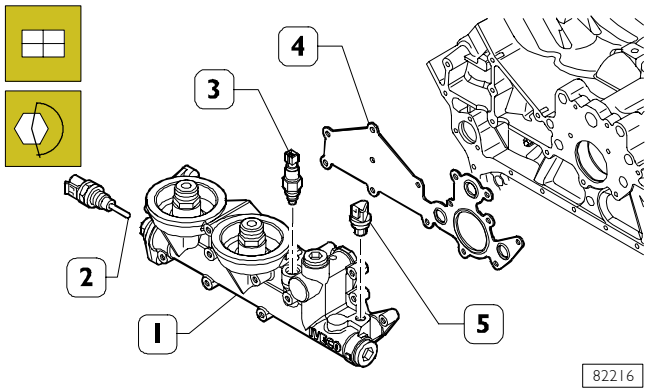
- ❑ Fit the gear (8) on the cover assembly (4) and check its rotation.
- ❑ Fit the cover together with the gears on the pump casing (5).
- ❑ Fit the suction strainer on the pump with a new seal: M8x1.25 screws (tightening torque 22–27 Nm).
- ❑ Fit the pump together with the suction strainer to the crankcase.
  The oil pump is secured with three M10x25mm hexagonal–head screws with a tightening torque of 38–45 Nm, tightening the M8 screws to a torque of 22–27 Nm.
  The suction strainer is secured to the cap for the central support with two M8x25mm hexagonal–head screws with a torque of 22–27 Nm.
- ❑ Fit the oil pipe (10) securing it with the screws (11) M8x45mm to a tightening torque of 22–27 Nm.

NOTE Always change the seals (12) and O-rings.

- ❑ Lastly, fit the oil sump with a new seal.
  Tighten the M10 nuts on the stud bolts of the gearbox to a torque of 38–45 Nm. The remaining M10x1.5x35 mm screws (24 in all) must be tightened to a torque of 38÷45 Nm.

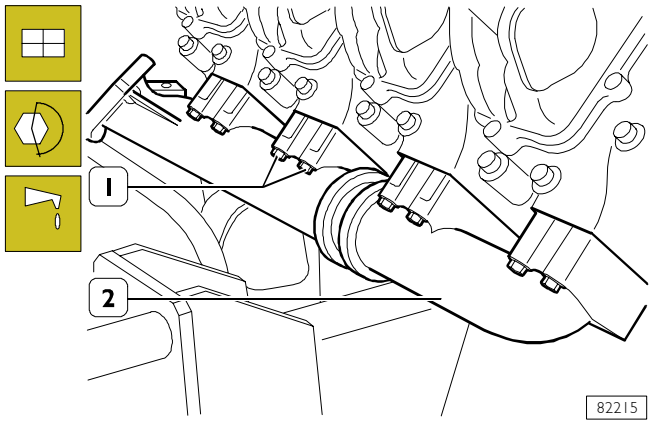
COMPLETING THE ENGINE

Figure 69



- ❑ From the front, fit the engine oil filter support (1) together with the temperature transmitter (2), pressure sensor (5), the gasket (4) and the filter clog sensor (3).
- ❑ Tighten the M8x1.25 fixing screws to a torque of 22–27 Nm.

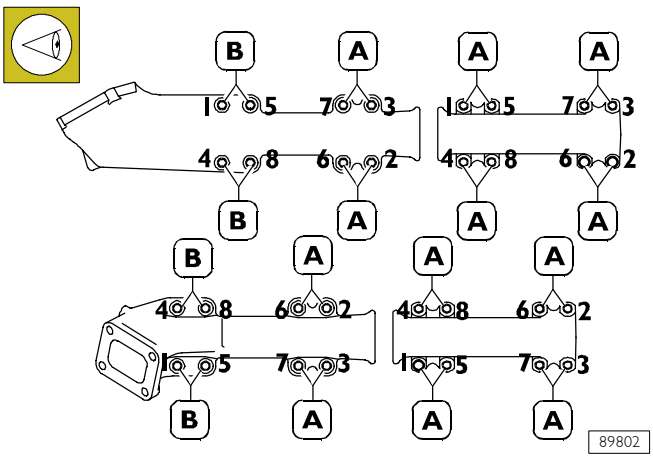
Figure 70



- ❑ Fit the exhaust manifolds (2) tightening the screws (1) M10x1.5 in two phases:

A: torque	47÷53Nm
B: pre–torque	47÷53 Nm
torque	64÷70 Nm

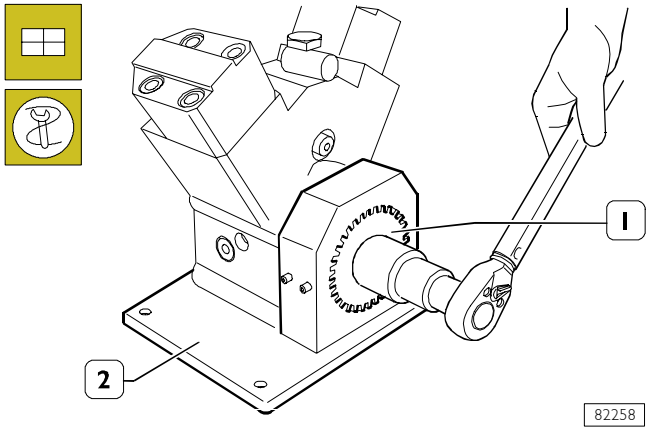
Figure 71



NOTE Before tightening the screws (see order in Figure 71), lubricate them with graphitized oil.

NOTE Always fit new gaskets.

Figure 72



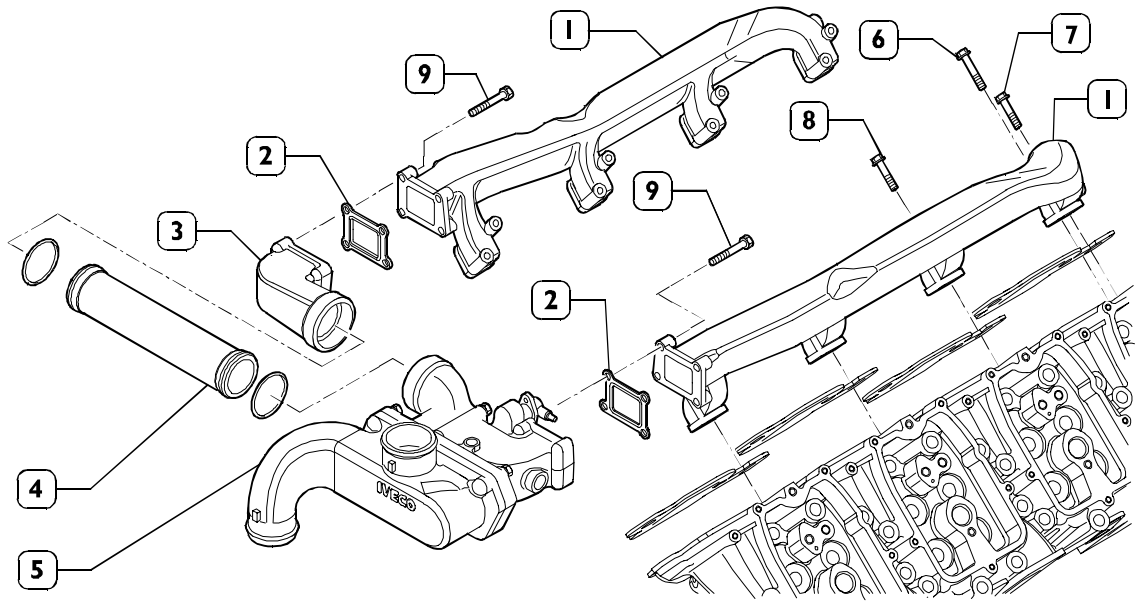
NOTE Wash and grease the shaft of the pump before mounting the gear.

- ❑ Assemble gear (1) with tool 99368517; tighten the fixing nut to 350 torque (300 Nm with the screwdriver with final take off at 350 Nm with dynamometric wrench).
- ❑ Fit the high–pressure fuel pump together with its driving gear and seals.
- ❑ Tighten the M10x1.5 fixing screws to a torque of 49–60 Nm.

NOTE Before tightening, lubricate the screws with UTDM oil or alternatively with engine oil.

- ❑ Fit the intake manifolds together with new gaskets on the heads.
- ❑ Tighten the M10x1.25 screws to a torque of 38–45 Nm.
- ❑ Fit the diesel supply pipe to the high–pressure pump. Piping M18x1.5 tighten on the coupling to a torque of 50 Nm.
- ❑ Fit the water–oil cooler after changing the two O–rings.
- ❑ Tighten the 6 M10x1.5x40 mm screws to a torque of 25–30 Nm.

Figure 73



- ❑ Fit the head water outlet pipes (1).
- ❑ Fit the seals (2), fit the elbow (3), the connecting pipes (4) and O-rings and the thermostat casing (5).

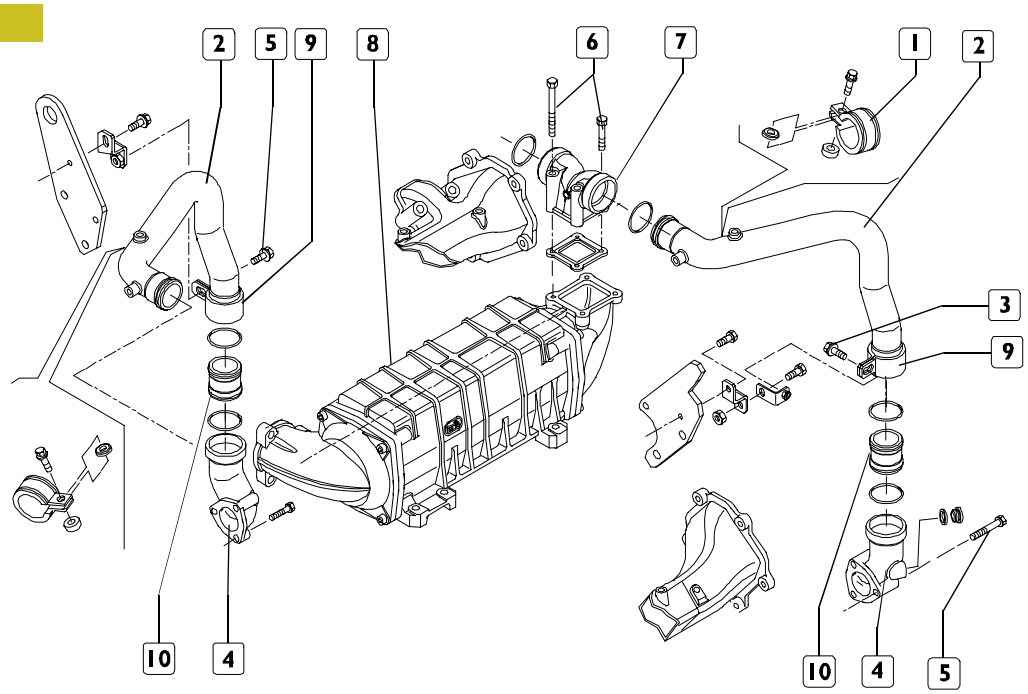
NOTE The new head–side gaskets have already been fitted together with the air intake manifolds.

- ❑ Tighten all the screws to a torque of 22–27 Nm.

NOTE To facilitate assembly, here we describe how to use the water pipe fixing screws correctly.

6. M8x1.25x75 mm
7. M8x65 mm
8. M8x1.25x60 mm
9. M8x20 mm
10. M8x30 mm

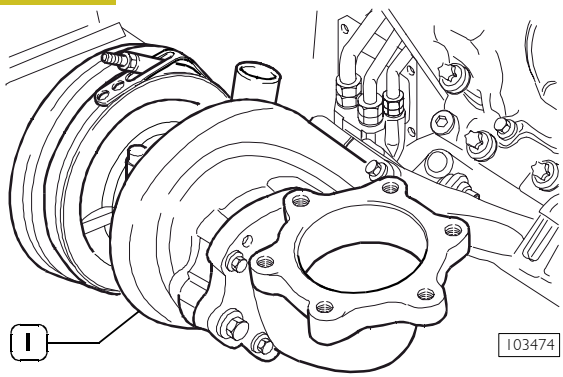
Figure 74



- ❑ Fit the three–way coupling (7) on the water/oil cooler (8) with the gasket.
- ❑ Tighten the M8x40mm and M8x100 mm screws (6) to a torque of 22–27 Nm.
- ❑ Fit the couplings (4) on the main bearings with the gaskets, tightening the screws to a torque of 22–27 Nm.
- ❑ Fit pipes (2) on three-way fitting (7). Connect pipes (2) and fittings (4) to the engine blocks by means of gaiters (10). Secure the pipes with collars (1) and (9).

For G-DRIVE / GRIFFON and DRAGON applications

Figure 75

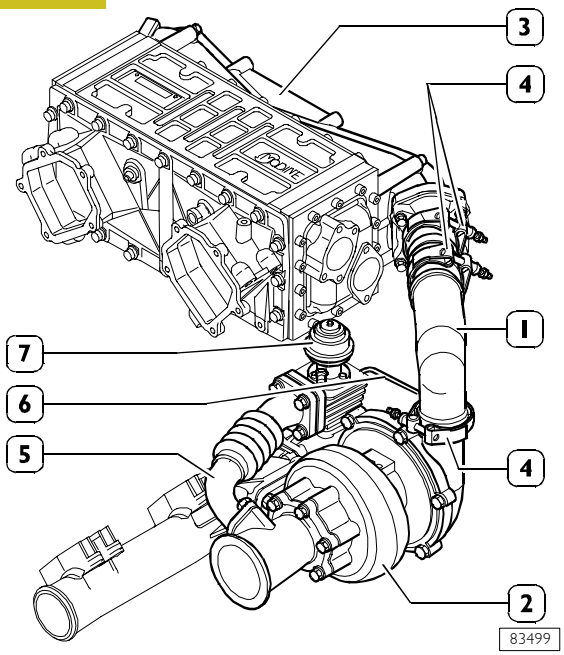


- ❑ Fit the turbocharger (1) on the exhaust manifold tightening the M12x1.75 mm nuts:Torque 85-95 Nm
  Repeat the operation on the opposite side.
- ❑ Fit the air supply manifold to the air/air heat exchanger on the bracket tightening the 4 bolts from underneath
- ❑ Fit the blow-by filter on the manifold and the inlet and outlet pipes from the filter.

NOTE Always change the gaskets with new spare parts. Do not reuse gaskets even if they look sound.

For SRINKLER applications

Figure 76

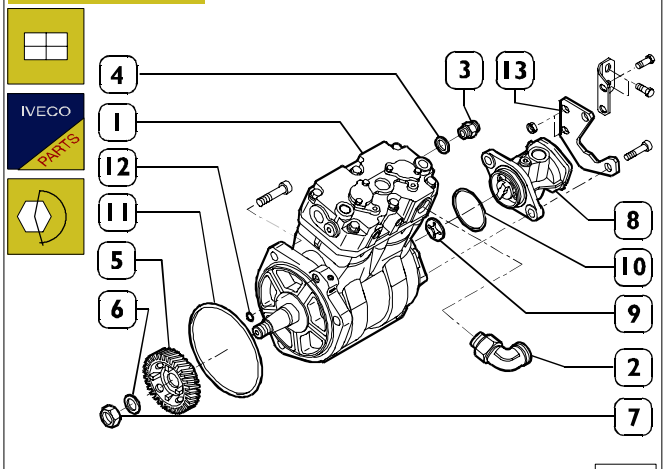


- ❑ Fit the turbo–blower (2) on the exhaust manifold tightening the M12x1.75mm nuts in two successive phases:
  Torque 85–95 Nm
- ❑ Then fit the waste–gate valve (7) on the exhaust manifold.
- ❑ Fit the waste–gate cooling pipes and the air pipe (6) between turbo–blower and waste–gate.
- ❑ Fit the exhaust pipe (4) between the waste–gate valve and the turbo–blower exhaust pipes.
- ❑ Fit the manifold (1) between the turbo–blower and the intercooler with the clamp (4).

NOTE Always change the gaskets with new spare parts. Do not reuse gaskets even if they look sound.

For DRAGON applications

Figure 77



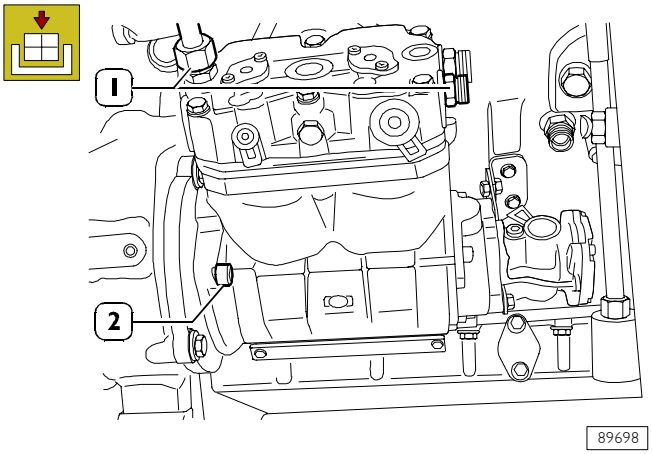
- ❑ On the bench, fit the previously removed fittings onto the compressor (1): suction (2) and compression (3) fittings: thread M26 = 100 Nm.

NOTE Change the gasket (4) at the fitting mounted on the compression port.

- ❑ Insert the gear (5), flat washer (6) and screw down the nut (7), tightening to a torque of from 160 ÷ 180 Nm.
- ❑ Fit the low-pressure pump (8), inserting the universal joint (9) and O-ring (10).
- ❑ During assembly, check that the coupling drive (9) and the teeth on the front of the secondary circuit cooling pump gear show no signs of wear or cracks. Change any damaged parts.
- ❑ Fit support bracket (13) and tighten the screws securing the low–pressure pump support to the air compressor to the prescribed torque: 42÷51 Nm.

NOTE Change the gaskets (10), (11) and (12).

Figure 78

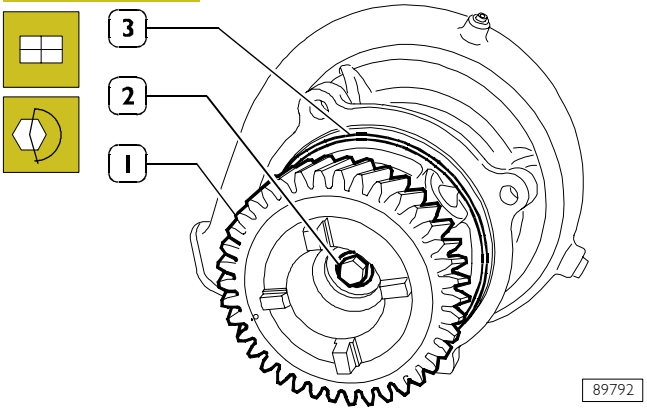


NOTE Should compressor have been dismounted jointly with spacer, tighten (M12x1.75) screws securing it to gears box at 42 ÷ 51 Nm tightening torque.

- ❑ Put compressor into its seat by tightening (M12x1.75) at 74 ÷ 90 Nm Nm torque.
- ❑ Secure bracket (13, Figure 77) to engine block.

For all applications

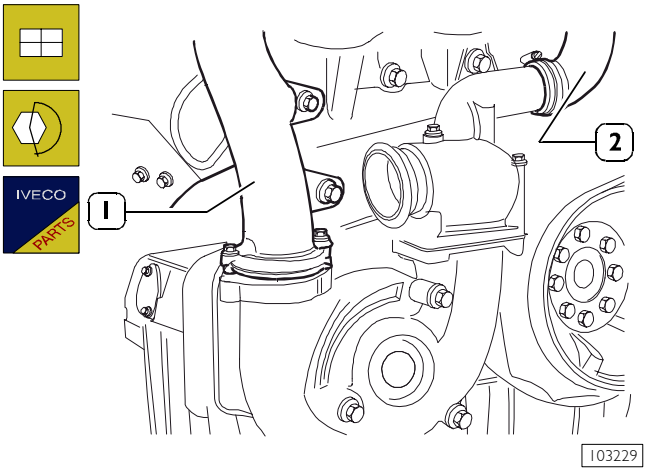
Figure 79



- ❑ Fit the cooling pump.
- ❑ If the same pump is used replace seal (3).
- ❑ If necessary, replace the pump gear (1) tightening the bolt (2) to the recommended torque.

NOTE Having to tighten screw (2), it is necessary to prevent the gear (1) from turning in an appropriate manner without damaging the parts. Before tightening, lubricate the screws with UTDM oil or alternatively with engine oil. (The gear has a left-hand locking screw).

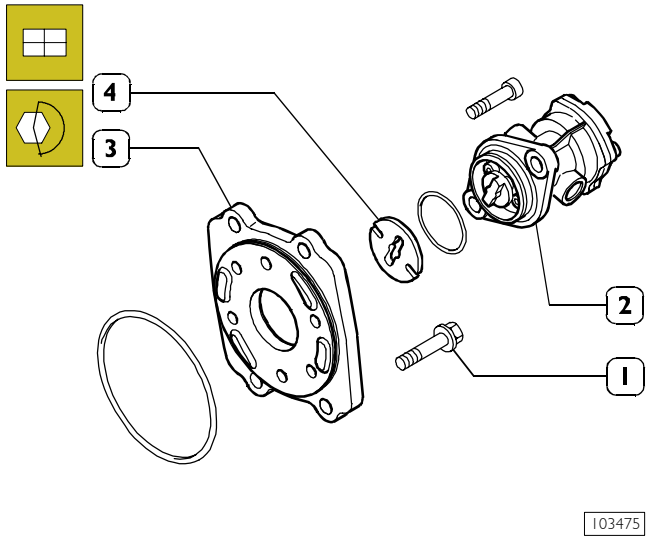
Figure 80



- ❑ At the front of the gearbox, fit the secondary system cooling circuit pump together with the gears.
- ❑ Supporting the pump place it in its seat. Tighten the M10x1.5 nuts securing the water pump to the front gear cover 33 ÷ 40 Nm.
- ❑ Then fit the pipe (1) securing it to the actual pump and the hose (2) using the two bolts (1).

For G-DRIVE / SPRINKLER and GRIFFON applications

Figure 81



- ❑ Fit the low–pressure pump (2) together with the coupling drive (4), O–ring and spacer (3) on the back of the gearbox: tighten the screws (1) to the prescribed torque.

NOTE Whilst fitting the drive coupling, check that the front drive teeth on the pump gear are properly housed inside the splining.

- ❑ During assembly, check that the coupling drive and the teeth on the front of the secondary circuit cooling pump gear show no signs of wear or cracks. Change any damaged parts.
- ❑ Tighten the screws securing the low–pressure pump support to the gearbox to the prescribed torque.

COMMON RAIL ASSEMBLY PROCEDURE

Preparing for assembly

- ❑ This procedure allows to have the best assembling, reducing the stress on the CR components due to tolerances and misalignments and will avoid the risk to have dangerous fuel leakage under pressure, during all typical condition of the Vector engines operative duty.
- ❑ This procedure will apply during first CR assembling in manufacturing plant as well as during maintenance and replacement of one or more CR components

NOTE It is vital to use a special torque wrench for the fitting procedure described here.

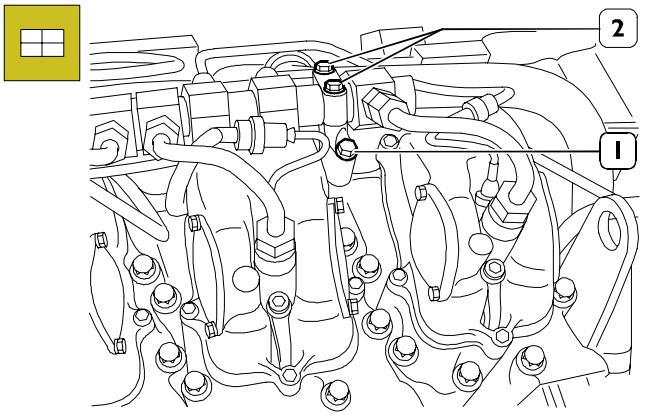
Cleaning and preparation

- ❑ Before mounting, assure that each pipe is protected with appropriate plastic cap supplied by Bosch. Remove by hands the protective caps just before the installation. Do not use sharp tooling that might cause damage on the sealing surface. All pipes have to be cleaned up and to be particulate free, and the sealing surface have to be without any defect.
- ❑ All sealing surfaces, nuts and threads have to be lubricated with clean engine oil (for example: 15W40).

Assembly procedure

- ❑ The high pressure pump (HPP) and the injector's are mounted firmly in average position of bolt clearance, with the defined tightening torque.

Figure 82



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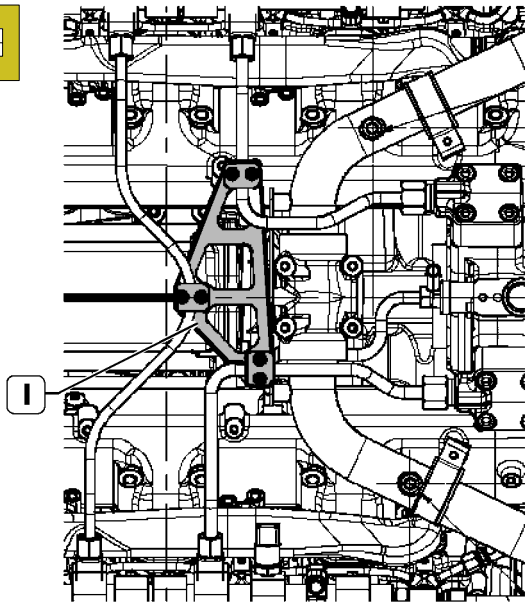
- ❑ The rails are installed on their supports, previously fixed on the cylinder heads by the related screws tightened with proper tightening torque of 25 Nm (screws 1). The rails have to be in horizontal position and aligned and the fixing caps have to be positioned with the related screws loose on the support (screws 2).
- ❑ lubricate all the connectors with clean oil.

Figure 83



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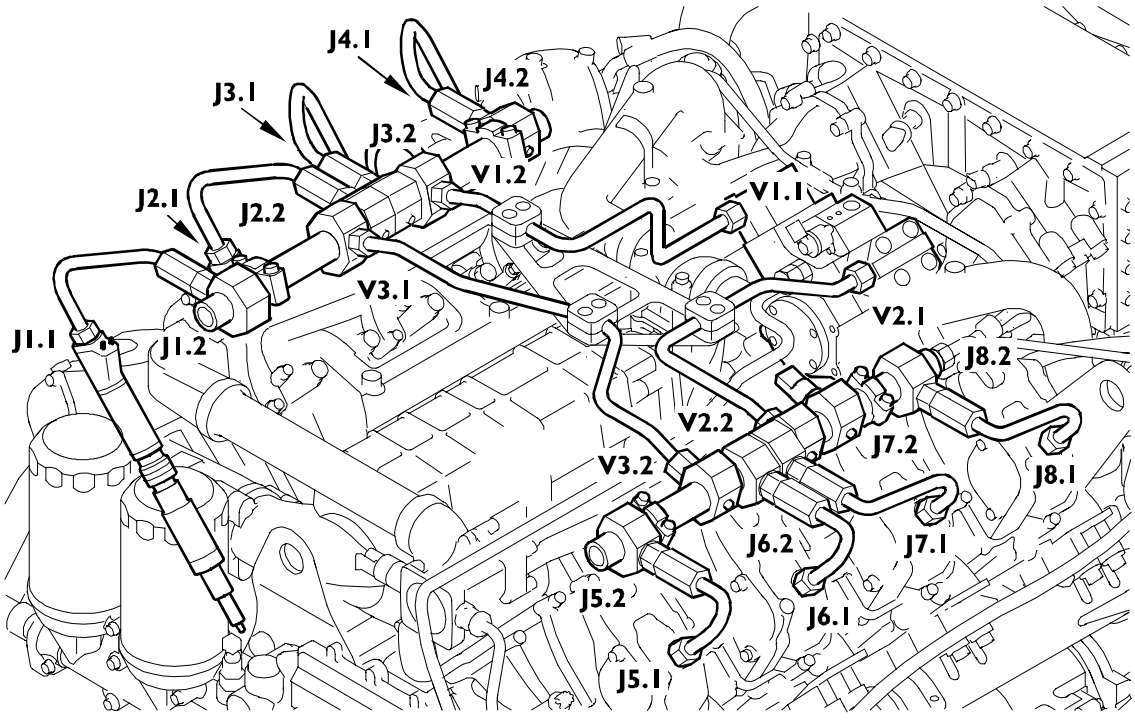
- ❑ All the pipes are fitted by only tightening the areas connected to the HPP, the rails and the injectors manually (J1.1 - J8.2, V1.1 - V3.2: see Figure Figure 84). Fit the centre support plate (1) closing the fastenings for the pipes from the HPP to the rails, from the rails to the injectors and on the intermediate pipe checking that the centre pipes are kept in a horizontal position and are flat. Apply a pre-tightening torque of 20 Nm and then a pre-tightening torque of 50 Nm to all the connectors.

Figure 84



- ❑ Tighten the connectors for the pipes from the HPP to the rails (V1.1 and V2.1) to the interface with the HPP to torque checking that the pipes are kept in a horizontal position and are flat. Apply a tightening torque of 140 + 5 Nm.
- ❑ Tighten the connectors (V1.2 and V2.2) to the interface with the rails checking that the pipes are kept in a horizontal position and are flat in order to ensure the seal between the contact surfaces. Apply a tightening torque of 130 + 5 Nm.
- ❑ Tighten the connectors for the V3 pipe to a torque of 130 + 5 Nm in total for both parts.Check the horizontal alignment of the pipe.
- ❑ Tighten the injector/rail connecting pipes to the interface with the common rails in the following order: J 8.2 - J 7.2 - J 6.2 - J 5.2 - J 4.2 - J 3.2 - J2.2 - J1.2. During this fitting procedure the flow limiters should be kept against the tightening direction.Apply a torque of 115 + 5 Nm.
- ❑ Tighten the connectors for the injector/rail connecting pipes to the interface with the injectors in the following order: J 8.1 - J 7.1 - J 6.1 - J 5.1 - J 4.1 - J 3.1 - J 2.1 - J 1.1.During this fitting procedure the injectors should be kept against the tightening direction.Apply a torque of 95 + 5Nm.
- ❑ Tighten all the bolts for the common rail supports to the caps (bolts (B)) to the recommended torque of 25 Nm.
- ❑ Any leaks are checked when the engine is switched on.

Test procedure for checking for diesel leaks from the Common Rail system.

The following procedure is carried out on the engine to check that there are no diesel leaks from the Common Rail system after repair operations.

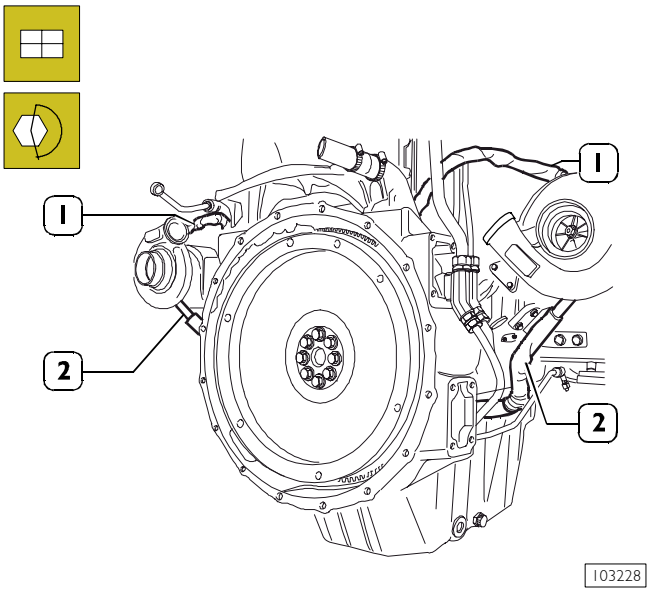
The aim of this test is to let the rail pressure reach maximum values with the engine running in no load idling conditions.

Equipment to be used: IST or ELTRAC tool

Order of operations:

1) Switch on the engine and let it reach idle speed.
2) Key in the DIAGNOSTICS window on the IST
3) Select DIAGNOSTIC TESTS
4) Select FUEL RAIL PRESSURE TEST
5) Key in START at the bottom
6) Key in STEP UP several time up to 150-160 Mpa with the engine idling.
7) Check that there are no leaks from all the connectors. If a leak is detected, switch off the engine and carry out the procedures describe previously.
8) Return to the nominal pressure using the STEP DOWN button.
9) When running in the engine, check the tightening torques of all fittings at least once and adjust. The aim of this operation is to tighten any fittings that have become loose due to settlement. Do not unscrew any fittings but simply tighten to the specified installation torque. After running in the engine, tighten all the fittings to the specified torques using a torque wrench. Check the remaining torques as indicated in the installation procedure.

Figure 85



- ❑ Fit the oil pipes (1) and (2) for lubricating the turbines. Tightening torques:
  screw fixing bottom pipes draining oil from the turbo–blower to the oil sump – M8x1.25 = 22–27 Nm.
  Screw fixing pipes delivering oil to the turbo–blower – M8x1.25 = 22–27 Nm.
- ❑ Fit the engine support.

  Screw fixing rear engine support (M16x2)

1st step Torque: 95÷105 Nm

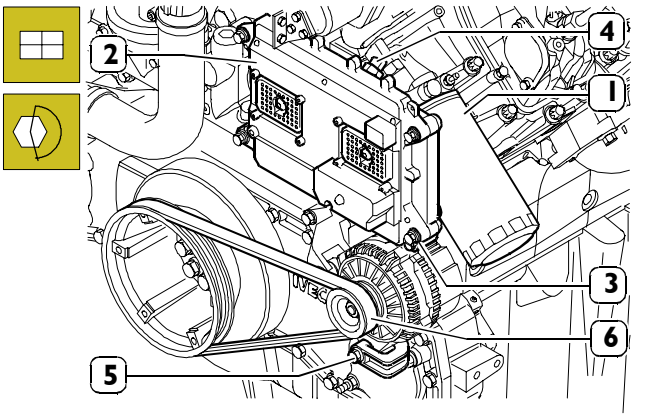
2nd step Angle: 85°-90°
Guard torque: 310÷420 Nm

Screw fixing front engine support (M14x2)

1st step Torque: 65÷75 Nm

2nd step Angle: 60°-65°
Guard torque: 190÷270 Nm

Figure 86



- ❑ Fit the control unit support (3) on the engine (M8x1.25 bolts to be tightened to a torque of 22-27Nm) complete with atmospheric pressure sensor (5) and diesel filter mounting.
- ❑ If present on the application, fit the air conditioning compressor (17, Figure 3) and the flexible belt (16, Figure 3).
- ❑ Fit the alternator complete with mounting bracket and tension the bolt (6) tightening the bolt (5).
- ❑ Fit the ADEM III control unit (2) on the support with the flexible mounts (3) (M8x1.25 screws to tighten to a torque of 22 – 27 Nm).
- ❑ Fit the engine electric cable connecting the control unit to the various sensors and services.
  Suitably secure the electric cable on the engine with the clamps.
- ❑ Fit the oil filters and the diesel filter (if present).

NOTE The filters must be tightened by hand after lightly lubricating the seals.
Tighten for another 3/4 turn with 99368539 tool.

- ❑ Fit the protective grilles (if present).
- ❑ Affix the plate warning the engine has no lubricating oil.

Checks and inspections

NOTE The following checking inspections must be carried out after the engine assembly on the vehicle .

Start the engine and leave it running just above the idling speed, wait until the coolant reaches the temperature necessary to open the thermostat and then check:

- ❑ that there are no water leaks from the connecting sleeves of engine cooling circuit pipes and cab internal heating pipes, tighten the clamping collars if required;
- ❑ the connection between the low pressure fuel pipes and the relevant connectors;
- ❑ that there are no oil leaks between the cover and the cylinder head, between oil sump and engine block, between heat exchanger oil filter and the relevant housings and between the different pipes in the lubricating circuit;
- ❑ that there are no fuel leaks from the fuel pipes;
- ❑ that there are no air leaks from pneumatic pipes (if fitted);

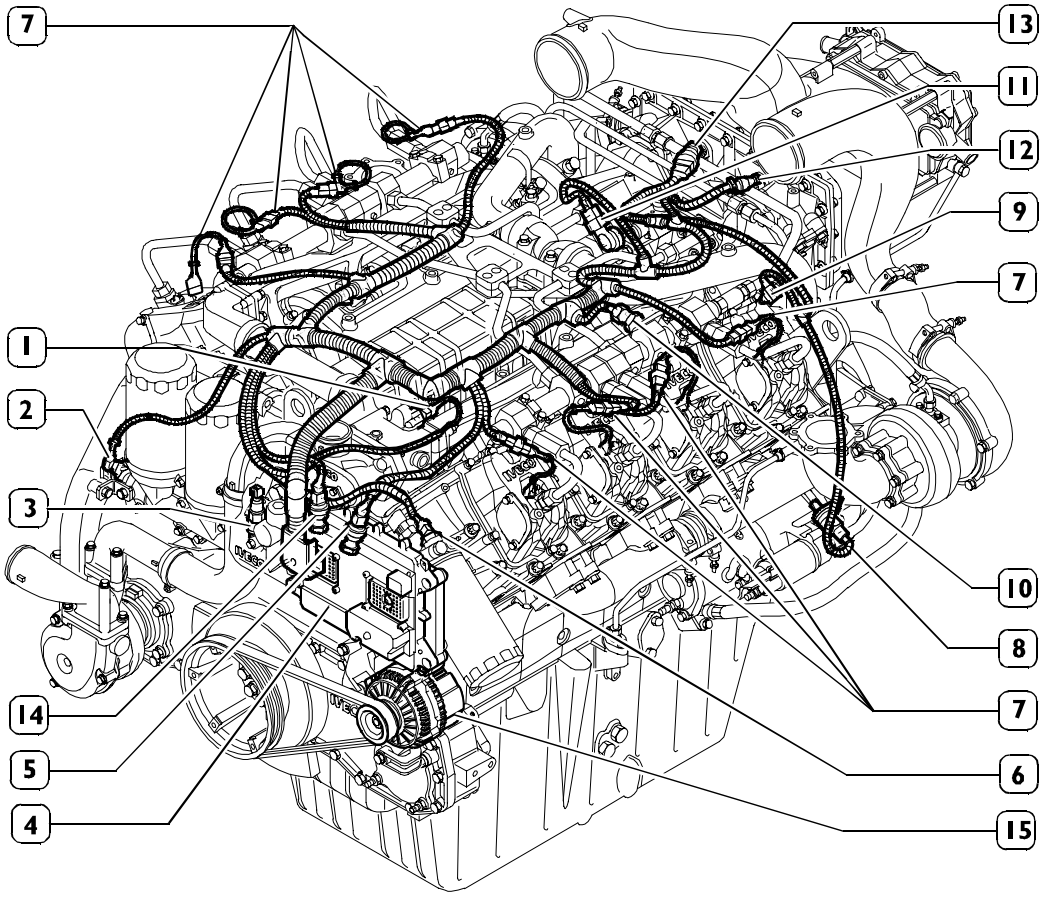
Carefully check and bleed the engine cooling equipment by repeated draining operations.

SECOND PART -

ELECTRICAL EQUIPMENT

LOCATION OF COMPONENTS ON THE ENGINE

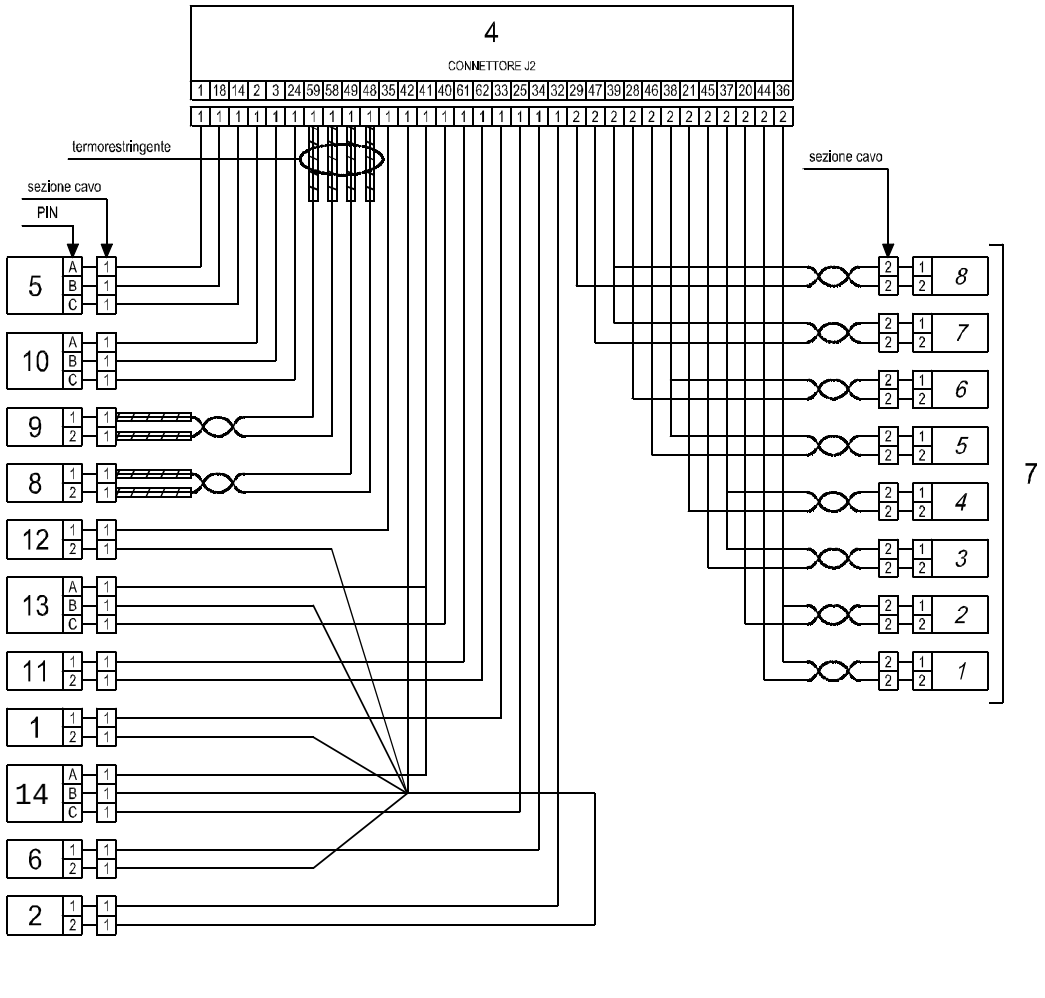
Figure 1



1. Engine coolant temperature sensor – 2. Engine oil temperature sensor – 3. Oil filter clogging sensor – 4. ADEM III engine control module – 5. Atmospheric pressure sensor – 6. Fuel temperature sensor – 7. Electro–injectors – 8. Engine speed/timing sensor on crankshaft – 9. Engine speed/timing sensor on camshaft – 10. Common rail fuel pressure sensor – 11. Common rail high pressure control solenoid valve, also called pulse wide modulation (PWM) or M–Promp valve – 12. Intake air temperature sensor after intercooler – 13. Intake air pressure sensor – 14. Engine oil pressure sensor – 15. Alternator

Circuit diagram of engine cable

Figure 2



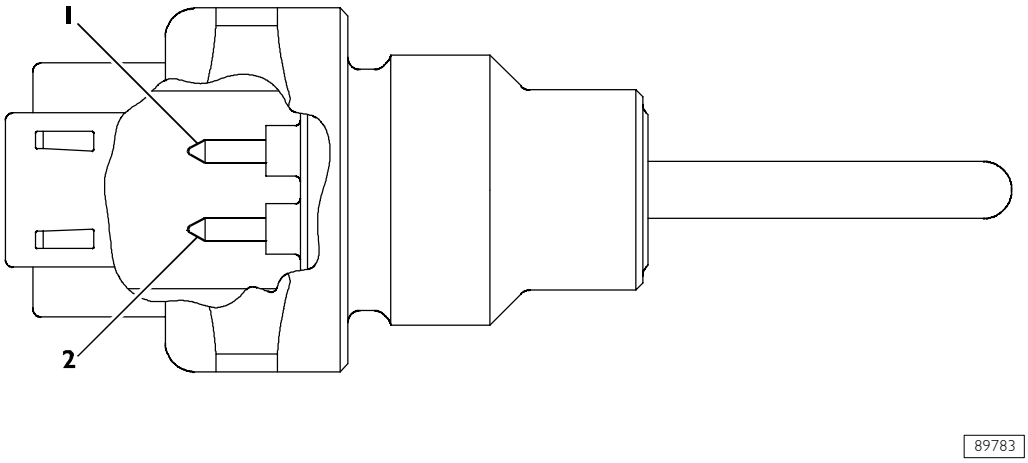
1. Engine coolant temperature sensor – 2. Engine oil temperature sensor – 3. Oil filter clogging sensor – 4. ADEM III engine control module – 5. Atmospheric pressure sensor – 6. Fuel temperature sensor – 7. Electro–injectors – 8. Engine speed/timing sensor on crankshaft – 9. Engine speed/timing sensor on camshaft – 10. Common rail fuel pressure sensor – 11. Common rail high pressure control solenoid valve, also called pulse wide modulation (PWM) or M–Promp valve – 12. Intake air temperature sensor after intercooler – 13. Intake air pressure sensor – 14. Engine oil pressure sensor

Engine components

Temperature sensors

These are NTC type sensors and are used to indicate the operating temperatures of the engine coolant (reference 1, Figure 1), engine oil (reference 2, Figure 1), fuel (reference 6, Figure 1) and exchanger outlet air (reference 12, Figure 1) to the electronic unit

Figure 3



Tecnical view
1. electrical signal - 2. Ground

Pressure sensors

The pressure sensors are used to indicate the oil pressure (reference 3, Figure 1), atmospheric pressure (reference 5, Figure 1) and turbo outlet air pressure (reference 13, Figure 1) values to the electronic unit.

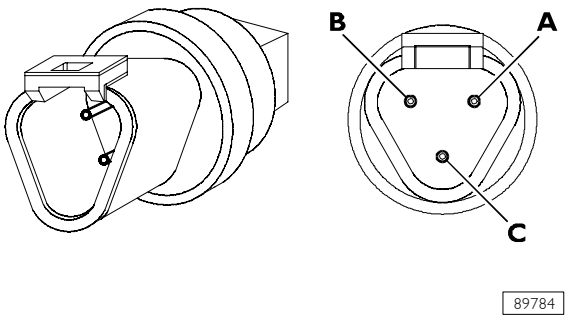
Features:

Air pressure sensor
- max pressure . : . . . . . 472 kPa (absolut)
- voltage . . . . . 5 ± 0.25 Vdc
- energy absorption . . . . 20 mA Max
- Tightening torque . . . . 10 ± 2 Nm

Engine oil pressure sensor
- max pressure . . . . . 1135 kPa (absolut)
- voltage . . . . . 5 ± 0,25 Vdc
- energy absorption . . . . 20 mA Max
- Tightening torque . . . . 10 ± 2 Nm

Atmosferic pressure sensor
- max pressure . . . . . 116 kPa (assoluta)
- voltage . . . . . 5 ± 0,25 Vdc
- energy absorption . . . . 20 mA Max
- Tightening torque . . . . 10 ± 2 Nm

Figure 4



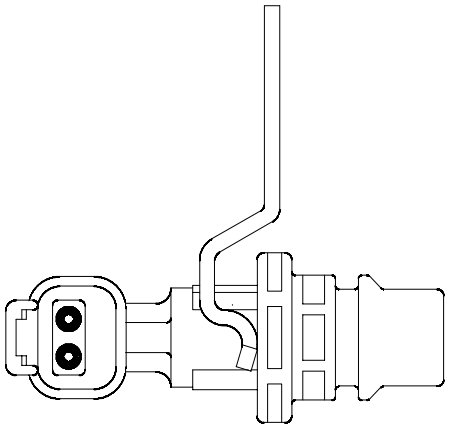
A. feed - B. ground - C. Electrical signal

Engine speed/timing sensor on camshaft

This is an inductive type sensor and is positioned on the distribution shaft (reference 9, Figure 1).

It generates signals that are obtained by means of the magnetic flow lines that close up through the holes on the gears that are keyed on the distribution shaft.. The signal that is generated and sent to the electronic unit that can calculate the injection moment. The sensor must be assembled by tightening it to torque 28 ± 7 Nm.

Figure 5



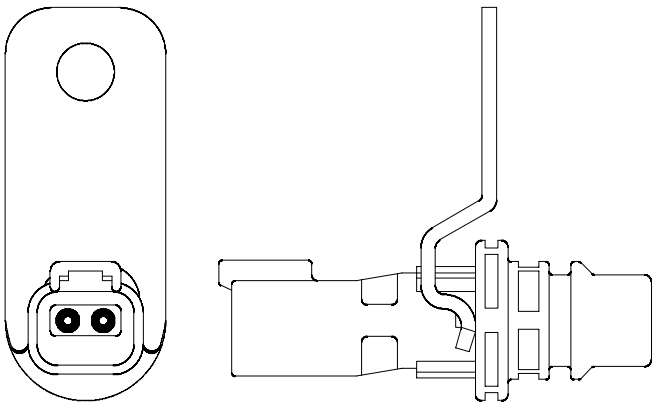
Tecnical view

Engine speed/timing sensor on crankshaft

This is an inductive type sensor and it is positioned on the engine flywheel (reference 8, Figure 1).

It generates signals obtained by means of the magnetic flow lines that close up through the holes that are made in the flywheel. The electronic unit uses this signal in order to detect different engine r.p.m. states.

Figure 6



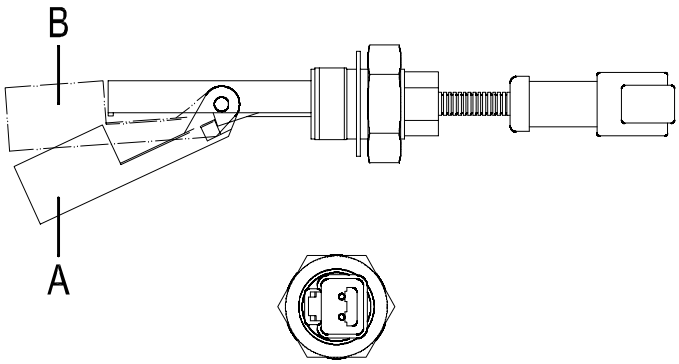
Tecnical view

Engine oil level sensor

This sensor is used to indicate that the sump oil level is too low.

Features:
- max pressure . : . . . . . 5 - 28 Vdc
- resistance . . . . . 130 mA a 28 Vdc Max
- work temperature . . . -40°C / + 125°C
- Tightening torque . . . . 10 ± 2 Nm

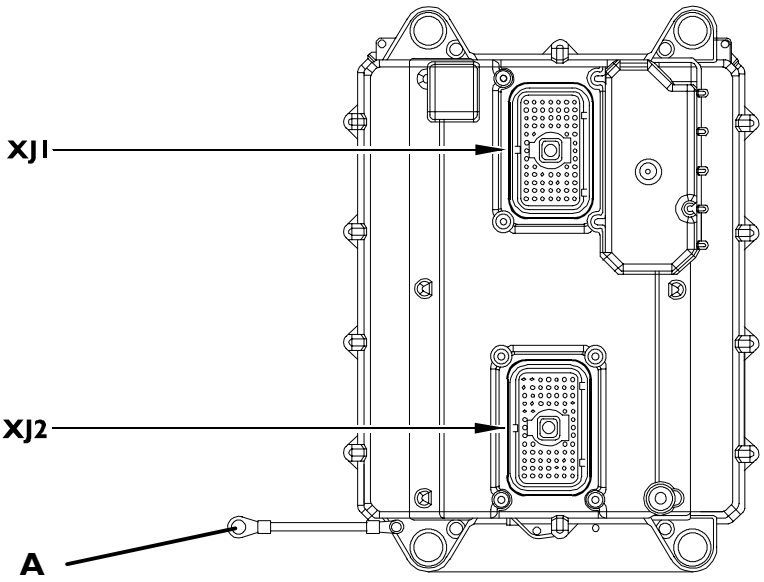
Figure 7



A. Electrical contact in open position – B. Electrical contact in close position - low level in the oil sump

ADEM III engine control unit

Figure 8



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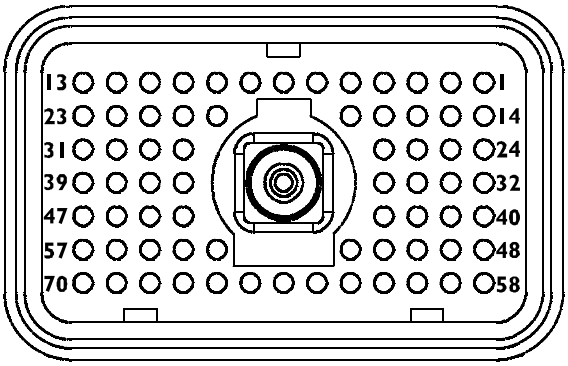
A: Ground wire

XJ1: connector on utilities

XJ2: connector on engine side.

It is fitted directly on the engine using flexible plugs that dampen the vibration transmitted by the engine.

Figure 9



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Connector on engine side.

Pinout of engine side connector XJ2

Pin	Function	Cable code
1	Potential +5V supplying atmospheric pressure sensor	0905
2	Potential +5V supplying rail fuel pressure sensor	1004
3	Reference potential 0V for the rail fuel pressure sensor	1005
4	Not used	–
5	Not used	–
6	Not used	–
7	Not used	–
8	Not used	–
9	Not used	–
10	Not used	–
11	Not used	–
12	Not used	–
13	Not used	–
14	Indicator signal of atmospheric pressure	0907
15	Not used	–
16	Not used	–
17	Not used	–
18	Reference potential 0V for the atmospheric pressure sensor	0906
19	Not used	–
20	Cylinder 2 injector (pin 2)	0915
21	Cylinder 4 injector (pin 2)	0918
22	Not used	–
23	Not used	–
24	Indicator signal of rail fuel pressure	1006
25	Indicator signal of engine oil pressure	0910
26	Not used	–
27	Not used	–
28	Cylinder 6 injector (pin 2)	0921
29	Cylinder 8 injector (pin 2)	1013
30	Not used	–
31	Not used	–
32	Indicator signal of engine oil temperature	0911
33	Indicator signal of engine coolant temperature	1002
34	Indicator signal of fuel temperature	1003
35	Indicator signal of turbo–blower air temperature	0912
36	Common to pins 1 of cylinder 1 and 2 injectors	0913
37	Common to pins 1 of cylinder 3 and 4 injectors	0916
38	Common to pins 1 of cylinder 5 and 6 injectors	0919
39	Common to pins 1 of cylinder 7 and 8 injectors	1011
40	Indicator signal of turbine air outlet pressure	1001
41	Potential +5V supplying turbine air outlet and engine oil pressure sensors	0908
42	Reference potential 0V for the sensors on the engine	0909
43	Not used	–
44	Cylinder 1 injector (pin 2)	0914
45	Cylinder 3 injector (pin 2)	0917
46	Cylinder 5 injector (pin 2)	0920
47	Cylinder 7 injector (pin 2)	1012
48	Positive of the engine speed sensor	1009
49	Negative of the engine speed sensor	1010
50	Not used	–

Pin	Function	Cable code
51	Not used	–
52	Not used	–
53	Not used	–
54	Not used	–
55	Not used	–
56	Not used	–
57	Not used	–
58	Positive of the timing system speed sensor	1007
59	Negative of the timing system speed sensor	1008
60	Not used	–
61	To the rail pressure control valve (pin 1)	1014
62	To the rail pressure control valve (pin 2)	1015
63	Not used	–
64	Not used	–
65	Not used	–
66	Not used	–
67	Not used	–
68	Not used	–
69	Not used	–
70	Not used	–

Electronic control of the engine control unit

ENGINE PRE–HEATING ELEMENT CONTROL

Pre/post–heating is turned on even if just one of the water, air or fuel temperature sensors signals a temperature ≤ 5 °C.

PHASE RECOGNITION

The cylinder in which fuel must be injected is identified upon starting via the signals of the sensor on the camshaft and/or on the crankshaft.

INJECTION CONTROL

The control unit, according to the information from the sensors, governs the pressure regulator and varies the injection modes.

INJECTION PRESSURE CLOSED CYCLE CONTROL

Depending on the engine load, determined by processing the signals from the various sensors, the control unit governs the regulator to have the optimum pressure at all times.

PILOT AND MAIN INJECTION ADVANCE CONTROL

Depending on the signals from the various sensors, the control unit determines the optimal injection point according to internal mapping.

PEAK SPEED LIMITATION

Appropriate engine speed thresholds are stored in the control unit according to the application. When the engine speed exceeds these thresholds the control unit actuates suitable reductions in power by controlling the electro–injector energising time.

SMOKE CONTROL

With load requirements, depending on the signals received from both the engine speed sensor, air temperature and the pressure sensors the control unit adjusts the air fuel ratio in order to avoid black smoke.

THIRD PART -

DIAGNOSTICS

TROUBLESHOOTING

General information

This Troubleshooting guide has been written for first level service engineers.

The initial part of this Section describes the procedure for connection and diagnosis by means of equipment 99368550.

By jointly using the troubleshooting "clues" and the summarizing tables with the event and error codes, you will get an exhaustive picture of the situation as well as the specific instructions to remedy the main faults.

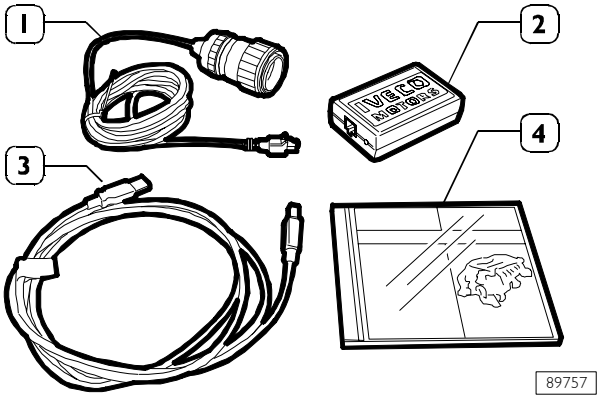
Troubleshooting carried out with the 99368550 equipment can be performed by using simulation tool ILC 99368543 with which it is possible to pilot the power pack that is to be monitored locally.

The description of the ILC simulator tool follow the diagnosis procedure.

NOTE The connection of the two tools is different so that they cannot be mixed up. The tags of tool 99368550 tool have DIAGNOSE written on them and the ones for of tool 99368543 have LOCAL CONTROL written on them.

TROUBLESHOOTING WITH TOOL 99368550

Figure 1



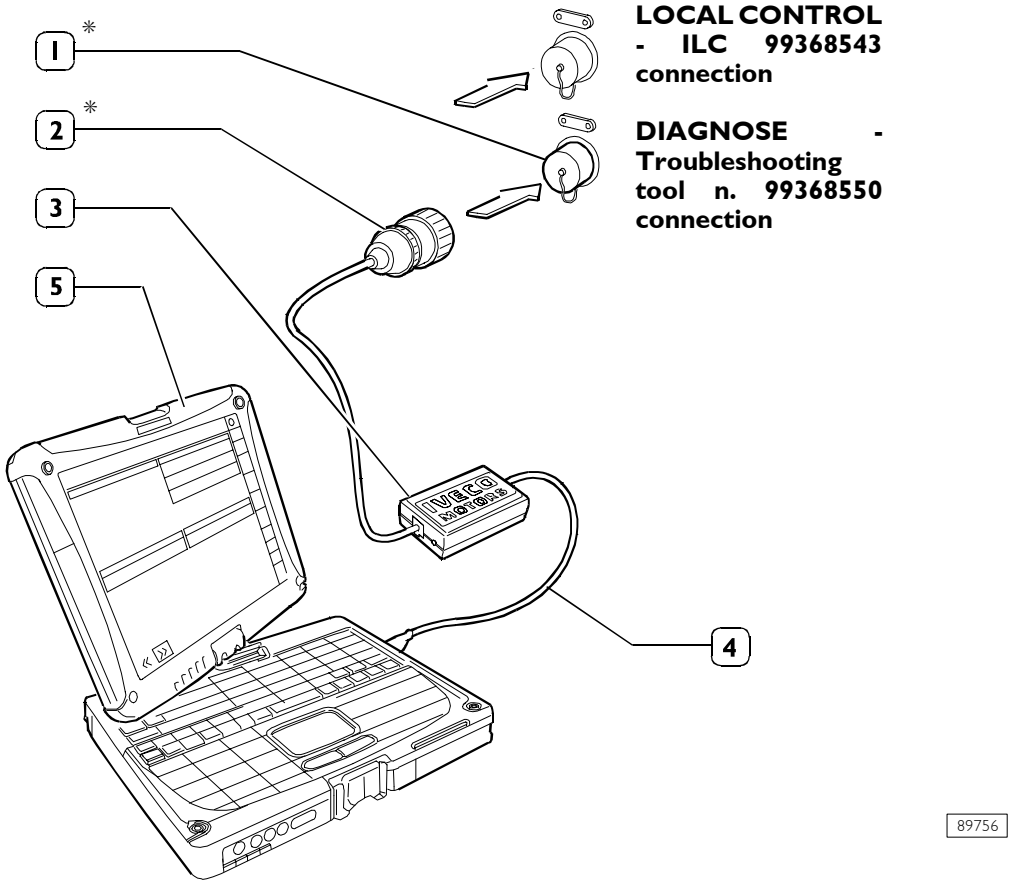
Diagnosis interface kit for Vector motors
1. Cable connecting part 2 to diagnosis connector on switch box - 2. Signal transcoding adapter (Compact Communication Adapter) - 3. USB cable for PC - 4. Installation CD

The CD must be installed on a personal computer (not included in the kit) having following minimum characteristics:

- Processor Intel Centrino I.IULV
- 512 MB Ram
- 40 GByte HD
- Internal modem 56 kbps V90
- Card LAN 100 BASE-TX/10-BASE-T
- 88 character keyboard
- Standard PC external interfaces
- Operating system Windows 2000 Professional.

Program installation must be performed following the procedures that are contained on the CD in the kit.

Figure 2



LOCAL CONTROL - ILC 99368543 connection

DIAGNOSE - Troubleshooting tool n. 99368550 connection

* The diagnostic connection (1) and the connector (2) vary depending on the application.

Connection procedures

- ❑ Unscrew plug (1) on switch box diagnosis connector.
- ❑ Connect the 25-pole connection of cable (2) on switch box diagnosis connector.
- ❑ Connect signal transcoding adapter (3) (Compact Communication Adapter) to the other side of cable (2).
- ❑ Connect cable (4) to the opposite side of part (3).
- ❑ Connect the USB connection of PC (5) to the other end of cable (4).

Diagnosis procedures for Vector 8V engines

SW IVECO MOTORS user interface for VECTOR diagnosis.

The graphic interface of the Vector diagnosis software has been designed to ensure easier utilization of the equipment available to the user, as well as make the available functions visible, and make the diagnosis procedures understandable and adjustable to many different requirements.

The graphic interface is divided into three sections:

- a blue section, referred to as "Title Area", providing the information for the selected product and specifying the point where you are within the exploration route of the diagnosis process.
- A left-hand section, referred to as "Button Area", which allows you to select the functions.
- A central area, referred to as "Operative Area", which makes it possible to display the available lists and functions, thus allowing you to access the various operations.

Main screen with function selecting options

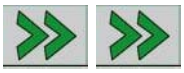
Description of buttons

STOP

- It allows you to exit the VECTOR application at any time.

TOOLS

- This button is selected to access the "Select language" function.
- If you do not wish to use the function shown, select the "Tools" button again.



NAVIGATION

- These buttons allow you to shift between different environments.

SCROLL

- It allows you to scroll long lists which cannot be displayed by means of one single screen.

ON-OFF

- When ON is selected, the parameters are continuously updated.
- When OFF is selected, the parameters will be "frozen" upon selecting.

SAVE ON FILE

- It allows you to save the parameter registration data on a file.

PRINT

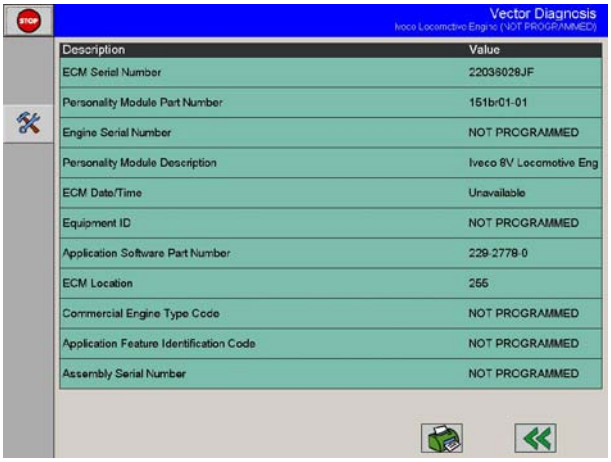
Diagnosis Environment

ECM electronic control unit identification code

The diagnosis instrument consults a storage area of the electronic control unit, where the identification data are listed. Then it displays, if available, the identification code, the control unit and software versions, the date of manufacture and the ECU configuration data.

In the event that communication with the control unit is interrupted, you can print the "Identification code" screen (where enabled) by selecting the PRINT button.

Consulting the "Identification code" card is essential in the event that information is requested from the Service Department.



Control unit identification code reading

NOTE The screen is saved automatically in the ELTRAC folder. It is advisable to rename the identification file because it will be overwritten if there is a connection to the diagnostic socket of another power unit.

Fault code reading

Faults (memorized by the control unit) are automatically identified by the diagnosis instrument after actuating communication with the electronic control unit.

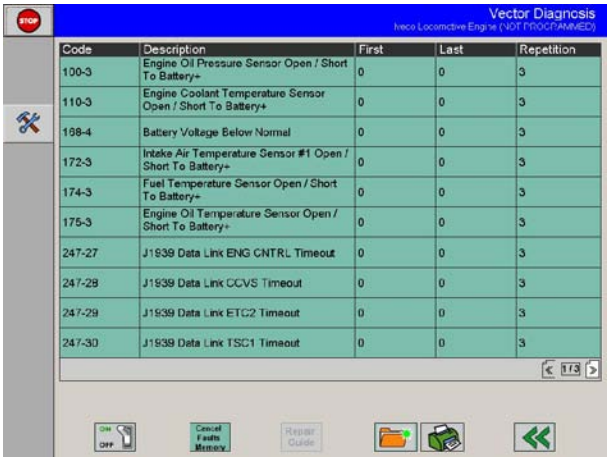
This screen lists the faults or malfunctioning relative to the components directly connected and managed by the electronic control unit.

Reading the FAULT CODES (available in the control unit)

Stored fault code reading

Some of the stored and listed faults might be intermittent. More precisely, some of them might, when being diagnosed, not be present, yet previously memorized by the control unit itself (intermittent faults).

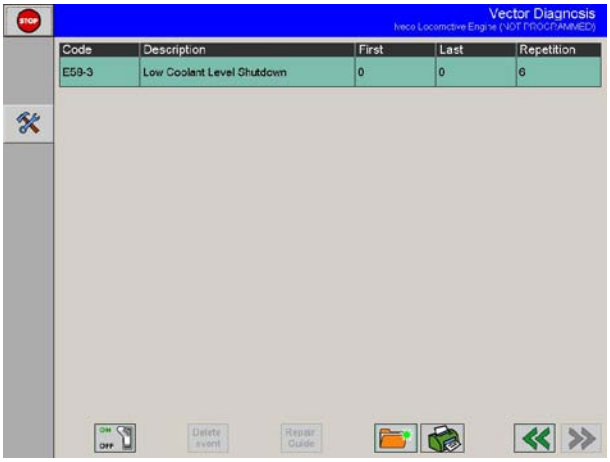
This screen also allows you to clear the faults found in the memory after the repair work has been carried out.



Reading the FAULT CODES (present and intermittent)

Event code reading

This screen lists anomalous faults or malfunctioning of components not closely related to the engine management electronic control unit, but which could in any case affect correct operation of the engine.

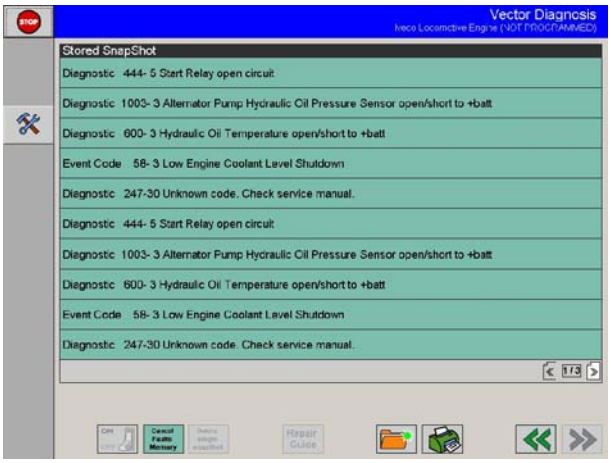


Reading the EVENT CODES (out-of-range sensors)

NOTE **Note** – Save key use: pressing the save key the file of the screen is saved in the ELTRAC folder and a name will be automatically given to it. The name of the file includes the hours, minutes and seconds of when it was saved. The name is univocal and cannot be overwritten.

Fault parameter registration

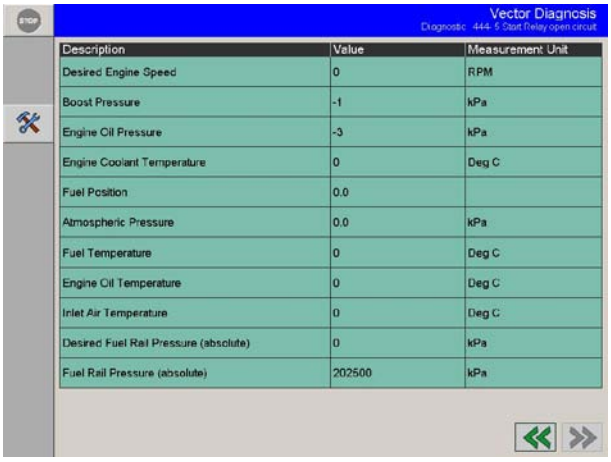
The "Stored SnapShot" screen provides a picture of the conditions at the time when a fault or event occurred. The diagnosis software makes it possible to store up to 50 faults or events. This screen also allows you to perform clearing.



Reading and recording fault parameters

Fault parameter reading - Environment conditions

By selecting a fault or event from the previous screen, the related environment conditions are provided.



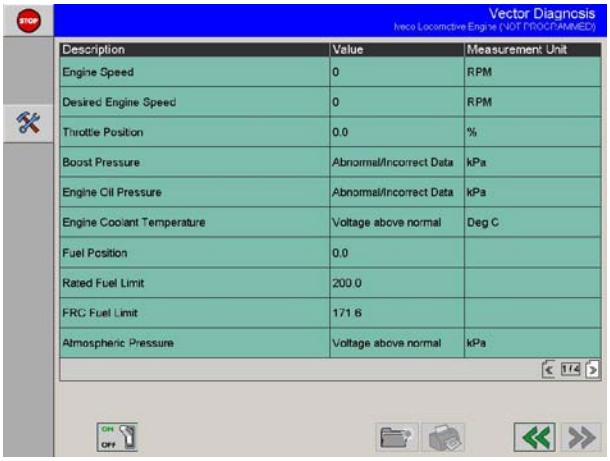
Displaying the related environment conditions

Work parameter reading

Work parameters include all the parameters available in the control unit.

It is important that work parameters are read when the system is active (engine running).

The ON/OFF button allows you to have, according to the choice made, the parameters updated (button set to ON) or frozen upon selection (button set to OFF).



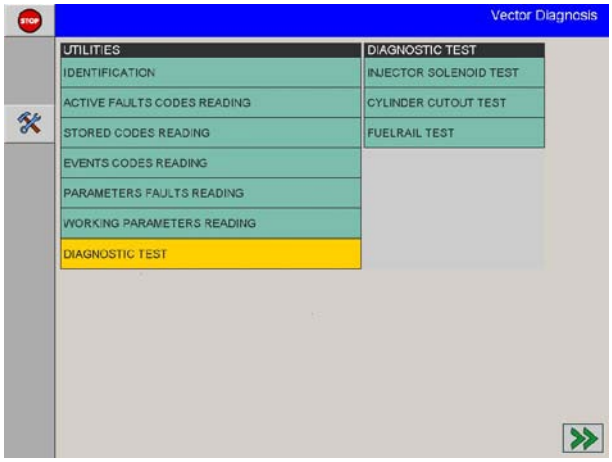
Work parameter reading

NOTE **Note** – In order to "freeze" the parameters displays, position the ON/OFF pushbutton on OFF. Then save by pressing the specific pushbutton.

Diagnostic Test

The "Utilities" screen allows you display the Engine Test options available.

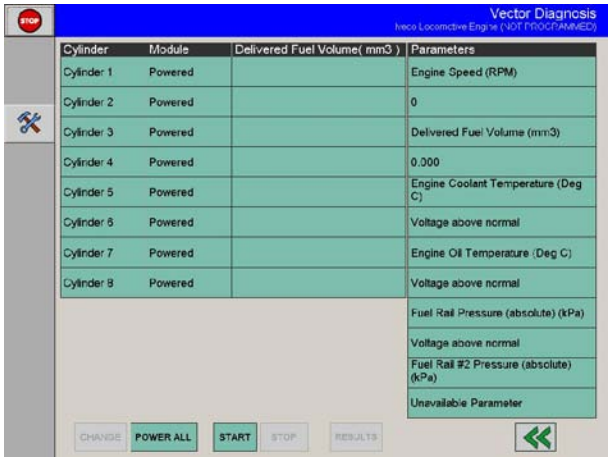
The diagnosis software provides for the following tests:



Displaying the Engine Test options available

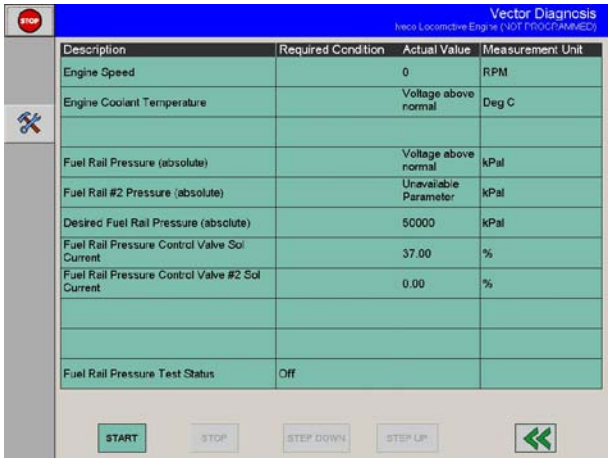
❑ Electric test of injector solenoid valves with engine OFF.

❑ Injector efficiency test with engine started (cut-out test).



NOTE During the injector operation inspection, the VARIATION OF THE FUEL DELIVERY is to be observed while a cylinder is excluded. (the value must increase). If the value remains the same the injector will be locked.

❑ High pressure system efficiency test with engine started (rail pressure step test).



The initial conditions are:
- Engine on idle
- Initial pressure in kPa

Press START; three other pushbuttons will be displayed:
- STOP
- STEP UP
- STEP DOWN

Press on STEP UP making the rail operation pressure rise up to 160.000 kPa.

Let the engine run in these conditions for 5 minutes and see if there is any leakage from the rail and from the pipes.

Then press STEP DOWN in order to bring the pressure back to the initial level.

Press STOP to finish the test.

ENGINE PARAMETER READING

Parameter	Units of measurement
Engine speed	rpm
Desired Engine speed	rpm
Throttle Position	%
Boost pressure	kPa
Engine Oil Pressure	kPa
Engine Coolant Temperature	Deg C
Fuel Position	
Rated Fuel Limit	
FRC Fuel Limit	
Atmospheric Pressure	kPa
Fuel Temperature	Deg C
Engine Load Factor	%
Diagnostic Clock	hours
Engine Oil Pressure (abs)	kPa
Turbo Outlet Pressure (abs)	kPa
Battery Voltage	Volt
Hydraulic Oil Temperature	Deg C
Injection Actuation Pressure	kPa
Fuel Consumption Rate	l/h
Engine Oil Temperature	Deg C
Inlet Air Temperature	Deg C
Fan Pump Pressure	kPa
Injector Actuation Current	%
Number of Engine Cylinders	
Active Diagnostic Codes Present	
Delivered Fuel Volume	mm^3
Desired Fuel Rail Pressure (absolute)	kPa
Fuel Rail Pressure (absolute)	kPa
Fuel Rail Pressure Control Valve Sol Current	%

READING PARAMETER FOR SAVE CODE

Parameter	Units of measurement
Desired Engine speed	rpm
Boost pressure	kPa
Engine Oil Pressure	kPa
Engine Coolant Temperature	Deg C
Fuel Position	
Atmospheric Pressure	kPa
Fuel Temperature	Deg C
Engine Oil Temperature	Deg C
Inlet Air Temperature	Deg C
Desired Fuel Rail Pressure (absolute)	kPa
Fuel Rail Pressure (absolute)	kPa

EVENTS TABLE

Low Engine Oil temperature Warning	492-1
Low Fuel Rail Pressure - Pressure Derate	398-2
Low Fuel Rail Pressure - Pressure Shutdown	398-3
Low Fuel Rail Pressure - Pressure Warning	398-1
Low Oil Level	171-1
Very Low Oil Level	171-2
Water In Fuel Derate	2093-2
Water In Fuel Shutdown	2093-3
Water In Fuel Warning	2093-1
Engine Oil Filter Restriction Derate	1-2
Engine Oil Filter Restriction Shutdown	2-3
Engine Oil Filter Restriction Warning	99-1
Engine Overspeed Derate	3-2
Engine Overspeed Shutdown	4-3
Engine Overspeed Warning	190-1
Fuel Filter Restriction Derate	5-1
Fuel Filter Restriction Shutdown	6-3
Fuel Filter Restriction Warning	95-1
Fuel Repair Pressure Leak Derate	499-2
Fuel Repair Pressure Leak Shutdown	499-3
Fuel Repair Pressure Leak Warning	499-1
High Boost Pressure Derate	162-2
High Boost Pressure Shutdown	162-3
High Boost Pressure Warning	162-1
High Engine Coolant Temperature Derate	15-2
High Engine Coolant Temperature Shutdown	16-3
High Engine Coolant Temperature Warning	17-1
High Engine Oil Temperature Derate	18-2
High Engine Oil Temperature Shutdown	19-3
High Engine Oil Temperature Warning	20-1

EVENTS TABLE

High Fuel Rail Pressure - Pressure Derate	396-2
High Fuel Rail Pressure - Pressure Shutdown	396-3
High Fuel Rail Pressure - Pressure Warning	396-1
High Fuel Temperature Derate	54-2
High Fuel Temperature Shutdown	55-3
High Fuel Temperature Warning	56-1
High Hydraulic Oil Temperature Derate	23-2
High Hydraulic Oil Temperature Shutdown	24-3
High Hydraulic Oil Temperature Warning	600-1
High Inlet Air Temperature Derate	25-2
High Inlet Air Temperature Shutdown	26-3
High Inlet Air Temperature Warning	27-1
Low Boost Pressure Derate	93-2
Low Boost Pressure Shutdown	93-3
Low Boost Pressure Warning	93-1
Low Coolant Level Derate	57-2
Low Coolant Level Shutdown	58-3
Low Coolant Level Warning	59-1
Low Engine Oil Pressure Derate	39-2
Low Engine Oil Pressure Shutdown	40-3
Low Engine Oil Pressure Warning	100-1
Low Engine Oil Temperature Derate	492-2
Low Engine Oil Temperature Shutdown	492-3

FAULTS TABLE

5 Volt Supply Above Normal	262-3
5 Volt Supply Below Normal	262-4
8 Volt Supply Above Normal	41-3
8 Volt Supply Below Normal	41-4
Alternator Disable Relay Open Circuit	1002-5
Alternator Disable Relay Short Circuit	1002-6
Alternator Pump Pressure Sensor Open / Short To Battery +	1003-3
Atmospheric Pressure Sensor Open / Short To Battery +	274-3
Atmospheric Pressure Sensor Open - Short to Ground	274-4
Battery Voltage Above Normal	168-3
Battery Voltage Below Normal	168-4
Diagnostic Lamp Open Circuit	1266-5
Diagnostic Lamp Short Circuit	1266-6
Engine Coolant Temperature Sensor Open / Short To Battery +	110-3
Engine Coolant Temperature Sensor Short to Ground	110-4
Engine Coolant Fan Pump Pressure Sensor Short to Ground	290-4
Engine Oil Pressure Sensor Open / Short To Battery +	100-3
Engine Oil Pressure Sensor Short to Ground	100-4
Engine Oil Refill Relay Open Circuit	1000-5
Engine Oil Refill Relay Short Circuit	1000-6
Engine Oil Temperature Sensor Open / Short To Battery +	175-3
Engine Oil Temperature Sensor Short to Ground	175-4
Engine Starter Relay Open Circuit	444-5
Engine Starter Relay Short Circuit	444-6
Fuel Filter Heater Relay Open Circuit	1001-5
Fuel Filter Heater Relay Short Circuit	1001-6
Fuel Rail Pressure Control Valve # 1 Machanical System	1779-7
Fuel Rail Pressure Control Valve # 1 Open Circuit	1779-5
Fuel Rail Pressure Control Valve # 1 Short Circuit	1779-6
Fuel Rail Pressure Sensor # 1 Open / Short To Battery +	1797-3

FAULTS TABLE

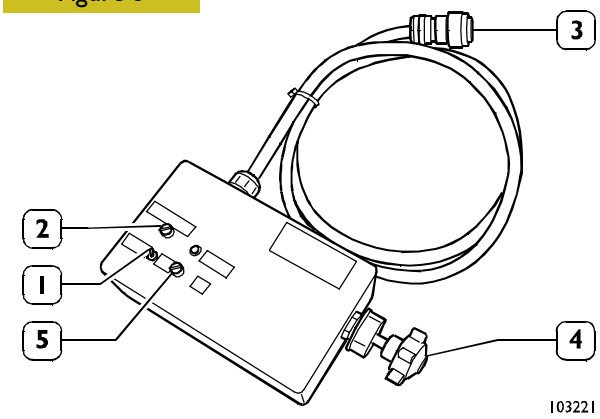
Fuel Rail Pressure Sensor # 1 Short To Ground	1797-4
Fuel Temperature Sensor Open / Short To Battery +	174-3
Fuel Temperature Sensor Short To Ground	174-4
Hydraulic Oil Temperature Sensor Open / Short To Battery +	600-3
Hydraulic Oil Temperature Sensor Short To Ground	600-4
Injector Cylinder 1 Open Circuit	1-5
Injector Cylinder 1 Short Circuit	1-6
Injector Cylinder 2 Open Circuit	2-5
Injector Cylinder 2 Short Circuit	2-6
Injector Cylinder 3 Open Circuit	3-5
Injector Cylinder 3 Short Circuit	3-6
Injector Cylinder 4 Open Circuit	4-5
Injector Cylinder 4 Short Circuit	4-6
Injector Cylinder 5 Open Circuit	5-5
Injector Cylinder 5 Short Circuit	5-6
Injector Cylinder 6 Open Circuit	6-5
Injector Cylinder 6 Short Circuit	6-6
Injector Cylinder 7 Open Circuit	7-5
Injector Cylinder 7 Short Circuit	7-6
Injector Cylinder 8 Open Circuit	8-5
Injector Cylinder 8 Short Circuit	8-6
Inlet Air Heater Relay Open Circuit	617-5
Inlet Air Heater Relay Short Circuit	617-6
Intake Air Temperature Sensor #1 Open / Short to Battery +	172-3
Intake Air Temperature Sensor #1 Short To Ground	172-4
J1939 Data Link CCVS Timeout	247-28
J1939 Data Link ENG CNTRL Timeout	247-27
J1939 Data Link ETC2 Timeout	247-29
J1939 Data Link TSC1 Timeout	247-30
Loss of Primary Engine Speed Signal	190-2

FAULTS TABLE

Loss of Secondary Engine Speed Signal	342-2
Engine flywheel speed irregular signal	605-8
Personality Module Interlock Mismatch	253-2
Primary Engine Speed Signal Abnormal	190-8
Remote Operator's Lamp Open Circuit	823-5
Remote Operator's Lamp Short Circuit	823-6
Remote Throttle Position Sensor	1923-8
Secondary Engine Speed Signal abnormal	342-8
Secondary Engine Speed Signal Machanical Failure	342-11
TGC Relay Open Circuit	477-5
TGC Relay Short Circuit	477-6
Turbo Outlet Pressure Sensor # 1 Open / Short To Battery +	273-3
Turbo Outlet Pressure Sensor # 1 Short To Ground	273-4
Warning Lamp Open Circuit	324-5
Warning Lamp Short Circuit	324-6

ILC SIMULATOR 99368543 TOOL

Figure 3



1. Switch - 2. Engine oil fill up pushbutton (prearranged only for a few Vector versions) - 3. Connection to electronic control unit - 4. Potentiometer for remote intervention on engine rpm.

NOTE The connection (3) varies depending on the application.

The ILC simulation tool is used to start the power unit remotely and in order to be able to monitor operation via the diagnostic equipment.

ILC simulator tool use:

- ❑ Connect connector (3) to the electrical shunt box on which the unit is inserted.
- ❑ Press switch (1) (+15).
- ❑ Press START (5).
- ❑ If required use potentiometer (4) in order to increase engine rpm.
- ❑ Pushbutton (2) used to fill up the sump with oil is not used in this Vector version.

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to electrical malfunctioning:				
The engine will not start.	No sign of starting.	Starting motor cables connected improperly or not connected at all	Connect electrical cables properly	
		Starter motor defective.	Replace starter motor.	(Changing the motor must be the last activity to do if all the preceding checks have proved negative).
		The relay for starter motor shorted or circuit open.	Check cable integrity before requesting relay replacement	In this case the diagnosis is available in the unit
		Unit diagnosis inhibited at startup	Check diagnosis codes present in order to verify the cause.	
		Trouble in the ADEM III electronic control unit. (Short circuit)	Check unit cabling integrity before replacing it	No enabled diagnosis is available (the unit is damaged)
		Crankshaft sensor: no signal or signal not plausible.	Check the sensor is clean and correctly secured. Check the phonic wheel is clean and integral. Check the integrity of the sensor (R $\simeq$ 920 Ω). If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the XJ2 EDC connector pin 49, between the sensor connector (wiring side) pin 2 and the XJ2 EDC connector pin 48.	The engine fails to start because after a few turns the control unit turns off the starter motor. This check cannot be made with the motor fitted: it is necessary to remove the flywheel housing.
	Total absence of pressure in the rail	Pressure sensor damaged	Check the trouble level of sensor and wiring and change the defective components.	

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to malfunctioning in the fuel supply:				
The engine will not start.	Indicators on - No startup sign	No fuel in the tank or defect ascribable to a suction defect	Fill up the tank and check why there is no fuel. Check suction device and remove whatever caused clogging.	In order to ascribe or exclude level sensor, suction device or fuel level indicator defect check fuel level in the tank by relevant level indicator.
	Indicators on	Excessive water in the prefilter	After checking is there is any condensate exhaust as described on the ordinary maintenance manual or during sensor inspection. Therefore first check the sensor connection and replace the sensor if trouble is due to it.	
	Indicators on	Filters clogged	After checking the conditions of cartridge clogging replace them or check the sensor. Afterwards check the connection and if the trouble is due to the sensor replace it.	
	Fuel leaking from the pipes.	Rupture of the supply circuit pipes	Check and replace the damaged part.	
	Total absence of pressure in the rail	Air in the fuel circuit	Check the fuel supply circuit on low pressure side. Check the fuel supply circuit on high pressure side.	Check that there is no air in the prefilters and in the fine filters. Check that there is no air in the rail and in the high pressure pump bleed. If the trouble persists with suitable pressure gauge check the high and low pressure pump inlet and outlet pressures.
		Flow regulating valve (M-promp) locked closed.	Replace M-promp	

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to electric malfunctioning or inefficient sensors:				
Starting difficult.	Startup difficult in every case	M-prop valve locked open	If diagnosis is present in the unit check sensor and cabling integrity. If the checks turn out to be negative replace the M-promp valve	
	a) Heater always on. The battery runs down.	Defective remote control for duel filter heater.	Check vehicle cable.	Fuel heats up too much
	b) Heater never turns on. Possible filter clogging due to fuel paraffining with very low outside temperatures (< –15 °C).	Remote control for the fuel filter heater is defective.	Check vehicle cable and/or replace the filter.	The clogged filter indicator turns on.
	a) The pre/post–heating elements are not powered, cold starting may be difficult and smokiness on starting. b) The pre/post–heating elements are always powered: early deterioration of the heating elements, the batteries quickly run down.	The air heater control relays assembled on the vehicle are faulty.	Check that the connections of the two remote controls are not cut off. Check that the wiring of the engine cable and the resistances for air heating are not cut off.	Resistance enabling and/or low battery charge indications.

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to mechanical malfunctioning:				
Starting difficult.	No starting sign	Low pressure pump operating defect	Check the degree of the trouble and replace the damage or inefficient parts checking with a pressure gauge that the pressures exceed 4.5 bar	
		High pressure pump damaged	Change the high–pressure pump	
	No visible sign	Inefficient high pression pump	After checking and excluding any other possibility replace the pump	
	Startup requires at least 20 seconds, large amount of while smoke from exhaust, fuel smell.	Injector jammed open (irreversibly).	Without any diagnosis instrument, the injector that does not work can be found because the relevant high pressure pipes are not heated CAUTION hot engine parts may cause severe injuries	Normally with these symptoms it is natural to abandon the attempt of starting the engine. Because insisting the engine starts with one cylinder less and slowly the smoke diminishes and disappears
		Check that the relevant engine-injector cable cylinder number match	Check cable positioning and if required connect the engine cable properly	
	Difficult startup and poor performance in all conditions	Inefficient low or high pressure pump	After checking and excluding any other possibility and checking rail pressure trend, replace the high or low pressure pump according to which component is damaged	
	Difficult startup, poor performances and engine runs with one cylinder missing	Injector with shutter or solenoid core (mechanical part) locked open.	Without any diagnosis instrument, the injector that does not work can be found by feeling if there is no pulsation on the high pressure piping	With slight blow-by that jeopardises the mechanical operation of the injector but does not enable the flow limiter

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to malfunctioning in the fuel supply:				
Abnormal performance	Scarce loading request performances. Possible smoke and rocking	Insufficient fuel level during operation	Check fuel level	The lack of fuel causes trouble to normal system operation mostly when there is a remarkable request of fuel.
		Fuel system clogged before the prefilter	Check if the prefilter priming pump works properly. If the knob of the pump remains aspirated downwards by the depression, disassemble and check prefilter integrity. If the trouble persists have the manufacturer check the system between the tank and the prefilter.	Check accurately and clean fuel system
		Fuel leaks from fittings or pipes after the low pressure pump.	Check the conditions of the pipes and relevant seals.	
		Diesel fuel filter clogged	Check the presence of errors (detectable data) with the diagnosis instrument, then replace the filters	
		Air blow-by before the low pressure pump	Check the conditions of the pipes and relevant seals between the prefilter and the low pressure pump. Check that the bleed screws on the filter are tightened.	
	With full load performance decay occurs.	One or more injectors blocked.	The injector that does not work can be found even without diagnosis instruments even if it is completely closed because the relevant high pressure pipes would be cold.	CAUTION: hot engine parts may cause severe injuries.
		Air filters clogged as indicated by the sensors.	Request cleaning/replacement of the filters and clean the intake ducts before the filters	

Symptom	Visible trouble	Possible cause	Repair	Notes
Attributable to electrical malfunctioning.				
Abnormal performance	Engine does not accelerate	PWM signal not plausible or malfunction of the accelerator potentiometer.	Check active diagnosis and any cabling control. Replace, if required	
	Power reduction	The rail pressure does not correspond to the one wanted	Check active diagnosis and any adjustable flow control valve replacement.	If replacement does not resolve the trouble, with a multimeter check that cabling works properly
		Rail pressure sensor does not work properly	Check active diagnosis and any sensor replacement	If replacement does not resolve the trouble, with a multimeter check that cabling works properly
		The pressure regulator does not work properly	Check active diagnosis, check that the connector is properly connected to the pressure regulator and any sensor replacement	If replacement does not resolve the trouble, with a multimeter check that cabling works properly
	The engine suddenly stops (without previous hesitations) and does not restart	The fuel filter is clogged	Check diagnosis and then fuel filter replacement	Check why clogging occurs
		Rupture or malfunction of the rail pressure sensor or of the overpressure valve	Check active diagnosis and any sensor replacement	If replacement does not resolve the trouble, with a multimeter check that cabling works properly
			Check and/or replace the overpressure valve	
Coolant high temperature detected by the engine sensor	None	Insufficient engine water level	Request tank level reset	

FOURTH PART -

PLANNED MAINTENANCE

VECTOR 8 DRAGON FVAE2884A*B200 MAINTENANCE PLAN

	Hourly intervals h	Time intervals
First level service	500	1 year
Second level service	2500	5 years
General overhaul	5000	10 years
Engine replacement	25000	25 years

DAILY CHECKS
Check fumes
Check for faults during start-up
Check for clogged air/oil/diesel filter warning light activation
Check for abnormal noises

WEEKLY CHECKS
Check oil level manually - top up if necessary
Check coolant level - top up if necessary
Check for fluid leaks
Inspect the engine for lost or missing bolts/damaged parts
Inspect belt wear
Remove any dirt built up on the engine (leaves, dust, etc)
Take note of oil/diesel consumption per service hours/km and report and unexplained increases.
Check coolant overheating or excessive heating time

FIRST LEVEL MAINTENANCE **Carry out every 500 hours or at least once per year**
Change oil filters
Change fuel filters
Change fuel prefilter
Change engine oil
Adjust valve clearance
Change alternator belt
Change blow-by filter

SECOND LEVEL MAINTENANCE **Carry out every 2500 hours or at least once every 5 years**
Operations from the previous level
Change water pump
Change injectors
Change starter motor
Change alternator

GENERAL OVERHAUL **Carry out every 5000 hours or at least once every 10 years** **In addition to the operations at the previous level, change the following:**
Cylinder liners
Cylinder heads
Damper
Pistons
Camshaft
High pressure fuel pump
Low pressure fuel pump
Wiring
Turbochargers
Turbocharger oil delivery/return pipes
Starter motor
Seals and gaskets
Oil pump
Oil pressure regulation valve
Gears
Oil exchanger
Oil level sensor
Oiljet pressure regulation valves
Air/oil/water heaters
Taper roller bearings on front casing
Crankshaft and camshaft bearings
Rockers and mounts
Roller tappets
Rocker shafts
Connecting rods

ENGINE REPLACEMENT **Carry out every 25000 hours or at least once every 25 years**

VECTOR 8 GENSET FVAE2885X*A100 MAINTENANCE PLAN

PRIME POWER

Prime Power is the maximum power available at variable loads for an unlimited number of hours. The average power available during a 24 hour operating period should not exceed 80% of the prime power between the recommended servicing intervals in standard environmental conditions.

An overload of 10% for 1 hour for every 12 hours of operation.

STAND-BY POWER

This is the maximum power available for a period of 500 hours/year with an average load factor of 90% of the stand-by power. No type of overload is permitted for this usage.

CONTINUOUS POWER

Contact the Iveco Motors sales organization.

	Continuous / Prime		**Stand-By**	
Periodic Checks	100 h		1 month	
	Hourly intervals h	**Time intervals**	**Hourly intervals h**	**Time intervals**
First level service	1000	1 year	500	1 year
Second level service	5000	2 years	1000	2 years
General overhaul	25000	10 years	2000	10 years

For special applications (heavy operating conditions, $T_{ambient}$>40°C) the following reduction in these intervals is required:

Periodic checks	0%
First level service	0%
Second level service	- 40%
General overhaul	- 40%

LIST OF OPERATIONS

PERIODIC CHECKS
Check oil level/top up (Urania Turbo LD)
Check coolant level/top up
Check whether air/oil/diesel filter blocked warning lights are on (if wired)
Check water in diesel prefilter warning light

FIRST LEVEL SERVICE
Oil filter replacement
Fuel filter replacement[1)]
Fuel pre-filter replacement[1)]
Blow-by filter replacement
Engine oil change
Check density and pH of coolant
Valve clearance adjustment[1)]
Check on cooling assembly cleanliness
Replace supercharging hoses

1) only at the end of the service interval expressed in hours of operation

SECOND LEVEL SERVICE
Alternator drive belt replacement
Water pump replacement
Injector replacement
Coolant replacement

GENERAL OVERHAUL
Oil Jet pressure relief valves adjustment
Clean oil heat exchanger
Gear inspection
Oil pressure relief valve replacements
Valve control rods replacement
Connecting rod replacement
Oil pump replacement
Gasket replacement
Starter motor replacement
Oil return hoses replacement
Oil intake hoses replacement
Turbine replacement
Engine lead assembly replacement
Low pressure pump replacement
High pressure pump replacement
Conical roller bearing replacement
Camshaft replacement (including gear)
Rocker arms and supports replacement
Bearing kit replacement
Piston assembly replacement
Cylinder liner/bore replacement
Cylinder head replacement
Additional earth replacement
Tappet roller replacement
Torsion damper replacement
Common rail replacement
Alternator replacement
Overhaul thermostat
General engine overhaul

DESCRIPTION OF PREVENTIVE AND ROUTINE MAINTENANCE WORK

Philosophy of Preventive and Routine Maintenance Work

To make sure the working conditions are always perfect, the following pages specify the controls, checks and adjustments that must be carried out on the various parts of the engine at the scheduled times.

Regular maintenance is the best guarantee for safe operation and keeping running costs at optimal levels.

These operations are to be carried out at the set mileages.

User recommendations

The frequency of engine lubrication is in relation to a percentage of sulphur in the diesel of less than 0.5%.

If using diesel with a percentage of sulphur higher than 0.5%, the mileage must be halved.

CHECKING/REFILLING ENGINE OIL FILTERS

Handle all parts extremely carefully.
Never get your hands or fingers between pieces.
Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

Every 25,000 km check the level of oil in the sump with the dipstick.
The level must be between the max and min marks on the dipstick.
If necessary, top up with oil of the same type contained in the sump via the filler (Urania Turbo type of oil)

NOTE When filling, it is recommended to take out the dipstick to help the oil flow into the sump.

CHANGING ENGINE OIL FILTERS

Handle all parts extremely carefully.

Never get your hands or fingers between pieces.
Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

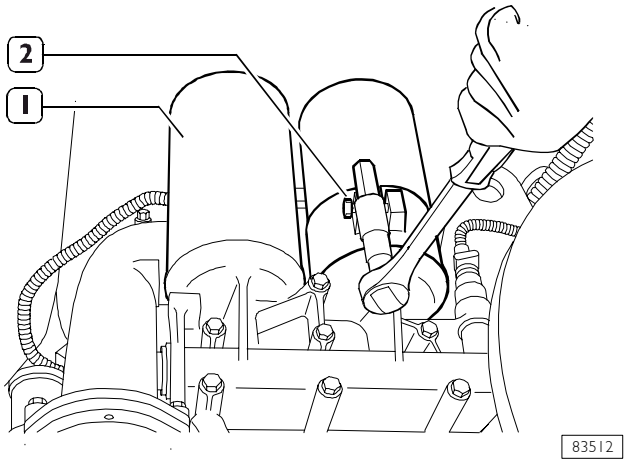
Before touching the filters, make sure the engine temperature is not such as to cause burns.

Engine lubricating oil is harmful: avoid contact with skin and eyes. In the event of contact, wash with plenty of running water.

To change the engine oil filters, proceed as illustrated here.

NOTE Before removing the filters, place a tray of sufficient capacity in a suitable position: each filter contains approximately 1 kg of engine oil.

Figure 1

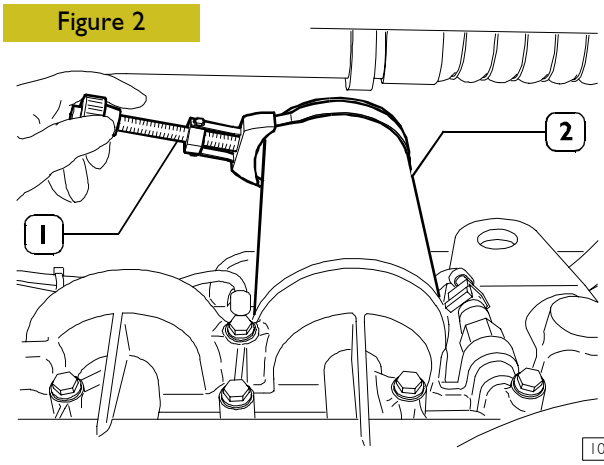


To remove the engine oil filters (2) use tool 99368538 (1).

Improper waste disposal is a threat for the environment. Potentially hazardous waste used on IVECO vehicles includes lubricants, fuels, coolants, filters and batteries.

- Use watertight containers when draining off fluids. Never use containers for foodstuffs or beverages that can lead people to drink from them.
- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

Figure 2



Replace the filters with new parts, lubricate the seals slightly with engine oil, hand screw and tighten for another 3/4 turn (tighten whit tool 99368539).

NOTE Use only genuine products, capable of extending the efficiency and life of the engine.

After fitting the filters, check the sump oil level and turn the engine for a little while.

Stop the engine, wait for roughly ten minutes and check the oil level again.

Top up as necessary.

CHANGING THE ENGINE OIL

Handle all parts extremely carefully. Never get your hands or fingers between pieces. Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

Before touching the sump plug, check that the temperature of the oil in the engine is not such as to cause burns.

Engine lubricating oil is harmful: avoid contact with skin and eyes. In the event of contact, wash with plenty of running water.

The engine lubricating oil must be changed every 100000 km according to the directions illustrated here.

NOTE Before draining off the oil, place a tray of sufficient capacity under the oil sump in correspondence with the drain plug. Quantity of oil contained in sump approximately 40 litres.

- ❑ Unscrew the plug on the filler and extract the dipstick.
- ❑ Unscrew the oil drain plug and insert the drain tool 99368537.
- ❑ Drain the oil from the sump.
- ❑ Extract the drain tool 99368537 and screw on the plug.
- ❑ Add clean oil, checking the level from time to time by inserting the dipstick. Quantity of oil approximately 40 litres.
- ❑ Put the plug on the filler.
- ❑ If not done beforehand, change the oil filters.
- ❑ Start up the engine, checking there is no leakage or seepage.

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- Never throw waste on the ground, on tips or in water courses.
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CHANGING FUEL PREFILTER AND WATER SEPARATOR FILTER

Handle all parts extremely carefully.

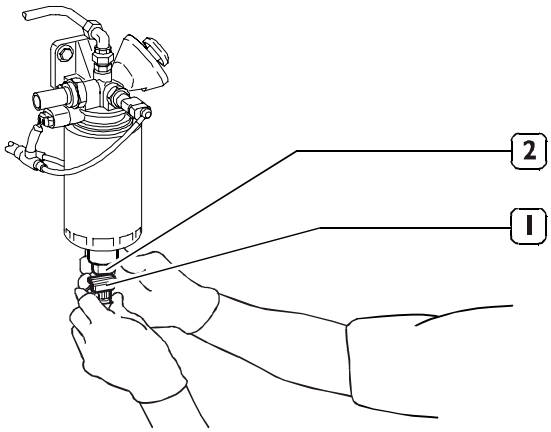
Never get your hands or fingers between pieces.

Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

To change the fuel pre–filter and water separator filter, proceed as illustrated here.

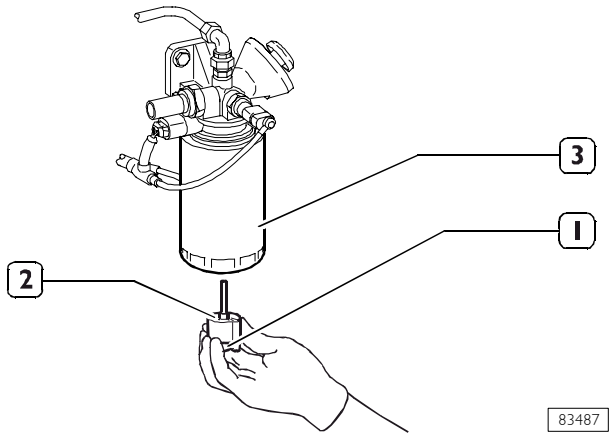
NOTE Before disassembling, place under the filter a basin of suitable capacity.

Figure 3



❑ Remove the connector (3) for indicating water in the fuel filter by acting on the locking piston (4).

Figure 4

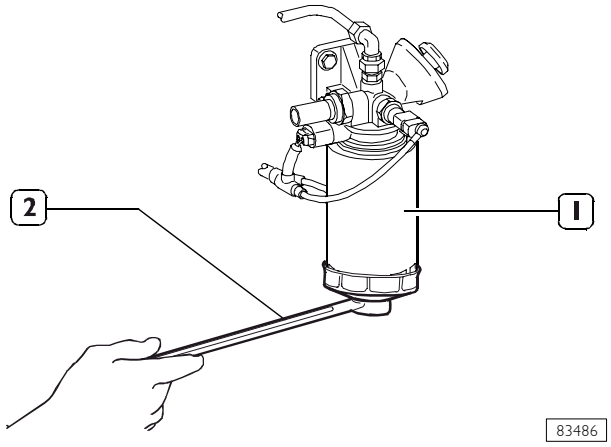


❑ Turn the screw (1) and separate the connecting head (2) from the filter casing (3).

❑ If the condensate drain operation is carried out, retighten the screw plug as soon as the fuel begins to emerge.

❑ If you need to change the filter, fully drain the diesel in the filter cartridge and separate component (2) from filter cartridge (3).

Figure 5



❑ After positioning the tool 99360076 under the filter, unscrew and remove the filter (1) with the aid of a 27 mm wrench (2).

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- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

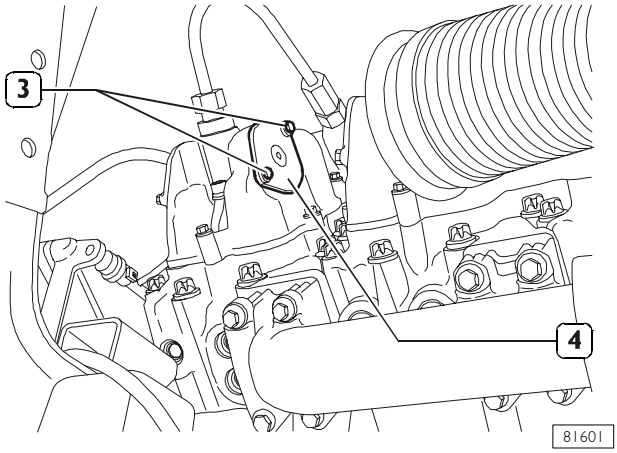
Hand screw and tighten for another 3/4 turn.

ADJUSTING ROCKER ARM ASSEMBLY

Handle all parts extremely carefully. Never get your hands or fingers between pieces. Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

To adjust the rocker arm assembly, proceed as illustrated here:

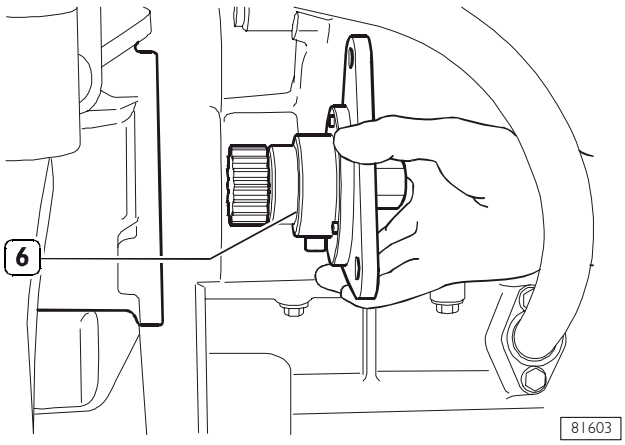
Figure 6



❑ Unscrewing the relevant screws (3), remove the 16 covers of the tappet housings (4).

NOTE In maintenance conditions with the engine on the stand to obtain greater precision in positioning cylinder 1 at T.D.C. it is also possible to remove the tappet cover.

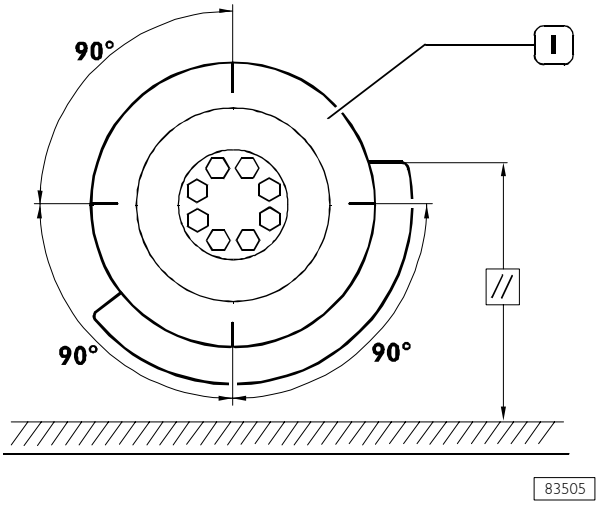
Figure 7



❑ Fit the tool 99368502 (6) in correspondence with the inside of the flywheel housing (opposite side to the starter motor).

❑ Fitting the 24 mm ratchet wrench on the back of tool 99368502 (see preceding page), turn the engine flywheel until we obtain the required cylinder balancing (the 4 valves are at the same height).

Figure 8



❑ To obtain cylinder no.1 or no.6 in T.D.C. conditions it is necessary to position the damping flywheel as indicated in the picture.
For the following balancing/adjustments it is recommended to trace some marks on the elastic joint drive wheel, placed at 90° one from theother.

❑ After obtaining this condition of balancing we move on to adjust the valves in the following order.

Figure 9

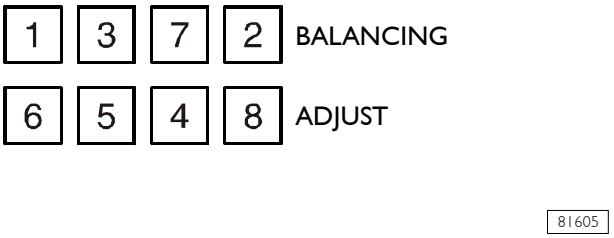


Figure 10

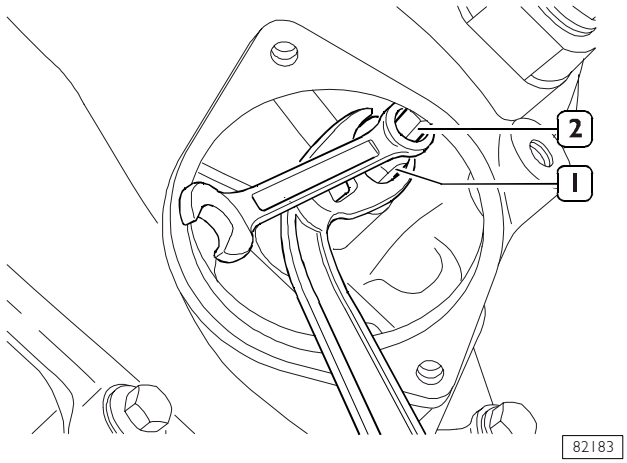
SECOND STEP

6	5	4	8	BALANCING
1	3	7	2	ADJUST

81606

❑ To make the adjustment, proceed as illustrated here:

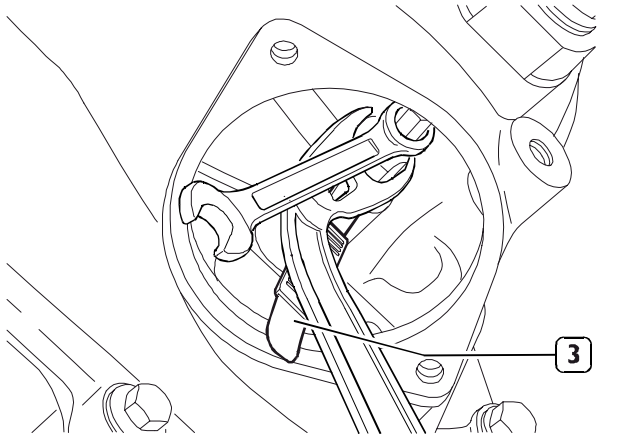
Figure 11



82183

❑ Using the wrench kit 99368503, loosen the lock nut (1) of the adjuster screw (2).

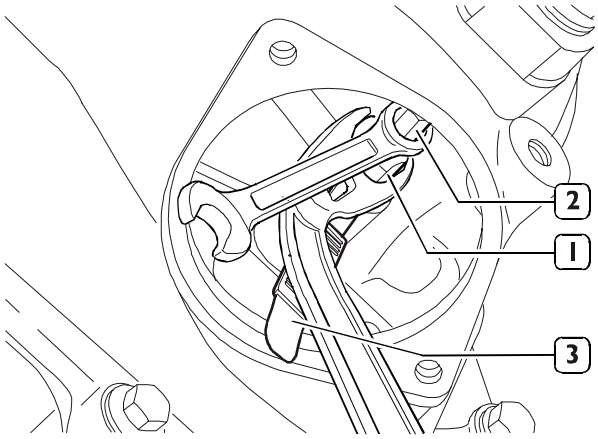
Figure 12



82184

❑ Insert the tappet feeler gauge (0.50) 99368545 (3).

Figure 13

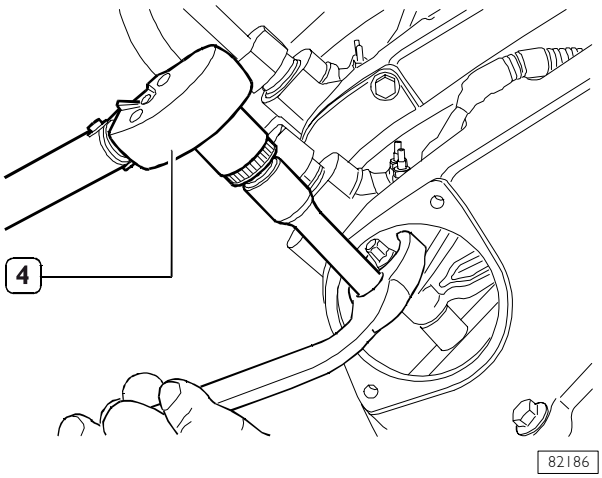


82185

❑ With kit wrench 99368503, screw or unscrew the adjuster screw (2).

❑ Check that the tappet feeler gauge (3) can slide with a slight amount of friction.
Keeping the adjuster screw (2) still use wrench 99368503 to lock the check nut of the adjuster screw (1).

Figure 14

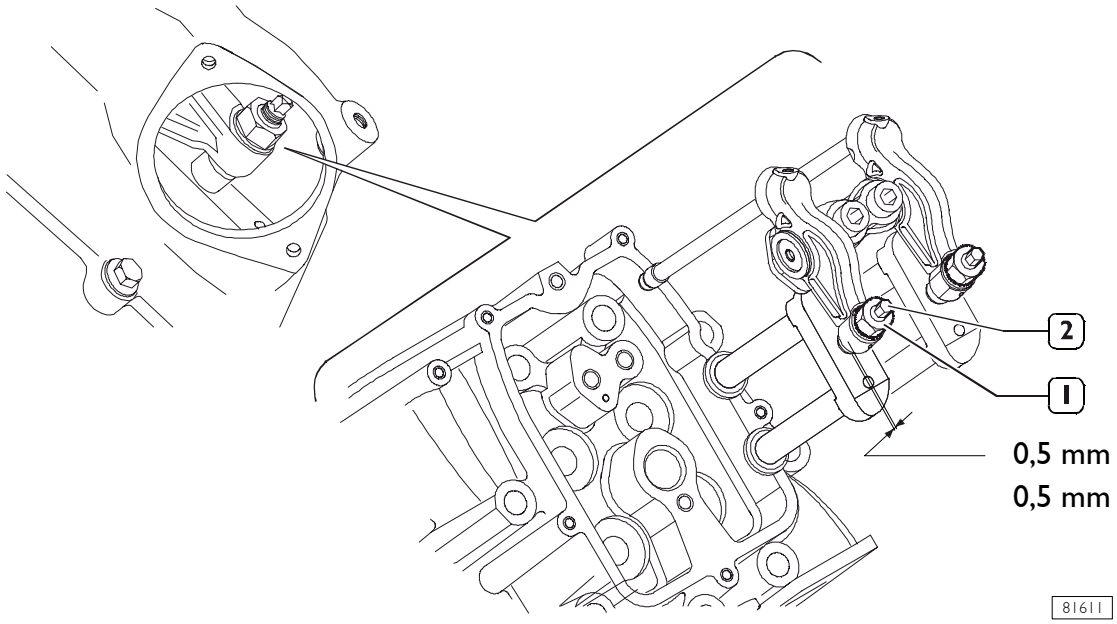


❑ Apply the 10 – 60 Nm torque wrench with the 3/8" square connection 99389831 (4) to the wrench 99368503 to lock the lock nut to a torque of 40 Nm.

❑ Adjust the other valves in the order shown on previous page.

❑ Now close all 16 covers, extract the tool for turning the flywheel and close the flywheel cover.
Tightening torque 7 ÷ 10 Nm.

Figure 15



1. Adjuster screw lock nut – 2. Adjuster screw.

CHANGING FUEL FILTERS

Handle all parts extremely carefully.
Never get your hands or fingers between pieces.
Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

NOTE Before disassembling, place under the filter a basin of suitable capacity.

Figure 16

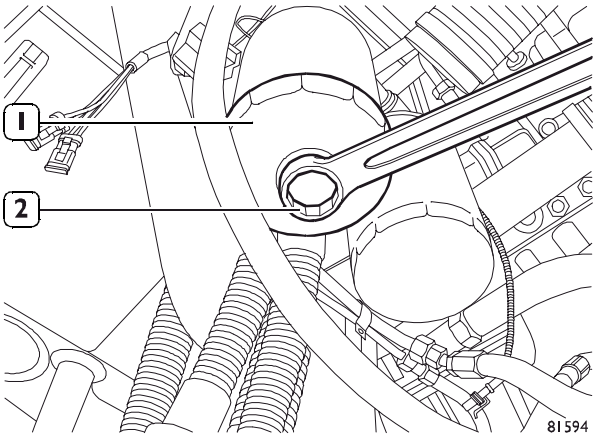
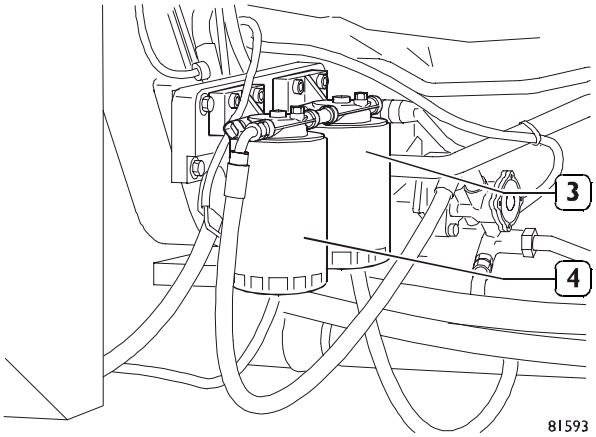


Figure 17



After positioning the tool (1) 99360091 under the filter, unscrew and remove the filters (3) and (4) with the aid of a 27 mm wrench (2). Hand screw and tighten for another 3/4 turn. Unscrew the air jets nozzle on filters support and pump on the manual priming pump. Tighten the air jets nozzle when the fuel go out.

Improper waste disposal is a threat for the environment. Potentially hazardous waste used on IVECO vehicles includes lubricants, fuels, coolants, filters and batteries.

- Use watertight containers when draining off fluids. Never use containers for foodstuffs or beverages that can lead people to drink from them.
- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

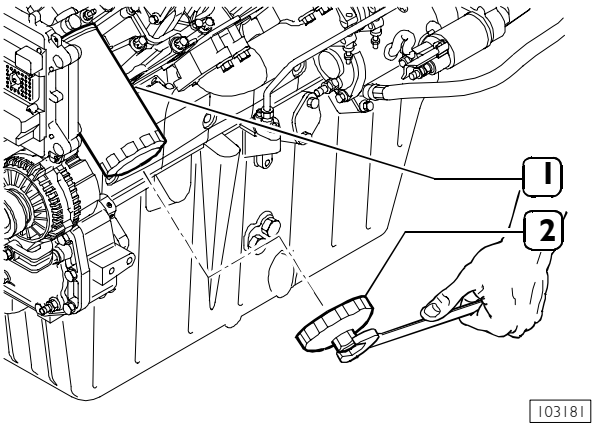
REPLACING DIESEL FILTER(S)
For applications DRAGON and GRIFFON

Handle all parts extremely carefully. Never get your hands or fingers between pieces. Wear the required safety clothing such as goggles, gloves, safety shoes and helmet.

To change the fuel filters, proceed as illustrated here.

NOTE Before disassembling, place under the filter a basin of suitable capacity.

Figure 18



After positioning the tool (1) 99360091 under the filter, unscrew and remove the filters (3 and 4) with the aid of a 27 mm wrench.

Improper waste disposal is a threat for the environment. Potentially hazardous waste used on IVECO vehicles includes lubricants, fuels, coolants, filters and batteries.

- Use watertight containers when draining off fluids. Never use containers for foodstuffs or beverages that can lead people to drink from them.
- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

Replace the filters with new parts, hand screw and tighten for another 3/4 turn.

CHANGING AN INJECTOR

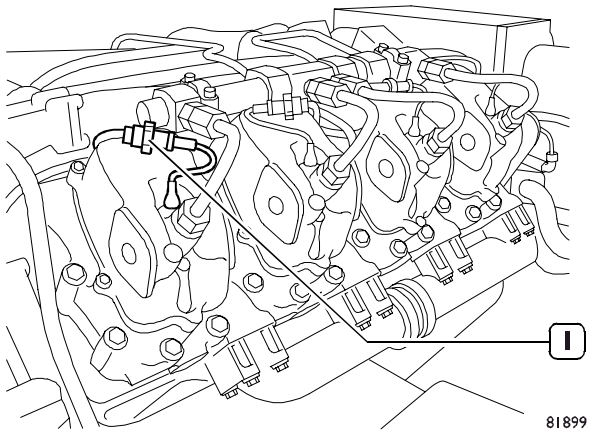
To change an injector, proceed as illustrated here:

Handle all parts extremely carefully.

Never get your hands or fingers between pieces.

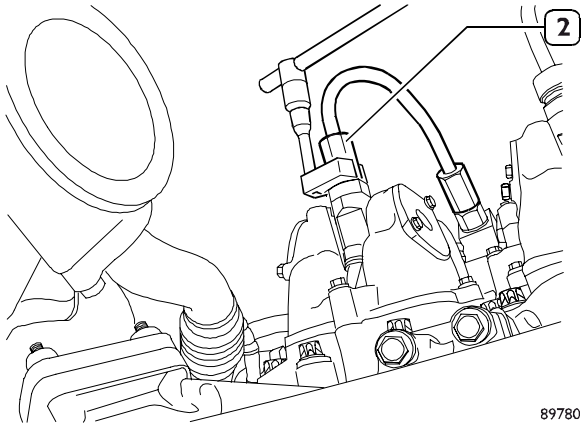
Wear the required safety clothing such as goggles, gloves, safety shoes and helmet

Figure 19



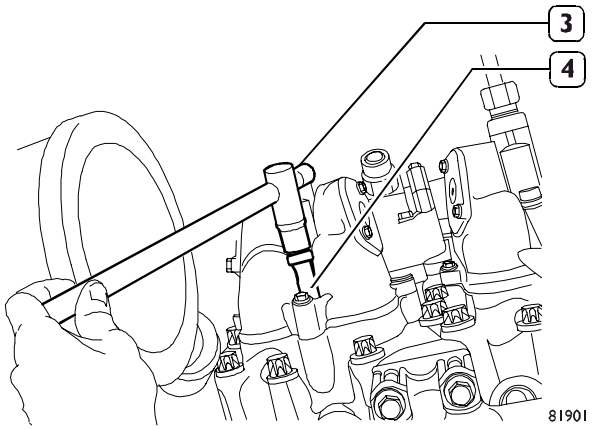
❑ Disconnect the power supply cables (1).

Figure 20



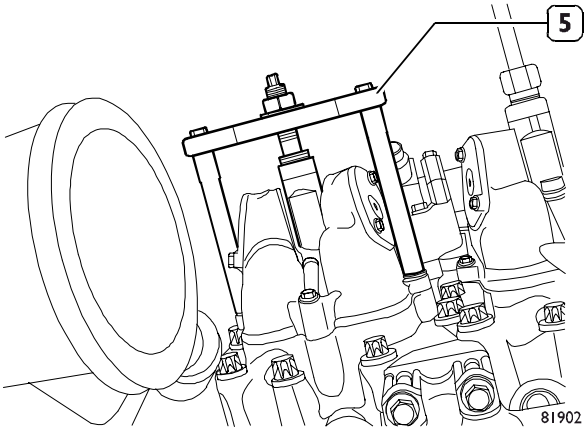
❑ Disassemble the pipes (2) on the injector side and on the flow limiting device side by means of wrench 99368506.

Figure 21



❑ Unscrew the cheese-headed screw M10x70 (3) fastening the fixing bracket (4).

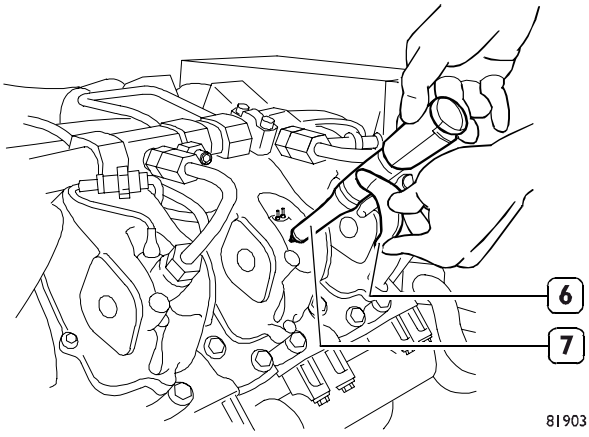
Figure 22



❑ Now fit on tool 99368505 (5) and, using the specific wrench, completely remove the injector from its casing.

❑ Clean the injector seat.

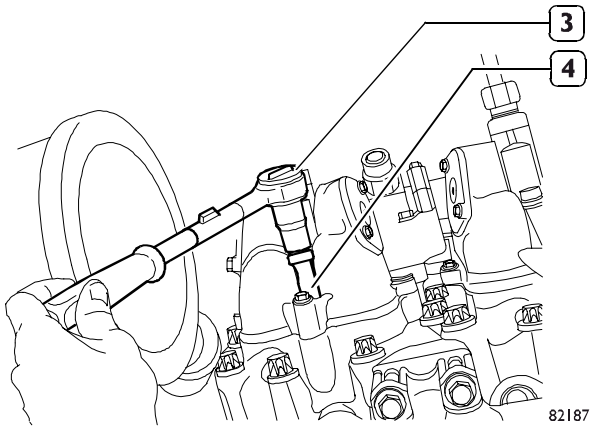
Figure 23



❑ On completing these operations, fit the injector (7) back on together with the fixing bracket (6).

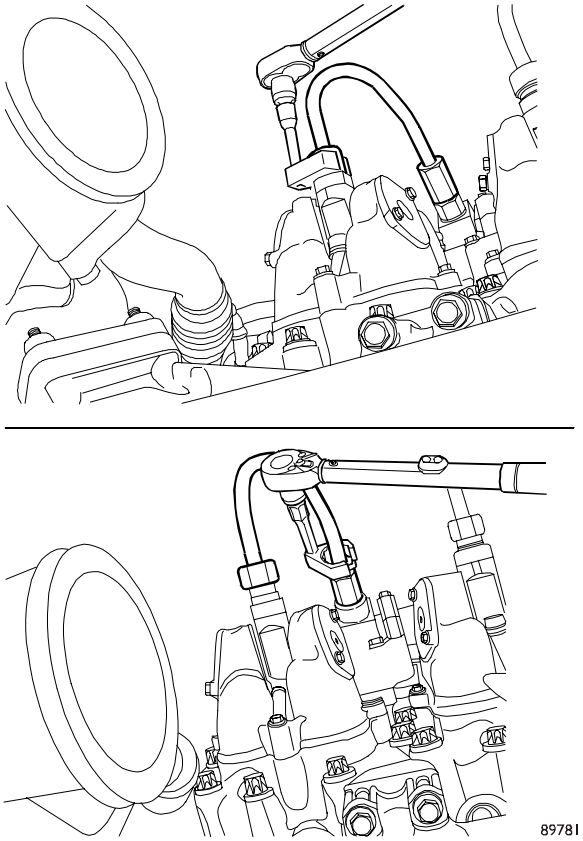
Always change the O–ring in the assembly phase. Lubricate the O–ring before installation (use vaseline).

Figure 24



- ❑ Using the specific wrench, screw the cheese–headed screw M10x70 back on to a tightening torque of 32 ÷ 36 Nm.
- ❑ Check the sealing surface of the leaking pipe and the surface on the injector and flow limiter. Cleaning the surfaces and remove dirt if necessary. In case the sealing surface are damaged , replace the part.
- ❑ Lubricate with clean engine oil the fitting and the sealing surface.
- ❑ Tight by hand the fitting on both side , flow-limiter and injector side.

Figure 25



During positioning please clean well the spherical surfaces and the Threaded part of pipe by dipping it in a clean container filled with clean motor oil.

- ❑ Tight with a pre-torque of 20 Nm the fitting on both side, flow-limiter and injector side. During the tightening procedure the injector and the flow-limiter have to be hold against the tighten direction.
- ❑ Tight with a final torque of 80±5 Nm the fitting on both side, flow-limiter and injector side. During the tightening procedure the injector and the flow-limiter have to be hold against the tighten direction.
- ❑ Test engine for leak detection.

CHANGING BLOW-BY FILTER

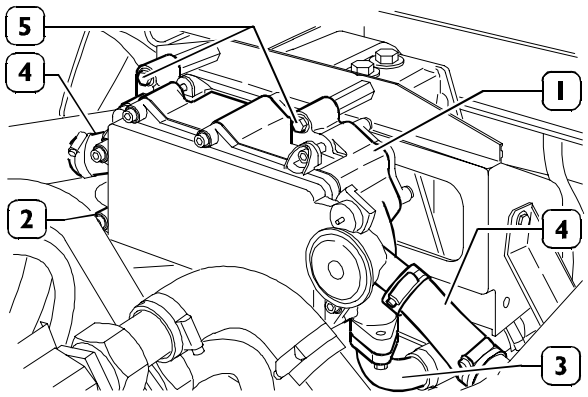
The blow-by filter is positioned, by means of a support, to the gearbox supporting bracket in front of the passenger cab water/heating water heat exchanger.

The blow-by filters can only be replaced by taking the unit apart completely and disassembling the same at the bench.

Improper waste disposal is a threat for the environment. Potentially hazardous waste used on IVECO vehicles includes lubricants, fuels, coolants, filters and batteries.

- Use watertight containers when draining off fluids. Never use containers for foodstuffs or beverages that can lead people to drink from them.
- Never throw waste on the ground, on tips or in water courses.
- Obtain information on the appropriate ways of recycling or disposing of waste from the local authorities or collection centres.

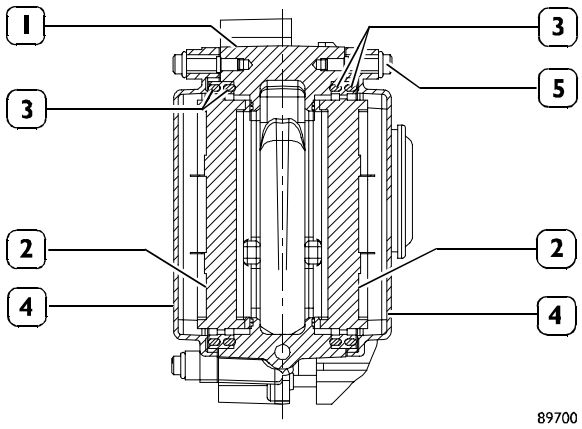
Figure 26



- ❑ Disconnect the inlet pipe (3) to the filter and the condensed oil drain pipe (2) to the sump.
- ❑ Loosen the straps that retain the sleeves (4) for vapour escape towards the outlets.
- ❑ Unscrew the screws (5) securing the filter on its bracket.

NOTE Support the blow-by filter to prevent sudden disconnection.

Figure 27



- ❑ Loosen screws (5) on both sides, then separate the two covers (4) from the filter (1) body.
- ❑ Take out the two filters (2), then replace them.
- ❑ Re-assemble the various parts after washing the body and covers with a suitable detergent.

NOTE Replace the gasket (3).

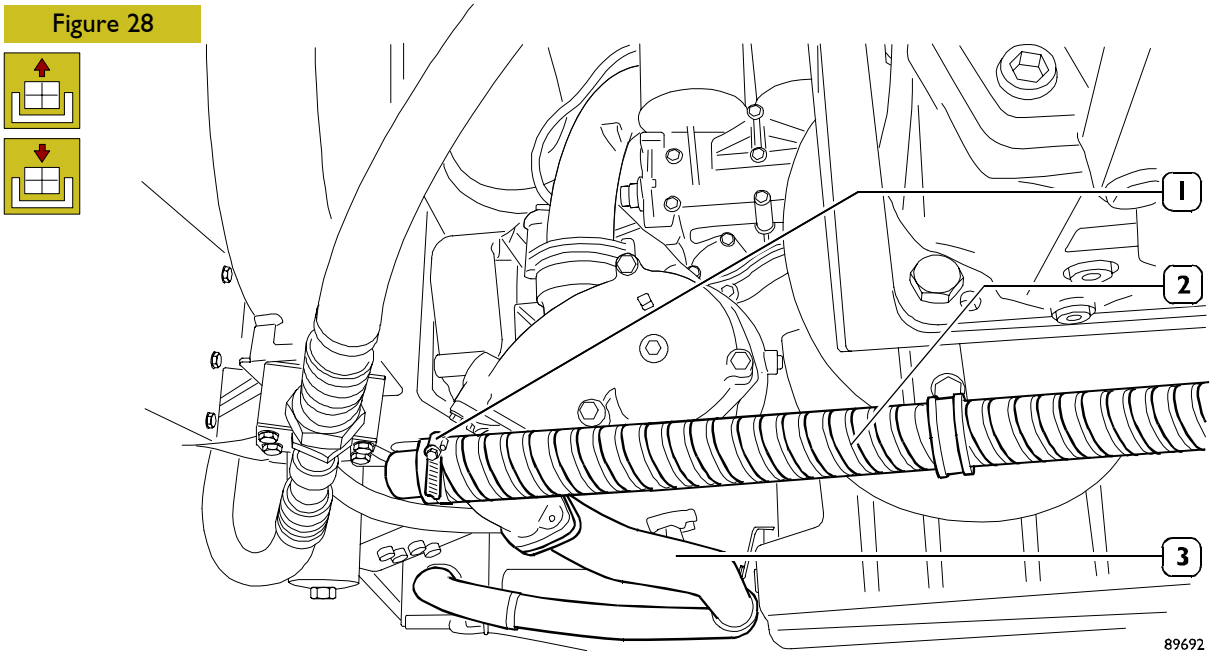
- ❑ After the filter has been fitted, place it into its own housing on the support secured to the gearbox supporting bracket.

CHANGING PRIMARY SYSTEM PUMP

Removal

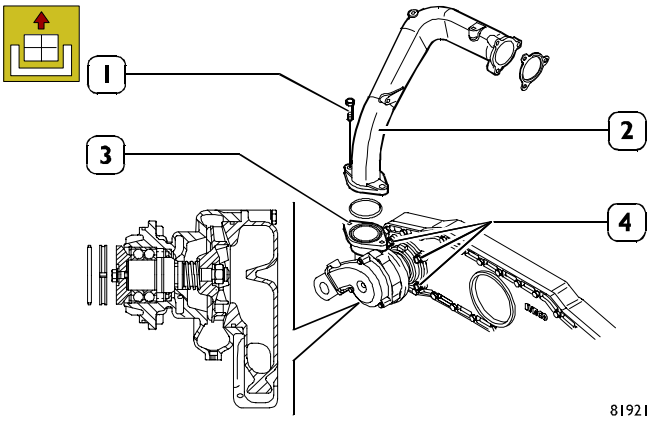
The centrifugal pump of the primary cooling system can be changed as follows:

Figure 28



- ❑ Place a big enough container to collect the motor's coolant contained in the sections of piping that have to be removed and in the pump itself.
- ❑ Unscrew the retaining ring nut and after loosening the clamp (1), remove the pipe (2) feeding the tank's pump.
- ❑ Undo the screws fixing the pipe (3) returning to the pump from the radiator.

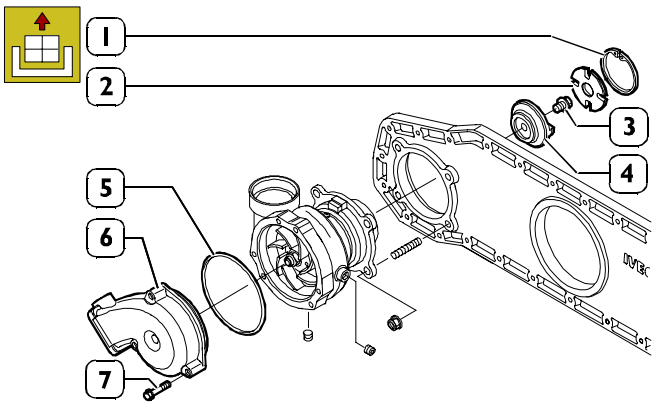
Figure 29



- ❑ On the top side, undo the screws (1) to free the pipe (2) from the flange (3) fitted on the pump
- ❑ Unscrew the nuts (4) securing the pump to the cover of the gearbox.
- ❑ Use a crowbar to separate the pump from the gearbox cover.

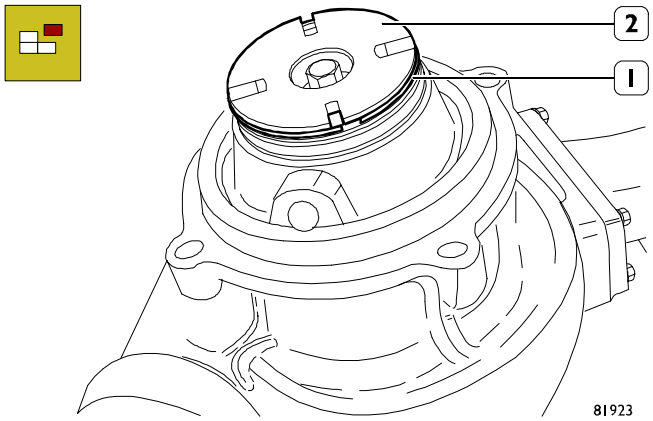
Support the pump to prevent sudden disconnection.

Figure 30



❑ After removing the pump, separate the components from (1) to (7).

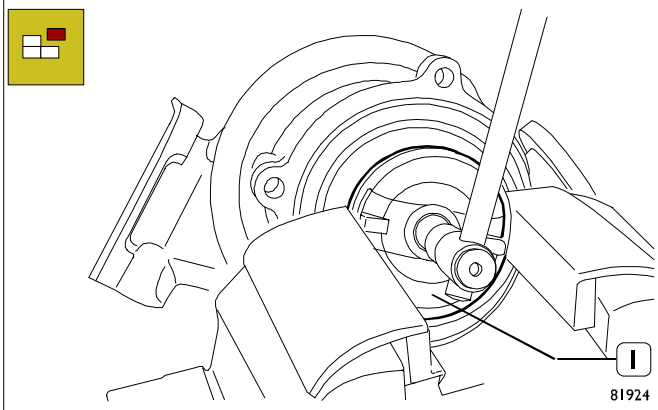
Figure 31



❑ Put the pump on the bench and, using the right pliers, remove the snap ring (1).

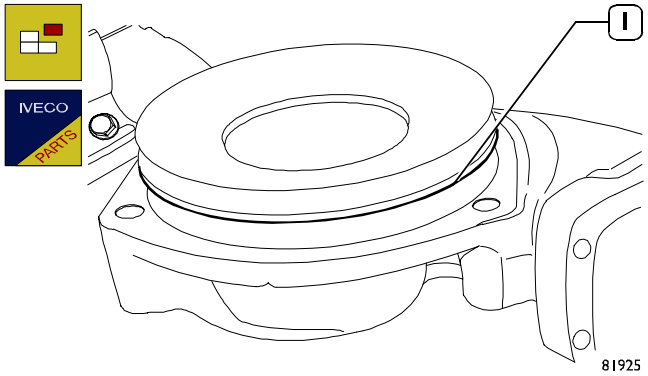
❑ Remove the drive disc (2).

Figure 32



❑ Put in a vice and undo the central screw so as to be able to remove the disc (1).

Figure 33



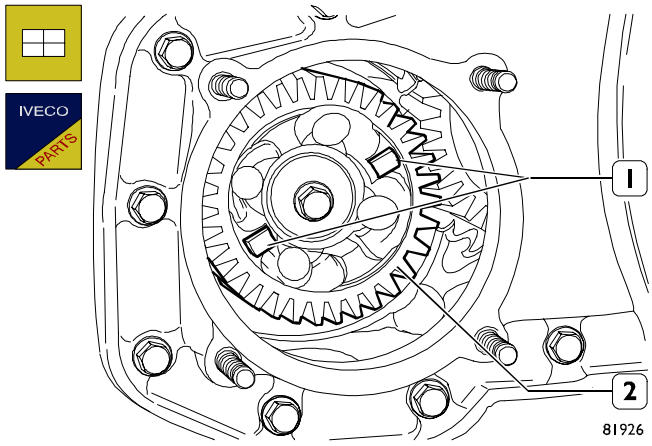
❑ Turn the pump and undo the three screws (7, Figure 30) fixing the cover (6, Figure 30), complete with seal (1).

Fitting

❑ At the assembly stage, after changing the damaged parts, assemble all the parts on the bench to complete the pump.

NOTE Change the seal on the cover. If the pump is not changed, wash to remove any incrustation.

Figure 34



❑ Fitting the complete pump on the gearbox must include engaging the teeth (1) on the gear (2) on the drive disc.

❑ then screw the nuts onto the stud bolts on the gearbox.

❑ tightening torque 33 ÷ 40 Nm.

❑ then connect the water pipes.

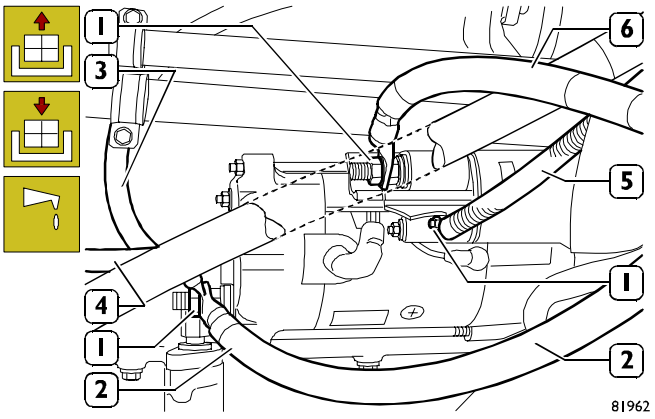
REMOVING/REFITTING STARTER MOTOR

Removal

Before proceeding to work on an electric or electronic component, make sure the system is not powered.

The starter motor is located on the left-hand side of the flywheel housing in an area fairly easy to access from the bottom. Its disassembly requires no special tools and is not particularly difficult. Proceed as follows:

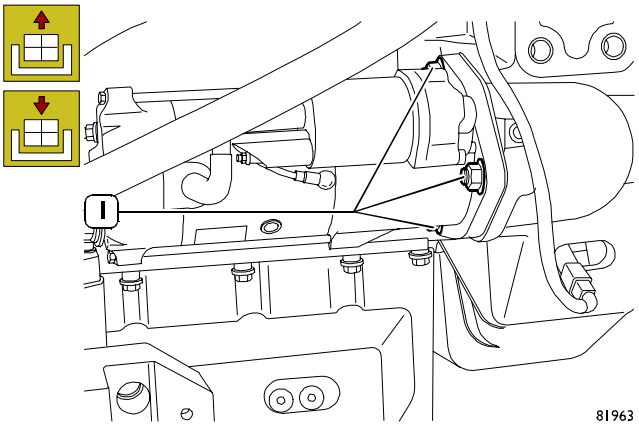
Figure 35



❑ Unscrew the nuts (1). Disconnect the electrical connections of cables (2), (3), (4), (5) and (6).

NOTE It is recommended to mark the cables in order to make a secure connection in the assembly phase.

Figure 36



❑ Remove the starter motor by unscrewing the nuts (1).

Fitting

❑ Change the motor with a new one and position it in its seat after changing the gasket between the flywheel housing and the motor. Tighten the fixing nut (M12 x 1.75) to a torque of 105 ÷ 86 Nm.

NOTE Always change the gasket with a new one. Do not reuse the one removed.

❑ Restore the electrical connections.
Tightening torque should be as follow:
Terminal 30: 20 ÷ 30 Nm
Terminal G: 20 ÷ 30 Nm
Terminal 50: 2 ÷ 3 Nm

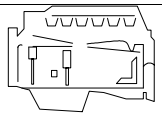
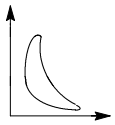
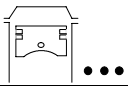
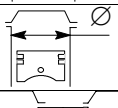
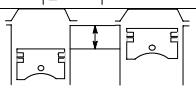
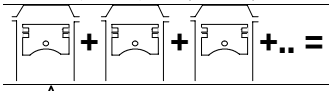
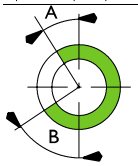
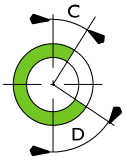
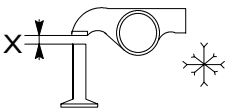
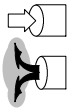
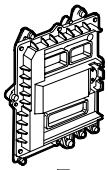
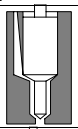
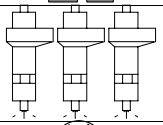
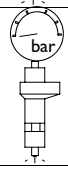
NOTE Apply a light layer of Vaseline onto the terminals to protect them from rusting.

❑ Check the engine starting.

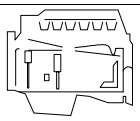
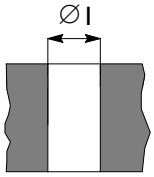
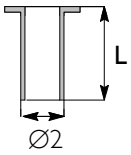
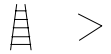
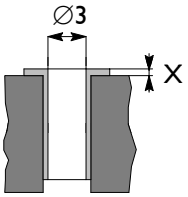
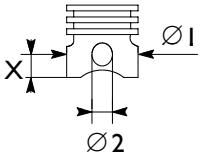
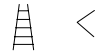
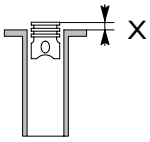
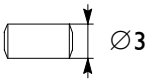
SECTION 4

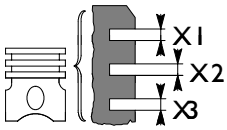
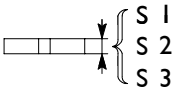
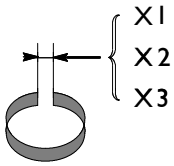
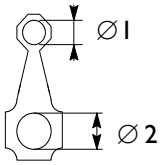
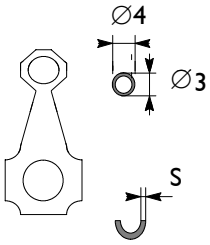
Overhaul and technical specifications

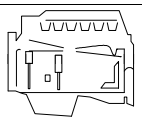
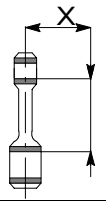
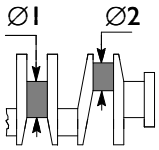
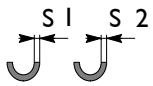
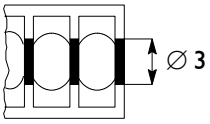
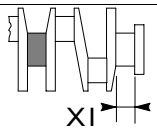
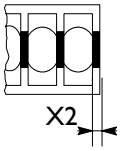
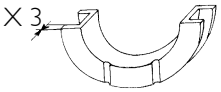
GENERAL SPECIFICATIONS

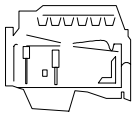
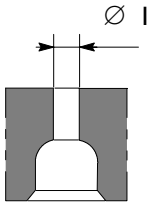
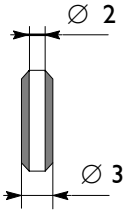
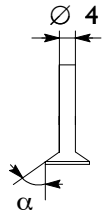
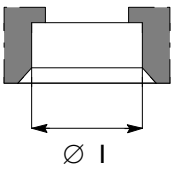
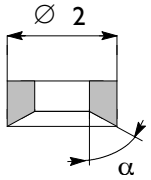
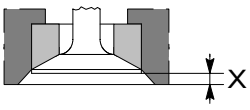
	Type		**VECTOR 8**
	Cycle		Four-stroke diesel engine
	Power		Supercharged with intercooler
	Injection		Direct
	Number of cylinders		8 in two banks at 90°
	Bore	mm	145
	Stroke	mm	152
	Total displacement	cm^3	20.080
   	**TIMING** start before T.D.C. end after B.D.C. start before B.D.C. end after T.D.C.	 A B D C	 16° 25° 66° 15°
   	Checking timing X Checking operation X	mm mm mm mm	- - 0.5 0.5
	**FUEL FEED** Injection Type:	 Bosch	 high pressure common rail Control unit ADEM III
	Nozzle type		Injectors
	Injection sequence		1 - 3 - 7 - 2 - 6 - 5 - 4 - 8
	Injection pressure	bar	Variable up to 1600 bar, controlled by the ECU. The safety valve cuts in at 1850 bar.

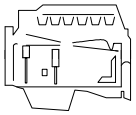
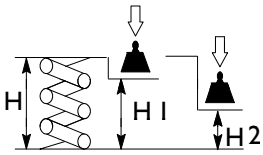
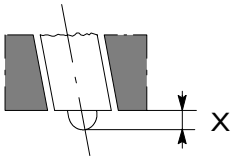
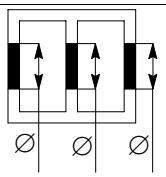
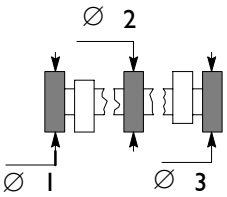
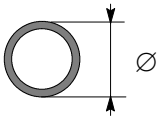
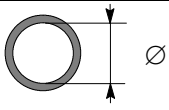
ASSEMBLY CLEARANCE DATA

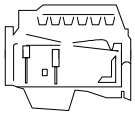
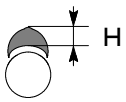
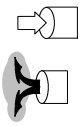
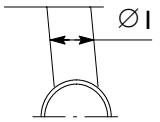
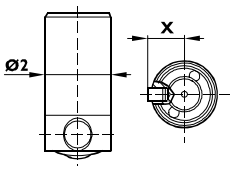
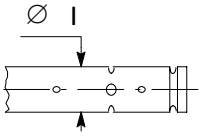
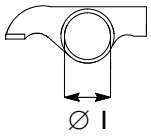
	Type		**VECTOR 8**
CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS			mm
	Cylinder liners	Ø 1	164.000 ÷ 164.025
	Cylinder liners: outside diameter length	 Ø L	 164.003 ÷ 164.028 266.5 ÷ 267.5
	Cylinder sleeve – crankcase seats (interference)		0.028 ÷ 0.022
IVECO PARTS 	Outside diameter	Ø2	–
	Cylinder liners Cylinder liner position on crankcase inside diameter	 X Ø 3	 0.025 ÷ 0.095 145.00 ÷ 145.03
	Pistons: measuring dimension outside diameter outside diameter	 X Ø 1 Ø 2	 25 144.825 ÷ 144.870 62.000 ÷ 62.008
	Piston – cylinder liners		0.261 ÷ 0.309
IVECO PARTS 	Piston diameter	Ø 1	–
	Pistons position from crankcase	X	0.19 ÷ 0.59
	Gudgeon pin	Ø 3	61.982 ÷ 61.990
	Gudgeon pin – pin housing		0.010 ÷ 0.026

	Type	VECTOR 8
		mm
	Type of piston X1* Piston ring slots X 2 X3 *measured on Ø of 140 mm	3.440 ÷ 3.470 3.060 ÷ 3.080 6.030 ÷ 6.050
	Piston rings S1* S2 S3 *measured on Ø of 140 mm	3.330 ÷ 3.296 2.975 ÷ 2.990 5.975 ÷ 5.990
	Piston rings – slots 1 2 3	0.110 ÷ 0.174 0.070 ÷ 0.105 0.040 ÷ 0.075
	Piston rings	–
	Piston ring end opening in cylinder liners: X1 X2 X3	 0.50 ÷ 0.65 0.90 ÷ 1.15 0.40 ÷ 0.70
	Small end bushing seat Ø 1 Big end bearing seat Ø2	67.994 ÷ 67.963 110.000 ÷ 110.022
	Small end bushing diameter outside Ø4 inside Ø 3 Big end bearing shell supplied as spares S	 68.080 ÷ 68.120 62.015 ÷ 62.030 2.466 ÷ 2.478
	Small end bush – seat	0.086 ÷ 0.157
	Gudgeon pin – bushing	0,056 ÷ 0.080
	Big end bearing shells	–

		VECTOR 8
	Type	mm
	Measuring dimension X Max. error on alignment of connecting rod axes — —	125 0.08
 	Main journals Ø1 Crankpins Ø2 Main bearing shells S1* Big end bearing shells S2* *supplied as spares	121.995 ÷ 121.975 105.000 ÷ 104.980 2.958 ÷ 2.970 2.466 ÷ 2.478
	Main bearing housings	128.000 ÷ 130.025
	Bearing shells – main journals: no. 1 – 5 no. 2 – 3 – 4	 0.065 ÷ 0.134 0.065 ÷ 0.134
	Bearing shells – crankpins	0.044 ÷ 0.110
	Main bearing shells Big end bearing shells	– –
	Main journal, for shoulder X1	56.00 ÷ 56.40
	Main bearing housing, for shoulder; middle front/rear X2	 43.184 ÷ 43.232 –
	Half thrust washer X3	–
	Crankshaft shoulder	–

	Type	**VECTOR 8**
CYLINDER HEAD – VALVE TRAIN		mm
	Valve guide seats in cylinder head Ø1	16.980 ÷ 16.997
	Valve guide Ø2 Ø3	10.015 ÷ 10.030 17.012 ÷ 17.015
	Valve guides and seats on the head	0.015 ÷ 0.035
	Valve guide	17.212 ÷ 17.225
	Valves: Ø4 α Ø4 α	9.960 ÷ 9.975 60° 30′ ± 7′ 30 9.960 ÷ 9.975 45° 30′ ± 7′ 30″
	Valve stem and its guide	0.052 ÷ 0.092
	Valve seat in head Ø1 Ø1	52.985 ÷ 53.020 50,985 ÷ 51.020
	Outside diameter of valve seat; angle of valve seat in cylinder head: Ø2 α Ø2 α	53.000 ÷ 52.500 60° 51.000 ÷ 50.500 45°
	Recessing of valve X X	0.50 ÷ 0.80 0.50 ÷ 0.80

		VECTOR 8
	Type	mm
	Between valve seat and head 	0.050 ÷ 0.100
		0.050 ÷ 0.100
	Valve seat 	54.270 ÷ 54.285
		51.270 ÷ 51.285
	Valve spring height:	
	free height H	74
	under a load of:	
	N 450 ±25 H1	57.5
	N 800 ±40 H2	46.5
	Injector protrusion X	not adjustable
	Seats for camshaft bushing no. 1 – 5: Camshaft seats no. 2 – 3 – 4	86.000 ÷ 86.030
		–
	Camshaft supporting pins: 1 ⇒ 5 Ø	79.950 ÷ 79.968
	Outer diameter of camshaft bushings: Ø	86.133 ÷ 86.163
	Inner diameter of camshaft bushings: Ø	80.018 ÷ 80.087
	Bushings and housings in the cylinder head	0.163 ÷ 0.130
	Bushings and bearing journals	–

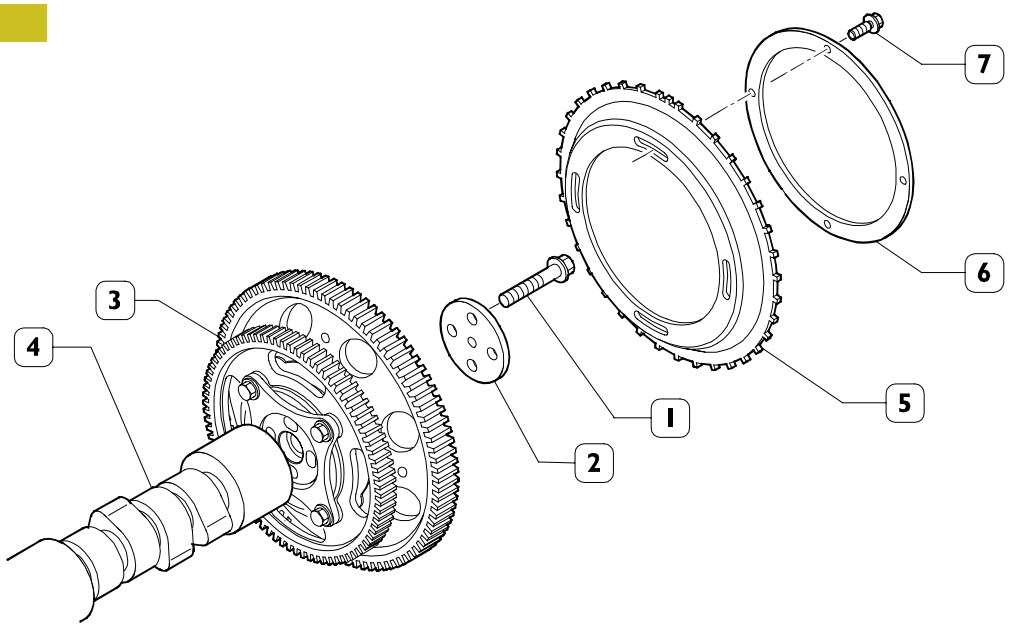
		VECTOR 8
	Type	
		mm
	Cam lift: 	6.9360 7.4066
	Tappet cap seat in the crankcase: Ø1	34.025 ÷ 34.000
	Tappet cap outside diameter: Ø2 Measurement from axis tappet at end of fixing pin X	33.600 ÷ 33.800 18.80 ÷ 19.00
	Rocker arm shaft Ø1	31.984 ÷ 32.000
	Rocker arms Ø1	32.025 ÷ 32.050
	Between rocker arms and shaft	0.025 ÷ 0.066

ENGINE OVERHAUL

Dismantling the engine at the bench

The instructions below assume that the engine has been fitted on an overhaul stand and all the specific components for Iveco Motors application components have been removed (see Section 3 of this manual).The section therefore includes all the most important overhaul procedures for the engine block.

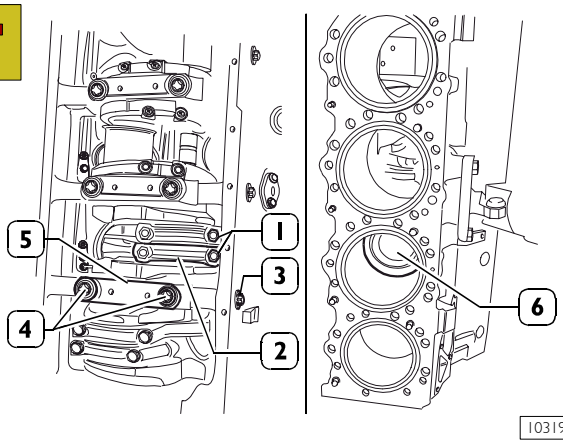
Figure 1



❑ Remove the gear fitted on the camshaft: unscrew the screw (1) and remove the spacer (2); extract the gear (3) from the camshaft.

NOTE During disassembly, the components (5) and (6) are fastened by the screws (7) on the gear (3). If necessary, separate the various parts and replace the worn ones.

Figure 2



Check the protrusion of the pistons (6) from the crankcase and note it down.
Set the cylinder assembly upright. Extract the pistons as follows:

❑ Loosen the nuts (1) of the bolts fixing the connecting rod caps to the connecting rods.

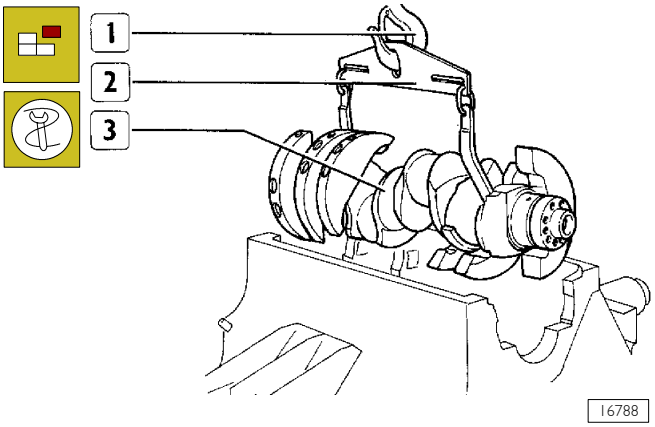
❑ Turn the crankshaft until the piston is exactly at the TDC; in any other position it would not be possible to extract the piston because the connecting would interfere with the cylinder liner.

❑ Remove the connecting rod cap (2) and extract the piston from the cylinder liner.

Set the crankcase horizontally. Remove the top (4) and side (3) bolts fixing the main bearing caps to the crankcase and extract them.

NOTE On the central main bearing housings (5) and on the cap there are the thrust half–rings for adjusting the crankshaft end float.

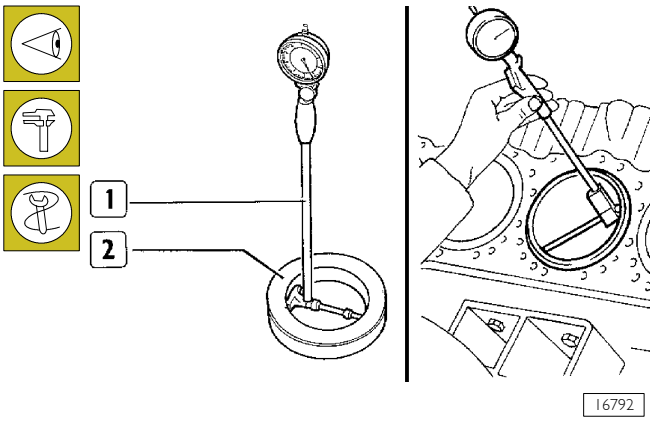
Figure 3



- ❑ Using a hoist (1) and tool 99360500 (2), appropriately fitted on the crankpins, extract the crankshaft (3) from the cylinder assembly.
- ❑ Extract the camshaft from the cylinder assembly, taking care not to damage the supporting bushings. Extract the roller tappets.

REPAIR OPERATIONS
CYLINDER UNIT
Checks and measurements

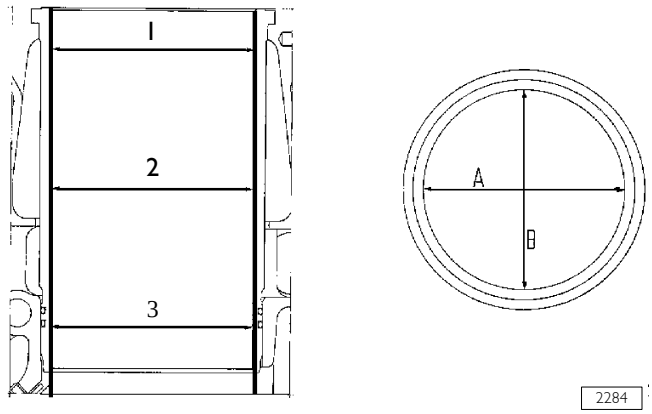
Figure 4



- ❑ Once engine is disassembled, clean accurately the cylinder–block assembly. Use the proper rings to handle the cylinder unit. The engine block shall not show cracks.
- ❑ Check operating plug conditions and replace them in case of uncertain seal or if rusted.
- ❑ Inspect cylinder barrel surfaces; they shall be free from seizing, scores, ovalisation, taper or excessive wear. Inspection of cylinder barrel bore to check ovalisation, taper and wear shall be performed using the bore dial gauge 99395687 (1) fitted with the dial gauge previously set to zero on the ring gauge (2) of the cylinder barrel diameter.

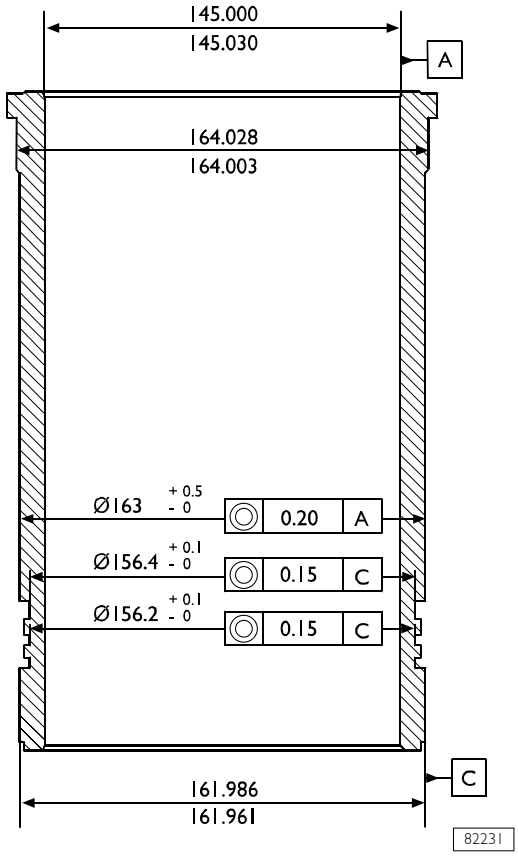
NOTE Should the ring gauge be not available, use a micrometer for zero–setting.

Figure 5



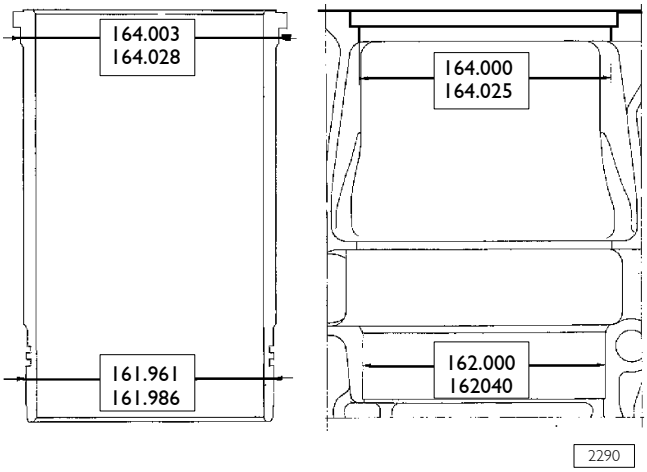
- ❑ Measurements shall be performed on each cylinder, at three different heights in the barrel and on two planes perpendicular with each other: one parallel to the longitudinal axis of the engine (A), and the other perpendicular (B). Maximum wear is usually found on plane (B) in correspondence with the first measurement.

Figure 6



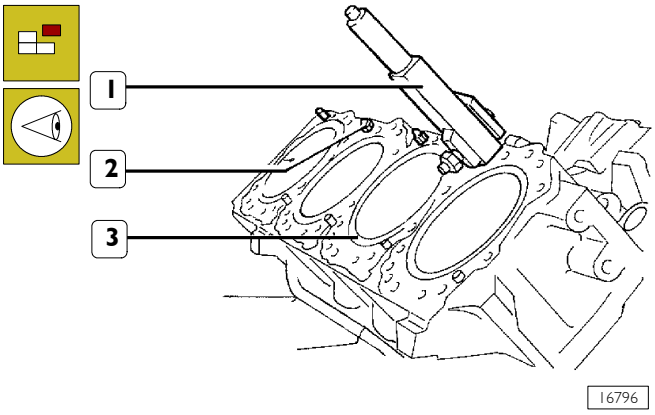
If the measurements are higher than as shown in the figure, it is necessary to change the cylinder liners. Their internal surface is treated with liquid nitriding, so grinding, lapping or facing are not permissible.

Figure 7



The diagram gives the diameters: the outside diameter of the cylinder liner and the inside diameter of its seat.
If necessary, the cylinder liners can be extracted and fitted several times in different seats.

Figure 8

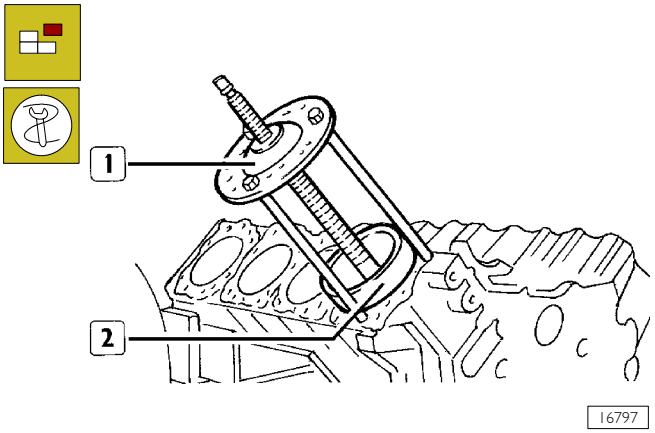


❑ Check the flatness of the cylinder head mating surface with a calibrated rule and feeler gauge.
After finding the areas of deformation, level off the supporting surface, after taking out the centring pins (2), with tool (1), and the cylinder liners (3) according to the procedures given under the heading REPLACING CYLINDER LINERS.

The crankcase can be levelled off only after making sure that, after machining, the piston protrudes from the cylinder liner from 0.19 to 0.59 mm.

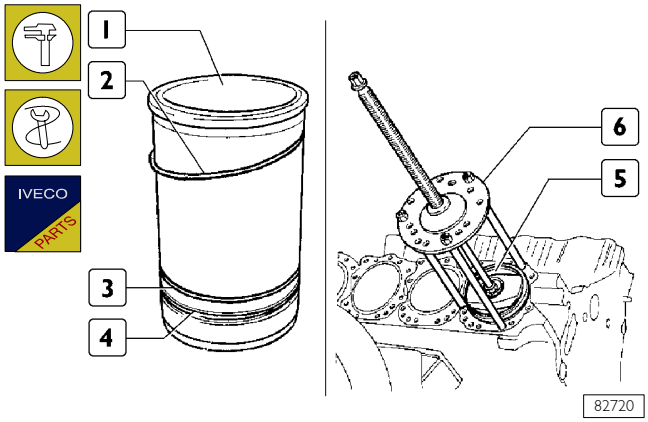
Replacing Cylinder Liners

Figure 9



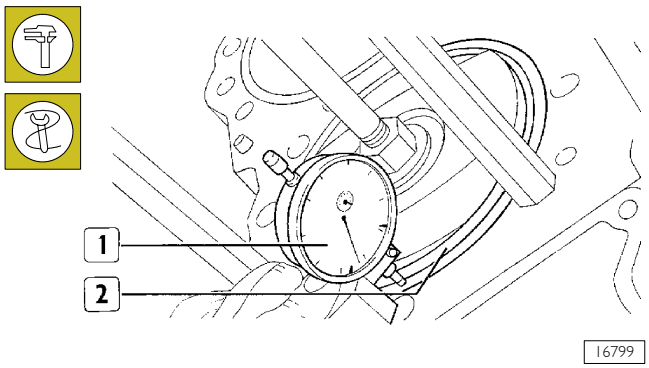
❑ Remove the cylinder liners (2) from the cylinder assembly with tool 99360799 (1) fitted as illustrated in the figure.
Carefully check the seats of the cylinder liners and the side surfaces of the crankcase.
Check the state of the plugs fitted in the cylinder assembly machining holes and replace them if they are rusty or there is any doubt about their seal

Figure 10



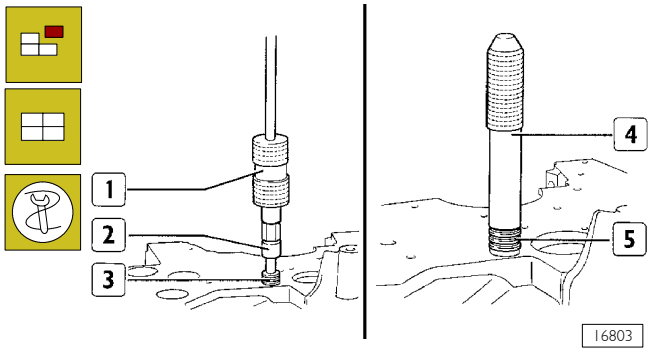
❑ Always change the coolant seals (3, 4 and 5).
Fit the top brass ring (2) onto the cylinder liner (1). Lubricate its bottom portion and fit it in the cylinder assembly with the plate (5) of tool 99360799 (6).

Figure 11



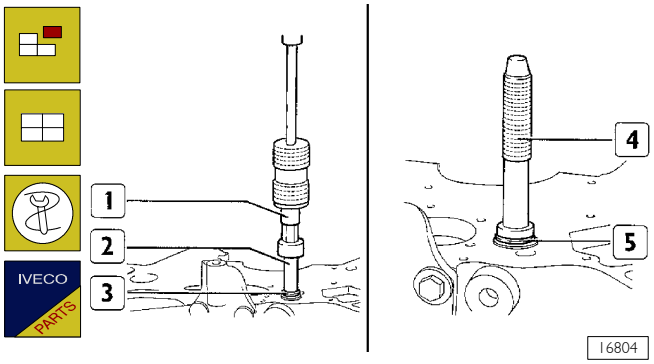
❑ Using a dial gauge (1), check that the protrusion of the cylinder liner (2) from the mating surface of the cylinder head is from 0.025 to 0.095 mm.

Figure 12



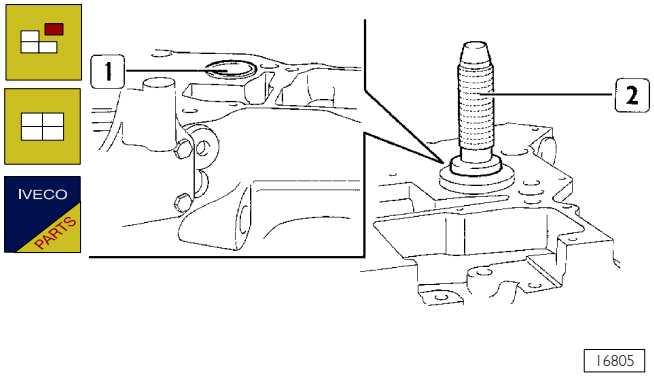
❑ Change the seals (5) of the bushing (3) for the left–hand main oilway. The bushing (3) is removed from the cylinder assembly with a percussion extractor (1) and a suitable part (2). Use an appropriate drift to fit the bushing.

Figure 13



❑ Change the seals (5) of the bushing (3) for the right–hand main oilway. The bushing (3) is removed from the cylinder assembly with a percussion extractor 99340205 (1) and a suitable part (2). Use an appropriate drift to fit the bushing.

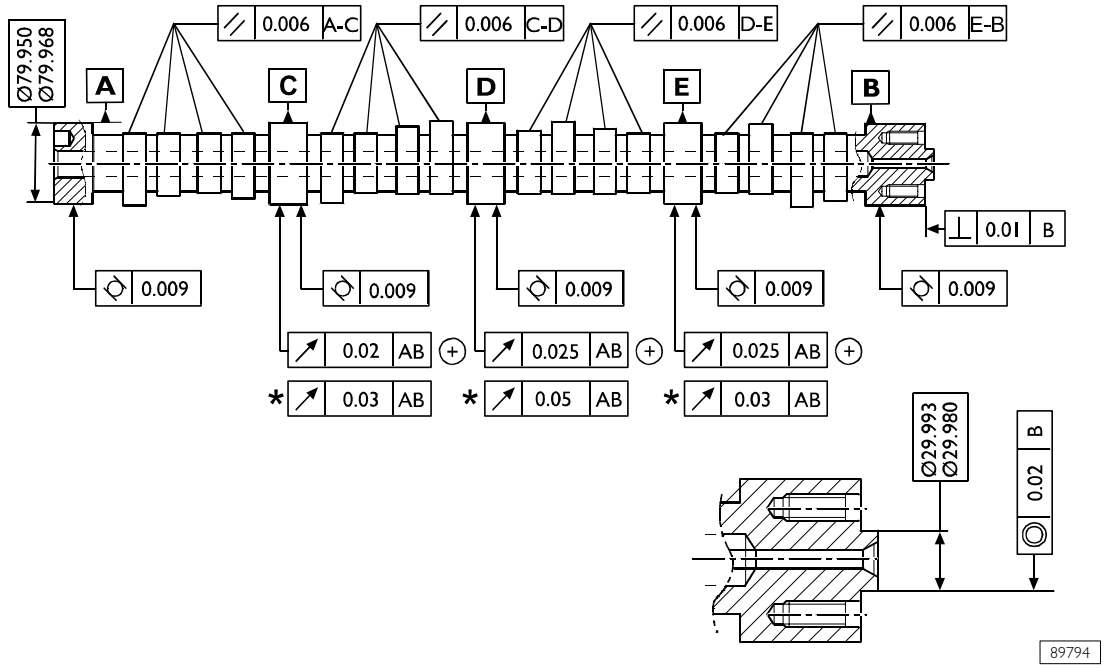
Figure 14



❑ If changing the bushing (1) for the coolant duct, use general tools for removal; use an appropriate drift (2) for assembly.

TIMING SYSTEM
Camshaft

Figure 15



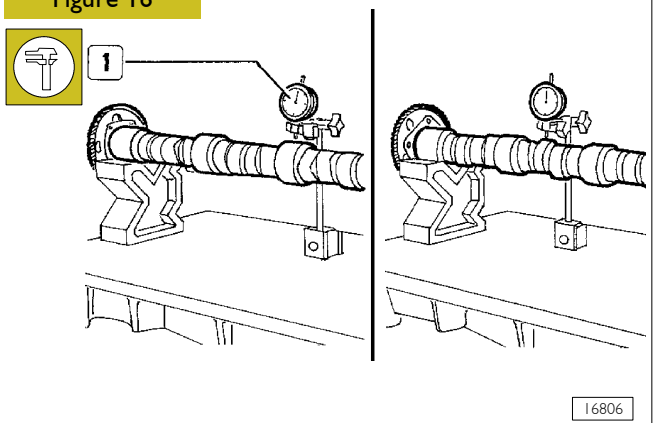
MAIN DATA ABOUT CAMSHAFT PINS

Camshaft pin and cam surfaces shall be absolutely smooth; if they show any traces of seizing or scoring replace the camshaft and the bushes.

* Data concerning the distribution shaft assembled on the engines with serial numbers starting from 01/01/2005

Checking cam lift and pin alignment

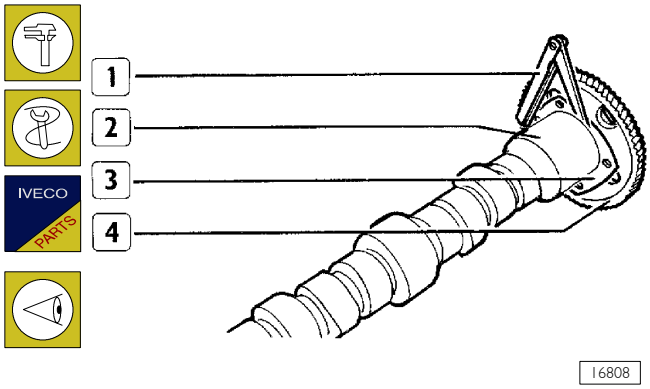
Figure 16



❑ Check the alignment of the supporting pins, setting the camshaft as illustrated.
By means of a magnetic based comparator (1) read the alignment error that must not exceed the one indicated on the figure; otherwise replace the distribution shaft.
Check the useful cam lift that must be the same for both the inlet and exhaust; if it is not, change the camshaft.

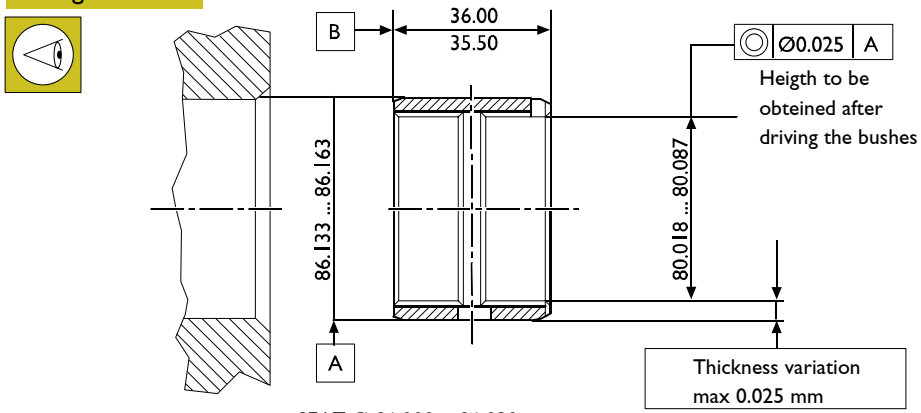
Replacing the camshaft idle gear

Figure 17

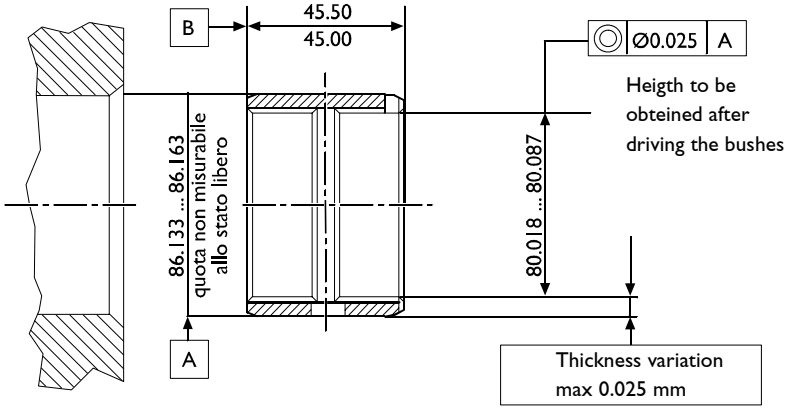


❑ Using a feeler gauge (1), check that the clearance between the plate (3) retaining the camshaft (2) to the cylinder assembly and the driving gear (4) is from 0.070 to 0.175 mm.
Check that the teeth of the driving gear (4) are neither broken nor excessively worn.
The driving gear (4) of the camshaft is removed with an extractor.
For assembly, heat the gear (4) to reach a temperature difference of 250°C between it and the camshaft.

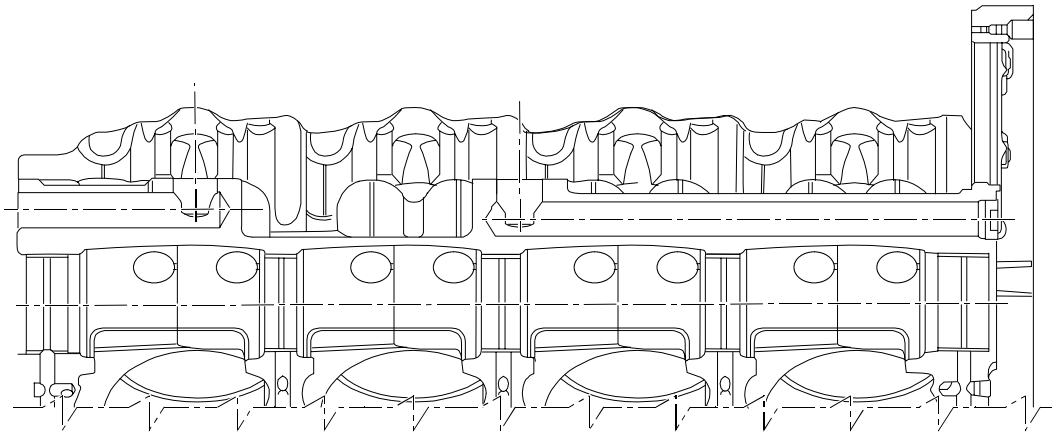
Figure 18



SEAT Ø 86.000 ÷ 86.030
PIN Ø 79.950 ÷ 79.968



SEAT Ø 86.000 ÷ 86.030
PIN Ø 79.950 ÷ 79.968

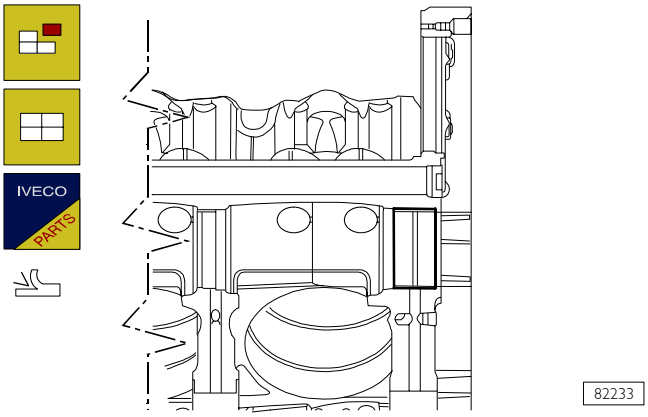


82233

MAIN DATA OF THE BUSHINGS SUPPORTING THE CAMSHAFT AND SEATS IN THE CRANKCASE.
The bushings must have been forced into their seats. The internal surfaces must be smooth with no sign of seizure or wear.

Changing the bushings

Figure 19



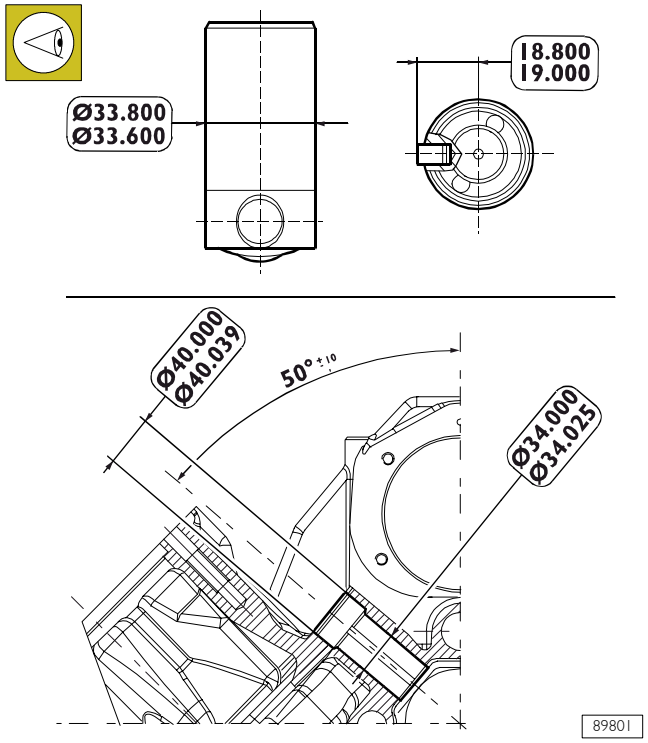
Having to change the bushings, use one drift for removal and assembly. The camshaft assembly clearance must be from 0.070 to 0.150 mm.

NOTE During assembly, the bushings must be facing so that the lubrication holes match those in the seats.

On completing assembly, bore the bushings to the diameter shown in Figure 18.

Changing the tappets

Figure 20



- ❑ The surface of the tappets in contact with the cams of the camshaft must be perfectly smooth with no dents.
  Slight dents can be removed with an extremely fine abrasive stone.
  Changing the tappets, due to excessive clearance in the seats, involves fitting oversized tappets after boring the seats with an appropriate reamer.

Fitting tappets and camshaft

Lubricate the tappets and fit them in their seats.

NOTE We recommend to lubricate the tappets carefully by keeping them immersed for 30'.

Lubricate the camshaft bushings and fit the shaft, taking care not to damage the supporting bushings. Fit the nozzles, checking that the centring pins are correctly positioned in the cylinder assembly.

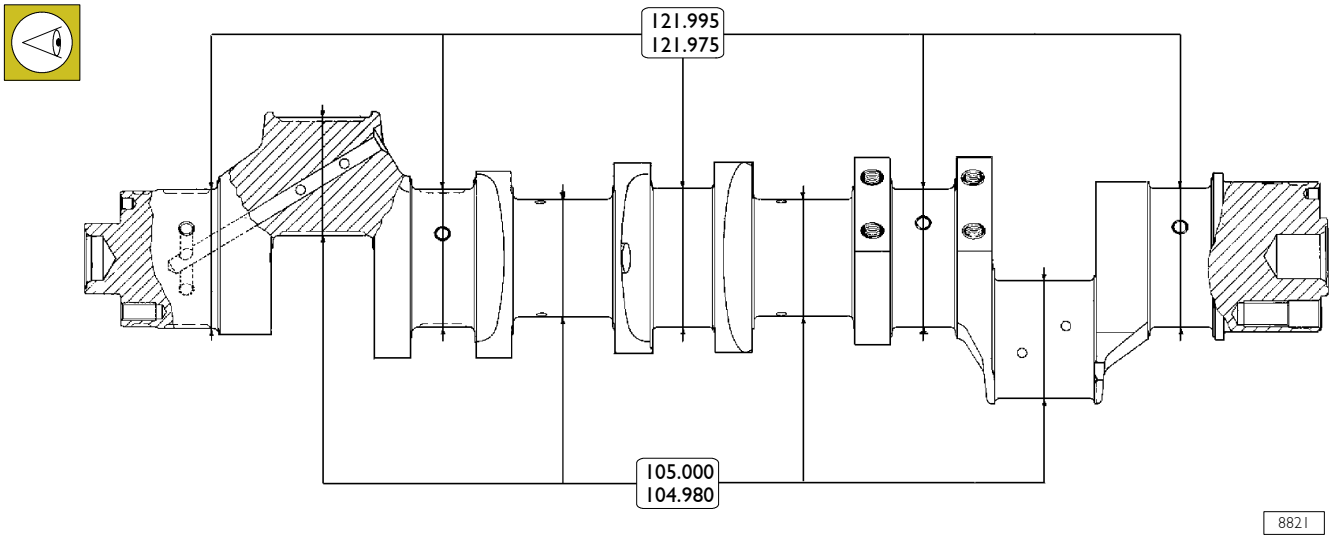
OUTPUT SHAFT

Measuring journals and crankpins

- ❑ Measure the pins of the bench and of the connecting rod with the micrometric calliper and establish if the engine shaft and/or the connecting rod and bench bearings need to be replaced.

NOTE It is recommended to insert the found values in the proper table.

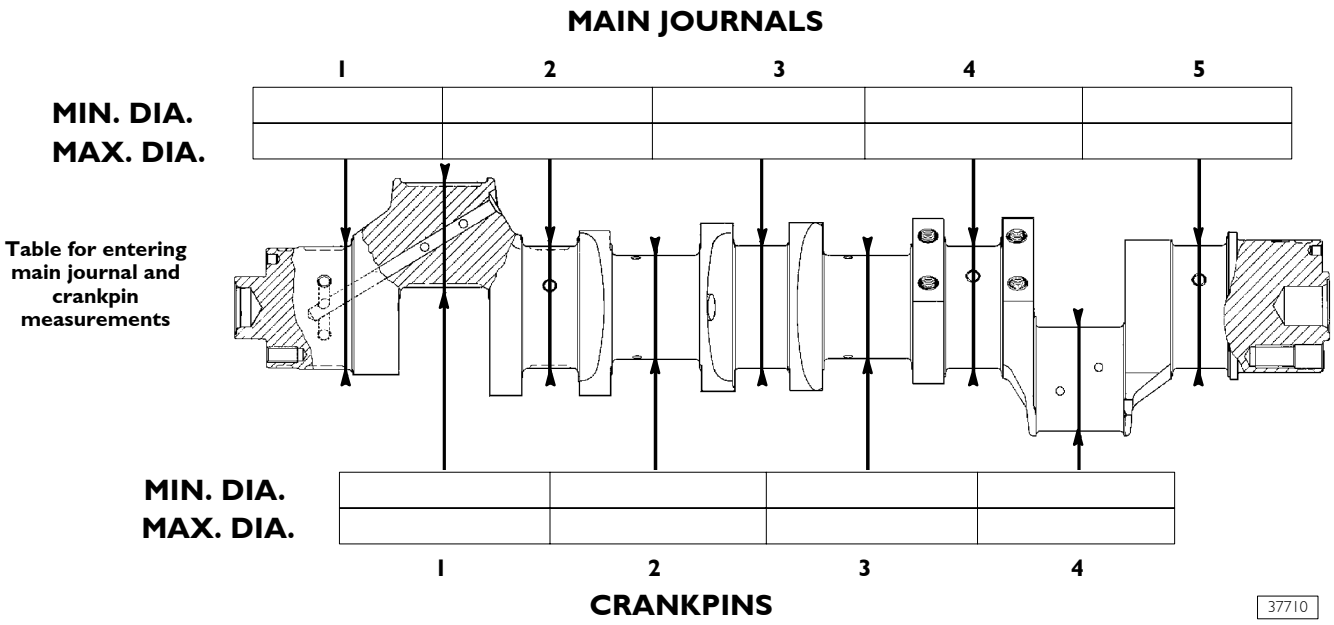
Figure 21



CRANKSHAFT JOURNAL DATA

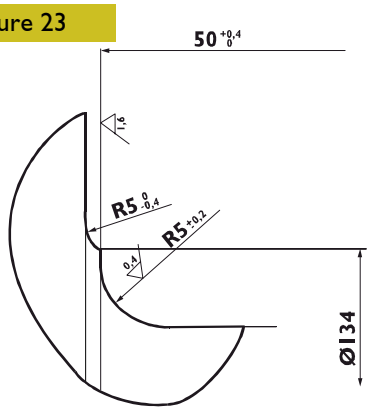
Check the state of the main journals and crankpins of the crankshaft. They must show no sign of scoring, ovality or excessive wear. The data given refer to the nominal pin diameter.

Figure 22



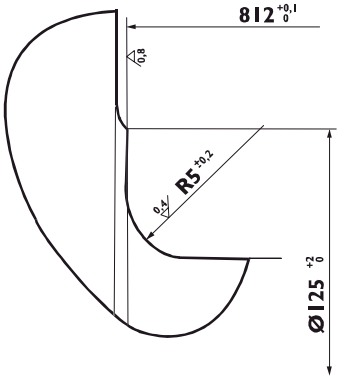
NOTE The engine shaft is nitrided and its grinding is not foreseen

Figure 23



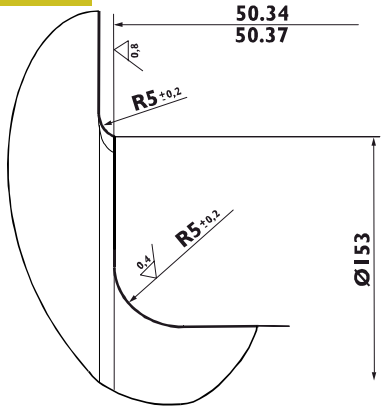
Detail of couplings of central main journal.

Figure 24



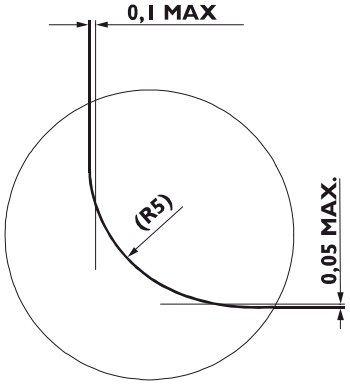
Detail of couplings of crankpin.

Figure 25



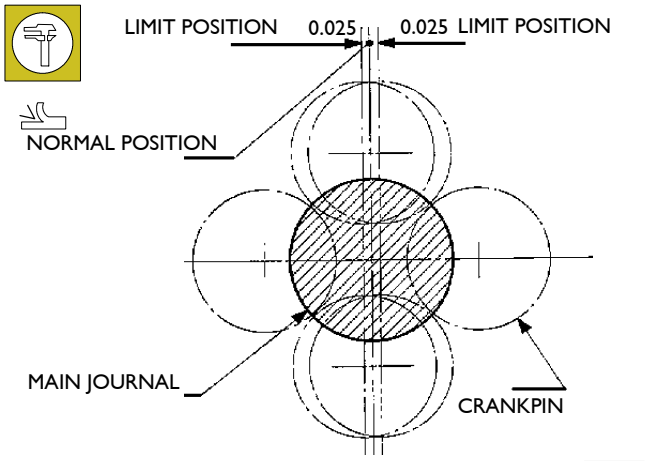
Detail of couplings of rear – thrust main journal.

Figure 26



Checking main journal alignment

Figure 27



The tolerances allowed on the engine shaft pins are:

- ovality = 0.007 mm
- taper 0.012 mm
- main journal misalignment 0.10 mm
- crankpin misalignment ± 0.025 mm
- tolerance on the distances between the axis of the crankshaft and the outside of each crankpin ± 0.10 mm

Figure 28

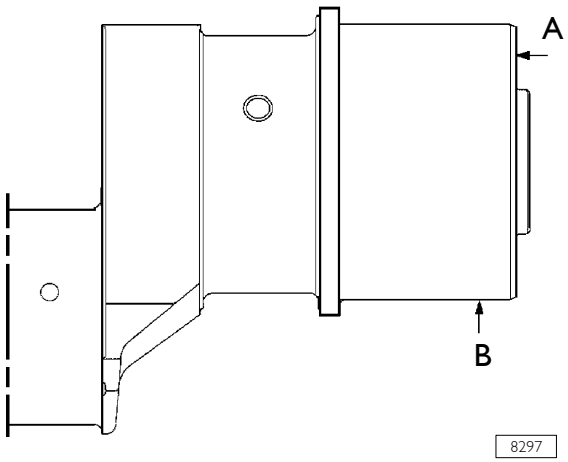
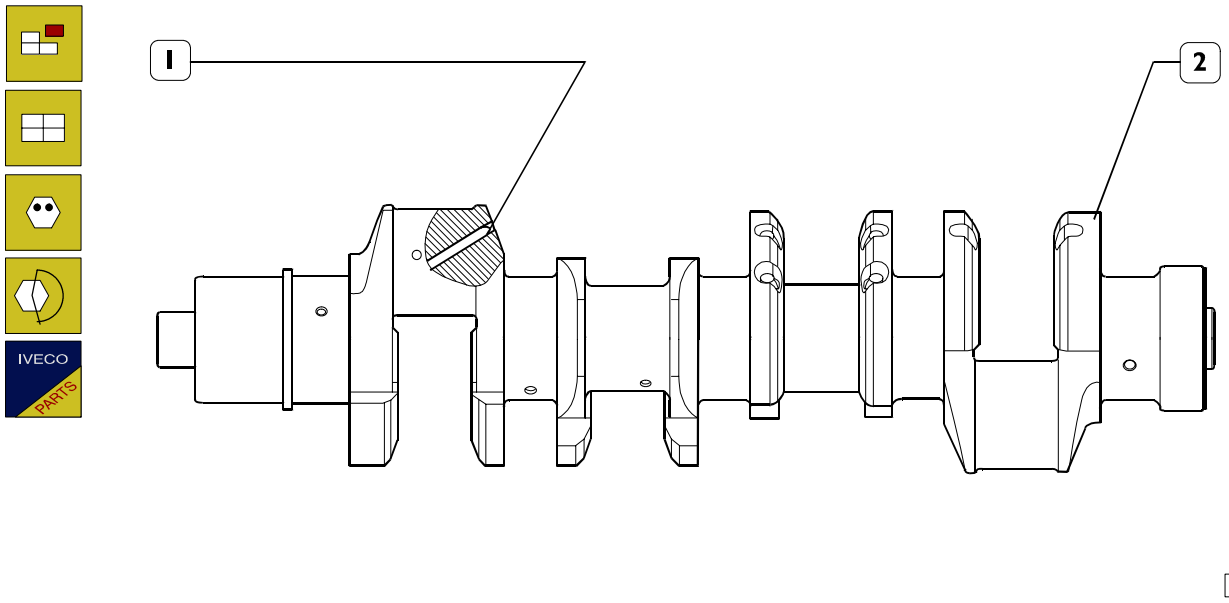


Diagram for checking the flywheel mating surface is orthogonal and coaxial with the axis of rotation and main journals.
Turn the shaft:

- with the dial gauge at B no change greater than 0.04 mm must be measured on the dial gauge;
- with the dial gauge at A no change greater than 0.03 mm must be measured.

Figure 29



Check that with a pressure of 15 bar (15 kg/cm2) there is no leakage from the plugs (1).
The counterweights (2) must be fitted with the crankshaft fitted in the cylinder assembly. The numbering marked on the counterweights must correspond to that marked on the cranks of the crankshaft.
The bolts fixing the counterweights to the crankshaft must be lubricated with "UTDM" oil and tightened to the prescribed torque (pre–torque 40 Nm, torque 90° check window 110–170 Nm) when the counterweights are parallel to the main bearing housings.

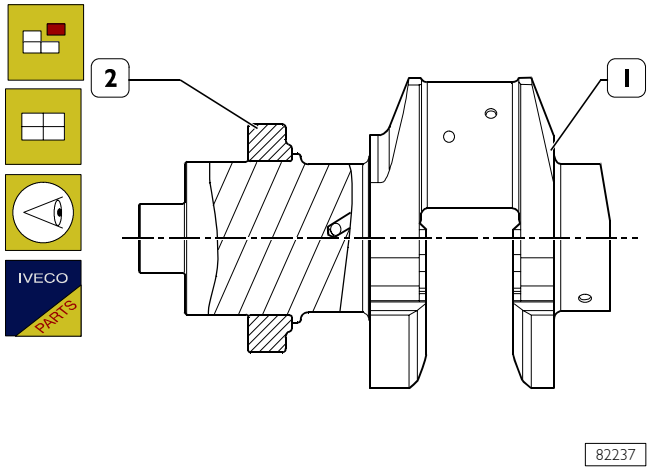
Crankshaft balancing instructions

The crankshaft must be dynamically balanced.

Maximum permissible unbalance for each of the two planes of balancing: 1000 g mm.

Replacing water pump drive gear

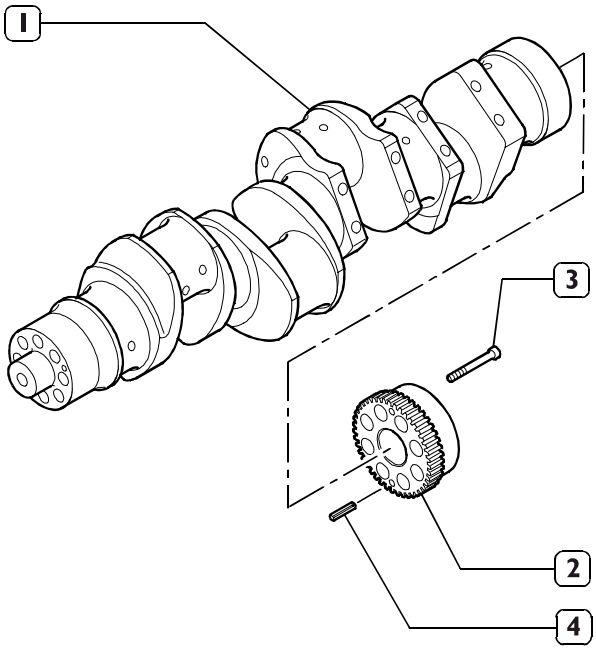
Figure 30



- ❑ Check that the toothing of the gear (2) is neither damaged nor worn; if it is, then extract it with an appropriate extractor. The gear (2) must be mounted on the crankshaft (1) when there is a difference in temperature between them of 200°C.
- ❑ Check that under a load of 32000 N the gear (2) does not shift in relation to the shaft.

Changing the oil pump and timing system gear

Figure 31

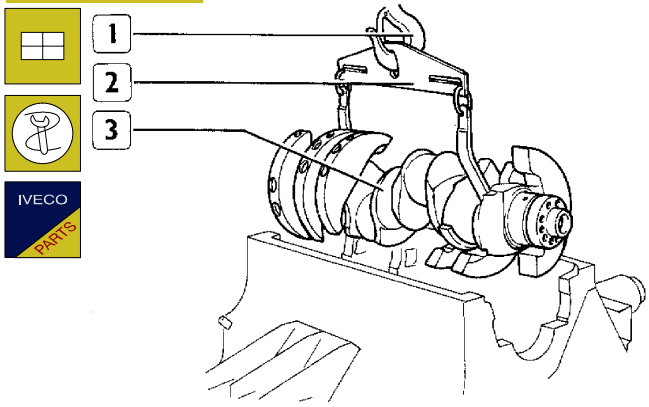


❑ Check that the gear toothing (2) is neither damaged nor worn. If it is, remove the gear by unscrewing the screw (3) and using an extractor.
Take out the split pin (4).
The gear (2) must be fitted on the crankshaft (1) by bringing the gear into alignment with the threaded seat and with the housing of the split pin on the crankshaft.
Using the right drift, bring the gear flush onto the crankshaft and screw down the M8x1.25x80 mm screw, tightening it to a torque of 22 to 27 Nm.

Fitting the main bearings

NOTE The crankshaft must be dynamically balanced.

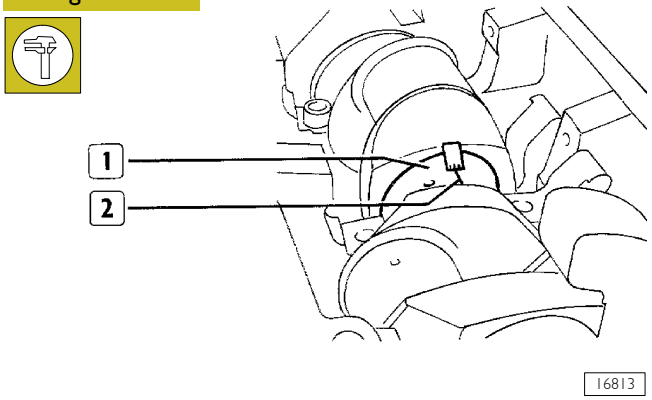
Figure 32



Arrange the main bearing shells with the lubrication hole in their respective seats and fit the crankshaft (3) with the tool 99360500 (2) and suitable hoist (1).

Finding journal clearance

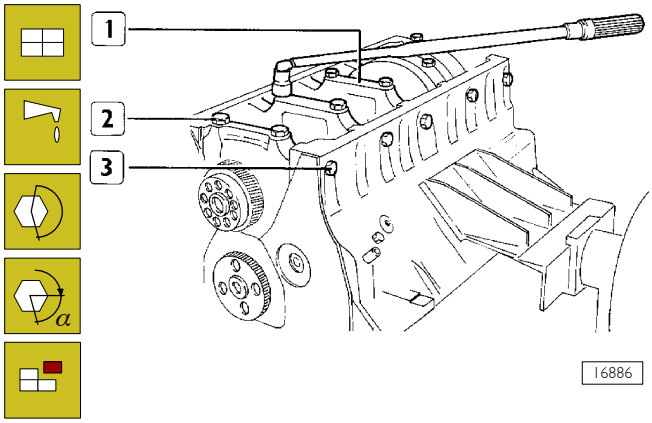
Figure 33



Check the clearance between the crankshaft main journals and their respective bearings as follows:

- ❑ thoroughly clean the pins;
- ❑ apply a calibrated wire (2) on the main journals (1);

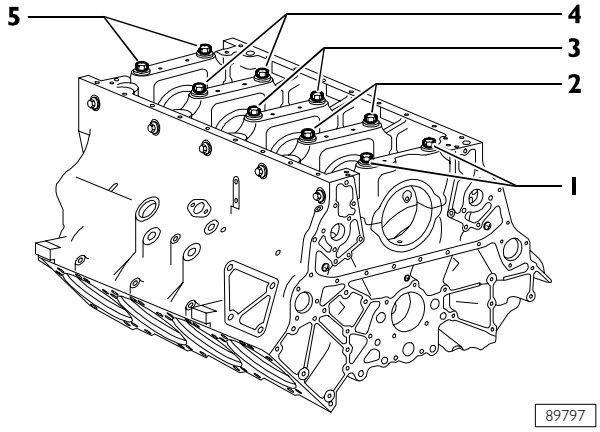
Figure 34



- ❑ fit the caps (1) of the main bearing housings with the half bearings so that the stamped numbers face the same side as the corresponding ones on the cylinder assembly;
- ❑ Lubricate under the bottom side of the heads of screws (2 and 3) that fix the bench caps with engine oil and tighten to the fixing torque prescribed;

Tightening sequence

Figure 35

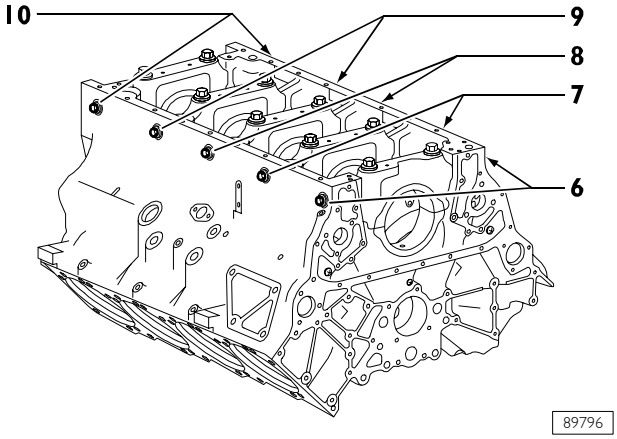


M20x1.5 bolts

Type of tightening: pre-torque + angle

Pre-torque	160Nm
Angle	240°
Guard-torque	600 ÷ 1000 Nm

Figure 36



M16x1.5 bolts

Type of tightening: pre-torque + angle

Pre-torque	~70Nm
Angle	120°
Guard-torque	240 ÷ 460 Nm

NOTE When tightening to an angle, use tool 99395216.

❑ Remove caps from supports.

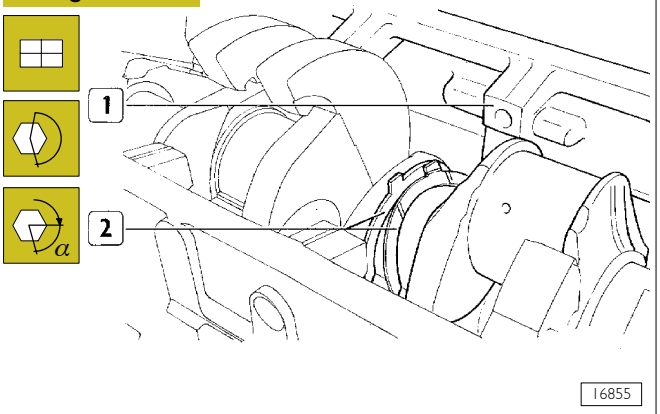
The backlash between the main bearings and the pins is found by comparing the width of the calibrated wire (2) at the narrowest point with the scale on the envelope (1) containing the calibrated wire.

The numbers on the scale indicate the backlash in mm.

Once the screws securing (vertical and lateral) main bearing caps have been screwed up, they must compulsorily keep their position during caps dismounting and remounting successive operations.

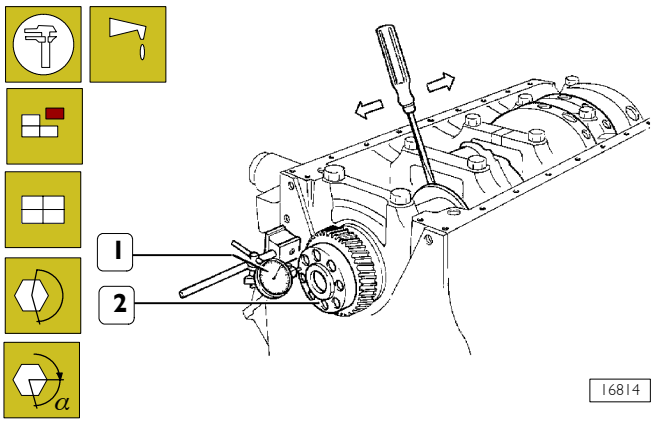
Checking crankshaft thrust clearance

Figure 37



❑ Arrange the thrust rings (2) on the central main bearing housing (1) with the grooves facing the crankshaft shim adjustment.
Fit the caps (1, Figure 34) back on and tighten the screws (2, Figure 34) to the prescribed tightening torque.

Figure 38



The thrust clearance of the crankshaft (2) is checked by placing a dial gauge (1) with a magnetic base and proceeding as shown in the figure. The normal assembly clearance is from 0.070 to 0.270 mm.
If a greater clearance is measured, replace the thrust washers with new ones of the normal thickness or oversized, if necessary.
The housing washers are not interchangeable with those of the cap.
Remove again:

❑ main bearing housing caps;

❑ lubricate the main journals, main bearings and thrust washers with engine oil;

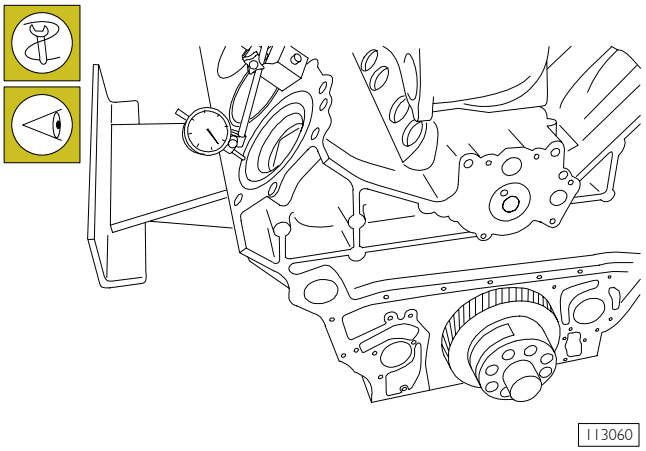
❑ refit the main bearing caps and tighten the screws (2 and 3, Figure 34) to the prescribed torque.

NOTE When tightening to an angle, use tool 99395216.

Camshaft timing

Method 1 (without equipment)

Figure 39

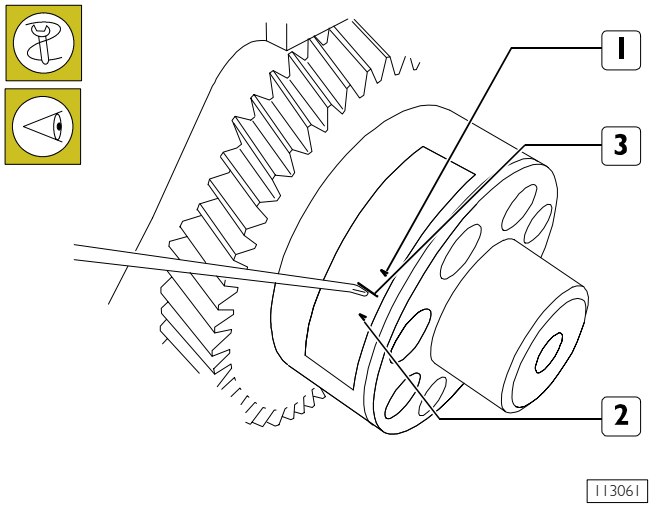


113060

Determine top dead centre (TDC) for cylinder 1 proceeding as follows:

- ❑ Rotate the crankshaft so that the piston for cylinder 1 is close to TDC.
- ❑ Fit the dial gauge as illustrated in the diagram.
- ❑ Carefully determine TDC (the point at which the dial gauge pointer stops).

Figure 40

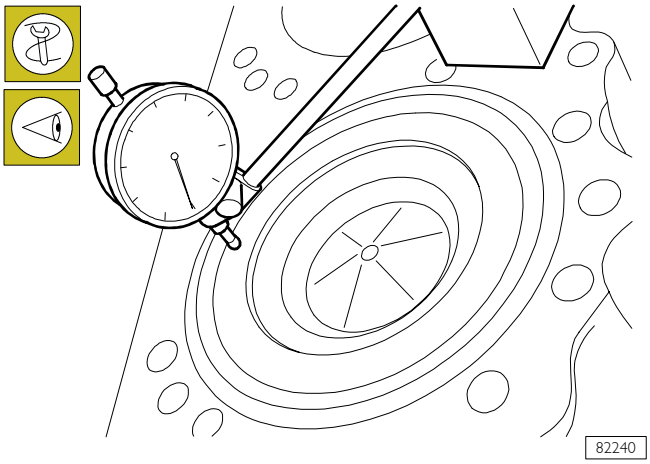


113061

Trace two marks, one on the crankshaft key (1) and one reference one on the cylinder block/crankcase:

- ❑ Rotate the crankshaft until a movement of the pointer is detected on the dial gauge and then make a second mark on the crankshaft (2).
- ❑ Measure the halfway point between the two reference marks and make a third reference mark (3) on the crankshaft.

Figure 41

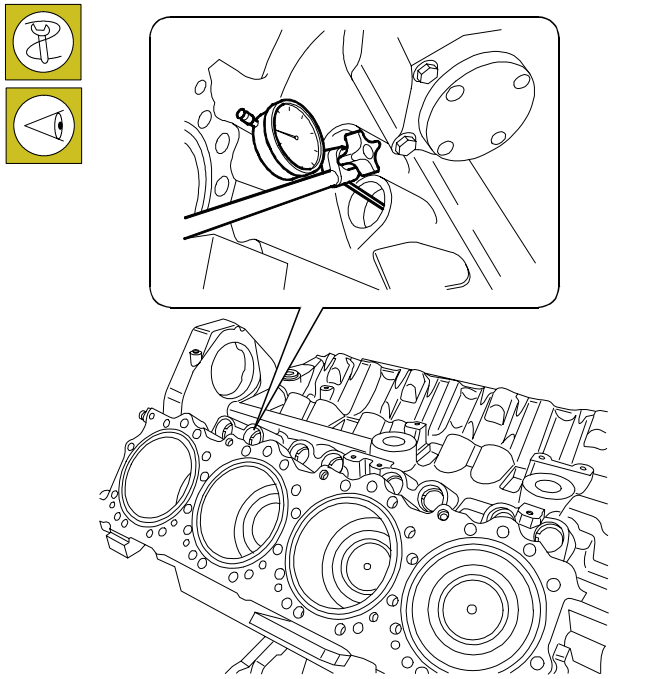


82240

Check that TDC coincides with the mark made:

- ❑ Rotate the crankshaft backwards.
- ❑ Rotate the crankshaft again, forwards, until the dial gauge changes direction.
- ❑ Check that the point at which the dial gauge changes direction (zero point on the dial gauge) coincides with the reference marks made on the crankshaft andon the cylinder block/crankcase.

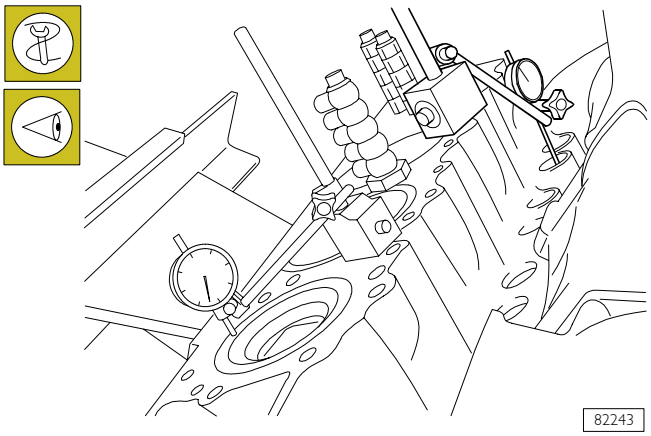
Figure 42



113062

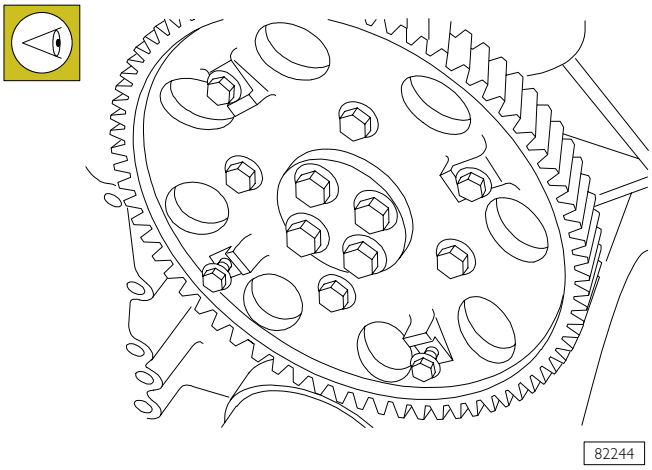
- ❑ Fit the dial gauge on the exhaust tappet for cylinder no. 4.
- ❑ Search for the point at which the tappet on which the dial gauge is fitted is fully lowered and zero the dial gauge.

Figure 43



- ❑ Rotate the crankshaft fowards until a lifting height of 5.48 mm is reached.
- ❑ The camshaft is timed if the reference mark made previously on the crankshaft is aligned with the reference on the cylinder block/crankcase.

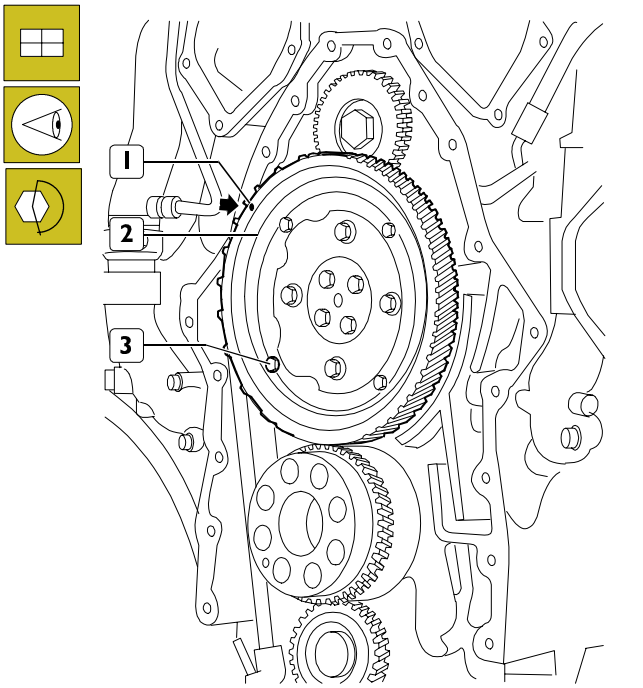
Figure 44



If the above condition is not achieved, the camshaft should be adjusted using the openings in the toothed wheel.

See timing diagrams overleaf.

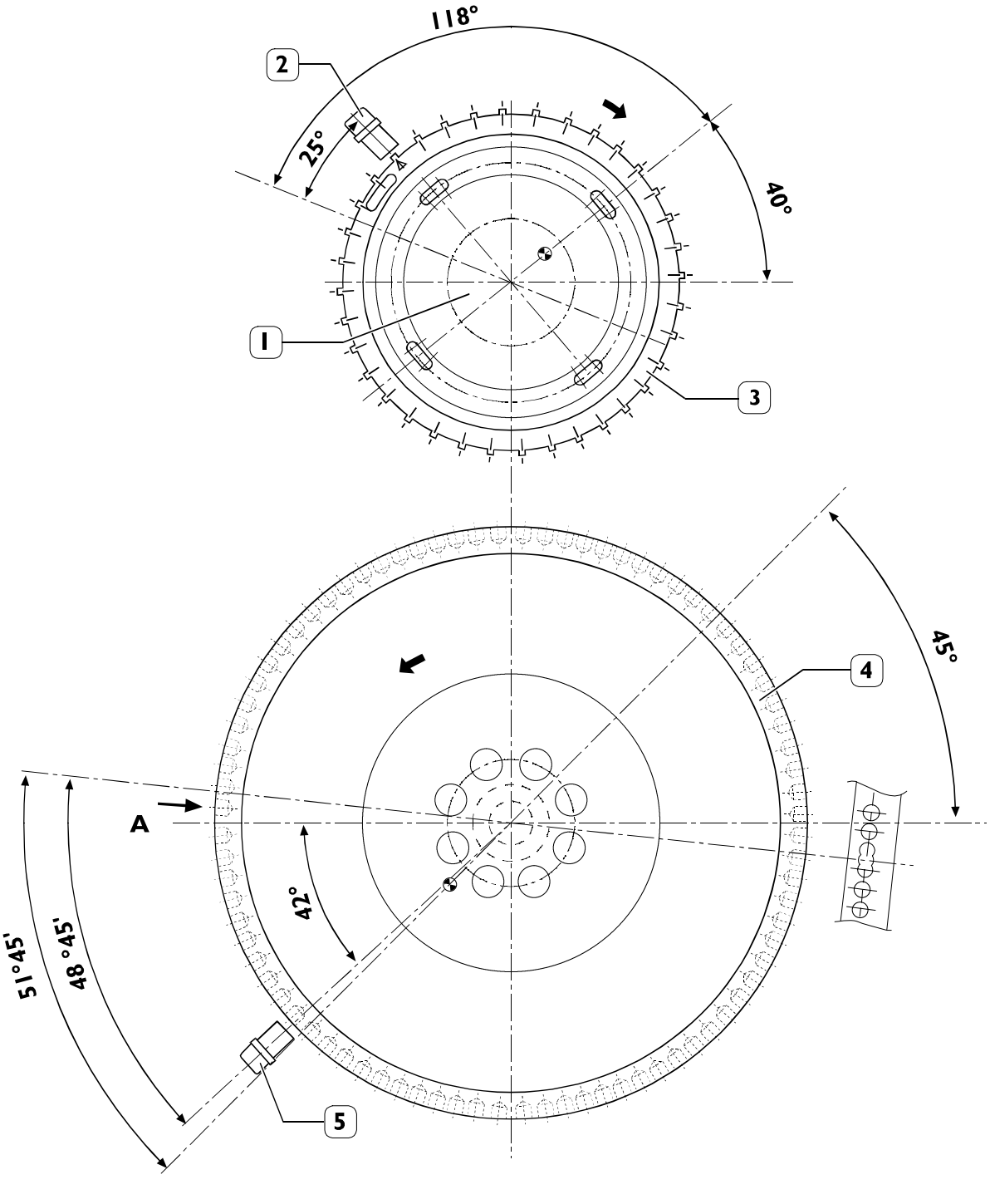
Figure 45



Fit the flywheel (2) taking care to ensure that the reference markt (1) is aligned with the position of the camshaft rpm sensor (see timing diagrams on the pages that follow).

Tighten the bolts (3) to the recommended torque.

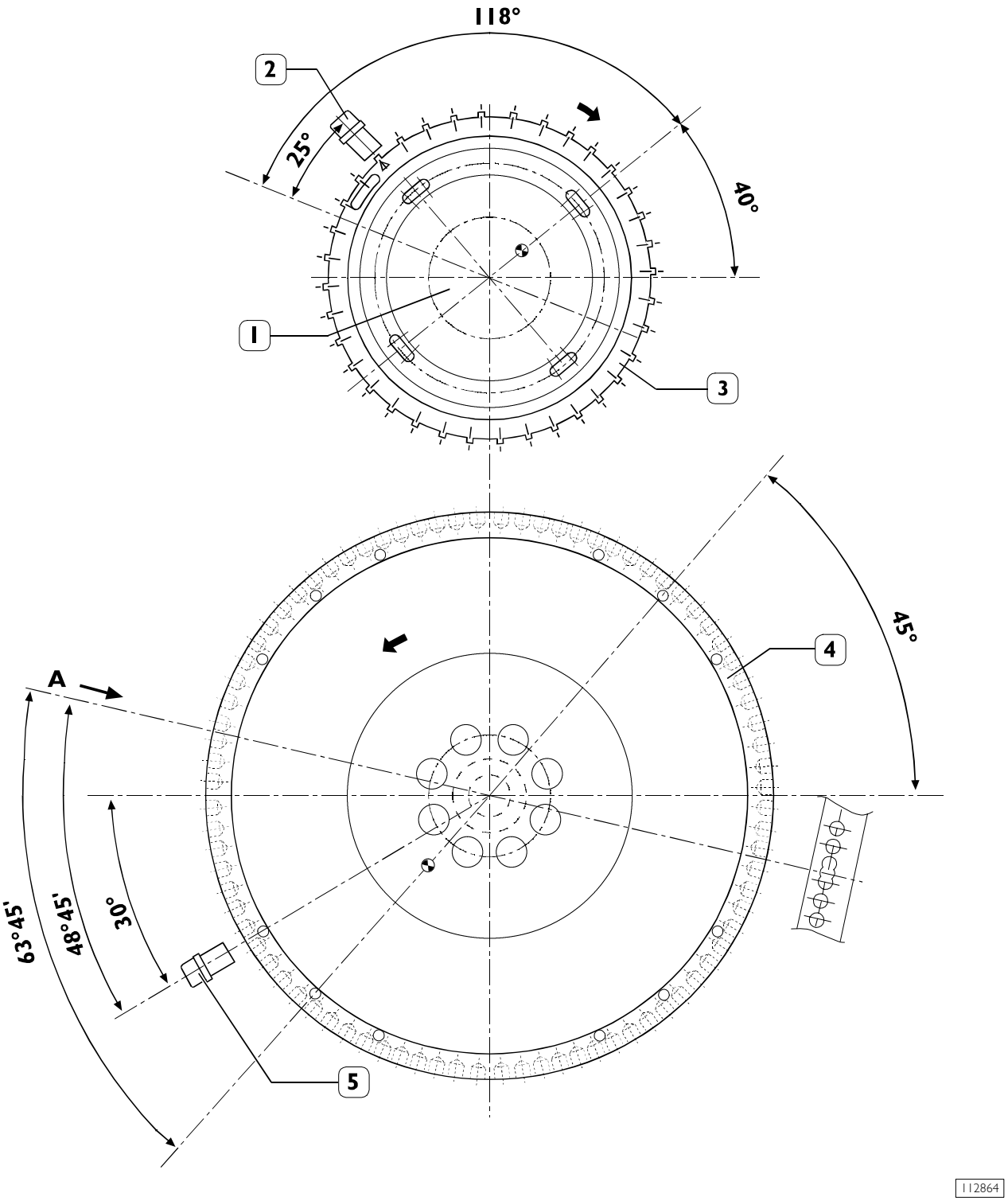
Figure 46



TIMING DIAGRAMS FOR THE FOLLOWING APPLICATIONS:G
DRIVE - GRIFFON - SPRINKLER

1. Camshaft - 2. Camshaft rpm sensor - 3. Camshaft flywheel - 4. Engine flywheel - 5. Crankshaft rpm sensor fitted on the flywheel casing

Figure 47

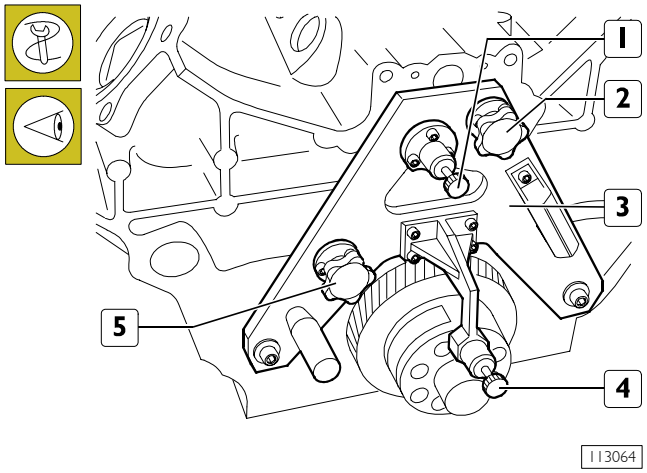


TIMING DIAGRAMS FOR THE FOLLOWING APPLICATIONS:
DRAGON

1. Camshaft - 2. Camshaft rpm sensor - 3. Camshaft flywheel - 4. Engine flywheel - 5. Crankshaft rpm sensor fitted on the flywheel casing

Method 2 (using equipment)

Figure 48



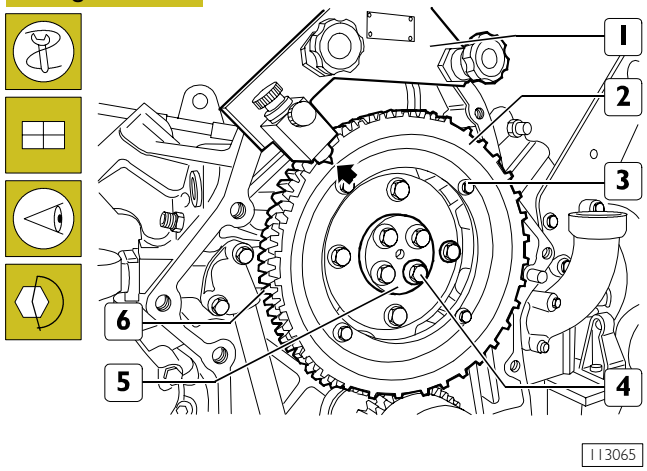
Position cylinders 1 and 6 at TDC.

Fit tool 99368509 (3) on the front casing.Secure it using the bolts (2, 5).

At TDC the pins (2) and (3) for the tool engage in the dowels for the crankshaft and the camshaft respectively guaranteeing the timing.

Flywheel timing

Figure 49



With tool 99368509 (3, Figure 48) fitted, fit the two timing gears (6) and the spacer (5) and secure the assembly using the bolts (4).

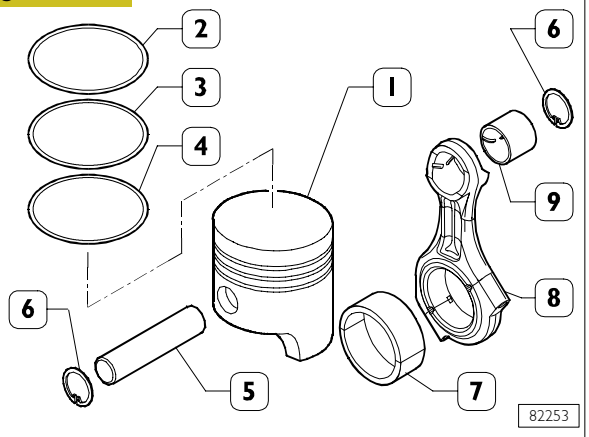
Fit the tool (1) 99368508 on the front casing as shown in the diagram.

Fit the flywheel (2) so that the tool 99368508 is inserted, via the seat for the timing sensor, on the tooth on the flywheel (see arrow).

Proceed with tightening the bolts (3).

PISTON ROD ASSEMBLY

Figure 50

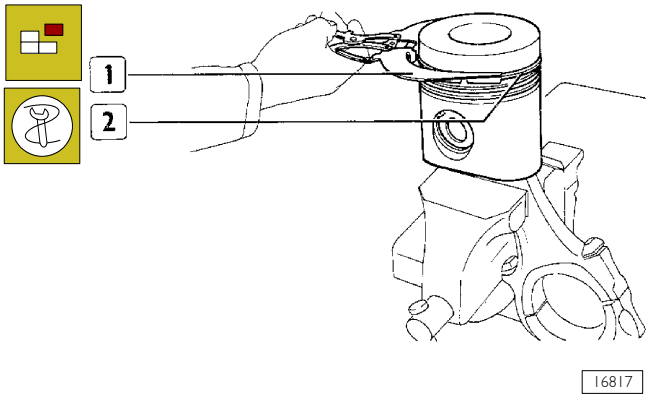


PISTON–GUDGEON PIN ASSEMBLY

1. Piston – 2. Trapezoidal grommet – 3. Washer – 4. Oil scraper ring – 5. Gudgeon pin – 6. Split rings – 7. Half baerings – 8. Connecting rod – 9. Bush

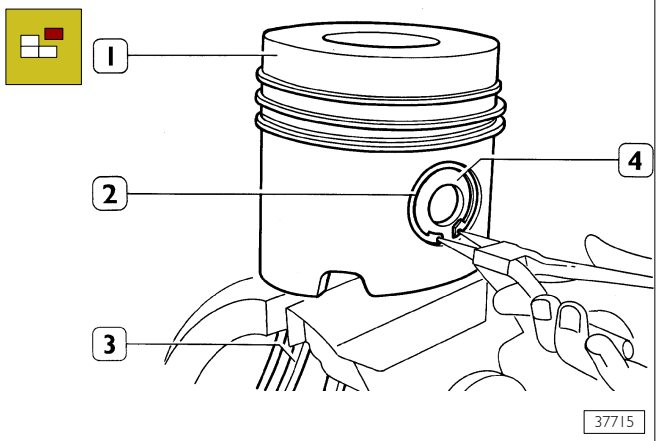
❑ Check pistons for any signs of seizure, cracks or excessive wear; if there are, replace them.

Figure 51



❑ Use pincers 99360183 (1) to remove the rings (2) from the piston.

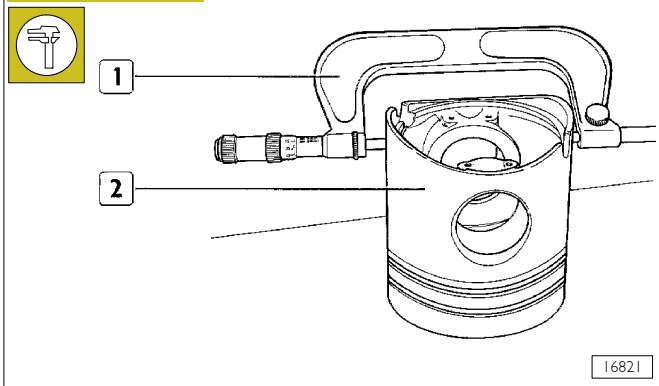
Figure 52



❑ Remove the piston (1) from the rod (3) by removing the ring (2) and extracting the gudgeon pin (4).

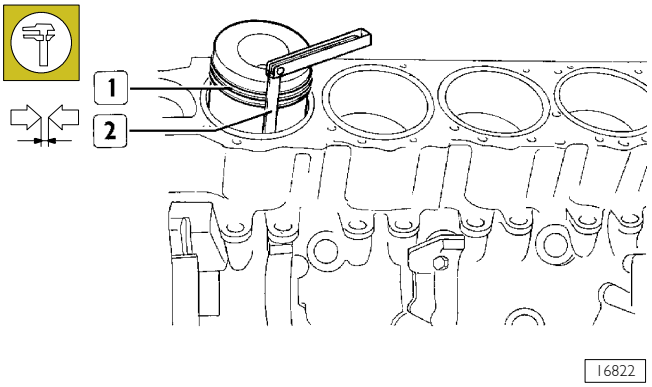
Pistons
Measuring the piston diameter

Figure 53



❑ Measure through the micrometer (1) the piston diameter (2) to determine the assembly play. The diameter shall be measured at 21 mm from the piston skirt.

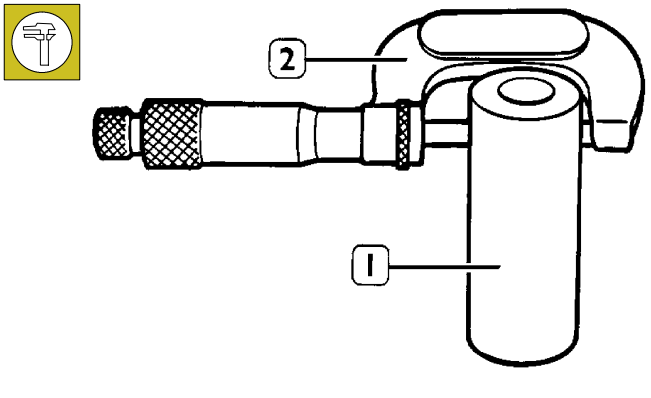
Figure 54



❑ The clearance between the piston (1) and cylinder liner can be checked using a feeler (2) as shown in the above figure.

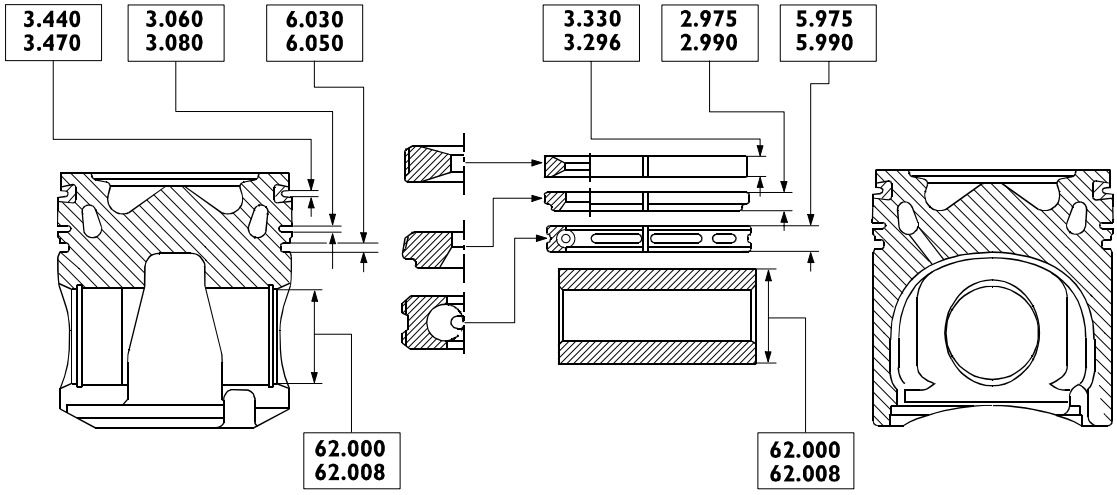
Gudgeon pins

Figure 55



❑ Measure the diameter of the gudgeon pin (1) using a micrometer (2).

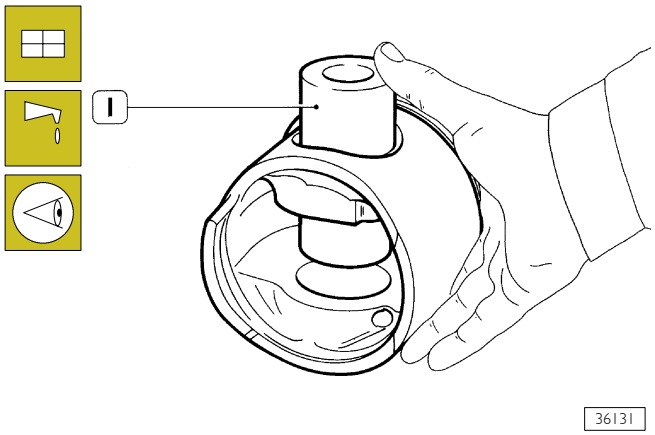
Figure 56



PRINCIPAL PISTON, GUDGEON PIN AND PISTON RING DATA

Conditions for correct mating of gudgeon pin and piston

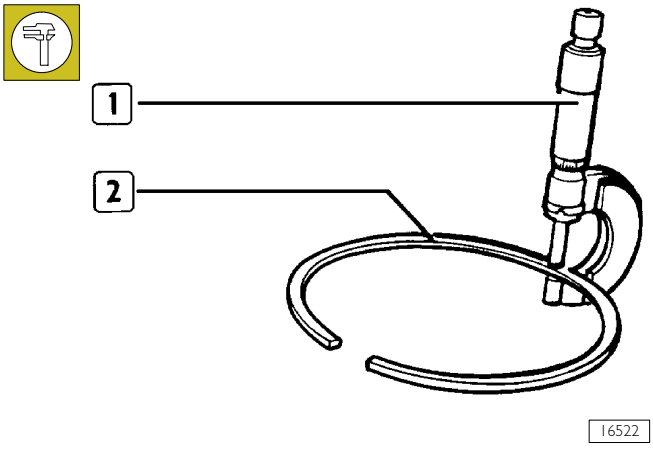
Figure 57



❑ Lubricate the gudgeon pin (1) and its seating on the piston with engine oil; arrange the piston so that the gudgeon pin can be inserted into the piston with a slight thumb pressure and does not drop out by gravity.

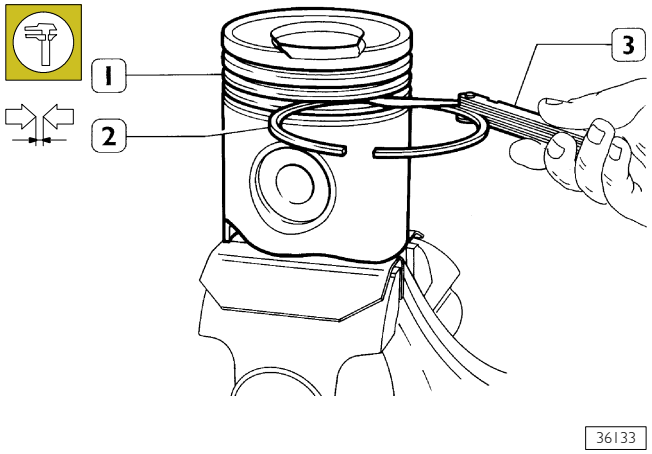
Piston rings

Figure 58



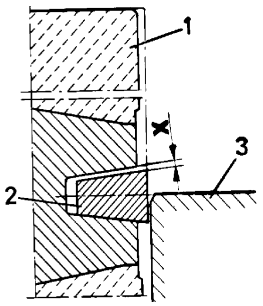
❑ Check thickness of piston rings (2) by a micrometer (1).

Figure 59



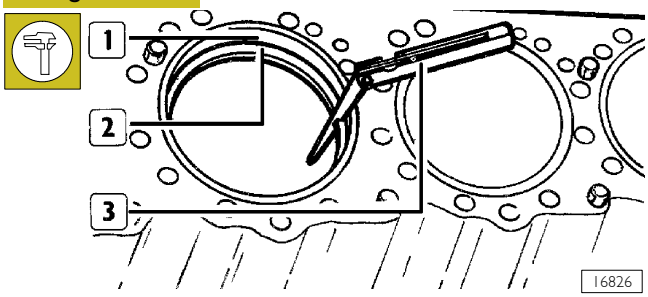
❑ Check the clearance between the piston rings (2) and their seats on the piston (1) using a feeler gauge (3).

Figure 60



The ring (2) of the first slot has a V–shape.
The clearance "X" between a ring and its seat is measured by placing the piston (1), with its ring, in the cylinder liner (3) so that the ring comes half–way out of the cylinder liner.

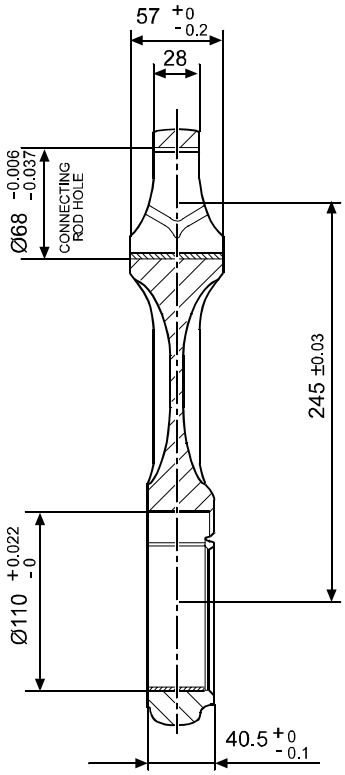
Figure 61



❑ Using a feeler gauge (3) check the gap between the ends of the piston rings (2) once they have been fitted into the cylinder liners (1).

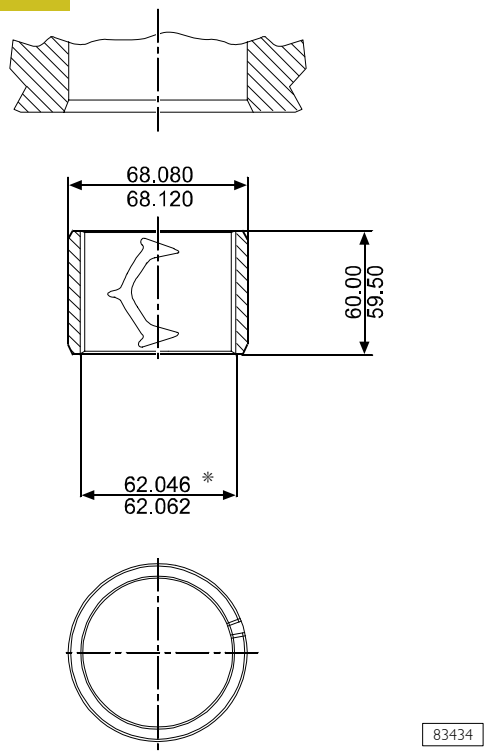
Connecting rods

Figure 62



PRINCIPAL ROD, BUSHING, GUDGEON PIN AND BEARING HALF DATA
* internal diameter to check on the rod small end

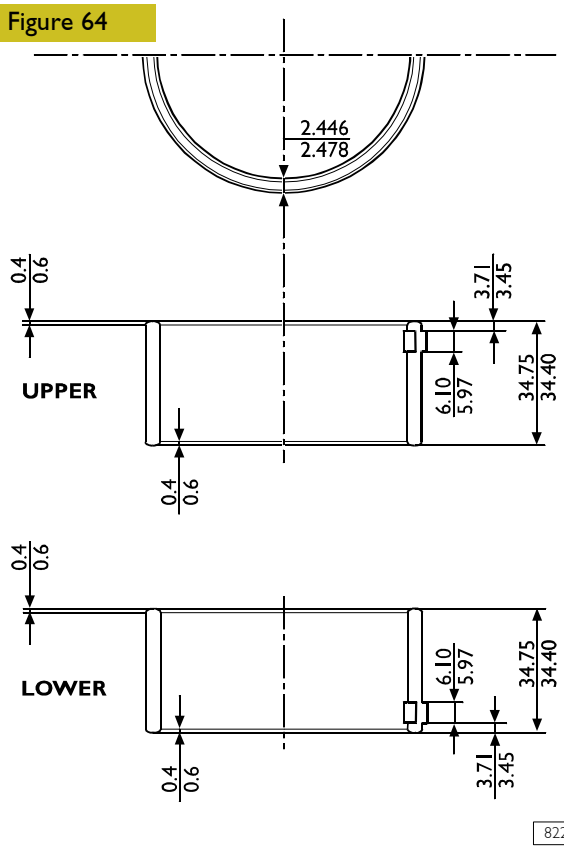
Figure 63



CONROD BUSHING

NOTE The upper bushing of the connecting rod cannot be replaced.

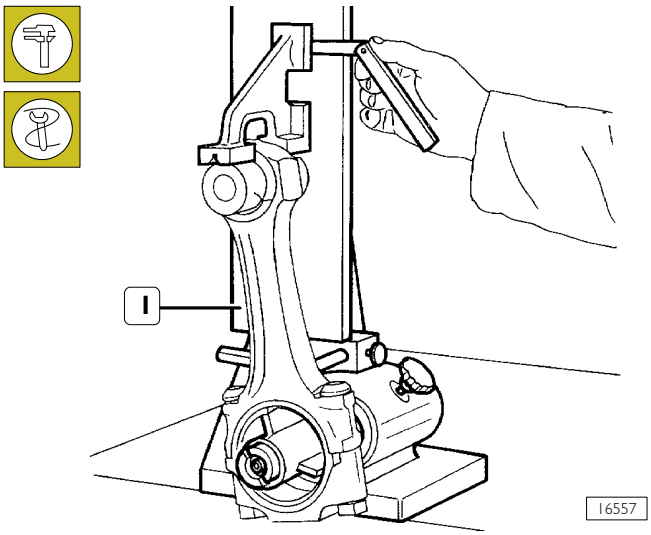
Figure 64



ROD HALF (LOWER AND UPPER)

Check of connecting rod alignment

Figure 65

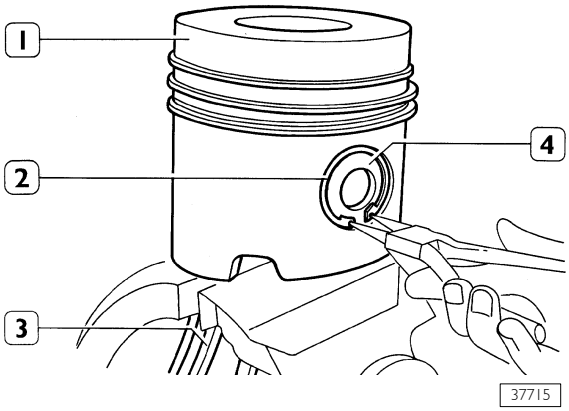


Use apparatus 99395363 (1) to check parallelism of the rod arms. The maximum permitted tollerance is ± 0.05 mm, measured at 125 mm from the longitudinal axis of the rod. If a misalignment exceeding the permitted tolerance is encountered, replace the rod.

NOTE The body and cap of every connecting rod is marked with a number indicating the part with which is to be mated. In addition, the number of the cylinder where the rod should be installed may be stamped on it. Therefore, when replacing the rod, it is necessary to mark the new rod with the same number as the rod whitch is being replaced.

Fitting the connecting rod–piston assembly
Connecting rod–piston mating

Figure 66

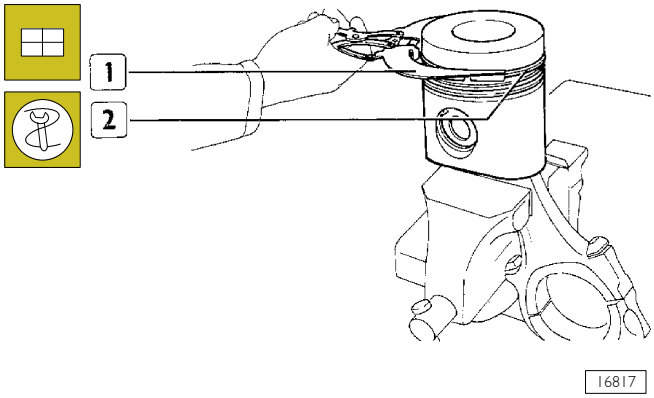


The connecting rod – piston coupling must be made taking account that, on fitting the assembly in the cylinder block, the wording "TAPPET SIDE" (stamped on the crown of the piston) must be facing the tappet side of the engine and the numbering of the connecting rods must be facing the corresponding numbering stamped on the cylinder block.

❑ Position the piston (1) on the rod (3), insert the pin (4) and secure it with the piston rings (2).

Fitting the piston rings

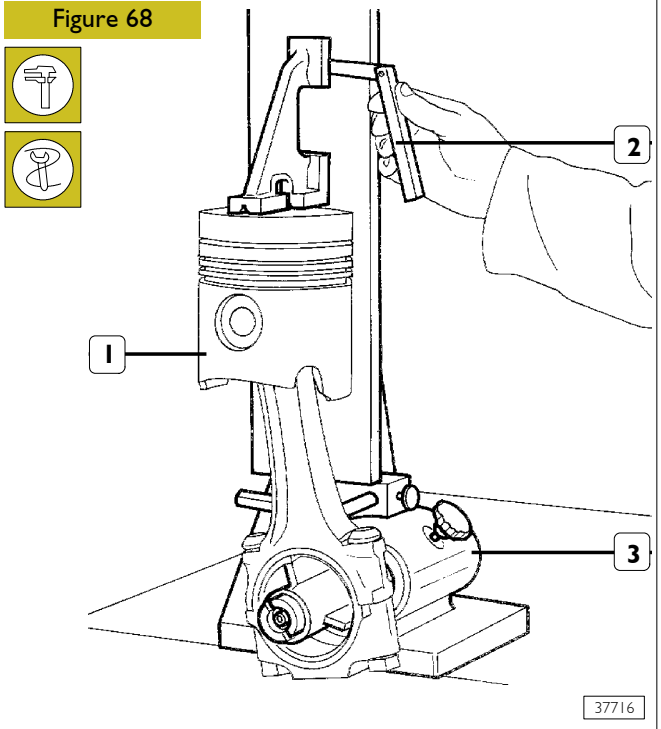
Figure 67



❑ Insert the piston rings (2) on the piston using pliers 99360183 (1).

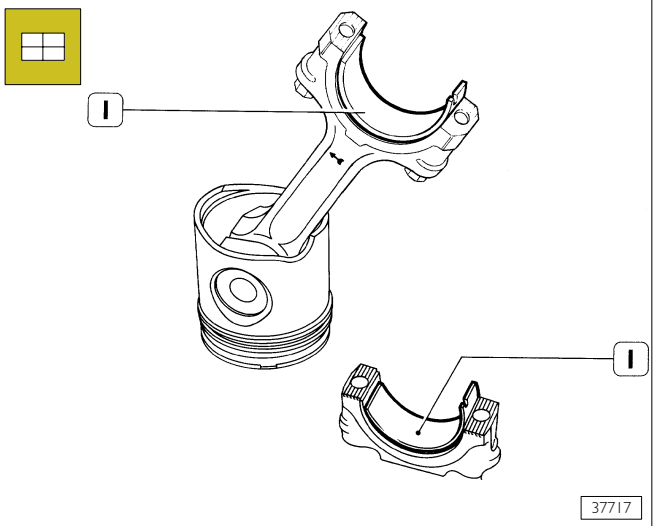
Check of rod/piston alignment

Figure 68



After assembling the rod–piston group (1) check the squaring using apparatus 99395363 (3) and feeler gauge (2). Squaring must be exact otherwise the cause should be found and faulty part replaced.

Figure 69



❑ Fit half bearings (1) on connecting rod and cap.

NOTE Refit the main bearings that have not been replaced, in the same position found at removal. Do not try to adapt the half bearings.

Fitting the rod–piston assemblies into the cylinder liners

Figure 70

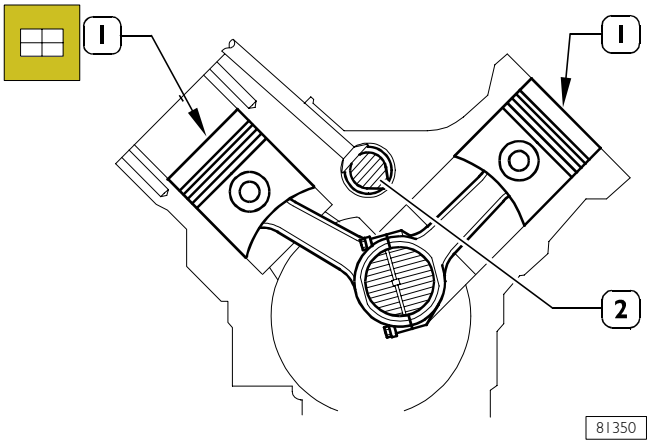
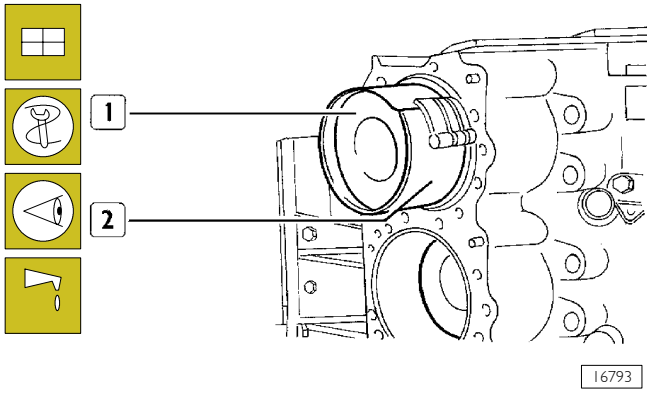


DIAGRAM FOR INSERTING THE CONNECTING ROD-PISTON ASSEMBLY IN CYLINDER

1. Tappet side – 2. Camshaft

Figure 71



The connecting rod – piston assemblies (1) are fitted in the cylinder liners with the aid of the flexible band 99360603 (2) observing the following requirements:

❑ lubricate the pistons, piston rings and cylinder liners with engine oil;

❑ take the crankpin of the piston involved in assembly to T.D.C.;

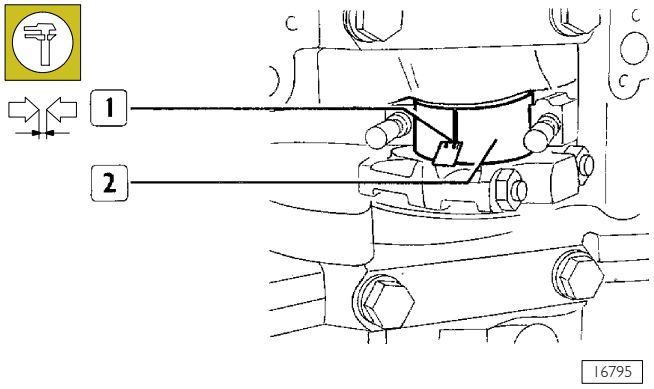
❑ the number of the connecting rod must correspond to the number of the cylinder liner in which it is inserted and must face the same side as that stamped on the cylinder block; in addition, the wording "TAPPET SIDE" on the crown of the piston must face the camshaft;

❑ the gaps in the piston rings must be staggered 120° apart.

NOTE If it is not necessary to replace the big end bearings, they must be reassembled according to the same order and position found upon disassembly.

Measuring the mounting clearance of big end pins

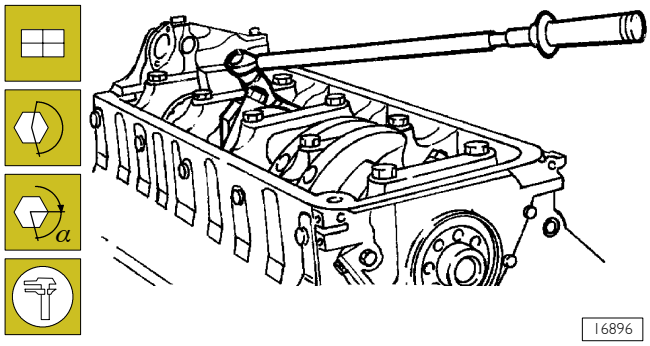
Figure 72



To check the clearance proceed as follows:

- ❑ clean all the parts accurately and remove any traces of oil;
- ❑ arrange the bearings in their seats;
- ❑ place a length of calibrated wire (1) on the drive shaft pins (2).

Figure 73



- ❑ connect the connecting rods to the journals of the crankshaft and fit the connecting rod caps together with the half bearings;
- ❑ tighten the screws, which have been previously lubricated with UTDM oil, with a dynamometer spanner to a prescribed torque;
- ❑ remove the cap.

Measure the existing play by comparing the width of the calibrated wire with the graduated scale shown on the package which contained the wire. If the measured play is not equal to the prescribed value, replace the bearing halves and repeat the check.

Fitting the connecting rod caps

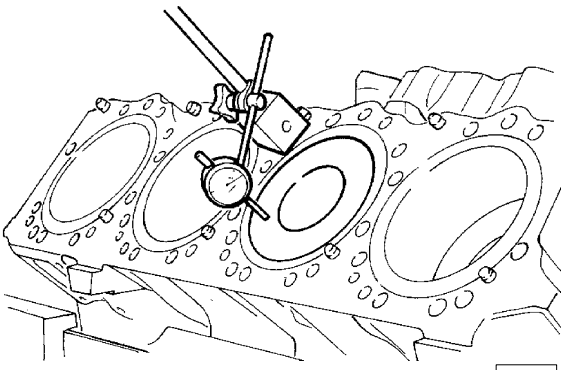
- ❑ Thoroughly clean the journals of the crankshaft and the big end bearing shells of the remains of the calibrated wire. Lubricate them and refit the connecting rod caps tightening the nuts as described for measuring the assembly clearance.

Upon final reassembly, the big end cap fastening screws must always be replaced.

- ❑ Manually check that the connecting rods can be moved sideways on the drive shaft pins.

Check of piston protrusion

Figure 74



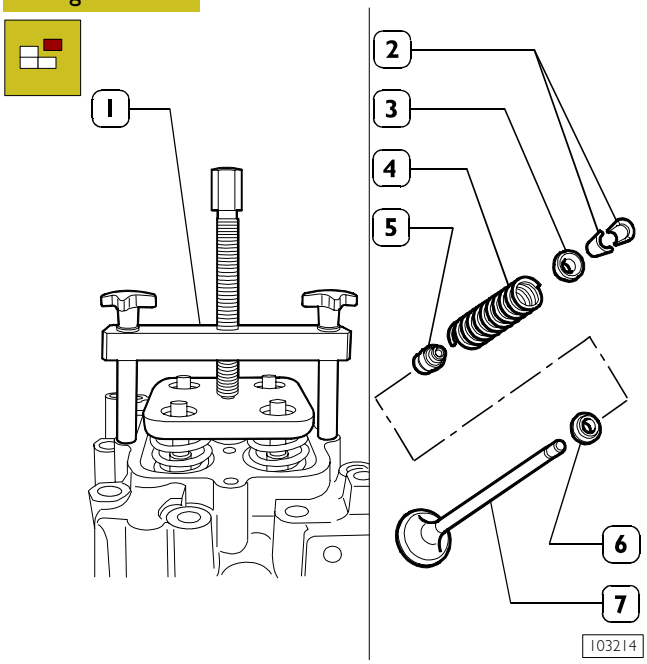
- ❑ When the rod–piston group have been assembled, check for piston protrusion at T.D.C. from the upper engine block level.
- ❑ The protrusion should be from – 0.21 to +0.59 mm.

CYLINDER HEAD
Hydraulic leak test

Before dismantling the cylinder head, carry out the hydraulic leak test using the appropriate tool.
Pump water heated to approx. 90° C and at a pressure of 4 ÷ 5 bar into the cylinder head. Under these conditions, no leaks should be found; if they are, replace the cylinder head.

Dismantling valves

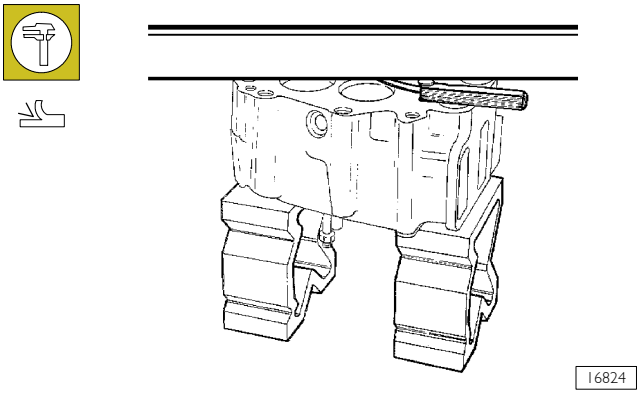
Figure 75



❑ Rest the cylinder head on the workbench and use tool 99368544 (1) to apply pressure to spring cups (3) so that by compressing springs (4) valve collets (2) can be removed.
Then take off upper cups (3), springs (4), caps (5) and lower cups (6).
Turn the cylinder head upside down and withdraw valves (7). Repeat the operation on all the cilinder heads.

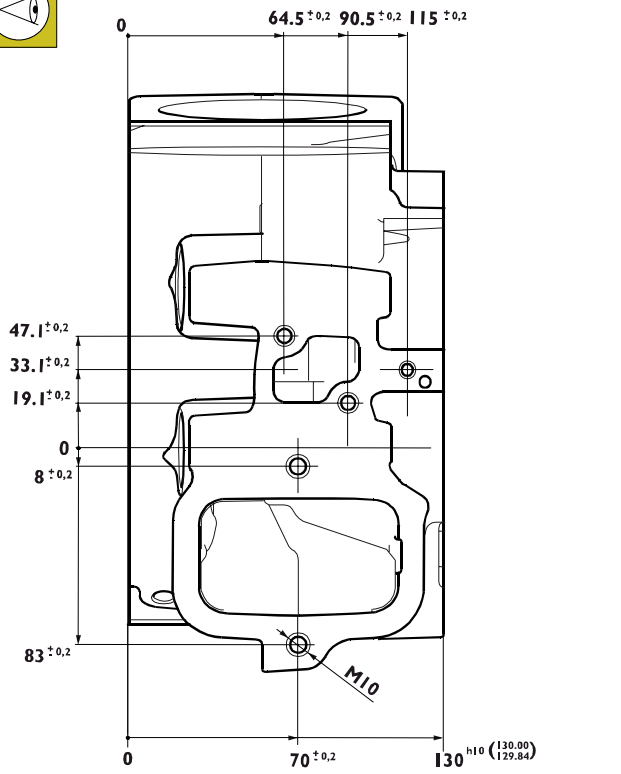
Checking the cylinder head support surface

Figure 76



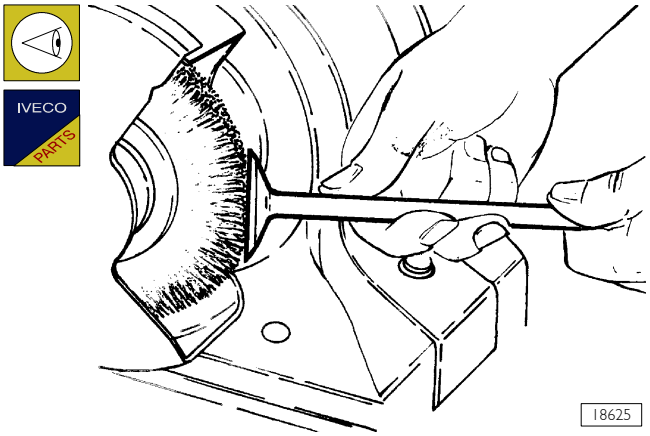
Check the flatness of the support surface using a rule and a feeler gauge.

Figure 77



VALVE
Removing carbon deposits, and checking the valves

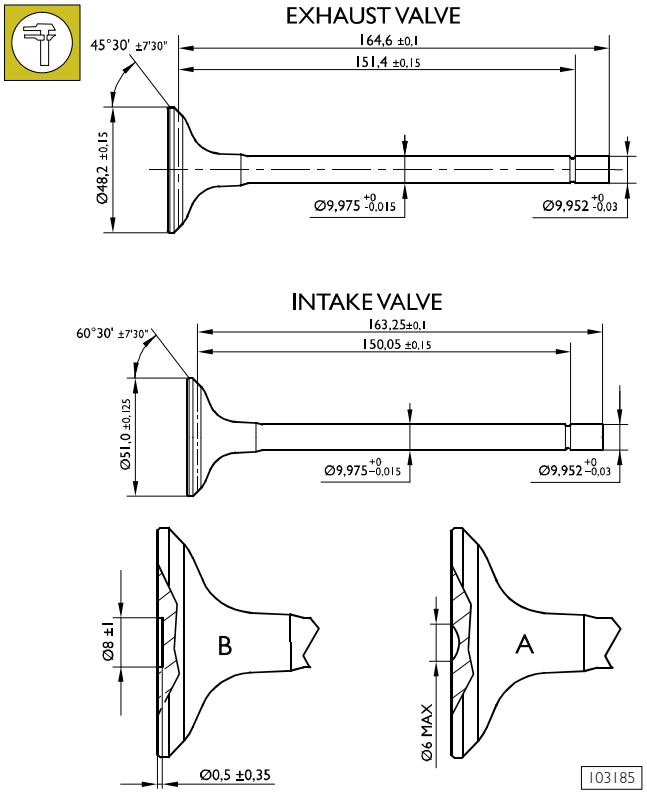
Figure 78



❑ Remove carbon deposits from valve using a steel brush. Check that valves do not show signs of binding or cracking.
Use a micrometer to check that the valve rod diamter is as specified (see Figure 79). If not, replace the valves.

Refacing the valves

Figure 79

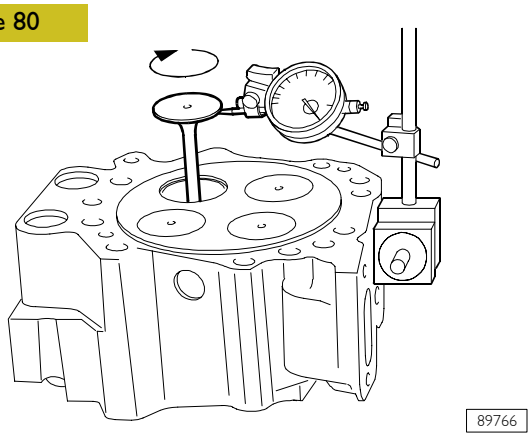


A. Intake valve on the engines with serial numbers starting up to 484 - B. Intake valve on the engines with serial numbers starting from 485

❑ Check with a micrometer that the diameter of the valve stems is as indicated; if necessary, rebore the seats on the valves with the grinding machine, removing as little material as possible.
After machining, check that the dimensions come within the permissible tolerance.

Checking valve centering

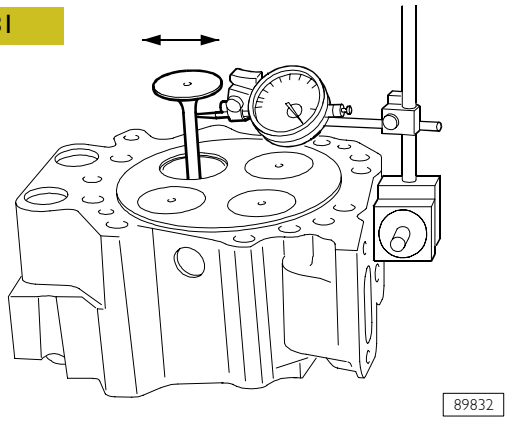
Figure 80



These checks are carried out using a magnetic support dial gauge which is positoned as shown in the figure above.
By rotating the valve check that the centering error does not exceed 0.03 mm.

Checking clearance between valve stem

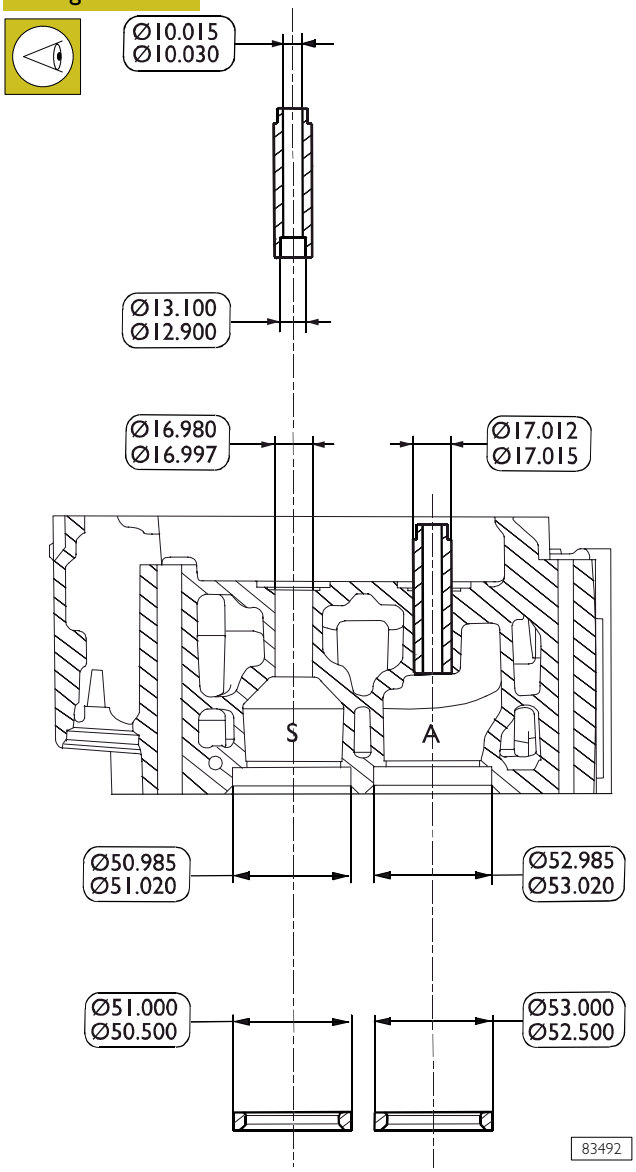
Figure 81



These checks are carried out using a magnetic support dial gauge which is positoned as shown in the figure above.
The mounting clearance is from 0.045 to 0.070.

VALVE GUIDES

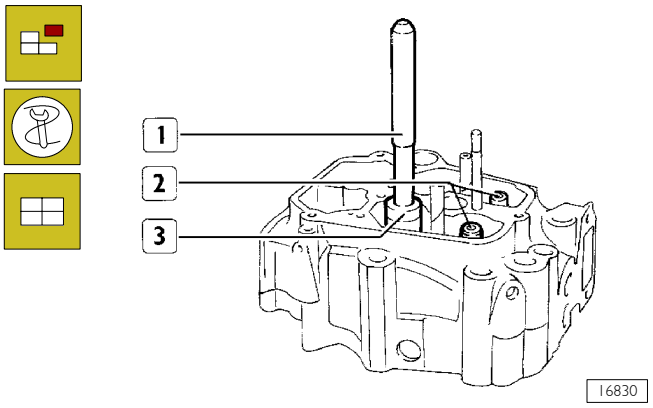
Figure 82



MAIN DATA OF THE VALVE SEATS AND VALVE GUIDE SEATS ON THE CYLINDER HEADS
A = INLET – S = EXHAUST

Replacing the valve guides

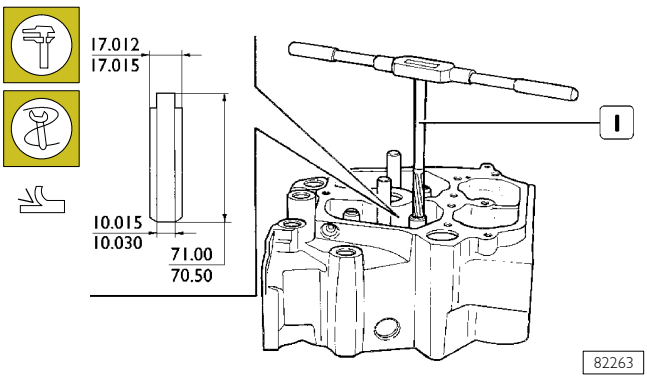
Figure 83



❑ Dismantle the valve guides (2) with beater 99360143 (1); mount the new valve guides using a beater 99360143 (1) fitted with part 99360291 (3).

Reaming the valve guides

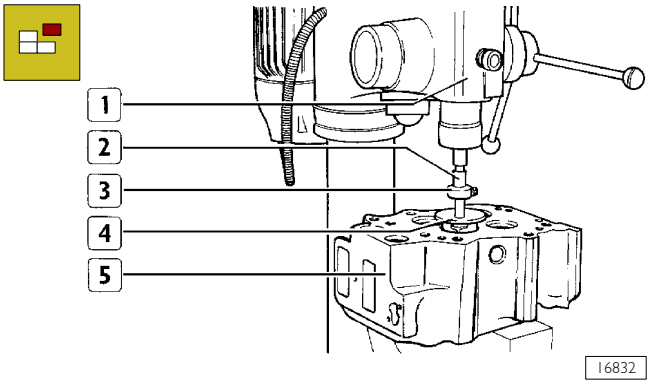
Figure 84



❑ Using the reamer (1), ream the valve guide bore to obtain the indicated value.

Replacing and regrinding the valve seats

Figure 85



Replace the valve seats as follows:

❑ place the cylinder head (5) on the pillar drill (1);

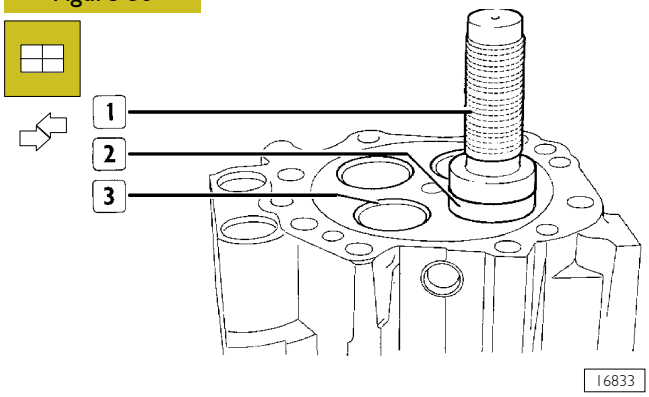
❑ fit tool (4) on the pillar drill;

❑ adjust the stop device (3) on the milling cutter (2);

❑ operate the milling cutter and remove the valve seat;

❑ thoroughly clean the cylinder head.

Figure 86



❑ cool the new valve seats to – 180°C in liquid nitrogen;

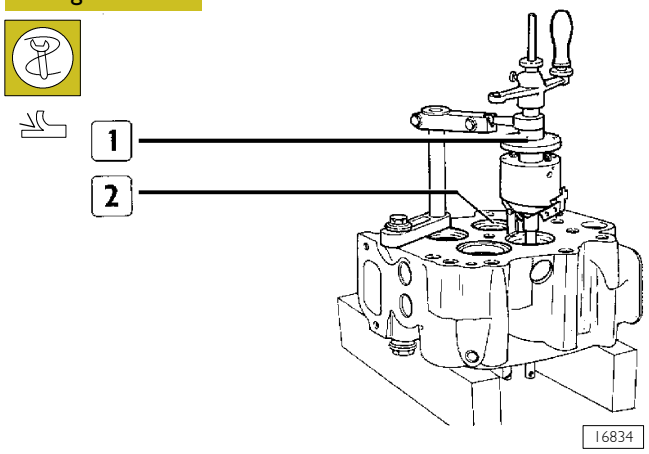
❑ drive the valve seats (3) into the cylinder head with a drift (1) and suitable part (2).

Assembly interference:

❑ inlet: 0.015 to 0.035 mm

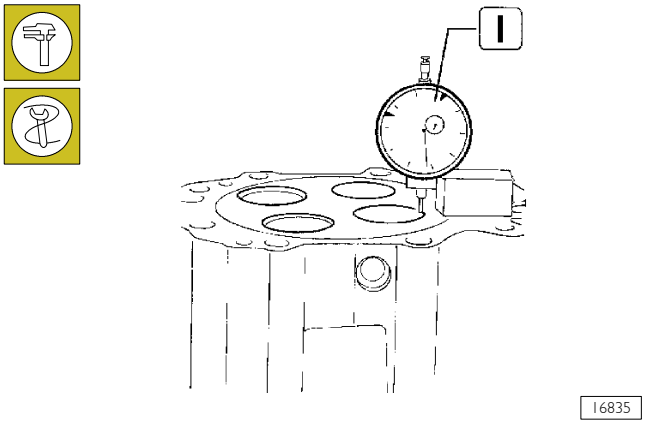
❑ exhaust: 0.015 to 0.035 mm

Figure 87



❑ Regrind the valve seats (2) with tool 99305019 (1).

Figure 88



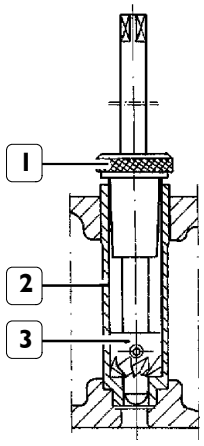
After regrinding the valve seats, use a dial gauge (1) on tool 99370415 to check that:

❑ the valve recessing is from 0.50 to 0.80 mm.

REPLACING THE INJECTOR–HOLDER CASES

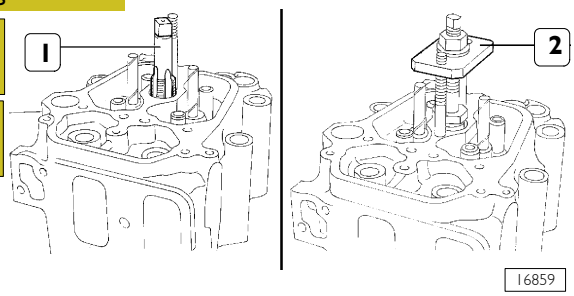
Imperfect coupling between the injector and case, forced into the cylinder head or between the case and the seat on the cylinder head, causes a loss of compression or water leakage.

Figure 89



In the first case, the trouble is eliminated by regrinding the seat of the case (2) with the milling cutter 99394011 (3) and the bushing 99394019 (1) taking account that the electro–injector recessing from the cylinder head face must be from 0.47 to 1.16 mm.

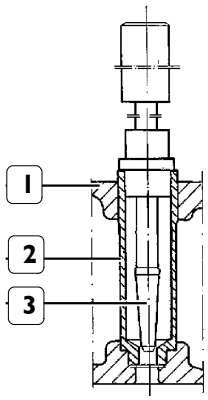
Figure 90



In the second case, it is necessary to replace the case as follows:

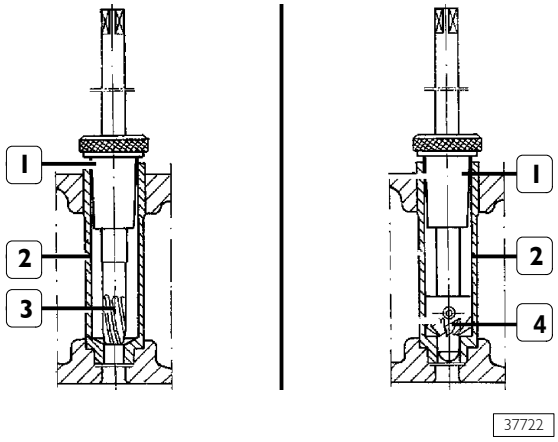
- ❑ thread the case with the set of screw taps 99390800 (1);
- ❑ extract the case from the cylinder head with tool 99342145 (2).

Figure 91



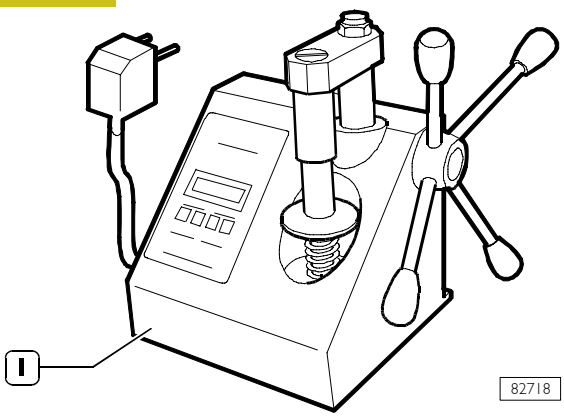
- ❑ Fit the new case (2) in the cylinder head (1) and cold–head its bottom seat, on the cylinder head, with the cold–heading tool 99365063 (3).

Figure 92



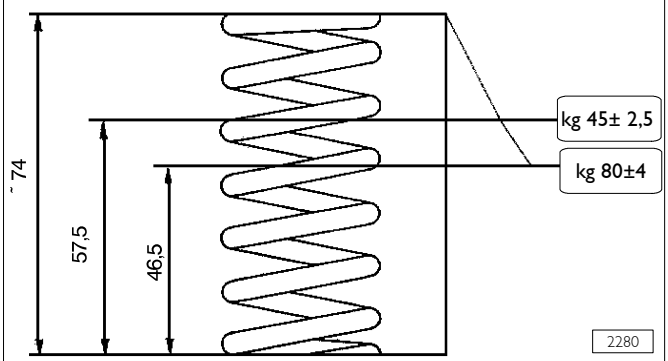
- ❑ Restore the hole in the case (2) with the reamer 99394017 (3) and the bushing 99394019 (1).
  Restore the injector recessing, in relation to the face of the cylinder head, with the milling cutter 99394018 (4) and bushing 99394019 (1) that must be from 0.47 to 1.16 mm.

Figure 93



- ❑ Before mounting, check the flexibility of the valve spring using tool 99305047. Compare the loading and deformation data with those of the new spring indicated in the following diagrams.

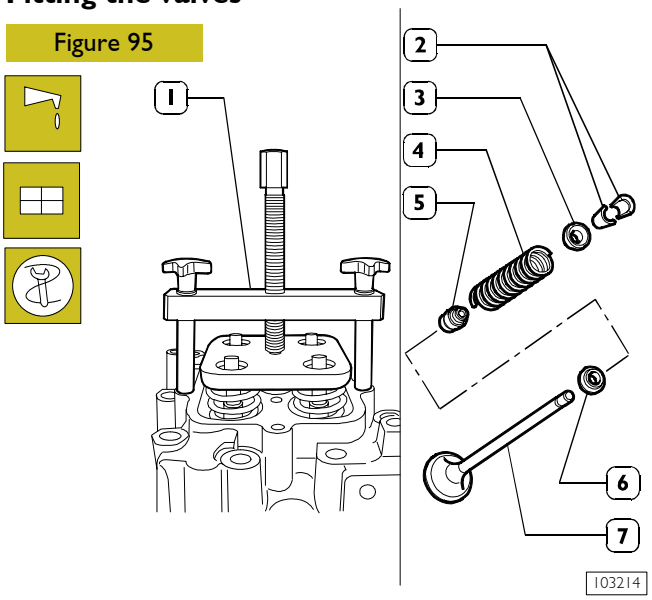
Figure 94



PRINCIPAL DATA FOR CHECKING SPRINGS FOR INTAKE AND EXHAUST VALVE

Fitting the valves

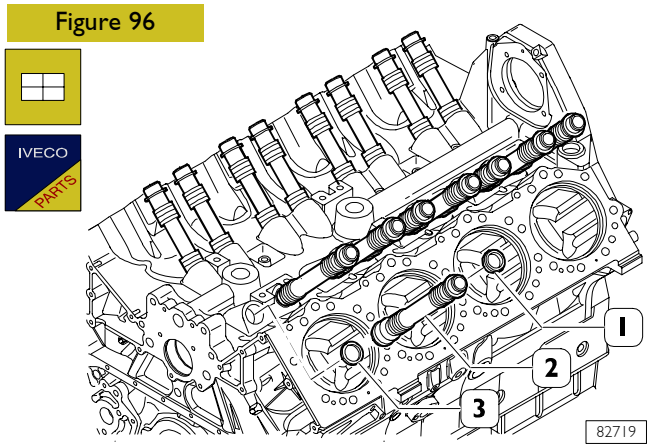
Figure 95



❑ Lubricate the stems of the valves (7) and insert them in their respective valve guides. Position the bottom plates (6), springs (4) and top plates (3) on the cylinder head. Using tool 99368544 (1), compress the springs and fit the retaining cotters (2).

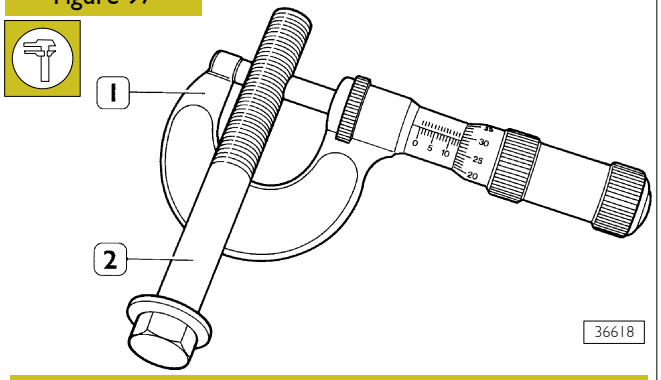
Installing the cylinder head

Figure 96



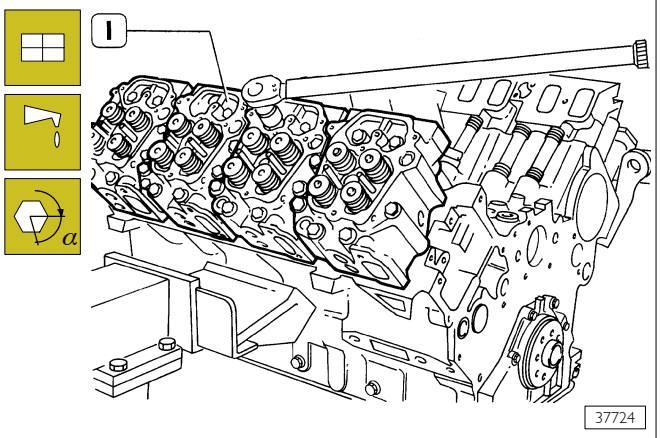
❑ Fit the rings (1 and 3) on the cases (2) and insert them in the cylinder block.

Figure 97



NOTE To reuse the bolts (2) fixing the cylinder heads, check with a micrometer (1) that the diameter of its thread is no less than 14.5 mm.

Figure 98



Fit new cylinder head gaskets. Mount the cylinder heads (1). Lubricate the fixing bolts with "UTDM" oil. Align the cylinder heads with the tool applied in the holes to fasten the exhaust manifolds.

Tighten the cylinder head bolts, following the order shown in the following figure, as follows:

❑ first phase: pre–torque 70 Nm;

Figure 99

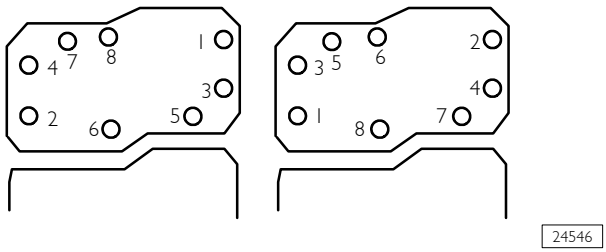
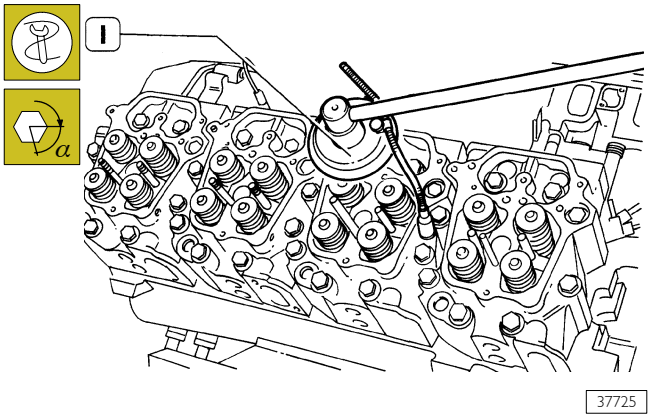


DIAGRAM OF TIGHTENING SEQUENCE FOR CYLINDER HEAD BOLTS

Figure 100



Apply tool 99395216 (1) to the wrench.

❑ second phase: angle 240°;

❑ guard torque: 220 – 390 Nm.

NOTE The screw can be used again as long as the external diameter of the shank is 14.5 mm long in each point.

TIGHTENING TORQUE

COMPONENT		TORQUE	
		Nm	kgm
Cylinder head fixing bolt (*)	pre–torque angle guard–torque	70 240° 220 ÷ 390	7 240° 22 ÷ 39
Crankcase cap fixing bolt (*)	pre–torque angle guard–torque	160 240° 600 ÷ 1000	16 240° 60 ÷ 100
Crankcase cap side fixing bolt (*)	pre–torque angle guard–torque	70 120° 260 ÷ 460	7 120° 26 ÷ 46
Connecting rod cap fixing bolt (*)	pre–torque angle guard–torque	90 60° 170 ÷ 230	9 60° 17 ÷ 23
Engine flywheel fixing bolt (*)	pre–torque angle guard–torque	350 120° 910 ÷ 1600	35 120° 91 ÷ 160
Damper fixing bolt (*)	pre–torque angle guard–torque	160 120° 540 ÷ 960	16 120° 54 ÷ 96
Nut fixing front cover oil sump (M10x1.5)		38 ÷ 45	3.8 ÷ 4.5
Bolt fixing oil sump to front cover and crankcase (M10x1.5)		38 ÷ 45	3.8 ÷ 4.5
Bolt fixing crankcase front gearbox (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing front gearbox and cover to crankcase (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing front cover to front gearbox (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Nut fixing front cover to front gear casing		27 ÷ 33	2.2 ÷ 2.7
Bolt fixing flywheel housing to crankcase (M12x1.75)		86 ÷ 105	8.6 ÷ 10.5
Bolt fixing flywheel casing to crankcase (M14x2)		135 ÷ 165	13.5 ÷ 16.5
Bolt fixing flywheel casing to crankcase (M14x2)		135 ÷ 165	13.5 ÷ 16.5
Bolt fixing gear pin centring (M10x1.5) (*)		45 ÷ 50	4.5 ÷ 5.0
Bolt fixing centring pin (M12x1.75) (*)		100 ÷ 110	10.0 ÷ 11.0
Bolt fixing cylinder head cover (M8x1.25)		20 ÷ 24	2.0 ÷ 2.4
Bolt fixing clearance adjustment cover (M6x1)		7 ÷ 10	0.7 ÷ 1.0
Bolt fixing left and right intake manifold to cylinder head (M10x1.5)		38 ÷ 45	3.8 ÷ 4.5
Bolt fixing exhaust manifold (M10x1.5) (**) N. 12 bolts from front side (on both side) N. 4 bolts from rear side (on both side)	 torque pre–torque torque	 47 ÷ 53 47 ÷ 53 64 ÷ 70	 4.7 ÷ 5.3 4.7 ÷ 5.3 6.4 ÷ 7.0
Bolt fixing thrust plate to crankcase (M8x1.25) (*)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing inlet pipe to the right and left intake manifolds (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing driving gear to driven gear governing camshaft (M10x1.5) (*)		49 ÷ 60	4.9 ÷ 6.0
Bolt fixing rocker–arm assembly to head (M12x1.75) (*)		80 ÷ 89	8.0 ÷ 8.9
Nut adjusting clearance (rocker arms) (M10x1.25) (*)		34 ÷ 44	3.4 ÷ 4.4
Bolt fixing crankshaft rear gear (M8x1.25) (*)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing gear to PTO (M12x1.75) (*)		86 ÷ 105	8.6 ÷ 10.5
Bolt fixing PTO to spacer (M12x1.75)		74 ÷ 90	7.4 ÷ 9.0
Bolt fixing PTO spacer to gearbox (M12x1.75)		74 ÷ 90	7.4 ÷ 9.0
Bolt fixing gear assembly to camshaft (M12x1.75)		86 ÷ 105	8.6 ÷ 10.5
Bolt fixing phonic wheel to gear (M8x1.25)		24 ÷ 30	2.4 ÷ 3.0
Bolt fixing injector bracket to cylinder head (M10x1.5) (*)		32 ÷ 36	3.2 ÷ 3.6
Nut fixing turbo to exaust manifold (M12x1,75)		55 ÷ 65	5,5 ÷ 6,5
Bolt fixing oil delivery pipe to turbo (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7

COMPONENT		TORQUE	
		Nm	kgm
Bolt fixing air conveyor to cooler body (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing air delivery elbows to conveyor (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing oil pump to crankcase (M10x1.5)		38 ÷ 45	3.8 ÷ 4.5
Bolt fixing conveyor to intake manifold (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing bottom pipes discharging oil from turbo–blowers to oil sump (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing suction rose to oil pump (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing suction rose to cap for central support (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing oil pressure adjuster valve (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing oil filter body to crankcase (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing oil filter body to crankcase (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing engine oil cooler body to crankcase (M10x1.5)		25 ÷ 30	2.5 ÷ 3.0
Bolt fixing piston cooling jet (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing oil pressure adjuster valve for piston cooling jet (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Nut fixing coolant pump to front gear cover (M10x1.5)		33 ÷ 40	3.3 ÷ 4.0
Bolt fixing right and left manifold for coolant outlet from cylinder heads (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing elbow to head coolant outlet right manifold (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing head coolant outlet manifold union body (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing coolant pump connecting pipe and cooler cover (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing pipe from main coolant pump to crankcase (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing spacer to front casing (M12x1.75)		74 ÷ 90	7.4 ÷ 9.0
Bolt fixing air compressor spacer		74 ÷ 90	7.4 ÷ 9.0
Bolt fixing high–pressure pump (HPP) to crankcase (M10x1.5) (*)		49 ÷ 60	4.9 ÷ 6.0
High pressure gear pump fixing nut (HPP)		350	35
High pressure gear pump fixing nut (HPP)		160 ÷ 180	35
Bolt fixing ECU to support (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Nut fixing compressor drive gear		160 ÷ 180	16 ÷ 18
Bolt fixing low pressure pump to air compressor (M10x1.5)		42 ÷ 51	4.2 ÷ 5.1
Bolt fixing front manoeuvring hook (M12x1.75)		86 ÷ 105	8.6 ÷ 10.5
Bolt fixing front adjustment hook (M14x2)		153 ÷ 187	15.3 ÷ 18.7
Bolt fixing rear manoeuvring hooks (M14x2)		153 ÷ 187	15.3 ÷ 18.7
Bolt fixing heater to conveyor (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing front engine supports (M14x2)	torque angle guard-torque	65 ÷ 75 60° - 65° 190 ÷ 270	6.5 ÷ 7.5 60° - 65° 19.0 ÷ 27.0
Bolt fixing rear engine supports (M16x2)	torque angle guard-torque	95 ÷ 105 85° - 90° 310 ÷ 420	9.5 ÷ 10.5 85° - 90° 31.0 ÷ 42.0
Bolt fixing air/water radiator support to flywheel casing (M10x1.5)		49 ÷ 60	4.9 ÷ 6.0
Bolt fixing air/water radiator support to radiator (M10x1.5)		49 ÷ 60	4.9 ÷ 6.0
Bolt fixing flywheel speed sensor (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
Bolt fixing phonic wheel speed sensor (M8x1.25)		22 ÷ 27	2.2 ÷ 2.7
High pressure pump / delivery pipe nut (M27x2) (*)		115 ÷ 125	11.8 ÷ 13.2
Delivery / rail pipe nut (M27x2) (*)		85 ÷ 95	10.0 ÷ 11.0
Compensating pipe BETWEEN rail 1 and 2 (M27x2) (*)		85 ÷ 95	10.0 ÷ 11.0
Injector / fuel inlet pipe nut (M22x1.5) (*)		45 ÷ 55	8.0 ÷ 8.5
Rail / fuel inlet pipe nut (M20x1.5) (*)		70 ÷ 80	8.0 ÷ 8.5
Flow limiter (only for loss, disassembly or replacement)		20 + 30°	2.0 + 30°

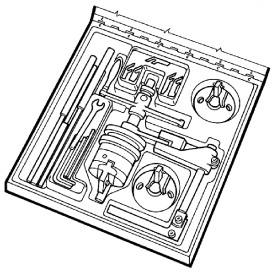
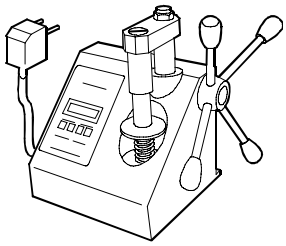
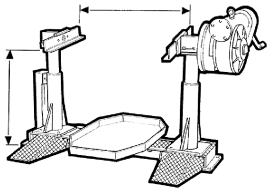
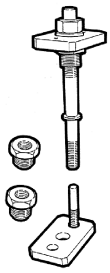
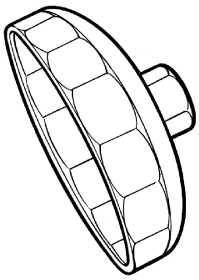
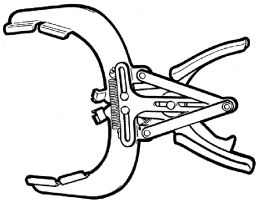
(*) Before tightening, lubricate the bolt with UTDM oil or, alternatively, with engine oil.
(**) Before tightening, lubricate the bolt with grafitato oil.

SECTION 5

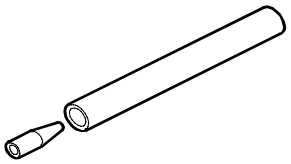
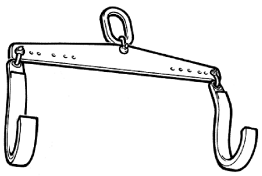
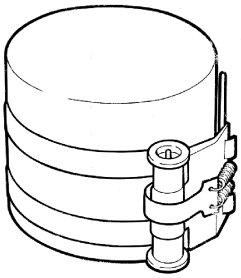
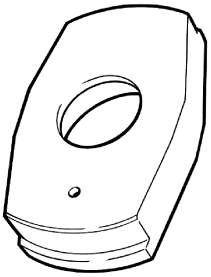
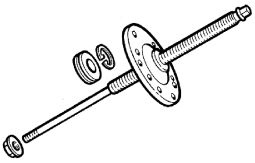
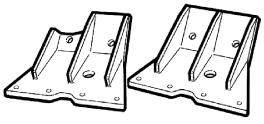
Tools

Page

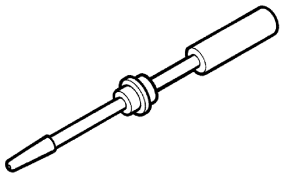
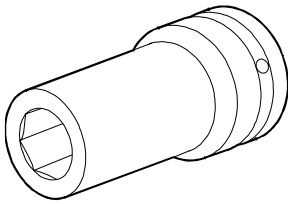
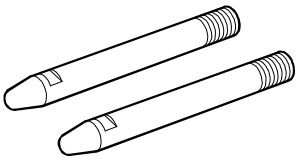
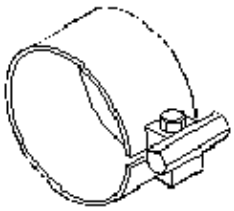
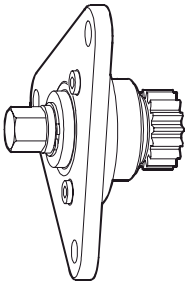
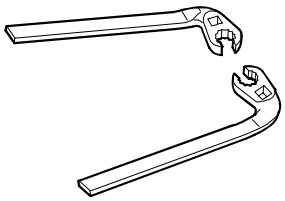
TOOLS

TOOL NO.		DESCRIPTION
99305019		Case with full set of valve seating regrinding tools
99305047		Spring loading control apparatus
99322230		Rotary telescopic stand (capapity 2000 daN, torque 375 daNm)
99342145		Puller to remove injector holder
99360091		Tool for dismantling fuel filter
99360184		Calipers for disassembling and reassembling engine piston rings (105 – 160 mm)

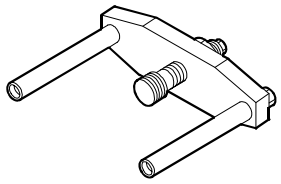
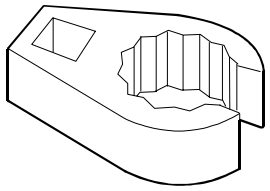
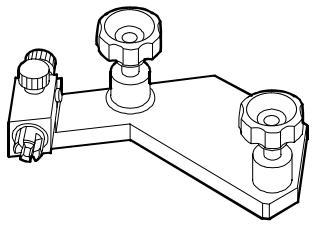
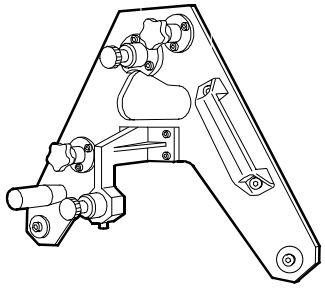
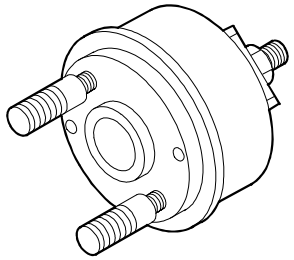
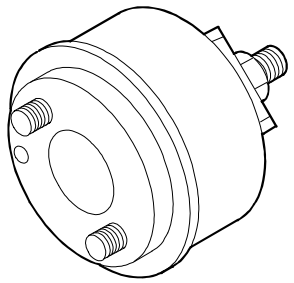
TOOLS

TOOL NO.		DESCRIPTION
99360329		Key for installing gasket on valve guides
99360500		Tool for lifting the output shaft
99360603		Band for inserting piston into cylinder barrel (90 – 175)
99360785		Ring (145 mm) (use with 99360799)
99360799		Tool for disassembling and reassembling cylinder liners (use with special rings)
99361011		Brackets securing engine to rotating overhaul stand 99322230

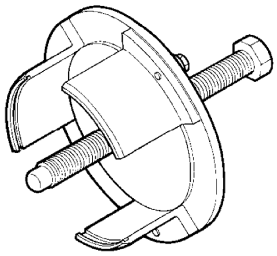
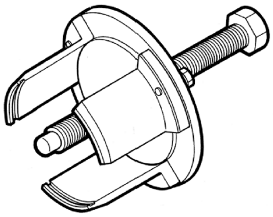
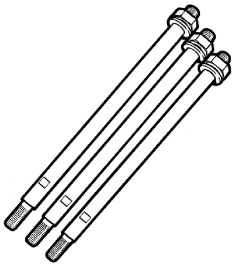
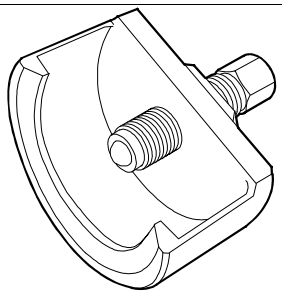
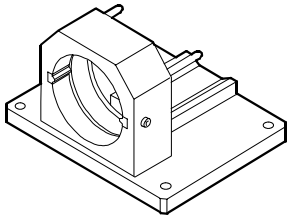
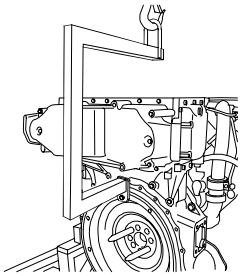
TOOLS

TOOL NO.		DESCRIPTION
99365063		Tool for heading electro–injector seat
99367016		Sleeve key (27 mm) for flywheel fixing bolts
99367019		Guides set (2) M24x2 to mount engine flywheel
99368501		Tool for rotating the engine flywheel
99368502		Tool for rotating engine flywheel (to be used with 99368547)
99368503		Key for adjusting tappet clearance screw (use with 99389831)

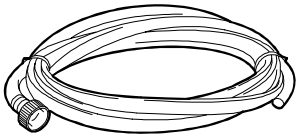
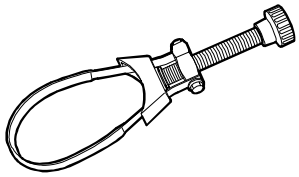
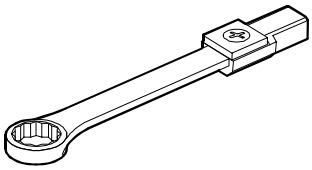
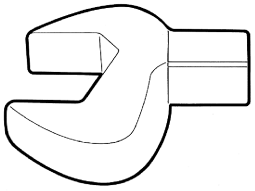
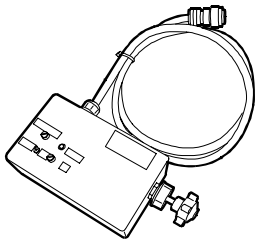
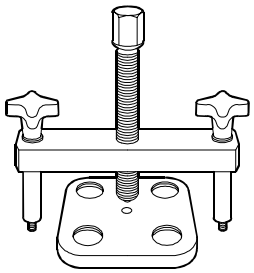
TOOLS

TOOL NO.		DESCRIPTION
99368505		Puller for dismantling injectors
99368506		Key (27 mm) for dismantling fuel injector pipes (use with 99389813)
99368508		Tool for positioning fonic wheel during timing ignition
99368509		Tool for timing camshaft
99368511		Tool for fiitting output shaft rear gasket
99368512		Tool for fiitting output shaft front gasket

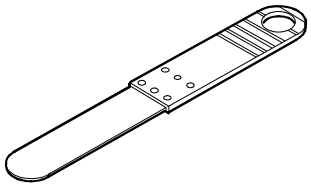
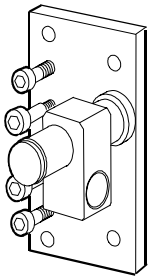
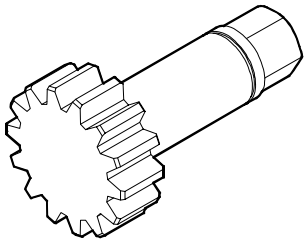
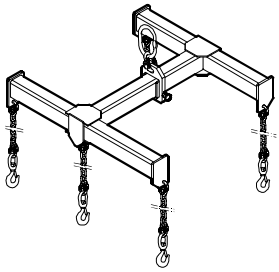
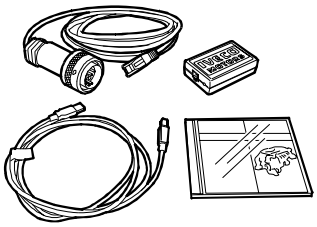
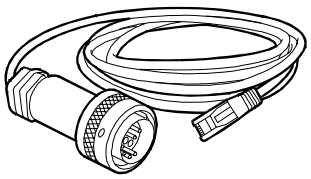
TOOLS

TOOL NO.		DESCRIPTION
99368513		Tool to remove output shaft rear gasket
99368514		Tool to remove output shaft front gasket
99368515		Stud set (use with 99360799)
99368516		Puller to remove the control gear of hight pressure pump (use with 99368517)
99368517		Retainer tool control gear of hight pressure pump
99368533		Support for disassembling and assembling the engine flywheel

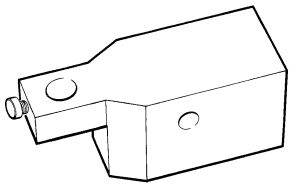
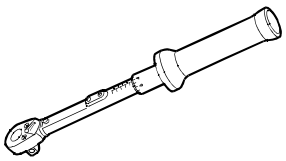
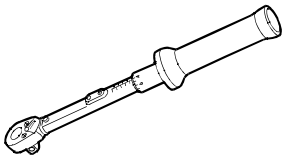
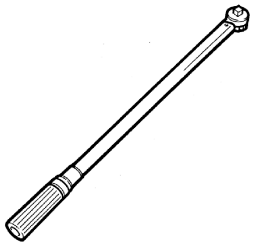
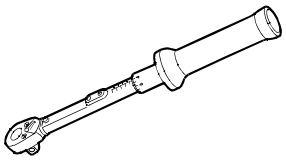
TOOLS

TOOL NO.		DESCRIPTION
99368537		Tool for drain engine oil
99368539		Installer oil filter (engine)
99368540		Ring wrench with 14X18 insert (18mm) for turbine bolts
99368542		Set of 8 insert box wrenches 14X18 (13 - 17 - 18 - 19 - 21- 22 - 24 - 27 - 30 mm)
99368543		ILC simulator for Vector Engine
99368544		Tool for disassembling and reassembling engine valves

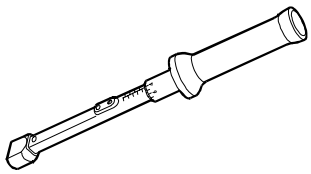
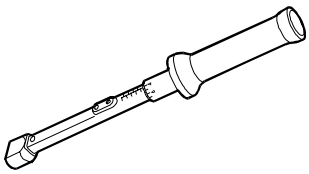
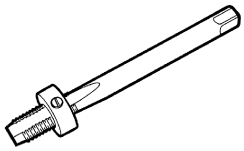
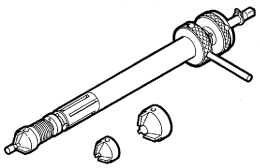
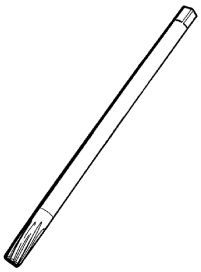
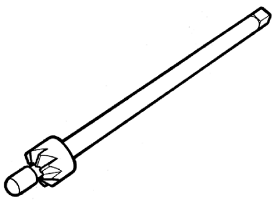
TOOLS

TOOL NO.		DESCRIPTION
99368545		Thickness gauge (0.50 mm) for tappets
99368546		Torque overgear reaction for teeghtening fly wheel bolts (use with 99367016-99389816-99389818)
99368547		Dial gauge base to adjust transmission shaft bearings (use with 99395603)
99368548		Dial gauge base to adjust transmission shaft bearings (use with 99395603)
99368550		Diagnostic interface for Vector engine
99368551		Dial gauge base to adjust transmission shaft bearings (use with 99395603)

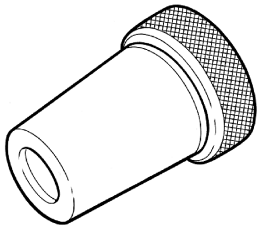
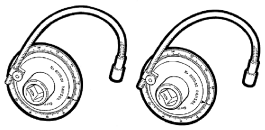
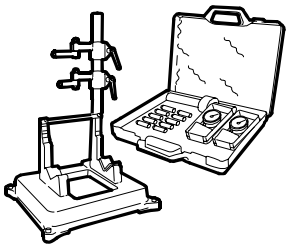
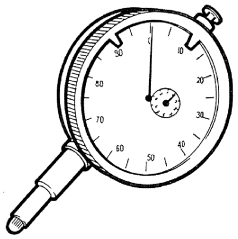
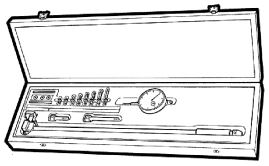
TOOLS

TOOL NO.		DESCRIPTION
99370415		Dial gauge base to adjust transmission shaft bearings (use with 99395603)
99389813		Torque wrench (20 – 120 Nm) with 1/2" square attachment
99389816		Torque overgear x 4 with 3/4" square attachment
99389817		Torque wrench (60 – 320 Nm) with 1/2" square attachment
99389818		Torque wrench (150 – 800Nm) with 3/4" square attachment
99389831		Torque wrench (10 – 60 Nm) with 3/8" square attachment

TOOLS

TOOL NO.		DESCRIPTION
99389832		Torque wrench with 14X18 attachment (60-320 Nm)
99389833		Torque wrench with 14X18 attachment (20-120 Nm)
99390425		Tap for to thread injector seat (disassembly) (M12x1.75)
99394004		End mill for to work the rocker side of injector seat
99394017		Reamer for to work the bottom side fo the injector seat (use with 99394019)
99394018		End mill for to work the rocker side of injector seat (use with 99394019)

TOOLS

TOOL NO.		DESCRIPTION
99394019		Driver bushing
99395216		Pair of measuring devices for angular tightening with 1/2" and 3/4" square attachments
99395363		Complete square for checking rod squaring
99395603		Dial gauge (0 – 10 mm)
99395687		Bore gauge (50 – 178 mm)

Appendix

SAFETY PRESCRIPTIONS

Standard safety prescriptions

Particular attention shall be drawn on some precautions that must be followed absolutely in a standard working area and whose non fulfillment will make any other measure useless or not sufficient to ensure safety to the personnel in-charge of maintenance.

Be informed and inform personnel as well of the laws in force regulating safety, providing information documentation available for consultation.

- ❑ Keep working areas as clean as possible, ensuring adequate aeration.
- ❑ Ensure that working areas are provided with emergency boxes, that must be clearly visible and always provided with adequate sanitary equipment.
- ❑ Provide for adequate fire extinguishing means, properly indicated and always having free access. Their efficiency must be checked on regular basis and the personnel must be trained on intervention methods and priorities.
- ❑ Organize and displace specific exit points to evacuate the areas in case of emergency, providing for adequate indications of the emergency exit lines.
- ❑ Smoking in working areas subject to fire danger must be strictly prohibited.
- ❑ Provide Warnings throughout adequate boards signaling danger, prohibitions and indications to ensure easy comprehension of the instructions even in case of emergency.

Prevention of injury

- ❑ Do not wear unsuitable cloths for work, with fluttering ends, nor jewels such as rings and chains when working close to engines and equipment in motion.
- ❑ Wear safety gloves and goggles when performing the following operations:
  - filling inhibitors or anti-frost
  - lubrication oil topping or replacement
  - utilization of compressed air or liquids under pressure (pressure allowed: ≤ 2 bar)
- ❑ Wear safety helmet when working close to hanging loads or equipment working at head height level.
- ❑ Always wear safety shoes when and cloths adhering to the body, better if provided with elastics at the ends.
- ❑ Use protection cream for hands.
- ❑ Change wet cloths as soon as possible
- ❑ In presence of current tension exceeding 48-60 V verify efficiency of earth and mass electrical connections. Ensure that hands and feet are dry and execute working operations utilizing isolating foot-boards. Do not carry out working operations if not trained for.
- ❑ Do not smoke nor light up flames close to batteries and to any fuel material.
- ❑ Put the dirty rags with oil, diesel fuel or solvents in anti-fire specially provided containers.
- ❑ Do not execute any intervention if not provided with necessary instructions.
- ❑ Do not use any tool or equipment for any different operation from the ones they've been designed and provided for: serious injury may occur.
- ❑ In case of test or calibration operations requiring engine running, ensure that the area is sufficiently aerated or utilize specific vacuum equipment to eliminate exhaust gas. Danger: poisoning and death.

During maintenance

- ❑ Never open filler cap of cooling circuit when the engine is hot. Operating pressure would provoke high temperature with serious danger and risk of burn. Wait unit the temperature decreases under 50°C.
- ❑ Never top up an overheated engine with cooler and utilize only appropriate liquids.
- ❑ Always operate when the engine is turned off: whether particular circumstances require maintenance intervention on running engine, be aware of all risks involved with such operation.
- ❑ Be equipped with adequate and safe containers for drainage operation of engine liquids and exhaust oil.
- ❑ Keep the engine clean from oil tangles, diesel fuel and or chemical solvents.
- ❑ Use of solvents or detergents during maintenance may originate toxic vapors. Always keep working areas aerated. Whenever necessary wear safety mask.
- ❑ Do not leave rags impregnated with flammable substances close to the engine.
- ❑ Upon engine start after maintenance, undertake proper preventing actions to stop air suction in case of runaway speed rate.
- ❑ Do not utilize fast screw-tightening tools.
- ❑ Never disconnect batteries when the engine is running.
- ❑ Disconnect batteries before any intervention on the electrical system.
- ❑ Disconnect batteries from system aboard to load them with the battery loader.
- ❑ After every intervention, verify that battery clamp polarity is correct and that the clamps are tight and safe from accidental short circuit and oxidation.
- ❑ Do not disconnect and connect electrical connections in presence of electrical feed.
- ❑ Before proceeding with pipelines disassembly (pneumatic, hydraulic, fuel pipes) verify presence of liquid or air under pressure. Take all necessary precautions bleeding and draining residual pressure or closing dump valves. Always wear adequate safety mask or goggles. Non fulfillment of these prescriptions may cause serious injury and poisoning.

- ❑ Avoid incorrect tightening or out of couple. Danger: incorrect tightening may seriously damage engine's components, affecting engine's duration.
- ❑ Avoid priming from fuel tanks made out of copper alloys and/or with ducts not being provided with filters.
- ❑ Do not modify cable wires: their length shall not be changed.
- ❑ Do not connect any user to the engine electrical equipment unless specifically approved by Iveco Motors.
- ❑ Do not modify fuel systems or hydraulic system unless Iveco specific approval has been released. Any unauthorized modification will compromise warranty assistance and furthermore may affect engine correct working and duration.

For engines equipped with electronic gearbox:

- ❑ Do not execute electric arc welding without having priory removed electronic gearbox.
- ❑ Remove electronic gearbox in case of any intervention requiring heating over 80°C temperature.
- ❑ Do not paint the components and the electronic connections.
- ❑ Do not vary or alter any data filed in the electronic gearbox driving the engine. Any manipulation or alteration of electronic components shall totally compromise engine assistance warranty and furthermore may affect engine correct working and duration.

Respect of the Environment

- ❑ Respect of the Environment shall be of primary importance: all necessary precautions to ensure personnel's safety and health shall be adopted.
- ❑ Be informed and inform the personnel as well of laws in force regulating use and exhaust of liquids and engine exhaust oil. Provide for adequate board indications and organize specific training courses to ensure that personnel is fully aware of such law prescriptions and of basic preventive safety measures.
- ❑ Collect exhaust oils in adequate specially provided containers with hermetic sealing ensuring that storage is made in specific, properly identified areas that shall be aerated, far from heat sources and not exposed to fire danger.
- ❑ Handle the batteries with care, storing them in aerated environment and within anti-acid containers. Warning: battery exhalation represent serious danger of intoxication and environment contamination.