CURSOR SERIES

C9

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.

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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.

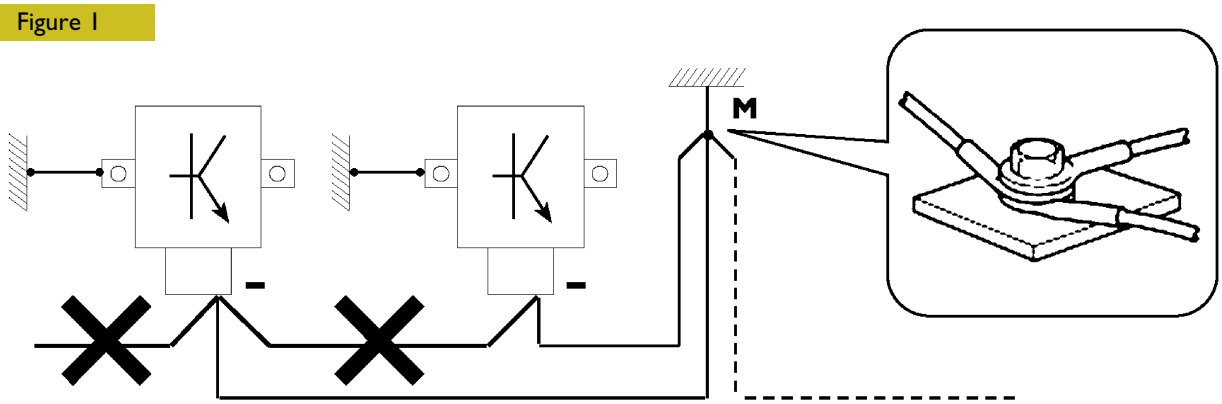
Bonding and screening

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:

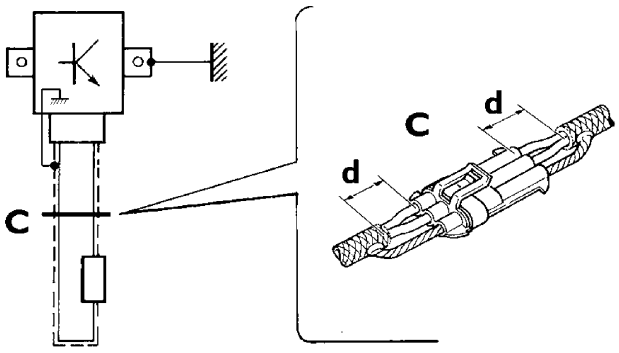
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative 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



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

F2C CURSOR ENGINES

PREFACE TO USER'S GUIDELINE MANUAL

Section 1 describes the F2C 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:

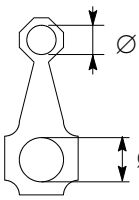
1. Mechanical part, related to the engine overhaul, limited to those components with different characteristics based on the relating specific duty.
2. Electrical part, concerning wiring harness, electrical and electronic equipment with different characteristics based on the relating specific duty.
3. 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.
The appendix contains a list of the general safety regulations to be respected by all installation and maintenance engineers in order to prevent serious accidents taking place.

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

Graph and symbols

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Warning Note
	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

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Replacement Original spare parts
	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

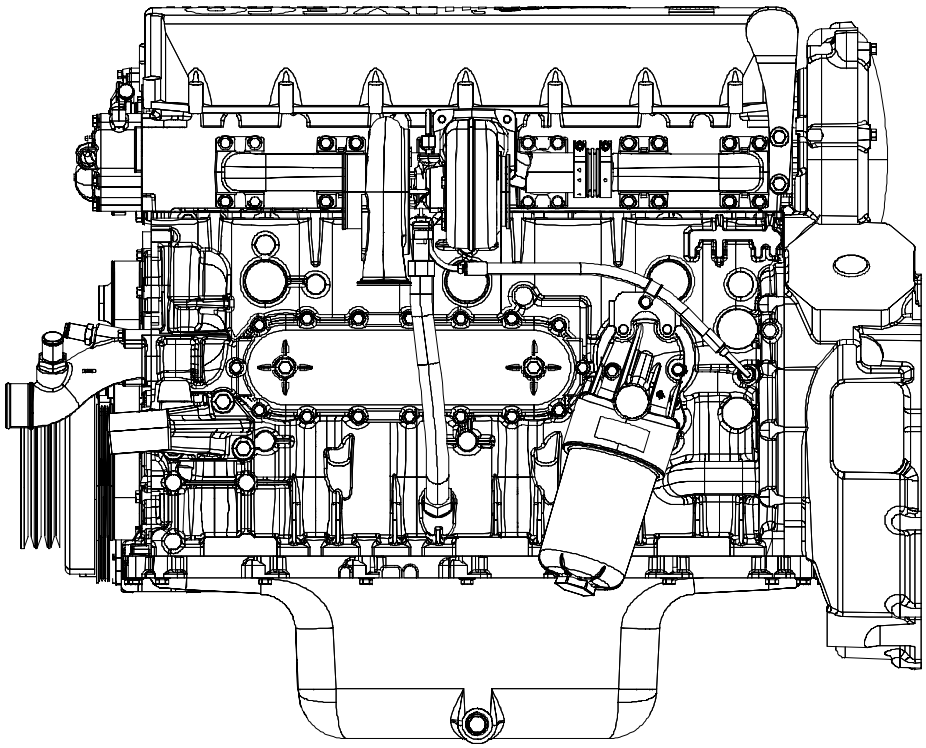
General Specifications

TECHNICAL CODE

Technical Code
F2CE9684A*E004
F2CE9684B*E001
F2CE9684C*E001
F2CE9684D*E001
F2CE9684C*E002
F2CE9684E*E002
F2CE9684H*E003
F2CE9684L*E005

VIEWS OF THE ENGINE (for types: F2CE9684A*E004 - F2CE9684B*E001 - F2CE9684C*E001 - F2CE9684D*E001 - F2CE9684C*E002 - F2CE9684E*E002)

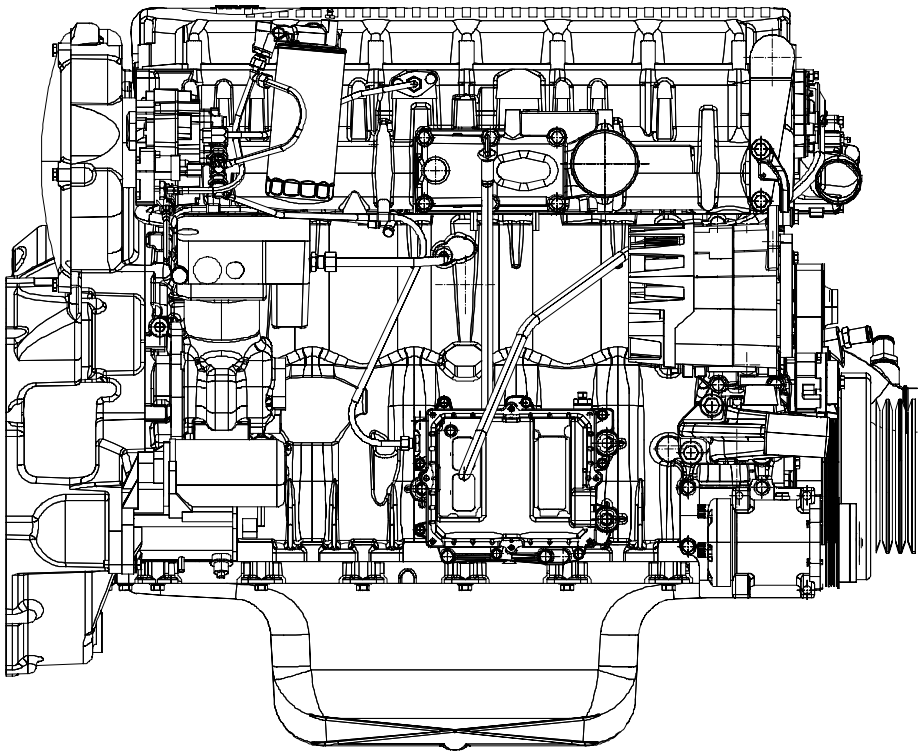
Figure 1



113047

LEFT-HAND SIDE VIEW

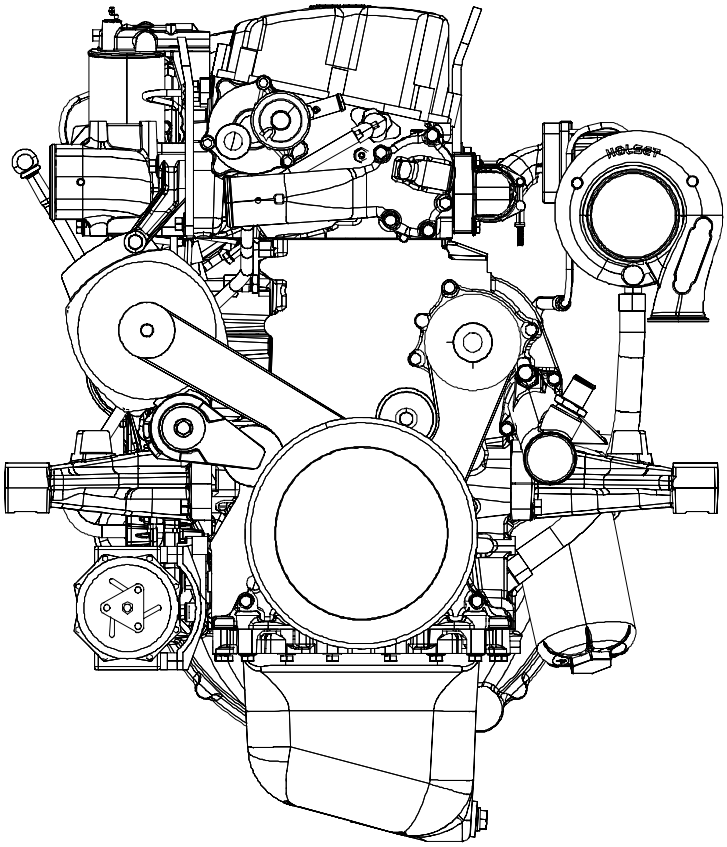
Figure 2



113048

RIGHT-HAND SIDE VIEW

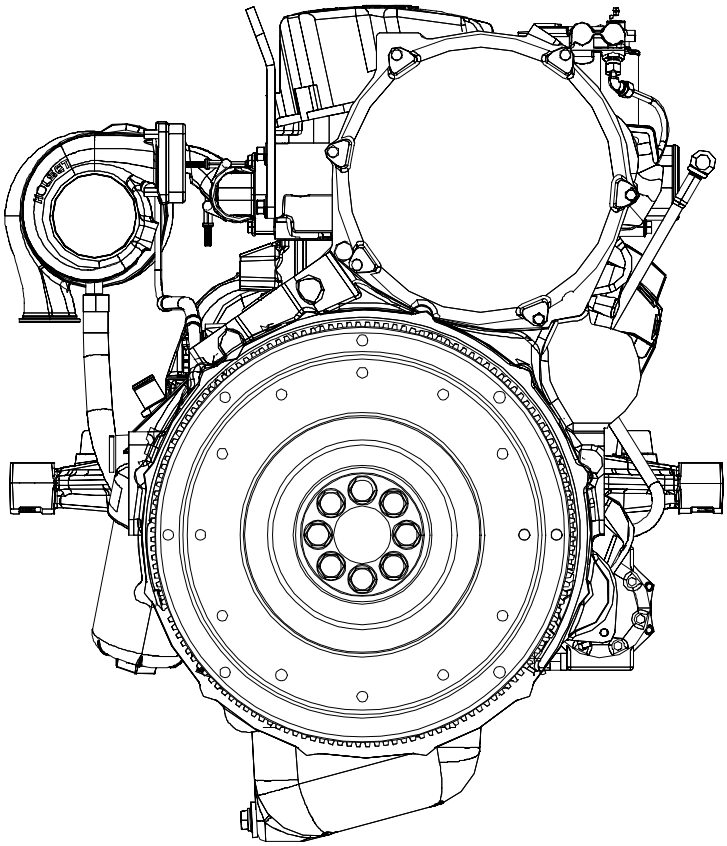
Figure 3



113049

FRONT HAND SIDE VIEW

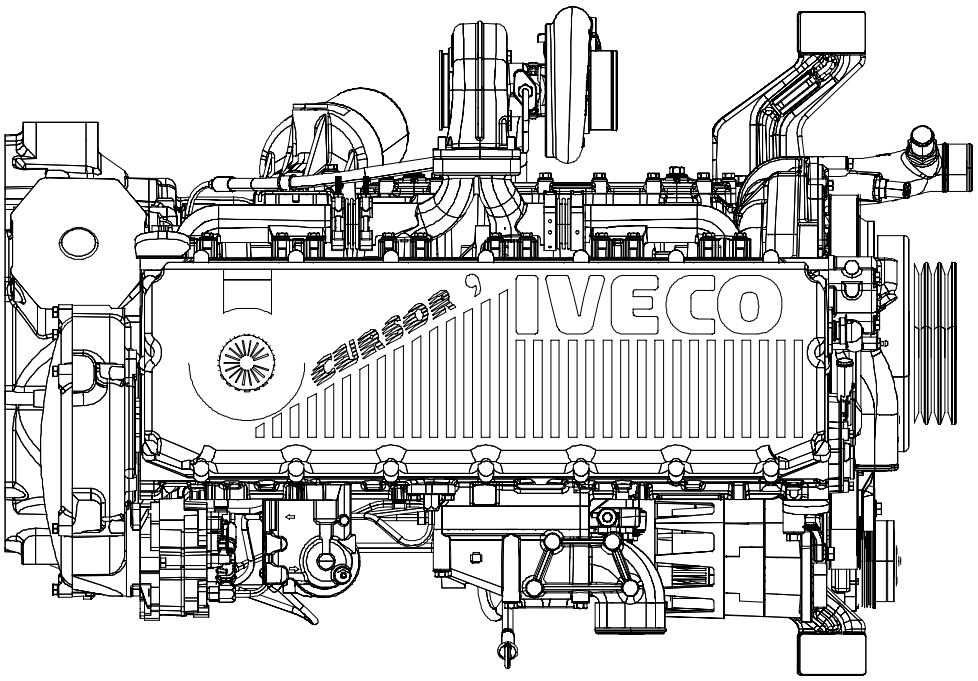
Figure 4



113050

REAR HAND SIDE VIEW

Figure 5

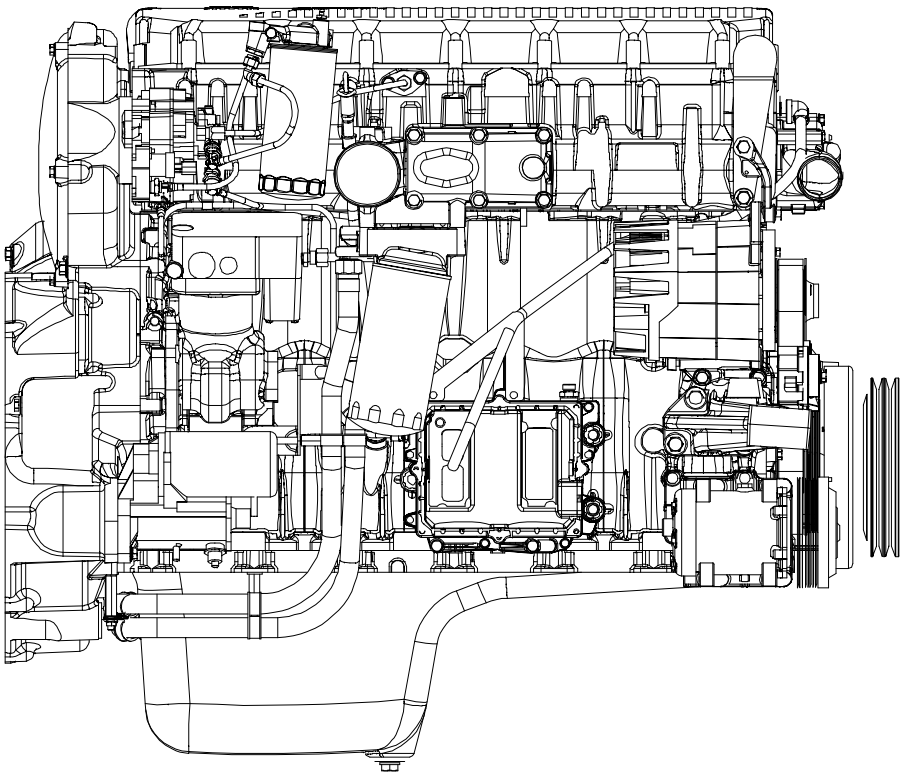


113051

TOP VIEW

VIEWS OF THE ENGINE (for types: F2CE9684L*E005)

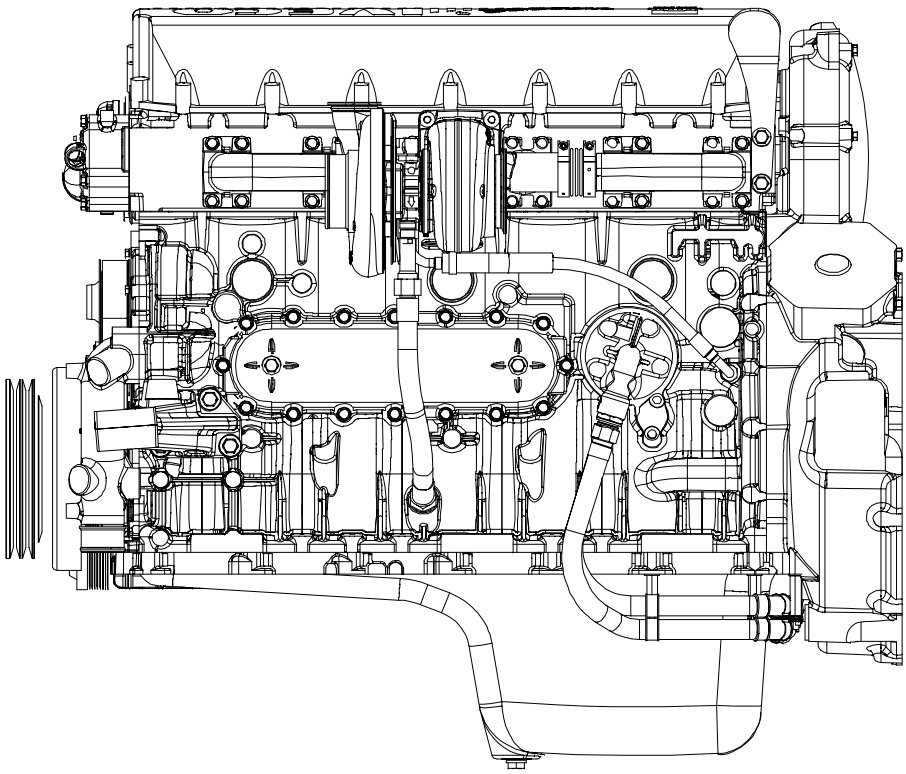
Figure 6



114203

RIGHT-HAND SIDE VIEW

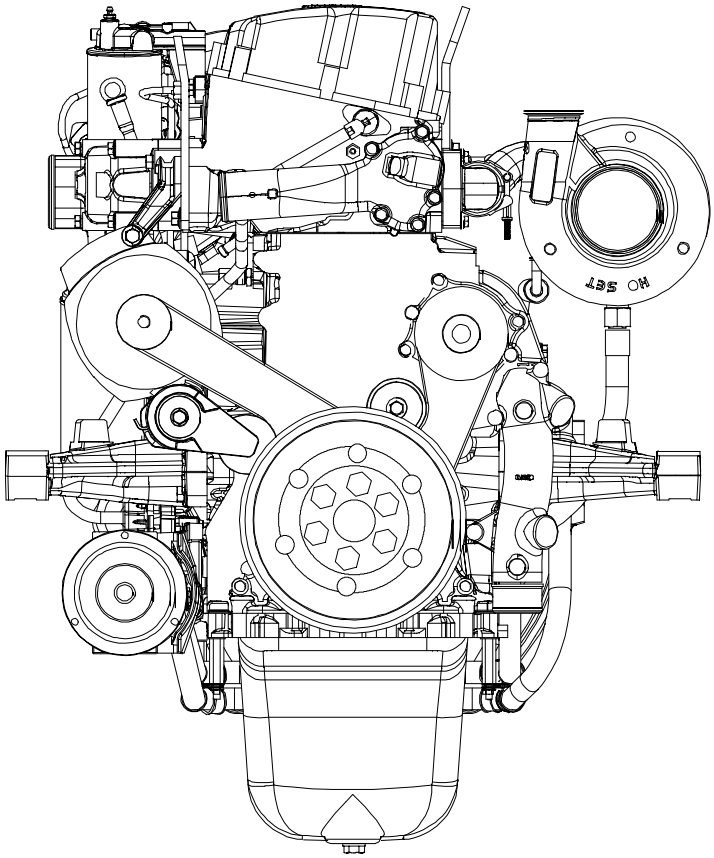
Figure 7



114204

LEFT-HAND SIDE VIEW

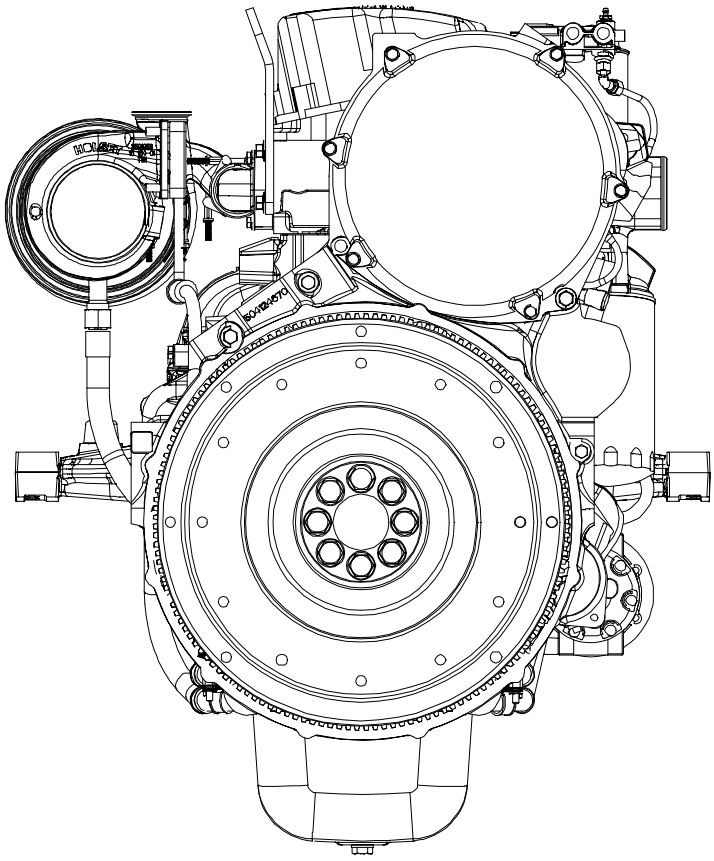
Figure 8



114205

FRONT-HAND SIDE VIEW

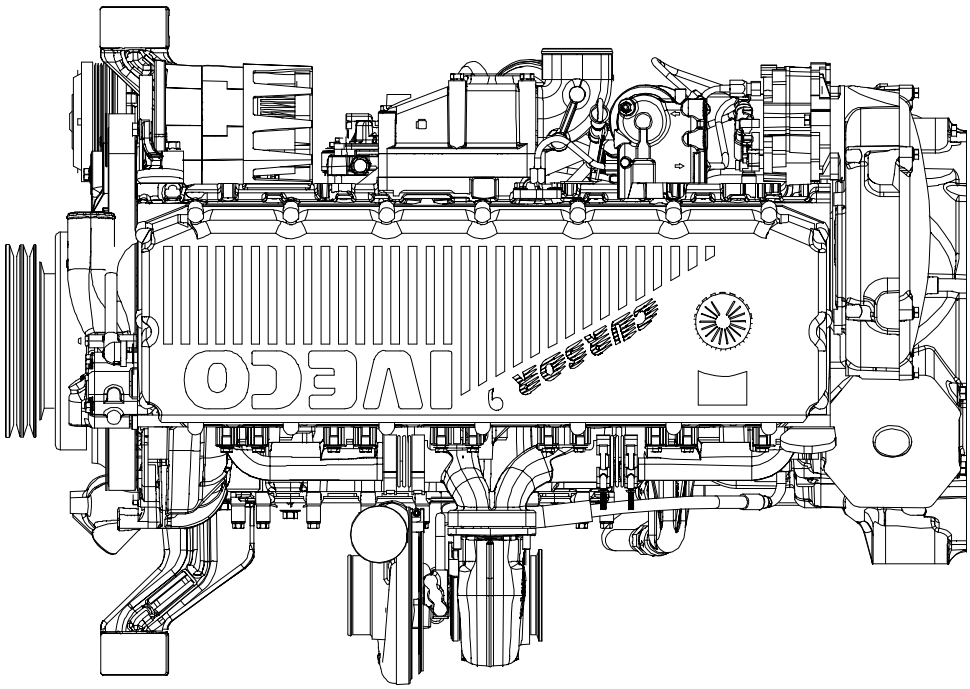
Figure 9



104206

REAR-HAND SIDE VIEW

Figure 10

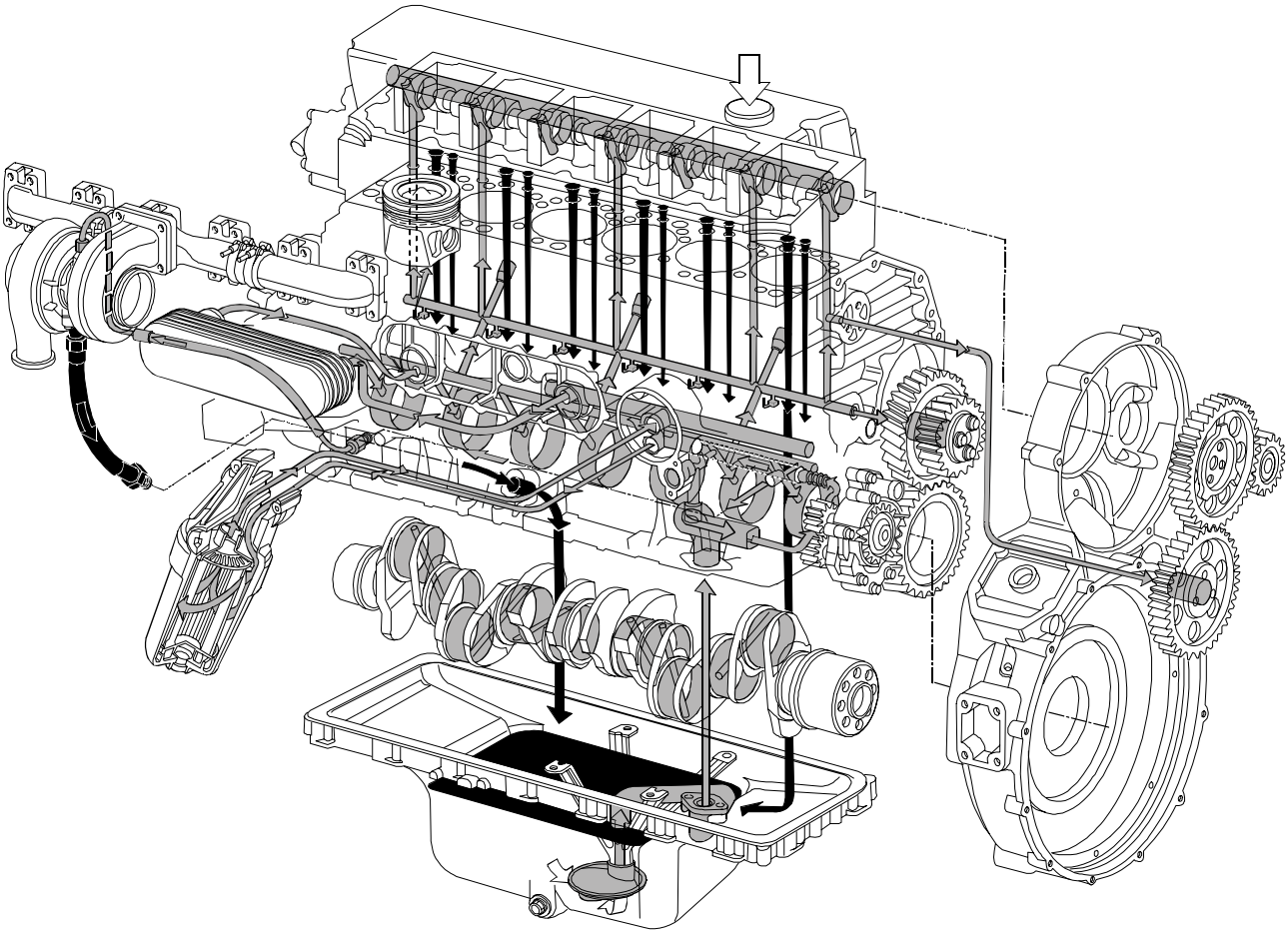


114207

TOP SIDE VIEW

LUBRICATION DIAGRAM

Figure 11



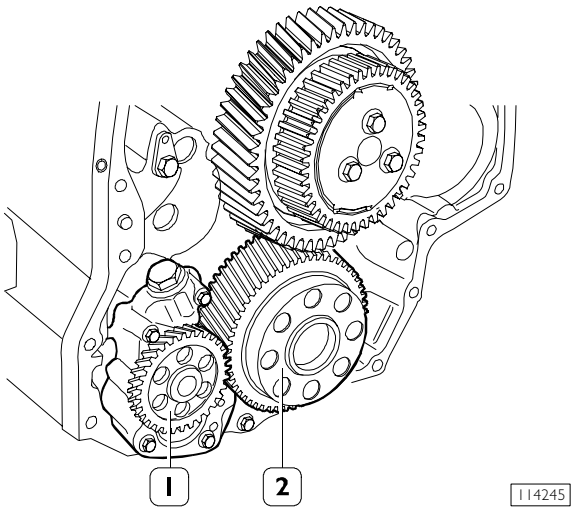
Dropping oil

Pressure oil

114244

Oil pump

Figure 12

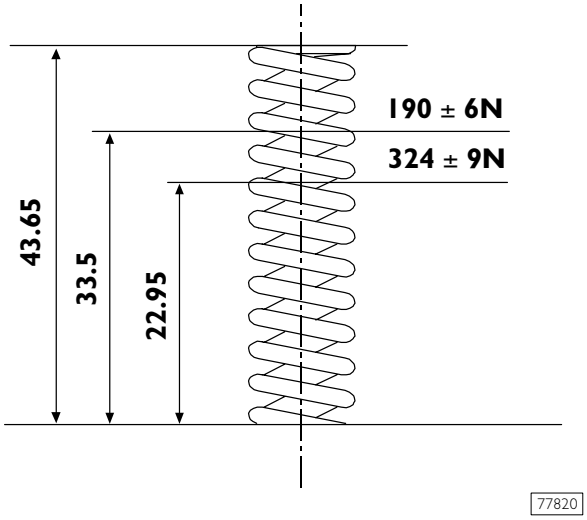


The oil pump (1) cannot be overhauled. On finding any damage, replace the oil pump assembly.

See under the relevant heading for replacing the gear (2) of the crankshaft.

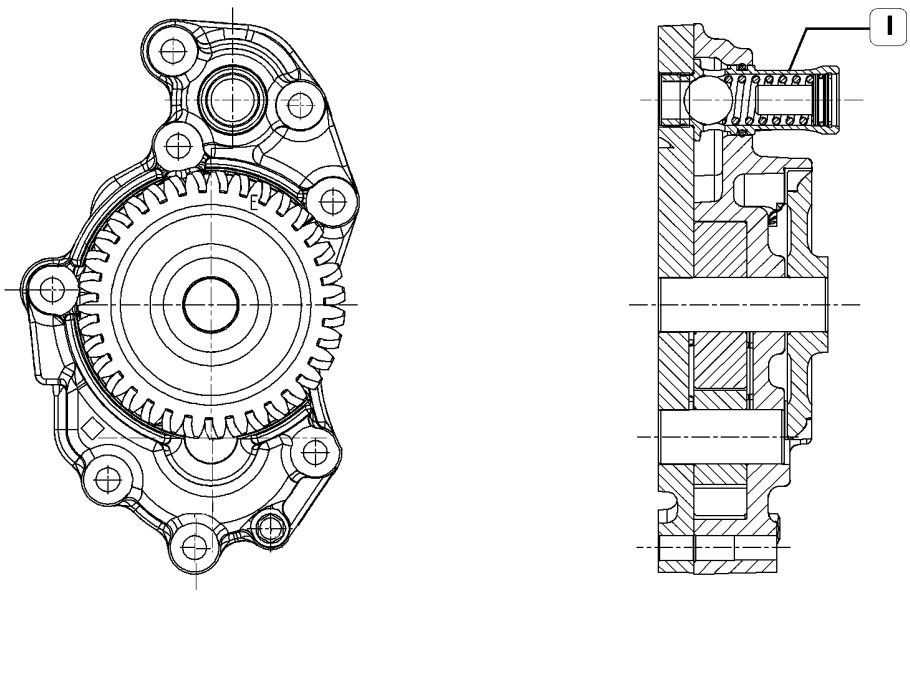
Overpressure valve

Figure 14



MAIN DATA TO CHECK THE OVERPRESSURE VALVE SPRING

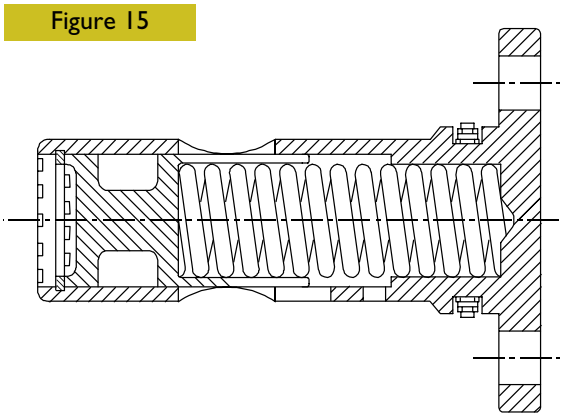
Figure 13



OIL PUMP CROSS-SECTION
1. Overpressure valve – Start of opening pressure 10.1 ±0.7 bars.

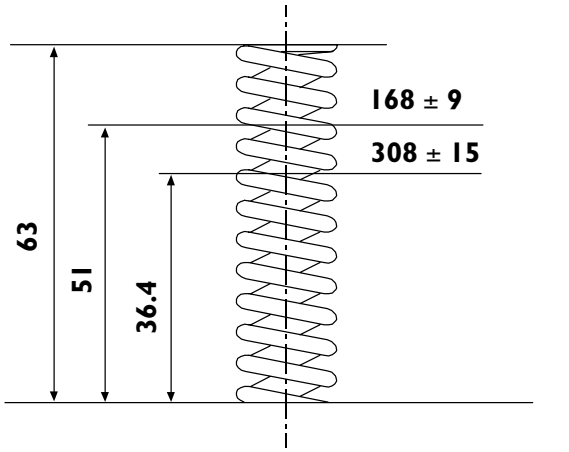
Oil pressure control valve

Figure 15



The oil pressure control valve is located on the left-hand side of the crankcase.
Start of opening pressure 5 bars.

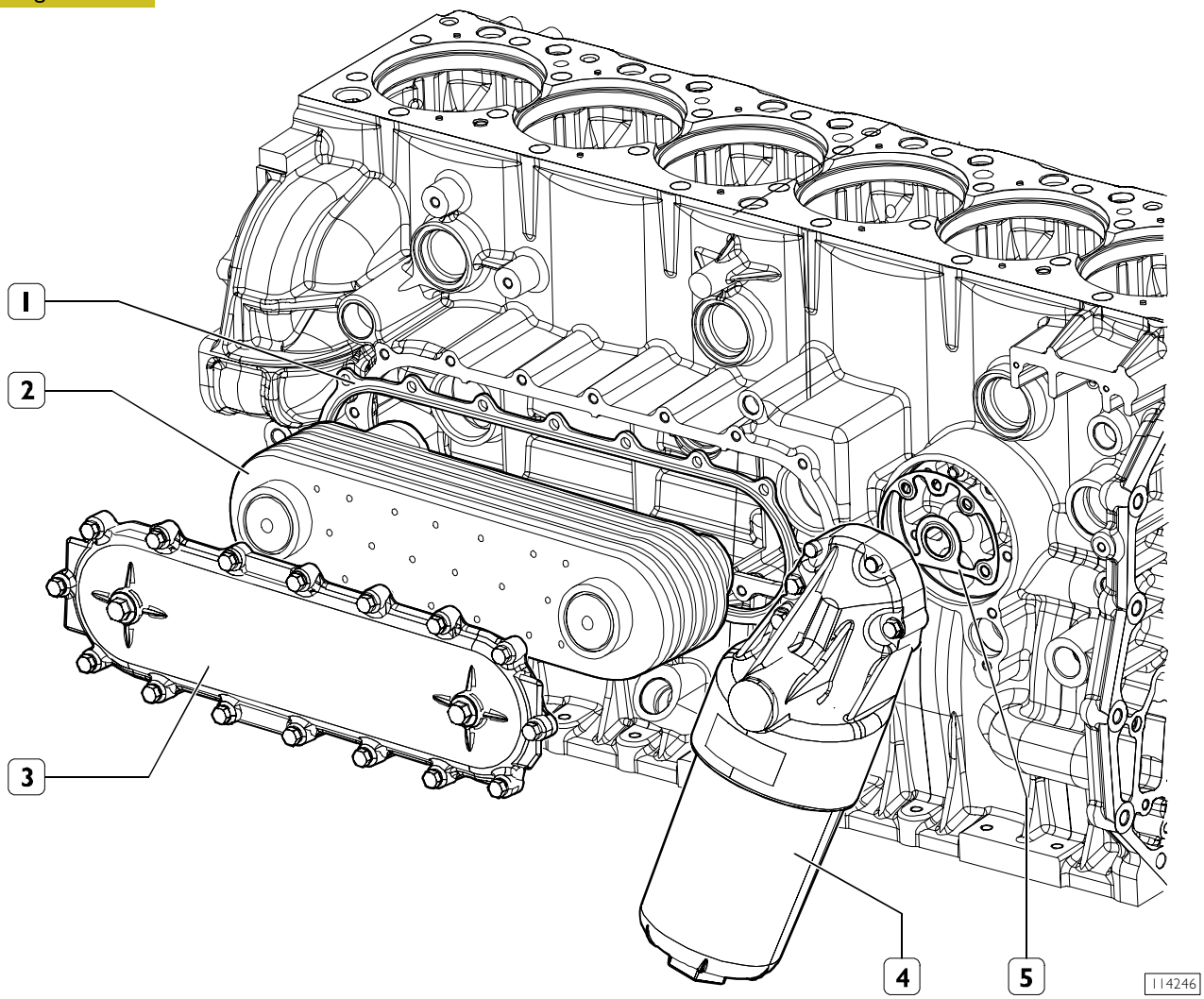
Figure 16



MAIN DATA TO CHECK THE OIL PRESSURE CONTROL VALVE SPRING

Heat exchanger

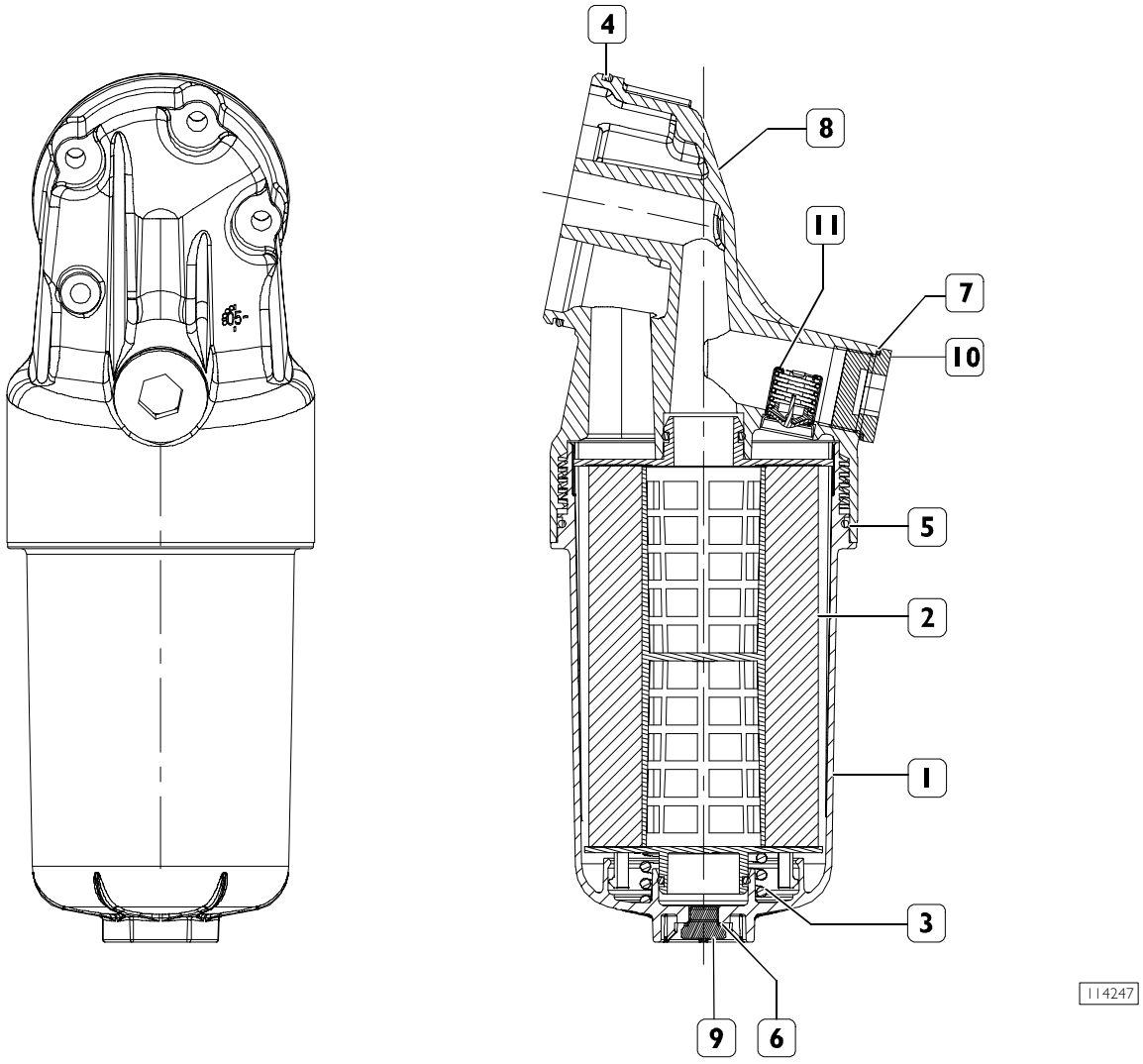
Figure 17



1. Exchanger seal - 2. Internal heat exchanger element - 3. Cover - 4.Oil filter - 5. Oil filter seal

ENGINE OIL FILTER

Figure 18



1. Closure cap - 2. Cartridge - 3. Spring - 4. Support O-ring - 5. Tank O-ring - 6. Washer - 7. Washer - 8. Support - 9. Plug M14x1.5 - 10. Plug M38x1.5 - 11. By-pass valve 3.4 bars.

Characteristics

1. Max working pressure: 13 bars
2. Working temperature: - 30° C ÷ + 120° C
3. By-pass valve opening value: 3,4 ± 0,3 bar

Lock torques

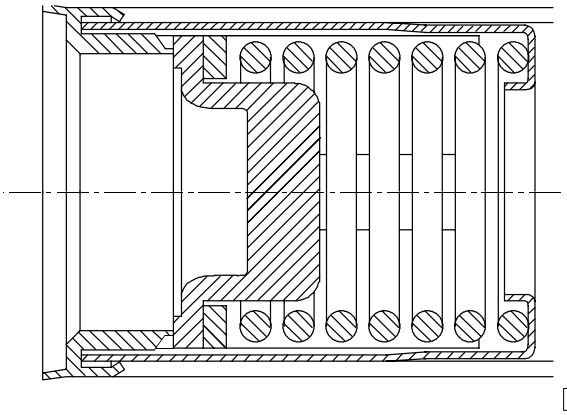
Cap (part 1):	60 ± 5 Nm
Plug (part 9):	30 ± 5 Nm
Plug (part 10):	90 ± 5 Nm

Installation rule

Use threadlock for plug (part 10).

Filter by-pass valve

Figure 19



Valve opens quickly at 3,4 ± 0,3 bar pressure.

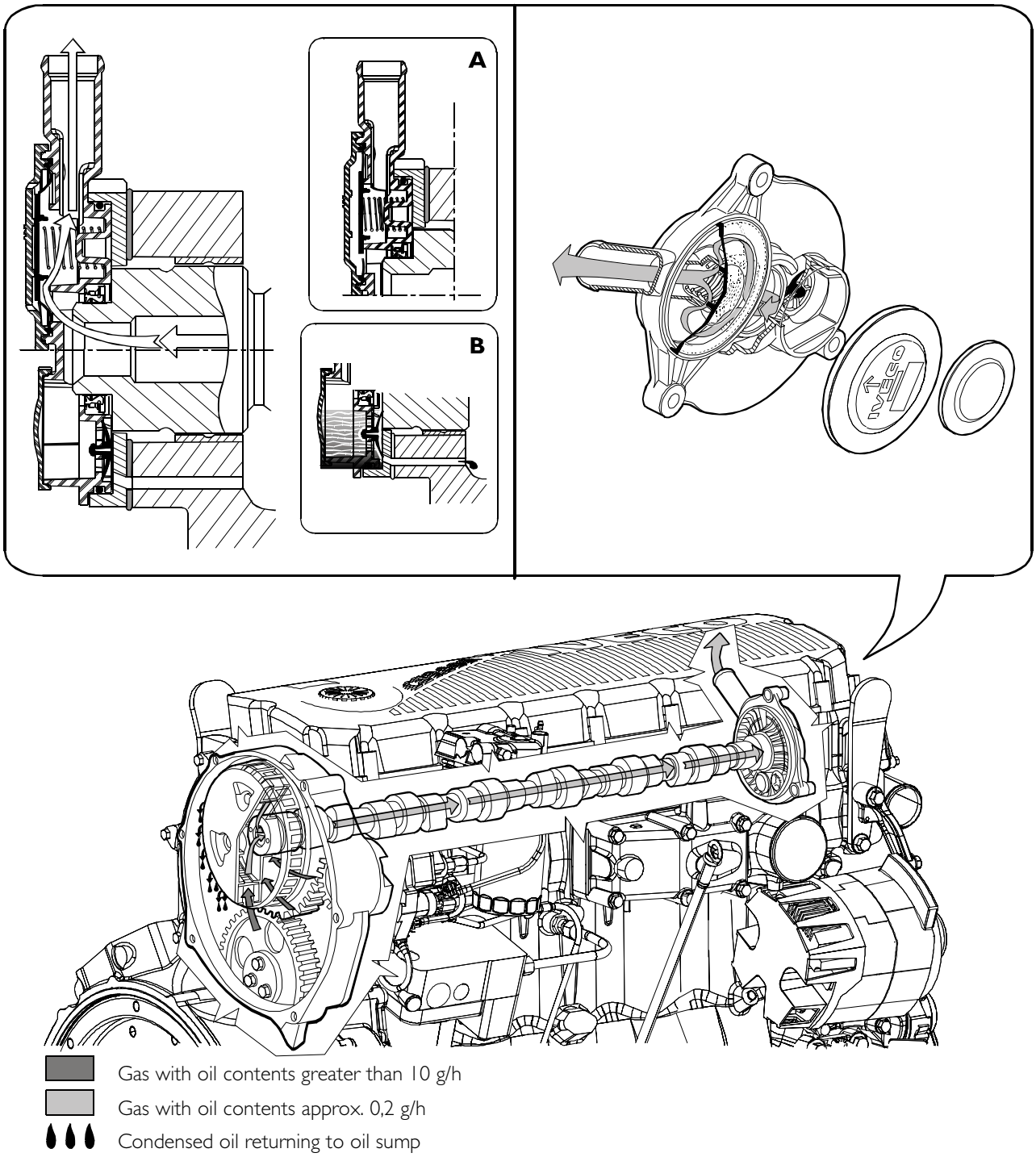
Oil fume recycle (Blow-by)

Part of gas produced by combustion during engine operation leaks through piston elastic ring openings into sump, mixing with oil fumes in sump.

This mixture, conveyed upward, is partially separated from oil by a device located in timing cover upper part and introduced in air intake circuit.

The device mainly consists of a rotary filter secured on propeller shaft and by a front cover housing normally closed valves controlling mixture flow.

Figure 20



COOLING

Description

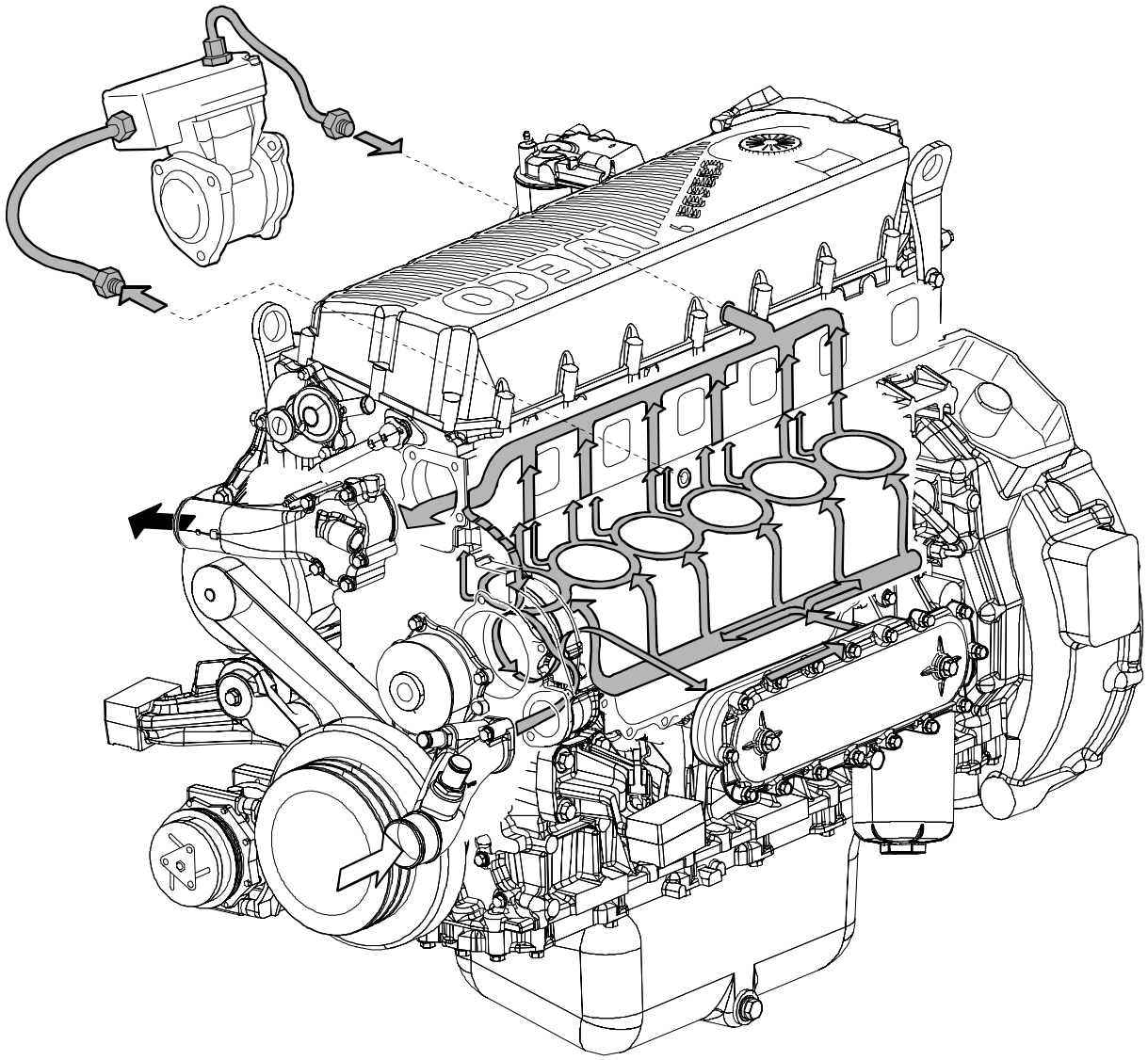
The engine cooling system is of the closed-circuit, forced circulation type.
It consists mainly of the following components:

- ❑ expansion tank, not supplied (by IVECO);
- ❑ a heat exchanger to cool down lubrication oil;
- ❑ a water pump with centrifugal system incorporated in the cylinder block;
- ❑ fan, not supplied;
- ❑ a 2-way thermostat controlling the coolant circulation.

Operation

The water pump is actuated by the crankshaft through a poli-V belt and sends coolant to the cylinder block, especially to the cylinder head (bigger quantity). When the coolant temperature reaches and overcomes the operating temperature, the thermostat is opened and from here the coolant flows into the radiator and is cooled down by the fan.
The pressure inside the system, due to temperature change, is adequately controlled through the expansion vessel.

Figure 21



Water flowing out of the thermostat

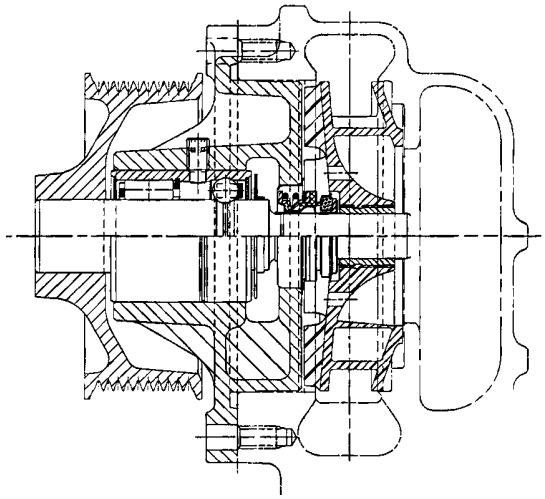
Water circulating in the engine

Water flowing into the pump

114249

Water pump

Figure 22



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CROSS-SECTION OF THE WATER PUMP

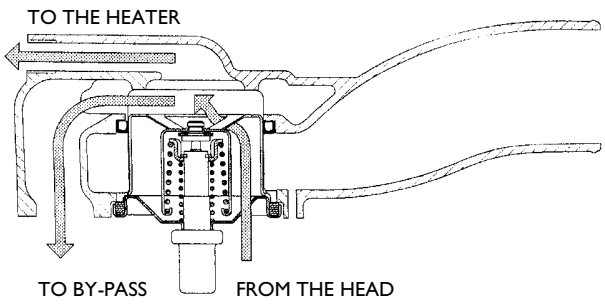
The water pump consists of: rotor, shaft with bearing, T-gasket and drive pulley with dust shield.

NOTE Check that the pump body has no cracks or water leakage; if it does, replace the entire water pump.

Thermostat

View of thermostat operation

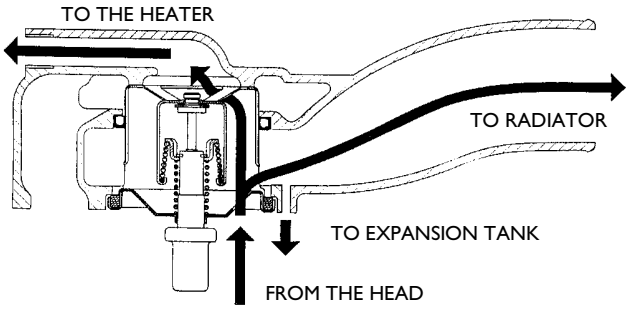
Figure 23



45357

Water circulating in the engine

Figure 24



45358

Water leaving the thermostat

Check the thermostat works properly; replace it if in doubt.

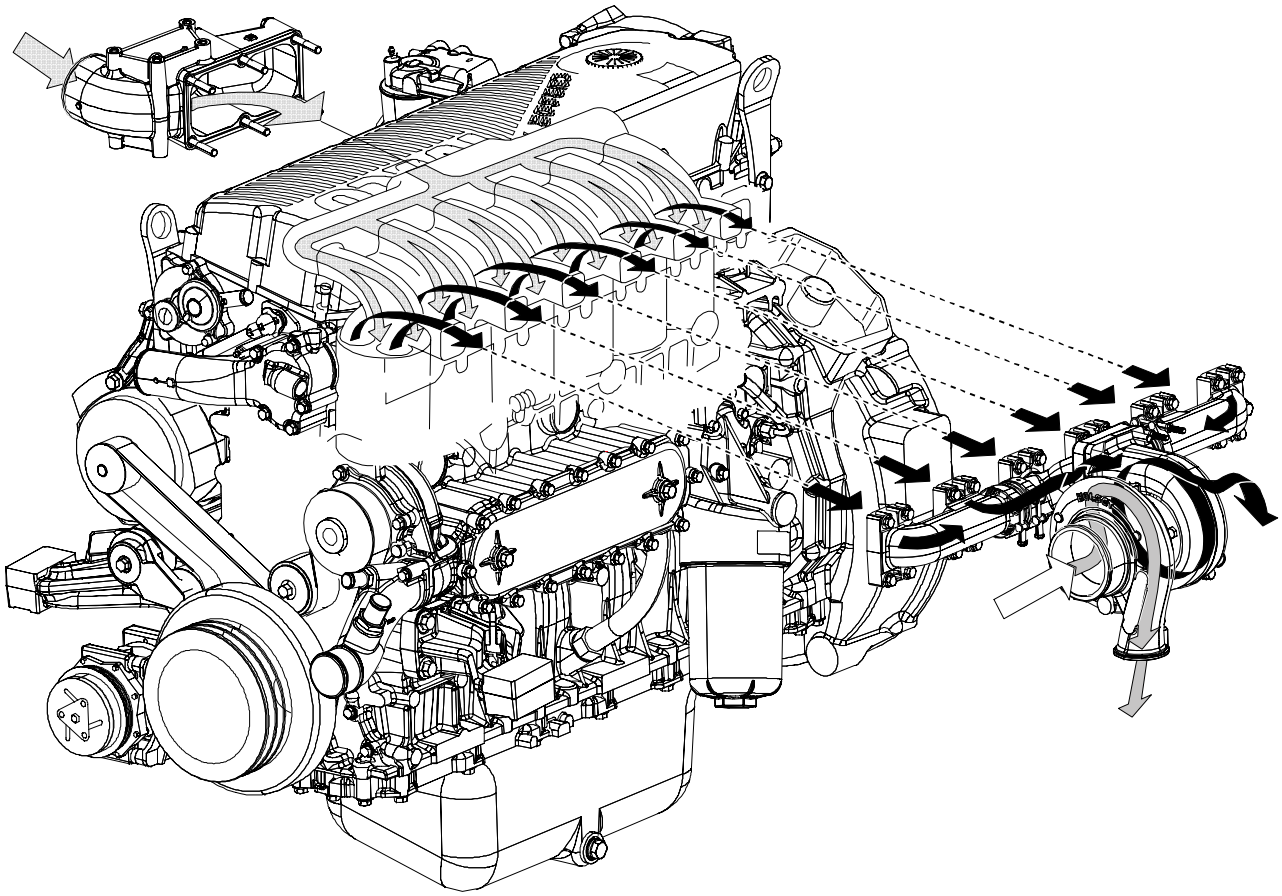
Temperature of start of travel 84°C ±2°C.
Minimum travel 15 mm at 94°C ±2°C.

TURBOCHARGING

The turbocharging system consists of:

- ❑ air filter;
- ❑ Wastegate turbocharger.

Figure 25



Exhaust gas

Compressed air (hot)

Inlet air

Intake compressed air

114251

EGR EXHAUST GAS RECYCLE SYSTEM

The exhaust gas can be partially recycled to cylinders to reduce maximum temperature values of combustion that produce nitrogen oxides (NOx).

The exhaust gas recycle system (EGR) reduces combustion temperature and therefore is an efficient NOx emission control system.

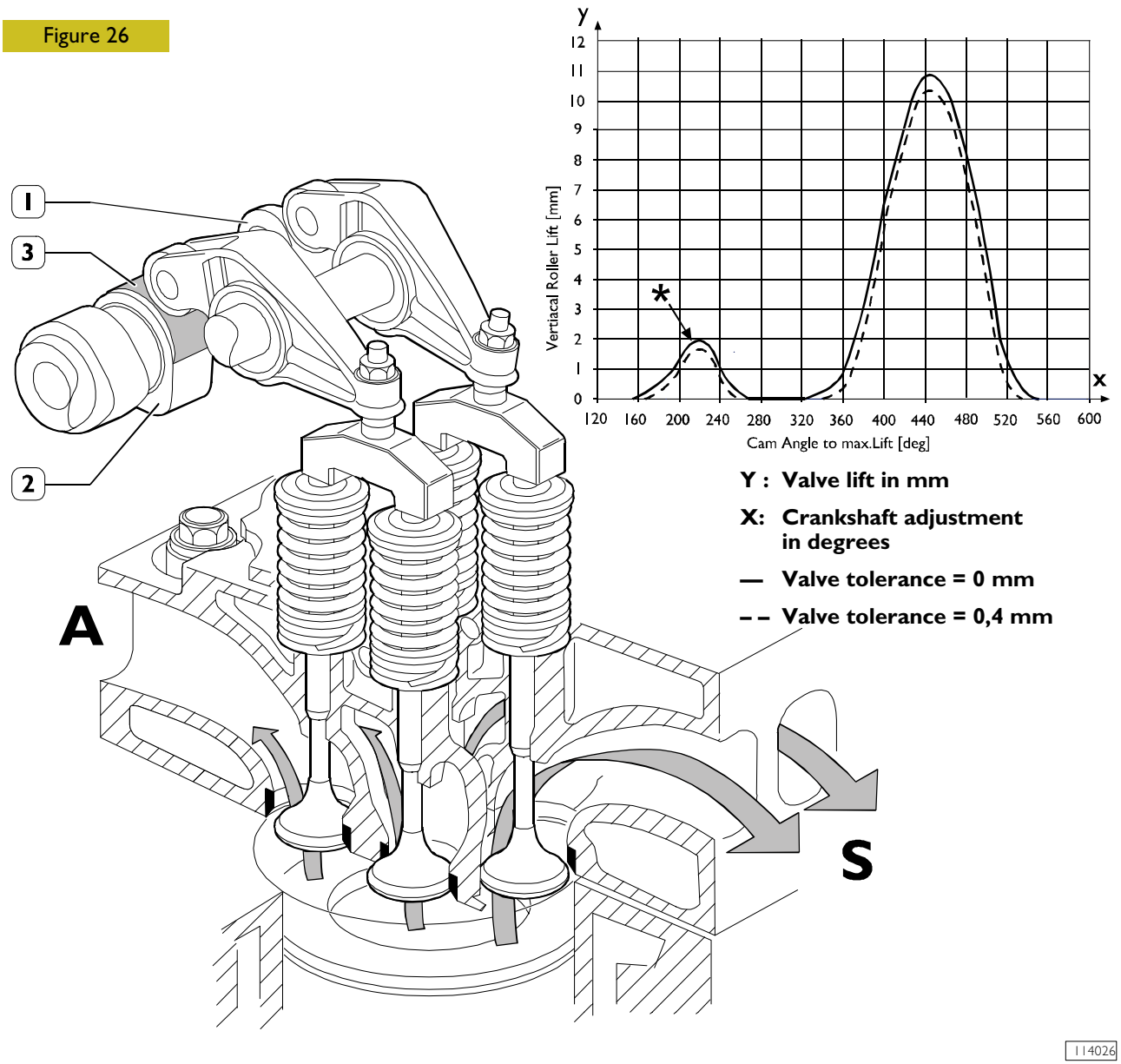
INTERNAL EGR OPERATING ON SUCTION VALVES

The specific design of suction cams of the internal EGR system allows part of exhaust gas to be recycled to engine cylinders.

This type of EGR, called internal EGR, is not equipped with any electronic control, the system is always active. Its configuration requires no additional parts such as control valves, pipelines or heat exchangers therefore engine profile remains unchanged.

Besides main lobe, suction cam has an additional lobe (3) as to configuration without EGR. During concerned cylinder exhaust phase, this lobe allows a shaft advanced opening of intake valve (*). In this way, part of the exhaust gas is trapped in the suction duct and later, during cylinder suction phase, this gas is recycled to cylinder inlet for combustion phase.

Figure 26



1. Exhaust cams - 2. Suction cams - 3. EGR lobe - S. Exhaust ducts - A. Intake ducts

SECTION 2

Fuel

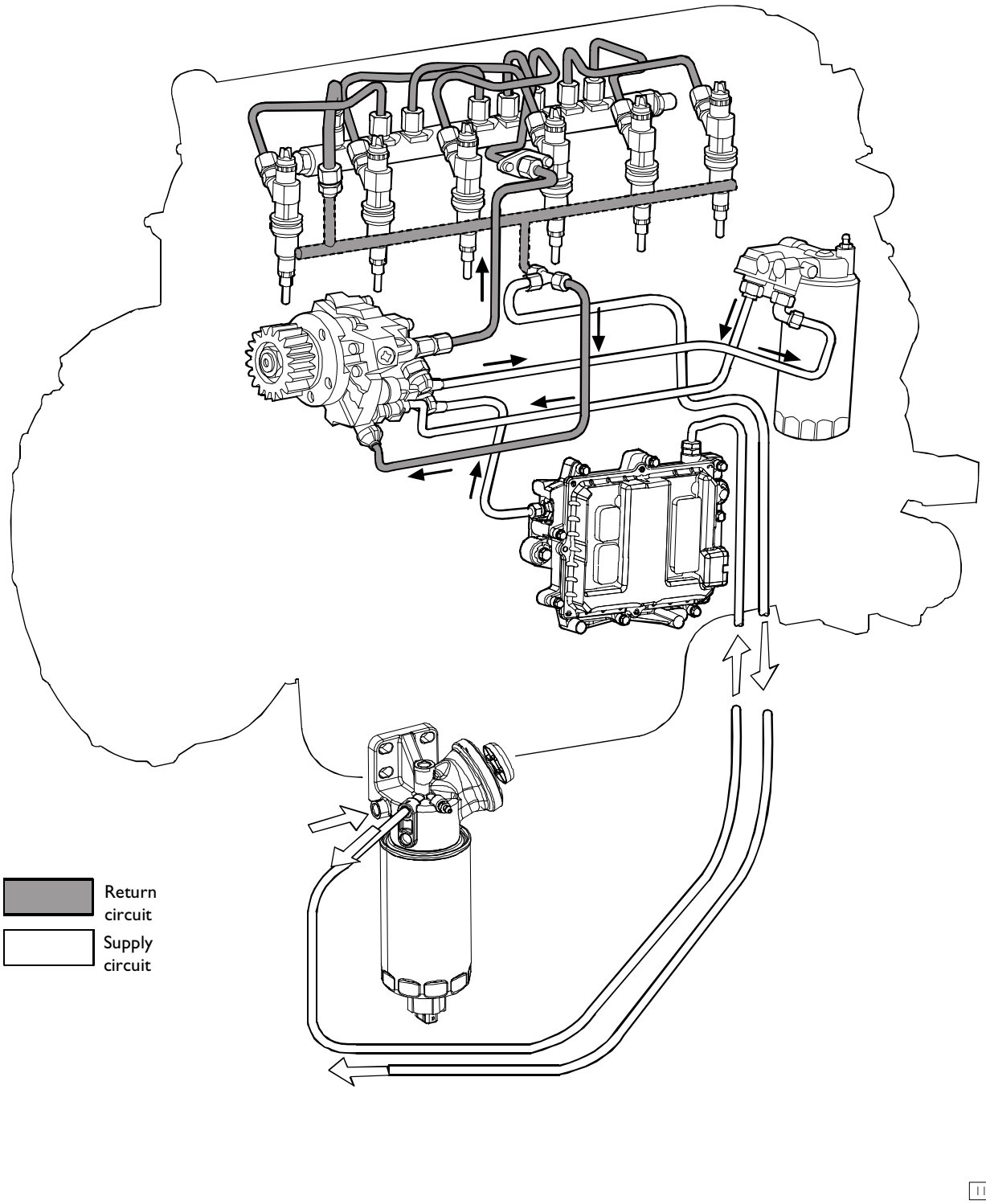
SUPPLY

The Common Rail supply system is equipped with a special pump that maintains fuel at constant high pressure regardless from phase and cylinder under injection and accumulated in an common duct shared by all electric injectors.

Therefore, fuel at injection pressure, calculated by ECU, is always available at electric injection inlet.

When the solenoid valve of an injector is energized by ECU, in related cylinder the injection of fuel taken directly from the rail takes place.

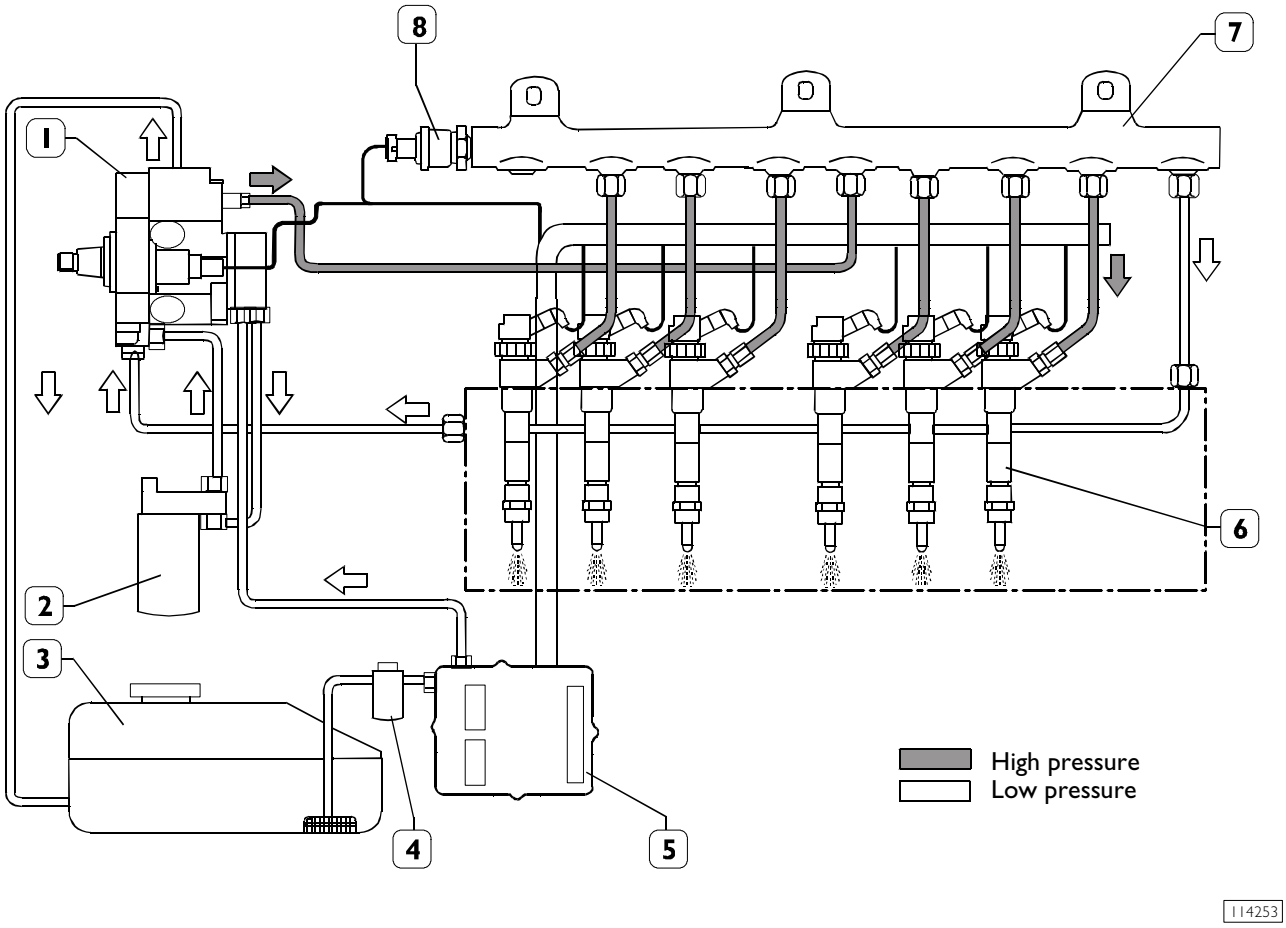
Figure 1



114252

FUEL SUPPLY DIAGRAM

Figure 2



1. High-pressure pump - 2. Fuel filter - 3.Tank - 4. Fuel pre-filter - 5.ECU - 6. Electric injectors - 7.Common Rail - 8. Pressure sensor

After high-pressure pipeline installation, during the following 20 hours of work, frequently check engine oil level.

(IT MUST NOT INCREASE).

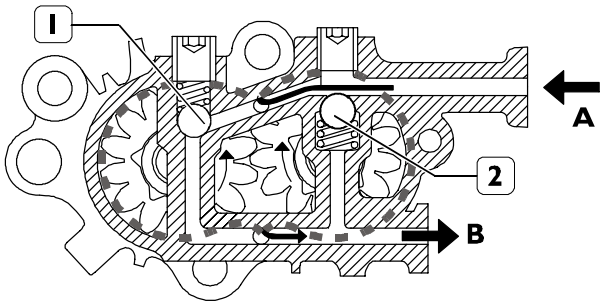
MECHANICAL SUPPLY PUMP

Gear pump, fitted on the rear side of the high pressure pump and used to supply it.

It is controlled by high pressure pump shaft.

Normal operating conditions

Figure 3

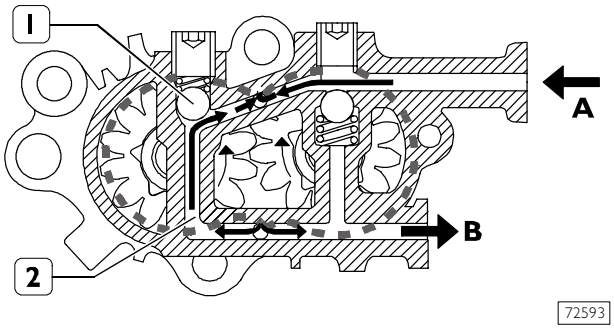


72592

A Fuel inlet from tank, B fuel outlet to filter, 1-2 by-pass valves in close position

Overpressure condition at outlet

Figure 4

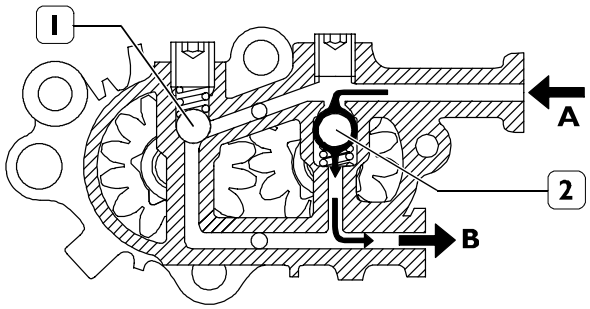


72593

The by-pass valve (1) cuts in when overpressure is generated at outlet B. The existing pressure, overcoming valve spring (1) elastic strength, makes inlet and outlet communicating through duct (2).

Drain conditions

Figure 5



72594

The by-pass valve (2) cuts in when, with engine off, the fuel system shall be filled through the priming pump. In this situation the by-pass valve (1) stays closed whereas by-pass valve (2) opens due to inlet pressure, and fuel is drained out through **B**.

NOTE The mechanical supply pump cannot be replaced individually, therefore it cannot be removed from the high pressure pump.

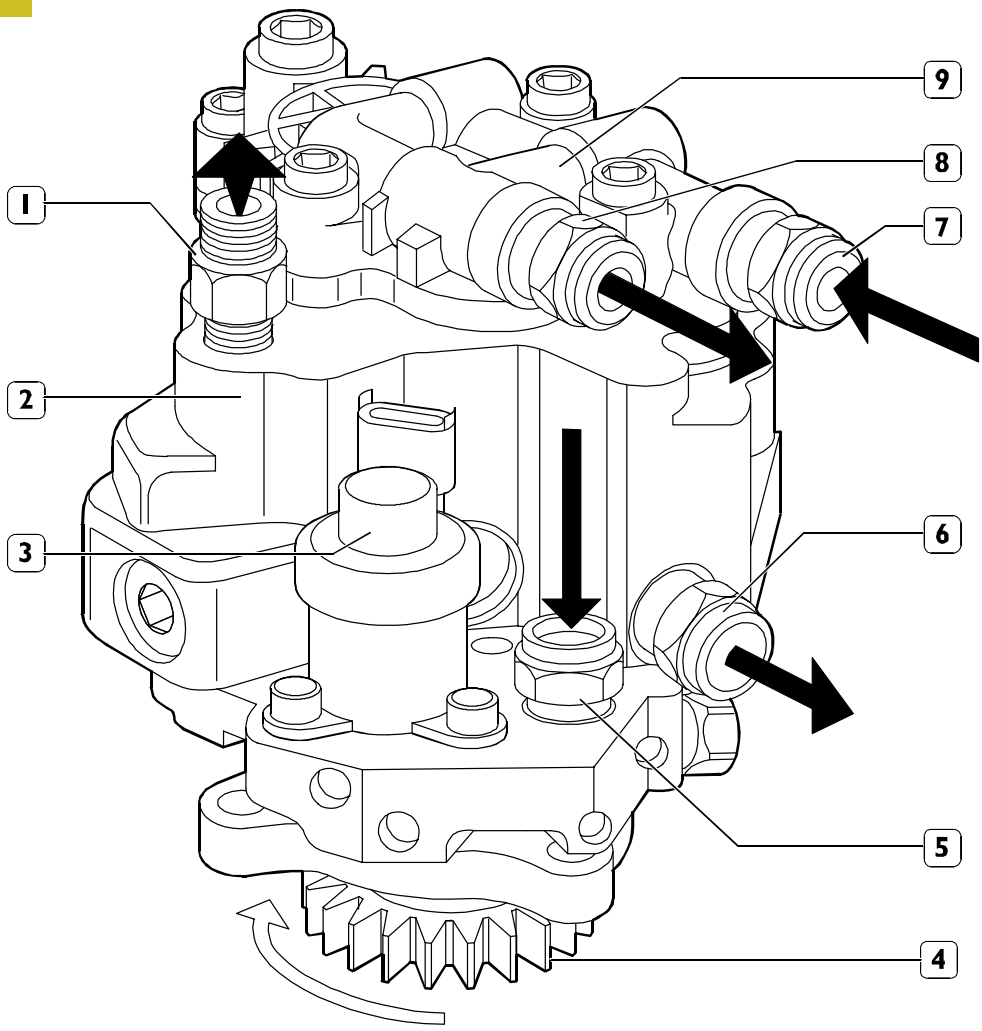
CP3 HIGH-PRESSURE PUMP

Pump with 3 radial pistons controlled by the timing gear, without needing any setting. On the rear side of the high pressure pump is fitted the mechanical supply pump controlled by the high pressure pump shaft.

The following work must be carried out on the feed pump / high-pressure pump assembly:

- ❑ replacing the drive gear;
- ❑ replacing the pressure regulator.

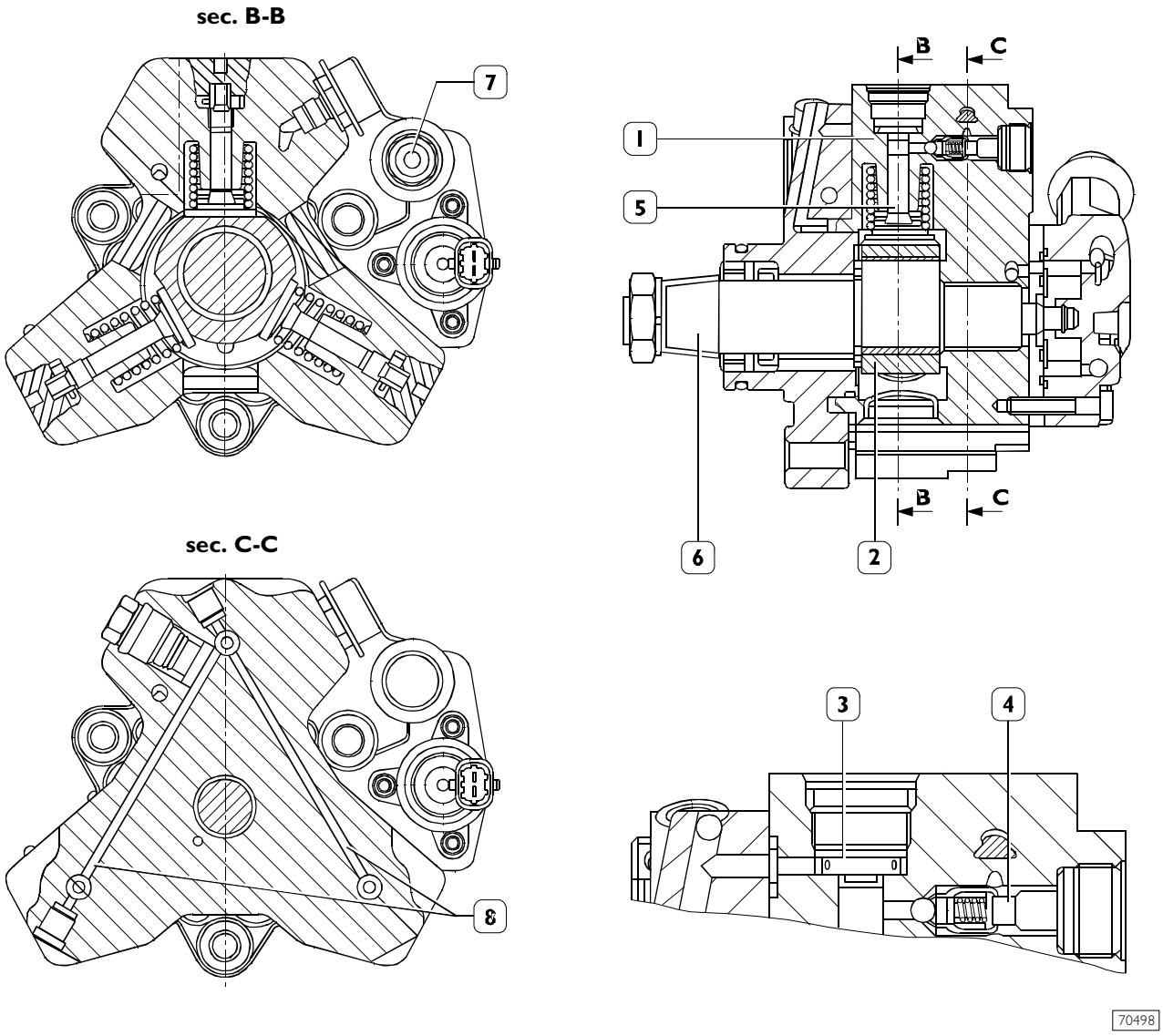
Figure 6



1. Fuel outlet fitting to rail - 2. High-pressure pump - 3. Pressure regulator - 4. Control gear - 5. Fuel inlet fitting from filter - 6. Fuel outlet fitting to filter support - 7. Fuel inlet fitting from control unit heat exchanger - 8. Fuel outlet fitting from supply pump to filter - 9. Mechanical supply pump

HIGH-PRESSURE PUMP - INSIDE STRUCTURE

Figure 7



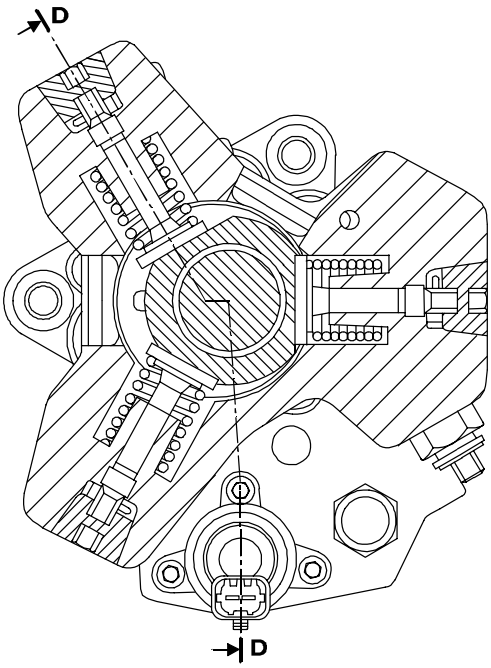
1. Cylinder – 2. Three-lobe element – 3. Cap intake valve – 4. Ball delivery valve – 5. Piston – 6. Pump shaft – 7. Low-pressure fuel inlet – 8. Pumping elements supplying fuel ducts

Every pumping unit is composed of:

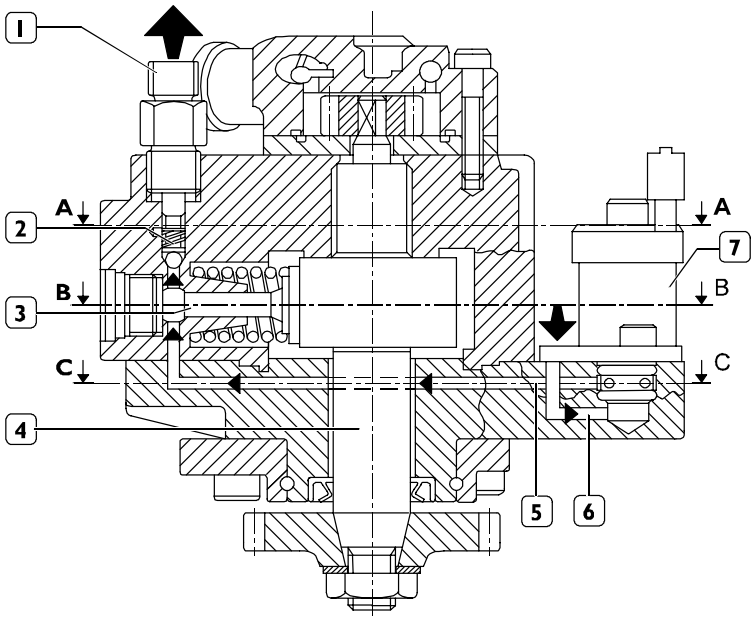
- a piston (5) actuated by a three-lobe element (2) floating on the pump shaft (6). The element (2), being **floating** on a misaligned part of the shaft (6), when the shaft rotates, does not rotate therewith but is only translated in a circular movement along a wider radius, with the resulting alternate actuation of the three pumping elements;
- cap intake valve (3);
- ball delivery valve (4).

Operating principle

Figure 8



Sec. B – B



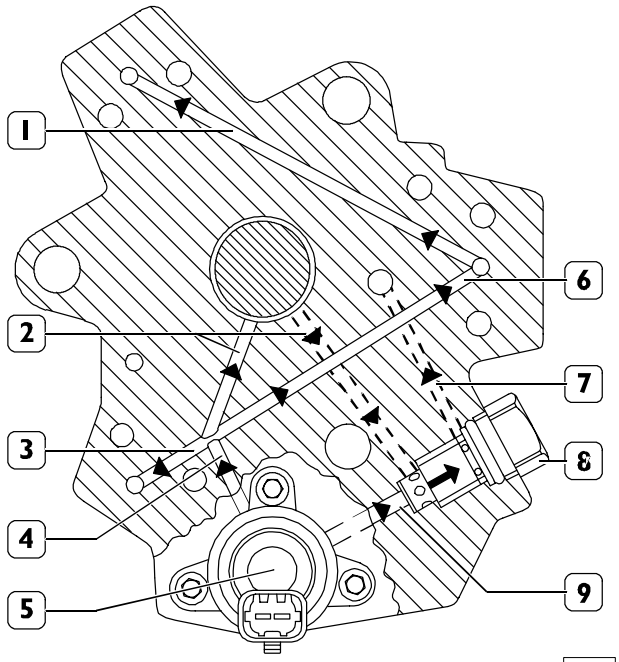
Sec. D – D

72597

1. Fuel outlet fitting to rail - 2. Delivery valve to rail - 3. Pumping element - 4. Pump shaft - 5. Pumping element supply duct - 6. Pressure regulator supply duct - 7. Pressure regulator

Pumping element (3) is oriented to pump shaft (4) cam. During intake, the pumping element is supplied through supply duct (5). The fuel amount to be sent to the pumping element is set by the pressure regulator (7). The pressure regulator meters fuel flow to pumping element according to the PWM signal received from ECU. During pumping element compression stage, fuel reaches the pressure required to open the delivery valve to common rail (2) and to feed it through outlet (1).

Figure 9



Sec. C – C

1. Pumping element inlet - 2. Pump lubrication ducts - 3. Pumping element inlet - 4. Main pumping element supply duct - 5. Pressure regulator - 6. Pumping element inlet - 7. Regulator exhaust duct - 8. 5 bar pressure relief valve - 9. Fuel drain from regulator inlet

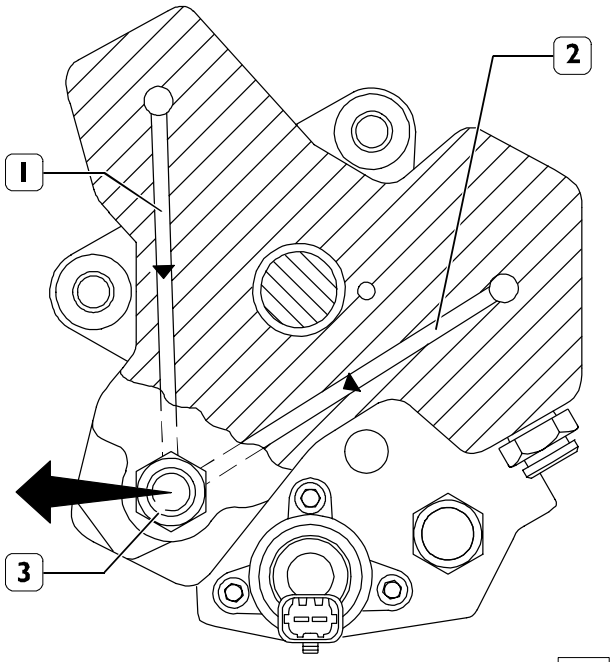
Figure 9 shows low pressure fuel paths inside the path and highlights: main pumping element supply duct (4), pumping element supply ducts (1 – 3 – 6), pump lubrication ducts (2), pressure regulator (5), 5 bar pressure relief valve (8) and fuel drain duct (7).

Pump shaft is lubricated by fuel through delivery and return ducts (2).

Pressure regulator (5) establishes the fuel amount to send to pumping elements; excess fuel is drained out through duct (9).

5 bar pressure relief valve acts as fuel exhaust manifold and keeps 5 bar constant pressure at regulator inlet.

Figure 10



Sec. A – A

1. Fuel outlet duct - 2. Fuel outlet duct - 3. Fuel outlet from pump with high pressure pipe fitting for common rail

Figure 10 shows high pressure fuel flow through pumping element outlet ducts.

Operation

The cylinder is filled through the cap intake valve only if the supply pressure is suitable to open the delivery valves set on the pumping elements (about 2 bars).

The amount of fuel supplying the high-pressure pump is metered by the pressure regulator, placed on the low-pressure system; the pressure regulator is controlled by the EDC7 control unit through a PWM signal.

When fuel is sent to a pumping element, the related piston is moving downwards (suction stroke). When the piston stroke is reversed, the intake valve closes and the remaining fuel in the pumping element chamber, not being able to come out, is compressed above the supply pressure value existing in the rail.

The thereby-generated pressure makes the exhaust valve open and the compressed fuel reaches the high-pressure circuit.

The pumping element compresses the fuel till the top dead center (delivery stroke) is reached. Afterwards, the pressure decreases till the exhaust valve is closed.

The pumping element piston goes back towards the bottom dead center and the remaining fuel is decompressed.

When the pumping element chamber pressure becomes less than the supply pressure, the intake valve is again opened and the cycle is repeated.

The delivery valves must always be free in their movements, free from impurities and oxidation.

The rail delivery pressure is modulated by the electronic control unit, through the pressure regulator solenoid valve.

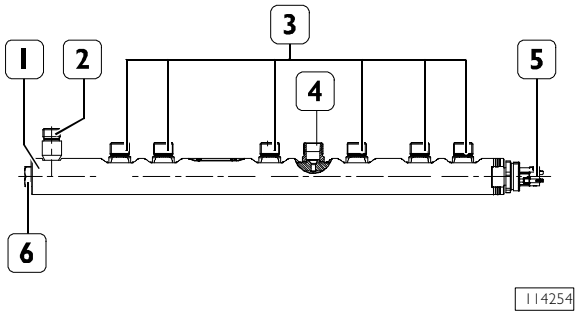
The pump is lubricated and cooled by the fuel.

The radialjet pump disconnection – reconnection time on the engine is highly reduced in comparison with traditional injection pumps, because it does not require setting.

If the pipe between fuel filter and high-pressure pump is to be removed-refitted, be sure that hands and components are absolutely clean.

RAIL (PRESSURE ACCUMULATOR)

Figure 11



1. Rail - 2. Fuel return - 3.Pipelines to injectors - 4. Fuel supply to high pressure pump - 5. Pressure sensor - 6. Overpressure valve

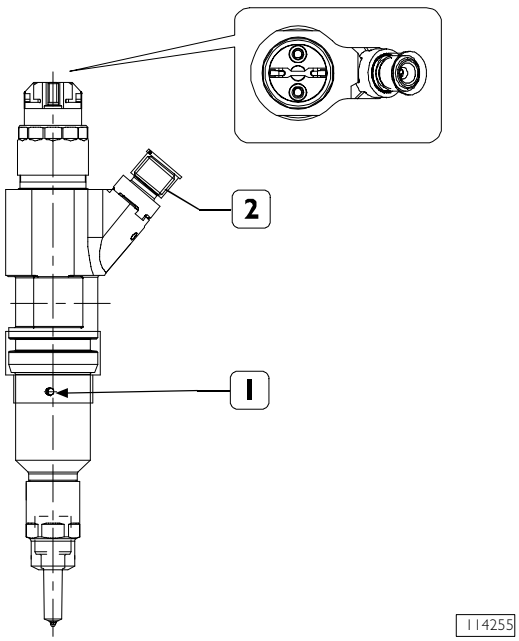
The rail volume is of reduced sizes to allow a quick pressurisation at startup, at idle and in case of high flow-rates.

It anyway has enough volume as to minimise use of plenum chambers caused by injectors openings and closings and by the high-pressure pump operation. This function is further enabled by a calibrated hole being set downstream of the high-pressure pump.

A fuel pressure sensor (5) is screwed to the rail. The signal sent by this sensor to the electronic control unit is a feed-back information, depending on which the rail pressure value is checked and, if necessary, corrected.

Electroinjector

Figure 12

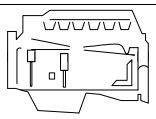
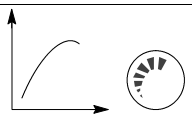
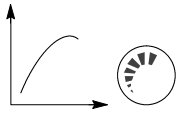
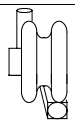
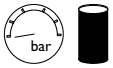


1. Fuel return hole - 2. Fuel supply

SECTION 3

Industrial application

CLEARANCE DATA

			F2CE9684							
	Type		A*E004	B*E001	C*E001	D*E001	C*E002	E*E002	H*E003	L*E005
ϱ	Compression ratio		16.5:1							
	Max. output	kW (HP)	260 (314)	240 (318)	220 (299)	210 (286)	220 (299)	200 (272)	260 (364)	279 (353)
		rpm	2100	2100	2100	2100	2100	2100	2100	2100
	Peak power	kW (HP)	290	268	245	234	245	223	290	290
		rpm	1800	1800	1800	1800	1800	1800	1800	1800
	Max. torque	Nm (kgm)	1600	1477	1355	1293	1355	1232	1600	1600
		rpm	1500	1500	1500	1500	1500	1500	1500	1500
	Loadless engine idling	rpm	1000 ± 25						800 ± 25	1000 ± 25
	Loadless engine peak	rpm	2100							
	Bore x stroke	mm	117 x 135							
	Displacement	cm^3	8710							
	SUPERCHARGING		Intercooler Direct injection							
	Turbocharger type		HX55	HX40					HX55	
	LUBRICATION		Forced by gear pump, relief valve single action oil filter							
	Oil pressure (warm engine)									
	- idling	bar	4							
	- peak rpm	bar	5							
	COOLING		Liquid							
	Water pump control		Through belt							
	Thermostat									
	- start of opening	°C	81							

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.

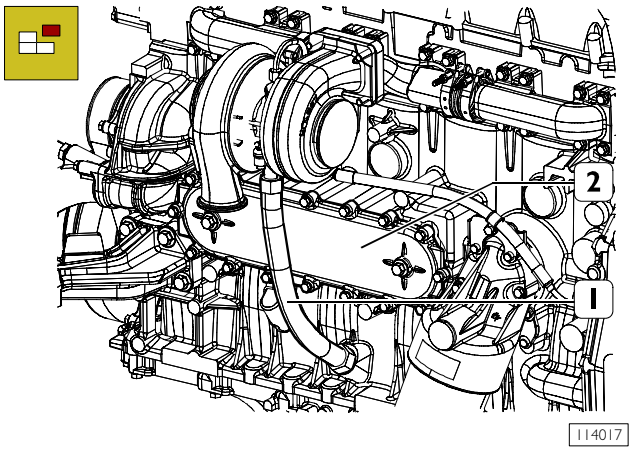
PART ONE -
MECHANICAL COMPONENTS

540110 ENGINE DISASSEMBLY ON BENCH

NOTE Before installing engine on rotary stand 99322230, remove parts that might interfere with the installation of brackets 99361042.

Therefore, remove heat exchanger and oil line as shown below.

Figure 1



Under heat exchanger (2) place a container for engine coolant drain.

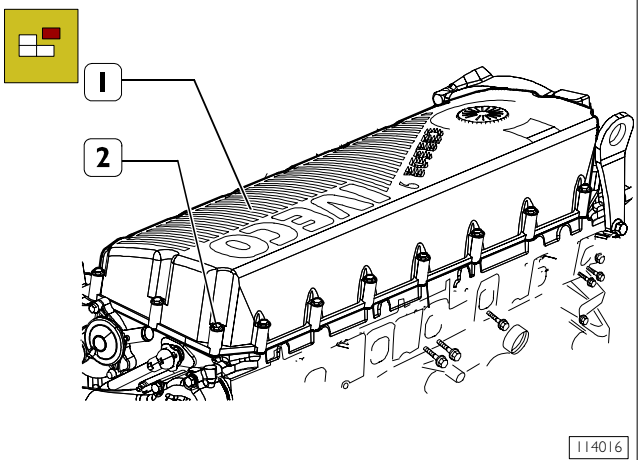
Unlock retaining screws and remove heat exchanger assembly (2).

Remove oil outlet line (1).

Install engine on rotary stand 99322230.

Drain sump oil in specific container.

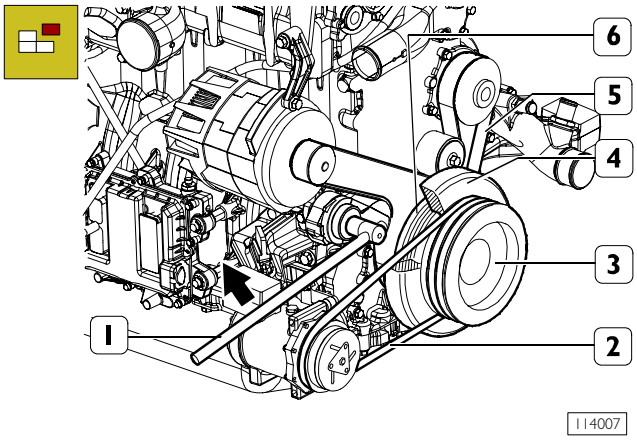
Figure 2



Unlock retaining screws (2) and remove head cover (1) to reach injector and rail wiring.

Remove wiring from all components shown in "Electric equipment" section.

Figure 3

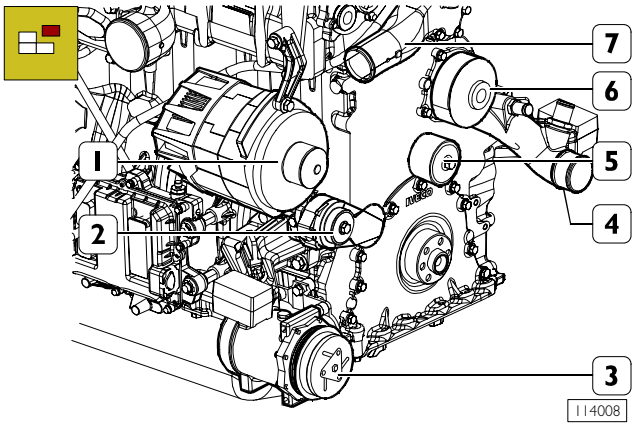


If air conditioner compressor is installed, cut belt (2) as it must not be reused.

Use specific tool (1) and operate in the arrow direction to remove water pump and alternator control belt (5).

Remove screws and separate pulleys (3) and (6) with damping flywheel (4).

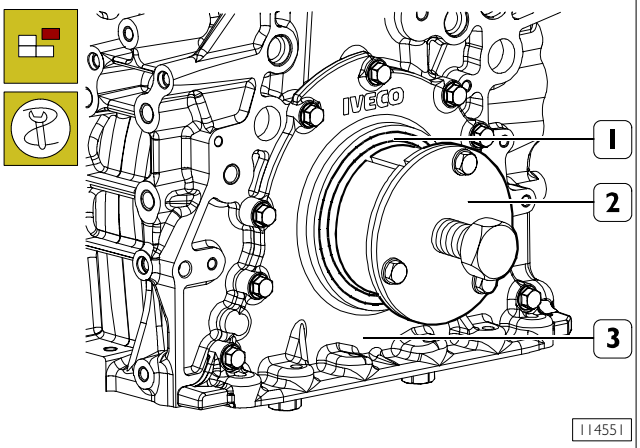
Figure 4



Remove parts below:

- ❑ alternator (1);
- ❑ belt tensioner (2);
- ❑ if present, air conditioner compressor (3);
- ❑ water pump (6);
- ❑ flanged pipe (4);
- ❑ fixed belt tensioner (5);
- ❑ thermostat assembly (7).

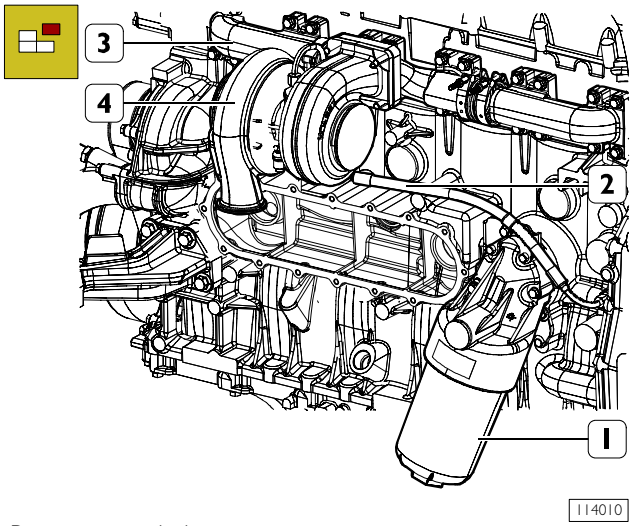
Figure 5



Apply extractor 99340051 (2) and remove seal (1).

Unlock screws and remove front cover (3).

Figure 6

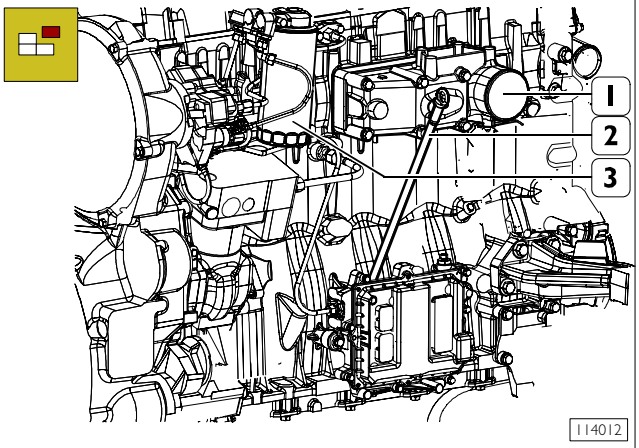


Remove parts below:

- ❑ oil filter (1);
- ❑ oil inlet line (2);
- ❑ turbocompressor (4) and exhaust manifold (3).

On opposite engine side, remove start-up motor.

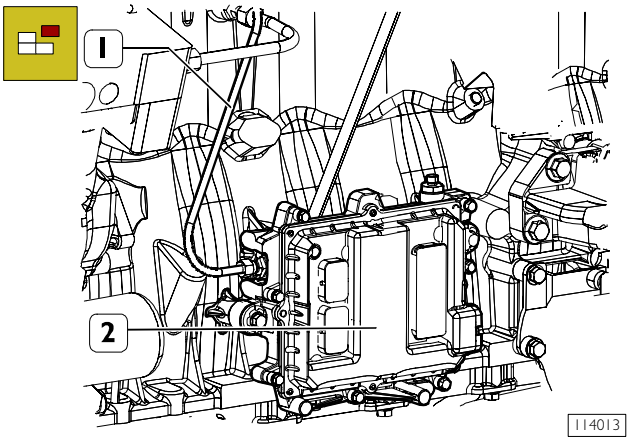
Figure 7



Remove parts below:

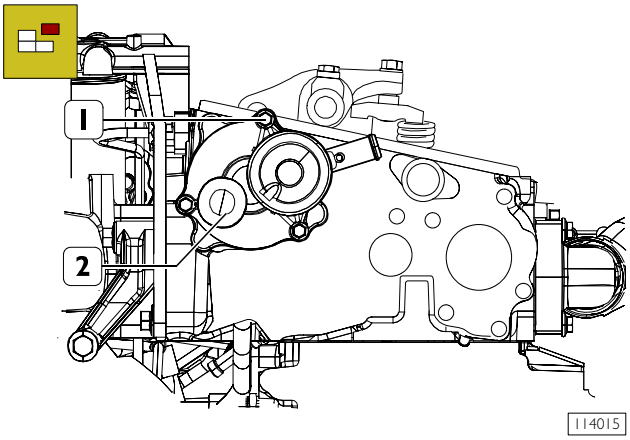
- ❑ fuel filter (3);
- ❑ oil level rod (2);
- ❑ intake manifold (1).

Figure 8



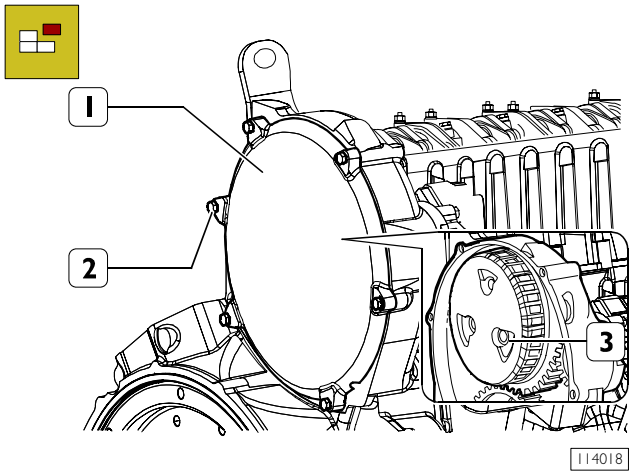
Disconnect line (1) from high pressure pump support and remove ECU (2) with support below.

Figure 9



Remove screws (1) and blow-by box (2).

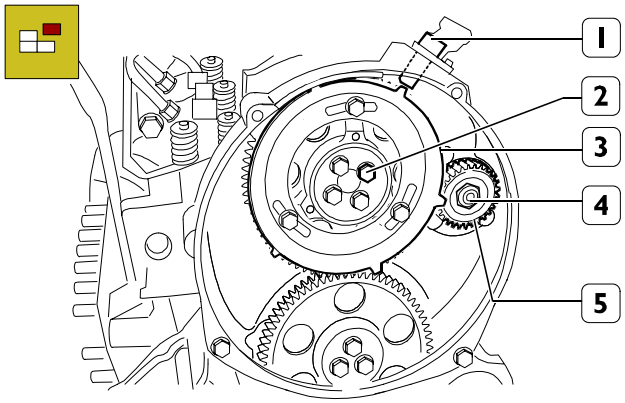
Figure 10



114018

Unlock screws (1) and remove cover (2). Remove centrifugal filter (3) below.

Figure 11



114019

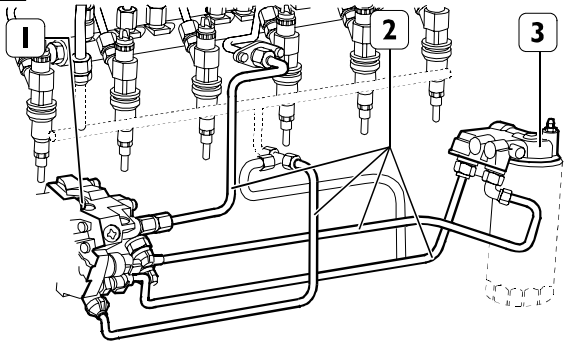
Use specific spanner to unlock screws (2) and remove gear (3) complete with tune wheel.

Unlock nut (4) and remove control gear (5) of high pressure pump.

Remove rpm sensor (1).

NOTE In case removal of gear (5) is difficult, release high pressure pump screws with light beater strokes on control shaft and remove gear (5).

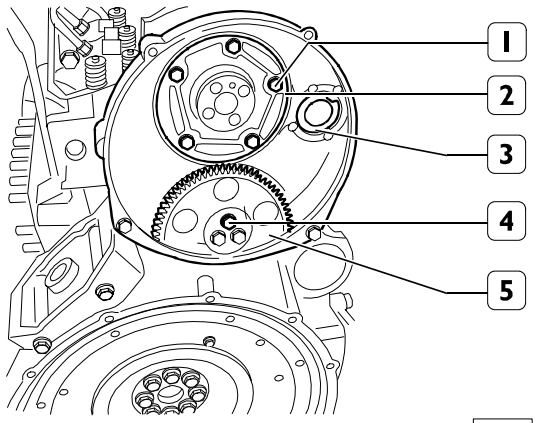
Figure 12



114014

Disconnect fuel lines (2), unlock retaining screws and remove high pressure pump (1). Remove fuel filter support (3) complete with pipeline.

Figure 13



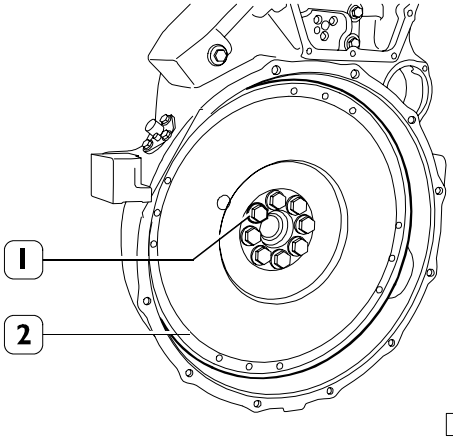
114020

Unlock screws (1) and remove thrust plate (2).

Use specific spanner to unlock screws (4) and remove relay gear (5).

Remove high pressure pump mount flange (3).

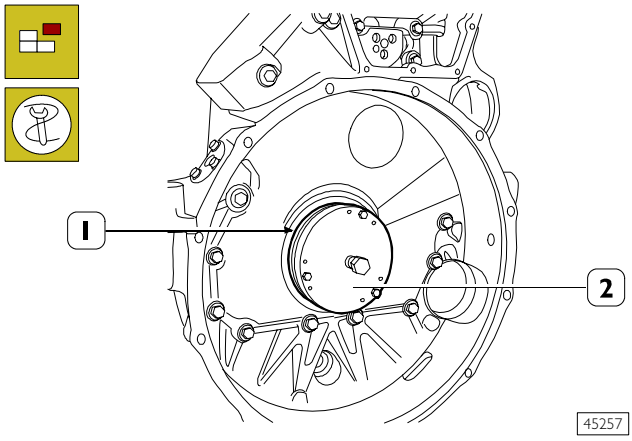
Figure 14



114009

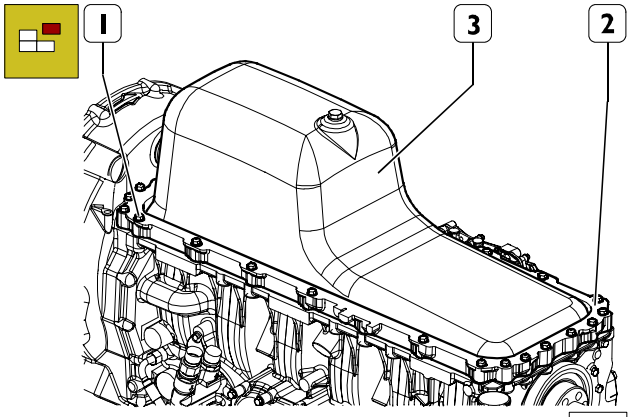
Use specific tool lock engine flywheel (2) rotation, unlock retaining screws (1) and remove engine flywheel.

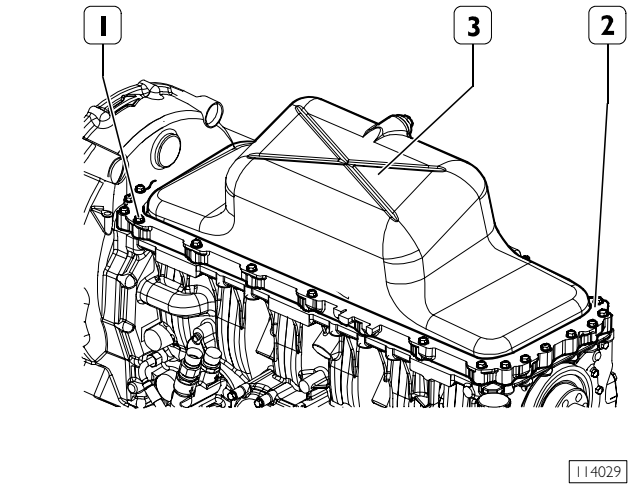
Figure 15



Apply extractor 99340054 (2) and remove seal (1).

Figure 16

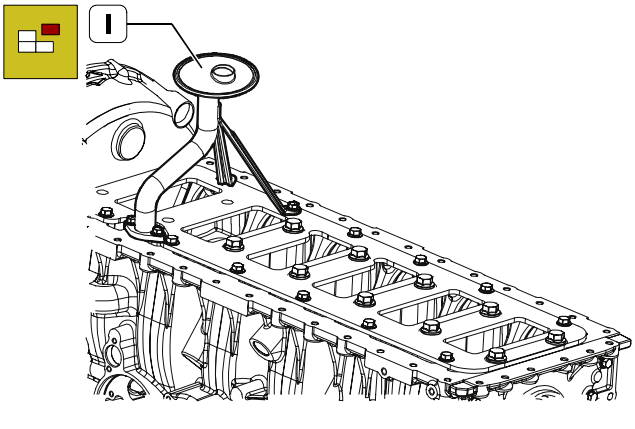


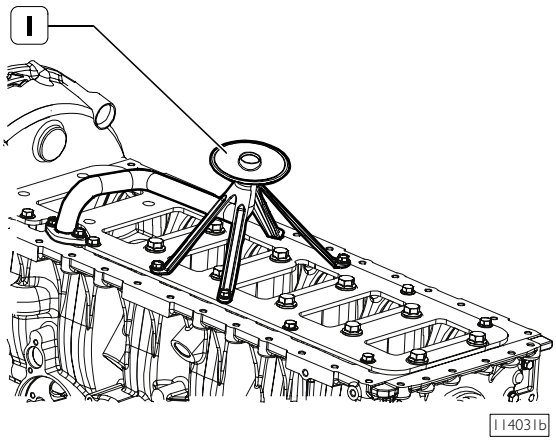


Unlock screws (1) and remove engine oil sump (3) complete with spacer (2) and seal.

NOTE Sump shape depends on application type.

Figure 17

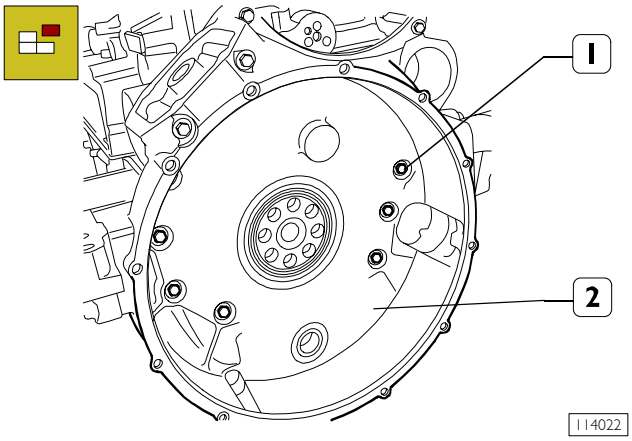




Unlock screws and remove suction rose (1).

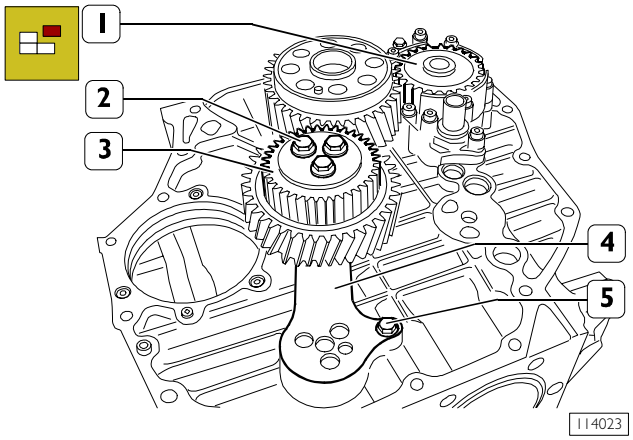
NOTE Suction rose shape depends on application type.

Figure 18



Unlock screws (1) and remove flywheel box (2).

Figure 19

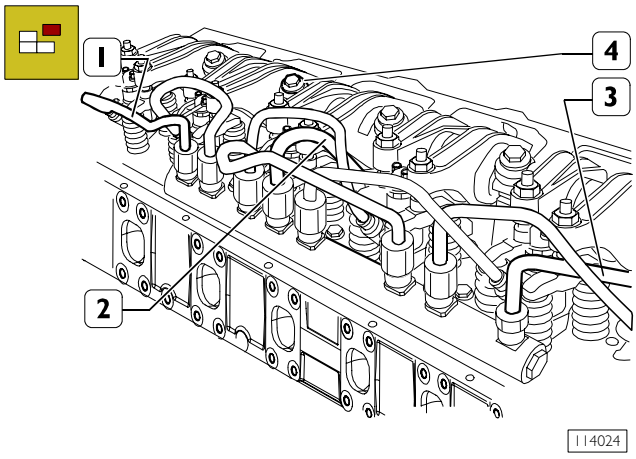


Remove screws (2) and double gear (3).

Remove retaining screw (5) and connecting rod (4).

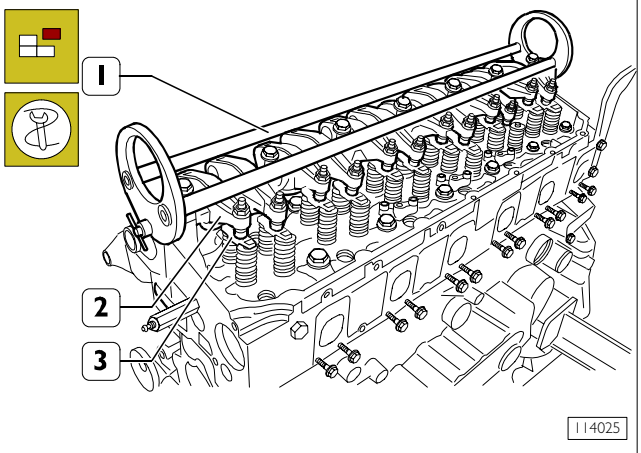
Remove oil pump (1).

Figure 20



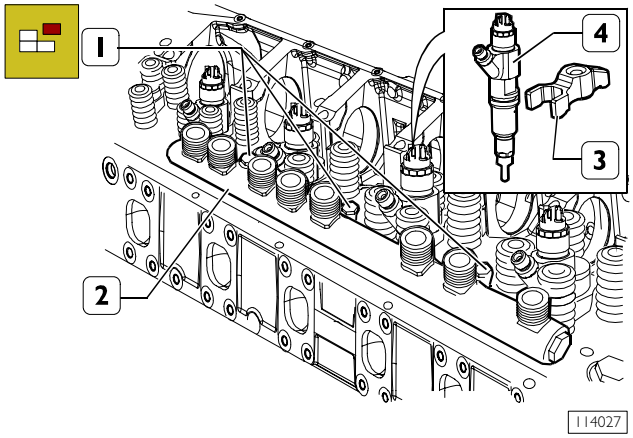
- ❑ Unlock rocker arm shaft retaining screws (4).
- ❑ Disconnect fuel pipelines (1) from injector rail, fuel supply line (2) of high pressure pump to rail and return line (3).

Figure 21



Apply tool 99360558 (1) to rocker arm shaft and remove shaft, remove crosspieces (3) from cylinder head.

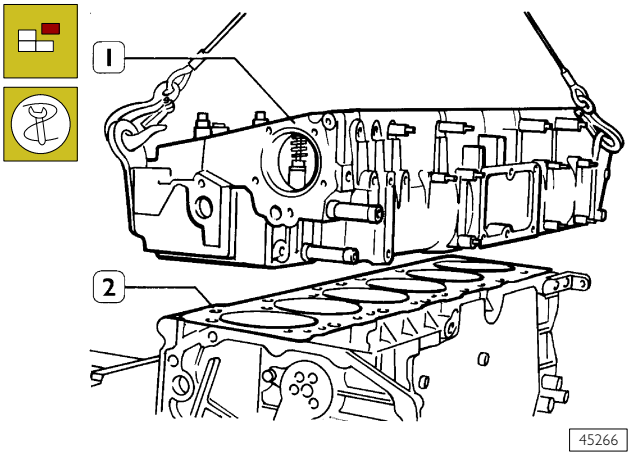
Figure 22



Remove retaining brackets (3) and remove injectors (4).

Remove retaining screws (1) and remove rail (2).

Figure 23

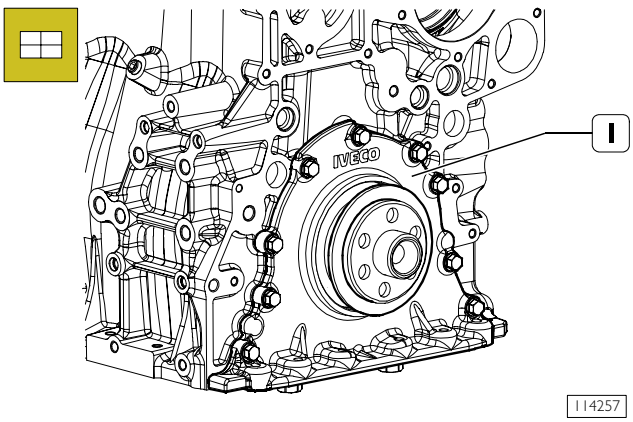


Remove camshaft and remove cylinder head retaining screws.

Use metallic ropes to lift cylinder head (1) and remove seal (2).

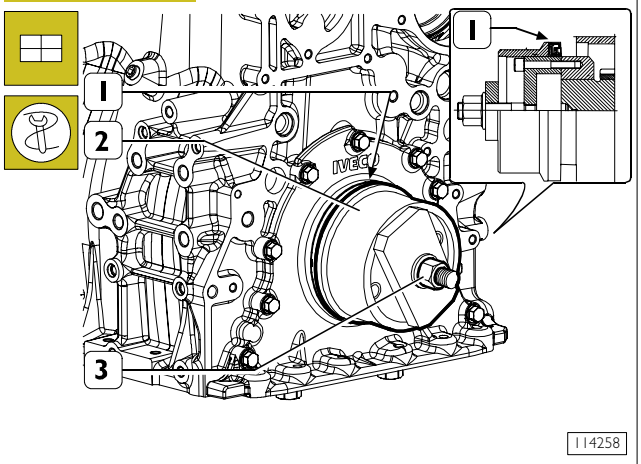
ASSEMBLY

Figure 24



Install front cover (1) and lock retaining screw at required torque.

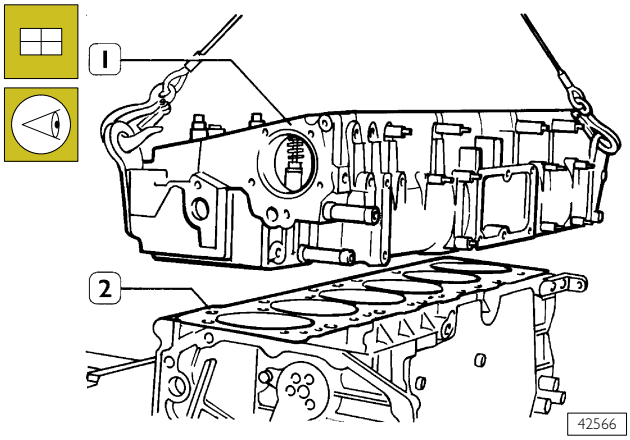
Figure 25



114258

Secure seal (1), install special tool 99346260 (2), lock nut (3) to secure seal (1).

Figure 26



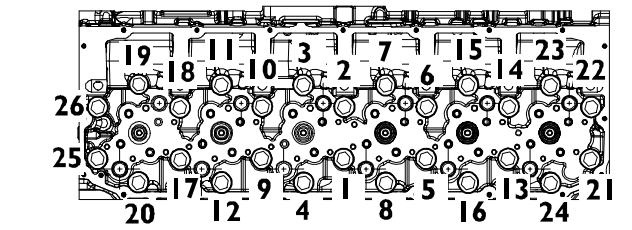
42566

Check that pistons 1-6 are exactly at T.D.C.

Place seal (2) on cylinder block.

Install cylinder head (1) and lock screws as shown in figures below.

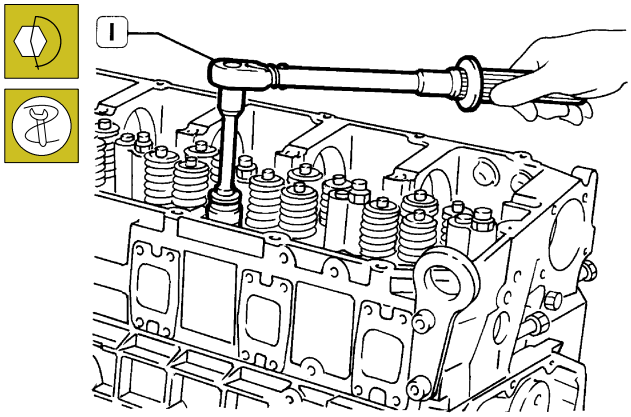
Figure 27



114259

Cylinder head retaining screw locking sequence diagram.

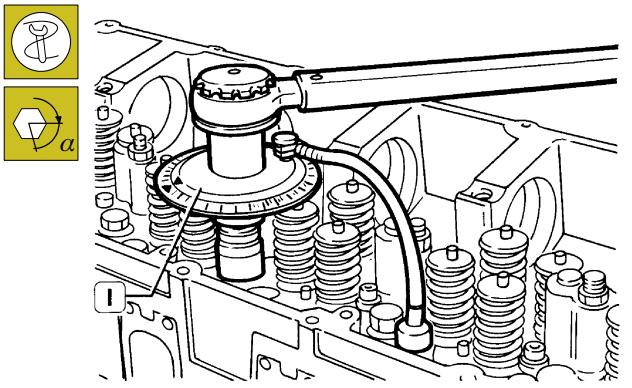
Figure 28



45267

❑ Pre-lock by torque wrench (1):
1st phase: 50 Nm (5 kgm);
2nd phase: 100 Nm (10 kgm).

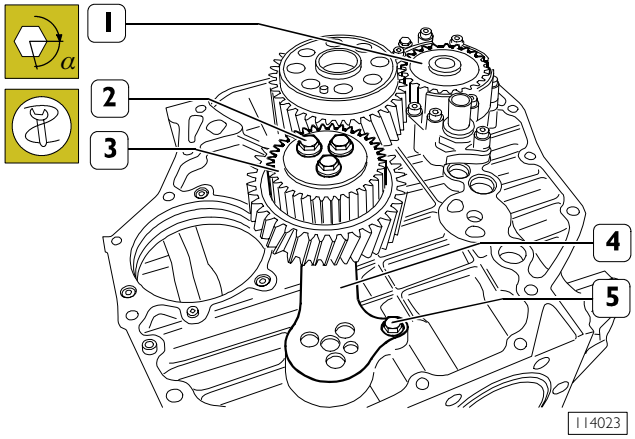
Figure 29



45268

❑ Angle locking by means of tool 99395216 (1):
3rd phase: 90° angle
4th phase: 75° angle.

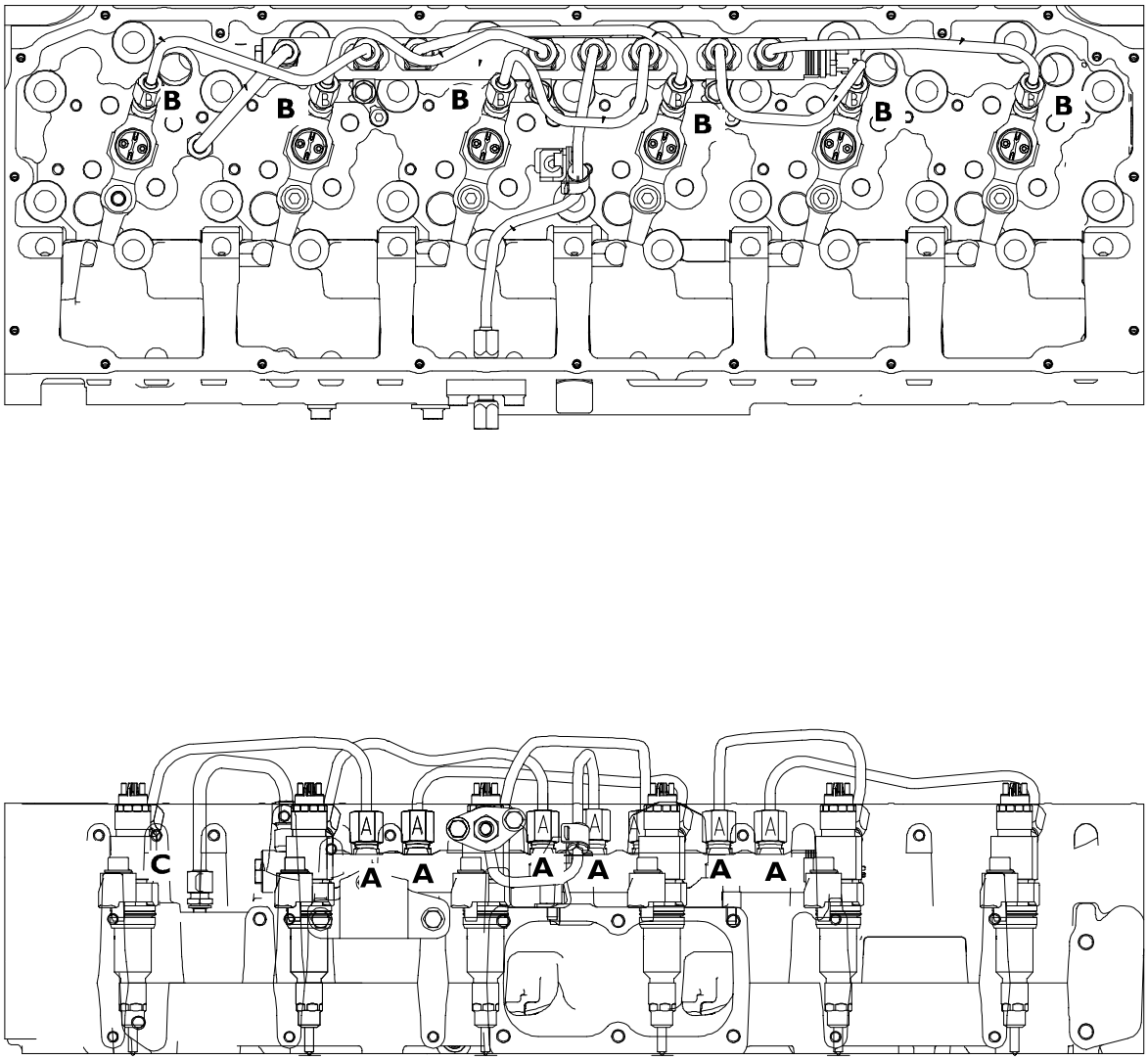
Figure 30



114023

Install oil pump (1), double gear (3) complete with connecting rod (4) and lock screws (2) in two phases:
pre-lock 30 Nm
90° angle lock

Figure 31



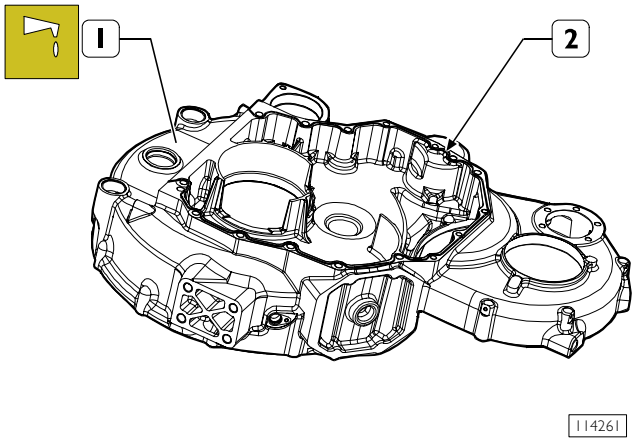
NOTE The previously removed pipes ca no longer be refit and must be replaced.

1. Install rail on cylinder head and lock retaining screws by hand.
2. Install injectors in correct position and lock to required torque.
3. Install pipes on rail and lock fittings by hand.
4. Lock rail to cylinder head retaining screws at required torque.
5. Fit pipes on injectors and head locking fittings by hand.
6. Lock fittings on rail (A, C) at required torque .
7. Lock fittings on injectors and head (B, C) at required torque.

TYPE	DESCRIPTION	LOCK TORQUE
A	M18 x 1.5	40 ± 2 Nm
B	M14 x 1.5	35 ± 2 Nm
C	M16 x 1.5	40 ± 2 Nm

After fitting the high-pressure pipelines, during the following 20 hours of work, frequently check engine oil level (IT MUST NOT INCREASE).

Figure 32

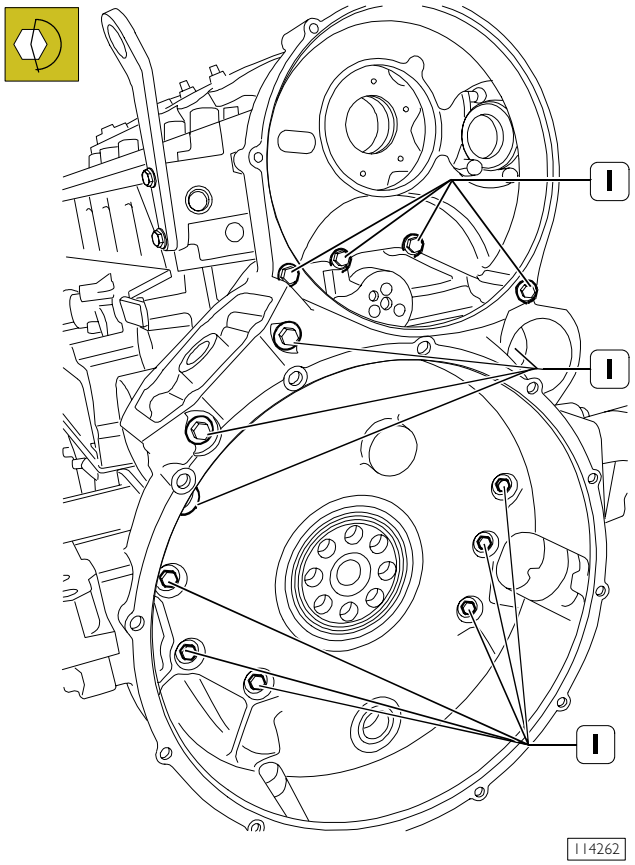


Clean surfaces to be coupled to remove dirt and oil residuals. Apply LOCTITE 275 silicone on gear casing (1) as shown in the figure.

The sealant seam diameter must be 1.5 ± 0.5/0.2.

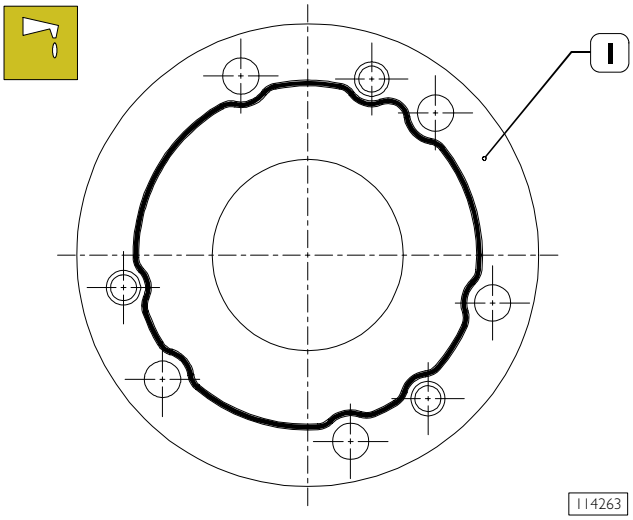
Install gear casing within 10 min. from sealant application.

Figure 33



Use torque wrench to lock screws (1) at required torque.

Figure 34

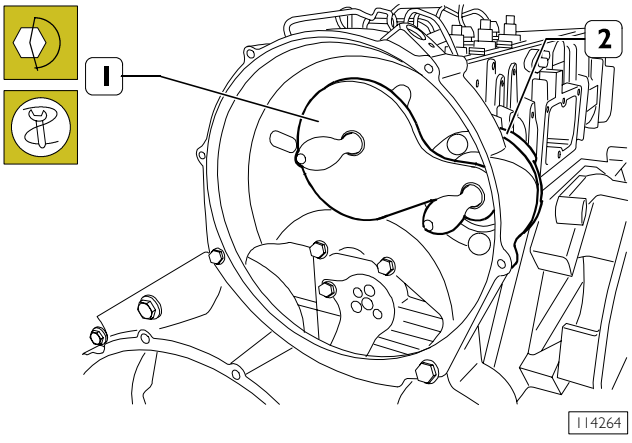


Clean surfaces to be coupled to remove dirt and oil residuals. Apply LOCTITE 275 silicone on gear casing (1) as shown in the figure.

The sealant seam diameter must be 1.5 ± 0.5/0.2.

Install gear casing within 10 min. from sealant application.

Figure 35

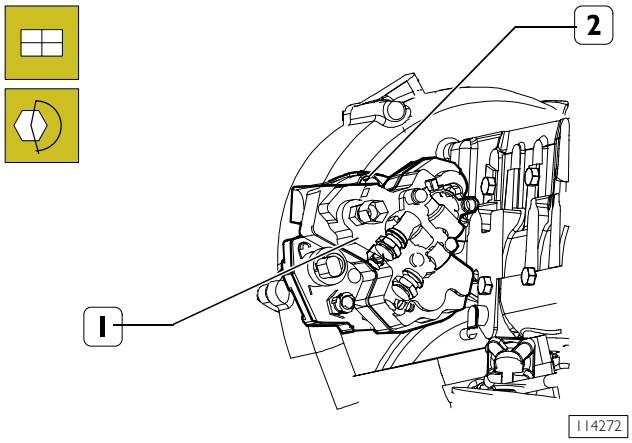


Apply gage 99395221 (1) to check and adjust position of high-pressure pump connection flange (2).

Fix flange screws (2) at required torque.

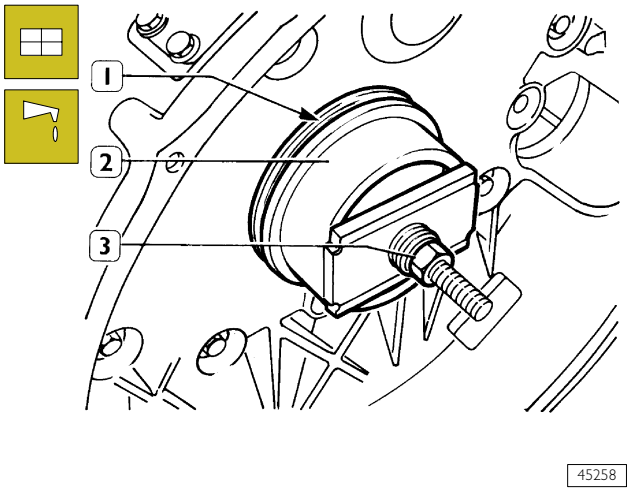
High pressure pump installation

Figure 36



Install high-pressure pump (1) on flange (2).

Figure 37



Secure seal (1), install special tool 99346260 (2), lock nut (3) to secure seal.

540850 ENGINE FLYWHEEL

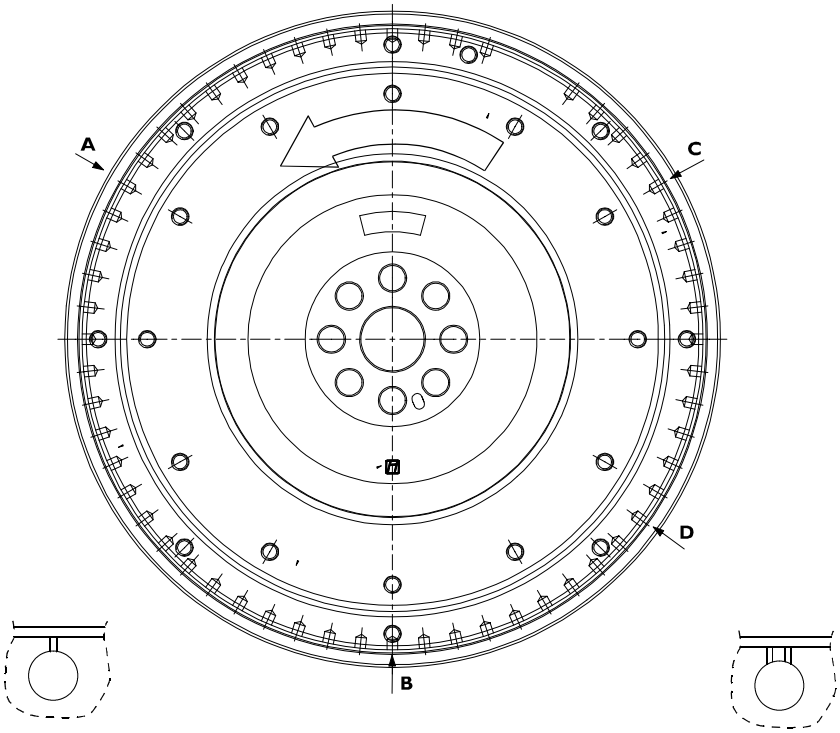
NOTE If toothing on engine flywheel for engine start-up is very damaged, change crown wheel.

Refit crown wheel after heating up at approx. 200°C.

Engine flywheel installation

NOTE Crankshaft has a reference pin that must match with related housing on engine flywheel.

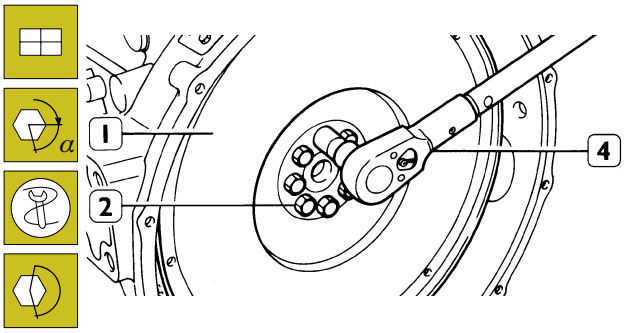
Figure 38



DETAIL OF PISTON POSITION STAMPING ON ENGINE FLYWHEEL

A. Hole on flywheel with a notch corresponding to pistons 3-4 TDC - B. Hole on flywheel with a notch, corresponding to piston 1-6 TDC - C. Hole on flywheel with a notch corresponding to pistons 2-5 TDC - D. Hole on flywheel with 2 notches, position corresponding to 54°.

Figure 39



49037

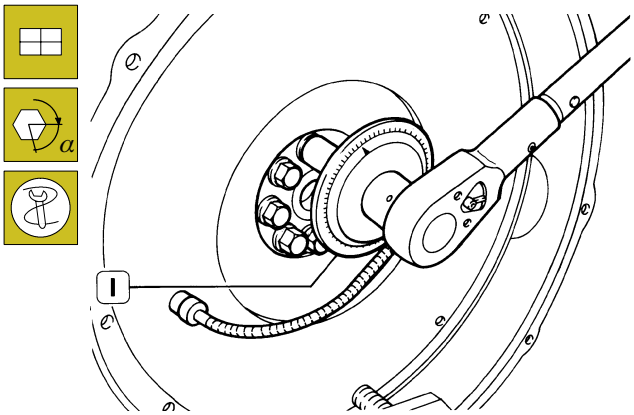
Position flywheel (1) on crankshaft, lubricate screws (2) threading with engine oil and lock them.

Stop rotation using specific tool.

Lock screws (2) in three phases.

1st phase: pre-lock with torque wrench (4) at 100 Nm torque (10 kgm).

Figure 40

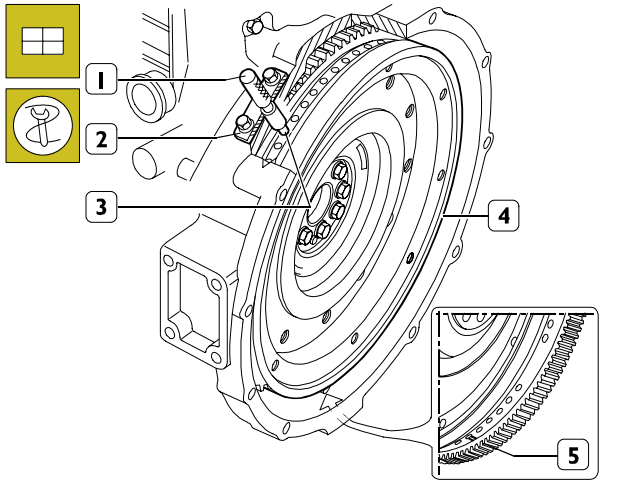


49036

2nd phase: 60° angle locking using tool 99395216 (1).

Camshaft installation

Figure 41



72436

Position crankshaft with pistons 1 and 6 at TDC.

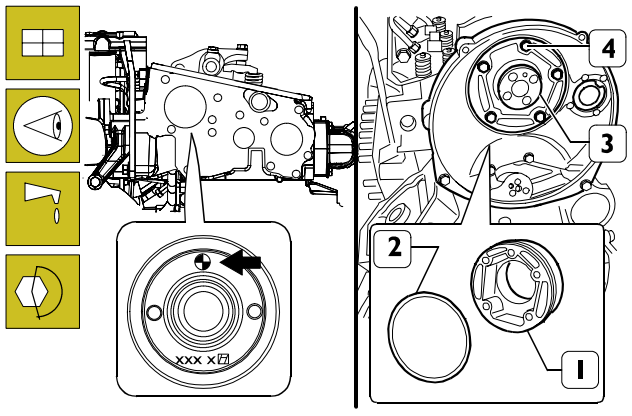
This condition is obtained when:

1. hole with notch (5) of engine flywheel (4) is visible through manhole;
2. tool 99360612 (1), through housing (2) of engine rpm sensor, inserts in hole (3) drilled on engine flywheel (4).

Otherwise, adjust engine flywheel orientation (4).

Remove too 99360612 (1).

Figure 42

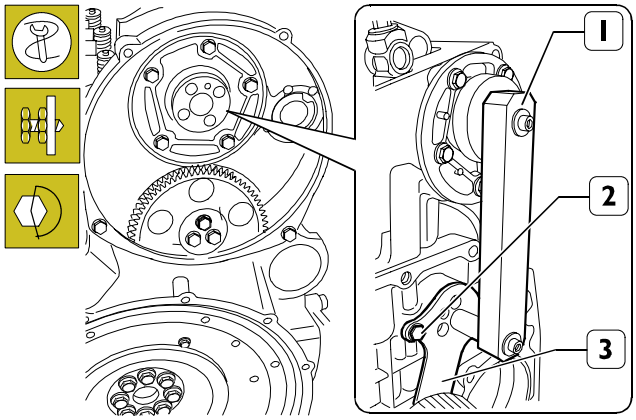


114267

Install camshaft (3) and orient it with references (→) positioned as in the figure.

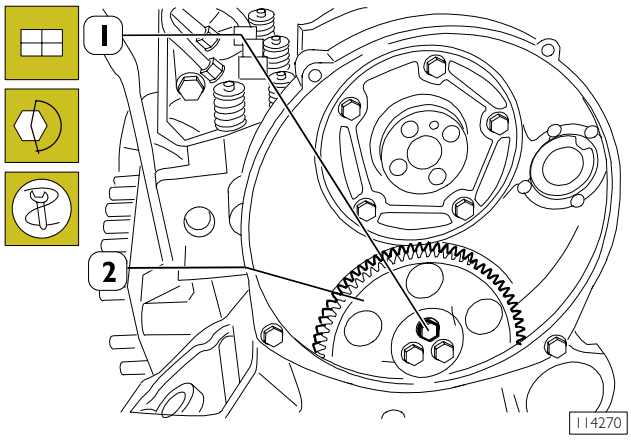
Install thrust plate (1) with seal (2) and lock screws (4) at required torque.

Figure 43



Apply gage 99395222 (1), check and adjust position of connecting rod (3) for relay gear, lock screw (2) at required torque.

Figure 44

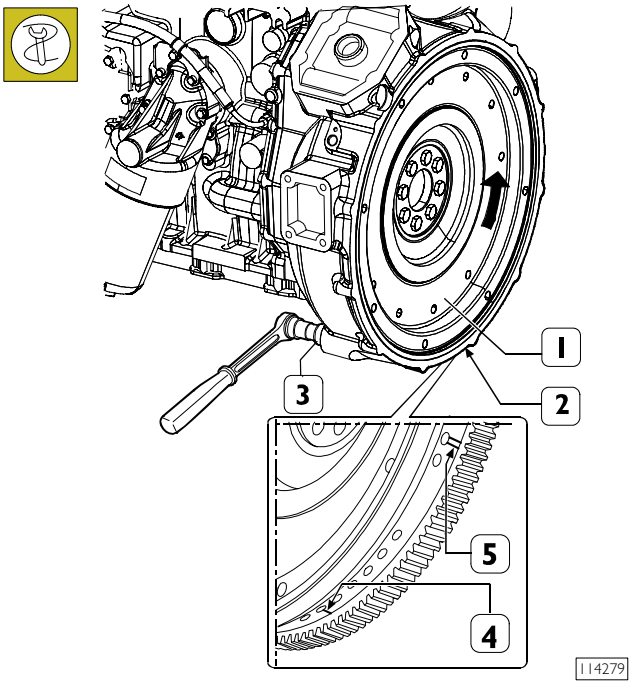


Refit relay gear (2) and lock screws (1) using six-splined spanner at required torque.

NOTE The relay gear (1) bushing can be replaced when worn out. After securing bushing, grind it to reach dia. 58.010 ± 0.10 mm.

Camshaft tuning

Figure 45



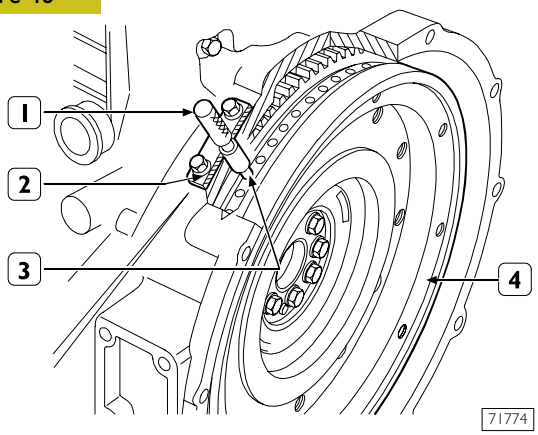
Secure special tool 99360641 (3) to gear casing.

NOTE The arrow indicated engine rotation direction.

Use tool above to rotate engine flywheel (1) in engine rotation direction to bring cylinder 1 piston approx. to TDC in blast phase.

This condition is reached when hole with notch (4), following hole with two notches (5) drilled on engine flywheel (1), is visible through manhole (2).

Figure 46

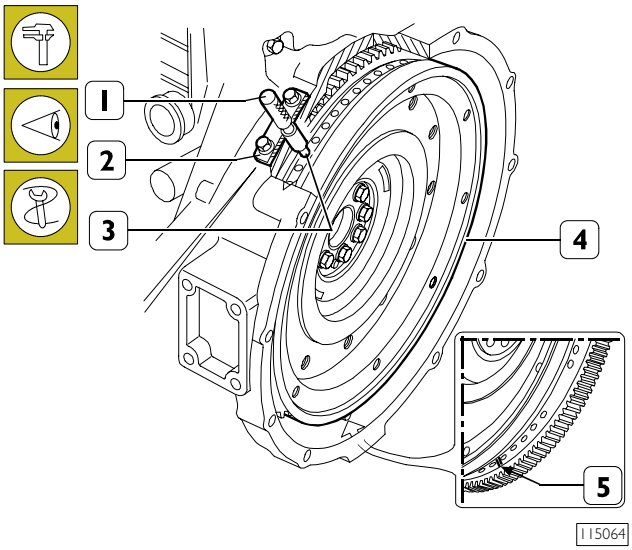


The exact position of piston no.1 at TDC is obtained when, in conditions described above, tool 99360612 (1), through engine rpm sensor housing (2), inserts in hole (3) drilled on engine flywheel (4).

Otherwise, rotate engine flywheel (4) to adjust its orientation.

Remove tool 99360612 (1).

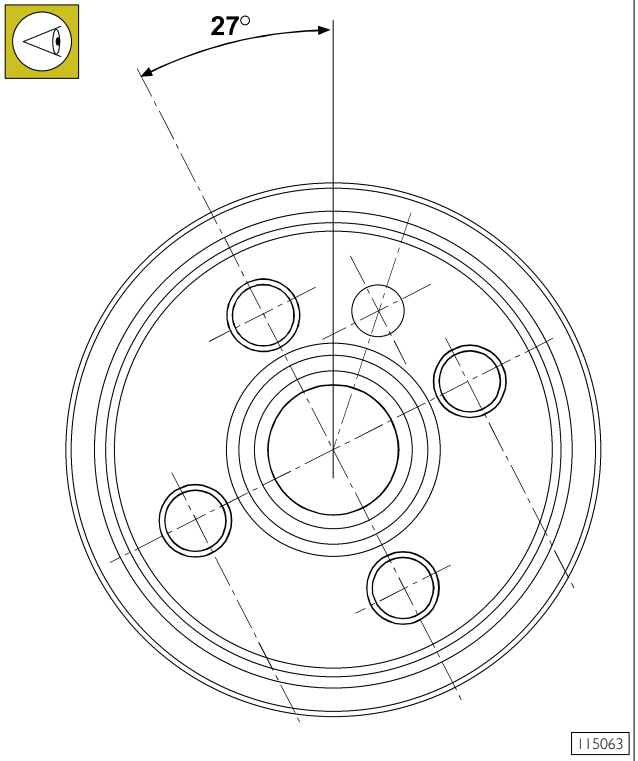
Figure 47



Rotate crankshaft to check conditions below:

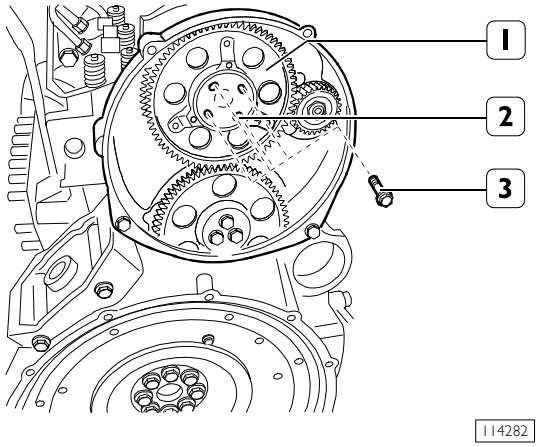
1) hole identified with two notches (5) is visible through manhole;
2) fixture 99360612 (1) through housing (2) of engine rpm sensor inserts in hole (3) on engine flywheel (4).

Figure 48



Rotate camshaft by 27° in anticlockwise direction as shown in the figure.

Figure 49

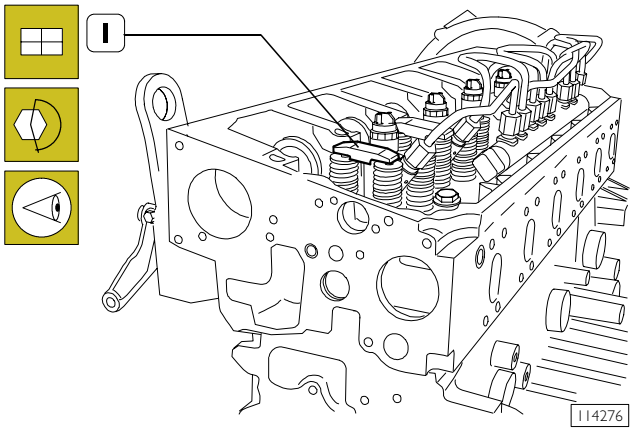


Install gear (1) controlling camshaft so that fastening holes on shaft coincide with slots (2) on control gear.

Lock retaining screws (3).

NOTE Check that camshaft has maintained position shown in Figure 48.

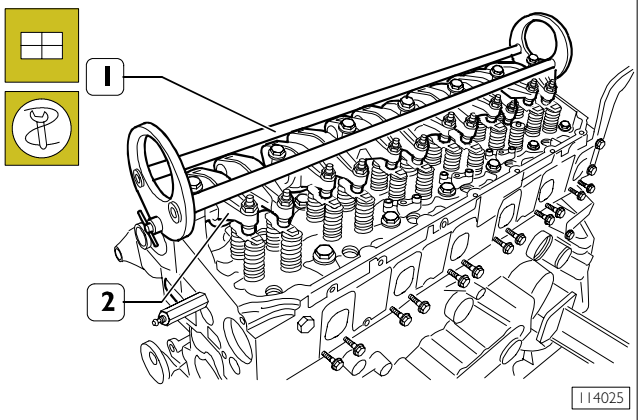
Figure 50



Install crosspieces (1) on valve rod.

NOTE Before refitting rocker arm shaft assembly, check that all adjustment screws have been fully unlocked.

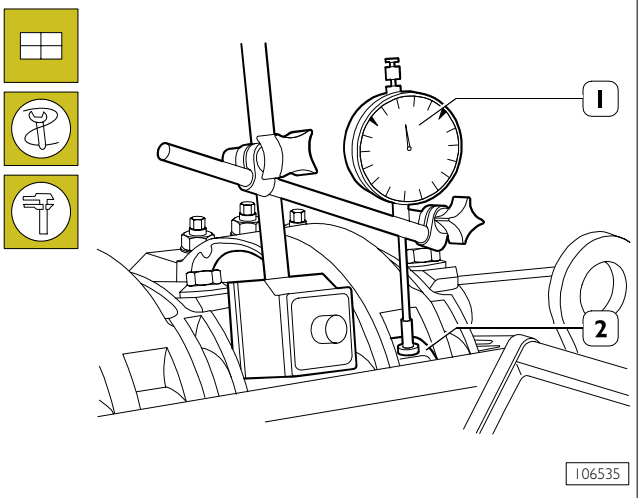
Figure 51



Apply tool 99360558 (1) to rocker arm shaft (2) and install shaft on cylinder head.

Lock retaining screws at required torque.

Figure 52



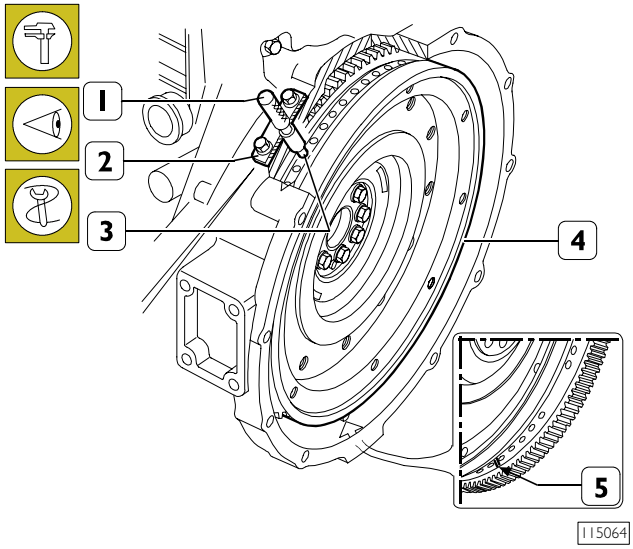
Place dial gage on magnetic base (1) with rod placed on roller (2) of rocker arm controlling cylinder no.3 exhaust valve and apply 6 mm preload.

Using tool 99360341 (3, Figure 45), rotate crankshaft clockwise till dial gage arrow reaches minimum value (max cam lift), after which it no longer varies.

Zero set dial gage.

Rotate engine flywheel anticlockwise till dial gage reads camshaft cam lift value = 4.70 ± 0.05 mm.

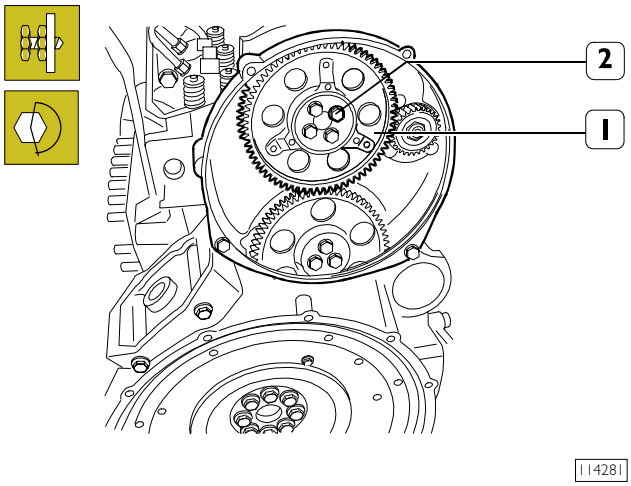
Figure 53



Camshaft is timed if conditions below are found at cam lift values 4.70 ± 0.05:

1) hole identified with two notches (5) is visible through manhole;
2) fixture 99360612 (1) through housing (2) of engine rpm sensor inserts in hole (3) on engine flywheel (4).

Figure 54

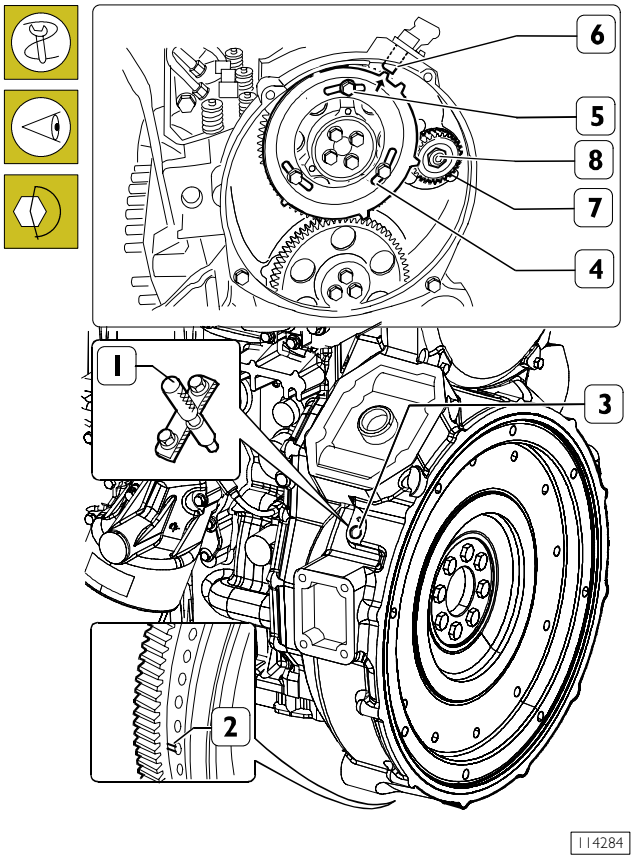


In case conditions shown in Figure 53 and shown at paras 1 and 2 are not found, operate as follows:

1) release screws (2) securing gear (1) of camshaft to as to make control gear and camshaft independent;
2) conveniently operate on engine flywheel so as to obtain conditions indicated at paras 1 and 2, Figure 53, considering that cam lift value must remain unchanged;
3) lock screws (2) and repeat control as already described;
4) lock screws (2) at required torque.

Tune wheel timing

Figure 55



Install gear (7) of high pressure pump and lock nut (8) at required torque.

Install tune wheel (4).

Rotate crankshaft and bring cylinder n.1 piston to compression phase at TDC: Rotate flywheel opposite to regular rotation direction by 1/4 of rev.

Rotate flywheel again in regular rotation direction till hole identified by double notch (2) shows through inspection hole under flywheel cover box.

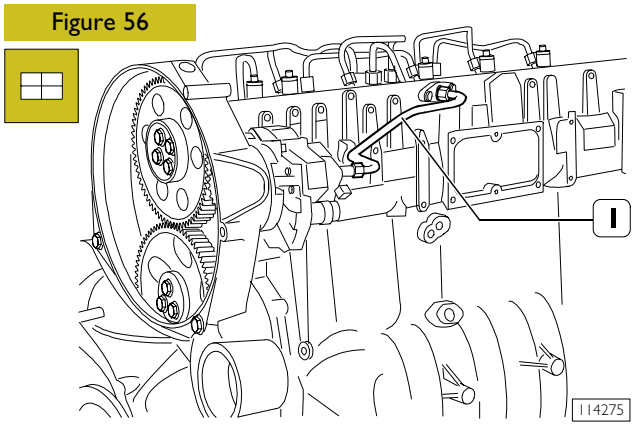
Insert tool 99360612 (5) in flywheel sensor housing.

Insert tool 99360613 through phase sensor housing (6) on tooth machined on tune wheel.

In case tool (6) is difficult to insert, unlock screws (5) and orient tune wheel (4) to properly match the tooth.

Lock screws (5).

Figure 56



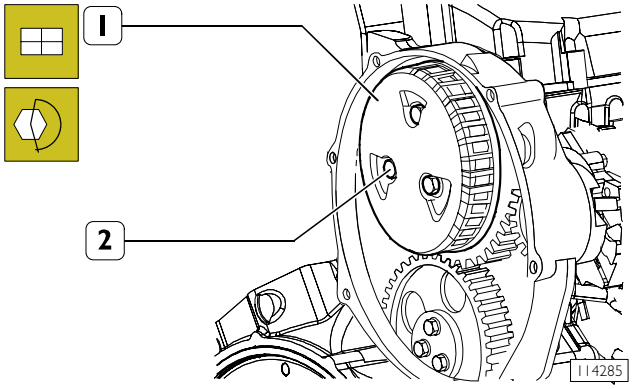
NOTE Pipes previously removed ca no longer be refit. Change them.

Install fuel supply pipeline (1) from high pressure pump to rail.

Lock nuts at 35 Nm torque.

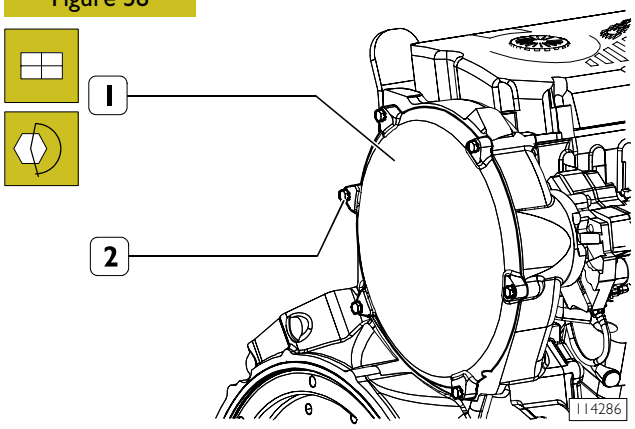
After high-pressure pipe installation, during the following 20 hours of work, frequently check engine oil level (IT MUST NOT INCREASE).

Figure 57



Install centrifugal filter (1) on tune wheel and lock screws (2) at required torque.

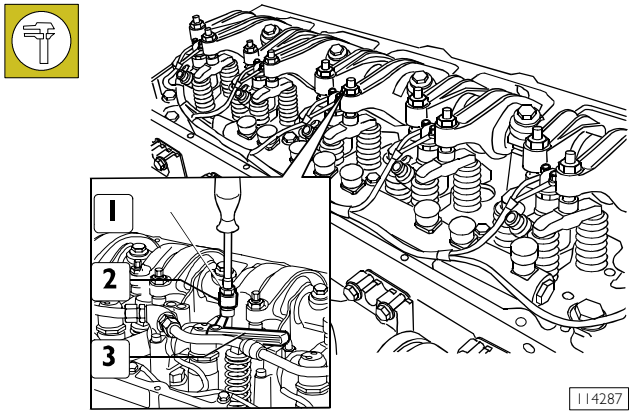
Figure 58



Install timing cover (1) and lock retaining screws (2) at required torque.

Intake and exhaust rocker arm clearance adjustment

Figure 59



Adjustment of clearance between rocker arms and intake/exhaust valve control crosspieces must be performed with utmost care. Bring to blast phase cylinder to be adjusted; the valves of this cylinder are closed while the symmetric cylinder valves are balanced. Symmetric cylinders are 1-6; 2-5 and 3-4.

In order to perform these operations correctly, refer to procedure and table below.

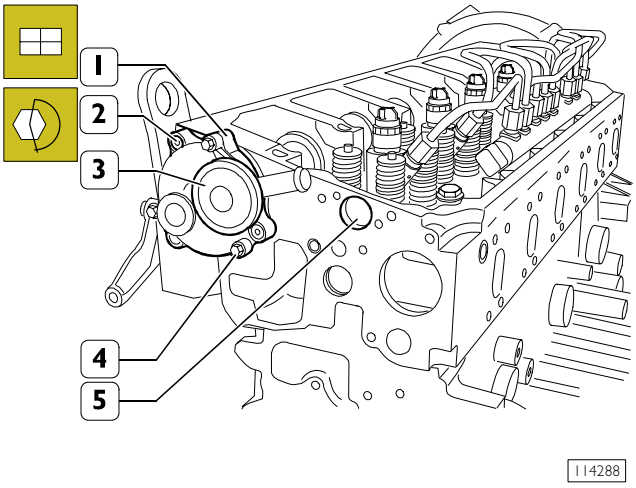
- Use a polygonal spanner to release lock nut (1) of rocker arm adjustment screw (2).
- Insert filler gage (3) having same value of operating clearance shown in "Characteristic and data" tables.
- Use special spanner to lock/unlock adjustment screw.
- Check that filler gage (3) slides with a low friction.
- Lock nut (1) retaining the adjustment screw.

IGNITION ORDER 1-4-2-6-3-5

START AND ROTATION CLOCKWISE	BALANCE VALVES OF CYLINDER No.	ADJUST CLEARANCE OF VALVES CYLINDER No.
1 and 6 at TDC	6	1
120°	3	4
120°	5	2
120°	1	6
120°	4	3
120°	2	5

NOTE In order to correctly carry out adjustments above, it is mandatory to perform the sequence indicated in the table, checking exact positioning at each phase by means of pin 99360612.

Figure 60

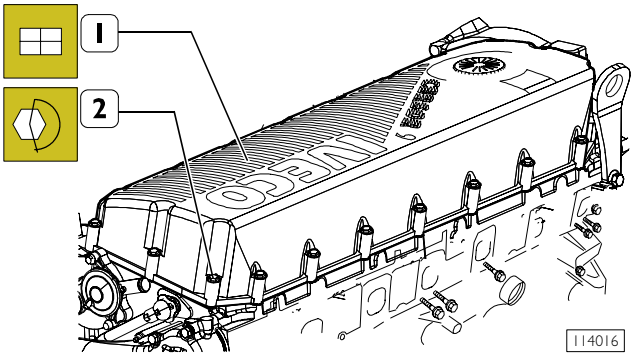


Install blow-by body (1) with related seal and lock screws (2) at required torque.

Install cover (3) and lock screws (4) at required torque.

Install wiring harness to injectors and pressure sensor of rail through hole (5).

Figure 61



Install cylinder head cover (1) and lock screws (2) at required torque following order shown in Figure 62 diagram.

Figure 62

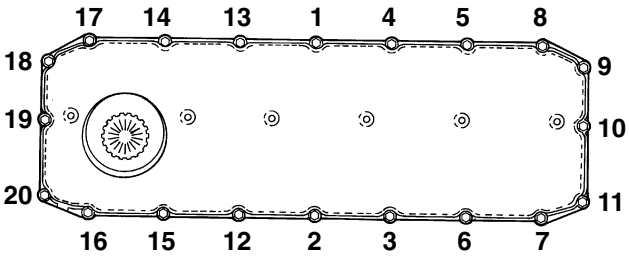
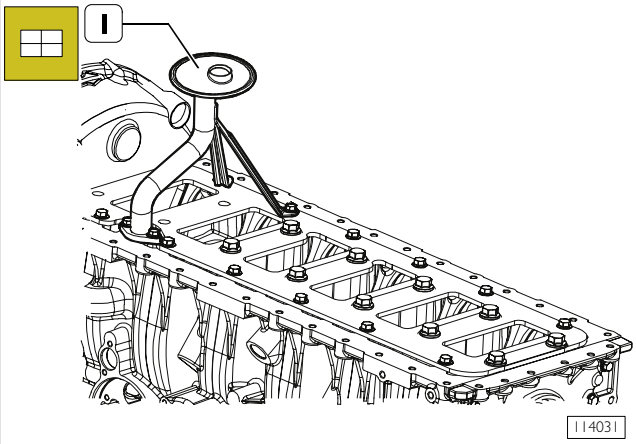
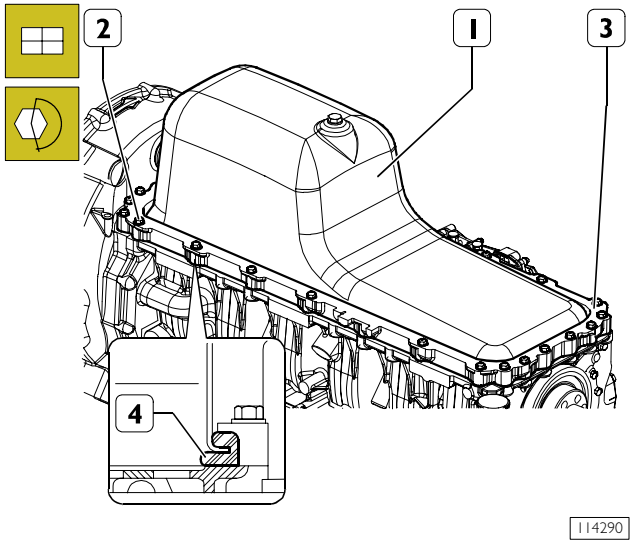


Figure 63



Install suction rose (1).

Figure 64



Rotate engine.

Fit seal (4) on oil sump (1), fit spacer (3) and install sump on engine block locking screws (2) at required torque.

ENGINE ASSEMBLY COMPLETION

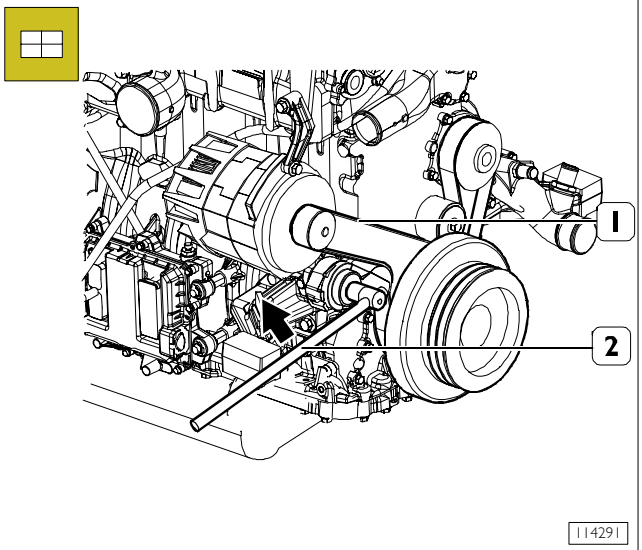
Complete engine assembly fitting or connecting parts below:

- complete fuel filter support and pipelines;
- EDC ecu;
- intake manifold with pre-heating resistor;
- heat exchanger;
- exhaust manifold;
- turbocharger and related water and oil;
- pulley and damper flywheel assy (install fixed guide pulley 5, Figure 3, before assy);
- thermostat assy;
- belt tensioner, water pump, alternator;
- oil level rod;
- start-up motor;
- oil filter;
- electric connections and sensors.

NOTE Fittings of pipelines, cooling water and turbocharger lube oil must be locked at:

- 35 ± 5Nm, water pipeline fittings;
- 55 ± 5Nm, oil pipeline female fitting;
- 20-25 Nm, oil pipeline make fitting.

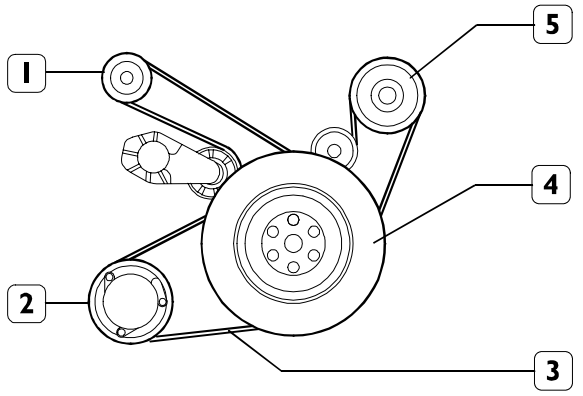
Figure 65



Use specific equipment (2) to install belt (1) on belt tensioner, in direction shown by arrow.

NOTE Belt tensioner is automatic, therefore no further adjustments are required after installation.

Figure 66



COMPRESSOR CONTROL ELASTIC BELT INSTALLATION DIAGRAM
1. Alternator - 2. Air conditioner compressor - 3. Elastic belt - 4. Crankshaft - 5. Water pump

Install the conditioner compressor (2) and lock retaining screws at required torque.

Install elastic belt (3) on crankshaft pulley.

Fit belt on air conditioner pulley queue (2).

Use specific tool to rotate crankshaft in order to fit belt on conditioner pulley.

NOTE During operation, conveniently guide belt to prevent torsions/tensions that might adversely affect it.

Possibly place a bit of rubber between pulley and belt.

NOTE Elastic belt must be replaced with a new one after each disassembly operation.

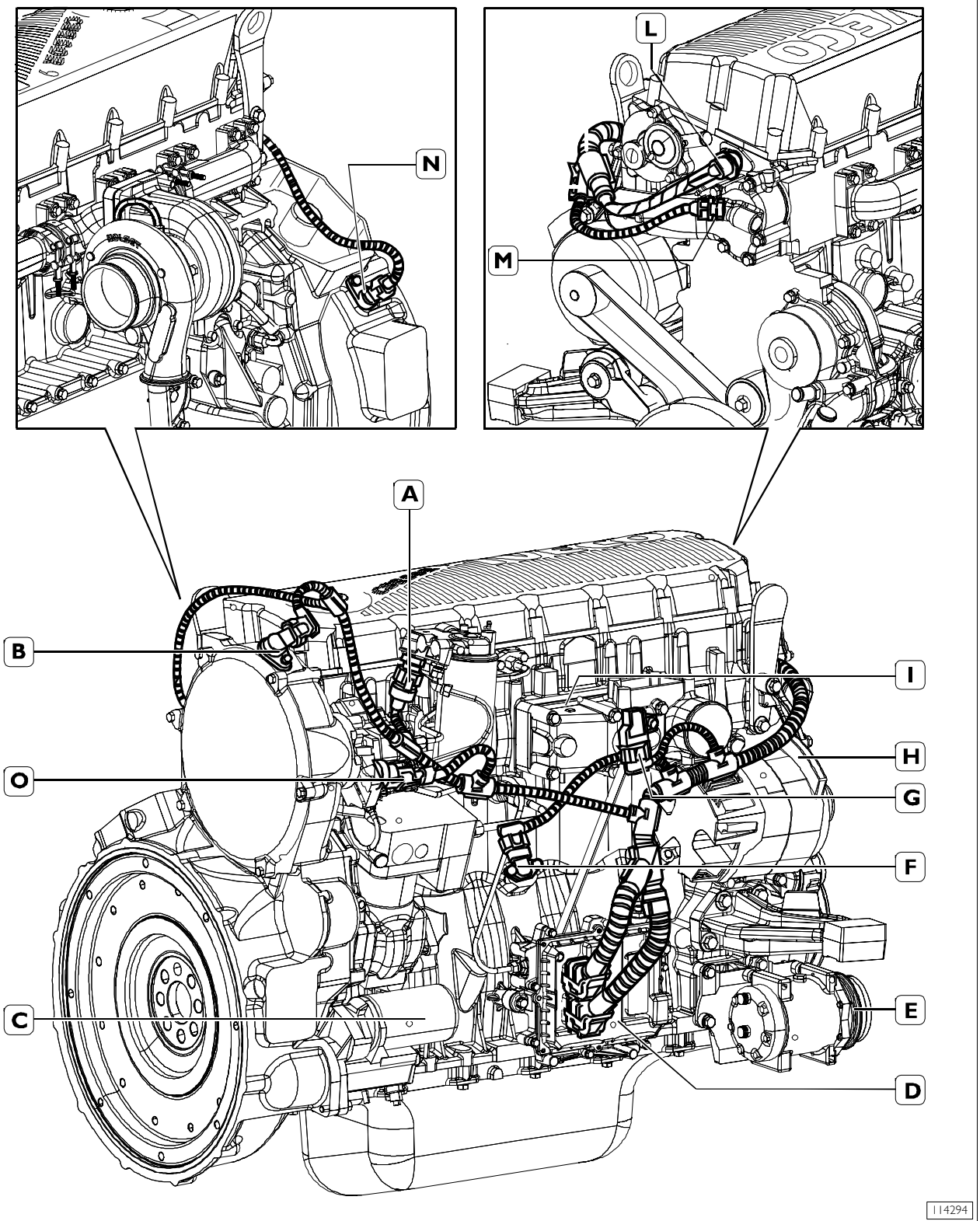
Refill engine with required quantity of oil.

Remove engine from stand and fit heat exchanger with turbocharger oil drain pipeline.

PART TWO -
ELECTRICAL EQUIPMENT

Components on the engine F2C

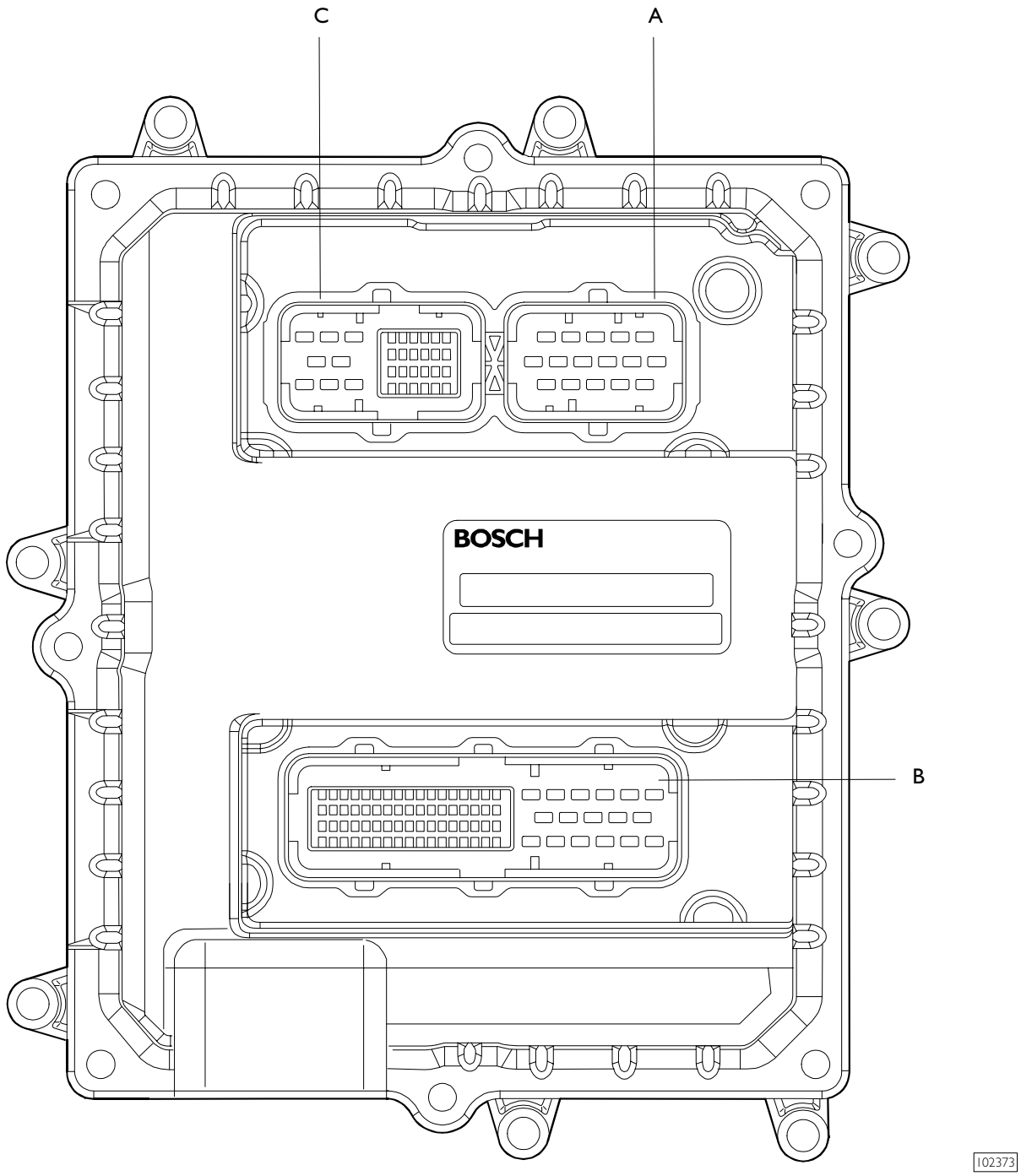
Figure 1



A. Fuel temperature sensor - B. Engine rpm sensor on camshaft - C. Starter motor - D. EDC 7 control unit - E. Conditioner compressor - F. Pressure/temperature transmitter - G. Temperature/air pressure sensor - H. Alternator - I. Resistance for engine warming - L. Connector on engine block for connection with electro-injectors - M. Water temperature sensor - N. Engine speed on flywheel sensor - O. Fuel adjustment valve on high pressure pump

EDC 7 UC31 electronic control unit

Figure 2

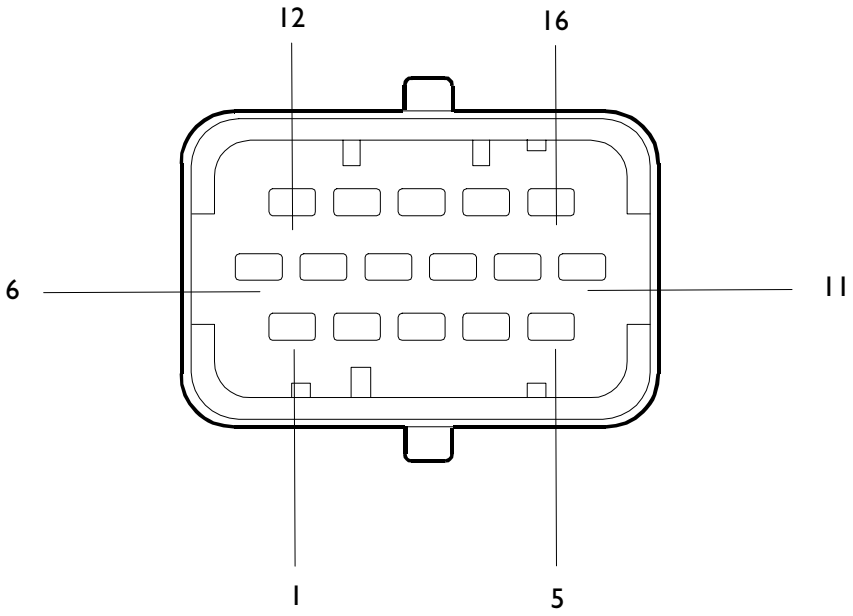


A. Electro-injector connector - B. Chassis connector - C. Sensor connector

EDC control unit PIN-OUT

Electric injector connector "A"

Figure 3



Colour legend

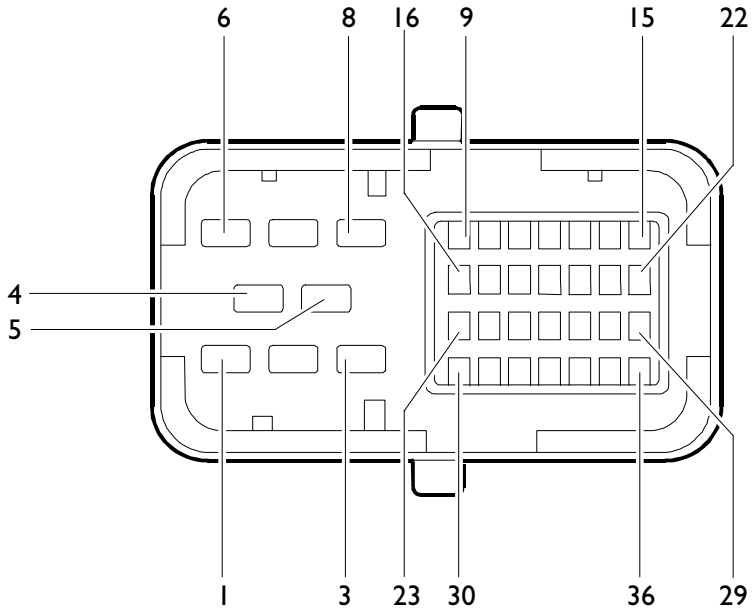
B	black
R	red
U	blue
W	white
P	purple
G	green
N	brown
Y	yellow
O	orange
E	grey
K	pink

Pin	Function
1	Solenoid valve for electronic cylinder 5 injection
2	Solenoid valve for electronic cylinder 6 injection
3	Solenoid valve for electronic cylinder 4 injection
4	Solenoid valve for electronic cylinder 1 injection
5	Solenoid valve for electronic cylinder 3 injection
6	Solenoid valve for electronic cylinder 2 injection
7	Free
8	Free
9	Fuel high pressure pump
10	Fuel high pressure pump
11	Solenoid valve for electronic cylinder 2 injection
12	Solenoid valve for electronic cylinder 3 injection
13	Solenoid valve for electronic cylinder 1 injection
14	Solenoid valve for electronic cylinder 4 injection
15	Solenoid valve for electronic cylinder 6 injection
16	Solenoid valve for electronic cylinder 5 injection

EDC control unit PIN-OUT

Sensor connector "C"

Figure 4



Colour legend

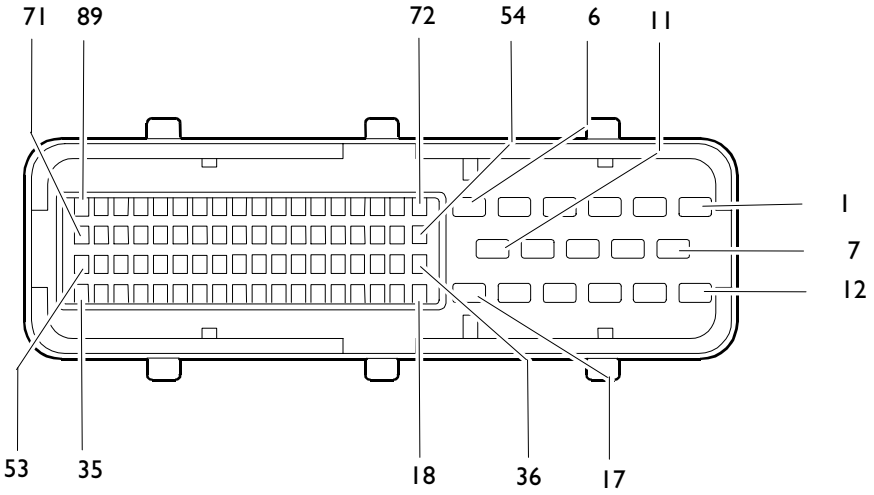
B	black
R	red
U	blue
W	white
P	purple
G	green
N	brown
Y	yellow
O	orange
E	grey
K	pink

Pin	Function
1÷8	N.C.
9	Engine speed sensor (timing)
10	Engine speed sensor (timing)
11	N.C.
12	Pressure sensor on rail
13	Pressure sensor on rail
14	Pressure sensor on rail
15	Coolant temperature sensor
16	N.C.
17	N.C.
18	Fuel temperature sensor
19	Engine speed sensor (flywheel)
20	N.C.
21	N.C.
22	N.C.
23	Engine speed sensor (flywheel)
24	Engine oil pressure/temperature sensor
25	Air pressure/temperature sensor supply
26	Coolant temperature sensor
27	Engine oil temperature/pressure sensor
28	Engine oil temperature/pressure sensor
29	N.C.
30	N.C.
31	N.C.
32	Engine oil temperature/pressure sensor
33	Air pressure signal from air pressure/temperature sensor
34	Air temperature signal from air pressure/temperature sensor
35	Fuel temperature sensor
36	Air temperature signal from air pressure/temperature sensor

EDC control unit PIN-OUT

Chassis connector "B"

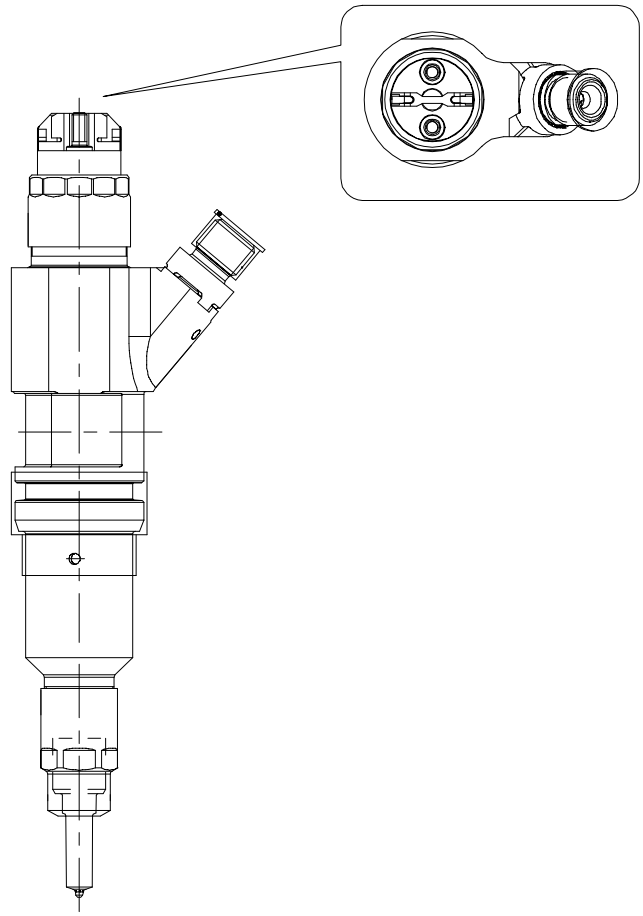
Figure 5



Pin	Function
1	---
2	Power supply positive (+B)
3	Power supply positive (+B)
4	---
5	Power supply negative (-B)
6	Power supply negative (-B)
7	---
8	Power supply positive (+B)
9	Power supply positive (+B)
10	Power supply negative (-B)
11	Power supply negative (-B)
12	Pre-heating resistor relay command
13÷28	---
29	EDC system diagnostics switch supply (provision)
30÷33	---
34	CAN L (ECB) line
35	CAN H (ECB) line
36÷39	---
40	Battery positive with key ON
41	---
42	Signal in from water present in fuel sensor
43÷74	---
75	Pre-post heating resistor relay positive
76÷88	---
89	ISO "K" diagnostics line

Electroinjectors

Figure 6



I14255

It is a N.O. solenoid valve.

They are connected to the EDC ECU on connector A.

The resistance of each injector coil is 0.56 - 0.57 Ohm.

The injector is built like the traditional ones, except for no needle return spring; the electroinjector can be considered as consisting of 2 parts:

- actuator - atomizer including pressure rod, needle and nozzle;
- control solenoid valve including coil and pilot valve.

The solenoid valve controls atomizer needle lift.

INJECTION START

When coil is energized, lock pin moves upward.

The control volume fuel flows to return duct causing control volume pressure drop.

At the same time, fuel pressure in pressure chamber causes needle uplift and therefore fuel injection in cylinder.

END OF INJECTION

When coil is de-energized, lock pin returns to lock position to look for a force balance such to return to needle close position and stop injection.

Engine coolant temperature sensor

This N.T.C. type sensor located on the water outlet sump on the engine head left measures coolant temperature for the various operating logics with a hot or cold engine and identifies injection enrichment requirements for a cold engine or fuel reduction requirements for a hot engine.

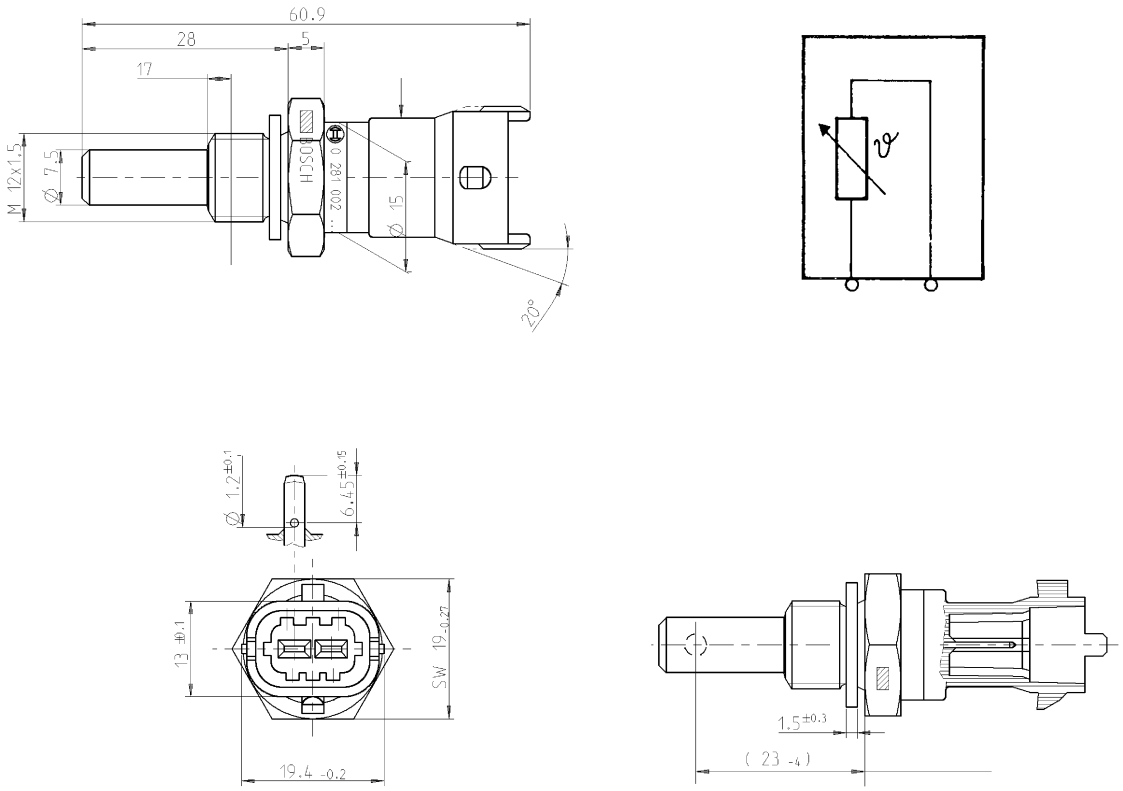
It is connected to electronic center pins 15/26.

Sensor behavior as a function of temperature:

- 10 °C	8,10 ÷ 10,77 kOhm
+ 20 °C	2,28 ÷ 2,72 kOhm
+ 80 °C	0,29 ÷ 0,364 kOhm

At 60 to 90 °C, voltage at A5 and A22 ranges from 0.6 to 2.4V.

Figure 7



104266

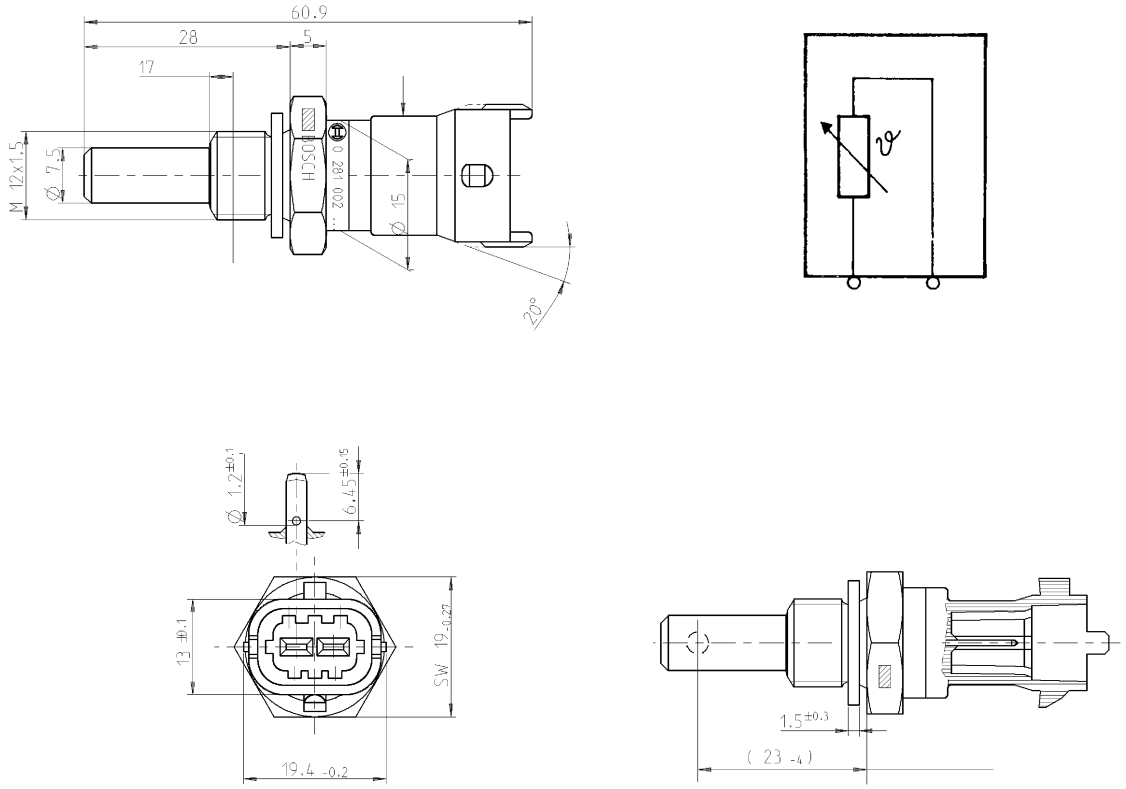
Description	Cable colour
To EDC center pin 15 (Sensor connector "C")	K
To EDC center pin 26 (Sensor connector "C")	Y

Fuel temperature sensor

Specifications

Supplier	BOSCH
Max. tightening torque	35 Nm

Figure 8



104267

Description	Cable colour
To pin 18 of EDC control unit (Sensor connector "C")	O/B
To pin 35 of EDC control unit (Sensor connector "C")	W/R

High pressure pump (pressure regulator)

Pump with 3 radial pistons commanded by timing gear, requiring no tuning, with rotor supply pump applied on rear end.

A. Fuel drain outlet fitting to filter support

B. Fuel inlet fitting from ECU heat exchanger

C. Fuel inlet fitting from fuel filter

D. Fuel outlet fitting from supply pump to filter

E. Fuel outlet fitting to rail

1. High-pressure pump

2. Supply pump

3. Pressure regulator (NO solenoid valve modulated by ECU with PWM signal).

Pressure regulator

Located at high-pressure pump inlet, on low pressure system, it modulates the amount of fuel for high-pressure pump supply based on commands received from ECU.

It mainly consists of parts below:

- ❑ trapezoidal-section lock pin;
- ❑ valve control pin;
- ❑ pre-load valve;
- ❑ coils.

When no control signal is present, the pressure regulator is normally open, therefore the high pressure pump is in max delivery condition.

The ECU modulates a PWM control signal to extend or reduce section of fuel supply line to high-pressure pump.

The component cannot be replaced as an individual part, therefore it cannot be removed.

The quantity of high-pressure supply fuel is metered by a proportional valve positioned on low-pressure system and it is managed by the ECDC 7 ECU.

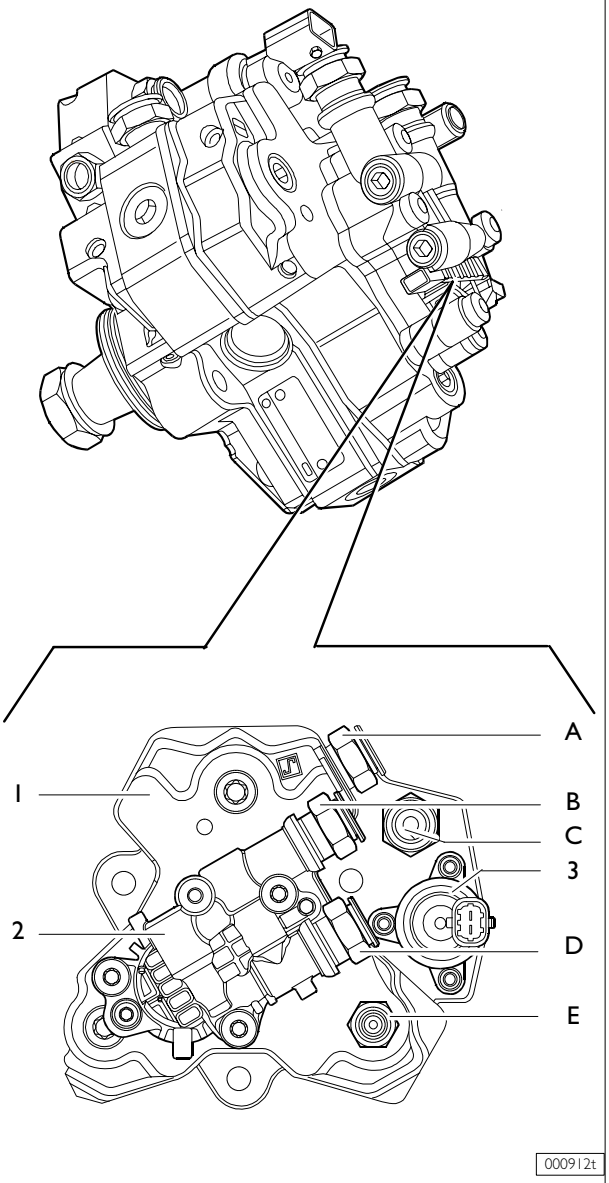
The delivery pressure to rail is modulated between 250 and 1400 bars by ECU operating on pressure regulator solenoid valve.

It is a NO solenoid valve.

Its resistance is ~ 3,2 Ω.

It is connected to ECU pins C5 - C7.

Figure 9

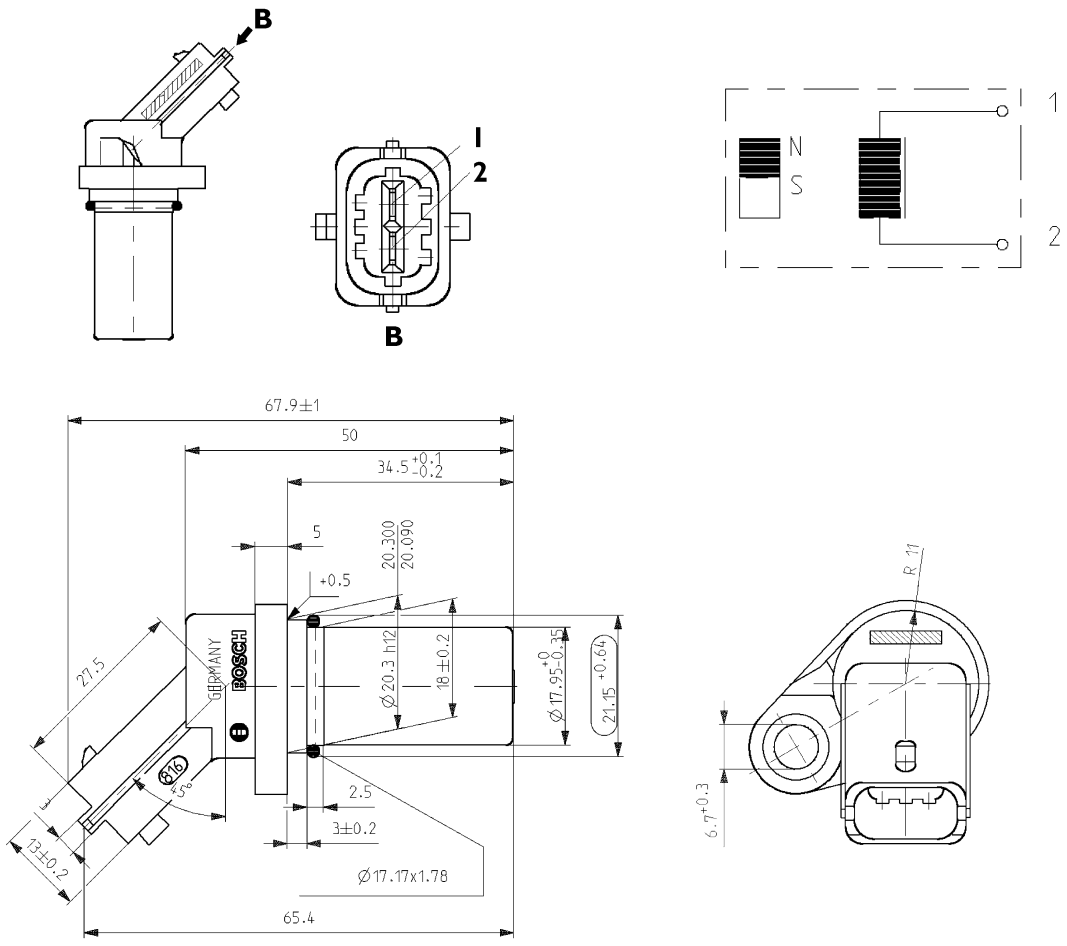


Flywheel pulse transmitter

Specifications

Supplier	BOSCH
Max. tightening torque	8 ± 2 Nm

Figure 10



104269

Description	Cable colour
To pin 19 of EDC control unit (Sensor connector "C")	B
To pin 23 of EDC control unit (Sensor connector "C")	W

Distribution pulse transmitter

Features

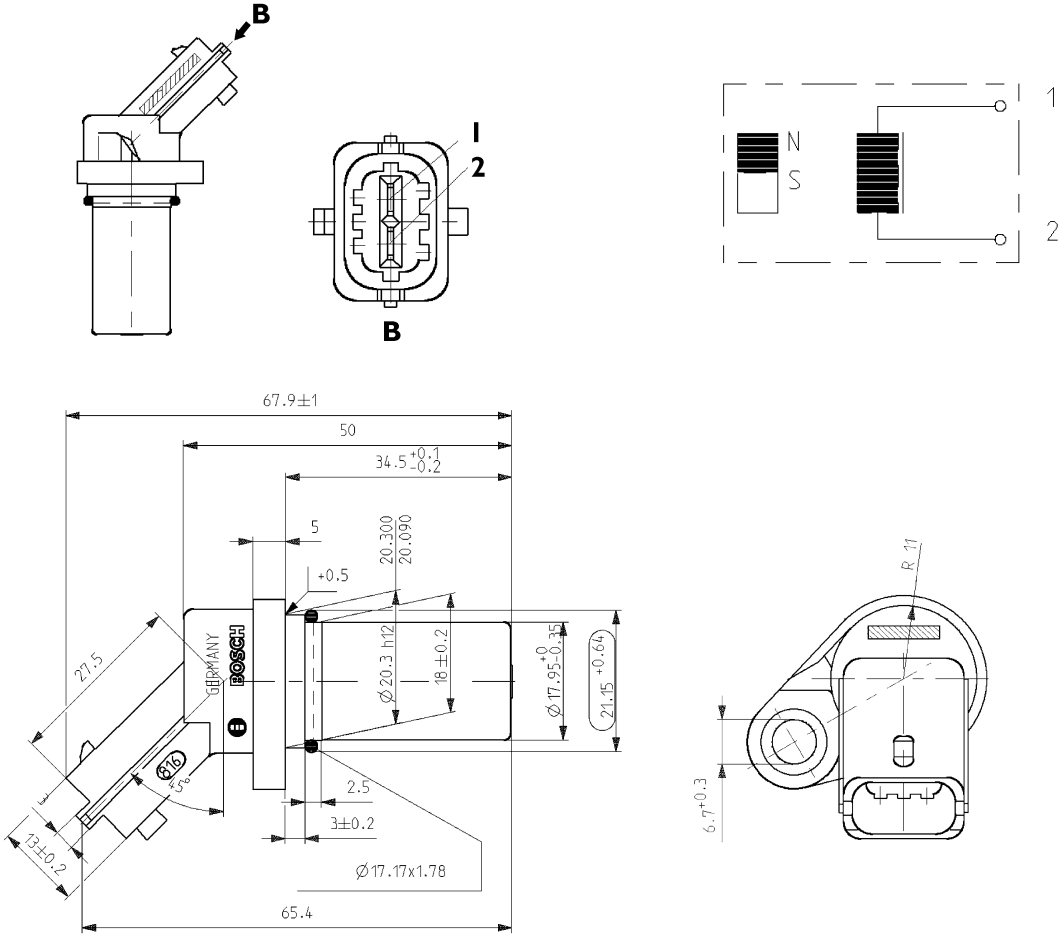
Vendor	BOSCH
Torque	8 ± 2 Nm
Resistance	880 ÷ 920 Ω

This induction type sensor located on the camshaft generates signals obtained from the magnetic flow lines that close through the 6 plus 1 phase teeth of a sound wheel mounted on the shaft.

The electronic center uses the signal generated by this sensor as an injection step signal.

This sensor's air gap is NOT ADJUSTABLE.

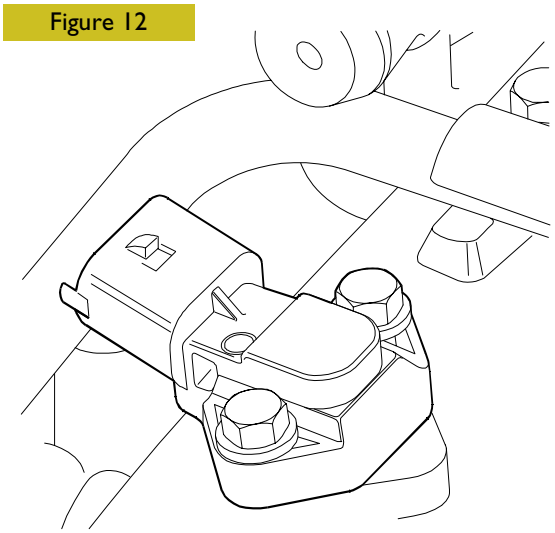
Figure 11



104269

Description	Cable colour
To EDC center pin 9 (Sensor connector "C")	W
To EDC center pin 10 (Sensor connector "C")	R

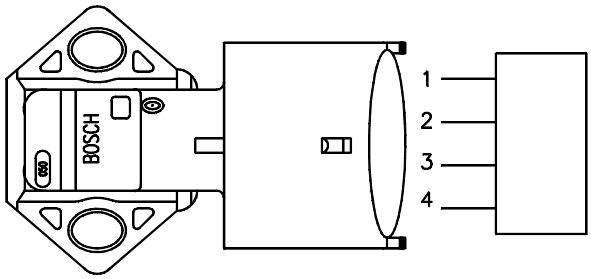
Figure 12



50324

Sensor external view

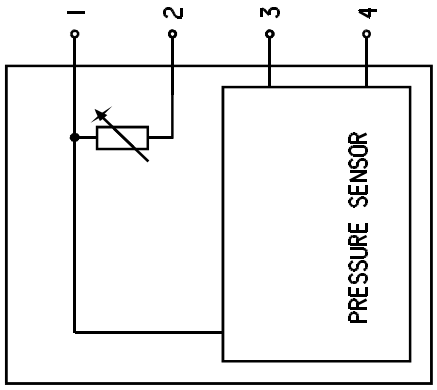
Figure 13



50323

Linking connector

Figure 14



50344

Wiring diagram

Oil temperature/pressure sensor (42030 / 47032)

This component is identical to the air pressure/temperature sensor and replaced single sensors 47032 / 42030.

It is fitted onto the engine oil filter, in a horizontal position.

It measures the engine oil temperature and pressure.

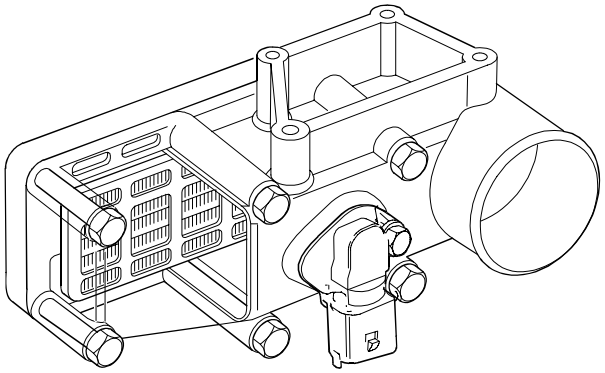
The measured signal is sent to the EDC control unit which controls, in turn, the indicator instrument on the dashboard (low pressure warning lights / gauge).

Pin (EDC)	24/C - 32/C	Power supply
Pin (EDC)	27/C	Temperature
Pin (EDC)	28/C	Pressure

The engine oil temperature is used only by the EDC control unit.

Ref.	Description	Control unit pin
1	Ground	24C
2	Temp. Sign.	27C
3	+5	32C
4	Press. Sign.	28C

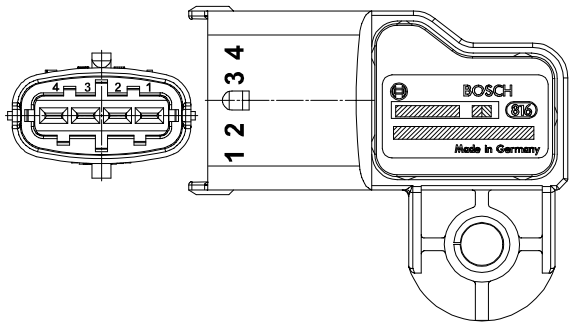
Figure 15



114266

Sensor external view

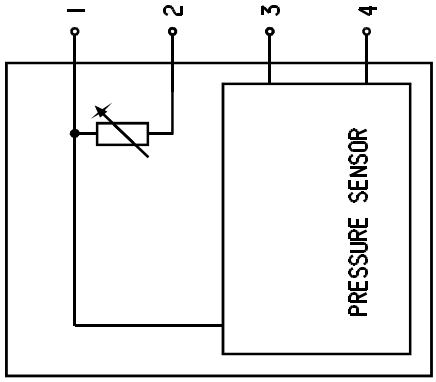
Figure 16



114273

Linking connector

Figure 17



50344

Wiring diagram

Air pressure/temperature sensor (85156).

This component incorporates a temperature sensor and a pressure sensor.

Ilt replaces the temperature sensors (85155) and pressure sensors (85154) available in the preceding systems.

It is fitted onto the intake manifold and measures the maximum supplied air flow rate used to accurately calculate the amount of fuel to be injected at every cycle.

The sensor is powered with 5 V.

The output voltage is proportional to the pressure or temperature measured by the sensor.

Pin (EDC)	25/C - 33/C	Power supply
Pin (EDC)	36/C	Temperature
Pin (EDC)	34/C	Pressure

Ref.	Description	Control unit pin
1	Ground	25C
2	Temp. Sign.	36C
3	+5	33C
4	Press. Sign.	34C

Fuel pressure sensor on rail

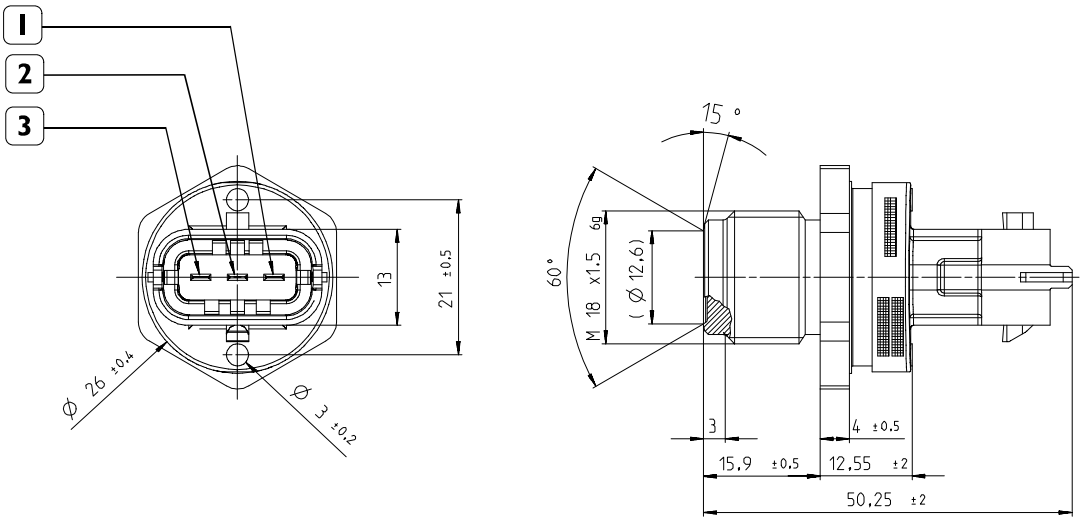
Installed on one rail end, it measures actual fuel pressure in order to determine injection pressure.

The injection pressure value is used for pressure check and to determine the injection electric command duration.

It is supplied with 5 volts.

It is connected to ECU on pins 12C - 13C - 14C.

Figure 18



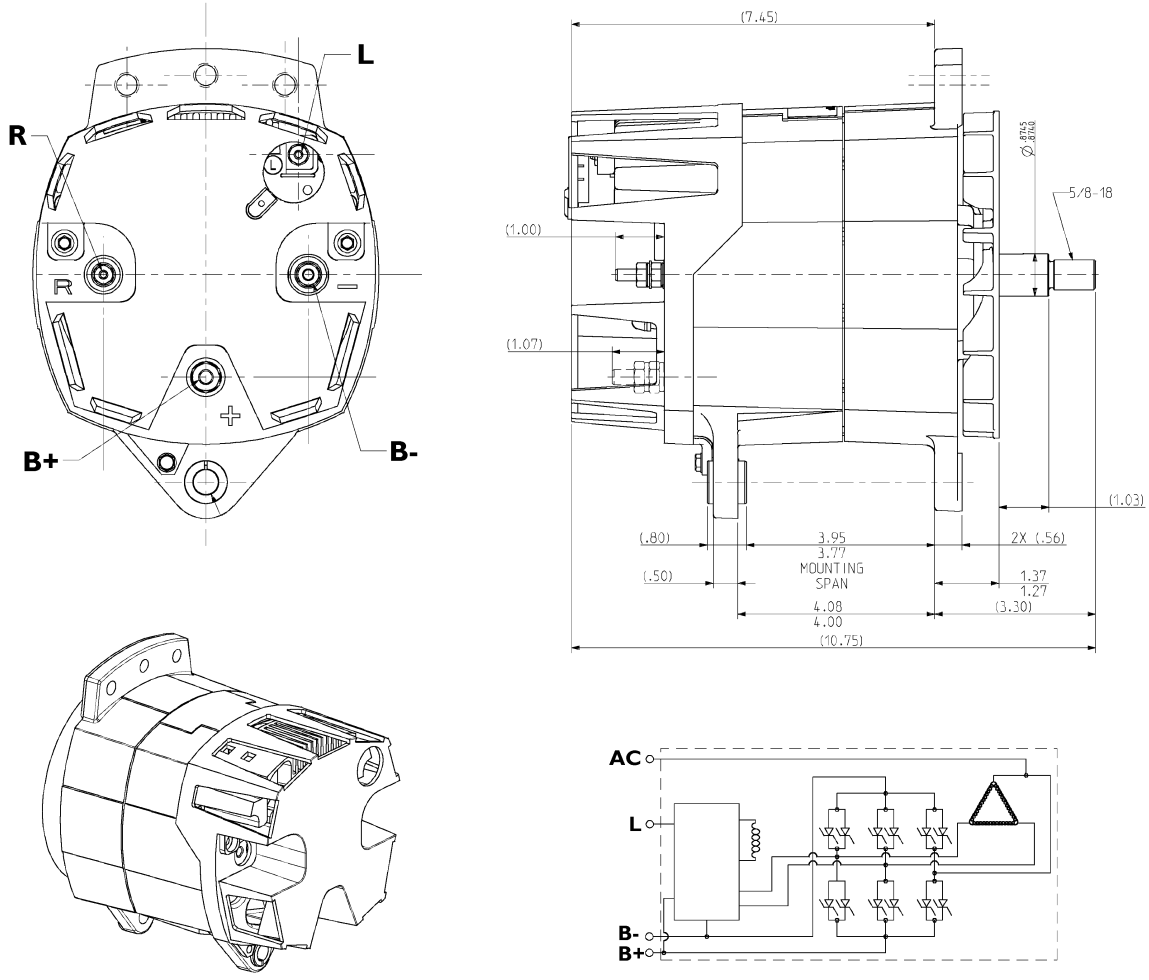
114620

Ref.	Description	Pin ecu
1	ECU pin	12C
2	Ground	13C
3	Supply Pressure	14C

Alternator
(for types: F2CE9684A - F2CE9684B - F2CE9684C*E001 - F2CE9684D - F2CE9684L)

Supplier LEECE NEVILLE
Technical features 12V - 185A

Figure 19



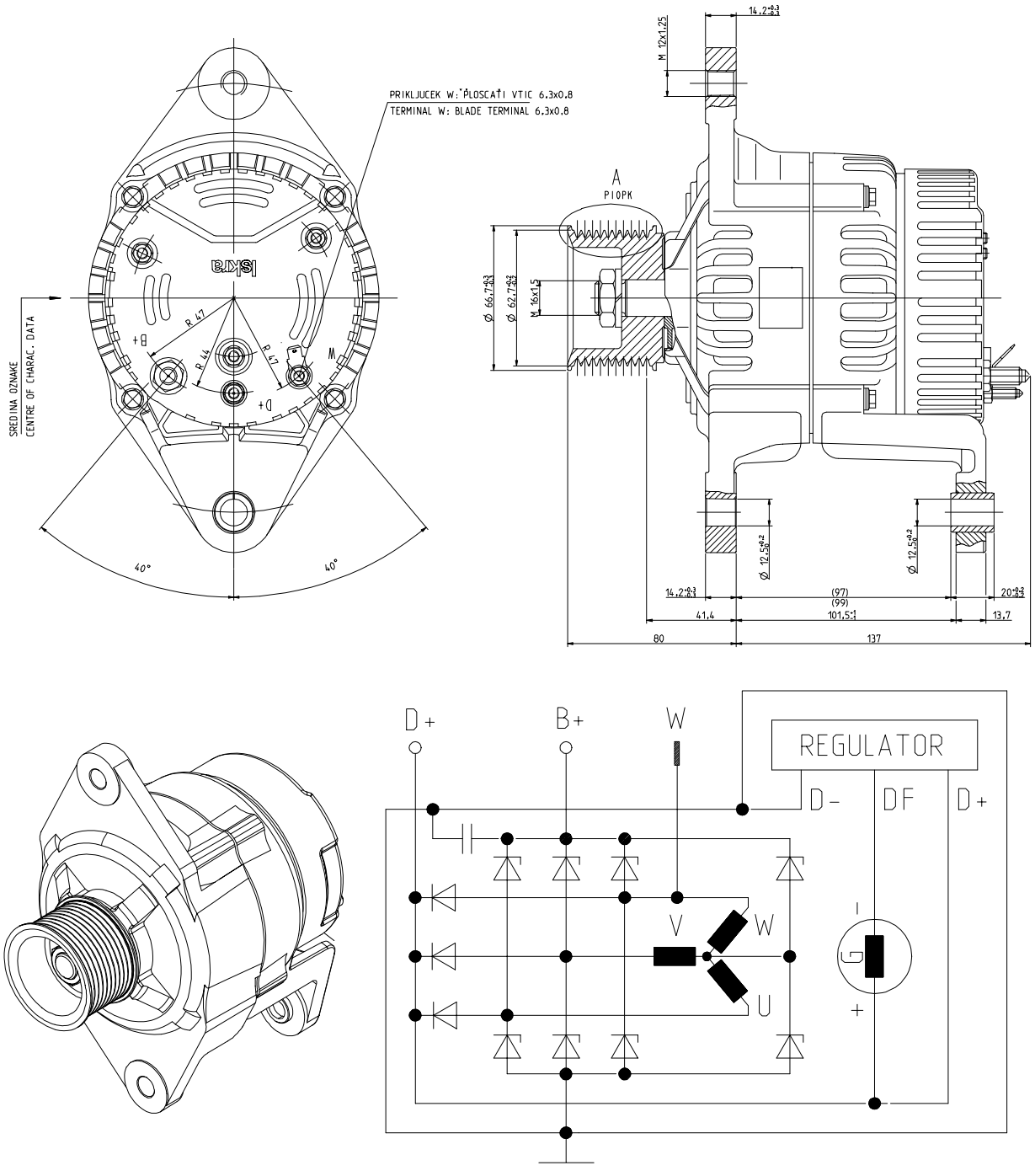
104314

Connector	Description
R	AC Connector
L	Driver warning light connector
-	Negative
+	Positive

Alternator (for types: F2CE9684C*E002 - F2CE9684E)

Supplier ISKRA
Technical features 12V - 120A

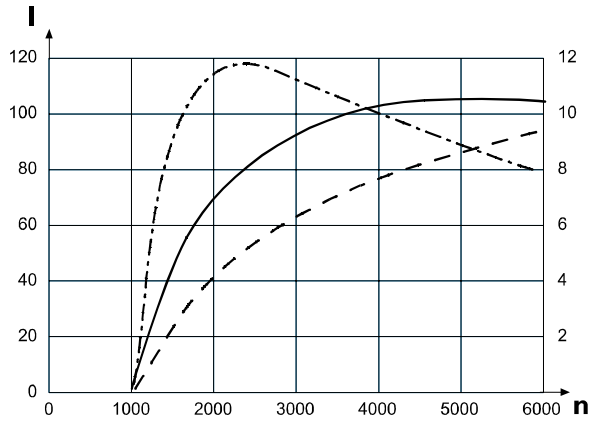
Figure 20

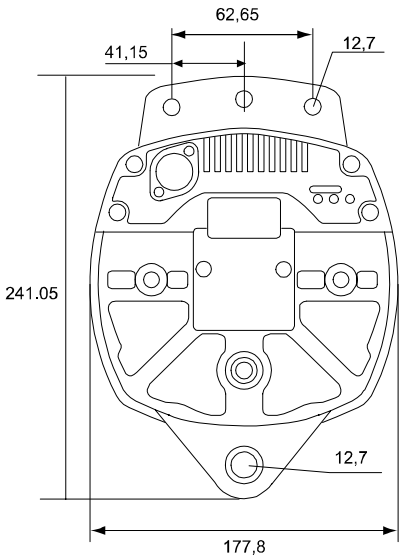


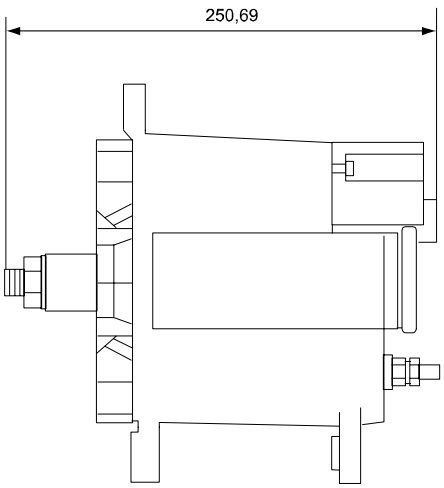
Alternator (per type: F2CE9684H)

Supplier LEECE NEVILLE
Technical features 24V - 100A

Figure 21







114295

I = outlet current

n = number of revolutions per minute

—•—• = Torque

——— = Outlet current

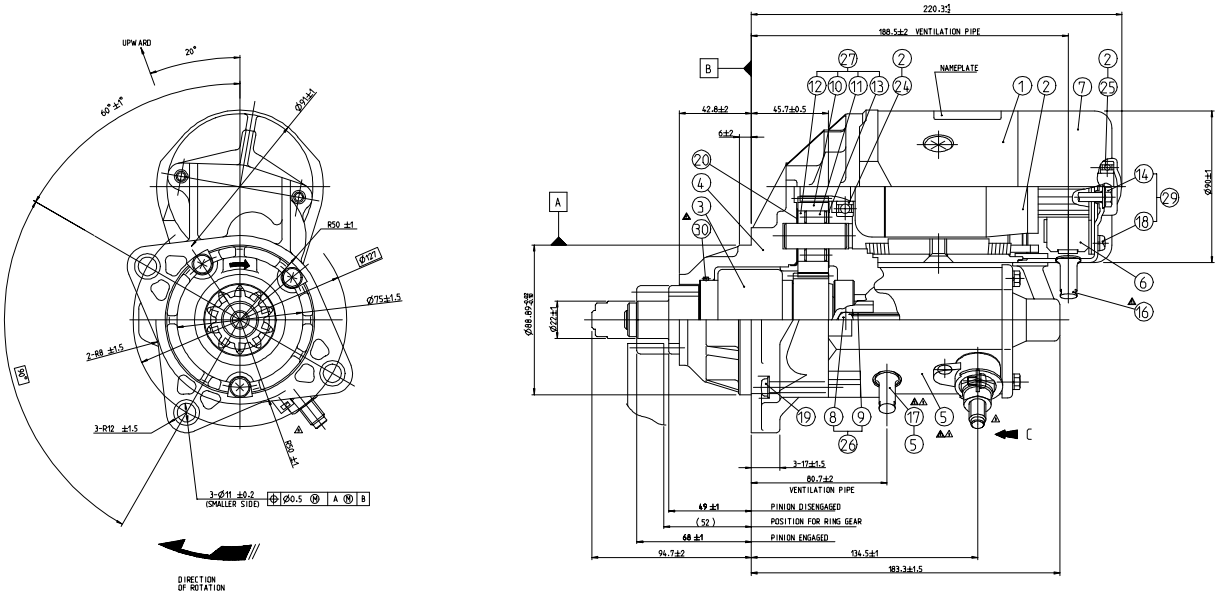
— — = Power

Starting motor

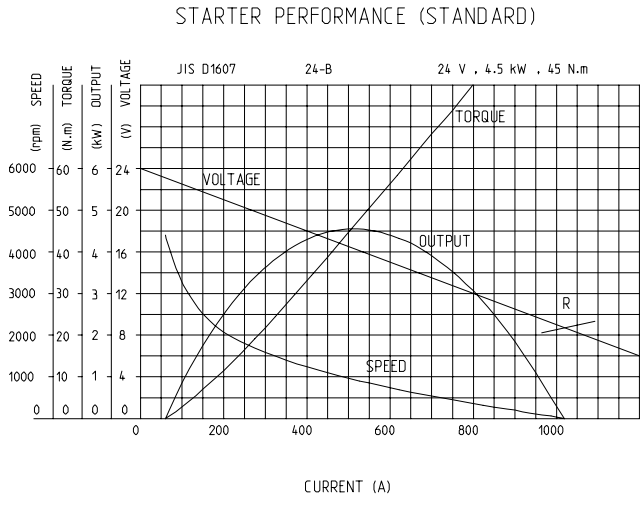
Specifications

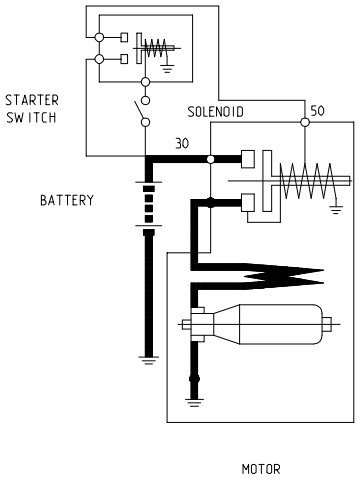
Supplier	DENSO
Type	2280005641
Electrical system	24 Volt
Nominal output	4.5 Kw

Figure 22



CONNECTING DIAGRAM
RELAY





I14283

PRE/POST-HEATING RESISTANCE

The resistance is ~ 0.7 Ohm.

Such resistance is placed between the cylinder head and the suction manifold. It is used to heat up air during pre/post-heating operations.

When the ignition key is inserted, should any one of the temperature sensors – water, air, gas oil – detect a value below 10°C, the electronic control unit will activate pre/post-heating and turn on the relevant dashboard warning light for a variable time depending on the temperature.

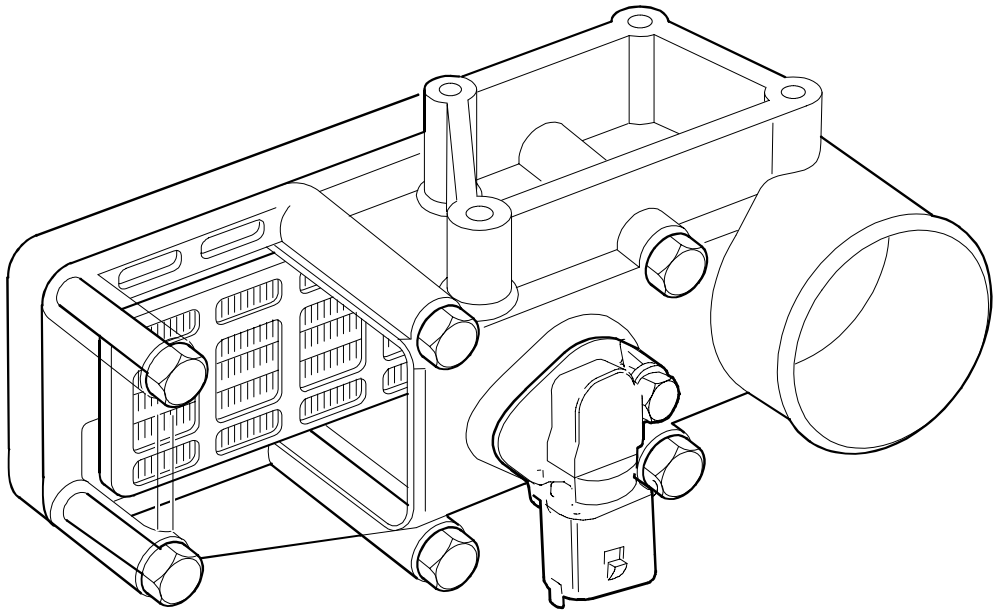
After that time, the warning light starts blinking thus informing the driver that the engine can be started.

When the engine is running the warning light goes off, while the resistance is being fed for a certain time as a result of post-heating.

If the engine is not started, with the warning light flashing, in 20 / 25 seconds, the operation is cancelled to prevent draining the battery.

On the contrary, if reference temperatures are over 10°C, when the ignition key is inserted the warning light comes on for about 2 seconds and carries out the test and then goes out to signal that the engine can be started.

Figure 23



114610

EDC SYSTEM FUNCTIONS

The EDC 7 UC31 electronic center manages the following main functions:

Fuel injection
Accessory functions such as cruise control, speed limiter, PTO and the like
Self-diagnosis
Recovery

It also enables:

Interfacing with other electronic systems (if any) available on the vehicle

Diagnosis

Fuel dosing

Fuel dosing is calculated based on:
- accelerator position
- engine rpm
- quantity of air admitted.

The result can be corrected based on:
- water temperature

or to prevent:
- noise
- fumes
- overloads
- overheating

Pressure can be adjusted in case of:
- engine brake actuation
- external device actuation (e.g. speed reducer, cruise control)
- serious defects involving load reduction or engine stop.

After determining the mass of air introduced by measuring its volume and temperature, the center calculates the corresponding mass of fuel to be injected into the cylinder involved, with account also taken of gas oil temperature.

Delivery correction based on water temperature

When cold, the engine encounters greater operating resistance, mechanical friction is high, oil is till very viscous and operating plays are not optimized yet.
Fuel injected also tends to condense on cold metal surfaces.
Fuel dosing with a cold engine is therefore greater than when hot.

Delivery correction to prevent noise, fumes or overloads

Behaviors that could lead to the defects under review are well known, so the designer has added specific instructions to the center to prevent them.

De-rating

In the event of engine overheating, decreasing delivery proportionally to the temperature reached by the coolant changes injection.

Injection lead electronic control

Injection lead, or the start of fuel delivery expressed in degrees, can differ from one injection to the next, even from one cylinder to another and is calculated similarly to delivery according to engine load, namely, accelerator position, engine rpm and air admitted.
Lead is corrected as required:
- during acceleration
- according to water temperature

and to obtain:
- reduced emissions, noise abatement and no overload
- better vehicle acceleration

High injection lead is set at start, based on water temperature.
Delivery start feedback is given by injection electro valve impedance variation.

Engine start

Cylinder 1 step and recognition signal synchronization (flywheel and drive shaft sensors) takes place at first engine turns. Accelerator pedal signal is ignored at start. Star delivery is set exclusively based on water temperature, via a specific map. The center enables the accelerator pedal, when it detects flywheel acceleration and rpm such as to consider the engine as started and no longer drawn by the starter motor.

Cold start

Pre-post reheating is activated when even only one of the three water, air or gas oil temperature sensors records a temperature of below 10 °C. The pre-heat warning light goes on when the ignition key is inserted and stays on for a variable period of time according to temperature, while the intake duct input resistor heats the air, then starts blinking, at which point the engine can be started.
The warning light switches off with the engine revving, while the resistor continues being fed for a variable period of time to complete post-heating. The operation is cancelled to avoid uselessly discharging the batteries if the engine is not started within 20 ÷ 25 seconds with the warning light blinking. The pre-heat curve is also variable based on battery voltage.

Hot start

On inserting the ignition key the warning light goes on for some 2 seconds for a short test and then switches off when all reference temperatures are above 10 °C. The engine can be started at this point.

Run Up

When the ignition key is inserted, the center transfers data stored at previous engine stop to the main memory (Cf. After run), and diagnoses the system.

After Run

At each engine stop with the ignition key, the center still remains fed by the main relay for a few seconds, to enable the microprocessor to transfer some data from the main volatile memory to an non-volatile, cancelable and rewritable (Eeprom) memory to make tem available for the next start (Cf. Run Up).
These data essentially consists of:
- miscellaneous settings, such as engine idling and the like
- settings of some components
- breakdown memory

The process lasts for some seconds, typically from 2 to 7 according to the amount of data to be stored, after which the ECU sends a command to the main relay and makes it disconnect from the battery.

This procedure must never be interrupted, by cutting the engine off from the battery cutout or disconnecting the latter before 10 seconds at least after engine cutout.

In this case, system operation is guaranteed until the fifth improper engine cutout, after which an error is stored in the breakdown memory and the engine operates at lower performance at next start while the EDC warning light stays on.

Repeated procedure interruptions could in fact lead to center damage.

Cut-off

It refers to the supply cut-off function during deceleration.

Cylinder Balancing

Individual cylinder balancing contributes to increasing comfort and operability.
This function enables individual personalized fuel delivery control and delivery start for each cylinder, even differently between each cylinder, to compensate for injector hydraulic tolerances.
The flow (rating feature) differences between the various injectors cannot be evaluated directly by the control unit. This information is provided by the entry of the codes for every single injector, by means of the diagnosis instrument.

NOTE Not present on agricultural versions.

Synchronization search

The center can anyhow recognize the cylinder to inject fuel into even in the absence of a signal from the camshaft sensor.
If this occurs when the engine is already started, combustion sequence is already acquired, so the center continues with the sequence it is already synchronized on; if it occurs with the engine stopped, the center only actuates one electro valve. Injection occurs onside that cylinder within 2 shaft revs at the utmost so the center is only required to synchronize on the firing sequence and start the engine.

PART THREE - TROUBLESHOOTING

PREFACE

A successful troubleshooting is carried out with the competence acquired by years of experience and attending training courses.

When the user complains for bad efficiency or working anomaly, his indications must be kept into proper consideration using them to acquire any useful information to focus the intervention.

After the detection of the existing anomaly, it is recommended to proceed with the operations of troubleshooting by decoding the auto-troubleshooting data provided by the EDC system electronic central unit.

The continuous efficiency tests of the components connected to, and the check of working conditions of the entire system carried out during working, can offer an important diagnosis indication, available through the decoding of the "failure/anomaly" codes issued by blinking of the failure led: the "blink-code" (whether programmed).

Please consider that the interpretation of the indications provided by the blink-code is not sufficient to guarantee the solution to the existing anomalies.

Using Iveco Motors processing instruments, it is also possible to establish a bi-directional connection with the central unit, by which not only to decoding the failure codes but also input an enquiry relying on memory files, in order to achieve any further necessary information to identify the origin of the anomaly.

Every time there is a breakdown claim and this breakdown is actually detected, it is necessary to proceed inquiring the electronic unit in one of the ways indicated and then proceed with the diagnostic research making trials and tests in order to have a picture of the working conditions and identify the root causes of the anomaly.

In case the electronic device is not providing any indication, it will be necessary to proceed relying on the experience, adopting traditional diagnosis procedures.

In order to compensate the operators' lack of experience in this new system, we are hereby providing the USER's GUIDELINE FOR TROUBLESHOOTING in the following pages.

Any kind of operation on the electronic center unit must be executed by qualified personnel, duly authorized by Iveco Motors.

Any unauthorized tamper will involve decay of after-sales service in warranty.

FAULT CODES

Failure code	Failure description	Warning lamp
	Vehicle 1 (Sensors/Plausibility checks)	
10019	Terminal 15 failure	
	Vehicle 2 (Lamps/relays/actuators)	
10025	Main relay defect	
20025	Interrupted afterrun	
10026	Battery voltage fault	SysLamp ON
10028	Main relay SCBatt (Lambda H./Grid H./Batt.switch)	SysLamp ON
20028	Main relay SCGND	
10029	Main relay 3	
1002B	Power stage air heater 1 actuator	SysLamp ON
1002E	Grid heater always switched on	
	Engine 1 (Temperature and Pressure Sensors)	
10031	Coolant temperature sensor	SysLamp ON
10032	Coolant temperature sensor dynamic test	
10033	Boost Temp. Signal	
10034	Boost pressure sensor	SysLamp ON
10035	Fuel Temp. Signal	SysLamp ON
10036	Rail pressure sensor CP3	SysLamp ON
20036	Rail pressure sensor offset monitoring	SysLamp ON
10037	Rail pressure relief valve	SysLamp ON
10038	Oil Pressure Sensor	SysLamp ON
20038	Oil Pressure too low	SysLamp ON
20032	Coolant temperature sensor	SysLamp ON
1003A	Oil Temp. Sensor	SysLamp ON
2003A	Oil Temperature above normal	SysLamp ON
	Engine 2 (Speed sensing/actuators)	
10041	Crankshaft sensor failure	SysLamp ON
10042	Running with camshaft sensor only	SysLamp ON
10043	Camshaft sensor failure	SysLamp ON
10044	Offset between camshaft and cranksh	SysLamp ON
1004D	Engine overspeed protection	
	Fuel metering CR Systems	
	Fuel metering Unit Injector Systems	
10052	Rail pr.max.pos.deviation exceeded conc.set flow of fuel	SysLamp ON
10053	Max. negative rail pressure deviation with metering unit on lower limit is exceeded	SysLamp ON
10054	Minimum rail pressure exceeded	SysLamp flashes
10055	Maximum rail pressure exceeded	SysLamp flashes
10056	Rail pressure drop rate is higher than expected	SysLamp ON
10057	Setpoint of metering unit in overrun mode not plausible	
10058	Setpoint of fuel volume flow through metering unit is lower than calculated limit	SysLamp ON
10059	Metering unit PWM-powerstage	SysLamp ON
20059	Short circuit to battery of metering unit output	SysLamp ON
30059	Short circuit to ground of metering unit output	
1005B	High pressure test (deactivates rail pr.Monitor)	

Failure code	Failure description	Warning lamp
	Injectors 1	
10061	Cylinder1 - Short circuit Low/High	SysLamp ON
10062	Cylinder2 - Short circuit Low/High	SysLamp ON
10063	Cylinder3 - Short circuit Low/High	SysLamp ON
10064	Cylinder4 - Short circuit Low/High	SysLamp ON
10065	Cylinder5 - Short circuit Low/High	SysLamp ON
10066	Cylinder6 - Short circuit Low/High	SysLamp ON
10067	Cylinder1 - Open load	SysLamp ON
10068	Cylinder2 - Open load	SysLamp ON
10069	Cylinder3 - Open load	SysLamp ON
1006A	Cylinder4 - Open load	SysLamp ON
1006B	Cylinder5 - Open load	SysLamp ON
1006C	Cylinder6 - Open load	SysLamp ON
1006E	The minimum number of injections was not reached --> stop the engine	
	Injectors 2	
10071	Bank 1 specific errors - Short circuit / not classifyable	SysLamp ON
10073	Bank 2 specific errors - Short circuit / not classifyable	SysLamp ON
1007C	Chip-specific errors-->only lamp on	SysLamp ON
2007C	Chip-specific errors-->only lamp on	SysLamp ON
	Boost system and turbine speed	
1009D	Torque limitation due to limited performance	
1009E	Torque limitation due to excessive smoke	
4009E	Torque limitation due to mechanical part protection	
6009E	Torque limitation due to fuel quantity reduction	
	Interfaces 1 (CAN-Bus)	
100B1	Busoff in CAN A	
100B3	Busoff in CAN C	
200B4	Timeout for BC2EDC2	SysLamp ON
100B5	Timeout for VM2EDC	SysLamp ON
	Interfaces 2 (CAN messages timeout)	
100C6	Timeout of CAN message TSC1-PE	SysLamp ON
200C6	Timeout of CAN message TSC1-TE (inactive)	SysLamp ON
100C8	Timeout of CAN message TSC1-VE	SysLamp ON
300C8	Timeout of CAN message TSC1-VR (inactive)	SysLamp ON
	ECU 1 (internal checks)	
100D1	Communication error of SPI	SysLamp flashes
100D2	Error state of EEPROM	
100D3	Recovery which is locked	SysLamp flashes
200D3	Recovery which is suppressed	SysLamp flashes
300D3	Recovery which is visible	SysLamp flashes
100D4	Communic.supervision Watchdog/Contr.-Flag	SysLamp flashes
100D5	Redundant shutoff paths during initial.	SysLamp flashes
100D6	Deviation between TPU and system time	SysLamp ON
100D7	Dataset variant coding	SysLamp flashes
100D8	Supervision of SPI-handler Flag	SysLamp ON
100D9	Error status ADC monitoring	SysLamp ON

Failure code	Failure description	Warning lamp
ECU 2 (Powerst./Immobil./Overrun/Sensor supply)		
100E1	Short circuit to Batt or Ground, no load, excess.temp. for high side power stage	SysLamp ON
200E1	Short circuit to Batt or Ground, no load, excess.temp. for low side power stage	SysLamp ON
100E3	Energising time exceeds limit of overrun monitor.	SysLamp flashes
100E4	Plausibility error in engine speed check	SysLamp flashes
100E5	12V sensor supply voltage	SysLamp flashes
100E6	Sensor supply voltage 1	SysLamp ON
100E7	Sensor supply voltage 2	SysLamp ON
100E8	Sensor supply voltage 3	SysLamp ON
100E9	Supply voltage ECU upper limit	SysLamp flashes
100EA	Supply voltage ECU lower limit	SysLamp flashes
100EB	Atmospheric pressure sensor	SysLamp ON

PART FOUR -

MAINTENANCE PLANNING

MAINTENANCE

Maintenance services chart

The covered distances indicated in this schedule are typical of engines used in vehicles.

The kilometre frequency for engine lubrication is in relation to a percentage of sulphur in diesel of under 0.5%.

NOTE: If using diesel with a percentage of sulphur above 0.5%, the oil-change frequency has to be halved.

Use engine oil: **ACEA E3 - 96**

- In the case of very low annual mileage of less than 600 hours, the engine oil and filters must be changed every 12 months.
- Premature clogging of the air cleaner is generally due to the operating conditions. The filter should therefore be renewed whenever clogging is signalled by the sensor regardless of the prescribed time interval, which should in any case be respected in the absence of any specific indications.

The covered distances specified in this schedule are provided purely as indications, owing to their being typical of average use of vehicle engines related to their displacement.

CHECKS AND/OR MAINTENANCE WORK

Type of operation	Every 150 hours	Every 300 hours	Every 600 hours	Every 1000 hours	Every 1500 hours
Engine					
Engine oil topping up	•				
Change engine oil			•		
Change engine oil filters			•		
Change of blow-by filter			•		
Replacing fuel filter		•			
Adjustment of valve clearance	Not necessary				
Change miscellaneous drive belts					•
Chassis and mechanical assemblies					
Change fuel pre-filter (if available)		•			

OFF-PLANE OPERATIONS

Every year – Before winter

and possibly when a maintenance operation is carried out

Check the antifreeze percentage in the engine cooling water

Every two year

and possibly when a maintenance operation is carried out

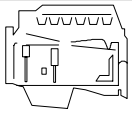
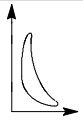
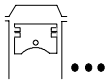
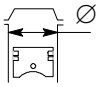
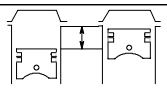
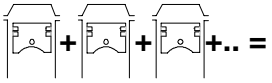
Change engine coolant

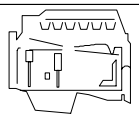
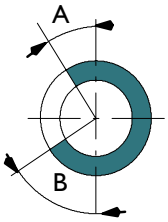
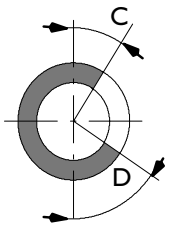
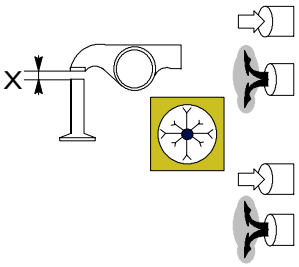
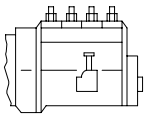
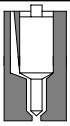
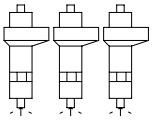
(1) Early air filter clogging is usually due to environmental conditions. For this reason, the filter should be changed if clogging is signalled by the related sensor, regardless of the prescriptions that shall be observed if no specific indications have been provided.

SECTION 4

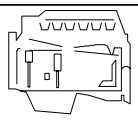
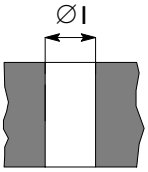
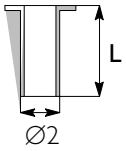
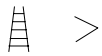
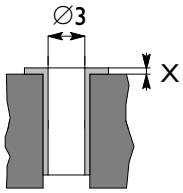
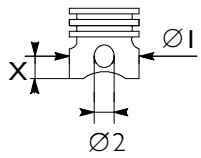
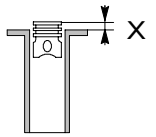
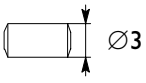
Overhaul and technical specifications

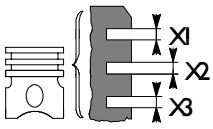
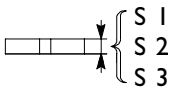
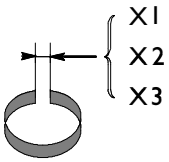
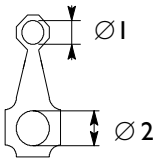
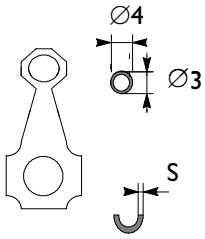
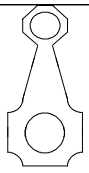
GENERAL CHARACTERISTICS

	Type		F2C
	Cycle		4-stroke Diesel engine
	Fuel feed		Turbocharged
	Injection		Direct
	No. of cylinders		6 in line
	Bore	mm	117
	Stroke	mm	135
	Total displacement	cm^3	8710

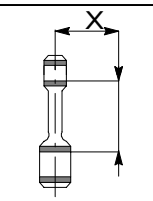
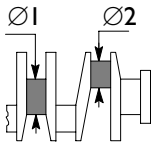
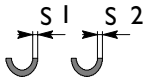
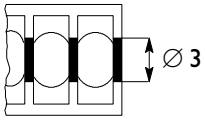
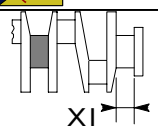
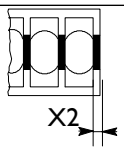
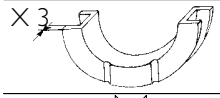
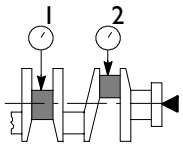
	Type	**F2C**
 	VALVE TIMING	
	opens before T.D.C. A	17°
	closes after B.D.C. B	31°
 	opens before B.D.C. D	48°
	closes after T.D.C. C	9°
	For timing check	
	X { mm	-
	mm	-
	Running	
	X { mm	0.35 to 0.45
	mm	0.35 to 0.45
	FEED	Bosch Common Rail with CRIN2 injectors and high pressure pump CP3.3
	Nozzle type	DLLA 137
	Injection order	1 - 4 - 2 - 6 - 3 - 5
	Injection pressure bar	1800
	Injector calibration bar	296 ± 6

ASSEMBLY CLEARANCE DATA

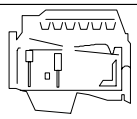
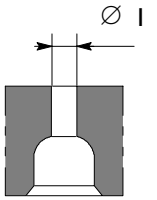
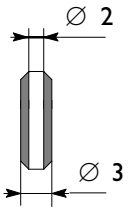
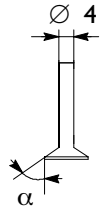
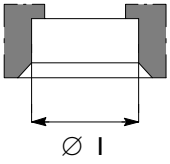
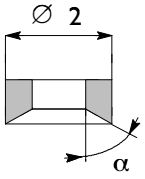
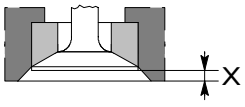
	Type	F2C
CYLINDER BLOCK AND CRANKMECHANISM COMPONENTS		mm
	Bores for cylinder liners: Ø1 upper Ø1 lower	 130.500 to 130.525 129.510 to 129.535
	Cylinder liners: external diameter: Ø2 upper Ø2 lower length L	 130.461 to 130.486 129.475 to 129.500 226.15
	Cylinder liners - crankcase bores upper lower	 0.014 to 0.064 0.010 to 0.060
IVECO PARTS 	External diameter Ø2	-
 * Selection class	Cylinder sleeve inside diameter Ø3A* inside diameter Ø3B* Protrusion X	 117.000 to 117.012 117.010 to 117.022 0.035 to 0.065
	Pistons: measuring dimension X external diameter Ø1A external diameter Ø1B pin bore Ø2	 15 116.894 to 116.906 116.904 to 116.916 52.010 to 52.016
 * Selection class	Piston - cylinder sleeve A* B*	 0.094 to 0.118 0.094 to 0.118
IVECO PARTS 	Piston diameter Ø1	-
	Pistons protrusion X	0.873 to 1.117
	Gudgeon pin Ø3	51.994 to 52.000
	Gudgeon pin - pin housing	0.010 to 0.022

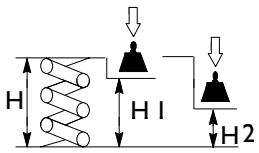
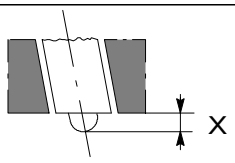
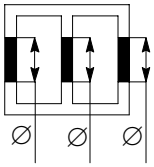
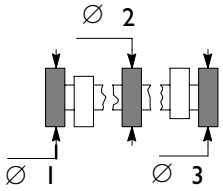
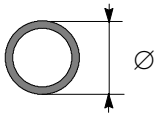
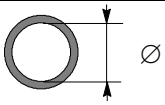
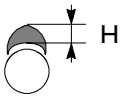
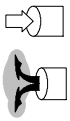
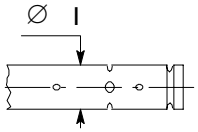
	Type		F2C
			mm
	Piston ring grooves	X1	3.120 to 3.140
		X2	2.550 to 2.570
		X3	4.020 to 4.040
	Piston rings: trapezoidal seal	S1	3.000
	lune seal	S2	2.470 to 2.500
	milled scraper ring with slits and internal spring	S3	3.970 to 3.990
	Piston rings - grooves	1	-
		2	0.050 to 0.100
		3	0.030 to 0.070
	Piston rings		-
	Piston ring end gap in cylinder liners		
		X1	0.3 to 0.4
		X2	0.60 to 0.75
		X3	0.35 to 0.65
	Small end bush housing	Ø1	55.700 to 55.730
	Big end bearing housing	Ø2	85.987 to 86.013
	Selection classes	1	85.987 to 85.996
		2	85.997 to 86.005
		3	86.006 to 86.013
	Small end bush diameter		
	outside	Ø4	55.780 to 55.820
	inside	Ø3	52.015 to 52.030
	Big end bearing shell	S	
	Red		1.994 to 2.002
	Green		2.002 to 2.010
	Yellow ●		2.010 to 2.018
	Small end bush - housing		0.05 to 0.08
	Piston pin - bush		0.015 to 0.036
	Big end bearing		0.127 - 0.254 - 0.508
	Connecting rod weight	A	g
	Class	A	3450 to 3470
		B	3471 to 3490
		C	3491 to 3510

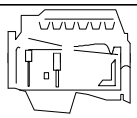
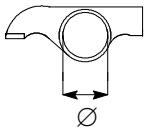
● Fitted in production only and not supplied as spares

	Type	F2C
		mm
	Measuring dimension X	125
	Max. connecting rod axis misalignment tolerance	0.08
	Main journals Ø1	
	- nominal	92.970 to 93.000
	- class 1	92.970 to 92.980
	- class 2	92.980 to 92.990
	- class 3	92.990 to 93.000
	Crankpins Ø2	
	- nominal	81.915 to 81.945
	- class 1	81.915 to 81.925
	- class 2	81.925 to 81.935
	- class 3	81.935 to 81.945
	Main bearing shells S1	
	Red	2.968 to 2.978
	Green	2.978 to 2.988
	Yellow*	2.988 to 2.998
	Big end bearing shells S2	
	Red	1.994 to 2.002
	Green	2.002 to 2.010
	Yellow*	2.010 to 2.018
	Main bearing housings Ø3	
	- nominal	99.000 to 99.030
	- class 1	99.000 to 99.009
	- class 2	99.010 to 99.019
	- class 3	99.020 to 99.030
	Bearing shells - main journals	0.050 to 0.090
	Bearing shells - big ends	0.040 to 0.080
	Main bearing shells	0.127 - 2.254 - 0.508
	Big end bearing shells	0.127 - 2.254 - 0.508
	Main journal, thrust bearing X1	39.96 to 40.04
	Main bearing housing, thrust bearing X2	38.94 to 38.99
	Thrust washer halves X3	3.38 to 3.43
	Crankshaft end float	0.10 to 0.30
	Alignment 1 - 2	-
	Ovalization 1 - 2	0.04
	Taper 1 - 2	-

* Fitted in production only and not supplied as spares

	Type	F2C
CYLINDER HEAD - VALVE TRAIN		mm
	Valve guide housings in cylinder head Ø1	12.9800 to 12.997
	Valve guide Ø2 Ø3	8.023 to 8.038 13.012 to 13.025
	Valve guides - housings in the cylinder heads	0.015 to 0.045
	Valve guide	0.2 - 0.4
	Valves: Ø4 α Ø4 α	 7.970 to 7.985 60° 30′ ± 7′ 30″ 7.970 to 7.985 45° +15 -0
	Valve stem and its guide	0.040 to 0.070
	Valve seat in head Ø1 Ø1	 41.985 to 42.020 40.985 to 41.020
	Outside diameter of valve seat; angle of valve seat in cylinder head: Ø2 α Ø2 α	 42.060 to 42.075 60° - 30′ 41.060 to 41.075 45° - 30′
	Recessing of valve	0.5 to 0.8 1.6 to 1.9
	Between valve seat and head	0.040 to 0.090

	Type	F2C	
		mm	
	Valve spring height:		
	free height H	70.77	71.34
	under a load of:		
	N 460 ± 23 H1A	51	
	N 460 ± 22 H1B		
	N 740 ± 33 H2A	39	
	N 731,4 ± 42 H2B		
	Injector protrusion X	1.2 to 1.5	
	Camshaft bushing housing in the cylinder head: 1 ⇒ 7 Ø	69.000 to 69.030	
	Camshaft bearing journals: 1 ⇒ 7 Ø	64.924 to 64.080	
	Outer diameter of camshaft bushings: Ø	69.090 to 69.130	
	Inner diameter of camshaft bushings: Ø	65.080 to 65.116	
	Bushings and housings in the cylinder head	0.060 to 0.130	
	Bushings and bearing journals	0.100 to 0.192	
	Cam lift: 	7.4034	
		8.2108	
	Rocker shaft Ø1	31.964 to 31.980	

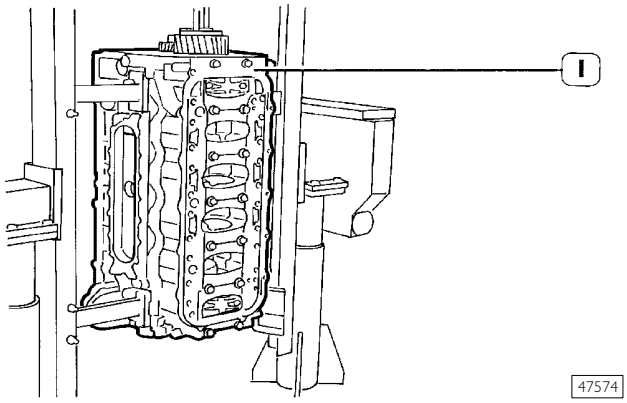
	Type	F2C	
		mm	
	Bushing housing in rocker arms		
		32.025 to 32.041	
		32.025 to 32.041	
	Between bushings and housings		
		0.045 to 0.077	
		0.045 to 0.077	
TURBOCHARGER			
Type		HX55	HX40
End float		0.025 to 0.127	0.025 to 0.127
Radial play		0.406 to 0.127	0.330 to 0.508

ENGINE OVERHAUL
ENGINE REMOVAL AT THE BENCH

The following instructions are prescribed on the understanding that the engine has previously been placed on the rotating bench and that removal of all specific components of the equipment have been already removed as well. (See Section 3 of the manual herein).

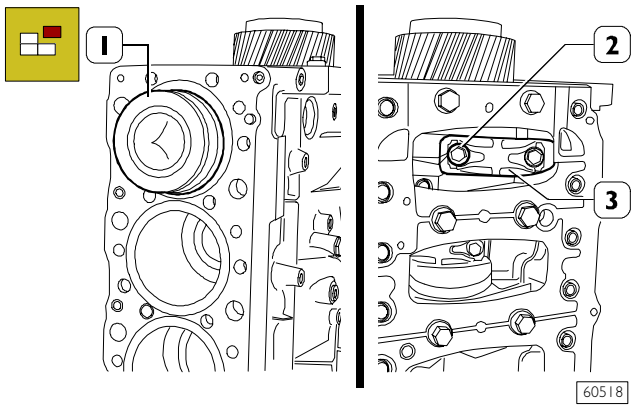
The section illustrates therefore all the most important engine overhaul procedures.

Figure 1



Rotate the block (1) to the vertical position.

Figure 2

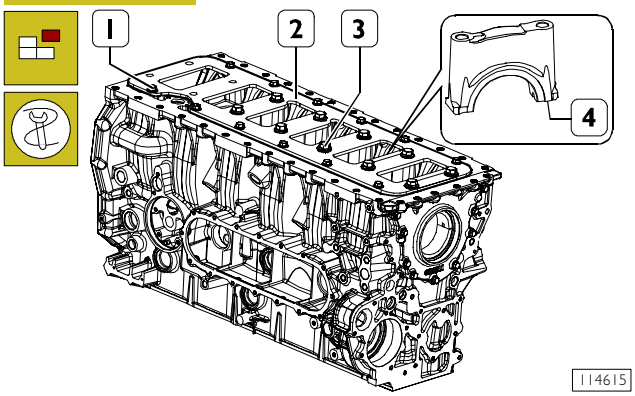


Untighten screws (2) fixing the connecting rod cap (3) and remove it. Remove the connecting rod-piston (1) assembly from the upper side.

Repeat these operations for the other pistons.

Keep the big end bearing shells in their respective housings and/or note down their assembly position since, if reusing them, they will need to be fitted in the position found upon removal.

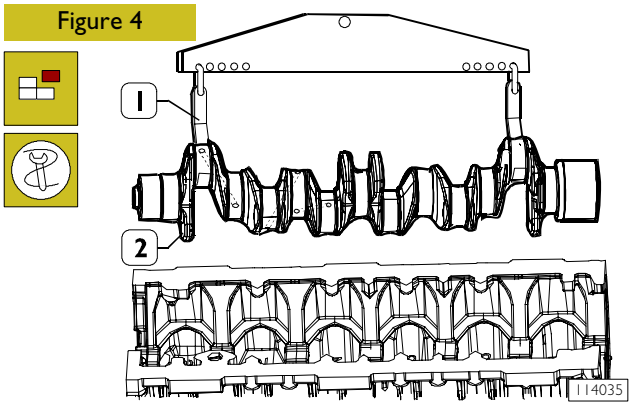
Figure 3



Use adequate hexagonal spanner, unlock screws (1 and 3) and remove stiffening plate (2) as well as main journals (4).

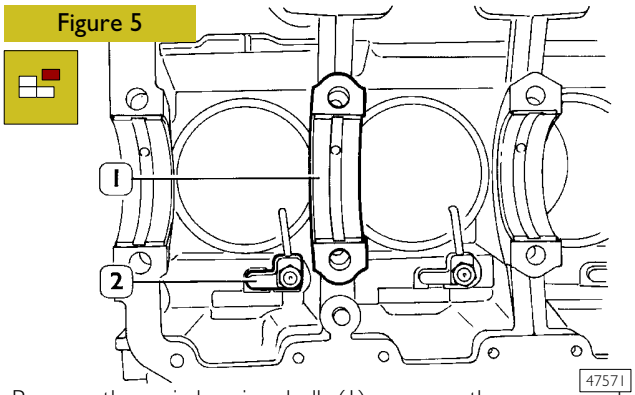
NOTE Note down the assembly position of the top and bottom main bearing shells since, if reusing them, they will need to be fitted in the position found upon removal.

Figure 4



Using tool 99360500 (1), remove the crankshaft (2).

Figure 5



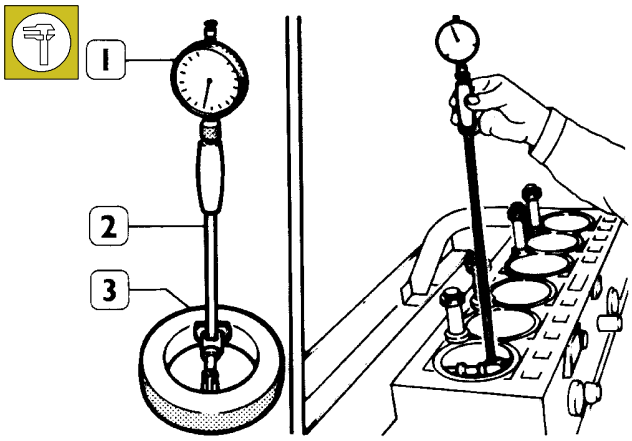
Remove the main bearing shells (1), unscrew the screws and take out the oil nozzles (2).
Remove the cylinder liners as described under the relevant subheading on page 15.

After disassembling the engine, thoroughly clean disassembled parts and check their integrity.

Instructions for main checks and measures are given in the following pages, in order to determine whether the parts can be re-used.

REPAIR OPERATIONS
CYLINDER BLOCK
Checks and measurements

Figure 6 (Demonstration)

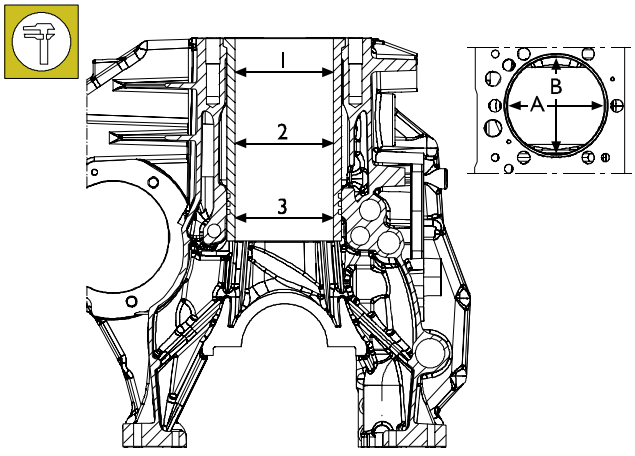


34994

Internal diameter of the cylinder liners is checked for ovalization, taper and wear, using a bore dial (1) centesimal gauge 99395687 (2) previously reset to ring gauge (3), diameter 117 mm.

NOTE If dia.117 mm ring gage is not available, use a micrometer.

Figure 7

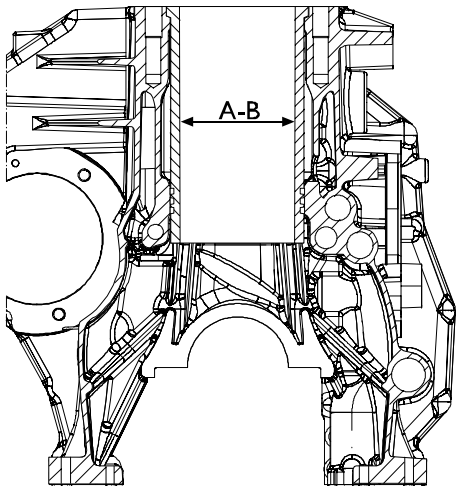


114035

1 = 1st measuring
2 = 2nd measuring
3 = 3rd measuring

Carry out measurings on each cylinder liner at three different levels and on two (A-B) surfaces, to one another perpendicular, as shown in Figure.

Figure 8



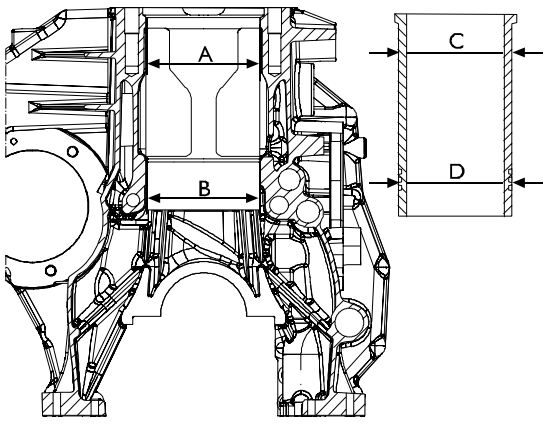
225036

A = Selection class Ø 117 – 117.012 mm
B = Selection class Ø 117.010 – 117.022 mm
X = Selection class marking area

In case of maximum wear >0.150 mm or maximum ovalization >0.100 mm compared to the values indicated in the figure, the liners must be replaced as they cannot be ground, lapped or trued.

NOTE Cylinder liners are equipped with spare parts with "A" selection class.

Figure 9



114037

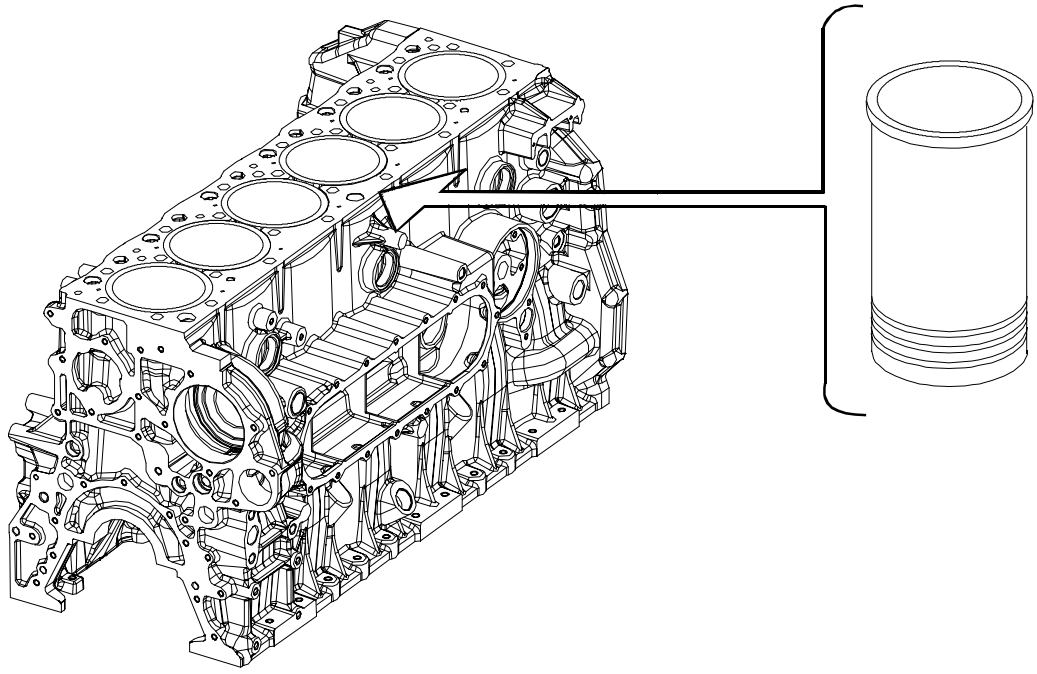
A = Ø 130.500 to 130.525 mm
B = Ø 129.510 to 129.535 mm
C = Ø 130.461 to 130.486
D = Ø 129.475 to 129.500 mm

The figure shows the outer diameters of the cylinder liners and the relative seat inner diameters.

The cylinder liners can be extracted and installed several times in different seats, if necessary.

CYLINDER LINERS

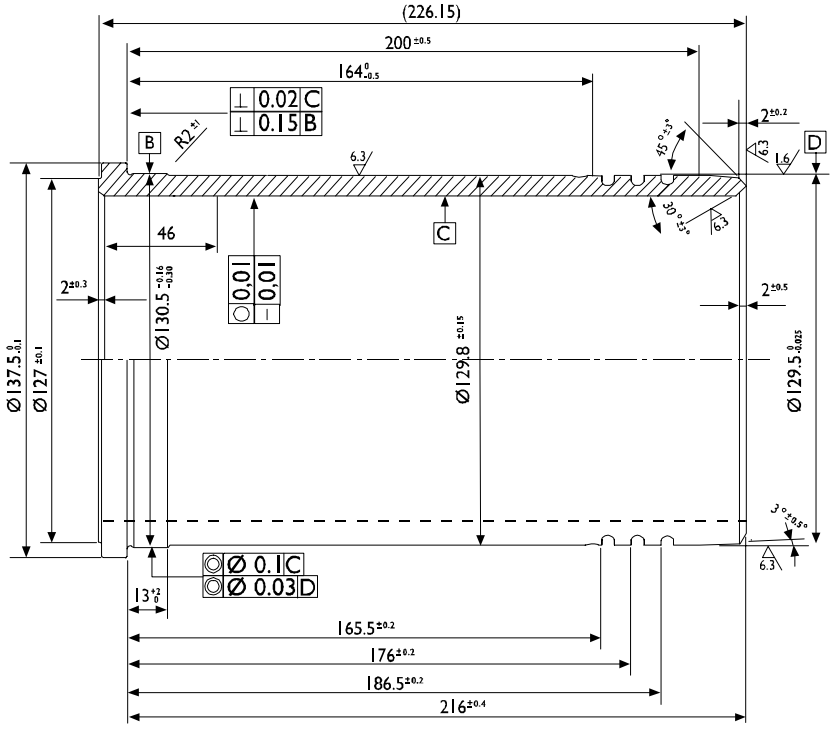
Figure 10



114038

CYLINDER BLOCK ASSEMBLY WITH CHROME-PLATED CYLINDER LINERS

Figure 11

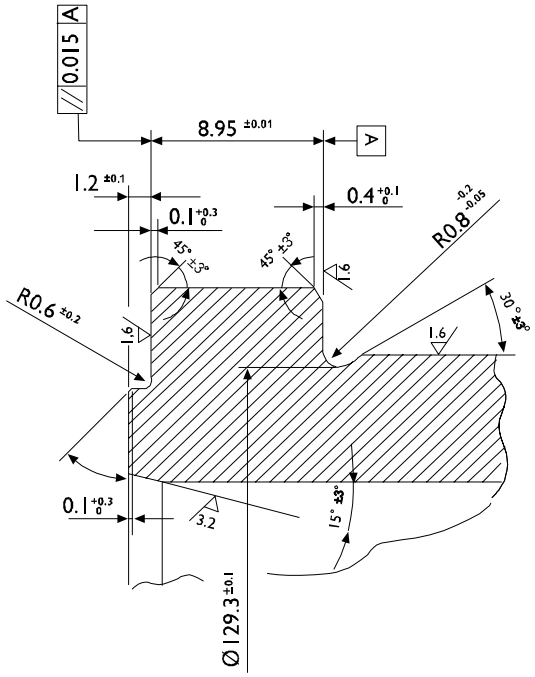


114039

CYLINDER LINERS MAIN DATA

Selection class { A mm 117.000 to 117.012
B mm 117.010 to 117.022

Figure 12



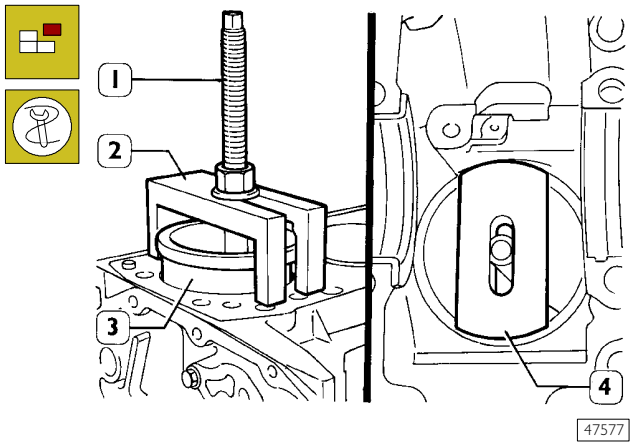
114040

DETAIL "X"
"A" = Selection class marking area

540420 Replacing cylinder liners

Removal

Figure 13

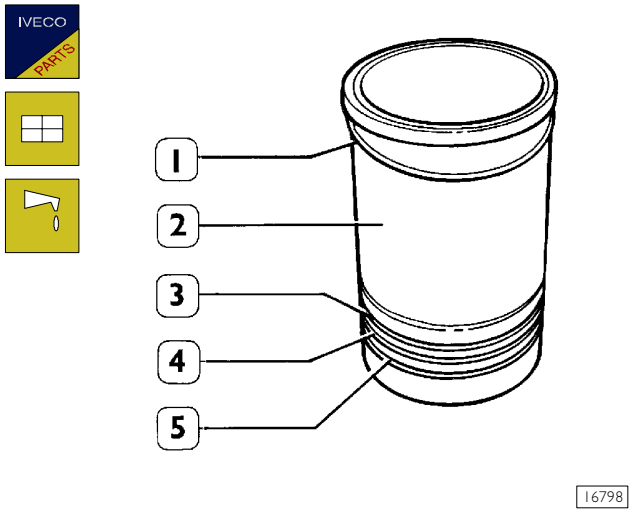


Place details 99360706 (1 and 2) and plate 99360724 (4) as shown in the figure, by making sure that the plate (4) is properly placed on the cylinder liners.

Tighten the screw nut (1) and remove the cylinder liner (3) from the block.

Fitting and checking protrusion

Figure 14

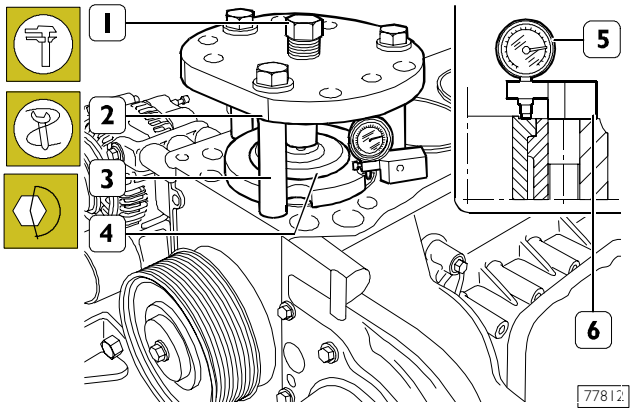


Always replace water sealing rings (3, 4 and 5).

Install the adjustment ring (1) on the cylinder liner (2); lubricate lower part of liner and install it in the cylinder unit using the proper tool.

NOTE The adjustment ring (1) is supplied as spare parts in the following thicknesses: 0.08 mm - 0.10 mm - 0.12 mm.

Figure 15

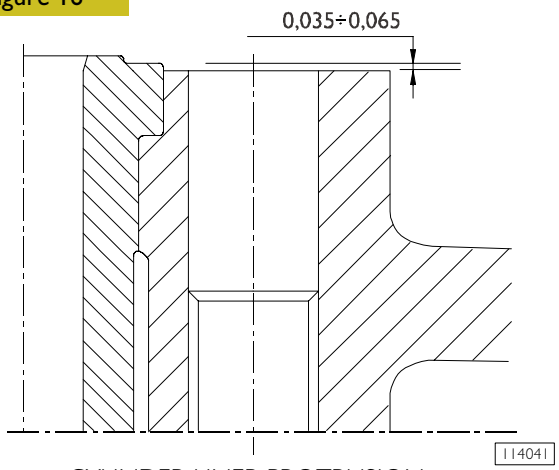


Check cylinder barrel protrusion with tool 99360334 (1-2-3-4) and tighten screw (1) to 170 Nm.

With dial gauge 99395603 (5) placed on base 99370415 (6).

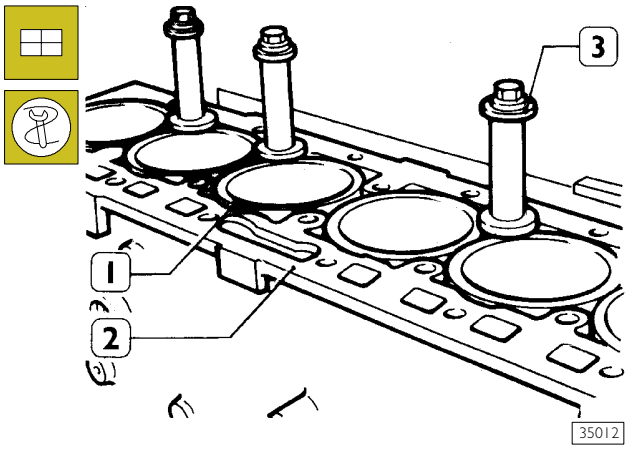
Measure the cylinder barrel protrusion compared to the cylinder head supporting plane, it must be 0,035 to 0,065 mm (Figure 16); otherwise replace the adjusting ring (1, Figure 14) fitted with spare parts having different thickness.

Figure 16



CYLINDER LINER PROTRUSION

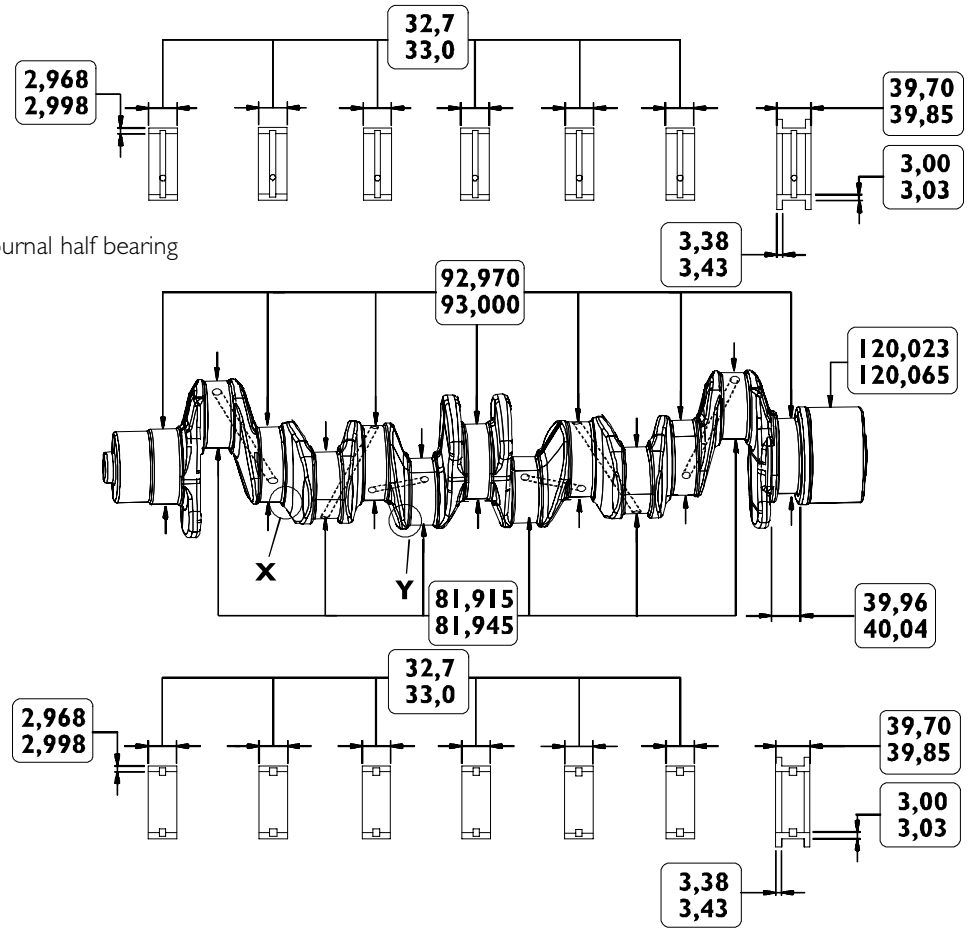
Figure 17 (Demonstration)



When the installation is completed, block the cylinder liners (1) to the block (2) with studs 99360703 (3).

5408 CRANKSHAFT

Figure 18



Upper main journal half bearing

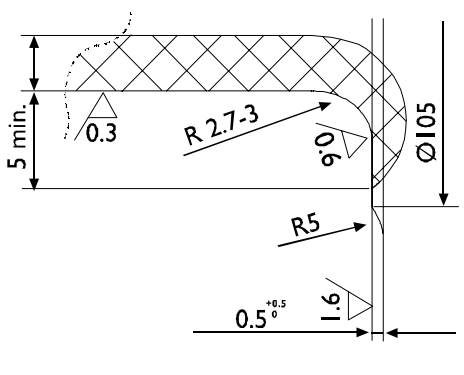
Lower main journal half bearings

114042

MAIN DATA FOR THE CRANK SHAFT PINS AND THE HALF BEARINGS

Check the condition of the journals and the big end pins; there must no be signs of scoring, ovalization or excessive wear.
The data given refer to the normal diameter of the pins.

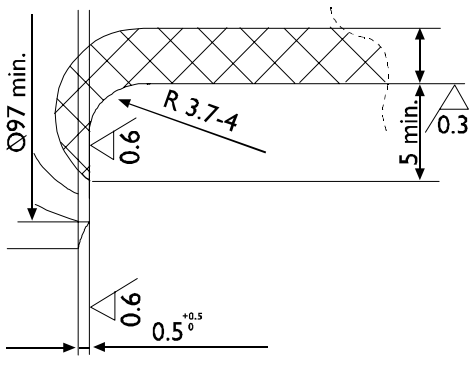
Figure 19



114043

X. Detail of main journals connections

Figure 20



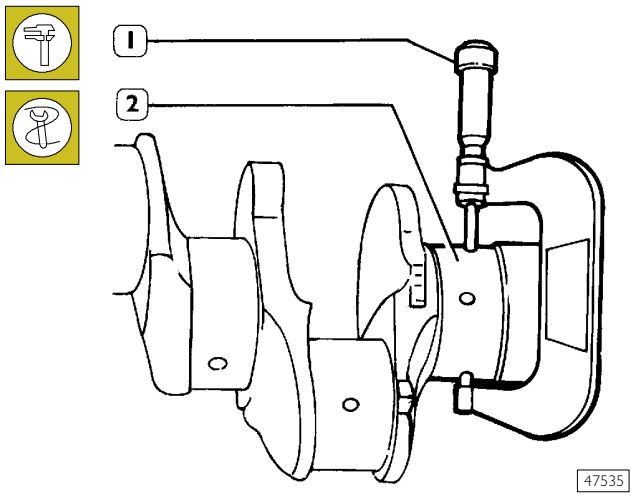
114044

Y. Detail of crank pins connections

540812 Measuring main journals and crank pins

Before grinding the crank pins using a micrometer (1), measure the main journals and the crank pins (2) and decide, on the basis of the undersizing of the bearings, the final diameter to which the pins are to be ground.

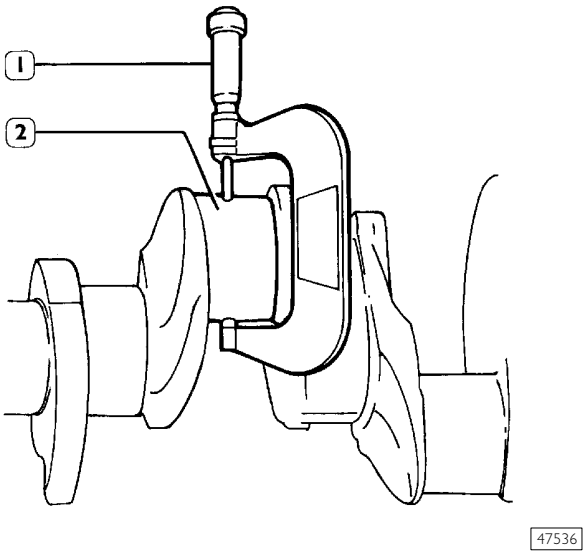
Figure 21



MEASURING THE MAIN JOURNALS

NOTE It is advisable to enter the values found in a table (Figure 23).

Figure 22



MEASURING CRANK PINS

During grinding, pay attention to journal and crank pins values specified in figures 68 and 69.

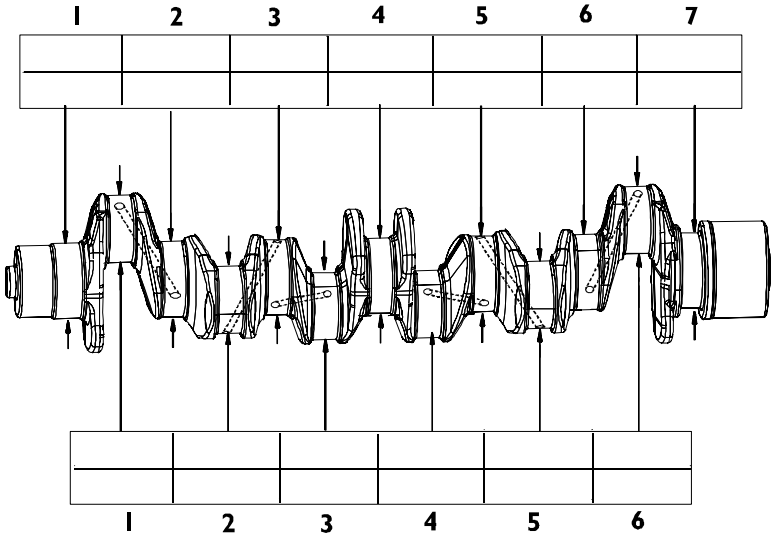
NOTE All journals and crank pins must also be ground to the same undersizing class, in order to avoid any alteration to shaft balance.

Figure 23

Fill in this table with the measurements of the main journals and the crank pins.

MAIN JOURNALS

	1	2	3	4	5	6	7
∅ MIN.							
∅ MAX.							



	1	2	3	4	5	6
∅ MIN.						
∅ MAX.						

CRANK PINS

114045

PRELIMINARY MEASUREMENT OF MAIN AND BIG END BEARING SHELL SELECTION DATA

For each of the journals of the crankshaft, it is necessary to carry out the following operations:

MAIN JOURNALS:

- ❑ Determine the class of diameter of the seat in the crankcase.
- ❑ Determine the class of diameter of the main journal.
- ❑ Select the class of the bearing shells to mount.

CRANKPINS:

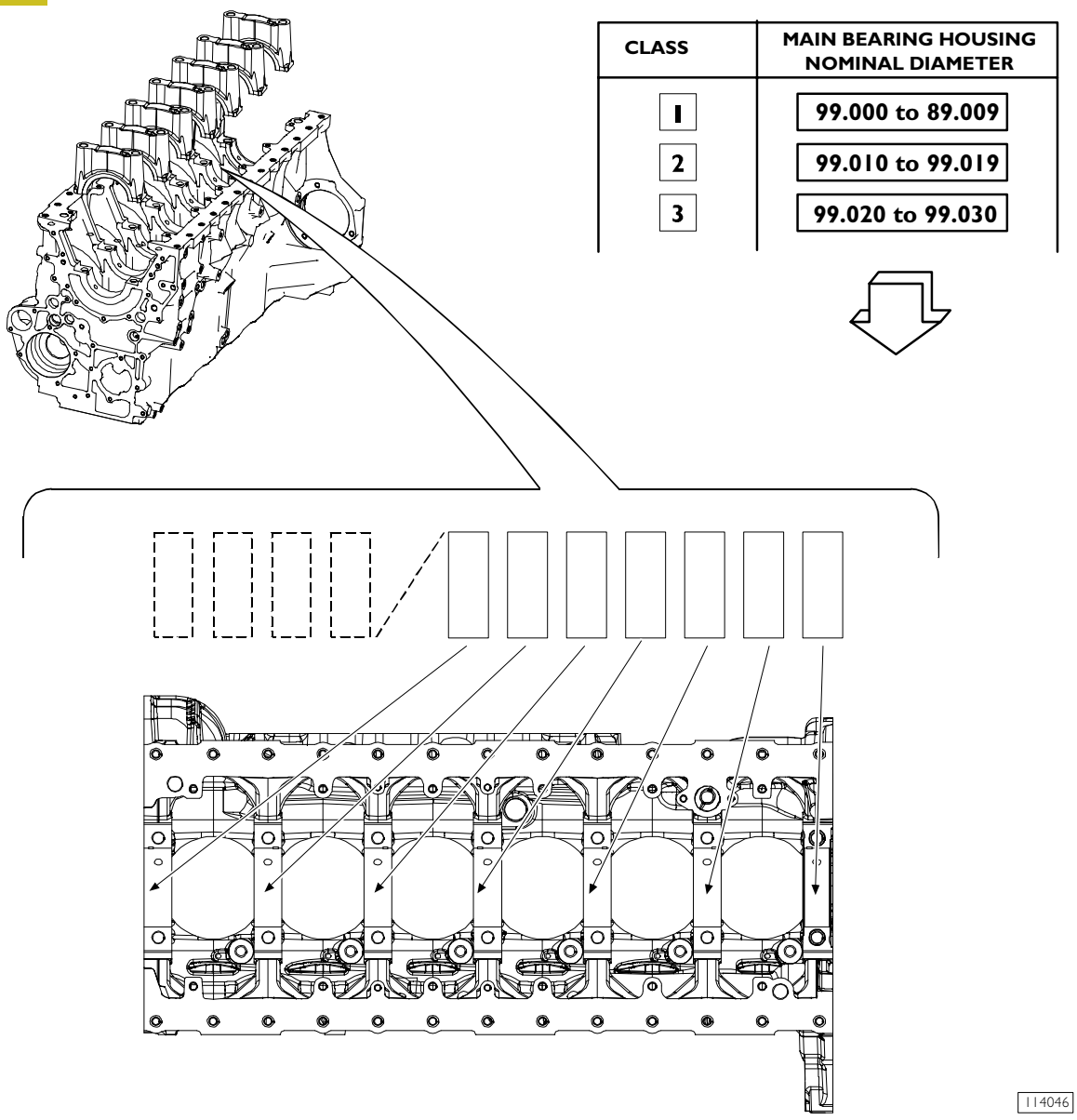
- ❑ Determine the class of diameter of the seat in the connecting rod.
- ❑ Determine the class of diameter of the crankpin.
- ❑ Select the class of the bearing shells to mount.

DEFINING THE CLASS OF DIAMETER OF THE SEATS FOR BEARING SHELLS ON THE CRANKCASE

On the front of the crankcase, two sets of numbers are marked in the position shown (Figure 24 at top).

- ❑ The first set of digits (four) is the coupling number of the crankcase with its base.
- ❑ The following seven digits, taken singly, are the class of diameter of each of the seats referred to (Figure 24 at bottom).
- ❑ Each of these digits may be **1**, **2** or **3**.

Figure 24



Selecting the main and big end bearing shells

NOTE To obtain the required assembly clearances, the main and big end bearing shells need to be selected as described hereunder.

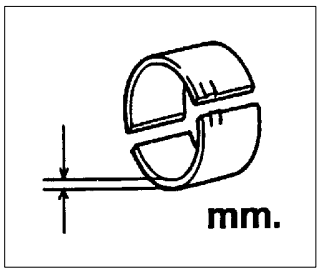
This operation makes it possible to identify the most suitable bearing shells for each of the journals (the bearing shells, if necessary, can have different classes from one journal to another).

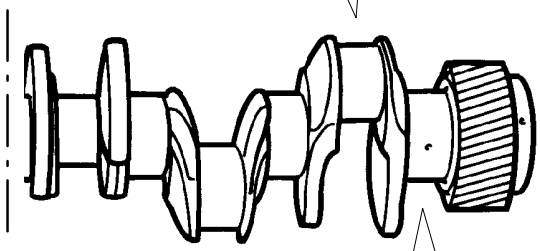
Depending on the thickness, the bearing shells are selected in classes of tolerance marked by a coloured sign (red-green – red/black – green/black).

The following tables give the specifications of the main and big end bearing shells available as spares in the standard sizes (STD) and in the permissible oversizes (+0.127, +0.254, +0.508).

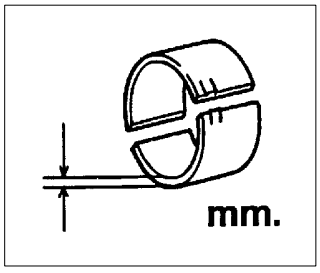
Figure 25

	STD	+0.127
red	1.994 to 2.002	
red/black		2.057 to 2.065
green	2.002 to 2.010	
green/black		2.065 to 2.073
yellow*	2.010 to 2.018	
yellow/black*		2.073 to 2.081





	STD	+0.127
red	2.968 to 2.978	
red/black		3.031 to 3.041
green	2.978 to 2.988	
green/black		3.041 to 3.051
yellow*	2.988 to 2.998	
yellow/black*		3.051 to 3061



* Fitted in production only and not supplied as spares

DEFINING THE CLASS OF DIAMETER OF THE MAIN JOURNALS AND CRANKPINS (Journals with nominal diameter)

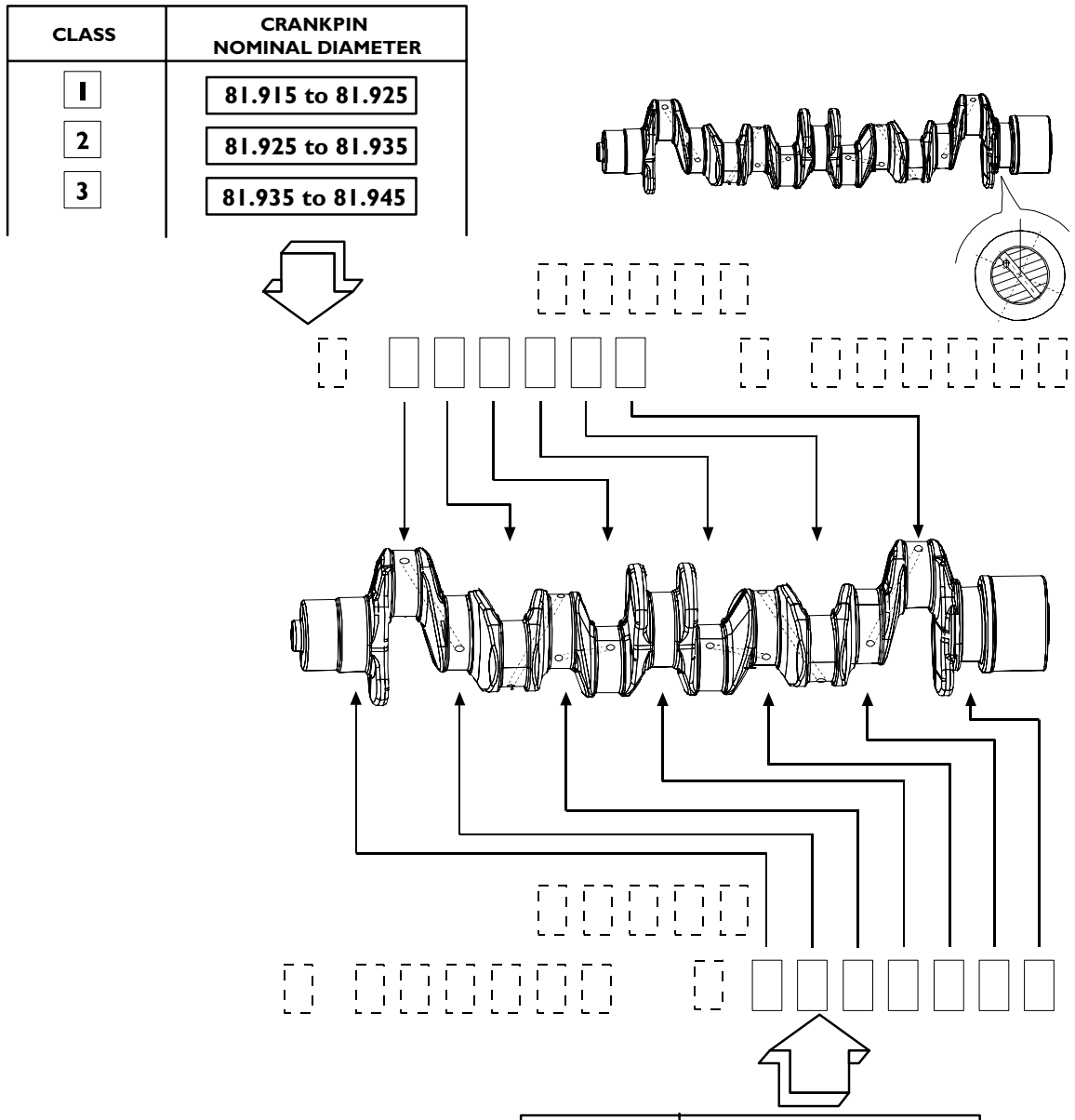
Main journals and crankpins: determining the class of diameter of the journals.

Three sets of numbers are marked on the crankshaft in the position shown by the arrow (Figure 26 at top):

- The first number, of five digits, is the part number of the shaft.
- Under this number, on the left, a set of six digits refers to the crankpins and is preceded by a single digit showing the status of the journals (1 = STD, 2 = -0.127), the other six digits, taken singly, give the class of diameter of each of the crankpins they refer to (Figure 26 at top).
- The set of seven digits, on the right, refers to the main journals and is preceded by a single digit: the single digit shows the status of the journals (1 = STD, 2 = -0.127), the other seven digits, taken singly, give the class of diameter of each of the main journals they refer to (Figure 26 at bottom).

Figure 26

CLASS	CRANKPIN NOMINAL DIAMETER
1	81.915 to 81.925
2	81.925 to 81.935
3	81.935 to 81.945



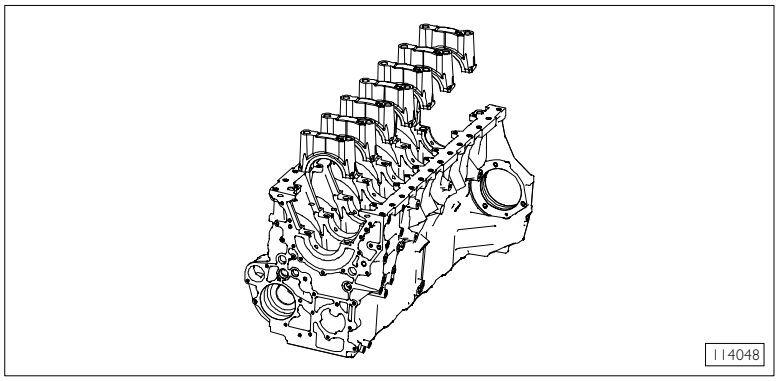
CLASS	MAIN JOURNALS NOMINAL DIAMETER
1	92.970 to 92.980
2	92.980 to 92.990
3	92.990 to 93.000

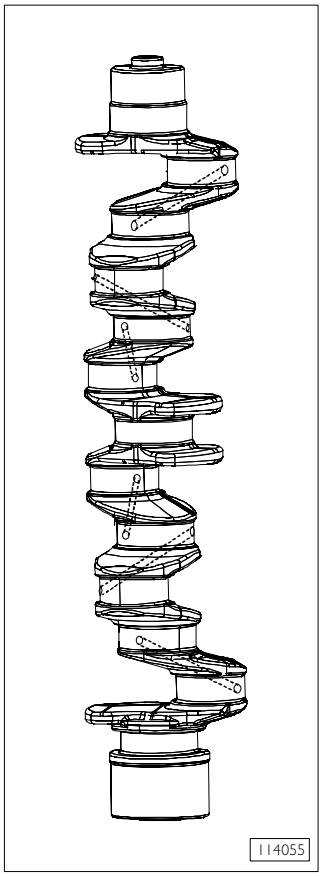
Selection of main half-bearings (nominal diameter pins)

After detecting, for each journal, the necessary data on block and crankshaft, select the type of half-bearings to be used, in compliance with the following table:

Figure 27

STD.





	1	2	3
1	green	green	yellow
	green	yellow	yellow
2	red	green	green
	green	green	yellow
3	red	red	green
	red	green	green

Selection of main half-bearings (rectified pins)

If the journals have been rectified, the procedure described cannot be applied.

In this case, make sure that the new diameter of the journals is as specified on the table and install the only half-bearing type required for this undersizing.

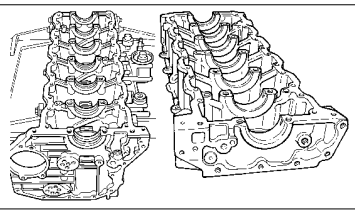
Figure 28

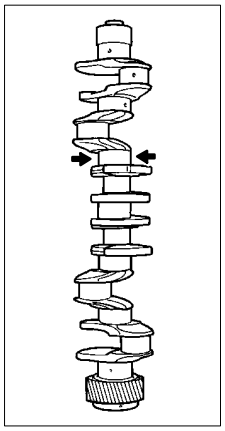
red/black = mm 3.031 to 3.041

green/black = mm 3.041 to 3.051

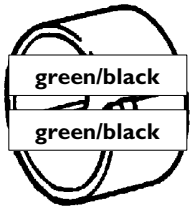
green/black = mm 3.0513 to 3.061

-0.127





		1	2	3
92.843 92.853	1	green/black green/black	green/black yellow/black	yellow/black yellow/black
92.853 92.863	2	red/black green/black	green/black green/black	green/black yellow/black
92.863 92.872	3	red/black red/black	red/black green/black	green/black green/black



SELECTING THE BIG END BEARING SHELLS (JOURNALS WITH NOMINAL DIAMETER)

There are three markings on the body of the connecting rod in the position shown in the view from "A":

1 Letter indicating the class of weight:

A = 3450 to 3470 g.
B = 3471 to 3490 g.
C = 3491 to 3510 g.

2 Number indicating the selection of the diameter of the big end bearing seat:

1 = 85.987 to 85.996 mm
2 = 85.997 to 86.005 mm
3 = 86.006 to 86.013 mm

3 Numbers identifying the cap-connecting rod coupling.

The number, indicating the class of diameter of the bearing shell seat may be **1**, **2** o **3**.

Determine the type of big end bearing to fit on each journal by following the indications in the table (Figure 30).

Figure 29

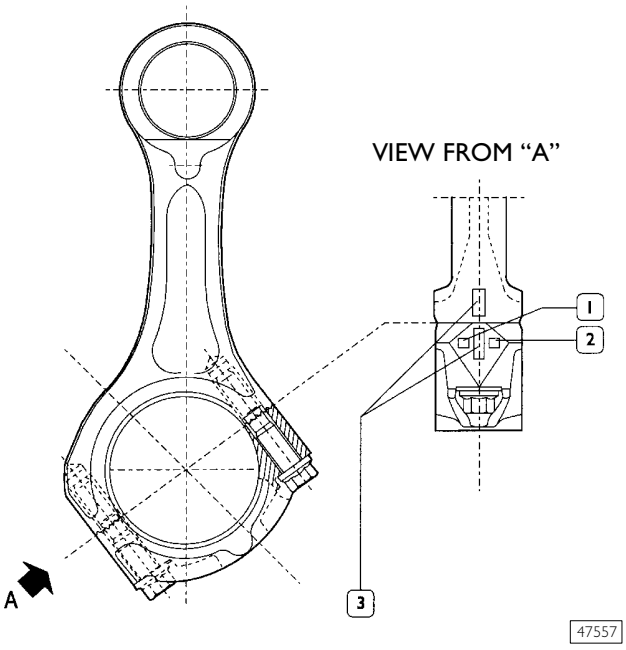
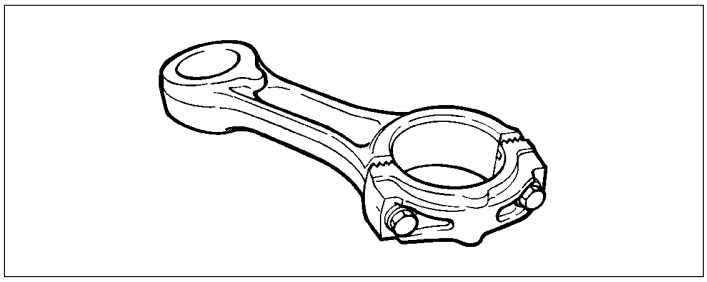
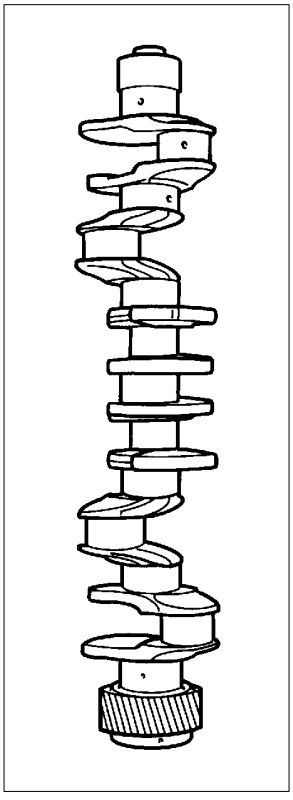


Figure 30

STD.





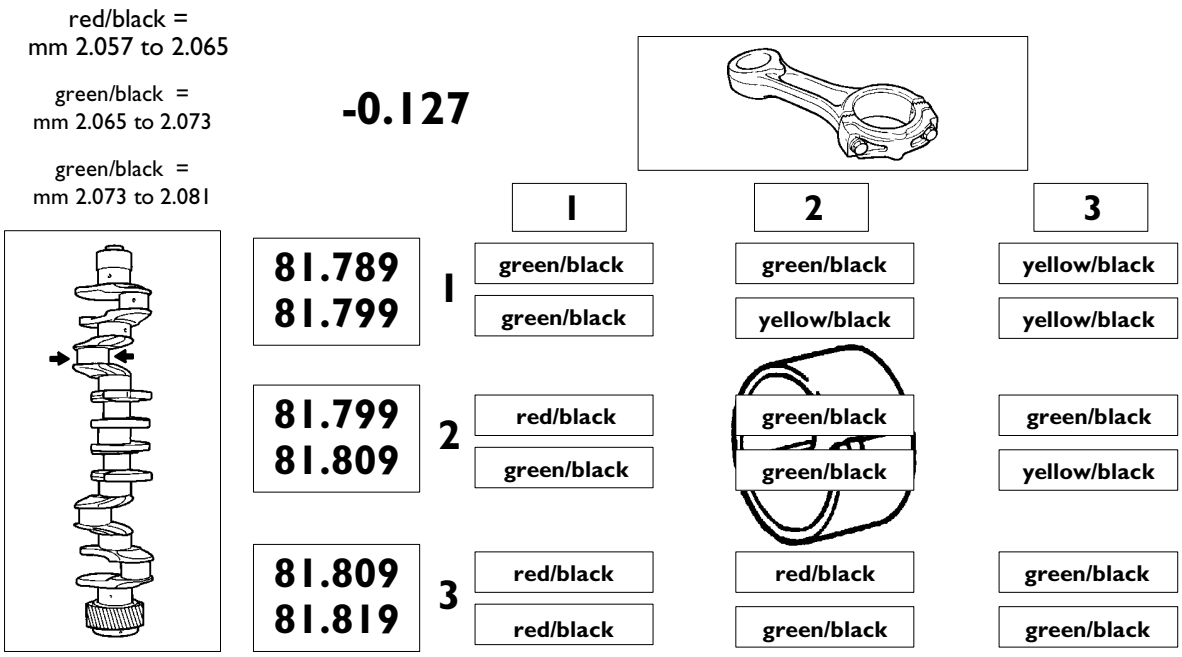
Class	1	2	3
1	green	green	yellow
	green	yellow	yellow
2	red	green	green
	green	green	yellow
3	red	red	green
	red	green	green

Selection of connecting rod half-bearings (rectified pins)

If pins have been rectified, the procedure described must be applied.

In this case, (for each undersizing) determine the tolerance field the new big end pins belong to, and install the half-bearings identified according to the relative table.

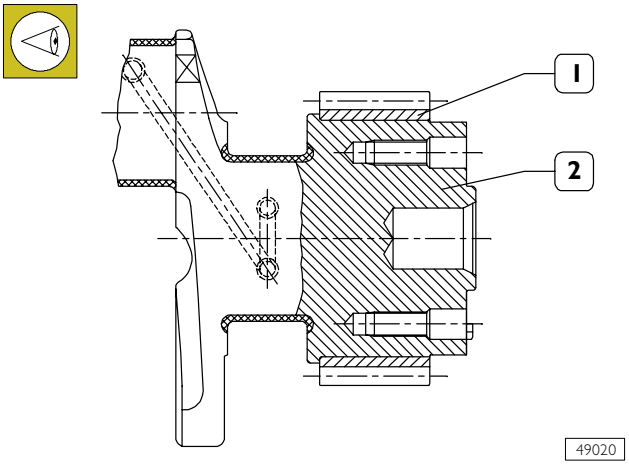
Figure 31



540815 Replacing the timing control gear and the oil pump

Check that the teeth of the gears are not damaged or worn, otherwise remove them using the appropriate extractor.

Figure 32



NOTE Before fitting the gear, spread Loctite type 603 on approx. 5 mm wide band on crankshaft, at 30 mm from contact surface.

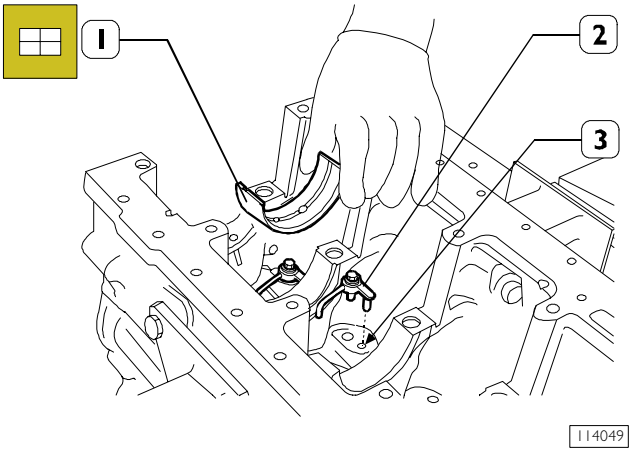
After fitting the gear (1) on the crankshaft (2), heat it for ~15 minutes in an oven at temperature not higher than 180°C.

Let them cool down after the installation.

If changing the pin (3), after fitting it on, check it protrudes from the crankshaft as shown in the figure.

540811 Checking main journal installation clearance

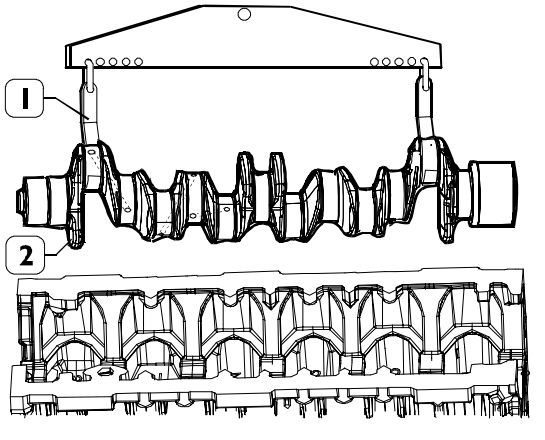
Figure 33



Install the oil spray nozzles (2) and have the dowel coincide with the block hole (3).

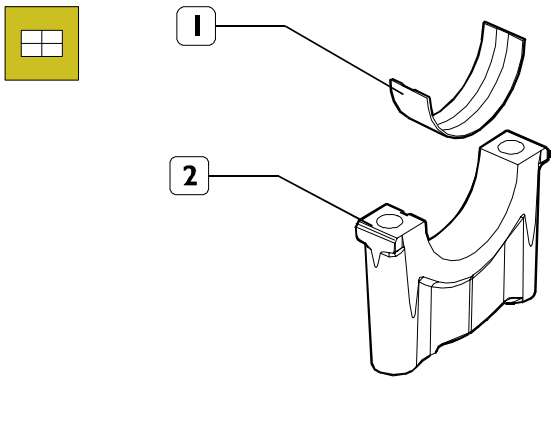
Install the half-bearings (1) on the main bearings.

Figure 34



Using the hoist and hook 99360500 (1) mount the driving shaft (2).

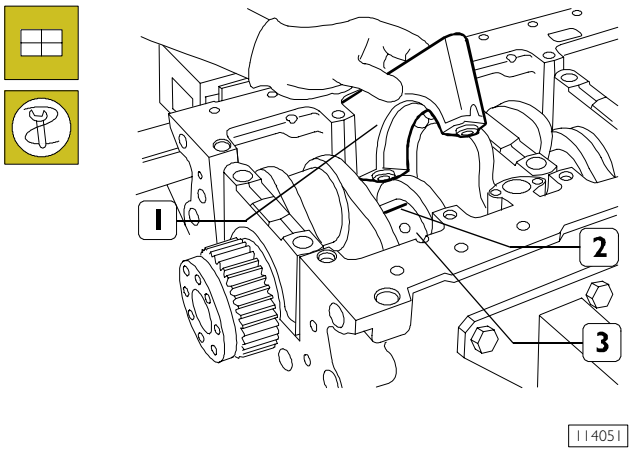
Figure 35



Place bearing halves (1) on main journals (2).

Check the installation clearance between the main journals and the relative bearings as follows.

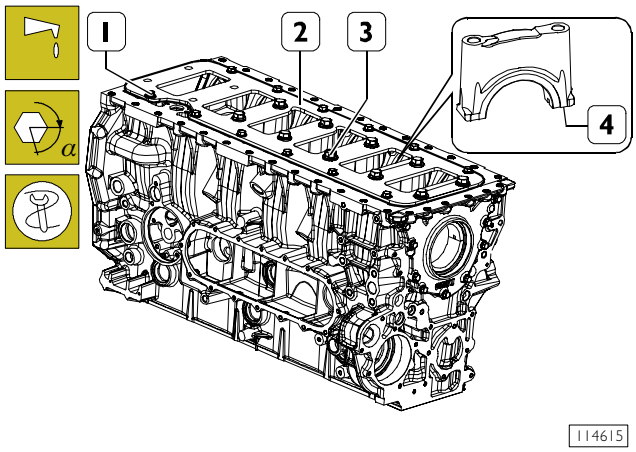
Figure 36



Fit sized wire sections (2) on crankshaft (3) parallel to longitudinal axis.

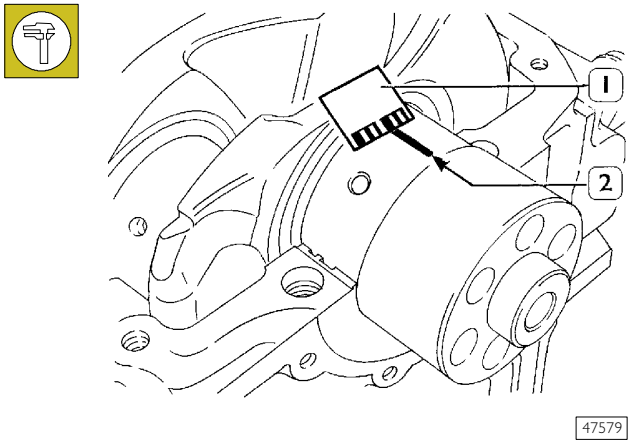
Install main journals (1).

Figure 37



- ❑ Fit main journals (4) and install stiffening plate (2).
- ❑ Lubricate internal screws (3) and external screws (1) with UTDM oil and lock them by torque wrench at 140 Nm with 60°+60° lock angle.

Figure 38



- ❑ Remove main journals.

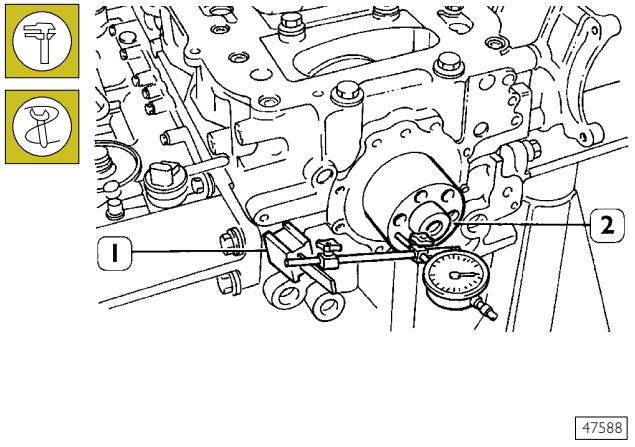
The clearance between the main bearings and the journals is obtained by comparing the calibrated wire length (2) at the maximum deflection point, with the calibrated scale on the coating (1) containing the calibrated wire.

Numbers shown on the scale specify the clearance in coupling millimeters.

If the clearance obtained is different from the clearance required, replace the half-bearings and repeat this check.

Checking crankshaft end float

Figure 39

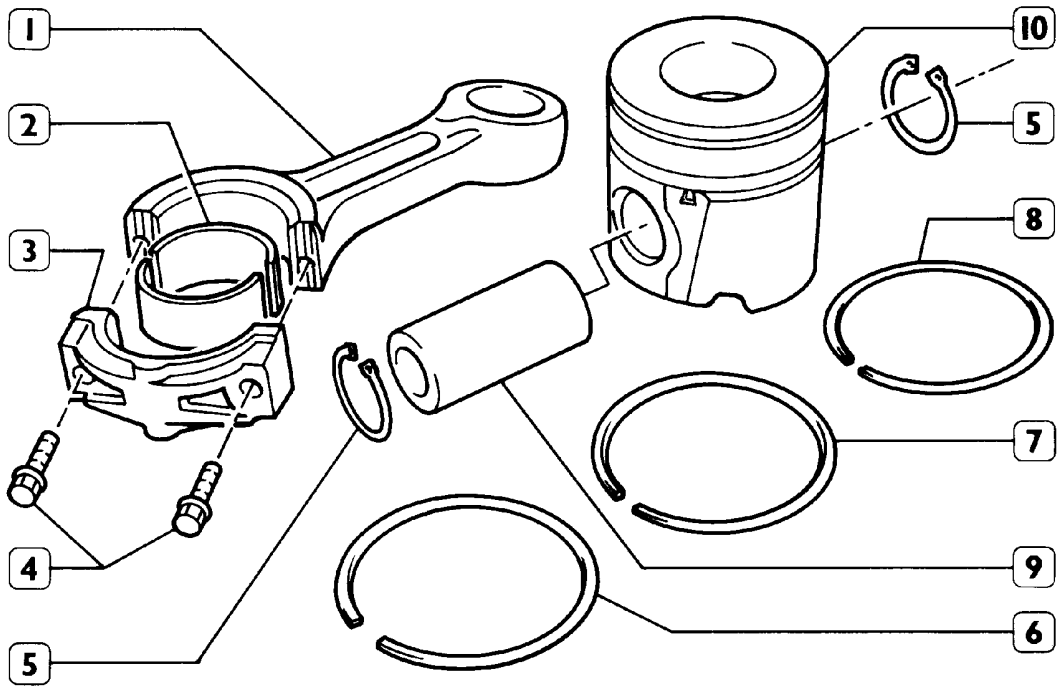


End float is checked by placing a magnetic dial gauge (1) on the crankshaft (2), as shown in the figure.

If the value obtained is higher than specified, replace the rear thrust half-bearings and repeat this check.

5408 PISTON-CONNECTING ROD ASSEMBLY

Figure 40



PISTON CONNECTING ROD ASSEMBLY

1. Connecting rod body - 2. Half bearings - 3. Connecting rod cap - 4. Cap fastening screws - 5. Split ring - 6. Scraper ring with spiral spring - 7. Bevel cut sealing ring - 8. Trapezoidal sealing ring - 9. Piston pin - 10. Piston

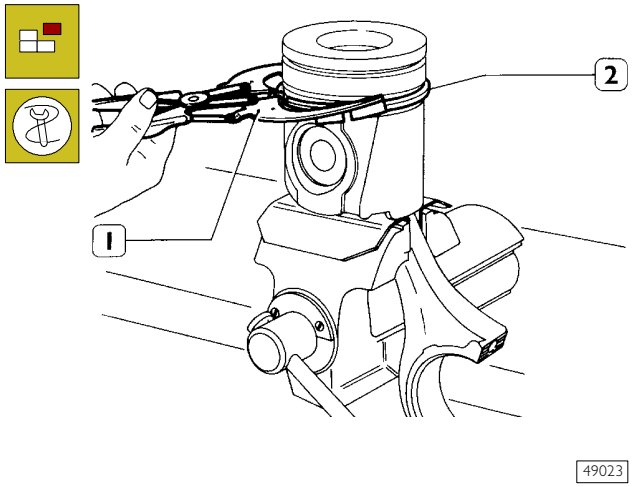
Make sure the piston does show any trace of seizing, scoring, cracking; replace as necessary.

Pistons are equipped with three elastic rings: a sealing ring, a trapezoidal ring and a scraper ring.

Pistons are grouped into classes A and B for diameter.

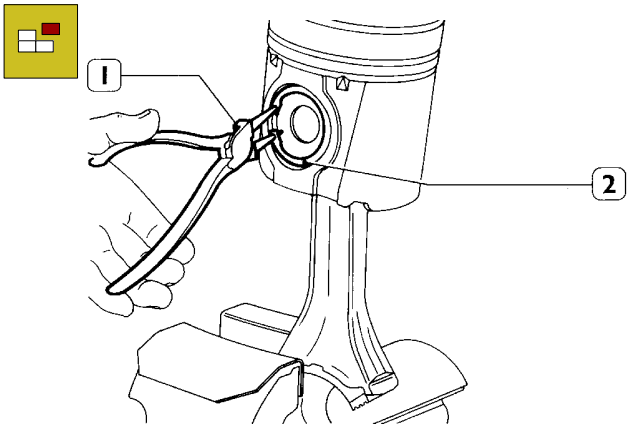
Removal

Figure 41



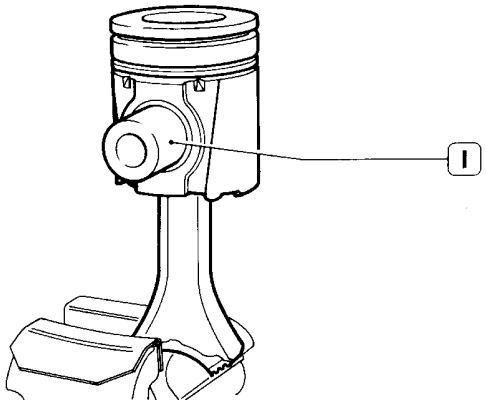
Removal of the piston split rings (2) using the pliers 99360184 (1).

Figure 42



Remove the piston pin split rings (2) using the round tipped pliers (1).

Figure 43



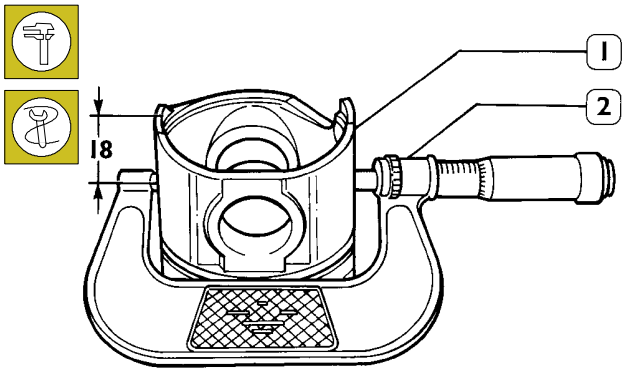
49025

Remove the piston pin (1).

If removal is difficult use the appropriate beater.

Measuring the diameter of the pistons

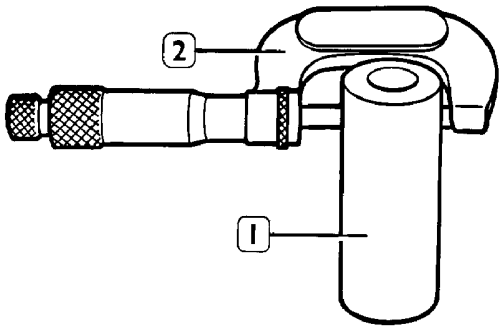
Figure 44



47584

Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance; the diameter should be measured at the specified value.

Figure 45

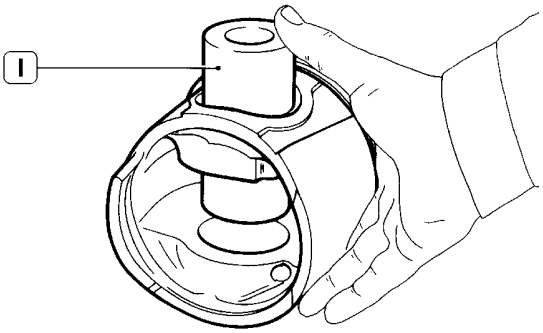


32618

Measuring the gudgeon pin diameter (1) with a micrometer (2).

Conditions for correct gudgeon pin-piston coupling

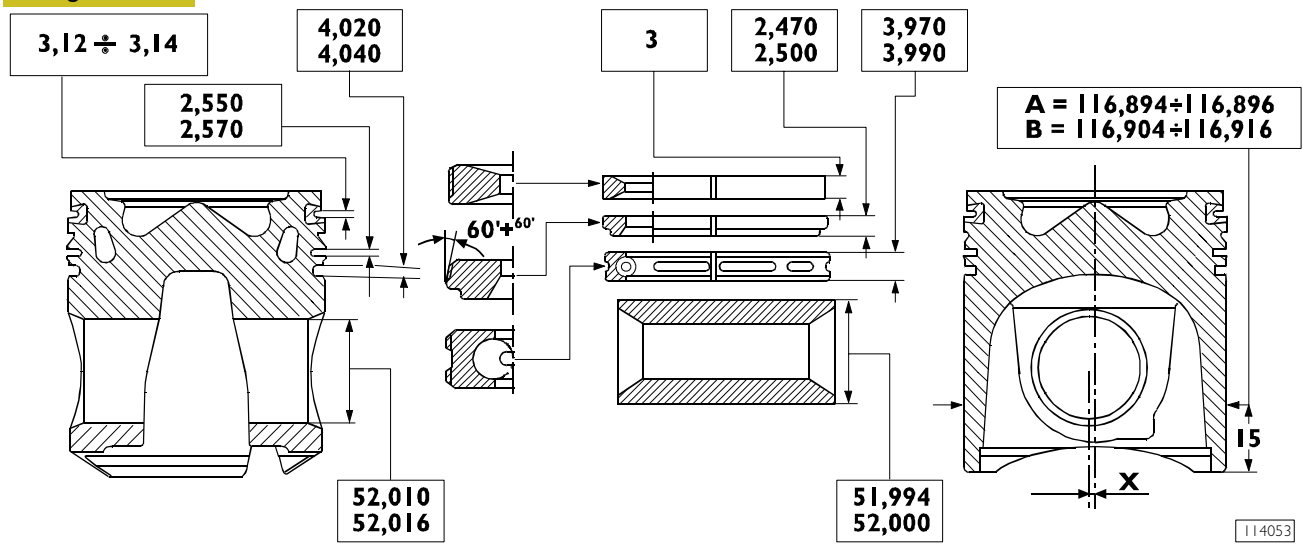
Figure 46



49026

Lubricate the pin (1) and the relevant housing on the piston hubs with engine oil; piston must be inserted with a slight finger pressure and it should not come out by gravity.

Figure 47



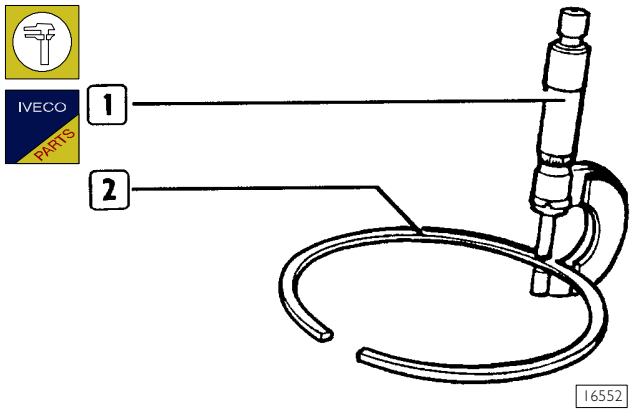
MAIN DATA OF PISTON, SNAP RINGS AND PIN

X = 0,6 ± 0,15

- The dimension is measured on a ∅ of 113 mm

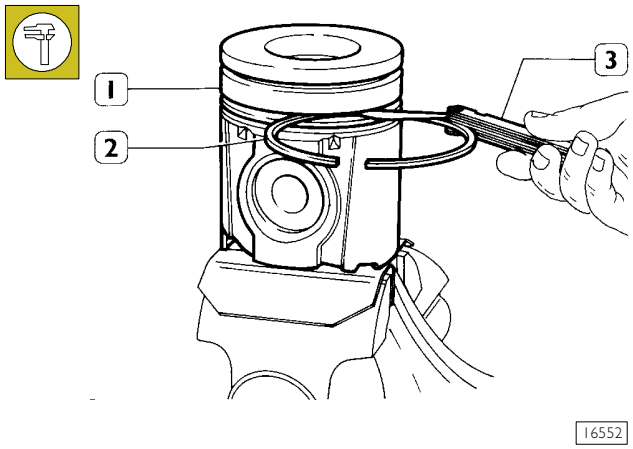
540842 Piston rings

Figure 48



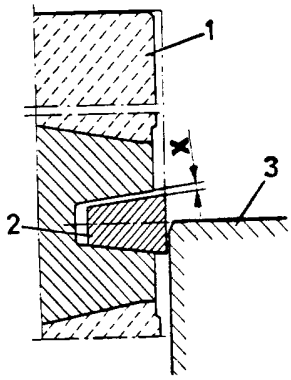
Check the thickness of the piston ring (2) using a micrometer (1).

Figure 49



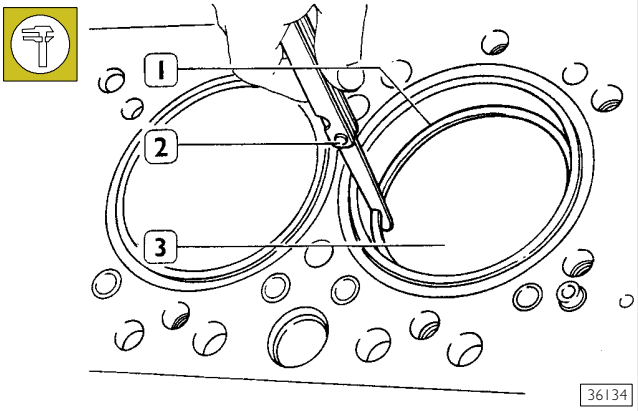
Check the clearance between the sealing rings (2) and the relative piston housings (1) using a thikness gauge (3).

Figure 50



The sealing ring (2) of the 1° cavity is trapezoidal. Clearance "X" between the sealing ring and its housing is measured by placing the piston (1) with its ring in the cylinder barrel (3), so that the sealing ring is half-projected out of the cylinder barrel.

Figure 51



Check the opening between the ends of the sealing rings (1), using a thickness gauge (2), entered in the cylinder barrel (3).

If the distance between ends is lower or higher than the value required, replace split rings.

540830 CONNECTING ROD

Figure 52

Data concerning the class section of connecting rod housing and weight are stamped on the big end.

At connecting rod refitting, check that they all are of same class and from same supplier.

NOTE The connecting rod/cap is of the "torn" type; before fitting, check that connecting rod is not damaged. Each connecting rod can be installed with its cap only. If cap is installed reversed, the connecting rod must be rejected.

DIAGRAM CONNECTING ROD MARKS

1 Letter indicating the weight class:

A = 3450 to 3470 g.
B = 3471 to 3490 g.
C = 3491 to 3510 g.

2 Number indicating the selection of diameter for the big end bearing housing:

1 = 85.987 to 85.996 mm
2 = 85.997 to 86.005 mm
3 = 86.006 to 86.13 mm

3 Numbers identifying cap-connecting rod coupling

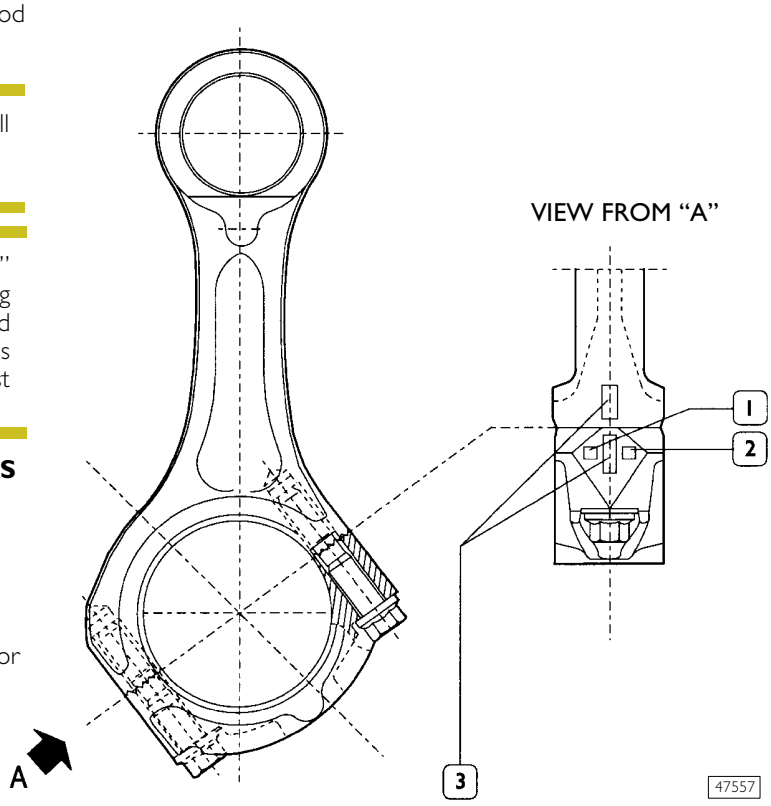
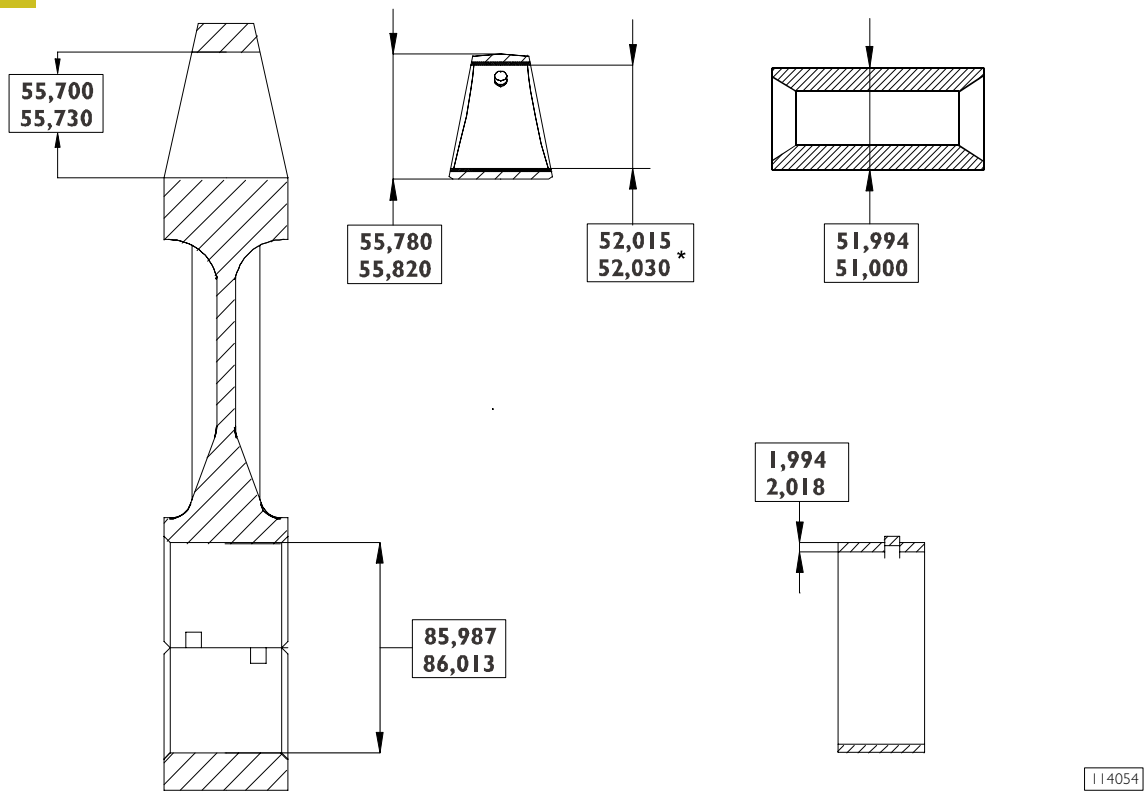


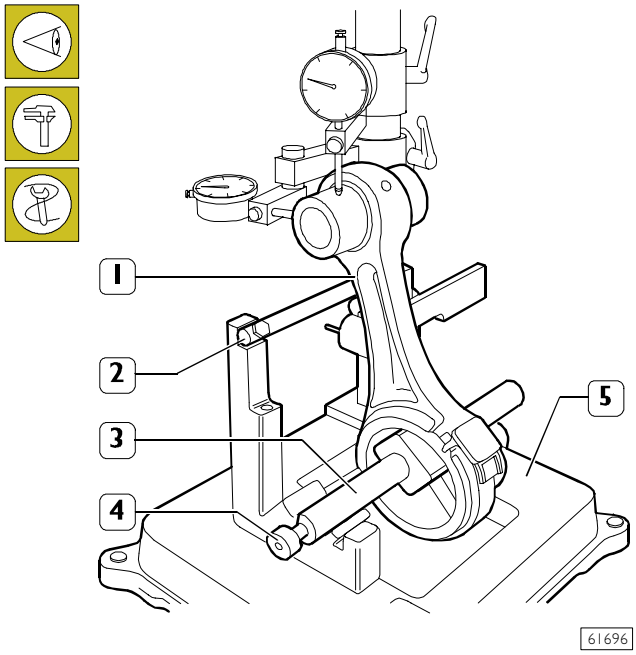
Figure 53



MAIN DATA - BUSH, CONNECTING ROD, PIN AND HALF-BEARINGS
* Values to be obtained after installing the bush

Checking connecting rod alignment

Figure 54



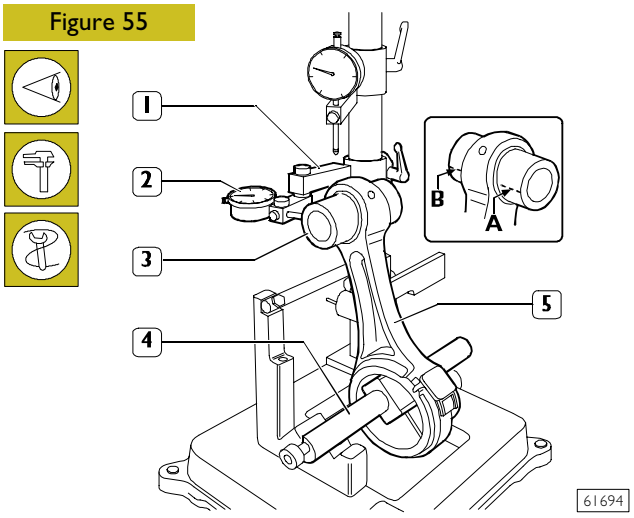
Checking axis alignment

Check the alignment of the axes of the connecting rods (1) with device (5), proceeding as follows:

- ❑ Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).
- ❑ Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

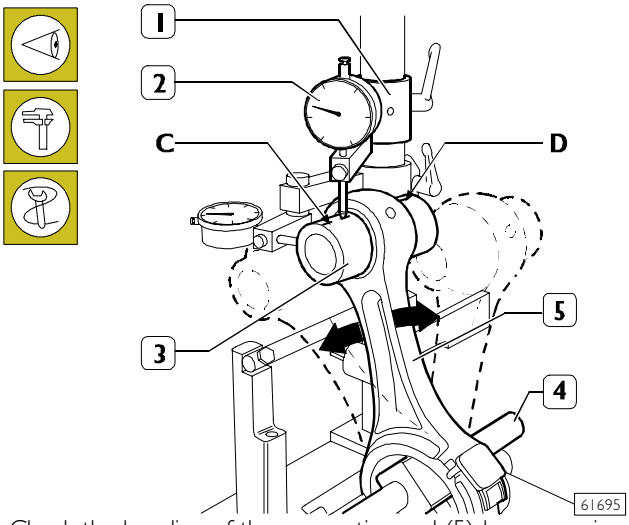
Figure 55



Check the torsion of the connecting rod (5) by comparing two points (**A** and **B**) of the pin (3) on the horizontal plane of the axis of the connecting rod.
Position the mount (1) of the dial gauge (2) so that this pre-loads by approx. 0.5 mm on the pin (3) at point **A** and zero the dial gauge (2). Shift the spindle (4) with the connecting rod (5) and compare any deviation on the opposite side **B** of the pin (3): the difference between **A** and **B** must be no greater than 0.08 mm.

Checking bending

Figure 56



Check the bending of the connecting rod (5) by comparing two points **C** and **D** of the pin (3) on the vertical plane of the axis of the connecting rod.
Position the vertical mount (1) of the dial gauge (2) so that this rests on the pin (3) at point **C**.
Swing the connecting rod backwards and forwards seeking the highest position of the pin and in this condition zero the dial gauge (2).
Shift the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side **D** of the pin (3). The difference between point **C** and point **D** must be no greater than 0.08 mm.

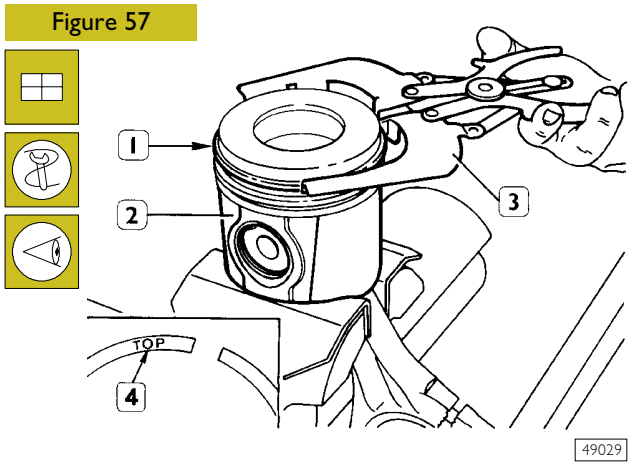
Mounting the connecting rod - piston assembly

Carry out the steps for removal described on pages 27 and 28 in reverse order.

NOTE The connecting rod screws can be reused as long as the diameter of the thread is not less than 11.4 mm.

Mounting the piston rings

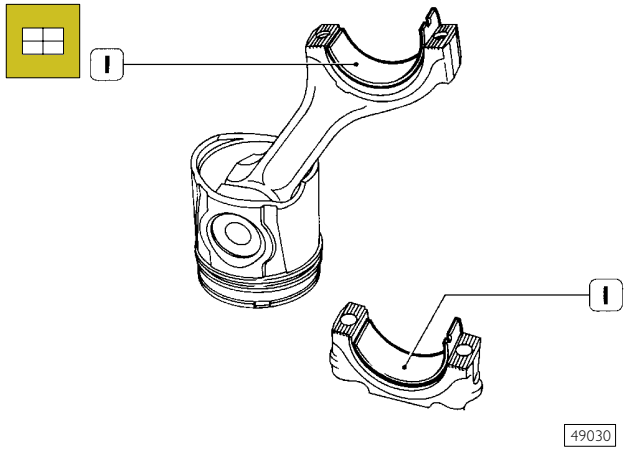
Figure 57



To fit the piston rings (1) on the piston (2) use the pliers 99360184 (3).
The rings need to be mounted with the word "TOP" (4) facing upwards. Direct the ring openings so they are staggered 120° apart.

Fitting the connecting rod-piston assembly into the piston liners

Figure 58



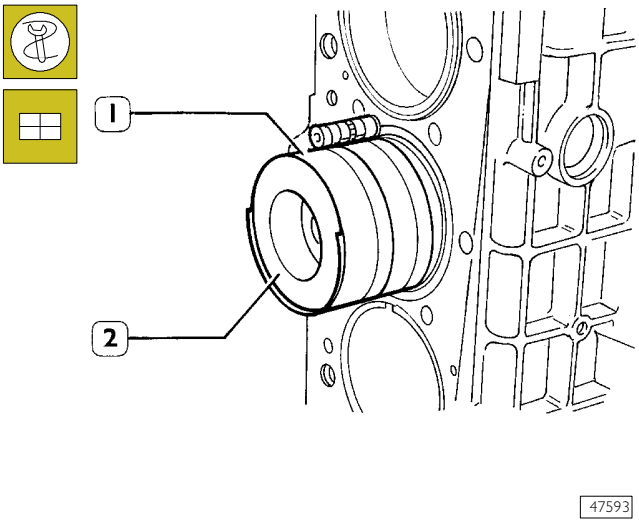
Fit the half-bearings (1), selected as described on pages 19 to 24, both on the connecting rod and on the stand.

NOTE As spares, class A pistons are provided and can be fitted also to cylinder barrels belonging to class B.

Fit the connecting rod-piston assemblies (1) into the piston liners (2) using band 99360605 (1, Figure 60). Check the following:

- ❑ the openings of the split rings are offset by 120°;
- ❑ all pistons belong to the same class, A or B;
- ❑ ideogram stamped on the piston crown is placed toward the engine flywheel, or the cavity, on the piston cover, corresponds to the position of the oil spray nozzles.

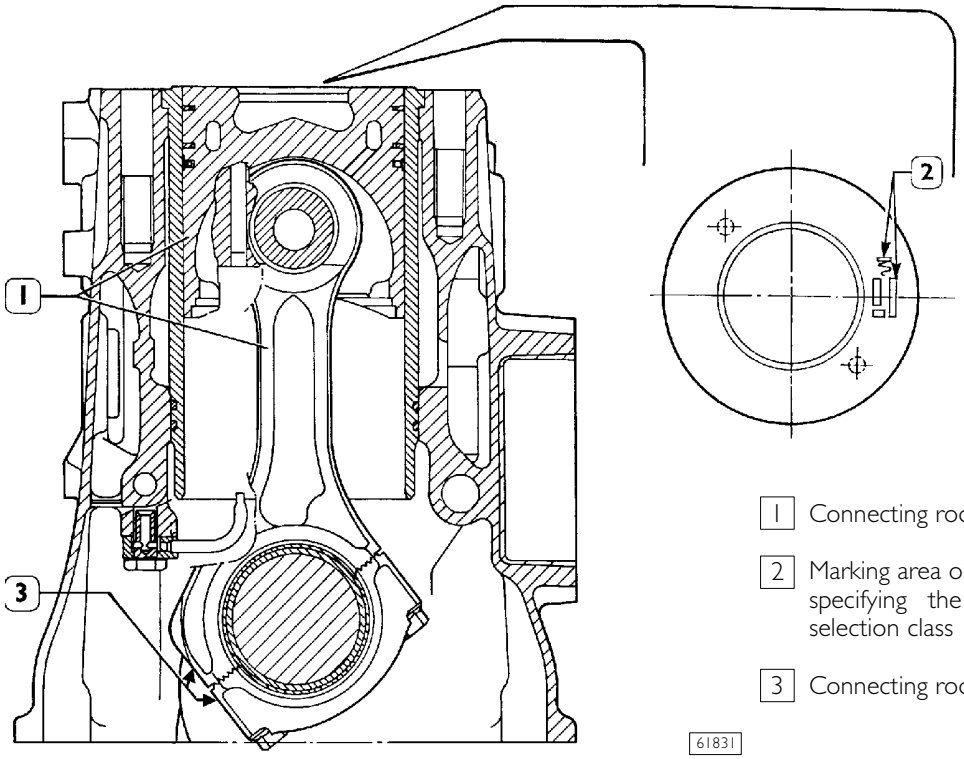
Figure 60



Piston protrusion check

Once assembly is complete, check piston protrusion from cylinder barrels: it must be 0.873 to 1.177 mm.

Figure 59



1 Connecting rod-piston assembly

2 Marking area on the piston crown of ideogram specifying the assembly position and the selection class

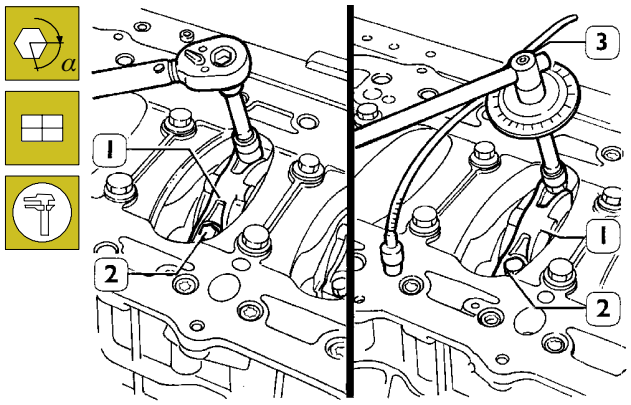
3 Connecting rod marking area (see Figure 52).

540831 Checking assembly clearance of big end pins

To check the clearance proceed as follows:

connect the connecting rods to the relative main journals, place a length of calibrated wire on the latter.

Figure 61



47594

Install the connecting rod caps (1) with half-bearings; tighten the connecting rod cap fixing screws (2) to 50 Nm (5 kgm) torque. By tool 99395216 (3), tighten the screws further at 90° angle.

Remove the caps and check the clearance by comparing the width of the calibrated wire with the scale calibration on the envelope containing the wire.

540610 CYLINDER HEAD

Before dismounting cylinder head, check cylinder head for hydraulic seal by proper tooling; in case of leaks not caused by cup plugs or threaded plugs, replace cylinder head.

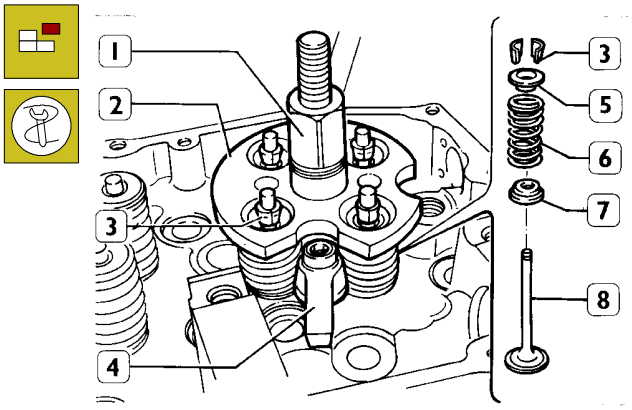
NOTE In case of plugs dismounting/replacement, on mounting, apply sealant Loctite 270 on plugs.

Dismounting the valves

NOTE Before dismounting cylinder head valves, number them in view of their remounting in the position observed on dismounting should they not have to be overhauled or replaced.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

Figure 62



47583

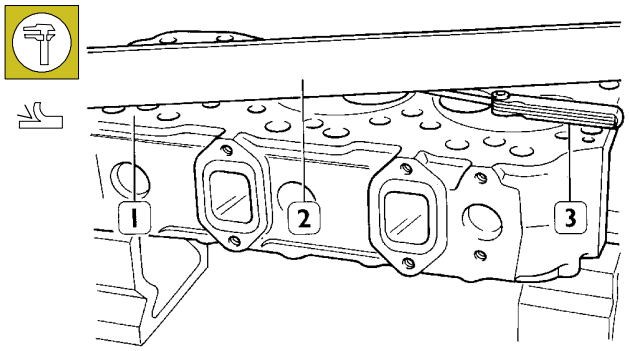
Install and fix tool 99360264 (2) with bracket (4); tighten by lever (1) until cotters are removed (3); remove the tool (2) and the upper plate (5), the spring (6) and the lower plate (7).

Repeat the operation on all the valves.

Turn the cylinder head upside down and remove the valves (8).

Checking the planarity of the head on the cylinder block

Figure 63 (Demonstration)



36159

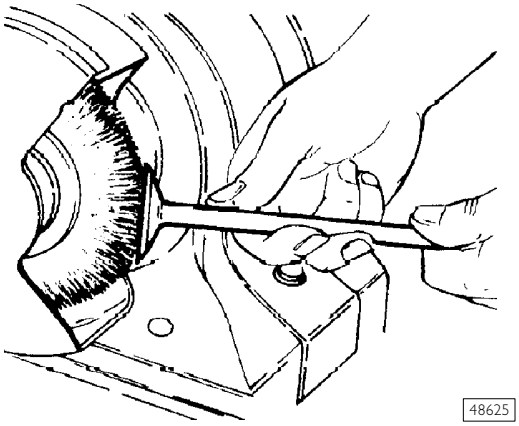
The planarity (1) is checked using a ruler (2) and a thikness gauge (3). If deformations exist, surface the head using proper surface grinder; the maximum amount of material to be removed is 0.2 mm.

NOTE After leveling, make sure that valve sinking and injector protrusion are as described in the relative paragraph.

540622 VALVE

Removing deposits and checking the valves

Figure 64

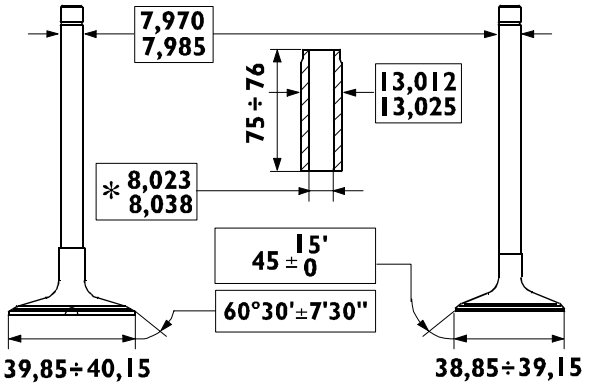


48625

Remove carbon deposits using the metal brush supplied. Check that the valves show no signs of seizure or cracking.

Check the diameter of the valve stem using a micrometer (see Figure 65) and replace if necessary.

Figure 65



92841

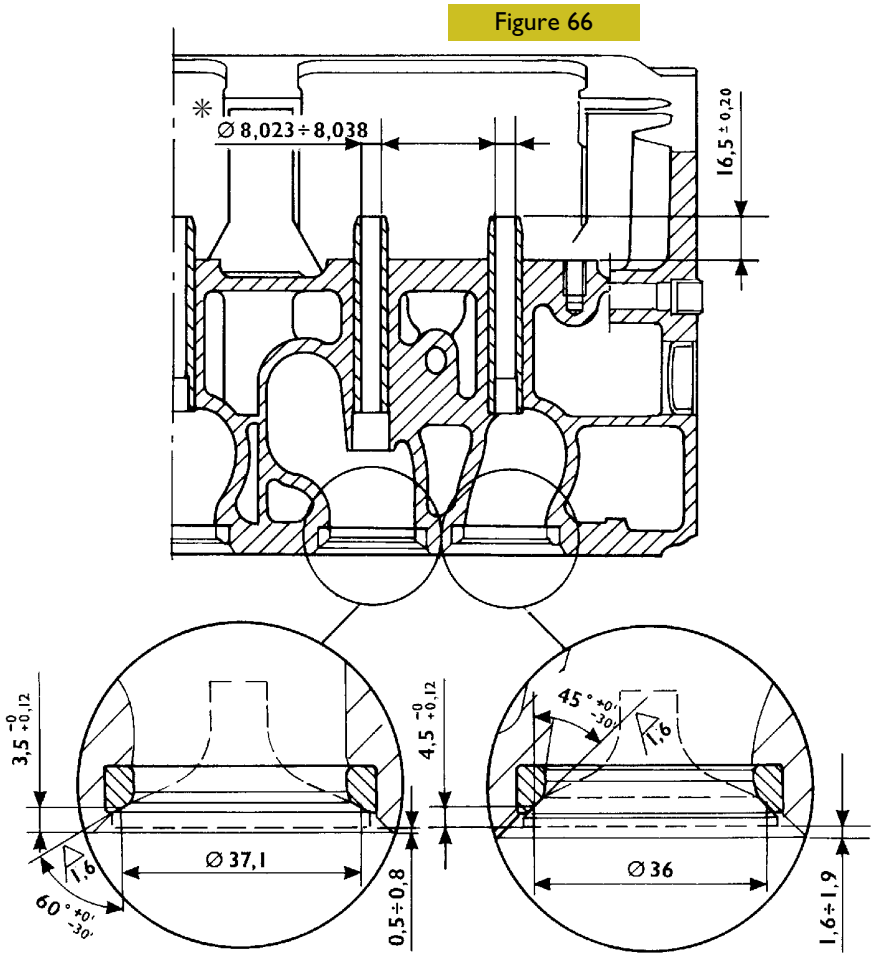
MAIN DATA - VALVES AND VALVE GUIDES

* Values to be obtained after installing the valve guides

Check, by means of a micrometer, that valve stem diameters are as specified; if necessary, grind the valves seat with a grinder, removing the minimum quantity of material.

540667 VALVE GUIDES

Figure 66



47509

INSTALLATION DIAGRAM FOR VALVE GUIDES AND VALVES

* Values to be obtained after installing the guide valves

Replacing of valve guides

Remove valve guides by means of tool 99360288.

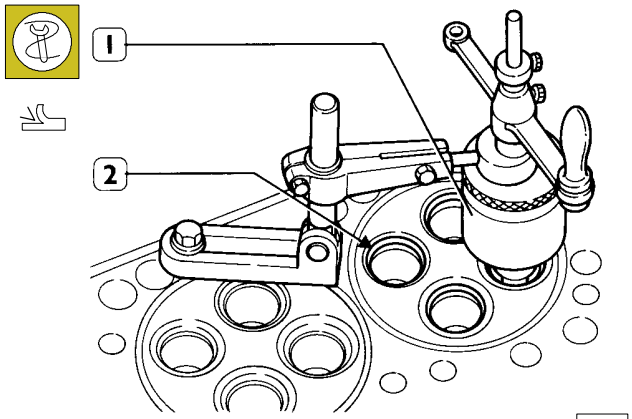
Install by means of tool 99360288 equipped with part 99360294, which determines the exact installation position of valve guides into the cylinder heads; if they are not available, install the valve guides in the cylinder head so that they project out by mm 16.3 to 16.7 (Figure 65).

After installing the valve guides, smooth their holes with sleeker 99390310.

Replacing - Reaming the valve seats

To replace the valve seats, remove them using the appropriate tool.

Figure 67



Ream the valve seats (2) on cylinder head using tool (1).

NOTE Valve seats must be reamed whenever valves or valve guides are replaced or ground.

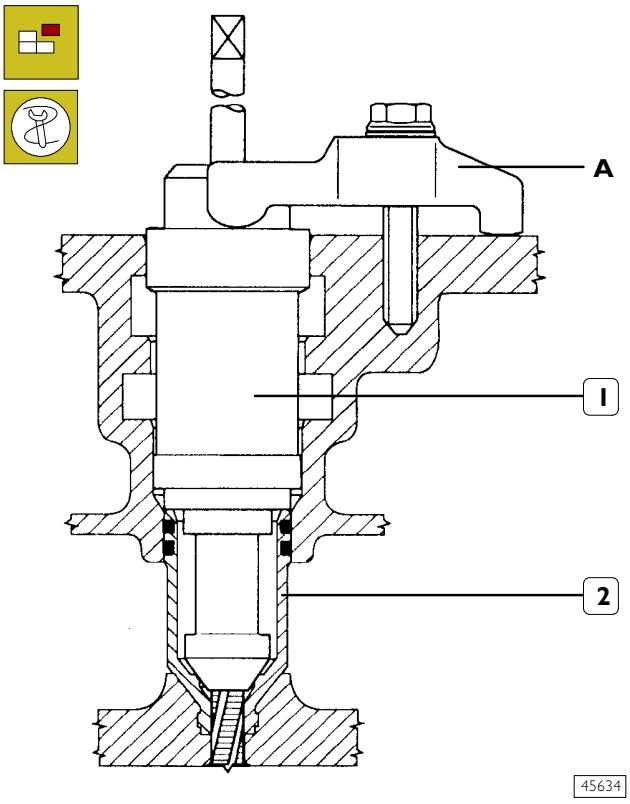
After reaming the valve seats, use tool 99370415, to make sure that the valve position, with respect to the cylinder head surface, is the following:

- ❑ -0.5 to -0.8 mm (recessing) of exhaust valves;
- ❑ -1.6 to 1.9 mm (recessing) of discharge valves.

540613 REPLACING INJECTOR HOLDER CASES

Removal

Figure 68

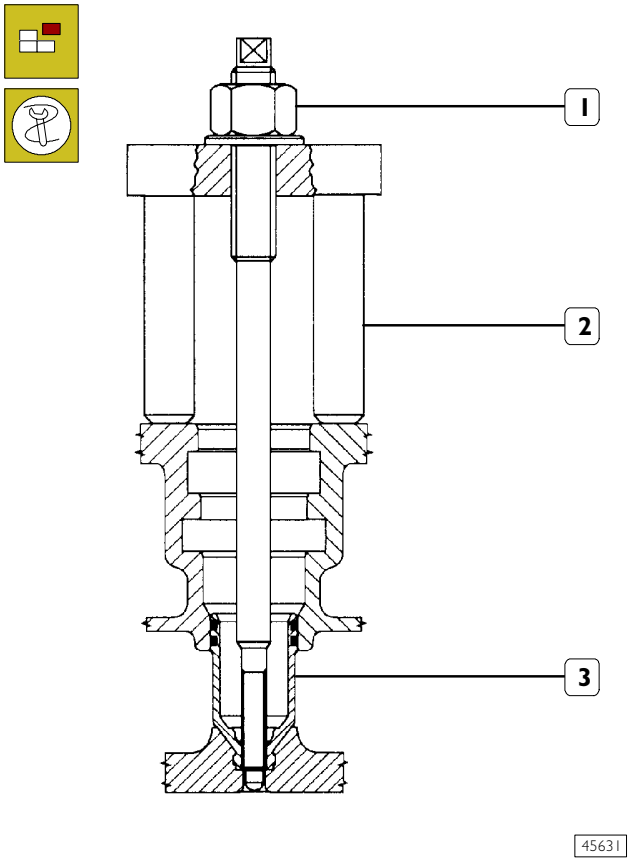


To replace the injector case (2), act as follows:

- ❑ thread the case (2) with tool 99390804 (1).

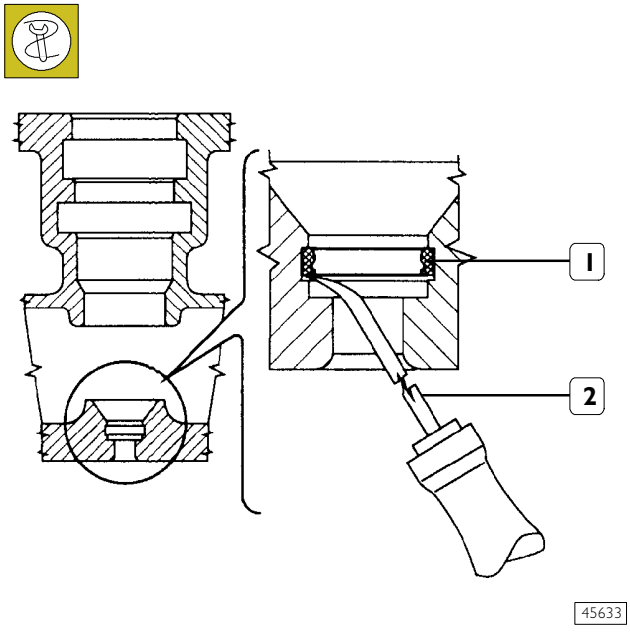
Carry out operations described in the following figs. by fixing tools to the cylinder head by means of braket A.

Figure 69



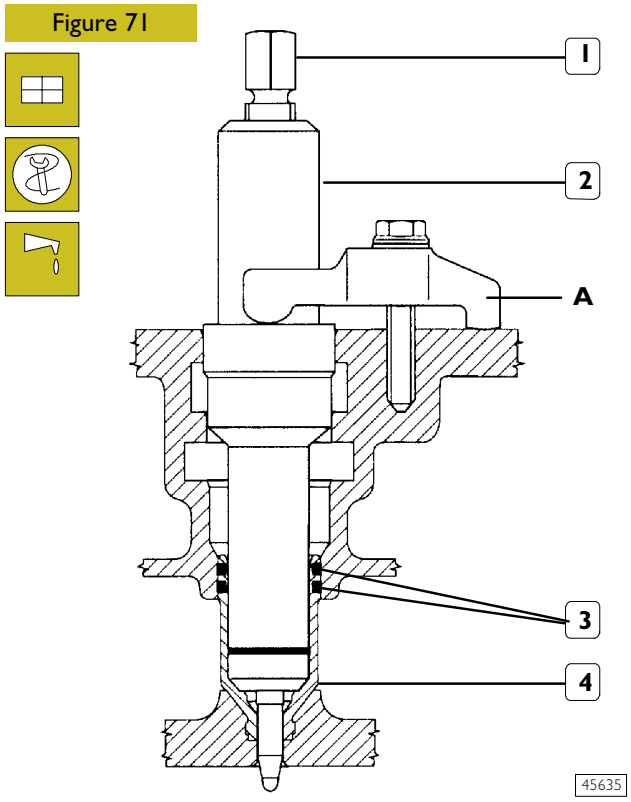
❑ fasten extractor 99342149 (2) to case (3), by tightening the nut (1), and pull out the case from cylinder head.

Figure 70



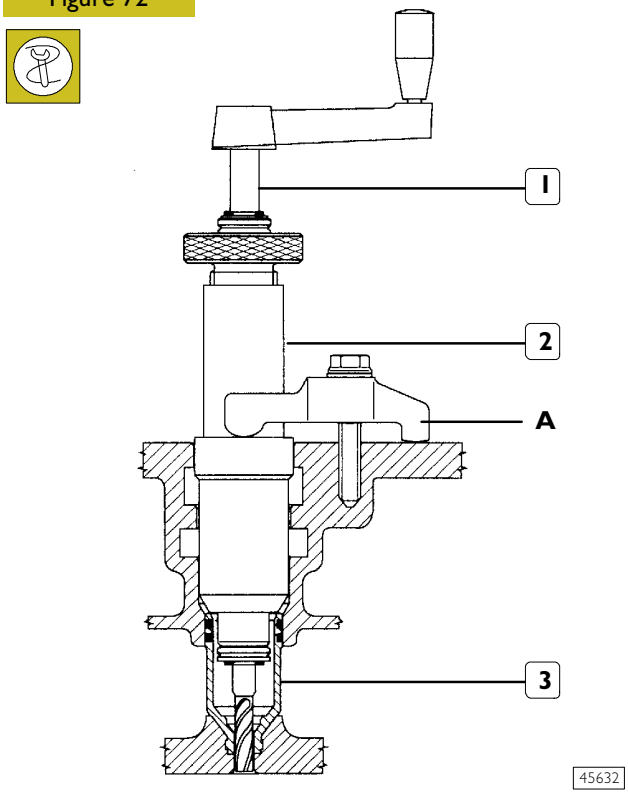
❑ Remove any residue (1), with tool 99390772 (2), from the cylinder head groove.

Figure 71



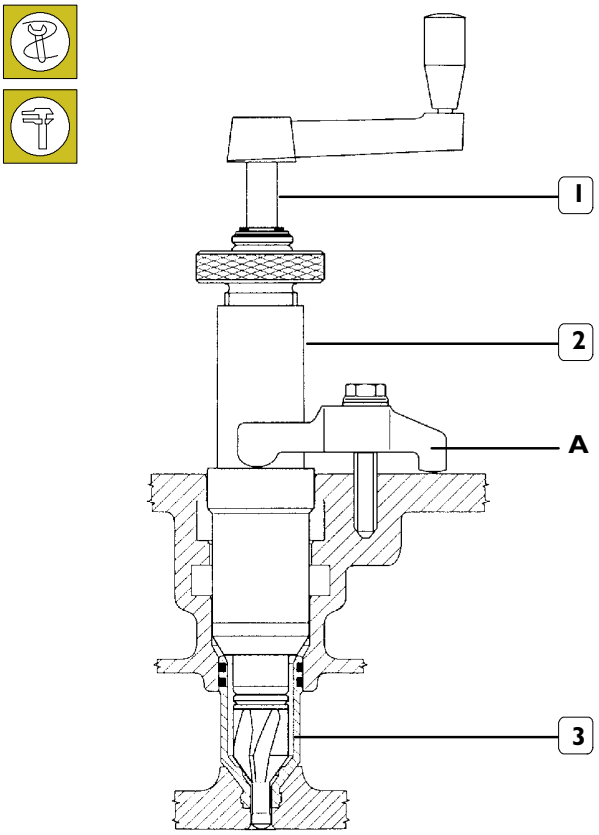
❑ Lubricate sealing rings (3) and fit them to the case (4); fix tool 99360554 (2) to the cylinder head by means of bracket **A**, install the new case, tighten the screw (1), upsetting the case lower part.

Figure 72



❑ Adjust the casing hole (3) with borer 99394043 (1) and guide bushing 99394045 (2).

Figure 73

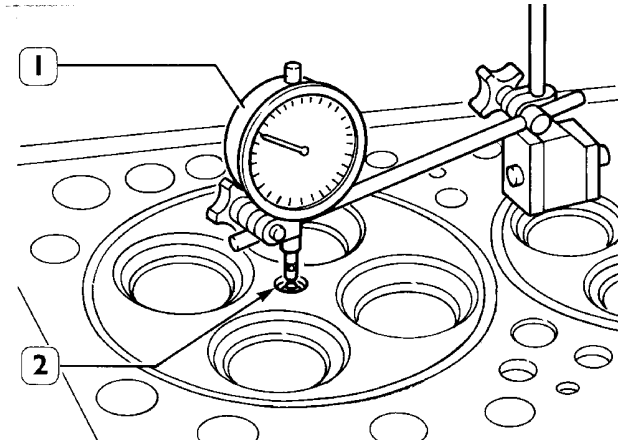


45636

❑ Through miller 99394044 (1) and bushing 99394045 (2), ream the injector seat in the case (3), check the injector protrusion from the cylinder head plane which must be 1.2 to 1.5 mm.

Checking protrusion of injectors

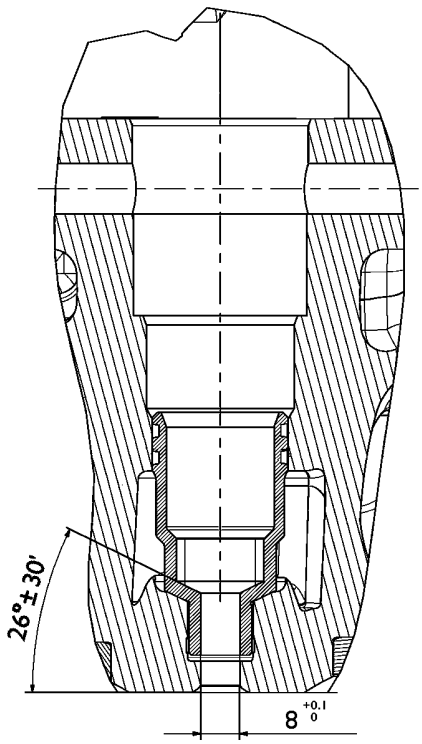
Figure 74



47585

Using dial gauge (1), check the protrusion of the injector (2) which must be 1.2 to 1.5 mm.

Figure 75

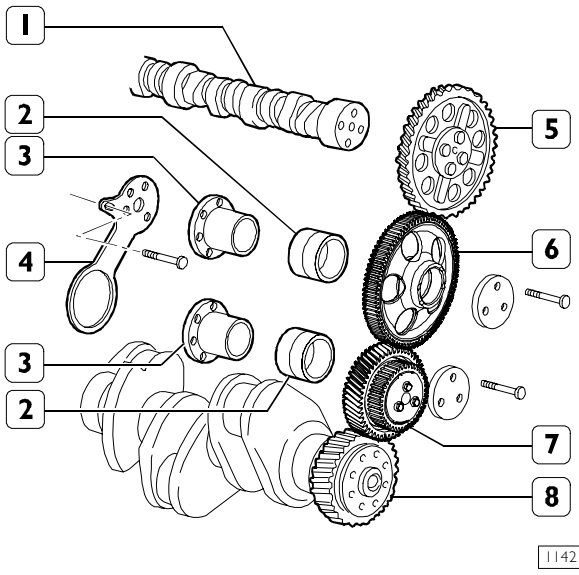


114056

INSTALLATION DIAGRAM FOR INJECTOR CASE

5412 TIMING GEAR
Camshaft drive

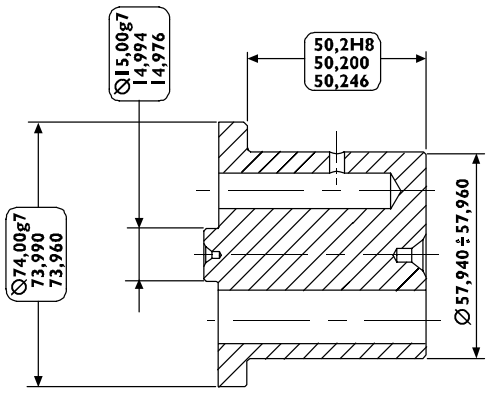
Figure 76



TIMING CONTROL COMPONENT PARTS
1. Camshaft - 2. Bushing - 3. Pin - 4. Articulated rod - 5. Camshaft control gear - 6. Idler gear - 7. Twin idler gear - 8. Drive shaft driving gear.

541253 Intermediate gear pin

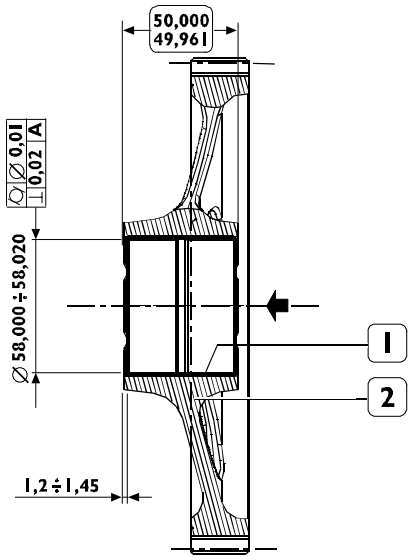
Figure 77



Rated assembling play between idler gear bushings and pins: 0.040 ÷ 0.080 mm.

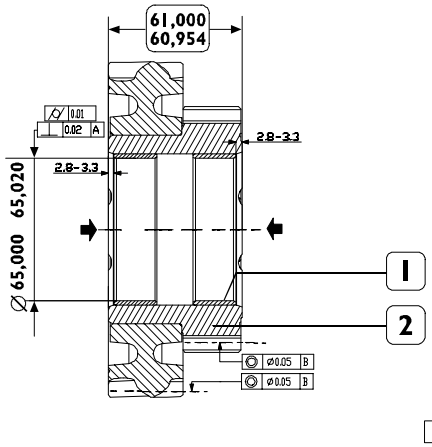
541252 Idler gear

Figure 78



541252 Twin idler gear

Figure 79



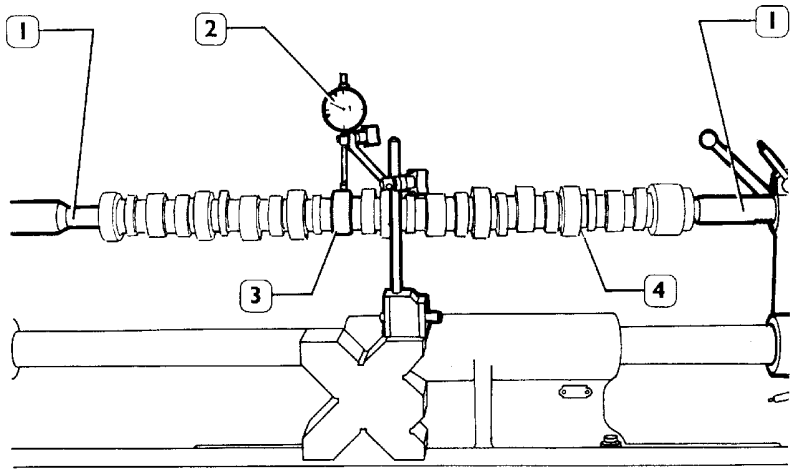
541254 Replacing the bushings

Bushings (1, Figures 78-79) can be replaced when they are worn. Put up the bushing, then grind it so as to bring it to a dimension of Ø 65.010 ± 0.10 mm.

NOTE Bushing fitting in gears (2, Figures 78-79) must be performed in arrow direction, placing them as shown in figures.

541210 Camshaft
541211 Checking cam lift and pin alignment

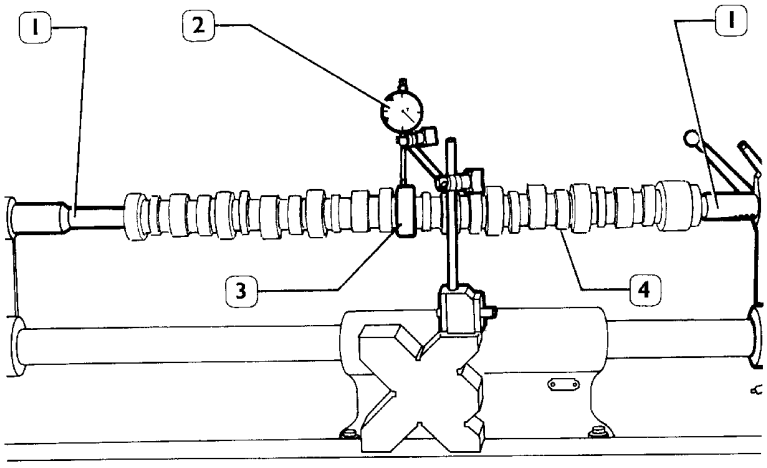
Figure 80



47506

Place the camshaft (4) on the tailstock (1) and check cam lift (3) using a centesimal gauge (2); values are shown in table on page 9.

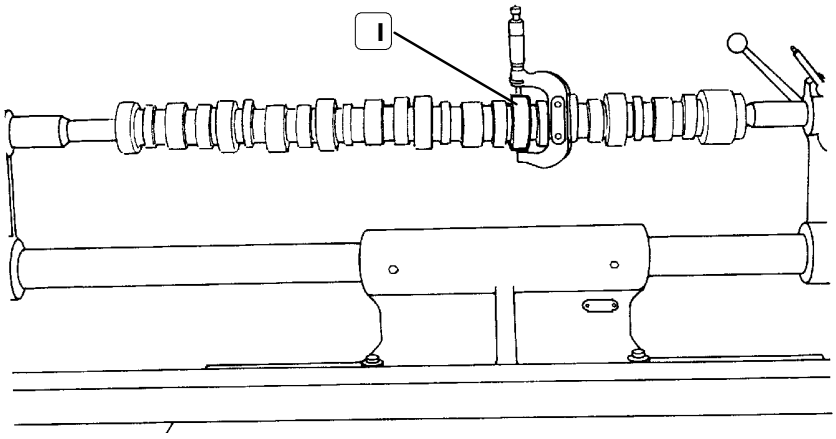
Figure 81



47507

When the camshaft (4) is on the tailstock (1), check alignment of supporting pin (3) using a centesimal gauge (2); it must not exceed 0.030 mm.
If misalignment exceeds this value, replace the shaft.

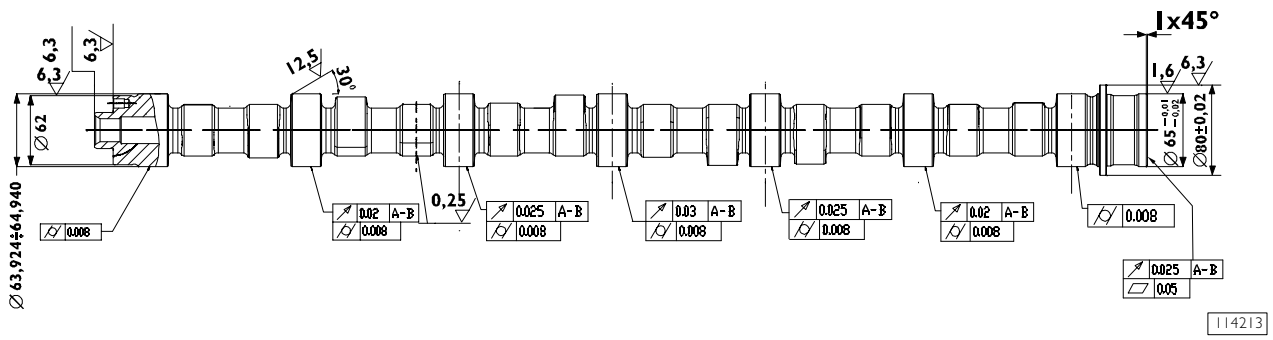
Figure 82



47505

In order to check installation clearance, measure bush inner diameter and camshaft pin (1) diameter; the real clearance is obtained by their difference.
If clearance exceeds 0.150 mm, replace bushes and, if necessary, the camshaft.

Figure 83



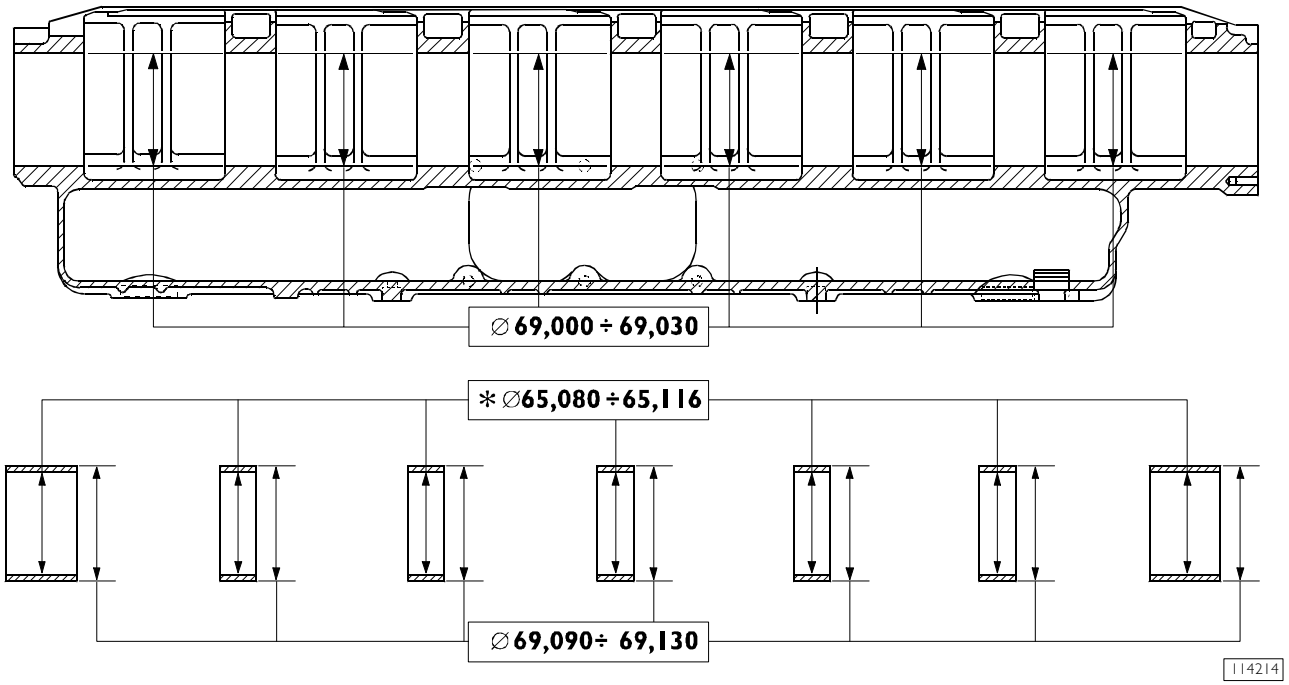
MAIN DATA - CAMSHAFT AND TOLERANCES

The surfaces of shaft supporting pin and cams must be extremely smooth; if you see any sign of seizing or scoring, replace the shaft and the relative bushes.

TOLERANCES	TOLERANCE CHARACTERISTIC	SYMBOL
ORIENTATION	Perpendicularity	⊥
POSITION	Concentricity or coaxial alignment	◎
OSCILLATION	Circular oscillation	↗
IMPORTANCE CLASS ASSIGNED TO PRODUCT CHARACTERISTICS		**SYMBOL**
CRITICAL		©
IMPORTANT		⊕
SECONDARY		⊖

541213 Bushes

Figure 84



MAIN DATA - CAMSHAFT BUSHES AND RELATIVE BLOCK SEATS

* Bush inner diameter after installation

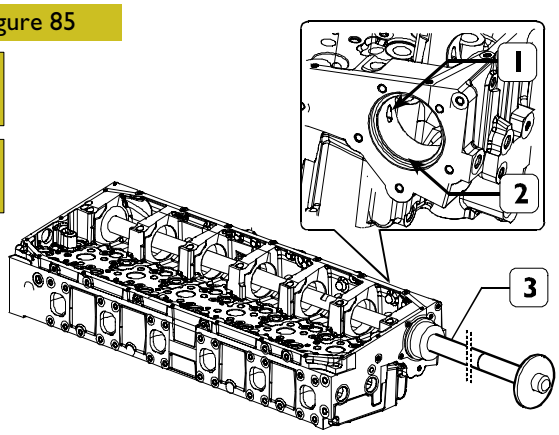
The bush surfaces must not show any sign of seizing or scoring; if they do replace them.

Measure the bush inner diameters with a baremeter and replace them, if the value measured exceeds the tolerance value.
To take down and fit back the bushes, use the proper tool 99360487.

Use beater 99360505 to change bushings

Removal

Figure 85



Use tool 99360505 (3) fitted as shown in fig. to remove bushings (2).

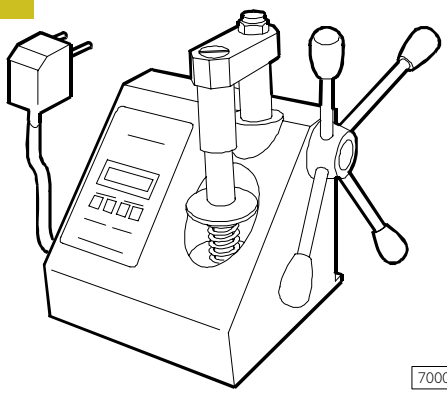
Accurately position beater during removal phase.

Fitting

For fitting, reverse operations performed for removal, with care to make lube hole (3), drilled on bushing, coincide with corresponding hole in housing.

540665 VALVE SPRINGS

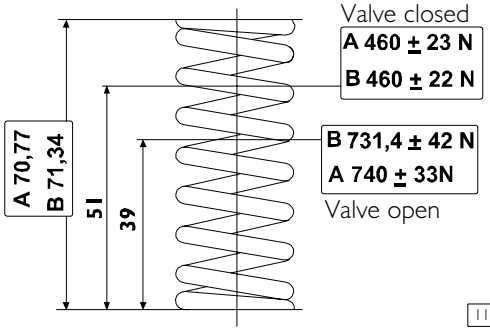
Figure 86



Before fitting, check valve spring flexibility using specific tool.

Compare the load and elastic deformation data with those of the new springs given in the following figure.

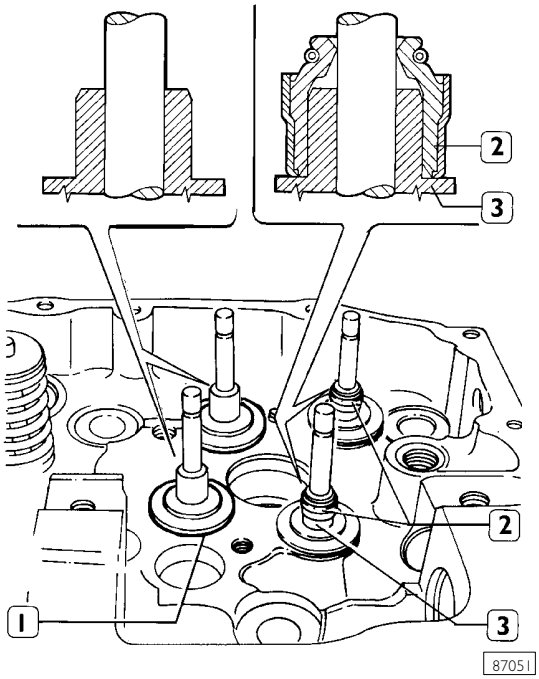
Figure 87



MAIN DATA TO CONTROL EXHAUST AND DISCHARGE VALVE SPRING

Fitting the valves and oil seal ring

Figure 88

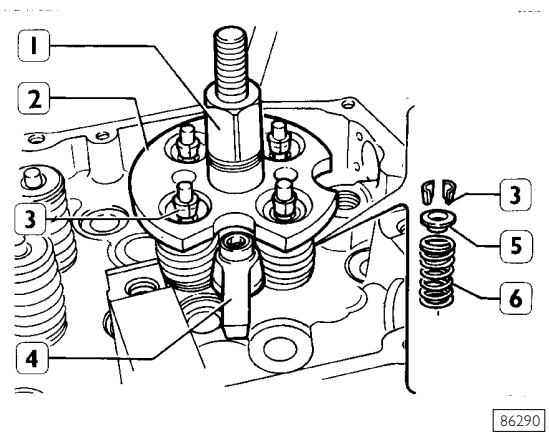


Lubricate the valve stem and insert the valves in the respective valve guides; fit the lower caps (1). Use tool 99360329 to fit the oil seal (2) on the valve guides (3) of the exhaust valves; then, to fit the valves, proceed as follows.

NOTE Should valves not have been overhauled or replaced, remount them according to numbering performed on dismounting.

Intake valves are different form exhaust valves in that they have a notch placed at valve head centre.

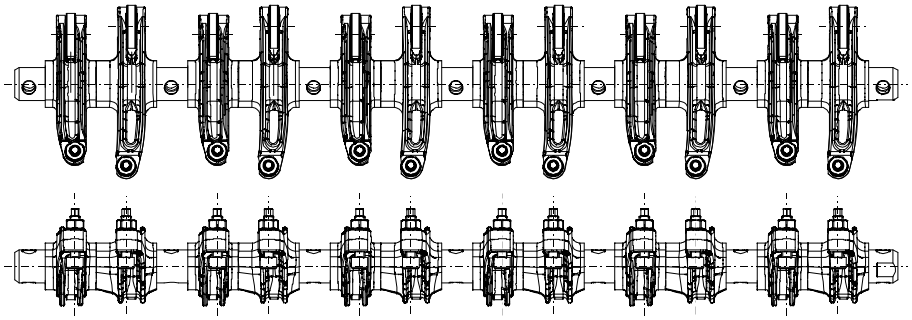
Figure 89



- ❑ fit springs (6) and the upper plate (5);
- ❑ apply tool 99360264 (2) and block it with bracket (4); tighten the lever (1) until cotters are installed (3), remove tool (2).

5412 ROCKER SHAFT

Figure 90

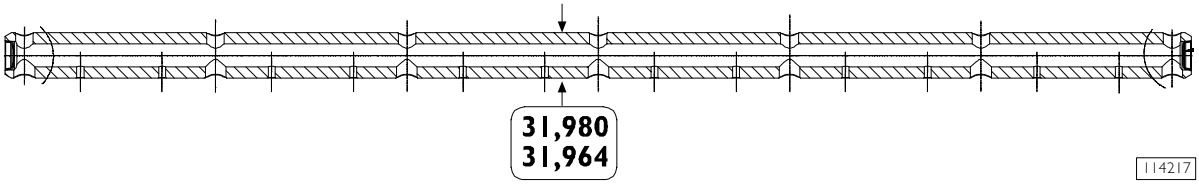


114216

The camshaft eccentric elements control the 12 valve rocker arms directly. Valve control rocker arms are fitted directly on rocker arm shaft. Rocker arms slide directly on cam profiles by rollers. The other end operates on a crosspiece laid directly on the two valve rods. A pad is placed between rocker arm adjustment screw and crosspiece. Two lube ducts are machined inside rocker a rms. Rocker arms shaft runs through the cylinder head; it must be removed to reach all units below.

Shaft

Figure 91



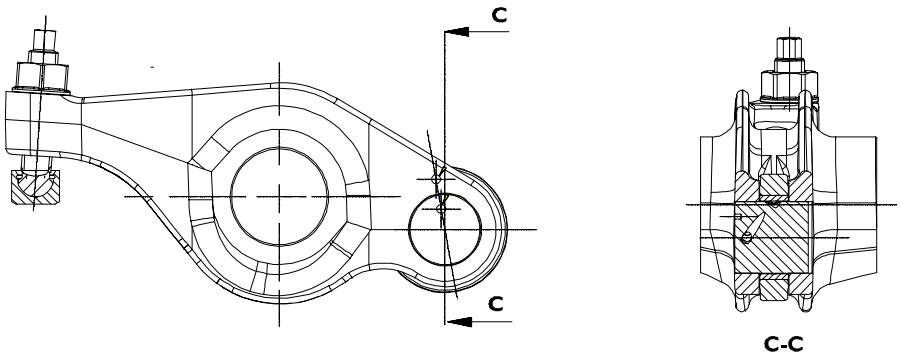
114217

MAIN DATA OF THE ROCKER ARM SHAFT

Check that the surface of the shaft shows no scoring or signs of seizure; if it does, replace it.

Rocker

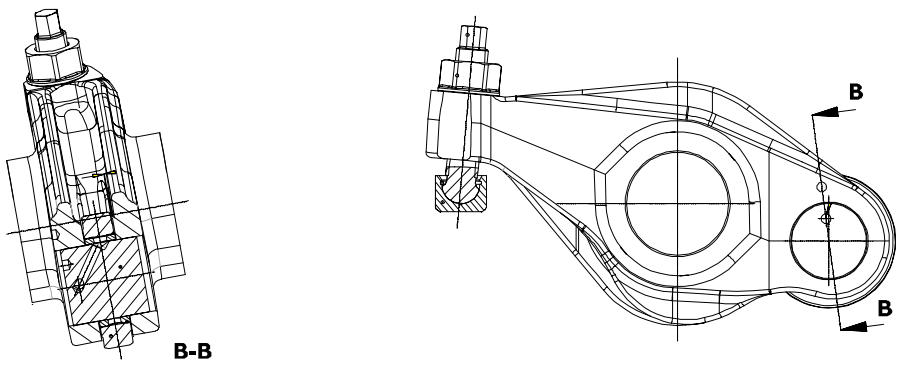
Figure 92



114219

DISCHARGE VALVE ROCKER

Figure 93



114218

EXHAUST VALVES ROCKER

The bush surfaces must not show any trace of scoring of excessive wear; otherwise, replace bushes or the whole rocker.

TIGHTENING TORQUES

PART			TORQUE	
			Nm	kgm
Pipe union for piston cooling nozzle		M12X1.5	35 ± 2	3.5 ± 0.2
Heat exchanger retaining screws			63 ± 7	6.3 ± 0.7
Plug			125 ± 15	12.5 ± 1.5
Spacer and oil sump fastening screws				
		M10	41.5 ± 3.5	4.1 ± 0.3
		M12	63 ± 7	6.3 ± 0.7
Gearcase fastening screws to cylinder block:				
		M10x1.25	41.5 ± 3.5	4.1 ± 0.3
		M12x1.75	63 ± 7	6.3 ± 0.7
		M8x1.25	23.5 ± 1.5	2.3 ± 1.5
Cylinder head fastening screw ♦				
First stage	pre-tightening		50	5
Second stage	pre-tightening		100	10
Third stage	angle closing		90°	
Fourth stage	angle closing		75°	
Rocker arm shaft fastening screw			104.5 ± 10.5	10.4 ± 1
Locknut for rocker arm adjusting screw ♦			39 ± 5	3.9 ± 5
Electroinjector retaining bracket screws ♦				
		M10	41.5 ± 3.5	4.1 ± 0.3
		M8	24.5 ± 2.5	2.4 ± 0.2
Shoulder plate fastening screws to head ♦			20 ± 2	2 ± 0.2
Engine support bracket fastening screws to cylinder head			74 ± 8	7.4 ± 0.8
Gear fastening screws to camshaft •				
First stage	pre-tightening		25	2.5
Second stage	pre-tightening		45°	
Phonic wheel fastening screws to distribution gear			8.5 ± 1.5	0.8 ± 0.1
Exhaust pipe fastening screws •				
pre-tightening			40 ± 5	4 ± 0.5
tightening			70 ± 5	7 ± 0.5
Connecting rod cap fastening screws: ♦				
First stage	pre-tightening		50	5
Second stage	pre-tightening		90°	
Engine flywheel fastening screws ♦		M18x1.5x72		
First stage	pre-tightening		120	12
Second stage	pre-tightening		90°	
Flywheel pulley fastening screws to crankshaft ♦				
First stage	pre-tightening		70	7
Second stage	pre-tightening		50°	
Main journal retaining screws ♦				
First stage	pre-tightening		140	14
Second stage	pre-tightening		60° + 60°	

♦ Lubricate with oil MOLYKOTE before assembly
• Lubricate with graphitized oil before assembly

PART		TORQUE	
		Nm	kgm
Damper flywheel fastening screws ♦		115 ± 15	11.5 ± 1.5
Idler gear pin fastening screws ♦			
First stage	pre-tightening	30	3
Second stage	angle closing	90°	
Idle gear link rod fastening screw		24.5 ± 2.5	2.4 ± 0.2
Oil pump fastening screw		24.5 ± 2.5	2.4 ± 0.2
Oil pump suction rose fastening screw		24.5 ± 2.5	2.4 ± 0.2
Front cover fastening screw to cylinder block		19 ± 3	1.9 ± 0.3
Control unit fastening screw to cylinder block		19 ± 3	1.9 ± 0.3
Fuel filter support fastening screw to cylinder head ♦		24.5 ± 2.5	2.4 ± 0.2
Screw securing the engine support to the wheelcase ♦			
First stage	pre-tightening	100	10
Second stage	angle closing	60°	
Turbo-compressor fastening screws and nuts •			
pre-tightening		35 ± 5	3.5 ± 0.5
tightening		46 ± 2	4.6 ± 0.2
Water pump fastening screw to cylinder block		24.5 ± 2.5	2.4 ± 0.2
Pulley fastening screw to hub		55 ± 5	5.5 ± 0.5
Rocker arm cover fastening screws		8.5 ± 1.5	0.8 ± 0.1
Thermostat box fastening screws to cylinder head		24.5 ± 2.5	2.4 ± 0.2
Automatic tightener fastening screws to cylinder block		45 ± 5	4.5 ± 0.5
Fixed tightener fastening screws to cylinder block		105 ± 5	10.5 ± 0.5
Fan support fastening screws to cylinder block		24.5 ± 2.5	2.4 ± 0.2
Starter fastening screws		44 ± 4	4 ± 0.4
Air heater on cylinder head		50 ± 5	5 ± 0.5
Hydraulic power steering pump gear fastening nut		105 ± 5	10.5 ± 0.5
Air conditioner compressor fastening screw to support		24.5 ± 2.5	2.4 ± 2.5
Alternator support superior fastening screw		71.5 ± 4.5	7.1 ± 0.4
Alternator bracket fastening screw to cylinder block		24.5 ± 2.5	2.4 ± 0.2
Water pipe unions		35	3.5
Water temperature sensor		32.5 ± 2.5	3.2 ± 0.2

♦ Lubricate with oil MOLYKOTE before assembly
• Lubricate with graphitized oil before assembly

PART	TORQUE	
	Nm	kgm
Flywheel rev sensor fastening screw	8 ± 4	0.8 ± 0.2
Camshaft rev sensor fastening screw	8 ± 2	0.8 ± 0.2
P.D.E solenoid connector fastening screw	1.62 ± 0.3	0.1 ± 0.3
Overboost pressure sensor fastening screw	8 ± 2	0.8 ± 0.2
Absolute pressure sensor fastening screw	22.5 ± 2.5	2.2 ± 0.2
P.W.M. control valve fastening screw/nut	8 ± 2	0.8 ± 0.2
Fuel/coolant temperature sensor	35	3.5
Coolant temperature indicator	23.5 ± 2.5	2.3 ± 0.2
Filter clogging sensor	10	1
Oil temperature switch	25 ± 1	2.5 ± 0.1
Oil pressure sensor	25 ± 1	2.5 ± 0.1
Electric wire fastening screw	8 ± 2	0.8 ± 0.2
Heater fastening screw	12.5 ± 2.5	1.2 ± 0.2

SECTION 5

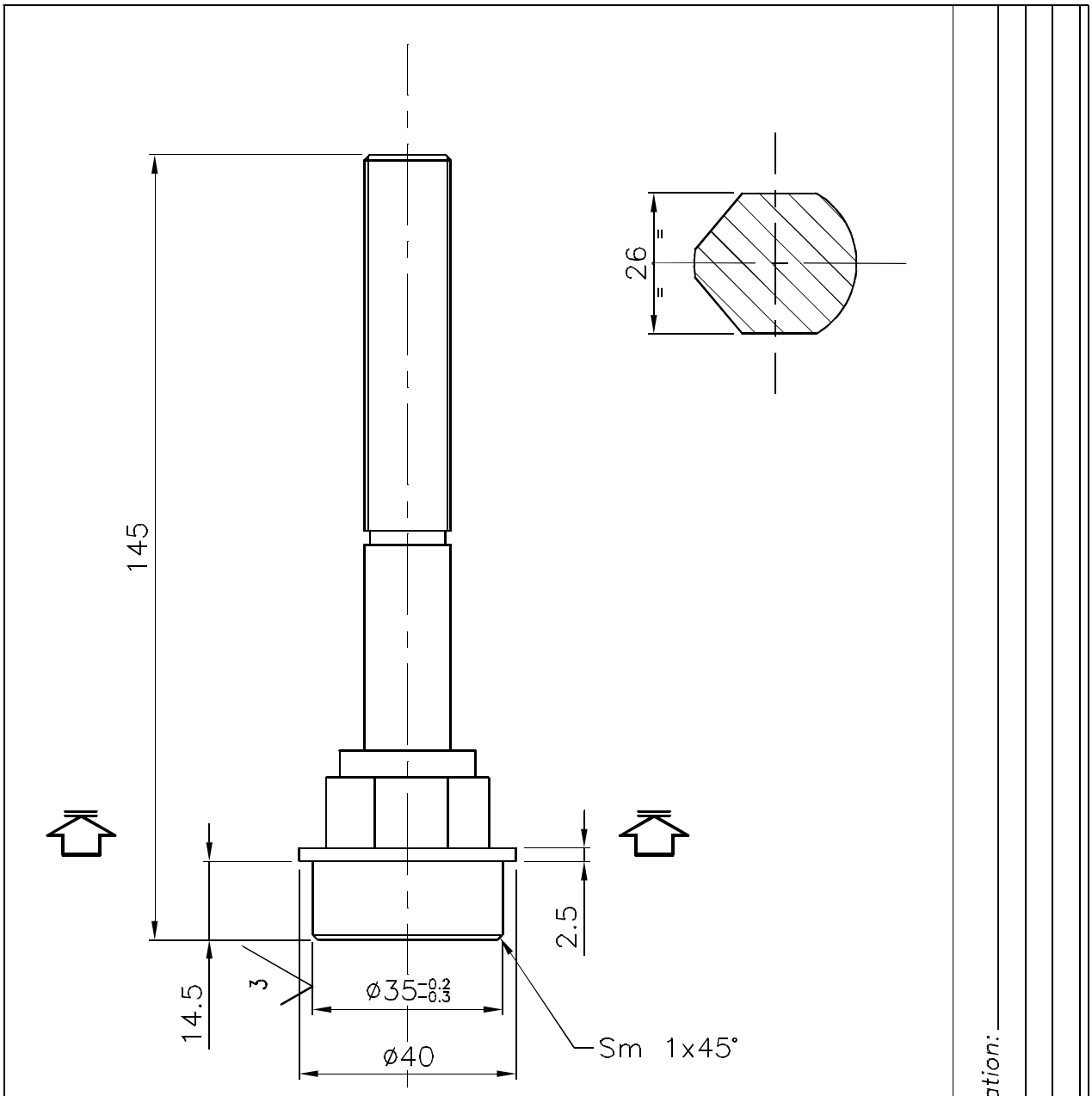
Tools

TOOLS

TOOL NO.	DESCRIPTION
99322230	Rotary telescopic stand
99340051	Extractor for crankshaft front gasket
99340054	Extractor for crankshaft rear gasket
99342149	Extractor for injector-holder
99346245	Tool to install the crankshaft front gasket
99346260	Tool to install the crankshaft rear gasket
99360184	Pincers for removing and refitting circlips and pistons (105-160 mm)
99360264	Tool to take down-fit engine valves (tool modified for CURSOR 9 upgrade, see Table at page 5)
99360288	Tool to remove valve guide
99360292	Tool to install gasket on valve guide
99360294	Valve guide refitting beater (use with 99360288)
99360334	Tool for checking cylinder barrel projection
99360335	Cylinder barrel compression cap (to be used with 99360334)
99360500	Tool to lift crankshaft
99360558	Tool to lift and transport rocker shaft (tool modified for CURSOR 9 upgrade, see Table at page 6)
99360585	Balance for lifting and handling engine
99360505	Belt to insert piston in cylinder liner (60 - 125 mm)
99360612	Engine flywheel timing pin
99360613	Tool for timing of phonic wheel on timing gear
99360703	Tool to stop cylinder liners
99360706	Tool to extract cylinder liners
99360724	Tool to extract the cylinder liners (to be used with 99360706)
99361042	Brackets fixing the engine to rotary stand 99322230
99365054	Tool for injector holder heading (tool modified for CURSOR 9 upgrade, see Table at page 7)
99370415	Tool to detect cylinder liner projections (use with 99395603)
99390310	Valve guide sleeker
99390772	Tool to remove residues from injector holder
99390804	Tool to thread injector holders to be extracted (tool modified for CURSOR 9 upgrade, see Table at page 8)

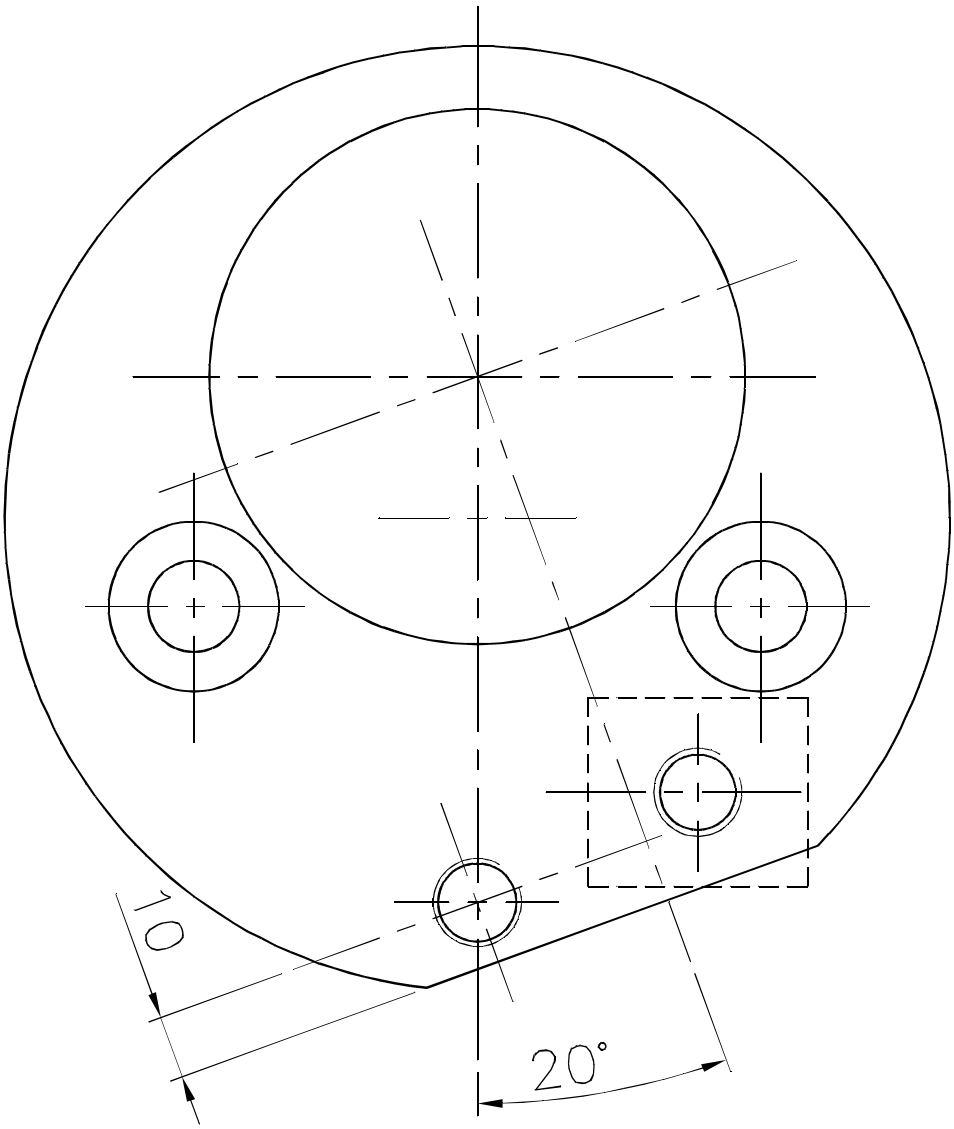
TOOLS

TOOL NO.	DESCRIPTION
99394043	Reamer to rectify injector holder lower side (to be used with 99394045)
99395216	Measuring pair for angular tightening with 1/2" and 3/4" square couplings
99395603	Dial gauge (0 - 5 mm)
99395221	Gage for high-pressure pump alignment
99394045	Guide bush (to be used with 99394044 or 99394043)
99360505	Tool to take down and fit back camshaft bushes
99394044	Cutter to rectify injector holder housing (to be used with 99360505)
99360341	Tool to rotate engine flywheel
99395222	Gauge for centre distance check between camshaft and idle gear



For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO *STD 10-2311*

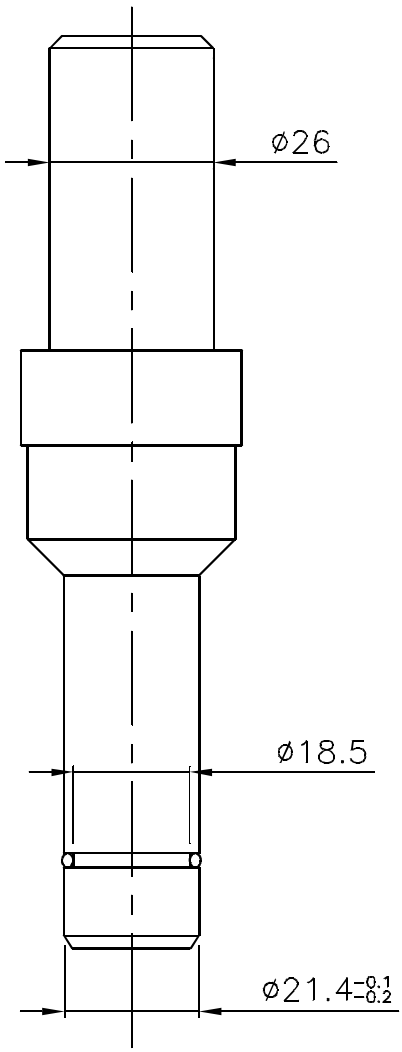
MAT.	COVER.	DRAWN UTS /	N°DRAWING 99360264
Modifica per adeguamento		APPROVED	EXPER. / SIZE A4
attrezzo a motore		DATE	SHEET
CURSOR 9		SUPERSEDES	
C/=0 I.S. 18-0011		SCALE 1:1	IVECO
		Q.TY 1	02



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO *STD 10-2311*

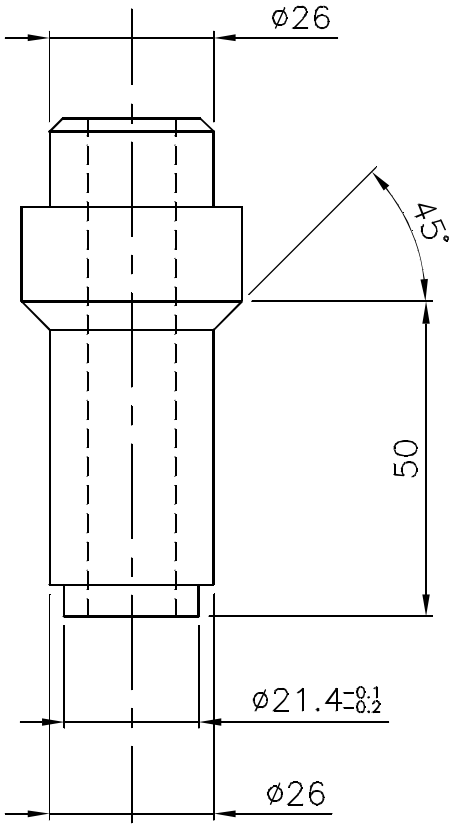
MAT.	COVER.	DRAWN UTS /	N°DRAWING 99360558
		APPROVED	EXPER. / SIZE A4
Modifica per adeguamento		DATE	SHEET
attrezzo a motore		SUPERSEDES	
CURSOR 9		SCALE 1:1	
C/=0 I.S. 18-0011		Q.TY 1	IVECO 02



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO *STD 10-2311*

MAT.	COVER.	DRAWN UTS /	N°DRAWING 99365054
	Modifica per adeguamento	APPROVED	EXPER. / SIZE A4
	attrezzo a motore	DATE	SHEET
	CURSOR 9	SUPERSEDES	
C/=0 I.S. 18-0011		SCALE 1:1	IVECO
		Q.TY 1	02



Modification:

For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO *STD 10-2311*

MAT.	COVER.	DRAWN UTS /	N°DRAWING 99390804
	Modifica per adeguamento	APPROVED	EXPER. / SIZE A4
	attrezzo a motore	DATE	SHEET
	CURSOR 9	SUPERSEDES	
C/=0 I.S. 18-0011		SCALE 1:1	IVECO
		Q.TY 1	02

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.
- ❑ 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.