NEF TIER 2 SERIES

Power generation application

NEF 45

GE NEF 45M
GE NEF 60M
GE NEF 75M
GE NEF 85M
GE NEF 100M
GS NEF 45M
GS NEF 60M
GS NEF 75M
GS NEF 85M
GS NEF 100M

NEF 60

GE NEF 200E
GS NEF 200E

NEF 67

GE NEF 125M
GE NEF 130M
GE NEF 160M
GS NEF 125M
GS NEF 130M
GS NEF 160M

Technical and Repair manual

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

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

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

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

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

Publication edited by
Iveco Motors
Iveco SpA
PowerTrain
Mkt. Advertising & Promotion
Viale dell'Industria, 15/17
20010 Pregnana Milanese
Milano (Italy)
Print **P4D32N001 E** - 2nd Ed. 04.2007

Produced by:

SATIZ

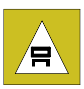
B.U. TECHNICAL PUBLISHING
Iveco Technical Publications
Lungo Stura Lazio, 15/19
10156 Turin - Italy

PRELIMINARY REMARKS

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

SYMBOLS - WARNINGS

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



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

General danger
It includes the dangers of above described signals.

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

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

GENERAL WARNINGS

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

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

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

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

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

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

Keep personnel not authorised to operations clear of working area.

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

Do not leave the running assembly unattended when making repairs.

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

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

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

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

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

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

Print P4D32N001 E

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.

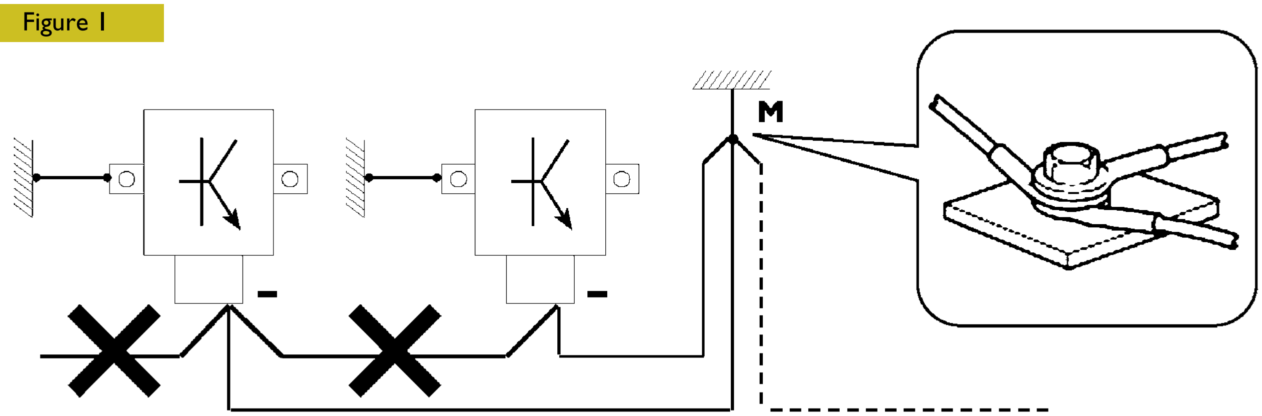
Bonding and screening

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:

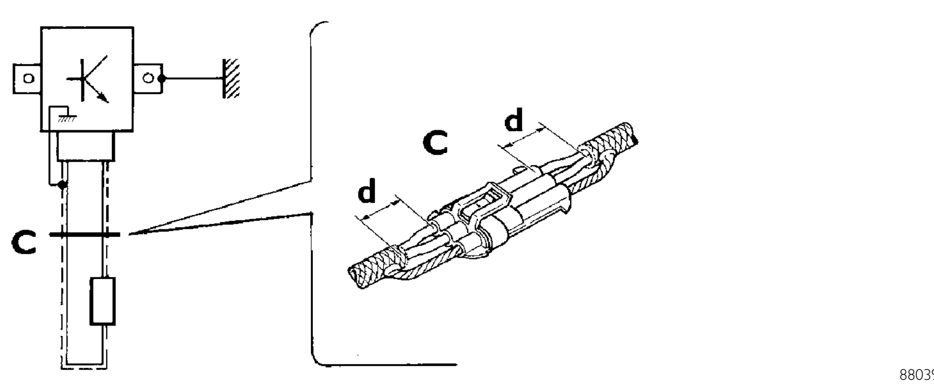
- Electronic central units must be connected to system bonding when they are provided with a metallic shell.
- Electronic central units negative cables must be connected both to a system bonding point such as the dashboard opening bonding (avoiding "serial" or "chain" connections), and to battery negative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

NEF POWER GENERATION ENGINES

Part 1
F4GE NEF ENGINES

PREFACE TO USER'S GUIDELINE MANUAL

Section 1 describes the NEF 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.

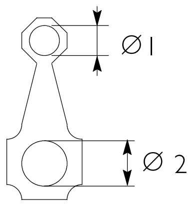
F4GE NEF ENGINES

Print P4D32N001 E

SPECIAL REMARKS

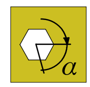
Diagrams and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with, (see next page) instead of giving descriptions of some operations or procedures.

Example



Ø 1 = housing for connecting rod small end bush

Ø 2 = housing for connecting rod bearings



Tighten to torque
Tighten to torque + angular value

SYMBOLS - ASSISTANCE OPERATIONS

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
α	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Visual inspection Fitting position check
	Measurement Value to find Check
	Equipment
	Surface for machining Machine finish
	Interference Strained assembly
	Thickness Clearance
	Lubrication Damp Grease
	Sealant Adhesive
	Air bleeding
IVECO PARTS	Replacement Original spare parts
	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
bar	Pressure
>	Oversized Higher than…. Maximum, peak
<	Undersized Less than…. Minimum
	Selection Classes Oversizing
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

Print P4D32N001 E

UPDATING

Section	Description	Page	Date of revision

SECTION 1

General specifications

ELECTRICAL SPECIFICATIONS OF THE GENERATING SETS

Generating set	Assembled Engine	Electrical specifications				
		Ratings	50 Hz		60 Hz	
			kVA	kW (*)	kVA	kW (*)
GE NEF 45M	NEF 45 AM1	Prime	45	36	50	40
		Stand By	50	40	55	44
GE NEF 60M	NEF 45 SM1	Prime	60	48	66	53
		Stand By	66	53	73	58
GE NEF 75M	NEF 45 SM2	Prime	75	60	75	60
		Stand By	82	66	82	66
GE NEF 85M	NEF 45 TM1	Prime	85	68	100	80
		Stand By	94	75	110	88
GE NEF 100M	NEF 45 TM2	Prime	100	80	110	88
		Stand By	110	88	121	97
GE NEF 125M	NEF 67 SM1	Prime	125	100	145	116
		Stand By	138	110	160	128
GE NEF 130M	NEF 67 TM2	Prime	130	104	145	116
		Stand By	143	114	160	128
GE NEF 160M	NEF 67 TM3	Prime	160	128	170	136
		Stand By	176	141	187	150
GS NEF 45M	NEF 45 AM1	Prime	45	36	50	40
		Stand By	50	40	55	44
GS NEF 60M	NEF 45 SM1	Prime	60	48	66	53
		Stand By	66	53	73	58
GS NEF 75M	NEF 45 SM2	Prime	75	60	75	60
		Stand By	82	66	82	66
GS NEF 85M	NEF 45 TM1	Prime	85	68	100	80
		Stand By	94	75	110	88
GS NEF 100M	NEF 45 TM2	Prime	100	80	110	88
		Stand By	110	88	121	97
GS NEF 125M	NEF 67 SM1	Prime	125	100	145	116
		Stand By	138	110	160	128
GS NEF 130M	NEF 67 TM2	Prime	130	104	145	116
		Stand By	143	114	160	128
GS NEF 160M	NEF 67 TM3	Prime	160	128	170	136
		Stand By	176	141	187	150

(*) Power factor 0.8.

Prime Power

The Prime Power is the maximum power available with varying loads for an unlimited number of hours. The average power output during a 24 h period of operation must not exceed 80% of the declared prime power between the prescribed maintenance intervals and at standard environmental conditions. A 10% overload is permissible for 1 hour every 12 hours of operation.

Stand-by Power

This is the maximum power available for a period of 500 hours/year with a mean load factor of 90% of the declared stand-by power. No kind of overload is permissible for this use.

CORRESPONDENCE BETWEEN TECHNICAL CODE AND COMMERCIAL CODE

Technical Code	Commercial Code
F4GE0405A*F600	GE NEF 45M
F4GE0405B*F600	GE NEF 45M
F4GE0455A*F600	GE NEF 75M
F4GE0455B*F600	GE NEF 75M
F4GE0455C*F600	GE NEF 60M
F4GE0485C*F600	GE NEF 85M
F4GE0485A*F600	GE NEF 100M
F4GE0655B*B600	GE NEF 125M
F4GE0685D*F601	GE NEF 130M
F4GE0685B*F601	GE NEF 160M

Technical Code	Commercial Code
F4GE0405A*F600	GS NEF 45M
F4GE0405B*F600	GS NEF 45M
F4GE0455A*F600	GS NEF 75M
F4GE0455B*F600	GS NEF 75M
F4GE0455C*F600	GS NEF 60M
F4GE0485C*F600	GS NEF 85M
F4GE0485A*F600	GS NEF 100M
F4GE0655B*B600	GS NEF 125M
F4GE0685D*F601	GS NEF 130M
F4GE0685B*F601	GS NEF 160M

Print P4D32N001 E

LUBRICATION

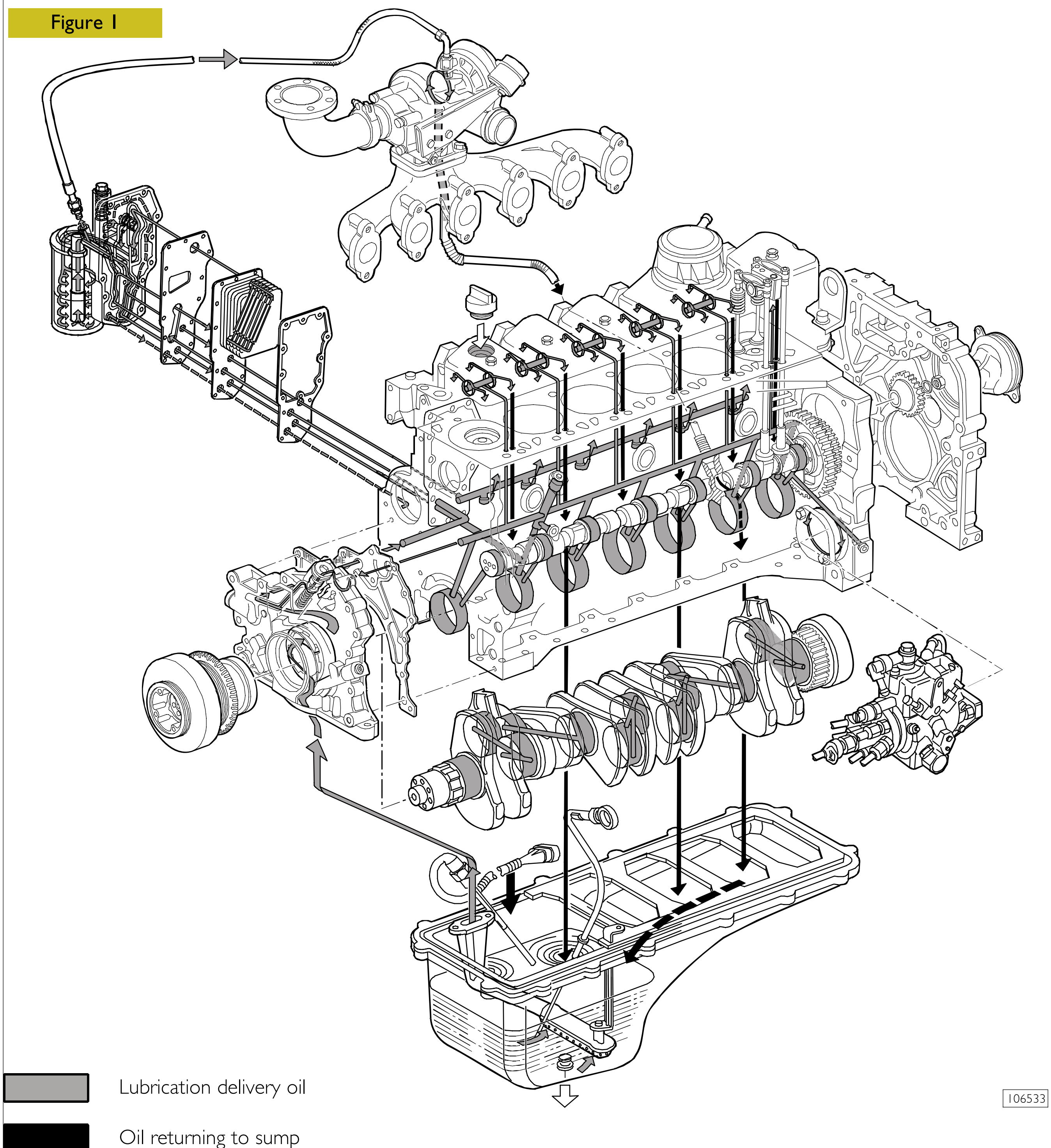
Lubrication by forced circulation is achieved through oil rotary expansion pump, placed in the front part of the basement, driven by the straight-tooth gear splined to the shaft's bar hold.

From the pan, the lubrication oil flows to the driving shaft, to the camshaft and to the valve drive.

Lubrication involves the heat exchanger (2,3), the turboblower for turbocompressed versions, and for any compressed air system.

All these components may often vary according to the specific duty.

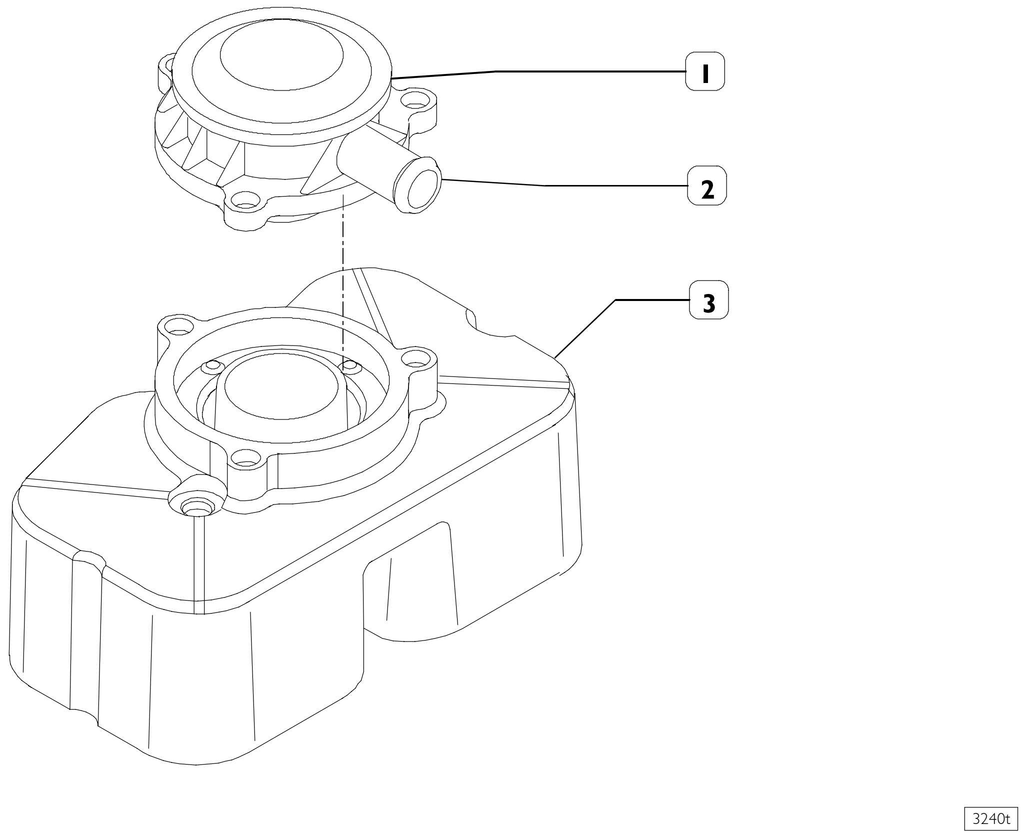
Figure 1



LUBRICATION SYSTEM LAYOUT (6 cyl. engines)

OIL VAPOUR RECIRCULATING SYSTEM

Figure 2



1. Valve - 2. Breather pipe - 3. Tappet Cap.

On the tappet cap (3) there is a valve (1) whose duty is to condense oil vapour inducing these to fall down because of gravity, to the Tappet cap underneath.

The remaining non-condensed vapours shall be properly conveyed through the breather pipe (2), by suction as an example (connection towards these vapours shall be designed by the Engineer).

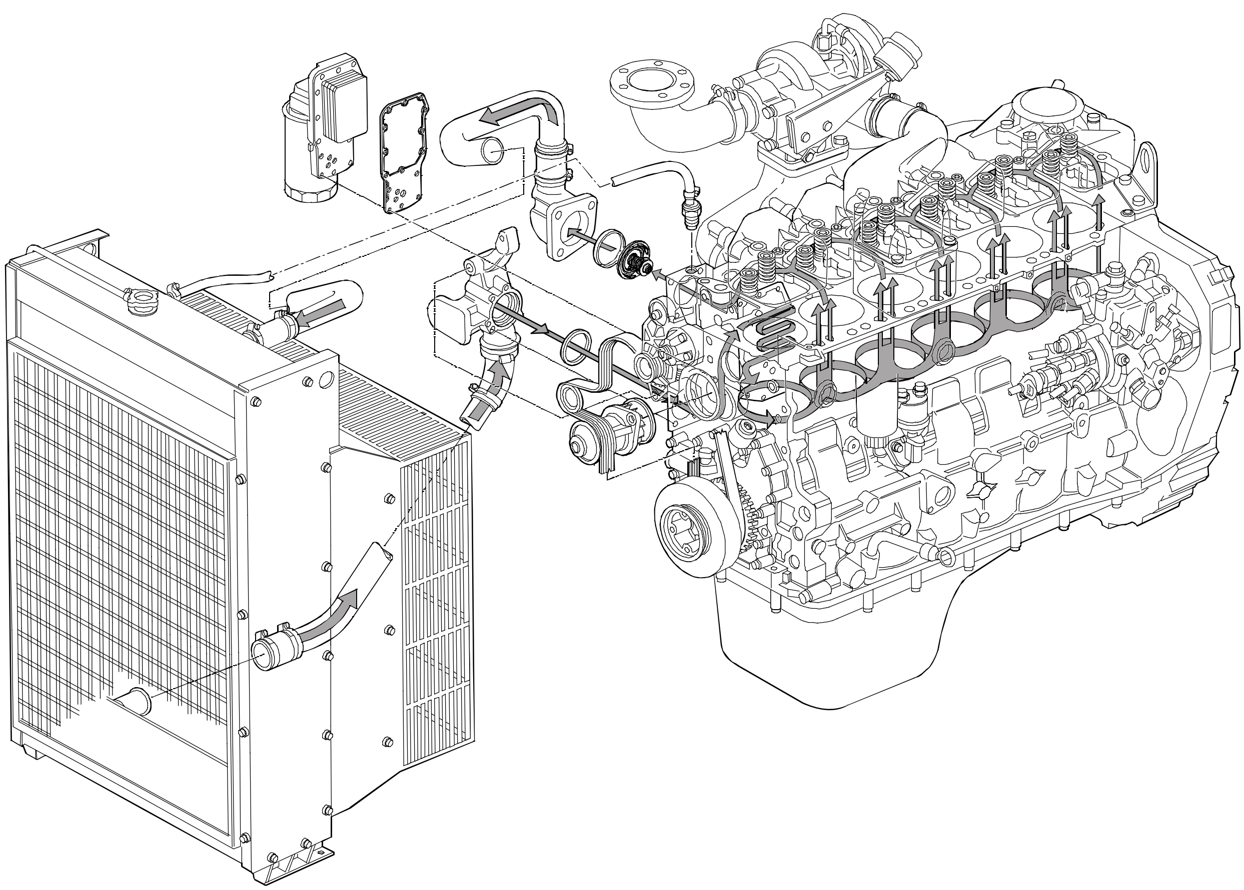
Print P4D32N001 E

COOLING SYSTEM

The engine cooling system, closed circuit forced circulation type, generally incorporates the following components:

- expansion tank; placement, shape and dimensions are subject to change according to the engine's equipment;
- radiator, which has the duty to dissipate the heat subtracted to the engine by the cooling liquid. Also this component will have specific peculiarities based on the equipment developed, both for what concerns the placement and the dimensions;
- visc pusher fan, having the duty to increase the heat dissipating power of the radiator. This component as well will be specifically equipped based on the engine's development;
- heat exchanger to cool the lubrication oil: even this component is part of the engine's specific equipment;
- centrifugal water pump, placed in the front part of the engine block;
- thermostat regulating the circulation of the cooling liquid;
- the circuit may eventually be extended to the compressor, if this is included in the equipment.

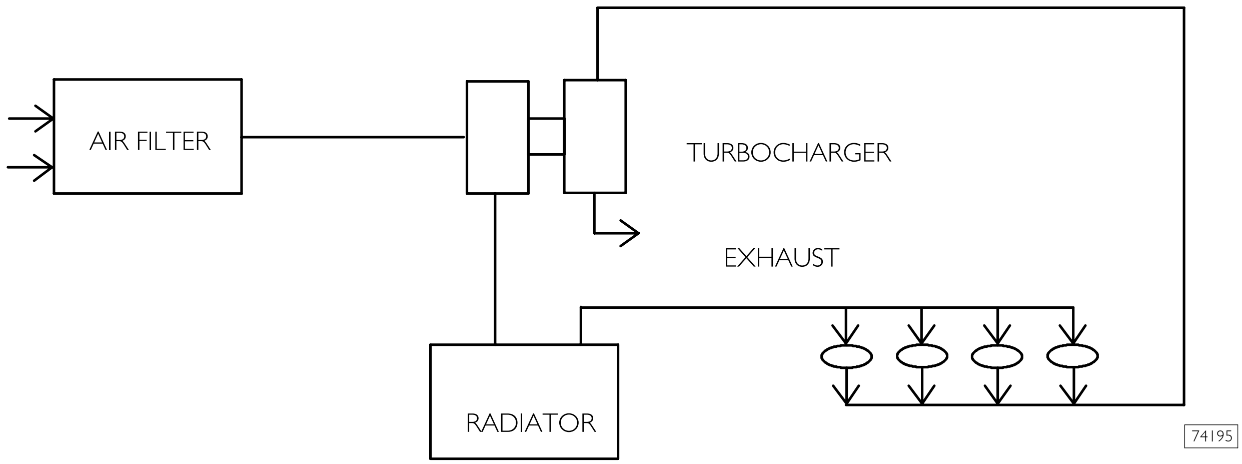
Figure 3



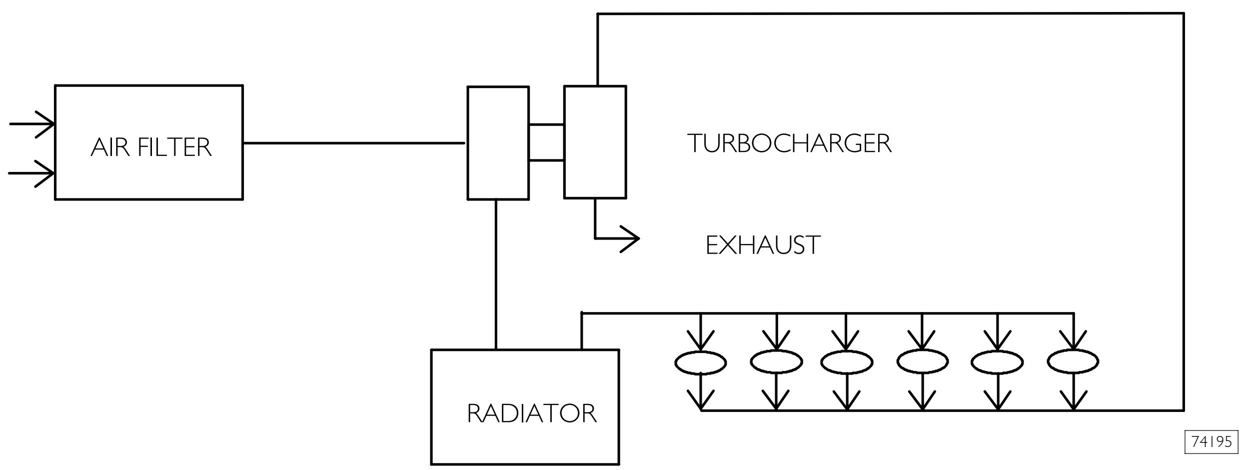
COOLING SYSTEM LAYOUT (6 cyl. engines)

AIR INDUCTION BOOST DIAGRAM

Figure 4



4 cylinders version



6 cylinders version

Description

The turbocharger is composed by the following main parts: one turbine, one transforming valve to regulate the boost feeding pressure , one main body and one compressor.

During engine working process, the exhaust emission flow through the body of the turbine, provoking the turbine disk wheel's rotation.

The compressor rotor, being connected by shaft to the turbine disk wheel, rotates as long as this last one rotates, compressing the sucked air through the air filter.

The above mentioned air is then cooled by the radiator and flown through the piston induction collector.

The turbocharger is equipped with a transforming valve to regulate the pressure , that is located on the exhaust collector before the turbine and connected by piping to the induction collector.

It's duty is to choke the exhaust of the emissions , releasing part of them directly to the exhaust tube when the boost feeding pressure, over the compressor, reaches the prescribed bar value.

The cooling process and the lubrication of the turbocharger and of the bearings is made by the oil of the engine.

Print P4D32N001 E

SECTION 2

Fuel

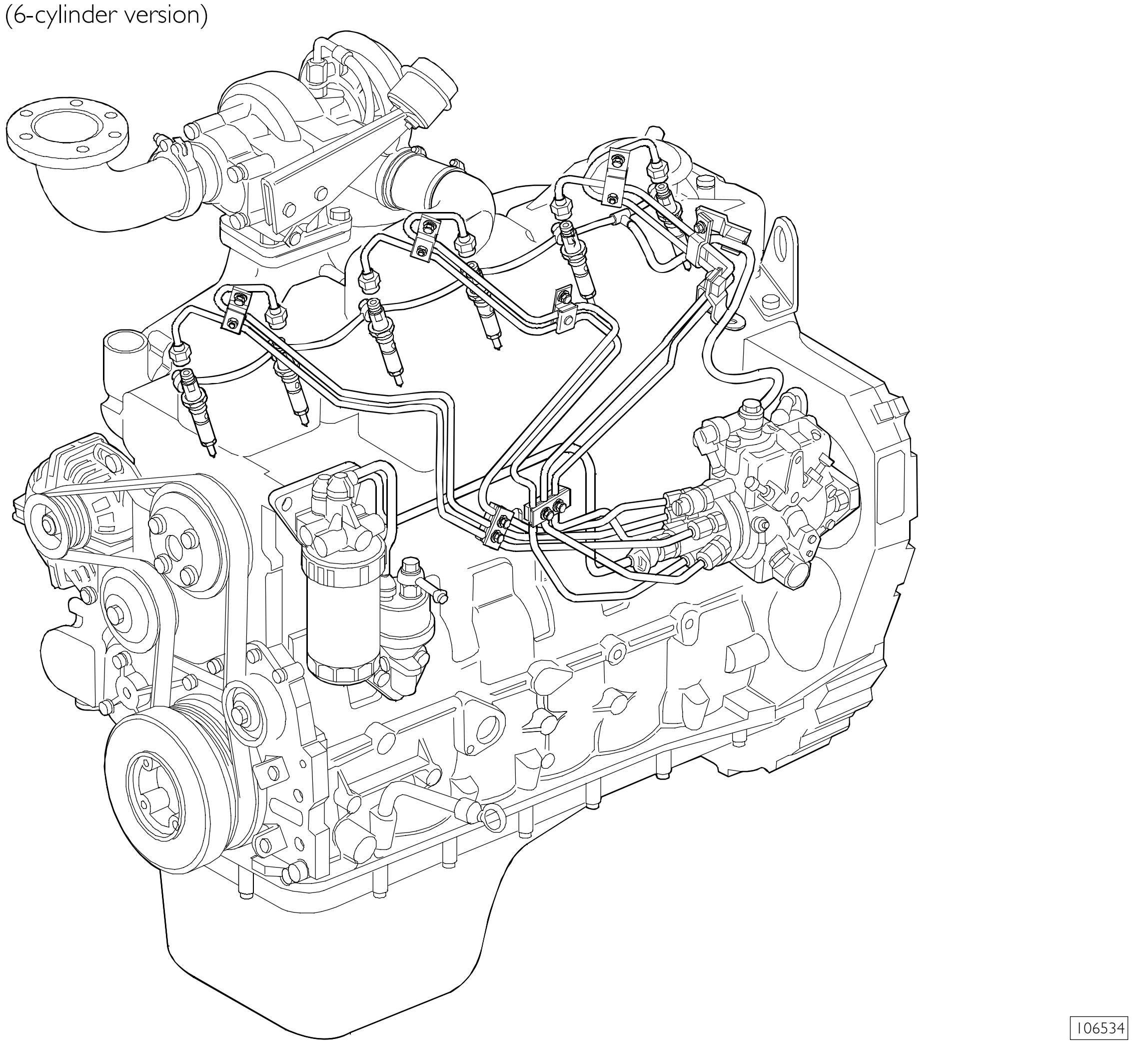
INJECTION FEED SYSTEM BY MECHANICAL ROTARY PUMP

General information

Fuel feed system is composed by:

- Fuel tank
- Fuel delivery and back-flow to tank
- Fuel pre-filter
- Priming pump, assembled to the engine and driven by the camshaft
- Fuel filter
- Fuel feed rotary pump
- Injector feed pipeline
- Injectors

Figure 1 (6-cylinder version)



Description of working principles

Fuel is sucked from the fuel tank by the priming pump. This last one is placed on the engine basement and is driven by the camshaft.

Throughout the filter, the fuel is piped to the union fitting vacuum chamber of the transfer pump.

Transfer pump is placed inside the feed pump, and is bladed type; its duty is to increase fuel pressure in correspondence with the increase of the number of revolutions.

The fuel arrives therefore to the valve gauging the pressure inside feed pump.

The distribution plunger further increases this pressure and delivers fuel throughout the delivery pipe fitting to the injectors.

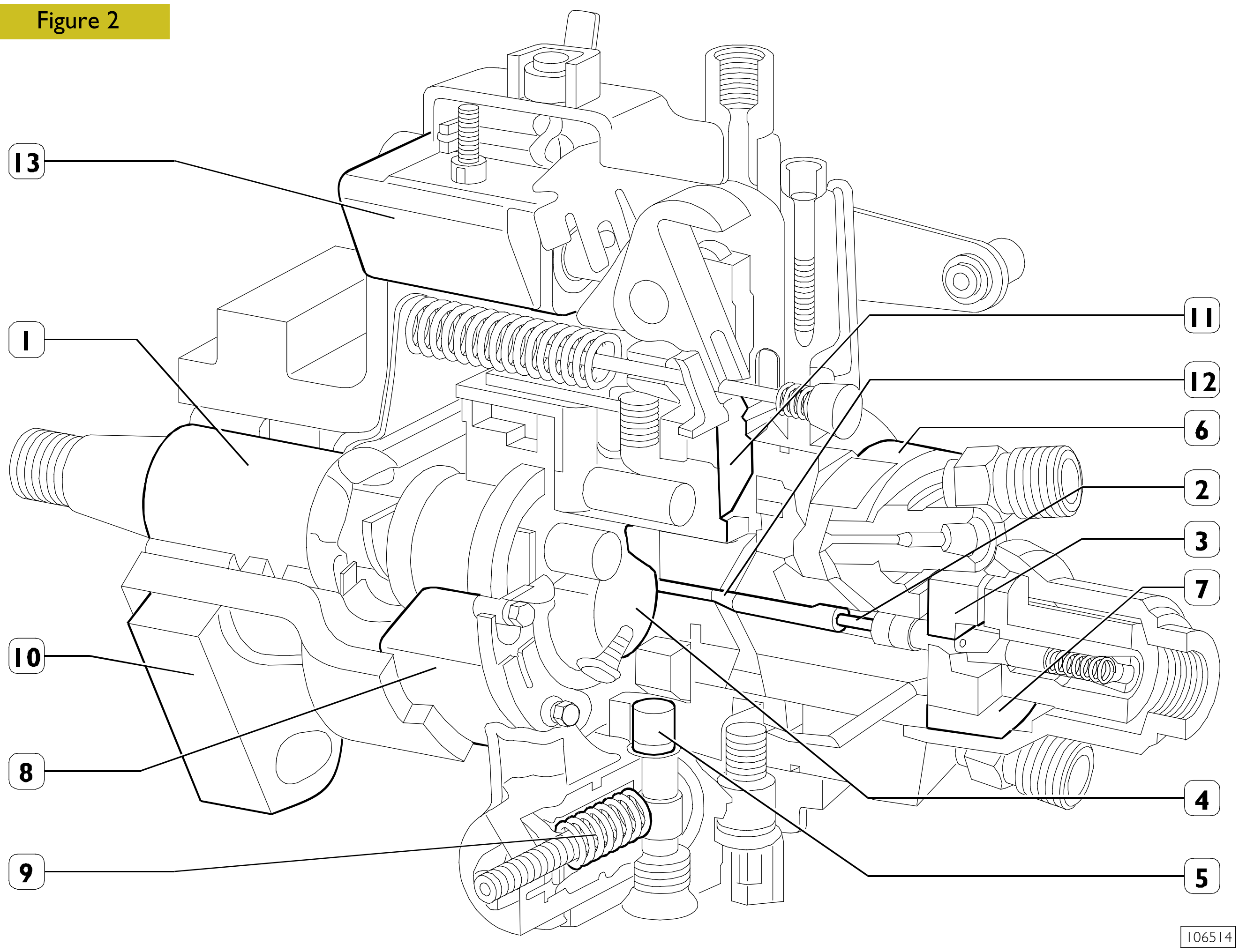
The fuel drawing from the injectors is recovered and delivered to the tank again.

FEED PUMP

The rotary type pump is driven by a gear mating the camshaft's one.

STANADYNE DB4 pump

Figure 2



1. Camshaft - 2. Distributor rotor - 3. Transfer pump vanes - 4. Pump element pistons (4) - 5. Cam - 6. Hydraulic head - 7. Pressure regulator unit - 8. Regulator - 9. Automatic advance - 10. Casing - 11. Metering valve- 12. Delivery valve - 13. Electrical power cut-off solenoid.

Description of operation

The main rotating components are propeller shaft (1), distributor rotor (2), transfer pump vanes (3) and regulator (8). With reference to the Figure 2, the propeller shaft engages the distributor rotor inside the hydraulic head.

The four pistons are driven simultaneously, one towards the other, by a cam by means of rollers and pads positioned on the peripheral part of the rotor. There is one cam lobe for each engine cylinder.

The transfer pump, positioned on the rear part of the rotor, is sealed inside by the end cap. This also contains the filter mesh and the transfer pump pressure regulator.

The upper part of the regulator unit is pressed against the distributor rotor and acts as a seal for the transfer pump.

The distributor rotor incorporates two fuel inputs, an axial hole and an exhaust that serves all the outputs to the injection ports.

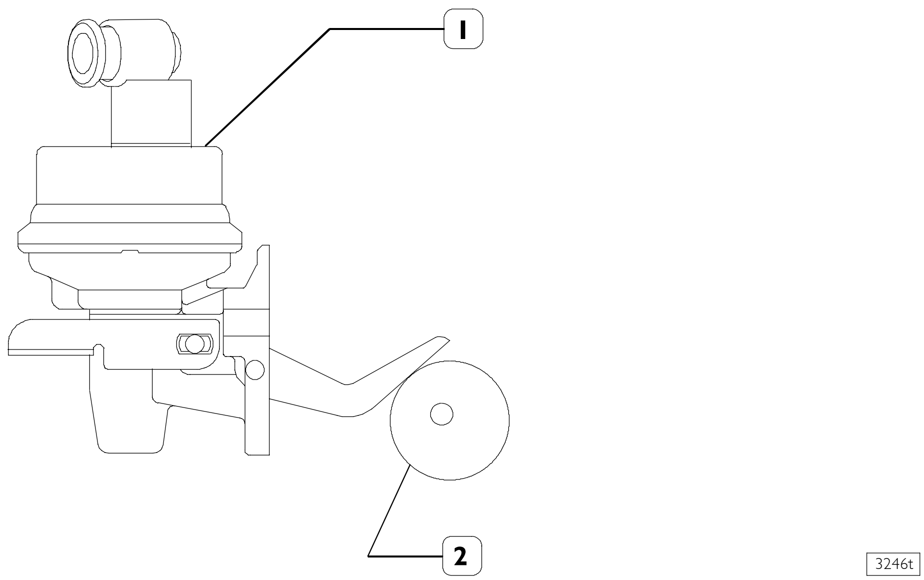
The hydraulic head contains the head in which the rotor turns, the metering valve seat, the fuel inputs and the connectors to the injectors. The high pressure injection pumps, connected to the injectors, are fastened to the above connectors.

Print P4D32N001 E

PRIMING PUMP

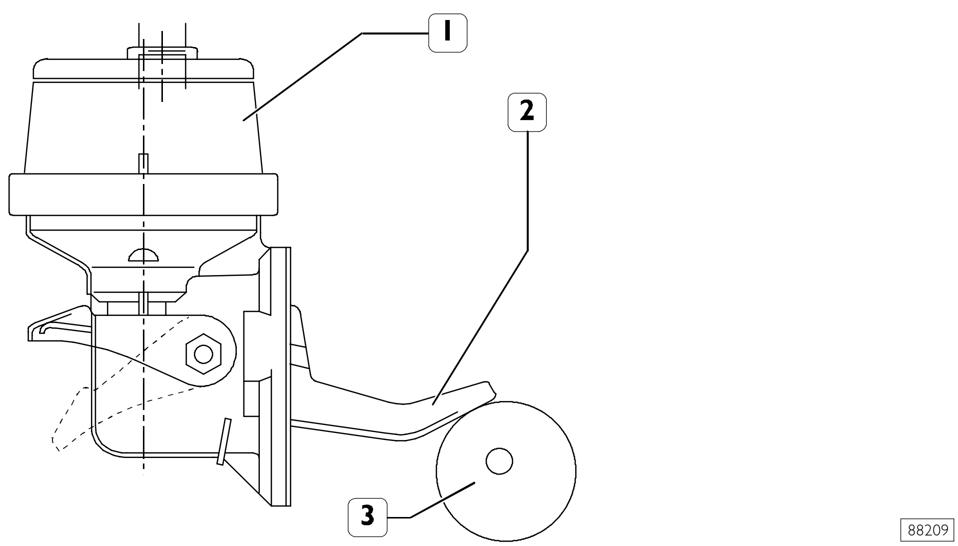
This pump has the specific duty to prime the fuel available in the tank and convey it to the feed pump inlet. It is assembled to the engine basement and driven by the camshaft.

Figure 3



1. Priming pump - 2. Camshaft.

Figure 4



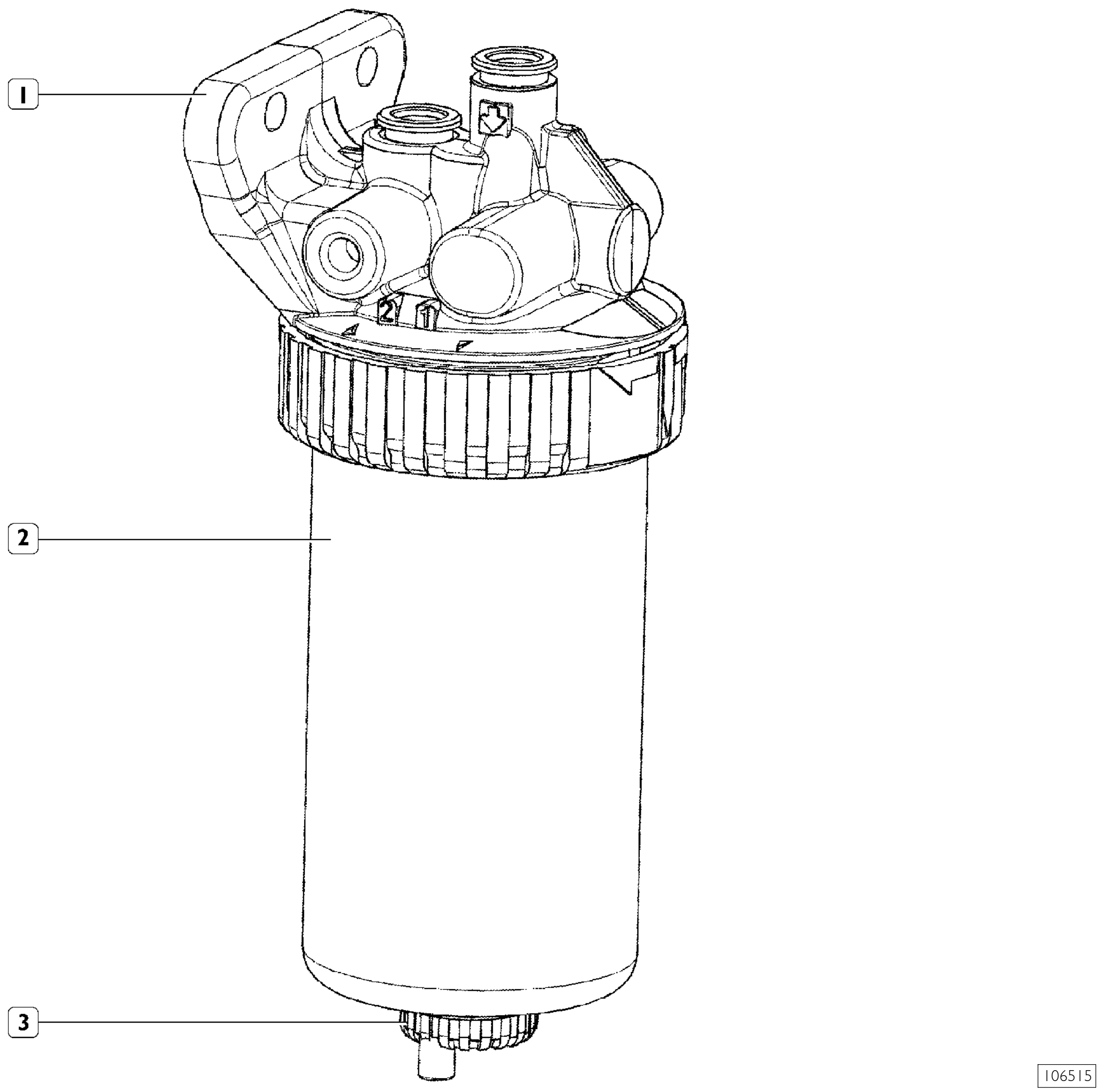
1. Priming pump - 2. Drive lever - 3. Camshaft.

FUEL FILTER

The filter is assembled close to the feed and priming pump and has the specific duty to provide barrier to the impurities and separation of water from fuel.

On the filter cartridge base there is a water dump screw, throughout which it is possible to provide regular drainage; on the bearing for those equipment applications requiring it (cold climate areas), there can be a heater assembled to and a temperature sensor. On some versions, a water presence sensor is present at filtering cartridge base.

Figure 5



1. Fuel filter bearing- - 2. Filter cartridge - 3. Water dump screw.

Print P4D32N001 E

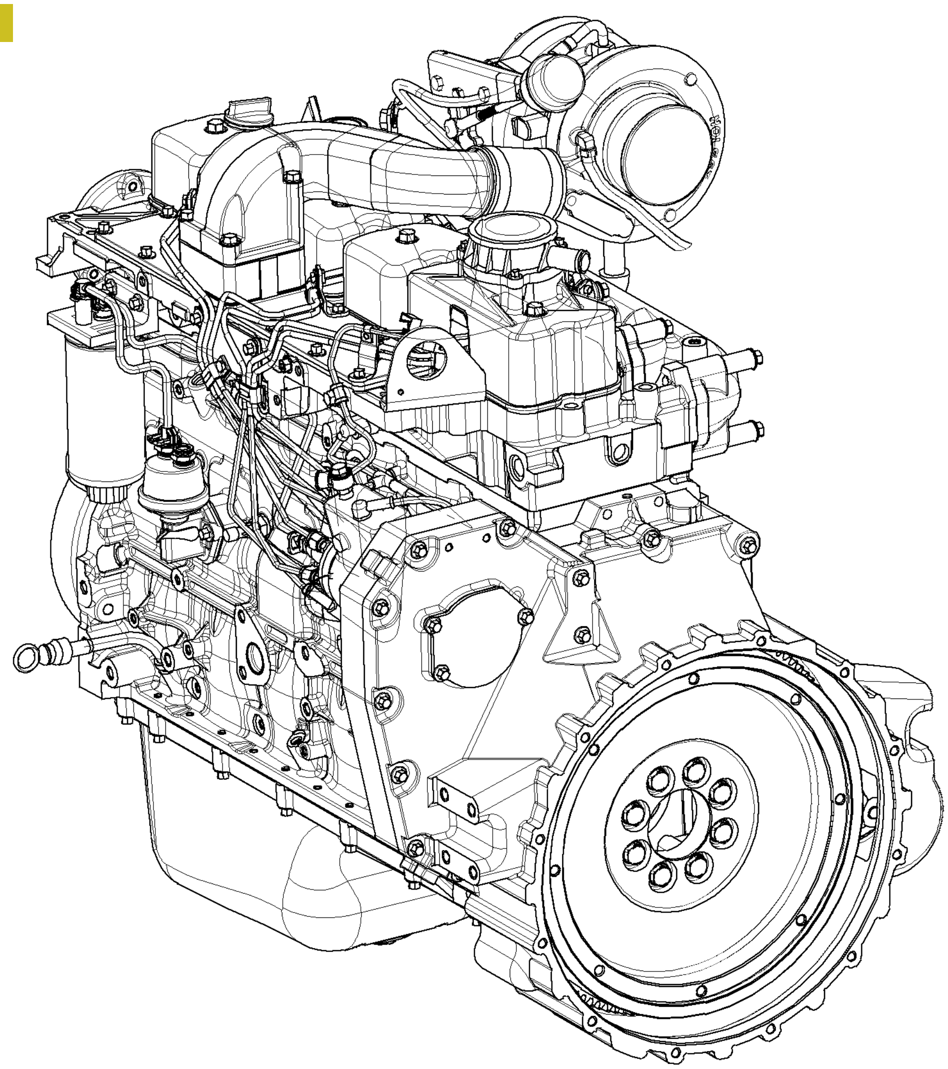
SECTION 3

Power Generation application

Page

GENERAL INFORMATION

Figure 1



106522

ENGINE WITH 6 CYLINDERS

The NEF engines have been specifically designed by Iveco Motors for the power generation application.

They are internal combustion engines, with a 4-stroke Diesel cycle, 4 or 6 cylinders and 2 valves per cylinder.

They are fueled by a rotary mechanical pump.

Data, technical specifications and performances granted shall be valid only if the Setter will follow and comply with all installation prescriptions provided by Iveco Motors.

Furthermore, the expanders assembled by the Setter must always comply with couple, power and number of revolutions based on which the engine has been designed.

The section herein described is composed or four directories:

- directory of mechanical overhaul prescribed in accordance to the engine's specific duty, illustrating all necessary operations to remove and assembly the external components of the engine, including cylinder heads, gearbox of the timing system and of the front part cover;
- electrical directory, describing the connections of the different components, of the pre-post heating gearbox (only for some versions) and of the sensors assembled to the engine;
- troubleshooting directory;
- directory of preventive and regular maintenance operations, providing instructions for the execution of the main operations.

Clearance data - 4 cyl.

	Type		**F4GE0405A*F600**	**F4GE0405B*F600**
ϱ	Compression ratio		17.5:1	
	Working power	kW	50	52
		rpm	1500	1800
	Working torque	Nm	318	-
		rpm	1500	-
	Loadless engine idling	rpm	.	-
	Loadless engine peak rpm	rpm	-	-
	Bore x stroke	mm	104 x 132	
	Displacement	cm^3	4485	
bar	**LUBRICATION**		Forced by gear pump, relief valve single action oil filter	
	Oil pressure (warm engine)			
	- idling	bar	0.70	
	- peak rpm	bar	3.50	
	COOLING		By centrifugal pump, regulating thermostat, heat exchanger, intercooler	
	Water pump control		Through belt	
	Thermostat			
	- start of opening	°C	81 ± 2	
15W40 ACEA E3	**FILLING**			
	engine sump	liters	-	
	engine sump + filter	liters	-	

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

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

Print P4D32N001 E

Clearance data - 4 cyl.

	Type		F4GE0455A*F600	F4GE0455B*F600	F4GE0455C*F600
ϱ	Compression ratio		17.5:1		
	Working power	kW	74	74	60
		rpm	1500	1800	1500
	Working torque	Nm	471	393	382
		rpm	1500	1800	1500
	Loadless engine idling	rpm	.	-	-
	Loadless engine peak rpm	rpm	-	-	-
	Bore x stroke	mm	104 x 132		
	Displacement	cm^3	4485		
	SUPERCHARGING		Without intercooler direct injection		
	Turbocharger type		HOLSET HX25	HOLSET HX25W	HOLSET HX25
bar	**LUBRICATION**		Forced by gear pump, relief valve single action oil filter		
	Oil pressure (warm engine)				
	- idling	bar	0.70		
	- peak rpm	bar	3.50		
	COOLING		By centrifugal pump, regulating thermostat, heat exchanger, intercooler		
	Water pump control		Through belt		
	Thermostat - start of opening	°C	81 ± 2		
15W40 ACEA E3	**FILLING**				
	engine sump	liters	-		
	engine sump + filter	liters	-		

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

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

Clearance data - 4 cyl.

		Unit	F4GE0485A*F600	F4GE0485C*F600
Type			**F4GE0485A*F600**	**F4GE0485C*F600**
ρ	Compression ratio		17.5:1	
	Working power	kW	98	87
		rpm	1500	1500
	Working torque	Nm	471	554
		rpm	1500	1500
	Loadless engine idling	rpm	.	-
	Loadless engine peak rpm	rpm	-	-
	Bore x stroke	mm	104 x 132	
	Displacement	cm^3	4485	
	SUPERCHARGING		With intercooler direct injection	
	Turbocharger type		HOLSET HX27W	
	LUBRICATION		Forced by gear pump, relief valve single action oil filter	
bar	**Oil pressure (warm engine)**			
	- idling	bar	0.70	
	- peak rpm	bar	3.50	
	COOLING		By centrifugal pump, regulating thermostat, heat exchanger, intercooler	
	Water pump control		Through belt	
	Thermostat - start of opening	°C	81 ± 2	
15W40 ACEA E3	**FILLING**			
	engine sump	liters	-	
	engine sump + filter	liters	-	

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

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

Clearance data - 6 cyl.

	Type		F4GE0655 B*B600	F4GE0685	
				D*F601	B*F601
ρ	Compression ratio		17.5:1		
	Working power	kW	125	130	156
		rpm	1500	1500	1500
	Working torque	Nm	796	815	969
		rpm	1500	1500	1500
	Loadless engine idling	rpm	-	-	-
	Loadless engine peak	rpm	-	-	-
	Bore x stroke	mm	104 x 132		
	Displacement	cm^3	6728		
	SUPERCHARGING		Without intercooler direct injection	With intercooler direct injection	
	Turbocharger type		HOLSET HX35W		
	LUBRICATION		Forced by gear pump, relief valve single action oil filter		
bar	Oil pressure (warm engine)				
	- idling	bar	0.70		
	- peak rpm	bar	3.50		
	COOLING		Liquid		
	Water pump control		Through belt		
	Thermostat - start of opening	°C	81 ± 2		
15W40 ACEA E3	**FILLING**				
	engine sump*	liters	15		
	engine sump + filter*	liters	16		
	* First filling operation				

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

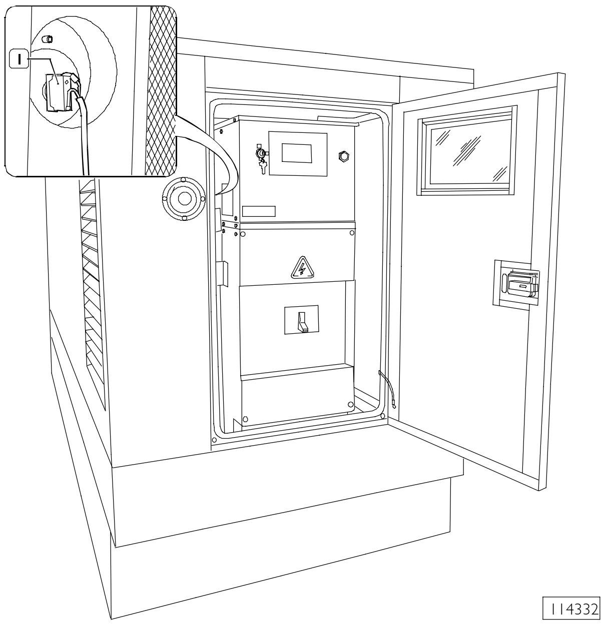
Furthermore, the users assembled by the setter shall always be in conformance to couple, power and number of turns based on which the engine has been designed.

PART ONE - MECHANICAL COMPONENTS

REMOVING AND REFITTING THE SOUND-PROOFING UNIT

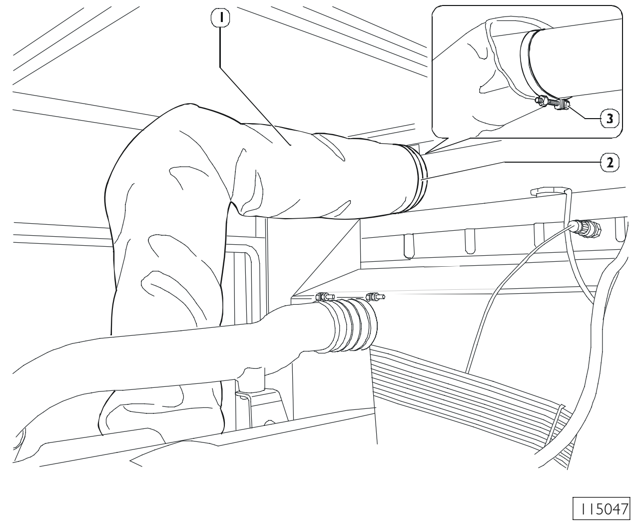
Removal

Figure 2



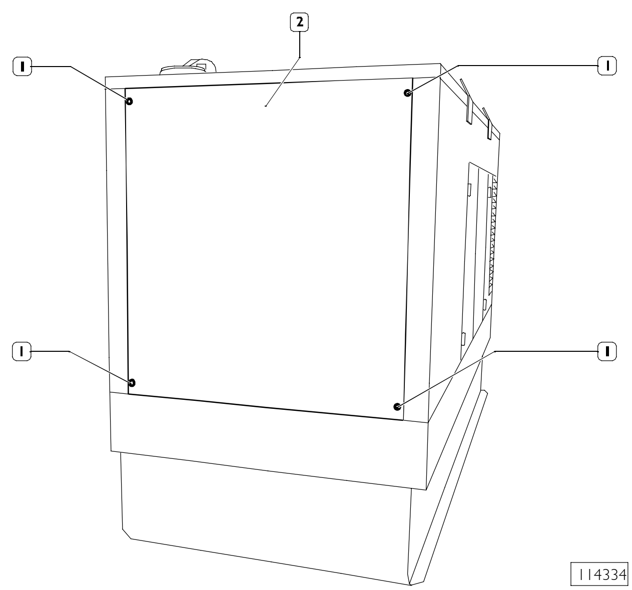
Operate from the control board side and disconnect the electric connection (1) from the stop button.

Figure 3



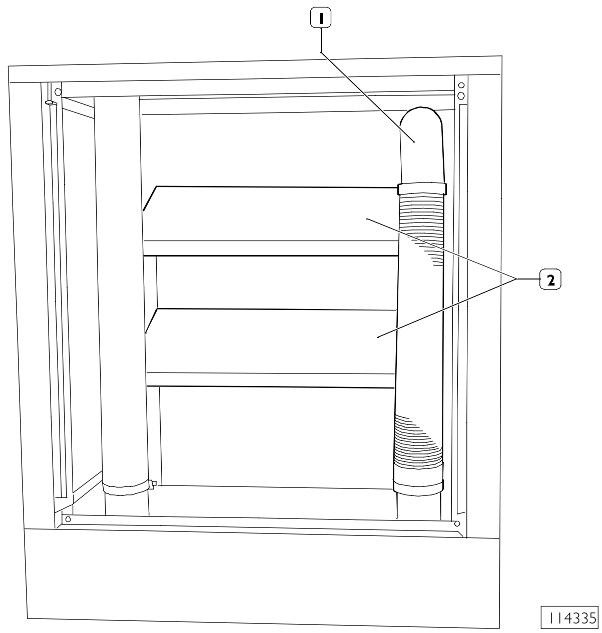
Operate inside the soundproofing unit and move back the exhaust pipe cover (1) in order to reach the stop collar (2), then loosen the fastening screw (3).

Figure 4



Operate from the exhaust pipes side and loosen the covering panel (2) fastening nuts (1) and remove it.

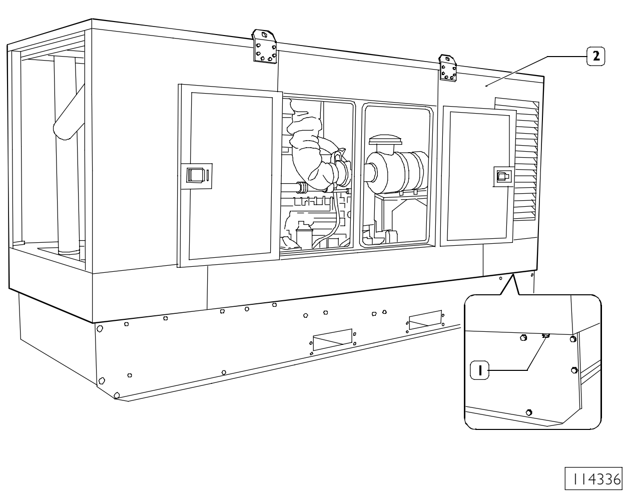
Figure 5



Remove pipe (1) from its seat.

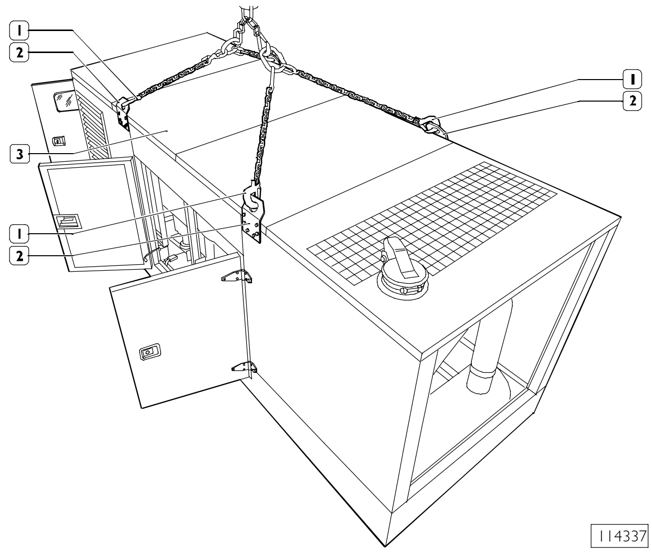
NOTE When removing pipe (1), pay attention not to damage the cooling unit air ducts (2).

Figure 6



Operate along the perimeter and loosen the soundproofing unit (2) fastening screws (1).

Figure 7



Secure hooks with chain catches (1) into the slots (2) provided for the purpose and, by means of a proper hoisting device, lift the soundproofing unit (3) and remove it with the aid of another operator.

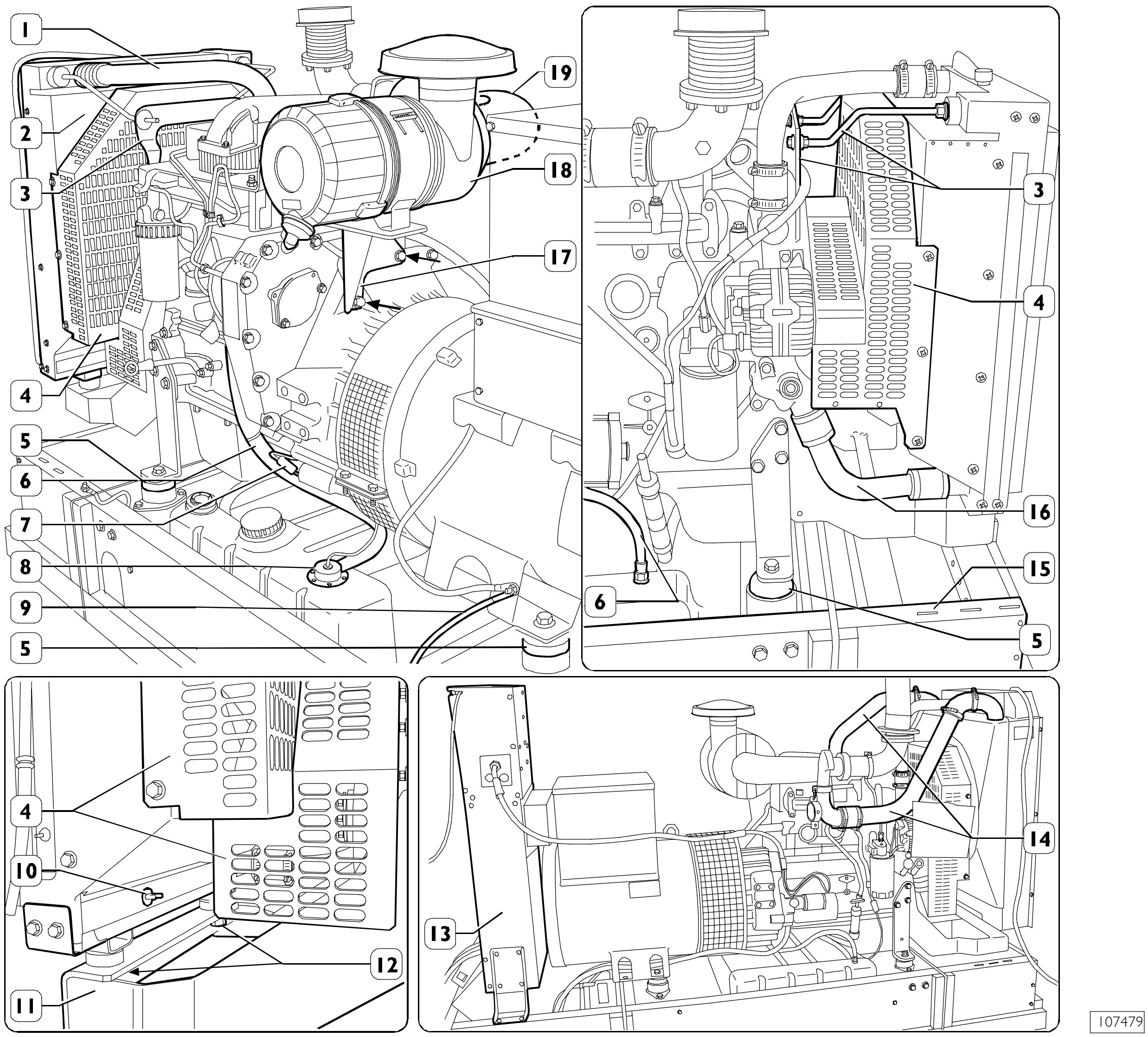
NOTE Make sure that the rods have all the same length in order to lift the soundproofing unit along the vertical axis, thus reducing interferences.

Refitting

To refit, reverse the removal instructions.

REMOVING AND REFITTING THE ENGINE/GENERATOR

Figure 8



Removal

Disconnect the electrical system by detaching the cables from the battery.

Disconnect the positive and negative cables from any clamps, detach them from their attachments on the starter motor, then remove them.

Remove the fan safety grilles (4) by undoing the relevant fasteners.

Place a container under the cock (10) to collect the coolant.

Disconnect and remove the pipes (1) and (16) together with the sleeves by undoing the clamps. Block the radiator suitably and remove it from its seat after disconnecting the brackets (3) from the engine and the nuts (12) from the support (11).

Disconnect the diesel pipes (6) from the engine and from the tank, taking care to collect any diesel coming down, then remove them from their seat.

Disconnect the electrical connection (7) of the diesel level signal (8) and earth (9).

Disconnect the air hose (19) from the turbocharger of the turbine and the oil vapour recovery pipe from the cover of the cylinder head. Remove the air cleaner (18) by undoing the fasteners (←) and remove it from its seat together with the support (17).

Fit a lifting tool onto the specific hooks on the engine and keep it under tension.

Remove the fixing nuts from the four supports (5) of the engine/generator assembly.

Separate the engine/generator assembly from the crankcase.

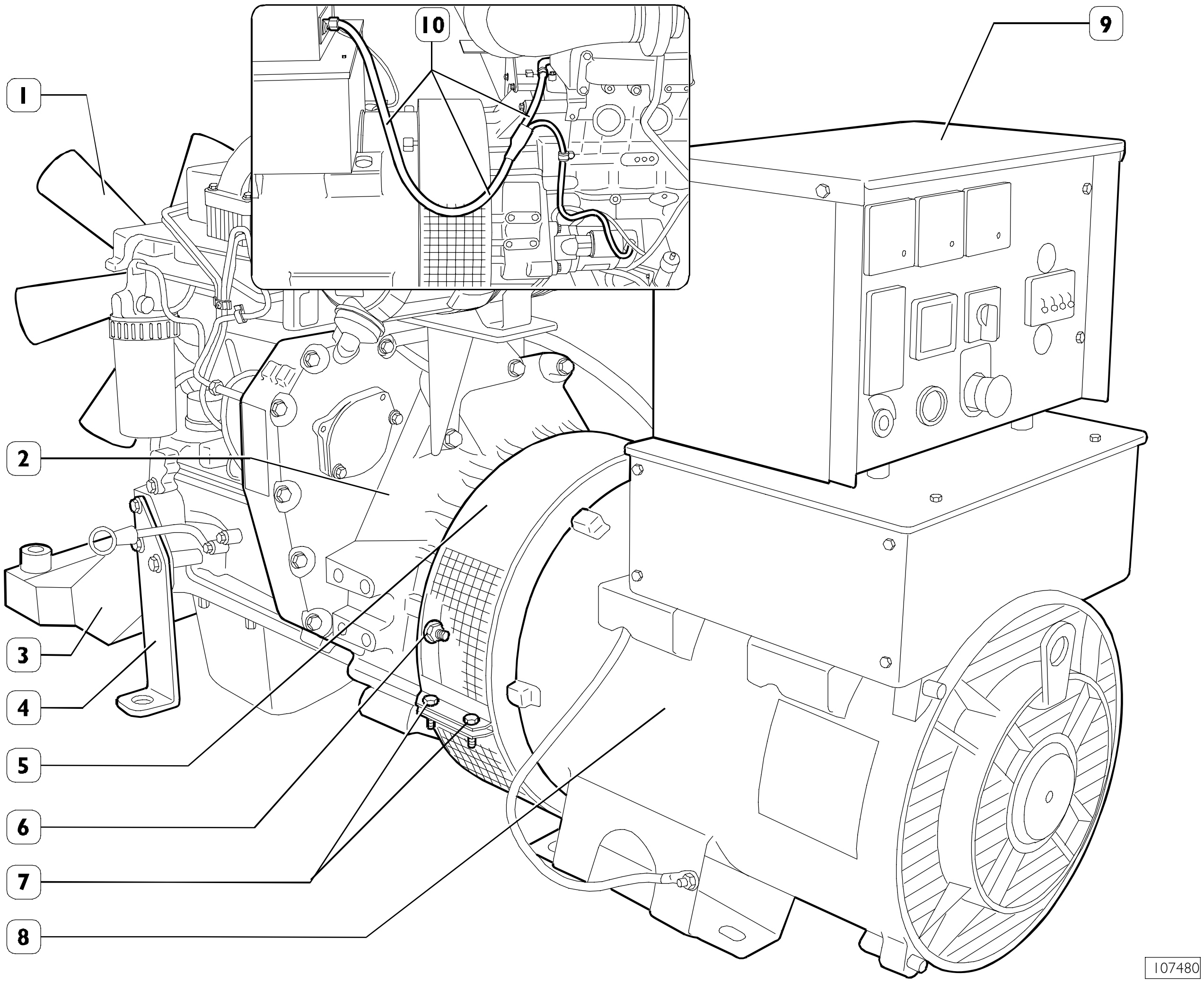
Refitting

To refit, reverse the removal instructions; restore the coolant system as described in the procedure on page 49.

NOTE Check the integrity of the rubber-type blocks in the supports (5) of the pipes and electrical connections.

SEPARATING THE GENERATOR FROM THE ENGINE

Figure 9



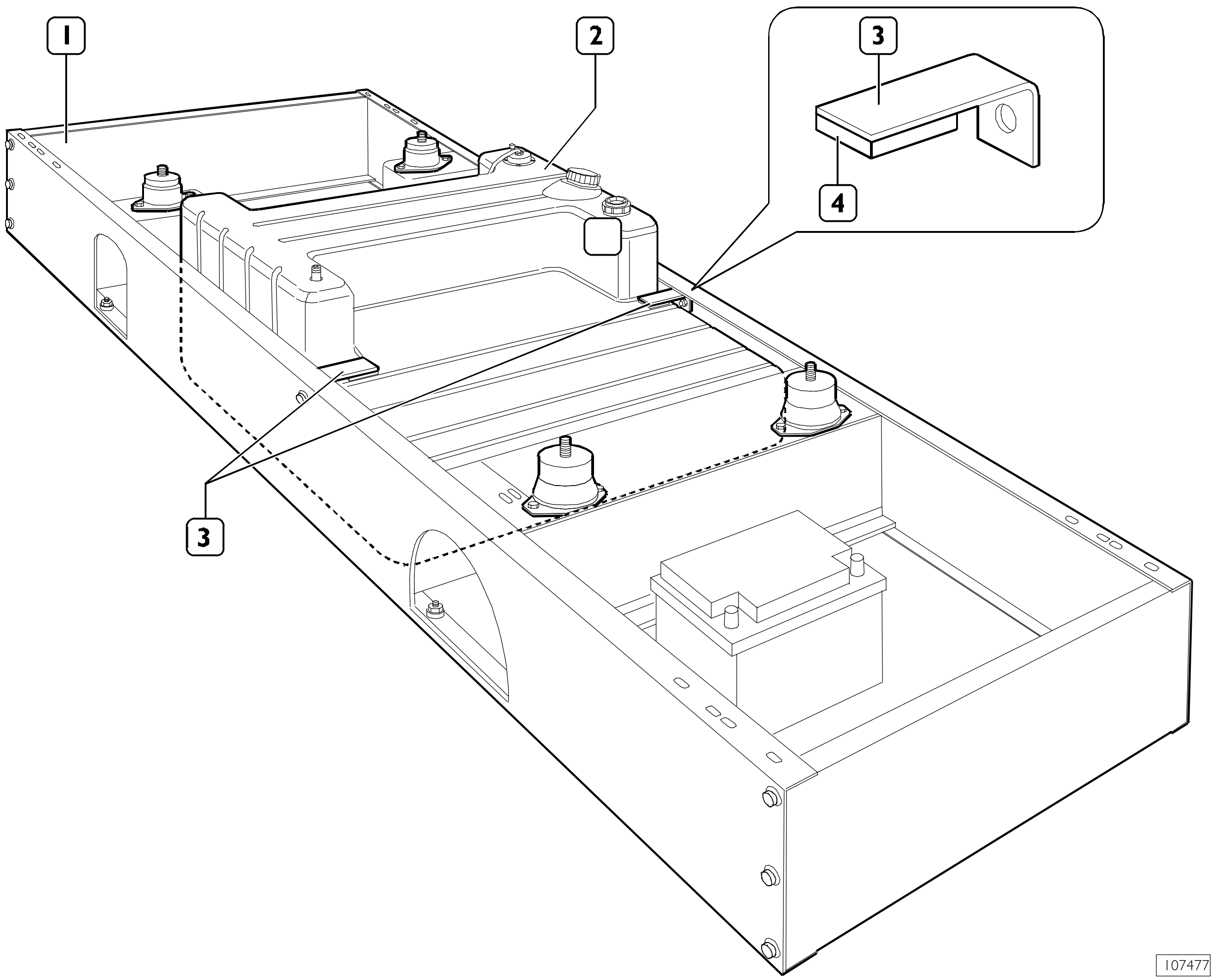
Remove the fan (1), the brackets of the supports (4) and the support (3).

Separate the generator from the engine as follows:

- disconnect the wiring (10) from the engine at each of its points of connection with the parts of the engine: starter motor, alternator, various sensors, etc. Then fasten it appropriately to the control panel (9) so as not to hinder operations when separating the two assemblies;
- remove the safety grilles (5) by undoing the fasteners (7), unscrew all the nuts (6) connecting the generator (8) to the housing of the engine flywheel;
- block the generator suitably and separate it from the engine.

DETACHING THE TANK FROM THE BASE

Figure 10



The tank is blocked inside the base (1) with angular brackets (3).
To remove the tank (2) from its seat, remove the brackets (3) by undoing the relevant fasteners.

At the time of assembly, check that the adhesive rubber blocks (4) are sound and positioned by the brackets (3).

NOTE At the time of assembly, check that the adhesive rubber blocks (4) are sound and positioned by the brackets (3).

OVERHAULING THE 6-CYLINDER ENGINE

Introduction

The following description concerns the operations of overhauling the engine restricted to the components that differentiate it according to its specific use.

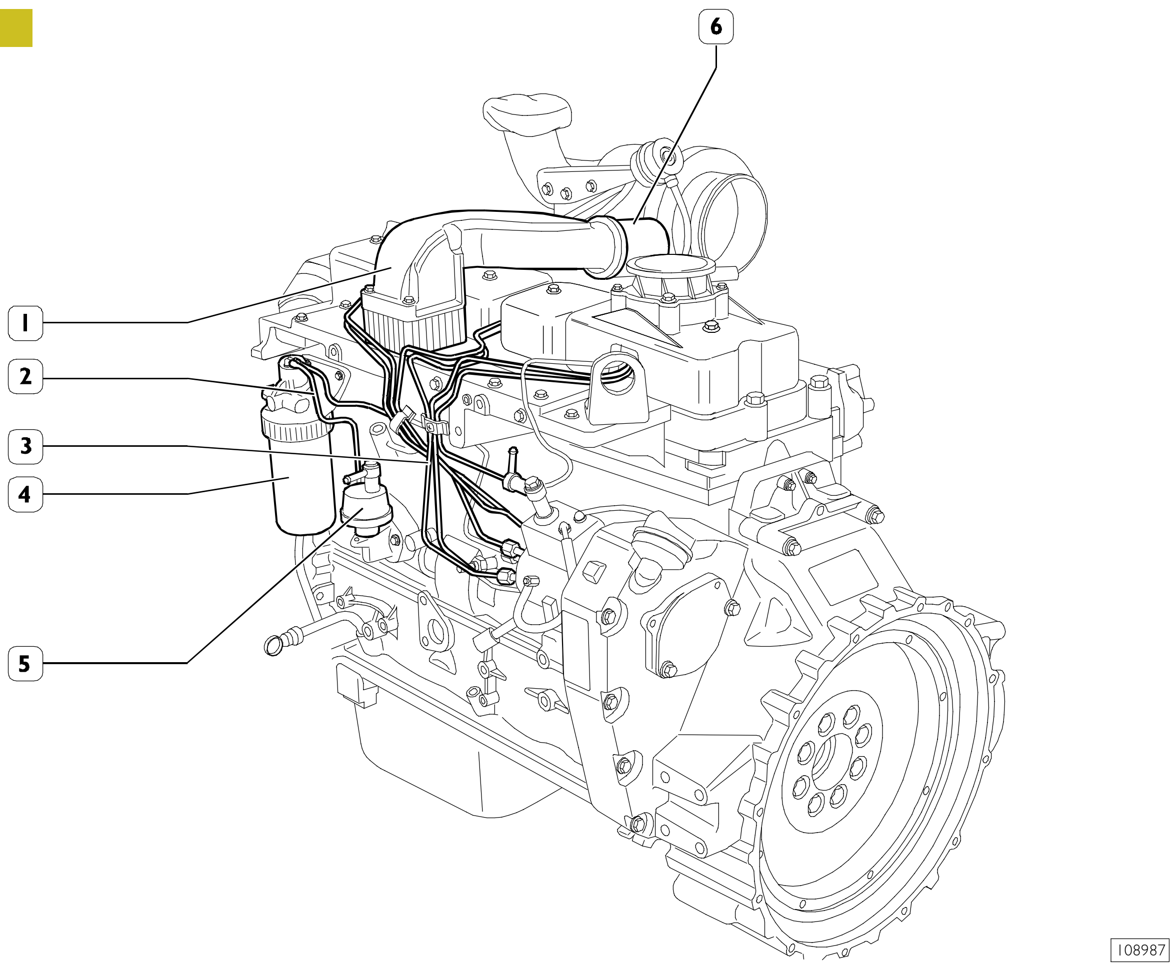
NOTE Due to requirements dictated by the application, some assemblies may be located on the engine in different positions.

The "General Overhaul" section contains all the operations of overhauling the engine block and this section is therefore to be considered as following this topic.

NOTE The operations of removing the engine, as those for overhauling, must be performed by skilled personnel with specific tools.

Operations of preparing the engine for assembly on the rotary stand

Figure 11

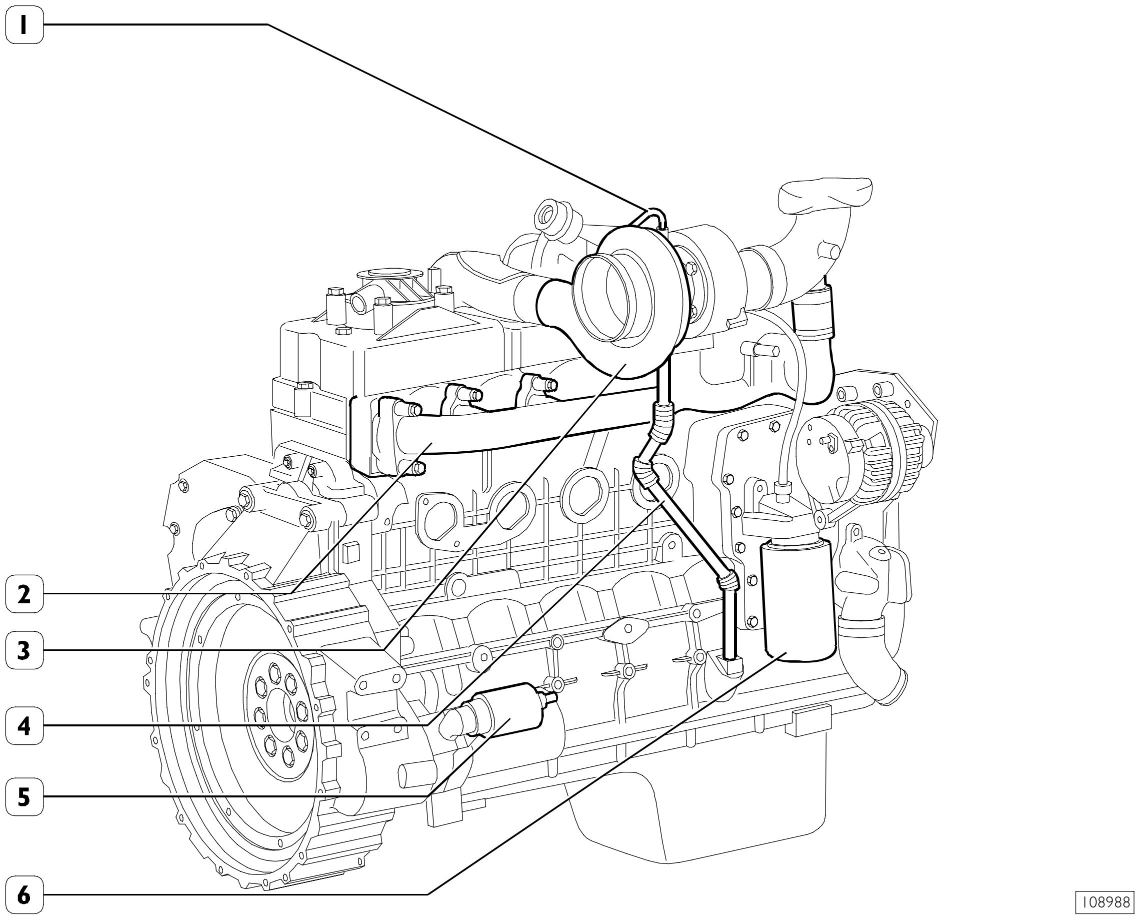


- ❑ Remove the intake manifold (1) and the sleeve (6).
- ❑ Remove the fuel hoses (2).
- ❑ Place a container under the diesel filter and unscrew the condensation bleed cock located under the filter; drain off all the diesel it contains.
- ❑ Fully unscrew the cock and, using tool 99360076, remove the diesel filter (4).
- ❑ Remove the fuel filter mounting (4) from the bracket secured to the cylinder head.
- ❑ Remove the priming pump (5).
- ❑ Disconnect the pipes (3) from the injection pump.

NOTE Removing the injection pump requires a specific procedure described in this section.

Print P4D32N001 E

Figure 12



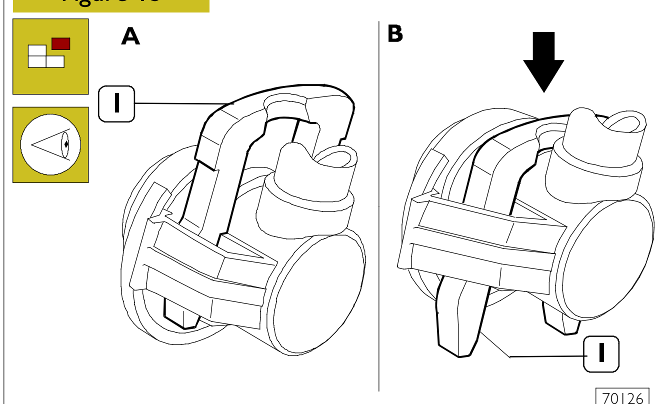
- Disconnect the pipe (1) delivering oil to the turbine (3).
- Disconnect the pipe (4) returning oil to the turbine (3).
- Remove the turbine (3).
- Remove the oil filter (6) with tool 99360076.
- Remove the starter motor (5).
- Remove the exhaust manifold (2).

NOTE Warning: the oil filter contains inside aprx. 1 kg. of engine oil.
Provide tank with sufficient capacity to contain the liquid.

Warning: avoid contact of engine oil with the skin: in case of skin contamination rinse in running water.

Engine oil is highly pollutant: provide for disposal in compliance with the law and regulations in force.

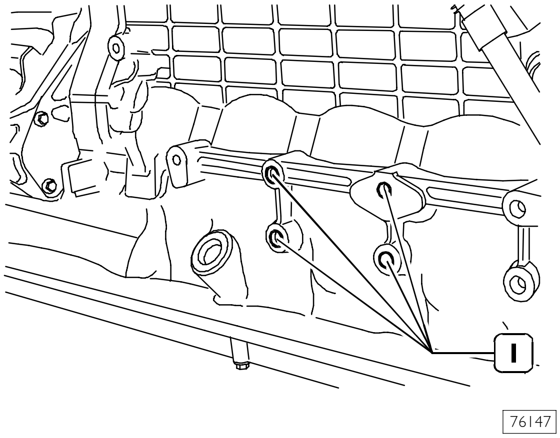
Figure 13



NOTE To disconnect fuel pipelines (2, Figure 11), in low pressure from the relating pipe fittings, it is Necessary to press the locking fastener (1) as shown in picture **B**.

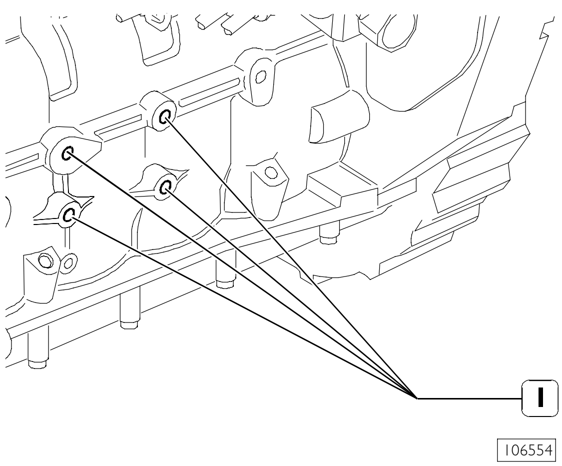
After having disconnected the pipeline, reset the locking fastener (1) in lock position as shown in. picture **A**, to avoid any possible deformation of the fastener itself.

Figure 14



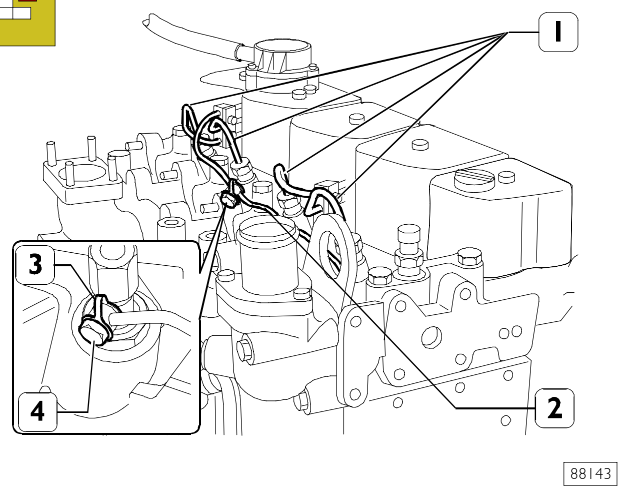
- ❑ Assemble the bracket bearing 99361037 using the four screw threaded ports (1).

Figure 15



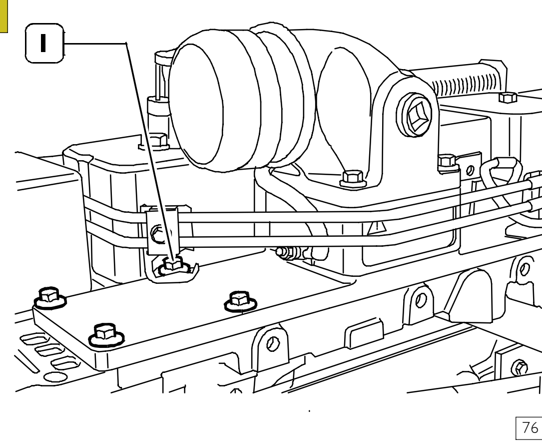
- ❑ Assemble the second bracket 99361037 throughout the screw-threaded ports (1).
- ❑ Lift the engine using the rocker arm 99360595 and put it on the turning stand 99322205.
- ❑ Remove the oil level rod together with guide pipe; (loosen the guide pipe disassembling from the block); properly pipe the screw-threaded port to avoid inlet of foreign matters.
- ❑ Drain the oil through the cap underneath the plug.

Figure 16



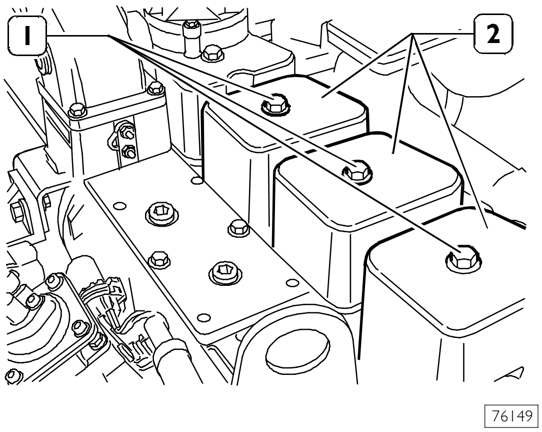
- ❑ Disconnect the supply pipe unit from the injectors (1).
- ❑ Remove fuel exhaust pipe (2) from the injectors by removing screw (4) and seal (3).

Figure 17 (Demonstration)



- ❑ Loosen the screws (1) holding the fixing brackets of such pipelines; pipe the pipeline ends.

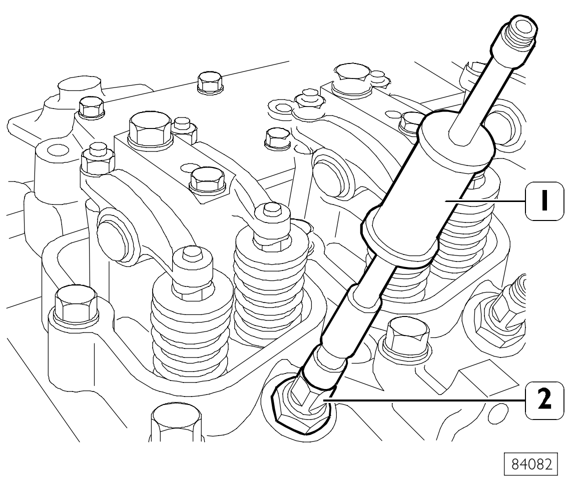
Figure 18 (Demonstration)



- ❑ Remove tappet caps: loosen the fixing screws (1) and lift the caps (2); remove the gaskets.

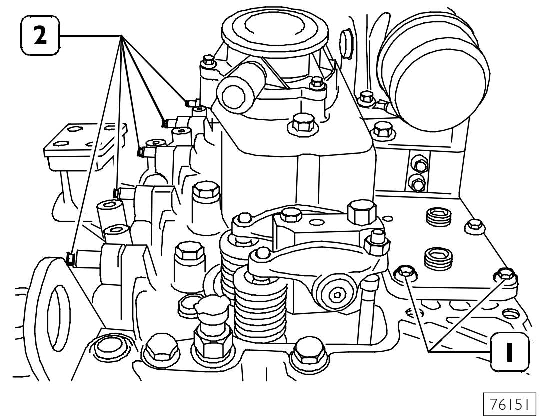
NOTE On the tappet cap there is a blow-by valve for the lubrication oil vapours.
All the gaskets shall always be replaced during assembly.

Figure 19



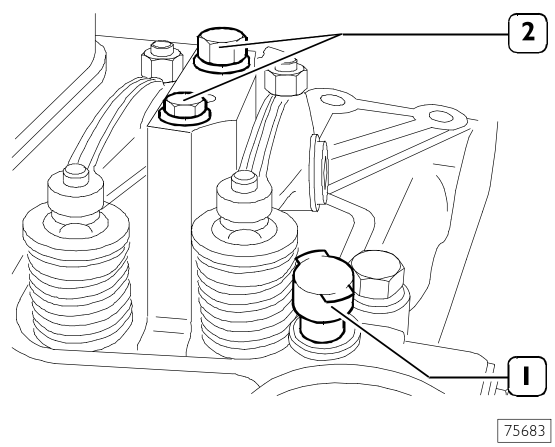
- ❑ Remove injectors (2) with tool 99340205 (1) and take out the cylinder head.

Figure 20 (Demonstration)



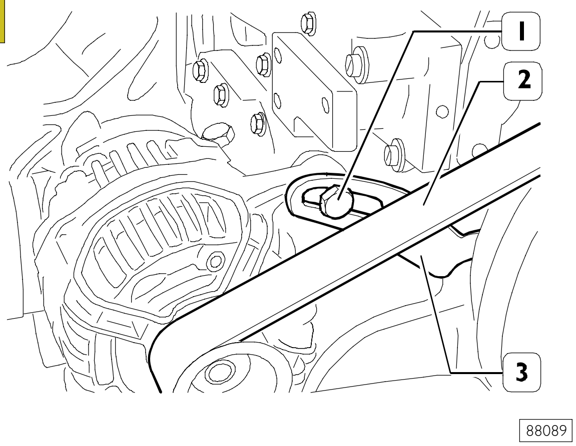
- ❑ Disassemble suction and exhaust manifolds: loosen the screws (1) fixing the suction manifold plate to the cylinder head (some of them have already been screwed-out since fixing the pipe brackets to the injectors).
From the exhaust manifold side loosen the (2) fixing screws; remove the gaskets.

Figure 21



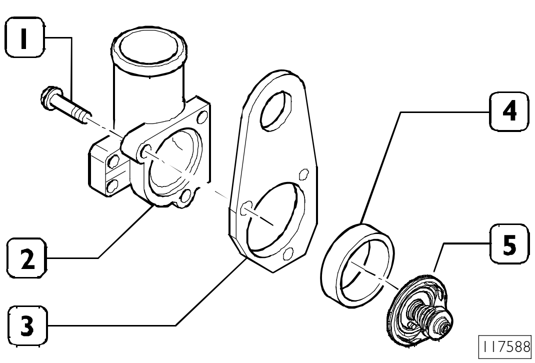
- ❑ Disassemble rocker arm bearings; loosen the two fixing screws (2) and remove the complete rocker arm bearing; withdraw tappet rods. Repeat the operation for all the remaining rocker arm bearings.
- ❑ Disassemble water temperature transmitter (1).

Figure 22



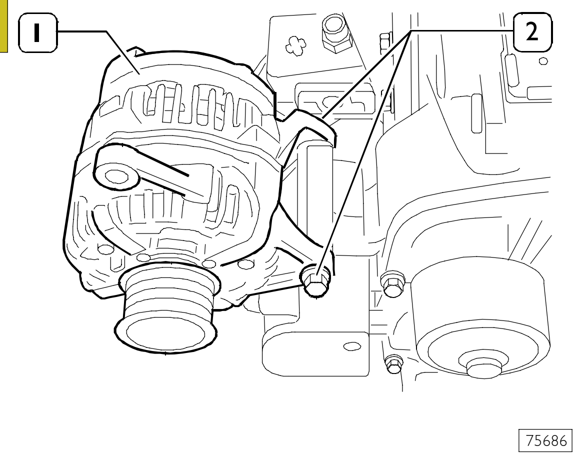
- ❑ Loosen screw (1) and relevant nut on belt stretcher bracket (3).
- ❑ Loosen screw (2) in order to slide out POLY-V belt (2).
- ❑ Remove belt stretcher bracket (3).
- ❑ Remove the cooling fan.
- ❑ Disassemble the control pipe pulleys and the guide rollers.

Figure 23



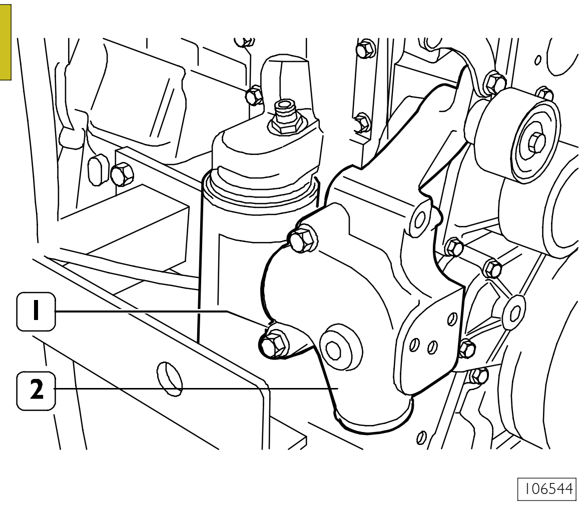
- ❑ Disassemble thermostat unit; loosen the three fixing screws (1) and disassemble the thermostat unit (2) together with the bracket (3); remove the gasket (4) and the thermostat (5).
- ❑ In order to facilitate head overhauling operations at the test bench keep bracket (3) assembled on it by fixing it with the thermostat unit screws.

Figure 24



- ❑ Properly hold the alternator (1) separating it from its bearing by loosening the screw (2); remove screw nut and washer.

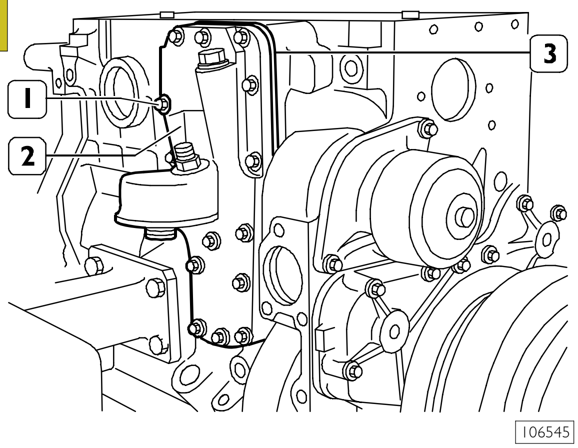
Figure 25



- ❑ Loosen the screws (1) and withdraw the alternator bearing (2).

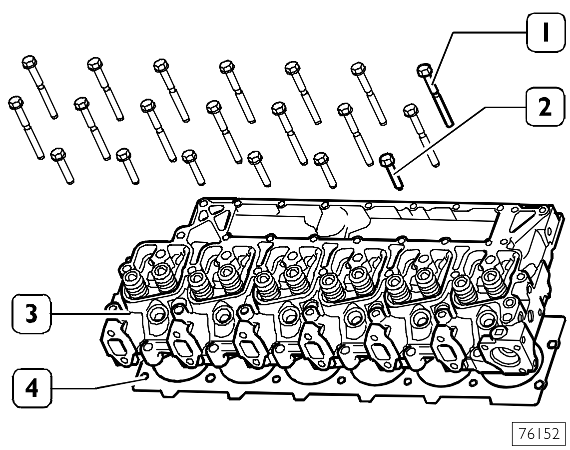
NOTE The shape and the dimensions of the support of the alternator vary according to the use of the engine. The relevant pictures provide a general trace of the intervention that is to be carried out. The procedures described are always applicable.

Figure 26



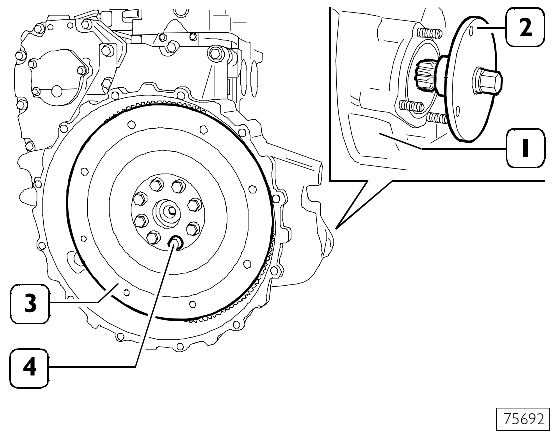
- ❑ Loosen the screws (4) and disassemble the oil pressure/temperature sensor (3) (if fitted).
- ❑ Disassemble injection pump (see specific procedure).

Figure 27



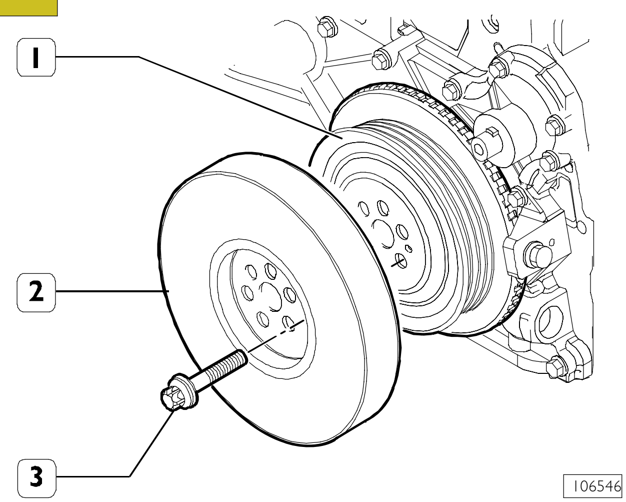
- ❑ Disassemble cylinder head;
  loosen the screws (1) and (2) fixing the cylinder head (3); hook the brackets with metal ropes and, throughout a hoist withdraw cylinder head from the block.

Figure 28



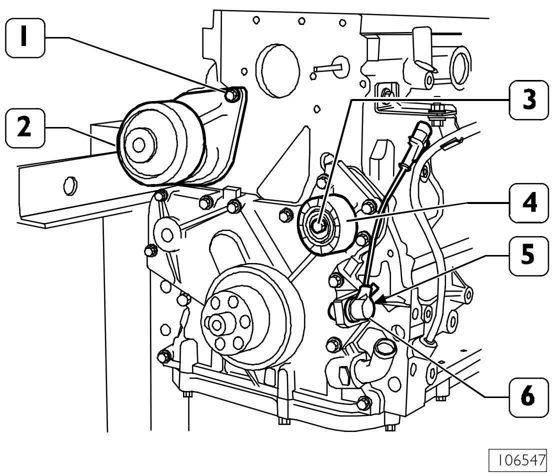
- ❑ Apply the suitable tool (2) on the flywheel covering box (1) in order to lock flywheel (3) rotation. (use the starting motor fixing nuts and studs).
- ❑ Loosen the flywheel fixing screws (4) to engine drive shaft.

Figure 29



- ❑ Unloose the screws (3) and disassemble the damping flywheel (2) and the pulley (1).
- ❑ The engine flywheel lock tool can facilitate the removal of damper flywheel (2) installed on pulley (1).

Figure 30

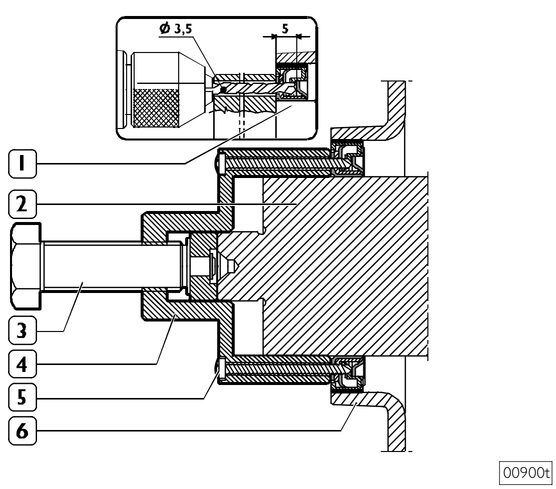


❑ Remove the screws (1) and disconnect the water pump (2).

❑ Remove the screw (3) and the roller (4).

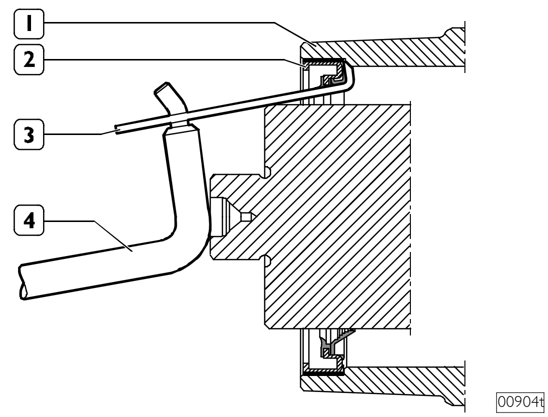
❑ Remove the screw (5) and disconnect the engine speed sensor (6).

Figure 31



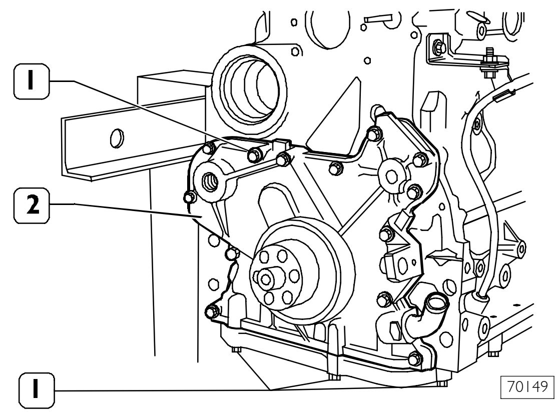
❑ Remove the engine drive shaft fixing ring from the front cover. Use the tool 99340055 (4) to operate on the front tang (2) of the engine drive shaft. Throughout the tool guide ports, drill the internal holding ring (1) using Ø 3,5 mm drill for a 5mm depth. Fix the tool to the ring tightening the 6 screws specially provided.
Proceed withdrawing the ring (1) tightening the screw (3).

Figure 32



❑ Using the specially provided tie rod (3) for the tool 99363204 and the lever (4), withdraw the external holding ring (2) from the front cover (1).

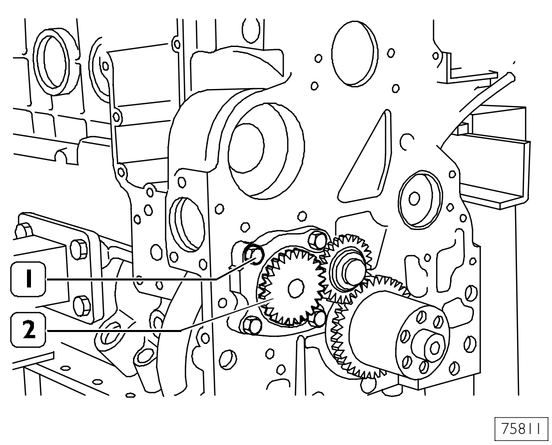
Figure 33



❑ Loosen the screws (1) and remove the front cover (2).

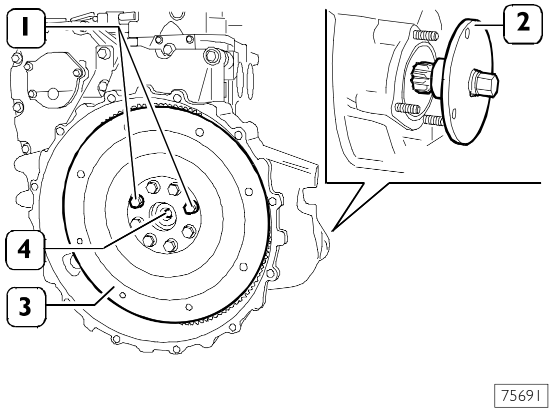
NOTE Take note of the screw (1) assembly position, since the screws have different length.

Figure 34



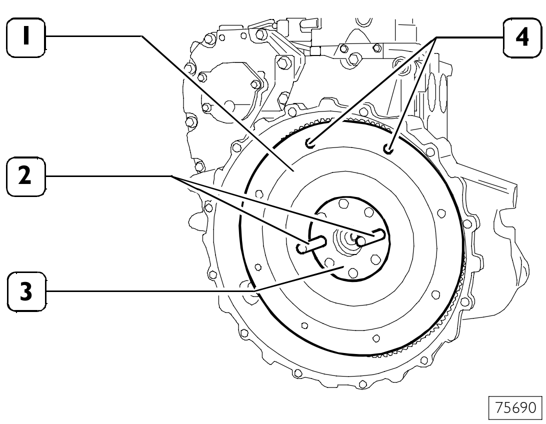
❑ Loosen the screws (1) and remove oil pump (2).

Figure 35



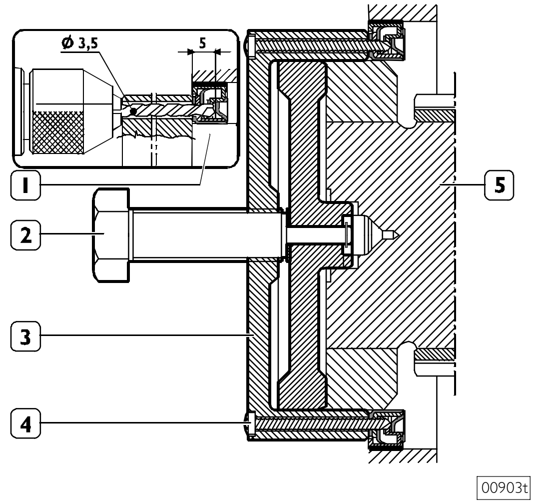
- Screw out the opposite screws (1) from the ports where the withdrawal pins shall be introduced (see picture following).
- Loosen remaining flywheel fixing screws (3) to the engine drive shaft (4).
- Remove the flywheel block tool (2).

Figure 36



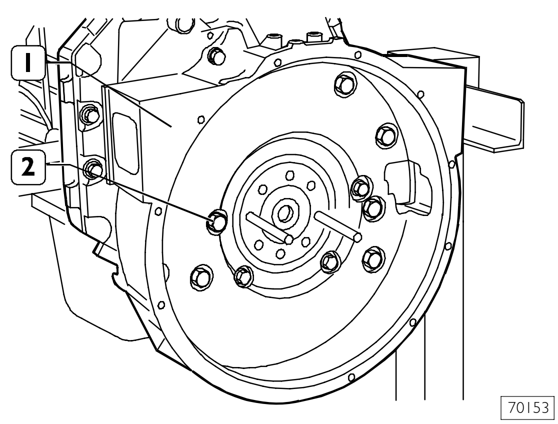
- Screw up two medium length screws in the ports (4) to sling the flywheel with a hoist.
  Throughout two guide pins (2) previously screwed up into the engine drive shaft ports (3) control the engine flywheel withdrawal by means of a hoist.

Figure 37



- Remove the flywheel cover box fixing ring using the tool 99340056 (3) to operate on the back tang (5) of the engine drive shaft. Throughout the tool guide ports, drill the internal holding ring using Ø 3,5 mm drill for a 5mm depth.
- Fix the tool 99340056 (3) to the ring (1) tightening the 6 screws specially provided (4).
- Proceed with drawing the ring (1) tightening the screw (2).
- Using the specially provided tie rod (3) for the tool 99363204 and the lever (4), withdraw the external holding ring of the flywheel cover box.

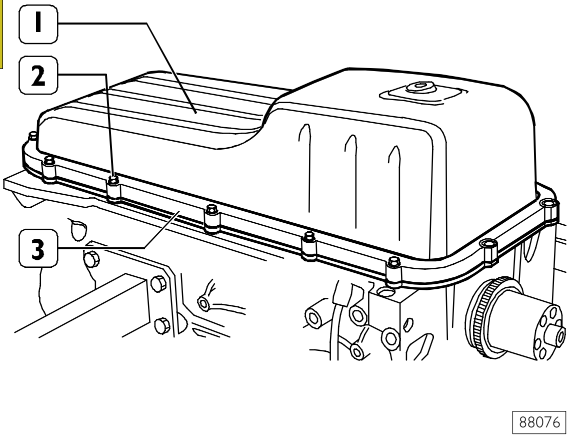
Figure 38



- Loosen the screws (2) and remove the flywheel cover box (1).

NOTE Take note of the screw (1) assembly position, since the screws have different length.

Figure 39

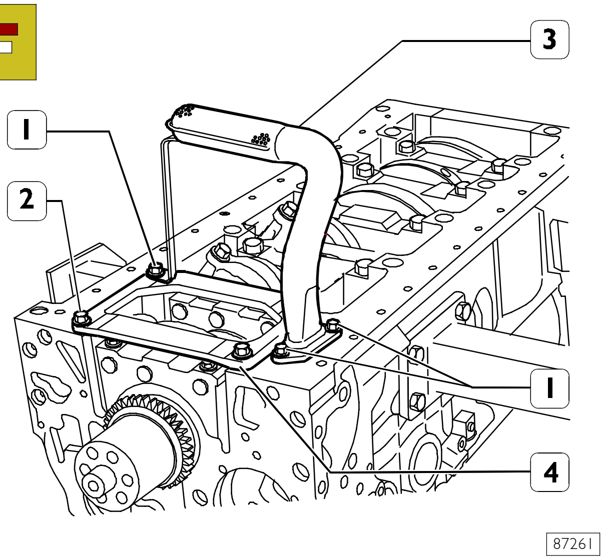


❑ Turn the engine upside-down.

❑ Loosen the screws (2), disassemble the plate (3) and remove the oil pan (1).

NOTE The shape and dimensions of the pan and of the rose pipe may vary according to the engine application. The relating illustrations provide general guidelines of the operation to be performed. The procedures described are applicable anyway.

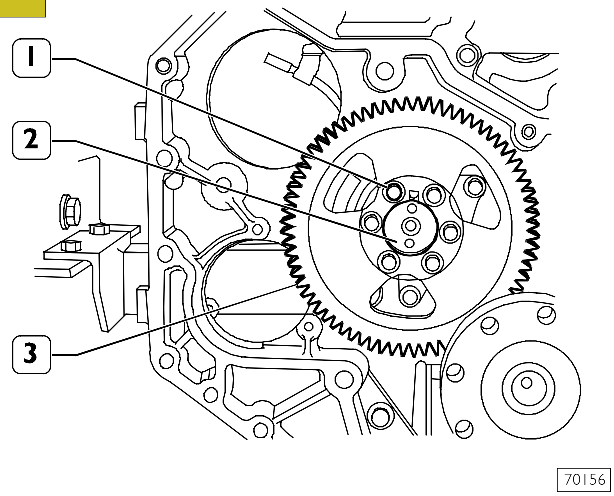
Figure 40



❑ Loosen the screws (1) and disassemble the oil suction rose pipe (3).

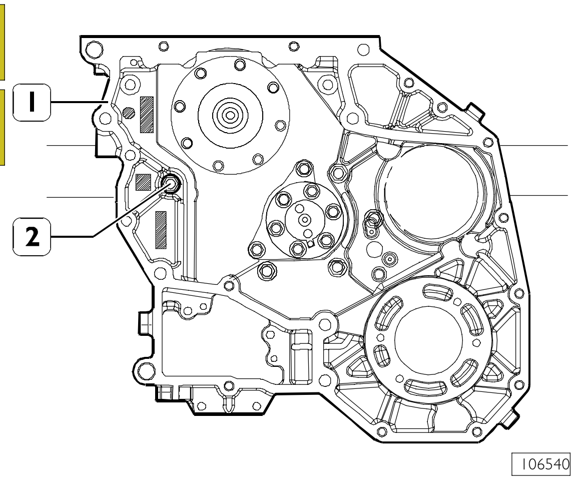
❑ Loosen the screws (2) and remove the stiffening plate (4).

Figure 41



❑ Loosen the screws (1) and disassemble the gear from the camshaft (2).

Figure 42



❑ Loosen the screws (2) and disassemble the timing gearbox (1).

NOTE Take note of the screw (2) assembly position, since the screws have different length.

Print P4D32N001 E

Installation of rear components

Figure 43

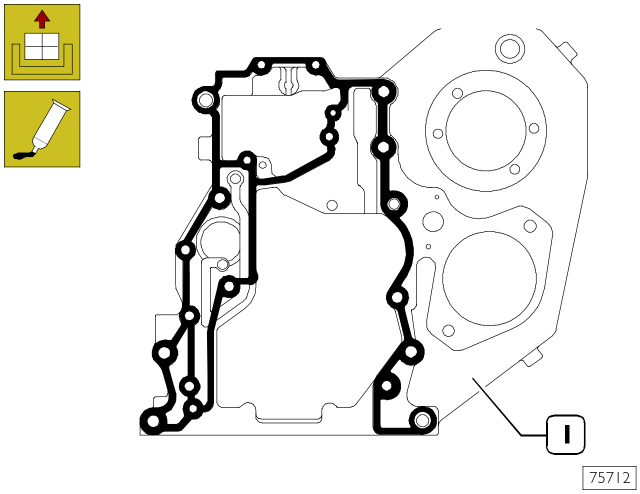


DIAGRAM SHOWING SEALING LOCTITE 5205 APPLICATION WITHIN GEARBOX AREAS

- Accurately clean the timing gearbox (1) and the engine block.

NOTE It is necessary and essential to clean the surface to be sealed in order to achieve excellent tight seal.

Apply sealing LOCTITE 5205 on the box in order to form a kerbstone of a few mm. Diameter.

It must be uniform (no crumbs), with no air blisters, thinner or irregular zones.

Any eventual imperfection shall be correct as soon as possible.

Avoid using material in excess to seal the joint. Too much sealing material would drop out on both sides of the joint and obstruct lubricant passages.

Couplings must be assembled within 10 minutes after completing the sealing operation.

Figure 44

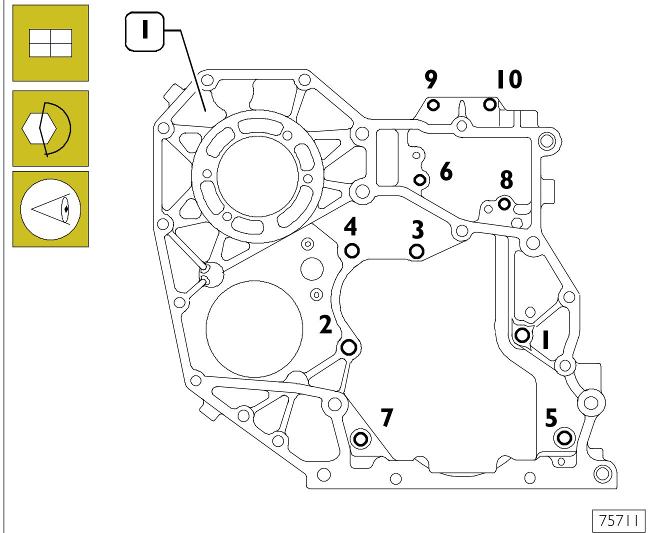


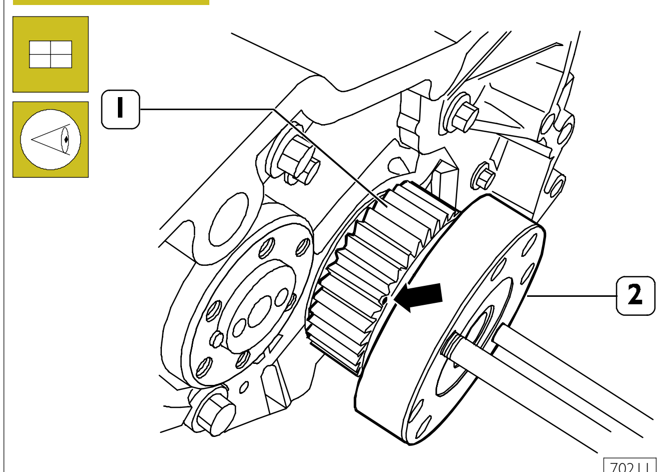
DIAGRAM SHOWING SCREW TIGHTENING TO FIX REAR GEARBOX

- Reassemble to box (1) to the engine block.
- Tighten the fixing screws in the same position as found out during disassembly and fix the screws to the locking couples listed here below, following the order as shown in the picture.

Screws M12	65 ÷ 89 Nm
Screws M8	20 ÷ 28 Nm
Screws M10	42 ÷ 52 Nm

NOTE Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

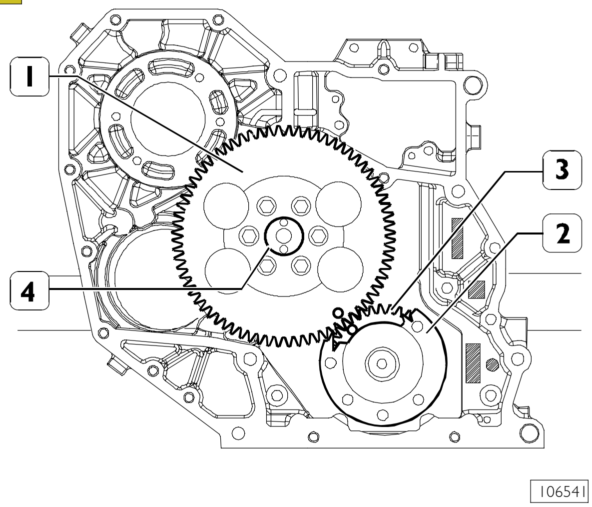
Figure 45



- With a pen marker, mark the tooth (1) of the driving gear assembled to the engine drive shaft with (2) (→) timing notch.

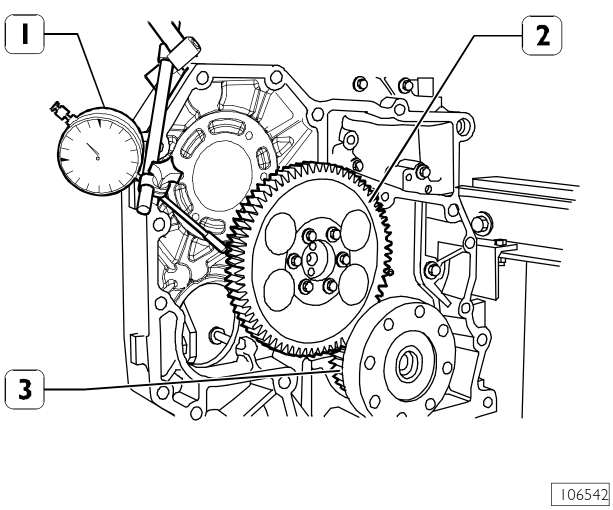
NOTE Screw up two pins to facilitate operation of engine drive shaft rotation.

Figure 46



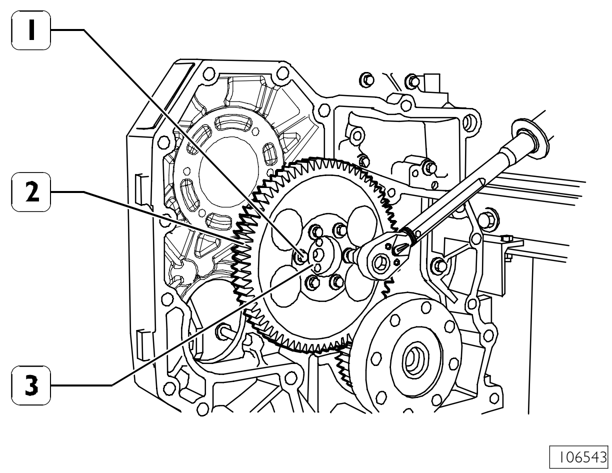
❑ Orient engine drive shaft (3) and camshaft (4) taking care that in phase of assembly of the driving gear (2) to the camshaft, the notches marked on the gears (1 and 2) shall match.

Figure 47



❑ Position comparator (1) on timing system gear (2) and check that the clearance between gears (2) and (3) is within 0.076 ÷ 0.280 mm range.

Figure 48



❑ Tighten the screws (1) fixing the gear to the camshaft (3) and lock them to the prescribed couple.

Figure 49

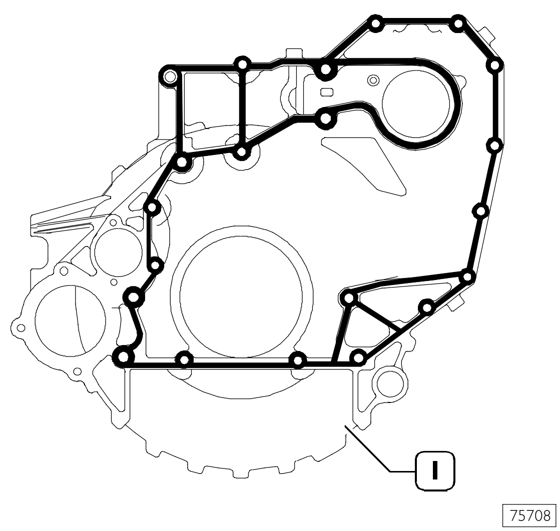


DIAGRAM SHOWING SEALING LOCTITE 5205 APPLICATION.

NOTE It is necessary and essential to clean the surface to be sealed in order to achieve excellent tight seal.

Apply sealing LOCTITE 5205 on the box in order to form a kerbstone of a few mm. Diameter. It must be uniform (no crumbs), with no air blisters, thinner or irregular zones.

Any eventual imperfection shall be correct as soon as possible.

Avoid using material in excess to seal the joint. Too much sealing material would drop out on both sides of the joint and obstruct lubricant passages.

Couplings must be assembled within 10 minutes after completing the sealing operation.

Figure 50

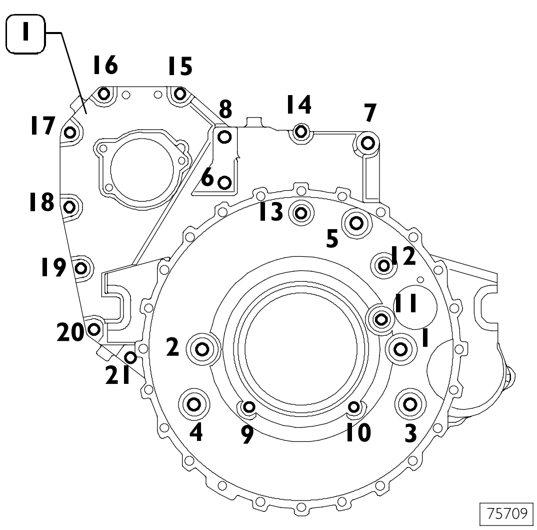


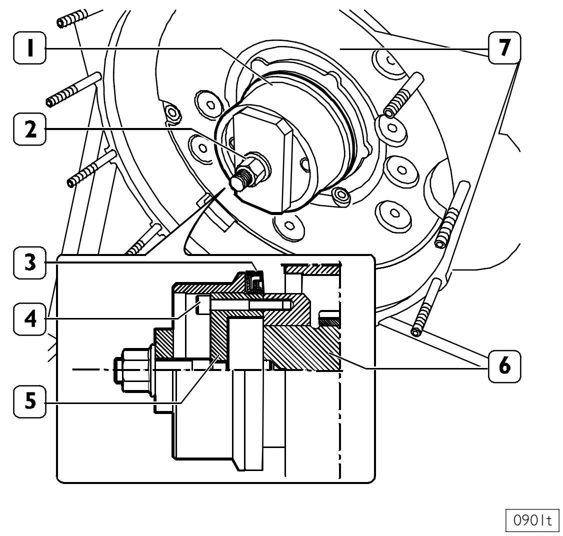
DIAGRAM SHOWING SCREW TIGHTENING TO FIX FLYWHEEL COVER BOX.

- Reassemble the box (1) to the engine block, tighten the fixing screws in the same position as found out during disassembly and fix the screws to the locking couples listed here below, following the order as shown in the picture.

Screws M12	75 ÷ 95 Nm
Screws M10	44 ÷ 53 Nm

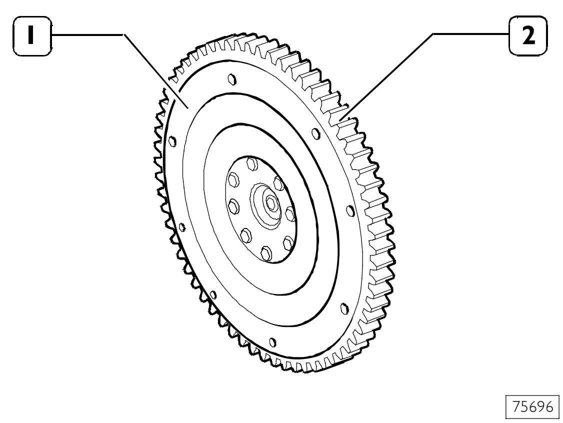
NOTE Tightening to angle is performed using tool 99395216.

Figure 51



- Apply to engine drive shaft rear tang (6), the detail (5) of the tool 99346252, fix it tightening the screws (4) and key the new holding ring on it (3).
- Place detail (1) on detail (5), tighten the screw nut (2) until complete assembly of the fixing ring (3) into the flywheel cover box (7).

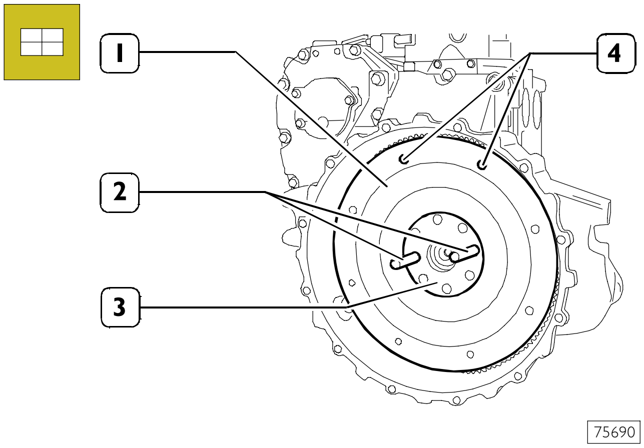
Figure 52



- Check the conditions of the rim tooth (2). Whether tooth break or excessive wear is detected, disassemble the rim from the engine flywheel using a common willow and replace with a new one, previously heated to 150° C degrees for 15' ÷ 20'; seconds; bevelling must be made towards engine flywheel direction.

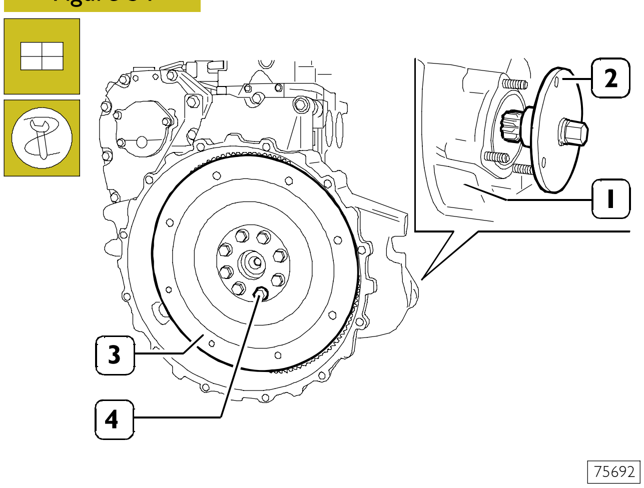
Flywheel installation

Figure 53



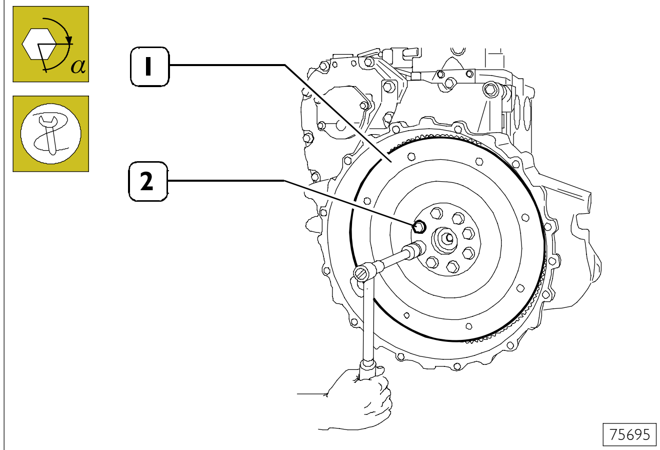
- ❑ Screw up two hooks or trail rings in the flywheel (1) threaded ports (4) for handling .
- ❑ Using a hoist, handle the flywheel to place it in its housing inside the flywheel cover box.
- ❑ Screw up to pins (2) having appropriate length, in the shaft ports (3) and using them as guide, assemble the engine flywheel (1) properly placing it inside the flywheel cover box.

Figure 54



- ❑ Tighten the screws (4) fixing the engine flywheel (3) to the engine shaft. Use tool 99360339 (2) to operate on the flywheel cover box (1) to block engine flywheel rotation.

Figure 55



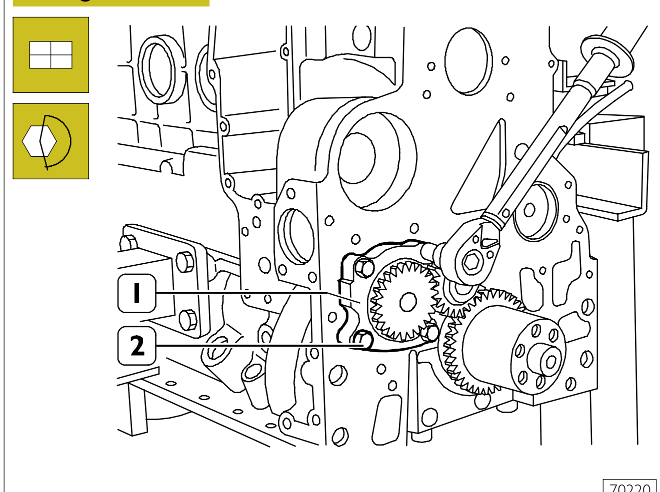
Tighten the engine flywheel (1) fixing screws (2) in two phases:

- ❑ 1st phase; tightening by means of dynamometric wrench to couple 30 ± 4 Nm;
- ❑ 2nd phase, 60° ± 5° angle dwell.

NOTE Angle dwell shall always be performed using 99395216 tool.
Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

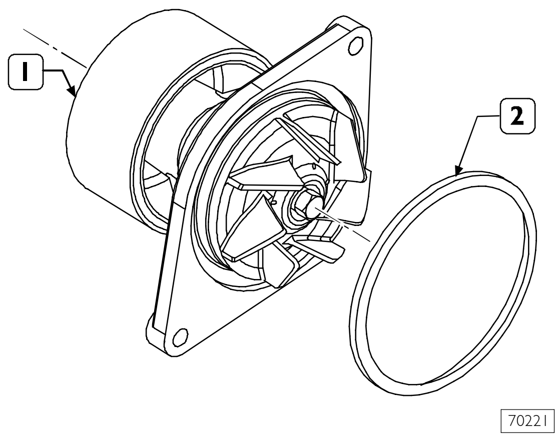
Installation of front components

Figure 56



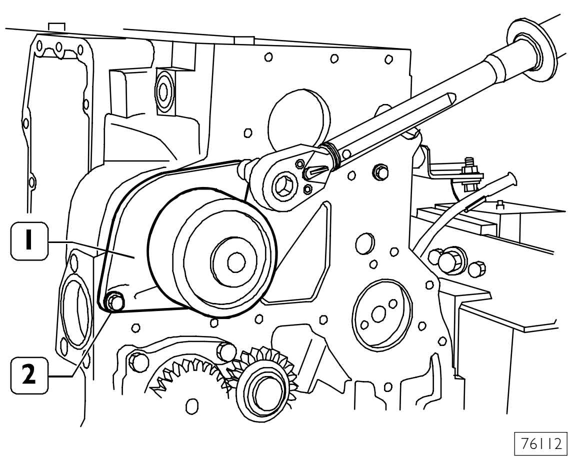
- ❑ Assemble oil pump (1).
- ❑ Tighten fixing screws (2) and lock them to the prescribed couple.

Figure 57



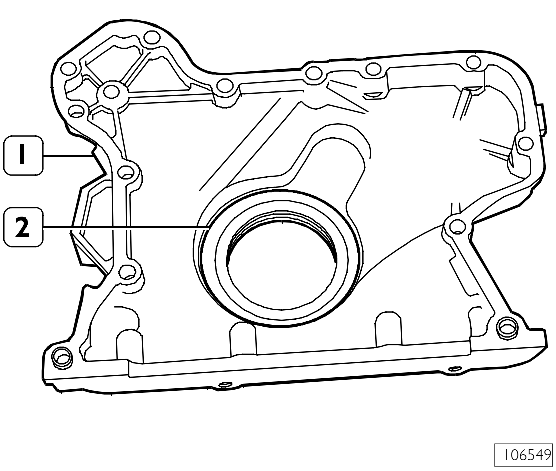
- Apply to the water pump (1) a new fixing ring (2).

Figure 58



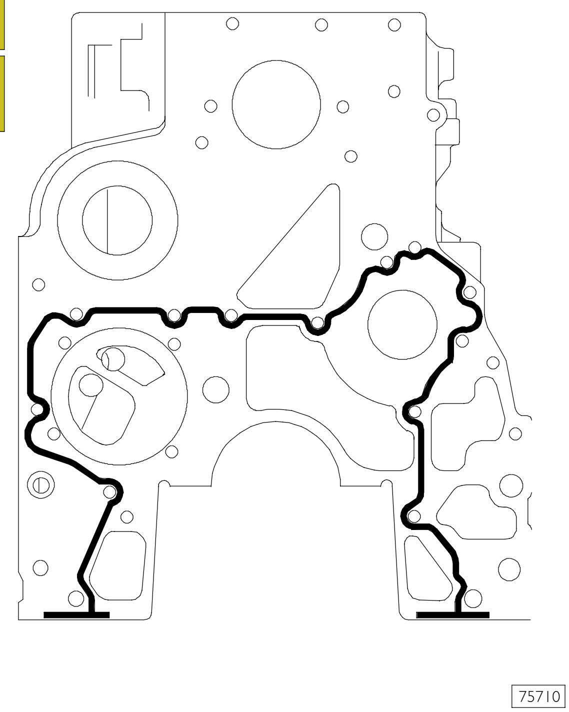
- Assemble the water pump (1).
- Tighten the screws (2) and lock them to the prescribed couple.

Figure 59



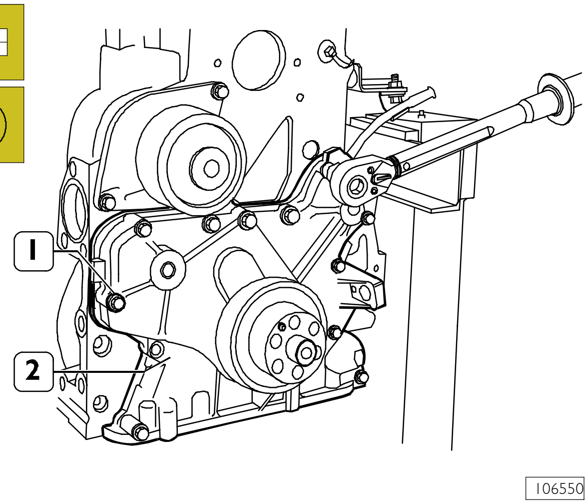
- Remove the fixing ring (2) from the front cover (1), accurately clean the plug surface.

Figure 60



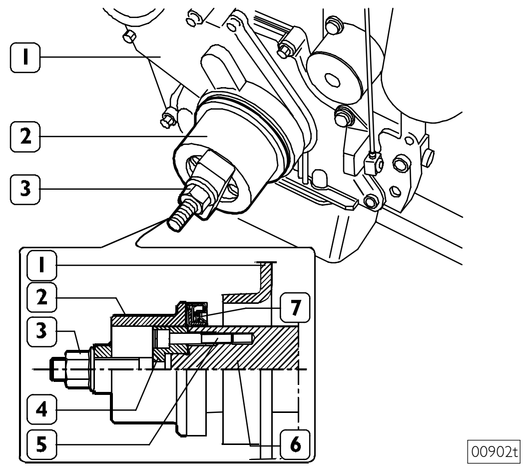
- Accurately clean the contact surface of engine block and apply sealing LOCTITE 5205 on it in order to form a uniform and continuous kerbstone with no crumbs.

Figure 61



- Assemble the front cover (2) to the block and tighten the screws (1) fixing them to the prescribed couple.

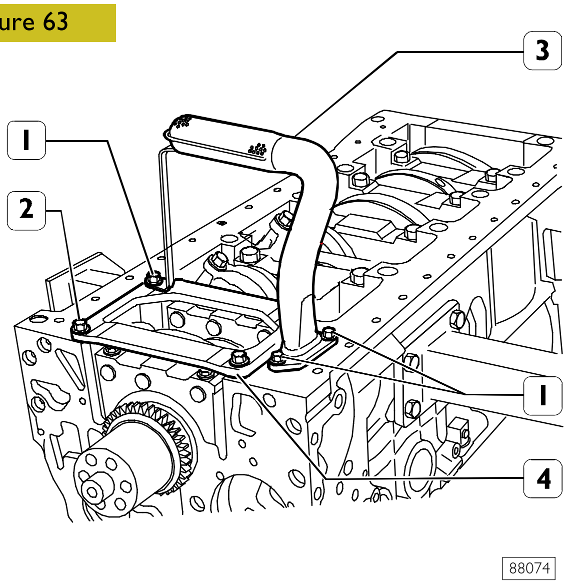
Figure 62



❑ Apply on engine drive shaft front tang (6) the detail (4) of the tool 99346252, fix it with the screws (5) and key the new holding ring on it (7).

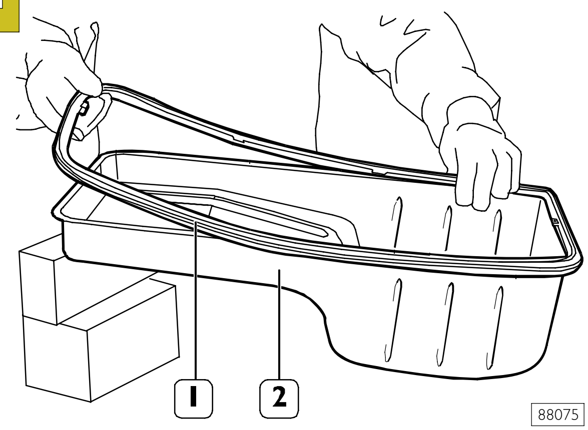
❑ Place the detail (2) on the detail (4), screw-up the threaded nut until carrying out the complete assembly of the holding ring (7) to the front cover.

Figure 63



❑ Assemble plate (4), suction rose (3) and tighten the fixing screws (2 and 1) locking them on the prescribed torque.

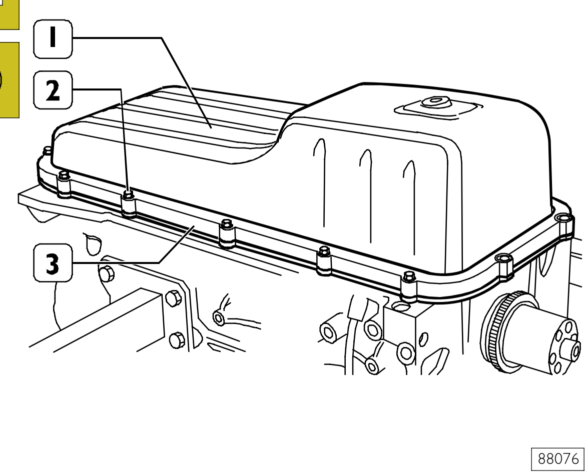
Figure 64



❑ Provide for new gasket replacement (1) of the oil pan (2).

NOTE The pictures illustrating the pan and of the rose pipe may not correspond to the ones of your model.
However the procedures described are applicable anyway.

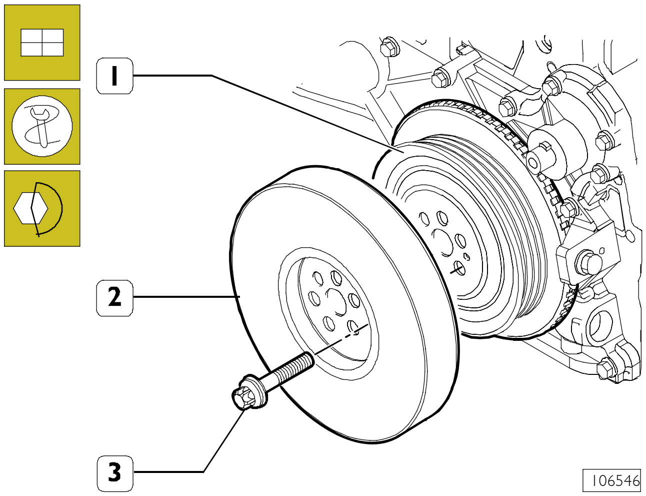
Figure 65



❑ Assemble oil pan (1), apply the plate over it (2). Tighten the screws (2) and lock them to the prescribed couple.

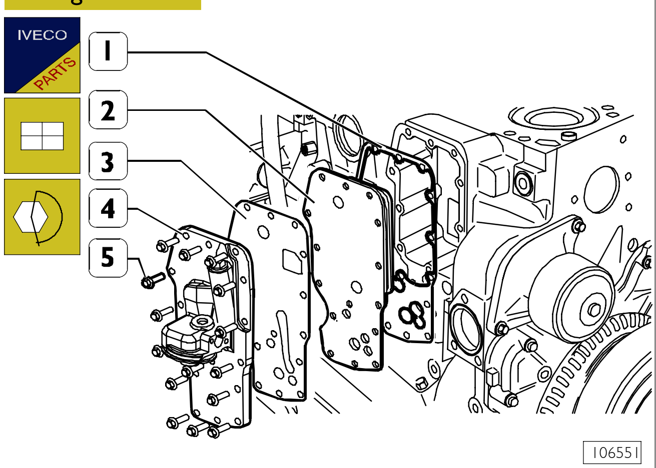
NOTE Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

Figure 66



- ❑ Assemble the pulley (1) and the dumping flywheel (2) to the driving shaft.
- ❑ Tighten the fixing screws (3) and clamp them to the couple 68 ± 7 Nm.

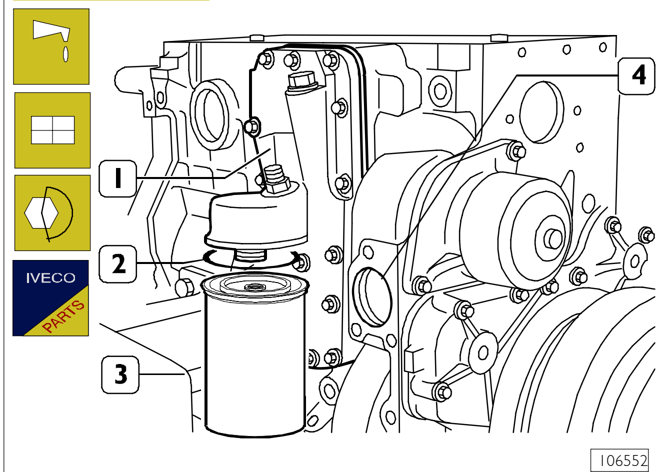
Figure 67



- ❑ Assemble the following elements to the block: new gasket (1), heat exchanger (2), new gasket (3), oil filter bearing (4).
  Tighten the screws (5) and lock them to the prescribed couple.

NOTE Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

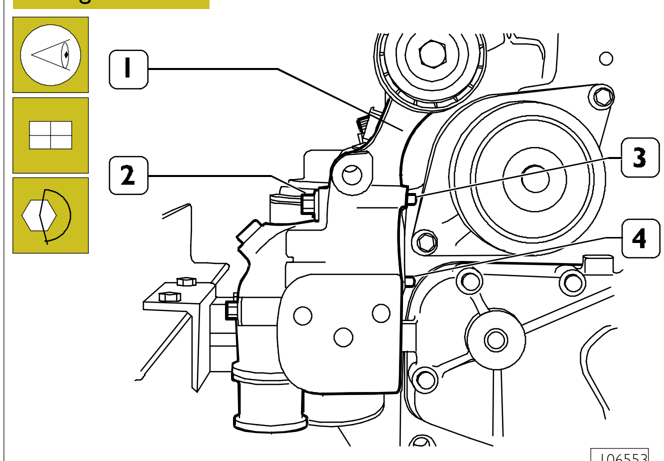
Figure 68



- ❑ Lubricate the fixing ring (2) using engine oil and place it on the oil filter (3).
- ❑ Manually start the oil filter (3) on the bearing union (1) until counter-boring, further screw up the oil filter (3) by 3/4 turn.
- ❑ Place a new fixing ring on the block housing (4).

NOTE In some applications, the bearing of the exchanger shall be assembled to a screw threaded union connected to the filter on the opposite side of the engine, throughout two pipelines.

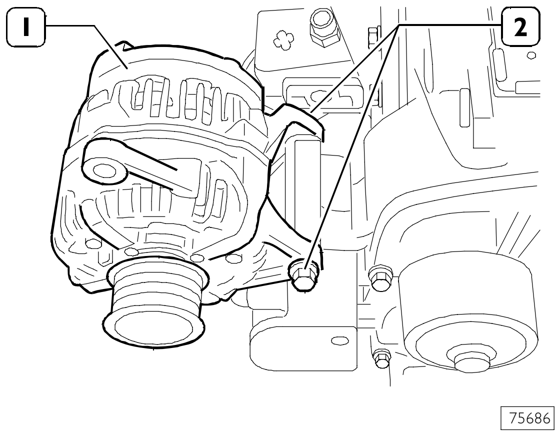
Figure 69



- ❑ Assemble the alternator bearing (1) ensuring that the pins (3 and 4) are against the engine block.
- ❑ Tighten the screws (2) and lock them to the prescribed couple.

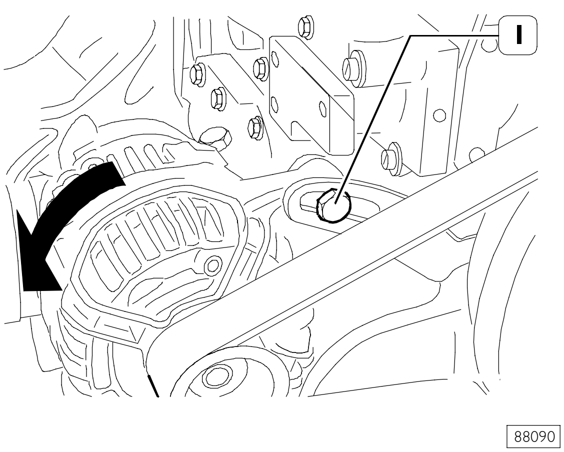
NOTE Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

Figure 70



- ❑ Connect the alternator (1) to the support.
- ❑ Tighten without locking the screw (2).

Figure 71

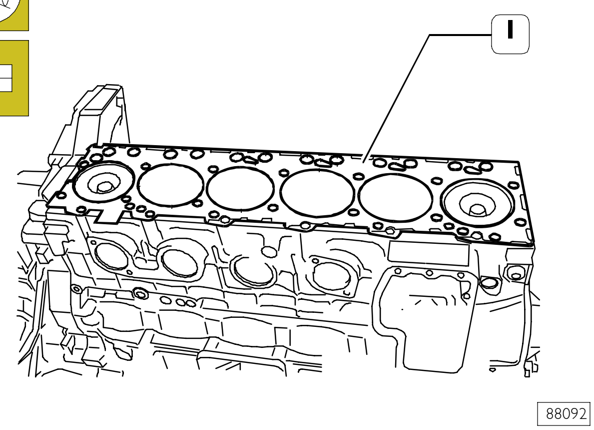


To refit the POLY-V belt, perform the steps described in Figure 22 in reverse order.

NOTE For belt stretching rotate the alternator as indicated in the figure, lock screw (1) and screw (2, Figure 70).

NOTE In case the same belt priory removed is assembled again, proceed examining it carefully to check there

Figure 72



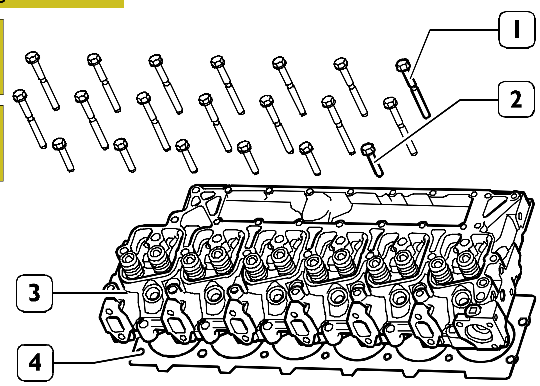
- ❑ Place the gasket (1) over the block.
  The choice of the gasket's thickness shall be made in consideration of the cylinder protrusion measured with respect to the block's upper surface.

NOTE Verify that the engine block stand is clean.

Do not grease the gasket. It is recommended to keep the gasket inside packaging until assembly to the cylinder head.

Print P4D32N001 E

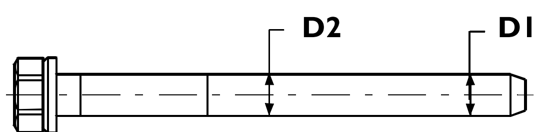
Figure 74



76152

❑ Place the head (3) over the block and insert screws (1) and (2).

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.

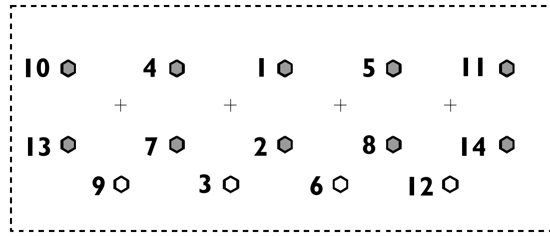


75703

NOTE If the valves have been removed from the head, it is necessary to assemble them before assembling the head itself on the engine block.

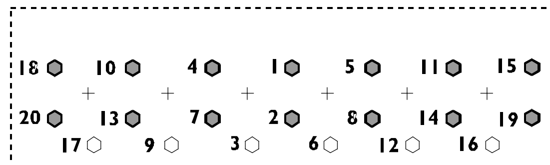
Figure 73

4 cylinder engine



76115

6 cylinder engine



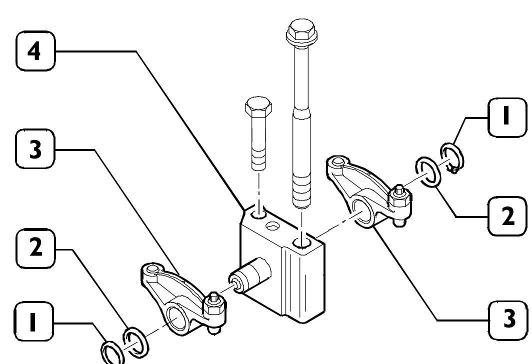
76214

❑ Lubricate cylinder head bolts and install to head.

❑ Bolts must be torqued using stitching pattern starting with the centre bolts and moving out. Bolts to be torqued in stages: all bolts torqued to snug torque, then 90 degrees rotation for all bolts. Then a further 90 degrees for the M12 x 140 and M12 x 180.

M12 x 70	50 Nm + 90 deg's
M12 x 140	40 Nm + 180 deg's
M12 x 180	70 Nm + 180 deg's

Figure 75

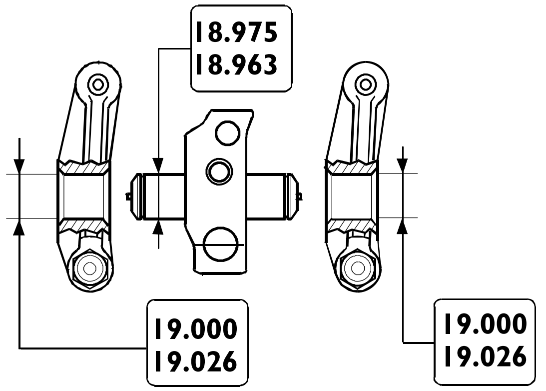


75705

ROCKER ARM UNIT COMPONENTS:
1. Elastic ring - 2. Spacer- 3. Rocker arms- 4. Support.

❑ Carry out the assembly of the rocker arms after previous check of the components.

Figure 76

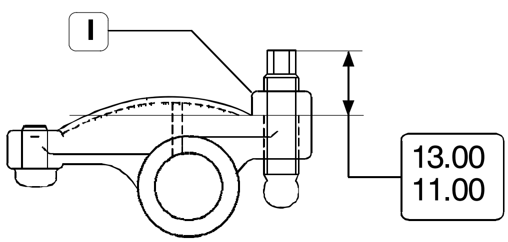


75704

SHAFT AND ROCKER ARM BASIC DATA

Check the coupling surfaces of bearing and shaft: no evidence of excessive wear shall be detected or damages.
Replace if necessary.

Figure 77

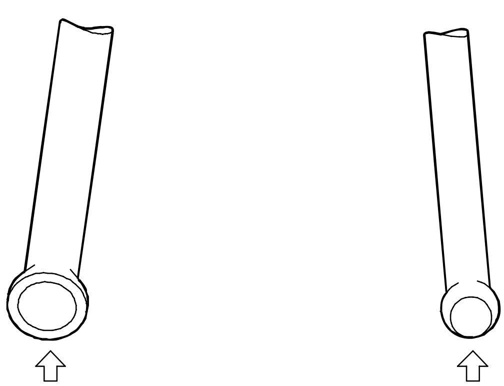


116391

ROCKER ARM ADJUSTMENT SCREW

If the adjuster screw has been removed, check the adjustment distance.
Tighten the screw-threaded nut (1) to the 4 - 6 Nm couple.

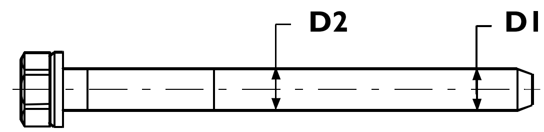
Figure 78



32655

Before executing assembly, check the Rocker Arm driving rods: these shall not be deformed; the spherical ends in contact with the Rocker Arm adjustment screw and with the tappet (arrows) shall not present evidence of seizure or wear: in case of detection proceed replacing them.
The rods driving the suction and exhaust valves are identical and therefore interchangeable.

Figure 79

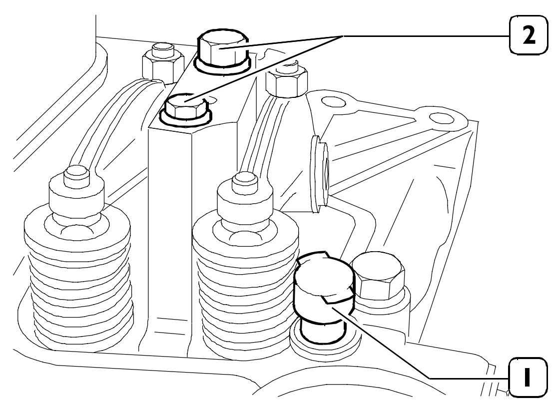


75703

Insert the tappet driving rods and the Rocker Arm unit. Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:

- if D1 - D2 < 0,1 mm the screw can be utilised again;
- if D1 - D2 > 0,1 mm the screw must be replaced.

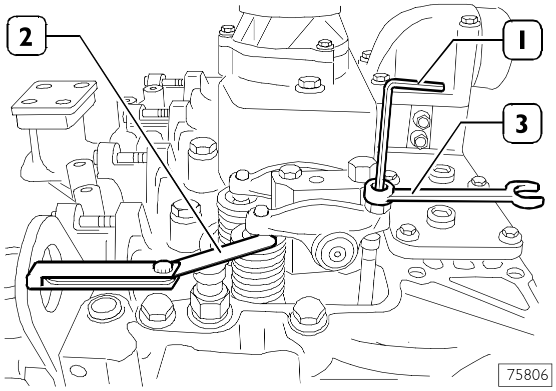
Figure 80



75683

- Tighten the screws (2) to the prescribed couple and assemble water temperature sensor (1).

Figure 81



Adjust the slack between rocker arms and valves using socket wrench (1), point wrench (3) and feeler gauge (2).

Correct slack is:

- suction valves 0.25 ± 0.05 mm
- exhaust valves 0.50 ± 0.05 mm.

NOTE In order carry out a quicker adjustment of the working slack between rocker arms and valves, proceed as following:

6 cylinder engine

Rotate the engine drive shaft, balance the valves of cylinder 1 and adjust the valves identified by star symbol, as indicated in the following table:

Cylinder n.	1	2	3	4	5	6
Suction	-	-	*	-	*	*
Exhaust	-	*	-	*	-	*

Rotate the engine drive shaft, balance the valves of cylinder 6 and adjust the valves identified by star symbol, as indicated in the following table:

Cylinder n.	1	2	3	4	5	6
Suction	*	*	-	*	-	-
Exhaust	*	-	*	-	*	-

4 cylinder engine

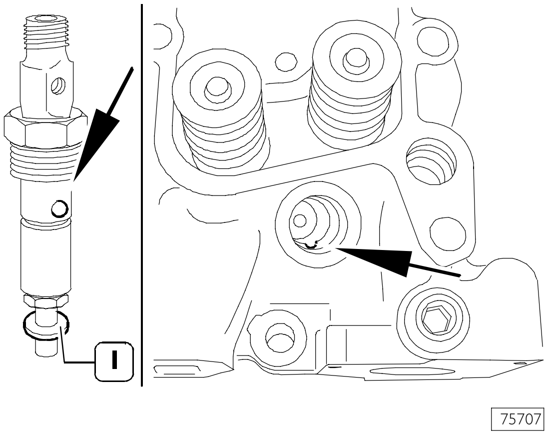
Rotate the engine drive shaft, balance the valves of cylinder 1 and adjust the valves identified by star symbol, as indicated in the following table:

Cylinder n.	1	2	3	4
Suction	-	-	*	*
Exhaust	-	*	-	*

Rotate the engine drive shaft, balance the valves of cylinder 4 and adjust the valves identified by star symbol, as indicated in the following table:

Cylinder n.	1	2	3	4
Suction	*	*	-	-
Exhaust	*	-	*	-

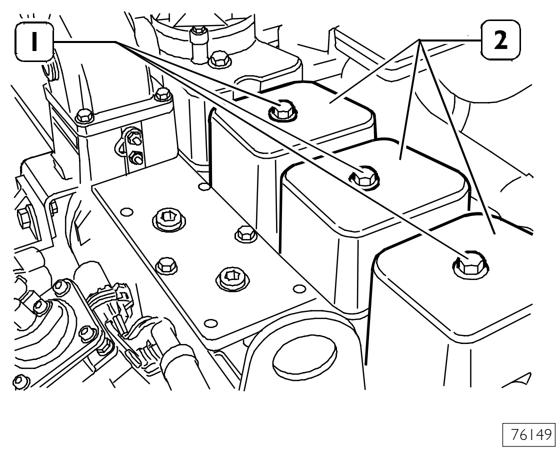
Figure 82



❑ Assemble injectors after having replaced the sealing gasket (1).

NOTE During assembly of injectors, verify that the injector sphere is correctly positioned on the head housing.

Figure 83 (Demonstration)



❑ Assemble cylinder covers (2) with the respective gaskets;

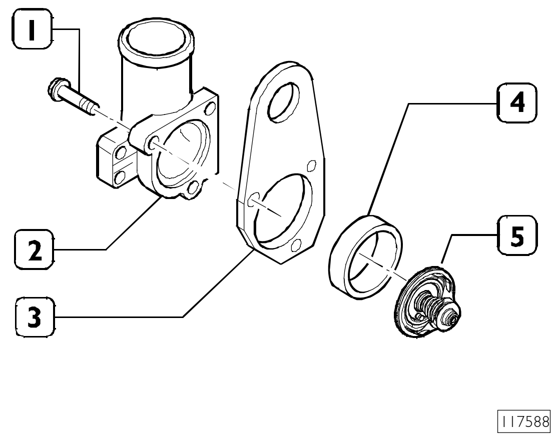
❑ Fit the seal nods and tighten the screws (1) fixing them to the prescribed couple.

NOTE Always replace the gaskets using new ones.

Check the threads of the fixing screws: there shall be no evidence of wear or dirt deposit.

Seal nods shall have no visible deformation. In such case provide for replacement with new nods.

Figure 84 (Demonstration)



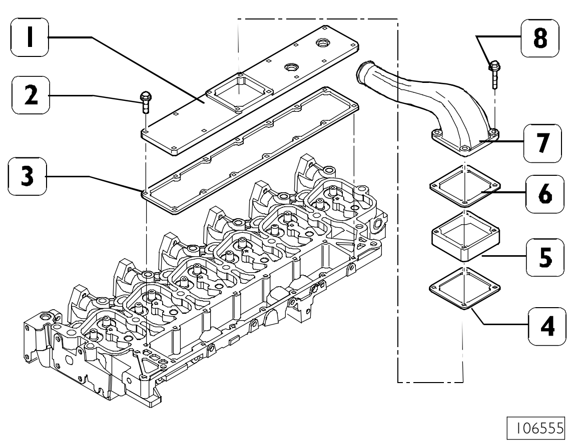
- ❑ Assemble thermostat unit (2) including thermostat (5) and gasket (4).
- ❑ Tighten the screws to the prescribed couple.

NOTE The screws (1) have been have been utilised to fix the bracket (3).

Disassemble the bracket (3) and reassemble components from 1 to 5 as shown in the picture.

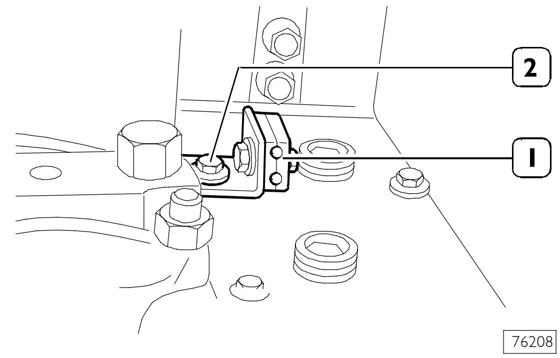
The gasket (4) must be new.

Figure 85



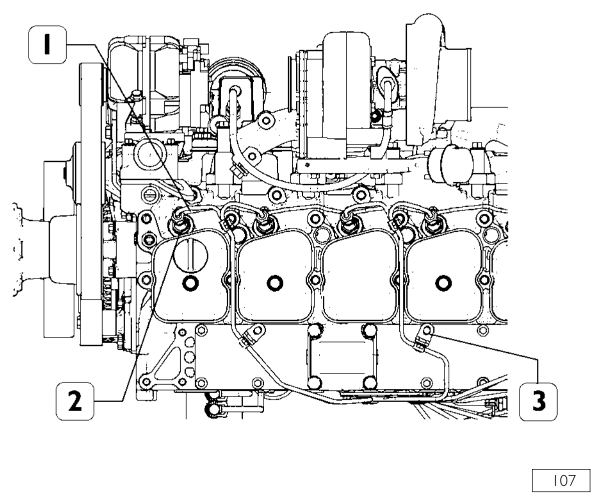
- ❑ Apply on the surface joining the suction manifold plate (1) the gasket (3) and provide. Fixing the screws (2) to the prescribed couple.
- ❑ If you have removed the pipe (7) and the spacer (5) from the intake manifold plate (1) fit it back on after inserting two new gaskets (4-6).
- ❑ Tighten the screws (8) to the prescribed couple.

Figure 86 (Demonstration)



- ❑ Assemble the brackets (1) fixing the fuel pipelines to the injectors: use the same screws (2) fixing the manifold plate as shown in the picture.

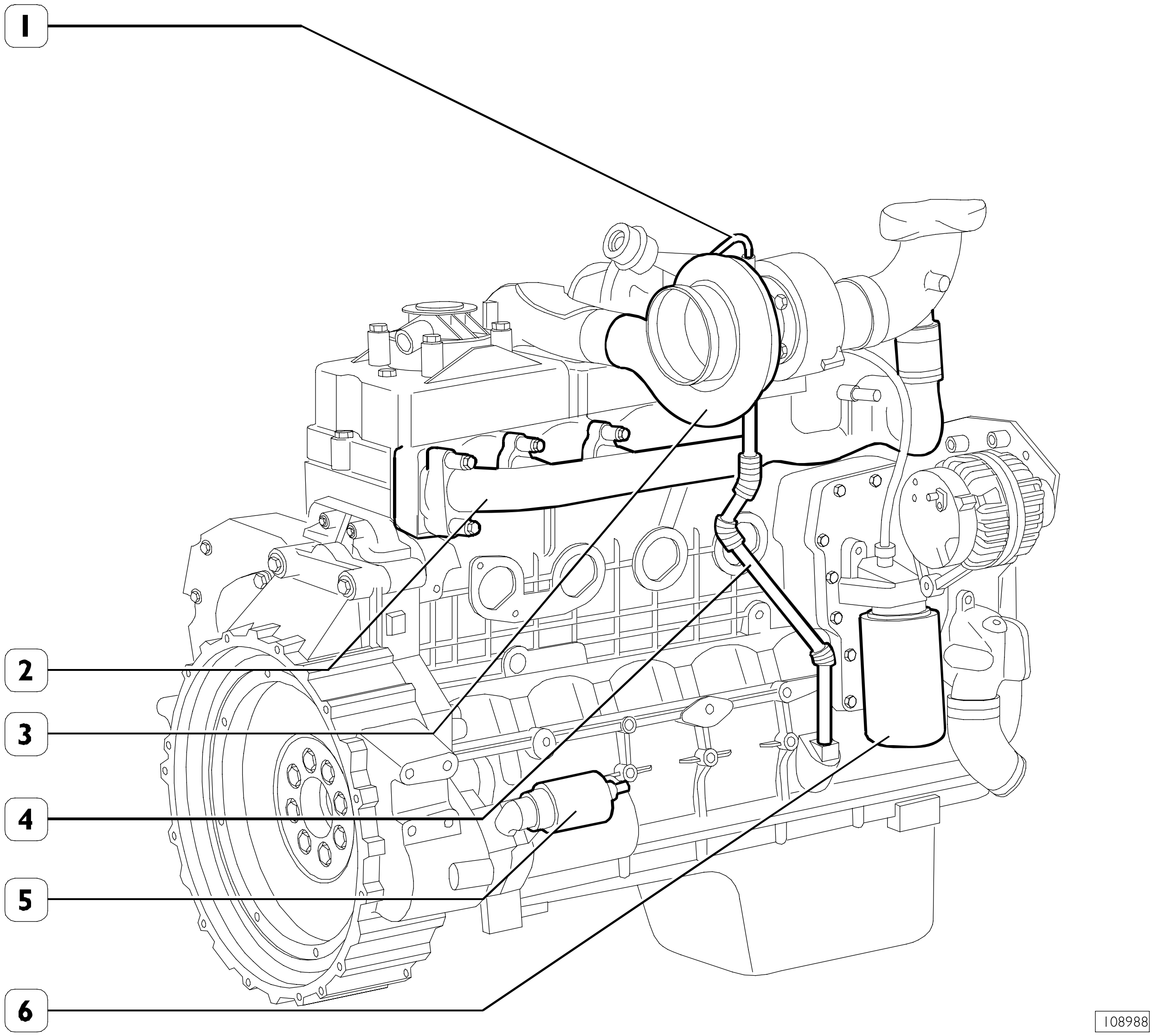
Figure 87



- ❑ Fix the fuel pipes (1) to the injectors (2) and to the connectors (3) previously fitted.

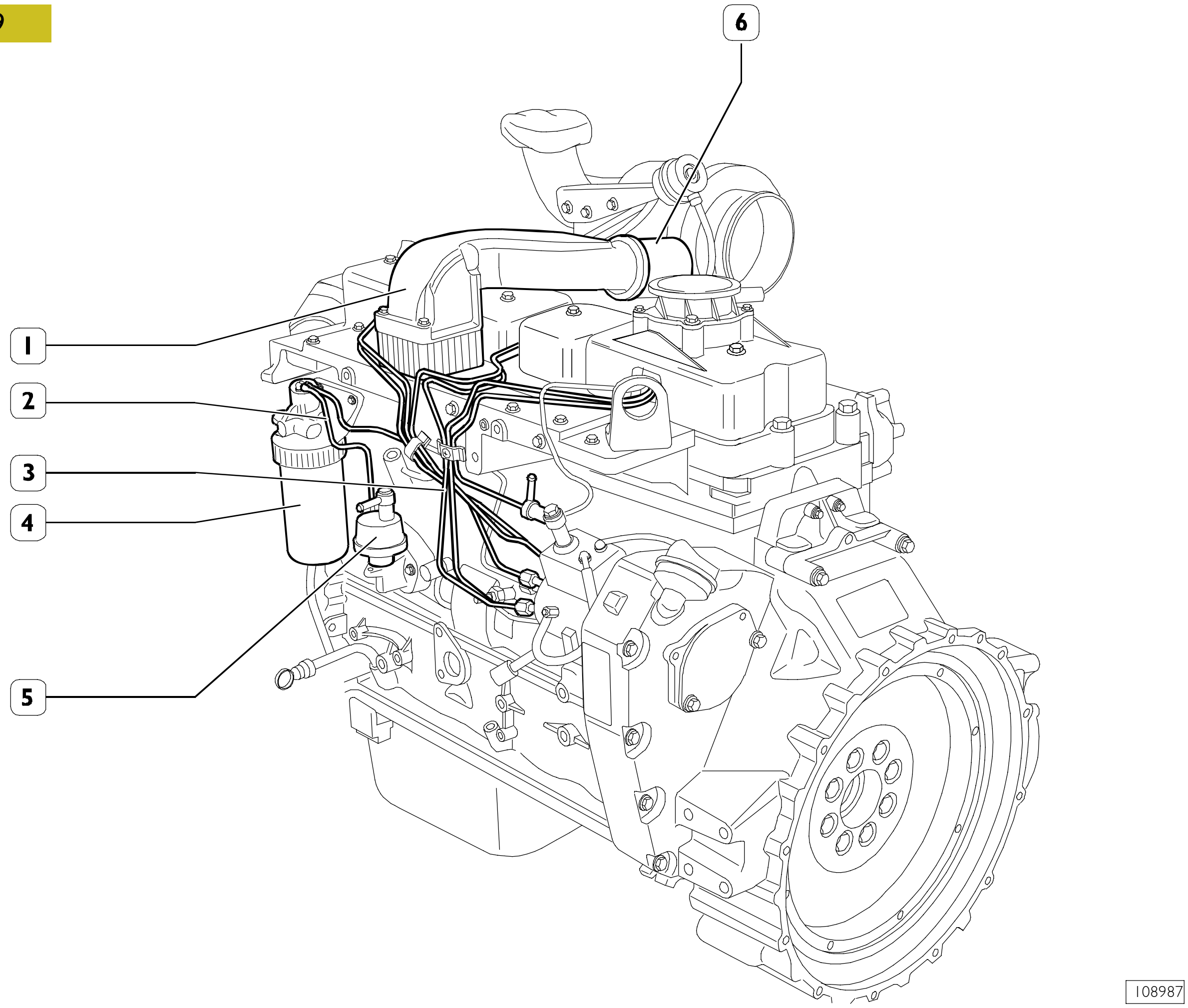
Completing the engine

Figure 88



- ❑ Fit the starter motor (5).
- ❑ Fit the oil filter (6) with tool 99360076.
- ❑ Fit the exhaust manifold (2).
- ❑ Fit the turbine (3).
- ❑ Fit the pipe (4) returning oil from the turbine (3).
- ❑ Fit the pipe (1) delivering oil to the turbine (3).

Figure 89



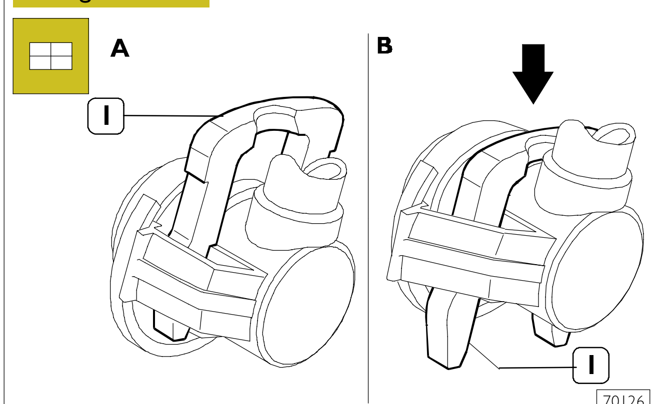
NOTE Fitting the injection pump requires a specific procedure described in this section.

- ❑ Fit the pipes (3) to the injection pump.
- ❑ Fit the priming pump (5).
- ❑ Fit the fuel filter mounting (4).
- ❑ Fit the diesel filter (4) with tool 99360076.

NOTE The filter shall be priory filled with fuel to facilitate feed system bleed operations.

- ❑ Fit the fuel pipes (2).
- ❑ Fit the intake manifold (1) and the sleeve (6).

Figure 90



NOTE To connect fuel pipelines (3, Figure 89) in low pressure from the relating connection unions it is necessary to press the locking fastener (1) as shown in picture **B**.
After having connected the pipeline, reset the fastener (1) into block position as shown in picture **A**.

Print P4D32N001 E

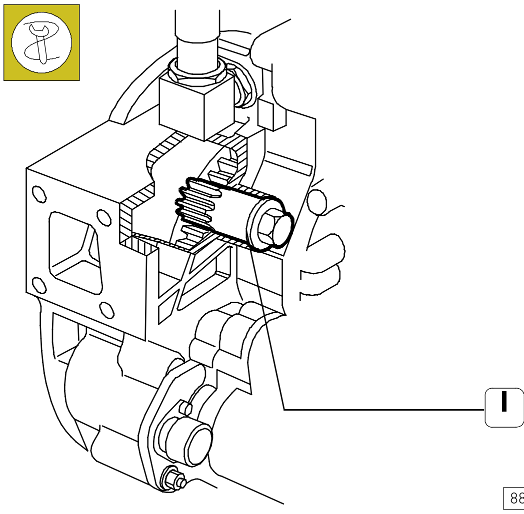
Rotary feed pump disassembly and assembly procedure

This procedure prescribes that:

- the fuel pipes (from the pumping elements to the injectors, recovering blow-by from the injectors to the pump and the supply from the priming pump) have all been removed;
- the electrical connections have been disconnected.
- Accelerator cable shall be disconnected.

Engine versions with tool (99360330)

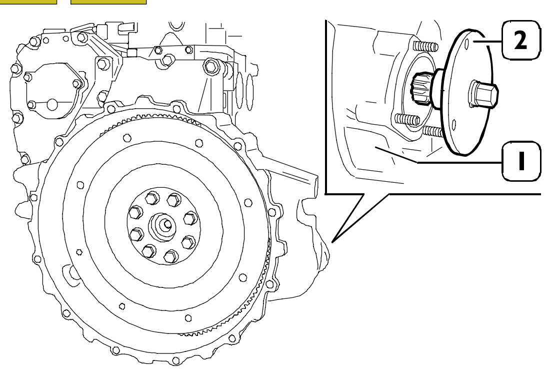
Figure 91



Disassemble the starter from the flywheel box and use tool 99360330 to rotate the flywheel.

Engine versions with tool (99360339)

Figure 92



Disassemble the starter from the flywheel box (1) and use tool 99360339 (2) to rotate the flywheel.

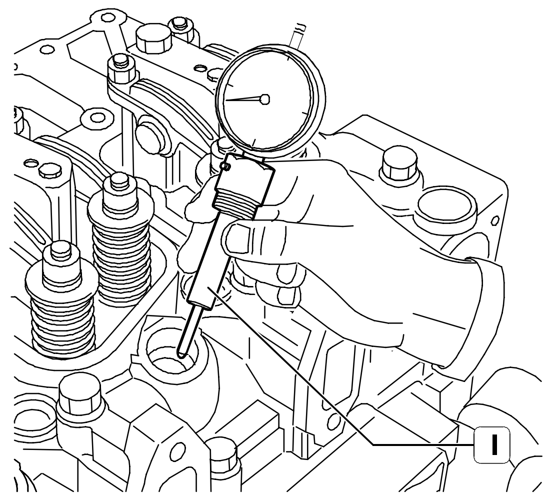
In case feed pump replacement is necessary, this shall be supplied pre-set already as spare part.

On the other hand, in case the pump shall be disassembled and reassembled later on without being repaired it will be necessary to pr-set it while it is still assembled to the engine and disassemble it only afterwards.

The following procedure analyses this second hypothesis since it is the more complex.

Find the top dead centre with the tool (99395097) - False injector

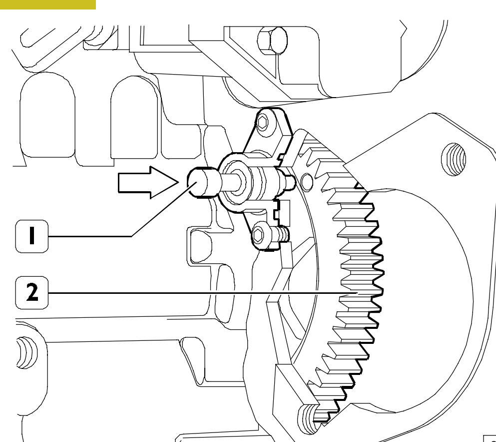
Figure 93



Remove the rocker covers of the 1st cylinder; remove the 1st injector and place the tool (1) to set the 1st cylinder top dead centre position (end-of-compression phase). Pre-load the gauge.
The searched condition is obtained by rotating the engine shaft properly until you find the maximum value on the comparator and then checking that the intake and exhaust valves are both closed.
Once PMS has been obtained, lock the flywheel by means of tool 99360339 (Figure 93).

Searching for the top dead centre with timing gear blocking pin

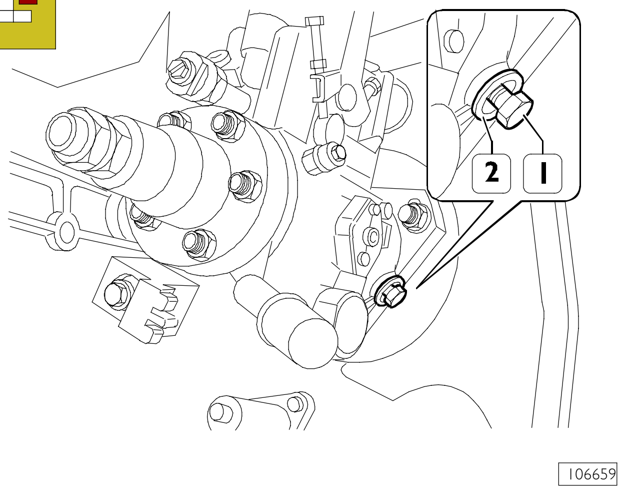
Figure 94



Turn the flywheel until, when pushing the pin (1), it blocks the gear (2) obtaining the TDC of the 1° cylinder.

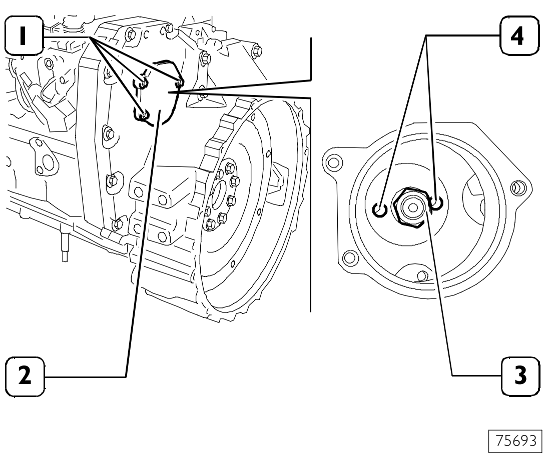
Disassembly

Figure 95



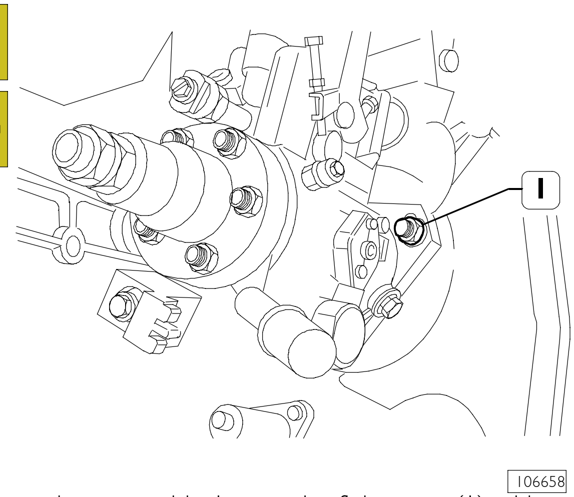
- Partially unlock pump shaft retaining screw (1) and move spacer with slot (2) in area with lager size hole for complete screw passage.
- Lock applying a torque ranging between 11,9 and 12,4 Nm retaining screw (1) till reaching spacer, thus locking pump shaft rotation.

Figure 96



- From timing side, remove the cover (2) loosening the screws (1) in order to have access to the union fixing nut (3) to the pump driving gear.
- Loosen the fixing nut (3) and remove the relating washer.

Figure 97



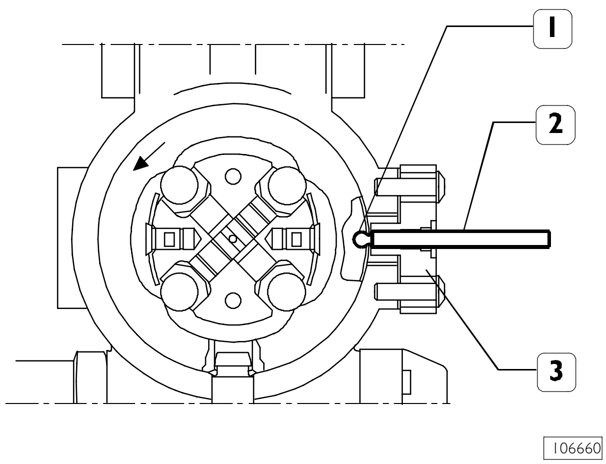
- From the pump side, loosen the fixing nuts (1) without removing them in order to enable moving the pump backwards using 99340035 extractor.
- Assemble the 99340035 extractor throughout the two threaded ports (4, Figure 96) and withdraw the gear from the pump shaft.
- Properly hold the feed pump and loosen completely the fixing nuts.
- Withdraw the pump from the studs, together with the gasket.

NOTE Hold the pump driving gear to avoid interference or crawling during timing gear rotation.

Print P4D32N001 E

Rotary feed pump setting check

Figure 98



1. Slot on the hub of the hydraulic rotor -
2. Synchronization pin 99365196 - 3. Plate.

The synchronization pin 99365196 (2) has been designed for use in the event of the rotor shaft being inadvertently released.
The correct synchronization of the pump with the engine is obtained when the synchronization pin 99365196 (2), fitted in the hole on the plate (3), enters the slot (1) on the exterior of the hydraulic rotor hub.

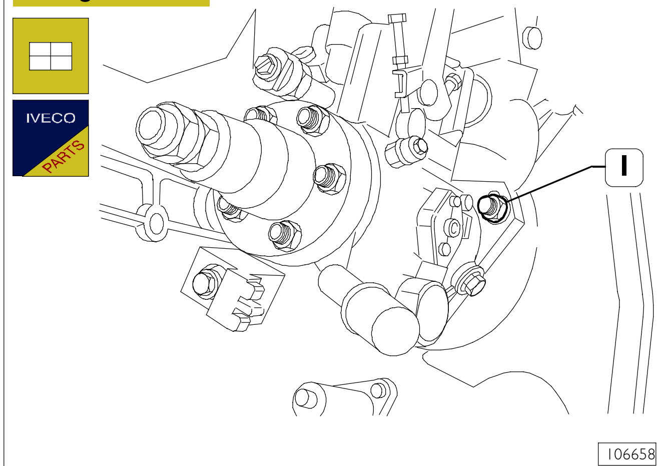
Therefore:

- Remove the screw cap (3) at the centre of the plate.
- Insert the synchronization pin (1) 99365196 in the hole on the plate (3). The synchronization position is obtained when the synchronization pin (2) enters the slot on the hydraulic rotor hub.
- Lock the control shaft in the correct position by means of the screw (1, Figure 95).
- Remove the synchronization pin and fit the screw cap of the plate (3). Tighten the cap using a torque of 2.3 ÷ 3.4 Nm.

NOTE Support the pump gear to prevent interference or sticking when the timing system gears turn.

Assembly

Figure 99

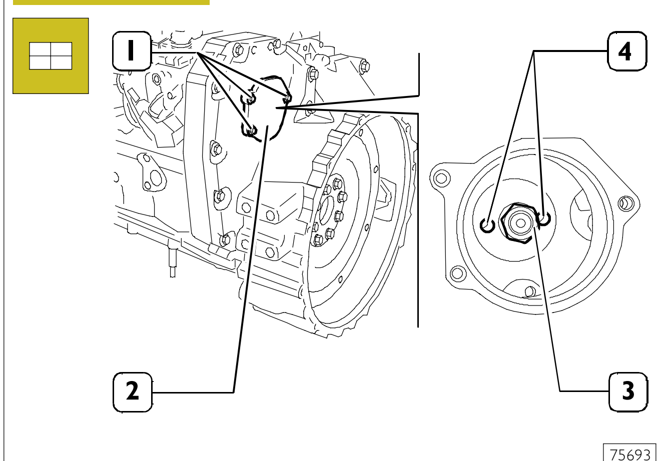


When installing supplì pump on engine, cylinder no.1 must be at TDC, end of compression phase.

- Assemble the pump pre-set in its housing on the engine, fitting the shaft into the gear port (not provided with wrench).
- Tighten the fixing nuts (1) locking the pump flange in the slot centre.

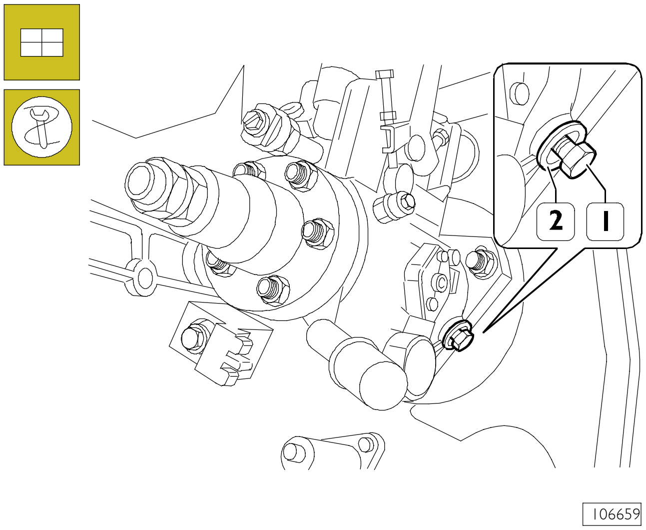
NOTE The gasket removed during pump disassembly shall not be utilised again.
Always use original spare parts.

Figure 100



- On the timing side, throughout the specially appointed port, fit the washer and screw up the fixing nut (3) to the pump shaft. Lock the nut to the 190-203 Nm couple.
- Assemble the cover (2) including gasket and tighten the screws (1).

Figure 101

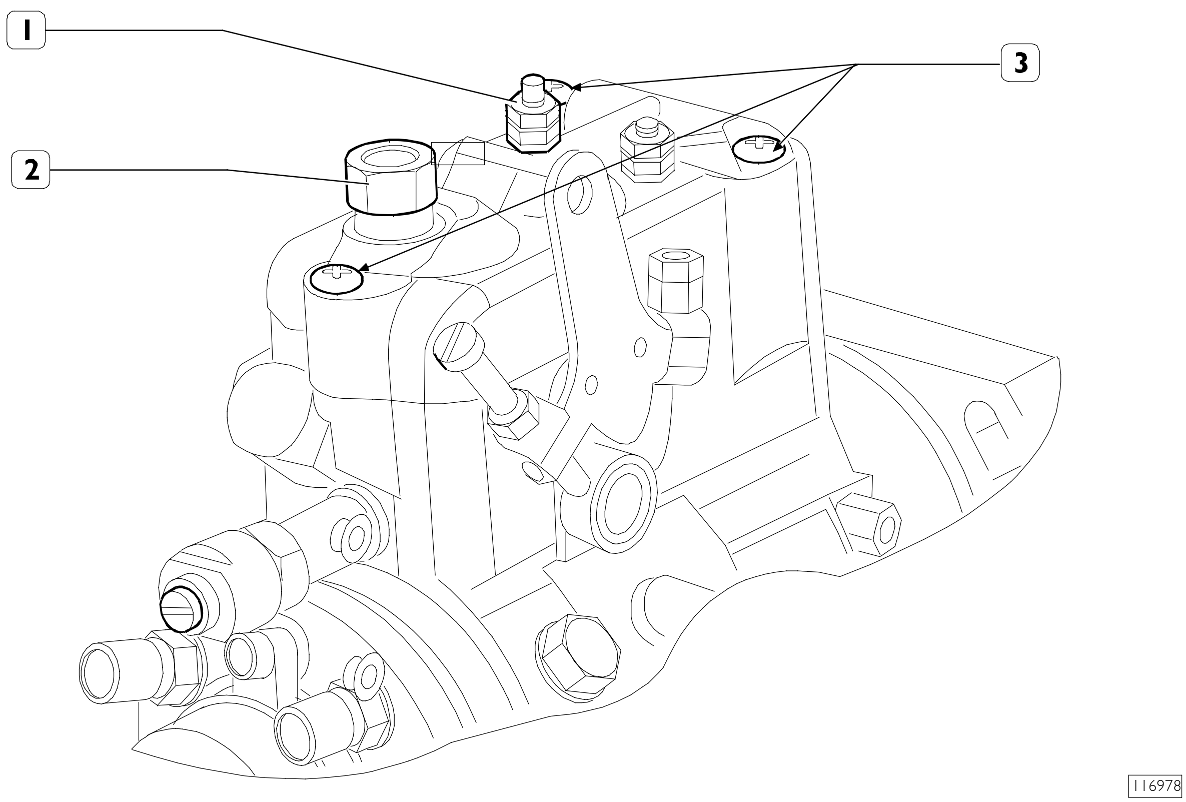


- ❑ - Svitare, senza rimuovere, la vite (1) di bloccaggio rotazione dell'alberino della pompa e spostare il distanziale con asola nella zona del foro di dimensioni minori. Avvitare fino a battuta la vite bloccando il suddetto distanziale: in questo modo l'alberino della pompa di alimentazione è libero di ruotare.
- ❑ Disassemble the flywheel rotation/locking tool 99360339 or 99360330; arrange the starting motor in its seat.
- ❑ Connect all the pipes (from the pumping elements to the injectors, recovering blow-by from the injectors to the pump and the supply from the priming pump).
- ❑ Connect the electrical connections.

NOTE In case pump removal has been carried out while the engine was assembled, connect acceleration cable.

ASSEMBLY PROCEDURE OF THE ”ADC100” ELECTRONIC ACTIVATOR ON STANADYNE SERIES ”D” INJECTION PUMPS

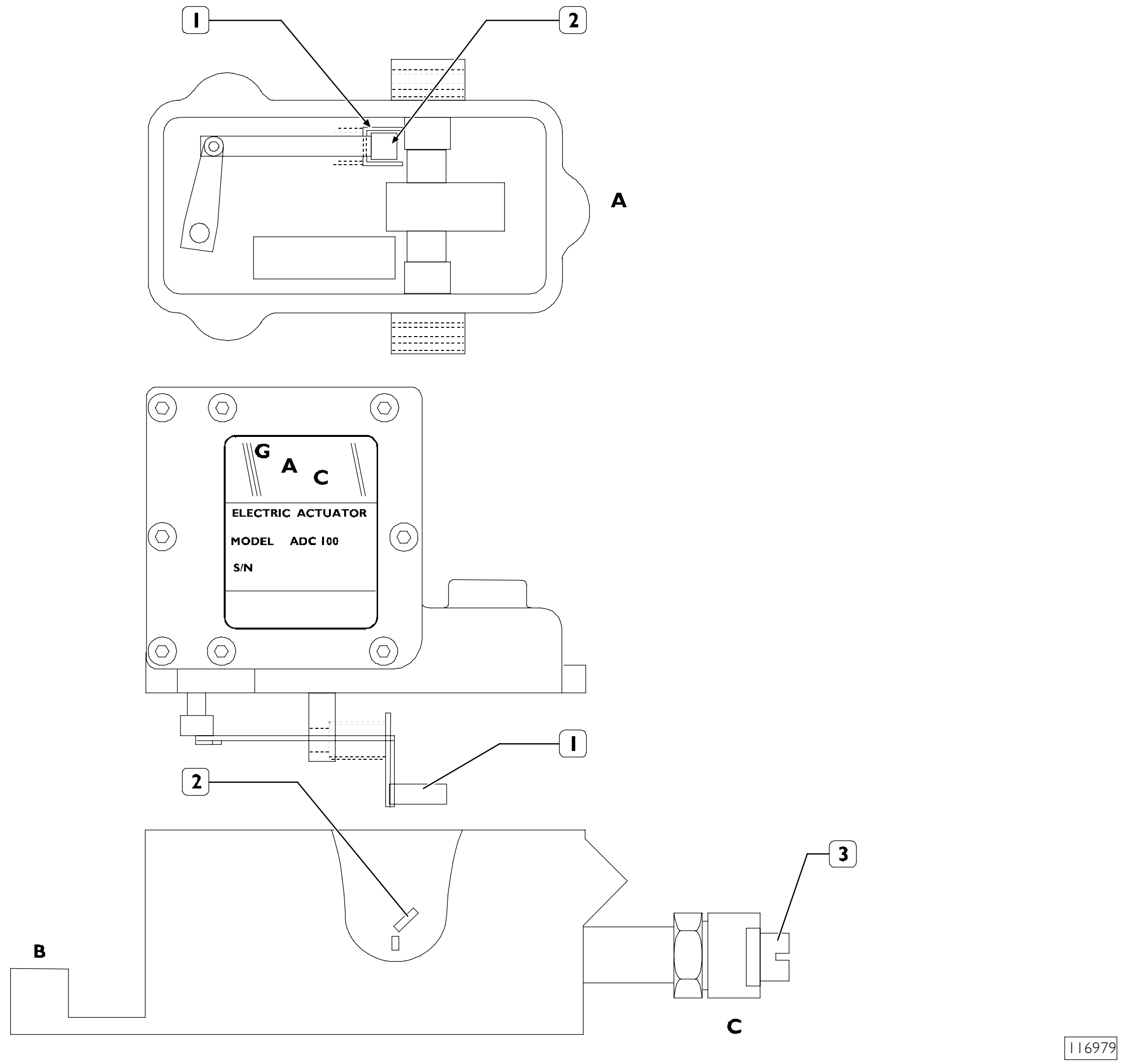
Figure 102



Before proceeding in the removal of the Injection Pump cover and then to the replacement with the electronic actuator, it is important to clean the external part of the pump, if necessary, using solvents. This prevents contamination of the internal part of the pump.

- Disconnect the wire of the stop electro-valve from the clamp (l) positioned on the pump cover, being careful to isolate it.
- Remove the fuel return pipe from the connection (2).
- Remove the three screws (3) of the pump cover. The screws will then be replaced assembling the screws supplied with the ADC100 actuator.
- Remove the cover of the injection pump very carefully so that the dirt won't penetrate inside the pump.
- Remove the connection (2) of the fuel return pipe and the sealing from the injection pump cover. Keep the connection (2) and the sealing that will have to be assembled on the electronic actuator.

Figure 103



A. The injection pump open seen from above - B. Front (carter side) - C Rear (injector side)
1. The "U" shaped hook of the electronic actuator- 2. Injection pump lever- 3. Droop adjustment screws

Assembly of the actuator

- Reassemble the connection forthe fuel return pipe and the pump cover's original dealing, on the ADC 100 electronic actuator.
- Position the electronic actuator on the injection pump with the highest part slightly titled upwards.
- Slide the electronic actuator towards the rear part of the pump (injectors' side) until the "U" shape hook (1) of the actuator engages the lever of the injection pump (2).Once engaged, align the holes of the pump and the electronic actuator.

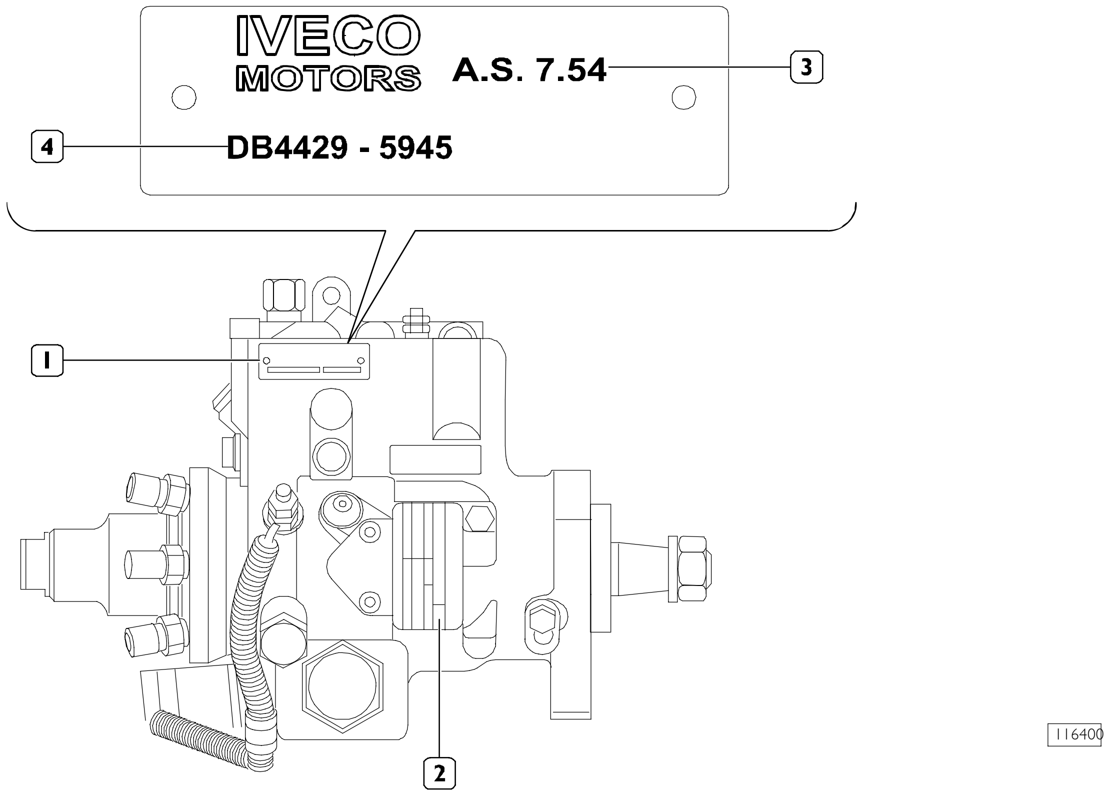
NOTE Couplings mistakes between the actuator's hook (1) and the lever (2) of the injection pump cancause motor over speed conditions.

- Tighten the ADC 100 actuator to the injection pump, using the screws supplied with the actuator.
- Reconnect the fuel return pipe to the connection placed on the actuator.

 Print P4D32N001 E

PASSAGE FROM 50 HZ TO 60 HZ FOR NEF MOTORS WITH STANADYNE PUMP

Figure 104



According to the specific needs of the motor employment it is possible that a request to vary the adjustment of the Stanadyne pump be made to obtain adifferent use frequency:

- 1500 rpm / 50 Hz
- 1800 rpm / 60 Hz

The necessary procedures will be described in order to execute the following adjustments:

- passage from 50 Hz to 60 Hz and vice versa.
- stabilizing of the rotation regime.

NOTE If only the Stanadyne identification tag (2) is present, this means that the injection pump presents a setting of 50 Hz.

In case of modification of the setting from 50 Hz to 60 Hz done in the factory, an identification tag (1) is applied by Iveco Motors.

On the Iveco Motors tag (I) reported are:

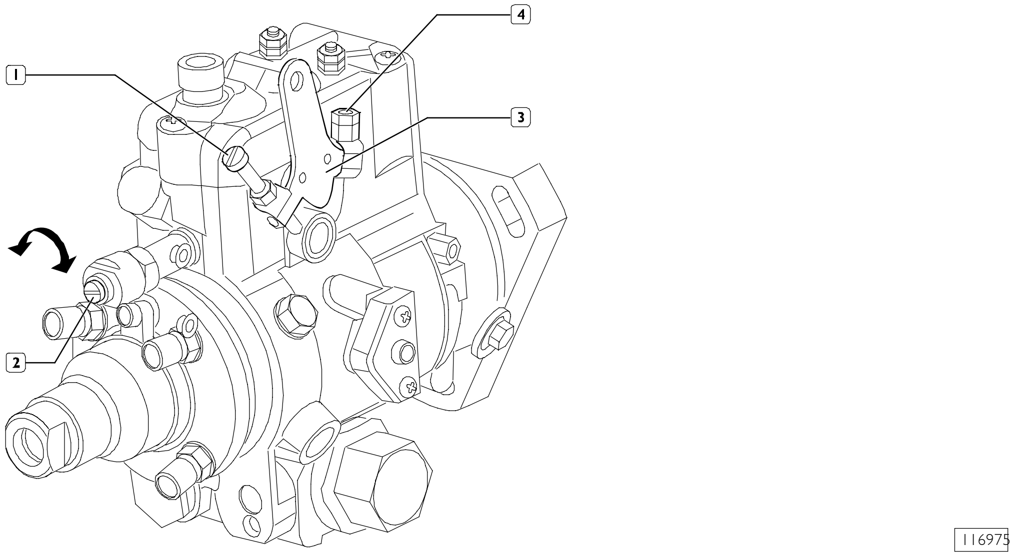
- the model of the injection pump (4);
- an identification code (3) of the specific application of the setting ofthe injection pump, forexample: A.S. 7.54 identifies the setting at 1800 rpm of 60 Hz.

Passage from 50 Hz to 60 Hz

To carry out the passage from 50 Hz to 60 Hz you must, first of all:

- identify the code of the injection pump from the Stanadyne tag (2).

Figure 105



Type of injection pump (Stanadyne tag)	Screw rotations at 50 Hz from the final position (clockwise)	Screw rotations at 60 Hz from the final position (clockwise)	Difference of rotations from 50 Hz to 60 Hz (clockwise)
DB 4629 - 5927	2	6	4
DB 4629 - 5932	2	9	7
DB 4629 - 5944	2.5	8.5	6
DB 4429 - 5945	3	6	3
DB 4429 - 5954	2	8.5	6.5
DB 4427 - 5955	3	9	6

- Act on the droop setting adjustment screw (2), rotating it clockwise the number of rotations indicated in the chart figure, starting from the position in which the screw is.

NOTE In case of doubt you can always unscrew the droop setting register screw (2) counter clockwise till you get to the final position - do not force it further in order to not damage the adjustment system. At this point, always referring to the chart figure, rotate the droop setting screw clockwise (2), the number of rotations indicated for the regime of 60 Hz from the final position.

- After starting the motor you must operate the maximum (l) and minimum (4) register screws in order to block the accelerator lever (3) in the position to obtain the desired regime, considering the frequency fall in the passage from empty to full of the motor (about 2 Hz).

If, for example, for a motor with an injection pump with code DB 4429 - 5945, originally set at 50 Hz, you want to pass to 60 Hz, it is sufficient to act on the droop setting adjustment screw (2) rotating it 3 times clockwise from the position in which it is, start the motor, loosen the adjustment screw of the maximum regime and accelerate with the accelerator lever, till you obtain the empty rotation regime equal to 62 Hz (l860 rpm),

- Then regulate the screw of the minimum regime (4) so to block the accelerator lever in the newly obtained position and finally block both adjustment screws (l and 4) using the appropriate lock nuts (tightening torque 3,5 - 4 Nm).

NOTE The adjustment screw of the minimum regime (4) does not allow the attainment of the minimum intended in the "classical" meaning of the term because the injection pump regulator imposes a superior rotation regime since it is about an injection pump for the application of a generator.

Passage from 60 Hz to 50 Hz

To pass from a 60 Hz regime to the 50 Hz regime, operate analogously to what seen above, remembering to act on the droop setting adjustment screw (2, Figure 105), rotating the same of 3 counter clockwise rotations from the position in which it is for the functioning at 60 Hz.

Stabilization of the rotation regime

In case of instability of the rotation regime, act on the droop setting adjustment screw (2, Figure 105) rotating lightly the same clockwise/counter clockwise till the stabilization of the motor rotation regime.

NOTE Attention! Some motors cannot undergo the passage from 50 Hz to 60 Hz and vice versa, as they need a specific injection pump to work at the required regimes.

Make reference to the SI 191 I "Service Information" to verify which motors cannot undergo the passage from 50 Hz to 60 Hz and vice versa.

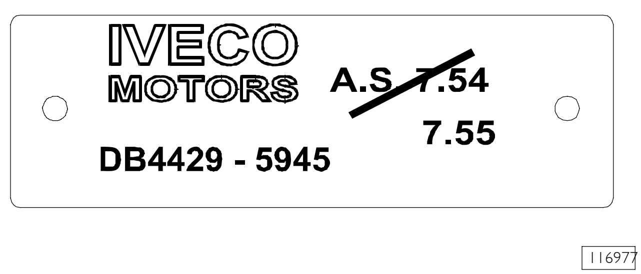
Identification tag

Figure 106

In case the Iveco Motors tag is not present because it is a motor with an injection pump that has a setting of 50 Hz, it is necessary to proceed in the application of a tag in the illustrated area as in Figure 4 stamping it as the figure example.

The blank tag can be ordered at the Part Replacement Service.

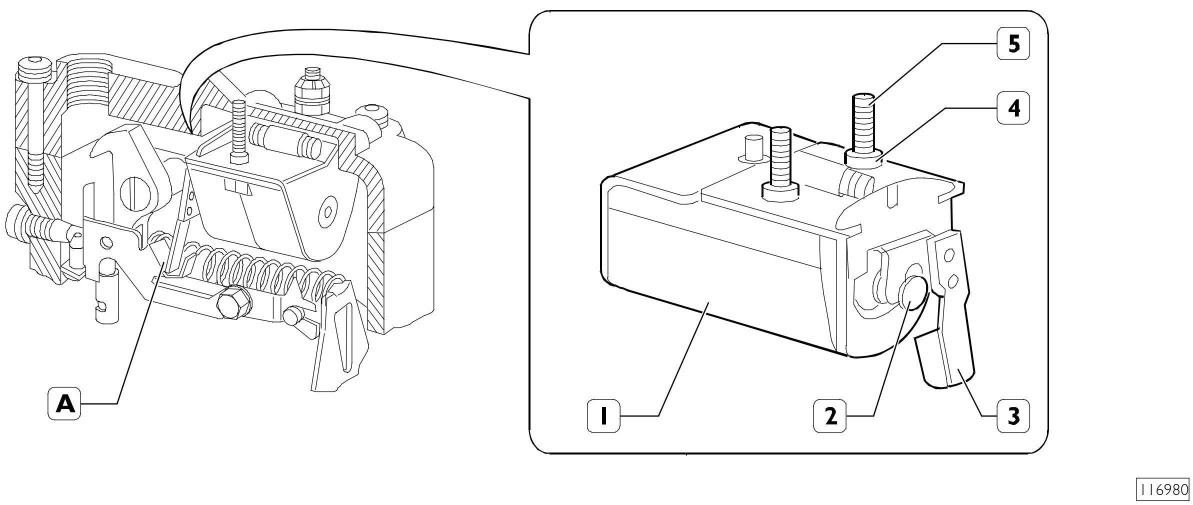
Figure 107



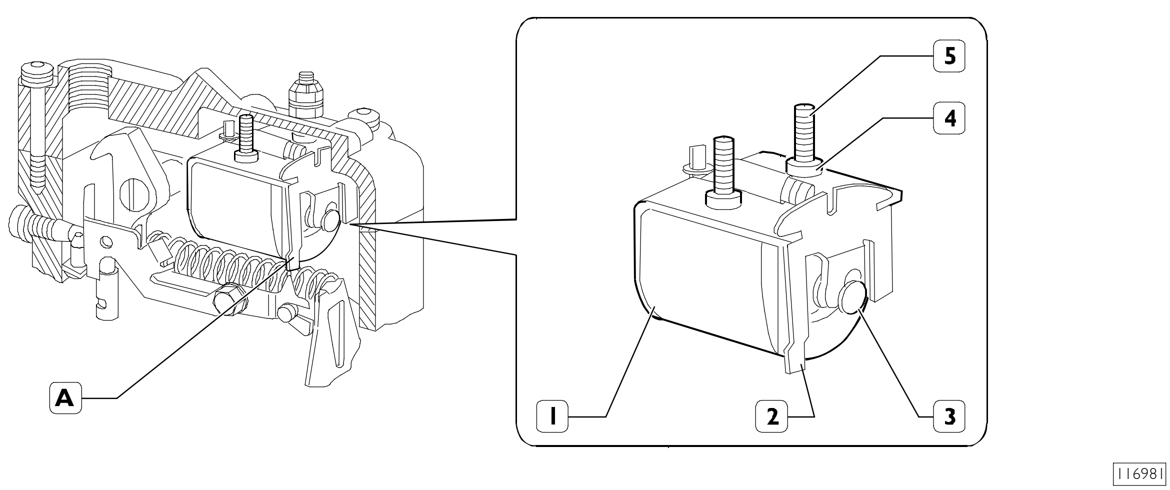
If the Iveco Motors tag is already on the injection pump, you must proceed stamping the new identification suffix of the newly obtained setting and strikethrough the identification of the preceding setting, as illustrated in the figure example.

REPLACEMENT OF THE ELECTRO-VALVE AND THE SOLENOID VALVE THROTTLE ON STANADYNE PUMPS

Figure 108



A. Position of the electro-valve arm - I. Encapsulated coil - 2. Mobile nucleus of the electro-valve -3. Electro-valve arm - 4. Isolator - 5. Solenoid valve ends



A. Position of the electro-valve arm - I. Encapsulated coil - 2. Mobile nucleus of the electro-valve -3. Electro-valve arm - 4. Isolator - 5. Solenoid valve ends

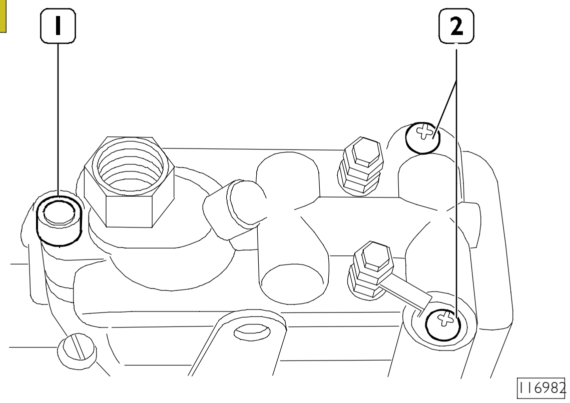
Two types of electro-valves can be used on Stanadyne injection pumps:

- ETR (Energize To Run)
- ETSO (Energize To Stop).

Please note, in the figure, the different assembling position of the electro-valve according to the ETR - ETSO functions.

Electro-valve replacement

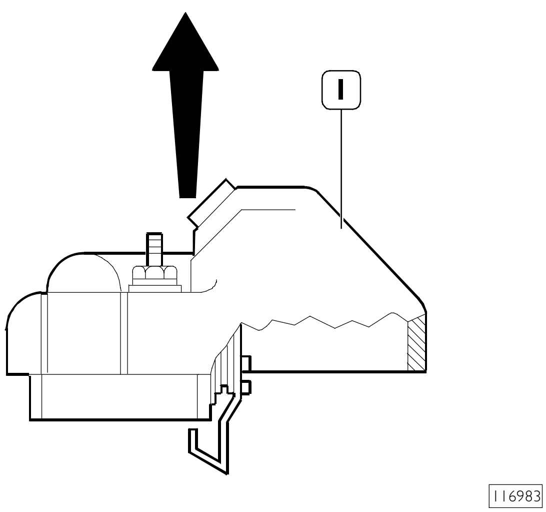
Figure 109



To replace the electro-valve remove the cover of the injection pump loosening and removing the three fixing screws (1 and 2) of the cover and the relative washers.

NOTE Check the state of wear of the rubber couplings.

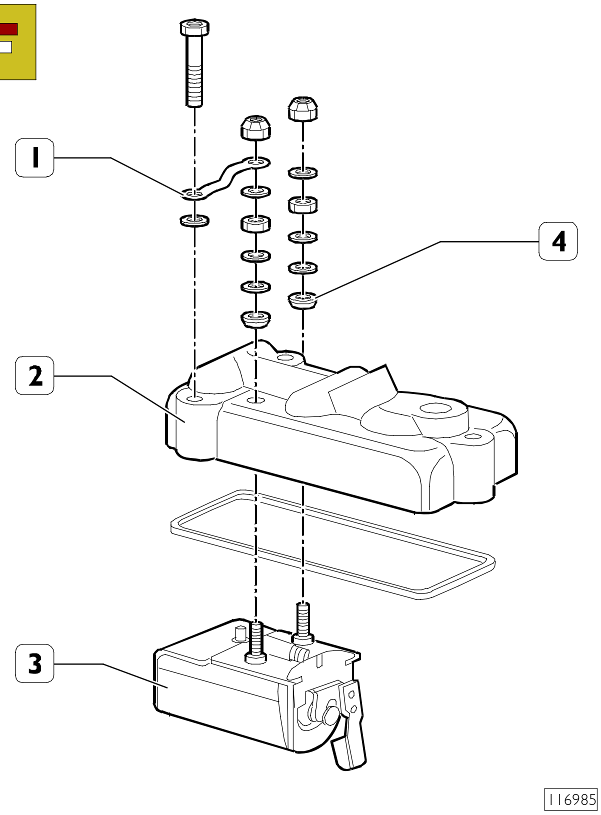
Figure 110



Remove the entire cover of the electro-valve (1), pulling it upwards perpendicularly to the injection pump.

Be careful that nothing falls into the injection pump.

Figure 111



Remove the electro-valve (3) from the cover (2).

NOTE Since the ends of the component are electrically isolated from the cover, make sure to remember the assembling order of the nuts, of the washers and of the components, for the electrical connection of the electro-valve ends; one end is earthed through an appropriate element (1). Pay attention to the position of the isolating element (4).

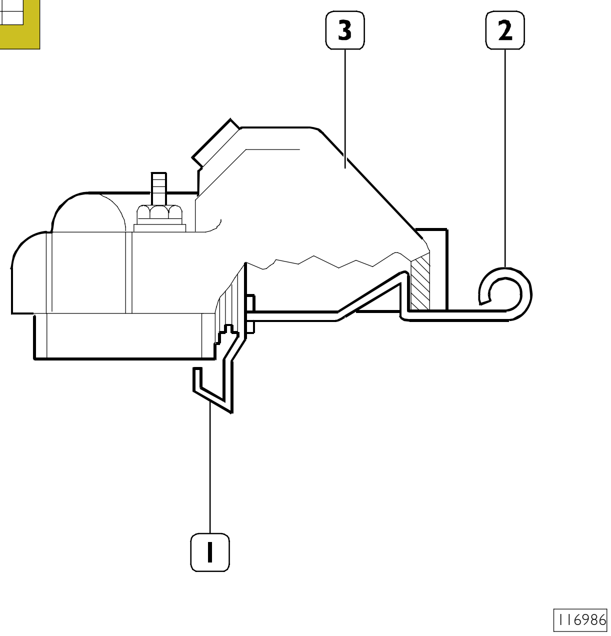
Assemble of the new electro-valve on the injection pump's cover, using the appropriate kits:

- 12 V-ETR
- 24 V-ETR
- 12 V-ETSO
- 24 V-ETSO

The kits contain the indicated type Check the state of wear of the rubber couplings. of electro-valve and all that is needed for its assembling.

The nuts fixing the electro-valve (3) to the cover (2) must be tightened to a 1, 1 ÷ 1,7 Nm torque.

Figure 112



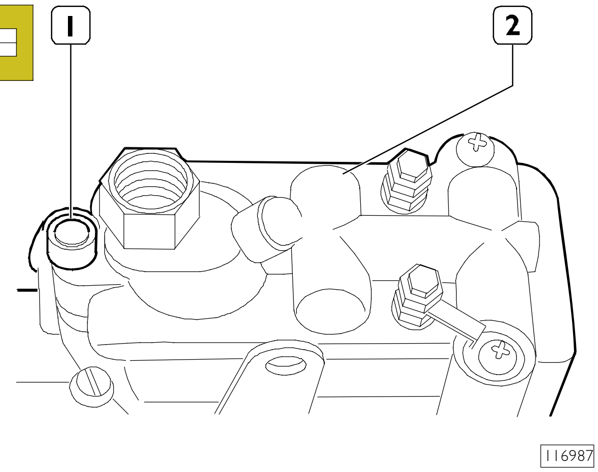
In the electro-valve **ETR** kit there is the joint tool (I) which must be used to position the electro-valve's arm (2) and to reassemble the cover on the injection pump.

NOTE This tool (I) allows to keep in the excitation position the arm of the electro-valve (2), allowing the correct assembling of the cover and avoiding dangerous over rotations at the starting of the motor.

Once the cover is put on the assembling seat and the relative screws are pointed on the injection pump, rotate the joint tool (I) and then pull it carefully from underneath the cover (3), making sure not to move or damage its sealing.

Then tighten the screws with a 4,0 ÷ 5,1 Nm tightening torque, making sure not to damage the connection earthed element of the electro-valve end.

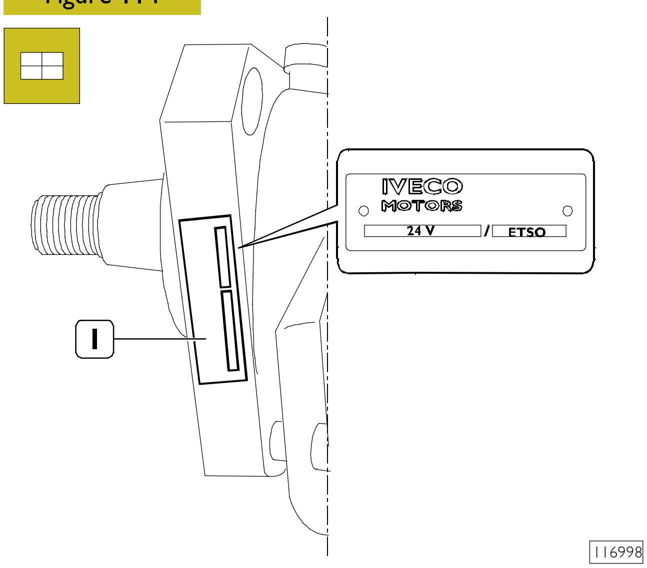
Figure 113



The repositioning of the cover (2) must be done proceeding in reverse to what described for its disassembling, making sure that it corresponds perfectly to the assembling seat without forcing it (for the ETR version the cover of the pump will correspond to the assembling seat only after the joint tool has been removed).

NOTE A blue seal is included in the kit and it has to be positioned on the screw (I), after the cover reassembling operations (2): when new, the seal is not blue.

Figure 114

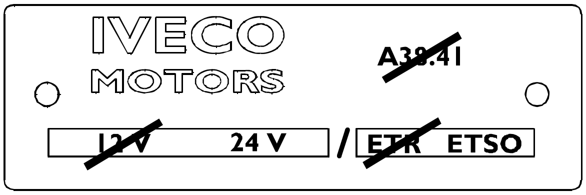


In case the original electro-valve should be replaced and its characteristics modified (different voltage, ETR instead of ETSO, eco), it is necessary the application of an identification tag (I) in the indicated place.

The tag must be stamped (I) as shown in details in the figure.

Print P4D32N001 E

Figure 115



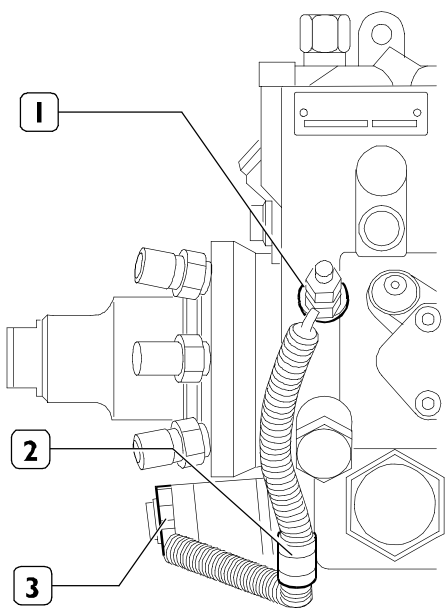
116989

In some cases the tag may already be present. If the tag is already present, it is necessary to strikethrough the old identification elements and stamping the new ones, as shown in the example in the figure.

The electro-valve and the solenoid valve throttle on the same injection pump, must have the same operating voltage, so in case of a change in the motor's operating voltage, both must be replaced.

Replacement of the solenoid valve throttle

Figure 116

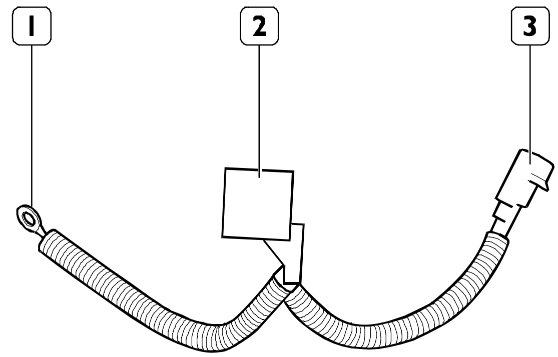


116990

Disconnect the linkage connector from the temperature sensor on the motor, and then remove the fixing nut of the socket clamp (2) and the nut (1) of the cable group end, so to release the electrical lead assembly of the solenoid valve throttle.

Remove the fixing nut (3) from the magnet and remove the component from its seat.

Figure 117



116991

Insert the connection cable socket (1) in the cable group end and screw the nut (1, Figure 116) tightening it to a 5, 7 ÷ 6,8 Nm torque.

Position the socket clamp (2, Figure 116) and screw the fixing nut tightening it to a 7, 9 ÷ 9, 0 Nm torque.

Position the magnet in its seat and screw the self-blocking fixing nut, supplied with the replacement kit, tightening it to a 5, 1 ÷ 5, 7 Nm torque.

NOTE The operating voltage of the device is easy to find looking at the colors of the supply wires of the solenoid:

- BLACK: forthe 12V device
- RED: for the 24V device

The electro-valve and the solenoid valve throttle on the same injection pump, must have the same operating voltage, so in case of a change in the motor's operating voltage, both must be replaced.

Checks and controls

The following tests shall be made after engine assembly.

Preventively check that the liquid levels have been correctly restored.

Start the engine, let it run at revolution regimen slightly higher than idling and wait that the cooling liquid temperature reaches the value enabling thermostat opening, then check that:

- no coolant leaks from the coupling sleeves of the cooling circuit piping, tightening the collars further if necessary.
- Carefully check the fuel connection pipes to the respective unions.
- There is no oil leakage from the lubrication circuit of the various pipelines connecting cover and.
- Cylinder head, oil pan and bearing, oil filter and heat exchanger as well as relating housings.
- There is no fuel leakage from fuel pipelines.
- Verify correct working of the lighting leds of the dashboard containing the tools as well as of the equipment that was disconnected during engine disconnection.
- Check and blow by with care the engine cooling system, carrying out frequent drainage.

Print P4D32N001 E

PART FOUR - MAINTENANCE PLANNING

MAINTENANCE PLANNING
Recovery

To ensure optimised working conditions, in the following pages we are providing instructions for the overhaul control interventions, checks and setting operations that must be performed on the engine at due planned dates.

The frequency of the maintenance operations is just an indication since the use of the engine is the main characteristic to determine and evaluate replacements and checks.

It is not only allowed but recommended that the staff in charge of the maintenance should also carry out the necessary maintenance and controlling operations even if not being included in the ones listed here below but that may be suggested by common sense and by the specific conditions in which the engine is run.

Planning of controls and periodical intervention

Controls and periodical intervention	Frequency (hours)
Visual check of engine	Daily
Check presence of water in fuel filter or pre-filter	Daily
Check of belt wear status	-
Check and setting of tappet clearance	4000
Replacement of engine's oil and filter	500
Replacement of fuel filter	500
Replacement of belt	1500

NOTE The maintenance operations are valid only if the setter fully complies with all the installation prescriptions provided by Iveco Motors.

Checks not included in maintenance planning-daily checks

It is a good habit to execute, before engine start, a series of simple checks that might represent a valid warranty to avoid inconveniences, even serious, during engine running. Such checks are usually up to the operators and to the vehicle's drivers.

- Level controls and checks of any eventual leakage from the fuel, cooling and lubricating circuits.

- Notify the maintenance if any inconvenience is detected of if any filling is necessary.

After engine start and while engine is running, proceed with the following checks and controls:

- check presence of any eventual leakage from the fuel, cooling and lubricating circuits.

- Verify absence of noise or unusual rattle during engine working.

- Verify, using the vehicle devices, the prescribed pressure temperature and other parameters.

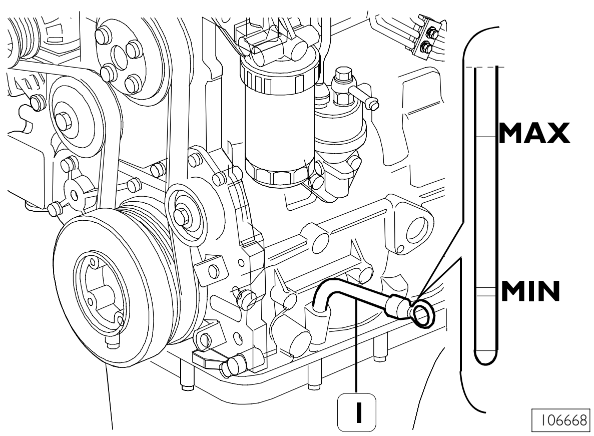
- Visual check of fumes (colour of exhaust emissions)

- Checking the coolant level.

MAINTENANCE PROCEDURES
Checks and controls

Engine oil level check.

Figure 118



The check must be executed when the engine is disconnected and possibly cool.

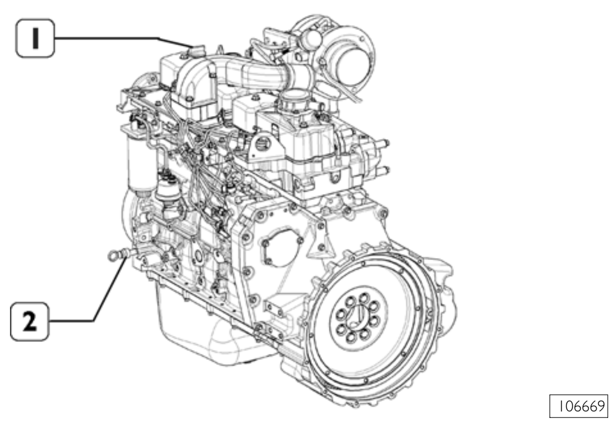
The check can be made using the specially provided flexible rod (1).

Draw off the rod from its slot and check that the level is within the etched tags of minimum and maximum level.

Whether it should be difficult to make the evaluation, proceed cleaning the rod using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.

In case the level results being close to the tag showing minimum level, provide filling lubrication of the engine's components.

Figure 119



To provide filling, operate through the upper top (1) or through the lateral top (2). During filling operation, the tops must be removed as well as the rod in order to make the oil flow easier".

The engine oil is highly polluting and harmful.
In case of contact with the skin, rinse well with water and detergent.

Adequately protect the skin and the eyes, operate in full compliance with safety regulations.

Disposal must be carried out properly, and in full compliance with the law and regulations in force.

Check of fuel system

The check must be executed both when the engine disconnected and when it is running.
The check is made by observing the fuel pipes from the tank to the fuel pump and to the injectors.

Cooling system check

The check must be executed both when the engine disconnected and when it is running.

Check the pipes from the engine to the radiator and vice versa; note any seepage and the state of the pipes especially near the coupling clamps.

Verify that the radiator is clean, the correct working of the fan flywheels, the presence of any leakage from the connectors, from the manifold and from the radiating unit.

Due to the high temperatures achieved by the system, do not operate immediately after the engine's disconnection, but wait for the time deemed necessary for the cooling.
Protect the eyes and the skin from any eventual high pressure jet of cooling liquid.

The density of the cooling liquid must be checked any how every year before winter season and be replaced in any case every two year.

NOTE If refilled, bleed the system as described on page 49.

If bleeding of the system is not carried out, serious inconvenience might be caused to the engine due to the presence of air pockets in the engine's head.

Lubricating system check

The check must be executed both when the engine disconnected and when it is running.

Verify the presence of any oil leakage or blow-by from the head, from the engine pan of from the heat exchanger.

The engine oil is highly polluting and harmful.
In case of contact with the skin, rinse well with water and detergent.

Adequately protect the skin and the eyes, operate in full compliance with safety regulations.

Disposal must be carried out properly, and in full compliance with the law and regulations in force.

Check for any water in the fuel filter

NOTE The components of the system can be damaged very quickly in presence of water or impurity within the fuel.

Take prompt action on the filter to drain off the water in the fuel circuit.

Fuel filter is equipped with pump screw-valve to drain the water eventually mixed with fuel.

Place a container underneath the filter and slightly loosen the screw. Drain the water eventually contained in the filter's bottom.

Lock the screw (max 0.5 Nm locking couple) as soon as fuel starts bleeding.

Check of drive belt tensioning

Some applications are equipped with an automatic tensioner that provides correcting belt tensioning.

Check of belt's tear and wear status

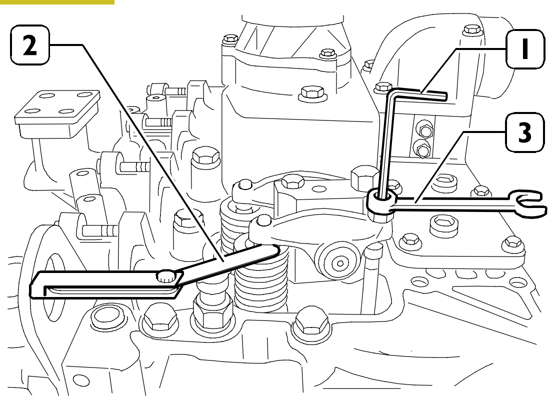
Carefully verify the belt's surface in order to detect any sign of incision, crack, excessive wear in correspondence of toothing; check end and surface grinding.

Danger: if the engine is switched off but is still hot, unexpected motion of the belt may occur.

Wait for engine temperature cooling as a precaution in order to avoid serious danger injury.

Check and setting of tappet clearance

Figure 120



75806

Adjust clearance between rockers and valves using setscrew wrench (1), box wrench (3) and feeler gauge (2).

Clearance shall be as follows:

- intake valves 0.25 ± 0.05 mm
- exhaust valves 0.50 ± 0.05 mm.

NOTE In order to more quickly perform the operating clearance adjustment for rocker arms – valves, proceed as follows:

rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

4 cylinder engine

Rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

Cylinder n.	1	2	3	4
Suction	-	-	*	*
Exhaust	-	*	-	*

Rotate the drive shaft, balance cylinder 4 valves and adjust the valves marked by the asterisk as shown in the table:

Cylinder n.	1	2	3	4
Suction	*	*	-	-
Exhaust	*	-	*	-

6 cylinder engine

Rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

Cylinder n.	1	2	3	4	5	6
Suction	-	-	*	-	*	*
Exhaust	-	*	-	*	-	*

Rotate the drive shaft, balance cylinder 6 valves and adjust the valves marked by the asterisk as shown in the table:

Cylinder n.	1	2	3	4	5	6
Suction	*	*	-	*	-	-
Exhaust	*	-	*	-	*	-

Print P4D32N001 E

Oil motor and filter replacement

Warning: We recommend to wear proper protections because of high motor service temperature.

The motor oil reaches very high temperature: you must always wear protection gloves.

We recommend to carry out the oil drainage when the motor is hot.

- Place a proper container for the oil collecting under the pan connected with the drain plug.
- Unscrew the plug and then take out the control dipsick and the inserting plug to ease the downflow of the lubrication oil.

The oil motor is very pollutant and harmful.

In case of contact with the skin, wash with much water and detergent.

Protect properly skin and eyes: operate according to safety rules.

Dispose of the residual properly following the rules.

- After the complete drainage, screw the plug and carry out the clean oil filling.

Use only the recommended oil or oil having the requested features for the corrrect motor functioning.

In case of topping up, don't mix oils having different features.

If you don't comply with theses rules, the service warranty is no more valid.

- Check the level through the dipsick until when the filling is next to the maximum level notch indicated on the dipsick.

Whereas you replace the lubrication oil, it is necessary to replace the filter.

- The filter is composed by a support and a filtering cartridge. For the cartridge replacement use the 9936076-tool.

Warning: the oil filter contains inside a quantity of oil of about 1 kg.

Place properly a container for the liquid.

Warning: avoid the contact of skin with the motor oil: in case of contact wash the skin with running water.

The motor oil is very pollutant: it must be disposed of according to the rules.

- Replace the filtering cartidge with a new one and screw manually until when the gasket is in contact with the support.
- Tigthen by means of the 99360076-tool of three fourth turn.
- Operate the motor for some minutes and check the level through the dipsick again. If it is necessary, carry out a topping up to compensate the quantity of oil used for the filling of the filtering cartridge.

Changing the coolant

- Position a container beneath the radiator tap to recover the coolant.
- Open the tap and allow all the coolant in the radiator to flow out.
- Charge the coolant for the first time.
- Leave the radiator cap open.
- Start the engine and leave it running for at least a minute so that all the air in the circuit is completely removed.
- Stop the engine.
- Top up.

NOTE If the procedure described is not followed, the radiator fluid level will be incorrect.

Fuel filter replacement

During this operation don't smoke and don't use free flames.

Avoid to breathe the vapors coming from filter.

NOTE After filters replacement the supply equipment deaeration must be carried out.

However the following operations are valid for all applications.

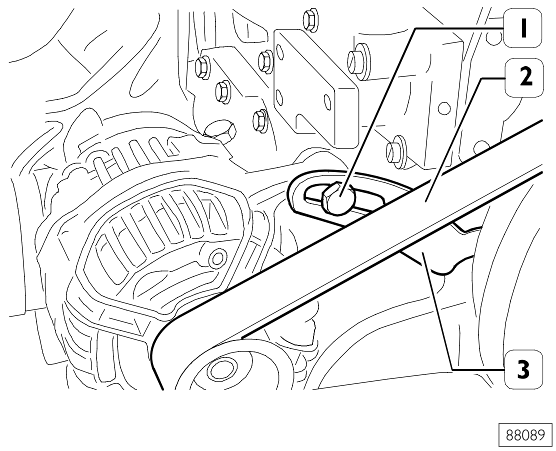
- ❑ Drain the fuel inside the filter by operating the water release screw. Collect the fuel in a container without impurities.
- ❑ Unscrew the cartridge by using the 99360076-tool.
- ❑ Collect the eventual fuel inside the filtering cartridge.
- ❑ Clean the gasket seat on the support and oil slightly the gasket on the new filtering cartridge.
- ❑ Screw manually the new filtering cartdrige until when the gasket is completely on its seat.
- ❑ Tigthen through the 99360076-tool at 10-5 Nm torque.

Alternator belt replacement

Warning: with switched off motor (but still hot) the belt can operate without advance notice.

Wait for the motor temperature lowering to avoid very serious accidents.

Figure 121



- ❑ Loosen screw (1) and the relevant nut on belt stretching bracket (3).
- ❑ Loosen the bolt that fixes the alternator to the support.
- ❑ Remove the worn Poly-V belt (2) from the pulleys and driving rollers.
- ❑ Fit the new Poly-V belt (2) onto the pulleys and driving rollers.
- ❑ Fit the new POLY-V belt (2) on the pulleys and guide rollers.
- ❑ Stretch POLY-V belt (2).
- ❑ Lock screw (1) and the bolt that fixes the alternator to the support
- ❑ Run the engine for a few hours and check proper belt stretching.

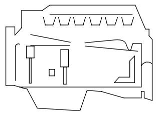
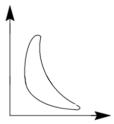
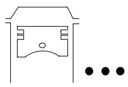
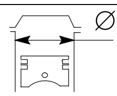
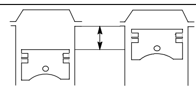
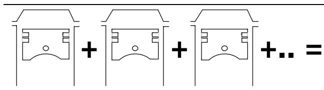
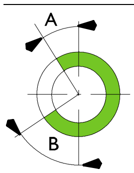
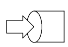
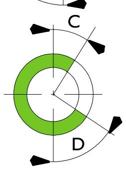
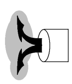
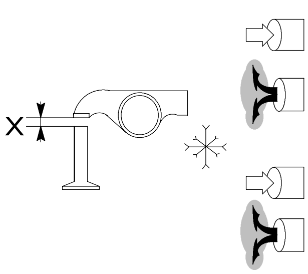
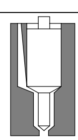
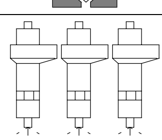
 Print P4D32N001 E

SECTION 4

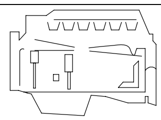
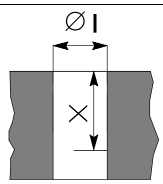
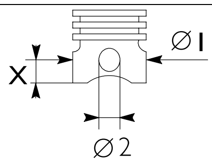
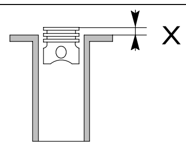
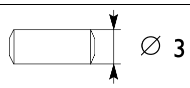
Overhaul and technical specifications

Page

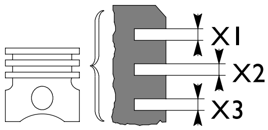
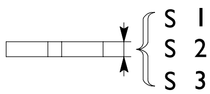
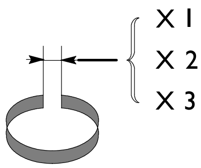
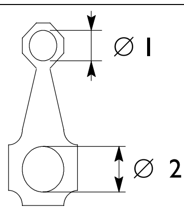
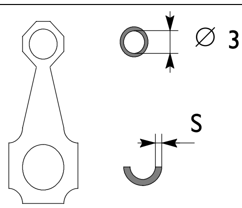
GENERAL SPECIFICATIONS

	Type		**4 CYLINDERS**	**6 CYLINDERS**
	Cycle		Four-stroke diesel engine	
	Power		Supercharged with intercooler	
	Injection		Direct	
	Number of cylinders		4 in-line	6 in-line
	Bore	mm	104	
	Stroke	mm	132	
	Total displacement	cm^3	4553	6728
	**TIMING**			
	start before T.D.C. end after B.D.C.	A B	15° 35°	
 	start before B.D.C. end after T.D.C.	D C	69° 21°	
	Checking timing			
		mm	-	
	X	mm	-	
	Checking operation			
		mm	0.25 to 0.05	
	X	mm	0.50 to 0.05	
	FUEL FEED			
	Injection Type:	rotary	STANADYNE DB 4	
	Nozzle type		DSLA 145 P	
	Injection sequence		1 - 3 - 4 - 2	1 - 5 - 3 - 6 - 2 - 4

CLEARANCE DATA

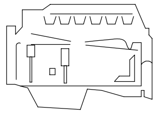
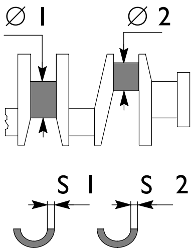
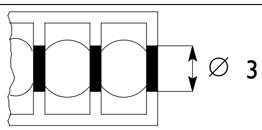
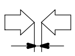
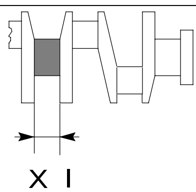
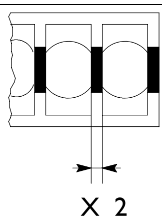
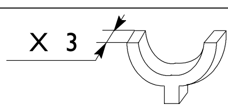
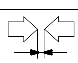
	Type		4 CYLINDERS	6 CYLINDERS
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm	
	Cylinder barrels	Ø1 > Ø1	104.000 to 104.024 0.4	
	Pistons: Size Outside diameter Pin housing	 X Ø 1 Ø 2	55.9 / 52.4 (•) 103.714 ÷ 103.732 / 103.755 ÷ 103.733 (•) 38.010 to 38.016	
>	Piston diameter	Ø 1	0.4	
	Piston protrusion	X	0.28 to 0.52	
	Piston pin	Ø 3	37.994 to 38.000	
	Piston pin – pin housing		0.010 to 0.022	

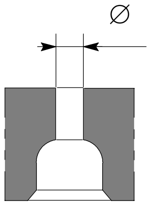
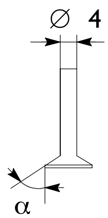
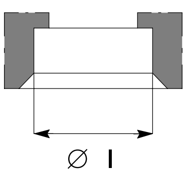
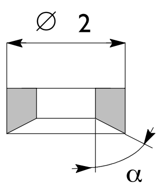
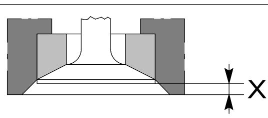
(•) Applicable to F4GE0405 engines only

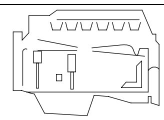
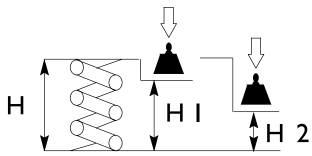
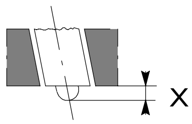
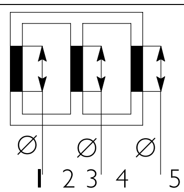
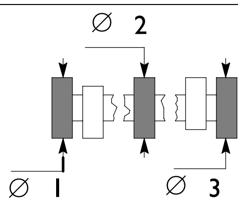
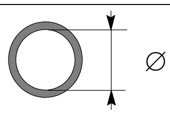
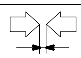
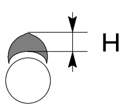
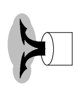
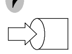
	Type		4 CYLINDERS	6 CYLINDERS
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm	
	Split ring slots * measured on a ∅ of 99.00 mm	X1* X 2 X 3	2.705 to 2.735* / 2.600 to 2.620 (•) 2.440 to 2.460 / 2.550 to 2.570 (•) 4.030 to 4.050	
	Split rings	S 1* S 2 S 3	3.000 (••) / 2.470 to 2.500 (•) 2.350 to 2.380 / 2.478 to 2.490 (•) 3.970 to 3.990	
	Split rings - slots	1 2 3	- / 0.100 to 0.150 (•) 0.060 to 0.110 / 0.060 to 0.092 (•) 0.040 to 0.080	
IVECO PARTS	Split rings		0.4	
	Split ring end opening in cylinder barrel:	X 1 X 2 X 3	0.30 to 0.45 / 0.25 to 0.55 (•) 0.60 to 0.80 / 0.30 to 0.55 (•) 0.30 to 0.55	
	Small end bush housing Big end bearing housing	∅ 1 ∅ 2	40.987 to 41.013 72.987 to 73.013	
	Small end bush diameter Inside Spare big end half bearings	∅ 3 S	38.019 to 38.033 2.205 to 2.218	
	Piston pin – bush		0.019 to 0.039	
IVECO PARTS	Big end half bearings		0.250; 0.500	

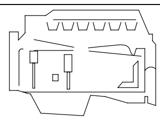
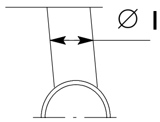
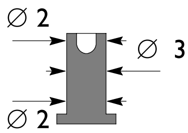
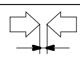
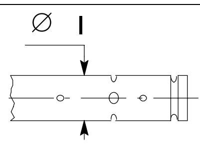
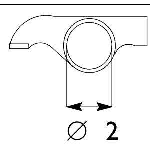
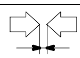
(•) Applicable to F4GE0405 engines only

(••) Nominal dimension

<table>
<tr><td></td><td colspan="2">Type</td><td>4 CYLINDERS</td><td>6 CYLINDERS</td></tr>
<tr><td colspan="3">CYLINDER UNIT AND CRANKSHAFT COMPONENTS</td><td colspan="2">mm</td></tr>
<tr><td rowspan="2"></td><td>Journals
Crankpins</td><td>∅ 1
∅ 2</td><td colspan="2">82.99 to 83.01
68.987 to 69.013</td></tr>
<tr><td>Main half bearings
Big end half bearings</td><td>S 1
S 2</td><td colspan="2">2.456 to 2.464
1.955 to 1.968</td></tr>
<tr><td></td><td>Main bearings
No. 1–5 / 1-7
No. 2–3–4 / 2-3-4-5-6</td><td>
∅ 3
∅ 3</td><td colspan="2">87.982 to 88.008
87.977 to 88.013</td></tr>
<tr><td rowspan="2"></td><td>Half bearings – Journals
No. 1–5 / 1-7
No. 2–3–4 / 2-3-4-5-6</td><td></td><td colspan="2">0.064 to 0.095
0.059 to 0.100</td></tr>
<tr><td>Half bearings - Crankpins</td><td></td><td colspan="2">0.033 to 0.041</td></tr>
<tr><td>IVECO PARTS</td><td>Main half bearings
Big end half bearings</td><td></td><td colspan="2">0.250; 0.500</td></tr>
<tr><td></td><td>Shoulder journal</td><td>X 1</td><td colspan="2">37.475 to 37.545</td></tr>
<tr><td></td><td>Shoulder main bearing</td><td>X 2</td><td colspan="2">32.180 to 32.280</td></tr>
<tr><td></td><td>Shoulder half-rings</td><td>X 3</td><td colspan="2">37.28 to 37.38</td></tr>
<tr><td></td><td>Output shaft shoulder</td><td></td><td colspan="2">0.095 to 0.265</td></tr>
</table>

	Type		4 CYLINDERS	6 CYLINDERS
CYLINDER HEAD – TIMING SYSTEM			mm	
	Valve guide seats on cylinder head	∅ 1	8.019 to 8.039	
	Valves:			
		∅ 4 α	7.960 to 7.980 60°	
		∅ 4 α	7.960 to 7.980 45°	
	Valve stem and guide		0.039 to 0.076	
	Housing on head for valve seat:			
		∅1	46.987 to 47.013	
		∅1	43.637 to 43.663	
	Valve seat outside diameter; valve seat angle on cylinder head:			
		∅ 2 α	47.063 to 47.089 60°	
		∅ 2 α	43.713 to 43.739 45°	
	Sinking	X	0.356 to 1.102	
		X	0.104 to 0.840	
	Between valve seat and head		0.050 to 0.102	
			0.050 to 0.102	
IVECO PARTS	Valve seats		-	

	Type		4 CYLINDERS	6 CYLINDERS
CYLINDER HEAD – TIMING SYSTEM			mm	
	Valve spring height: free spring under a load equal to: 329 N 641 N	 H H1 H2	 63.50 49.02 38.20	
	Injector protrusion	X		
	Camshaft bush housings No. 1 (flywheel side) Camshaft housings No. 2-3-4-5/2-3-4-5-6-7		59.222 to 59.248 54.089 to 54.139	
	Camshaft journals: 1 ⇒ 5 1 ⇒ 7	 Ø Ø	53.995 to 54.045	
	Bush inside diameter	Ø	54.083 to 54.147	
	Bushes and journals		0.038 to 0.162	
	Cam lift:  	 H H	 11.02 10.74	

	Type	**4 CYLINDERS**	**6 CYLINDERS**
CYLINDER HEAD – TIMING SYSTEM		mm	
	Tappet cap housing on block Ø 1	16.000 to 16.030	
	Tappet cap outside diameter: Ø 2 Ø 3	15.929 to 15.959 15.965 to 15.980	
	Between tappets and housings	-	
IVECO PARTS	Tappets	-	
	Rocker shaft Ø 1	18.963 to 18.975	
	Rockers Ø 2	19.000 to 19.026	
	Between rockers and shaft	0.025 to 0.063	

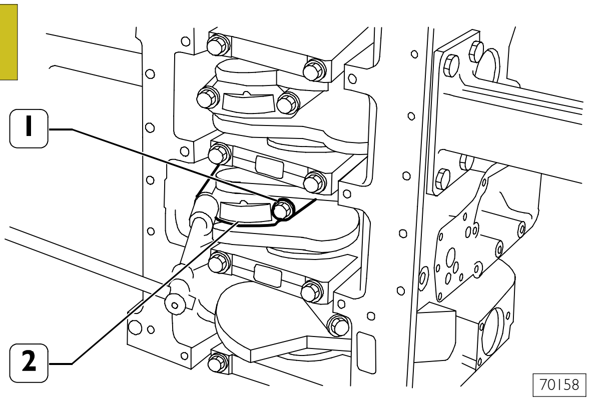
ENGINE OVERHAUL
ENGINE REMOVAL AT THE BENCH

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.

The following operations are relating to the 6 cylinders engine but are analogously applicable for the 4 cylinders.

Figure 1

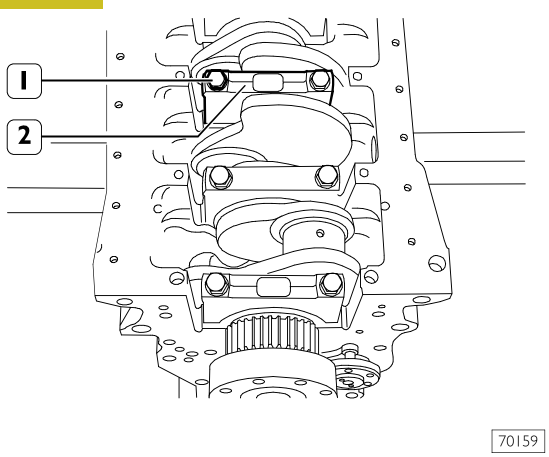


Remove the screws (1) fastening the connecting rod caps (2) and remove them.

Withdraw the pistons including the connecting rods from the top of the engine block.

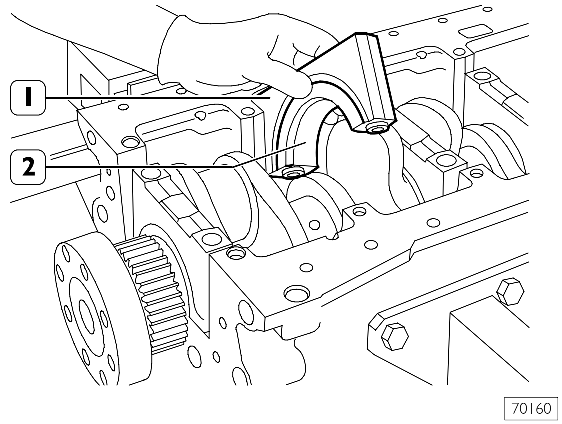
NOTE Keep the half-bearings into their housings since in case of use they shall be fitted in the same position found at removal.

Figure 2



Remove the screws (1) and the main bearing caps (2).

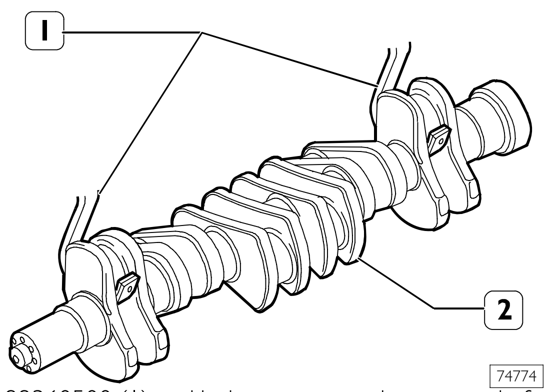
Figure 3



The second last main bearing cap (1) and the relevant support are fitted with shoulder half-bearing (2).

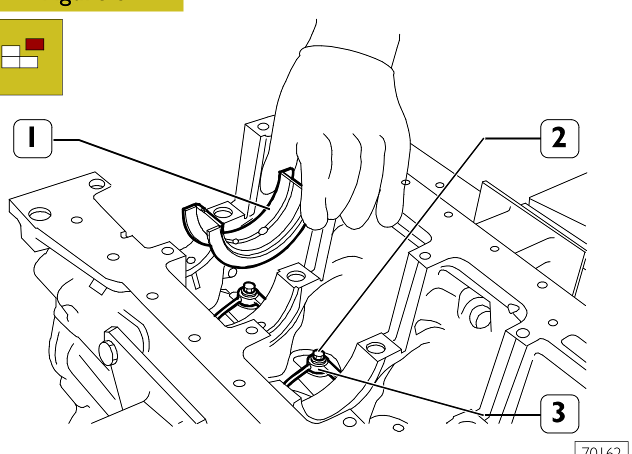
NOTE Take note of lower and upper half-bearing assembling positions since in case of reuse they shall be fitted in the same position found at removal.

Figure 4



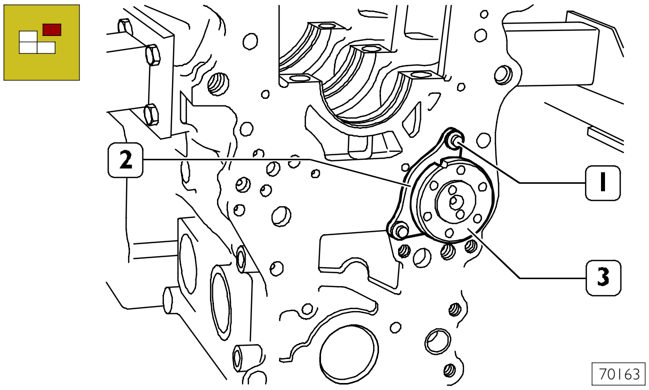
Use tool 99360500 (1) and hoist to remove the output shaft (2) from the block.

Figure 5



Remove the main half-bearings (1).
Remove the screws (2) and remove the oil nozzles (3).

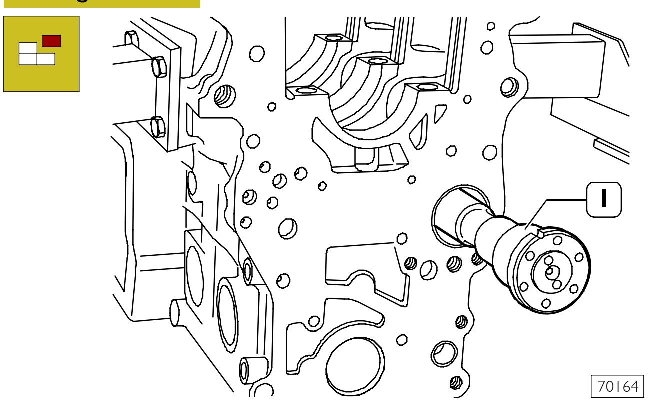
Figure 6



Remove the screws (1) and disconnect camshaft (3) retaining plate (2).

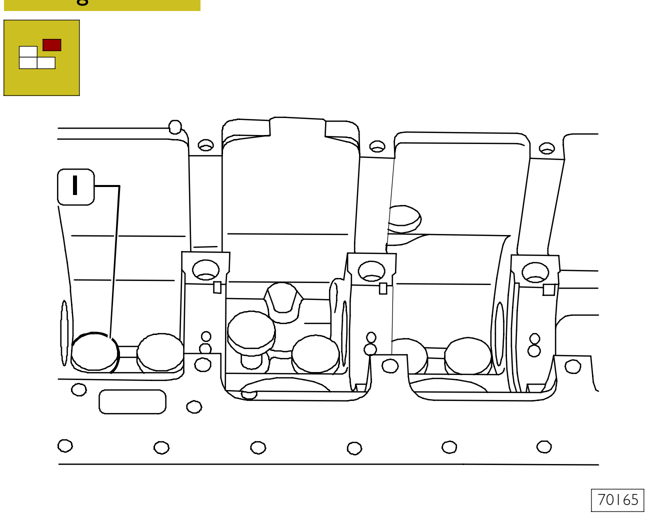
NOTE Take note of plate (2) assembling position.

Figure 7



Withdraw carefully the camshaft (1) from the engine block.

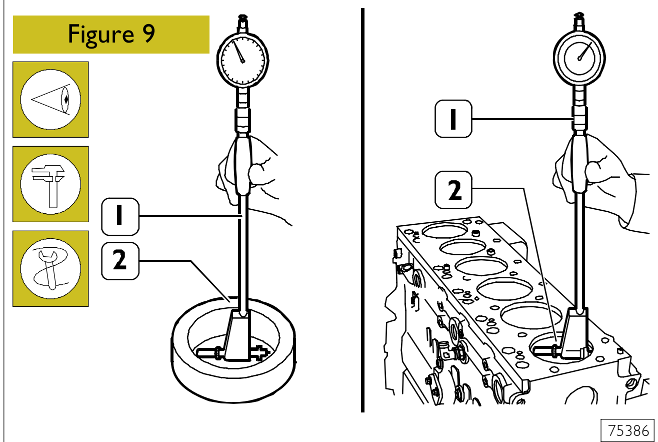
Figure 8



Withdraw the tappets (1) from the engine block.

REPAIR OPERATIONS
CYLINDER UNIT
Checks and measurements

Figure 9



Once engine is disassembled, clean accurately the cylinder-block assembly.
Use the proper rings to handle the cylinder unit.

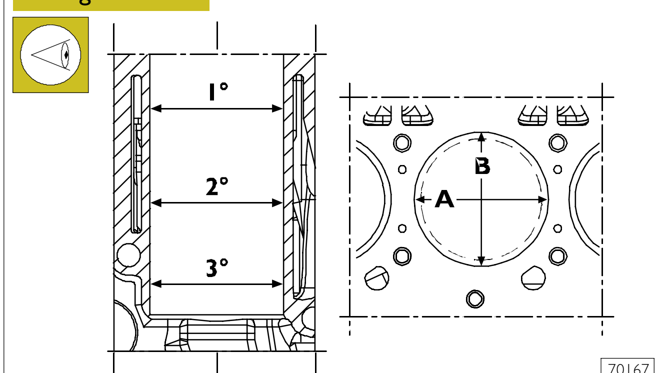
The engine block shall not show cracks.
Check operating plug conditions and replace them in case of uncertain seal or if rusted.

Inspect cylinder barrel surfaces; they shall be free from seizing, scores, ovalisation, taper or excessive wear.

Inspection of cylinder barrel bore to check ovalisation, taper and wear shall be performed using the bore dial gauge (1) fitted with the dial gauge previously set to zero on the ring gauge (2) of the cylinder barrel diameter.

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

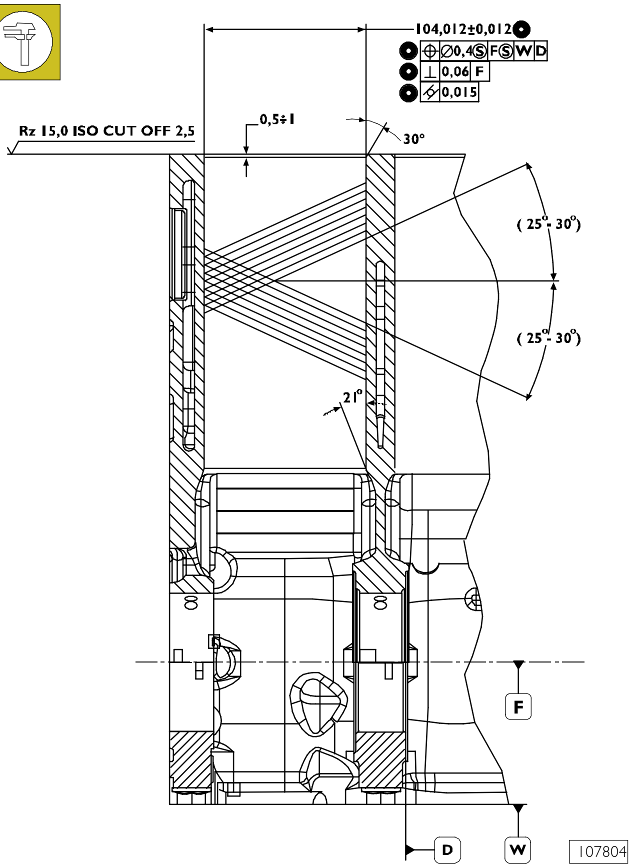
Figure 10



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

Should ovalisation, taper or wear be found, bore and grind the cylinder barrels. Cylinder barrel regrinding shall be performed according to the spare piston diameter oversized by 0.5 mm and to the specified assembling clearance.

Figure 11



NOTE In case of regrinding, all barrels shall have the same oversize (0.4 mm).

Check main bearing housings as follows:

- fit the main bearings caps on the supports without bearings;
- tighten the fastening screws to the specified torque;
- use the proper internal gauge to check whether the housing diameter is falling within the specified value.

Replace if higher value is found.

Checking head supporting surface on cylinder unit

When finding the distortion areas, replace the cylinder unit.

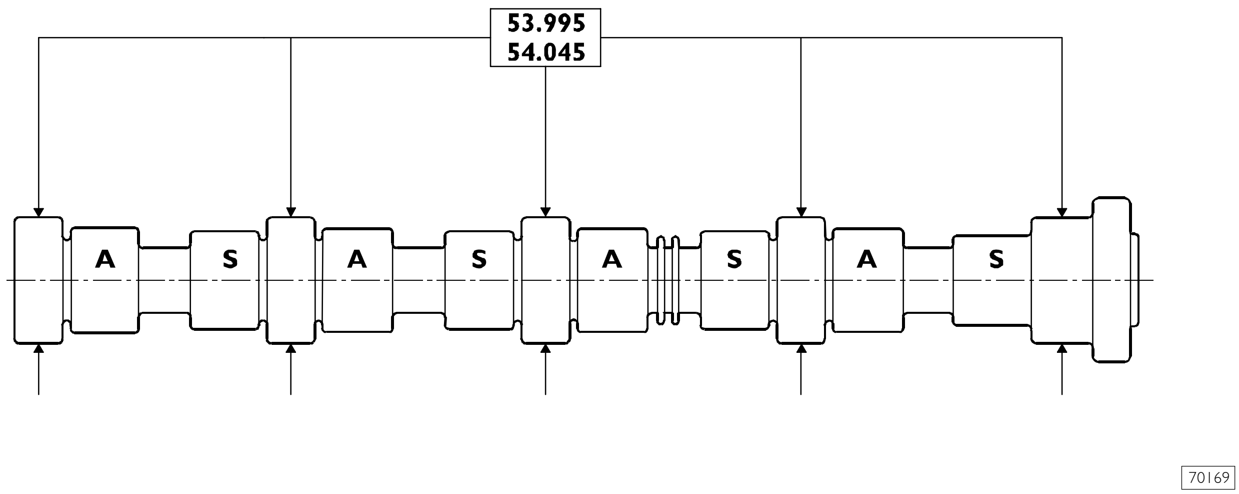
Planarity error shall not exceed 0.075 mm.

Check cylinder unit operating plug conditions, replace them in case of uncertain seal or if rusted.

Print P4D32N001 E

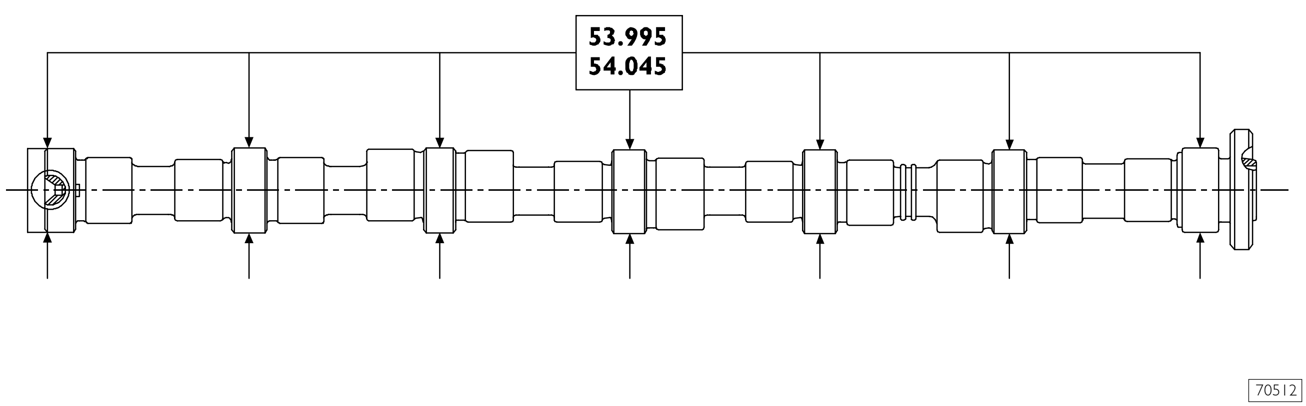
TIMING SYSTEM
Camshaft

Figure 12



CAMSHAFT MAIN DATA
Specified data refer to pin standard diameter

Figure 13



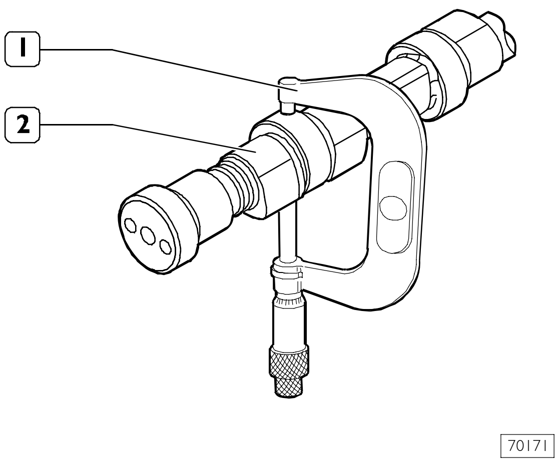
MAIN DATA ABOUT CAMSHAFT PINS

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

Checking cam lift and pin alignment

Set the camshaft on the tailstock and using a 1/100 gauge set on the central support, check whether the alignment error is not exceeding 0.04 mm, otherwise replace the camshaft.

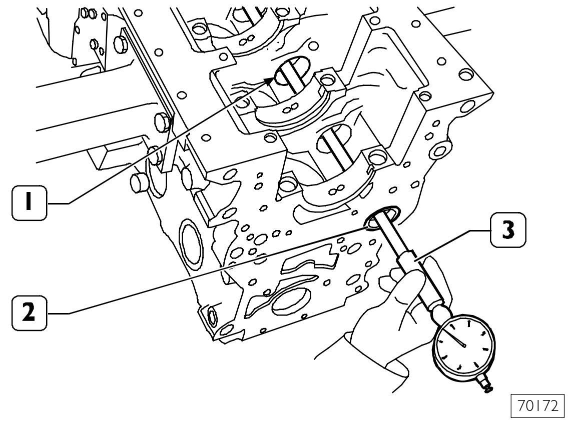
Figure 14



Check camshaft (2) pin diameter using micrometer (1) on two perpendicular axes.

BUSHES

Figure 15



The camshaft bushing (2) must be forced into its seat.

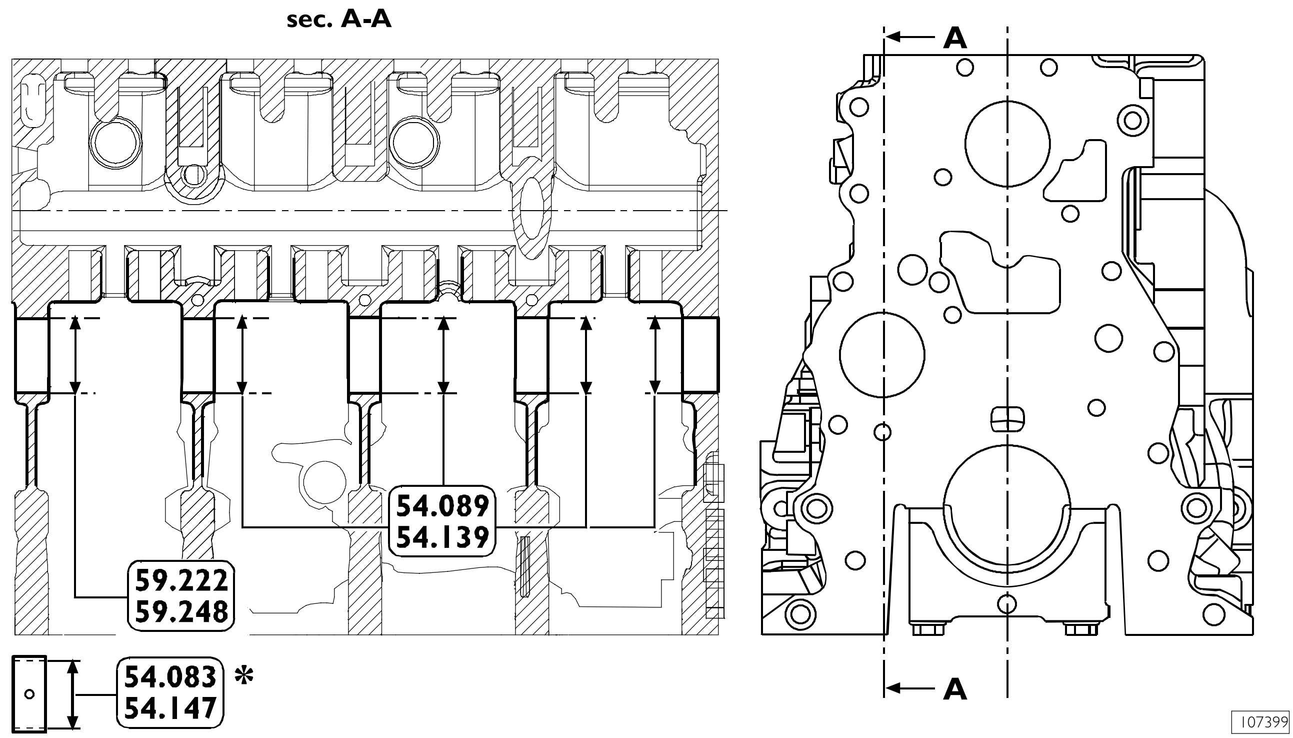
Internal surfaces must not show seizing or wear.

Using a bore gauge (3), measure the diameter of the bushing (2) and of the intermediate seats (1) for the camshaft.

Measurements shall be performed on two perpendicular axes.

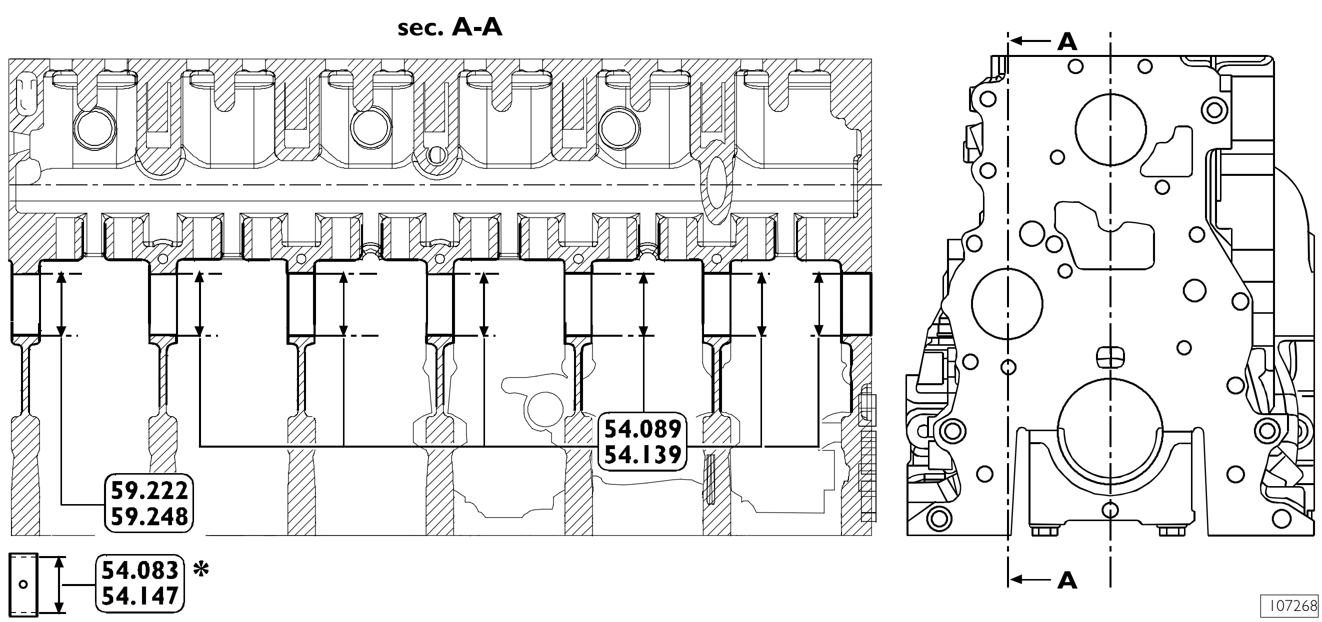
Print P4D32N001 E

Figure 16



MAIN DATA OF BUSHING FOR CAMSHAFT AND ASSOCIATED SEAT (4 cylinders)
* Measurement to make after fitting the bushing.

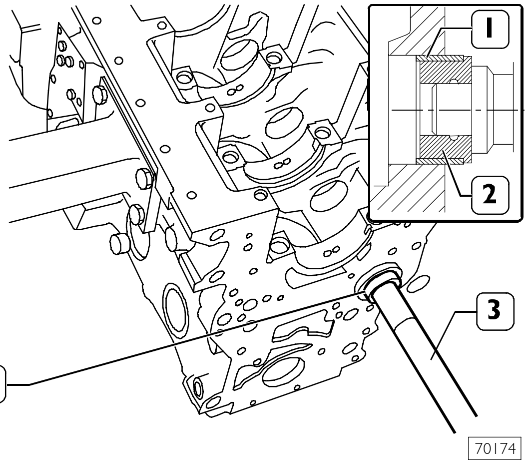
Figure 17



MAIN DATA OF BUSHING FOR CAMSHAFT AND ASSOCIATED SEAT (6 cylinders)
* Measurement to make after fitting the bushing.

Bush replacement

Figure 18

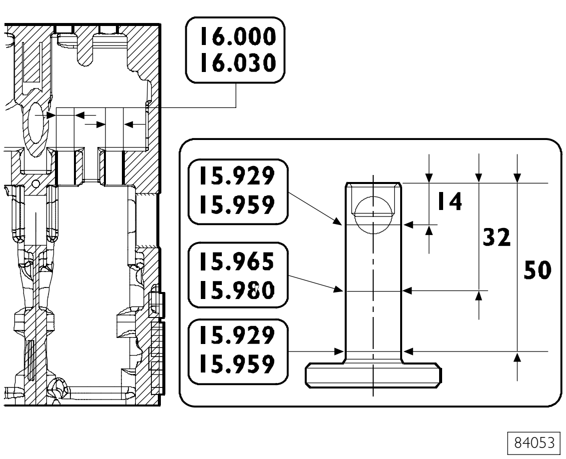


To change the bushing (1), use the drift 99360362 (2) and grip 99370006 (3) for its disassembly and assembly.

NOTE Upon assembly, the bushing (1) must be directed so that the lubrication holes coincide with the holes in the seats in the crankcase.

Tappets

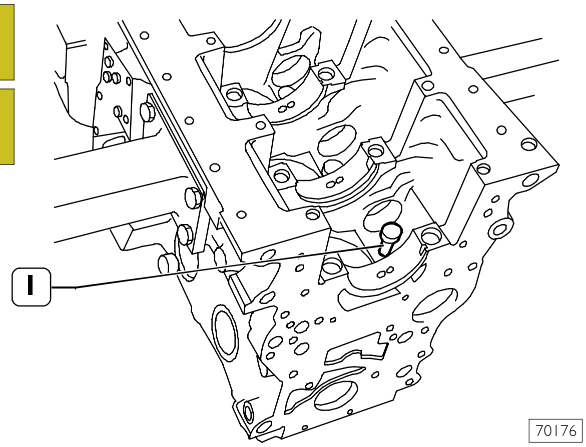
Figure 19



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON THE ENGINE BLOCK

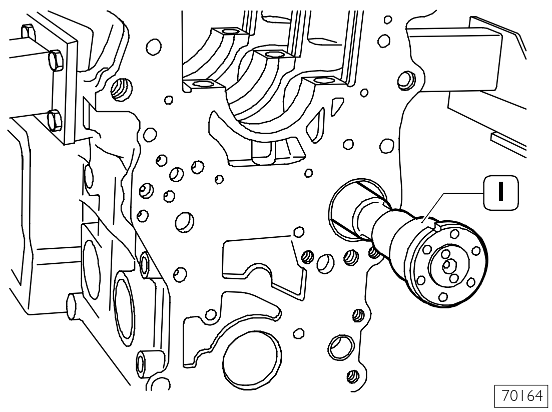
Fitting tappets – camshaft

Figure 20



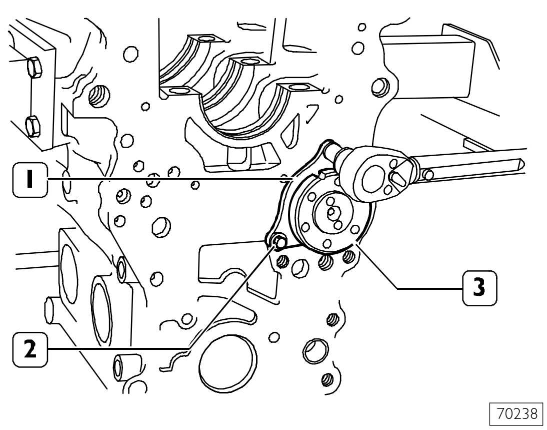
Lubricate the tappets (1) and fit them into the relevant housings on the engine block.

Figure 21



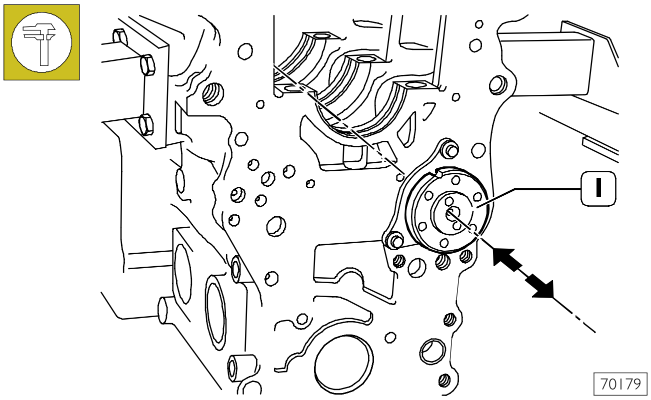
Lubricate the bushing supporting the camshaft and install the camshaft (1) taking care that, during this process, the bushing or the supporting seats do not get damaged.

Figure 22



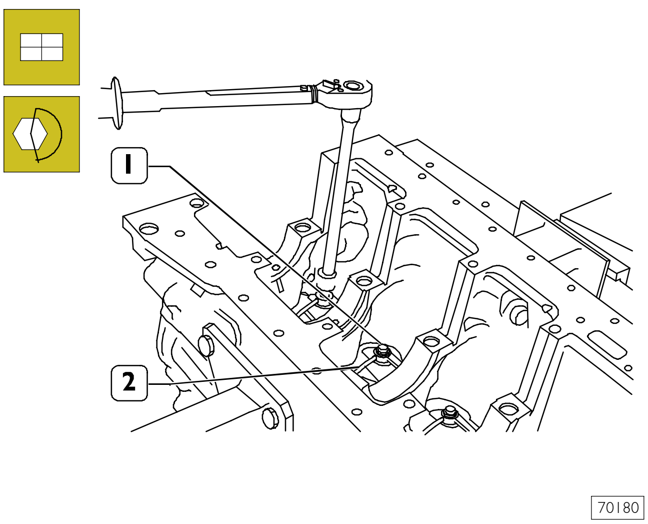
Set camshaft (3) retaining plate (1) with the slot facing the top of the engine block and the marking facing the operator, then tighten the screws (2) to the specified torque.

Figure 23



Check camshaft end float (1).
It shall be 0.23 ± 0.13 mm.

Figure 24

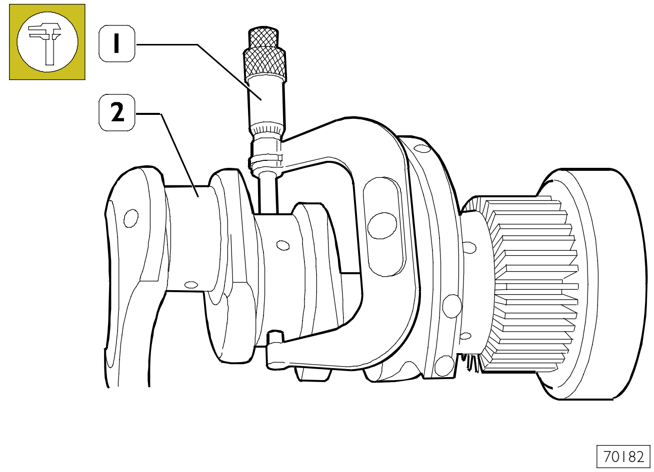


Fit nozzles (2) and tighten the fastening screws (1) to the specified torque.

OUTPUT SHAFT

Measuring journals and crankpins

Figure 25



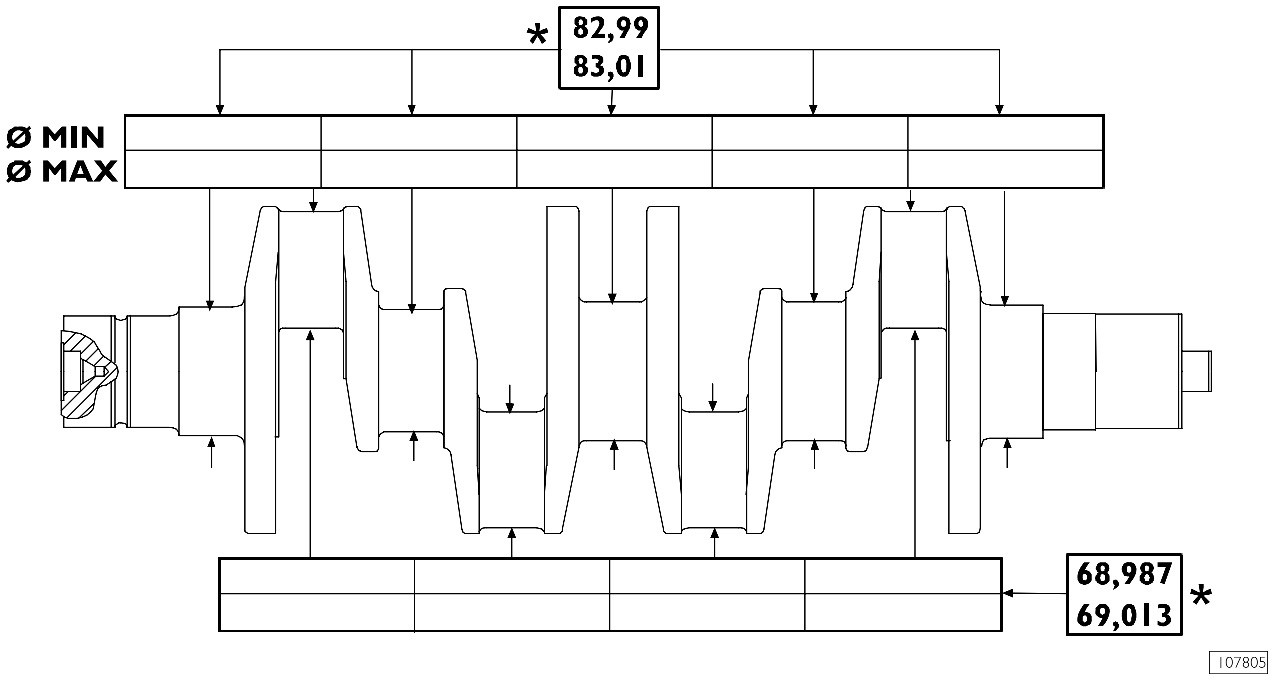
Grind journals and crankpins if seizing, scoring or excessive ovalisation are found. Before grinding the pins (2) measure them with a micrometer (1) to decide the final diameter to which the pins are to be ground.

NOTE It is recommended to insert the found values in the proper table.
See Figure 24 and 28.

Undersize classes are: 0250 - 0.500 mm.

NOTE Journals and crankpins shall always be ground to the same undersize class.
Journals and crankpins undersize shall be marked on the side of the crank arm No.1.
For undersized crankpins: letter M
For undersized journals: letter B
For undersized crankpins and journals: letters MB

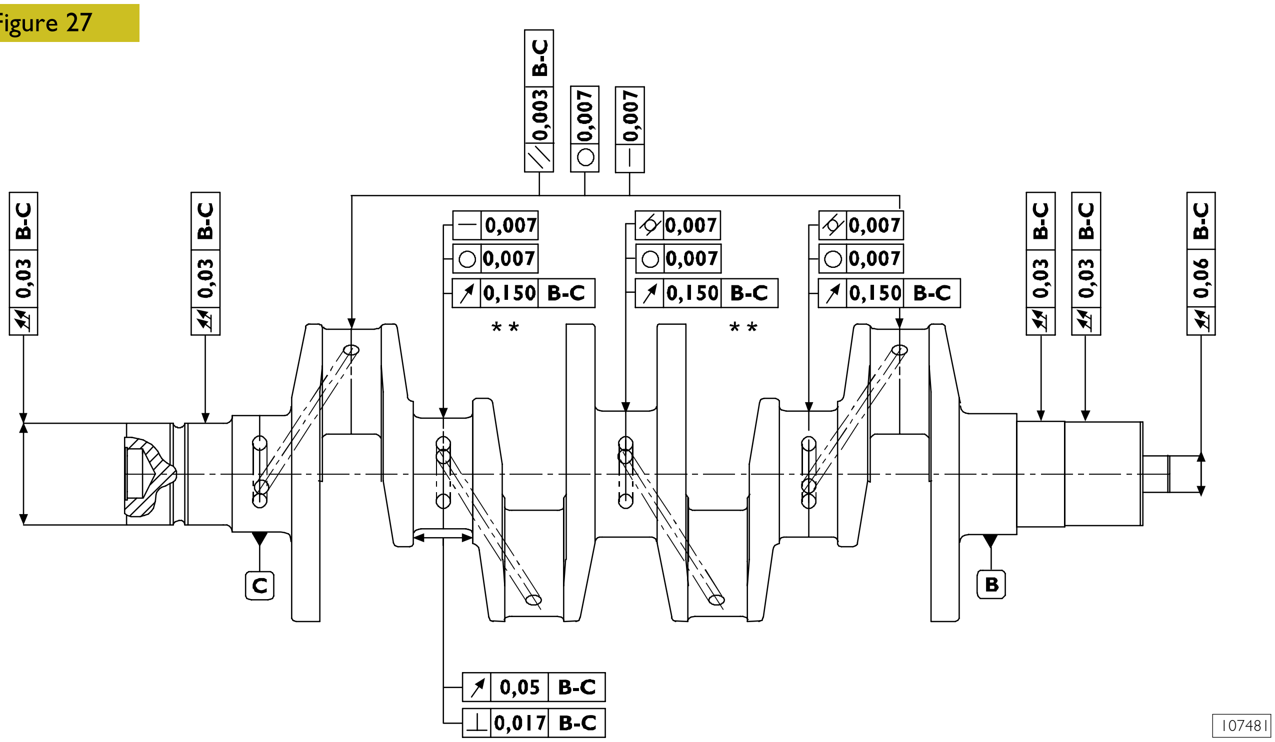
Figure 26



FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES (4 CYLINDERS)

*Rated value

Figure 27



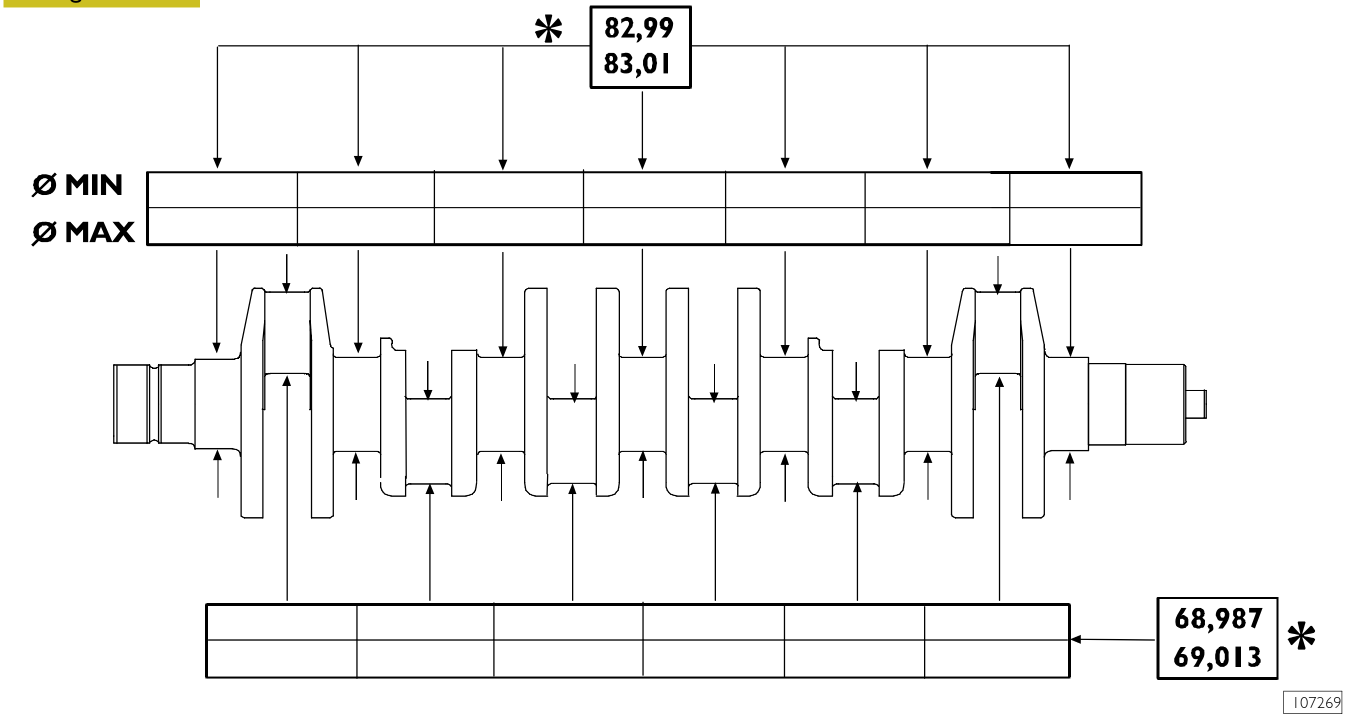
* Measured on a radius greater than 45.5 mm

** ↗ 0.500 between adjacent main journals

MAIN OUTPUT SHAFT TOLERANCES

Print P4D32N001 E

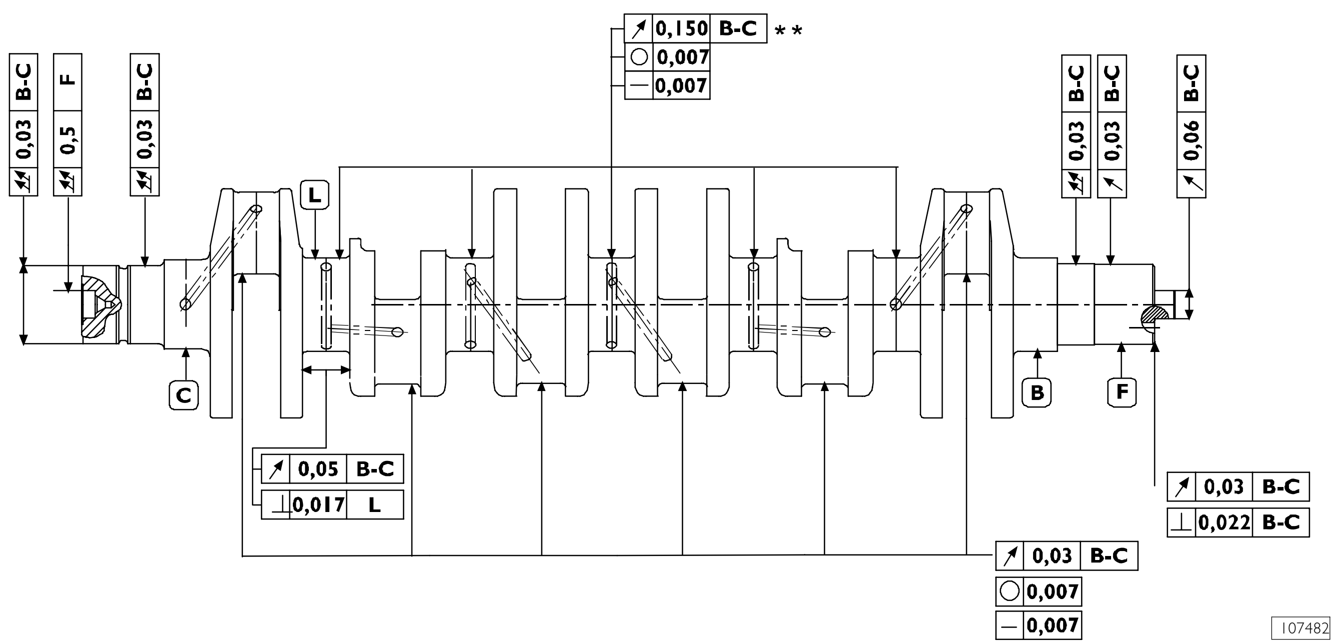
Figure 28



FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES (6 CYLINDERS)

*Rated value

Figure 29

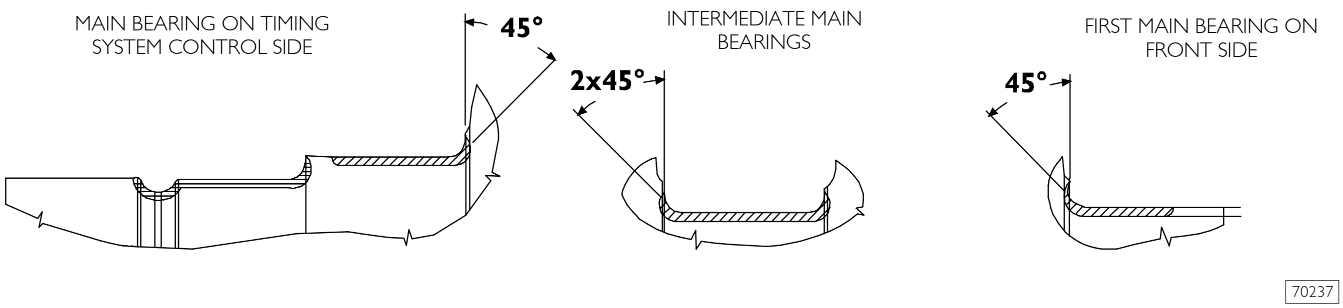


* Measured on a radius greater than 45.5 mm

** ↗ 0.500 between adjacent main journals

MAIN OUTPUT SHAFT TOLERANCES (6 CYLINDERS)

Figure 30

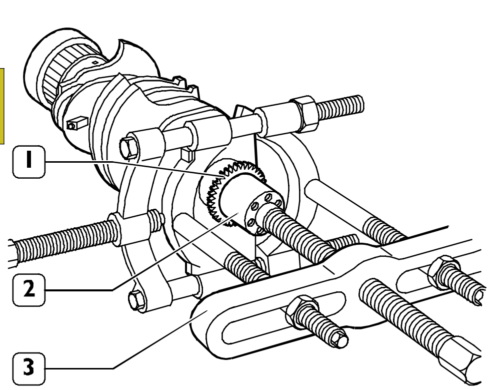


TOLERANCES	TOLERANCE CHARACTERISTIC	GRAPHIC SYMBOL
SHAPE	Roundness	○
	Cilindricity	/○/
DIRECTION	Parallelism	//
	Verticality	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	↗↗

LEVELS OF IMPORTANCE FOR PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Replacing oil pump control gear

Figure 31



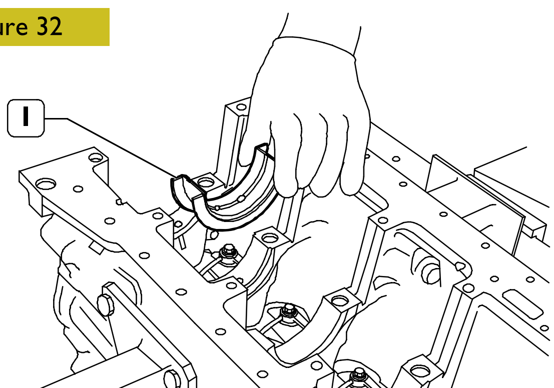
70184

Check that gear toothing (1) is not damaged or worn, otherwise remove it using the proper puller (3).

When fitting the new gear, heat it to 180°C for 10 minutes in an oven and then key it to the output shaft.

Fitting main bearings

Figure 32



70185

NOTE Refit the main bearings that have not been replaced, in the same position found at removal.

Main bearings (1) are supplied spare with 0.250 – 0.500 mm undersize on the internal diameter.

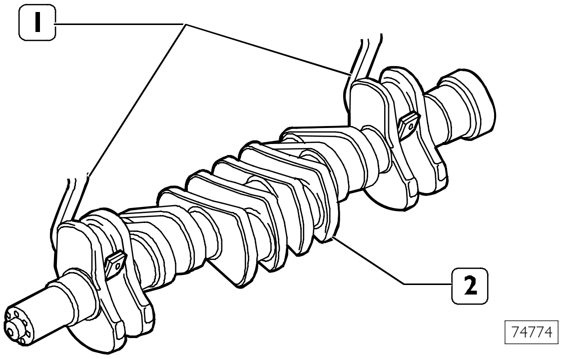
NOTE Do not try to adapt the bearings.

Clean accurately the main half bearings (1) having the lubricating hole and fit them into their housings.

The second last main half bearing (1) is fitted with shoulder half rings.

Finding journal clearance

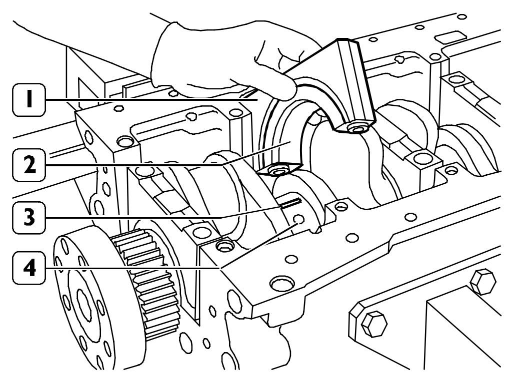
Figure 33



74774

Refit the output shaft (2).
Check the backlash between output shaft main journals and the relevant bearings as follows:

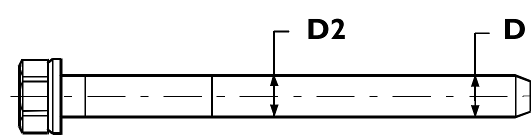
Figure 34



70186

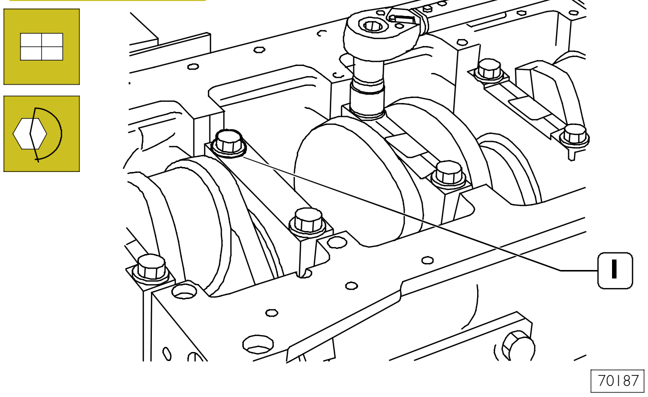
- ❑ clean accurately the parts and remove any trace of oil;
- ❑ position a piece of calibrated wire (3) on the output shaft pins (4) so that it is parallel to the longitudinal axis;
- ❑ fit caps (1), including the half bearings (2) on the relevant supports.

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.



75703

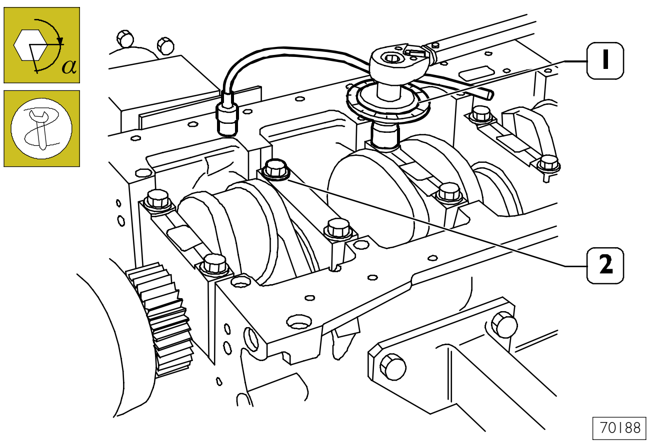
Figure 35



Tighten the pre-lubricated screws (1) in the following three successive stages:

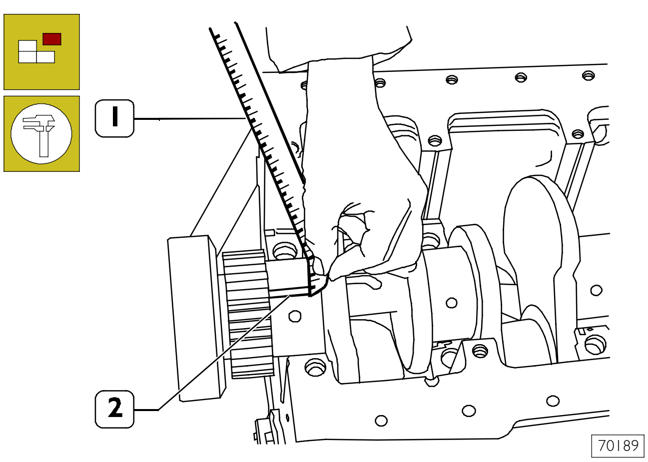
- ❑ 1st stage, with dynamometric wrench to 50 ± 6 Nm.
- ❑ 2nd stage, with dynamometric wrench to 80 ± 6 Nm.

Figure 36



- ❑ 3rd stage, with tool 99395216 (1) set as shown in the figure, tighten the screws (2) with 90° ± 5° angle.

Figure 37



- ❑ Remove caps from supports.

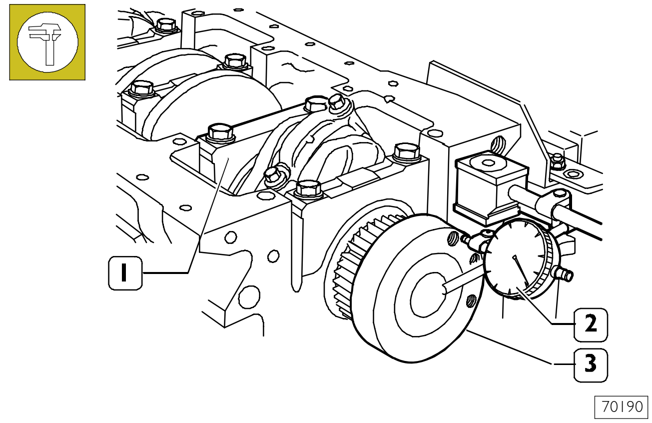
The backlash between the main bearings and the pins is found by comparing the width of the calibrated wire (2) at the narrowest point with the scale on the envelope (1) containing the calibrated wire.

The numbers on the scale indicate the backlash in mm.

Replace the half bearings and repeat the check if a different backlash value is found. Once the specified backlash is obtained, lubricate the main bearings and fit the supports by tightening the fastening screws as previously described.

Checking output shaft shoulder clearance

Figure 38

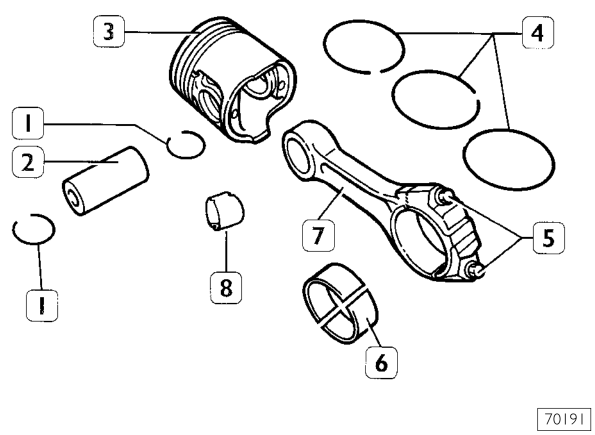


This check is performed by setting a magnetic-base dial gauge (2) on the output shaft (3) as shown in the figure, standard value is 0.068 to 0.41.

If higher value is found, replace main thrust half bearings of the second last rear support (1) and repeat the clearance check between output shaft pins and main half bearings.

CONNECTING ROD – PISTON ASSEMBLY

Figure 39



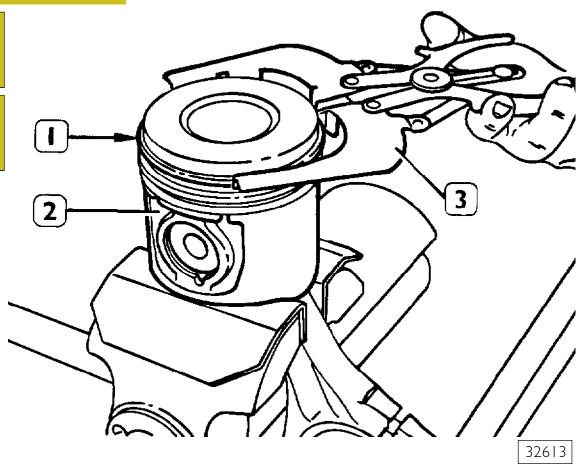
CONNECTING ROD – PISTON ASSEMBLY COMPONENTS

1. Stop rings - 2. Pin - 3. Piston - 4. Split rings - 5. Screws - 6. Half bearings - 7. Connecting rod - 8. Bush.

NOTE Pistons are supplied as spare parts in standard sizes or 0,4 mm oversize.

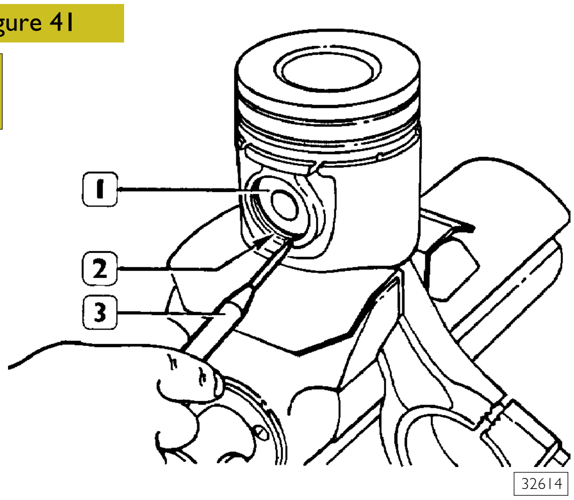
Print P4D32N001 E

Figure 40



Remove split rings (1) from piston (2) using pliers 99360183 (3).

Figure 41

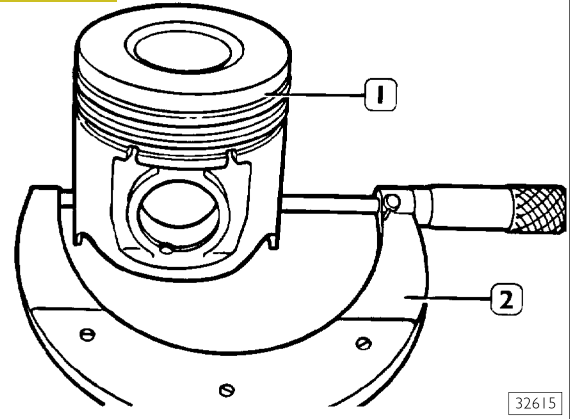


Piston pin (1) split rings (2) are removed using a scriber (3).

Pistons

Measuring piston diameter

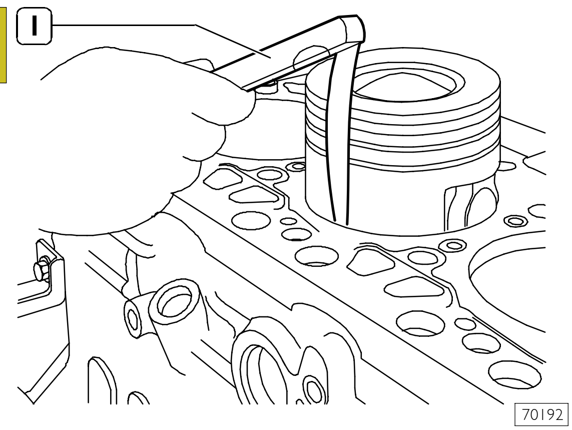
Figure 43



Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance.

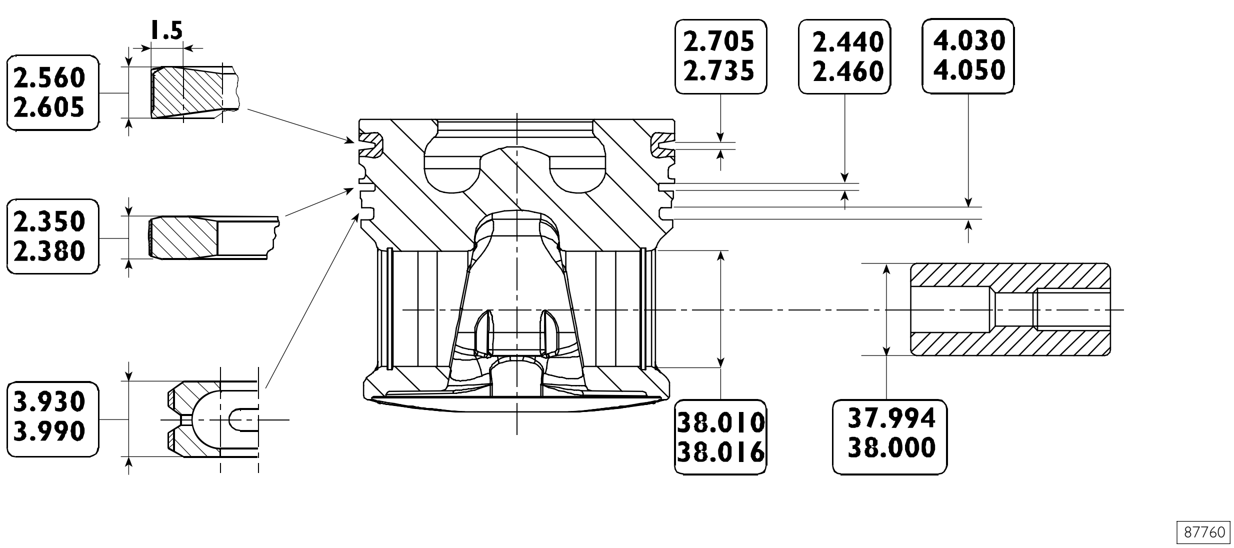
NOTE The diameter shall be measured at 55.9 mm from the piston skirt.

Figure 44



The clearance between the piston and the cylinder barrel can be checked also with a feeler gauge (1) as shown in the figure.

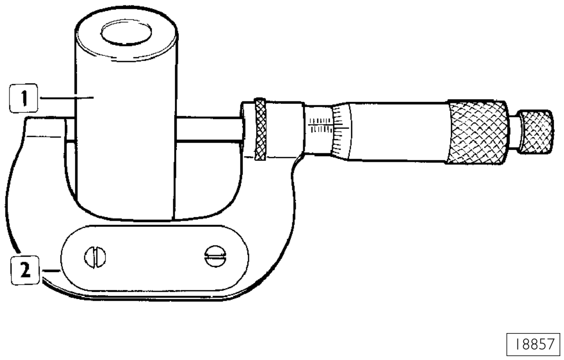
Figure 42



MAIN DATA OF THE PISTON RINGS AND PINS

Piston pins

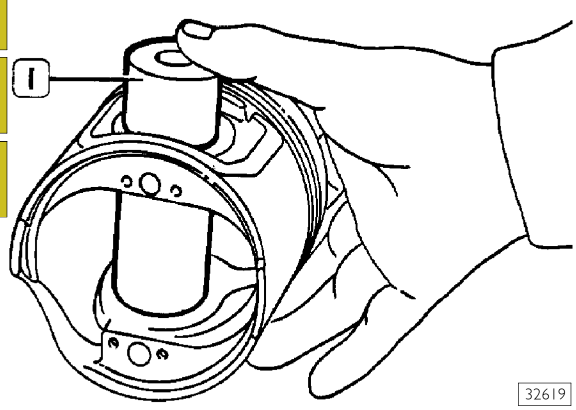
Figure 45



To measure the piston pin (1) diameter use the micrometer (2).

Conditions for proper pin-piston coupling

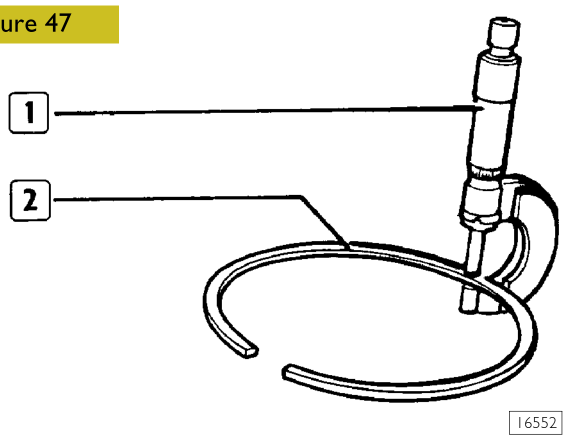
Figure 46



Lubricate the pin (1) and its seat on piston hubs with engine oil; the pin shall be fitted into the piston with a slight finger pressure and shall not be withdrawn by gravity.

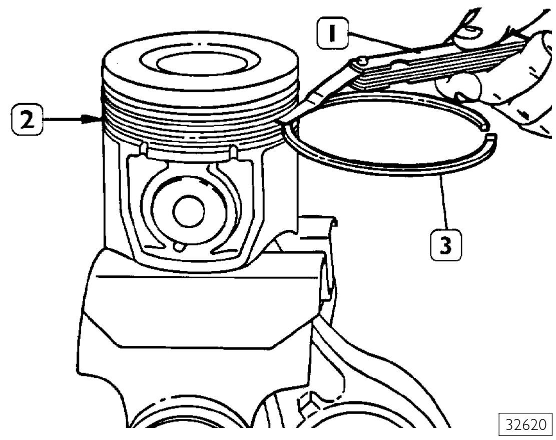
Split rings

Figure 47



Use a micrometer (1) to check split ring (2) thickness.

Figure 48



Check the clearance between the sealing rings (3) of the 2nd and 3rd slot and the relevant housings on the piston (2), using a feeler gauge (1).

Figure 49

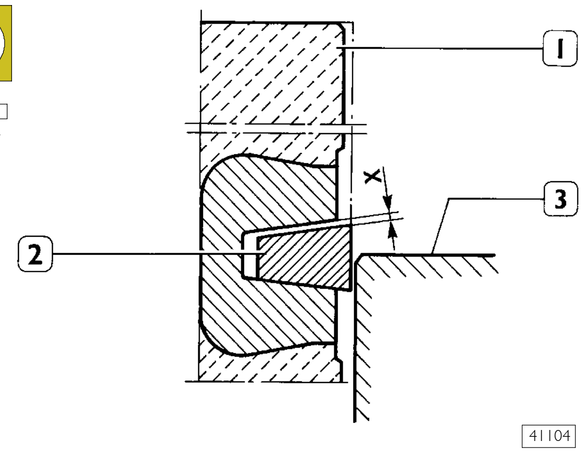


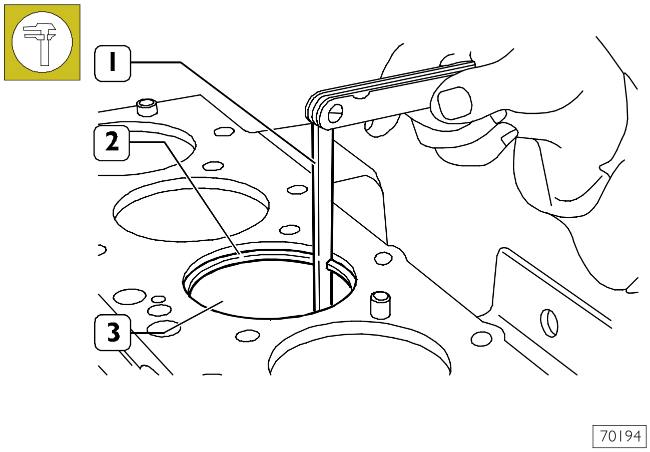
DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING

Since the first sealing ring section is trapezoidal, the clearance between the slot and the ring shall be measured as follows: make the piston (1) protrude from the engine block so that the ring (2) protrudes half-way from the cylinder barrel (3).

In this position, use a feeler gauge to check the clearance (X) between ring and slot: found value shall be the specified one.

Print P4D32N001 E

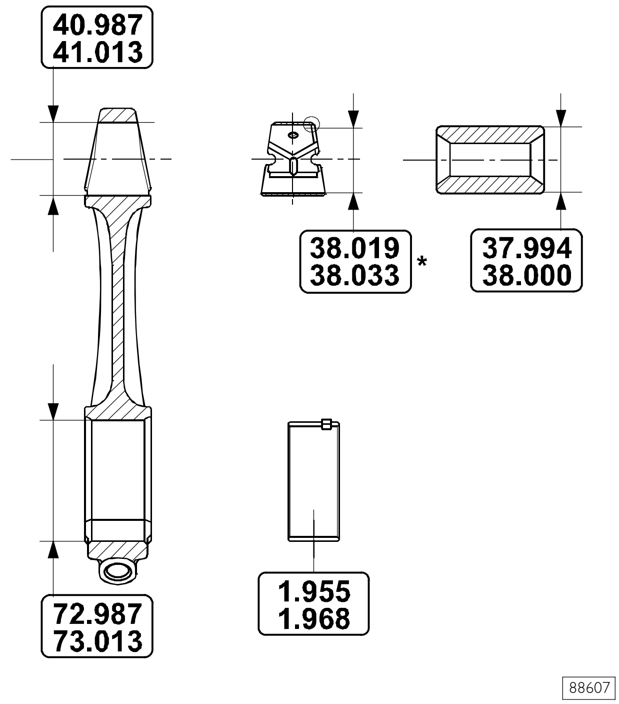
Figure 50



Use feeler gauge (1) to measure the clearance between the ends of the split rings (2) fitted into the cylinder barrel (3).

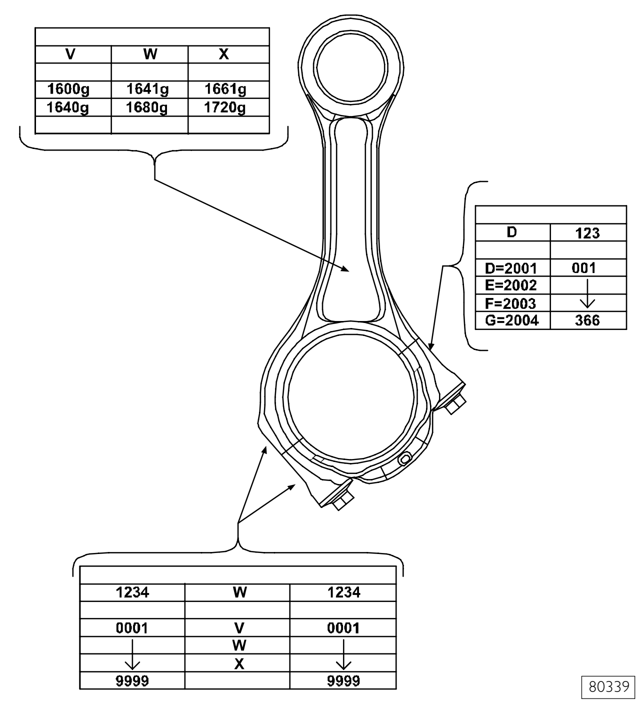
Connecting rods

Figure 51



NOTE The surface of connecting rod and rod cap are knurled to ensure better coupling.
Therefore, it is recommended not to smooth the knurls.

Figure 52



NOTE Every connecting rod is marked as follows:

- ❑ On body and cap with a number showing their coupling and the corresponding cylinder. In case of replacement it is therefore necessary to mark the new connecting rod with the same numbers of the replaced one.
- ❑ On body with a letter showing the weight of the connecting rod assembled at production:
  - V, 1820 to 1860 (yellow marking);
  - W, 1861 to 1900 (green marking);
  - X, 1901 to 1940 (blue marking);

Spare connecting rods are of the W class with green marking *.

Material removal is not allowed.

Bushes

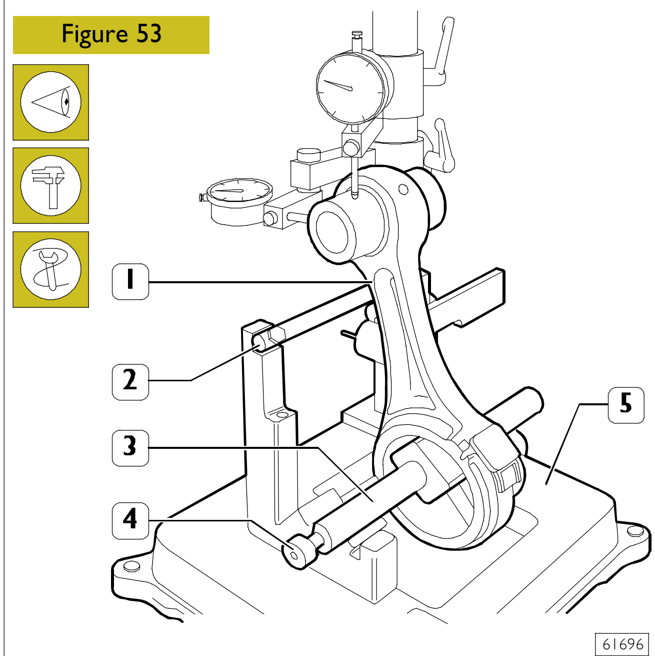
Check that the bush in the connecting rod small end is free from scoring or seizing and that it is not loosen. Otherwise replace.

Removal and refitting shall be performed using the proper beater.

When refitting take care to make coincide the oil holes set on the bush with those set on the connecting rod small end. Grind the bush to obtain the specified diameter.

Checking connecting rods

Figure 53

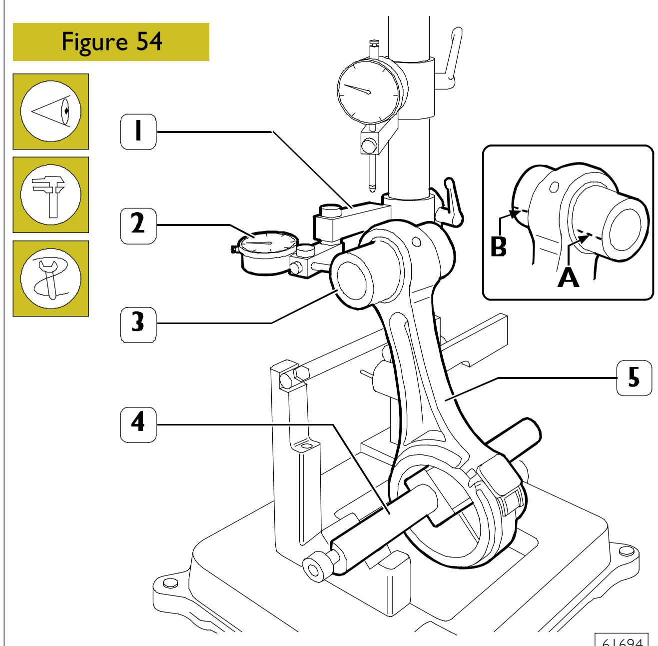


Check that the axes of the connecting rods (1) are parallel using tool 99395363 (5) as follows:

- ❑ fit the connecting rod (1) on tool 99395363 (5) spindle and lock it with screw (4);
- ❑ set the spindle (3) on V-blocks by resting the connecting rod (1) on the stop bar (2).

Checking torsion

Figure 54



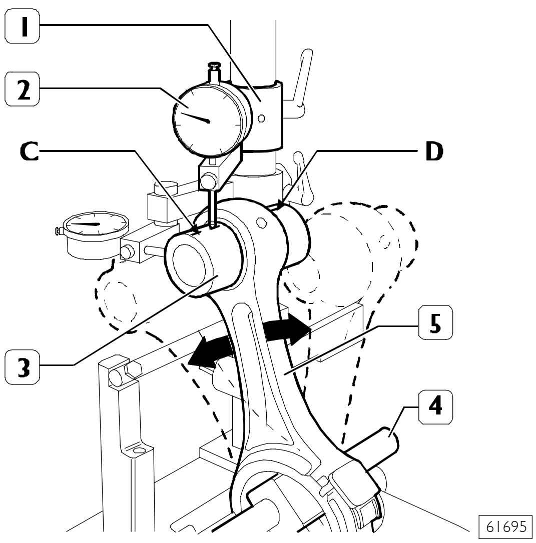
Check connecting rod (5) torsion by comparing two points (A and B) of pin (3) on the horizontal plane of the connecting rod axis.

Position the dial gauge (2) support (1) to obtain a preload of approx. 0.5 mm on the pin (3) in point A and then set the dial gauge (2) to zero. Move 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 shall not exceed 0.08 mm.

Print P4D32N001 E

Checking bending

Figure 55



Check connecting rod (5) bending by comparing two points C and D of the pin (3) on the vertical plane of the connecting rod axis.

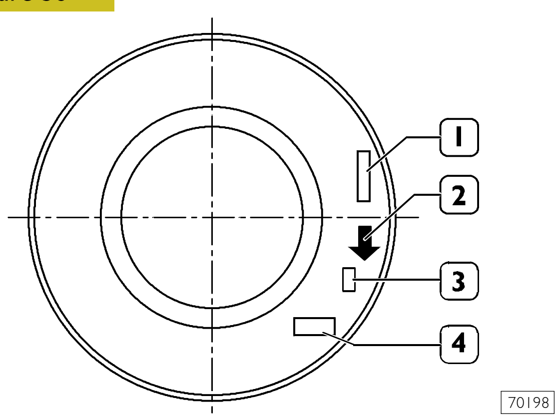
Position the vertical support (1) of the dial gauge (2) to rest the latter on pin (3), point C.

Move the connecting rod forwards and backwards to find pin top position, then in this condition reset the dial gauge (2).

Move the spindle with the connecting rod (5) and repeat the check of the top point on the opposite side D of the pin (3). The difference between point C and point D shall not exceed 0.08 mm.

Fitting connecting rod-piston assembly Connecting rod-piston coupling

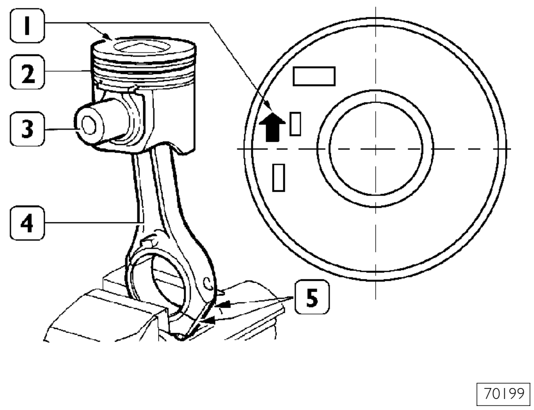
Figure 56



The piston crown is marked as follows:

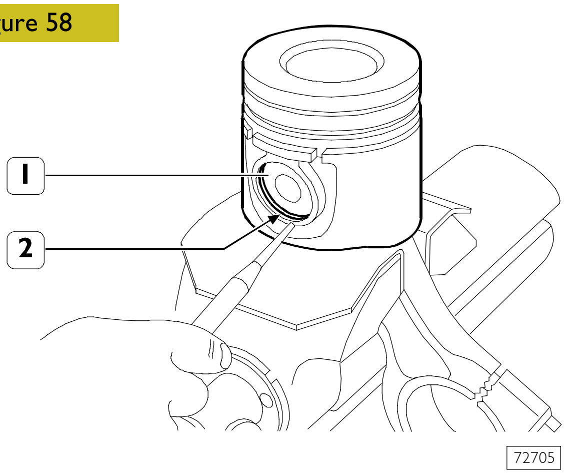
1. Part number and design modification number;
2. Arrow showing piston assembling direction into cylinder barrel, this arrow shall face the front key of the engine block;
3. Marking showing 1st slot insert testing;
4. Manufacturing date.

Figure 57



Connect piston (2) to connecting rod (4) with pin (3) so that the reference arrow (1) for fitting the piston (2) into the cylinder barrel and the numbers (5) marked on the connecting rod (5) are read as shown in the figure.

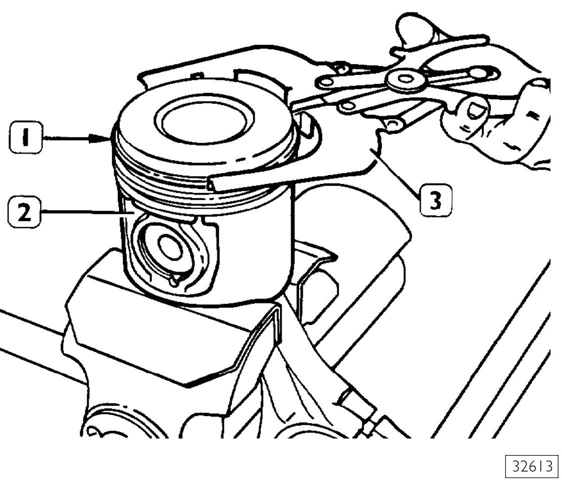
Figure 58



Position the piston (1) on the connecting rod according to the diagram shown in the figure, fit the pin (3) and stop it by the split rings (2).

Fitting split rings

Figure 59

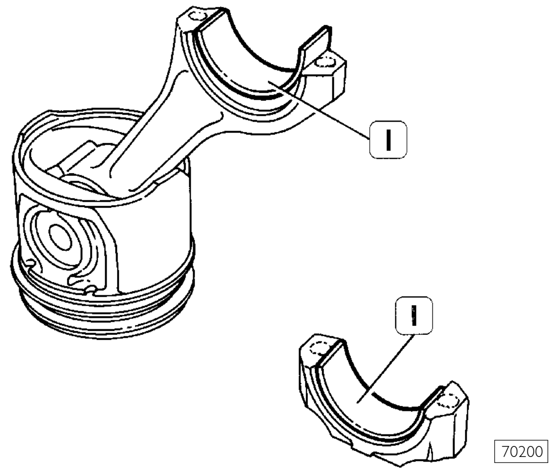


Use pliers 99360183 (3) to fit the split rings (1) on the piston (2).
Split rings shall be fitted with the marking "TOP" facing upwards and their openings shall be displaced with each other by 120°.

NOTE Split rings are supplied spare with the following sizes:

- standard;
- 0.4 mm oversize.

Figure 60

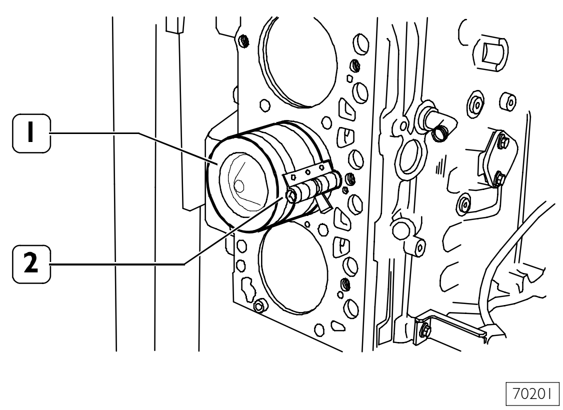


Fit half bearings (1) on connecting rod and cap.

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

Fitting connecting rod-piston assembly into cylinder barrels

Figure 61



Lubricate accurately the pistons, including the split rings and the cylinder barrel inside.
Use band 99360605 (2) to fit the connecting rod-piston assembly (1) into the cylinder barrels and check the following:

- ❑ the number of each connecting rod shall correspond to the cap coupling number.

Figure 62

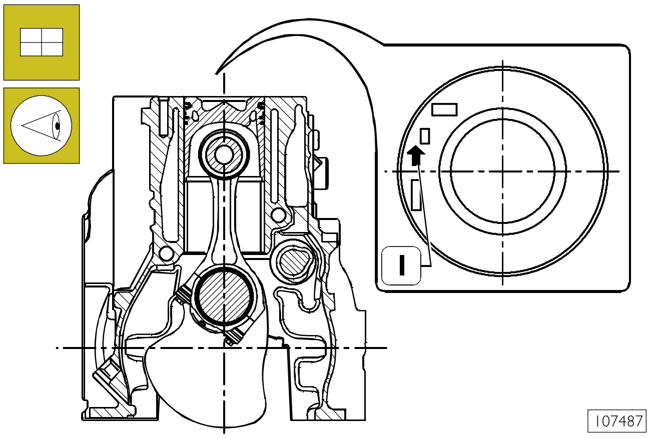
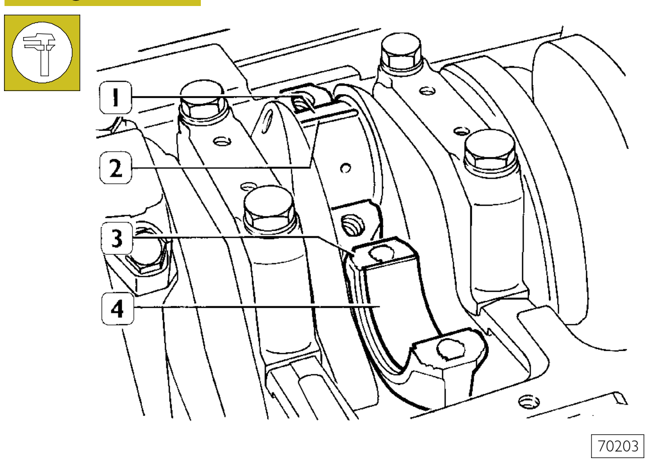


DIAGRAM FOR CONNECTING ROD-PISTON ASSEMBLY FITTING INTO BARREL

- Split ring openings shall be displaced with each other by 120°;
- connecting rod-piston assemblies shall have the same weight;
- the arrow marked on the piston crown shall be facing the front side of the engine block or the slot obtained on the piston skirt shall be corresponding to the oil nozzle position.

Finding crankpin clearance

Figure 63



To measure the clearance proceed as follows:

- clean the parts accurately and remove any trace of oil;
- set a piece of calibrated wire (2) on the output shaft pins (1);
- fit the connecting rod caps (3) with the relevant half bearings (4).

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.

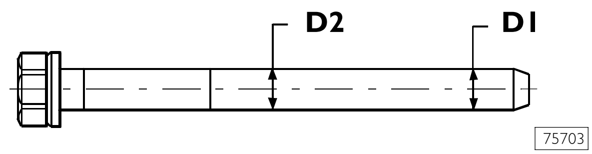
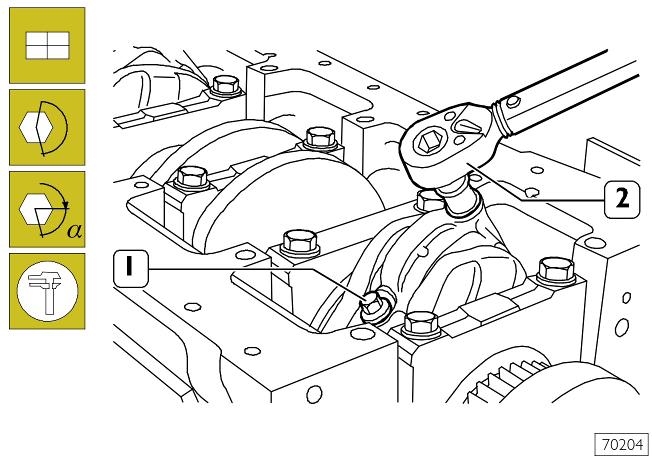
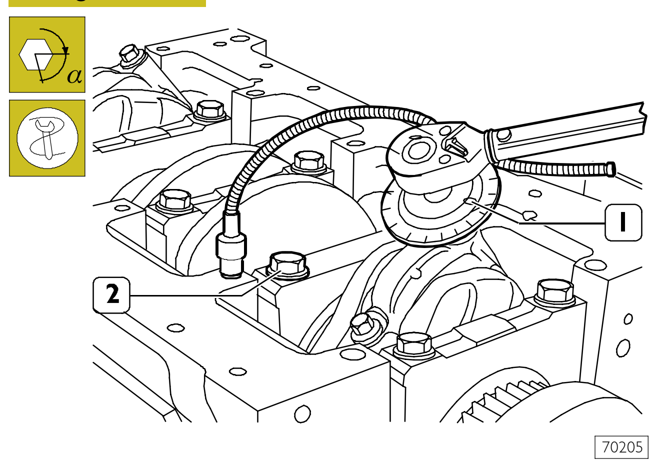


Figure 64



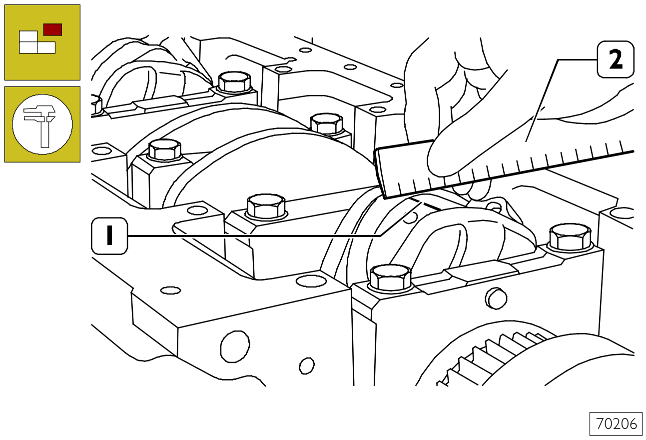
- Lubricate the screws (1) with engine oil and then tighten them to the specified torque using the dynamometric wrench (2).

Figure 65



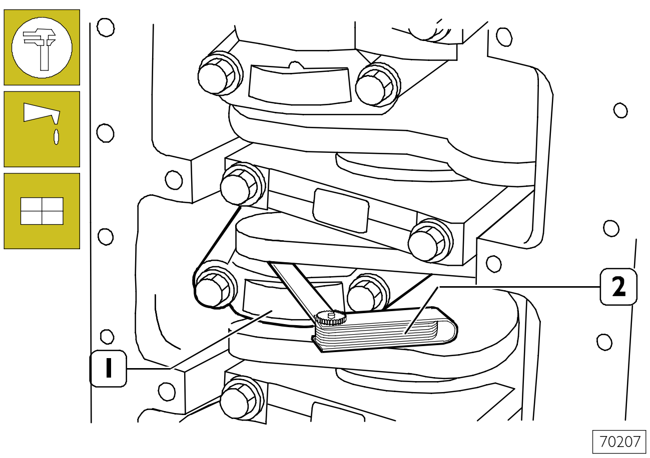
- Apply tool 99395216 (1) to the socket wrench and tighten screws (2) of 60°.

Figure 66



❑ Remove the cap and find the existing clearance by comparing the calibrated wire width (1) with the scale on the wire envelope (2).

Figure 67



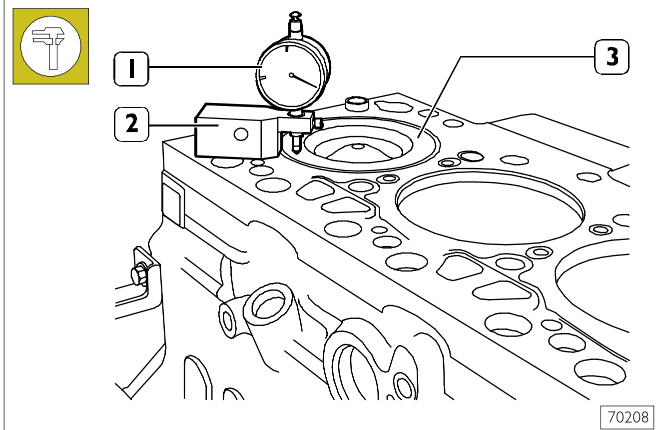
If a different clearance value is found, replace the half bearings and repeat the check.

Once the specified clearance has been obtained, lubricate the main half bearings and fit them by tightening the connecting rod cap fastening screws to the specified torque.

Check manually that the connecting rods (1) are sliding axially on the output shaft pins and that their end float, measured with feeler gauge (2) is 0.250 to 0.275 mm.

Checking piston protrusion

Figure 68



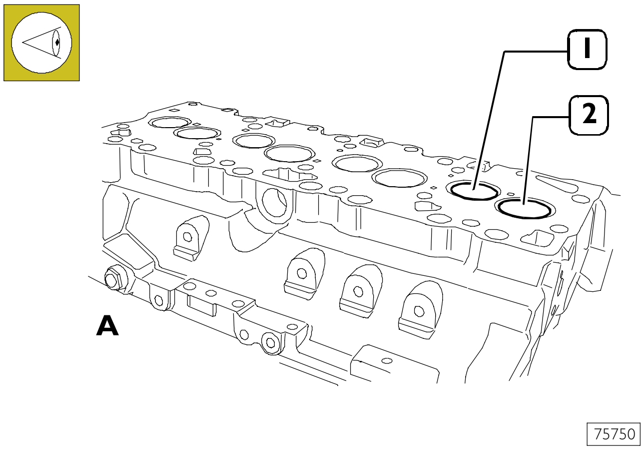
Once connecting rod-piston assemblies refitting is over, use dial gauge 39395603 (1) fitted with base 99370415 (2) to check piston (3) protrusion at T.D.C. with respect to the top of the engine block.

Protrusion shall be 0.28 to 0.52 mm.

 Print P4D32N001 E

CYLINDER HEAD
Removing the valves

Figure 69

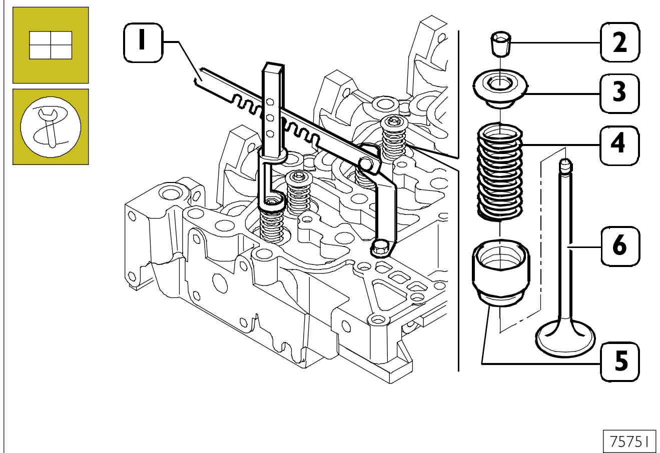


Intake (1) and exhaust (2) valves have heads with the same diameter.

NOTE Should cylinder head valves be not replaced, number them before removing in order to refit them in the same position.

A = intake side

Figure 70

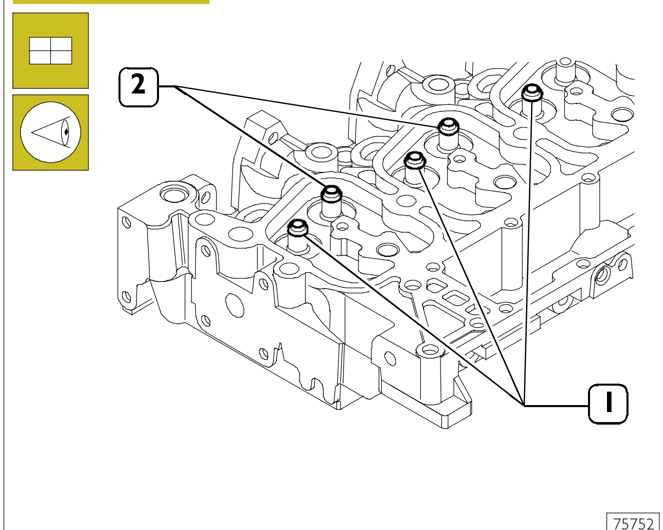


Valve removal shall be performed using tool 99360268 (1) and pressing the cap (3) so that when compressing the springs (4) the cotters (2) can be removed. Then remove the cap (3) and the springs (4).

Repeat this operation for all the valves.

Overturn the cylinder head and withdraw the valves (5).

Figure 71



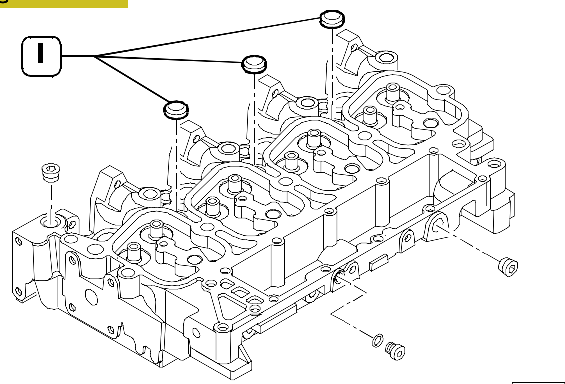
Remove sealing rings (1 and 2) from the valve guide.

NOTE Sealing rings (1) for intake valves are yellow.

Sealing rings (2) for exhaust valves are green.

Checking cylinder head wet seal

Figure 72



This check shall be performed using the proper tools.

Use a pump to fill with water heated to approx. 90°C and 2 to 3 bar pressure.

Replace the cup plugs (1) if leaks are found, use the proper beater for their removal/refitting.

NOTE Before refitting, smear the plug surfaces with water-repellent sealant.

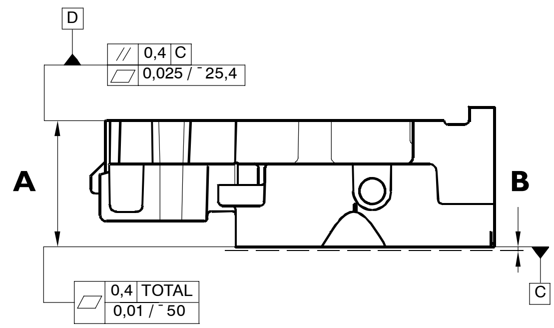
Replace the cylinder head if leaks are found.

Checking cylinder head supporting surface

Distortion found along the whole cylinder head shall not exceed 0.20 mm.

If higher values are found grind the cylinder head according to values and indications shown in the following figure.

Figure 73



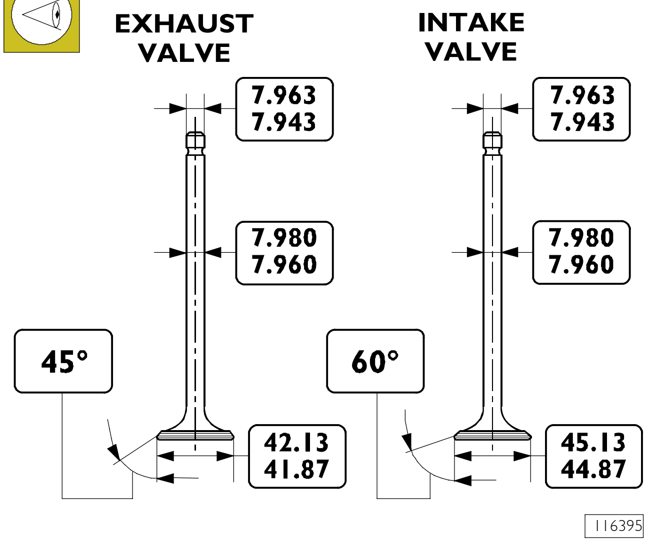
The rated thickness A for the cylinder head is 95 ± 0.25 mm, max. metal removal shall not exceed thickness B by 1 mm.

NOTE After grinding, check valve sinking. Regrind the valve seats, if required, to obtain the specified value.

Print P4D32N001 E

VALVES

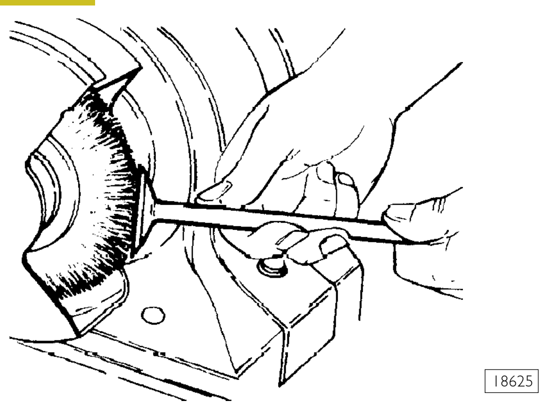
Figure 74



INTAKE AND EXHAUST VALVE MAIN DATA

Removing carbon deposits, checking and grinding valves

Figure 75

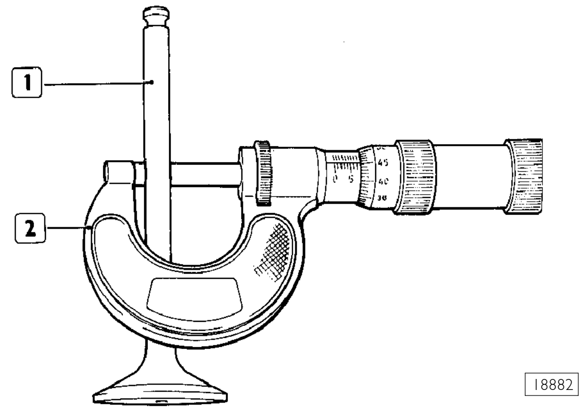


Remove carbon deposits from valves using the proper metal brush.

Check that the valves show no signs of seizing, scoring or cracking.

Regrind the valve seats, if required, using tool 99305018 and removing as less material as possible.

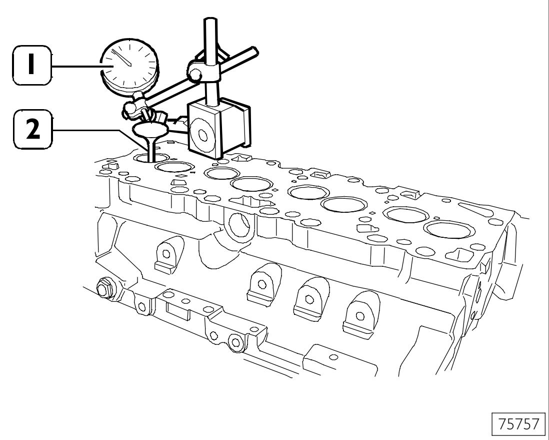
Figure 76



Check the valve stem (1) using a micrometer (2), it shall be 7.960 to 7.980.

Checking clearance between valve stem and valve guide and valve centering

Figure 77

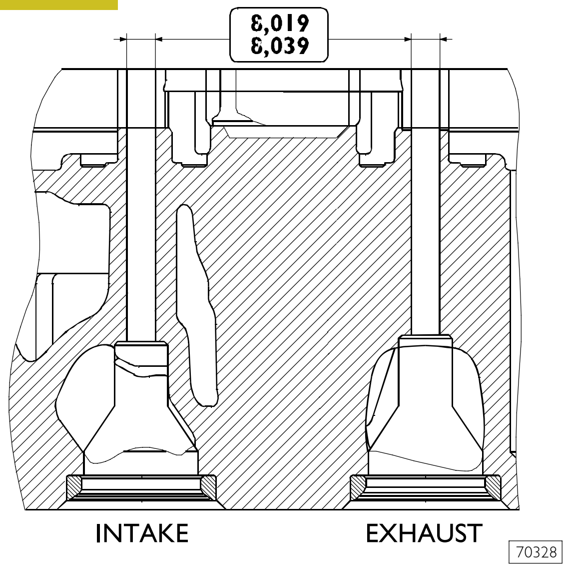


Use a magnetic base dial gauge (1) set as shown in the figure, the assembling clearance shall be 0.056 ± 0.096 mm.

Turn the valve (2) and check that the centering error is not exceeding 0.03 mm.

VALVE GUIDE

Figure 78

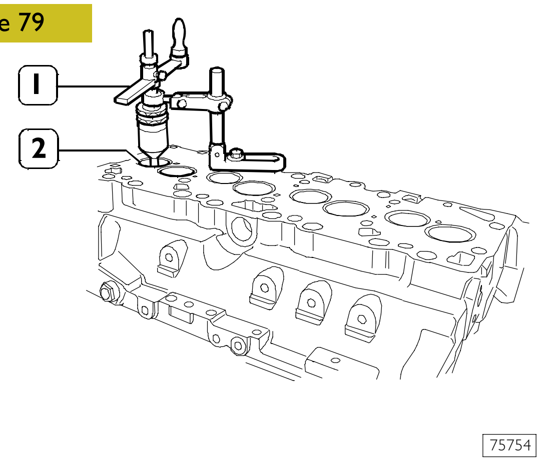


Use a bore dial gauge to measure the inside diameter of the valve guides, the read value shall comply with the value shown in the figure.

VALVE SEATS

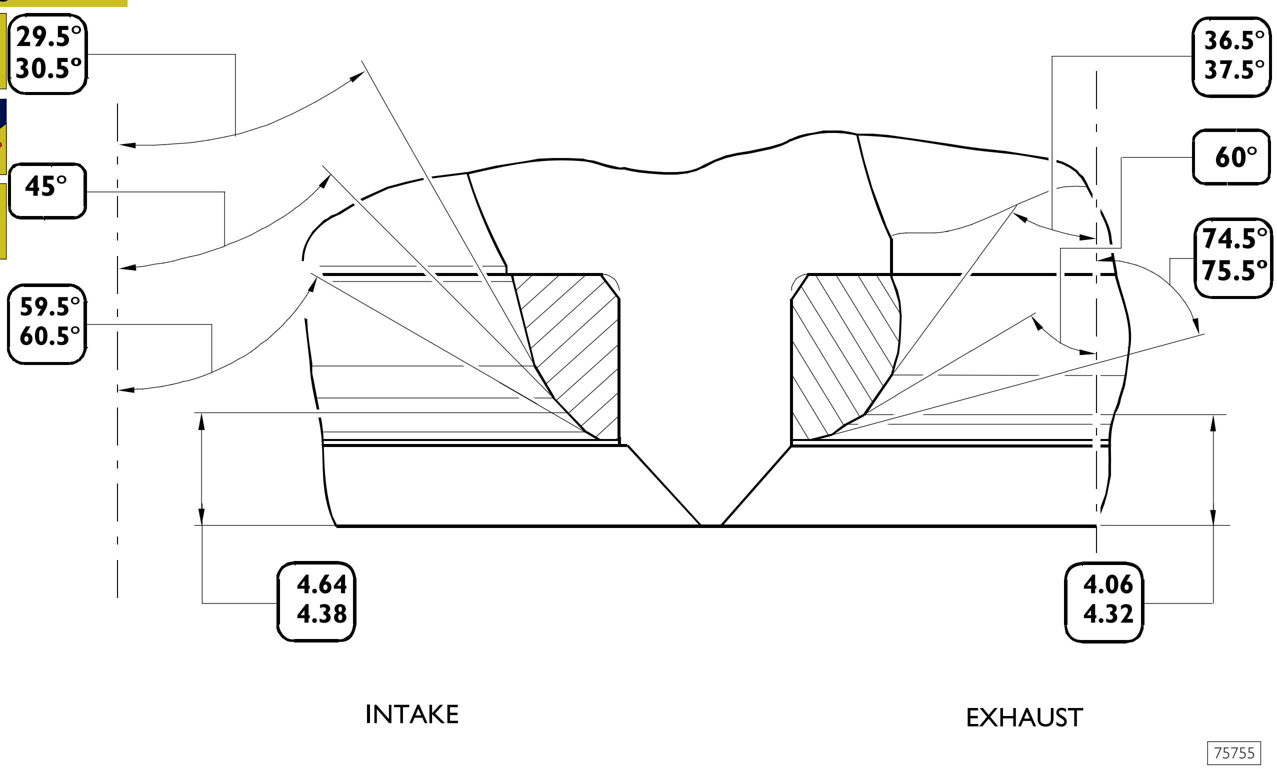
Regrinding – replacing the valve seats

Figure 79



Check the valve seats (2). If slight scoring or burnout is found, regrind seats using tool 99305014 (1) according to the angle values shown in Figure 80.

Figure 80



VALVE SEAT MAIN DATA

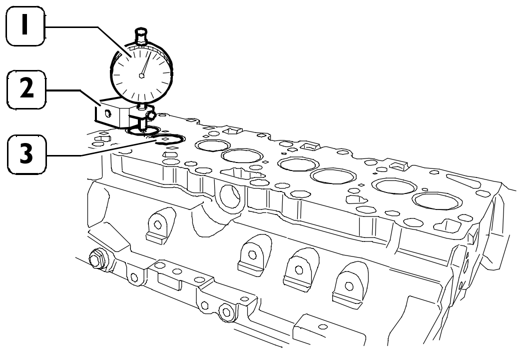
Should valve seats be not reset just by regrinding, replace them with the spare ones. Use tool 99305019 (Figure 79) to remove as much material as possible from the valve seats (take care not to damage the cylinder head) until they can be extracted from the cylinder head using a punch.

Heat the cylinder head to 80° - 100°C and using the proper beater, fit the new valve seats, previously cooled, into the cylinder head.

Use tool 99305019 to regrind the valve seats according to the values shown in Figure 80.

 Print P4D32N001 E

Figure 81

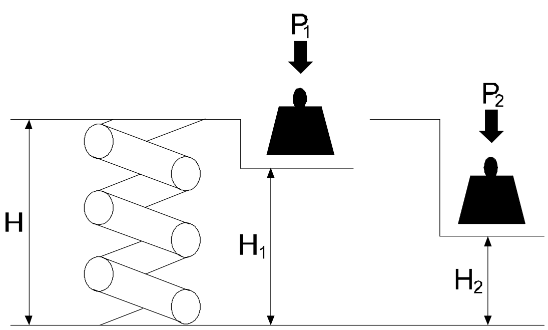


75758

After regrinding, check that valve (3) sinking value is the specified one by using the base 99370415 (2) and the dial gauge 99395603 (1).

VALVE SPRINGS

Figure 82



50676

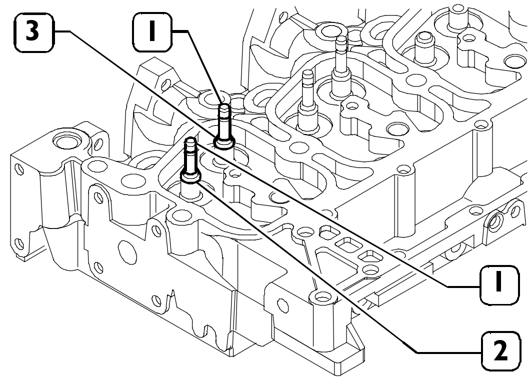
MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Before refitting use tool 99305047 to check spring flexibility. Compare load and elastic deformation data with those of the new springs shown in the following table.

Height		Under a load of
mm		N
H (free)	63.50	-
H_1	49.02	329
H_2	38.20	641

FITTING CYLINDER HEAD

Figure 83



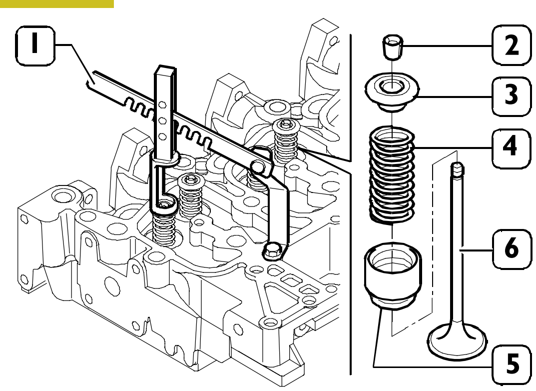
75759

Lubricate the valve stems (1) and fit them into the relevant valve guides according to the position marked at removal.

Fit the sealing rings (2 and 3) on the valve guide.

NOTE Sealing rings (2) for intake valves are yellow and sealing rings (3) for exhaust valves are green.

Figure 84

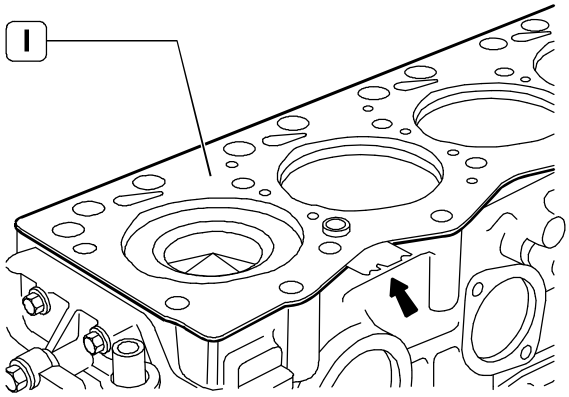


75751

Position on the cylinder head: the spring (4), the upper cap (3); use tool 99360268 (1) to compress the spring (4) and lock the parts to the valve (5) by the cotters (2).

Refitting the cylinder head

Figure 85



87759

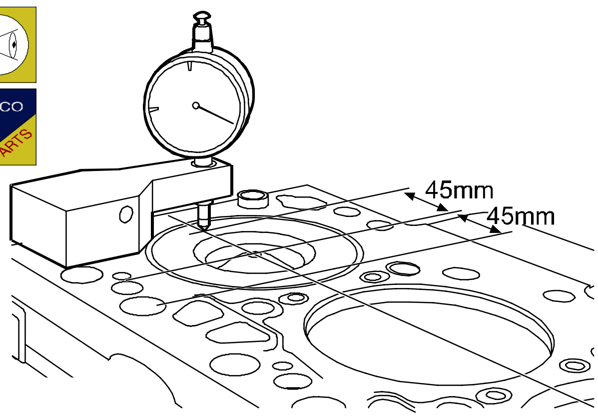
Check cleanness of cylinder head and engine block coupling surface.

Take care not to foul the cylinder head gasket.

Set the cylinder head gasket (1) with the marking "N. of component" (1) facing the head.

The arrow shows the point where the gasket thickness is given.

Figure 86



88775

There are two types of head seals, for the thickness (1.25 mm Type A and 1.15 mm Type B) take the following measures:

- for each piston detect, as indicated on Figure 86, at a distance of 45 mm from the centre of the piston overhandings S1 and S2 in relation to the engine base upper plane then calculate the average:

For 4 cylinder versions: $S_{cil1} = \frac{S1 + S2}{2}$

Repeat the operation for pistons 2, 3 and 4 and calculate the average value.

$$S = \frac{S_{cil1} + S_{cil2} + S_{cil3} + S_{cil4}}{4}$$

For 6 cylinder versions:

Repeat the operation for pistons 2, 3, 4, 5 and 6 and calculate the average value.

$$S = \frac{S_{cil1} + S_{cil2} + S_{cil3} + S_{cil4} + S_{cil5} + S_{cil6}}{6}$$

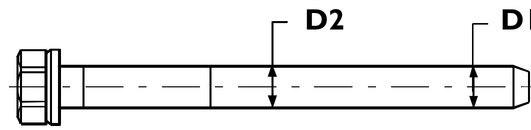
If S is > 0,40 mm use seal type A.

If S is < 0,40 mm use seal type B.

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:

if D1 - D2 < 0,1 mm the screw can be utilised again;

if D1 - D2 > 0,1 mm the screw must be replaced.



75703

TIGHTENING TORQUE

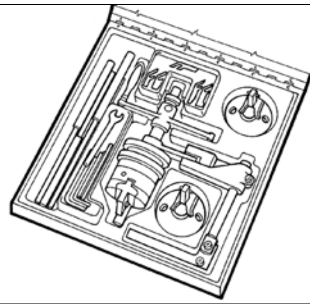
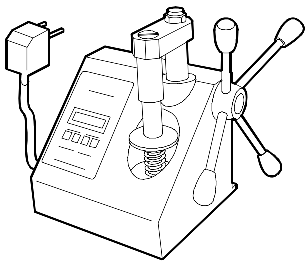
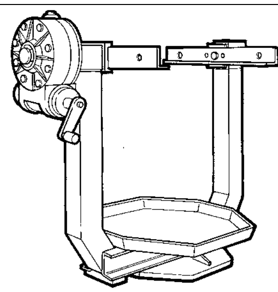
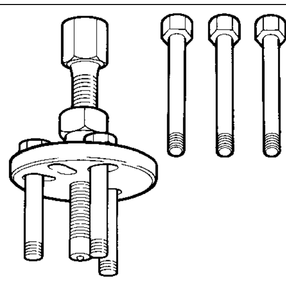
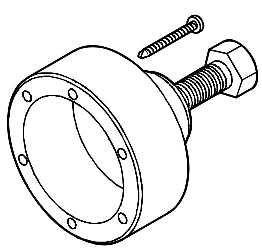
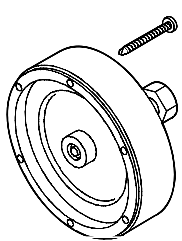
COMPONENT		TORQUE Nm	TORQUE kgm
Cooling Nozzles (M8x1.25x10)		15 ± 3	1.5 ± 0.3
Main bearing cap	1st stage 2nd stage 3rd stage	50 ± 6 80 ± 6 90° ± 5°	5.0 ± 0.6 8.0 ± 0.6
Rear gear housing assembly (M8x1.25x40) (M8x1.25x25) (M10x1.5)		24 ± 4 24 ± 4 49 ± 5	2.4 ± 0.4 2.4 ± 0.4 4.9 ± 0.5
Oil pump (M8x1.25x30)		8 ± 1	0.8 ± 0.1
Front cover assembly (M8x1.25x45) (M8x1.25x30)		24 ± 4 24 ± 4	2.4 ± 0.4 2.4 ± 0.4
Connecting rod bolts (M11x1.25)	1st stage 2nd stage	30 ± 3 60 ± 5 60° ± 5°	3.0 ± 0.3 6.0 ± 0.5
Ladder frame assembly (M10x1.25x25)		43 ± 5	4.3 ± 0.5
Oil rifle plugs (M10x1) (M14x1.5)		6 ± 1 11 ± 2	0.6 ± 0.1 1.1 ± 0.2
Assemble oil suction tube (M8x1.25x20)		24 ± 4	2.4 ± 0.4
Oil pan assembly (M8x1.25x25) (M18x1.50)		24 ± 4 60 ± 9	2.4 ± 0.4 6.0 ± 0.9
Set timing pin		5 ± 1	0.5 ± 0.1
Fuel pump assembly M8 screw M6 screw M6 nut		24 ± 4 10 ± 1 10 ± 1	2.4 ± 0.4 1.0 ± 0.1 1.0 ± 0.1
M10x1.5 flange head nuts	pre-torque Final torque	10 - 15 50 - 55	1.0 - 1.5 5.0 - 5.5
Fuel pump gear (drive gear nut)	Snug torque Final torque	15 - 20 85 - 90	1.5 - 2.0 8.5 - 9.0
Timing pin cap of fuel pump		30 - 35	3.0 - 3.5
Rocker assys (M8)		24 ± 4	2.4 ± 0.4
Cylinder head bolts (M12x70) (M12x140) (M12x180)		50 + 90° 40 + 180° 70 + 180°	5.0 + 90° 4.0 + 180° 7.0 + 180°
Assy rocker covers (M8x1.25x25)		24 ± 4	2.4 ± 0.4
Intake manifold (M8x1.25)		24 ± 4	2.4 ± 0.4
Assy air intake connection (M8x1.25)		24 ± 4	2.4 ± 0.4
Oil bypass valve into lube filter head (M22x1.5x10)		80 ± 8	8.0 ± 0.8
Plug (M12x1.5x12)		10 ± 1	1.0 ± 0.1
Exhaust manifold (M10x1.5x65)		43 ± 6	4.3 ± 0.6
Water pump (M8x1.25x25)		24 ± 4	2.4 ± 0.4
Water outlet connection (M8x1.25x35) (M8x1.25x70)		24 ± 4 24 ± 4	2.4 ± 0.4 2.4 ± 0.4
Fan support (M10x1.5x20)		33 ± 5	3.3 ± 0.5
Fan pulley (M6) (M10)		10 ± 2 43 ± 6	1.0 ± 0.2 4.3 ± 0.6

COMPONENT		TORQUE	
		Nm	kgm
Rear lifting bracket (M12x1.75x30)		77 ± 12	7.7 ± 1.2
Crankshaft pulley (M12x1.75x10.9)		110 ± 5	11.0 ± 0.5
Flywheel housing (M12x120) (M12x80) (M10x80) (M10x40)		 85 ± 10 85 ± 10 49 ± 5 49 ± 5	 8.5 ± 1.0 8.5 ± 1.0 4.9 ± 0.5 4.9 ± 0.5
Flywheel housing (M12x1.25)	1st stage 2nd stage	30 ± 4 60° ± 5°	3.0 ± 0.4
Assy rear cover plate to flywheel housing (M8x1.25x16)		24 ± 4	2.4 ± 0.4
Fuel injectors		60 ± 5	6.0 ± 0.5
Fuel lift pump		24 ± 4	2.4 ± 0.4
Turbocharger to exhaust manifold (M10)		43 ± 6	4.3 ± 0.6
Oil feed to oil filter head		24 ± 4	2.4 ± 0.4
Oil feed to turbocharger (M12x1.5)		35 ± 5	3.5 ± 0.5
Oil drain (M8x1.25x16)		24 ± 4	2.4 ± 0.4
Alternator to alternator support (M8x1.25x30)		24 ± 4	2.4 ± 0.4
Alternator to water inlet conn. assy (M8x1.25x30)		24 ± 4	2.4 ± 0.4
Lower alternator mounting (M10x1.25x25)		24 ± 4	2.4 ± 0.4
Alternator upper pivot to support (M10)		49 ± 5	4.9 ± 0.5
Alternator mounting hardware (M12x1.75x120)		43 ± 6	4.3 ± 0.6
Alternator wiring (M6x1.0 nut)		10 ± 2	1.0 ± 0.2
Starter motor to gear case (M10)		49 ± 5	4.9 ± 0.5
Screw M8 for fastening cylinder barrel lubricating nozzles		15 ± 3	1.5 ± 0.3
Screw M12 for fastening output shaft caps	1st stage 2nd stage 3rd stage	50 ± 6 80 ± 6 90° ± 5°	5 ± 0.6 8 ± 0.6
Screw M8 for fastening camshaft longitudinal retaining plate		24 ± 4	2.4 ± 0.4
Screw M8 for fastening camshaft gear		36 ± 4	3.6 ± 0.4
Screw M110 for fastening connecting rod caps	1st stage 2nd stage	60 ± 5 60° ± 5°	6 ± 0.5

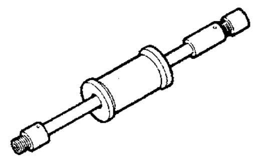
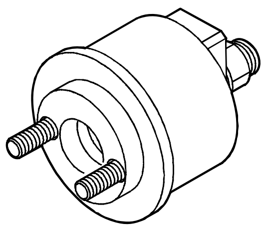
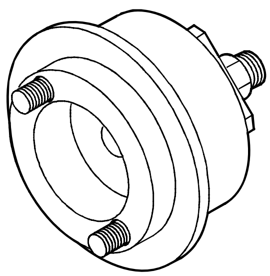
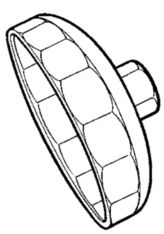
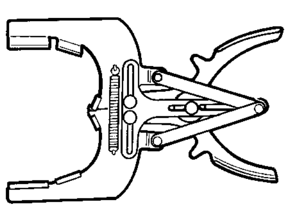
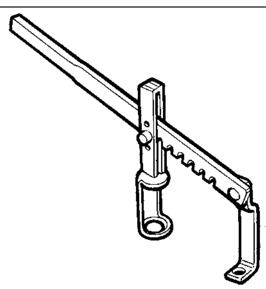
SECTION 5

Tools

Page

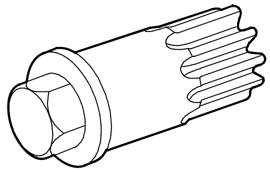
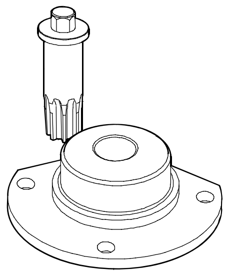
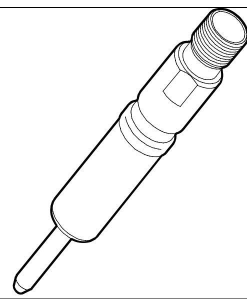
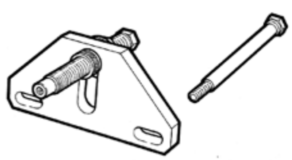
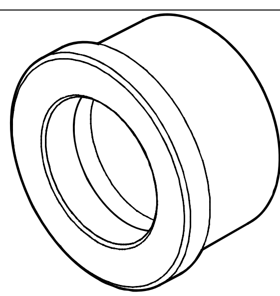
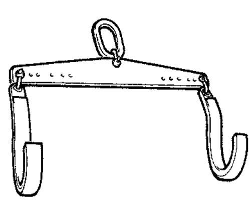
TOOLS		
TOOL NO.		DESCRIPTION
99305019		Kit for valve seat regrinding
99305047		Spring load tester
99322205		Revolving stand for overhauling units (700 daN/m capacity, 120 daN/m torque)
99340035		Injection pump gear extractor.
99340055		Tool to remove output shaft front gasket
99340056		Tool to remove output shaft rear gasket

TOOLS

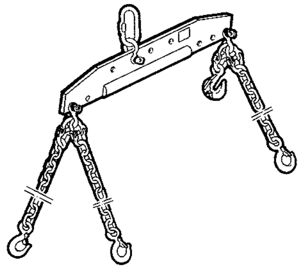
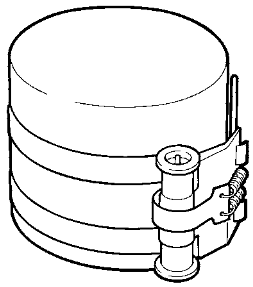
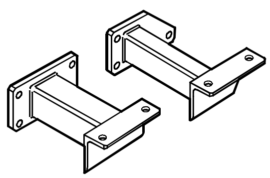
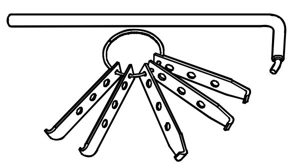
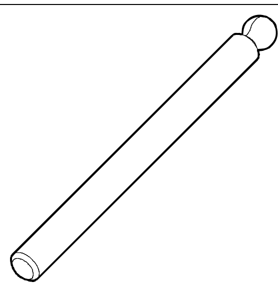
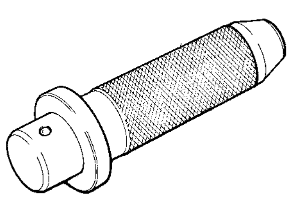
TOOL NO.		DESCRIPTION
99340205		Tool to remove injectors
99346252		Tool for fitting output shaft rear gasket
99346253		Tool for fitting output shaft rear gasket
99360076		Tool to remove oil filter (engine)
99360183		Pliers for removing/refitting piston rings (65 – 110 mm)
99360268		Tool for removing/refitting engine valves

Print P4D32N001 E

TOOLS

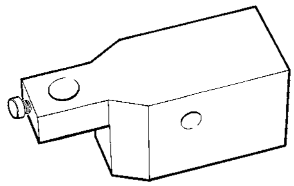
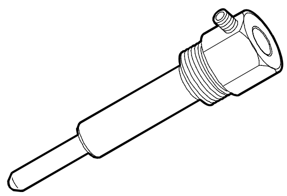
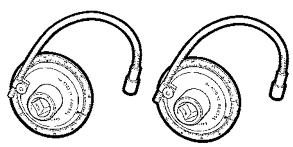
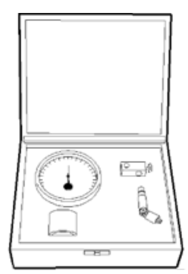
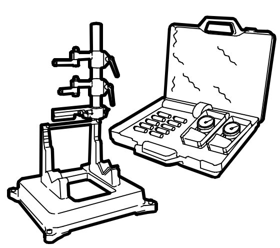
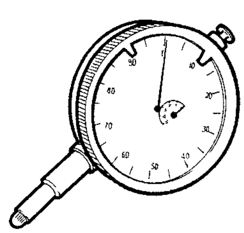
TOOL NO.		DESCRIPTION
99360330		Flywheel crank handle
99360339		Tool for stopping the engine flywheel
99360344		Adapter, cylinder compression test (use with 99395682)
99360351		Tool for flywheel holding
99360362		Beater for removing/refitting camshaft bushes (to be used with 993700069)
99360500		Tool for lifting the output shaft

TOOLS

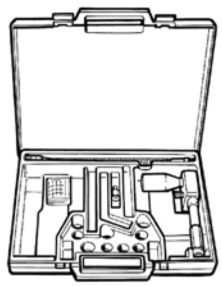
TOOL NO.		DESCRIPTION
99360595		Lifting rig for engine removal/refitting
99360605		Band for fitting piston into cylinder barrel (60 – 125 mm)
99361037		Brackets for fastening engine to revolving stand 99322205
99363204		Tool to remove gaskets
99365196		Tool for positioning the injection pump at the start of delivery
99370006		Interchangeable willow handgrip

Print P4D32N001 E

TOOLS

TOOL NO.		DESCRIPTION
99370415		Gauge base for different measurements (to be used with 99395603)
99395097		Tool to check top dead centre (use with 99395604)
99395216		Pair of gauges with ½" and ¾" square head for angle tightening
99395220		All-purpose goniometer/Inclinometer
99395363		Complete bush testing square
99395603		Dial gauge (0 – 5 mm)

TOOLS

TOOL NO.		DESCRIPTION
99395604		Dial gauge (0 – 10 mm)
99395682		Diesel fuel engine cylinder compression control device

Print P4D32N001 E

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

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

For engines equipped with electronic gearbox:

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

Respect of the Environment

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

Print P4D32N001 E

Part 2
F4AE NEF ENGINES

Sezione

PREFACE TO USER'S GUIDELINE MANUAL

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

Section 2 describes the type of fuel feed.

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

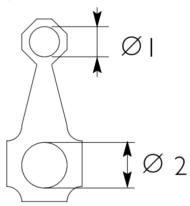
1. Mechanical part, related to the engine overhaul, limited to those components with different characteristics based on the relating specific duty.
2. Electrical part, concerning wiring harness, electrical and electronic equipment with different characteristics based on the relating specific duty.
3.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

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

SPECIAL REMARKS

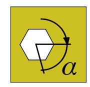
Diagrams and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with, (see next page) instead of giving descriptions of some operations or procedures.

Example



Ø 1 = housing for connecting rod small end bush

Ø 2 = housing for connecting rod bearings



Tighten to torque
Tighten to torque + angular value

SYMBOLS - ASSISTANCE OPERATIONS

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

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

Print P4D32N001 E

UPDATING

Section	Description	Page	Date of revision

SECTION 1

General specifications

Page

ELECTRICAL SPECIFICATIONS OF THE GENERATING SETS

Generating set	Assembled engine	Electrical specifications				
		Ratings	50 Hz		60 Hz	
			kVA	kW (*)	kVA	kW (*)
GE NEF 200E	**NEF 60 TE2**	Prime	200	160	225	180
		Stand By	220	176	248	198
GS NEF 200E	**NEF 60TE2**	Prime	200	160	225	180
		Stand By	220	176	248	198

(*) Power factor 0.8.

Prime Power

The Prime Power is the maximum power available with varying loads for an unlimited number of hours. The average power output during a 24 h period of operation must not exceed 80% of the declared prime power between the prescribed maintenance intervals and at standard environmental conditions. A 10% overload is permissible for 1 hour every 12 hours of operation.

Stand-by Power

This is the maximum power available for a period of 500 hours/year with a mean load factor of 90% of the declared stand-by power. No kind of overload is permissible for this use.

CORRESPONDENCE BETWEEN TECHNICAL CODE AND COMMERCIAL CODE

Technical Code	Commercial Code
F4AE0685A*F101	GE NEF 200E
F4AE0685A*F100	GE NEF 200E

Technical Code	Commercial Code
F4AE0685A*F101	GS NEF 200E
F4AE0685A*F100	GS NEF 200E

Print P4D32N001 E

LUBRICATION

Lubrication by forced circulation is achieved through oil rotary expansion pump, placed in the front part of the basement, driven by the straight-tooth gear splined to the shaft's bar hold.

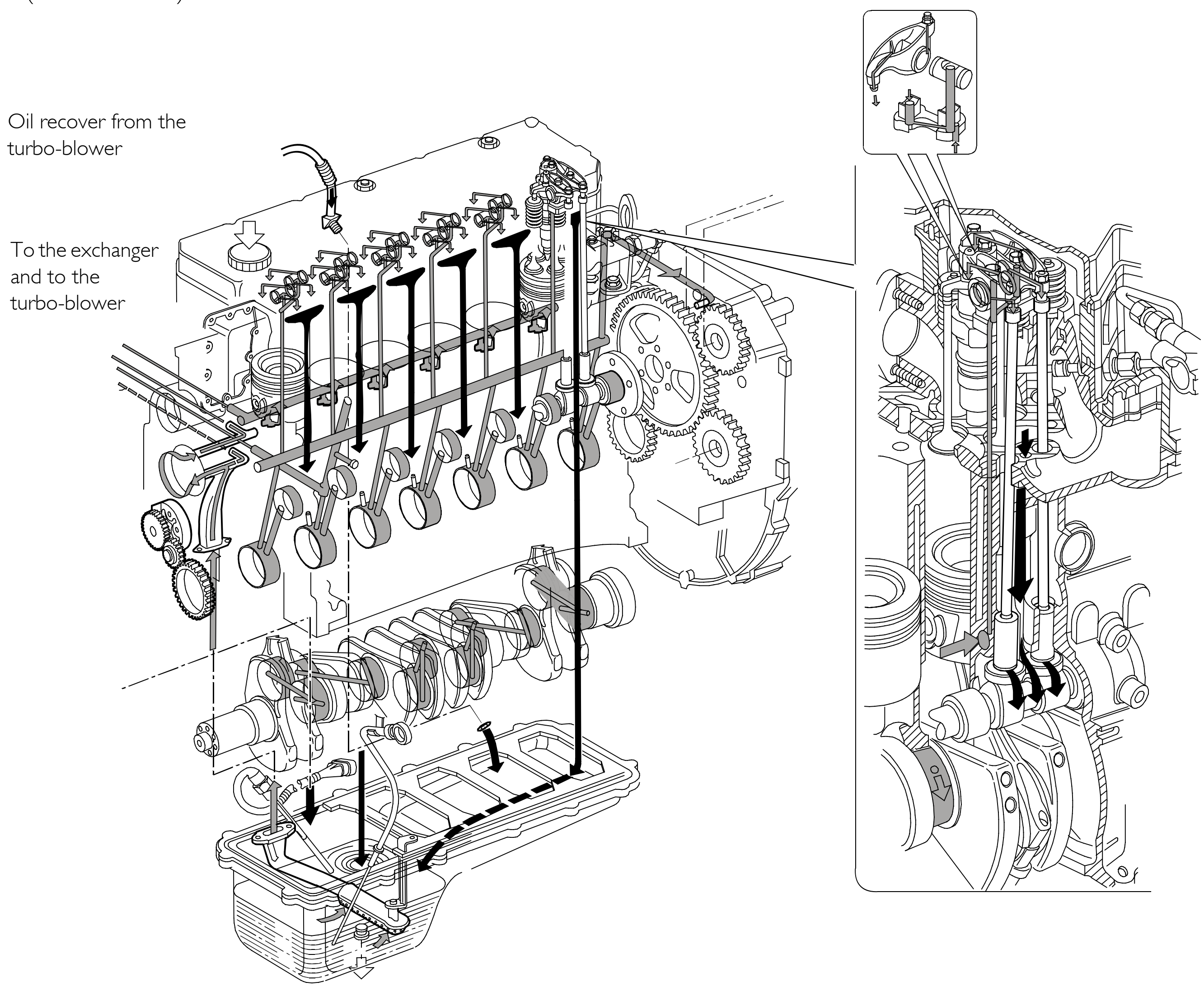
From the pan, the lubrication oil flows to the driving shaft, to the camshaft and to the valve drive.

Lubrication involves the heat exchanger (2,3), the turboblower for turbocompressed versions, and for any compressed air system.

All these components may often vary according to the specific duty.

Figure 1

(Demonstration)



Routing of oil under pressure

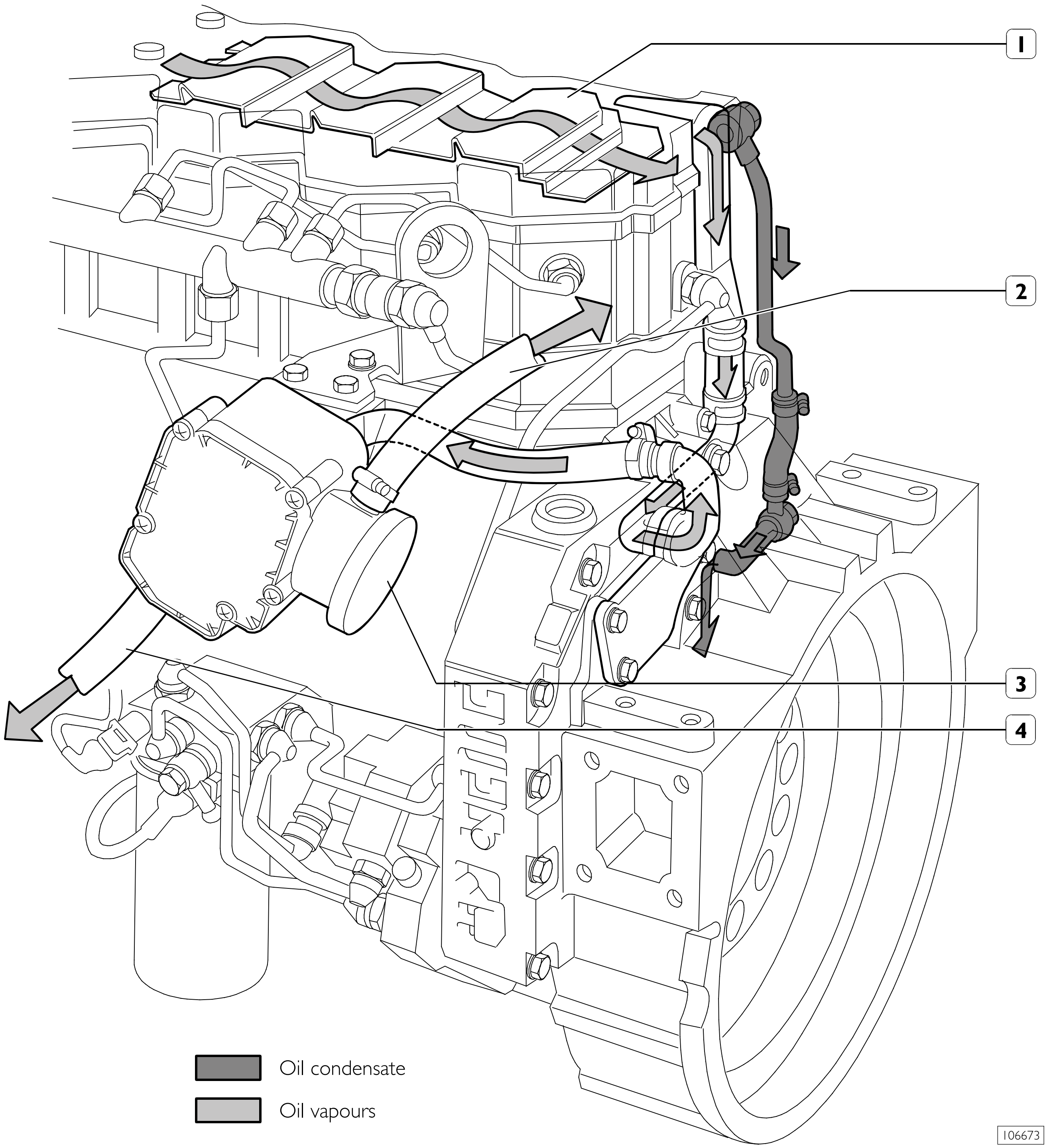
Routing of oil return by gravity to sump

Introduction of oil

LUBRICATION SYSTEM LAYOUT

OIL VAPOUR RECYCLING

Figure 2



1. Pre-separator - 2. Exhaust to the outside (temporary) - 3. Filter - 4. Return to engine.

The tappet cover houses the pre-separator (1), whose shape and position determines an increase in oil vapour outlet speed and condenses a part of vapours at the same time.

Condensate oil returns to the oil sump whereas the residual vapours are ducted, collected and filtered in the blow-by (3).

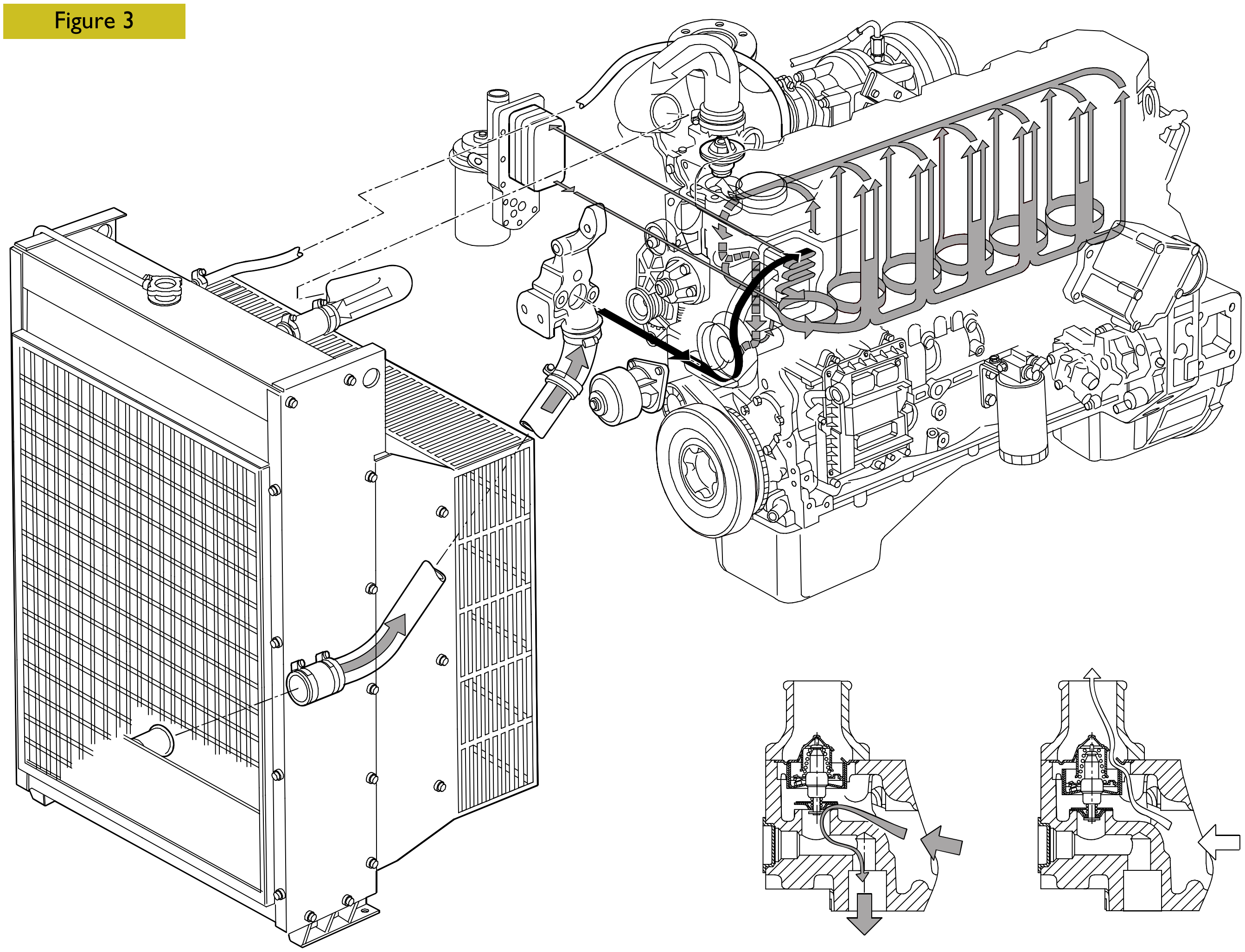
In the blow-by (3), part of the vapours condense and return to the oil sump whereas the remaining part is put into cycle again through pipe (2).

COOLING SYSTEM

The engine cooling system, closed circuit forced circulation type, generally incorporates the following components:

- expansion tank; placement, shape and dimensions are subject to change according to the engine's equipment;
- radiator, which has the duty to dissipate the heat subtracted to the engine by the cooling liquid. Also this component will have specific peculiarities based on the equipment developed, both for what concerns the placement and the dimensions;
- visc pusher fan, having the duty to increase the heat dissipating power of the radiator. This component as well will be specifically equipped based on the engine's development;
- heat exchanger to cool the lubrication oil: even this component is part of the engine's specific equipment;
- centrifugal water pump, placed in the front part of the engine block;
- thermostat regulating the circulation of the cooling liquid;
- the circuit may eventually be extended to the compressor, if this is included in the equipment.

Figure 3



Water leaving the thermostat

Coolant recirculating in the engine

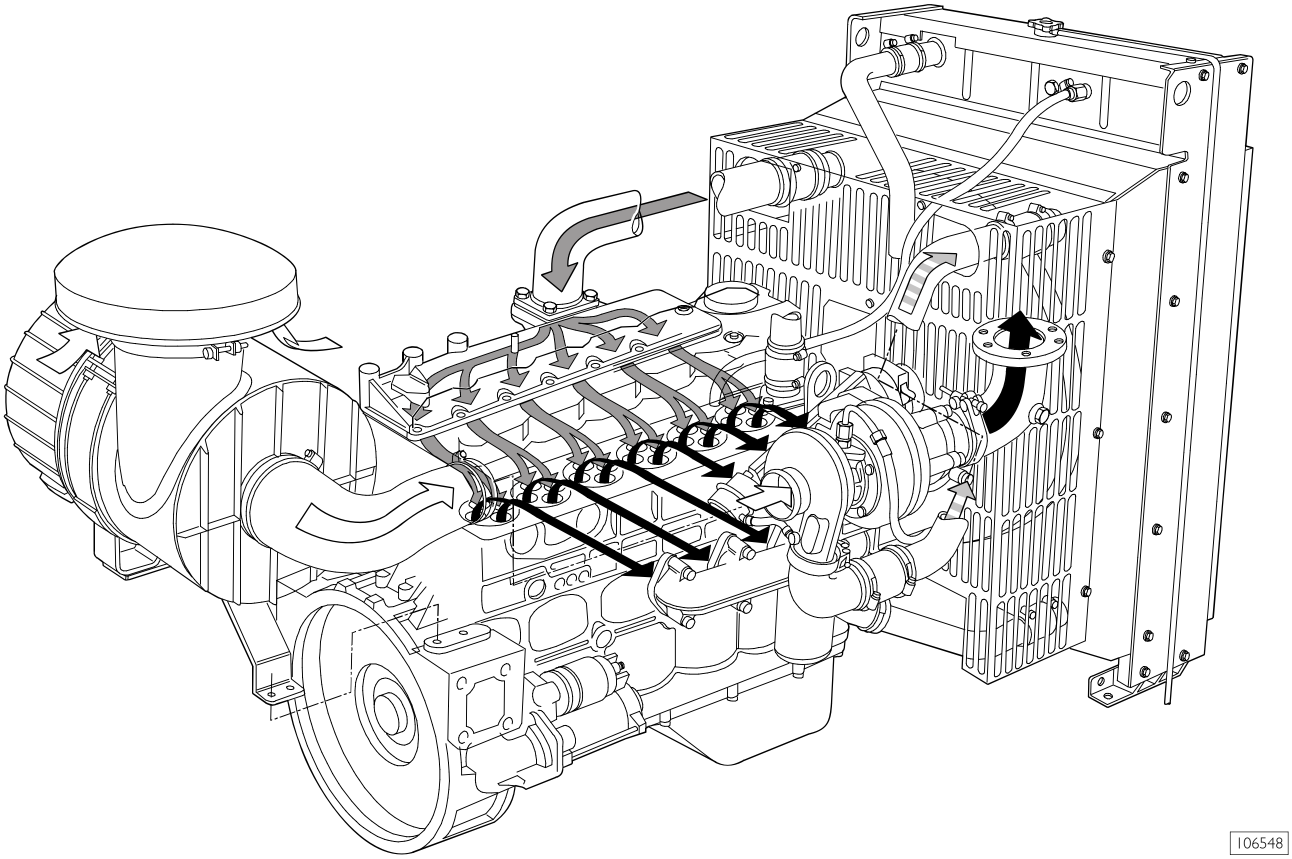
Water entering the pump

106529

DIAGRAM OF THE COOLING SYSTEM

AIR INDUCTION - BOOST DIAGRAM

Figure 4



Intake air

Compressed air to the heat exchanger

Refrigerated compressed air to the pistons

Exhaust gas

TURBOCHARGING DIAGRAM

Description

The turbocharger is composed by the following main parts: one turbine, one transforming valve to regulate the boost feeding pressure , one main body and one compressor.

During engine working process, the exhaust emissions flow through the body of the turbine, causing the turbine disk wheel's rotation.

The compressor rotor, being connected by shaft to the turbine disk wheel, rotates as long as this last one rotates, compressing the drawn air through the air filter.

The above mentioned air is then cooled by the radiator and flown through the piston induction collector.

The turbocharger is equipped with a transforming valve to regulate the pressure , that is located on the exhaust collector before the turbine and connected by piping to the induction collector.

It's funchon is to restrict the exhaust of the emissions , releasing part of them directly to the exhaust tube when the boost feeding pressure, over the compressor, reaches the prescribed bar value.

The cooling process and the lubrication of the turbocharger and of the bearings is made by the oil of the engine.

Print P4D32N001 E

SECTION 2

Fuel

Page

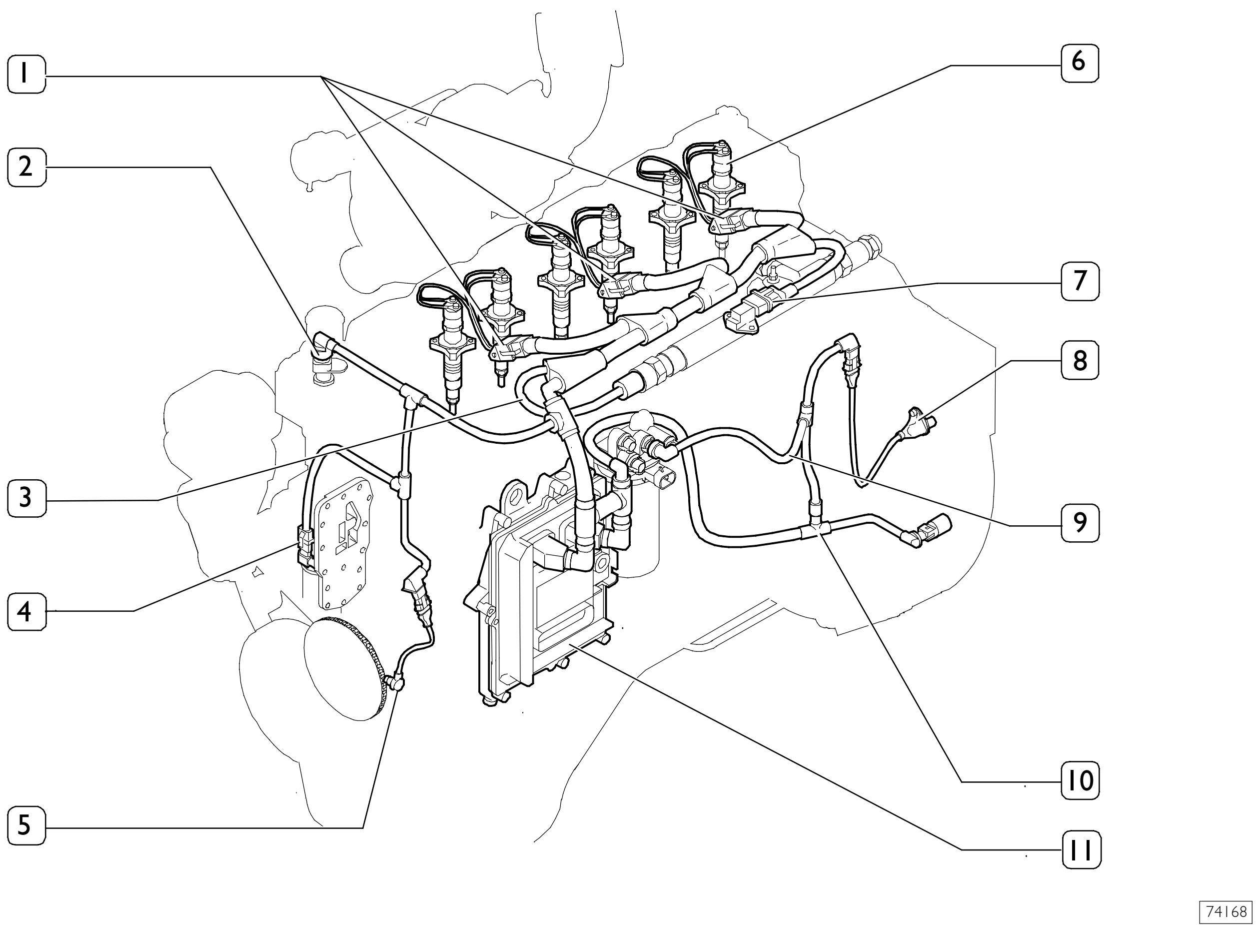
COMMON RAIL

General specifications

In order to reduce PARTICULATES emissions, very high injection pressures are required.
The Common Rail system allows injecting the fuel up to pressures reaching **1400 bar**, at the same time, the injection precision, obtained by the electronic system control, optimizes the engine performance, reducing emissions and consumption.

Electric system description

Figure 1



1. Connection to Electro-injectors - 2. Sensor monitoring temperature of engine's cooling liquid - 3. Fuel pressure sensor cable - 4. Sensor of engine's oil temperature and pressure - 5. Driving shaft sensor - 6. Electro-injector - 7. Temperature and air pressure sensor - 8. Camshaft sensor - 9. Fuel heater cable and fuel temperature sensor - 10. Pressure gauge cable - 11. EDC 7 gearbox.

Through the sensors, present on the engine, the ECU controls the engine operation.

Air pressure/temperature sensor

It is a component integrating a temperature sensor and a pressure sensor.

Fitted on the intake manifold, it measures the max. inlet air capacity to calculate precisely the fuel quantity to inject at every cycle.

The outlet voltage is proportional to the pressure or temperature obtained by the sensor.

Engine oil temperature and pressure sensor

Same as air pressure/temperature sensor, it is fitted on the engine oil filter, in a horizontal position.

It measures engine oil temperature and pressure.

Fuel pressure sensor

Assembled on a rail end, it measures the fuel pressure in the rail in order to determine the injection pressure.

The injection pressure value is used to control the pressure and to determine the electric injection control length.

Fuel temperature sensor

It is a sensor that is equal to the previous one.

It measures fuel temperature to provide the control unit with an index of the diesel fuel thermal state.

Coolant temperature sensor

It is a variable-resistance sensor suitable to measure the coolant temperature to provide the control unit with an index of the engine thermal state.

Output shaft sensor

It is an inductive sensor placed on the front engine part. Signals generated through the magnetic flow that is closed on the phonic wheel, change their frequencies depending on output shaft rotation speed.

Timing sensor

It is an inductive sensor placed on the engine rear left part. It generates signals obtained from magnetic flow lines that are closed through holes obtained on the keyed gear on the camshaft. The signal generated by this sensor is used by the ECU as injection phase signal.

Though being equal to the flywheel sensor, it is NOT interchangeable since it has a different outside shape.

System functionality

Self-diagnosis

The ECU self-diagnostic system checks signals coming from sensors by comparing them with threshold data.

Engine pre-heating resistance check

The pre-post heating is activated when even only one of the water, air or fuel temperature sensors signals a temperature that is less than 5 °C.

Phase recognition

By means of signals coming from camshaft sensor and flywheel sensor, the cylinder on which fuel must be injected is recognised upon startup.

Injection control

The control unit, depending on information coming from sensors, controls the pressure regulator, and changes pre-injection and main injection modes.

Closed-loop control for injection pressure

Depending on engine load, measured by processing signals coming from various sensors, the control unit controls the regulator in order to always have the optimum pressure.

Pilot and main injection spark advance control

The control unit, depending on signals coming from various sensors, computes the optimum injection point according to an internal mapping.

Idle speed control

The control unit processes signals coming from various sensors and adjusts the amount of injected fuel.
It controls the pressure regulator and changes the injection time of injectors.
Within certain thresholds, it also takes into account the battery voltage.

Maximum speed limiting

At 2700 rpm, the controlunit limits fuel flow-rate by reducing the injectors opening time.
Over 3000 rpm it deactivates the injectors.

Cut Off

Fuel cut off upon release is controlled by the control unit performing the following logics:

- ❑ it cuts off injectors supply;
- ❑ it re-activates the injectors shortly before idle speed is reached;
- ❑ it controls fuel pressure regulator.

Smoke control upon acceleration

With strong load requests, the control unit, depending on signals received by air inlet meter and engine speed sensor, controls the pressure regulator and changes the injectors actuation time, in order to avoid exhaust smoke.

Fuel temperature control

When the fuel temperature exceeds 75 °C (measured by the sensor placed on fuel filter) the control unit intervenes by reducing injection pressure.
If the temperature exceeds 90 °C, the power is reduced to 60%.

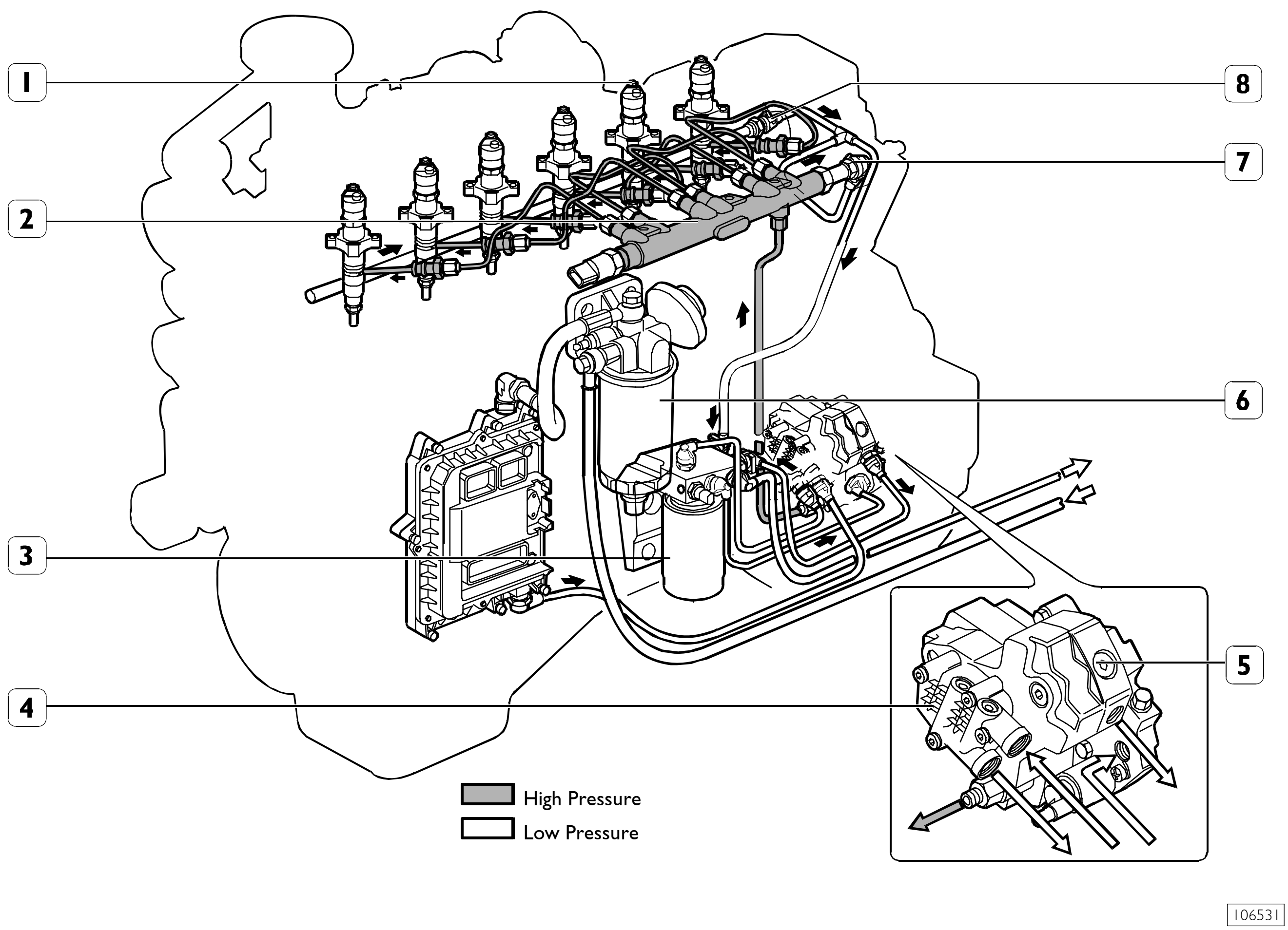
AC compressor engagement control (if fitted)

The control unit is able to drive engagement and disengagement of the electromagnetic compressor clutch depending on coolant temperature.
If the coolant temperature reaches about 105 °C, it disengages the clutch.

Print P4D32N001 E

WORKING PROCESS

Figure 2



1. Injector - 2. Common Rail - 3. Fuel filter - 4. Mechanical rotor pump - 5. High-pressure pump - 6. Prefilter assembled on chassis - 7. Rail overpressure valve - 8. Pressure limiter for fuel return.

The Common Rail system has a special pump that continuously keeps fuel at high pressure, independently from stroke and cylinder that has to receive the injection and accumulates fuel in a common duct for all injectors.

Therefore, fuel at the injection pressure computed by the ECU is always available at the injectors inlet.

When an injector solenoid valve is energised by the electronic control unit, the injection of fuel directly taken from rail takes place in the related cylinder.

The hydraulic system is implemented by a low-pressure circuit and a high-pressure circuit.

The high-pressure circuit is composed of the following pipings:

- piping connecting high-pressure pump outlet to rail;
- pipings supplying injectors from rail.

The low-pressure circuit is composed of the following pipings:

- fuel suction piping from tank to prefilter;
- pipings supplying the mechanical supply pump through the control unit heat exchanger, manual priming pump and prefilter;
- pipings supplying the high-pressure pump through the fuel filter.

The fuel draining circuit from rail and from injectors and the high-pressure pump cooling circuit complete the system.

FUEL SYSTEM DIAGRAM

The following figure outlines the common rail injection system with pump CP3.3.

The pressure regulator, located upstream from the high-pressure pump, governs the necessary flow of fuel on the low-pressure system. Then the high-pressure pump supplies the rail correctly. This solution, pressurizing only the necessary amount of fuel, improves energy efficiency and limits fuel heating in the system.

The pressure relief valve (2), fitted on the high-pressure pump, has the function of keeping the regulator inlet pressure constant at 5 bar, irrespective of the efficiency of the fuel filter and of the system upstream.

The action of the pressure relief valve (2) causes an increase in the flow of fuel in the cooling circuit of the high-pressure pump through the pipe (16) for the intake and exhaust from the pipe (8).

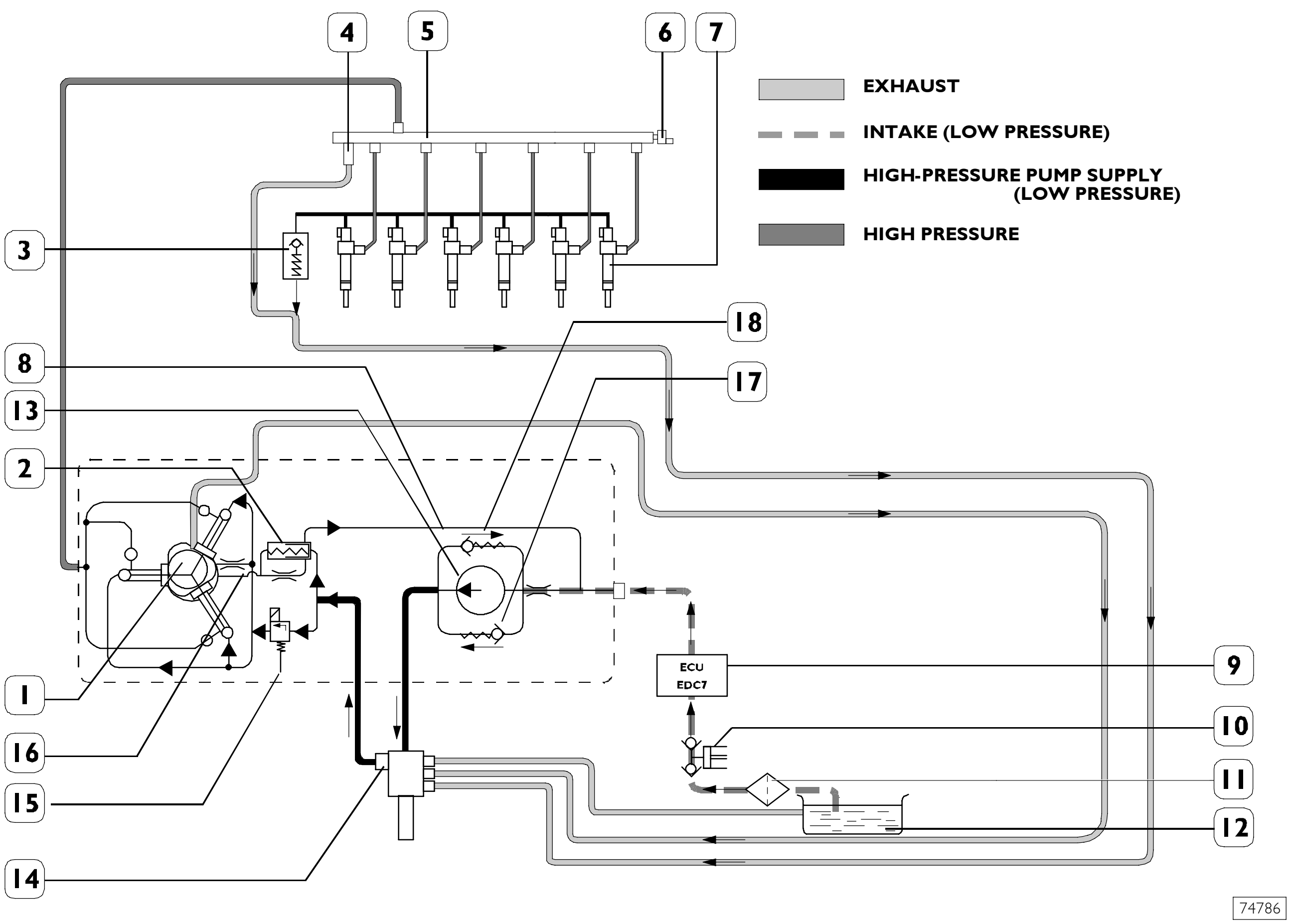
The pressure relief valve housed on the cylinder head, fitted on the return of the electro-injectors (3), limits the fuel return flow from the electro-injectors to a pressure of 1.3 ÷2 bar.

In parallel with the mechanical supply pump there are two by-pass valves.

The by-pass valve (18) is used to run off the fuel from the outlet of the mechanical pump at its inlet when the pressure at the inlet of the fuel filter exceeds the allowed limit.

The by-pass valve (17) is used to fill the fuel system through the manual priming pump (10).

Figure 3



1. High-pressure pump - 2. Pressure relief valve on the high-pressure pump, 5 bar. - 3. Pressure relief valve fitted on the fuel return from the electro-injectors, from 1.3 to 2 bar. - 4. Rail pressure relief valve. - 5. Common Rail.- 6. Pressure sensor. - 7. Electro-injector. - 8. Return feed line. - 9. Heat exchanger of the control unit. - 10. Mechanical priming pump. - 11. Prefilter fitted on the chassis (if applicable)- 12. Fuel tank - 13. Mechanical fuel pump. - 14. Fuel filter. - 15. Pressure regulator. - 16. Pipe for cooling high-pressure pump. - 17. By-pass valve. - 18. By-pass valve.

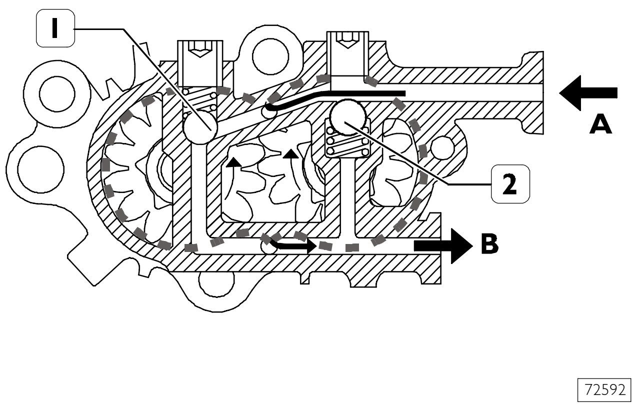
 Print P4D32N001 E

MECHANICAL FEEDING PUMP

The gear pump is fitted on the back of the high-pressure pump and feeds it. It is driven by the shaft of the high-pressure pump.

Ordinary working condition

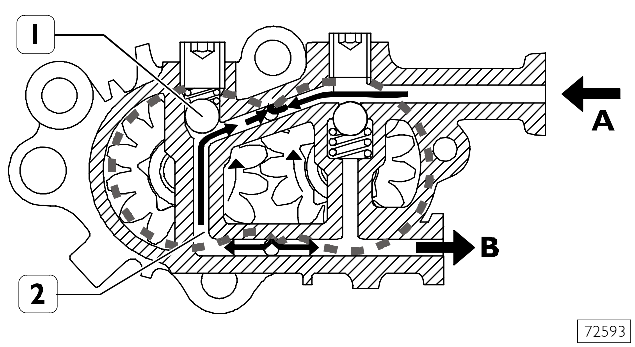
Figure 4



A- Fuel entry flowing from the tank. B- Fuel exhaust to filter, I - 2 By-pass valves in close position.

Overpressure condition in exhaust unit

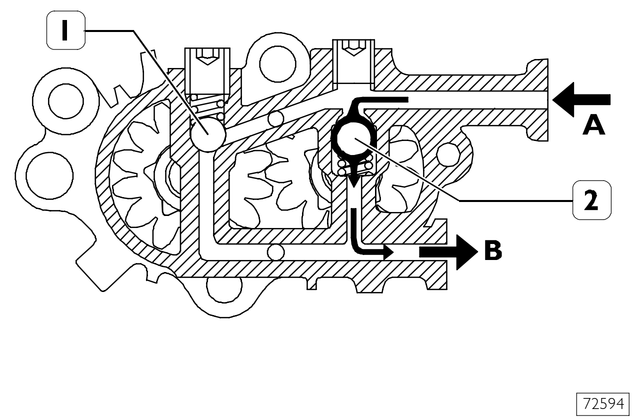
Figure 5



The by-pass valve (I) is activated in case of overpressure on B Exhaust unit. The actual pressure, overcoming the resistance of the valve's spring (I), connects the exhaust with the entry through the gallery (2).

Jettison condition

Figure 6



The dump by-pass valve (2) is activated in case, when the engine is off, it is necessary to fill the feeding system through the priming pump. In this condition the by pass valve (I) keeps closed while the dump by-pass valve (2) opens up due to the pressure effect on the entry unit so the fuel flows to the exhaust unit B.

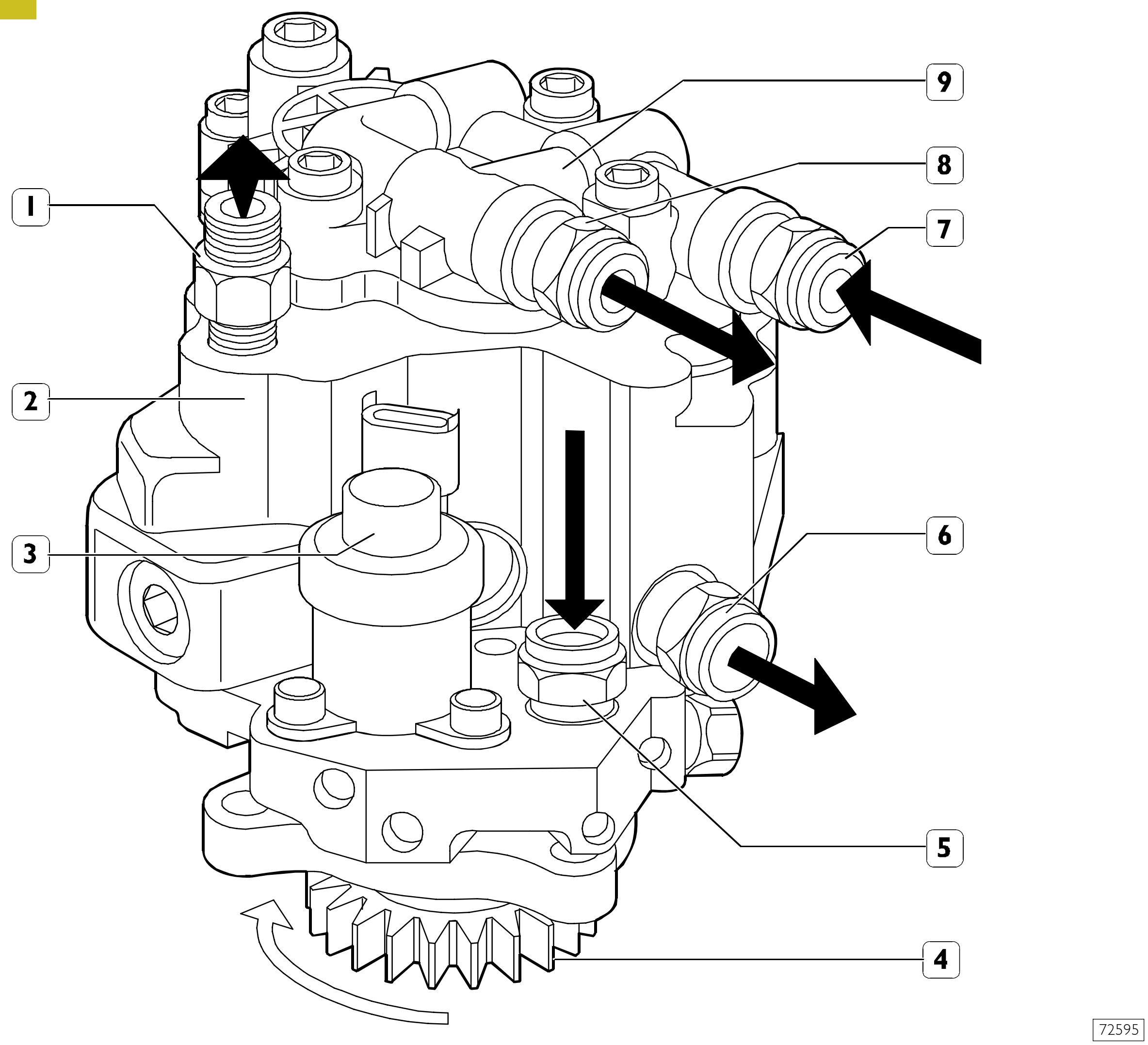
NOTE The mechanical feeding pump cannot be replaced separately, therefore it must not be disassembled from the high pressure pump.

CP3.3 HIGH PRESSURE PUMP

It is a pump with 3 radial pumping elements driven by the timing gear and needs no timing. The mechanical feeding pump driven by the high pressure pump's shaft is assembled to the rear side of the high pressure pump.

NOTE The high pressure pump unit - feeding pump is not subject to overhaul , therefore it must not be disassembled neither the fixing screws must be tampered.
The only allowed interventions concern control gear and pressure regulator replacement.

Figure 7

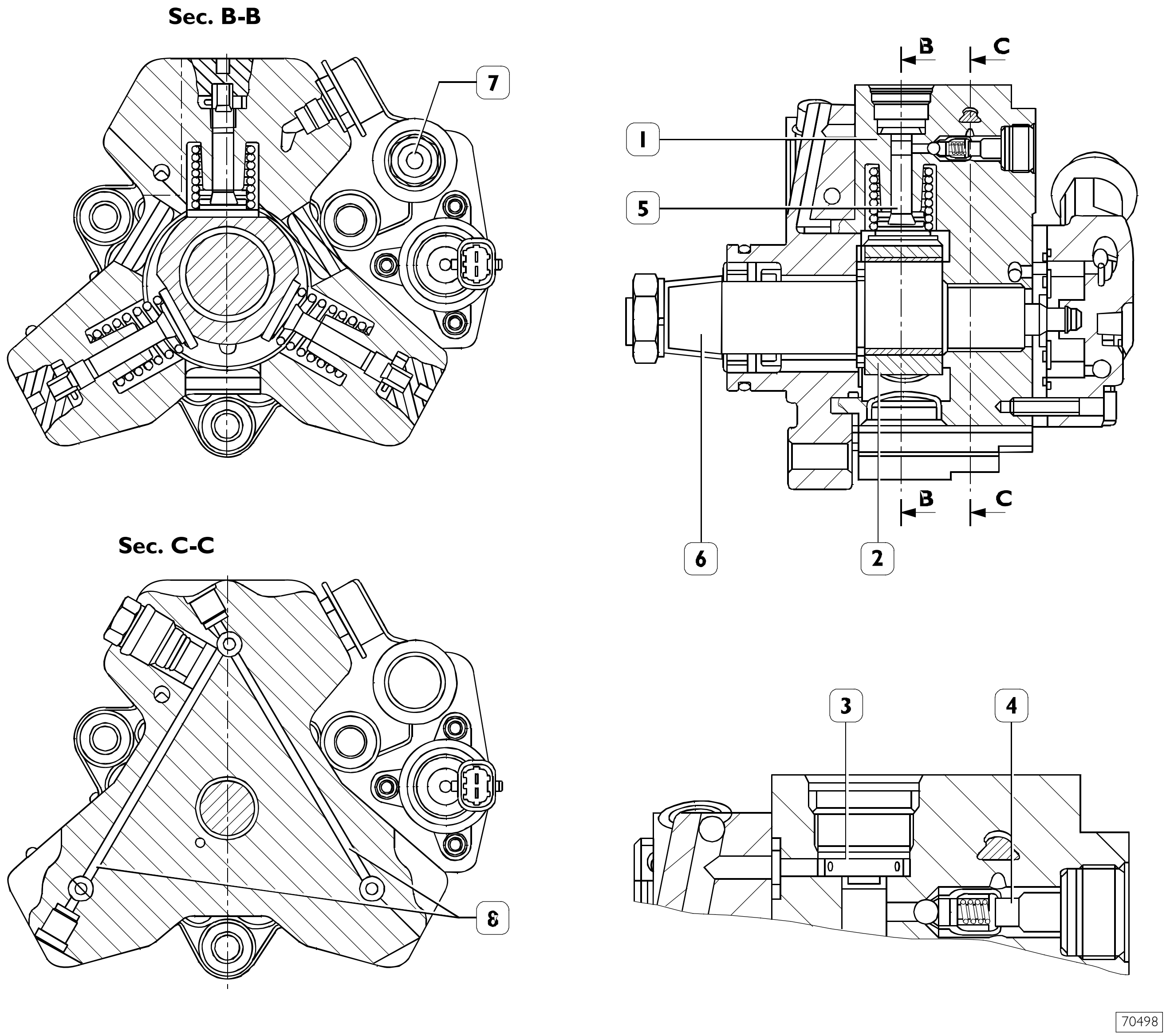


1. Fuel exhaust connector to rail - 2. High pressure pump - 3. Pressure regulating gauge - 4. Driving gear - 5. Connector to fuel entry flowing from filter - 6. Connector to fuel exhaust to filter support - 7. Connector to fuel entry flowing from engine control module heat exchanger - 8. Connector to fuel exhaust flowing from mechanic pump to filter - 9. Mechanical feeding pump.

Print P4D32N001 E

High pressure pump-inside structure

Figure 8



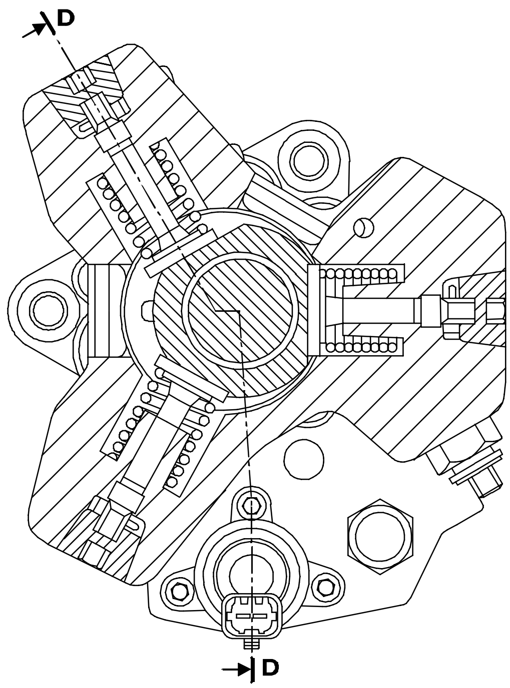
1. Cylinder. – 2. Three-lobe element. – 3. Cap intake valve. – 4. Ball delivery valve. – 5. Piston. – 6- Pump shaft. – 7. Low-pressure fuel inlet. – 8. Pumping elements supplying fuel ducts.

Every pumping unit is composed of:

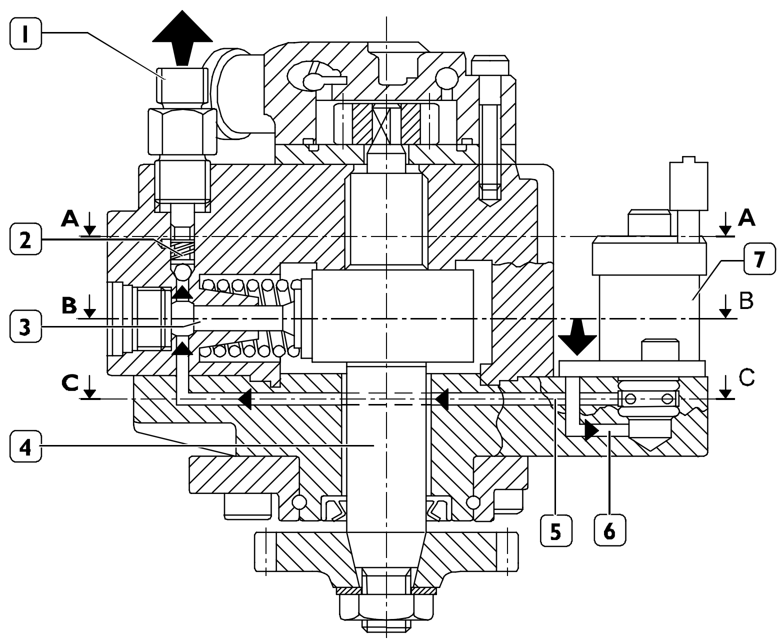
- a piston (5) actuated by a three-lobe element (2) floating on the pump shaft (6). The element (2), being floating on a misaligned part of the shaft (6), when the shaft rotates, does not rotate therewith but is only translated in a circular movement along a wider radius, with the resulting alternate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

Working principle

Figure 9



Sec. B - B



Sec. D - D

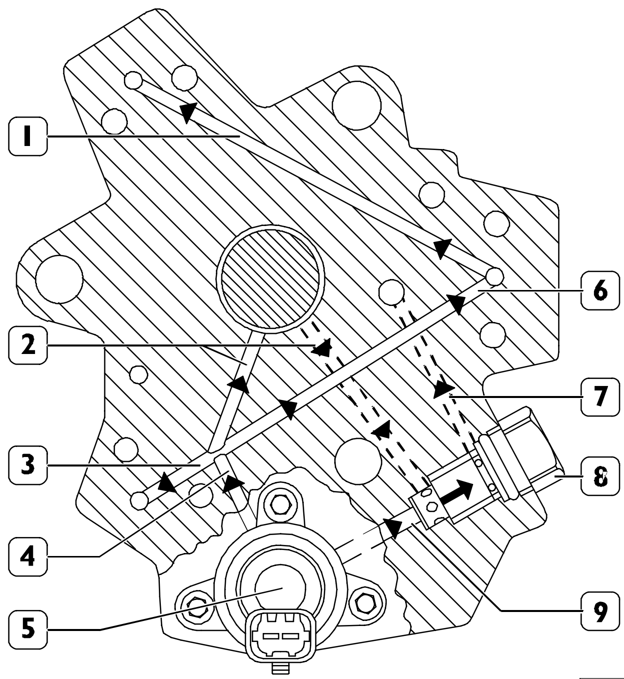
72597

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.

The pumping element (3) is orientated towards the pump's camshaft (4). During the intake phase, the pumping element is fed through the feeding line (5). The quantity of fuel to flow to the pumping element is determined by the pressure regulating gauge (7). The pressure regulating gauge, according to the PWM command received by the engine control module, stops the fuel flow to the pumping element.

During compression phase of the pumping element, the fuel achieves the level of pressure determining the opening of the by-pass valve to common rail (2), feeding it through the exhaust unit (1).

Figure 10



Sec. C - C

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.

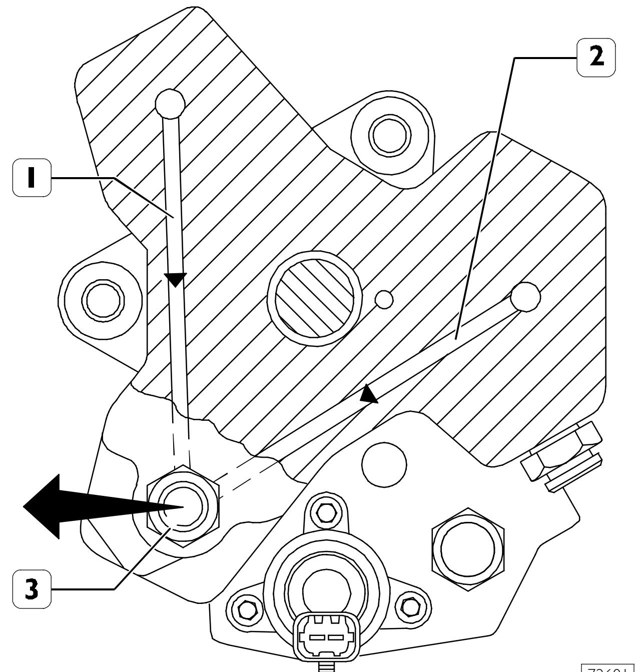
Picture 10 shows the fuel runs at low pressure inside the pump; the following elements are clearly visible: the main feeding line to the pumping elements (4); the feeding lines to the pumping elements (1-3-6), the duct lines run for the pump lubrication (2), the pressure gauge (5), the flow limiting valve to 5 bar (8) and the fuel exhaust flue (7).

The pump shaft is lubricated by the fuel through the feeding and recovery lines.

The pressure gauge (5) determines the quantity of fuel to feed the pumping elements: the fuel in excess flows through the exhaust gallery (9).

The limiting valve to 5 bar, in addition to recovering fuel exhaust as a collector has also function to keep the pressure constant to 5 bar limit at gauge entry.

Figure 11



Sec. A - A

1. Fuel exhaust flue - 2. Fuel exhaust gallery - 3 Fuel exhaust flowing from pump with connector to high pressure pipe for common rail.

Figure 11 shows the fuel flow under high pressure running through the exhaust galleries of the pumping elements.

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 between **250** and **1400** bars by the electronic control unit, through the pressure regulator solenoid valve.

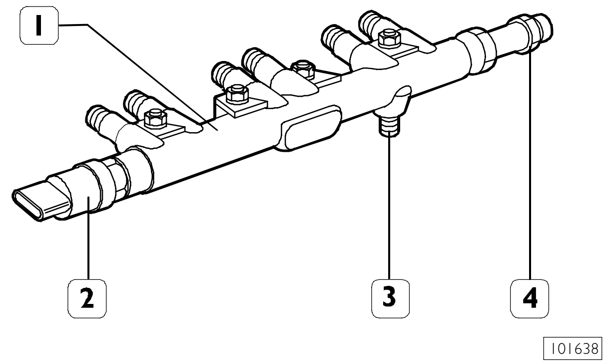
The pump is lubricated and cooled by the fuel.

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

Figure 12



1. Rail. – 2. Pressure sensor - 3. Fuel inlet from high-pressure pump. – 4. Overpressure valve.

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

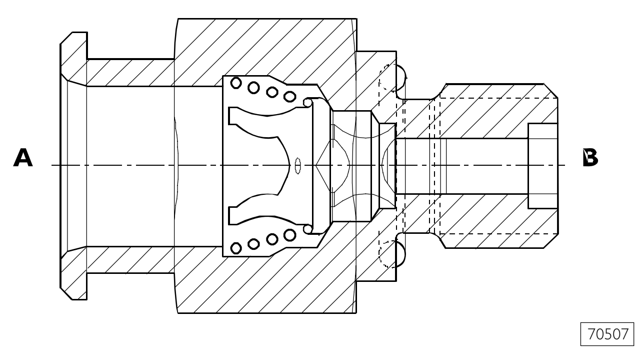
It anyway has enough volume as to minimise system spikes and the use of plenum chambers caused by injectors openings and closings and by the high-pressure pump operation. This function is further enabled by a calibrated hole being set downstream of the high-pressure pump.

A fuel pressure sensor (4) 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.

PRESSURE LIMITER FOR FUEL RETURN

It is housed on the rear of the cylinder head, and adjusts the pressure of fuel returning from injectors at a pressure 1.3 and 2 bars. By guaranteeing this pressure to the return fuel, the fuel vapours formation inside injectors is avoided, optimising fuel spraying and combustion.

Figure 13



A To tank – **B** From injectors

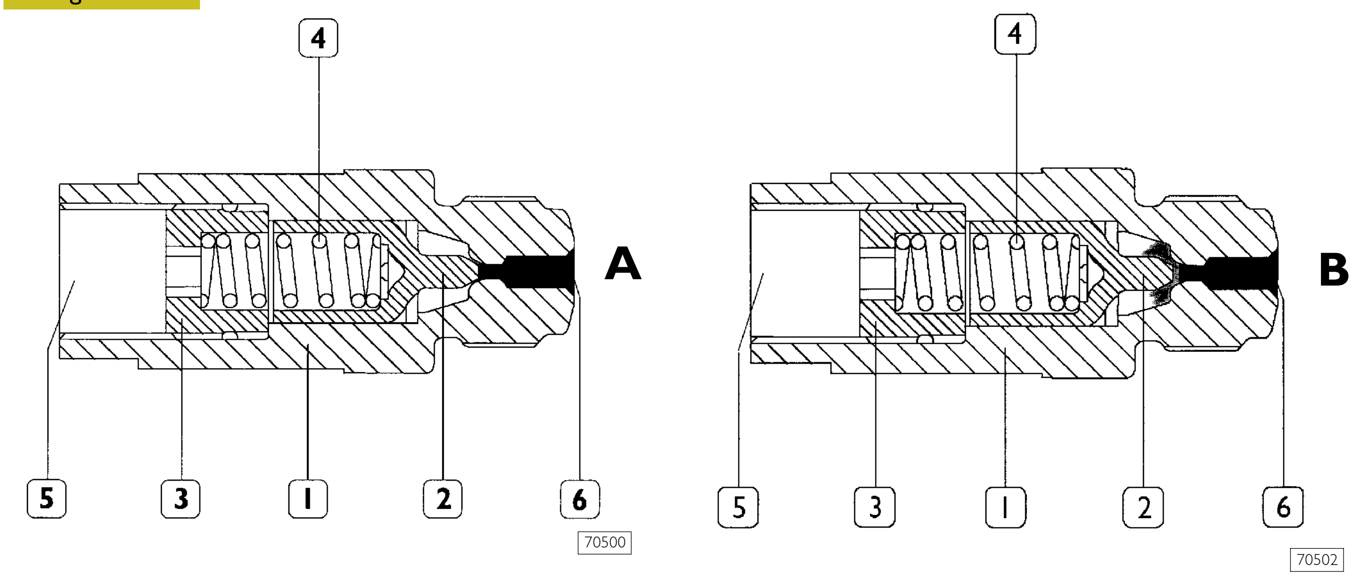
BOOST GAUGE VALVE

The boost valve (1750 bars) is assembled to the rail with the purpose to protect the system's components in case of excessive increase of pressure within the high pressure system. Pressure limiter.

The valve can be single-stage (as the one showed in the picture) or double-stage with double working limit (1750 bars and 800 bars).
In the second case, when the pressure within the high pressure system reaches 1750 bars, the valve is activated as a single-stage one to exhaust the fuel and consequently reduce the pressure until reaching safety parameters. Then it provides mechanically gauging the pressure into rail to aprx. 800 bars. This way the valve enables working of the engine for extended timing at limited performances, avoiding the fuel's overheating and preserving the exhaust galleries.

If the above mentioned valve is activated, the engine control module excludes by isolation the pressure gauge and records the errore code 8.4.
The pump will flow the maximum delivery to the rail.

Figure 14



1. Body – 2. Small piston – 3. Stop – 4. Spring – 5. Direct tank discharge – 6. Seat on rail.

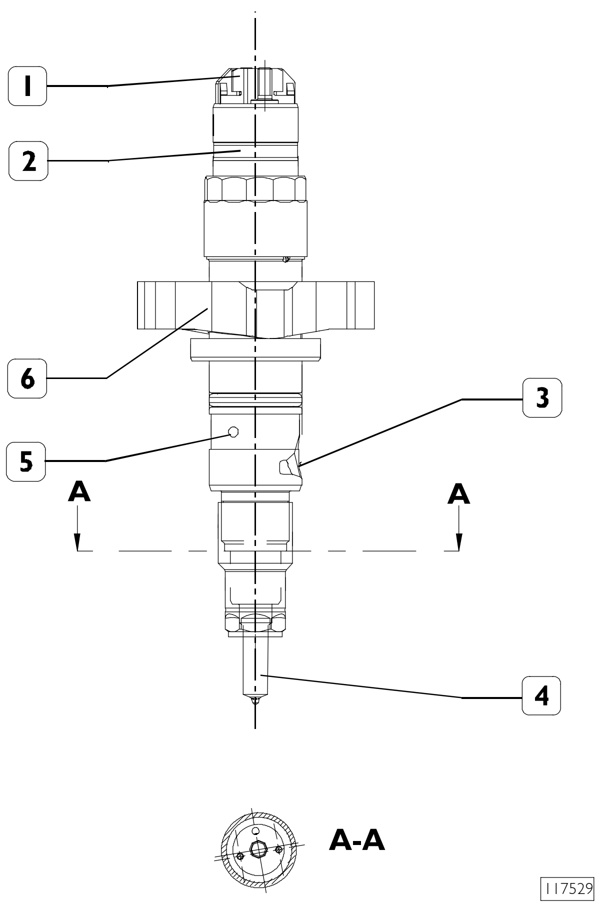
A Normally, the tapered piston end keeps closed the discharge towards the tank.

B If the 1750 bar fuel pressure is exceeded in rail, the small piston is displaced and the excess pressure is discharged into the tank.

ELECTRO-INJECTOR

The injector is similar as construction to the traditional ones, apart from the absence of plunger return springs.

Figure 15

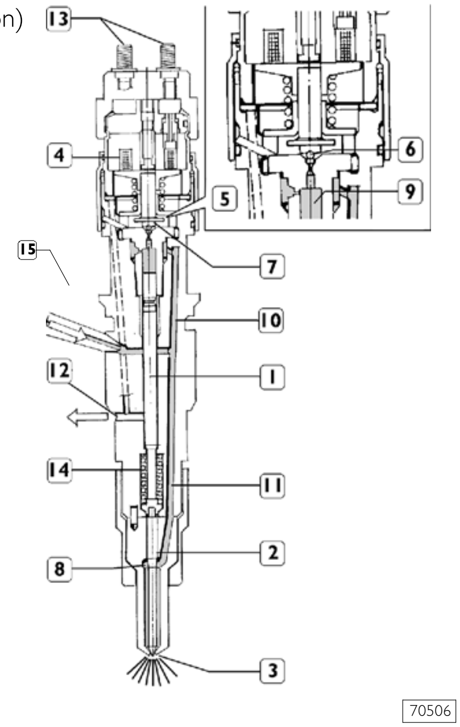


1. Electric connection - 2. Coil - 3.High-pressure fuel inlet - 4. Nozzle - 5. Control fuel outlet - 6. Mount bracket .

Injection start

Figure 16

(Demonstration)



When coil (4) is energised, it makes shutter (6) move upwards. The control volume (9) fuel flows towards flow duct (12) making a pressure drop occur in control volume (9). Simultaneously the fuel pressure into pressure chamber (8) makes plunger (2) lift, with following fuel injection into the cylinder.

Injection end

When coil (4) is de-energised, shutter (6) goes back to its closing position, in order to re-create such a force balance as to make plunger (2) go back to its closing position and end the injection.

NOTE The injector cannot be overhauled and therefore it must not be disassembled.

Print P4D32N001 E

SECTION 3

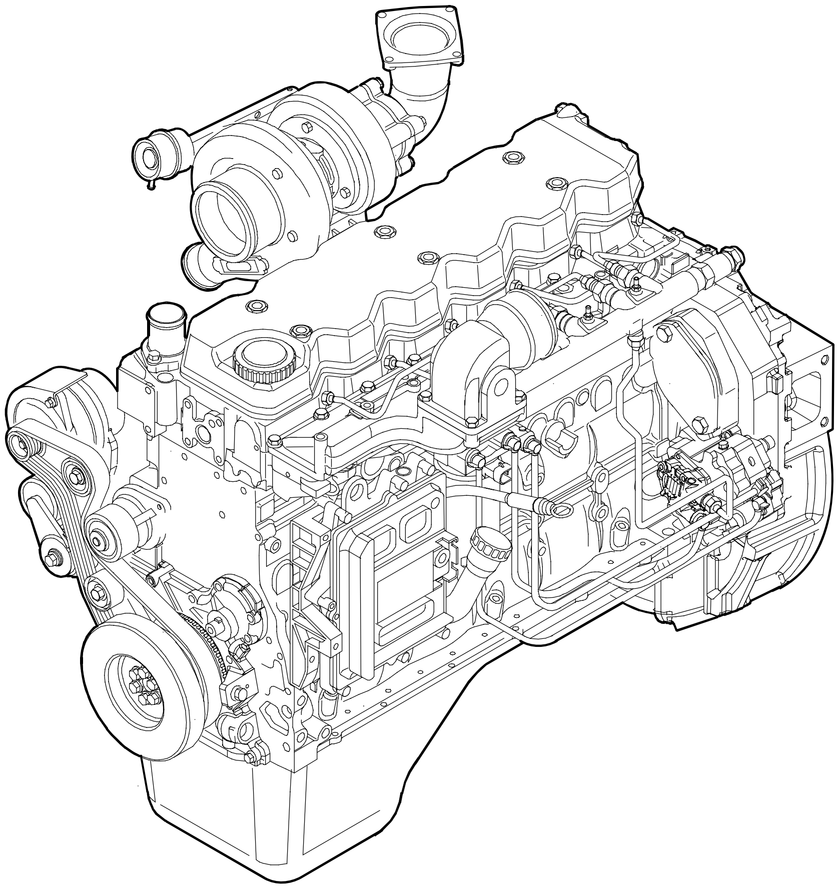
Power Generation application

Page

Print P4D32N001 E

GENERAL SPECIFICATIONS

Figure 1 (Demonstration)



74190

The NEF F4AE0685 engines have a 4-stroke Diesel cycle, turbocharged with 6 cylinders and 4 valves per cylinder.

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

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

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

The section herein described is composed or four sections:

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

Clearance data - 6 cyl.

			F4AE0685A	
	Type		*F100	*F101
ϱ	Compression ratio		17 : 1	
	Max. output	kW (HP) rpm	193 1500	215 1800
	Max. torque	Nm (kgm) rpm	- -	1140 (114) 1800
	Loadless engine idling	rpm	-	
	Loadless engine peak	rpm	-	
	Bore x stroke Displacement	 cm^3	102 x 120 5880	
	TURBOCHARGING Turbocharger type		with aftercooler HOLSET HX35W	
	LUBRICATION		Forced by gear pump, relief valve single action oil filter	
bar	**Pump characteristics** **Oil pressure with engine hot:** **- a 750 rpm** **- a 4200 rpm**	 **bars** **bars**	 2 4	
	COOLING **Water pump control** **Thermostat** - start of opening	 °C	By centrifugal pump, regulating thermostat, heat exchanger, intercooler Through belt 81 ± 2	
15W40 ACEA E3-E5	FILLING engine sump engine sump + filter	 liters liters	 15 ~ 17	

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

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

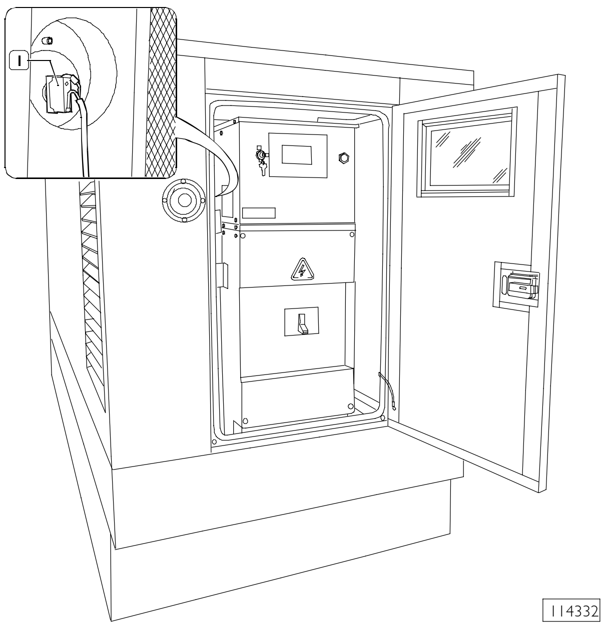
 Print P4D32N001 E

PART ONE - MECHANICAL COMPONENTS

REMOVING AND REFITTING THE SOUND-PROOFING UNIT

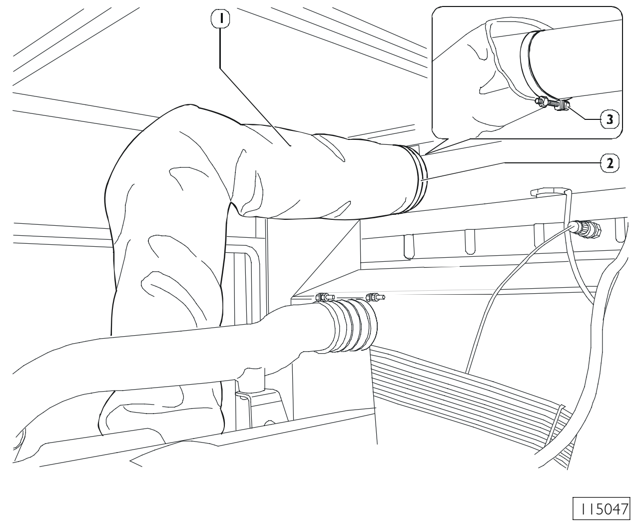
Removal

Figure 2



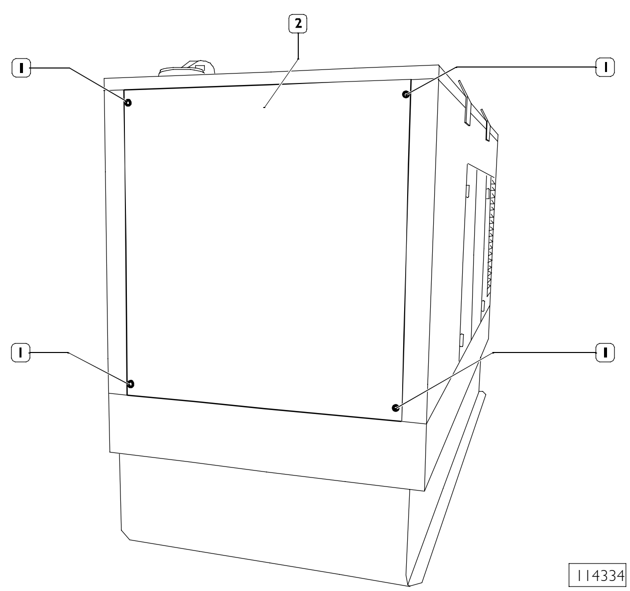
Operate from the control board side and disconnect the electric connection (1) from the stop button.

Figure 3



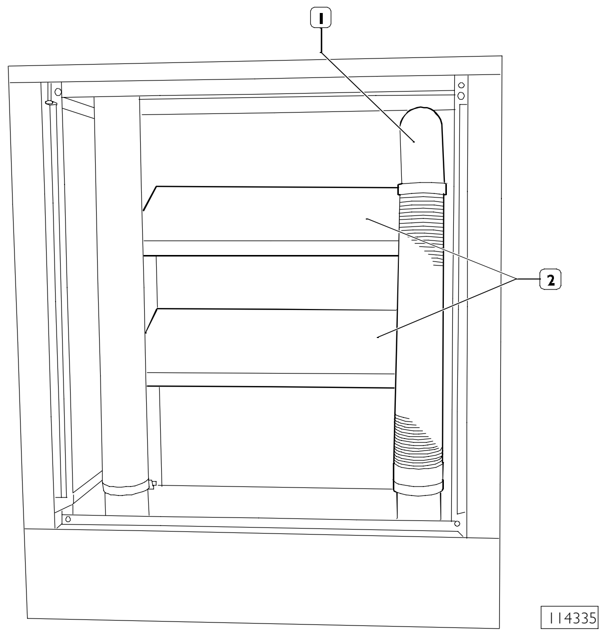
Operate inside the soundproofing unit and move back the exhaust pipe cover (1) in order to reach the stop collar (2), then loosen the fastening screw (3).

Figure 4



Operate from the exhaust pipes side and loosen the covering panel (2) fastening nuts (1) and remove it.

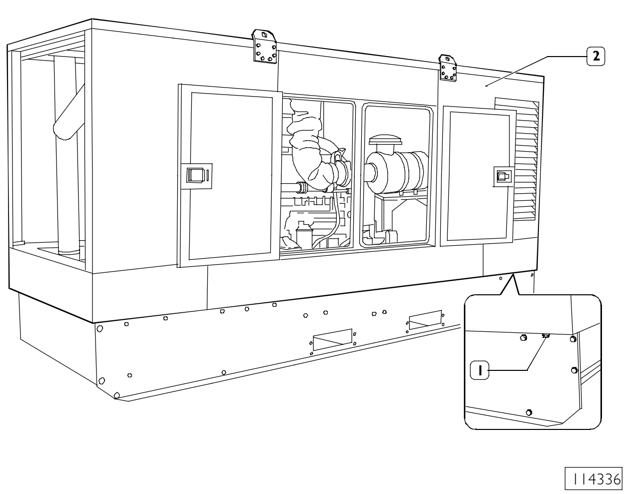
Figure 5



Remove pipe (1) from its seat.

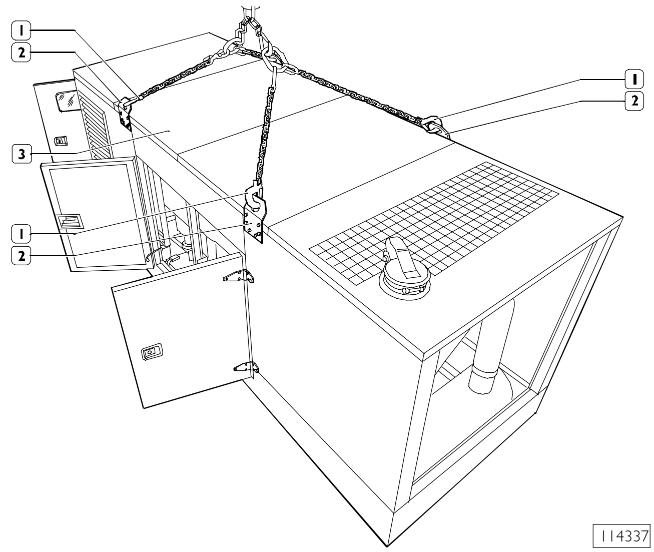
NOTE When removing pipe (1), pay attention not to damage the cooling unit air ducts (2).

Figure 6



Operate along the perimeter and loosen the soundproofing unit (2) fastening screws (1).

Figure 7



Secure hooks with chain catches (1) into the slots (2) provided for the purpose and, by means of a proper hoisting device, lift the soundproofing unit (3) and remove it with the aid of another operator.

NOTE Make sure that the rods have all the same length in order to lift the soundproofing unit along the vertical axis, thus reducing interferences.

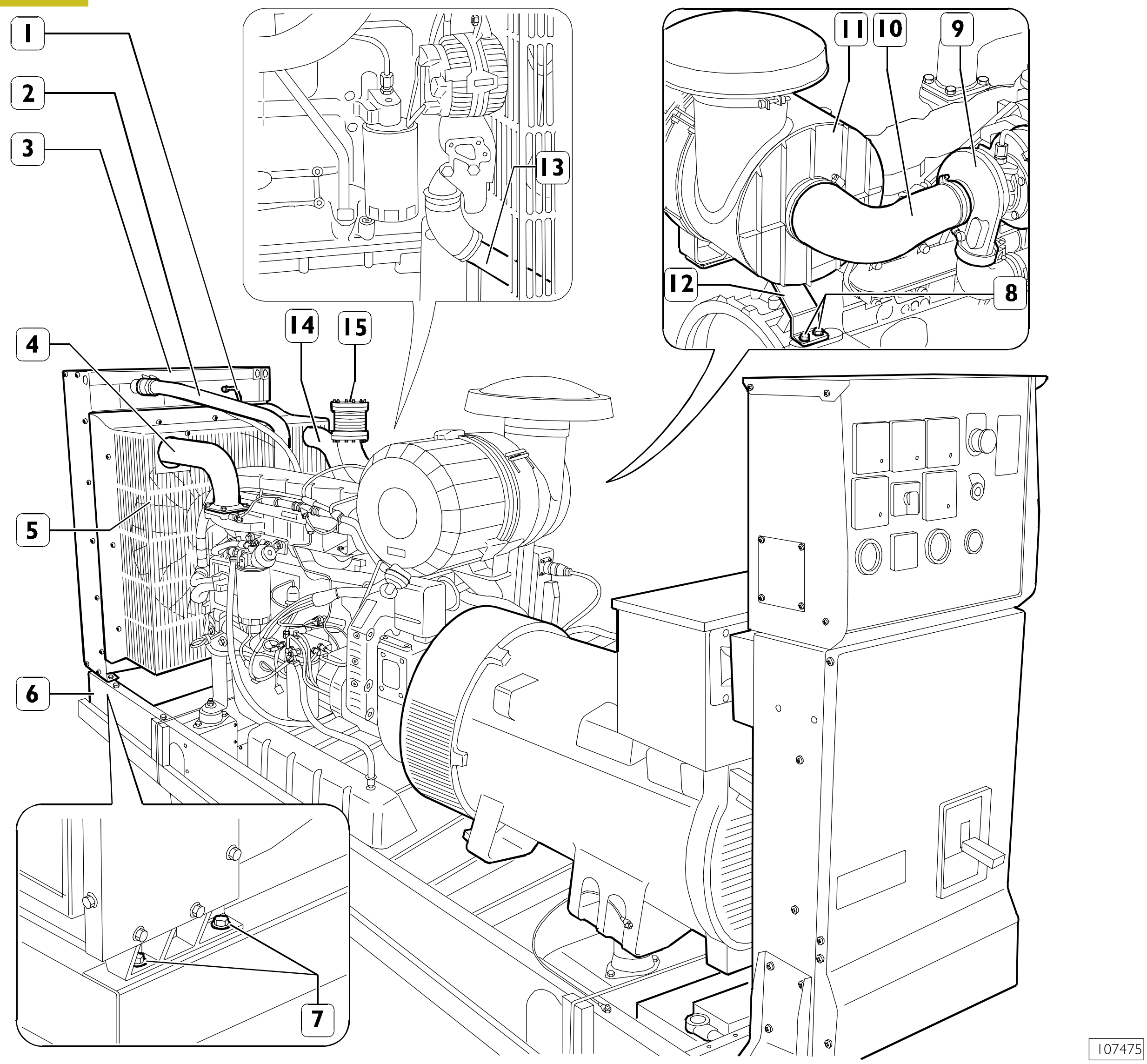
Refitting

To refit, reverse the removal instructions.

Print P4D32N001 E

REMOVING AND REFITTING THE RADIATOR ASSEMBLY AND ENGINE AIR CLEANER

Figure 8



Removal

Remove the fan safety grilles (5) by undoing the relevant fasteners.
Place a container under the pipe (13) to collect the coolant.
Disconnect and remove the pipe (13) together with the sleeves by undoing the clamps.
Disconnect the air pipes (4) and (14) from the air exchanger and from the engine, then remove it from its seat. Disconnect the exhaust pipe (15) from the system.
Disconnect and remove the coolant pipes (1) and (2).
Block the radiator assembly (3) appropriately, then detach it from the crankcase (6) by undoing the fasteners (7) on both sides.
Remove the radiator assembly from its seat, taking care over any interference with the fan.
Disconnect the air hose (10) from the turbocharger of the turbine (9).
Remove the air cleaner (11) by undoing the fasteners (8) and remove it from its seat together with the support (12).

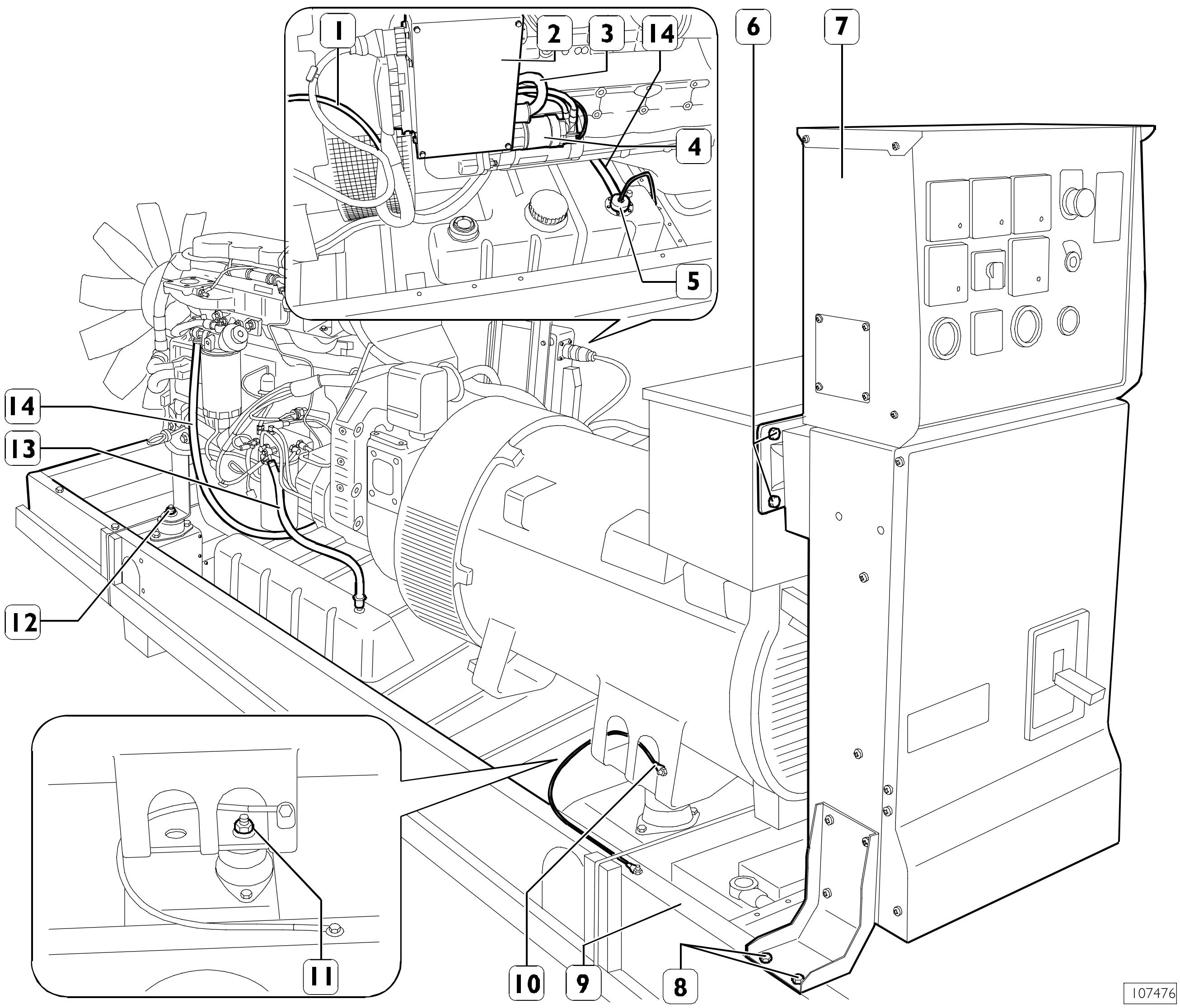
Refitting

Reverse the removal instructions; restore the coolant system as described in the procedure on page 39.

NOTE Check the state of wear of the rubber couplings.

REMOVING AND REFITTING THE ENGINE/GENERATOR

Figure 9



Removal

Disconnect the electrical system by detaching the cables from the battery.
Disconnect the positive and negative cables from any clamps, detach them from their attachments on the starter motor (4), then remove them.
Block the control panel (7) suitably for subsequently removing it from its seat.
Take the cover off the interface box (2) and disconnect the connections of the wiring (3).
Disconnect the wiring (3) from the clamps along its route, then fasten it appropriately to the control panel (7).
Remove the fasteners (6) and (8) from both sides of the control panel.
Extract the control panel from its seat.
Disconnect the diesel pipes (13) and (14) from the engine, taking care to collect any diesel coming down.
Disconnect the electrical connections of the diesel level signal (5) and earth (10).
Fit a lifting tool onto the specific hooks on the engine and keep it under tension.
Remove the fixing nuts (11) and (12) from the four supports of the engine/generator assembly.
Separate the engine/generator assembly from the crankcase (9).

Refitting

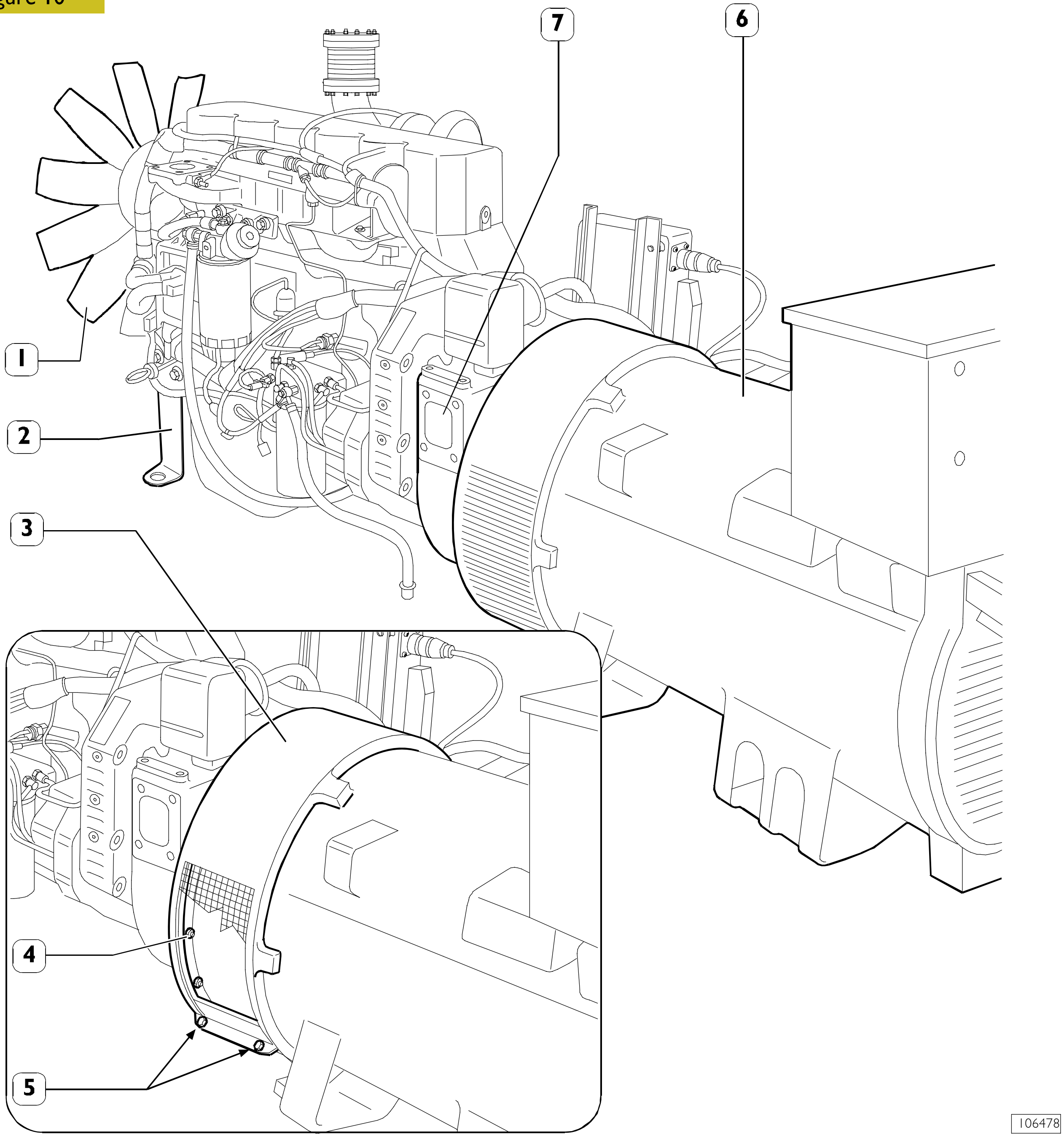
For refitting, reverse the steps described for removal.

NOTE Check the integrity of the rubber-type blocks in the supports (11) and (12) of the pipes and electrical connections.

 Print P4D32N001 E

SEPARATING THE GENERATOR FROM THE ENGINE

Figure 10



Remove the fan (1).

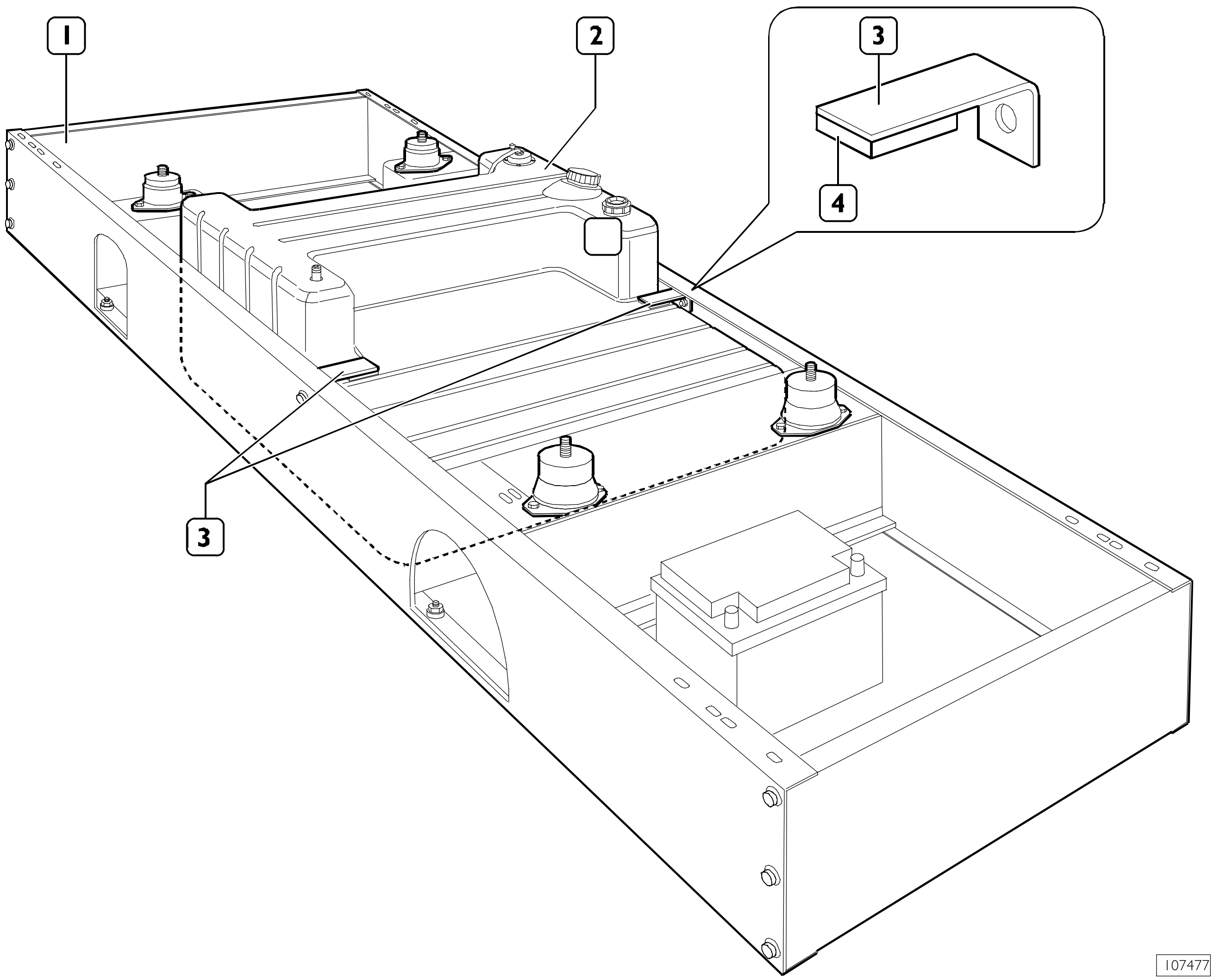
Remove the brackets of the supports (2).

Separate the generator from the engine as follows:

- remove the safety grilles (3) by undoing the fasteners (5), unscrew all the nuts (4) connecting the generator (6) to the housing of the engine flywheel (7);
- block the generator suitably and separate it from the engine.

DETACHING THE TANK FROM THE BASE

Figure 11



The tank is blocked inside the base (1) with angular brackets (3).
To remove the tank (2) from its seat, remove the brackets (3) by undoing the relevant fasteners.

At the time of assembly, check that the adhesive rubber blocks (4) are sound and positioned by the brackets (3).

NOTE At the time of assembly, check that the adhesive rubber blocks (4) are sound and positioned by the brackets (3).

ENGINE OVERHAUL

Preface

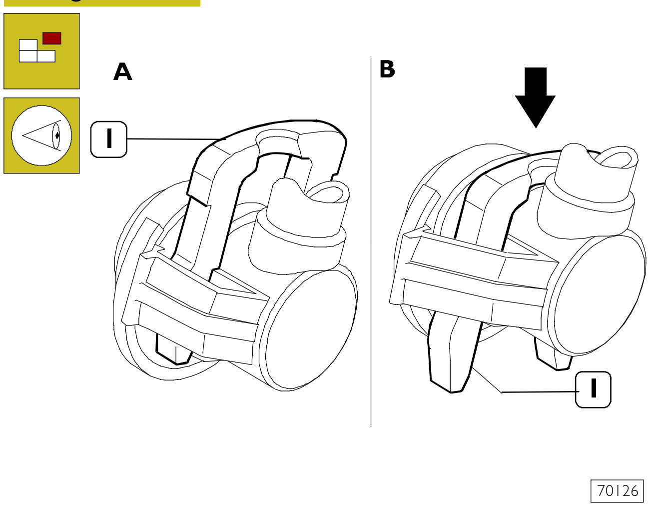
Some of the operations described in this section can be carried out directly with the engine connected to the generator.

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

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

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

Figure 12



Press clamp (1), as shown in Figure **B,** to disconnect the low pressure fuel pipes from the corresponding connections.

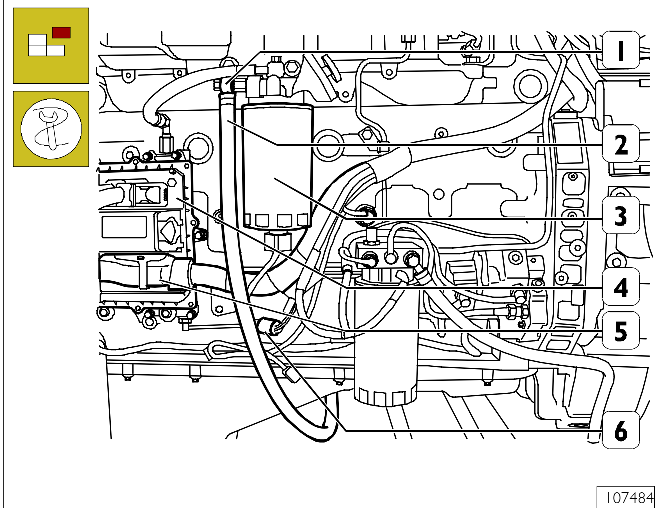
After disconnecting the pipe, reset the clamp (1) in locking position (Figure **A**) to prevent distortions.

NOTE Because of the high pressure in the pipelines running from the high pressure pump to the rail and from this last one to the electro-injectors, it is absolutely required NOT to:

- disconnect the pipelines when the engine is working;
- re-use the disassembled pipelines.

Engine setting operations for the assembly on turning stand

Figure 13

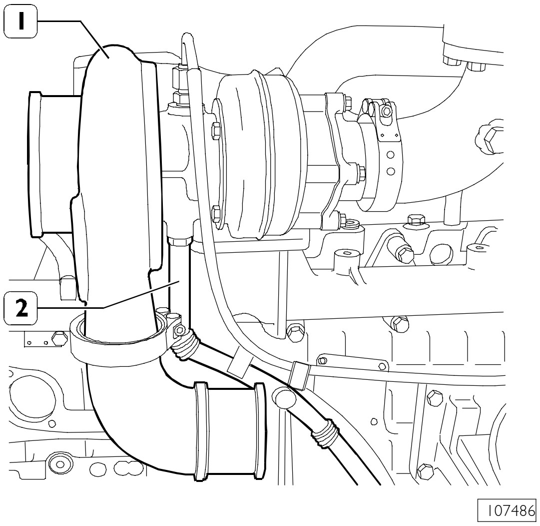


In order to apply the brackets 99361037 to the engine block to fix it on to the stand for the overhaul, it is necessary to perform the following operations on the left hand side of the engine:

- Using the tool 99360073 disassembly the fuel filter (6) and remove it from the support (1);
- Disconnect the electrical connection (2) from the support (1) and the heater's one (placed on the filter support as well);
- Disconnect the fuel low pressure pipelines (3-4-5) from the support (1);
- Disconnect pipeline (9) from the support (1);
- Remove the sustaining support bracket (1) from the block.

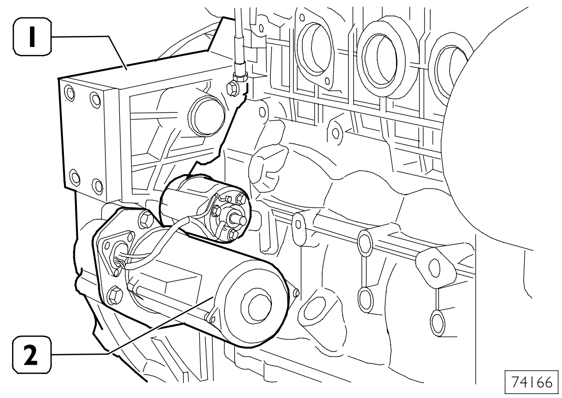
On the right hand side of the engine:

Figure 14



Remove the screws and remove the oil pipe (2) from the turbocharger pipe (1) and from the engine block.

Figure 15



Disconnect the oil feed pipeline unlocking the three screws M12x25. Remove the O-ring from the pipe.

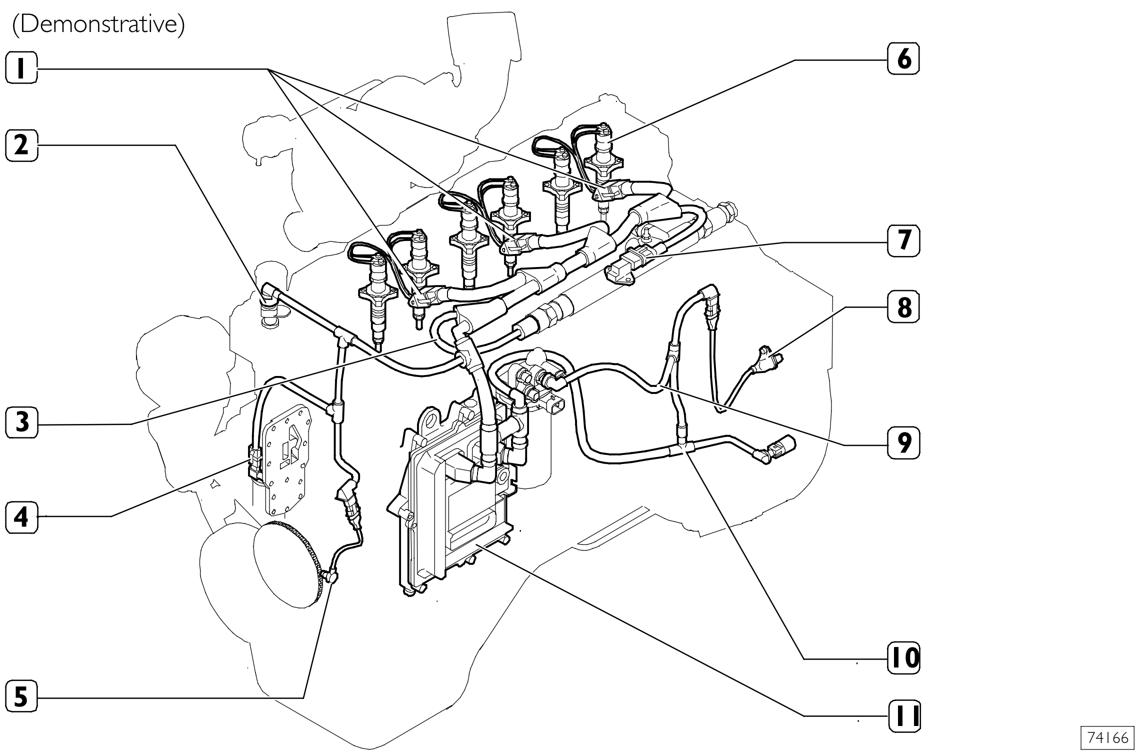
Remove the starter (2) from the flywheel housing (1).

Apply brackets 99361037 to engine block and use them to secure the engine to the revolving stand 99322205. Remove sump cap and drain out oil.

Remove the fan from the output shaft pulley.

Disassembly of application components

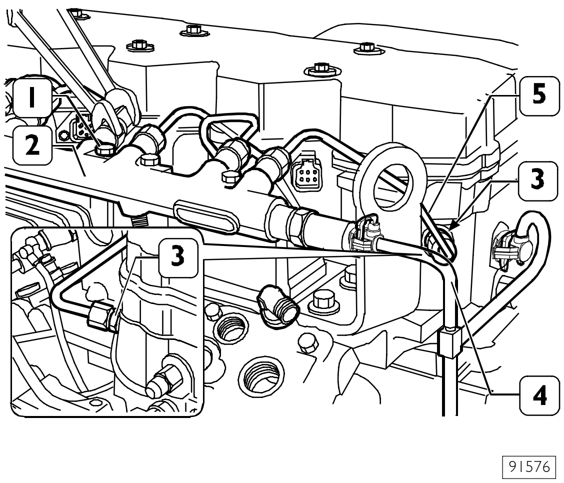
Figure 16 (Demonstrative)



1. Connections for Electro-injectors - 2. Engine cooling liquid temperature's sensor - 2. Cable of the fuel pressure sensor - 4. Sensor of engine's oil temperature and pressure - 5. Driving shaft sensor - 6. Electro-injector - 7. Temperature - air pressure sensor - 8. Timing system sensor - 9. Cable of fuel heater and fuel temperature's sensor - 10. Cable of pressure regulating gauge - 11. EDC 7 gearbox.

Disconnect the engine cable by disconnecting the connectors: (1) from injector wiring (6); (7) air pressure/temperature sensor; (3) fuel pressure sensor; (11) ECU; (10) high pressure pump sensor; (8) timing sensor; (2) engine coolant temperature sensor on thermostat; (5) engine speed sensor.

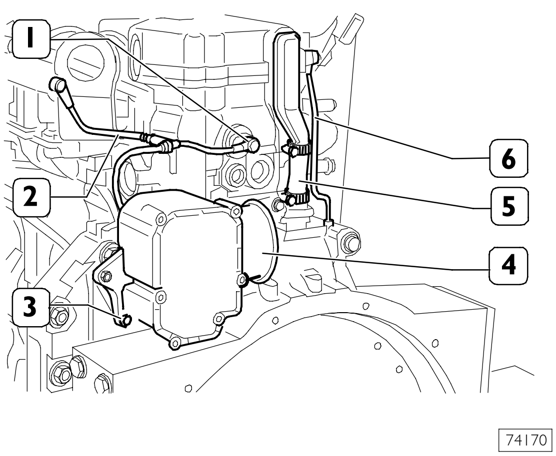
Figure 17



Disconnect from the rail (2): the fuel pipe (4) according to procedures described in Figure 12. Disconnect fuel pipes (5) from rail (2) and injector manifolds (3).

Remove the screws (1) and disconnect the rail (2).

Figure 18



Disconnect the pipeline (2) from the fuel recover pressure-limiter, working on the connections as described in Figure 13.

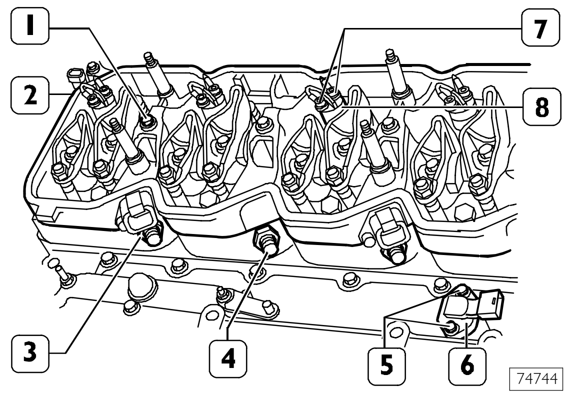
Unscrew the nut and loosen the clamp tightening the oil vapour pipe.

Remove the pipe (6).

Loosen the screws (3) and disassemble the blow-by filter (4).

Remove on the nuts and tappet cover.

Figure 19



Remove nuts (7) and disconnect the electrical cables from injectors (8).

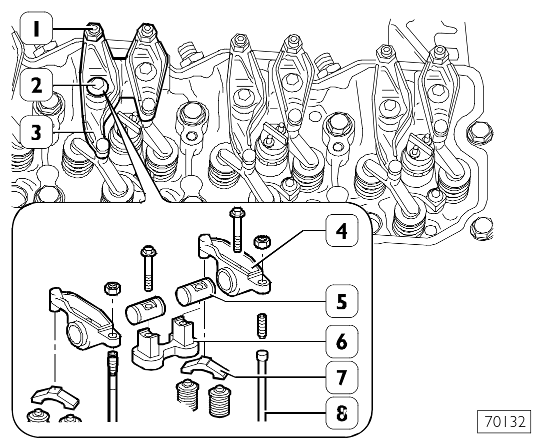
Remove screws (1) and disconnect injector wiring support (2) including the gasket.

Remove screws (5), disconnect air pressure/temperature sensor (6).

Remove nuts (3) and remove fuel manifolds (4).

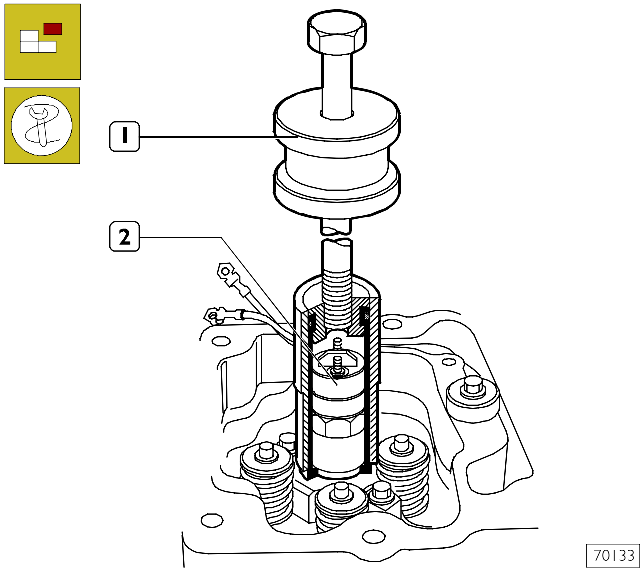
NOTE Disassembled fuel manifolds (4) must not be used again, but however replaced with other new ones.

Figure 20



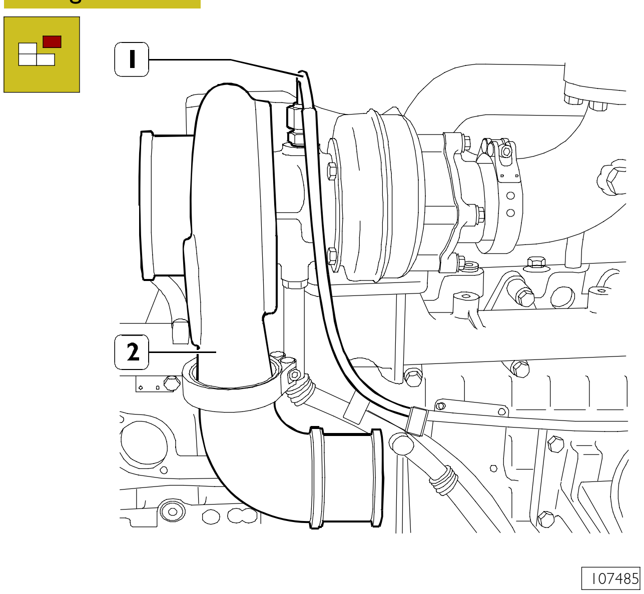
Loosen tappet adjustment fastening nuts (1) and unscrew the adjusters.
Remove the screws (2), remove the rocker assembly (3), consisting of: bracket (6), rockers (4), shafts (5) and remove jumpers (7) from valves.
Remove rods (8).

Figure 21



Remove injector fastening screws. Use tool 99342101 (1) to remove injectors (2) from the cylinder head.

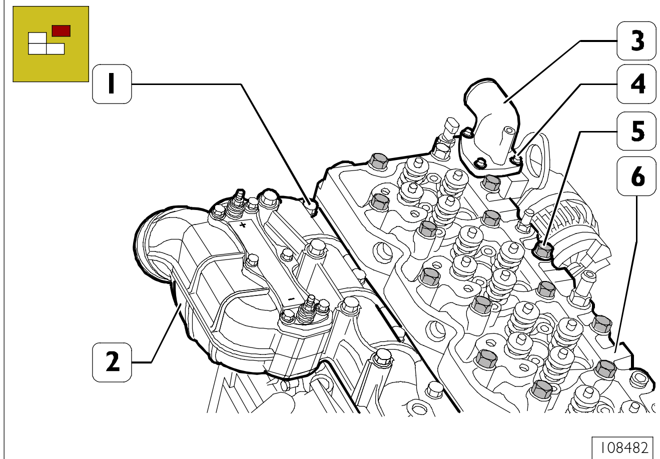
Figure 22



Remove the pipe (1) returning oil from the turboblower.

Remove the nuts and detach the turbocharger (2) from the exhaust manifold.

Figure 23 (Demonstrative)

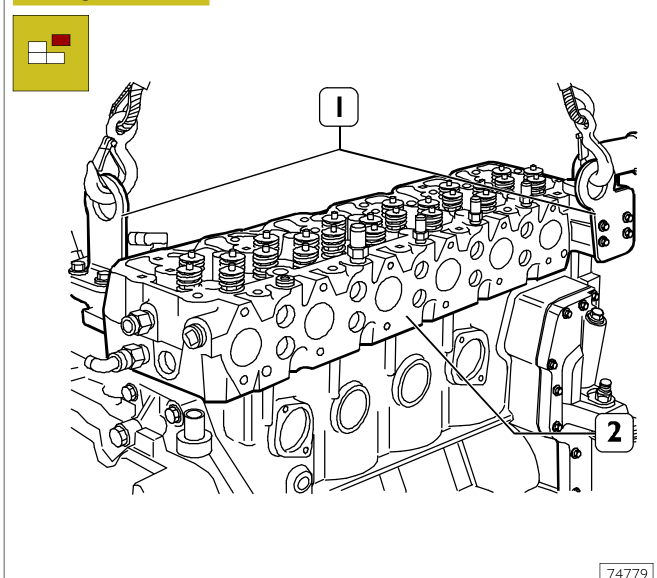


Remove screws (1) and disconnect air conveyor (2) complete with heater. Remove screws (4), remove cover (3) and thermostat below.

Remove screws (5) retaining cylinder head (6).

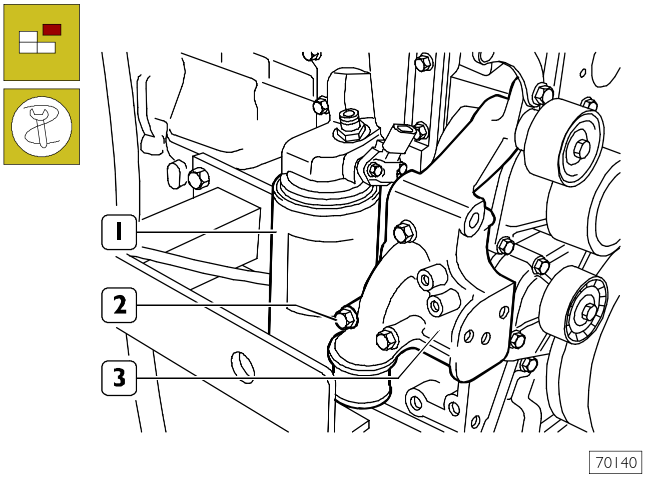
NOTE The external highlighted screws are shorter.

Figure 24



Hook brackets (1) with suitable lifting chains and remove cylinder head (2) from block using hoist.

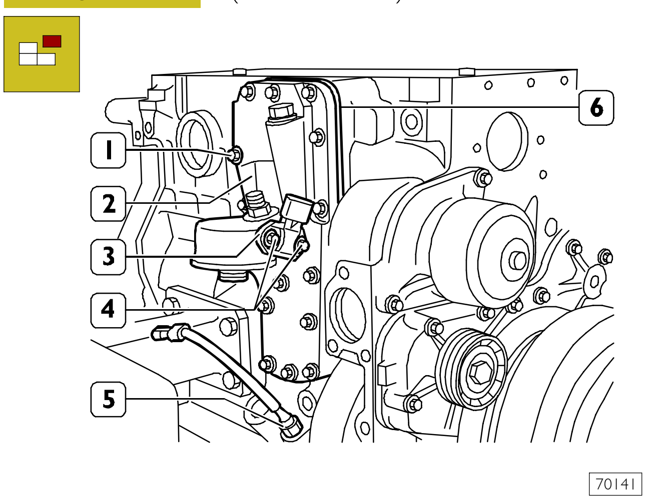
Figure 25 (Demonstrative)



Remove the screws (2) and disconnect the alternator support (3).

Use tool 99360076 to remove the oil filter (1).

Figure 26 (Demonstrative)

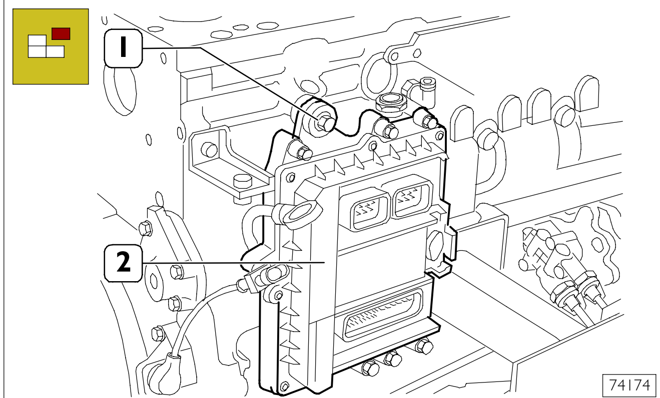


Remove the screws (4) and disconnect the oil temperature/pressure sensor (3).

Remove the screws (1) and then remove: heat exchanger/oil filter support (2), intermediate plate (6) and relevant gaskets.

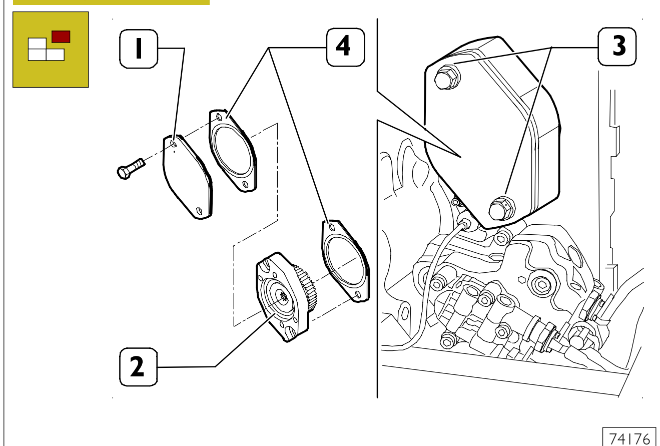
Remove the oil level sensor (5).

Figure 27



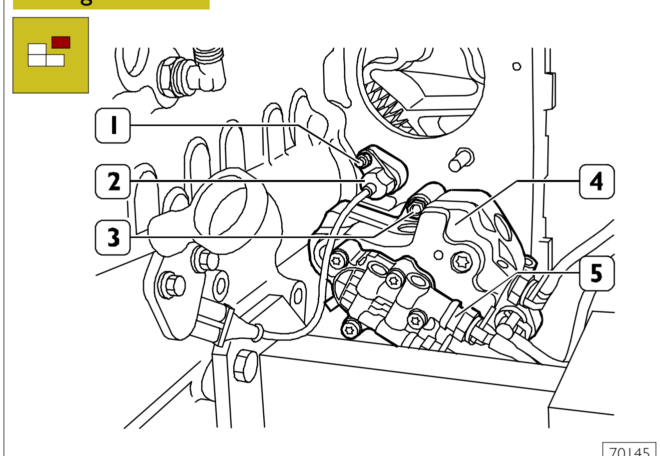
Remove the screws (1) and disconnect the ECU (2) including the heat exchanger.

Figure 28



Unloose the screws (3) and remove the cap (1). Keep the gasket (4), the power take-off (2) and the second gasket (4).

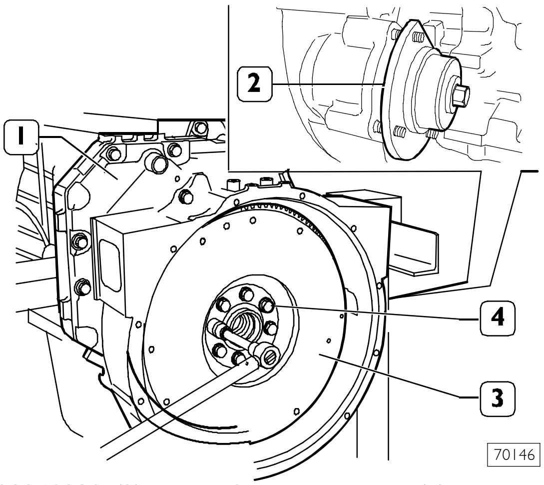
Figure 29



Remove the nut (1) and disconnect the timing sensor (2).

Remove the nuts (3) and disconnect the high pressure pump (4) including the feed pump (5).

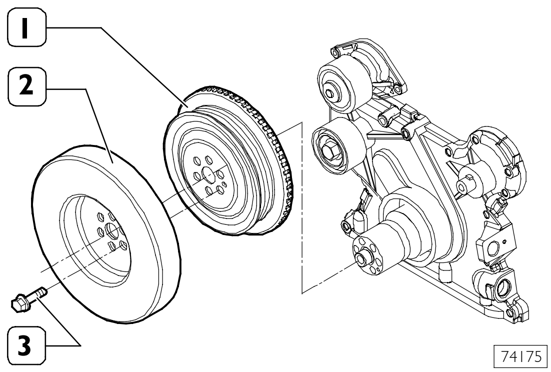
Figure 30



Fit tool 99360339 (2) to the flywheel housing (1) to stop flywheel (3) rotation.

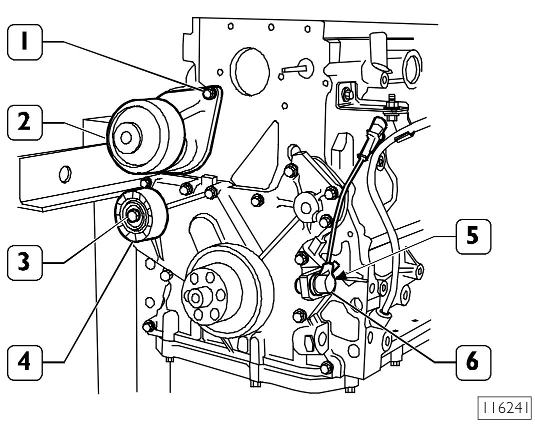
Loosen the screws (4).

Figure 31



Remove the screws (3) and disassemble the damping flywheel (2) and the pulley (1).

Figure 32

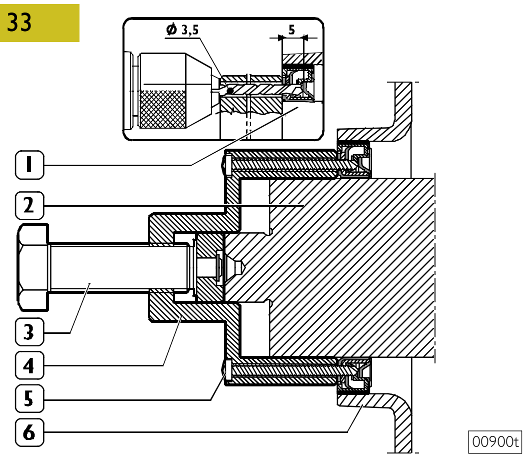


Remove the screws (1) and disconnect the water pump (2).

Remove the screw (3) and the roller (4).

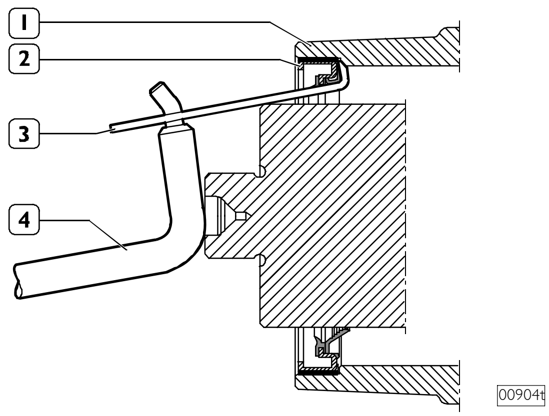
Remove the screw (5) and disconnect the engine speed sensor (6).

Figure 33



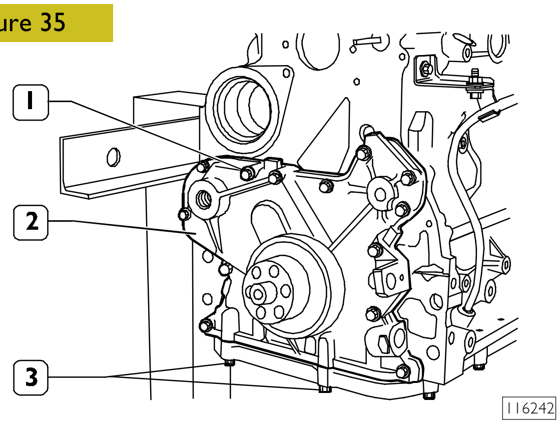
Remove the ring sealing the engine's driving shaft from the front cover. Use the tool 99340055 (4) to operate on the front bar hold of the driving shaft. Through the steering holes of the tool, perforate the inside holding ring (1) with a straight way drill (diam. 3,5mm) for the depth of 5mm. Fix the tool to the ring tightening the 6 screws provided with the equipment. Then proceed removing the ring (2) by tightening the screw (3).

Figure 34



Using the specific tie rod (3) of the tool 99363204 and the ancillary lever (4), remove the external holding ring (2) from the front cover (1).

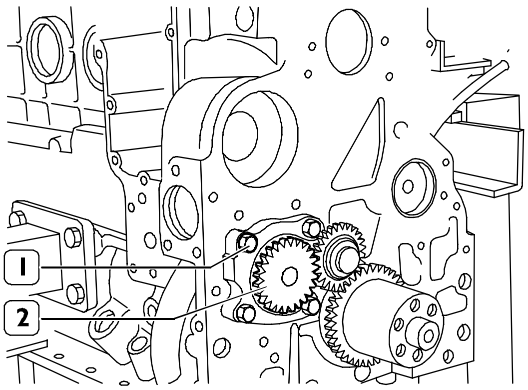
Figure 35



Remove the screws (1 and 3) and take out the front cover (2).

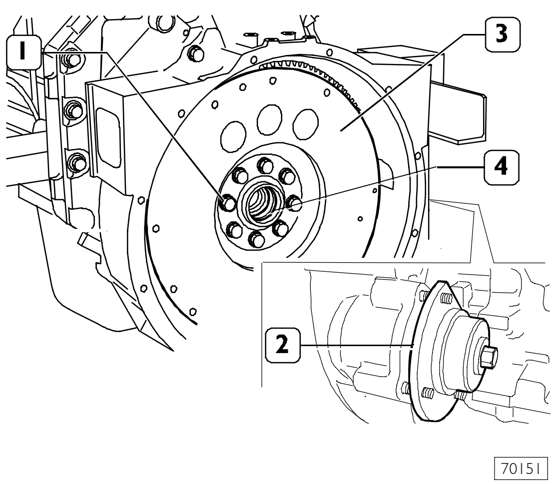
NOTE Take note of screw (1) assembling positions since they have different lengths.

Figure 36



Remove the screws (1) and disconnect the oil pump (2).

Figure 37

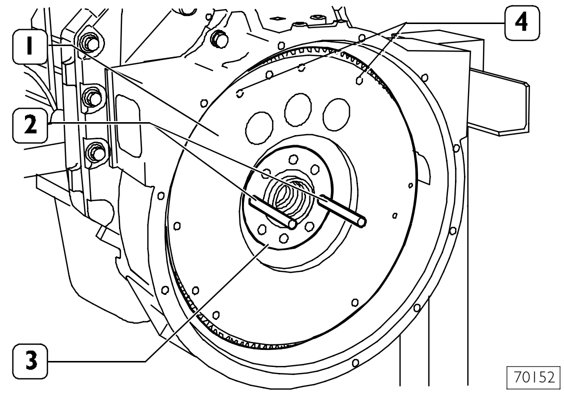


Remove two opposite screws (1) from the area where the withdrawal pins will be introduced (2, Figure 37).

Loosen the remaining flywheel fixing screws (3) from the driving shaft (4).

Remove the flywheel locking tool 99360351.

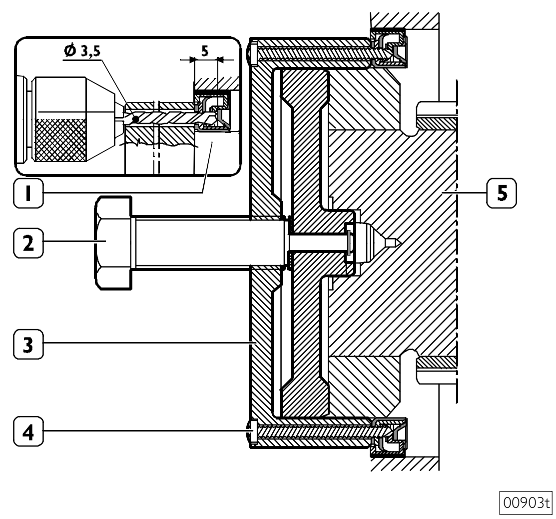
Figure 38



Tighten two screws of medium length into the holes (4) to sling the flywheel with the hoist.

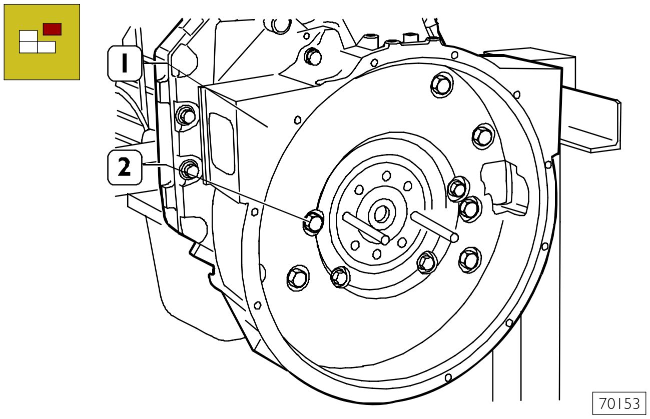
Throughout the two guide pins (2) previously screw into the driving shaft holes (3) withdraw the engine flywheel (1) after slinging it with the hoist.

Figure 39



Remove the holding ring of the flywheel cover box using the tool 99340056 (3) to operate on the driving shaft's back bar hold (5).
Through the steering holes of the tool, perforate the inside holding ring with a straight way drill (diam. 3,5mm) for the depth of 5mm.
Fix the tool 99340056 (3) to the ring tightening the 6 screws provided with the equipment.(4)
Then proceed removing the ring (1) by tightening the screw (2).
Using a specific tie rod of the tool 99363204 and an ancillary lever, remove the external holding ring (2) from the front cover.

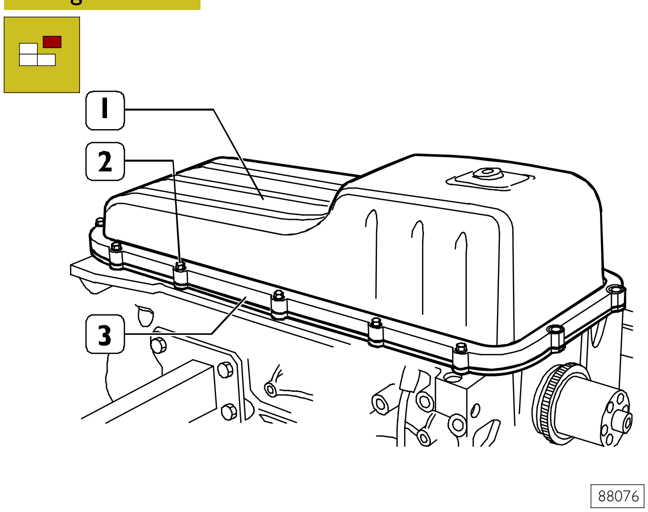
Figure 40



Remove the screws (2) and take out the rear cover (1).

NOTE Take note of screw (2) assembling positions since they have different sizes.

Figure 41

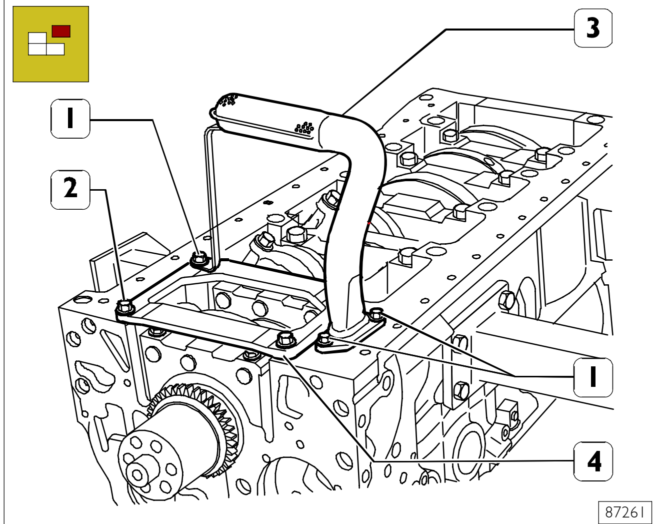


Overturn the engine.

Remove the screws (2), disassemble the plate (3) and disconnect the oil sump (1).

NOTE The shape and the dimensions of the oil pan and of the suction tube may vary according to the duty of the engine. The relevant pictures of the instructions are therefore providing an outline of the intervention to be executed.
However the procedures described are still applicable.

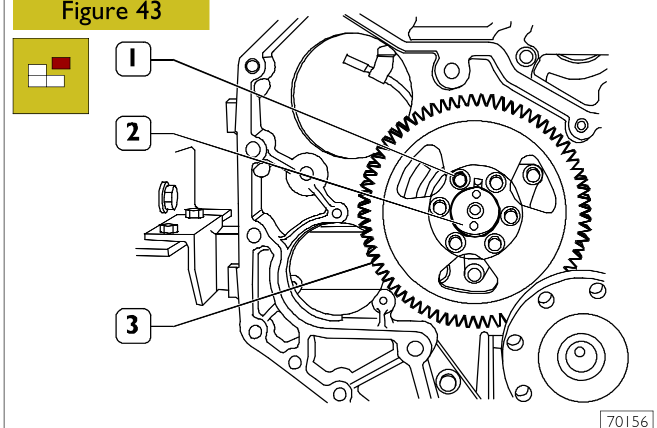
Figure 42 (Demonstrative)



Remove the screws (1) and disassemble the oil suction tube (3).

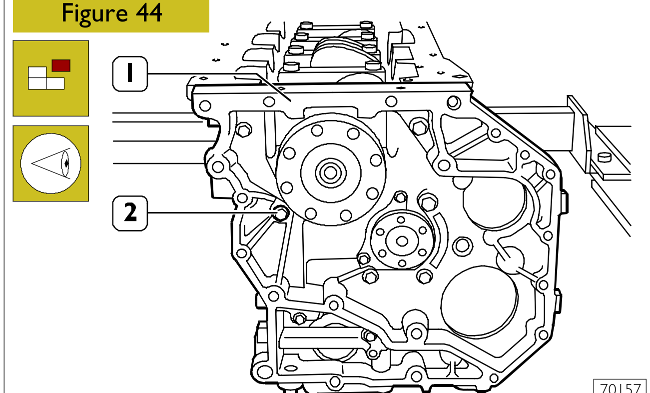
Remove the screws (2) and disassemble the stiffening plate (4).

Figure 43



Remove the screws (1) and remove the gear (3) from the camshaft (2).

Figure 44

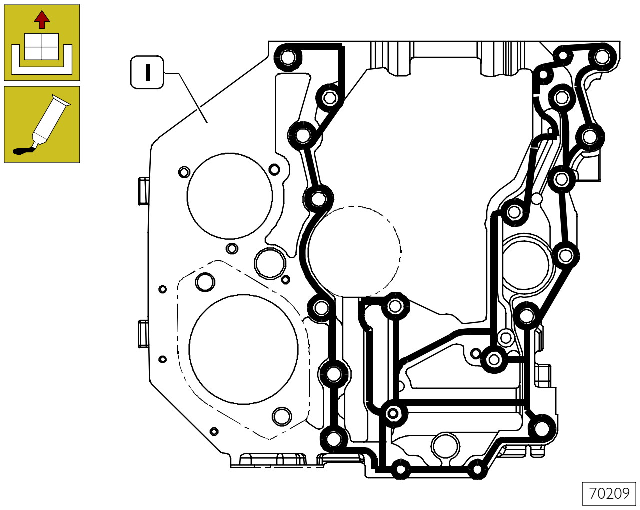


Remove the screws (2) and disconnect the timing gear case (1).

NOTE Take note of screw (2) assembling positions since they have different sizes.

Assembly of application components

Figure 45



LOCTITE 5205 SEALANT APPLICATION AREAS

Clean accurately the timing gear case (1) and the engine block.

NOTE Perfect seal is only obtained by cleaning accurately the surface to seal.

Smear the case with LOCTITE 5205 to obtain a bead of few mm diameter.

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

Any imperfection shall be corrected as soon as possible.

Avoid to use excess material to seal the joint.

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

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

Figure 46

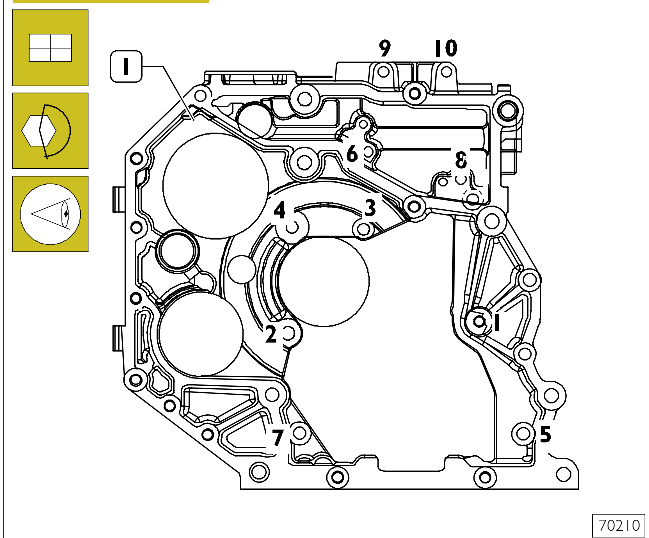


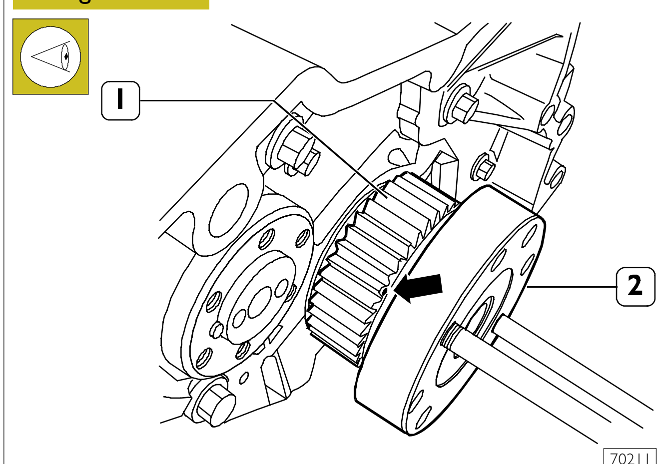
DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

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

Screws M12	65 to 89 Nm
Screws M8	20 to 28 Nm
Screws M10	42 to 52 Nm

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

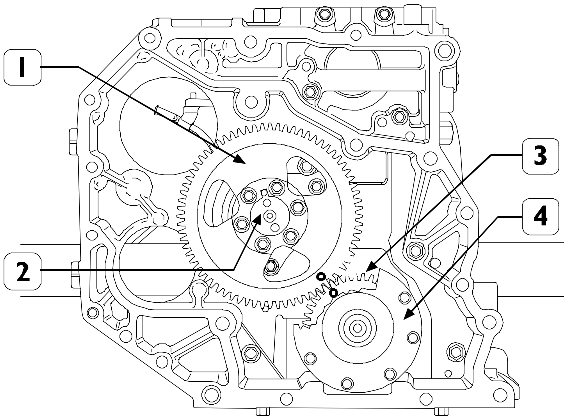
Figure 47



Use a felt pen to mark the driving gear (1) tooth fitted on the output shaft (2) having the mark (→) for timing on the side surface.

NOTE Fasten screwing of the two pins to facilitate the operation of engine driving shaft rotation.

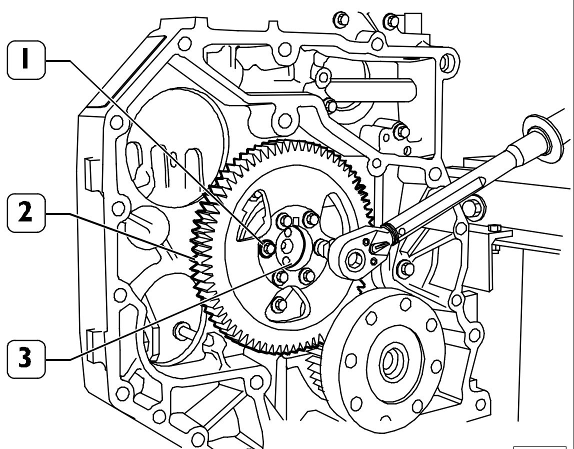
Figure 48



70212

Rotate the output shaft (4) and the camshaft (2) so that when fitting the driven gear (1) on the camshaft the marks on the gears (1 and 3) are coinciding.

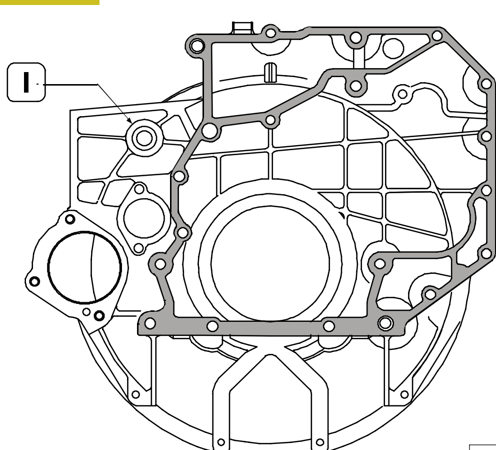
Figure 49



70213

Tighten the screws (1) fastening gear (2) to camshaft (3) to the specified torque.

Figure 50



70214

LOCTITE 5205 SEALANT APPLICATION AREAS

NOTE Perfect seal is only obtained by cleaning accurately the surface to seal.

Smear the case with LOCTITE 5205 to obtain a bead of few mm diameter.

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

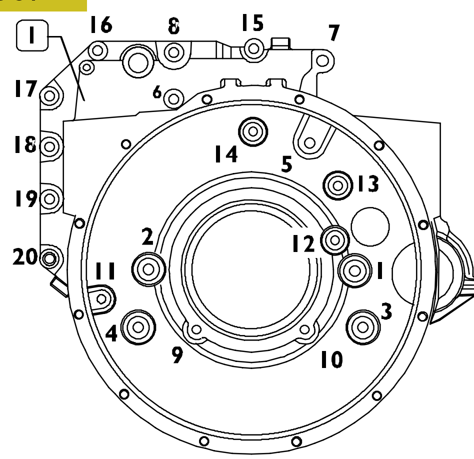
Any imperfection shall be corrected as soon as possible.

Avoid to use excess material to seal the joint.

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

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

Figure 51



70215

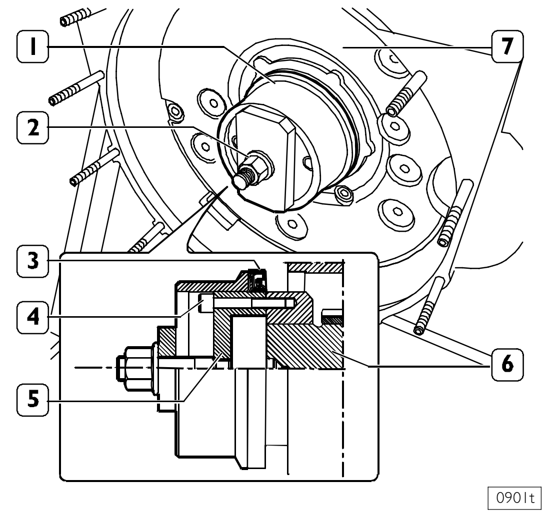
SEQUENCE FOR TIGHTENING THE FLYWHEEL HOUSING FASTENING SCREWS

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

Screws M12 75 to 95 Nm
Screws M10 44 to 53 Nm

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

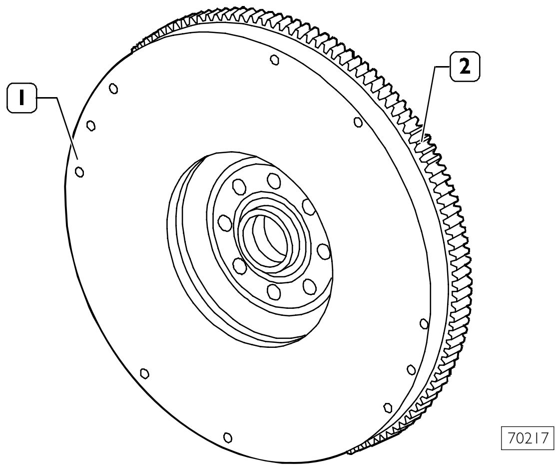
Figure 52



Apply tool 99346252 part (6) to the rear output shaft tang (5), secure it by screws (4) and fit the new sealing ring (3).

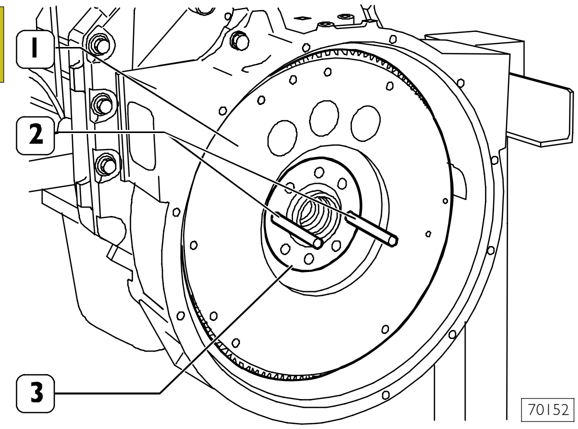
Position part (1) on part (5), screw nut (2) until completing sealing ring (3) fitting into flywheel housing (7).

Figure 53 (Demonstrative)



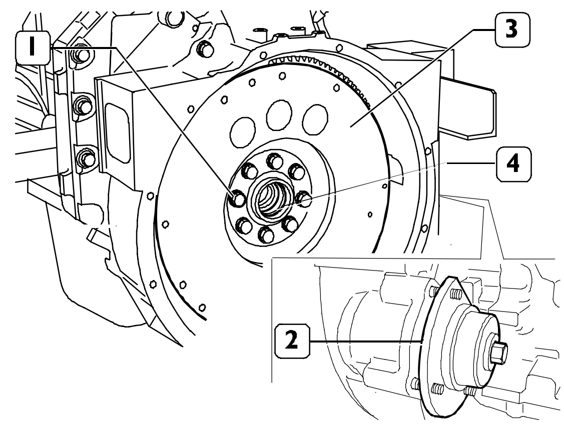
Check ring gear teeth (2), if breakage or excessive wear is found remove the ring gear from the engine flywheel (1) using a suitable hammer and fit the new one, previously heated to 150°C for 15 to 20 minutes. Chamfering on ring gear inside diameter shall be facing the engine flywheel.

Figure 54



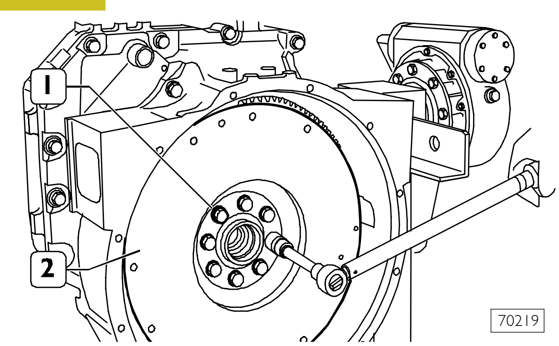
Screw two pins (2) having suitable length into shaft holes (3) and remove the engine flywheel (1) using proper sling and hoister.

Figure 55



Apply tool 99360339 (2) to the flywheel housing to stop engine flywheel (3) rotation. Tighten the screws (1) fastening the engine flywheel (3) to the output shaft.

Figure 56

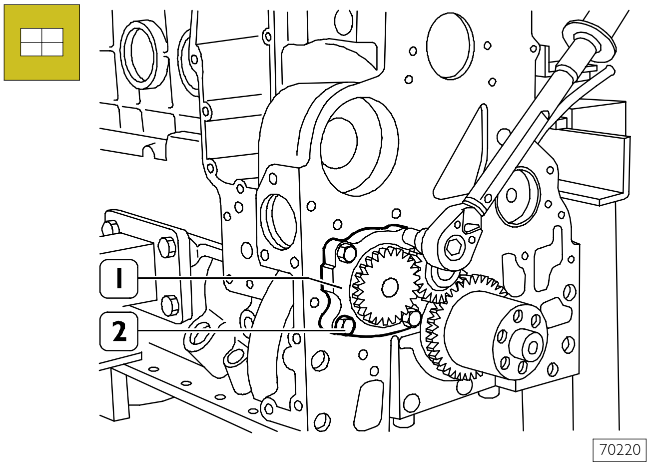


Tighten engine flywheel (2) fastening screws (1) in two stages:

- ❑ 1st stage, tightening to 30 ± 4 Nm torque with dynamometric wrench;
- ❑ 2nd stage, tightening to 60 ± 5° angle.

NOTE Tightening to angle is performed using tool 99395216.
Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

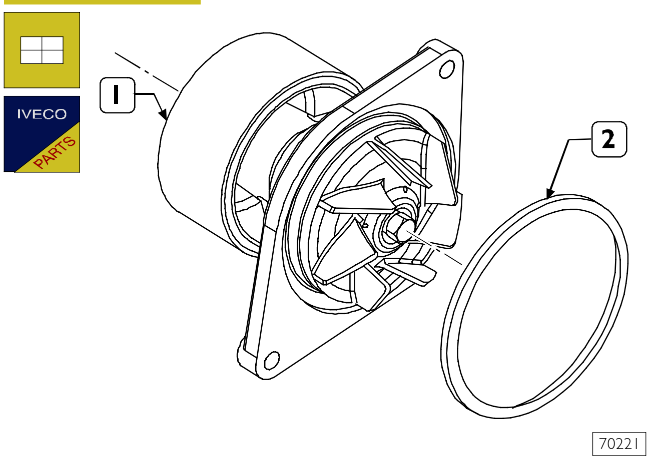
Figure 57



Fit the oil pump (1).

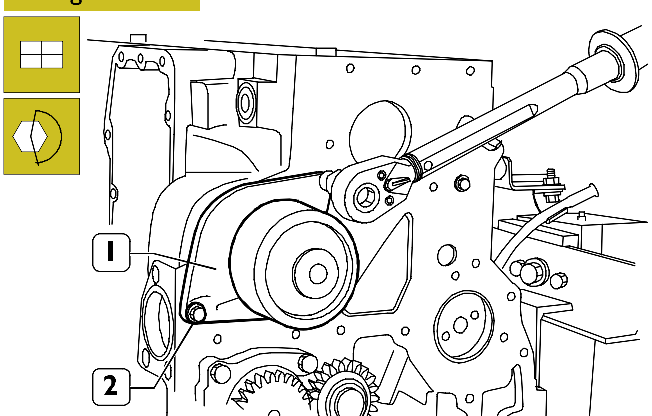
Tighten the fastening screws (2) to the specified torque.

Figure 58



Apply a new sealing ring (2) to the water pump (1).

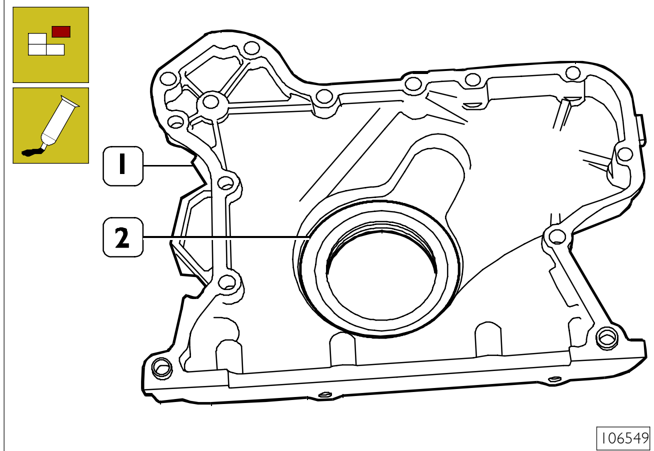
Figure 59



Fit the water pump (1).

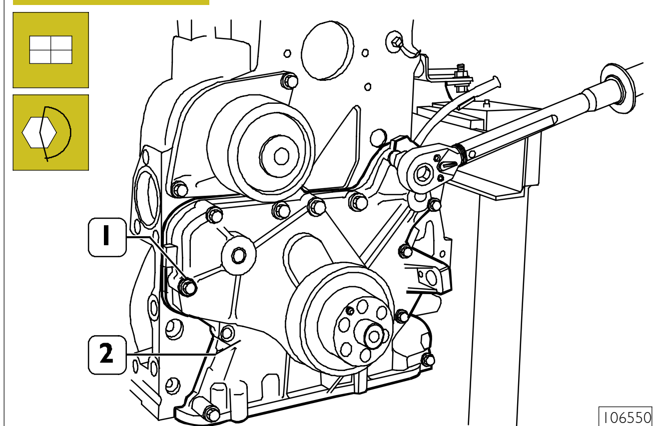
Tighten the screws (2) to the specified torque.

Figure 60



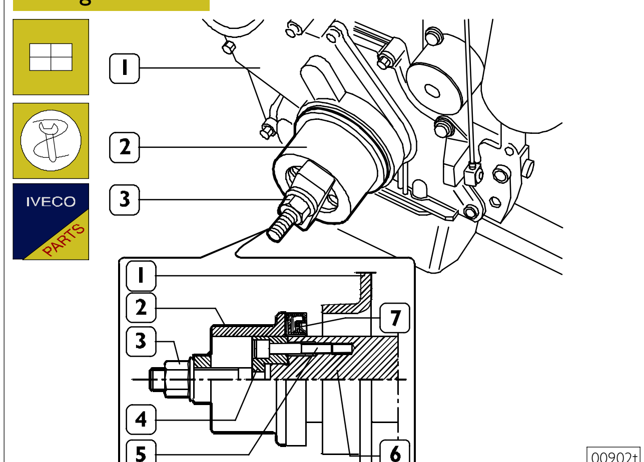
Remove the sealing ring (2) from the front cover (1), clean accurately the coupling surfaces and smear them with LOCTITE 5205.

Figure 61



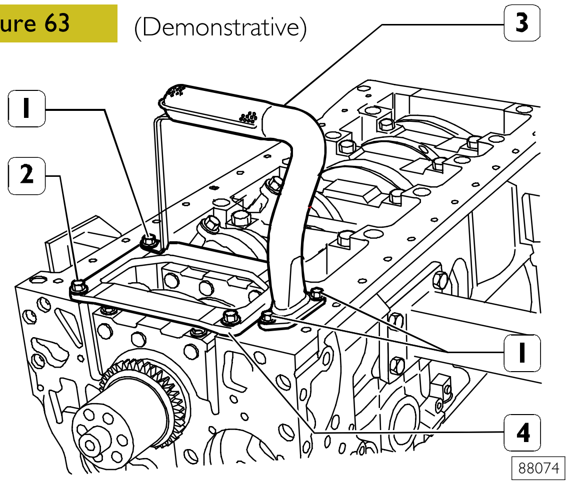
Clean accurately the front cover (2) surface and refit it. Tighten the screws (1) to the specified torque.

Figure 62



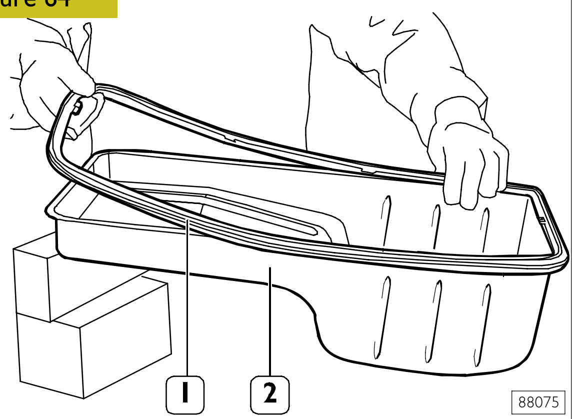
Apply tool 99346252 part (4) to the front output shaft tang (6), secure it by screws (5) and fit the new sealing ring (7). Position part (2) on part (4), screw nut (3) until completing sealing ring (7) fitting into front cover (1).

Figure 63 (Demonstrative)



Fit the plate (4), the oil pick up tube (3) and tighten the fastening screws (2 and 1) to the specified torque.

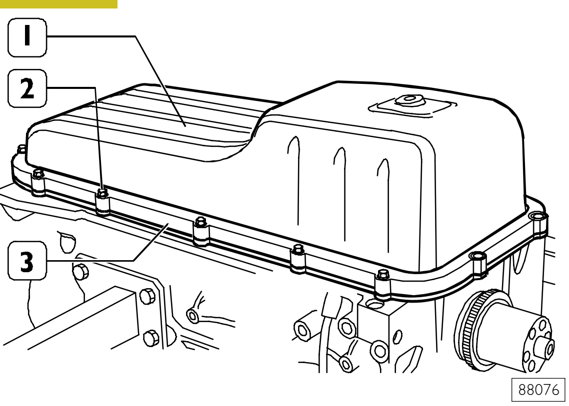
Figure 64



Set the gasket (1) on the oil sump (2).

NOTE The pictures of the instructions relating to the oil pan and to thesuction rose may not reflect the actual shape and dimensions of your engine equipment. However the procedures described are still applicable.

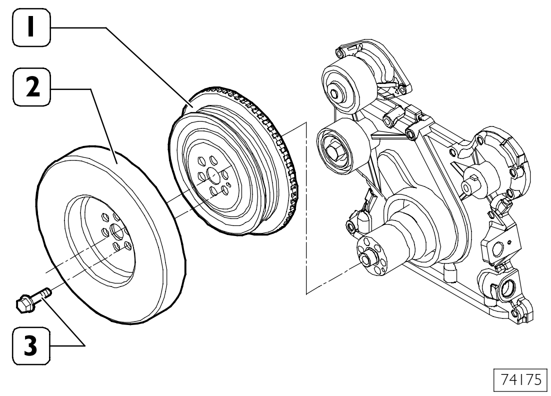
Figure 65



Fit the oil sump (1) and apply the plate (3) to it.
Tighten the screws (2) to the specified torque.

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

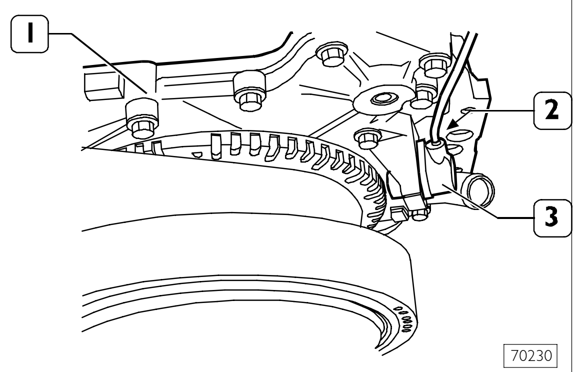
Figure 66 (Demonstrative)



Assemble the pulley (1) and the damping flywheel (2) to the driving shaft.

Tighten the fixing screws (3) and clamp them to the couple 68 ± 7 Nm.

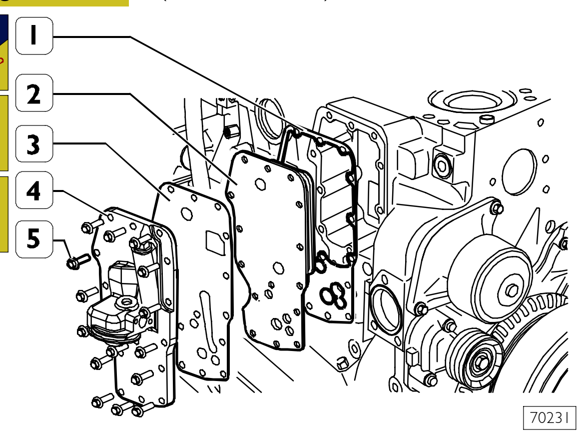
Figure 67



Fit a new sealing ring on the speed sensor (3).

Fit the speed sensor (3) on the front cover (1) and tighten the screw (2) to the specified torque.

Figure 68 (Demonstrative)

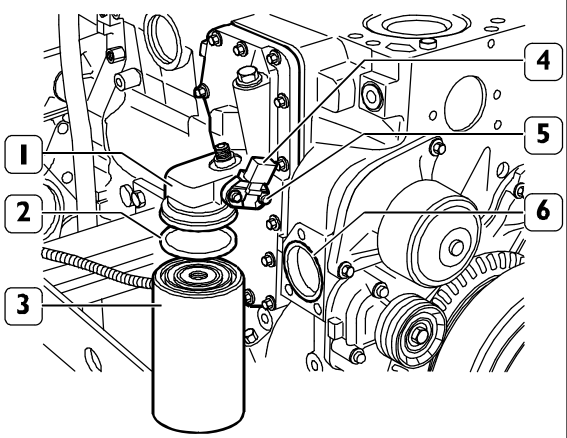


Fit on the engine block: a new gasket (1), the heat exchanger (2) a new gasket (3) and the oil filter support (4).

Tighten the screws (5) to the specified torque.

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

Figure 69 (Demonstrative)



Lubricate the sealing ring (2) with engine oil and set it on the oil filter (3).

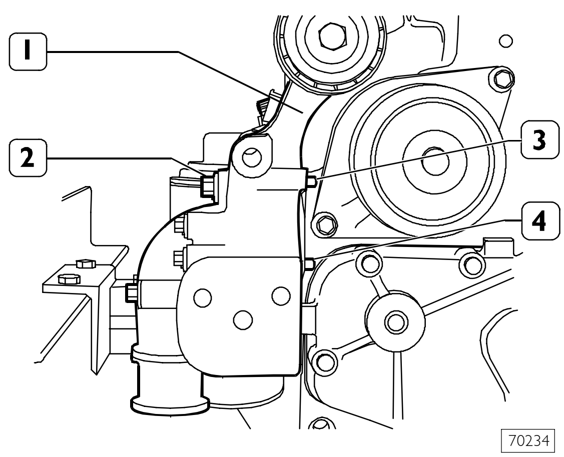
Screw manually to seat the oil filter (3) on the support connection (1) and then screw again the oil filter (3) by ¾ turn.

Apply a new sealing ring on the oil temperature/pressure sensor (4) and fit it on the support (1).

Tighten the screws (5) to the specified torque.

Fit a new sealing ring (6) in the engine block seat.

Figure 70 (Demonstrative)

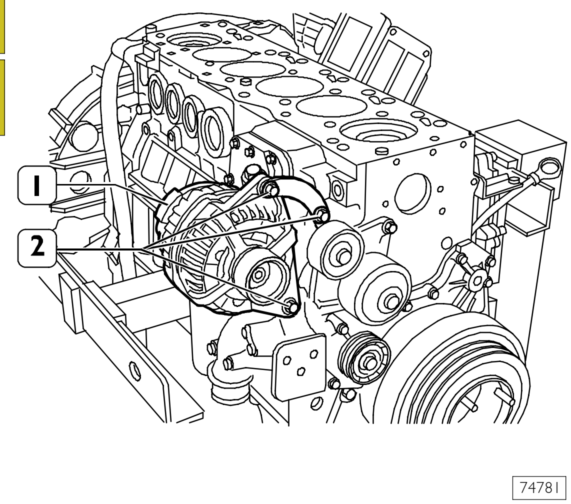


Position the alternator support (1) so that pins (3 and 4) are set against the engine block.

Tighten the screws (2) to the specified torque.

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

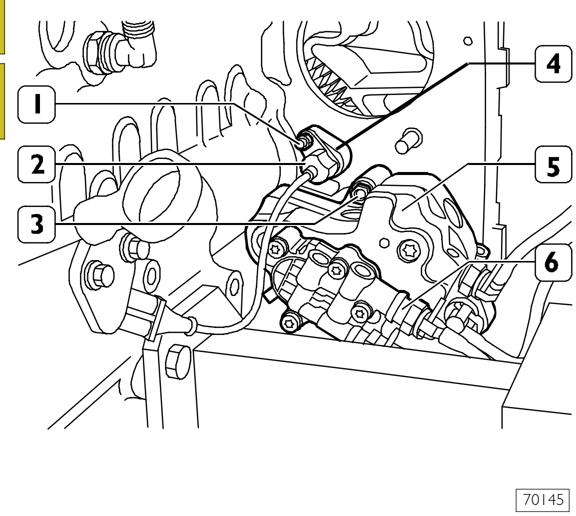
Figure 71



Reconnect the alternator (1).

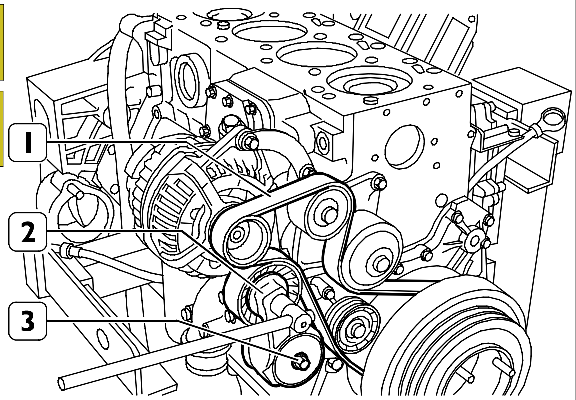
Tighten the screw (2) to the specified torque.

Figure 72



Refit the high pressure pump (6) including the feed pump (5) and tighten the nuts (3) to the specified torque. Fit the support (4) with a new sealing ring, the timing sensor (2) with a new sealing ring and tighten the relevant fastening nut (1) to the specified torque.

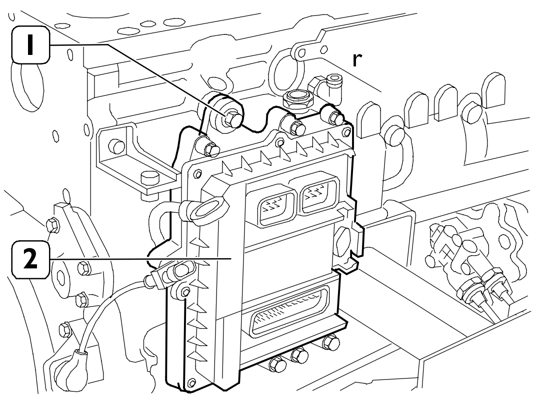
Figure 73



70235

Reconnect automatic belt tensioner (2).
Lock screw (3) at predefined torque by means of specific spanner, rotate automatic belt tensioner (2) to fix belt (1) on drive pulleys and rollers.

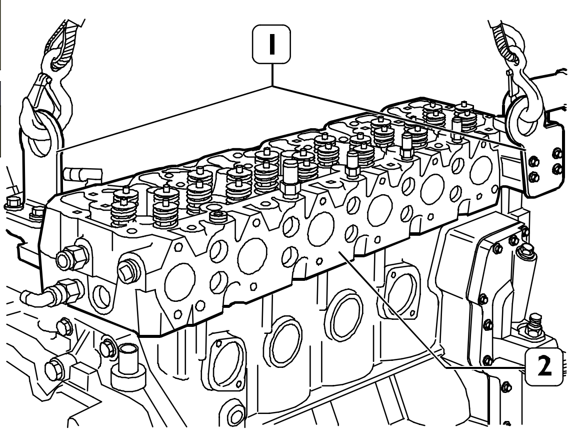
Figure 74



74174

Assemble the electronic gearbox (2) equipped with the exchanger to the engine, fixing it with the screws (1).
In case the rubber buffers are cracked or excessively deformed, provide replacing them.

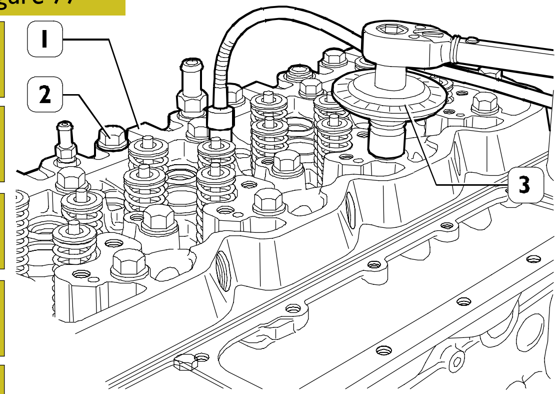
Figure 75



74779

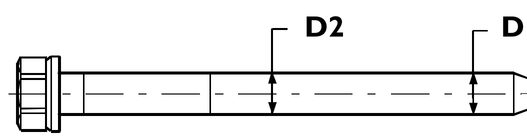
Apply a new gasket to the engine block and then place the cylinder head (2) slung by the hanger brackets (1).

Figure 77



70336

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.



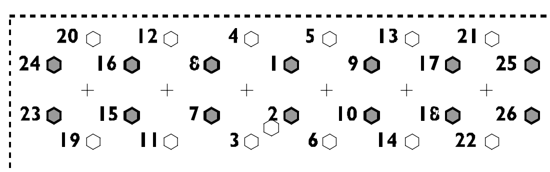
75703

Assemble cylinder head (1), tighten the screws (2) in three following steps, following order and mode shown in the figure below.

NOTE The angle tightening is carried out through tool 99395216 (3).

NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

Figure 76



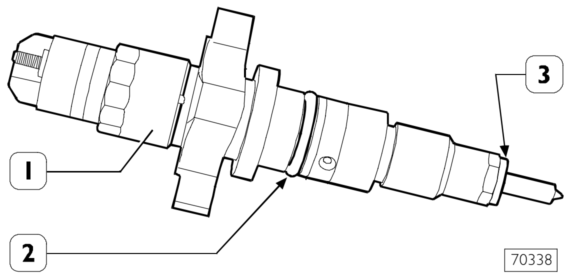
70476

Tightening order layout for cylinder head fastening screws:

- ❑ 1st step pre-tightening with a torque wrench:
  • Screw 12x1.75x130 ( ) 35 ± 5 Nm
  A • Screw 12x1.75 x 150 ( ) 55 ± 5 Nm
- ❑ 2nd step tightening with a 90 ± 5° angle
- ❑ 3rd step tightening with a 90 ± 5° angle

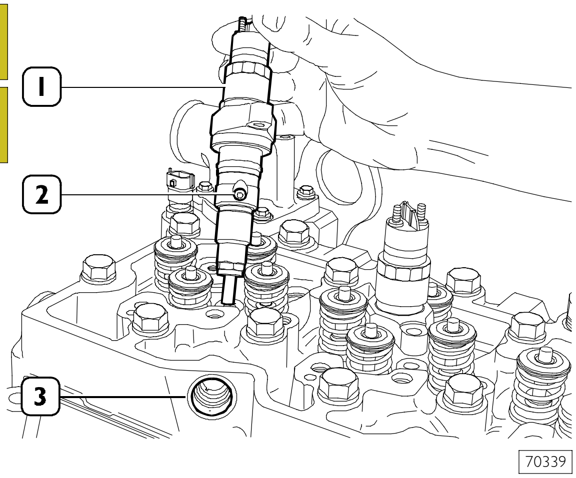
A = Front side

Figure 78



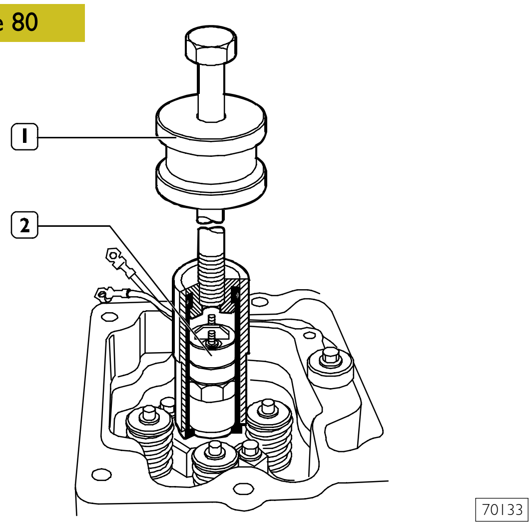
Fit a new sealing ring (2) lubricated with petroleum jelly and a new sealing washer (3) on injector (1).

Figure 79



Fit injectors (1) on the cylinder head seats, directed so that the fuel inlet hole (2) is facing the fuel manifold seat (3) side.

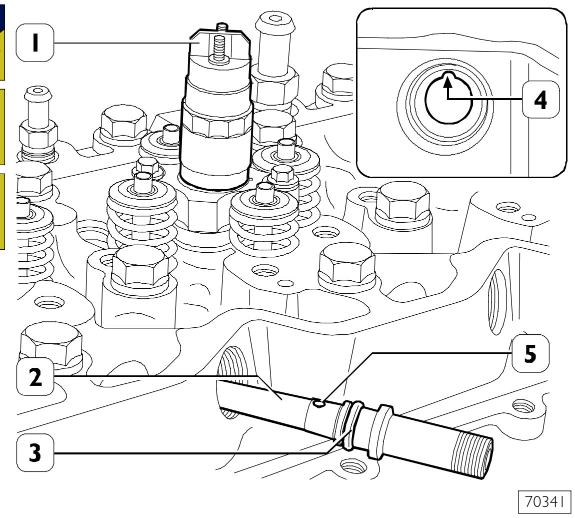
Figure 80



Use tool 99342101 (1) to fit the injector (2) into its seat.

Screw injector fastening screws without tightening them.

Figure 81



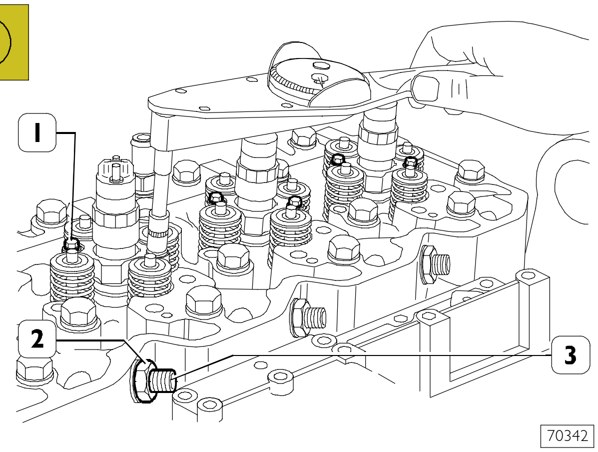
Fit a new sealing ring (3) lubricated with petroleum jelly on the fuel manifold (2) and fit it into the cylinder head seat so that the positioning ball (5) is coinciding with the relevant housing (4).

NOTE Disassembled fuel manifolds (2) must not be used again. Replace with new items.

Screw the fastening nuts (2, Figure 82) without locking them.

NOTE During this operation, the injector (1) shall be moved so that the manifold (2, Figure 79) is properly inserted into the fuel inlet hole (2, Figure 81).

Figure 82



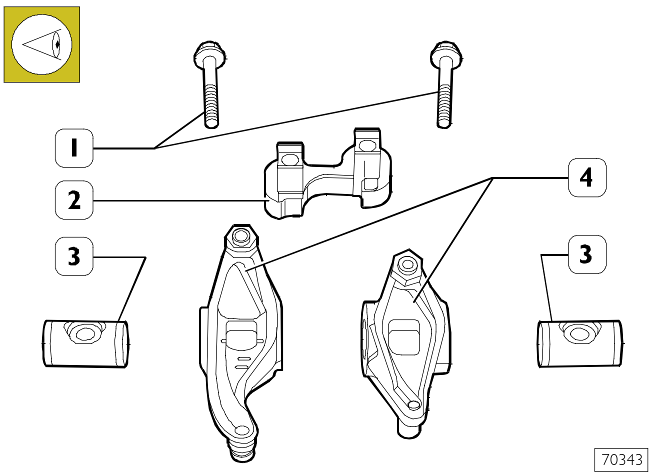
Use the torque wrench to tighten gradually and alternately the injector fastening screws (1) to 8.5 ± 0.8 Nm torque.

Tighten the fuel manifold (3) fastening nuts (2) to 50 Nm torque.

Carry out the assembly of the equalisers' unit , after previous check of the components.

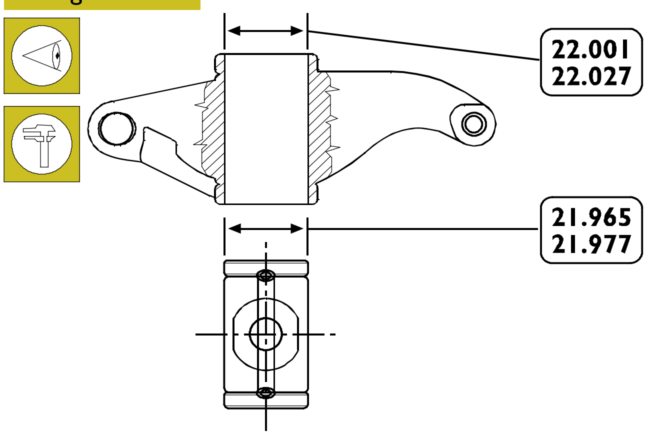
Print P4D32N001 E

Figure 83



ROCKER ASSEMBLY COMPONENTS:
1. Screws - 2. Bracket - 3. Shafts - 4. Rockers.

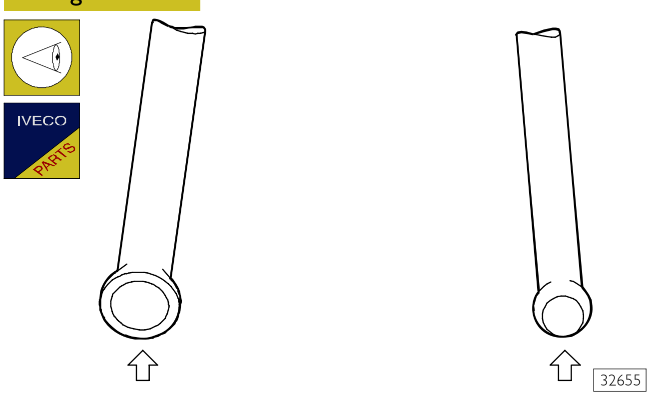
Figure 84



SHAFT-ROCKER MAIN DATA

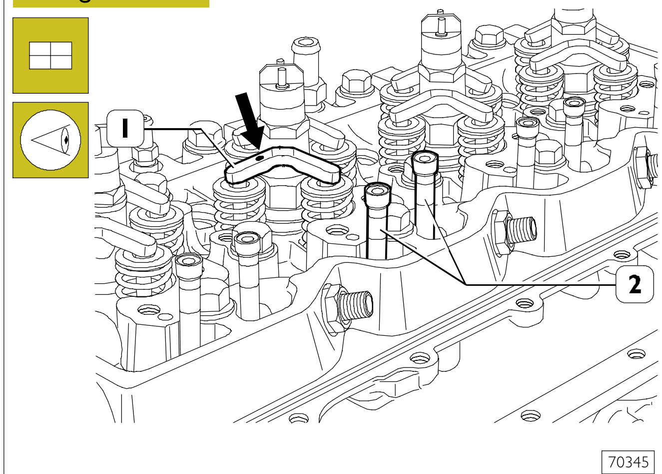
Check that shaft/rocker coupling surfaces are not showing excessive wear or damages.

Figure 85



Rocker control rods shall not be distorted; the ball seats in touch with the rocker adjusting screw and with tappets (arrows) shall not show seizing or wear; otherwise replace them. Intake and exhaust valve control rods are identical and are therefore interchangeable.

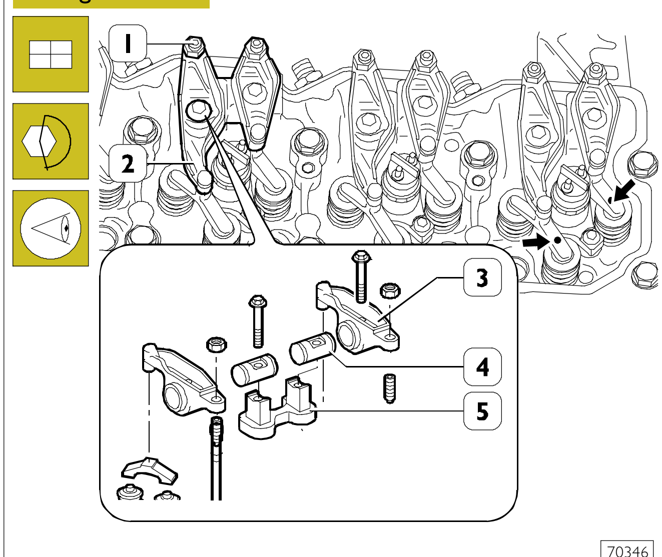
Figure 86



Fit the rods (2).

Position jumpers (1) on valves with marks (→) facing the exhaust manifold.

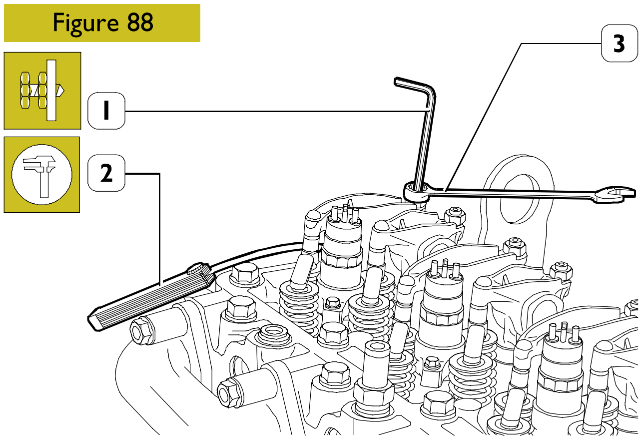
Figure 87



Check that tappet adjusters (1) are loose to prevent their balking on the rods (2, Figure 86) when refitting the rocker assembly.

Then refit the rocker assembly consisting of: bracket (5), rockers (3), shafts (4) and secure them to the cylinder head by tightening the fastening screws (2) to 36 Nm torque.

Figure 88



70520

Adjust clearance between rockers and valves using setscrew wrench (1), box wrench (3) and feeler gauge (2).

Clearance shall be as follows:

- intake valves 0.25 ± 0.05 mm
- exhaust valves 0.50 ± 0.05 mm.

NOTE In order to more quickly perform the operating clearance adjustment for rocker arms – valves, proceed as follows:

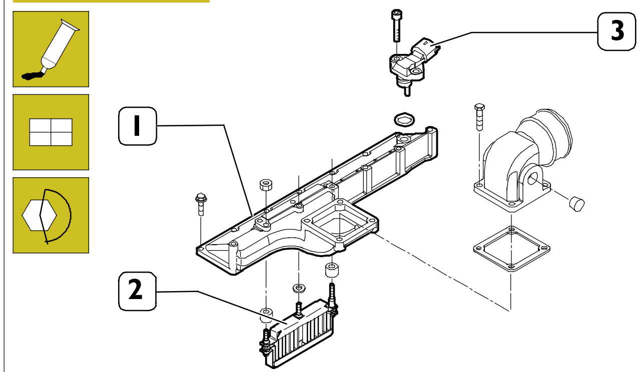
rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	-	-	*	-	*	*
exhaust	-	*	-	*	-	*

Rotate the drive shaft, balance cylinder 6 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	*	*	-	*	-	-
exhaust	*	-	*	-	*	-

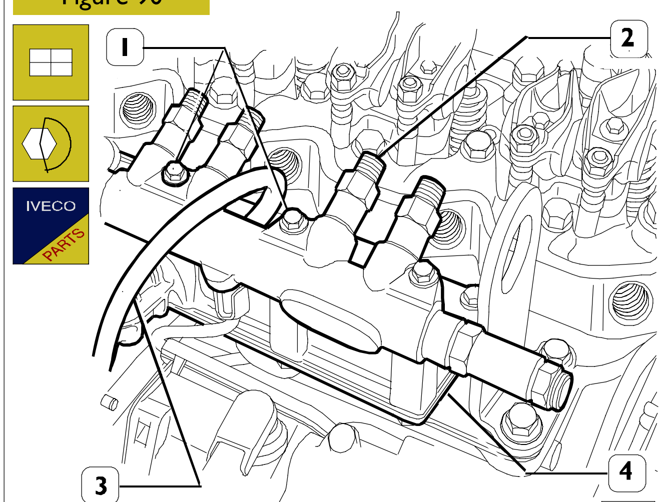
Figure 89 (Demonstrative)



74173

Apply to the coupling surface of the intake manifold (1) equipped with heater (2) a sufficient coat of LOCTITE 5999 and provide tightening the screws to the prescribed matching couple.

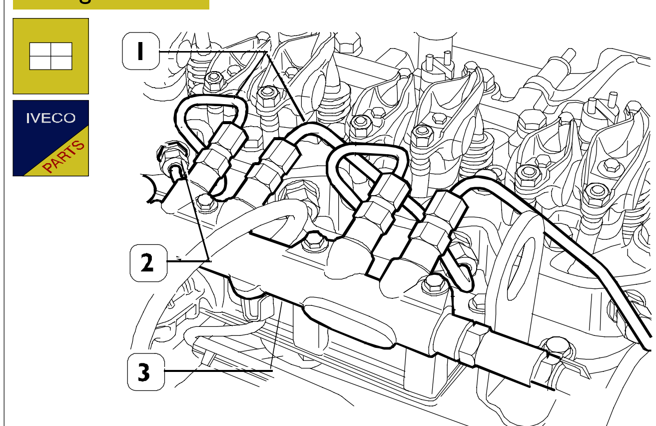
Figure 90



74179

Fit the rail (2) and tighten the screws (1) to the specified torque, connect the ground cable (3) to the intake manifold (4) and tighten the fastening nut to the specified torque.

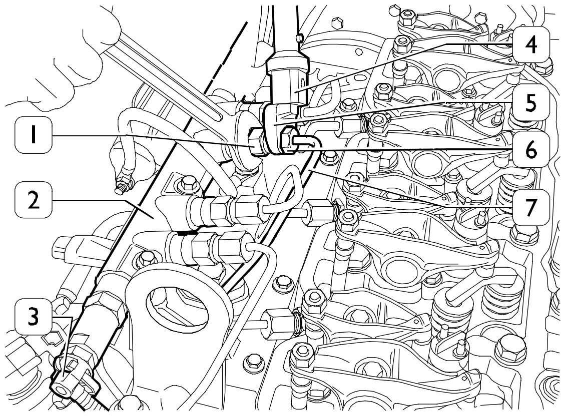
Figure 91



74180

Connect new fuel pipes (1) to rail (3) and injector manifolds (2).

Figure 92

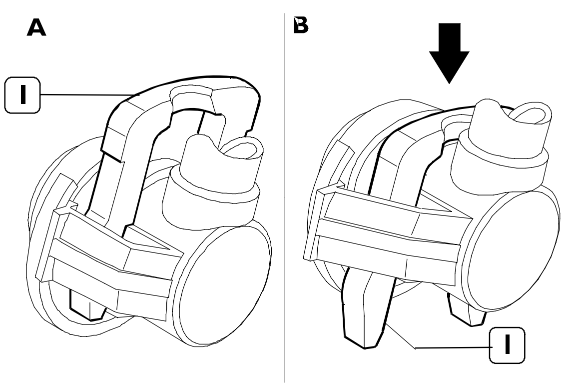


74181

NOTE Pipe (7) connections shall be tightened to 20 Nm torque, using the proper wrench (5) and the torque wrench 99389833 (4).
Connections (6) shall be tightened by holding the flow limiting valve hexagon (1) with the proper wrench.

Connect the fuel pipe (3) to the rail (2) following the procedure shown in the following figure.

Figure 93

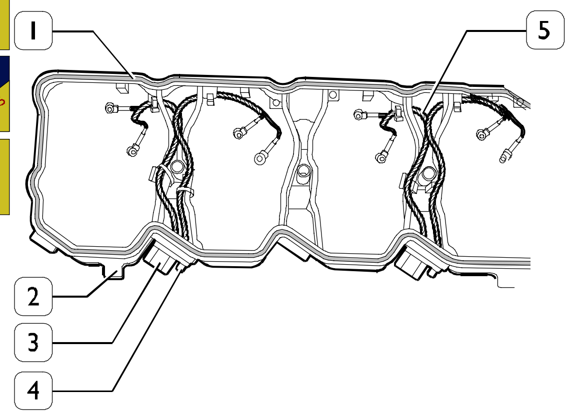


70126

Press the clamp (1) in arrow direction (Figure B) and connect the pipe to the rail, reset the clamp to the initial locking position "A".

NOTE Check proper fuel pipe connection.

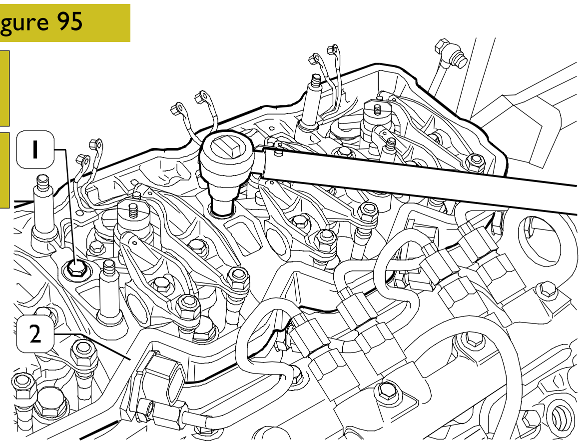
Figure 94



70352

Check electrical cable (5) conditions, replace if damaged by cutting the support (2) clamps and removing the screws (4) that secure it to connections (3).
Fit a new gasket (1) on the support (2).

Figure 95



70353

Fit the wiring support (2) and tighten the screws (1) to the specified torque.

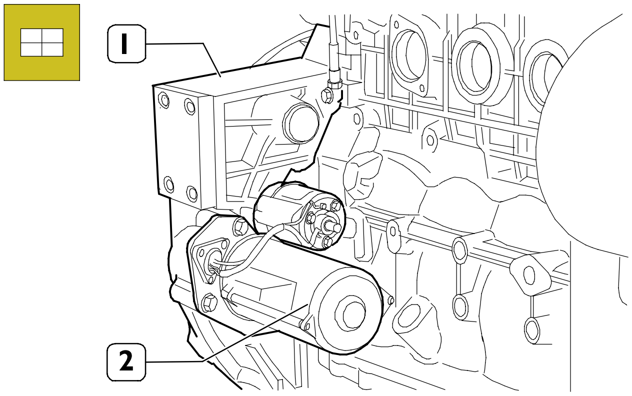
NOTE Before any assembly operation always verify that the hole and screw threads have no evidence of wear or dirt.

Completion of the engine

Properly handle the engine holding it by a lifter, remove it from the rotating shaft, remove the brackets 99341009 and place it on proper suitable support to carry out the completion.

Proceed assembling the oil filter.

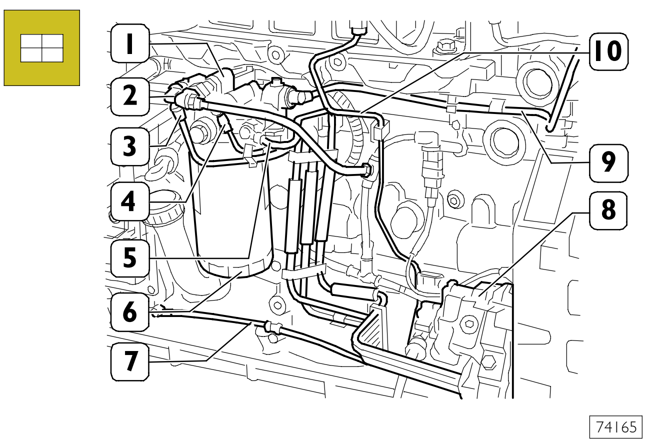
Figure 96



Assemble the starter (2) to the internal part of the flywheel cover.

Assemble the oil feeding pipe using a new O-ring. Fix with three M12x25 screws.

Figure 97



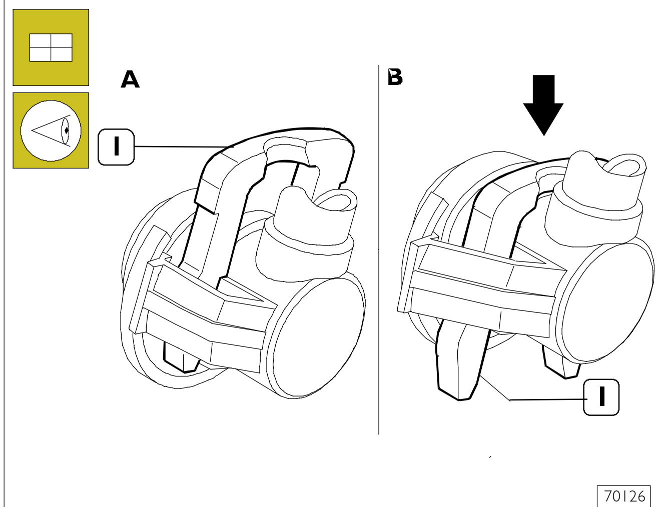
Assemble the bracket and the support (1) of the fuel filter (6).

Proceed connecting in sequence the pipelines (9,3,4 and 5) of the support (1) to the high pressure pump (8).

Connect the pipeline (7) from the high pressure pump to the engine control module heat exchanger.

Connect the pipeline (10) from the high pressure pump to the rail diffuser.

Figure 98



All the fuel pipelines are fixed using the clamps shown in the picture.

For the connection of the pipes, press the clamp (I) following the arrow's direction (Figure B) and connect the pipe to the clamp on the high pressure pump or on the support of the fuel filter.

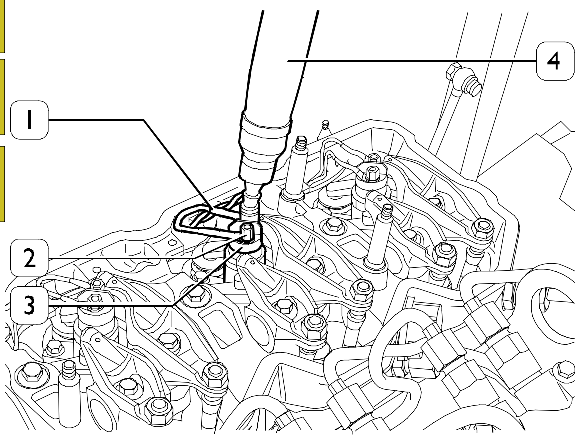
Reset the clamp in the initial locking "A" position.

NOTE In case the pipes are re-employed, they must keep the sealing tops at the edges.
Make sure that the fuel pipeline is correctly connected.

Reconnect the engine harness to all the sensors, the engine control module and the rail diffuser.

 Print P4D32N001 E

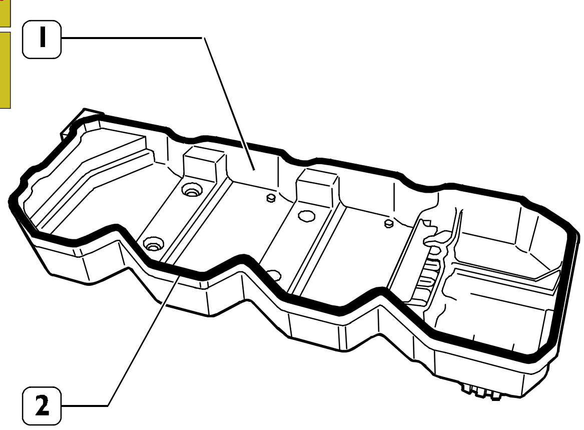
Figure 99



70354

Connect the electrical cables (1) to the injectors (3) and use the torque wrench 99389834 (4) to tighten the fastening nuts (2) to the specified torque.

Figure 100

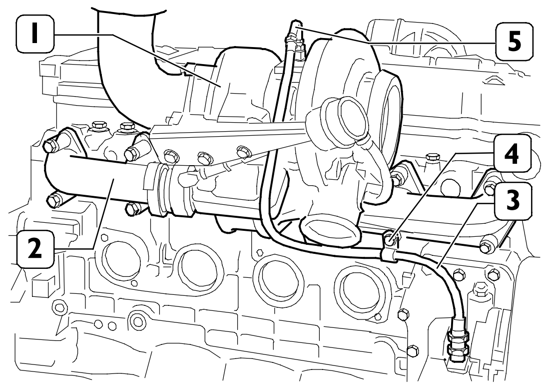


70355

Fit a new gasket (2) on the tappet cover (1).

Place the tappet cover on, install the bolts in the correct position and tighten.

Figure 101



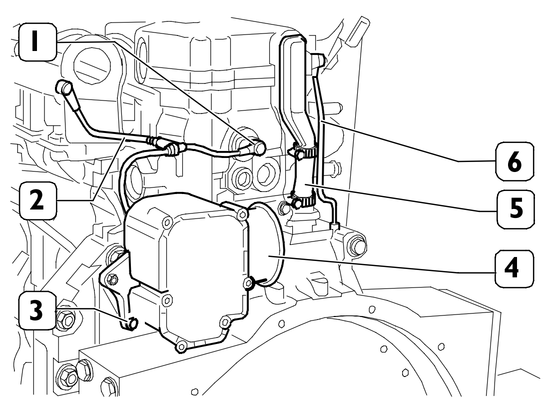
74172

Reconnect the exhaust manifold (2) with new gaskets. Tighten the fastening screws (1) to the specified torque.

Sling the turbocharger (1) and place it over the manifold after having first inserted a new gasket.

Connect the oil pipeline (3) to the support of the heat exchanger /oil filter. Fix the pipe (3) to the pipe fitting on the turbocharger through the clamp (4) and the screw locking to the block.

Figure 102



74170

Insert the blow-by filter (4) tightening the screws.

Connect the pipeline (6) and fix the oil vapour recover pipe through the clamp (5); lock up the nut fixing it to the upper edge.

Connect the pipeline (2) to the pressure- limiter (1).

Checks and inspections

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

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

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

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

PART TWO - MAINTENANCE PLANNING

MAINTENANCE PLANNING
Recovery

To ensure optimised working conditions, in the following pages we are providing instructions for the overhaul control interventions, checks and setting operations that must be performed on the engine at due planned dates.

The frequency of the maintenance operations is just an indication since the use of the engine is the main characteristic to determine and evaluate replacements and checks.

It is not only allowed but recommended that the staff in charge of the maintenance should also carry out the necessary maintenance and controlling operations even if not being included in the ones listed here below but that may be suggested by common sense and by the specific conditions in which the engine is run.

Regular maintenance and inspection planning

Checks and periodical inspections	**Frequency (hours)**
Visual check of engine	Daily
Inspection presence of water in fuel filter or pre-filter	Daily
Inspection blow-by filter elements	-
Inspection of belt wear status	-
Inspection and setting of tappet clearance	4000
EDC	500
Replacement of engine's oil and filter	-
Replacement of pre-filter	1000
Replacement of fuel filter	500
Replacement of blow by filter	500
Replacement of belt	1500

NOTE The maintenance operations 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.

Checks not included in maintenance planning-daily checks

It is a good habit to execute, before engine start, a series of simple checks that might represent a valid warranty to avoid inconveniences, even serious, during engine running. Such checks are usually up to the operators.

- Level controls and checks of any eventual leakage from the fuel, cooling and lubricating circuits.

- Notify the maintenance if any inconvenience is detected of if any filling is necessary.

After engine start and while engine is running, proceed with the following checks and controls:

- check presence of any eventual leakage from the fuel, cooling and lubricating circuits.

- Verify absence of noise or unusual rattle during engine working.

- Visual check of fumes (colour of exhaust emissions)

- Visual check of cooling liquid level, in the expansion tank.

MAINTENANCE PROCEDURES

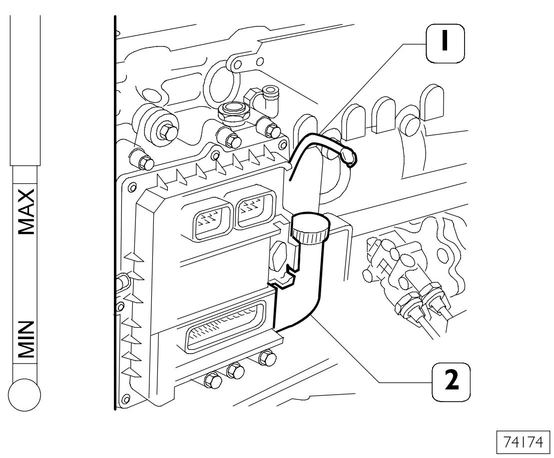
Checks and inspections

Engine oil level check

The check must be made with the engine switched off and preferably cold.

The check can be made using the specially provided flexible rod (1) placed on the right hand side of the EDC.

Figure 103

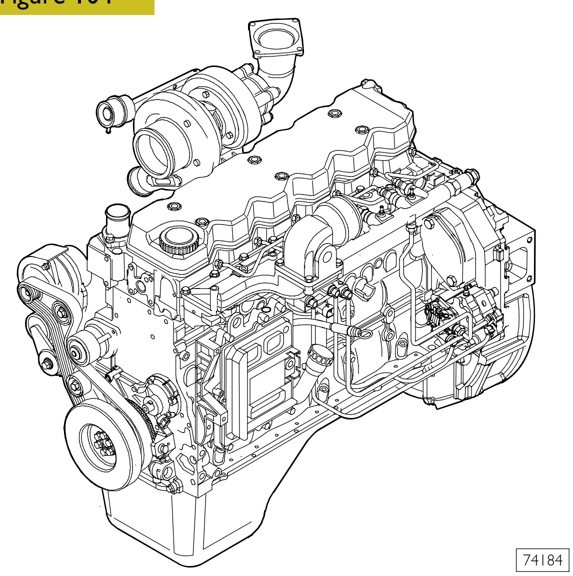


Draw off the rod from its slot and check that the level is within the etched tags of minimum and maximum level.

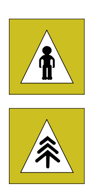
Whether it should be difficult to make the evaluation, proceed cleaning the rod using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.

In case the level results being close to the tag showing minimum level, provide filling lubrication of the engine's components.

Figure 104



To provide filling, operate through the upper top (1) or through the lateral top (2). During filling operation, the tops must be removed as well as the rod in order to make the oil flow easier".



The engine oil is highly polluting and harmful.

In case of contact with the skin, rinse well with water and detergent.

Adequately protect the skin and the eyes, operate in full compliance with safety regulations.
Disposal must be carried out properly, and in full compliance with the law and regulations in force.

Combustion system inspection

The check must be executed both when the engine disconnected and when it is running.
The check operation consists in examining the fuel pipelines running from the tank to the pre-filter (if provided in the specific equipment), to the filter, to the high pressure pump and to the rail diffuser and from this last one to the head.

Special attention must be paid to the connections on the high pressure pipelines.

Due to the high pressure within the pipelines running from the high-pressure pump to the rail diffuser and from this last one to the electro-injectors, special attention must be aid also in checking presence of any leakage or blow-by.

Protect the eyes and the skin from any eventual high pressure jet: these may deeply penetrate under the skin surface provoking serious poisoning.

Cooling system inspection

The check must be executed both when the engine disconnected and when it is running.

Check the pipelines from the engine to the radiator, from the expansion tank and vice-versa. Find out any blow-by, verify the status of the pipes specially close to the holding strips.

Verify that the radiator is clean, the correct working of the fan flywheels, the presence of any leakage from the connectors, from the manifold and from the radiating unit.

Due to the high temperatures achieved by the system, do not operate immediately after the engine's disconnection, but wait for the time deemed necessary for the cooling.
Protect the eyes and the skin from any eventual high pressure jet of cooling liquid.

The density of the cooling liquid must be checked any how every year before winter season and be replaced in any case every two year.

NOTE If refilled, bleed the system as described on page 49.

If bleeding of the system is not carried out, serious inconvenience might be caused to the engine due to the presence of air pockets in the engine's head.

Lubricating system inspection

The check must be executed both when the engine disconnected and when it is running.

Verify the presence of any oil leakage or blow-by from the head, from the engine pan of from the heat exchanger.

The engine oil is highly polluting and harmful.

In case of contact with the skin, rinse well with water and detergent.

Adequately protect the skin and the eyes, operate in full compliance with safety regulations.
Disposal must be carried out properly, and in full compliance with the law and regulations in force.

Inspection of water presence within fuel filter or pre-filter

NOTE The components of the common rail system can be damaged very quickly in presence of water or impurity within the fuel.

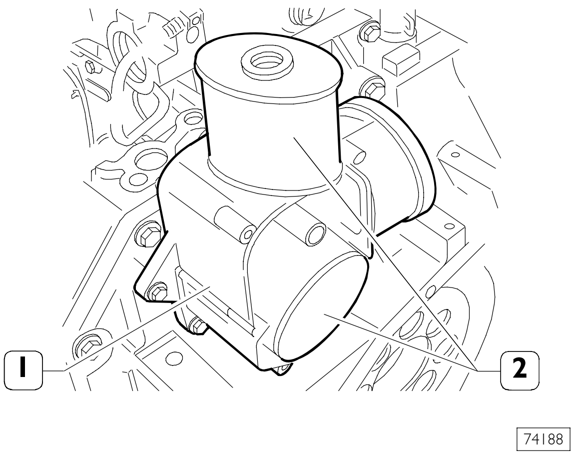
Timely proceed operating on the pre-filter (not available on the engine block) to carry out the drainage of the water within the feed circuit.

Inspection/replacement of blow-by filter

The filter in subject has been developed and equipped for the collection, filtering and condense of the lubricating oil vapours.

Within the filter unit (1) two cartridge filters are included (2).

Figure 105



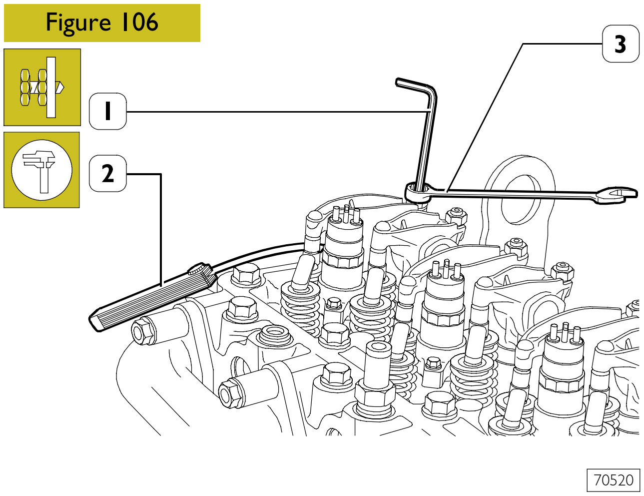
The check of the filtering element is carried out by removing the cover and drawing off the cartridges (2).

Inspection of drive belt tensioning

The drive belt tensioning control is made using an automatic tensioning device therefore no intervention is required apart from checking the wear status of the belt itself.

Inspection and setting of tappet clearance

Figure 106



Adjust clearance between rockers and valves using setscrew wrench (1), box wrench (3) and feeler gauge (2).

Clearance shall be as follows:

- intake valves 0.25 ± 0.05 mm
- exhaust valves 0.50 ± 0.05 mm.

NOTE In order to more quickly perform the operating clearance adjustment for rocker arms – valves, proceed as follows:

rotate the drive shaft, balance cylinder 1 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	-	-	*	-	*	*
exhaust	-	*	-	*	-	*

Rotate the drive shaft, balance cylinder 6 valves and adjust the valves marked by the asterisk as shown in the table:

cylinder n.	1	2	3	4	5	6
intake	*	*	-	*	-	-
exhaust	*	-	*	-	*	-

Oil motor and filter replacement

Warning: We recommend to wear proper protections because of high motor service temperature.

The motor oil reaches very high temperature: you must always wear protection gloves.

Due to the several applications, the pan shape and the oil quantity can change slightly. However, the following operations are valid for all applications.

We recommend to carry out the oil drainage when the motor is hot.

- Place a proper container for the oil collecting under the pan connected with the drain plug.
- Unscrew the plug and then take out the control dipsick and the inserting plug to ease the downflow of the lubrication oil.

The oil motor is very pollutant and harmful.

In case of contact with the skin, wash with much water and detergent.

Protect properly skin and eyes: operate according to safety rules.

Dispose of the residual properly following the rules.

- After the complete drainage, screw the plug and carry out the clean oil filling.

NOTE Use only the recommended oil or oil having the requested features for the corrrect motor functioning.

In case of topping up, don't mix oils having different features.

If you don't comply with theses rules, the service warranty is no more valid.

- Check the level through the dipsick until when the filling is next to the maximum level notch indicated on the dipsick.

Whereas you replace the lubrication oil, it is necessary to replace the filter.

According to the application the filter can be located in different positions: the following procedure is a valid guide for all applications.

- The filter is composed by a support and a filtering cartridge. For the cartridge replacement use the 9936076-tool.

Warning: the oil filter contains inside a quantity of oil of about 1 kg.

Place properly a container for the liquid.

Warning: avoid the contact of skin with the motor oil: in case of contact wash the skin with running water.

The motor oil is very pollutant: it must be disposed of according to the rules.

- Replace the filtering cartidge with a new one and screw manually until when the gasket is in contact with the support.
- Tigthen by means of the 99360076-tool of three fourth turn.
- Operate the motor for some minutes and check the level through the dipsick again. If it is necessary, carry out a topping up to compensate the quantity of oil used for the filling of the filtering cartridge.

Changing the coolant

- Position a container beneath the radiator tap to recover the coolant.
- Open the tap and allow all the coolant in the radiator to flow out.
- Charge the coolant for the first time.
- Leave the radiator cap open.
- Start the engine and leave it running for at least a minute so that all the air in the circuit is completely removed.
- Stop the engine.
- Top up.

NOTE If the procedure described is not followed, the radiator fluid level will be incorrect.

Fuel filter replacement

During this operation don't smoke and don't use free flames.

Do not breathe the vapours generated in the filter.

According to the applications the filters position and the quantity can change.

However the following operations are valid for all applications.

- Drain the fuel inside the filter by operating the water release screw. Collect the fuel in a container without impurities.
- Unscrew the cartridge by using the 99360076-tool.
- Collect the eventual fuel inside the filtering cartridge.
- Clean the gasket seat on the support and oil slightly the gasket on the new filtering cartridge.
- Screw manually the new filtering cartdrige until when the gasket is completely on its seat.
- Tigthen through the 99360076-tool at 10 to 15 Nm torque.

Alternator belt replacement

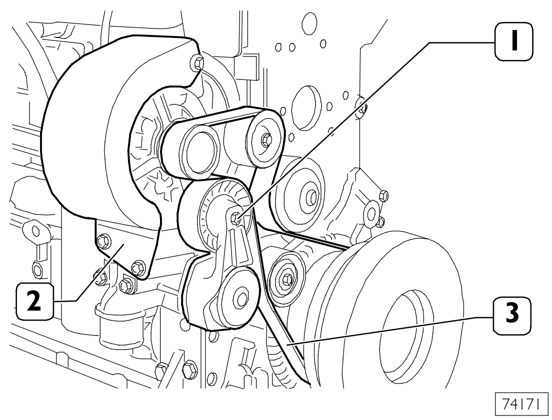
Due to several applications the belt run can change very much.

Warning: with switched off motor (but still hot) the belt can operate without advance notice.

Wait for the motor temperature lowering to avoid very serious accidents.

For applications with automatic belt stretcher, the procedure is the following:

Figure 107



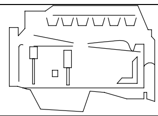
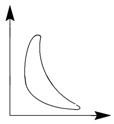
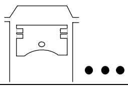
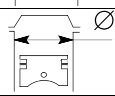
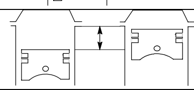
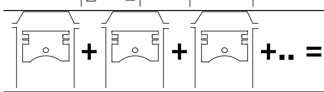
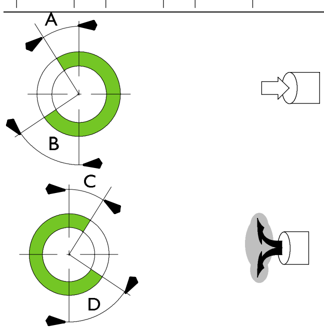
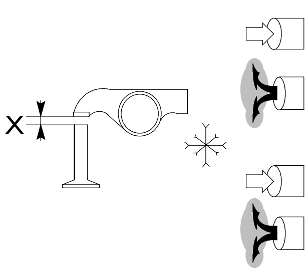
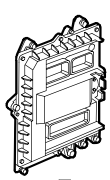
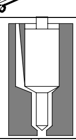
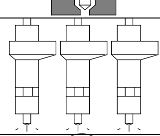
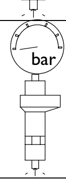
- Unscrew the screws which fix the belt guard (2) to the support and dismount it.
- Operate on the tightener (1) and withdraw the belt (3) from the alternator and water pumps from pulleys and from the returns pumps.
- Replace the worn belt with a new one.
- Place the belt on the pulleys and the guide rollers.
- Place the automatic tightener in order to key the belt in the functioning position.
- Further adjustments are not required.

SECTION 4

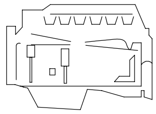
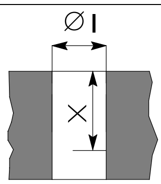
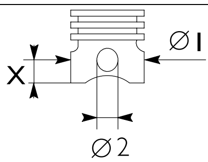
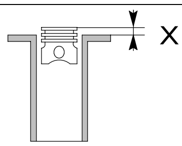
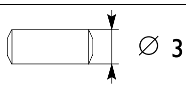
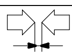
Overhaul and technical specifications

Print P4D32N001 E

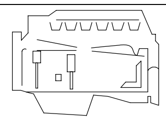
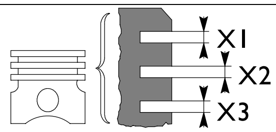
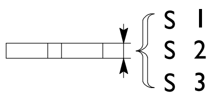
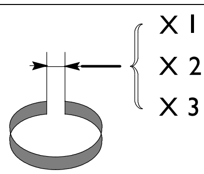
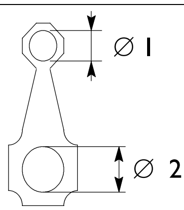
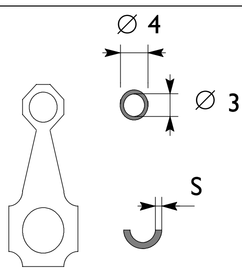
GENERAL SPECIFICATIONS

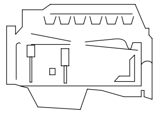
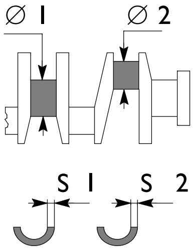
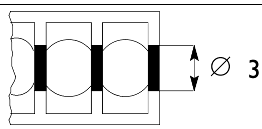
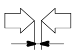
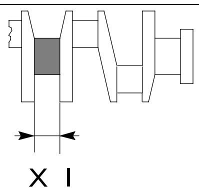
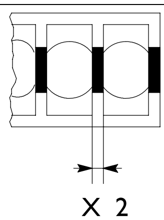
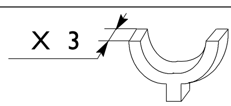
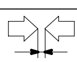
	Type		**6 CYLINDERS**
	Cycle		Four-stroke diesel engine
	Power		Supercharged with aftercooler
	Injection		Direct
	Number of cylinders		6
	Bore	mm	102
	Stroke	mm	120
	Total displacement	cm^3	5880
	**TIMING**		
	start before T.D.C.	A	18.5°
	end after B.D.C.	B	29.5°
	start before B.D.C.	D	67°
	end after T.D.C.	C	35°
	Checking timing X	mm	-
		mm	-
	Checking operation X	mm	0.20 to 0.30
		mm	0.45 to 0.55
	**FUEL FEED**		
	Injection Type:	Bosch	high pressure common rail EDC7 ECU
	Nozzle type		Injectors
	Injection sequence		1 - 5 - 3 - 6 - 2 - 4
	Injection pressure	bar	250 ÷ 1400

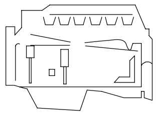
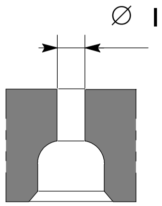
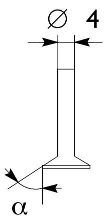
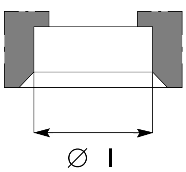
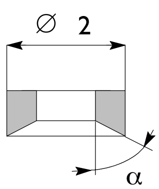
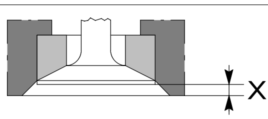
CLEARANCE DATA

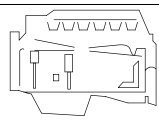
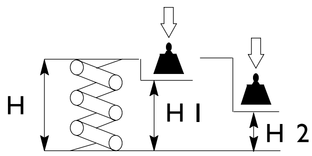
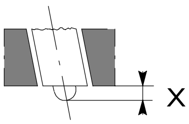
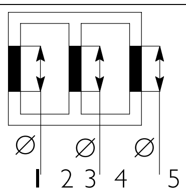
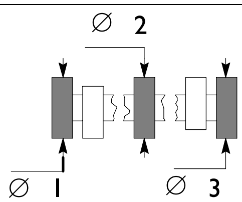
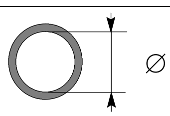
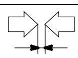
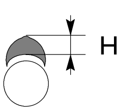
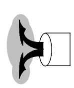
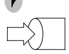
	Type		**6 CYLINDERS**
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			**mm**
	Cylinder barrels	Ø1 > Ø1	102.01 to 102.03 0.5
	Spare pistons type: Size Outside diameter Pin housing	 X Ø 1 Ø 2	 60.5 102.226 to 102.244 40.008 to 40.014
IVECO PARTS >	Piston diameter	Ø 1	0.5
	Piston protrusion	X	0.28 to 0.52 0.28 to 0.52
	Piston pin	Ø 3	39.9938 to 40.0002
	Piston pin – pin housing		0.0006 to 0.0202

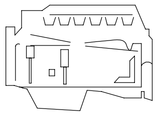
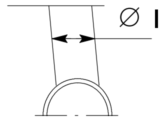
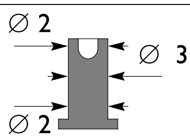
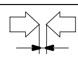
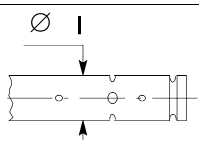
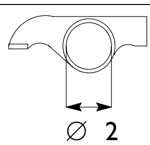
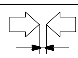
Print P4D32N001 E

	Type		6 CYLINDERS
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			mm
	Split ring slots * measured on 99 mm ∅	X1* X 2 X 3	2.705 to 2.735 2.420 to 2.440 4.020 to 4.040
	Split rings	S 1* S 2 S 3	2.560 to 2.605 2.350 to 2.380 3.975 to 4.000
	Split rings - slots	1 2 3	0.100 to 0.175 0.040 to 0.90 0.020 to 0.065
IVECO PARTS	Split rings		0.5
	Split ring end opening in cylinder barrel:	 X 1 X 2 X 3	 0.30 to 0.40 0.60 to 0.80 0.25 to 0.55
	Small end bush housing Big end bearing housing	 ∅ 1 ∅ 2	 42.987 to 43.013 72.987 to 73.013
	Small end bush diameter Inside Big end half-bearings Supplied as spare parts	 ∅ 3 S	 40.019 to 40.033 1.955 to 1.968
	Piston pin – bush		0.0188 to 0.0372
IVECO PARTS	Big end half bearings		0.250; 0.500

	Type		**6 CYLINDERS**
CYLINDER UNIT AND CRANKSHAFT COMPONENTS			**mm**
	Journals Crankpins Main half bearings Big end half bearings *provided as spare part	Ø 1 Ø 2 S 1 S 2	82.99 to 83.01 68.987 to 69.013 2.456 to 2.464 1.955 to 1.968
	Main bearings No. 1–7 No. 2–3–4–5–6	 Ø 3 Ø 3	 87.982 to 88.008 87.977 to 88.013
	Half bearings – Journals No. 1–7 No. 2–3–4–5–6		 0.044 to 0.106 0.039 to 0.111
	Half bearings - Crankpins		0.038 to 0.116
IVECO PARTS	Main half bearings Big end half bearings		0.250; 0.500
	Shoulder journal	X 1	37.475 to 37.545
	Shoulder main bearing	X 2	32.180 to 32.280
	Shoulder half-rings	X 3	37.28 to 37.38
	Output shaft shoulder		0.095 to 0.265

	Type		**6 CYLINDERS**
CYLINDER HEAD – TIMING SYSTEM			**mm**
	Valve guide seats on cylinder head	∅ 1	8.019 to 8.039
	Valve guides		-
	Valves:		
		∅ 4 α	6.970 to 6.999 60 ± 0.25°
		∅ 4 α	6.970 to 6.999 45 ± 0.25°
	Valve stem and guide		0.052 to 0.092
	Housing on head for valve seat:		
		∅1	34.837 to 34.863
		∅1	34.837 to 34.863
	Valve seat outside diameter; valve seat angle on cylinder head:		
		∅ 2 α	34.917 to 34.931 59.5°
		∅ 2 α	34.917 to 34.931 44.5°
	Sinking	X	0.59 to 1.11
		X	0.96 to 1.48
	Between valve seat and head		0.054 to 0.094
			0.054 to 0.094
	Valve seats		-

	Type		**6 CYLINDERS**
CYLINDER HEAD – TIMING SYSTEM			mm
	Valve spring height: free spring under a load equal to: 339.8 ± 9 N 741 ± 39 N	 H H1 H2	 47.75 35.33 25.2
	Injector protrusion	X	-
	Camshaft bush housings No. 1 Camshaft housings No. 2-3-4-5-6-7		59.222 to 59.248 54.089 to 54.139
	Camshaft journals: 1 ⇒ 7	∅	53.995 to 54.045
	Bush inside diameter	∅	54.083 to 54.147
	Bushes and journals		0.038 to 0.162
	Cam lift:  	 H H	 6.045 7.582

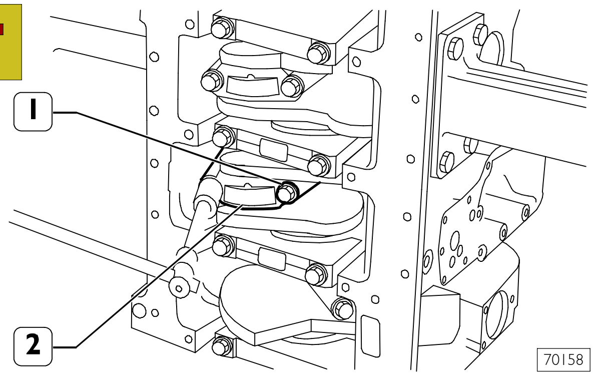
	Type	**6 CYLINDERS**
CYLINDER HEAD – TIMING SYSTEM		**mm**
	Tappet cap housing on block Ø 1	16.000 to 16.030
	Tappet cap outside diameter: Ø 2 Ø 3	15.924 to 15.954 15.960 to 15.975
	Between tappets and housings	0.025 to 0.070
IVECO PARTS	Tappets	-
	Rocker shaft Ø 1	21.965 to 21.977
	Rockers Ø 2	22.001 to 22.027
	Between rockers and shaft	0.024 to 0.162

ENGINE OVERHAUL
ENGINE REMOVAL AT THE BENCH

The following instructions assume that the engine has previously been placed on the rotating bench and that removal of all specific components of the Iveco Motors 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

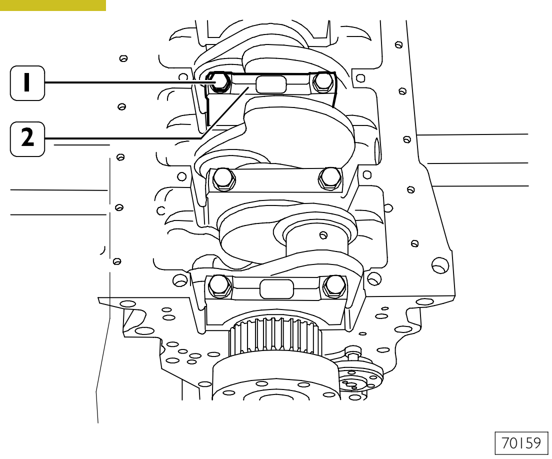


Loosen the fixing screws (1) and remove the rod caps (2).

Withdraw the pistons including the connecting rods from the top of the engine block.

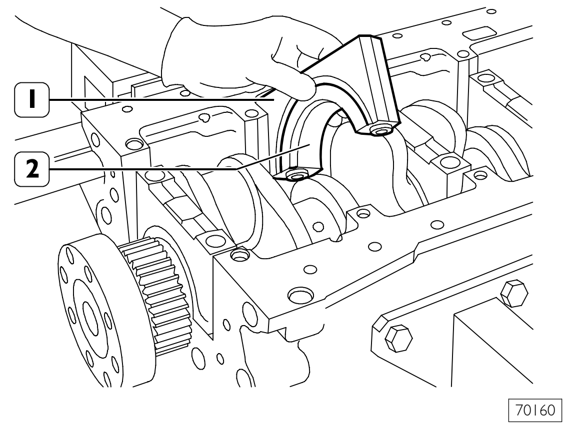
NOTE Keep the half-bearings into their housings since in case of use they shall be fitted in the same position found at removal.

Figure 2



Remove the screws (1) and the main bearing caps (2).

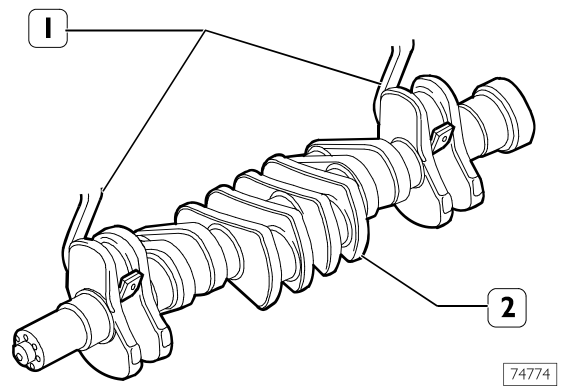
Figure 3



The second last main bearing cap (1) and the relevant support are fitted with shoulder half-bearing (2).

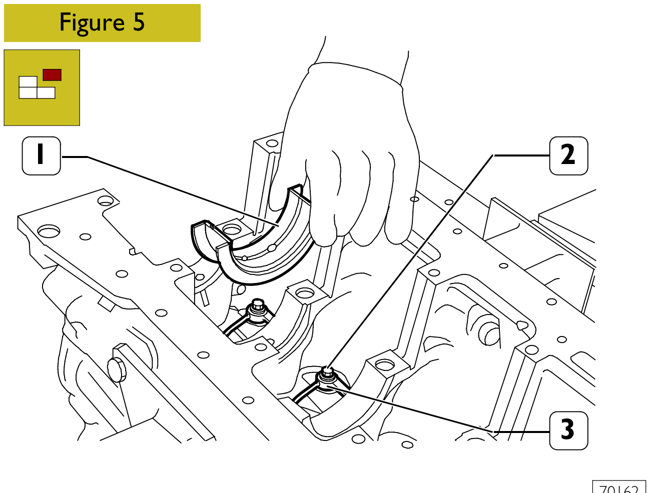
NOTE Take note of lower and upper half-bearing assembling positions since in case of reuse they shall be fitted in the same position found at removal.

Figure 4



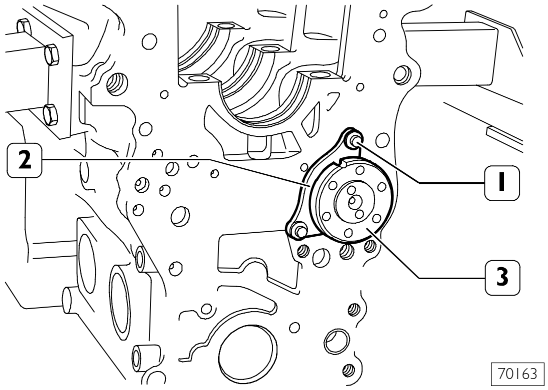
Use tool 99360500 (1) and hoist to remove the crankshaft (2) from the block.

Figure 5



Remove the main half-bearings (1).
Remove the screws (2) and remove the oil nozzles (3).

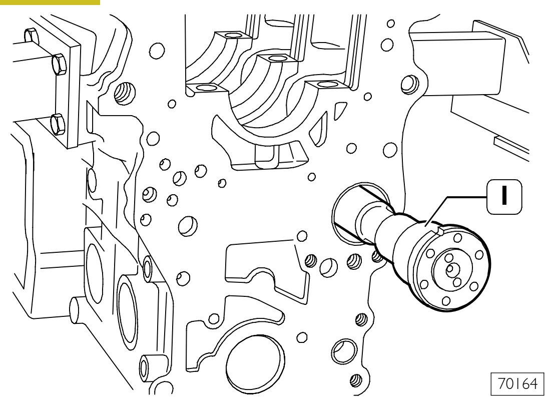
Figure 6



Remove the screws (1) and disconnect camshaft (3) retaining plate (2).

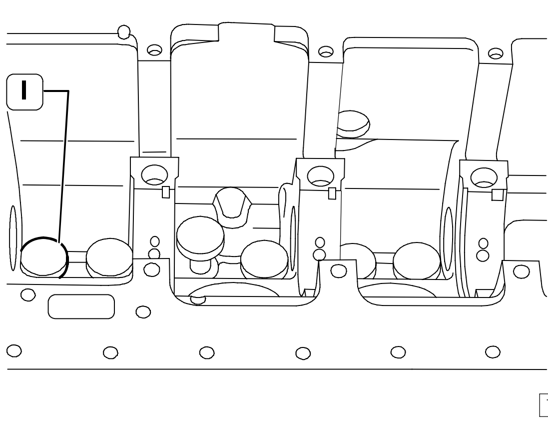
NOTE Take note of plate (2) assembling position.

Figure 7



Withdraw carefully the camshaft (1) from the engine block.

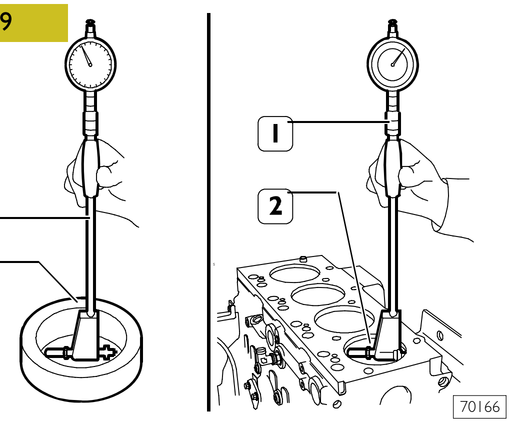
Figure 8



Withdraw the tappets (1) from the engine block.

REPAIR OPERATIONS
CYLINDER UNIT
Checks and measurement

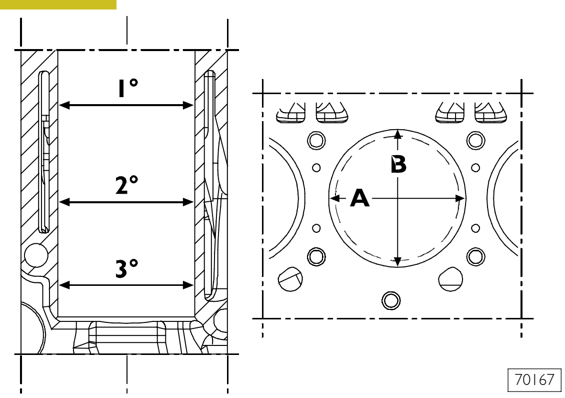
Figure 9



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

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

Figure 10

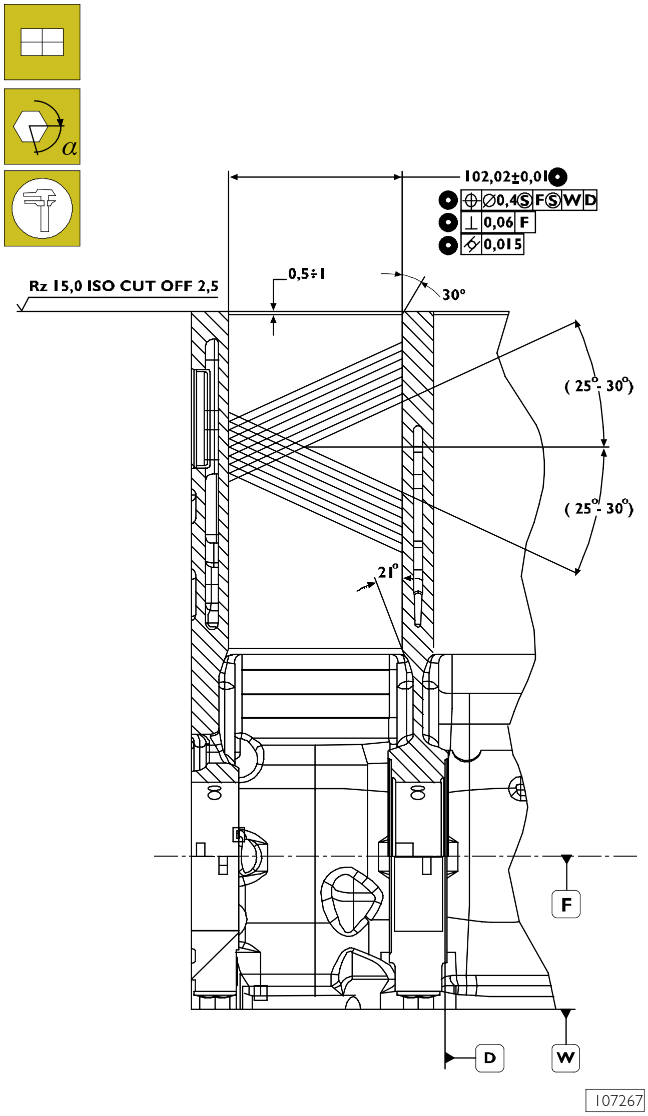


Measurements shall be performed on each cylinder, at three different heights in the barrel and on two planes perpendicular with each other: one parallel to the longitudinal axis of the engine (A), and the other perpendicular (B). Maximum wear is usually found on plane (B) in correspondence with the first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

Should ovalisation, taper or wear be found, bore and grind the cylinder barrels. Cylinder barrel regrinding shall be performed according to the spare piston diameter oversized by 0.5 mm and to the specified assembling clearance.

Print P4D32N001 E

Figure 11



NOTE In case of regrinding, all barrels shall have the same oversize (0.5 mm).

Check main bearing housings as follows:

- fit the main bearings caps on the supports without bearings;
- tighten the fastening screws to the specified torque;
- use the proper internal gauge to check whether the housing diameter is falling within the specified value.

Replace if higher value is found.

Checking head supporting surface on cylinder unit

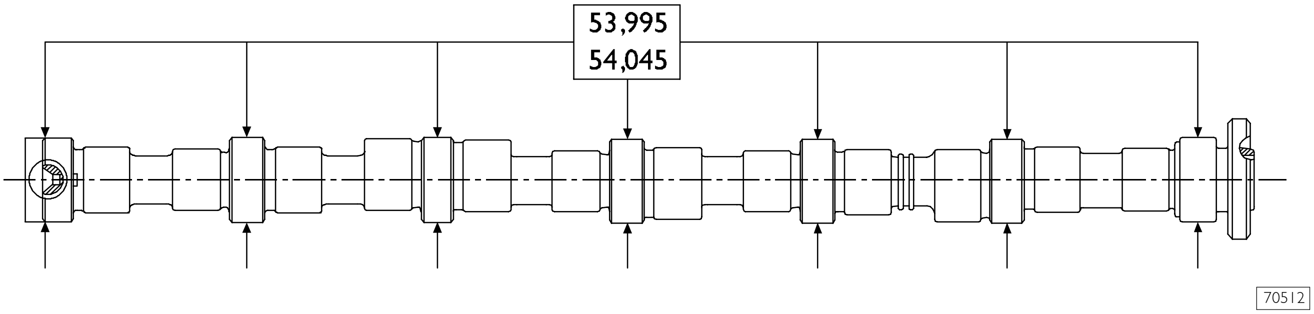
When finding the distortion areas, replace the cylinder unit.

Planarity error shall not exceed 0.075 mm.

Check cylinder unit operating plug conditions, replace them in case of uncertain seal or if rusted.

TIMING SYSTEM
Camshaft

Figure 12



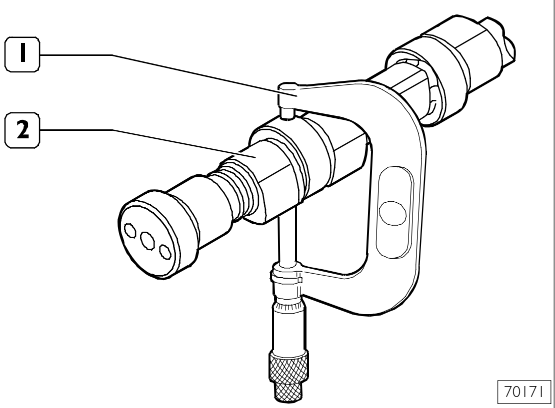
CAMSHAFT MAIN DATA (6 F4AE0685 engine cylinders)
Specified data refer to pin standard diameter

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

Checking cam lift and pin alignment

Set the camshaft on the tailstock and using a 1/100 gauge set on the central support, check whether the alignment error is not exceeding 0.04 mm, otherwise replace the camshaft. Check cam lift; found values shall be: 6.045 mm for exhaust cams and 7.582 mm for intake cams, in case of different values replace the camshaft.

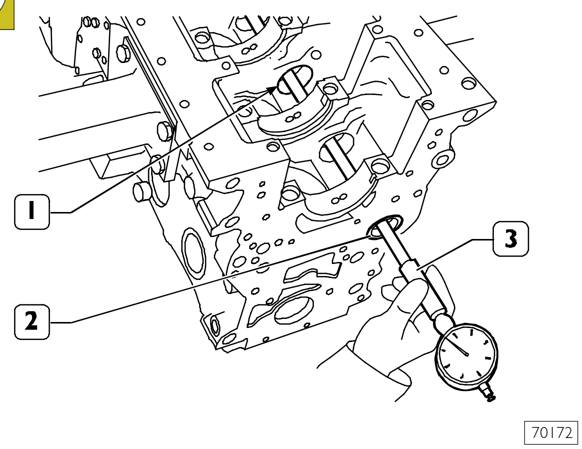
Figure 13



Check camshaft (2) pin diameter using micrometer (1) on two perpendicular axes.

BUSHES

Figure 14



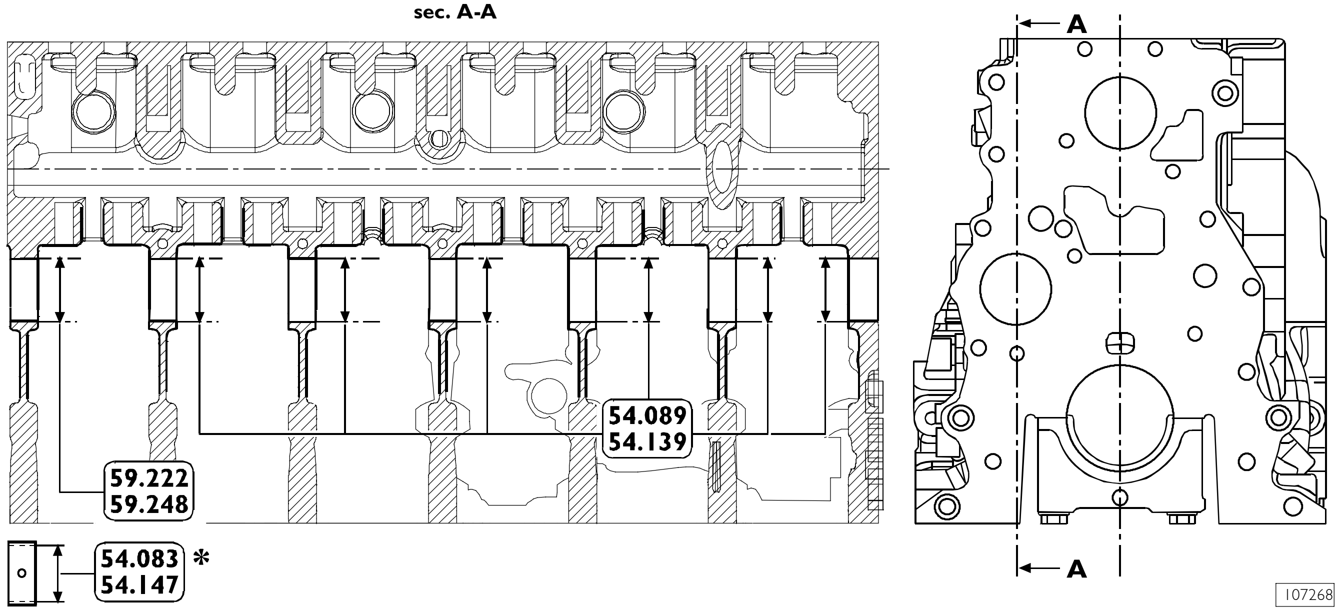
The camshaft bushing (2) must be forced into its seat.

Internal surfaces must not show seizing or wear.

Using a bore gauge (3), measure the diameter of the bushing (2) and of the intermediate seats (1) for the camshaft.

Measurements shall be performed on two perpendicular axes.

Figure 15

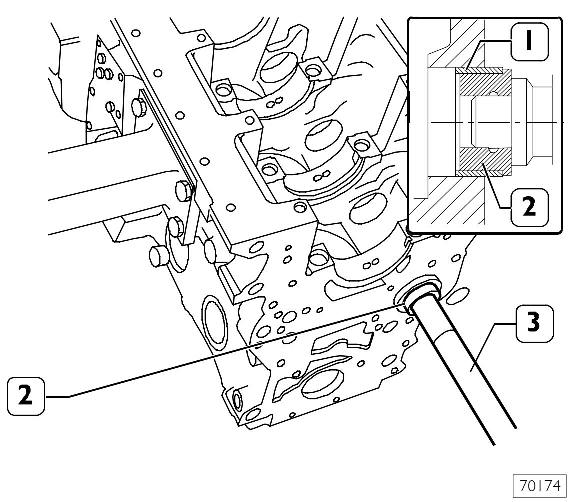


MAIN DATA ABOUT CAMSHAFT BUSHES AND RELATED HOUSINGS

*Height to be obtained after driving the bushes.

Bush replacement

Figure 16

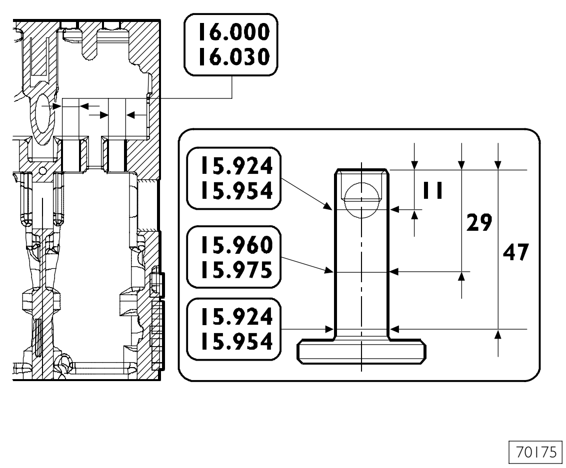


To change the bushing (1), use the drift 99360362 (2) and grip 99370006 (3) for its disassembly and assembly.

NOTE Upon assembly, the bushing (1) must be directed so that the lubrication holes coincide with the holes in the seats in the crankcase.

Tappets

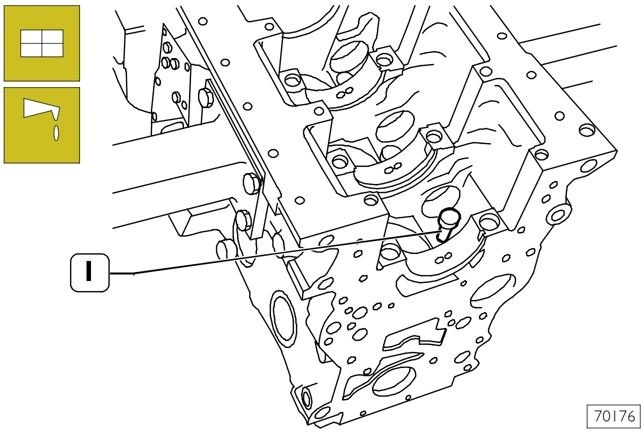
Figure 17



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON THE ENGINE BLOCK

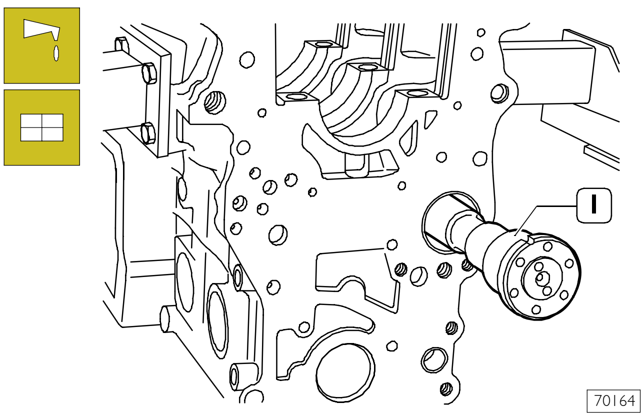
Fitting tappets – camshaft

Figure 18



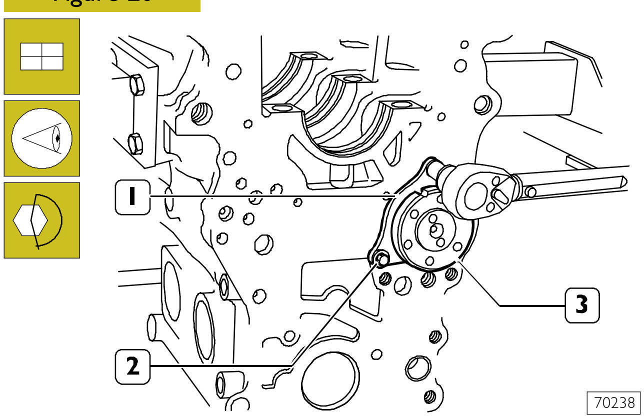
Lubricate the tappets (1) and fit them into the relevant housings on the engine block.

Figure 19



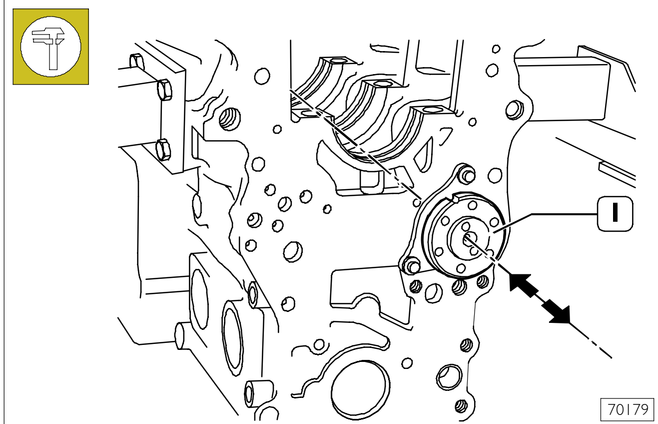
Lubricate the camshaft bushes and fit the camshaft (1) taking care not to damage the bushes or the housings.

Figure 20



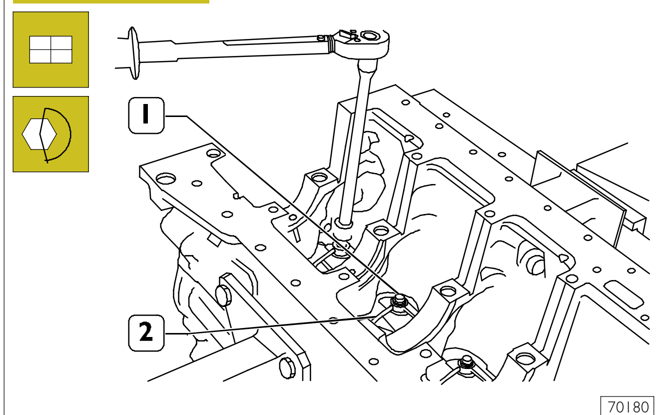
Set camshaft (3) retaining plate (1) with the slot facing the top of the engine block and the marking facing the operator, then tighten the screws (2) to the specified torque.

Figure 21



Check camshaft end float (1).
It shall be 0.23 ± 0.13 mm.

Figure 22

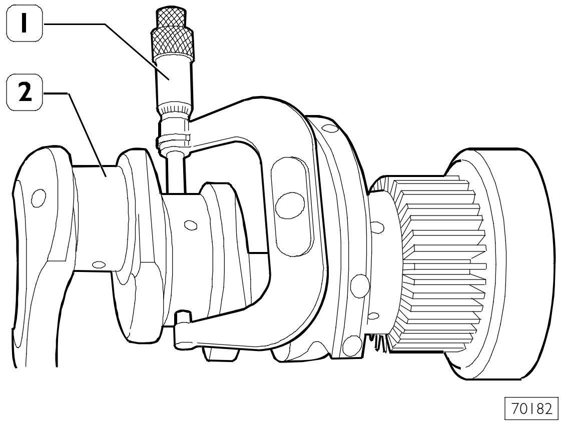


Fit nozzles (2) and tighten the fastening screws (1) to the specified torque.

OUTPUT SHAFT

Measuring journals and crankpins

Figure 23



Grind journals and crankpins if seizing, scoring or excessive ovalisation are found. Before grinding the pins (2) measure them with a micrometer (1) to decide the final diameter to which the pins are to be ground.

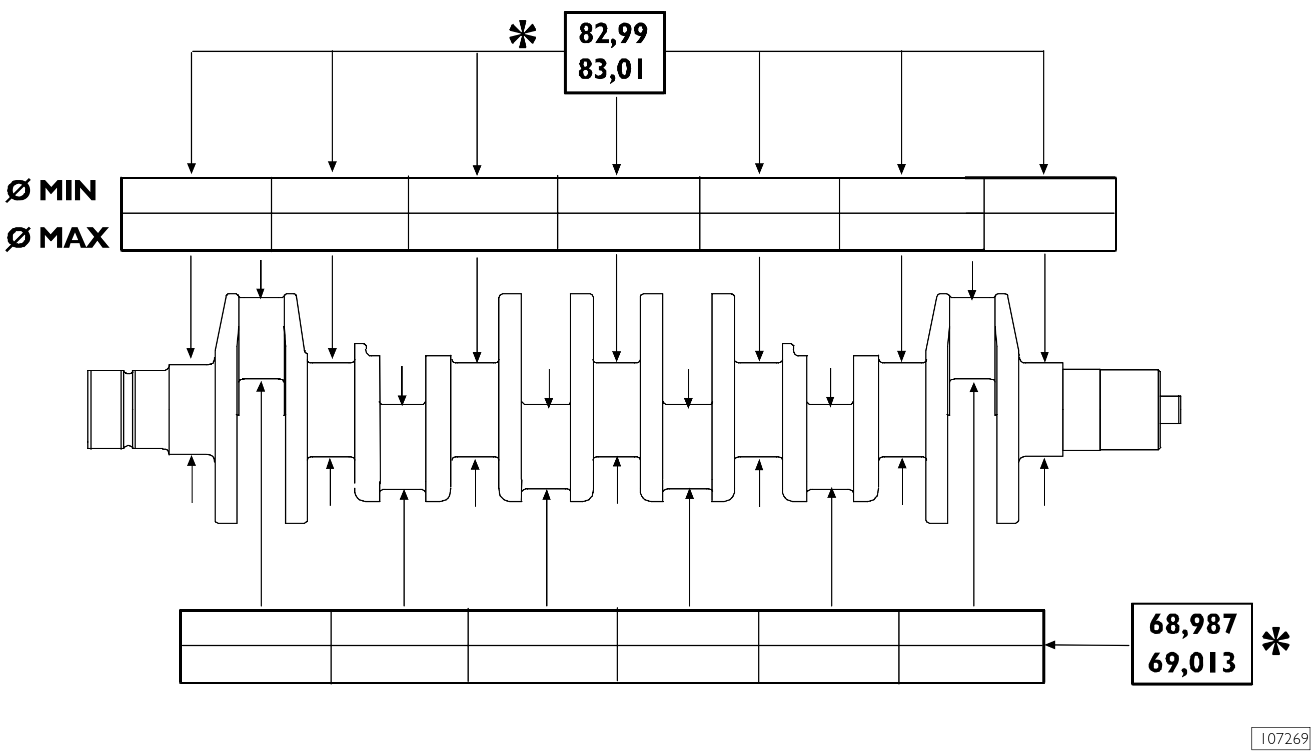
NOTE It is recommended to insert the found values in the proper table. See Figure 24.

Undersize classes are:

NOTE Journals and crankpins shall always be ground to the same undersize class.
Journals and crankpins undersize shall be marked on the side of the crank arm No.1.
For undersized crankpins: letter M.
For undersized journals: letter B.
For undersized crankpins and journals: letters MB.

Measuring journals and crankpins (6 cyl.)

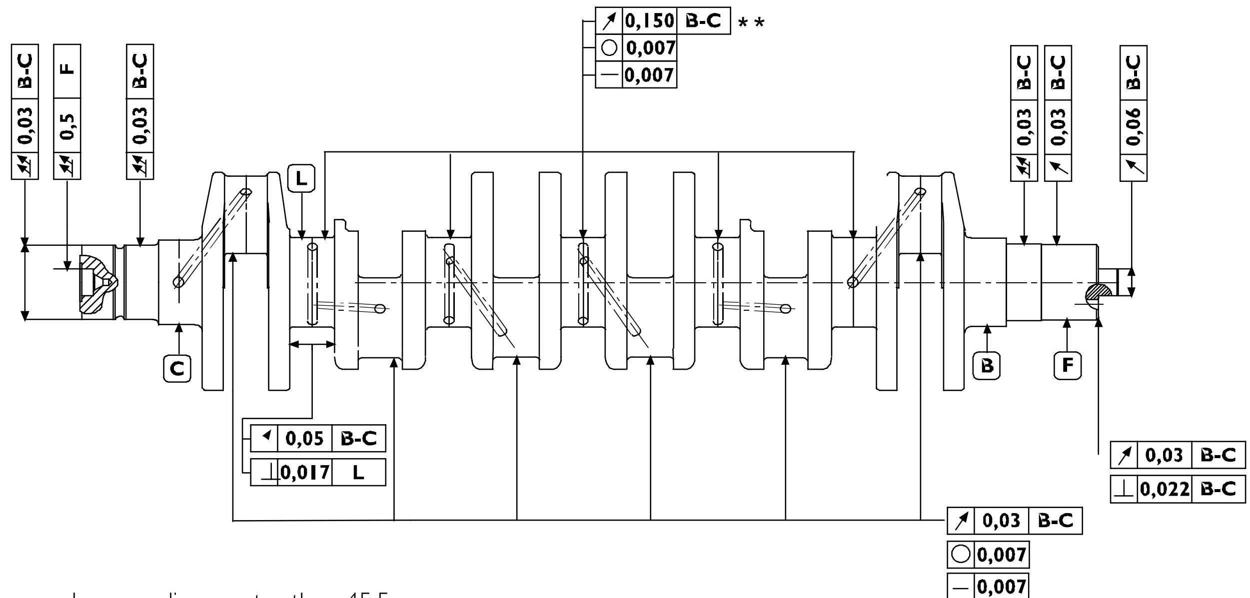
Figure 24



FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES

*Rated value

Figure 25



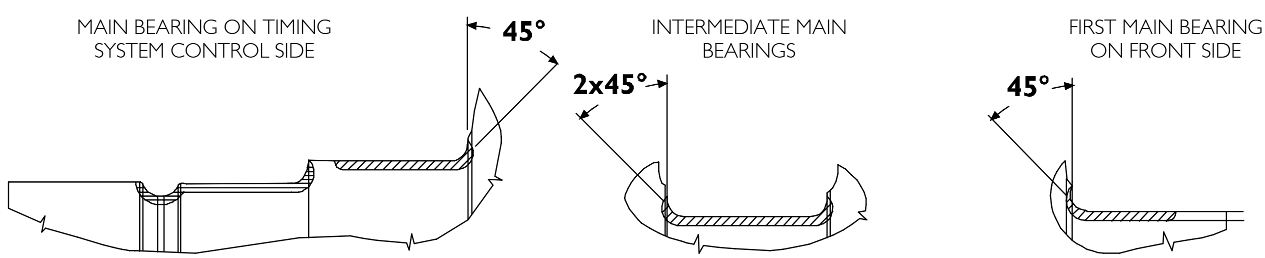
* Measured on a radius greater than 45.5 mm

** ↗ 0.500 between adjacent main journals

70577

MAIN OUTPUT SHAFT TOLERANCES

Figure 26

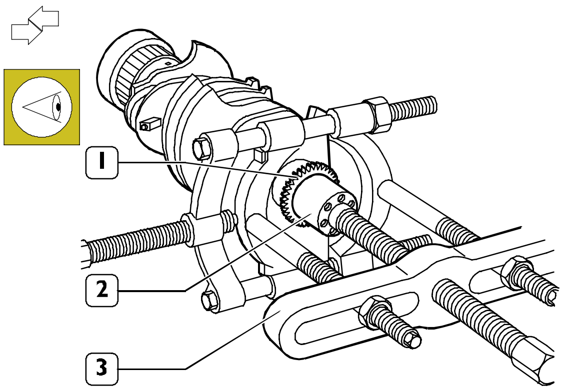


70237

TOLERANCES	TOLERANCE CHARACTERISTIC	GRAPHIC SYMBOL
SHAPE	Roundness	○
	Cilindricity	/○/
DIRECTION	Parallelism	//
	Verticality	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	⇗

Replacing oil pump control gear

Figure 27



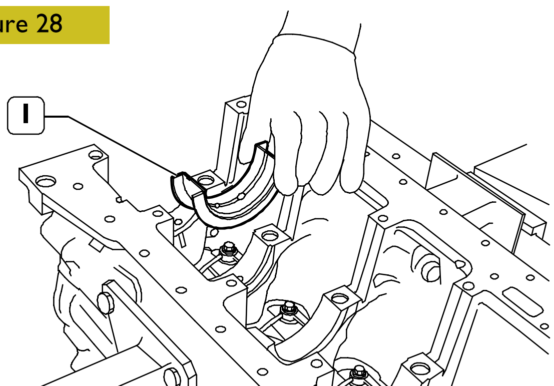
70184

Check that gear toothing (1) is not damaged or worn, otherwise remove it using the proper puller (3).

When fitting the new gear, heat it to 180°C for 10 minutes in an oven and then key it to the crankshaft.

Fitting main bearings

Figure 28



70185

NOTE Refit the main bearings that have not been replaced, in the same position found at removal.

Main bearings (1) are supplied spare with 0.250 – 0.500 mm undersize on the internal diameter.

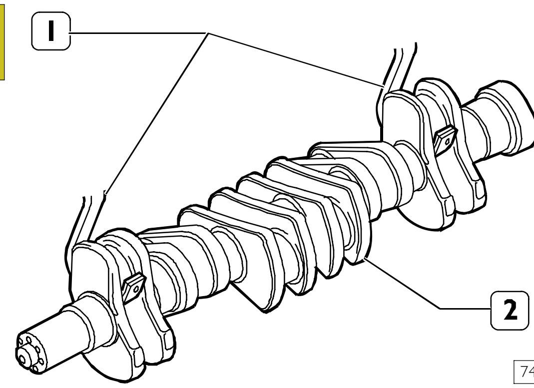
NOTE Do not try to adapt the bearings.

Clean accurately the main half bearings (1) having the lubricating hole and fit them into their housings.

The second last main half bearing (1) is fitted with shoulder half rings.

Finding journal clearance

Figure 29

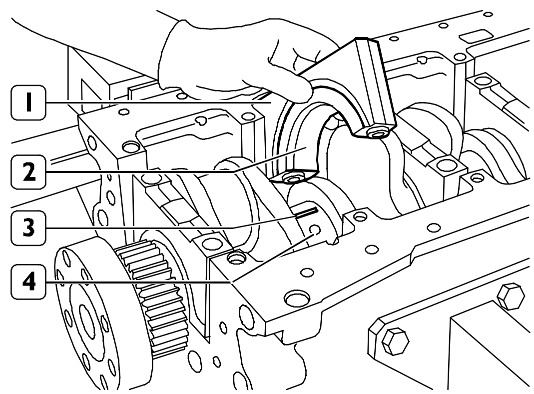


74774

Refit the output shaft (2).

Check the backlash between crankshaf main journals and the relevant bearings as follows:

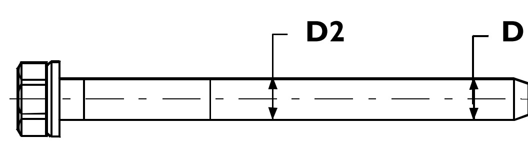
Figure 30



70186

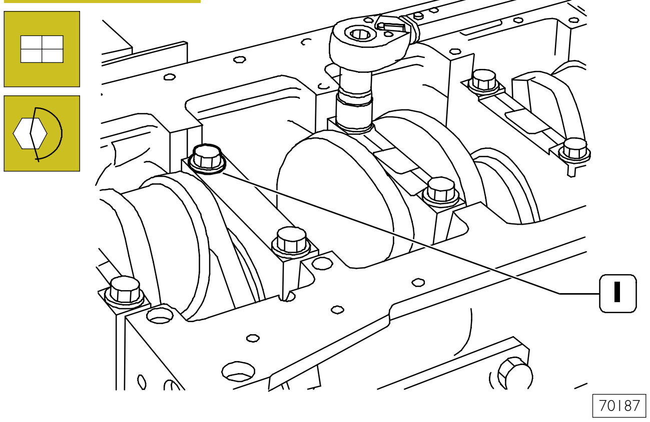
- clean accurately the parts and remove any trace of oil;
- position a piece of calibrated wire (3) on the crankshaft pins (4) so that it is parallel to the longitudinal axis;
- fit caps (1), including the half bearings (2) on the relevant supports.

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.



75703

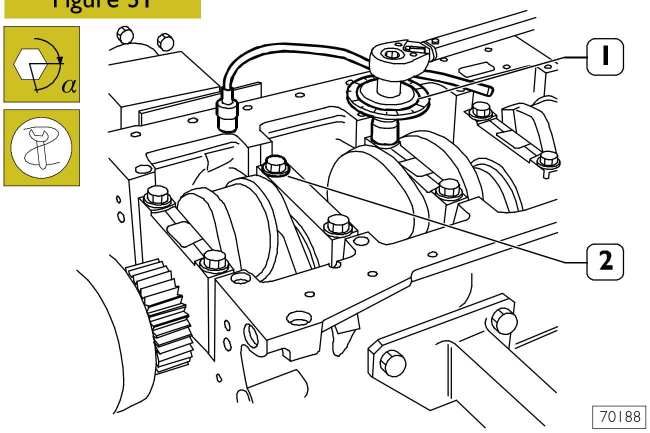
Figure 35



Tighten the pre-lubricated screws (1) in the following three successive stages:

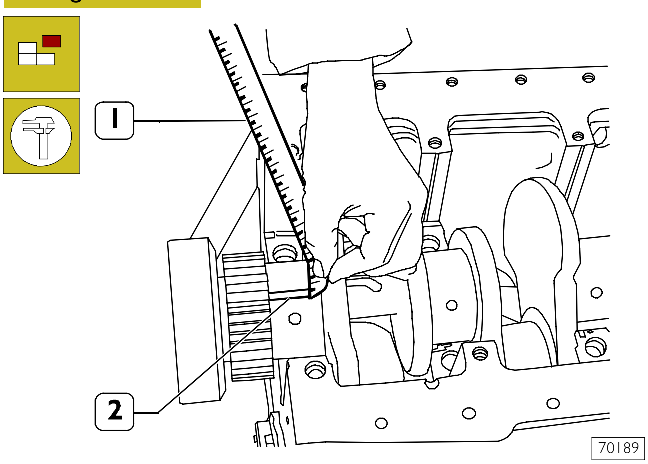
- ❑ 1st stage, with torque wrench to 50 ± 6 Nm.
- ❑ 2nd stage, with torque wrench to 80 ± 6 Nm.

Figure 31



- ❑ 3rd stage, with tool 99395216 (1) set as shown in the figure, tighten the screws (2) with 90 ± 5° angle.

Figure 32



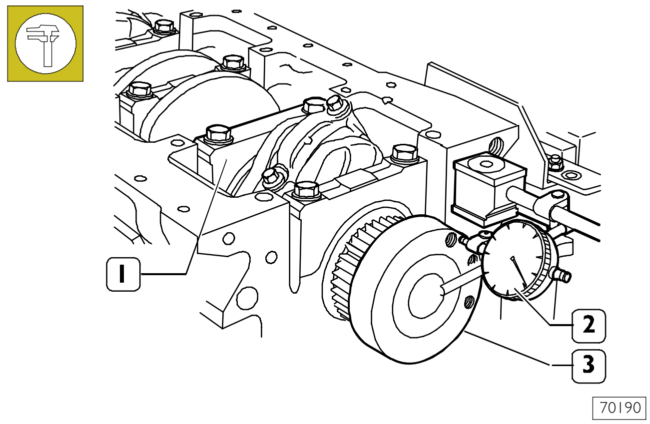
- ❑ Remove caps from supports.

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

Replace the half bearings and repeat the check if a different backlash value is found. Once the specified backlash is obtained, lubricate the main bearings and fit the supports by tightening the fastening screws as previously described.

Checking crankshaft shoulder clearance

Figure 33

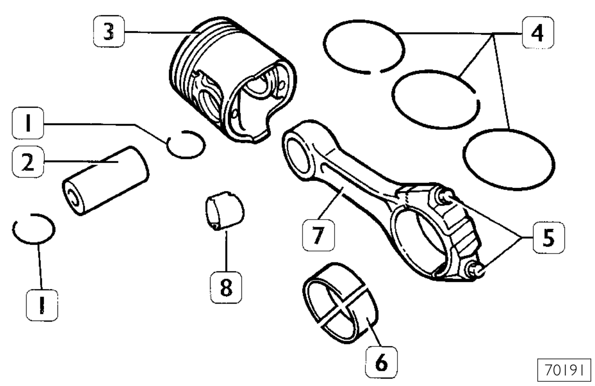


This check is performed by setting a magnetic-base dial gauge (2) on the crankshaft (3) as shown in the figure, standard value is 0.068 to 0.41.

If higher value is found, replace main thrust half bearings of the second last rear support (1) and repeat the clearance check between crankshaft pins and main half bearings.

CONNECTING ROD – PISTON ASSEMBLY

Figure 34

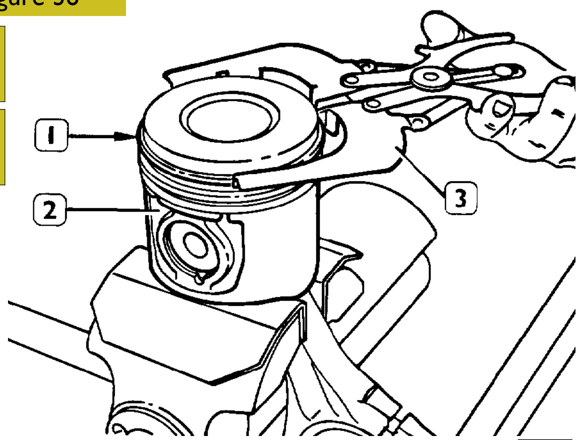


CONNECTING ROD – PISTON ASSEMBLY COMPONENTS

1. Stop rings - 2. Pin - 3. Piston - 4. Split rings - 5. Screws - 6. Half bearings - 7. Connecting rod - 8. Bush.

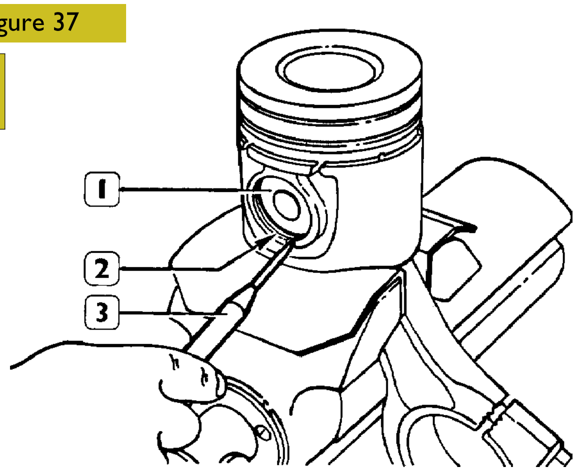
NOTE Pistons are supplied spare with 0.5 mm oversize.

Figure 36



Remove split rings (1) from piston (2) using pliers 99360183 (3).

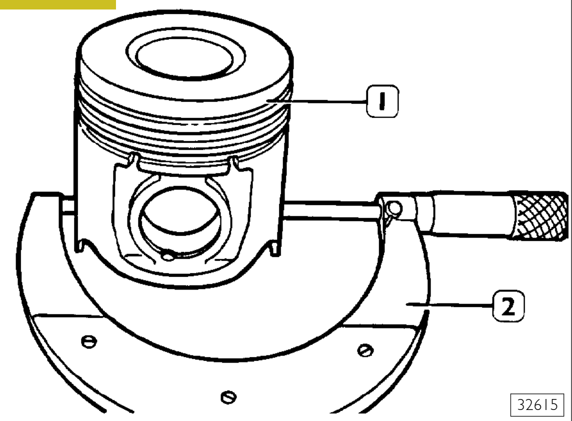
Figure 37



Piston pin (1) split rings (2) are removed using a scriber (3).

Pistons
Measuring piston diameter

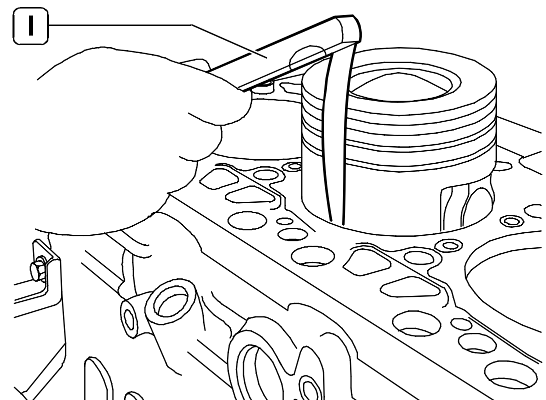
Figure 39



Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance.

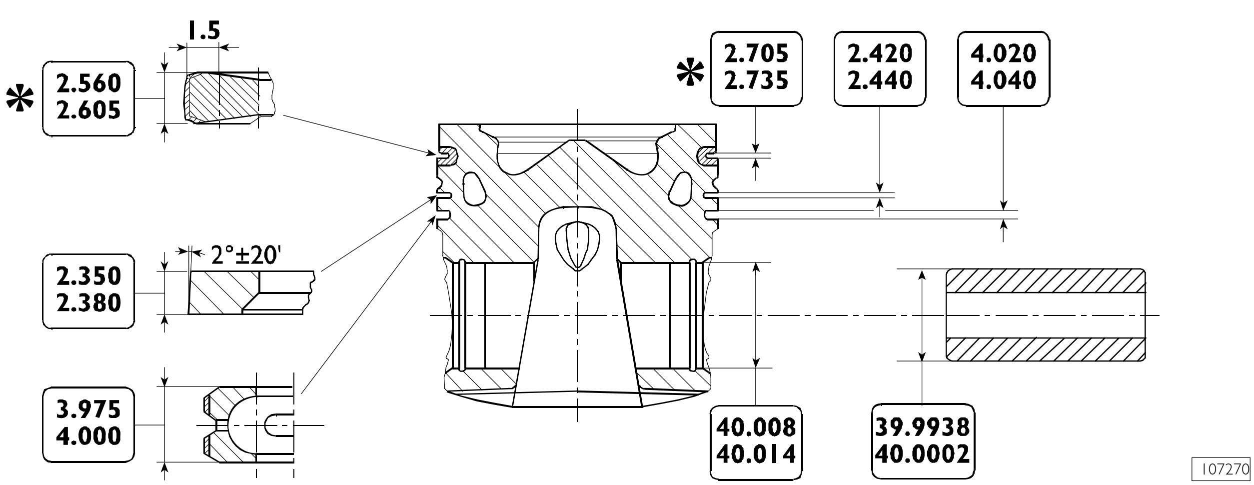
NOTE The diameter shall be measured at 60.5 mm from the piston skirt.

Figure 40



The clearance between the piston and the cylinder barrel can be checked also with a feeler gauge (1) as shown in the figure.

Figure 38

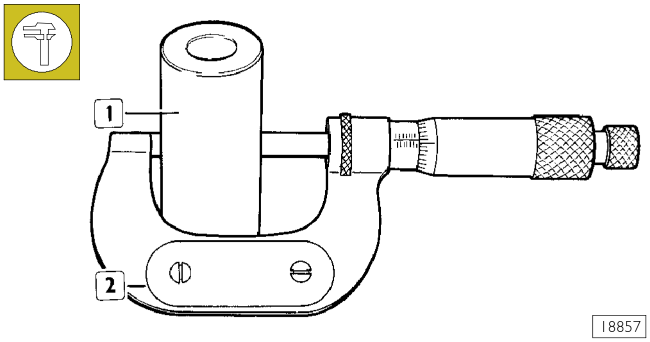


MAIN DATA CONCERNING KS. PISTON, PINS AND SPLIT RINGS

* Value measured on 99 mm diameter

Piston pins

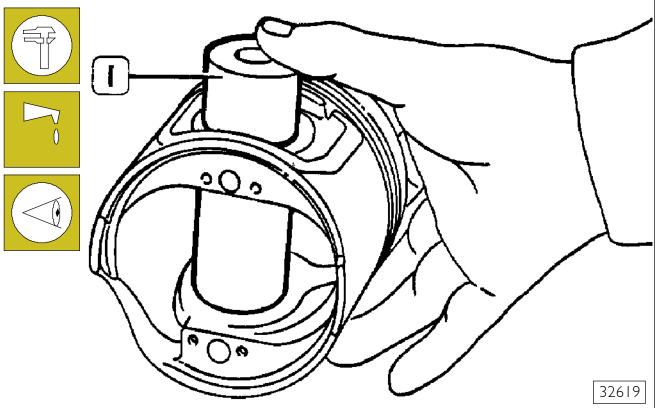
Figure 41



To measure the piston pin (1) diameter use the micrometer (2).

Conditions for proper pin-piston coupling

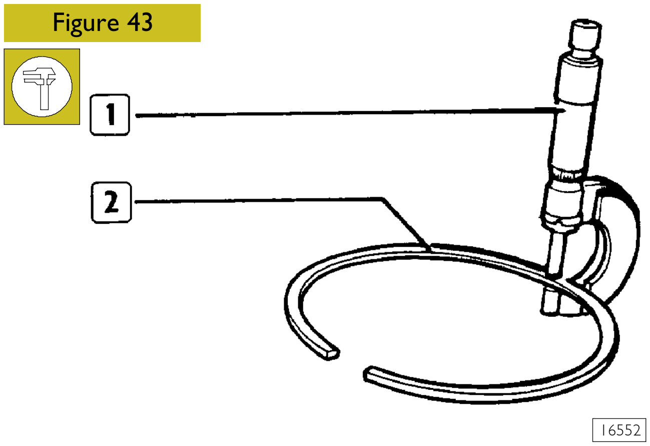
Figure 42



Lubricate the pin (1) and its seat on piston hubs with engine oil; the pin shall be fitted into the piston with a slight finger pressure and shall not be withdrawn by gravity.

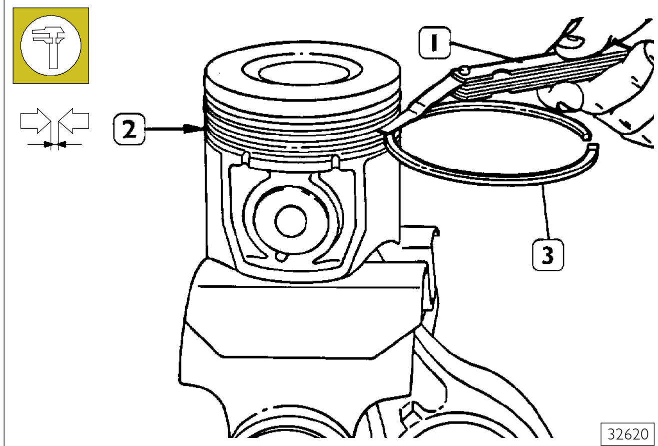
Piston rings

Figure 43



Use a micrometer (1) to check split ring (2) thickness.

Figure 44



Check the clearance between the sealing rings (3) of the 2nd and 3rd slot and the relevant housings on the piston (2), using a feeler gauge (1).

Figure 45

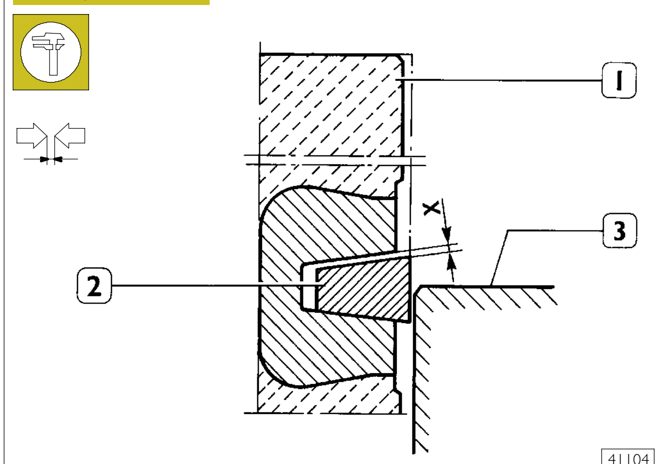


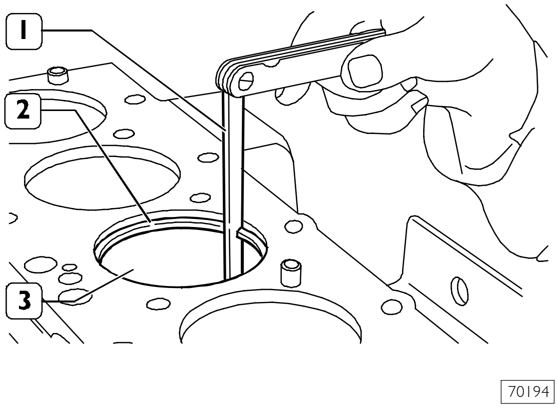
DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING

Since the first sealing ring section is trapezoidal, the clearance between the slot and the ring shall be measured as follows: make the piston (1) protrude from the engine block so that the ring (2) protrudes half-way from the cylinder barrel (3).

In this position, use a feeler gauge to check the clearance (X) between ring and slot: found value shall be the specified one.

Print P4D32N001 E

Figure 46

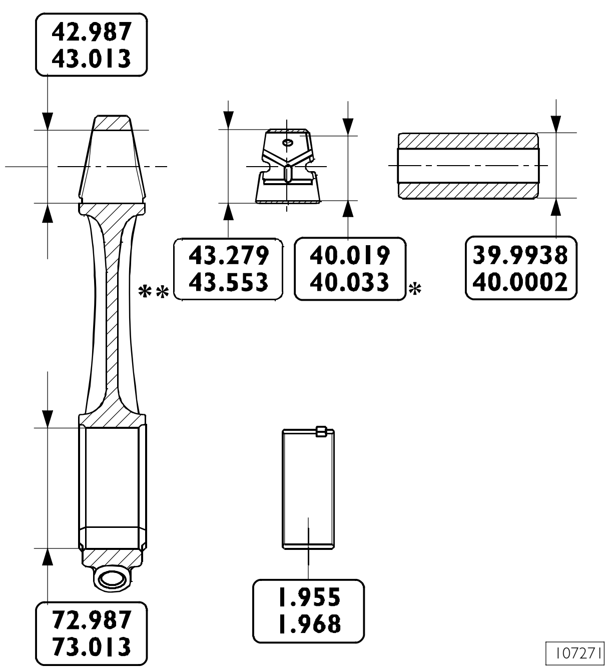


Use feeler gauge (1) to measure the clearance between the ends of the split rings (2) fitted into the cylinder barrel (3).

Use a micrometer (1) to check split ring (2) thickness.

Connecting rods

Figure 47

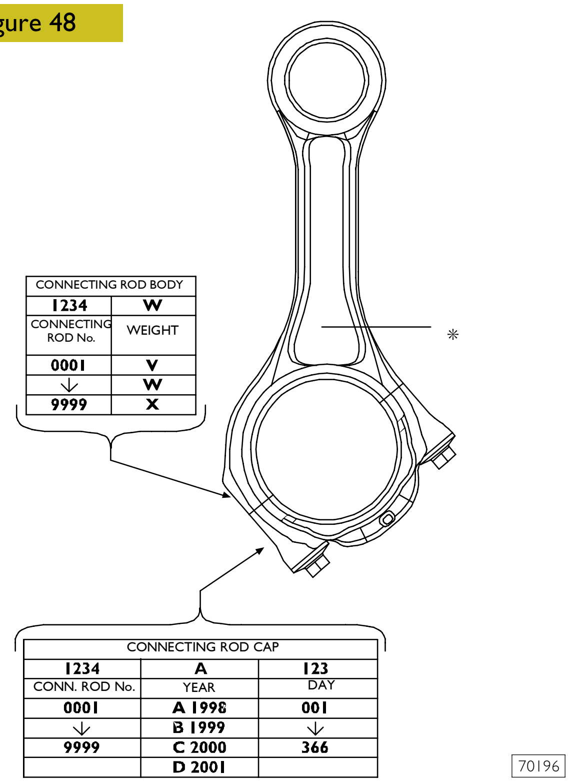


MAIN DATA FOR CONNECTING ROD, BUSH, PISTON PIN AND HALF BEARINGS

* Value for inside diameter to be obtained after driving in connecting rod small end and grinding.
** Value not measurable in released condition.

NOTE The surface of connecting rod and rod cap are knurled to ensure better coupling.
Therefore, it is recommended not to smooth the knurls.

Figure 48



NOTE Every connecting rod is marked as follows:

- ❑ On body and cap with a number showing their coupling and the corresponding cylinder.
  In case of replacement it is therefore necessary to mark the new connecting rod with the same numbers of the replaced one.
- ❑ On body with a letter showing the weight of the connecting rod assembled at production:
  - V, 1820 to 1860 (yellow marking);
  - W, 1861 to 1900 (green marking);
  - X, 1901 to 1940 (blue marking);

Bushes

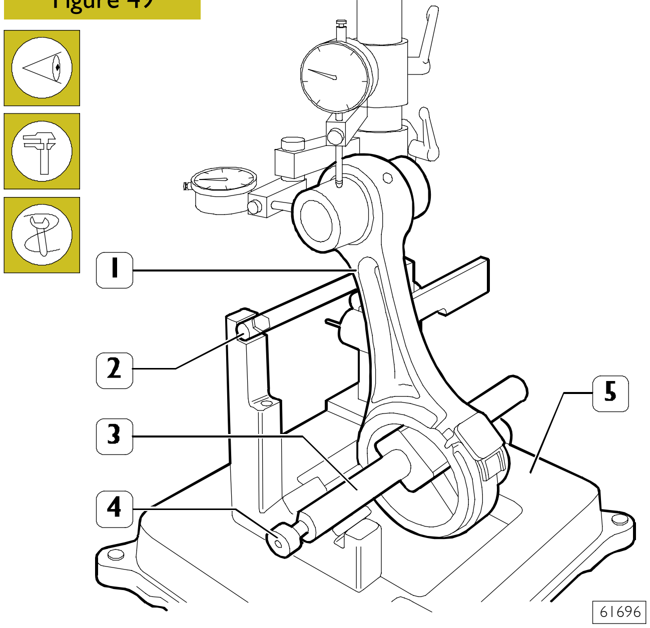
Check that the bush in the connecting rod small end is free from scoring or seizing and that it is not loosen. Otherwise replace.

Removal and refitting shall be performed using the proper beater.

When refitting take care to make coincide the oil holes set on the bush with those set on the connecting rod small end. Grind the bush to obtain the specified diameter.

Checking connecting rods

Figure 49

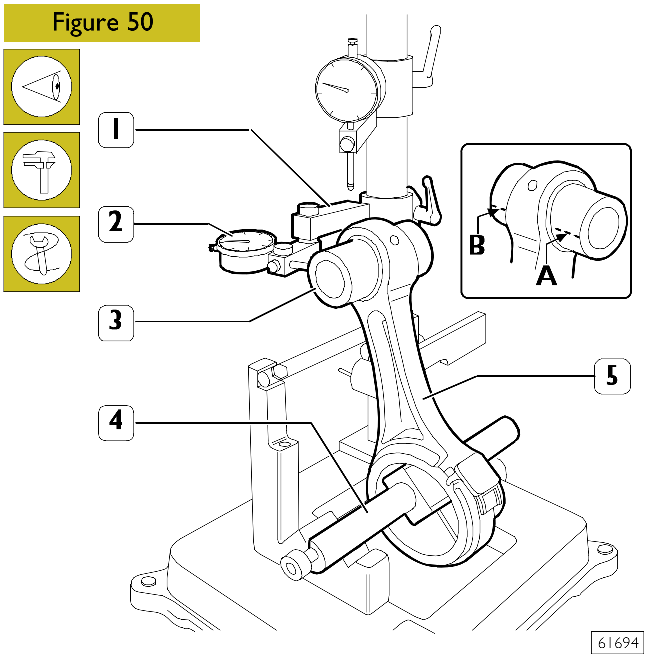


Check parallelism of conrod axes (1) by means of specific tool (5) as follows:

- fit the connecting rod (1) on tool (5) spindle and lock it with screw (4);
- set the spindle (3) on V-blocks by resting the connecting rod (1) on the stop bar (2).

Checking torsion

Figure 50

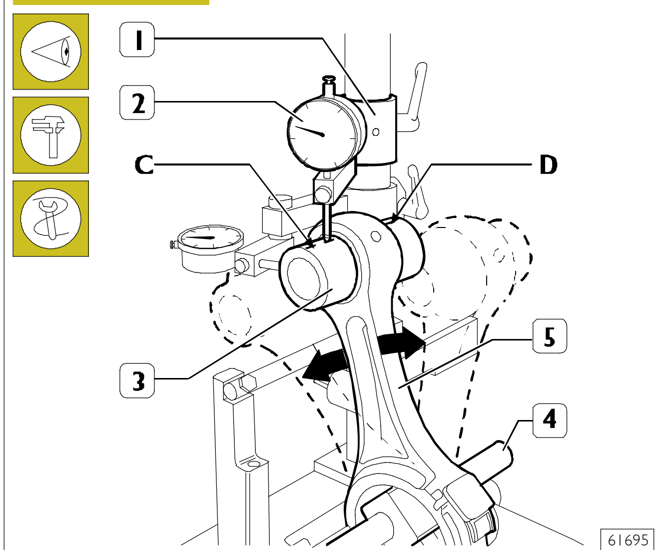


Check connecting rod (5) torsion by comparing two points (A and B) of pin (3) on the horizontal plane of the connecting rod axis.

Position the dial gauge (2) support (1) to obtain a preload of approx. 0.5 mm on the pin (3) in point A and then set the dial gauge (2) to zero. Move 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 shall not exceed 0.08 mm.

Checking bending

Figure 51



Check connecting rod (5) bending by comparing two points C and D of the pin (3) on the vertical plane of the connecting rod axis.

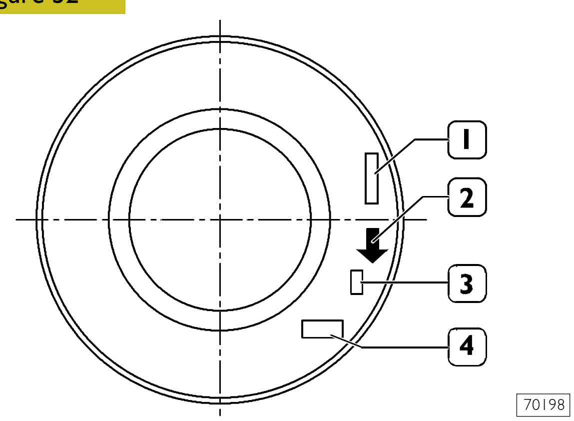
Position the vertical support (1) of the dial gauge (2) to rest the latter on pin (3), point C.

Move the connecting rod forwards and backwards to find pin top position, then in this condition reset the dial gauge (2).

Move the spindle with the connecting rod (5) and repeat the check of the top point on the opposite side D of the pin (3). The difference between point C and point D shall not exceed 0.08 mm.

Fitting connecting rod-piston assembly
Connecting rod-piston coupling

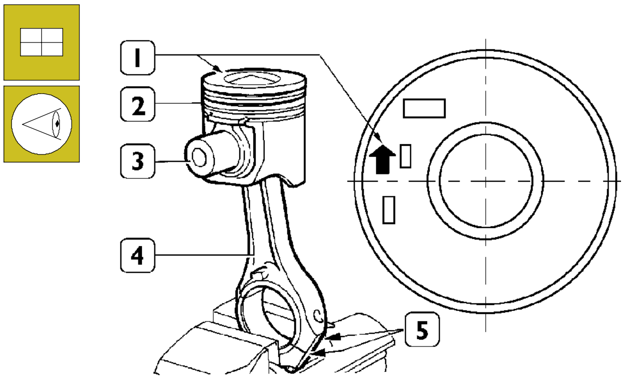
Figure 52



The piston crown is marked as follows:

1. Part number and design modification number;
2. Arrow showing piston assembling direction into cylinder barrel, this arrow shall face the front key of the engine block;
3. Marking showing 1st slot insert testing;
4. Manufacturing date.

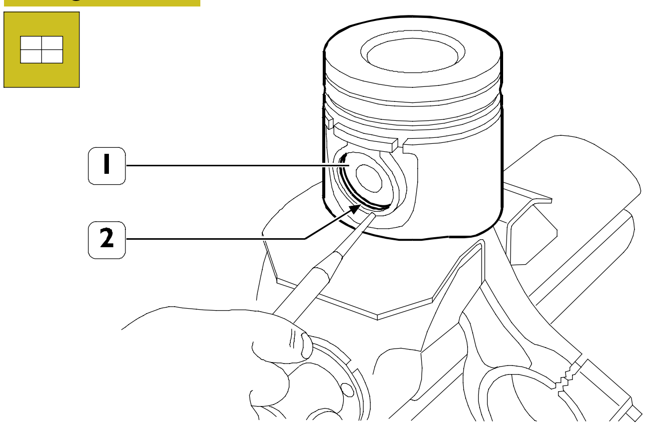
Figure 53



70199

Connect piston (2) to connecting rod (4) with pin (3) so that the reference arrow (1) for fitting the piston (2) into the cylinder barrel and the numbers (5) marked on the connecting rod (5) are read as shown in the figure.

Figure 54

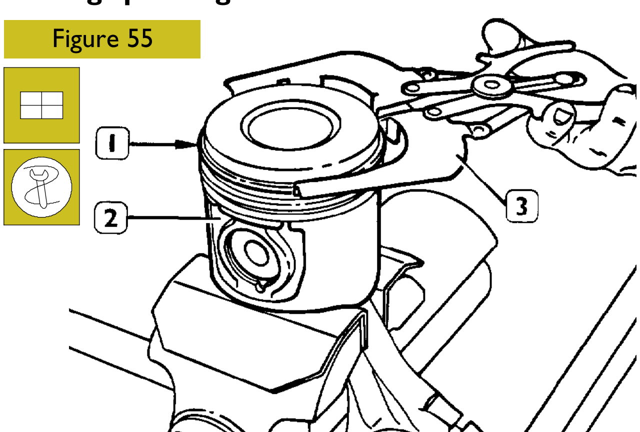


72705

Position the piston (1) on the connecting rod according to the diagram shown in the figure, fit the pin (3) and stop it by the split rings (2).

Fitting split rings

Figure 55



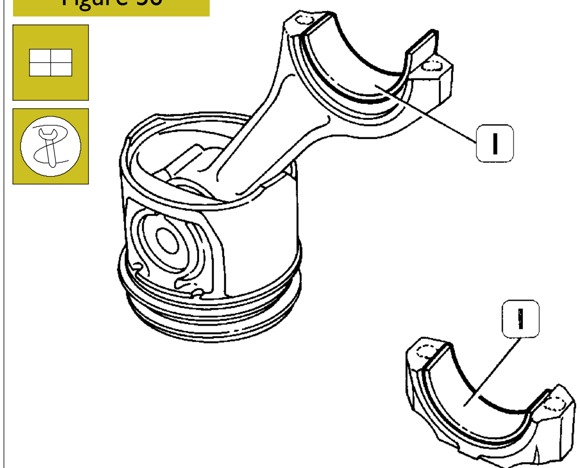
32613

Use pliers 99360183 (3) to fit the split rings (1) on the piston (2).
Split rings shall be fitted with the marking "TOP" facing upwards and their openings shall be displaced with each other by 120°.

NOTE Split rings are supplied spare with the following sizes:

- standard;
- 0.5 mm oversize, yellow/green marking;

Figure 56



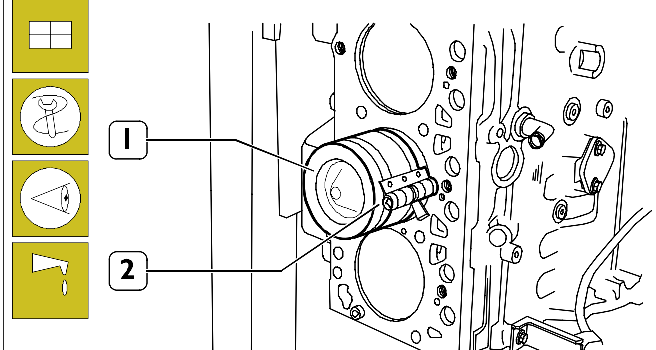
70200

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

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

Fitting connecting rod-piston assembly into cylinder barrels

Figure 57



70201

Lubricate accurately the pistons, including the split rings and the cylinder barrel inside.
Use band 99360605 (2) to fit the connecting rod-piston assembly (1) into the cylinder barrels and check the following:

- ❑ the number of each connecting rod shall correspond to the cap coupling number.

Figure 58

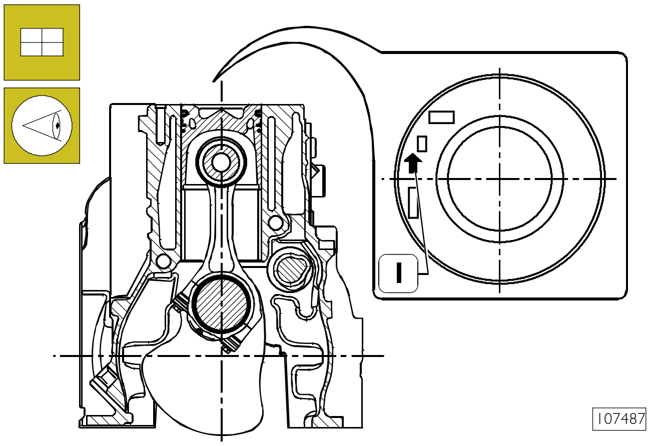
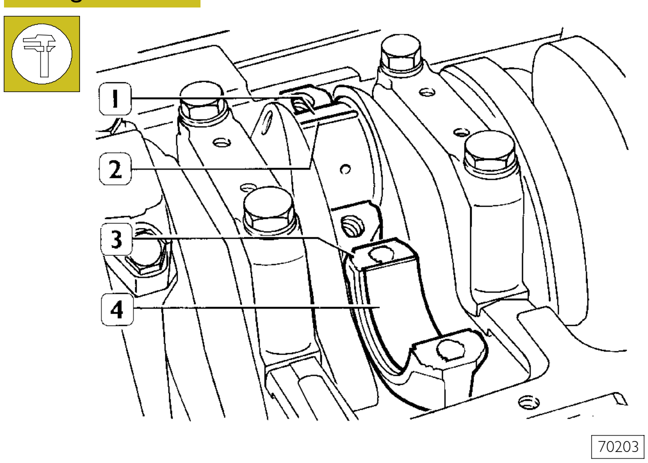


DIAGRAM FOR CONNECTING ROD-PISTON ASSEMBLY FITTING INTO BARREL

- ❑ Split ring openings shall be displaced with each other by 120°;
- ❑ connecting rod-piston assemblies shall have the same weight;
- ❑ the arrow marked on the piston crown shall be facing the front side of the engine block or the slot obtained on the piston skirt shall be corresponding to the oil nozzle position.

Finding crankpin clearance

Figure 59

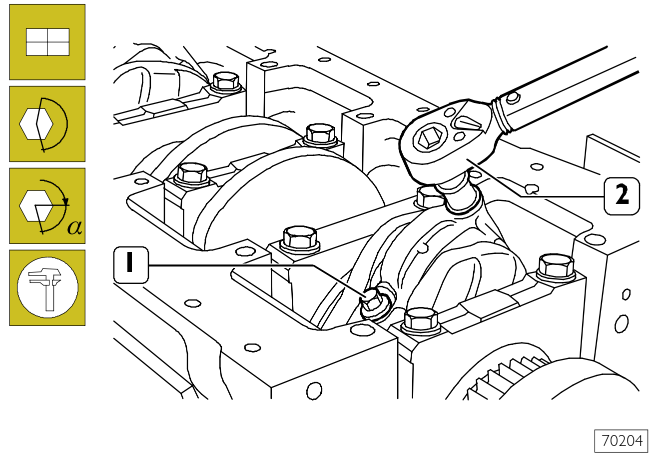


To measure the clearance proceed as follows:

- ❑ clean the parts accurately and remove any trace of oil;
- ❑ set a piece of calibrated wire (2) on the output shaft pins (1);
- ❑ fit the connecting rod caps (3) with the relevant half bearings (4).

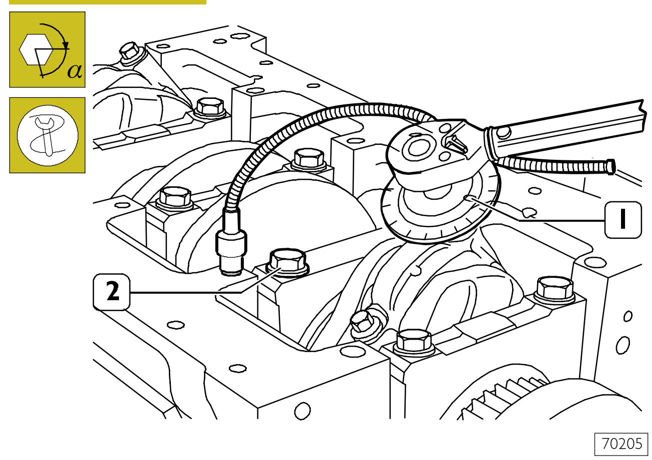
NOTE The M11 screws of the connecting rods cups, must be replaced if the nominal diameter of the of the threaded part that does not work, presents a diameter of < 0,1 mm compared to the nominal value.

Figure 60



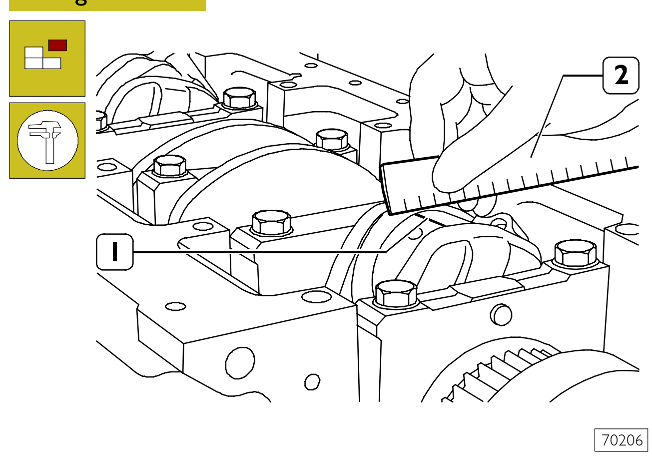
- ❑ Lubricate the screws (1) with engine oil and then tighten them to the specified torque using the torque wrench (2).

Figure 61



- ❑ Apply tool 99395216 (1) to the socket wrench and tighten screws (2) of 60°.

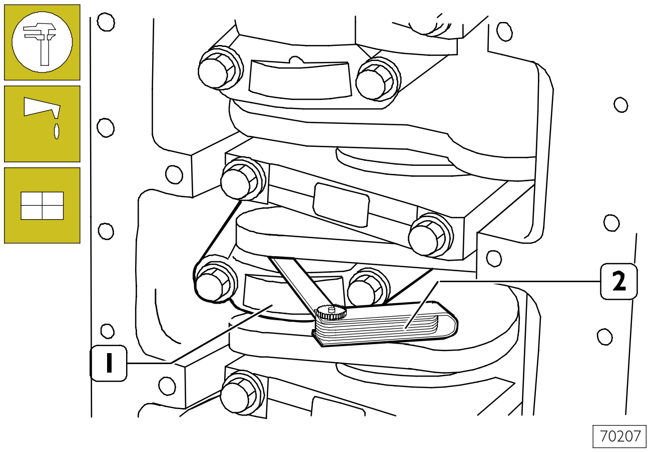
Figure 62



- ❑ Remove the cap and find the existing clearance by comparing the calibrated wire width (1) with the scale on the wire envelope (2).

Print P4D32N001 E

Figure 63



If a different clearance value is found, replace the half bearings and repeat the check.

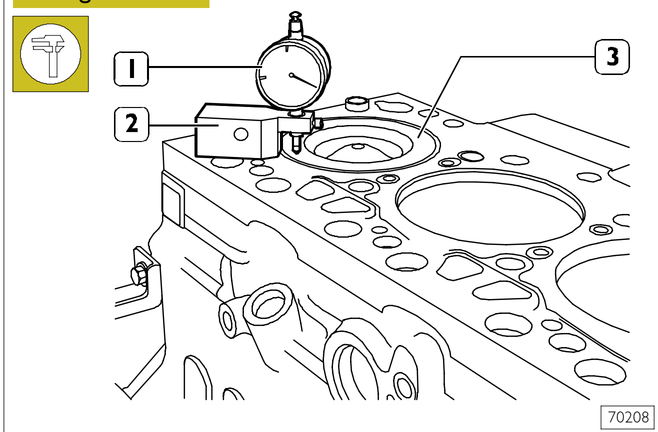
Once the specified clearance has been obtained, lubricate the main half bearings and fit them by tightening the connecting rod cap fastening screws to the specified torque.

NOTE Before the final fitting of the connecting rod cap fastening screws, check that their diameter measured at the centre of the thread length is not < 0.1 mm than the diameter measured at approx. 10 mm from screw end.

Check manually that the connecting rods (1) are sliding axially on the output shaft pins and that their end float, measured with feeler gauge (2) is 0.10 to 0.33 mm.

Checking piston protrusion

Figure 64

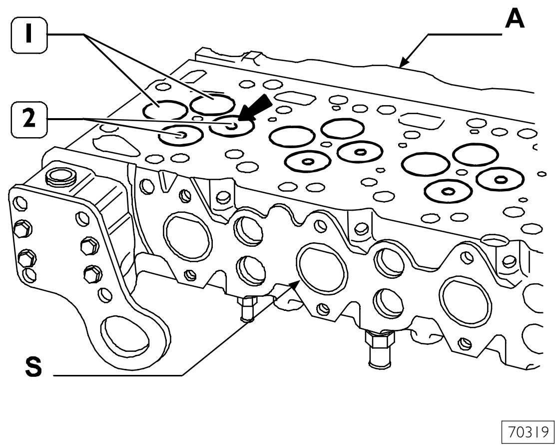


Once connecting rod-piston assemblies refitting is over, use dial gauge 39395603 (1) fitted with base 99370415 (2) to check piston (3) protrusion at T.D.C. with respect to the top of the engine block.

Protrusion shall be 0.28 to 0.52 mm.

CYLINDER HEAD
Removing the valves

Figure 65



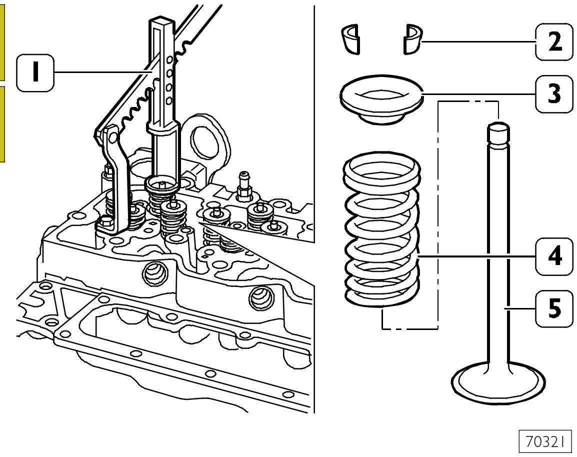
Intake (1) and exhaust (2) valves have heads with the same diameter.

The central notch (→) of the exhaust valve (2) head distinguishes it from the intake valve.

NOTE Should cylinder head valves be not replaced, number them before removing in order to refit them in the same position.

A = intake side – S = exhaust side

Figure 66

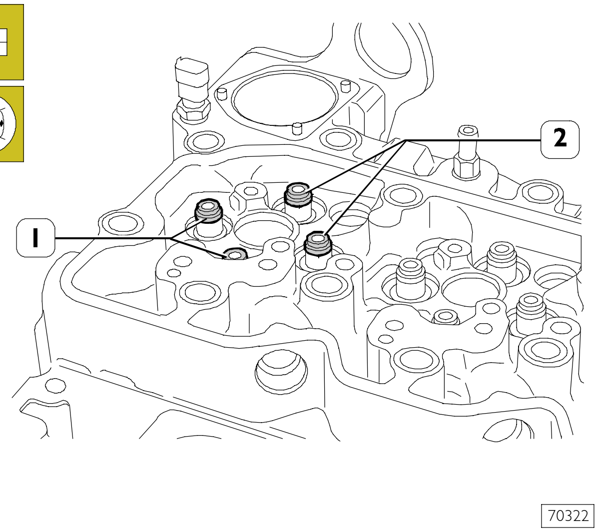


Valve removal shall be performed using tool 99360268 (1) and pressing the cap (3) so that when compressing the springs (4) the cotters (2) can be removed. Then remove the cap (3) and the springs (4).

Repeat this operation for all the valves.

Overturn the cylinder head and withdraw the valves (5).

Figure 67



Remove sealing rings (1 and 2) from the valve guide.

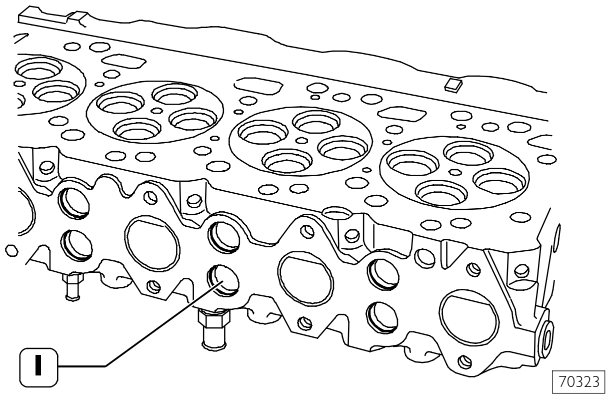
NOTE Sealing rings (1) for intake valves are yellow.

Sealing rings (2) for exhaust valves are green.

Print P4D32N001 E

Checking cylinder head wet seal

Figure 68



This check shall be performed using the proper tools.

Use a pump to fill with water heated to approx. 90°C and 2 to 3 bar pressure.

Replace the core plugs (1) if leaks are found, use the proper punch for their removal/refitting.

NOTE Before refitting, smear the plug surfaces with water-repellent sealant.

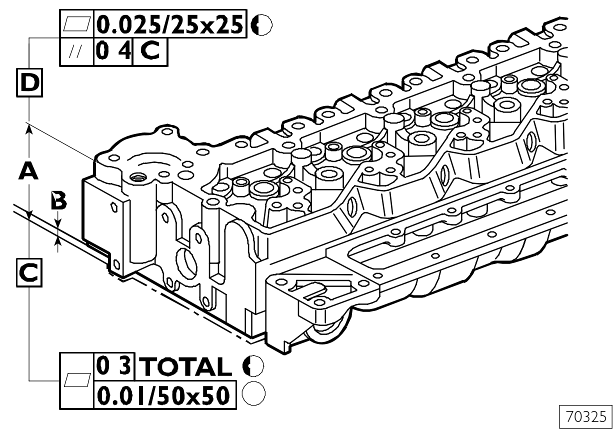
Replace the cylinder head if leaks are found.

Checking cylinder head supporting surface

Distortion found along the whole cylinder head shall not exceed 0.20 mm.

If higher values are found grind the cylinder head according to values and indications shown in the following figure.

Figure 69

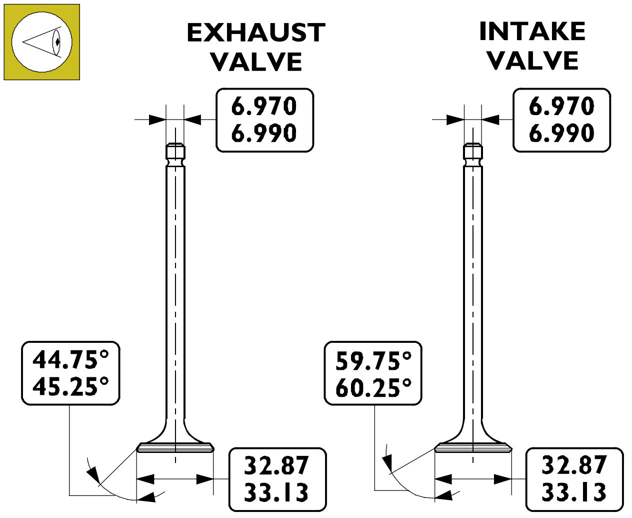


The rated thickness A for the cylinder head is 105 ± 0.25 mm, max. metal removal shall not exceed thickness B by 1 mm.

NOTE After grinding, check valve sinking. Regrind the valve seats, if required, to obtain the specified value.

VALVES

Figure 70

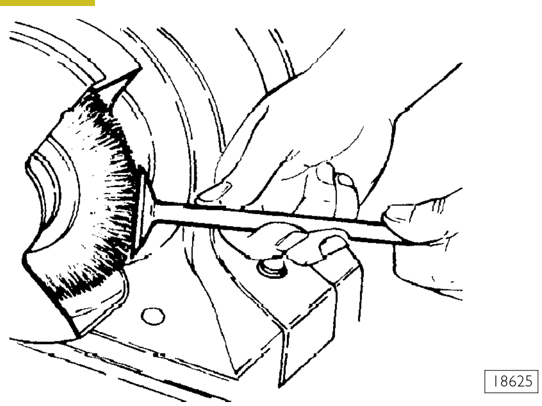


107280

INTAKE AND EXHAUST VALVE MAIN DATA

Removing carbon deposits, checking and grinding valves

Figure 71



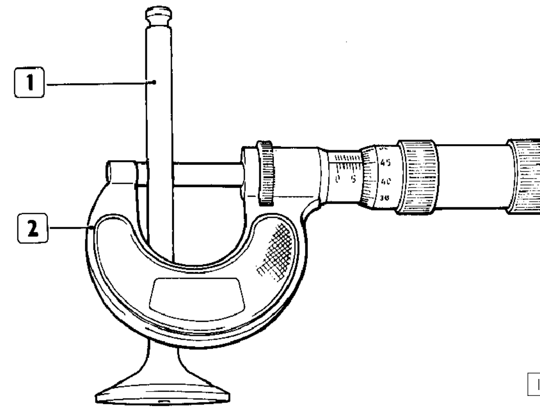
18625

Remove carbon deposits from valves using the proper metal brush.

Check that the valves show no signs of seizing, scoring or cracking.

Regrind the valve seats, if required, using tool 99305018 and removing as less material as possible.

Figure 72

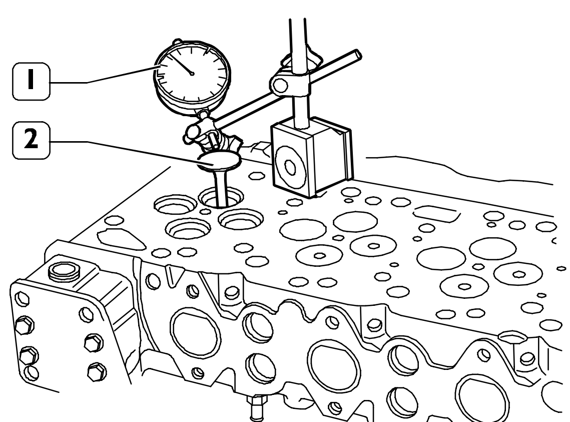


18882

Check the valve stem (1) using a micrometer (2), it shall be 6.970 ± 6.990 mm.

Checking clearance between valve stem and valve guide and valve centering

Figure 73



70327

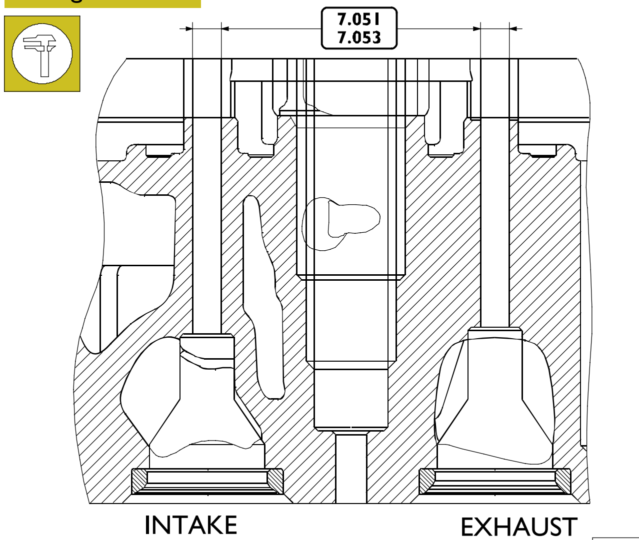
Use a magnetic base dial gauge (1) set as shown in the figure, the assembling clearance shall be 0.052 ± 0.092 mm.

Turn the valve (2) and check that the centering error is not exceeding 0.03 mm.

Print P4D32N001 E

VALVE GUIDE

Figure 74



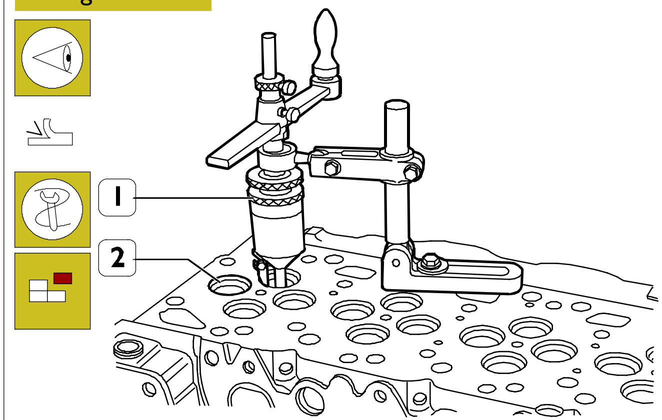
70328

Use a bore dial gauge to measure the inside diameter of the valve guides, the read value shall comply with the value shown in the figure.

VALVE SEATS

Regrinding – replacing the valve seats

Figure 75

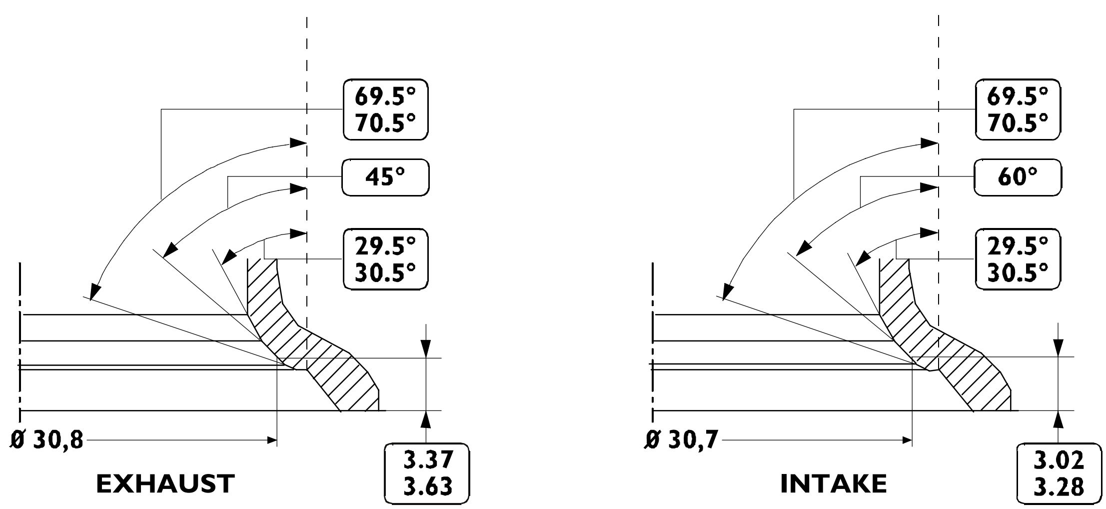


70330

Check valve seats (2). In case slight burns or scratches are found, regrind using specific tool (1) with inclination values shown in Figure 76.

CYLINDER HEAD VALVE SEATS

Figure 76

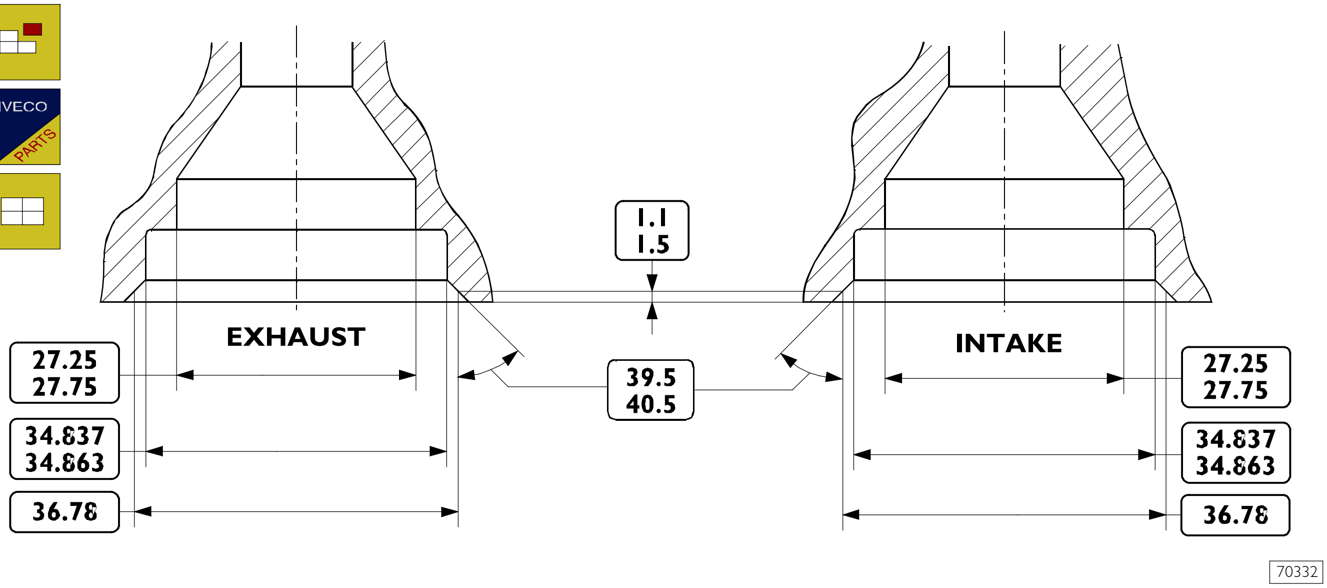


107281

MAIN DATA ABOUT ENGINE VALVE SEATS

Valve seats are installed by cooling onto the cylinder head and machining to the correct dimension.

Figure 77



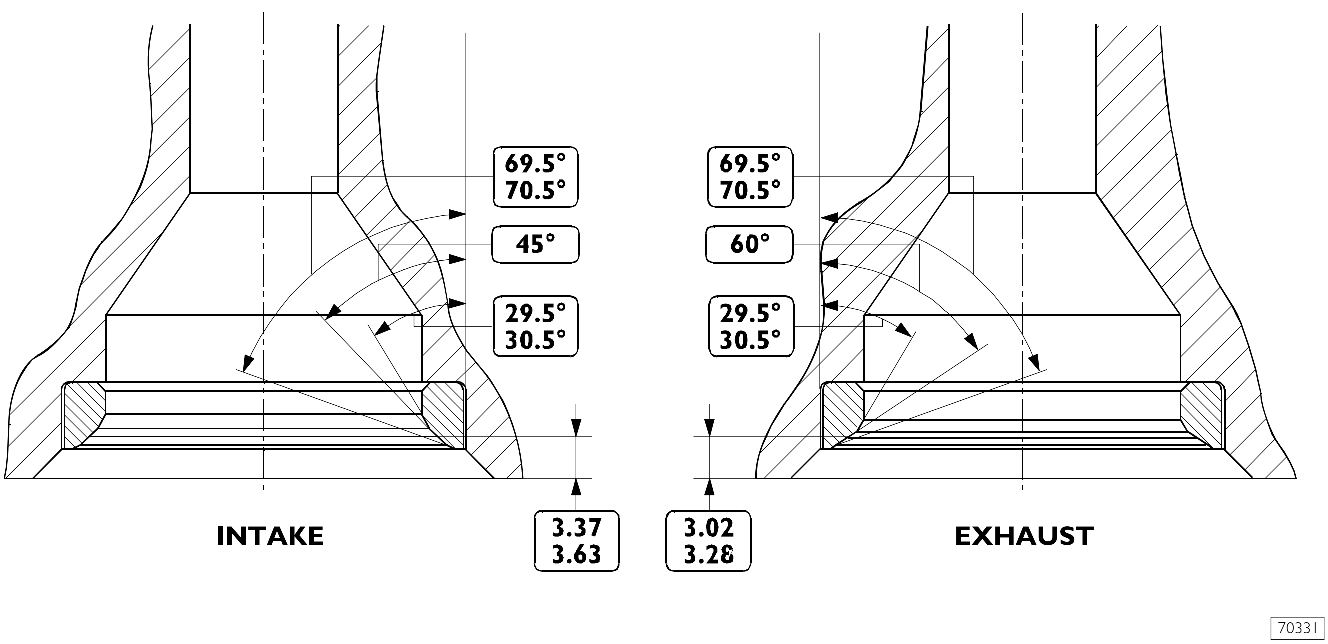
If valve seats cannot be restored just by regrinding, it is possible to assemble the spare inserts provided.

In this case, it is necessary to install seats into the cylinder head sized as shown in the figure and to assemble the valve seats.

In order to assemble the valve seats into the cylinder head, it is necessary to heat the cylinder head to 80° to 100°C and, through a suitable punch, to assemble the new, previously cooled valve seats (2) into the head.

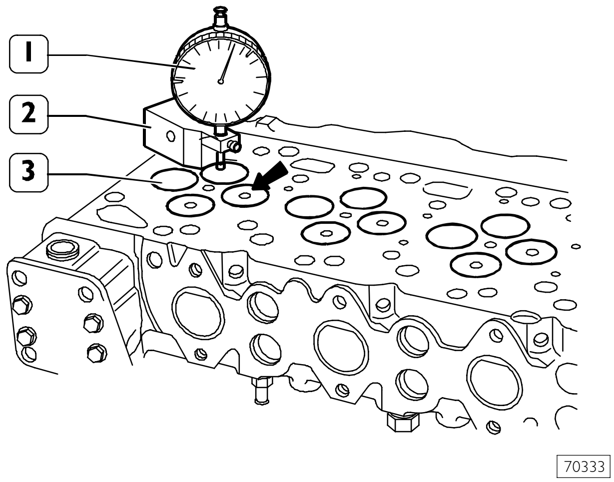
Therefore, use specific tool to regrind valve seats as per values shown in Figure 78.

Figure 78



VALVE SEAT MAIN DATA

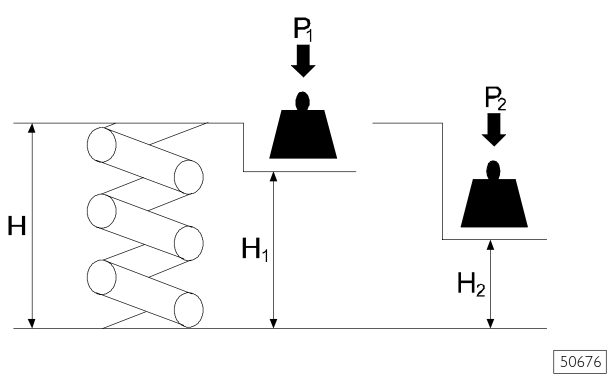
Figure 79



After regrinding, check that valve (3) sinking value is the specified one by using the base 99370415 (2) and the dial gauge 99395603 (1).

VALVE SPRINGS

Figure 80



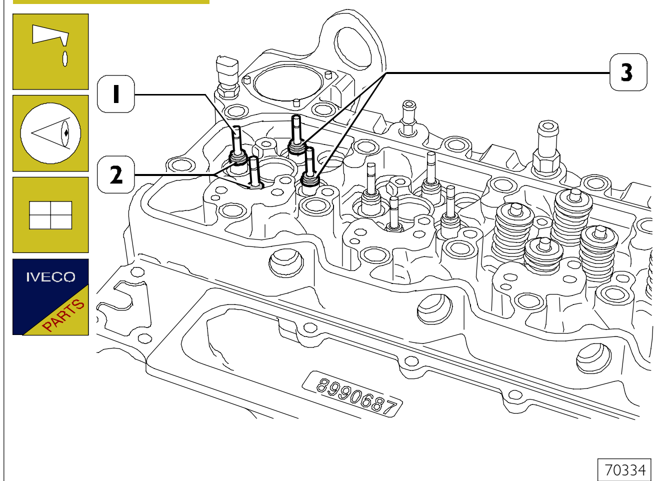
MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Before refitting, check valve spring flexibility using a specific tool. Compare load and elastic deformation data with those of new springs shown in table below.

Height	Under a load of
mm	N
H 47.75	Free
H_1 35.33	P_1 339.8 ± 19 N
H_2 25.2	P_2 741 ± 39 N

FITTING CYLINDER HEAD

Figure 81

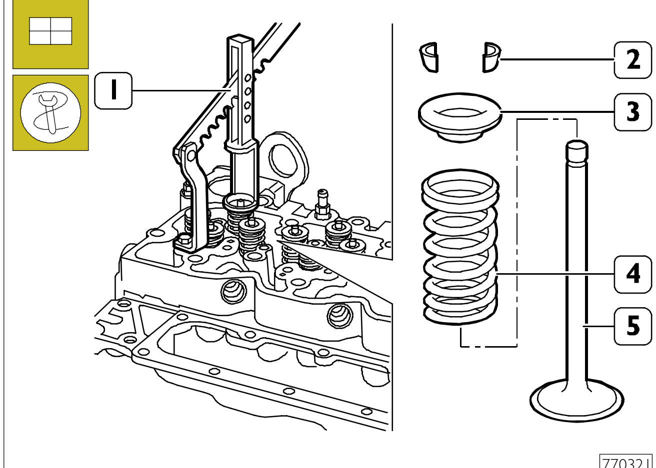


Lubricate the valve stems (1) and fit them into the relevant valve guides according to the position marked at removal.

Fit the sealing rings (2 and 3) on the valve guide.

NOTE Sealing rings (2) for intake valves are yellow and sealing rings (3) for exhaust valves are green.

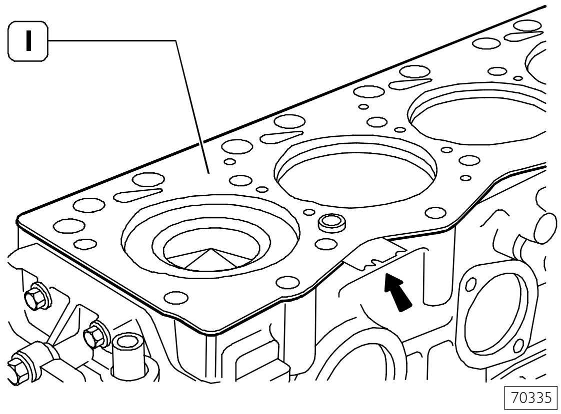
Figure 82



Position on the cylinder head: the spring (4), the upper cap (3); use tool 99360268 (1) to compress the spring (4) and lock the parts to the valve (5) by the cotters (2).

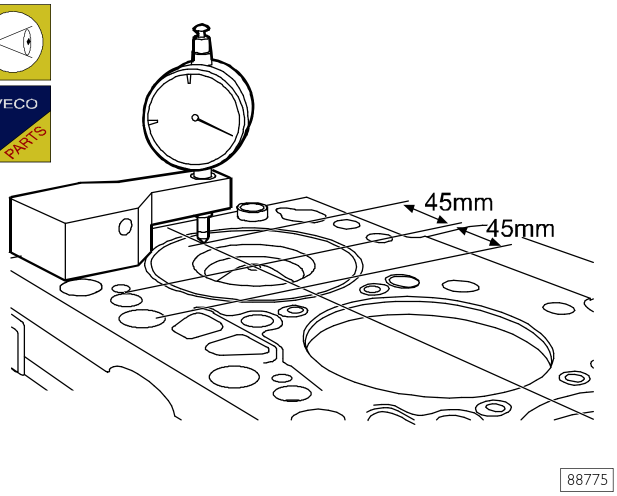
Refitting the cylinder head

Figure 83



Check cleanness of cylinder head and engine block coupling surface.
Take care not to foul the cylinder head gasket.
Set the cylinder head gasket (1) with the marking "TOP" (1) facing the head.
The arrow shows the point where the gasket thickness is given.

Figure 84



There are two types of head seals for F4AE06..,engines, for the thickness (1.25 mm Type A and 1.15 mm Type B) take the following measures:

- ❑ for each piston detect, as indicated on Figure 84, at a distance of 45 mm from the centre of the piston overhandings S1 and S2 in relation to the engine base upper plane then calculate the average:

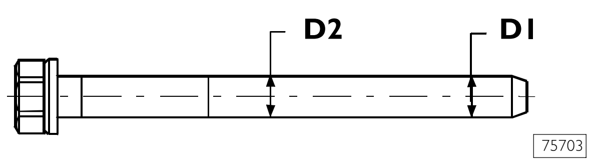
$$S_{cil1} = \frac{S1 + S2}{2}$$

Repeat the operation for pistons 2, 3, 4, 5 and 6 and calculate the average value.

$$S = \frac{S_{cil1} + S_{cil2} + S_{cil3} + S_{cil4} + S_{cil5} + S_{cil6}}{6}$$

If S is > 0,40 mm use seal type A.
If S is < 0,40 mm use seal type B.

NOTE Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
if D1 - D2 < 0,1 mm the screw can be utilised again;
if D1 - D2 > 0,1 mm the screw must be replaced.



TIGHTENING TORQUE

COMPONENT		TORQUE Nm	TORQUE kgm
Studs M6 for camshaft sensors		8 ± 2	0.8 ± 0.2
Studs M8 for feed pump		12 ± 2	1.2 ± 0.2
Screw M12 for fastening rear gear case Screw M10 for fastening rear gear case Screw M8 for fastening rear gear case		77 ± 12 47 ± 5 24 ± 4	7.7 ± 1.2 4.7 ± 0.5 2.4 ± 0.4
Nut M6 for fastening camshaft sensor		10 ± 2	1 ± 0.2
Screw M8 for fastening oil pump	1st stage 2nd stage	8 ± 1 24 ± 4	0.8 ± 0.1 2.4 ± 0.4
Screw M8 for fastening front cover		24 ± 4	2.4 ± 0.4
Screw M8 for fastening camshaft longitudinal retaining plate		24 ± 4	2.4 ± 0.4
Screw M8 for fastening camshaft gear		36 ± 4	3.6 ± 0.4
Screw M10 for fastening crankcase plate		43 ± 5	4.3 ± 0.4
Nut M18 for fastening high pressure pump gear		105 ± 5	10.5 ± 0.5
Nuts M8 for fastening fuel pump		24 ± 4	2.4 ± 0.4
½ inch plug on cylinder head ¼ inch plug on cylinder head ¾ inch plug on cylinder head		24 ± 4 36 ± 5 12 ± 2	2.4 ± 0.4 3.6 ± 0.5 1.2 ± 0.2
Screw M6 for fastening injectors	1st stage 2nd stage	8,5 ± 0,35 75° ± 5°	0.85 ± 0.035
Nut fastening for injector feed connector		50 ± 5	5 ± 0.5
Nut M6 for flame start grille on intake manifold		8 ± 2	0.8 ± 0.2
Screw M8 for fastening intake manifold		24 ± 4	2.4 ± 0.4
Screw M12 for fastening rear brackets for engine lifting		77 ± 12	7.7 ± 1.2
Screws M8 for fastening Common Rail		24 ± 4	2.4 ± 0.4
Connectors M14 for high pressure fuel pipes		20 ± 2	2 ± 0.2
Screw M12 (12 x 1.75 x 130) for fastening cylinder head Screw M12 (12 x 1.75 x 150) for fastening cylinder head	} 1st stage 2nd stage 3rd stage	35 ± 5 55 ± 5 90° ± 5° 90° ± 5°	3.5 ± 0.5 5.5 ± 0.5
Screw for fastening rocker bracket		36 ± 5	3.6 ± 0.5
Valve clearance adjusting nuts		24 ± 4	2.4 ± 0.4
Nuts M14 for fastening fuel pipes from high pressure pump to Common Rail		20 ± 2	2 ± 0.2
Screw M8 for fastening high pressure pipe connector		24 ± 4	2.4 ± 0.4
Screw M6 for fastening wiring bulkhead		10 ± 2	1 ± 0.2
Screw M8 for fastening electric wiring support for injector feed		24 ± 4	2.4 ± 0.4
Nuts for fastening wiring on each injector		1,5 ± 0,25	0.15 ± 0.025
Screw M12 for fastening fuel filter bracket		77 ± 8	7.7 ± 0.8
Screw M8 for fastening fuel filter holder		24 ± 4	2.4 ± 0.4
Fuel filter		contact + ¾ turn	
Screw M22 for fastening oil pressure relief valve on oil filter support		80 ± 8	8 ± 0.8
Screw M8 for radiator seal and oil filter support		24 ± 4	2.4 ± 0.4
Oil filter		contact + ¾ turn	
11/8 inch connection on filter support for turbine lubrication		24 ± 4	2.4 ± 0.4
Nut M12 for fastening turbine lubrication pipe		10 ± 2	1 ± 0.2
Screw M10 for fastening engine coolant inlet connection		43 ± 6	4.3 ± 06
90° elbow fastening (if required) to engine coolant inlet connection		24 ± 4	2.4 ± .0.4
Pipe on cylinder head for compressor cooling		22 ± 2	2.2 ± 0.2

COMPONENT		TORQUE Nm	kgm
Screw M6 for fastening engine coolant drain connector		10 ± 2	1 ± 0.2
Pin fastening on engine block for exhaust manifold		10 ± 2	1 ± 0.2
Screw M10 for fastening exhaust manifold on cylinder head		53 ± 5	5.3 ± 0.5
Screw M12 for fastening damper adapter and damper on output shaft	1st stage 2nd stage	50 ± 5 90°	5 ± 0.5
Screw M10 for fastening pulley on output shaft		68 ± 7	6.8 ± 0.7
Screw M8 for fastening water pump		24 ± 4	2.4 ± 0.4
Screw M10 for fastening auxiliary component control belt tensioners		43 ± 6	4.3 ± 0.6
Screw M10 for fastening fixed pulleys for auxiliary component control belt		43 ± 6	4.3 ± 0.6
Screw M10 for fastening flywheel housing Screw M12 for fastening flywheel housing		85 ± 10 49 ± 5	8.5 ± 1 4.9 ± 0.5
Screw M6 for fastening heat exchanger for control unit Screw M8 for fastening heat exchanger for control unit		10 ± 2 24 ± 4	1 ± 0.2 2.4 ± 0.4
Connection M12 for fuel inlet-outlet on heat exchanger		12 ± 2	1.2 ± 0.2
Nut M8 for fastening valve cover		24 ± 4	2.4 ± 0.4
Screw M6 for fastening camshaft sensor		8 ± 2	0.8 ± 0.2
Screw M6 for fastening output shaft sensor		8 ± 2	0.8 ± 0.2
Screw M14 for fastening coolant temperature sensor		20 ± 3	2 ± 0.3
Screw M5 for fastening oil pressure/temperature sensor		6 ± 1	0.6 ± 0.1
Screw for fastening fuel pressure sensor		35 ± 5	3.5 ± 0.5
Screw M14 for fastening fuel temperature sensor		20 ± 3	2 ± 0.3
Screw for fastening air temperature/pressure sensor on intake manifold		6 ± 1	0.6 ± 0.1
Screw M12 for fastening engine oil level sensor		12 ± 2	1.2 ± 0.2
Turbine fixing to exhaust manifold	{ pins M10 { nuts M10	7 ± 1 43 ± 6	0.7 ± 0.1 4.3 ± 0.6
Adapter M12 on turbine for lubricant oil pipes (inlet)		35 ± 5	3.5 ± 0.5
Pipe fixing on adapter M10 for turbine lubrication		35 ± 5	3.5 ± 0.5
Oil pipe fixing on adapter M10 for turbine lubrication to block		43 ± 6	4.3 ± 0.6
Oil drain pipe fixing M8 on turbine		24 ± 4	2.4 ± 0.4
Connector fixing M6 for oil return from cylinder head to flywheel housing		10 ± 2	1 ± 0.2
Screw M12 for fastening engine flywheel	1st stage 2nd stage	30 ± 4 60° ± 5°	3 ± 0.4
Screw M8 for fastening front bracket for engine lifting		24 ± 4	2.4 ± 0.4
Screw for fastening engine oil sump		24 ± 4	2.4 ± 0.4
Screw M8 for fastening cylinder barrel lubricating nozzles		15 ± 3	1.5 ± 0.3
Screw M12 for fastening output shaft caps	1st stage 2nd stage 3rd stage	50 ± 6 80 ± 6 90° ± 5°	5 ± 0.6 8 ± 0.6
Screw M8 for fastening camshaft longitudinal retaining plate		24 ± 4	2.4 ± 0.4
Screw M8 for fastening camshaft gear		36 ± 4	3.6 ± 0.4
Screw M101 for fastening connecting rod caps	1st stage 2nd stage	60 ± 5 60° ± 5°	6 ± 0.5
Alternator			
M10 Screw, Bracket fixing on water feed pipefitting		43 ± 6	4.3 ± 0.6
M10 Screw, alternator locking		43 ± 6	4.3 ± 0.6
Starter			
Starter fixing screw		43 ± 6	4.3 ± 0.6

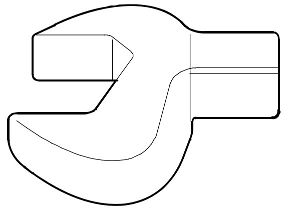
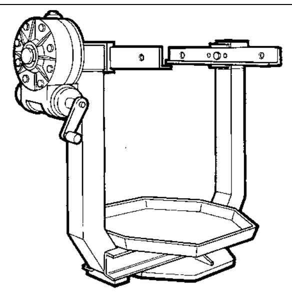
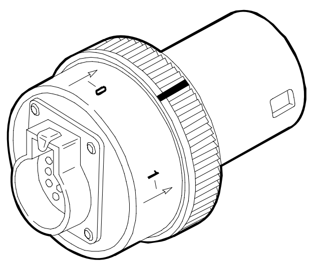
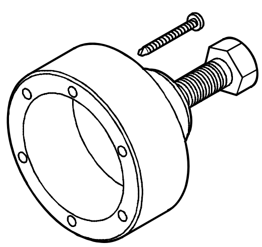
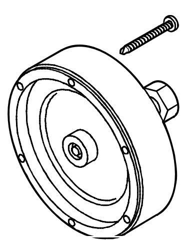
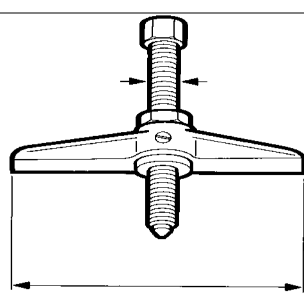
Print P4D32N001 E

SECTION 5

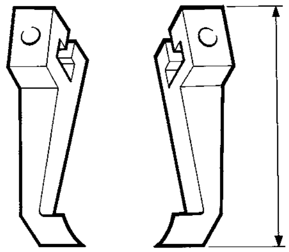
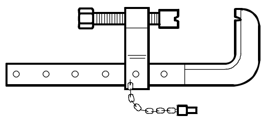
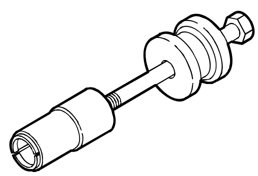
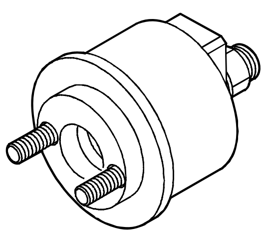
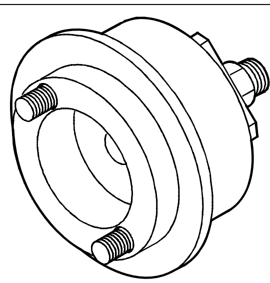
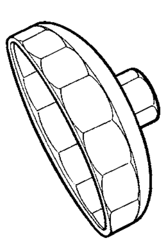
Tools

Page

TOOLS

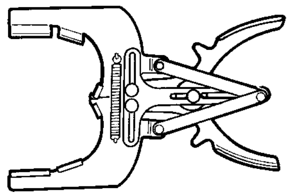
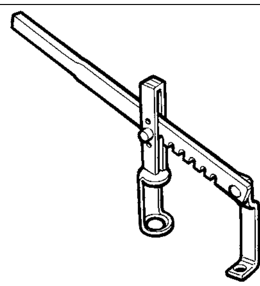
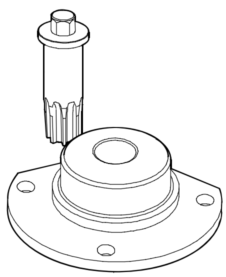
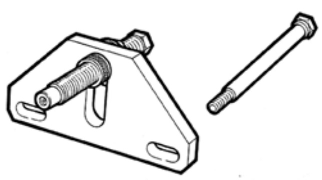
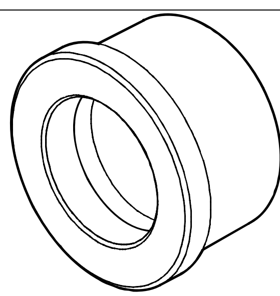
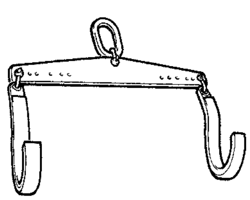
TOOL NO.		DESCRIPTION
99317915		Set of 3 pin wrenches (14 - 17 - 19 mm)
99322205		Revolving stand for overhauling units (700 daN/m capacity, 120 daN/m torque)
99331043		Adapter from 38 pin to 30 pin (component of 99368554)
99340055		Tool to remove output shaft front gasket
99340056		Tool to remove output shaft rear gasket
99341001		Double acting puller

TOOLS

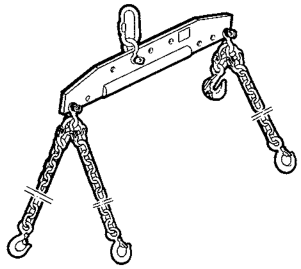
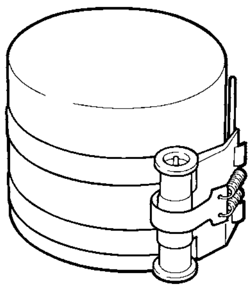
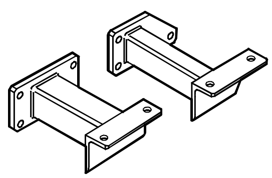
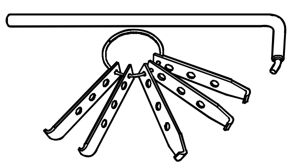
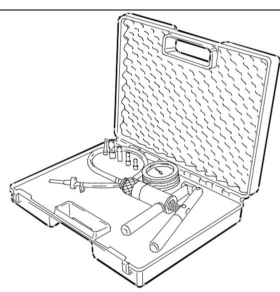
TOOL NO.		DESCRIPTION
99341009		Pair of brackets
99341015		Press
99342101		Tool to remove injectors
99346252		Tool for fitting output shaft rear gasket
99346253		Tool for fitting output shaft rear gasket
99360076		Tool to remove oil filter (engine)

Print P4D32N001 E

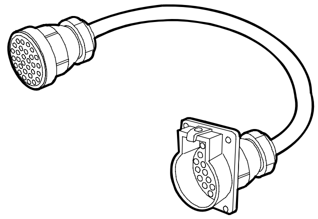
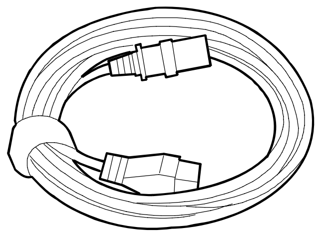
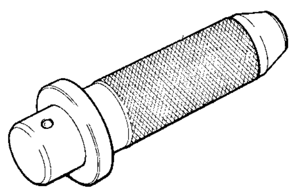
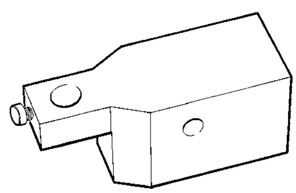
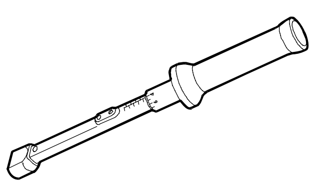
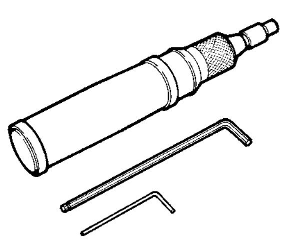
TOOLS

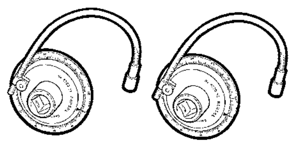
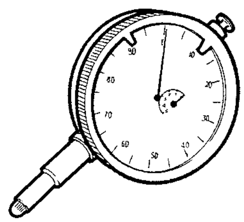
TOOL NO.		DESCRIPTION
99360183		Pliers for removing/refitting piston rings (65 to 110 mm)
99360268		Tool for removing/refitting engine valves
99360339		Tool for rotating/stopping the engine flywheel
99360351		Equipment for flywheel holding
99360362		Beater for removing/refitting camshaft bushes (to be used with 993700069)
99360500		Tool for lifting the output shaft

TOOLS

TOOL NO.		DESCRIPTION
99360595		Lifting rig for engine removal/refitting
99360605		Band for fitting piston into cylinder barrel (60 to 125 mm)
99361037		Brackets for fastening engine to revolving stand 99322205
99363204		Tool to remove gaskets
99367121		Manual pump for pressure and depression measures
99368554		PT01 Hand-held tester for electronic controlled engine testing (includes also 99331043 - 99368555 - 99368556)

TOOLS

TOOL NO.		DESCRIPTION
99368555		Adapter from 30 to 19 pins (component of 99368554)
99368556		Adapter (5 m) for connecting PT01 tester to 30-pin test socket (component of 99368554)
99370006		Handgrip for interchangeable beaters
99370415		Gauge base for different measurements (to be used with 99395603)
99389829		Dog type dynamometric wrench 9x12 (5 to 60 Nm)
99389834		Torque screwdriver for injector solenoid valve connector stop nut setting

TOOLS		
TOOL NO.		DESCRIPTION
99395216		Pair of gauges with ½" and ¾" square head for angle tightening
99395603		Dial gauge (0 to 5 mm)

Print P4D32N001 E

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

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

For engines equipped with electronic gearbox:

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

Respect of the Environment

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

Print P4D32N001 E

Part 3
MAIN ELECTRICAL POWER ON THE MACHINE AND TROUBLESHOOTING

PREFACE TO USER'S GUIDELINE MANUAL

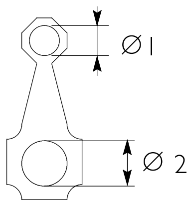
Section 1 describes the electrical equipment as regards its characteristics and its general operation in relation to the engines described in the preceding parts.

Section 2 describes the fault diagnosis of the engines described in the preceding parts, dedicated to technical support providers who need straightforward guidelines in order to verify the causes of the main failures.

SPECIAL REMARKS

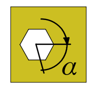
Diagrams and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with, (see next page) instead of giving descriptions of some operations or procedures.

Example



Ø 1 = housing for connecting rod small end bush

Ø 2 = housing for connecting rod bearings



Tighten to torque
Tighten to torque + angular value

SYMBOLS - ASSISTANCE OPERATIONS

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

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
bar	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

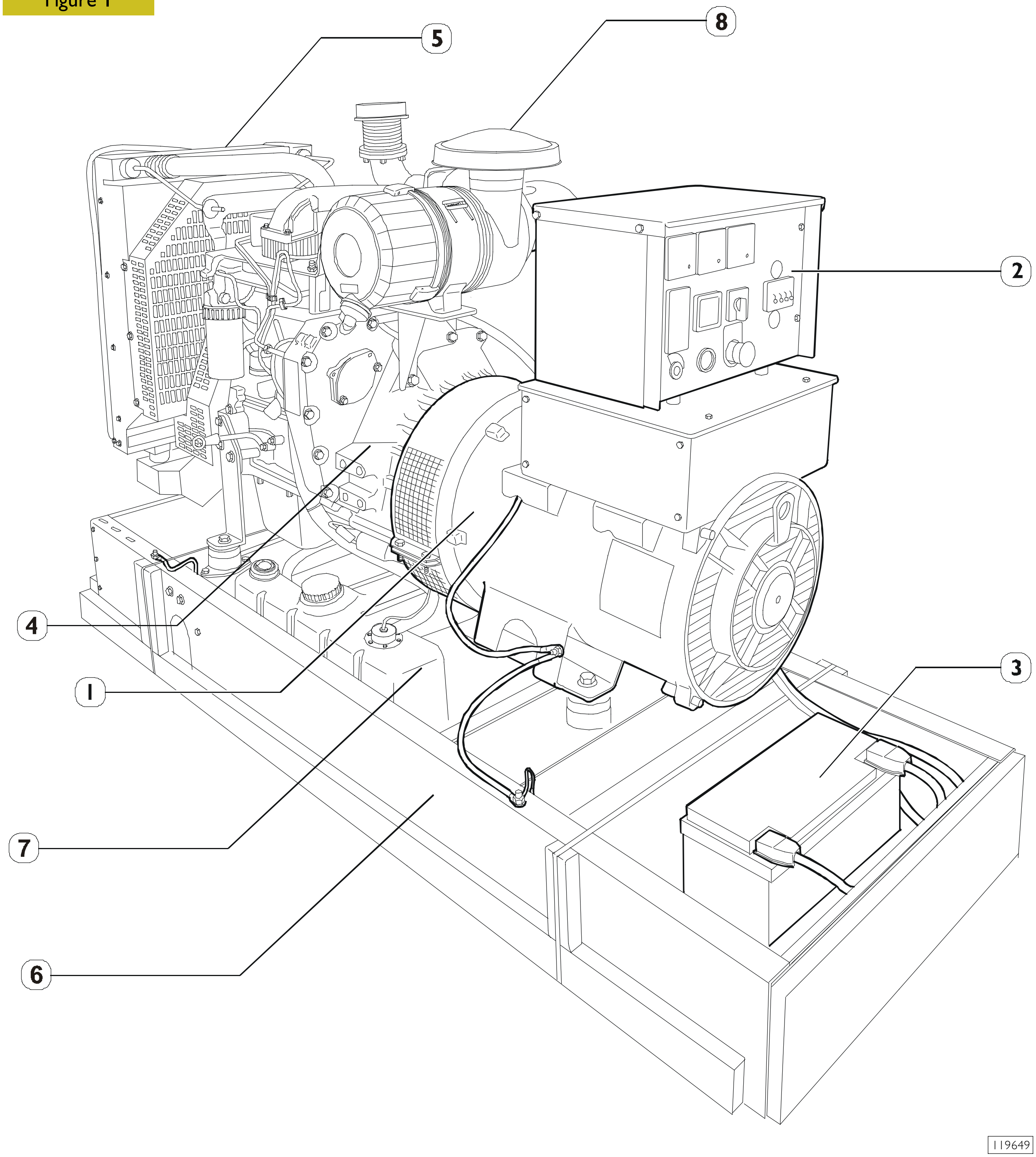
SECTION 1

Main electrical power on the machine

 Print P4D32N001GB

GENERATOR SET COMPONENTS LAYOUT
GENEF - MECHANIC PUMP

Figure 1

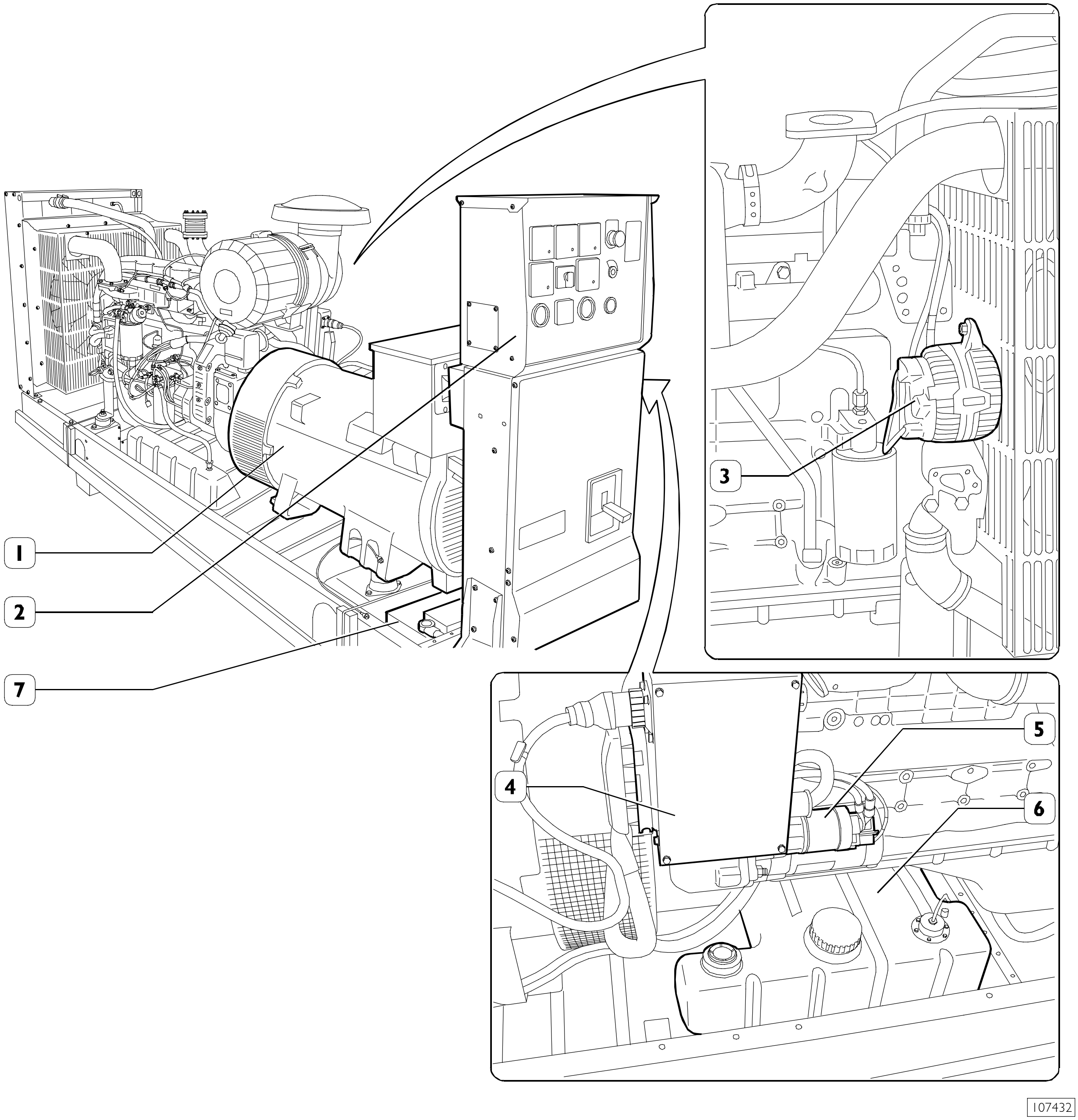


GENERATOR SET GENEF - MECHANIC PUMP

1. Three-phase generator - 2. Control board - 3. Battery - 4. Engine - 5. Heat exchanger - 6. Support frame - 7. Fuel tank - 8. Air intake and filter.

GENEF - COMMON RAIL

Figure 2

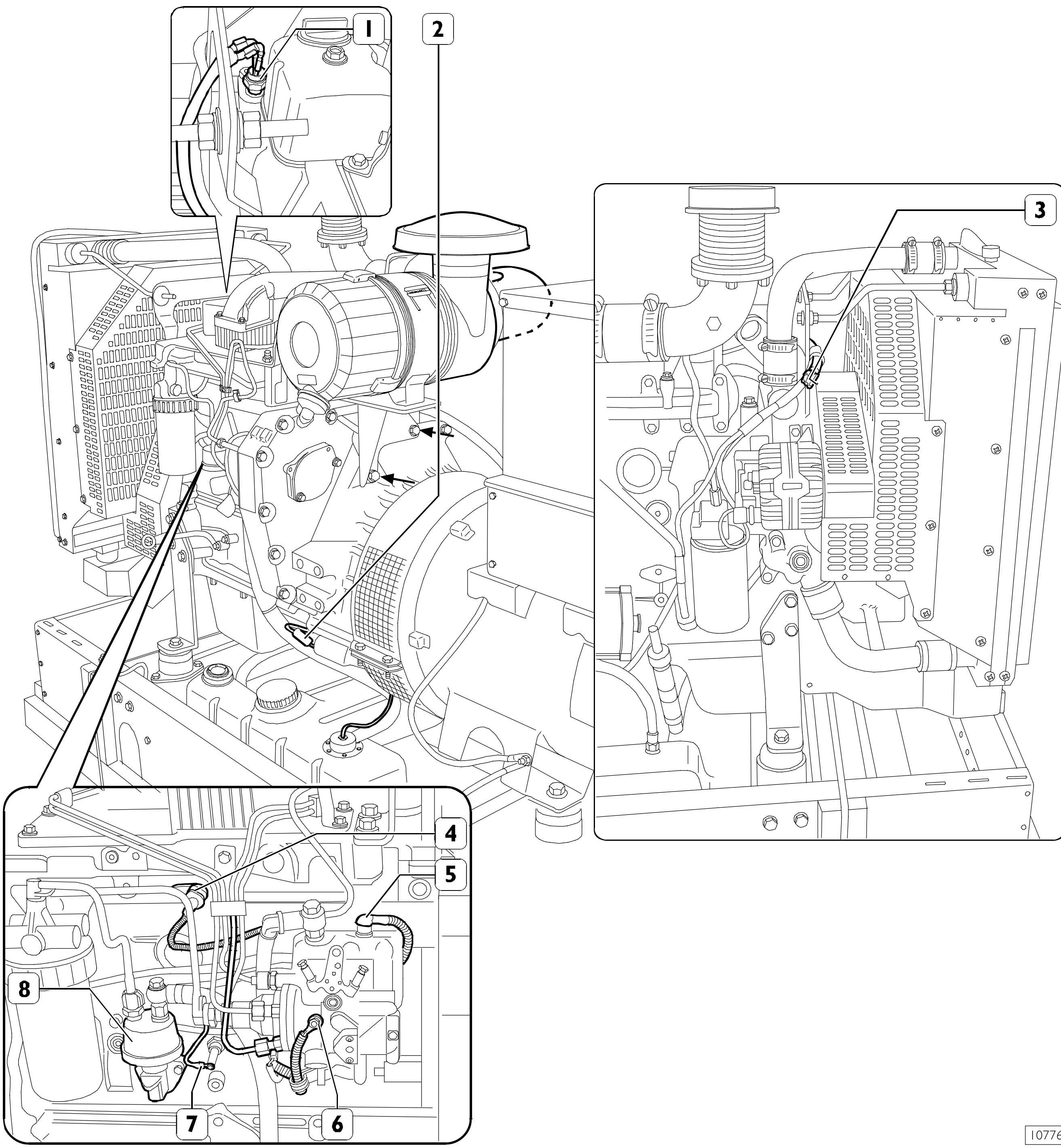


GENERATOR SET GENEF - COMMON RAIL

1. Three-phase generator - 2. Control panel - 3. Alternator - 4. Control panel/engine interface box - 5. Starter motor - 6. Fuel tank - 7. Battery.

LOCATION OF COMPONENTS ON ENGINE GENEF - MECHANIC PUMP

Figure 3

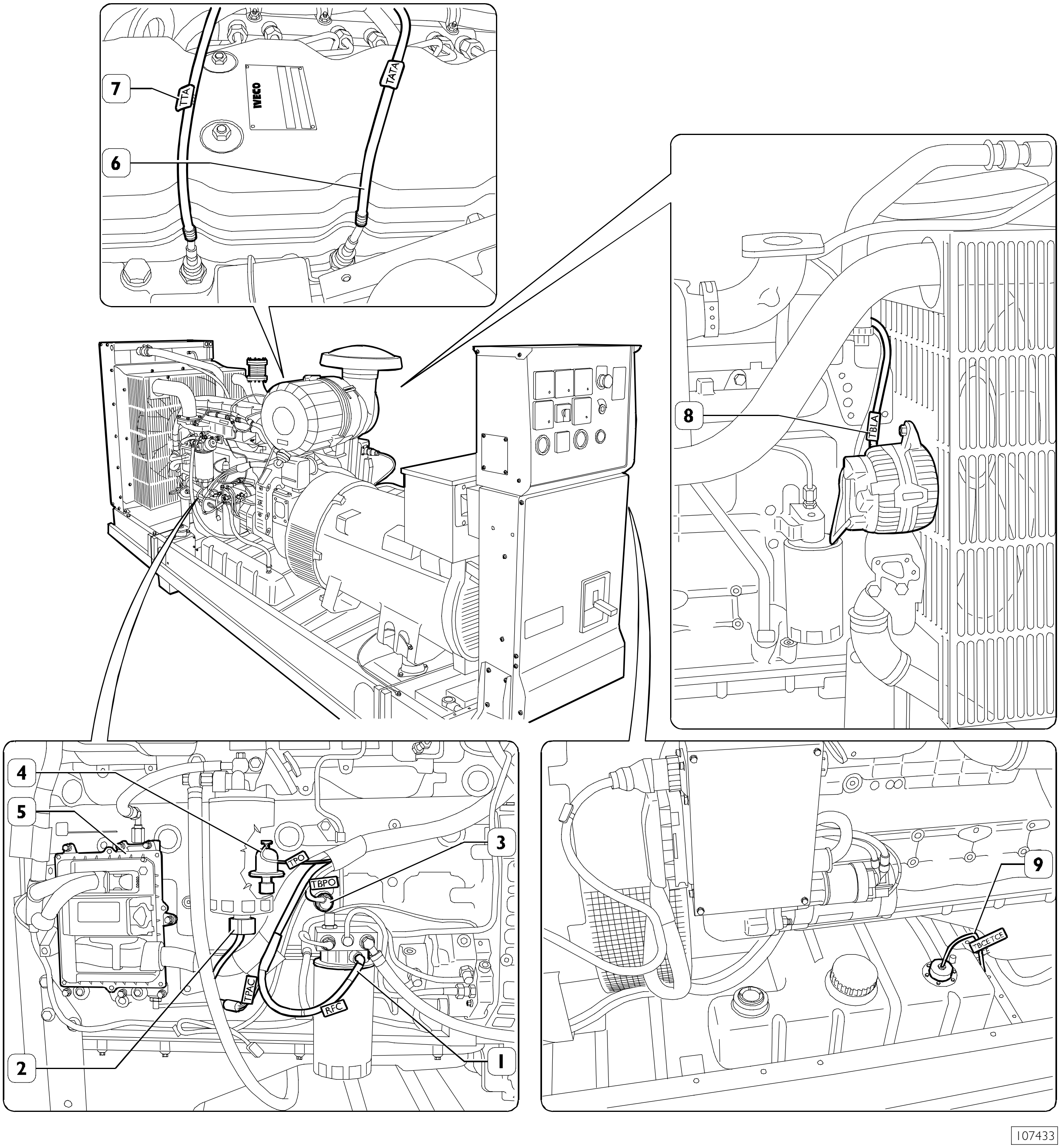


LOCATION OF COMPONENTS ON ENGINE

1. High engine water temperature and engine water temperature transmitter - 2. Low fuel level transmitter - 3. Low engine water level transmitter - 4. Water temperature sensor for KSB - 5. KSB control - 6. Stop solenoid valve - 7. Low engine oil pressure transmitter - 8. Engine oil pressure transmitter.

GENEF - COMMON RAIL

Figure 4

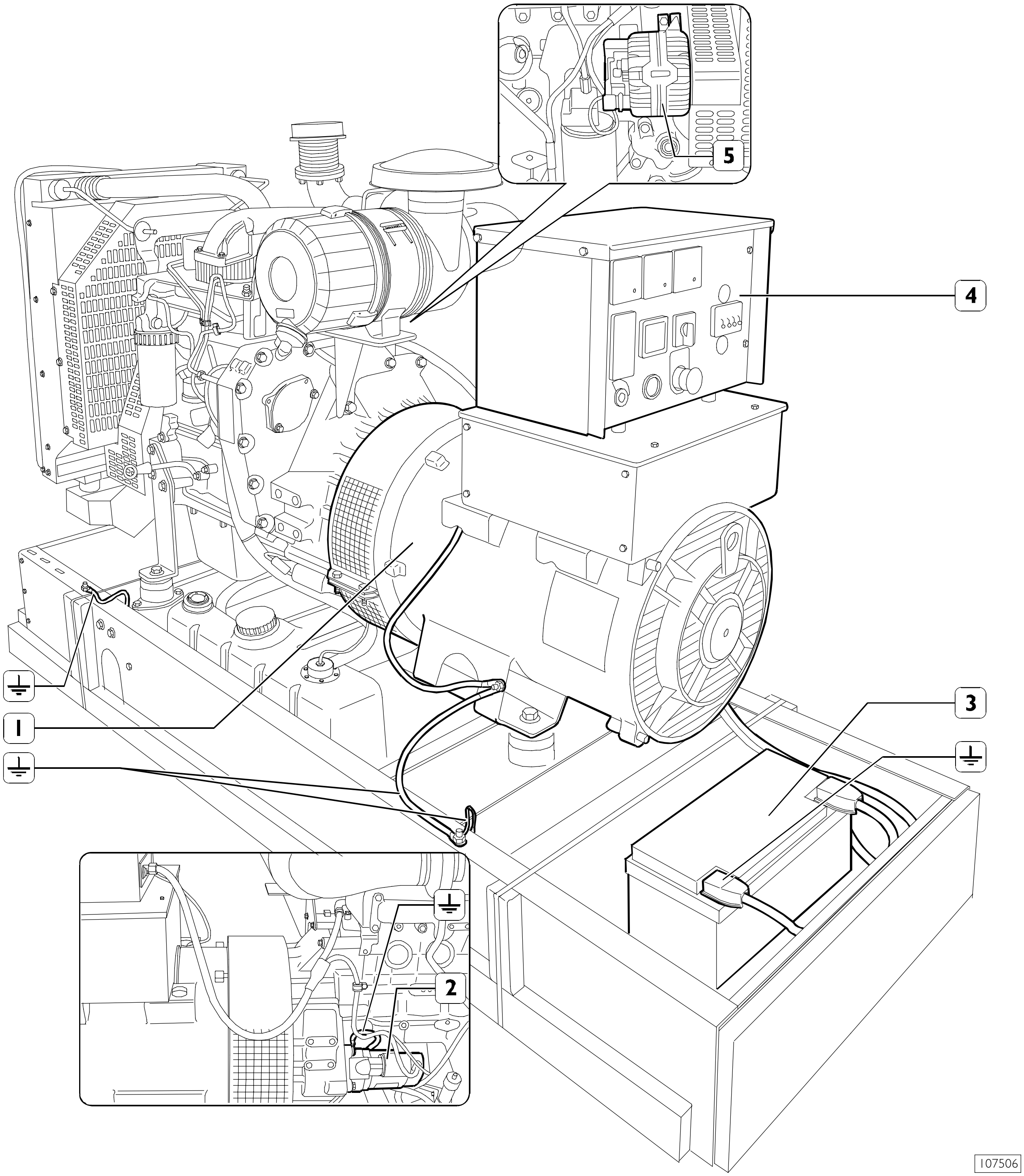


LOCATION OF COMPONENTS ON ENGINE

1. Diesel heating element - 2. Water in the fuel filter transmitter - 3. Low engine oil pressure transmitter - 4. Oil pressure transmitter - 5. EDC electronic control unit 7 - 6. High engine water temperature transmitter - 7. Engine water temperature transmitter - 8. Low engine water level transmitter - 9. Low fuel level transmitter and no fuel transmitter.

POWER NETWORK
GENEF - MECHANIC PUMP

Figure 5

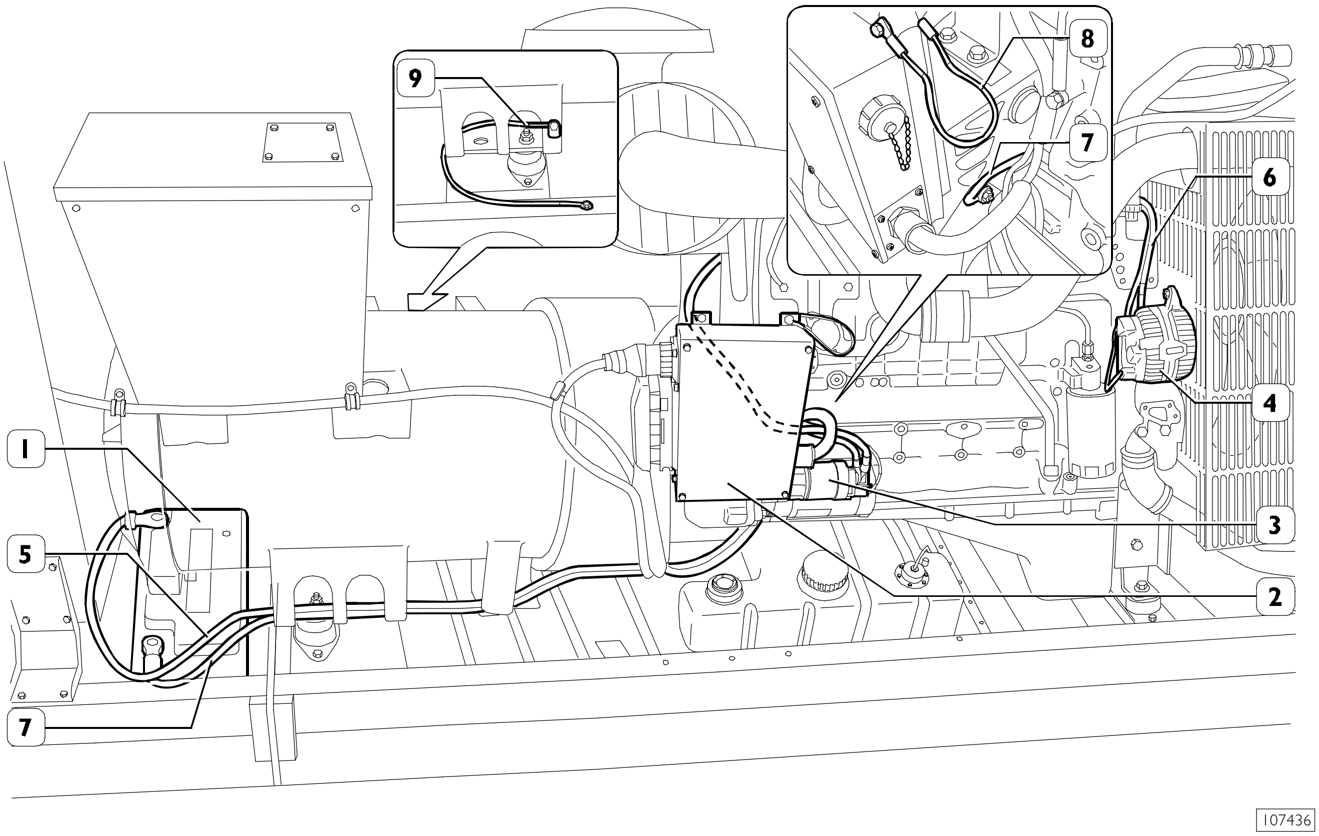


MAIN COMPONENTS OF THE POWER NETWORK

1. Three-phase generator - 2. Starter motor - 3. Battery - 4. Control panel.

GENEF - COMMON RAIL

Figure 6

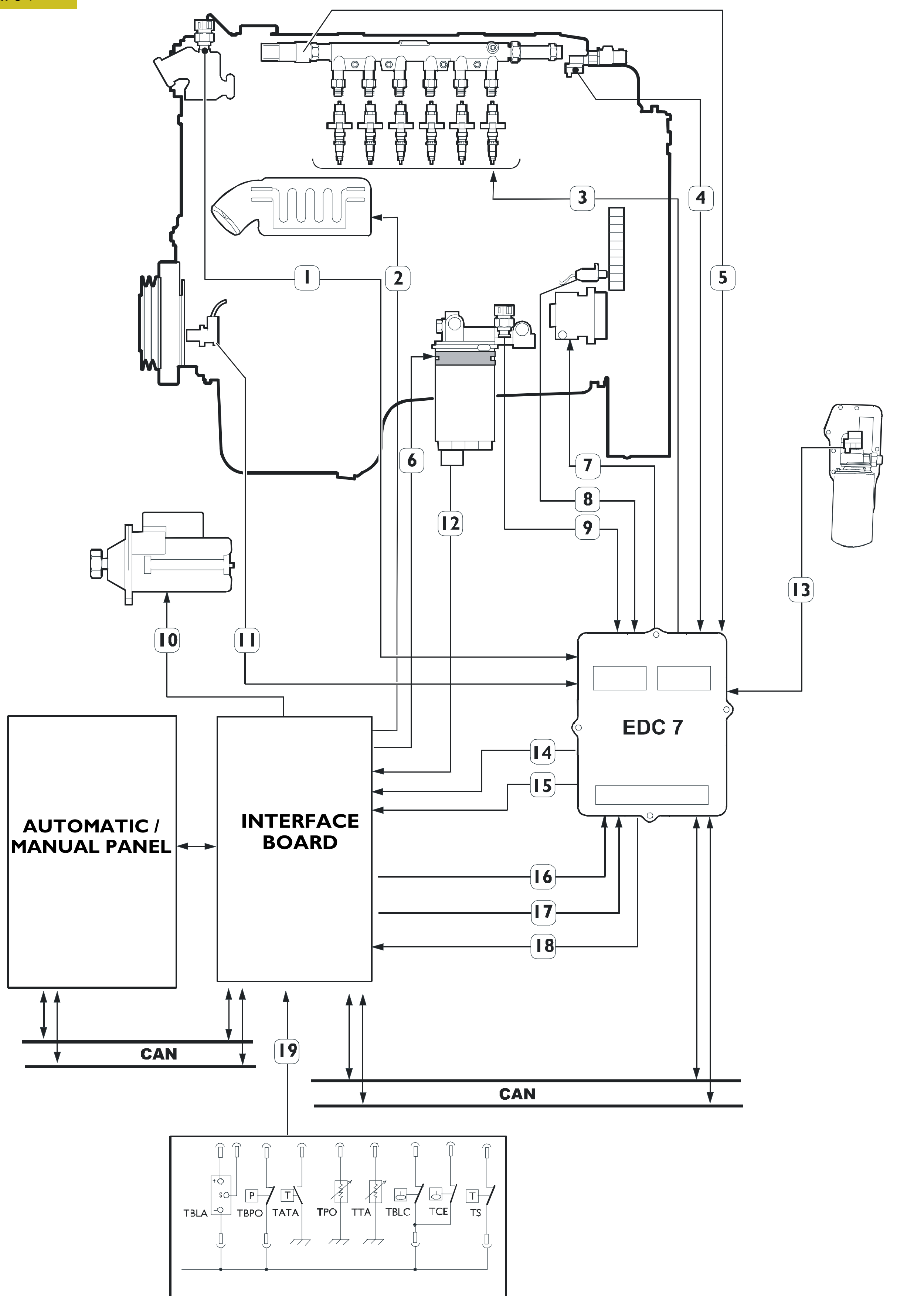


MAIN COMPONENTS OF THE POWER NETWORK

1. Battery 12VDC - 2. Interface box - 3. Starter motor - 4. Alternator - 5. Positive cable from battery to starter motor - 6. Positive cable from starter motor to alternator - 7. Negative cable from battery to starter motor - 8. Interface box earthing point - 9. Three-phase generator/support earthing point.

ASSEMBLY DRAWING OF INJECTION SYSTEM AND CONTROL PANEL INTERFACE GENEF - COMMON RAIL

Figure 7

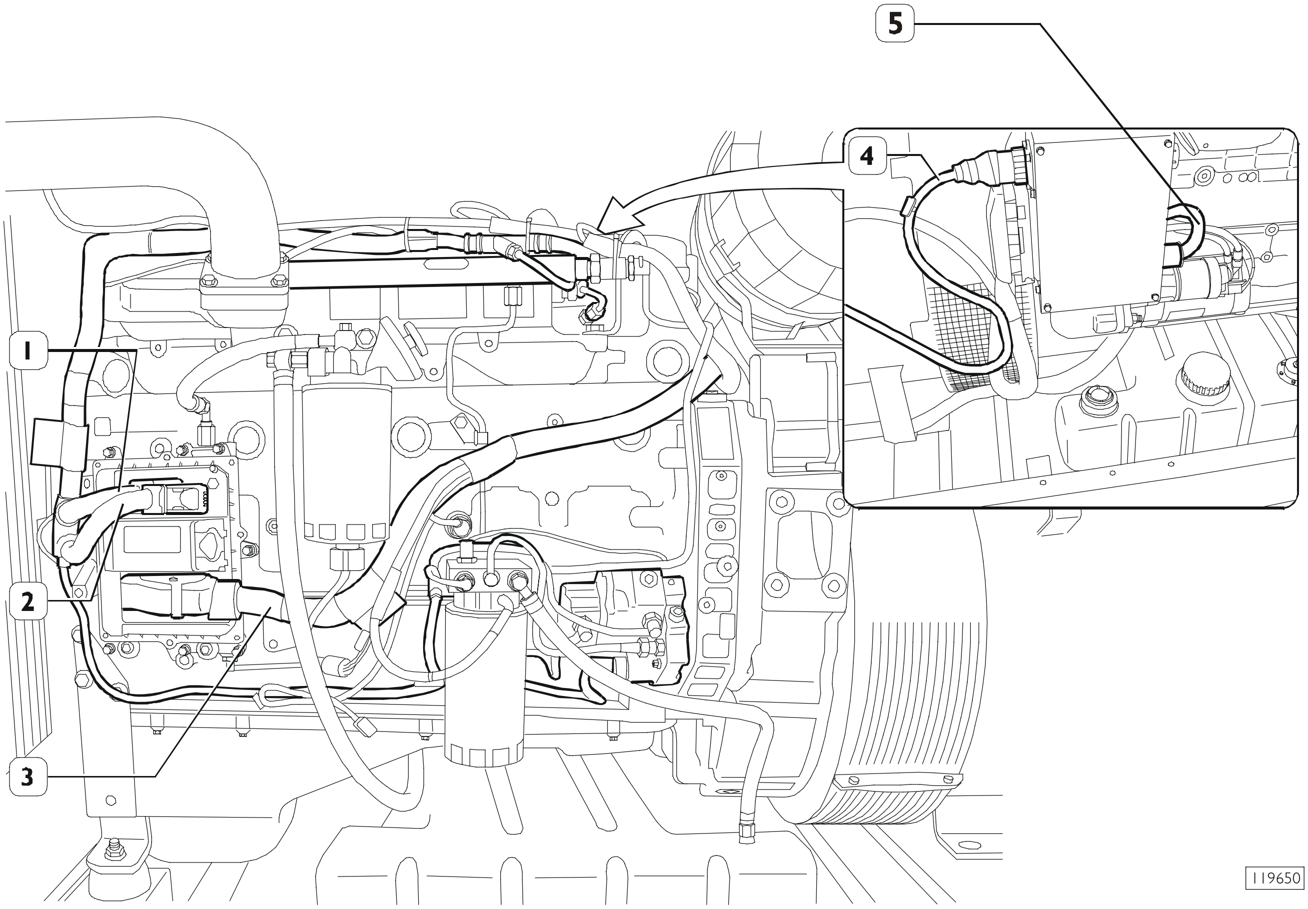


Key

REF.	DESCRIPTION
1	Coolant temperature sensor
2	Pre-heating element (starter heater)
3	Electro-injectors
4	Air temperature/pressure sensor
5	Fuel pressure sensor
6	Fuel heating element
7	Pressure regulator solenoid valve
8	Timing sensor
9	Fuel temperature sensor
10	Starter motor
11	Crankshaft sensor
12	Water in the fuel filter transmitter (TPAC)
13	Oil temperature/pressure sensor
14	Preheating electromagnetic switch
15	Blink-Code indicator light (AUTOMATIC/MANUAL panel)
16	Multistate switch (engine speed selection)
17	Blink-Code push-button
18	Diagnosis connector
19	Sensors for instruments on AUTOMATIC/MANUAL panel
TBLA	Low water level transmitter (AUTOMATIC/MANUAL panel)
TBPO	Low oil pressure transmitter (AUTOMATIC/MANUAL panel)
TATA	High water temperature transmitter (AUTOMATIC/MANUAL panel)
TPO	Oil pressure transmitter (AUTOMATIC/MANUAL panel)
TTA	Water temperature transmitter (AUTOMATIC/MANUAL panel)
TBLC	Low fuel level transmitter (AUTOMATIC/MANUAL panel)
TCE	No fuel transmitter (AUTOMATIC/MANUAL panel)
TS	Water heater thermostat

Electric wiring GENEF - COMMON RAIL

Figure 8

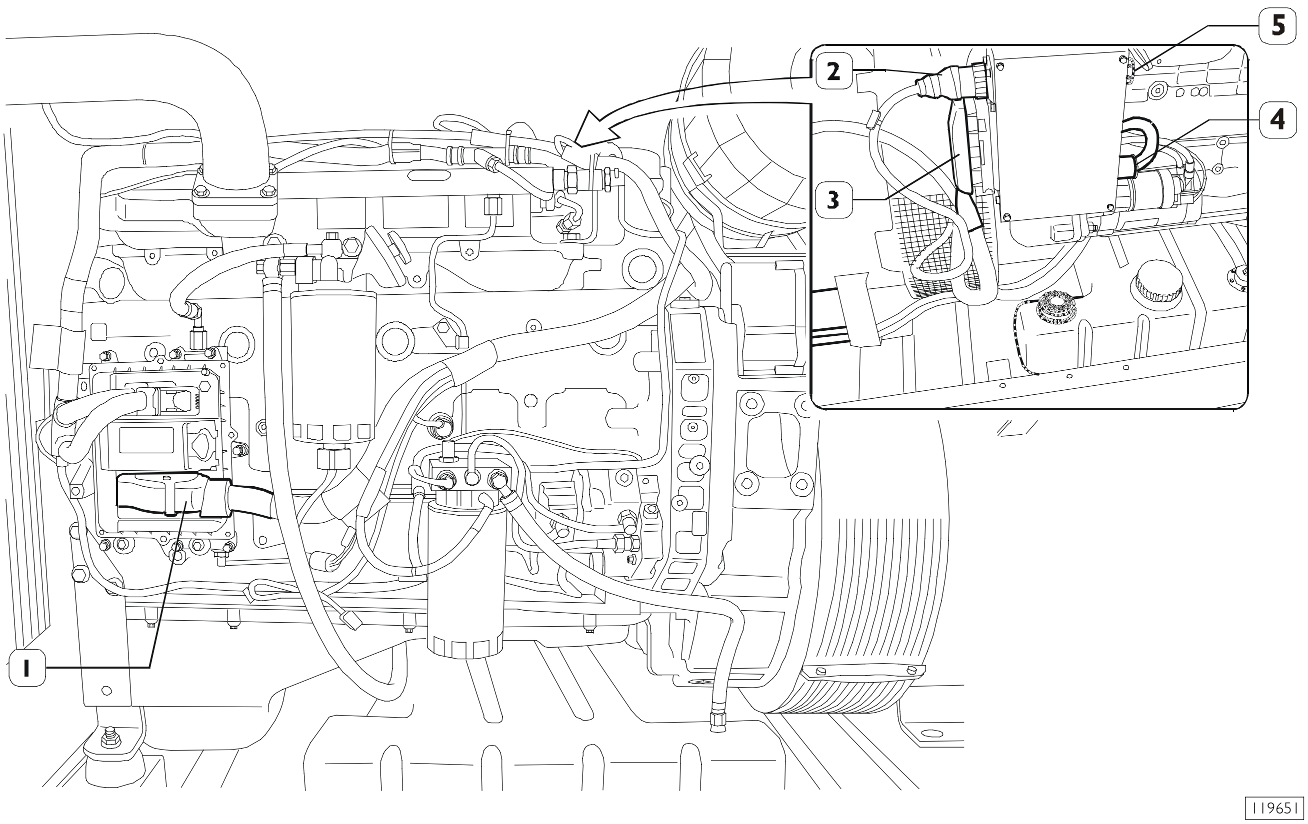


ELECTRIC WIRING

1. Wiring from EDC control unit to injectors - 2. Wiring from EDC control unit to EDC system components - 3. Wiring from EDC control unit to interface box - 4. Wiring from interface box for power connection - 5. Wiring from interface board to control board.

Connectors GENEF - COMMON RAIL

Figure 9



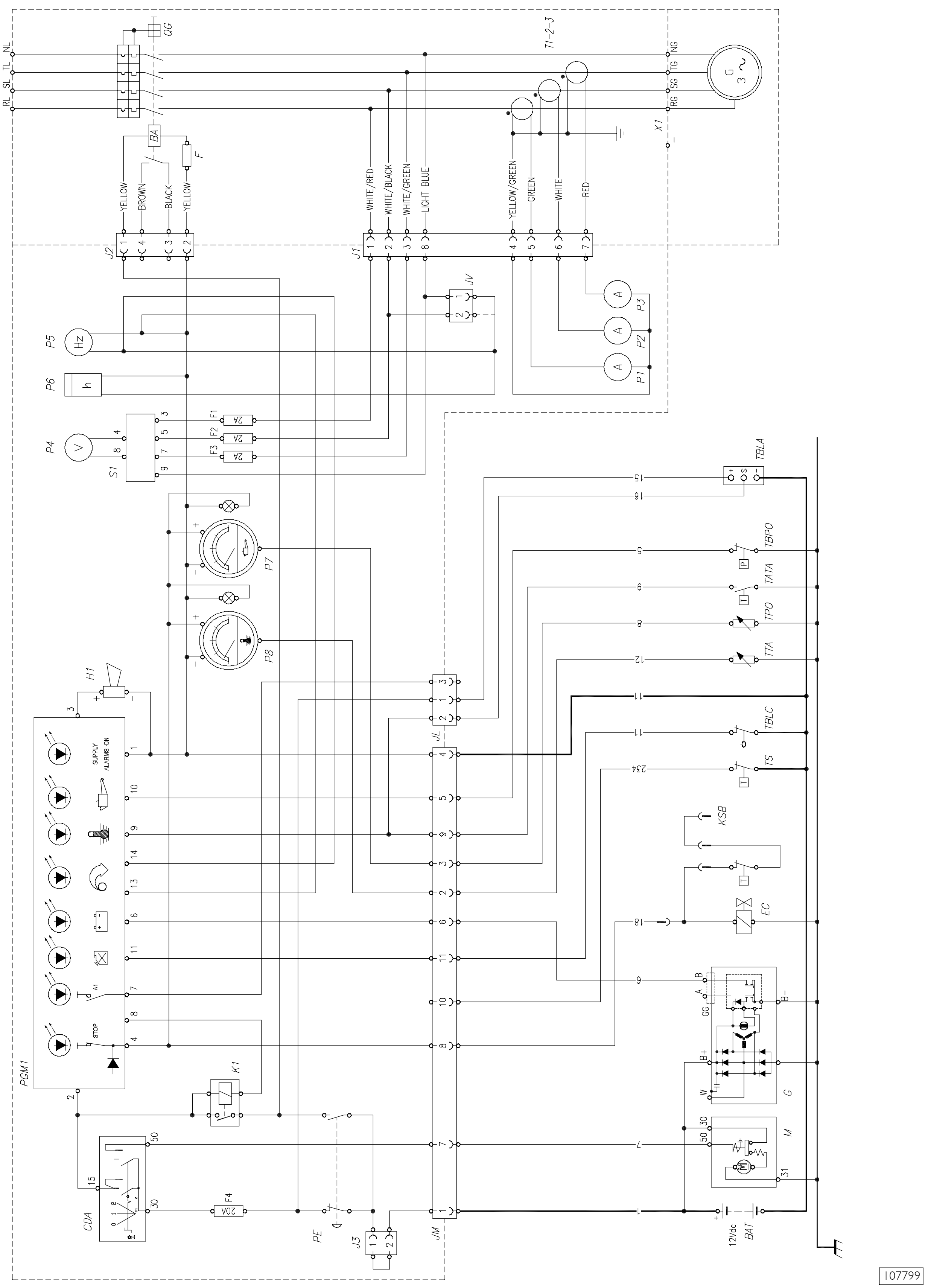
CONNECTORS

1. EDC control unit connector (B) - 2. Connector (J1) for power connection -
3. Connector (J2) between interface box and engine wiring - 4. Connector from interface box to control board (Connectors J3, J7 e J9 inside the interface board) - 5. Connector for diagnostic tool.

GENERATOR SET WIRING DIAGRAMS

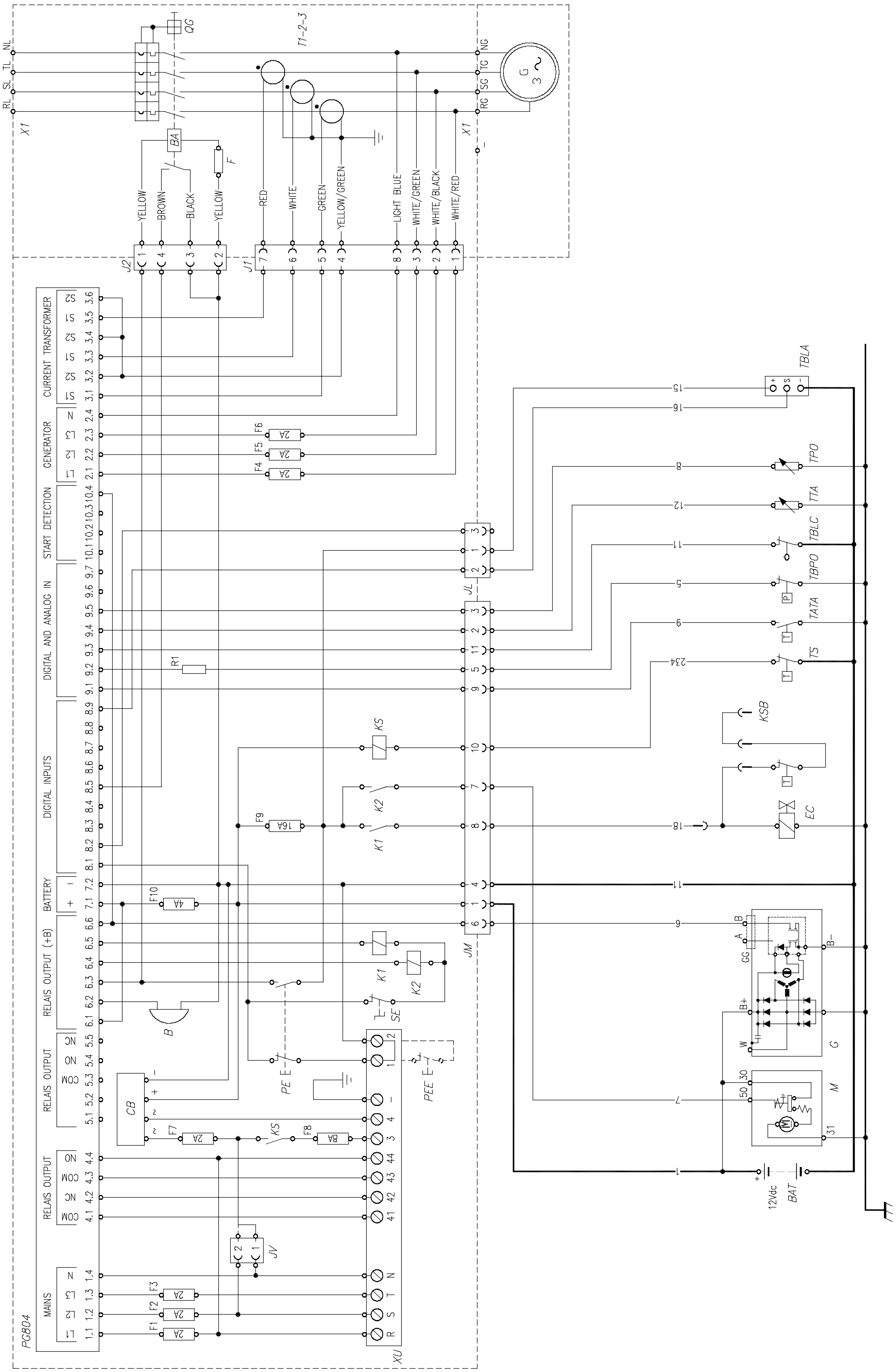
Generator set with manual column panel PGM1 for 230Vac applications
GENEF - MECHANIC PUMP

Figure 10



Generator set with PG804 automatic panel
GENEF - MECHANIC PUMP

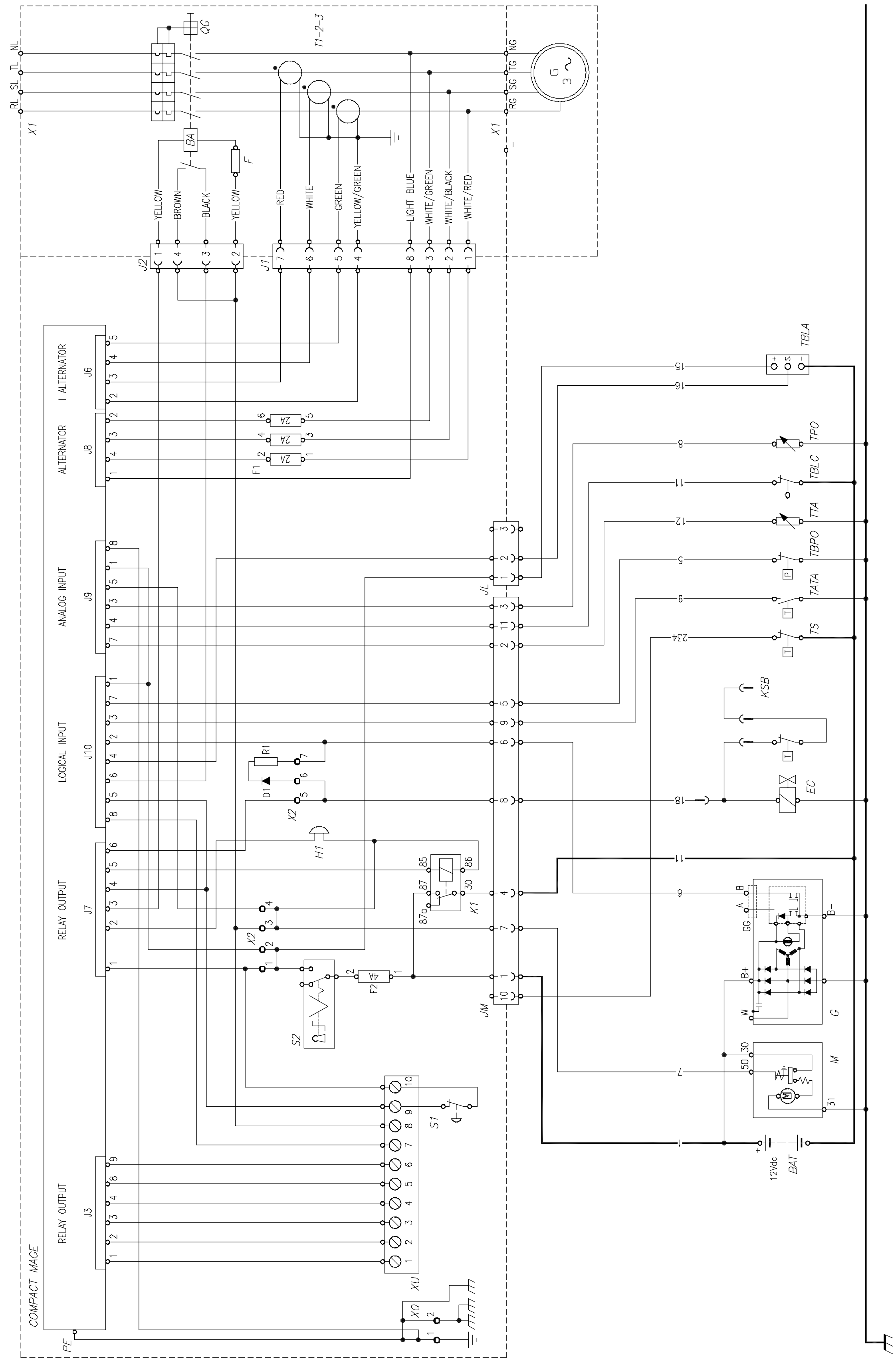
Figure 11



107800

Generator set with Compact Mage manual panel
GENEF - MECHANIC PUMP

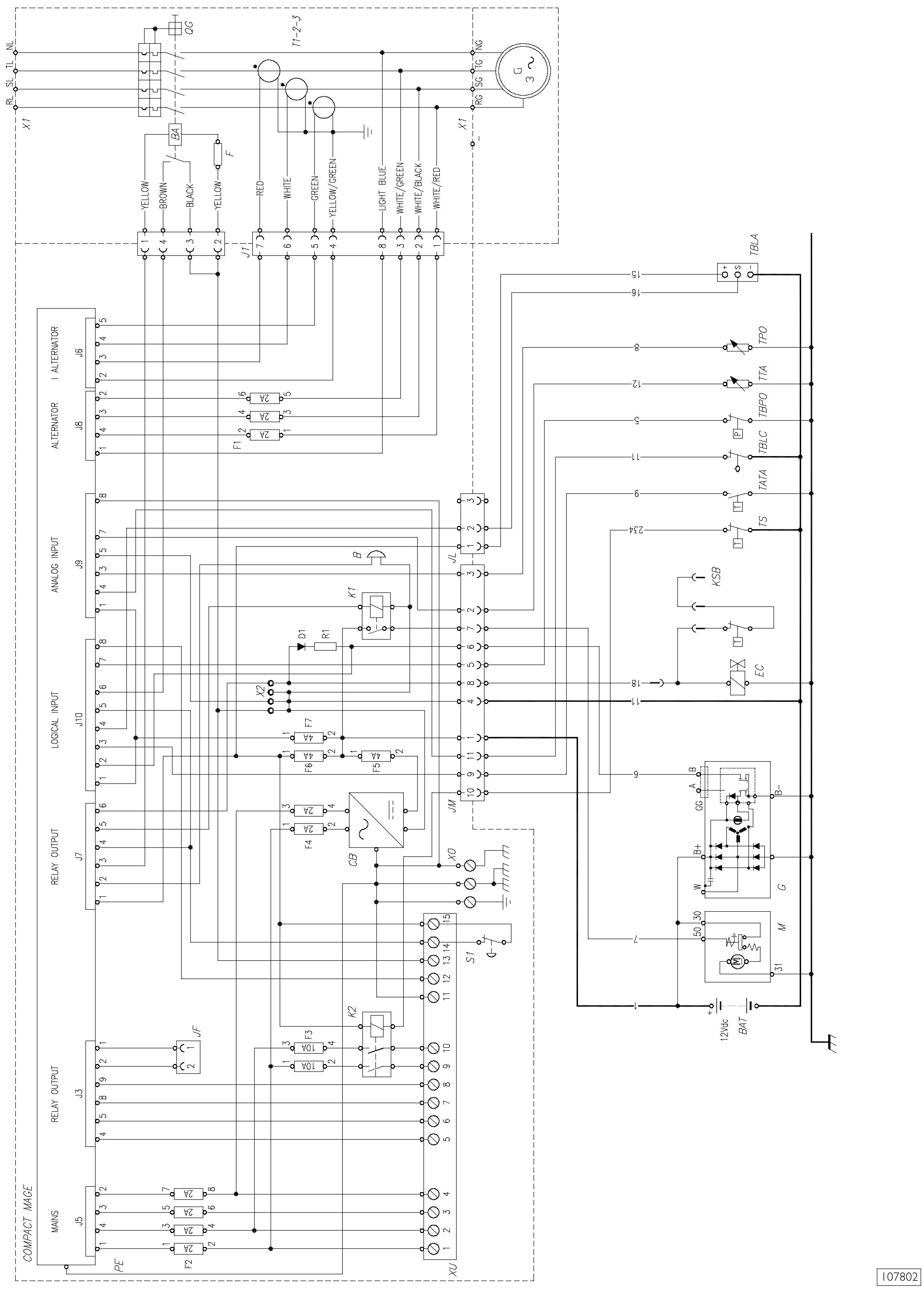
Figure 12



107801

Generator set with Compact Mage automatic panel
GENEF - MECHANIC PUMP

Figure 13



Key to components on engine side

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TBLC	Float for fuel level
TS	Engine water heater thermostat
TATA	High engine water temperature thermostat
EC	Stop solenoid valve
KSB	Advance regulator

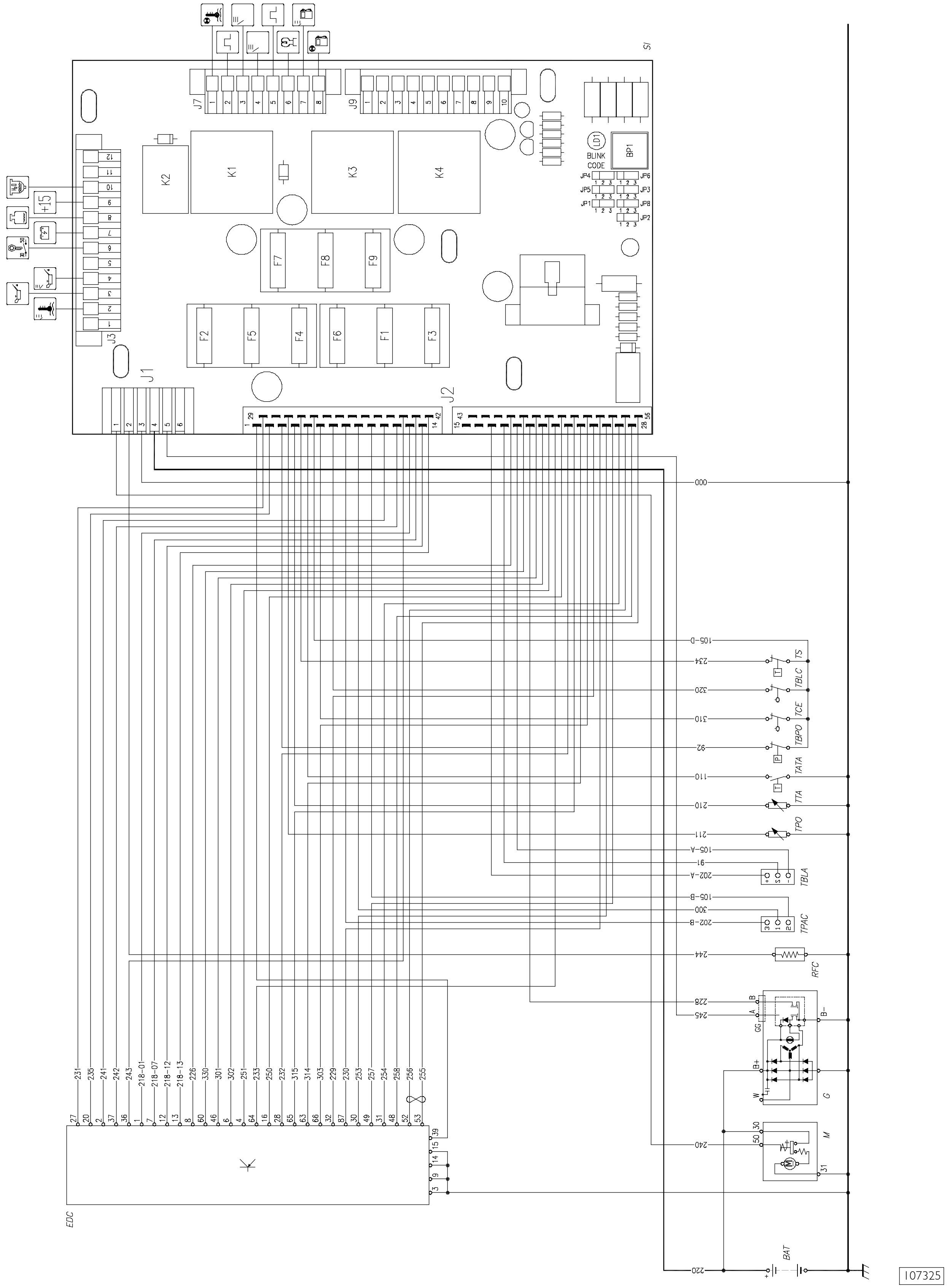
Key to control panel components

CONTROL PANEL PG804		CONTROL PANEL PGM1	
B	Buzzer	CDA	Starter switch
CB	Battery charger	F1	2 A fuse
F1-8	Disconnectable fuses 230 Vac	F2	2 A fuse
F9-10	Fuses 12 - 24 Vdc	F3	2 A fuse
T1-2-3	Amperometric transformers	F4	20 A delayed fuse
J1	Switch connector	T1-2-3	Amperometric transformers
J2	Switch connector	H1	Electronic siren 12 - 24 Vdc
JL	Engine connector	JL	Engine connector
JM	Engine connector	JM	Engine connector
JV	Voltage selection connector	K1	Contactor
K1	Stop relay	P1	Ammeter
K2	Start relay	P2	Ammeter
KS	Water heater cut-in relay	P3	Ammeter
PE	Emergency button	P4	Voltmeter
R1	Current limiting resistor TBPO	P5	Frequency meter
SE	Safety selector	P6	Hour meter
XU	User terminal block	P7	Engine oil pressure gauge
BA	Switch coil	P8	Engine water temperature thermometer
QG	Switch	PE	Emergency stop button
		S1	Ammeter three-way switch
		BA	Switch coil
		QG	Switch

MANUAL CMAGE CONTROL PANEL		AUTOMATIC CMAGE CONTROL PANEL	
H1	Buzzer	H1	Buzzer
F1-F2	Disconnectable fuses 230 Vac	F1-F2	Disconnectable fuses 230 Vac
T1-T2-T3	Amperometric transformers	T1-T2-T3	Amperometric transformers
J1	Switch connector	J1	Switch connector
J2	Switch connector	J2	Switch connector
JL	Engine connector	JL	Engine connector
JM	Engine connector	JM	Engine connector
JV	Voltage selection connector	JV	Voltage selection connector
K1	Start relay	JF	Fuel pump connector
K2	Water heater cut-in relay	K1	Start relay
S1	Emergency button	K2	Water heater cut-in relay
S2	Panel ignition selector	S1	Emergency button
XU	User terminal block	S2	Panel ignition selector
D1	Diode to signal battery charging	XU	User terminal block
R1	Resistor to signal battery charging	D1	Diode to signal battery charging
BA	Switch coil	R1	Resistor to signal battery charging
QG	Switch	BA	Switch coil
		QG	Switch

Wiring diagram for 12Vdc applications GENEF - COMMON RAIL

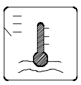
Figure 14

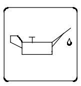


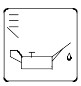
Key to components

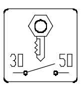
BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating resistor
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Function symbols for the control panel

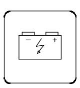

ENGINE WATER TEMPERATURE THERMOMETER

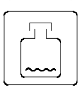

LOW ENGINE OIL PRESSURE VISUAL WARNING

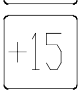

ENGINE OIL PRESSURE GAUGE



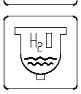
STARTING THE ENGINE (+50)


NO BATTERY CHARGING VISUAL WARNING

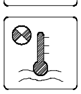

LOW ENGINE WATER LEVEL VISUAL WARNING

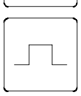


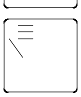
CAPTIVE KEY POSITIVE (+15)

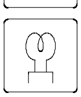


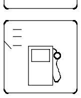
WATER IN THE FUEL FILTER VISUAL WARNING

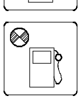

HIGH ENGINE WATER TEMPERATURE VISUAL WARNING


CAN LINE


CONTROL PANEL POWER SUPPLY

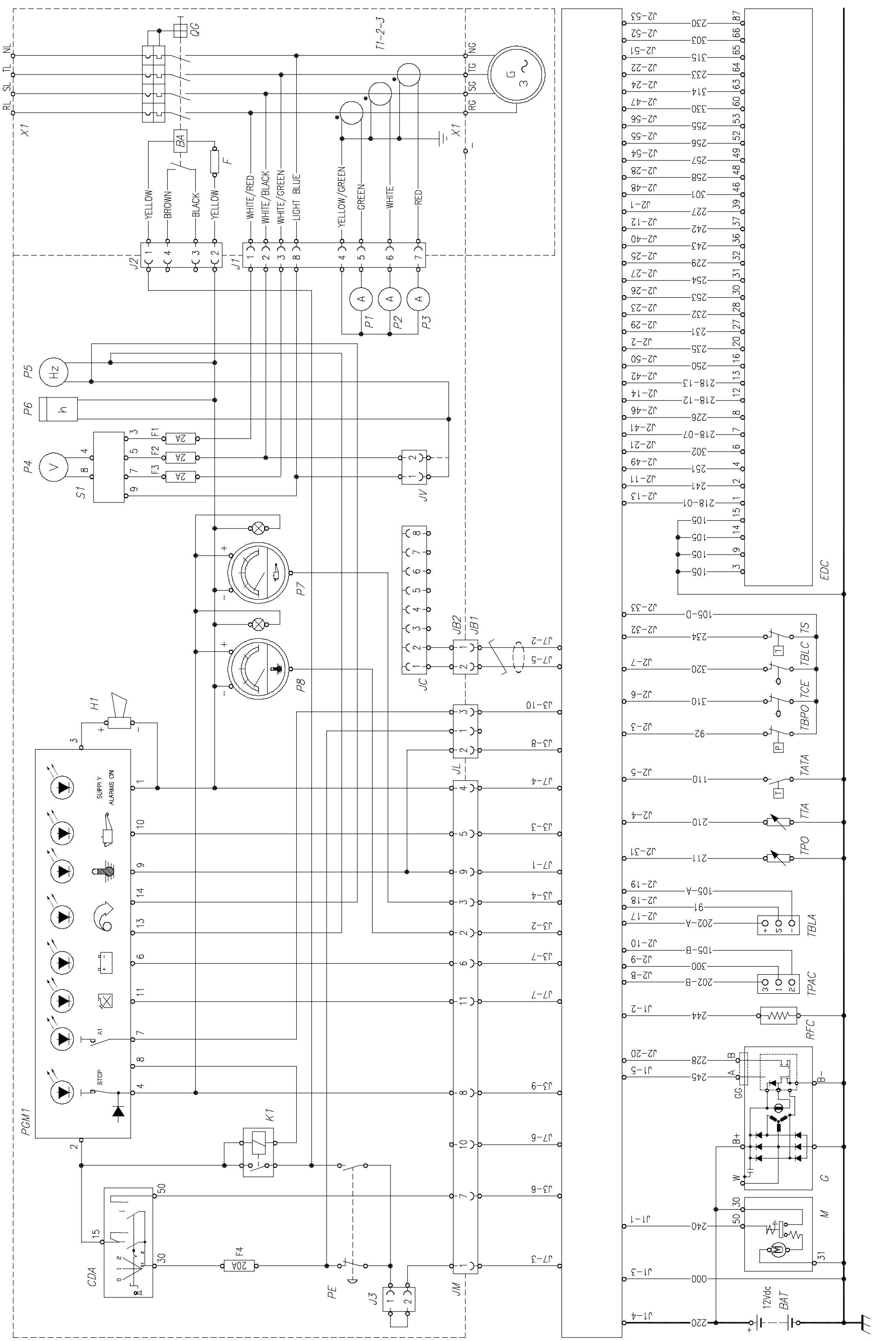

ENGINE PRE-HEATING


FUEL LEVEL VISUAL WARNING


NO FUEL VISUAL WARNING (OPTION)

Wiring diagram for 12Vdc applications with manual control panel PGM1 GENEF - COMMON RAIL

Figure 15



107325

PGM1 control panel components

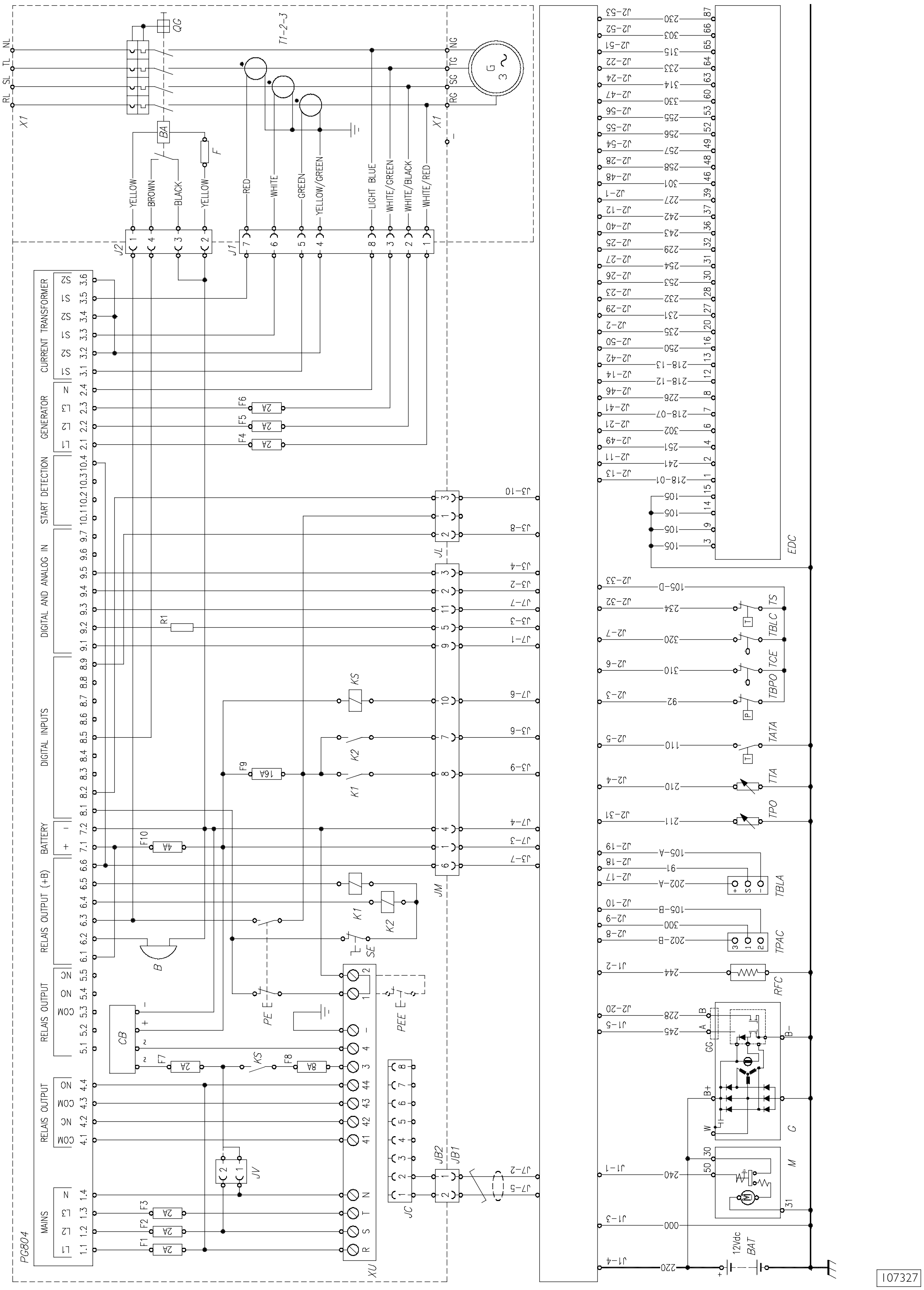
CDA	Ignition switch
F1	Fuse - 2 A
F2	Fuse - 2 A
F3	Fuse - 2 A
F4	20 A delayed fuse
T1-T2-T3	Amperometric transformers
H1	Electronic siren 12 - 24 Vdc
JL	Engine connector
JM	Engine connector
K1	Contactor
P1	Ammeter
P2	Ammeter
P3	Ammeter
P4	Voltmeter
P5	Frequency meter
P6	Hour meter
P7	Engine oil pressure gauge
P8	Engine water temperature thermometer
PE	Emergency stop button
S1	Ammeter three-way switch
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 12Vdc applications with automatic control panel PGM1 GENEF - COMMON RAIL

Figure 16



Components of automatic control panel PG804

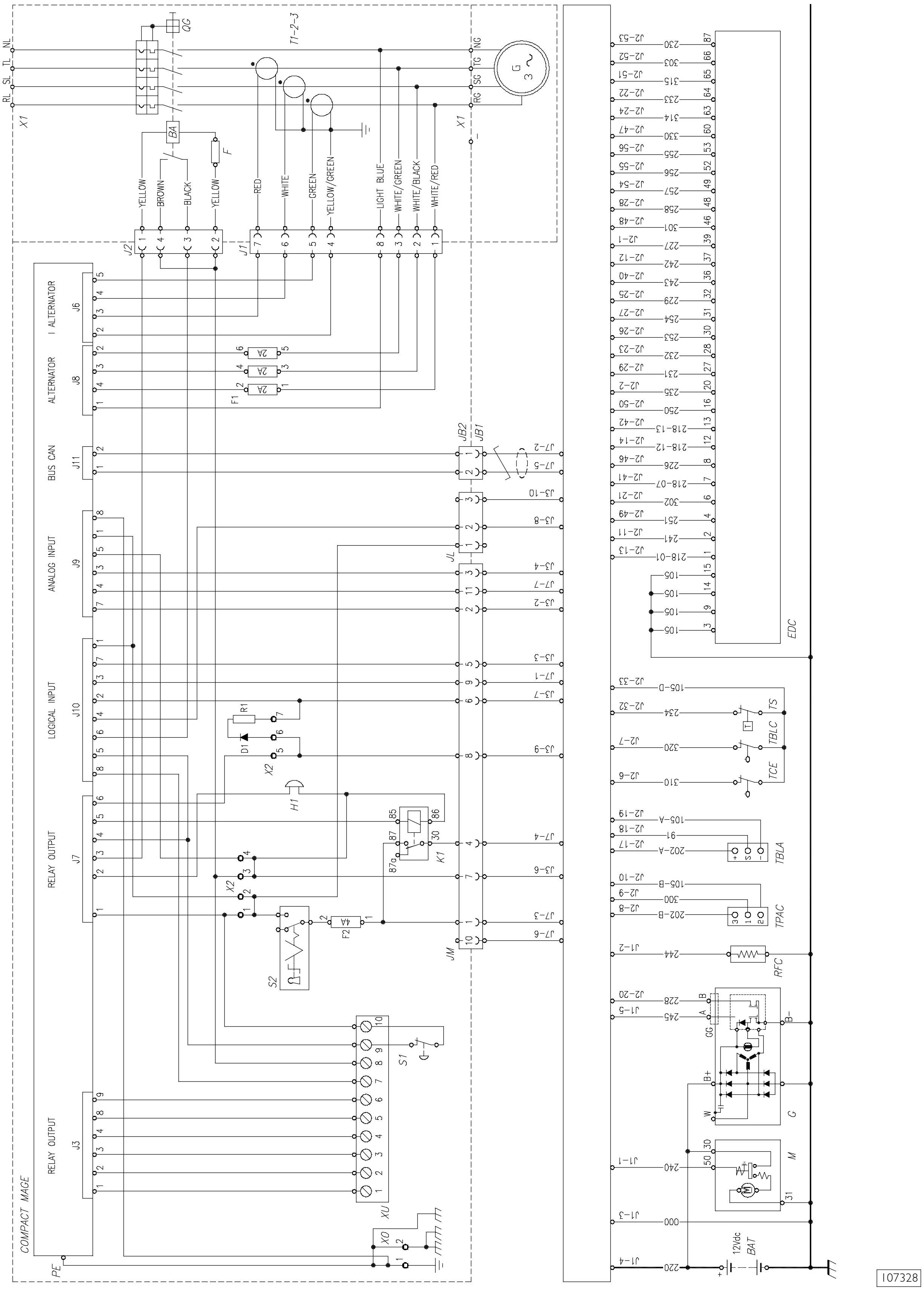
B	Buzzer
CB	Battery charger
F1-8	Disconnectable fuses 230 Vac
F9-10	Fuses 12 - 24 Vdc
T1-2-3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
K1	Stop relay
K2	Start relay
KS	Water heater cut-in relay
PE	Emergency button
R1	Current limiting resistor TBPO
SE	Safety selector
XU	User terminal block
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 12Vdc applications with manual control panel Compact Mage GENEF - COMMON RAIL

Figure 17



Components of manual control panel Compact Mage

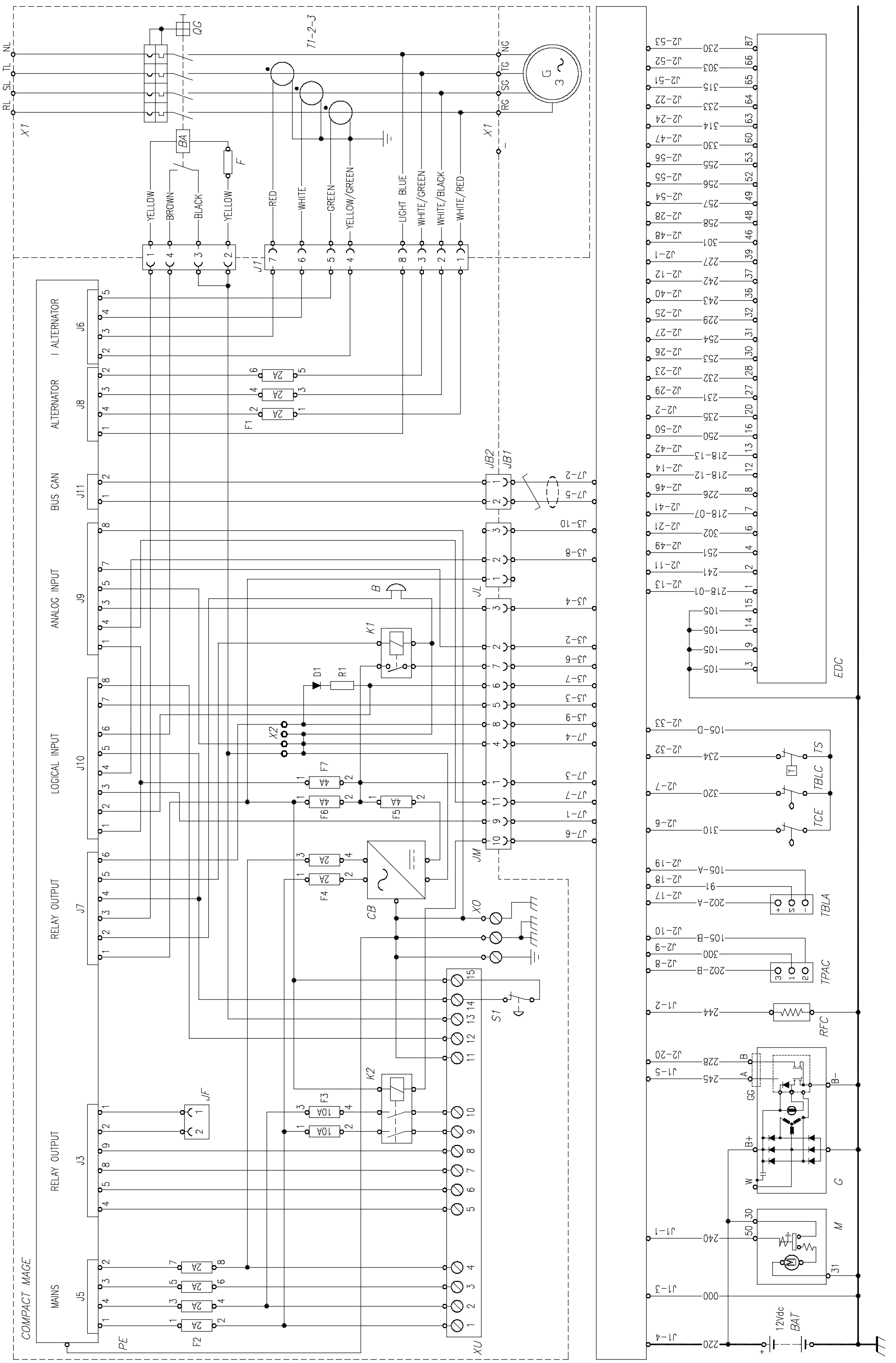
H1	Buzzer
F1-F2	Disconnectable fuses 230 Vac
T1-T2-T3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
K1	Start relay
K2	Water heater cut-in relay
S1	Emergency button
S2	Panel ignition selector
XU	User terminal block
D1	Diode to signal battery charging
R1	Resistor to signal battery charging
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 12Vdc applications with Compact Mage automatic control panel GENEF - COMMON RAIL

Figure 18



107329

Components of automatic control panel Compact Mage

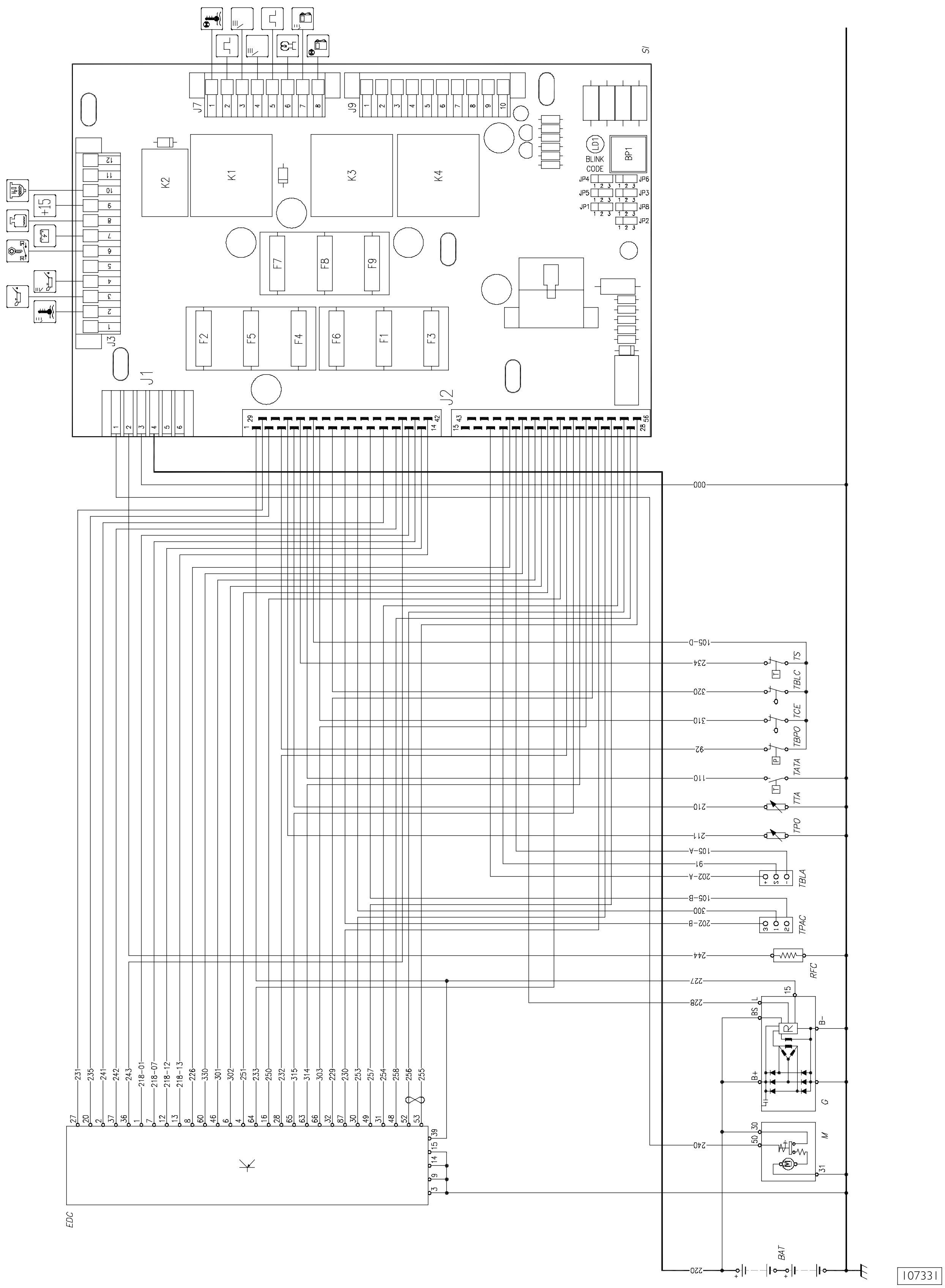
H1	Buzzer
F1-F2	Disconnectable fuses 230 Vac
T1-T2-T3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
JF	Fuel pump connector
K1	Start relay
K2	Water heater cut-in relay
S1	Emergency button
S2	Panel ignition selector
XU	User terminal block
D1	Diode to signal battery charging
R1	Resistor to signal battery charging
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 24Vdc applications GENEF - COMMON RAIL

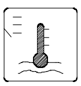
Figure 19

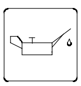


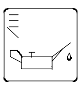
Key to components

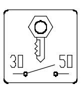
BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating resistor
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Function symbols for the control panel

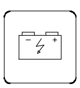
 ENGINE WATER TEMPERATURE THERMOMETER

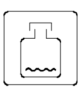
 LOW ENGINE OIL PRESSURE VISUAL WARNING

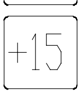
 ENGINE OIL PRESSURE GAUGE



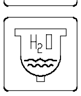
STARTING THE ENGINE (+50)

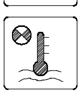
 NO BATTERY CHARGING VISUAL WARNING

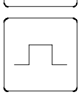
 LOW ENGINE WATER LEVEL VISUAL WARNING

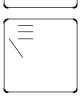


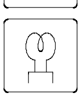
CAPTIVE KEY POSITIVE (+15)

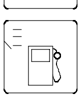
 WATER IN THE FUEL FILTER VISUAL WARNING

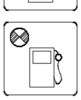
 HIGH ENGINE WATER TEMPERATURE VISUAL WARNING

 CAN LINE

 CONTROL PANEL POWER SUPPLY

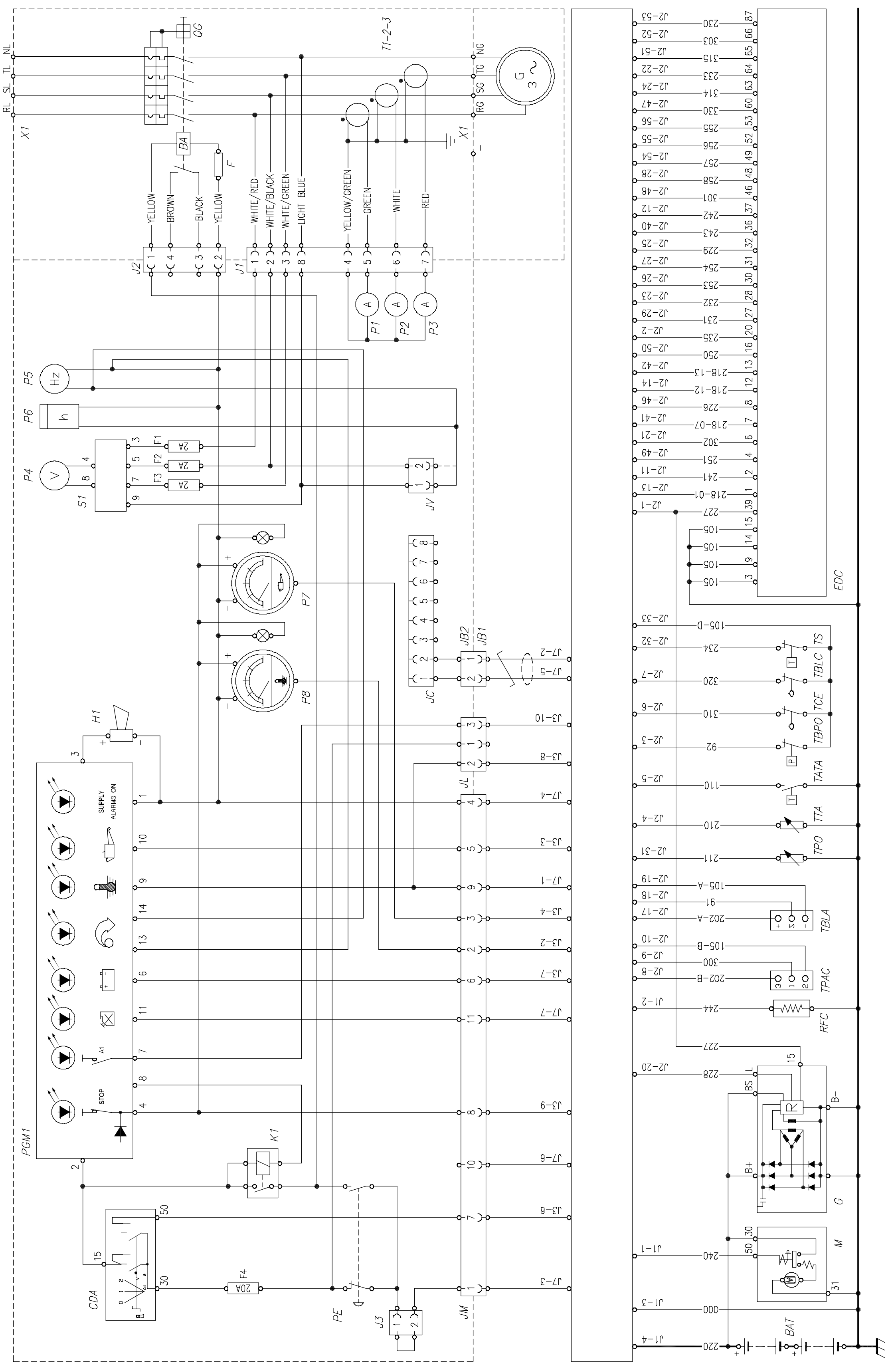
 ENGINE PRE-HEATING

 FUEL LEVEL VISUAL WARNING

 NO FUEL VISUAL WARNING (OPTION)

Wiring diagram for 24Vdc applications with manual control panel PGM1 GENEF - COMMON RAIL

Figure 20



107332

PGM1 control panel components

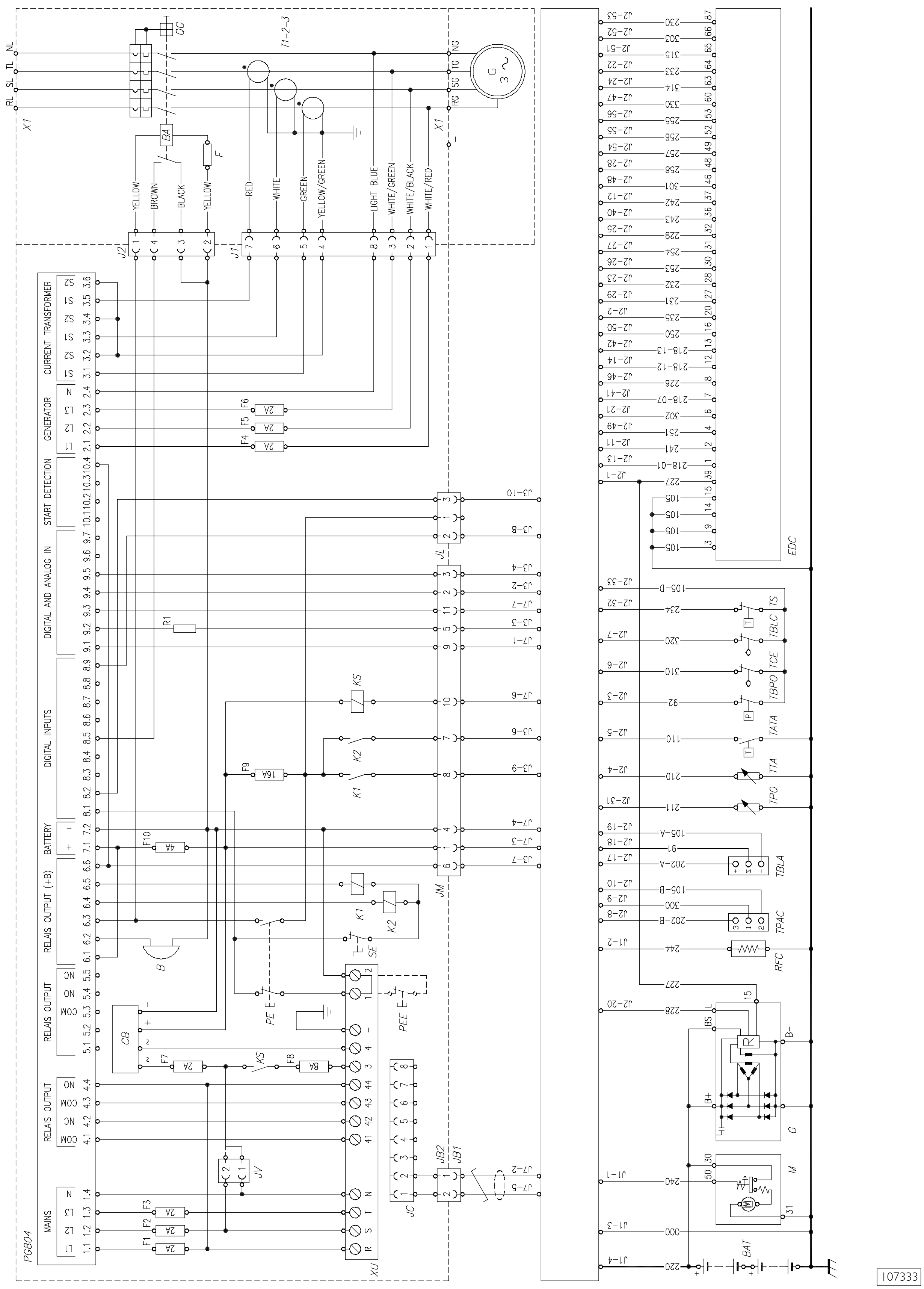
CDA	Ignition switch
F1	Fuse - 2 A
F2	Fuse - 2 A
F3	Fuse - 2 A
F4	20 A delayed fuse
T1-T2-T3	Amperometric transformers
H1	Electronic siren 12 - 24 Vdc
JL	Engine connector
JM	Engine connector
K1	Contactor
P1	Ammeter
P2	Ammeter
P3	Ammeter
P4	Voltmeter
P5	Frequency meter
P6	Hour meter
P7	Engine oil pressure gauge
P8	Engine water temperature thermometer
PE	Emergency stop button
S1	Ammeter three-way switch
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 24Vdc applications with automatic control panel PG804 GENEF - COMMON RAIL

Figure 21



107333

Components of automatic control panel PG804

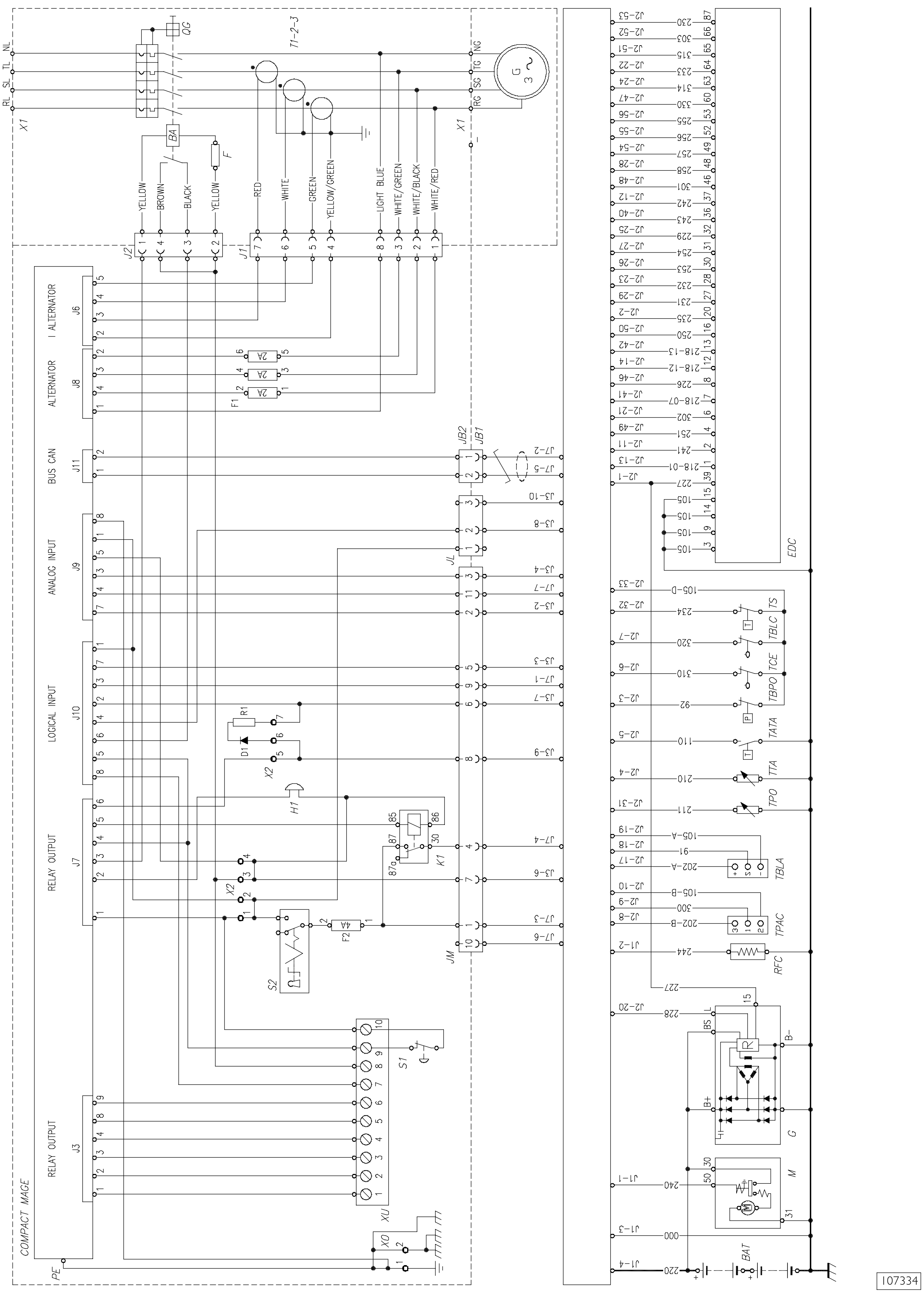
B	Buzzer
CB	Battery charger
F1-8	Disconnectable fuses 230 Vac
F9-10	Fuses 12 - 24 Vdc
T1-2-3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
K1	Stop relay
K2	Start relay
KS	Water heater cut-in relay
PE	Emergency button
R1	Current limiting resistor TBPO
SE	Safety selector
XU	User terminal block
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 24Vdc applications with manual control panel Compact Mage GENEF - COMMON RAIL

Figure 22



107334

Print P4D32N001GB

Components of manual control panel Compact Mage

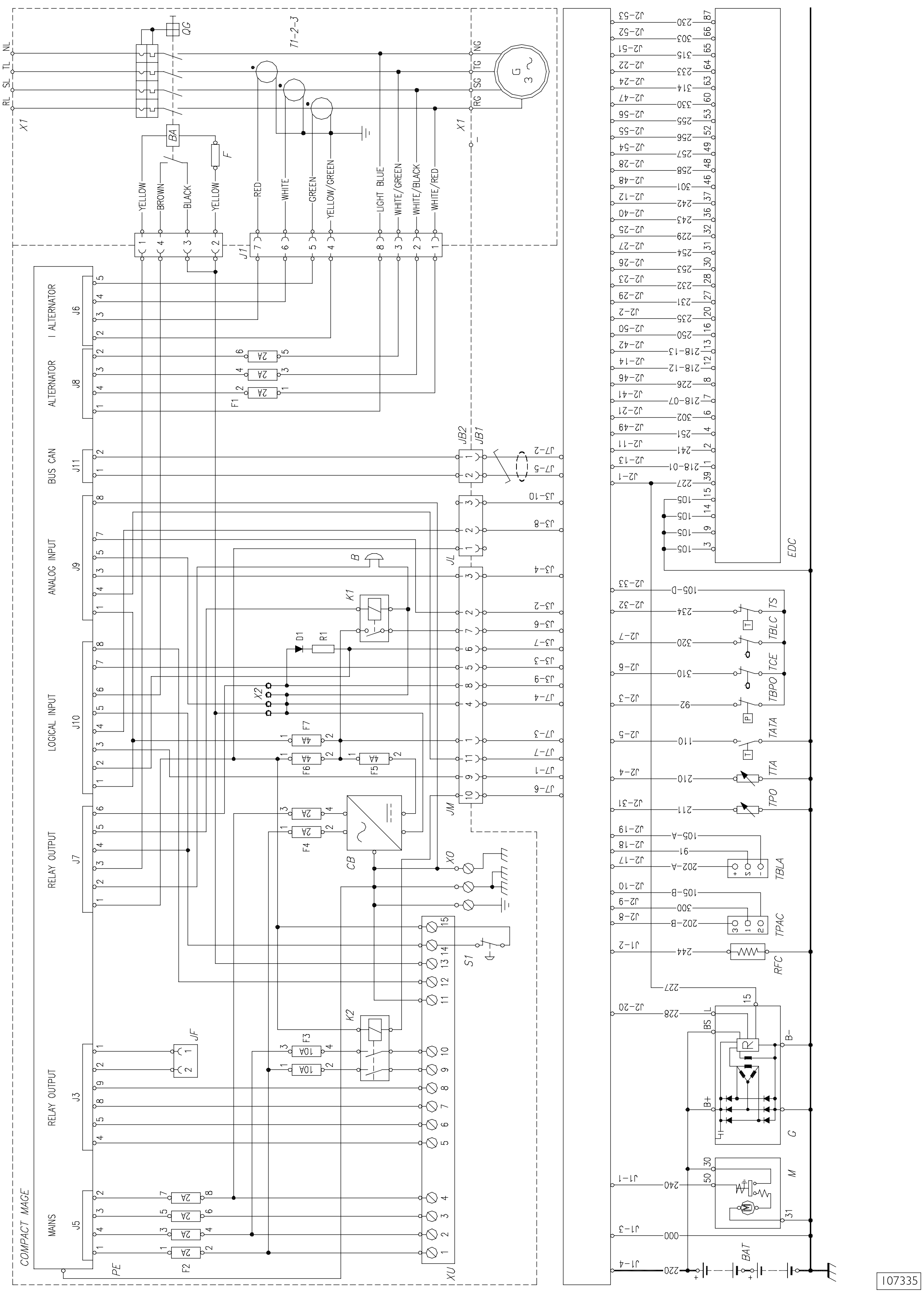
H1	Buzzer
F1-F2	Disconnectable fuses 230 Vac
T1-T2-T3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
K1	Start relay
K2	Water heater cut-in relay
S1	Emergency button
S2	Panel ignition selector
XU	User terminal block
D1	Diode to signal battery charging
R1	Resistor to signal battery charging
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

Wiring diagram for 24Vdc applications with Compact Mage automatic control panel GENEF - COMMON RAIL

Figure 23



107335

Components of automatic control panel Compact Mage

H1	Buzzer
F1-F2	Disconnectable fuses 230 Vac
T1-T2-T3	Amperometric transformers
J1	Switch connector
J2	Switch connector
JL	Engine connector
JM	Engine connector
JV	Voltage selection connector
JF	Fuel pump connector
K1	Start relay
K2	Water heater cut-in relay
S1	Emergency button
S2	Panel ignition selector
XU	User terminal block
D1	Diode to signal battery charging
R1	Resistor to signal battery charging
BA	Switch coil
QG	Switch

Components on engine

BAT	Starter battery 12V
M	Starter motor
G	Battery charger alternator
RFC	Fuel filter heating element
TPAC	Water in the fuel filter transmitter
TBLA	Low engine water level transmitter
TPO	Engine oil pressure switch
TBPO	Low engine oil level pressure switch
TTA	Engine water temperature transmitter
TCE	No fuel transmitter (option)
TBLC	Float for fuel level
TS	Engine water heater thermostat
EDC	Engine electronic control unit
TATA	High engine water temperature thermostat
SI	Control panel - engine interface box

LINE DIAGRAMS

Wiring of engine for generator set GENEF - MECHANIC PUMP

Figure 24

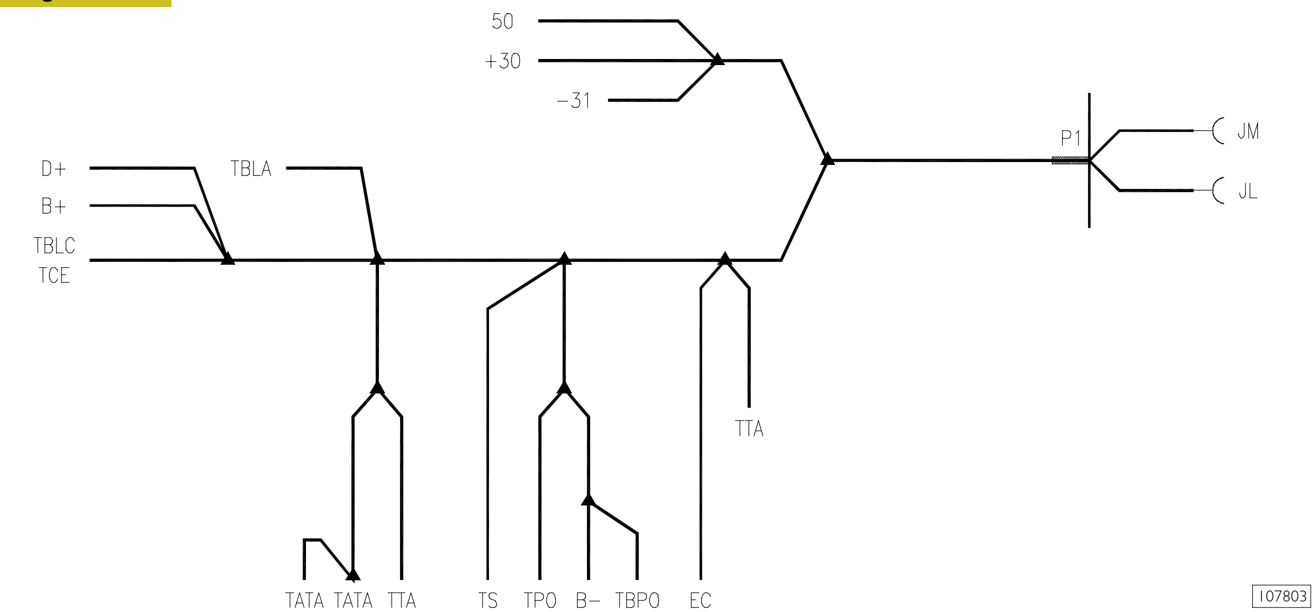
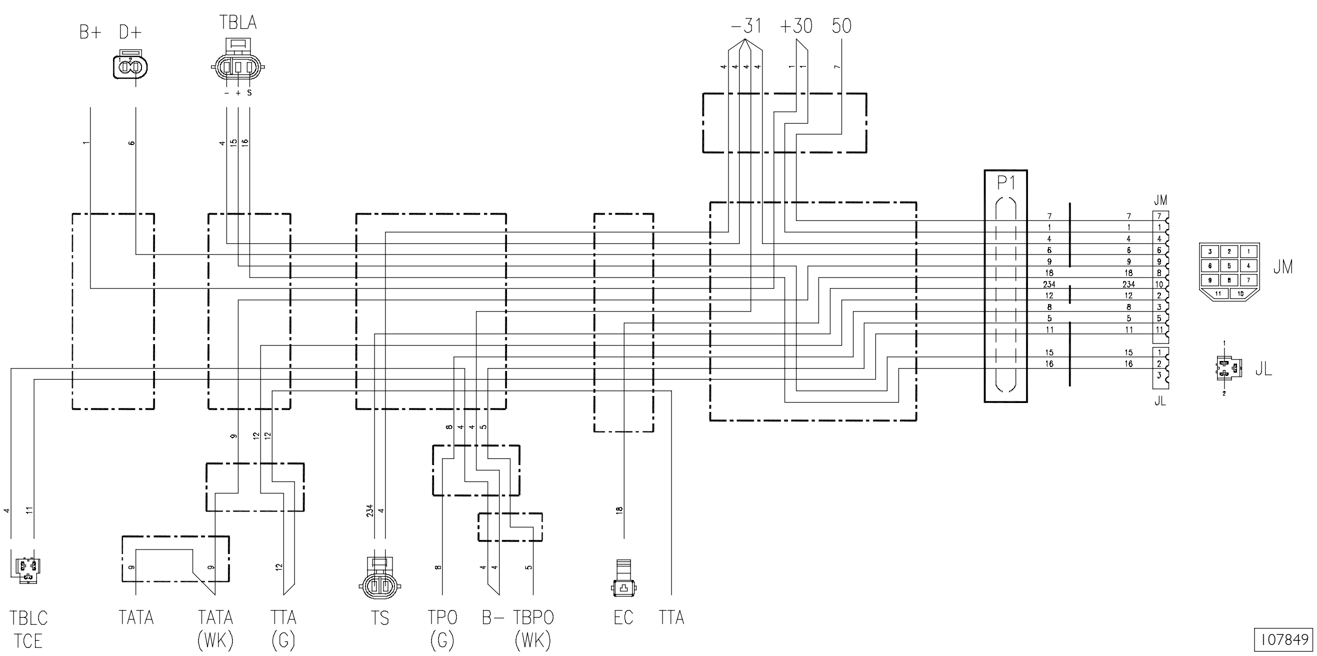


Figure 25



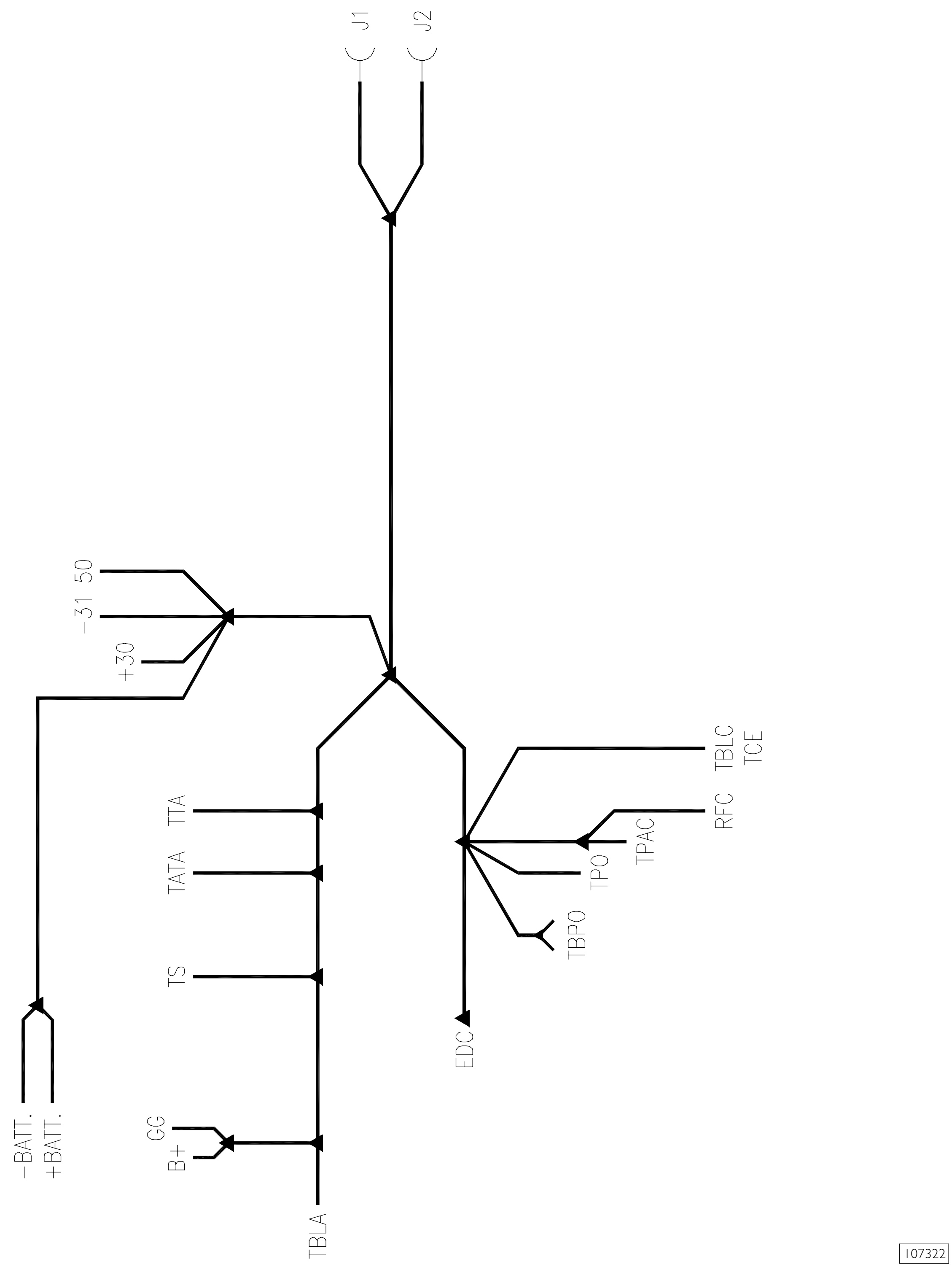
LIST OF COMPONENTS

B+/D+. Alternator - TBLA. Low radiator water level transmitter - -31/+30/50. Starter motor - JM/JL. Control panel connectors - TTA. Engine water temperature transmitter - EC. Stop solenoid valve - TBPO. Low engine oil pressure transmitter - TPO. Engine oil pressure transmitter - TS. Heater transmitter - TATA. High engine water temperature transmitter - TBLC. Low fuel level transmitter.

Print P4D32N001GB

Wiring from interface box to engine for 12/24Vdc applications GENEF - COMMON RAIL - One line diagram

Figure 26

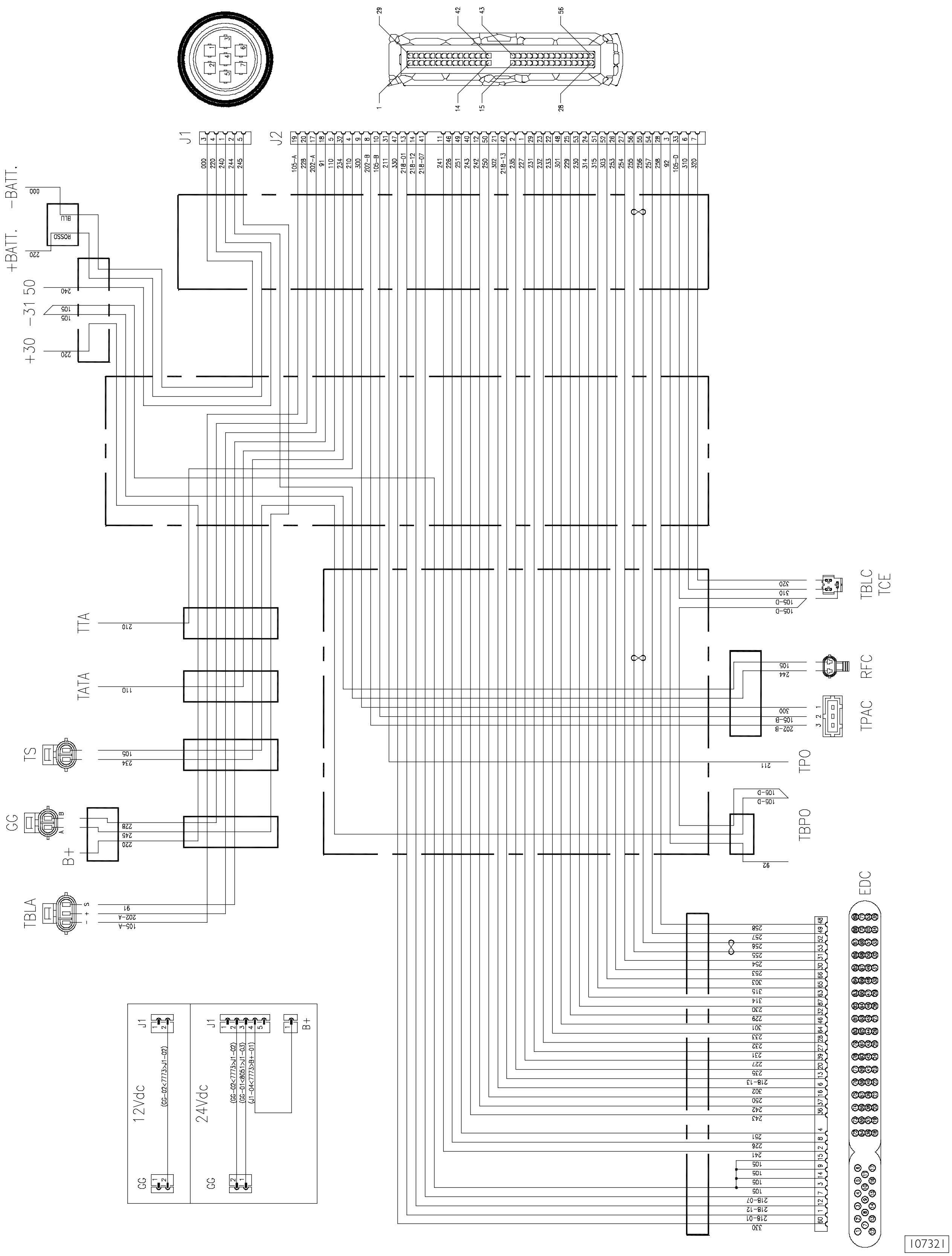


LIST OF COMPONENTS

BATT. Battery - +30/-31/50. Starter motor - B+/GG. Alternator - TBLA. Low engine water level transmitter - TS. Heater thermostat - TATA. High engine water temperature transmitter - TTA. Engine water temperature transmitter - EDC. Engine electronic control unit - TBPO. Low engine oil pressure transmitter -
TPO. engine oil pressure transmitter - TPAC. Water in the fuel filter transmitter - RFC. Fuel filter heating element - TBLC. Low fuel level transmitter - J1/J2. Interface box connectors.

Wiring from interface box to engine for 12/24Vdc applications GENEF - COMMON RAIL - Multi-line diagram

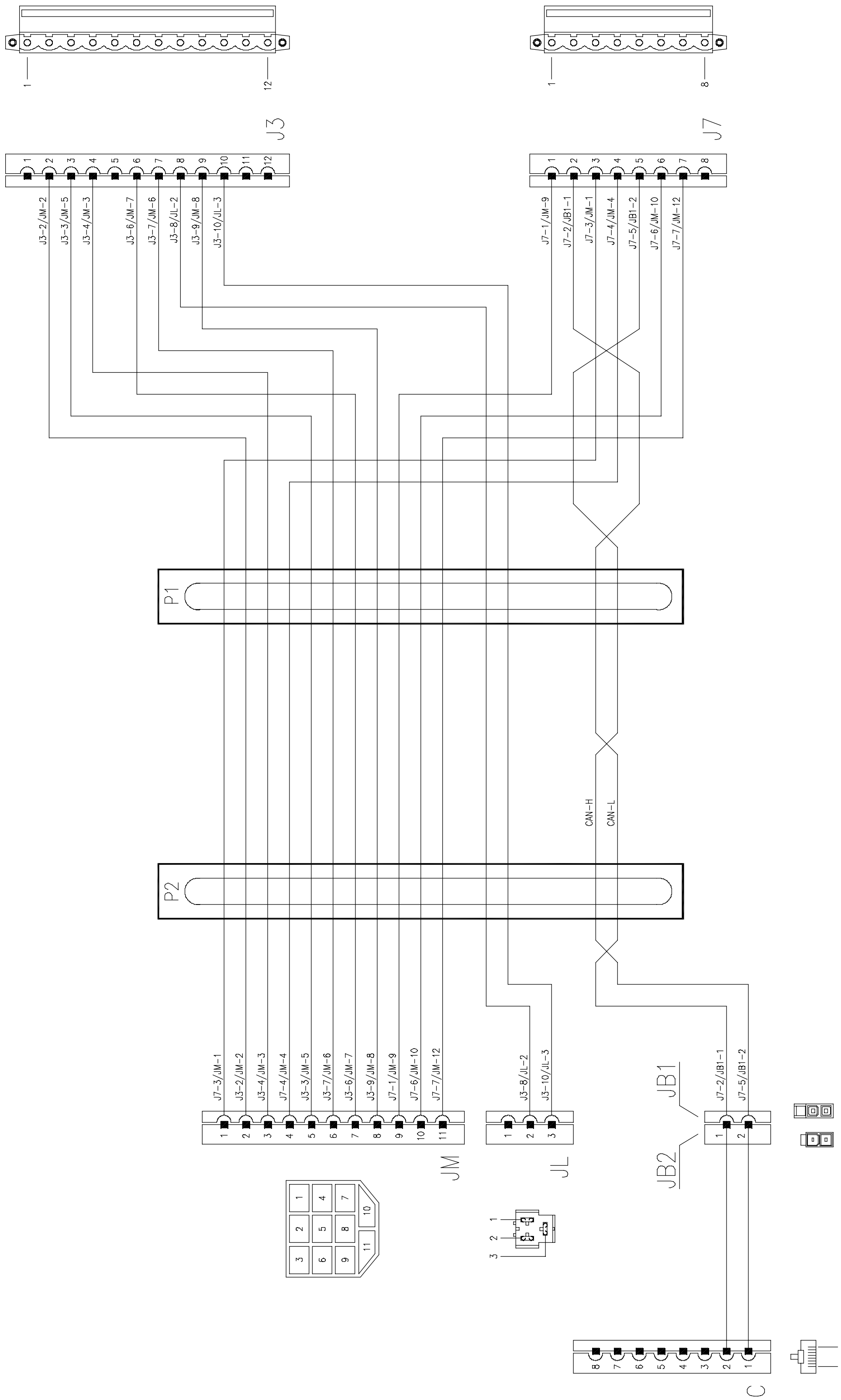
Figure 27



 Print P4D32N001GB

Wiring from control panel to interface box for 12/24Vdc application GENEF - COMMON RAIL

Figure 28

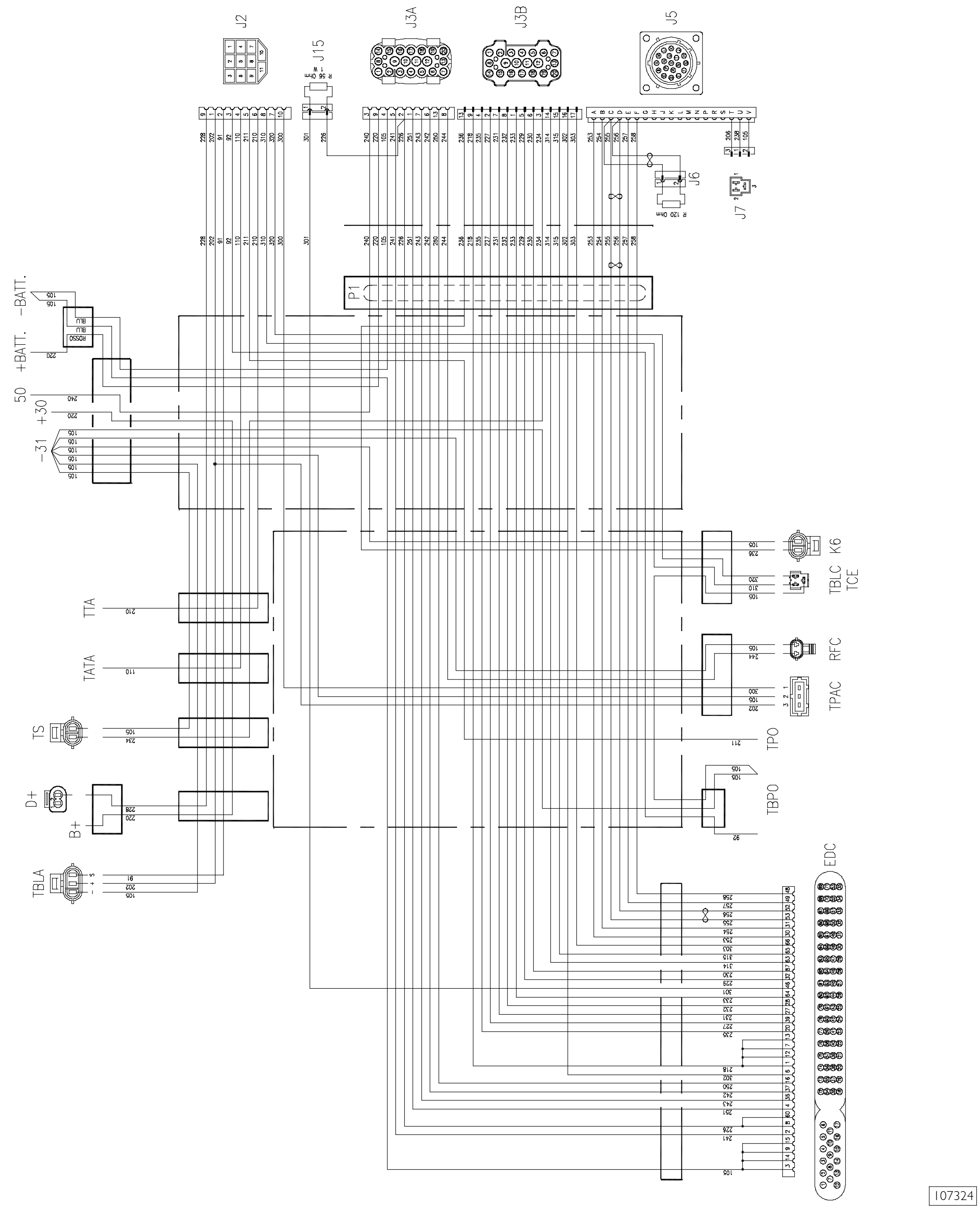


LIST OF COMPONENTS

JM/JL. Control panel connectors - JB1/JB2. Connectors from control panel to CAN line - JC. Connector inside the control panel for CAN line - J3/J7. Connectors for interface box - P1/P2. Bulkhead connector.

Engine wiring for generator set without interface box with 12/24Vdc application GENEF - COMMON RAIL

Figure 29



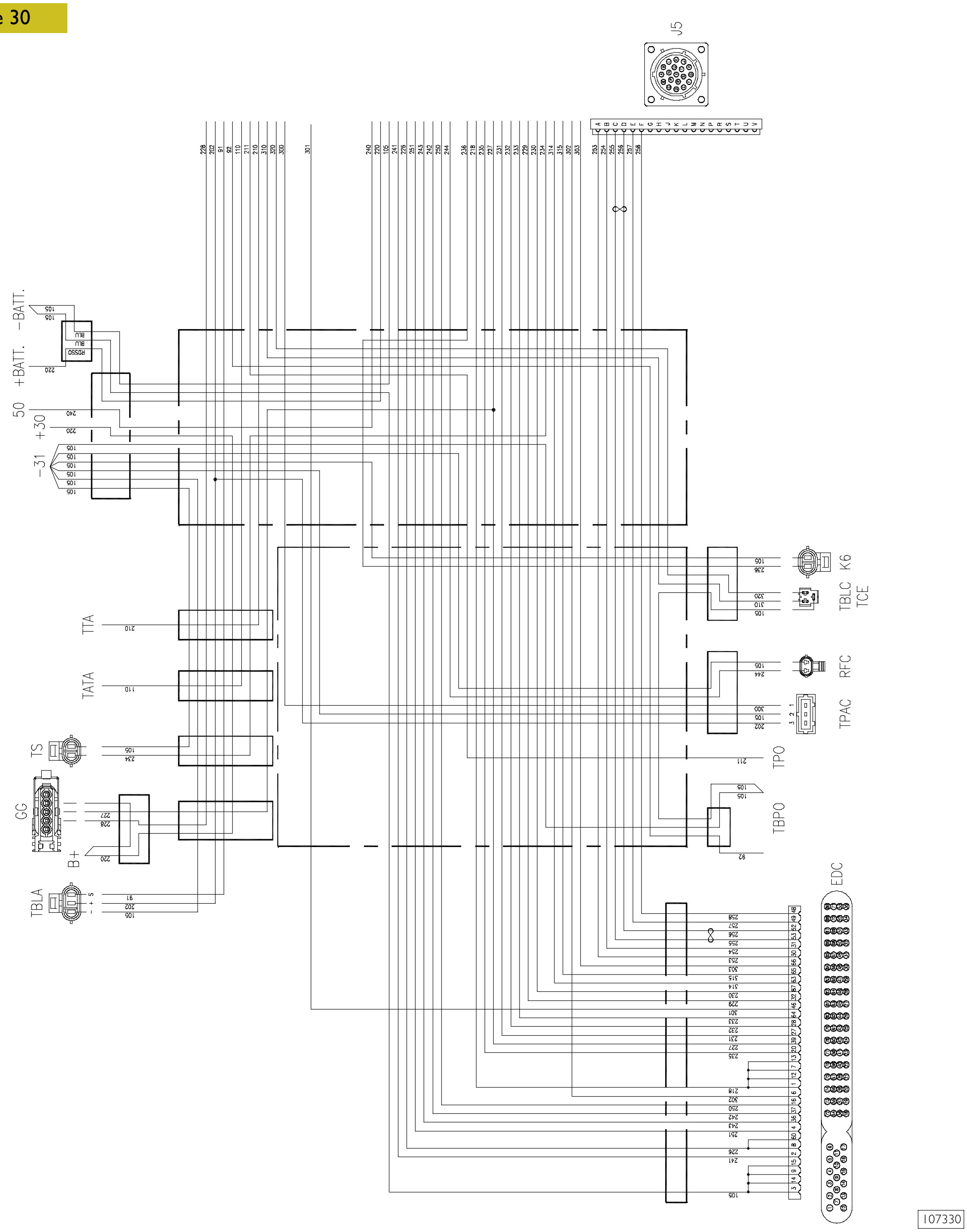
LIST OF COMPONENTS

BATT. Battery - +30/-31/50. Starter motor - B+/GG. Alternator - TBLA. Low engine water level transmitter - TS. Heater thermostat - TATA. High engine water temperature transmitter - TTA. Engine water temperature transmitter - EDC. Engine electronic control unit - TBPO. Low engine oil pressure transmitter - TPO. engine oil pressure transmitter - TPAC. Water in the fuel filter transmitter - RFC. Fuel filter heating element - TBLC. Low fuel level transmitter - TCE. No fuel transmitter (option) - K6. Contactor for heater - J2. Instrument panel/control panel connector - J3A/J3B/J7. Services panel/control panel connectors - J5. Test connector/control panel connector - J6. Connector for CAN line - J15. Connector for pre-heating indicator light (prearrangement).

Print P4D32N001GB

Engine wiring for generator set without interface box with 24Vdc application GENEF - COMMON RAIL

Figure 30

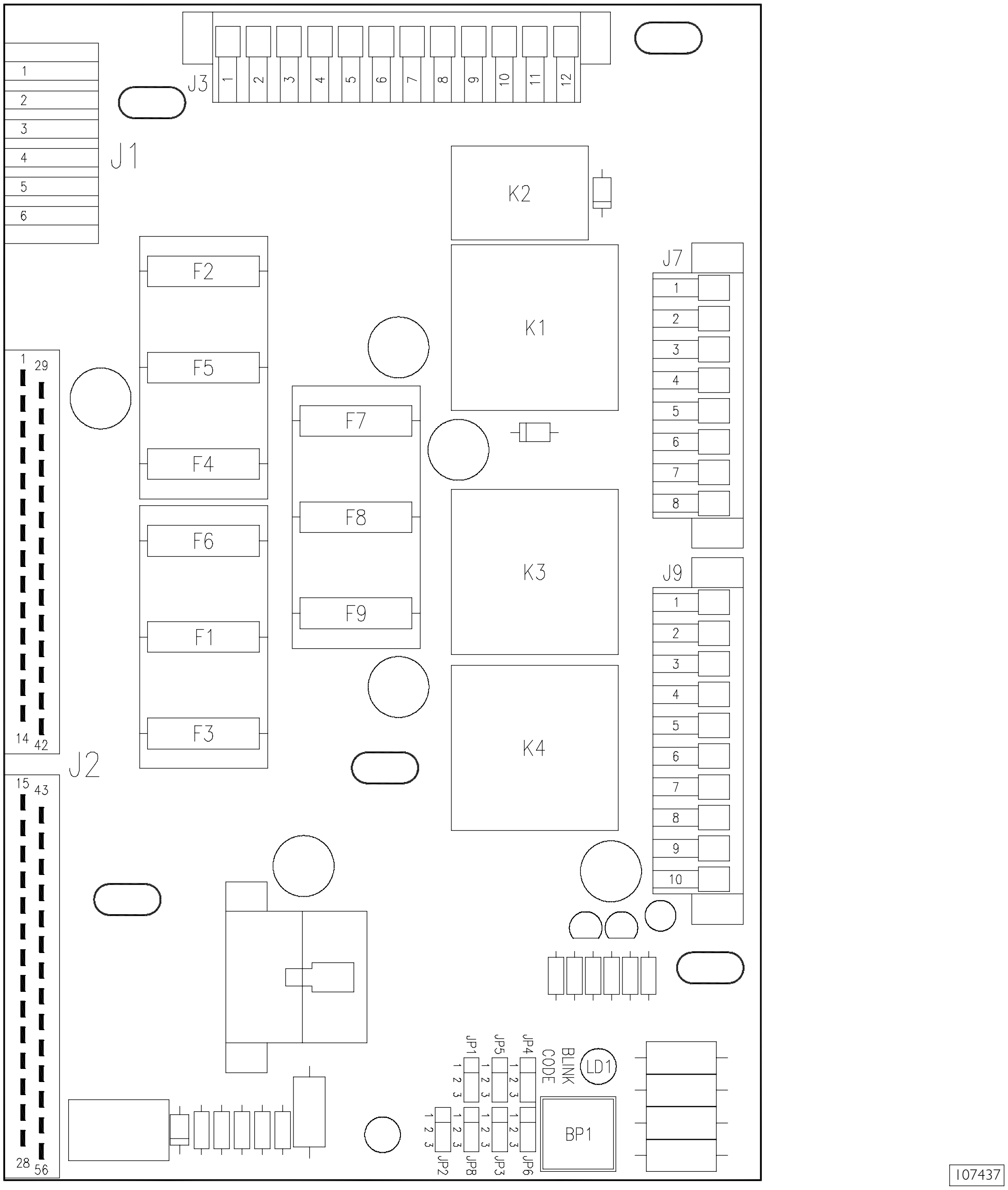


LIST OF COMPONENTS

BATT. Battery - +30/-31/50. Starter motor - B+/GG. Alternator - TBLA. Low engine water level transmitter - TS. Heater thermostat - TATA. High engine water temperature transmitter - TTA. Engine water temperature transmitter - EDC. Engine electronic control unit - TBPO. Low engine oil pressure transmitter - TPO. Engine oil pressure transmitter - TPAC. Water in the fuel filter transmitter - RFC. Fuel filter heating element - TBLC. Low fuel level transmitter - TCE. No fuel transmitter (option) - K6. Contactor for heater - J5. Test connector/control panel connector.

CONTROL PANEL - ENGINE INTERFACE BOX (12V/24V)

Figure 31

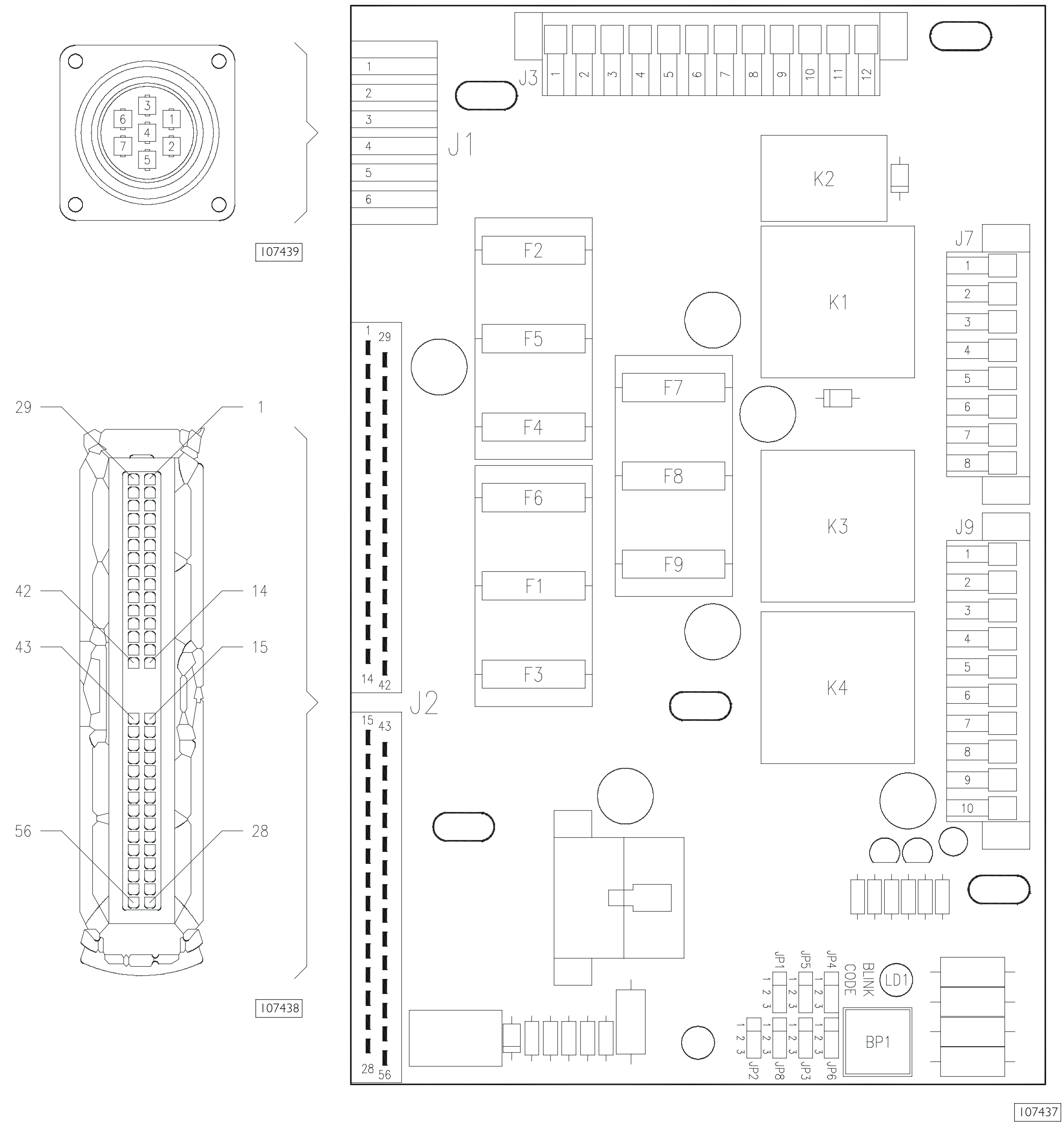


LIST OF COMPONENTS

K1. Power relay with key inserted (+15) - K2. Starting phase signal relay - K3. Starting relay - K4. Relay to cut in fuel filter heating element - JP1. Jumper to select frequency (jumper on 1-2= 50Hz - jumper on 2-3= 60Hz) - JP2. Jumper to select operating mode (jumper on 1-2= diagnosis - jumper on 2-3= standard operation) - JP3. Jumper to select cold start signal connection (1-2= connected - 2-3= disconnected) - JP4. Jumper to select heat. function for cold starting (1-2= connected - 2-3= disconnected) - JP5. Jumper for CAN line presence selection (1-2 = CAN line connected - 2-3 = CAN line not connected) - JP6. Not used - JP8. Not used - BP1. Switch for blink-code signal request - LD1. LED signalling blink/code - F1. 10A fuse for starting engine - F2. 3A fuse for diagnostics - F3. 20A fuse for fuel filter heating element - F4. 30A fuse for electronic control unit - F5. 10A fuse for control panel - F6. 5A fuse for cut-in +15 ON ECU - F7. Not used - F8. Not used - F9. Not used - J1. Connector for power connections - J2. Connector for interface with engine control unit - J3. Connector for interface with control panel - J7. Connector for interface with control panel - J9. Connector for interface with control panel.

INTERNAL CONNECTORS TO ENGINE INTERFACE BOX

Figure 32



CONNECTOR J1 on engine interface box - control panel for power supplies

1	To terminal 50 of the starter motor
2	Supply from F3 for fuel filter heating resistance
3	Battery negative
4	Battery positive
5	To connector GG (pin a) of the alternator
6	Free

-

CONNECTOR J2 on engine interface box - control panel for EDC electronic control unit connections

1	Key positive (+15) to supply EDC electronic control unit (pin 39)
2	Positive from keyswitch (+50) for engine starting phase in EDC control unit (pin 20)
3	Signal from low engine oil pressure switch for visual warning on panel (to connector J3 pin 3)
4	Signal from engine water temp. transmitter for thermometer on panel (to connector J3 pin 2)
5	Signal from high engine water temp. thermostat for visual warning on panel (to connector J7 pin 1)
6	Signal from no fuel transmitter (optional) (to connector J7 pin 8)
7	Signal from fuel level float for visual warning on panel (to connector J7 pin 7)
8	Positive for water in fuel filter transmitter
9	Sign. from water in fuel filter transm. for visual warning on panel (to connector J3 pin 10)
10	Negative for water in fuel filter transmitter
11	Negative for starting relay and diesel heating relay from EDC control unit (pin 2)
12	Positive for starting relay from EDC control unit (pin 37)
13	Battery positive to power EDC control unit (pin 1)
14	Battery positive to power EDC control unit (pin 12)
15	Free
16	Free
17	Positive for low engine water level transmitter
18	Signal from low engine water level transm. for visual warning on panel (to connector J3 pin 8)
19	Negative for low engine water level transmitter
20	From D+ alternator for visual warning no battery charging on panel (to connector J3 pin 7)
21	Engine water temperature signal from EDC control unit (pin 6). Available from connector J9 pin 7
22	Negative from EDC control unit (pin 64) for visual indicator "BLINK-CODE"
23	Positive from EDC control unit (pin 28) for visual indicator "BLINK-CODE"
24	Alarm signal for low engine oil pressure from electronic control unit (pin 63)
25	From resistor module to EDC control unit (pin 32)
26	To the diagnosis connector (line L - pin A) from EDC control unit (pin 30)
27	To the diagnosis connector (line K - pin B) from EDC control unit (pin 31)
28	To the diagnosis connector (engine timing signal - pin F) from EDC control unit (pin 48)
	25829 Positive from Blink-code request button to EDC control unit (pin 27)
30	Free
31	Signal from engine oil pressure switch for pressure gauge on panel (to connector J3 pin 4)
32	Signal from engine water heater thermostat (to connector J7pin 6)
33	Negative for no fuel transmitter (opt), for fuel level float and heater thermostat and low engine oil level signal pressure switch
34	Free
35	Free - jumpered with pin 6 of connector J9
36	Free
37	Free
38	Free - jumpered with pin 11 of connector J3
39	Free
40	Positive for diesel heating relay from EDC control unit (pin 36)
41	Battery positive for EDC control unit (pin 7)
42	Battery positive for EDC control unit (pin 13)
43	Free
44	Free
45	Free - jumpered with pin 5 of connector J9
46	Positive for cold start signal from EDC (pin 8) (opt)
47	Connected with EDC (pin 60)
48	Negative for pre-heating visual signal from EDC electronic control unit (pin 46)
49	Positive for pre-heating cut-in relay from EDC control unit (pin 4)
50	Negative for pre-heating cut-in relay from EDC control unit (pin 16)
51	Alarm signal for high engine water temperature from EDC control unit (pin 65)
52	Engine oil pressure signal from EDC control unit (pin 66)
53	Common resistance module for EDC control unit frequency selection (pin 87)
54	To the diagnosis connector (engine speed signal - pin E) from EDC control unit (pin 49)
55	To the diagnosis connector (CAN line L - pin D) from EDC control unit (pin 52)
56	To the diagnosis connector (CAN line H - pin C) from EDC control unit (pin 53)

NOTE **Pins 3 - 9 - 14 - 15 of the EDC control unit are connected to the battery negative**

Print P4D32N001GB

CONNECTOR J3 inside the engine interface box for signals to control panel

1 Free
2 From the engine water temperature transmitter for signal to thermometer on control panel
3 From the low engine oil pressure switch for visual warning on control panel
4 From engine oil pressure switch for signal to pressure gauge on control panel
5 Free
6 Ignition control
7 From the alternator for battery charging visual indicator on control panel
8 From the low engine water level transmitter for visual warning on control panel
9 To the control panel for stop control
10 From the water in fuel filter transmitter for visual warning on control panel
11 Free
12 Free

CONNECTOR J7 inside the engine interface box for signals to control panel

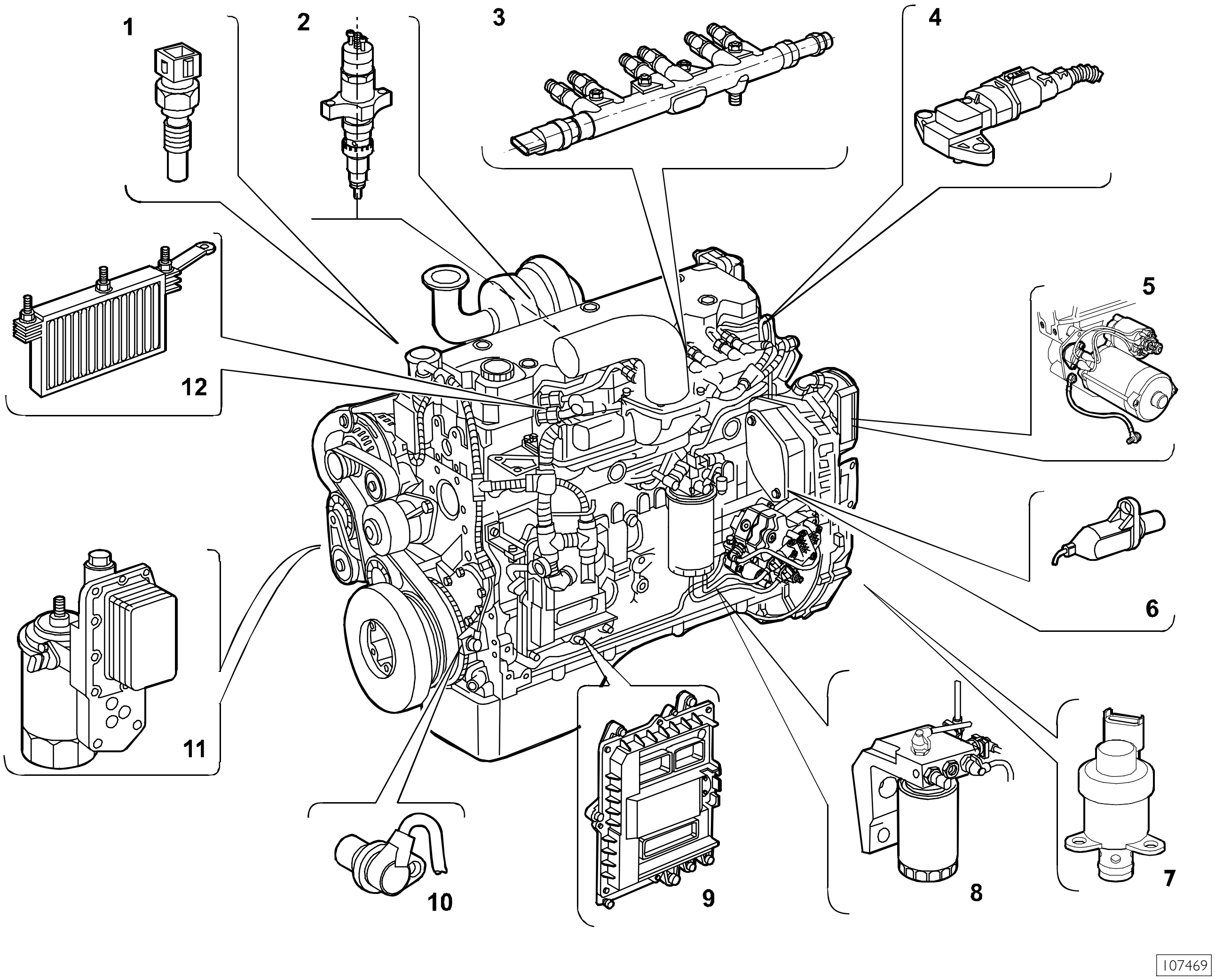
1 From the engine coolant high temp. thermostat (connector J2 - pin5) for visual signal on control panel
2 CAN line L to the control panel
3 Positive to power control panel
4 Negative to power control panel
5 CAN line H to the control panel
6 From the engine water heater thermostat (connector J2 - pin32) to the control panel
7 From the fuel level transmitter (connector J2 - pin7) for visual warning on control panel
8 From the no fuel transmitter (opt) (connector J2 - pin6)

CONNECTOR J9 inside the engine interface box

1 Cold start signal (option) if jumper JP3 set on 1-2
2 Cold start signal (option) if jumper JP3 set on 1-2
3 Cold start heater relay (option) if jumper JP4 set on 1-2
4 Cold start heater relay (option) if jumper JP4 set on 1-2
5 Free
6 Free
7 Coolant temperature check from ECU
8 Low oil pressure signal from ECU
9 Coolant temperature signal from ECU
10 Oil pressure check from ECU

EDC SYSTEM

Figure 33

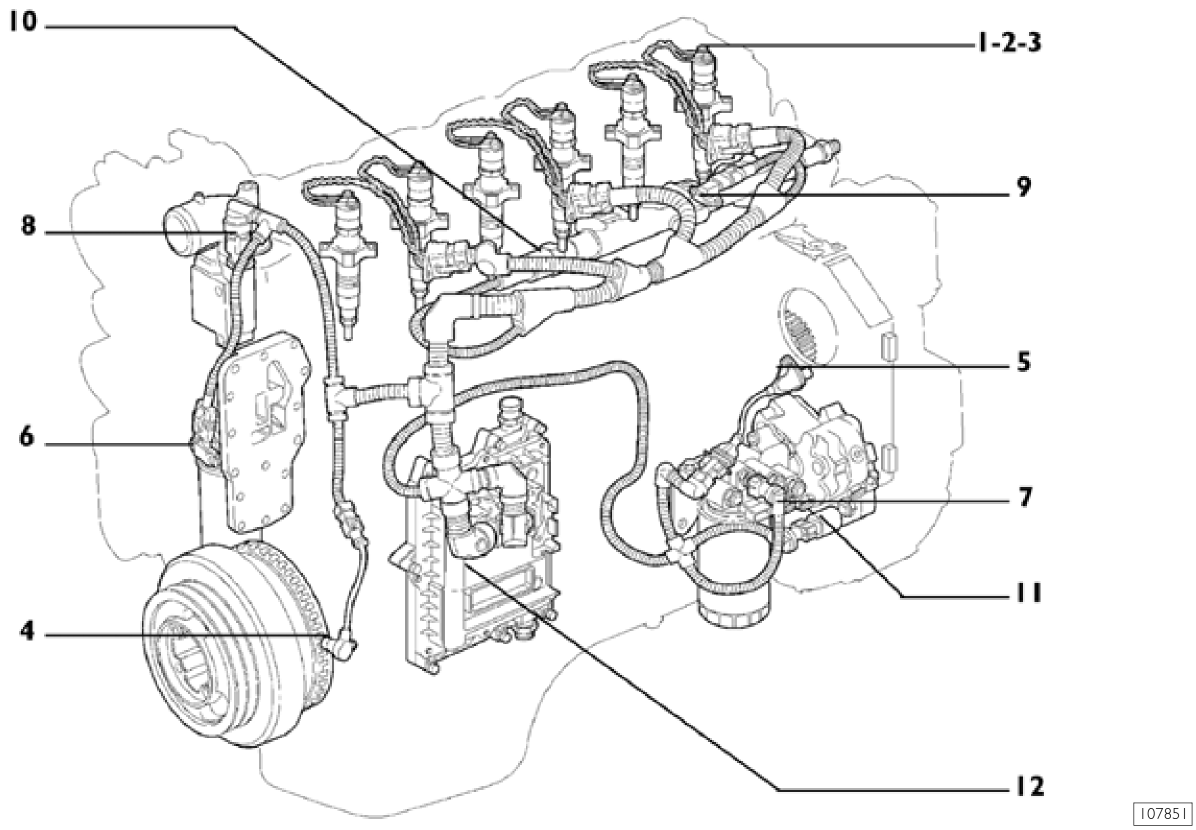


1. Coolant temperature sensor - 2. Electro-injector - 3. RAIL pressure sensor -
4. Air temperature/pressure sensor - 6. Timing sensor -
7. Solenoid valve for pressure regulator - 8. Fuel temperature sensor -
9. EDC electronic control unit - 10. Crankshaft sensor -
11. Engine oil pressure/temperature sensor - 12. Heating element for pre-post heating.

Print P4D32N001GB

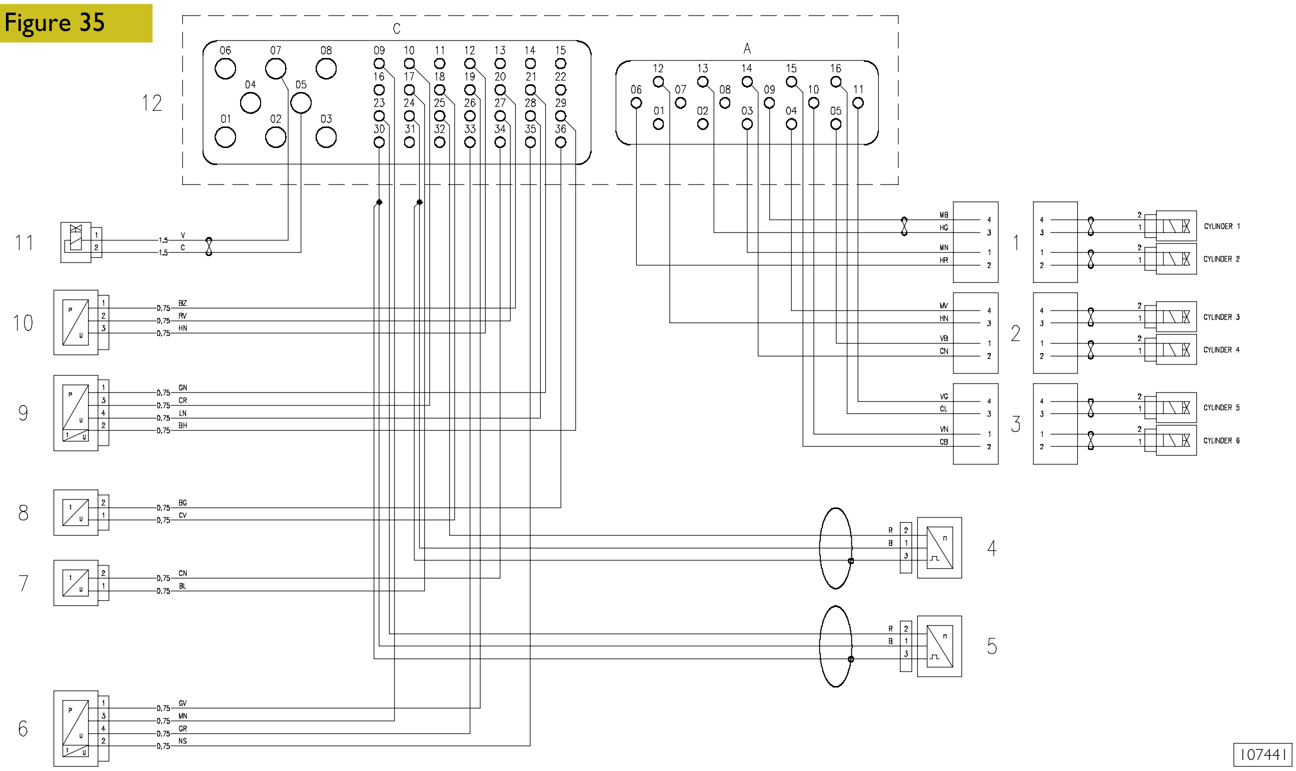
WIRING DIAGRAM ON ENGINE SIDE

Figure 34



1. Connection for cylinders 1 and 2 - 2. Connection for cylinders 3 and 4 - 3. Connection for cylinders 5 and 6 - 4. Engine speed sensor - 5. Pulse sensor on timing system - 6. Engine oil temperature and pressure sensor - 7. Diesel temperature sensor - 8. Engine water temperature sensor - 9. Turbocharging air temperature and pressure sensor - 10. Fuel pressure sensor (rail) - 11. Solenoid valve for fuel pressure regulator - 12. EDC electronic control unit.

Figure 35



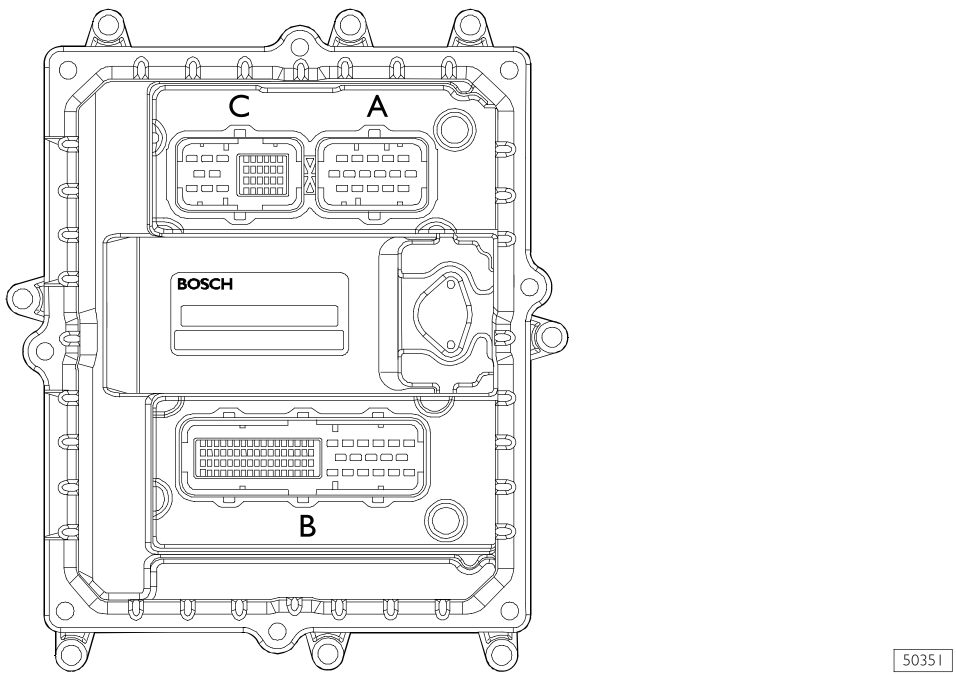
EDC CONTROL UNIT

It is fitted straight onto the engine via a heat exchanger to cool it, using rubber-type blocks that reduce the vibration transmitted by the engine.

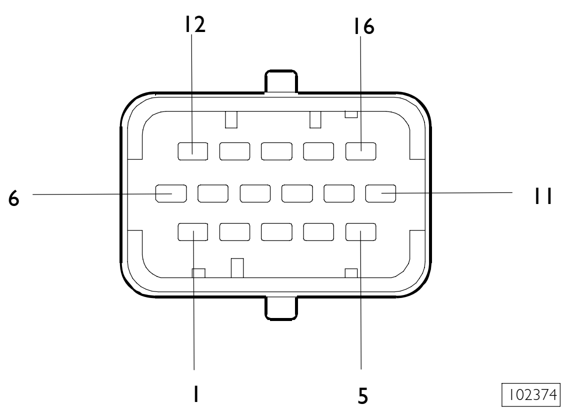
INJECTION CONTROL

Depending on the information from the sensors, the control unit governs the pressure regulator and varies pre-injection and the main injection. On Nef engines, pre-injection is active at any engine speed.

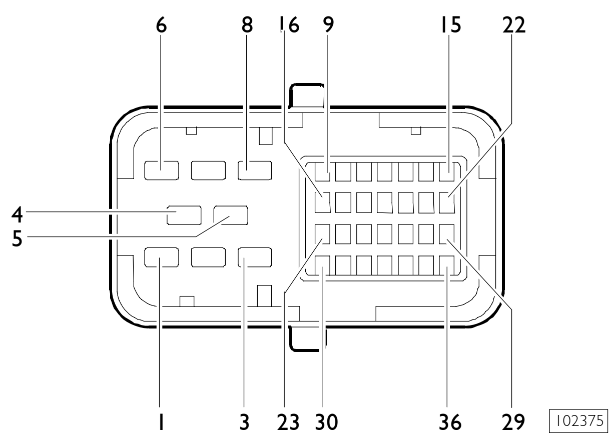
Figure 36



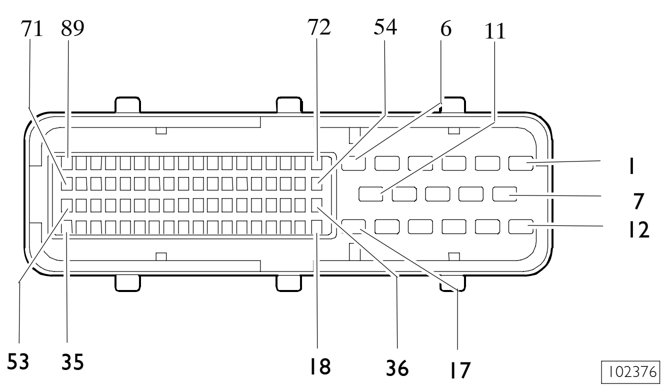
Electro-injector connector "A"



Sensor connector "C"

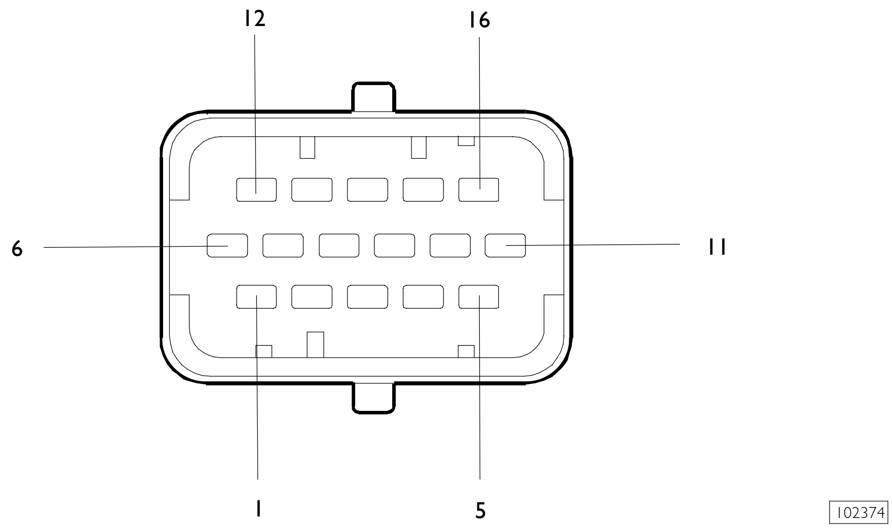


Connector "B"



Electro-injector connector "A"

Figure 37



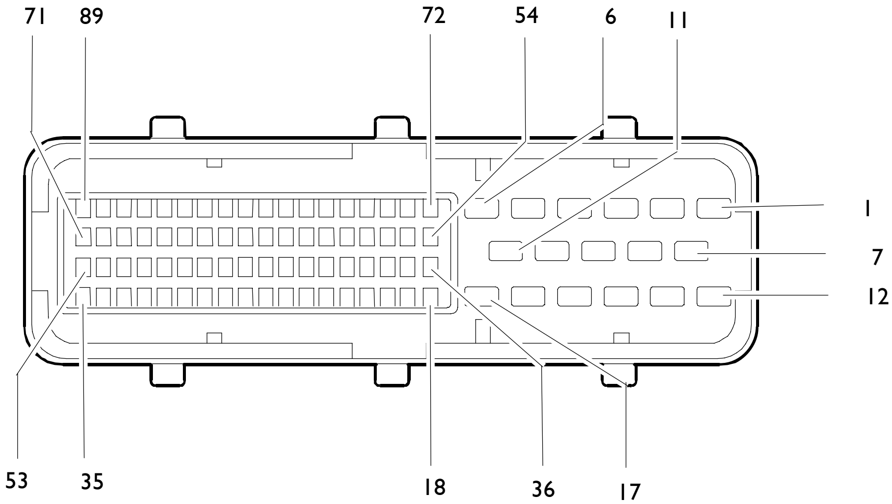
PIN	CABLE COLOUR	FUNCTION
1	-	-
2	-	-
3	MN	Cylinder injector 2
4	MV	Cylinder injector 3
5	VB	Cylinder injector 4
6	HR	Cylinder injector 2
7	-	-
8	-	-
9	MB	Cylinder injector 1
10	VN	Cylinder injector 6
11	VG	Cylinder injector 5
12	HN	Cylinder injector 3
13	HG	Cylinder injector 1
14	CN	Cylinder injector 4
15	CB	Cylinder injector 6
16	CL	Cylinder injector 5

Colours

B	WHITE	V	GREEN
R	RED	N	BLACK
L	BLUE	A	AZURE
H	GREY	W	HAZEL
M	BROWN	S	PINK
G	YELLOW		
C	ORANGE		

Connector (B) engine control EDC electronic control unit

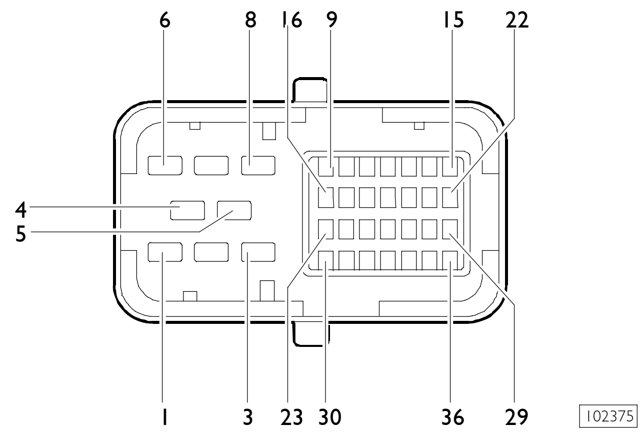
Figure 38



PIN-OUT	FUNCTION
1	Al J2 pin 13 of the interface box - Battery positive
2	To J2 pin 11 of the interface box - Negative for starting relay and diesel heating relay
3	Battery negative
4	To J2 pin 49 of the interface box - Positive for pre-heating cut-in relay
5	Free
6	To J2 pin 21 of the interface box - Engine water temperature signal
7	To J2 pin 41 of the interface box - Battery positive
8	To J2 pin 46 of the interface box - Key positive (+15)
9	Battery negative
10-11	Free
12	To J2 pin 14 of the interface box - Battery positive
13	To J2 pin 42 of the interface box - Battery positive
14	Battery negative
15	Battery negative
16	To J2 pin 50 of the interface box - Negative for pre-heating cut-in relay
17-19	Free
20	To J2 pin 2 of the interface box - Positive from key switch (+50) for starting phase engine
21-26	Free
27	To J2 pin 29 of the interface box - Positive from Blink-code request button
28	To J2 pin 23 of the interface box - Positive for visual indicator "BLINK-CODE"
29	Free
30	To J2 pin 26 of the interface box - To the diagnosis connector (line L - pin A)
31	To J2 pin 27 of the interface box - To the diagnosis connector (line K - pin B)
32	To J2 pin 25 of the interface box - Resistor module
33-35	Free
36	To J2 pin 40 of the interface box - Positive for diesel heating relay
37	To J2 pin 12 of the interface box - Positive for starting relay control
38	Free
39	To J2 pin 1 of the interface box - Key positive (+15)
40-45	Free
46	To J2 pin 48 of the interface box - Negative for pre-heating visual indicator
47	Free
48	To J2 pin 28 of the interface box - To the diagnosis connector (engine phase signal - pin F)
49	To J2 pin 54 of the interface box - To the diagnosis connector
50-51	Free
52	To J2 pin 55 of the interface box - To the diagnosis connector (CAN line L - pin D)
53	To J2 pin 56 of the interface box - To the diagnosis connector (CAN line H - pin C)
54-59	Free
60	To J2 pin 47 of the interface box - Key positive (+15)
61-62	Free
63	To J2 pin 24 of the interface box - Alarm signal for low engine oil pressure
64	To J2 pin 22 of the interface box - Negative for visual indicator "BLINK-CODE"
65	To J2 pin 51 of the interface box - Alarm signal for high engine water temperature
66	To J2 pin 52 of the interface box - Engine oil pressure signal
67-86	Free
87	To J2 pin 53 of the interface box - Resistor module
88-89	Free

Sensor connector "C"

Figure 39



PIN	CABLE COLOUR	FUNCTION
1-4	-	Not connected
5	C	Negative for pressure regulator
6	-	Not connected
7	V	Positive for pressure regulator
8	-	Not connected
9	MN	Positive for engine oil temperature/pressure sensor
10	CR	Positive for air temperature/pressure sensor
11	-	Not connected
12	HN	Positive for rail pressure sensor
13-16	-	Not connected
17	BL	Negative for fuel temperature sensor
18	CV	Negative for coolant temperature sensor
19	GV	Negative for engine oil temperature/pressure sensor
20	BZ	Negative for rail pressure sensor
21	GN	Negative for air pressure/temperature sensor
22	-	Not connected
23	R	Camshaft sensor (timing)
24	B	Engine shaft sensor (rounds)
25	R	Engine shaft sensor (rounds)
26	-	Not connected
27	RV	Signal form rail pressure sensor
28	LN	Signal from air pressure sensor
29	BH	Signal from air temperature
30	B	Camshaft sensor (timing)
31	-	Not connected
32	-	Not connected
33	GR	Signal from engine oil temperature sensor
34	CN	Positive from fuel temperature sensor
35	NS	Signal from engine oil pressure sensor
36	BG	Positive from coolant temperature sensor

Colours

		G	GREEN
B	BLACK	N	BROWN
U	BLUE	Y	YELLOW
W	WHITE	R	RED
P	CYAN	O	ORANGE

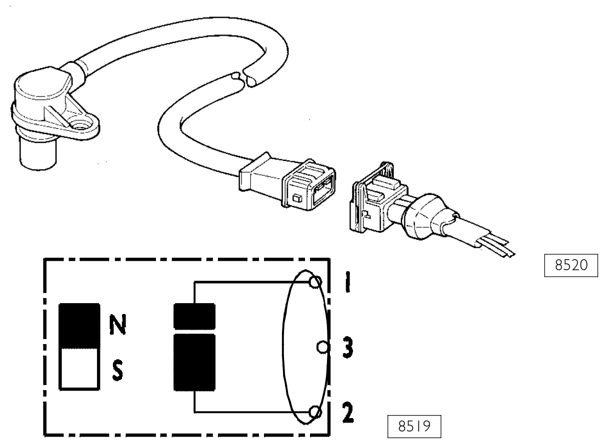
Engine speed sensor

This inductive sensor is located on the front left part of the engine.
It generates signals obtained from lines of magnetic flux that close through the openings of a phonic wheel keyed onto the crankshaft.

It is connected to the control unit on pins 25C - 24C.
The sensor resistance is ~ 900 Ohm.

- Supplier Bosch
- Tightening torque 8 ± 2 Nm

Figure 40



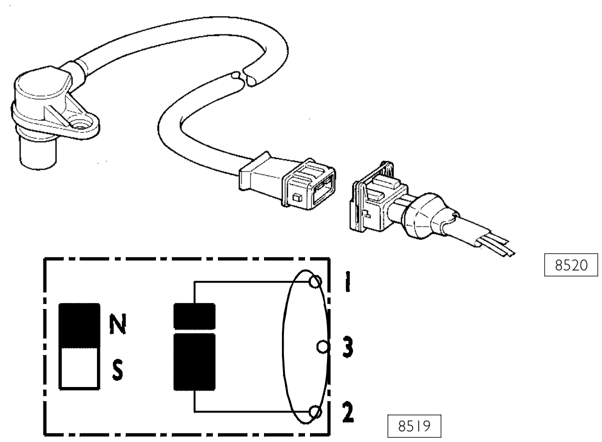
Pulse sensor on timing system

This inductive sensor is located on the rear left part of the engine.
It generates signals obtained from lines of magnetic flux that close through the holes of a gear keyed onto the camshaft.
The signal generated by this sensor is used by the electronic control unit as an injection phase signal.
While being the same as the crankshaft sensor it is NOT interchangeable since it has a different outer shape.

It is connected to the control unit on pins 23C - 30C.
The sensor resistance is ~ 900.

- Supplier Bosch
- Tightening torque 8 ± 2 Nm

Figure 41



Electro-injectors

It is a N/O solenoid valve.
They are connected to the EDC control unit on connector A.
The coil resistance of each single injector is 0.56 - 0.57 Ohm.
The construction of the injector is similar to that of conventional ones, except that
there are no needle return springs.
The electro-injector can be considered to comprise two parts:

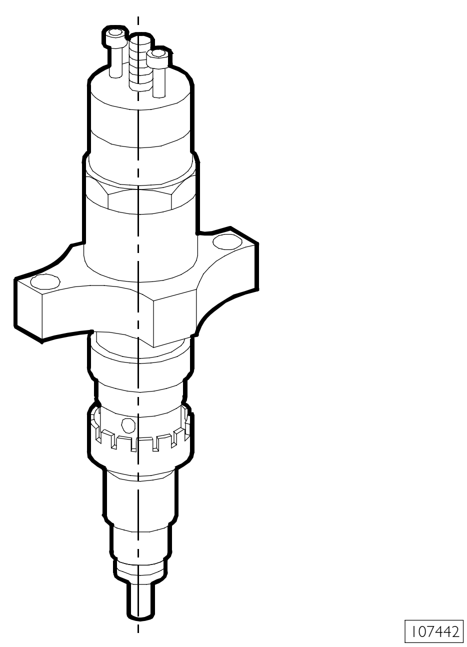
- actuator - nozzle composed of a pressure rod, needle and nozzle;
- control solenoid valve composed of coil and pilot valve.

The solenoid valve controls the lift of the needle of the nozzle.

INJECTION START
When the coil is energized, it causes the shutter to move upwards.
The fuel of the control volume flows out towards the backflow pipe, causing a drop in pressure in the control volume.
At the same time, the pressure of the fuel in the pressure chamber causes the needle to rise, with fuel getting injected into the cylinder as a result.

INJECTION END
When the coil is de-energized, the shutter goes back into its closed position to form such a balance of forces as to make the needle go back into its closed position and end injection.

Figure 42



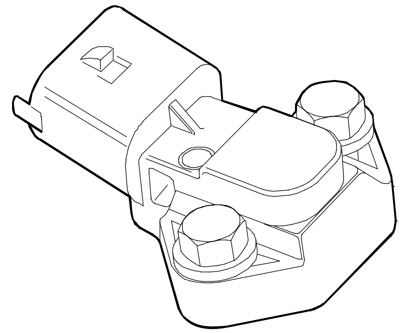
Oil pressure / oil temperature sensor

It is fitted on the engine oil filter in a horizontal position.
It measures the engine oil temperature and pressure.
The signal is sent to the EDC control unit.

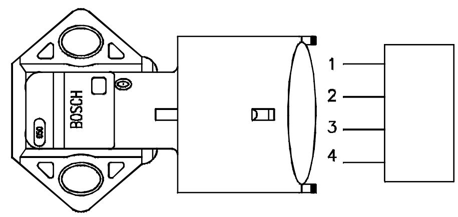
The engine oil temperature is used only by the EDC control unit.

It is connected to the control unit on pins 19C - 33C - 9C - 35C.
Pin 19/C - 35/C Temperature
Pin 9/C - 33/C Pressure

Figure 43



107443



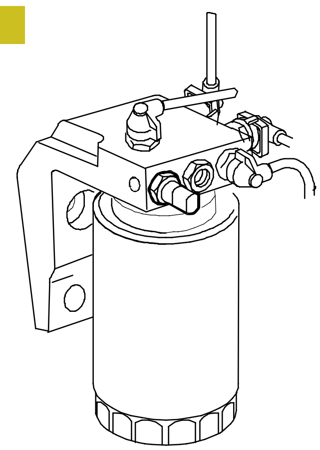
107444

Fuel temperature sensor

It measures the temperature of the fuel to give the control unit a pointer on the thermal state of the diesel.
The control unit pilots the control relay for heating the filter to a fuel temperature less than or equal to 36 °C.

It is connected to the control unit on pins 17C - 34C.
Its resistance at 20°C = 2.50 KOhm.

Figure 44



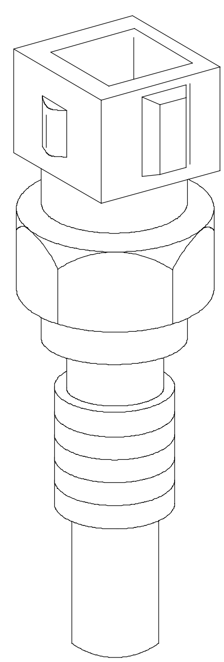
107488

Coolant temperature sensor

It is a variable resistance sensor able to measure the coolant temperature to give the control unit a pointer on the thermal state of the engine.
It is located at the top of the engine.

It is connected to the control unit on pins 18C - 36C.
Its resistance at 20 °C = 2.50 KOhm.

Figure 45



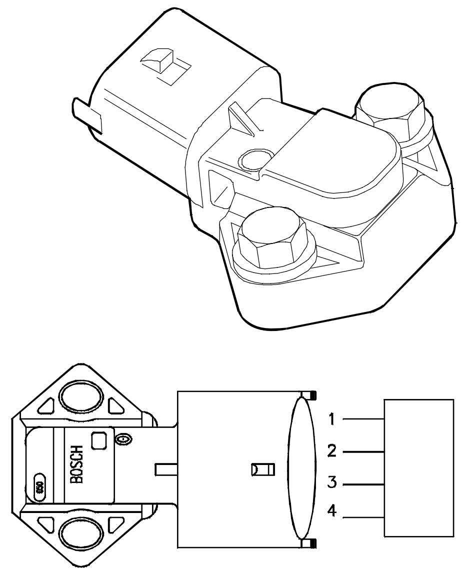
107471

Turbocharging air temperature and pressure sensor

This component integrates a pressure and a temperature sensor.
Fitted on the intake manifold, it measures the maximum flow rate of air introduced in order to accurately calculate the quantity of fuel to inject in each cycle.
The output voltage is proportional to the pressure or temperature measured by the sensor.
It is supplied at 5 Volts.

It is connected to the control unit on pins 21C - 29C - 10C - 28C.
Pin 21C - 29C Temperature
Pin 10C - 28C Pressure

Figure 46

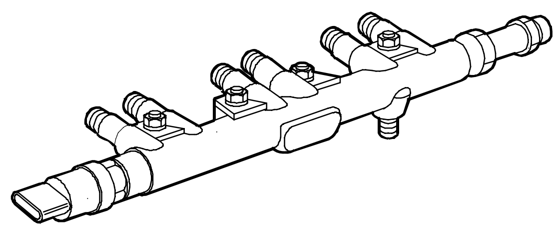


107443
107444

Fuel pressure sensor

Fitted on one end of the rail, it measures the existing fuel pressure in order to determine the injection pressure.
The injection pressure is used to control the pressure itself and to determine the duration of the electrical injection command.
It is supplied at 5 Volts.
It is connected to the control unit on pins 20C - 27C - 12C.

Figure 47



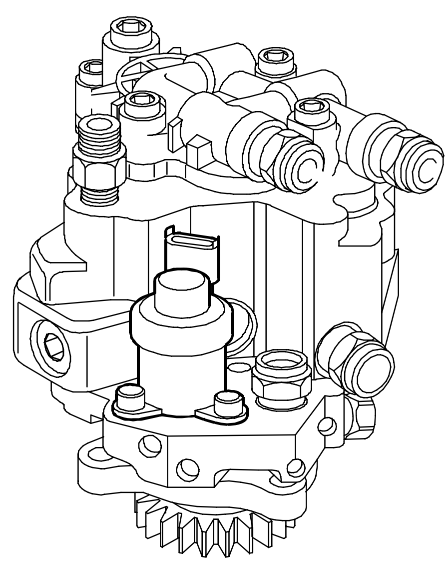
101638

Solenoid valve for fuel pressure regulator

Located at the high-pressure pump inlet, on the low-pressure system, it modulates the quantity of fuel with which to supply the high-pressure pump according to the commands received from the electronic control unit.

It is a N/O solenoid valve.
Its resistance is ~ 3.2 Ohm.
It is connected to the control unit on pins 5C - 7C.

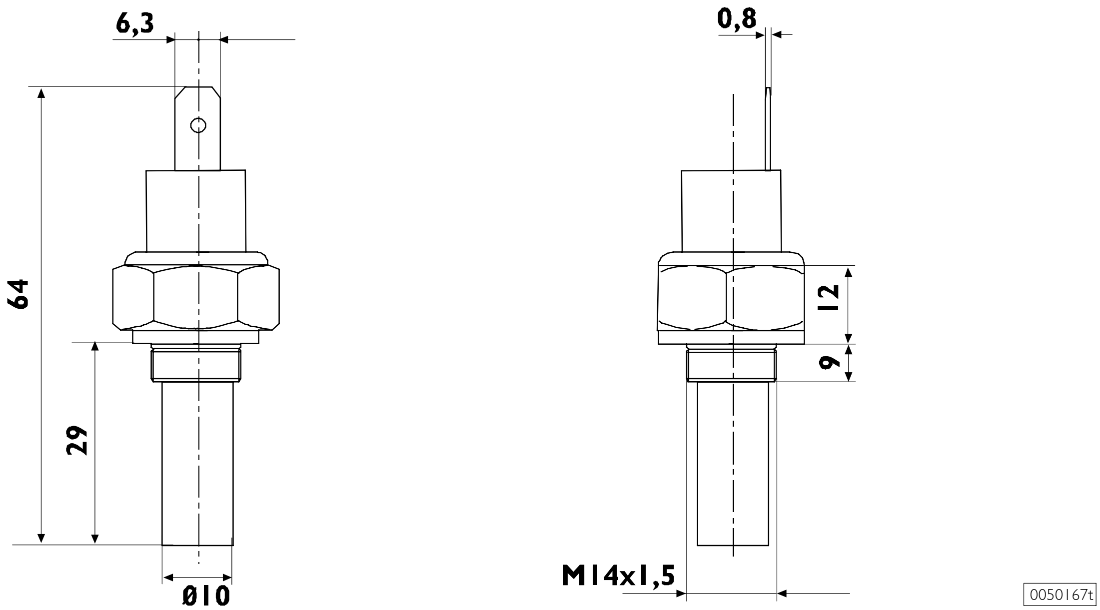
Figure 48



107470

SENSORS FOR INSTRUMENTS ON AUTOMATIC/MANUAL PANEL
High water temperature transmitter sensor (TATA)

Figure 49



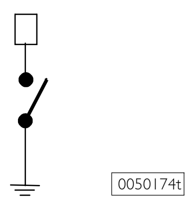
Note: measurements in mm

Technical data:

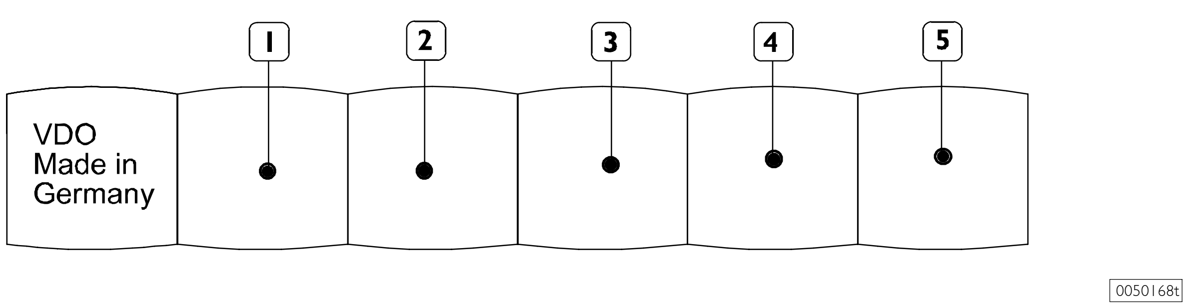
- Operating voltage: 6V ÷ 24V
- Trigger temperature 100 ± 3 °C
- Max temperature 160 °C
- Switch capacity: 3W max non-inductive

Wiring diagram:

Contact closed with temperature above the trip threshold.



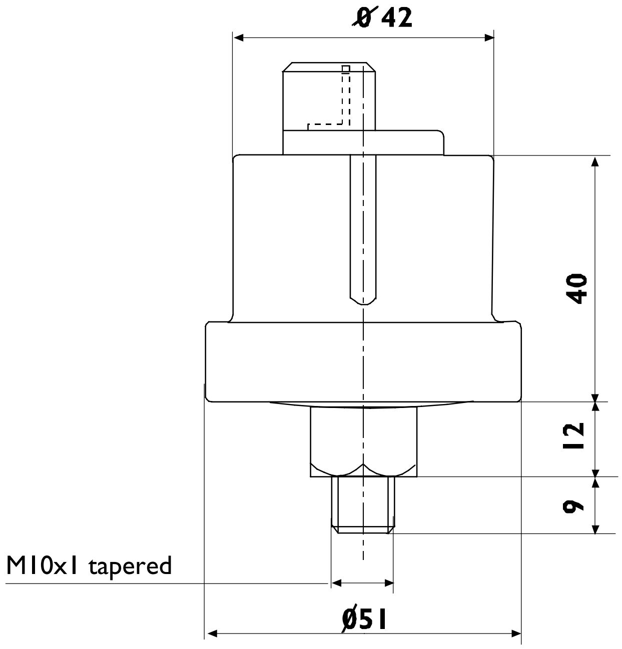
Stamping on hexagon:



1. VDO reference - 2. Calibration value - 3. Maximum working temperature - 4. Date of construction - 5. Electrical specifications.

Oil pressure transmitter (TPO)

Figure 50



Note: measurements in mm

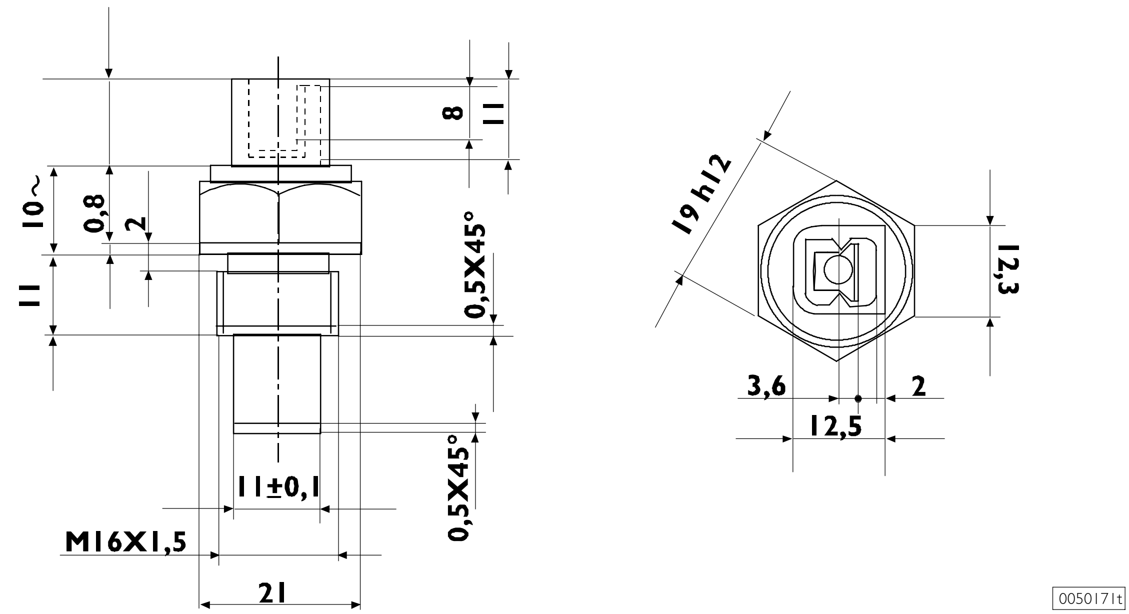
Operating voltage: from 12V to 24V
Setting: from 0 to 8 kg/cm^2
Table of transducer electrical specifications

0 bar - 259 Ohm
2 bar - 172 Ohm
4 bar - 106 Ohm
6 bar - 60 Ohm
8 bar - 32 Ohm

Print P4D32N001GB

Water temperature transmitter (TTA)

Figure 51

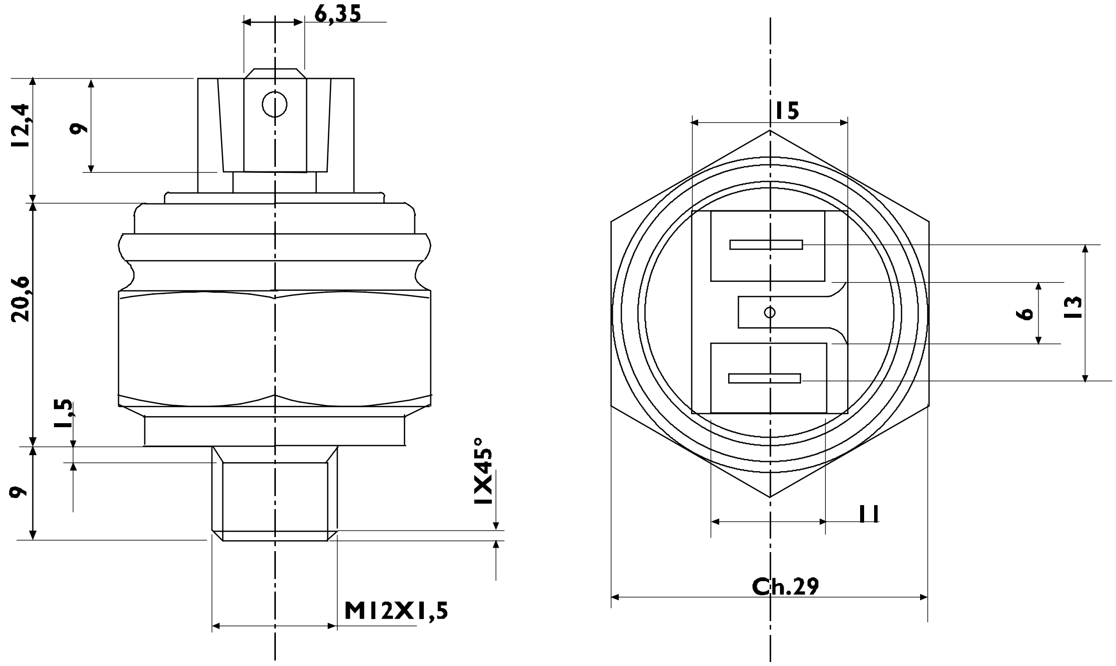


Sensor trend in relation to temperature:

T°C	Resist.	R mini	R Maxi
-40	84756.89	62760	108734
-35	60561.83	45563	75801
-30	43783.02	33403	54183
-25	31979.02	24728	39230
-20	23595.57	18477	28714
-15	17580.07	13932	21228
-10	13220.97	10596	15846
-5	10032.16	8126	11936
0	7678.16	6283	9074
5	5925.19	4895	6955
10	4608.79	3842	5375
15	3812.24	3038	4187
20	2851.93	2418	3288
25	2267.52	1938	2597
30	1815.08	1563	2067
35	1462.37	1288	1657
40	1185.68	1035	1338
45	968.98	850	1084
50	793.23	702	885
55	654.34	582	728
60	542.66	488	600
65	452.36	407	498
70	378.97	343	415
75	319.01	290	348
80	269.77	247	293
85	229.15	210	248
90	195.47	180	211
95	167.44	155	180
100	144.00	134	154
105	124.32	115	133
110	107.72	99	118
115	93.68	88	101
120	81.75	75	89
125	71.57	65	78
130	62.87	57	69
135	55.40	50	61
140	48.96	44	54
145	43.39	39	48
150	38.57	35	43

Oil pressure switch (TBPO)

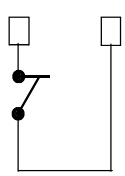
Figure 52



0050172t

Technical data:
Operating voltage: from 6V to 24V
Setting: from 0.5 to 0.8 bar
Closing pressure: 0.5 bar
Opening pressure: 0.8 bar
Switch capacity: 15 A non-inductive
Isolated pole transmitter

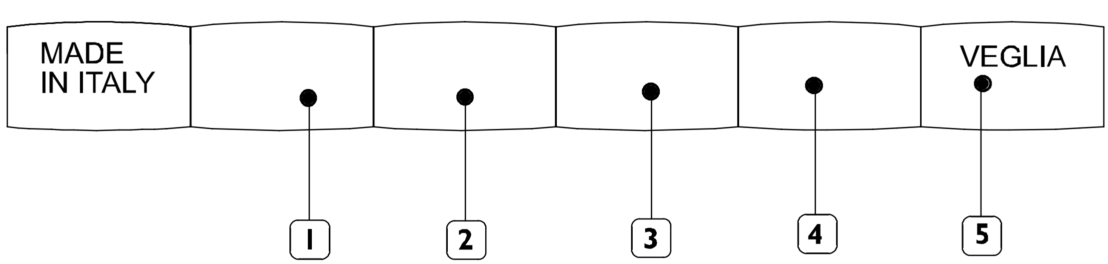
Wiring diagram:



N/C contact with engine stationary or oil pressure < 0.5 bar

0050175t

Stamping on hexagon:



0050173t

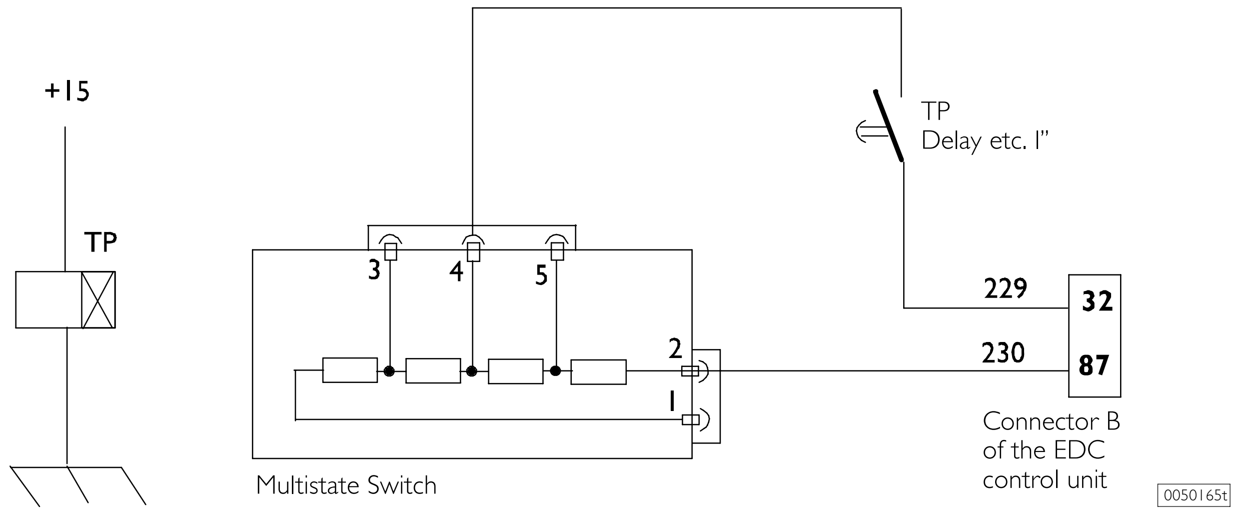
1. Class - 2. Customer classification - 3. Settings - 4. Customer abbreviation - 5. Date of construction.

Multistate Switch (M.S.S.) supplied by Iveco (Applications with no interface box)

Depending on the destination country it is possible to select the working frequency of the current generator (50/60 Hz) with an appropriate configuration of the Multistate Switch.

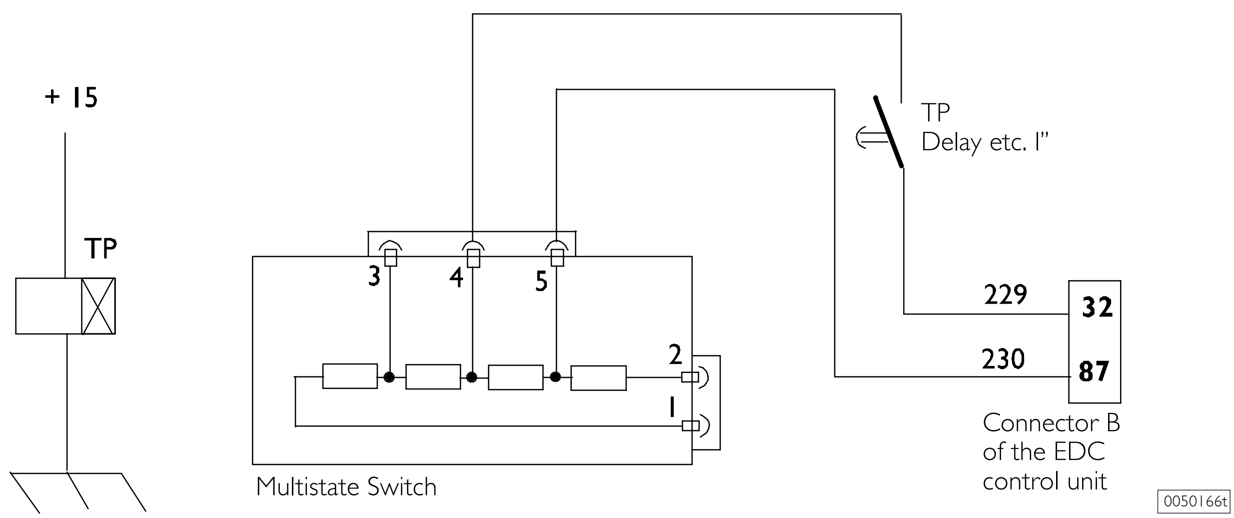
FOR CONFIGURATION 50 HZ

Figure 53



R between pin 2 and pin 4 = 1330 Ω

FOR CONFIGURATION 60 HZ



R between pin 4 and pin 5 = 820 Ω
TP = Timed Contactor

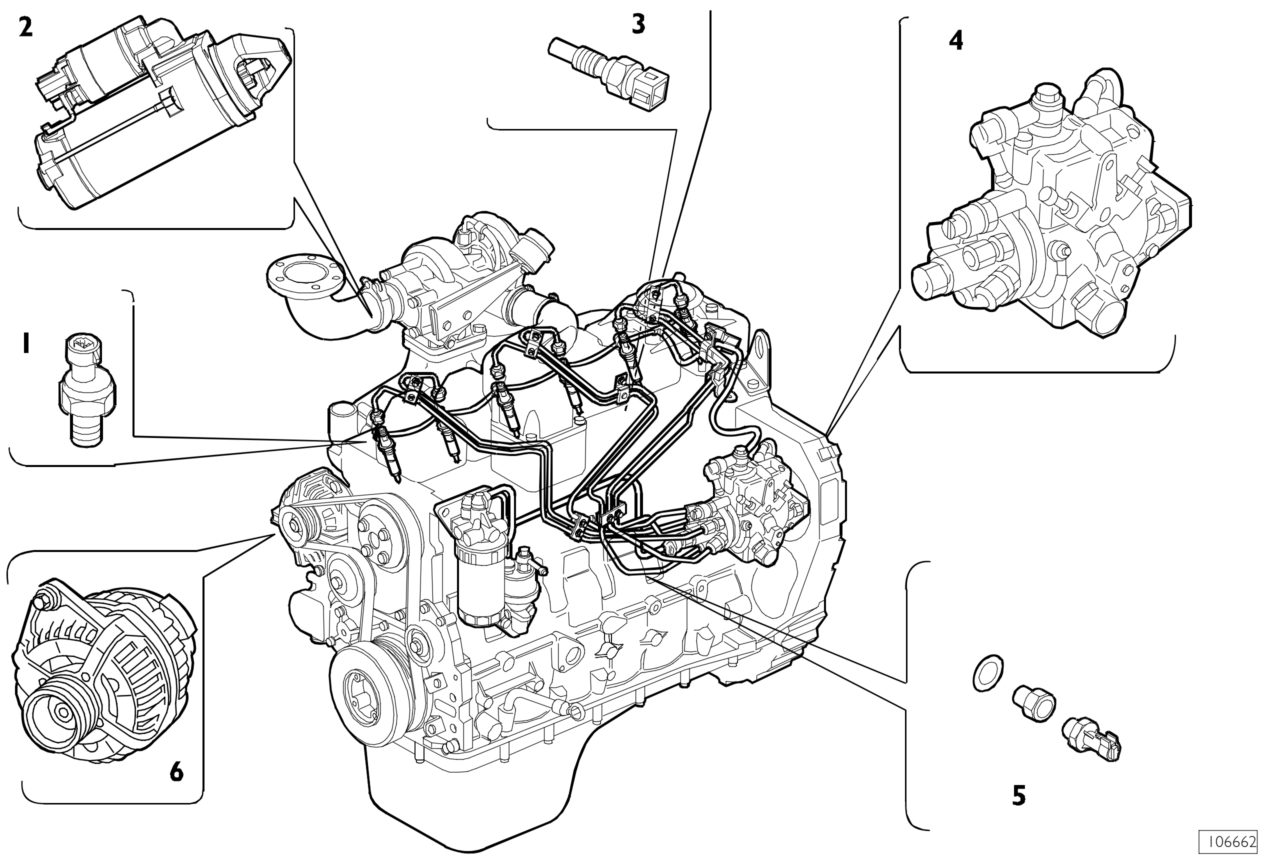
Note: When the operating frequency changes 50-60 Hz it is necessary to set the AVR (automatic voltage regulator) of the electrical machine appropriately.

Power switch

Inserted in the electric panel. It must be regulated according to the Imax current delivered. The maximum current delivered by the electric machine depends on the selected working frequency 50-60 Hz.

ELECTRICAL COMPONET LAYOUT (6 CYL. ENGINES WITH ROTARY PUMP) GENEF

Figure 54

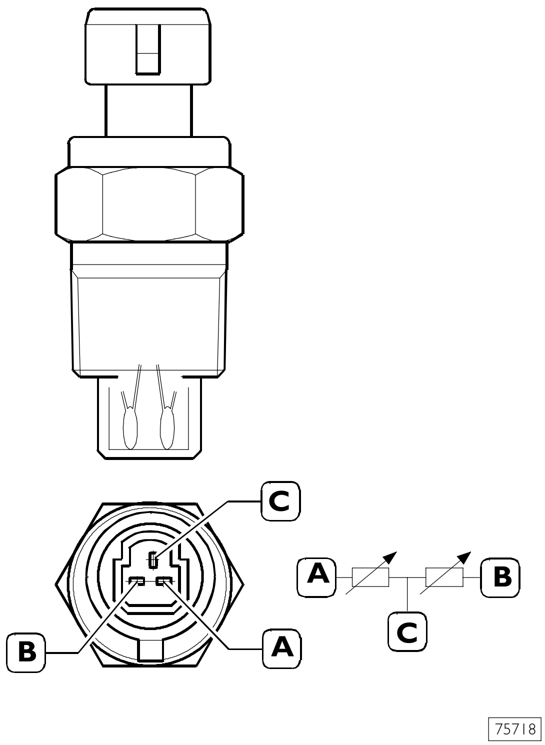


Below there are listed the electric components which are present on NEF F4GE engines.

1. Cooling liquid temperature sensor;
2. Starter;
3. Injection pump water temperature sensor;
4. Magnets mounted on feed pump:
5. Oil pressure sensor;
7. Alternator.

Cooling liquid temperature sensor

Figure 55



It is a component integrating a temperature sensor.

It is assembled to the engine head close to the thermostat unit and its duty is to detect engine cooling liquid temperature.

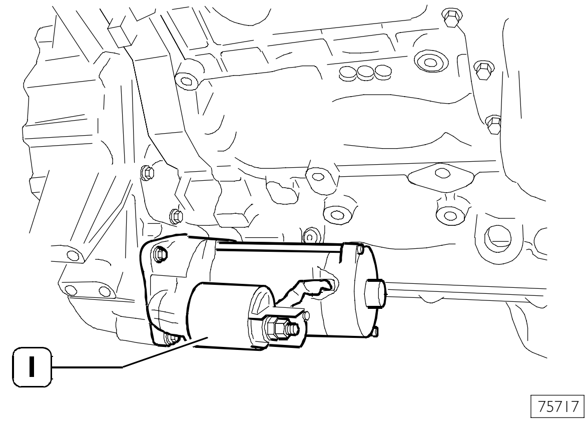
Specifications:

Range of working temperatures:

Connection side	-40 ÷ +150 °C for < 10 min.
Bulb side on engine:	-40 ÷ +140 °C
Working tensions:	6 ÷ 28 V
Settings:	
80 °C	0.304 ÷ 0.342 kΩ
20 °C	2.262 ÷ 2.760 kΩ
-10 °C	8.244 ÷ 10.661 kΩ

Starter

Figure 56



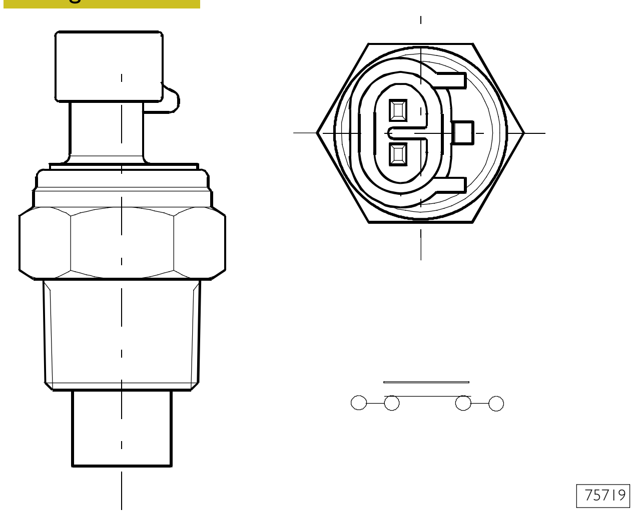
Starter is usually driven by starting unit placed on the vehicle dashboard and provides positive tension to the tele-switch assembled to the starter itself.

Specifications:

BOSCH 4 kW - 24V

Injection pump water temperature sensor

Figure 57



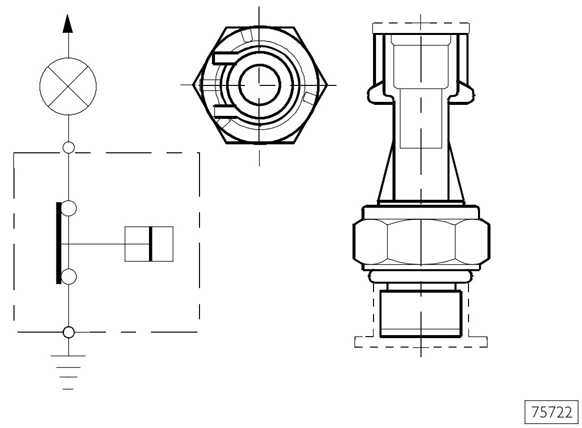
It is assembled to the cylinder head on the engine left hand side.

Specifications:

Working tensions:	12 ÷ 24 V
Electrical Power load:	2.5 A (induction) 5.0 A (resistance)
Setting:	32±2 °C Contact opening upon increasing temperature 22±2 °C Contact closure upon decreasing temperature

Oil pressure sensor

Figure 58



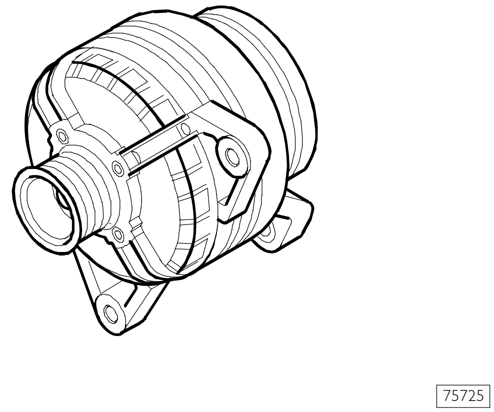
It is assembled to the block on the engine's left hand side.

Specifications:

Working tensions:	12 ÷ 24 V
Contact closure upon lower pressure:	0.2 bar
Contact opening upon higher pressure:	0.9 bar

Alternator

Figure 59



It is place front view on the right hand side of the engine, and is driven by tooth belt.

Specifications:

Rated tensions:	24 V
Current delivered:	90A (at 6000 rpm)
Absorption in stand-by:	≤ 1mA
Sense of rotation:	clockwices

Print P4D32N001GB

SECTION 2

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.

The GUIDELINE is composed of three different parts:

- ❑ Blink Code, relating to the anomalies identified by the gearbox, mainly of electric and electrical nature;
- ❑ Troubleshooting guide using PT-01 portable tester. Tool identified as IVECO p/n 8093731.
- ❑ Guideline for troubleshooting without blink code, divided per symptoms, describing all possible anomalies not detected by the electronic gearbox, often of mechanical and hydraulic nature.

NOTE 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.

METHODS OF DIAGNOSIS

The available diagnosis systems are currently:

- ❑ BLINK CODE
- ❑ PT-01
- ❑ SYMPTOMS

Blink code

This is the preliminary information that the electronic control unit gives the operator (with a blink code) about any trouble with the system.

The blink-code test button, blink-code signal request button and 19 pole connector for the PT-01 instrument are integrated in the interface box.

PT-01

Figure 1

1. Connector with 19-pin diagnosis socket - 2. LED signalling communication between the instrument - control unit and correct power supply - 3. USB indicator light - 4. Serial port indicator light - 5. Power supply connector (power only to update SW with serial port).

DIAGNOSIS WITH BLINK CODE

EDC indicator light behaviour
After turning the key selector onto "ON" the EDC indicator light will come on; afterwards, if no trouble is found, the EDC indicator light must go out.
Depending on whether there is any trouble, the indicator light may behave as follows:

Indicator light off

1. No fault
2. Slight trouble

performance not affected
fault detectable with BLINK CODE and diagnostic instrumentation.

Indicator light on steady

1. Serious fault

fault detectable with BLINK CODE or diagnostic instrumentation

Indicator light blinking

2. Very serious fault

In many cases, switching off the engine
fault detectable with BLINK CODE or diagnostic instrumentation.

BLINK CODE activation / reading

The blink code is activated by pressing the BLINK CODE button inside the interface box.
The BLINK CODE identifies one problem at a time without distinguishing between present and intermittent faults. To display all the codes in memory you need to activate the BLINK CODE button several times.
The code is composed of two digits and is displayed with slow blinks followed by fast blinks.
If there are no faults in the system, the EDC indicator light will give no information and come on just once.
Each time the key is turned "ON", the EDC indicator light has to come on; if this does not occur, check the wiring and indicator light.

IMPORTANT

The operations of removing and refitting the control unit must be performed with the positive pole of the battery disconnected.

EDC BLINK-CODE

Blink-Code	Description of anomaly	Power reduction
	ENGINE 1	
2.1	Signal from cooling liquid temperature sensor	-
2.2	Signal from air temperature sensor, boosting	-
2.3	Signal from fuel temperature sensor	-
2.4	Signal form sensor of pressure boosting	-
2.5	Signal from atmospheric pressure sensor	-
2.6	Signal from oil pressure sensor	-
2.7	Signal from oil temperature sensor	-
2.8	Signal from heated filter driving relé	-
2.9	Signal from pre-post heating resistor driving relé	-
	ENGINE 2	
3.7	Battery tension	-
3.8	Alert led pre-post heating	-
3.9	Pre-post heating resistor	-
	INJECTORS (6 cylinders)	
5.1	Electro-valve injector of cylinder 1	X
5.2	Electro-valve injector of cylinder 2	X
5.3	Electro-valve injector of cylinder 3	X
5.4	Electro-valve injector of cylinder 4	X
5.5	Electro-valve injector of cylinder 5	X
5.6	Electro-valve injector of cylinder 6	X
5.7	Power stage 1 (cylinders 1-2-3)	X
5.8	Power stage 2 (cylinders 4-5-6)	X

X = Power reduction

Blink-Code	Description of anomaly	Power reduction
	ENGINE RUNNING	
6.1	Signal from engine driving shaft sensor	-
6.2	Signal from camshaft sensor	-
6.4	Engine runaway speed rate	XX
6.5	Relé of the starter	-
6.6		-
	FUEL PRESSURE	
8.1	Control fuel pressure	X
8.2	Fuel pressure signal	X
8.3	Pressure regulating electro-valve	X
8.4	Intervention to double stage boosting valve	X
8.5	Rail Min/Max pressure failure	X
	EDC	
9.4	Main relè	-
9.6	Gearbox disconnection procedure	-
9.7	Sensor feed	-

X = Power reduction
XX = Engine disconnection

Procedure for failure memory clear by Blink Code key

Key change over switch in OFF position.
Keep the Blink Code key pressed for 4 to 8 seconds after turning the key change over switch in ON position.
Wait at least for 10 seconds before switching off the key change over switch.

TROUBLESHOOTING

Software release 4.1_2

Note: The EDC indicator light condition refers to an OCCURRED error

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
1.2	Not used	Not used	Not used	Not used	Not used
2.1	On	Water temperature sensor shorted or circuit open		Measurable parameter readout: with this error, the water temperature read on the control unit will be the same as the engine oil. Using a multimeter, check the integrity of the sensor (R = approximately 2.5 kOhm at 20 °C) between its pins 1 and 2 If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C18, between the sensor connector (wiring side) pin 2 and the EDC connector pin C36.	
2.2	Off	Air temperature sensor on intake manifold shorted or circuit open		Measurable parameter readout with the diagnosis instrument: with this error, the turbocharging air temperature will be fixed on 30 °C. If the temperature is fixed on 30 °C, check the integrity of the sensor (R = approximately 2.5 kOhm at 20 °C) its pins 1 and 2. If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C21, between the sensor connector (wiring side) pin 2 and the EDC connector pin C29.	The temperature sensor is integrated with the pressure sensor.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
2.3	Off	Fuel temperature sensor shorted or circuit open.		Measurable parameter readout: with this error, the fuel temperature will be fixed on 20 °C. Check the integrity of the sensor (R = approximately 2.5 kOhm at 20 °C). If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C17, between the sensor connector (wiring side) pin 2 and the EDC connector pin C34.	
2.4	On	Air pressure sensor on intake manifold shorted or circuit open.		Measurable parameter readout with the diagnosis instrument: with this error, the turbocharging pressure will be fixed on 1600 mbar. Check the wiring between the sensor connector (wiring side) pin 3 and the EDC connector pin C10, between the sensor connector (wiring side) pin 4 and the EDC connector pin C28.	The pressure sensor is integrated with the temperature sensor. If the electrics are in order, check the turbocharger wastegate valve works properly.
2.5	Off	Ambient pressure sensor shorted or circuit open.		Measurable parameter readout with the diagnosis instrument: with this error, the turbocharging pressure will be fixed on 970 mbar Call the Help Desk and follow their instructions to replace the control unit, if necessary.	The sensor is integrated in the EDC control unit and cannot be changed on its own. Any painting of the engine/control unit can jeopardize the measurement of the ambient pressure.

Print P4D32N001GB

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
2.6	On	Oil pressure sensor shorted or circuit open.		Measurable parameter readout with the diagnosis instrument: with this error, the oil pressure will be fixed on 60 mbar. Check the wiring between the sensor connector (wiring side) pin 3 and the EDC connector pin C9, between the sensor connector (wiring side) pin 4 and the EDC connector pin C35.	The pressure sensor is integrated with the temperature sensor.
2.7	On	Oil temp. sensor shorted or circuit open.		Measurable parameter readout: with this error, the engine oil temperature will be fixed on 120 °C. Check the integrity of the sensor (R = approximately 2.5 kOhm at 20 °C). If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector C19, between the sensor connector (wiring side) pin 2 and the EDC connector pin C33.	If the oil temperature is too low, immediately after starting, engine speed is limited according to the oil temperature (engine protection strategy).
2.8	Off	Fuel filter heater relay defective (optional).	a) Heater always on. The batteries run down. b) Heater never turns on. Possible filter clogging due to fuel paraffining with very low outside temperatures (< -15 °C).		a) Possibly saving 2.3 because the fuel heats up too much

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
2.9	On	Pre-post heating element control relay defective.	a) The pre/post-heating elements are not powered, cold starting may be difficult and smokiness on starting. b) The pre/post-heating element is always powered: early deterioration of the heating element, the batteries quickly run down.	Diagnosis active. Check the wiring between the relay pin 85 and EDC connector pin B4, between the relay pin 86 and EDC connector pin B36.	
3.1	Not used	Not used	Not used	Not used	Not used
3.2	Not used	Not used	Not used	Not used	Not used
3.3	Not used	Not used	Not used	Not used	Not used
3.4	Not used	Not used	Not used	Not used	Not used
3.5	Not used	Not used	Not used	Not used	Not used
3.6	Not used	Not used	Not used	Not used	Not used
3.7	On (software release for single-stage valve). Off (software release for twin-stage valve).	Battery voltage signal too low		Measurable parameter readout to check the battery voltage. Make the appropriate checks on the voltage regulator, batteries and recharging system.	The voltage might not actually be too low, but the control unit might recognize it as such.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
3.8	Off	Pre-heating indicator lamp shorted or defective (optional).	a) Pre-heating indicator light always on. b) Pre-heating indicator light always off.	Perform active diagnosis with the diagnosis instrument. If the result is negative, check the integrity of the indicator light module. If the indicator light module is integral, check the wiring between the indicator light module pin 14 and the EDC connector pin B46 passing through the bulkhead connector B pin 19.	Cold starting may be difficult because pre-heating works but no feedback is obtained from the indicator lamp.
3.9	On	Pre/post-heating procedure monitoring (optional).	Possible smokiness after starting.	Check that the cables are firmly secured to the terminals of the pre/post-heating element. Check the integrity of the pre/post-heating element (R = approximately 0.5 Ohm). Check the wiring and connections between the contactor of the pre/post-heating element pin 87 and the (+) terminal of the heating element, passing through the bulkhead connector E pin 40. Check the wiring and connections between the (–) terminal of the heating element and earth.	The control unit does not detect the increase in temperature resulting from the operation of the heating element (via the air temperature sensor in the intake manifold).
4.2	Not used	Not used	Not used	Not used	Not used
4.3	Not used	Not used	Not used	Not used	Not used
4.4	Not used	Not used	Not used	Not used	Not used
4.5	Not used	Not used	Not used	Not used	Not used

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
5.1	On	Electrical part of injector cylinder no. 1 shorted or circuit open.	The engine runs on 3 (5) cylinders.	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 1 pin 3 and 4 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 1 pin 3 and the EDC connector pin A13, between cylinder head connector 1 pin 4 and the EDC connector pin A9.	Immediately afterwards the engine might keep on turning on 2 (3) cylinders as the injectors are controlled by two power stages. In this case error 5.7 could be saved to memory too.
5.2	On	Electrical part of injector cylinder no. 2 shorted or circuit open.	The engine runs on 3 (5) cylinders.	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 1 pin 1 and 2 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 1 pin 1 and the EDC connector pin A3, between cylinder head connector 1 pin 2 and the EDC connector pin A6.	Immediately afterwards the engine might keep on turning on 2 (3) cylinders as the injectors are controlled by two power stages. In this case error 5.7 (6 cylinders) or 5.8 (4 cylinders) could be saved to memory too.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
5.3	On	Electrical part of injector cylinder no. 3 shorted or circuit open.	The engine runs on 3 (5) cylinders.	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 2 pin 3 and 4 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 2 pin 3 and the EDC connector pin A12, between cylinder head connector 2 pin 4 and the EDC connector pin A4.	Immediately afterwards the engine might keep on turning on 2 (3) cylinders as the injectors are controlled by two power stages. In this case error 5.7 (6 cylinders) or 5.8 (4 cylinders) could be saved to memory too.
5.4	On	Electrical part of injector cylinder no. 4 shorted or circuit open.	The engine runs on 3 (5) cylinders.	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 2 pin 1 and 2 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 2 pin 1 and the EDC connector pin A5, between cylinder head connector 2 pin 2 and the EDC connector pin A14.	Immediately afterwards the engine might keep on turning on 2 (3) cylinders as the injectors are controlled by two power stages. In this case error 5.7 (4 cylinders) or 5.8 (6 cylinders) could be saved to memory too.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
5.5	On	Electrical part of injector cylinder no. 5 shorted or circuit open.	The engine runs on 5 cylinders.	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 3 pin 3 and 4 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 3 pin 3 and the EDC connector pin A16, between cylinder head connector 3 pin 4 and the EDC connector pin A11.	Immediately afterwards the engine might keep on turning on 3 cylinders as the injectors are controlled by two power stages. In this case error 5.8 could be saved to memory too
5.6	On	Electrical part of injector cylinder no. 6 shorted or circuit open.	The engine runs on 5 cylinders	Check that the cable retaining nuts on the solenoid valve of the injector are correctly tightened to a torque of 1.5 Nm. Check the continuity and resistance of the injector solenoid valve (R = approximately 0.5 Ohm). If the solenoid valve is integral, check the wiring on the cylinder head between connector 3 pin 1 and 2 and the electro-injector. If the cylinder head wiring is integral, check the engine cable between cylinder head connector 3 pin 1 and the EDC connector pin A10, between cylinder head connector 3 pin 2 and the EDC connector pin A15.	Immediately afterwards the engine might keep on turning on 3 cylinders as the injectors are controlled by two power stages. In this case error 5.8 could be saved to memory too.

Print P4D32N001GB

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
5.7	On	Power stage for the electro-injectors of cylinders 1-4 (4 cylinder engine) or 1-2-3 (6 cylinder engine) defective.	The engine runs on 2 (3) cylinders.	Delete the fault memory and try again. If the error remains, <u>and only after excluding the injector defect (see note 5.x)</u>, call the Help Desk and follow their instructions to replace the control unit, if necessary.	
5.8	On	Power stage for the electro-injectors of cylinders 2-3 (4 cylinder engine) or 4-5-6 (6 cylinder engine) defective.	The engine runs on 2 (3) cylinders.	Delete the fault memory and try again. If the error remains, <u>and only after excluding the injector defect (see note 5.x)</u>, call the Help Desk and follow their instructions to replace the control unit, if necessary.	
6.1	On	Crankshaft sensor: no signal or signal not plausible.	High reduction in power on the software version for engine with single-stage pressure relief valve. Slight reduction in power on the software version for engine with twin-stage pressure relief valve.	Check the sensor is clean and correctly secured. Check the phonic wheel is clean and integral. Check the integrity of the sensor (R = approximately 920 Ohm). If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C25, between the sensor connector (wiring side) pin 2 and the EDC connector pin C24.	Error 6.1 is always associated with 6.3. The engine fails to start because after a few turns the control unit turns off the starter motor.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
6.2	On	Camshaft sensor: no signal or signal not plausible.	Starting difficult in all conditions. False injections and smokiness at exhaust during starting. Slight reduction in power on the software version for engine with single-stage pressure relief valve.	Check the sensor is clean and correctly secured. Check the integrity of the sensor (R = approximately 890 Ohm). If the sensor is integral, check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C23, between the sensor connector (wiring side) pin 2 and the EDC connector pin C30.	This error is always associated with 6.3
6.3	On	No plausibility between the signals of the flywheel sensor and the camshaft sensor.	Slight power reduction.	Fault memory reading: check the ambient conditions associated with this error. If the error has been saved with engine speed under 650 rpm, delete the fault memory and resolve the vehicle. On the contrary, check the integrity of the damper flywheel and of the phonic wheel on the crankshaft, the cleanliness and correct fixing of the two sensors.	Sometimes only error 6.3 is saved to memory whereas in actual fact the camshaft signal is defective. In this case, run the checks prescribed to resolve problem 6.2 This error could occasionally get saved if the engine is switched off with the button under the cab. If the damper flywheel has deteriorated, it will be locally buckled and, if the joining areas of the enclosure have started to give, in the surrounding area there will be traces of silicone. Check that there are no strips of adhesive tape on the phonic wheel and that it turns with no axial oscillation due to impact deformation.
6.4	Blinking	Engine overspeed.	Engine cuts out (only on the software version for engine with single-stage pressure relief valve).	Flight Recorder (Saved Data) readout to ascertain the extent and frequency of the phenomenon.	Make the driver aware of how to drive correctly.

Print P4D32N001GB

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
6.5	On	Relay for starter motor shorted or circuit open.	Impossible to start the engine. If it is already running, it cuts out.	Check the integrity of the component. Check the wiring between the relay and EDC connector pin B37.	
6.6	Off	Rev counter signal shorted or circuit open.	The rev counter does not work.	Check the wiring between pin 3 of the instrument and EDC connector pin B49.	
6.8	Off	Synchronization signal from EDC to the diagnosis instrument shorted or circuit open.		Check the integrity of the wiring between EDC connector pin B48 and diagnosis socket pin 23 passing through the brown bulkhead connector B pin 11.	
7.2	Off	CAN line		Check the wiring, connections and closing resistance (120 ohm) of the CAN line.	
7.3	Not used	Not used	Not used	Not used	Not used
7.4	Not used	Not used	Not used	Not used	Not used
7.6	Off (optional)	Low engine oil pressure warning light signal shorted or circuit open.	The warning light does not work or is always on.	Check the integrity of the indicator light between pins 2 and 4 of the oil pressure instrument. If the warning light is integral, check the wiring between pin 2 of the instrument and EDC connector pin B63 passing through the brown bulkhead connector B pin 17.	

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
7.8	Off (optional)	High engine coolant temperature warning light signal shorted or circuit open.	The warning light does not work or is always on.	Check the integrity of the indicator light between pins 1 and 4 of the temperature instrument. If the warning light is integral, check the wiring between pin 1 of the instrument and EDC connector pin B65 passing through the brown bulkhead connector B pin 15.	
8.1	Blinking	Fuel pressure adjustment: the pressure in the rail is lower or greater than that calculated by the control unit.	Considerable power reduction.	(with release 2-2001 and later): in normal conditions, at idling with no load and the engine warm, this value must be approximately 5% lower. If this value is higher, make the following checks.	
8.1	Blinking	a) Fuel suction tube in the tank partially blocked by debris or buckling due to overheating		Check whether the priming pump on the pre-filter works correctly. If the knob of the pump remains sucked down by the lower pressure, remove and check the tank suction tube. If the suction tube is alright, change the pre-filter.	If any chips have been sucked up (due to machining performed by the bodybuilder on the fuel tank), clean the tank carefully. The problem could recur due to other chips left in the tank.

Print P4D32N001GB

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
8.1	Blinking	b) Air intake upstream from the fuel gear pump.		Check the O-Rings and that the fittings of the pipes between the tank and fuel pump are correctly connected (the clips must be out and the fittings well hooked on).	
8.1	Blinking	c) Fuel leakage from the fittings or low-pressure pipes downstream from the fuel pump. d) Possible defect of the rail pressure sensor signal.		Check the O-Rings and that the fittings of the pipes downstream from the fuel pump are correctly connected (the clips must be out and the fittings well hooked on). Inspect the integrity of the low-pressure pipes. e) Run the checks of 8.2	
8.2	Blinking	Rail pressure sensor shorted or circuit open.	Engine cuts out (only on the software version for engine with single-stage pressure relief valve). High reduction in power (only on the software version for engine with twin-stage pressure relief valve).	Check the wiring between the sensor connector (wiring side) pin 1 and the EDC connector pin C20, between the sensor connector (wiring side) pin 2 and the EDC connector pin C27, between the sensor connector (wiring side) pin 3 and the EDC connector pin C12. After excluding all other possibilities, replace the sensor.	
8.3	Blinking	Pressure regulator shorted or circuit open.	Considerable power reduction.	Check that the connector is correctly connected to the pressure regulator. Using a multimeter, check the integrity of the pressure regulator solenoid valve (r = APPROXIMATELY 3.2 Ohm). If the component is integral, check the wiring between the pressure regulator connector and the EDC connector pin C5 – C7.	Remember that as of September 2003 the pressure regulator, which can be replaced on its own, is available as a spare part.

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
8.4	Blinking	Twin-stage pressure relief valve trips.	Considerable power reduction.	Run the checks prescribed for 8.2 and 8.3.	(only on the software version for engine with twin-stage pressure relief valve). If 8.1 is saved at the same time, resolve 8.4 first since 8.1 is a direct consequence. In the event of 8.4 (with EDC warning light off) on 210 HP and 240 HP with single-stage pressure relief valve, call the Help desk.
8.5	Blinking	Rail min-max pressure error.	Engine cuts out.	Change the pressure relief valve. Check that the fuel suction and return pipes from the tank have not been swapped over. If the trouble remains, run the checks prescribed for 8.2 and 8.3.	(only on the software version for engine with twin-stage pressure relief valve).
8.6	Not used	Not used	Not used	Not used	Not used
8.7	Not used	Not used	Not used	Not used	Not used
8.8	Not used	Not used	Not used	Not used	Not used
9.3	Not used	Not used	Not used	Not used	Not used
9.4	On	Main relay fails to turn off	The control unit is always powered and the EDC indicator light stays on even with the key OFF. The batteries run down.	Try taking out and putting back in the EDC fuse and delete the fault memory. If the trouble remains, call the Help Desk to replace the control unit, if necessary.	The main relay is incorporated in the EDC control unit and cannot be changed on its own.

Print P4D32N001GB

BLINK CODE	EDC INDICATOR LIGHT	POSSIBLE CAUSE	REACTIONS OF THE SYSTEM / VEHICLE	RECOMMENDED TESTS OR ACTION	NOTES
9.6	On	Failure of the internal test procedure in the control unit every time the engine is stopped.	Considerable power reduction	Check the wiring between +15 of the key and the control unit connector pin B39 passing through the bulkhead connector B pin 2. Delete the fault memory and try again: if in normal conditions of switching off the engine the error signal persists, call the Help Desk to replace the control unit, if necessary.	The engine fails to stop in the set time when the +15 key is turned OFF.
9.7	On	Internal defect of the control unit in the sensor supply circuit.	Irregular engine operation due to sensors not being correctly supplied. Power reduction.	Delete the fault memory and try again. If the trouble remains, call the Help Desk and follow their instructions to replace the control unit, if necessary.	Possible signalling of defect with various sensors powered by the control unit.

TROUBLESHOOTING WITH PT-01 PORTABLE TESTER (IVECO P.N. 8093731)

PT-01 PORTABLE TESTER

Using PT-01 with portable tester it is possibile to execute troubleshooting and test the EDC7 electronic module of NEF engines.

PT-01 has been designed and developed to ensure stoutness and practicality and is particularly suitable to be used in workshop and industrial environment.

The tool is connected to the engine gearbox by means of one only cable providing both tester feed and communication with the electronic module.

Main functions

NOTE Before connecting the tester to the electronic module, check the wording on the electronic module to select the correct software on the tool.

1	2	3	4	5	6	7	8	.	A	B	C
u	m	m	k	a	a	*	*	.	v	a	0

a a software 3.3_1
a b software 4.1_2

Easy access to different functions is available through the menu:

- ID. Reading of the electronic module;
- Reading of failure memory and relevant environment conditions;
- Failure memory clear;
- Reading of working parameters;
- Reading of status parameters;
- Active troubleshooting (switching on heat starter, fuel pump, EDC warning led and so on)

Test parameters

- Engine revolutions;
- Spark advance;
- Battery voltage;
- Accelerator foot pedal position;
- Over voltage pressure;
- Over voltage air temperature;
- Cooling liquid temperature;
- Fuel temperature;
- Oil temperature;
- Oil pressure;
- Fuel delivery;
- Fuel pressure;
- Rail pressure duty cycle electro-valve.

FAILURE CODES (SOFTWARE VERSION 3.3_1)

Blink code	Warning type	Failure description	System degradation
ENGINE1			
2.1	1	Coolant Temp. Signal	0
2.2	0	Boost Temp. Signal	0
2.3	0	Fuel Temp. Signal	0
2.4	1	Boost Pressure Signal	0
2.5	0	Atmospheric Pressure Signal	0
2.6	1	Oil Pressure Signal	0
2.7	1	Oil Temp. Signal	0
2.8	0	Power stage Fuel filter heater	0
2.9	1	HS Power stage cold start heater relay	0
ENGINE2			
3.1	0	Adapt.cylinder balancing Cyl.1	0
3.2	0	Adapt.cylinder balancing Cyl.5	0
3.3	0	Adapt.cylinder balancing Cyl.3	0
3.4	0	Adapt.cylinder balancing Cyl.6	0
3.5	0	Adapt.cylinder balancing Cyl.2	0
3.6	0	Adapt.cylinder balancing Cyl.4	0
3.7	0	Battery voltage signal	0
3.8	0	LS Power stage cold start lamp	0
3.9	1	Cold start heater monitoring	0
INJECTORS			
5.1	1	Injector solenoid valve Cyl.1	0
5.2	1	Injector solenoid valve Cyl.5 (•)	0
5.3	1	Injector solenoid valve Cyl.3	0
5.4	1	Injector solenoid valve Cyl.6 (•)	0
5.5	1	Injector solenoid valve Cyl.2	0
5.6	1	Injector solenoid valve Cyl.4	0
5.7	1	Injector Booster Voltage C1	0
5.8	1	Injector Booster Voltage C2	0

System degradation:

0 = 0% derate

1 = slight derate

2 = moderate derate

3 = significant derate

4 = engine stop

Blink types:

0 = No light

1 = Continous light

2 = Blinking light

Classification of power output:

LS = slight level

HS = high level

SS = moderate signal

Print P4D32N001GB

Blink code	Warning type	Failure description	System degradation
ENGINE SPEED			
6.1	1	Increment speed signal	1
6.2	1	Segment speed signal	1
6.3	1	Engine speed sensing	1
6.4	2	Engine overspeed	0
6.5	1	HS power stage 8 for Starter control	0
6.6	0	SS power stage 1 for TD-signal	0
6.8	0	SS power stage 2 for sync.-signal	0
FUEL PRESSURE			
8.1	2	Fuel pressure monitoring CP3	3
8.2	2	System degradation	3
8.3	2	CC HS Power stage 1 fuel press. Control	3
8.4	2	Monitoring of rail pressure relief valve	3
8.5	2	Rail pressure Min/Max error	4
8.6	-	CC HS Power stage 2 EGR control	0
8.7	-	Air Mass Signal	0
8.8	-	Ambient Temp. Signal	0
ECU			
9.4	1	Main relay defect	0
9.6	1	ECU: Self Test Shutoff Paths	3
9.7	1	Power supply for sensors	0

System degradation:

0 = 0% derate

1 = slight derate

2 = moderate derate

3 = significant derate

4 = engine stop

Blink types:

0 = No light

1 = Continous light

2 = Blinking light

Classification of power output:

LS = slight level

HS = high level

SS = moderate signal

FAILURE CODES (SOFTWARE VERSION 4.1_2)

Blink code	Warning type	Failure description	System degradation
ENGINE1			
2.1	1	Coolant Temp. Signal	0
2.2	0	Boost Temp. Signal	0
2.3	0	Fuel Temp. Signal	0
2.4	1	Boost Pressure Signal	0
2.5	0	Atmospheric Pressure Signal	0
2.6	1	Oil Pressure Signal	0
2.7	1	Oil Temp. Signal	0
2.8	0	Power stage Fuel filter heater	0
2.9	1	HS Power stage cold start heater relay	0
ENGINE2			
3.1	0	Adapt.cylinder balancing Cyl.1	0
3.2	0	Adapt.cylinder balancing Cyl.5 (•)	0
3.3	0	Adapt.cylinder balancing Cyl.3	0
3.4	0	Adapt.cylinder balancing Cyl.6 (•)	0
3.5	0	Adapt.cylinder balancing Cyl.2	0
3.6	0	Adapt.cylinder balancing Cyl.4	0
3.7	0	Battery voltage signal	0
3.8	0	LS Power stage cold start lamp	0
3.9	1	Cold start heater monitoring	0
INJECTORS			
5.1	1	Injector solenoid valve Cyl.1	0
5.2	1	Injector solenoid valve Cyl.5 (•)	0
5.3	1	Injector solenoid valve Cyl.3	0
5.4	1	Injector solenoid valve Cyl.6 (•)	0
5.5	1	Injector solenoid valve Cyl.2	0
5.6	1	Injector solenoid valve Cyl.4	0
5.7	1	Injector Booster Voltage C1	0
5.8	1	Injector Booster Voltage C2	0

*) System degradation for STUP failure not applicable (not available in ASAP)
*) Masked out
**) Masked out

System degradation:

0 = 0% derate

1 = slight derate

2 = moderate derate

3 = significant derate

4 = engine stop

Blink types:

0 = No light

1 = Continous light

2 = Blinking light

Classification of power output:

LS = slight level

HS = high level

SS = moderate signal

(•): not applicable for the 4 cylinders

Print P4D32N001GB

Blink code	Warning type	Failure description	System degradation
ENGINE SPEED			
6.1	1	Increment speed signal	1
6.2	1	Segment speed signal	1
6.3	1	Engine speed sensing	1
6.4	2	Engine overspeed	0
6.5	1	HS power stage 8 for Starter control	0
6.6	0	SS power stage 1 for TD-signal	0
6.8	0	SS power stage 2 for sync.-signal	0
FUEL PRESSURE			
8.1	2	Fuel pressure monitoring CP3	3
8.2	2	System degradation	3
8.3	2	CC HS Power stage 1 fuel press. Control	3
8.4	2	Monitoring of rail pressure relief valve	3
8.5	2	Rail pressure Min/Max error	4
8.6	-	CC HS Power stage 2 EGR control	0
8.7	-	Air Mass Signal	0
8.8	-	Ambient Temp. Signal	0
ECU			
9.4	1	Main relay defect	0
9.6	1	ECU: Self Test Shutoff Paths	3
9.6	2	ECU: Self Test Shutoff Paths	*
9.7	1	Power supply for sensors	0

System degradation:

0 = 0% derate

1 = slight derate

2 = moderate derate

3 = significant derate

4 = engine stop

Blink types:

0 = No light

1 = Continous light

2 = Blinking light

Classification of power output:

LS = slight level

HS = high level

SS = moderate signal

*) System degradation for STUP failure not applicable (not available in ASAP)
*) Masked out
**) Masked out

TROUBLESHOOTING

F4GE engines

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
The engine does not start	Battery flat or faulty.	Check and recharge battery. Replace battery if necessary.	
	Connections to battery terminals corroded or loose.	Clean, examine and tighten the nuts on the battery terminals. Replace the cable terminals and the nuts if excessively corroded.	
	Incorrect timing of injection pump.	Check and correctly time the injection pump.	See your Iveco Motors dealer.
	Deposits or water in the fuel tank.	Disconnect the hoses and clean them using a jet of compressed air. Dismantle and clean the injection pump. Remove water from tank and refuel.	Drain feed system.
	No fuel in tank.	Refuel.	
	No power supply.	Overhaul or replace the fuel or transfer pump.	
	Air bubbles in the fuel lines or injection pump.	Check the hoses to ensure that air is in fact present and also check the fuel pump. Eliminate the air from the injection pump by unscrewing the cap and working the fuel pump by hand.	
	Faulty starter motor.	Repair or replace the starter motor.	

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
The engine does not start at low temperatures	Fuel system clogged with paraffin crystals forming due to the use of unsuitable fuel.	Replace the fuel with fuel suitable for use at low temperatures. Replace the fuel filters.	
The engine cuts out.	Idle rpm too low.	Adjust with adjustment screw.	See your Iveco Motors dealer.
	Irregular flow of injection pump.	Adjust flow.	Drain feed system.
	Impurities or water in the fuel lines.	Disconnect the hoses and clean them using a jet of compressed air. Dismantle and clean the injection pump. Remove water from fuel tank and refuel.	
	Clogged fuel filter.	Dismantle and replace if necessary.	
	Presence of air in the fuel and injection system.	Check that the hoses are not cracked or the unions loose. Replace worn parts, remove the air from the hoses and deaerate the injection pump and fuel filter by unscrewing the caps and working the primer pump by hand.	
	Broken injection pump controls.	Replace the faulty parts.	
	Abnormal clearance between camshaft cams and tappets.	Adjust clearance by replacing shims.	
	Burnt, corroded or chalky valves.	Replace the valves, rectify or replace the cylinder head seatings.	

Print P4D32N001GB

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
The engine overheats	Faulty water pump.	Check the unit and replace if necessary. Replace the gasket.	
	Malfunctioning thermostat.	Replace the thermostat.	
	Fouling in coolant openings in the cylinder head and cylinder groups.	Wash following the standards specified for the type of descaling product used.	
	Water pump drive belt slack.	Check and adjust the tightness of the belt.	On applications provided with automatic tensioner, check corret worching of such device.
	Coolant level too low.	Top-up radiator with coolant.	
	Incorrect engine timing.	Check timing and tune correctly.	
	Incorrect calibration of injection pump.	Correct the delivery rate of the pump on a bench so that the injection is at the specified rate.	See your Iveco Motors dealer.
	Dry air cleaner blocked.	Clean the air filter or replace if necessary.	
Engine operation is irregular and lacks power	Incorrect timing of injection pump.	Check timing and correctly set pump.	
	K.S.B. automatic cold advance device malfunctioning.	Check or replace injection pump.	
	Excessive piston wear.	Check or replace injection pump.	
	Incorrect calibration of speed regulator.	Check and correctly calibrate the regulator.	See your Iveco dealer.

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
Engine operation is irregular and lacks power	Partial blockage of nozzles or faulty operation of injectors.	Clean the nozzles of the atomisers using the appropriate tools and completely overhaul the injectors.	
	Impurities or water in the fuel and injection system.	Carefully clean the system and refuel.	If necessary drain feed system.
	Incorrect play between camshaft cams and tappets.	Check and correct play	
	Faulty turbocharger.	Replace complete unit.	
	Air cleaner blocked.	Clean or replace air cleaner.	
	Tie rods between accelerator pedal and regulation lever incorrectly adjusted.	Adjust the tie-rods so that the command lever can be moved to the full delivery position.	
Engine running with abnormal knocking	Faulty operation of injectors.	Replace all injectors.	
	Fuel lines blocked.	Dismantle the hoses, clean them and replace those that are seriously dented.	
	Incorrect set-up of injection pump.	Correct the set-up of the pump so that injection occurs at the specified angle.	See your Iveco Motors dealer.

Print P4D32N001GB

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
Engine running with abnormal knocking	Knocking of crankshaft causing excessive play on one or more main or rod bearings or excessive play on shoulders.	Rectify the pins of the crankshaft and install smaller bearings. Replace the thrust half-rings.	
	Crankshaft unbalanced.	Check alignment of crankshaft.	
	Loosening of screws securing flywheel.	Replace the loosened screws and tighten all the screws to the specified torque.	
	Misalignment of rods.	Replace the rods.	
	Noise from piston journals due to excessive play of piston hubs and in the rod bushing. Loose bushings in the rod seatings.	Replace the piston journal and/or the piston and rod bushing. Replace with new bushings.	
	Noisy timing.	Adjust the play between camshaft cams and tappets and check that there are no broken springs, that there is no excessive play between the valve stems and the valve guides, tappets and seatings.	
The engine smokes abnormally. Black or dark grey smoke.	Excessive maximum pump output.	Disconnect the pump and adjust delivery in accordance with the data given in the calibration table.	See your Iveco Motors dealer.
	There is an excessive delay on the injection pump.	Correct the set-up.	

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	REMEDY	NOTE
The engine smokes abnormally. Black or dark grey smoke.	The injection pump has an excessive advance.	Correct the set-up.	
	The holes in the atomisers (or some of them) are partially or entirely blocked.	Replace the injectors with a series of new injectors or clean and rectify the original ones using suitable equipment.	
	Air cleaner blocked or deteriorated.	Clean or replace the filter element.	
	Loss of compression in the engine due to: stuck or worn flexible rings; worn cylinder liners; valves deteriorated or badly adjusted.	Overhaul the engine or limit the interventions to the relative parts.	
	Unsuitable injectors, different types of injectors or incorrectly calibrated.	Replace or calibrate the injectors.	
	Injection hoses with an unsuitable internal diameter, end of hoses pinched due to repeated blocking.	Check conditions of the end or unions and where necessary replace the hoses.	
Blue, grey-blue, grey smoke tending to white.	Excessive delay in injection pump.	Correct the set-up of the pump.	See your Iveco Motors dealer.
	Faulty injector.	Replace the injector.	
	Leaking of oil from the piston rings caused by glued or worn rings or wearing of cylinder liner walls.	Overhaul the engine.	
	Engine oil passing through the intake guides-valves following wearing of guides or valve stems.	Recondition the cylinder head.	
	Engine too cold (thermostat blocked or inefficient).	Replace the thermostat.	

Print P4D32N001GB

F4AE engines

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	RECOMMENDED TESTS OR INTERVENTION	REMARKS
Low performance at load request. Possible exessive smoke. Low fuel pressure (error 8.1).	Insufficient fuel level in the tank.	Check fuel level.	The excessive smoke is due to the fact that, in case of insufficient fuel feeding, the engine control module tries to compensate prolonging the injectors working time.
	Fuel tank device partially obstructed by impurities or deformed because of overheating.	Check if the priming pump of the pre-filter is working correctly. If the pump plunger is permanently depressed disassemble and check the tank pick.-up tube. If this is in order, replace the pre-filter.	
	Obstructed air filter.	Replace the air filter.	Solve the cause of the filter's obstruction.
	Excessive fuel blow-by from rail boost valve.	Check the O Rings and the correct connection of the pipe fittings under the feeding pump (the lockers must stay outside and the fittings must be well locked). Visually check the low pressure pipeline integrity.	Unless the leakage is significant, no performance failures will be detected. To verify O-rings integrity, extract from the tank the fuel recycling pipeline, seal the end and activate the priming pump driving the low pressure circuit.
	Excessive fuel blow-by from rail boost valve.	Disconnect the pipe and visually check if there are any significant blow-by from the boost gauge valve; in such case replace the valve.	
The engine suddenly stops (with no previous problems) and does not start again.	Obstructed fuel filter.	Replace the fuel filter.	Solve the cause of the filter's obstruction (empty and clean the tank and the part of the circuit over the filter, refill with clean fuel).

ANOMALY	POSSIBLE CAUSE (*) = if available in the equipment	RECOMMENDED TESTS OR INTERVENTION	REMARKS
The engine disconnects or does not start.	(*) EDC "burned" by short circuit on the wiring harness of the friction clutch.	Eliminate the short circuit and replace the EDC.	Verify that the wire line, close to the pedal, is not exposed to.
Difficult start and low performance in all conditions.	Inefficient high pressure pump.	After having excluded any other possible cause, replace the high pressure pump.	
Difficult start, low performance and engine running with one cylinder less.	Injector with obstructer or solenoid (mechanical part) blocked open.	The non-working injector is easily recognisable detecting by feeling the absence of pulsing within the relevant high pressure pipe.	In case of low entity blow-by, inficiating the mechanical working of the injector but not involving flow limiter activation, there is no error memorisation in the engine control module. If the flow limiter is activated. Check error code memory.
Starting requires in excess of ten seconds, followed by huge white exhaust fumes, and a fuel smell.	Injector blocked in open position (with no return).	The non-working injector is easily recognisable detecting by feeling the absence of pulsing within the relevant high pressure pipe.	Usually, whether such symptoms appear, it is instinctive to give up engine start. However, by insisting, it is possible to start the engine. As a matter of facts, by insisting, if within the rail the pressure makes the flow limiter close up, the engine starts with one cylinder less and gradually the grade of fumes reduces and disappears.
Breaking of high pressure pipeline from pump to rail.	Strange vibrations provoked by slack of pipe bracket.	Replace the pipeline ensuring the correct tightening of the anti-vibration bracket screws.	It is very important, in addition to correct blocking, to keep the brackets in the original position.
The engine works with one cylinder less, without memorising failure blink codes in the engine control module.	Injector blocked in closed position.	Identify the injector that is not working any more and the relating high pressure filler.	The non-working injector is easily recognisable detecting by feeling the absence of pulsing within the relevant high pressure pipe.

Print P4D32N001GB