NEF SERIES STAGE IIIA

G_Drive application

NEF45

NEF45 SM1F
NEF45 TE1F
NEF45 TE2F

NEF67

NEF67 TM1F
NEF67 TE1F
NEF67 TE2F

Technical repair manual

This document provides data, specifications, instructions and methods to perform repair interventions on the assembly and its components.

Anyhow, this document is addressed to qualified and specialised personnel.

Before performing any intervention, check that the document relating to the vehicle model on which the intervention is being performed is available and also make sure that all accident prevention devices, including but not limited to, goggles, helmet, gloves, shoes, as well as work equipment, lifting and transport equipment, etc., are available and efficient, and also make sure that the vehicle is in safety conditions for intervention.

Making interventions strictly observing the indications given here, as well as using specific equipment indicated, assures a correct repair intervention, execution timing observance and operators' safety.

Each repair intervention must be finalised to the recovery of functionality, efficiency and safety conditions that are provided by Iveco.

Each intervention on the vehicle that is finalised to a modification, alteration or anything else which has not been authorised by FPT relieves FPT of any liability, and, in particular, where the assembly is covered by a warranty, each intervention will immediately invalidate the warranty.

FPT declines any liability for repair work.

FPT is available to provide any information necessary for the implementation of the interventions and to provide instructions for any cases and situations not covered in this publication.

The data contained in this issue may not be up-to-date due to possible modifications made by the Manufacturer for technical or commercial reasons, or to adaptations required by laws in force in different countries.

In the event of discordance between the information in this publication and the actual assembly, please contact the FPT network before performing any interventions."

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FPT Industrial S.p.A.
Via Puglia 15, 10156 Turin, Italy
www.fptindustrial.com
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NEF G-Drive Stage IIIA SERIES

NEF F4GE Series	**Part 1**
NEF F4HE Series	**Part 2**

GENERAL INFORMATION

Manuals for repairs are split into Parts and Sections, each one of which is marked by a number; the contents of these sections are indicated in the general table of contents.

Sections with mechanical contents include technical data, tightening torque collections, tool lists, assembly connections - disconnections, overhauls at the bench, troubleshooting and scheduled maintenance.

The sections or parts on the electrical/electronic system contain descriptions of the electrical network and the unit's electronic systems, the wiring diagrams, the electrical features of the components and the component codes.

Sections 1 and 2 describe the engines with regard to their features and general operation.

Section 3 describes the electrical part, regarding wiring, electrical and electronic equipment which vary depending on the specific use.

Section 4 covers scheduled maintenance.

Sections 5 and 6 address the removal/refitting of the main components and general overhaul operations on the engine mounted on the rotating stand.

Sections 7 and 8 contain the technical features of the engine, such as mounting clearance, tightening torque and specific tools.

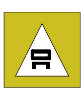
The appendix provides a list of the general safety regulations which all operators, whether installers or maintenance technicians, must comply with to prevent any serious injury.

The manual uses proper symbols in its descriptions; the purpose of these symbols is to classify information.

In particular, a set of symbols has been defined to classify warnings, while another set has been specified for service operations.

SYMBOLS - Warnings

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



Risk of serious damage to the assembly
The partial or total non-observance of these instructions could cause serious damage to the assembly and may nullify the warranty.

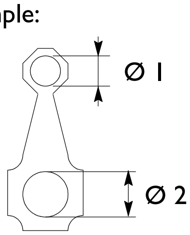
General danger
Includes the dangers of both above described signals.

Environmental protection
Indicates correct behaviour in order for the assembly use to be as environmentally friendly as possible.

NOTE Indicates an additional explanation for a piece of information.

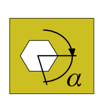
Service operations

Example:



Ø 1 = Housing for connecting rod small end bush.

Ø 2 = Housing for connecting rod bearings ings.



Tighten to torque
Tighten to torque + angle value

	Removal Disconnect
	Refitting Connect
	Disassembly Dismantling
	Assembly Assemble
	Tighten to the specified torque
α	Tighten to the specified torque + angle value
	Press or caulk
	Registration Adjustment
	Visual check Fitting position check
	Measuring Value to be found Check
	Equipment
	Surface for machining Finished workpiece
	Interference Forced assembly
	Clearance Shim
	Lubricate Moisten Grease
	Coolant Sealant
	Bleeding air

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angle value
	Revolutions per time unit
	Temperature
bar	Pressure
>	Oversized Oversized by no more than ..... Max
<	Undersized Undersized by no more than..... Min.
	Selection of oversizing class
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer
	Preload

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GENERAL WARNINGS

The warnings shown may not be representative of all the dangerous situations that may occur. Therefore, supervisors should be contacted whenever a dangerous situation that has not been described occurs.

Use the specific and generic tools according to the indications in the respective use and maintenance manuals. Check the working condition and suitability of tools not subject to periodic review.

The manual handling of loads must be assessed in advance since it also depends not only on weight but also 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 show clear indications regarding maximum acceptable carrying capacity. The use of such tools is strictly permitted by authorised personnel only. Stay at a safe distance from the load and never below it.

In disassembly operations, always observe the provided prescriptions and prevent any mechanical parts being taken out from accidentally striking workshop personnel.

Shop activities performed by two technicians must always been executed with caution; avoid operations that may be dangerous for any collaborators due to lack of field of vision or incorrect position.

Keep any personnel not assigned to the operations clear of working area.

Learn the necessary concepts of operation and safety relating to the vehicle prior to working on it. Scrupulously observe all safety warnings on the assembly.

Do not leave the assembly in motion unattended during repair work.

When working on an assembly off the ground, make sure that it is resting firmly on the appropriate supporting stands and that the manual/automatic safety devices are activated in the event of lifting with a hydraulic ramp.

When working on assemblies fuelled with natural gas, in addition to the instructions given in the document, also observe all the specific safety regulations provided.

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

Flammable fuels and all fluids and liquids must be handled with care, according to the indications provided in the 16 point cards of harmful materials. Refuelling must be performed outdoors with the engine off, avoiding lit cigarettes, free flames or sparks, in order to prevent sudden fires/explosions. Adequately store inflammable, corrosive and polluting fluids and liquids according to what provided by regulations in force. Strictly avoid using containers for food to store harmful liquids. Avoid drilling or burning pressurised containers and discard cloths impregnated with inflammable substances into suitable containers.

Worn out, damaged or consumable parts must be replaced with original spare parts.

During workshop activities, always keep the workplace clean; promptly free or clean floors of any accidental spills and stains of liquids and oils. Electric sockets and electrical equipment necessary to perform repair operations must meet safety rules.

Wear all required P.P.E and garments when called for by the operation at issue. Contact with moving parts may cause serious injuries. Use suitable, preferably tight-fitting garments and avoid wearing jewellery, scarves, etc.

Do not leave the engine running in workshops not equipped with a pipe to extract exhaust gas outside.

Do not breathe fumes from heating or welding of paint, as they are harmful; operate outdoors or in well-ventilated areas. Wear an appropriate respirator in the presence of paint dust.

Avoid contact with hot water or steam from the engine, radiator and hoses as they could cause serious burns. Avoid direct contact with liquids and fluids inside vehicle systems; consult the 12 remedy points sheet if accidental contact occurs.

Before overhauling, clean the assemblies and make sure they are integral and complete.
Tidy up detached or disassembled parts with their securing elements (screws, nuts, etc.) into special containers.

Check the integrity of the parts that prevent the loosening of screws: split washers, split pins, clips, etc. Self-locking nuts with nylon inserts must always be replaced.

Avoid contact of rubber with diesel fuel, petrol or other incompatible substances.

Before pressure washing mechanical parts, protect electrical connectors and any control units.

The tightening of screws and nuts should always be carried out according to directions. FPT's sales and assistance network is available to provide any clarifications necessary to carry out any repair work not covered by this document.

Before welding:

- Disconnect all electronic control units and unplug the power cable from the battery's positive terminal (connecting it to the chassis ground) and connectors.
- Remove paint by using proper solvents or paint removers and clean relevant surfaces with soap and water.
- Wait approximately 15 minutes before proceeding with welding.
- Use suitable fire-resistant protections to protect hoses or other components in which fluids or other flammable materials flow when welding.

If the vehicle is subjected to temperatures above 80 °C (drying ovens) remove the electronic control units.

The disposal of all liquids and fluids should be carried out in strict compliance with specific regulations in force.

GENERAL WARNINGS REGARDING THE ELECTRICAL SYSTEM

When having to operate on the electrical/electronic circuit, disconnect the batteries from the circuit, disconnecting the chassis ground cable first of all from the negative terminal of the battery.

Before connecting the batteries to the system, make sure that the system is suitably insulated.

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

Do not cause sparks to verify the presence of voltage in a circuit.

Do not use a test lamp to verify circuit continuity, but proper control equipment only.

Make sure that the wirings of electronic devices (length, type of cable, location, strapping, connection of screen braiding, grounding, etc.) conform with the FPT system and that they are carefully restored after repair or maintenance work.

Measurements on the ECUs, jack connections and electrical connections of components must be done only on regular test lines, with special jacks and jack bushings. Never use improvised equipment like metal wires, screwdrivers, pins or similar. This may not only cause short circuits, but also damage the jack connectors, resulting in poor contact.

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

Incorrect polarisation of voltage supply to the electronic control units (for example, incorrect polarization of batteries) may lead to their destruction.

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

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

Isolate the circuit prior to disconnecting the junction connector from an electronic control unit.

Do not directly supply current to components served by electronic control units with nominal vehicle voltage.

The cables must be routed in such a way as to be parallel to the reference plane, as close as possible to the chassis/body.

Upon completing work on the electrical circuit, restore the electrical connectors and wiring as originally provided.

Grounding and screening

The negative conductors connected to circuit ground point must be as short as possible and connected in "star" form, ensuring that their tightening is done neatly and sufficiently (Figure 1 ref. M).

The following precautions must be observed regarding the electronic components:

– electronic control units must be connected to the system ground when equipped with metal housings.

– The negative cables of the electronic control units must be connected at a circuit ground point, such as dashboard compartment ground (avoiding "serial" or "chain" connections), as well as to the negative terminal of the battery or batteries.

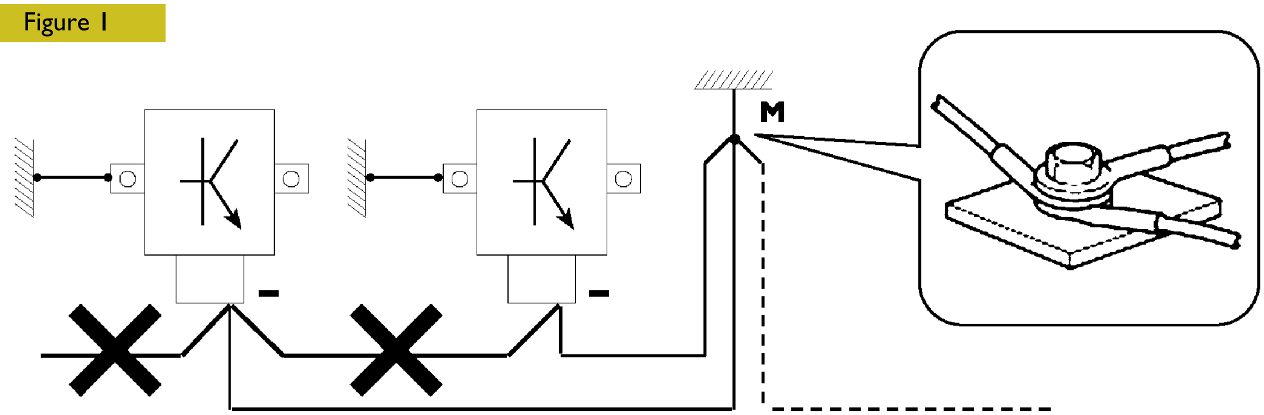
– Even if not connected to the circuit ground/battery negative terminal, analogue ground (sensors) should have optimal insulation. Consequently, particular care should be given to terminal parasitic resistances: oxidation, clinching defects, etc.

– The metal braid of shielded circuits must be in contact only at the ECU side to which the signal is to be sent (Figure 2).

– In the case of junction connectors, the unshielded section **d** near to them must be as short as possible (Figure 2).

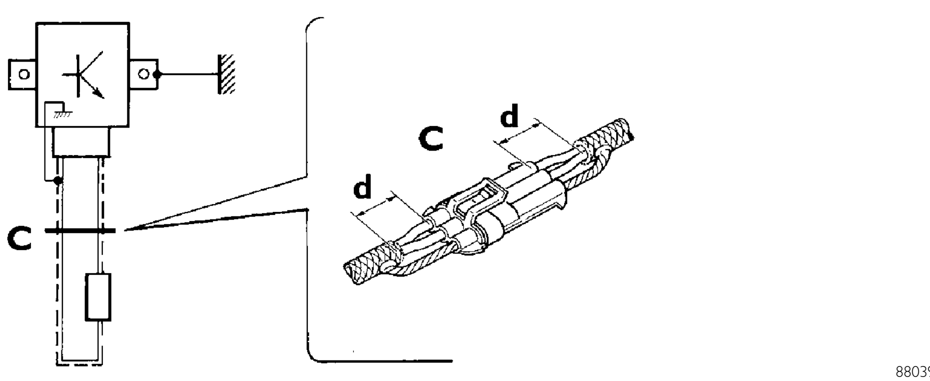
– The cables must be routed in such a way as to be parallel to the reference plane, as close as possible to the chassis/body.

Figure 1



1. "STAR" CONNECTIONS OF NEGATIVE CABLES TO THE CIRCUIT GROUND **M**

Figure 2



2. SHIELDING BY METAL BRAID OF A CABLE TO AN ELECTRONIC COMPONENT - **C.** CONNECTOR
d. DISTANCE → 0

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OPTIONAL ELECTRICAL AND MECHANICAL PARTS INSTALLATIONS

Accessory installation, additions and changes on the assembly must be carried out in compliance with the FPT assembly directives. It is reminded that, especially with regard to the electric system, several electric sockets are provided for as standard (or optional) sockets in order to simplify and normalise the electrical intervention by vehicle manufacturers.

It is strictly forbidden to carry out any modifications or connections to the electronic control unit wiring. In particular, the data line between the control units (CAN line) is to be considered untouchable.

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

Power

1 kW = 1.36 CV
1 kW = 1.34 hp
1 CV = 0.735 kW
1 CV = 0.986 hp
1 hp = 0.746 kW
1 hp = 1,014 CV

NOTE the unit CV is converted into hp for simplicity according to a 1:1 ratio
1 hp = 1 CV.

Torque

1 Nm = 0.1019 kgm
1 kgm = 9.81 Nm

Revolutions per time unit

1 rpm = 0.1047 rad/s
1 rad/s = 9.55 rpm

Pressure

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

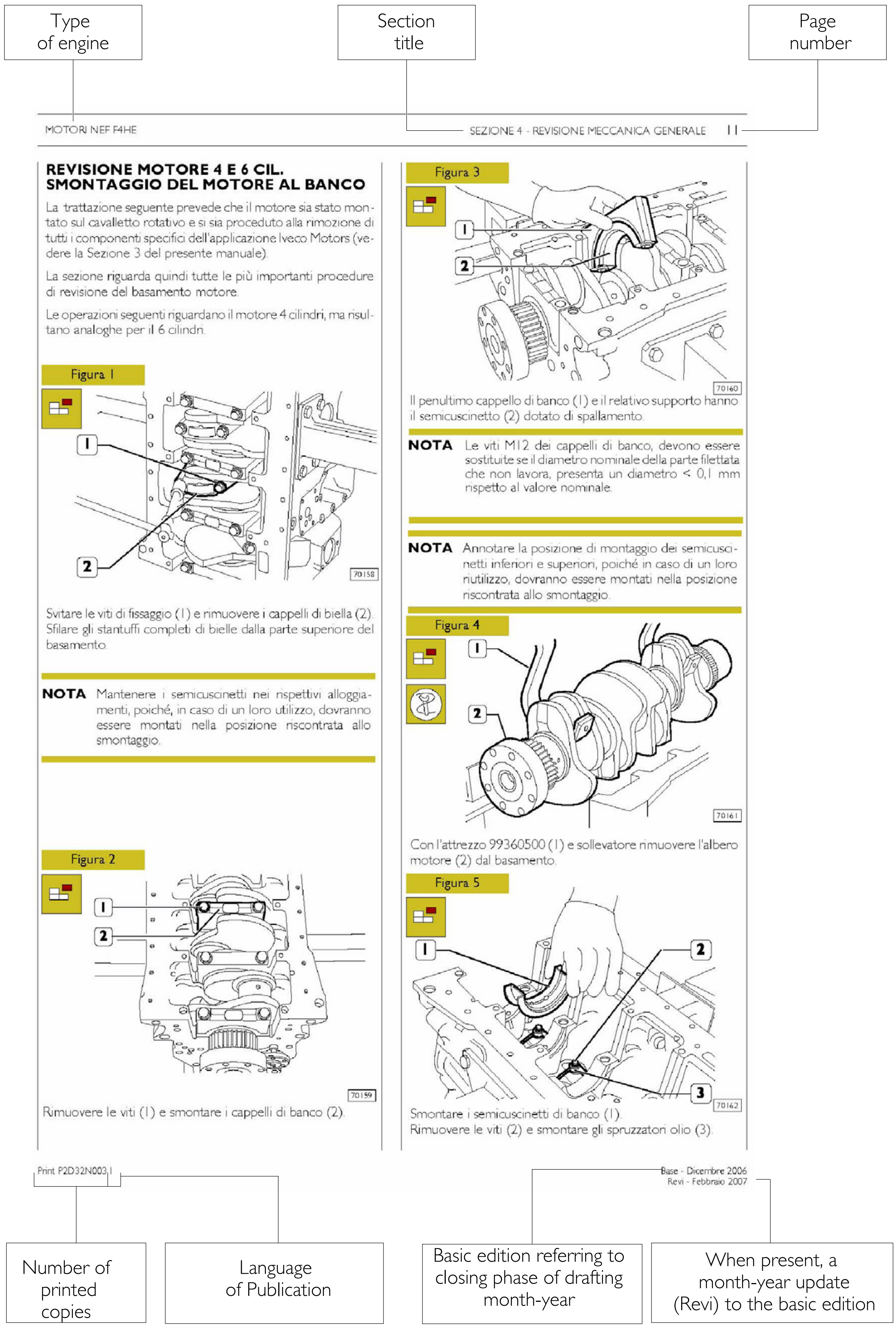
NOTE Where accuracy is not particularly required:

- the unit Nm is converted into kgm for simplicity according to a ratio of 10:1
  1 kgm = 10 Nm;
- the unit bar is converted into kg/cm^2 for simplicity according to a ratio of 1:1
  1 kg/cm^2 = 1 bar.

Temperature

0 °C = 273.15 K
0 °F = 255.37 K
0 °C = 32°F (the conversion factor between Celsius and Fahrenheit is 1:1.8)

PAGE HEADER AND FOOTER INTERPRETATION



MOTORI NEF F4HE SEZIONE 4 - REVISIONE MECCANICA GENERALE 11

REVISIONE MOTORE 4 E 6 CIL. SMONTAGGIO DEL MOTORE AL BANCO

La trattazione seguente prevede che il motore sia stato montato sul cavalletto rotativo e si sia proceduto alla rimozione di tutti i componenti specifici dell'applicazione Iveco Motors (vedere la Sezione 3 del presente manuale).

La sezione riguarda quindi tutte le più importanti procedure di revisione del basamento motore.

Le operazioni seguenti riguardano il motore 4 cilindri, ma risultano analoghe per il 6 cilindri.

Figura 1

Svitare le viti di fissaggio (1) e rimuovere i cappelli di biella (2). Sfilare gli stantuffi completi di bielle dalla parte superiore del basamento.

NOTA Mantenere i semicuscinetti nei rispettivi alloggiamenti, poiché, in caso di un loro utilizzo, dovranno essere montati nella posizione riscontrata allo smontaggio.

Figura 2

Rimuovere le viti (1) e smontare i cappelli di banco (2).

Figura 3

Il penultimo cappello di banco (1) e il relativo supporto hanno il semicuscinetto (2) dotato di spallamento.

NOTA Le viti M12 dei cappelli di banco, devono essere sostituite se il diametro nominale della parte filettata che non lavora, presenta un diametro < 0,1 mm rispetto al valore nominale.

NOTA Annotare la posizione di montaggio dei semicuscinetti inferiori e superiori, poiché in caso di un loro riutilizzo, dovranno essere montati nella posizione riscontrata allo smontaggio.

Figura 4

Con l'attrezzo 99360500 (1) e sollevatore rimuovere l'albero motore (2) dal basamento.

Figura 5

Smontare i semicuscinetti di banco (1).
Rimuovere le viti (2) e smontare gli spruzzatori olio (3).

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Base - Dicembre 2006
Revi - Febbraio 2007

UPDATE DATA

Section	Section name	Description of modification	Page	Revision date

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NEF 45 SERIES

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Operating diagrams	2
Electric / electronic equipment	3
Scheduled maintenance	4
Removal/refitting of the main components of the engine	5
General mechanical overhaul	6
Technical specifications	7
Tools	8

c

SECTION 1

General information

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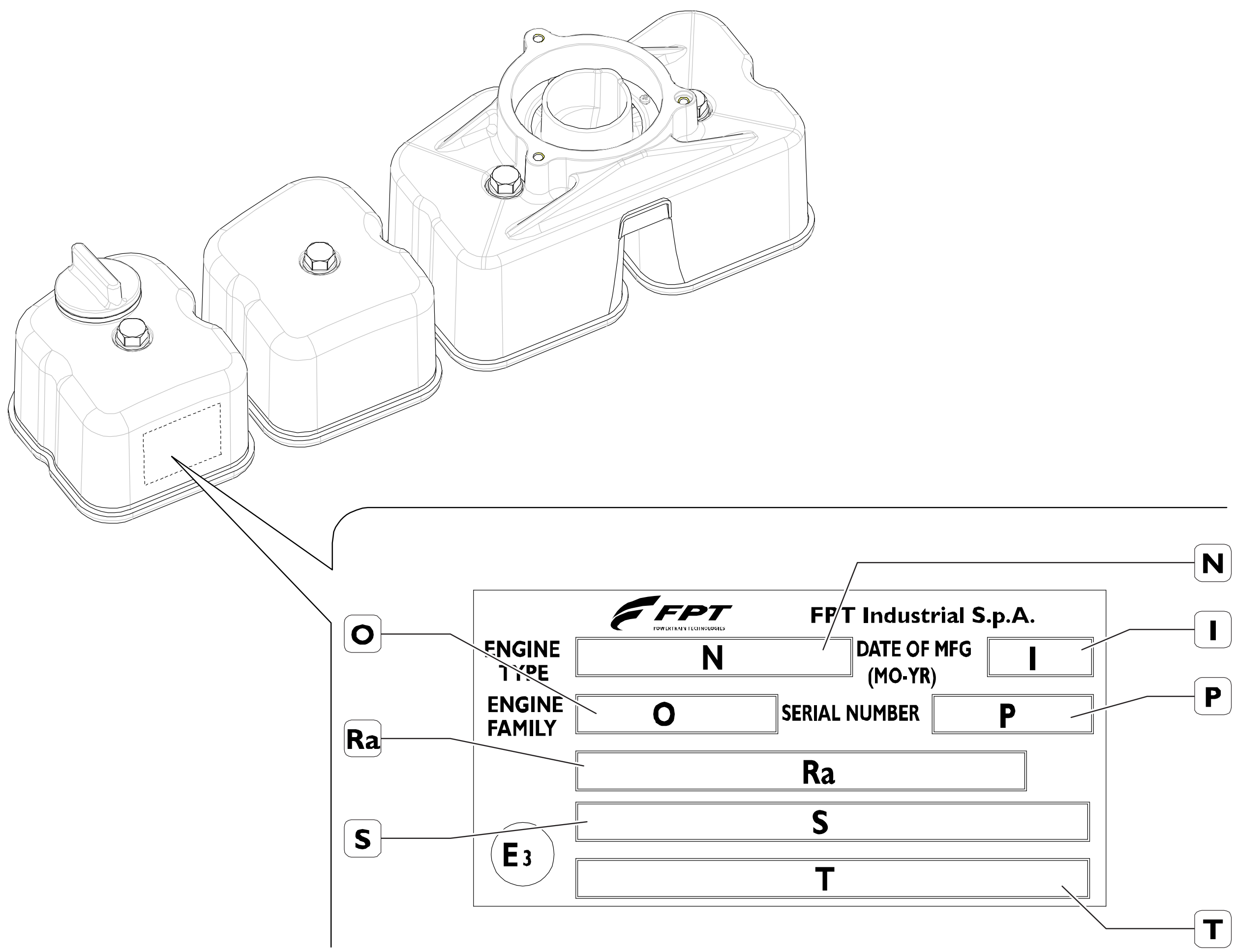
APPROVAL PLATE

Figure 1



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Box "I": month and year of registration;
Box "N": engine variant to be completed according to engine records (last three digits of the theoretical code);
Box "P": Serial number to be assigned in the manufacturing plant;
For the remaining data to be entered onto the plate, refer to the engine details of P.N. 504257007 (file in D.B. Matrix)

Support: material 3812, white;
Fixed + removable protection: shiny clear polyester;
Tape: TA 980, resin based black;
Material specifications: the adhesive plate must comply with regulation CNH 82877191;
Glueing procedure according to I.S. 17-1610 cycle "E" with use of manual roller (as with cycle "C").

CORRESPONDENCE BETWEEN TECHNICAL CODES AND COMMERCIAL CODES

Technical codes	Commercial Codes
F4GE9455E*J601	**NEF45 SM1F**
F4HE0485C*J101	**NEF45 TE1F**
F4HE0485B*J101	**NEF45 TE2F**

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TECHNICAL CODES

F4 G E 9 4 5 5 E * J 601

F4 = NEW ENGINE FAMILY

G

Code	Crankcase	Bore to stroke	Valves
A	Not structural	102 x 120	4
B	Not structural	102 x 120	2
C	Structural	104 x 132	2
D	Structural	104 x 132	4
E	Structural	102 x 120	4
F	Structural	102 x 120	2
G	Not structural	104 x 132	2
H	Not structural	104 x 132	4

E = ENGINE

9 – Configuration of cylinders

0 = 4 times vertical
1 = 4 times horizontal
3 = 4 times vert. post-treat.
4 = 4 times horiz. post-treat.
E = 4 times vert. Extra Europa
5 = 4 times vert. external EGR
9 = 4 times vert. internal EGR

4 – Number of cylinders.
(Note: 0 = 10 cylinders 1 = 12 and more)

5 – Main engine features

0 = Natural diesel intake, direct injection
1 = Natural diesel intake, indirect injection
2 = Natural petrol intake
3 = Natural methane gas intake
4 = Methane gas turbocharged
5 = Direct injection diesel turbocharged
6 = Indirect injection diesel turbocharged
7 = Petrol turbocharged
8 = Direct injection diesel turbocharged with inter.
9 = Indirect injection diesel turbocharged with inter.

5 – Application

0 = Applications other than the following
1 = Truck
2 = Bus
3 = Railway
4 = Ground movement and tractor machines
5 = Genset
6 = Marine
7 = Industrial machines and forklifts
8 = Cars and products
9 = Military

E – Approval for performance

A = First calibration
B = Second calibration
C = Third calibration
... and so on

J – Approval for regulations

A = EURO 2
B = Tier 1
C = EURO 3
D = Tier 2
E = MARINE
F = GENSET
G = On road with CRT or GAS filter
H = EURO 4 (do not use)
J = Tier 3
K = GENSET Tier 3
L = EURO 4 step 1 SCRT
M = EURO 5 step 1 SCR
N = EURO 5 step 1 SCRT
P = EURO 4 step 1 SCR
R = EURO 4 step 2 SCR
S = EURO 5 step 1 SCR
T = EURO 4 step 2 SCRT
U = Euro EEV
Z = Euro V OBD

601 – In particular, the first of the three numbers indicates the type of injection

1 = Common Rail 4 valves
2 = Common Rail 2 valves
3 = In line injection pump 4 valves
4 = In line injection pump 2 valves
5 = Rotary injection pump 4 valves
6 = Rotary injection pump 2 valves
8 = Lightweight engine for spare parts
A... E = Truck variants without derating

The remaining numbers indicate the engine variant

COMMERCIAL CODES

NEF **45** **S** **M** **I** **F**

F – Application

I – Power level
1,2,3 etc. = Different power values
ex. 1 for 180 kVA
2 for 200 kVA

M – Injection / Management
E = Electronic with ECU
M = Mechanical
R = Electronic + Mechanical regulator

S – Intake
A = Natural
S = Turbocharged
T = Turbocharged with Air/Air intercooler
W = Turbocharged with Air/Water intercooler

45 – Displacement or No. Cylinders
litres per displacement > 10 litres
litres x 10 per displacement < 10 litres
No. Cylinders per Vector
For NEF the first number is also the number of cylinders

NEF – Engine family

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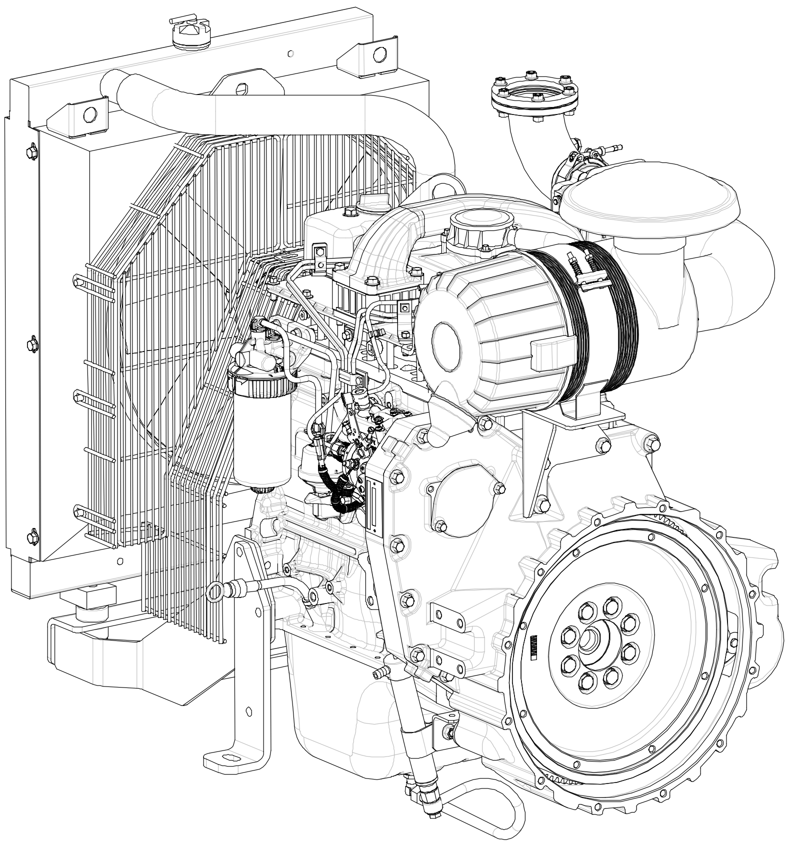
ISO VIEW

Figure 2



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NEF45 SM1F

They are characterised by a 4 time diesel cycle, sucked in or supercharged with 4 cylinders with 2 or 4 valves per cylinder.

They are powered with a mechanical rotary pump or an in-line pump, depending on the application.

NOTE The data, specifications and performance figures are only valid if the vehicle manufacturer complies with all the installation regulations provided by FPT.

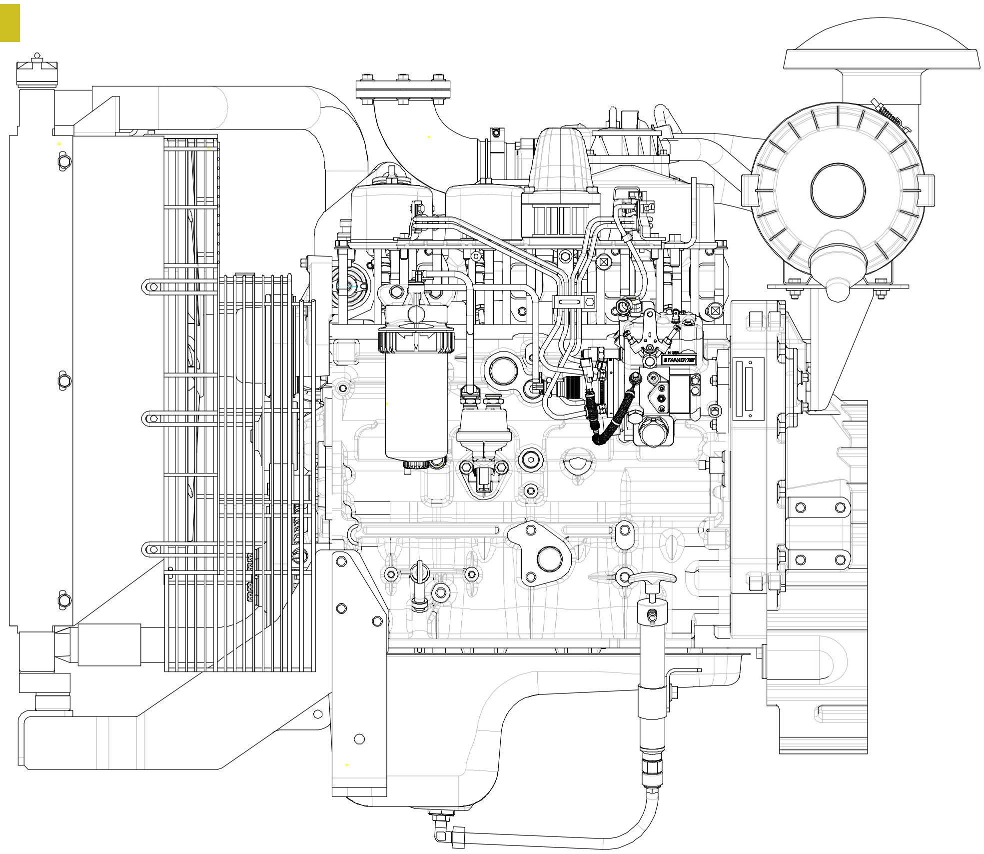
Furthermore, the fitted appliances must always be in compliance with the torque, power and engine speed for which the engine was designed.

This section consists of four parts:

- the part covering specific mechanical overhaul based on use, describing the operations necessary to remove and install the engine components including the cylinder head, timing gear housing and the front cover;
- the electric part, describing the connections of the various components, the pre-post heating control unit (only for some versions) and the sensors located on the engine;
- diagnostics;
- preventive or routine maintenance operations, with indications regarding the main operations.

ENGINE VIEWS (NEF45 SM1F)

Figure 3



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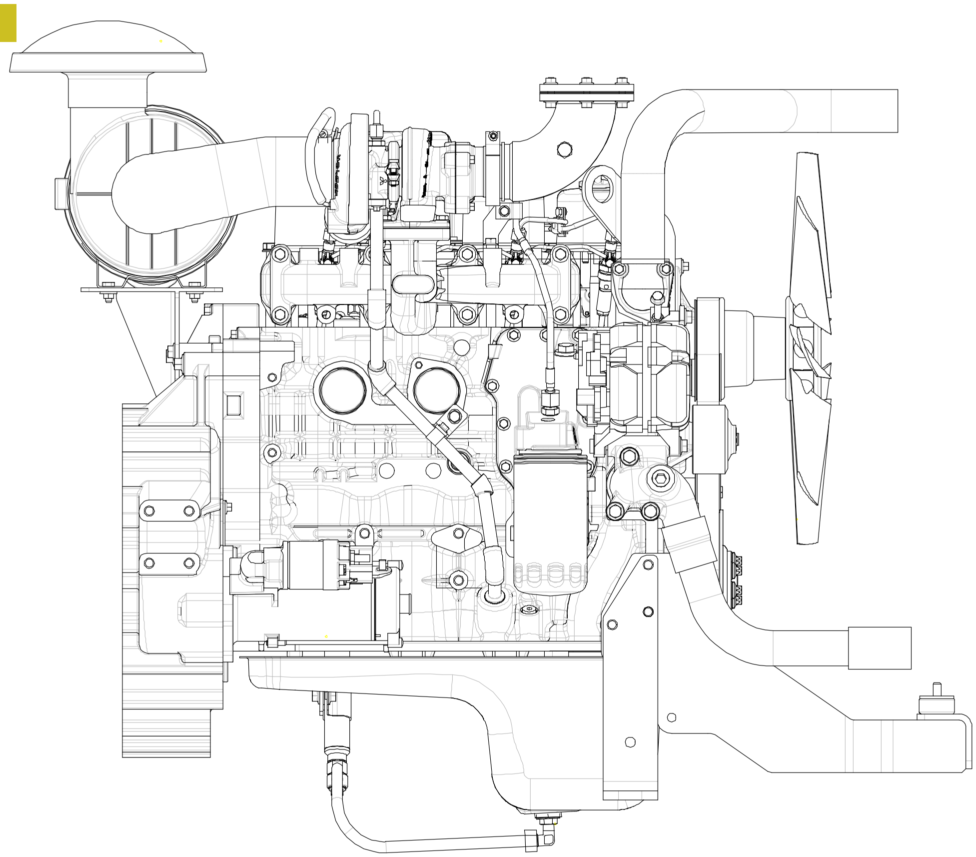
LEFT SIDE VIEW

Figure 4



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RIGHT SIDE VIEW

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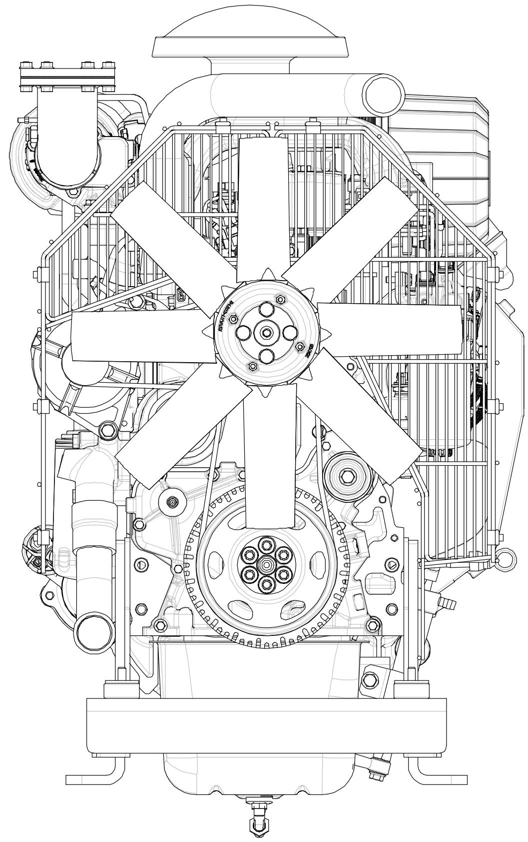
Figure 5



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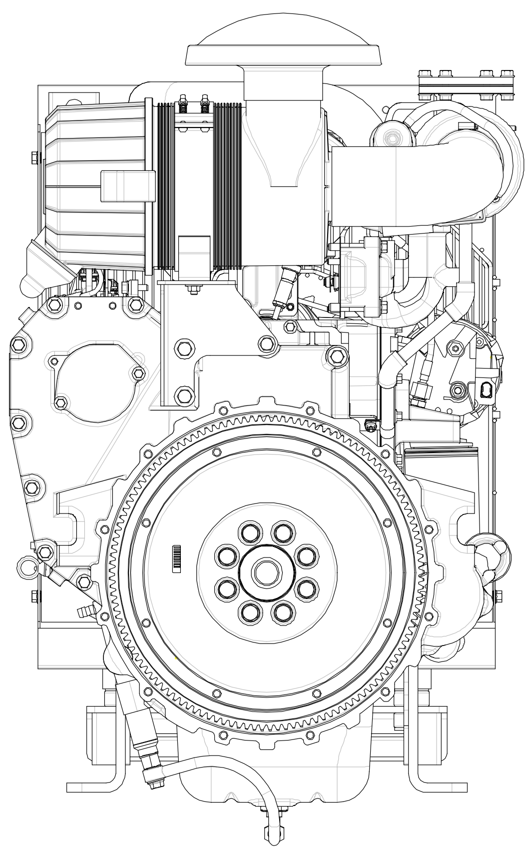
FRONT VIEW

Figure 6



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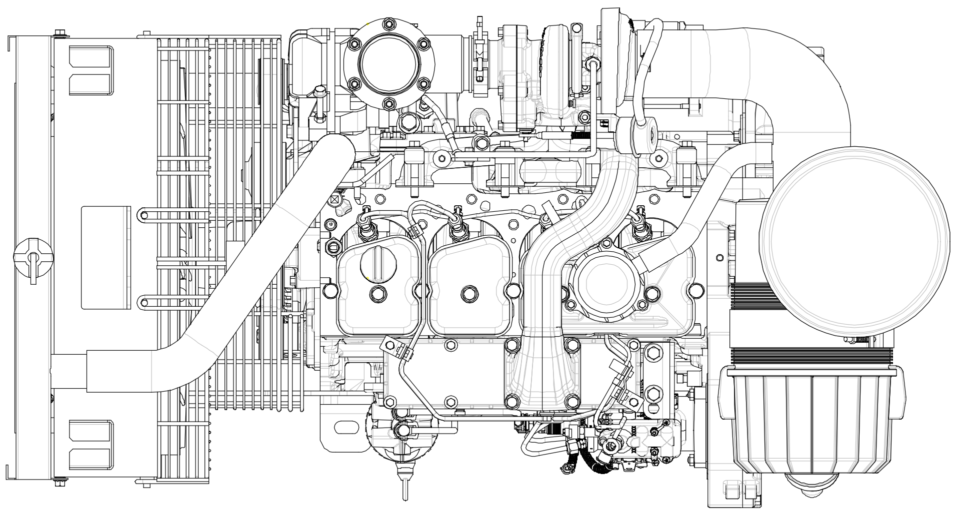
REAR VIEW

Figure 7



TOP VIEW

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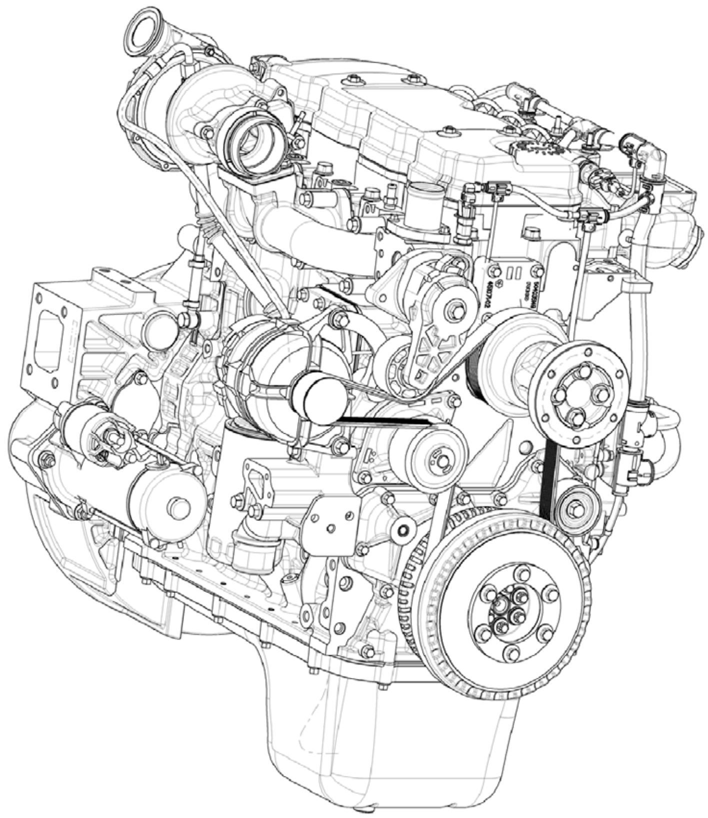
ISO VIEW (NEF45 TE1F/TE2F)

Figure 8



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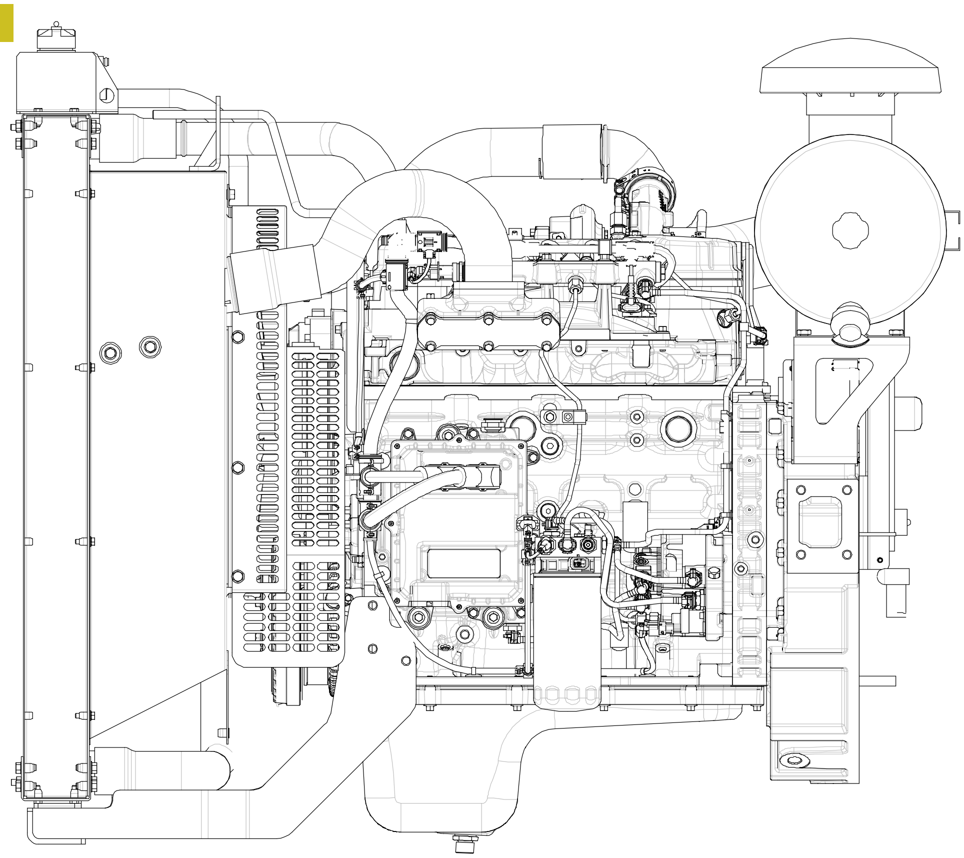
ENGINE VIEWS (NEF45 TE1F/TE2F)

Figure 9



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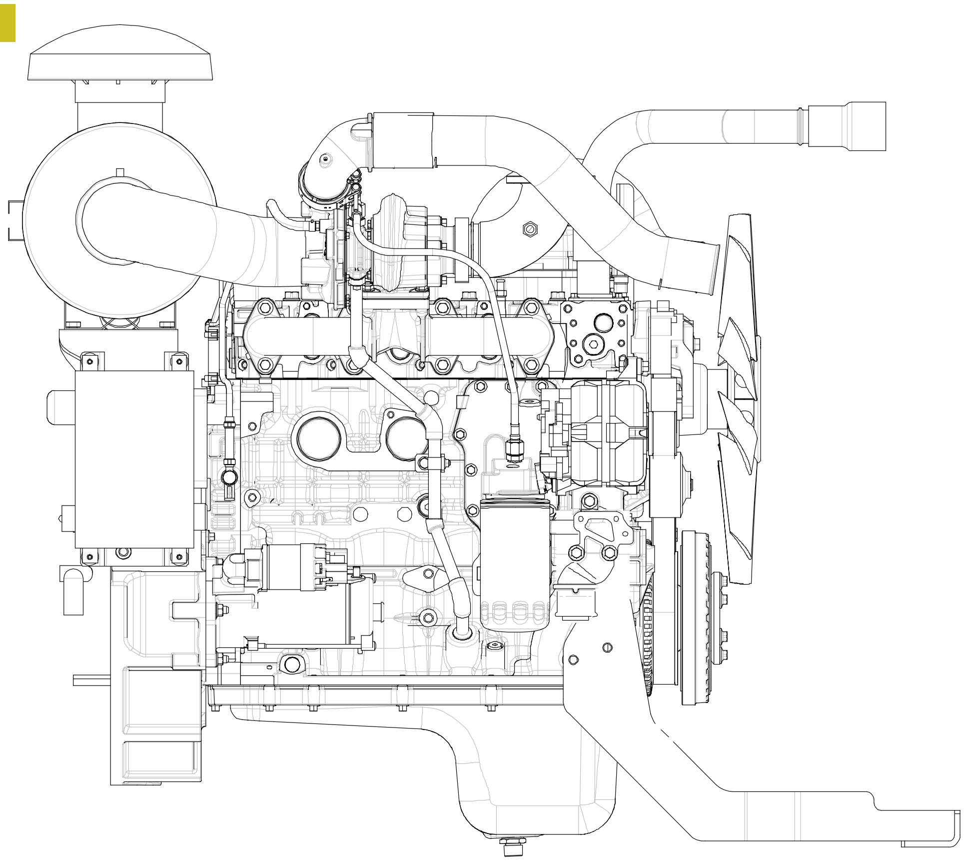
LEFT SIDE VIEW

Figure 10



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RIGHT SIDE VIEW

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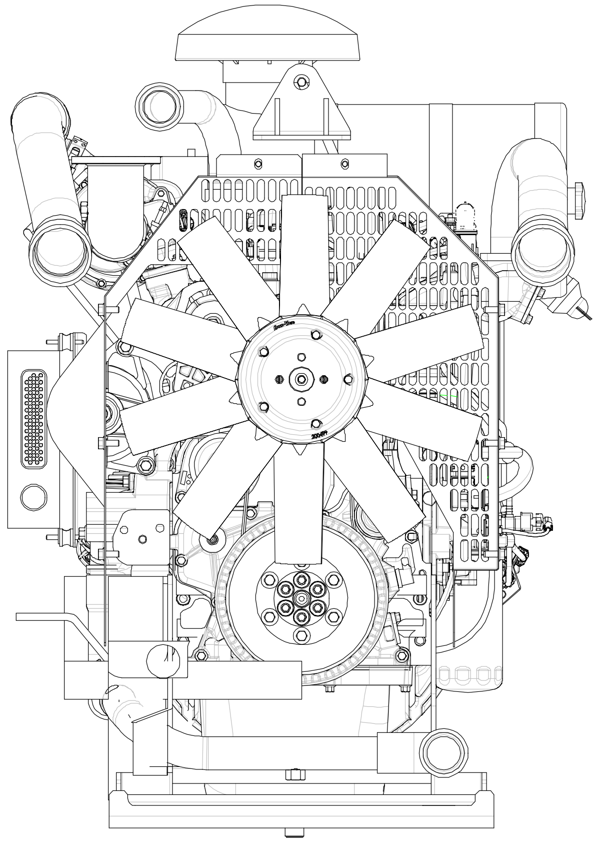
Figure 11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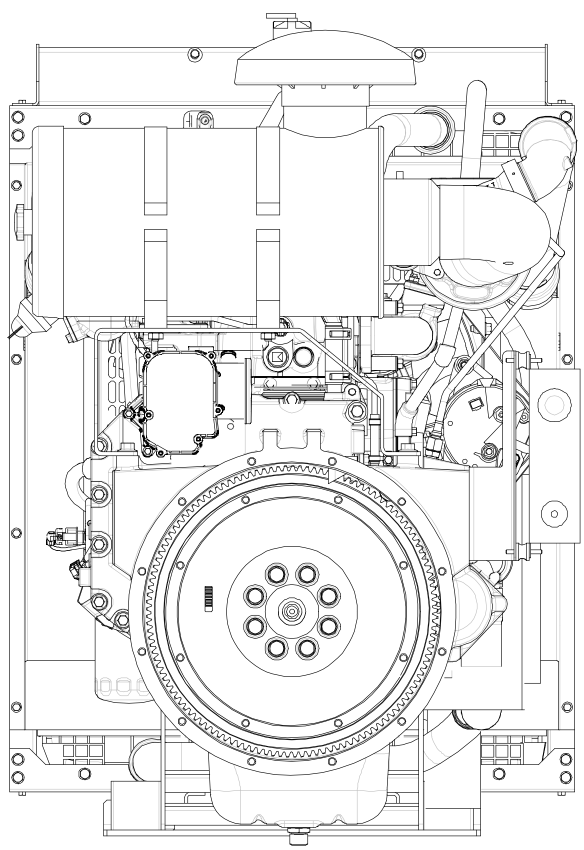
FRONT VIEW

Figure 12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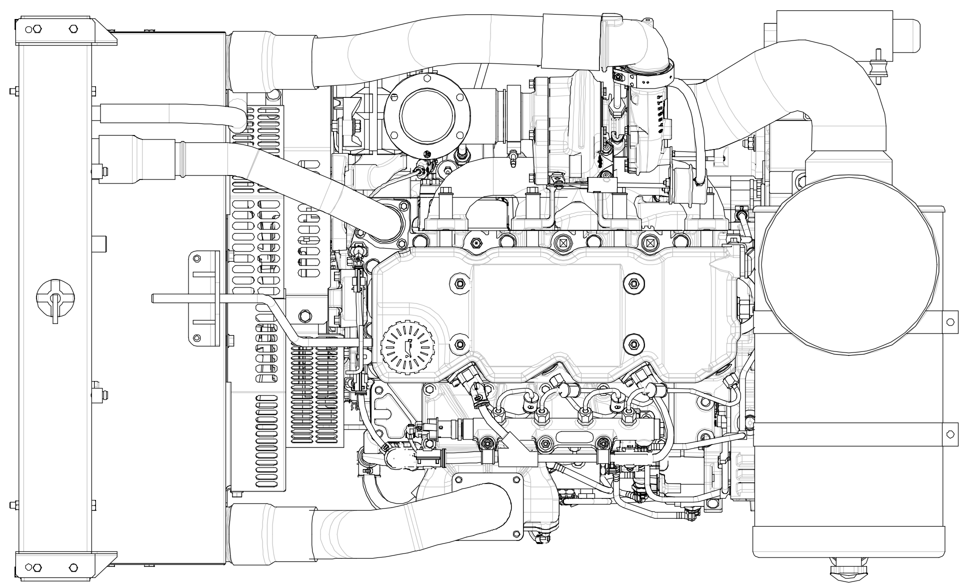
REAR VIEW

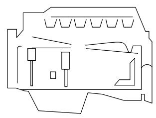
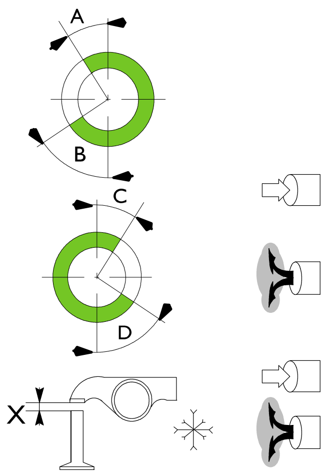
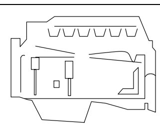
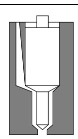
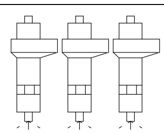
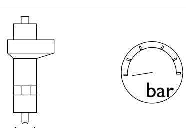
Figure 13



TOP VIEW

GENERAL FEATURES

	type		**F4GE9455E* J601**	**F4HE0485C* J101**	**F4HE0485B* J101**
	Cycle		Diesel 4-stroke		
	Power supply		Turbocharged without intercooler	Turbocharged with turbocharger and intercooler	
	Injection		Direct		
	Number and arrangement of cylinders		4 in line		
	Bore	mm	104		
	Stroke	mm	132		
+ + +.. =	Total displacement	cm^3	4485		
ϱ	Compression ratio		17.5 : 1		
	Prime Power	kWm rpm	54.5 1500	72.5 1500	89 1500
	Stand-by Power	kWm rpm	60 1500	80 1500	98 1500
	Low idle speed	rpm	-		
	High idle speed	rpm	-		
	TURBOCHARGING		Turbocharger with Waste gate intercooler		
	Turbocharger type: Supercharger type:		**Holsett HX25W**	GARRETT WG HTT	
bar **SAE 15W40 API CI-4 ACEA E7**	**LUBRICATION**		Forced by gear pump, pressure relief valve, oil filter		
	Oil pressure with hot engine (100 °C ± 5 °C):				
	at idle speed	bar	3		
	at max speed	bar	5		

	type		**F4GE9455E* J601**	**F4HE0485C* J101**	**F4HE0485B* J101**
	COOLING		Liquid		
	Water pump drive:		Belt driven		
	Thermostat:				
	initial opening	°C	79 ± 2		
	maximum opening	°C	96		
	**DISTRIBUTION**				
	Start before T.D.C.	A	17°		
	Until after B.D.C.	B	31°		
	Start before B.D.C.	D	48°		
	Until after T.D.C..	C	9°		
	For timing check				
	X	mm	0.25 ± 0.05		
		mm	0.50 ± 0.05		
	**POWER SUPPLY**		Mechanical pump	high pressure pump	
	Pump type:		rotating STANADYNE DB 4	BOSCH CP3.3	
	Nozzle type		STANADYNE XNHM882224	CRIN2 DLL137PV3	
	Firing order		1 - 3 - 4 - 2		
	Injection pressure	bar	1,800	1,600	

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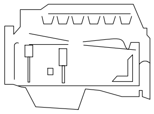	type		F4GE9455E* J601	F4HE0485C* J101	F4HE0485B* J101
REFUELLING					
Cooling circuit (1)	engine (4)	litres		**8.5**	
	G-Drive (5)	litres		18.5	
Lubrication circuit (2) (3)		litres (kg)		12.8 (11.8)	
Periodic replacement:					
Sump at minimum level		litres (kg)		5.5 (4.95)	
Sump at maximum level		litres (kg)		8.5 (7.65)	
Fuel tank (4)		litres (kg)		- (-)	

(1). Use a 50% mixture of water and PARAFLU 11 or the equivalent corresponding to the specification SAE J1034.

(2). Use lubricants that comply with international specifications ACEA E5/E7
The consumption of oil is considered acceptable up to a quantity of 0.1% of fuel consumption.

(3). The quantities indicated refer to the first refuel only and are relative to the engine, oil sump and filter refilling.

(4). The quantities indicated only refer to the engine in its standard configuration.

(5). The quantities shown are relative to the total capacity of the G-Drive including engine capacity.

! Refuelling from drums or tanks can cause contamination of the diesel, with the consequent risk of damaging the injection system; if necessary, perform suitable filtration or sedimentation of the impurities before refuelling.

! The data, specifications and performance figures are only valid if the vehicle manufacturer complies with all the installation instructions provided by FPT.
Furthermore, the fitted appliances must always be in compliance with the torque, power and engine speed for which the engine was designed.

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SUPPLY SYSTEM

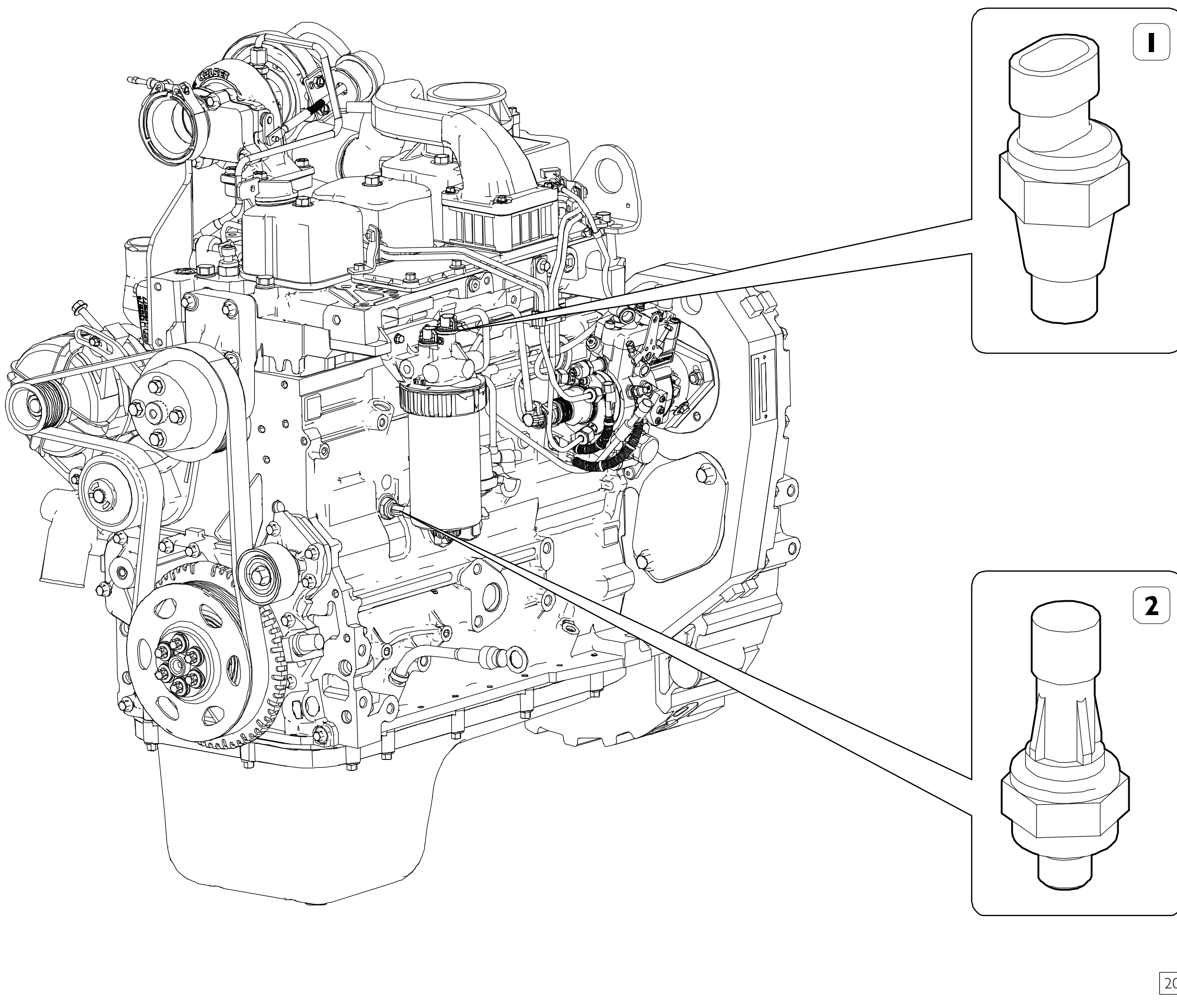
Principles

The fuel supply system is composed of:

- Fuel tank
- Fuel delivery and return pipes
- Priming pump, mounted on the engine and controlled by the camshaft
- Fuel filter
- Rotating feed pump
- Injector supply pipes
- Injectors

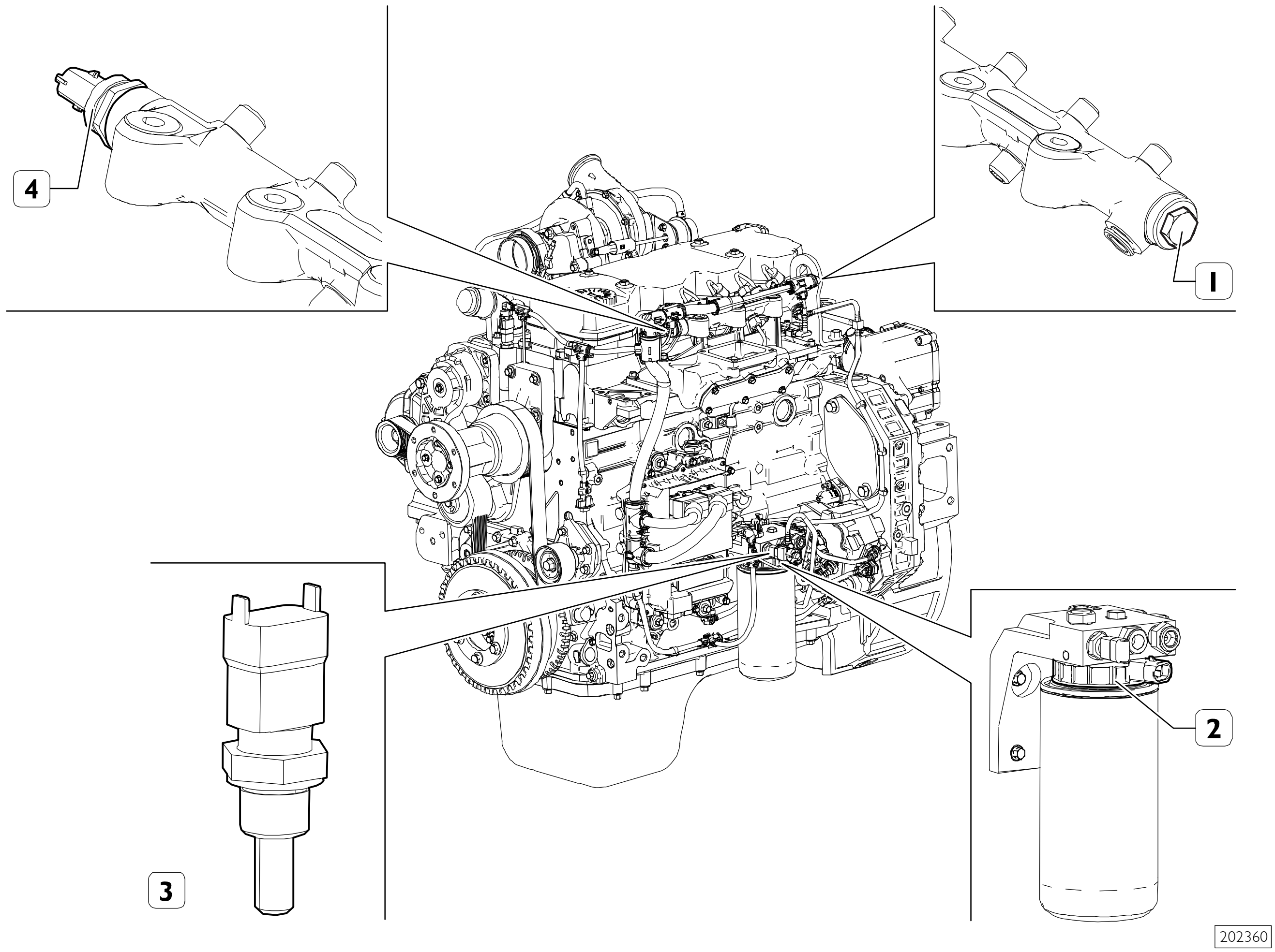
ELECTRICAL SYSTEM

Figure 1 (NEF45 SM1F)



1. Water temperature sensor - 2. Oil pressure sensor

Figure 2 (NEF45 TE1F/TE2F)



1. Pressure regulation valve on Rail - 2. Pressure sensor on Rail - 3. Fuel temperature sensor - 4. Fuel heater on filter

SENSORS

(NEF45 SM1F)

Oil pressure sensor

Mounted on the right side of the crankcase, measure the engine oil pressure.

Water pressure sensor

The same as the oil pressure sensor, it is fitted on the head on the right of the crankcase.

(NEF45 TE1F/TE2F)

Pressure regulator valve

The pressure regulator valve is fixed to the Rail and has the function of regulating and maintaining the pressure according to the engine load condition.
If the pressure is too high, the valve opens to make part of the fuel flow from the Rail to the tank; if the pressure is too low in the Rail, the valve closes and separates the high pressure side from the low pressure side.
This is a solenoid valve electronically controlled by the control unit (EDC module). Pressure variation is carried out by regulating the return flow of diesel to the tank

Fuel heater on filter

This resistor ensures that the fuel remains liquid even if temperatures fall below the freezing point. When temperatures are too low, the fuel tends to form clots that can cause clogging of electro-injectors and problems with cylinder ignition.

Fuel temperature sensor

This sensor is just like the coolant temperature sensor.
It detects the fuel temperature to provide the control unit with an index of the fuel's thermal state.

Pressure Sensor on Rail

Assembled on one end of the rail, measures the existing fuel pressure and informs the control unit (feed - back).
The value of injection pressure is used to keep the pressure level under control and to determine the time duration of the injection electronic command.

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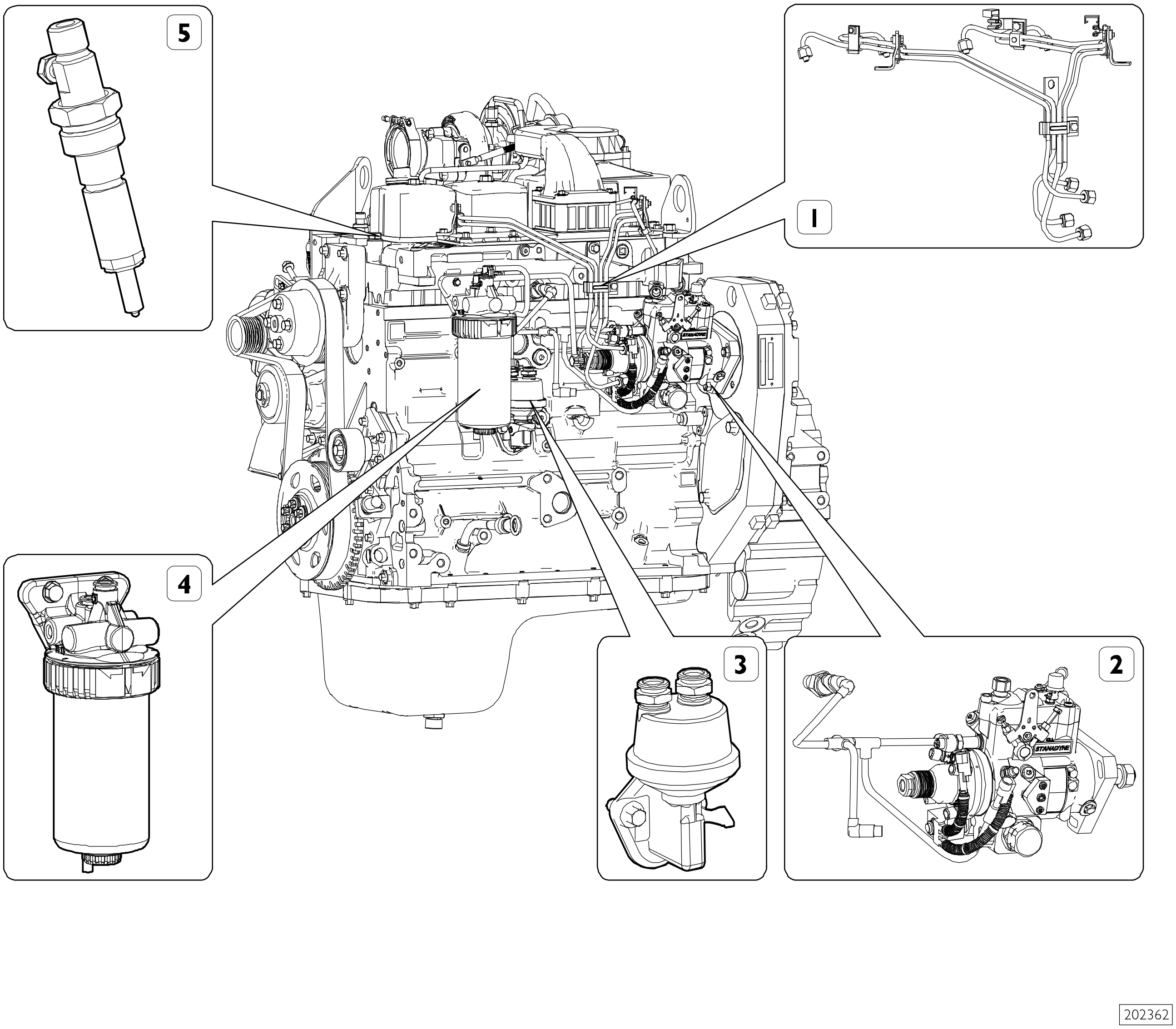
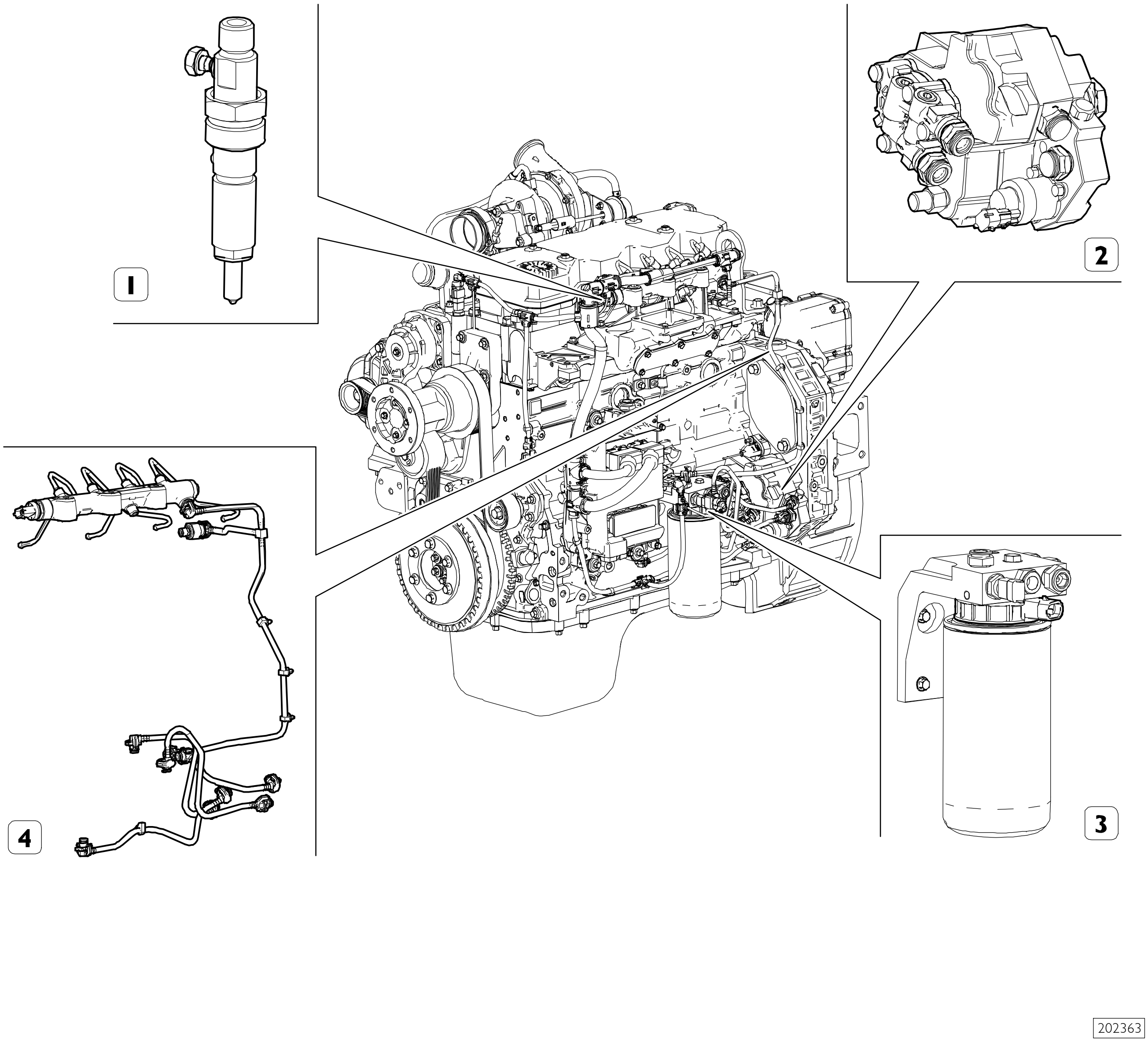
HYDRAULIC SYSTEM

Figure 3 (NEF45 SM1F)



1. High pressure pipes - 2. Stanadyne rotating pump - 3. Priming pump - 4. Fuel filter - 5. Injector

Figure 4 (NEF45 TE1F/TE2F)



1. Electro-injector - 2. High-pressure pump - 3. Fuel filter - 4. Complete fuel piping

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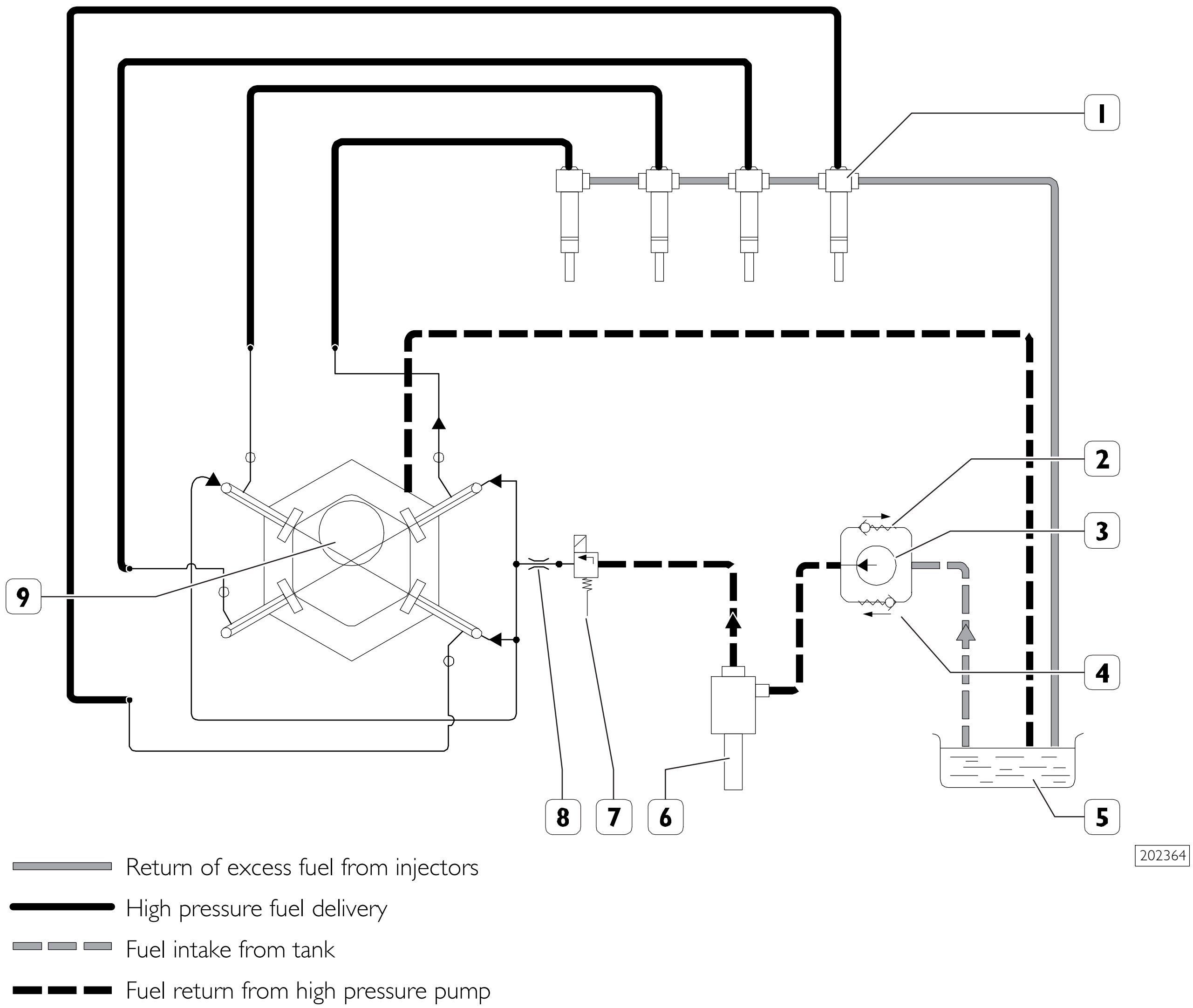
SUPPLY DIAGRAM

Figure 5 (NEF45 SM1F)



1. Injector - 2. Bypass valve - 3. Priming pump - 4. By-pass valve - 5. Fuel tank - 6. Fuel filter - 7. Pressure regulator - 8. Cooling pipes for high pressure pump - 9. Rotating pump

The fuel is sucked into the fuel tank by means of the priming pump.

This is located on the engine crankcase and is activated by the camshaft.

The fuel is conveyed through the filter to the inlet fitting placed in communication with the intake chamber of the transfer pump. (For intended uses in cold climates, the fuel filter is equipped with a heater)

The transfer pump is positioned inside the supply pump and is of the blade type; its purpose is to increase the fuel pressure depending on the increase of the number of revolutions.

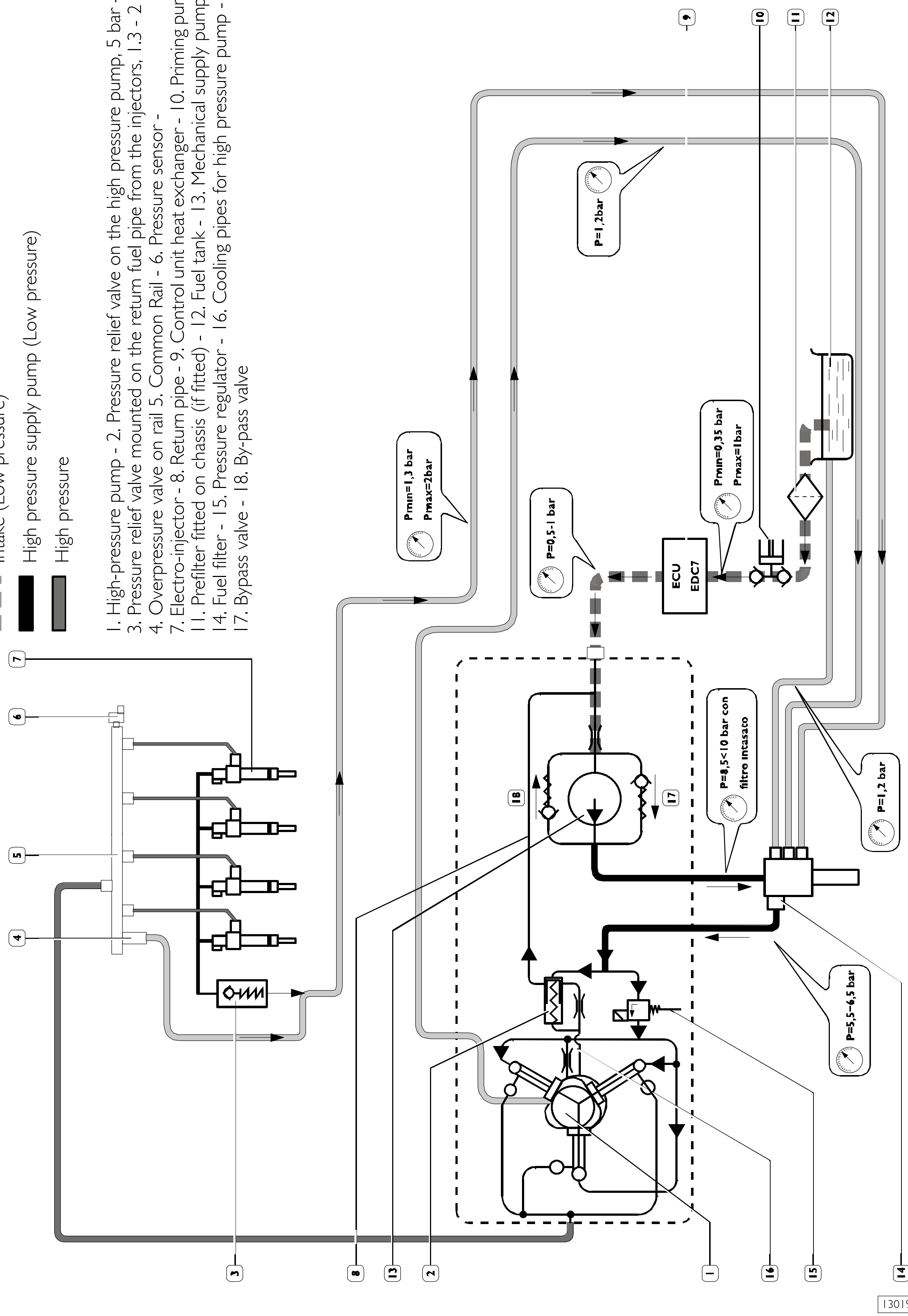
The fuel therefore reaches the valve which regulates the pressure inside the supply pump.

The distributor piston further increases this pressure and sends it through the fuel delivery coupling to the injectors.

The fuel which leaks from the injectors is recovered and sent to the tank again.

Figure 6 (NEF45 TE1F/TE2F)

- Exhaust
- Intake (Low pressure)
- High pressure supply pump (Low pressure)
- High pressure



1. High-pressure pump - 2. Pressure relief valve on the high pressure pump, 5 bar - 3. Pressure relief valve mounted on the return fuel pipe from the injectors, 1.3 - 2 bar 4. Overpressure valve on rail 5. Common Rail - 6. Pressure sensor - 7. Electro-injector - 8. Return pipe - 9. Control unit heat exchanger - 10. Priming pump- 11. Prefilter fitted on chassis (if fitted) - 12. Fuel tank - 13. Mechanical supply pump - 14. Fuel filter - 15. Pressure regulator - 16. Cooling pipes for high pressure pump - 17. Bypass valve - 18. By-pass valve

This CP3 Common Rail injection pump system is shown in the 4-cylinder version.

The pressure regulator, placed upstream of the high-pressure pump, adjusts the fuel flow that is necessary on the low-pressure system.

Afterwards, the high-pressure pump takes care of supplying the rail properly.

This solution, only pressurising the necessary fuel, improves the energy efficiency and limits heating the fuel in the system.

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

The pressure relief valve (2) intervention brings about a fuel flow increase in the high-pressure pump cooling circuit, through inlet and drain piping (16) from piping (8).

The pressure relief valve seated on the cylinder head, mounted on the back of the electro-injectors (3), restricts the return flow of fuel by the electro-injectors at a pressure of 1.3 ÷ 2 bar.

Two by-pass valves are placed in parallel with the mechanical supply pump.

The by-pass valve (18) allows fuel to flow from mechanical pump outlet to its inlet, when the fuel filter inlet pressure exceeds the allowed threshold value.

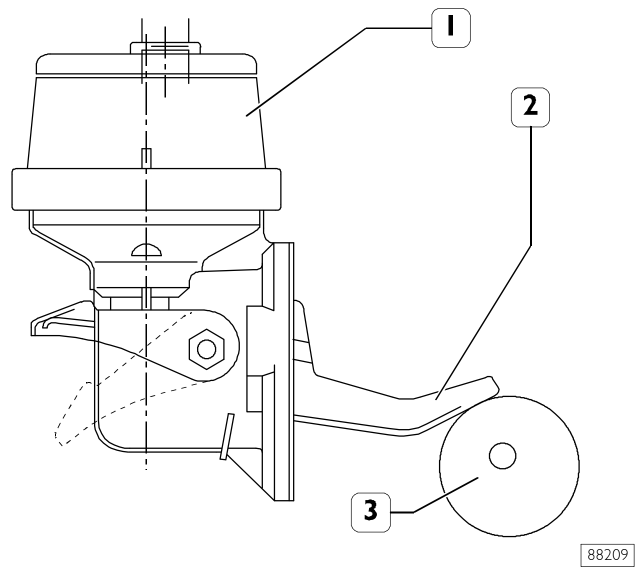
The by-pass valve (17) allows filling the supply system through the manual priming pump (10).

SUPPLY SYSTEM COMPONENTS

Priming pump

The pump has the function of priming the fuel in the tank and conveying it to the fuel supply pump. This is located on the engine crankcase and is activated by the camshaft.

Figure 7 (NEF45 SM1F)



1. Pump - 2. Control lever - 3. Camshaft.

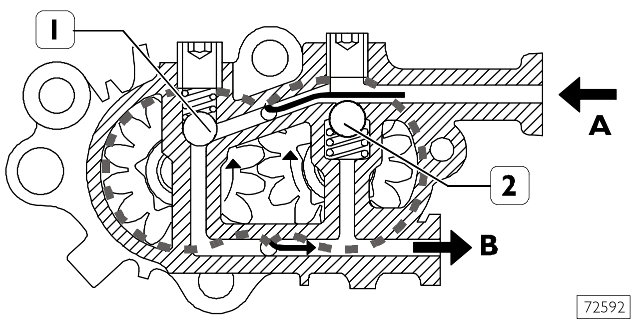
Mechanical supply pump

(NEF45 TE1F/TE2F)

Gear pump, mounted on the rear part of the high pressure pump, has the function of supplying it. It is controlled by the high pressure pump shaft.

Normal operating condition

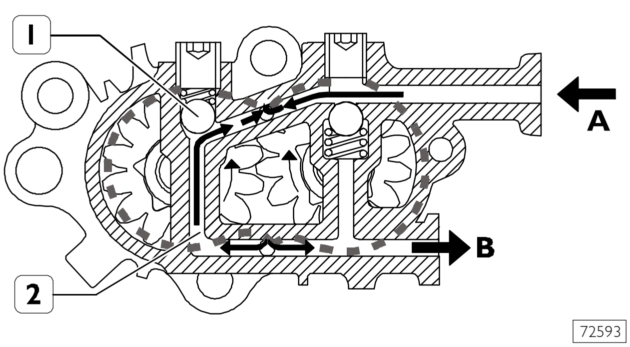
Figure 8



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

Output overpressure condition

Figure 9

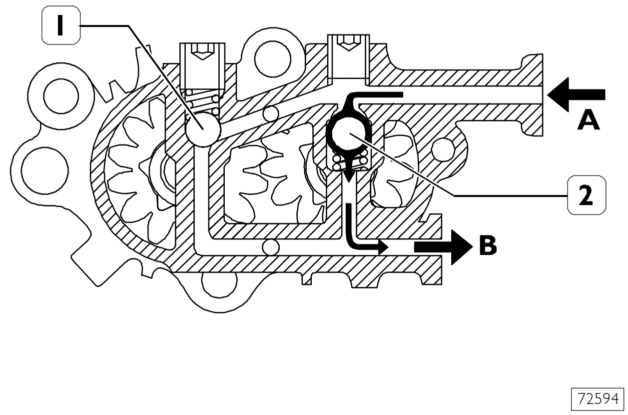


By-pass valve (1) opens in the presence of overpressure at the outlet B.

The pressure of the fuel overcomes the force exerted by the spring of the valve (1), thereby placing the pump outlet in communication with the inlet by way of passage (2).

Air bleeding conditions

Figure 10



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

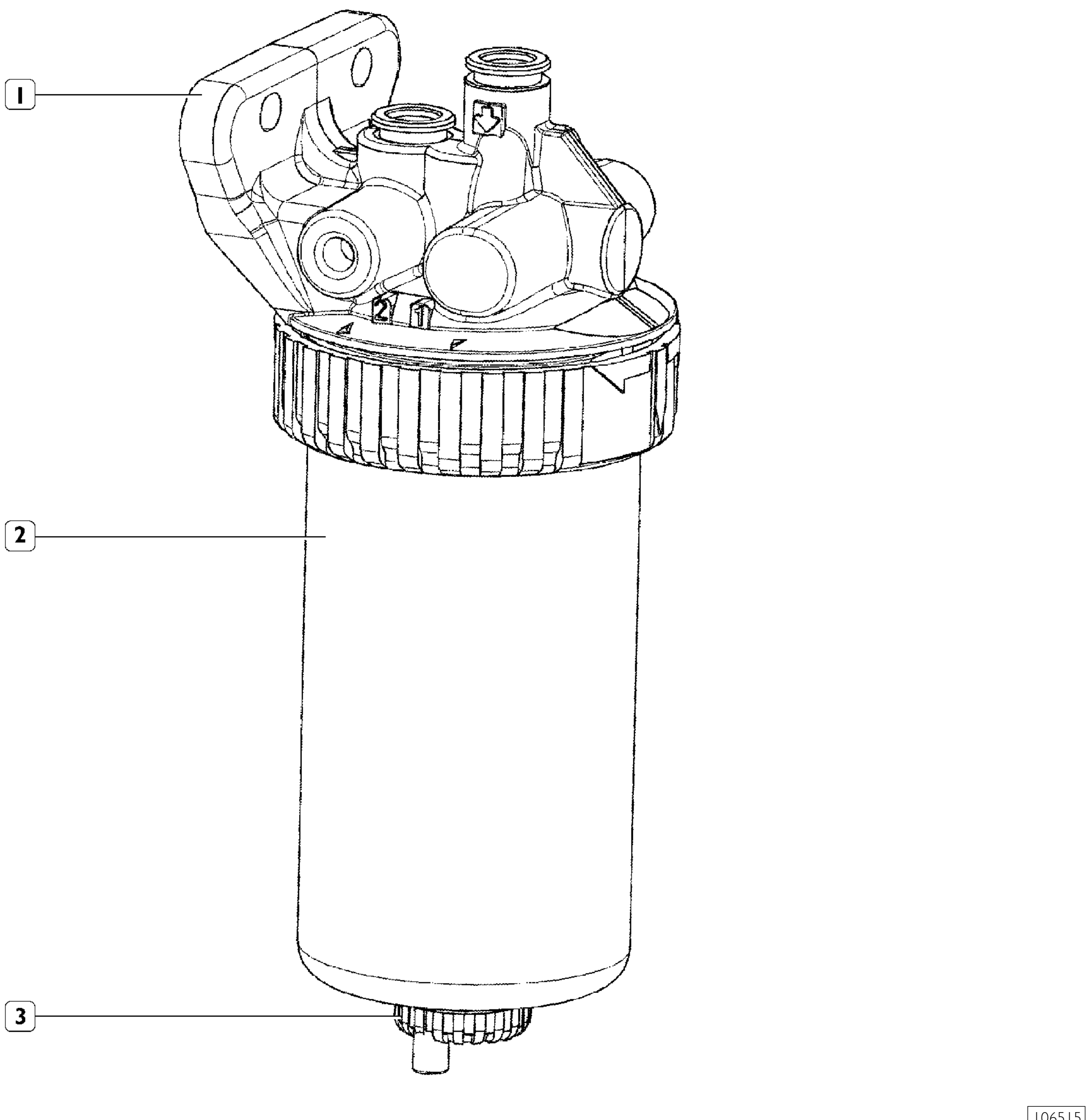
NOTE The mechanical supply pump cannot be replaced individually, so it must not be removed from the high pressure pump.

Fuel filter

The filter is positioned near the feed pump and the priming pump, and has the function of retaining impurities and separating the water contained in the fuel.

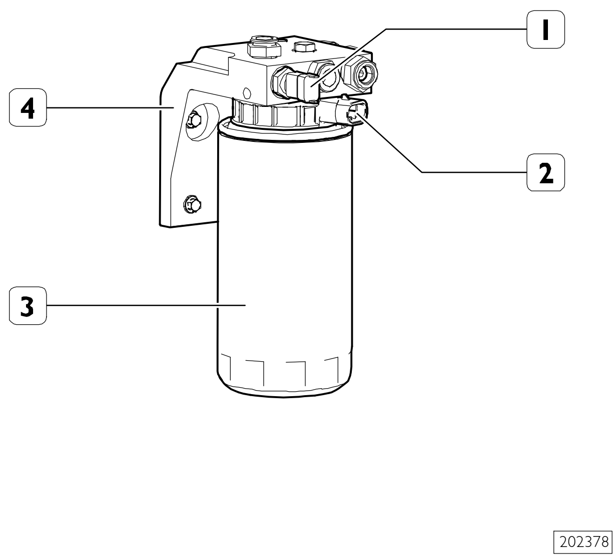
At the base of the filter cartridge, there is a water bleed screw through which it is possible to drain it from time to time; a heater and temperature sensor can be placed on the support for the uses that require it (use in cold climates). On some versions, there is a water presence sensor at the base of the filtering cartridge.

Figure 11 (NEF45 SM1F)



1. Fuel filter support - 2. Filtering cartridge - 3. Water bleed screw.

Figure 13 (NEF45 TE1F/TE2F)

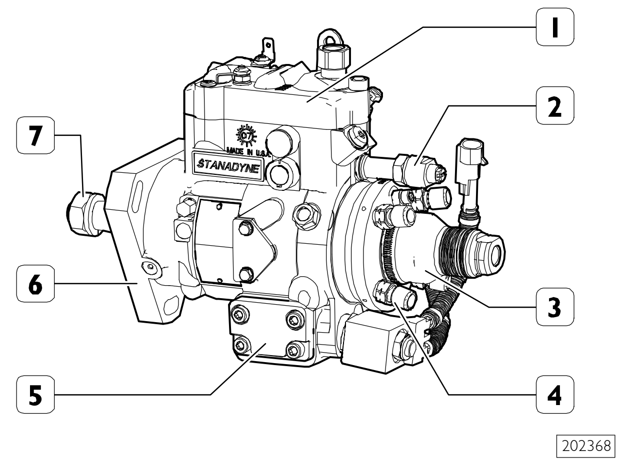


1.Fuel temperature sensor - 2. Fuel heater - 3. Cartridge - 4. Complete filter support

Feed pump

The rotary pump is driven by a gear coupled to the camshaft.

Figure 12 (NEF45 SM1F)



1. Power switch-off solenoid valve - 2. Metering valve - 3. Pressure regulator unit - 4. Hydraulic head - 5. Automatic advance - 6. Seat - 7. Propeller shaft

Operation description

The main rotation components are the propeller shaft (7), the distribution rotor, the transfer pump vanes and the regulator (3). Referring to Figure 12, the propeller shaft engages the distribution rotor inside the hydraulic head.

The four pistons are engaged towards each other simultaneously by the cam inner ring through the rollers and the sliding blocks that are transported into the holes located on the end of the rotor.

The number of cam lobes is equal to the number of engine cylinders.

The transfer pump positioned no the rear part of the rotor is positive cylinder type and is closed within the end plug. The end plug also contains the screen of the inlet filter and the pressure regulator of the transfer pump. The upper part of the regulator unit is pressed against the distribution rotor and forms a final seal for the transfer pump.

The distribution rotor contains two loading ports, a single axial hole and an exhaust port serving all outputs to the injection lines.

The hydraulic head contains the hole in which the rotor turns, the hole of the metering, opening and loading valves, and the fittings for the discharge outlet. The high pressure injection lines connected to the injectors are fixed to the above mentioned exhaust couplings.

High pressure pump CP3

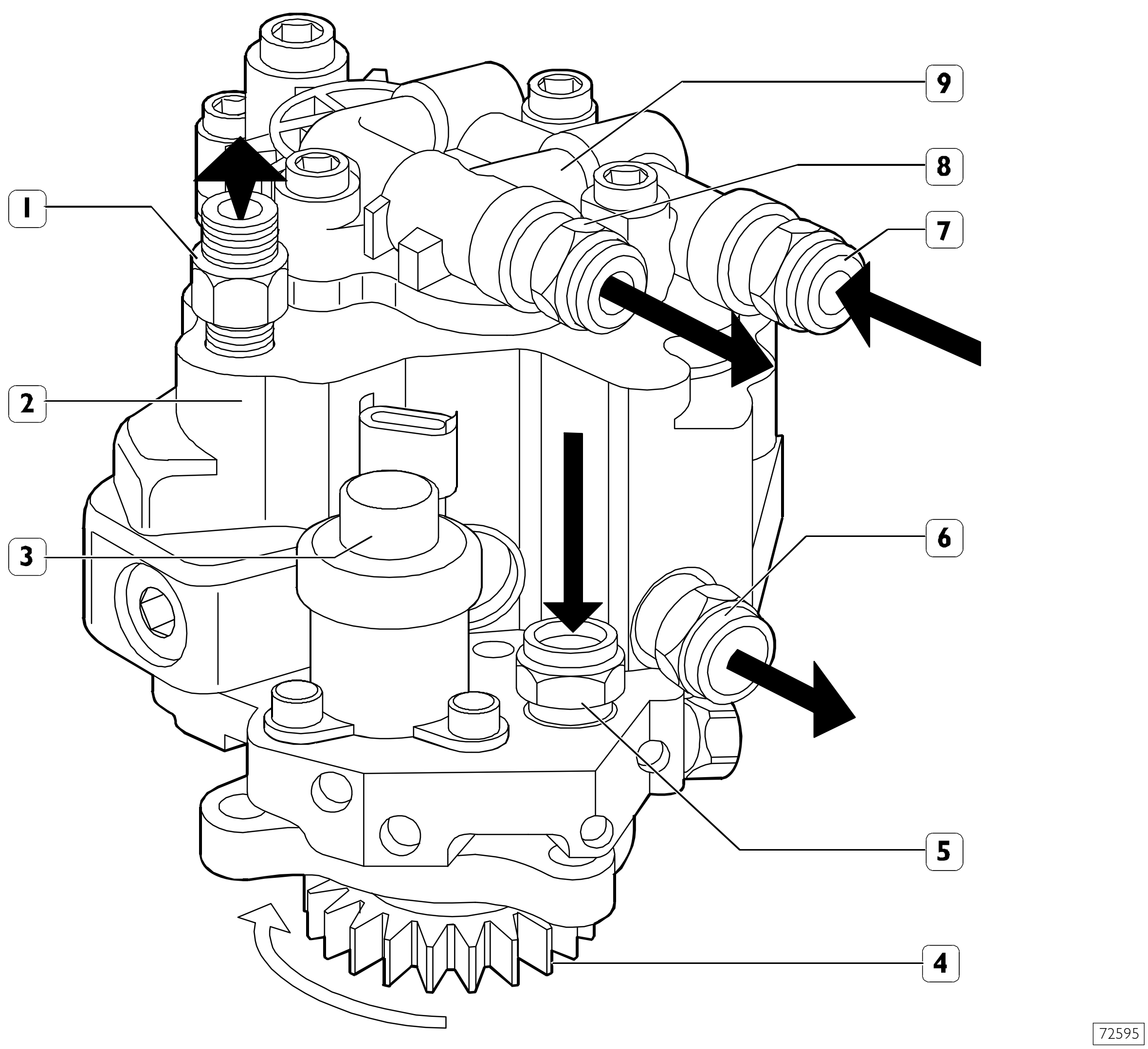
Pump with 3 radial plungers, controlled by distribution gears, requires no timing.

The mechanical supply pump controlled by the high pressure pump shaft is mounted on the rear side of the high pressure pump.

The high pressure pump - feed pump assembly cannot be overhauled and therefore should not be removed and the fastening screws should not be tampered with.

The only operation that can be carried out is the replacement of the drive gear and pressure regulator.

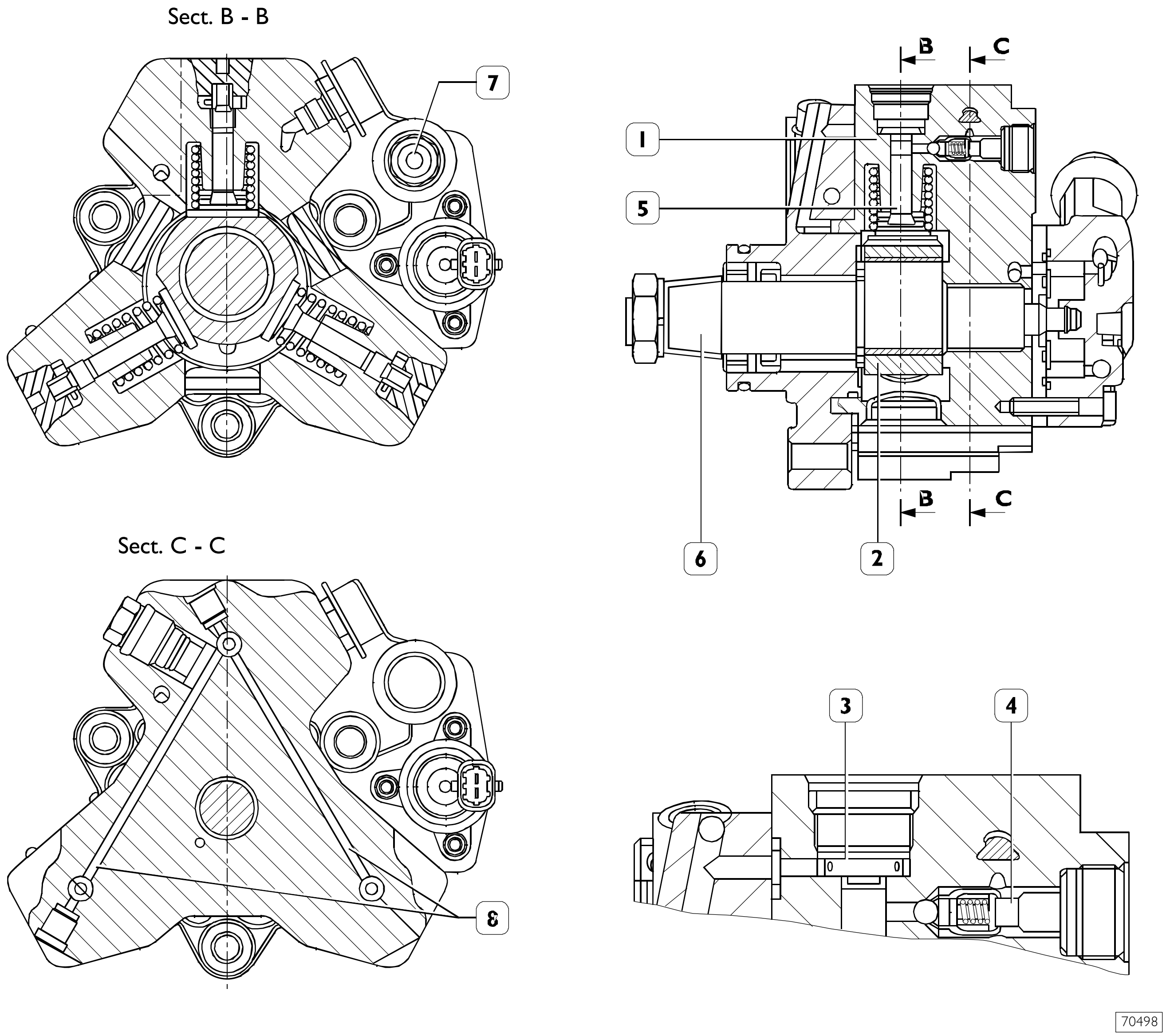
Figure 14 (NEF45 TE1F/TE2F)



1. Connection between fuel outlet and rail - 2. High pressure pump - 3. Pressure regulator - 4. Drive gear 5. Filter fuel inlet union - 6. Connection between fuel outlet and filter bracket - 7. Connection for fuel inlet from heat exchanger ECU - 8. Connection between fuel outlet from mechanical pump and filter - 9. Mechanical supply pump.

High-pressure pump internal structure

Figure 15



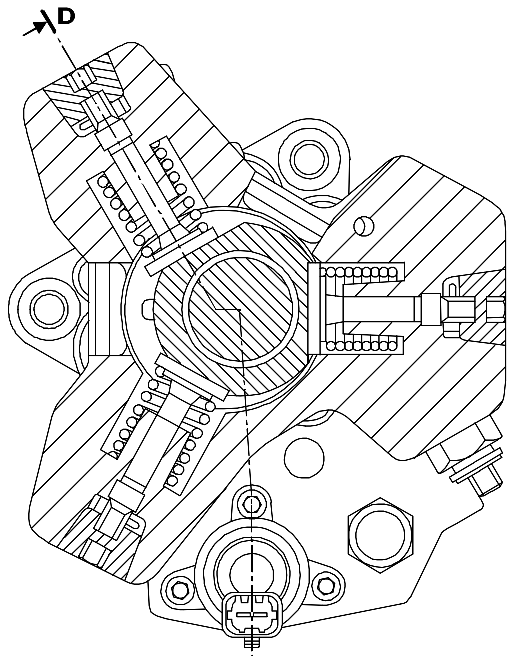
1. Cylinder. - 2. Triple-lobe element - 3. Cap intake valve. - 4. Ball delivery valve. - 5. Piston. - 6. Pump shaft. - 7. Low-pressure fuel inlet. - 8. Plungers supplying fuel ducts.

Each pump unit consists of:

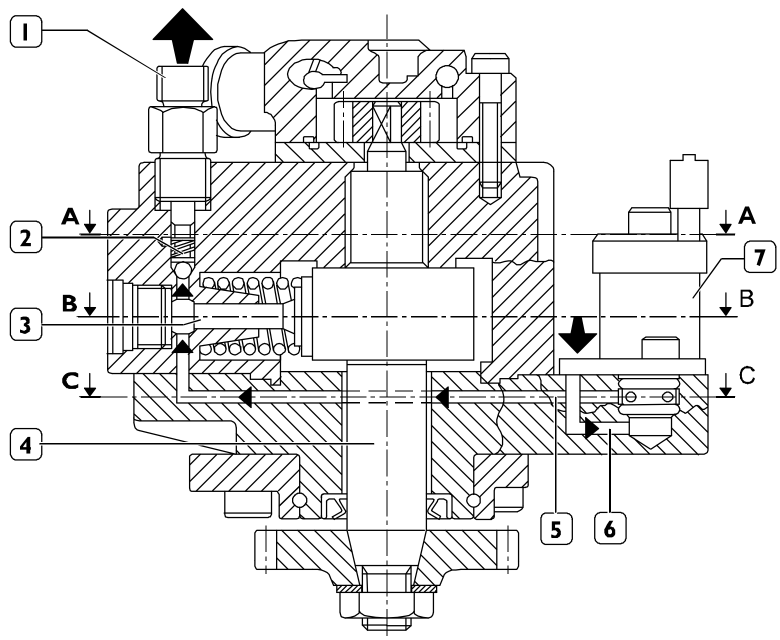
- a piston (5) actuated by a three-lobe element (2) floating on the pump shaft (6). Since the element (2) floats on an offset part of the shaft (6), during the rotation of the shaft it does not rotate with it but is only pushed towards one of the pistons (5) (distributed with an interval of 120° on the entire crown), and activated.
- cap intake valve (3);
- ball delivery valve (4).

Operating principle

Figure 16



Sect. B - B



Sect. D - D

72597

1. Connection between fuel outlet and rail - 2. Delivery valve to rail - 3. Plunger - 4. Pump shaft - 5. Plunger supply pipe - 6. Pressure regulator supply pipe - 7. Pressure regulator.

Plunger (3) is oriented to pump shaft (4) cam.

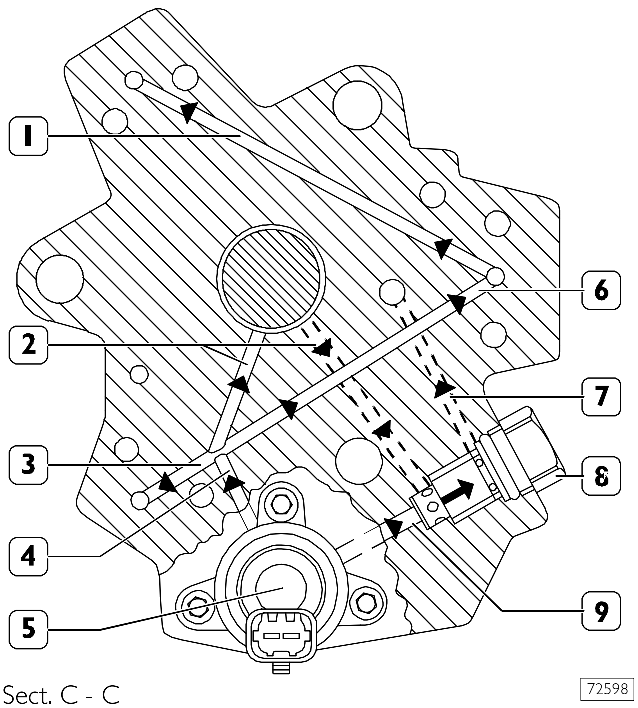
During intake, the plunger is supplied through supply duct (5).

The fuel amount to be sent to the plunger is set by the pressure regulator (7).

The pressure regulator, according to the PWM command received from the control unit, chokes the flow of fuel to the pumping element.

During plunger compression stage, fuel reaches the pressure required to open the delivery valve to common rail (2) and to feed it through outlet (1).

Figure 17



Sect. C - C

1. Plunger inlet - 2. Pump lubrication pipes - 3. Plunger inlet - 4. Main plunger supply pipe - 5. Pressure regulator - 6. Plunger inlet - 7. Regulator drainpipe - 8. Pressure limiting valve 5 bar - 9. Fuel discharge from regulator inlet.

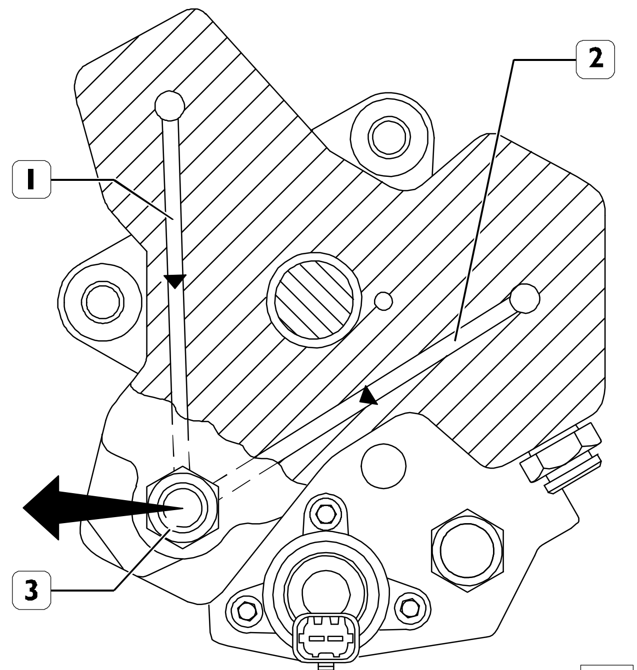
Figure 17 shows the routes of the fuel at low pressure inside the pump; it shows the main supply pipe of the pumping elements (4), the pumping element supply pipes (1 - 3 - 6), the pipes used to lubricate the pump (2), the pressure regulator (5), the 5-bar pressure relief valve (8) and the fuel discharge (7).

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

The pressure regulator (5) establishes the quantity of fuel to be supplied to the plungers; The excess fuel flows off through the pipe (9).

The 5 bar relief valve, in addition to functioning as a collector for fuel discharge, has the function of keeping the pressure constant at 5 bar at the entrance of the regulator.

Figure 18



Sect. A - A

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

Figure 18 shows high pressure fuel flow through plunger outlet ducts.

Operation

The cylinder is filled through the plate intake valve only if the supply pressure can open the delivery valves on the plungers (approx. 2 bar).

The amount of fuel that supplies the high pressure pump is metered by the pressure regulator, positioned on the low pressure system; the pressure regulator is controlled by the EDC 7 control unit through a PWM signal.

If the fuel is sent to the plunger, its piston is moving down (intake stroke). When the piston stroke inverts, the intake valve closes and the fuel remaining in the plunger chamber, which cannot exit, is compressed beyond the existing supply pressure in the rail.

The pressure generated this way causes the discharge valve to open and the compressed fuel reaches the high pressure circuit.

The plunger compresses the fuel till the top dead centre (delivery stroke) is reached. Then the pressure decreases so that the discharge valve closes.

The plunger piston returns to the bottom dead centre and the residual fuel is decompressed.

When the pressure in the plunger chamber is lower than the supply pressure, the intake valve opens again and the cycle is repeated.

The delivery valves must always be free in their movement, with no impurities or oxidation.

The rail delivery pressure is modulated between 250 and 1,600 bar by the electronic control unit through the solenoid valve of the pressure regulator.

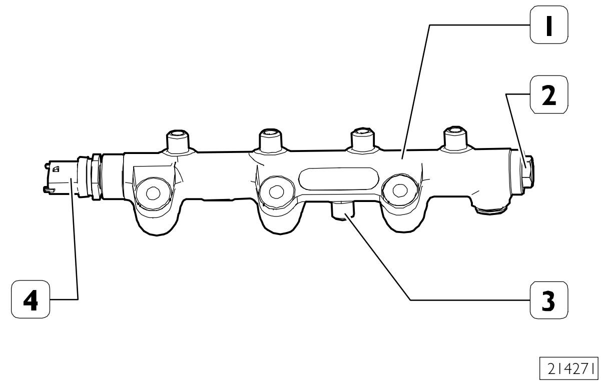
The pump is lubricated and cooled by the same fuel.

The removal - refitting time of the radial jet pump on the engine is significantly reduced compared to traditional injection pumps because no timing is necessary.

In the event of removal - refitting of the fuel filter pipe and high pressure pump, make sure hands and components are as clean as possible.

Rail (pressure accumulator)

Figure 19



1. Rail. - 2. High pressure overpressure valve. -
3 Entrance of fuel from the pump -
4. Pressure sensor.

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

It anyway has enough volume as to minimise pulsations 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.

Overpressure valve

Once the valve has been mounted at one rail end, the valve task is to protect system components in the case where a fault in either rail pressure sensor or pump pressure regulator CP3 causes pressure excessive increment in high pressure system.

When pressure reaches 1800 bars in the rail, initially valve intervenes to drain fuel and therefore reduce pressure to safe values, then it mechanically adjusts pressure in rail at approx. 800 bars.

This valve enables to have the engine operated for long time with limited performance and inhibits fuel excessive overheating, so preserving the pipings returning from the tank.

Electro-injector

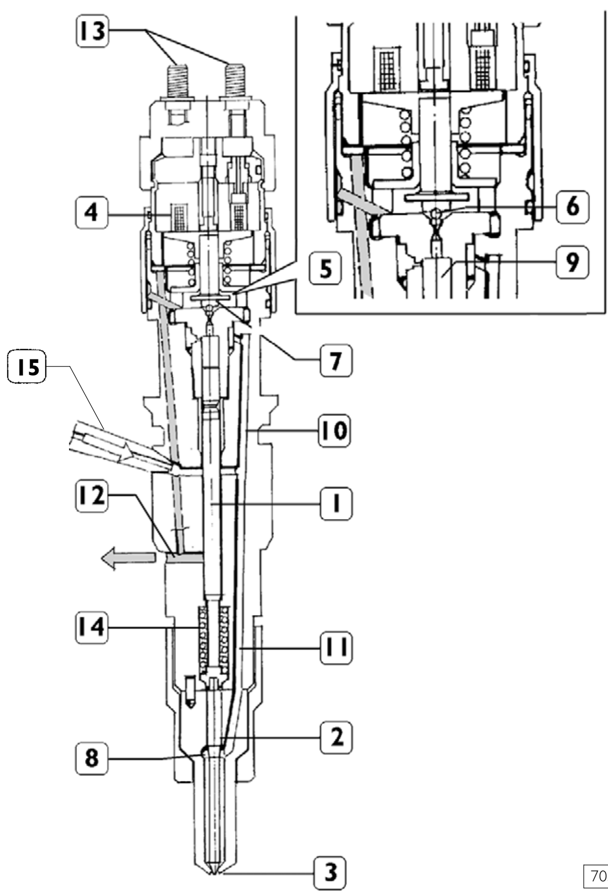
The injector features a traditional construction, save for the fact that it has no needle return springs.
The electro-injector essentially consists of two parts:

- actuator - spray nozzle composed of pressure rod (1), plunger (2) and nozzle (3);
- control solenoid valve composed of coil (4) and pilot valve (5).

The solenoid valve checks the lift of the nozzle needle.

Injector in resting position

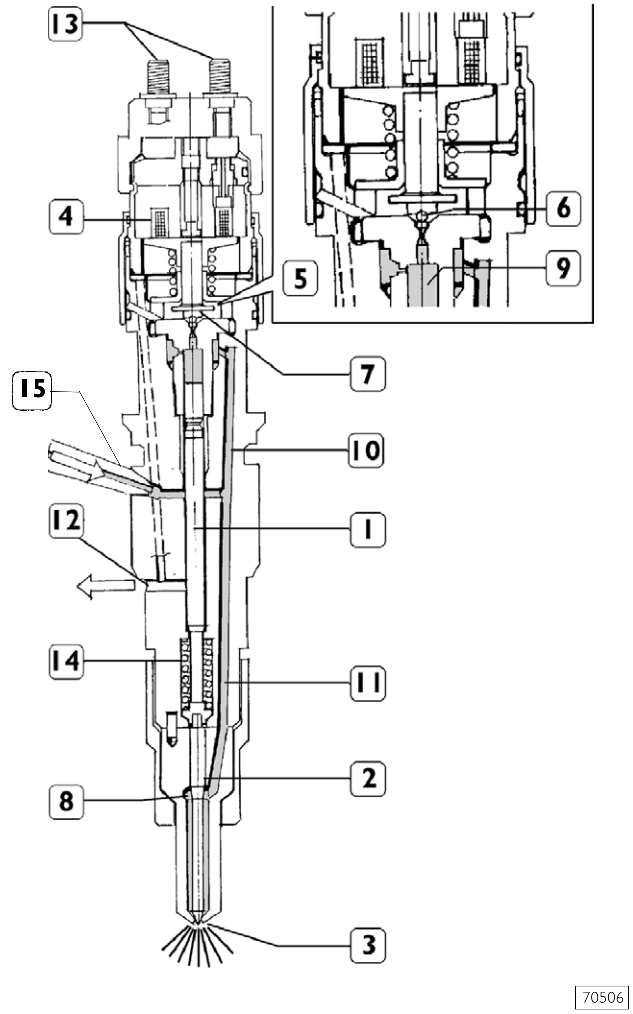
Figure 20



1. Pressure rod - 2. Needle - 3. Nozzle -
4. Coil - 5. Pilot valve - 6. Ball shutter -
7. Control area - 8. Pressure chamber - 9. Control volume -
10. Control duct - 11. Supply pipe - 12. Control fuel outlet -
13. Power connection - 14. Spring -
15. High pressure fuel inlet.

Beginning of injection

Figure 21



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.

End of injection

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 electro-injector cannot be overhauled and therefore it must not be disassembled.

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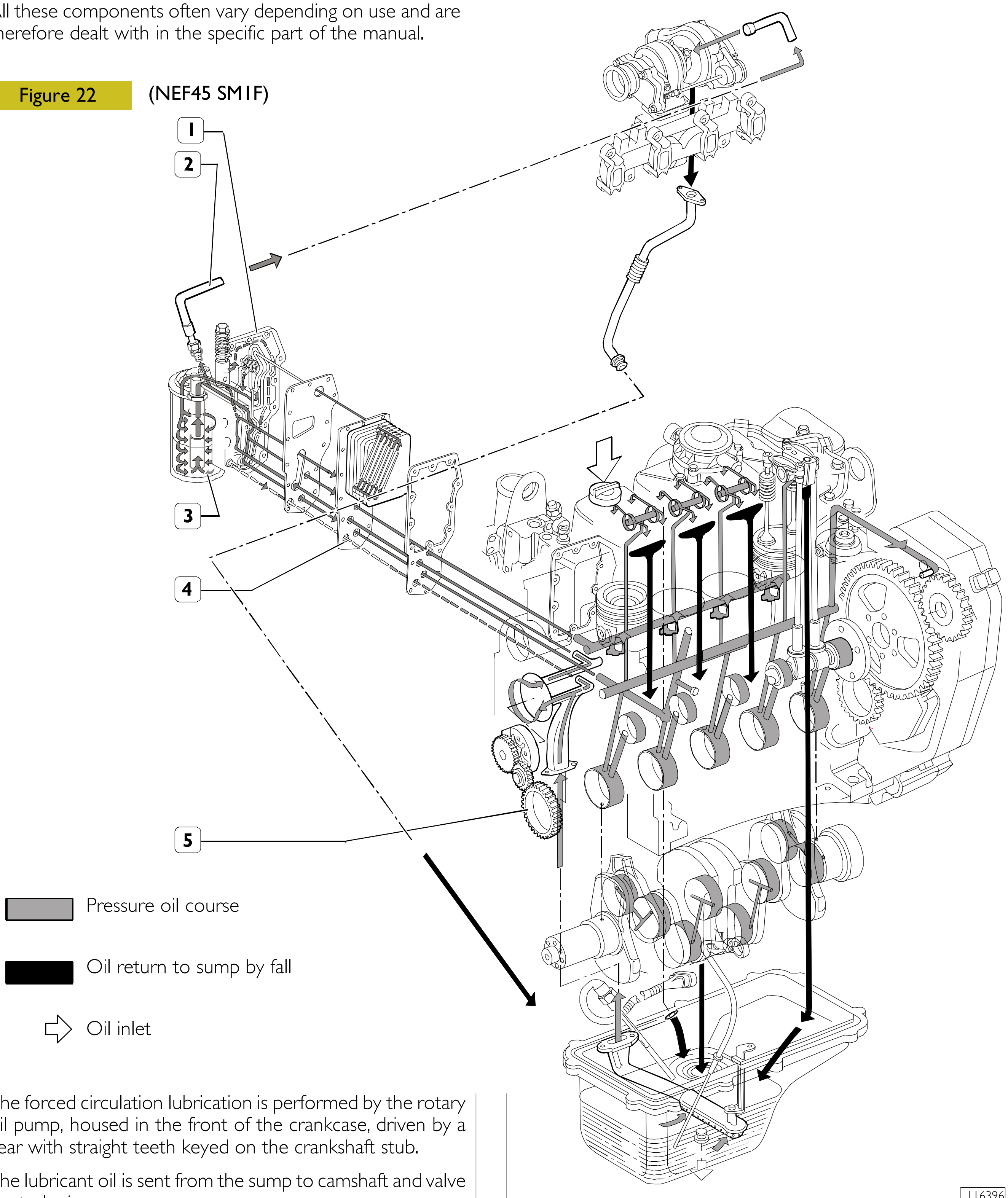
LUBRICATION CIRCUIT

Principles

The lubrication system includes components such as the heat exchanger, the turbocharger, for the turbocharged versions, and the compressor to the compressed air system if necessary.

All these components often vary depending on use and are therefore dealt with in the specific part of the manual.

Figure 22 (NEF45 SM1F)

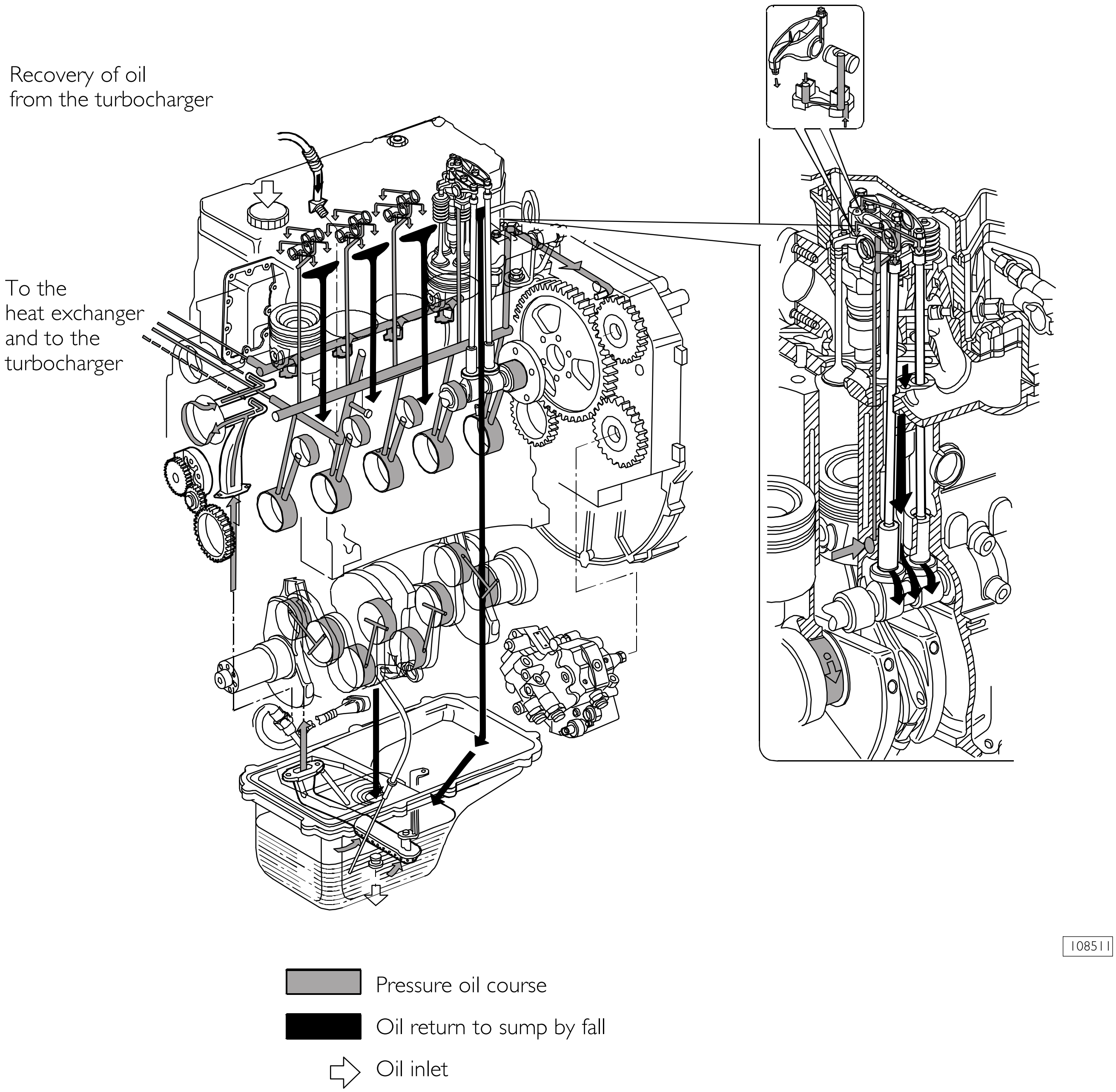


1. Heat exchanger body - 2. Turbocharger lubrication delivery pipe - 3. Oil filter - 4. Heat exchanger - 5. Oil pump.

The forced circulation lubrication is performed by the rotary oil pump, housed in the front of the crankcase, driven by a gear with straight teeth keyed on the crankshaft stub.

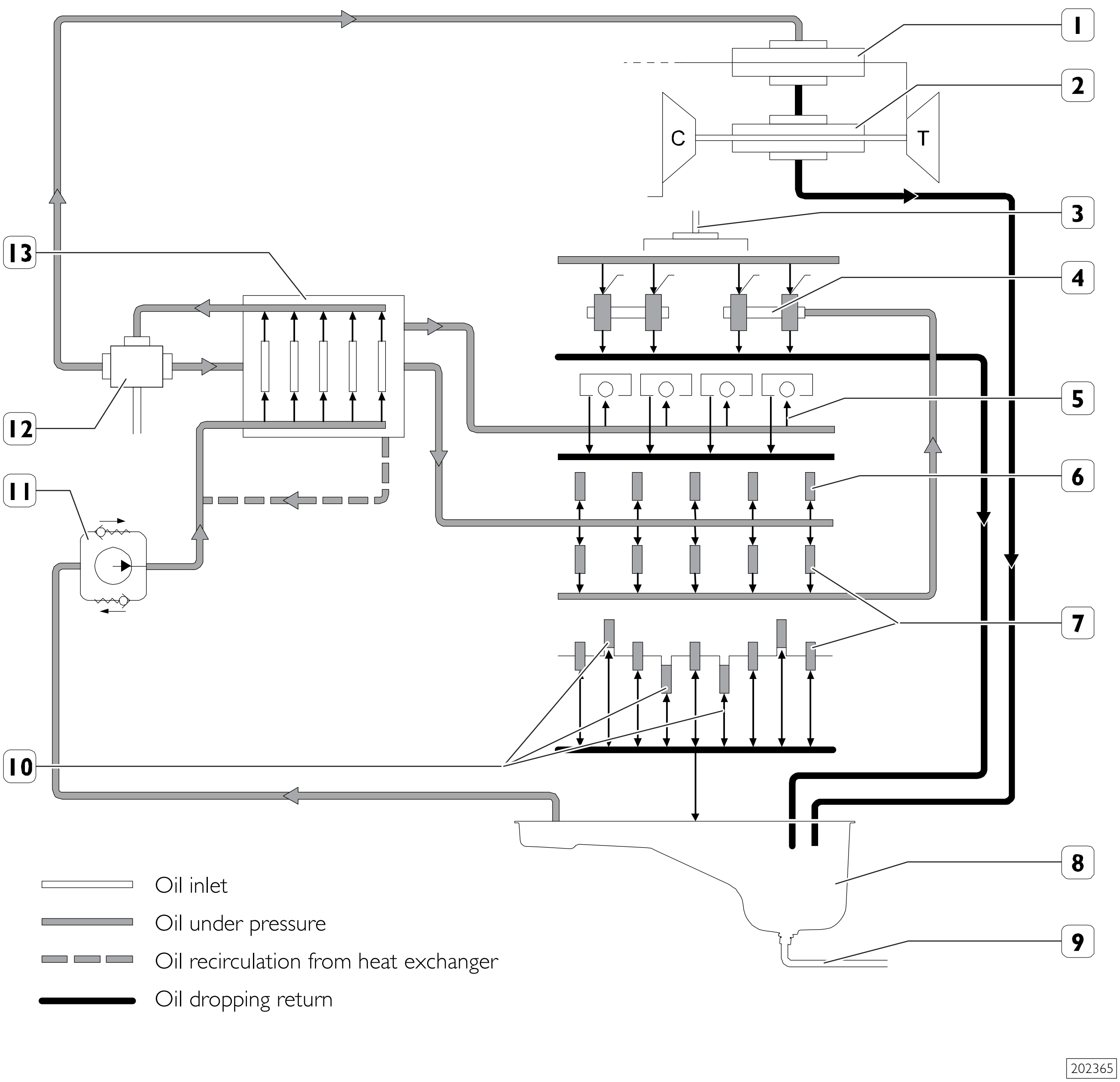
The lubricant oil is sent from the sump to camshaft and valve control wing.

Figure 23 (NEF45 TE1F/TE2F)



LUBRICATION DIAGRAM

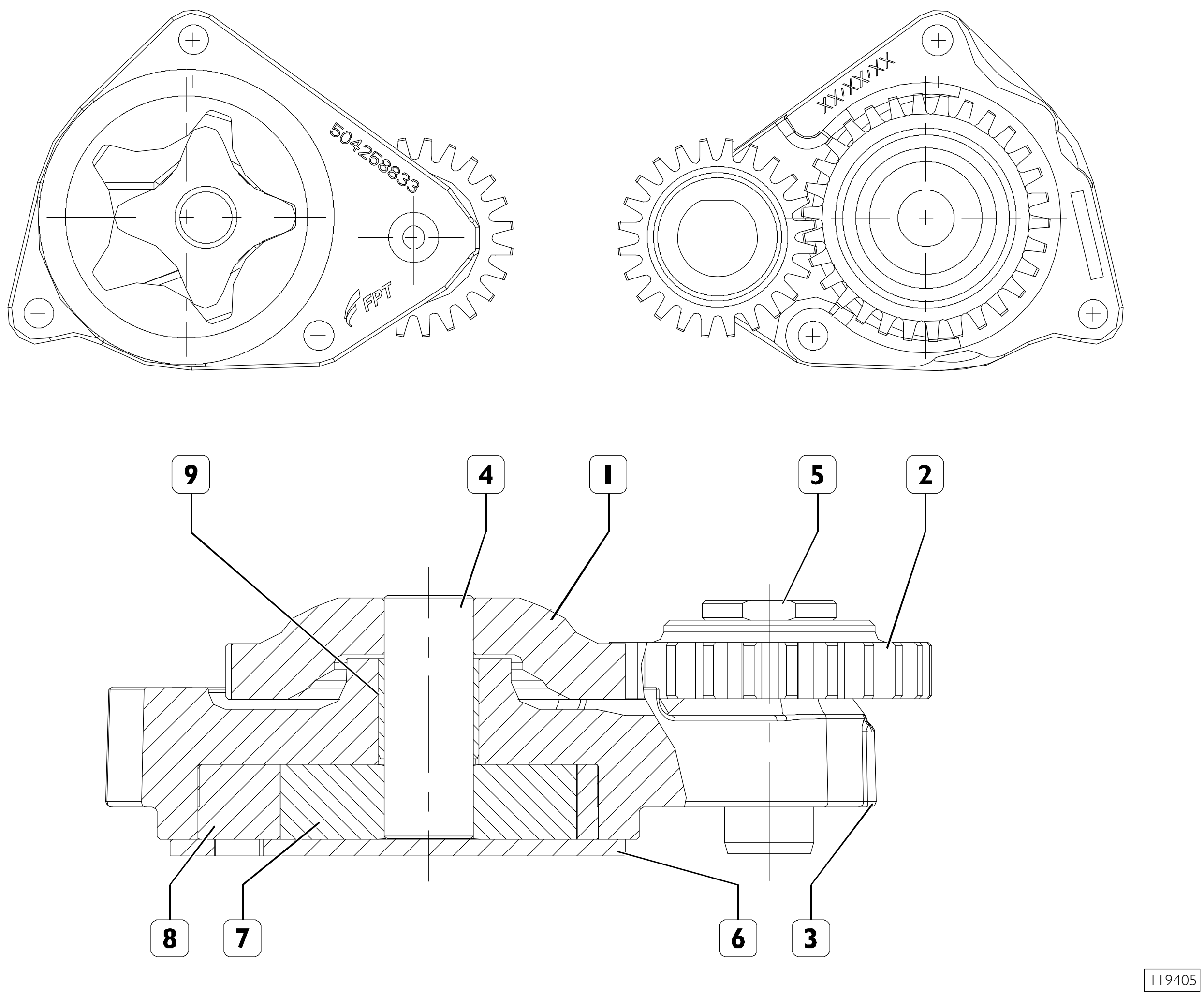
Figure 24



1. Exhaust manifold - 2. Turbocharger shaft - 3. Oil filling plug - 4. Rocker arms -
5. Piston lubricating nozzles - 6. Camshaft mounts - 7. Crankshaft main bearings - 8. Oil sump - 9. Oil drain plug -
10. Connecting rod bearings - 11. Oil pump - 12. Oil filter - 13. Heat exchanger

LUBRICATION CIRCUIT COMPONENTS
Oil pump

Figure 25

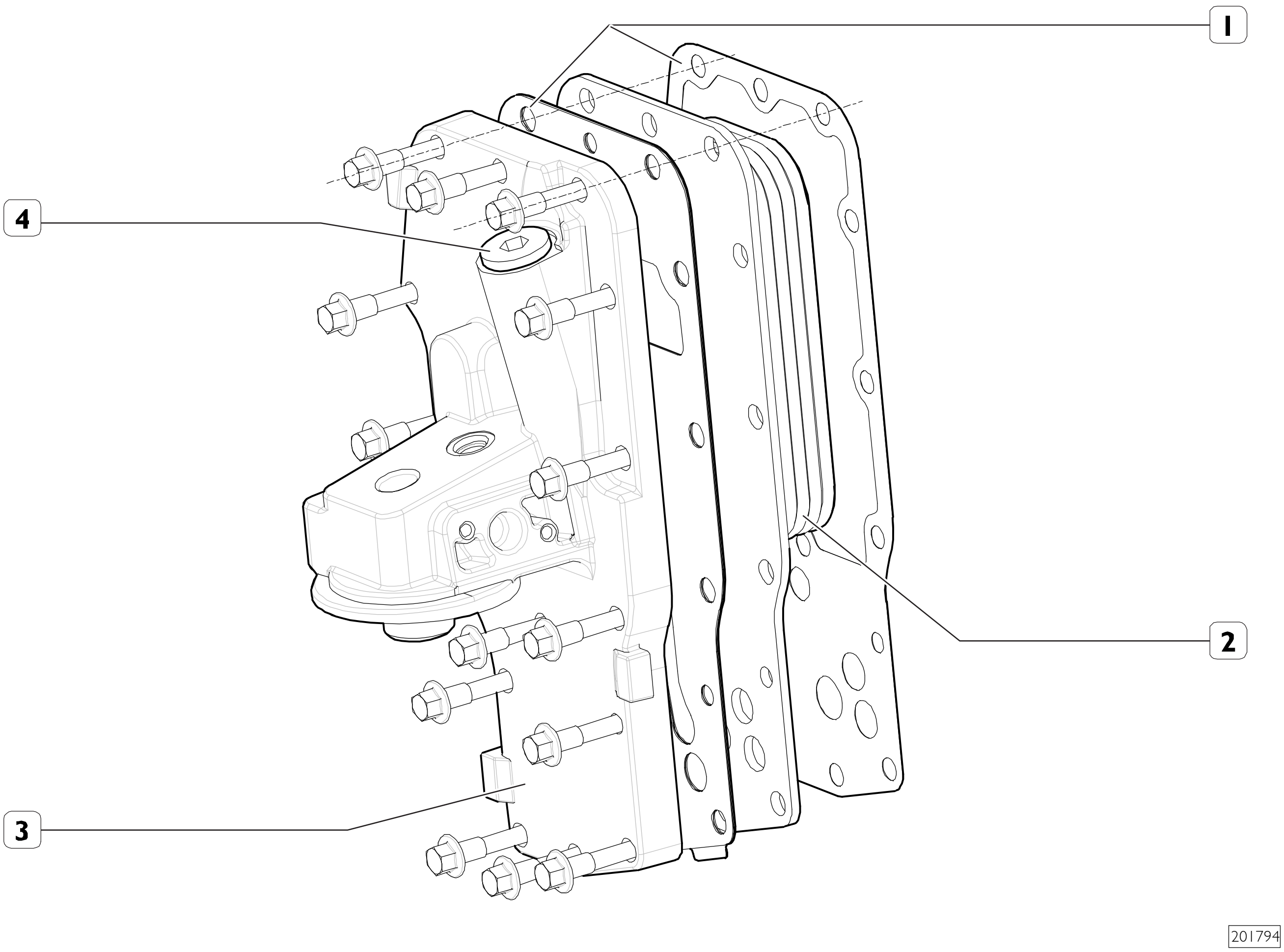


PUMP FEATURES	
Rotation speed	750 rpm - 4200 rpm
Delivery pressure	2 Bar - 4 Bar
Ampere rating	12.2 l/min - 75.9 l/min
Type of oil	SAE 20/30
Max oil temperature	80 °C

1. Primary gear - 2. Secondary gear - 3. Pump body - 4. Control shaft - 5. Layshaft
6. Cover - 7. Internal rotor - 8. External rotor - 9. Bushing.

Heat exchanger

Figure 26



1. Gaskets - 2. Internal heat exchanger element (7 elements) - 3. Heat exchanger body -
4. Pressure regulator valve

The heat exchanger, installed in the engine cooling system, has the task of regulating the oil temperature by subtracting heat through the use of coolant.

Performance according to GT 0179	
Pressure range	0... 2.5 MPa
Frequency	0.5 ÷ 3 Hz
Trend	Sinusoidal
No. of cycles	>500000
Explosion pressure	> 10 MPa

Piping	
Engine	5W30
Internal oil temperature	115.6 °C
Capacity	51 dm^3/min

Skirt	
Refrigerant	glycol
Internal coolant temperature	82.2 °C
External flow rate	230 dm^3/min

Oil pressure regulating valve

Figure 27

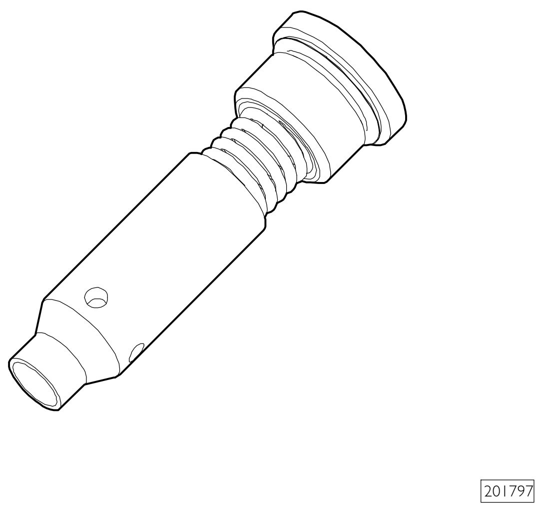
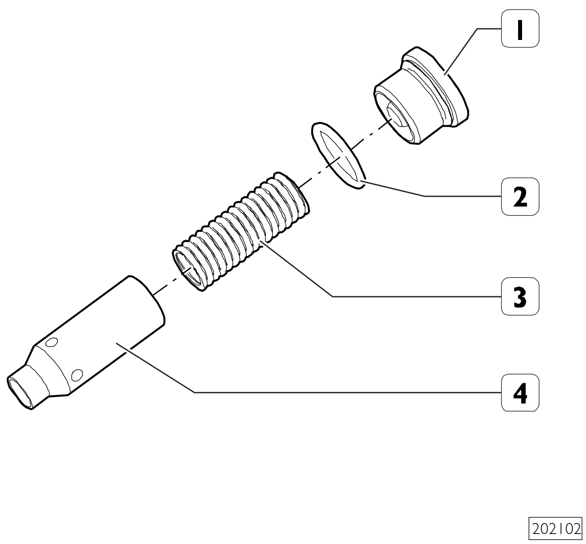


Figure 28



1. Threaded plug - 2. Seal -
3 Compression spring - 4. Valve body

MAIN DATA OF OIL PRESSURE CONTROL SPRING VALVE

Free length = 66 mm

Open valve load = 136.9 ± 10.5 N

Open valve height = 41.25 mm

Operating load = 695.8 MPa

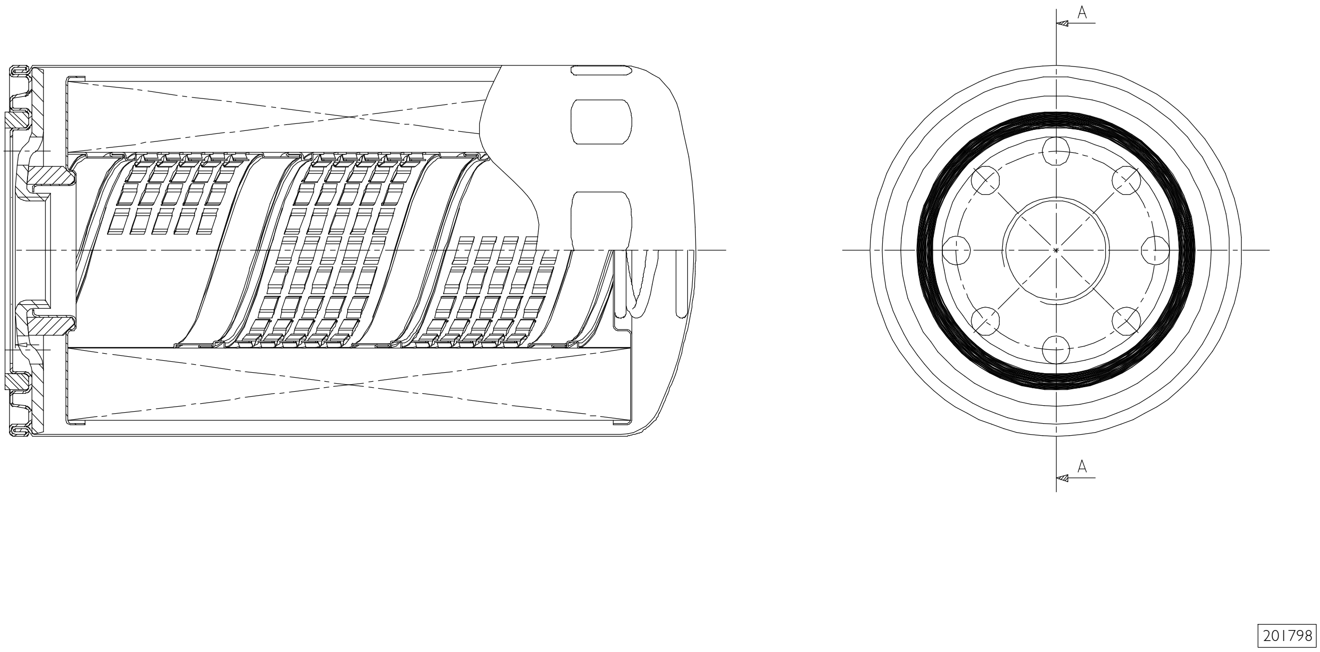
Constant spring load = 945.3 MPa

Natural frequency = 320 Hz

Spring flexibility = 5.4 N/mm

Engine oil filter

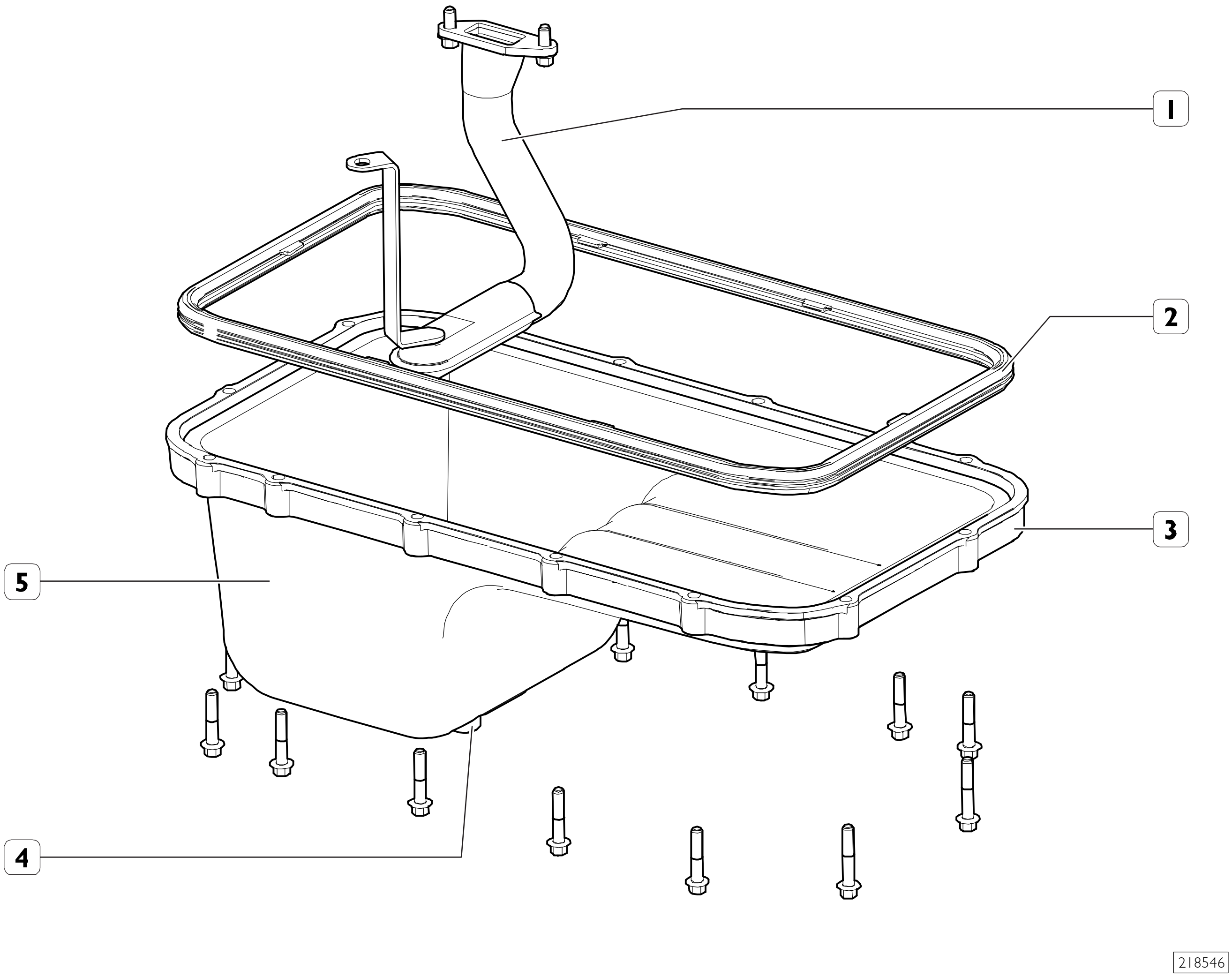
Figure 29



	C. Filtration	U.F.I.
Explosion pressure:	20 bar (ISO 4548/3)	20 bar (ISO 4548/3)
Button pressure:	0-15 bar (1Hz) > 50,000 cycles (ISO 4548/5)	0- 15 bar (1Hz) > 50,000 cycles (ISO 4548/5)
Operating temperature:	-40 / +140 °C	-40 / + 140 °C
Tightening torque:	20 0/+5 Nm	18 ± 2 Nm
Maximum flow rate:	100 l/mn	100 l/mn
Loss of load at end of life:	2.5 bar	2.5 bar
Accumulation power:	>20 gr with loss of load 1.72 bar (SAE J1858)	>60 gr with loss of load 2.5 bar (ISO 16889)

Oil sump

Figure 30



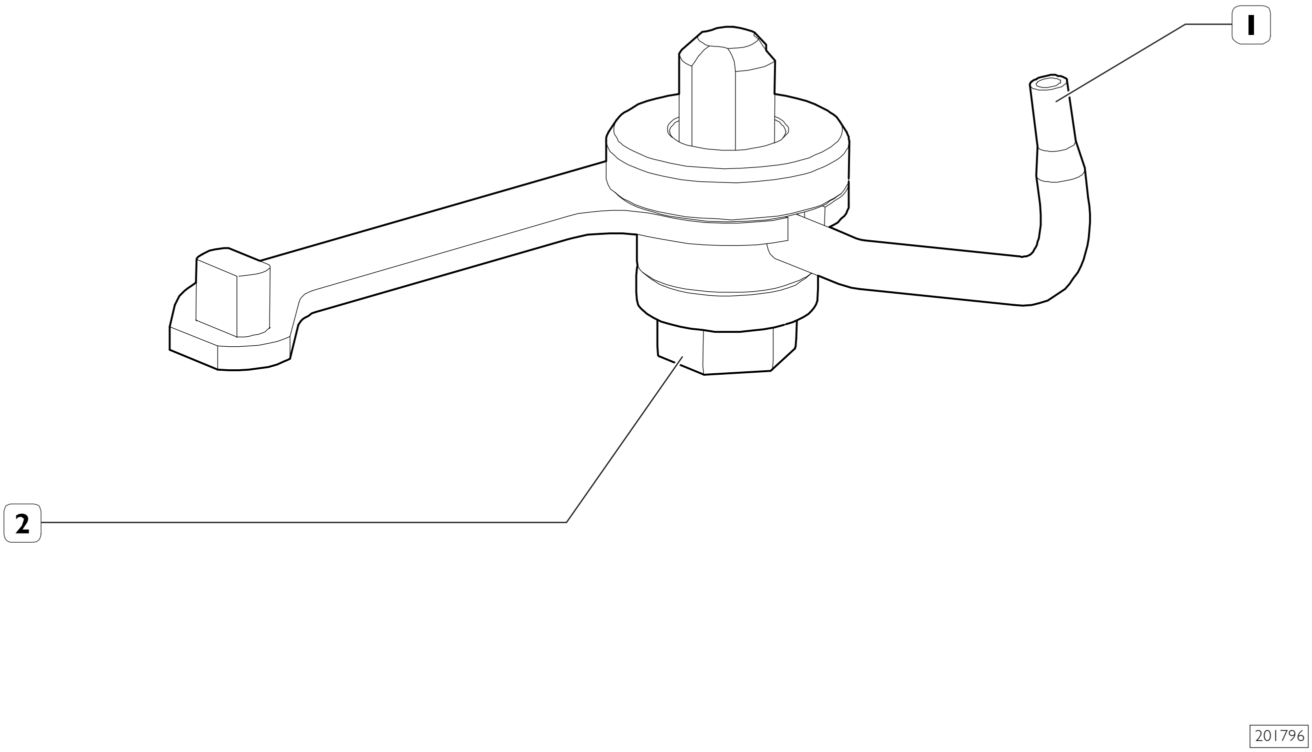
1. Suction strainer - 2. Gasket - 3. Fastening plate - 4. Exhaust valve - 5. Oil sump

The oil sump, mounted at the bottom the crankcase, has the purpose of containing the engine lubricant oil.

The oil is sucked by the pump, through which it is possible to lubricate the engine in its components.

Cooling nozzles

Figure 31



1. Cooling nozzle - 2. Nozzle union

The cooling nozzles are designed to inject the lubricant oil to the pistons.

The orientation and layout inside the crankcase allow them to convey the lubricant directly in correspondence with the crankpins.

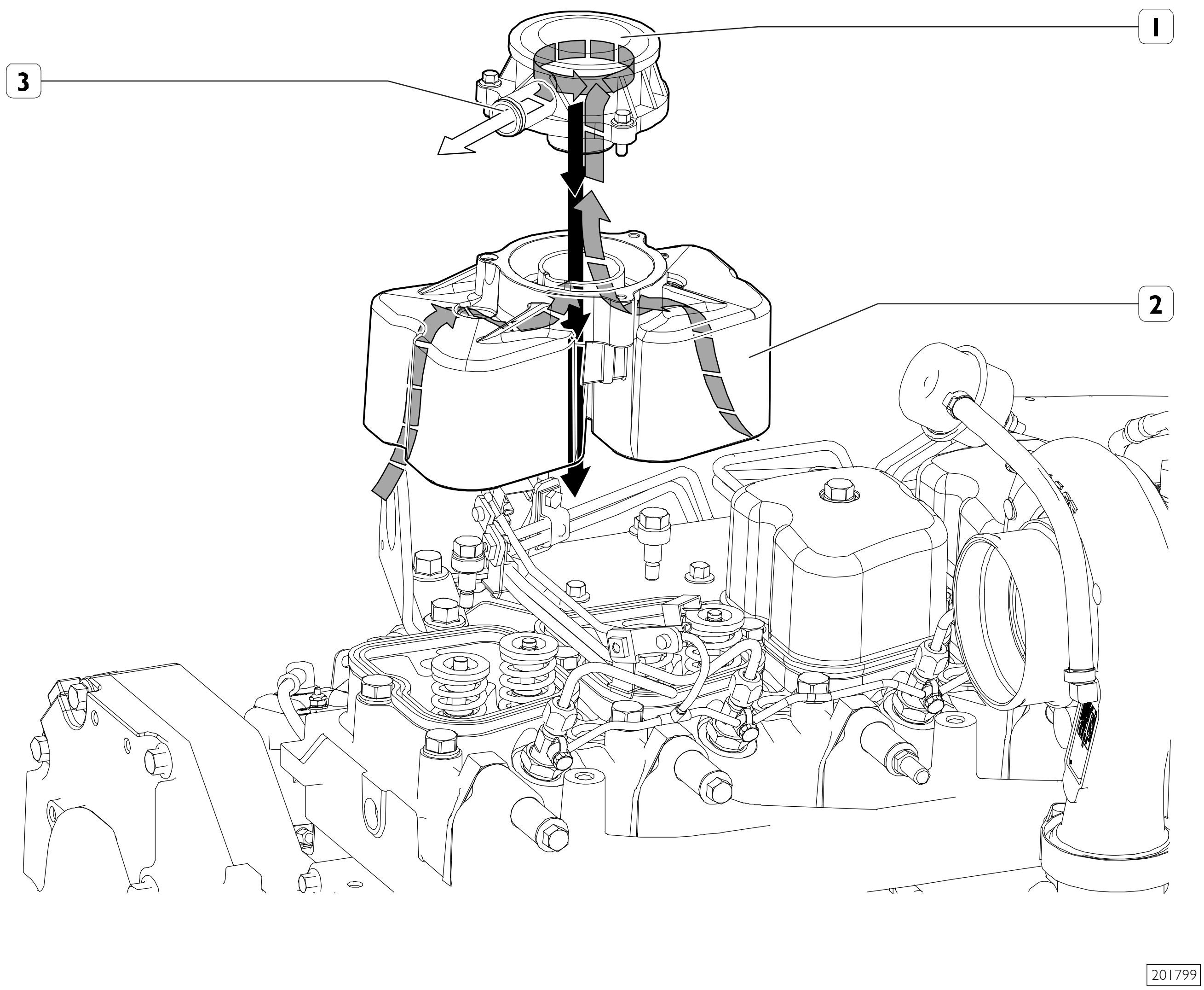
The dropping oil is then recovered in the sump.

OIL VAPOUR RECYCLING SYSTEM

Principles

The oil vapour recycling system, blow-by, makes it possible to recover part of the oil that evaporates at the cylinder head due to the high temperatures inside the engine, and convey it back to the sump.

Figure 32 (NEF45 SM1F)

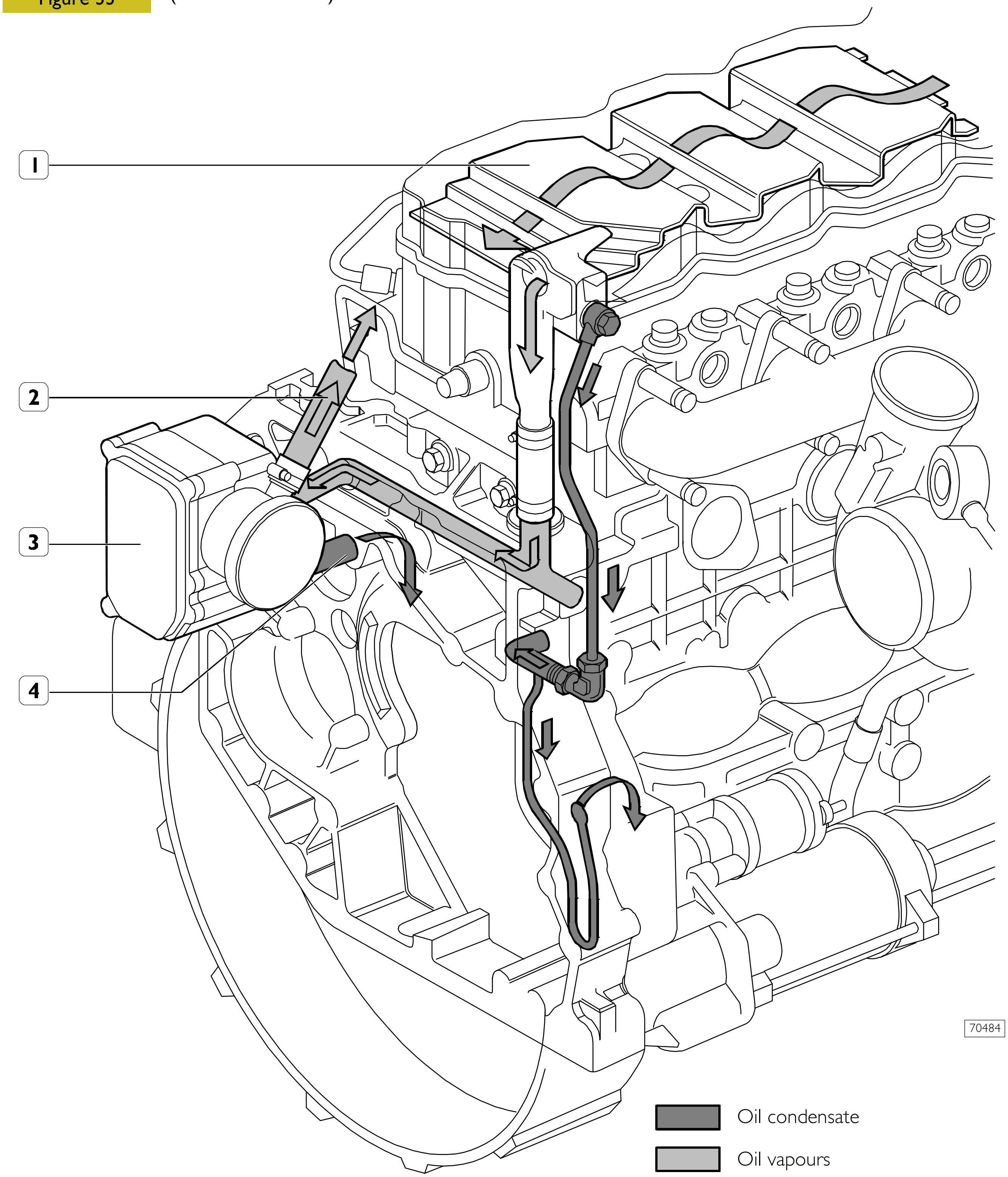


1. Blow-by filter - 2. Tappet cover - 3. Oil vapour breather

The system requires the presence of a valve that allows the oil to condense and fall by gravity into the underlying tappet cover.

By means of the appropriate breather, any vapours which have not condensed can be conveyed into ducts where lubrication is required such as the intake or exhaust manifolds.

Figure 33 (NEF45 TE1F/TE2F)



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

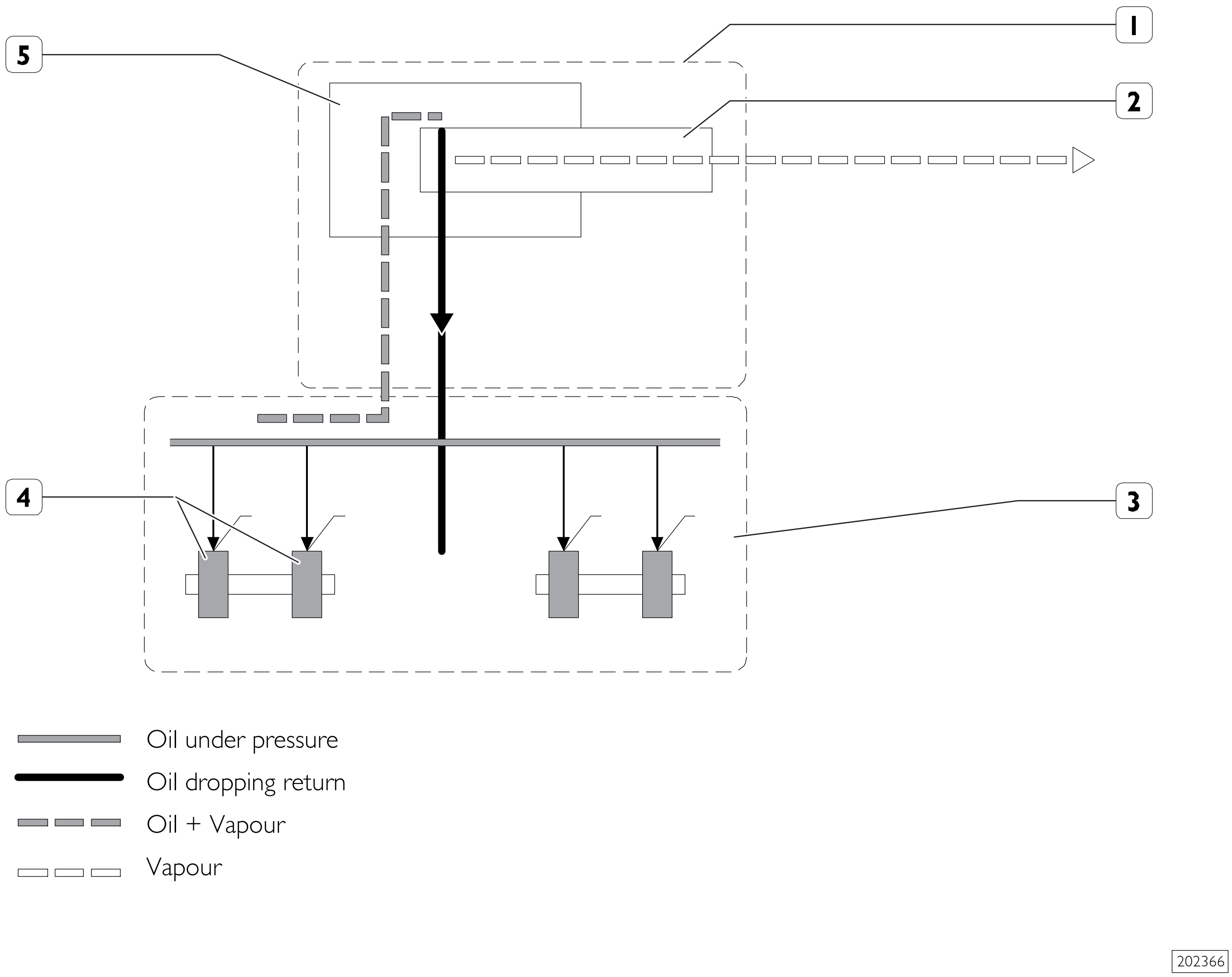
The tappet cover houses the pre-separator (1), whose shape and position determines an increase in oil vapour outlet speed and condenses a part of the vapours at the same time.

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).

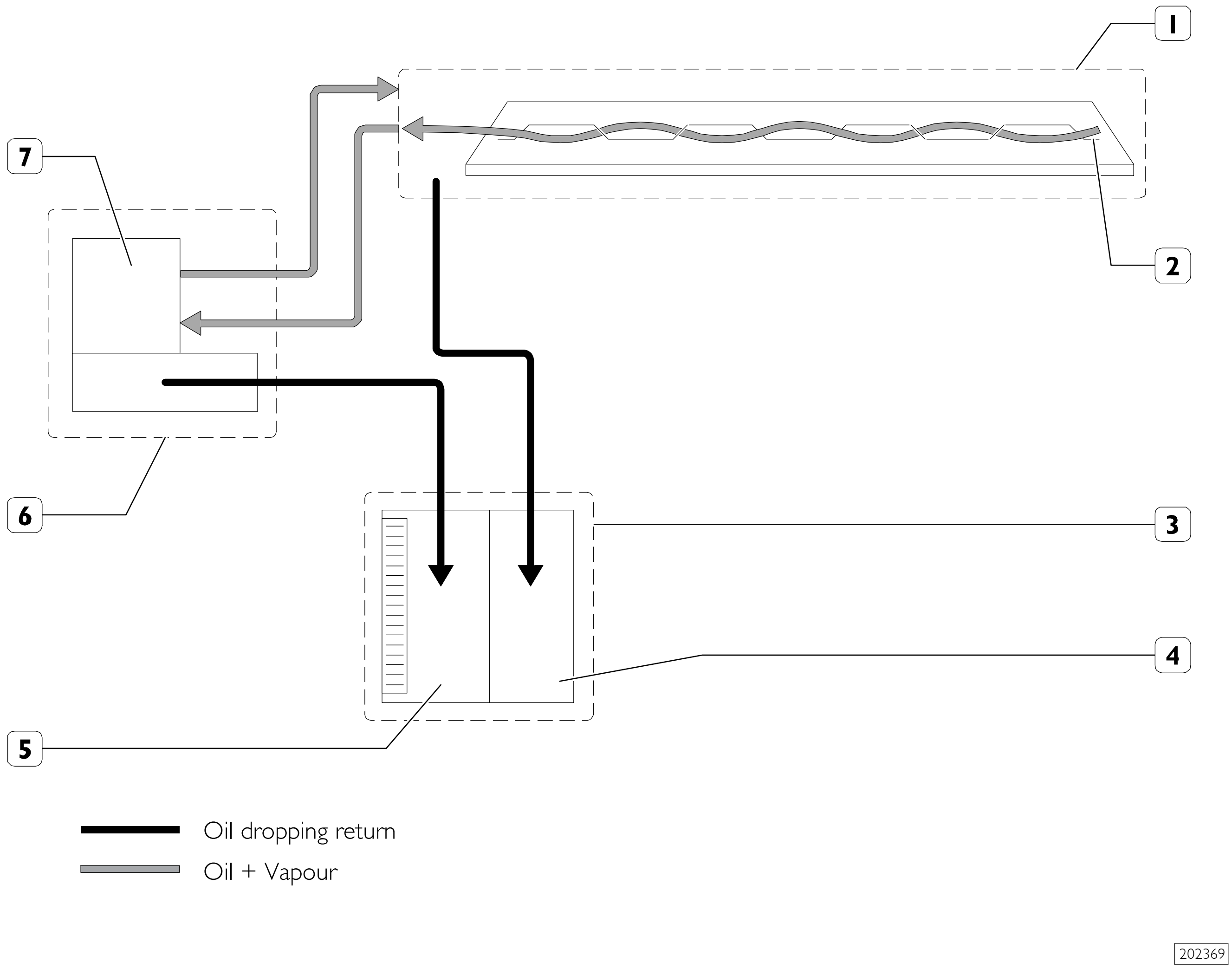
OIL VAPOUR RECYCLING DIAGRAM

Figure 34 (NEF45 SM1F)



1. "Blow-by" control volume - 2. Breather duct - 3. "Tappet cover" control volume - 4. Rocker arm mounts - 5. Blow-by valve

Figure 35 (NEF45 TE1F/TE2F)

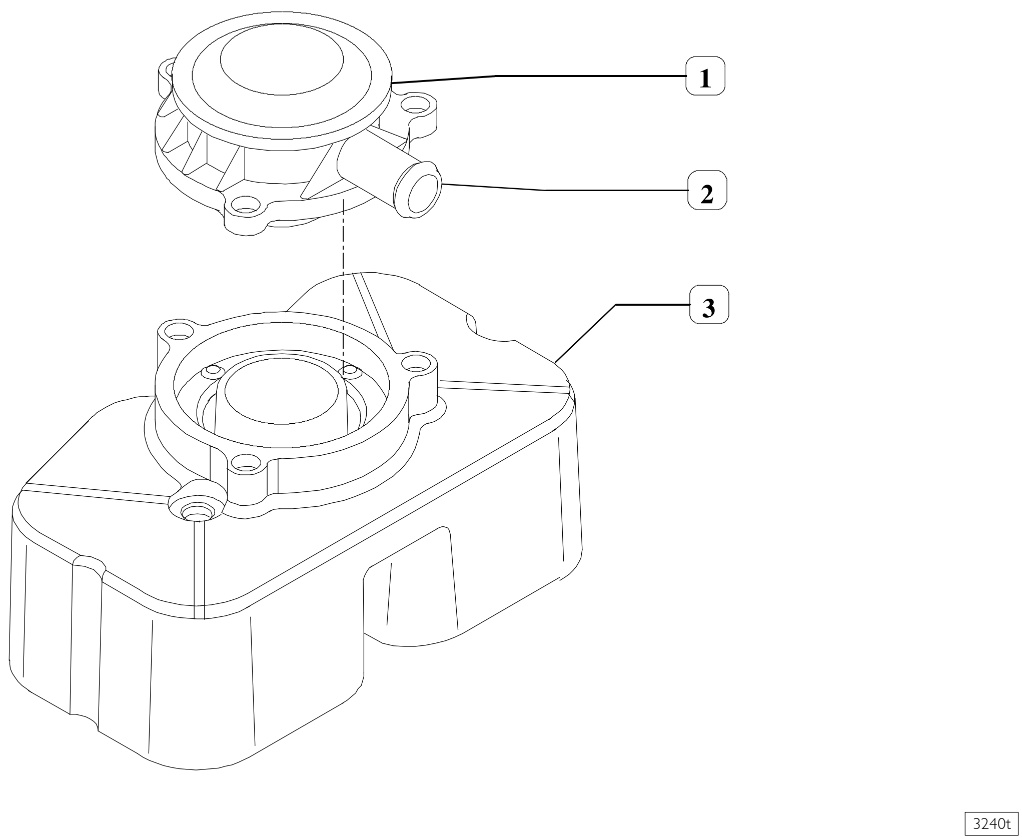


1. Cylinder head control volume - 2. Pre-separator - 3. Flywheel and gear housing volume control - 4. Distribution gear housing - 5. Flywheel - 6. Oil vapour filter control volume - 7. Oil vapour filter

OIL VAPOUR RECYCLING SYSTEM COMPONENTS (BLOW-BY)

Blow-by filter (NEF45 SM1F)

Figure 36



1. Valve - 2. Breather - 3. Tappet cover.

On the tappet cover (3) there is a valve (1) with the task of condensing the oil vapours by making them fall by gravity into the underlying tappet cover (3).

The remaining non-condensed vapours are conveyed properly through the breather (2), for example, in suction (the connection of these vapours must be provided by the vehicle manufacturer).

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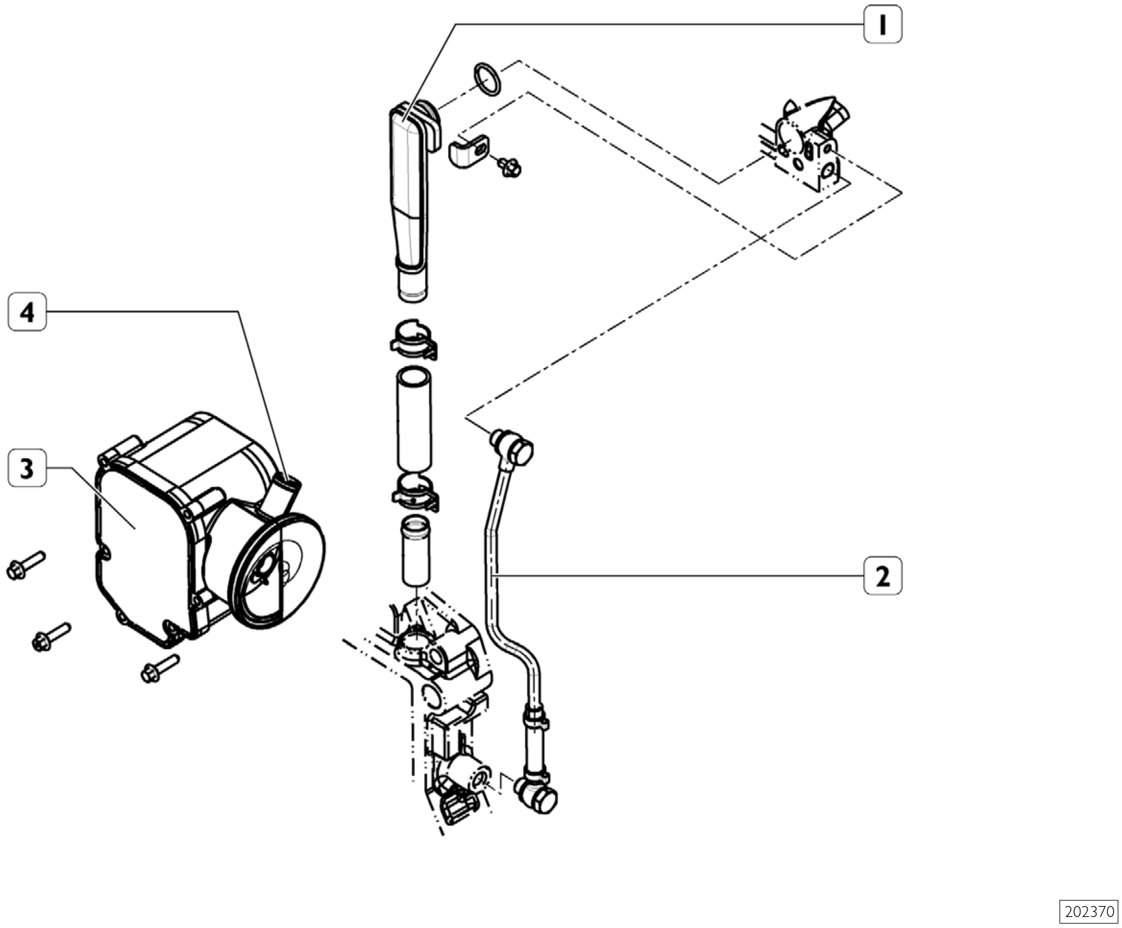
Blow-by filter (NEF45 TE1F/TE2F)

Figure 37



1. Engine vapour breather pipe - 2. Condensate oil return pipe to the engine - 3. Oil vapour filter body - 4. Breather pipe

On the flywheel housing there is a valve (3) with the task of condensing the oil vapours from the crankcase through the pipe (1), causing them to fall by gravity, through the pipe (2).

Vapours that do not condense are conveyed via the breather (4) in suction, for example. In any case, the set-up of this connection is the responsibility of the customer.

COOLING CIRCUIT

Principles

The cooling system is of the closed circuit forced circulation type.

Its purpose is to dissipate the excess heat, by heat exchange between the engine lubricant oil and the coolant.

The main components are:

- expansion tank;
- radiator;
- viscous fan;
- heat exchanger;
- water pump;
- thermostat;
- a possible compressor.

Figure 38 (NEF45 SM1F)

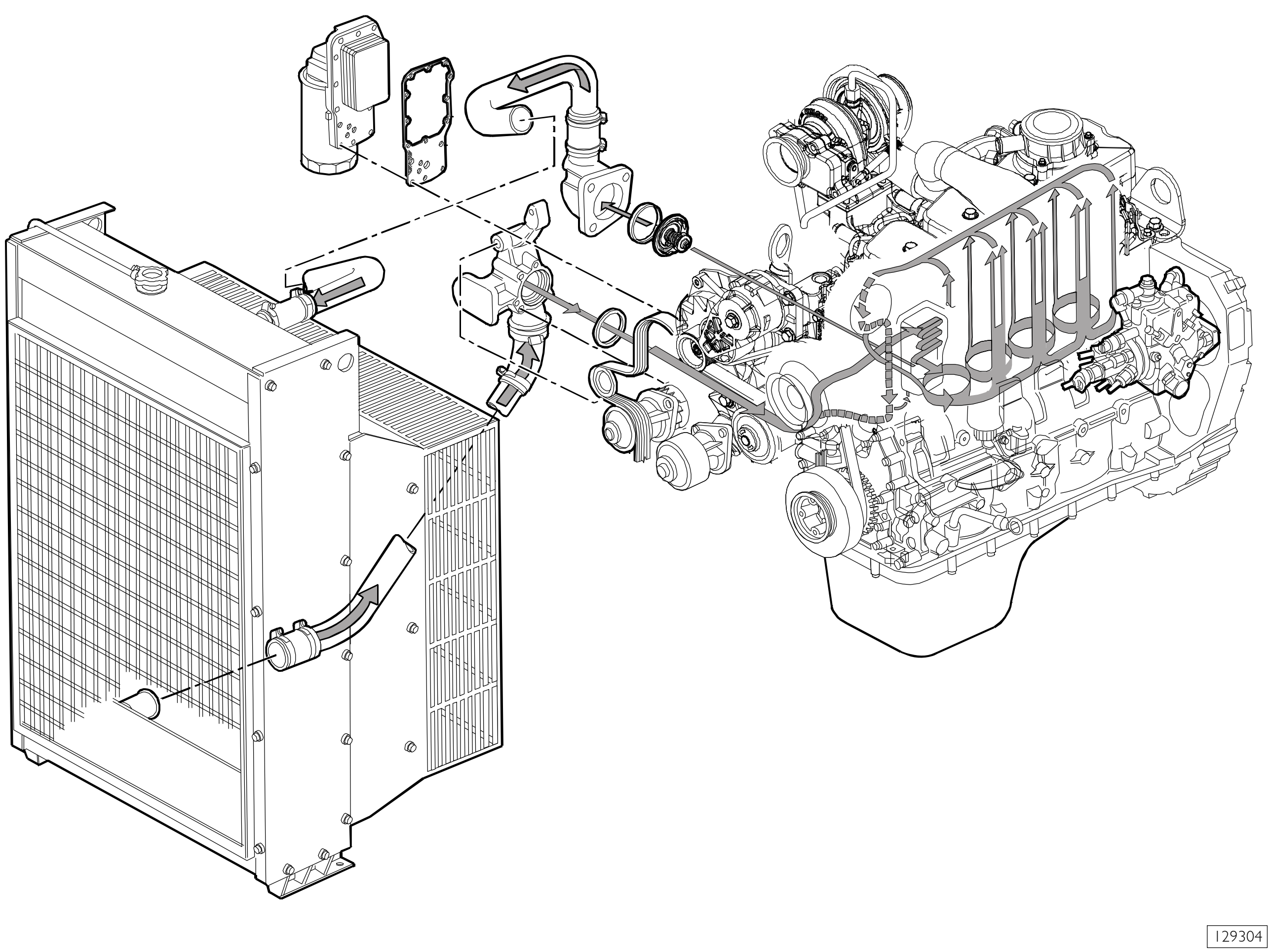
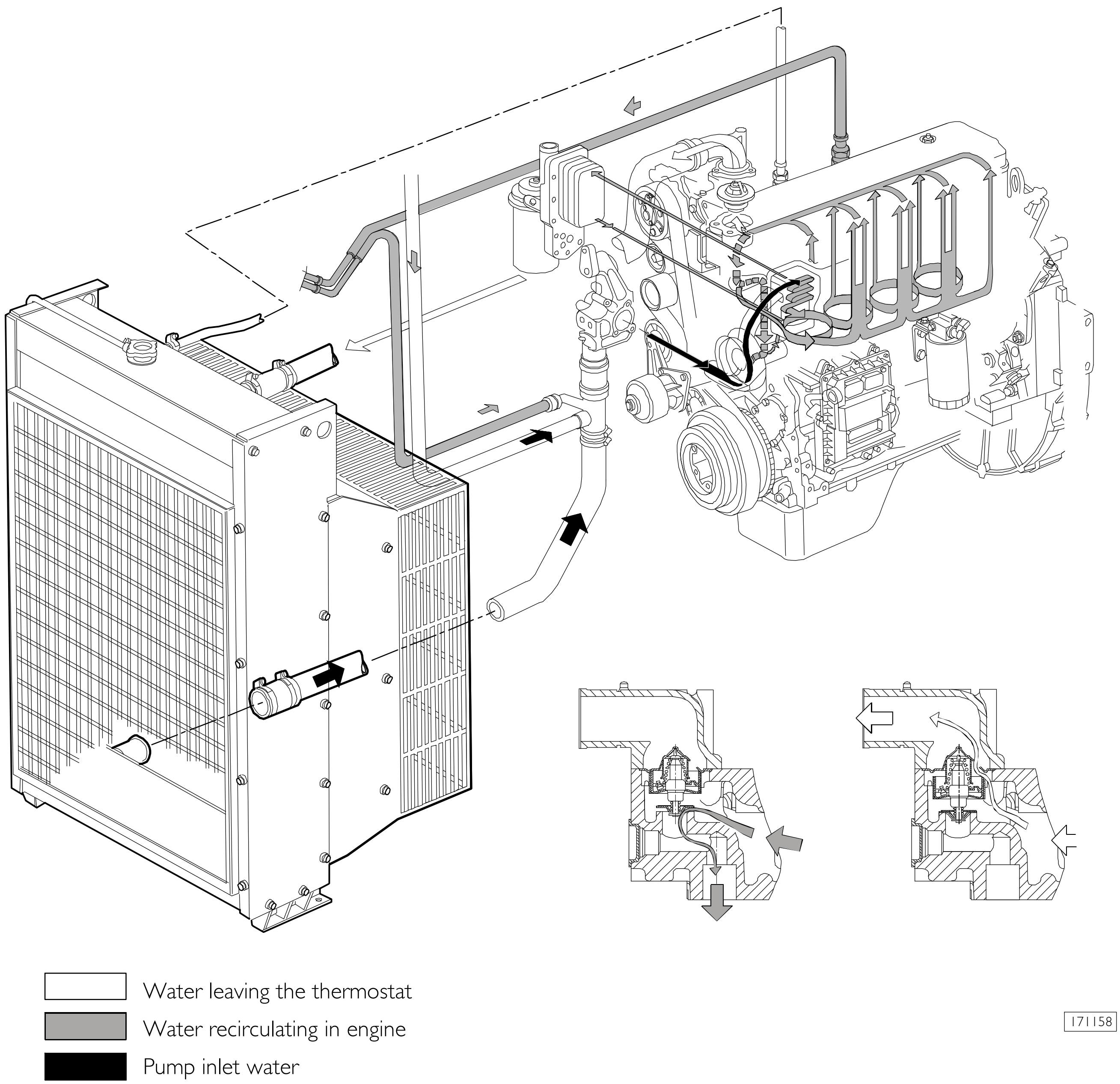


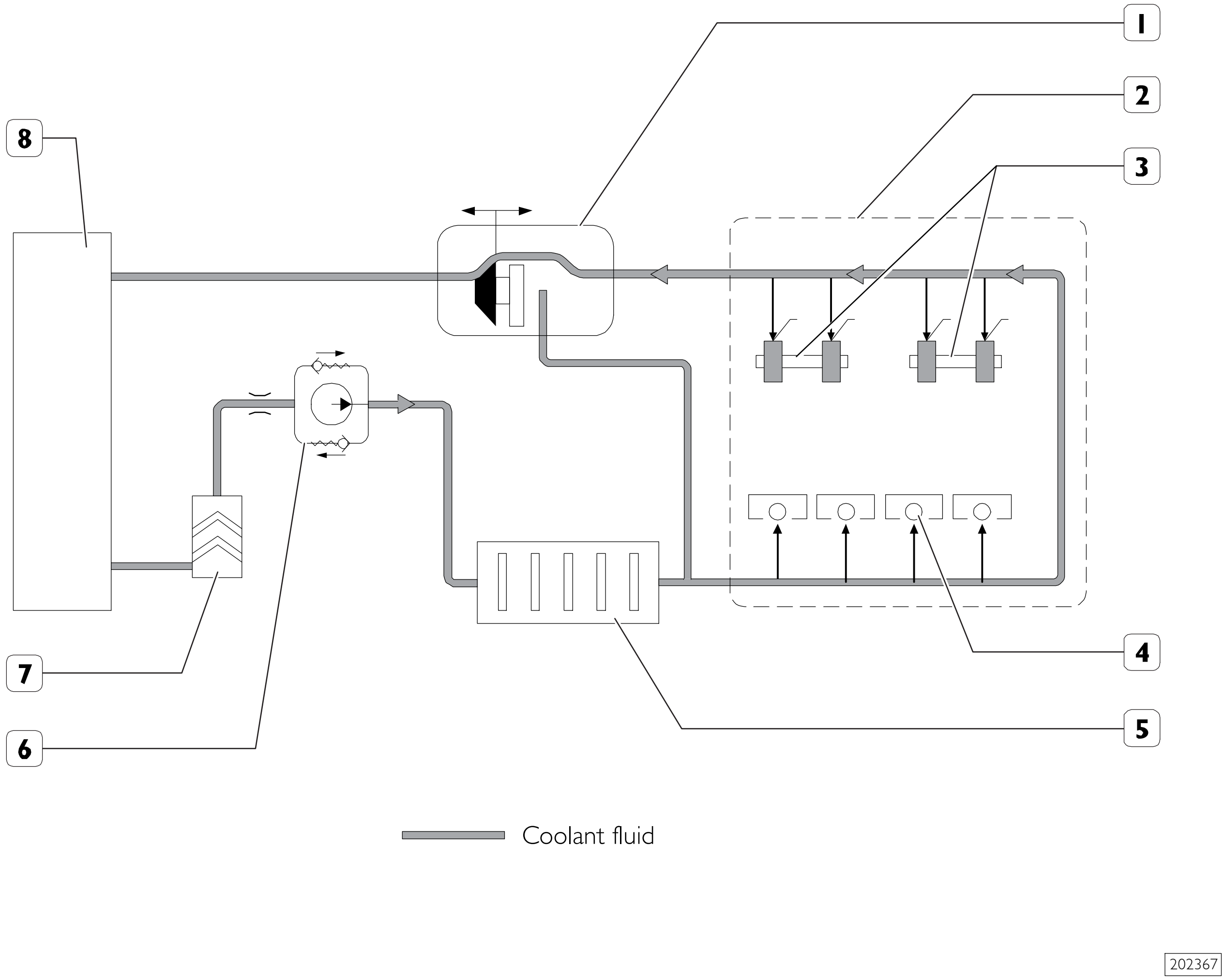
Figure 39 (NEF45 TE1F/TE2F)



The heat exchange between the lubricant oil and the coolant (water), designed to keep the temperature within the established and control values, takes place inside of the heat exchanger. The coolant is sucked by a pump from the expansion tank, the position of which varies depending on the set-up of the engine; the fluid moves into the radiator through the conveyor and then into the flow regulator. The pump then sends the coolant to the heat exchanger (inside of which it moves in the skirt). Upon leaving the heat exchanger, it is conveyed into the engine and then the thermostat, whose task is to regulate the circulation of the coolant. The coolant circuit ends with the return back into the radiator. The radiator dissipates the heat taken from the engine by the coolant. The dissipating power of the radiator is increased by the viscous fan which is present depending on the engine outfitting.

COOLING DIAGRAM

Figure 40

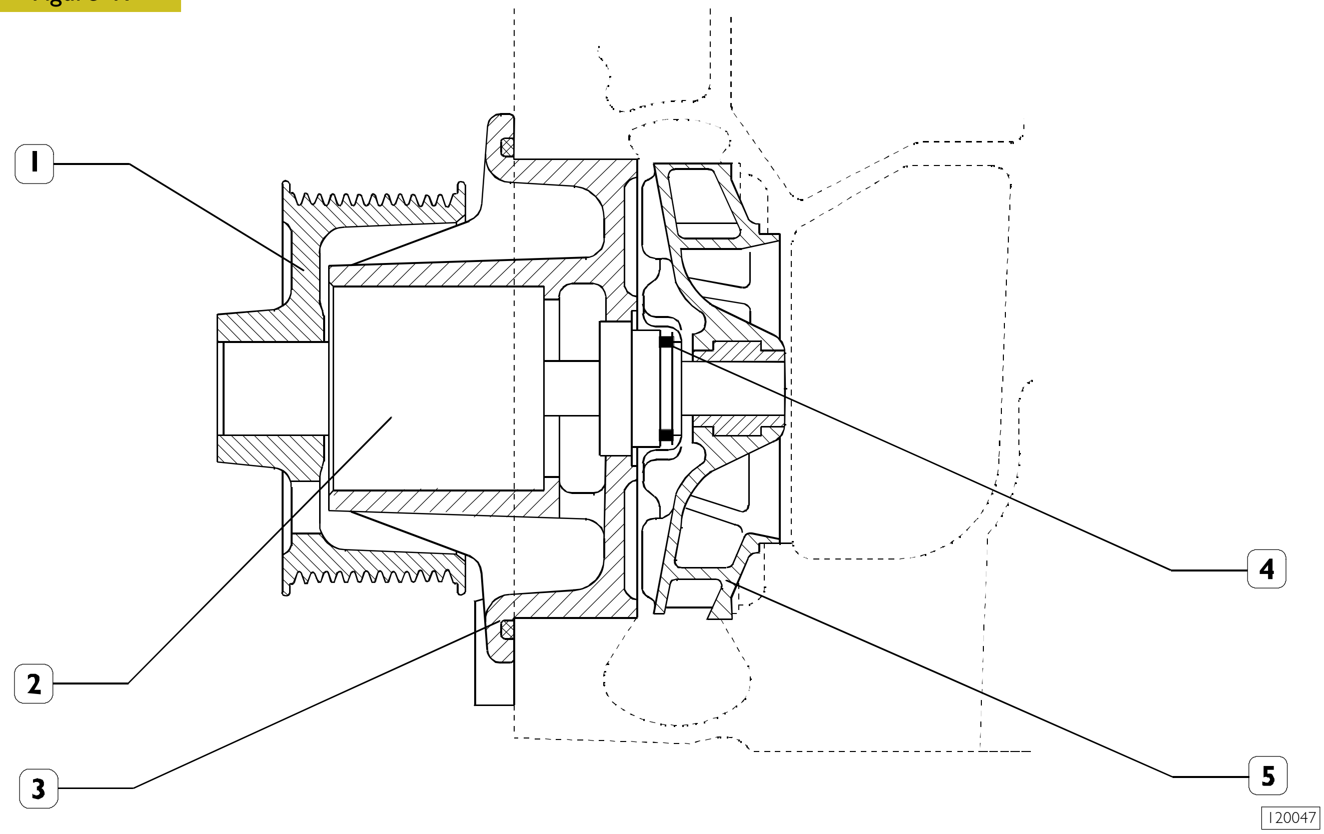


1. Thermostat - 2. "Engine" control volume - 3. Rocker arms unit - 4 .Pistons - 5. Heat exchanger - 6. Water pump - 7. Flow conveyor - 8. Radiator

COOLING CIRCUIT COMPONENTS

Water pump

Figure 41

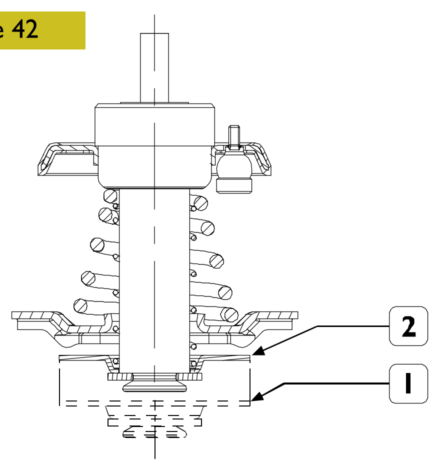


WATER PUMP SECTION
1. Hub - 2. Shaft with bearing - 3. Pump body - 4. Gasket - 5. Impeller

The water pump is of the vane centrifugal type. The pump bearing (2) forms a single piece with the spindle of the impeller. The water seal between the pump body (3) and the spindle (2) is obtained by the gasket (4).

Thermostat

Figure 42



THERMOSTAT DIAGRAM

operation

When the engine is cold the water comes out from the front of the cylinder head entering a union where the thermostat is located, which excludes the movement of the water in the radiator. This way water circulation will take place only between the pump and the engine, allowing its rapid heating.

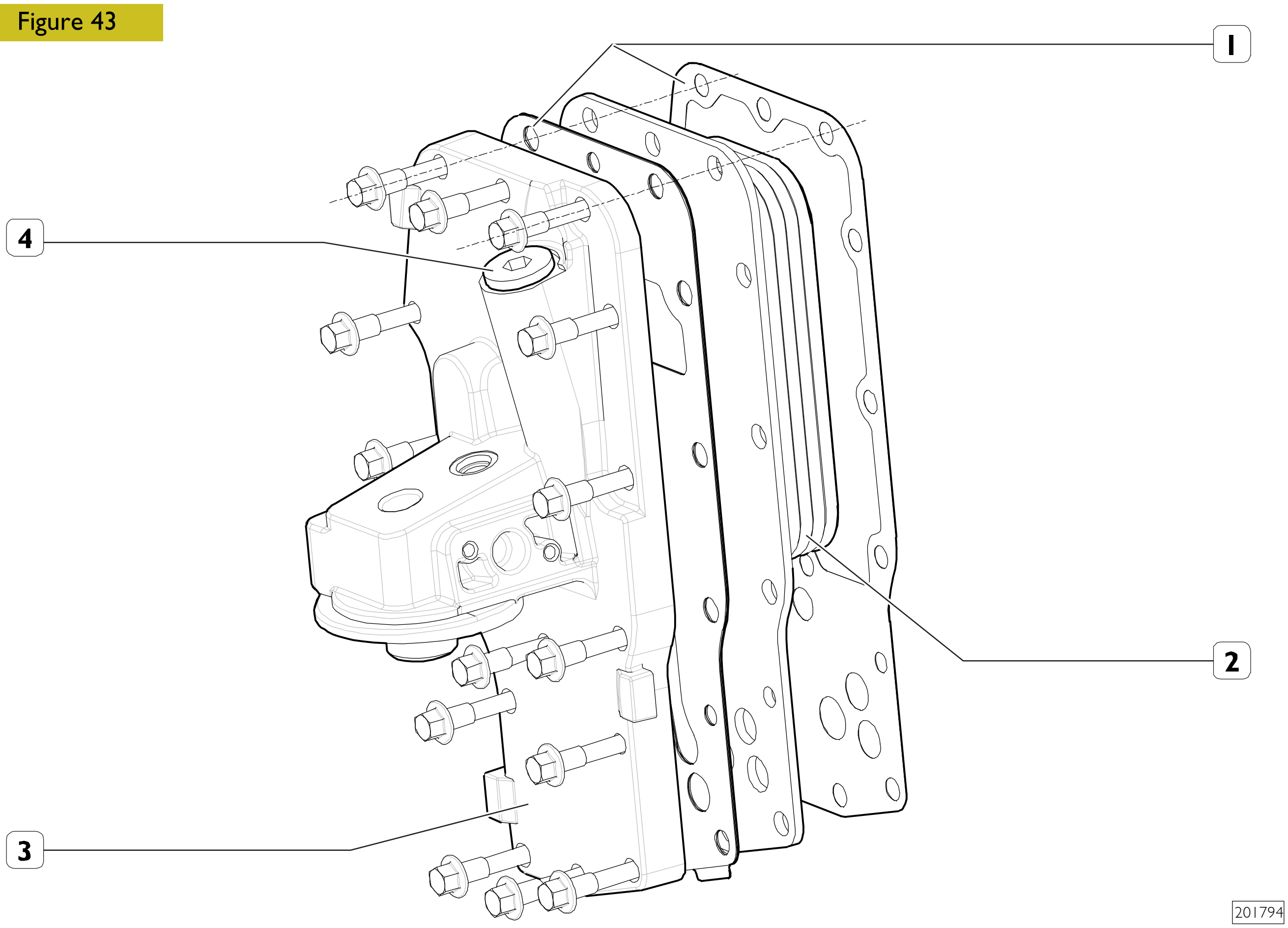
The thermostat valve starts to open at about 80˚ C, allowing water circulation through the radiator and simultaneously blocking the direct return to the engine.

Check that the thermostat works properly, replace it if there is any doubt.

1. Start stroke at approximately 79˚ ± 2 ˚C
2. Stroke of 7.5 mm at 96 ˚C

Heat exchanger

Figure 43



1. Gaskets - 2. Internal heat exchanger element (7 elements) - 3. Heat exchanger body - 4. Pressure regulator valve

The heat exchanger, installed in the engine cooling system, has the task of regulating the oil temperature by subtracting heat through the use of coolant.

Performance according to GT 0179	
Pressure range	0... 2.5 MPa
Frequency	0.5 ÷ 3 Hz
Trend	Sinusoidal
No. of cycles	>500000
Explosion pressure	> 10 MPa

Piping	
Engine	5W30
Internal oil temperature	115.6 °C
Capacity	51 dm^3/min

Skirt	
Refrigerant	glycol
Internal coolant temperature	82.2 °C
External flow rate	230 dm^3/min

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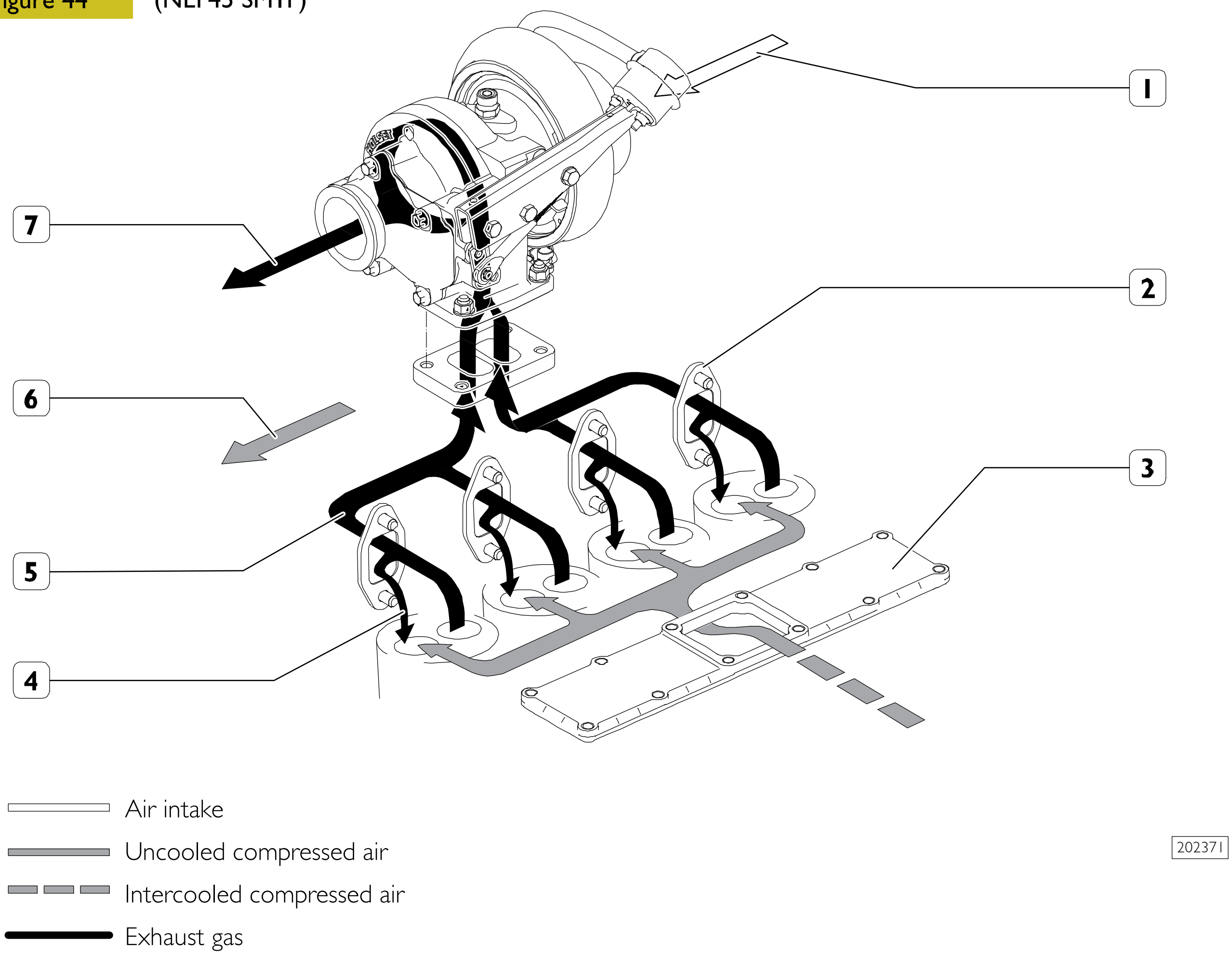
INTAKE AND EXHAUST SYSTEM

Principles

The intake and exhaust system consists of the following components:

- Intake and exhaust manifolds;
- Turbocharger with WG valve;
- EGR system.

Figure 44 (NEF45 SM1F)



1. Air inlet to compressor - 2. Exhaust manifold - 3. Intake manifold - 4. Reflow of exhaust gas in EGR - 5. Exhaust gas inlet in turbine - 6. Air outlet from compressor - 7. Exhaust gas outlet in turbine

This system allows you to manage the flow of combustion air through the components listed above.

The combustion air is sucked by the compressor of the turbocharger, within which its pressure is increased, to then be fed through the intake manifold in the cylinder liners. The exhaust gas flows out of the cylinder liners towards the exhaust manifold.

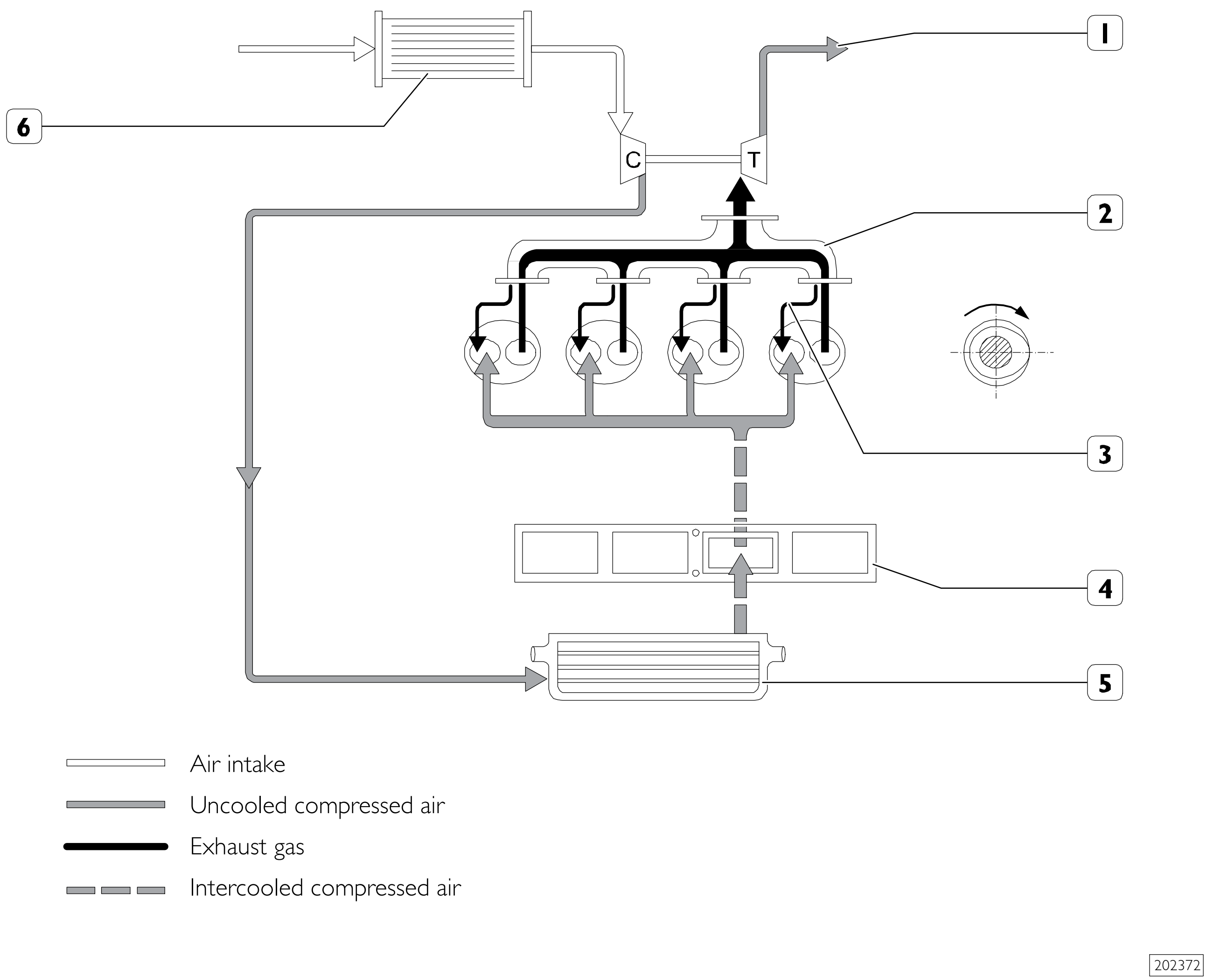
Finally the exhaust gas flow is conveyed towards the turbine.

For Stage IIIA version engines, the EGR system does not require the presence of electronically controlled elements but only the modification of the exhaust cam profile.

During the intake phase the exhaust valve is partially opened with the subsequent reintroduction of some of the exhaust gas into the engine cylinders.

INTAKE AND EXHAUST DIAGRAM

Figure 45



1. Exhaust - 2. Exhaust manifold - 3. EGR - 4. Intake manifold - 5. Intercooler - 6. Air filter

INTAKE AND EXHAUST SYSTEM COMPONENTS

Intake and exhaust manifolds

The intake manifold receives cooled compressed air from the intercooler and conveys it to the cylinder chambers.

Figure 46 (NEF45 SM1F)

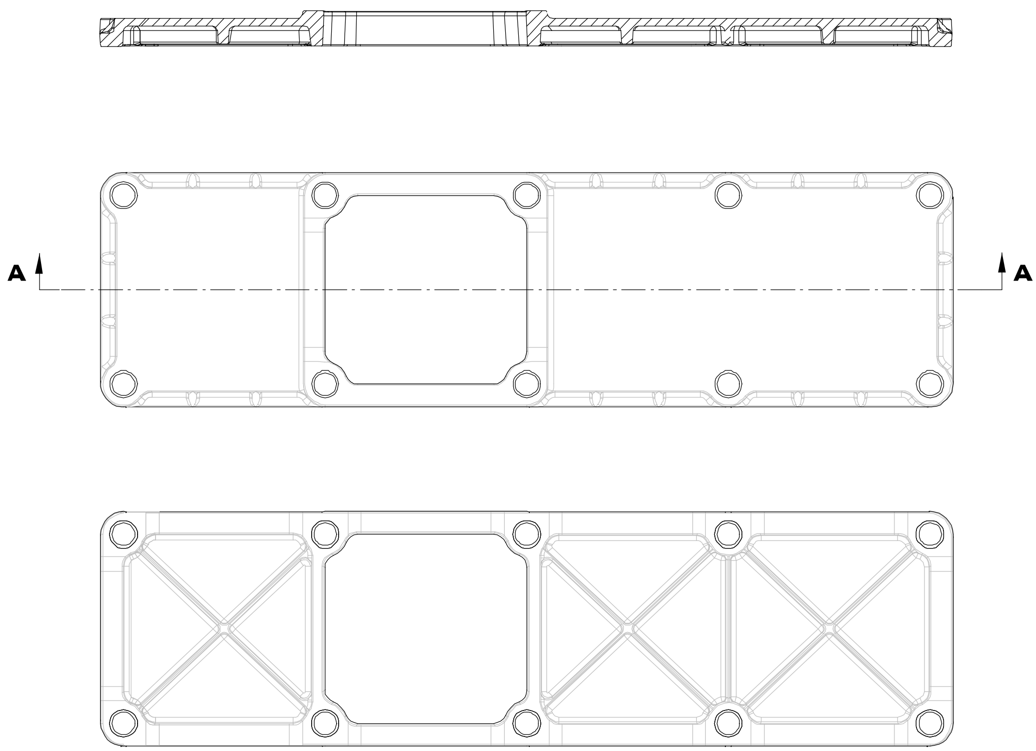


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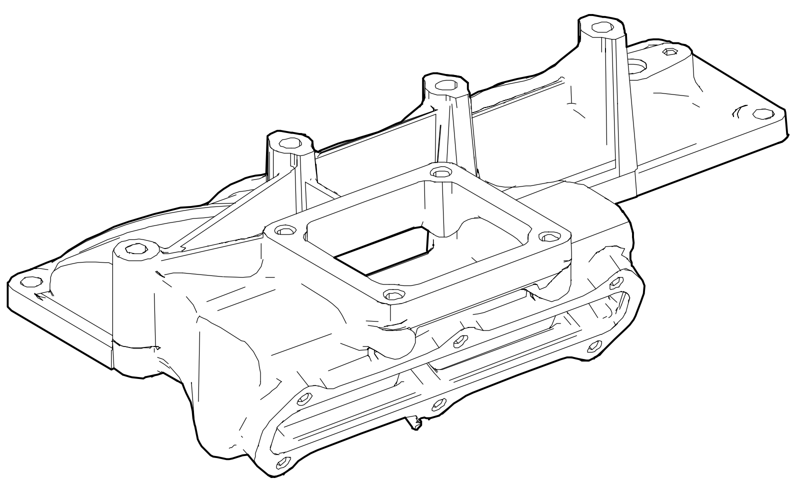
Figure 47 (NEF45 TE1F/TE2F)



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Intake manifolds

Exhaust manifolds

The exhaust manifold however conveys the combusted gas from the cylinder chambers to the turbine.

Its internal structure allows the six flows from the chambers to come together in two distinct flows conveyed to the turbine impeller.

Figure 48 (NEF45 SM1F)

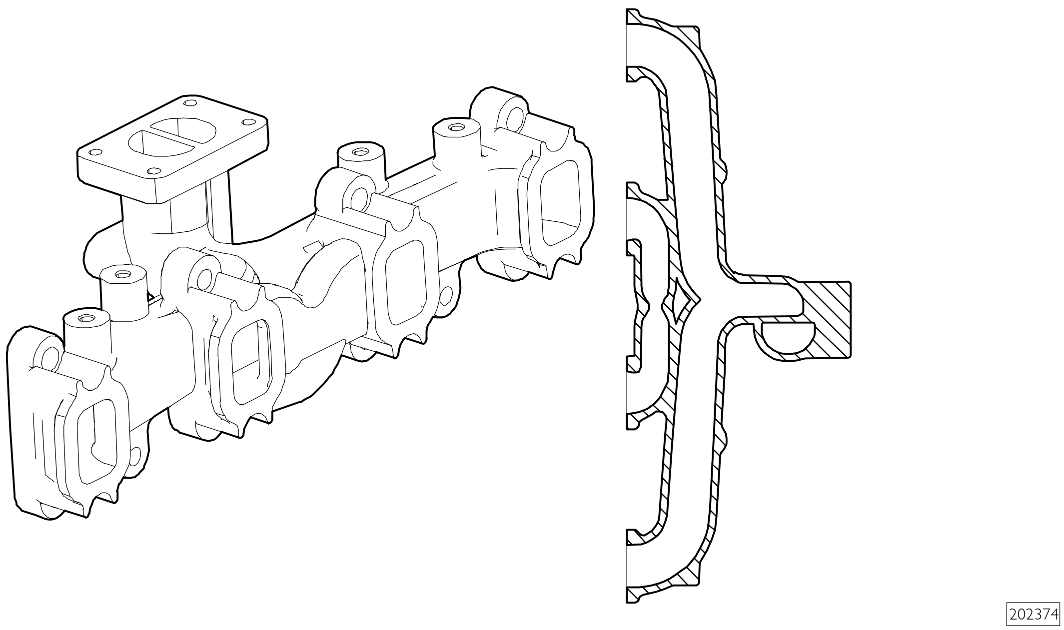
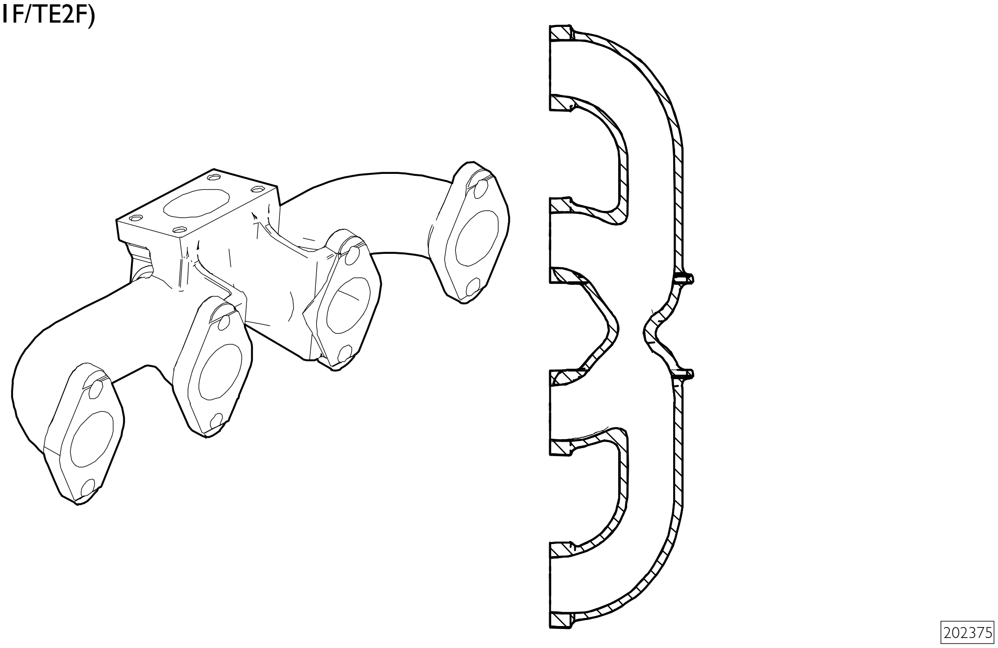


Figure 49 (NEF45 TE1F/TE2F)



Exhaust manifolds

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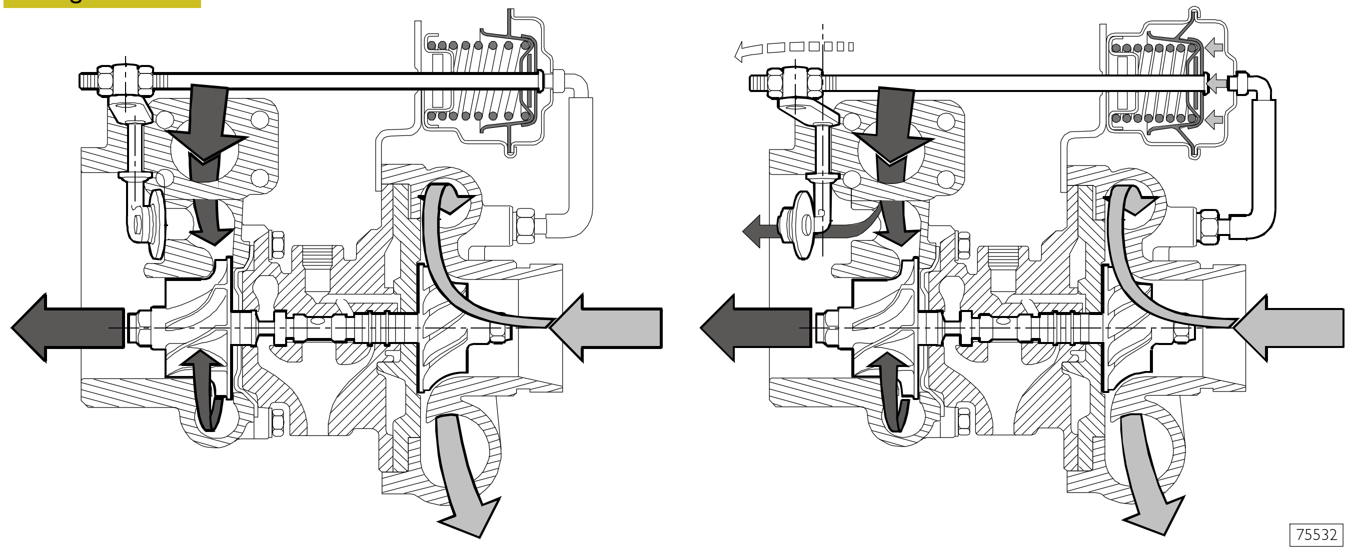
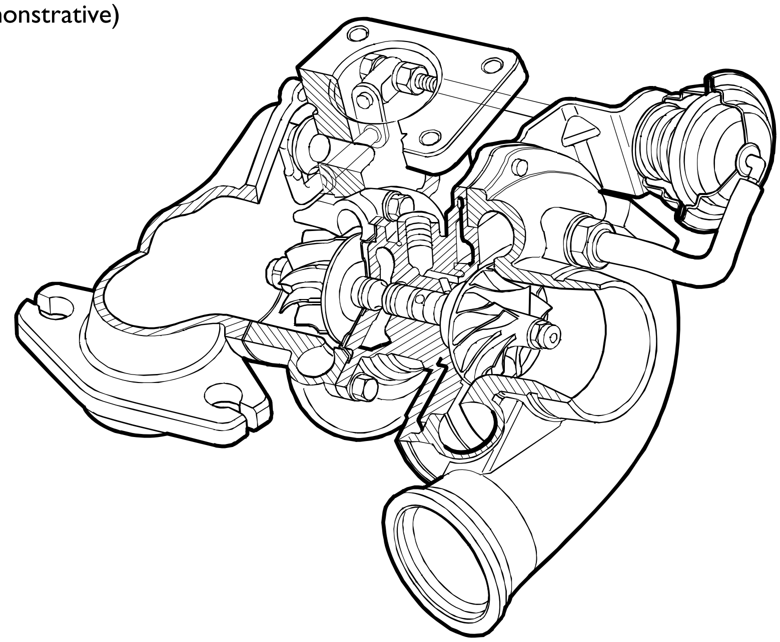
HOLSET HX25W turbocharger

Figure 50



A. WG VALVE CLOSED A. WG VALVE OPEN

Figure 51 (Demonstrative)



Description (HOLSET HX25W/GARRETT WG HTT)

The turbocharger consists of the following main parts, a turbine, a valve for regulating the boost pressure, a central body and a compressor.

During operation of the engine exhaust gases pass through the body of the turbine by rotating the impeller of the turbine itself.

Since the compressor impeller is connected to the turbine impeller by means of a spindle, it turns with the turbine impeller compressing the air taken in through the air filter.

This is cooled by the radiator and sent through the intake manifold to the pistons.

The turbocharger is equipped with a pressure regulating valve placed on the exhaust manifold before the turbine and connected via pipes to the intake manifold.

Its purpose is to choke the exit of the exhaust gas sending a part directly into the exhaust pipe when the boost pressure downstream of the compressor reaches the specified value in bar.

Cooling and lubrication of the turbocharger and the bearing brass is performed by means of the engine oil.

EGR SYSTEM (ONLY FOR NEF 45 SM1F)

In the STAGE IIIA version, the profile of the exhaust cam has been modified to allow the partial opening of the corresponding valve during the suction phase (EGR exhaust gas recirculation) with the consequent re-entry of a part of the exhaust gas into the engine cylinders.

The exhaust gases can be brought partially into the cylinders to reduce the maximum combustion temperature values responsible for the production of nitrogen oxides (NO_X).

The exhaust gas recirculation (EGR) system, by reducing the combustion temperature through the decrease in the concentration of oxygen in the combustion chamber, thus represents an effective system for controlling the emission of NO_X.

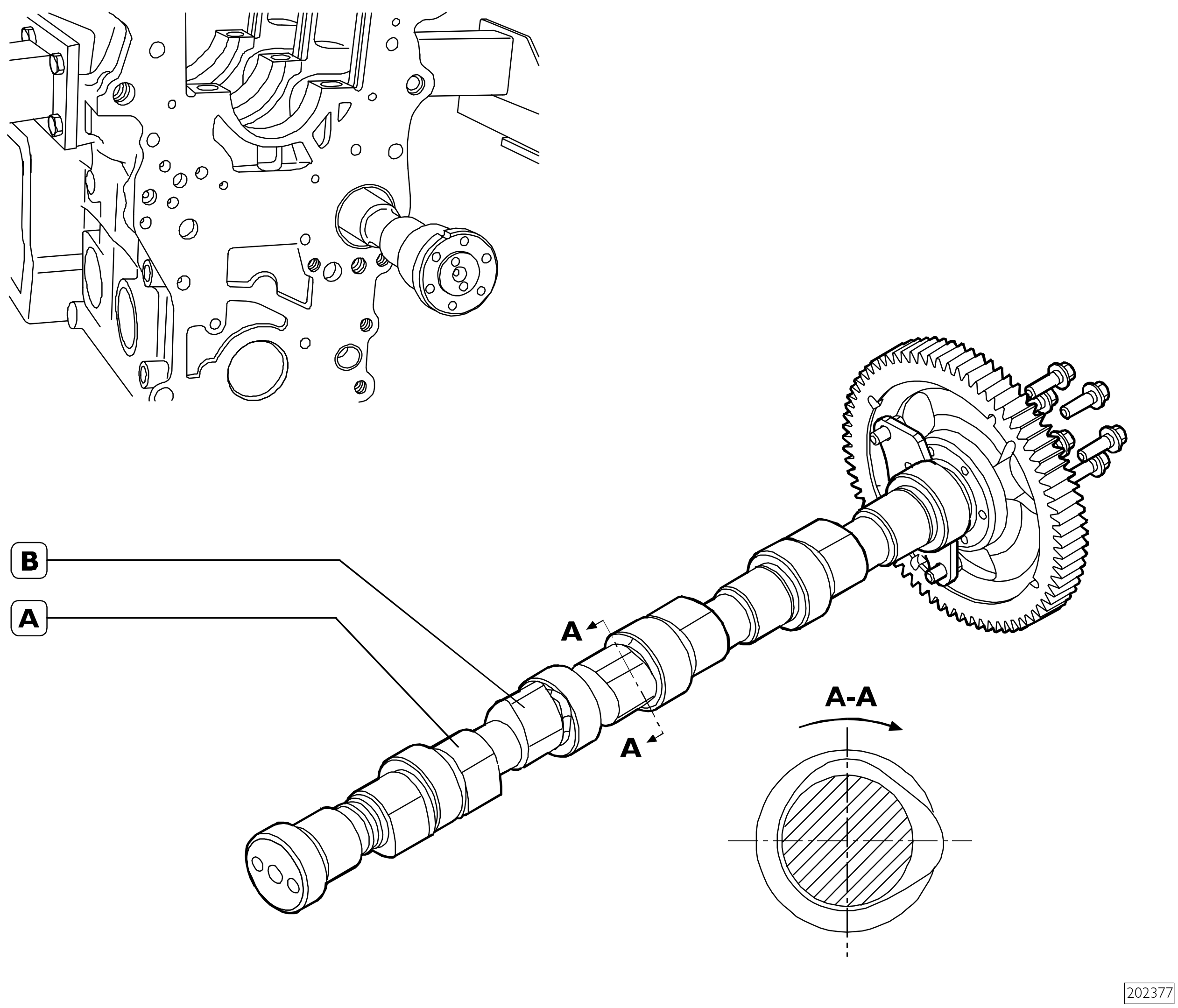
The internal EGR system does not come with any electronically controlled elements: the system is always active.

Its configuration does not need additional elements such as control valves, pipes or heat exchangers.

The exhaust cam (B) presents an addition lobe to the main lobe (see Sec. A-A of the figure) compared to the configuration without EGR.

The additional lobe, during the suction phase of the cylinder in question, allows a quick opening of the exhaust valve by generating a recirculation due to the recall of the exhaust gas caused by the vacuum that is created inside the cylinder in the suction phase.

Figure 52



A. Intake valve control - B. Exhaust valve control.

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SECTION 3

Electric / electronic equipment

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❑ Starter motor	4
❑ Water temperature sensor for KSB	4
❑ Oil pressure sensor	5
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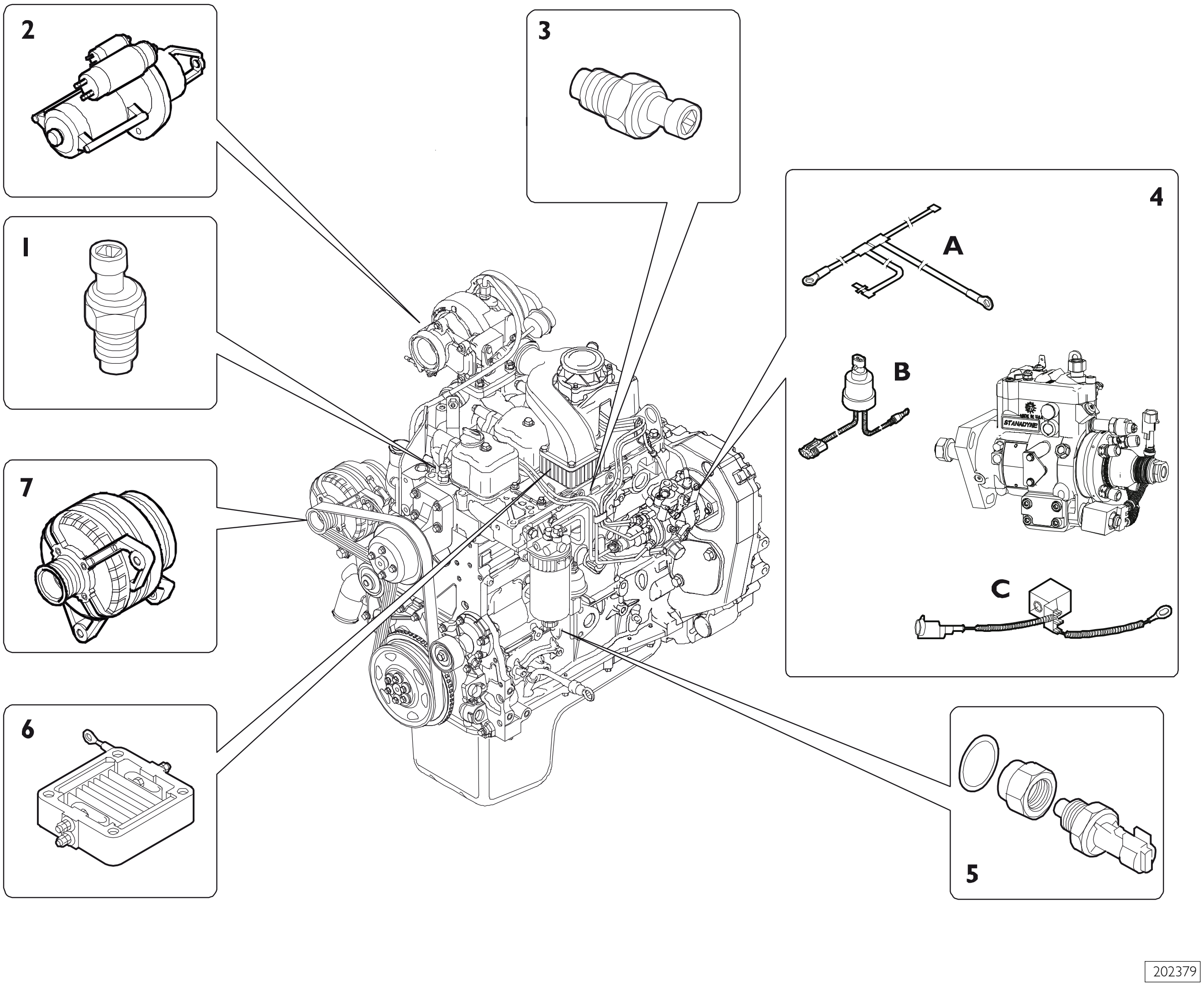
GENERAL INFORMATION ON THE LOCATION OF ELECTRICAL COMPONENTS ON THE ENGINE

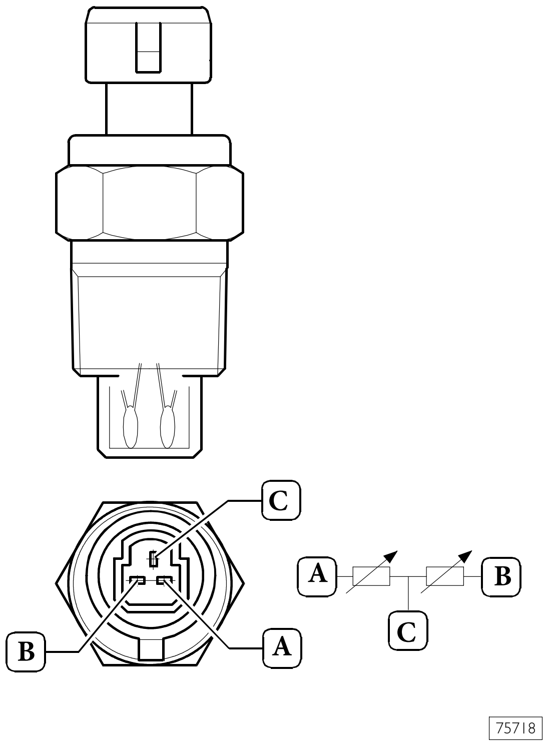
Figure 1 (NEF45 SM1F)



1. Coolant temperature sensor;
2. Starter;
3. Water temperature sensor for KSB;
4. (A) KSB connection cable - Stanadyne pump
   (B) Timer (where provided);
   (C) CSA.
5. Oil pressure sensor;
6. Resistor for cold starts;
7. Alternator.

Coolant temperature sensor

Figure 2



This component incorporates a temperature sensor.

It is mounted on the engine head in the vicinity of the thermostat body and has the function of detecting the temperatures of the coolant of the engine

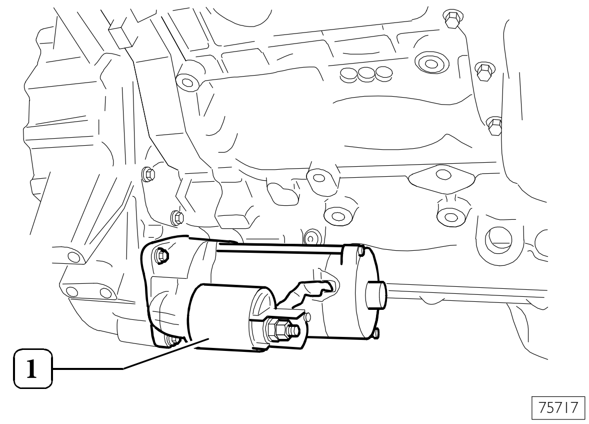
Characteristics:

Operating temperature field:

Connector side	-40 ÷ +150 °C for periods of < 10 min.
bulb side on engine	-40 ÷ +140 °C
Operating voltage:	6 ÷ 28 V
Calibrations:	
at 80 °C	0.304 ÷ 0.342 kΩ
at 20 °C	2.262 ÷ 2.760 kΩ
at -10 °C	8.244 ÷ 10.661 kΩ

Starter motor

Figure 3



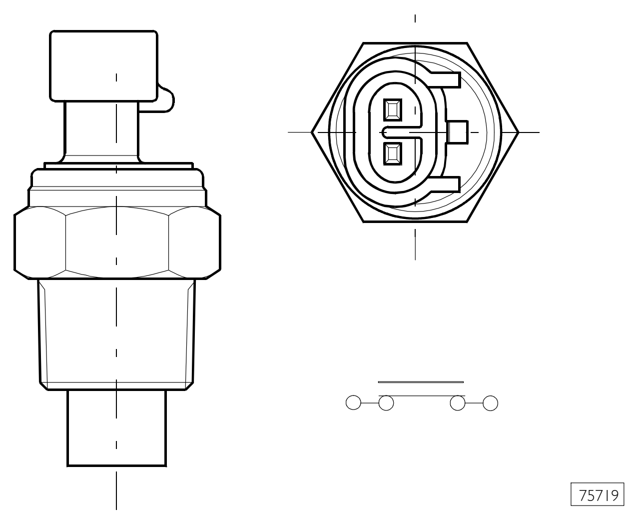
Starting is usually controlled via the ignition switch placed in the dashboard of the vehicle and provides a positive voltage to the motor contactor placed on the starter motor (1).

Characteristics:

BOSCH 12V

Water temperature sensor for KSB

Figure 4



It is mounted on the engine head on the left side of the engine.

Characteristics:

Operating voltage:	12 ÷ 24 V
Electric load:	2.5 A (inductive)
	5.0 A (resistive)
Calibration:	30±3 °C Opening of contacts with temperature rising
	20±3 °C Closer of contacts with temperature lowering

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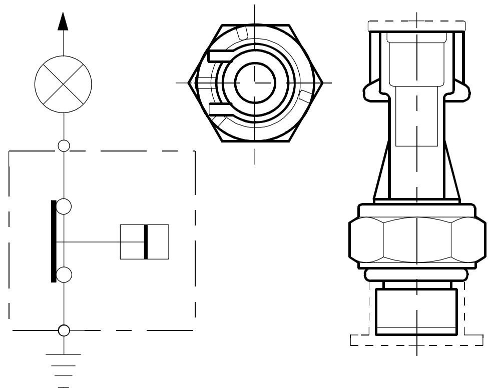
Oil pressure sensor

Figure 5



75722

It is mounted on the crankcase on the left side of the engine.

Characteristics:

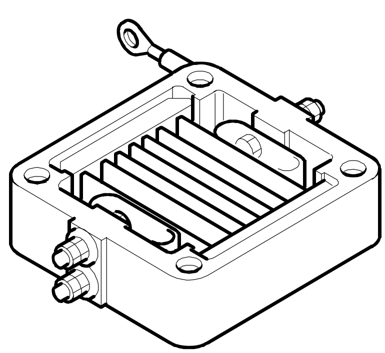
Operating voltage: 12 ÷ 24 V

Contact closure
with pressure decreasing: 0.6 bar

Contact opening
with pressure rising: 0.9 bar

Pre-post heating (if present)

Figure 6



75723

It is a resistor positioned on the intake manifold and is utilised to heat the air in the operations of pre / post heating.

Is powered by a contactor usually positioned in the immediate vicinity of the engine.

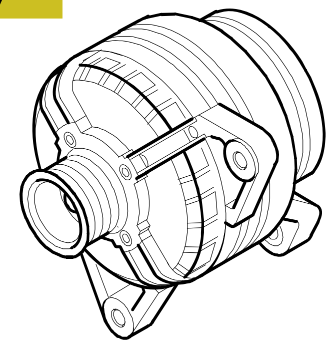
Characteristics:

Working voltage: 12 V

Maximum air flow
possible: 2 cc / min
(at the pressure of 138 kPa)

Alternator

Figure 7



75725

It is located on the front right side of the engine and is controlled through a toothed belt.

Characteristics:

Working voltage: 14 V

Current strength: 90A (a 6000 rpm)

Absorption in stand-by: ≤1mA

Direction of rotation: Clockwise

Figure 8

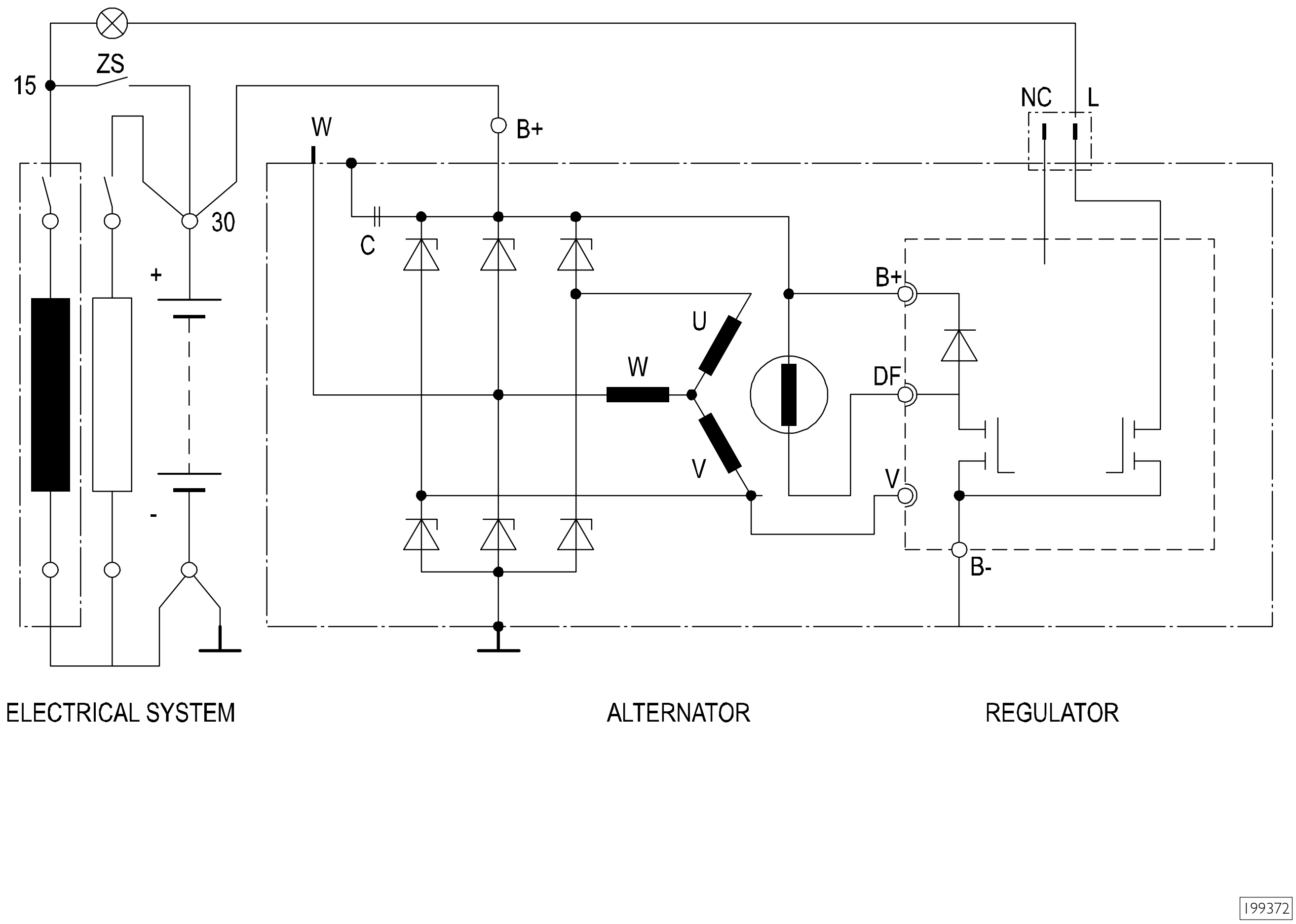
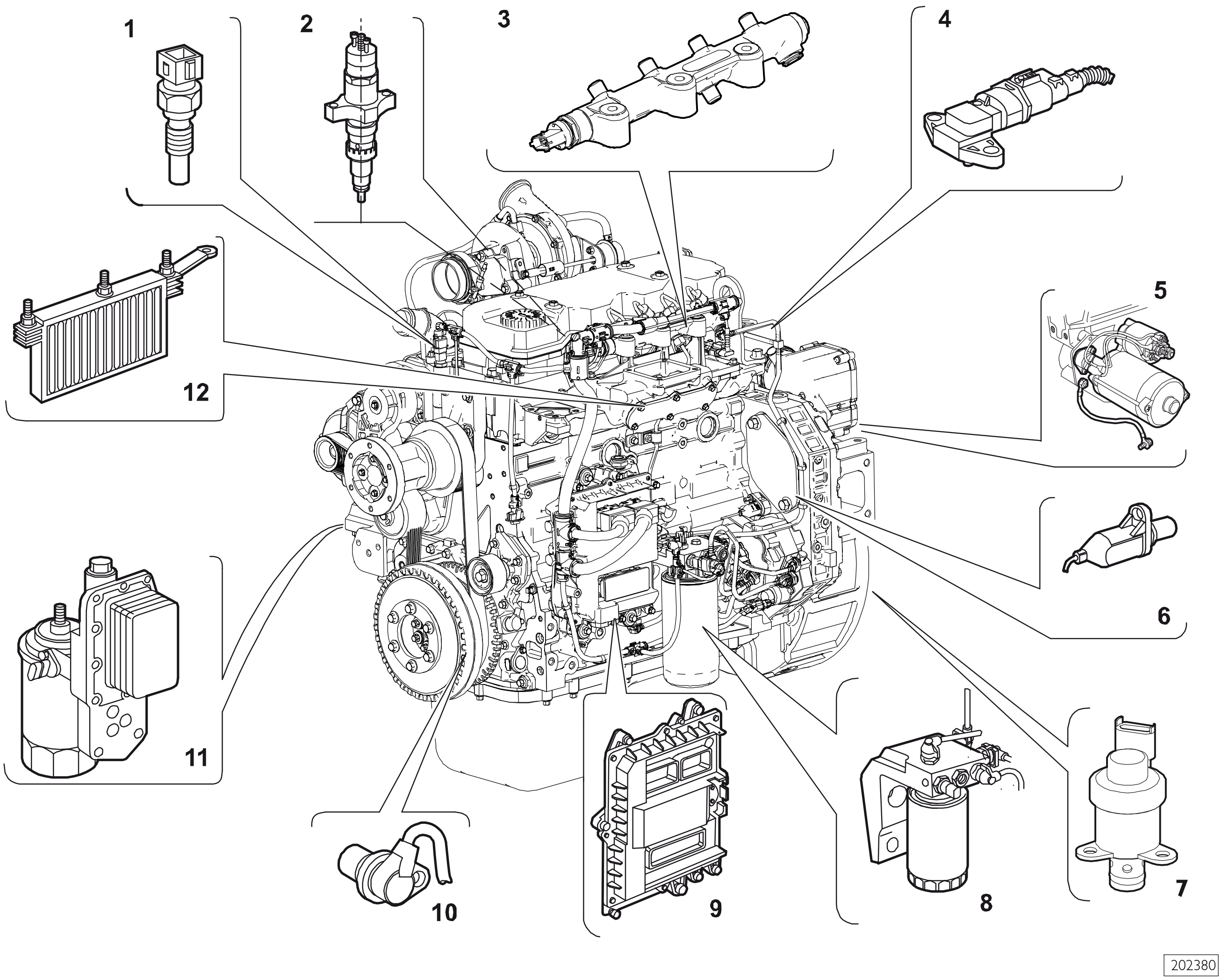

15
ZS
W
B+
NC
L
30
C
+
-
U
W
V
B+
DF
V
B-
ELECTRICAL SYSTEM
ALTERNATOR
REGULATOR
199372

Figure 9 (NEF45 TE1F/TE2F)



The NEF F4HE engines are entirely managed by the electronic control unit. This is mounted directly on the engine by means of a heat exchanger that allows the cooling, using the elastic plugs which reduce the vibrations transmitted from the engine.

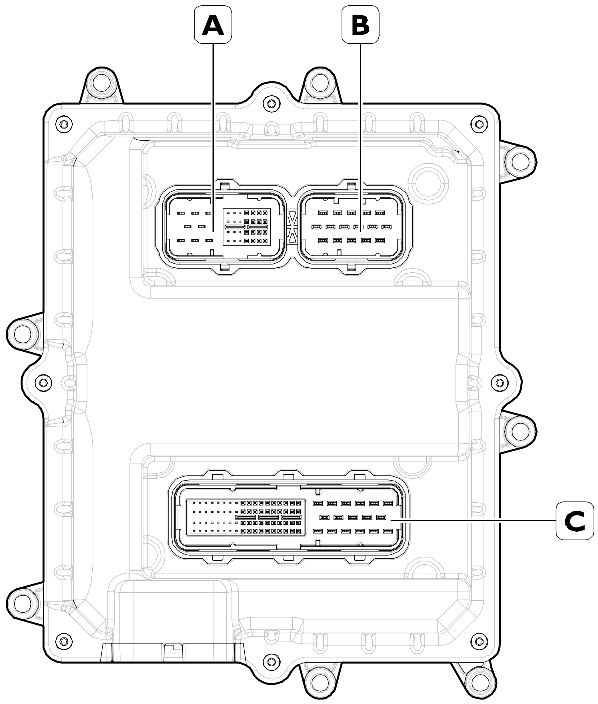
With the electronic control unit you can verify the correct operation of the engine. (see the third part of this manual, specifically dedicated to diagnostics).

Listed below are the electrical and electronic components on the engine:

1. Coolant temperature sensor.
2. Electro-injector.
3. RAIL Pressure sensor.
4. Air pressure/temperature sensor.
5. Starter motor
6. Timing sensor.
7. Pressure regulator solenoid valve.
8. Fuel temperature sensor.
9. EDC electronic control unit.
10. Crankshaft sensor.
11. Engine oil temperature/pressure sensor.
12. Resistor for pre-post heating.

EDC7 UC31 electronic control unit

Figure 10



A. Sensor connector - B. Injector connector - C. Chassis side connector

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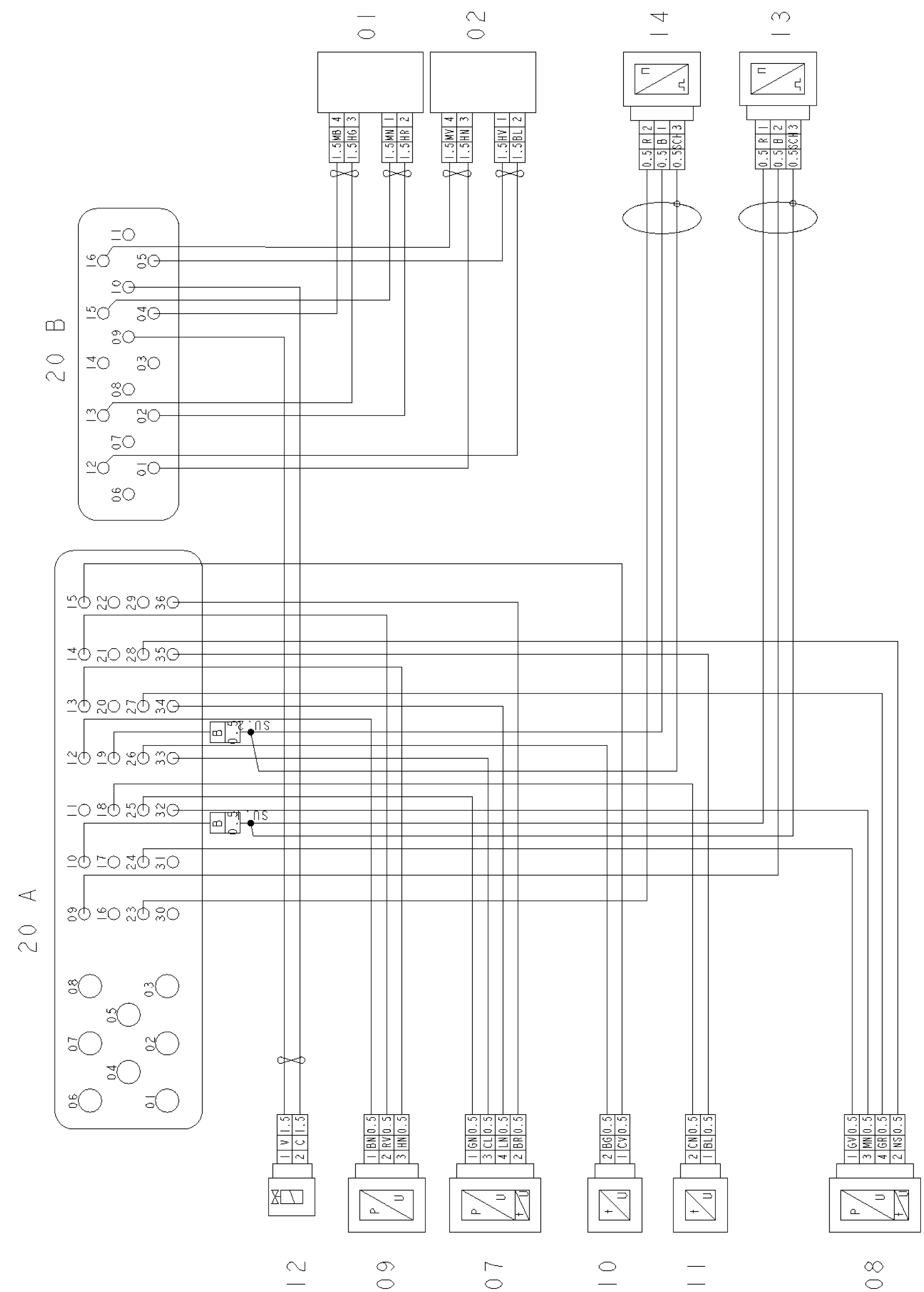
Figure 11



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Sensor connector (A)

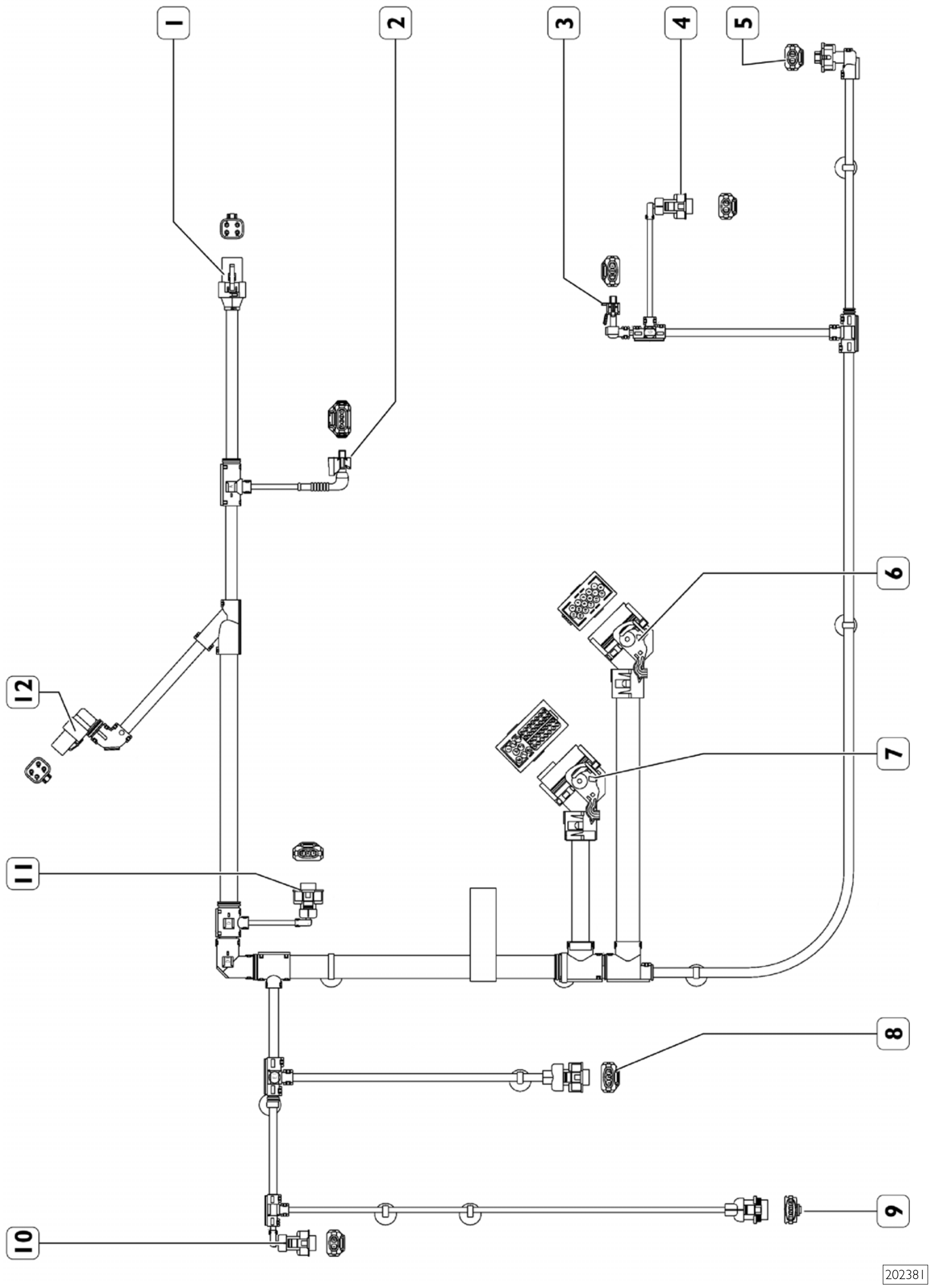
ECU PIN	FUNCTION
1	-
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	Timing sensor
10	Timing sensor
11	-
12	Negative for Rail pressure and temperature sensor
13	Positive for Rail pressure and temperature sensor
14	Signal from Rail pressure and temperature sensor
15	Coolant temperature sensor
16	-
17	-
18	Fuel temperature sensor signal
19	Engine speed sensor
20	-
21	-
22	-
23	Engine speed sensor
24	Negative for engine oil pressure and temperature sensor
25	Negative for air pressure and temperature sensor
26	Coolant temperature sensor
27	Signal from engine oil pressure sensor
28	Signal from engine oil temperature sensor
29	-
30	-
31	-
32	Positive for engine oil pressure and temperature sensor
33	Positive for air pressure and temperature sensor
34	Signal from air pressure sensor
35	Negative for fuel temperature sensor
36	Signal from air temperature sensor

Injector connector (B)

ECU PIN	FUNCTION
1	Cylinder 5 injector
2	Cylinder 6 injector
3	Cylinder 4 injector
4	Cylinder 1 injector
5	Cylinder 3 injector
6	Cylinder 2 injector
7	-
8	-
9	Pressure regulator
10	Pressure regulator
11	Cylinder 2 injector
12	Cylinder 3 injector
13	Cylinder 1 injector
14	Cylinder 4 injector
15	Cylinder 6 injector
16	Cylinder 5 injector

KSB connection cable - Stanadyne pump

Figure 12

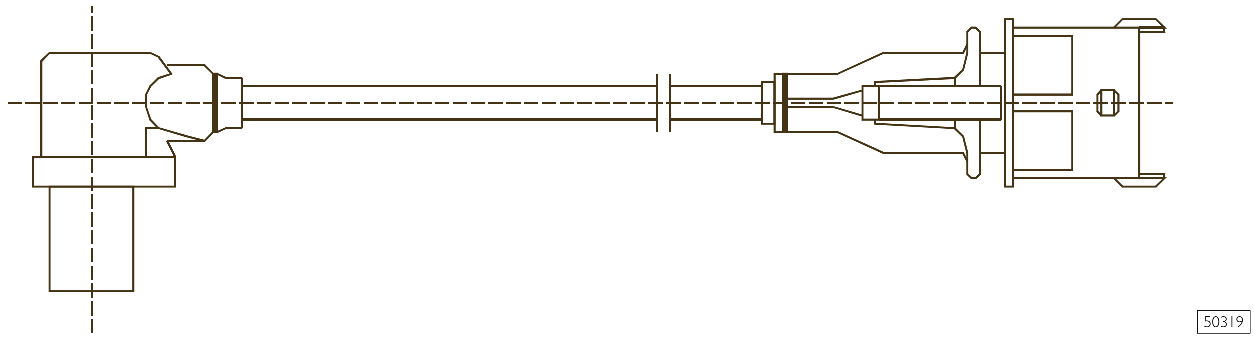


1. Electro-injectors cyl 3 - 4 - 2. Air temperature-pressure sensor - 3. Timing sensor - 4. Fuel temperature sensor - 5. Pump pressure regulation sensor - 6. Power control unit - 7. Signal control unit - 8. Crankshaft rpm sensor - 9. Oil press/temper sensor - 10. Water temperature sensor - 11. Rail pressure sensor - 12. Electro-injectors cyl 1 - 2

Crankshaft sensor

This inductive sensor is located on the left front of the engine. It generates signals obtained from changes in magnetic flux created by spaces between the teeth on the phonic wheel fitted to the crankshaft.
It is connected to the control unit at pins 19A - 23A. The sensor resistance value is ~900 Ω.

Figure 13

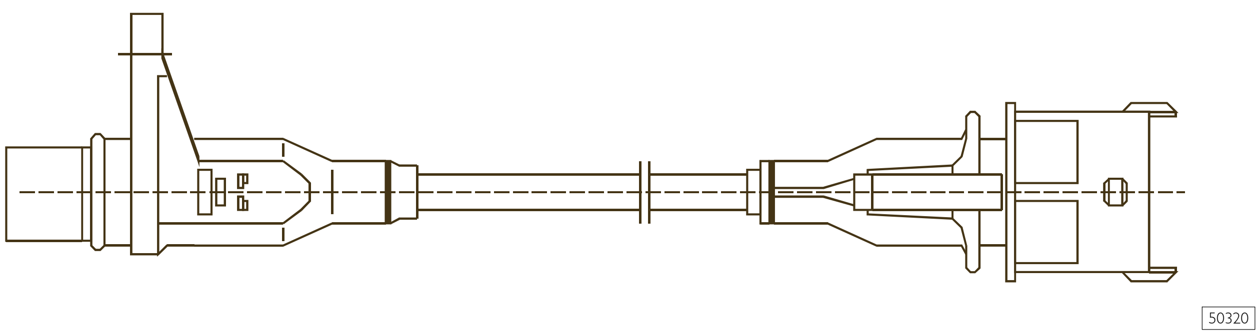


Crankshaft sensor

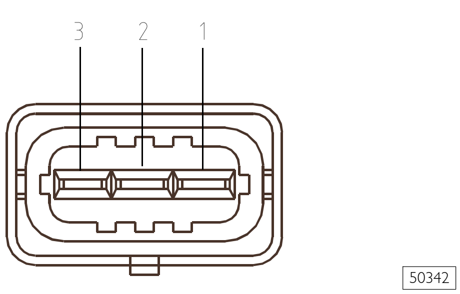
Timing sensor

This inductive type sensor is located on the rear left part of the engine. It generates the signals obtained from the magnetic flux lines that close through the holes keyed
on the gear of the camshaft. The signal generated by this sensor is used by the control unit as the injection timing signal.
Although similar to the flywheel sensor, they are NOT interchangeable since it has a different outer shape.
It is connected to the control unit at pins 9A - 10A. The sensor resistance value is ~900 Ω.

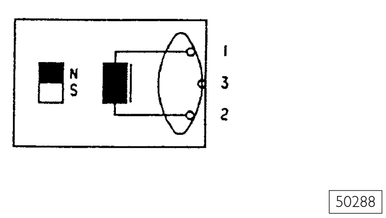
Figure 14



Timing sensor



Connector



Wiring Diagram

Ref.	Description	Control unit pin	
		Crankshaft sensor	Timing sensor
1	Signal	19A	10A
2	Signal	23A	9A
3	Shielding		

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Turbocharged air pressure/temperature sensor;

This component incorporates a temperature sensor and a pressure sensor.
It is fitted to the intake manifold so that, by measuring the maximum quantity of air taken in, it makes it possible to determine the exact amount of fuel to be injected at each cycle.
It is connected to the control unit at pins 25A - 36A - 33A - 34A.
It is powered at 5 volt
The voltage present at output is proportional to the pressure or temperature detected by the sensor.

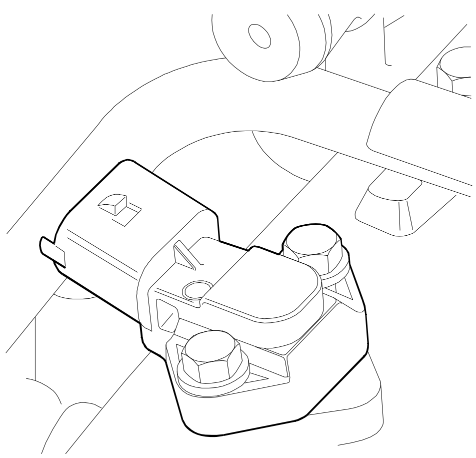
Pins 25A - 36A Temperature
Pins 33A - 34A Pressure

Engine oil temperature/pressure sensor;

This component is identical to the air temperature/pressure sensor.
It measures the temperature and pressure of the engine oil.
It measures the engine oil temperature and pressure.
It is connected to the control unit at pins 24A - 28A - 32A - 27A.
It runs on 5 Volts. The detected signal is sent to the EDC control unit which in turn controls the indicator tool in the dashboard (indicator + low pressure light).
The oil temperature is not shown by any of the instruments- it can only be used by the Control Unit.

Pins 24A - 28A Temperature
Pins 32A - 27A Pressure

Figure 15



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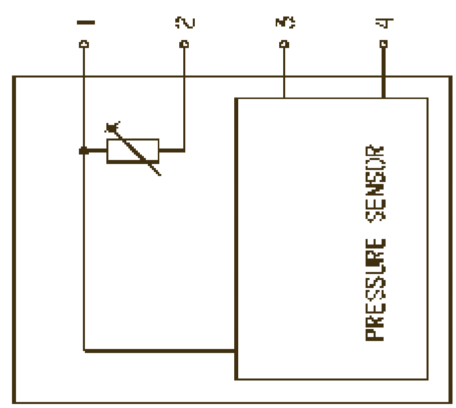

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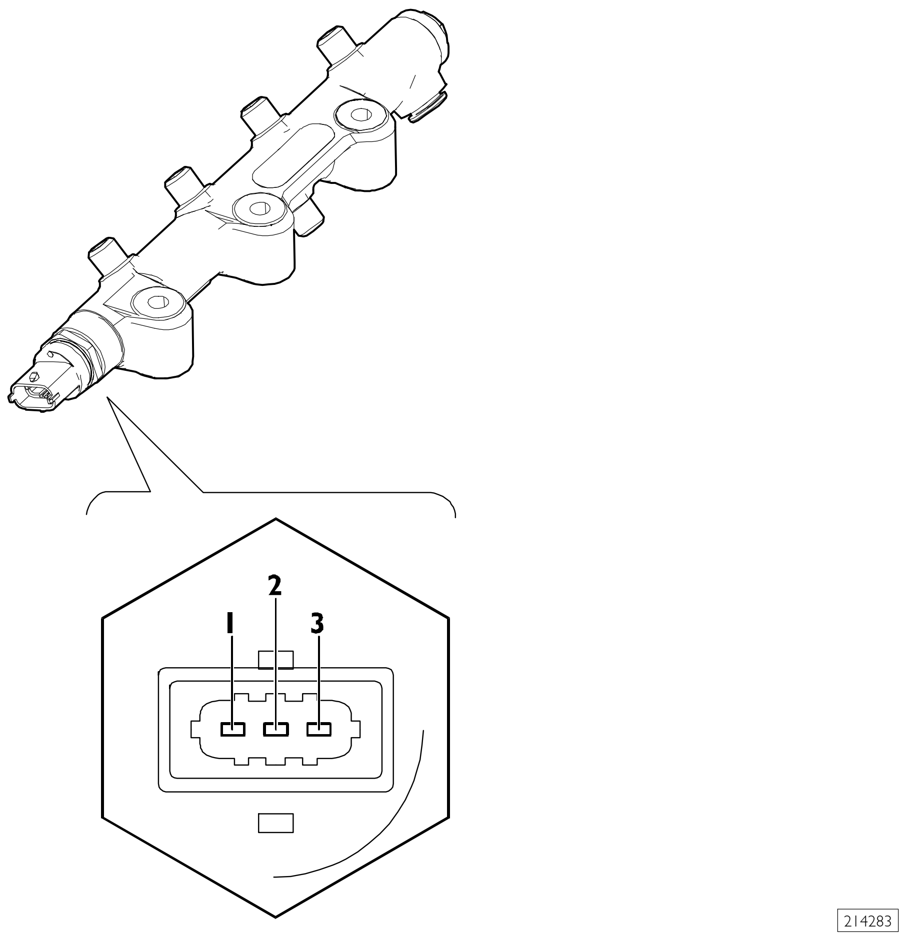
Wiring Diagram

Ref.	Description	Control unit pin	
		Engine	Air
1	Ground	24A	25A
2	NTC signal (temperature)	28A	36A
3	Power supply +5 V	32A	33A
4	Signal (pressure)	27A	34A

Fuel pressure sensor

Assembled on one end of the rail, measures the existing fuel pressure and informs the control unit (feed - back).
The value of injection pressure is used to keep the pressure level under control and to determine the time duration of the injection electronic command.
It is connected to the control unit at pins 12A - 14A - 13A.
It runs on 5 Volts.

Figure 16



Fuel pressure sensor connector

Ref.	Description	Control unit pin
1	Ground	12A
2	Signal	14A
3	Power supply	13A

Electro-injectors

This is an N.O. solenoid valve.
They are individually connected to the EDC control unit on connector B.
The coil resistance of each individual injector is 0.56 ÷ 0.57 Ω.

Ref.		Description	Control unit pin
CONNECTOR 1	1 2 3 4	Cylinder injector 2 Cylinder injector 2 Cylinder injector 1 Cylinder injector 1	15 B 2 B 13 B 4 B
CONNECTOR 2	1 2 3 4	Cylinder injector 4 Cylinder injector 4 Cylinder injector 3 Cylinder injector 3	5 B 12 B 1 B 16 B

Figure 17

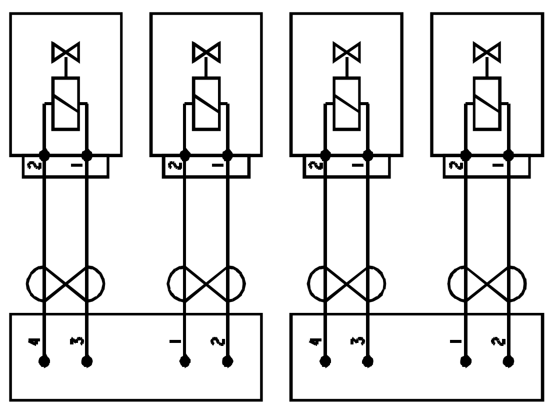


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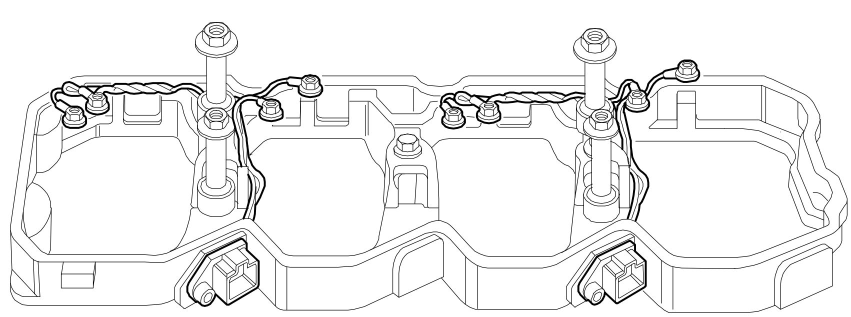
Figure 18



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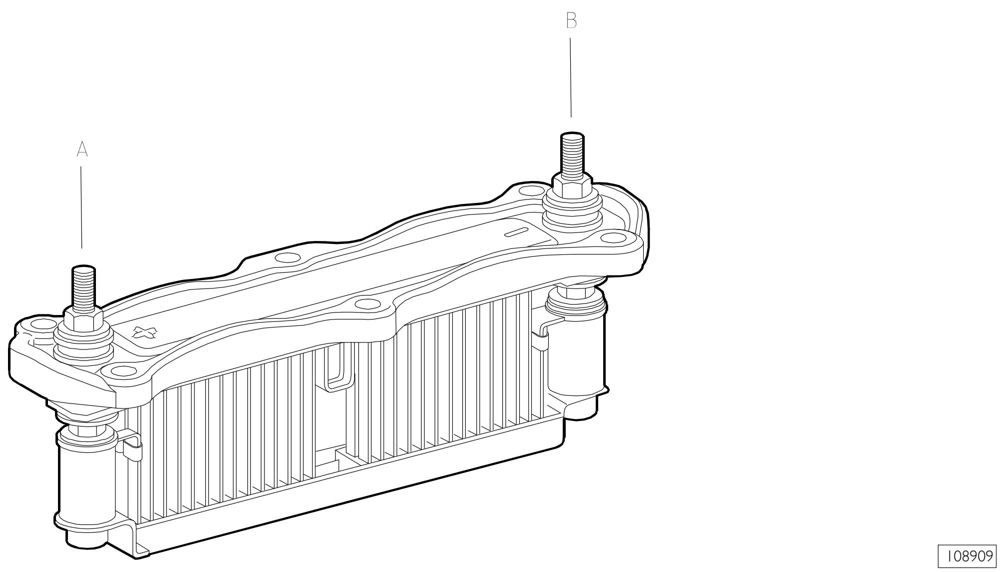
Resistor and contactor for pre-post heating

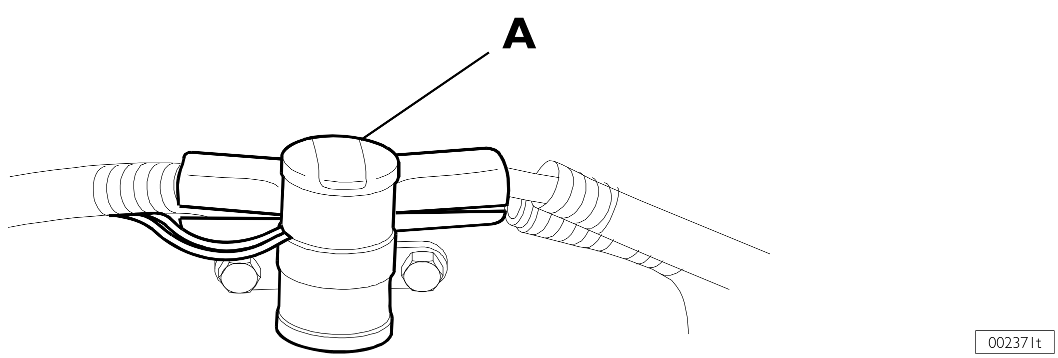
This element is located on the intake manifold.
It is utilised to heat the air in the operations of pre / post heating. It is powered via contactor.
Its resistance is approximately 0.5 Ω.

Figure 19



A. - B. Connecting terminals

Figure 20



A. Control contactor

The power contactor is connected to ECU connector B
Activation takes place with water and/or fuel temperature lower than 5 °C.
The resistance of the contactor is approx. 15 Ω.

Do not use flammable liquids or gases to facilitate starting the engine.
These substances may readily catch fire when in contact with the resistor, creating seriously dangerous situations.

Coolant temperature sensor

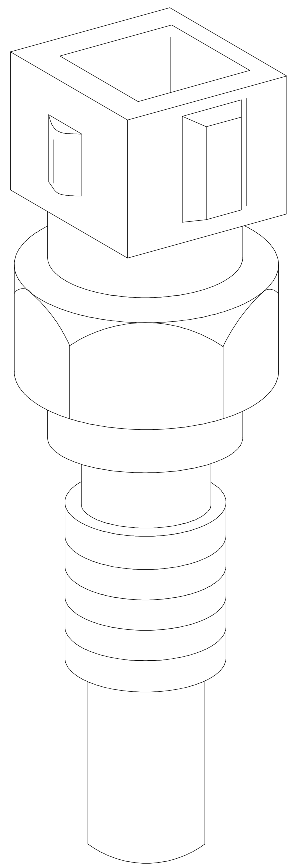
This is a variable resistance sensor that is able to measure coolant temperature and transmit a signal to the control unit reflecting the thermal conditions of the engine.

The same signal is used by the control unit to drive a temperature device, if present, in the dashboard.

It is connected to the control unit at pins 15A - 26A.

Its resistance at 20 °C is about 2.50 Ω.

Figure 21

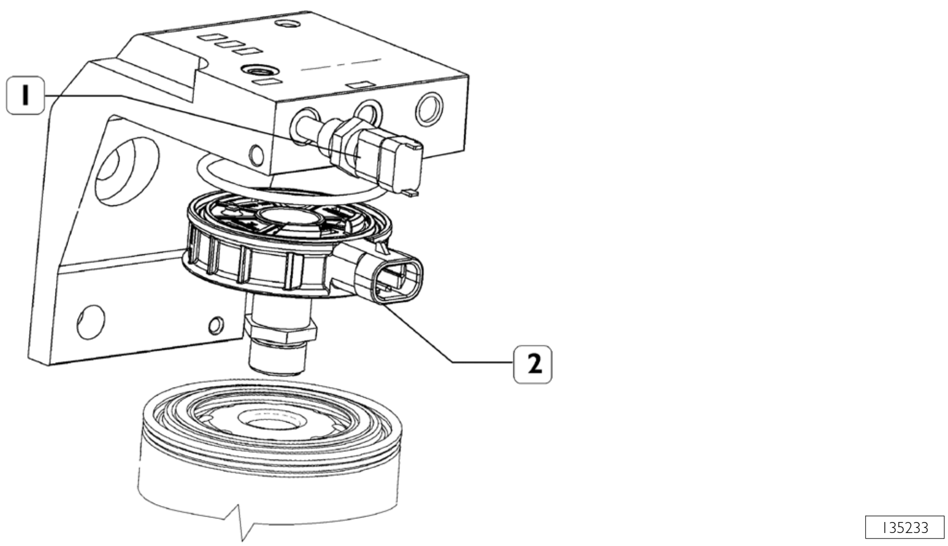


107471

Fuel temperature sensor

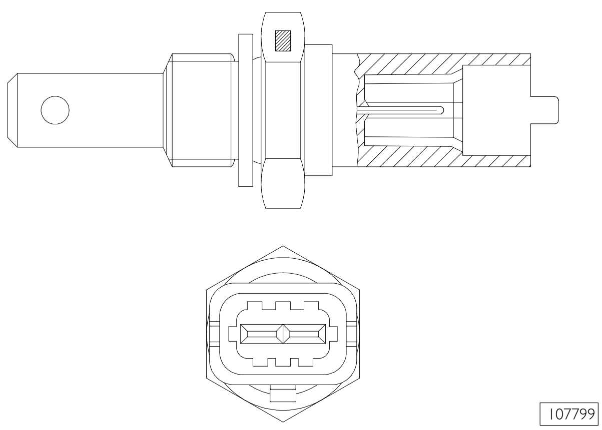
This sensor is identical to the previous one.
It detects the fuel temperature to provide the control unit with an index of the fuel's thermal state.
It is connected to the control unit at pins 35A - 18A.
Its resistance at 20 °C is about 2.50 Ω.

Figure 22

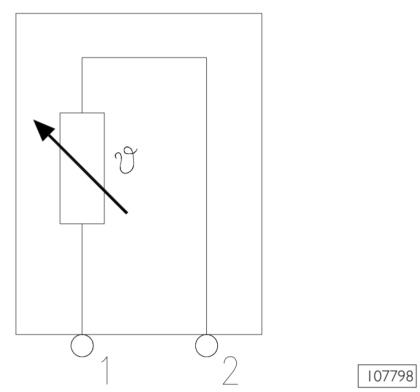


1. Fuel temperature sensor - 2. Resistor for filter preheating.

The ECU controls the power contactor for heating the filter to a fuel temperature of ≤ 5 °C.



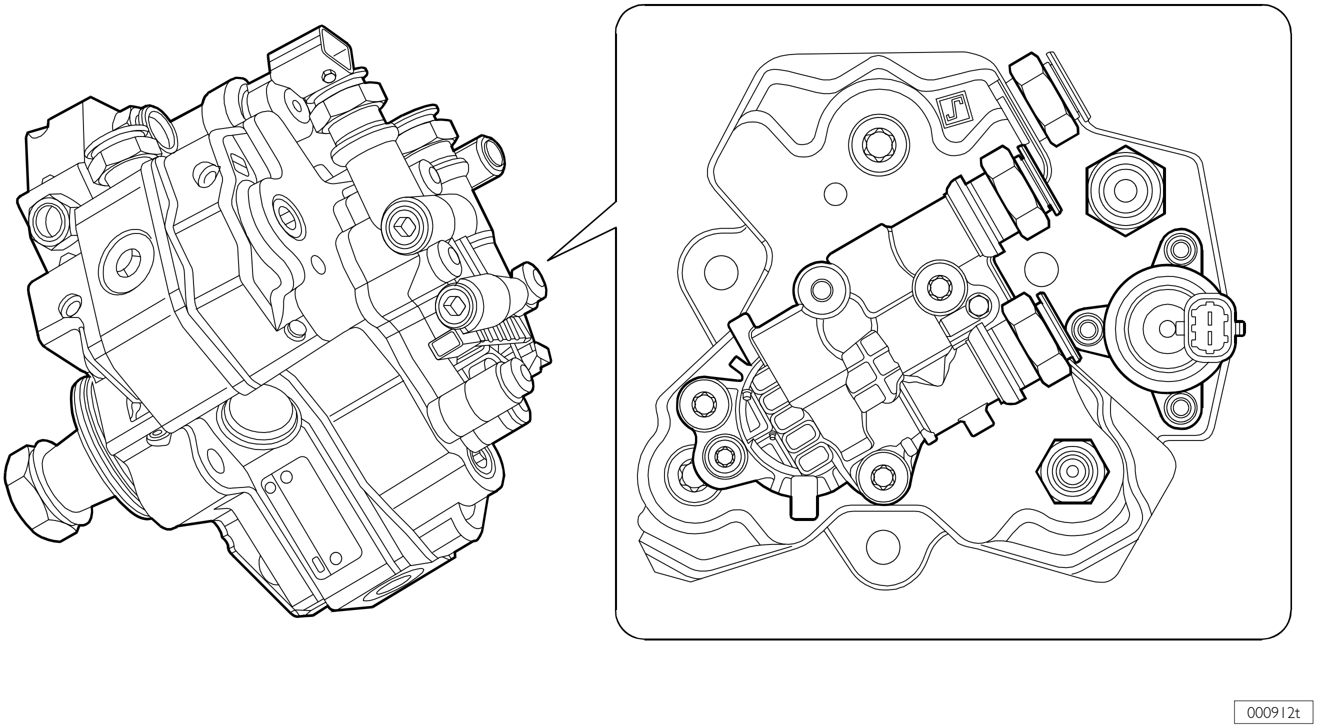
Connector



Ref.	Description	Control unit pin	
		Water	Comb.
1	Ground	15A	35A
2	Temperature signal	26A	18A

High pressure pump - pressure regulator

Figure 23



A. Pressure regulator

The amount of fuel that supplies the high pressure pump is metered by the pressure regulator, positioned on the low pressure system; the pressure regulator is managed by the EDC7 control unit.

The delivery pressure to the rail is regulated between 250 and 1450 bar by the ECU acting on the pressure regulator solenoid valve.

- It is a N.O. solenoid valve.
- It is connected to the control unit at pins 9B - 10B.
- Its resistance is approximately 3.2 Ω.

SECTION 4

Scheduled maintenance

	Page
Principles	3
Checks and scheduled maintenance procedures	4
Periodical maintenance	7
Unscheduled maintenance	11

Principles

To ensure best operating conditions, the checks, tests and adjustments which are to be carried out on the different parts at the established time are provided on the following pages.

The frequencies of the maintenance operations are indicative since the engine use and its characteristics are essential to evaluate replacements and checks.

Not only it is permitted, but it is recommended that the staff in charge of maintenance should also perform those checking and maintenance operations which are not included in the list below, but are recommended by good-practices and particular conditions of use of the engine.

Checks and scheduled maintenance procedures	Intervals (hours)
Check the engine lubricant oil level	daily
Check engine coolant level	daily
Check cleanliness of the heat exchanger	daily
Check cleanliness of the air filter	300 hours (2)
Check belt condition and tension	Six-months
Checking/topping-up the level of the electrolytic solution in the batteries and cleaning the terminals	Six-months
Check the condition of the exhaust duct(s)	Six-months
Periodical maintenance	
Engine lubricant oil change	600 hours (3)(4)
Oil filter change	600 hours (3)(4)(5)
Fuel filter replacement	600 hours (1)(3)(5)
Fuel pre-filter change	600 hours (1)(3)
Change oil vapour filters	900 hours (3)(4)
Drain water from the fuel filter	150 hours (1)
Drainage/suction of water, condensation and impurities from the fuel tank/s	150 hours (1)
Change air filter	1200 hours (6)
Change the engine coolant	1200 hours / 3 years
Unscheduled maintenance	
Visually inspect turbocharger	1200 hours
Ancillary belt replacement	1200 hours
Clean the heat exchanger (radiator)	1200 hours
Injector calibration (Mechanical engines)	1800 hours
Checking and setting the valve clearance	3000 hours

1) Maximum period relating to the use of high quality fuel, (specification EN 590); it decreases depending on fuel contamination and the alarm signals for filter clogging and/or the presence of water in the pre-filter.
The filter clogging signal indicates that the filter must be replaced. If the alarm signalling water in the pre-filter is not turned off, the pre-filter must be replaced.

2) Refers to engines with conventional and automatic tensioners

3) Must be performed annually even if the intended operating hours are not reached

4) Intervals valid for lubricants as specified in the REFUELLING table.

5) Only use filters with the following specifications:
- degree of filtering < 12 μm
- filtering efficiency ß > 200.

6) The frequency depends on the ambient conditions and product efficiency/wear.

NOTE Checks, inspections and changes are indicative and must integrate those specifications foreseen for vehicles equipped with an NEF engine.

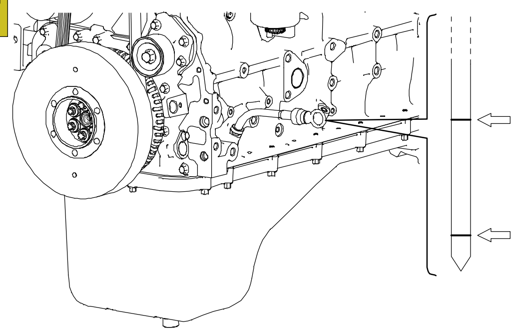
The data are only valid if the vehicle manufacturer observes all the installation regulations provided by FPT.

Checks and scheduled maintenance procedures

Check the engine lubricant oil level

Only proceed when the engine is not turning and is at low temperature in order not to run the risk of burns.

Figure 1 (For all engines)



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- Use the oil dipstick to check that the lubricant oil level is between the "Min" and "Max" limits.
- If the level is insufficient, it is necessary to top up with lubricant oil which meets the international specifications ACEA E7 (high power engines): remove the lubricant oil plug and pour engine lubricant oil through the hole.
- Use the oil dipstick to check that the oil level lubricant oil level does not exceed the "Max" limit.

The engine oil is highly pollutant and noxious.

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

Suitably protect skin and eyes; proceed in accordance with accident prevention standards.

Suitably dispose of the residuals and in accordance with regulations.

Check engine coolant level

The verification should be performed both when the engine is stopped and during operation.

Check the pipes from the engine to the radiator, from the expansion chamber and vice versa; identify any leakage, the state of the pipes, particularly near the junction clamps.

Check the cleanliness of the radiator, the integrity of the ventilation flaps, any leakage from the clamps, sleeves and radiating body.

The engine oil is highly pollutant and noxious.

Given the high temperatures which are reached inside the system, do not carry out operations immediately after the engine has stopped but wait until the temperature has fallen.

Protect your eyes and skin from any high pressure spray of coolant.

The density of the coolant should still be checked every year before the winter season and replaced at least every two years.

In case of new refilling proceed with the de-aeration of the system by means of the breathers on the engine.

Failure to vent the system could cause serious damage to the engine due to the presence of air pockets in the cylinder head of the engine.

- Make sure that when the engine is cold the fluid level in the exchanger covers the internal elements of the exchanger.
- Top up if necessary, using water free of impurities. Do not use distilled water.

NOTE if frequent top-ups are necessary, the cooling circuit must be diagnosed.

If set-up requires the presence of the level indicator external to the heat exchangers, refill it if necessary, taking care that the fluid does not saturate the internal volume of the heat exchanger to allow the temperature increase to cause the increase of the liquid volume.

Check cleanliness of the heat exchanger

Check that the air intake surfaces of the radiators are free of impurities.

The use of compressed air requires the use of suitable protective equipment for the hands, face and eyes.

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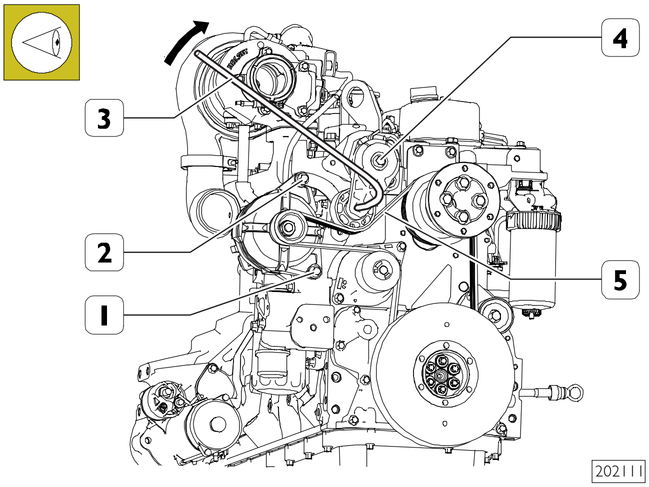
Check ancillary belt condition and tension

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Figure 2 (NEF45 TE1F/TE2F)



- ❑ Remove any casing protecting the pulleys.
- ❑ Make sure the belt is not torn, in an obvious state of wear or soiled by lubricants and fuels. Otherwise replace it.
- ❑ At the same time, check the efficiency of the tensioner by acting on it as shown in the figure.
- ❑ Refit the casing into place by tightening the resealing protection elements.

Inspection of the exhaust duct

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.

- ❑ Make sure that there is no risk of harmful fumes in the environment where the engine is being worked on. Contact the manufacturer if necessary.

Check tightening and cleanliness of battery terminals

Check that the battery terminals and cable clamps are clean, well tightened and protected by Vaseline.

In the event of dirty cable clamps and battery terminals:

- ❑ Loosen the nut and remove the terminal from the negative terminal (marked with a "-").
- ❑ Loosen the nut and remove the terminal from the positive terminal (marked with a "+").
- ❑ Use a metal brush or fine grade sand paper to clean the cable terminals and the battery terminals until they are shiny.
- ❑ Smear the cable terminals with Vaseline and insert them onto the battery terminals making sure that the positive pole is connected first, followed by the negative pole, and then tighten each terminal.

Check the cables and clamps for signs of wear and corrosion; if there is any deterioration, replace them.

Visually check the condition of the battery: the terminals must not show signs of deterioration and the body must not be damaged, otherwise they should be replaced.

Wear protective glasses and gloves

Check electrolyte level of the batteries

The batteries used are of reduced maintenance type. Therefore, under normal conditions of use, no top up of the electrolyte is required.

However, the routine checking of the electrolyte level is recommended.

Proceed after positioning the batteries on a horizontal surface.

- ❑ Visually check that the electrolyte level is between the "Min" and "Max" reference marks on the batteries; in the absence of any reference marks, make sure the liquid covers the lead plates contained in the elements by approx. 5 mm.
- ❑ Only use distilled water to top up the elements whose level is below the minimum.
- ❑ If the battery has to be recharged, contact a specialised workshop.

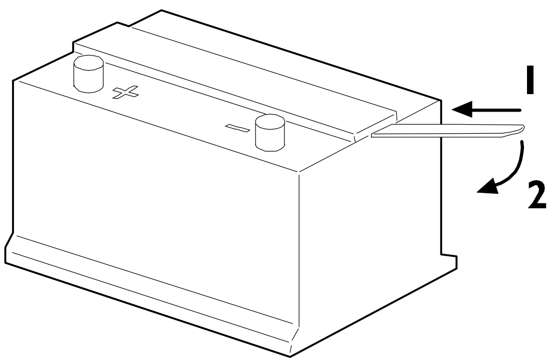
Contact the staff of a specialized workshop if all elements of the battery need to be topped off with a large amount of distilled water and diagnose the state of efficiency of the system and battery.

The batteries contain sulphuric acid, which is highly caustic and corrosive; while topping up, wear gloves and safety glasses and an apron to protect clothing.

If possible, have this check performed by qualified personnel.

During the checks do not smoke or allow naked flames near the batteries. Ensure that the work area is suitably ventilated.

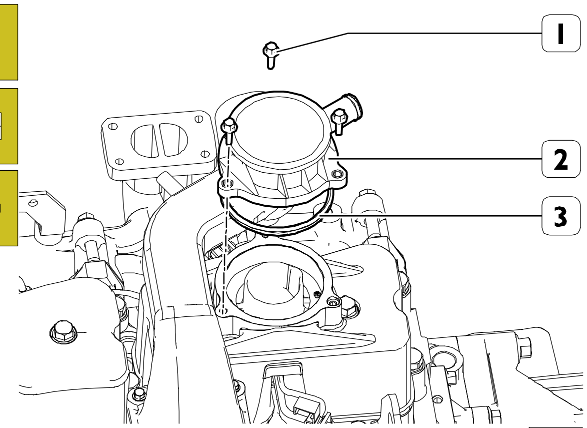
Figure 3



Some batteries have a single cover for the inspection plugs. To access the elements, use a lever as shown in the figure.

Check the condition of the oil vapour filter

Figure 4 NEF45 SM1F engines



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Remove the oil vapour filter (2) from the tappet cover (3) of cylinders 3 - 4, acting on the retaining screws (1).

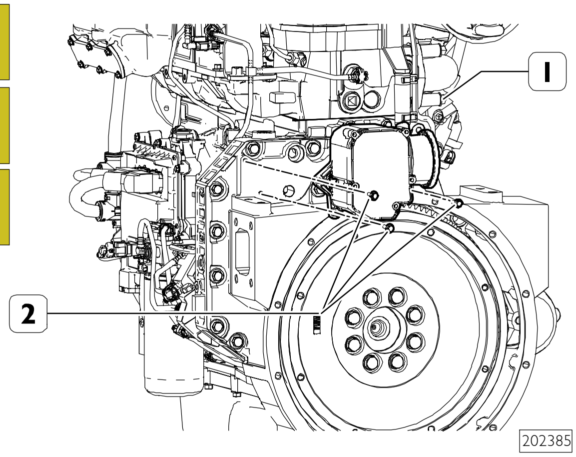
Ref.	No.	Screws description
(1)	3	Screw -

- ❑ Make sure the oil vapour filter (2) is free from scale, otherwise replace.
- ❑ Reposition the oil vapour filter (2) in the seat on the tappet cover (3) of cylinders 3 - 4 and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

Figure 5 NEF45 TE1F/TE2F engines



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Remove the oil vapour filter (1), acting on the retaining screws (2).

Ref.	No.	Screws description
(2)	3	Screw -

- Make sure the oil vapour filter (1) is free from scale, otherwise replace.
- Reposition the oil vapour filter (1) in its seat on the flywheel and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

Check the condition of the exhaust duct(s)

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.

- Make sure that there is no the risk of dangerous fumes inside the car. Contact the manufacturer if necessary.

Periodical maintenance

Engine lubricant oil change

Due to the high operating temperature of the engine it is recommended to wear suitable protection.

The oil reaches very high temperatures: always wear protective gloves.

It is recommended that the oil is drained while hot.

- Place an appropriate container for the oil collection under the sump in correspondence with the drain plug.
- Unscrew the plug and then remove the oil level dipstick and the filler plug to facilitate the lubricant oil flow.

The engine oil is highly pollutant and noxious.

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

Suitably protect skin and eyes; proceed in accordance with accident prevention standards.

Suitably dispose of the residuals and in accordance with regulations.

- When draining has been completed, screw in the plug and then fill with clean oil.

Use only the recommended oils or oils with the characteristics required for the proper functioning of the engine.

If topping up, do not mix oils with different properties.

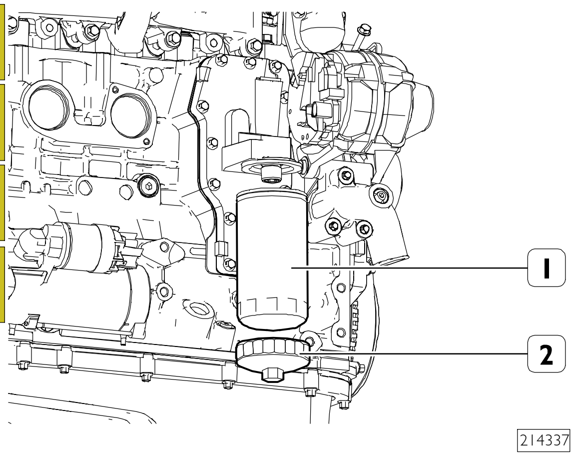
Failure to comply with these rules will result in the loss of guarantee assistance.

- Check the level using the dipstick up to obtain a filling close to the maximum level mark on the dipstick itself.

Oil filter change

NOTE The replacement of the oil filter must take place in conjunction with the changing of the lubricant oil.

Figure 6



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- Use tool 99360076 (2) to unscrew the oil filter (1).

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Be careful since the oil filter contains a significant quantity of engine oil .

Properly position a container that can contain the liquid.

Attention! Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

- Tighten the oil filter (1) in correspondence to the slot on the heat exchanger (2).
- Operate the engine for a few minutes and then check the level using the dipstick. If necessary, top up to compensate for the quantity of oil used to fill up the filtering cartridge.

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

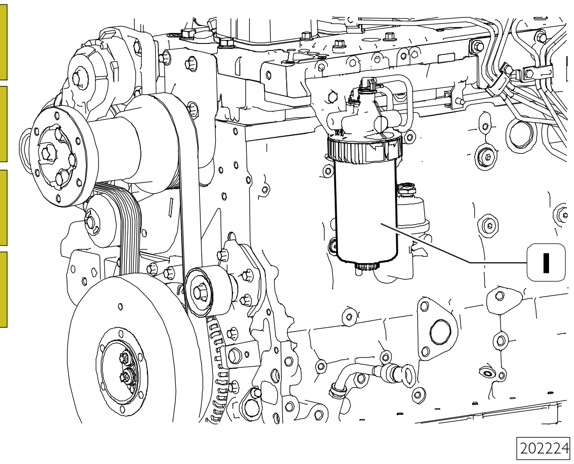
Fuel filter replacement

Do not smoke or use open flames during this operation.

Do not inhale the vapours that exit the filter.

When replacing the filters, the feed system must then always be deaerated.

Figure 7 NEF45 SM1F engines



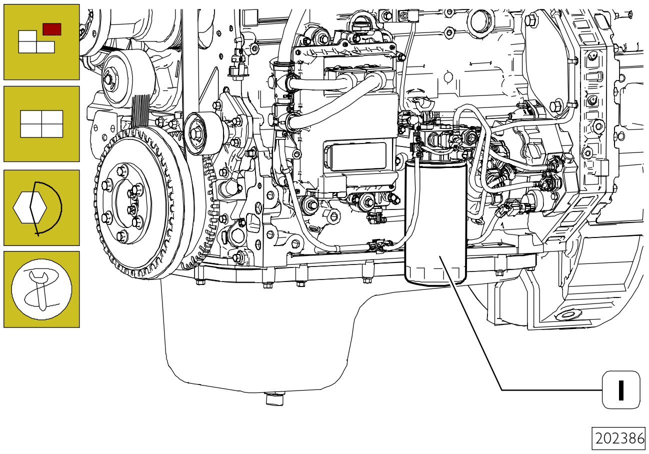
Drain the fuel contained in the filter by acting on the water bleed tap.

Collect the fuel in a clean container.

- Unscrew the cartridge (1) using the specific tool 99360076.
- Collect any fuel still present in the filtering cartridge.
- Clean the gasket seat on the support and lightly oil the gasket on the new filtering cartridge.
- Manually screw in the new filtering cartridge until the gasket rests completely on its seat.
- Tighten further with the help of the tool 99360076.

When replacing the filters, the feed system must then always be deaerated.

Figure 8 NEF45 TE1F/TE2F engines



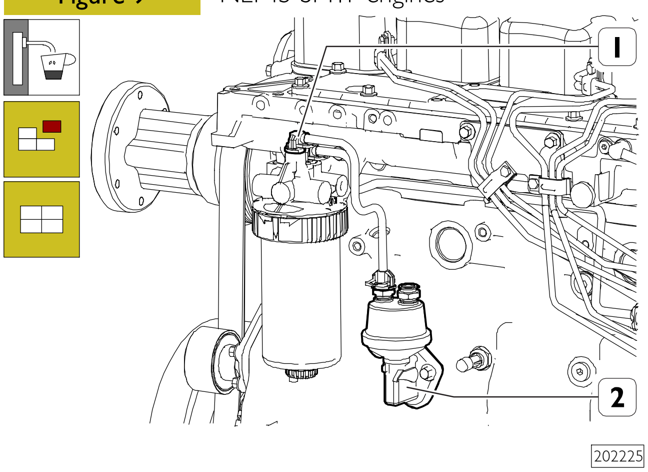
Drain the fuel contained in the filter by acting on the water bleed tap.

Collect the fuel in a clean container.

- Unscrew the cartridge (1) using the specific tool 99360076.
- Collect any fuel still present in the filtering cartridge.
- Clean the gasket seat on the support and lightly oil the gasket on the new filtering cartridge.
- Manually tighten the new filtering cartridge until the gasket rests completely on its seat.
- Tighten further with the help of the tool 99360076.

Bleeding procedure:

Figure 9 NEF45 SM1F engines

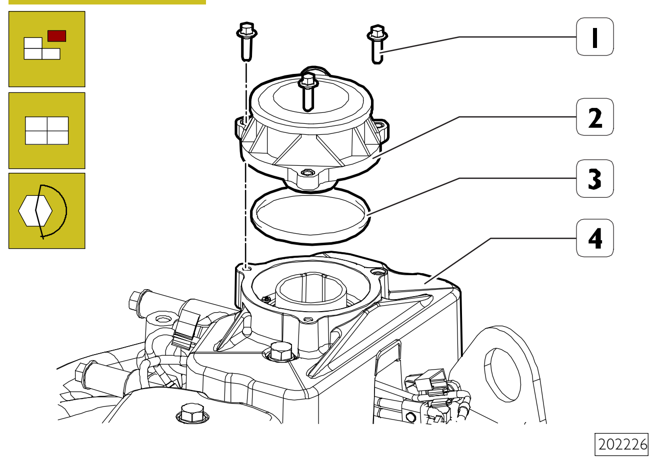


- Loosen the fuel outlet fitting located on the top of the filter (1).
- Ensure that the diesel fuel leakages does not dirty the auxiliary drive belt and is not dispersed into the environment.
- Act on the pre-filter hand pump until the diesel comes out with no residual air content or carry out a similar operation on the mechanical feed pump (2).
- Tighten the previously loosened fitting to the specified torque.
- Dispose of the diesel that leaked during the operation according to specifications.
- Start the engine and run it at idle for a few minutes to remove any residual air.

NOTE If it is necessary to accelerate the bleeding of residual air, proceed by acting on the hand pump, even during start-up.

Change oil vapour filters

Figure 10 NEF45 SM1F engines



- Remove the oil vapour filter (2) from the tappet cover (4) of cylinders 3 - 4, acting on the retaining screws (1).

Ref.	No.	Screws description
(1)	3	Screw -

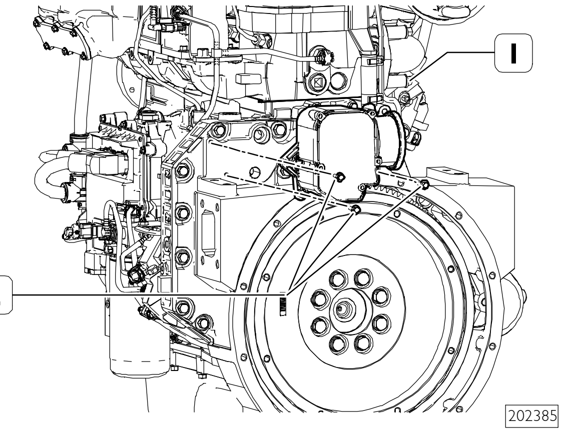
- Replace the oil vapour filter (2) and its gasket (3).
- Reposition the oil vapour filter (2) in the seat on the tappet cover (4) of cylinders 3 - 4 and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. The FPT Technical Service Network workshops are equipped for this purpose.

Change oil vapour filters

Figure 11 NEF45 TE1F/TE2F engines



❑ Remove the oil vapour filter (1), acting on the retaining screws (2).

Ref.	No.	Screws description
(2)	3	Screw -

❑ Replace the oil vapour filter (1) and its gasket.

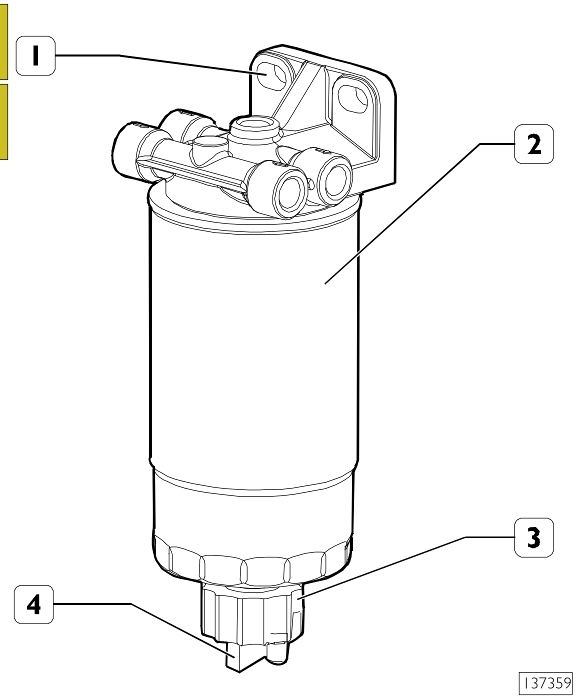
❑ Reposition the oil vapour filter (1) in its seat on the flywheel and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

Drain water from the fuel filter

Figure 12 NEF45 SM1F engines



The high risk of refuelling fuel polluted with foreign agents and water suggests performing a check at every refuel.

Proceed when the engine is not rotating.

❑ Position a container for collecting the liquid below the filter.

❑ Unscrew the valve plug (4) located at the bottom of the filter; in some versions, the plug includes the water in diesel sensor.

❑ Drain the liquid until it recognises the presence of only "diesel".

❑ Fully retighten the plug manually.

❑ Dispose of the drained liquids according to the applicable regulations in force.

Drainage/suction of water, condensation and impurities from the fuel tank/s

Perform the drainage/suction of water, condensation and impurities from the fuel tank/s following the instructions in the manual provided by the manufacturer of the tank/s.

Proceed as necessary based on the structure or location of the tank: engines that operate in adverse environments and conditions and/or that are refuelled using drums or jerry cans, require more attention when cleaning the tank.

Engine lubricant oil change

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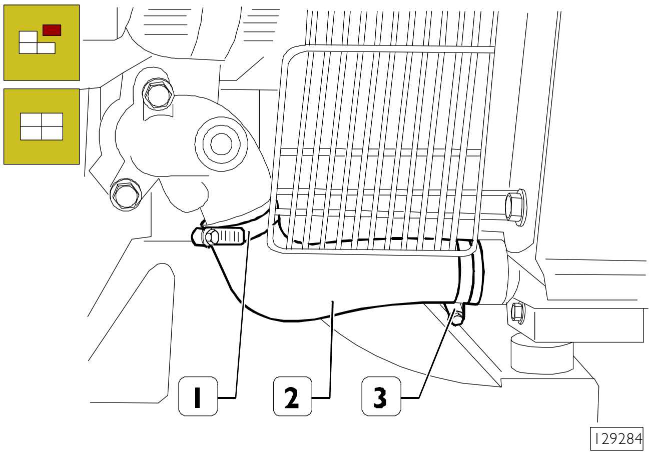
Change the engine coolant

Figure 13



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Use suitable containers to ensure that the coolant is not dispersed in the environment.
- Loosen the retaining elements (1 and 3), remove the sleeves (2) connecting the engine circuit to the heat exchanger and wait for emptying to complete. Once emptied, restore the condition of the circuit, ensuring the perfect seal of the sleeves.
- Refill the circuit.
- Refill the engine and the exchanger until the exchanger is completely full.
- With the filler plug open, start the engine and idle it for approximately 1 minute.
  This phase helps to completely bleed the air contained in the cooling circuit.
- Stop the engine and then top up with the amount which is still needed.

Unscheduled maintenance

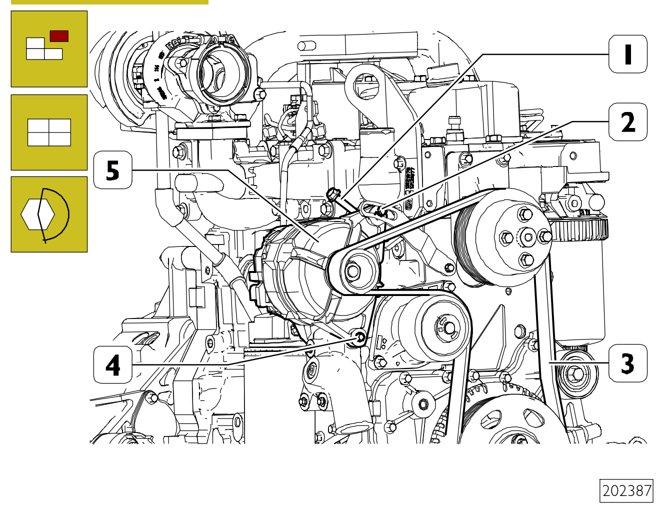
Ancillary belt replacement

Replace the ancillary belt if it shows signs of abrasions, cracks or tears or if it is soiled with oil or fuel.

When the engine is off, but still hot, the belt may start to move without warning.

Wait for the engine temperature to decrease in order to avoid serious risk of injury.

Figure 14 NEF45 SM1F engines



- Remove the protective grille and the fan together with spacer by acting on the relative fasteners.
- Loosen the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.
- Remove the belt (3).

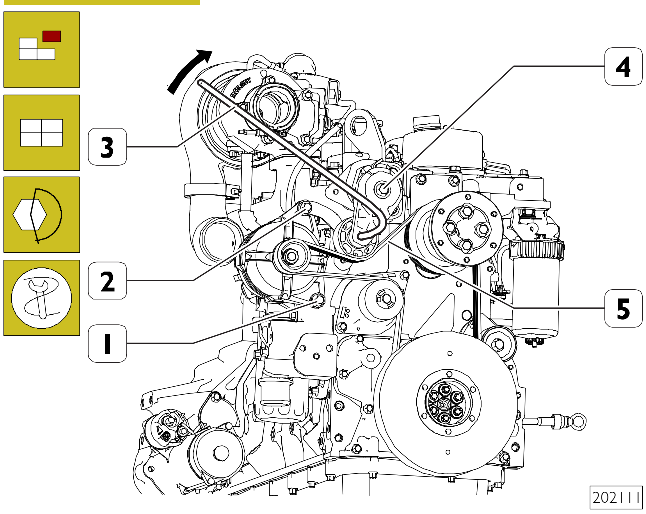
Ref.	No.	Screws description
(1)	1	Screw M8x1.25x100
(2)	1	Screw M10x1.5x40
(4)	1	Screw M10x1.5x110

- Place the new belt (3) inside of the shoulders of all the pulleys.
- Tighten the screw (1) adjusting the alternator (5).
- Tighten the screws (2 and 4) anchoring the alternator to its support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x100	-
(2)	1	Screw M10x1.5x40	43 ± 6 Nm
(4)	1	Screw M10x1.5x110	43 ± 6 Nm

- Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Figure 15 NEF45 TE1F/TE2F engines



❑ Remove the protective grille and the fan together with spacer by acting on the relative fasteners.

❑ Loosen the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

❑ Use the special tool (3) to turn the automatic tensioner (4) in the direction of the arrow and remove the belt (5).

❑ Use the special tool (3) to turn the automatic tensioner (4) and place the new belt (5) inside the shoulders of all the pulleys.

❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Visually inspect turbocharger

Only proceed when the engine is not turning over. Visually check that the impellers of the turbine and the compressor and their relative inlets and outlets are not blocked or damaged; in this case, proceed with replacement.

Clean the heat exchanger (radiator)

Check that the air intake surfaces of the radiators are free of impurities.

Clean them using compressed air or steam.

The use of compressed air requires the use of suitable protective equipment for the hands, face and eyes.

Injector calibration (Mechanical engines)

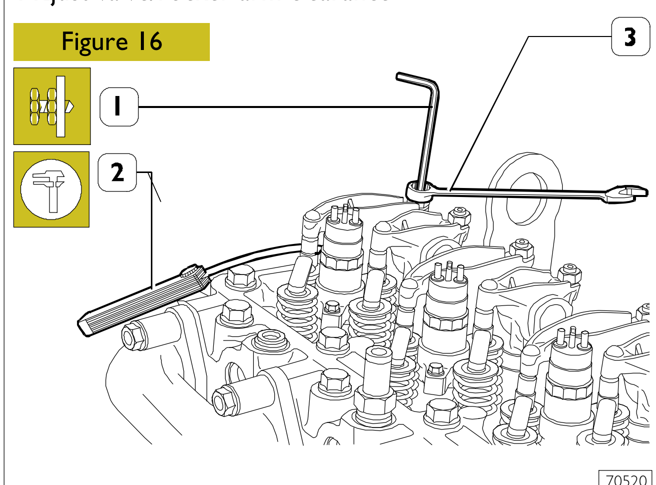
The injectors require periodic cleaning and calibration of the exact injection pressure, through the addition or replacement of shims inserted under the spring; check the injection pressure by using a hand operated pump equipped with a pressure gauge which, operated by the lever, enables the injector calibration pressure to be obtained and which is displayed on the pump pressure gauge at the moment in which diesel delivery occurs.

During testing it is also possible to see whether the flow direction is correct and whether the injector is leaking fuel.

Clean the injectors by removing carbon deposits from the top of the sprayer with a metallic brush.

Adjust valve/rocker arm clearance

Figure 16



Registration of the clearance between the rocker arms and crossbars which control the intake and exhaust valves must be carried out carefully using the hex key (1) box wrench (3) and feeler gauge (2).

The clearance is:

❑ intake valves 0.25 ± 0.05 mm

❑ exhaust valves 0.50 ± 0.05 mm.

SECTION 5

Removal/refitting of the main components of the engine

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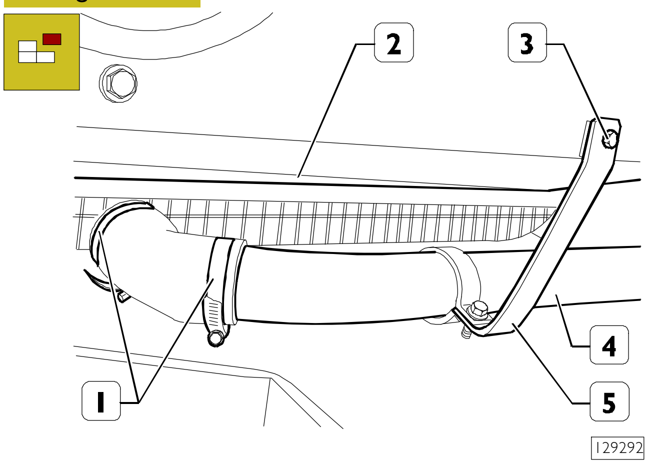
PROCEDURE FOR REMOVAL/REFITTING OF PROTECTION GRILLE

Removal

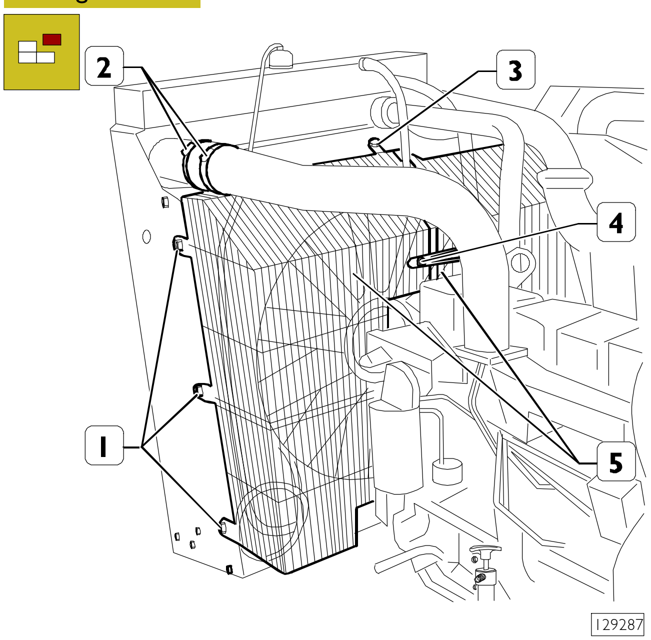
Figure 1



- ❑ Prepare a suitable container in correspondence with the pipe (4) for the recovery of the coolant. Disconnect the pipe (4) by acting on the relative clamps (1).
- ❑ Unscrew the screw (3) and detach the pipe (4) complete with bracket (5) from the radiator assembly (2).

Ref.	No.	Screws description
(3)	1	Screw M8x1.25x16

Figure 2

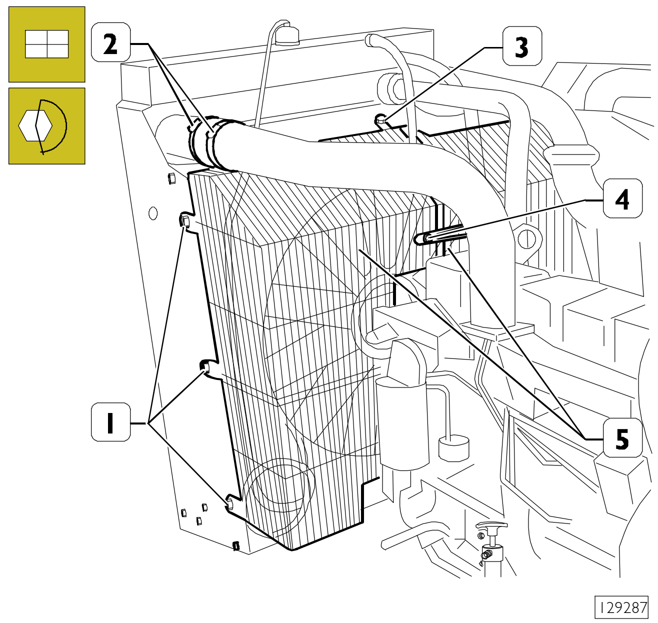


- ❑ Remove the fan protection grilles (5) by undoing the relative fastenings (1), (3) and (4).
- ❑ Open the clamps (2).

Ref.	No.	Screws description
(1)	6	Screw M6x1x16
(3)	1	Screw M8x1.25x16
(4)	1	Screw M6x1x16

Refitting

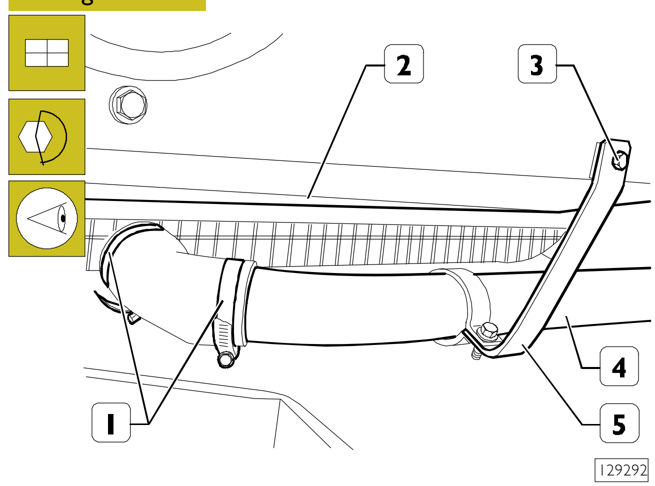
Figure 3



- ❑ Mount the protection grilles (5) of the fan
- ❑ Tighten the relative fasteners (1, 3 and 4).
- ❑ Close the clamps (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm
(4)	1	Screw M6x1x16	43 ± 6 Nm

Figure 4



- ❑ Connect the pipe (4) complete with hoses and bracket (5) to the radiator assembly (2)
- ❑ Close the relative clamps (1).
- ❑ Tighten the screw (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

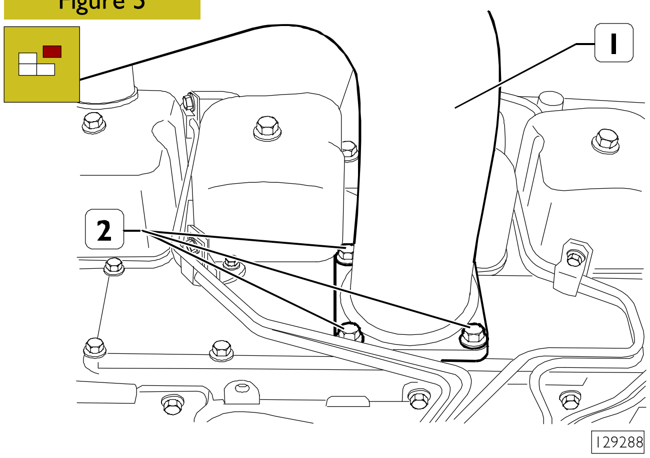
- ❑ Refill the cooling system with coolant.
- ❑ Bleed the air from the 'supply system as described in the relevant paragraph.
- ❑ Check the engine oil level

PROCEDURE RADIATOR REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

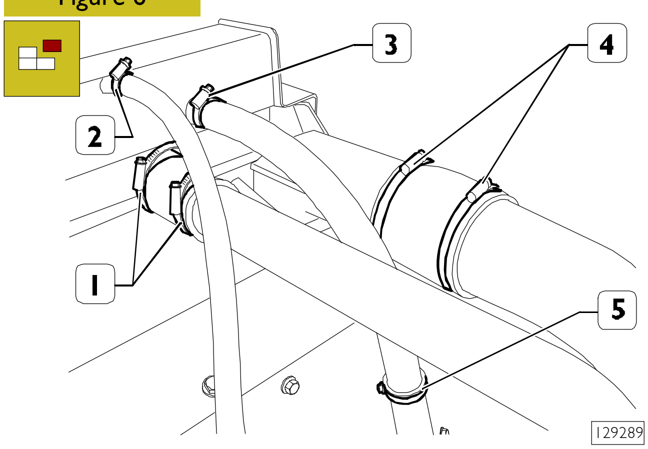
Figure 5



- ❑ Unscrew the screws (2) and remove the pipe (1) from the intake manifold.

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

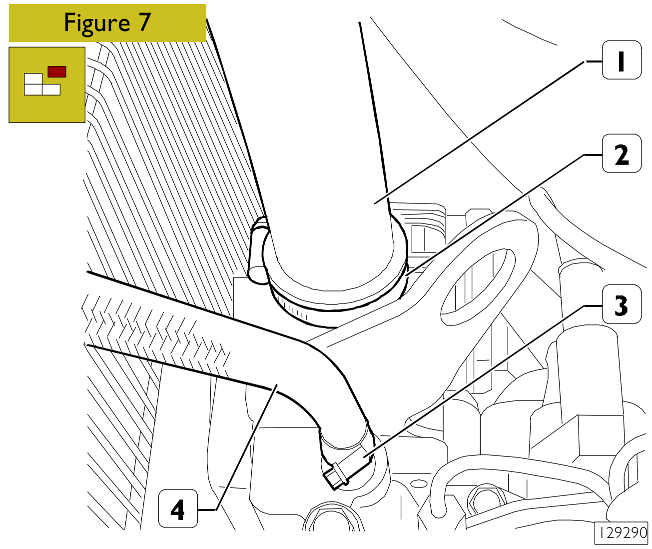
Figure 6



- ❑ Disconnect the air and water pipes from the radiator assembly.
- ❑ Unscrew the screws on the clamps (1, 2, 3 and 4) and on the fixing bracket (5).

Ref.	No.	Screws description
(5)	1	Screw M6x1x16

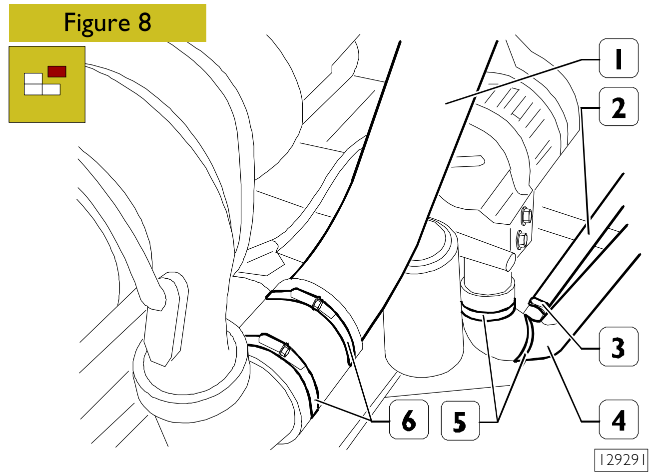
Figure 7



- ❑ Disconnect and remove the pipes (1 and 4), complete with sleeves, from the engine side.
- ❑ Unscrew the screws on clamps (2 and 3).

Ref.	No.	Screws description
(2)	1	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Figure 8



- ❑ Disconnect and remove the pipe (1), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (6).
- ❑ Disconnect and remove the pipe (2), unscrewing the screws on the relative clamp (3).
- ❑ Disconnect and remove the pipe (4), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (5).
- ❑ Properly lock the radiator unit, then release it from the base by adjusting the hardware on both sides.
- ❑ Remove the radiator unit from its seat.

Ref.	No.	Screws description
(3)	2	Screw M6x1x16
(5)	2	Screw M8x1.25x16
(6)	2	Screw M6x1x16

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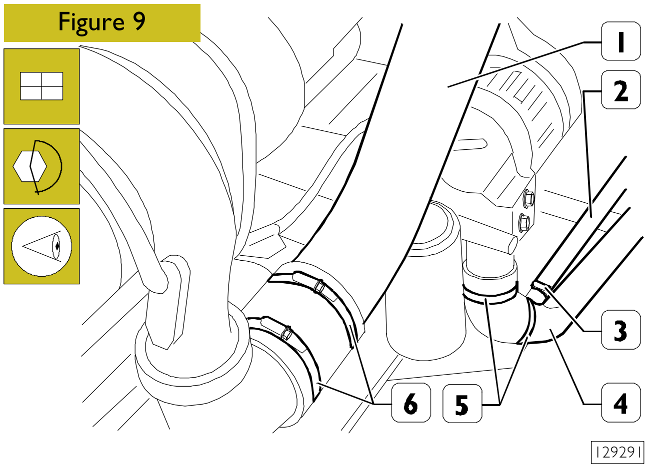
Refitting

Figure 9

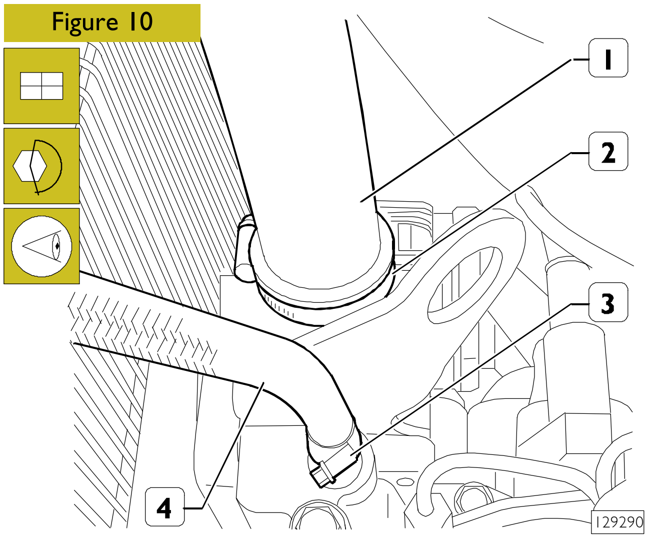


- ❑ Fit the pipe (4) complete with sleeves, from the engine side, acting on the relative clamps (5).
- ❑ Fit the pipe (2) complete with sleeves, from the engine side, acting on the relative clamps (3).
- ❑ Fit the pipe (1) complete with sleeves, from the engine side, acting on the relative clamps (6).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M6x1x16	43 ± 6 Nm
(5)	2	Screw M8x1.25x16	43 ± 6 Nm
(6)	2	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 10

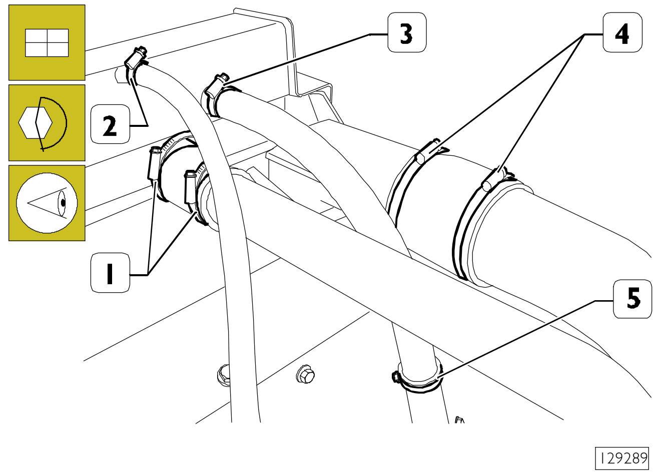


- ❑ Fit the pipes (1 and 4) complete with sleeves acting on the relative clamps (2 and 3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 11

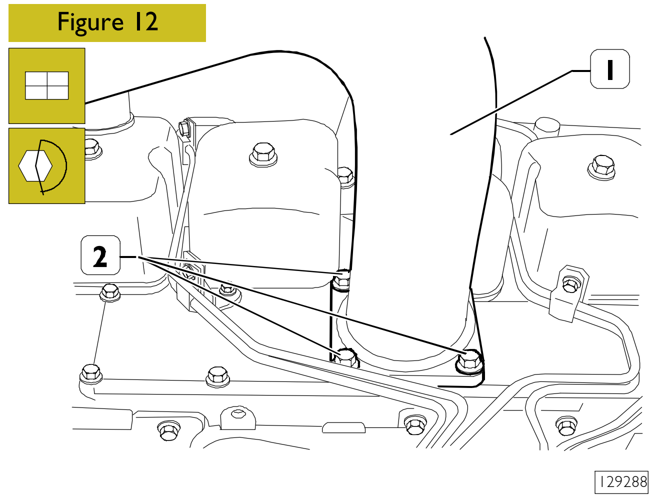


- ❑ Connect the air and water pipes to the radiator assembly using the clamps (1, 2, 3 and 4) and the mounting bracket (5).

Ref.	No.	Screws description	Tightening torques
(5)	1	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 12



- ❑ Mount the pipe (1).
- ❑ Tighten the screws (2).

Fit the protection grille as described in the relative procedure.

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	24 ± 4 Nm

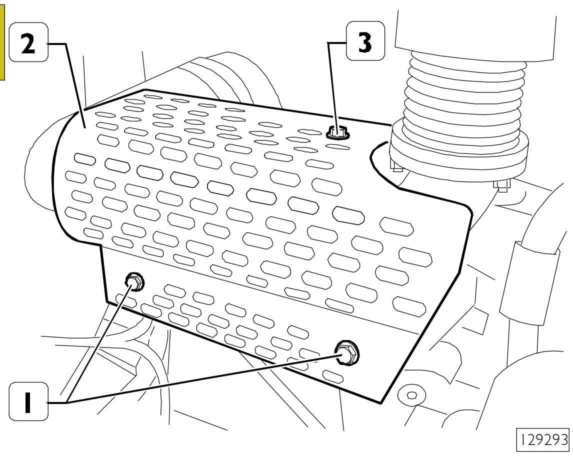
PROCEDURE FOR FAN REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

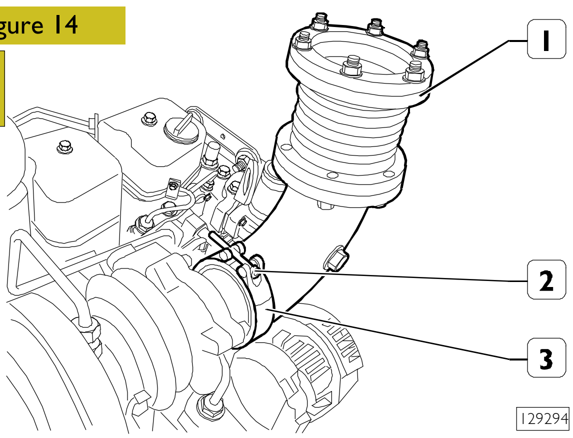
Figure 13



- ❑ Unscrew the screws (1 and 3).
- ❑ Remove the grille (2) protecting the turbine, if present.
- ❑ Then remove the mounting brackets.

Ref.	No.	Screws description
(1)	2	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Figure 14



- ❑ Unscrew the screw (2) to open the clamp (3).
- ❑ Disconnect the exhaust pipe (1).

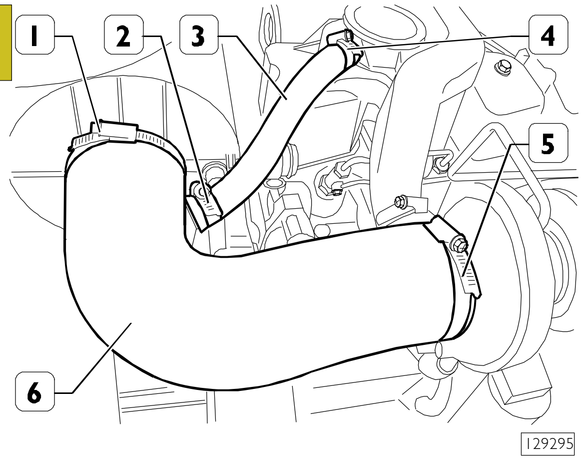
NOTE The shape and the size of the exhaust pipe will vary depending on use of the engine.

The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	1	Screw M7x1

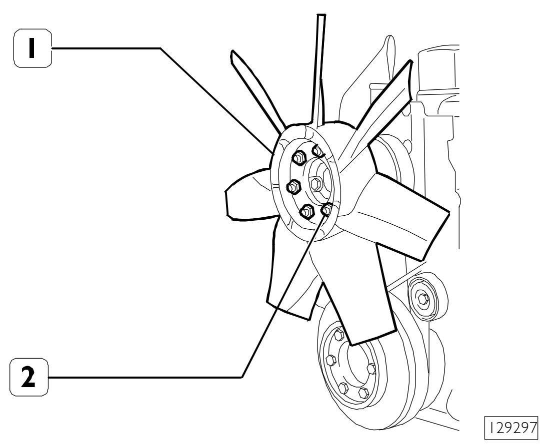
Figure 15



- ❑ Unscrew the screws on the relative clamps (2 and 4).
- ❑ Disconnect and remove the oil vapour recovery pipe (3).
- ❑ Unscrew the screws on the relative clamps (1 and 5).
- ❑ Disconnect and remove the air intake pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M7x1
(5)	1	Screw M7x1

Figure 16



- ❑ Unscrew the screws (2).
- ❑ Remove the fan (1), complete with spacer.

NOTE The shape and the size of the fan varies according to the use of the engine.

The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

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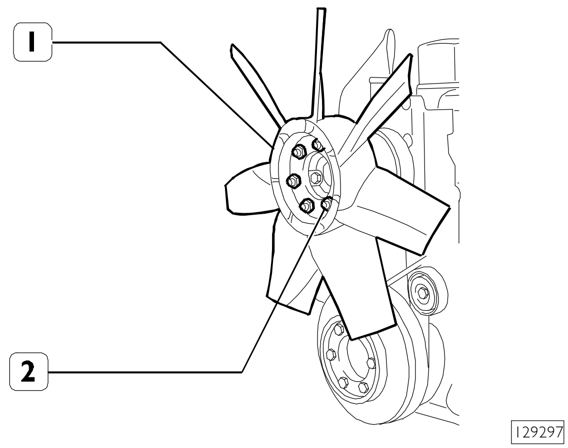
Refitting

Figure 17

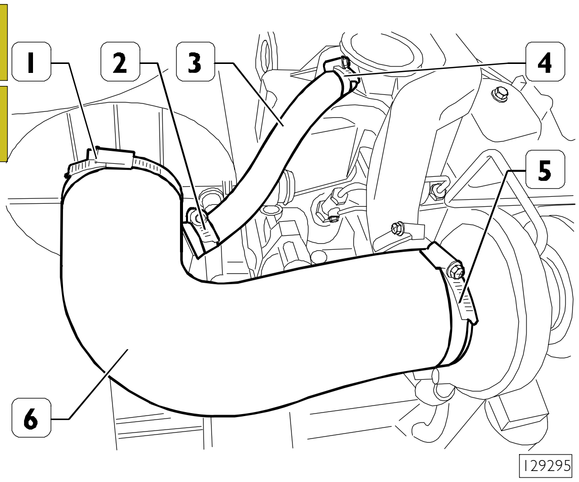


❑ Position the fan (2), complete with spacer.

❑ Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	6	Screw M8x1.25	24 ± 4 Nm

Figure 18

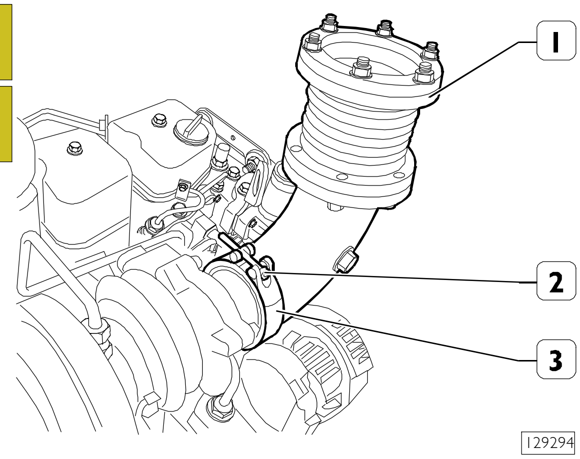


❑ Connect the air intake pipes (6), closing their clamps (1) and (5)

❑ Connect the oil vapour recovery pipes (3), closing their clamps (2) and (4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M7x1	13 ± 2 Nm
(5)	1	Screw M7x1	13 ± 2 Nm

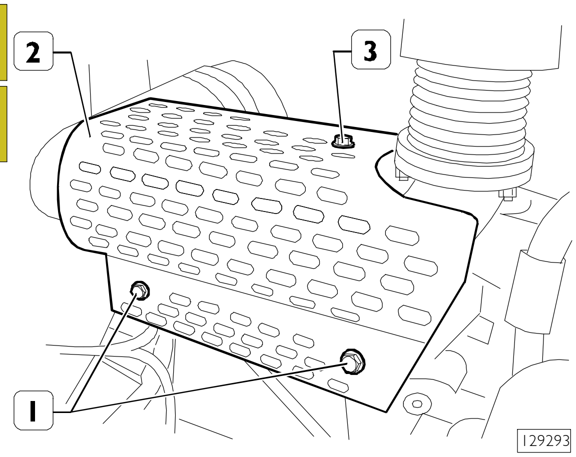
Figure 19



❑ Connect the discharge pipe (1), tightening the screw (2) to close the clamp (3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M7x1	13 ± 2 Nm

Figure 20



❑ If present, refit the turbine protection grille (2), restoring the relative mounting brackets.

❑ Replace the radiator unit on the crankcase, making sure not to interference with the fan.

❑ Tighten the fastening screws (1 and 3) on both sides.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR ANCILLARY BELT REMOVAL/REFITTING

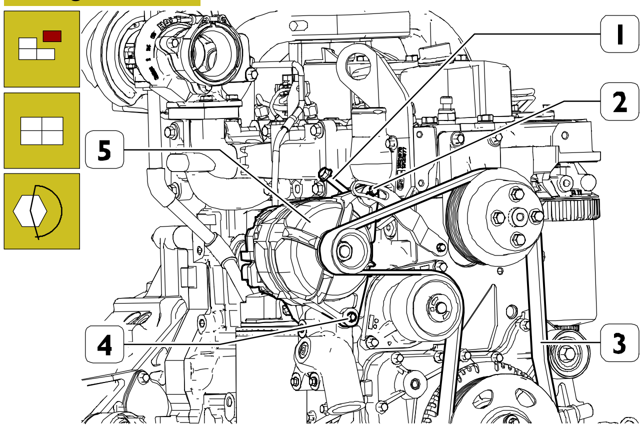
Removal NEF45 SM1F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Figure 21



202387

- ❑ Remove the protective grille and the fan together with spacer by acting on the relative fasteners.
- ❑ Loosen the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.
- ❑ Remove the belt (3).

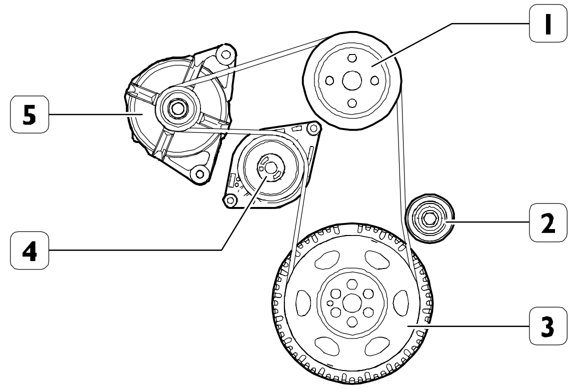
Ref.	No.	Screws description
(1)	1	Screw M8x1.25x100
(2)	1	Screw M10x1.5x40
(4)	1	Screw M10x1.5x110

Refitting

- ❑ Place the new belt (3) inside of the shoulders of all the pulleys.
- ❑ Tighten the screw (1) adjusting the alternator (5).
- ❑ Tighten the screws (2 and 4) anchoring the alternator to its support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x100	-
(2)	1	Screw M10x1.5x40	43 ± 6 Nm
(4)	1	Screw M10x1.5x110	43 ± 6 Nm

Figure 22



202394

BELT ASSEMBLY DIAGRAM
1. Fan pulley - 2. Idler pulley - 3. Crankshaft pulley - 4. Water pump - 5. Alternator

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

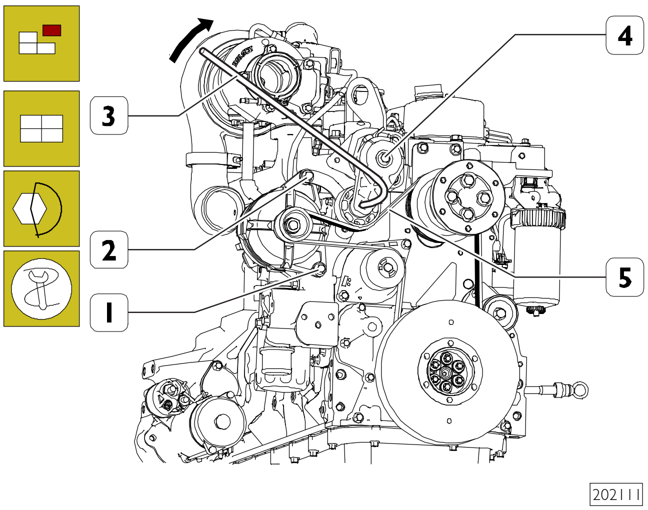
Removal NEF45 TE1F/TE2F engine

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Figure 23



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Unscrew the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

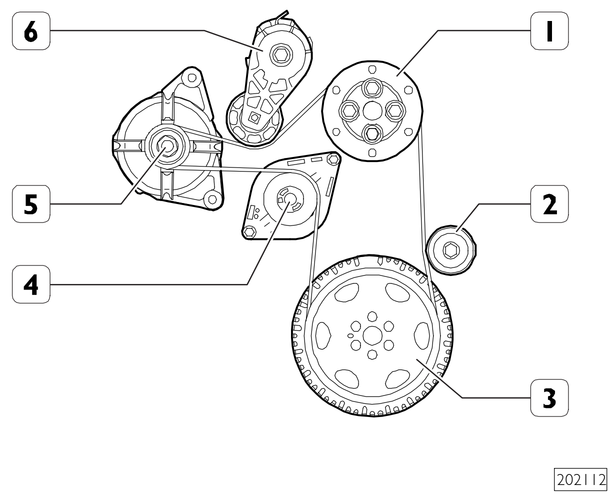
- ❑ Use the special tool (3) to turn the automatic tensioner (4) in the direction of the arrow and remove the belt (5).

Refitting

- ❑ Use the special tool (3) to turn the automatic tensioner in the direction of the arrow (4) and reposition the belt (5) inside the shoulders of all the pulleys.
- ❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

Figure 24



BELT ASSEMBLY DIAGRAM
1. Fan pulley - 2. Idler pulley - 3. Crankshaft pulley - 4. Water pump - 5. Alternator - 6. Automatic belt tensioner

Fit the fan as described in the relevant section.

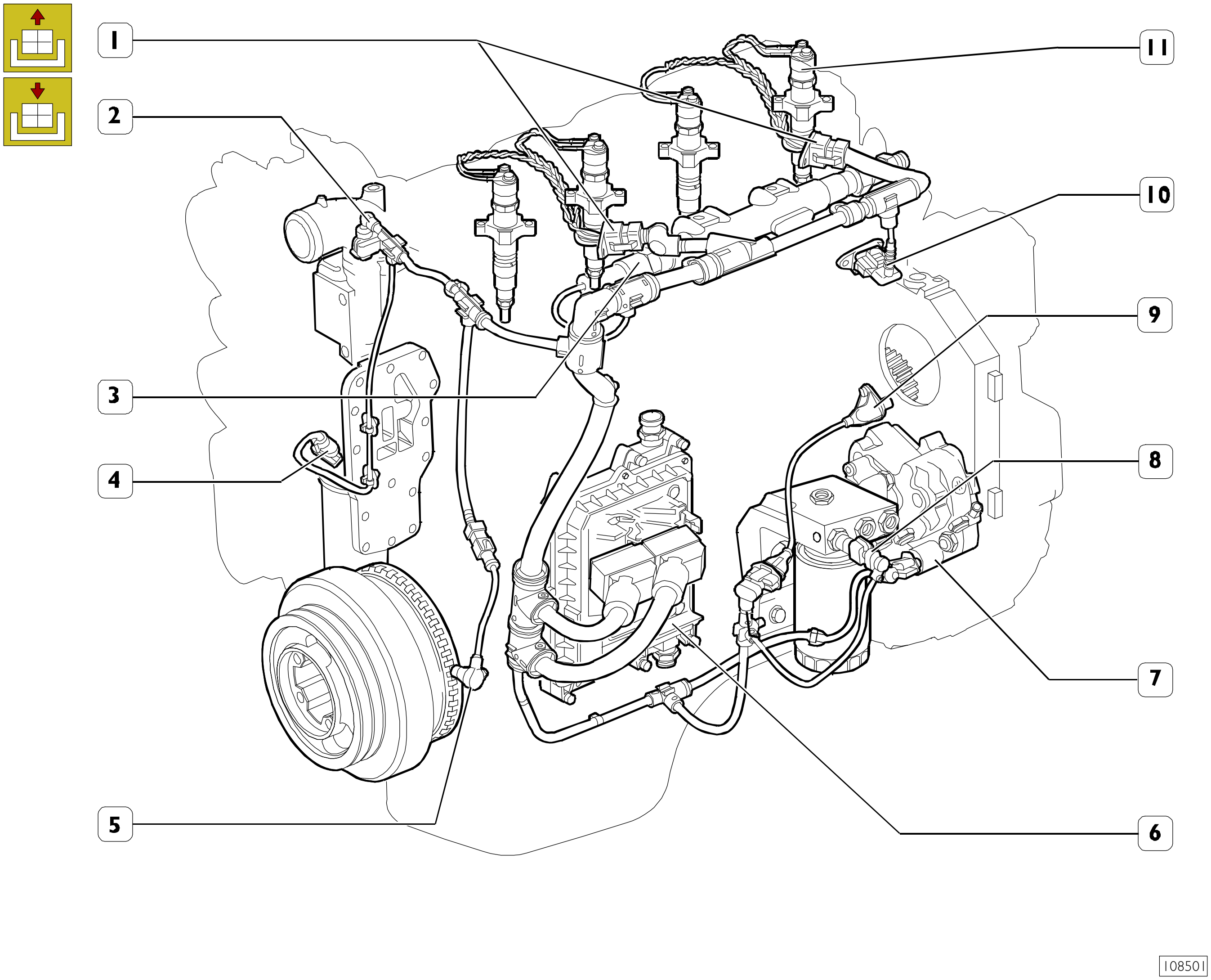
Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR ENGINE CABLE REMOVAL/REFITTING

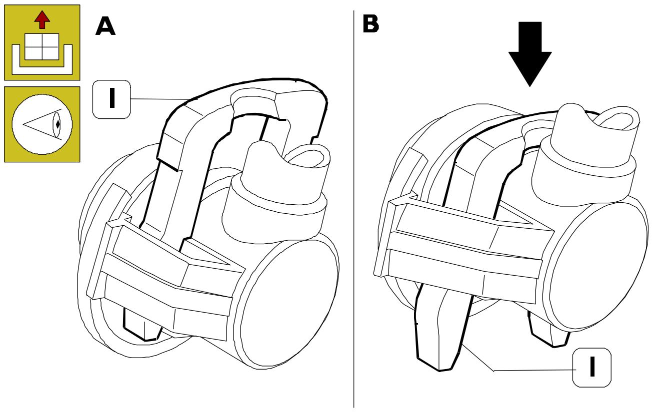
Removal NEF45 TE1F/TE2F engines

Figure 25



1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9. Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

Figure 26



70126

To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

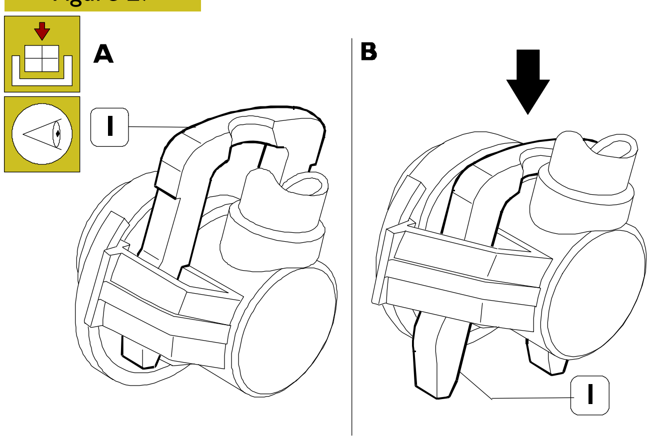
After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Disconnect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Remove the clamps that hold it to the crankcase and remove it completely.

Refitting

Figure 27



70126

To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

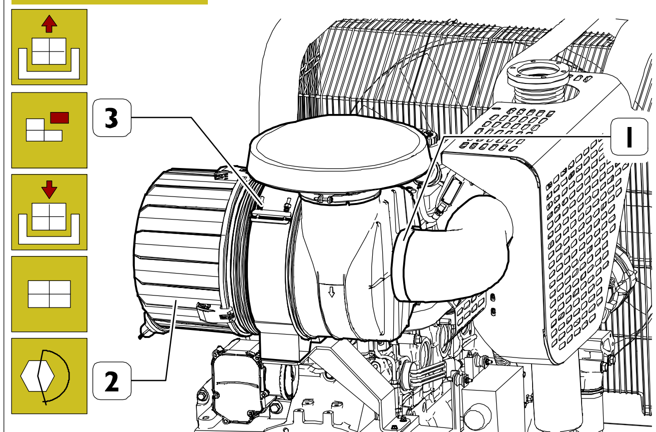
Connect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Insert the clamps that hold it to the crankcase.

PROCEDURE FOR AIR FILTER REMOVAL/REFITTING

Removal

Figure 28 (Demonstrative)



214289

- ❑ Remove the clamp (1).
- ❑ Unscrew the screws (3) and remove the air filter (2) from its support.

Ref.	No.	Screws description
(3)	2	Screw M8x1.25x100

Refitting

- ❑ Place the air filter (2) in the relative position.
- ❑ Tighten the screws (3) to the support clamp.
- ❑ Connect the clamp (1).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M8x1.25x100	-

PROCEDURE FOR ALTERNATOR REMOVAL-REFITTING

Removal NEF45 SM1F engine

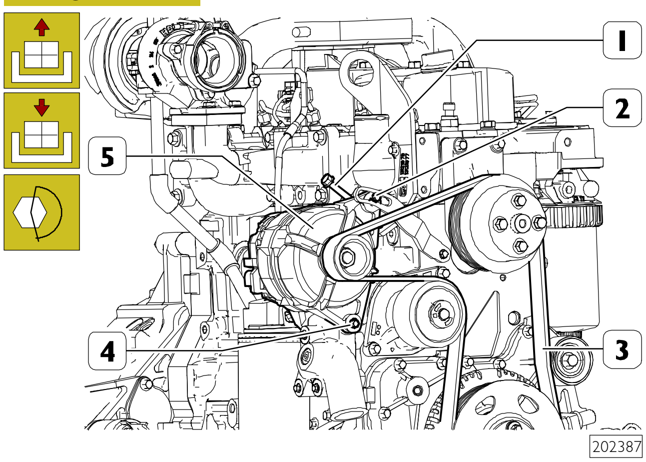
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 29



❑ Unscrew the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.

Ref.	No.	Screws description
(1)	1	Screw M8x1.25x100
(2)	1	Screw M10x1.5x40
(4)	1	Screw M10x1.5x110

❑ Remove the alternator (5) from its housing.

Refitting

Position the alternator (5) in its housing.

❑ Place the new belt (3) inside of the shoulders of all the pulleys.

❑ Tighten the screw (1) adjusting the alternator (5).

❑ Tighten the screws (2 and 4) anchoring the alternator to its support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x100	-
(2)	1	Screw M10x1.5x40	43 ± 6 Nm
(4)	1	Screw M10x1.5x110	43 ± 6 Nm

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

Removal NEF45 TE1F/TE2F engines

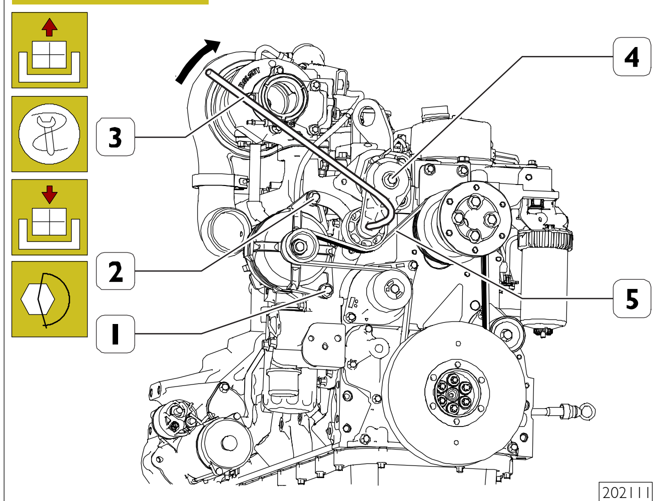
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 30



❑ Unscrew the screw (1) anchoring the alternator to its lower support and the screw (2) securing the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

❑ Remove the alternator from its housing.

Refitting

Position the alternator in its housing.

❑ Use the special tool (3) to turn the automatic tensioner in the direction of the arrow (4) and reposition the belt (5) inside the shoulders of all the pulleys.

❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR WATER PUMP REMOVAL/REFITTING

Removal

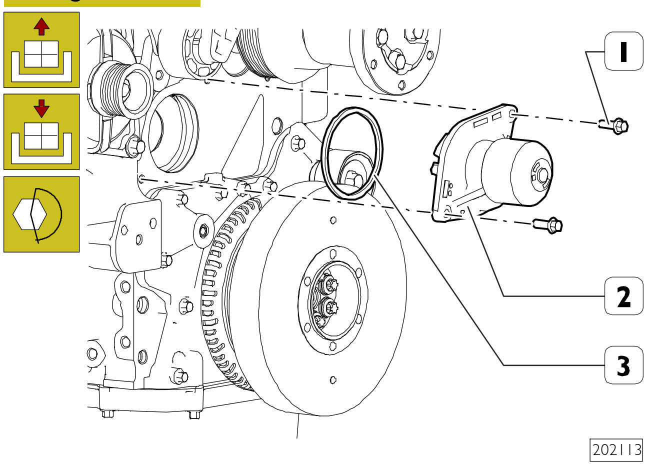
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 31



- ❑ Loosen and remove the screws (1).
- ❑ Take the water pump (2) out of its housing.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25

- ❑ Recover the gasket (3).

Refitting

- ❑ Insert the gasket (3) into the seat on the crankcase.
- ❑ Position the water pump (2) in its housing and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm

Fit the belt as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

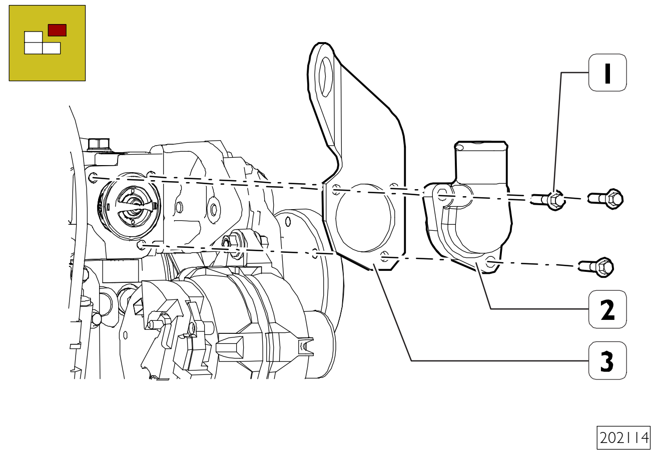
PROCEDURE FOR THERMOSTAT REMOVAL/REFITTING

Removal NEF45 SM1F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

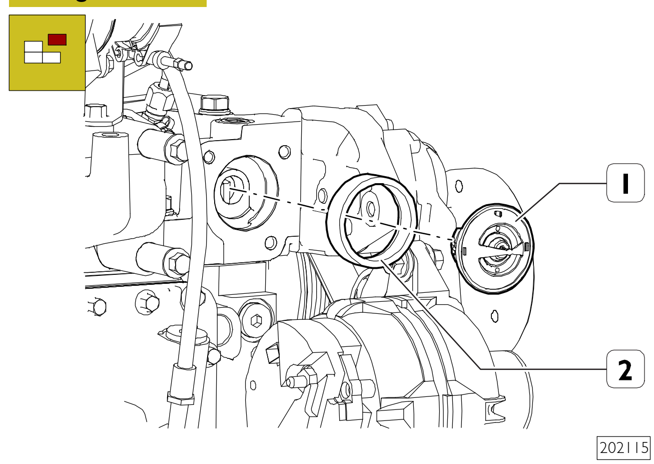
Figure 32



- ❑ Unscrew the screws (1) securing the thermostat cover (2).
- ❑ Remove the thermostat cover (2).
- ❑ Remove the lifting eyelet (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1

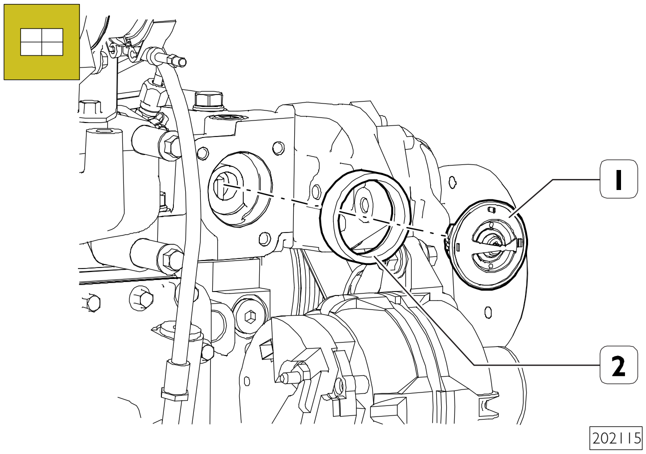
Figure 33



- ❑ Remove the thermostat assembly (1).
- ❑ Remove the gasket (2) of the cover.

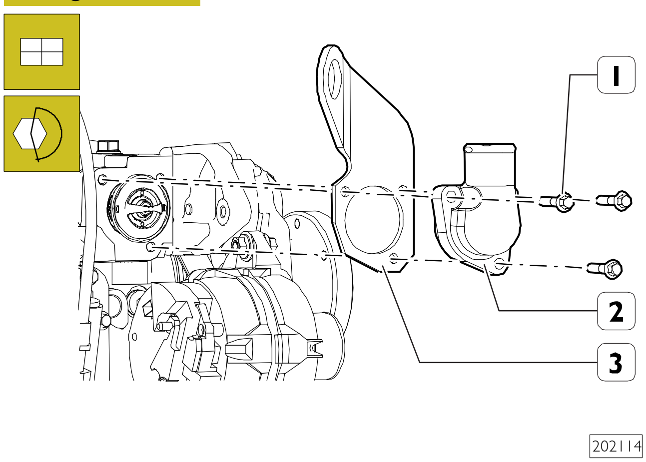
Refitting

Figure 34



- ❑ Insert the gasket (2) of the cover in the specific seat.
- ❑ Insert the thermostat assembly (1).

Figure 35



- ❑ Position the lifting eyelet (3).
- ❑ Position the thermostat cover (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1	10 ± 2 Nm

Fit the radiator as described in the relevant section.

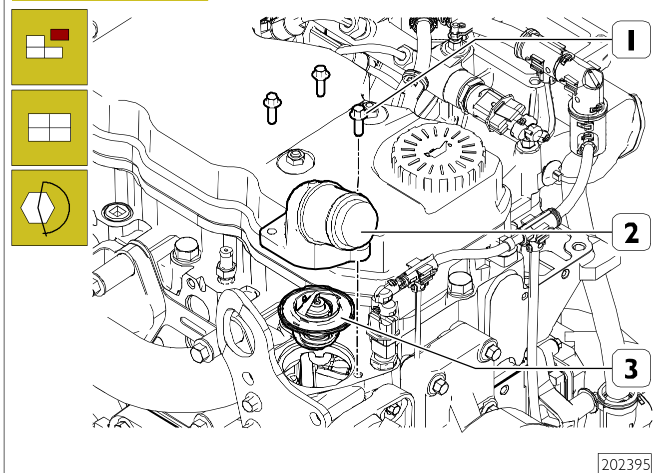
Fit the protection grille as described in the relative procedure.

Removal NEF45 TE1F/TE2F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Figure 36



- ❑ Unscrew the screws (1) securing the thermostat cover (2).
- ❑ Remove the thermostat cover (2).
- ❑ Remove the thermostat (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Refitting

- ❑ Insert the thermostat assembly (3) into the relative seat.
- ❑ Position the thermostat cover (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	10 ± 2 Nm

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

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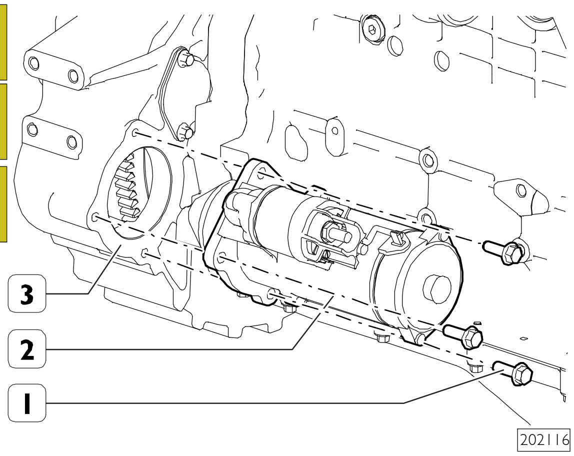
PROCEDURE FOR ELECTRIC STARTER MOTOR REMOVAL/REFITTING

Removal

Figure 37



- ❑ Unscrew the screws (1) securing the starter motor (2) to the flywheel housing (3).
- ❑ Remove the starter motor (2) from its seat.

Ref.	No.	Screws description
(1)	3	Screw M10x1.5

Refitting

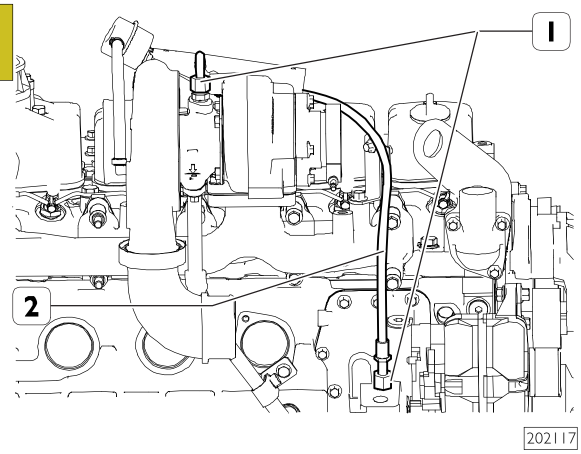
- ❑ Insert the starter motor (2) in its seat at the flywheel housing (3).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M10x1.5	43 ± 6 Nm

PROCEDURE FOR TURBOCHARGER REMOVAL/REFITTING

Removal

Figure 38



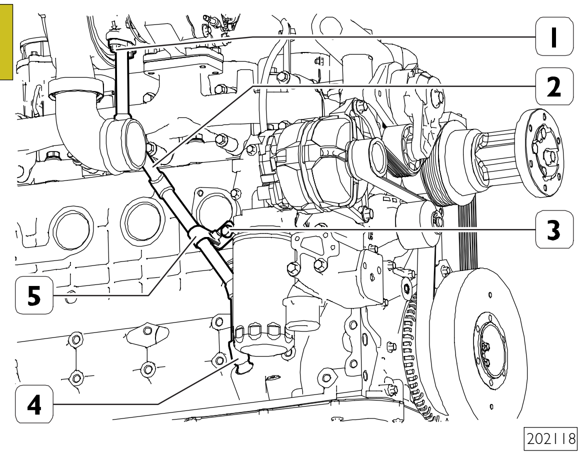
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- ❑ Unscrew the delivery pipe (2) fittings (1).

Ref.	No.	Screws description
(1)	2	Coupling M16

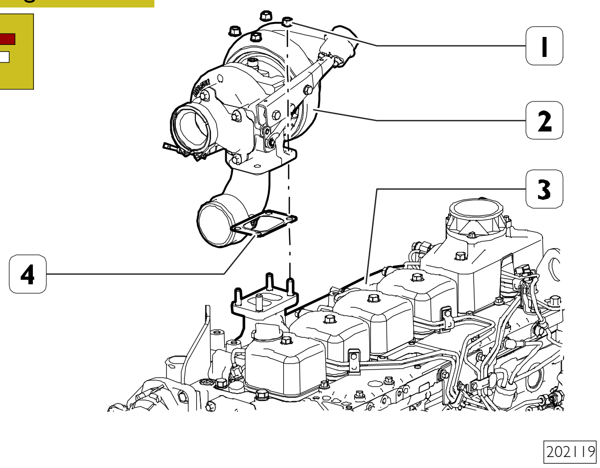
Figure 39



- ❑ Unscrew the screws (1) supporting the oil return pipe (2).
- ❑ Unscrew the screw (3) securing the pipe to the crank-case via the fastening collar (5).
- ❑ Unscrew the fitting (4).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25
(3)	1	Screw M8x16
(4)	2	Fitting M16

Figure 40

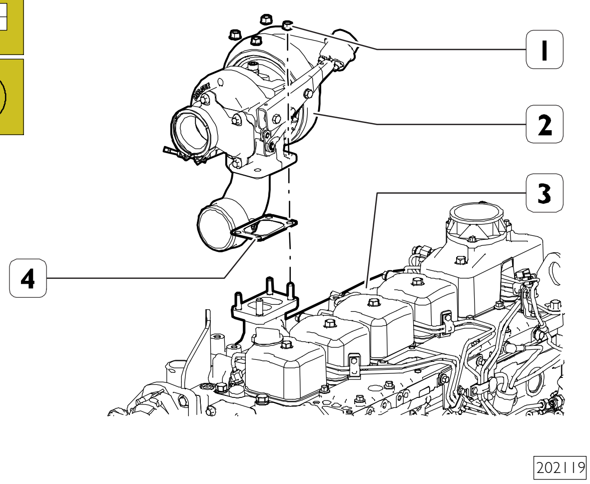


- ❑ Unscrew the nuts (1) securing the turbocharger (2) to the exhaust manifold (3).
- ❑ Recover the gasket (4).

Ref.	No.	Screws description
(1)	4	Nut M10x1.5

Refitting

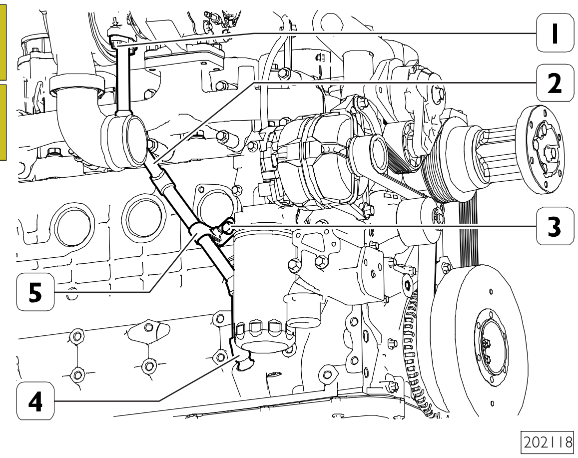
Figure 41



- ❑ Position the gasket (4) on the exhaust manifold (3).
- ❑ Position the turbocharger (2) in correspondence to the specific seat.
- ❑ Tighten the nuts (1) securing the turbocharger (2) to the exhaust manifold (3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M10x1.5	43 ± 6 Nm

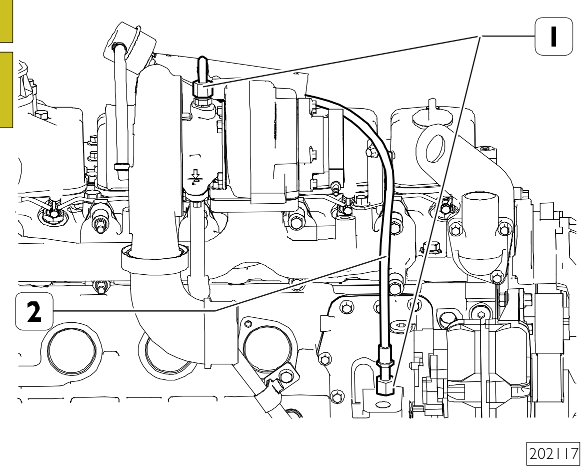
Figure 42



- ❑ Connect the oil return pipe (2) from the turbocharger.
- ❑ Tighten the fastening screws (1).
- ❑ Tighten the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- ❑ Tighten the fitting (4).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm
(3)	1	Screw M8x16	24 ± 4 Nm
(4)	1	Fitting M16	36 ± 5 Nm

Figure 43



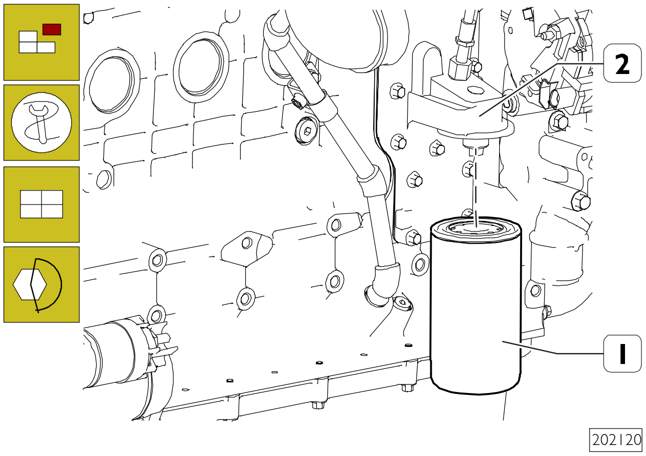
- ❑ Connect the oil delivery pipe (2) to the turbocharger.
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	M16 nut	36 ± 5 Nm

PROCEDURE FOR OIL FILTER REMOVAL/REFITTING

Removal

Figure 44



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- ❑ Use tool 99360076 to unscrew the oil filter (1).

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Refitting

- ❑ Tighten the oil filter (1) in correspondence to the slot on the heat exchanger (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

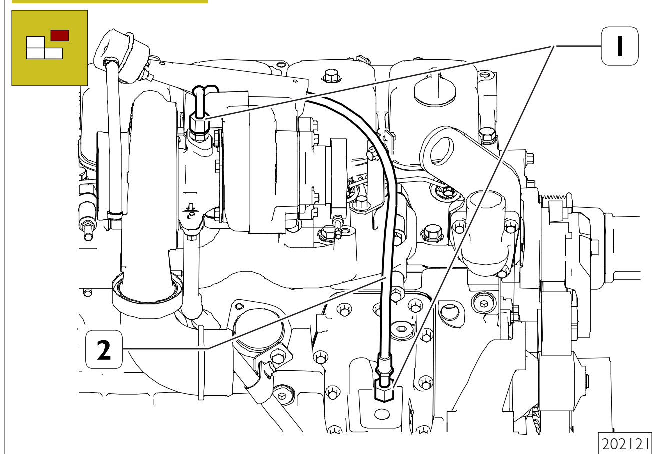
PROCEDURE FOR HEAT EXCHANGER REMOVAL/REFITTING

Removal

Remove the oil filter as described in the relevant section.

Remove the alternator as described in the relevant section.

Figure 45

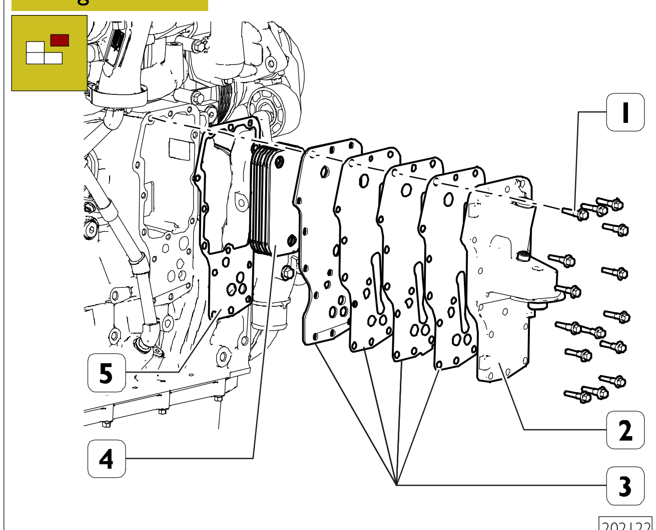


Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Unscrew the delivery pipe (2) fittings (1).

Ref.	No.	Screws description
(1)	2	M16 nut

Figure 46

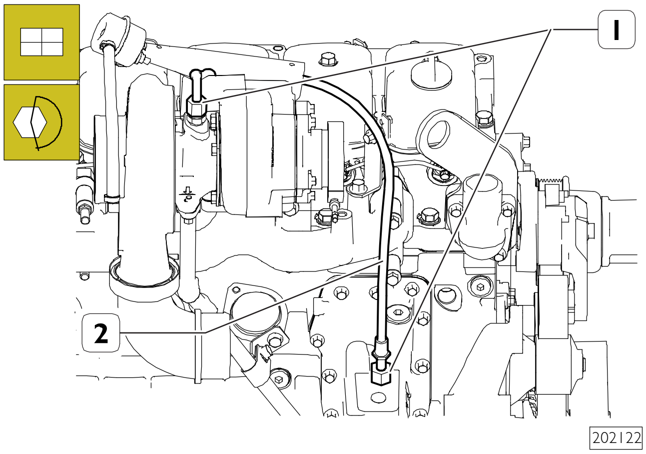


- ❑ Unscrew the screws (1) and remove the oil filter housing (2).
- ❑ Extract the insulating plates (3).
- ❑ Extract the heat exchange elements (4).
- ❑ Remove the seal gasket (5).

Ref.	No.	Screws description
(1)	15	Screw M8x1.25x35

Refitting

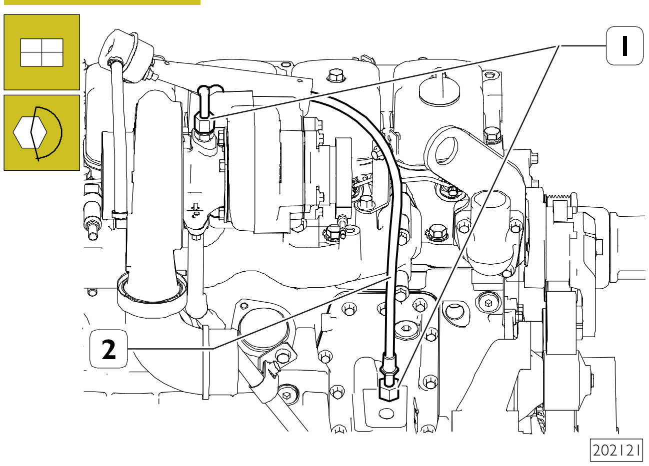
Figure 47



- ❑ Position the gasket (5).
- ❑ Insert the heat exchange elements (4).
- ❑ Position the insulating plates (3).
- ❑ Position the oil filter housing (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	15	Screw M18x1.25x35	26 ± 4 Nm

Figure 48



- ❑ Connect the oil delivery pipe (2) to the turbocharger.
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	M16 nut	36 ± 5 Nm

Fit the alternator as described in the relevant section.

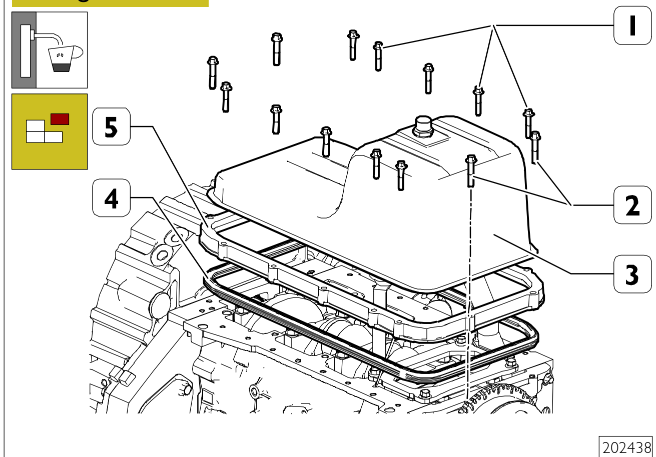
Fit the oil filter as described in the relevant section.

Proceed to refill the heat exchanger with the lubricant oil and coolant.

PROCEDURE FOR OIL SUMP REMOVAL/REFITTING

Removal

Figure 49

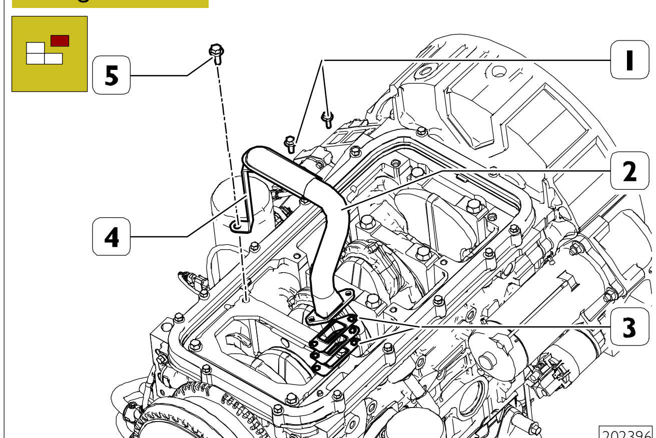


Drain the lubricant oil from the engine.

- ❑ Overturn the engine.
- ❑ Unscrew the screws (1 and 2) fixing the oil sump.
- ❑ Remove the oil sump (3).
- ❑ Remove the spacer (5) and the gasket (4).

Ref.	No.	Screws description
(1)	10	Screw M8x1.25x40
(2)	4	Screw M8x1.25x45

Figure 50



- ❑ Unscrew the screws (1 and 5).
- ❑ Remove the suction strainer (2) together with the support strap (4).
- ❑ Recover the gaskets (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x20
(5)	1	Screw M10x1.5x25

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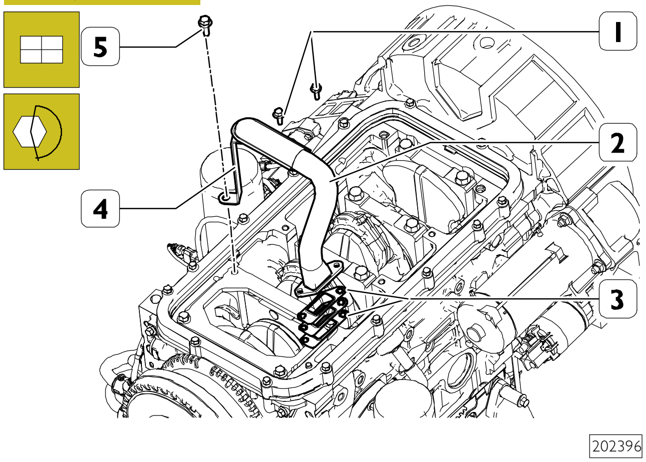
Refitting

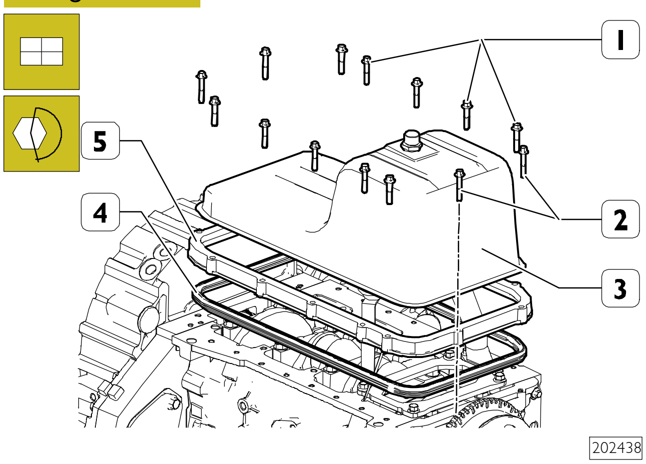
Figure 51



- ❑ Position the gaskets (3).
- ❑ Position the suction strainer (2) together with the support bracket (4) in the relative seat.
- ❑ Tighten the screws (1 and 5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x20	24 ± 4 Nm
(5)	1	Screw M10x1.5x25	43 ± 5 Nm

Figure 52



- ❑ Position the gasket (4) and the spacer (5) in the specific seats.
- ❑ Position the oil sump (3).
- ❑ Tighten the screws (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M8x1.25x40	24 ± 4 Nm
(2)	4	Screw M8x1.25x45	24 ± 4 Nm

Refill with lubricant oil.

PROCEDURE FOR OIL PUMP REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

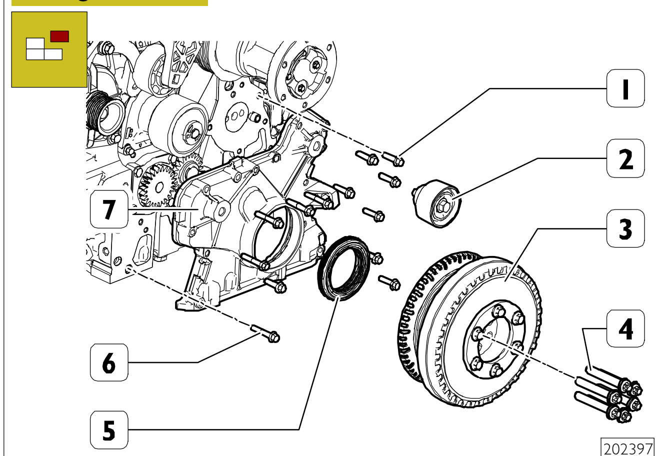
Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the ancillary belt as described in the relevant section.

Remove the oil sump as described in the relevant section.

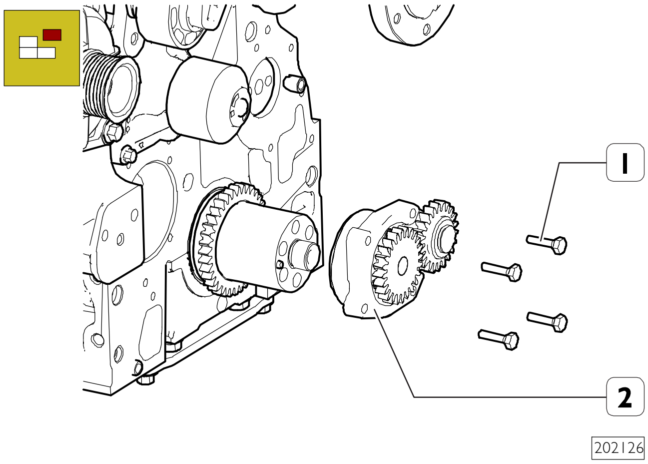
Figure 53



- ❑ Unscrew the screws (4) securing the front damper.
- ❑ Remove the front damper (3) together with the phonic wheel.
- ❑ Unscrew the guide pulley screw (2).
- ❑ Unscrew the screws (1 and 6) securing the front cover (7).
- ❑ Remove the gasket (5)
- ❑ Remove the front cover (7).

Ref.	No.	Screws description
(1)	8	Screw M8x1.25x30
(2)	1	Screw M10x1.5x70
(4)	6	Screw M12x1.25x78.5
(6)	5	Screw M8x1.25x45

Figure 54

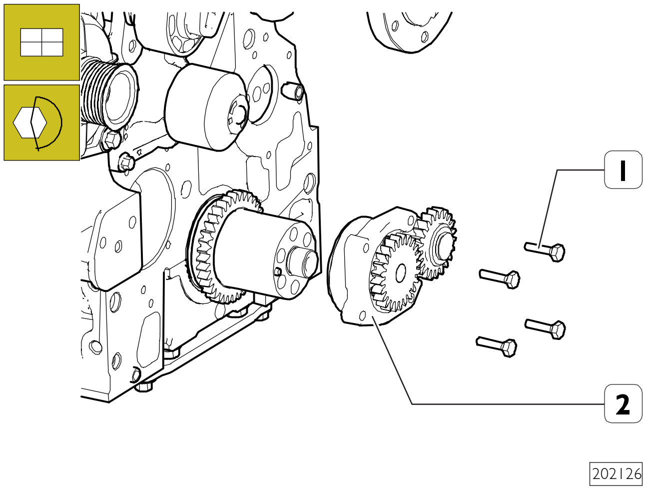


- Unscrew the supporting screws (1).
- Remove the oil pump (2).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x30

Refitting

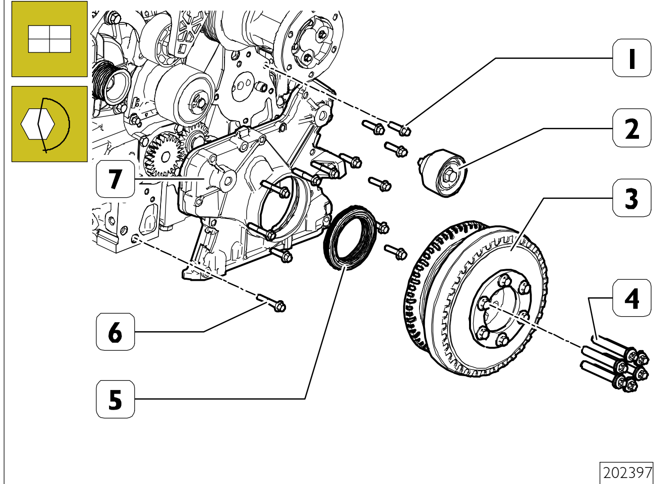
Figure 55



- Fit the oil pump (2).
- Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x30	24 ± 4 Nm

Figure 56



- Mount the front cover (7) and place the gasket (5) in its seat.
- Tighten the screws (1 and 6).
- Tighten the guide pulley screw (2).
- Fit the front damper (3) together with the phonic wheel and tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M8x1.25x30	24 ± 4 Nm
(2)	1	Screw M10x1.5x70	43 ± 6 Nm
(4)	6	Screw M12x1.25x78.5	68 ± 7 Nm
(6)	5	Screw M8x1.25x45	24 ± 4 Nm

Fit the oil sump as described in the relevant section.

Fit the ancillary belt as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

Refill with lubricant oil.

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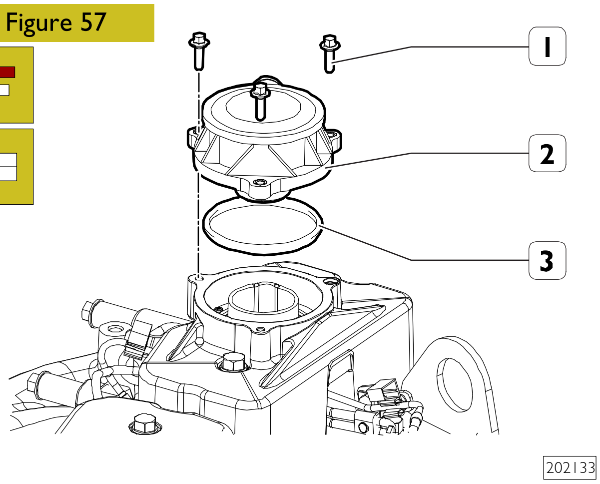
PROCEDURE FOR OIL VAPOUR RECIRCULATION SYSTEM REMOVAL/REFITTING

Removal NEF45 SM1F engines

Figure 57



- ❑ Unscrew the screws (1) securing the oil vapour filter (2).
- ❑ Take out the gasket (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Refitting

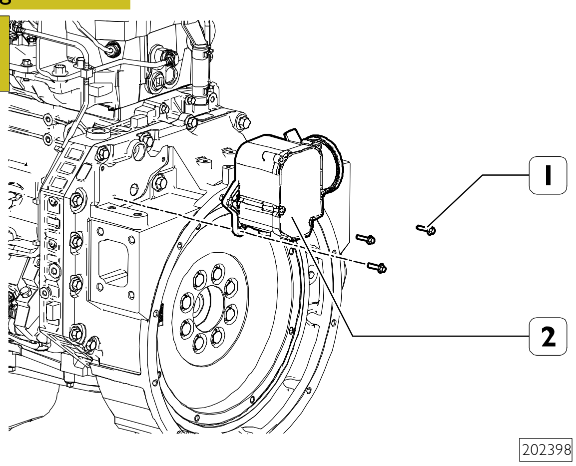
- ❑ Insert the gasket (3) into its seat.
- ❑ Fit the oil vapour filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	-

Removal NEF45 TE1F/TE2F engines

Remove the air filter as described in the relevant section

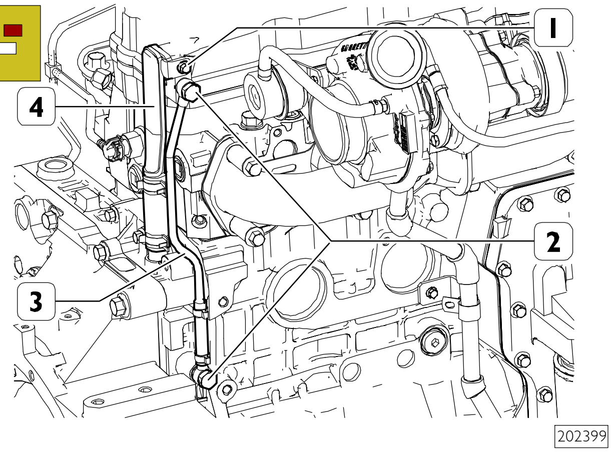
Figure 58



- ❑ Unscrew the screws (1) securing the oil vapour filter (2).
- ❑ Remove the filter (2).

Ref.	No.	Screws description
(1)	3	Screw M6x1x25

Figure 59

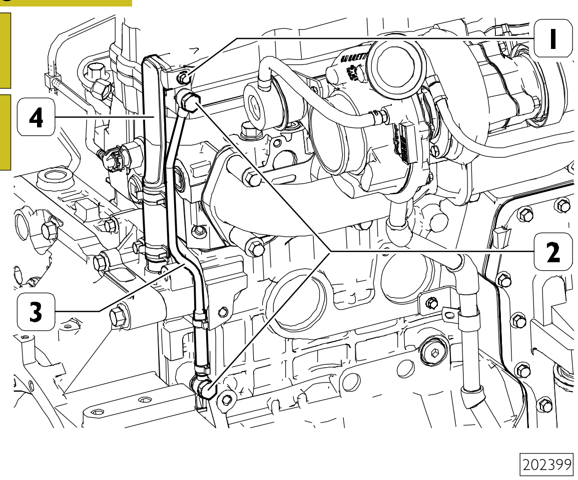


- ❑ Unscrew the support screw (1) from the clamp.
- ❑ Remove the engine breather pipe (4).
- ❑ Unscrew the threaded couplings (2) and remove the pipe (3).

Ref.	No.	Screws description
(1)	1	Screw -
(2)	2	Coupling M12x1.5x11

Refitting

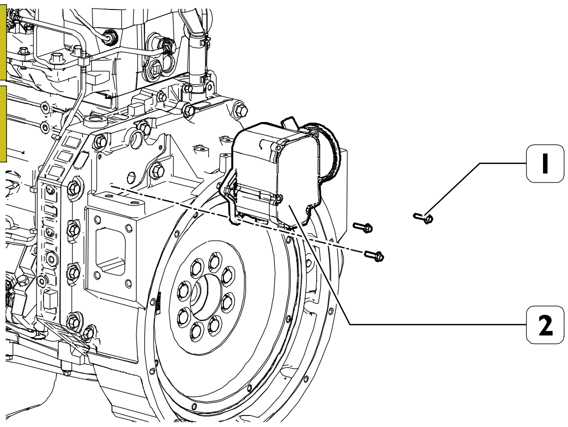
Figure 60



- ❑ Position the pipe (3) in its seat and tighten the threaded couplings (2).
- ❑ Insert the engine breather pipe (4) in its seat.
- ❑ Tighten the support screw (1) to the clamp.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw -	-
(2)	2	Coupling M12x1.5x11	-

Figure 61



202398

- Place the filter (2) in its seat.
- Fit the oil vapour filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x25	10 ± 2 Nm

Fit the air filter as described in the relevant section

PROCEDURE FOR LOW PRESSURE FUEL PIPE REMOVAL/REFITTING

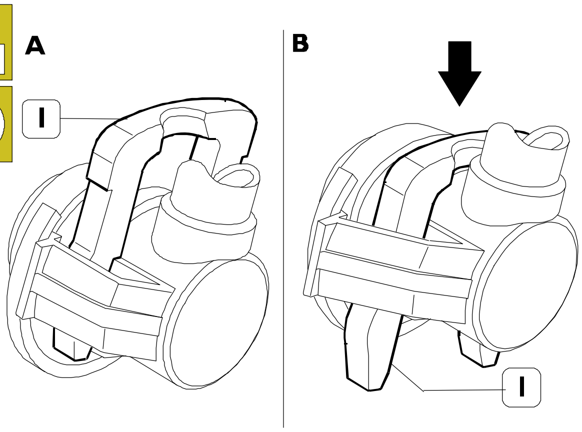
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engines

Remove the oil vapour filter as described in the relevant section.

Figure 62

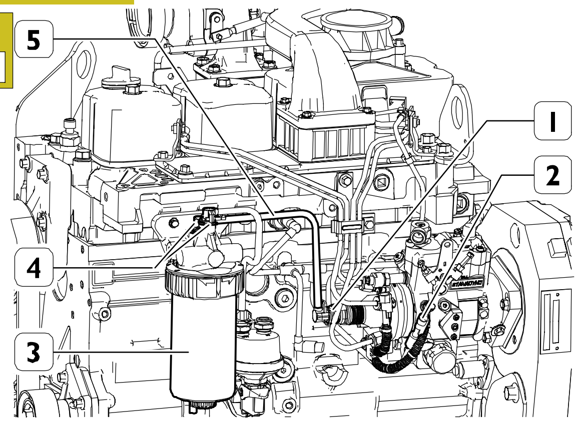


70126

To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Figure 63

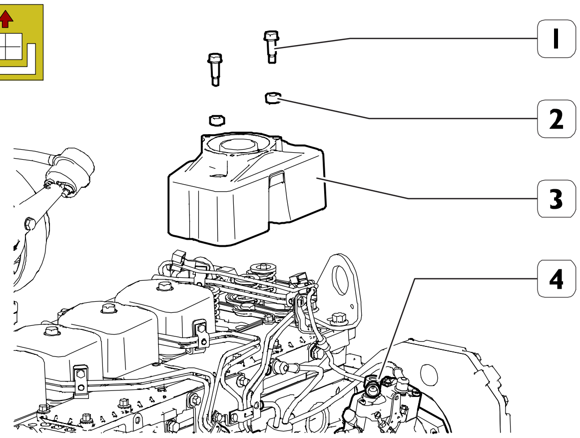


214294

- Unscrew the nut (1) connecting to the injection pump (2).
- Take out the quick-fit couplings (4) on the fuel filter (3) and remove the pipe (5).

Ref.	No.	Screws description
(1)	1	Nut -

Figure 64

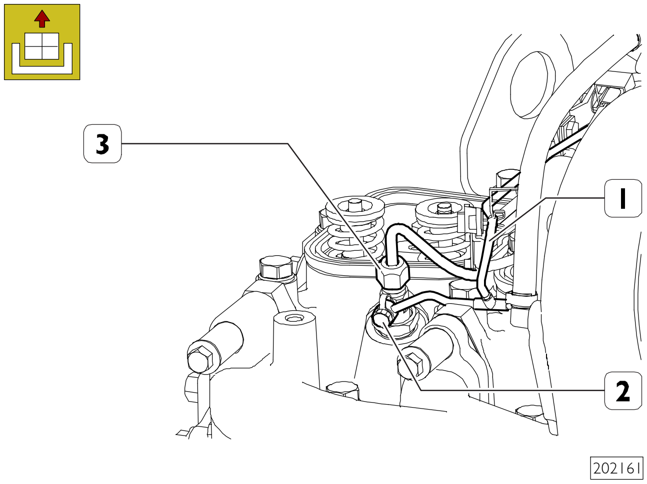


202160

- Unscrew the fastening screws (1) and remove the cover (3).
- Recover the sound-proofing elements (2).
- Remove the ring for the adjustable fitting (4) from the injection pump.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25

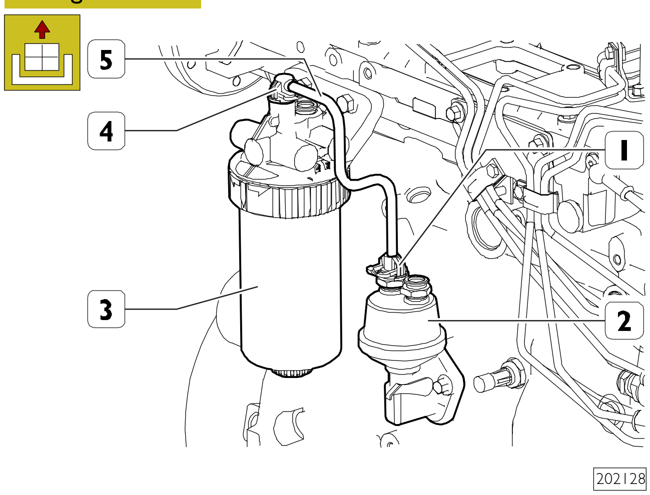
Figure 65



- ❑ Unscrew the 4 threaded fittings (2) passing through the injectors (3).
- ❑ Remove the exhaust pipes (1) from the injectors (3).

Ref.	No.	Screws description
(2)	4	Nut M6x1

Figure 66

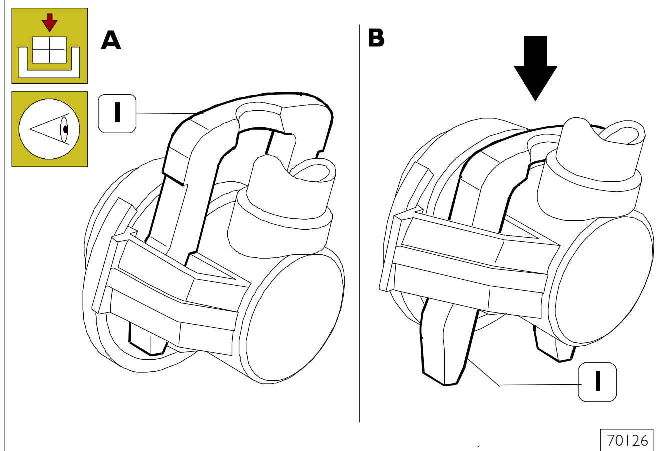


- ❑ Unscrew the connector (1) on the priming pump (2).
- ❑ Take out the quick-fit coupling (4) on the fuel filter (3).
- ❑ Remove the pipe (5).

Ref.	No.	Screws description
(1)	1	Nut M12x1.5

Refitting

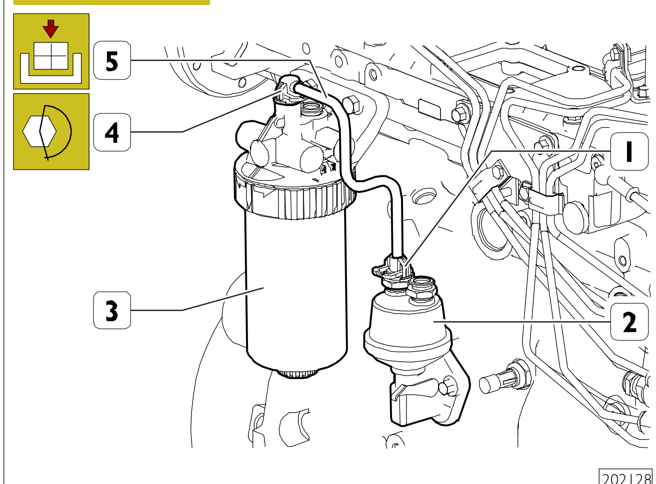
Figure 67



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

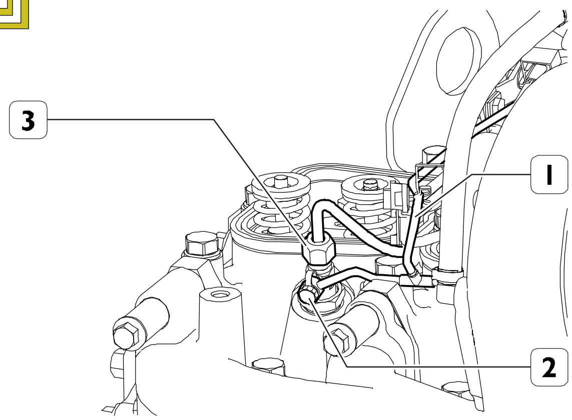
Figure 68



- ❑ Separately connect the pipe (5) to the quick-fit coupling (1).
- ❑ Connect the quick-fit coupling (4) on the fuel filter.
- ❑ Tighten the quick-fit coupling (1) on the priming pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M12x1.5	-

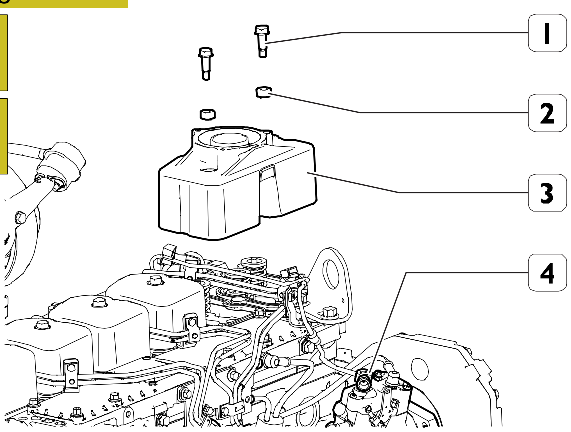
Figure 69



202161

❑ Position the pipes (1) and connect the 4 threaded fittings (2) passing the injectors (3).

Figure 70



202160

❑ Fix the ring for the adjustable fitting (4) to the injection pump.

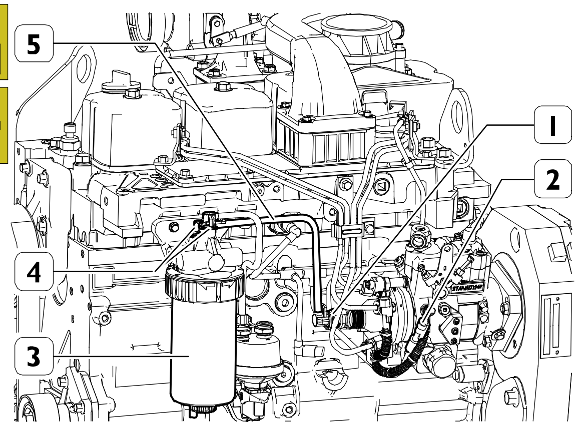
❑ Insert the sound-proofing elements (2).

❑ Position the tappet cover (3) and tighten the screws (1) securing the tappet cover (3).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm

Fit the oil vapour filter as described in the specific procedure.

Figure 71



214294

❑ Separately connect the pipe (5) to the quick-fit coupling (4).

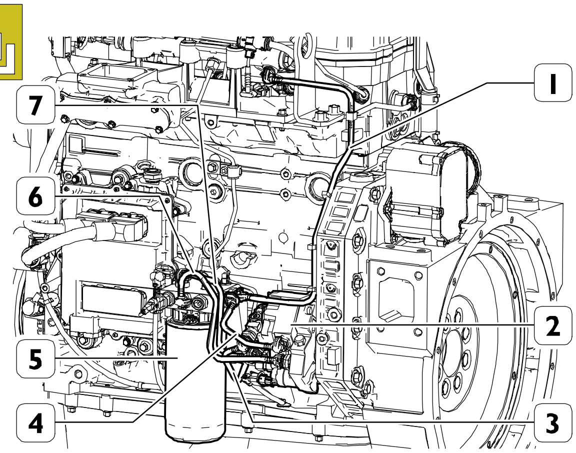
❑ Connect the quick-fit coupling (4) on the fuel filter (3).

❑ Tighten the nut (1) on the injection pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut -	-

Removal NEF45 TE1F/TE2F engines

Figure 72



202400

❑ Remove the excess fuel return pipe (1) from the Common Rail.

❑ Remove the fuel supply pipe (3) for the injection pump (2) from the control unit.

❑ Remove the fuel return pipe (4) from the filter (5).

❑ Remove the fuel delivery pipe (6) from the injection pump (2) to the filter (5).

❑ Remove the fuel return pipe (7) for the injection pump (2) from the filter (5).

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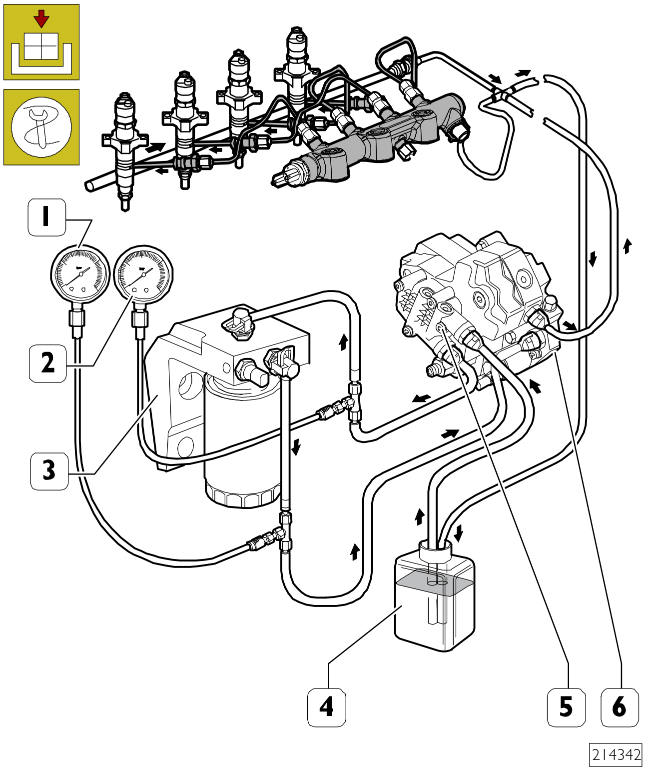
Check mechanical pump power using tool 99305453

Figure 73



1. Filter outlet pipe pressure gauge - 2. Filter inlet pipe pressure gauge - 3. Fuel filter support - 4. External tank - 5. Gear pump - 6. High pressure mechanical feed pump CP.3.3

- The gear pump (5) has the function of feeding the high-pressure pump CP.3.3 (6). It is controlled by the shaft of the high pressure pump and is fitted on its rear part. Keeping the kit instrumentation mounted as in the previous figure with batteries charged at 24.7 V, the engine should be started within 20 seconds of activation of the starter motor, sucking the diesel from an external container (4) placed up to 1 meter lower than the engine.
- If the pump can not suck diesel within the indicated time and then start the engine, replace the pump.

NOTE If the test was performed with a new mechanical supply pump from Spare Parts, before doing the test, a first start is necessary in order to restore normal operation conditions.

- After starting the engine at 1500 rpm check the pressure gauge (2).

Technical data	
Pressure value at pressure gauge	6 ÷ 9 bar

- If measured value is below 6 bar replace the pump, and if the value is above 9 bar replace the diesel filter.
- The pressure gauge (1) must show a pressure above 5 bar; if the pressure is lower, replace the diesel fuel filter. If the problem is not cleared, check the seals of the high pressure pump inlet and fuel filter support unions.

NOTE In Spare a new mechanical supply pump has been introduced, that is interchangeable with the previous version.

The new pump has a new seal protecting against water entering the area where the two pumps are joined, thus preventing the formation of rust which could cause breakage of the shaft connecting the high and low pressure pumps.

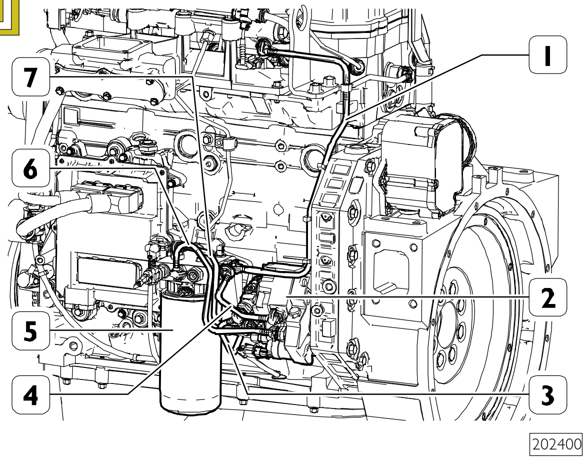
The pump is equipped with seal, however the single seal is provided as a spare.

When replacing the low pressure pump, accurately clean the coupling area with the high-pressure pump CP.3.3

- Remove tool 99305453.

Refitting

Figure 74



- ❏ Connect the fuel return pipe (7) for the injection pump (2) from the filter (5).
- ❏ Connect the fuel delivery pipe (6) from the injection pump (2) to the filter (5).
- ❏ Connect the fuel return pipe (4) from the filter (5).
- ❏ Connect the fuel supply pipe (3) for the injection pump (2) from the control unit.
- ❏ Connect the excess fuel return pipe (1) from the Common Rail.

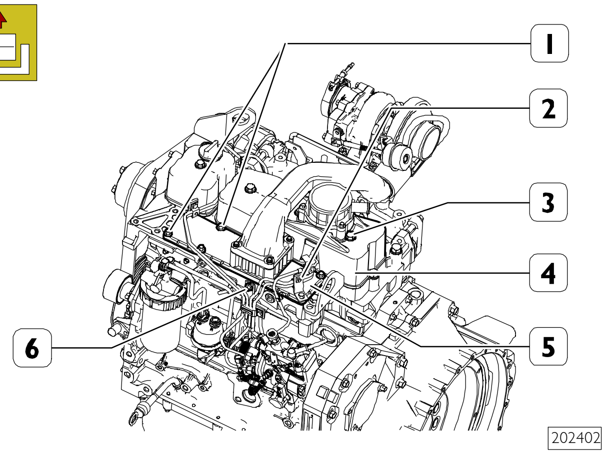
PROCEDURE FOR HIGH PRESSURE FUEL PIPE REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engines

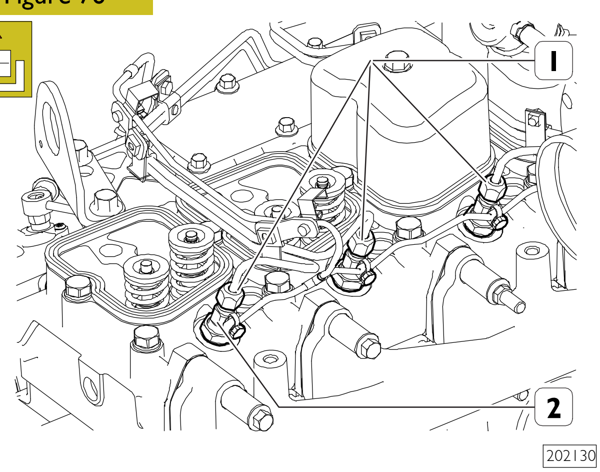
Figure 75



- ❏ Unscrew the support bracket (2) fastening screws (1) at the intake manifold (5).
- ❏ Unscrew the screws (3) securing the tappet cover (4).
- ❏ Unscrew the screws (6) securing the support plate.

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25
(2)	2	Screw
(6)	2	Screw M8x1.25x16

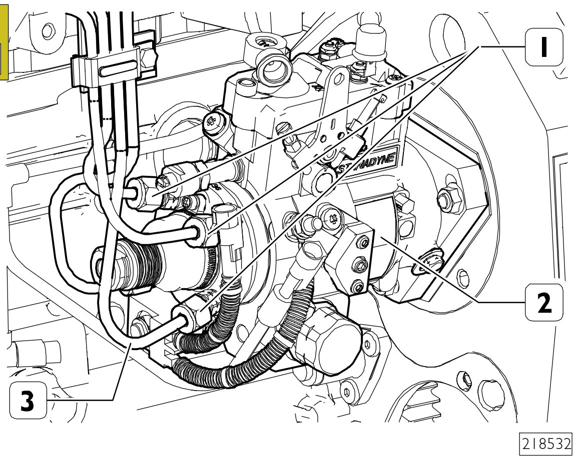
Figure 76



- ❏ Unscrew the fittings (1) connecting to the injectors (2).

Ref.	No.	Screws description
(1)	4	Nut M14x1.5

Figure 77



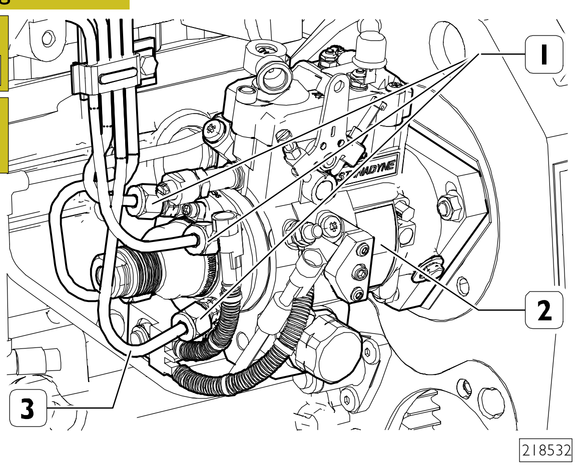
- ❑ Unscrew the fittings (1) connecting to the injection pump (2).
- ❑ Remove the high pressure pipes (3).

Ref.	No.	Screws description
(1)	4	Nut -

Refitting

The pipes which were removed cannot be refitted. They must be replaced.

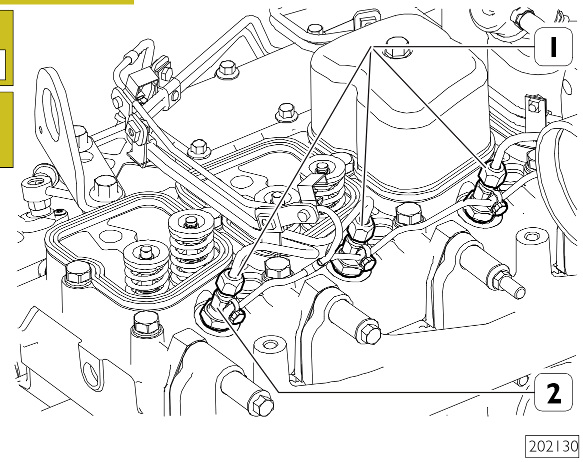
Figure 78



- ❑ Connect the high pressure pipes (3) to the injection pump (2)
- ❑ Tighten the fitting nuts (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut	-

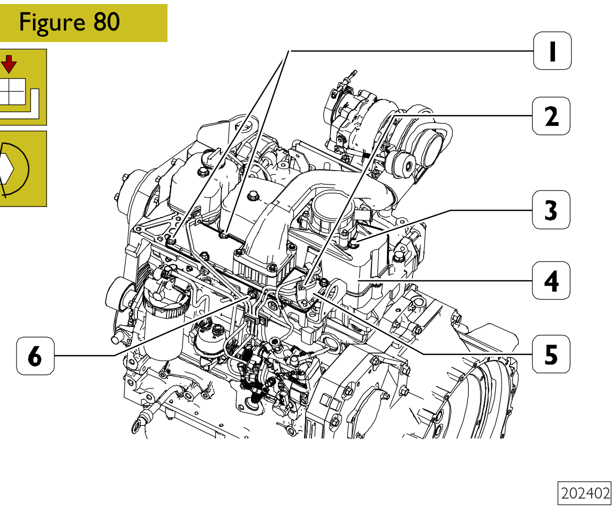
Figure 79



- ❑ Connect the coupling nuts (1) to the injectors (2).
- ❑ Tighten the fitting nuts (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M14x1.5	37 ± 3 Nm

Figure 80

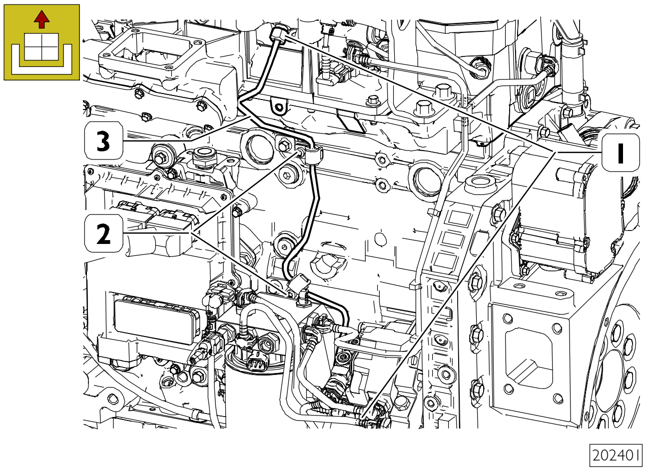


- ❑ Tighten the screws (6) securing the support plate.
- ❑ Position the support clamps (2) and tighten the screws (1) securing the intake manifold (5).
- ❑ Position the tappet cover (4) and tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	24 ± 4 Nm
(2)	2	Screw	-
(1)	2	Screw M8x1.25x16	24 ± 4 Nm

Removal NEF45 TE1F/TE2F engines

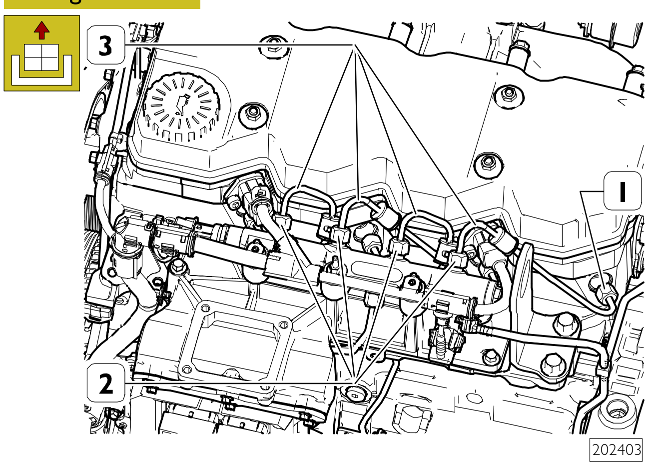
Figure 81



- ❑ Unscrew the screws (2) of the support clamps.
- ❑ Unscrew the fittings (1) connecting the fuel delivery pipe (3) to the Common Rail.
- ❑ Remove the pipe (3).

Ref.	No.	Screws description
(1)	2	Connector M14x1.5
(2)	2	Screw M6x1x12

Figure 82



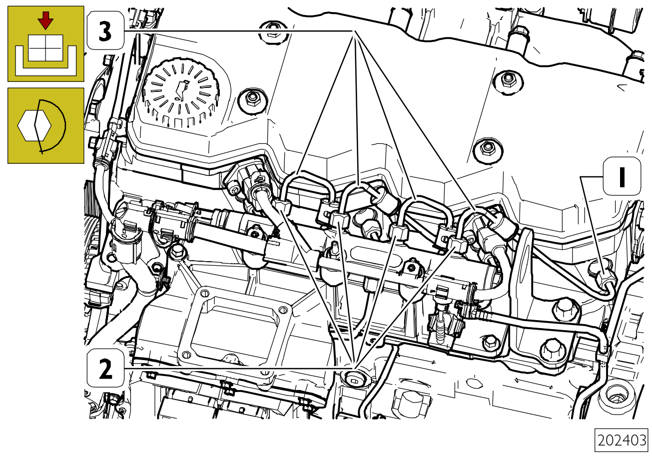
- ❑ Unscrew the fittings (2 and 3) connecting the Common Rail.
- ❑ Unscrew the fittings (1) connecting to the injectors.
- ❑ Remove the pipes (3).

Ref.	No.	Screws description
(1)	4	Connector M14x1.5
(2)	4	Connector M14x1.5

Refitting

The pipes which were removed cannot be refitted. They must be replaced.

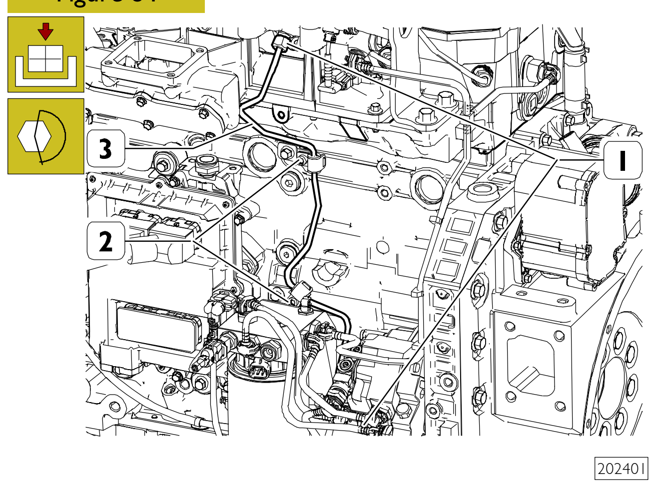
Figure 83



- ❑ Position the high pressure pipes (3).
- ❑ Screw the screws (2) to the support clamps.
- ❑ Tighten the fittings (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Connector M14x1.5	28 ± 2 Nm
(2)	4	Connector M14x1.5	28 ± 2 Nm

Figure 84



- ❑ Position the pipe (3).
- ❑ Screw the screws (2) to the support clamps.
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M14x1.5	28 ± 2 Nm
(2)	2	Screw M6x1.5x12	-

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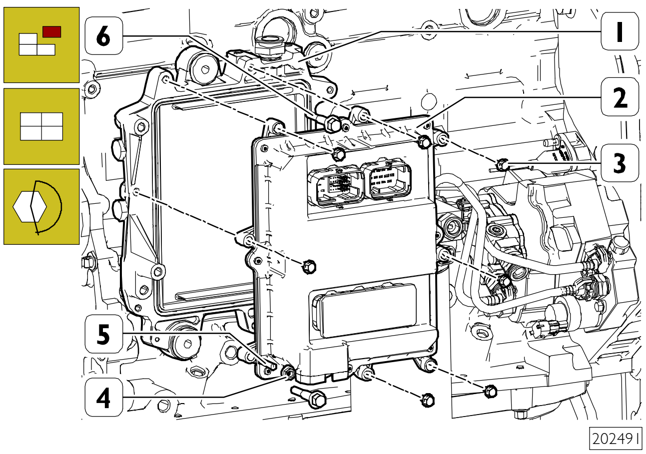
PROCEDURE FOR REMOVAL/REFITTING OF ELECTRONIC CONTROL UNIT

Removal NEF45 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Figure 85



- ❑ Unscrew the screws (3 and 6).
- ❑ Unscrew the nut (4) and the corresponding stud (5).
- ❑ Remove the control unit (2).
- ❑ Remove the support (1).

Ref.	No.	Screws description
(3)	7	Screw M6x1x30
(4)	1	Nut M6x1
(5)	1	Stud M6x1x25
(6)	3	Screw M8x1.25x45

Refitting

- ❑ Place the support (1) in its seat.
- ❑ Position the control unit (2).
- ❑ Tighten the stud (5) and the corresponding nut (4).
- ❑ Tighten the screws (3 and 6).

Ref.	No.	Screws description	Tightening torques
(3)	7	Screw M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	1	Stud M6x1x25	10 ± 2 Nm
(6)	3	Screw M8x1.25x45	24 ± 4 Nm

Fit the low pressure pipes as described in the relevant section.

Fit the engine cable as described in the relevant section.

PROCEDURE FOR FUEL FILTER REMOVAL/-REFITTING

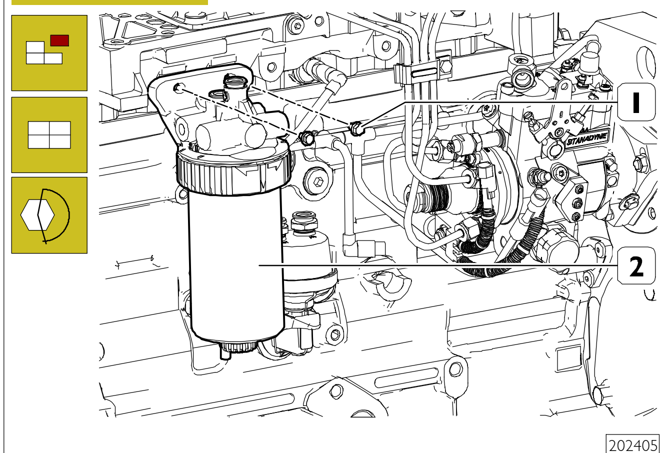
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engines

Remove the low pressure pipe as described in the relevant section.

Figure 86



- ❑ Unscrew the screws (1) securing to the crankcase.
- ❑ Remove the fuel filter (2) together with the support and the filtering cartridge.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x25

Refitting

- ❑ Set the fuel filter (2) and tighten the screws (1) securing it to the crankcase.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x25	80 ± 8 Nm
(2)	2	Screw M6x1.5x12	-

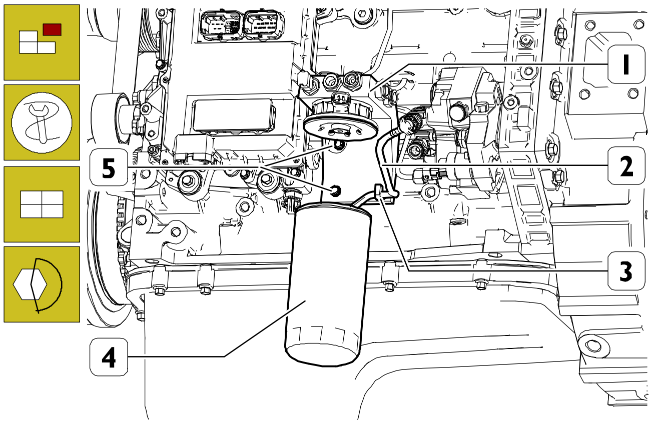
Fit the low pressure pipes as described in the relevant section.

Removal NEF45 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Figure 87



202406

- ❑ Unscrew the cartridge (4) of the filter using tool 99360076.
- ❑ Remove the clamp (3) for supporting the pipe (2) in low pressure.
- ❑ Unscrew the screws (5) and remove the filter support (1).

Ref.	No.	Screws description
(4)	1	Cartridge M20x1.5
(5)	2	Screw M12x1.75x30

Refitting

- ❑ Position the support (1) in the relative seat and tighten the screws (5).
- ❑ Insert the clamp (3) for supporting the pipe (2) in low pressure.
- ❑ Tighten the cartridge (4) using tool 99360076.

Ref.	No.	Screws description	Tightening torques
(4)	1	Cartridge M20x1.5	20 0/+5 Nm
(5)	2	Screw M12x1.75x30	80 ± 8 Nm

Fit the low pressure pipes as described in the relevant section.

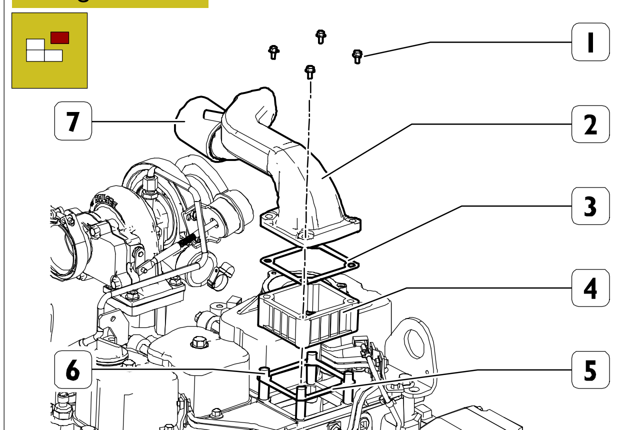
Fit the engine cable as described in the relevant section.

PROCEDURE FOR TAPPET COVER REMOVAL/REFITTING

Removal NEF45 SM1F engines

Remove the oil vapour filter as described in the relevant section

Figure 88

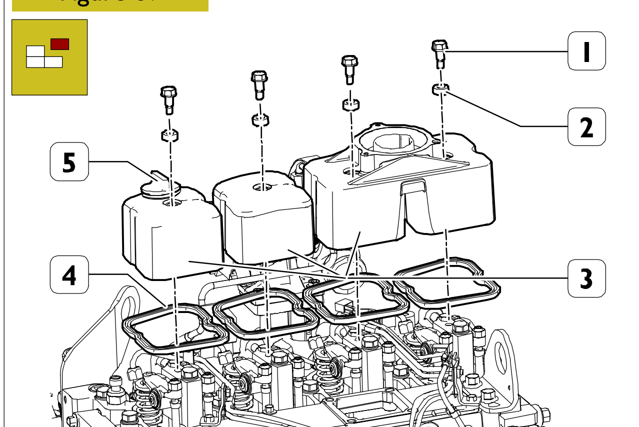


202407

- ❑ Unscrew the screws (1).
- ❑ Disconnect the engine air intake (2) from the turbocharger at the sleeve (7).
- ❑ Recover the gasket (3).
- ❑ Remove the support (4) and recover the centring pins (6).
- ❑ Recover the gasket (5).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x80

Figure 89



202408

- ❑ Unscrew the screws (1) securing the tappet covers (3).
- ❑ Recover the sound-proofing elements (2).
- ❑ Recover the oil filling cap (5).
- ❑ Remove the tappet covers (3).
- ❑ Recover the gaskets (4).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25

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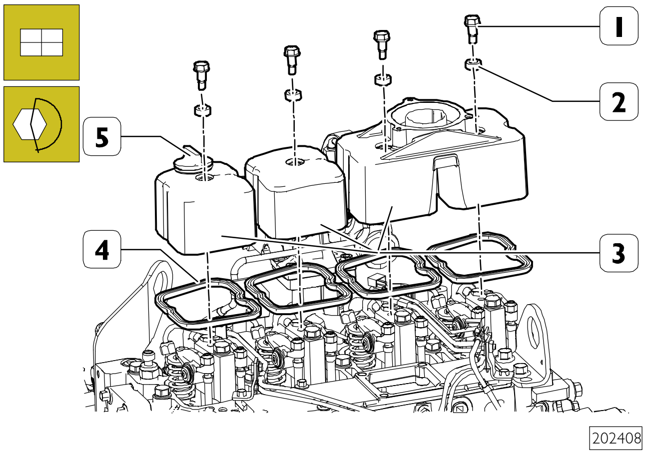
Refitting

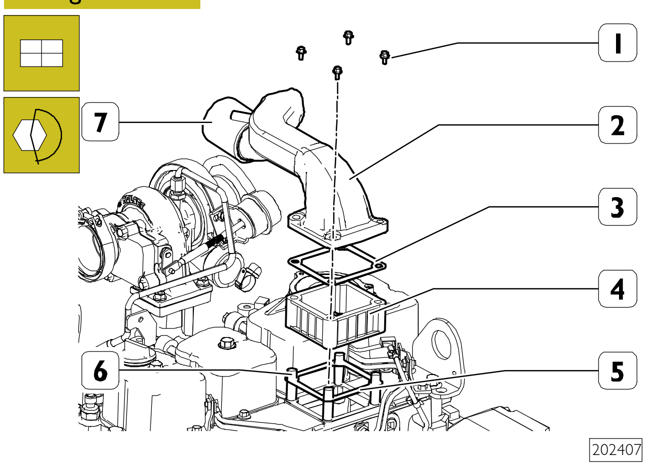
Figure 90



- ❑ Insert the 4 gaskets (4) in the relative seats.
- ❑ Position the tappet covers (3).
- ❑ Insert the sound-proofing elements (2).
- ❑ Tighten the screws (1) securing the tappet covers (3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25	24 ± 4 Nm

Figure 91



- ❑ Insert the gasket (5) and the centring pins (6).
- ❑ Insert the support (4) in its seat.
- ❑ Insert the gasket (3).
- ❑ Connect the engine air intake (2) from the turbocharger at the sleeve (7).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x80	24 ± 4 Nm

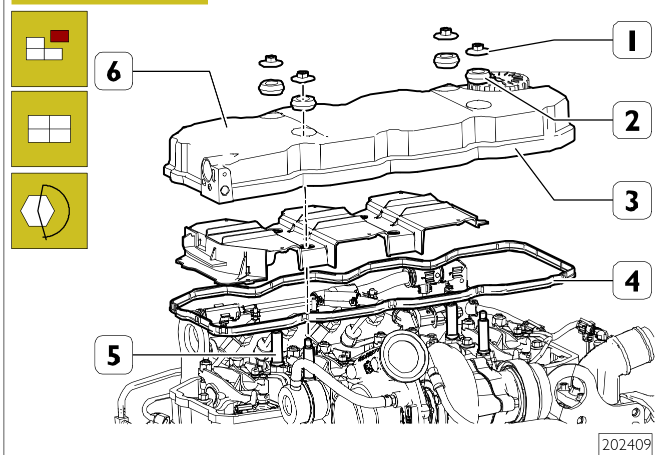
Fit the oil vapour filter as described in the relevant section.

Removal NEF45 TE1F/TE2F engines

Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Figure 92



- ❑ Unscrew the flanged nuts (1) and remove the elastic plugs (2).
- ❑ Remove the tappet covers (6).
- ❑ Recover the oil vapour condensation sector (3).
- ❑ Recover the gasket (4).
- ❑ Unscrew the double stem screws (5).

Ref.	No.	Screws description
(1)	4	Nut M8x1.25
(5)	4	Screw M8x1.25x17

Refitting

- ❑ Tighten the double stem screws (5).
- ❑ Insert the gasket (4) into the relative seat.
- ❑ Insert the oil vapour condensation sector (3).
- ❑ Position the tappet cover (6) in the relative seat.
- ❑ Insert the elastic plugs and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M8x1.25	24 ± 4 Nm
(5)	4	Screw M8x1.25x17	24 ± 4 Nm

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section

PROCEDURE FOR ROCKER ARM ASSEMBLY REMOVAL/REFITTING

NEF45 TE1F/TE2F ENGINES

Removal

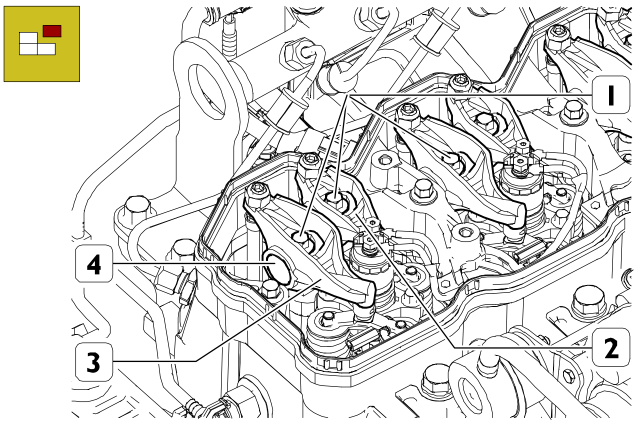
Remove the high pressure pipe as described in the relevant section.

Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Figure 93

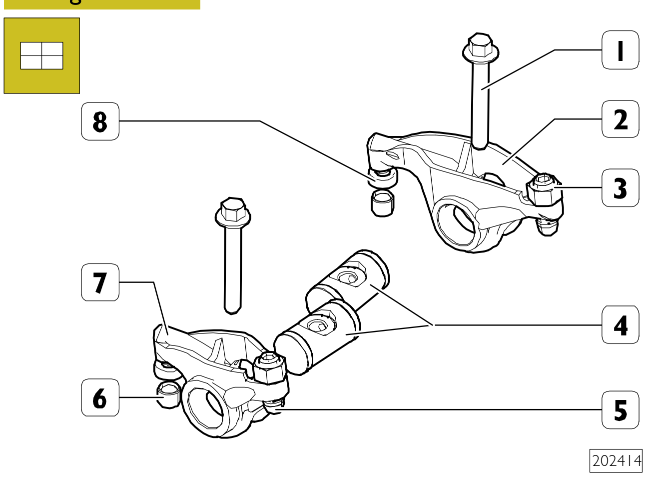


❑ Remove the screws (1) and remove the intake rocker arms (2) and exhaust rocker arms (3), together with the rocker arm shafts (4).

Ref.	No.	Screws description
(1)	8	Screw M8x1.25x55

Refitting

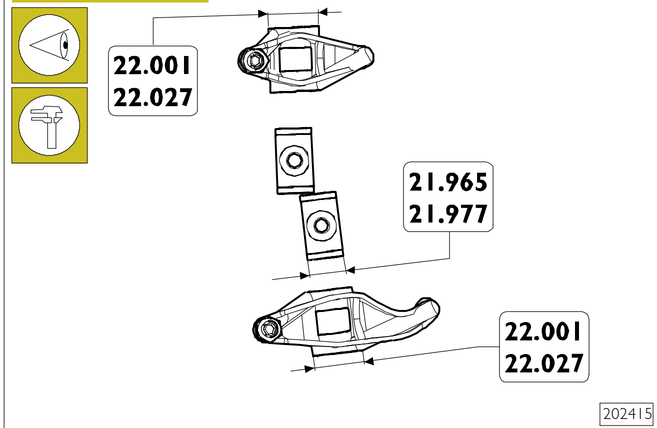
Figure 94



❑ After checking, fit the rocker arm assembly.

ROCKER ASSEMBLY COMPONENTS:
1. Fastening screw - 2. Exhaust rocker arm - 3. Nuts for tappet adjuster - 4. Rocker arm shafts - 5. Tappet - 6. Shoe - 7. Intake rocker arm - 8. Spring clip

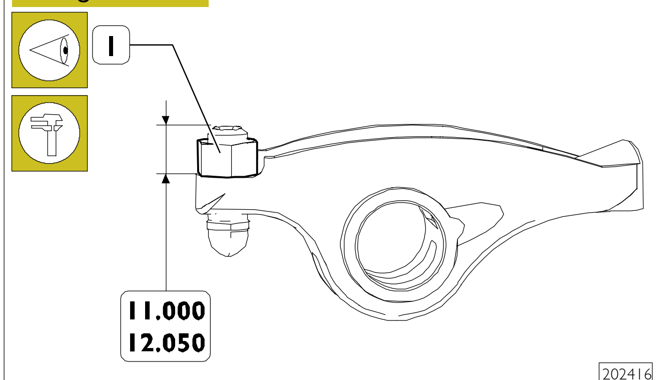
Figure 95



MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 96

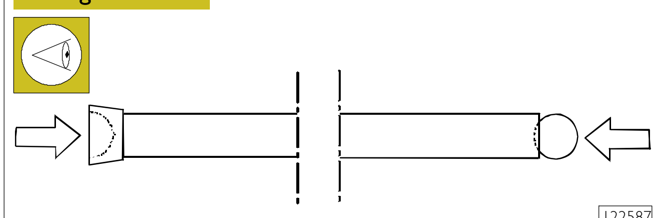


MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

If disassembled, check the adjustment dimension. Tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M24x1.5	5 ± 1 Nm

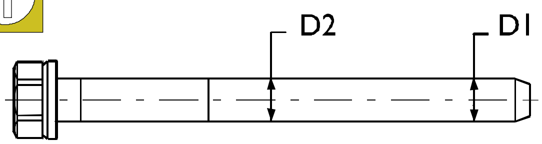
Figure 97



Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

Intake and exhaust valve push rods are identical and are therefore interchangeable.

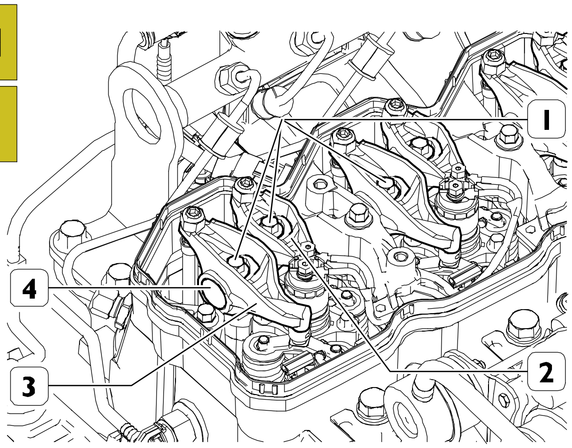
Figure 98



75703

- ❑ Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
  if D1 - D2 < 0.1 mm the screw can be reused
  if D1 - D2 > 0.1 mm the screw must be replaced

Figure 99



202413

- ❑ Position the intake rocker arms (2) and exhaust rocker arms (3) together with the rocker arm shafts.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M8x1.25x55	36 ± 5 Nm

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

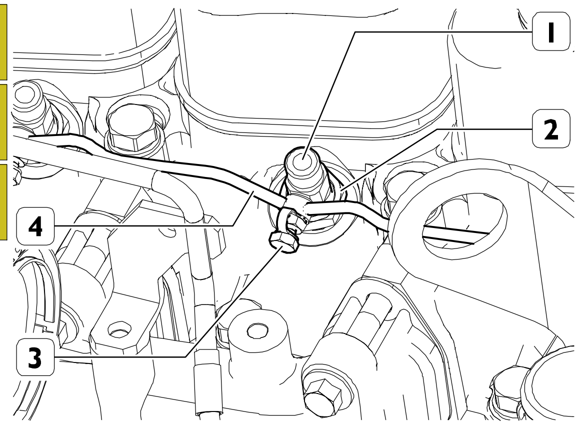
Fit the high pressure engine cable as described in the relevant section.

PROCEDURE FOR INJECTOR REMOVAL/-REFITTING

Removal NEF45 SM1F engines

Remove the high pressure pipe as described in the relevant section.

Figure 100



202410

- ❑ Unscrew the unions (3).
- ❑ Remove the injector exhaust pipe (4).
- ❑ Unscrew the ring nut (2) and remove the injector (1).

Ref.	No.	Screws description
(2)	4	Ring nut M24x1.5
(3)	4	M6x1 union

Refitting

- ❑ Insert the injector (1) together with the ring nut (2) in the specific seat.
- ❑ Tighten the ring nut (2).
- ❑ Position the injector exhaust pipe (4) and tighten the fittings (3).

Ref.	No.	Screws description	Tightening torques
(2)	4	Ring nut M24x1.5	60 ± 5 Nm
(3)	4	M6x1 union	-

Connect the high pressure pipe as described in the relevant section.

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Removal NEF45 TE1F/TE2F engines

Remove the high pressure pipe as described in the relevant section.

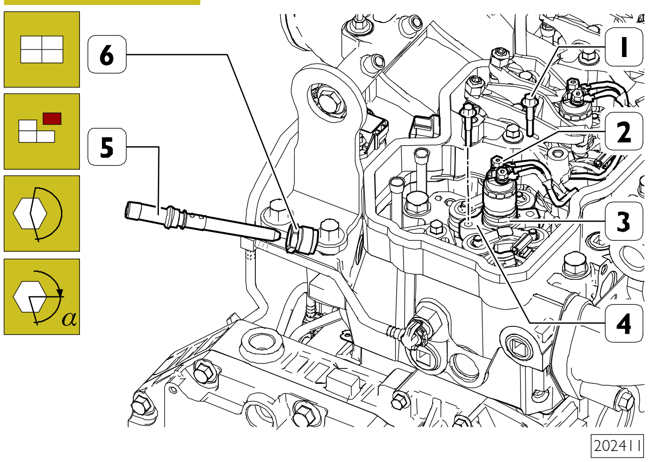
Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the rocker arm assembly as described in the relevant section.

Figure 101



- ❑ Unscrew the nut (6) connecting the head.
- ❑ Remove the union (5).
- ❑ Unscrew the nuts (2) fixing the wiring on the injectors.
- ❑ Unscrew the screws (1).
- ❑ Remove the injector (3) together with the fastening bracket (4).

Ref.	No.	Screws description
(1)	8	Screw M6x1x35
(6)	4	Nut M22x1.5

Refitting

- ❑ Insert the injector (3) together with the fastening bracket (4).
- ❑ Tighten the screws (1).
- ❑ Tighten the nuts (2) fixing the wiring on the injectors.
- ❑ Position the union (5).
- ❑ Tighten the nut (6) connecting the head.

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M6x1x35 1st phase 2nd phase angle	 3.5 ± 0.35 Nm 7.5 ± 2.5 Nm 25°+25°+25°
(6)	4	Nut M22x1.5	60 ± 5 Nm

Fit the rocker arm assembly as described in the relevant section.

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

Connect the high pressure pipe as described in the relevant section.

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PROCEDURE FOR FEED PUMP REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

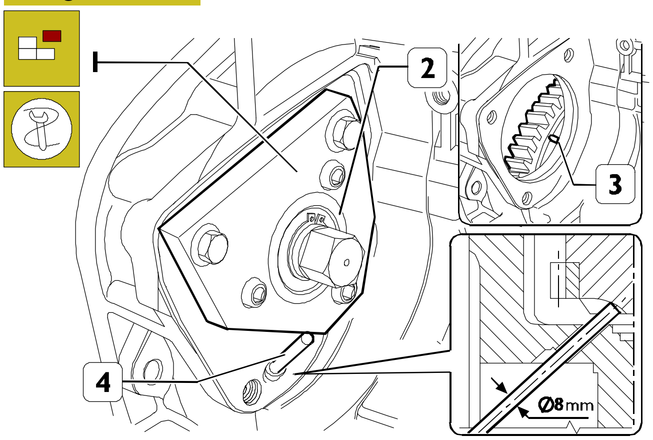
Place a container for the oil recovery.

Removal NEF45 SM1F engines

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Figure 102



123031

Once the starter motor is removed, fit tool 99360339 (1) to rotate the flywheel.

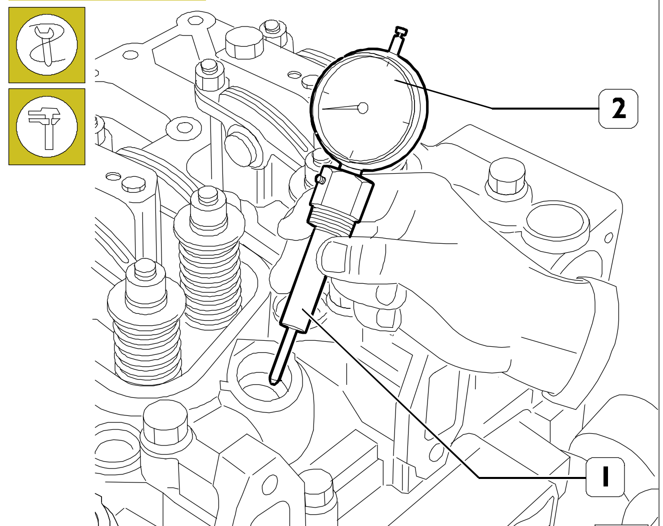
If it is necessary to replace the feed pump, this spare is supplied preset.

If however the pump needs to be disassembled and refitted without having undergone any repair interventions, reset it while it is still fitted on the engine and only then remove it.

The following procedure refers to the second possibility as this is the more complex one.

Identifying top dead centre with tool (99395097) - False injector

Figure 103



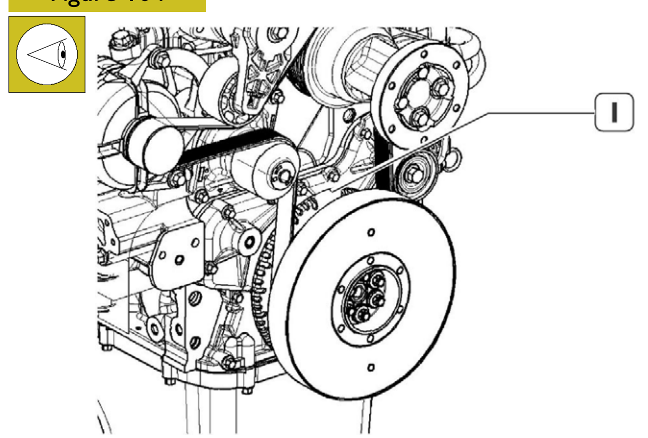
88141

To search for the position of 1st cylinder at top dead, end of compression stroke, remove the rocker arm cover of the 1st cylinder, remove the 1st injector and position the tool (1). pre-load the dial gauge.

NOTE For the removal of the 1st injector and the tappet cover refer to the relevant section.

The required condition is obtained by turning the crankshaft appropriately until the maximum value appears on the dial gauge and making sure that the intake and exhaust valves are both closed.

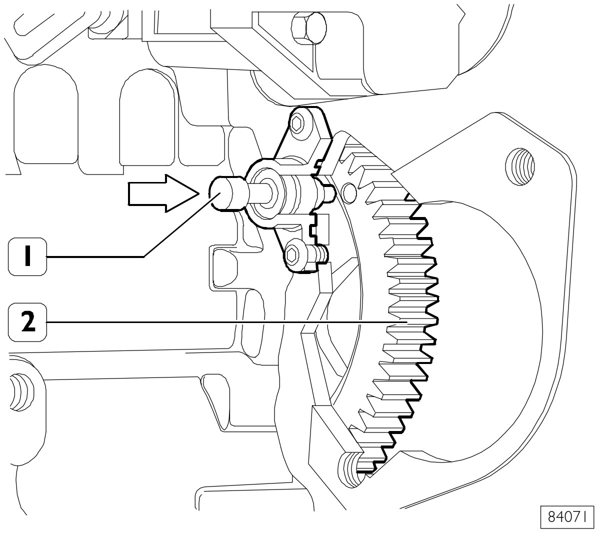
Figure 104



130192

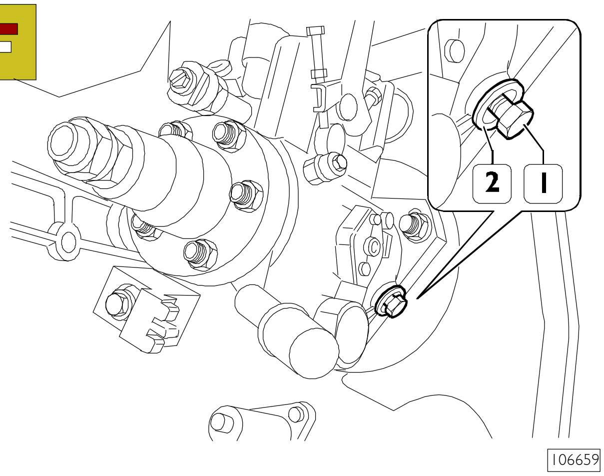
Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 105



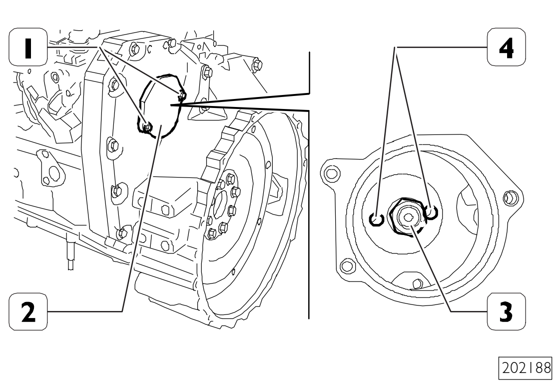
Rotate the flywheel until it pushes the pin 99360616 (1), this will not block the gear (2), obtaining the TDC of the 1st cylinder.

Figure 106



- ❑ Partially unscrew the screw (1) locking the pump spindle and move the spacer with the slot (2) to the largest part of the hole to allow the screw to fit in completely.
- ❑ Apply a torque of between 11.9 and 12.4 Nm to tighten the locking screw (1) flush with the spacer locking the pump spindle rotation.

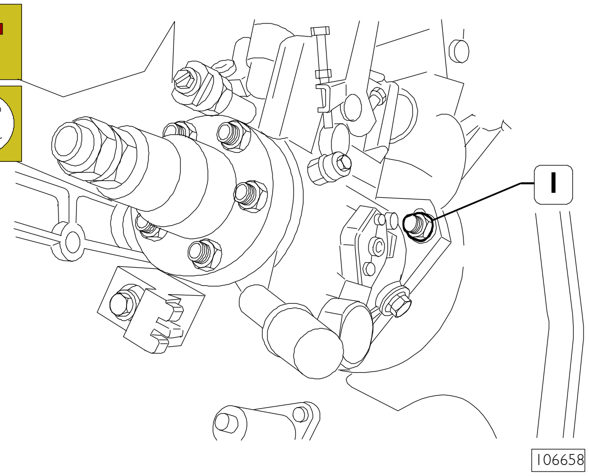
Figure 107



- ❑ On the timing gear side, remove the small cover (2) unscrewing the screws (1) so as to access the nut (3) securing the pump drive gear.
- ❑ Unscrew the nut (3) and recover the relative washer.

Ref.	No.	Screws description
(1)	2	Screw M6x1
(3)	1	Nut M14x1.5

Figure 108



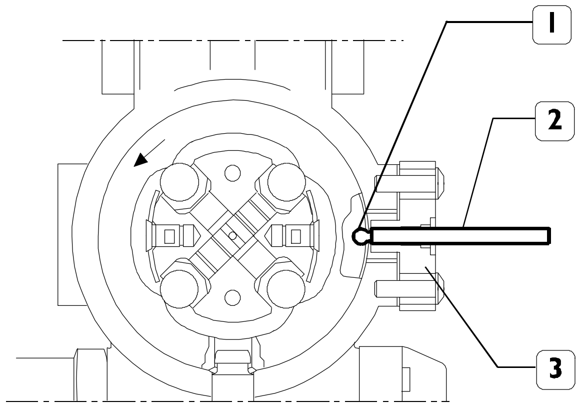
- ❑ From the side of the pump, loosen the fastening nuts (1) without removing them in order to allow the pump to move backwards when the extractor 99340035 operates.
- ❑ Fit the extractor 99340035 using the two threaded holes (4, Figure 107) and detach the gear from the pump spindle.
- ❑ Suitably support the feed pump and unscrew the fastening nuts completely.
- ❑ Take the pump off the studs together with the gasket.

Ref.	No.	Screws description
(1)	3	Nut M8x1.25

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Check correct setting of rotating feed pump

Figure 109



106660

1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

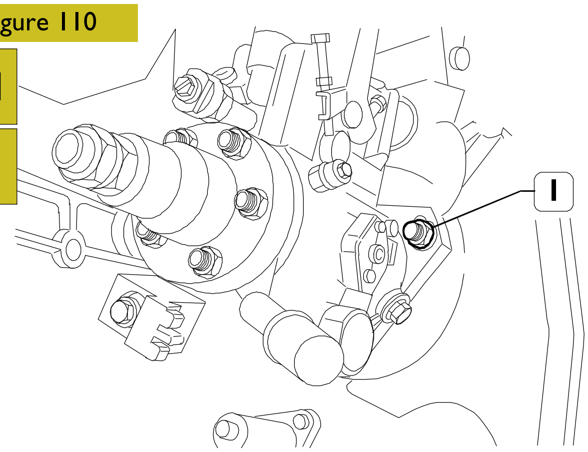
Therefore:

- ❑ Remove the screw plug (3) at the centre of the plate.
- ❑ Insert synchronisation pin (1) 99365196 into the hole in the plate (3). The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.
- ❑ Lock the drive shaft in the correct position using the screw (1, Figure 104).
- ❑ Remove the synchronisation pin and fit the screw plug of the plate (3). Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Refitting

Figure 110



106658

When fitting the feed pump on the engine, the conditions of the T.D.C at the 1st cylinder at the end of the compression stroke must be met.

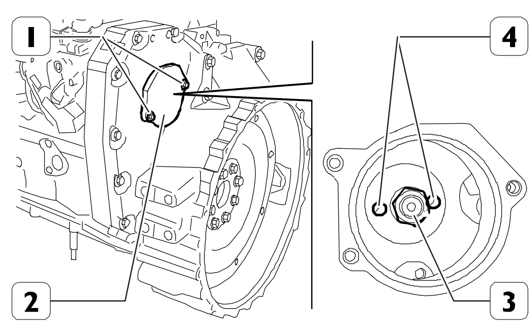
- ❑ Fit the preset pump into its seat on the engine, fitting the shaft into the hole of the gear (without key).
- ❑ Tighten the fastening nuts (1) locking the pump flange at the centre of the slot.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M8x1.25	24 ± 4 Nm

NOTE The gasket removed during pump disassembly must not be reused.

Always use original spare parts.

Figure 111

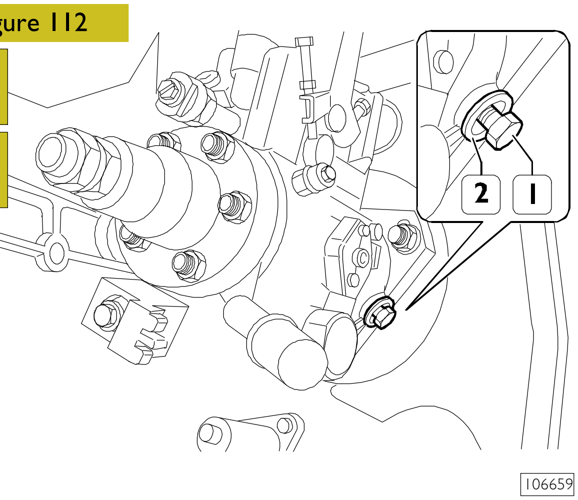


202188

- ❑ On the timing gear side, fit the washer through the specific hole and screw in the nut (3) on the pump spindle.
- ❑ Fit the small cover (2) together with the gasket and screw in the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M14x1.5	90 ± 5 Nm

Figure 112



- ❑ Undo but do not remove screw (1) locking the rotation of the pump spindle and move the spacer with slot into the small part of the hole.
- ❑ Screw in the screw (1) until flush locking the spacer: in this way, the feed pump spindle is free to rotate.
- ❑ Remove tool 99360339 or 99360330 for locking/rotation of flywheel.

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

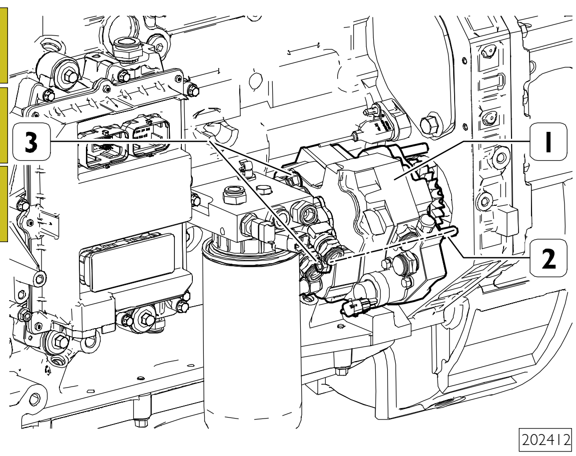
Removal NEF45 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Figure 113



- ❑ Loosen the nuts (3).
- ❑ Remove the supply pump assembly (1).
- ❑ Unscrew the studs (2).

Ref.	No.	Screws description
(2)	3	Stud M8x1.25x5
(3)	3	Nut M8x1.25

Refitting

- ❑ Tighten the studs (2).
- ❑ Position the supply pump (1) in the relative seat.
- ❑ Tighten the nuts (3).

Ref.	No.	Screws description	Tightening torques
(2)	3	Stud M8x1.25x5	-
(3)	3	Nut M8x1.25	24 ± 4 Nm

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

Fit the engine cable as described in the relevant section.

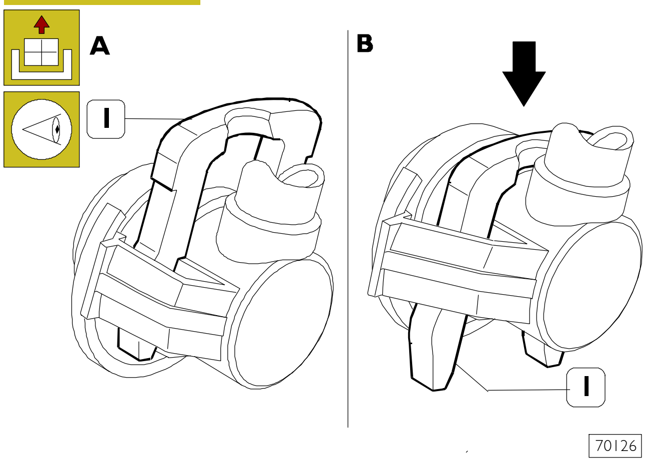
PROCEDURE FOR PRIMING PUMP REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engines

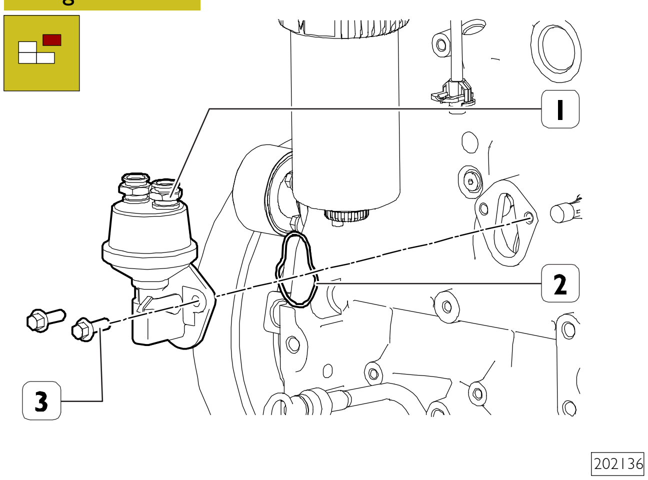
Figure 114



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Figure 115

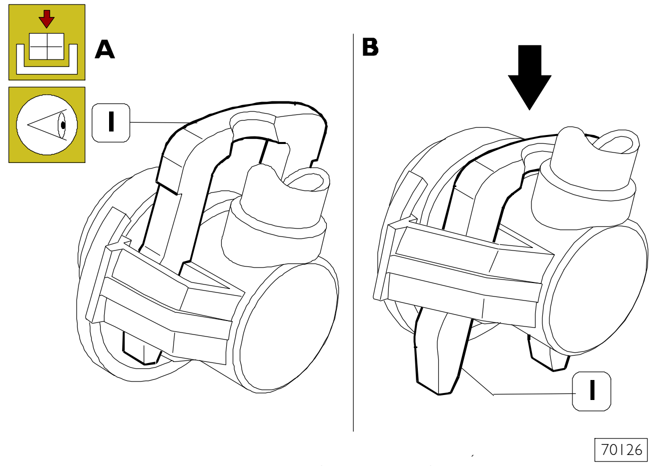


- ❑ Unscrew the screws (3).
- ❑ Remove the priming pump (1) and recover the gasket (2).

Ref.	No.	Screws description
(3)	2	Screw M8x1.25x25

Refitting

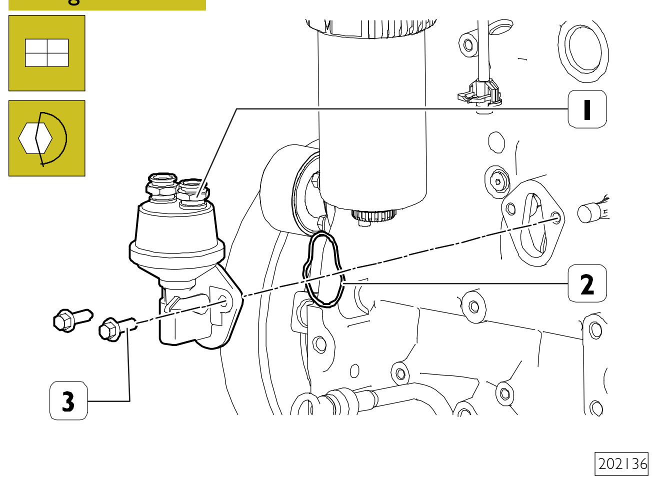
Figure 116



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

Figure 117



- ❑ Position the gasket (2) in its seat.
- ❑ Connect the priming pump (1).
- ❑ Tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M8x1.25x25	24 ± 4 Nm

PROCEDURE FOR ROCKER ARM ASSEMBLY REMOVAL/REFITTING
NEF45 SM1F engines

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

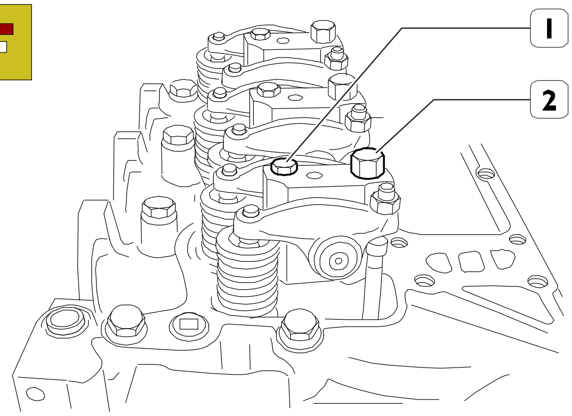
Place a container for the oil recovery.

Removal

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Figure 118



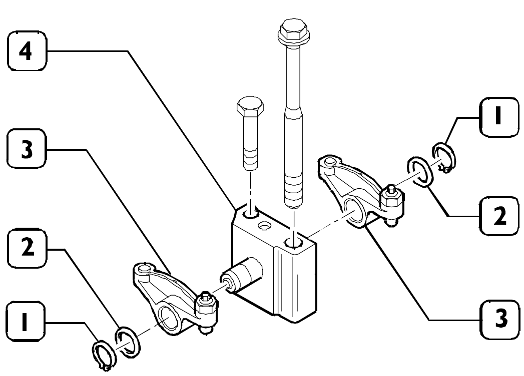
202143

- ❑ Disassemble the rocker arm mounts:
  unscrew the fastening screws (1 and 2) and disassemble the mount together with the rocker arms; remove the push rods.
  Repeat the operation for the remaining rocker arm mounts.

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x75
(2)	4	Screw M12x1.75x180

Refitting

Figure 119

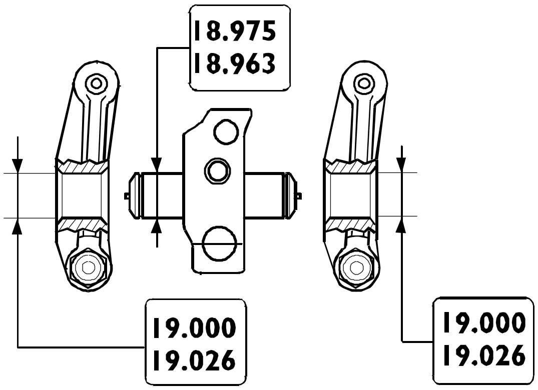


75705

- ❑ After checking, fit the rocker arm assembly

ROCKER ASSEMBLY COMPONENTS:
1. Circlip - 2. Spacer - 3. Rocker arms - 4. Support

Figure 120

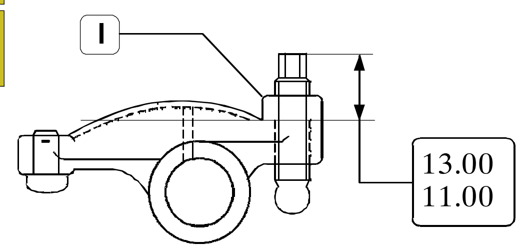


75704

MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 121



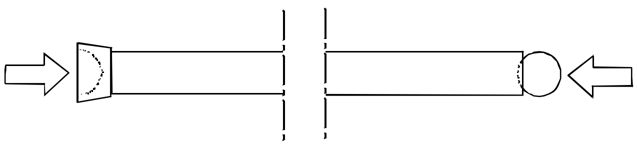
116391

MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

If disassembled, check the adjustment dimension. Tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M8x1.25	24 ± 4 Nm

Figure 122

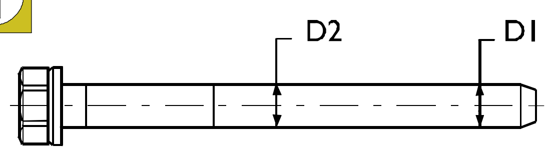


122587

Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

Intake and exhaust valve push rods are identical and are therefore interchangeable.

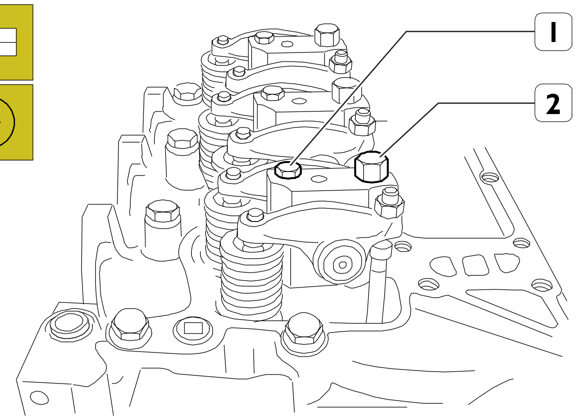
Figure 123



75703

- ❑ Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
  if D1 - D2 < 0.1 mm the screw can be reused
  if D1 - D2 > 0.1 mm the screw must be replaced

Figure 124



202143

- ❑ Tighten the screws (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x75	24 ± 3 Nm
(2)	4	Screw M12x1.75x180 1st phase 2nd phase	 70 ± 5 Nm 90° + 90°

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

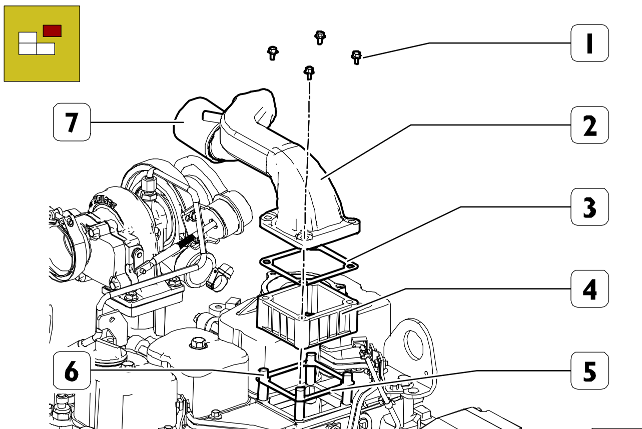
PROCEDURE FOR INTAKE MANIFOLD REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engines

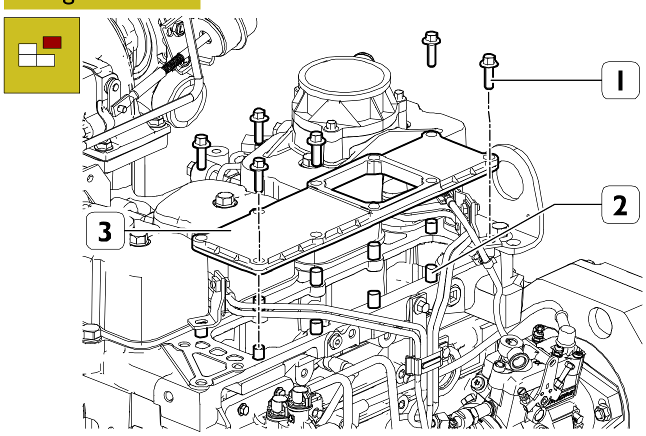
Figure 125



- ❑ Unscrew the screws (1).
- ❑ Disconnect the engine air intake (2) from the turbocharger at the sleeve (7).
- ❑ Recover the gasket (3).
- ❑ Remove the support (4) and recover the centring pins (6).
- ❑ Recover the gasket (5).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x80

Figure 126



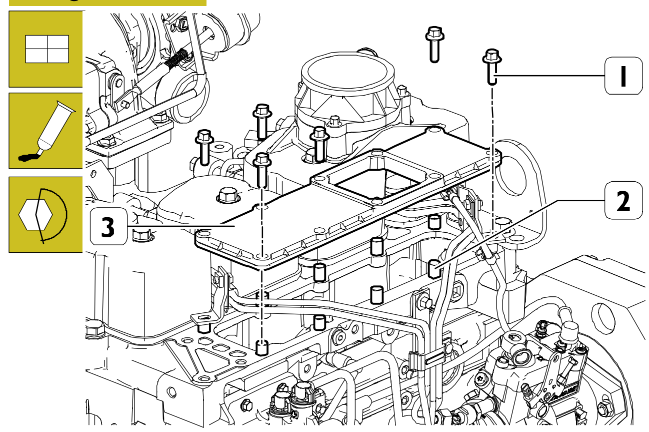
- ❑ Unscrew the screws (1).
- ❑ Remove the intake manifold (3).
- ❑ Recover the smooth bushings (2).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x80

NOTE Some screws for fastening the intake manifold have been removed during the removal of the engine air intake pipe. (Ref 2, Figure 125)

Refitting

Figure 127



- ❑ Insert the smooth bushings (2).
- ❑ Apply LOCTITE 5999 between the intake manifold and cylinder head.
- ❑ Place the intake manifold (3) in the specific seat.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x80	24 ± 4 Nm

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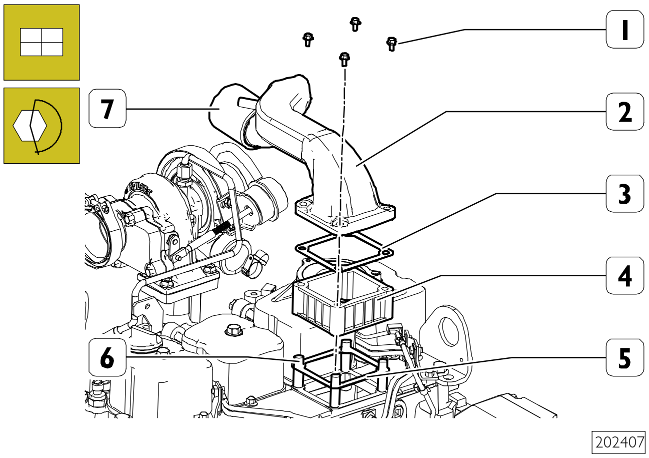
Figure 128



- ❑ Insert the gasket (5) and the centring pins (6).
- ❑ Insert the support (4) in its seat.
- ❑ Insert the gasket (3).
- ❑ Connect the engine air intake (2) from the turbocharger at the sleeve (7).
- ❑ Tighten the screws (1).

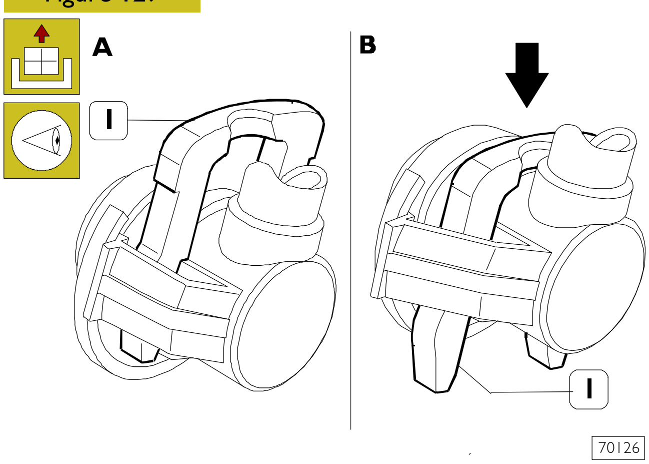
Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x80	24 ± 4 Nm

Removal NEF45 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

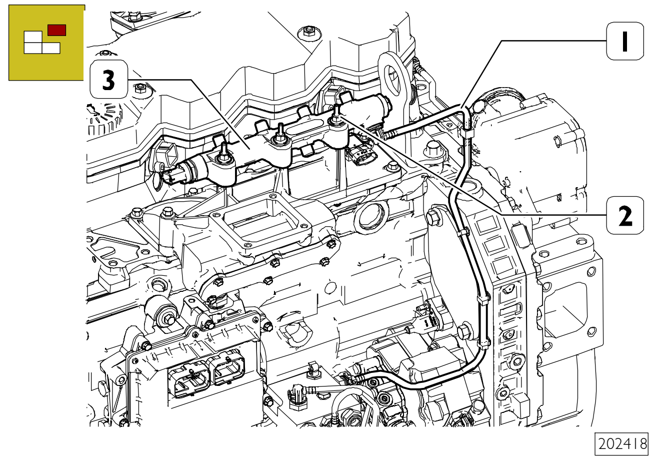
Figure 129



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

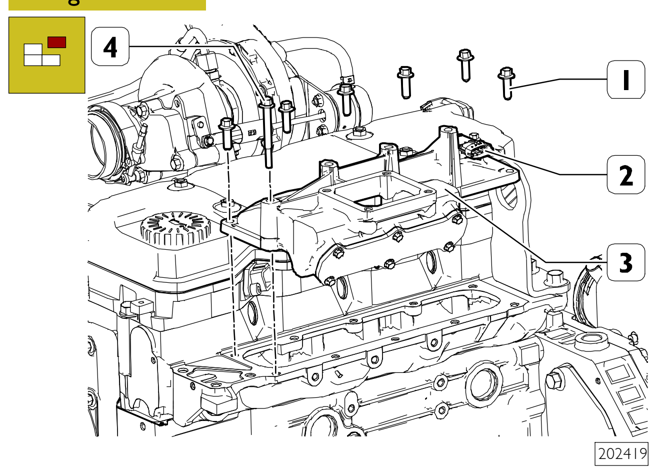
Figure 130



- ❑ Remove the fuel return pipe (1) from the Common Rail (3).
- ❑ Unscrew the threaded double stem screws (2).
- ❑ Remove the Common Rail (3).

Ref.	No.	Screws description
(2)	3	Screw M8x1.25x125

Figure 131

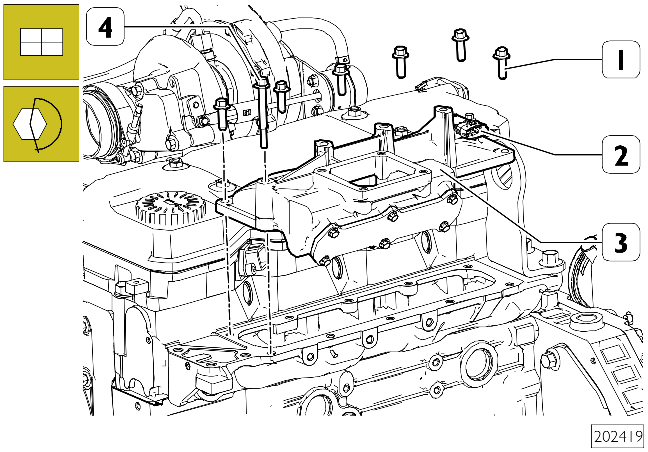


- ❑ Unscrew the screws (1 and 4).
- ❑ Remove the intake manifold (3), together with the air pressure and temperature sensor (2).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25
(4)	1	Screw M8x1.25x70

Refitting

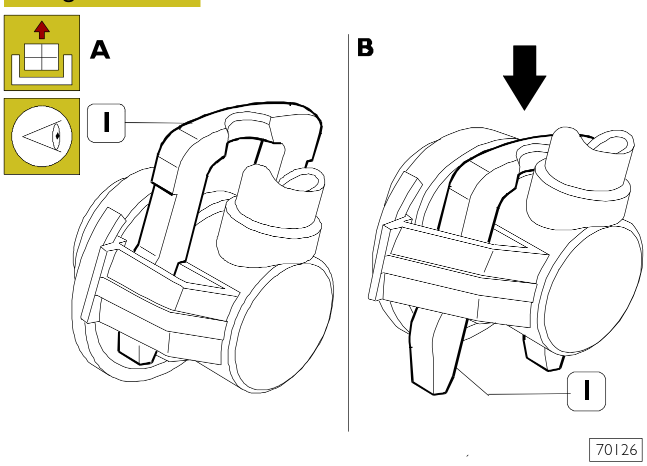
Figure 132



- Place the intake manifold (3) in its seat, together with the air pressure and temperature sensor (2).
- Tighten the screws (1 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	24 ± 4 Nm
(4)	1	Screw M8x1.25x70	24 ± 4 Nm

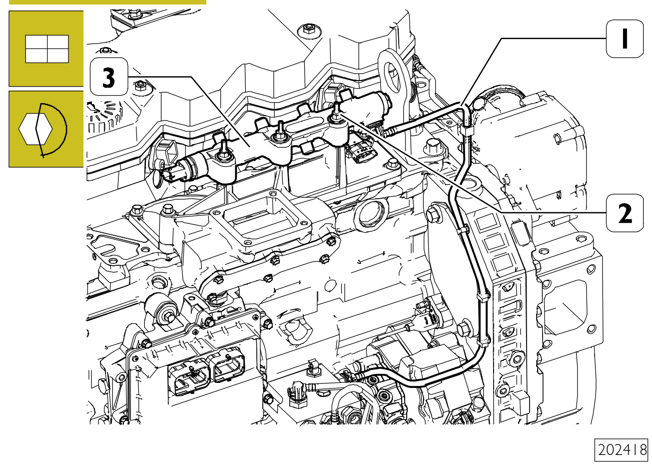
Figure 133



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

Figure 134



- Place the Common Rail (3) in its seat.
- Screw the threaded double stem screws (2).
- Fit the fuel return pipe (1) from the Common Rail (3).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M8x1.25x125	35 ± 6 Nm

Fit the high pressure pipes as described in the relevant section.

Fit the engine cable as described in the relevant section.

PROCEDURE FOR EXHAUST MANIFOLD REMOVAL/REFITTING

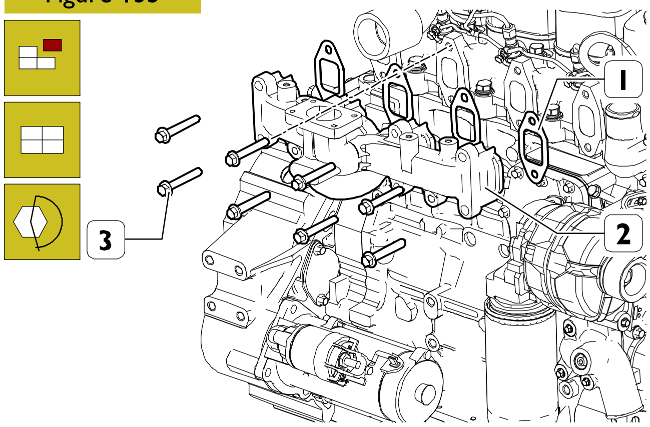
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Removal NEF45 SM1F engines

Place a container for the oil recovery.

Remove the turbocharger as described in the relevant section.

Figure 135



202420

- ❑ Unscrew the screws (3) securing the exhaust manifold (2).
- ❑ Remove the exhaust manifold (2).
- ❑ Recover the 4 gaskets (1).

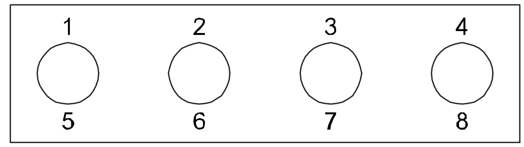
Ref.	No.	Screws description
(3)	8	Screw M10x1.5x65

Refitting

- ❑ Position the gaskets (1).
- ❑ Place the exhaust manifold (2) in the specific seat.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(3)	8	Screw M10x1.5x65	55 ± 3 Nm

Figure 136



202421

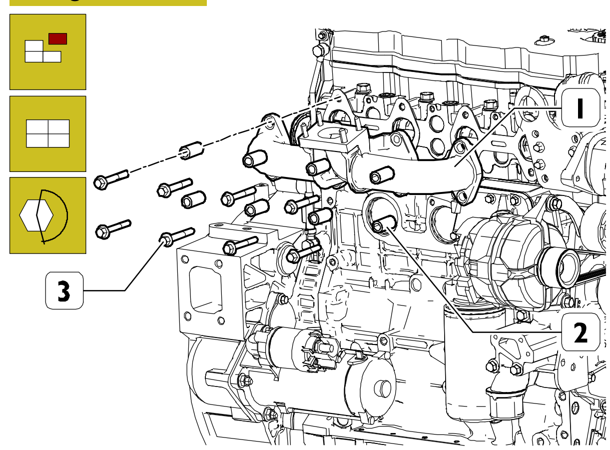
Tightening sequence:
2 - 7 - 3 - 6 - 1 - 8 - 4 - 5
TIGHTENING DIAGRAM FOR EXHAUST MANIFOLD FASTENING SCREWS AS SEEN FROM ENGINE SIDE

Fit the turbocharger as described in the relevant section.

Removal NEF45 TE1F/TE2F engines

Remove the turbocharger as described in the relevant section.

Figure 137



202422

- ❑ Unscrew the screws (3) securing the exhaust manifold (1).
- ❑ Recover the spacers (2).
- ❑ Remove the exhaust manifold (1).

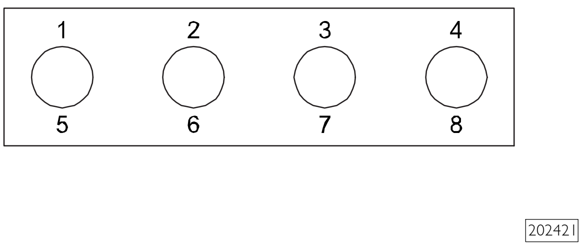
Ref.	No.	Screws description
(3)	8	Screw M10x1.5x65

Refitting

- ❑ Place the exhaust manifold (1) in the specific seat.
- ❑ Insert the spacers (2).
- ❑ Tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	8	Screw M10x1.5x65	55 ± 3 Nm

Figure 138



Tightening sequence:
2 - 7 - 3 - 6 - 1 - 8 - 4 - 5
TIGHTENING DIAGRAM FOR EXHAUST MANIFOLD FASTENING SCREWS AS SEEN FROM ENGINE SIDE

Fit the turbocharger as described in the relevant section.

PROCEDURE FOR CYLINDER HEAD REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF45 SM1F engine

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Remove the turbocharger as described in the relevant section.

Remove the exhaust manifold as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Remove the fuel filter as described in the relevant section.

Remove the intake manifold as described in the relevant section.

Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the injectors as described in the relevant section.

Remove the rocker arm assembly as described in the relevant section.

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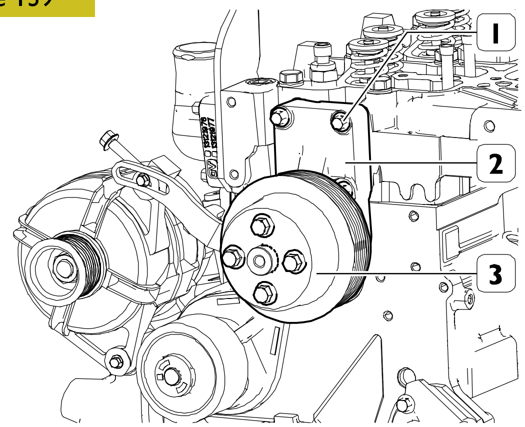
Figure 139

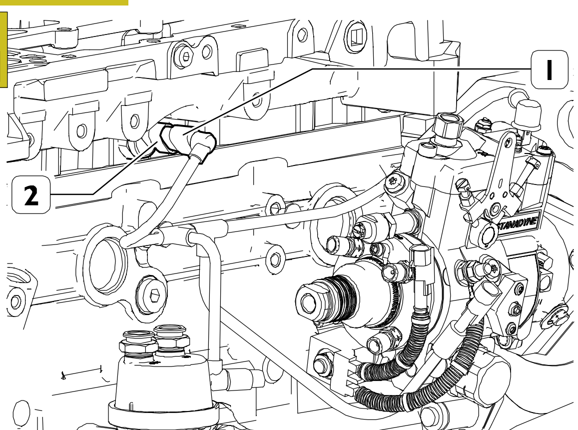


202423

- ❑ Unscrew the screws (1).
- ❑ Remove the fan support (2), together with the fan control pulley (3).

Ref.	No.	Screws description
(1)	4	Screw M8x25

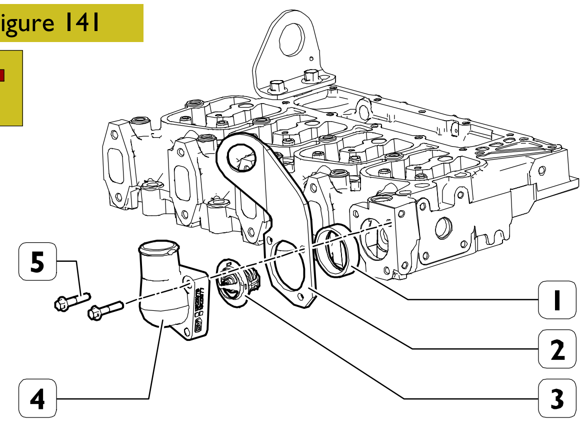
Figure 140



202424

- ❑ Disconnect the connection (1) to the water temperature sensor (2).

Figure 141



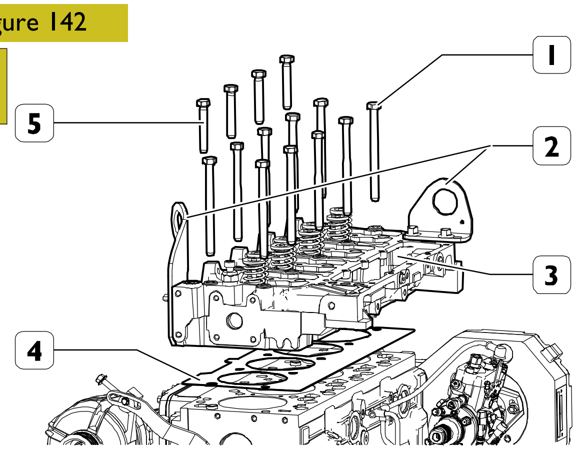
202498

- ❑ Unscrew the screws (5) securing the thermostat cover (4).
- ❑ Remove the thermostat cover (4).
- ❑ Remove the thermostat assembly (3).
- ❑ Remove the lifting eyelet (2).
- ❑ Remove the gasket (1) of the cover.

Ref.	No.	Screws description
(5)	3	Screw M6x1

To remove the cylinder head, fit the bracket into the original position and fasten it with the screws of the thermostat body.

Figure 142



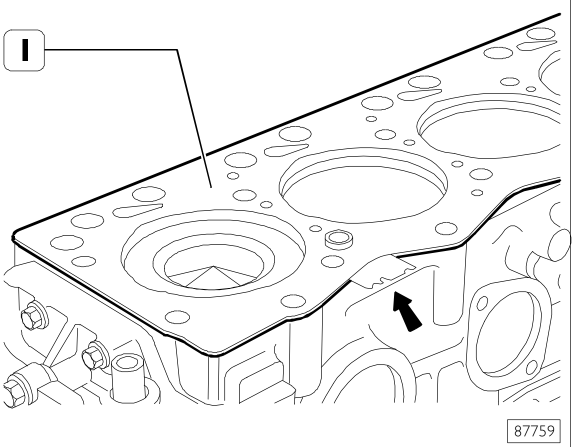
202425

- ❑ Unscrew the screws (1 and 5).
- ❑ Using the lifting eyelets (2), remove the cylinder head (3) together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (4).

Ref.	No.	Screws description
(1)	10	Screw M12x1.75x140
(5)	4	Screw M12x1.75x70

Refitting

Figure 143



❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

NOTE With piston protrusion equal to or less than 0.4, install the gasket with a thickness of 1.15.

With piston protrusion greater than 0.4, install the gasket with a thickness of 1.25.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.

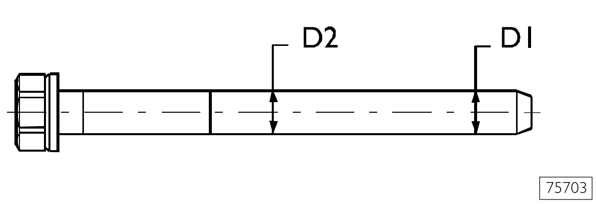
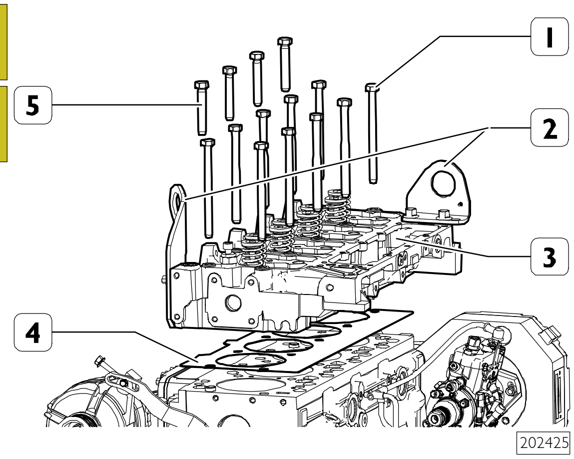


Figure 144

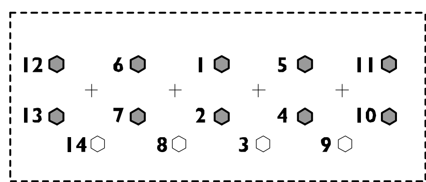


❑ Position the cylinder head (3) on the block using the lifting eyelets (2).

❑ Tighten the screws (1 and 5).

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x140 1^{st} phase 2^{nd} phase	 40 ± 5 Nm 90° + 90°
(5)	4	Screw M12x1.75x70 1^{st} phase 2^{nd} phase	 60 ± 5 Nm 90°

Figure 145



❑ Lubricate the bolts and fit them on the engine head.

❑ The bolts must be tightened according to a "spiral" pattern, starting with the central bolts and outward. Tighten the bolts in numerous phases until they have all been correctly tightened.

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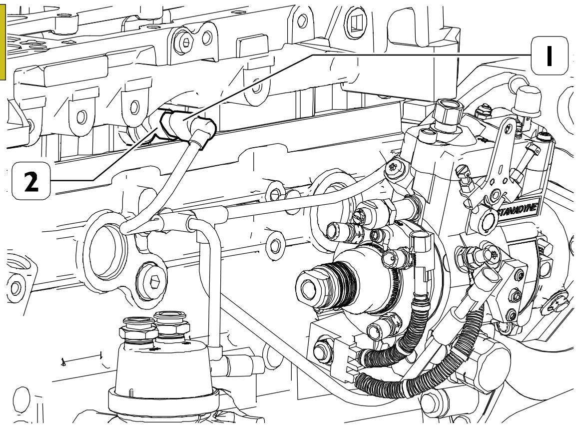
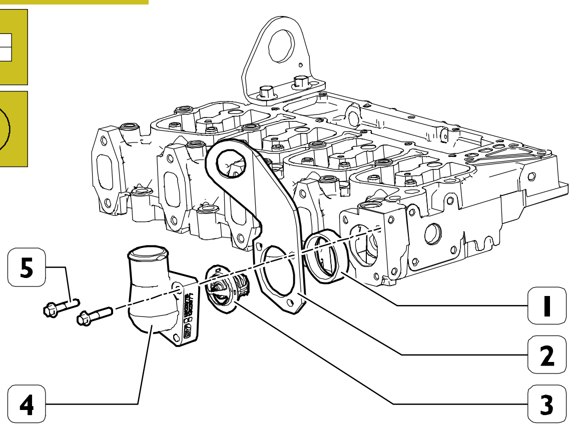
Figure 146



202424

- ❑ Connect the connection (1) to the water temperature sensor (2).

Figure 147

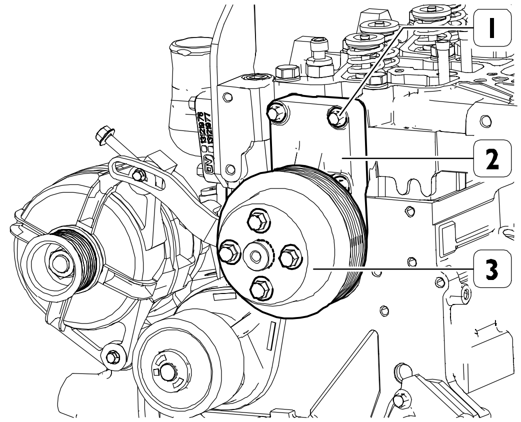


202498

- ❑ Position the gasket (1) of the cover.
- ❑ Position the lifting eyelet (2).
- ❑ Insert the thermostat assembly (3) into the relative seat.
- ❑ Position the thermostat cover (4).
- ❑ Tighten the screws (5) securing the thermostat cover (4).

Ref.	No.	Screws description	Tightening torques
(5)	3	Screw M6x1	10 ± 2 Nm

Figure 148



202423

- ❑ Position the fan support (2), together with the fan control pulley (3).
- ❑ Tighten the screws (1).

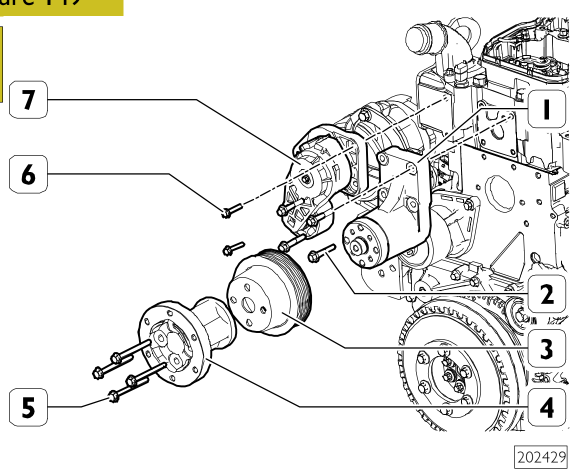
Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x25	-

Fit the rocker arm assembly as described in the relevant section.
Fit the injectors as described in the relevant section.
Fit the tappet cover as described in the relevant section.
Fit the oil vapour filter as described in the relevant section.
Fit the air filter as described in the relevant section.
Fit the intake manifold as described in the relevant section.
Fit the fuel filter as described in the relevant section.
Connect the high pressure pipe as described in the relevant section.
Connect the low pressure pipe as described in the relevant section.
Fit the exhaust manifold as described in the relevant section.
Fit the turbocharger as described in the relevant section.
Fit the belt as described in the relevant section.
Fit the fan as described in the relevant section.
Fit the radiator as described in the relevant section.
Fit the protection grille as described in the relative procedure.

Removal NEF45 TE1F/TE2F engine

Remove the protection grille as described in the relative procedure.
Remove the radiator as described in the relevant section.
Remove the fan as described in the relevant section.
Remove the engine cable as described in the relevant section.
Remove the belt as described in the relevant section.
Remove the turbocharger as described in the relevant section.
Remove the exhaust manifold as described in the relevant section.
Remove the low pressure pipe as described in the relevant section.
Remove the high pressure pipe as described in the relevant section.
Remove the intake manifold as described in the relevant section.
Remove the air filter as described in the relevant section.
Remove the oil vapour filter as described in the relevant section.
Remove the tappet cover as described in the relevant section.
Remove the injectors as described in the relevant section.
Remove the rocker arm assembly as described in the relevant section.

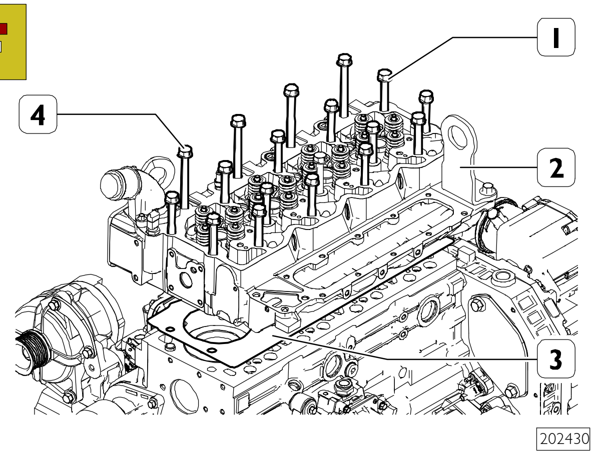
Figure 149



- ❑ Unscrew the screws (6) and remove the automatic belt tensioner (7).
- ❑ Unscrew the screws (5) and remove the spacer (4) for the fan coupling together with the pulley (3).
- ❑ Unscrew the screws (2).
- ❑ Remove the fan support (1).

Ref.	No.	Screws description
(2)	4	Screw -
(5)	4	Screw M10x1.5x110
(6)	2	Screw M8x1.25x30

Figure 150

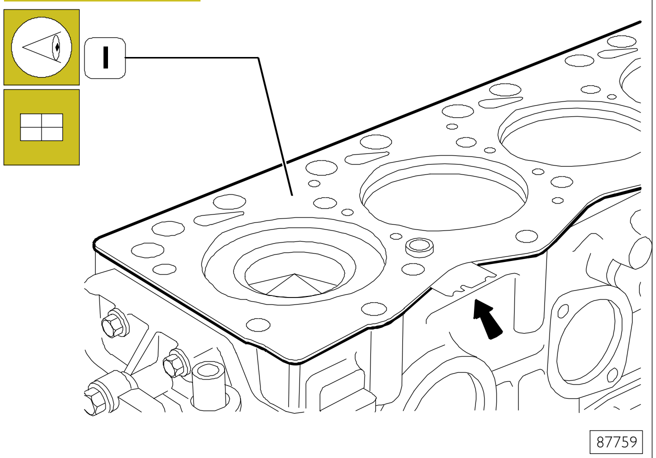


- ❑ Unscrew the screws (1 and 4).
- ❑ Using the lifting eyelets (2), remove the cylinder head together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (3).

Ref.	No.	Screws description
(1)	10	Screw M12x1.75x150
(4)	9	Screw M12x1.75x130

Refitting

Figure 151



❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

NOTE With piston protrusion equal to or less than 0.4, install the gasket with a thickness of 1.15.

With piston protrusion greater than 0.4, install the gasket with a thickness of 1.25.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.

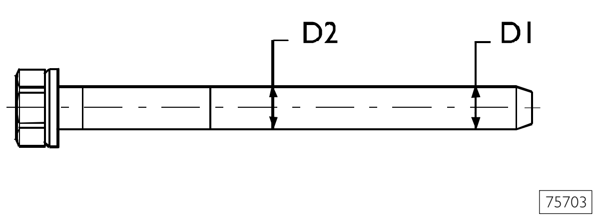
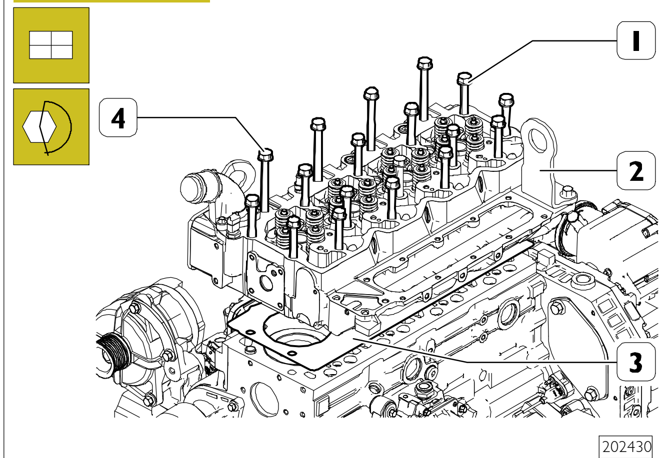


Figure 152

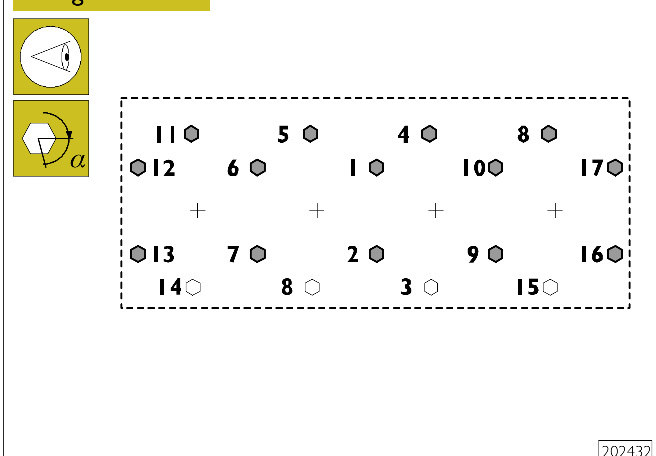


❑ Position the cylinder head on the block.

❑ Tighten the screws (1 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M12x1.75x150 1st phase 2nd phase	 55 ± 5 Nm 90° + 90°
(4)	4	Screw M12x1.75x130 1st phase 2nd phase	 35 ± 5 Nm 90° + 90°

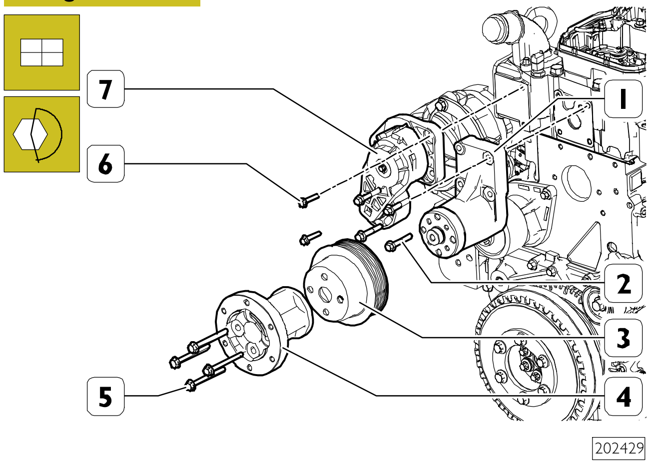
Figure 153



❑ Lubricate the bolts and fit them on the engine head.

❑ The bolts must be tightened according to a "spiral" pattern, starting with the central bolts and outward. Tighten the bolts in numerous phases until they have all been correctly tightened.

Figure 154



- Position the fan mount (1) and tighten the screws (2).
- Place the spacer (4) for attaching the fan, together with the pulley (3).
- Tighten the screws (5).
- Position the automatic belt tensioner (7) and tighten the screws (6).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw 1st phase 2nd phase	 27 ± 3 Nm 90° + 90°
(5)	4	Screw M10x1.5x110	-
(6)	2	Screw M8x1.25x30	-

Fit the rocker arm assembly as described in the relevant section.

Fit the injectors as described in the relevant section.

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

Fit the intake manifold as described in the relevant section.

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

Fit the exhaust manifold as described in the relevant section.

Fit the turbocharger as described in the relevant section.

Fit the belt as described in the relevant section.

Fit the engine cable as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

SECTION 6

General mechanical overhaul

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MOUNTING ON ROTATING STAND

Part of the operations covered in this section can be carried out in relation to the set-up.

NOTE Overhaul operations must be performed by qualified personnel with the specific tools.

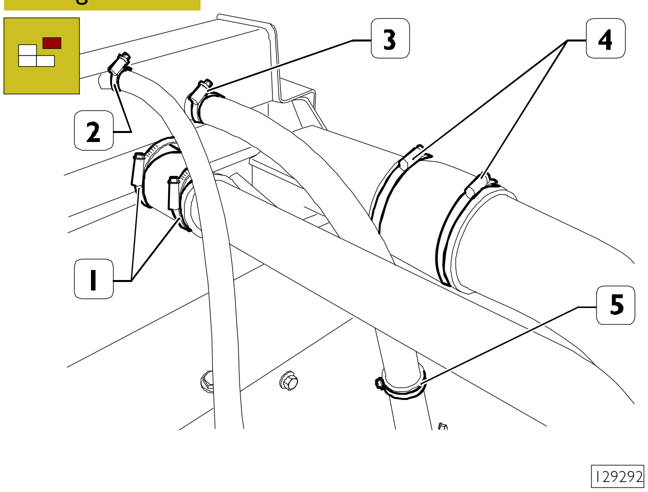
The following description covers the engine overhaul operation limited to components that differ according to the specific use.

NOTE For the needs dictated by application, some units may be placed on the motor in different positions.

The section "General mechanical overhaul" contains all the block overhaul operations.

Removal of radiator assembly pipes from engine

Figure 1

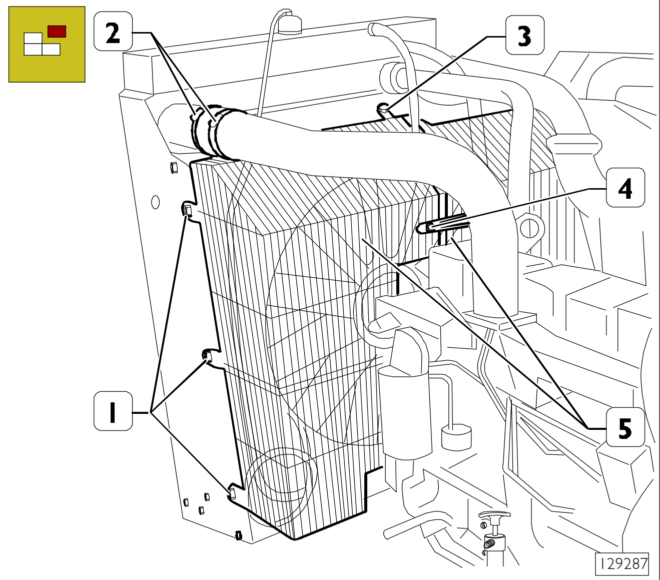


- Prepare a suitable container in correspondence with the pipe (4) for the recovery of the coolant. Disconnect the pipe (4) by acting on the relative clamps (1).
- Unscrew the screw (3) and detach the pipe (4) complete with bracket (5) from the radiator assembly (2).

Ref.	No.	Screws description
(3)	1	Screw M8x1.25x16

Protection grille removal

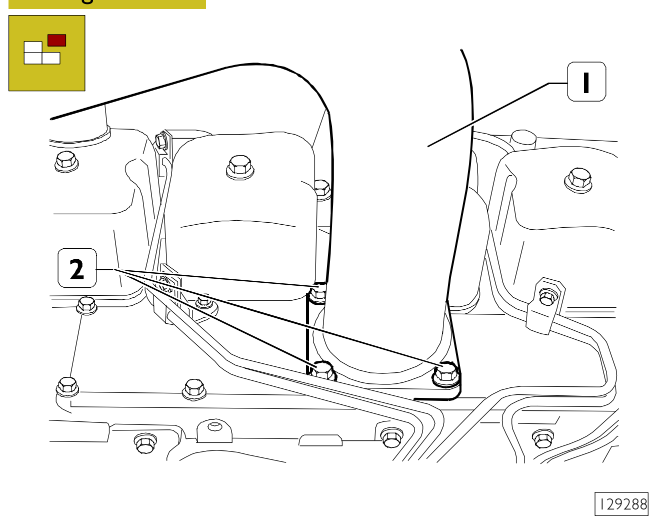
Figure 2



- Remove the fan protection grilles (5) by undoing the relative fastenings (1), (3) and (4).
- Open the clamps (2).

Ref.	No.	Screws description
(1)	6	Screw M6x1x16
(3)	1	Screw M8x1.25x16
(4)	1	Screw M6x1x16

Figure 3



- Unscrew the screws (2) and remove the pipe (1) from the intake manifold.

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

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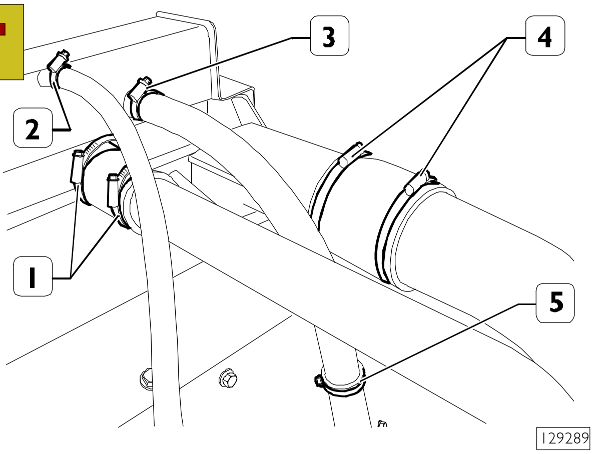
Removing the radiator

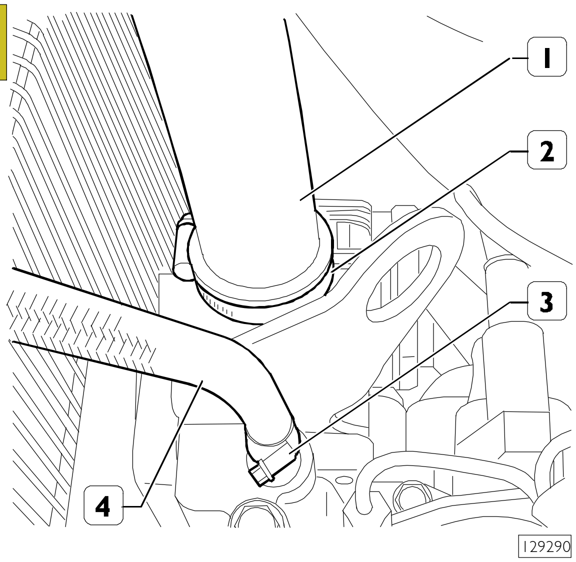
Figure 4



- ❑ Disconnect the air and water pipes from the radiator assembly.
- ❑ Unscrew the screws on the clamps (1, 2, 3 and 4) and on the fixing bracket (5).

Ref.	No.	Screws description
(5)	1	Screw M6x1x16

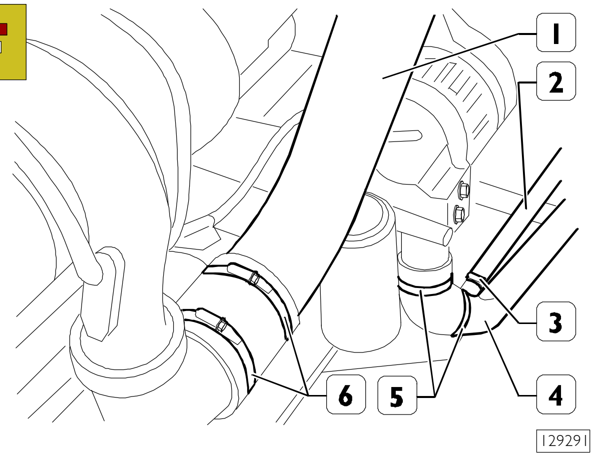
Figure 5



- ❑ Disconnect and remove the pipes (1 and 4), complete with sleeves, from the engine side.
- ❑ Unscrew the screws on clamps (2 and 3).

Ref.	No.	Screws description
(2)	1	Screw M6x1x16
(3)	1	Screw M8x1.25x16

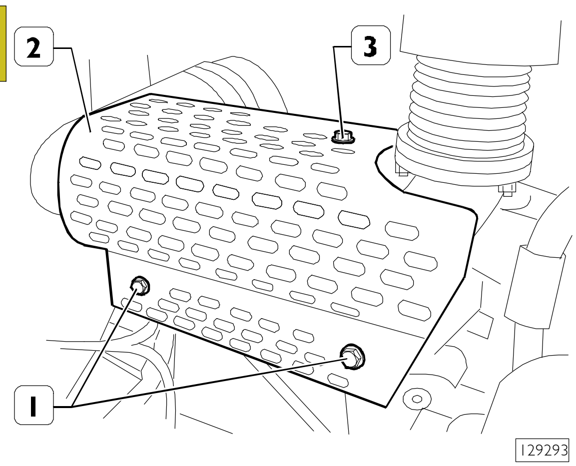
Figure 6



- ❑ Disconnect and remove the pipe (1), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (6).
- ❑ Disconnect and remove the pipe (2), unscrewing the screws on the relative clamp (3).
- ❑ Disconnect and remove the pipe (4), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (5).
- ❑ Properly lock the radiator unit, then release it from the base by adjusting the hardware on both sides.
- ❑ Remove the radiator assembly from its seat.

Ref.	No.	Screws description
(3)	2	Screw M6x1x16
(5)	2	Screw M8x1.25x16
(6)	2	Screw M6x1x16

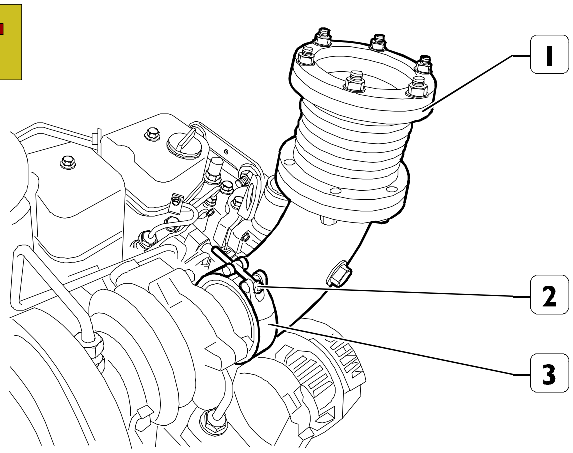
Figure 7



- ❑ Unscrew the screws (1 and 3).
- ❑ Remove the grille (2) protecting the turbine, if present.
- ❑ Then remove the mounting brackets.

Ref.	No.	Screws description
(1)	2	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Figure 8



129294

- ❑ Unscrew the screw (2) to open the clamp (3).
- ❑ Disconnect the exhaust pipe (1).

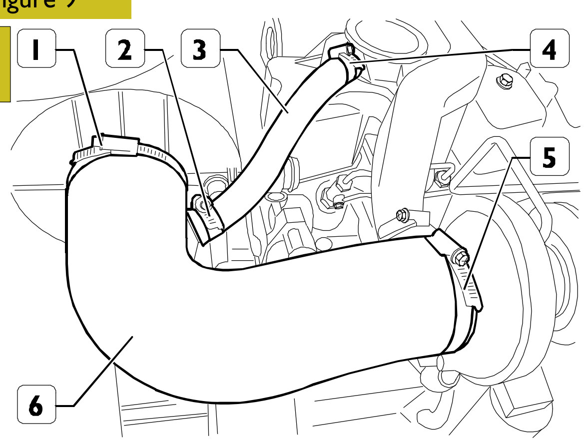
NOTE The shape and the size of the exhaust pipe will vary depending on use of the engine.

The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	1	Screw M7x1

Figure 9



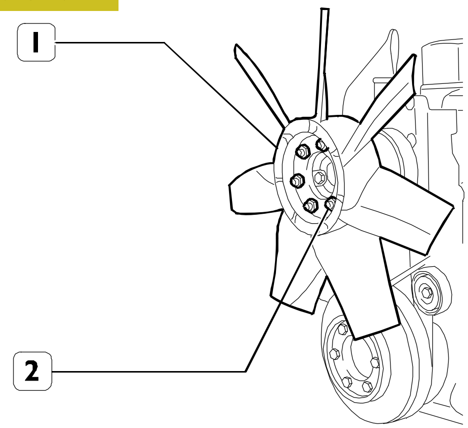
129295

- ❑ Unscrew the screws on the relative clamps (2 and 4).
- ❑ Disconnect and remove the oil vapour recovery pipe (3).
- ❑ Unscrew the screws on the relative clamps (1 and 5).
- ❑ Disconnect and remove the air intake pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M7x1
(5)	1	Screw M7x1

Fan removal

Figure 10



129297

- ❑ Unscrew the screws (2).
- ❑ Remove the fan (1), complete with spacer.

NOTE The shape and the size of the fan varies according to the use of the engine.

The illustrations provide a general path of the operation to be performed.

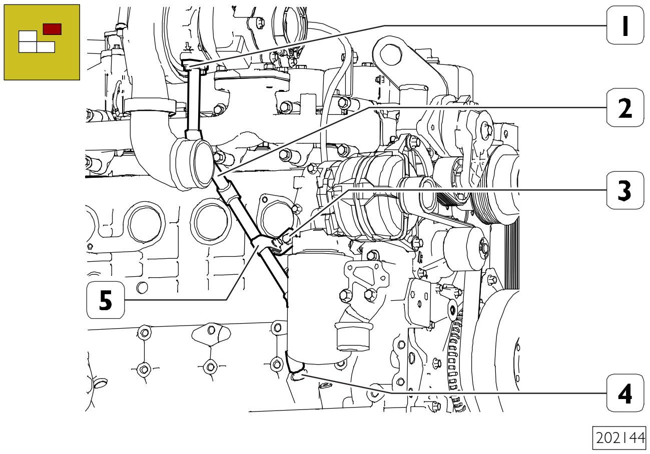
The procedures described are still applicable.

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

Removal of components hindering bracket assembly

Removal of turbocharger lubricant return pipe

Figure 11



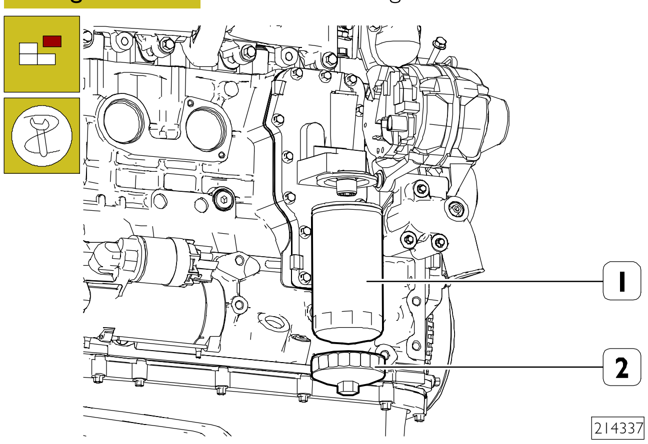
The lubricant oil drain pipe (2) from the turbocharger.

- ❑ unscrew the two screws (1) from under the turbocharger.
- ❑ Unscrew the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- ❑ Lastly, pull the connector (4) from the crankcase; plug the ends of the pipe and the exhaust on the turbocharger.

Ref.	No.	Screws description
(1)	2	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Removal of oil filter

Figure 12 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 10

In order to apply the bracket 99361037 fixing the crankcase to the stand 99322205 and overhaul it, operate in the following way.

From the right side, remove:

- ❑ with tool 99360076 (2) remove the oil filter (1) from the support.

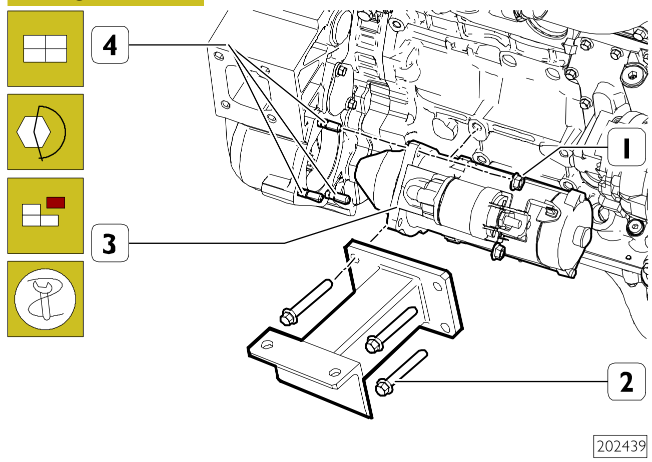
Attention, the oil filter contains approximately 1 kg of engine oil.

Collect and dispose of the engine oil according to applicable laws.

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Starter motor removal

Figure 13

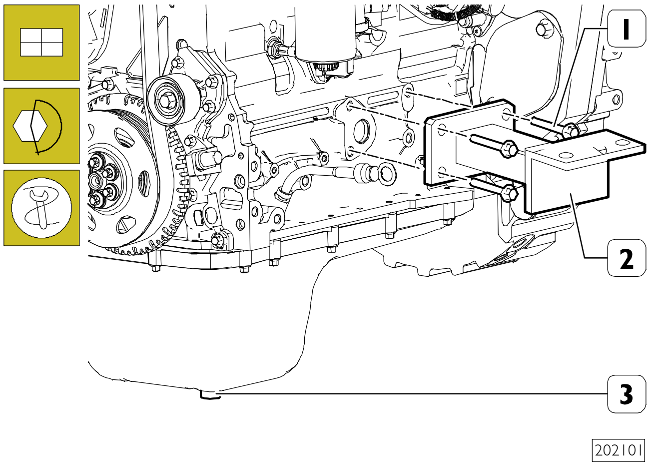


- ❑ Properly support the starter motor (3).
- ❑ Loosen the retaining nuts (1).
- ❑ Remove the starter motor (3) and unscrew the studs (4).
- ❑ Mount the support bracket 99361037 by inserting the screws (2) into the four threaded holes.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M10x1.5	-
(2)	4	Screw M12x1.75	43 ± 6 Nm
(4)	3	Stud M10x1.5x20	-

Mounting brackets on rotating stand

Figure 14



From the left side:

- ❑ connect the second bracket 99361037 (2) by inserting the screws (1) into the threaded holes.
- ❑ Lift the engine with arm 99360595 and put it on the rotating stand 99322205.

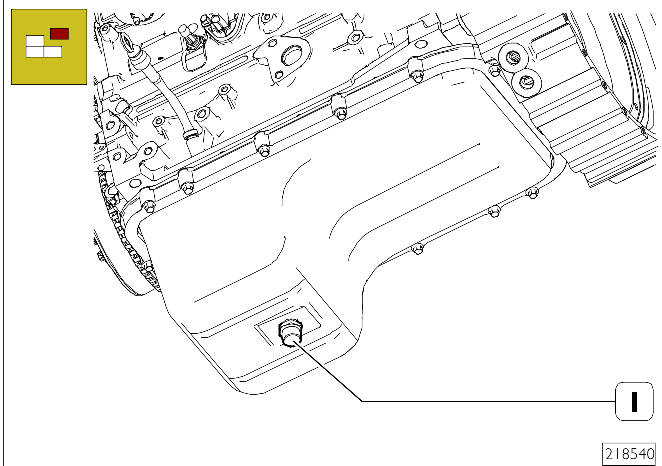
Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	43 ± 6 Nm

Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

Engine lubricant oil drainage

Figure 15



- ❑ Drain the oil through the plug (1) located below the oil sump.

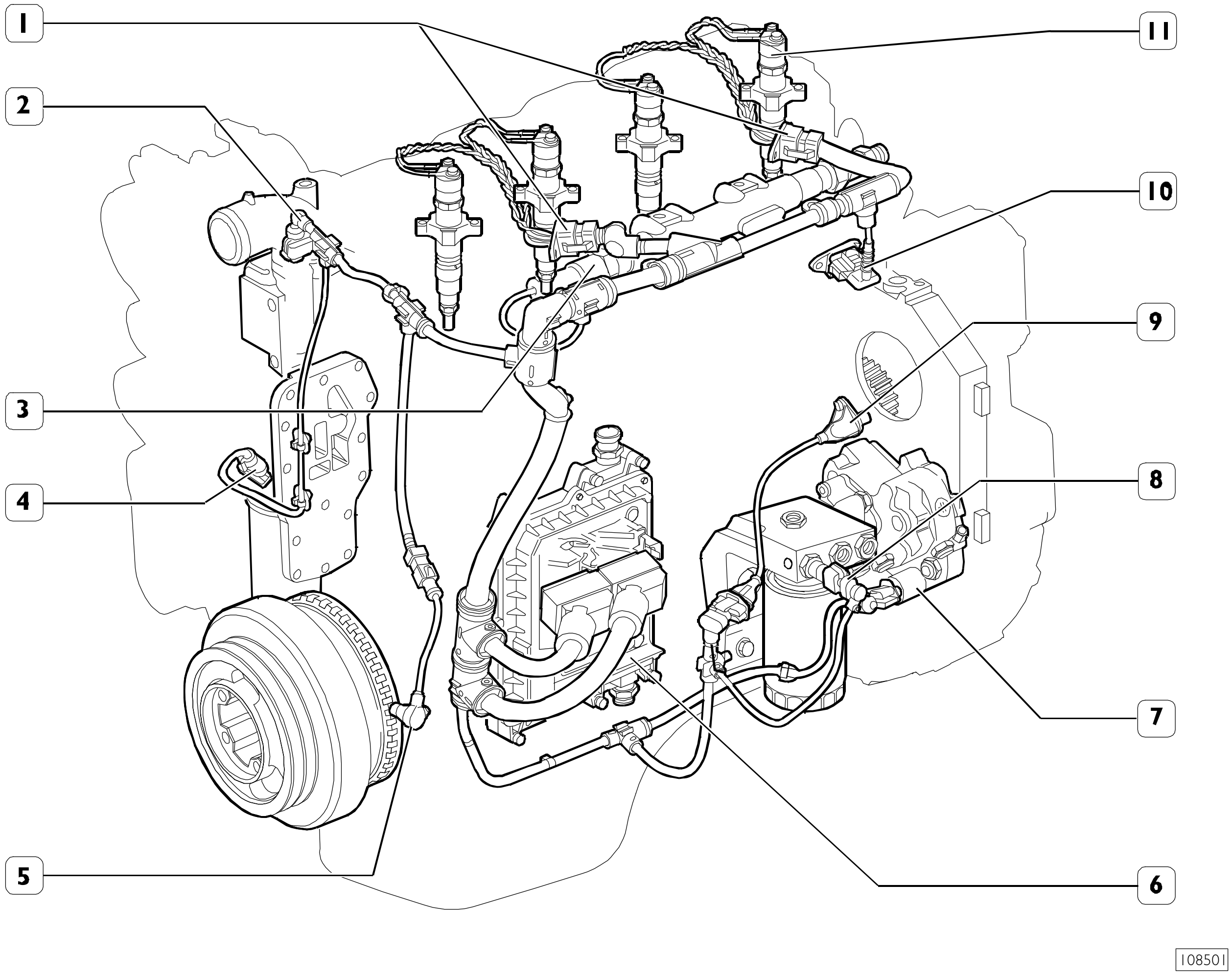
Ref.	No.	Screws description
(1)	1	Plug M18x1.5

The oil sump contains approximately 7.65 kg of engine oil.

Collect and dispose of the engine oil according to applicable laws.

Engine cable removal

Figure 16 NEF45 TE1F/TE2F engine



☞ NEF45 SM1F engine Page 15

1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9. Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

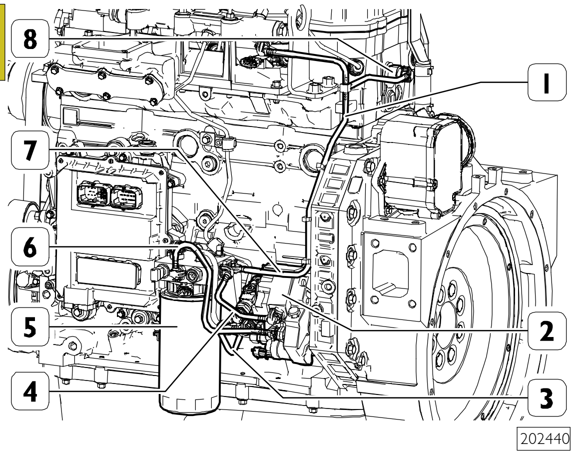
Disconnect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Remove the clamps that hold it to the crankcase and remove it completely.

Removal of components hindering bracket assembly

Removal of fuel pipes

Figure 17

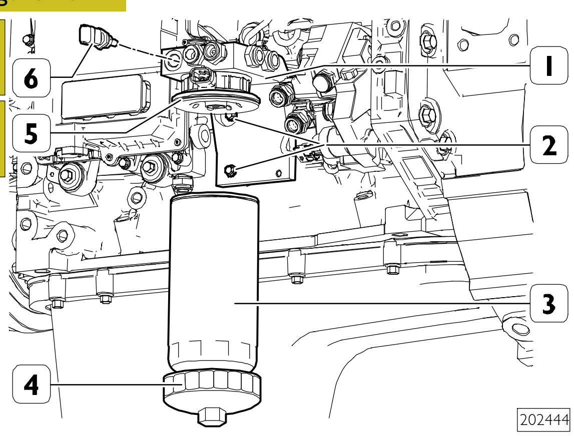


- ❑ Remove the excess fuel return pipe (1) from the Common Rail.
- ❑ Remove the fuel return pipe (3) for the injection pump (2).
- ❑ Remove the fuel delivery pipe (4) for the filter (5).
- ❑ Remove the fuel arrival pipe (6) for the injection pump (2).
- ❑ Remove the fuel returning pipe (7) from the injection pump (2) to the filter (5).
- ❑ Unscrew the Voss fitting (8).

Ref.	No.	Screws description
(8)	1	Connector M12x1.5

Fuel filter removal

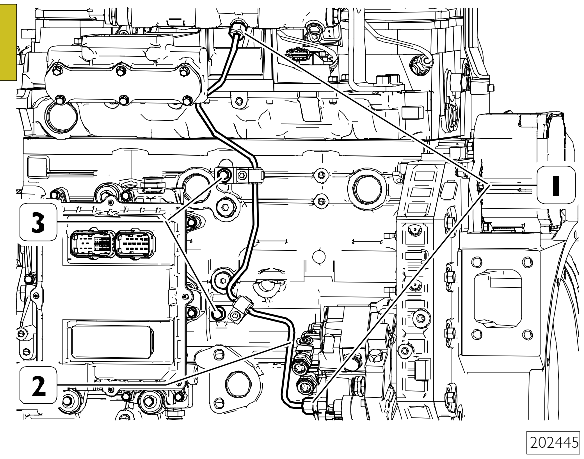
Figure 18



- ❑ Unscrew the fuel temperature sensor (6).
- ❑ Unscrew the cartridge (3) using tool 99360076 (4).
- ❑ Unscrew the screws (2).
- ❑ Remove the fuel filter support (1) together with the fuel preheating resistor (5).

Ref.	No.	Screws description
(2)	2	Screw M12x1.75
(3)	1	Cartridge M20x1.5
(6)	1	Sensor M14x1.5

Figure 19

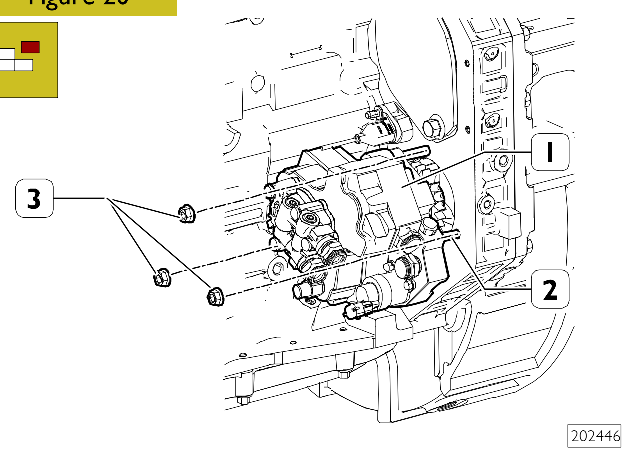


- ❑ Unscrew the unions (1).
- ❑ Unscrew the screws (3).
- ❑ Remove the Rail supply high pressure pipe (2).

Ref.	No.	Screws description
(1)	2	Connector M14x1.5
(3)	2	Screw M6x1x12

Feed pump removal

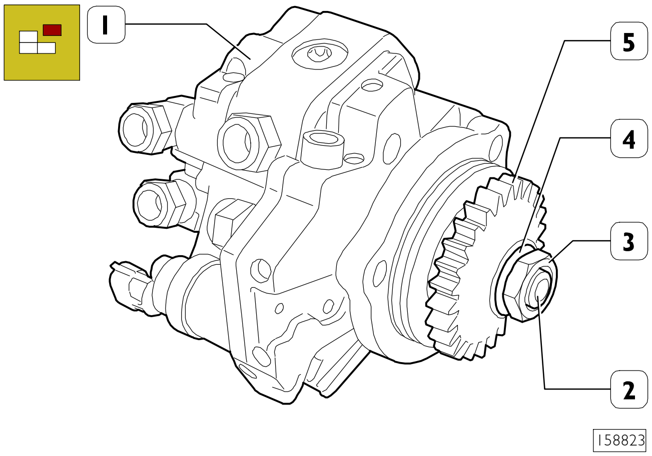
Figure 20



- ❑ Loosen the nuts (3).
- ❑ Remove the supply pump assembly (1).
- ❑ Unscrew the studs (2).

Ref.	No.	Screws description
(2)	3	Stud M8x1.25x5
(3)	3	Nut M8x1.25

Figure 21



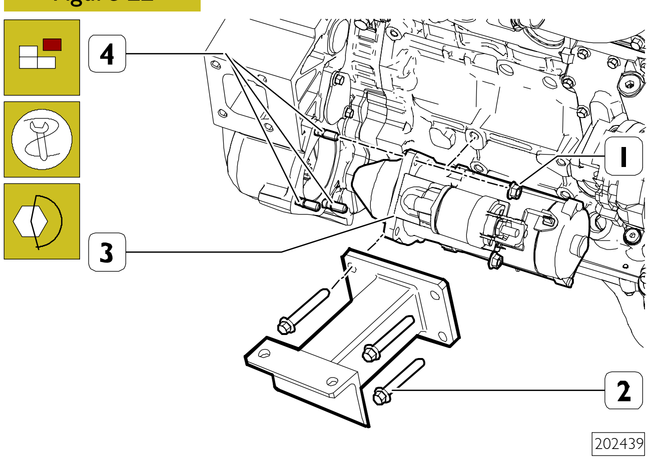
❑ Lock rotation of the high-pressure pump (1) drive shaft (2).

❑ Remove the nut (3) and the washer (4) using the double acting bridge 99341001, brackets 99341009 and clamp 99341015, remove the gear (5) from the shaft (2).

Ref.	No.	Screws description
(3)	1	Nut M18x15

Mounting brackets on rotating stand
Starter motor removal

Figure 22



❑ properly support the starter motor (3).

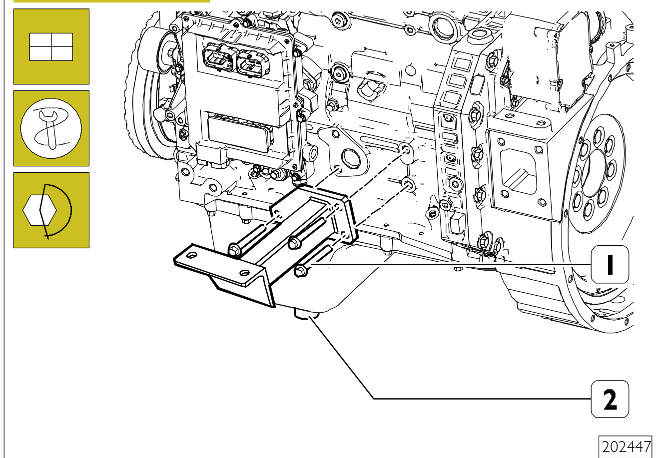
❑ Loosen the retaining nuts (1).

❑ Remove the starter motor (3) and unscrew the studs (4).

❑ Mount the support bracket 99361037 by inserting the screws (2) into the four threaded holes.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M10x1.5	-
(2)	4	Screw M12x1.75	43 ± 6 Nm
(4)	3	Stud M10x1.5x20	-

Figure 23



From the left side:

❑ connect the second bracket 99361037 by inserting the screws (1) into the threaded holes.

❑ Lift the engine with arm 99360595 and put it on the rotating stand 99322205.

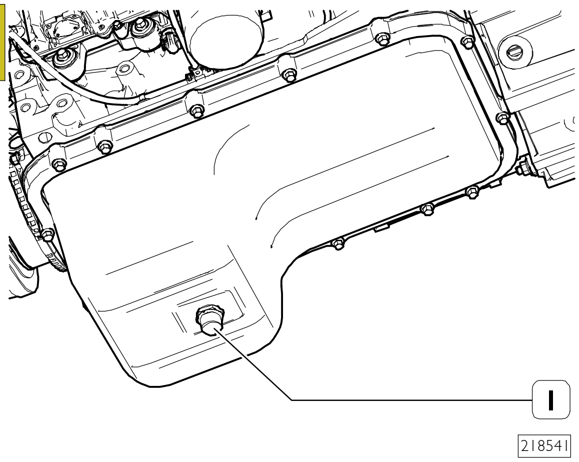
Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	43 ± 6 Nm

Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

Engine lubricant oil drainage

Figure 24



- Drain the oil through the plug (1) located below the oil sump.

The oil sump contains approximately 7.65 kg of engine oil.

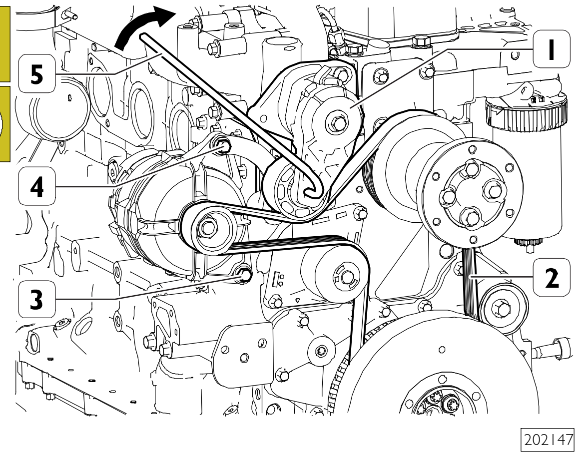
Collect and dispose of the engine oil according to applicable laws.

Ref.	No.	Screws description
(1)	1	Plug M18x1.5

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Alternator removal

Figure 25

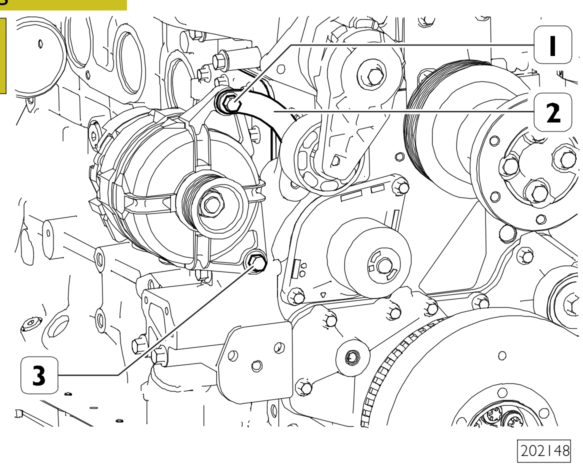


- Loosen the screw (3) anchoring the alternator to its lower support and the bolt (4) fixing the alternator to the bracket.

Ref.	No.	Screws description
(3)	1	Screw M10x1.5
(4)	1	Screw M10x1.5
(4)	1	Nut

- Use the special tool (5) to turn the automatic tensioner (1) in the direction of the arrow and remove the belt (2).

Figure 26



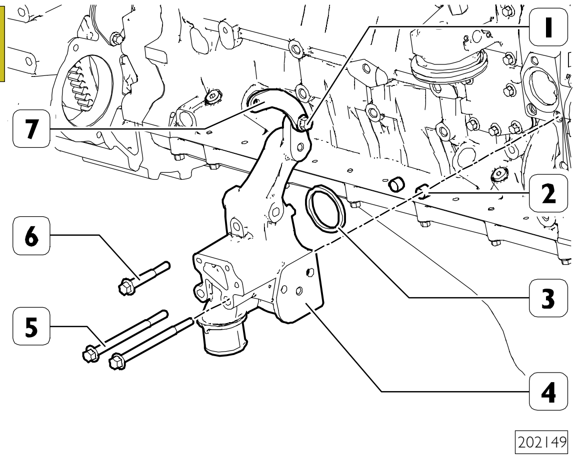
- Unscrew the screw (3) anchoring the alternator to its lower support and the screw (1) securing it to the bracket (2).

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(3)	1	Screw M10x1.5

- Remove the alternator from its housing.

Alternator mount removal

Figure 27

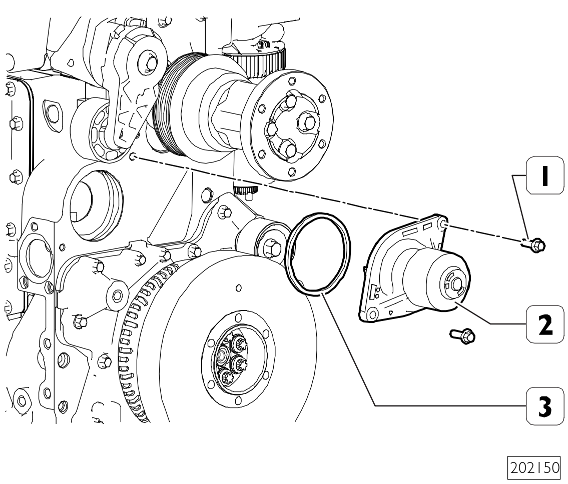


- ❑ Unscrew the screw (1) and remove the bracket (7).
- ❑ Unscrew the screws (5 and 6) and remove the alternator mount (4).
- ❑ Recover the gasket (3) and the cable reference dowel pins (2).

Ref.	No.	Screws description
(1)	1	Screw M10x1.5x20
(5)	2	Screw M10x1.5x135
(6)	1	Screw M10x1.5x70

Removal of water pump

Figure 28

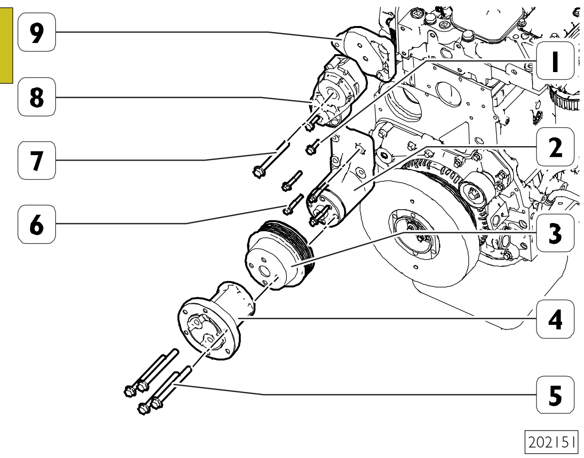


- ❑ Undo the screws (1) and remove them.
- ❑ Take the water pump (2) out of its housing.
- ❑ Recover the gasket (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x35

Removal of automatic belt tensioner and fan mount

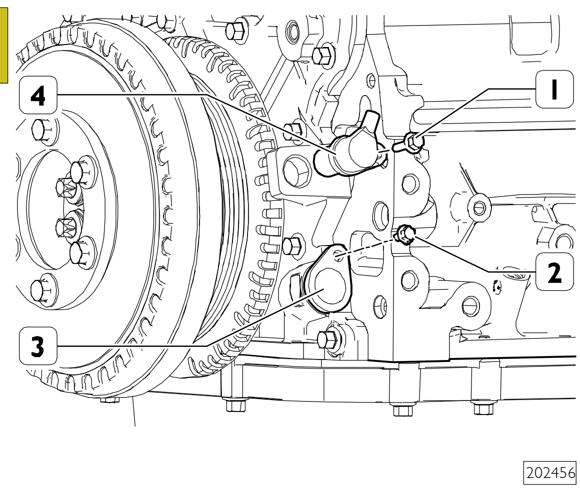
Figure 29



- ❑ Unscrew the screw (7) and remove the automatic belt tensioner (8).
- ❑ Unscrew the screws (1) and remove the belt tensioner mount (9).
- ❑ Unscrew the screws (5) and remove the spacer (4) for the fan coupling together with the drive pulley (3).
- ❑ Unscrew the screws (6) and remove the fan mount (2).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x30
(5)	4	Screw M10x1.5x110
(6)	4	Screw
(7)	1	Screw M10x1.5x70

Figure 30



- ❑ Unscrew the screw (1) and remove the crankshaft rpm sensor (4).
- ❑ Unscrew the screw (2) and remove the plug (3).

Ref.	No.	Screws description
(1)	1	Screw M6x1x20
(2)	1	Screw

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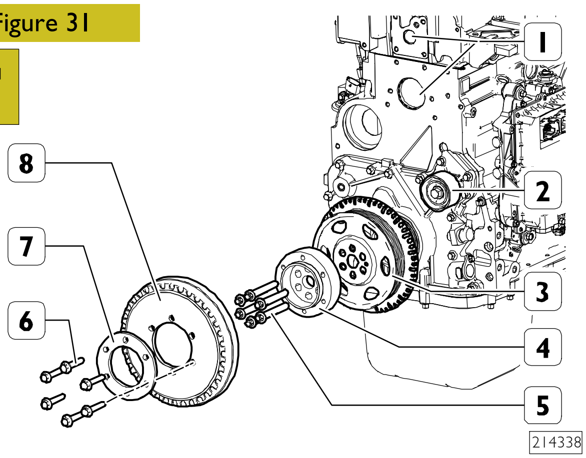
Removal of crankshaft pulley

Figure 31

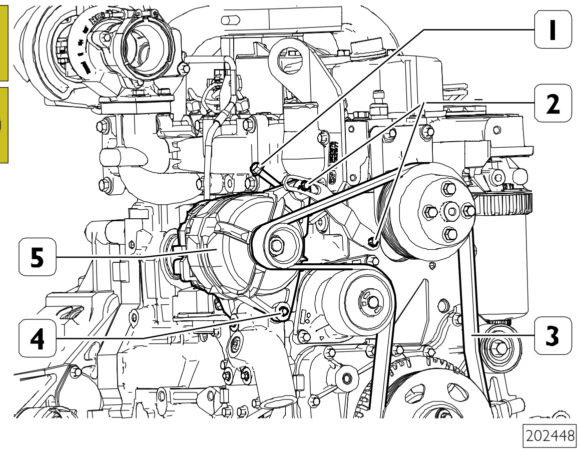


- ❑ Unscrew the screws (6) fixing the flange (7) to the front hub (8).
- ❑ Remove the front hub (8).
- ❑ Unscrew the screws (5).
- ❑ Remove the spacer (4) for the shaft and the pulley (3).
- ❑ Unscrew the screw (2) fixing the idler pulley.
- ❑ Remove the core plug (1).

Ref.	No.	Screws description
(2)	1	Screw M10x1.5
(5)	6	Screw M12x1.25x78.5
(6)	6	Screw M10x1.25x40

Alternator removal

Figure 32 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 17

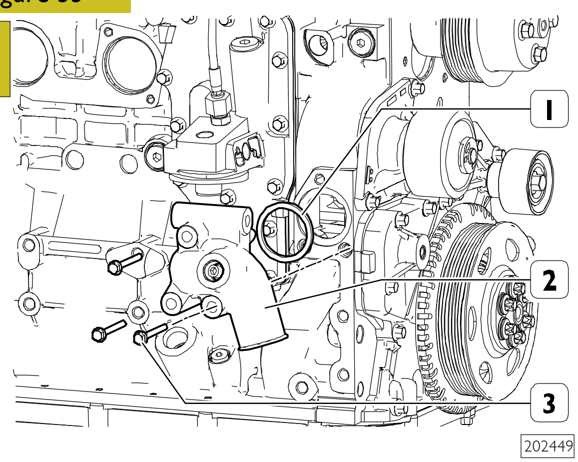
- ❑ Loosen the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.
- ❑ Remove the belt (3).
- ❑ Completely loosen the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.

Ref.	No.	Screws description
(1)	1	Screw M8x1.25x100
(2)	2	Screw M10x1.5x40
(4)	1	Screw M10x1.5x110

- ❑ Remove the alternator (5) from its housing.

Alternator mount removal

Figure 33

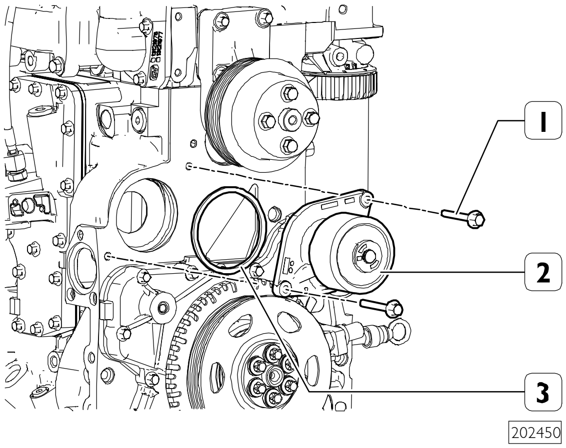


- ❑ Unscrew the screws (3).
- ❑ Remove the alternator mount (2).
- ❑ Recover the gasket (1).

Ref.	No.	Screws description
(3)	3	Screw M10x1.5x80

Removal of water pump

Figure 34

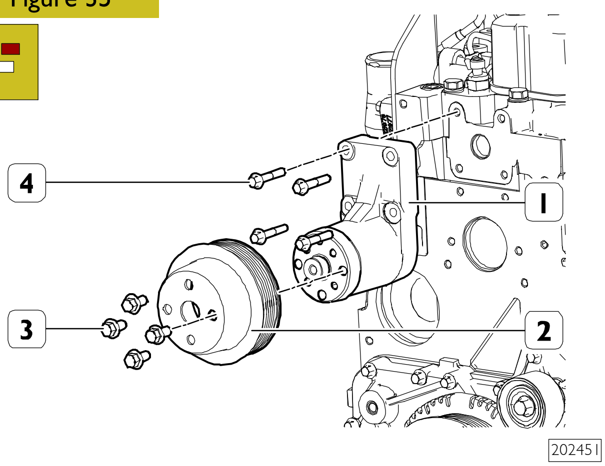


- ❑ Unscrew the screws (1).
- ❑ Remove the water pump (2) and recover the gasket (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x35

Fan mount removal

Figure 35



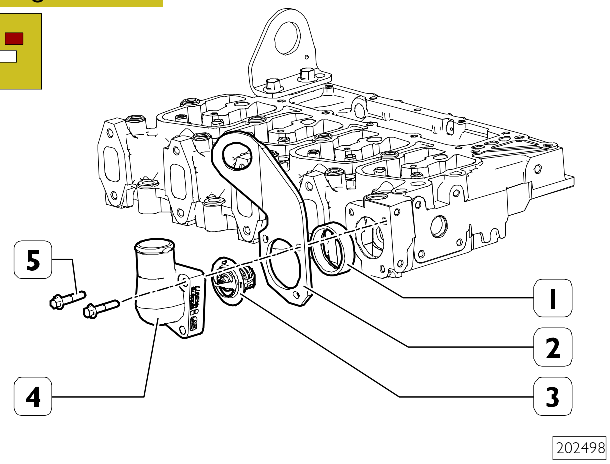
- ❑ Unscrew the screws (3) and remove the pulley (2).
- ❑ Unscrew the screws (4) and remove the fan mount (1).

Ref.	No.	Screws description
(3)	4	Screw M8x1.25x35
(4)	4	Screw M8x25

DISASSEMBLY OF ENGINE AT BENCH (SIDE COMPONENTS)

Thermostat removal

Figure 36



- ❑ Unscrew the screws (5) securing the thermostat cover (4).
- ❑ Remove the thermostat cover (4).
- ❑ Remove the thermostat assembly (3).
- ❑ Remove the lifting eyelet (2).
- ❑ Remove the gasket (1) of the cover.

Ref.	No.	Screws description
(5)	3	Screw M6x1

Prior to removing the cylinder head, fit the bracket into the original position and fasten it with the screws of the thermostat body.

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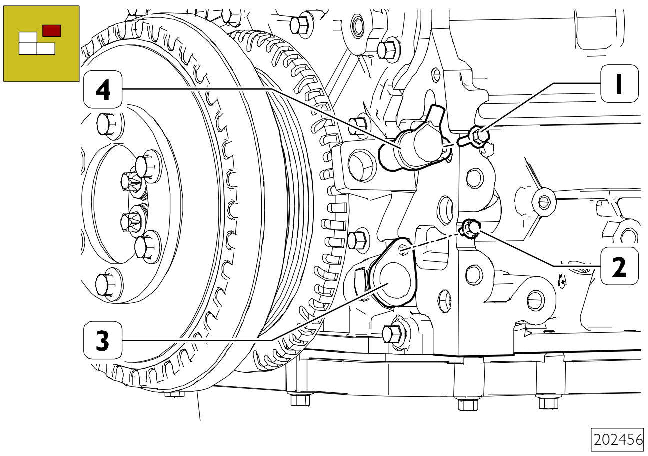
Figure 37



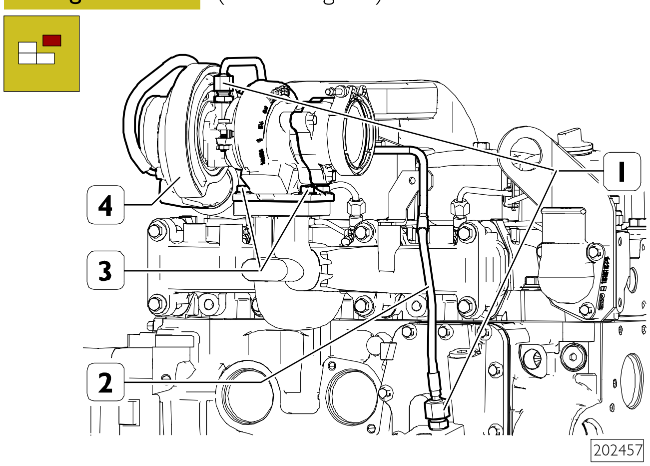
❑ Unscrew the screw (1) and remove the crankshaft rpm sensor (4).

❑ Unscrew the screw (2) and remove the plug (3).

Ref.	No.	Screws description
(1)	1	Screw M6x1x20
(2)	1	Screw

Turbocharger removal

Figure 38 (For all engines)



NOTE Before proceeding make sure that the turbocharger is disconnected from all of the engine air intake pipes and exhaust gas pipes.

❑ Unscrew the fittings (1) for the oil deliver pipe (2) to the turbocharger (4).

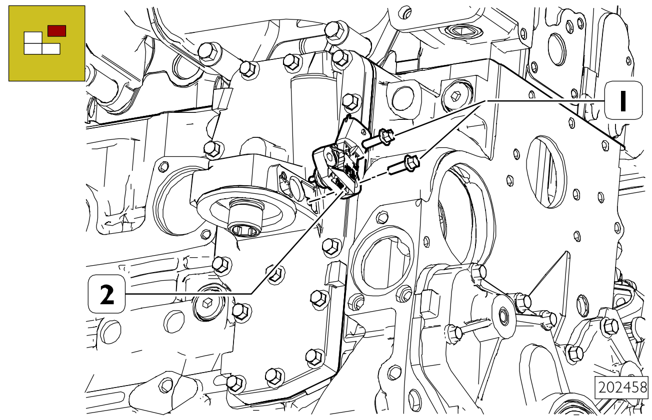
❑ Unscrew the nuts (3) and remove the turbocharger (4).

❑ Recover the gasket on the exhaust manifold.

Ref.	No.	Screws description
(1)	2	Fitting M10x1.25
(3)	4	Nut M8x1.25

Removal of heat exchanger

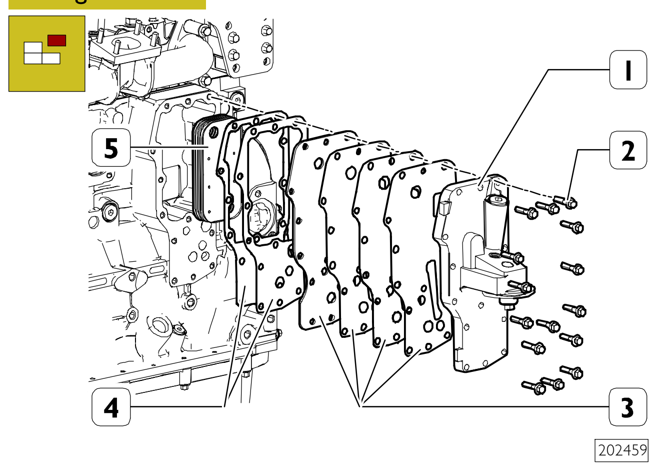
Figure 39



❑ Unscrew the screws (1) and remove the oil pressure/temperature sensor (2).

Ref.	No.	Screws description
(1)	2	Screw M6x1x20

Figure 40



❑ Unscrew the screws (2) and remove the oil filter support (1).

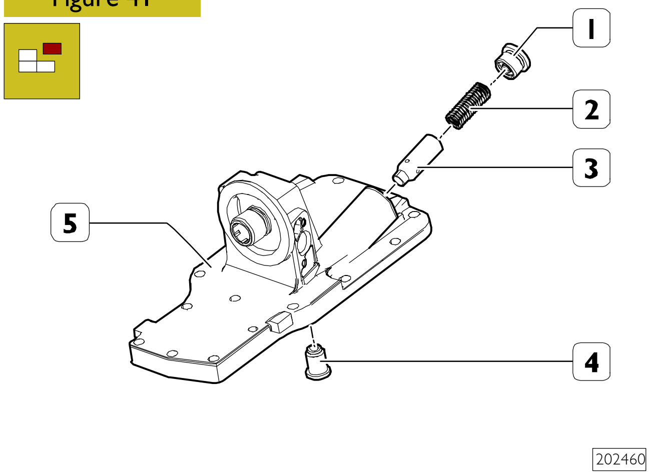
❑ Extract the insulating plates (3).

❑ Extract the heat exchange elements (5).

❑ Remove the two sealing gaskets (4).

Ref.	No.	Screws description
(2)	15	Screw M8x1.25x35

Figure 41



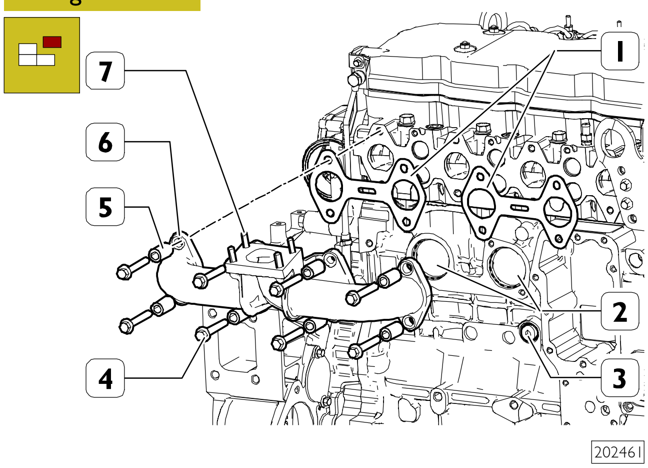
From the oil filter housing (5):

- ❑ remove the pressure control valve (4).
- ❑ unscrew the plug (1), remove the compression spring (2) and remove the pressure control valve (3).

Ref.	No.	Screws description
(1)	1	Plug M22x1.5

Exhaust manifold removal

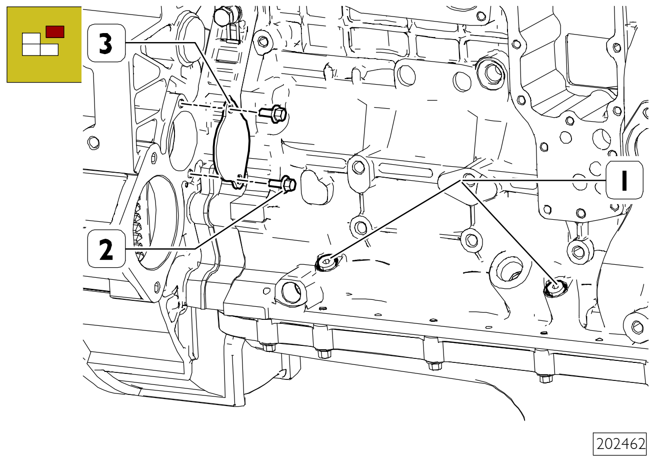
Figure 42



- ❑ Unscrew the screws (4) and recover the 8 spacers (5).
- ❑ Remove the exhaust manifold (6) and unscrew the turbocharger support studs (7).
- ❑ Recover the gaskets (1).
- ❑ Unscrew the plug (3) and recover the relative gaskets.
- ❑ Remove the core plugs (2).

Ref.	No.	Screws description
(3)	1	Plug M18x1.5
(4)	8	Screw M10x1.5x65
(7)	4	Stud M8x1.25x25

Figure 43



- ❑ Unscrew the plugs (1) and recover the relative gaskets.
- ❑ Unscrew the screws (2) and remove the inspection cover (3).

Ref.	No.	Screws description
(1)	2	Plug M12x1.5
(2)	2	Screw M8x1.25x16

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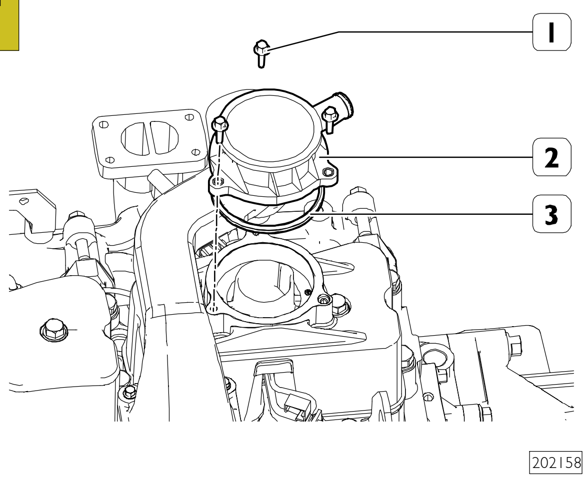
DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON UPPER SIDE)

Removal of oil vapour filter

Figure 44 NEF45 SM1F engine



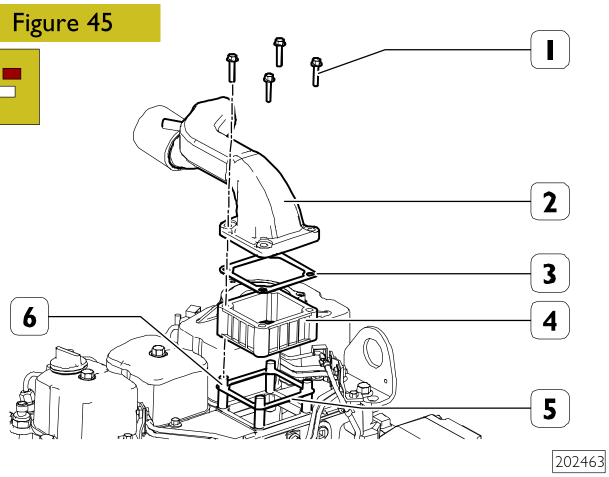
NEF45 TE1F/TE2F engine Page 23

- ❑ Unscrew the screws (1).
- ❑ Remove the oil vapour breather valve (2).
- ❑ Take out the gasket (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Intake elbow removal

Figure 45

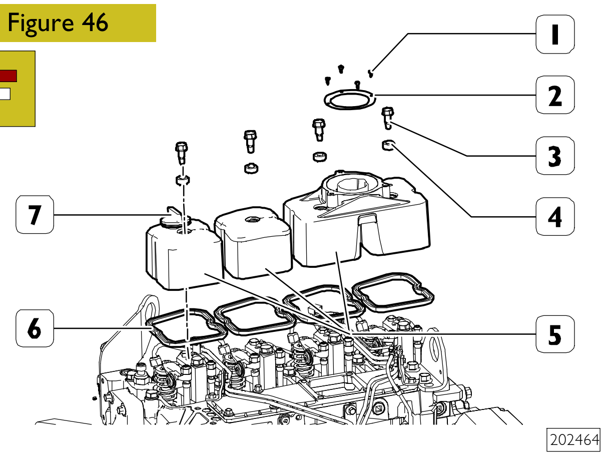


- ❑ Unscrew the screws (1).
- ❑ Disconnect the intake elbow (2).
- ❑ Recover the gasket (3).
- ❑ Remove the support (4) and recover the centring pins (6).
- ❑ Recover the gasket (5).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x80

Tappet cover removal

Figure 46

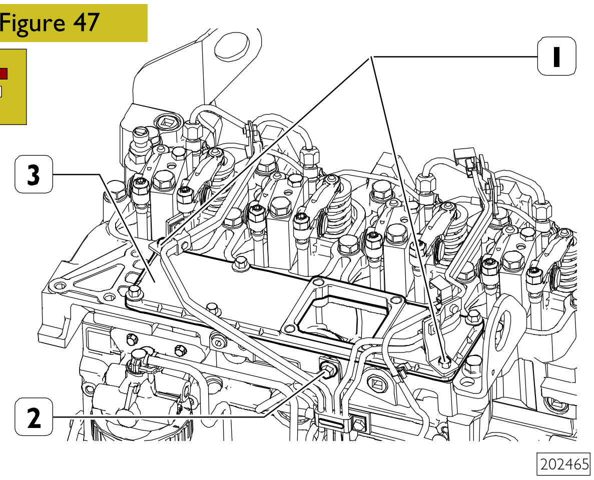


- ❑ Unscrew the screws (1).
- ❑ Remove the baffle (2).
- ❑ Unscrew the screws (3) securing the tappet covers (5).
- ❑ Recover the sound-proofing elements (4).
- ❑ Recover the oil filling plug (7).
- ❑ Remove the tappet covers (5).
- ❑ Recover the gaskets (6).

Ref.	No.	Screws description
(1)	4	Screw T 2.9x6.5 F
(3)	4	Screw M8x1.25

High pressure fuel pipe removal

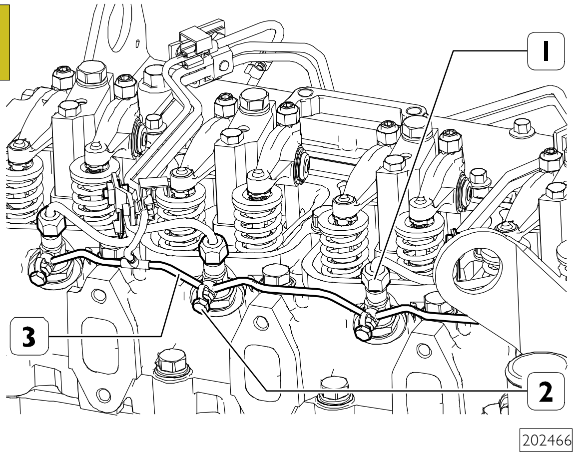
Figure 47



- ❑ Place a container for the fuel recovery.
- ❑ Unscrew the support bracket fastening screws (1) at the intake manifold (3).
- ❑ Unscrew the screw (2) securing the support plate.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x16
(2)	1	Screw M8x1.25x25

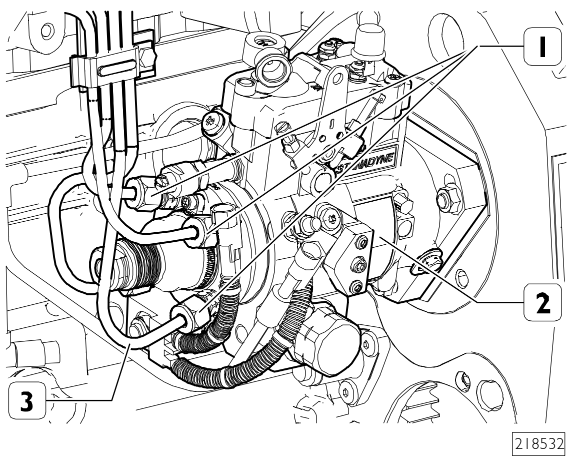
Figure 48



- ❑ Loosen the nuts (1).
- ❑ Unscrew the unions (2).
- ❑ Remove the injector exhaust pipe (3).

Ref.	No.	Screws description
(1)	4	Nut
(2)	4	M6x1x9 fitting

Figure 49



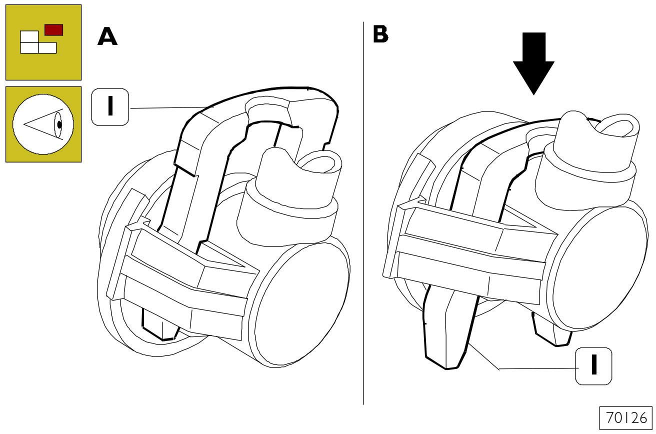
- ❑ Unscrew the fittings (1) connecting to the injection pump (2).
- ❑ Remove the high pressure pipes (3).

Ref.	No.	Screws description
(1)	4	Nut

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Low pressure fuel pipe removal

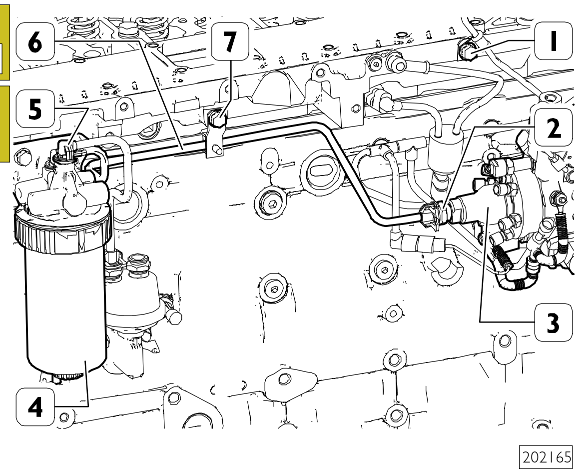
Figure 50



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Figure 51



- ❑ Unscrew the screws (1 and 7) fixing the support brackets
- ❑ Disconnect the clip (2) from the injection pump (3).
- ❑ Take out the quick-fit couplings (5) on the fuel filter (4) and remove the pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M8x16
(2)	1	Nut
(7)	1	Screw M8x16

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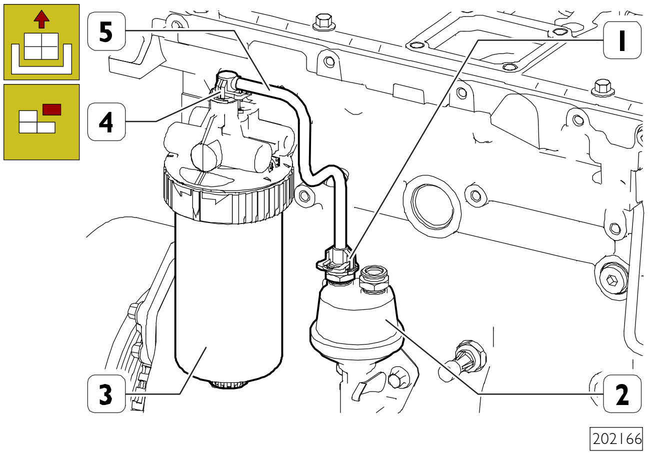
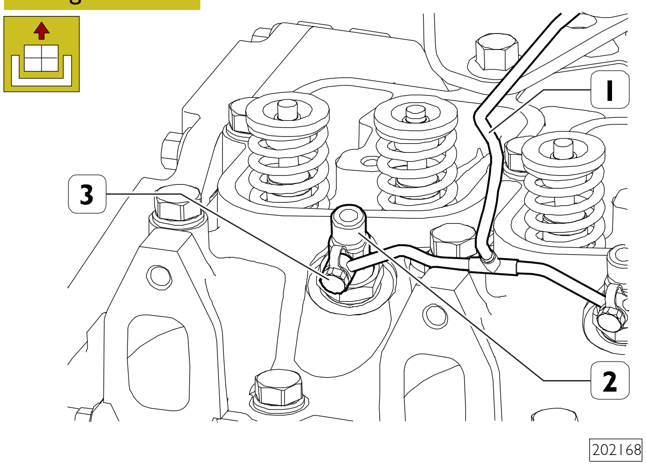
Figure 52



- Unscrew the connector (1) on the priming pump (2).
- Take out the quick-fit coupling (4) on the fuel filter (3).
- Remove the pipe (5).

Ref.	No.	Screws description
(1)	1	Nut M12x1.5

Figure 53

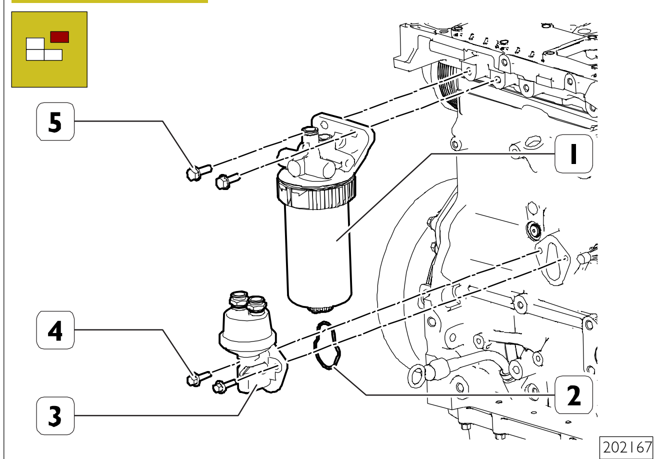


- Disconnect the 4 threaded fittings (3) passing through the injectors (2).
- Remove the exhaust pipes (1) from the injectors (2).

Ref.	No.	Screws description
(3)	4	Nut M6x1x10

Removal of fuel filter and priming pump

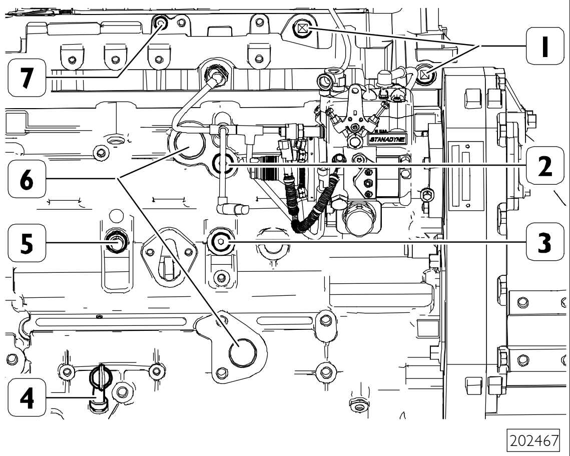
Figure 54



- Unscrew the screws (5) securing to the crankcase
- Remove the fuel filter (1) together with the support and the filtering cartridge.
- Unscrew the screws (4).
- Remove the priming pump (3) and recover the gasket (2).

Ref.	No.	Screws description
(4)	2	Screw M8x1.25x25
(5)	2	Screw M8x1.25x25

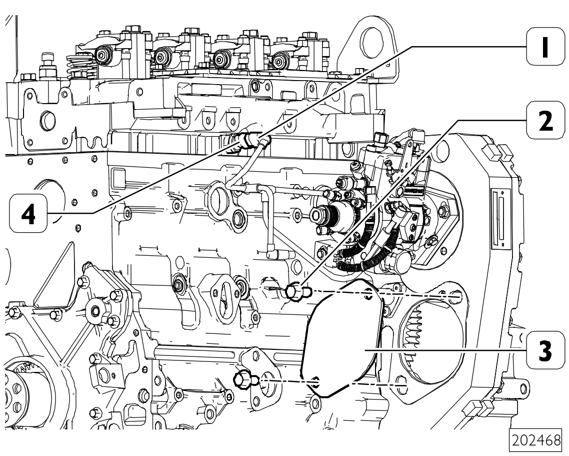
Figure 55



- ❑ Unscrew the threaded plugs (1) on the ducts for water delivery to the heater.
- ❑ Unscrew the threaded plugs (2 and 3).
- ❑ Pull out the oil level dipstick (4).
- ❑ Unscrew the oil pressure sensor (5).
- ❑ Remove the core plugs (6).
- ❑ Unscrew the threaded plug (7).

Ref.	No.	Screws description
(1)	2	Plug 3/4"
(2)	1	Plug 1/4"
(3)	1	Plug M14x1.5
(5)	1	Sensor M10x1
(7)	1	Plug M10x1

Figure 56



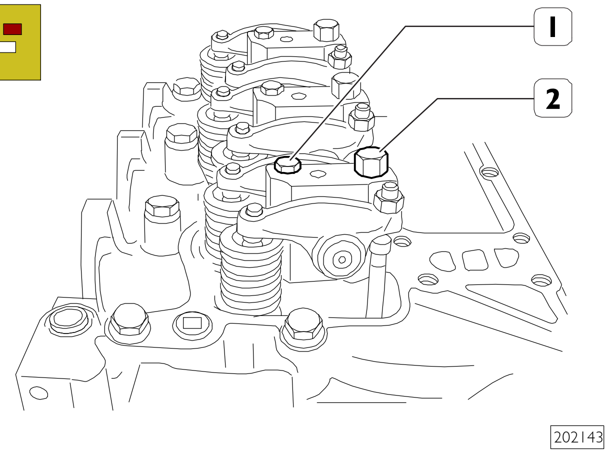
- ❑ Disconnect the connection (1).
- ❑ Disconnect all the electrical connections to the feed pump.
- ❑ Unscrew the water temperature sensor (4).
- ❑ Unscrew the screws (2) and remove the cover (3).

Ref.	No.	Screws description
(2)	2	Screw M12x1.75x25
(4)	1	Sensor 1/2 x14"

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON UPPER SIDE)

Rocker assembly removal

Figure 57

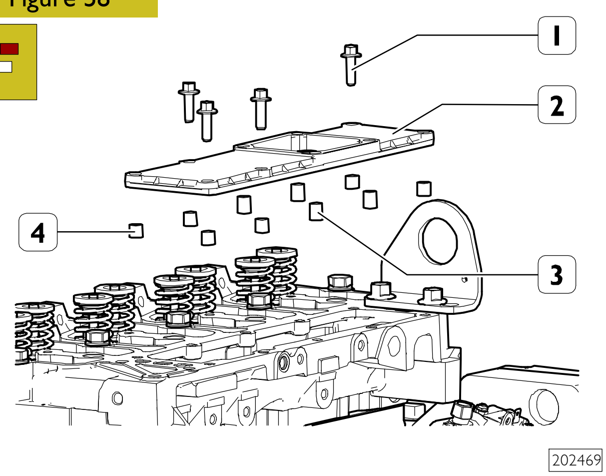


- ❑ Disassemble the rocker arm mounts:
- ❑ unscrew the two fastening screws (1 and 2) and disassemble the mount together with the rocker arms; remove the push rods.
- ❑ Repeat the operation for the remaining rocker arm mounts.

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x75
(2)	4	Screw M12x1.75x180

Intake manifold removal

Figure 58

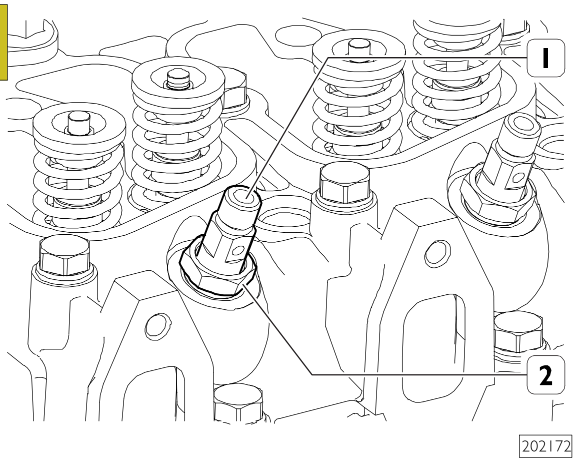


- ❑ Unscrew the screws (1).
- ❑ Remove the intake manifold (2).
- ❑ Extract the 4 smooth bushings [h = 14 mm] (3) in correspondence with the intake duct.
- ❑ Extract the 6 smooth bushings [h = 11 mm] (4).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x25

Injector removal

Figure 59

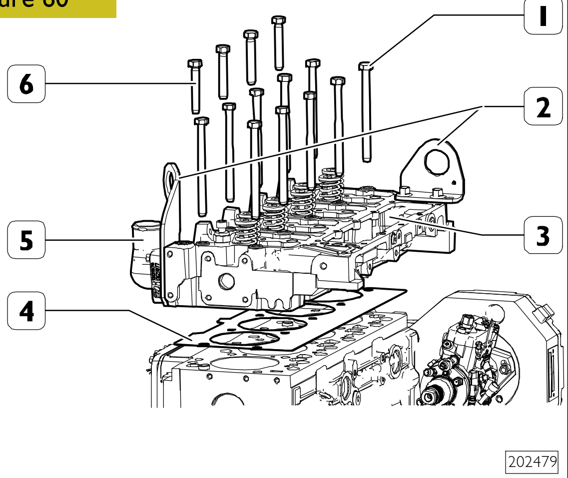


- ❑ Unscrew the ring nut (2) securing the injector (1).
- ❑ Extract the injector (1), together with the ring nut (2).

Ref.	No.	Screws description
(2)	4	Ring nut M24x1.5

Cylinder head removal

Figure 60



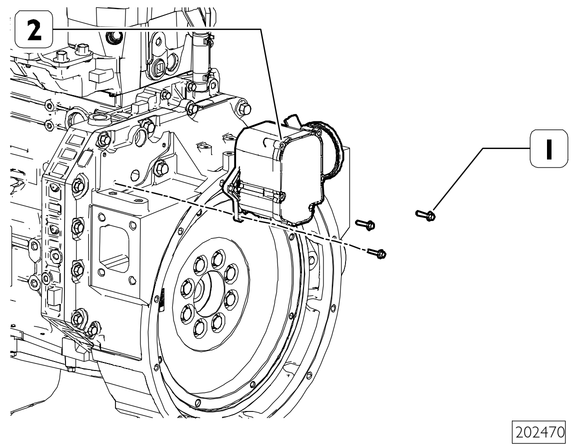
- ❑ Unscrew the screws (1 and 5).
- ❑ Using tool 99360595, by means of the lifting eyelets (2), remove the cylinder head (3) together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (4).

Ref.	No.	Screws description
(1)	10	Screw M12x1.75x140
(5)	4	Screw M12x1.75x70

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON UPPER SIDE)

Removal of oil vapour filter

Figure 61 NEF45 TE1F/TE2F engine

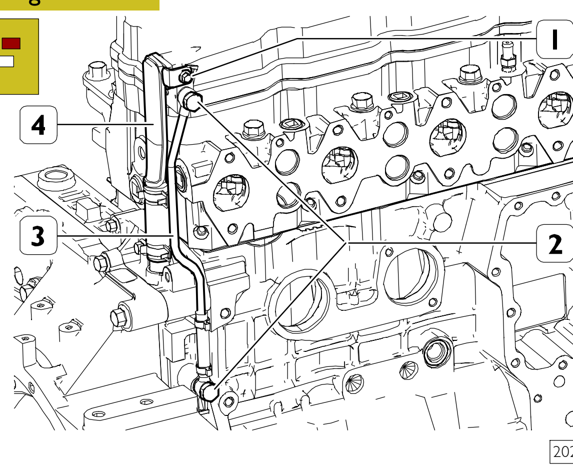


☞ NEF45 SM1F engine Page 27

- ❑ Unscrew the screws (1) securing the oil vapour filter (2).
- ❑ Remove the filter (2).

Ref.	No.	Screws description
(1)	3	Screw M6x1x25

Figure 62

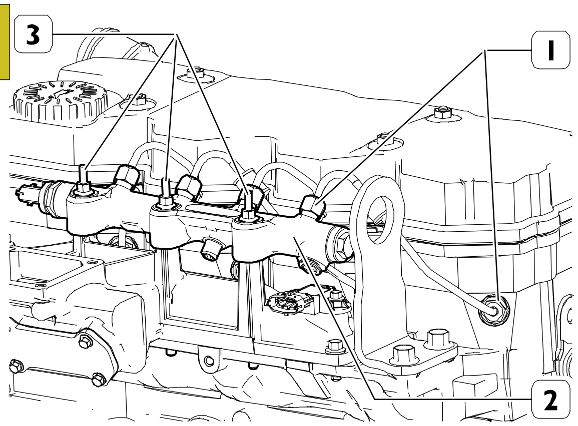


- ❑ Unscrew the support screw (1) from the clamp.
- ❑ Remove the engine breather pipe (4).
- ❑ Unscrew the threaded couplings (2) and remove the pipe (3).

Ref.	No.	Screws description
(1)	1	Screw M6x1
(2)	2	Coupling M12x1.5x11

Common Rail removal

Figure 63



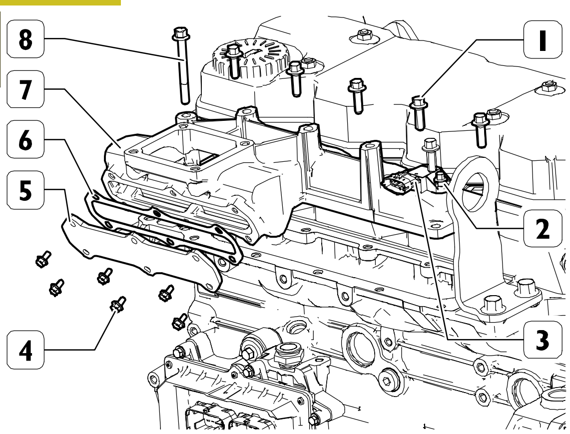
202473

- ❑ Unscrew the nuts (1) connecting the high pressure pipes to the Common Rail (2).
- ❑ Unscrew the threaded double action screws (3) and remove the Common Rail (2).

Ref.	No.	Screws description
(1)	8	Nut M14x1.5
(3)	3	Screw M8x1.25x125

Intake manifold removal

Figure 64



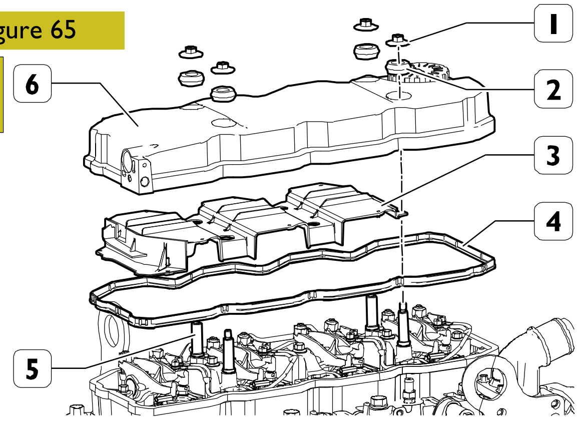
202474

- ❑ Unscrew the screw (2) and remove the air pressure and temperature sensor (3).
- ❑ Unscrew the screws (4) and remove the cover (5).
- ❑ Recover the gasket (6).
- ❑ Unscrew the screws (1 and 8) and remove the intake manifold (7).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25
(2)	1	Screw M6x1x20
(4)	6	Screw M6x1x20
(8)	1	Screw M8x1.25x70

Tappet cover removal

Figure 65



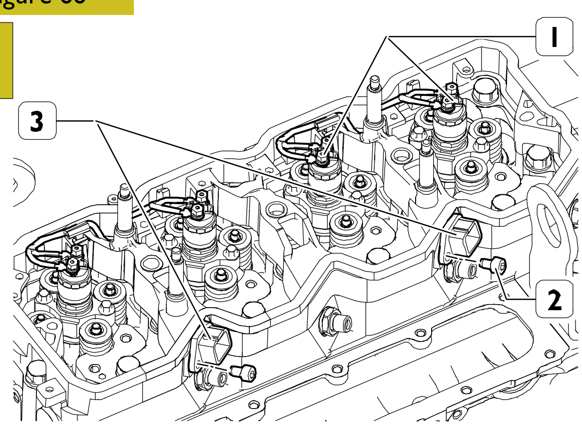
202472

- ❑ Unscrew the flanged nuts (1) and remove the elastic plugs (2).
- ❑ Remove the tappet covers (6).
- ❑ Recover the oil vapour condensation sector (3).
- ❑ Recover the gasket (4).
- ❑ Unscrew the double stem screws (5).

Ref.	No.	Screws description
(1)	4	Nut M8x1.25
(5)	4	Screw M8x1.25x17

Rocker assembly removal

Figure 66

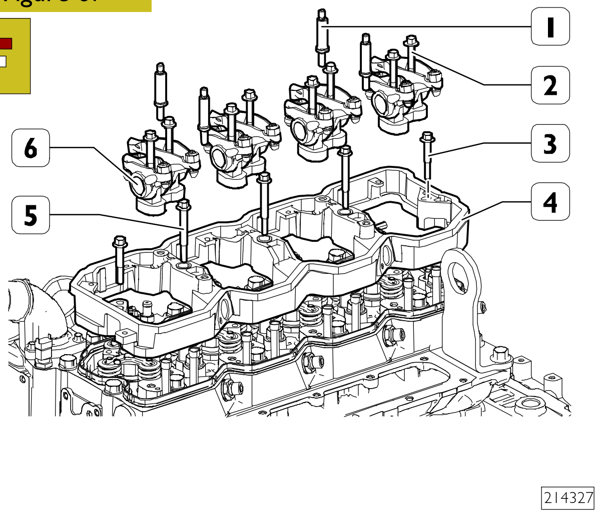


202475

- ❑ Unscrew the screws (2) and remove the connectors (3) on the electro-injectors.
- ❑ Loosen the nuts (1) on the electro-injectors.

Ref.	No.	Screws description
(1)	8	M4 nut
(2)	2	Screw M6x1x16

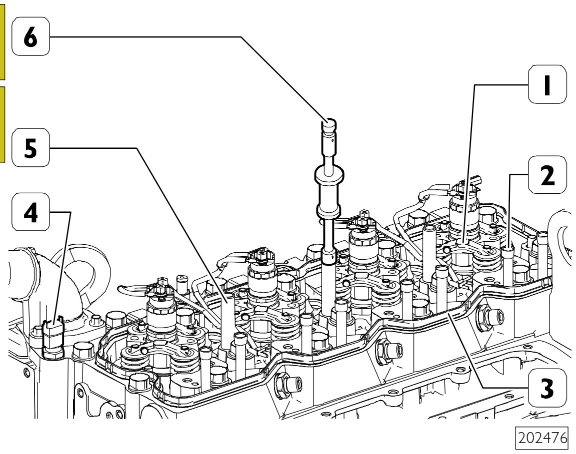
Figure 67



- Unscrew the double stem screws (1).
- Unscrew the screws (2) and remove the rocker arm unit (6).
- Unscrew the screws (3 and 5).
- Remove the housing (4).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x20
(2)	8	Screw M8x1.25x55
(3)	2	Screw M8x1.25x50
(5)	3	Screw M8x1.25x70

Figure 68

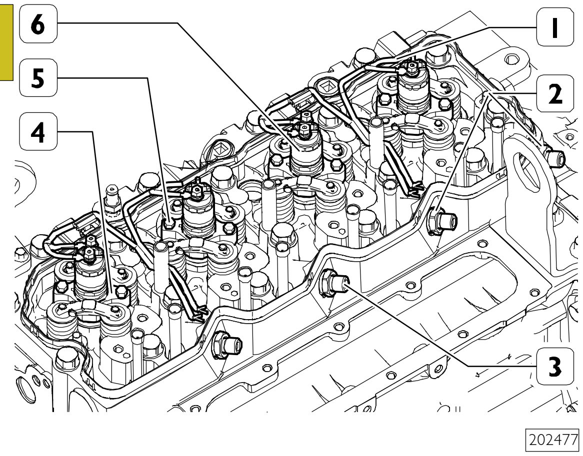


- Remove the rocker arm control rods (2) together with the housing seats and the balls.
- Remove the gasket (3).
- Remove the intake and exhaust crossbars (1).
- Remove the sheaths (5) using tool 99340205 (6).
- Unscrew the coolant temperature sensor (4).

Ref.	No.	Screws description
(4)	1	Sensor M14x1.5

Electro-injector removal

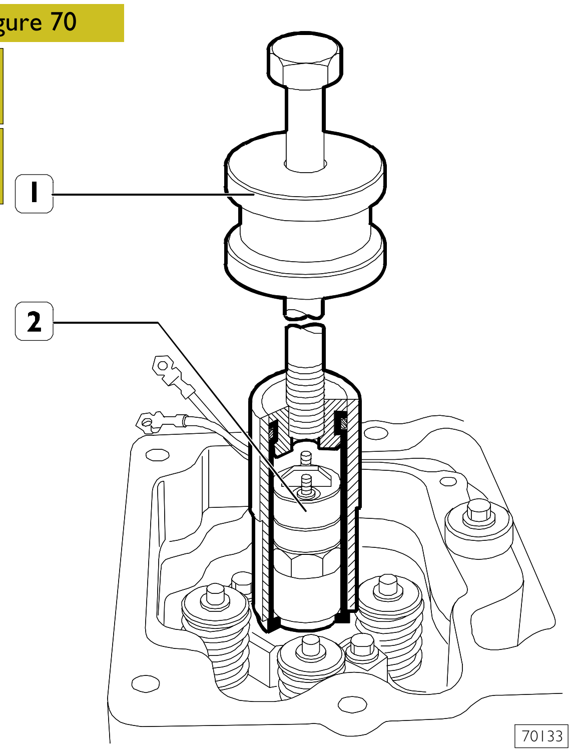
Figure 69



- Unscrew the ring nuts (2) and remove the unions (3).
- Disconnect the engine cable (1) from the injectors.
- Unscrew the screws (5) and remove the brackets (4) fixing the injectors (6).

Ref.	No.	Screws description
(1)	8	M4 nut
(2)	4	Ring nut M22x1.5
(5)	8	Screw M6x1x35

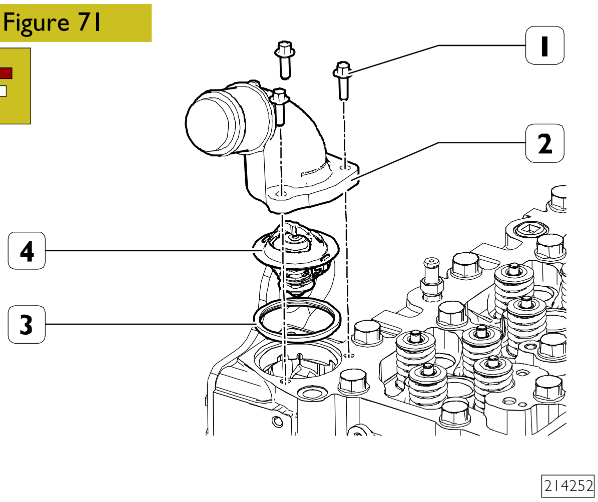
Figure 70



- Extract the electro-injectors (2) from the cylinder heads with tool 99342101 (1).

Thermostat unit removal

Figure 71

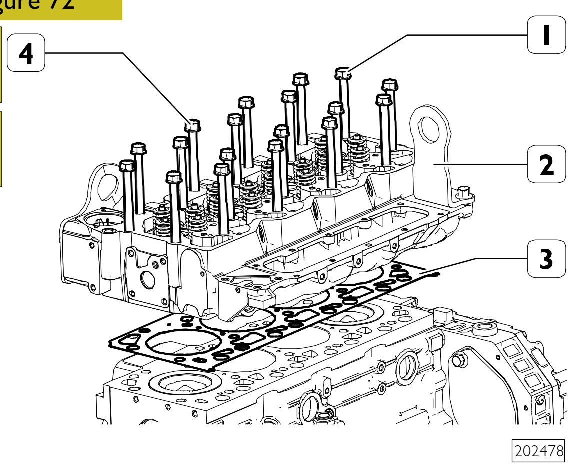


- Unscrew the screws (1) securing the thermostat cover (2).
- Remove the thermostat cover (2).
- Remove the thermostat assembly (4).
- Remove the gasket (3) of the cover.

Ref.	No.	Screws description
(1)	3	Screw M6x1

Cylinder head removal

Figure 72



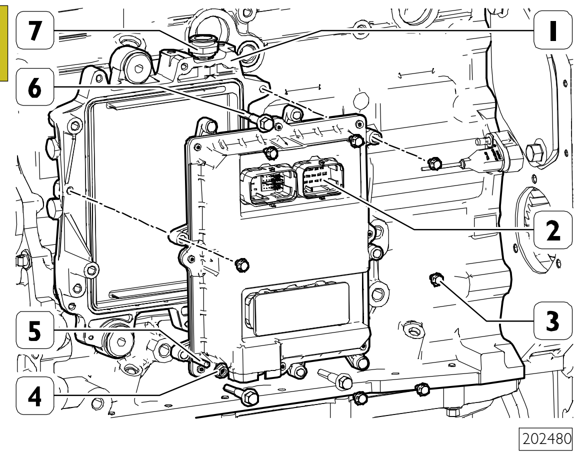
- Unscrew the screws (1 and 4).
- Using tool 99360595, by means of the lifting eyelets (2), remove the cylinder head together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- Recover the gasket (3).

Ref.	No.	Screws description
(1)	10	Screw M12x1.75x150
(4)	8	Screw M12x1.75x130

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Electronic Control Unit Removal

Figure 73



- Unscrew the screws (3 and 6).
- Unscrew the nut (4) and the corresponding stud (5).
- Remove the control unit (2).
- Unscrew the Voss fitting (7).
- Remove the support (1).

Ref.	No.	Screws description
(3)	7	Screw M6x1x30
(4)	1	Nut M6x1
(5)	1	Stud M6x1x25
(6)	3	Screw M8x1.25x45
(7)	1	Connector M12x1.25

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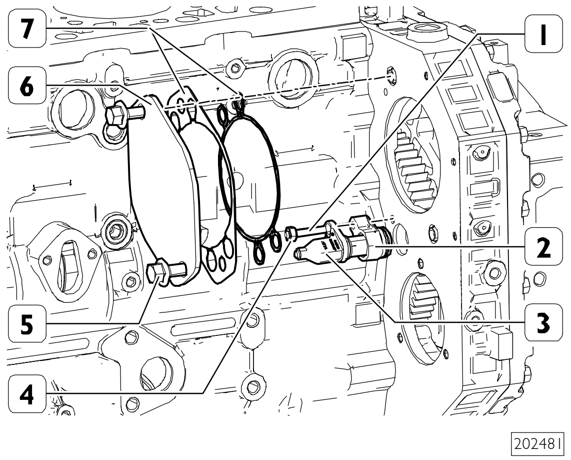
Figure 74



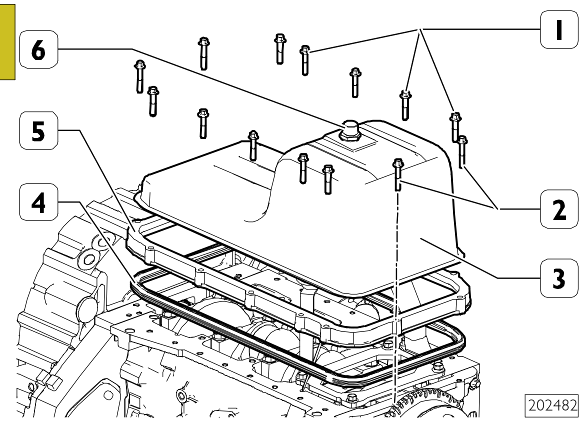
- Unscrew the screws (5) and remove the cover (6) from the control socket.
- Recover the gaskets (7).
- Unscrew the nut (4) and remove the camshaft rpm sensor (3).
- Unscrew the stud (1) and remove the support (2).

Ref.	No.	Screws description
(1)	1	Stud M6x1x30
(4)	1	Nut M6x1
(5)	2	Screw. M12x25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Oil sump removal

Figure 75 (For all engines)

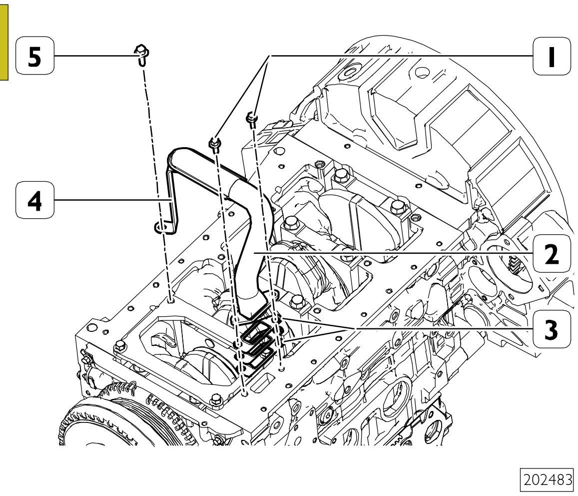


- Overturn the engine.
- Unscrew the screws (1 and 2) fixing the oil sump (3).
- Remove the oil sump (3).
- Remove the spacer (5) and the gasket (4).

Ref.	No.	Screws description
(1)	10	Screw M8x1.25x40
(2)	4	Screw M8x1.25x45

Suction strainer removal

Figure 76

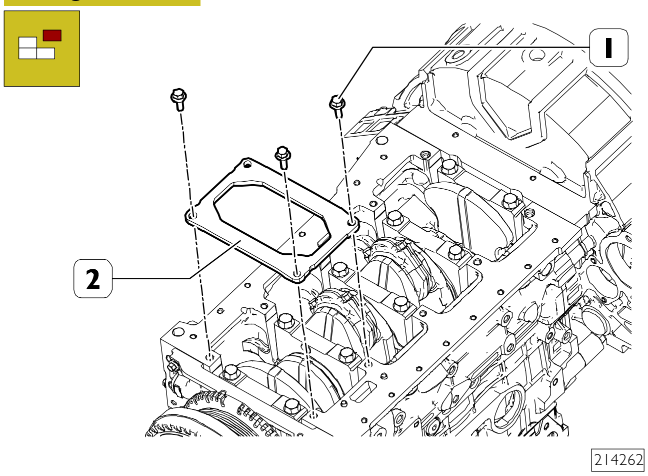


- Unscrew the screws (1 and 5).
- Remove the suction strainer (2) together with the support strap (4).
- Recover the gaskets (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x20
(5)	1	Screw M10x1.5x25

Sound-proofing plate removal

Figure 77

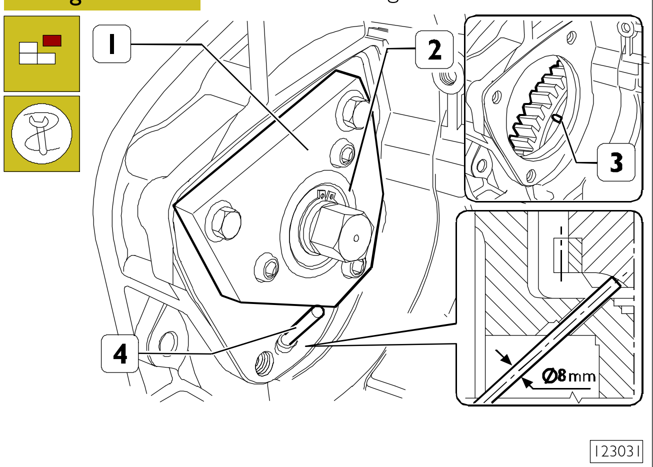


- ❑ Unscrew the screws (1).
- ❑ Remove the sound-proofing plate (2).
- ❑ Overturn the engine.

Ref.	No.	Screws description
(1)	3	Screw M10x1.5x25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Figure 78 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 33

Fit the tool 99360339 (1) in the starter motor seat to turn the flywheel.

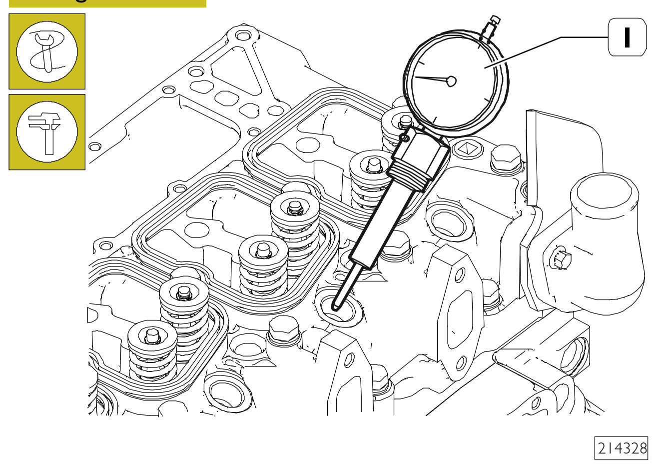
If it is necessary to replace the feed pump, this spare is supplied preset.

If however the pump needs to be disassembled and refitted without having undergone any repair interventions, preset it while it is still fitted on the engine and only then remove it.

The following procedure refers to the second possibility as this is the more complex one.

Identifying top dead centre with tool (99395097) - False injector

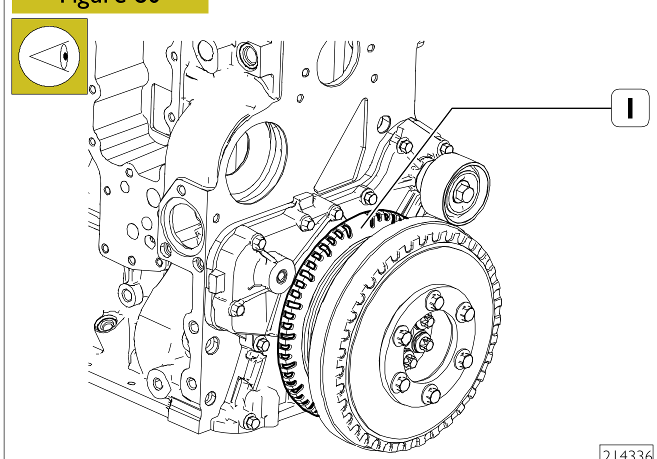
Figure 79



To search for the position of 1st cylinder at top dead, end of compression stroke, remove the rocker arm cover of the 1st cylinder, remove the 1st injector and position the tool (99395097 (1). Pre-load the dial gauge 99395604.

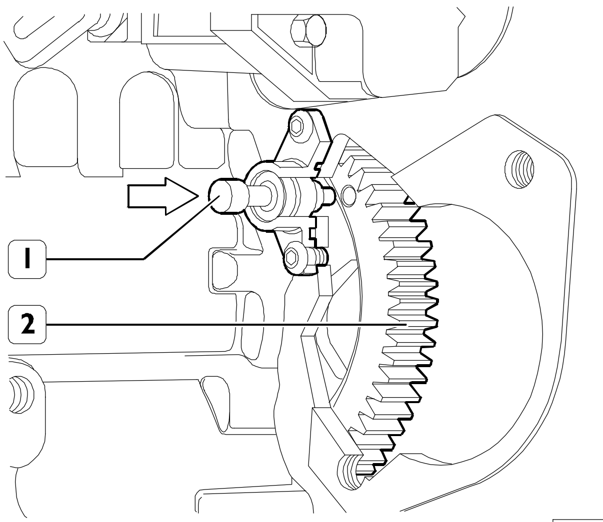
The required condition is obtained by turning the crankshaft appropriately until the maximum value appears on the dial gauge and making sure that the intake and exhaust valves are both closed.

Figure 80



- ❑ Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 81

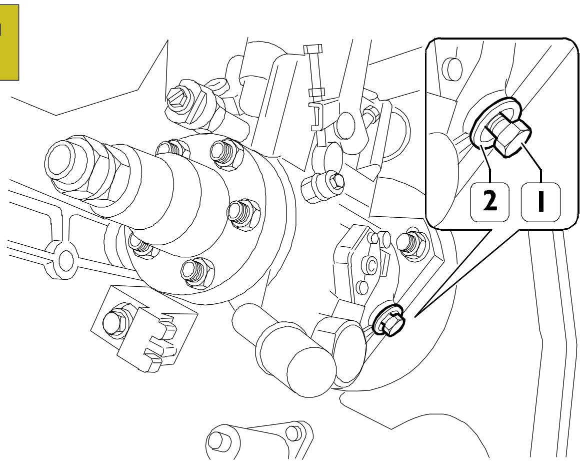


84071

Rotate the flywheel until it pushes the pin 99360616 (1), this will not block the gear (2), obtaining the TDC of the 1st cylinder.

Injection pump removal

Figure 82



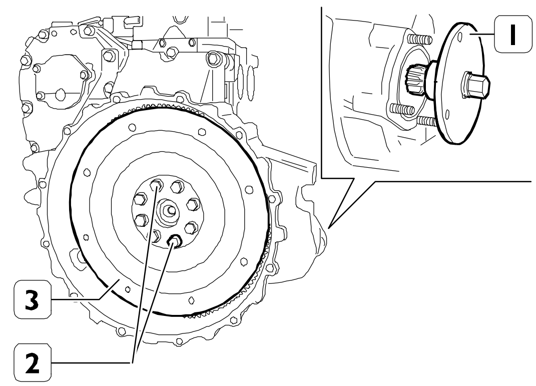
106659

- ❑ Partially unscrew the screw (1) locking the pump spindle and move the spacer with the slot (2) to the largest part of the hole to allow the screw to fit in completely.
- ❑ Apply a torque of between 11.9 and 12.4 Nm to tighten the locking screw (1) flush with the spacer locking the pump spindle rotation.

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Removal of engine flywheel

Figure 83

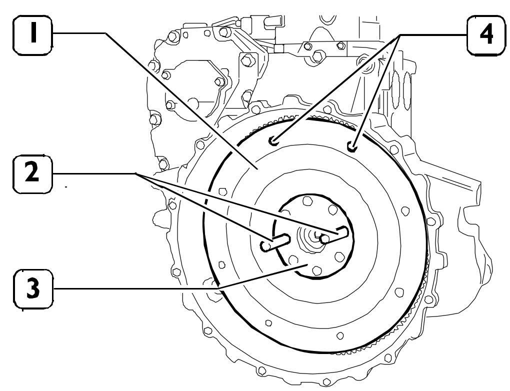


202265

- ❑ Unscrew the two opposing screws (2) where the extraction pins will be inserted (see following figure).
- ❑ Unscrew the remaining screws fixing the flywheel (3) from the crankshaft.
- ❑ Remove the flywheel locking tool (1) 99360339.

Ref.	No.	Screws description
(2)	8	Screw M12x1.25x30

Figure 84

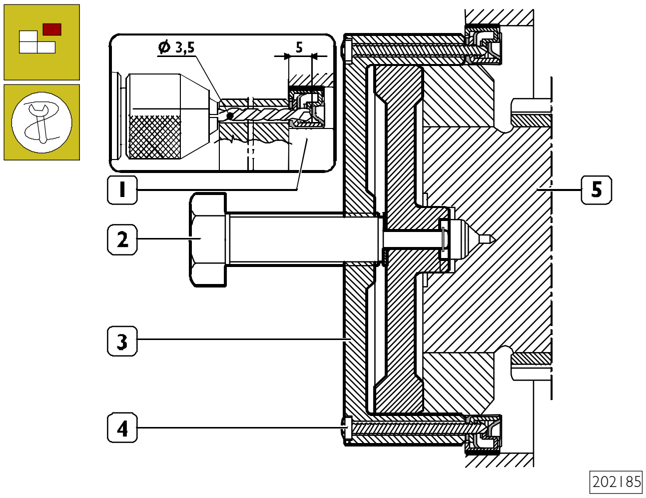


202258

- ❑ Screw in two screws of average length into the holes (4) to sling the flywheel with a hoist.
- ❑ Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) out with the help of the hoist.

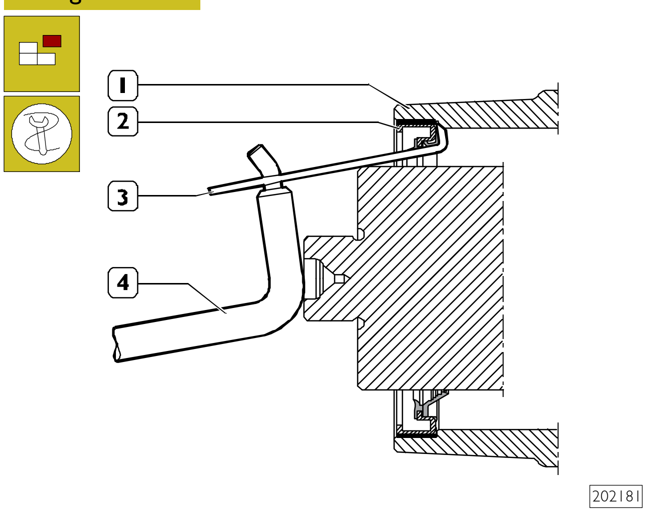
Removal of flywheel cover housing sealing ring

Figure 85



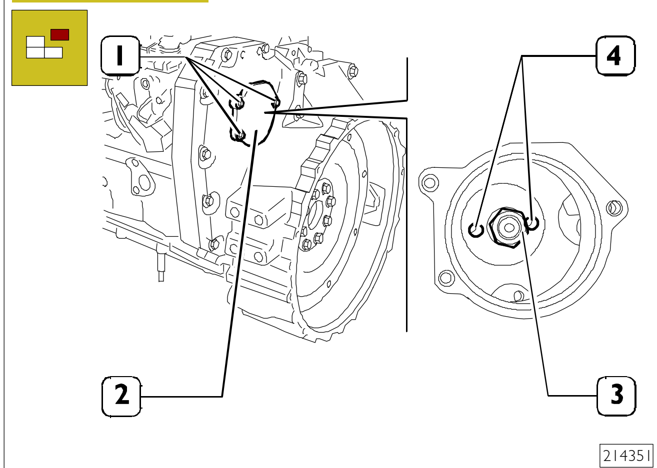
- Take out the flywheel housing seal ring applying tool 99340056 (3) onto the rear tang (5) of the crankshaft.
- Through the guiding holes of the tool itself, drill the internal seal ring with a bit (Ø 3.5 mm) to a depth of 5 mm.
- Secure tool 99340056 (3) to the ring (1) screwing in the 6 screws (4) supplied.
- Remove the ring (1) by screwing up the screw (2).

Figure 86



- Using an appropriate tie rod of tool 99363204 and a lever, take out the external seal ring from the flywheel housing

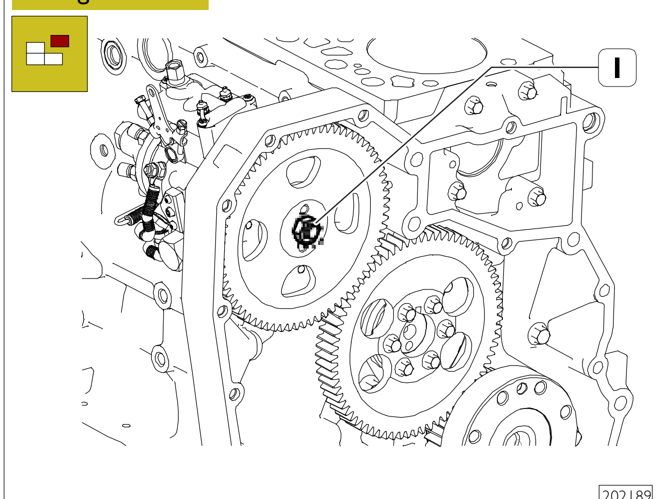
Figure 87



- On the timing gear side, remove the small cover (2) unscrewing the screws (1) so as to access the nut (3) securing the pump drive gear.
- Unscrew the nut (3) and recover the relative washer.

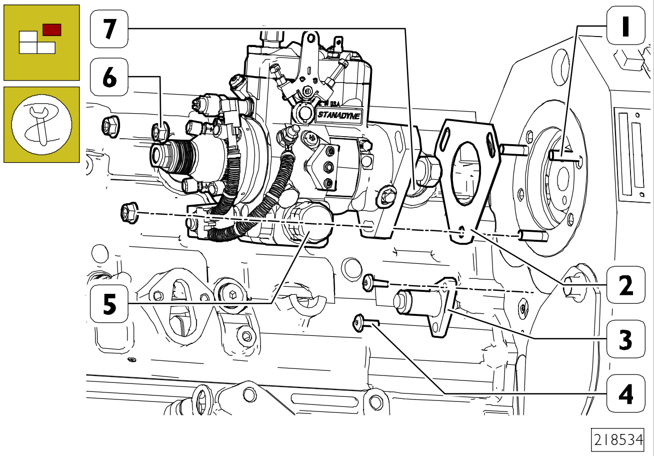
Ref.	No.	Screws description
(1)	3	Screw M8x1.25x20
(3)	1	Nut M14x1.5

Figure 88



- On the side of the timing gear, unscrew the nut (1) and recover the relative washer.

Figure 89



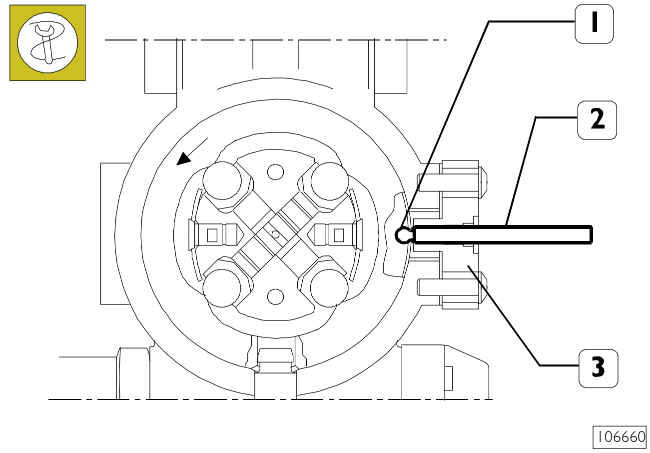
- From the side of the pump (5), loosen the fastening nuts (6) without removing them in order to allow the pump (5) to move backwards when the extractor 99340035 operates.
- Fit the extractor 99340035 using the two threaded holes and detach the gear from the pump spindle (5).
- Suitably support the feed pump (5) and unscrew the fastening nuts completely (6).
- Take the pump (5) off the studs (1) together with the gasket (2).
- Remove the core plug (7).
- Unscrew the screws (4) and remove the plate (3) together with the injection pump centring pin.

Ref.	No.	Screws description
(1)	3	Stud M8x1.25
(4)	2	Screw M5x0.8
(6)	3	Nut M8x1.25

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Check correct setting of rotating feed pump

Figure 90



1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

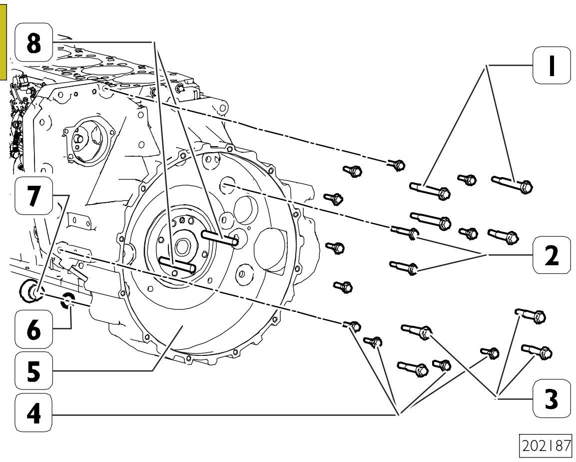
The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

Therefore:

- Remove the screw plug (3) at the centre of the plate.
- Insert synchronisation pin (1) 99365196 into the hole in the plate (3). The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.
- Lock the drive shaft in the correct position using the screw (1, Figure 82).
- Remove the synchronisation pin and fit the screw plug of the plate (3). Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

Removal of flywheel housing

Figure 91



❑ Unscrew the screws (1, 2, 3 and 4).

❑ Remove the male (7) and recover the gasket (6).

❑ Remove the 2 cable reference dowel pins (8).

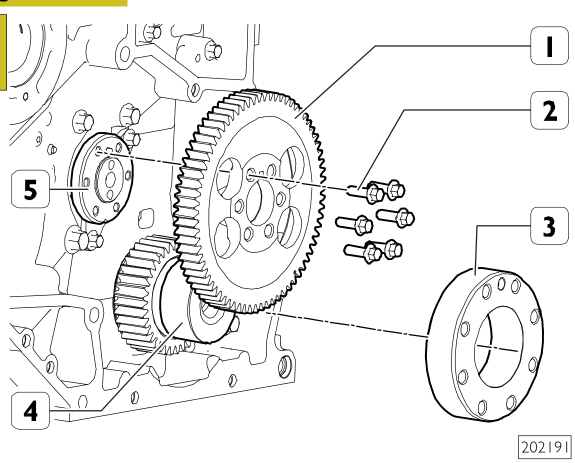
❑ Remove the flywheel housing (5).

Ref.	No.	Screws description
(1)	3	Screw M12x1.75
(2)	2	Screw M8x20
(3)	5	Screw M10x1.5
(4)	11	Screw

NOTE Take note of the screw (1, 2, 3 and 4) assembling positions since they are of different sizes.

Removal of timing gear

Figure 92



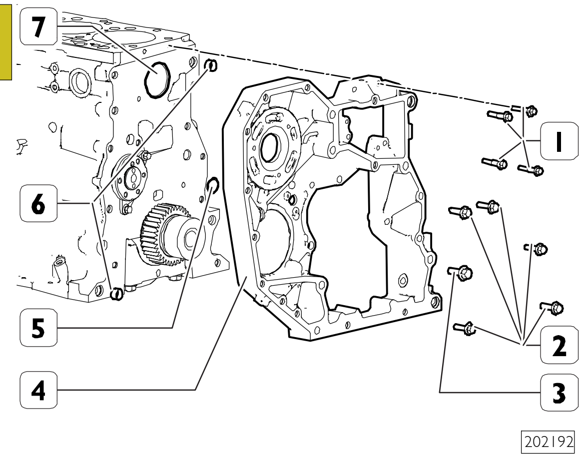
❑ Remove the collar 3) from the crankshaft (4).

❑ Unscrew the screws (2) and remove the gear (1) from the camshaft (5).

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

Timing gear case removal

Figure 93



❑ Unscrew the screws (1, 2 and 3).

❑ Remove the timing gear case (4).

❑ Recover the gasket (5).

❑ Recover the cable reference dowel pins (6).

❑ Remove the core plug (7).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x40
(2)	5	Screw M10x1.5x30
(3)	1	Screw M12x1.75x30

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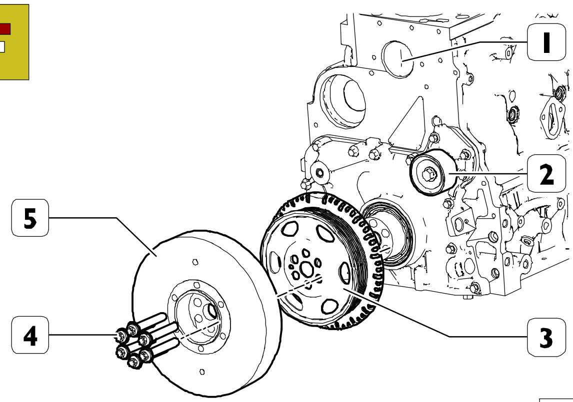
REMOVAL OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Removal of crankshaft pulley

Figure 94



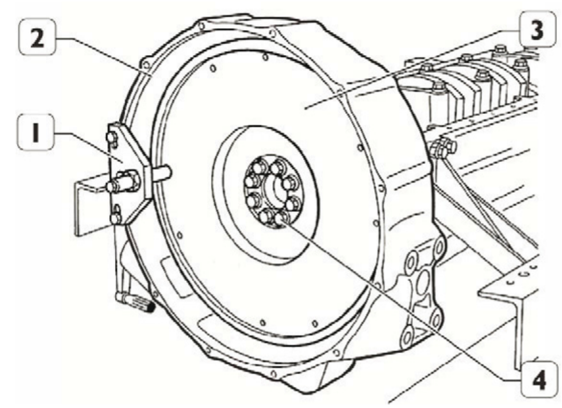
- ❑ Unscrew the screws (4) securing the front hub (5).
- ❑ Remove the front hub (5).
- ❑ Remove the pulley (3).
- ❑ Unscrew the screw (2) fixing the idler pulley.
- ❑ Remove the core plug (1).

Ref.	No.	Screws description
(2)	1	Screw M10x1.5
(4)	6	Screw M10x1.25x40

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Removal of engine flywheel

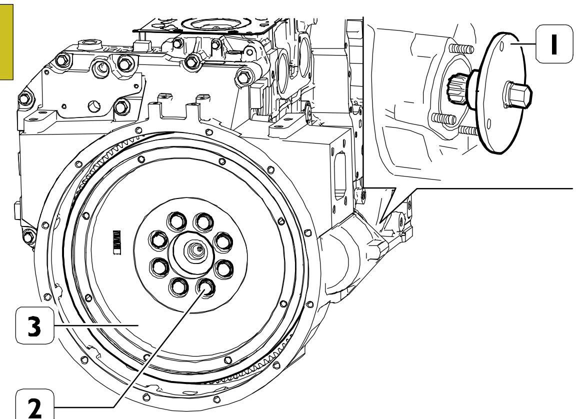
Figure 95 NEF45 TE1F/TE2F engine



☞ NEF45 SM1F engine Page 35

- ❑ Apply the tool 99360351 (2) to the flywheel housing (1), to stop the flywheel (3) rotation.
- ❑ Loosen the screws (4).

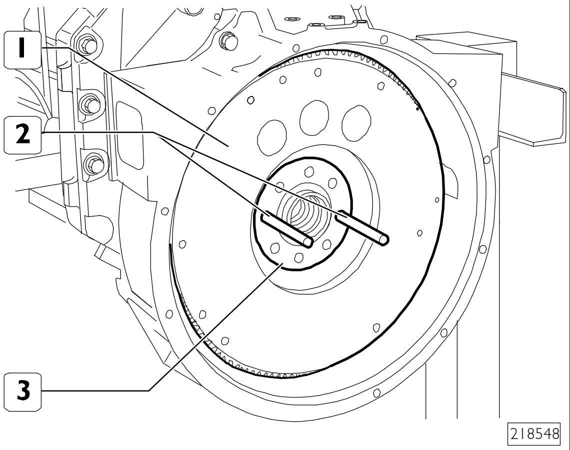
Figure 96



- ❑ Unscrew the two opposing screws (2) where the extraction pins will be inserted (see following figure).
- ❑ Unscrew the remaining screws fixing the flywheel (3) from the crankshaft.
- ❑ Remove the flywheel locking tool 99360351 (1).

Ref.	No.	Screws description
(2)	8	Screw M12x1.25x30

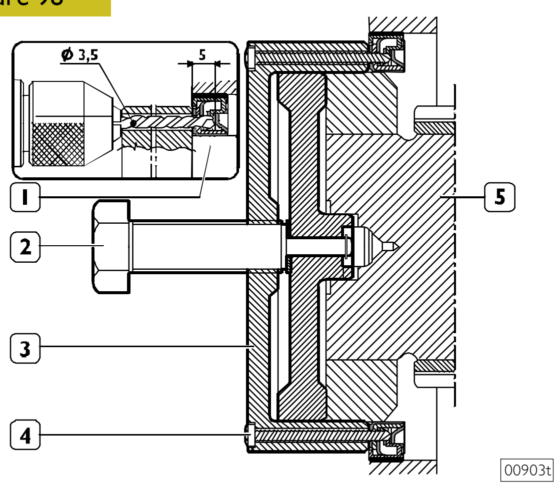
Figure 97



- Screw in two screws of average length into the holes to sling the flywheel with a hoist.
- Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) out with the help of the hoist.

Removal of flywheel cover housing sealing ring

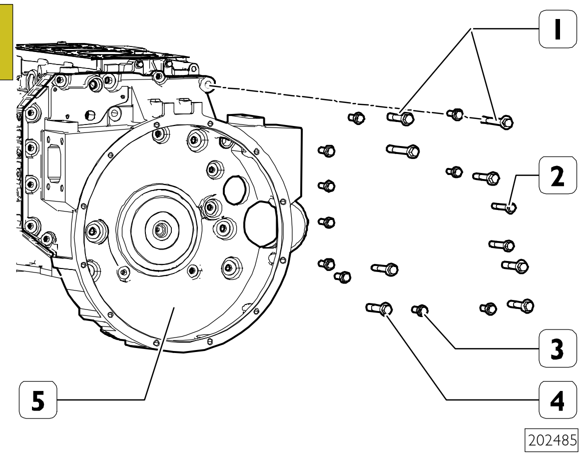
Figure 98



- Take out the flywheel housing seal ring, applying tool 99340056 (3) onto the rear tang (5) of the crankshaft.
- Through the guiding holes of the tool itself, drill the internal seal ring with a bit (Ø 3.5 mm) to a depth of 5 mm.
- Secure tool 99340056 (3) to the ring (1) screwing in the 6 screws (4) supplied.
- Remove the ring (1) by screwing up the screw (2).
- Using an appropriate tie rod of tool 99363204 and a lever, take out the external seal ring from the flywheel housing.

Removal of flywheel housing

Figure 99



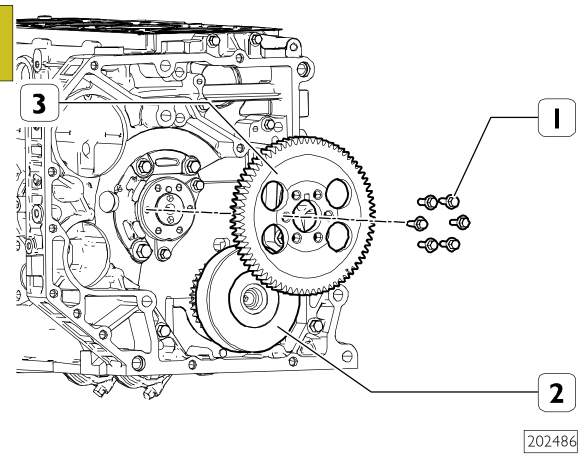
- Unscrew the screws (1, 2, 3 and 4).
- Remove the flywheel housing (5).

Ref.	No.	Screws description
(1)	2	Screw M12x1.75
(2)	2	Screw M10x1.5
(3)	10	Screw M10x1.5
(4)	6	Screw M12x1.75

NOTE Note the assembly position of the screws since they are of different sizes.

Removal of timing gear

Figure 100

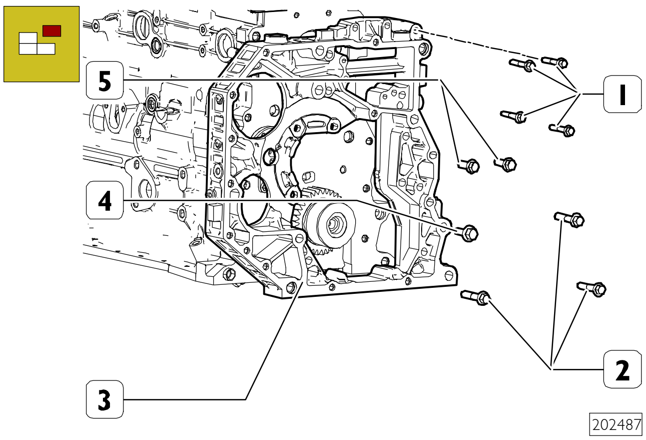


- Unscrew the screws (1) and remove the timing gear (3).
- Remove the collar (2).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25

Removal of timing gear case

Figure 101



- Unscrew the screws (1, 2, 4 and 5).
- Remove the timing gear case (3).

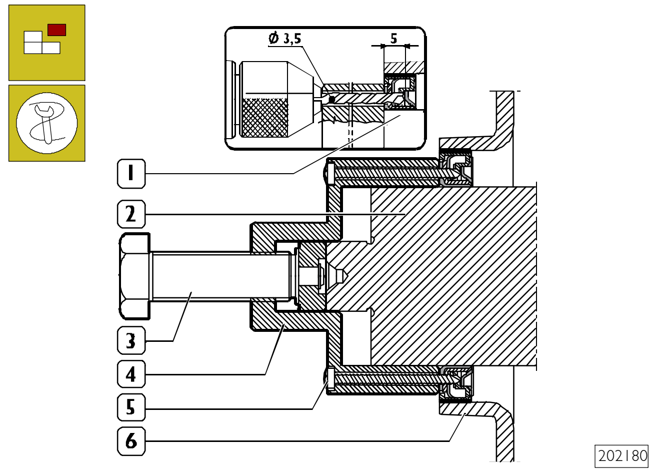
Ref.	No.	Screws description
(1)	4	Screw M8x1.25
(2)	3	Screw M10x1.5
(4)	1	Screw M12x1.75
(5)	2	Screw M10x1.5

NOTE Note the assembly position of the screws since they are of different sizes.

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

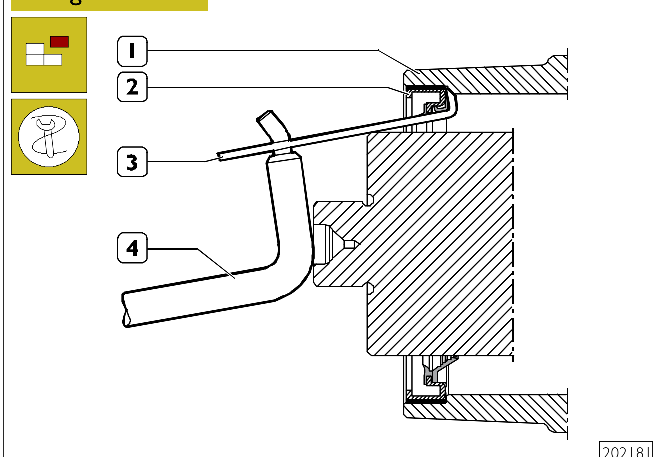
Removing the engine - front cover sealing ring

Figure 102 (For all engines)



- Take out the crankshaft seal ring from the front cover.
- Use tool 99340055 (4) on the front tang (2) of the crankshaft.
- Through the guiding holes of the tool itself, drill the internal seal ring (1) with a bit (Ø 3.5 mm) to a depth of 5 mm.
- Secure the tool to the ring screwing in the 6 screws supplied. Remove the ring (1) by screwing up the screw (3).

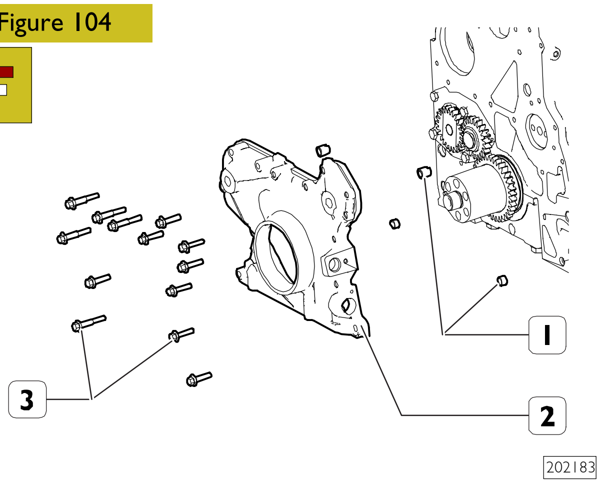
Figure 103



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

Removal of front cover

Figure 104



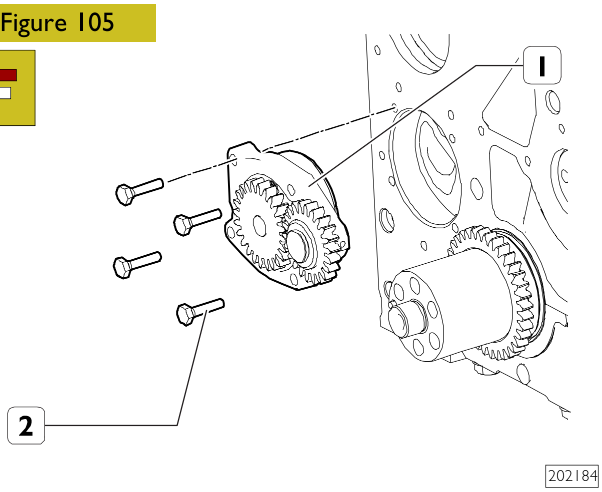
- ❑ Unscrew the screws (3) securing the front cover (2).
- ❑ Remove the front cover (2) and recover the cable reference dowel pins (1).

Ref.	No.	Screws description
(3)	13	Screw M8x1.25

NOTE Note the assembly position of the screws since they are of different sizes.

Oil pump removal

Figure 105



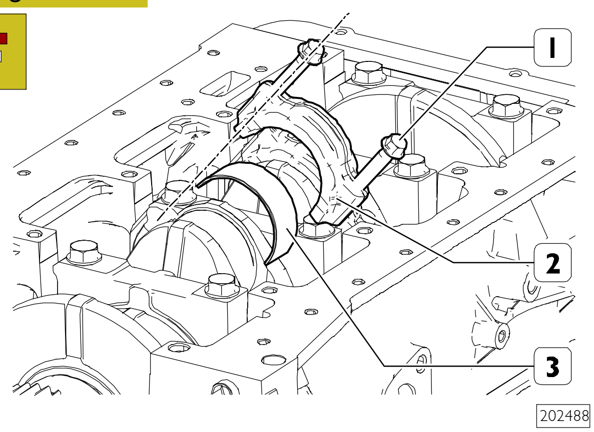
- ❑ Unscrew the supporting screws (2).
- ❑ Remove the oil pump (1).

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Piston-connecting rod unit removal

Figure 106



- ❑ Overturn the engine.
- ❑ Unscrew the screws (1).
- ❑ Remove the caps (2) and connecting rod half-bearings (3).
- ❑ Withdraw the pistons including the connecting rods from the top of the crankcase.

Ref.	No.	Screws description
(1)	8	Screw M10x1.25

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

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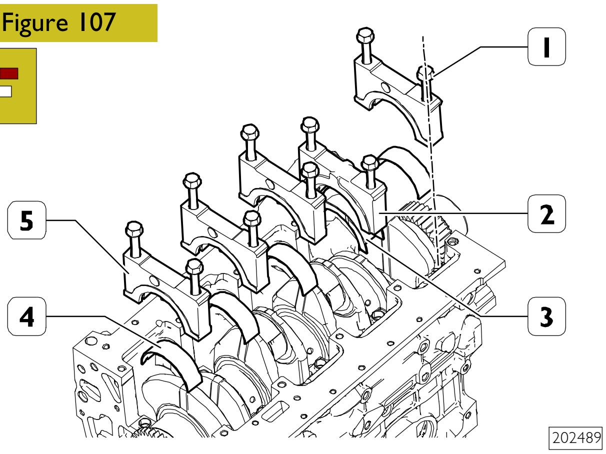
Removal of crankshaft

Figure 107



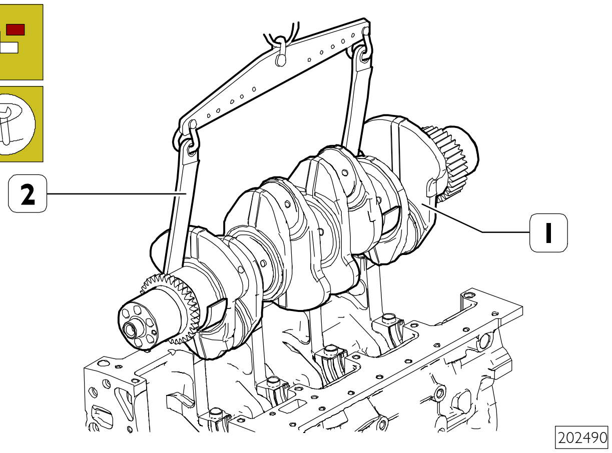
- ❑ Unscrew the main bearing cap screws (1).
- ❑ Remove the main bearing caps (5).
- ❑ Recover the cable reference dowel pins.
- ❑ Recover the lower main half-bearings (4).

Ref.	No.	Screws description
(1)	10	Screw M12x1.5x120

The second last main bearing cap (2) and the relevant support are fitted with shoulder half-bearing (3).

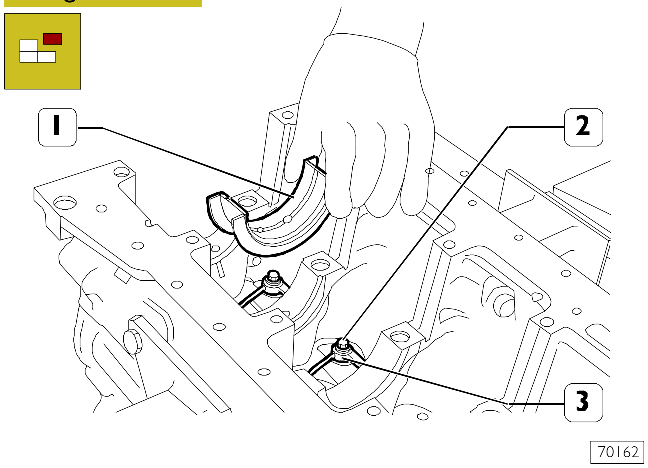
NOTE Take note of lower and upper half-bearing assembling positions since in case of reuse they shall be fitted in the same position found at removal.

Figure 108



- ❑ Use tool 99360500 (2) and hoist to remove the crankshaft (1) from the crankcase.

Figure 109



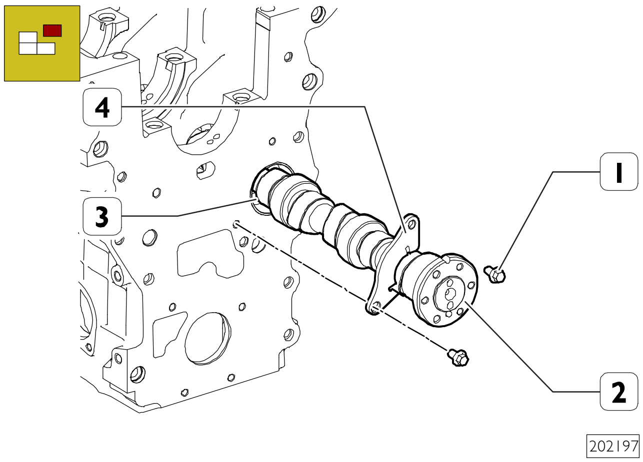
- ❑ Remove the main half-bearings (1).
- ❑ Unscrew the screws (2) and remove the oil sprayers (3).

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Camshaft removal

Figure 110



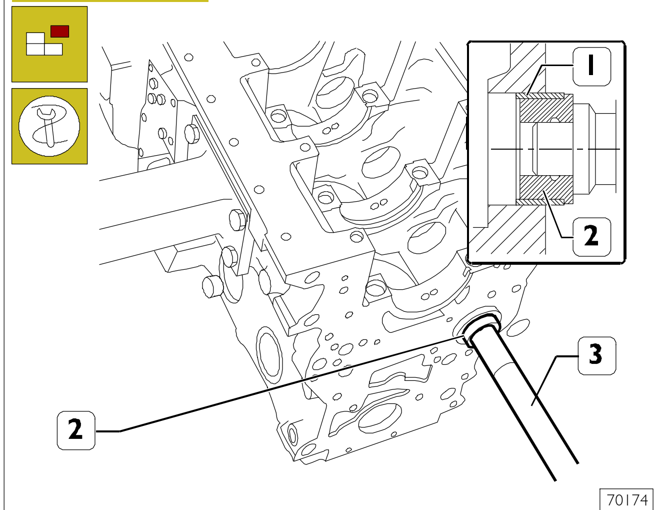
- Unscrew the screws (1).
- Carefully remove the camshaft (2) from the crankcase.
- Recover the shoulder plate (4).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x16

NOTE Take note of plate (3) assembling position.

Camshaft bushing removal

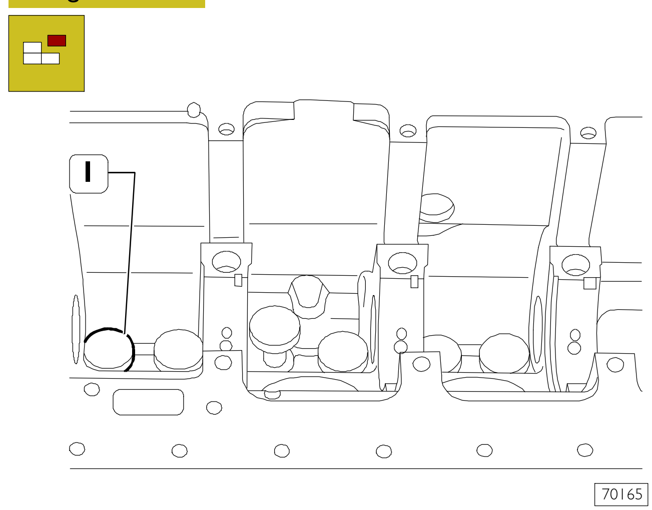
Figure 111



- Remove the camshaft bushing (3) using driver 99360362 (2) and handgrip 99370006 (3).

Tappet removal

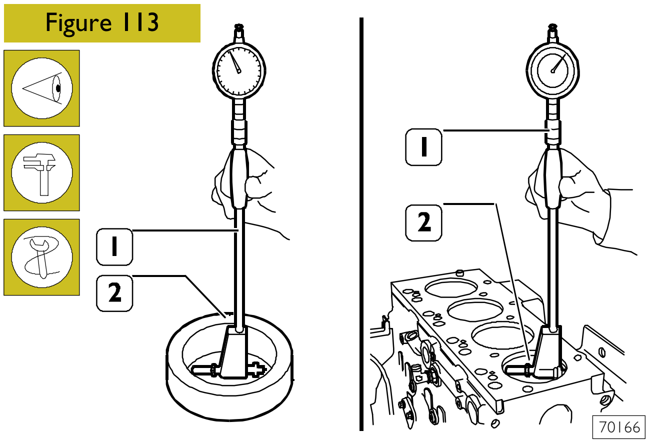
Figure 112



- Withdraw the tappets (1) from the crankcase.

CHECKS
Cylinder block

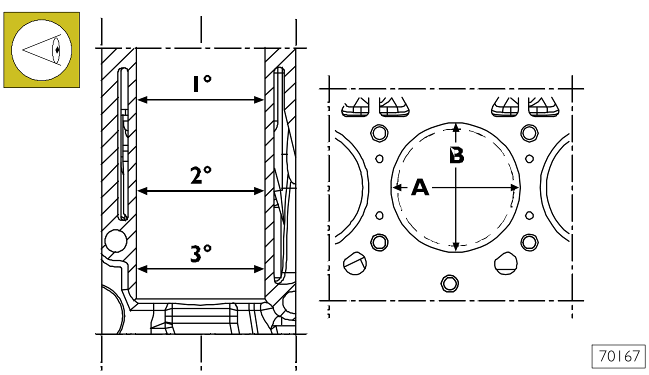
Figure 113



Once the engine is disassembled, thoroughly clean the cylinder-crankcase assembly.
Use the proper rings to handle the cylinder block.
Carefully inspect the crankcase for cracks.
Check the condition of casting hole plugs. If the caps are rusted, or if there is any doubt about the efficiency of the seal, replace them.
Inspect the surfaces of the cylinder liners; they should not be scored, seized, ovalised, conical or worn to excess.
The internal diameter of the cylinder liners is checked to ascertain the extent of ovalization, taper and wear, using the bore meter (1) fitted with a dial gauge previously reset on the ring gauge (2) of the diameter of the cylinder liner.

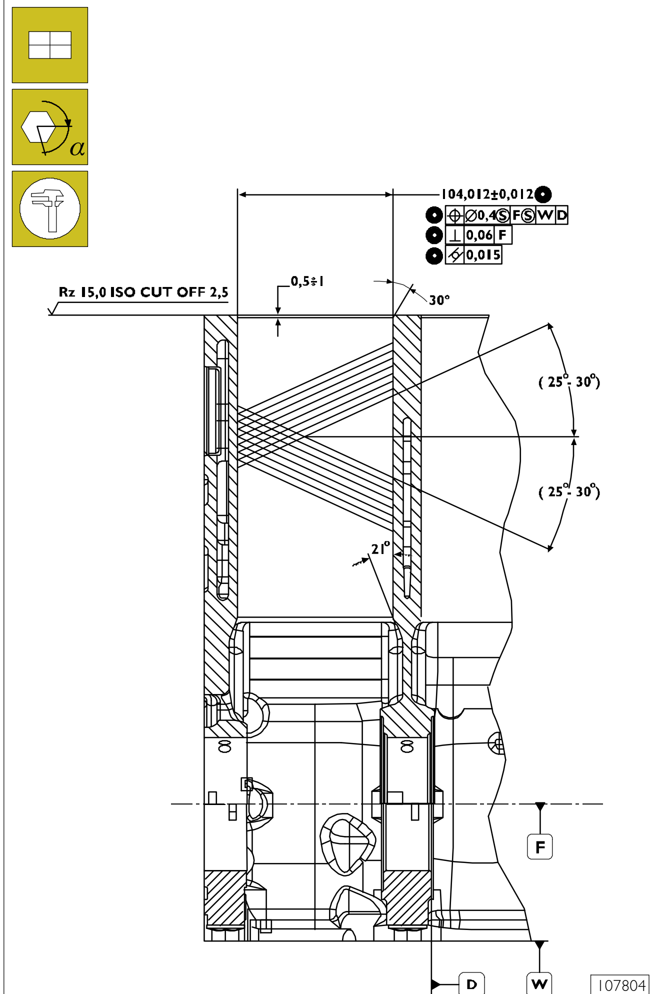
NOTE Should the ring gauge be not available, use a micrometer for zero-setting.

Figure 114



Measurements shall be performed on each cylinder, at three different heights in the bore and on two planes perpendicular with each other: one parallel to the longitudinal axis of the engine (A) and the other perpendicular to it (B); the greatest wear is usually found to be on this surface and during the first measurement.
Should ovalization, taper or wear be found, bore and grind the cylinders. The refacing of the cylinder liners should be made in relation to the diameter of the pistons supplied as spare parts, which are oversized by 0.4 - 0.8 mm of the nominal value and to the prescribed assembly clearance.

Figure 115



NOTE In case of regrinding, all cylinders are to have the same oversize (0.4 - 0.8 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 cylinder block head contact surface

After establishing the areas of deformation, correct the contact surface with a grinding machine.
Planarity error shall not exceed 0.075 mm.
Check the state of the cylinder assembly machining plugs; if they are rusty or there is any doubt at all about their seal, replace them.

Timing system

Camshaft

Figure 116 NEF45 SM1F engine

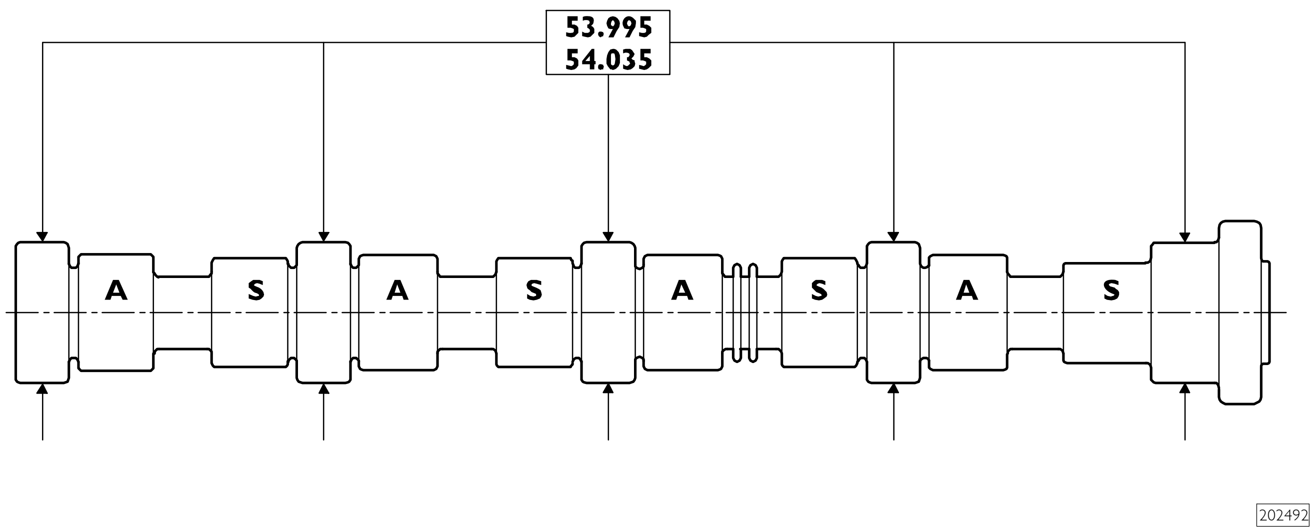
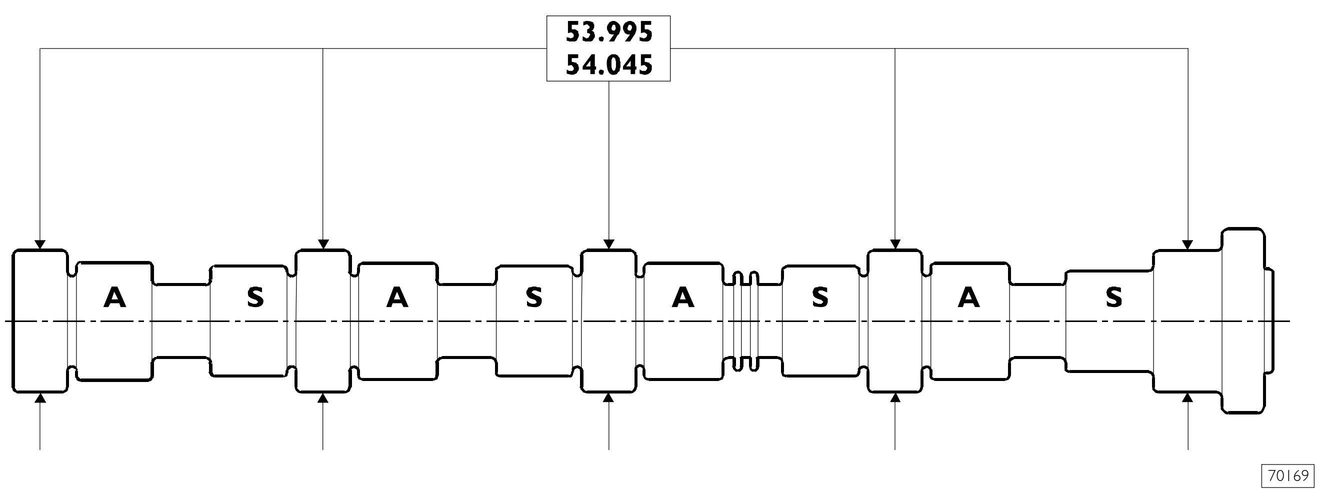


Figure 117 NEF45 TE1F/TE2F engine



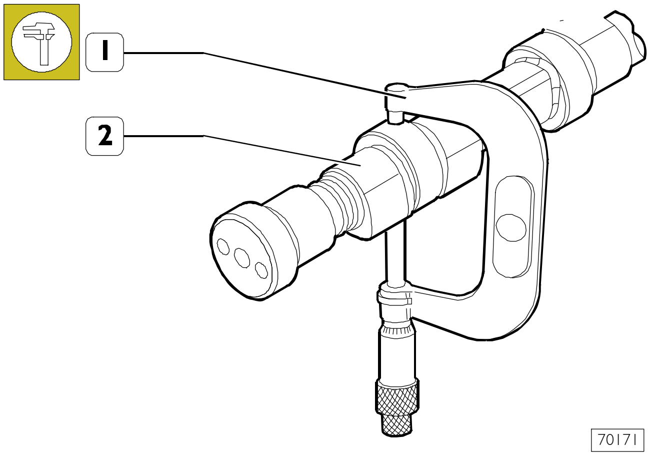
MAIN DATA ABOUT CAMSHAFT JOURNALS

The surfaces of the supporting pins of the shaft and those of the cams need to be extra smooth; if they show any signs of seizing or scoring, the shaft and the relevant bushings should be replaced.

Cam lift and pin alignment

Set the shaft on tailstocks and, using a dial gauge on the middle journal, check that the alignment error is no greater than 0.04 mm: change the shaft if it is any greater.

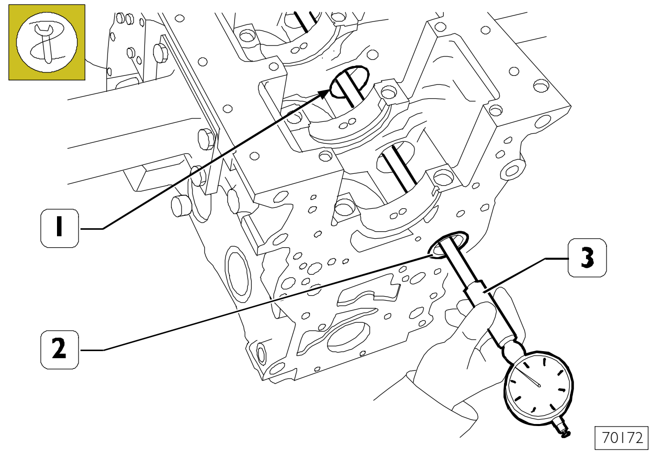
Figure 118 (For all engines)



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

Between bushings and

Figure 119



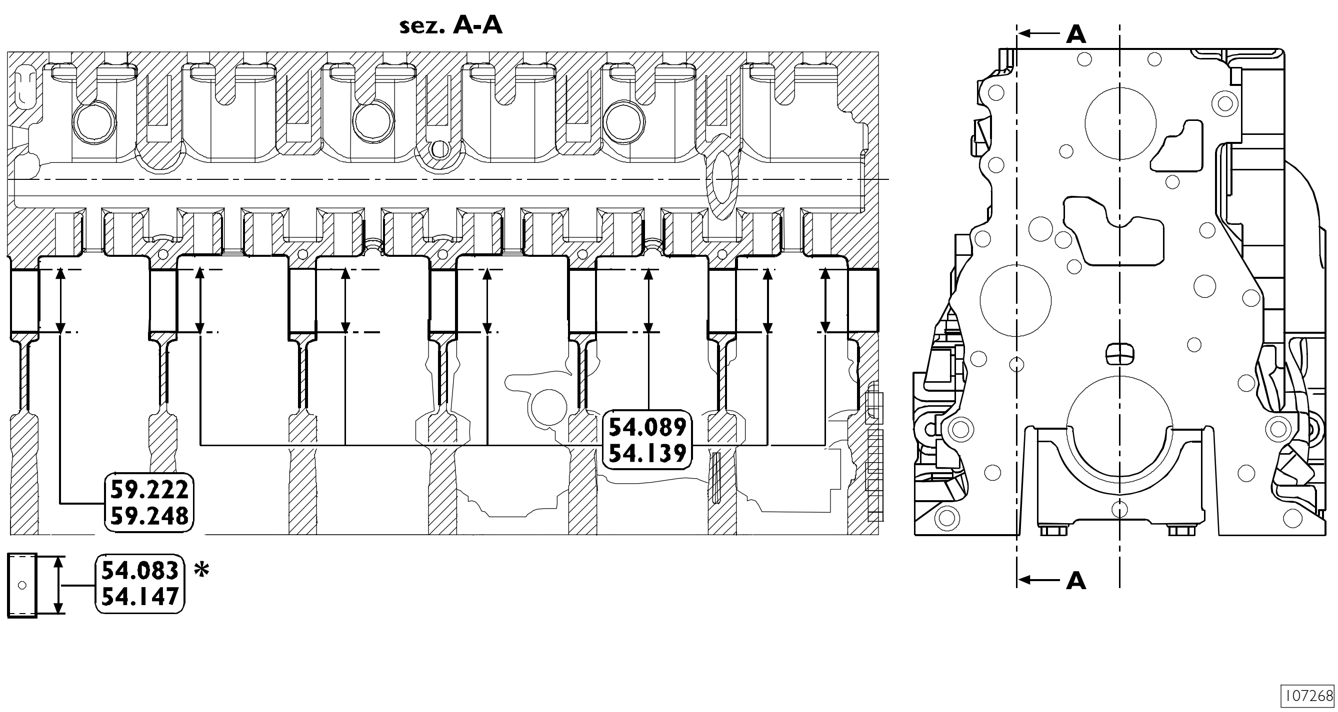
The camshaft bushing (2) must be forced into its seats.

Internal surfaces must not show seizing or wear.

Use bore gauge 99395603 (3) to measure the diameter of the bushing (2) and the intermediate seats (1) for the camshaft.

Measurements shall be performed on two perpendicular axes.

Figure 120

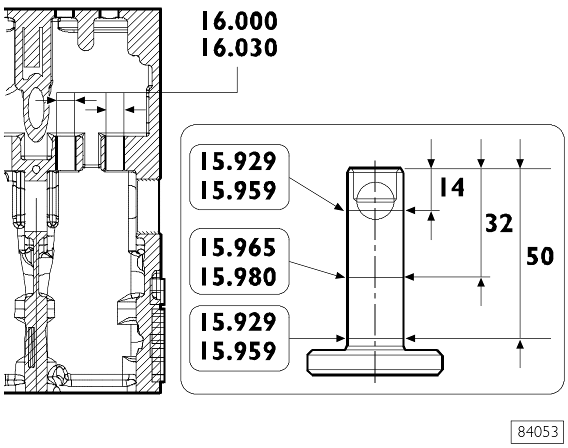


BUSHING MAIN DATA FOR CAMSHAFT AND RELATING SEAT

* Dimension to be obtained after driving the bushing

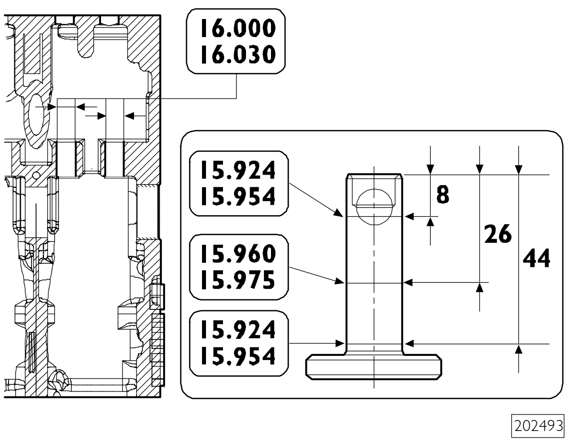
Tappets

Figure 121 NEF45 SM1F engine



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON CRANKCASE

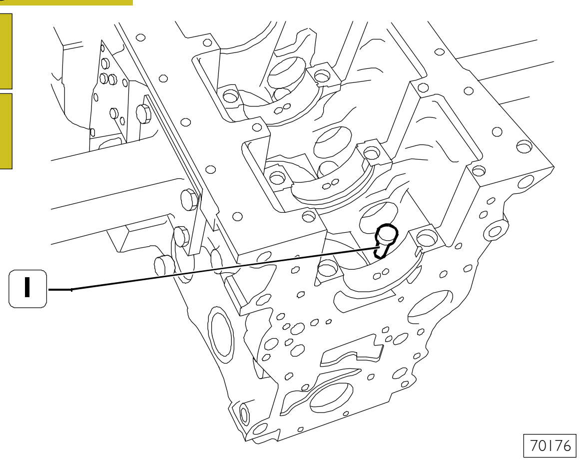
Figure 122 NEF45 TE1F/TE2F engine



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON CRANKCASE

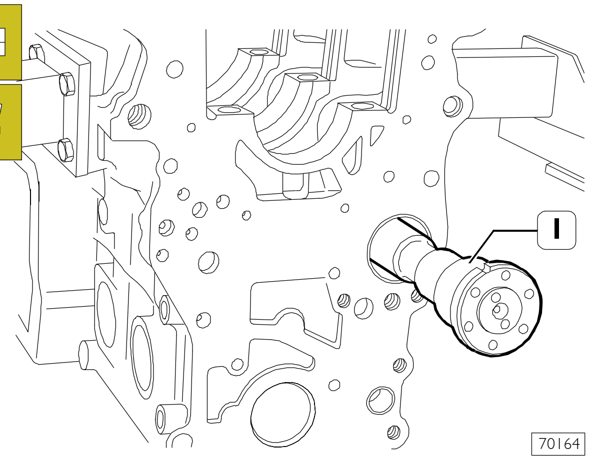
Fitting tappets - Camshaft

Figure 123 (For all engines)



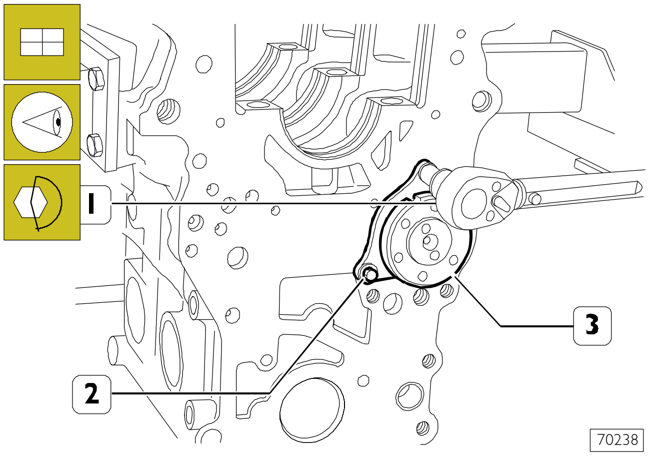
Lubricate the tappets (1) and fit them into the relevant housings on the crankcase.

Figure 124



Lubricate the camshaft support bushing and fit the camshaft (1) taking care not to damage the shaft support seats or bushing during this operation.

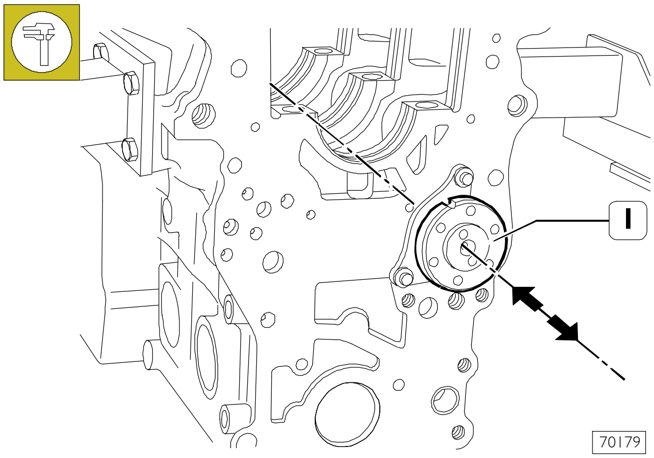
Figure 125



Place the plate (1) retaining the camshaft (3) with the slot facing the top side of the crankcase and the marking facing you, tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M8x1.25x16	24 ± 4 Nm

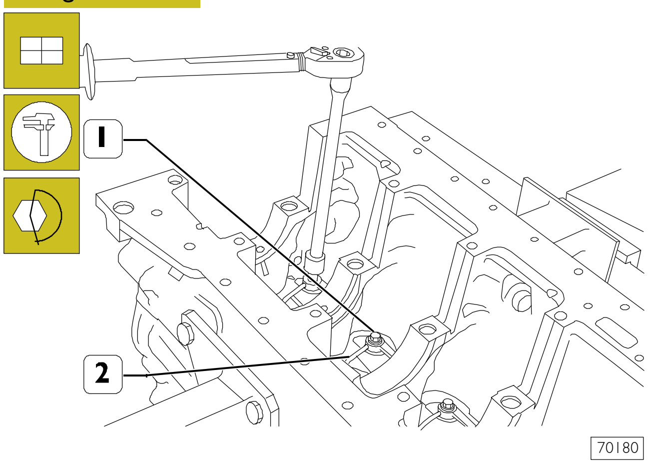
Figure 126



Check the axial clearance of the camshaft (1).

It must be 0.23 ± 0.13 mm.

Figure 127

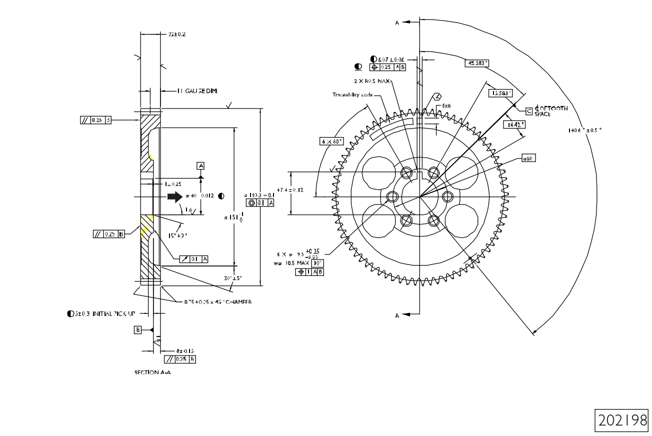


Fit the spray nozzles (2) and tighten the filler (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25	15 ± 3 Nm

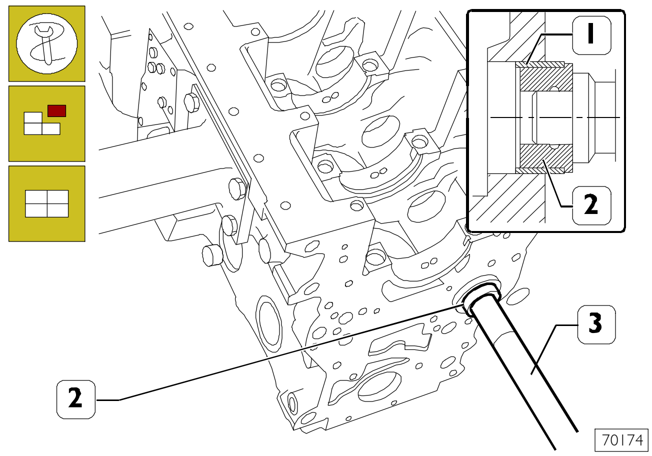
Transmission gear

Figure 128



Replacing bushing

Figure 129



To replace bushing (1), use driver 99360362 (2) and handgrip 99370006 (3) for dismounting and mounting the bushing.

The gear bushings shown in Figure 128 can be replaced when worn. After driving the bushing, proceed to bore it to obtain the diameter indicated in Figure 128.

NOTE The hammering of the bushing into the gear must be carried out in the direction of the arrow by placing it at the point indicated inFigure 128.

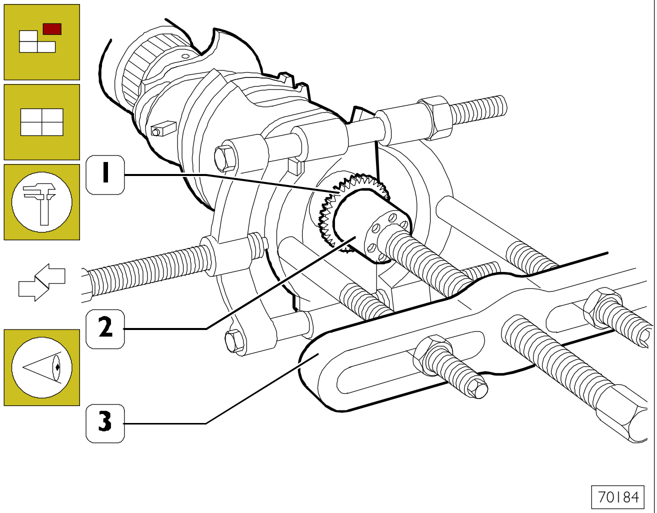
NOTE During assembly, the bushing (1) must be oriented so that the lubrication holes match with the ones on the seats of the crankcase.

Rated assembling play between gear bushings and pins:

0.038 ÷ 0.152 mm

Oil pump drive gear replacement

Figure 130

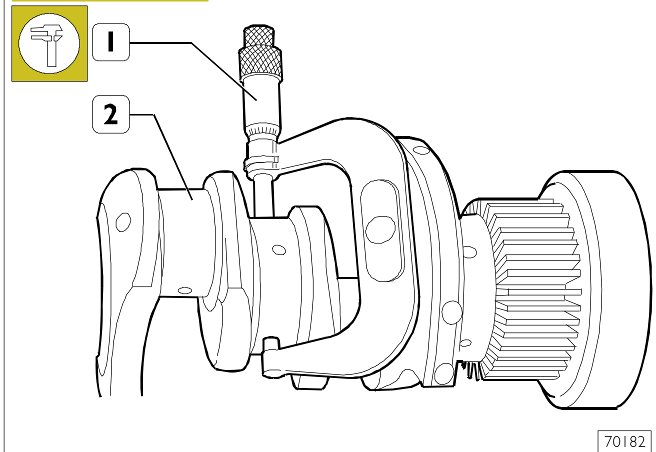


Check that gear toothing (1) is not damaged or worn, otherwise remove it using the proper puller (3).

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

Crankshaft
Main journals and connecting rod

Figure 131



If signs of seizure, scoring or excessive ovalisation on main journals and connecting rod are identified, it is necessary to regrind the pins. Before grinding the journals (2) measure them with a micrometer (1) to decide the final diameter to which the pins are to be ground.

NOTE It is advisable to enter readings in a table.

See Figure 132.

Undersize classes are of: 0.250 - 0.500 mm.

NOTE The main journals and connecting rod must always be ground to the same undersize class.

Main journals and connecting rod undersize shall be marked on the side of the crank arm No.1.

For undersized crankpins, letter M.

Letter B for undersized main journals.

For undersized crankpins and main journals, letter MB.

Measuring main journals and connecting rod

Figure 132

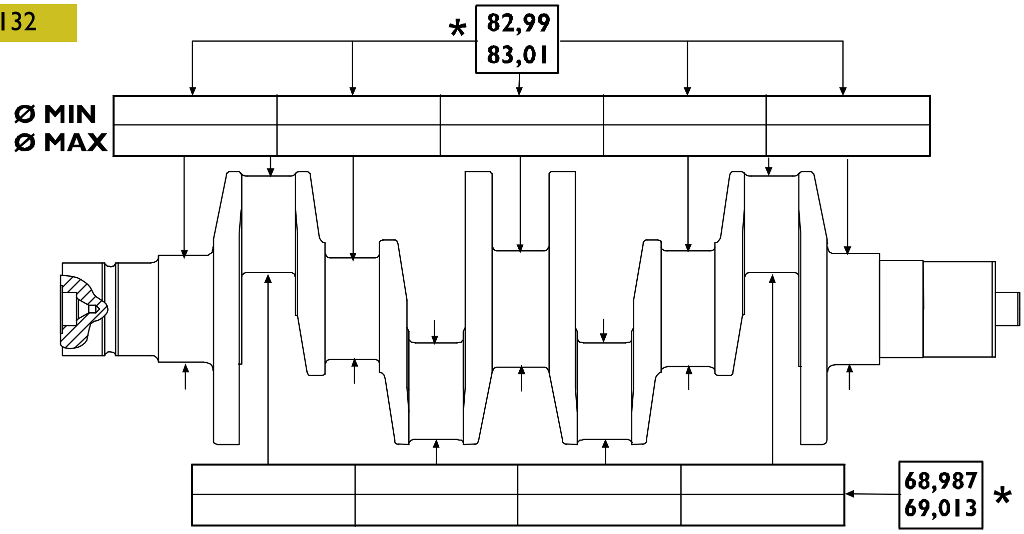
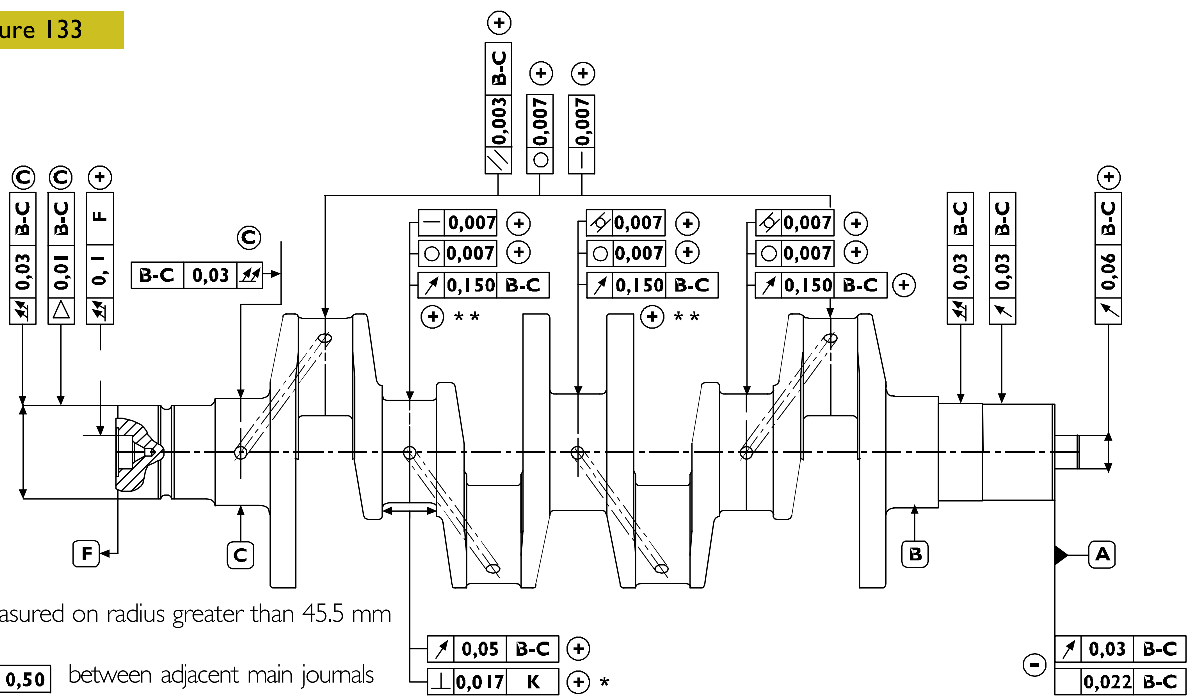


TABLE ON WHICH TO REPORT THE VALUES PERTAINING TO MEASURING THE MAIN JOURNALS AND CONNECTING ROD OF THE CRANKSHAFT
* Nominal value

Figure 133

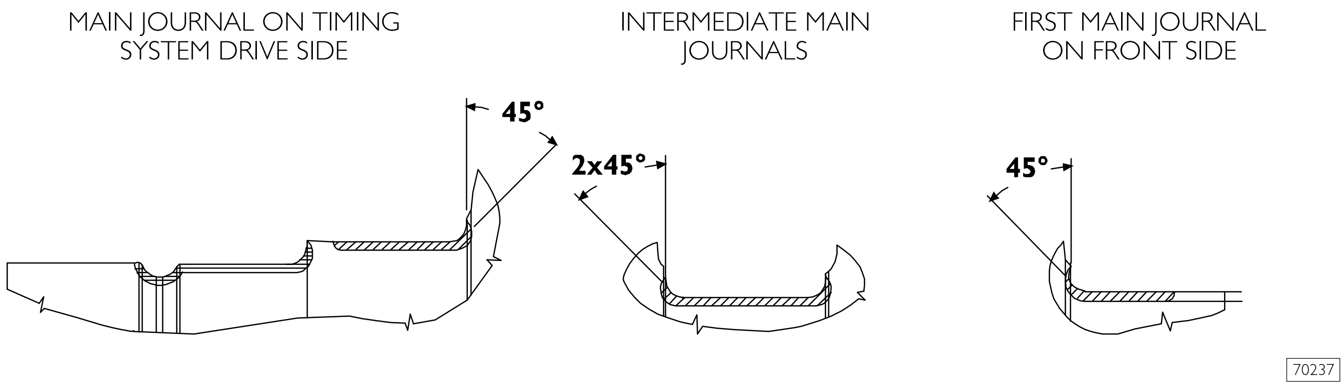


* measured on radius greater than 45.5 mm

** 0,50 between adjacent main journals

MAIN CRANKSHAFT TOLERANCES

Figure 134

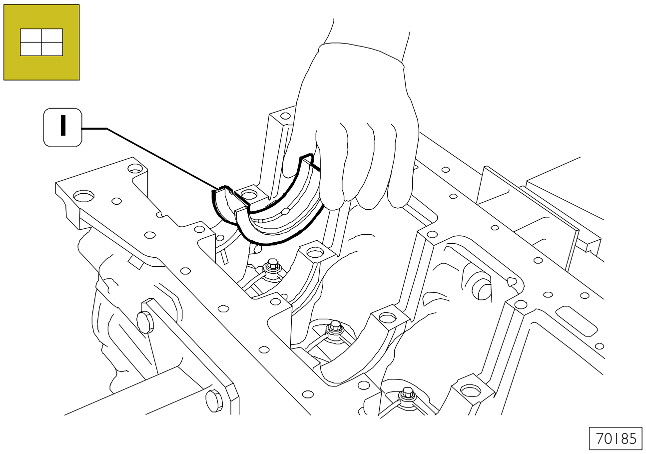


TOLERANCES	CHARACTERISTIC SUBJECT OF TOLERANCE	GRAPHIC SYMBOL
SHAPE	Circularity	○
	Cylindricity	/○/
ORIENTATION	Alignment	//
	Perpendicularity	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	⇗

CLASS OF IMPORTANCE ASSIGNED TO PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Main bearings assembly

Figure 135



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

The main bearings (1) are supplied as spare parts undersized on the inner diameter by 0.250 - 0.500 mm.

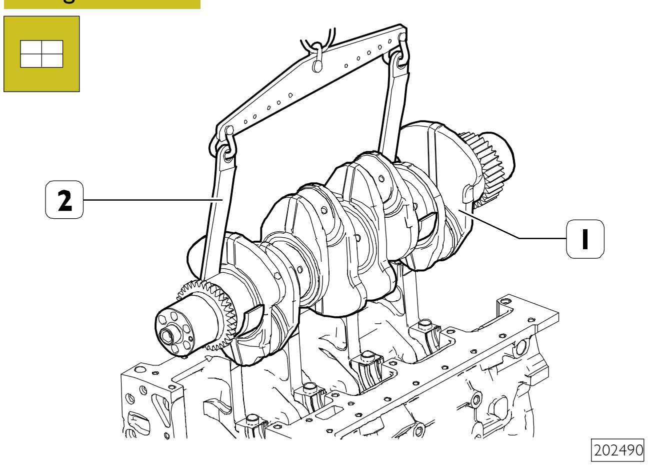
NOTE Do not modify the bearings in any way.

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.

Main journal assembly clearance measurement

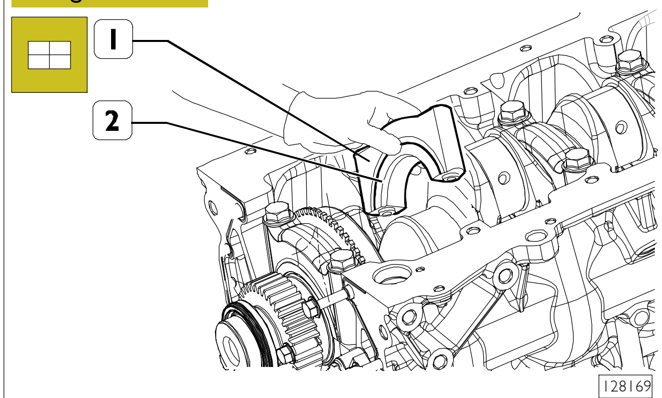
Figure 136



Install the crankshaft (1).

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

Figure 137



- thoroughly clean the parts and eliminate all traces of oil
- fit caps (1), including the half bearings (2) on the relevant supports.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced

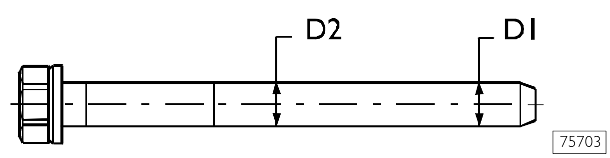
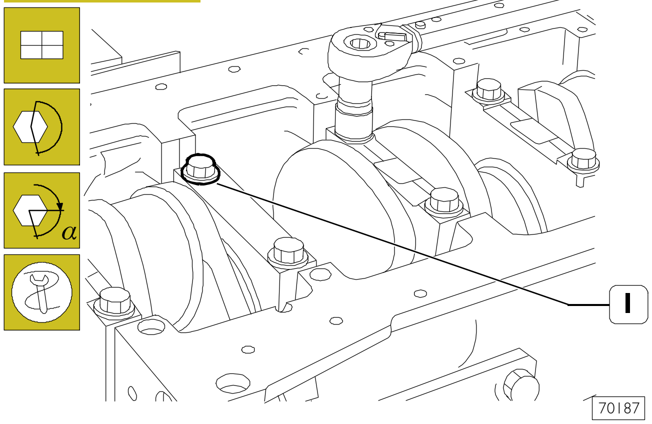


Figure 138



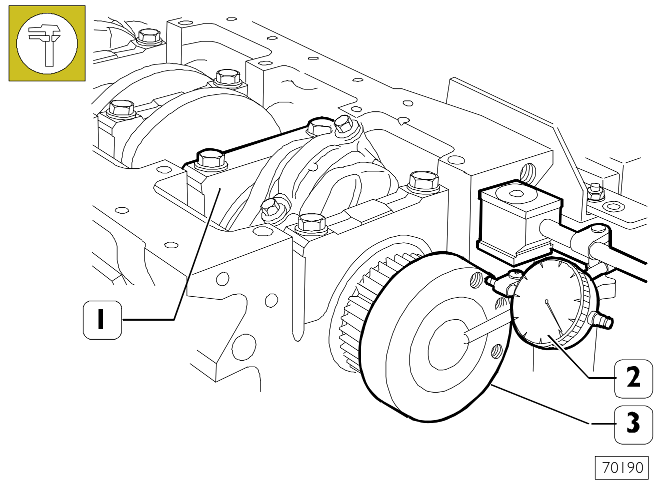
Screw in the pre-lubricated screws (1) in two phases:

- 1st phase with torque wrench;
- 2nd phase with tool 99395216.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.5x120	-
		1st phase 2nd phase	80 ± 6 Nm 90°

Checking crankshaft end float

Figure 139

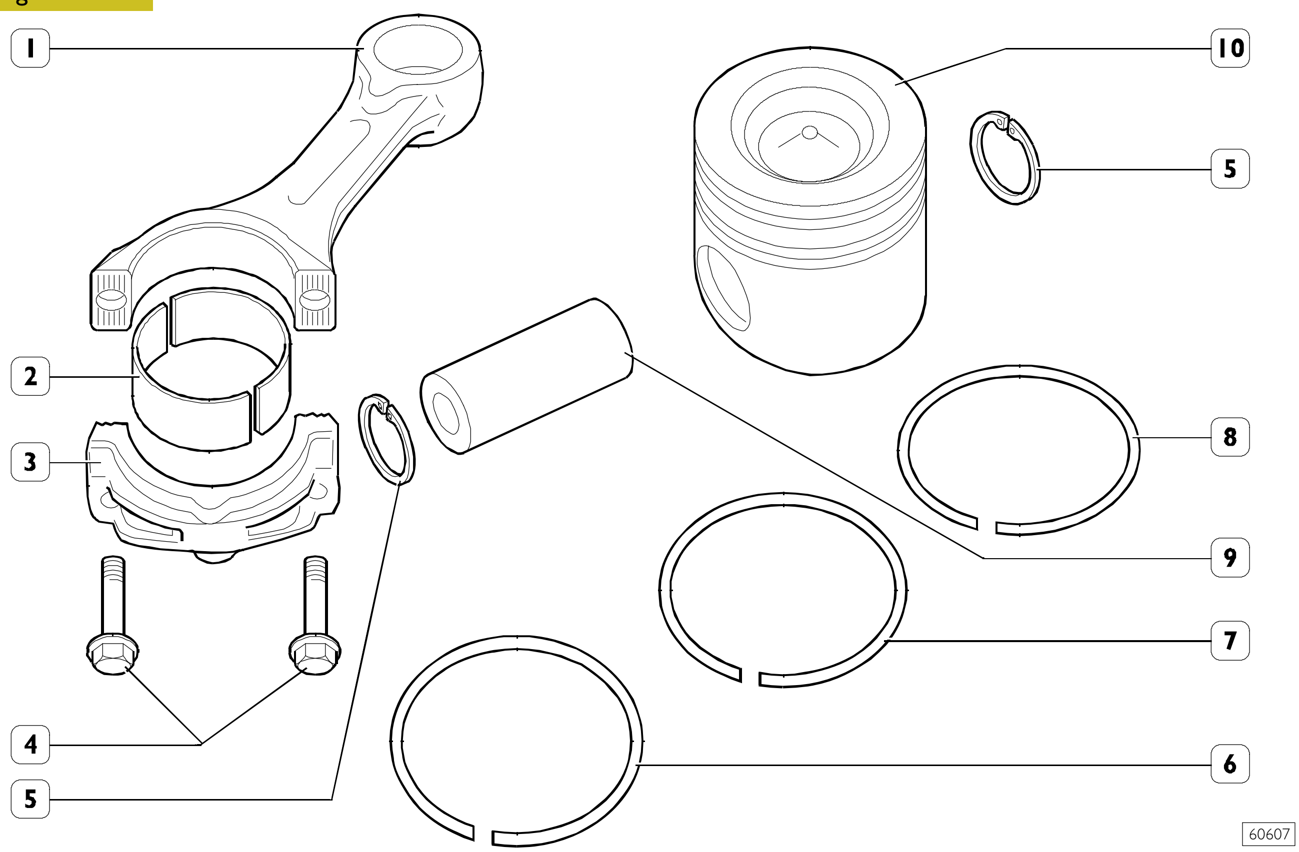


The clearance control of the shoulder is carried out by placing a dial gauge (2) to the magnetic base on the crankshaft (3) as shown in the figure, the normal mounting clearance is 0.068 ÷ 0.410 mm.

If a greater clearance is found, replace the main half bearings of the second last rear support (1) carrying the thrust bearings and repeat the clearance check between the main half bearings and crankshaft pins.

Piston-connecting rod assembly

Figure 140



PISTON - CONNECTING ROD ASSEMBLY

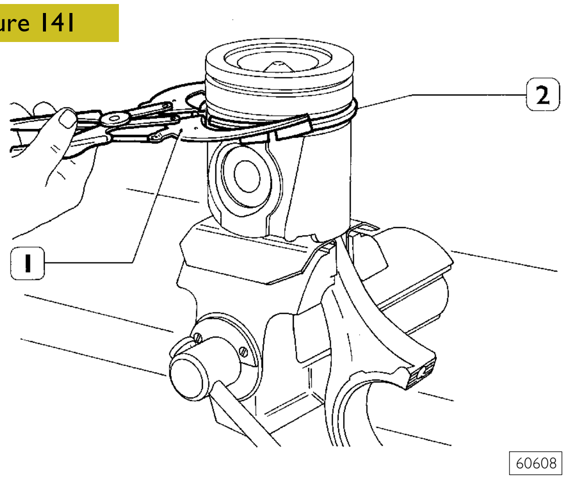
1. Connecting rod body - 2. Half-bearings - 3. Connecting rod cap - 4. Cap fixing screws - 5. Circlip - 6. Slotted oil scraper ring with spiral spring - 7. Claw seal ring - 8. Trapezoidal seal ring - 9. Piston pin - 10. Piston

Print P4D32N009 E

Make sure the pistons do not show any trace of seizing, scoring, cracking or excessive wear; otherwise, replace as necessary.

disassembly

Figure 141

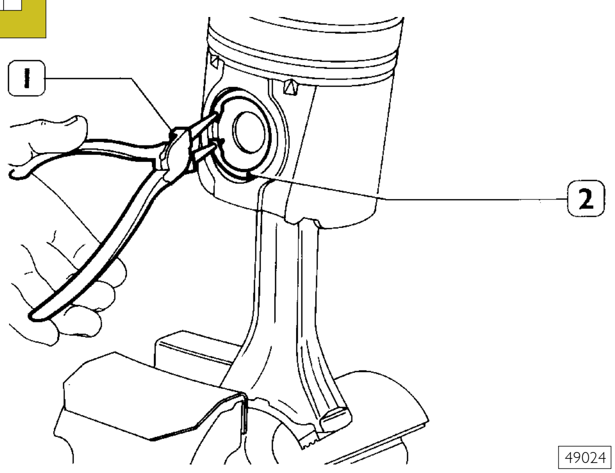


Removal of the piston rings (2) using the pliers 99360183 (1).

Pistons are equipped with three circlips: the first, a sealing ring, with trapezoidal section; the second, a sealing ring, with chamfer cut; a scraper ring.

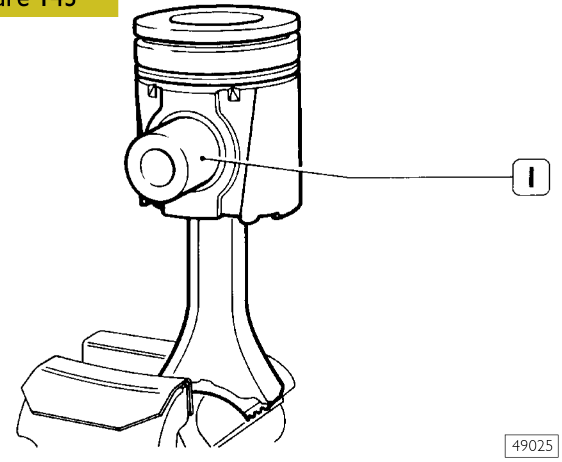
Pistons are grouped into classes A and B for diameter.

Figure 142



Removal of piston pin Seeger ring (2) using the round tipped pliers (1).

Figure 143

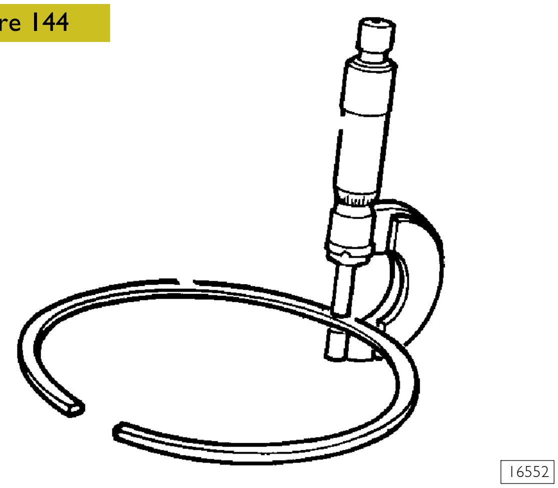


Piston pin removal (1).

If removal is difficult use the appropriate driver.

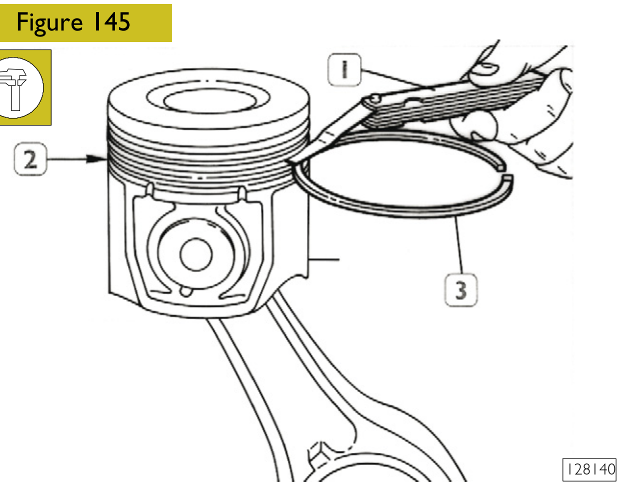
Circlips and seats

Figure 144



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

Figure 145



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

Figure 146

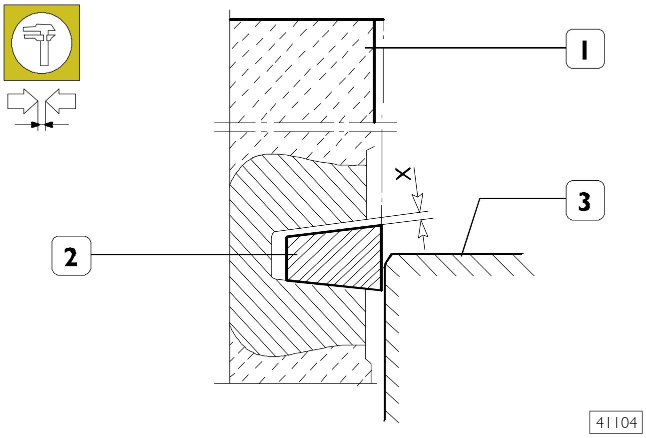
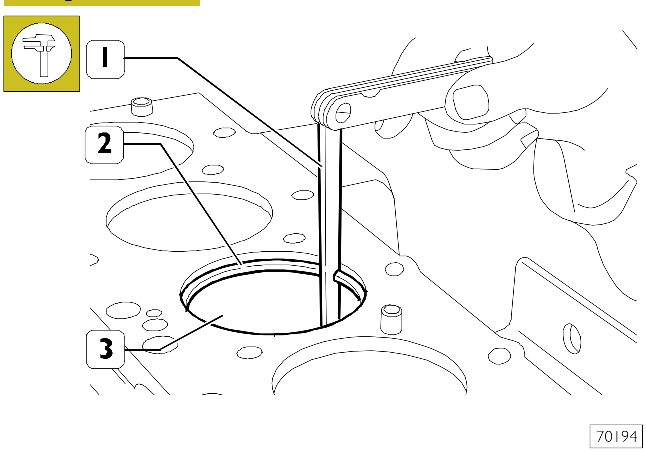


DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING

Since the first seal section is trapezoidal, the clearance between the slot and the ring is to be measured as follows; make the piston (1) protrude from the engine crankcase so that the ring (2) protrudes half-way from the cylinder liner (3).
In this position, use a feeler gauge to check the clearance (X) between the ring and the slot: this clearance must be as specified.

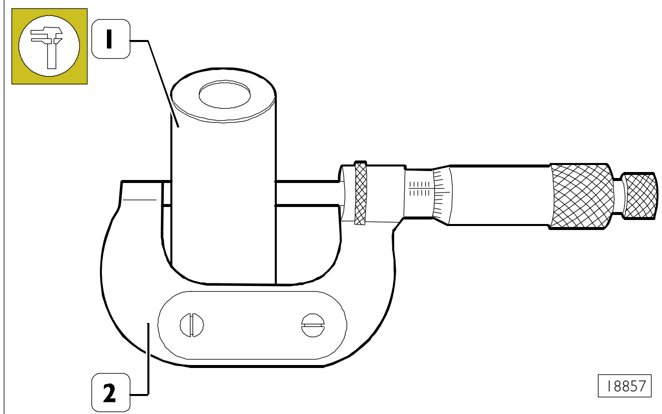
Figure 147



Use feeler gauge (1) to measure the clearance between the end of the circlips (2) fitted into the cylinder liner (3).

Piston pin

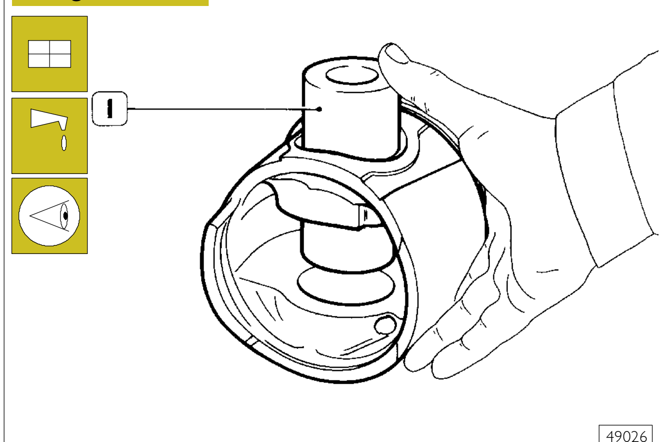
Figure 148



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

Conditions for correct pin-piston coupling

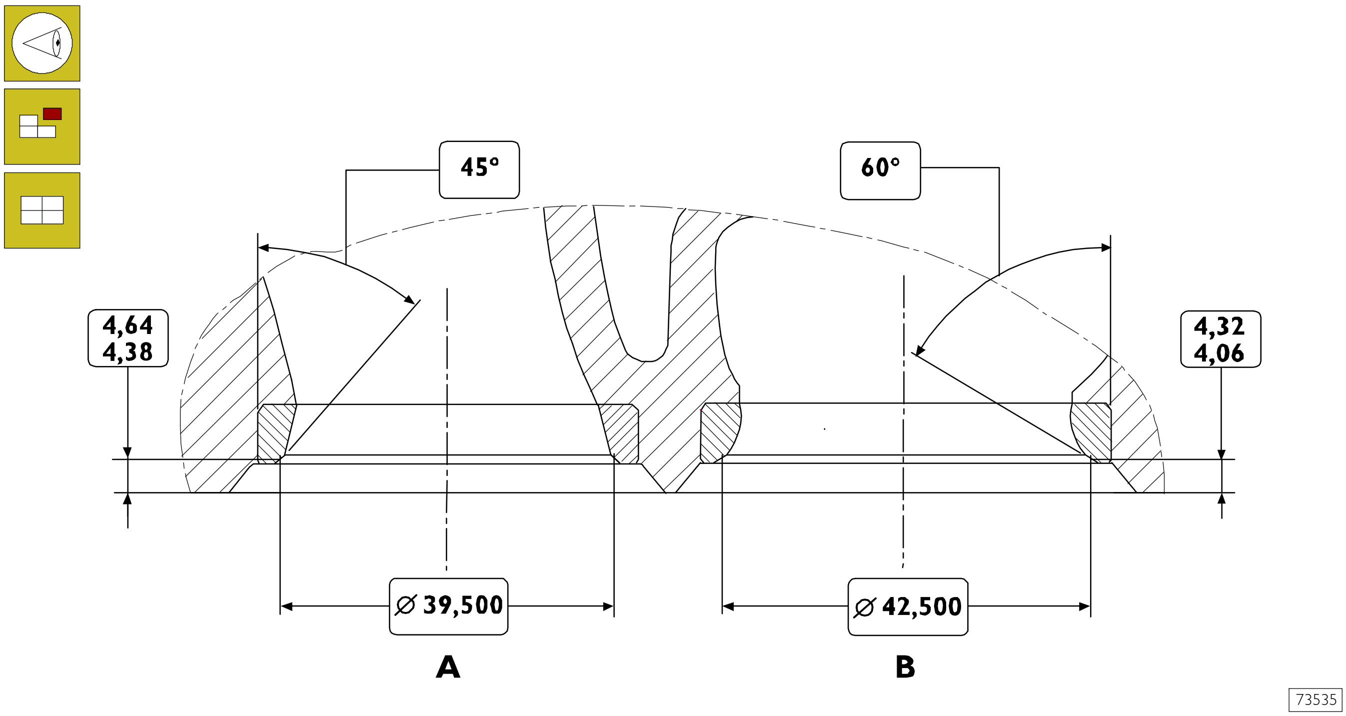
Figure 149



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

Bushings

Figure 150



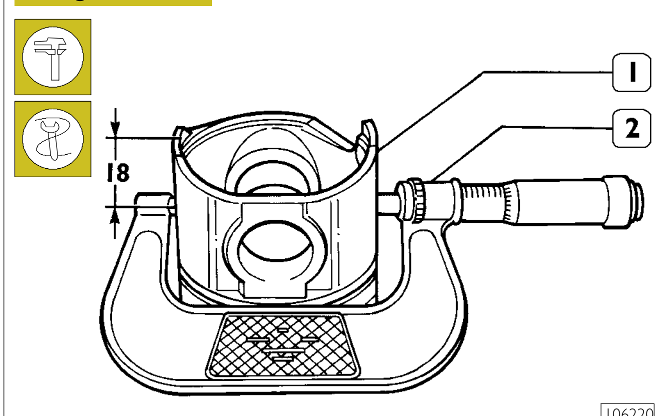
Check that the bushing in the connecting rod small end has not come loose and shows no sign of seizure or scoring. Otherwise replace it.

The bushing (2) is removed and fitted with a suitable driver (1).

When refitting take care to make the oil holes on the bushing coincide with those on the connecting rod small end. Use boring machine to go over the surface of the bushing in order to obtain the diameter of 40.987 ÷ 41.013 mm.

Pistons

Figure 151



Using a micrometer (2), measure the piston diameter (1) to determine the assembly clearance; The diameter has to be detected at the value indicated in figure.

Figure 152 NEF45 SM1F engine

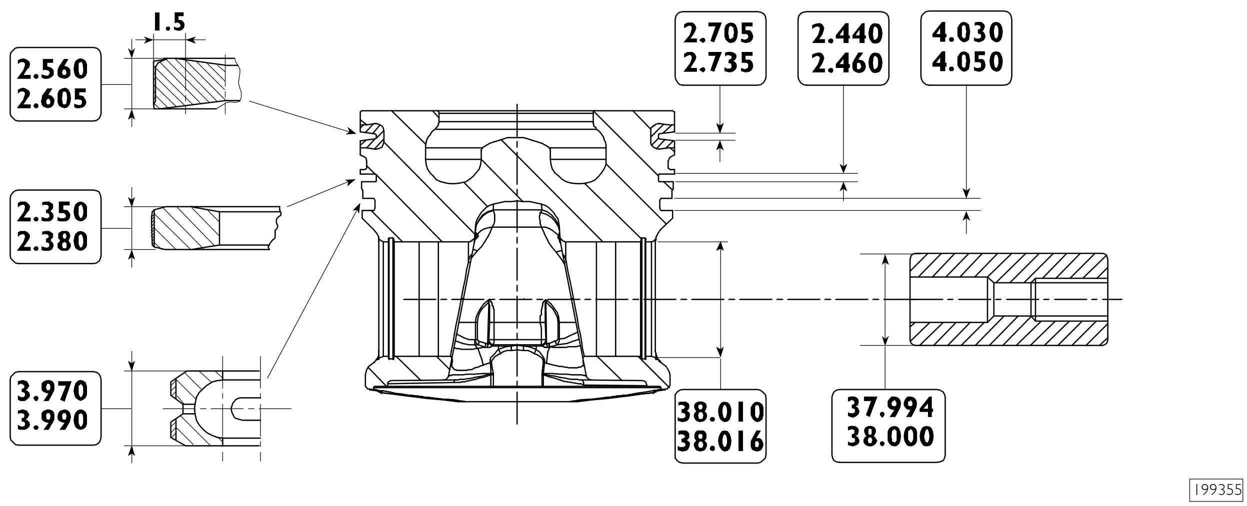
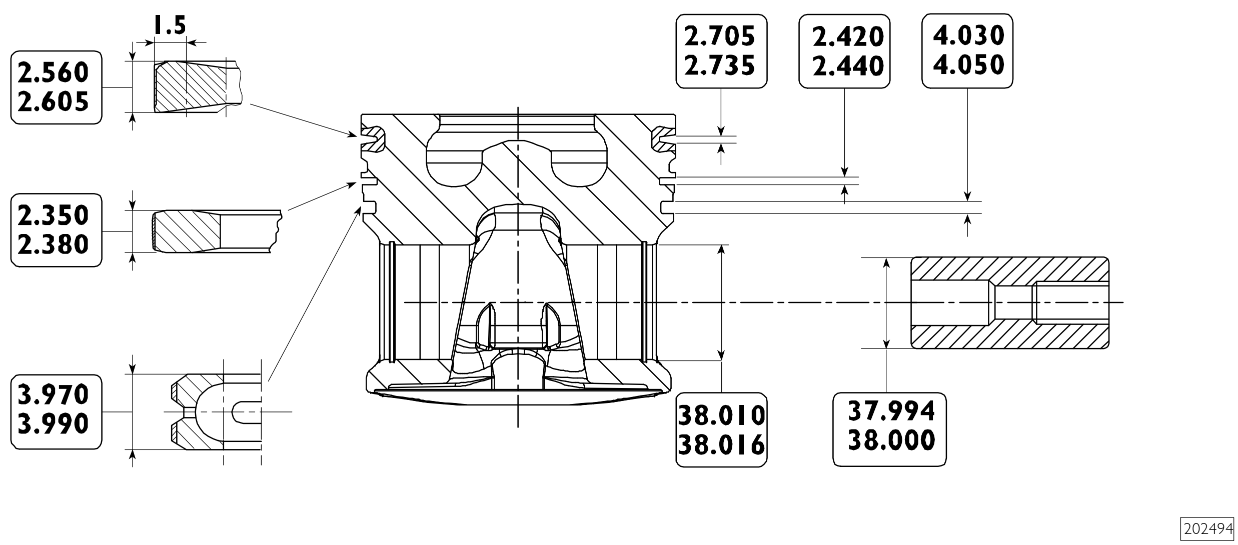


Figure 153 NEF45 TE1F/TE2F engine



MAIN DATA REGARDING KS PISTON, PIN AND CIRCLIPS

Connecting rods (For all engines)

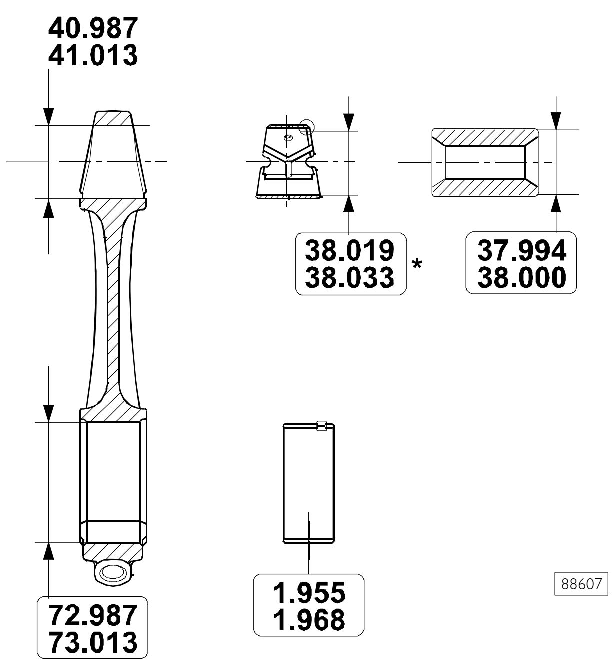
Every connecting rod is marked as follows:

- ❑ On the body and cap with a number showing their coupling and the corresponding cylinder into which it is to be fitted. In case of replacement it is therefore necessary to mark the new connecting rod with the same numbers of the replaced one.
- ❑ On the connecting rod body with a letter showing the weight of the connecting rod assembled at production:
  - V, 1560 ÷ 1600 g (marked in yellow);
  - W, 1601 ÷ 1640 g (marked in green);
  - X, 1641 ÷ 1680 g (marked in blue);

Replacement connecting rods are provided with class We marked in green.

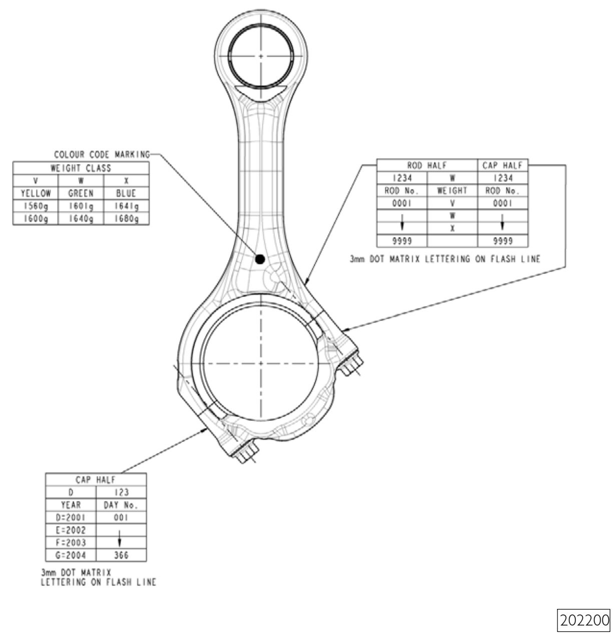
Removal of material is not permitted

Figure 154



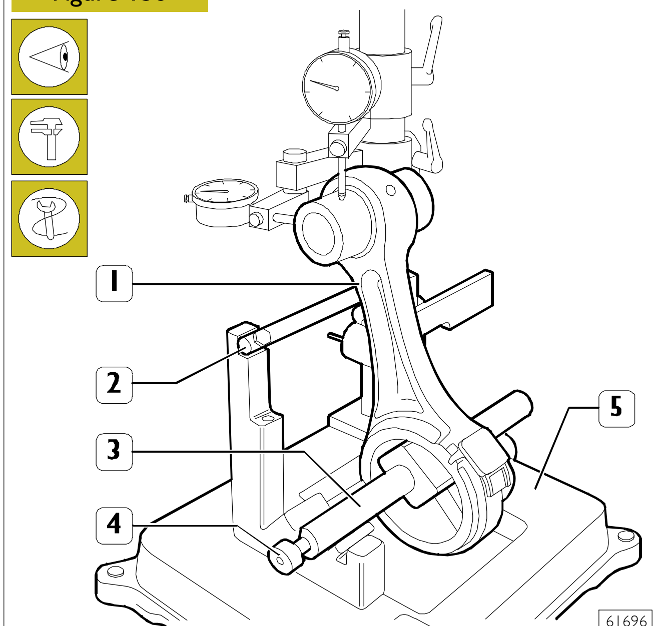
NOTE To obtain best coupling the connecting rod cap coupling surfaces are knurled. It is therefore recommended to not remove knurling.

Figure 155



Connecting rod check

Figure 156



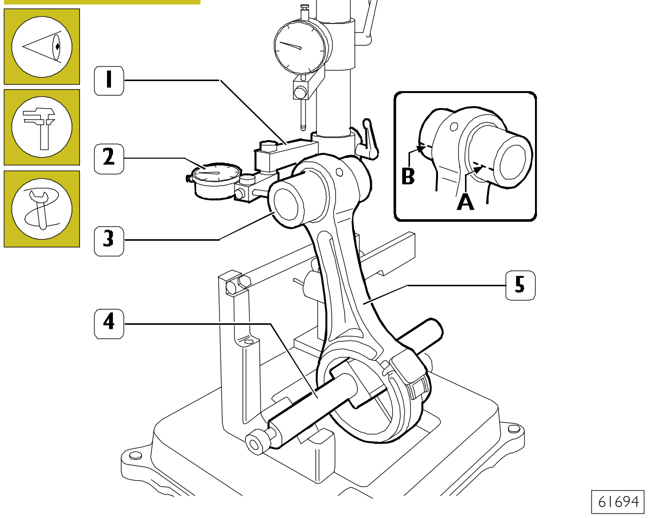
Checking axes alignment

Check the connecting rods axes for parallelism (1) using a suitable device (5) and proceeding as follows.

Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).

Place the spindle (3) on the "V" prisms supporting the connecting rod (1) on the stop rod

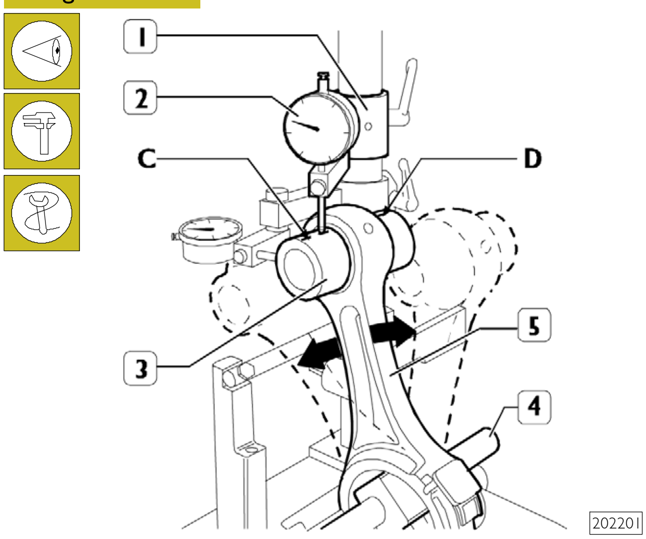
Figure 157



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

Position the dial gauge (2) support (1) to obtain a preload of ~ 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 must be no greater than 0.08 mm.

Figure 158



Bending check

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

Position the vertical support (1) of the dial gauge (2) so that it rests on the pin (3) at point C.

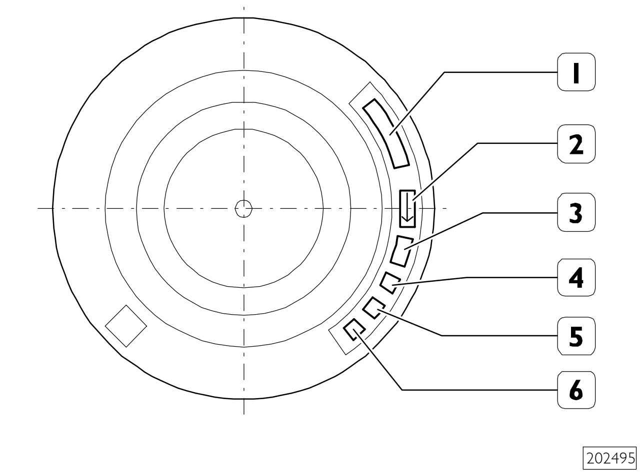
Swing the connecting rod forward and backward to find the highest position of the pin and when that is reached, reset the dial gauge (2).

Move the spindle (4) with the connecting rod (5) and repeat the check on the highest point on the opposite side D of the pin (3).

The difference between point C and point D should not be greater than 0.08 mm.

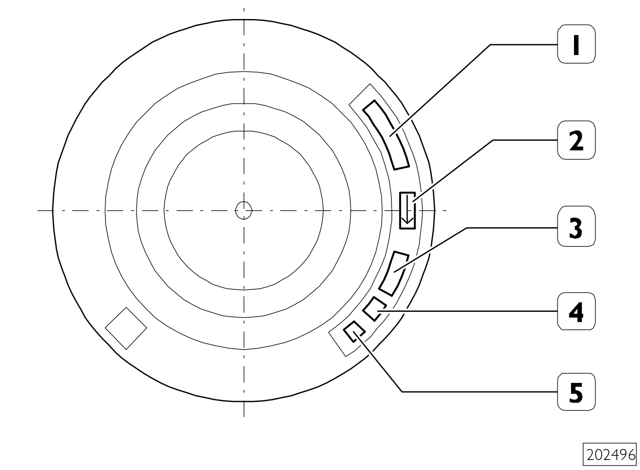
Connecting rod and piston assembly

Figure 159 NEF45 SM1F engine



1. Client Code - 2. Laser stamp "ARROW" - 3. Laser stamp Data - 4. Laser stamp "U" - 5. Laser stamp WORK SHIFT - 6. Laser stamp PRODUCTION LINE

Figure 160 NEF45 TE1F/TE2F engine



1. Stamp IVECO Part Number - 2. Stamp arrow - 3. Stamp date - 4. Stamp "U" for control of US insert attachment - 5. Mahle product tracking

Connecting rod-piston pairing

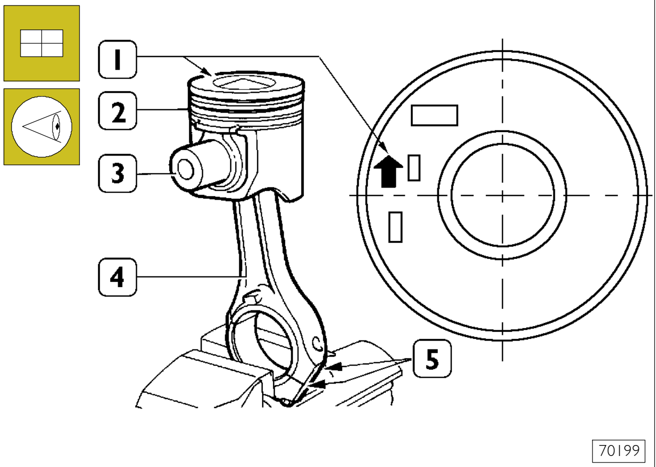
Box "I": month and year of registration;

Box "N": engine variant to be completed according to engine records (last three digits of the theoretical code);

Box "P": Serial number to be assigned in the manufacturing plant;

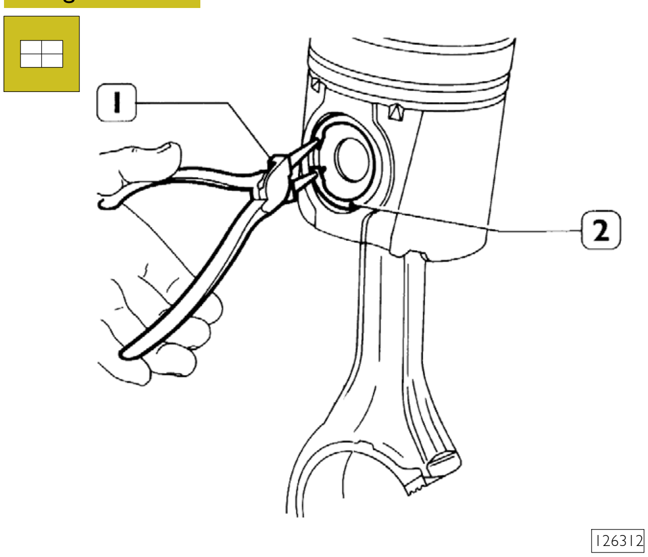
For the remaining data to be entered onto the plate, refer to the engine details of P.N. 504257007 (file in D.B. Matrix)

Figure 161 (For all engines)



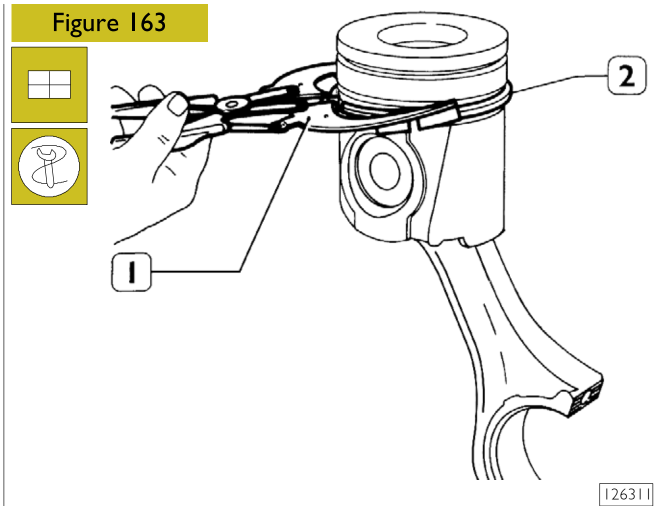
Connect piston (2) to the connecting rod (4) with pin (3) so that the reference arrow (1) for fitting the piston (2) into the cylinder barrel and the numbers (5) stamped on the connecting rod (4) are read as shown in the figure.

Figure 162



Fit the pin fastening circlips (2).

Figure 163



Fitting piston rings

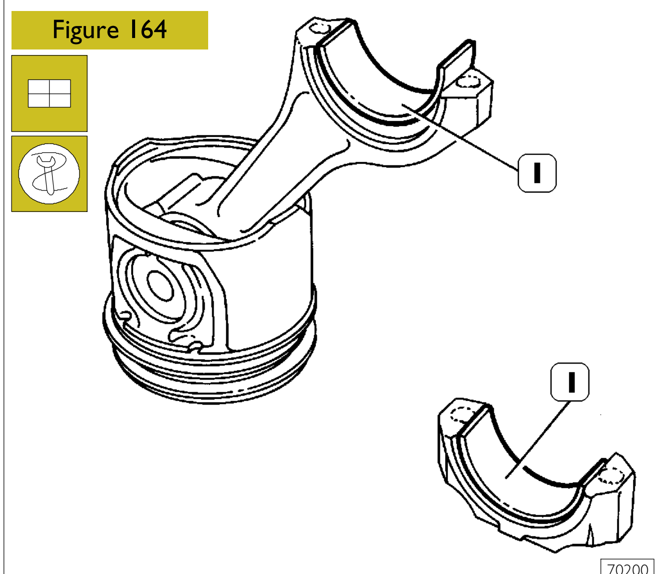
Use callipers 99360183 (1) to fit the circlips (2) on the piston.

Piston rings shall be fitted with the marking "TOP" facing upwards and their openings shall be displaced with each other by 120°.

NOTE Spare piston rings are supplied in the sizes below:

- standard;
- increased by 0.4 mm.

Figure 164



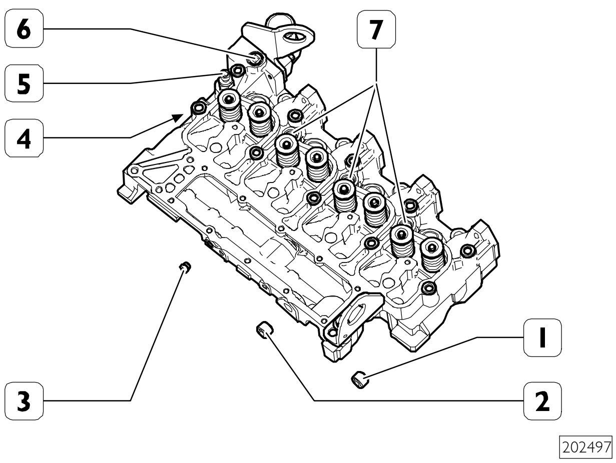
Fit half bearings (1) on connecting rod and cap.

NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal. Do not make any adjustment on the half-bearings.

Cylinder head

Cylinder head assembly removal

Figure 165 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 58

- ❑ Unscrew the threaded plug (3).
- ❑ Check the hydraulic seal using a suitable tool. Pump in water heated to
  ~ 90°C at a pressure of 2-3 bar.

Hydraulic seal

- ❑ Replace the cast hole plugs (7) if leaks are found, use the proper driver for their removal - refitting.
- ❑ Undo the plug (2).
- ❑ Unscrew the water temperature sensor (5).
- ❑ Unscrew the deaeration pipe tapered threaded plug (6).

Ref.	No.	Screws description
(2)	1	Plug
(5)	1	Sensor
(6)	1	Plug 1/2"

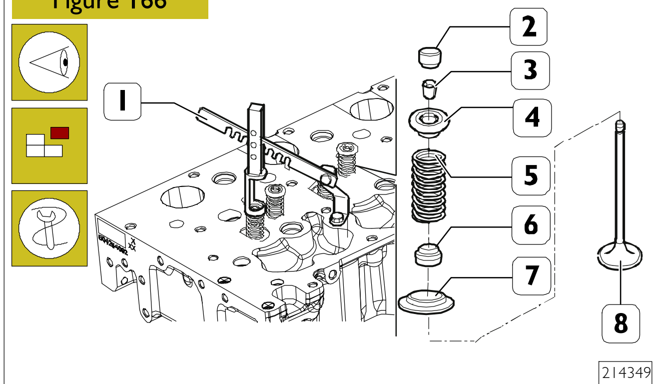
NOTE Before fitting the plugs, apply a layer of water-repellent sealant onto the seal surface.

Replace the cylinder head if leaks are found.

- ❑ Remove the core plugs (4 and 7).

Valve unit removal

Figure 166

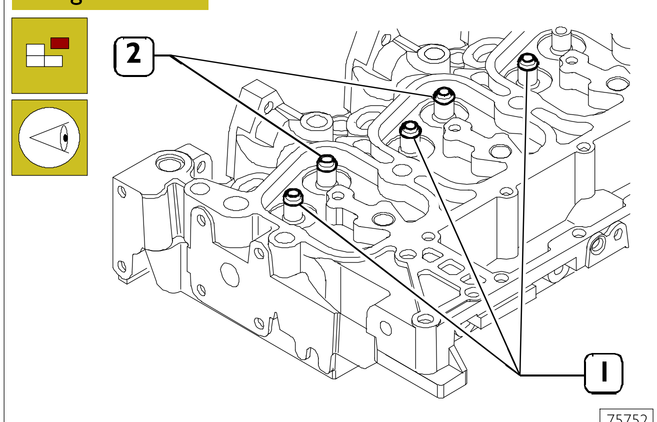


NOTE Before removing the valves from the cylinder head, number them so that they can be re-installed in the same positions they were removed from if they are to be re-used.

A = exhaust side.

- ❑ Valve removal is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to remove the valve cap (2) and the cotters (3). Then remove: plate (4) and spring (5).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head, remove the valve (8), the lower spring seat (7) and the oil seal (6).

Figure 167



- ❑ Remove the sealing rings (1 and 2) from the relevant valve guides.

NOTE The seal rings (1) for the intake valves are yellow.

The sealing rings (2) for the exhaust valve are green.

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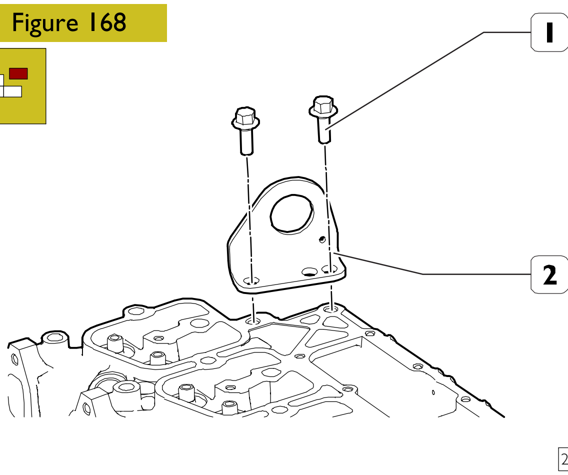
Figure 168



- Unscrew the screws (1).
- Remove the lifting eyelet (2).

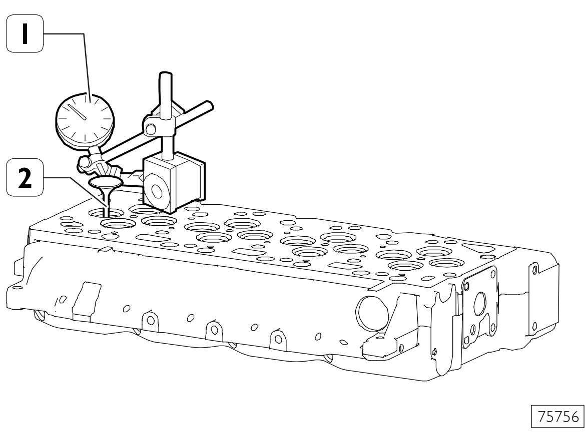
Ref.	No.	Screws description
(1)	2	Screw M12x1.75

Surfaces on lower side of cylinder head

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

If measurement results exceed this value, regrind the cylinder head according to the values and instructions provided in the figure below.

Figure 169

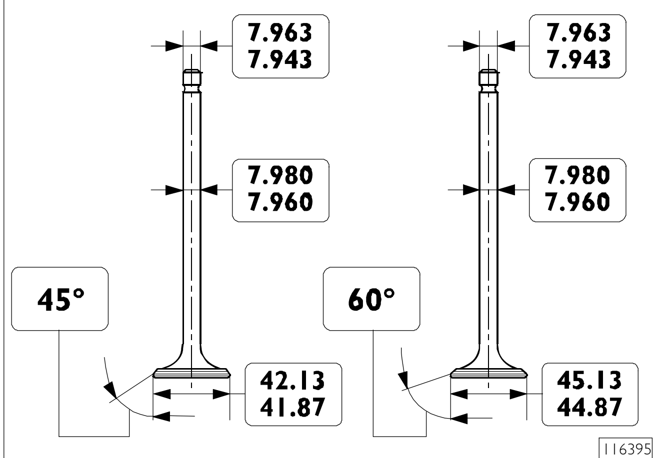


The rated thickness A for the cylinder head is 95 ± 0.25 mm, max. metal removal must not exceed thickness B by 0.13 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to meet the prescribed valve recess.

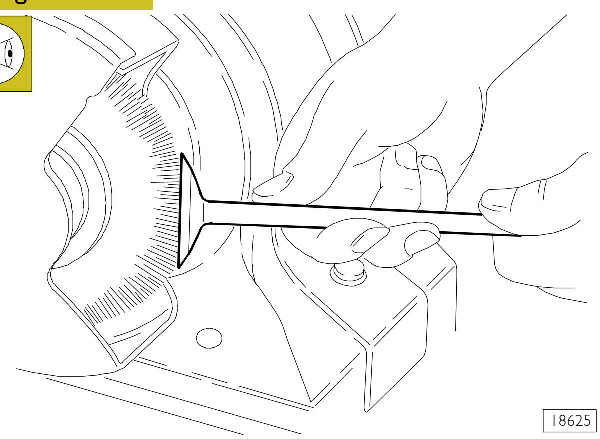
Intake and exhaust valves

Figure 170



INTAKE AND EXHAUST VALVE MAIN DATA

Figure 171



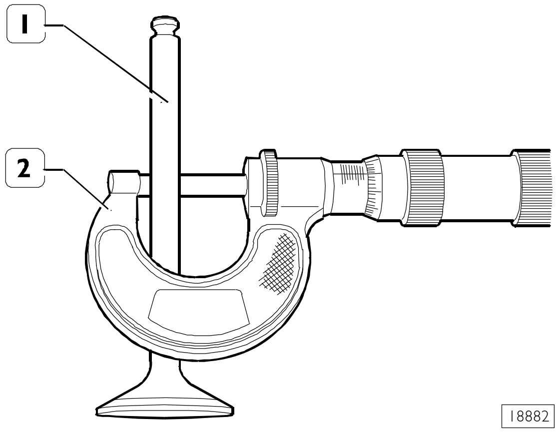
Valve descale, check and grind

Remove all carbon deposits from the valves using a wire brush.

Check that the valves show no signs of seizing, cracks or burns.

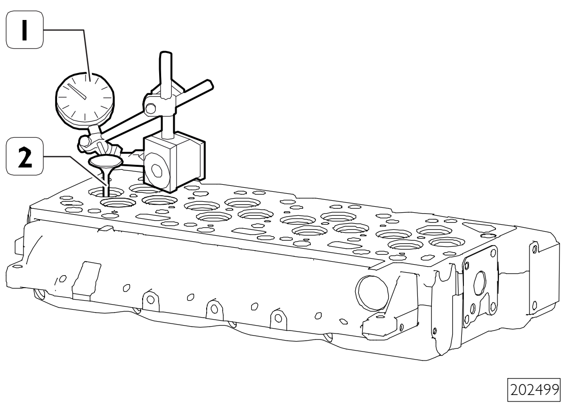
Regrind the valve seats, if required, removing as little material as possible.

Figure 172



Use micrometer (2) to measure valve (1) stem: it must be 7.960 - 7.980 mm.

Figure 173

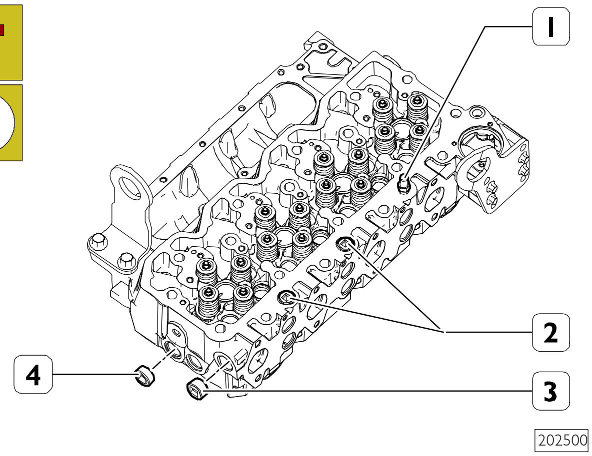


Checking clearance between valve stem, valve guide and valve centring

Use a magnetic-base dial gauge (1) set as shown, the assembling clearance must be 0.056 - 0.096 mm.

Making the valve (2) turn, check that the run out error is no greater than 0.03 mm.

Figure 174 NEF45 TE1F/TE2F engine



☞ NEF45 SM1F engine Page 61

- ❑ Unscrew the plugs (3 and 4).
- ❑ Check the hydraulic seal using a suitable tool. Pump in water heated to ~ 90°C at a pressure of 2-3 bar.

Hydraulic seal

- ❑ Replace the cast hole plugs (5) if leaks are found, use the proper driver for their removal - refitting.
- ❑ Unscrew the plugs (2)
- ❑ Unscrew the terminal fitting (1) of the air bleed pipe.

Ref.	No.	Screws description
(1)	1	Union 1/4"
(2)	2	Plug
(3)	1	Plug 3/4"
(4)	1	Plug 3/4"

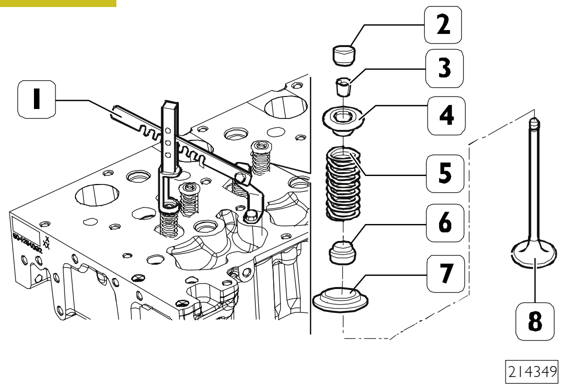
NOTE Before fitting the plugs, apply a layer of water-repellent sealant onto the seal surface.

Replace the cylinder head if leaks are found.

- ❑ Remove all the core plugs.

Valve unit removal

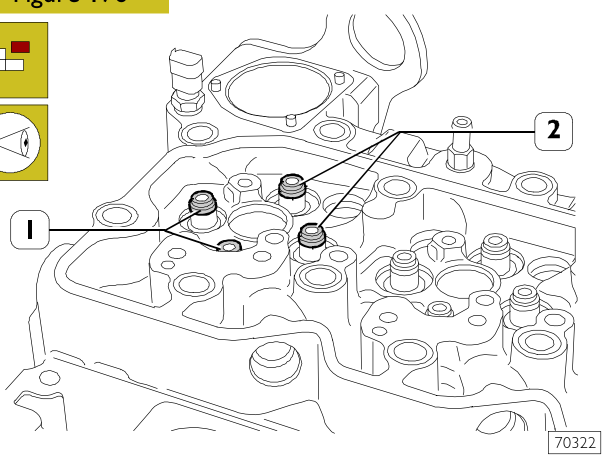
Figure 175



NOTE Before removing the valves from the cylinder head, number them so that they can be re-installed in the same positions they were removed from if they are to be re-used.

- ❑ Valve removal is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to remove the valve cap (2) and the cotters (3). Then remove: plate (4) and spring (5).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head, remove the valve (8), the lower spring seat (7) and the oil seal (6).

Figure 176



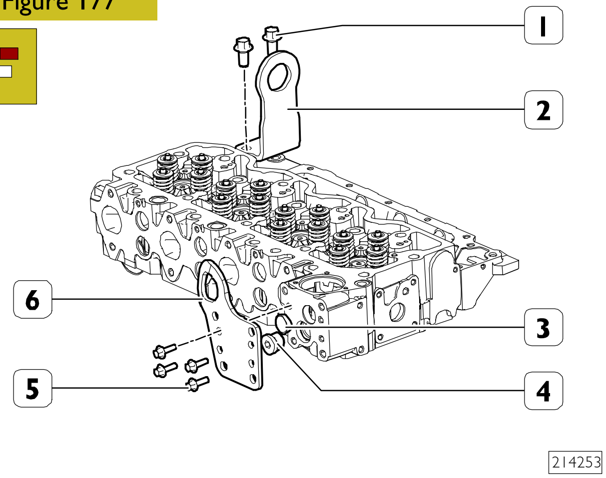
- ❑ Remove the sealing rings (1 and 2) from the relevant valve guides.

NOTE The seal rings (1) for the intake valves are yellow.

The sealing rings (2) for the exhaust valve are green.

Lifting eyelet removal

Figure 177



- ❑ Unscrew the screws (5).
- ❑ Remove the lifting eyelet (6).
- ❑ Unscrew the threaded plug (4) and the core plug (3).
- ❑ Unscrew the screws (1) and remove the lifting eyelet (2).

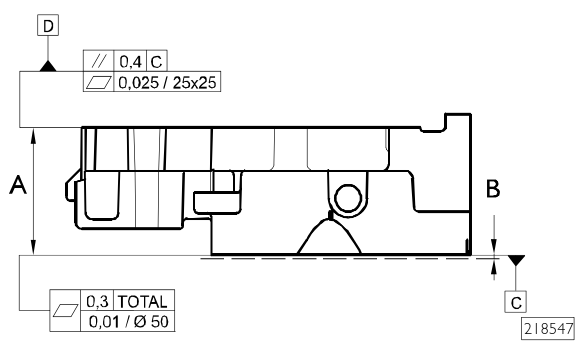
Ref.	No.	Screws description
(1)	2	Screw M12x1.75x25
(5)	4	Screw M12x1.25x25

Surfaces on lower side of cylinder head

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

If measurement results exceed this value, regrind the cylinder head according to the values and instructions provided in the figure below.

Figure 178

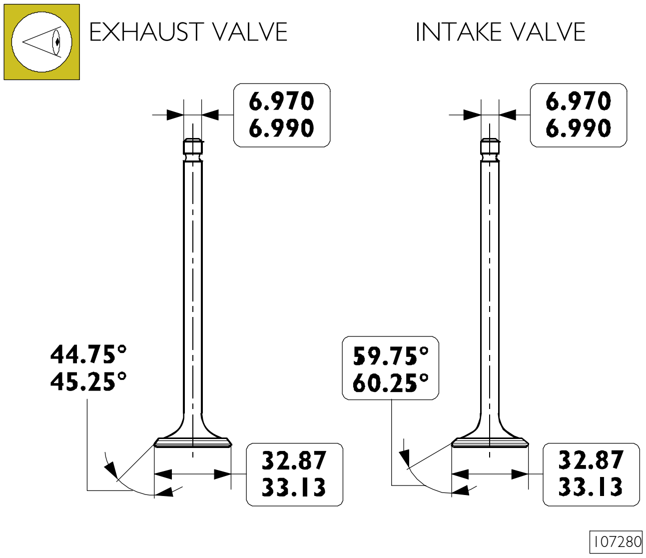


The rated thickness A for the cylinder head is 95 ± 0.25 mm, max. metal removal must not exceed thickness B by 0.13 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to meet the prescribed valve recess.

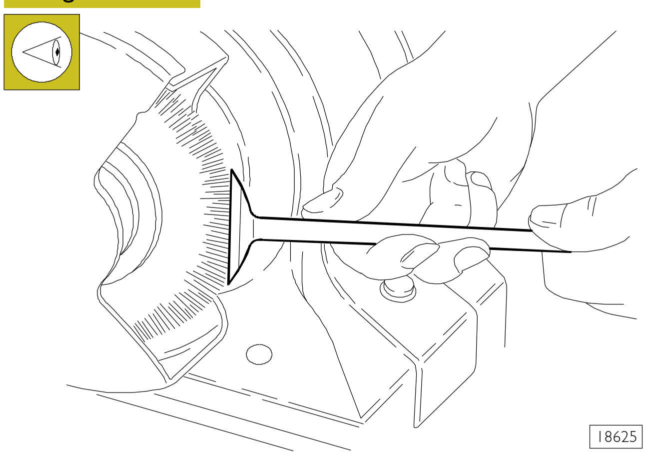
Intake and exhaust valves

Figure 179



INTAKE AND EXHAUST VALVE MAIN DATA

Figure 180

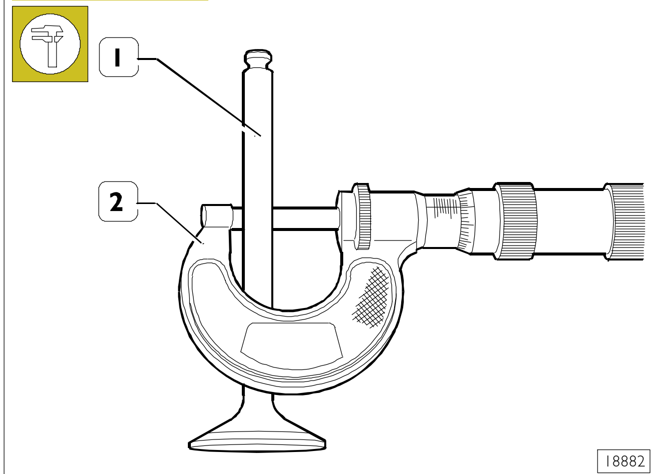


Valve descale, check and grind

Remove all carbon deposits from the valves using a wire brush. Check that the valves show no signs of seizing, cracks or burns.

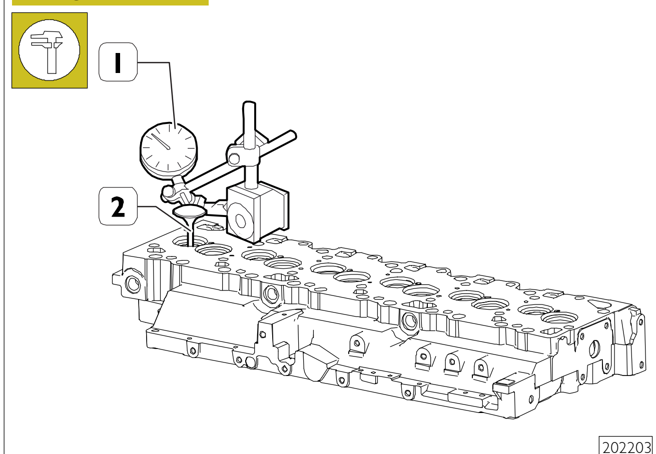
Regrind the valve seats, if required, removing as little material as possible.

Figure 181



Use micrometer (2) to measure valve (1) stem: it must be 6.990 ÷ 7.01 mm

Figure 182



Checking clearance between valve stem, valve guide and valve centring

Use a magnetic-base dial gauge (1) set as shown, the assembling clearance must be 0.056 - 0.096 mm.

Making the valve (2) turn, check that the run out error is no greater than 0.03 mm.

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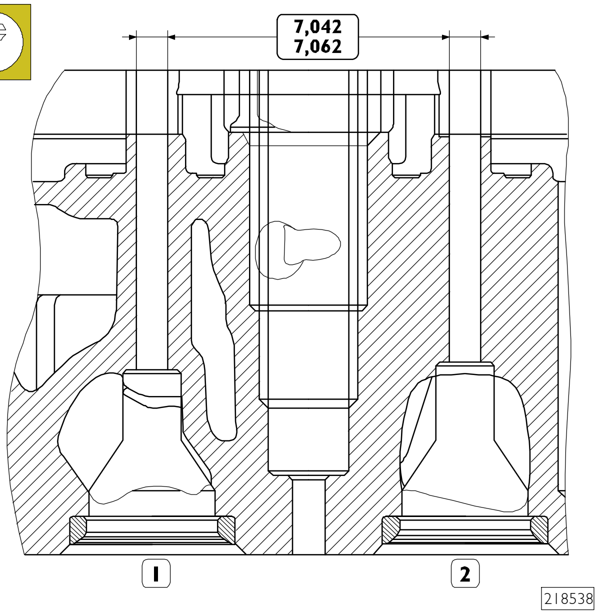
Valve guides

Figure 183 (For all engines)

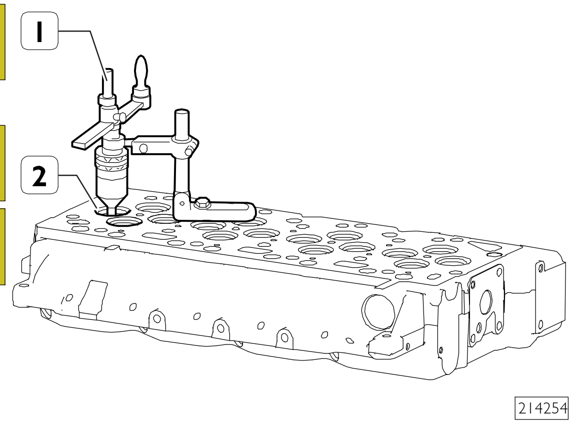


1. Exhaust - 2. Intake

Use a bore gauge, measure the internal diameter of the valve guides; it must be equal to the value shown in the figure.

Valve seats

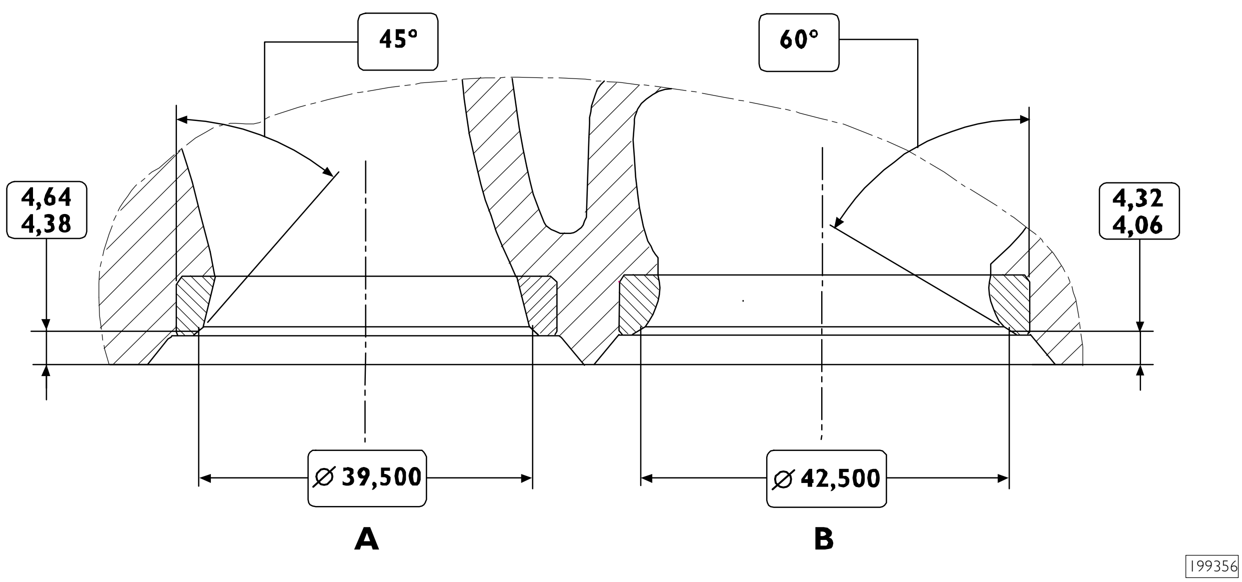
Figure 184



Regrinding - replacing the valve seats

Check the valve seats (2). If light scratches or burns are found, go over the surface with a suitable tool (1) according to the slope values given in Figure 185.

Figure 185



VALVE SEAT MAIN DATA

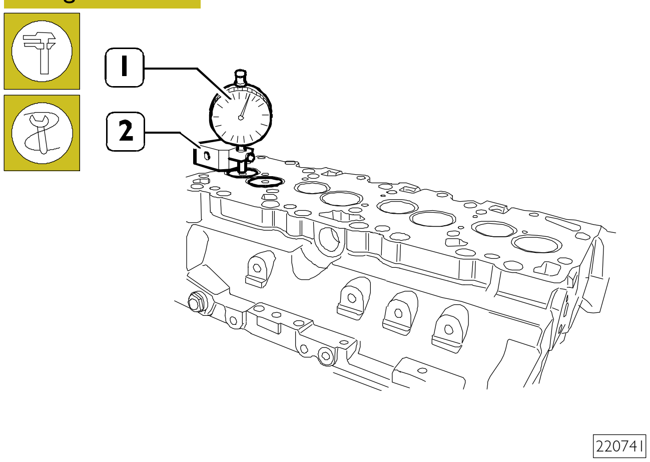
If valve seats cannot be restored just by regrinding, it is possible to replace them with spare seats.

Using a specific tool and taking care not to nick the cylinder head, remove as much material as possible from the valve seats until they can be removed from the cylinder head with a punch.

Heat the cylinder head to 80 ÷ 100° C and use a suitable driver to install new pre-cooled valve seats in it.

Then use a suitable tool to go over the valve seats according to the values shown in Figure 185.

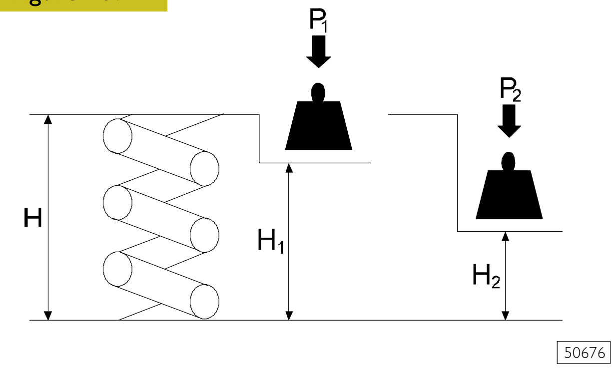
Figure 186



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

Valve springs

Figure 187



KEY DATA FOR CHECKING INTAKE AND EXHAUST VALVE SPRINGS

Before assembling, check the flexibility of the valve springs using the specific tool. Compare the elastic deformation and load data with those of the new springs shown in the following table.

NEF45 SM1F engine

Height	Under a load of
mm	N
H (free) 63.50	0
H1 49.02	329
H2 38.20	641

NEF45 TE1F/TE2F engine

Height	Under a load of
mm	N
H (free) 47.75	0
H1 35.53	339.8 ± 19
H2 25.2	741 ± 39

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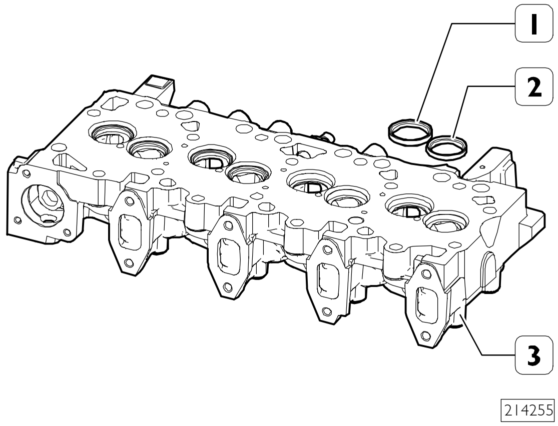
Cylinder head assembly fitting

Surfaces on lower side of cylinder head

Removal of valve seats

Figure 188 NEF45 SM1F engine



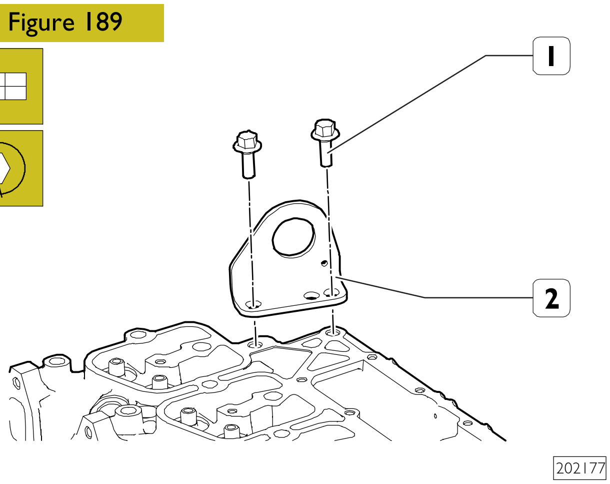
☞ NEF45 TE1F/TE2F engine Page 64

- ❑ Position the valve seats, intake (1) and exhaust (2), on the bottom of the cylinder head (3).

Surfaces on top of cylinder head

Refitting the second lifting eyelet

Figure 189

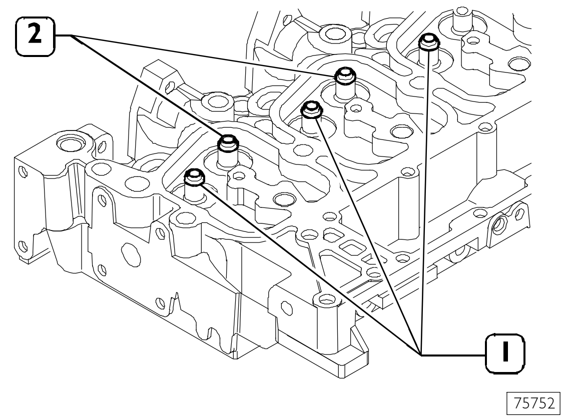


- ❑ Fit the lifting eyelet (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75	77 ± 12 Nm

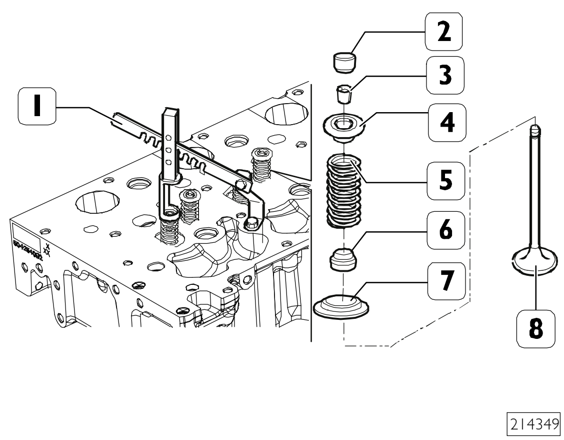
Refitting valve assembly

Figure 190



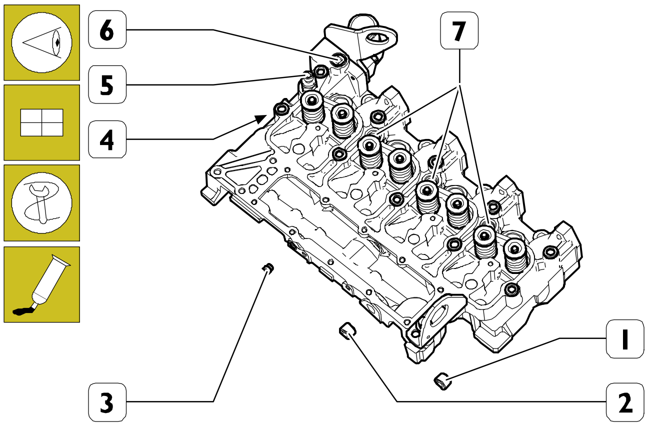
- ❑ Fit the seal rings (1 and 2) on the relative valve guide.

Figure 191



- ❑ Upturn the cylinder head and insert the oil seal (6), the spring seat (7) and the valve (8).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head and insert the spring (5) and the plate (4).
- ❑ Valve assembly is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to insert the cotters (3) and the valve cap (2).

Figure 192



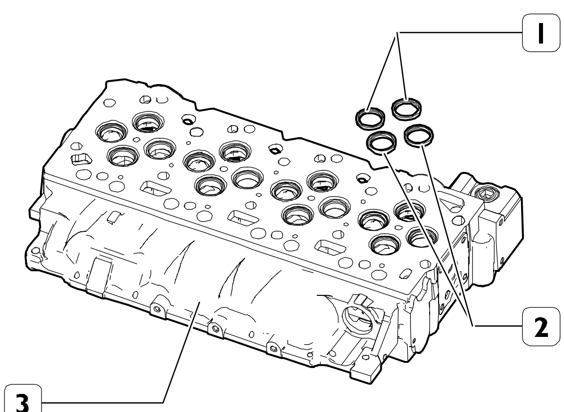
202497

- ❑ Fit the core plugs (4 and 7) after having applied a water-repellent sealant onto the seal.
- ❑ Tighten the deaeration pipe tapered threaded plug (6).
- ❑ Tighten the water temperature sensor (5).
- ❑ Tighten the threaded plug (3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Plug	12 ± 2 Nm
(3)	1	Plug	36 ± 5 Nm
(5)	1	Sensor	36 ± 5 Nm
(6)	1	Plug 1/2"	

Refitting of valve seats

Figure 193 NEF45 TE1F/TE2F engine



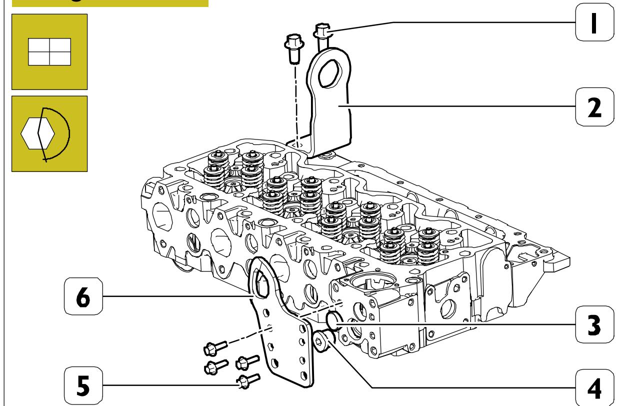
214256

Position the valve seats, exhaust (1) and intake (2), on the bottom of the cylinder head (3).

Lifting eyelet refitting

Surfaces on top of cylinder head

Figure 194



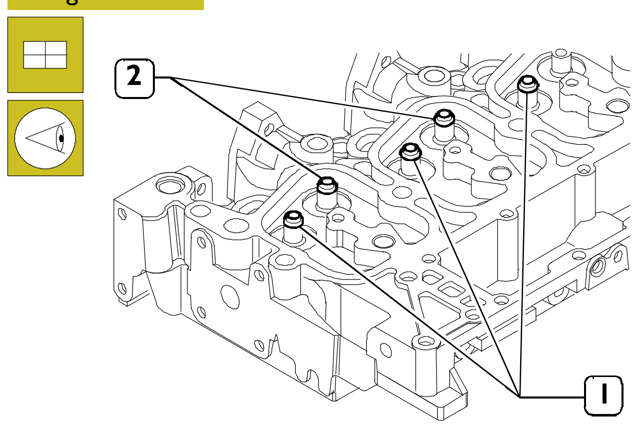
214253

- ❑ Position the lifting eyelet (2) and tighten the screws (1).
- ❑ Insert the core plug (3) and tighten the threaded plug (4).
- ❑ Fit the lifting eyelet (6).
- ❑ Tighten the screws (5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75x25	77 ± 12 Nm
(5)	4	Screw M12x1.25x25	36 ± 5 Nm

Refitting valve assembly

Figure 195



75752

- ❑ Fit the seal rings (1 and 2) on the relative valve guide.

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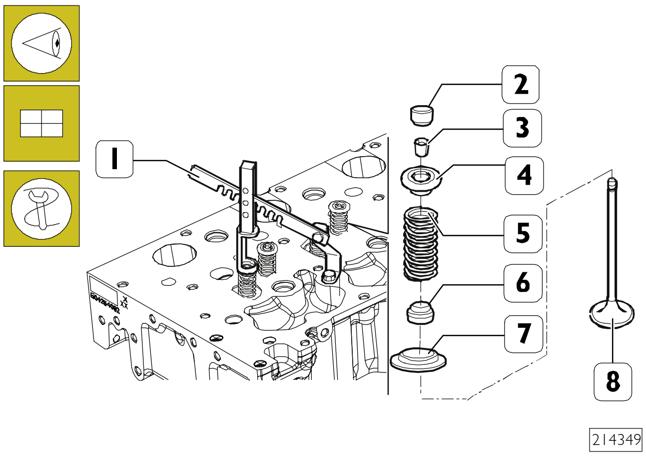
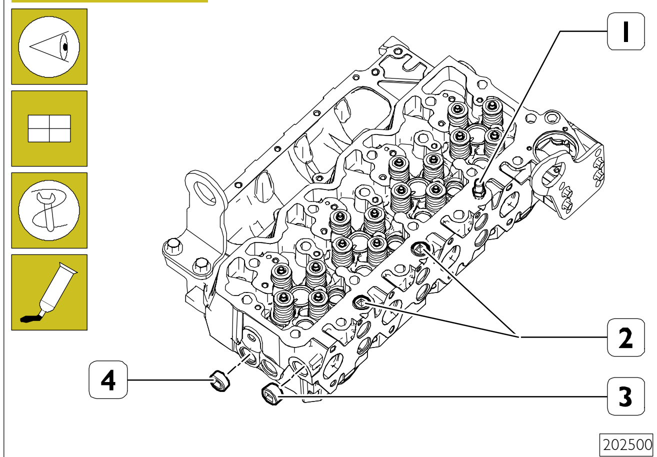
Figure 196



- Upturn the cylinder head and insert the oil seal (6), the spring seat (7) and the valve (8).
- Repeat this operation for all the valves.
- Upturn the cylinder head and insert the spring (5) and the plate (4).
- Valve assembly is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to insert the cotters (3) and the valve cap (2).

Figure 197

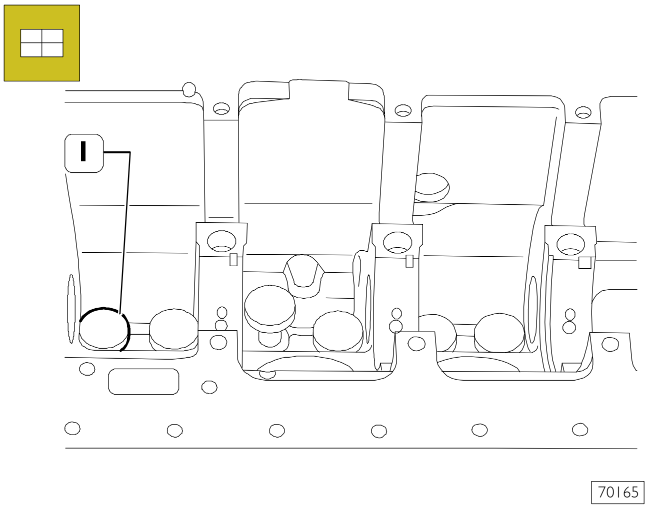


- Fit all core plugs after having applied a water-repellent sealant onto the seal.
- Screw the terminal fitting (1) of the air bleed pipe.
- Tighten the plugs (2).
- Tighten the plugs (3 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Union 1/4"	-
(2)	2	Plug	12 ± 2 Nm
(3)	1	Plug 3/4"	36 ± 5 Nm
(4)	1	Plug 3/4"	36 ± 5 Nm

ENGINE ASSEMBLY AT BENCH (CRANKCASE COMPONENTS)
Refitting tappets

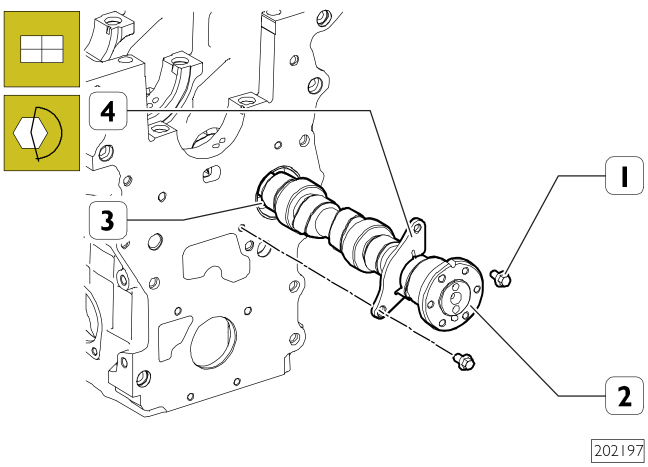
Figure 198 (For all engines)



- ❑ Fit the tappets (1) in the crankcase.

Refitting camshaft

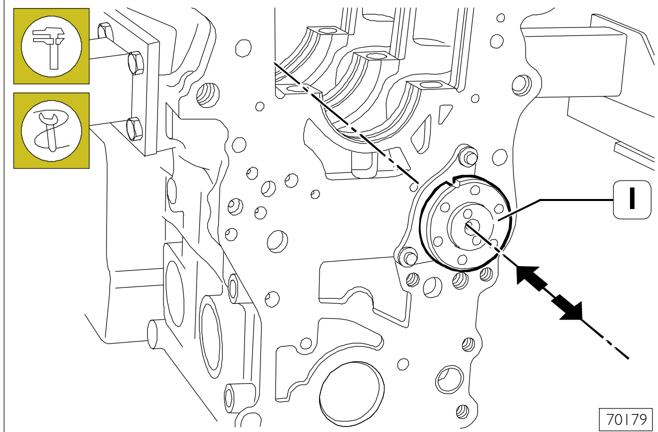
Figure 199



- ❑ Carefully insert the camshaft (2) together with the shoulder plate (4).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x16	24 ± 4 Nm

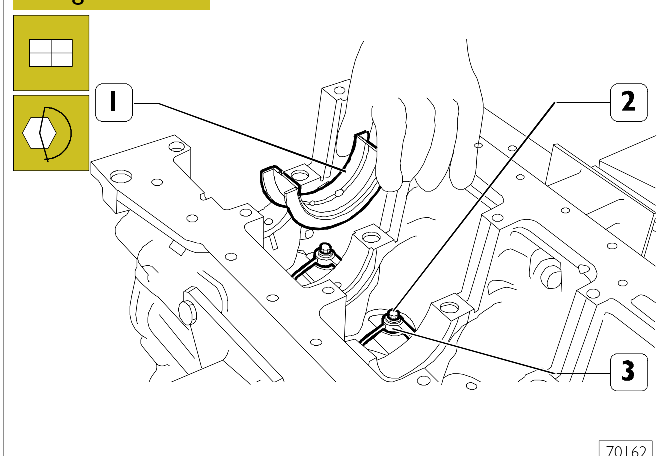
Figure 200



- ❑ Check the axial clearance of the camshaft (1) using tool 99395604.
- ❑ It must be 0.23 ± 0.13 mm.

Refit the oil sprayers and main half bearings

Figure 201

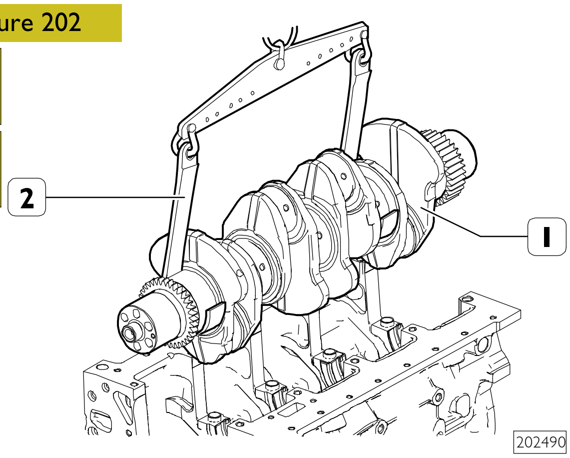


- ❑ Position the oil sprayers (3) and screw in the unions (2).
- ❑ Fit the main half-bearings (1).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	15 ± 3 Nm

Crankshaft refitting

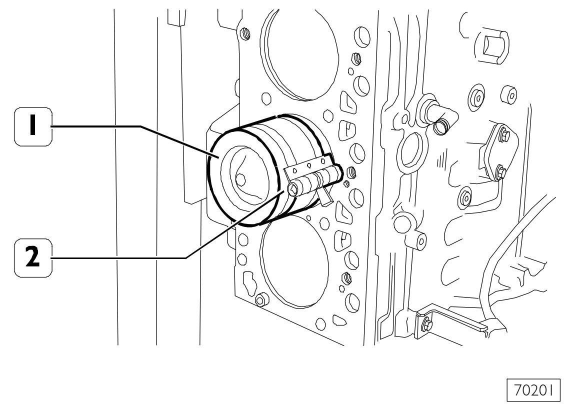
Figure 202



- ❑ Use tool 99360500 (2) to lift the crankshaft (1) and place it inside the crankcase.
- ❑ Check the clearance between the crankshaft main journals and their respective bearings as follows:

Pisting-connecting rod refitting

Figure 203



Lubricate the pistons well, including the piston rings and the inside of the cylinder liners.

With the aid of clamp 99360605 (2), fit the connecting rod-piston assemblies (1) in the cylinder liners, checking that:

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

Figure 204

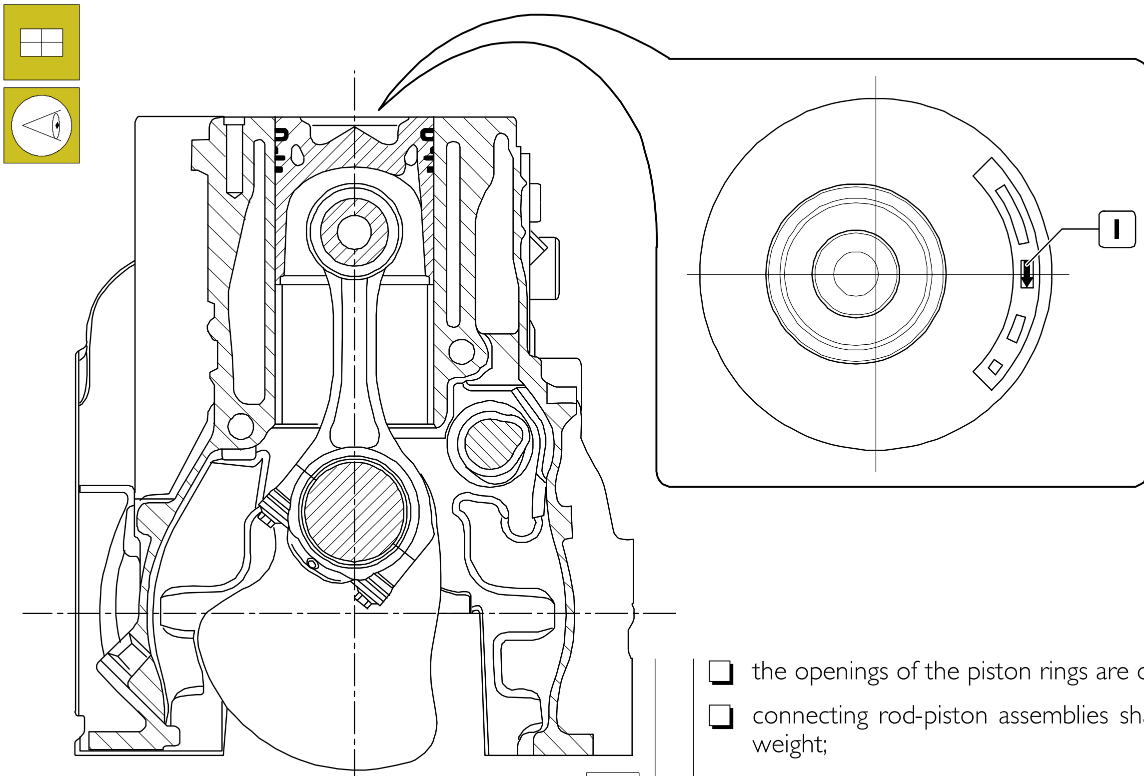
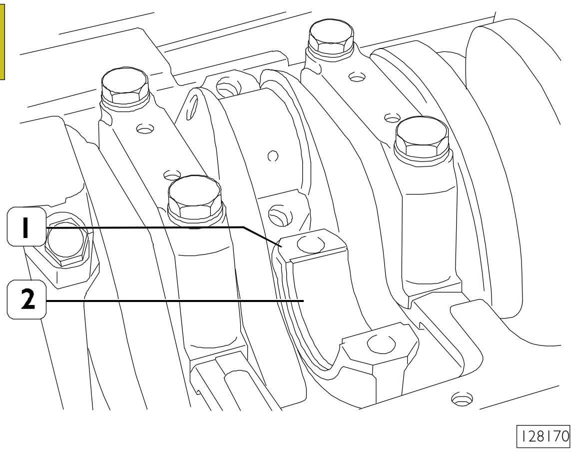


DIAGRAM FOR CONNECTING ROD-PISTON ASSEMBLY FITTING INTO CYLINDERS

- ❑ the openings of the piston rings are offset by 120°;
- ❑ connecting rod-piston assemblies shall have the same weight;
- ❑ the arrow stamped on the piston crown shall be facing the front side of the engine crankcase or the slot obtained on the piston skirt shall be corresponding to the oil nozzle position.

Figure 205



Crankpins assembly clearance measurement

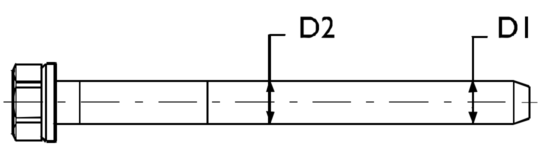
Carry out the following operations to measure the clearance:

- ❑ carefully clean the parts and remove any trace of oil;
- ❑ fit the connecting rod caps (1) with the relevant half bearings (2).

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

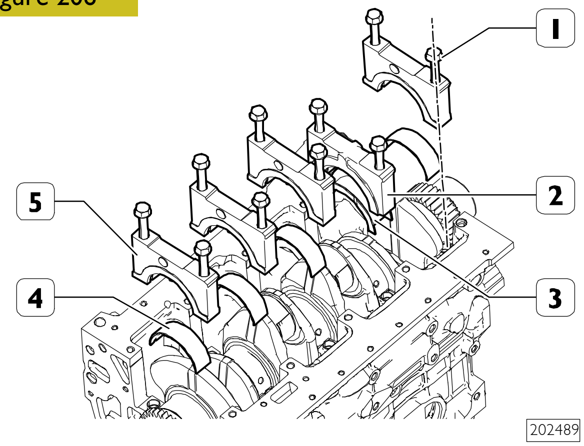
if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



Main bearing caps refitting

Figure 206

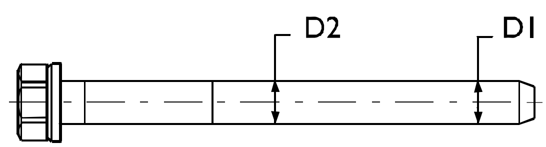


- ❑ Thoroughly clean the parts and eliminate all traces of oil;
- ❑ Fit the lower main half-bearings (4).
- ❑ Fit the cable reference dowel pins.
- ❑ Fit the main bearing caps (5).

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



- ❑ Tighten the main bearing cap screws (1) with a torque wrench.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x120 1st step	80 ± 8 Nm

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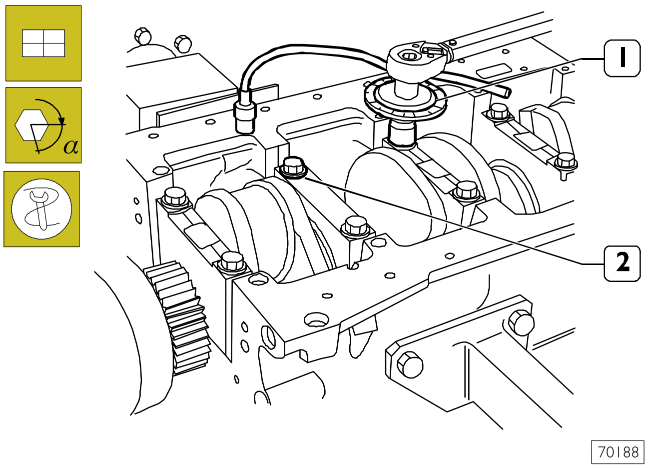
Figure 207

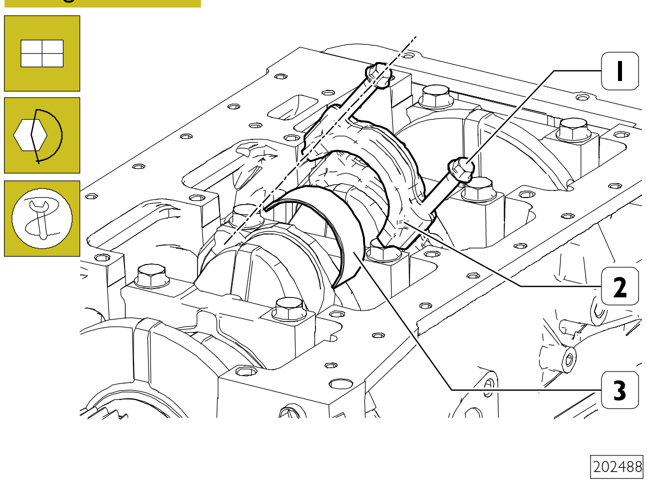


❑ Further tighten the screws (2) with tool 99395216 (1).

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x120 2nd step	90 °

Connecting rod caps refitting

Figure 208

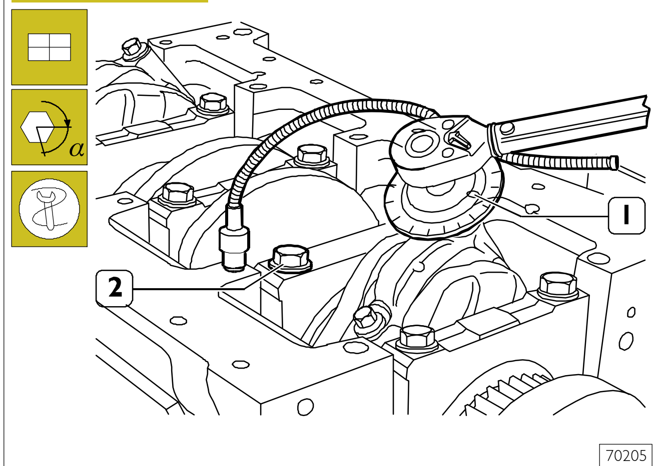


❑ Position the connecting rod caps (2).

❑ Tighten the screws (1) with a torque wrench after lubricating them with engine oil.

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M10x1.25x52 1st step	60 ± 5 Nm

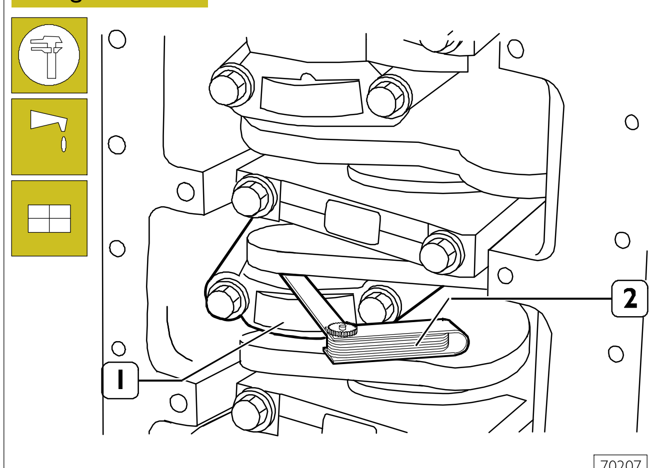
Figure 209



❑ Further tighten the screws (2) with tool 99395216 (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M10x1.25x52 2nd step	60°

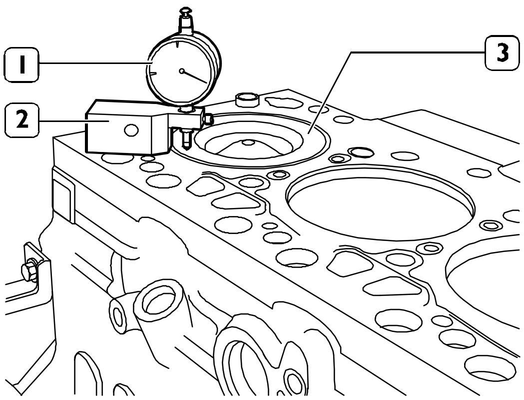
Figure 210



Manually check that the connecting rods (1) are sliding axially on the crankshaft pins and that their end float, measured with feeler gauge (2), is 0.250 - 0.275 mm.

Piston protrusion check

Figure 211



70208

After fitting the connecting rod - piston assemblies, use the dial gauge 39395603 (1) fitted with base 99370415 (2) to check the protrusion of the pistons (3) at T.D.C. in relation to the top crankcase surface.

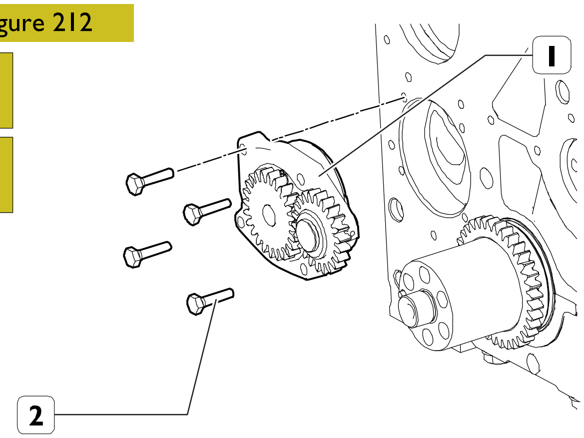
Procedure for calculating the thickness of piston No. 1:

- detect, as shown in the Figure, at the distance of 45 mm from the centre of the piston, protrusions S1 and S2 of the same compared to the upper level of the crankcase and then calculate the average protrusion;
- repeat the operation to calculate the average protrusion of pistons 2, 3, 4, 5 and 6, and then calculate the mean value of the protrusions;
- it must be 0.28 ÷ 0.52 mm.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Oil pump refitting

Figure 212



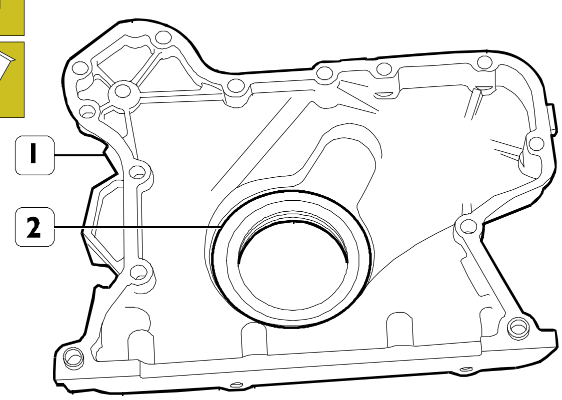
202184

- Position the oil pump (1).
- Tighten the screws (2) of the support.

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	
		1st step	8 ± 1 Nm
		2nd step	24 ± 4 Nm

Removing the front cover sealing ring

Figure 213

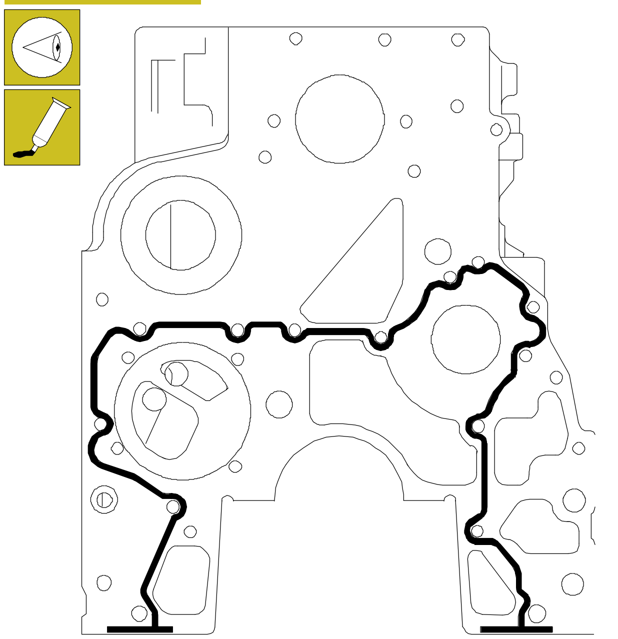


106549

- Remove the sealing ring (2) from the front cover (1) and carefully clean the connection surfaces.

Refitting front cover

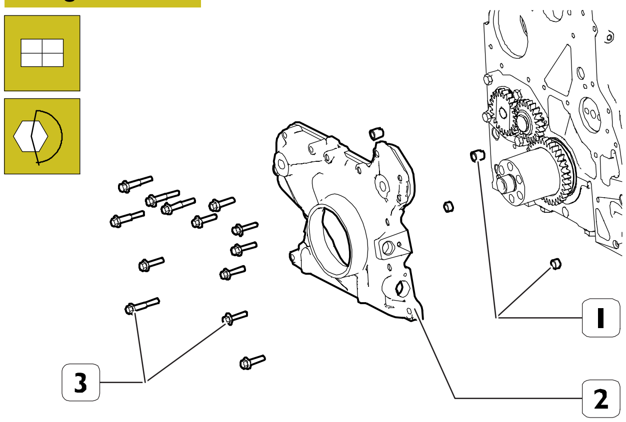
Figure 214



75710

- ❑ Thoroughly clean the contact surface on the engine block and apply sealant LOCTITE 5999 to form a uniform, continuous seam with no lumps.

Figure 215



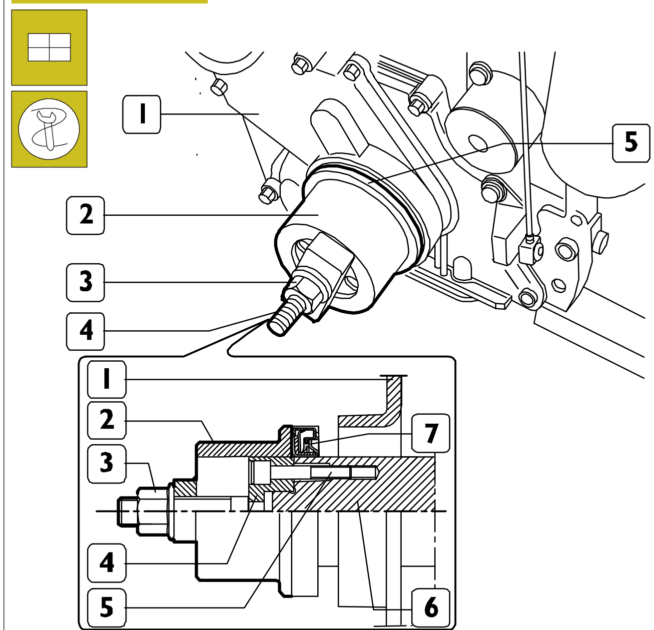
202183

- ❑ Fit the cable reference dowel pins (1).
- ❑ Position the front cover (2) in the relative seat.
- ❑ Tighten the front cover (2) fastening screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	13	Screw M8x1.25	24 ± 4 Nm

Refitting the engine - front cover sealing ring

Figure 216

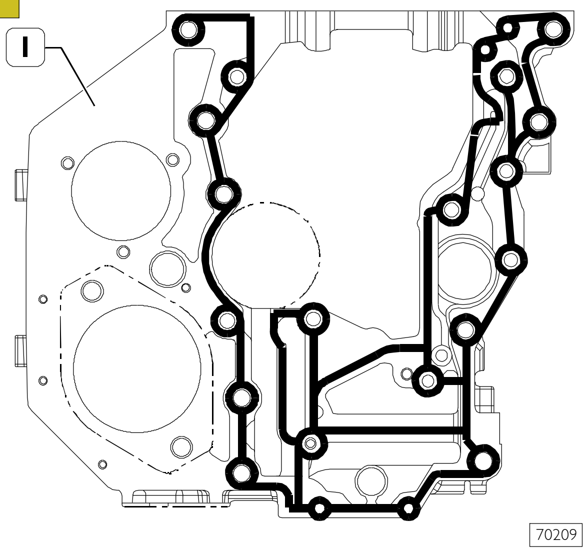


218549

- ❑ Apply tool 99346252 part (4) to the front crankshaft shaft (6), secure it by screws (5) and fit the new sealing ring (7).
- ❑ Position part (2) on part (4); screw down the nut (3) to fit the seal (7) fully inside the front cover (1).

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Timing gear case refitting

Figure 217 NEF45 TE1F/TE2F engine



☞ NEF45 SM1F engine Page 76

DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT ON THE GEAR CASE

- ❑ Carefully clean the timing gear case (1) and the crankcase.

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joints need to be assembled immediately (within 10 - 20 minutes).

Figure 218

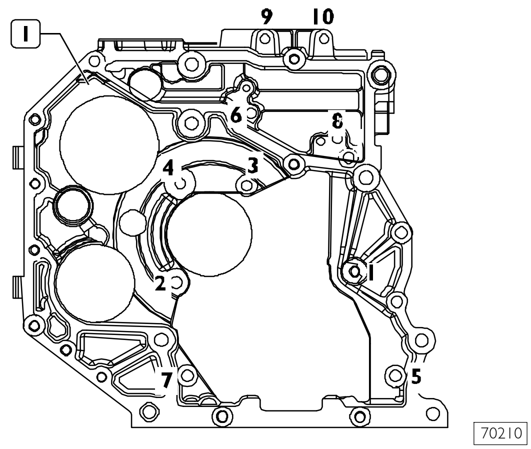
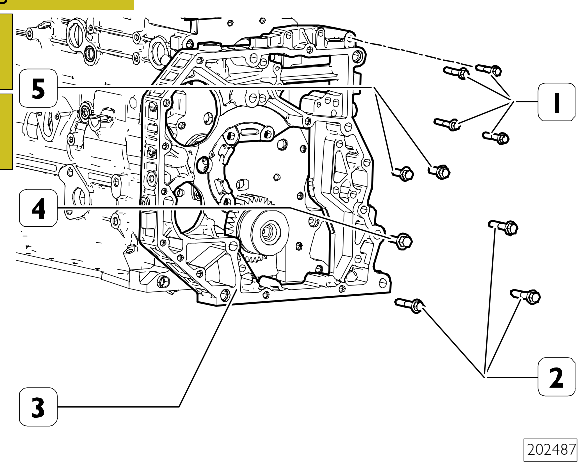


DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

- ❑ Position the case (1) in its seat at the crankcase.

Figure 219



- ❑ Screw the screws (1, 2, 4 and 5) in the position they were in at disassembly.

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25	24 ± 4 Nm
(2)	3	Screw M10x1.5	47 ± 5 Nm
(4)	1	Screw M12x1.75	77 ± 12 Nm
(5)	2	Screw M10x1.5	47 ± 5 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

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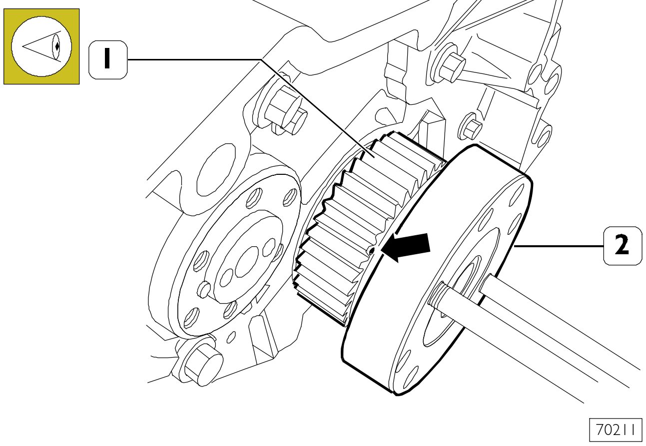
Camshaft gear refitting

Timing procedure

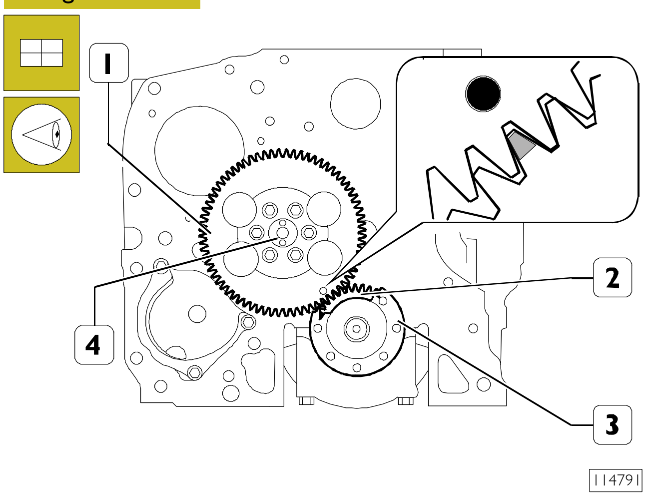
Figure 220



❑ Use a felt-tip pen to highlight the drive gear tooth (1) fitted on the crankshaft (2) with a chamfer (→) on its side for timing.

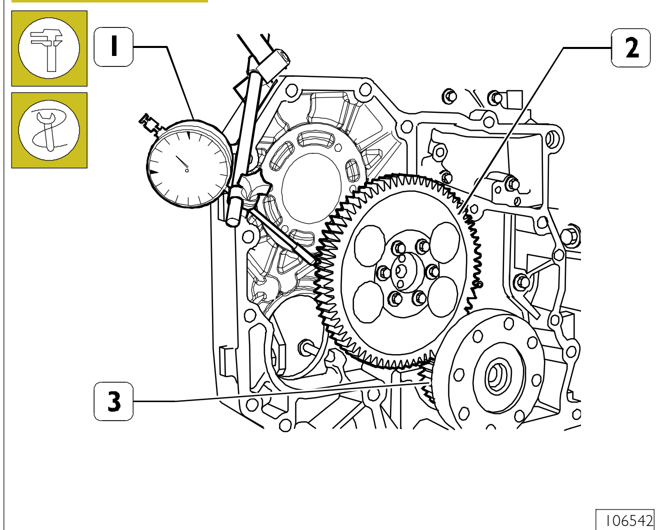
NOTE Screw in the two pins to facilitate crankshaft rotation.

Figure 221



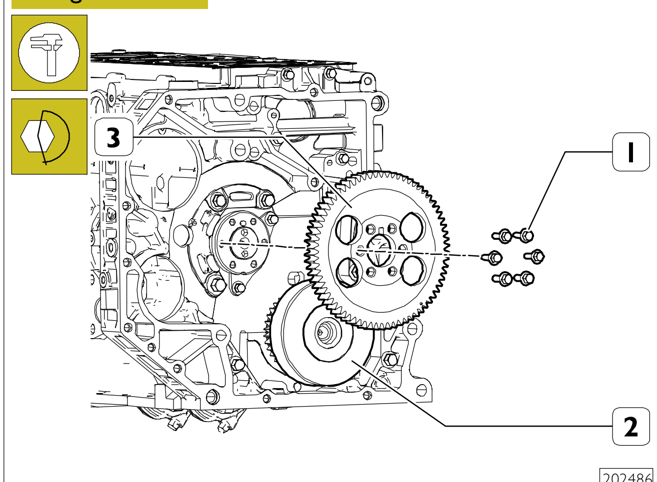
❑ Align the crankshaft (3) and the camshaft (4) so that when the driven gear (1) is mounted onto the latter, the sign stamped on the gear (1) coincides with the bevel gear tooth (2).

Figure 222



❑ Set the dial gauge (1) on the timing gear (2) and check that the clearance between the gears (2) and (3) is between 0.076 ÷ 0.280 mm.

Figure 223



❑ Place the collar (2) in its seat.

❑ Position the gear (3) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	36 ± 2 Nm

Refitting engine flywheel housing

Figure 224

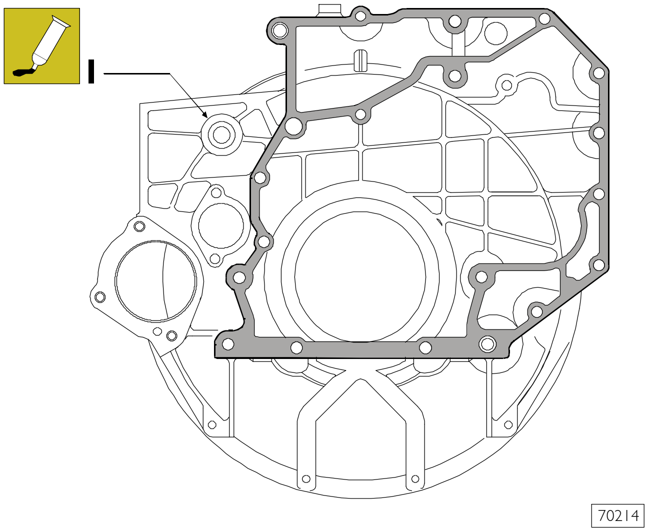


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

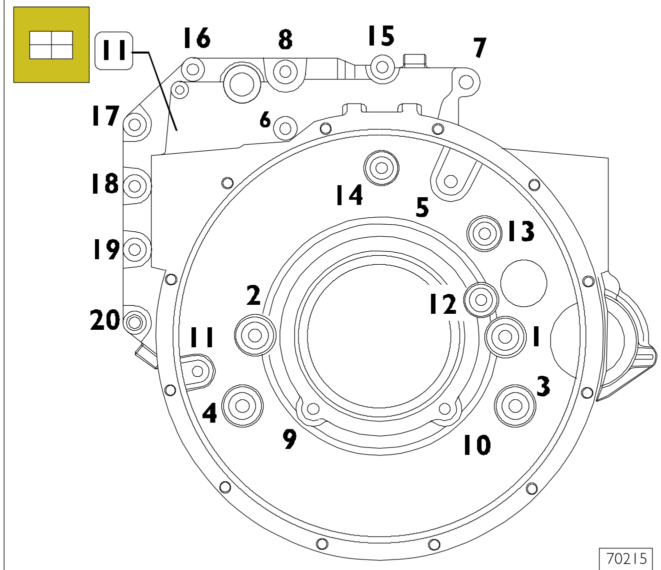
Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joints need to be assembled immediately (within 10 - 20 minutes).

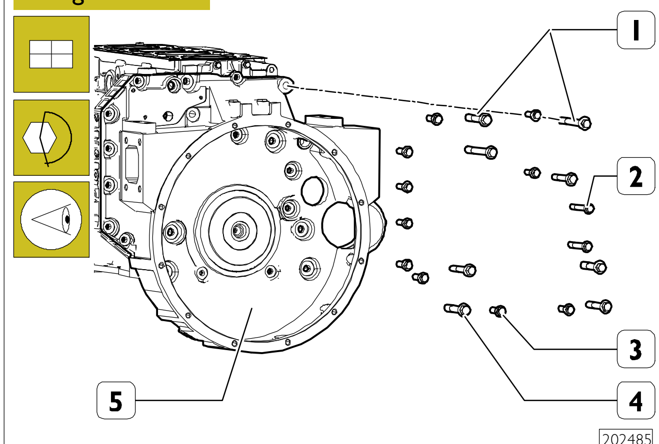
Figure 225



TIGHTENING SEQUENCE DIAGRAM OF FLYWHEEL HOUSING FASTENING SCREWS

- ❑ Position the flywheel housing (1) in its seat at the crankcase.

Figure 226



- ❑ Tighten the screws (1, 2, 3 e 4) fastening the flywheel housing (5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75	85 ± 10 Nm
(2)	2	Screw M10x1.5	49 ± 5 Nm
(3)	10	Screw M10x1.5	49 ± 5 Nm
(4)	6	Screw M12x1.75	85 ± 10 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

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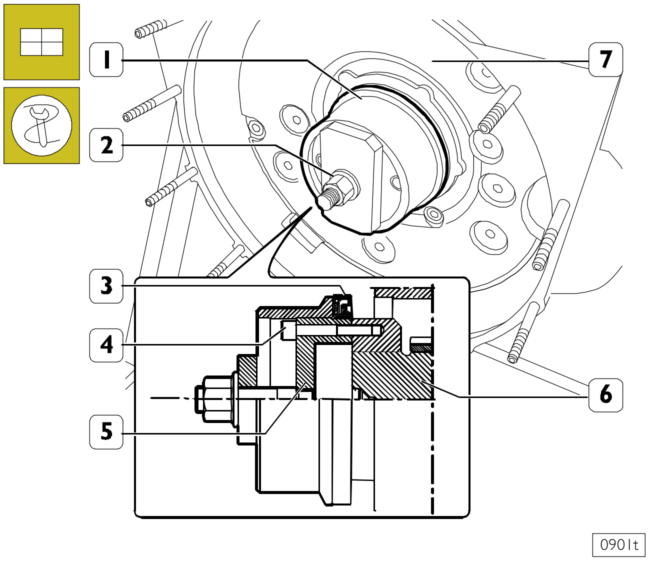
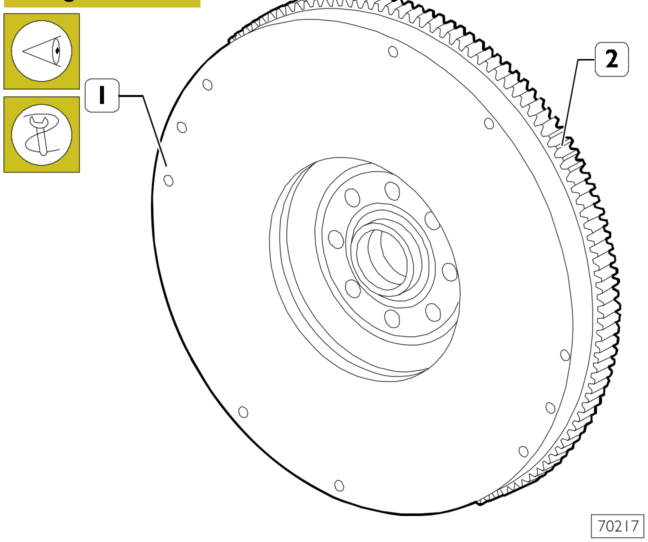
Refitting flywheel cover housing sealing ring

Figure 227



- Apply the tool 99340056 part (5) to the rear crankshaft tang (6), 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).

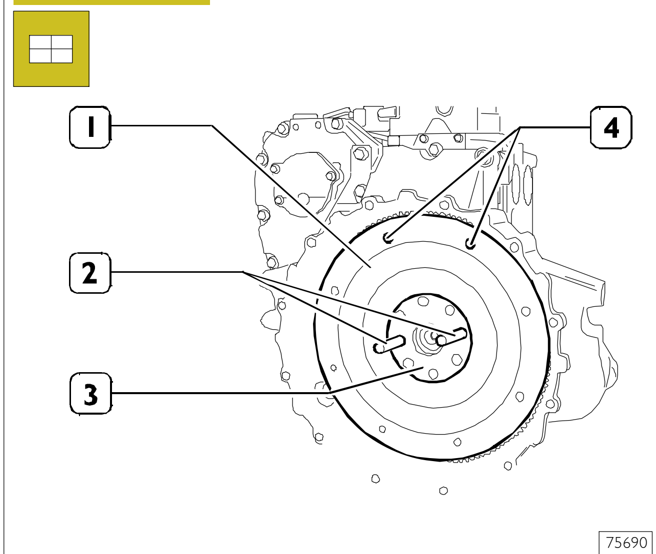
Figure 228



- Check the clutch plate working surface (1) and turn it if scored.
- Check the condition of the ring gear teeth (2). If cracks or excessive wear of the teeth are found, remove it from the engine flywheel (1) with a generic driver and install the new one, previously heated to a temperature of 150° C for 15 to 20 minutes; chamfering on ring gear inside diameter shall be facing the flywheel.

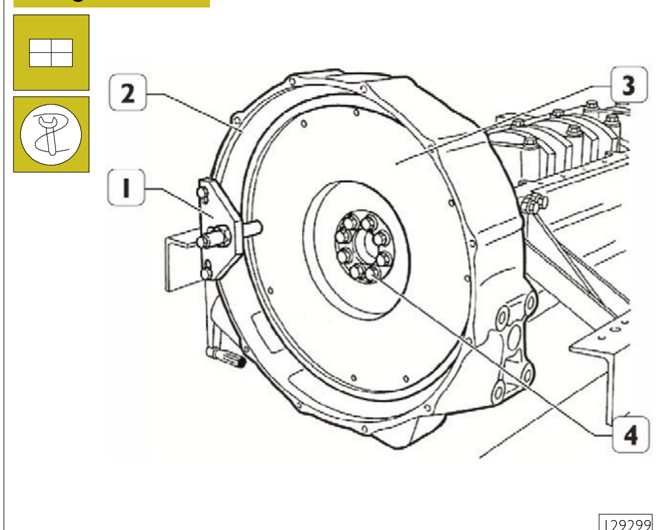
Refitting engine flywheel

Figure 229



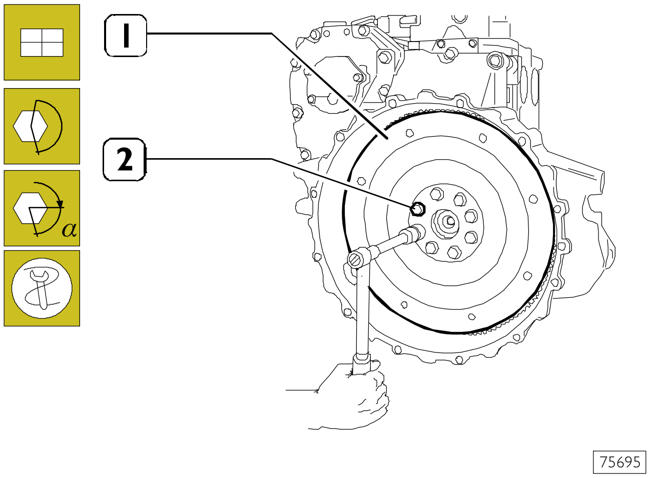
- Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) in with the help of the hoist.
- Remove the medium length screws from the holes (4), used to attach the flywheel.

Figure 230



- Position the flywheel locking tool 99360351 (2) to the flywheel housing (2).
- Tighten the screws (4) fastening the flywheel (3) to the crankshaft.

Figure 231



- ❑ Tighten the screws (2) securing the engine flywheel (1).
- ❑ Remove tool 99360351 from the flywheel housing.

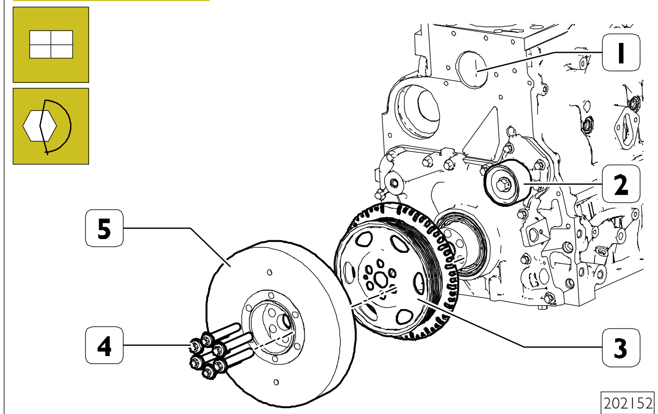
Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M12x1.25x30	
		1st phase	30 ± 4 Nm
		2nd phase	60°

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Crankshaft pulley refitting

Figure 232 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 92

- ❑ Insert the core plug (1).
- ❑ Position the idler pulley and tighten the screw (2).
- ❑ Position the pulley (3) and the front hub (5).
- ❑ Tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M10x1.5	43 ± 6 Nm
(4)	6	Screw M10x1.25x40	68 ± 7 Nm

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ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Timing gear case refitting

Figure 233

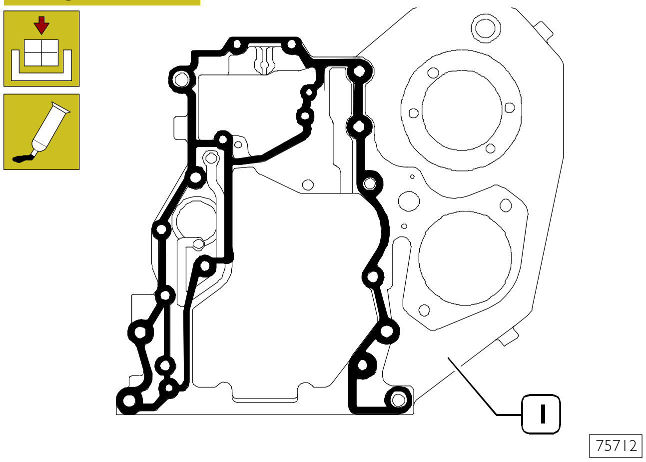


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT ON THE GEAR CASE

- Carefully clean the timing gear case (1) and the crankcase.

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

The joints must be assembled within 10 minutes after applying the sealant.

Figure 234

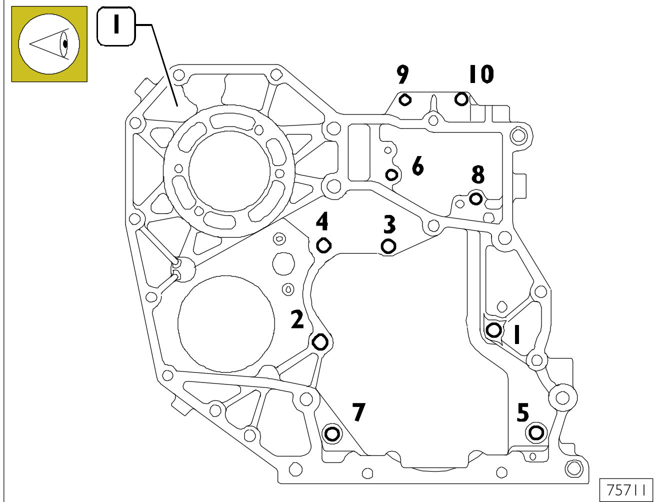
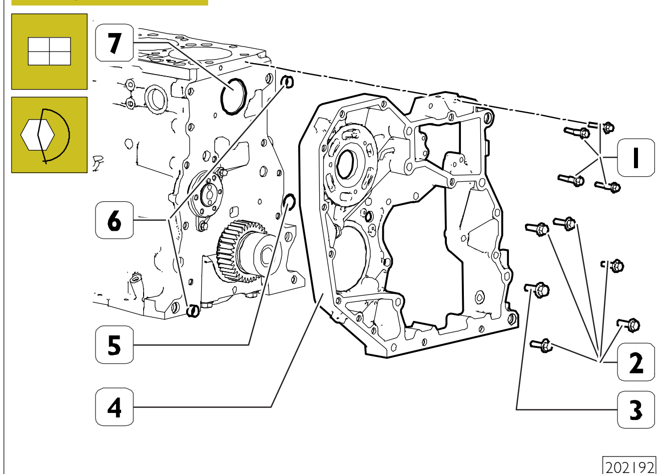


DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Figure 235

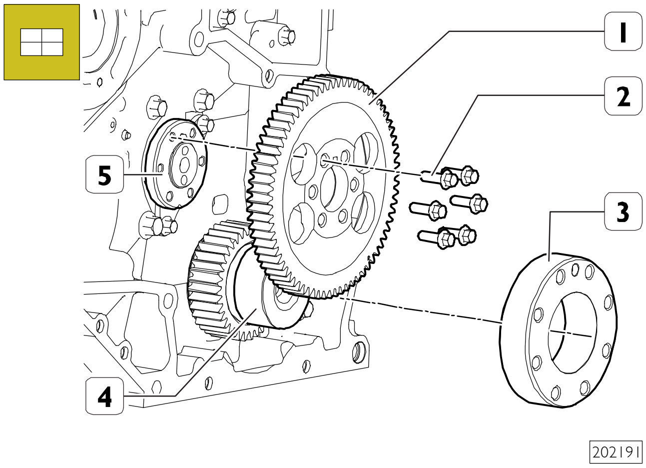


- Insert the core plug (7).
- Fit the cable reference dowel pins (6).
- Position the gasket (5) in the relative seat.
- Position the timing gear case (4).
- Tighten the screws (1, 2 and 3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x40	24 ± 4 Nm
(2)	5	Screw M10x1.5x30	47 ± 5 Nm
(3)	1	Screw M12x1.75x30	77 ± 12 Nm

Camshaft gear refitting

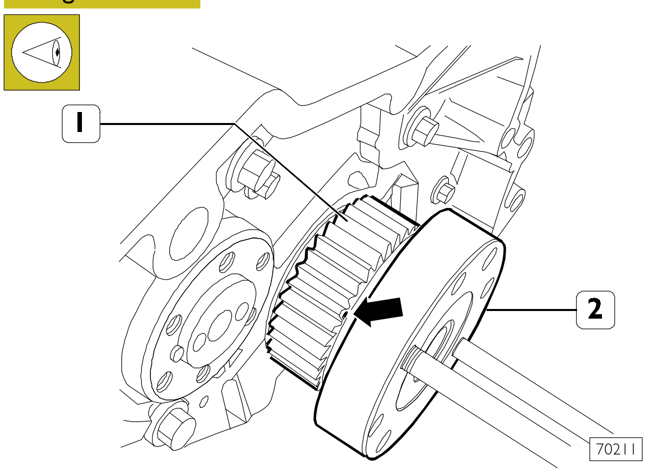
Figure 236



- Position the gear (1) on the camshaft (5).
- Screw in the screws (2) without tightening them.
- Position the collar (3) on the crankshaft (4).

Timing procedure

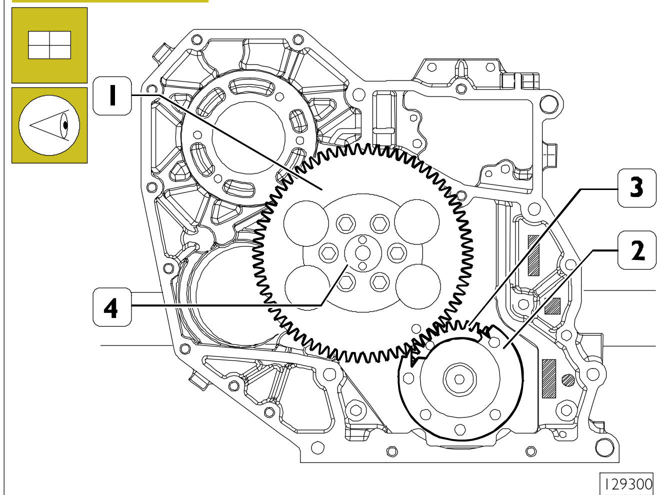
Figure 237



- Use a felt-tip pen to highlight the drive gear tooth (1) fitted on the crankshaft (2) with a chamfer (→) on its side for timing.

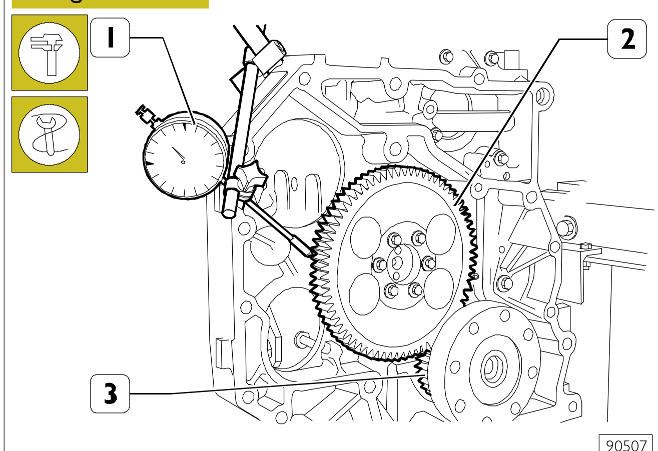
NOTE Screw in the two pins to facilitate crankshaft rotation.

Figure 238



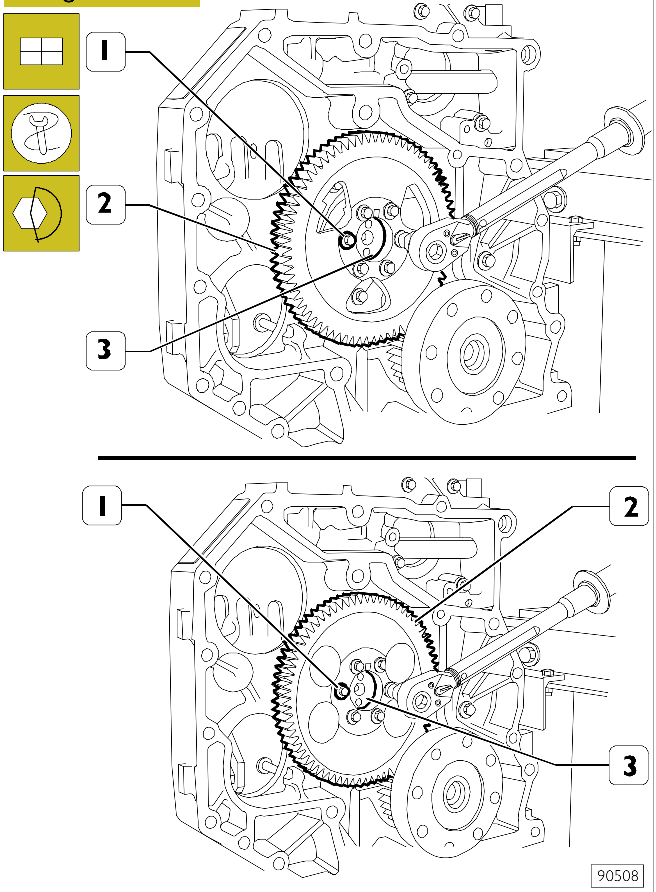
- Align the crankshaft (2) and the camshaft (4) so that when the driven gear (1) is mounted onto the latter, the sign stamped on the gear (1) coincides with the bevel gear tooth (3).

Figure 239



- Set the dial gauge 99395604 (1) on the timing gear (2) and check that the clearance between the gears (2) and (3) is between 0.076 and 0.280 mm.

Figure 240

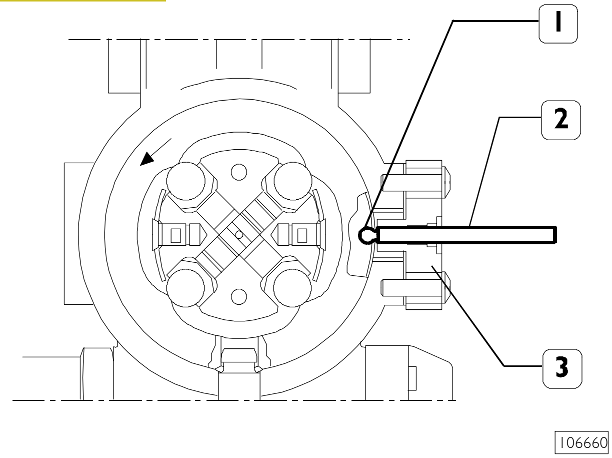


❑ Tighten the screws (1) fixing the gear (2) to the camshaft (3) using torque wrench 99389829.

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25	36 ± 2 Nm

Check correct setting of rotating feed pump

Figure 241



1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

Therefore:

❑ Remove the screw plug (3) at the centre of the plate.

❑ Insert synchronisation pin (1) 99365196 into the hole in the plate (3).
The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.

❑ Lock the drive shaft in the correct position using the screw (1, Figure 244).

❑ Remove the synchronisation pin and fit the screw plug of the plate (3).

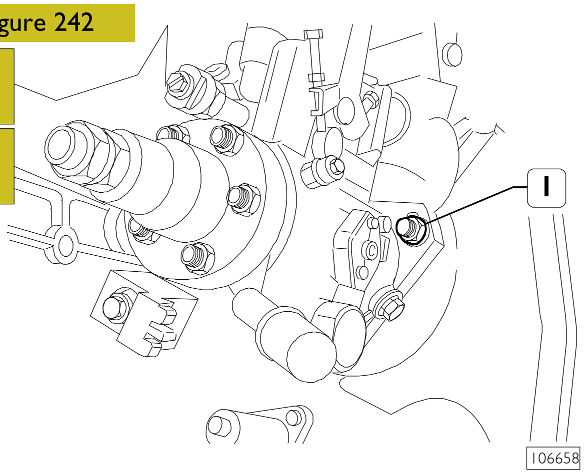
❑ Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

Ref.	No.	Screws description	Tightening torques
(3)	1	Plug M14x1.5	2.9 ± 0.5 Nm

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Injection pump refitting

Figure 242



When fitting the feed pump on the engine, the conditions of the T.D.C at the 1st cylinder at the end of the compression stroke must be met.

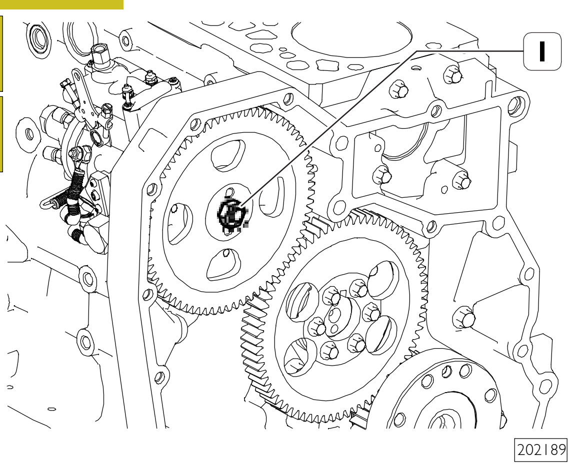
- ❑ Fit the preset pump into its seat on the engine, fitting the shaft into the hole of the gear (without key).
- ❑ Screw in the fastening nuts (1) locking the pump flange at the centre of the slot.

NOTE The gasket removed during pump disassembly must not be reused.

Always use original spare parts.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M8x1.25	24 ± 4 Nm

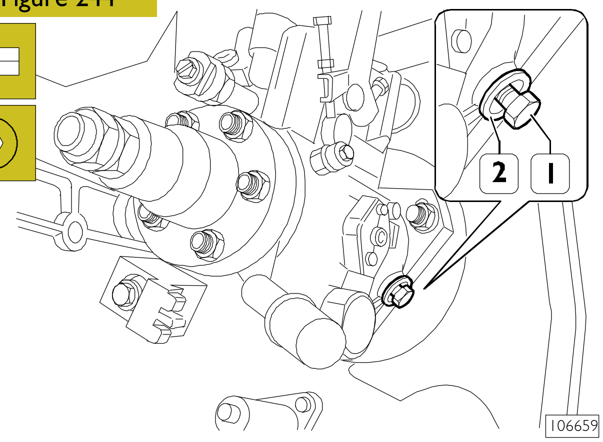
Figure 243



- ❑ On the side of the timing gear, fit the washer and tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M14x1.5	90 ± 5 Nm

Figure 244



- ❑ Tighten the screw (1) locking the pump spindle.
- ❑ Remove tool 99360339 of locking/rotation of flywheel.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M14x1.5	12.15 ± 0.125 Nm

Refitting engine flywheel housing

Figure 245

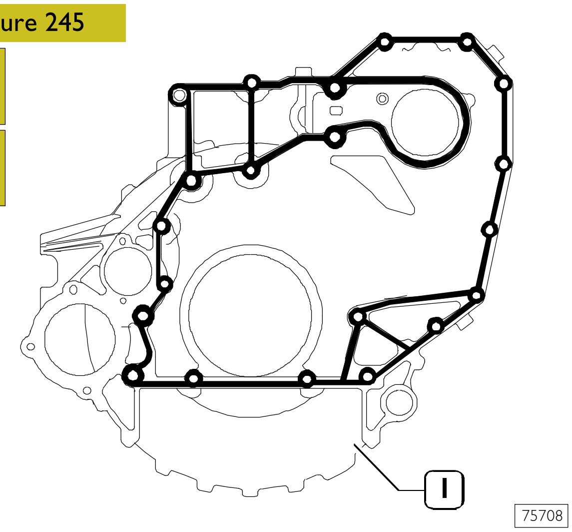
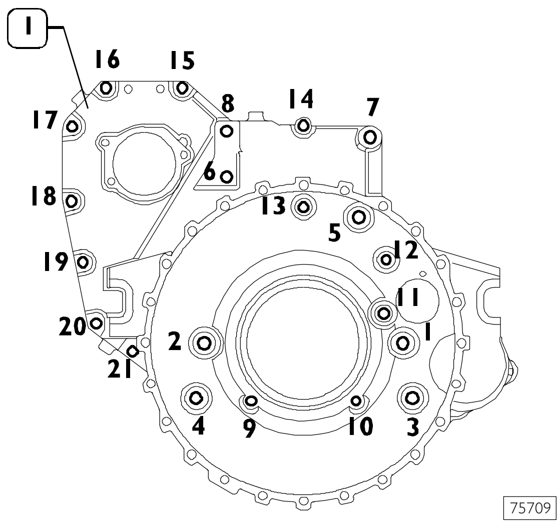


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT

Perfect seal is only obtained by cleaning accurately the surface to seal.
Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.
Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.
Any flaws must be corrected in as short a time as possible.
Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.
The joints must be assembled within 10 minutes after applying the sealant.

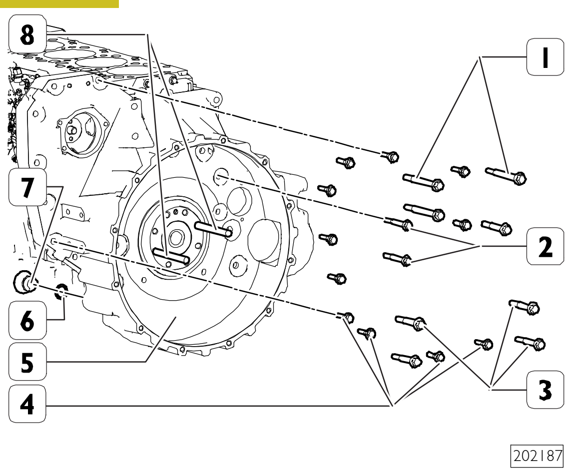
Figure 246



TIGHTENING SEQUENCE DIAGRAM OF FLYWHEEL HOUSING FASTENING SCREWS

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

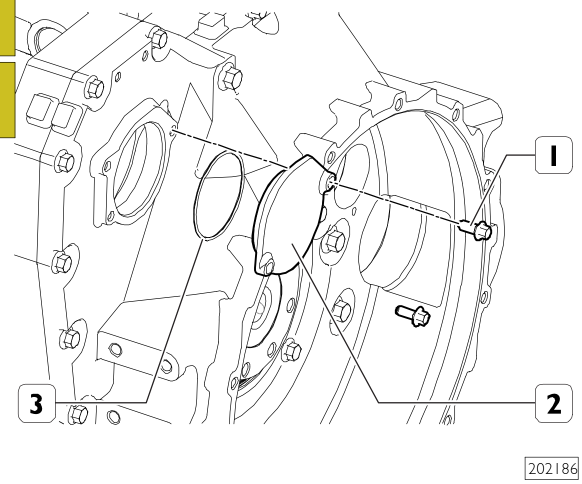
Figure 247



- Position the flywheel housing (5) in the relative seat.
- Insert the gasket (6) and male (7).
- Tighten the screws (1, 2, 3 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	85 ± 5 Nm
(2)	2	Screw M8x20	-
(3)	5	Screw M10x1.5	49 ± 5 Nm
(4)	11	Screw	-

Figure 248

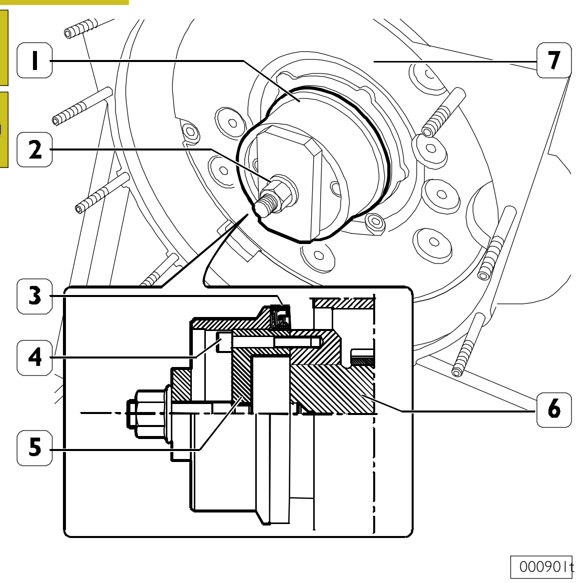


- Fit the toroidal gasket (3).
- Position the cover (2).
- Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1	24 ± 4 Nm

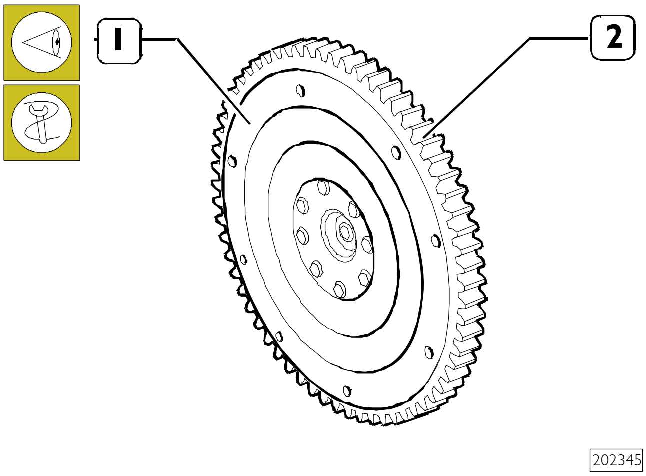
Refitting engine flywheel

Figure 249



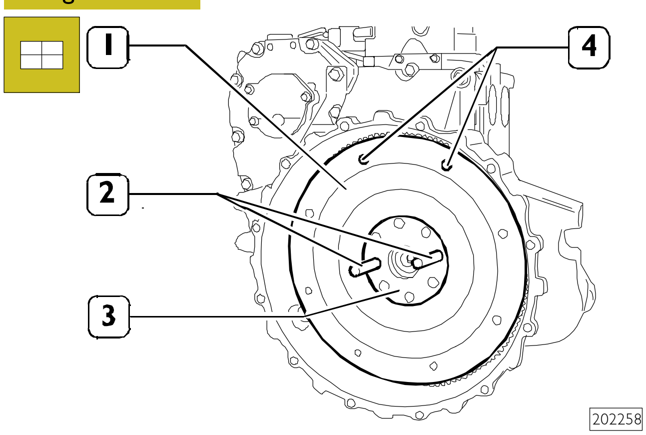
- Apply the tool 99346253 part (5) to the rear crankshaft tang (6), secure it by screws (4) and fit the new sealing ring (3).
- Position part (1) on part (5), fit the nut (2) until the seal ring (3) has fitted completely into flywheel housing (7).

Figure 250



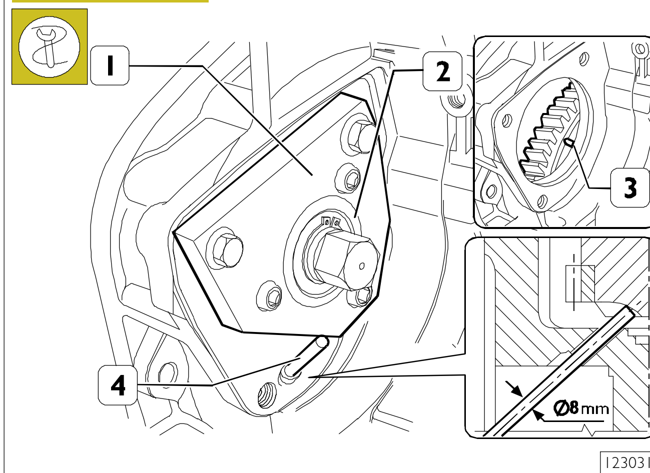
- Check the clutch plate working surface (1) and turn it if scored.
- Check the condition of the ring gear teeth (2). If cracks or excessive wear of the teeth are found, remove it from the engine flywheel (1) with a generic driver and install the new one, previously heated to a temperature of 150° C for 15 to 20 minutes; chamfering on ring gear inside diameter shall be facing the flywheel.

Figure 251



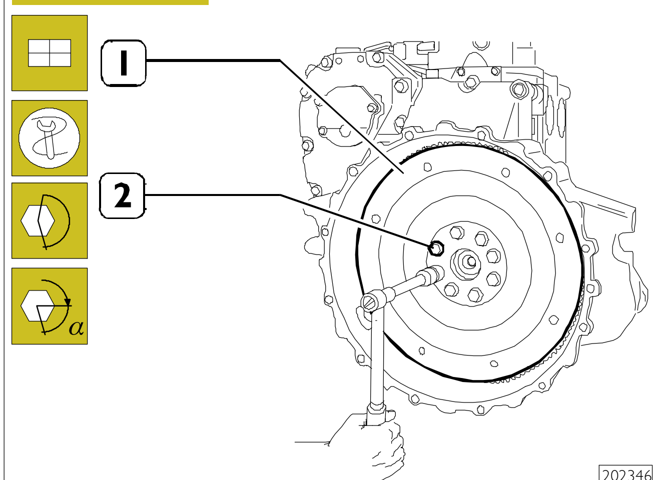
- Screw in two pull hooks or eyebolts in the flywheel (1) using the holes (4).
- Using a hoist, move the flywheel towards its seat inside the flywheel housing.
- Screw in two pins (2) of a suitable length into the shaft holes (3) and using them as a guide, fit the engine flywheel (1) positioning it correctly in the flywheel housing.

Figure 252



- Apply the tool 99360339 (1) to the flywheel housing to stop the rotation of the flywheel (3), using an adjustable wrench on the nut (2) and a pin (4).

Figure 253



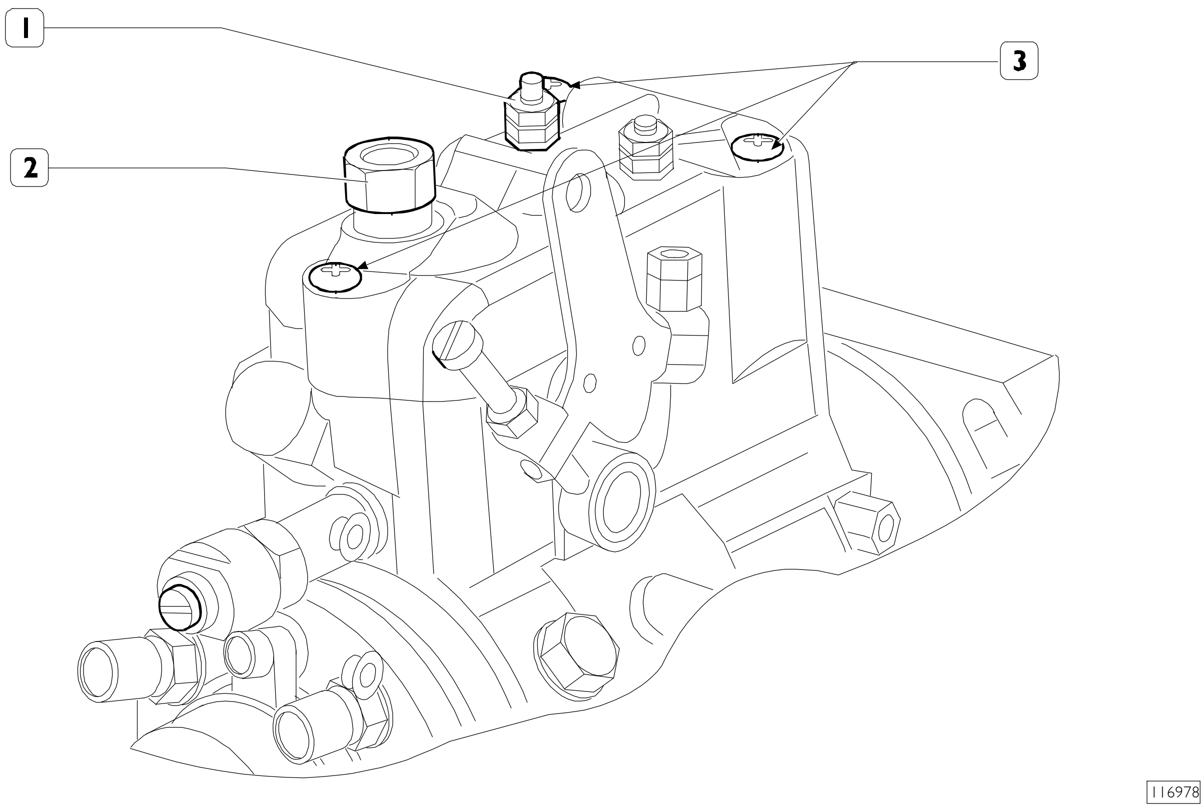
- Tighten the screws (2) securing the engine flywheel (1).

Ref.	No.	Screws description	Tightening torques
(2)	8	Screw M12x1.25x30 1st phase 2nd phase	 50 ± 5 Nm 60°

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

PROCEDURE FOR MOUNTING THE ”ADC100” ELECTRONIC ACTUATOR ON STANADYNE SERIES ”D” INJECTION PUMPS“

Figure 254

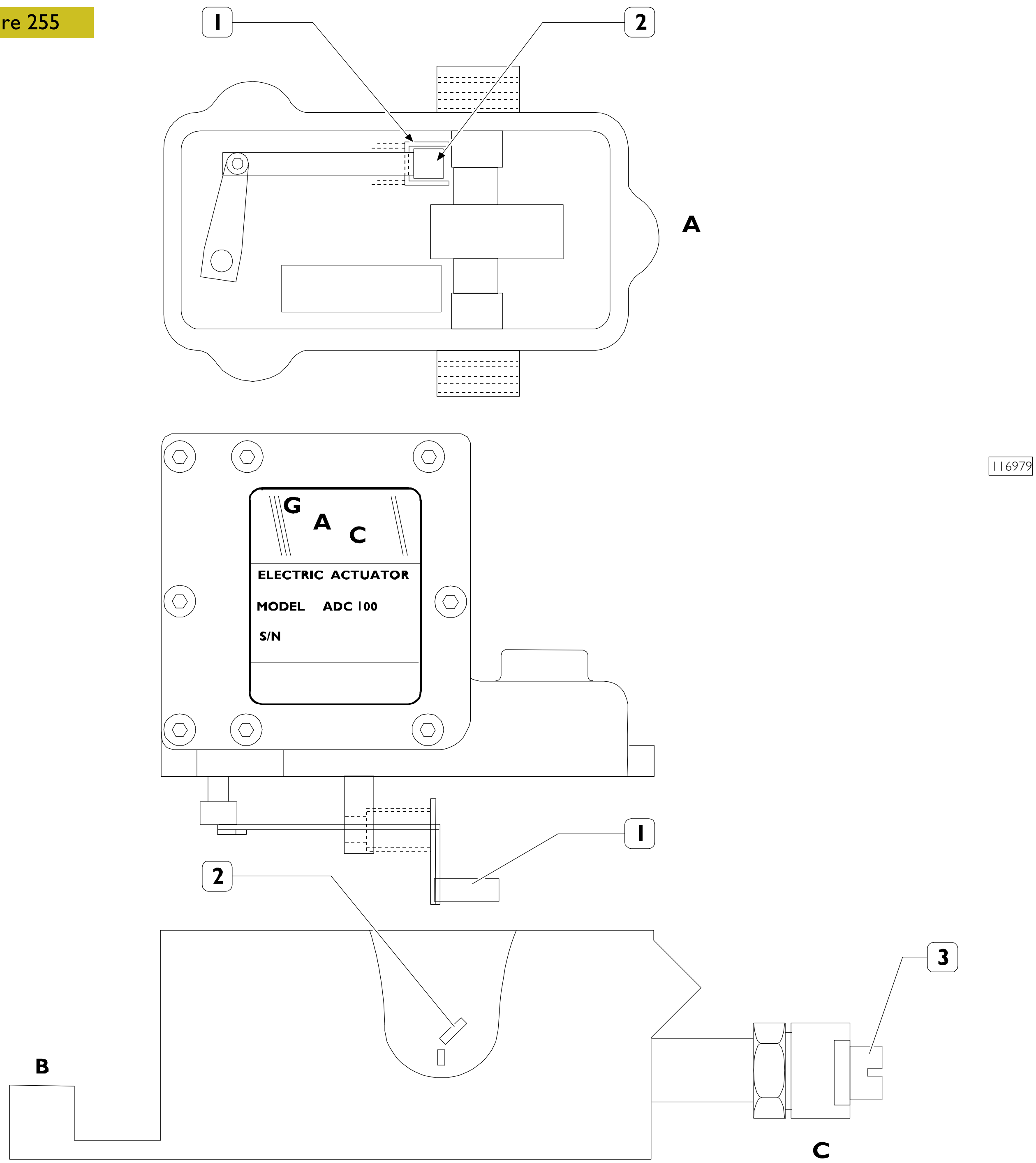


Before proceeding to the removal of the cover of the injection pump and its replacement with the electronic actuator, it is important to clean the external part of the pump, if necessary, using solvents.

This prevents contamination to the inside of the pump.

- Disconnect the wire of the solenoid valve to stop the terminal (1) on the cover of the pump, taking care to insulate it.
- Remove the fuel return pipe from the fitting (2).
- Remove the three screws (3) from the pump cover. The screws will be replaced with the screws supplied with the ADC100 actuator.
- Remove the injection pump cover making sure that no dirt gets into the inside of the pump.
- Remove the fuel return pipe fitting (2) and the gasket from the injection pump cover. Keep the fitting (2) and the gasket as they have to be fitted on the electronic actuator.

Figure 255



A. View from the top of the open injection pump - B. In front (guard side) - G Behind (injector side)
1. Electronic actuator "U" hook - 2. Injection pump lever - 3. Droop adjustment screw

Actuator assembly

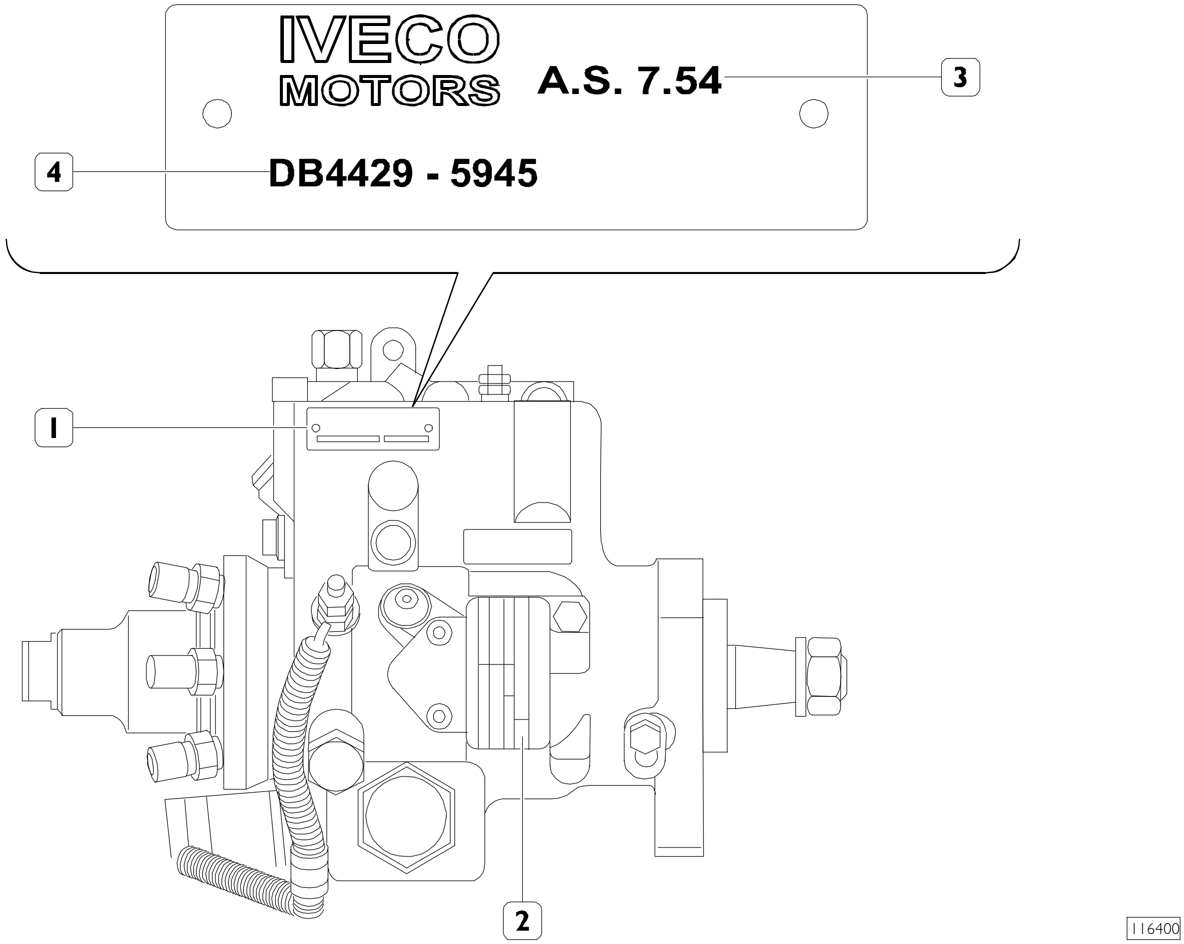
- Refit the fitting to the fuel return pipe and the original seal of the pump cover, on the electronic actuator ADC100.
- Position the electronic actuator on the injection pump with the higher part inclined slightly upwards.
- Let the electronic actuator slide towards the rear of the pump (injector side) until the "U" hook (1) of the actuator engages with the injection pump lever (2).

NOTE Incorrect couplings between the hook (1) of the actuator and lever (2) of the injection pump can cause engine overspeed conditions.

- Tighten the ADC100 actuator to the injection pump using the screws supplied with the actuator.
- Reconnect the fuel return pipe at the fitting located on the actuator.

SWITCHING FROM 50 HZ FOR NEF ENGINES WITH STANADYNE PUMP

Figure 256



Based on the specific operational requirements of the engine, it is possible to vary the adjustment of the Stanadyne pump so as to obtain a different operating frequency:

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

The procedures needed in order to carry out the following adjustments will be described:

- Switching from 50 Hz to 60 Hz and vice versa.
- Stabilisation of rotation speed.

NOTE If only the Stanadyne (2) identification plate is present, this means that the injection pump is calibrated at 50 Hz.

In the event of a factory modification of calibration from 50 Hz to 60 Hz, FPT applies an identification plate (1).

The FPT plate (1) will show:

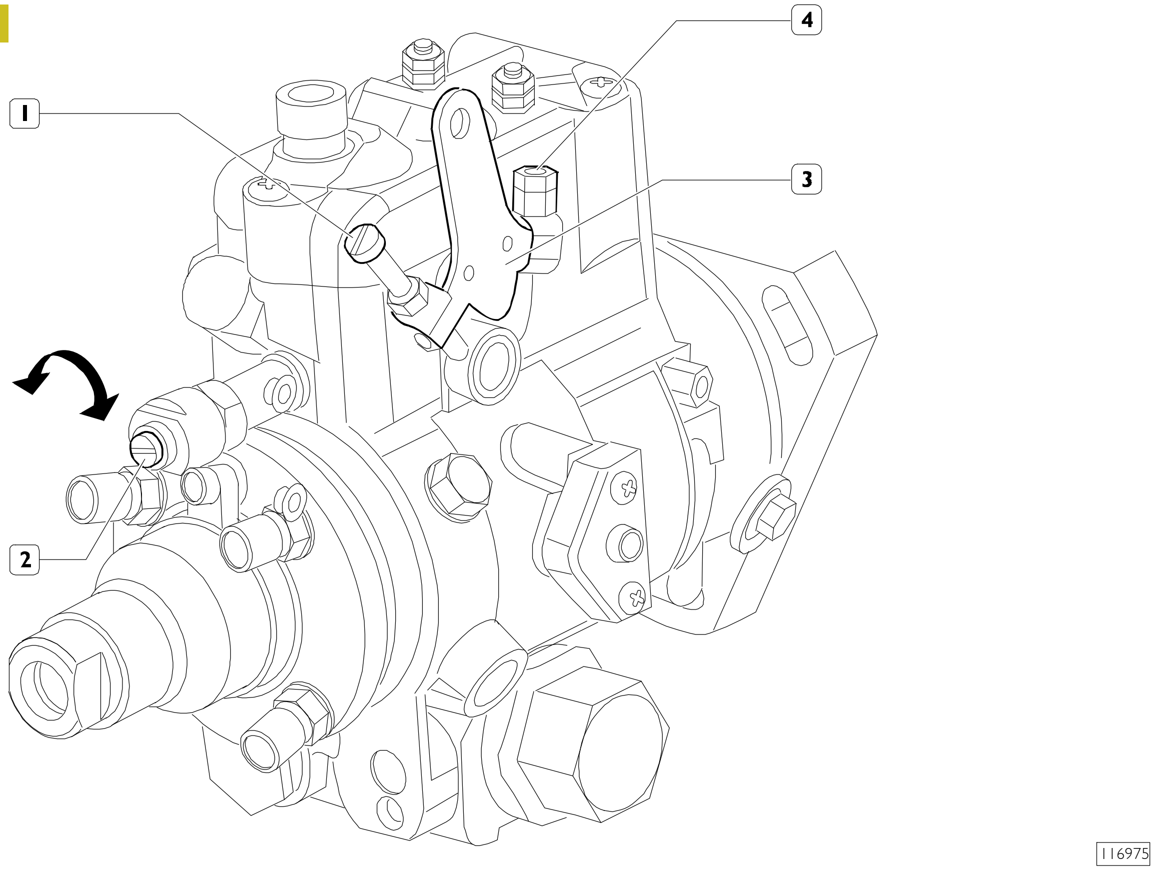
- the injection pump model (4);
- an identification code (3) for the specific application for injection pump calibration, for example: A.S. 7.54 identifies calibration at 1800 rpm - 60 Hz.

Switching from 50 Hz to 60 Hz

To switch from 50 Hz to 60 Hz first of all:

- identify the injection pump code on the Stanadyne identification plate (2).

Figure 257



Injection pump type (Stanadyne identification plate)	Screw turns at 50 Hz from end of travel position (clockwise)	Screw turns at 60 Hz from end of travel position (clockwise)	Difference in turns 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 4629 - 6197			
DB 4429 - 5945	3	6	3
DB 4429 - 5954	2	8.5	6.5
DB 4429 - 5955	3	9	6

❑ Act the adjustment screw of the droopsetting (2), turning it clockwise in the number of turns shown in the table in the figure, starting from the position in which the screw is located.

NOTE If in doubt, you can always unscrew the adjusting screw of the droopsetting (2) counter-clockwise until you reach the end - do not force further, to prevent damage to the control system.

At this stage, and always with reference to the table in the figure, turn the droop setting screw (2) clockwise by the number of turns indicated for the 60 Hz setting from the end of stroke position.

If, for example, for an engine having a fuel injection pump with code DB 4429 - 5945, originally calibrated at 50 Hz, you want to switch to 60 Hz, which is sufficient to act on the adjustment screw of the droopsetting (2) by rotating it 3 turns clockwise from its position, start the engine, loosen the adjustment screw for maximum speed and accelerate with the accelerator lever until it gets to an idle rotation speed of 62 Hz (1860 rpm).

❑ Then adjust the minimum speed screw (4) to block the accelerator lever in the new position and block both adjustment screws using the specific counternuts (1 and 4) tightening torque 3.5 - 4 Nm).

NOTE The idling speed adjustment screw (4) does not allow achievement of the minimum in the "classic" sense of the term, as the injection pump regulator imposes a higher rotation speed since it is the injection pump for the generator unit.

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Switching from 60 Hz to 50 Hz

To switch from a speed of 60 Hz to a speed of 50 Hz, operate similarly to what was seen above, remembering to turn the adjustment screw for the droopsetting (2, Figure 257), rotating it 3 turns counterclockwise from the position in which it is located for operation at 60 Hz.

Stabilisation of rotation speed

In case of instability of the engine rotation speed, turn the adjustment screw for the droopsetting (2, Figure 257) slightly rotating it clockwise/counterclockwise until the rotation speed of the engine is stabilised.

Identification plate

Figure 258

116976

If you do not find the FPT plate because it is an engine with the injection pump calibrated at 50 Hz, it is necessary to apply the plate to the area shown as in SENZA CODICE stamping it as shown in the figure.

Blank identification plates can be ordered through our Spare Parts Service.

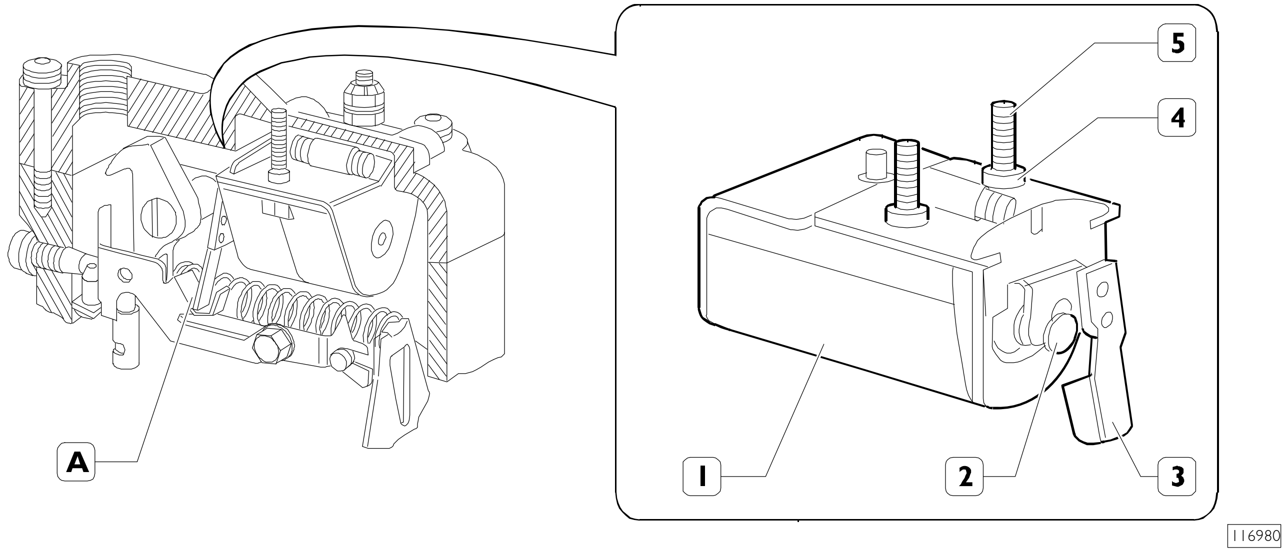
Figure 259

116977

If the FPT plate is already present on the injection pump, mark the new identification suffix for the new calibration and cancel the identification of the previous calibration, as shown in the figure.

REPLACING ELECTROSTOP AND COLD ADVANCE SOLENOID ON STANADYNE PUMP

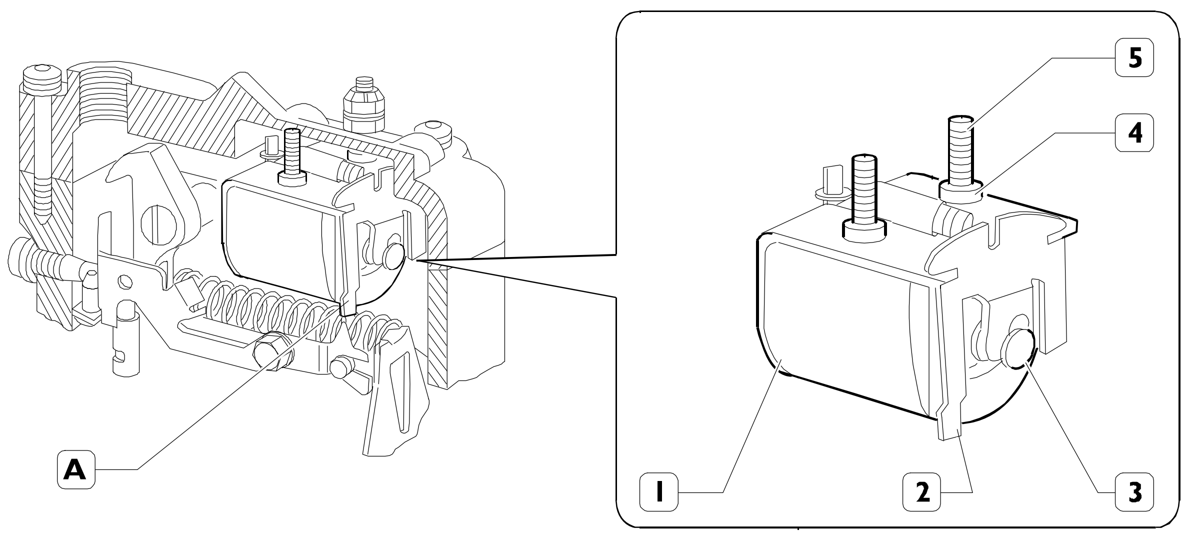
Figure 260



ETR

A. Position of the electrostop arm - 1. Encapsulated coil - 2. Electrostop mobile core - 3. Electrostop arm - 4. Insulator - 5. Solenoid terminals

Figure 261



ETSO

116981

A. Position of the electrostop arm - 1. Encapsulated coil - 2. Electrostop arm - 3. Electrostop mobile core 4. Insulator - 5. Solenoid terminals

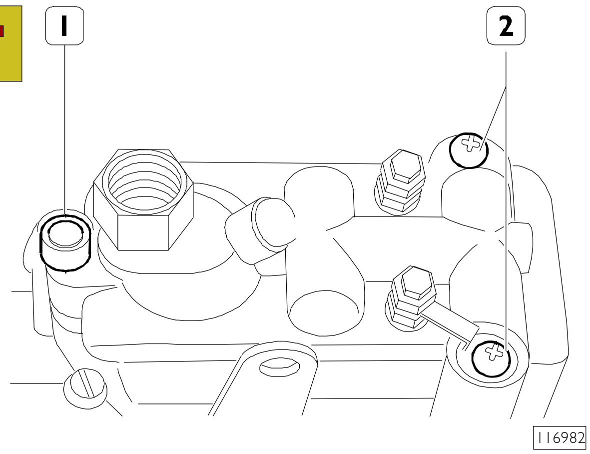
Two types of electrostops can be used on Stanadyne injection pumps:

- ETR (Energize To Run - stop in dexcitation)
- ETSO (Energize To Stop - stop in excitation).

In the figure, please note the different assembly position of the electrostop according to the ETR - ETSO functions.

Electrostop replacement

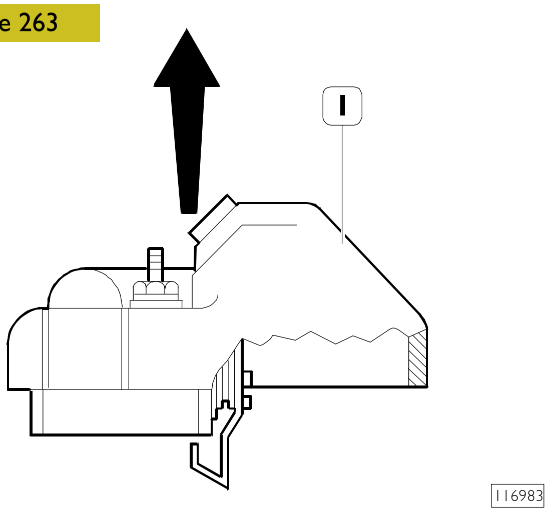
Figure 262



To replace the electrostop, remove the cover of the injection pump by loosening and removing the three fixing screws (1 and 2) of the cover and their washers.

NOTE The screw (1) has a seal which can be broken in order for it to be removed.

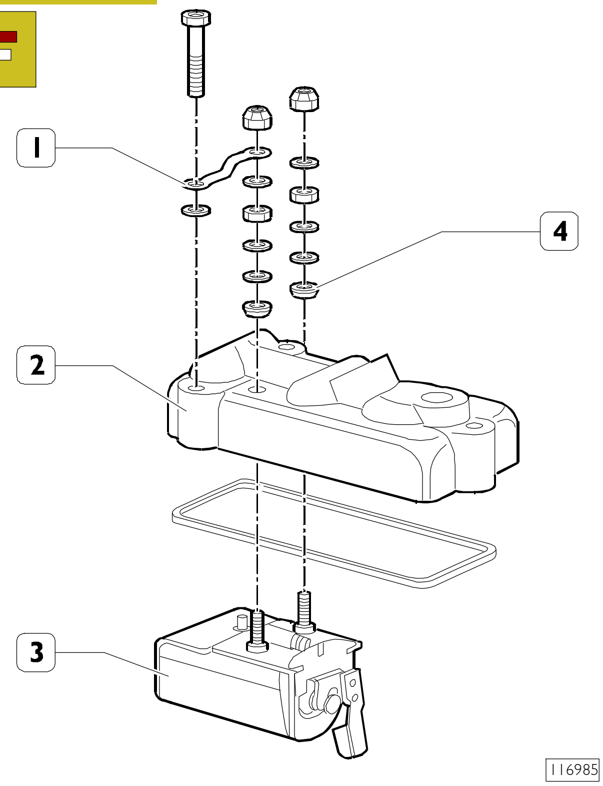
Figure 263



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

Be careful that nothing falls into the injection pump.

Figure 264



Remove the electrostop (3) from the cover (2).

NOTE Since the terminals of the component are electrically insulated from the cover, keep in mind the order of assembly of the nuts, washers and the components for the electrical connection of the electrostop terminals; one end is grounded through an appropriate element (1).

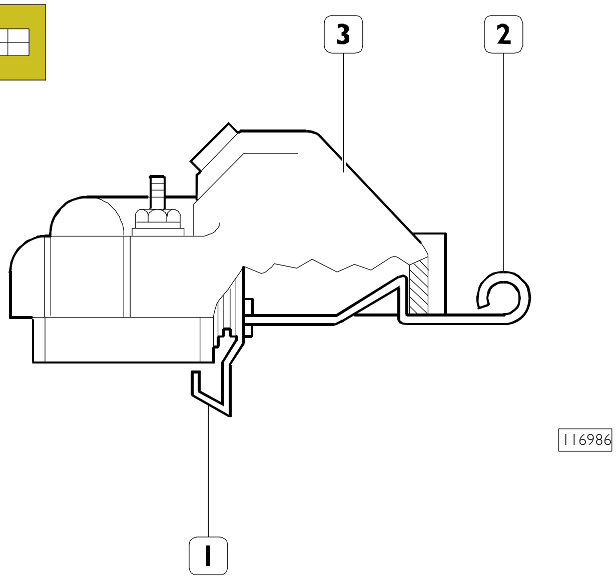
Pay attention to the position of the isolating element (4).

Fit the new electrostop on the injection pump cover using the specific kit:

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

In addition to the electrostop indicated, the kit contains all that is required for its assembling. The nuts securing the electrostop (3) to the cover (2) must be tightened to a torque of 1.1 ÷ 1.7 Nm.

Figure 265



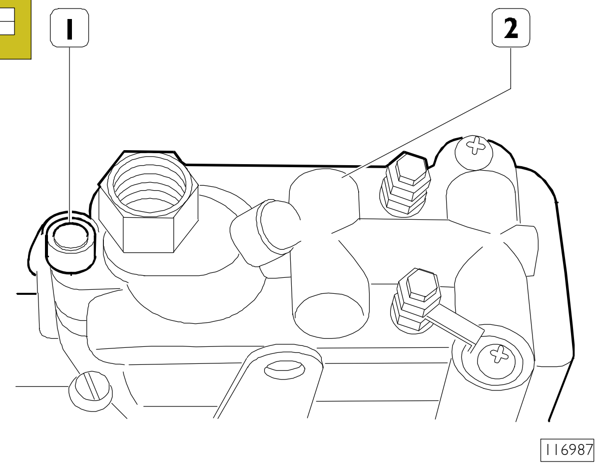
In the electrostop ETR kit there is the joint tool (1) which must be used to position the electrostop arm (2) correctly and to reassemble the cover on the injection pump.

NOTE This tool (1) allows to keep the arm of the electrostop (2) in the excitation position, allowing the correct assembling of the cover and avoiding dangerous overrevving when the engine is started.

Once the cover is put on the assembling seat and the relative screws are pointed on the injection pump, rotate the joint tool (1) and then pull it carefully from underneath the cover (3), making sure not to move or damage the gasket of the cover.

Proceed then to the closing of the screws, with a torque of 4.0 ÷ 5.1 Nm, being careful not damage the connecting element to ground of the electrostop terminal.

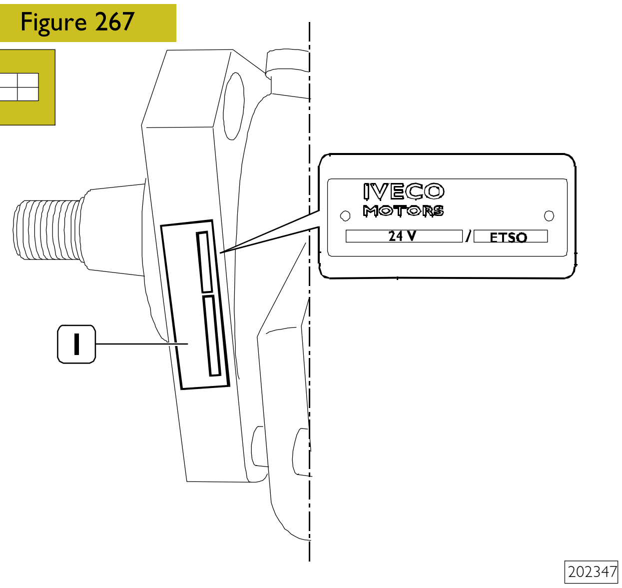
Figure 266



The placement of the cover (2) should be carried out in the reverse order to what is described about the disassembly, taking care that it fits perfectly on the mounting seat, without forcing (obviously for the ETR variant the pump cover will fit on the mounting seat only after the removal of the retaining tool).

NOTE A blue seal is included in the kit which has to be positioned on the screw (1), after the cover reassembling operations (2): when new, the seal is not blue.

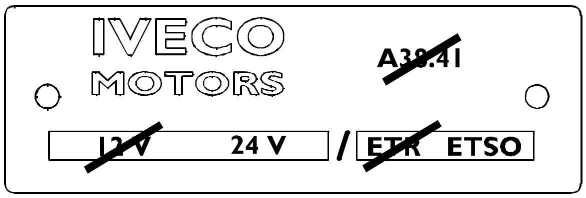
Figure 267



If replacing the electrostop originally supplied and changing the characteristics (different voltage, ETR rather than ETSO, etc.), you must apply a plate (1) identifying the area indicated.

The plate must be stamped (1) as shown in detail in the figure.

Figure 268



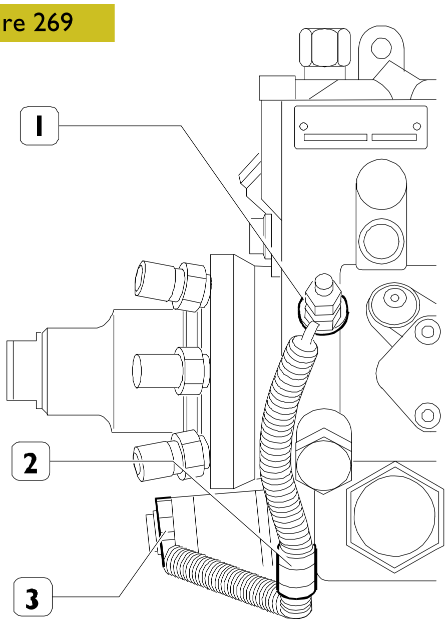
In some cases the plate may already be present.

If the plate is already present, the old identification elements must be cancelled and the new ones marked as shown in the example in the figure.

The electrostop and the cold advance solenoid on this injection pump must have the same operating voltage, therefore in the event of a modification in the engine operating voltage, they must both be replaced.

Cold advance solenoid replacement

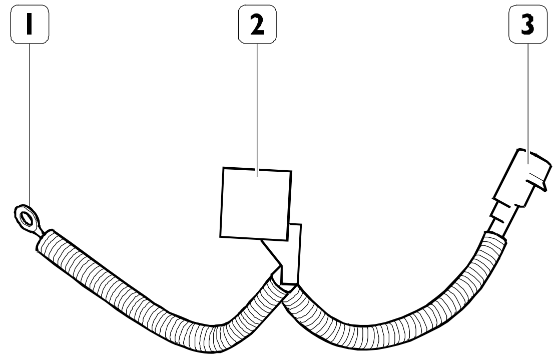
Figure 269



Disconnect the connector from the temperature sensor on the engine, and then remove the fastening nut of the socket clamp (2) and the nut (1) of the cable assembly end, in order to release the cold advance solenoid cables.

Remove the fastening nut (3) from the solenoid and remove the component from its seat.

Figure 270



Insert the connection lug (1) in the cable unit terminal and screw in the nut (1, Figure 269), tightening it to a torque of 5.7 ÷ 6.8 Nm.

Position the anchor clamp (2, Figure 269) and tighten the retaining nut to a torque of 7.9 ÷ 9.0 Nm.

Place solenoid in the seat and screw in the self-locking nut, supplied with the replacement kit, tightening it to a torque of 5.1 ÷ 5.7 Nm.

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

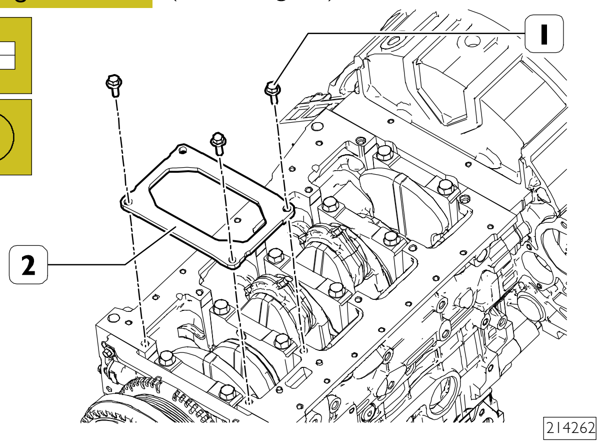
- ❑ BLACK for the 12V device
- ❑ RED: for the 24V device

The electrostop and the cold advance solenoid on this injection pump must have the same operating voltage, therefore in the event of a modification in the engine operating voltage, they must both be replaced.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Sound-proofing plate refitting

Figure 271 (For all engines)



❑ Overturn the engine.

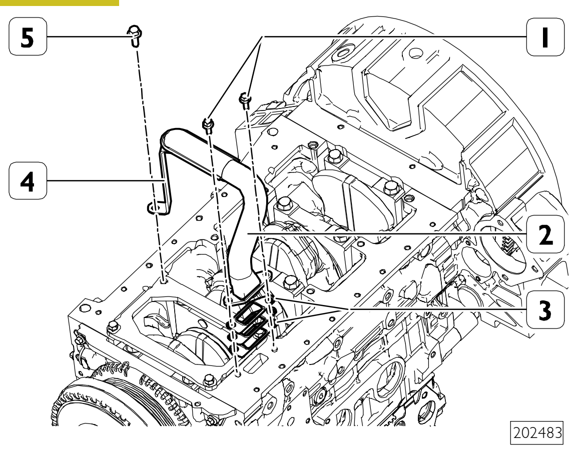
❑ Position the sound-proofing plate (2) in the relative seat.

❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M10x1.5x25	43 ± 5 Nm

Suction strainer refitting

Figure 272



❑ Position the gaskets (3).

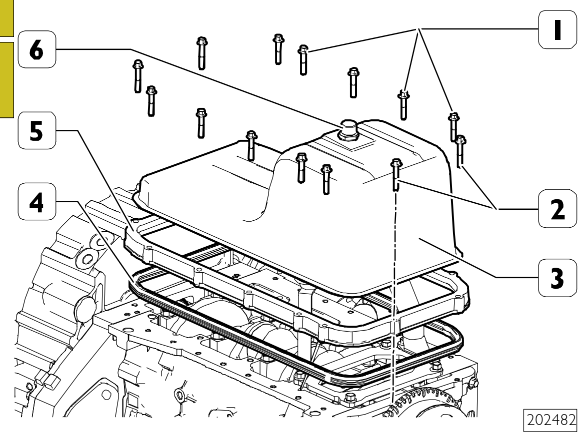
❑ Position the suction strainer (2) in its seat, together with the support clamp (4).

❑ Tighten the screws (1 and 5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x20	24 ± 4 Nm
(5)	1	Screw M10x1.5x25	43 ± 5 Nm

Oil sump refitting

Figure 273



❑ Position the new gasket (4) and the spacer (5).

❑ Position the oil sump (3) in the relative seat.

❑ Tighten the screws (1 and 2) fixing the oil sump.

❑ Tighten the plug (6).

❑ Overturn the engine.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M8x1.25x40	24 ± 4 Nm
(2)	4	Screw M8x1.25x45	24 ± 4 Nm
(6)	1	Plug M18x1.5	65 ± 10 Nm(*)
(6)	1	Plug M18x1.5	60 ± 9 Nm(**)

(*)NEF45 SM1F engines

(**)NEF45 TE1F/TE2F engines

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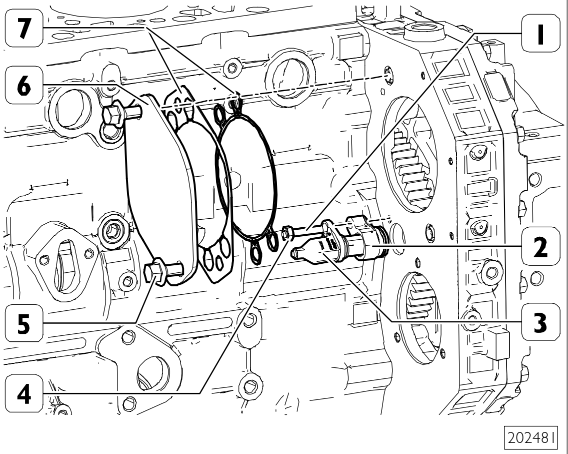
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Figure 274 NEF45 TE1F/TE2F engine



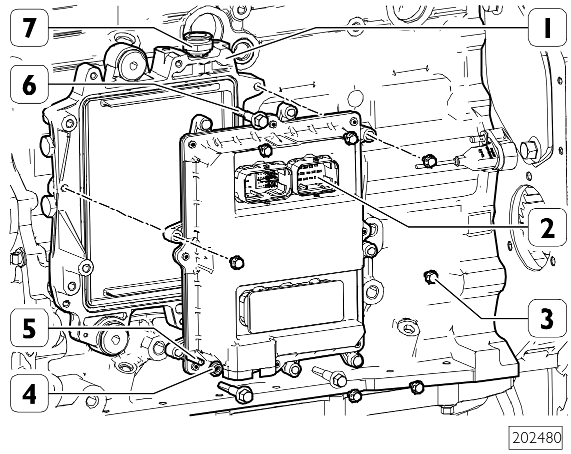
☞ NEF45 SM1F engine Page 102

- ❑ Position the support (2) and tighten the stud (1).
- ❑ Insert the camshaft rpm sensor (3) and tighten the nut (4).
- ❑ Insert the gaskets (7).
- ❑ Fit the control socket cover (6) and tighten the screws (5).

Ref.	No.	Screws description	Tightening torques
(1)	1	Stud M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	2	Screw. M12x25	65 ± 10 Nm

Electronic Control Unit Refitting

Figure 275

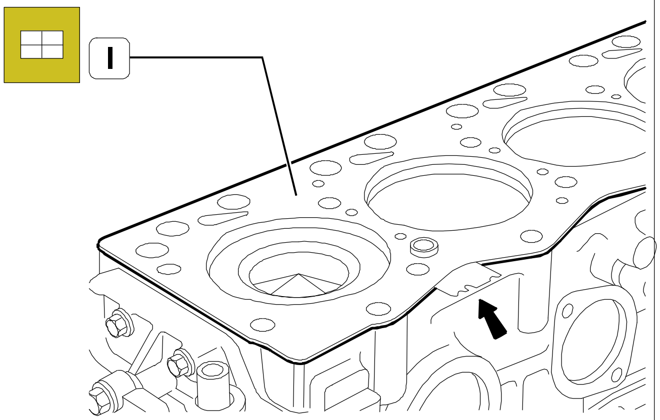


- ❑ Position the support (1).
- ❑ Tighten the Voss fitting (7).
- ❑ Position the control unit (2) in its seat.
- ❑ Tighten the stud (5) and the corresponding nut (4).
- ❑ Tighten the screws (3 and 6).

Ref.	No.	Screws description	Tightening torques
(3)	7	Screw M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	1	Stud M6x1x25	10 ± 2 Nm
(6)	3	Screw M8x1.25x45	24 ± 4 Nm
(7)	1	Connector M12x1.25	12 ± 2 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE TOP)
Cylinder head assembly refitting

Figure 276



87759

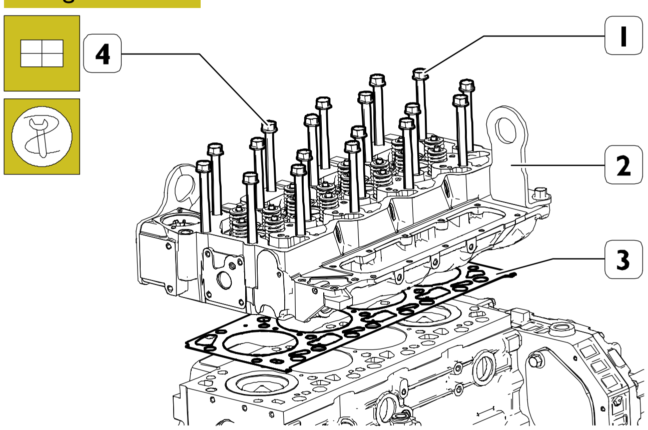
❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

Figure 277



202478

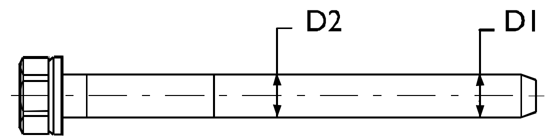
❑ Using tool 99360595, by means of the lifting eyelets (3), position the cylinder head assembly, together with all the elements relating to timing:

- Intake valves;
- Exhaust valve;
- Valve springs;
- Plates;
- Cotters.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

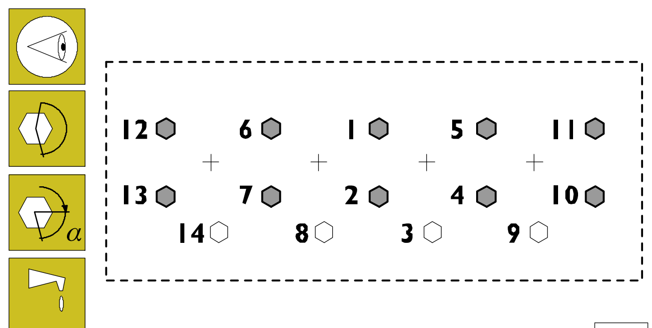
if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



75703

Figure 278



202426

❑ Lubricate the screws and fit them on the cylinder head.

❑ The screws must be tightened in a "stitch" pattern starting from the centre screws and moving outward.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x150	
		1st phase 2nd phase	55 ± 5 Nm 90° + 90°
(4)	8	Screw M12x1.75x130	
		1st phase 2nd phase	35 ± 5 Nm 90° + 90°

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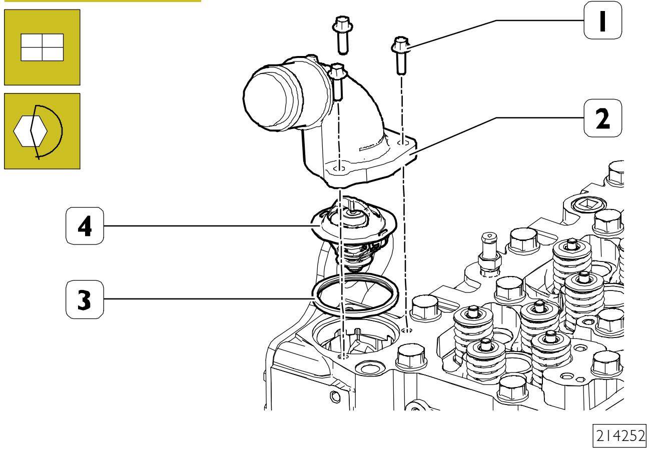
Thermostat unit refitting

Figure 279



❑ Fit the gasket (3) of the cover.

❑ Insert the thermostat assembly (4) into the relative seat.

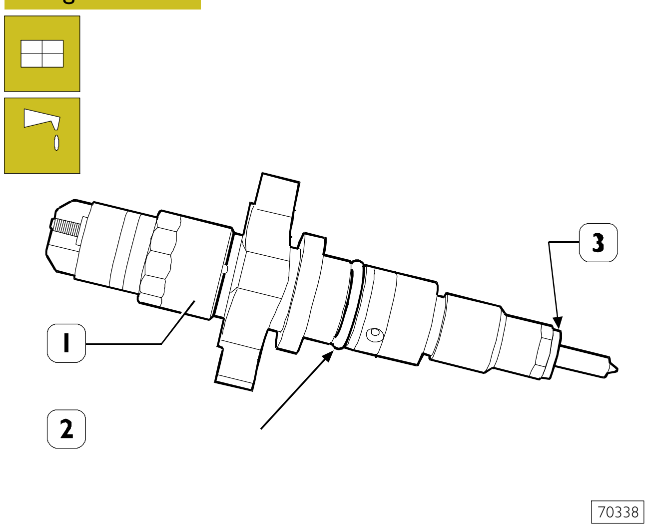
❑ Fit the thermostat cover (2).

❑ Tighten the screws (1) securing the thermostat cover (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1	10 ± 2 Nm

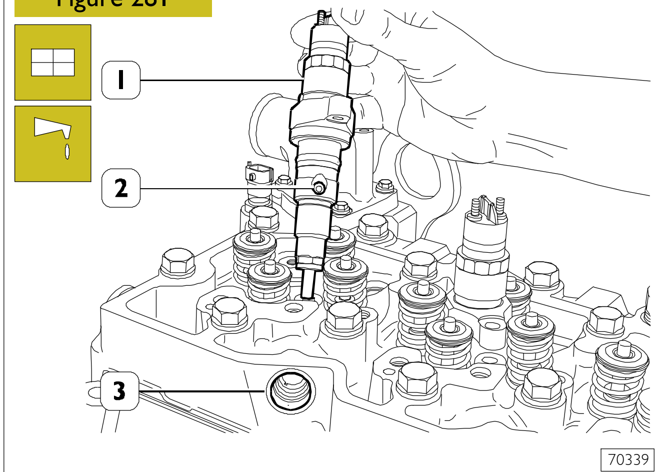
Refitting electro-injectors

Figure 280



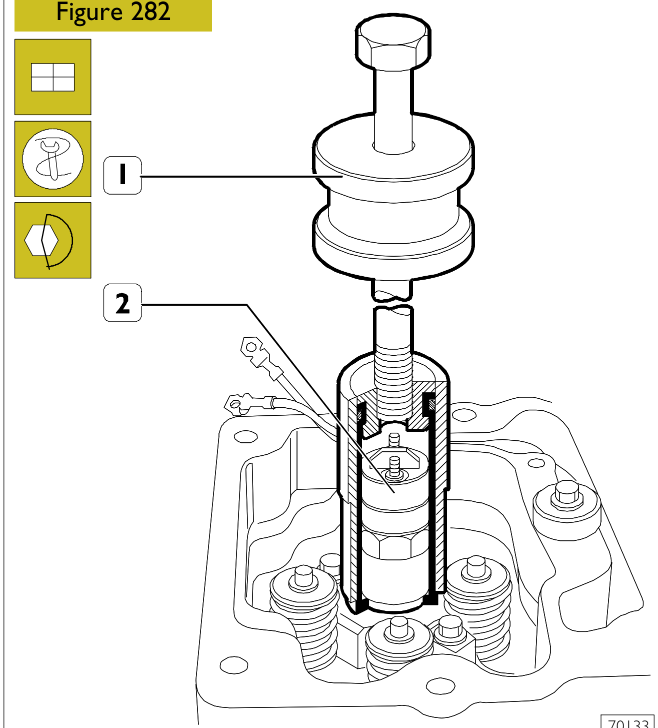
❑ Fit a new seal ring (2) lubricated with vaseline and a new sealing washer (3) on electro-injector (1).

Figure 281



❑ Fit injectors (1) on the cylinder head seats, directed so that the fuel inlet hole (2) is facing the fuel manifold seat (3) side.

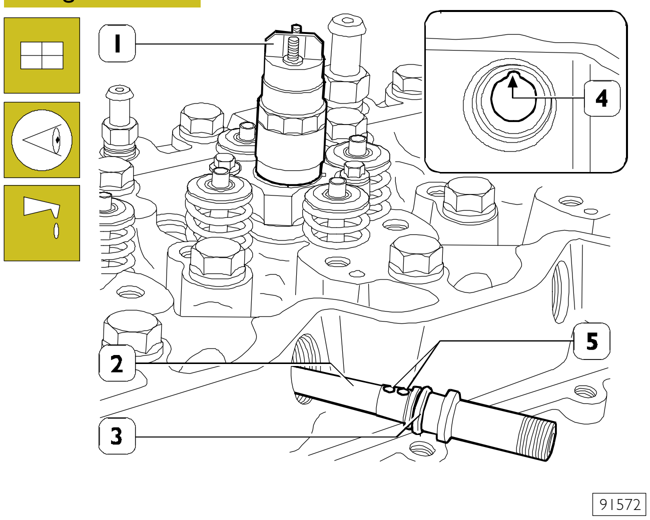
Figure 282



❑ Use tool 99342101 (1) to fit the electro-injector (2) into its seat.

❑ Screw injector fastening screws without tightening them.

Figure 283



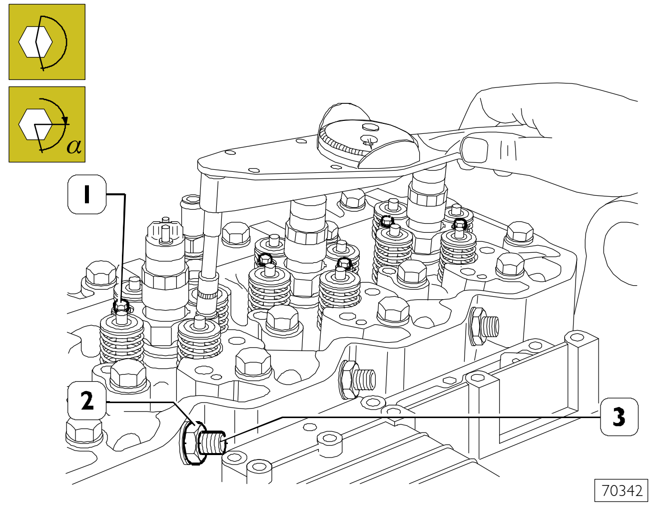
❑ Fit a new sealing ring (3), lubricated with petroleum jelly on the fuel manifold (2) and place it in the seat of the cylinder head so that the positioning balls (5) coincide with the position of the housing (4).

NOTE Disassembled fuel manifolds (2) must not be used again, but however replaced with other new ones. The fuel manifolds (2) in the engines have 2 positioning balls.

❑ Screw the fastening nuts (2, Figure 284) without locking them.

NOTE During this operation, the electro-injector (1) shall be moved so that the manifold (2, Figure 280) is properly inserted into the fuel inlet hole (2, Figure 283).

Figure 284



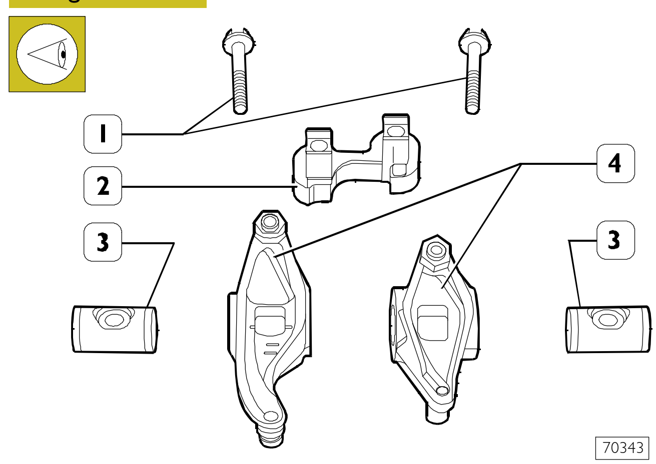
❑ With a torque wrench, tighten the fixing screws (1) gradually and alternately .

❑ Tighten the nuts (2) fixing the fuel manifolds (3).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M6x1x35	
		1st phase 2nd phase ang. clos.	3.5 ± 0.18 Nm 7.5 ± 2.5 Nm 25°+25°+25°
(2)	4	Ring nut M22x1.5	55 ± 5 Nm

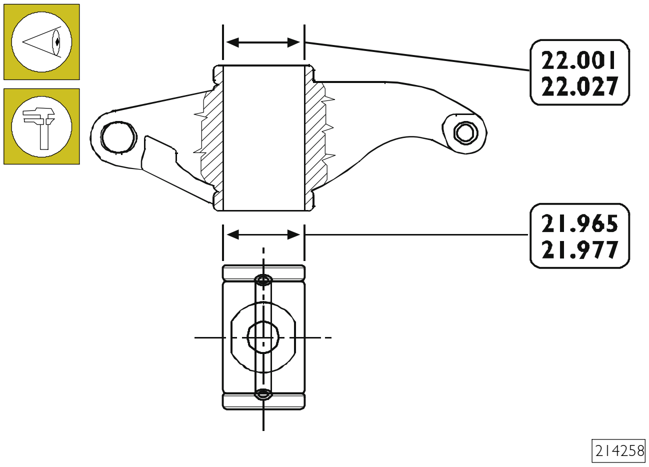
Refitting rocker assembly

Figure 285



ROCKER ASSEMBLY COMPONENTS:
1. Screws - 2. Support - 3. Shafts - 4. Rocker arms.

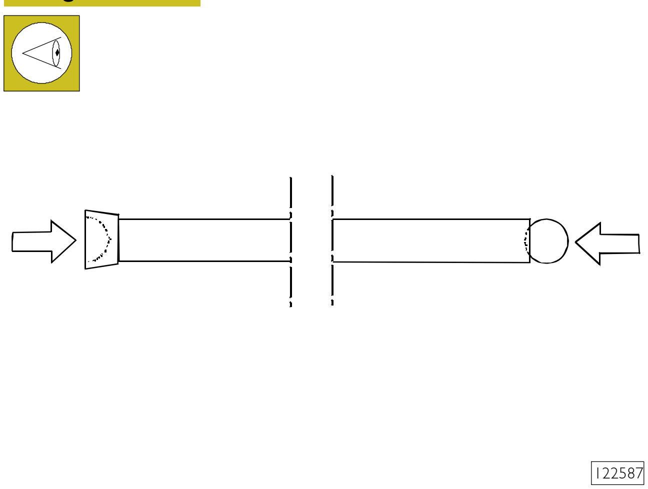
Figure 286



SHAFT-ROCKER MAIN DATA

- Check that shaft/rocker arm surfaces are not excessively worn or damaged.

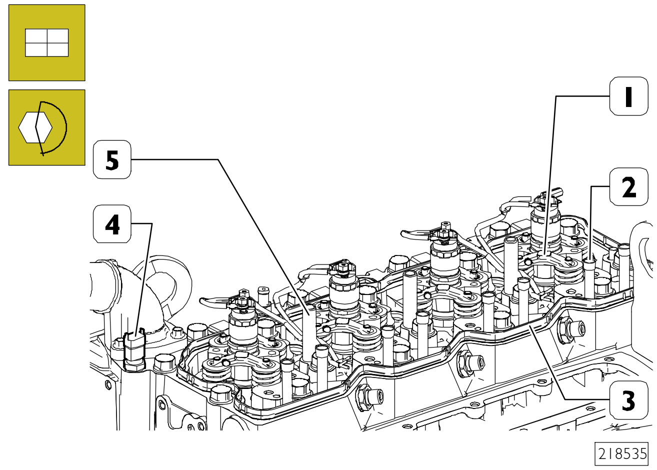
Figure 287



Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

Intake and exhaust valve push rods are identical and are therefore interchangeable.

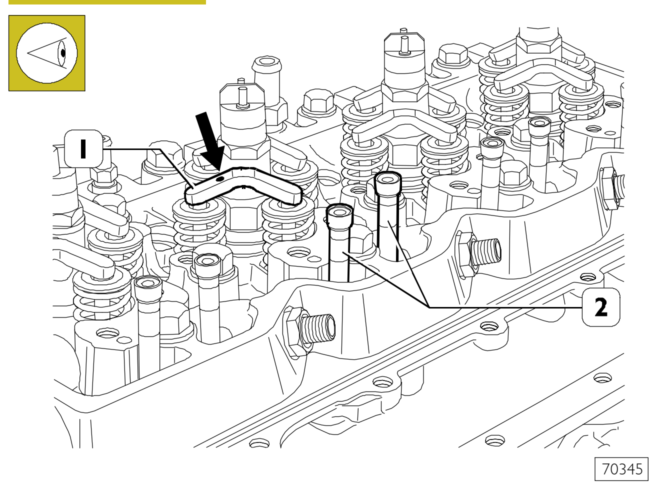
Figure 288



- Screw in the coolant temperature sensor (4).
- Insert the sheaths using a driver (5).
- Position the intake and exhaust crossbars (1).
- Insert the gasket (3).
- Insert the rocker arm control rods (2) together with the housing seats and the balls (3).

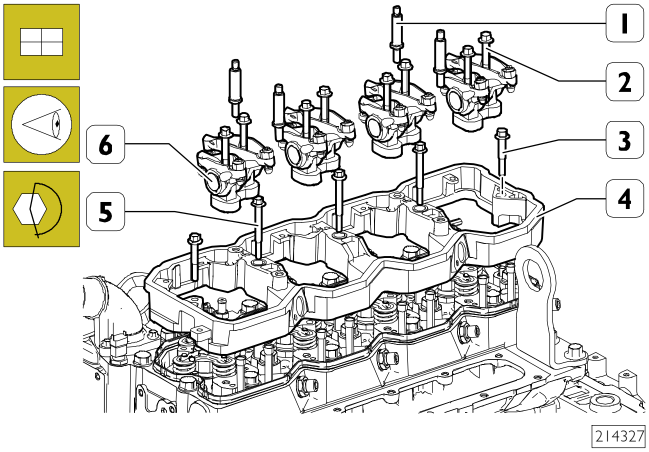
Ref.	No.	Screws description	Tightening torques
(4)	1	Sensor M14x1.5	24 ± 4 Nm

Figure 289

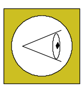


- Position bridges (1) on valves with marks (→) facing the exhaust manifold.

Figure 290



- Fit the housing (4).
- Tighten the screws (3 and 5).
- Position the rocker arm units (6) and tighten the screws (2)
- Screw the double stem screws (1).

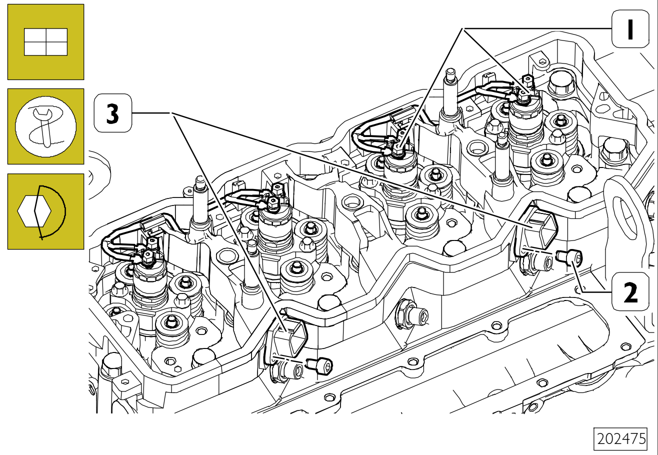


Verify that tappet adjusters are unscrewed to prevent their jamming on the rods (2, Figure 289), when fitting the rocker arms unit.

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x20	24 ± 4 Nm
(2)	8	Screw M8x1.25x55	36 ± 5 Nm
(3)	2	Screw M8x1.25x50	24 ± 4 Nm
(5)	3	Screw M8x1.25x70	24 ± 4 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

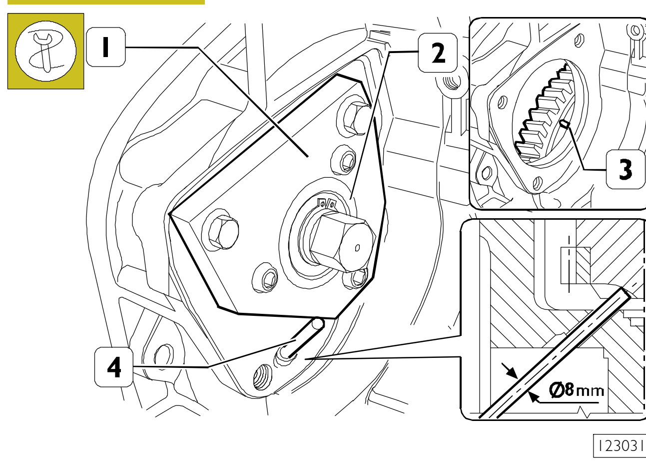
Figure 291



- Tighten the nuts (1) on the electro-injectors using torque wrench 99389834.
- Position the connectors (3) on the electro-injectors and tighten the screws (2).

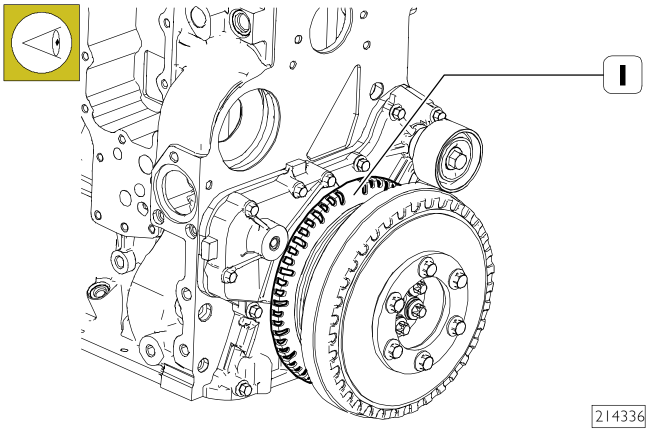
Ref.	No.	Screws description	Tightening torques
(1)	8	M4 nut	1.5 ± 0.25 Nm
(2)	2	Screw M6x1x16	10 ± 2 Nm

Figure 292



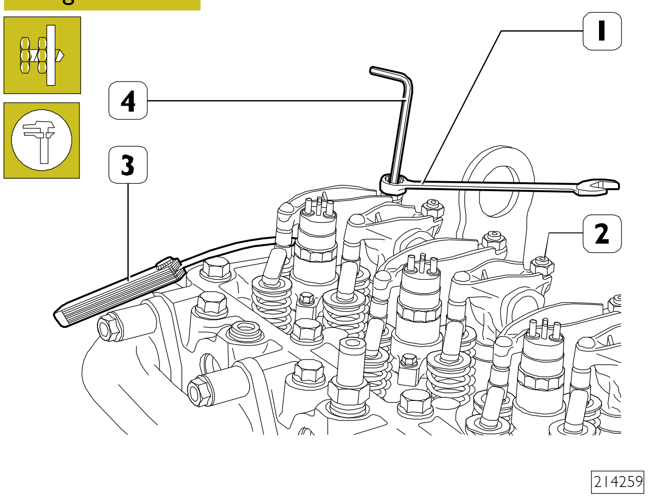
- Apply the tools 99360221 (1) and 99360222 (2) to the flywheel housing to stop the flywheel (3) rotation.
- Bring the 1st cylinder to the condition of TDC (top dead centre) at the end of compression by acting with an adjustable wrench on the tool 99360222 (2) and a pin (4).

Figure 293



- ❑ Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 294



- ❑ Adjust the clearance between the rocker arms and valves using an Allen wrench (4), a box wrench (1) and feeler gauge (3).
- ❑ Tighten the nuts (2).

The clearance is:

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

NOTE In STAGE IIIA engines, due to the presence of the additional lobe for INTERNAL EGR, you cannot follow the procedure for adjusting the valve clearances which includes adjusting the clearance for all the valves by carrying out only 2 crankshaft placements.

Each cylinder must be controlled by bringing it to TDC (top dead centre) at end of compression and adjusting the clearance of both valves exclusively on the cylinder in question.

FIRING ORDER: 1 - 3 - 4 - 2

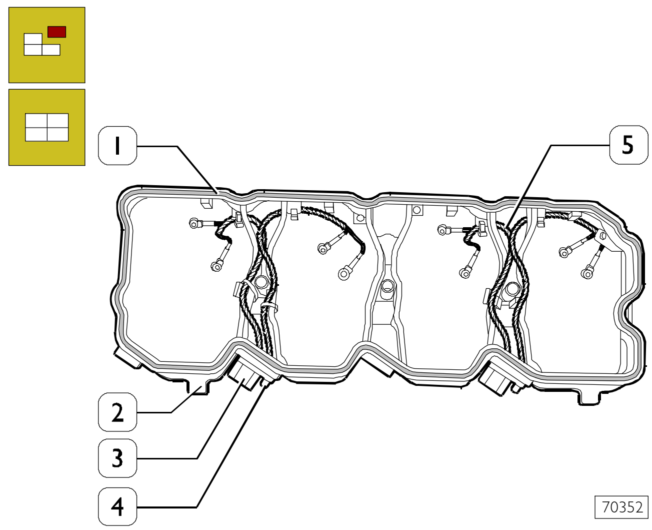
Start and rotation crankshaft	Adjust clearance intake and exhaust valves - cylinder No.
1° at PMS	1
180°	3
180°	4
180°	2

Ref.	No.	Screws description	Tightening torques
(2)	8	Nut M8x1.25	24 ± 4 Nm

- ❑ Remove tools 99360221 and 99360222, used to block flywheel rotation.

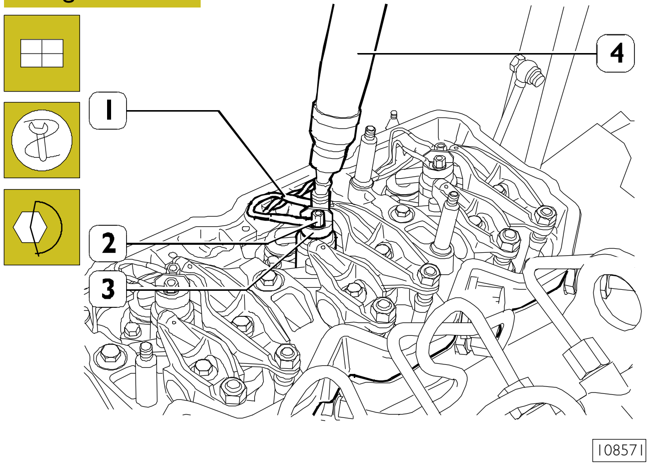
Refitting tappet covers

Figure 295



- ❑ Check electrical cable (5) conditions, replace if damaged by cutting the support (2) clamps and removing the screws (4) that secure it to the connections (3).
- ❑ Fit a new gasket (1) on the support (2).

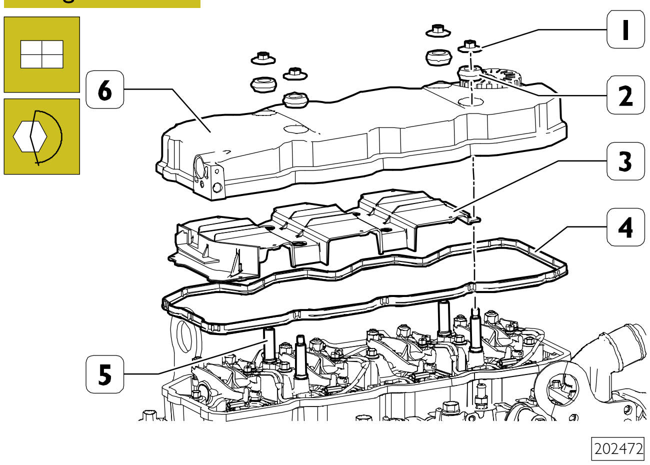
Figure 296



- Connect the electric cables (1) to the electro-injectors (3) and use the torque wrench 99389834 (4) to tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(1)	8	M4 nut	1.5 ± 0.125 Nm

Figure 297

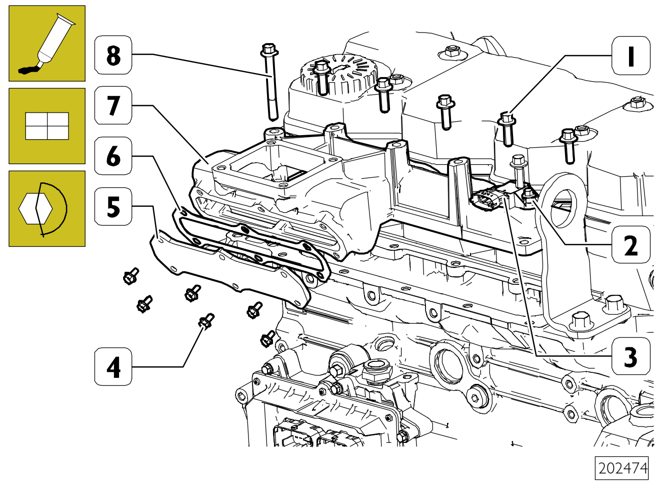


- Tighten the double stem screws (5).
- Fit a new gasket (4) on the tappet cover (6).
- Position the sector (3) for oil vapour condensation.
- Position the tappet covers (6).
- Insert the elastic plugs (2) and tighten the flanged nuts (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M8x1.25	24 ± 4 Nm
(5)	4	Screw M8x1.25x17	24 ± 4 Nm

Refitting intake manifold

Figure 298

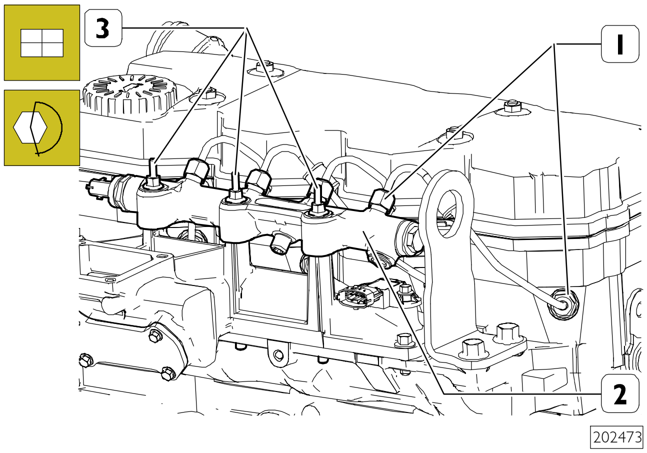


- Apply a sufficient layer of LOCTITE 5999 to the connection surface of the intake manifold (7).
- Tighten the screws (1 and 8).
- Fit a new gasket (6).
- Position the cover (5) and tighten the screws (4).
- Position the air pressure sensor (3), insert a new gasket and tighten the screw (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	24 ± 4 Nm
(2)	1	Screw M6x1x20	10 ± 2 Nm
(4)	6	Screw M6x1x20	10 ± 2 Nm
(8)	1	Screw M8x1.25x70	24 ± 4 Nm

Common Rail Refitting

Figure 299



- ❑ Position the Common Rail (2) and tighten the threaded double action screws (3).
- ❑ Tighten the nuts (1) connecting the high pressure pipes to the Common Rail (2).

Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M14x1.5	24 ± 4 Nm
(3)	3	Screw M8x1.25x125	36 ± 5 Nm

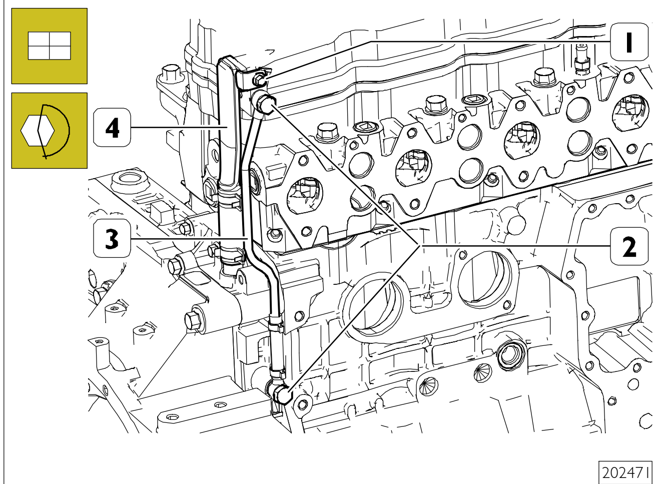
NOTE The pipe fittings must be tightened using the specific wrench and torque wrench 99389829.

The fittings (1) must be tightened using the specific wrench to hold the flow limiting valves.

The high pressure pipes must always be replaced.

Oil vapour filter refitting

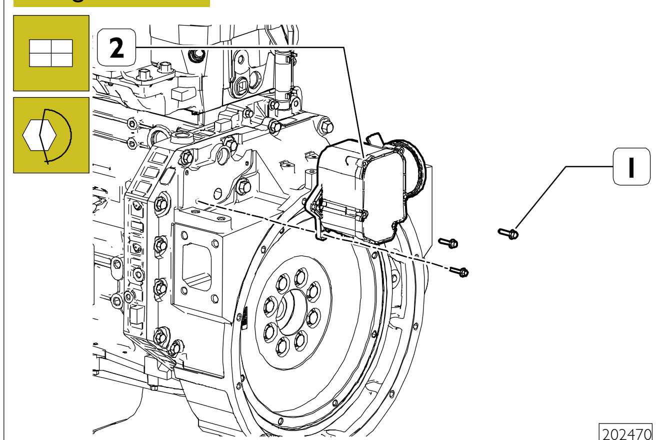
Figure 300



- ❑ Position the pipe (3) and the threaded fittings (2).
- ❑ Insert the engine breather pipe (4).
- ❑ Tighten the support screw (1) to the clamp.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1	10 ± 2 Nm
(2)	2	Coupling M12x1.5x11	20 ± 2 Nm

Figure 301

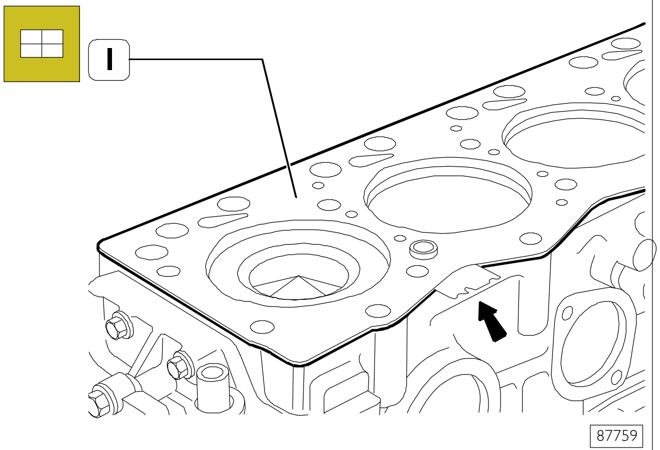


- ❑ Position the filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x25	10 ± 2 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)
Cylinder head assembly refitting

Figure 302 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 111

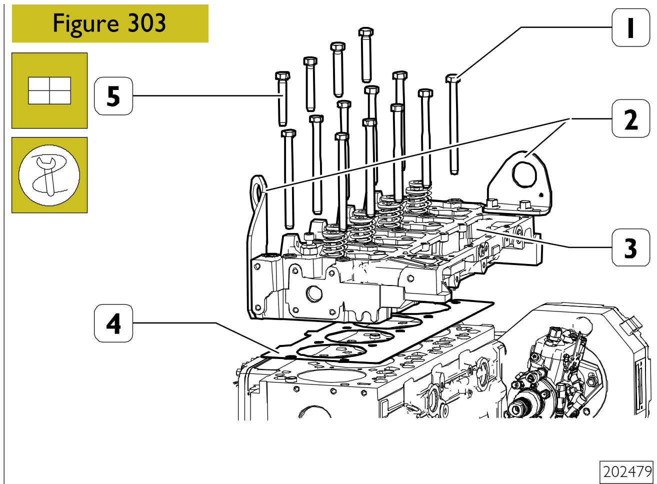
- ❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

Figure 303



- ❑ Fit the relative cable reference dowel pins (4) between the cylinder head assembly and the crankcase.
- ❑ Using tool 99360595, by means of the lifting eyelets (2), position the cylinder head assembly (3), together with all the elements relating to timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Fit the screws (1 and 5) into the relative seats.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.

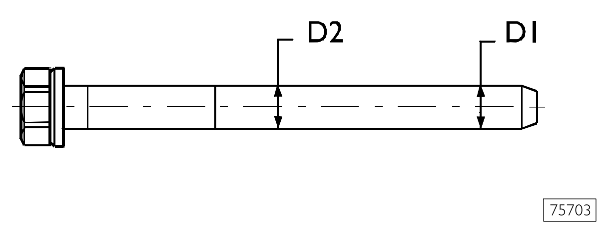


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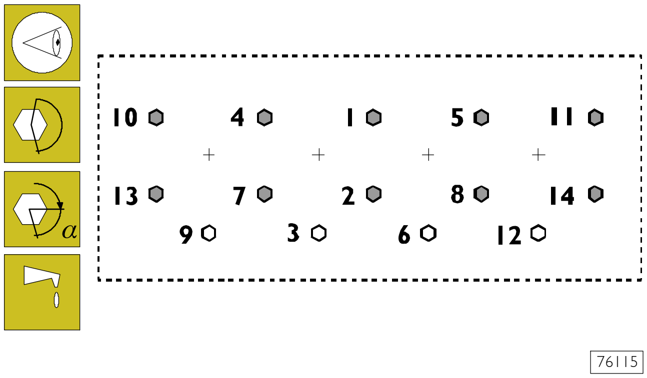
Figure 304

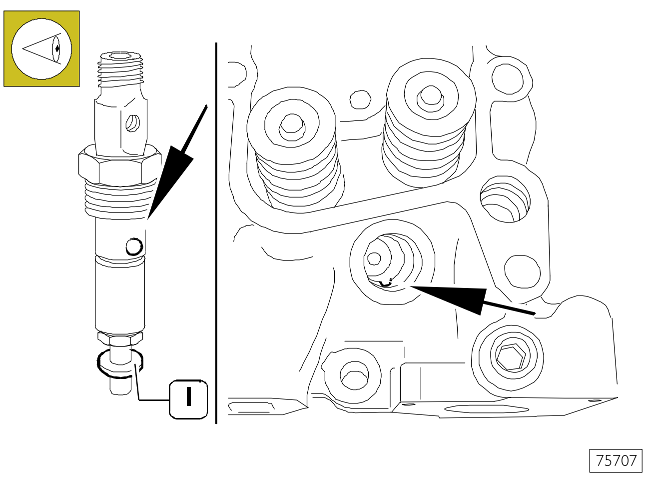


- Lubricate the screws and fit them on the cylinder head.
- The screws must be tightened in a "stitch" pattern starting from the centre screws and moving outward.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x140	
		1st phase	60 ± 5 Nm
		2nd phase	90° + 90°
(5)	4	Screw M12x1.75x70	
		1st phase	40 ± 5 Nm
		2nd phase	90°

Injector refitting

Figure 305

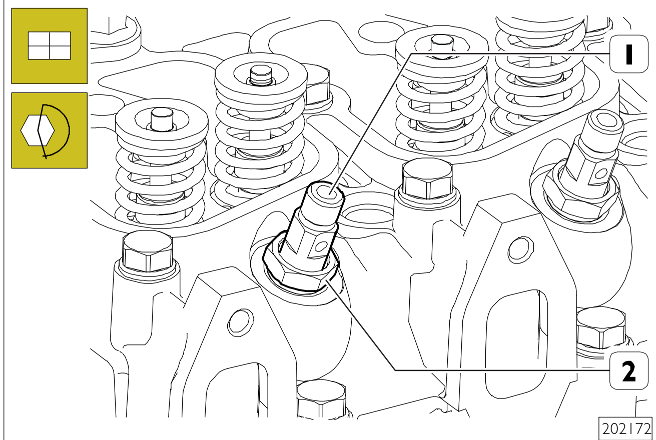


NOTE If compression in the cylinders is to be checked, using tool 99360344, leave the injector disassembled.

- Only assemble the injectors after having replaced the sealing gasket (1).

NOTE While carrying out injector assembly operations, check that the ball on the injector is at the engine head seat.

Figure 306

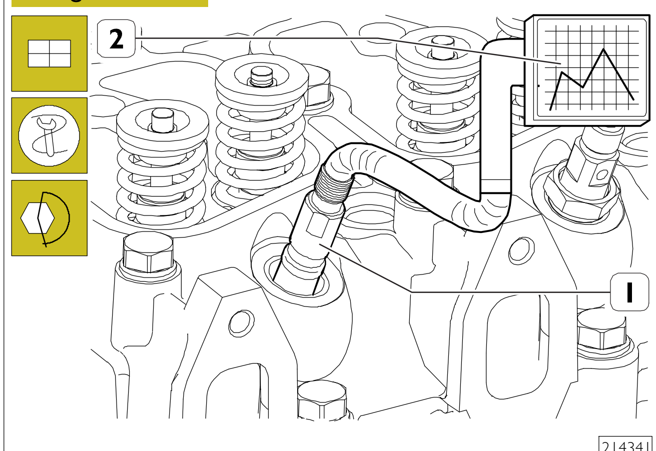


- Tighten the ring nut (2) securing the injectors (1).

Ref.	No.	Screws description	Tightening torques
(2)	4	Ring nut M24x1.5	60 ± 5 Nm

Procedure for checking compression in the cylinders using tool 99360344

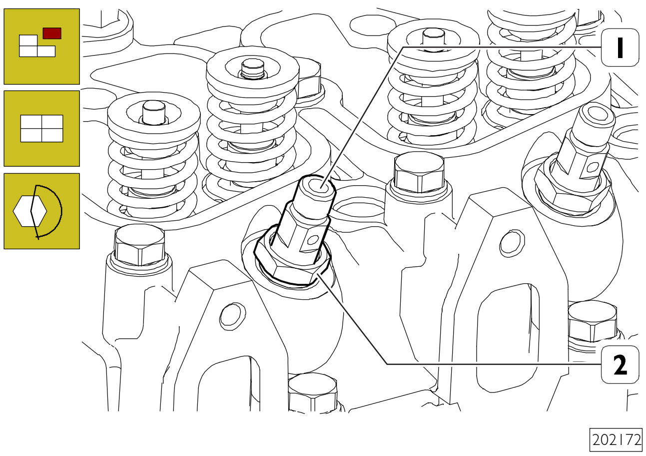
Figure 307



- Fit tool 99360344 (1).
- Connect it to tool 99395382 (2).
- Manually actuate the engine flywheel in order to turn the engine.
- Tool 99395382 (2) traces the pressure trend inside the cylinder according to the combustion chamber.

Ref.	No.	Screws description	Tightening torques
(1)	1	Tool M24x1.5	60 ± 5 Nm

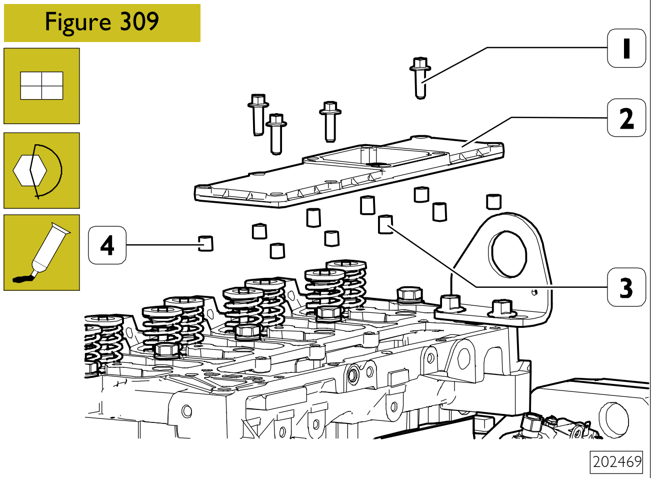
Figure 308



- ❑ Disassemble the tool 99360344.
- ❑ Tighten the ring nut (2) securing the injectors (1).

Refitting intake manifold

Figure 309



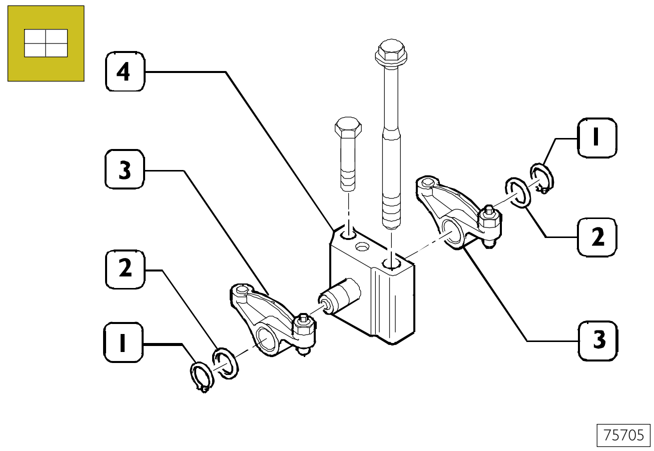
- ❑ Apply a bead of LOCTITE 5999 on the intake manifold plate mating surface (1).
- ❑ Insert 6 smooth bushings [h = 11 mm] (4) in their seats.
- ❑ Insert the 4 smooth bushings [h = 14 mm] (3) in correspondence with the intake manifold (1).
- ❑ Position the intake manifold (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x25	24 ± 4 Nm

NOTE Check that the intake manifold plate (1) is oriented correctly as shown in the figure (the shorter part near the air inlet hole must face the front end of the engine).

Refitting rocker assembly

Figure 310

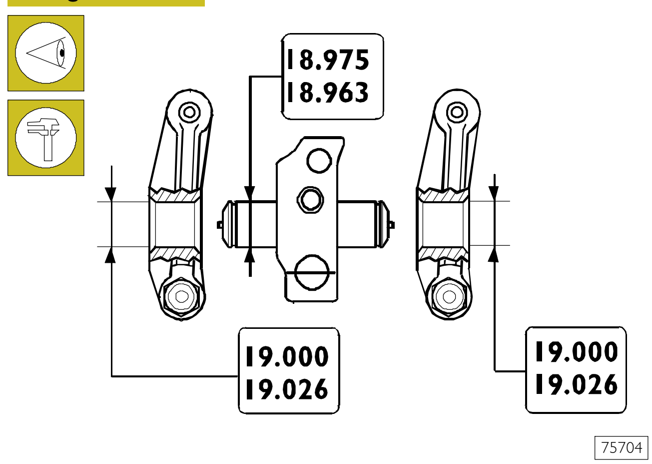


- ❑ Fit the rocker arm assembly after having checked the parts.

ROCKER ASSEMBLY COMPONENTS:

1. Circlip - 2. Spacer - 3. Rocker arms - 4. Support

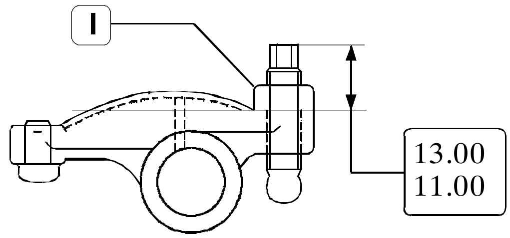
Figure 311



MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 312



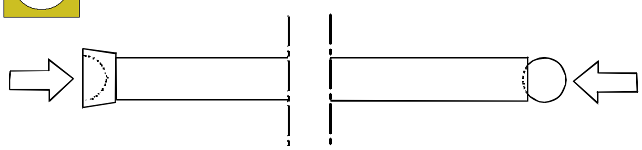
116391

MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

- ❑ If disassembled, check the adjustment dimension.
- ❑ Tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M8x1.25	24 ± 4 Nm

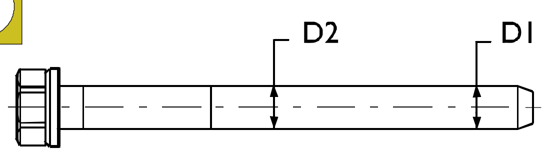
Figure 313



122587

Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them. Intake and exhaust valve push rods are identical and are therefore interchangeable.

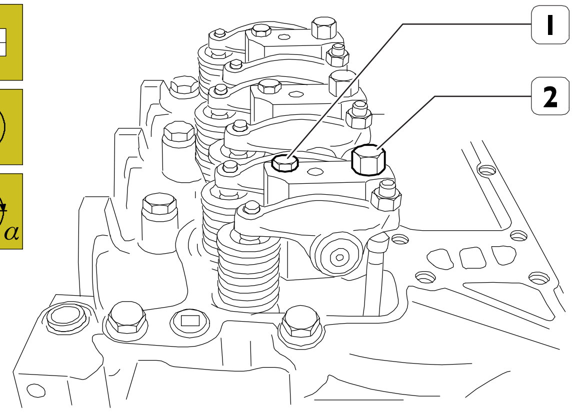
Figure 314



75703

- ❑ Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
  if D1 - D2 < 0.1 mm the screw can be reused;
  if D1 - D2 > 0.1mm the screw must be replaced.

Figure 315



202143

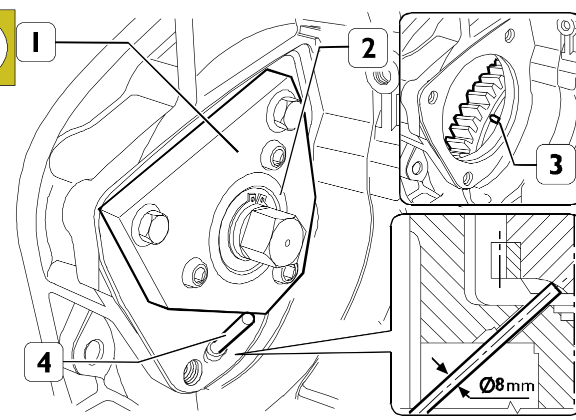
- ❑ Tighten the fastening screws (1 and 2).
- ❑ Repeat the operation for the remaining rocker arm units.

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x75	24 ± 3 Nm
(2)	4	Screw M12x1.75x180	
		1st phase	70 ± 5 Nm
		2nd phase	90° + 90°

Setting rocker free play

Preliminary operations

Figure 316

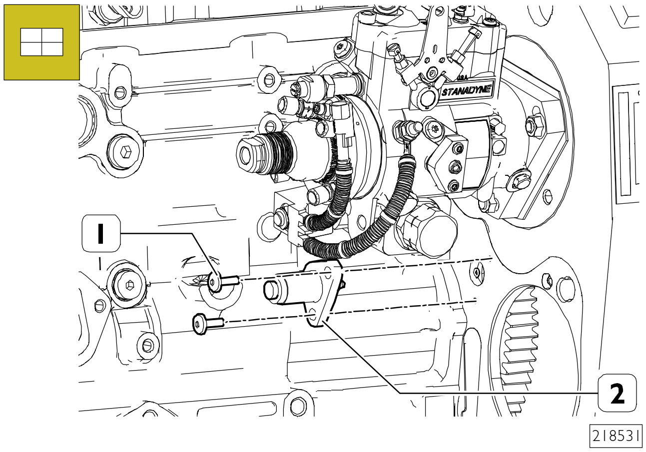


123031

- ❑ Fit tool 99360339 (1) to rotate the flywheel with the help of a wrench.

Identifying top dead centre at end of compression stroke for 1st cylinder using timing system lock pin (99360616) - False injector

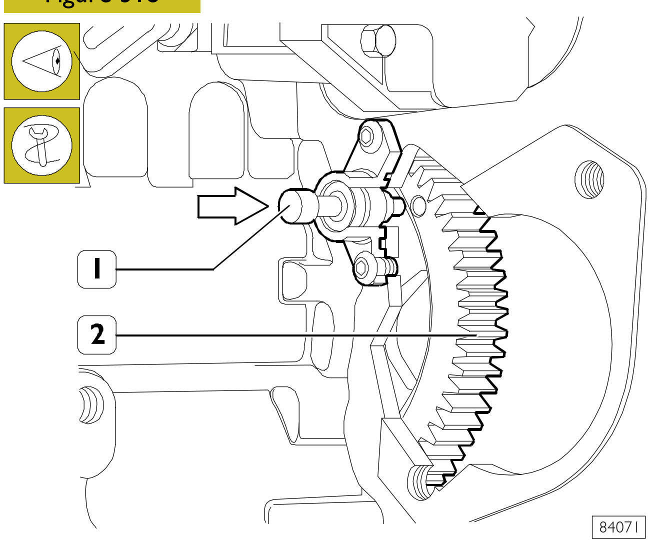
Figure 317



- ❑ Insert the plate (2) together with the centring pin.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M5x0.8x17	-

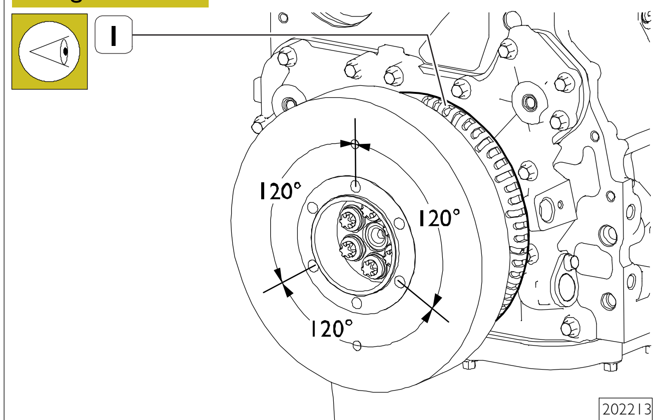
Figure 318



Identifying the 1st cylinder top dead centre position at the end of the compression stroke:

- ❑ remove the cylinder rocker arm cover;
- ❑ turn the flywheel until it pushes the pin 99360616 (1), blocking the gear (2);
- ❑ make sure that the intake and exhaust valves of the 1st cylinder are both closed and not balanced.

Figure 319



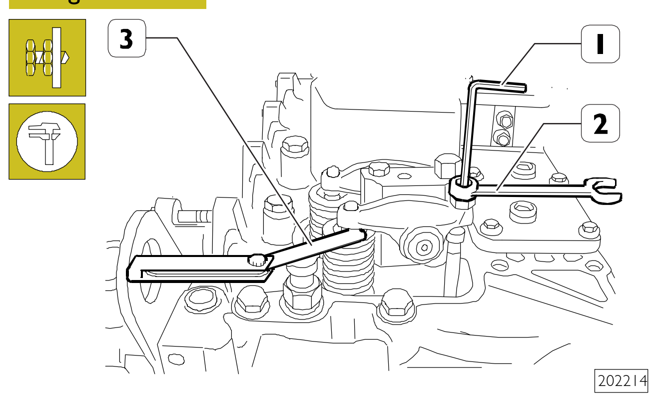
- ❑ Also make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis (condition with cylinder n.1 at TDC) and the valves of cylinder n. 4 are balanced. If cylinder n.1 is balanced, turn the engine by 1 revolution to bring it into the required condition.
- ❑ Adjust the 1st cylinder valve clearance as indicated in the relative paragraph.
- ❑ At this point, appropriately turn the crankshaft as shown in the Table to adjust the rocker arm clearance of the other cylinders.

<u>FIRING ORDER: 1 - 3 - 4 - 2</u>

Start and rotation crankshaft	Rocker arm clearance adjustment intake and exhaust valves - cylinder n°
Cyl. no.1 at TDC	1
Turn 180°	3
Turn 180°	4
Turn 180°	2

Setting rocker free play

Figure 320



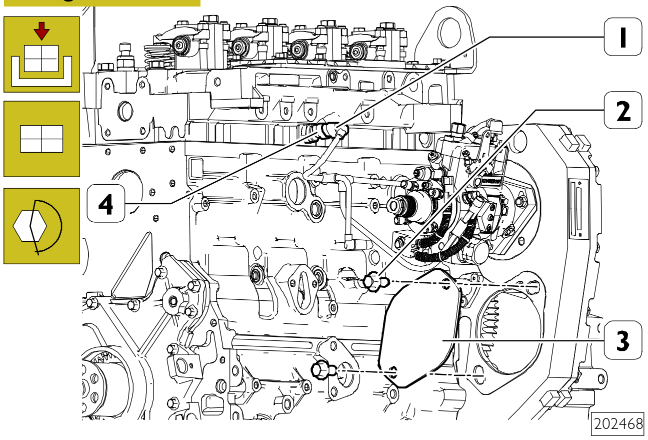
- ❑ Adjust the clearance between the rocker arms and valves using an Allen wrench (1), a box wrench (3) and feeler gauge (2).

The clearance is:

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

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

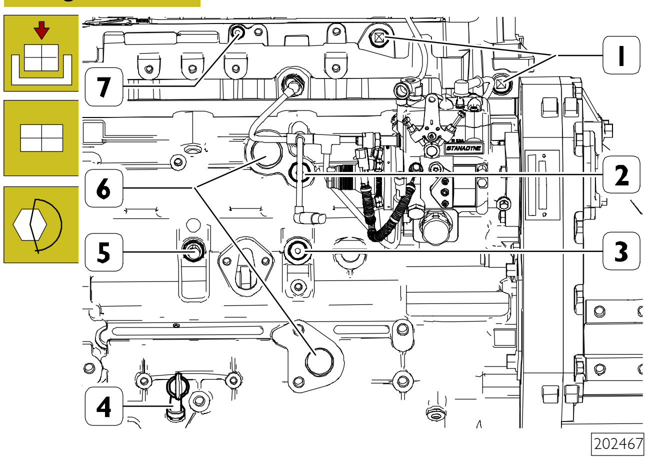
Figure 321



- ❑ Position the cover (3) in its seat and tighten the screws (2).
- ❑ Tighten the water temperature sensor (4).
- ❑ Connect all the electrical connections to the feed pump.
- ❑ Connect the connection (1).

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M12x1.75x25	80 ± 5 Nm
(4)	1	Sensor 1/2 x14"	28 ± 2 Nm

Figure 322

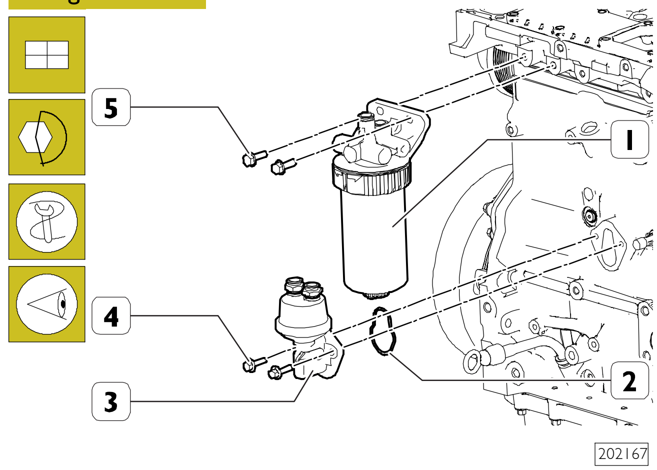


- ❑ Fit the core plugs (6).
- ❑ Tighten the threaded plug (7).
- ❑ Screw in the oil level dipstick (4).
- ❑ Tighten the oil pressure sensor (5).
- ❑ Tighten the threaded plugs (2 and 3).
- ❑ Tighten the threaded plugs (1) on the ducts for water delivery to the heater.

Ref.	No.	Screws description	Tightening torques
(1)	2	Plug 3/4"	36 ± 6 Nm
(2)	1	Plug 1/4"	14 ± 2 Nm
(3)	1	Plug M14x1.5	-
(5)	1	Sensor M10x1	35 ± 4 Nm
(7)	1	Plug M10x1	24 ± 4 Nm

Refitting of fuel filter and priming pump

Figure 323



Do not smoke or use open flames during this operation.

Do not inhale the vapours that exit the filter.

When replacing the filters, the feed system must then always be deaerated.

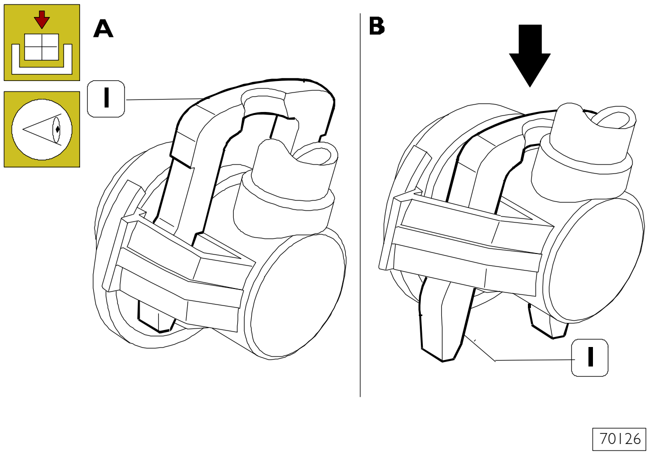
NOTE The filter must be previously filled with fuel to facilitate supply system bleeding operations.

- ❑ Fit the new gasket (2).
- ❑ Position the priming pump (3) in the relative seat.
- ❑ Tighten the screws (4).
- ❑ Position the filter mount to the crankcase.
- ❑ Tighten the screws (5).
- ❑ Clean the gasket seat on the fuel filter support (1) and lightly oil the gasket on the new filtering cartridge.
- ❑ Manually tighten the new filtering cartridge until the gasket rests completely on its seat.
- ❑ Tighten further with the help of the tool 99360076 to the torque of 12.5 ± 2.5 Nm.

Ref.	No.	Screws description	Tightening torques
(4)	2	Screw M8x1.25x25	24 ± 4 Nm
(5)	2	Screw M8x1.25x25	80 ± 8 Nm

Refitting low pressure pipes

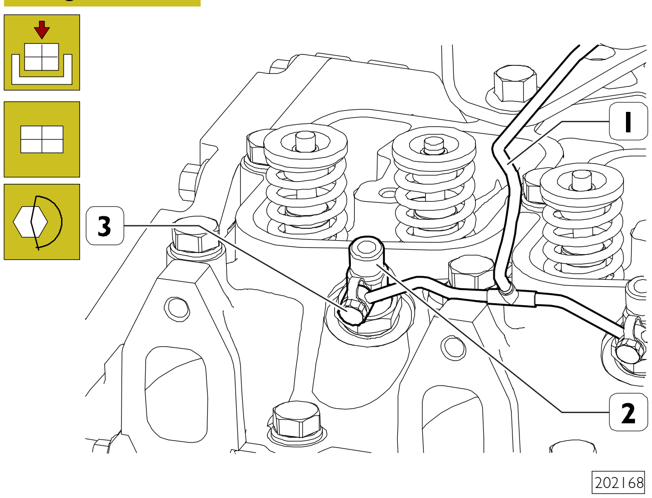
Figure 324



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

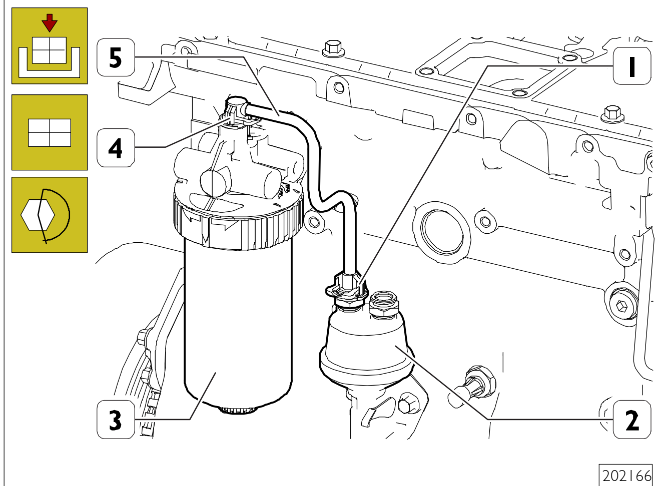
Figure 325



- ❑ Position the exhaust pipes (1) from the injectors (2).
- ❑ Connect the 4 threaded fittings (3) passing through the injectors (2).

Ref.	No.	Screws description	Tightening torques
(3)	4	Nut M6x1x10	80 ± 8 Nm

Figure 326

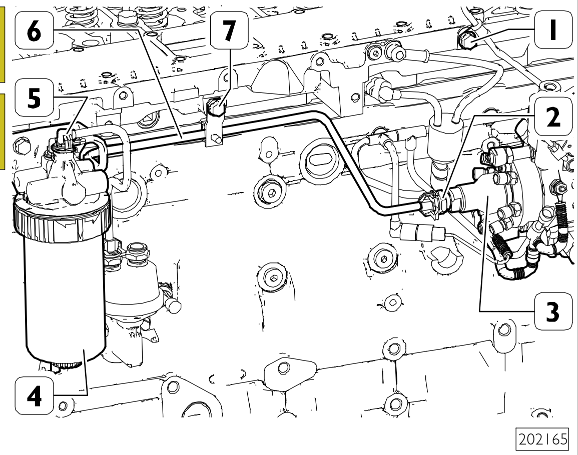


- ❑ Connect the pipe (5).
- ❑ Fit the quick-fit coupling (4) on the fuel filter (3).
- ❑ Tighten the connector (1) on the priming pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M12x1.5	80 ± 8 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE TOP)

Figure 327

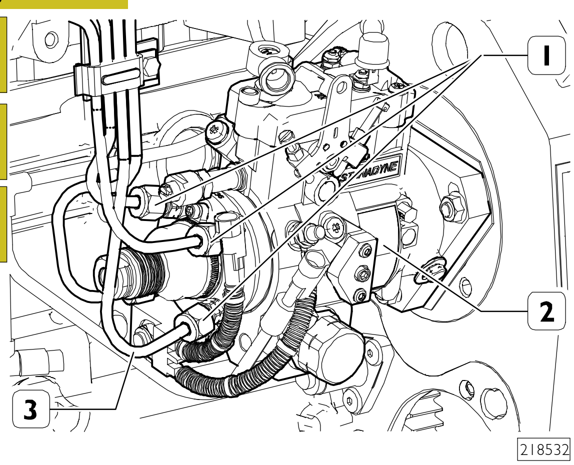


- ❑ Connect the quick-fit couplings (5) on the fuel filter (4) and connect the pipe (6).
- ❑ Connect the clip (2) from the injection pump (3).
- ❑ Tighten the screw (1 and 7) securing the support bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x16	80 ± 8 Nm
(7)	1	M8x16	80 ± 8 Nm

Refitting high pressure pipes

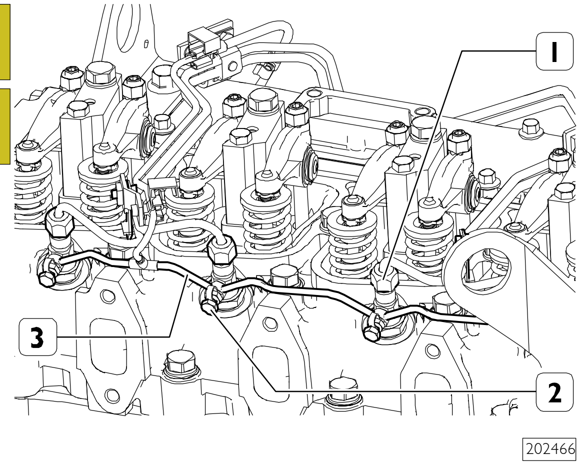
Figure 328



- ❑ Connect the high pressure pipes (3).
- ❑ Tighten the fittings (1) connecting to the injection pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M12x1.5	26 ± 1 Nm

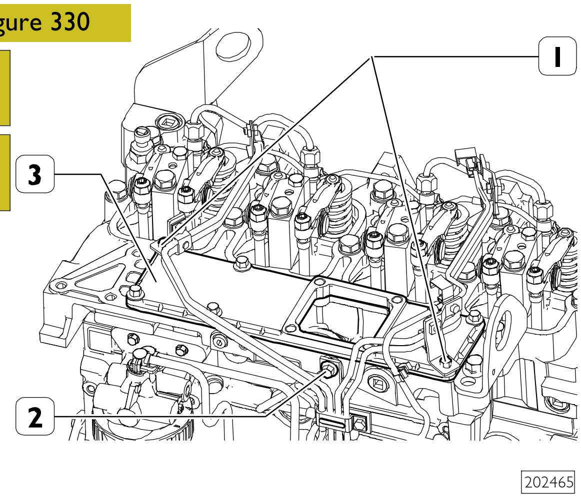
Figure 329



- ❑ Tighten the fittings (2) connecting to the injectors.

Ref.	No.	Screws description	Tightening torques
(2)	4	M6x1x9 fitting	80 ± 8 Nm

Figure 330

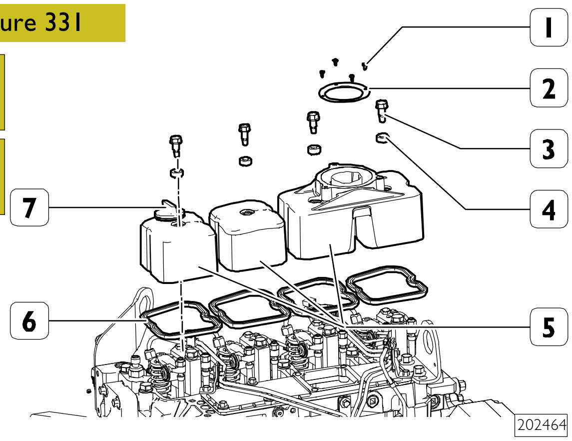


- ❑ Tighten the screw (2) securing the support plate.
- ❑ Tighten the support bracket fastening screws (1) at the intake manifold (3).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x16	24 ± 4 Nm
(2)	1	Screw M8x1.25x25	24 ± 4 Nm

Refitting tappet covers

Figure 331



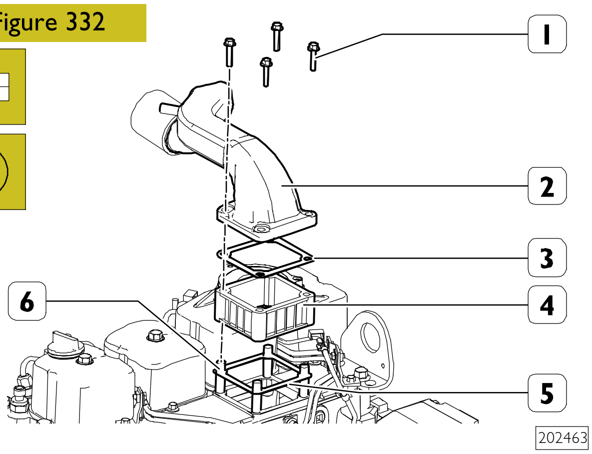
- ❑ Position the new gaskets (6) between the covers and the cylinder heads and screw in the oil filling cap (7).
- ❑ Position the tappet covers (5) in the relative seats.
- ❑ Fit the sound-proofing elements (4) and tighten the screws (3).
- ❑ Insert the deflector (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw T2,9x6.5 F	-
(3)	4	Screw M8x1.25	24 ± 4 Nm

NOTE Check the threading of the fastening screws: there should be no signs of wear or build-up of dirt. The seal plugs must not show any deformations. Otherwise, replace with new parts.

Intake elbow refitting

Figure 332

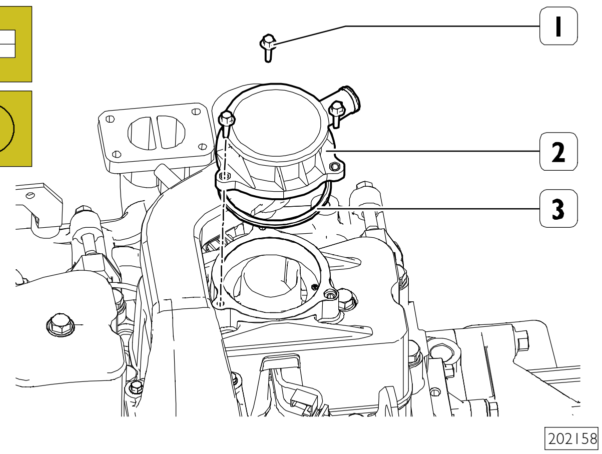


- ❑ Fit the new gasket (5).
- ❑ Insert the centring pins (6) and position the support (4).
- ❑ Fit the new gasket (3).
- ❑ Connect the intake elbow (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x80	24 ± 4 Nm

Oil vapour filter refitting

Figure 333



- ❑ Fit the new gasket (3) in the relative seat.
- ❑ Fit the oil vapour breather valve (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	24 ± 4 Nm

NOTE Always put in new gaskets.

Check the threading of the fastening screws: there should be no signs of wear or build-up of dirt.

The seal plugs must not show any deformations. Otherwise, replace with new parts.

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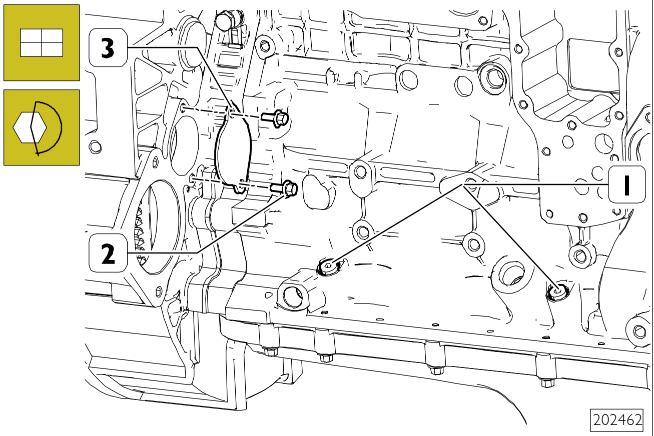
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Figure 334 (For all engines)

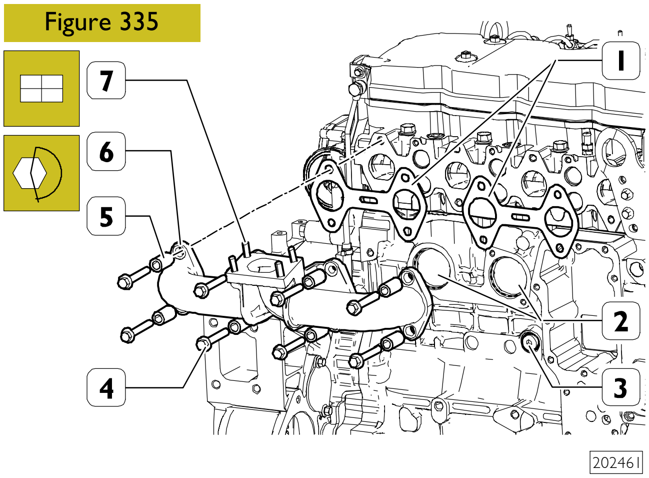


- ❑ Position the inspection cover (3) and tighten the screws (2).
- ❑ Tighten the plugs (1) after having inserted the relative gaskets.

Ref.	No.	Screws description	Tightening torques
(1)	2	Plug M12x1.5	24 ± 4 Nm
(2)	2	Screw M8x1.25x16	-

Refitting exhaust manifold;

Figure 335



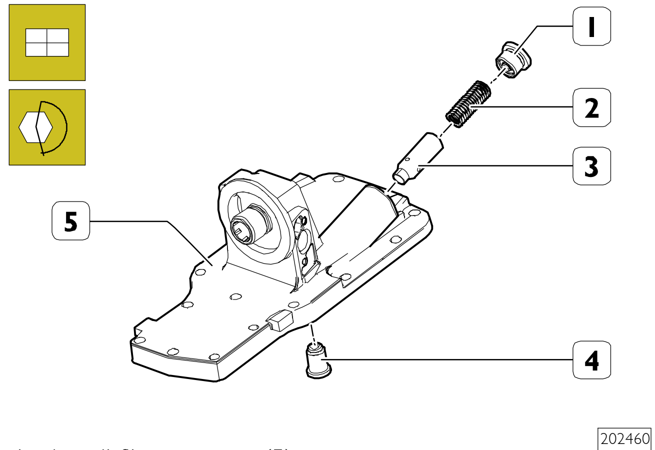
- ❑ Fit the core plugs (2).
- ❑ Unscrew the plug (3) and replace the relative gaskets.
- ❑ Position the gaskets (1) in the relative seats.
- ❑ Position the exhaust manifold (6) in its seat and tighten the studs (7) supporting the turbocharger.
- ❑ Position the 8 spacers (5) and tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(3)	1	Plug M18x1.5	24 ± 4 Nm
(4)	8	Screw M10x1.5x65	55 ± 5 Nm(*)
(4)	8	Screw M10x1.5x65	53 ± 5 Nm(**)
(7)	4	Stud M8x1.25x25	55 ± 3 Nm

(*) NEF45 SM1F engines
(**) NEF45 TE1F/TE2F engines

Refitting heat exchanger

Figure 336

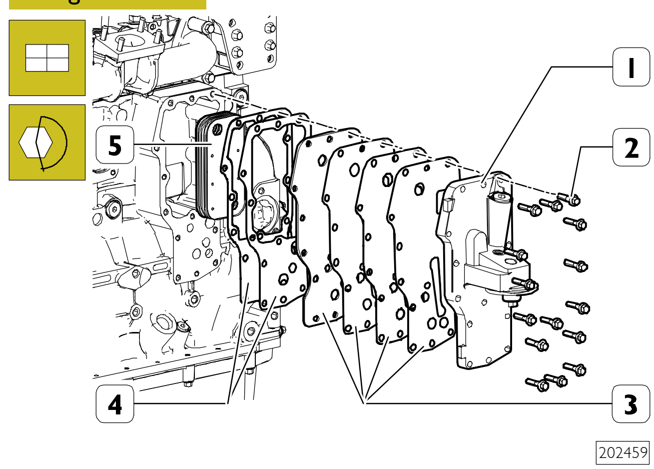


In the oil filter support (5):

- ❑ fit the oil pressure control valve (3), fit the compression spring (2) and tighten the plug (1).
- ❑ Fit the pressure control valve (4) in the relative seat.

Ref.	No.	Screws description	Tightening torques
(1)	1	Plug M22x1.5	80 ± 8 Nm

Figure 337

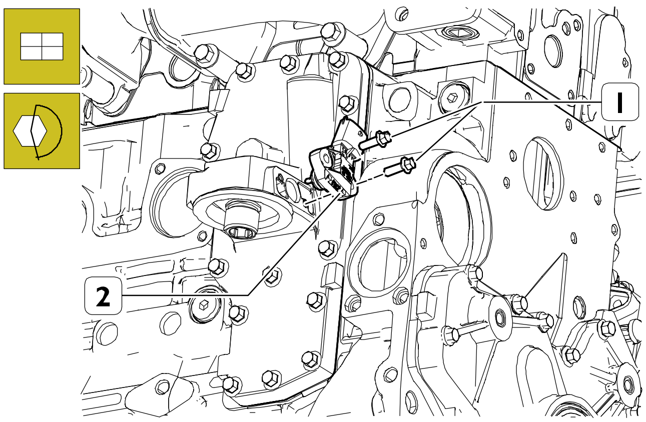


- ❑ Insert the two new sealing gaskets (4).
- ❑ Fit the heat exchange elements (5) in the relative seats.
- ❑ Fit the insulating plates (3).
- ❑ Position the oil filter support (1) in the relative seat and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	15	Screw M8x1.25x35	26 ± 4 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Figure 338



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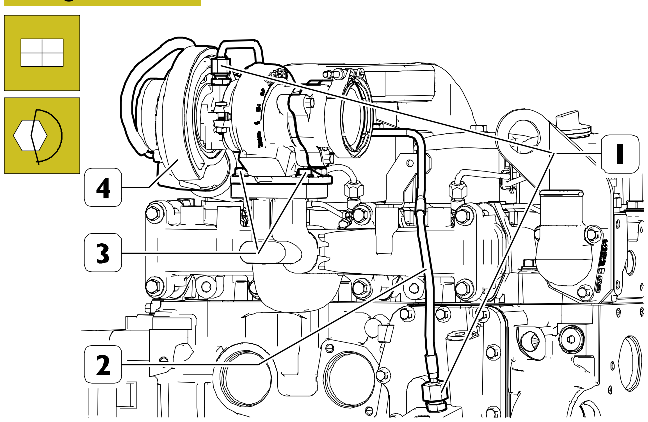
- Insert the oil pressure/temperature sensor (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x20	35 ± 4 Nm

Turbocharger refitting

Figure 339

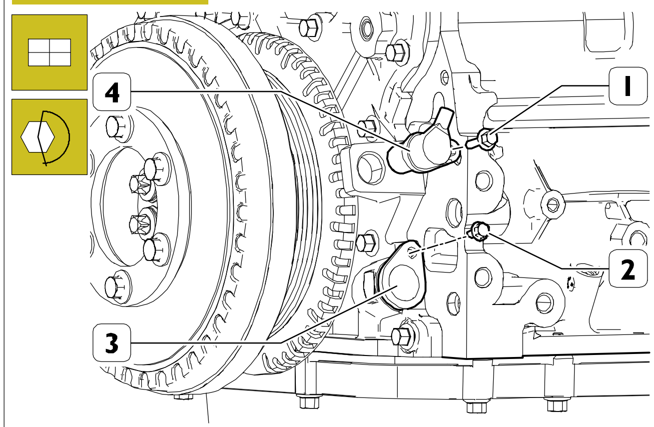


202457

- Insert the new gasket on the exhaust manifold.
- Position the turbocharger (4) and tighten the nuts (3).
- Tighten the fittings (1) of the oil delivery pipe (2) to the turbocharger (4).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M10x1.25	36 ± 5 Nm
(3)	4	Nut M8x1.25	24 ± 4 Nm

Figure 340 NEF45 SM1F engine



202456

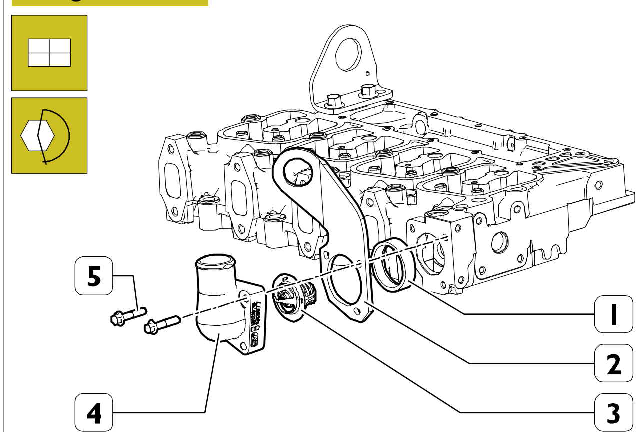
☞ NEF45 TE1F/TE2F engine Page 114

- Insert the plug (3) and tighten the screw (2).
- Insert the crankshaft rpm sensor (4) and tighten the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1x20	10 ± 2 Nm
(2)	1	Screw	26 ± 4 Nm

Thermostat unit refitting

Figure 341



202498

- Position the gasket (1) of the cover.
- Position the lifting eyelet (2).
- Insert the thermostat assembly (3) into the relative seat.
- Position the thermostat cover (4).
- Tighten the screws (5) securing the thermostat cover (4).

Ref.	No.	Screws description	Tightening torques
(5)	3	Screw M6x1	10 ± 2 Nm

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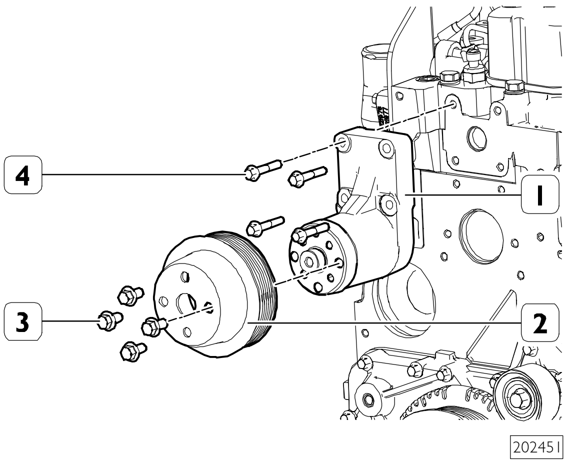
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Fan support refitting

Figure 342

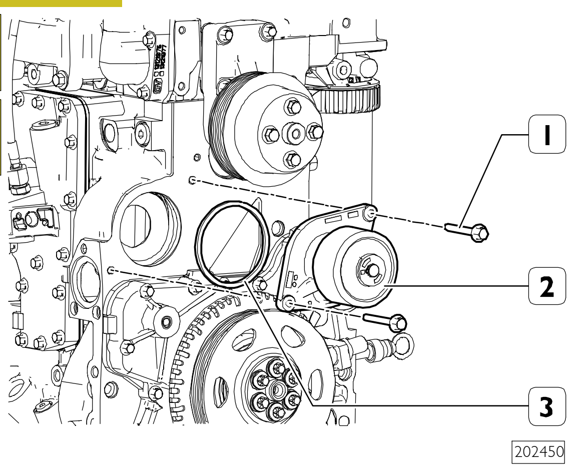


- ❑ Position the fan mount (1) and tighten the screws (4).
- ❑ Position the pulley (2) and tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	4	Screw M8x1.25x35	36 ± 5 Nm
(4)	4	Screw M8x25	26 ± 4 Nm

Refitting water pump

Figure 343

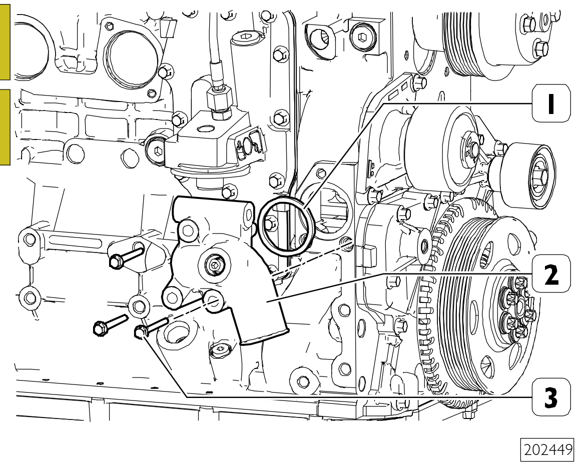


- ❑ Insert the gasket (3) and position the water pump (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x35	24 ± 4 Nm

Fan support refitting

Figure 344

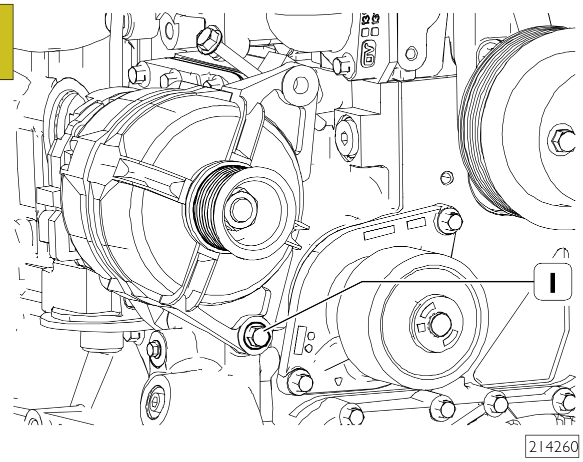


- ❑ Insert the gasket (1).
- ❑ Position the alternator support (2).
- ❑ Tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	3	Screw M10x1.5x80	43 ± 6 Nm

Refitting alternator

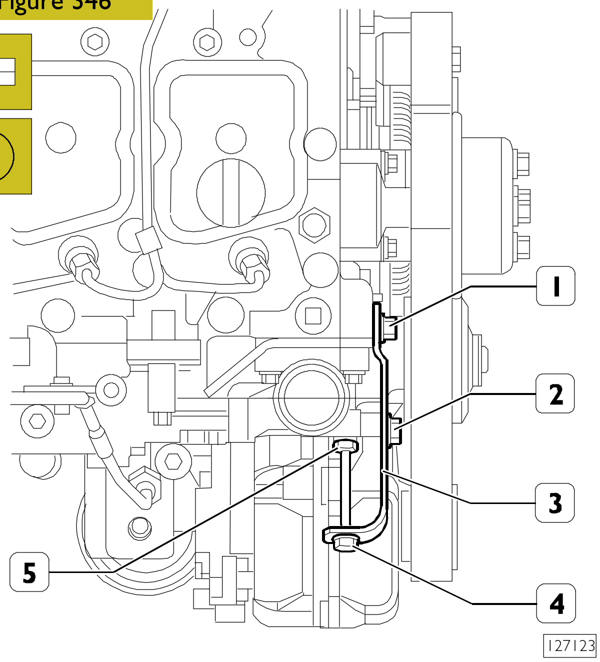
Figure 345



- ❑ Screw the screw (1) without tightening.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5x110	-

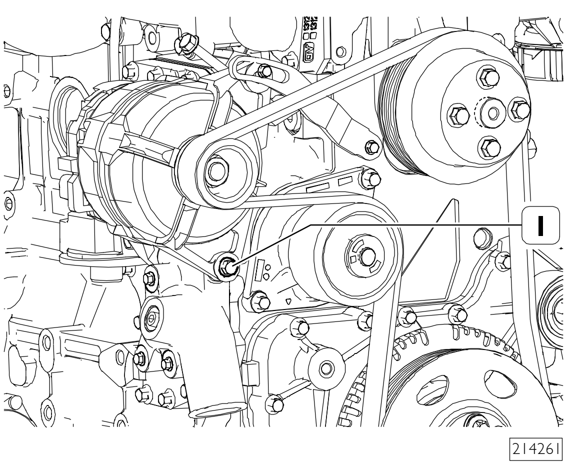
Figure 346



- ❑ Tighten the screw (2), the bolt (5) and the bolt securing the alternator to the mount.
- ❑ Fit the alternator tensioning bracket (3) and secure it with the screw (1)
- ❑ Screw the screw (2) without tightening.
- ❑ Put the belt in tension by acting on the screws (4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5x40	43 ± 6 Nm
(2)	1	Screw M10x1.5x40	43 ± 6 Nm
(4)	1	Screw M8x1.25x100	-
(5)	1	Nut M8x1.25	-

Figure 347

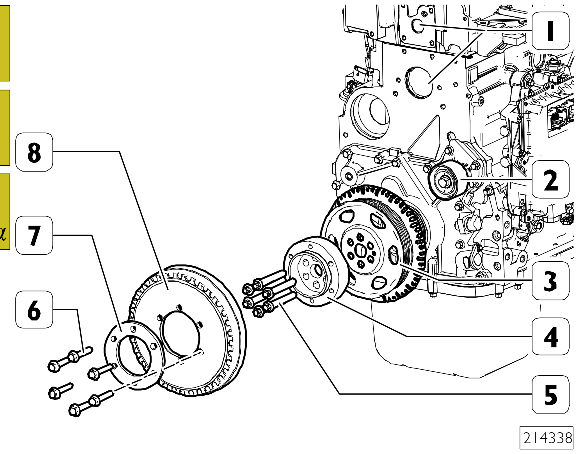


- ❑ Tighten the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5x110	43 ± 6 Nm

Crankshaft pulley refitting

Figure 348 NEF45 TE1F/TE2F engine



☞ NEF45 SM1F engine Page 120

- ❑ Position the core plug (1).
- ❑ Tighten the screw (2) fixing the idler pulley.
- ❑ Position the spacer (4) for the shaft and the pulley (3).
- ❑ Tighten the screws (5).
- ❑ Position the front damper (8) in the relative seat.
- ❑ Tighten the screw (6) fixing the flange (7) to the front hub.

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M10x1.5	43 ± 6 Nm
(5)	6	Screw M12x1.25x78.5	
		1^{st} phase	50 ± 5 Nm
		2^{nd} phase	90°
(6)	6	Screw M10x1.25x40	68 ± 7 Nm

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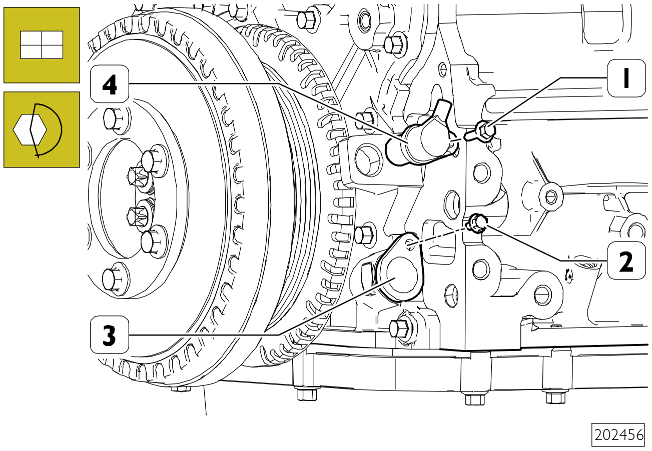
Figure 349

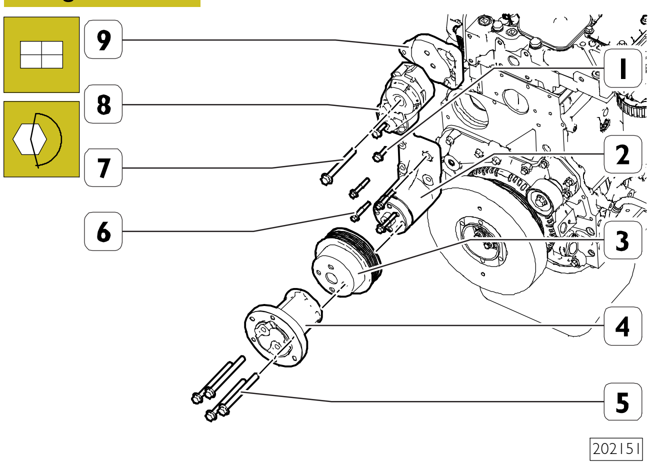


- ❑ Insert the plug.
- ❑ Insert the crankshaft rpm sensor (4) and tighten the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1x20	24 ± 4 Nm
(2)	1	Screw	-

Refitting of automatic belt tensioner and fan mount

Figure 350

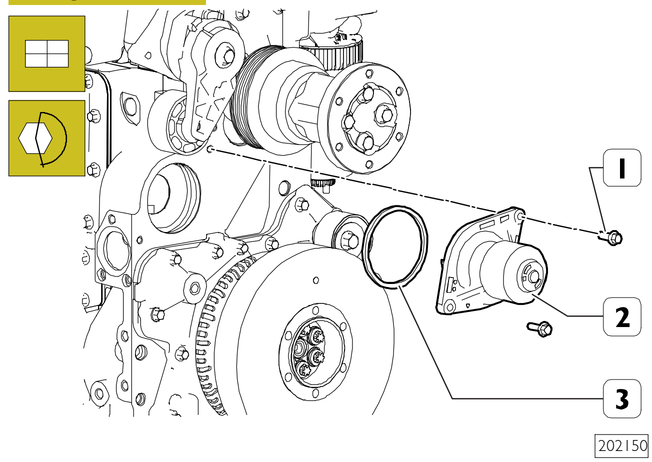


- ❑ Position the fan mount (2) in the relative seat and tighten the screws (6).
- ❑ Position the spacer (4) in its seat, together with the drive pulley (3) and tighten the screws (5).
- ❑ Position the belt tensioner mount (9) in the relative seat and tighten the screws (1).
- ❑ Position the automatic belt tensioner (8) in the relative seat and tighten the screw (7).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x30	43 ± 6 Nm
(5)	4	Screw M10x1.5x110	43 ± 6 Nm
(6)	4	Screw	43 ± 6 Nm
(7)	1	Screw M10x1.5x70	43 ± 6 Nm

Refitting water pump

Figure 351

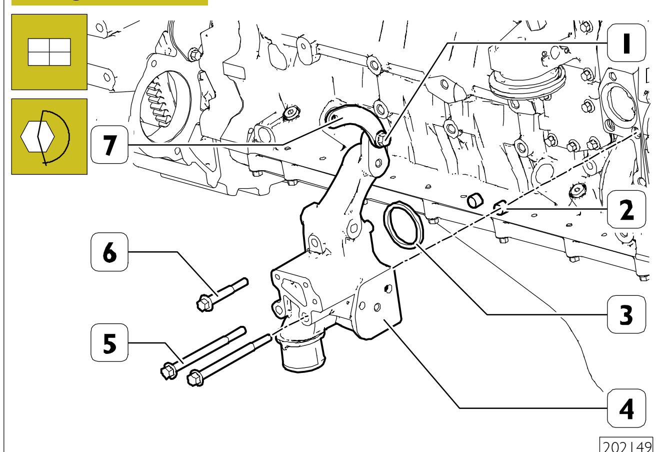


- ❑ Fit the new gasket (3).
- ❑ Position the water pump (2) in the relative seat.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x35	24 ± 4 Nm

Refitting alternator support

Figure 352

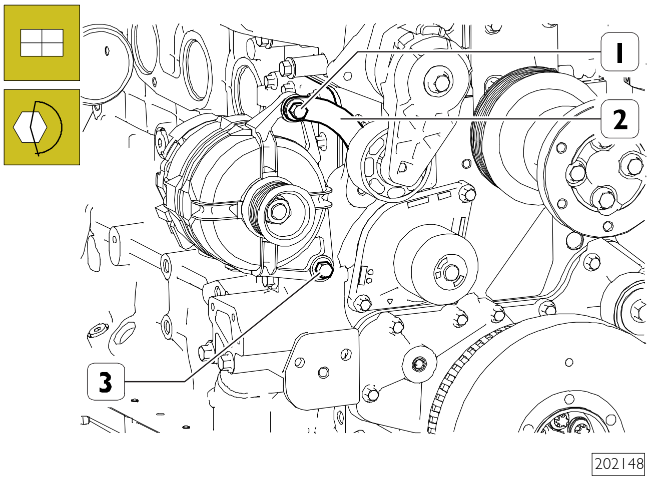


- ❑ Fit the cable reference dowel pins (2) and the new gasket (3) in their seats.
- ❑ Position the alternator mount (4) in the relative seat.
- ❑ Tighten the screws (5 and 6).
- ❑ Position the bracket (7) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5x20	43 ± 6 Nm
(5)	2	Screw M10x1.5x135	43 ± 6 Nm
(6)	1	M10x1.5x70	43 ± 6 Nm

Refitting alternator

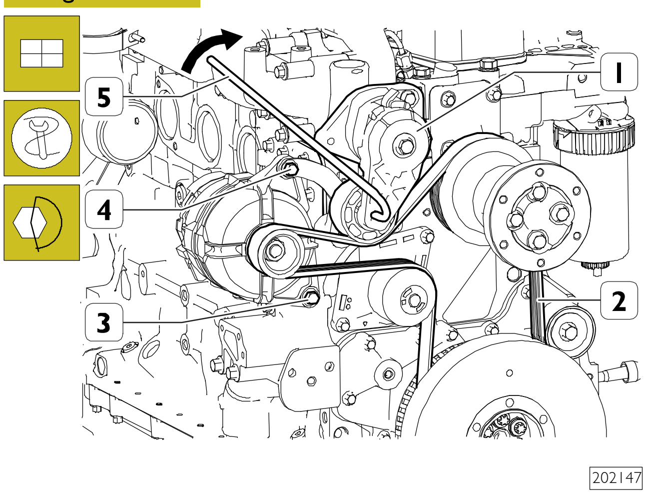
Figure 353



- ❑ Position the alternator in its seat, together with the bracket (2).
- ❑ Position but do not tighten the screw (3) anchoring the alternator to its lower mount and the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	-
(3)	1	Screw M10x1.5	-

Figure 354



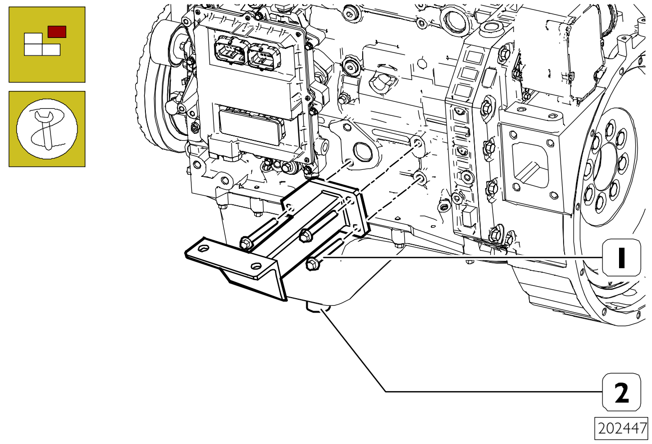
- ❑ Use the tool (5) to turn the automatic tensioner (1) in the direction of the arrow and put on the belt (2).
- ❑ Tighten the screw (4) securing the alternator to the bracket and the screw (3) securing the alternator to the lower mount.

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M10x1.5	43 ± 6 Nm
(4)	1	Screw M10x1.5	43 ± 6 Nm
(4)	1	Nut M10x1.5	43 ± 6 Nm

Engine completion

To complete the engine assembly operations, remove the rotating stand.

Figure 355



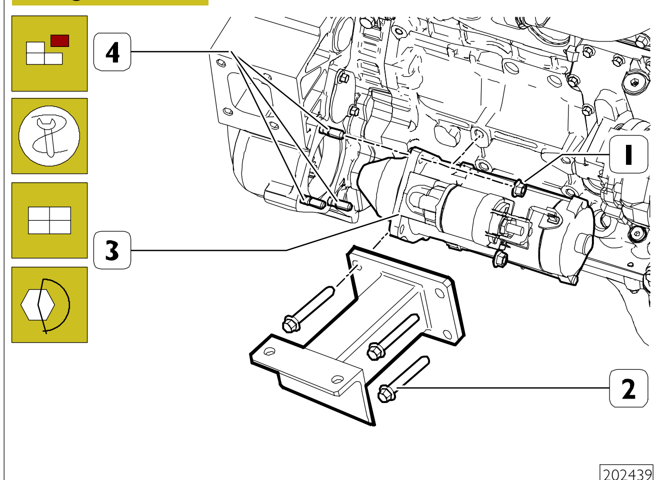
From the left side:

- ❑ Lift the engine with arm 99360595 and remove it from the rotating stand 99322205.
- ❑ Unscrew the screws (1) and remove the bracket 99361037.

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	-

Refitting electric starter motor

Figure 356

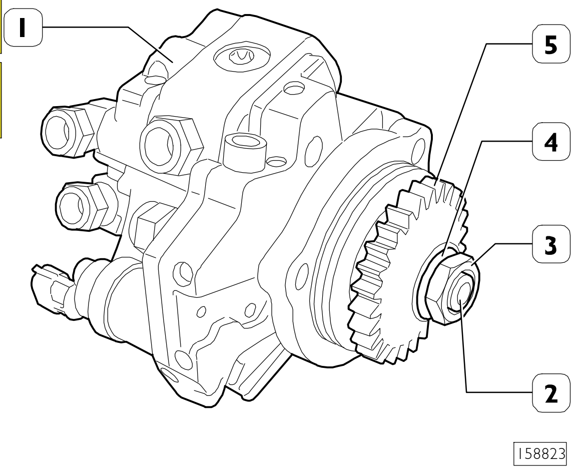


- ❑ Unscrew the screws (2) and remove the support bracket 99361037.
- ❑ Tighten the studs (4) and position the starter motor (3).
- ❑ Tighten the retaining nuts (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M10x1.5	43 ± 6 Nm
(2)	4	Screw M12x1.75	-
(4)	3	Stud M10x1.5x20	43 ± 6 Nm

Supply pump refitting

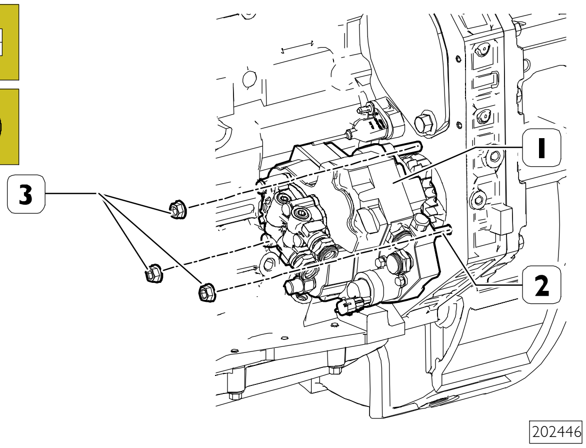
Figure 357



- ❑ Fit the gear (5) to the shaft (2).
- ❑ Lock rotation of the high-pressure pump (1) drive shaft (2).
- ❑ Tighten the nut (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Nut M18x15	105 ± 5 Nm

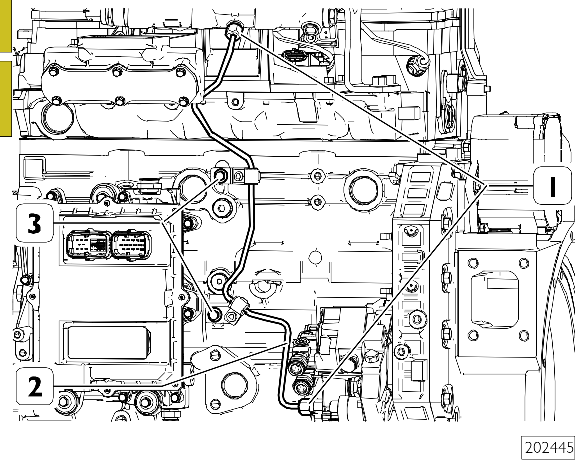
Figure 358



- ❑ Tighten the studs (2).
- ❑ Position the supply pump assembly (1).
- ❑ Tighten the nuts (3).

Ref.	No.	Screws description	Tightening torques
(2)	3	Stud M8x1.25x5	24 ± 4 Nm
(3)	3	Nut M8x1.25	24 ± 4 Nm

Figure 359

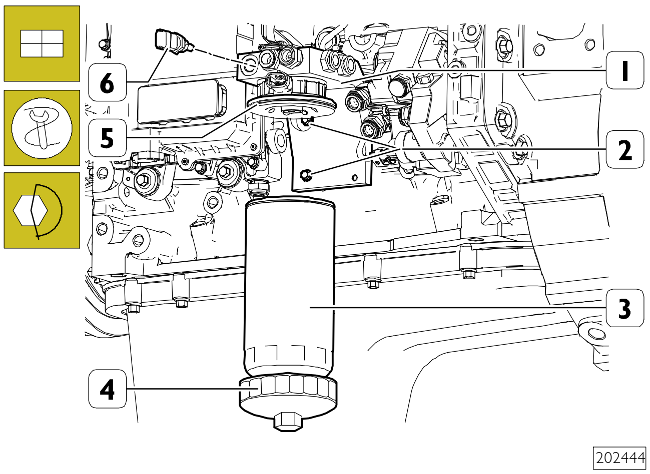


- ❑ Position the Rail supply high pressure pipe (2).
- ❑ Tighten the screws (3).
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M14x1.5	24 ± 4 Nm
(3)	2	Screw M6x1x12	40 ± 5 Nm

Fuel filter refitting

Figure 360

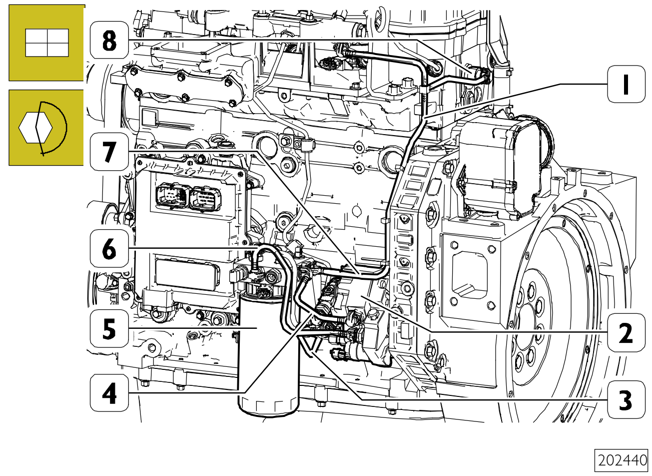


- ❑ Position the fuel filter support (1) together with the fuel preheating resistor (5).
- ❑ Tighten the screws (2).
- ❑ Tighten the cartridge (3) using tool 99360076 (4).
- ❑ Tighten the fuel temperature sensor (5).

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M12x1.75	80 ± 8 Nm
(3)	1	Cartridge M20x1.5	24 ± 4 Nm
(6)	1	Sensor M14x1.5	20 Nm

NOTE The filter must be previously filled with fuel to facilitate supply system bleeding operations.

Figure 361



- ❑ Tighten the Voss fitting (8).
- ❑ Connect the fuel returning pipe (7) from the injection pump (2) to the filter (5).
- ❑ Connect the fuel arrival pipe (6) for the injection pump (2).
- ❑ Connect the fuel delivery pipe (4) for the filter (5).
- ❑ Connect the fuel return pipe (3) for the injection pump (2).
- ❑ Connect the excess fuel return pipe (1) from the Common Rail.

The pipes which were removed cannot be refitted.

They must be replaced.

Ref.	No.	Screws description	Tightening torques
(8)	1	Connector M12x1.5	22 ± 2 Nm

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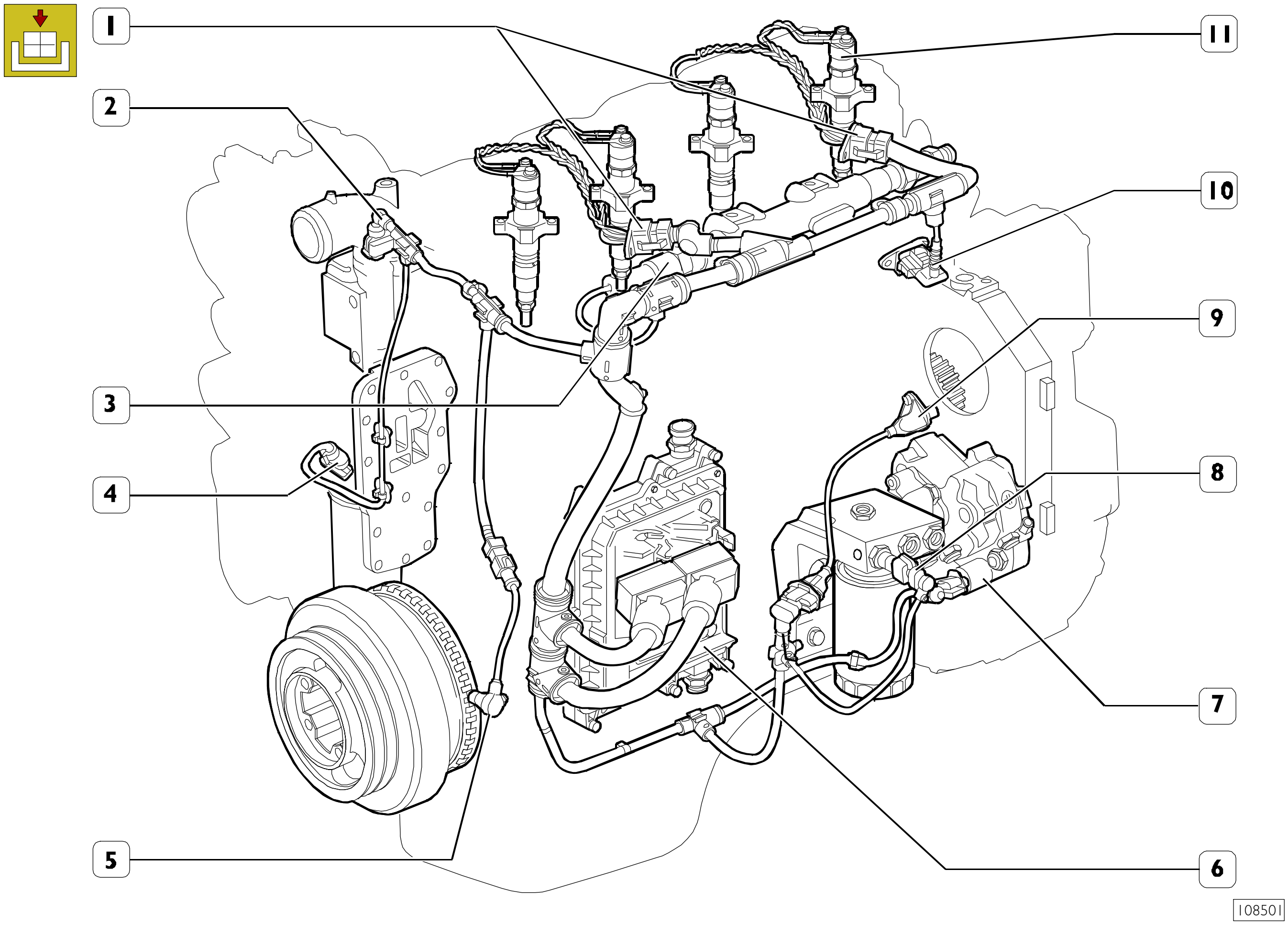
Refitting engine cable

Figure 362

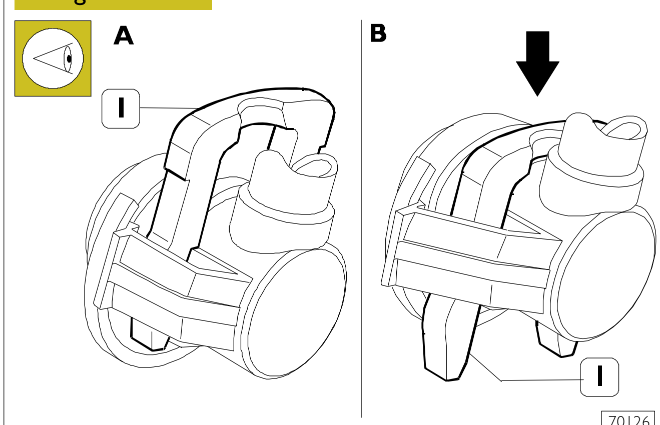


1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9 . Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

Connect the engine cable from the connectors: electro-- injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermo-stat; (5) engine rpm sensor.

Insert the clamps that hold it to the crankcase.

Figure 363



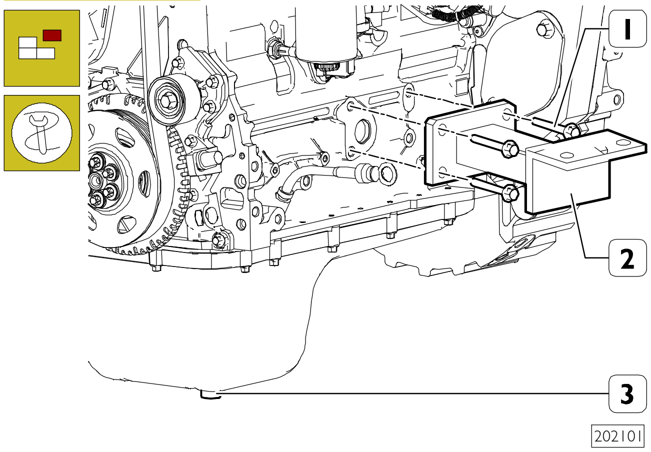
To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

Engine completion

To complete the engine assembly operations, remove the rotating stand.

Figure 364 NEF45 SM1F engine



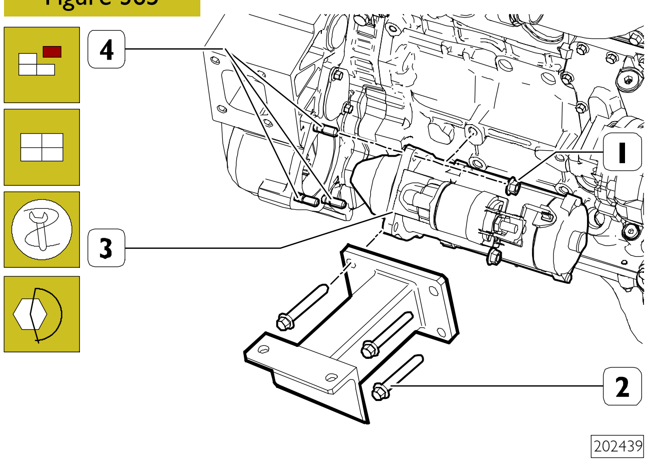
From the left side:

- ❑ Lift the engine with arm 99360595 and remove it from the rotating stand 99322205.
- ❑ Unscrew the screws (1) and remove the bracket 99361037 (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	-

Refitting electric starter motor

Figure 365

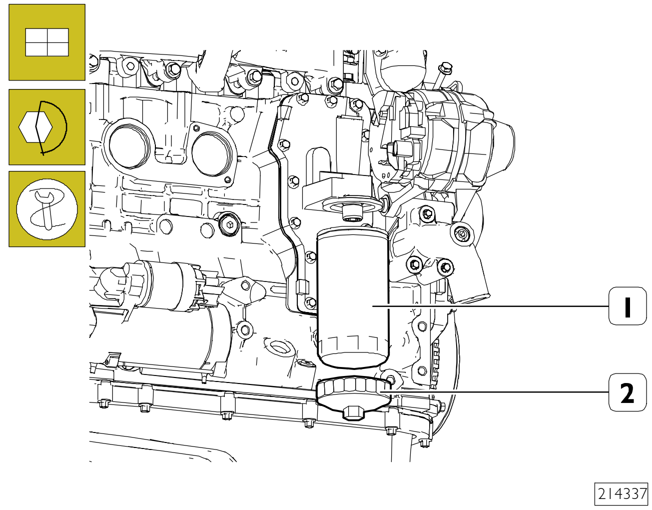


- ❑ Unscrew the screws (2) and remove the second support bracket 99361037.
- ❑ Tighten the studs (4) and position the starter motor (3).
- ❑ Tighten the retaining nuts (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M10x1.5	43 ± 6 Nm
(2)	4	Screw M12x1.75	-
(4)	3	Stud M10x1.5x20	43 ± 6 Nm

Refitting oil filter

Figure 366

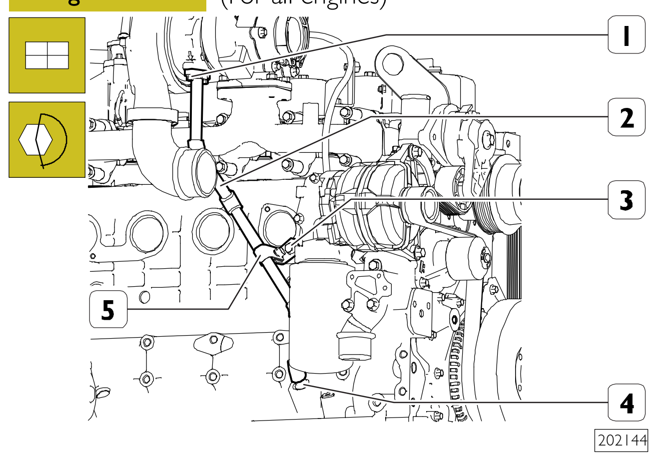


- ❑ With tool 99360076 (2) fit the oil filter (1) on the support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

Refitting lubricant oil return pipe from turbocharger

Figure 367 (For all engines)



the lubricant oil drain pipe (2) from the turbocharger.

- ❑ Free the ends of the pipe and the exhaust on the turbocharger. Fit the fitting (4) in the crankcase.
- ❑ Tighten the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- ❑ Tighten the two screws (1) under the turbocharger.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x16	10 ± 2 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

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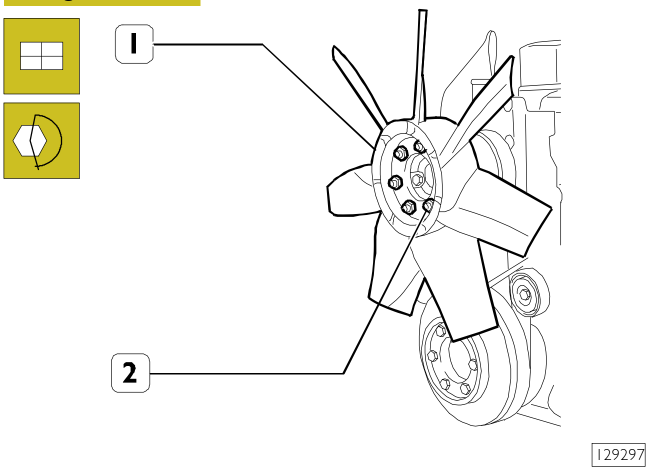
Refitting fan

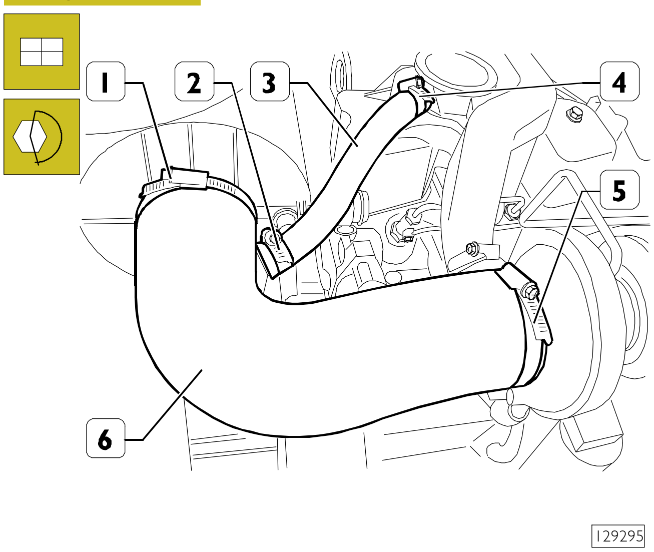
Figure 368



- Position the fan (2), complete with spacer.
- Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	6	Screw M8x1.25	24 ± 4 Nm

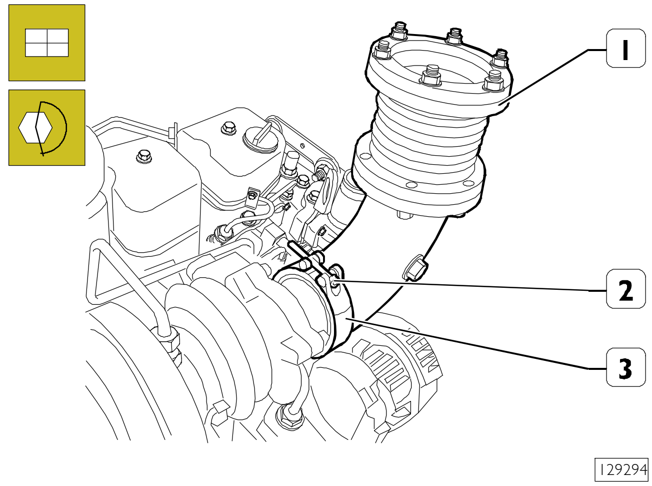
Figure 369



- Connect the air intake pipes (6), closing their clamps (1) and (5)
- Connect the oil vapour recovery pipes (3), closing their clamps (2) and (4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M7x1	13 ± 2 Nm
(5)	1	Screw M7x1	13 ± 2 Nm

Figure 370

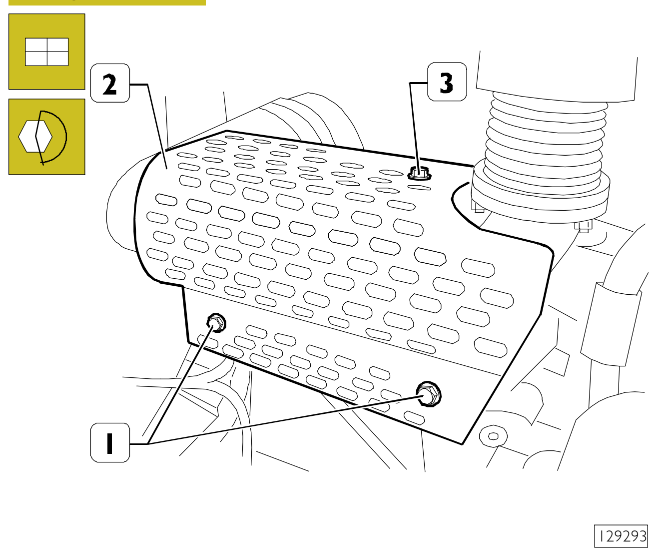


- Connect the discharge pipe (1), tightening the screw (2) to close the clamp (3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M7x1	13 ± 2 Nm

Refitting radiator assembly

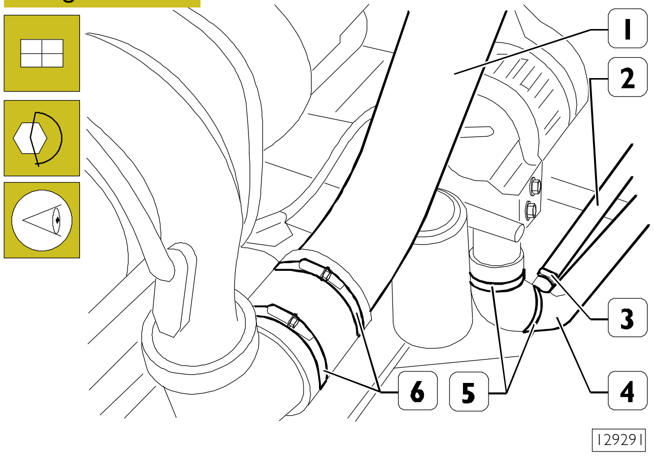
Figure 371



- If present, refit the turbine protection grille (2), restoring the relative mounting brackets.
- Replace the radiator unit on the crankcase, making sure to interference with the fan.
- Tighten the fastening screws (1 and 3) on both sides.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

Figure 372



❑ Fit the pipe (4) complete with sleeves, from the engine side, acting on the relative clamps (5).

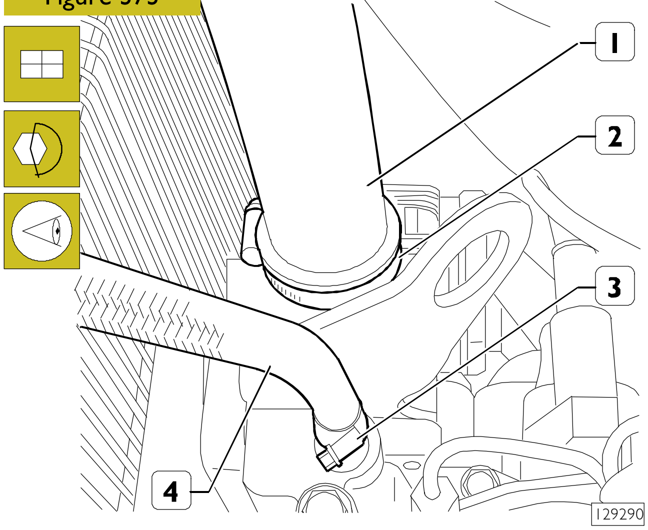
❑ Fit the pipe (2) complete with sleeves, from the engine side, acting on the relative clamps (3).

❑ Fit the pipe (1) complete with sleeves, from the engine side, acting on the relative clamps (6).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M6x1x16	43 ± 6 Nm
(5)	2	Screw M8x1.25x16	43 ± 6 Nm
(6)	2	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 373

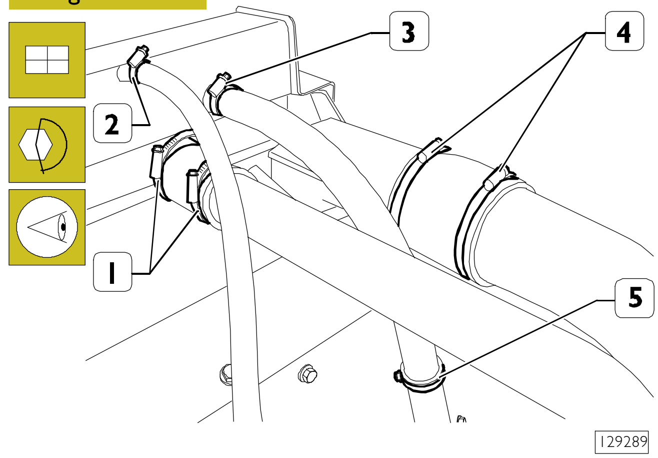


❑ Fit the pipes (1 and 4) complete with sleeves acting on the relative clamps (2 and 3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 374

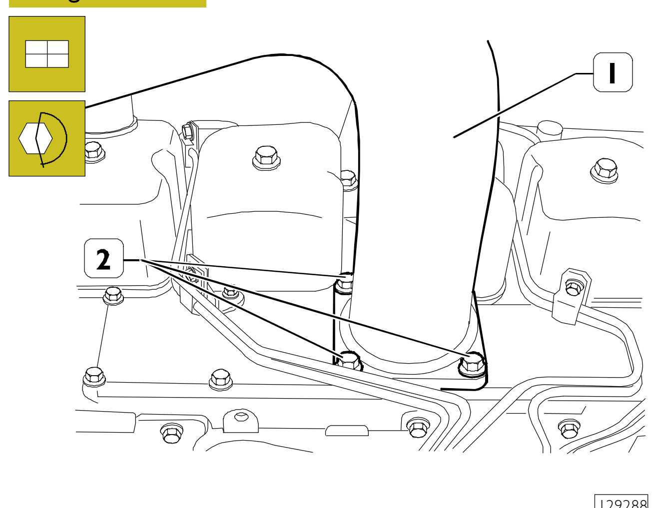


❑ Connect the air and water pipes to the radiator assembly using the clamps (1, 2, 3 and 4) and the mounting bracket (5).

Ref.	No.	Screws description	Tightening torques
(5)	1	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 375



❑ Mount the pipe (1).

❑ Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	24 ± 4 Nm

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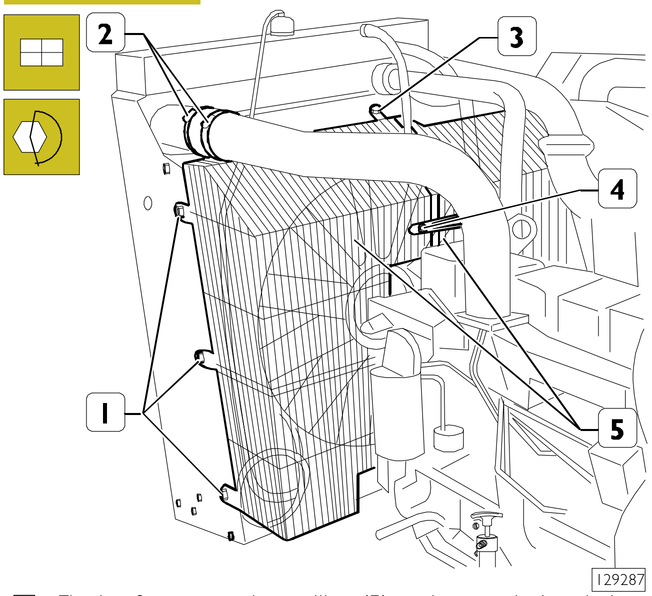
Figure 376

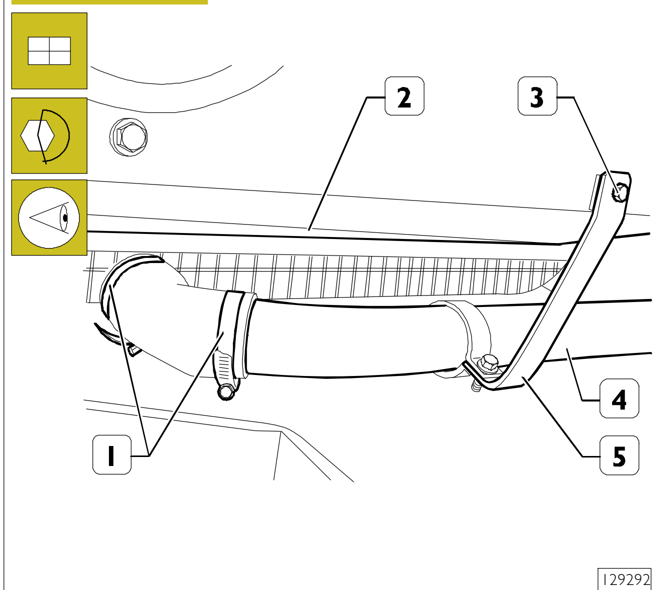


❑ Fit the fan protection grilles (5) acting on their relative fasteners (1), (3) and (4).

❑ Close the clamps (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm
(4)	1	Screw M6x1x16	43 ± 6 Nm

Figure 377



❑ Connect the pipe (4) complete with hoses and bracket (5) to the radiator assembly (2)

❑ Close the relative clamps (1).

❑ Tighten the screw (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

❑ Refill the cooling system with coolant.

❑ Bleed the air from the 'supply system as described in the relevant paragraph.

❑ Refill the engine oil as described in the relative paragraph.

SECTION 7

technical specifications

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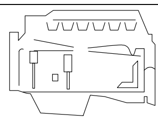
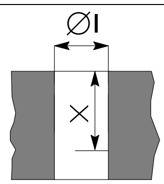
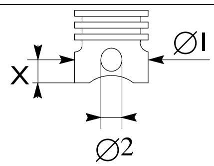
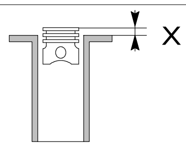
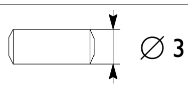
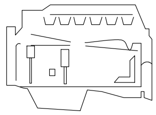
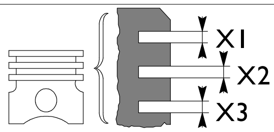
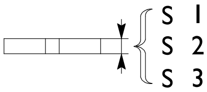
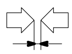
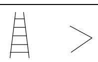
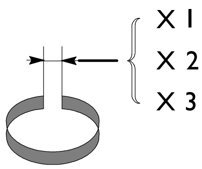
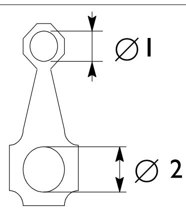
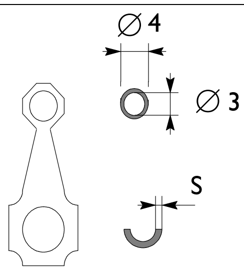
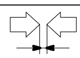
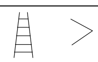
DATA - INSTALLATION CLEARANCES	3
TIGHTENING TORQUES (NEF45 SM1F)	9
TIGHTENING TORQUES (NEF45 TE1F/TE2F) .	11

DATA - INSTALLATION CLEARANCES

	Type	NEF45 SM1F	NEF45 TE1F/TE2F
CYLINDER ASSEMBLY AND CRANK GEARS		mm	
	Cylinder liners Ø1 > Ø 1	104.000 ÷104.024 0.4	
	Pistons Measuring point X Outer diameter Ø 1 Seat for pin Ø 3	55.9 103.714 ÷ 103.732 38.010 ÷ 38.016	49.5 103.739 ÷ 103.757 38.010 ÷ 38.016
	Piston - cylinder liners	0.268 ÷ 0.310	0.243 ÷ 0.285
	Piston diameter Ø 1	0.4	
	Piston position from crankcase X	0.28 ÷ 0.52	
	Piston pin Ø 3	37.994 ÷ 38.000	
	Piston pin - pin seat	0.010 ÷ 0.022	

	Type	NEF45 SM1F	NEF45 TE1F/TE2F
CYLINDER ASSEMBLY AND CRANK GEARS		mm	
	Circlip slots X1 X 2 X 3	2.705 ÷ 2.735 2.440 ÷ 2.460 4.030 ÷ 4.050	2.705 ÷ 2.735 2.420 ÷ 2.440 4.030 ÷ 4.050
	Circlips S 1 S 2 S 3	2.560 ÷ 2.605 2.350 ÷ 2.380 3.970 ÷ 3.990	
	Circlips - slots 1 2 3	0.100 ÷ 0.175 0.060 ÷ 0.110 0.040 ÷ 0.080	0.100 ÷ 0.175 0.040 ÷ 0.09 0.040 ÷ 0.080
	Piston rings	0.4	
	Piston ring end gap in cylinder liner: X 1 X 2 X 3	0.30 ÷ 0.40 0.60 ÷ 0.80 0.30 ÷ 0.55	
	Connecting rod small end bush seat ∅ 1 Connecting rod bearings seat ∅ 2	40.987 ÷ 41.013 72.987 ÷ 73.013	
	Connecting rod small end bush diameter Internal  ∅ 3 Connecting rod half-bearings S	38.019 ÷ 38.033 1.955 ÷ 1.968	
	Piston pin - bushing	0.019 ÷ 0.039	
	Connecting rod half-bearings	0.250; 0.500	

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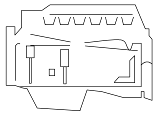
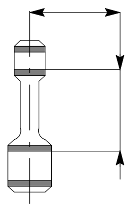
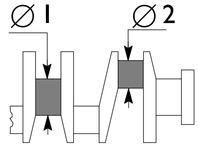
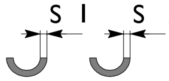
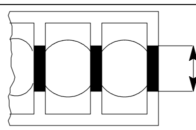
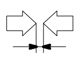
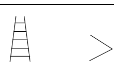
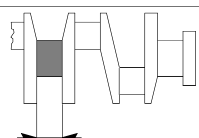
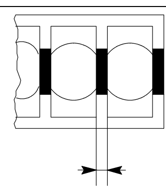
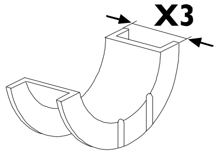
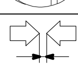
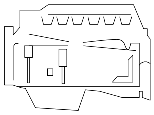
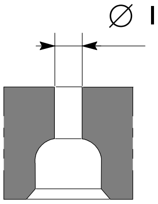
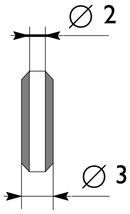
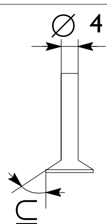
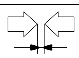
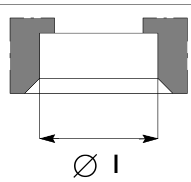
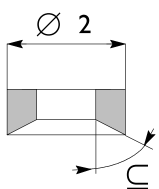
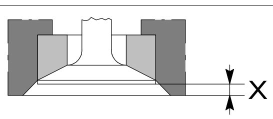
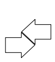
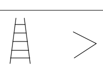
	Type	**NEF45 SM1F**	**NEF45 TE1F/TE2F**
CYLINDER ASSEMBLY AND CRANK GEARS		**mm**	
	Measuring point Maximum error on parallelism of connecting rod axles	- -	
	Main journals Ø 1 Crankpins Ø 2	82.99 ÷ 83.01 68.987 ÷ 69.013	
	Main half-bearings S 1 Connecting rod half-bearings S 2	2.456 ÷ 2.464 1.955 ÷ 1.968	
	Main journals No. 1-5 Ø3 No. 2-3-4 Ø 3	87.982 ÷ 88.008 87.977 ÷ 88.013	
	Half bearing - Main journals n° 1-5 n° 2-3-4	0.058 ÷ 0.121	
	Half bearings - crankpins	0.038 ÷ 0.116	
	Main half-bearings Connecting rod half-bearings	0.250; 0.500	
	Thrust main journal X 1	37.475 ÷ 37.550	37.475 ÷ 37.545
	Main journal support for thrust X 2	32.180 ÷ 32.280	
	Thrust half rings X 3	37.28 ÷ 37.38	
	Crankshaft thrust	0.095 ÷ 0.270	0.095 ÷ 0.265

	Type	**NEF45 SM1F**	**NEF45 TE1F/TE2F**
CYLINDER HEAD - TIMING SYSTEM		mm	
	Valve guide seats on cylinder head Ø 1	8.019 ÷ 8.039	7.042 ÷ 7.062
	Valve guide Ø 2	-	-
	Ø 3	-	-
	Valves:		
	Ø 4	7.960 ÷ 7.980	6.990 ÷ 7.01
	α	60°± 0° 7' 30"	60°± 0° 7' 30"
	Ø 4	7.960 ÷ 7.980	6.990 ÷ 7.01
	α	45°± 0° 10'	45°± 0° 10'
	Valve stem and related guide	0.039 ÷ 0.079	0.032 ÷ 0.072
	Housing on head for valve seat:		
	Ø1	46.987 ÷ 47.013	34.837 ÷ 34.863
	Ø1	43.637 ÷ 43.663	34.837 ÷ 34.863
	Valve seat outside diameter; valve housing inclination on cylinder head:		
	Ø 2	47.063 ÷ 47.089	34.917 ÷ 34.931
	α	60°± 0.5°	60°± 0° 7' 30"
	Ø 2	43.713 ÷ 43.739	34.917 ÷ 34.931
	α	45°± 0.5°	45°± 0.5°
	X	1.000 ÷ 1.520	0.390 ÷ 0.910
	Recessing X	1.000 ÷ 1.520	0.760 ÷ 1.280
	Between valve seat and cylinder head	0.050 ÷ 0.102	0.054 ÷ 0.094
		0.050 ÷ 0.102	0.054 ÷ 0.094
	Valve seats	-	

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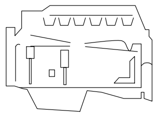
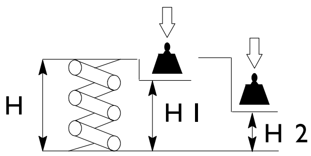
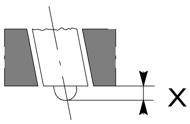
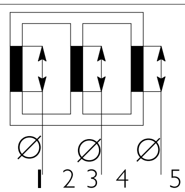
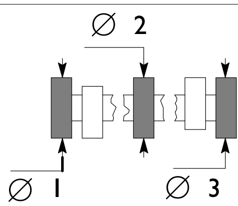
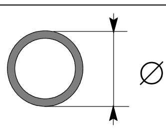
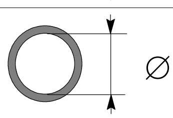
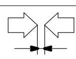
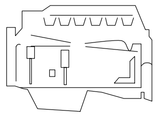
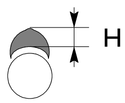
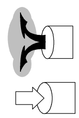
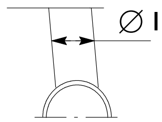
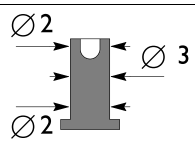
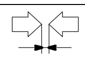
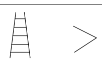
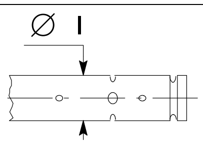
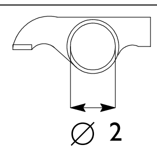
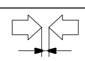
	Type	**NEF45 SM1F**	**NEF45 TE1F/TE2F**
CYLINDER HEAD - TIMING SYSTEM		mm	
	Valve spring height: free spring H under a load of: 329 N H1 641 N H2 339.8 ± 19 N H1 741 ± 39 N H2	 63.50 49.02 38.20	 47.75 35.33 25.2
	Injector protrusion X	It cannot be adjusted	
	Seat for camshaft bushings timing system No. 1 (flywheel side) Camshaft seats n° 2-3-4-5	59.222 ÷ 59.248 54.089 ÷ 54.139	
	Camshaft journal diameter: 1 ⇒ 5	53.995 ÷ 54.045	
	Outer diameter of bushings Ø	-	
	Inner diameter of bushings Ø	54.083 ÷ 54.147	
	Bushings and supporting pins	0.038 ÷ 0.152	

	Type	NEF45 SM1F	NEF45 TE1F/TE2F
CYLINDER HEAD - TIMING SYSTEM		mm	
	Useful cam height:  H H	- -	
	Tappet washer seat in crankcase Ø 1	16.000 ÷ 16.030	
	Tappet outside diameter: Ø 2 Ø 3	15.929 ÷ 15.959 15.965 ÷ 15.980	15.924 ÷ 15.954 15.960 ÷ 15.975
	Between tappets and seats	-	
	Tappets	-	
	Rocker-arm shaft Ø 1	18.963 ÷ 18.975	21.965 ÷ 21.977
	Rocker arms Ø 2	19.000 ÷ 19.026	22.001 ÷ 22.027
	Between rockers and shaft	0.025 ÷ 0.063	0.024 ÷ 0.062

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TIGHTENING TORQUES (NEF45 SM1F)

DETAIL			TORQUE		
			Quantity	Nm	Kgm
Cooling nozzles	M8		4	15 ± 3	1.5 ± 0.3
Screws for camshaft shoulder plate	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws for main bearing caps	M12x1.75		10	80 ± 6 90 °	8.0 ± 0.6
Screw for timing gear case	M12x1.75		1	77 ± 12	7.7 ± 1.2
Screws for timing gear case	M8x1.25		4	24 ± 4	2.4 ± 0.4
Screws for timing gear case	M10x1.5		5	47 ± 5	4.7 ± 0.5
Screws for timing gear	M8x1.25		6	36 ± 2	3.6 ± 0.2
Screws for connecting rod caps	M10x1.25		8	60 ± 5 60°	6.0 ± 0.5
Nut for injection pump gear	M14x1.5		1	90 ± 5	9.0 ± 0.5
Nuts for securing injection pump	M8x1.25		3	24 ± 4	2.4 ± 0.4
Plug for heat exchanger valve	M22x1.5		1	80 ± 8	8.0 ± 0.8
Screws securing heat exchanger	M8x1.25		15	26 ± 4	2.6 ± 0.4
Screws securing cylinder head	M12x1.75	L = 70	18	60 ± 5 90 °	6.0 ± 0.5
		L = 140		40 ± 5 (90° + 90°)	4.0 ± 0.5
		L = 180		70 ± 5 (90° + 90°)	7.0 ± 0.5
Screws securing rocker arms	M8x1.25		4	24 ± 3	2.4 ± 0.3
Nuts for tappet adjuster	M8x1.25		8	24 ± 4	2.4 ± 0.4
Screws securing tappet cover	M8x1.25		4	24 ± 4	2.4 ± 0.4
Screws for sound-proofing plate	M10x1.5		10	43 ± 5	4.3 ± 0.5
Screws securing suction strainer	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws securing suction strainer bracket	M10x1.5		2	43 ± 5	4.3 ± 0.5
Screws fixing the oil pump	M8x1.25		4	8 ± 1 24 ± 4	0.8 ± 0.1 2.4 ± 0.4
Screws securing front cover	M8x1.25		13	24 ± 4	2.4 ± 0.4
Screws securing flywheel housing	M12x1.75		8	85 ± 10	8.5 ± 1.0
Screws securing flywheel housing	M10x1.5		12	49 ± 5	4.9 ± 0.5
Screws securing oil sump	M8x1.25		14	24 ± 4	2.4 ± 0.4
Plug on oil sump	M18x1.5		1	65 ± 10	6.5 ± 1.0
Screws securing front hub	M12x1.25		6	50 ± 5 90 °	5.0 ± 0.5
Screws for pulley on front hub	M10x1.25		6	68 ± 7	6.8 ± 0.7
Plugs on cylinder head	½"		3	24 ± 4	2.4 ± 0.4
Plugs on cylinder head	¾"		2	36 ± 5	3.6 ± 0.5
Plug on cylinder head	¼"		1	12 ± 2	1.2 ± 0.2
Ring nut securing injectors	M24x1.5		4	60 ± 5	6.0 ± 0.5
Screws securing intake manifold	M8x1.25		8	24 ± 4	2.4 ± 0.4
Screws securing sling hook	M12x1.75		2	77 ± 12	7.7 ± 1.2
Screws securing sling hook	M8x1.25		4	36 ± 5	3.6 ± 0.5
Screws securing alternator	M10x1.5		3	43 ± 6	4.3 ± 0.6

DETAIL		TORQUE		
		Quantity	Nm	Kgm
Nut for compressor gear control	M18x1.5 lh	1	165 ± 10	16.5 ± 1.0
Nut securing compressor	M12x1.75	2	77 ± 12	7.7 ± 1.2
Screws securing compressor support bracket	M8x1.25	4	24 ± 4	2.4 ± 0.4
Screws securing thermostat cover	M6x1	3	10 ± 2	1.0 ± 0.2
Nuts securing starter motor	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nuts securing turbocharger	M8x1.25	4	43 ± 6	4.3 ± 0.6
Screws securing exhaust manifold	M10x1.5	8	55 ± 3	5.5 ± 0.3
Screws for alternator mount	M10x1.5	3	43 ± 6	4.3 ± 0.6
Screws for oil pressure sensor	M6x1	2	10 ± 2	1.0 ± 0.2
Plugs to crankcase	M18x1.5	3	24 ± 4	2.4 ± 0.4
Screws for plate 4896952	M6x1	2	24 ± 4	2.4 ± 0.4
Screws for water pump	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screws for power steering pump	M10x1.5	2	43 ± 6	4.3 ± 0.6
Fitting for turbocharger oil delivery pipe	M16	2	36 ± 5	3.6 ± 0.5
Screws for turbocharger oil drain pipe	M6x1	2	24 ± 4	2.4 ± 0.4
Oil level sensor	M12x1.5	1	10 ± 2	1.0 ± 0.2
Screws securing oil level dipstick bracket	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for oil dipstick fastening clamp	M6x1	1	10 ± 2	1.0 ± 0.2
Oil filter	M27x2	1	20 ± 2	2.0 ± 0.2
Screw for crankshaft speed sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for fuel filter bracket	M12x1.75	2	80 ± 8	8.0 ± 0.8
Intake elbow clam	M7x1	1	13 ± 2	1.3 ± 0.2
Suction strainer mounting bracket nuts	M10x1.5	2	24 ± 4	2.4 ± 0.4
Screw for belt tensioner	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4898548	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4892356	M10x1.5	1	43 ± 6	4.3 ± 0.6
Flywheel screws	M12x1.25	8	50 ± 5 60°	5.0 ± 0.5
Plug	M10x1	1	24 ± 4	2.4 ± 0.4

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TIGHTENING TORQUES (NEF45 TE1F/TE2F)

DETAIL			TORQUE		
			Quantity	Nm	Kgm
Cooling nozzles	M8		4	15 ± 3	1.5 ± 0.3
Screws for camshaft shoulder plate	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws for main bearing caps	M12x1.75		10	80 ± 6 90 °	8.0 ± 0.6
Screw for timing gear case	M12x1.75		1	77 ± 12	7.7 ± 1.2
Screws for timing gear case	M8x1.25		4	24 ± 4	2.4 ± 0.4
Screws for timing gear case	M10x1.5		5	47 ± 5	4.7 ± 0.5
Screws for timing gear	M8x1.25		6	36 ± 2	3.6 ± 0.2
Screws for connecting rod caps	M10x1.25		8	50 ± 5 60°	5.0 ± 0.5
Nut for injection pump gear	M18x1.5		1	105 ± 5	10.5 ± 0.5
Nuts for securing injection pump	M8x1.25		3	24 ± 4	2.4 ± 0.4
Plug for heat exchanger valve	M22x1.5		1	80 ± 8	8.0 ± 0.8
Screws securing heat exchanger	M8x1.25		15	26 ± 4	2.6 ± 0.4
Screws securing cylinder head	M12x1.75	L = 130	18	35 ± 5 (90° + 90°)	3.5 ± 0.5
		L = 150		55 ± 5 (90° + 90°)	5.5 ± 0.5
Screws securing rocker arms	M8x1.25		8	36 ± 5	3.6 ± 0.5
Nuts for tappet adjuster	M8x1.25		8	24 ± 4	2.4 ± 0.4
Housing securing screws	M8x1.25		3	24 ± 4	2.4 ± 0.4
Nuts securing tappet cover	M10x1.5		4	24 ± 4	2.4 ± 0.4
Screws for sound-proofing plate	M10x1.5		10	43 ± 5	4.3 ± 0.5
Nuts fixing wiring on injectors	M4		8	1.5 ± 0.25	0.2 ± 0.03
Screws securing suction strainer	M8x1.5		2	24 ± 4	2.4 ± 0.4
Screws securing suction strainer bracket	M10x1.5		2	43 ± 5	4.3 ± 0.5
Screws fixing the oil pump	M8x1.25		4	8 ± 1 24 ± 4	0.8 ± 0.1 2.4 ± 0.4
Screws securing front cover	M8x1.25		13	24 ± 4	2.4 ± 0.4
Screws securing flywheel housing	M12x1.75		8	85 ± 10	8.5 ± 1.0
Screws securing flywheel housing	M10x1.5		12	49 ± 5	4.9 ± 0.5
Screws securing oil sump	M8x1.25		14	24 ± 4	2.4 ± 0.4
Plug on oil sump	M18x1.5		1	60 ± 9	6.0 ± 0.9
Screws securing front hub	M12x1.25		6	50 ± 5 90 °	5.0 ± 0.5
Screws for pulley on front hub	M10x1.25		6	68 ± 7	6.8 ± 0.7
Plugs on cylinder head	½”		3	24 ± 4	2.4 ± 0.4
Plugs on cylinder head	¾”		2	36 ± 5	3.6 ± 0.5
Plug on cylinder head	¼”		1	12 ± 2	1.2 ± 0.2
Injector retaining screws	M6x1		8	3.5 ± 0.35 7.5 ± 2.5	0.4 ± 0.04 0.8 ± 0.3
Connectors on cylinder head	M22x1.5		4	55 ± 5	5.5 ± 0.5
Screws securing intake manifold	M8x1.25		7	24 ± 4	2.4 ± 0.4
Screws securing sling hook	M12x1.75		2	77 ± 12	7.7 ± 1.2
Screws securing sling hook	M8x1.25		4	36 ± 5	3.6 ± 0.5

DETAIL		TORQUE		
		Quantity	Nm	Kgm
Screws securing rail to intake manifold	M8x1.25	3	36 ± 5	3.6 ± 0.5
Screws securing alternator	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nut for compressor gear control	M18x1.5 lh	1	165 ± 10	16.5 ± 1.0
Nut securing compressor	M12x1.75	2	77 ± 12	7.7 ± 1.2
Screws securing compressor support bracket	M8x1.25	4	24 ± 4	2.4 ± 0.4
Screws securing thermostat cover	M6x1	3	10 ± 2	1.0 ± 0.2
Nuts securing starter motor	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nuts securing turbocharger	M8x1.25	4	43 ± 6	4.3 ± 0.6
Screws securing exhaust manifold	M10x1.5	8	53 ± 5	5.3 ± 0.5
Screws for alternator mount	M10x1.5	3	43 ± 6	4.3 ± 0.6
Screws for oil pressure sensor	M6x1	2	10 ± 2	1.0 ± 0.2
Plugs to crankcase	M18x1.5	3	24 ± 4	2.4 ± 0.4
High pressure pipe fittings	M14x1.5	2	24 ± 4	2.4 ± 0.4
Rail pipe bracket screw	M10x1.5	1	40 ± 5	4.0 ± 0.5
Fittings 4896491 and 4897881	M16x1.5	4	24 ± 4	2.4 ± 0.4
Screws for plate 4896952	M6x1	2	24 ± 4	2.4 ± 0.4
Screws for water pump	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for camshaft rpm sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for power steering pump	M10x1.5	2	43 ± 6	4.3 ± 0.6
Sensor on cylinder heads (temperature)	M14x1.5	1	24 ± 4	2.4 ± 0.4
Union 4891285	¾" - 14	1	36 ± 4	3.6 ± 0.4
Screws for turbocharger oil drain pipe	M6x1	2	10 ± 2	1.0 ± 0.2
Suction strainer mounting bracket nuts	M10x1.5	2	36 ± 5	3.6 ± 0.5
Breather plate screws	M6x1	3	10 ± 2	1.0 ± 0.2
Plate screw fixing breather on tappet cover	M6x1	3	10 ± 2	1.0 ± 0.2
Fittings securing breather 4899219	M12x1.5	3	20 ± 4	2.0 ± 0.4
Oil level sensor	M12x1.5	1	10 ± 2	1.0 ± 0.2
Screws securing oil level dipstick bracket	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for oil dipstick fastening clamp	M6x1	1	10 ± 2	1.0 ± 0.2
Voss fitting 4896329 on cylinder head	M12x1.5	1	22 ± 2	2.2 ± 0.2
Oil filter	M27x2	1	20 ± 2	2.0 ± 0.2
Screw for crankshaft speed sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for fuel filter bracket	M12x1.75	2	80 ± 8	8.0 ± 0.8
Intake elbow clam	M7x1	1	13 ± 2	1.3 ± 0.2
Suction strainer mounting bracket nuts	M10x1.5	2	36 ± 5	3.6 ± 0.5
Plugs securing the control unit	M8x1.25	3	24 ± 4	2.4 ± 0.4
Screw for belt tensioner 4898548	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4897031	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4892356	M10x1.5	1	43 ± 6	4.3 ± 0.6
Flywheel screws	M12x1.25	8	30 ± 4 60°	3.0 ± 0.4
Plug 4899009	M10x1	1	24 ± 4	2.4 ± 0.4
Screws securing control unit to support	M6x1	8	10 ± 2	1.0 ± 0.2
Nuts securing heater	M8x1.25	8	13 ± 3	1.3 ± 0.3
Voss fitting 4896542 on control unit supp.	M12x1.25	1	12 ± 2	1.2 ± 0.2
Screws securing sensor on intake manifold.	M6x1	2	10 ± 2	1.0 ± 0.2

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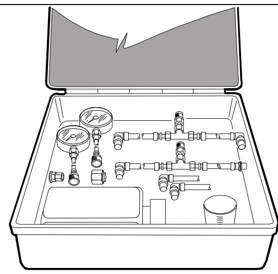
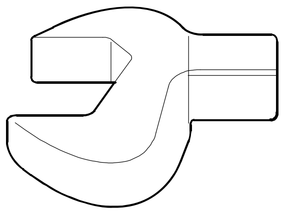
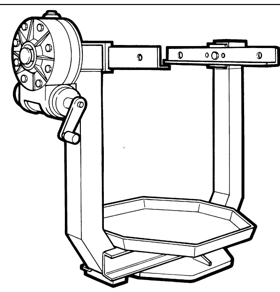
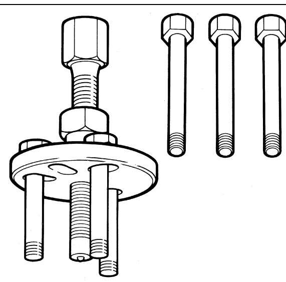
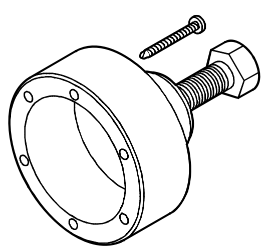
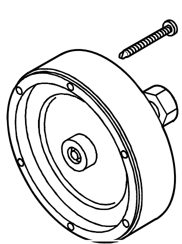
SECTION 8

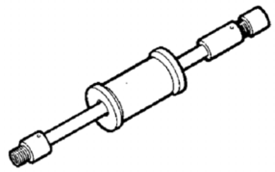
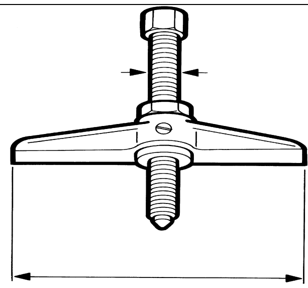
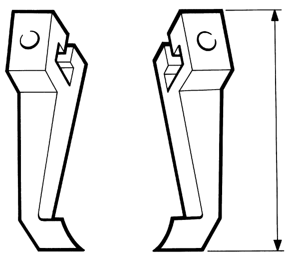
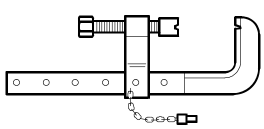
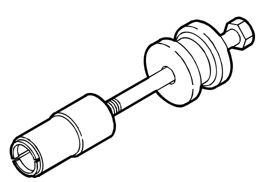
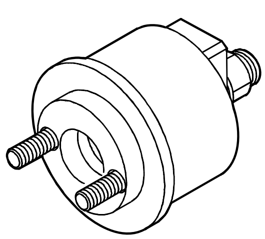
Tools

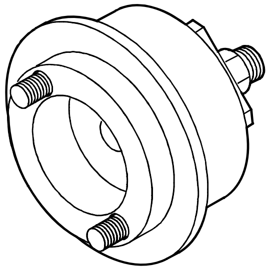
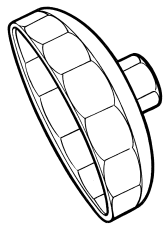
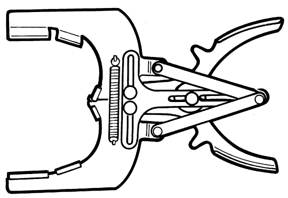
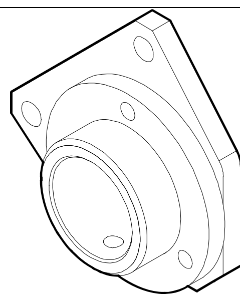
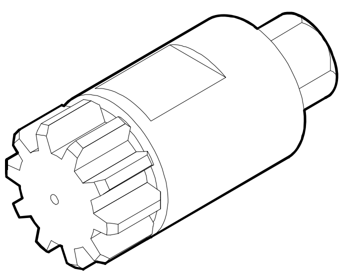
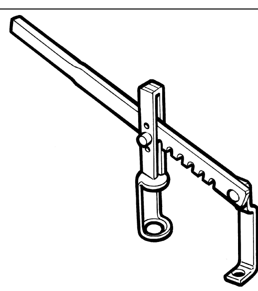
Page

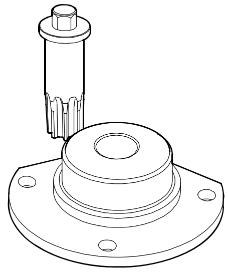
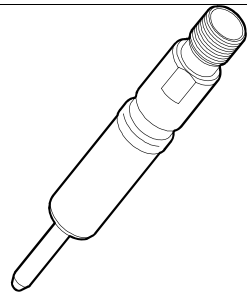
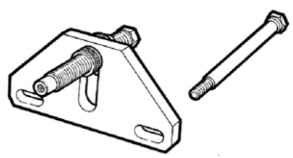
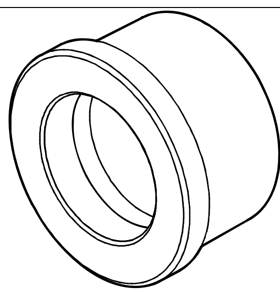
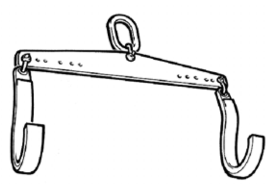
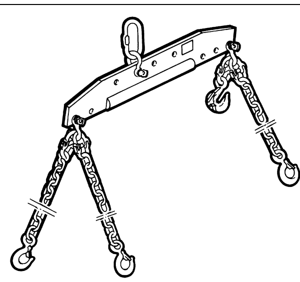
EQUIPMENT 3

EQUIPMENT

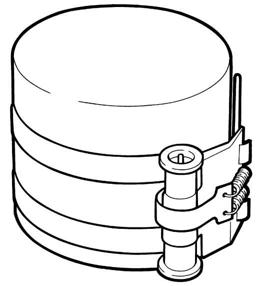
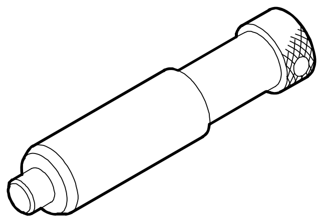
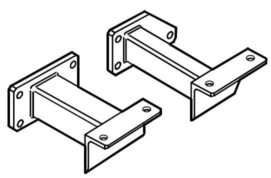
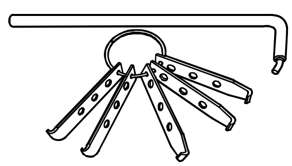
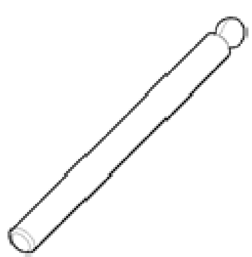
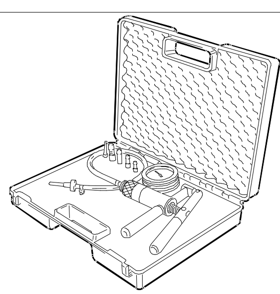
TOOL No.		NAME	F4GE	F4HE
99305453		Tool for checking diesel fuel system and common rail injection system		✓
99317915		Set of five 9x12 spintite wrenches (14 - 15 - 17 - 18 - 19)		✓
99322205		Revolving stand for overhauling units (capacity 1000 daN, torque 120 daNm)	✓	✓
99340035		Extractor for engine injection pump gear	✓	
99340055		Extraction tool for crankshaft front ring seal	✓	✓
99340056		Extraction tool for crankshaft rear gasket	✓	✓

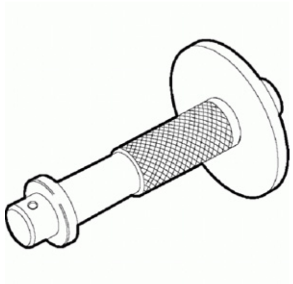
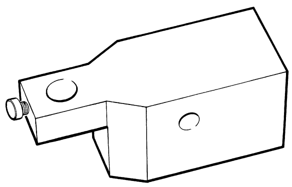
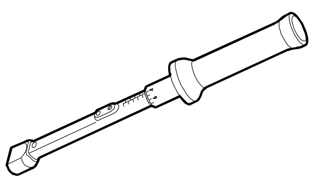
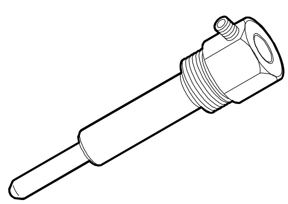
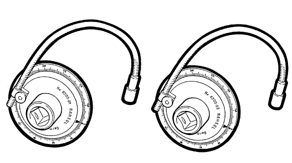
TOOL No.		NAME	F4GE	F4HE
99340205		Percussion extractor with parts for extraction	✓	
99341001		Double-acting bridge		✓
99341009		Pair of brackets		✓
99341015		Clamp		✓
99342101		Extraction tool for injectors		✓
99346252		Key to fit crankshaft front gasket	✓	✓

TOOL No.		NAME	F4GE	F4HE
99346253		Key to fit crankshaft rear gasket	✓	✓
99360076		Tool to remove oil filter (engine)	✓	✓
99360183		Tool for piston ring removal and assembly (65-110mm)	✓	✓
99360221		Engine flywheel rotation tool (use with 99360222)		✓
99360222		Pinion (use with 99360221)		✓
99360268		Tool to take down and fit back engine valves	✓	✓

TOOL No.		NAME	F4GE	F4HE
99360339		Tool to retain and rotate engine flywheel	✓	
99360344		Coupling for compression control in cylinders (use with 99395682)	✓	
99360351		Tool to retain flywheel	✓	✓
99360362		Drift tool for removing/fitting camshaft bushings (to be used with 99370006)	✓	✓
99360500		Tool for lifting the crankshaft	✓	✓
99360595		Arm for removing and refitting engine	✓	✓

Print P4D32N009 E

TOOL No.		NAME	F4GE	F4HE
99360605		Clamp for fitting piston into cylinder liners (60 ÷ 125 mm)	✓	✓
99360616		Tool for engine T.D.C. positioning	✓	
99361037		Brackets for fastening engine to 99322205 rotary stand	✓	✓
99363204		Tool to remove gaskets	✓	✓
99365196		Tool for positioning injection pump at delivery start	✓	
99367121		Manual pump for measuring pressure and vacuum	✓	✓

TOOL No.		NAME	F4GE	F4HE
99370006		Handgrip for interchangeable drift tools	✓	✓
99370415		Base of dial gauge for various measurements (use with 99395603)	✓	✓
99389829		9x12 coupling torque wrench (5-60 Nm)		✓
99389834		Torque screwdriver for connector retention nut adjustment injector solenoid valve (1 - 6 Nm)		✓
99395097		Tool for top dead centre control (use with 99395604)	✓	
99395216		Pair of gauges for angular tightening with 1/2" and 3/4" square heads	✓	✓

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TOOL No.		NAME	F4GE	F4HE
99395603		Dial gauge (0 ÷ 5 mm)	✓	✓
99395604		Comparator gauge (0 ÷ 10 mm)	✓	
99395682		Diesel engine cylinder compression test device	✓	

Part 2
NEF 67 SERIES

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Operating diagrams	2
Electric / electronic equipment	3
Scheduled maintenance	4
Removal/refitting of the main components of the engine	5
General mechanical overhaul	6
Technical specifications	7
Tools	8
Safety regulations	Appendix

c

SECTION 1

General information

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ENGINE VIEWS (NEF67 TE1F/TE2F)	12
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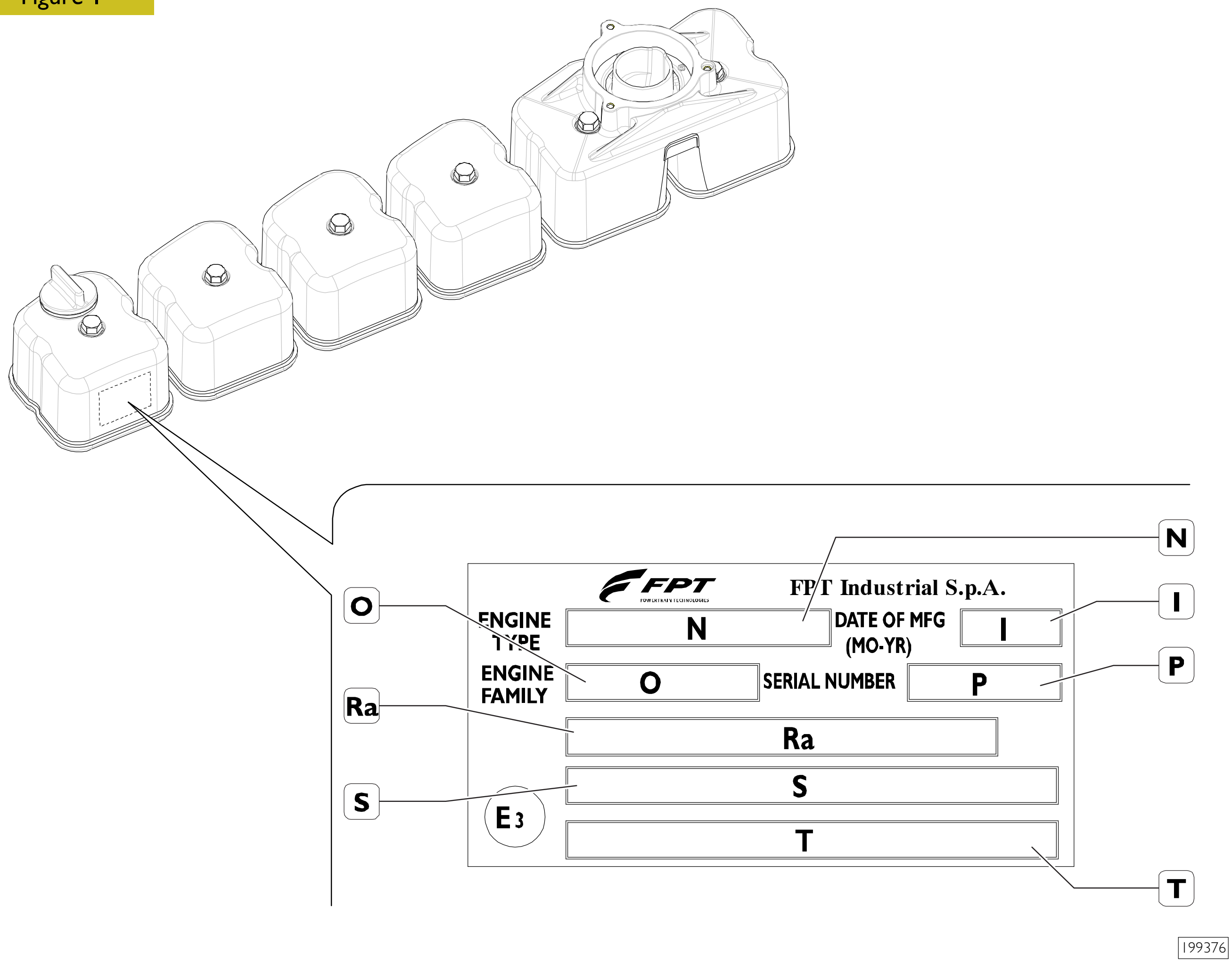
APPROVAL PLATE

Figure 1



Box "I": month and year of registration;
Box "N": engine variant to be completed according to engine records (last three digits of the theoretical code);
Box "P": Serial number to be assigned in the manufacturing plant;
For the remaining data to be entered onto the plate, refer to the engine details of P.N. 504257007 (file in D.B. Matrix)

Support: material 3812, white;
Fixed + removable protection: shiny clear polyester;
Tape: TA 980, resin based black;
Material specifications: the adhesive plate must comply with regulation CNH 82877191;
Glueing procedure according to I.S. 17-1610 cycle "E" with use of manual roller (as with cycle "C").

CORRESPONDENCE BETWEEN TECHNICAL CODES AND COMMERCIAL CODES

Technical codes	Commercial Codes
F4GE9685C*J600	**(NEF67 TM1F)**
F4HE0685G*J100	**NEF67 TE1F**
F4HE0685F*J100	**NEF67 TE2F**

Print P4D32N009 E

TECHNICAL CODES

F4 G E 9 6 8 5 C * J 600

F4 = NEW ENGINE FAMILY

Code	Crankcase	Bore to stroke	Valves
A	Not structural	102 x 120	4
B	Not structural	102 x 120	2
C	Structural	104 x 132	2
D	Structural	104 x 132	4
E	Structural	102 x 120	4
F	Structural	102 x 120	2
G	Not structural	104 x 132	2
H	Not structural	104 x 132	4

E = ENGINE

Configuration of cylinders

0 = 4 times vertical
1 = 4 times horizontal
3 = 4 times vert. post-treat.
4 = 4 times horiz. post-treat.
E = 4 times vert. Extra Europa
5 = 4 times vert. external EGR
9 = 4 times vert. internal EGR

Number of cylinders.
(Note: 0 = 10 cylinders 1 = 12 and more)

Main engine features

0 = Natural diesel intake, direct injection
1 = Natural diesel intake, indirect injection
2 = Natural petrol intake
3 = Natural methane gas intake
4 = Methane gas turbocharged
5 = Direct injection diesel turbocharged
6 = Indirect injection diesel turbocharged
7 = Petrol turbocharged
8 = Direct injection diesel turbocharged with inter.
9 = Indirect injection diesel turbocharged with inter.

Application

0 = Applications other than the following
1 = Truck
2 = Bus
3 = Railway
4 = Ground movement and tractor machines
5 = Genset
6 = Marine
7 = Industrial machines and forklifts
8 = Cars and products
9 = Military

Approval for performance
A = First calibration
B = Second calibration
C = Third calibration
... and so on

Approval for regulations

A = EURO 2
B = Tier 1
C = EURO 3
D = Tier 2
E = MARINE
F = GENSET
G = On road with CRT or GAS filter
H = EURO 4 (do not use)
J = Tier 3
K = GENSET Tier 3
L = EURO 4 step 1 SCRT
M = EURO 5 step 1 SCR
N = EURO 5 step 1 SCRT
P = EURO 4 step 1 SCR
R = EURO 4 step 2 SCR
S = EURO 5 step 1 SCR
T = EURO 4 step 2 SCRT
U = Euro EEV
Z = Euro V OBD

In particular, the first of the three numbers indicates the type of injection

1 = Common Rail 4 valves
2 = Common Rail 2 valves
3 = In line injection pump 4 valves
4 = In line injection pump 2 valves
5 = Rotary injection pump 4 valves
6 = Rotary injection pump 2 valves
8 = Lightweight engine for spare parts
A... E = Truck variants without derating

The remaining numbers indicate the engine variant

COMMERCIAL CODES

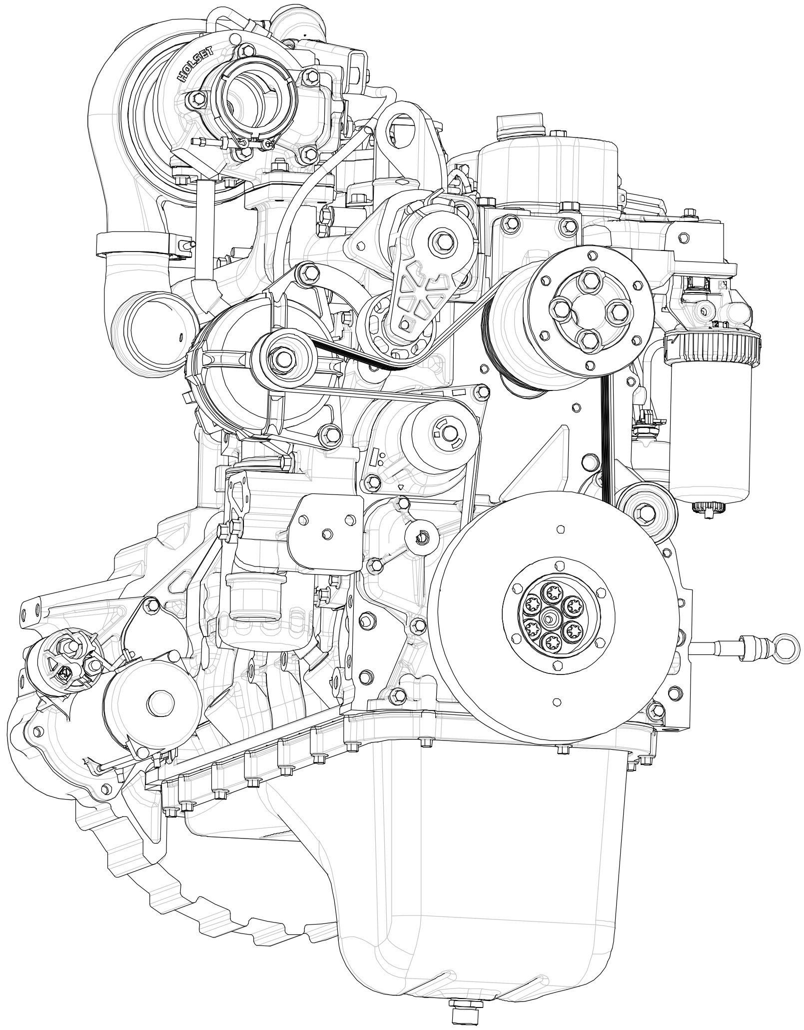
NEF **67** **T** **M** **I** **F**

- **F** — Application
- **I** — Power level
  1,2,3 etc. = Different power values
  ex. 1 for 180 kVA
  2 for 200 kVA
- **M** — Injection / Management
  E = Electronic with ECU
  M = Mechanical
  R = Electronic + Mechanical regulator
- **T** — Intake
  A = Natural
  S = Turbocharged
  T = Turbocharged with Air/Air intercooler
  W = Turbocharged with Air/Water intercooler
- **67** — Displacement or No. Cylinders
  litres per displacement > 10 litres
  litres x 10 per displacement < 10 litres
  No. Cylinders per Vector
  For NEF the first number is also the number of cylinders
- **NEF** — Engine family

Base - March 2014 Print P4D32N009 E

ISO VIEW

Figure 2



(NEF67 TM1F)

They are characterised by a 4 time diesel cycle, sucked in or supercharged with 6 cylinders with 2 or 4 valves per cylinder.

They are powered with a mechanical rotary pump or an in-line pump, depending on the application.

NOTE The data, specifications and performance figures are only valid if the vehicle manufacturer complies with all the installation regulations provided by FPT.

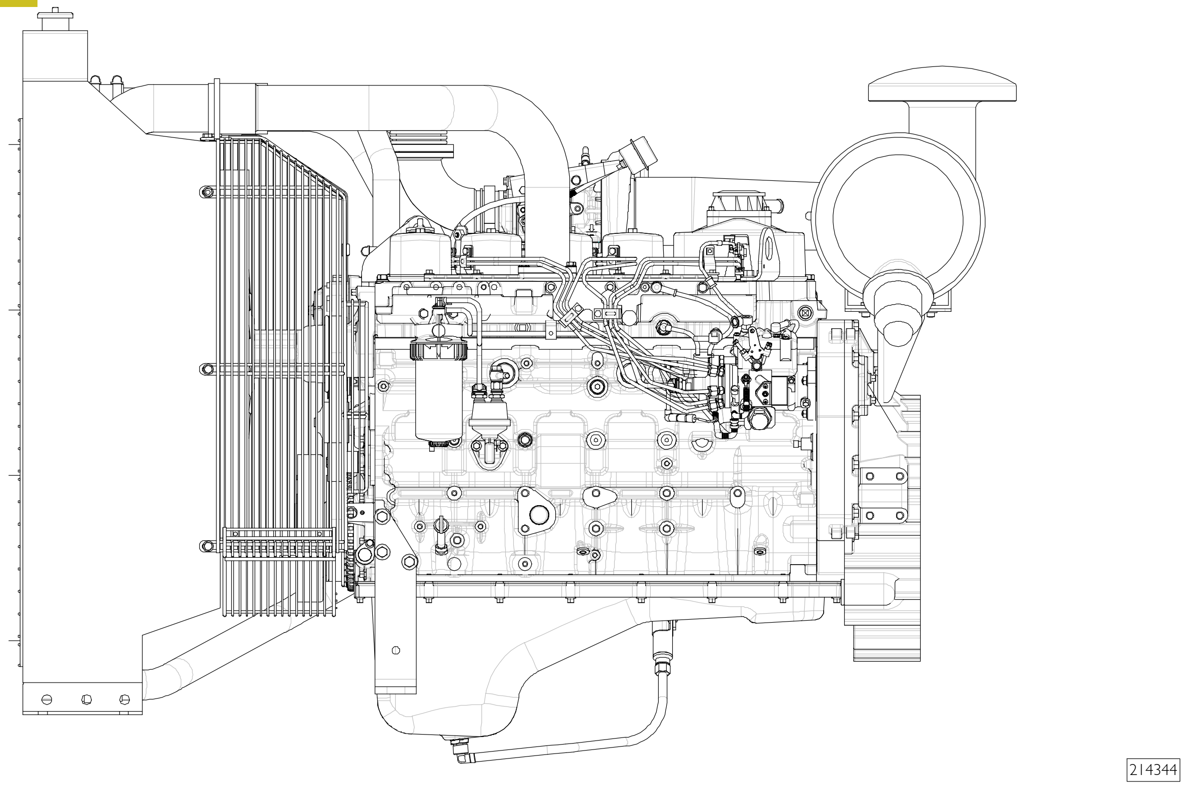
Furthermore, the fitted appliances must always be in compliance with the torque, power and engine speed for which the engine was designed.

This section consists of four parts:

- the part covering specific mechanical overhaul based on use, describing the operations necessary to remove and install the engine components including the cylinder head, timing gear housing and the front cover;
- the electric part, describing the connections of the various components, the pre-post heating control unit (only for some versions) and the sensors located on the engine;
- diagnostics;
- preventive or routine maintenance operations, with indications regarding the main operations.

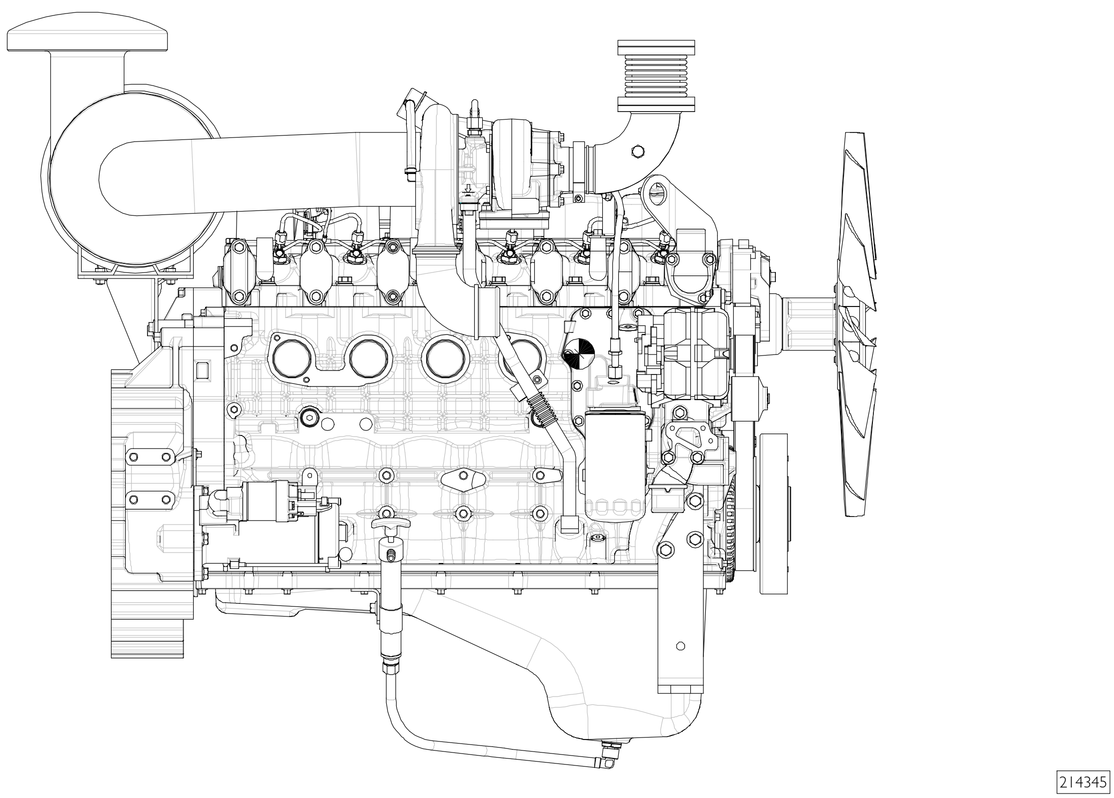
ENGINE VIEWS (NEF67 TM1F)

Figure 3



LEFT SIDE VIEW

Figure 4



RIGHT SIDE VIEW

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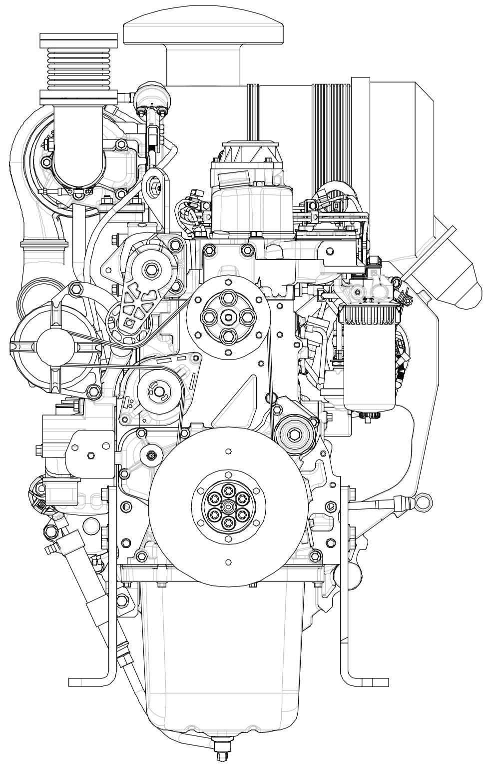
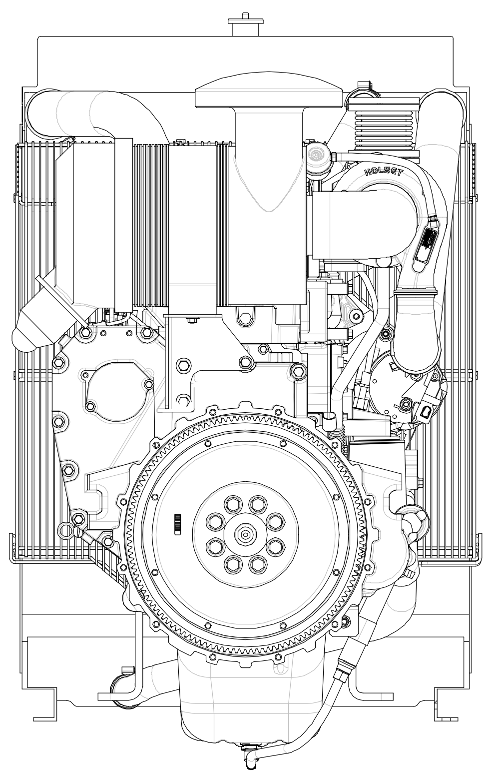
Figure 5



214346

FRONT VIEW

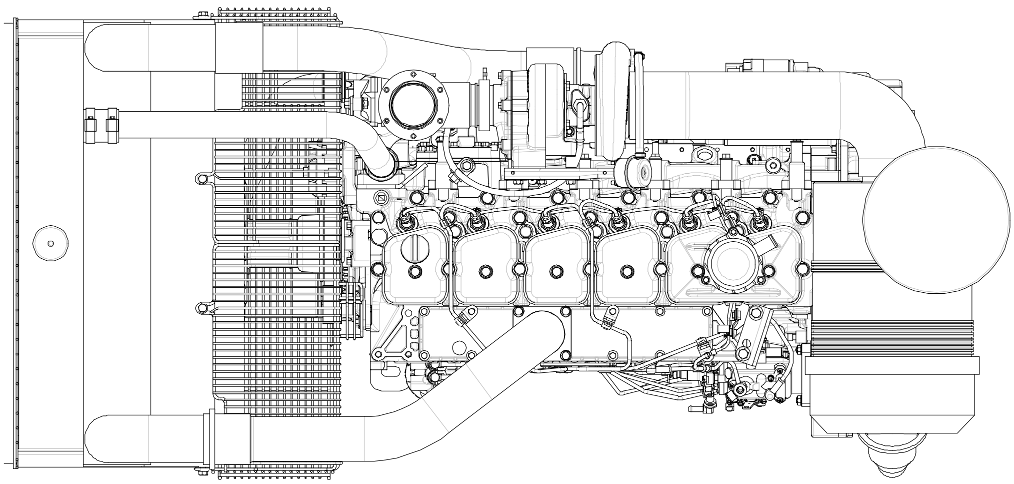
Figure 6



214347

REAR VIEW

Figure 7



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TOP VIEW

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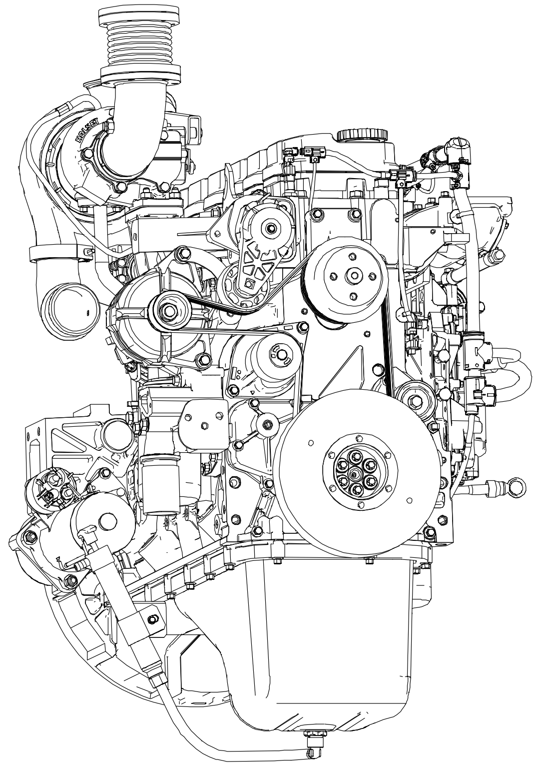
ISO VIEW (NEF67 TE1F/TE2F)

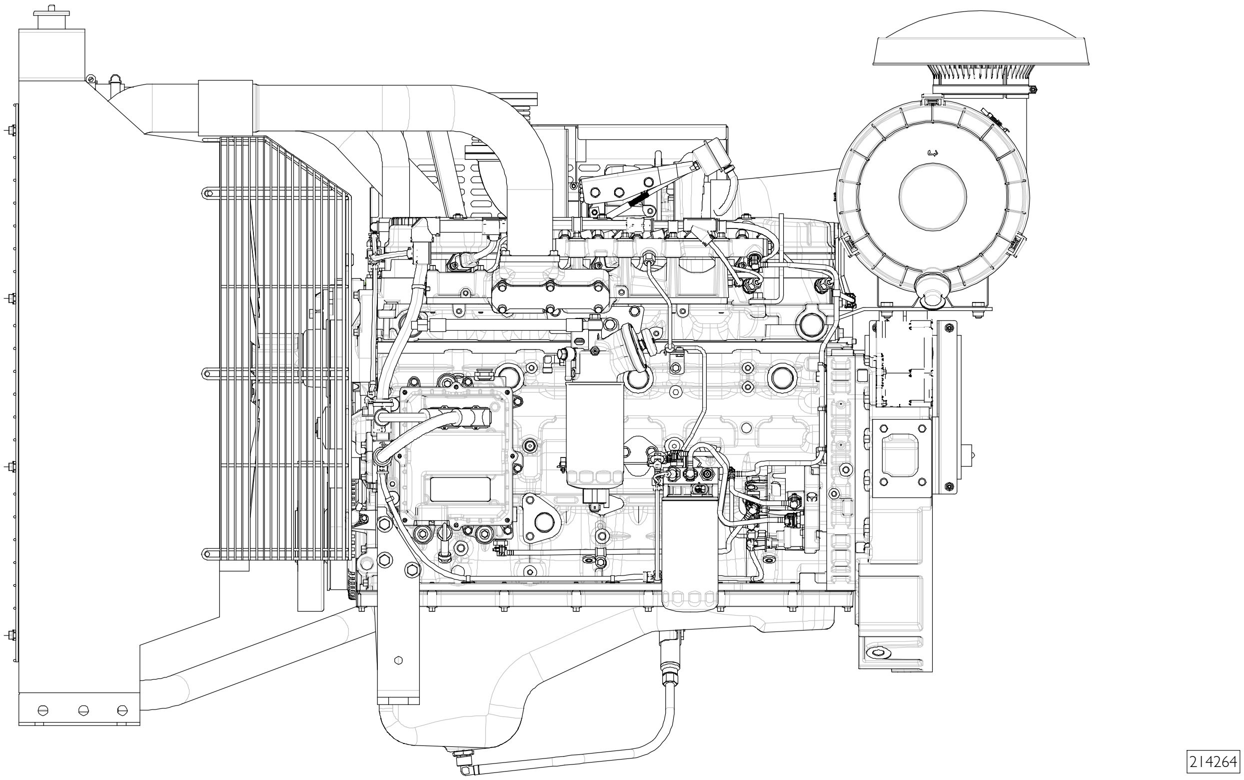
Figure 8



214263

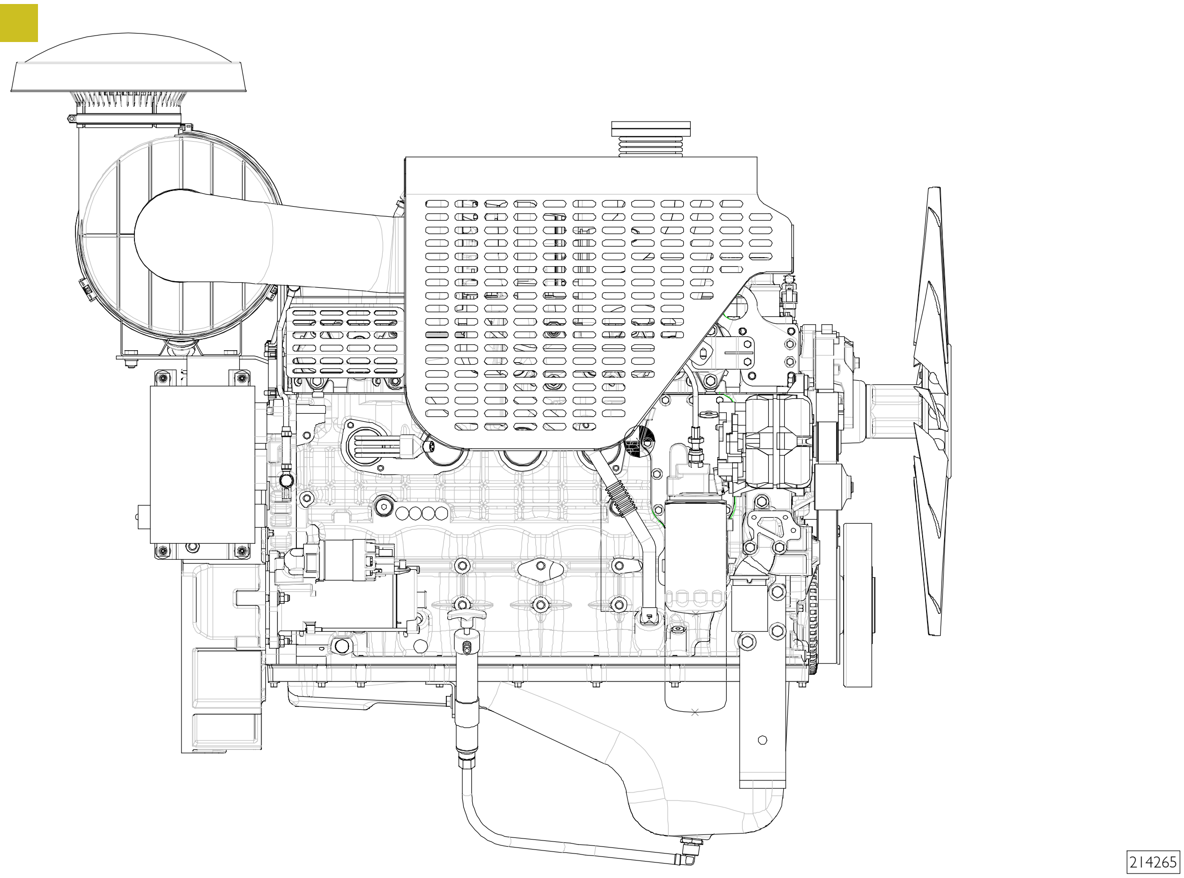
ENGINE VIEWS (NEF67 TE1F/TE2F)

Figure 9



LEFT SIDE VIEW

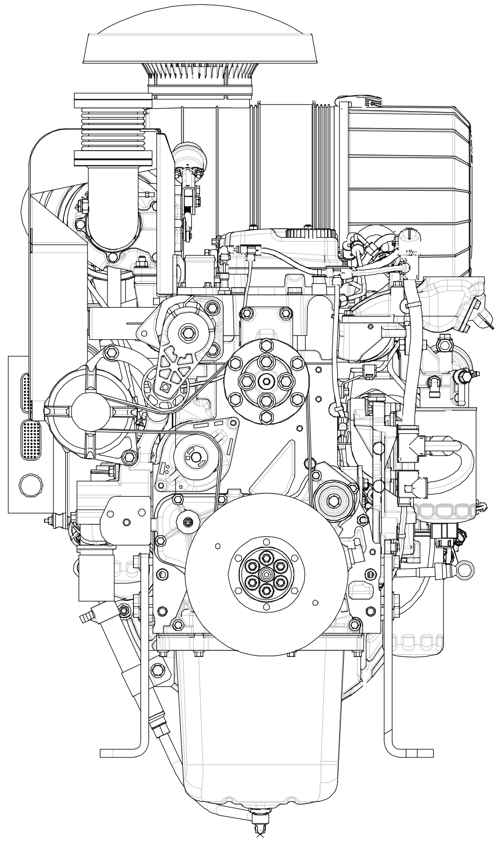
Figure 10



RIGHT SIDE VIEW

Print P4D32N009 E

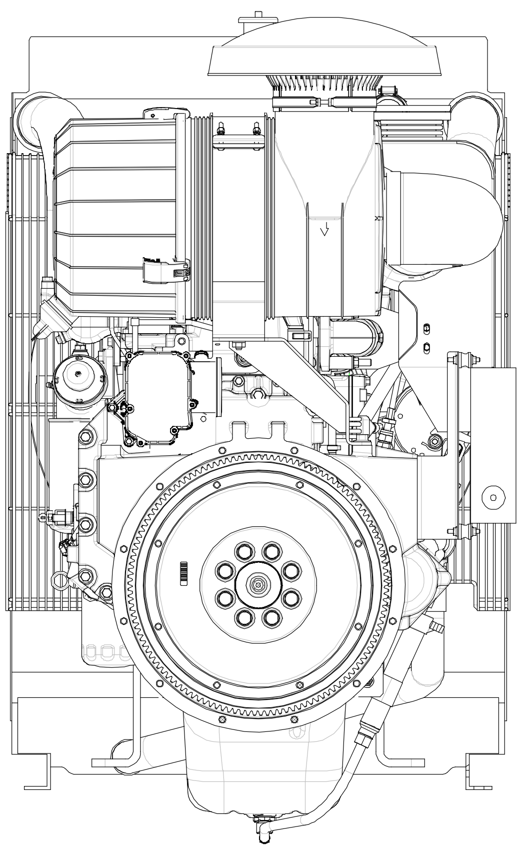
Figure 11



214266

FRONT VIEW

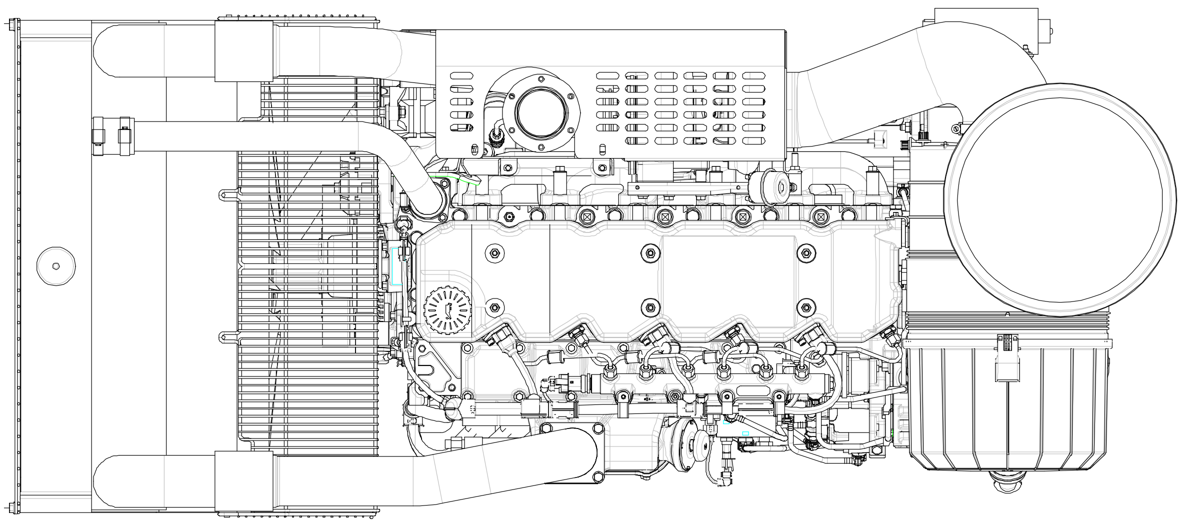
Figure 12



214267

REAR VIEW

Figure 13



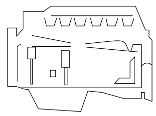
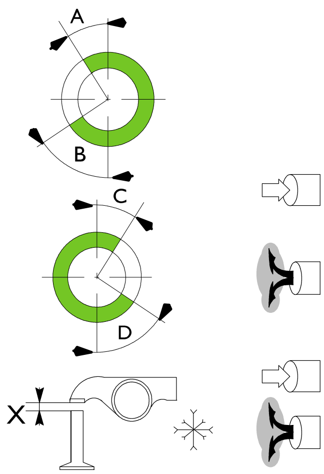
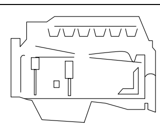
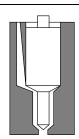
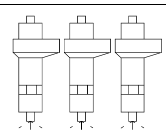
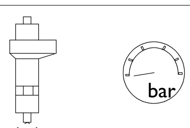
214268

TOP VIEW

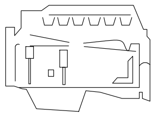
Print P4D32N009 E

GENERAL FEATURES

	type		F4GE9685C* J600	F4HE0685G* J100	F4HE0685F* J100
	Cycle		Diesel 4-stroke		
	Power supply		Turbocharged with turbocharger and intercooler		
	Injection		Direct		
	Number and arrangement of cylinders		6 in line		
	Bore	mm	104		
	Stroke	mm	132		
	Total displacement	cm^3	6726		
	Compression ratio		17.5 : 1		
	Prime Power	kWm rpm	113.5 1500	131.5 1500	150 1500
	Stand-by Power	kWm rpm	125 1500	145 1500	165 1500
	Low idle speed	rpm	-		
	High idle speed	rpm	-		
	TURBOCHARGING		Turbocharger with Waste gate intercooler		
	Turbocharger type: Supercharger type:		**Holsett HX35W**		
SAE 15W40 API CI-4 ACEA E7	**LUBRICATION** Oil pressure with hot engine (100 °C ± 5 °C):		Forced by gear pump, pressure relief valve, oil filter		
	at idle speed	bar	3		
	at max speed	bar	5		

	type		**F4GE9685C* J600**	**F4HE0685C* J100**	**F4HE0685F* J100**
	COOLING Water pump drive: **Thermostat:** initial opening maximum opening	 °C °C	Liquid Belt driven 79 ± 2 96		
	**DISTRIBUTION** Start before T.D.C. Until after B.D.C. Start before B.D.C. Until after T.D.C.. For timing check X	 A B D C mm mm	17° 31° 48° 9° 0.25 ± 0.05 0.50 ± 0.05		
	**POWER SUPPLY** Pump type:		Mechanical pump rotating STANADYNE DB 4	high pressure pump BOSCH CP3.3	
	Nozzle type		STANADYNE XNHM882224	CRIN2 DLL137PV3	
	Firing order		1 - 5 - 3 - 6 - 2 - 4		
	Injection pressure	bar	1,800	1,600	

Print P4D32N009 E

	type		**F4GE9685C* J600**	**F4HE0685C* J100**	**F4HE0685F* J100**
REFUELLING					
Cooling circuit (1)	engine (4)	litres	**10.5**		
	G-Drive (5)	litres	**25.5**		
Lubrication circuit (2) (3)		litres (kg)	17.2 (15.48)		17.2 (15.3)
Periodic replacement:					
Sump at minimum level		litres (kg)	8 (7.2)		8 (7.2)
Sump at maximum level		litres (kg)	12 (10.8)		15 (13.5)
Fuel tank (4)		litres (kg)	**-** **(-)**		

(1). Use a 50% mixture of water and PARAFLU 11 or the equivalent corresponding to the specification SAE J1034.

(2). Use lubricants that comply with international specifications ACEA E5/E7
The consumption of oil is considered acceptable up to a quantity of 0.1% of fuel consumption.

(3). The quantities indicated refer to the first refuel only and are relative to the engine, oil sump and filter refilling.

(4). The quantities indicated only refer to the engine in its standard configuration.

(5). The quantities shown are relative to the total capacity of the G-Drive including engine capacity.

! Refuelling from drums or tanks can cause contamination of the diesel, with the consequent risk of damaging the injection system; if necessary, perform suitable filtration or sedimentation of the impurities before refuelling.

! The data, specifications and performance figures are only valid if the vehicle manufacturer complies with all the installation instructions provided by FPT.
Furthermore, the fitted appliances must always be in compliance with the torque, power and engine speed for which the engine was designed.

SECTION 2

Operating diagrams

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❑ Fuel temperature sensor	4
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SUPPLY SYSTEM

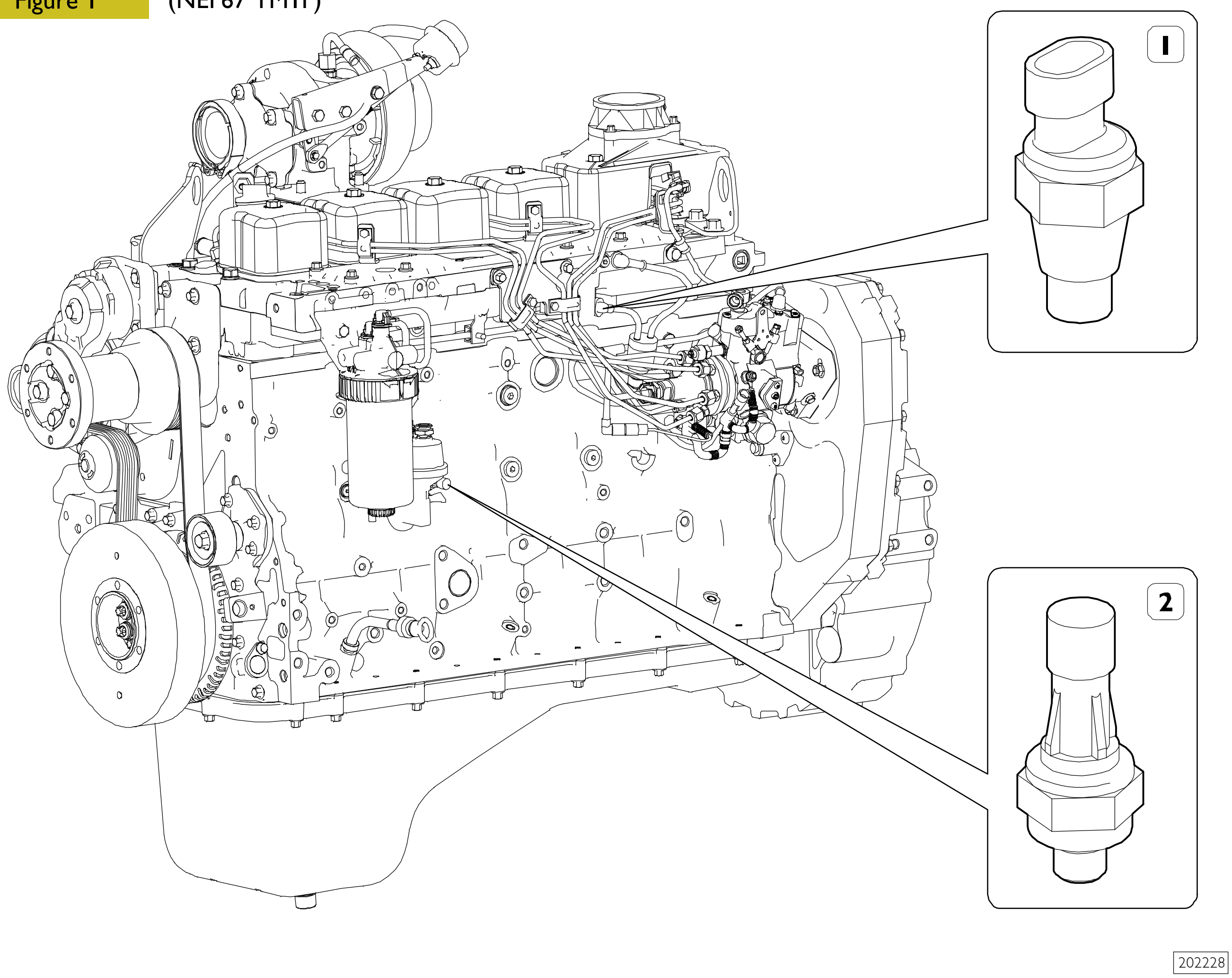
Principles

The fuel supply system is composed of:

- Fuel tank
- Fuel delivery and return pipes
- Priming pump, mounted on the engine and controlled by the camshaft
- Fuel filter
- Rotating feed pump
- Injector supply pipes
- Injectors

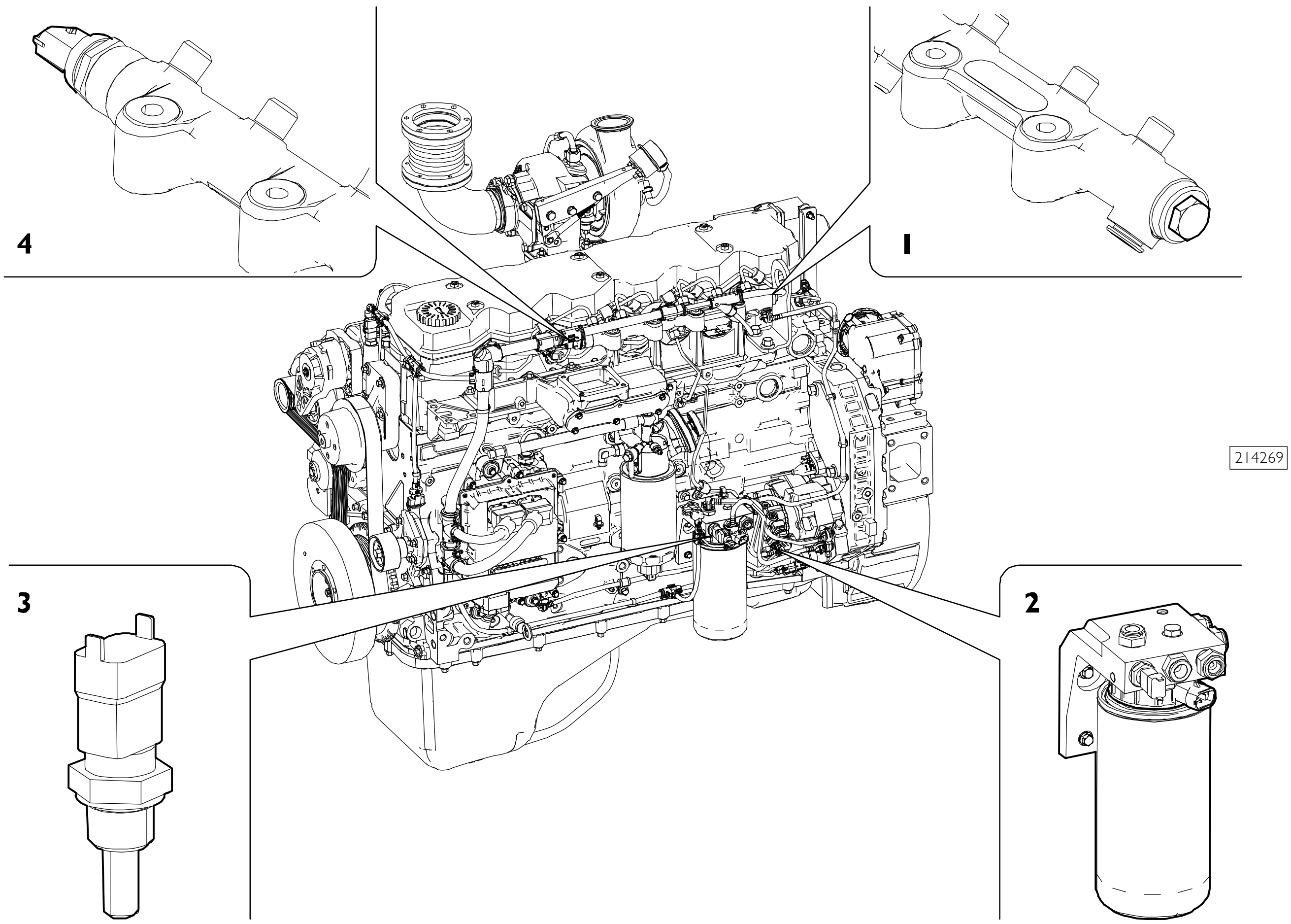
ELECTRICAL SYSTEM

Figure 1 (NEF67 TM1F)



1. Water temperature sensor - 2. Oil pressure sensor

Figure 2 (NEF67 TE1F/TE2F)



1. Pressure regulation valve on Rail - 2. Fuel heater on filter - 3. Fuel temperature sensor - 4. Pressure sensor on Rail

(NEF67 TM1F)

SENSORS

Oil pressure sensor

Mounted on the right side of the crankcase, measure the engine oil pressure.

Water pressure sensor

The same as the oil pressure sensor, it is fitted on the head on the right of the crankcase.

(NEF67 TE1F/TE2F)

SENSORS

Pressure regulator valve

The pressure regulator valve is fixed to the Rail and has the function of regulating and maintaining the pressure according to the engine load condition.
If the pressure is too high, the valve opens to make part of the fuel flow from the Rail to the tank; if the pressure is too low in the Rail, the valve closes and separates the high pressure side from the low pressure side.
This is a solenoid valve electronically controlled by the control unit (EDC module). Pressure variation is carried out by regulating the return flow of diesel to the tank

Fuel heater on filter

This resistor ensures that the fuel remains liquid even if temperatures fall below the freezing point. When temperatures are too low, the fuel tends to form clots that can cause clogging of electro-injectors and problems with cylinder ignition.

Fuel temperature sensor

This sensor is just like the coolant temperature sensor.
It detects the fuel temperature to provide the control unit with an index of the fuel's thermal state.

Pressure Sensor on Rail

Assembled on one end of the rail, measures the existing fuel pressure and informs the control unit (feed - back).
The value of injection pressure is used to keep the pressure level under control and to determine the time duration of the injection electronic command.

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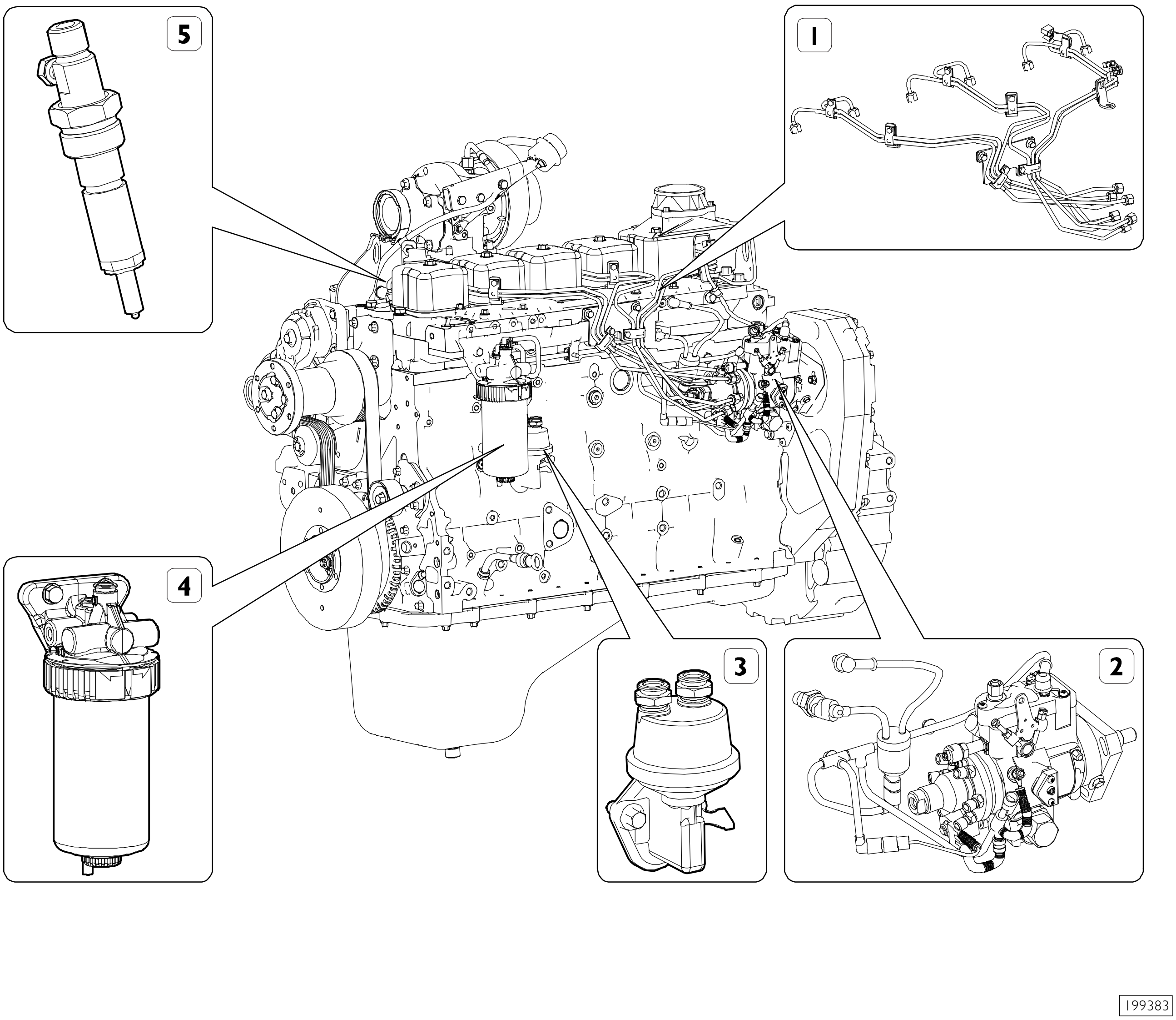
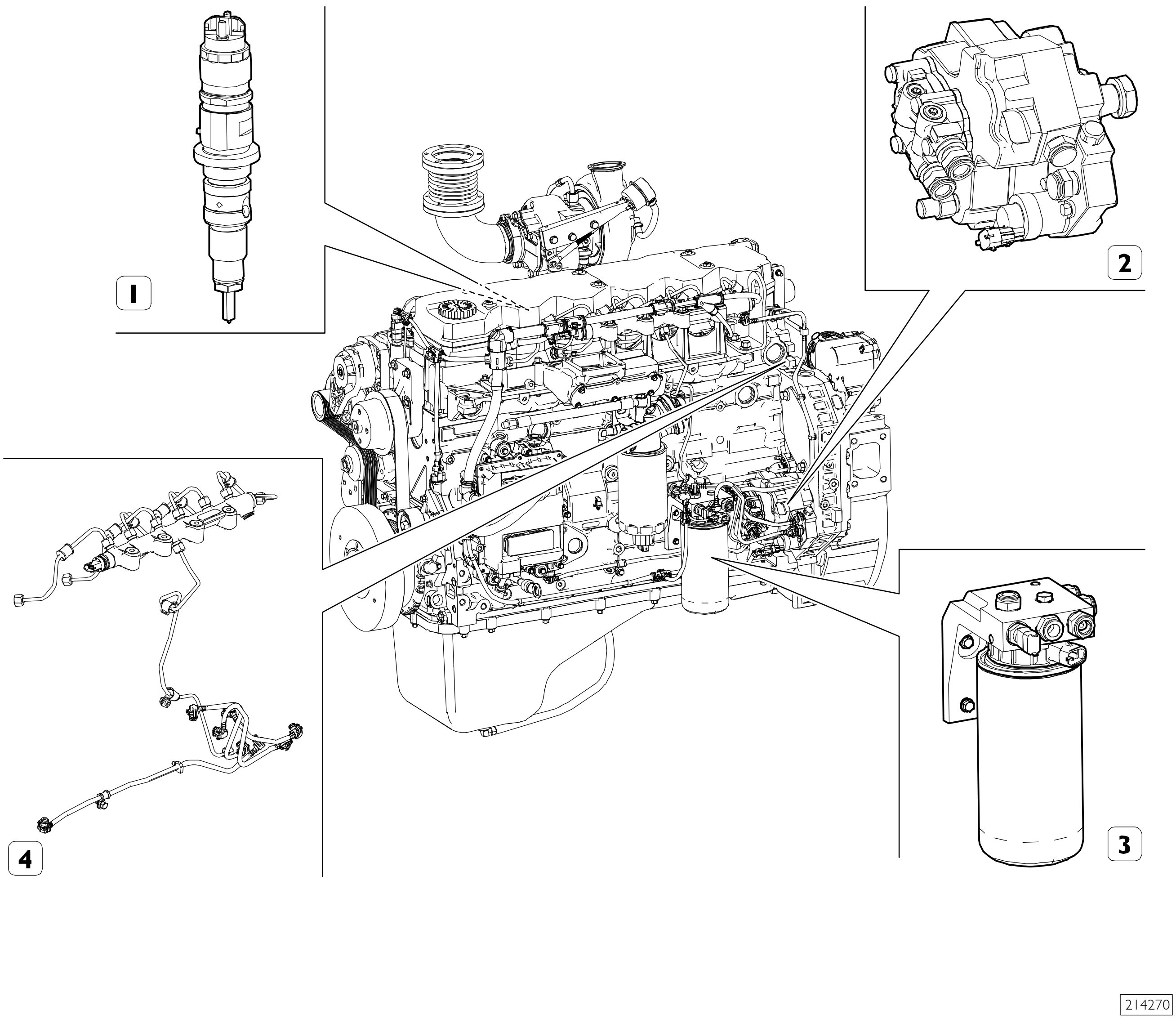
HYDRAULIC SYSTEM

Figure 3 (NEF67 TM1F)



1. High pressure pipes - 2. Stanadyne rotating pump - 3. Priming pump - 4. Fuel filter - 5. Injector

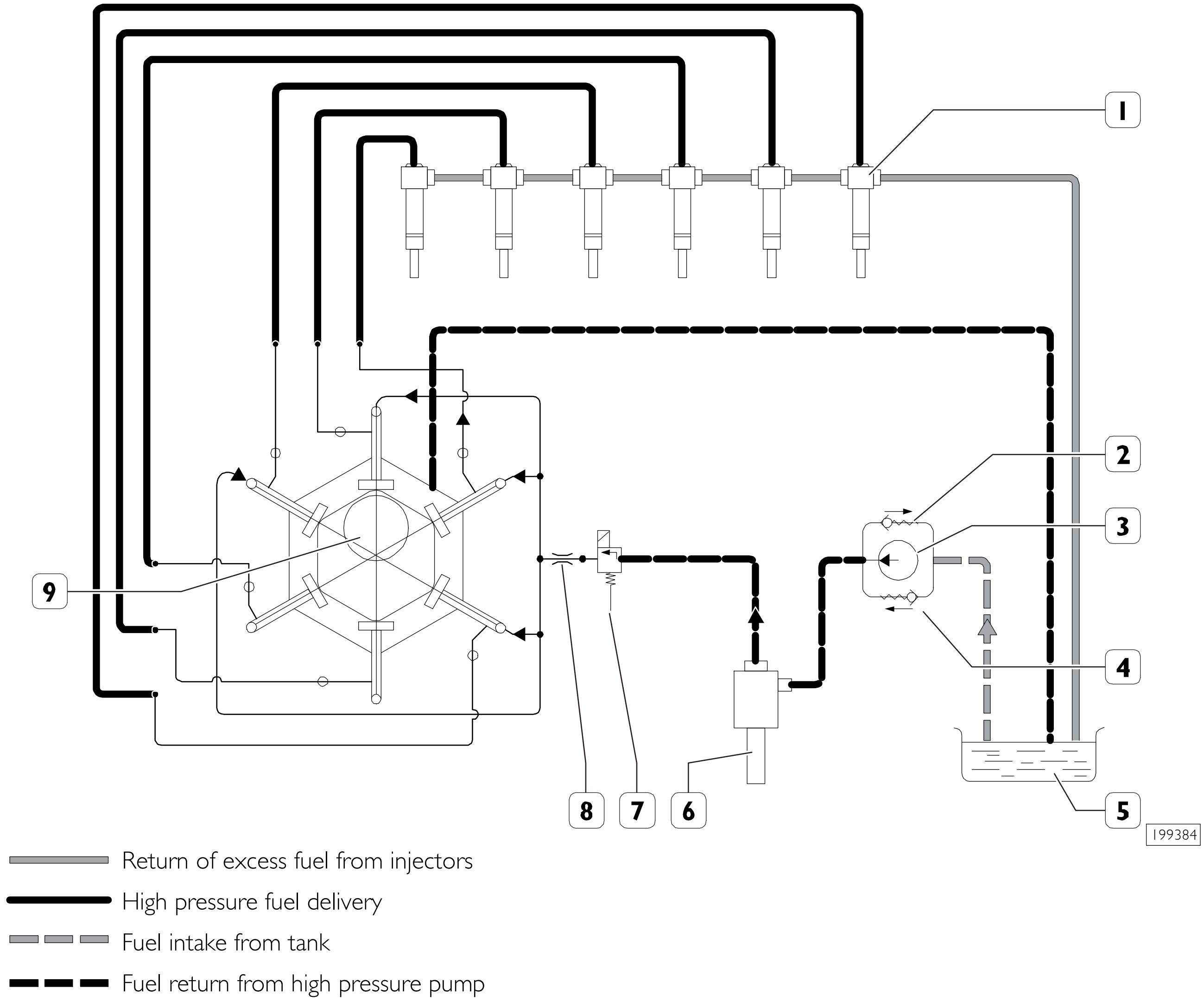
Figure 4 (NEF67 TE1F/TE2F)



1. Electro-injector - 2. High-pressure pump - 3. Fuel filter - 4. Complete fuel piping

SUPPLY DIAGRAM

Figure 5 (NEF67 TM1F)



1. Injector - 2. Bypass valve - 3. Priming pump - 4. By-pass valve - 5. Fuel tank - 6. Fuel filter - 7. Pressure regulator - 8. Cooling pipes for high pressure pump - 9. Rotating pump

The fuel is sucked into the fuel tank by means of the priming pump.

This is located on the engine crankcase and is activated by the camshaft.

The fuel is conveyed through the filter to the inlet fitting placed in communication with the intake chamber of the transfer pump. (For intended uses in cold climates, the fuel filter is equipped with a heater)

The transfer pump is positioned inside the supply pump and is of the blade type; its purpose is to increase the fuel pressure depending on the increase of the number of revolutions.

The fuel therefore reaches the valve which regulates the pressure inside the supply pump.

The distributor piston further increases this pressure and sends it through the fuel delivery coupling to the injectors.

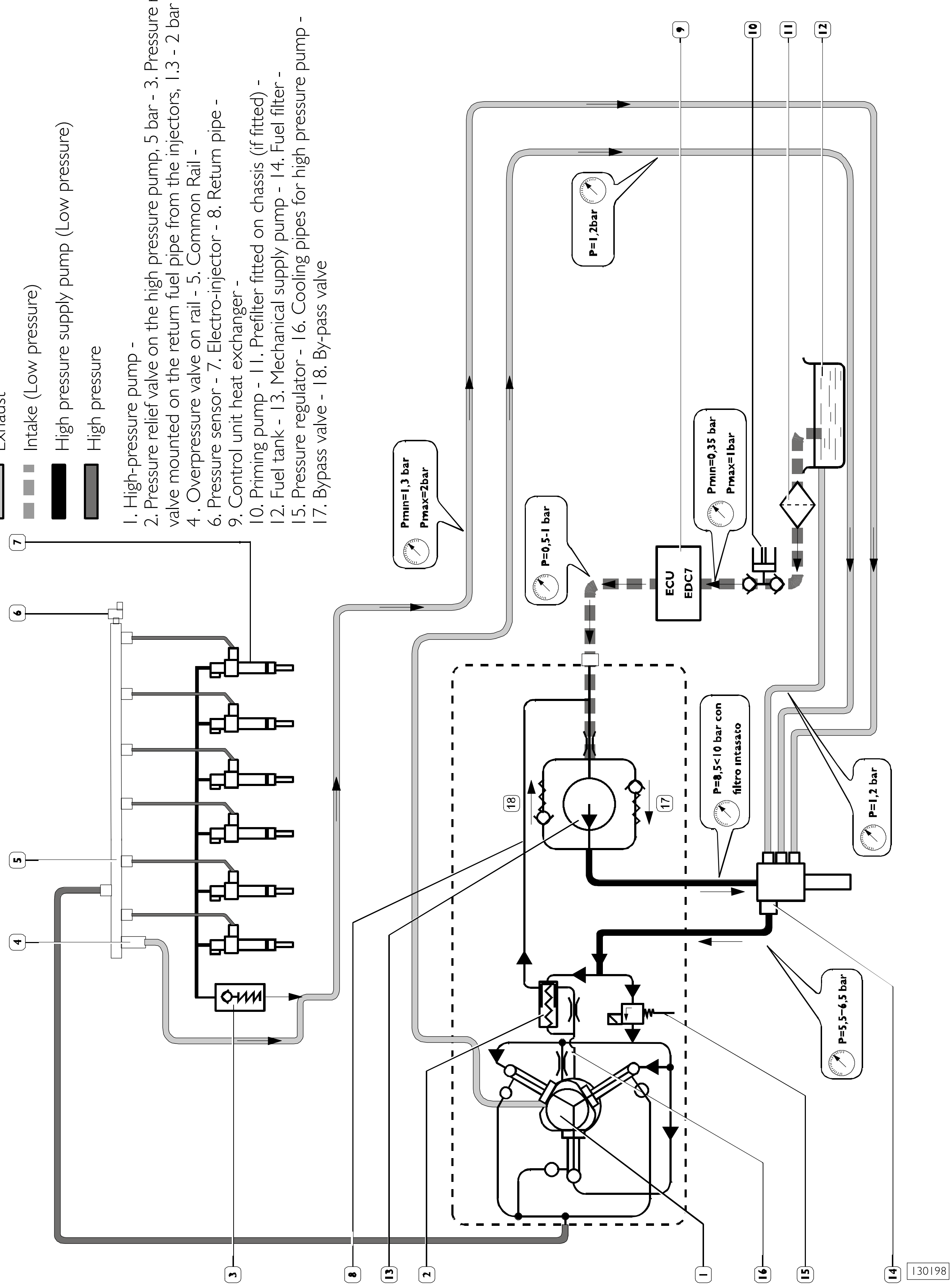
The fuel which leaks from the injectors is recovered and sent to the tank again.

Figure 6

(NEF45 TE1F/TE2F)

- Exhaust
- Intake (Low pressure)
- High pressure supply pump (Low pressure)
- High pressure

1. High-pressure pump - 2. Pressure relief valve on the high pressure pump, 5 bar - 3. Pressure relief valve mounted on the return fuel pipe from the injectors, 1.3 - 2 bar - 4 . Overpressure valve on rail - 5. Common Rail - 6. Pressure sensor - 7. Electro-injector - 8. Return pipe - 9. Control unit heat exchanger - 10. Priming pump - 11. Prefilter fitted on chassis (if fitted) - 12. Fuel tank - 13. Mechanical supply pump - 14. Fuel filter - 15. Pressure regulator - 16. Cooling pipes for high pressure pump - 17. Bypass valve - 18. By-pass valve



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This CP3 Common Rail injection pump system is shown in the 6-cylinder version.

The pressure regulator, placed upstream of the high-pressure pump, adjusts the fuel flow that is necessary on the low-pressure system.

Afterwards, the high-pressure pump takes care of supplying the rail properly.

This solution, only pressurising the necessary fuel, improves the energy efficiency and limits heating the fuel in the system.

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

The pressure relief valve (2) intervention brings about a fuel flow increase in the high-pressure pump cooling circuit, through inlet and drain piping (16) from piping (8).

The pressure relief valve seated on the cylinder head, mounted on the back of the electro-injectors (3), restricts the return flow of fuel by the electro-injectors at a pressure of 1.3 ÷ 2 bar.

Two by-pass valves are placed in parallel with the mechanical supply pump.

The by-pass valve (18) allows fuel to flow from mechanical pump outlet to its inlet, when the fuel filter inlet pressure exceeds the allowed threshold value.

The by-pass valve (17) allows filling the supply system through the manual priming pump (10).

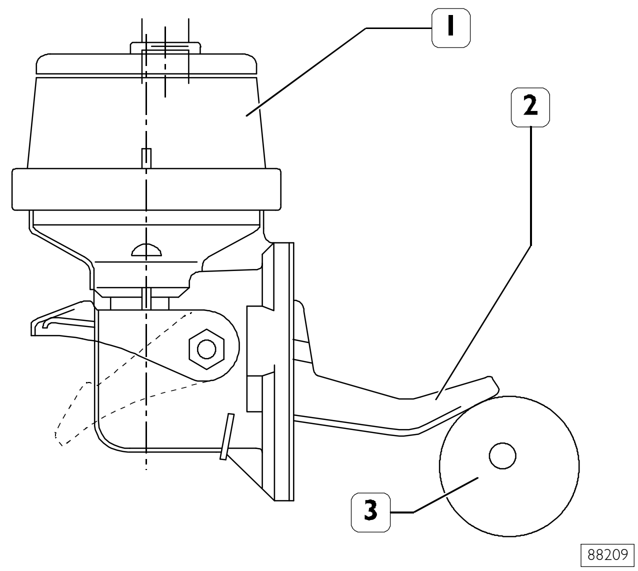
SUPPLY SYSTEM COMPONENTS

Priming pump

The pump has the function of priming the fuel in the tank and conveying it to the fuel supply pump.

This is located on the engine crankcase and is activated by the camshaft.

Figure 7 (NEF67 TM1F)



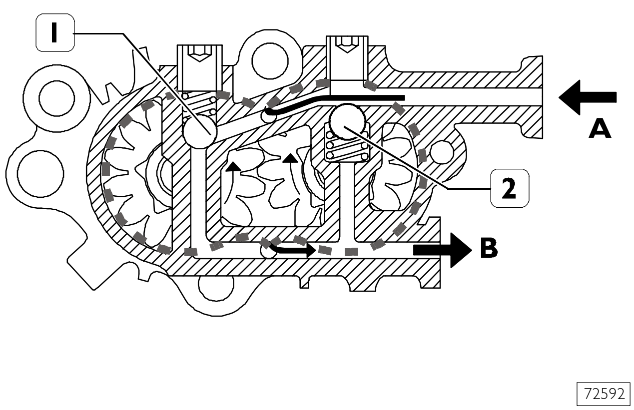
1. Pump - 2. Control lever - 3. Camshaft.

Mechanical supply pump (NEF67 TE1F/TE2F)

Gear pump, mounted on the rear part of the high pressure pump, has the function of supplying it. It is controlled by the high pressure pump shaft.

Normal operating condition

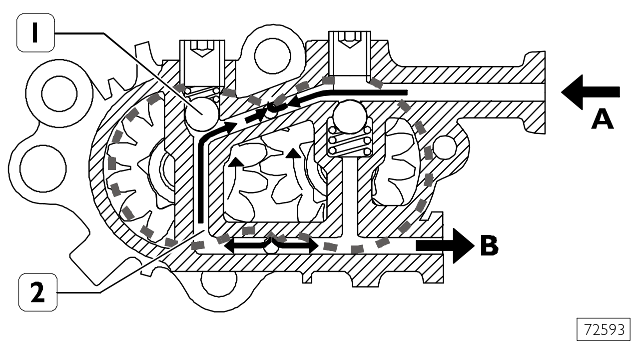
Figure 8



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

Output overpressure condition

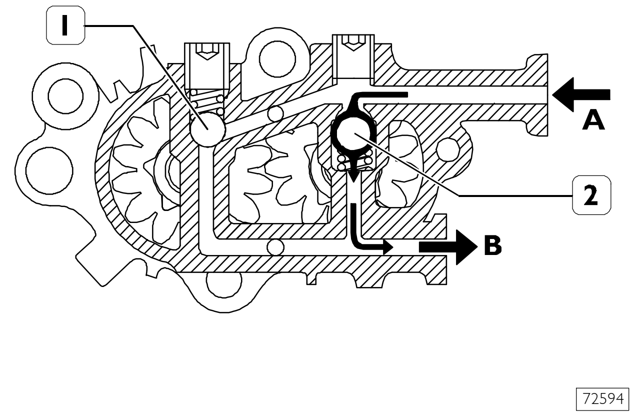
Figure 9



By-pass valve (1) opens in the presence of overpressure at the outlet B. The pressure of the fuel overcomes the force exerted by the spring of the valve (1), thereby placing the pump outlet in communication with the inlet by way of passage (2).

Air bleeding conditions

Figure 10



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

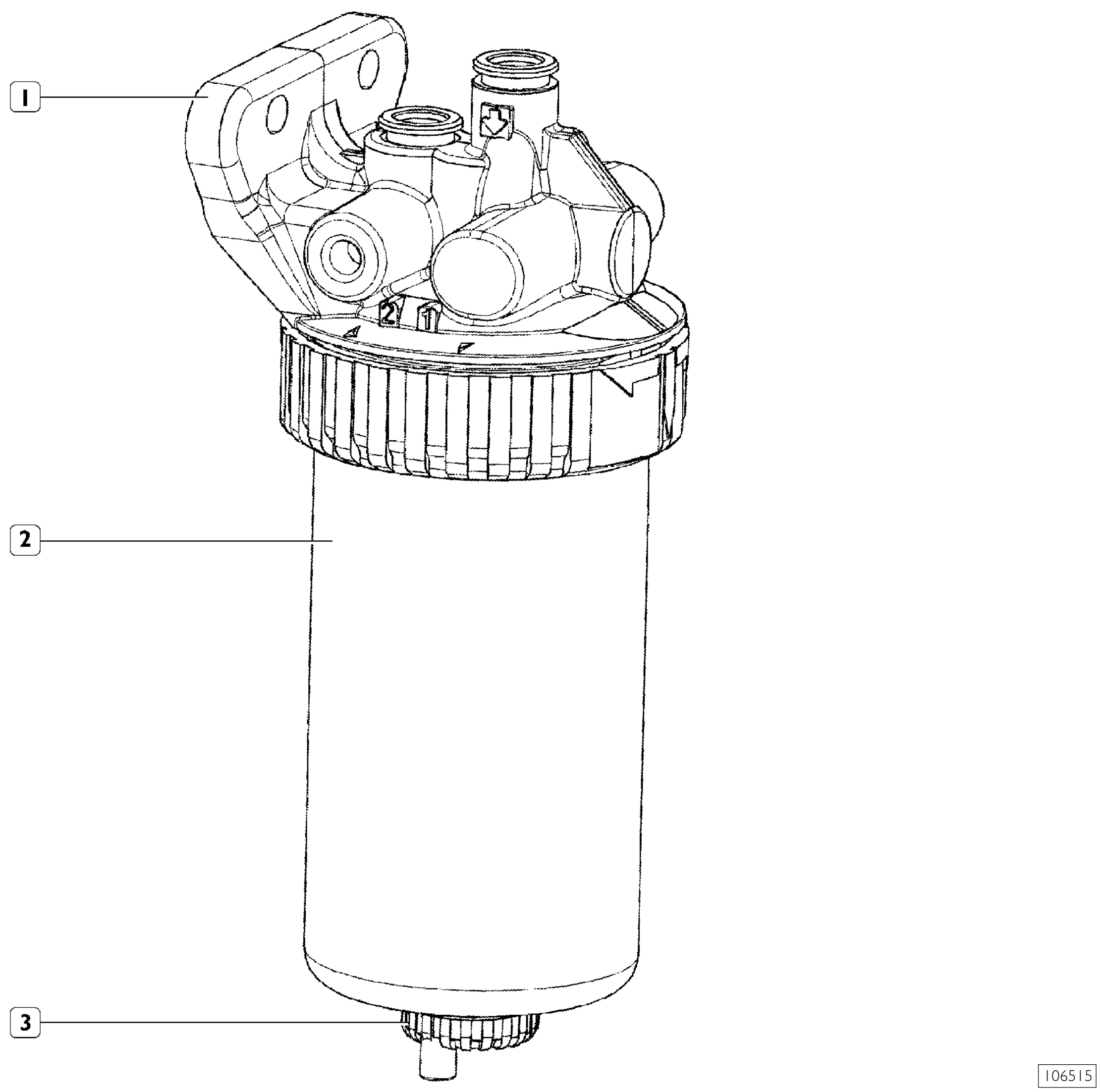
NOTE The mechanical supply pump cannot be replaced individually, so it must not be removed from the high pressure pump.

Fuel filter

The filter is positioned near the feed pump and the priming pump, and has the function of retaining impurities and separating the water contained in the fuel.

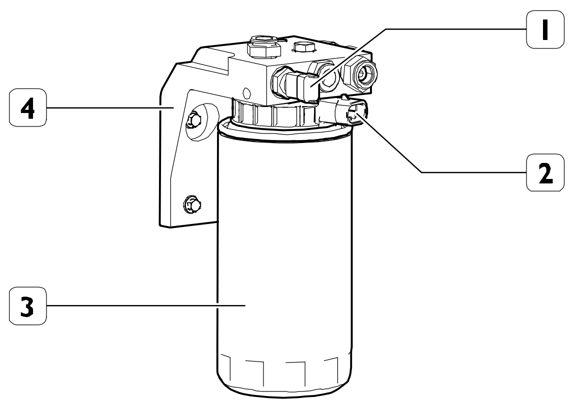
At the base of the filter cartridge, there is a water bleed screw through which it is possible to drain it from time to time; a heater and temperature sensor can be placed on the support for the uses that require it (use in cold climates). On some versions, there is a water presence sensor at the base of the filtering cartridge.

Figure 11 (NEF67 TM1F)



1. Fuel filter support - 2. Filtering cartridge - 3. Water bleed screw.

Figure 13 (NEF67 TE1F/TE2F)

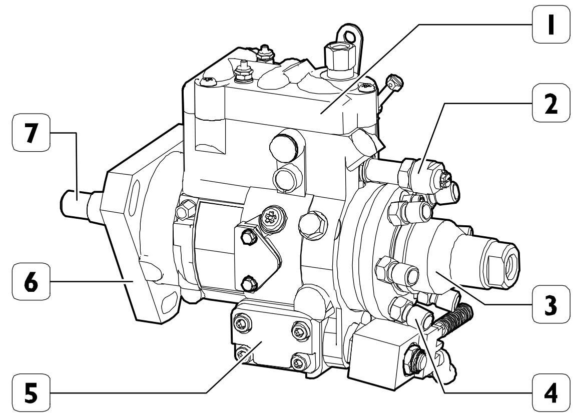


1.Fuel temperature sensor - 2. Fuel heater - 3. Cartridge - 4. Complete filter support

Feed pump (Demonstrative)

The rotary pump is driven by a gear coupled to the camshaft.

Figure 12 (NEF67 TM1F)



1. Power switch-off solenoid valve - 2. Metering valve - 3. Pressure regulator unit - 4. Hydraulic head - 5. Automatic advance - 6. Seat - 7. Propeller shaft

Operation description

The main rotation components are the propeller shaft (1), the distribution rotor (2), the transfer pump vanes (3) and the regulator (8). Referring to Figure 12, the propeller shaft engages the distribution rotor inside the hydraulic head.

The four pistons are engaged towards each other simultaneously by the cam inner ring through the rollers and the sliding blocks that are transported into the holes located on the end of the rotor.

The number of cam lobes is equal to the number of engine cylinders.

The transfer pump positioned no the rear part of the rotor is positive cylinder type and is closed within the end plug. The end plug also contains the screen of the inlet filter and the pressure regulator of the transfer pump. The upper part of the regulator unit is pressed against the distribution rotor and forms a final seal for the transfer pump.

The distribution rotor contains two loading ports, a single axial hole and an exhaust port serving all outputs to the injection lines.

The hydraulic head contains the hole in which the rotor turns, the hole of the metering, opening and loading valves, and the fittings for the discharge outlet. The high pressure injection lines connected to the injectors are fixed to the above mentioned exhaust couplings.

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High pressure pump CP3

(NEF67 TE1F/TE2F)

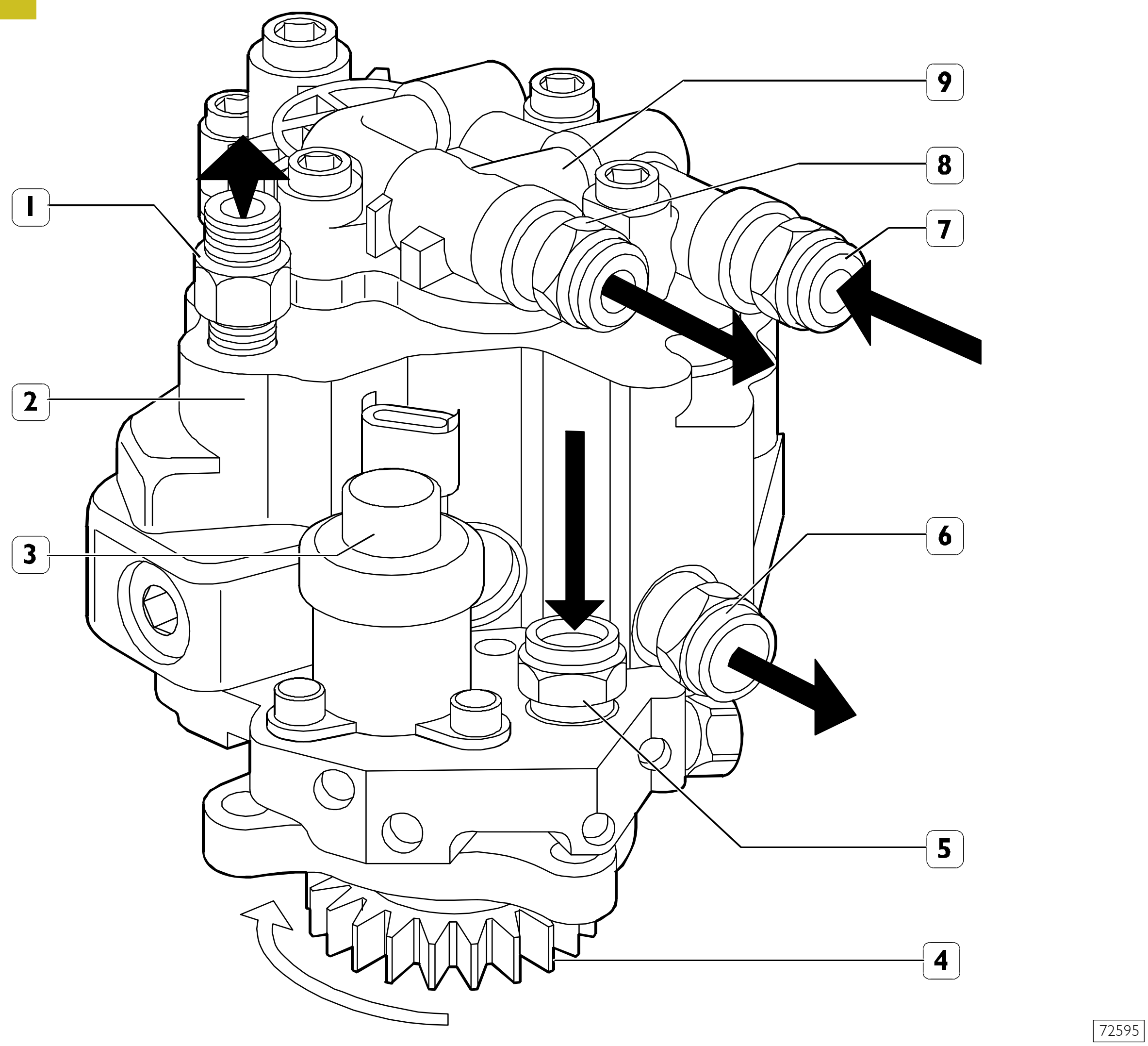
Pump with 3 radial plungers, controlled by distribution gears, requires no timing.

The mechanical supply pump controlled by the high pressure pump shaft is mounted on the rear side of the high pressure pump.

The high pressure pump - feed pump assembly cannot be overhauled and therefore should not be removed and the fastening screws should not be tampered with.

The only operation that can be carried out is the replacement of the drive gear and pressure regulator.

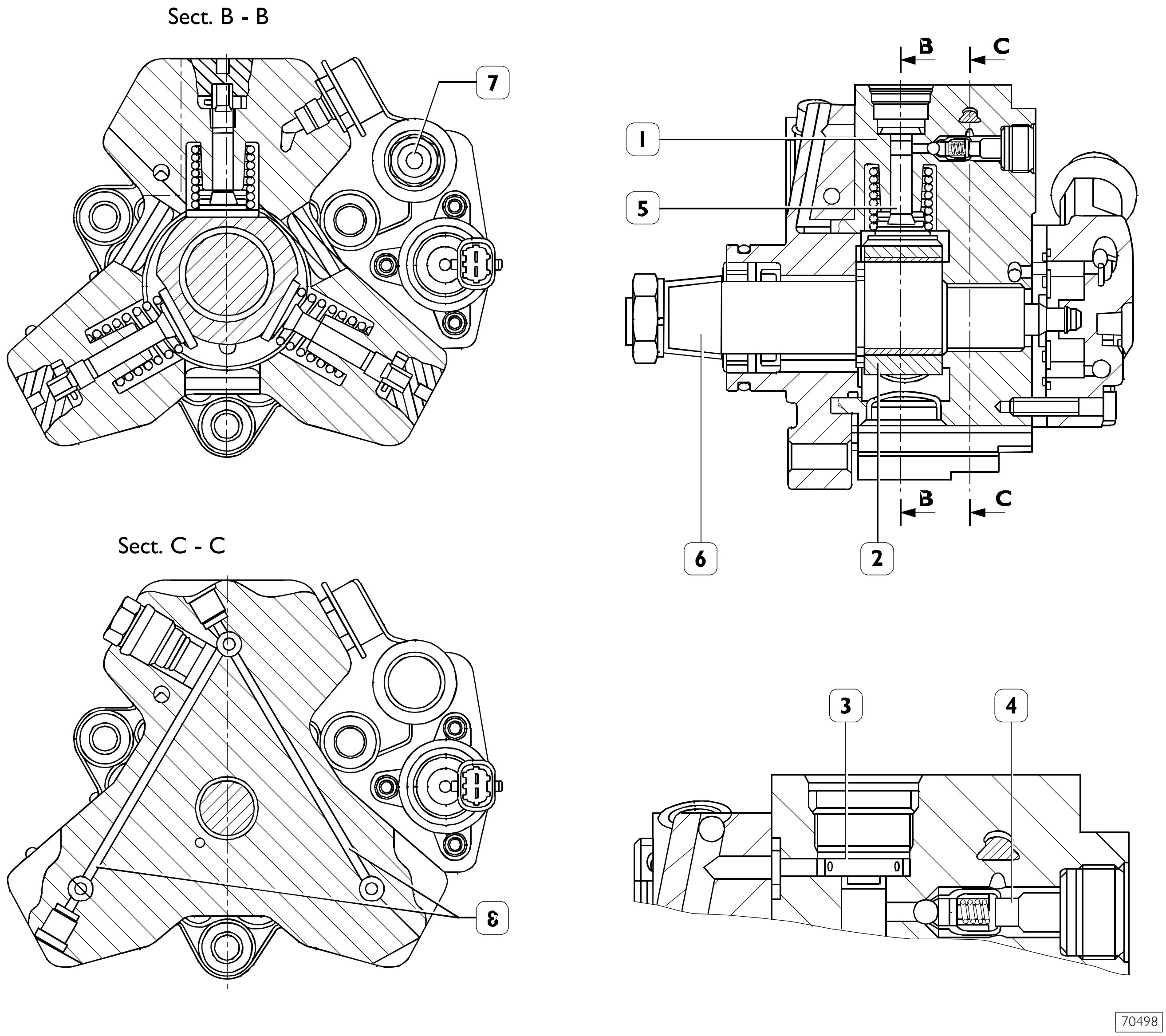
Figure 14



1. Connection between fuel outlet and rail - 2. High pressure pump - 3. Pressure regulator - 4. Drive gear 5. Filter fuel inlet union - 6. Connection between fuel outlet and filter bracket - 7. Connection for fuel inlet from heat exchanger ECU - 8. Connection between fuel outlet from mechanical pump and filter - 9. Mechanical supply pump.

High-pressure pump internal structure

Figure 15



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

Each pump unit consists of:

- a piston (5) actuated by a three-lobe element (2) floating on the pump shaft (6). Since the element (2) floats on an offset part of the shaft (6), during the rotation of the shaft it does not rotate with it but is only pushed towards one of the pistons (5) (distributed with an interval of 120° on the entire crown), and activated.
- cap intake valve (3);
- ball delivery valve (4).

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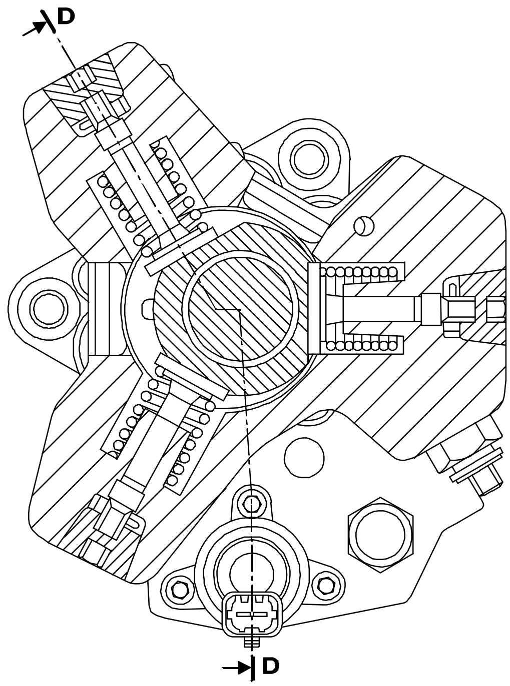
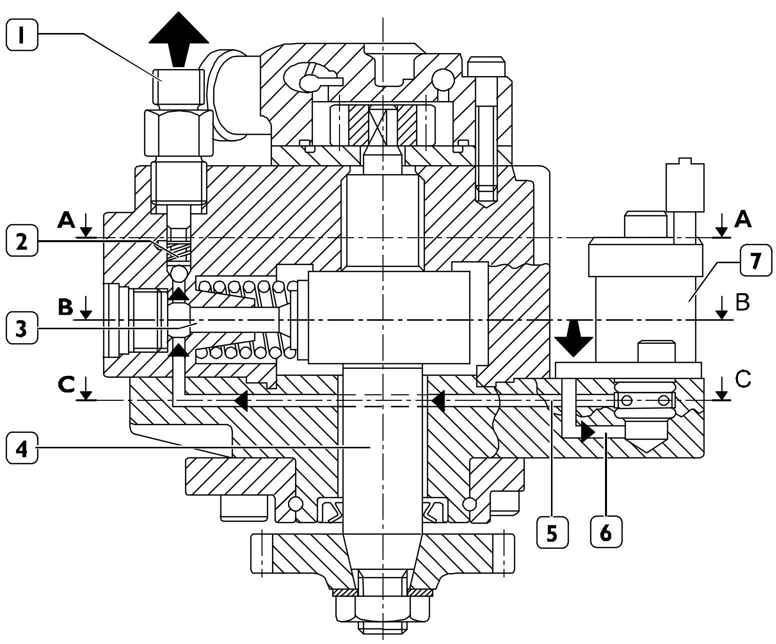
Operating principle

Figure 16



Sect. B - B



Sect. D - D

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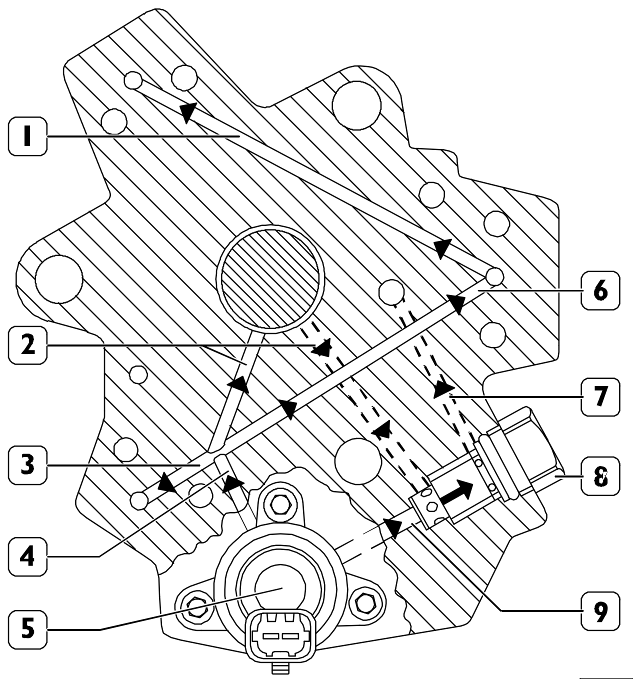
1. Connection between fuel outlet and rail - 2. Delivery valve to rail - 3. Plunger - 4. Pump shaft - 5. Plunger supply pipe - 6. Pressure regulator supply pipe - 7. Pressure regulator.

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

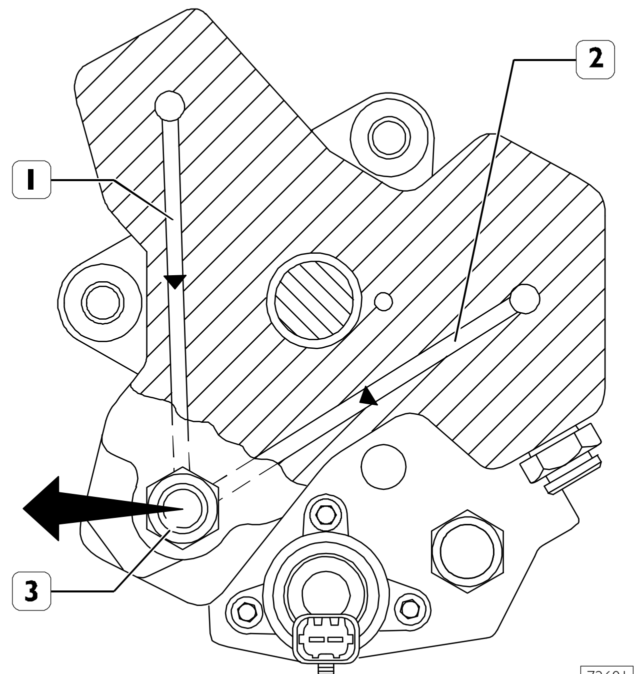
Figure 17



Sect. C - C

1. Plunger inlet - 2. Pump lubrication pipes - 3. Plunger inlet - 4. Main plunger supply pipe - 5. Pressure regulator - 6. Plunger inlet - 7. Regulator drainpipe - 8. Pressure limiting valve 5 bar - 9. Fuel discharge from regulator inlet.

Figure 18



Sect. A - A

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

Figure 17 shows the routes of the fuel at low pressure inside the pump; it shows the main supply pipe of the pumping elements (4), the pumping element supply pipes (1 - 3 - 6), the pipes used to lubricate the pump (2), the pressure regulator (5), the 5-bar pressure relief valve (8) and the fuel discharge (7).

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

The pressure regulator (5) establishes the quantity of fuel to be supplied to the plungers; The excess fuel flows off through the pipe (9).

The 5 bar relief valve, in addition to functioning as a collector for fuel discharge, has the function of keeping the pressure constant at 5 bar at the entrance of the regulator.

Figure 18 shows high pressure fuel flow through plunger outlet ducts.

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Operation

The cylinder is filled through the plate intake valve only if the supply pressure can open the delivery valves on the plungers (approx. 2 bar).

The amount of fuel that supplies the high pressure pump is metered by the pressure regulator, positioned on the low pressure system; the pressure regulator is controlled by the EDC 7 control unit through a PWM signal.

If the fuel is sent to the plunger, its piston is moving down (intake stroke). When the piston stroke inverts, the intake valve closes and the fuel remaining in the plunger chamber, which cannot exit, is compressed beyond the existing supply pressure in the rail.

The pressure generated this way causes the discharge valve to open and the compressed fuel reaches the high pressure circuit.

The plunger compresses the fuel till the top dead centre (delivery stroke) is reached. Then the pressure decreases so that the discharge valve closes.

The plunger piston returns to the bottom dead centre and the residual fuel is decompressed.

When the pressure in the plunger chamber is lower than the supply pressure, the intake valve opens again and the cycle is repeated.

The delivery valves must always be free in their movement, with no impurities or oxidation.

The rail delivery pressure is modulated between 250 and 1,600 bar by the electronic control unit through the solenoid valve of the pressure regulator.

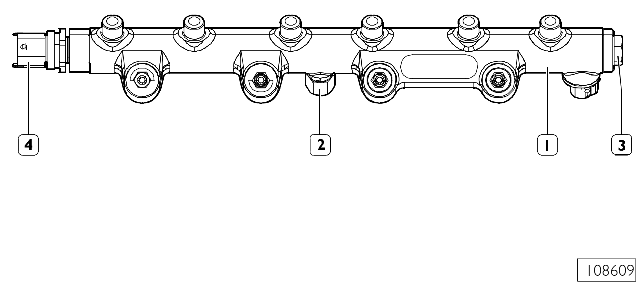
The pump is lubricated and cooled by the same fuel.

The removal - refitting time of the radial jet pump on the engine is significantly reduced compared to traditional injection pumps because no timing is necessary.

In the event of removal - refitting of the fuel filter pipe and high pressure pump, make sure hands and components are as clean as possible.

RAIL (PRESSURE ACCUMULATOR)

Figure 19 (NEF67 TE1F/TE2F)



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

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

It anyway has enough volume as to minimise pulsations 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.

OVERPRESSURE VALVE

Once the valve has been mounted at one rail end, the valve task is to protect system components in the case where a fault in either rail pressure sensor or pump pressure regulator CP3 causes pressure excessive increment in high pressure system.

When pressure reaches 1800 bars in the rail, initially valve intervenes to drain fuel and therefore reduce pressure to safe values, then it mechanically adjusts pressure in rail at approx. 800 bars.

This valve enables to have the engine operated for long time with limited performance and inhibits fuel excessive overheating, so preserving the pipings returning from the tank.

ELECTRO-INJECTOR

The injector features a traditional construction, save for the fact that it has no needle return springs.

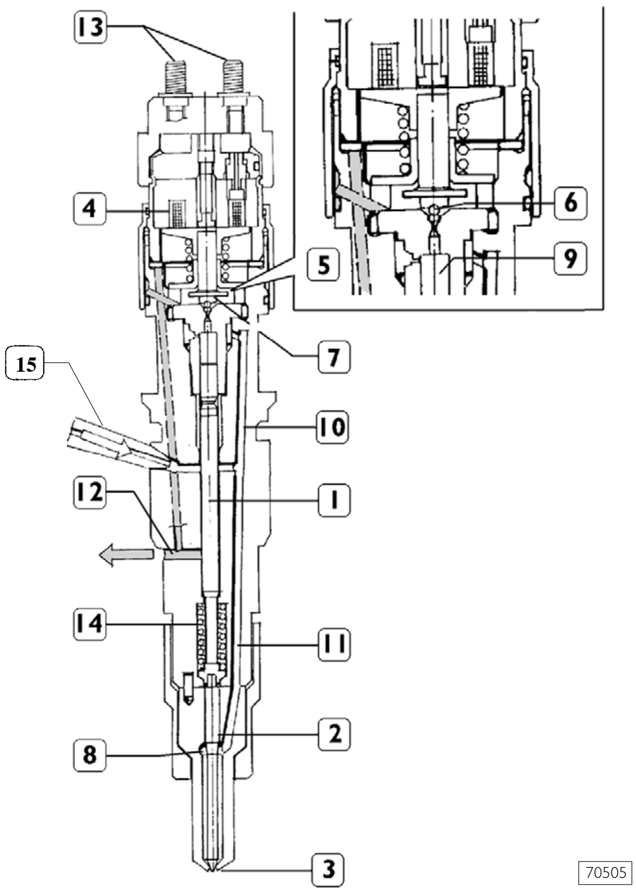
The electro-injector essentially consists of two parts:

- actuator - spray nozzle composed of pressure rod (1), plunger (2) and nozzle (3);
- control solenoid valve composed of coil (4) and pilot valve (5).

The solenoid valve checks the lift of the nozzle needle.

Injector in resting position

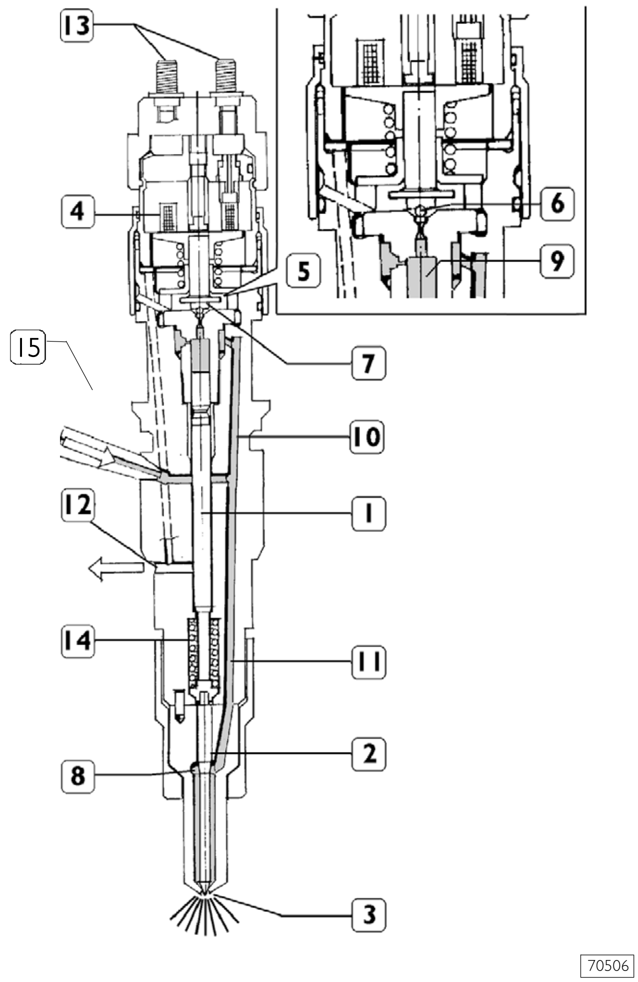
Figure 20



1. Pressure rod - 2. Needle - 3. Nozzle - 4. Coil - 5. Pilot valve - 6. Ball shutter - 7. Control area - 8. Pressure chamber - 9. Control volume - 10. Control duct - 11. Supply pipe - 12. Control fuel outlet - 13. Power connection - 14. Spring - 15. High pressure fuel inlet.

Beginning of injection

Figure 21



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.

End of injection

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 electro-injector cannot be overhauled and therefore it must not be disassembled.

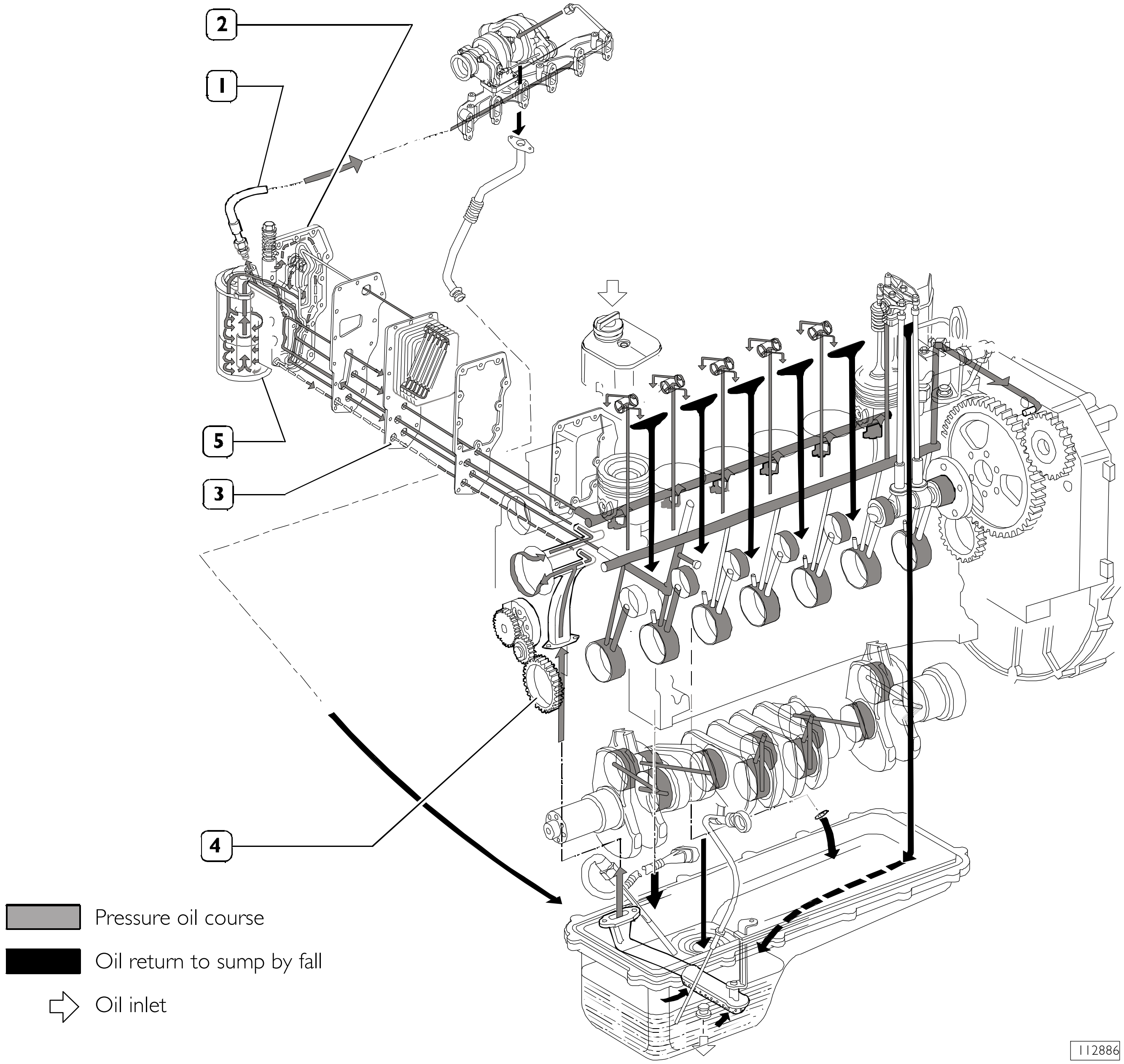
LUBRICATION CIRCUIT

Principles

The lubrication system includes components such as the heat exchanger, the turbocharger, for the turbocharged versions, and the compressor to the compressed air system if necessary.

All these components often vary depending on use and are therefore dealt with in the specific part of the manual.

Figure 22 (NEF45 SM1F)

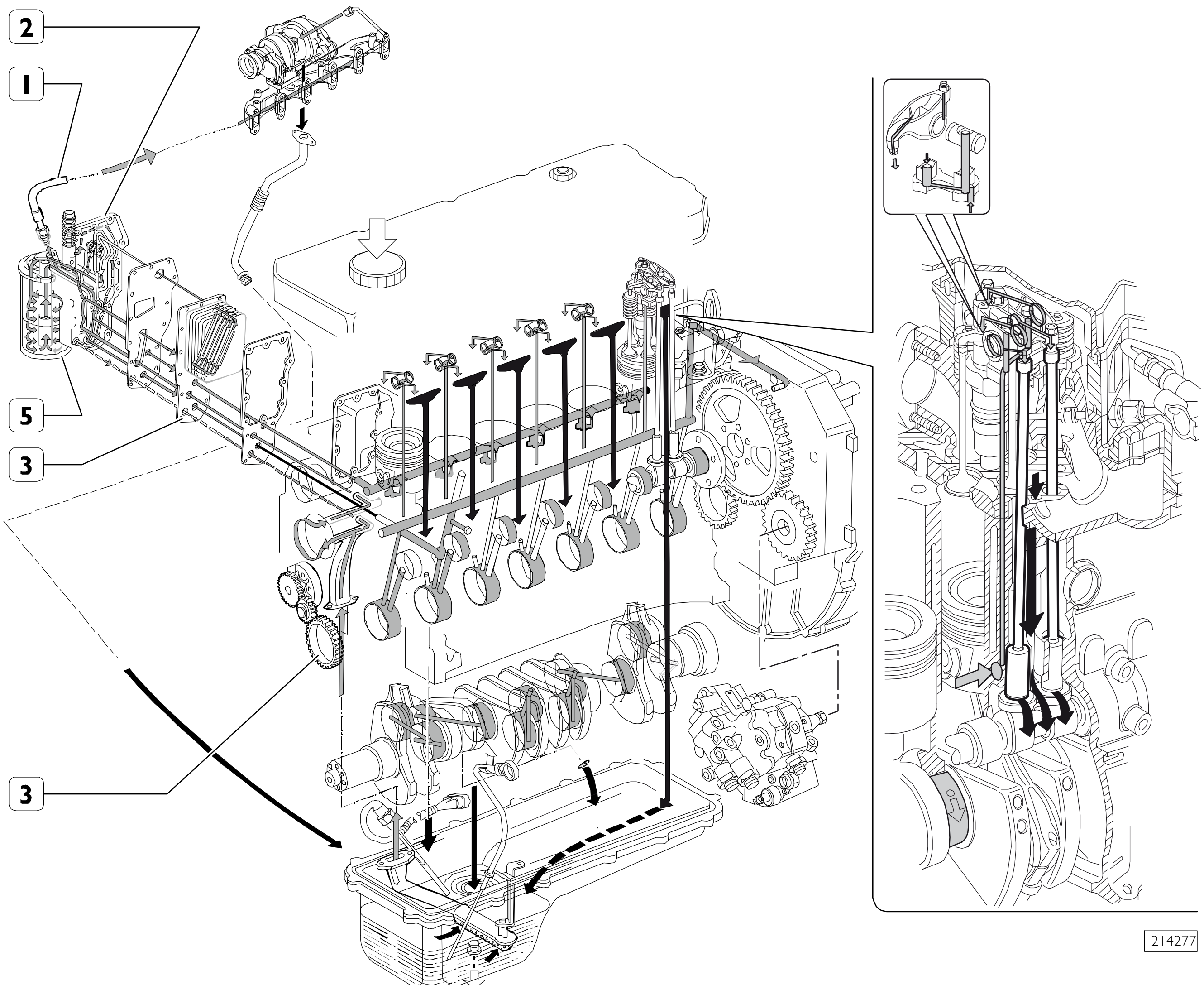


The forced circulation lubrication is performed by the rotary oil pump, housed in the front of the crankcase, driven by a gear with straight teeth keyed on the crankshaft stub.

The lubricant oil is sent from the sump to camshaft and valve control wing.

1. Heat exchanger body - 2. Turbocharger lubrication delivery pipe -
3. Oil filter - 4. Heat exchanger - 5. Oil pump.

Figure 23 (NEF67 TE1F/TE2F)



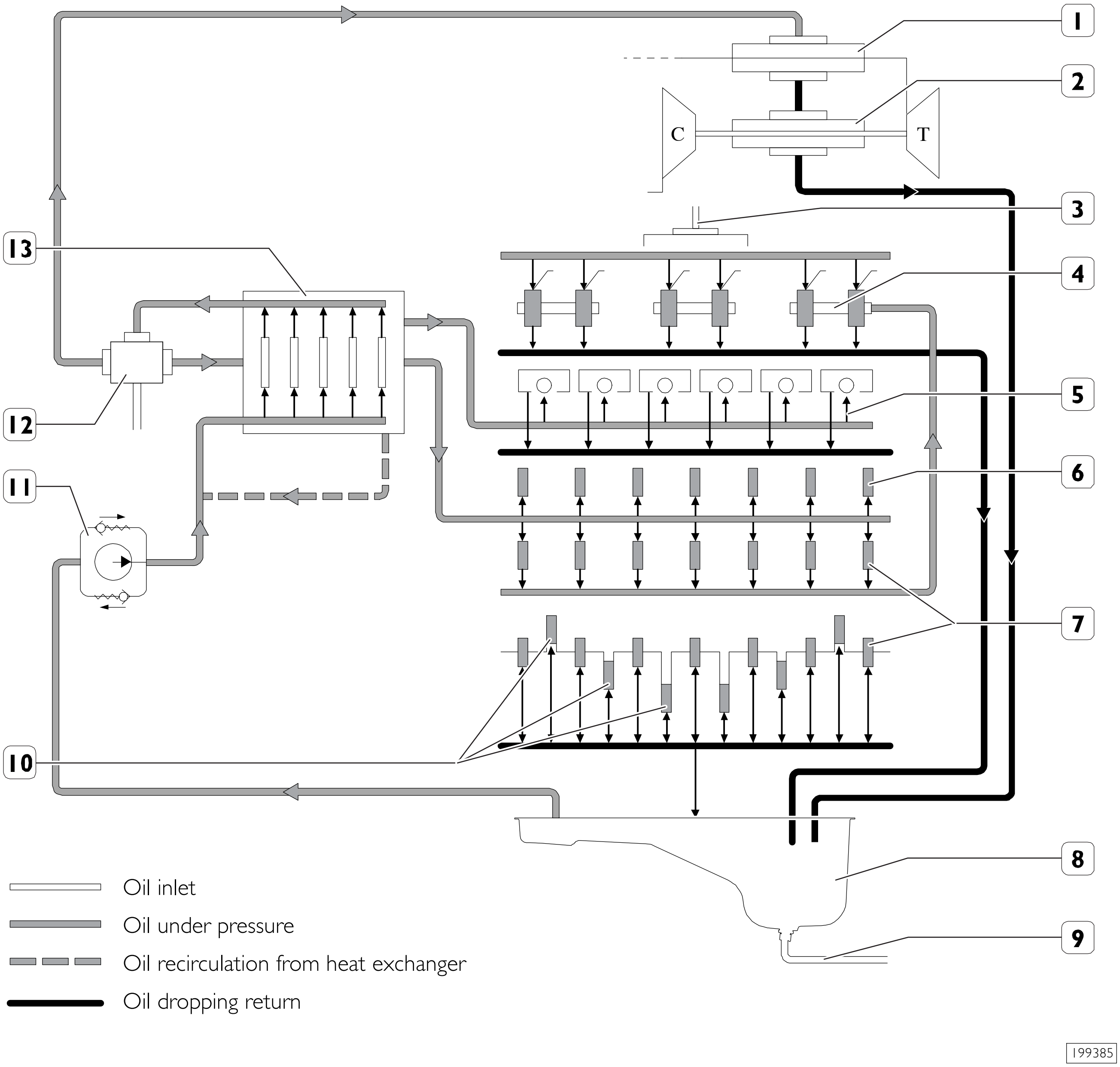
Oil inlet

Oil under pressure

Oil dropping

LUBRICATION DIAGRAM

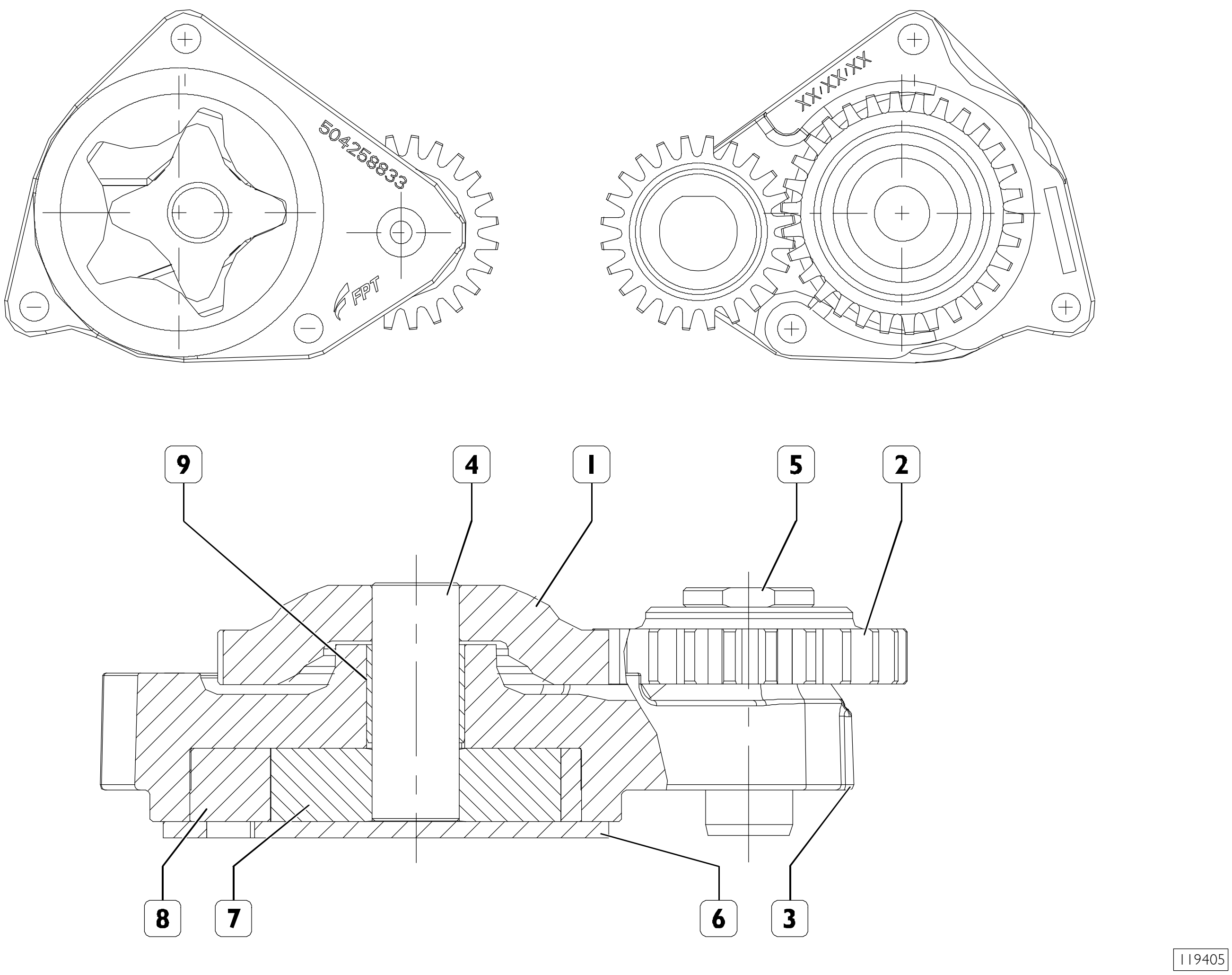
Figure 24



1. Exhaust manifold - 2. Turbocharger shaft - 3. Oil filling plug - 4. Rocker arms - 5. Piston lubricating nozzles - 6. Camshaft mounts - 7. Crankshaft main bearings - 8. Oil sump - 9. Oil drain plug - 10. Connecting rod bearings - 11. Oil pump - 12. Oil filter - 13. Heat exchanger

LUBRICATION CIRCUIT COMPONENTS
Oil pump

Figure 25

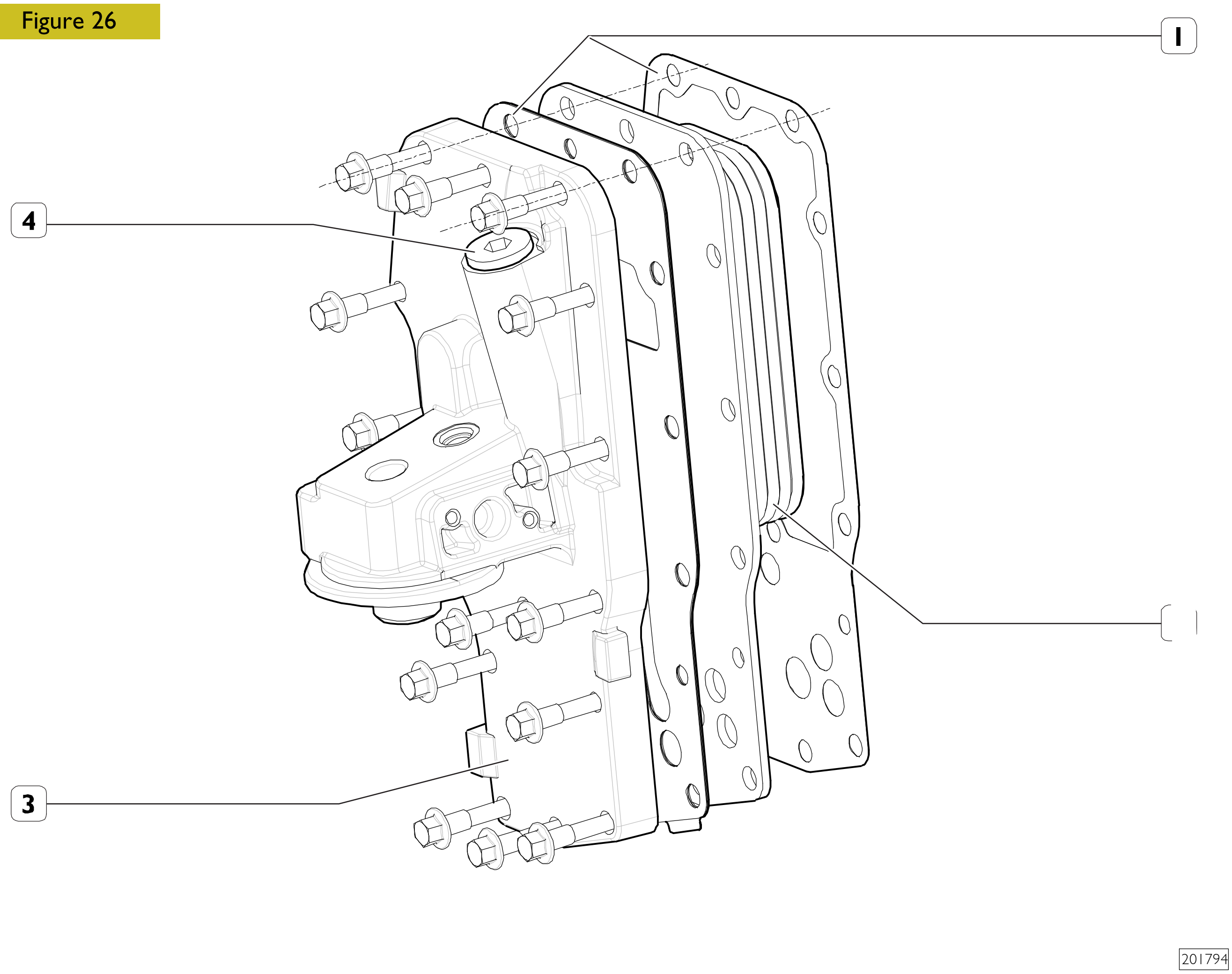


PUMP FEATURES	
Rotation speed	750 rpm - 4200 rpm
Delivery pressure	2 Bar - 4 Bar
Ampere rating	14.6 l/min - 93.5 l/min
Type of oil	SAE 20/30
Max oil temperature	80 °C

1. Primary gear - 2. Secondary gear - 3. Pump body - 4. Control shaft - 5. Layshaft
6. Cover - 7. Internal rotor - 8. External rotor - 9. Bushing.

Heat exchanger

Figure 26



1. Gaskets - 2. Internal heat exchanger element (7 elements) - 3. Heat exchanger body - 4. Pressure regulator valve

The heat exchanger, installed in the engine cooling system, has the task of regulating the oil temperature by subtracting heat through the use of coolant.

Performance according to GT 0179	
Pressure range	0... 2.5 MPa
Frequency	0.5 ÷ 3 Hz
Trend	Sinusoidal
No. of cycles	>500000
Explosion pressure	> 10 MPa

Piping	
Engine	5W30
Internal oil temperature	115.6 °C
Capacity	51 dm^3/min

Skirt	
Refrigerant	glycol
Internal coolant temperature	82.2 °C
External flow rate	230 dm^3/min

Oil pressure regulating valve

Figure 27

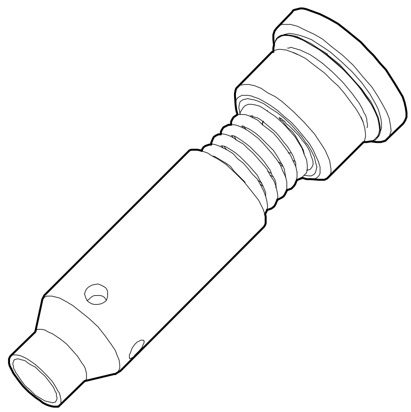
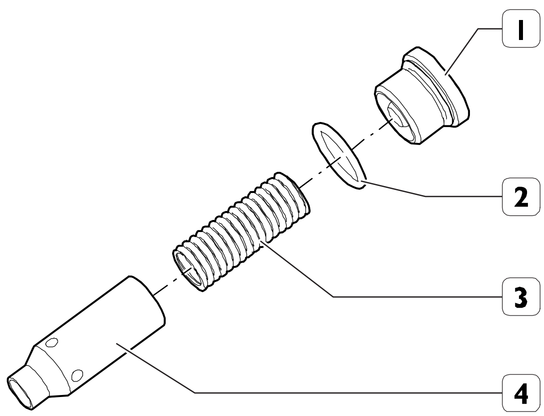


Figure 28



1. Threaded plug - 2. Seal - 3 Compression spring - 4. Valve body

MAIN DATA OF OIL PRESSURE CONTROL SPRING VALVE

Free length = 66 mm

Open valve load = 136.9 ± 10.5 N

Open valve height = 41.25 mm

Operating load = 695.8 MPa

Constant spring load = 945.3 MPa

Natural frequency = 320 Hz

Spring flexibility = 5.4 N/mm

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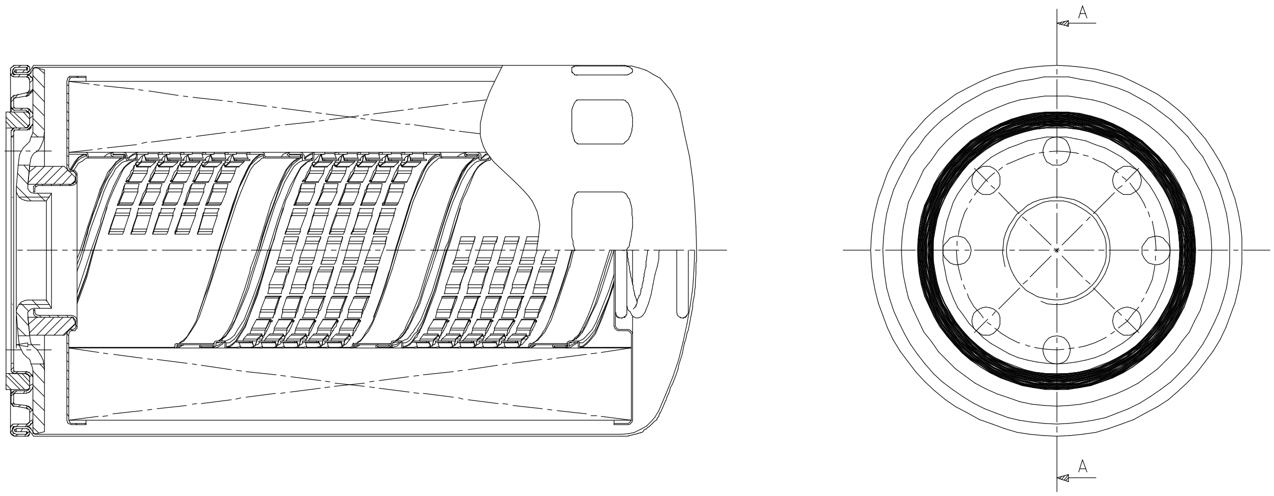
Engine oil filter

Figure 29



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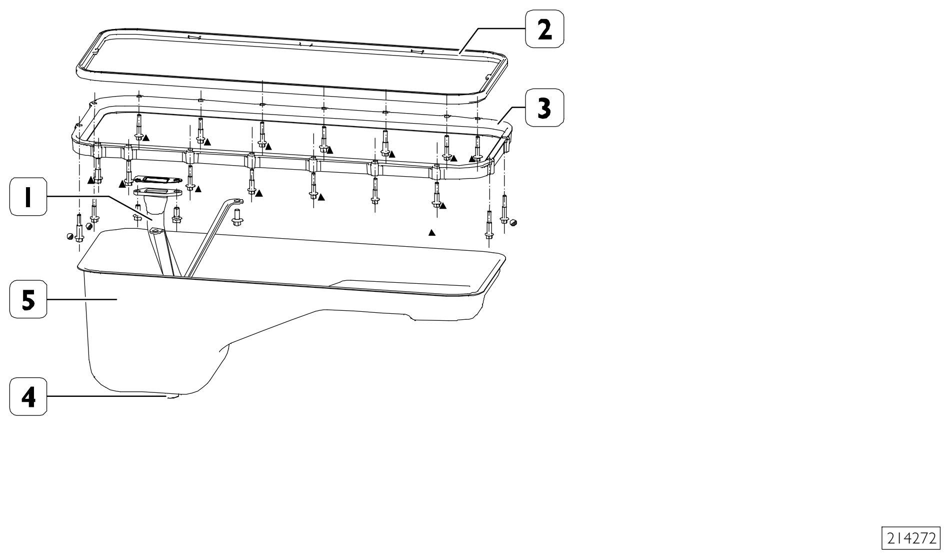
	C. Filtration	U.F.I.
Explosion pressure:	20 bar (ISO 4548/3)	20 bar (ISO 4548/3)
Button pressure:	0-15 bar (1Hz) > 50,000 cycles (ISO 4548/5)	0- 15 bar (1Hz) > 50,000 cycles (ISO 4548/5)
Operating temperature:	-40 / +140 °C	-40 / + 140 °C
Tightening torque:	20 0/+5 Nm	18 ± 2 Nm
Maximum flow rate:	100 l/mn	100 l/mn
Loss of load at end of life:	2.5 bar	2.5 bar
Accumulation power:	>20 gr with loss of load 1.72 bar (SAE J1858)	>60 gr with loss of load 2.5 bar (ISO 16889)

Oil sump

Figure 30



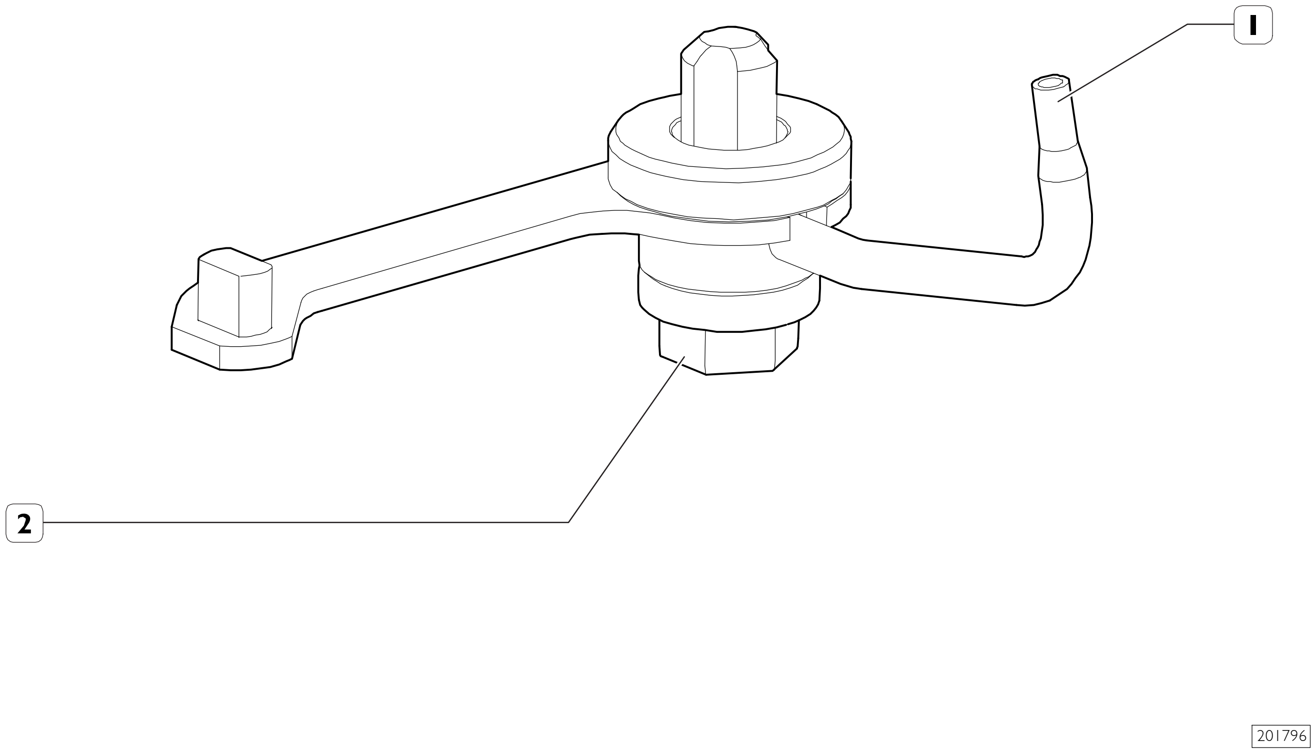
1. Suction strainer - 2. Gasket - 3. Fastening plate - 4. Exhaust valve - 5. Oil sump

The oil sump, mounted at the bottom the crankcase, has the purpose of containing the engine lubricant oil.

The oil is sucked by the pump, through which it is possible to lubricate the engine in its components.

Cooling nozzles

Figure 31



1. Cooling nozzle - 2. Nozzle union

The cooling nozzles are designed to inject the lubricant oil to the pistons.

The orientation and layout inside the crankcase allow them to convey the lubricant directly in correspondence with the crankpins.

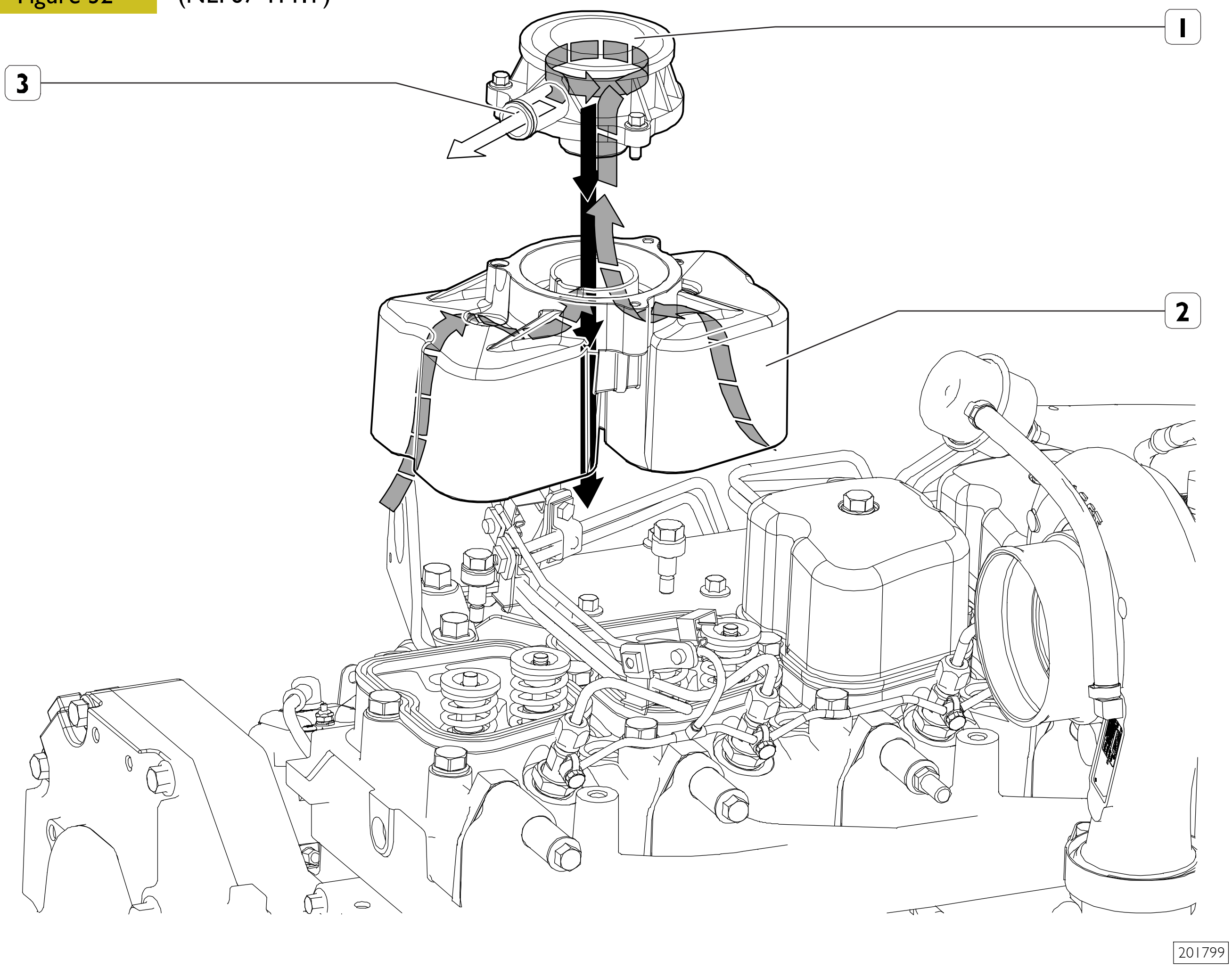
The dropping oil is then recovered in the sump.

OIL VAPOUR RECYCLING SYSTEM

Principles

The oil vapour recycling system, blow-by, makes it possible to recover part of the oil that evaporates at the cylinder head due to the high temperatures inside the engine, and convey it back to the sump.

Figure 32 (NEF67 TM1F)



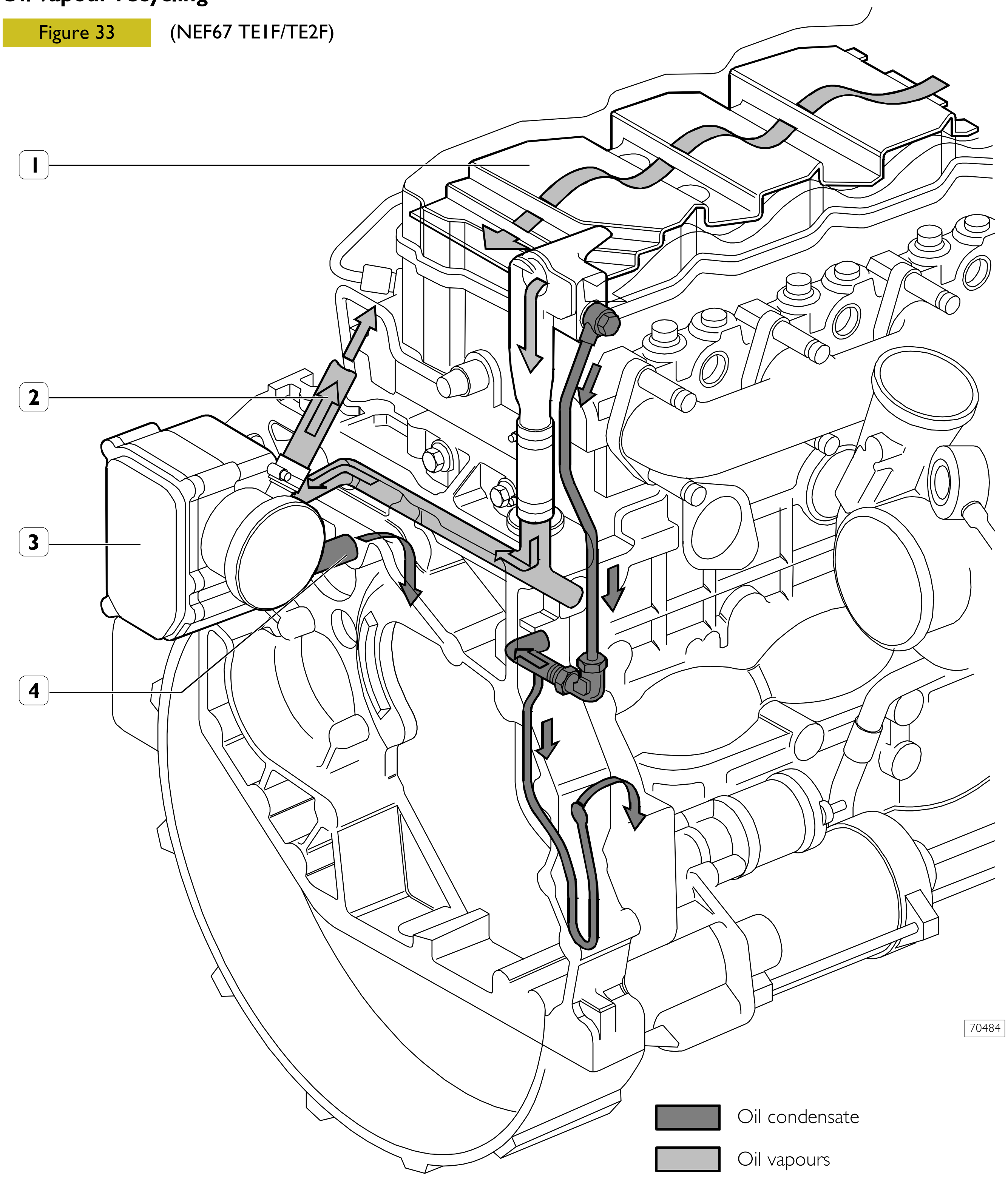
1. Blow-by filter - 2. Tappet cover - 3. Oil vapour breather

The system requires the presence of a valve that allows the oil to condense and fall by gravity into the underlying tappet cover.

By means of the appropriate breather, any vapours which have not condensed can be conveyed into ducts where lubrication is required such as the intake or exhaust manifolds.

Oil vapour recycling

Figure 33 (NEF67 TE1F/TE2F)



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

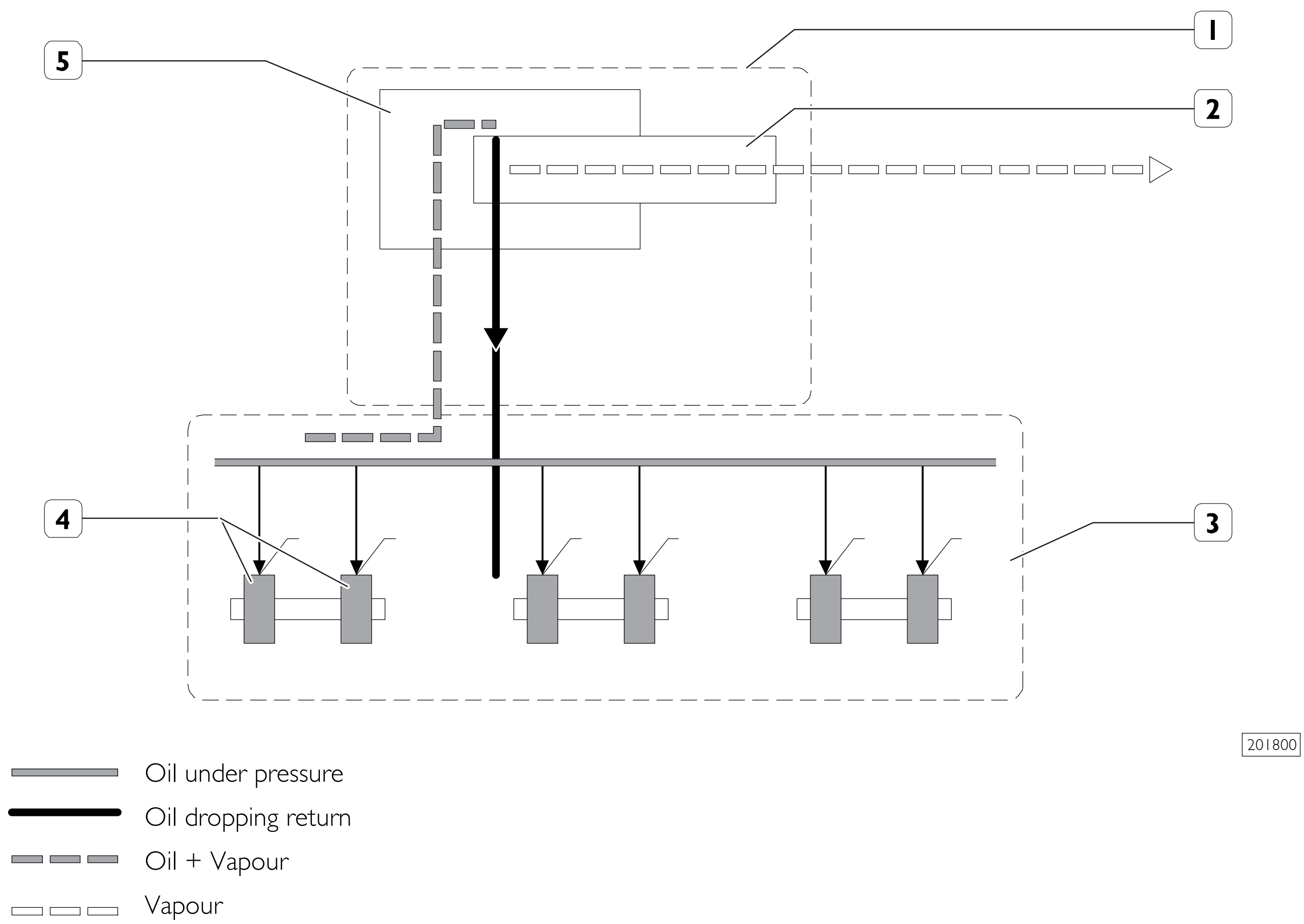
The tappet cover houses the pre-separator (1), whose shape and position determines an increase in oil vapour outlet speed and condenses a part of the vapours at the same time.

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).

OIL VAPOUR RECYCLING DIAGRAM

Figure 34 (NEF67 TM1F)



1. "Blow-by" control volume - 2. Breather duct - 3. "Tappet cover" control volume - 4. Rocker arm mounts - 5. Blow-by valve

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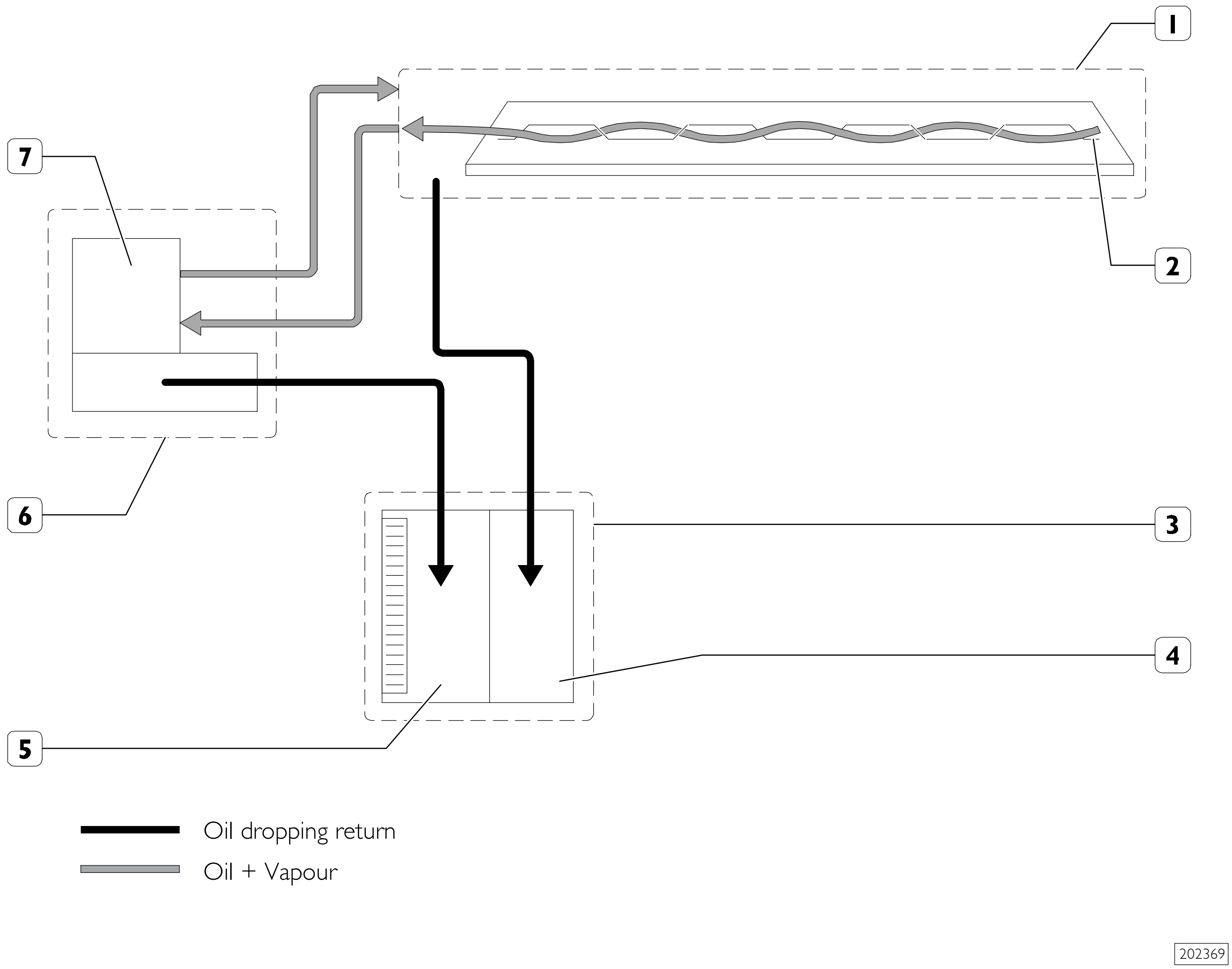
Figure 35 (NEF67 TE1F/TE2F)

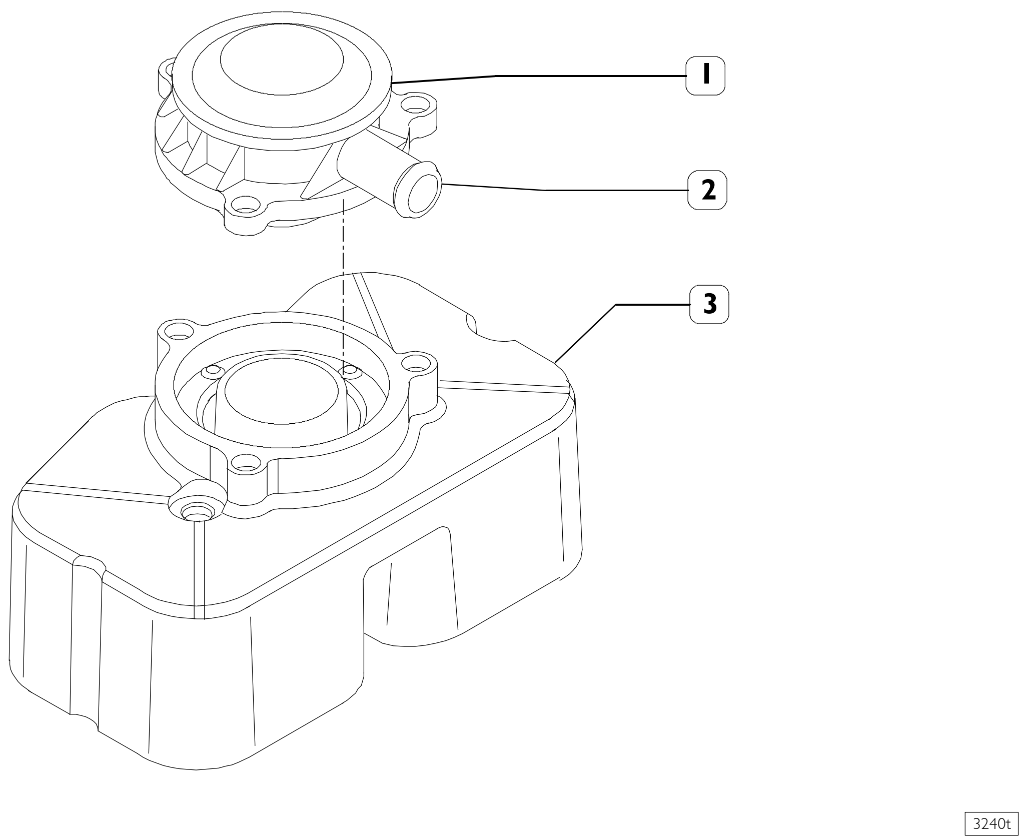


1.Cylinder head control volume - 2. Pre-separator - 3. Flywheel and gear housing volume control - 4. Distribution gear housing - 5. Flywheel - 6. Oil vapour filter control volume - 7. Oil vapour filter

OIL VAPOUR RECYCLING SYSTEM COMPONENTS (BLOW-BY)

Blow-by filter

Figure 36 (NEF67 TM1F)



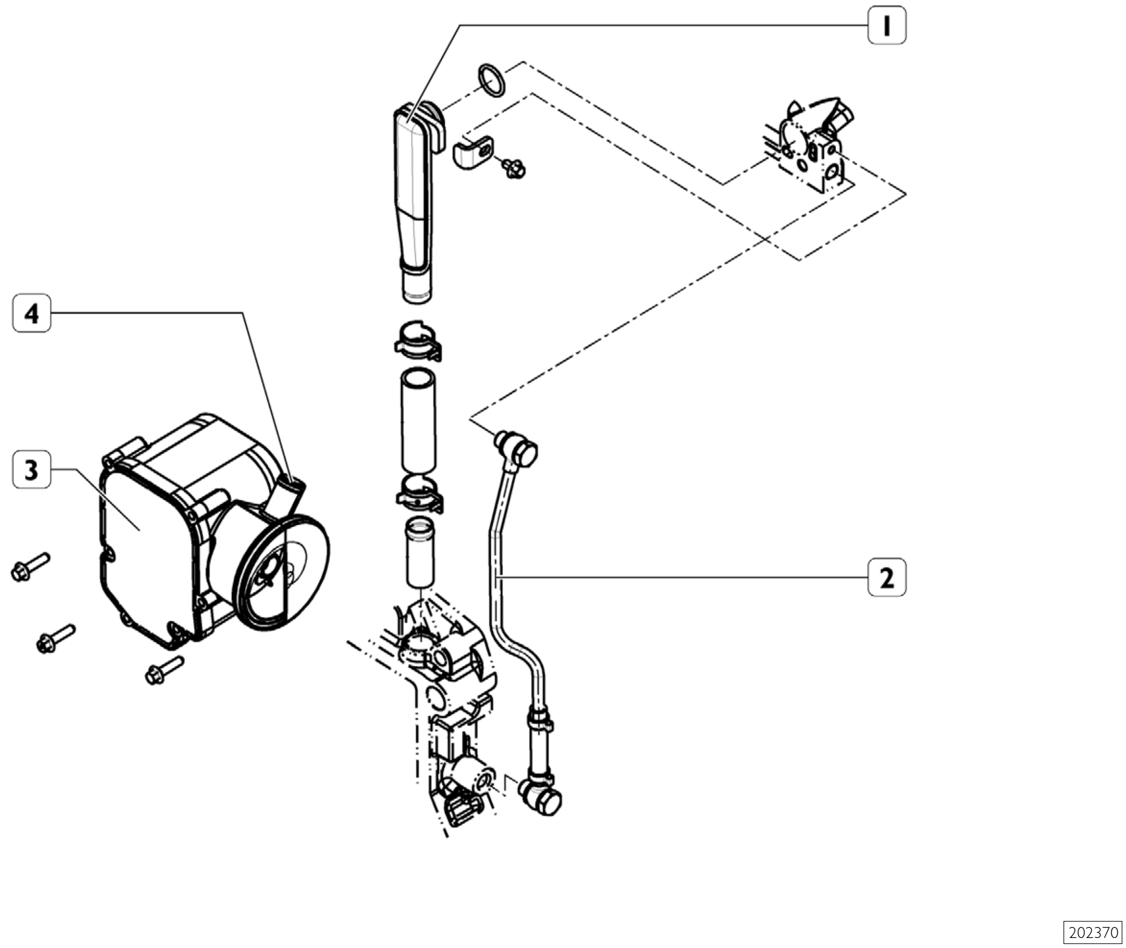
1. Valve - 2. Breather - 3. Tappet cover.

On the tappet cover (3) there is a valve (1) with the task of condensing the oil vapours by making them fall by gravity into the underlying tappet cover (3).

The remaining non-condensed vapours are conveyed properly through the breather (2), for example, in suction (the connection of these vapours must be provided by the vehicle manufacturer).

Blow-by filter

Figure 37 (NEF67 TE1F/TE2F)



1. Engine vapour breather pipe - 2. Condensate oil return pipe to the engine - 3. Oil vapour filter body - 4. Breather pipe

On the flywheel housing there is a valve (3) with the task of condensing the oil vapours from the crankcase through the pipe (1), causing them to fall by gravity, through the pipe (2). Vapours that do not condense are conveyed via the breather (4) in suction, for example. In any case, the set-up of this connection is the responsibility of the customer.

COOLING CIRCUIT

Principles

The engine cooling system, of the closed-loop forced-circulation type, is composed of the following components:

- expansion tank: the position, shape and dimensions can change depending on the engine outfitting.
- radiator, for dissipating the heat taken from the engine by the coolant. This component can also change depending on the outfitting both in terms of position and dimensions.
- viscostatic fan with the function of increasing the dissipating power of the radiator: this is also part of the specific outfitting for the engine.

a heat exchanger to cool the lubricant oil: this is also part of the specific outfitting for the engine.

centrifugal water pump set in the front part of the engine crankcase;

thermostat to control coolant circulation.

the circuit eventually extends to the compressor as well if present in the set-up.

Figure 38 (NEF67 TM1F)

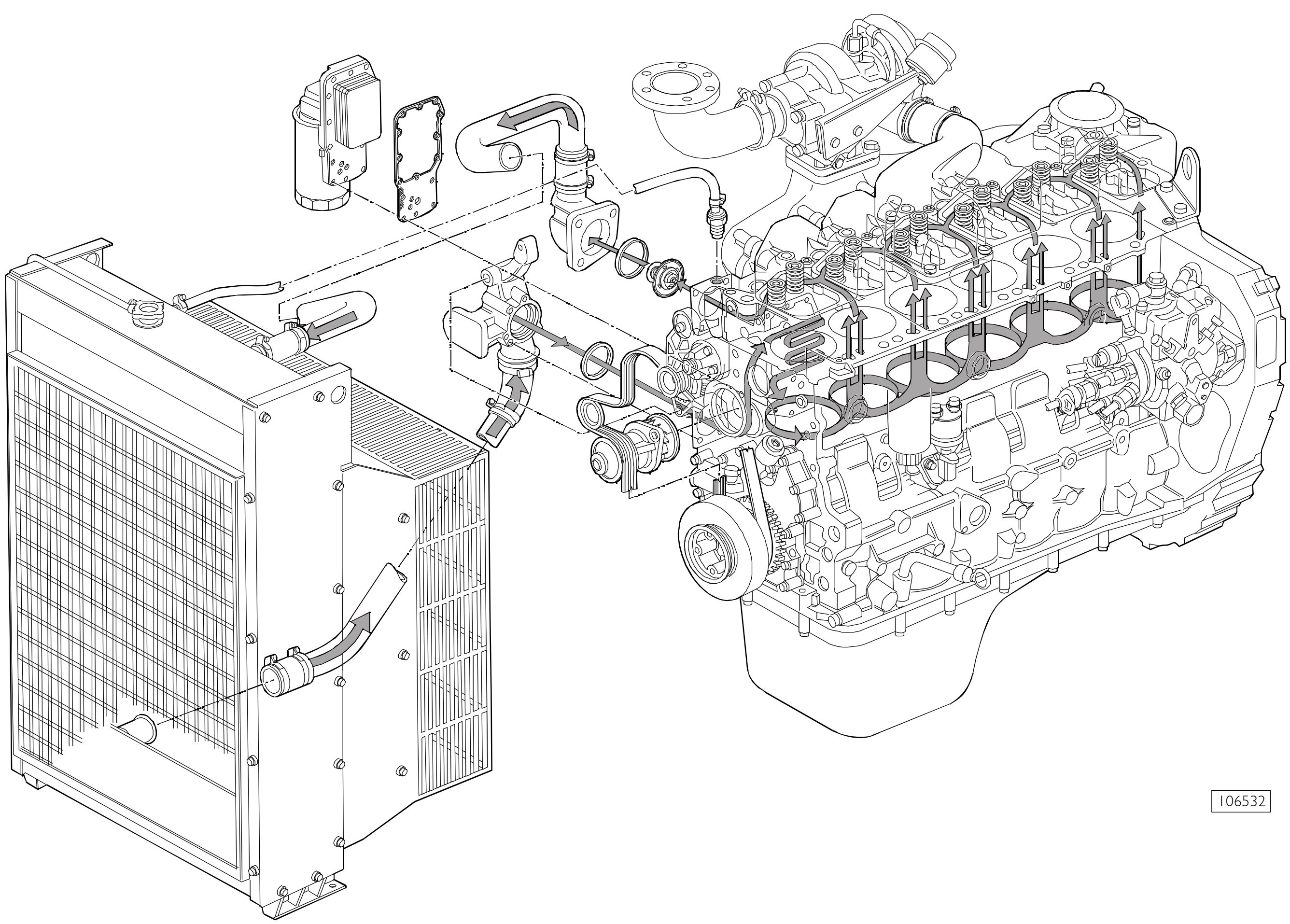
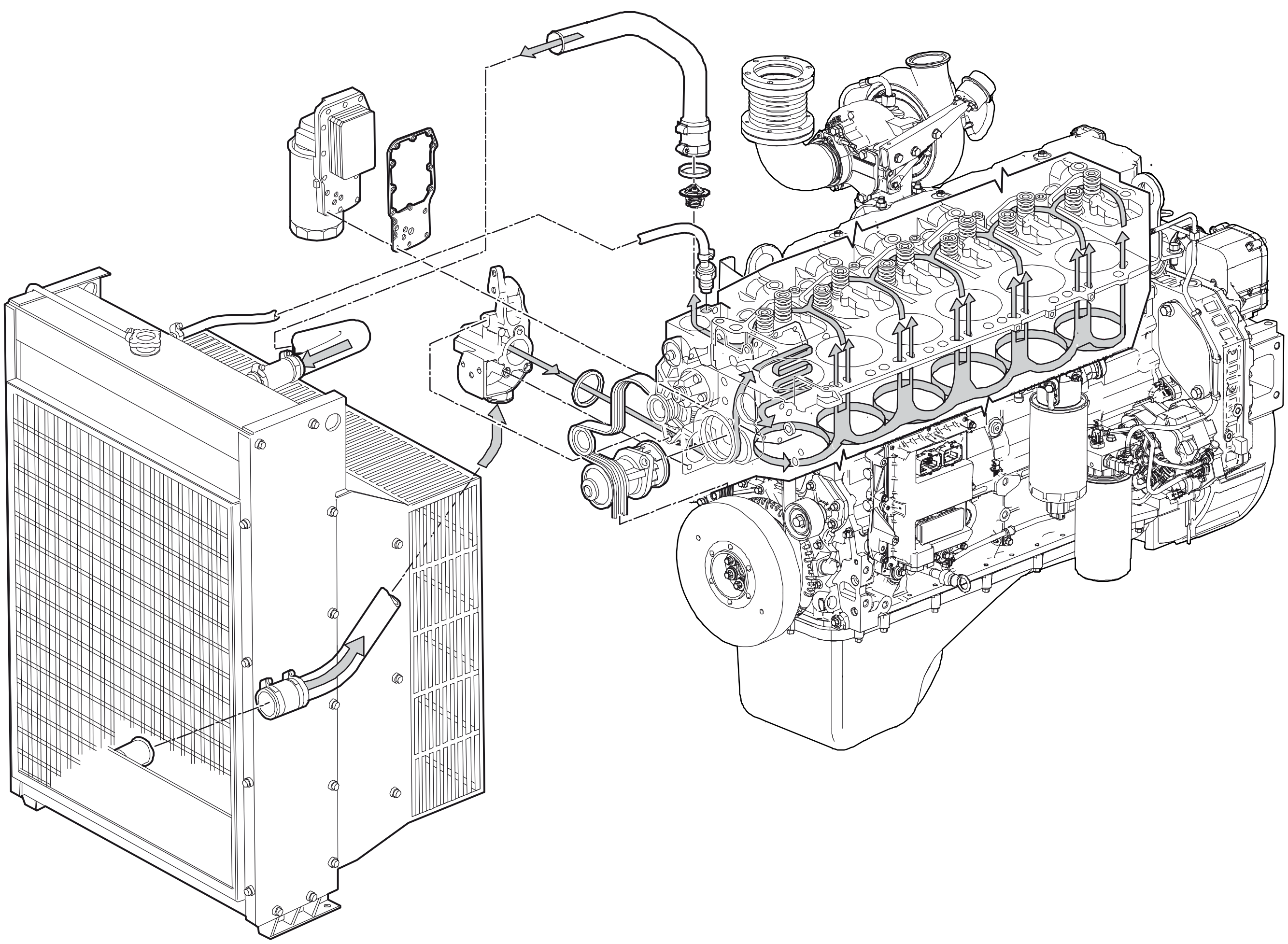


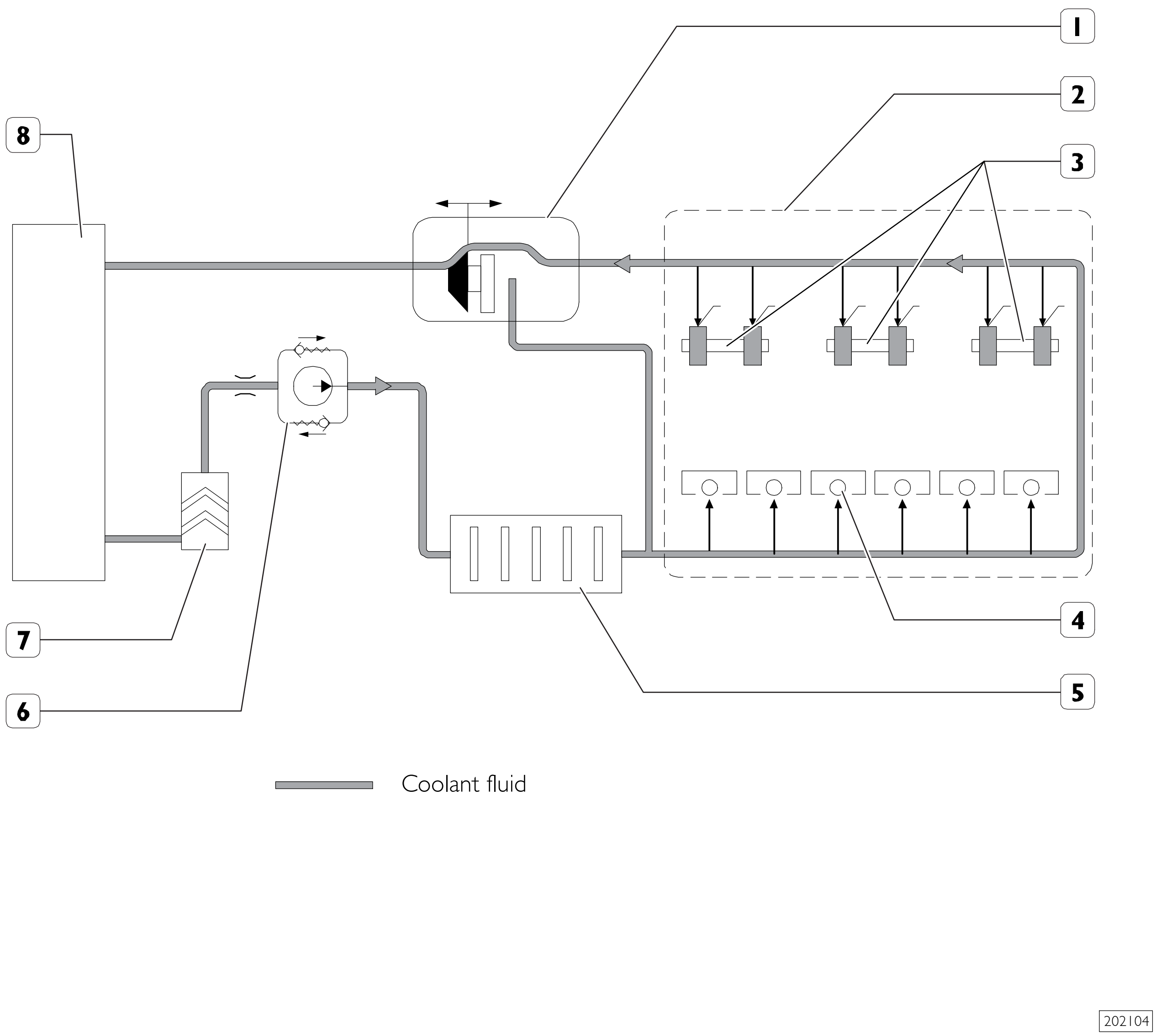
Figure 39 (NEF67 TE1F/TE2F)



The heat exchange between the lubricant oil and the coolant (water), designed to keep the temperature within the established and control values, takes place inside of the heat exchanger. The coolant is sucked by a pump from the expansion tank, the position of which varies depending on the set-up of the engine; the fluid moves into the radiator through the conveyor and then into the flow regulator. The pump then sends the coolant to the heat exchanger (inside of which it moves in the skirt). Upon leaving the heat exchanger, it is conveyed into the engine and then the thermostat, whose task is to regulate the circulation of the coolant. The coolant circuit ends with the return back into the radiator. The radiator dissipates the heat taken from the engine by the coolant. The dissipating power of the radiator is increased by the viscous fan which is present depending on the engine outfitting.

COOLING DIAGRAM

Figure 40

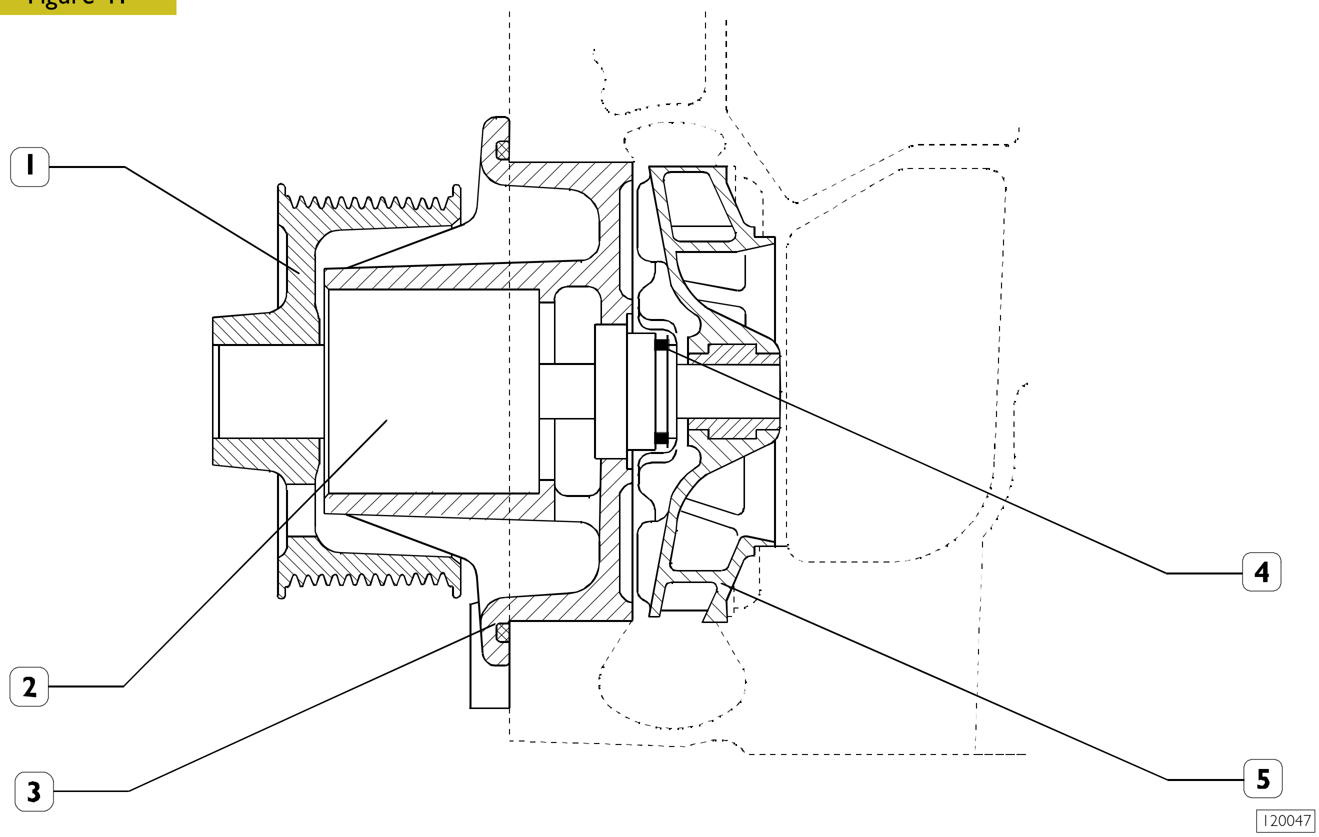


1. Thermostat - 2. "Engine" control volume - 3. Rocker arms unit - 4 .Pistons - 5. Heat exchanger - 6. Water pump - 7. Flow conveyor - 8. Radiator

COOLING CIRCUIT COMPONENTS

Water pump

Figure 41

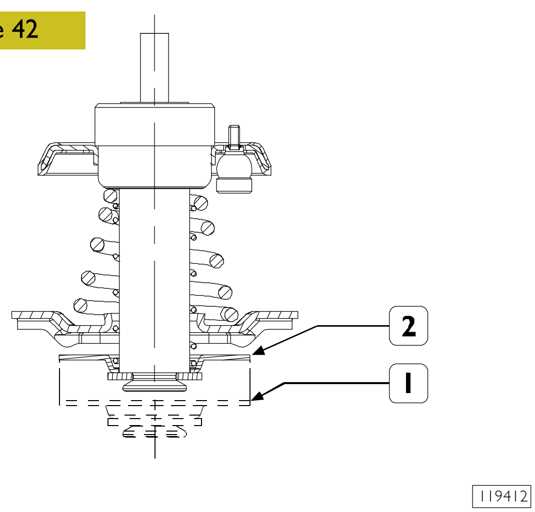


WATER PUMP SECTION
1. Hub - 2. Shaft with bearing - 3. Pump body - 4. Gasket - 5. Impeller

The water pump is of the vane centrifugal type. The pump bearing (2) forms a single piece with the spindle of the impeller. The water seal between the pump body (3) and the spindle (2) is obtained by the gasket (4).

Thermostat

Figure 42



THERMOSTAT DIAGRAM

operation

When the engine is cold the water comes out from the front of the cylinder head entering a union where the thermostat is located, which excludes the movement of the water in the radiator. This way water circulation will take place only between the pump and the engine, allowing its rapid heating.

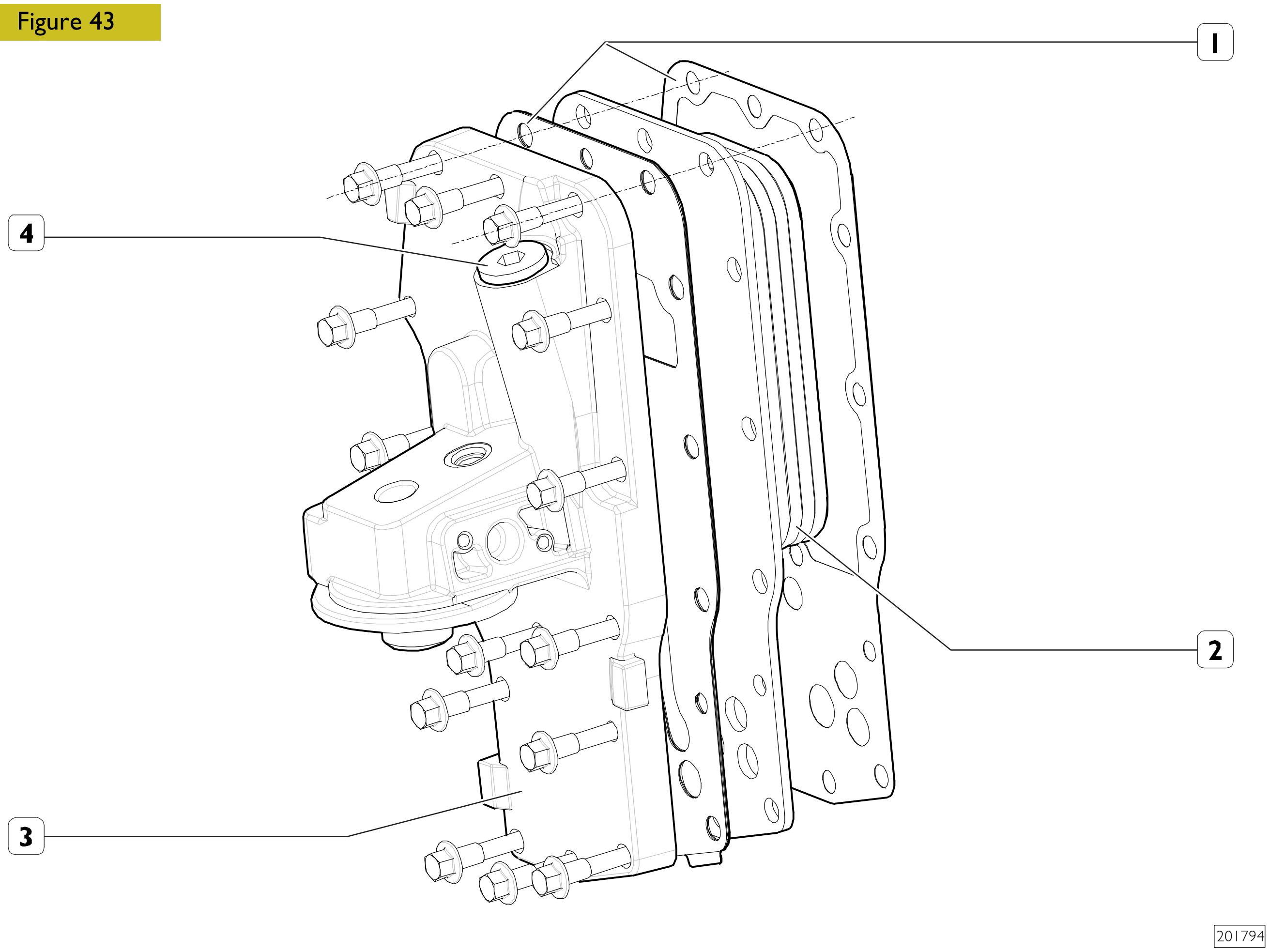
The thermostat valve starts to open at about 80° C, allowing water circulation through the radiator and simultaneously blocking the direct return to the engine.

Check that the thermostat works properly, replace it if there is any doubt.

1. Start stroke at approximately 79° ± 2 °C
2. Stroke of 7.5 mm at 96 °C

Heat exchanger

Figure 43



1. Gaskets - 2. Internal heat exchanger element (7 elements) - 3. Heat exchanger body - 4. Pressure regulator valve

The heat exchanger, installed in the engine cooling system, has the task of regulating the oil temperature by subtracting heat through the use of coolant.

Performance according to GT 0179	
Pressure range	0... 2.5 MPa
Frequency	0.5 ÷ 3 Hz
Trend	Sinusoidal
No. of cycles	>500000
Explosion pressure	> 10 MPa

Piping	
Engine	5W30
Internal oil temperature	115.6 °C
Capacity	51 dm^3/min

Skirt	
Refrigerant	glycol
Internal coolant temperature	82.2 °C
External flow rate	230 dm^3/min

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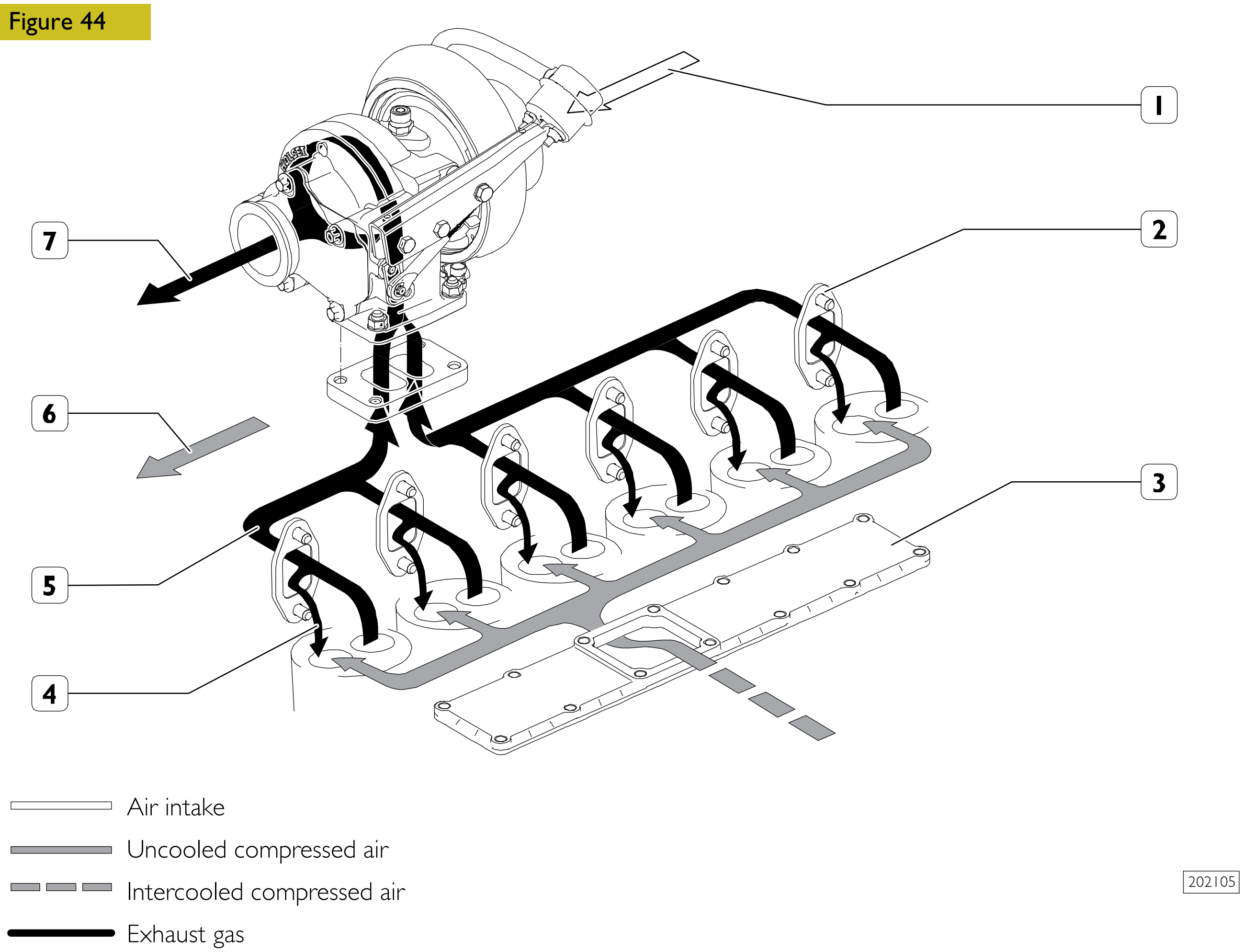
INTAKE AND EXHAUST SYSTEM

Principles

The intake and exhaust system consists of the following components:

- Intake and exhaust manifolds;
- Turbocharger with WG valve;
- EGR system.

Figure 44



1. Air inlet to compressor - 2. Exhaust manifold - 3. Intake manifold - 4. Reflow of exhaust gas in EGR - 5. Exhaust gas inlet in turbine - 6. Air outlet from compressor - 7. Exhaust gas outlet in turbine

This system allows you to manage the flow of combustion air through the components listed above.

The combustion air is sucked by the compressor of the turbocharger, within which its pressure is increased, to then be fed through the intake manifold in the cylinder liners. The exhaust gas flows out of the cylinder liners towards the exhaust manifold.

Finally the exhaust gas flow is conveyed towards the turbine.

For Stage IIIA version engines, the EGR system does not require the presence of electronically controlled elements but only the modification of the exhaust cam profile.

During the intake phase the exhaust valve is partially opened with the subsequent reintroduction of some of the exhaust gas into the engine cylinders.

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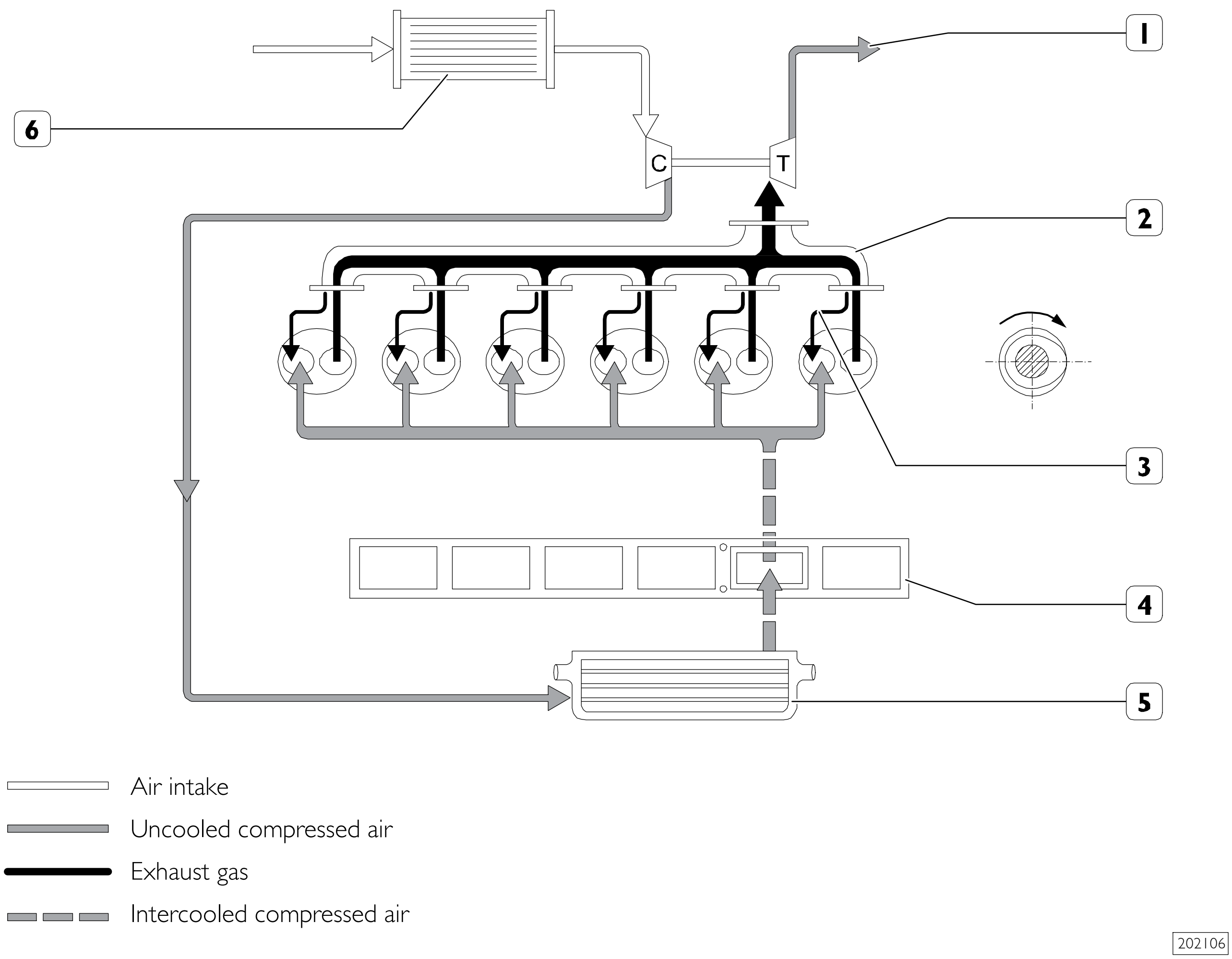
INTAKE AND EXHAUST DIAGRAM

Figure 45



1. Exhaust - 2. Exhaust manifold - 3. EGR - 4. Intake manifold - 5. Intercooler - 6. Air filter

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INTAKE AND EXHAUST SYSTEM COMPONENTS

Intake manifolds

The intake manifold receives cooled compressed air from the intercooler and conveys it to the cylinder chambers.

Figure 46 (NEF67 TM1F)

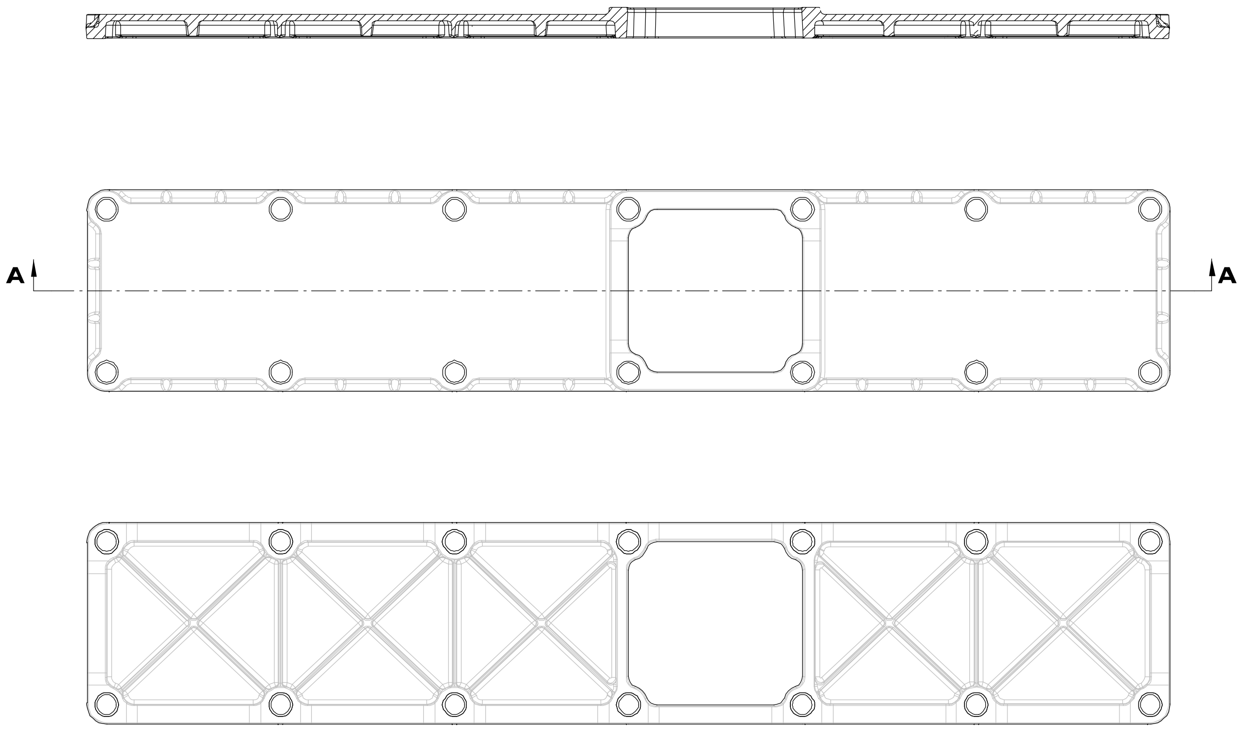

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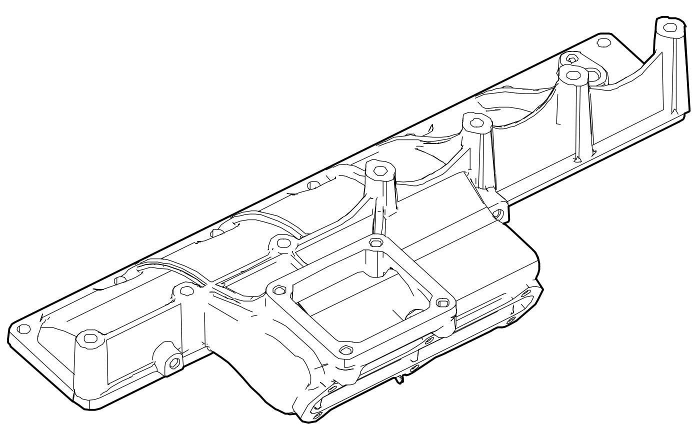
Figure 47 (NEF67 TE1F/TE2F)



214274

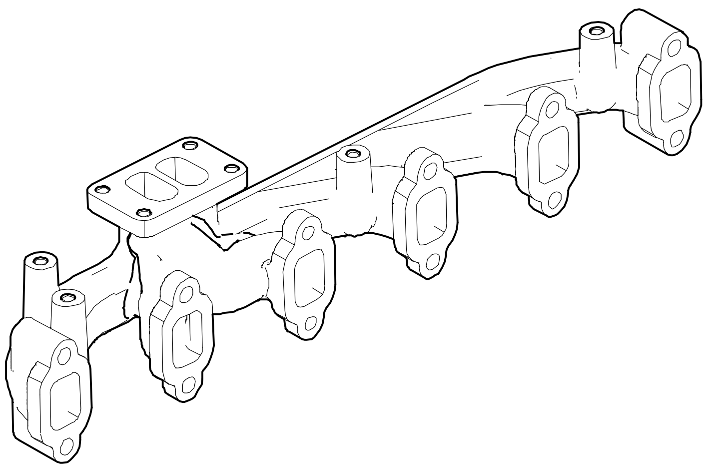
Intake manifolds

Exhaust manifolds

The exhaust manifold however conveys the combusted gas from the cylinder chambers to the turbine.

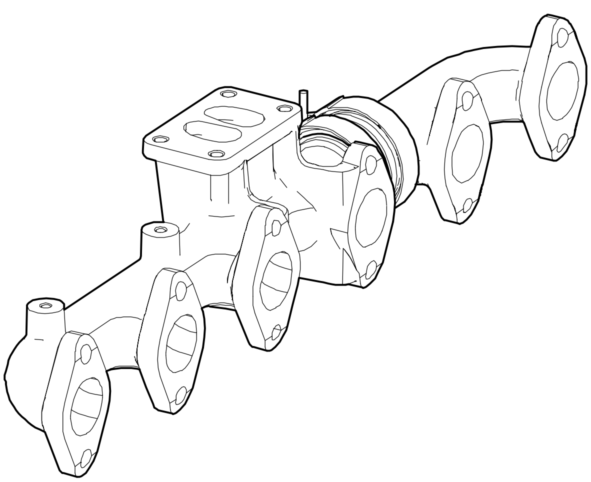
Its internal structure allows the six flows from the chambers to come together in two distinct flows conveyed to the turbine impeller.

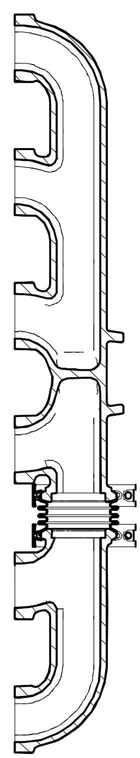
Figure 48 (NEF67 TM1F)



214275

Figure 49 (NEF67 TE1F/TE2F)





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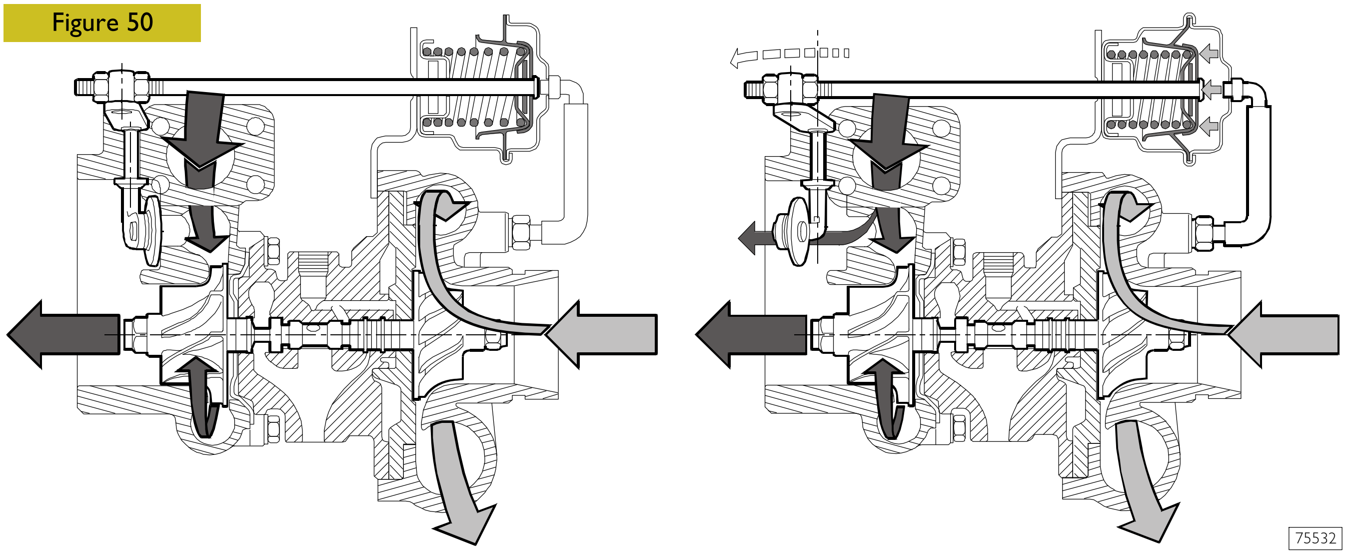
Exhaust manifolds

HOLSET HX35W turbocharger

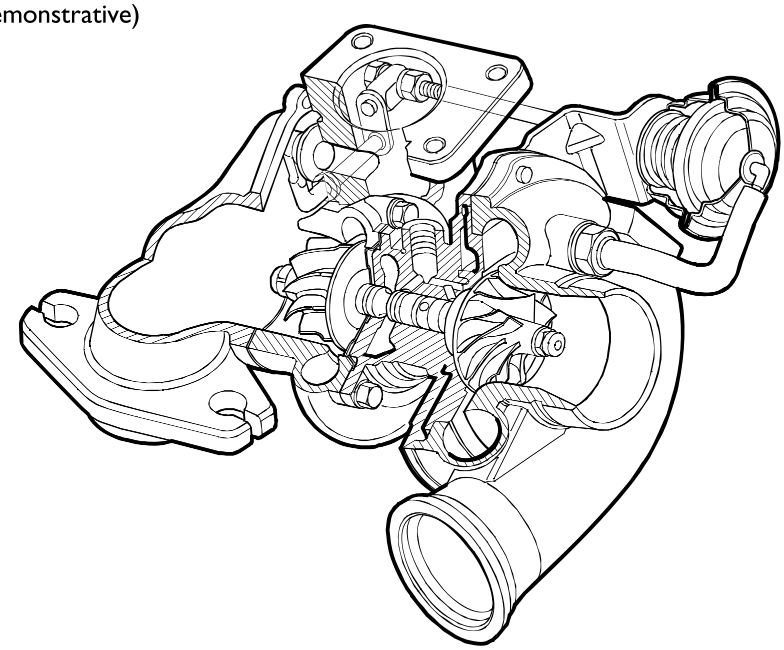
Figure 50



75532

A. WG VALVE CLOSED A. WG VALVE OPEN

Figure 51 (Demonstrative)



75533

Description

The turbocharger consists of the following main parts, a turbine, a valve for regulating the boost pressure, a central body and a compressor.

During operation of the engine exhaust gases pass through the body of the turbine by rotating the impeller of the turbine itself.

Since the compressor impeller is connected to the turbine impeller by means of a spindle, it turns with the turbine impeller compressing the air taken in through the air filter.

This is cooled by the radiator and sent through the intake manifold to the pistons.

The turbocharger is equipped with a pressure regulating valve placed on the exhaust manifold before the turbine and connected via pipes to the intake manifold.

Its purpose is to choke the exit of the exhaust gas sending a part directly into the exhaust pipe when the boost pressure downstream of the compressor reaches the specified value in bar.

Cooling and lubrication of the turbocharger and the bearing brass is performed by means of the engine oil.

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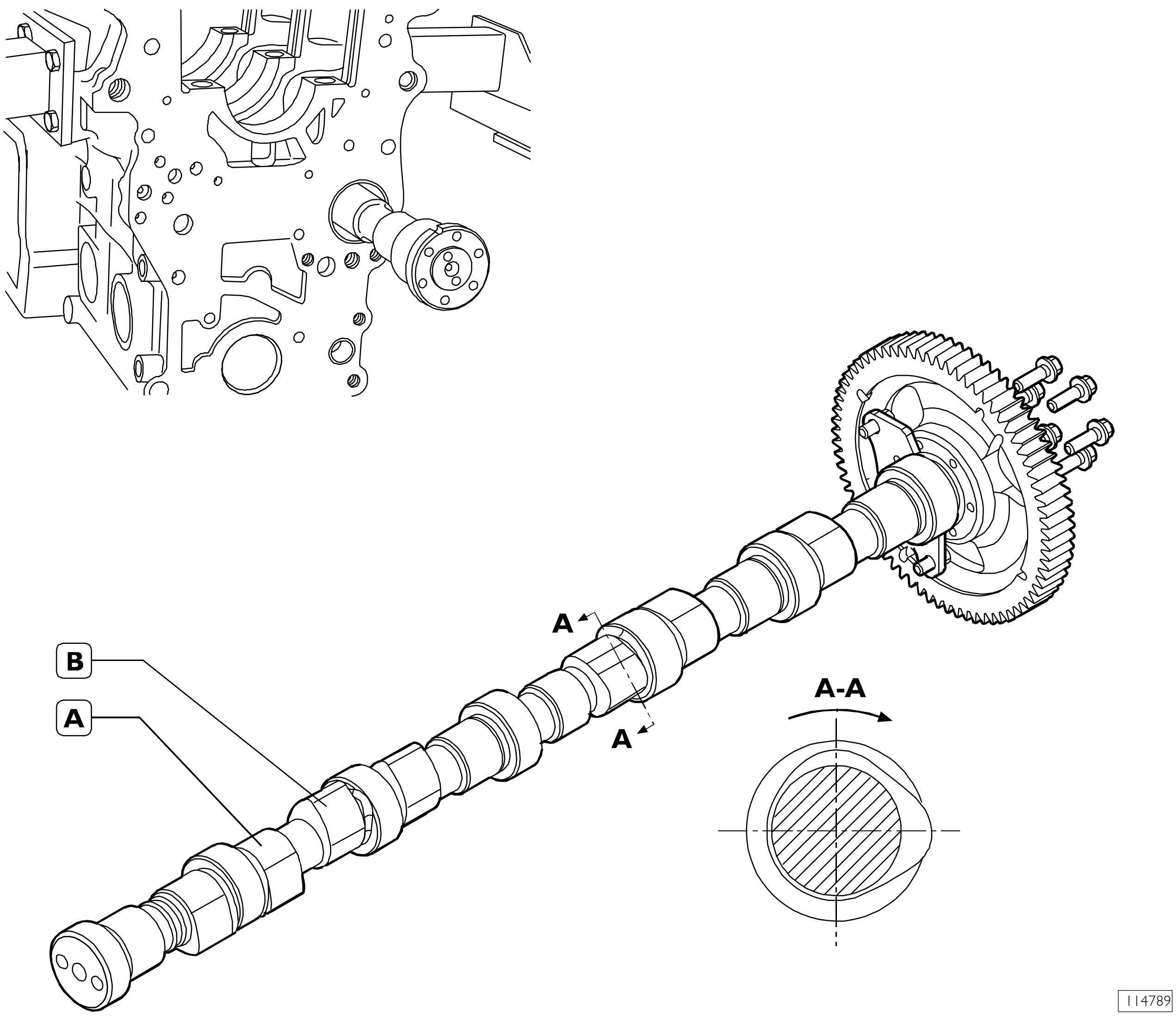
EGR SYSTEM (ONLY FOR NEF67 TM1F)

In the STAGE IIIA version, the profile of the exhaust cam has been modified to allow the partial opening of the corresponding valve during the suction phase (EGR exhaust gas recirculation) with the consequent re-entry of a part of the exhaust gas into the engine cylinders.
The exhaust gases can be brought partially into the cylinders to reduce the maximum combustion temperature values responsible for the production of nitrogen oxides (NO_X).
The exhaust gas recirculation (EGR) system, by reducing the combustion temperature through the decrease in the concentration of oxygen in the combustion chamber, thus represents an effective system for controlling the emission of NO_X.

The internal EGR system does not come with any electronically controlled elements: the system is always active.
Its configuration does not need additional elements such as control valves, pipes or heat exchangers.

The exhaust cam (B) presents an addition lobe to the main lobe (see Sec. A-A of the figure) compared to the configuration without EGR.
The additional lobe, during the suction phase of the cylinder in question, allows a quick opening of the exhaust valve by generating a recirculation due to the recall of the exhaust gas caused by the vacuum that is created inside the cylinder in the suction phase.

Figure 52



A. Intake valve control - B. Exhaust valve control.

SECTION 3

Electric / electronic equipment

	Page
GENERAL INFORMATION ON THE LOCATION OF ELECTRICAL COMPONENTS ON THE ENGINE	3
❑ Starter motor	4
❑ Water temperature sensor for KSB	4
❑ Oil pressure sensor	4
❑ Pre-post heating (if present)	4
❑ Alternator	5
❑ EDC7 UC31 electronic control unit	7
❑ Injector connector (A)	9
❑ Sensor connector (B)	9
❑ KSB connection cable - Stanadyne pump	10
❑ Crankshaft sensor	11
❑ Timing sensor	11
❑ Turbocharged air pressure/temperature sensor;	12
❑ Engine oil temperature/pressure sensor;	12
❑ Fuel pressure sensor	13
❑ Electro-injectors	14
❑ Resistor and contactor for pre-post heating	15
❑ Coolant temperature sensor	16
❑ Fuel temperature sensor	17
❑ High pressure pump - pressure regulator	18

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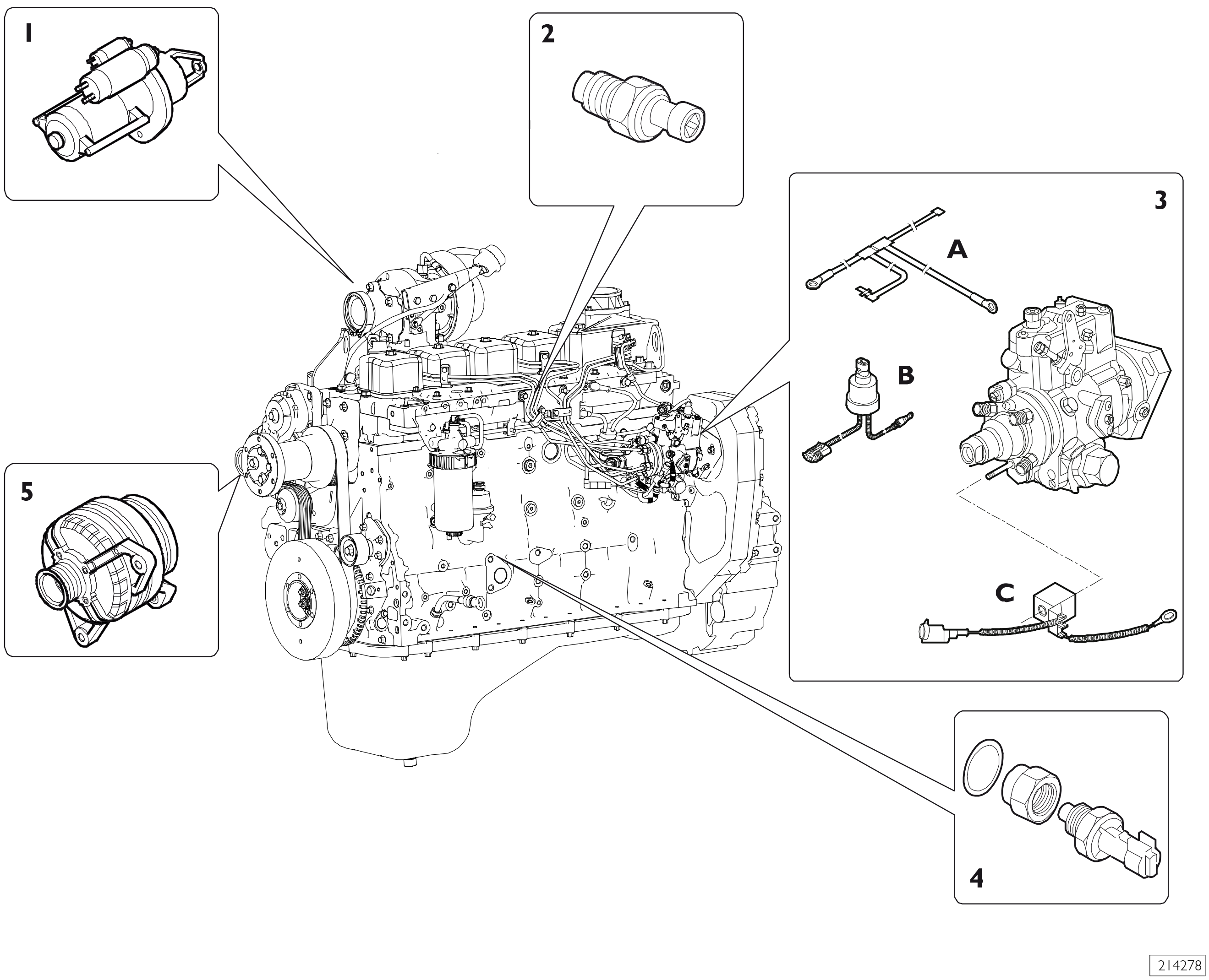
GENERAL INFORMATION ON THE LOCATION OF ELECTRICAL COMPONENTS ON THE ENGINE

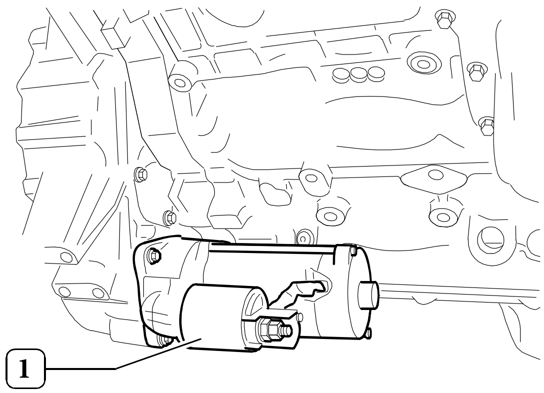
Figure 1 (NEF67 TM1F)



1. Starter;
2. Water temperature sensor for KSB;
3. (A) KSB connection cable - Stanadyne pump
   (B) Timer (where provided);
   (C) CSA.
4. Oil pressure sensor;
5. Alternator.

Starter motor

Figure 2



75717

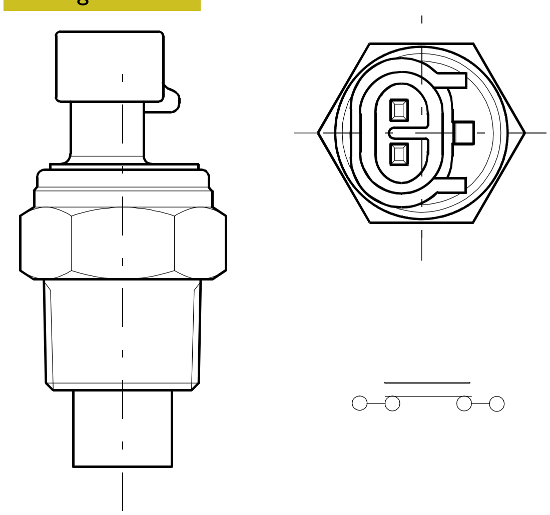
Starting is usually controlled via the ignition switch placed in the dashboard of the vehicle and provides a positive voltage to the motor contactor placed on the starter motor (1).

Characteristics:

BOSCH 12V, 3 kW

Water temperature sensor for KSB

Figure 3



75719

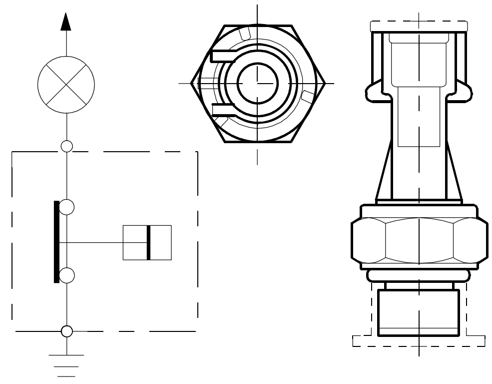
It is mounted on the engine head on the left side of the engine.

Characteristics:

Operating voltage:	12 ÷ 24 V
Electric load:	2.5 A (inductive) 5.0 A (resistive)
Calibration:	30 ± 3 °C Opening of contacts with temperature rising 20 ± 3 °C Closing of contacts with temperature lowering

Oil pressure sensor

Figure 4



75722

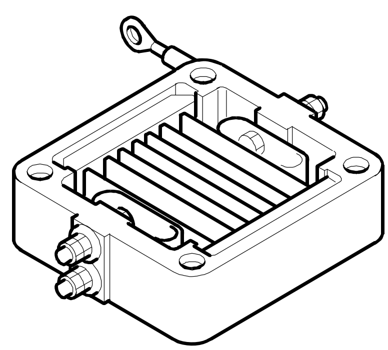
It is mounted on the crankcase on the left side of the engine.

Characteristics:

Operating voltage:	12 ÷ 24 V
Contact closure with pressure decreasing:	0.6 bar
Contact opening with pressure rising:	0.9 bar

Pre-post heating (if present)

Figure 5



75723

It is a resistor positioned on the intake manifold and is utilised to heat the air in the operations of pre / post heating.

Is powered by a contactor usually positioned in the immediate vicinity of the engine.

Characteristics:

Working voltage:	12 V
Maximum air flow possible:	2 cc / min (at the pressure of 138 kPa)

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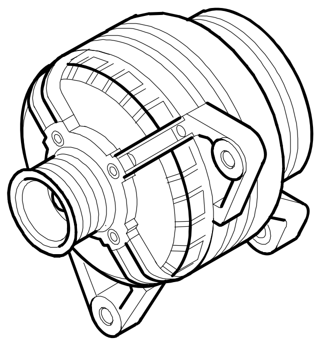
Alternator

Figure 7



It is located on the front right side of the engine and is controlled through a toothed belt.

Characteristics:

Working voltage:	14 V
Current strength:	90A (a 6000 rpm)
Absorption in stand-by:	≤1mA
Direction of rotation:	Clockwise

Figure 6

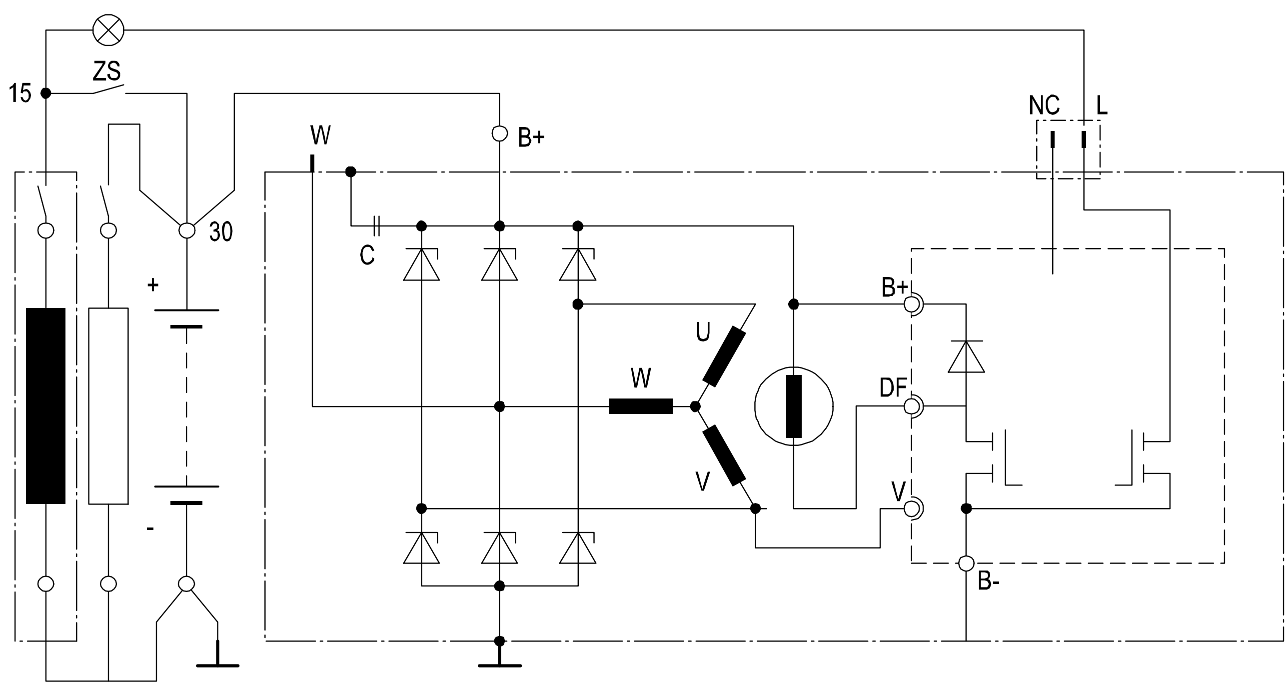
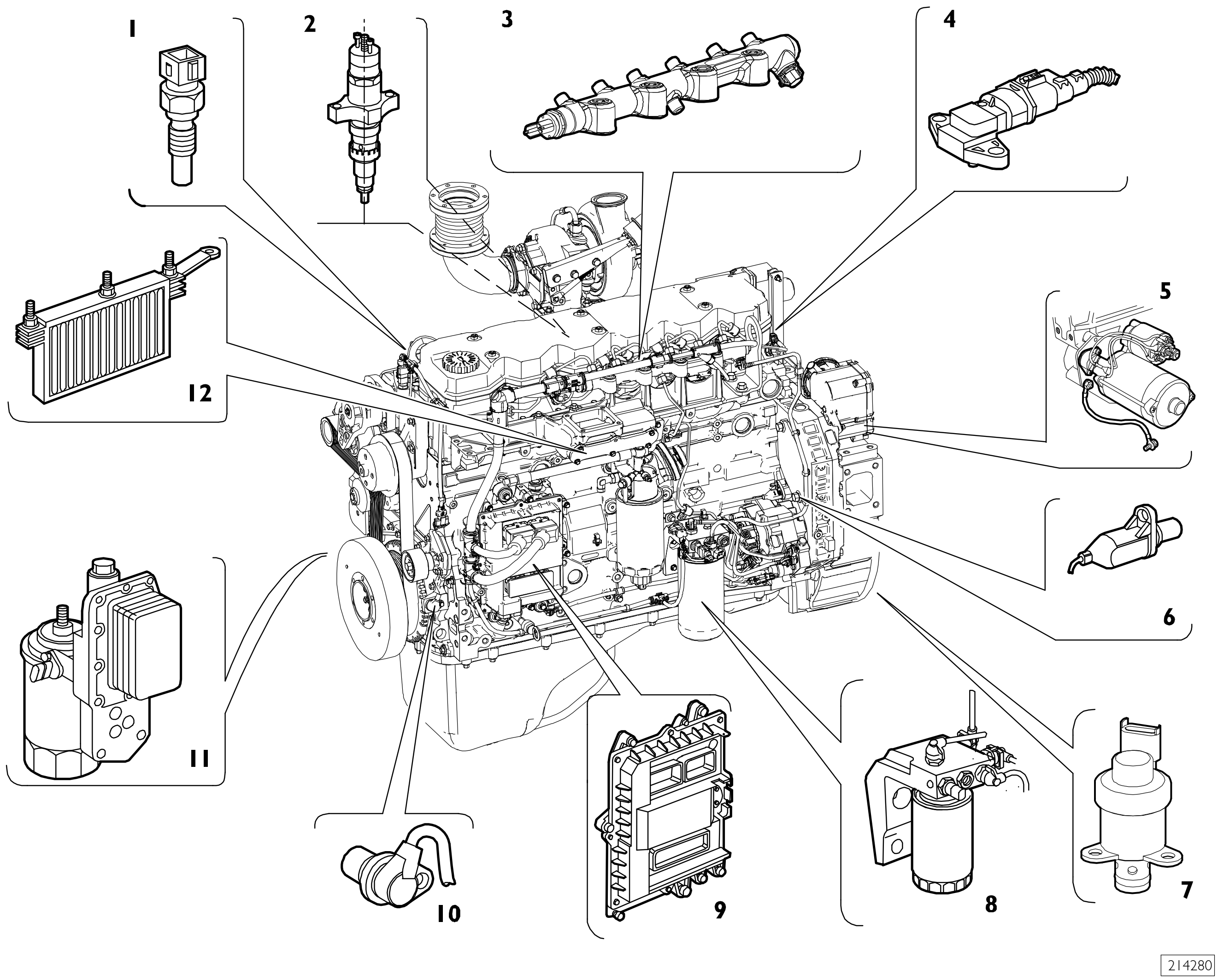


Figure 8 (NEF67 TE1F/TE2F)



The NEF F4HE engines are entirely managed by the electronic control unit. This is mounted directly on the engine by means of a heat exchanger that allows the cooling, using the elastic plugs which reduce the vibrations transmitted from the engine.

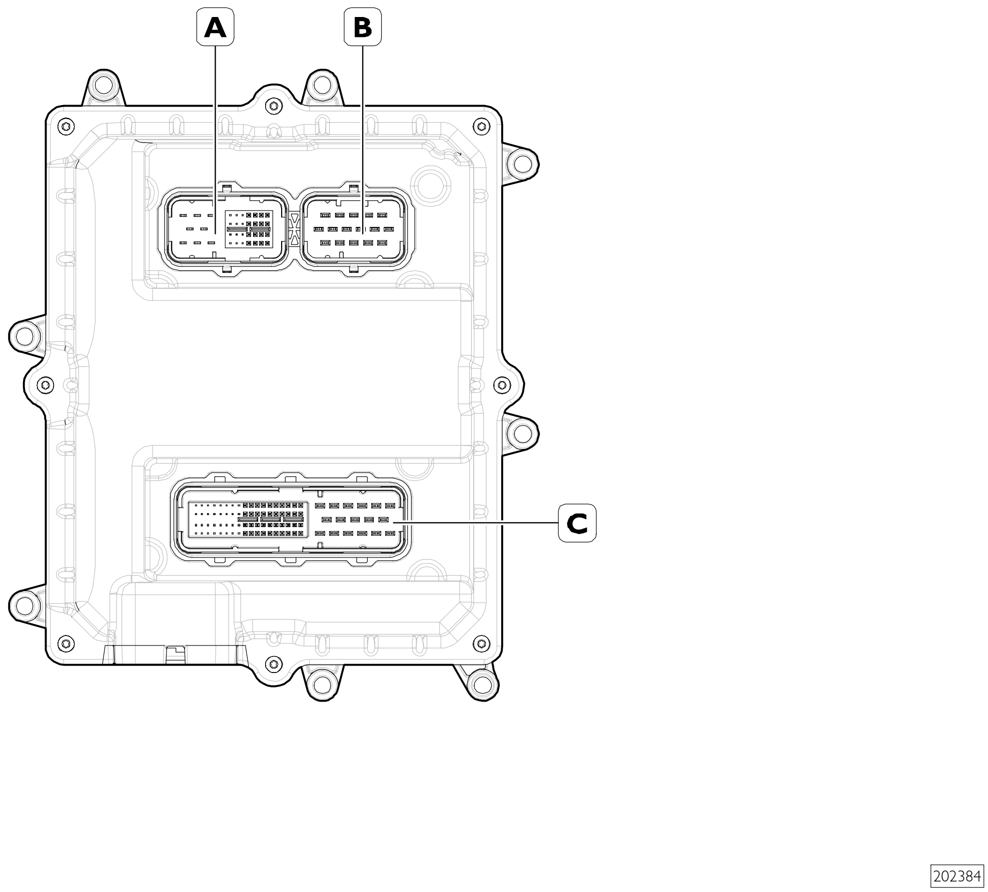
WIth the electronic control unit you can verify the correct operation of the engine. (see the third part of this manual, specifically dedicated to diagnostics).

Listed below are the electrical and electronic components on the engine:

1. Coolant temperature sensor.
2. Electro-injector.
3. RAIL Pressure sensor.
4. Air pressure/temperature sensor.
5. Starter motor
6. Timing sensor.
7. Pressure regulator solenoid valve.
8. Fuel temperature sensor.
9. EDC electronic control unit.
10. Crankshaft sensor.
11. Engine oil temperature/pressure sensor.
12. Resistor for pre-post heating.

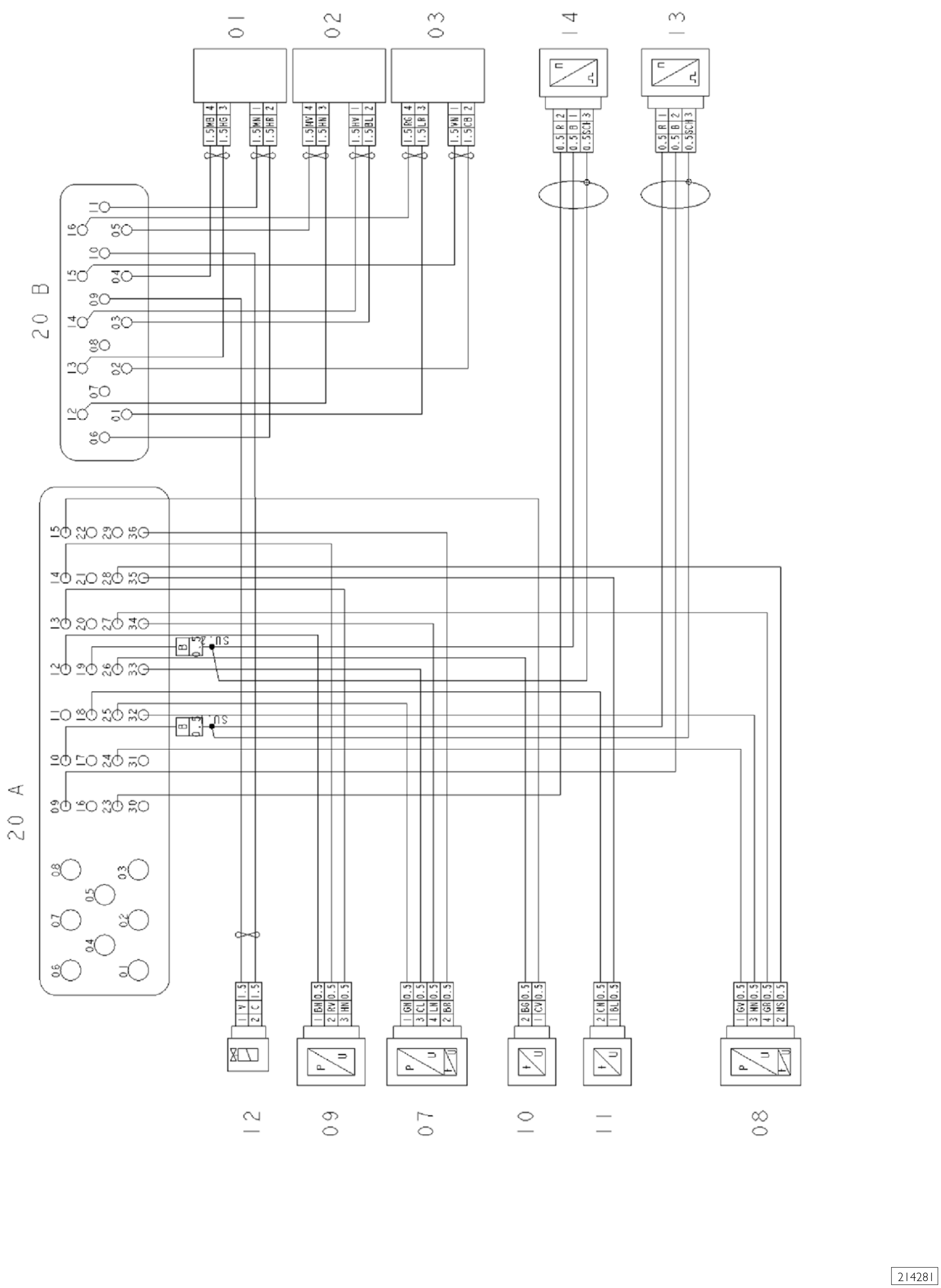
EDC7 UC31 electronic control unit

Figure 9



A. Sensor connector - B. Injector connector - C. Chassis side connector

Figure 10



Injector connector (A)

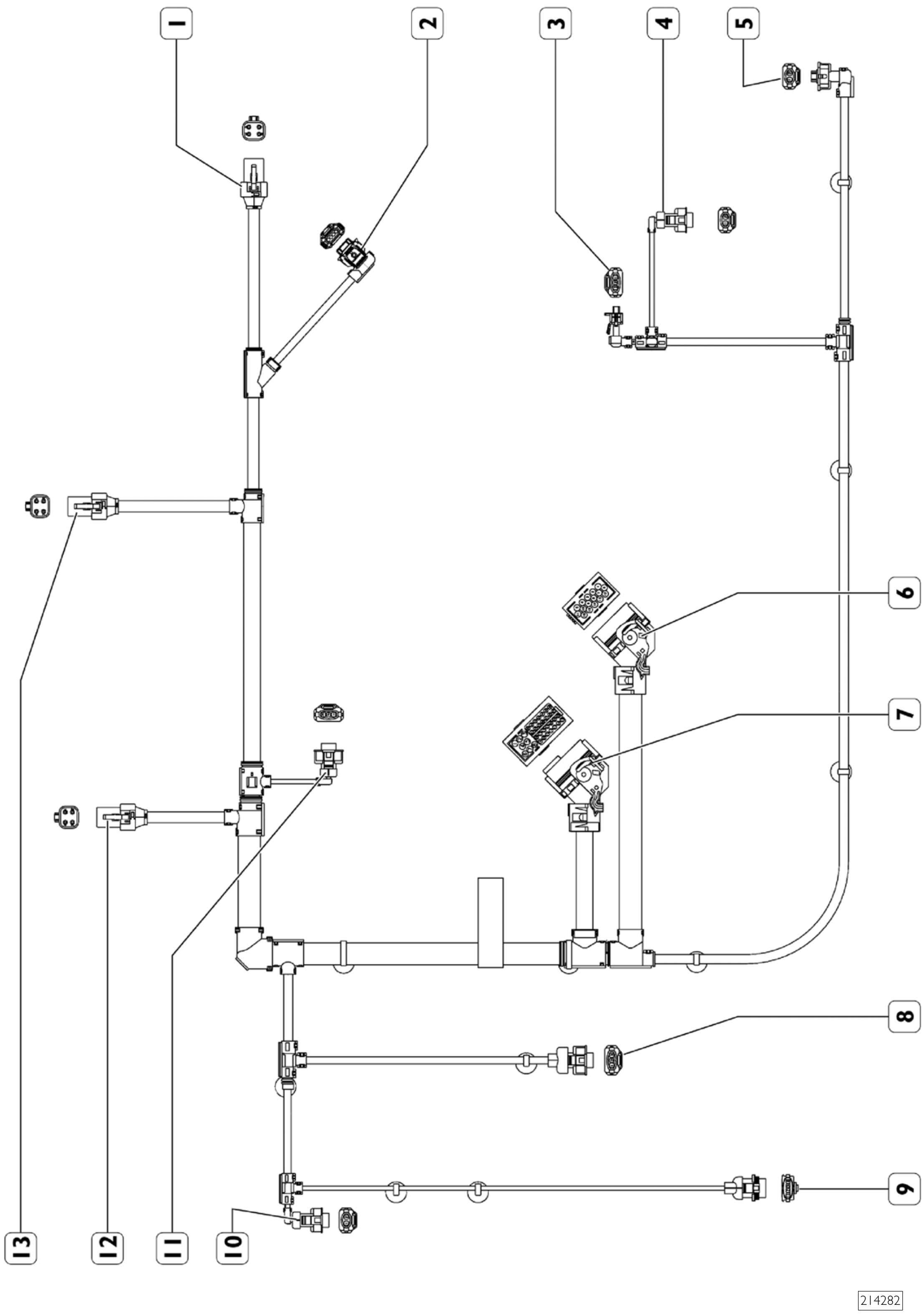
ECU PIN	FUNCTION
1	-
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	Timing sensor
10	Timing sensor
11	-
12	Negative for Rail pressure and temperature sensor
13	Positive for Rail pressure and temperature sensor
14	Signal from Rail pressure and temperature sensor
15	Coolant temperature sensor
16	-
17	-
18	Fuel temperature sensor signal
19	Engine speed sensor
20	-
21	-
22	-
23	Engine speed sensor
24	Negative for engine oil pressure and temperature sensor
25	Negative for air pressure and temperature sensor
26	Coolant temperature sensor
27	Signal from engine oil pressure sensor
28	Signal from engine oil temperature sensor
29	-
30	-
31	-
32	Positive for engine oil pressure and temperature sensor
33	Positive for air pressure and temperature sensor
34	Signal from air pressure sensor
35	Negative for fuel temperature sensor
36	Signal from air temperature sensor

Sensor connector (B)

ECU PIN	FUNCTION
1	Cylinder 5 injector
2	Cylinder 6 injector
3	Cylinder 4 injector
4	Cylinder 1 injector
5	Cylinder 3 injector
6	Cylinder 2 injector
7	-
8	-
9	Pressure regulator
10	Pressure regulator
11	Cylinder 2 injector
12	Cylinder 3 injector
13	Cylinder 1 injector
14	Cylinder 4 injector
15	Cylinder 6 injector
16	Cylinder 5 injector

KSB connection cable - Stanadyne pump

Figure 11

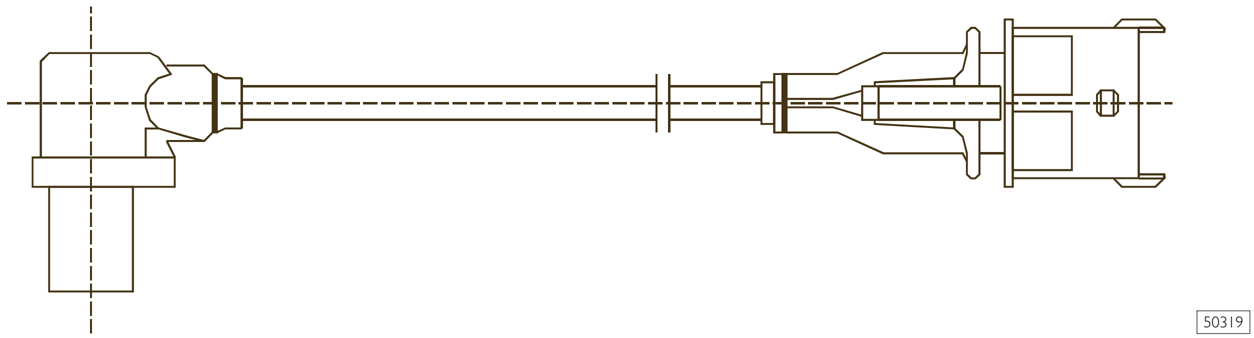


1. Electro-injectors cyl 3 - 4 - 2. Air temperature-pressure sensor - 3. Timing sensor - 4. Fuel temperature sensor - 5. Pump pressure regulation sensor - 6. Power control unit - 7. Signal control unit - 8. Crankshaft rpm sensor - 9. Oil press/temper sensor - 10. Water temperature sensor - 11. Rail pressure sensor - 12. Electro-injectors cyl 1 - 2

Crankshaft sensor

This inductive sensor is located on the left front of the engine. It generates signals obtained from changes in magnetic flux created by spaces between the teeth on the phonic wheel fitted to the crankshaft.
It is connected to the control unit at pins 19A - 23A. The sensor resistance value is ~900 Ω.

Figure 12

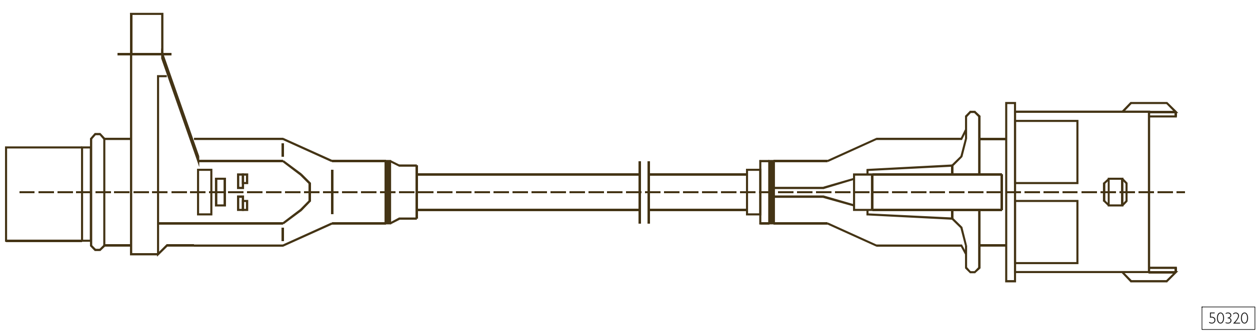


Crankshaft sensor

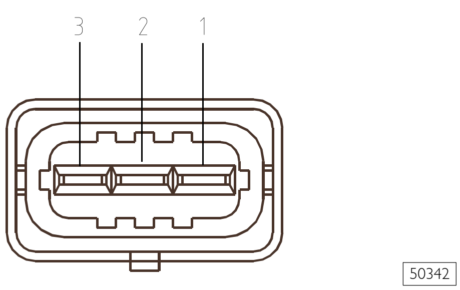
Timing sensor

This inductive type sensor is located on the rear left part of the engine. It generates the signals obtained from the magnetic flux lines that close through the holes keyed
on the gear of the camshaft. The signal generated by this sensor is used by the control unit as the injection timing signal.
Although similar to the flywheel sensor, they are NOT interchangeable since it has a different outer shape.
It is connected to the control unit at pins 9A - 10A. The sensor resistance value is ~900 Ω.

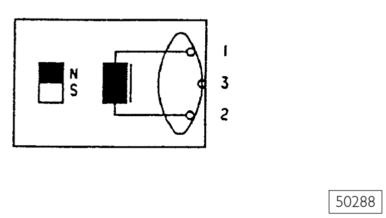
Figure 13



Timing sensor



Connector



Wiring Diagram

Ref.	Description	Control unit pin	
		Crankshaft sensor	Timing sensor
1	Signal	19A	10A
2	Signal	23A	9A
3	Shielding		

Turbocharged air pressure/temperature sensor;

This component incorporates a temperature sensor and a pressure sensor.
It is fitted to the intake manifold so that, by measuring the maximum quantity of air taken in, it makes it possible to determine the exact amount of fuel to be injected at each cycle.
It is connected to the control unit at pins 25A - 36A - 33A - 34A.
It is powered at 5 volt
The voltage present at output is proportional to the pressure or temperature detected by the sensor.

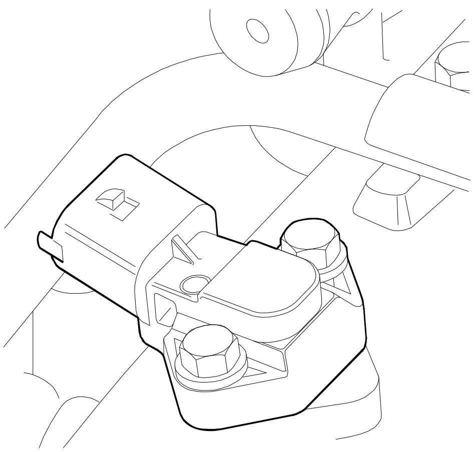
Pins 25A - 36A	Temperature
Pins 33A - 34A	Pressure

Engine oil temperature/pressure sensor;

This component is identical to the air temperature/pressure sensor.
It measures the temperature and pressure of the engine oil.
It measures the engine oil temperature and pressure.
It is connected to the control unit at pins 24A - 28A - 32A - 27A.
It runs on 5 Volts. The detected signal is sent to the EDC control unit which in turn controls the indicator tool in the dashboard (indicator + low pressure light).
The oil temperature is not shown by any of the instruments- it can only be used by the Control Unit.

Pins 24A - 28A	Temperature
Pins 32A - 27A	Pressure

Figure 14



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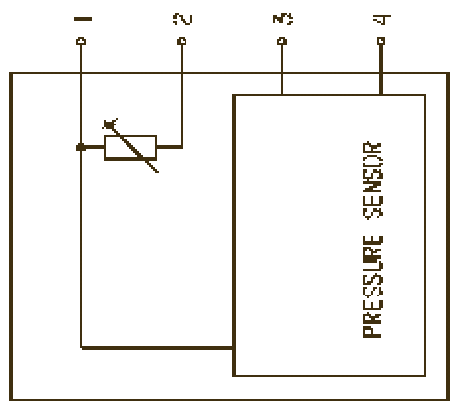

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Wiring Diagram

Ref.	Description	Control unit pin	
		Engine	Air
1	Ground	24A	25A
2	NTC signal (temperature)	28A	36A
3	Power supply +5 V	32A	33A
4	Signal (pressure)	27A	34A

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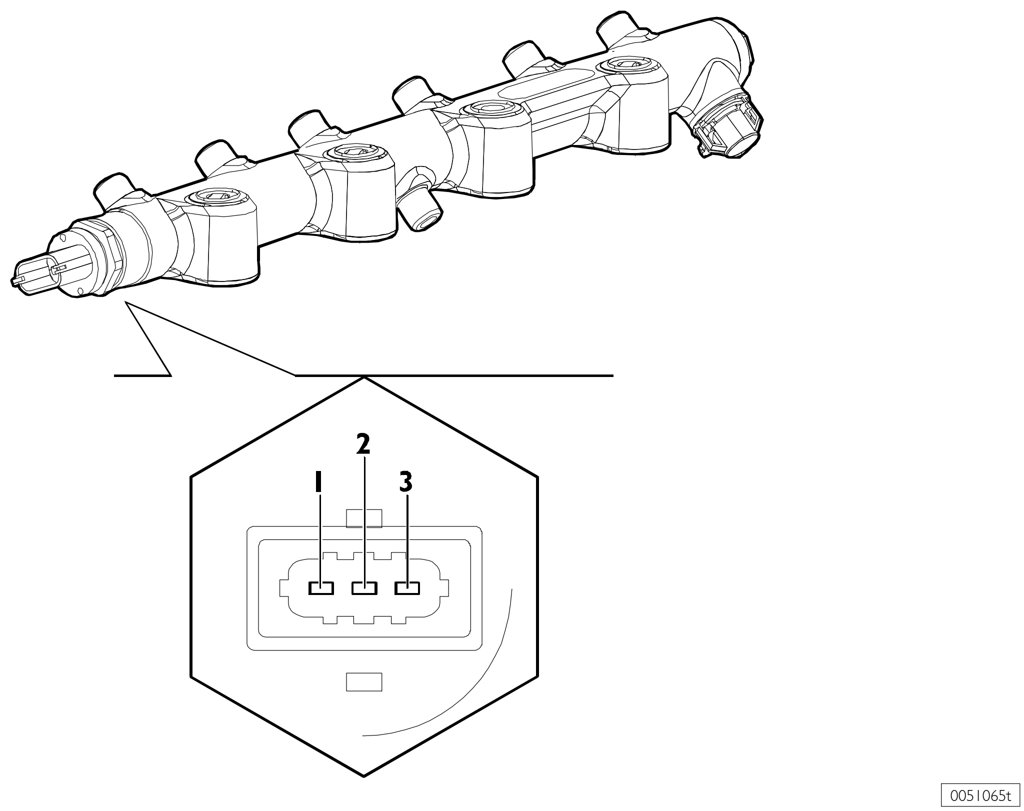
Fuel pressure sensor

Assembled on one end of the rail, measures the existing fuel pressure and informs the control unit (feed - back).
The value of injection pressure is used to keep the pressure level under control and to determine the time duration of the injection electronic command.
It is connected to the control unit at pins 12A - 14A - 13A.
It runs on 5 Volts.

Figure 15



Fuel pressure sensor connector

Ref.	Description	Control unit pin
1	Ground	12A
2	Signal	14A
3	Power supply	13A

Electro-injectors

This is an N.O. solenoid valve.
They are individually connected to the EDC control unit on connector B.
The coil resistance of each individual injector is 0.56 ÷ 0.57 Ω.

Ref.		Description	Control unit pin
CONNECTOR 1	1	Cylinder injector 2	11 B
	2	Cylinder injector 2	6 B
	3	Cylinder injector 1	13 B
	4	Cylinder injector 1	4 B
CONNECTOR 2	1	Cylinder injector 4	14 B
	2	Cylinder injector 4	3 B
	3	Cylinder injector 3	12 B
	4	Cylinder injector 3	5 B
CONNECTOR 3	1	Cylinder injector 6	15 B
	2	Cylinder injector 6	2 B
	3	Cylinder injector 5	1 B
	4	Cylinder injector 5	16 B

Figure 16

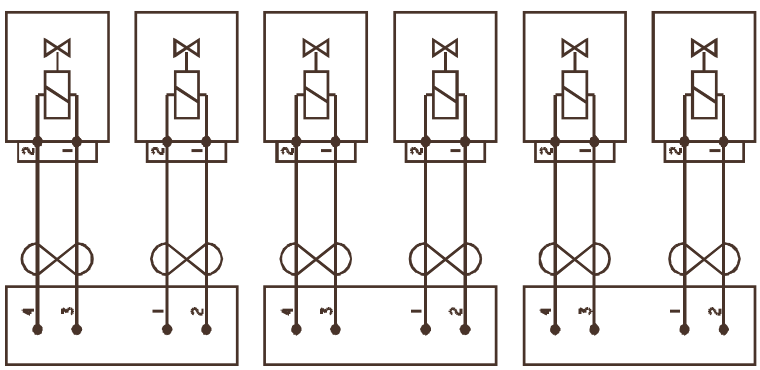


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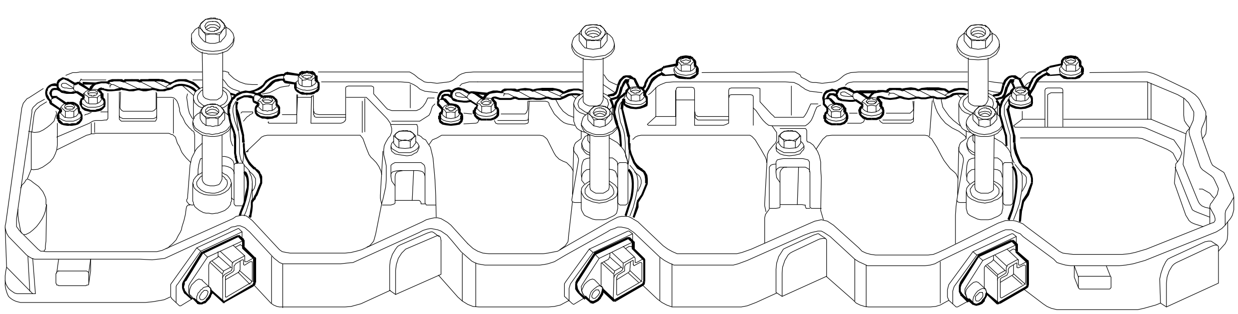
Figure 17



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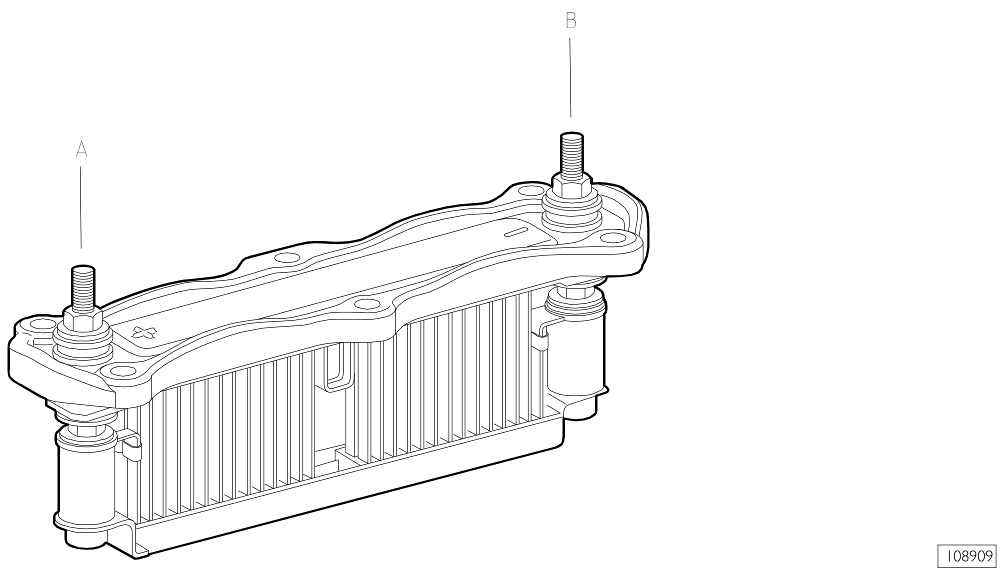
Resistor and contactor for pre-post heating

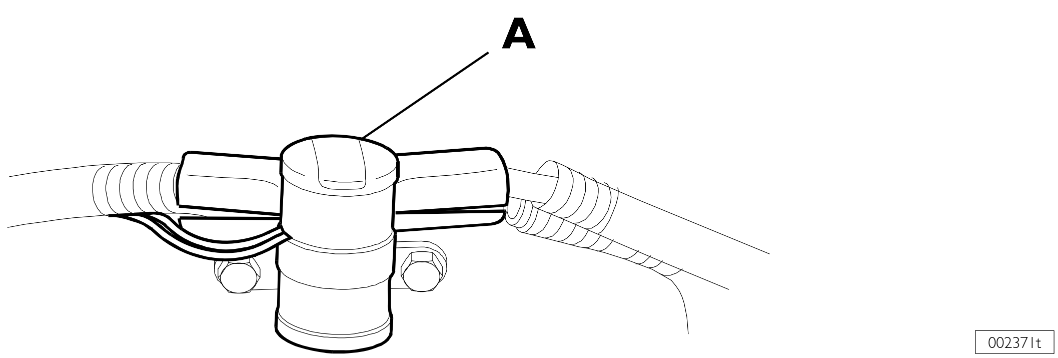
This element is located on the intake manifold.
It is utilised to heat the air in the operations of pre / post heating. It is powered via contactor.
Its resistance is approximately 0.5 Ω.

Figure 18



A. - B. Connecting terminals

Figure 19



A. Control contactor

The power contactor is connected to ECU connector B
Activation takes place with water and/or fuel temperature lower than 5 °C.
The resistance of the contactor is approx. 15 Ω.

Do not use flammable liquids or gases to facilitate starting the engine.
These substances may readily catch fire when in contact with the resistor, creating seriously dangerous situations.

Coolant temperature sensor

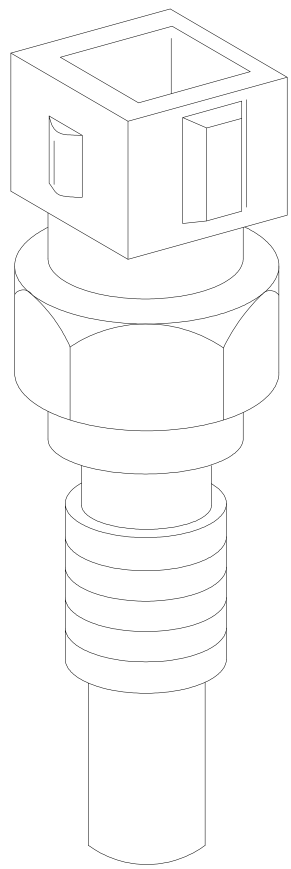
This is a variable resistance sensor that is able to measure coolant temperature and transmit a signal to the control unit reflecting the thermal conditions of the engine.

The same signal is used by the control unit to drive a temperature device, if present, in the dashboard.

It is connected to the control unit at pins 15A - 26A.

Its resistance at 20 °C is about 2.50 Ω.

Figure 20



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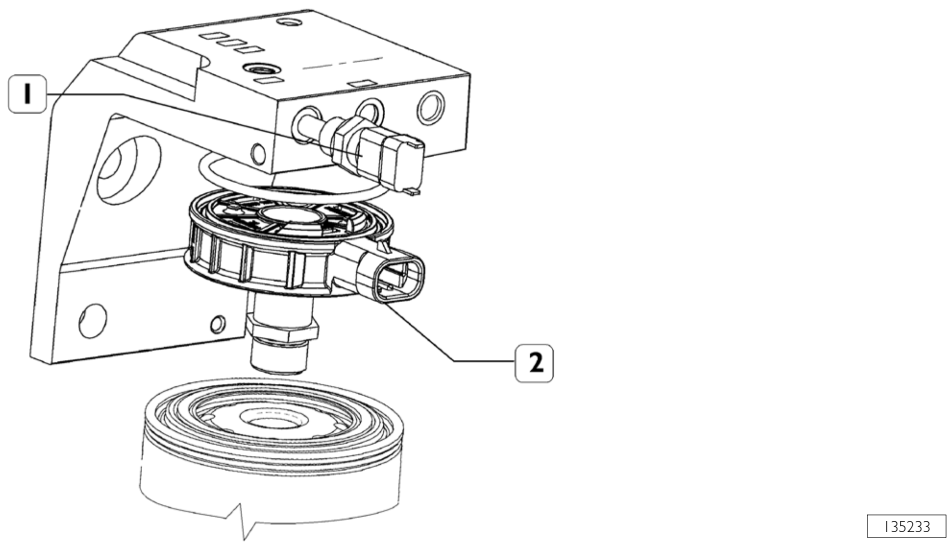
Fuel temperature sensor

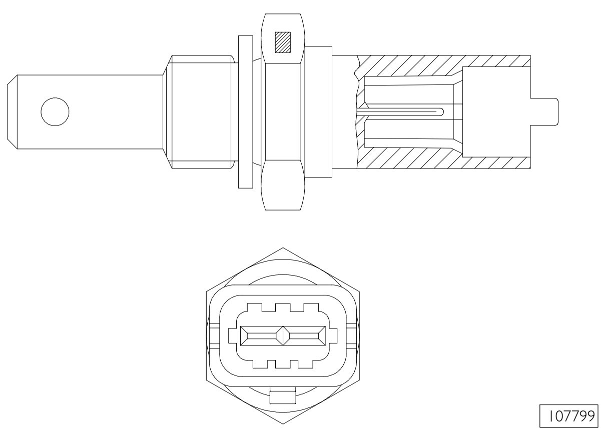
This sensor is identical to the previous one.
It detects the fuel temperature to provide the control unit with an index of the fuel's thermal state.
It is connected to the control unit at pins 35A - 18A.
Its resistance at 20 °C is about 2.50 Ω.

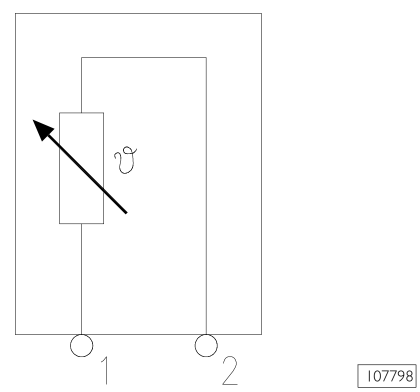
Figure 21



1. Fuel temperature sensor - 2. Resistor for filter preheating.

The ECU controls the power contactor for heating the filter to a fuel temperature of ≤ 5 °C.



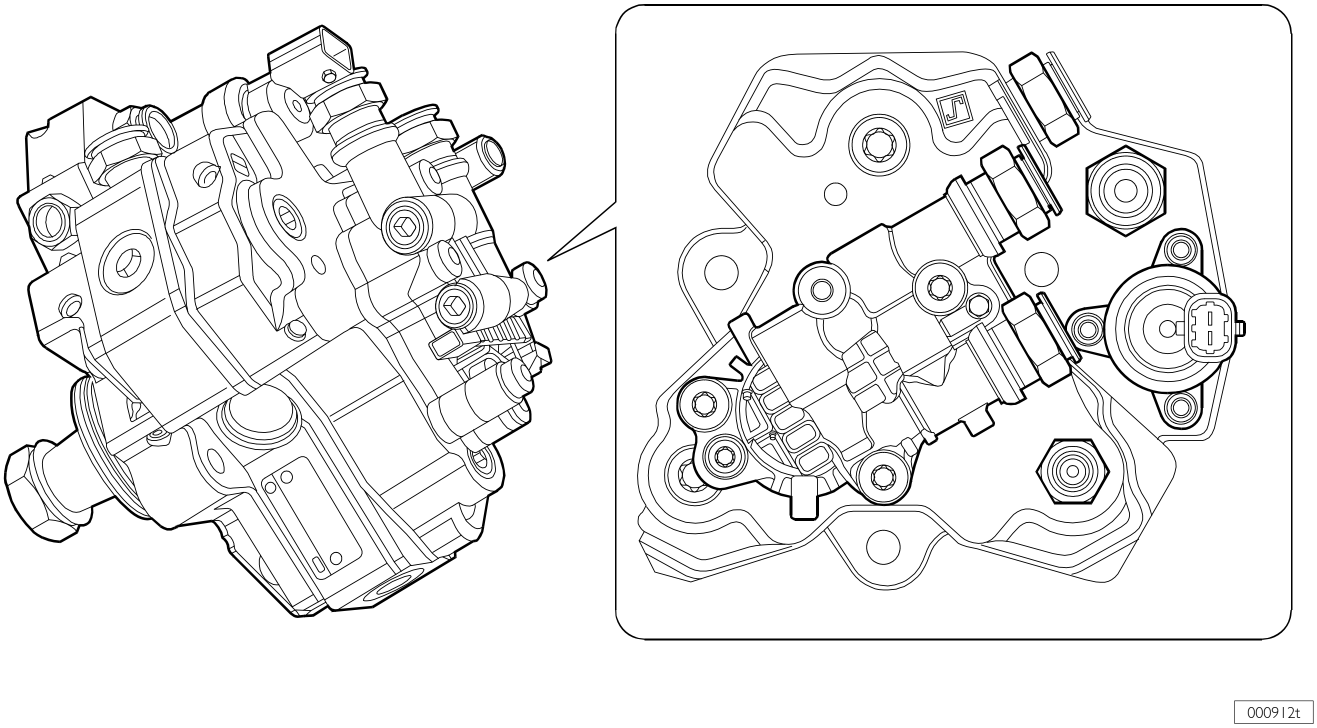


Connector

Ref.	Description	Control unit pin	
		Water	Comb.
1	Ground	15A	35A
2	Temperature signal	26A	18A

High pressure pump - pressure regulator

Figure 22



A. Pressure regulator

The amount of fuel that supplies the high pressure pump is metered by the pressure regulator, positioned on the low pressure system; the pressure regulator is managed by the EDC7 control unit.

The delivery pressure to the rail is regulated between 250 and 1450 bar by the ECU acting on the pressure regulator solenoid valve.

- It is a N.O. solenoid valve.
- It is connected to the control unit at pins 9B - 10B.
- Its resistance is approximately 3.2 Ω.

SECTION 4

Scheduled maintenance

Page

- Principles 3
- Checks and scheduled maintenance procedures 4
- Periodical maintenance 7
- Unscheduled maintenance 11

Principles

To ensure best operating conditions, the checks, tests and adjustments which are to be carried out on the different parts at the established time are provided on the following pages.

The frequencies of the maintenance operations are indicative since the engine use and its characteristics are essential to evaluate replacements and checks.

Not only it is permitted, but it is recommended that the staff in charge of maintenance should also perform those checking and maintenance operations which are not included in the list below, but are recommended by good-practices and particular conditions of use of the engine.

Checks and scheduled maintenance procedures	Intervals (hours)
Check the engine lubricant oil level	daily
Check engine coolant level	daily
Check cleanliness of the heat exchanger	daily
Check cleanliness of the air filter	daily
Check belt condition and tension	300 hours (2)
Checking/topping-up the level of the electrolytic solution in the batteries and cleaning the terminals	Six-months
Check the condition of the exhaust duct(s)	Six-months
Periodical maintenance	
Engine lubricant oil change	600 hours (3)(4)
Oil filter change	600 hours (3)(4)(5)
Fuel filter replacement	600 hours (1)(3)(5)
Fuel pre-filter change	600 hours (1)(3)
Change oil vapour filters	900 hours (3)(4)
Drain water from the fuel filter	150 hours (1)
Drainage/suction of water, condensation and impurities from the fuel tank/s	150 hours (1)
Change air filter	1200 hours (6)
Change the engine coolant	1200 hours / 3 years
Unscheduled maintenance	
Visually inspect turbocharger	1200 hours
Ancillary belt replacement	1200 hours
Clean the heat exchanger (radiator)	1200 hours
Injector calibration . . (Mechanical engines)	1800 hours
Checking and setting the valve clearance	3000 hours

1) Maximum period relating to the use of high quality fuel, (specification EN 590); it decreases depending on fuel contamination and the alarm signals for filter clogging and/or the presence of water in the pre-filter.
The filter clogging signal indicates that the filter must be replaced. If the alarm signalling water in the pre-filter is not turned off, the pre-filter must be replaced.

2) Refers to engines with conventional and automatic tensioners

3) Must be performed annually even if the intended operating hours are not reached

4) Intervals valid for lubricants as specified in the REFUELLING table.

5) Only use filters with the following specifications:
- degree of filtering < 12 μm
- filtering efficiency ß > 200.

6) The frequency depends on the ambient conditions and product efficiency/wear.

NOTE Checks, inspections and changes are indicative and must integrate those specifications foreseen for vehicles equipped with an NEF engine.

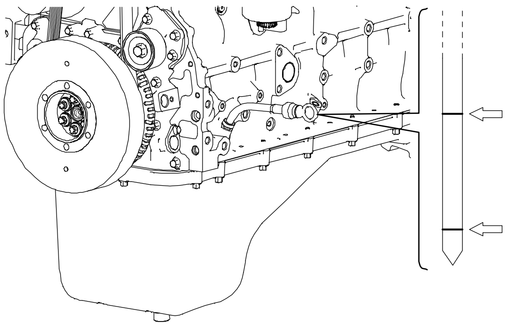
The data are only valid if the vehicle manufacturer observes all the installation regulations provided by FPT.

Checks and scheduled maintenance procedures

Check the engine lubricant oil level

Only proceed when the engine is not turning and is at low temperature in order not to run the risk of burns.

Figure 1 (For all engines)



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- ❑ Use the oil dipstick to check that the lubricant oil level is between the "Min" and "Max" limits.
- ❑ If the level is insufficient, it is necessary to top up with lubricant oil which meets the international specifications ACEA E5 (high power engines): remove the lubricant oil plug and pour engine lubricant oil through the hole.
- ❑ Use the oil dipstick to check that the oil level lubricant oil level does not exceed the "Max" limit.

The engine oil is highly pollutant and noxious.

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

Suitably protect skin and eyes; proceed in accordance with accident prevention standards.

Suitably dispose of the residuals and in accordance with regulations.

Check engine coolant level

The verification should be performed both when the engine is stopped and during operation.

Check the pipes from the engine to the radiator, from the expansion chamber and vice versa; identify any leakage, the state of the pipes, particularly near the junction clamps.

Check the cleanliness of the radiator, the integrity of the ventilation flaps, any leakage from the clamps, sleeves and radiating body.

The engine oil is highly pollutant and noxious.

Given the high temperatures which are reached inside the system, do not carry out operations immediately after the engine has stopped but wait until the temperature has fallen.

Protect your eyes and skin from any high pressure spray of coolant.

The density of the coolant should still be checked every year before the winter season and replaced at least every two years.

In case of new refilling proceed with the de-aeration of the system by means of the breathers on the engine.

Failure to vent the system could cause serious damage to the engine due to the presence of air pockets in the cylinder head of the engine.

- ❑ Make sure that when the engine is cold the fluid level in the exchanger covers the internal elements of the exchanger.
- ❑ Top up if necessary, using water free of impurities. Do not use distilled water.

NOTE if frequent top-ups are necessary, the cooling circuit must be diagnosed.

If set-up requires the presence of the level indicator external to the heat exchangers, refill it if necessary, taking care that the fluid does not saturate the internal volume of the heat exchanger to allow the temperature increase to cause the increase of the liquid volume.

Check cleanliness of the heat exchanger

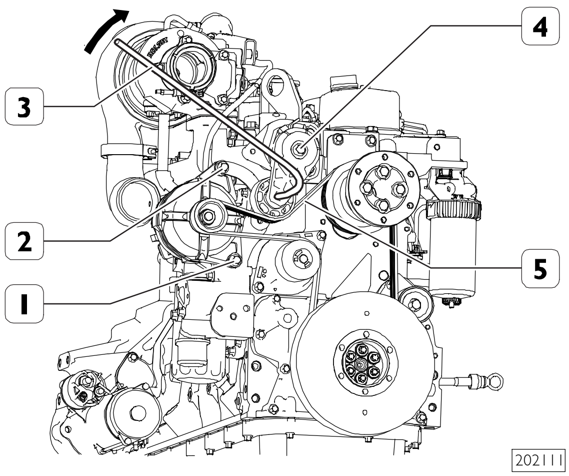
Check that the air intake surfaces of the radiators are free of impurities.

The use of compressed air requires the use of suitable protective equipment for the hands, face and eyes.

Check ancillary belt condition and tension

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Figure 2 (NEF67 TE1F/TE2F)



- ❑ Remove any casing protecting the pulleys.
- ❑ Make sure the belt is not torn, in an obvious state of wear or soiled by lubricants and fuels. Otherwise replace it.
- ❑ At the same time, check the efficiency of the tensioner by acting on it as shown in the figure.
- ❑ Refit the casing into place by tightening the resealing protection elements.

Inspection of the exhaust duct

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.

- ❑ Make sure that there is no risk of harmful fumes in the environment where the engine is being worked on. Contact the manufacturer if necessary.

Check tightening and cleanliness of battery terminals

Check that the battery terminals and cable clamps are clean, well tightened and protected by Vaseline.

In the event of dirty cable clamps and battery terminals:

- ❑ Loosen the nut and remove the terminal from the negative terminal (marked with a "-").
- ❑ Loosen the nut and remove the terminal from the positive terminal (marked with a "+").
- ❑ Use a metal brush or fine grade sand paper to clean the cable terminals and the battery terminals until they are shiny.
- ❑ Smear the cable terminals with Vaseline and insert them onto the battery terminals making sure that the positive pole is connected first, followed by the negative pole, and then tighten each terminal.

Check the cables and clamps for signs of wear and corrosion; if there is any deterioration, replace them.

Visually check the condition of the battery: the terminals must not show signs of deterioration and the body must not be damaged, otherwise they should be replaced.

Wear protective glasses and gloves

Check electrolyte level of the batteries

The batteries used are of reduced maintenance type. Therefore, under normal conditions of use, no top up of the electrolyte is required.

However, the routine checking of the electrolyte level is recommended.

Proceed after positioning the batteries on a horizontal surface.

- ❑ Visually check that the electrolyte level is between the "Min" and "Max" reference marks on the batteries; in the absence of any reference marks, make sure the liquid covers the lead plates contained in the elements by approx. 5 mm.
- ❑ Only use distilled water to top up the elements whose level is below the minimum.
- ❑ If the battery has to be recharged, contact a specialised workshop.

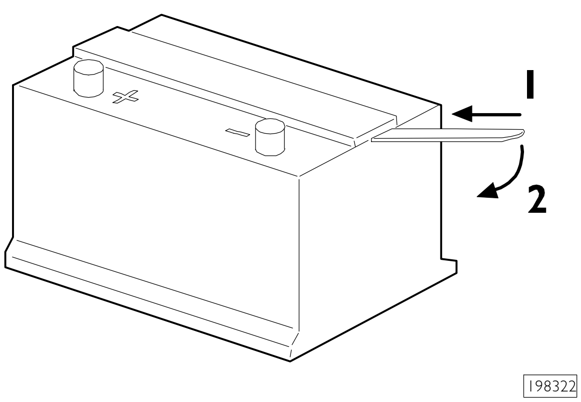
Contact the staff of a specialized workshop if all elements of the battery need to be topped off with a large amount of distilled water and diagnose the state of efficiency of the system and battery.

The batteries contain sulphuric acid, which is highly caustic and corrosive; while topping up, wear gloves and safety glasses and an apron to protect clothing.

If possible, have this check performed by qualified personnel.

During the checks do not smoke or allow naked flames near the batteries. Ensure that the work area is suitably ventilated.

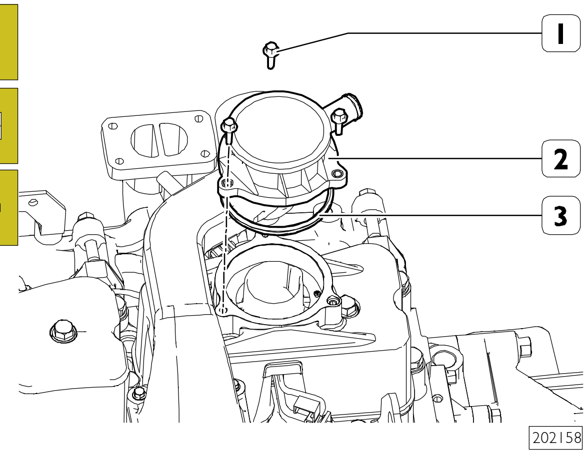
Figure 3



Some batteries have a single cover for the inspection plugs. To access the elements, use a lever as shown in the figure.

Check the condition of the oil vapour filter

Figure 4 NEF67 TM1F engines



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Remove the oil vapour filter (2) from the tappet cover (3) of cylinders 5 - 6, acting on the retaining screws (1).

Ref.	No.	Screws description
(1)	3	Screw -

- ❑ Make sure the oil vapour filter (2) is free from scale, otherwise replace.
- ❑ Reposition the oil vapour filter (2) in the seat on the tappet cover (3) of cylinders 3 - 4 and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

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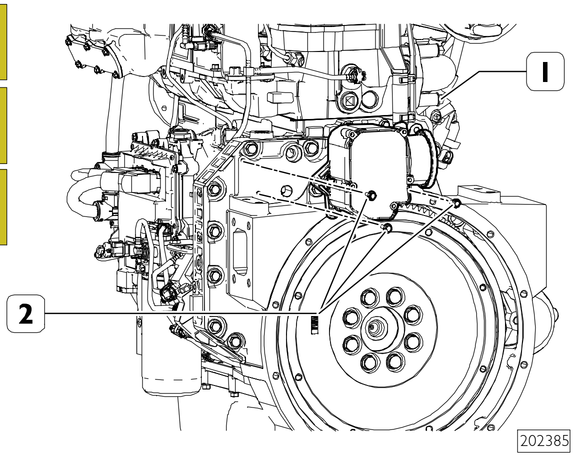
Figure 5 NEF67 TE1F/TE2F engines



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Remove the oil vapour filter (1), acting on the retaining screws (2).

Ref.	No.	Screws description
(2)	3	Screw -

- Make sure the oil vapour filter (1) is free from scale, otherwise replace.
- Reposition the oil vapour filter (1) in its seat on the flywheel and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

Check the condition of the exhaust duct(s)

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.

- Make sure that there is no the risk of dangerous fumes inside the car. Contact the manufacturer if necessary.

Periodical maintenance

Engine lubricant oil change

Due to the high operating temperature of the engine it is recommended to wear suitable protection.

The oil reaches very high temperatures: always wear protective gloves.

It is recommended that the oil is drained while hot.

- Place an appropriate container for the oil collection under the sump in correspondence with the drain plug.
- Unscrew the plug and then remove the oil level dipstick and the filler plug to facilitate the lubricant oil flow.

The engine oil is highly pollutant and noxious.

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

Suitably protect skin and eyes; proceed in accordance with accident prevention standards.

Suitably dispose of the residuals and in accordance with regulations.

- When draining has been completed, screw in the plug and then fill with clean oil.

Use only the recommended oils or oils with the characteristics required for the proper functioning of the engine.

If topping up, do not mix oils with different properties.

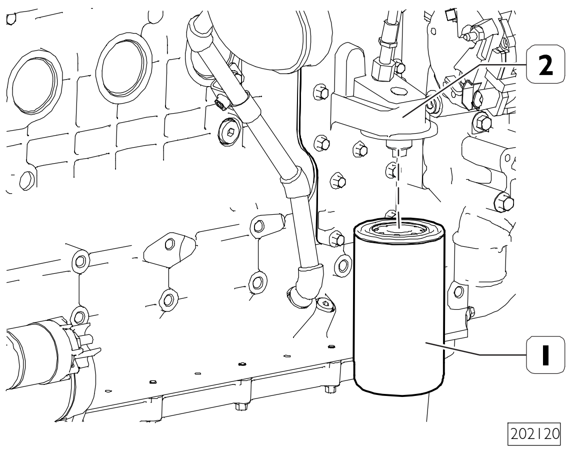
Failure to comply with these rules will result in the loss of guarantee assistance.

- Check the level using the dipstick up to obtain a filling close to the maximum level mark on the dipstick itself.

Oil filter change

NOTE The replacement of the oil filter must take place in conjunction with the changing of the lubricant oil.

Figure 6



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- Use tool 99360076 to unscrew the oil filter (1).

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Be careful since the oil filter contains a significant quantity of engine oil .

Properly position a container that can contain the liquid.

Attention! Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

- Tighten the oil filter (1) in correspondence to the slot on the heat exchanger (2).
- Operate the engine for a few minutes and then check the level using the dipstick. If necessary, top up to compensate for the quantity of oil used to fill up the filtering cartridge.

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

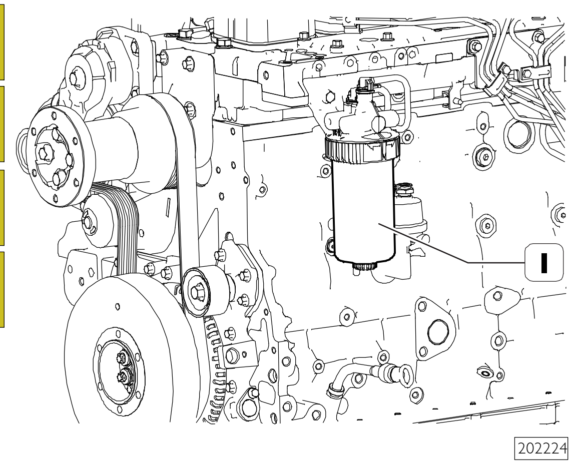
Fuel filter replacement

Do not smoke or use open flames during this operation.

Do not inhale the vapours that exit the filter.

When replacing the filters, the feed system must then always be deaerated.

Figure 7 NEF67 TM1F engines

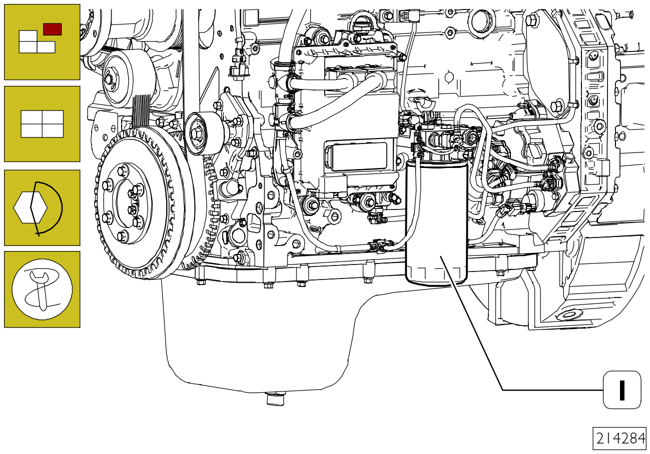


Drain the fuel contained in the filter by acting on the water bleed tap.

Collect the fuel in a clean container.

- Unscrew the cartridge (1) using the specific tool 99360076.
- Collect any fuel still present in the filtering cartridge.
- Clean the gasket seat on the support and lightly oil the gasket on the new filtering cartridge.
- Manually screw in the new filtering cartridge until the gasket rests completely on its seat.
- Tighten further with the help of the tool 99360076.

Figure 8 NEF67 TE1F/TE2F engines



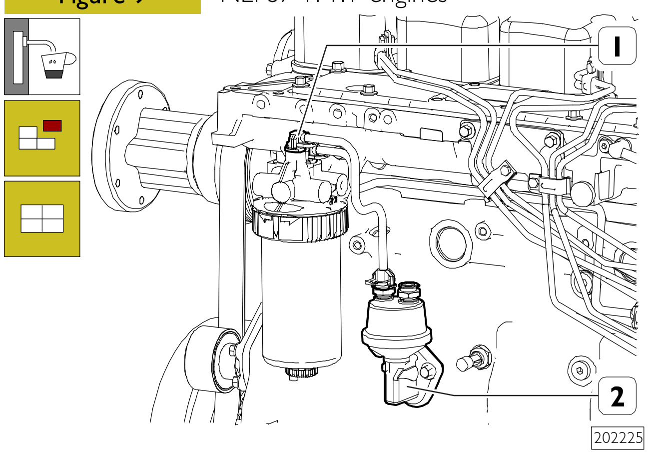
Drain the fuel contained in the filter by acting on the water bleed tap.

Collect the fuel in a clean container.

- ❑ Unscrew the cartridge (1) using the specific tool 99360076.
- ❑ Collect any fuel still present in the filtering cartridge.
- ❑ Clean the gasket seat on the support and lightly oil the gasket on the new filtering cartridge.
- ❑ Manually tighten the new filtering cartridge until the gasket rests completely on its seat.
- ❑ Tighten further with the help of the tool 99360076.

Bleeding procedure:

Figure 9 NEF67 TM1F engines

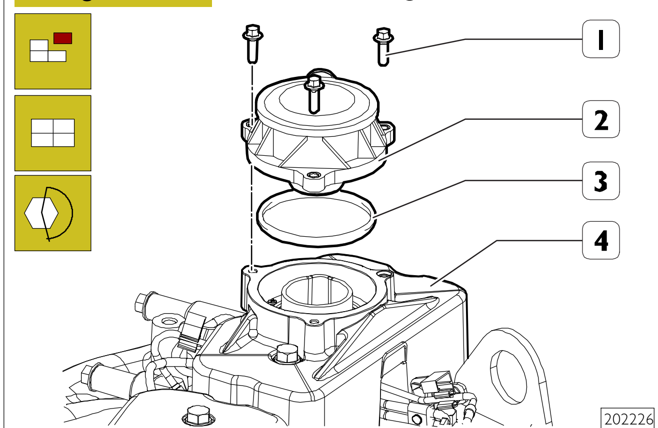


- ❑ Loosen the fuel outlet fitting located on the top of the filter (1).
- ❑ Ensure that the diesel fuel leakages does not dirty the auxiliary drive belt and is not dispersed into the environment.
- ❑ Act on the pre-filter hand pump until the diesel comes out with no residual air content or carry out a similar operation on the mechanical feed pump (2).
- ❑ Tighten the previously loosened fitting to the specified torque.
- ❑ Dispose of the diesel that leaked during the operation according to specifications.
- ❑ Start the engine and run it at idle for a few minutes to remove any residual air.

NOTE If it is necessary to accelerate the bleeding of residual air, proceed by acting on the hand pump, even during start-up.

Change oil vapour filters

Figure 10 NEF67 TM1F engines



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Remove the oil vapour filter (2) from the tappet cover (4) of cylinders 5 - 6, acting on the retaining screws (1).

Ref.	No.	Screws description
(1)	3	Screw -

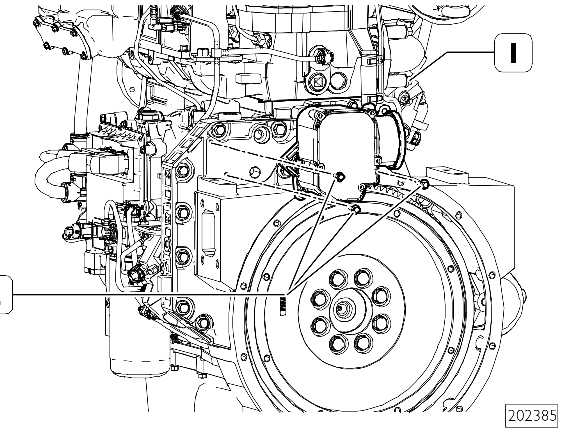
- ❑ Replace the oil vapour filter (2) and its gasket (3).
- ❑ Reposition the oil vapour filter (2) in the seat on the tappet cover (4) of cylinders 5 - 6 and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. The FPT Technical Service Network workshops are equipped for this purpose.

Change oil vapour filters

Figure 11 NEF67 TE1F/TE2F engines



- ❑ Remove the oil vapour filter (1), acting on the retaining screws (2).

Ref.	No.	Screws description
(2)	3	Screw -

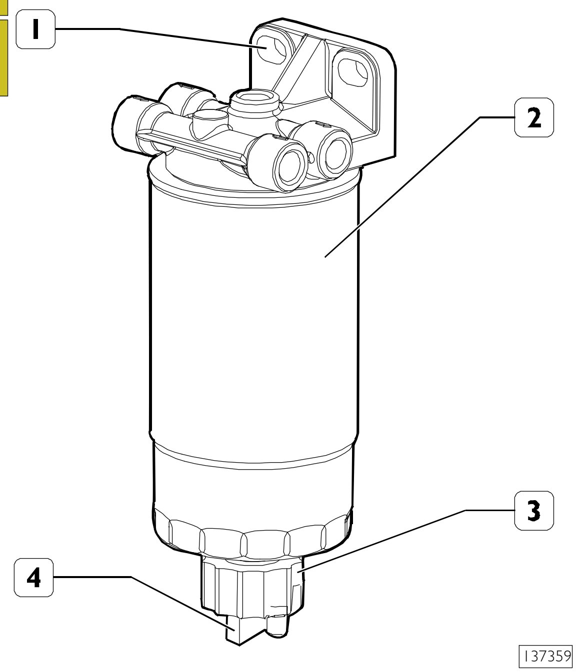
- ❑ Replace the oil vapour filter (1) and its gasket.
- ❑ Reposition the oil vapour filter (1) in its seat on the flywheel and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	3	Screw -	-

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law.
The FPT Technical Service Network workshops are equipped for this purpose.

Drain water from the fuel filter

Figure 12 NEF67 TM1F engines



The high risk of refuelling fuel polluted with foreign agents and water suggests performing a check at every refuel.

Proceed when the engine is not rotating.

- ❑ Position a container for collecting the liquid below the filter.
- ❑ Unscrew the valve plug (4) located at the bottom of the filter; in some versions, the plug includes the water in diesel sensor.
- ❑ Drain the liquid until it recognises the presence of only "diesel".
- ❑ Fully retighten the plug manually.
- ❑ Dispose of the drained liquids according to the applicable regulations in force.

Drainage/suction of water, condensation and impurities from the fuel tank/s

Perform the drainage/suction of water, condensation and impurities from the fuel tank/s following the instructions in the manual provided by the manufacturer of the tank/s.

Proceed as necessary based on the structure or location of the tank: engines that operate in adverse environments and conditions and/or that are refuelled using drums or jerry cans, require more attention when cleaning the tank.

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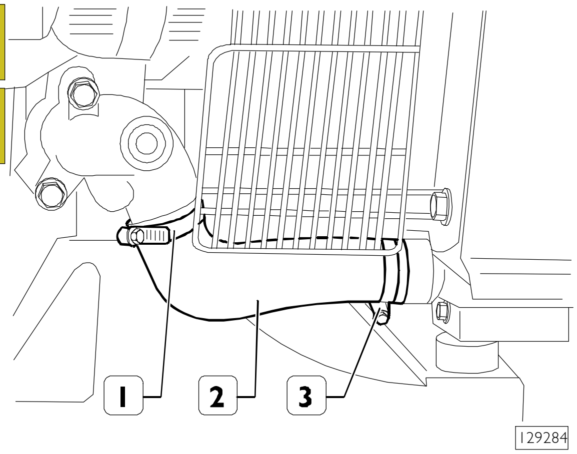
Change the engine coolant

Figure 13



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Use suitable containers to ensure that the coolant is not dispersed in the environment.
- ❑ Loosen the retaining elements (1 and 3), remove the sleeves (2) connecting the engine circuit to the heat exchanger and wait for emptying to complete. Once emptied, restore the condition of the circuit, ensuring the perfect seal of the sleeves.
- ❑ Refill the circuit.
- ❑ Refill the engine and the exchanger until the exchanger is completely full.
- ❑ With the filler plug open, start the engine and idle it for approximately 1 minute.
  This phase helps to completely bleed the air contained in the cooling circuit.
- ❑ Stop the engine and then top up with the amount which is still needed.

Unscheduled maintenance

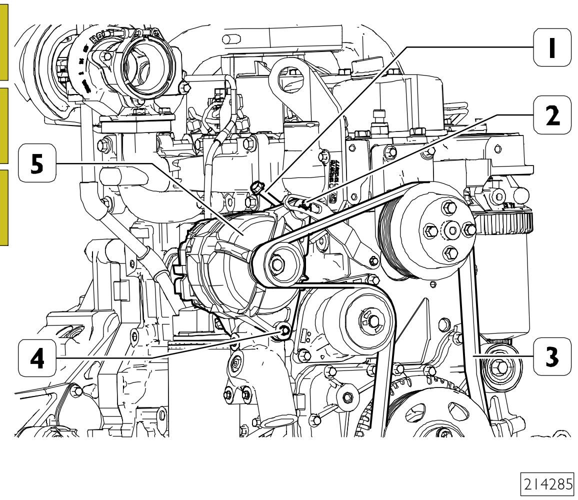
Ancillary belt replacement

Replace the ancillary belt if it shows signs of abrasions, cracks or tears or if it is soiled with oil or fuel.

When the engine is off, but still hot, the belt may start to move without warning.

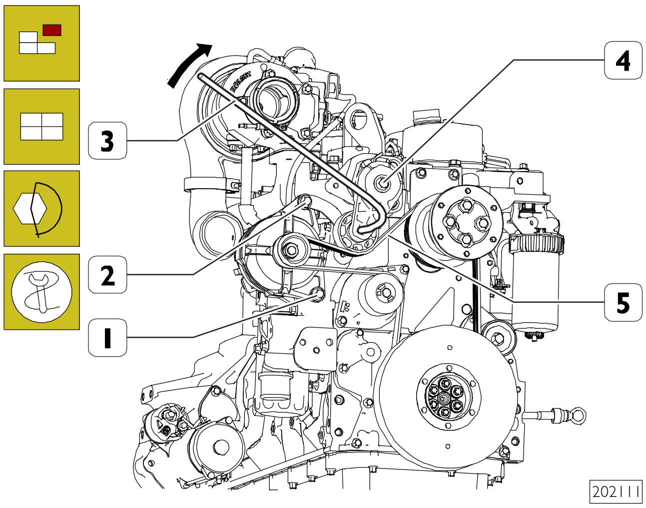
Wait for the engine temperature to decrease in order to avoid serious risk of injury.

Figure 14 NEF67 TM1F engines



- ❑ Remove the protective grille and the fan together with spacer by acting on the relative fasteners.
- ❑ Using tool (3), loosen the automatic belt tensioner (1).
- ❑ Remove the belt (3).
- ❑ Place the new belt (3) inside of the shoulders of all the pulleys.
- ❑ Release the automatic belt tensioner (1) and remove the tool (3).
- ❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Figure 15 NEF67 TE1F/TE2F engines



- ❑ Remove the protective grille and the fan together with spacer by acting on the relative fasteners.
- ❑ Loosen the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

- ❑ Use the special tool (3) to turn the automatic tensioner (4) in the direction of the arrow and remove the belt (5).
- ❑ Use the special tool (3) to turn the automatic tensioner (4) and place the new belt (5) inside the shoulders of all the pulleys.
- ❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

- ❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Visually inspect turbocharger

Only proceed when the engine is not turning over. Visually check that the impellers of the turbine and the compressor and their relative inlets and outlets are not blocked or damaged; in this case, proceed with replacement.

Clean the heat exchanger (radiator)

Check that the air intake surfaces of the radiators are free of impurities.

Clean them using compressed air or steam.

> The use of compressed air requires the use of suitable protective equipment for the hands, face and eyes.

Injector calibration (Mechanical engines)

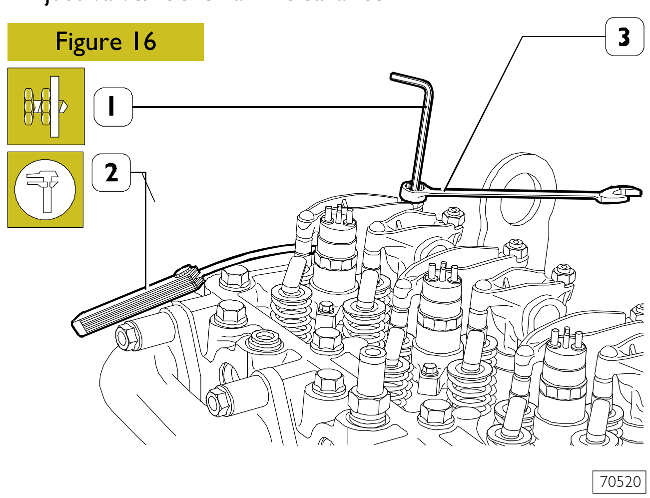
The injectors require periodic cleaning and calibration of the exact injection pressure, through the addition or replacement of shims inserted under the spring; check the injection pressure by using a hand operated pump equipped with a pressure gauge which, operated by the lever, enables the injector calibration pressure to be obtained and which is displayed on the pump pressure gauge at the moment in which diesel delivery occurs.

During testing it is also possible to see whether the flow direction is correct and whether the injector is leaking fuel.

Clean the injectors by removing carbon deposits from the top of the sprayer with a metallic brush.

Adjust valve/rocker arm clearance

Figure 16



Registration of the clearance between the rocker arms and crossbars which control the intake and exhaust valves must be carried out carefully using the hex key (1) box wrench (3) and feeler gauge (2).

The clearance is:

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

SECTION 5

Removal/refitting of the main components of the engine

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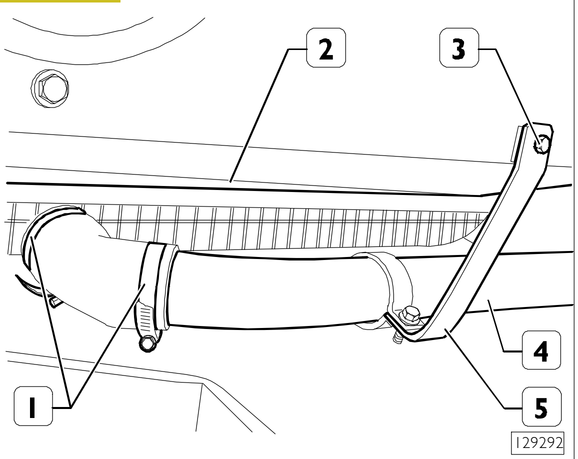
PROCEDURE FOR REMOVAL/REFITTING OF PROTECTION GRILLE

Removal

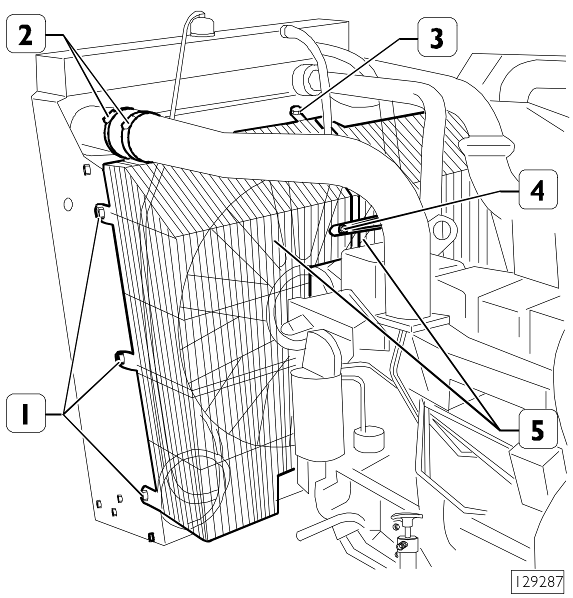
Figure 1



- ❏ Prepare a suitable container in correspondence with the pipe (4) for the recovery of the coolant. Disconnect the pipe (4) by acting on the relative clamps (1).
- ❏ Unscrew the screw (3) and detach the pipe (4) complete with bracket (5) from the radiator assembly (2).

Ref.	No.	Screws description
(3)	1	Screw M8x1.25x16

Figure 2

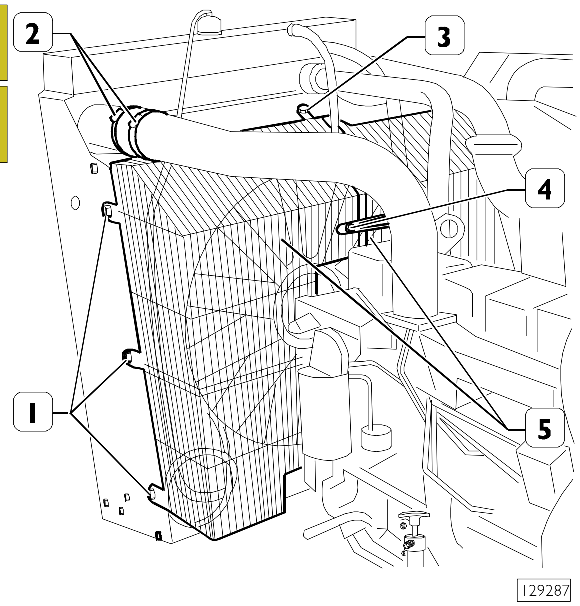


- ❏ Remove the fan protection grilles (5) by undoing the relative fastenings (1), (3) and (4).
- ❏ Open the clamps (2).

Ref.	No.	Screws description
(1)	6	Screw M6x1x16
(3)	1	Screw M8x1.25x16
(4)	1	Screw M6x1x16

Refitting

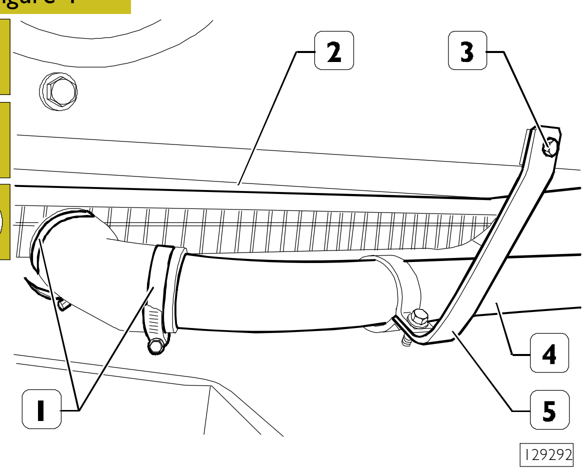
Figure 3



- ❏ Mount the protection grilles (5) of the fan
- ❏ Tighten the relative fasteners (1, 3 and 4).
- ❏ Close the clamps (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm
(4)	1	Screw M6x1x16	43 ± 6 Nm

Figure 4



- ❏ Connect the pipe (4) complete with hoses and bracket (5) to the radiator assembly (2)
- ❏ Close the relative clamps (1).
- ❏ Tighten the screw (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

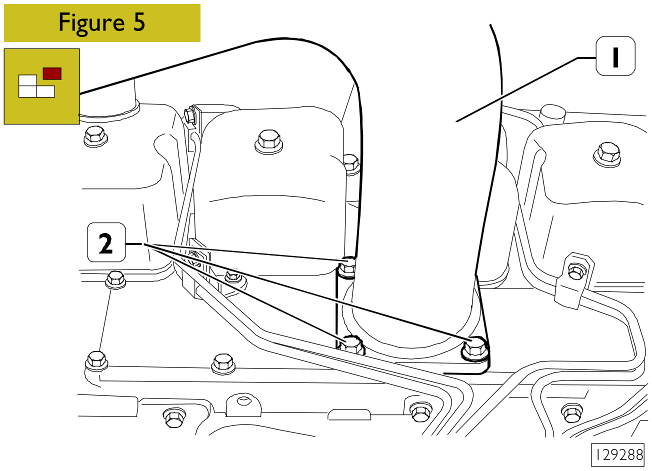
- ❑ Refill the cooling system with coolant.
- ❑ Bleed the air from the 'supply system as described in the relevant paragraph.
- ❑ Check the engine oil level

PROCEDURE RADIATOR REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

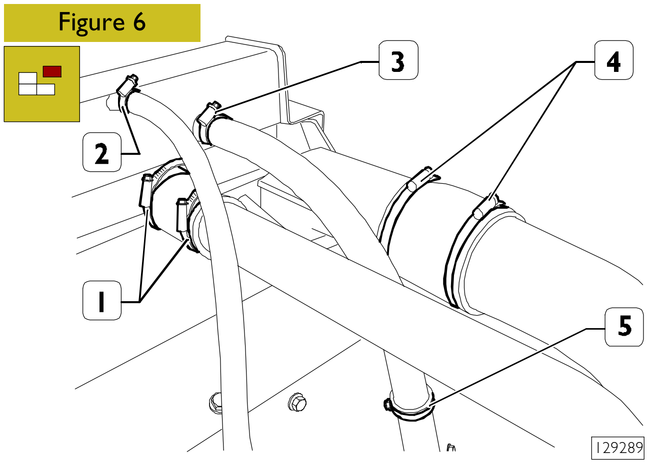
Figure 5



- ❑ Unscrew the screws (2) and remove the pipe (1) from the intake manifold.

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

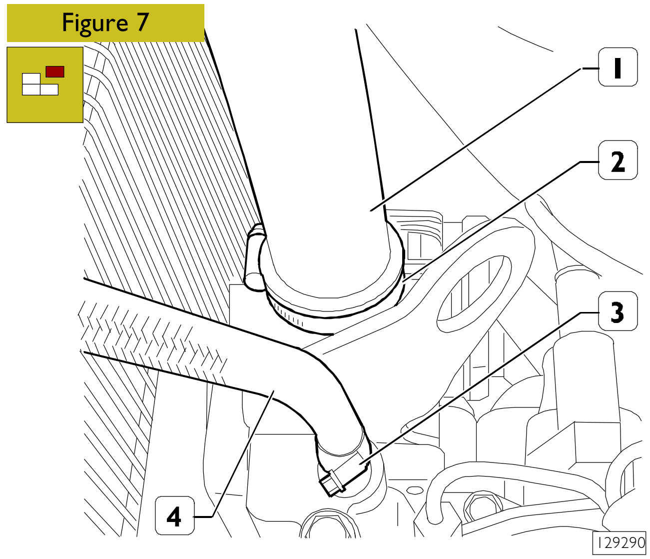
Figure 6



- ❑ Disconnect the air and water pipes from the radiator assembly.
- ❑ Unscrew the screws on the clamps (1, 2, 3 and 4) and on the fixing bracket (5).

Ref.	No.	Screws description
(5)	1	Screw M6x1x16

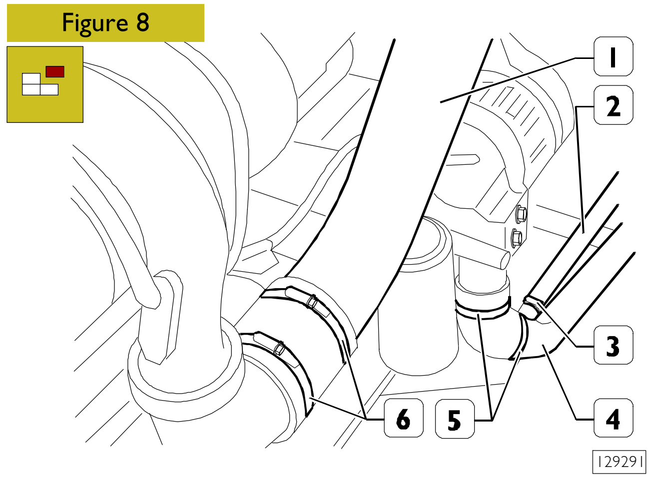
Figure 7



- ❑ Disconnect and remove the pipes (1 and 4), complete with sleeves, from the engine side.
- ❑ Unscrew the screws on clamps (2 and 3).

Ref.	No.	Screws description
(2)	1	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Figure 8

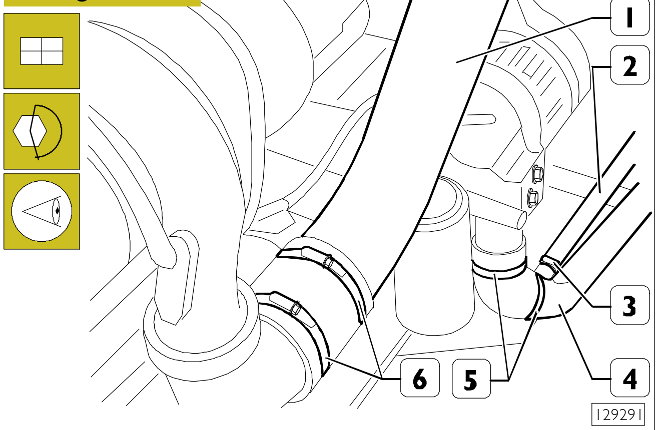


- ❑ Disconnect and remove the pipe (1), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (6).
- ❑ Disconnect and remove the pipe (2), unscrewing the screws on the relative clamp (3).
- ❑ Disconnect and remove the pipe (4), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (5).
- ❑ Properly lock the radiator unit, then release it from the base by adjusting the hardware on both sides.
- ❑ Remove the radiator unit from its seat.

Ref.	No.	Screws description
(3)	2	Screw M6x1x16
(5)	2	Screw M8x1.25x16
(6)	2	Screw M6x1x16

Refitting

Figure 9

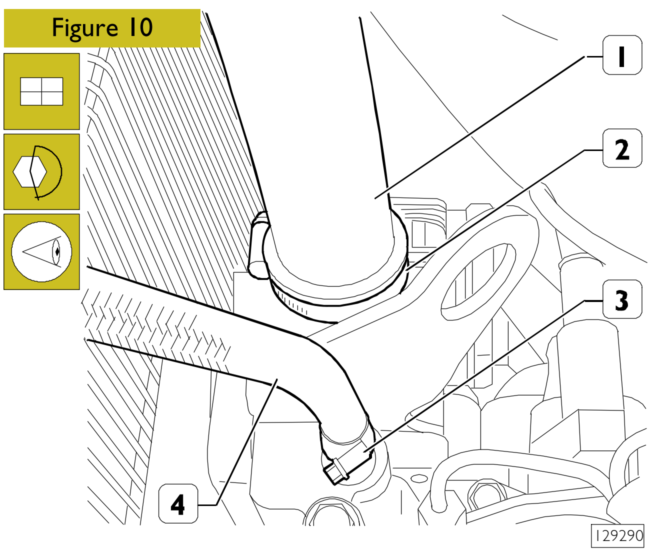


- ❑ Fit the pipe (4) complete with sleeves, from the engine side, acting on the relative clamps (5).
- ❑ Fit the pipe (2) complete with sleeves, from the engine side, acting on the relative clamps (3).
- ❑ Fit the pipe (1) complete with sleeves, from the engine side, acting on the relative clamps (6).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M6x1x16	43 ± 6 Nm
(5)	2	Screw M8x1.25x16	43 ± 6 Nm
(6)	2	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 10

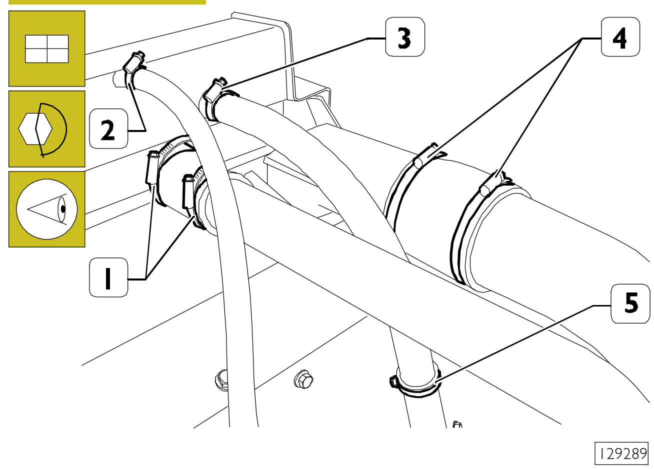


- ❑ Fit the pipes (1 and 4) complete with sleeves acting on the relative clamps (2 and 3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 11

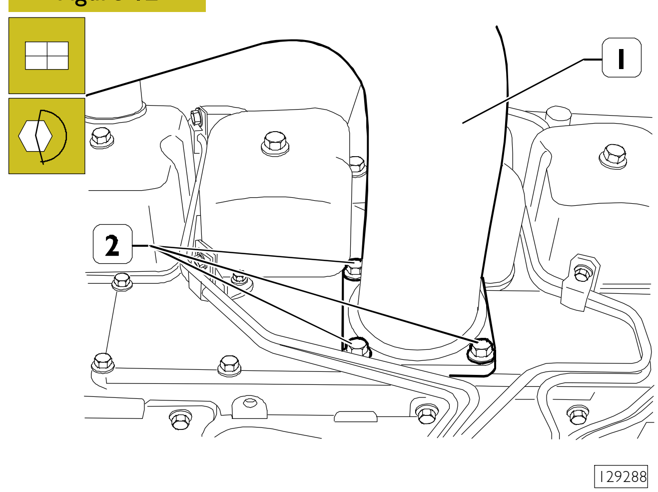


- ❑ Connect the air and water pipes to the radiator assembly using the clamps (1, 2, 3 and 4) and the mounting bracket (5).

Ref.	No.	Screws description	Tightening torques
(5)	1	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 12



- ❑ Mount the pipe (1).
- ❑ Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	24 ± 4 Nm

Fit the protection grille as described in the relative procedure.

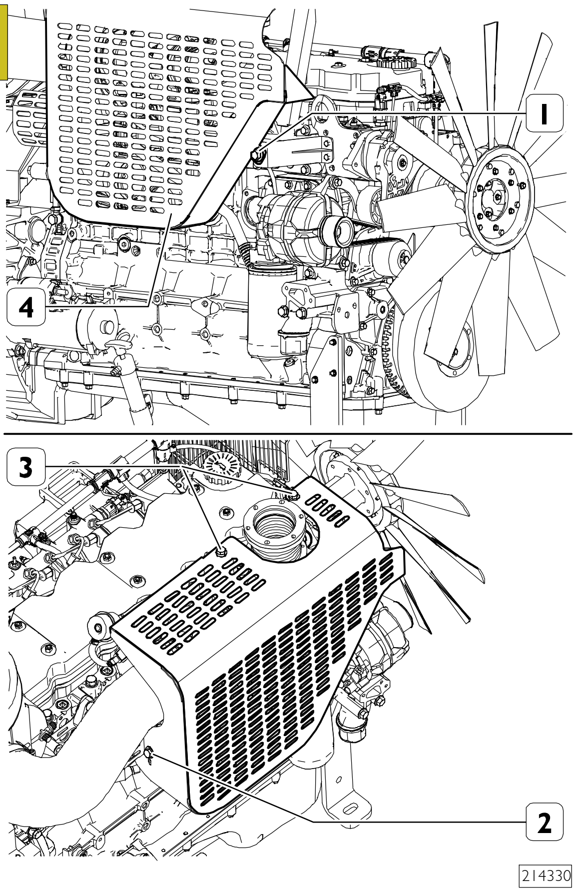
PROCEDURE FOR FAN REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

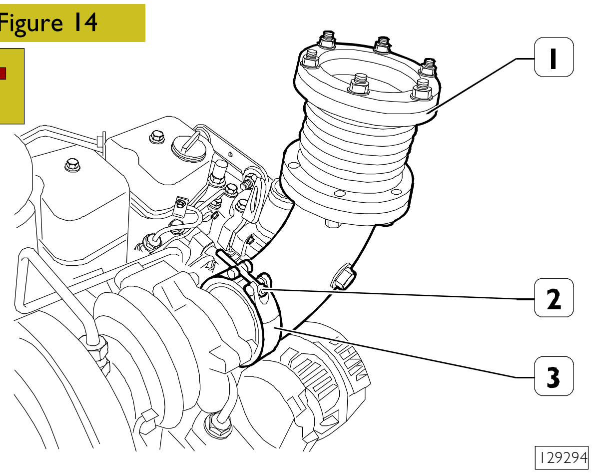
Figure 13



- ❑ Unscrew the screws (1, 2 and 3).
- ❑ Remove the grille (4)
  protecting the turbocharger, if present.

Ref.	No.	Screws description
(1)	1	Screw M6x1x16
(2)	2	Screw M6x1x16
(3)	2	Screw M8x1.25x16

Figure 14



- ❑ Unscrew the screw (2) to open the clamp (3).
- ❑ Disconnect the exhaust pipe (1).

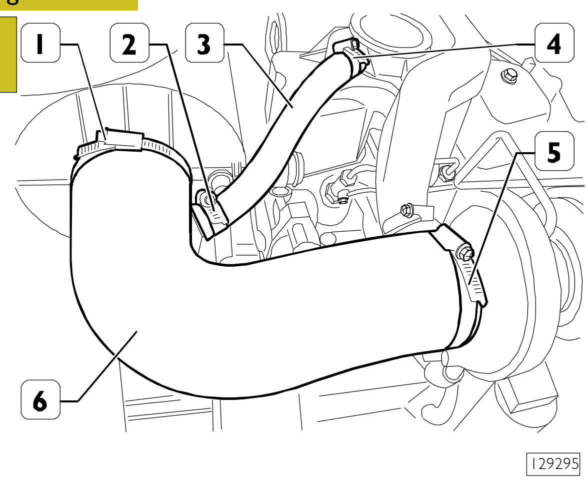
NOTE The shape and the size of the exhaust pipe will vary depending on use of the engine.

The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	1	Screw M7x1

Figure 15



- ❑ Unscrew the screws on the relative clamps (2 and 4).
- ❑ Disconnect and remove the oil vapour recovery pipe (3).
- ❑ Unscrew the screws on the relative clamps (1 and 5).
- ❑ Disconnect and remove the air intake pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M7x1
(5)	1	Screw M7x1

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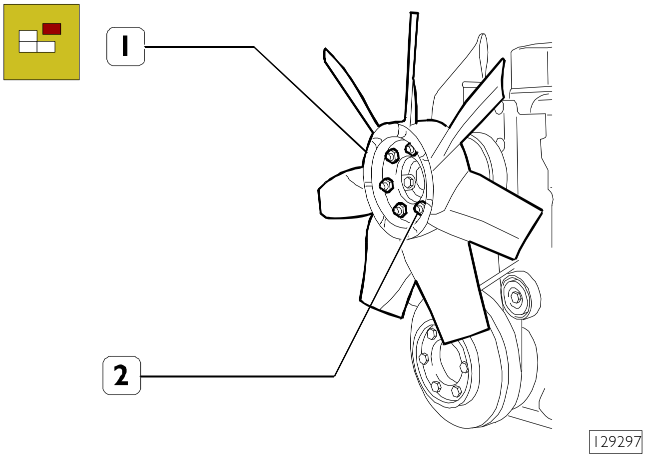
Figure 16



- Unscrew the screws (2).
- Remove the fan (1), complete with spacer.

NOTE The shape and the size of the fan varies according to the use of the engine.

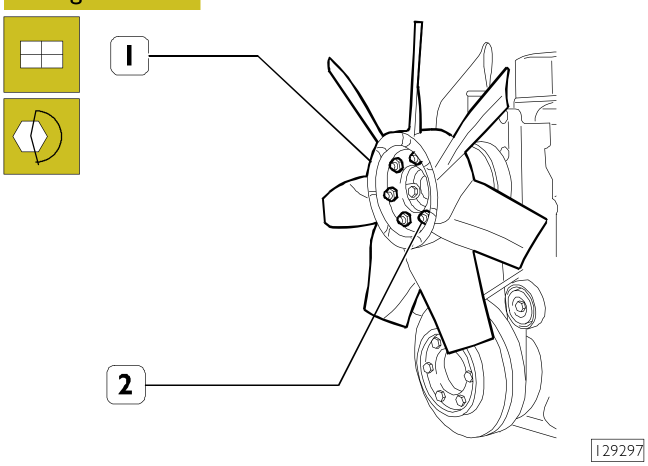
The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

Refitting

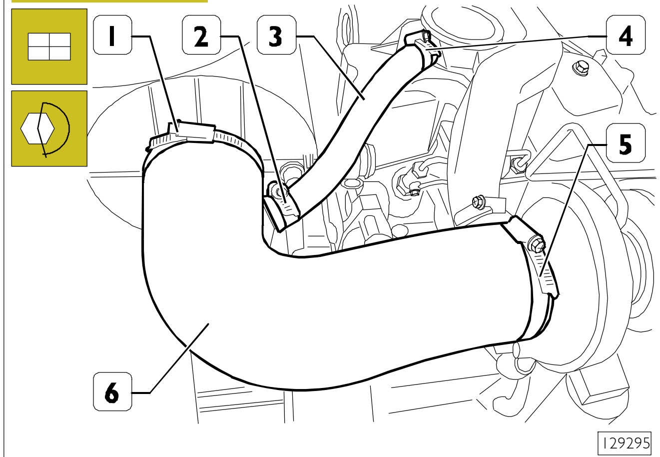
Figure 17



- Position the fan (2), complete with spacer.
- Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	6	Screw M8x1.25	24 ± 4 Nm

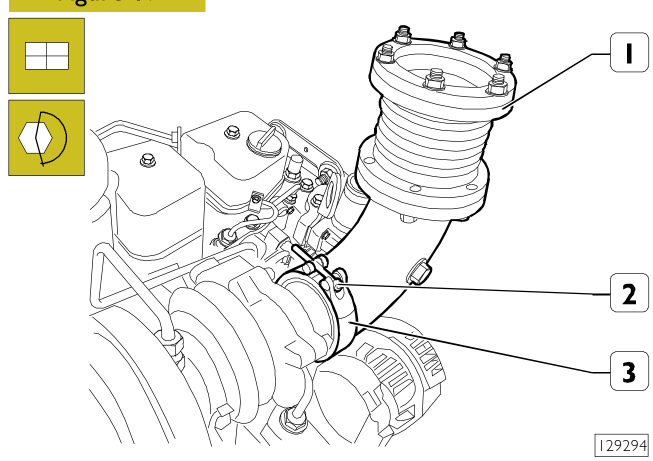
Figure 18



- Connect the air intake pipes (6), closing their clamps (1) and (5)
- Connect the oil vapour recovery pipes (3), closing their clamps (2) and (4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M7x1	13 ± 2 Nm
(5)	1	Screw M7x1	13 ± 2 Nm

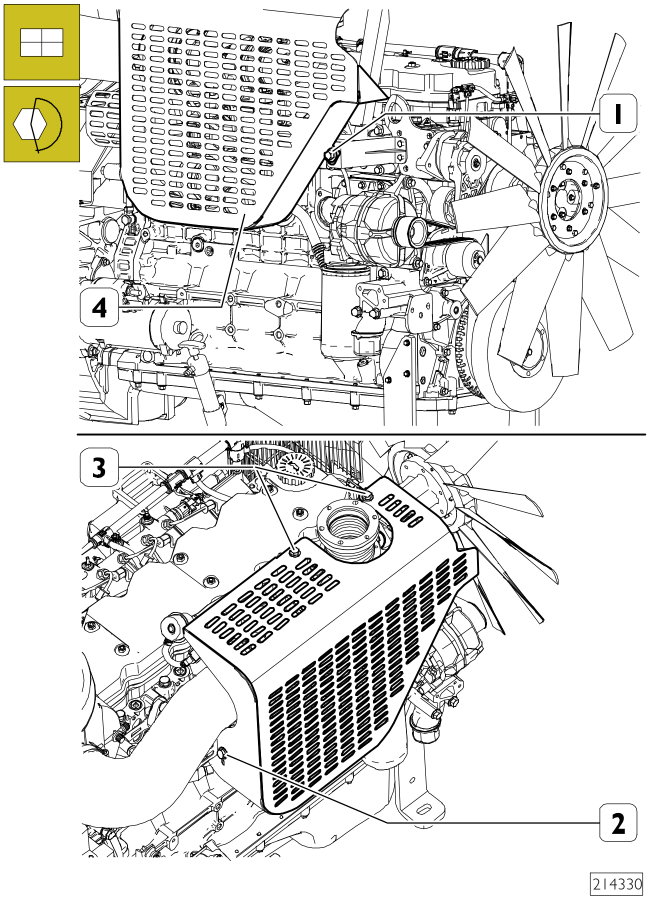
Figure 19



- Connect the discharge pipe (1), tightening the screw (2) to close the clamp (3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M7x1	13 ± 2 Nm

Figure 20



- Refit the grille (4) protecting the turbocharger.
- Replace the radiator unit on the crankcase, making sure not to interference with the fan.
- Tighten the fastening screws (1, 2 and 3) on both sides.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1x16	43 ± 6 Nm
(2)	2	Screw M6x1x16	43 ± 6 Nm
(3)	2	Screw M8x1.25x16	43 ± 6 Nm

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR ANCILLARY BELT REMOVAL/REFITTING

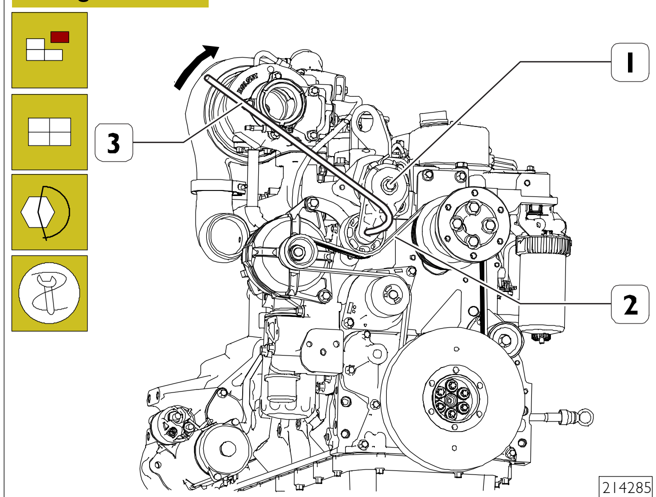
Removal NEF67 TM1F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Figure 21



- Using tool (3), loosen the automatic belt tensioner (1).
- Remove the belt (3).

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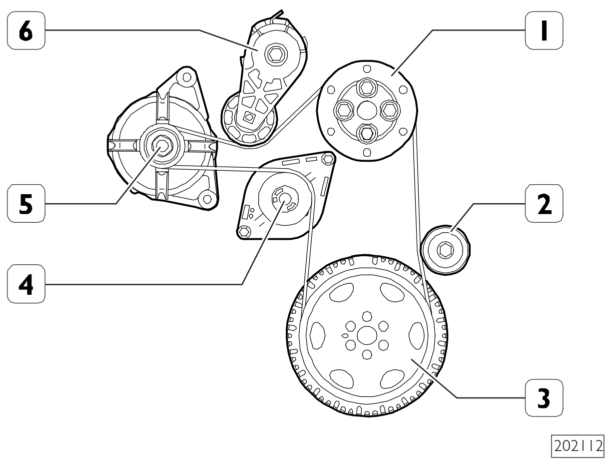
Refitting

- Place the new belt (3) inside of the shoulders of all the pulleys.
- Release the automatic belt tensioner (1) and remove the tool (3).
- Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Figure 22



BELT ASSEMBLY DIAGRAM
1. Fan pulley - 2. Idler pulley - 3. Crankshaft pulley - 4. Water pump - 5. Alternator

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

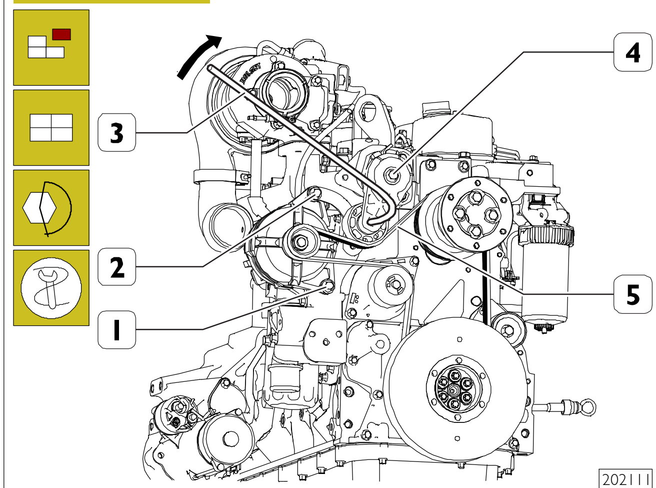
Removal NEF67 TE1F/TE2F engine

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Figure 23



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Remove the protective grille and the fan together with spacer by acting on the relative fasteners.
- Unscrew the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

- Use the special tool (3) to turn the automatic tensioner (4) in the direction of the arrow and remove the belt (5).

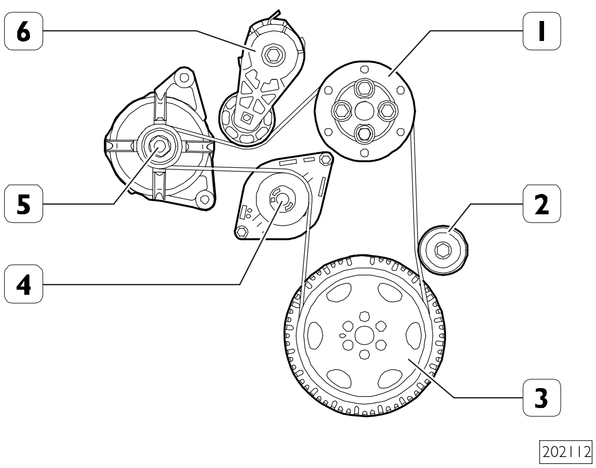
Refitting

- ❑ Use the special tool (3) to turn the automatic tensioner in the direction of the arrow (4) and reposition the belt (5) inside the shoulders of all the pulleys.
- ❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

- ❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.

Figure 24



BELT ASSEMBLY DIAGRAM
1. Fan pulley - 2. Idler pulley - 3. Crankshaft pulley - 4. Water pump - 5. Alternator - 6. Automatic belt tensioner

Fit the fan as described in the relevant section.

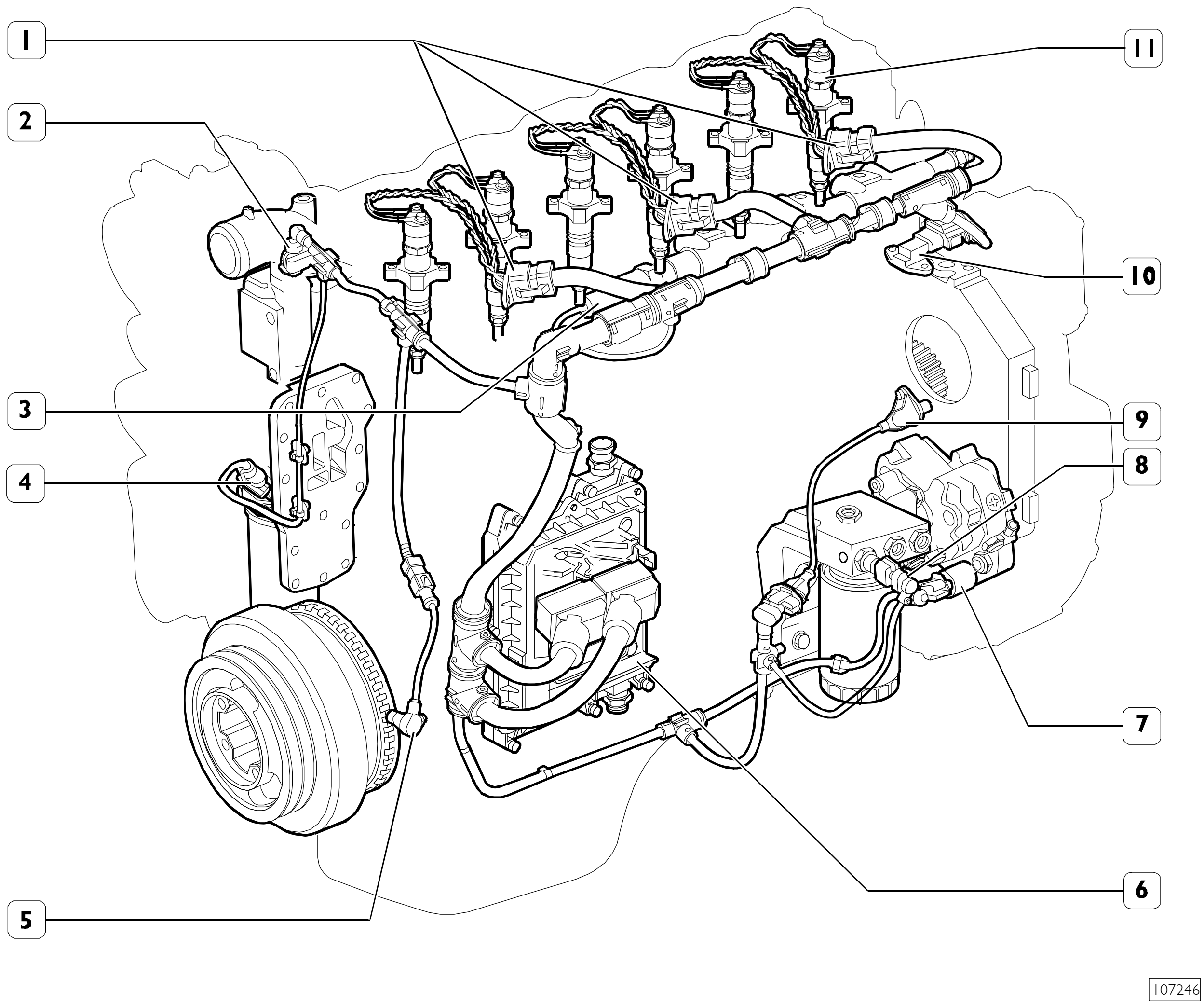
Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR ENGINE CABLE REMOVAL/REFITTING

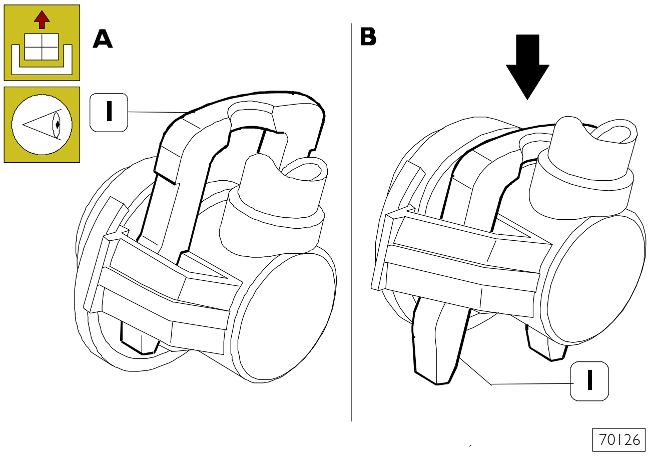
Removal NEF67 TE1F/TE2F engines

Figure 25



1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9. Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

Figure 26



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

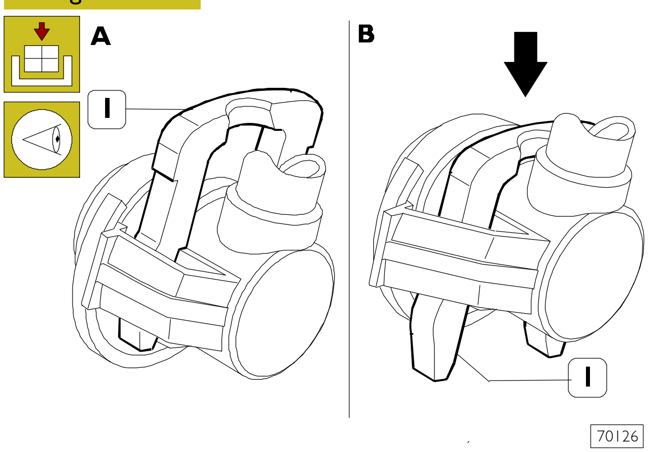
After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Disconnect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Remove the clamps that hold it to the crankcase and remove it completely.

Refitting

Figure 27



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

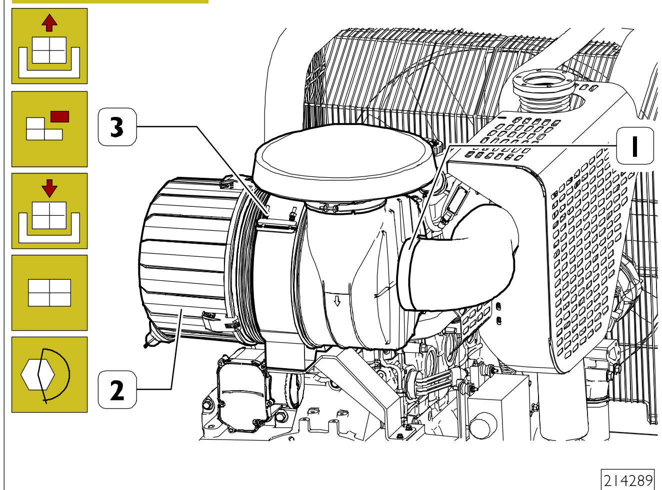
Connect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Insert the clamps that hold it to the crankcase.

PROCEDURE FOR AIR FILTER REMOVAL/REFITTING

Removal NEF67 TE1F/TE2F engines

Figure 28



- ❑ Remove the clamp (1).
- ❑ Unscrew the screws (3) and remove the air filter (2) from its support.

Ref.	No.	Screws description
(3)	2	Screw M8x1.25x100

Refitting

- ❑ Place the air filter (2) in the relative position.
- ❑ Tighten the screws (3) to the support clamp.
- ❑ Connect the clamp (1).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M8x1.25x100	-

PROCEDURE FOR ALTERNATOR REMOVAL/REFITTING

Removal NEF67 TM1F engine

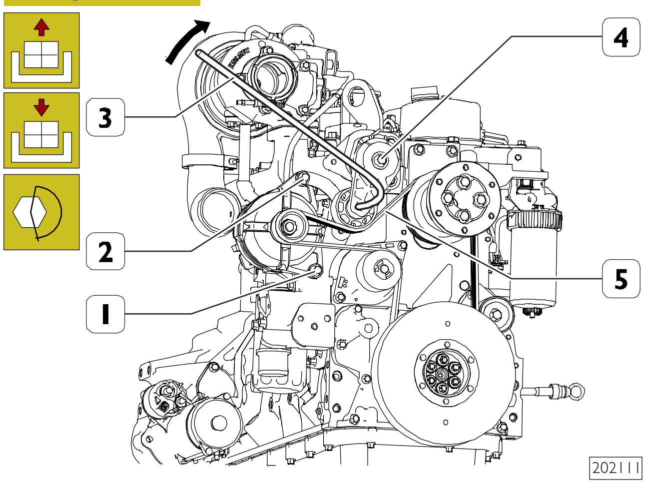
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 29



- ❑ Unscrew the screws (2 and 4) anchoring the alternator (5) to its support and the screw (1) adjusting the position of the alternator.

Ref.	No.	Screws description
(1)	1	Screw M8x1.25x100
(2)	1	Screw M10x1.5x40
(4)	1	Screw M10x1.5x110

- ❑ Remove the alternator (5) from its housing.

Refitting

Position the alternator (5) in its housing.

- ❑ Place the new belt (3) inside of the shoulders of all the pulleys.
- ❑ Tighten the screw (1) adjusting the alternator (5).
- ❑ Tighten the screws (2 and 4) anchoring the alternator to its support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x100	-
(2)	1	Screw M10x1.5x40	43 ± 6 Nm
(4)	1	Screw M10x1.5x110	43 ± 6 Nm

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

Removal NEF67 TE1F/TE2F engines

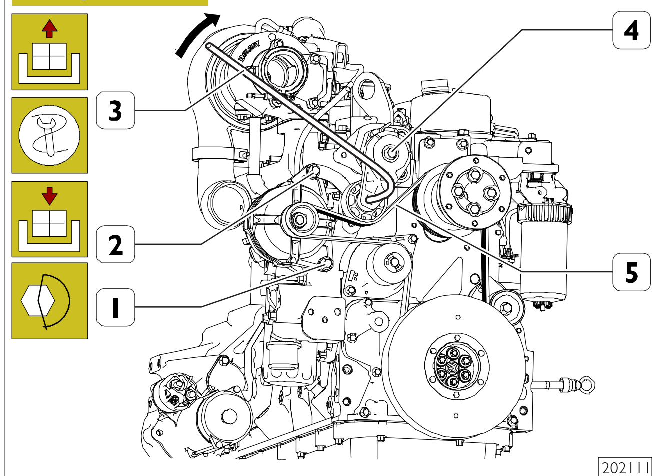
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 30



- ❑ Unscrew the screw (1) anchoring the alternator to its lower support and the screw (2) securing the bracket.

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(2)	2	Screw M10x1.5

- ❑ Remove the alternator from its housing.

Refitting

Position the alternator in its housing.

- ❑ Use the special tool (3) to turn the automatic tensioner in the direction of the arrow (4) and reposition the belt (5) inside the shoulders of all the pulleys.
- ❑ Tighten the bolt (1) anchoring the alternator to its lower support and the screw (2) fixing the alternator to the bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	43 ± 6 Nm
(2)	2	Screw M10x1.5	43 ± 6 Nm

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR WATER PUMP REMOVAL/REFITTING

Removal

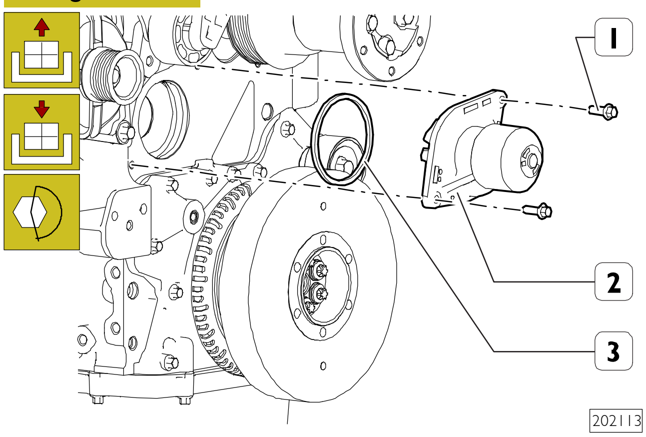
Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Figure 31



- ❑ Loosen and remove the screws (1).
- ❑ Take the water pump (2) out of its housing.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25

- ❑ Recover the gasket (3).

Refitting

- ❑ Insert the gasket (3) into the seat on the crankcase.
- ❑ Position the water pump (2) in its housing and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm

Fit the belt as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

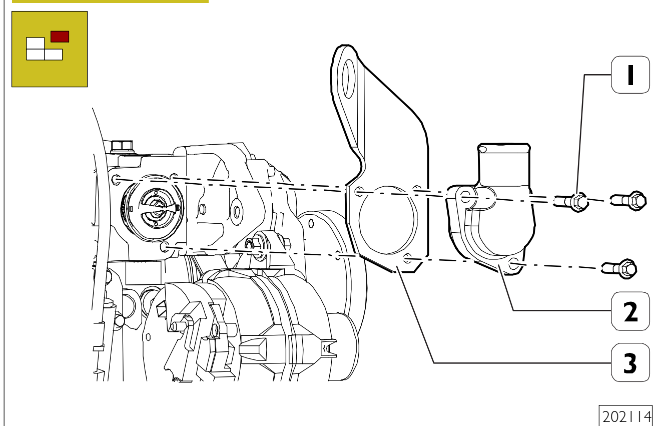
PROCEDURE FOR THERMOSTAT REMOVAL/REFITTING

Removal NEF67 TM1F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

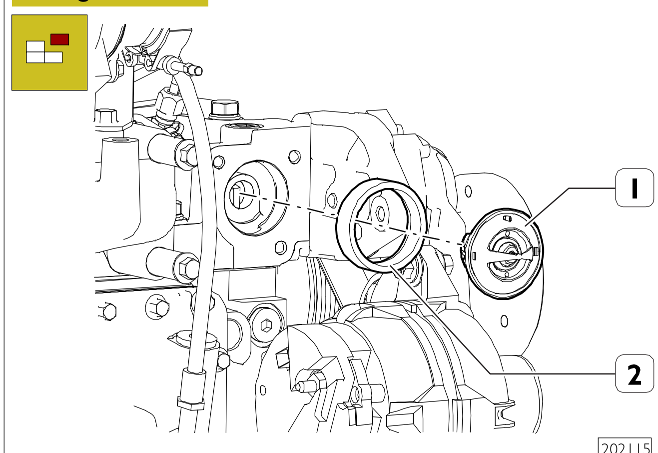
Figure 32



- ❑ Unscrew the screws (1) securing the thermostat cover (2).
- ❑ Remove the thermostat cover (2).
- ❑ Remove the lifting eyelet (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1

Figure 33



- ❑ Remove the thermostat assembly (1).
- ❑ Remove the gasket (2) of the cover.

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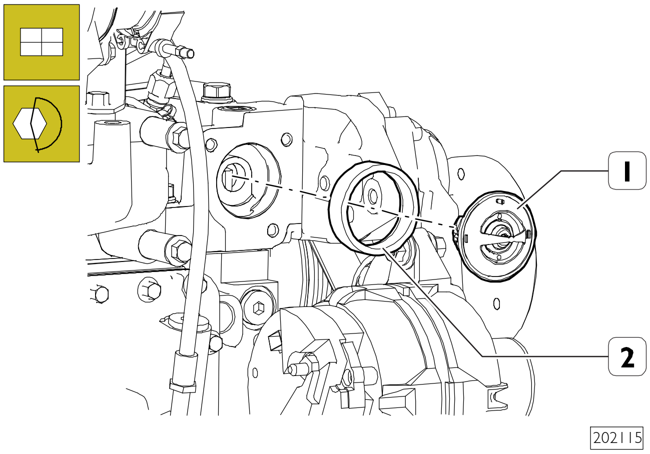
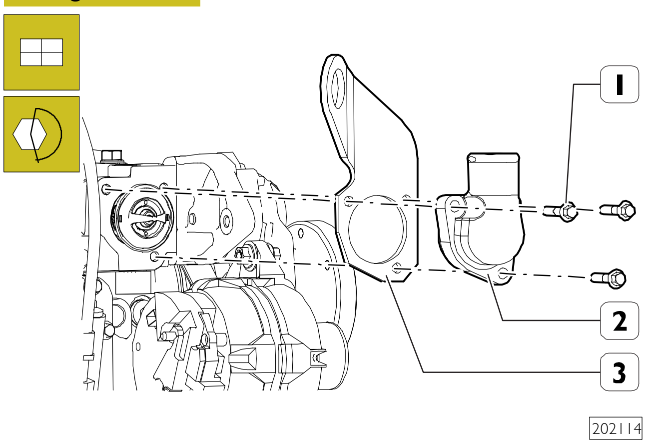
Refitting

Figure 34



- ❑ Insert the gasket (2) of the cover in the specific seat.
- ❑ Insert the thermostat assembly (1).

Figure 35



- ❑ Position the lifting eyelet (3).
- ❑ Position the thermostat cover (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1	10 ± 2 Nm

Fit the radiator as described in the relevant section.

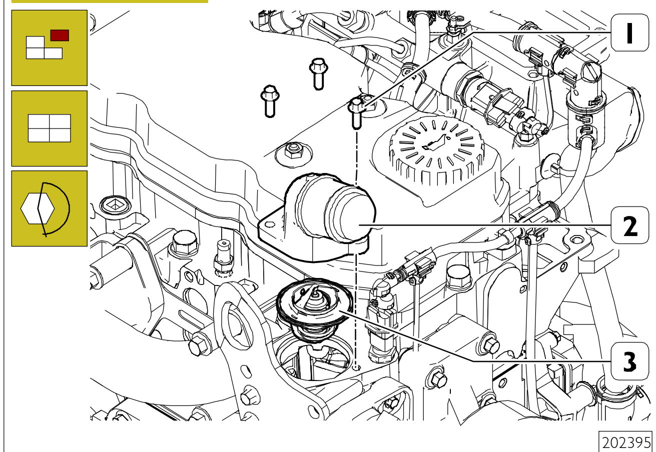
Fit the protection grille as described in the relative procedure.

Removal NEF67 TE1F/TE2F engines

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Figure 36



- ❑ Unscrew the screws (1) securing the thermostat cover (2).
- ❑ Remove the thermostat cover (2).
- ❑ Remove the thermostat (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Refitting

- ❑ Insert the thermostat assembly (3) into the relative seat.
- ❑ Position the thermostat cover (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	10 ± 2 Nm

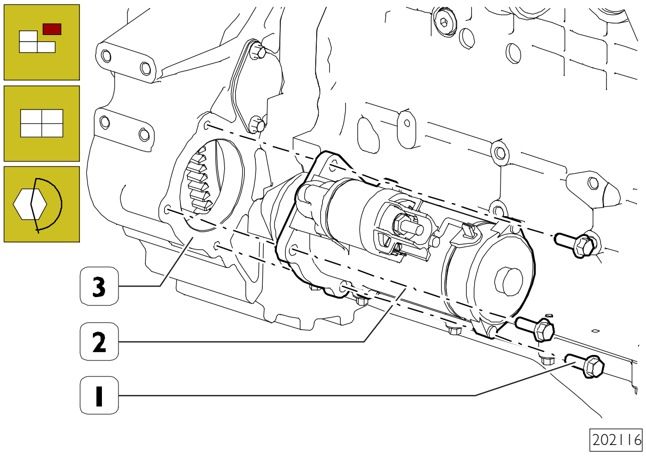
Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

PROCEDURE FOR ELECTRIC STARTER MOTOR REMOVAL/REFITTING

Removal

Figure 37



- ❑ Unscrew the screws (1) securing the starter motor (2) to the flywheel housing (3).
- ❑ Remove the starter motor (2) from its seat.

Ref.	No.	Screws description
(1)	3	Screw M10x1.5

Refitting

- ❑ Insert the starter motor (2) in its seat at the flywheel housing (3).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M10x1.5	43 ± 6 Nm

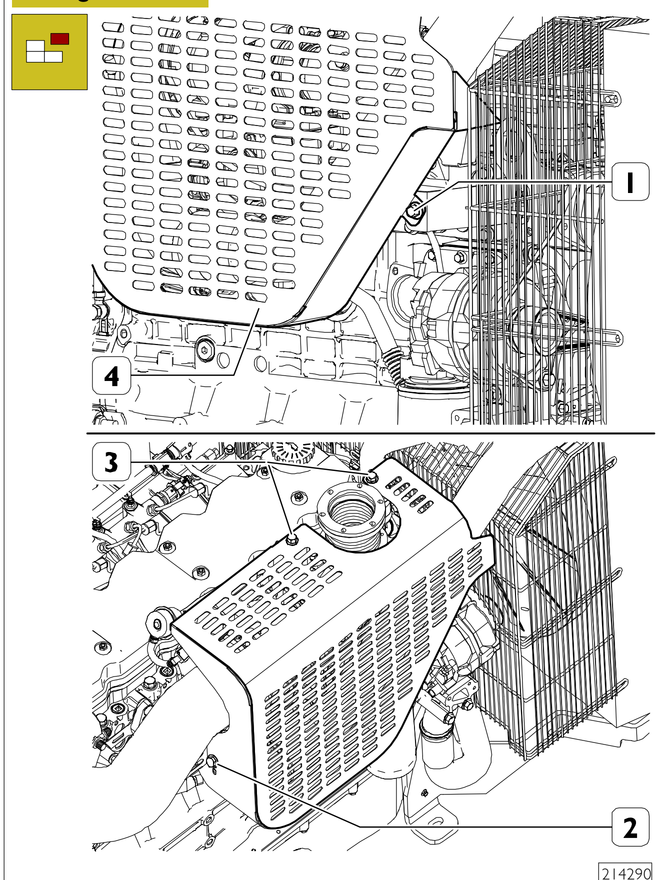
PROCEDURE FOR TURBOCHARGER REMOVAL/REFITTING

Removal

Remove the radiator as described in the relevant section.

Remove the air filter as described in the relevant section.

Figure 38



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- ❑ Unscrew the screws (1, 2 and 3).
- ❑ Remove the turbocharger protection grille (4).

Ref.	No.	Screws description
(1)	1	Screw M8x1x10
(2)	2	Screw M8x1x10
(3)	2	Screw M8x1x10

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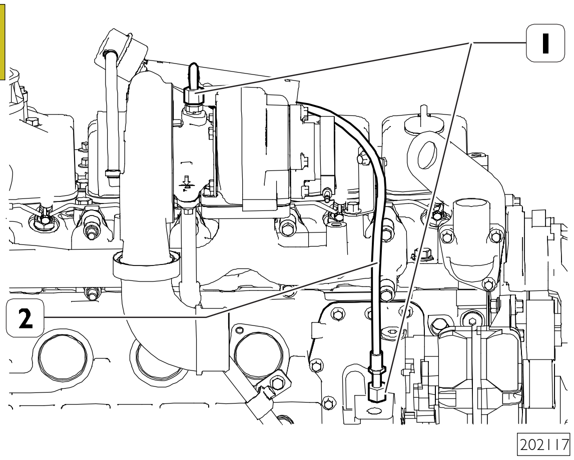
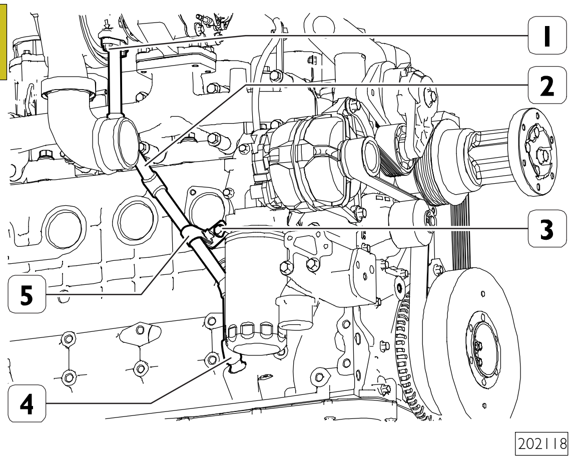
Figure 39



- ❑ Unscrew the delivery pipe (2) fittings (1).

Ref.	No.	Screws description
(1)	2	Fitting M16

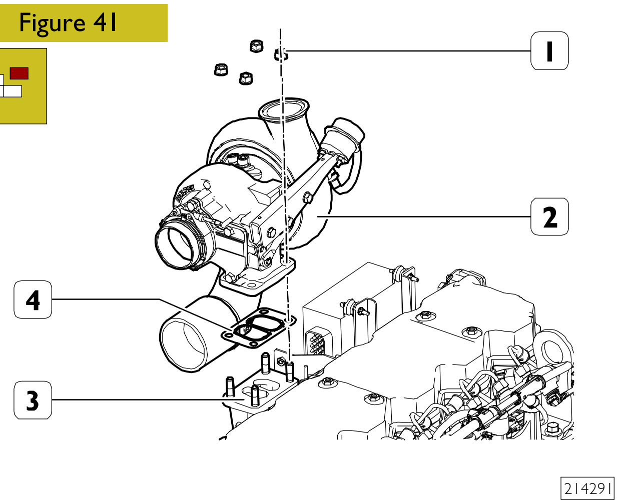
Figure 40



- ❑ Unscrew the screws (1) supporting the oil return pipe (2).
- ❑ Unscrew the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- ❑ Unscrew the fitting (4).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25
(3)	1	Screw M8x16
(4)	1	Fitting M16

Figure 41

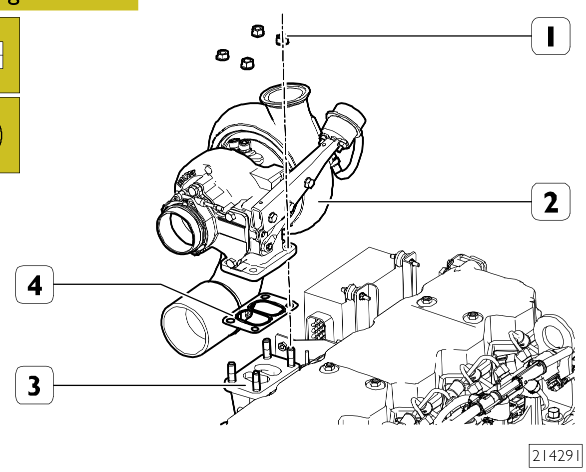


- ❑ Unscrew the nuts (1) securing the turbocharger (2) to the exhaust manifold (3).
- ❑ Recover the gasket (4).

Ref.	No.	Screws description
(1)	4	Nut M10x1.5

Refitting

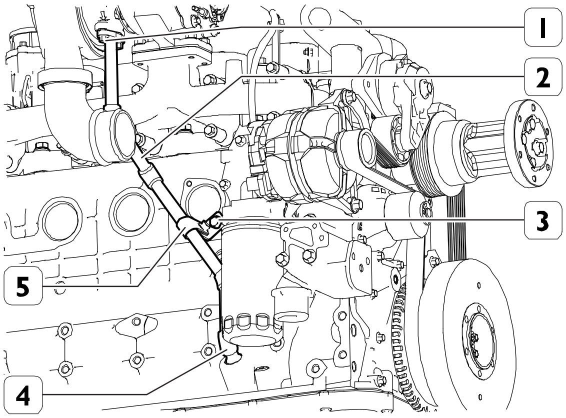
Figure 42



- ❑ Position the gasket (4) on the exhaust manifold (3).
- ❑ Position the turbocharger (2) in correspondence to the specific seat.
- ❑ Tighten the nuts (1) securing the turbocharger (2) to the exhaust manifold (3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M10x1.5	43 ± 6 Nm

Figure 43

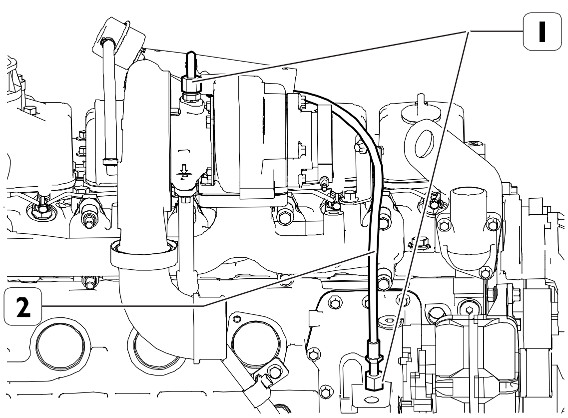


202118

- Connect the oil return pipe (2) from the turbocharger.
- Tighten the fastening screws (1).
- Tighten the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- Tighten the fitting (4).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm
(3)	1	Screw M8x16	24 ± 4 Nm
(4)	1	Fitting M16	36 ± 5 Nm

Figure 44

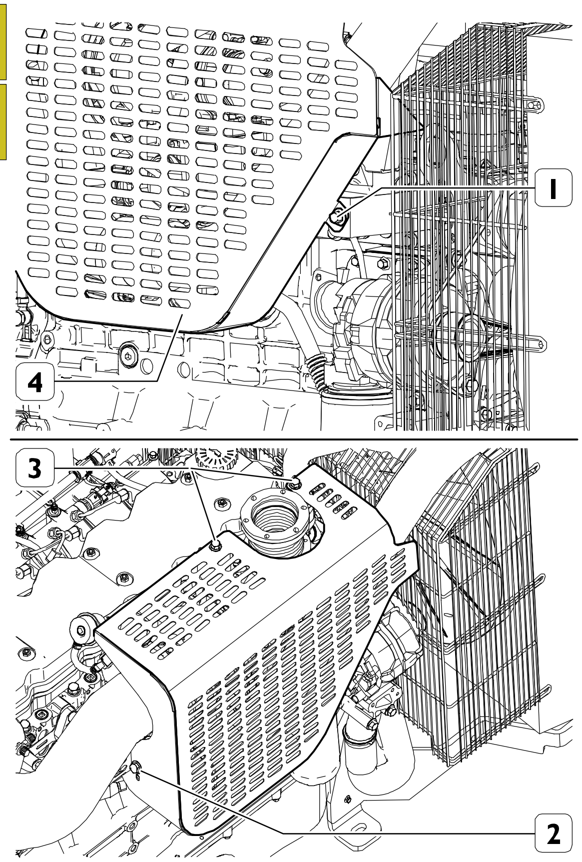


202117

- Connect the oil delivery pipe (2) to the turbocharger.
- Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	M16 nut	36 ± 5 Nm

Figure 45



214290

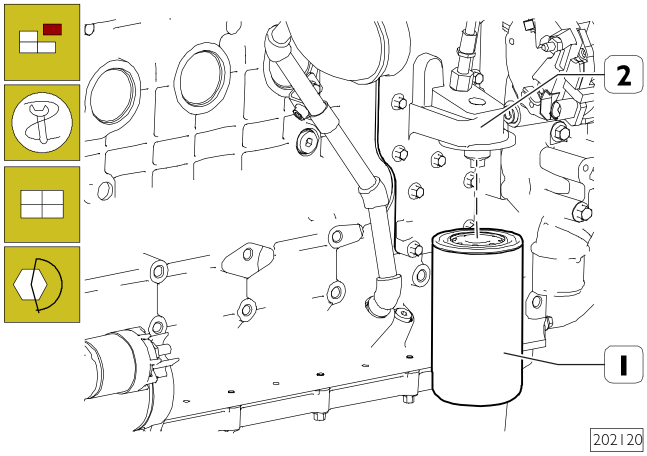
- Position the grille (4) protecting the turbocharger.
- Tighten the screws (1, 2 and 3).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1x10	36 ± 5 Nm
(2)	2	Screw M8x1x10	36 ± 5 Nm
(3)	2	Screw M8x1x10	36 ± 5 Nm

PROCEDURE FOR OIL FILTER REMOVAL/REFITTING

Removal

Figure 46



Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

- ❑ Use tool 99360076 to unscrew the oil filter (1).

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Refitting

- ❑ Tighten the oil filter (1) in correspondence to the slot on the heat exchanger (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

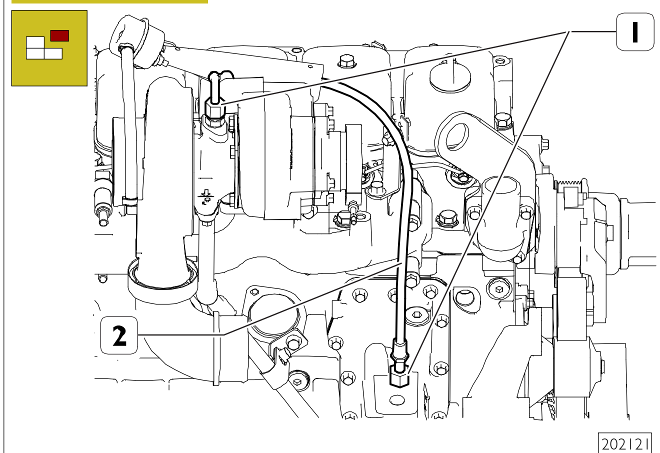
PROCEDURE FOR HEAT EXCHANGER REMOVAL/REFITTING

Removal

Remove the oil filter as described in the relevant section.

Remove the alternator as described in the relevant section.

Figure 47

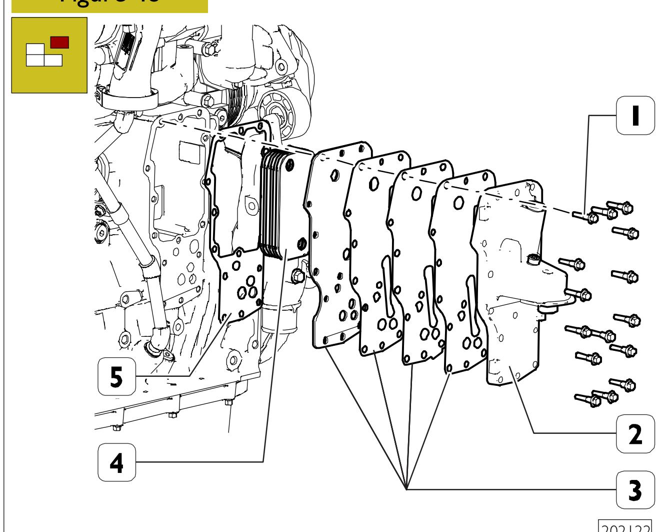


Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Unscrew the delivery pipe (2) fittings (1).

Ref.	No.	Screws description
(1)	2	M16 nut

Figure 48



- ❑ Unscrew the screws (1) and remove the oil filter housing (2).
- ❑ Extract the insulating plates (3).
- ❑ Extract the heat exchange elements (4).
- ❑ Remove the seal gasket (5).

Ref.	No.	Screws description
(1)	15	Screw M8x1.25x35

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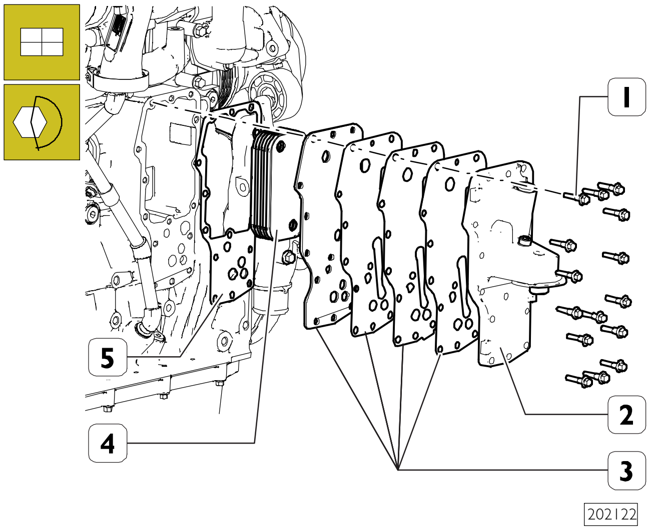
Refitting

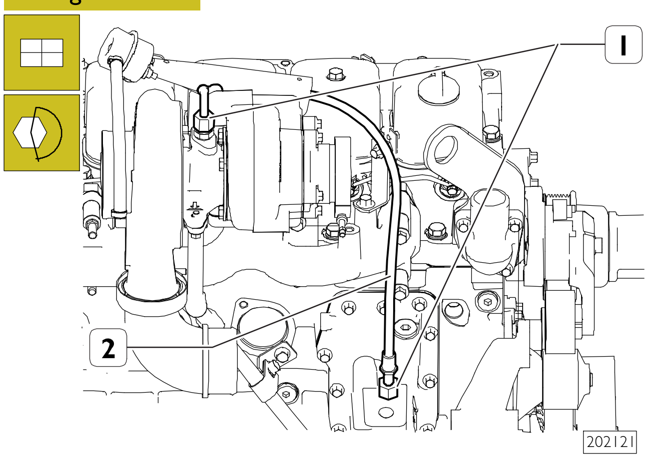
Figure 49



- ❑ Position the gasket (5).
- ❑ Insert the heat exchange elements (4).
- ❑ Position the insulating plates (3).
- ❑ Position the oil filter housing (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	15	Screw M18x1.25x35	26 ± 4 Nm

Figure 50



- ❑ Connect the oil delivery pipe (2) to the turbocharger.
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	M16 nut	36 ± 5 Nm

Fit the alternator as described in the relevant section.

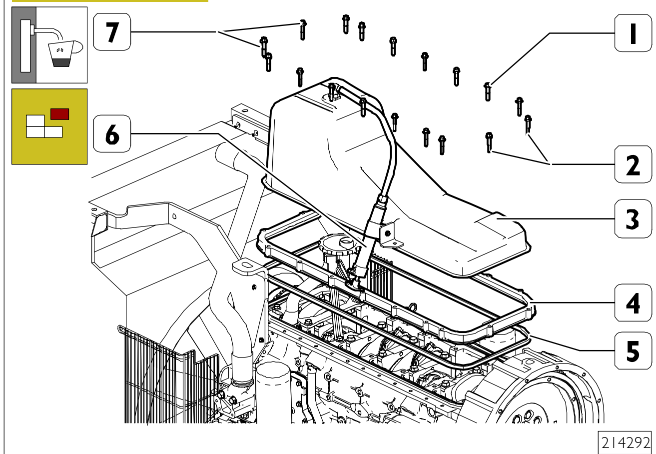
Fit the oil filter as described in the relevant section.

Proceed to refill the heat exchanger with the lubricant oil and coolant.

PROCEDURE FOR OIL SUMP REMOVAL/REFITTING

Removal

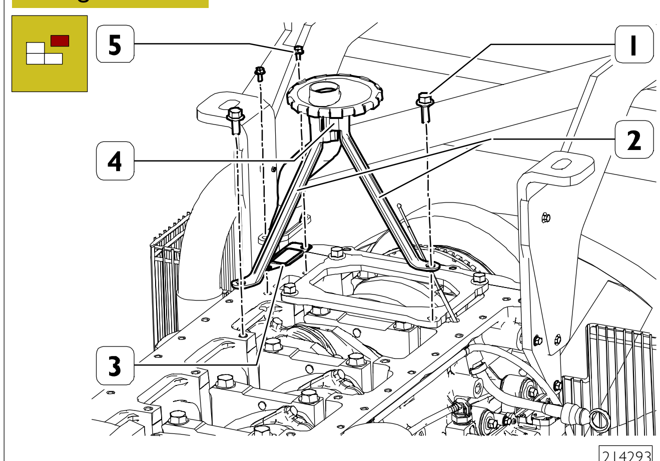
Figure 51



- ❑ Drain the lubricant oil from the engine through the pump (6).
- ❑ Overturn the engine.
- ❑ Unscrew the screws (1 and 2) fixing the oil sump.
- ❑ Remove the oil sump (3).
- ❑ Remove the spacer (4) and the gasket (5).

Ref.	No.	Screws description
(1)	14	Screw M8x1.25x40
(2)	4	Screw M8x1.25x45

Figure 52



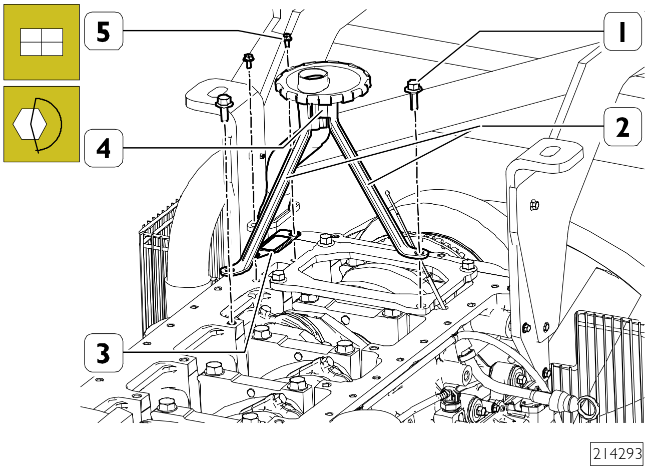
- ❑ Unscrew the screws (1 and 5).
- ❑ Remove the suction strainer (4) together with the support straps (2).
- ❑ Recover the gasket (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x20
(5)	1	Screw M10x1.5x25

Print P4D32N009 E

Refitting

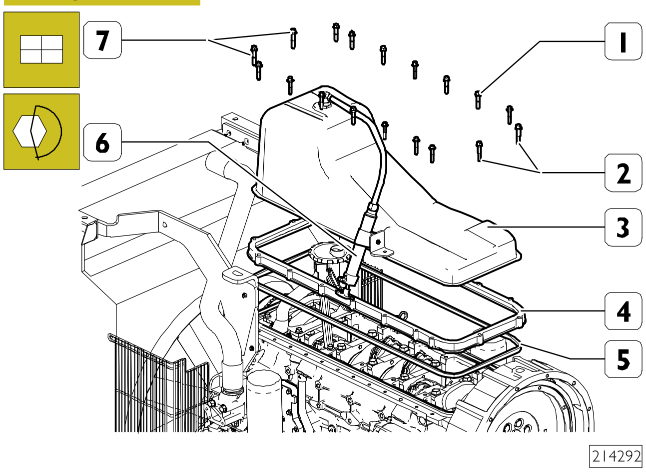
Figure 53



- Position the gasket (3).
- Position the suction strainer (4) together with the support straps (2) in the relative seat.
- Tighten the screws (1 and 5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x20	24 ± 4 Nm
(5)	1	Screw M10x1.5x25	43 ± 5 Nm

Figure 54



- Position the gasket (5) and the spacer (4) in the specific seats.
- Position the oil sump (3).
- Tighten the screws (1 and 2).
- Overturn the engine

Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M8x1.25x40	24 ± 4 Nm
(2)	4	Screw M8x1.25x45	24 ± 4 Nm

Refill with lubricant oil.

PROCEDURE FOR OIL PUMP REMOVAL/REFITTING

Removal

Remove the protection grille as described in the relative procedure.

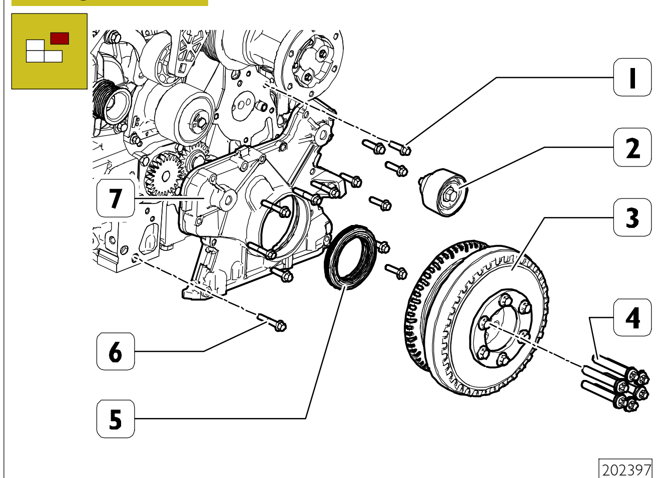
Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the ancillary belt as described in the relevant section.

Remove the oil sump as described in the relevant section.

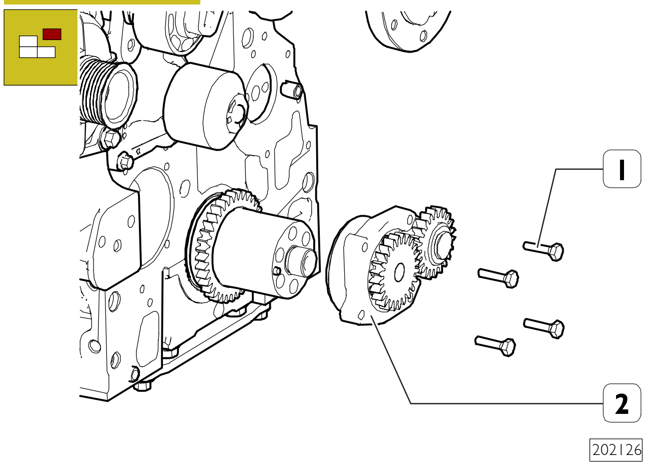
Figure 55



- Unscrew the screws (4) securing the front damper.
- Remove the front damper (3) together with the phonic wheel.
- Unscrew the guide pulley screw (2).
- Unscrew the screws (1 and 6) securing the front cover (7).
- Remove the gasket (5)
- Remove the front cover (7).

Ref.	No.	Screws description
(1)	8	Screw M8x1.25x30
(2)	1	Screw M10x1.5x70
(4)	6	Screw M12x1.25x78.5
(6)	5	Screw M8x1.25x45

Figure 56

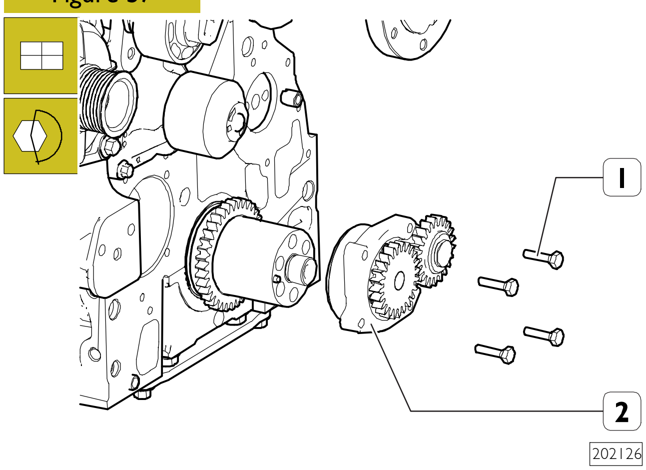


- ❑ Unscrew the supporting screws (1).
- ❑ Remove the oil pump (2).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x30

Refitting

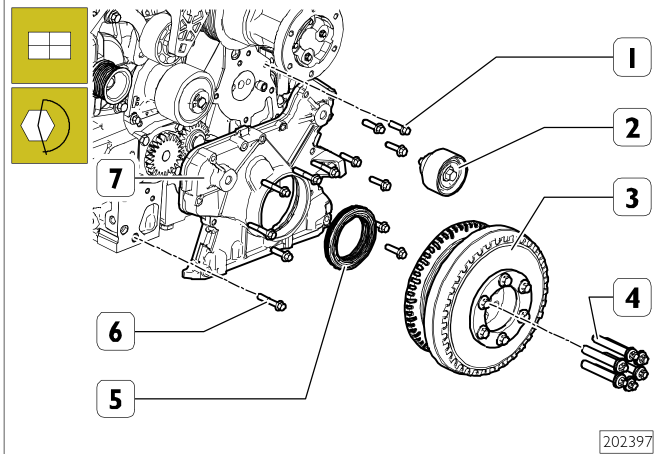
Figure 57



- ❑ Fit the oil pump (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x30	24 ± 4 Nm

Figure 58



- ❑ Mount the front cover (7) and place the gasket (5) in its seat.
- ❑ Tighten the screws (1 and 6).
- ❑ Tighten the guide pulley screw (2).
- ❑ Fit the front damper (3) together with the phonic wheel and tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M8x1.25x30	24 ± 4 Nm
(2)	1	Screw M10x1.5x70	43 ± 6 Nm
(4)	6	Screw M12x1.25x78.5	68 ± 7 Nm
(6)	5	Screw M8x1.25x45	24 ± 4 Nm

Fit the oil sump as described in the relevant section.

Fit the ancillary belt as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

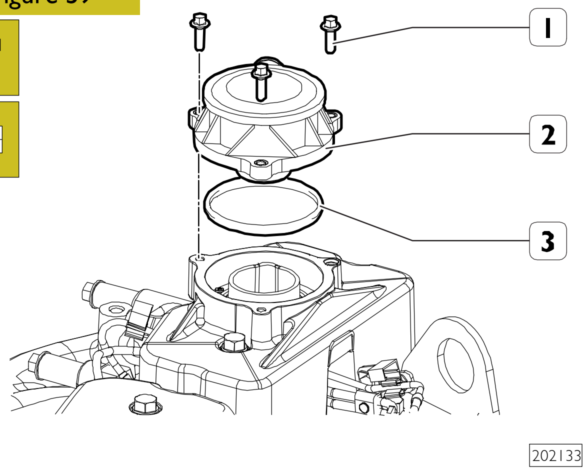
Fit the protection grille as described in the relative procedure.

Refill with lubricant oil.

PROCEDURE FOR OIL VAPOUR RECIRCULATION SYSTEM REMOVAL/REFITTING

Removal NEF67 TM1F engines

Figure 59



- ❑ Unscrew the screws (1) securing the oil vapour filter (2).
- ❑ Take out the gasket (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Refitting

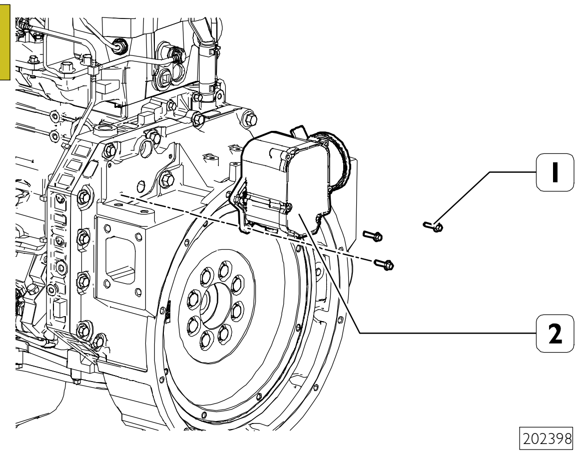
- ❑ Insert the gasket (3) into its seat.
- ❑ Fit the oil vapour filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	-

Removal NEF67 TE1F/TE2F engines

Remove the air filter as described in the relevant section

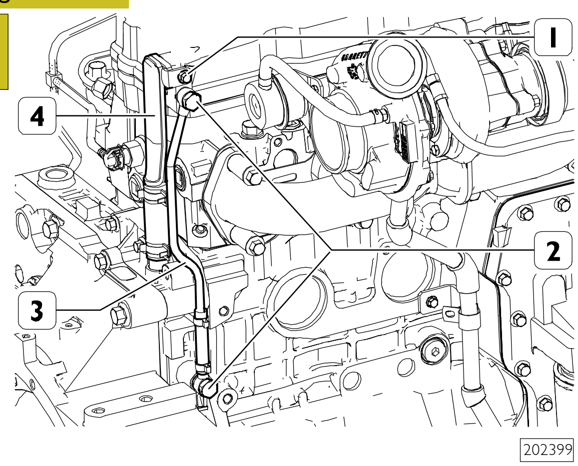
Figure 60



- ❑ Unscrew the screws (1) securing the oil vapour filter (2).
- ❑ Remove the filter (2).

Ref.	No.	Screws description
(1)	3	Screw M6x1x25

Figure 61

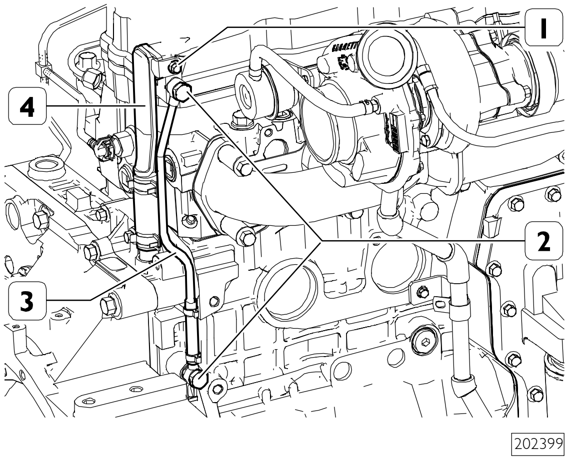


- ❑ Unscrew the support screw (1) from the clamp.
- ❑ Remove the engine breather pipe (4).
- ❑ Unscrew the threaded couplings (2) and remove the pipe (3).

Ref.	No.	Screws description
(1)	1	Screw -
(2)	2	Coupling M12x1.5x11

Refitting

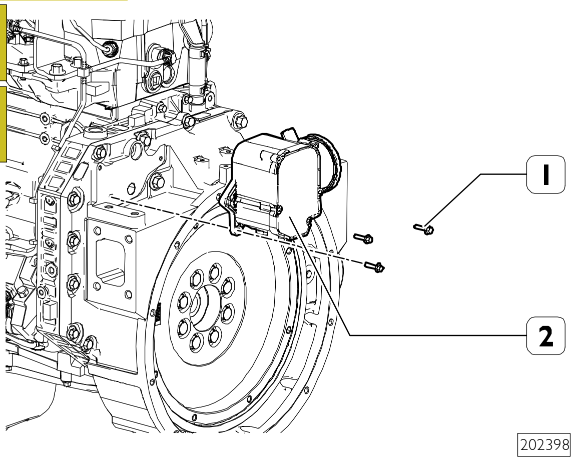
Figure 62



- Position the pipe (3) in its seat and tighten the threaded couplings (2).
- Insert the engine breather pipe (4) in its seat.
- Tighten the support screw (1) to the clamp.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw -	-
(2)	2	Coupling M12x1.5x11	-

Figure 63



- Place the filter (2) in its seat.
- Fit the oil vapour filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x25	10 ± 2 Nm

Fit the air filter as described in the relevant section

PROCEDURE FOR LOW PRESSURE FUEL PIPE REMOVAL/REFITTING

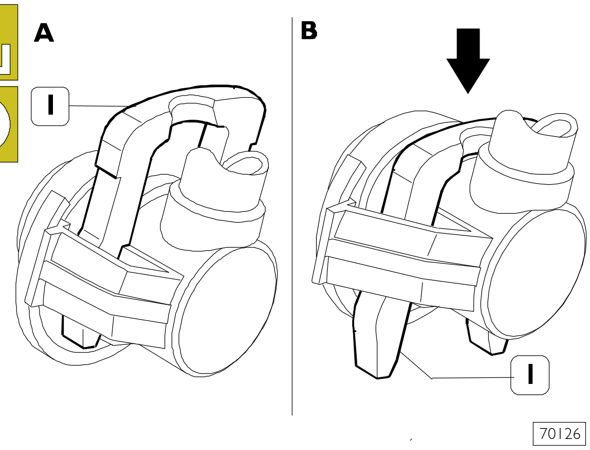
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF67 TM1F engines

Remove the oil vapour filter as described in the relevant section.

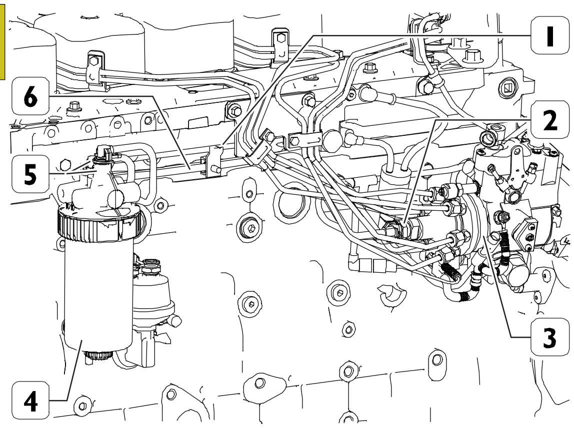
Figure 64



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Figure 65

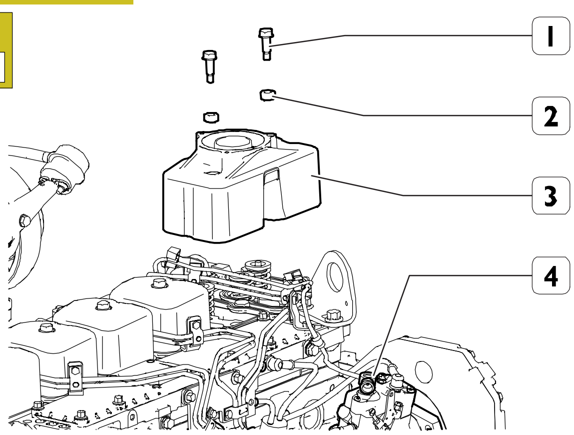


202127

- ❑ Unscrew the screw (1) securing the support yoke.
- ❑ Unscrew the nut (2) connecting to the injection pump (3).
- ❑ Take out the quick-fit couplings (5) on the fuel filter (4) and remove the pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M8x16
(2)	1	Nut -

Figure 66

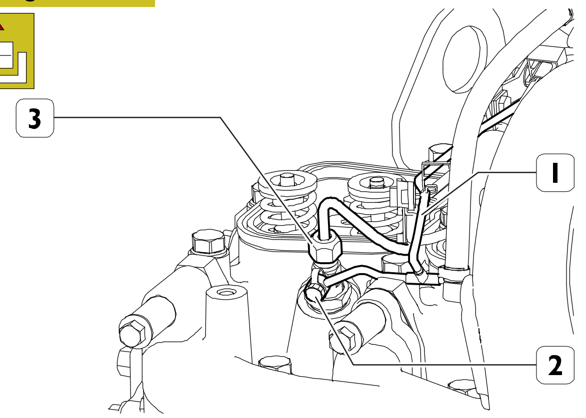


202160

- ❑ Unscrew the fastening screws (1) and remove the cover (3).
- ❑ Recover the sound-proofing elements (2).
- ❑ Remove the ring for the adjustable fitting (4) from the injection pump.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25

Figure 67

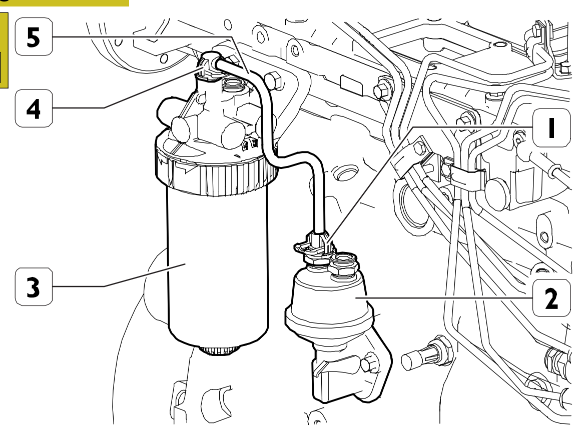


202161

- ❑ Unscrew the 6 threaded fittings (2) passing through the injectors (3).
- ❑ Remove the exhaust pipes (1) from the injectors (3).

Ref.	No.	Screws description
(2)	6	Nut M6x1

Figure 68



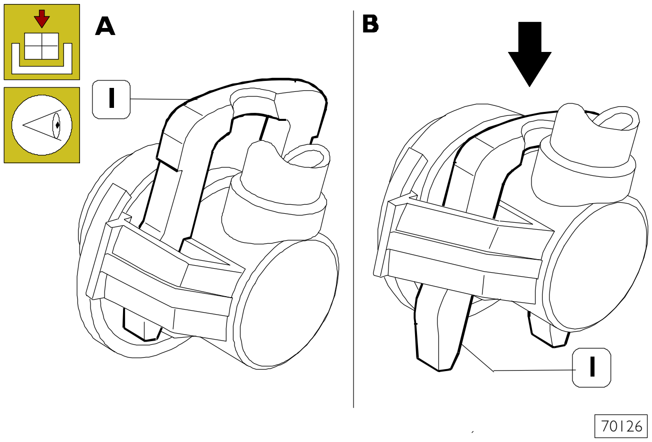
202128

- ❑ Unscrew the connector (1) on the priming pump (2).
- ❑ Take out the quick-fit coupling (4) on the fuel filter (3).
- ❑ Remove the pipe (5).

Ref.	No.	Screws description
(1)	1	Nut M12x1.5

Refitting

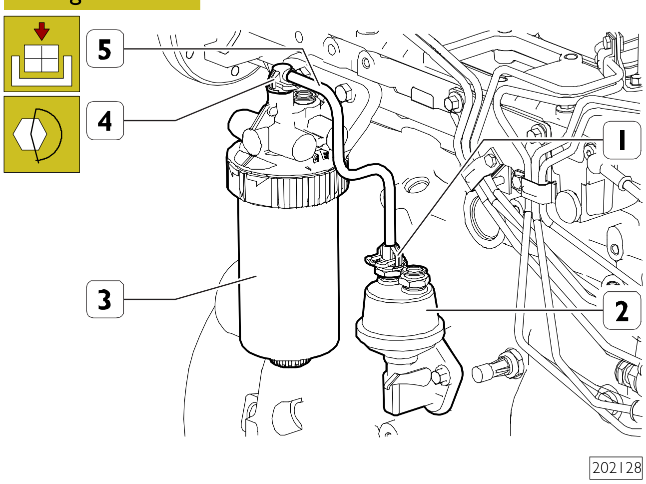
Figure 70



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

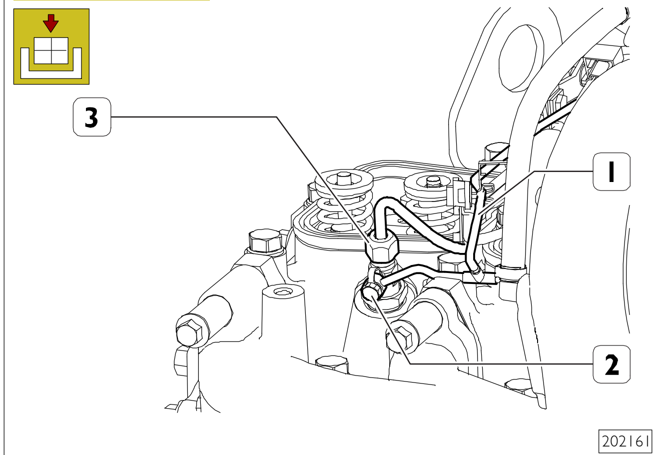
Figure 69



- ❑ Separately connect the pipe (5) to the quick-fit couplings (1 and 2).
- ❑ Connect the quick-fit coupling (4) on the fuel filter.
- ❑ Tighten the quick-fit coupling (1) on the priming pump (2).

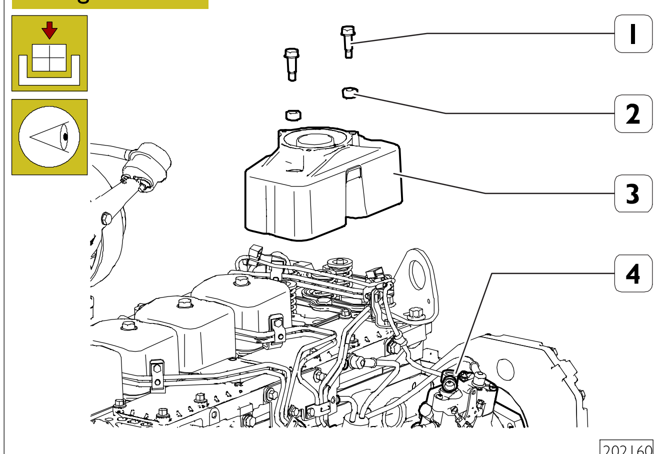
Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M12x1.5	-

Figure 71



- ❑ Position the pipes (1) and connect the 6 threaded fittings (2) passing the injectors (3).

Figure 72



- ❑ Fix the ring for the adjustable fitting (4) to the injection pump.
- ❑ Insert the sound-proofing elements (2).
- ❑ Position the tappet cover (3) and tighten the screws (1) securing the tappet cover (3).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25	24 ± 4 Nm

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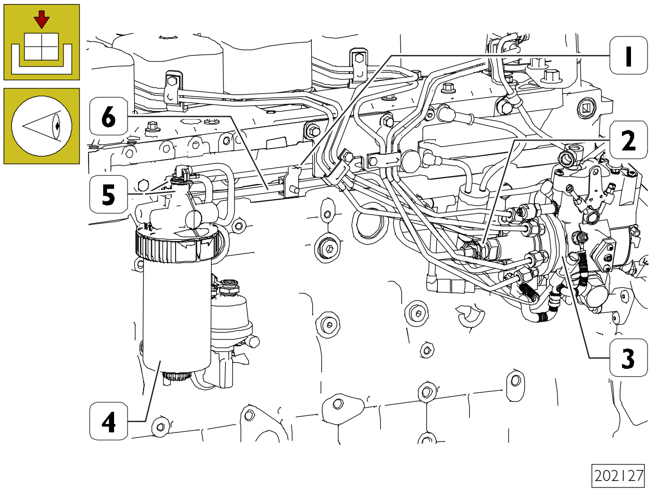
Fit the oil vapour filter as described in the specific procedure.

Figure 73

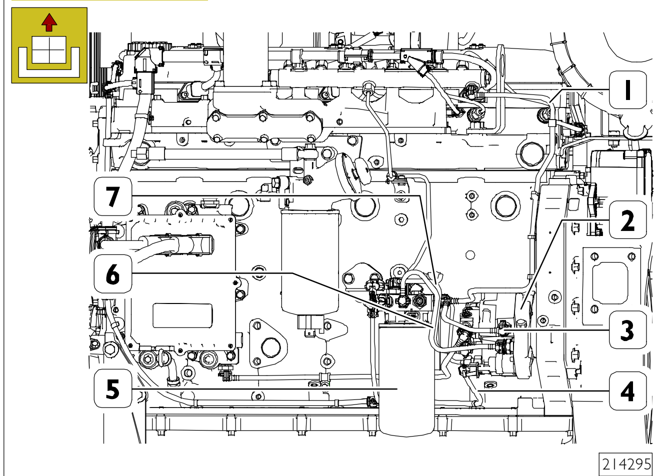


- ❑ Separately connect the pipe (7) to the quick-fit coupling (6).
- ❑ Connect the quick-fit coupling (5) on the fuel filter (4).
- ❑ Tighten the nut (2) on the injection pump (3).
- ❑ Tighten the screw (1) securing the support bracket.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x16	-
(2)	1	Nut -	-

Removal NEF67 TE1F/TE2F engines

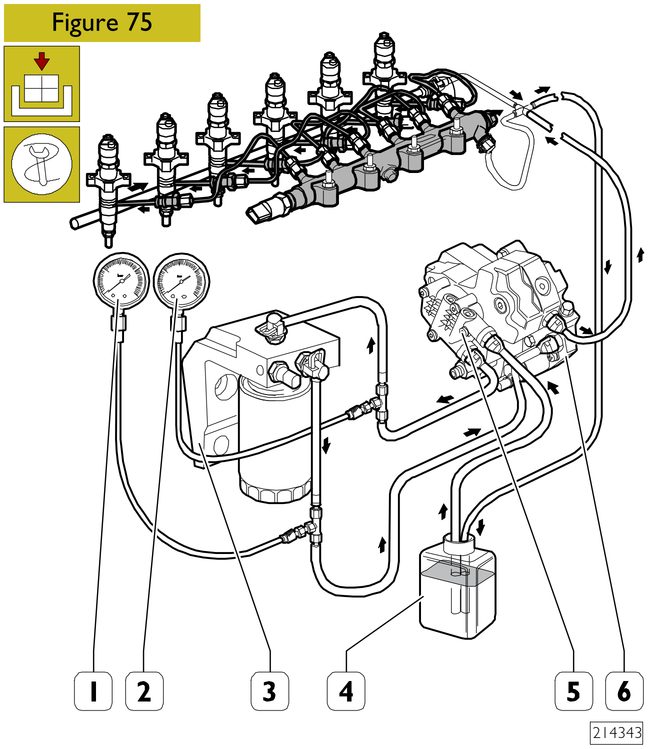
Figure 74



- ❑ Remove the excess fuel return pipe (1) from the Common Rail.
- ❑ Remove the fuel return pipe (3) for the injection pump (2) from the filter (5).
- ❑ Remove the fuel supply pipe (4) from the control unit.
- ❑ Remove the fuel delivery pipe (6) from the injection pump (2) to the filter (5).
- ❑ Remove the fuel delivery pipe (7) for the injection pump (2) from the filter (5).

Check mechanical pump power using tool 99305453

Figure 75



1. Filter outlet pipe pressure gauge -
2. Filter inlet pipe pressure gauge -
3. Fuel filter support - 4. External tank - 5. Gear pump -
6. High pressure mechanical feed pump CP.3.3

- ❑ The gear pump (5) has the function of feeding the high-pressure pump CP.3.3 (6). It is controlled by the shaft of the high pressure pump and is fitted on its rear part. Keeping the kit instrumentation mounted as in the previous figure with batteries charged at 24.7 V, the engine should be started within 20 seconds of activation of the starter motor, sucking the diesel from an external container (4) placed up to 1 meter lower than the engine.
- ❑ If the pump can not suck diesel within the indicated time and then start the engine, replace the pump.

NOTE If the test was performed with a new mechanical supply pump from Spare Parts, before doing the test, a first start is necessary in order to restore normal operation conditions.

- ❑ After starting the engine at 1500 rpm check the pressure gauge (2).

Technical data	
Pressure value at pressure gauge	6 ÷ 9 bar

- ❑ If measured value is below 6 bar replace the pump, and if the value is above 9 bar replace the diesel filter.
- ❑ The pressure gauge (1) must show a pressure above 5 bar; if the pressure is lower, replace the diesel fuel filter. If the problem is not cleared, check the seals of the high pressure pump inlet and fuel filter support unions.

NOTE In Spare a new mechanical supply pump has been introduced, that is interchangeable with the previous version.

The new pump has a new seal protecting against water entering the area where the two pumps are joined, thus preventing the formation of rust which could cause breakage of the shaft connecting the high and low pressure pumps.

The pump is equipped with seal, however the single seal is provided as a spare.

When replacing the low pressure pump, accurately clean the coupling area with the high-pressure pump CP.3.3.

- ❑ Remove tool 99305453.

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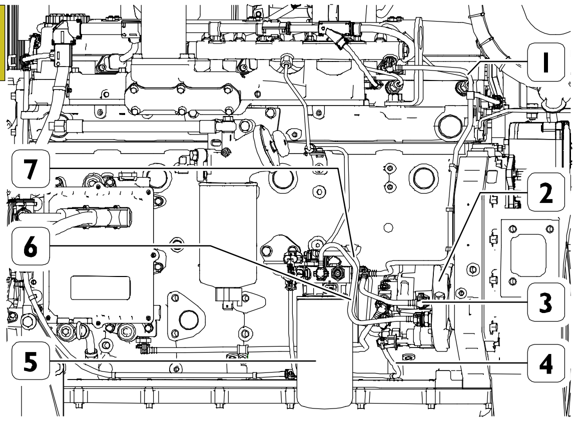
Refitting

Figure 76



214295

- ❑ Connect the fuel delivery pipe (7) for the injection pump (2) from the filter (5).
- ❑ Connect the fuel delivery pipe (6) from the injection pump (2) to the filter (5).
- ❑ Connect the fuel supply pipe (4) from the control unit.
- ❑ Connect the fuel return pipe (3) for the injection pump (2) from the filter (5).
- ❑ Connect the excess fuel return pipe (1) from the Common Rail.

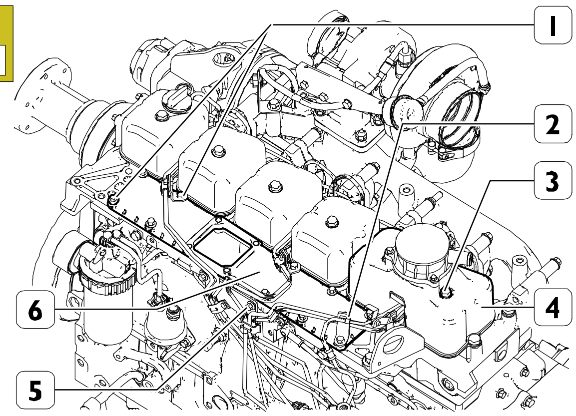
PROCEDURE FOR HIGH PRESSURE FUEL PIPE REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF67 TM1F engines

Figure 77

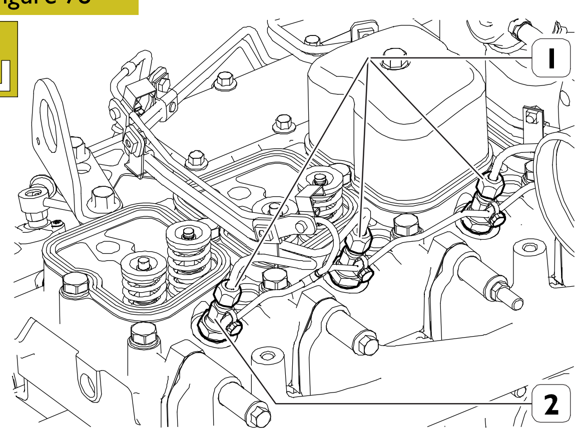


214296

- ❑ Unscrew the support bracket (2) fastening screws (1) at the intake manifold (5).
- ❑ Unscrew the screws (3) securing the tappet cover (4).
- ❑ Unscrew the screws (6) securing the support plate.

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25
(2)	2	Screw -
(5)	2	Screw M8x1.25x16

Figure 78

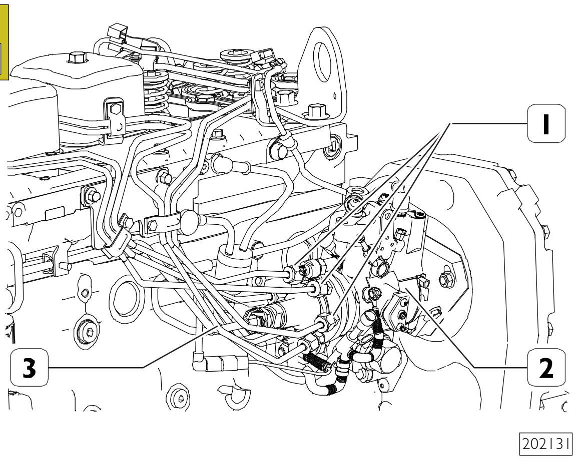


202130

- ❑ Unscrew the fittings (1) connecting to the injectors (2).

Ref.	No.	Screws description
(1)	6	Nut M14x1.5

Figure 79



- Unscrew the fittings (1) connecting to the injection pump (2).
- Remove the high pressure pipes (3).

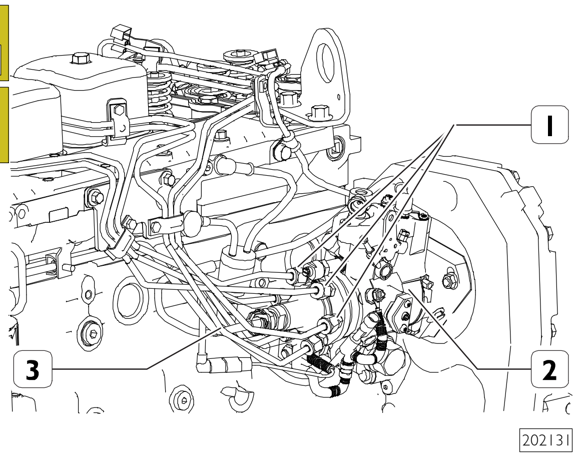
Ref.	No.	Screws description
(1)	6	Nut -

Refitting

The pipes which were removed cannot be refitted.

They must be replaced.

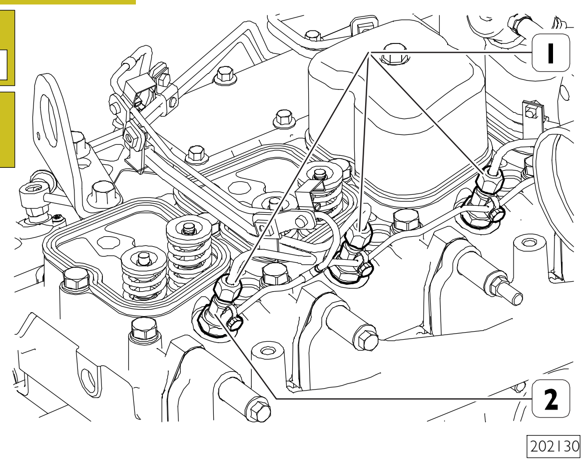
Figure 80



- Connect the high pressure pipes (3) to the injection pump (2)
- Tighten the fitting nuts (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut	-

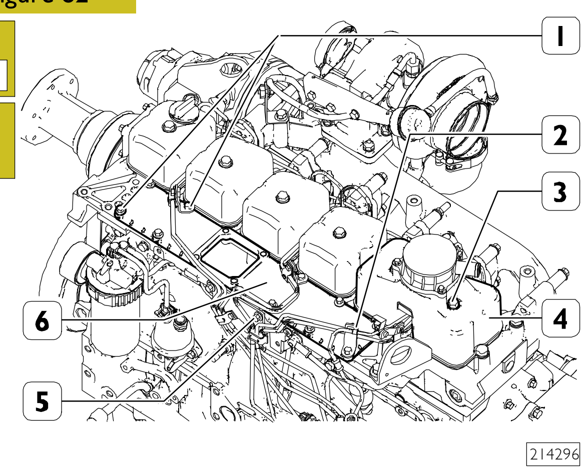
Figure 81



- Connect the coupling nuts (1) to the injectors (2).
- Tighten the fitting nuts (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M14x1.5	37 ± 3 Nm

Figure 82

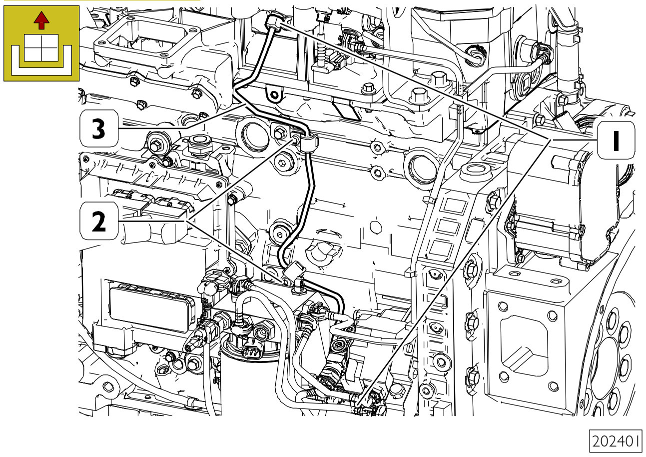


- Tighten the screws (5) securing the support plate.
- Position the support clamps (2) and tighten the screws (1) securing the intake manifold (6).
- Position the tappet cover (4) and tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	24 ± 4 Nm
(2)	2	Screw	-
(5)	2	Screw M8x1.25x16	24 ± 4 Nm

Removal NEF67 TE1F/TE2F engines

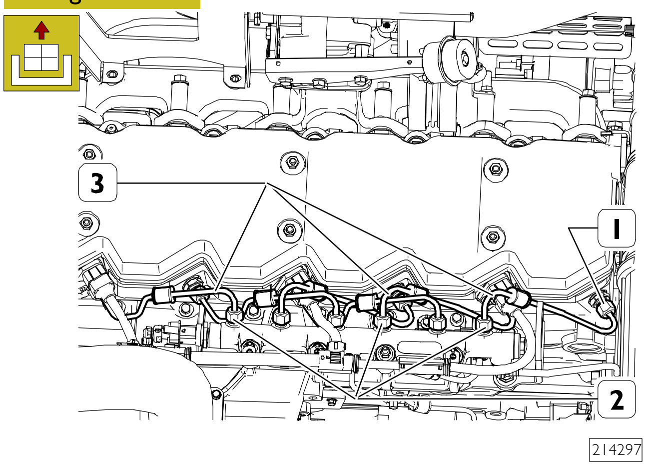
Figure 83



- ❑ Unscrew the screws (2) of the support clamps.
- ❑ Unscrew the fittings (1) connecting the fuel delivery pipe (3) to the Common Rail.
- ❑ Remove the pipe (3).

Ref.	No.	Screws description
(1)	2	Connector M14x1.5
(2)	2	Screw M6x1x12

Figure 84



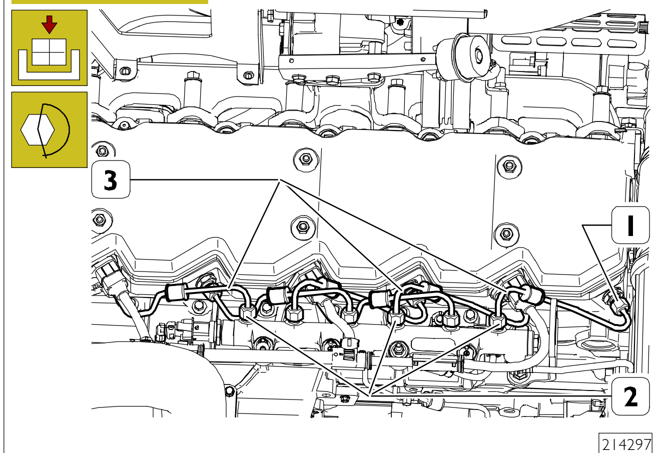
- ❑ Unscrew the fittings (2) connecting the Common Rail.
- ❑ Unscrew the fittings (1) connecting to the injectors.
- ❑ Remove the pipes (3).

Ref.	No.	Screws description
(1)	6	Connector M14x1.5
(2)	6	Connector M14x1.5

Refitting

The pipes which were removed cannot be refitted. They must be replaced.

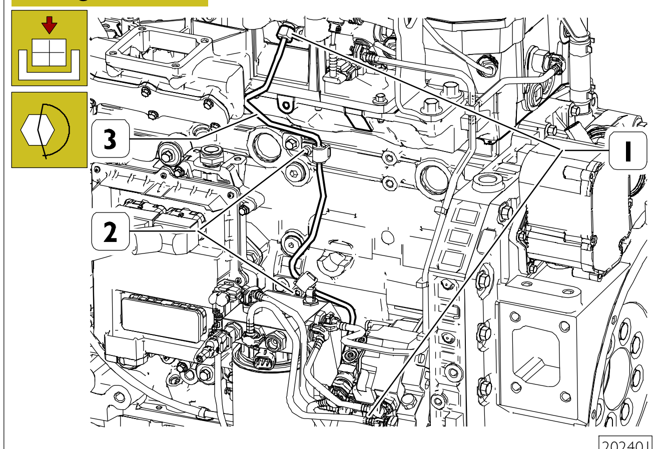
Figure 85



- ❑ Position the high pressure pipes (3).
- ❑ Screw the screws (2) to the support clamps.
- ❑ Tighten the fittings (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Connector M14x1.5	28 ± 2 Nm
(2)	6	Connector M14x1.5	28 ± 2 Nm

Figure 86



- ❑ Position the pipe (3).
- ❑ Screw the screws (2) to the support clamps.
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M14x1.5	28 ± 2 Nm
(2)	2	Screw M6x1.5x12	-

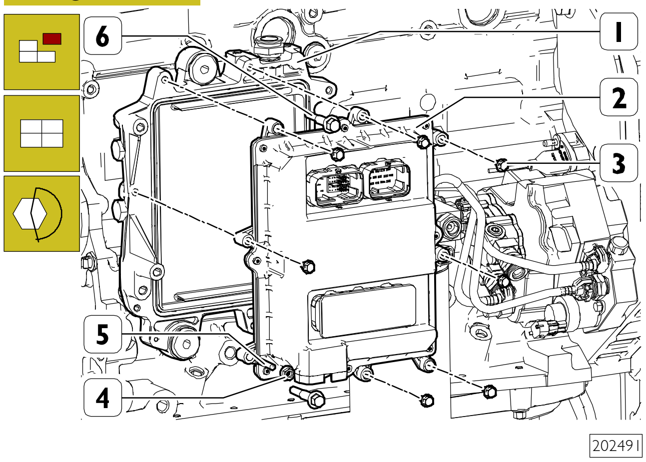
PROCEDURE FOR REMOVAL/REFITTING OF ELECTRONIC CONTROL UNIT

Removal NEF67 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Figure 87



- ❑ Unscrew the screws (3 and 6).
- ❑ Unscrew the nut (4) and the corresponding stud (5).
- ❑ Remove the control unit (2).
- ❑ Remove the support (1).

Ref.	No.	Screws description
(3)	7	Screw M6x1x30
(4)	1	Nut M6x1
(5)	1	Stud M6x1x25
(6)	3	Screw M8x1.25x45

Refitting

- ❑ Place the support (1) in its seat.
- ❑ Position the control unit (2).
- ❑ Tighten the stud (5) and the corresponding nut (4).
- ❑ Tighten the screws (3 and 6).

Ref.	No.	Screws description	Tightening torques
(3)	7	Screw M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	1	Stud M6x1x25	10 ± 2 Nm
(6)	3	Screw M8x1.25x45	24 ± 4 Nm

Fit the low pressure pipes as described in the relevant section.

Fit the engine cable as described in the relevant section.

PROCEDURE FOR FUEL FILTER REMOVAL/REFITTING

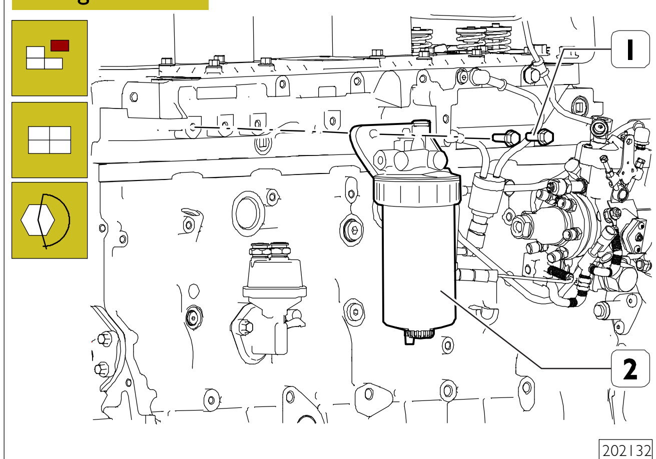
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF67 TM1F engines

Remove the low pressure pipe as described in the relevant section.

Figure 88



- ❑ Unscrew the screws (1) securing to the crankcase.
- ❑ Remove the fuel filter (2) together with the support and the filtering cartridge.

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x25

Refitting

- ❑ Set the fuel filter (2) and tighten the screws (1) securing it to the crankcase.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x25	80 ± 8 _Nm

Fit the low pressure pipes as described in the relevant section.

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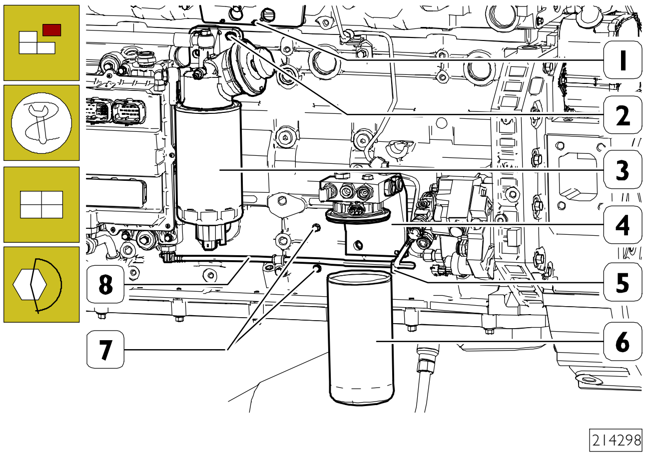
Removal NEF67 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Figure 89



- Disconnect the fuel pre-filter (3) from all connection pipes.
- Unscrew the screws (2) and recover their nuts (1).
- Remove the fuel pre-filter (3).
- Unscrew the cartridge (6) of the filter using tool 99360076.
- Remove the clamp (5) for supporting the pipe (8) in low pressure.
- Unscrew the screws (7) and remove the filter support (4).

Ref.	No.	Screws description
(1)	2	Nut M20x1.5
(2)	2	Screw M20x1.5
(6)	1	Cartridge M20x1.5
(7)	2	Screw M12x1.75x30

Refitting

- Position the support (4) in the relative seat and tighten the screws (7).
- Insert the clamp (5) for supporting the pipe (8) in low pressure.
- Tighten the cartridge (6) using tool 99360076.
- Position the pre-filter (3) and tighten the screws (2) and the relative nuts (1).
- Connect all the pipes to the pre-filter (3).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M20x1.5	-
(2)	2	Screw M20x1.5	20 0/+5 Nm
(6)	1	Cartridge M20x1.5	20 0/+5 Nm
(7)	2	Screw M12x1.75x30	80 ± 8 Nm

Fit the low pressure pipes as described in the relevant section.

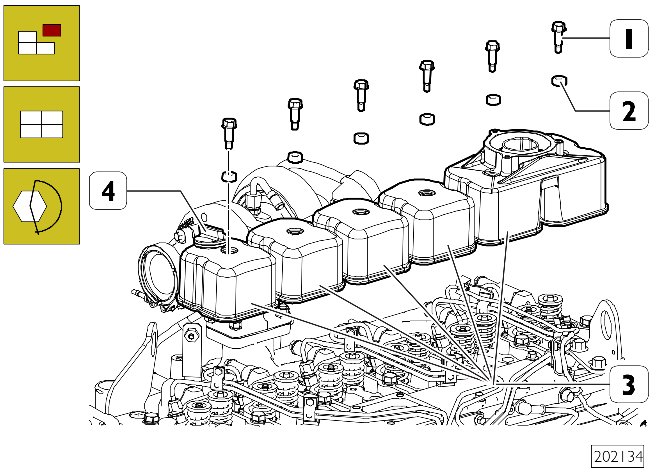
Fit the engine cable as described in the relevant section.

PROCEDURE FOR TAPPET COVER REMOVAL/REFITTING

Removal NEF67 TM1F engines

Remove the oil vapour filter as described in the relevant section

Figure 90



- Unscrew the screws (1) securing the tappet covers (3).
- Recover the sound-proofing elements (2).
- Recover the oil filling plug (4).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x80

Refitting

- Fit the tappet covers (3) into the specific seats.
- Insert the sound-proofing elements (2).
- Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x80	24 ± 4 Nm

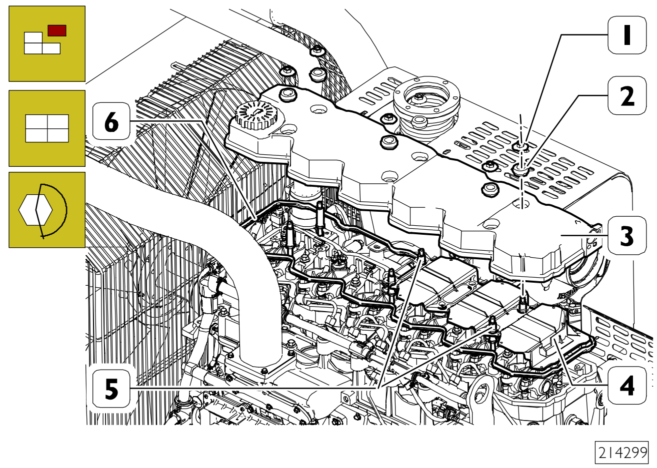
Fit the oil vapour filter as described in the relevant section.

Removal

Remove the air filter as described in the relevant section

Remove the oil vapour filter as described in the relevant section

Figure 91



- Unscrew the flanged nuts (1) and remove the elastic plugs (2).
- Remove the tappet covers (3).
- Recover the oil vapour condensation sector (4).
- Recover the gasket (6).
- Unscrew the double stem screws (5).

Ref.	No.	Screws description
(1)	6	Nut M8x1.25
(5)	6	Screw M8x1.25x17

Refitting

- Tighten the double stem screws (5).
- Insert the gasket (6) into the relative seat.
- Insert the oil vapour condensation sector (4).
- Position the tappet cover (3) in the relative seat.
- Insert the elastic plugs and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M8x1.25	24 ± 4 Nm
(5)	6	Screw M8x1.25x17	24 ± 4 Nm

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section

PROCEDURE FOR ROCKER ARM ASSEMBLY REMOVAL-REFITTING

Removal

NEF67 TE1F/TE2F ENGINES

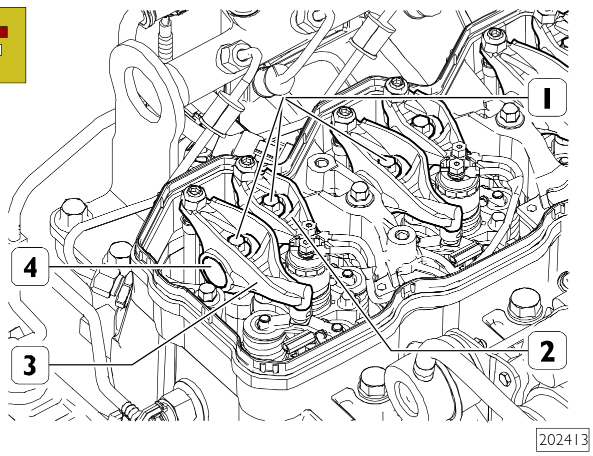
Remove the high pressure pipe as described in the relevant section.

Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Figure 92

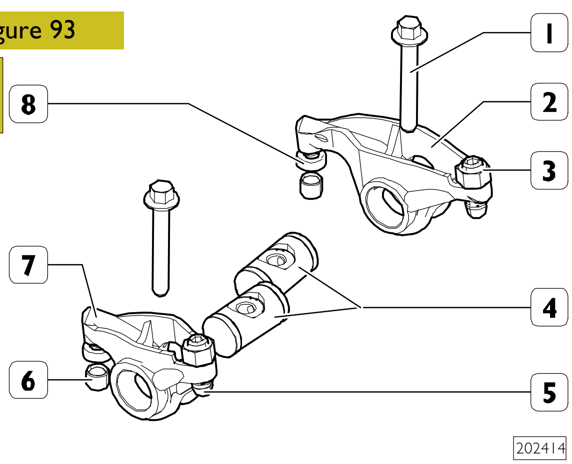


❑ Remove the screws (1) and remove the intake rocker arms (2) and exhaust rocker arms (3), together with the rocker arm shafts (4).

Ref.	No.	Screws description
(1)	8	Screw M8x1.25x55

Refitting

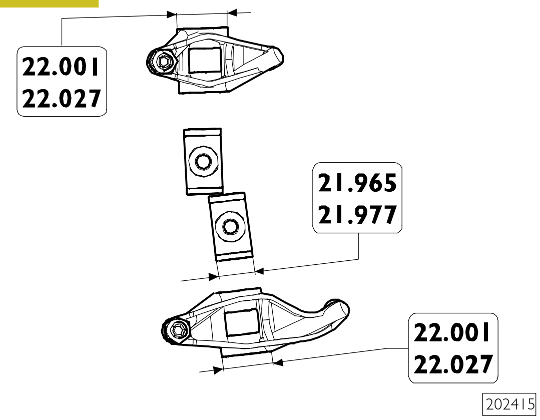
Figure 93



❑ After checking, fit the rocker arm assembly.

ROCKER ASSEMBLY COMPONENTS:
1. Fastening screw - 2. Exhaust rocker arm - 3. Nuts for tappet adjuster - 4. Rocker arm shafts - 5. Tappet - 6. Shoe - 7. Intake rocker arm - 8. Spring clip

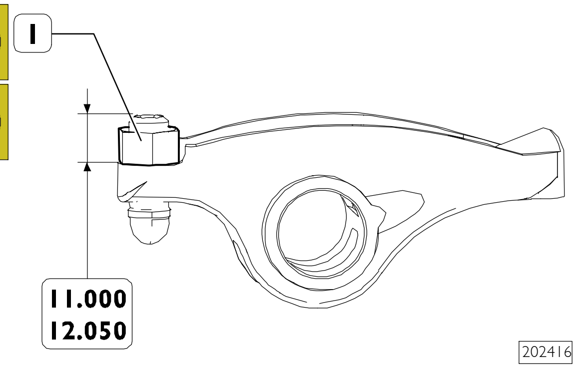
Figure 94



MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 95

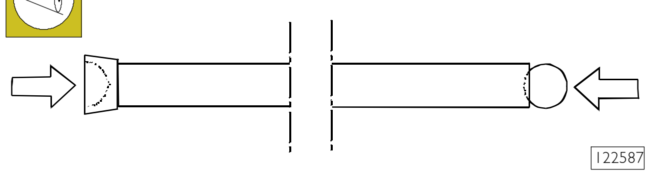


MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

If disassembled, check the adjustment dimension. Tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M24x1.5	5 ± 1 Nm

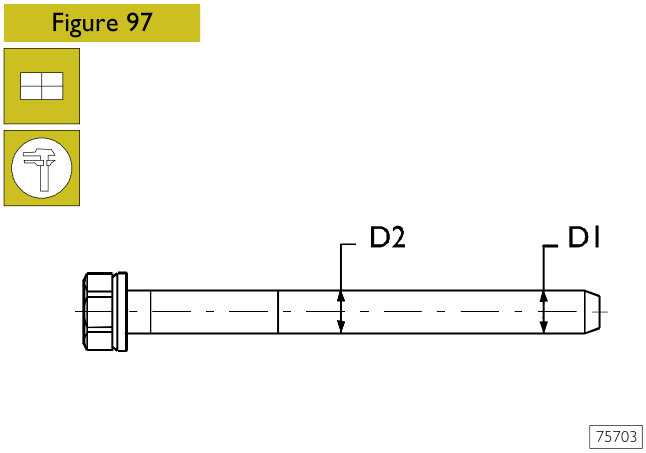
Figure 96



Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

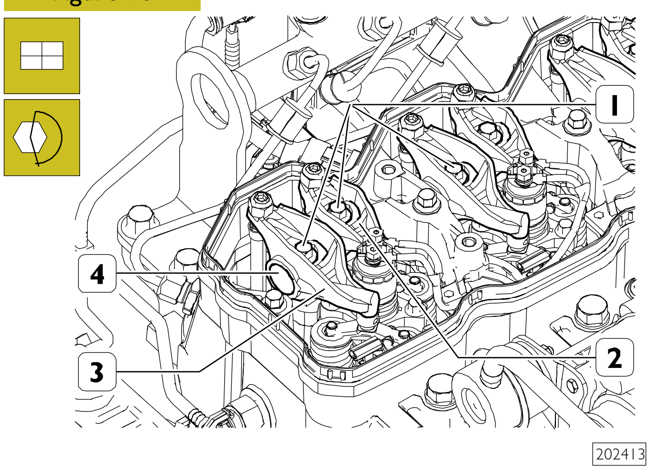
Intake and exhaust valve push rods are identical and are therefore interchangeable.

Figure 97



- Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
  if D1 - D2 < 0.1 mm the screw can be reused
  if D1 - D2 > 0.1 mm the screw must be replaced

Figure 98



- Position the intake rocker arms (2) and exhaust rocker arms (3) together with the rocker arm shafts.
- Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M8x1.25x55	36 ± 5 Nm

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

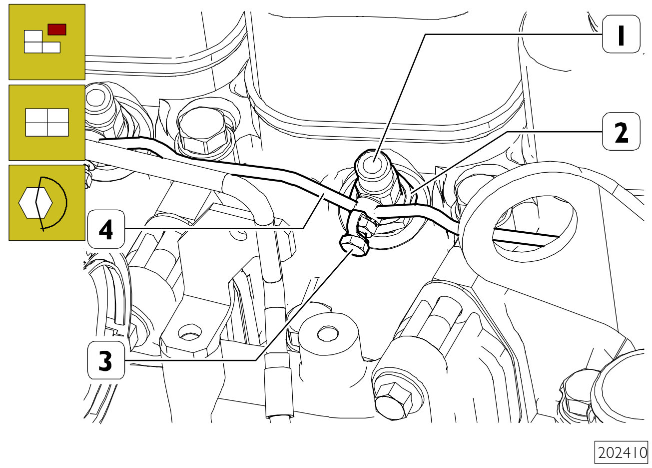
Fit the high pressure engine cable as described in the relevant section.

PROCEDURE FOR INJECTOR REMOVAL/REFITTING

Removal NEF67 TM1F engines

Remove the high pressure pipe as described in the relevant section.

Figure 99



- Unscrew the unions (3).
- Remove the injector exhaust pipe (4).
- Unscrew the ring nut (2) and remove the injector (1).

Ref.	No.	Screws description
(2)	4	Ring nut M24x1.5
(3)	4	M6x1 union

Refitting

- Insert the injector (1) together with the ring nut (2) in the specific seat.
- Tighten the ring nut (2).
- Position the injector exhaust pipe (4) and tighten the fittings (3).

Ref.	No.	Screws description	Tightening torques
(2)	4	Ring nut M24x1.5	60 ± 5 Nm
(3)	4	M6x1 union	-

Connect the high pressure pipe as described in the relevant section.

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Removal NEF67 TE1F/TE2F engines

Remove the high pressure pipe as described in the relevant section.

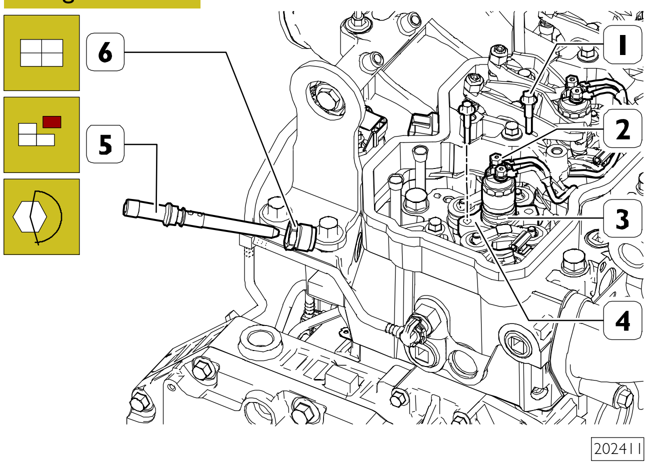
Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the rocker arm assembly as described in the relevant section.

Figure 100



- ❑ Unscrew the nut (6) connecting the head.
- ❑ Remove the union (5).
- ❑ Unscrew the nuts (2) fixing the wiring on the injectors.
- ❑ Unscrew the screws (1).
- ❑ Remove the injector (3) together with the fastening bracket (4).

Ref.	No.	Screws description
(1)	8	Screw M6x1x35
(6)	4	Nut M22x1.5

Refitting

- ❑ Insert the injector (3) together with the fastening bracket (4).
- ❑ Tighten the screws (1).
- ❑ Tighten the nuts (2) fixing the wiring on the injectors.
- ❑ Position the union (5).
- ❑ Tighten the nut (6) connecting the head.

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M6x1x35 1st phase 2nd phase angle	 3.5 ± 0.35 Nm 7.5 ± 2.5 Nm 25°+25°+25°
(6)	4	Nut M22x1.5	60 ± 5 Nm

Fit the rocker arm assembly as described in the relevant section.

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

Connect the high pressure pipe as described in the relevant section.

PROCEDURE FOR FEED PUMP REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

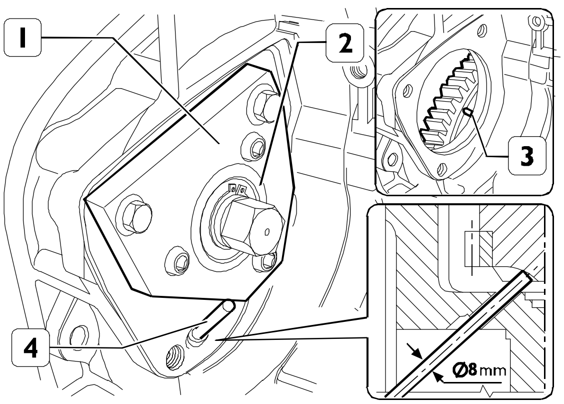
Place a container for the oil recovery.

Removal NEF67 TM1F engines

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Figure 101



123031

Once the starter motor is removed, fit tool 99360339 (1) to rotate the flywheel.

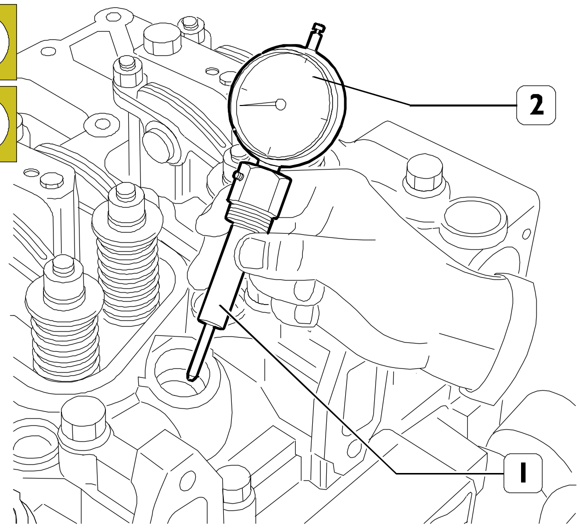
If it is necessary to replace the feed pump, this spare is supplied preset.

If however the pump needs to be disassembled and refitted without having undergone any repair interventions, reset it while it is still fitted on the engine and only then remove it.

The following procedure refers to the second possibility as this is the more complex one.

Identifying top dead centre with tool (99395097) - False injector

Figure 102



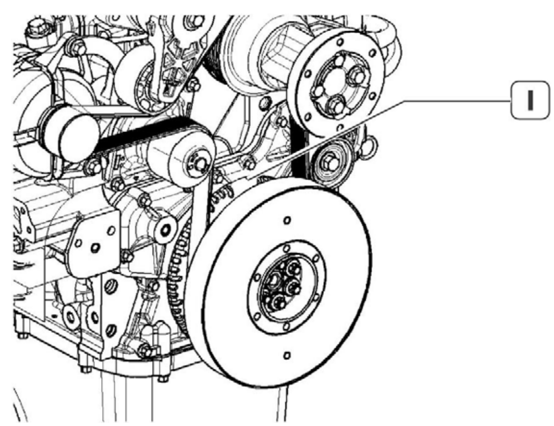
88141

To search for the position of 1st cylinder at top dead, end of compression stroke, remove the rocker arm cover of the 1st cylinder, remove the 1st injector and position the tool (1). pre-load the dial gauge.

NOTE For the removal of the 1st injector and the tappet cover refer to the relevant section.

The required condition is obtained by turning the crankshaft appropriately until the maximum value appears on the dial gauge and making sure that the intake and exhaust valves are both closed.

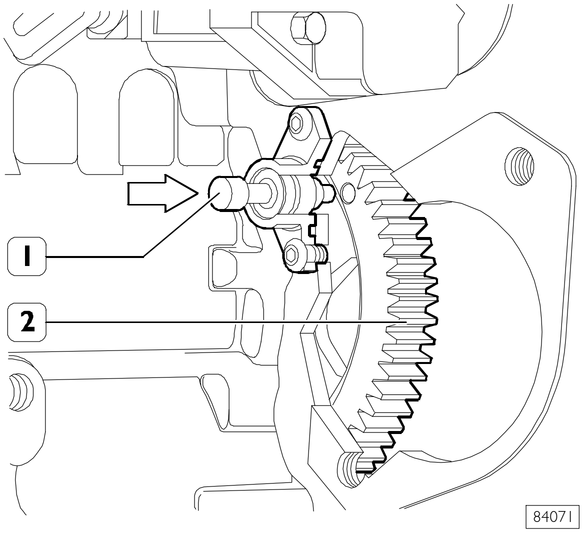
Figure 103



130192

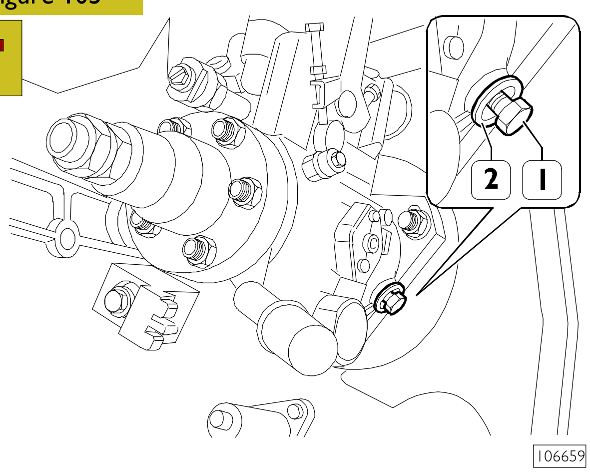
Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 104



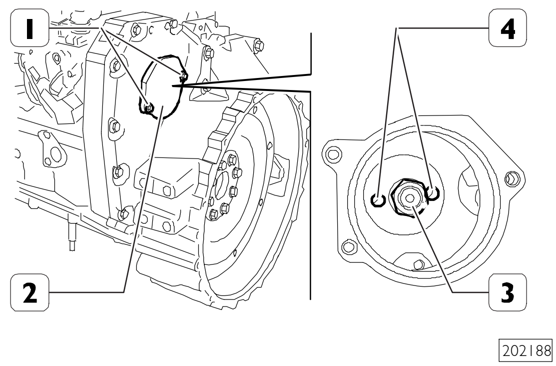
Rotate the flywheel until it pushes the pin 99360616 (1), this will not block the gear (2), obtaining the TDC of the 1st cylinder.

Figure 105



- Partially unscrew the screw (1) locking the pump spindle and move the spacer with the slot (2) to the largest part of the hole to allow the screw to fit in completely.
- Apply a torque of between 11.9 and 12.4 Nm to tighten the locking screw (1) flush with the spacer locking the pump spindle rotation.

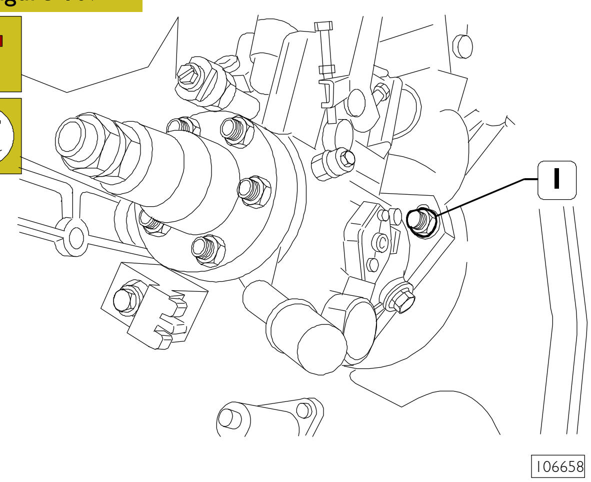
Figure 106



- On the timing gear side, remove the small cover (2) unscrewing the screws (1) so as to access the nut (3) securing the pump drive gear.
- Unscrew the nut (3) and recover the relative washer.

Ref.	No.	Screws description
(1)	2	Screw M6x1
(3)	1	Nut M14x1.5

Figure 107



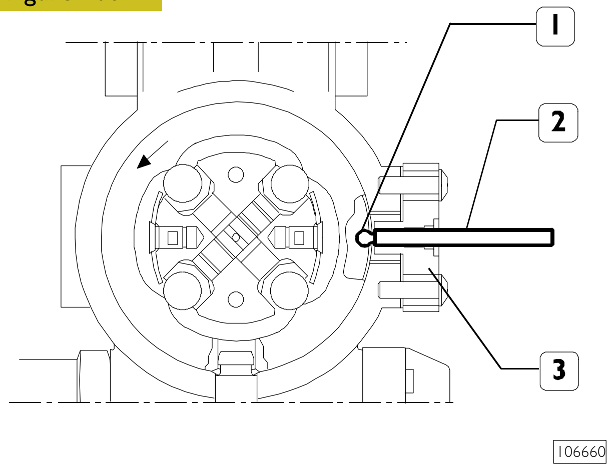
- From the side of the pump, loosen the fastening nuts (1) without removing them in order to allow the pump to move backwards when the extractor 99340035 operates.
- Fit the extractor 99340035 using the two threaded holes (4, Figure 106) and detach the gear from the pump spindle.
- Suitably support the feed pump and unscrew the fastening nuts completely.
- Take the pump off the studs together with the gasket.

Ref.	No.	Screws description
(1)	3	Nut M8x1.25

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Check correct setting of rotating feed pump

Figure 108



1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

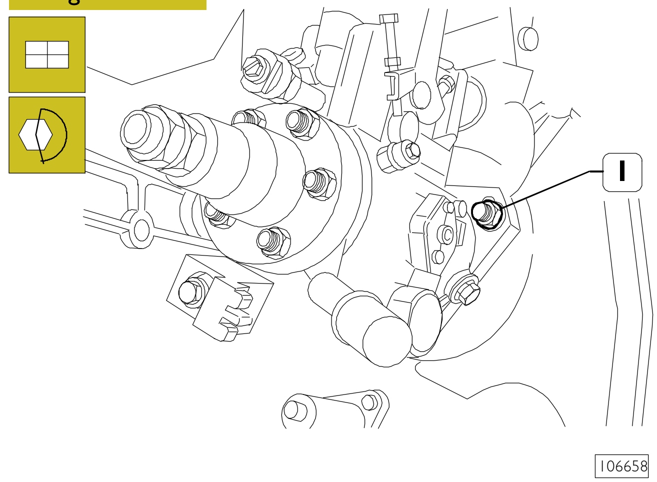
Therefore:

- ❑ Remove the screw plug (3) at the centre of the plate.
- ❑ Insert synchronisation pin (1) 99365196 into the hole in the plate (3). The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.
- ❑ Lock the drive shaft in the correct position using the screw (1, Figure 103).
- ❑ Remove the synchronisation pin and fit the screw plug of the plate (3). Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Refitting

Figure 109



When fitting the feed pump on the engine, the conditions of the T.D.C at the 1st cylinder at the end of the compression stroke must be met.

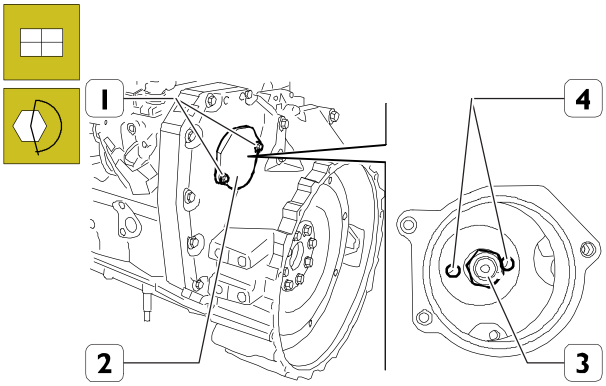
- ❑ Fit the preset pump into its seat on the engine, fitting the shaft into the hole of the gear (without key).
- ❑ Tighten the fastening nuts (1) locking the pump flange at the centre of the slot.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M8x1.25	24 ± 4 Nm

NOTE The gasket removed during pump disassembly must not be reused.

Always use original spare parts.

Figure 110



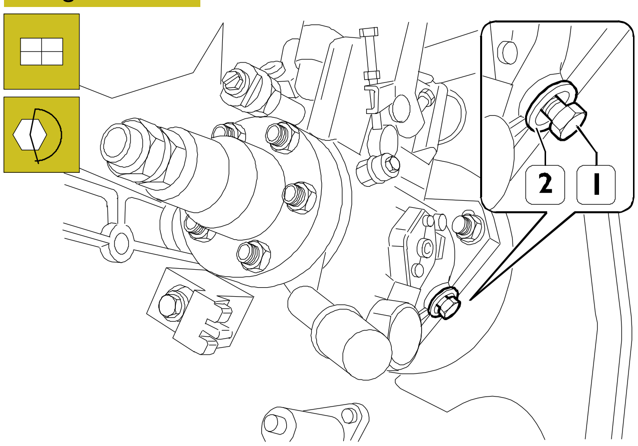
202188

❑ On the timing gear side, fit the washer through the specific hole and screw in the nut (3) on the pump spindle.

❑ Fit the small cover (2) together with the gasket and screw in the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M14x1.5	90 ± 5 Nm

Figure 111



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❑ Undo but do not remove screw (1) locking the rotation of the pump spindle and move the spacer with slot into the small part of the hole.

❑ Screw in the screw (1) until flush locking the spacer: in this way, the feed pump spindle is free to rotate.

❑ Remove tool 99360339 or 99360330 for locking/rotation of flywheel.

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

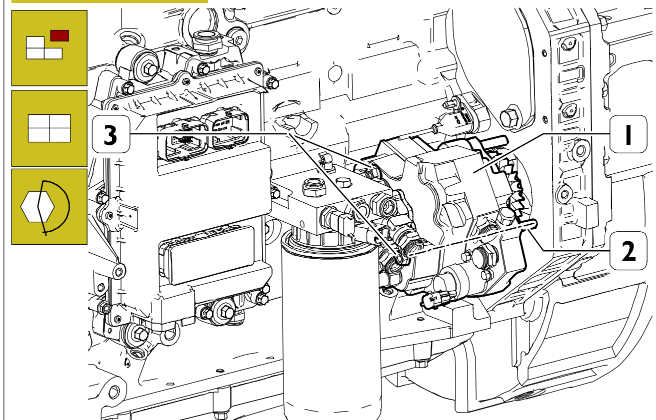
Removal NEF67 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Figure 112



202412

❑ Loosen the nuts (3).

❑ Remove the supply pump assembly (1).

❑ Unscrew the studs (2).

Ref.	No.	Screws description
(2)	3	Stud M8x1.25x5
(3)	3	Nut M8x1.25

Refitting

❑ Tighten the studs (2).

❑ Position the supply pump (1) in the relative seat.

❑ Tighten the nuts (3).

Ref.	No.	Screws description	Tightening torques
(2)	3	Stud M8x1.25x5	-
(3)	3	Nut M8x1.25	24 ± 4 Nm

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

Fit the engine cable as described in the relevant section.

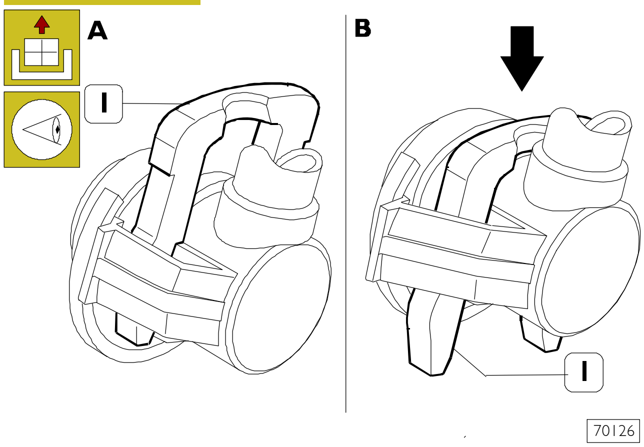
PROCEDURE FOR PRIMING PUMP REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF67 TM1F engines

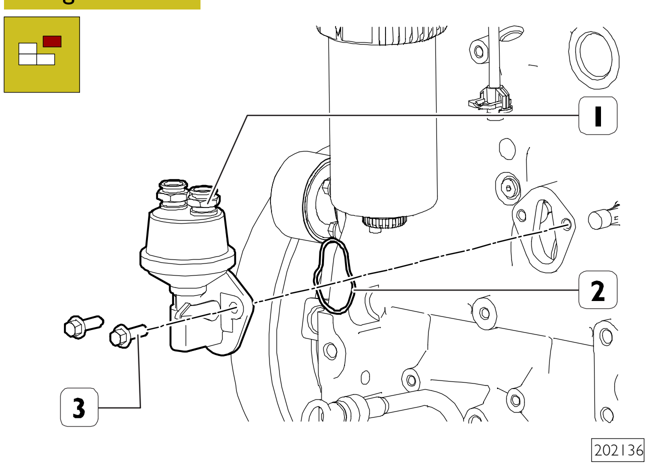
Figure 113



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

Figure 114

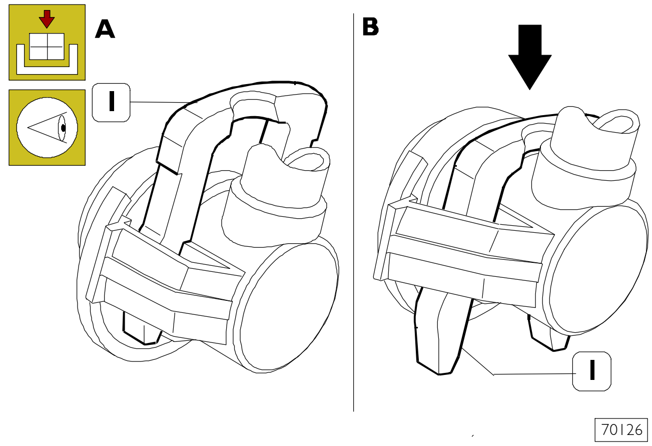


- ❑ Unscrew the screws (3).
- ❑ Remove the priming pump (1) and recover the gasket (2).

Ref.	No.	Screws description
(3)	2	Screw M8x1.25x25

Refitting

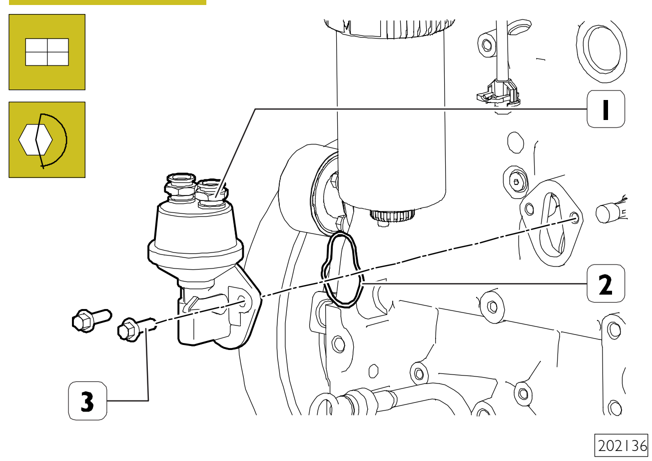
Figure 115



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

Figure 116



- ❑ Position the gasket (2) in its seat.
- ❑ Connect the priming pump (1).
- ❑ Tighten the screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M8x1.25x25	24 ± 4 Nm

PROCEDURE FOR ROCKER ARM ASSEMBLY REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

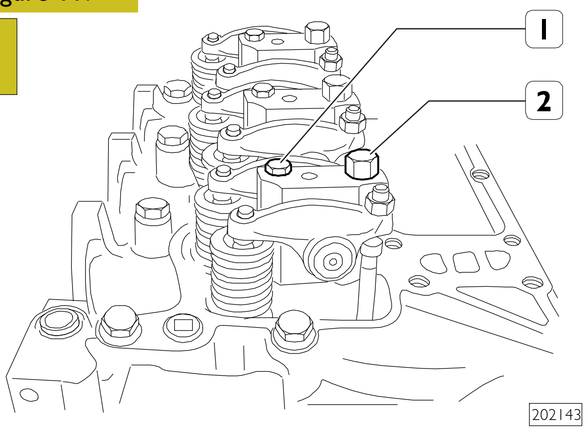
Place a container for the oil recovery.

Removal NEF67 TM1F engines

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Figure 117

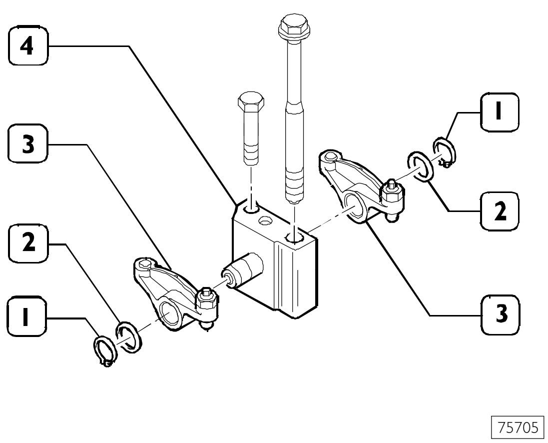


- ❑ Disassemble the rocker arm mounts:
  unscrew the fastening screws (1 and 2) and disassemble the mount together with the rocker arms; remove the push rods.
  Repeat the operation for the remaining rocker arm mounts.

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x75
(2)	4	Screw M12x1.75x180

Refitting

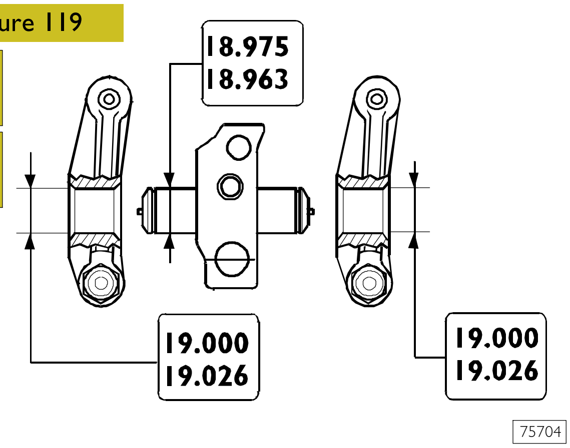
Figure 118



- ❑ After checking, fit the rocker arm assembly

ROCKER ASSEMBLY COMPONENTS:
1. Circlip - 2. Spacer - 3. Rocker arms - 4. Support

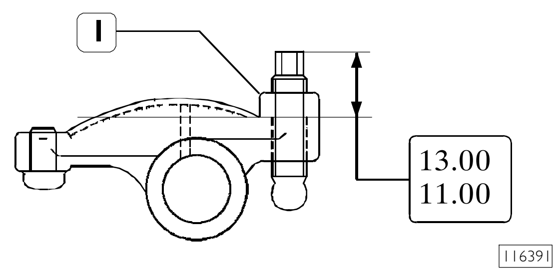
Figure 119



MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 120

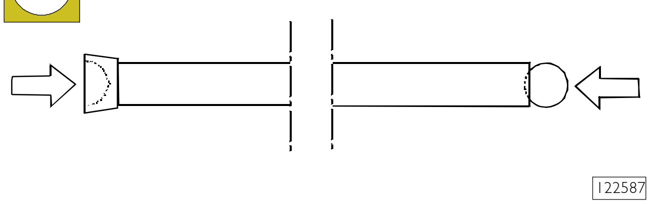


MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

If disassembled, check the adjustment dimension. Tighten the nut (1) to a torque of 24 to ±4 Nm.

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M8x1.25	24 ± 4 Nm

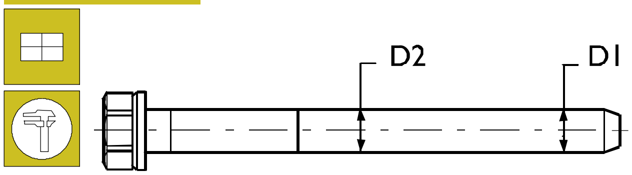
Figure 121



Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

Intake and exhaust valve push rods are identical and are therefore interchangeable.

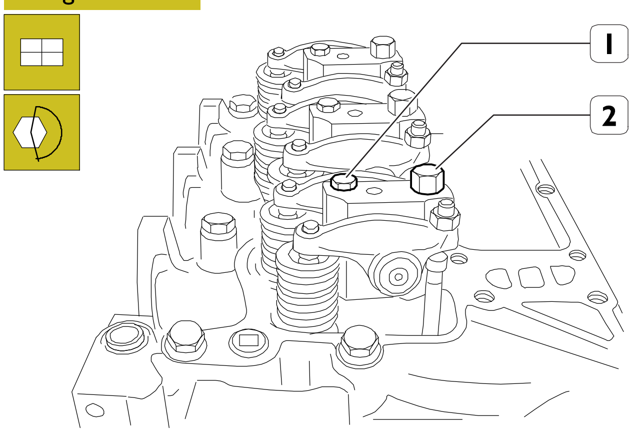
Figure 122



75703

❑ Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
if D1 - D2 < 0.1 mm the screw can be reused
if D1 - D2 > 0.1 mm the screw must be replaced

Figure 123



202143

❑ Tighten the screws (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x75	24 ± 3 Nm
(2)	4	Screw M12x1.75x180	
		1st phase	70 ± 5 Nm
		2nd phase	90° + 90°

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

PROCEDURE FOR INTAKE MANIFOLD REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

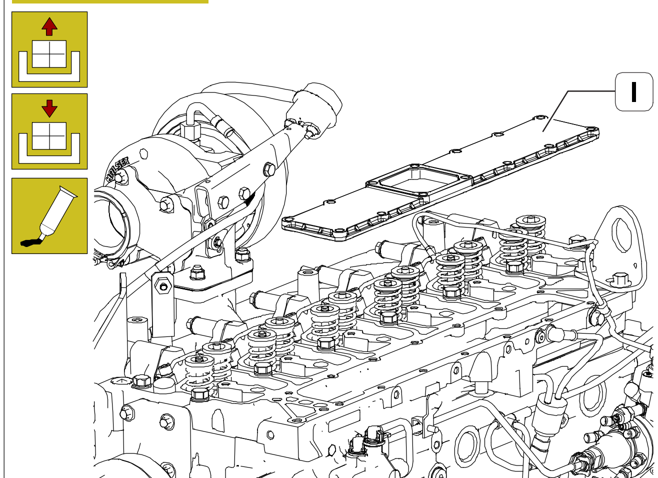
Removal NEF67 TM1F engines

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Figure 124



202137

❑ Remove the intake manifold (1).

NOTE The screws used to secure the intake manifold have been removed during removal of the high pressure fuel pipes

Refitting

❑ Apply LOCTITE 5999 between the intake manifold and cylinder head.

❑ Place the intake manifold (1) in the specific seat.

Refit the high pressure pipes as described in the relevant section.

Refit the tappet cover as described in the relevant section.

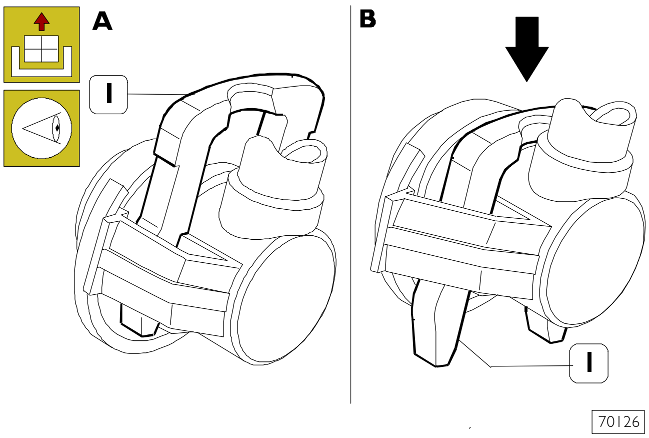
Refit the oil vapour filter as described in the relevant section.

Removal NEF67 TE1F/TE2F engines

Remove the engine cable as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

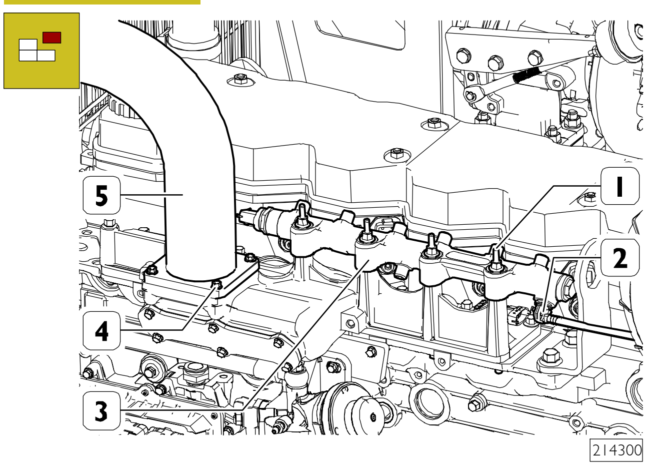
Figure 125



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

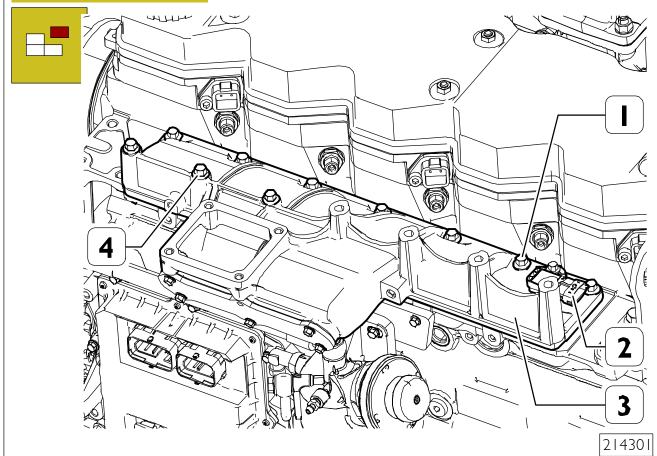
Figure 126



- ❑ Unscrew the screws (4) and remove the pipe (5) from the radiator connection.
- ❑ Remove the fuel return pipe (2) from the Common Rail (3).
- ❑ Unscrew the threaded double stem screws (1).
- ❑ Remove the Common Rail (3).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x125
(4)	4	Screw M8x1.25x20

Figure 127

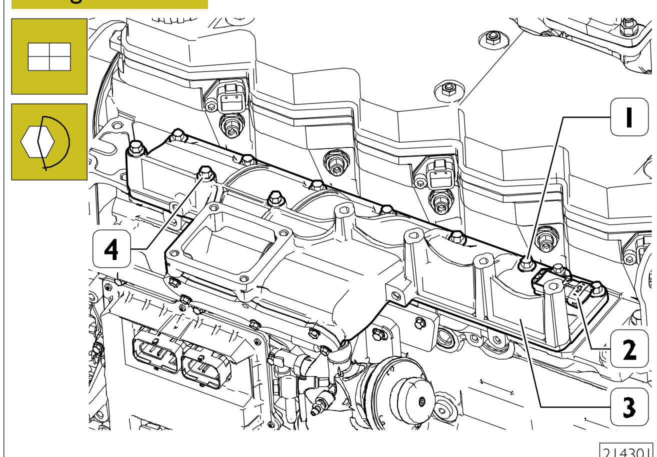


- ❑ Unscrew the screws (1 and 4).
- ❑ Remove the intake manifold (3), together with the air pressure and temperature sensor (2).

Ref.	No.	Screws description
(1)	7	Screw M8x1.25x125
(4)	3	Screw M8x1.25x70

Refitting

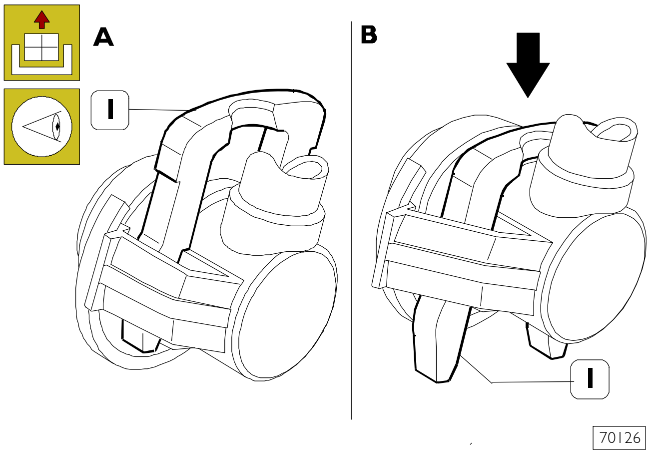
Figure 128



- ❑ Place the intake manifold (3) in its seat, together with the air pressure and temperature sensor (2).
- ❑ Tighten the screws (1 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	7	Screw M8x1.25x25	24 ± 4 Nm
(4)	3	Screw M8x1.25x70	24 ± 4 Nm

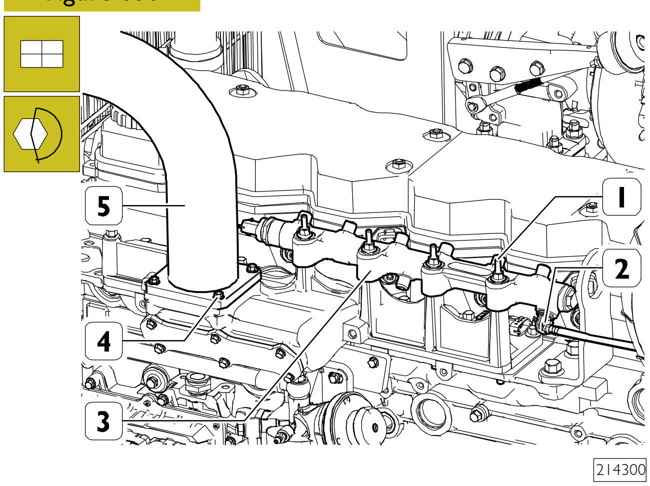
Figure 129



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

Figure 130



- ❑ Place the Common Rail (3) in its seat.
- ❑ Screw the threaded double stem screws (1).
- ❑ Fit the fuel return pipe (2) from the Common Rail (3).
- ❑ Position the radiator connection pipe (5) and tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M8x1.25x25	35 ± 6 Nm
(4)	4	Screw M8x1.25x70	35 ± 6 Nm

Fit the high pressure pipes as described in the relevant section.

Fit the engine cable as described in the relevant section.

PROCEDURE FOR EXHAUST MANIFOLD REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

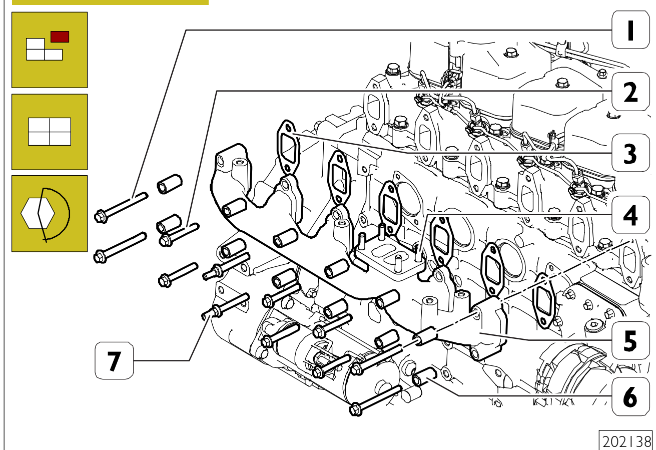
Place a container for the oil recovery.

Removal NEF67 TM1F engines

Place a container for the oil recovery.

Remove the turbocharger as described in the relevant section.

Figure 131



- ❑ Unscrew the studs (4) after having removed the turbocharger.
- ❑ Unscrew the screws (1, 2 and 7) securing the exhaust manifold (5).
- ❑ Recover the 12 spacers (6).
- ❑ Remove the exhaust manifold (5).
- ❑ Recover the gaskets (3).

Ref.	No.	Screws description
(1)	4	Screw M10x1.5x95
(2)	6	Screw M10x1.5x65
(4)	4	Stud M10x1.5x42
(7)	2	Screw M10x1.5x65

Refitting

- ❑ Position the gaskets (3).
- ❑ Place the exhaust manifold (5) in the specific seat.
- ❑ Tighten the screws (1, 2 and 7) together with the spacers (6).
- ❑ Tighten the studs (4) for the turbocharger assembly.

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M10x1.5x95	55 ± 3 Nm
(2)	6	Screw M10x1.5x65	55 ± 3 Nm
(4)	4	Stud M10x1.5x42	24 ± 4 Nm
(7)	2	Screw M10x1.5x65	55 ± 3 Nm

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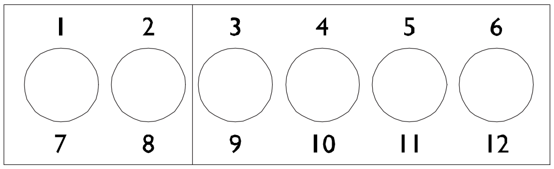
Figure 132



202139

Tightening sequence:

4 - 11 - 5 - 10 - 3 - 12 - 6 - 9 - 1 - 8 - 2 - 7

TIGHTENING DIAGRAM FOR EXHAUST MANIFOLD FASTENING SCREWS AS SEEN FROM ENGINE SIDE

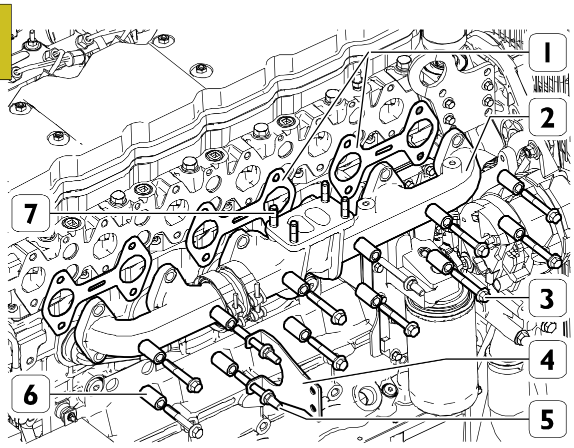
Fit the turbocharger as described in the relevant section.

Removal NEF67 TE1F/TE2F engines

Remove the air filter as described in the relevant section.

Remove the turbocharger as described in the relevant section.

Figure 133

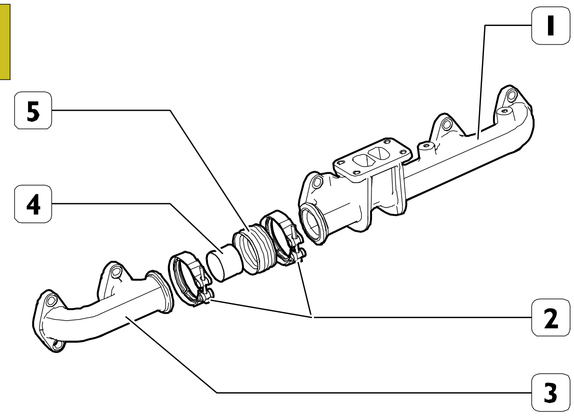


214302

- ❑ Unscrew the studs (7) for the turbocharger support.
- ❑ Unscrew the screws (3 and 5) securing the exhaust manifold (2).
- ❑ Remove the support bracket (4).
- ❑ Recover the spacers (6). Remove the exhaust manifold (2).
- ❑ Recover the gaskets (1).

Ref.	No.	Screws description
(3)	9	Screw M10x1.5x65
(5)	3	Screw M10x1.5x65
(7)	4	Stud M10x1.5x42

Figure 134



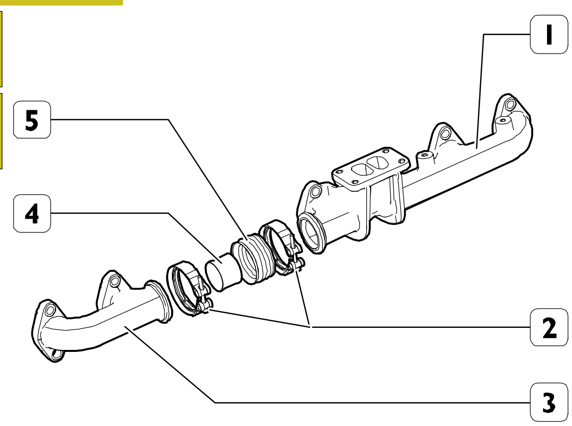
214303

- ❑ Unscrew the screws (2) from the connection clamps.
- ❑ Separate the two elements (1 and 3) that make up the exhaust manifold.
- ❑ Recover the coupling manifolds (4 and 5).

Ref.	No.	Screws description
(2)	2	Screw M6x55

Refitting

Figure 135



214303

- ❑ Fit the coupling manifolds (4 and 5) into the elements (2 and 3) that make up the exhaust manifold, together with the connection clamps.
- ❑ Put the elements (1 and 3) together.
- ❑ Screw the screws (2) from the connection clamps.

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M6x55	8 ± 0.5 Nm

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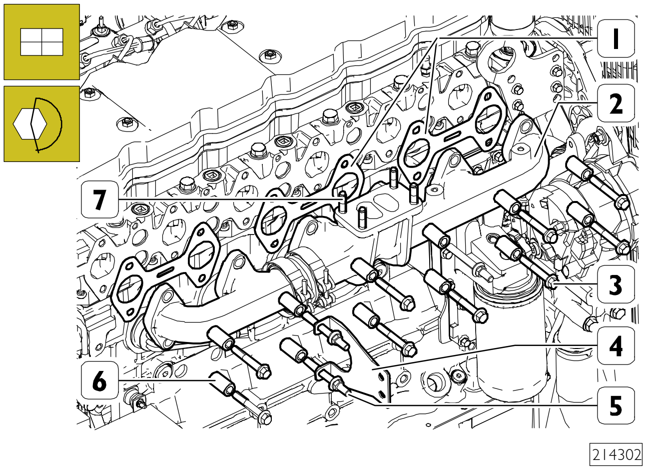
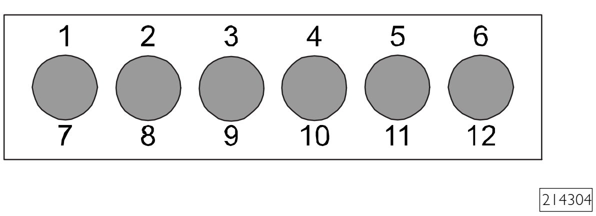
Figure 136



- ❑ Place the exhaust manifold (1) in the specific seat, together with the gaskets (1).
- ❑ Insert the spacers (6).
- ❑ Insert the support bracket (4).
- ❑ Tighten the screws (3 and 5).
- ❑ Tighten the studs (7) for the turbocharger support.

Ref.	No.	Screws description	Tightening torques
(3)	9	Screw M10x1.5x65	55 ± 3 Nm
(5)	3	Screw M10x1.5x65	55 ± 3 Nm
(7)	4	Stud M10x1.5x42	25 ± 5 Nm

Figure 137



Tightening sequence:

4 - 11 - 5 - 10 - 3 - 12 - 6 - 9 - 1 - 8 - 2 - 7

TIGHTENING DIAGRAM FOR EXHAUST MANIFOLD FASTENING SCREWS AS SEEN FROM ENGINE SIDE

Fit the turbocharger as described in the relevant section.

Fit the air filter as described in the relevant section.

PROCEDURE FOR CYLINDER HEAD REMOVAL/REFITTING

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

Place a container for the oil recovery.

Removal NEF67 TM1F engine

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the belt as described in the relevant section.

Remove the turbocharger as described in the relevant section.

Remove the exhaust manifold as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Remove the fuel filter as described in the relevant section.

Remove the intake manifold as described in the relevant section.

Remove the air filter as described in the relevant section.

Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the injectors as described in the relevant section.

Remove the rocker arm assembly as described in the relevant section.

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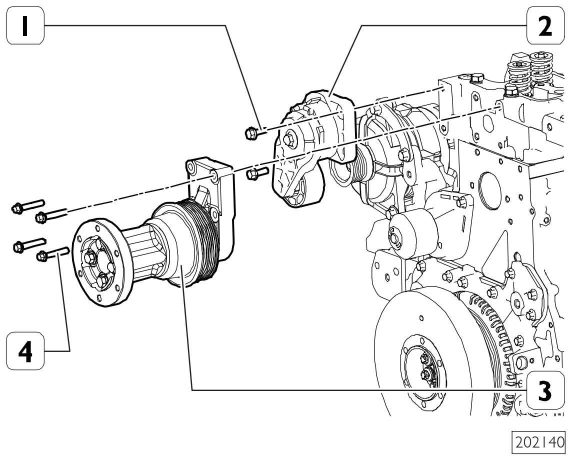
Figure 138

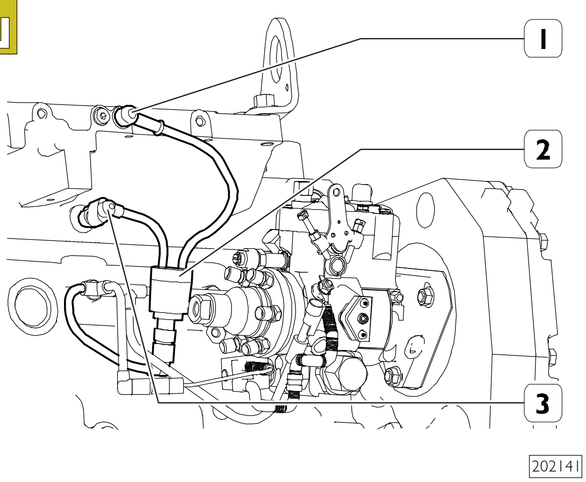


❑ Unscrew the screws (1) and remove the automatic belt tensioner (2).

❑ Unscrew the screws (4) and remove the fan mount (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x25
(4)	4	Screw M8x1.25x25

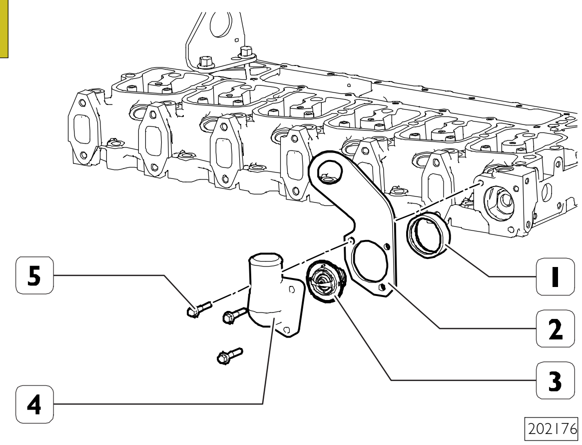
Figure 139



❑ Disconnect the connections (1) to the contactor (2).

❑ Disconnect the connections (1) to the water temperature sensor (3).

Figure 140



❑ Unscrew the screws (5) securing the thermostat cover (4).

❑ Remove the thermostat cover (4).

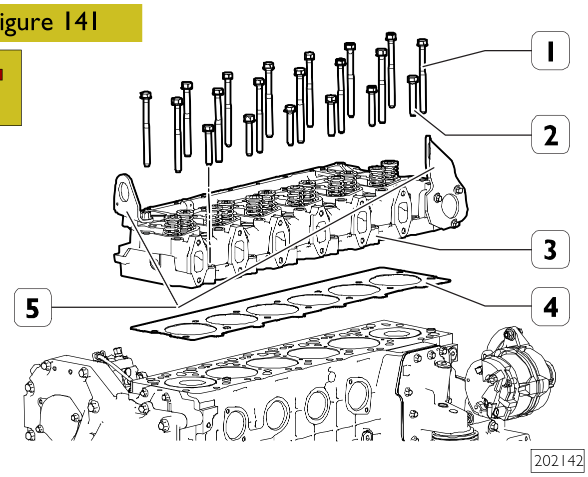
❑ Remove the thermostat assembly (3).

❑ Remove the gasket (1) of the cover.

Ref.	No.	Screws description
(5)	3	Screw M6x1

To remove the cylinder head, fit the bracket into the original position and fasten it with the screws of the thermostat body.

Figure 141



❑ Unscrew the screws (1 and 2).

❑ Using the lifting eyelets (5), remove the cylinder head (3) together with all the elements relating to the timing:

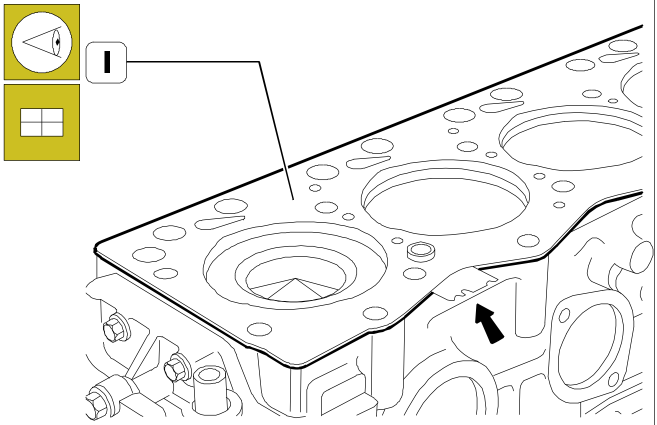
- Intake valves;
- Exhaust valve;
- Valve springs;
- Plates;
- Cotters.

❑ Recover the gasket (4).

Ref.	No.	Screws description
(1)	14	Screw M12x1.75x140
(2)	6	Screw M12x1.75x70

Refitting

Figure 142



87759

❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

NOTE With piston protrusion equal to or less than 0.4, install the gasket with a thickness of 1.15.

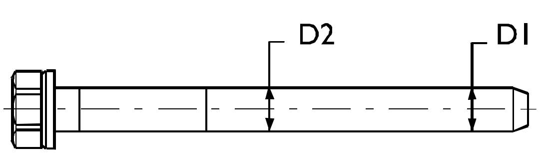
With piston protrusion greater than 0.4, install the gasket with a thickness of 1.25.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

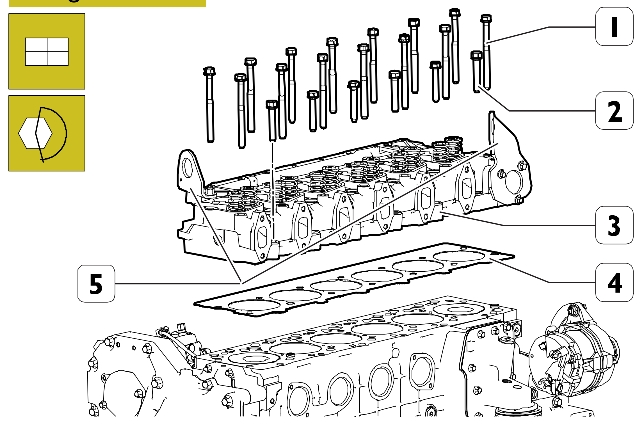
if D1 - D2 < 0.1mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



75703

Figure 143



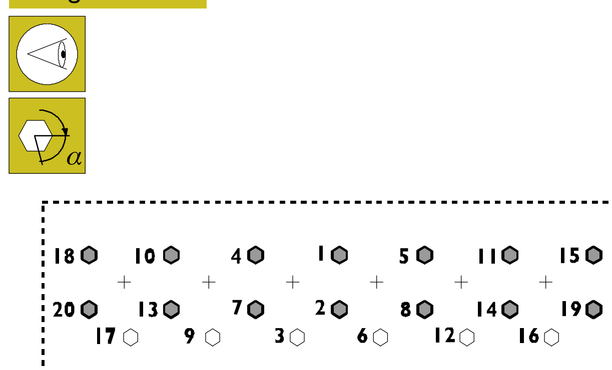
202142

❑ Position the cylinder head (3) on the block using the lifting eyelets (5).

❑ Tighten the screws (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M12x1.75x140 1st phase 2nd phase	 40 ± 5 Nm 90° + 90°
(2)	6	Screw M12x1.75x70 1st phase 2nd phase	 60 ± 5 Nm 90°

Figure 144



76214

❑ Lubricate the bolts and fit them on the engine head.

❑ The bolts must be tightened according to a "spiral" pattern, starting with the central bolts and outward. Tighten the bolts in numerous phases until they have all been correctly tightened.

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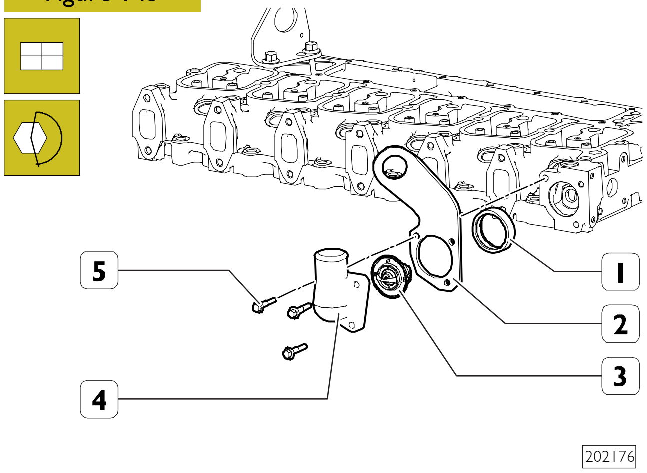
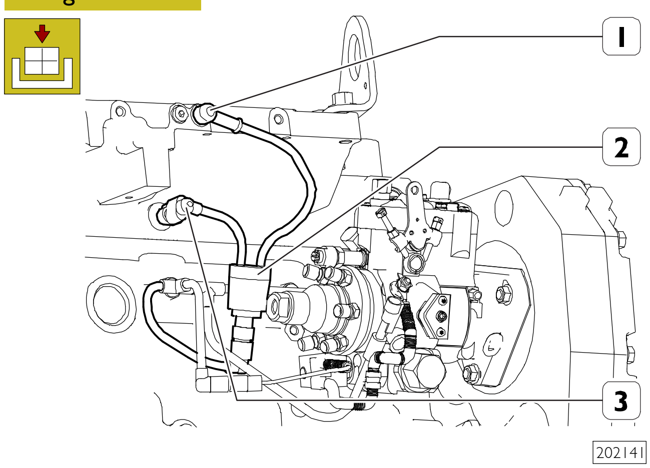
Figure 145



- Position the gasket (1) of the cover.
- Position the lifting eyelet (2).
- Insert the thermostat assembly (3) into the relative seat.
- Position the thermostat cover (4).
- Tighten the screws (5) securing the thermostat cover (4).

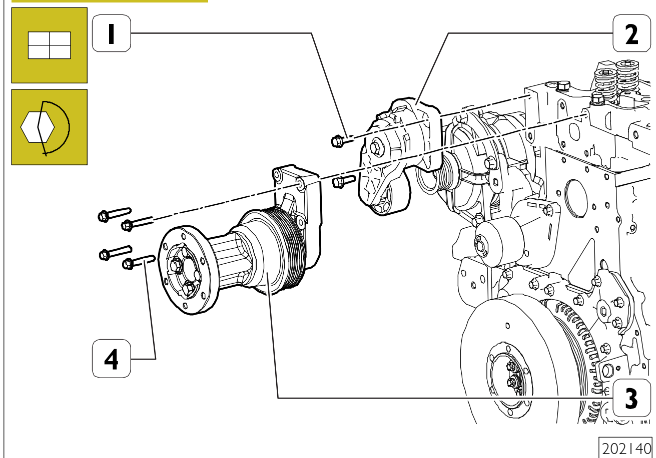
Ref.	No.	Screws description	Tightening torques
(5)	3	Screw M6x1	10 ± 2 Nm

Figure 146



- Connect the connections (1) to the contactor (2).
- Connect the connections (1) to the water temperature sensor (3).

Figure 147



- Position the fan mount (3) and tighten the screws (4).
- Position the automatic belt tensioner (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x25	-
(4)	4	Screw M8x1.25x25	-

Fit the rocker arm assembly as described in the relevant section.
Fit the injectors as described in the relevant section.
Fit the tappet cover as described in the relevant section.
Fit the oil vapour filter as described in the relevant section.
Fit the air filter as described in the relevant section.
Fit the intake manifold as described in the relevant section.
Fit the fuel filter as described in the relevant section.
Connect the high pressure pipe as described in the relevant section.
Connect the low pressure pipe as described in the relevant section.
Fit the exhaust manifold as described in the relevant section.
Fit the turbocharger as described in the relevant section.
Fit the belt as described in the relevant section.
Fit the fan as described in the relevant section.
Fit the radiator as described in the relevant section.
Fit the protection grille as described in the relative procedure.

Removal NEF67 TE1F/TE2F engine

Remove the protection grille as described in the relative procedure.

Remove the radiator as described in the relevant section.

Remove the fan as described in the relevant section.

Remove the engine cable as described in the relevant section.

Remove the belt as described in the relevant section.

Remove the turbocharger as described in the relevant section.

Remove the exhaust manifold as described in the relevant section.

Remove the low pressure pipe as described in the relevant section.

Remove the high pressure pipe as described in the relevant section.

Remove the intake manifold as described in the relevant section.

Remove the air filter as described in the relevant section.

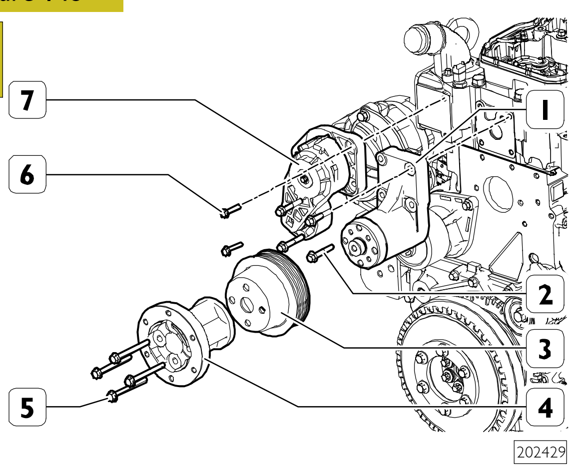
Remove the oil vapour filter as described in the relevant section.

Remove the tappet cover as described in the relevant section.

Remove the injectors as described in the relevant section.

Remove the rocker arm assembly as described in the relevant section.

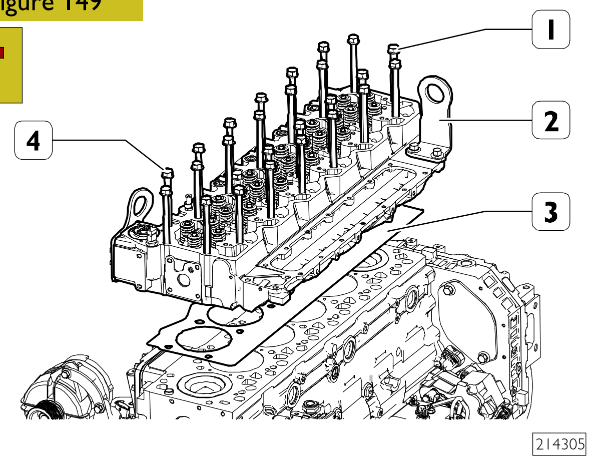
Figure 148



- ❑ Unscrew the screws (6) and remove the automatic belt tensioner (7).
- ❑ Unscrew the screws (5) and remove the spacer (4) for the fan coupling together with the pulley (3).
- ❑ Unscrew the screws (2).
- ❑ Remove the fan support (1).

Ref.	No.	Screws description
(2)	4	Screw -
(5)	4	Screw M10x1.5x110
(6)	2	Screw M8x1.25x30

Figure 149

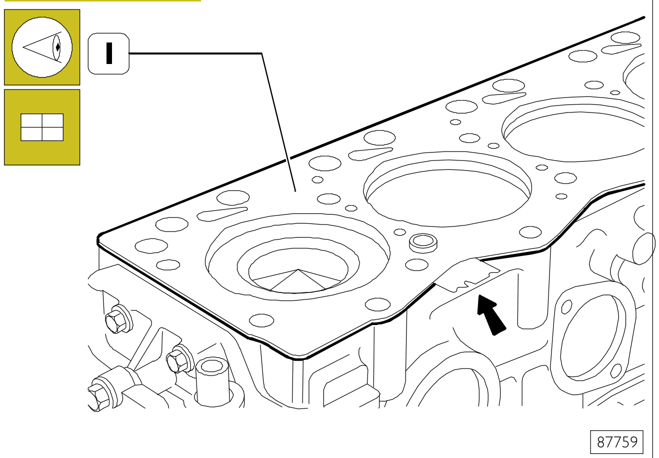


- ❑ Unscrew the screws (1 and 4).
- ❑ Using the lifting eyelets (2), remove the cylinder head together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (3).

Ref.	No.	Screws description
(1)	14	Screw M12x1.75x150
(4)	12	Screw M12x1.75x130

Refitting

Figure 151



❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

NOTE With piston protrusion equal to or less than 0.4, install the gasket with a thickness of 1.15.

With piston protrusion greater than 0.4, install the gasket with a thickness of 1.25.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.

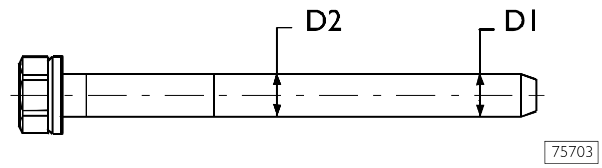
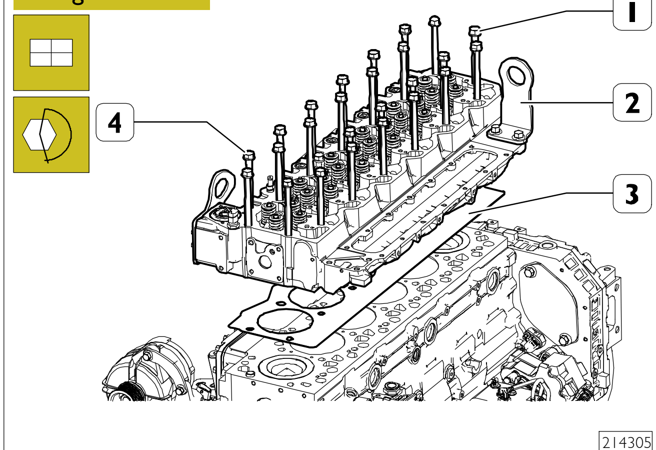


Figure 150

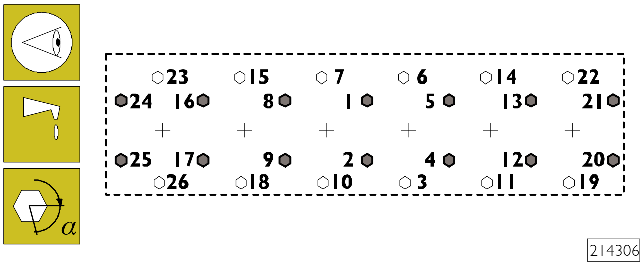


❑ Position the cylinder head on the block.

❑ Tighten the screws (1 and 4).

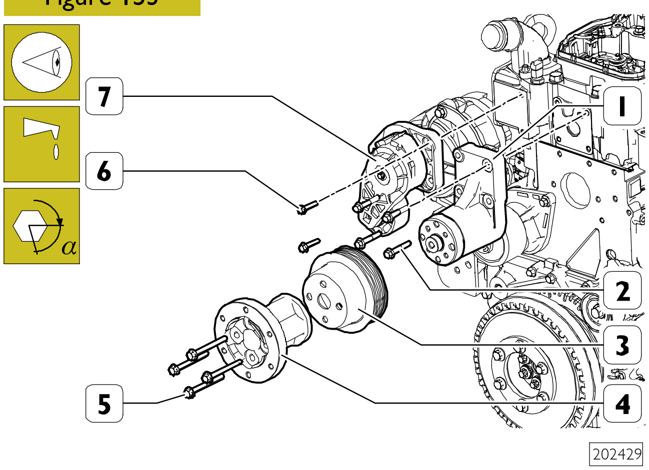
Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M12x1.75x150 1st phase 2nd phase	55 ± 5 Nm 90° + 90°
(4)	12	Screw M12x1.75x130 1st phase 2nd phase	35 ± 5 Nm 90° + 90°

Figure 152



- ❑ Lubricate the bolts and fit them on the engine head.
- ❑ The bolts must be tightened according to a "spiral" pattern, starting with the central bolts and outward.
- ❑ Tighten the bolts in numerous phases until they have all been correctly tightened.

Figure 153



- ❑ Position the fan mount (1) and tighten the screws (2).
- ❑ Place the spacer (4) for attaching the fan, together with the pulley (3).
- ❑ Tighten the screws (5).
- ❑ Position the automatic belt tensioner (7) and tighten the screws (6).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw - 1st phase 2nd phase	27 ± 3 Nm 90° + 90°
(5)	4	Screw M10x1.5x110	-
(6)	2	Screw M8x1.25x30	-

Fit the rocker arm assembly as described in the relevant section.

Fit the injectors as described in the relevant section.

Fit the tappet cover as described in the relevant section.

Fit the oil vapour filter as described in the relevant section.

Fit the air filter as described in the relevant section.

Fit the intake manifold as described in the relevant section.

Connect the high pressure pipe as described in the relevant section.

Connect the low pressure pipe as described in the relevant section.

Fit the exhaust manifold as described in the relevant section.

Fit the turbocharger as described in the relevant section.

Fit the belt as described in the relevant section.

Fit the engine cable as described in the relevant section.

Fit the fan as described in the relevant section.

Fit the radiator as described in the relevant section.

Fit the protection grille as described in the relative procedure.

SECTION 6

General mechanical overhaul

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MOUNTING ON ROTATING STAND

Part of the operations covered in this section can be carried out in relation to the set-up.

NOTE Overhaul operations must be performed by qualified personnel with the specific tools.

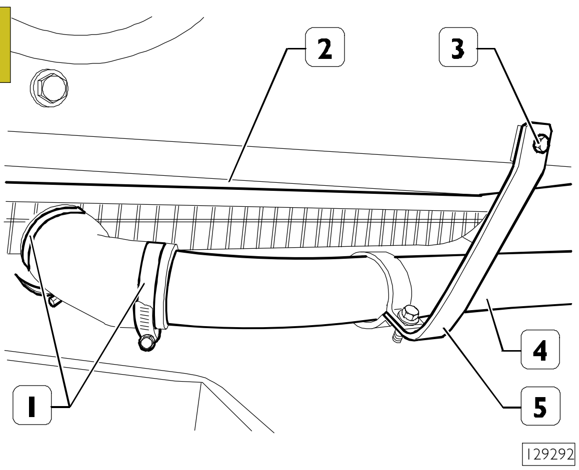
The following description covers the engine overhaul operation limited to components that differ according to the specific use.

NOTE For the needs dictated by application, some units may be placed on the motor in different positions.

The section "General mechanical overhaul" contains all the block overhaul operations.

Removal of radiator assembly pipes from engine

Figure 1

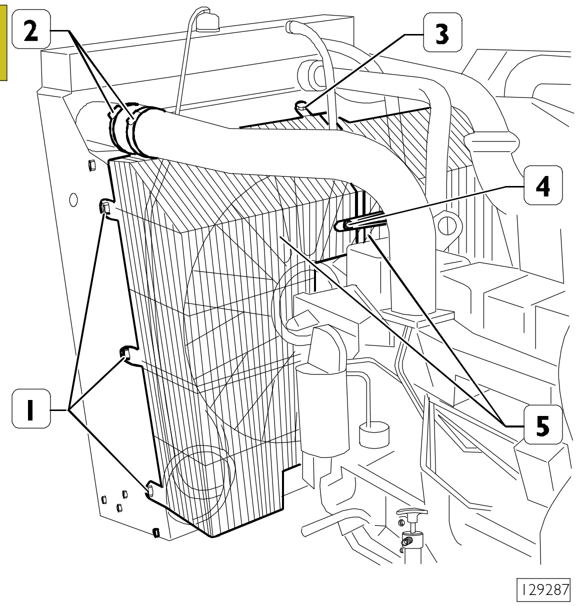


- ❑ Prepare a suitable container in correspondence with the pipe (4) for the recovery of the coolant. Disconnect the pipe (4) by acting on the relative clamps (1).
- ❑ Unscrew the screw (3) and detach the pipe (4) complete with bracket (5) from the radiator assembly (2).

Ref.	No.	Screws description
(3)	1	Screw M8x1.25x16

Protection grille removal

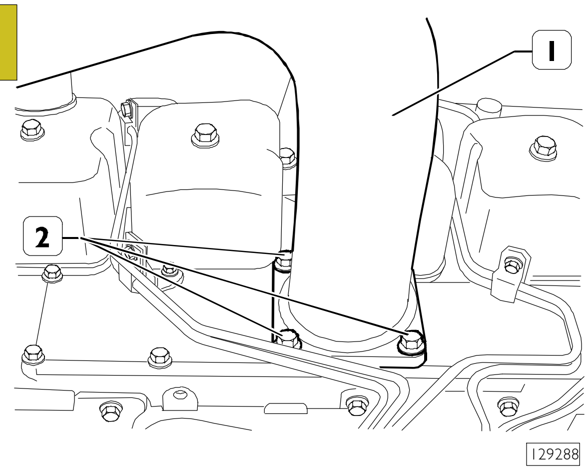
Figure 2



- ❑ Remove the fan protection grilles (5) acting on their relative fasteners (1, 3 and 4).
- ❑ Open the clamps (2).

Ref.	No.	Screws description
(1)	6	Screw M6x1x16
(3)	1	Screw M8x1.25x16
(4)	1	Screw M6x1x16

Figure 3

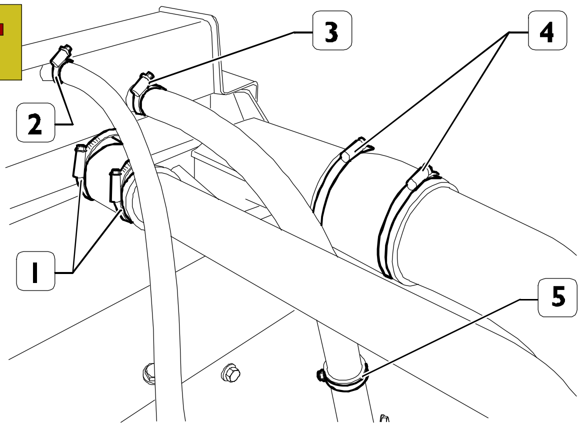


- ❑ Unscrew the screws (2) and remove the pipe (1) from the intake manifold.

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

Removing the radiator

Figure 4

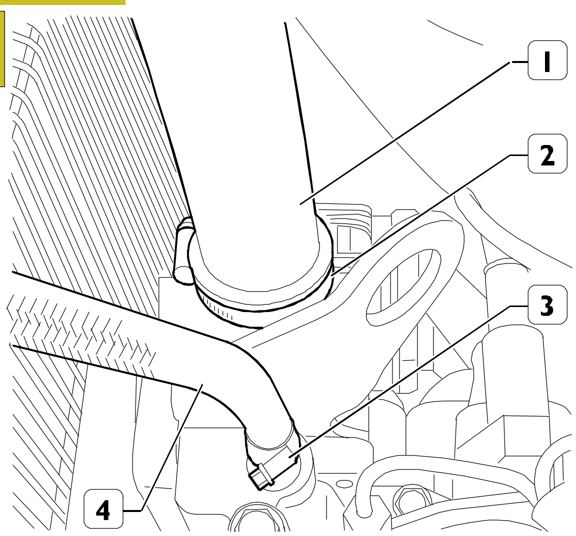


129289

- ❑ Disconnect the air and water pipes from the radiator assembly.
- ❑ Unscrew the screws on the clamps (1, 2, 3 and 4) and on the fixing bracket (5).

Ref.	No.	Screws description
(5)	1	Screw M6x1x16

Figure 5

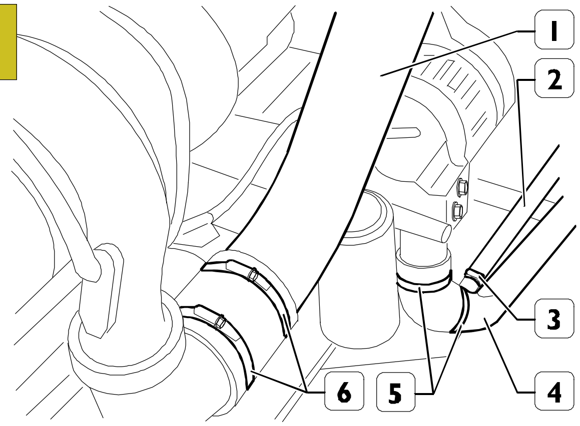


129290

- ❑ Disconnect and remove the pipes (1 and 4), complete with sleeves, from the engine side.
- ❑ Unscrew the screws on clamps (2 and 3).

Ref.	No.	Screws description
(2)	1	Screw M6x1x16
(3)	1	Screw M8x1.25x16

Figure 6



129291

- ❑ Disconnect and remove the pipe (1), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (6).
- ❑ Disconnect and remove the pipe (2), unscrewing the screws on the relative clamp (3).
- ❑ Disconnect and remove the pipe (4), complete with sleeves, from the engine side, unscrewing the screws on the relative clamps (5).
- ❑ Properly lock the radiator unit, then release it from the base by adjusting the hardware on both sides.
- ❑ Remove the radiator unit from its seat.

Ref.	No.	Screws description
(3)	2	Screw M6x1x16
(5)	2	Screw M8x1.25x16
(6)	2	Screw M6x1x16

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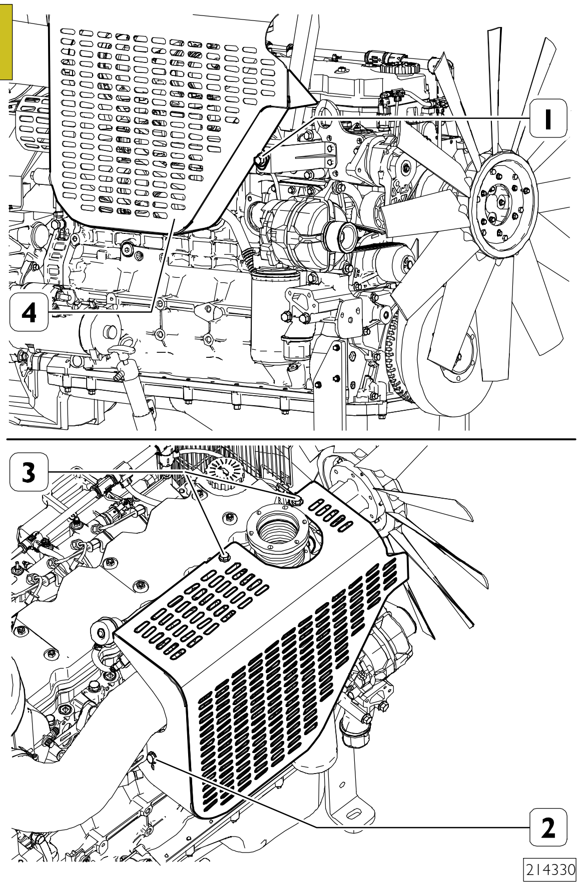
Figure 7

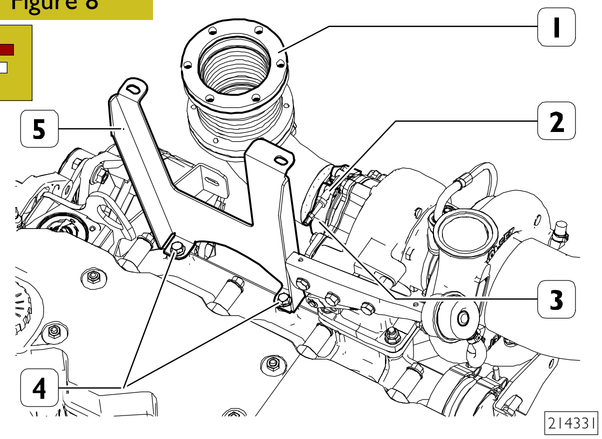


Proceed with disassembling the heat protection grille for the turbocharger:

- ❑ Unscrew the screws (1, 2 and 3).
- ❑ Remove the turbocharger protection grille (4).

Ref.	No.	Screws description
(1)	1	Screw M6x1x16
(2)	2	Screw M6x1x16
(3)	2	Screw M8x1.25x16

Figure 8



- ❑ Unscrew the screw (2) to open the clamp (3).
- ❑ Disconnect the exhaust pipe (1).
- ❑ Unscrew the screws (4) and remove the rib (5).

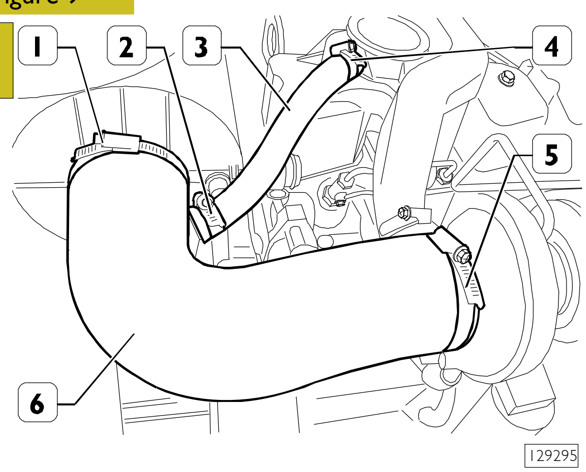
NOTE The shape and the size of the exhaust pipe will vary depending on use of the engine.

The illustrations provide a general path of the operation to be performed.

The procedures described are still applicable.

Ref.	No.	Screws description
(2)	1	Screw M7x1
(4)	2	Screw M7x1

Figure 9

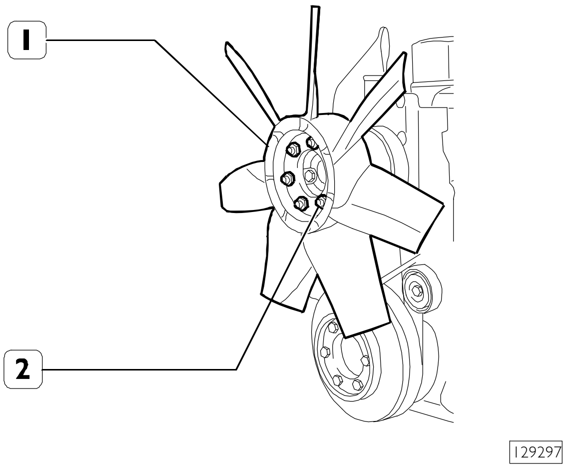


- ❑ Unscrew the screws on the relative clamps (2 and 4).
- ❑ Disconnect and remove the oil vapour recovery pipe (3).
- ❑ Unscrew the screws on the relative clamps (1 and 5).
- ❑ Disconnect and remove the air intake pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M7x1
(5)	1	Screw M7x1

Fan removal

Figure 10



- Unscrew the screws (2).
- Remove the fan (1), complete with spacer.

NOTE The shape and the size of the fan varies according to the use of the engine.

The illustrations provide a general path of the operation to be performed.

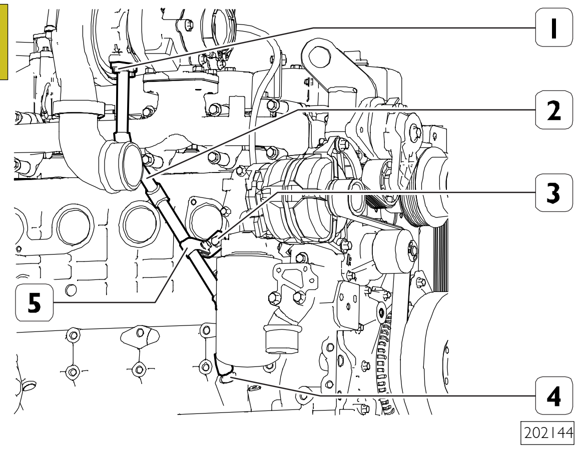
The procedures described are still applicable.

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

Removal of components hindering bracket assembly

Removal of turbocharger lubricant return pipes

Figure 11



the lubricant oil drain pipe (2) from the turbocharger.

- unscrew the two screws (1) from under the turbocharger.
- Unscrew the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- Lastly, pull the connector (4) from the crankcase; plug the ends of the pipe and the exhaust on the turbocharger.

Ref.	No.	Screws description
(1)	2	Screw M6x1x16
(3)	1	Screw M8x1.25x16

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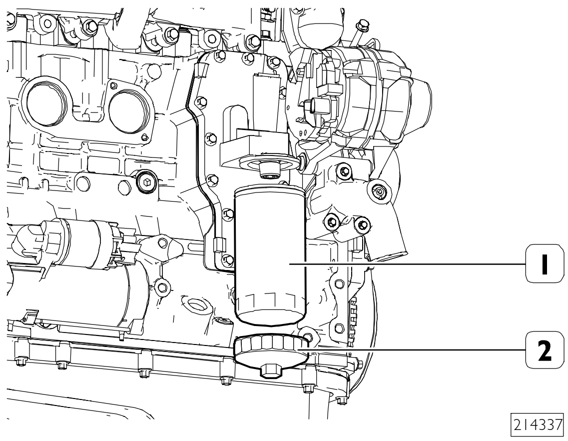
Removal of oil filter

Figure 12 NEF67 TM1F engine



☞ NEF67 TE1F/TE2F engine Page 10

In order to apply the bracket 99361037 fixing the crankcase to the stand 99322205 and overhaul it, operate in the following way.

From the right side, remove:

- ❑ with tool 99360076 (2) remove the oil filter (1) from the support.

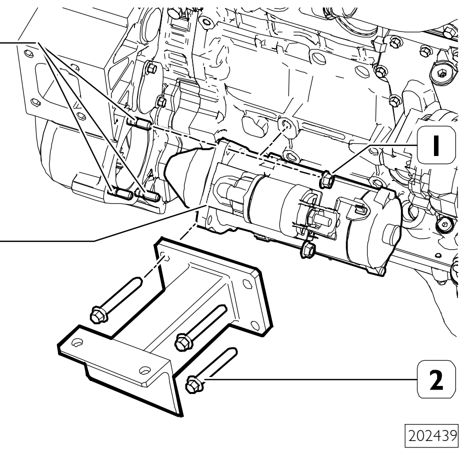
Attention, the oil filter contains approximately 1 kg of engine oil.

Collect and dispose of the engine oil according to applicable laws.

Ref.	No.	Screws description
(1)	1	Cartridge M27x2

Removal of starter motor

Figure 13

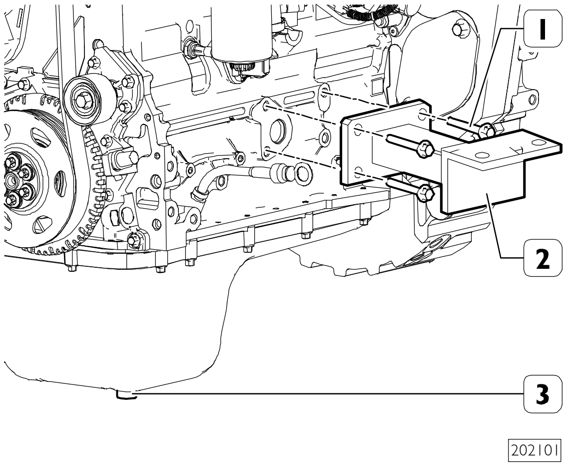


- ❑ properly support the starter motor (3).
- ❑ Loosen the retaining nuts (1).
- ❑ Remove the starter motor (3) and unscrew the studs (4).
- ❑ Mount the support bracket 99361037 by inserting the screws (2) into the four threaded holes.

Ref.	No.	Screws description	Tightening torques
(1)	3	M12x1.75	43 ± 6 Nm
(2)	3	Nut M10x1.5	-
(4)	3	Stud M10x1.5x20	-

Mounting brackets on rotating stand

Figure 14



From the left side:

- ❑ connect the second bracket 99361037 (2) by inserting the screws (1) into the threaded holes.
- ❑ Lift the engine with arm 99360595 and put it on the rotating stand 99322205.

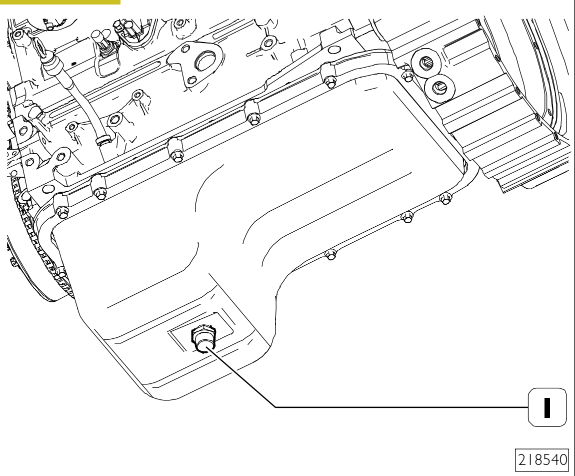
Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	43 ± 6 Nm

Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

Engine lubricant oil drainage

Figure 15



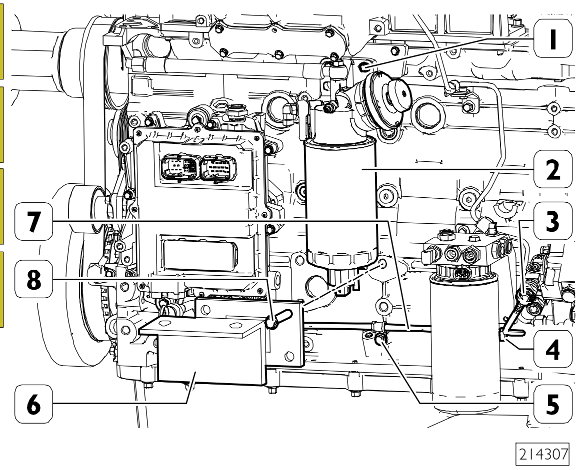
- ❑ Drain the oil through the plug (1) located below the oil sump.

The oil sump contains approximately 7.65 kg of engine oil.

Collect and dispose of the engine oil according to applicable laws.

Ref.	No.	Screws description
(1)	1	Plug M18x1.5

Figure 16 NEF67 TE1F/TE2F engine



☞ NEF67 TM1F engine Page 14

From the right hand:

- ❑ Disconnect the fuel pre-filter (2) from all connection pipes.
- ❑ Unscrew the screws (1) and the relative nuts.
- ❑ Remove the fuel pre-filter (2).
- ❑ Remove the clamp (4) for supporting the pipe (7) in low pressure.
- ❑ Unscrew the screws (5), remove the quick-fit couplings (3) and remove the low pressure pipe (7).
- ❑ Connect the bracket 99361037 (6) by inserting the screws (8) into the threaded holes.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M20x1.5	-
(5)	1	Screw M20x1.5	-
(8)	4	Screw M12x1.75	43 ± 6 Nm

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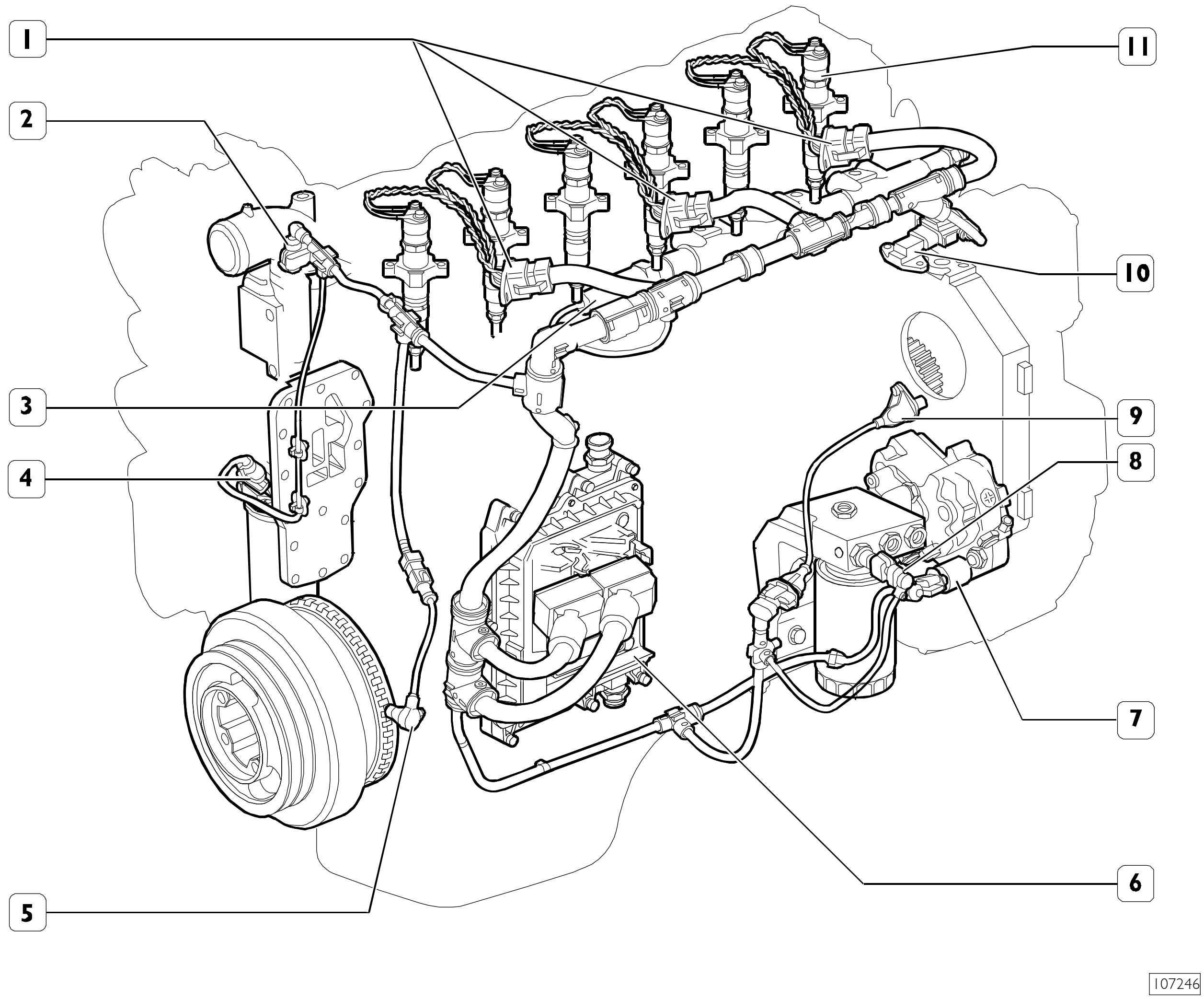
Engine cable removal

Figure 17



1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9. Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

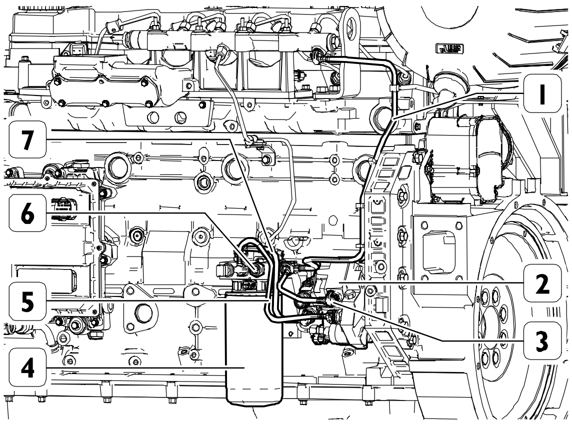
Disconnect the engine cable from the connectors: (1) injector wiring; (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Remove the clamps that hold it to the crankcase and remove it completely.

Removal of components hindering bracket assembly

Removal of fuel pipes

Figure 18



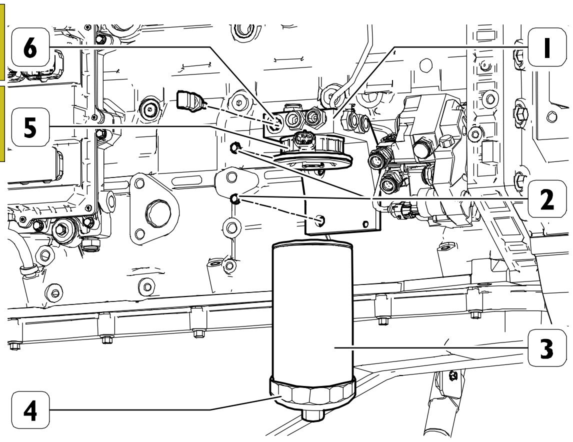
214308

- ❑ Remove the excess fuel return pipe (1) from the Common Rail.
- ❑ Remove the fuel return pipe (3) for the injection pump (2).
- ❑ Remove the fuel arrival pipe (5) for the injection pump (2).
- ❑ Remove the fuel returning pipe (7) from the injection pump (2) to the filter (4).
- ❑ Unscrew the Voss fitting (6).

Ref.	No.	Screws description
(6)	1	Connector M12x1.5

Fuel filter removal

Figure 19

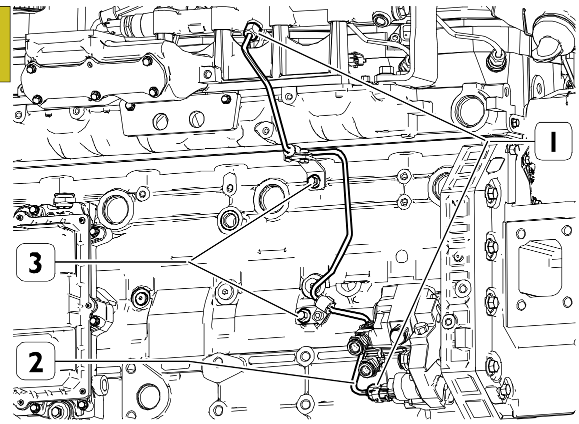


214309

- ❑ Unscrew the fuel temperature sensor (6).
- ❑ Unscrew the cartridge (3) using tool 99360076 (4).
- ❑ Unscrew the screws (2).
- ❑ Remove the fuel filter support (1) together with the fuel preheating resistor (5).

Ref.	No.	Screws description
(2)	2	Screw M12x1.75
(3)	1	Cartridge M20x1.5
(6)	1	Sensor M14x1.5

Figure 20



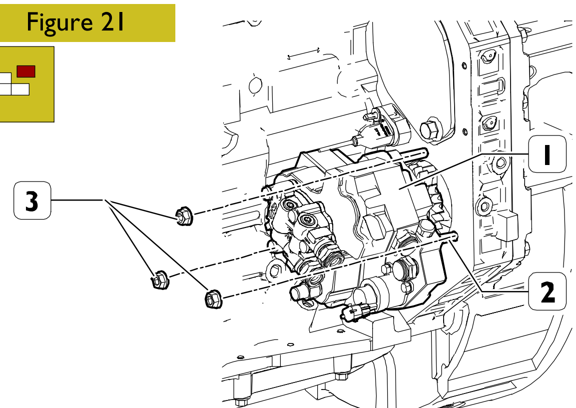
214310

- ❑ Unscrew the unions (1).
- ❑ Unscrew the screws (3).
- ❑ Remove the Rail supply high pressure pipe (2).

Ref.	No.	Screws description
(1)	2	Connector M14x1.5
(3)	2	Screw M6x1x12

Feed pump removal

Figure 21

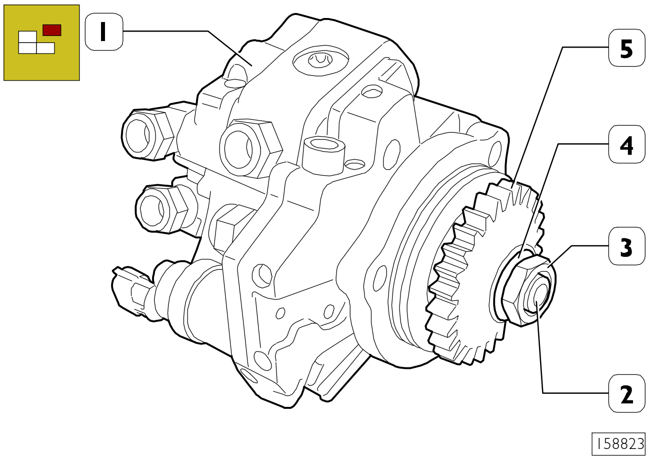


202446

- ❑ Loosen the nuts (3).
- ❑ Remove the supply pump assembly (1).
- ❑ Unscrew the studs (2).

Ref.	No.	Screws description
(2)	3	Stud M8x1.25x5
(3)	3	Nut M8x1.25

Figure 22

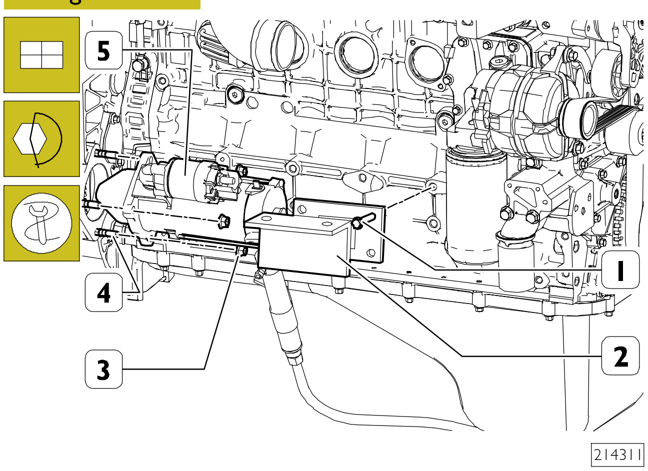


- ❑ Lock rotation of the high-pressure pump (1) drive shaft (2).
- ❑ Remove the nut (3) and the washer (4) using the double acting bridge 99341001, brackets 99341009 and clamp 99341015, remove the gear (5) from the shaft (2).

Ref.	No.	Screws description
(3)	1	Nut M18x15

Mounting brackets on rotating stand
Starter motor removal

Figure 23



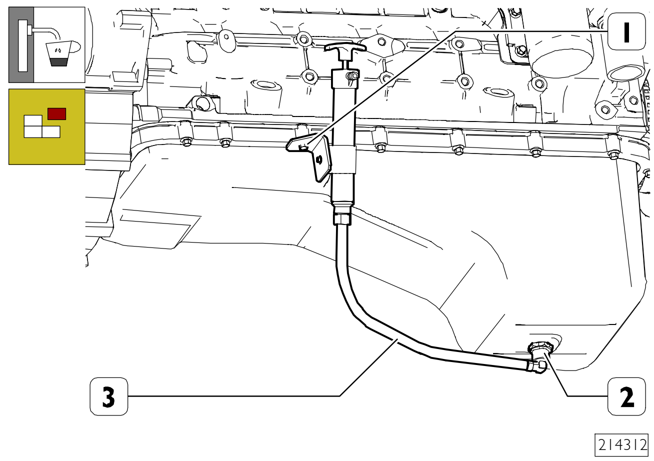
From the left side:

- ❑ connect the second bracket 99361037 (2) by inserting the screws (1) into the threaded holes.
- ❑ Lift the engine with arm 99360595 and put it on the rotating stand 99322205.
- ❑ Loosen the nuts (3).
- ❑ Remove the starter motor (4) and unscrew the studs (5).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M12x1.75	24 ± 4 Nm
(3)	3	Nut M10x1.5	-
(4)	3	Stud M10x1.5x20	-

Oil discharge pump removal

Figure 24



- ❑ Unscrew the screw (1) and remove the oil discharge pump (3).
- ❑ Undo the discharge valve (2) and drain the oil.

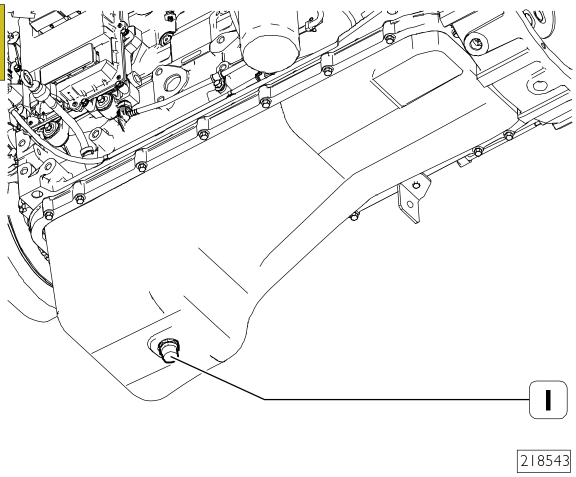
Ref.	No.	Screws description
(1)	1	Screw M8x1.25x40
(2)	1	Valve M22x1,5

Avoid skin contact with the engine oil: in case of contact, wash thoroughly with water.

The engine oil is highly pollutant: it must be disposed of according to applicable laws.

Engine lubricant oil drainage

Figure 25



- ❑ Drain the oil through the plug (1) located below the oil sump.

The oil sump contains approximately 13.5 kg of engine oil.

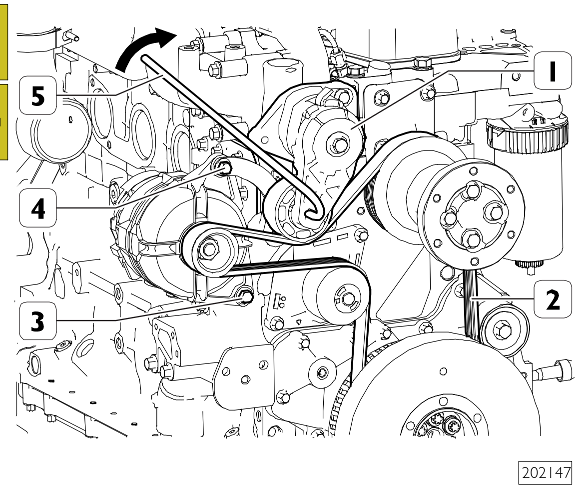
Collect and dispose of the engine oil according to applicable laws.

Ref.	No.	Screws description
(1)	1	Plug M18x1.5

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Alternator removal

Figure 26 (For all engines)

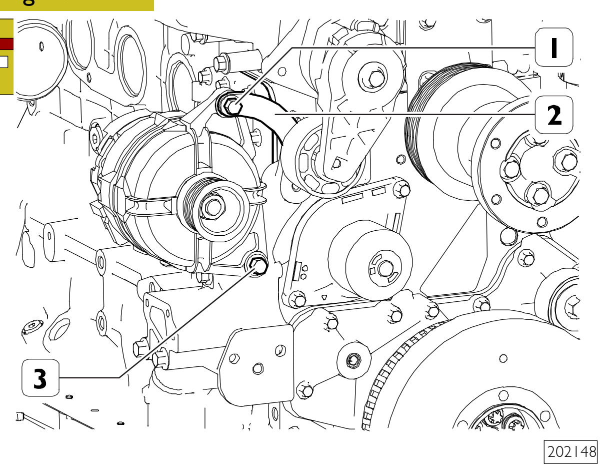


- ❑ Loosen the screw (3) anchoring the alternator to its lower support and the bolt (4) fixing the alternator to the bracket.

Ref.	No.	Screws description
(3)	1	Screw M10x1.5
(4)	1	Screw M10x1.5
(4)	1	Nut

- ❑ Use the special tool (5) to turn the automatic tensioner (1) in the direction of the arrow and remove the belt (2).

Figure 27



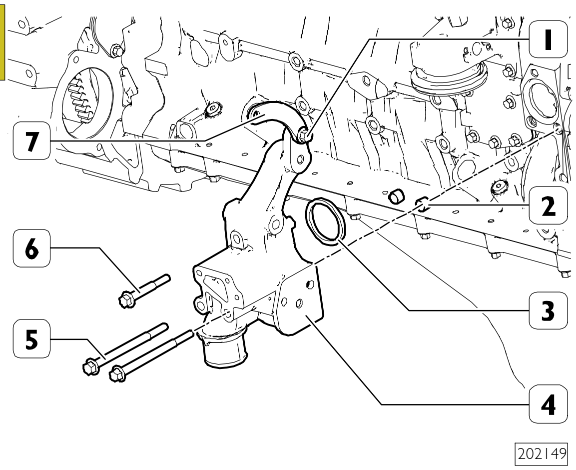
- ❑ Unscrew the screw (3) anchoring the alternator to its lower support and the screw (1) securing it to the bracket (2).

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(3)	1	Screw M10x1.5

- ❑ Remove the alternator from its housing.

Alternator mount removal

Figure 28

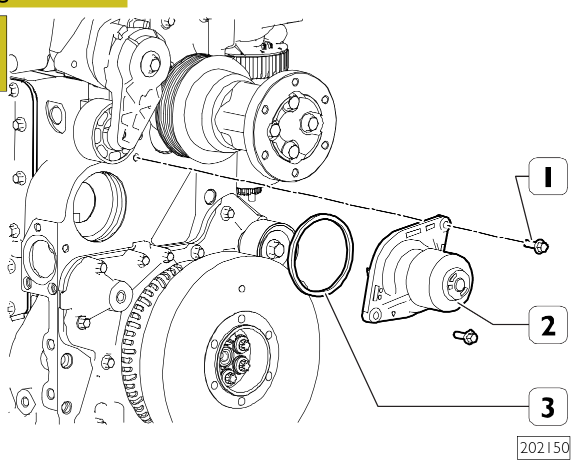


- Unscrew the screws (5 and 6).
- Remove the alternator mount (4).
- Unscrew the screw (1) and recover the support bracket (7).
- Recover the gasket (3) and the cable reference dowel pins (2).

Ref.	No.	Screws description
(1)	1	Screw M10x1.5
(5)	2	Screw M10x1.5x135
(6)	1	Screw M10x1.5x70

Removal of water pump

Figure 29

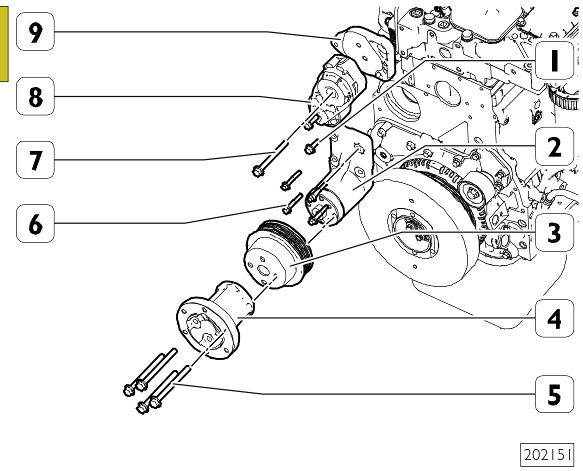


- Undo the screws (1) and remove them.
- Take the water pump (2) out of its housing.
- Recover the gasket (3).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x35

Removal of automatic belt tensioner and fan mount

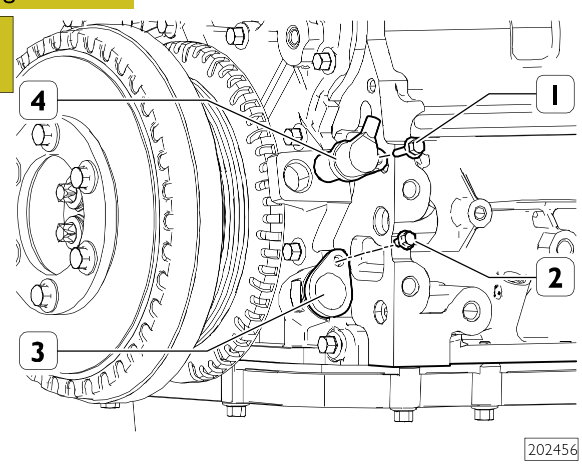
Figure 30



- Unscrew the screw (7) and remove the automatic belt tensioner (8).
- Unscrew the screws (1) and remove the belt tensioner mount (9).
- Unscrew the screws (5) and remove the spacer (4) for the fan coupling together with the drive pulley (3).
- Unscrew the screws (6) and remove the fan mount (2).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x30
(5)	4	Screw M10x1.5x110
(6)	4	Screw
(7)	1	Screw M10x1.5x70

Figure 31

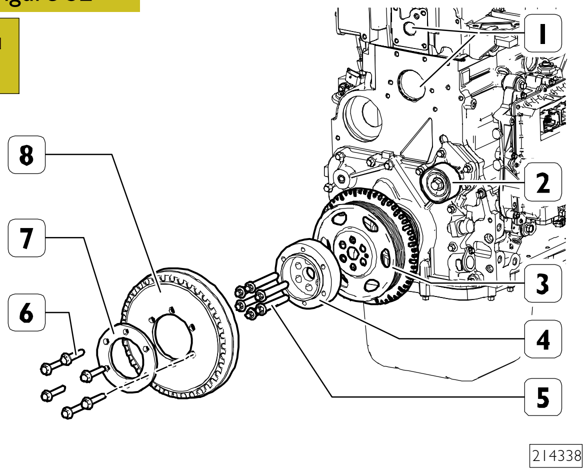


- Unscrew the screw (1) and remove the crankshaft rpm sensor (4).
- Unscrew the screw (2) and remove the plug (3).

Ref.	No.	Screws description
(1)	1	Screw M6x1x20
(2)	1	Screw

Removal of crankshaft pulley

Figure 32



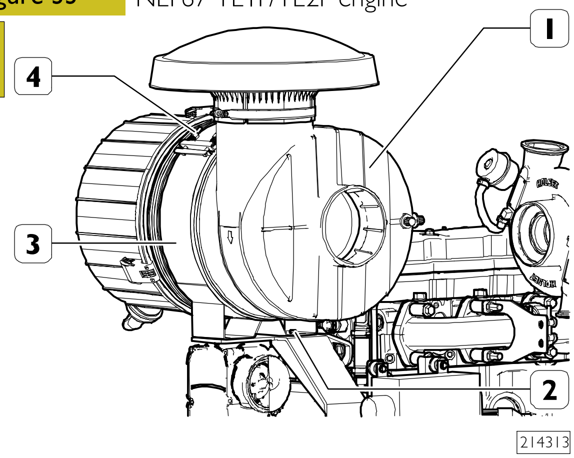
- ❑ Unscrew the screws (6) fixing the flange (7) to the front hub (8).
- ❑ Remove the front hub (8).
- ❑ Unscrew the screws (5).
- ❑ Remove the spacer (4) for the shaft and the pulley (3).
- ❑ Unscrew the screw (2) fixing the idler pulley.
- ❑ Remove the core plug (1).

Ref.	No.	Screws description
(2)	1	Screw M10x1.5
(5)	6	Screw M12x1.25x78.5
(6)	6	Screw M10x1.25x40

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Air filter removal

Figure 33 NEF67 TE1F/TE2F engine

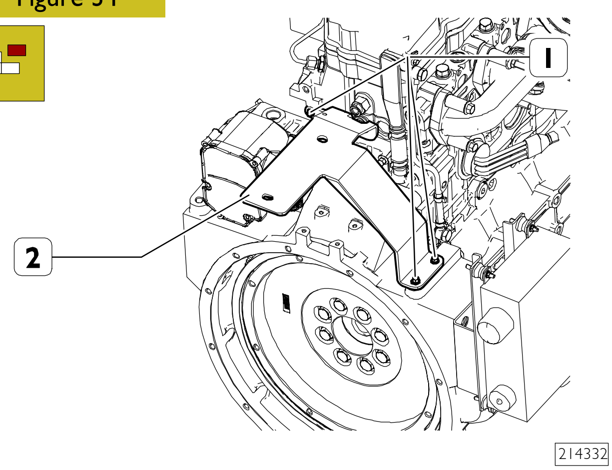


☞ NEF67 TM1F engine Page 17

- ❑ Unscrew the screws (4) and remove the air filter (1) from its support.
- ❑ Unscrew the screws (2) together with the relative nuts and remove the fan mount (3).

Ref.	No.	Screws description
(2)	2	Screw M8x1.25x100
(4)	2	Screw M8x1.25x100

Figure 34



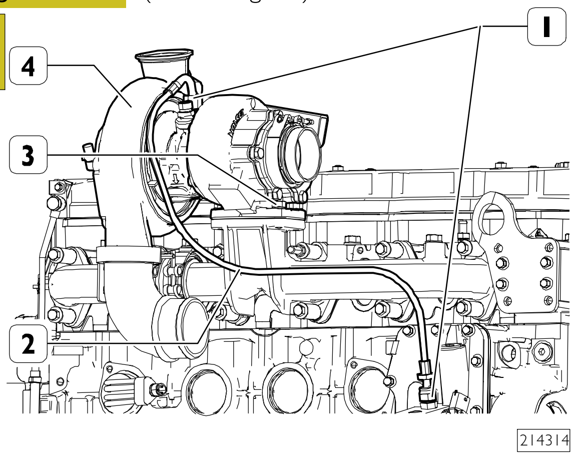
- ❑ Unscrew the screws (1) and remove the support (2).

Ref.	No.	Screws description
(1)	3	Screw M8x1.25x100

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Turbocharger removal

Figure 35 (For all engines)



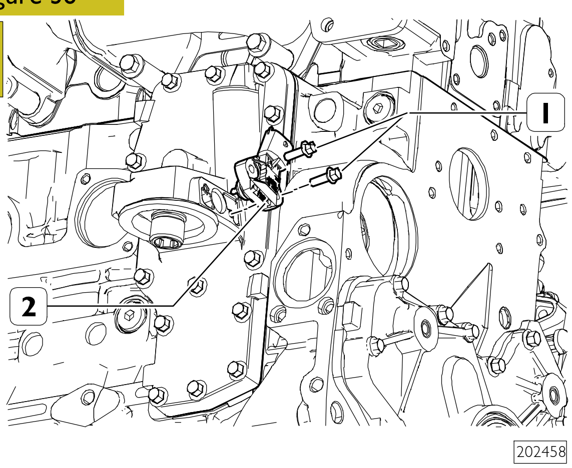
NOTE Before proceeding make sure that the turbocharger is disconnected from all of the engine air intake pipes and exhaust gas pipes.

- ❑ Unscrew the fittings (1) for the oil deliver pipe (2) to the turbocharger (4).
- ❑ Unscrew the nuts (3) and remove the turbocharger (4).
- ❑ Recover the gasket on the exhaust manifold.

Ref.	No.	Screws description
(1)	2	Fitting M10x1.25
(3)	4	Nut M8x1.25

Removal of heat exchanger

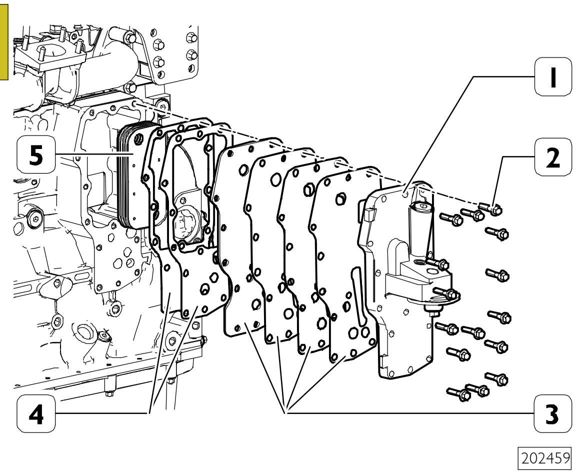
Figure 36



- ❑ Unscrew the screws (1) and remove the oil pressure/temperature sensor (2).

Ref.	No.	Screws description
(1)	2	Screw M6x1x20

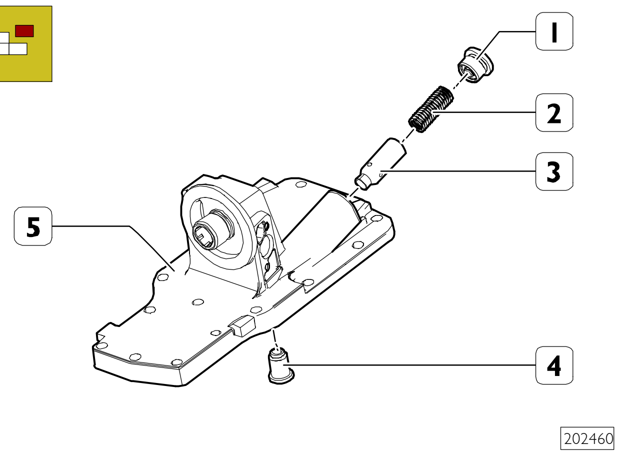
Figure 37



- ❑ Unscrew the screws (2) and remove the oil filter support (1).
- ❑ Extract the insulating plates (3).
- ❑ Extract the heat exchange elements (5).
- ❑ Remove the two sealing gaskets (4).

Ref.	No.	Screws description
(2)	15	Screw M8x1.25x35

Figure 38



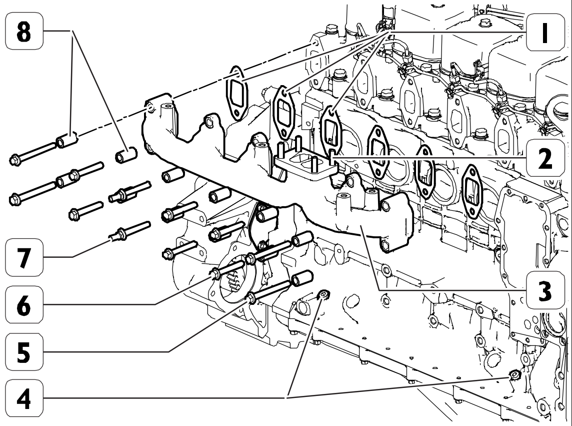
From the oil filter housing (5):

- ❑ remove the pressure control valve (4).
- ❑ unscrew the plug (1), remove the compression spring (2) and remove the pressure control valve (3).

Ref.	No.	Screws description
(1)	1	Plug M22x1.5

Exhaust manifold removal

Figure 39 NEF67 TM1F engine



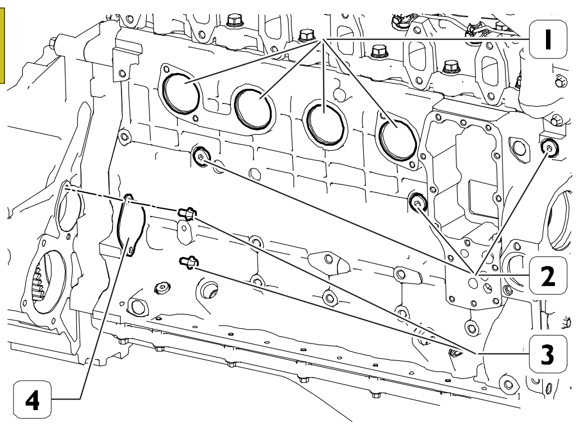
202156

☞ NEF67 TE1F/TE2F engine Page 23

- ❑ Unscrew the screws (5, 6 and 7) and recover the 12 spacers (8).
- ❑ Remove the exhaust manifold (3) and unscrew the turbocharger support studs (2).
- ❑ Recover the 6 gaskets (1).
- ❑ Unscrew the plugs (4) and recover the relative gaskets.

Ref.	No.	Screws description
(2)	4	Stud M10x1.5x42
(4)	2	Plug M18x1.5
(5)	4	Screw M10x1.5x95
(6)	2	Screw M10x1.5x95
(7)	6	Screw M10x1.5x95

Figure 40



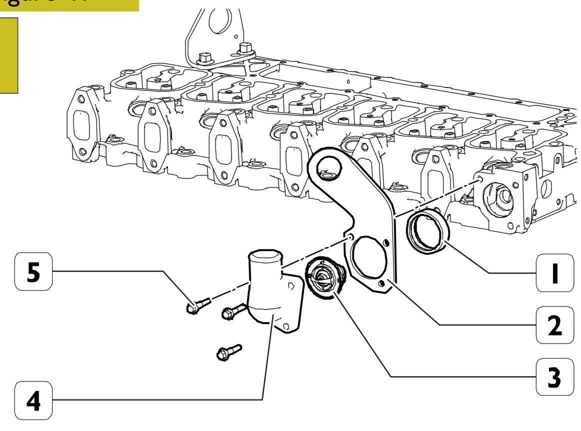
202157

- ❑ Remove the 4 core plugs (1).
- ❑ Unscrew the plugs (2) and recover the relative gaskets.
- ❑ Unscrew the screws (3) and remove the inspection cover (4).

Ref.	No.	Screws description
(2)	3	Plug M18x1.5
(3)	2	Screw M8x6

Thermostat unit removal

Figure 41



202176

- ❑ Unscrew the screws (5) securing the thermostat cover (4).
- ❑ Remove the thermostat cover (4).
- ❑ Remove the thermostat assembly (3).
- ❑ Remove the lifting eyelet (2).
- ❑ Remove the gasket (1) of the cover.

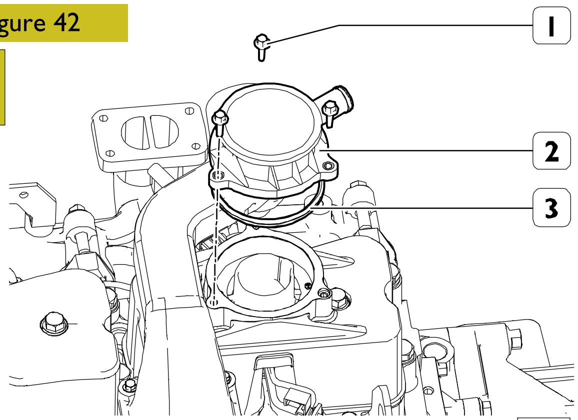
Ref.	No.	Screws description
(5)	3	Screw M6x1

Prior to removing the cylinder head, fit the bracket into the original position and fasten it with the screws of the thermostat body

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON UPPER SIDE)

Removal of oil vapour filter

Figure 42



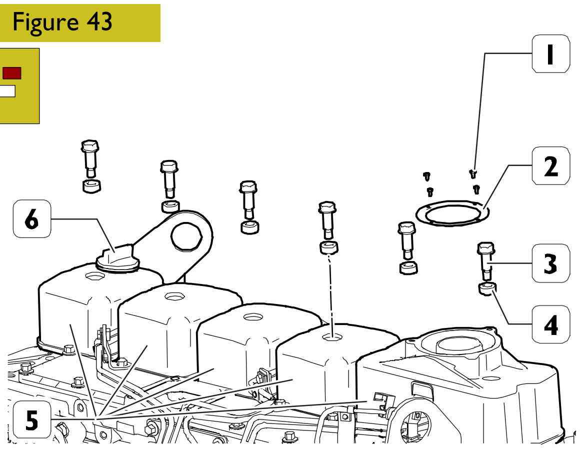
202158

- ❑ Unscrew the screws (1).
- ❑ Remove the oil vapour breather valve (2).
- ❑ Take out the gasket (3).

Ref.	No.	Screws description
(1)	3	Screw M6x1x20

Tappet cover removal

Figure 43



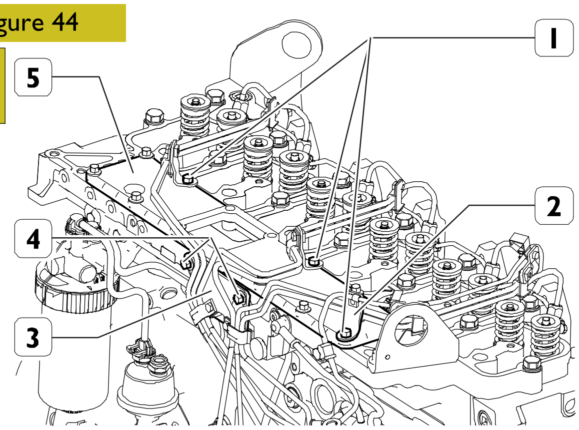
202159

- ❑ Unscrew the screws (1).
- ❑ Remove the baffle (2).
- ❑ Unscrew the screws (3) and recover the sound-proofing elements (4).
- ❑ Remove the tappet cover (5).
- ❑ Recover the oil filler plug (6) and the gaskets between the cover and the cylinder head.

Ref.	No.	Screws description
(1)	4	Screw T 2.9x6.5 F
(3)	6	Screw M8x1.25

High pressure fuel pipe removal

Figure 44

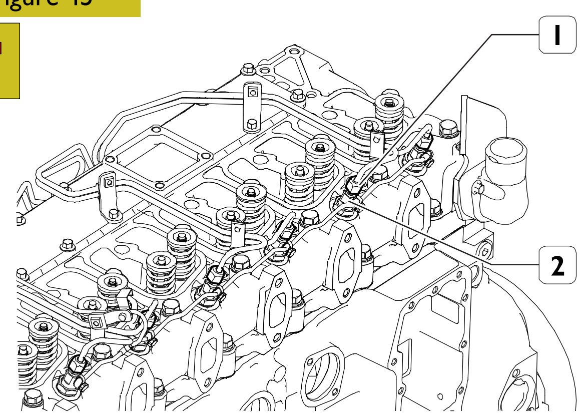


202162

- ❑ Place a container for the oil recovery
- ❑ Unscrew the support bracket (2) fastening screws (1) at the intake manifold (5).
- ❑ Unscrew the bracket (3) fastening screws (4).

Ref.	No.	Screws description
(1)	10	Screw M8x1.25
(4)	2	Screw M8x1.25x16

Figure 45

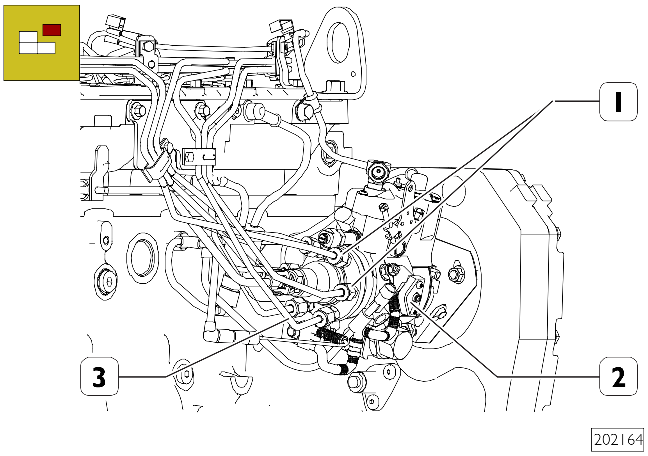


202163

- ❑ Unscrew the fittings (1) connecting to the injectors (2).

Ref.	No.	Screws description
(1)	6	Nut M14x1.5

Figure 46



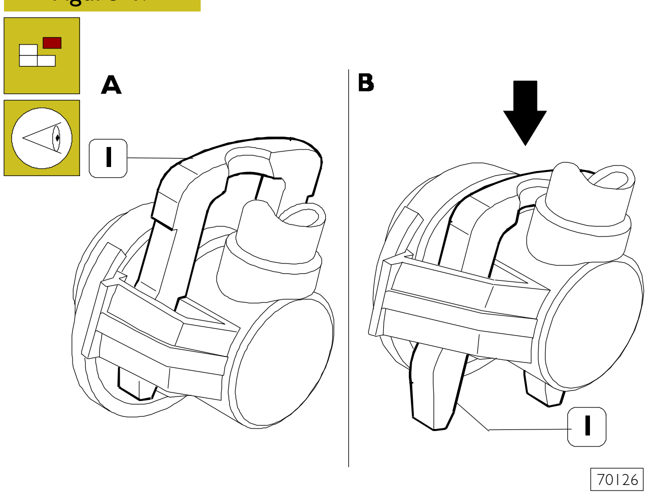
- Unscrew the fittings (1) connecting to the injection pump (2).
- Remove the high pressure pipes (3).

Ref.	No.	Screws description
(1)	6	Nut M12x1.5

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Low pressure fuel pipe removal

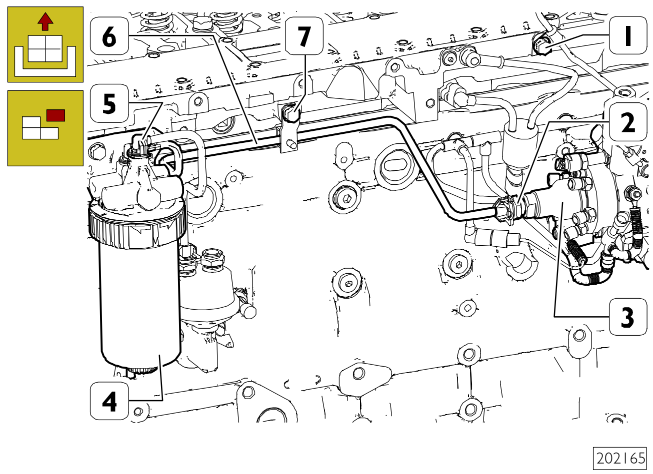
Figure 47



To disconnect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A) to prevent possible deformations.

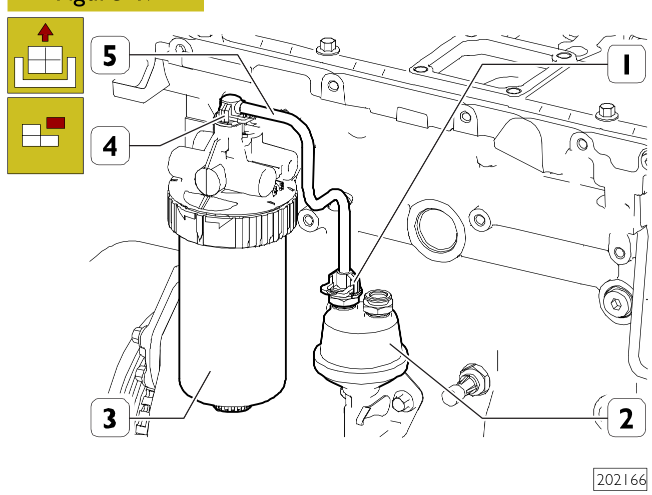
Figure 48



- Unscrew the screws (1 and 7) fixing the support brackets.
- Disconnect the clip (2) from the injection pump (3).
- Take out the quick-fit couplings (5) on the fuel filter (4) and remove the pipe (6).

Ref.	No.	Screws description
(1)	1	Screw M8x1.25x16
(7)	1	Screw M8x1.25x14

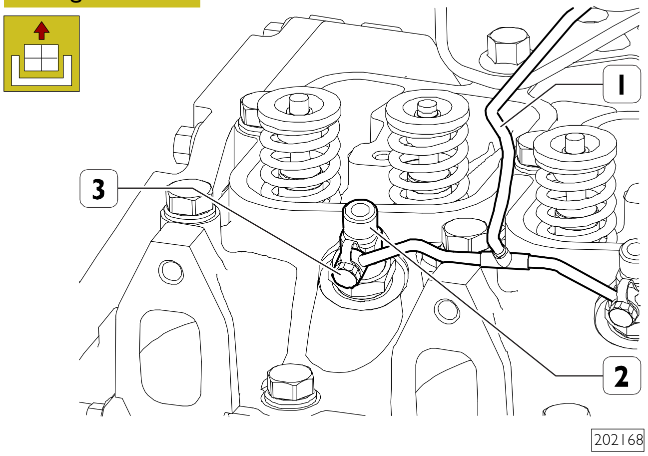
Figure 49



- Unscrew the connector (1) on the priming pump (2).
- Take out the quick-fit coupling (4) on the fuel filter (3).
- Remove the pipe (5).

Ref.	No.	Screws description
(1)	1	Nut M12x1.5

Figure 50

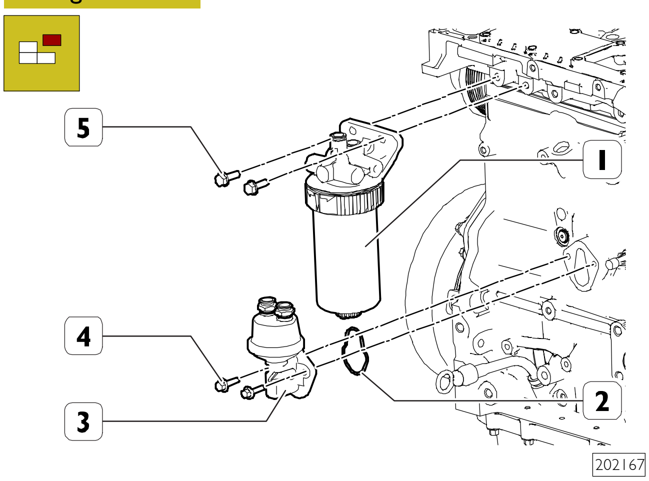


- Disconnect the 6 threaded fittings (3) passing through the injectors (2).
- Remove the exhaust pipes (1) from the injectors (2).

Ref.	No.	Screws description
(3)	6	Nut M6x1x10

Removal of fuel filter and priming pump

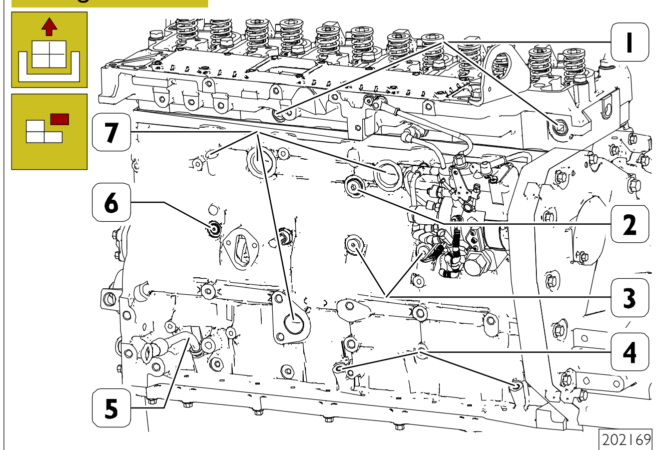
Figure 51



- Unscrew the screws (5) securing to the crankcase
- Remove the fuel filter (1) together with the support and the filtering cartridge.
- Unscrew the screws (4).
- Remove the priming pump (3) and recover the gasket (2).

Ref.	No.	Screws description
(4)	2	Screw M8x1.25x25
(5)	2	Screw M12x1.75

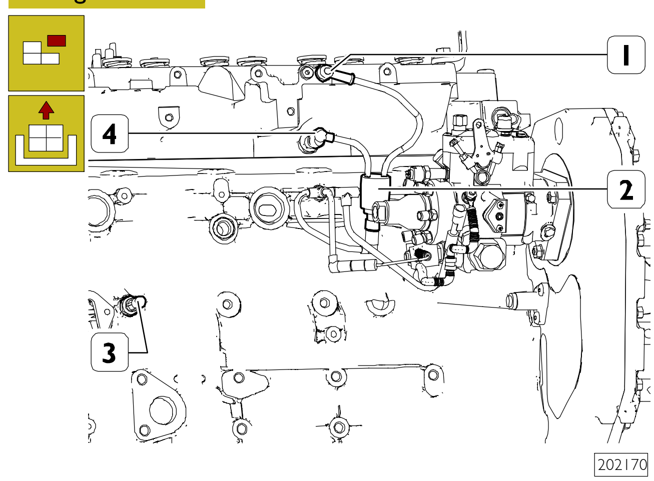
Figure 52



- Unscrew the threaded plugs (1) on the ducts for water delivery to the heater.
- Unscrew the threaded plugs (2, 3 and 6).
- Remove the core plugs (4 and 7).
- Unscrew the oil level dipstick (5).

Ref.	No.	Screws description
(1)	2	Plug ½"-14 0,610
(2)	1	Plug
(3)	2	Plug M10x1
(6)	1	Plug M18x1.5

Figure 53

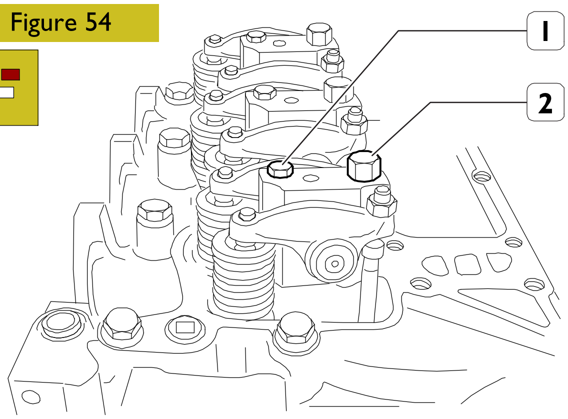


- Disconnect the connections to the contactor (2).
- Disconnect the connections (1) to the water temperature sensor (4).
- Disconnect all the electrical connections to the feed pump.
- Unscrew the water temperature sensor (4).
- Unscrew the oil pressure sensor (3).

Ref.	No.	Screws description
(3)	1	Sensor M10x1
(4)	1	Sensor ½ x14"

Rocker assembly removal

Figure 54



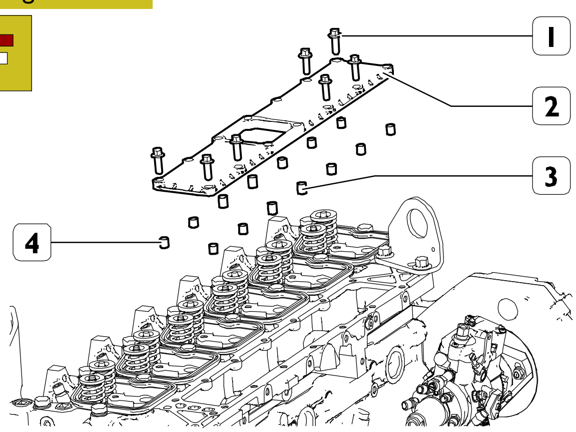
202143

- ❑ Disassemble the rocker arm mounts:
- ❑ Unscrew the two fastening screws (1 and 2) and disassemble the mount together with the rocker arms; remove the push rods.
- ❑ Repeat the operation for the remaining rocker arm mounts

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x75
(2)	6	Screw M12x1.75x180

Intake manifold removal

Figure 55



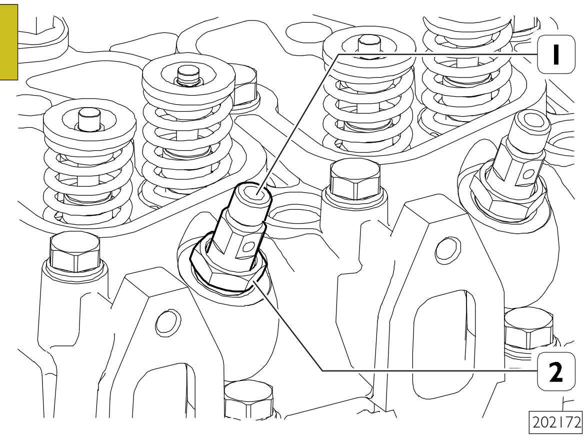
202171

- ❑ Unscrew the screws (1).
- ❑ Remove the intake manifold (2).
- ❑ Extract the 4 smooth bushings [h = 14 mm] (3) in correspondence with the intake duct.
- ❑ Extract the 10 smooth bushings [h = 11 mm] (4).

Ref.	No.	Screws description
(1)	7	Screw M8x1.25x25

Injector removal

Figure 56



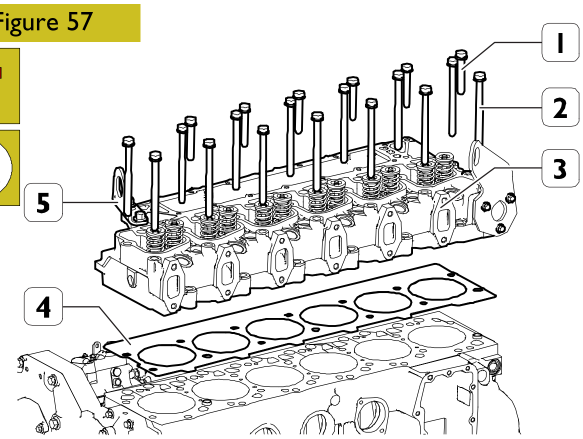
202172

- ❑ Unscrew the ring nut (2) securing the injector (1).
- ❑ Extract the injector (1), together with the ring nut (2).

Ref.	No.	Screws description
(2)	6	Ring nut M24x1.5

Cylinder head unit removal

Figure 57



202173

- ❑ Unscrew the screws (1 and 2).
- ❑ Using tool 99360595 via the lifting eyelets (5), remove the cylinder head (3) together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (4).
- ❑ Recover the cable reference dowel pins between the cylinder head assembly and the crankcase.

Ref.	No.	Screws description
(1)	6	Screw M12x1.75x70
(2)	14	Screw M12x1.75x140

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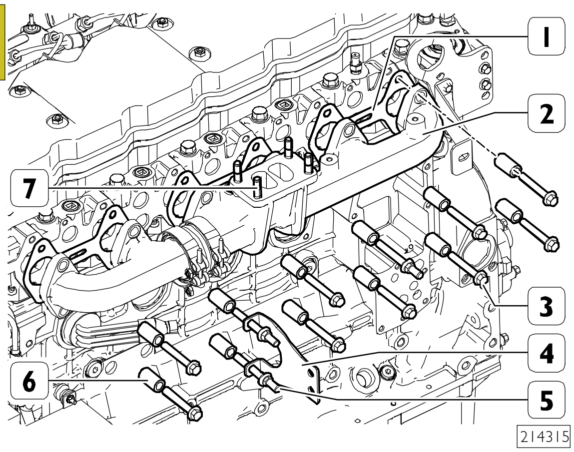
DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Exhaust manifold removal

Figure 58 NEF67 TE1F/TE2F engine



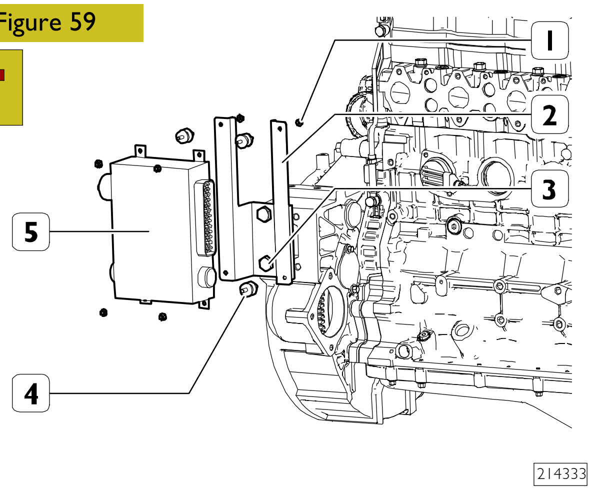
☞ NEF67 TM1F engine Page 29

- ❑ Unscrew the studs (7) for the turbocharger support.
- ❑ Unscrew the screws (3 and 5) securing the exhaust manifold (2).
- ❑ Remove the support bracket (4).
- ❑ Recover the spacers (6).
- ❑ Remove the exhaust manifold (2).
- ❑ Recover the gaskets (1).

Ref.	No.	Screws description
(3)	9	Screw M10x1.5x65
(5)	3	Screw M10x1.5x65
(7)	4	Stud M10x1.5x42

Extension kit removal

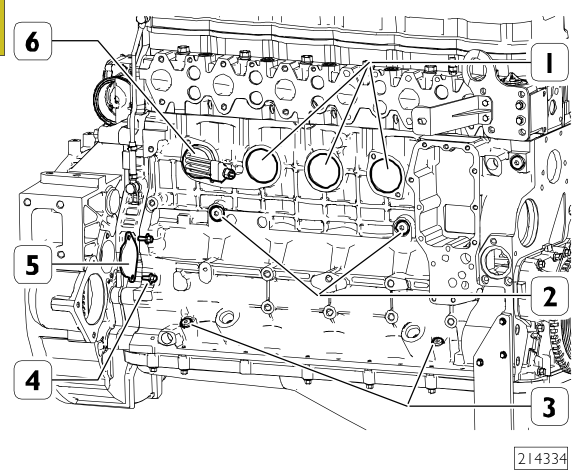
Figure 59



- ❑ Unscrew the nuts (1) from the elastic plugs (4).
- ❑ Remove the extension kit (5), together with the elastic plugs (4).
- ❑ Unscrew the screws (3) and remove the support (2).

Ref.	No.	Screws description
(1)	4	Nut M6x1
(3)	2	Screw M16x35

Figure 60



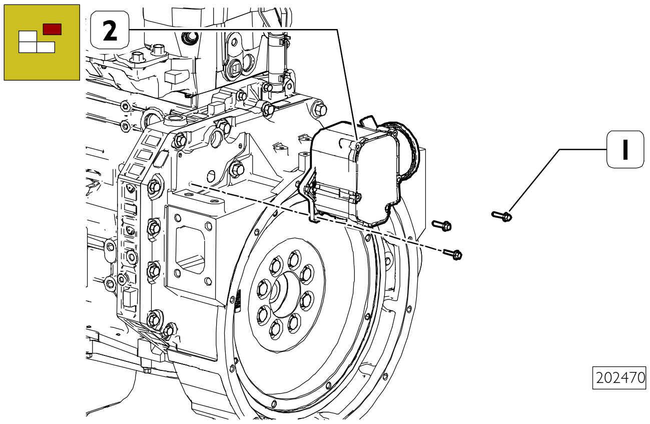
- ❑ Remove the 3 core plugs (1).
- ❑ Unscrew the plugs (2 and 3) and recover the relative gaskets.
- ❑ Unscrew the screws (4) and remove the inspection cover (5).
- ❑ Remove the water preheating resistor (6).

Ref.	No.	Screws description
(2)	3	Plug M18x1.5
(3)	3	Plug M12x1.5
(4)	2	Screw M8x6

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON UPPER SIDE)

Removal of oil vapour filter

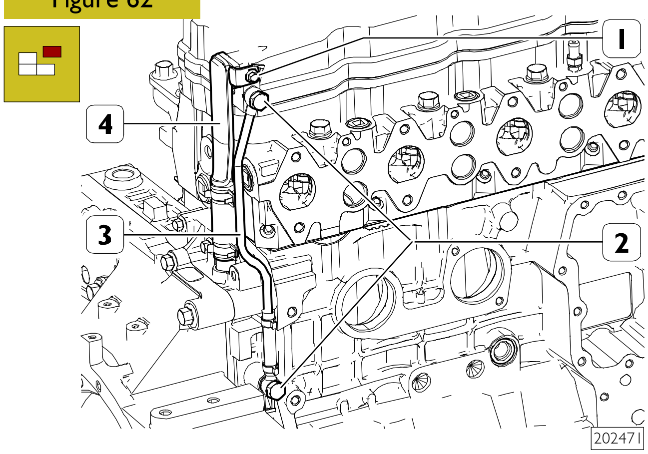
Figure 61



- Unscrew the screws (1) securing the oil vapour filter (2).
- Remove the filter (2).

Ref.	No.	Screws description
(1)	3	Screw M6x1x25

Figure 62

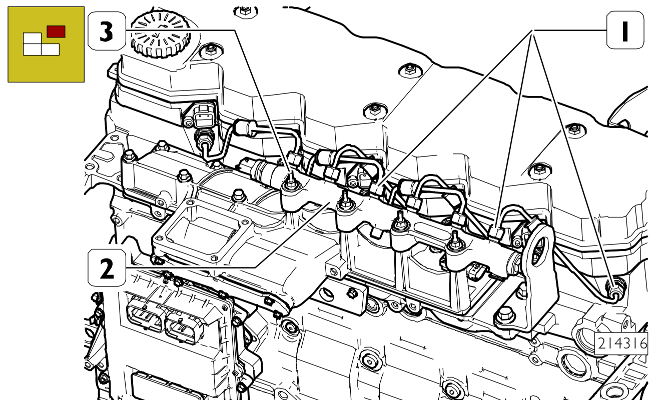


- Unscrew the support screw (1) from the clamp.
- Remove the engine breather pipe (4).
- Unscrew the threaded couplings (2) and remove the pipe (3).

Ref.	No.	Screws description
(1)	1	Screw M6x1
(2)	2	Coupling M12x1.5x11

Common Rail removal

Figure 63



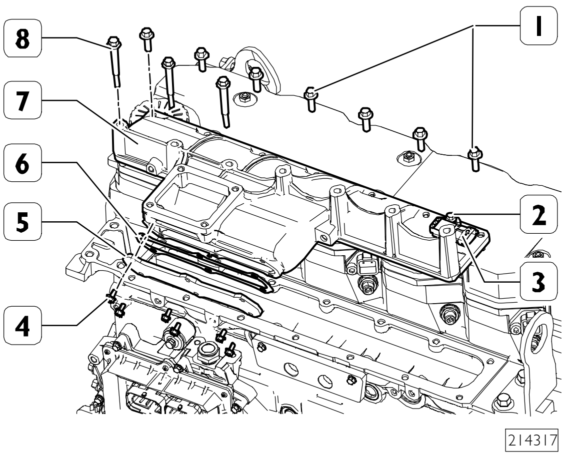
- Unscrew the nuts (1) connecting the high pressure pipes to the Common Rail (2).
- Unscrew the threaded double action screws (3) and remove the Common Rail (2).

Ref.	No.	Screws description
(1)	8	Nut M14x1.5
(3)	3	Screw M8x1.25x125

NOTE In unlocking the fittings securing the pipes to the rail, it is necessary to use a special wrench to prevent possible rotation of the flow limiters.

Intake manifold removal

Figure 64

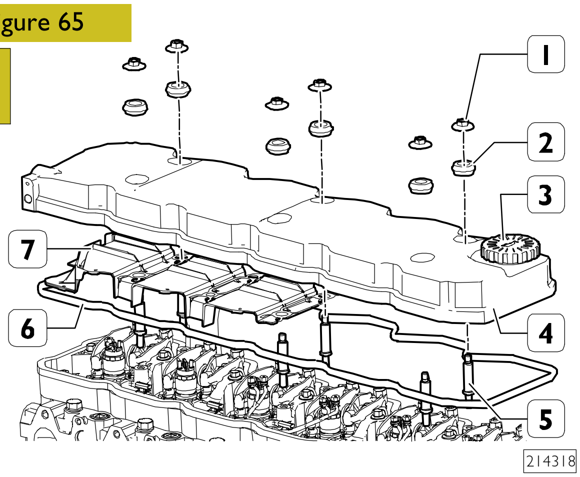


- Unscrew the screw (2) and remove the air pressure and temperature sensor (3).
- Unscrew the screws (4) and remove the cover (5).
- Recover the gasket (6).
- Unscrew the screws (1 and 8) and remove the intake manifold (7).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25
(2)	1	Screw M6x1x20
(4)	6	Screw M6x1x20
(8)	1	Screw M8x1.25x70

Tappet cover removal

Figure 65

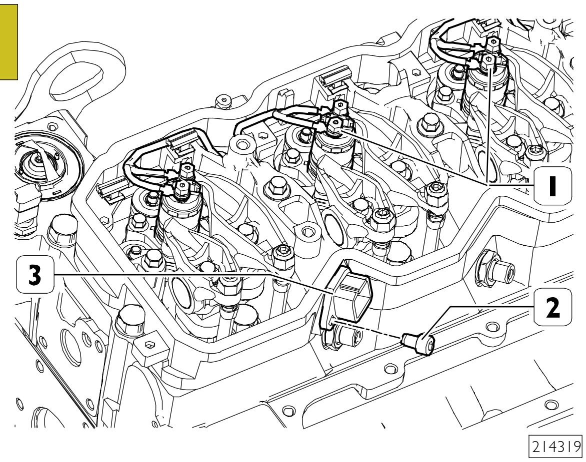


- Unscrew the flanged nuts (1) and remove the elastic plugs (2).
- Recover the oil filling cap (3).
- Remove the tappet covers (4).
- Recover the oil vapour condensation sector (7).
- Recover the gasket (6).
- Unscrew the double stem screws (5).

Ref.	No.	Screws description
(1)	4	Nut M8x1.25
(3)	1	Plug M38x3
(5)	4	Screw M8x1.25x17

Rocker assembly removal

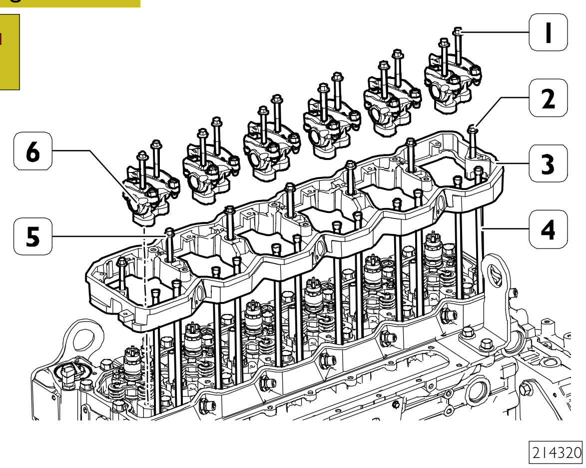
Figure 66



- Unscrew the screws (2).
- Loosen the nuts (1) on the electro-injectors.
- Remove the connectors (3) on the electro-injectors.

Ref.	No.	Screws description
(1)	12	M4 nut
(2)	3	Screw M6x1x16

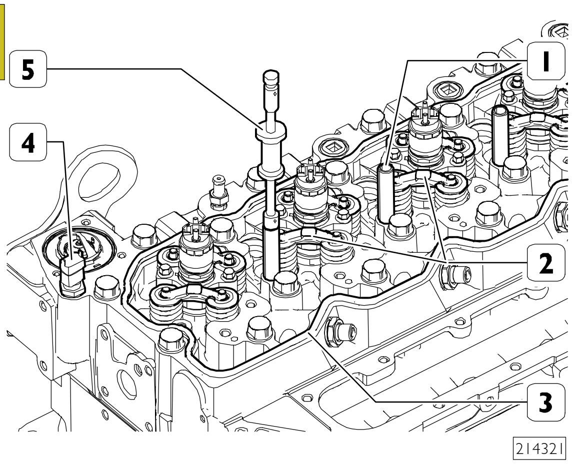
Figure 67



- Unscrew the screws (1) and remove the rocker arm unit (6).
- Unscrew the screws (2 and 5).
- Remove the housing (3) and the rocker arm control rods (4) together with the housing seats and the balls.

Ref.	No.	Screws description
(1)	12	Screw M8x1.25x55
(2)	2	Screw M8x1.25x50
(5)	5	Screw M8x1.25x70

Figure 68

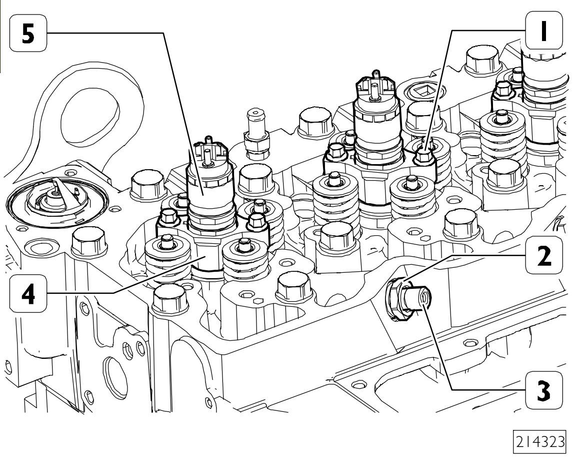


- ❑ Remove the gasket (3).
- ❑ Remove the intake and exhaust crossbars (2).
- ❑ Remove the sheaths (1) using tool 99340205 (5).
- ❑ Unscrew the coolant temperature sensor (4).

Ref.	No.	Screws description
(4)	1	Sensor M14x1.5

Electro-injector removal

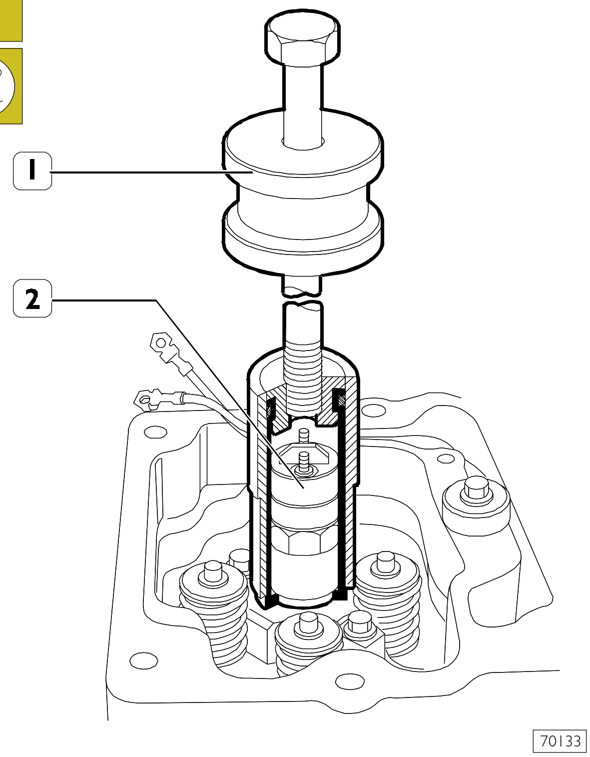
Figure 69



- ❑ Unscrew the ring nuts (2) and remove the unions (3).
- ❑ Unscrew the screws (1) and remove the rods (4) fixing the injectors (5).
- ❑ Remove the injectors (5).

Ref.	No.	Screws description
(1)	12	Screw M6x1x35
(2)	6	Ring nut M22x1.5

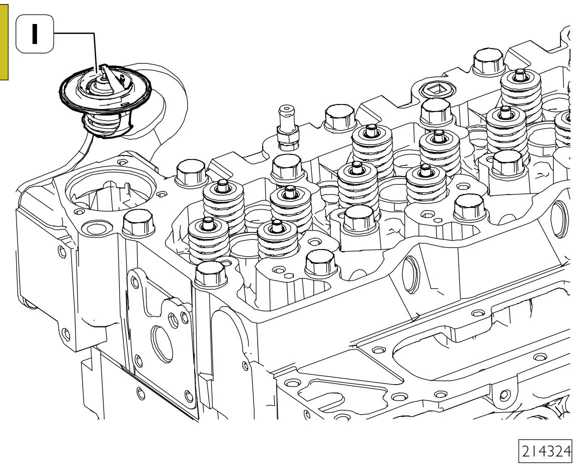
Figure 70



- ❑ Extract the electro-injectors (2) from the cylinder heads with tool 99342101 (1).

Thermostat unit removal

Figure 71



- ❑ Remove the thermostat unit (1), extracting it from its seat.

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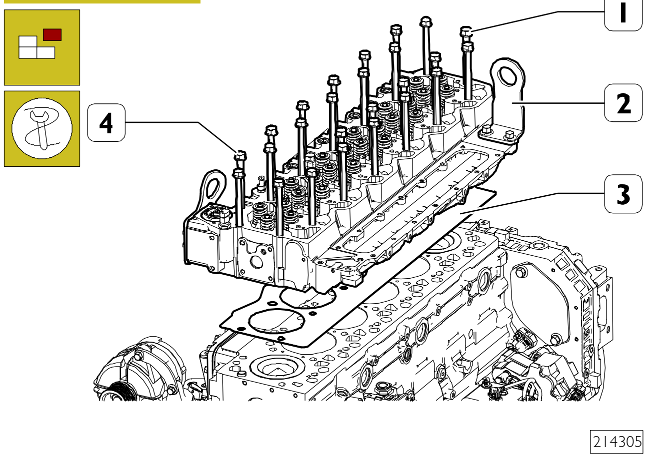
Cylinder head unit removal

Figure 72



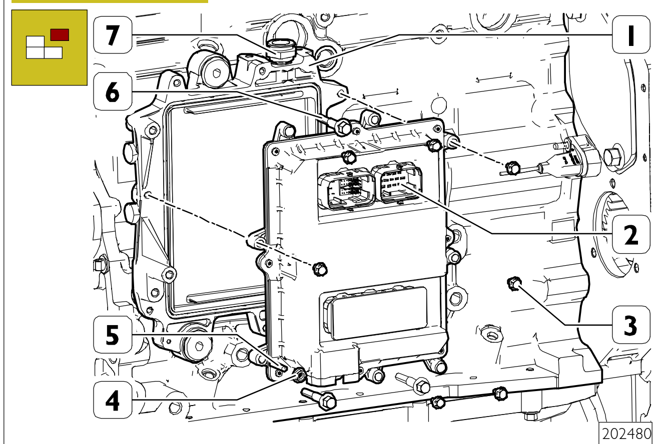
- ❑ Unscrew the screws (1 and 4).
- ❑ Using tool 99360595, by means of the lifting eyelets (2), remove the cylinder head together with all the elements relating to the timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.
- ❑ Recover the gasket (3).

Ref.	No.	Screws description
(1)	14	Screw M12x1.75x150
(4)	12	Screw M12x1.75x130

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Electronic Control Unit Removal

Figure 73

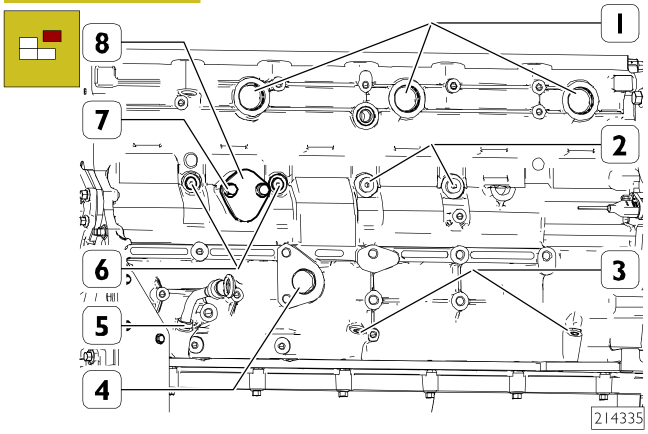


- ❑ Unscrew the screws (3 and 6).
- ❑ Unscrew the nut (4) and the corresponding stud (5).
- ❑ Remove the control unit (2).
- ❑ Unscrew the Voss fitting (7).
- ❑ Remove the support (1).

Ref.	No.	Screws description
(3)	7	Screw M6x1x30
(4)	1	Nut M6x1
(5)	1	Stud M6x1x25
(6)	3	Screw M8x1.25x45
(7)	1	Connector M12x1.25

Oil level dipstick removal

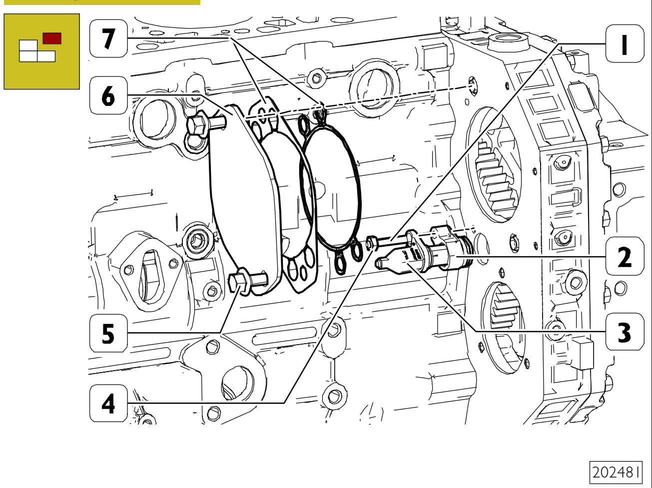
Figure 74



- Remove the core plugs (1, 3 and 4).
- Unscrew the plugs (2 and 6).
- Pull out the oil level dipstick (5).
- Unscrew the screws (7) and remove the cover (8) together with the gasket.

Ref.	No.	Screws description
(2)	2	Plug M14x1.5
(6)	2	Plug M10x1
(7)	2	Screw M8x1.25,20

Figure 75



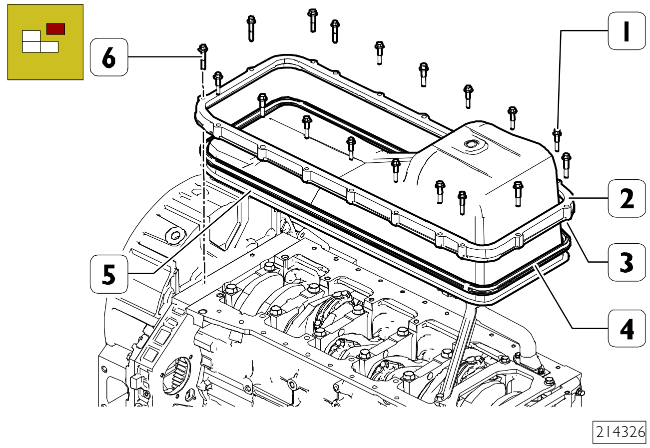
- Unscrew the screws (5) and remove the cover (6) from the control socket.
- Recover the gaskets (7).
- Unscrew the nut (4) and remove the camshaft rpm sensor (3).
- Unscrew the stud (1) and remove the support (2).

Ref.	No.	Screws description
(1)	1	Stud M6x1x30
(4)	1	Nut M6x1
(5)	2	Screw M12x25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Oil sump removal

Figure 76 (For all engines)



- Overturn the engine.
- Unscrew the screws (1 and 6) fixing the oil sump (3).
- Remove the spacer (2) and the gasket (4).
- Remove the oil sump (3).

Ref.	No.	Screws description
(1)	14	Screw M8x1.25x40
(2)	4	Screw M8x1.25x45

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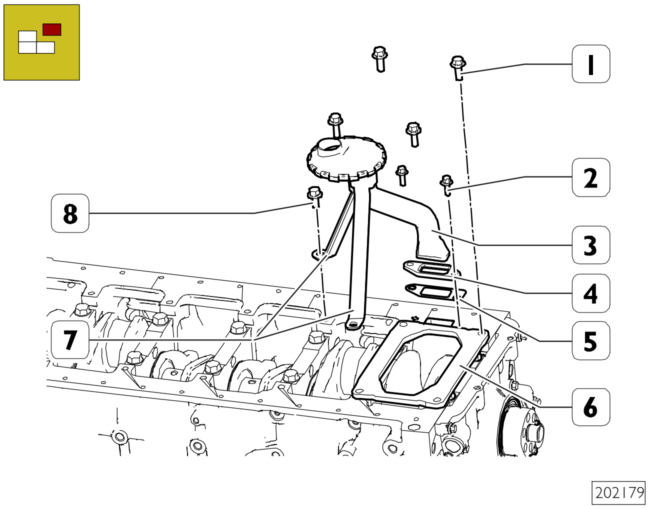
Suction strainer removal

Figure 77



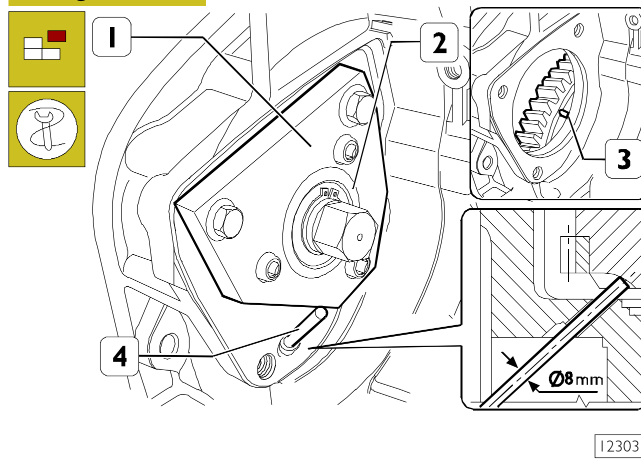
- Unscrew the screws (2) securing the suction strainer (3).
- Unscrew the screws (1) securing the bracket (7).
- Unscrew the screw (8).
- Remove the suction strainer (3) support bracket (7).
- Remove the suction strainer (3).
- Remove the flange (4).
- Recover the gasket (5).
- Remove the sound-proofing plate (6).
- Overturn the engine.

Ref.	No.	Screws description
(1)	4	Screw M10x1.5
(2)	2	Screw M8x1.25x20
(8)	1	Screw M8x1.25x45

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Injection pump removal

Figure 78 NEF67 TM1F engine



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Fit the tool 99360339 (1) in the starter motor seat to turn the flywheel.

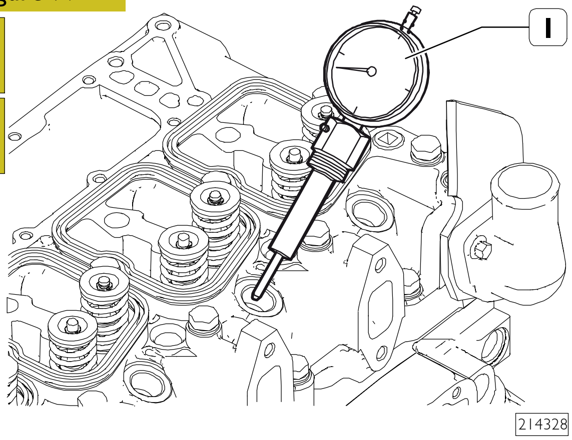
If it is necessary to replace the feed pump, this spare is supplied preset.

If however the pump needs to be disassembled and refitted without having undergone any repair interventions, preset it while it is still fitted on the engine and only then remove it.

The following procedure refers to the second possibility as this is the more complex one.

Identifying top dead centre with tool (99395097) - False injector

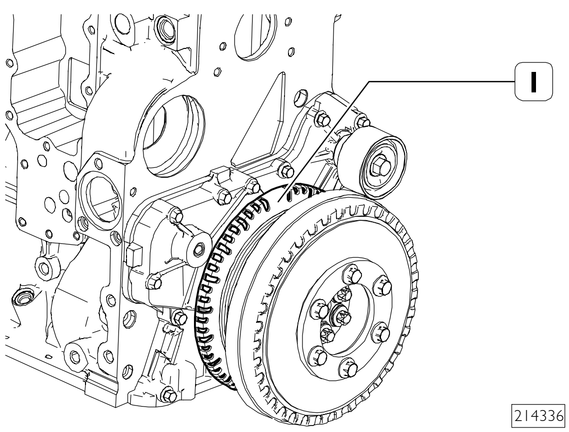
Figure 79



To search for the position of 1st cylinder at top dead, end of compression stroke, remove the rocker arm cover of the 1st cylinder, remove the 1st injector and position the tool (99395097 (1). Pre-load the dial gauge 99395604.

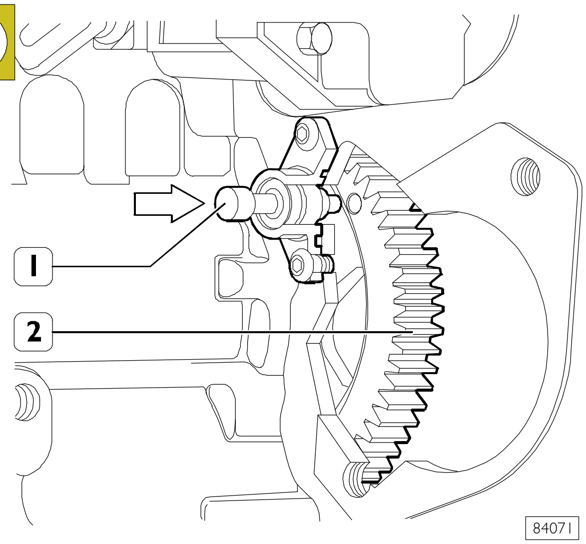
The required condition is obtained by turning the crankshaft appropriately until the maximum value appears on the dial gauge and making sure that the intake and exhaust valves are both closed.

Figure 80



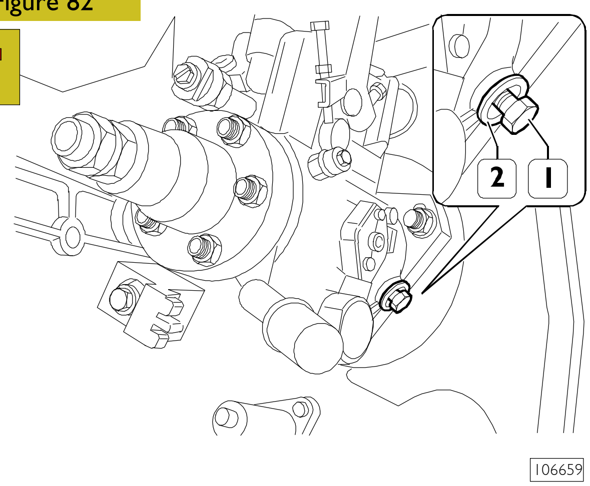
- ❑ Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 81



Rotate the flywheel until it pushes the pin 99360616 (1), this will not block the gear (2), obtaining the TDC of the 1st cylinder.

Figure 82



- ❑ Partially unscrew the screw (1) locking the pump spindle and move the spacer with the slot (2) to the largest part of the hole to allow the screw to fit in completely.
- ❑ Apply a torque of between 11.9 and 12.4 Nm to tighten the locking screw (1) flush with the spacer locking the pump spindle rotation.

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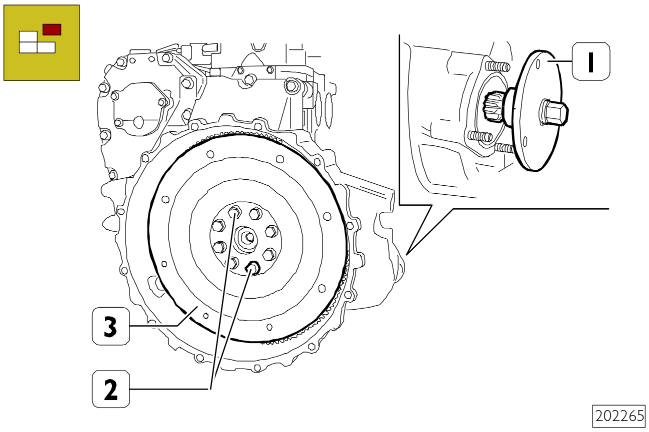
DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Removal of engine flywheel

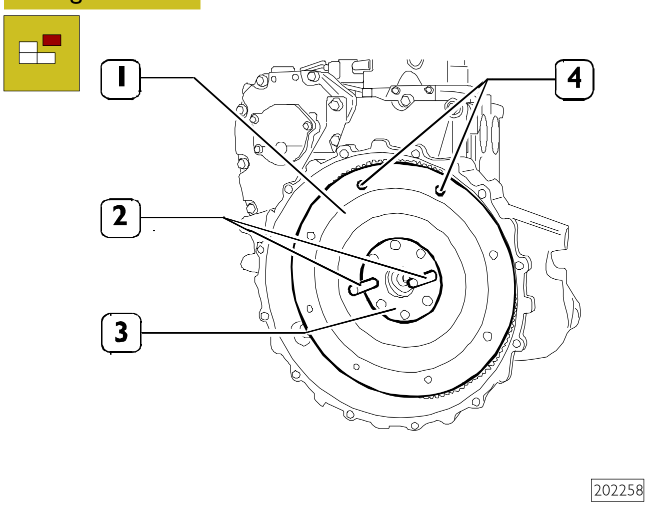
Figure 83



- Unscrew the two opposing screws (2) where the extraction pins will be inserted (see following figure).
- Unscrew the remaining screws fixing the flywheel (3) from the crankshaft.
- Remove the flywheel locking tool (1).

Ref.	No.	Screws description
(2)	8	Screw M12x1.25x30

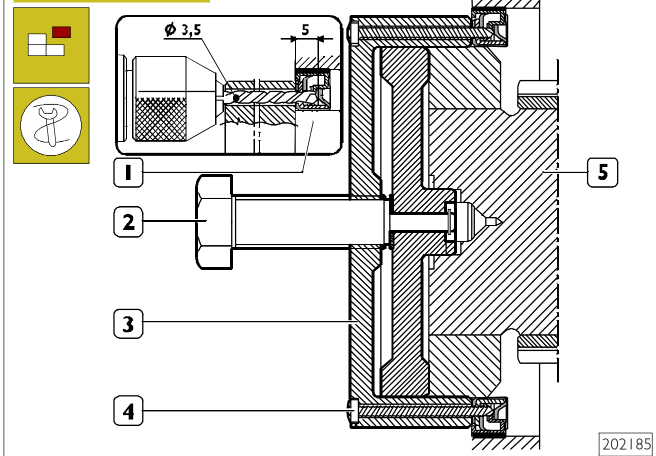
Figure 84



- Screw in two screws of average length into the holes (4) to sling the flywheel with a hoist.
- Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) out with the help of the hoist.

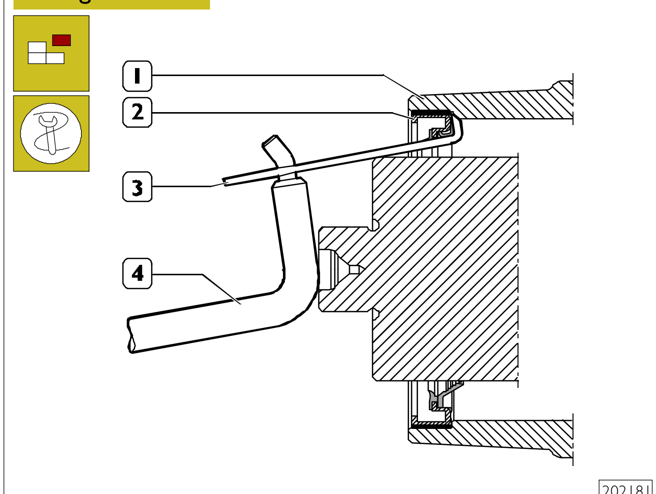
Removal of flywheel cover housing sealing ring

Figure 85



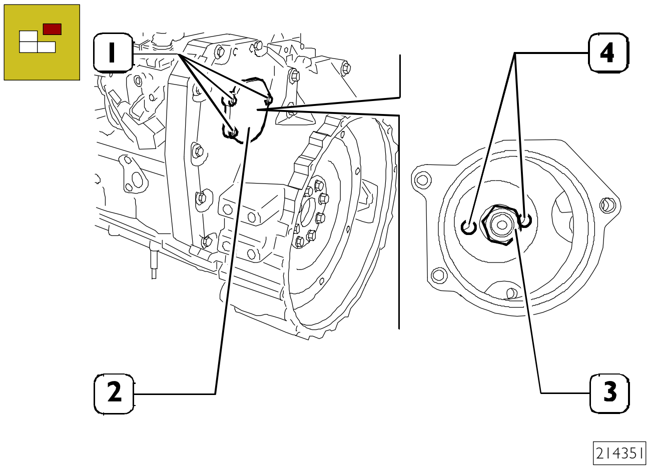
- Take out the flywheel housing seal ring applying tool 99340056 (3) onto the rear tang (5) of the crankshaft.
- Through the guiding holes of the tool itself, drill the internal seal ring with a bit (∅ 3.5 mm) to a depth of 5 mm.
- Secure tool 99340056 (3) to the ring (1) screwing in the 6 screws (4) supplied.
- Remove the ring (1) by screwing up the screw (2).

Figure 86



- Using an appropriate tie rod of tool 99363204 and a lever, take out the external seal ring from the flywheel housing

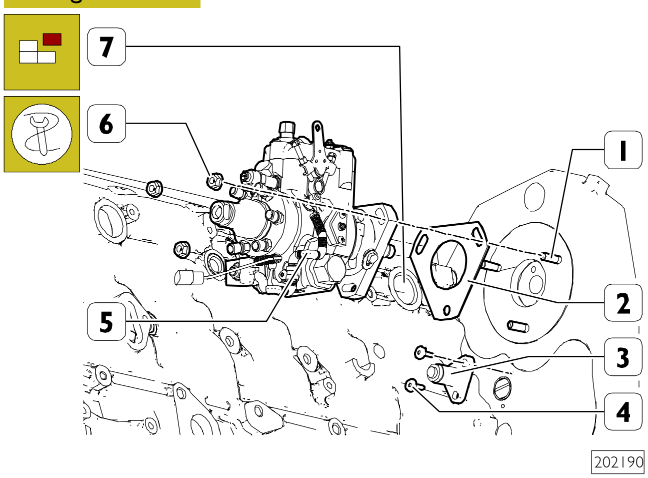
Figure 87



- On the timing gear side, remove the small cover (2) unscrewing the screws (1) so as to access the nut (3) securing the pump drive gear.
- Unscrew the nut (3) and recover the relative washer.

Ref.	No.	Screws description
(1)	3	Screw M8x1.25x20
(3)	1	Nut M14x1.5

Figure 88



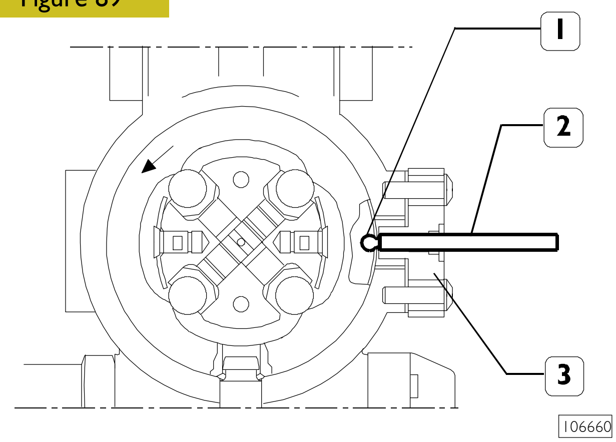
- From the side of the pump (5), loosen the fastening nuts (6) without removing them in order to allow the pump (5) to move backwards when the extractor 99340035 operates.
- Fit the extractor 99340035 using the two threaded holes and detach the gear from the pump spindle (5).
- Suitably support the feed pump (5) and unscrew the fastening nuts completely (6).
- Take the pump (5) off the studs (1) together with the gasket (2).
- Remove the core plug (7).
- Unscrew the screws (4) and remove the plate (3) together with the injection pump centring pin.

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Ref.	No.	Screws description
(1)	3	Stud M8x1.25
(4)	2	Screw M5x0.8
(6)	3	Nut M8x1.25

Check correct setting of rotating feed pump

Figure 89



1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

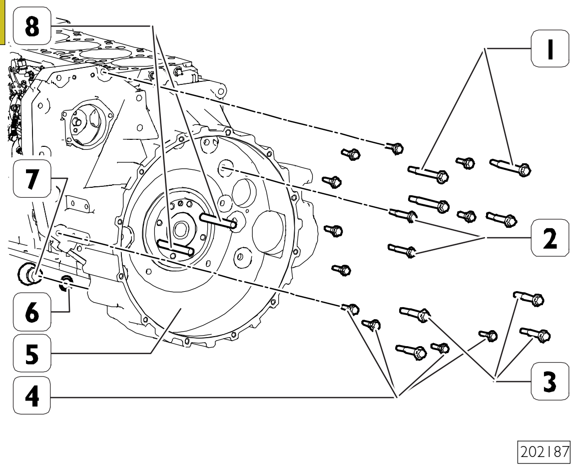
The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

Therefore:

- Remove the screw plug (3) at the centre of the plate.
- Insert synchronisation pin (1) 99365196 into the hole in the plate (3). The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.
- Lock the drive shaft in the correct position using the screw (1, Figure 82).
- Remove the synchronisation pin and fit the screw plug of the plate (3). Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

Removal of flywheel housing

Figure 90



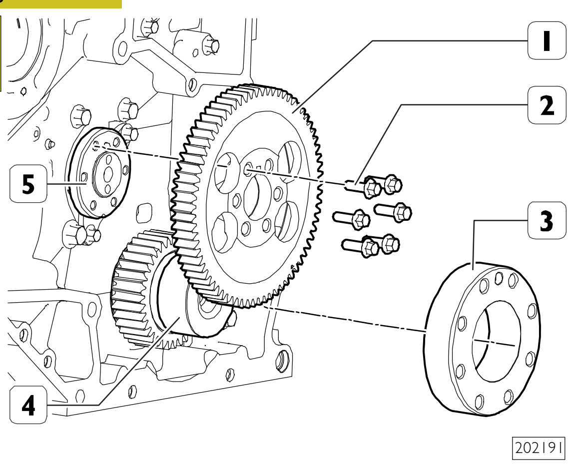
- ❑ Unscrew the screws (1, 2, 3 and 4).
- ❑ Remove the male (7) and recover the gasket (6).
- ❑ Remove the 2 cable reference dowel pins (8).
- ❑ Remove the flywheel housing (5).

Ref.	No.	Screws description
(1)	3	Screw M12x1.75
(2)	2	Screw M8x20
(3)	5	Screw M10x1.5
(4)	11	Screw

NOTE Take note of the screw (1, 2, 3 and 4) assembling positions since they are of different sizes.

Removal of timing gear

Figure 91

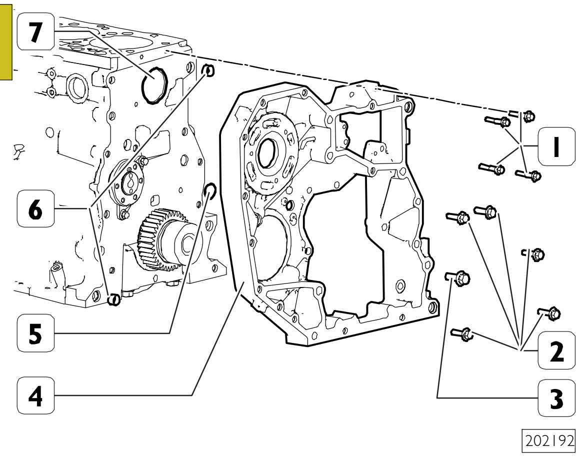


- ❑ Remove the collar 3) from the crankshaft (4).
- ❑ Unscrew the screws (2) and remove the gear (1) from the camshaft (5).

Ref.	No.	Screws description
(2)	6	Screw M8x1.25

Timing gear case removal

Figure 92



- ❑ Unscrew the screws (1, 2 and 3).
- ❑ Remove the timing gear case (4).
- ❑ Recover the gasket (5).
- ❑ Recover the cable reference dowel pins (6).
- ❑ Remove the core plug (7).

Ref.	No.	Screws description
(1)	4	Screw M8x1.25x40
(2)	5	Screw M10x1.5x30
(3)	1	Screw M12x1.75x30

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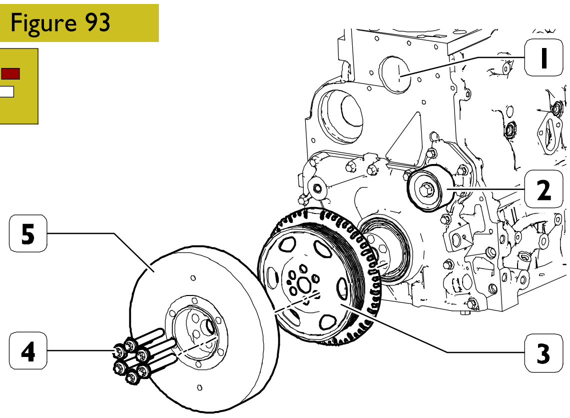
DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Removal of crankshaft pulley

Figure 93



202152

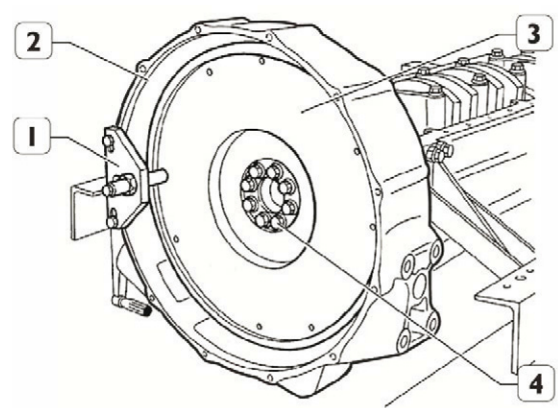
- ❑ Unscrew the screws (4) securing the front hub (5).
- ❑ Remove the front hub (5).
- ❑ Remove the pulley (3).
- ❑ Unscrew the screw (2) fixing the idler pulley.
- ❑ Remove the core plug (1).

Ref.	No.	Screws description
(2)	1	Screw M10x1.5
(4)	6	Screw M10x1.25x40

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Removal of engine flywheel

Figure 94 NEF67 TE1F/TE2F engine

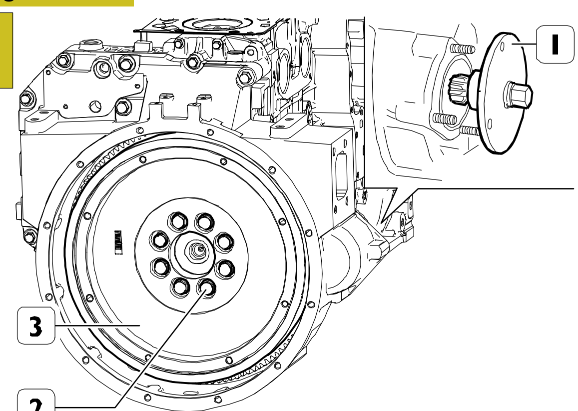


129299

☞ NEF67 TM1F engine Page 36

- ❑ Apply the tool 99360351 (2) to the flywheel housing (1), to stop the flywheel (3) rotation.
- ❑ Loosen the screws (4).

Figure 95



202484

- ❑ Unscrew the two opposing screws (2) where the extraction pins will be inserted (see following figure).
- ❑ Unscrew the remaining screws fixing the flywheel (3) from the crankshaft.
- ❑ Remove the flywheel locking tool 99360351 (1).

Ref.	No.	Screws description
(2)	8	Screw M12x1.25x30

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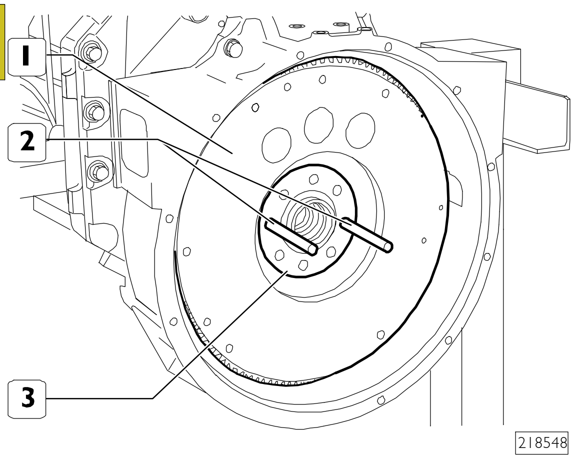
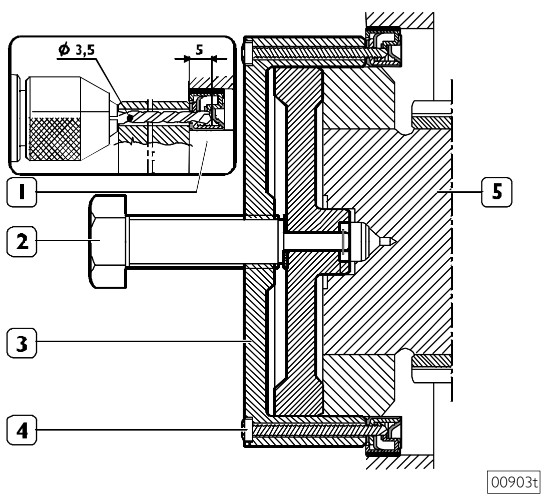
Figure 96



- ❑ Screw in two screws of average length into the holes (4) to sling the flywheel with a hoist.
- ❑ Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) out with the help of the hoist.

Removal of flywheel cover housing sealing ring

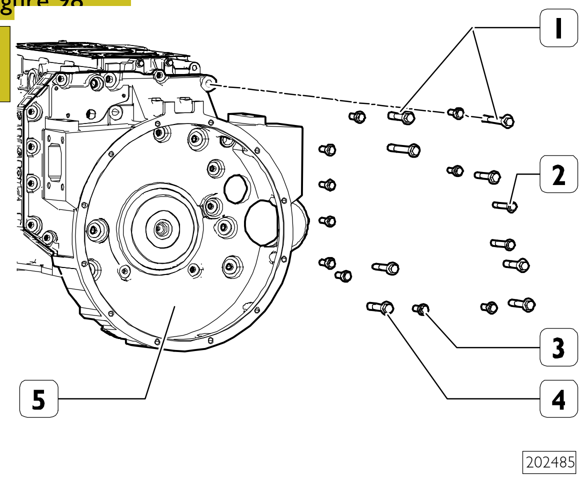
Figure 97



- ❑ Take out the flywheel housing seal ring, applying tool 99340056 (3) onto the rear tang (5) of the crankshaft.
- ❑ Through the guiding holes of the tool itself, drill the internal seal ring with a bit (∅ 3.5 mm) to a depth of 5 mm.
- ❑ Secure tool 99340056 (3) to the ring (1) screwing in the 6 screws (4) supplied.
- ❑ Remove the ring (1) by screwing up the screw (2).
- ❑ Using an appropriate tie rod of tool 99363204 and a lever, take out the external seal ring from the flywheel housing.

Removal of flywheel housing

Figure 98



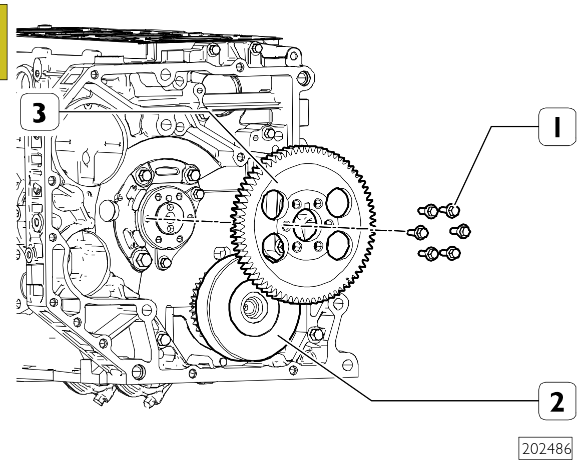
- ❑ Unscrew the screws (1, 2, 3 and 4).
- ❑ Remove the flywheel housing (5).

Ref.	No.	Screws description
(1)	2	Screw M12x1.75
(2)	2	Screw M10x1.5
(3)	10	Screw M10x1.5
(4)	6	Screw M12x1.75

NOTE Note the assembly position of the screws since they are of different sizes.

Removal of timing gear

Figure 99

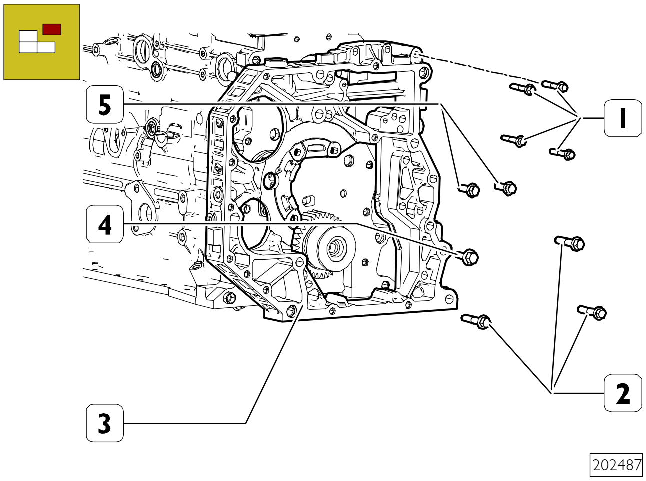


- ❑ Unscrew the screws (1) and remove the timing gear (3).
- ❑ Remove the collar (2).

Ref.	No.	Screws description
(1)	6	Screw M8x1.25x25

Removal of timing gear case

Figure 100



- Unscrew the screws (1, 2, 4 and 5).
- Remove the timing gear case (3).

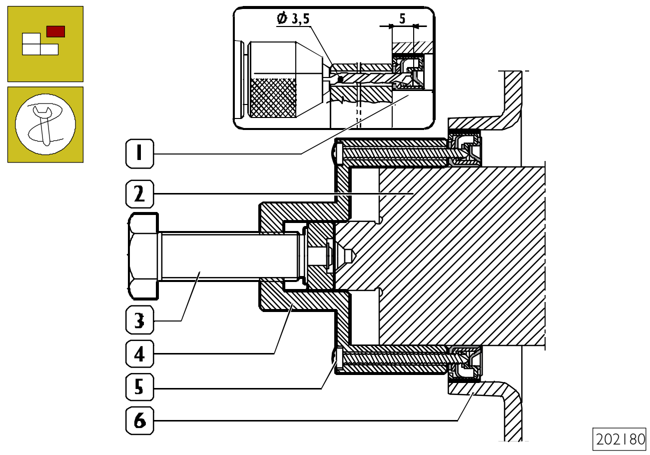
Ref.	No.	Screws description
(1)	4	Screw M8x1.25
(2)	3	Screw M10x1.5
(4)	1	Screw M12x1.75
(5)	2	Screw M10x1.5

NOTE Note the assembly position of the screws since they are of different sizes.

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

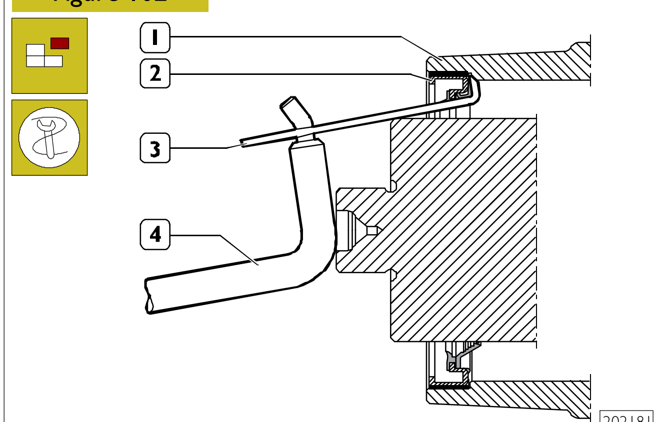
Removing the engine - front cover sealing ring

Figure 101 (For all engines)



- Take out the crankshaft seal ring from the front cover.
- Use tool 99340055 (4) on the front tang (2) of the crankshaft.
- Through the guiding holes of the tool itself, drill the internal seal ring (1) with a bit (Ø 3.5 mm) to a depth of 5 mm.
- Secure the tool to the ring screwing in the 6 screws supplied. Remove the ring (1) by screwing up the screw (3).

Figure 102



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

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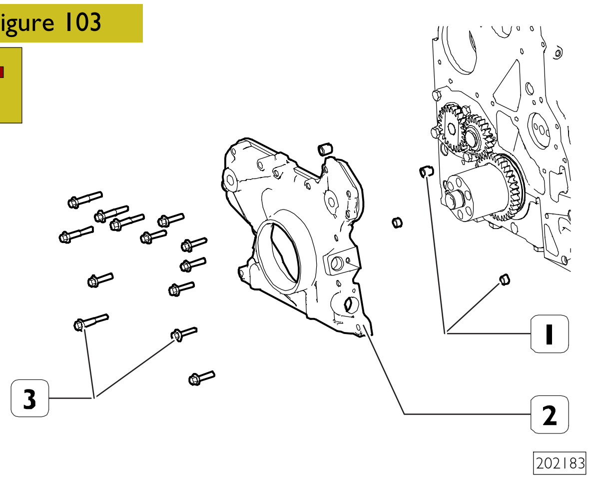
Removal of front cover

Figure 103

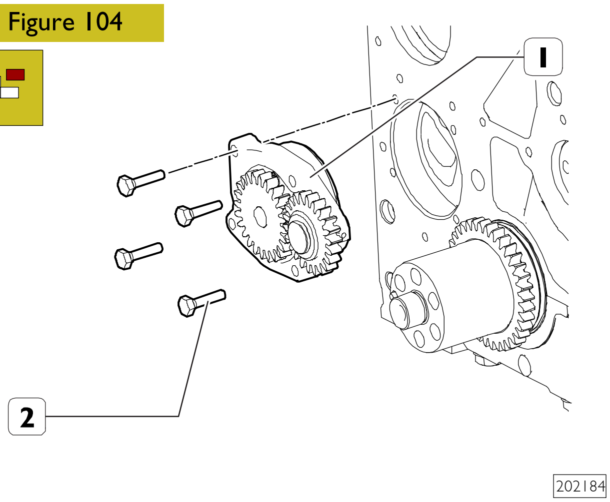


- ❑ Unscrew the screws (3) securing the front cover (2).
- ❑ Remove the front cover (2) and recover the cable reference dowel pins (1).

Ref.	No.	Screws description
(3)	13	Screw M8x1.25

Oil pump removal

Figure 104



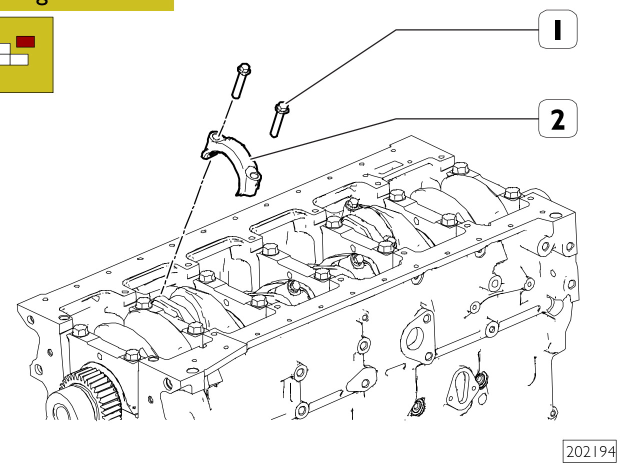
- ❑ Unscrew the supporting screws (2).
- ❑ Remove the oil pump (1).

Ref.	No.	Screws description
(2)	4	Screw M8x1.25

DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Piston-connecting rod unit removal

Figure 105



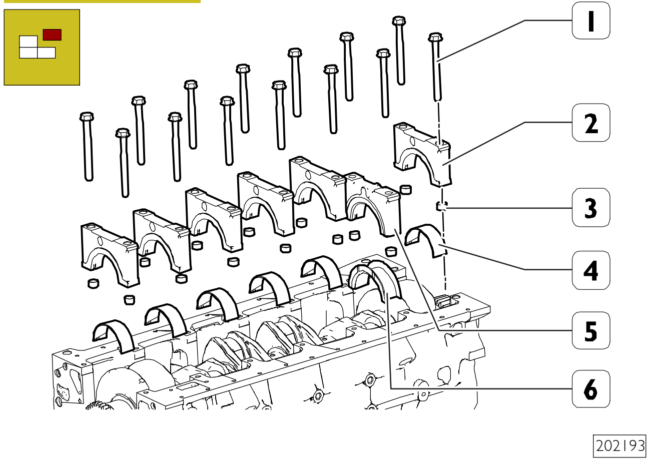
- ❑ Overturn the engine.
- ❑ Unscrew the screws (1).
- ❑ Remove the caps (2) and connecting rod half-bearings.
- ❑ Withdraw the pistons including the connecting rods from the top of the crankcase.

Ref.	No.	Screws description
(1)	12	Screw M10x1.25

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

Removal of crankshaft

Figure 106



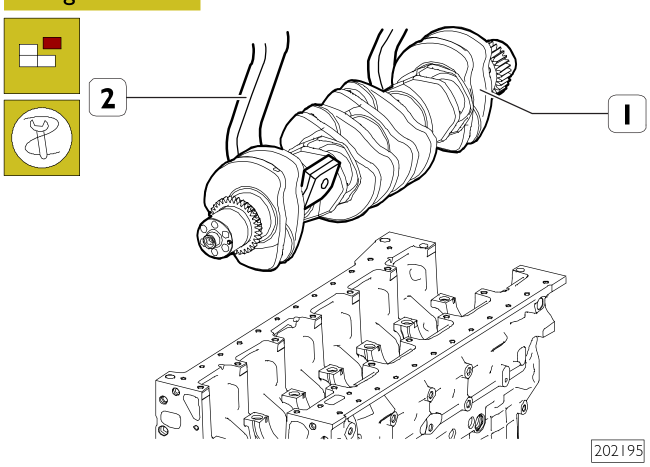
- Unscrew the main bearing cap screws (1).
- Remove the main bearing caps (2).
- Recover the cable reference dowel pins (3).
- Recover the lower main half-bearings (4).

Ref.	No.	Screws description
(1)	14	Screw M12x1.75x120

The second last main bearing cap (5) and the relevant support are fitted with shoulder half-bearing (6).

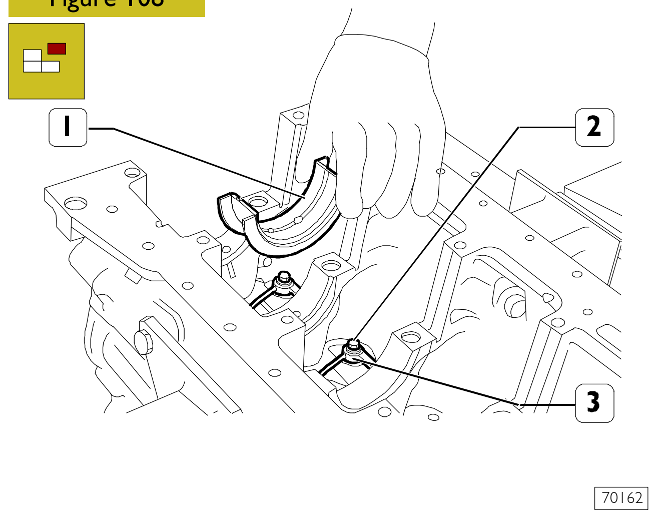
NOTE Take note of lower and upper half-bearing assembling positions since in case of reuse they shall be fitted in the same position found at removal.

Figure 107



- Use tool 99360500 (2) and hoist to remove the crankshaft (1) from the crankcase.

Figure 108



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

Ref.	No.	Screws description
(2)	4	Screw M8x1.25x10

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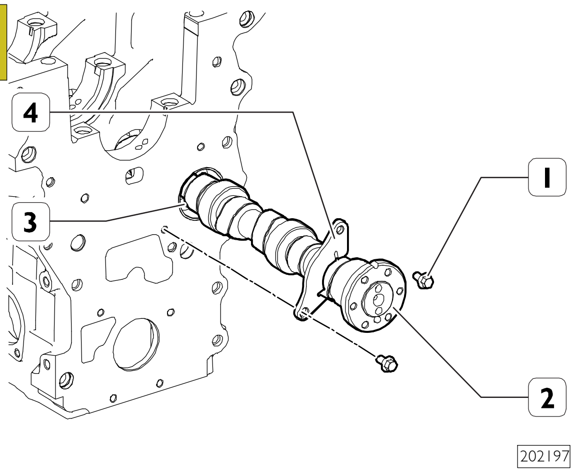
DISASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Camshaft removal

Figure 109



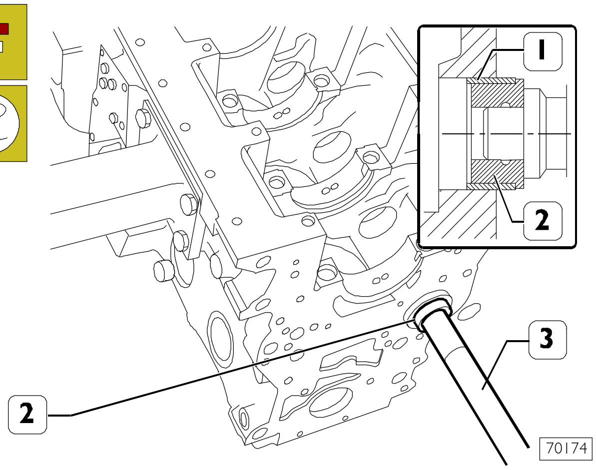
- ❑ Unscrew the screws (1).
- ❑ Carefully remove the camshaft (2) from the crankcase.
- ❑ Recover the shoulder plate (4).

Ref.	No.	Screws description
(1)	2	Screw M8x1.25x16

NOTE Take note of plate (4) assembling position.

Camshaft bushing removal

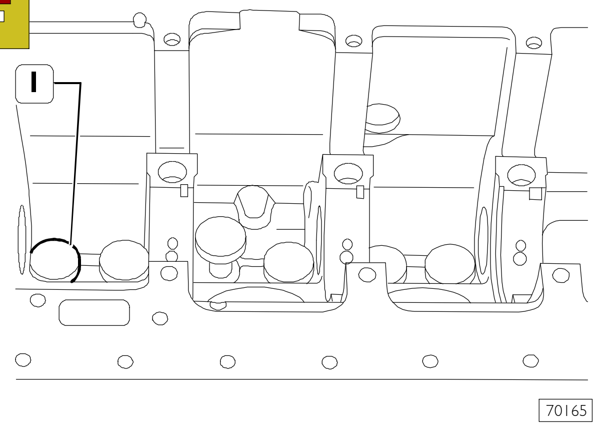
Figure 110



- ❑ Remove the camshaft bushing (3) using driver 99360362 (2) and handgrip 99370006 (3).

Tappet removal

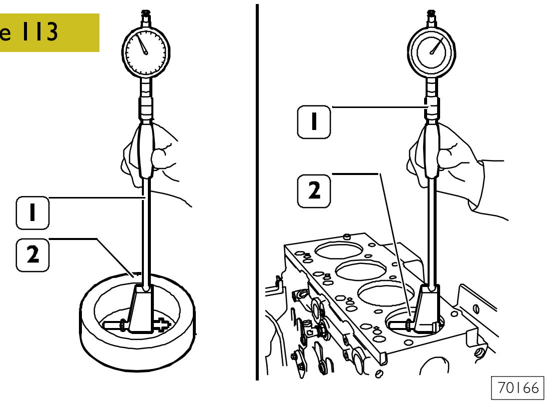
Figure 111



- ❑ Withdraw the tappets (1) from the crankcase.

CHECKS
Cylinder block

Figure 113



Once the engine is disassembled, thoroughly clean the cylinder-crankcase assembly.

Use the proper rings to handle the cylinder block.

Carefully inspect the crankcase for cracks.

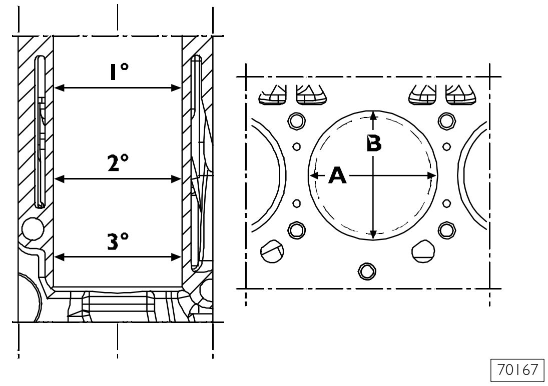
Check the condition of casting hole plugs. If the caps are rusted, or if there is any doubt about the efficiency of the seal, replace them.

Inspect the surfaces of the cylinder liners; they should not be scored, seized, ovalised, conical or worn to excess.

The internal diameter of the cylinder liners is checked to ascertain the extent of ovalization, taper and wear, using the bore meter (1) fitted with a dial gauge previously reset on the ring gauge (2) of the diameter of the cylinder liner.

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

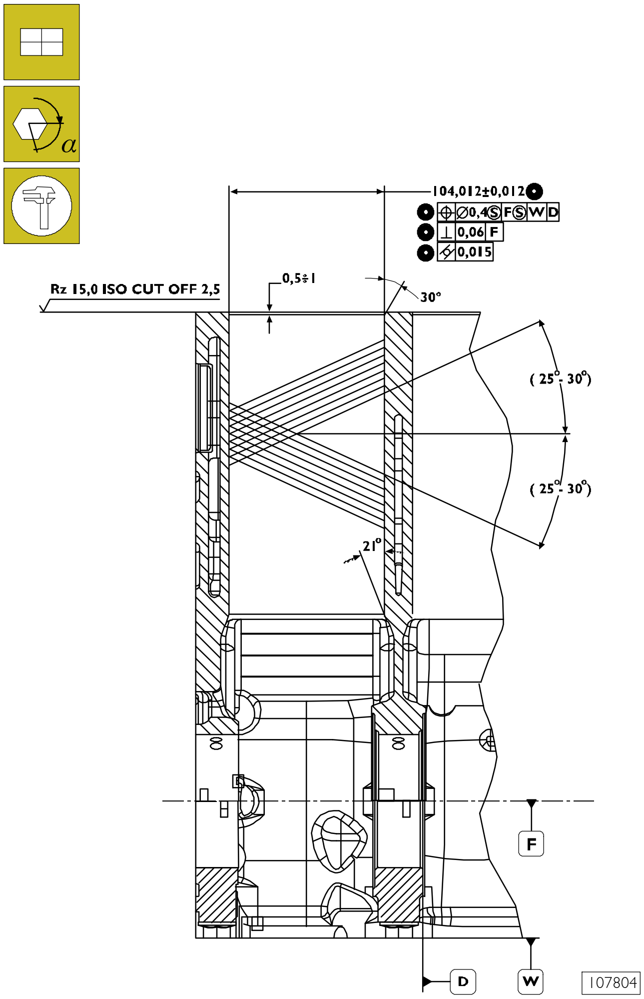
Figure 112



Measurements shall be performed on each cylinder, at three different heights in the bore and on two planes perpendicular with each other: one parallel to the longitudinal axis of the engine (A) and the other perpendicular to it (B); the greatest wear is usually found to be on this surface and during the first measurement.

Should ovalization, taper or wear be found, bore and grind the cylinders. The refacing of the cylinder liners should be made in relation to the diameter of the pistons supplied as spare parts, which are oversized by 0.4 - 0.8 mm of the nominal value and to the prescribed assembly clearance.

Figure 114



NOTE In case of regrinding, all cylinders are to have the same oversize (0.4 - 0.8 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 cylinder block head contact surface

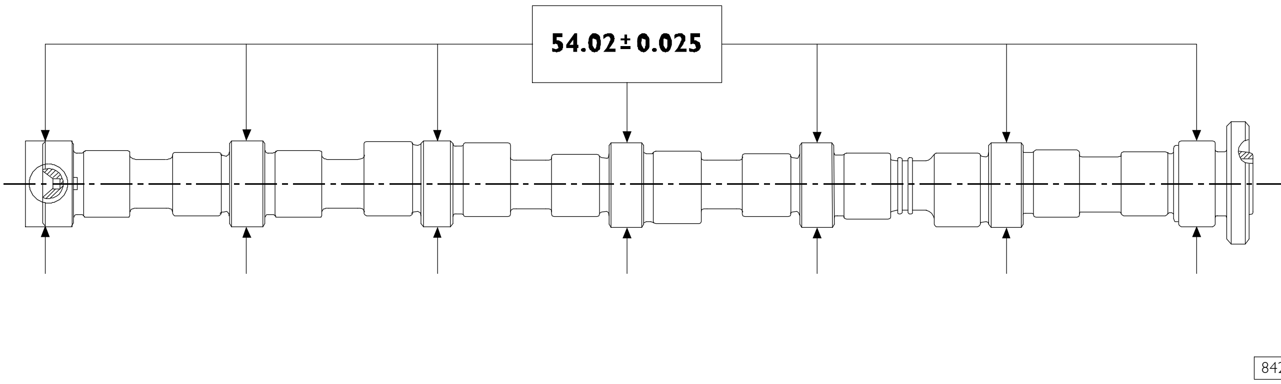
After establishing the areas of deformation, correct the contact surface with a grinding machine.

Planarity error shall not exceed 0.075 mm.

Check the state of the cylinder assembly machining plugs; if they are rusty or there is any doubt at all about their seal, replace them.

Timing system
Camshaft

Figure 115



MAIN DATA ABOUT CAMSHAFT JOURNALS

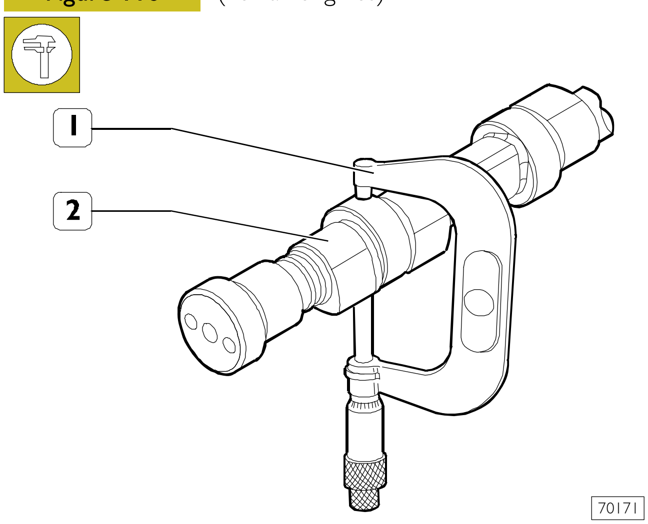
The above data refer to the normal diameter of the pins

The surfaces of the supporting pins of the shaft and those of the cams need to be extra smooth; if they show any signs of seizing or scoring, the shaft and the relevant bushings should be replaced.

Cam lift and pin alignment

Set the shaft on tailstocks and, using a dial gauge on the middle journal, check that the alignment error is no greater than 0.04 mm: change the shaft if it is any greater.

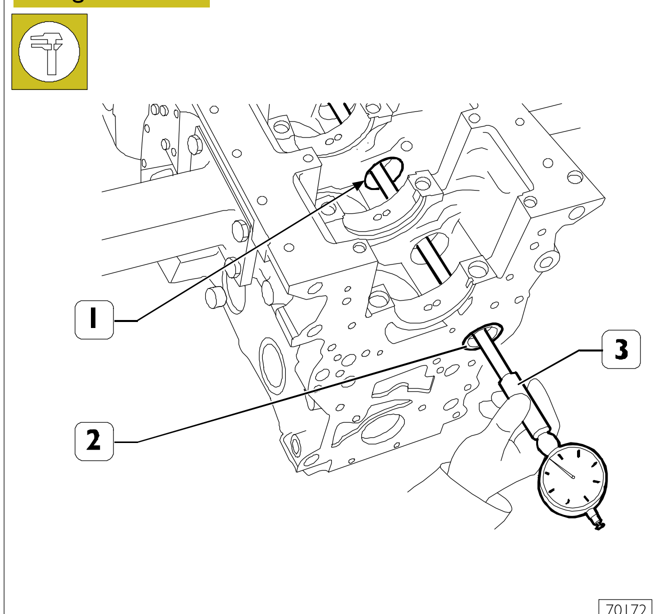
Figure 116 (For all engines)



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

Between bushings and

Figure 117



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

Internal surfaces must not show seizing or wear.

Use bore gauge (3) to measure the diameter of the bushing (2) and the intermediate seats (1) for the camshaft.

Measurements shall be performed on two perpendicular axes.

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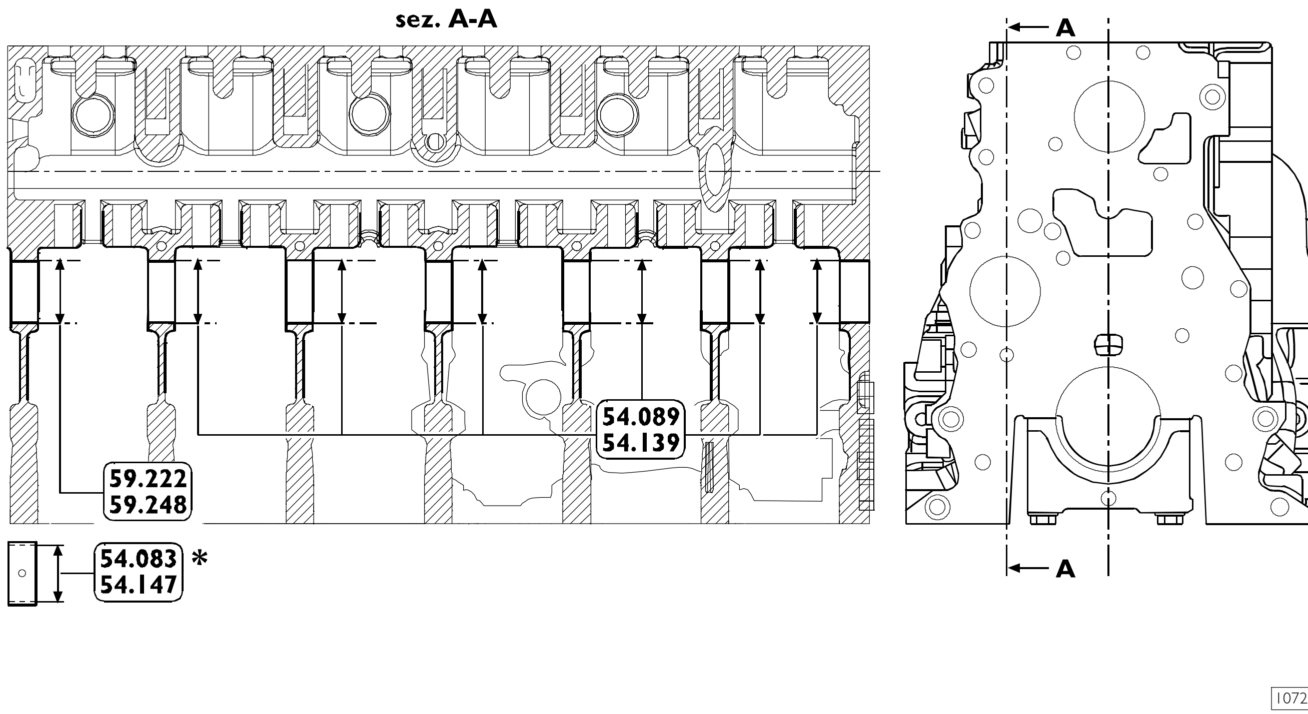
Figure 118

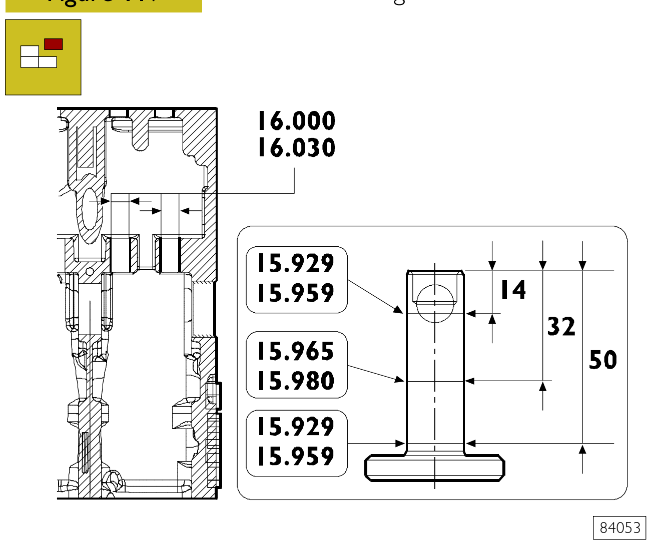


BUSHING MAIN DATA FOR CAMSHAFT AND RELATING SEAT

* Dimension to be obtained after driving the bushing

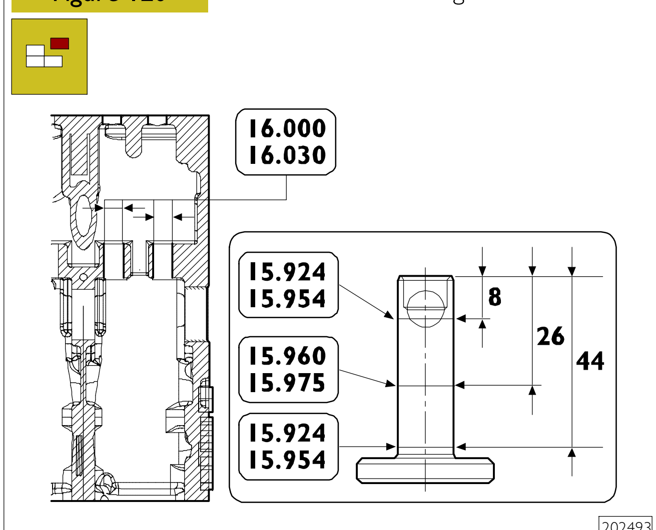
Tappets

Figure 119 NEF67 TM1F engine



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON CRANKCASE

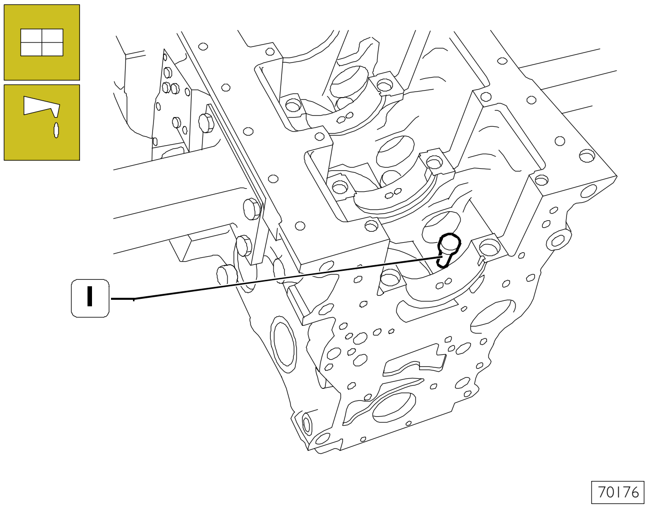
Figure 120 NEF67 TE1F/TE2F engine



MAIN DATA CONCERNING THE TAPPETS AND THE RELEVANT HOUSINGS ON CRANKCASE

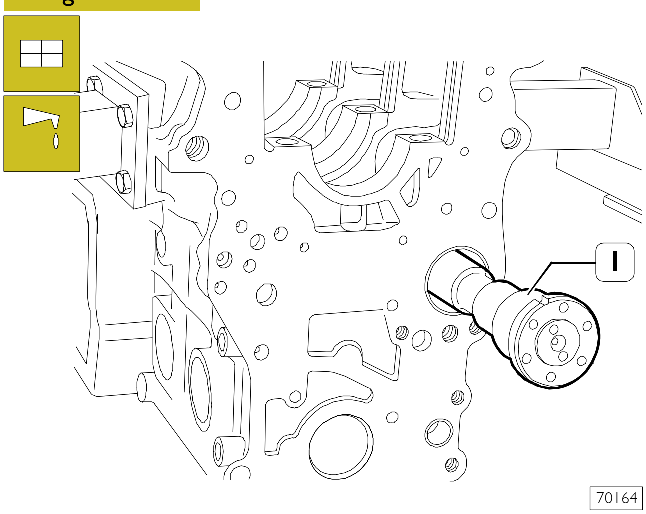
Fitting tappets - Camshaft

Figure 121 (For all engines)



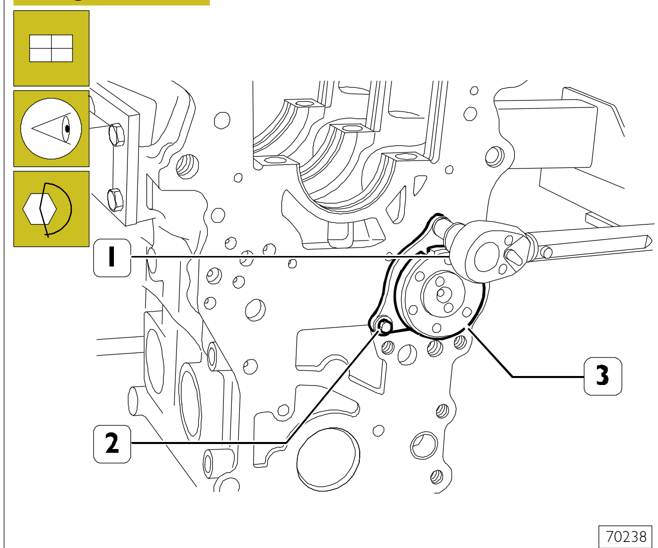
Lubricate the tappets (1) and fit them into the relevant housings on the crankcase.

Figure 122



Lubricate the camshaft support bushing and fit the camshaft (1) taking care not to damage the shaft support seats or bushing during this operation.

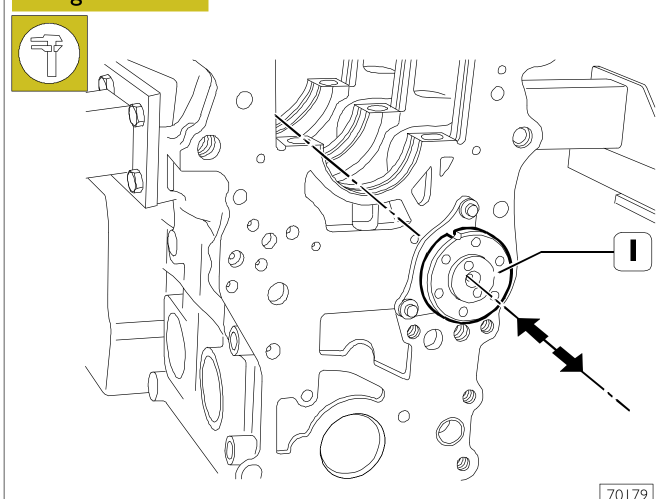
Figure 123



Place the plate (1) retaining the camshaft (3) with the slot facing the top side of the crankcase and the marking facing you, tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M8x1.25x16	24 ± 4 Nm

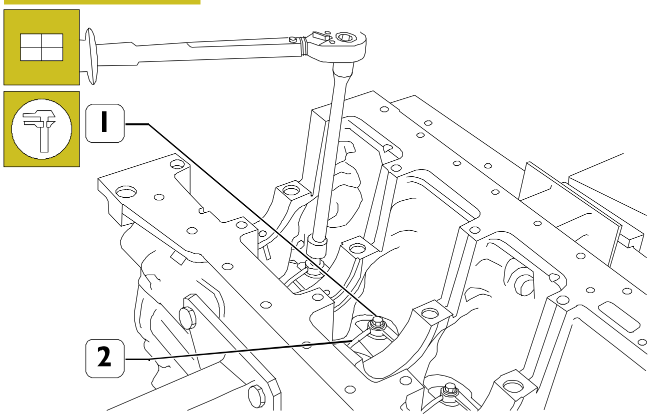
Figure 124



Check the axial clearance of the camshaft (1).

It must be 0.23 ± 0.13 mm.

Figure 125

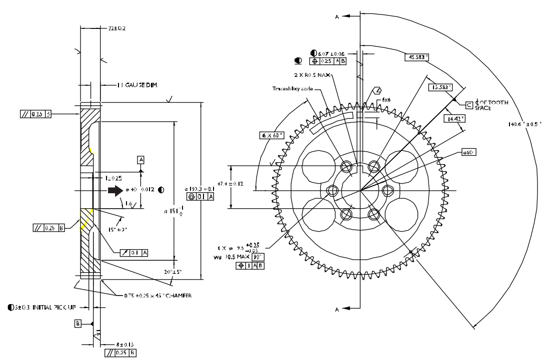


Fit the spray nozzles (2) and tighten the filler (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25	15 ± 3 Nm

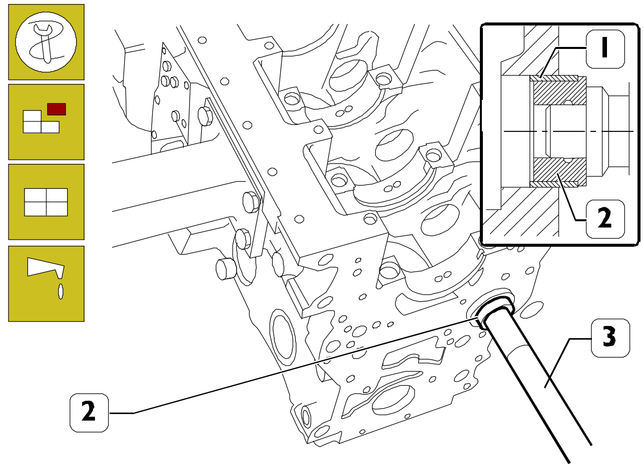
Transmission gear

Figure 126



Replacing bushing

Figure 127



To replace bushing (1), use driver 99360362 (2) and handgrip 99370006 (3) for dismounting and mounting the bushing.

The gear bushings shown in Figure 126 can be replaced when worn. After driving the bushing, proceed to bore it to obtain the diameter indicated in Figure 126.

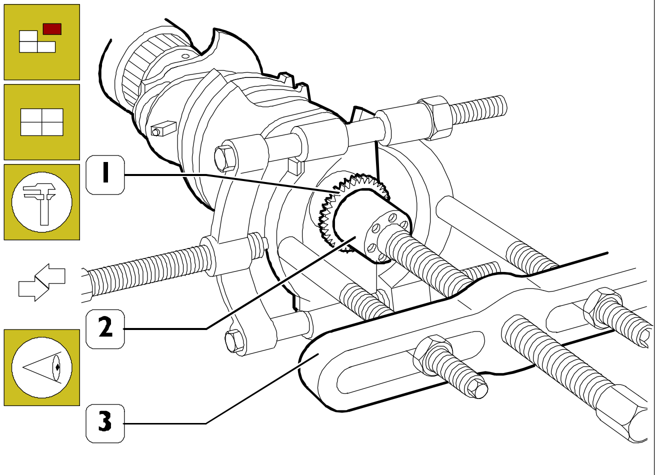
NOTE The hammering of the bushing into the gear must be carried out in the direction of the arrow by placing it at the point indicated inFigure 126.

NOTE During assembly, the bushing (1) must be oriented so that the lubrication holes match with the ones on the seats of the crankcase.

Rated assembling play between gear bushings and pins: 0.038 ÷ 0.152 mm

Oil pump drive gear replacement

Figure 128



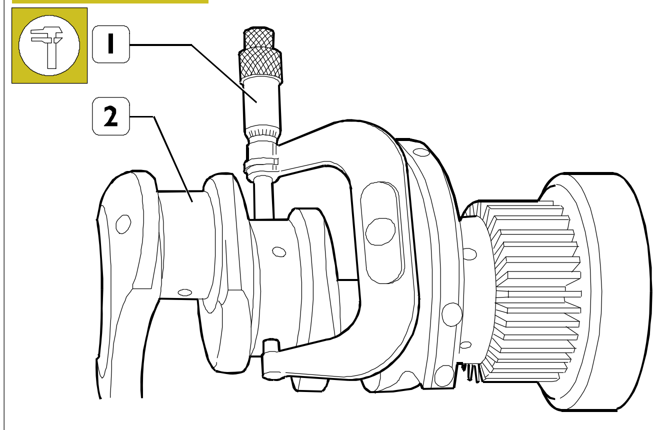
70184

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, then key it to the crankshaft.

Crankshaft
Main journals and connecting rod

Figure 129



70182

If signs of seizure, scoring or excessive ovalisation on main journals and connecting rod are identified, it is necessary to regrind the pins. Before grinding the journals (2) measure them with a micrometer (1) to decide the final diameter to which the pins are to be ground.

NOTE It is advisable to enter readings in a table.

See Figure 130.

Undersize classes are of: 0.250 - 0.500 mm.

NOTE The main journals and connecting rod must always be ground to the same undersize class.

Main journals and connecting rod undersize shall be marked on the side of the crank arm No.1.

For undersized crankpins, letter M.

Letter B for undersized main journals.

For undersized crankpins and main journals, letter MB.

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Measuring main journals and connecting rod

Figure 130

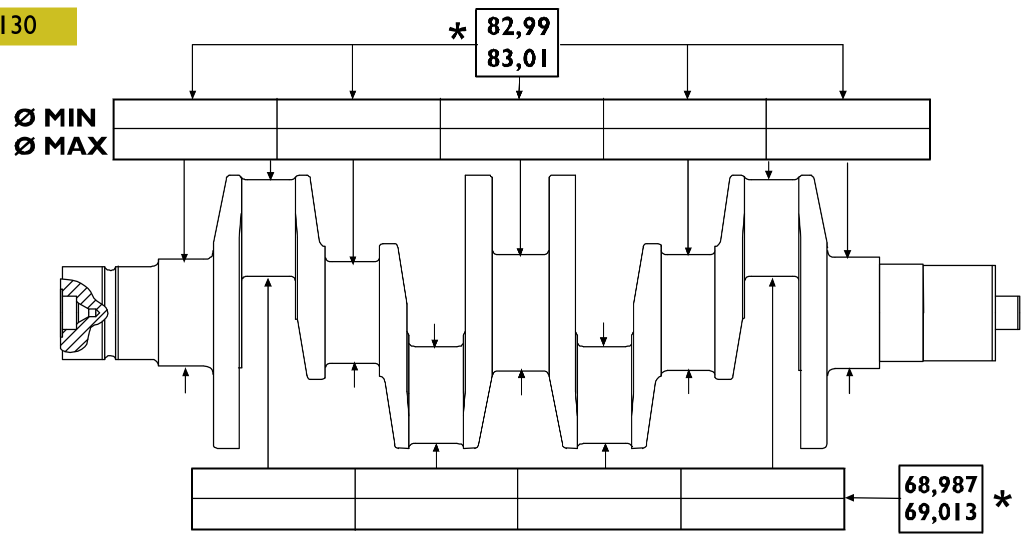
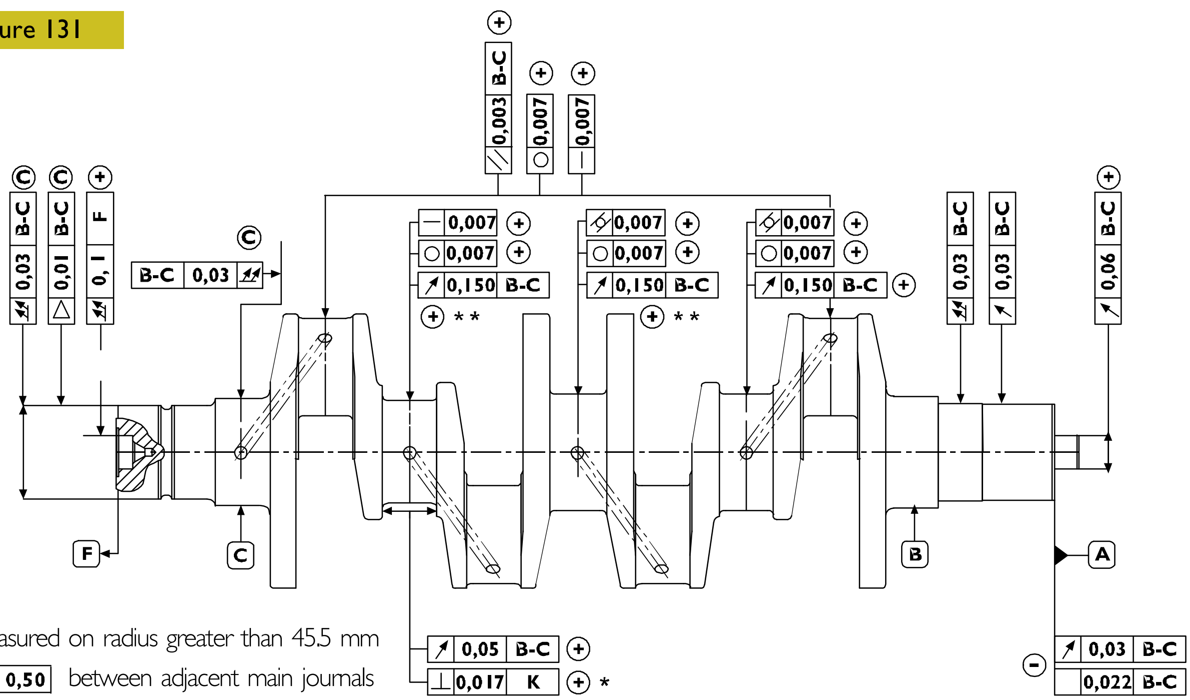


TABLE ON WHICH TO REPORT THE VALUES PERTAINING TO MEASURING THE MAIN JOURNALS AND CONNECTING ROD OF THE CRANKSHAFT
* Nominal value

Figure 131

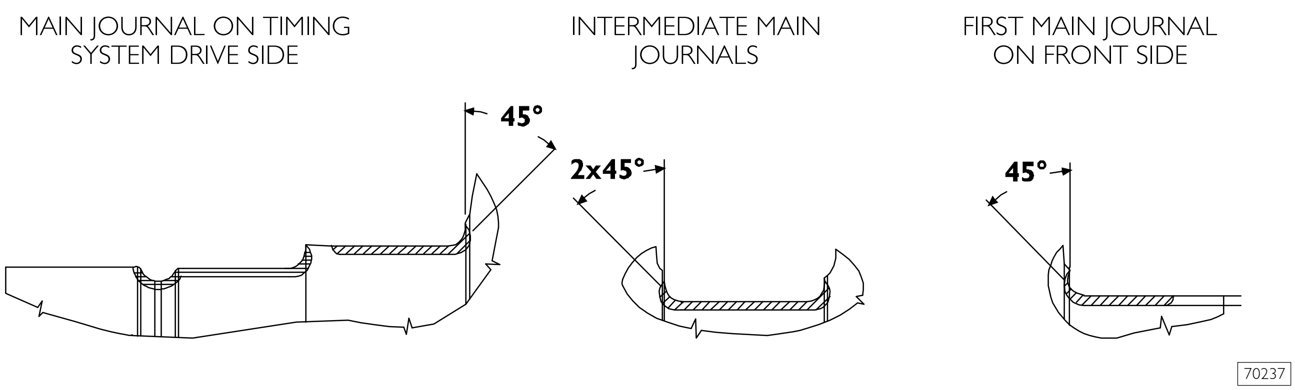


* measured on radius greater than 45.5 mm

** 0,50 between adjacent main journals

MAIN CRANKSHAFT TOLERANCES

Figure 132

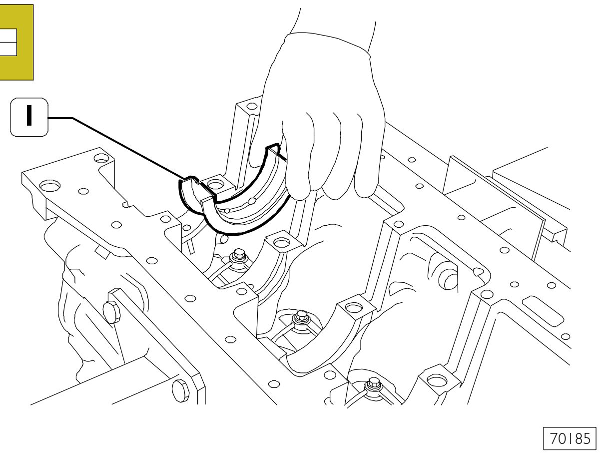


TOLERANCES	CHARACTERISTIC SUBJECT OF TOLERANCE	GRAPHIC SYMBOL
SHAPE	Circularity	○
	Cylindricity	/○/
ORIENTATION	Alignment	//
	Perpendicularity	⊥
	Straightness	—
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	⇗

CLASS OF IMPORTANCE ASSIGNED TO PRODUCT CHARACTERISTICS	GRAPHIC SYMBOL
CRITICAL	©
IMPORTANT	⊕
SECONDARY	⊖

Main bearings assembly

Figure 133



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

The main bearings (1) are supplied as spare parts undersized on the inner diameter by 0.250 - 0.500 mm.

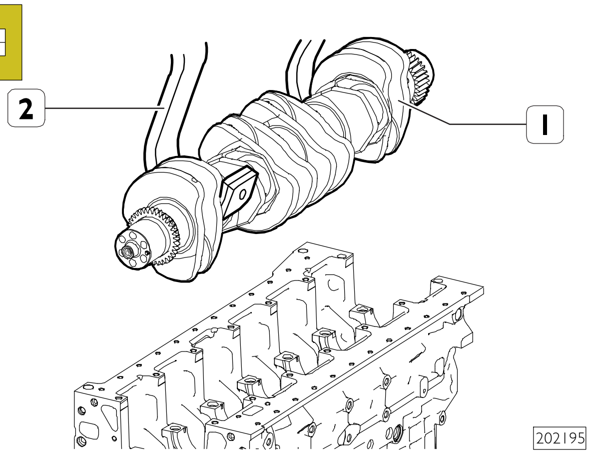
NOTE Do not modify the bearings in any way.

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.

Main journal assembly clearance measurement

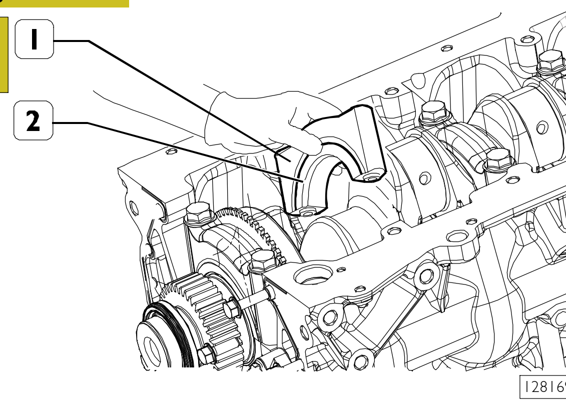
Figure 134



Install the crankshaft (1).

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

Figure 135



- thoroughly clean the parts and eliminate all traces of oil
- fit caps (1), including the half bearings (2) on the relevant supports.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced

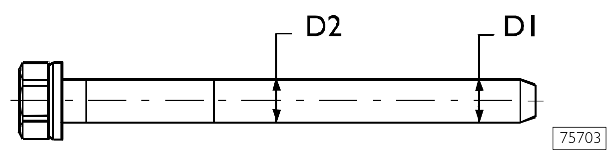
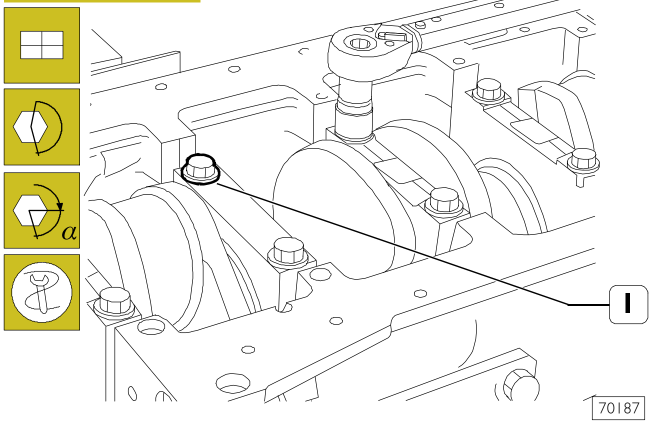


Figure 136



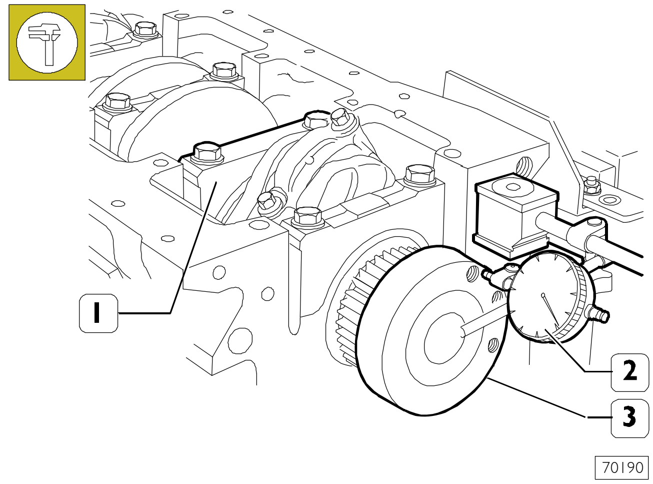
Screw in the pre-lubricated screws (1) in two phases:

- ❑ 1st phase with torque wrench;
- ❑ 2nd phase with tool 99395216.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.5x120	
		1st phase 2nd phase	80 ± 6 Nm 90°

Checking crankshaft end float

Figure 137

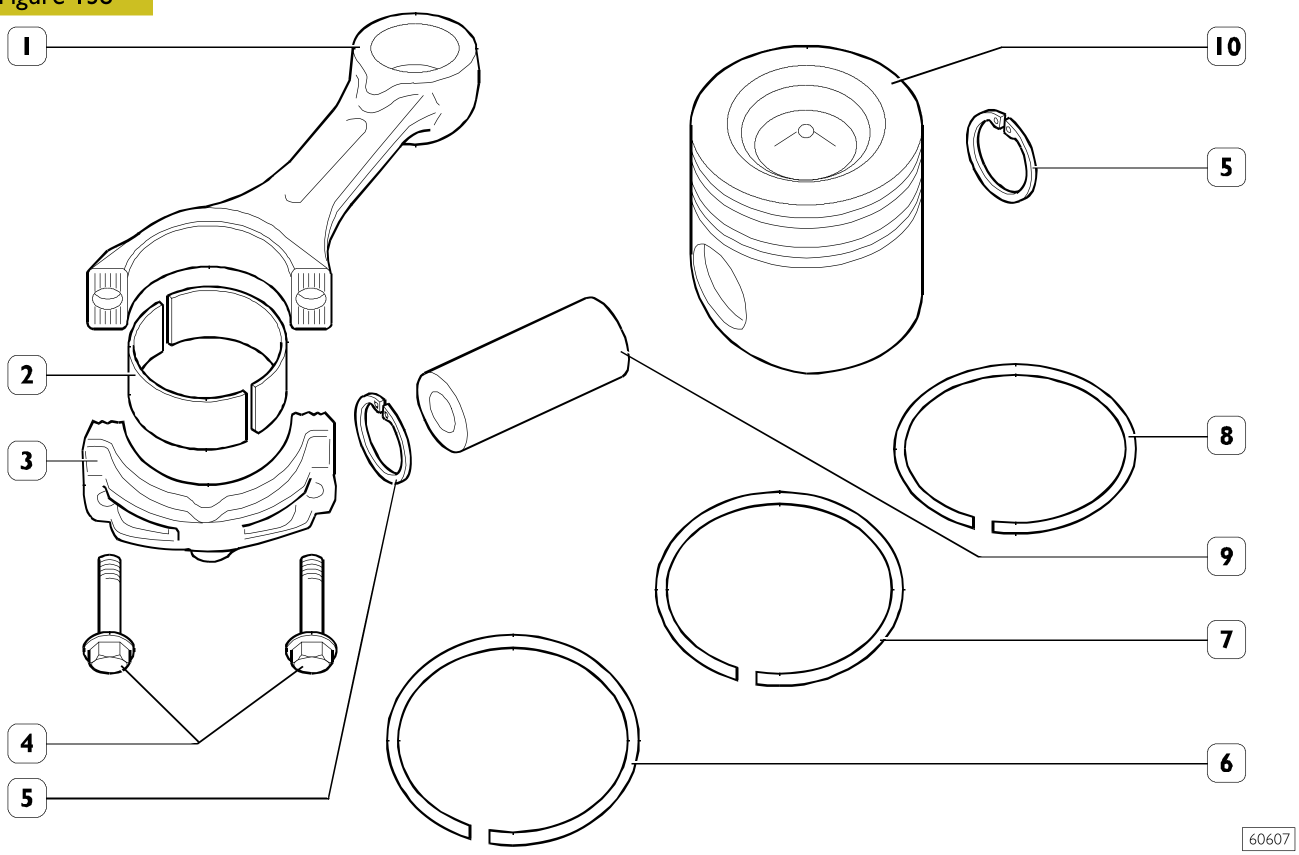


The clearance control of the shoulder is carried out by placing a dial gauge (2) to the magnetic base on the crankshaft (3) as shown in the figure, the normal mounting clearance is 0.068 ÷ 0.410 mm.

If a greater clearance is found, replace the main half bearings of the second last rear support (1) carrying the thrust bearings and repeat the clearance check between the main half bearings and crankshaft pins.

Piston-connecting rod assembly

Figure 138

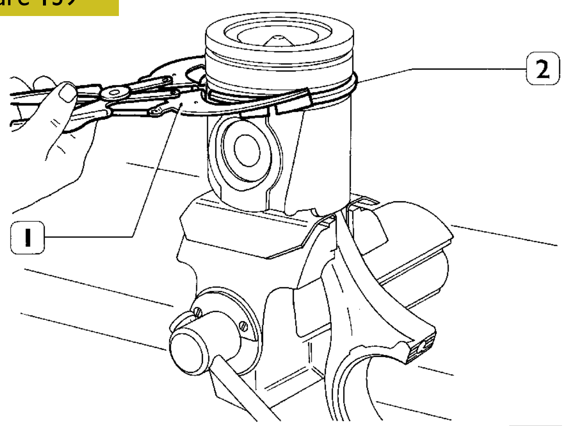


PISTON - CONNECTING ROD ASSEMBLY
1. Connecting rod body - 2. Half-bearings - 3. Connecting rod cap - 4. Cap fixing screws - 5. Circlip - 6. Slotted oil scraper ring with spiral spring - 7. Claw seal ring - 8. Trapezoidal seal ring - 9. Piston pin - 10. Piston

Make sure the pistons do not show any trace of seizing, scoring, cracking or excessive wear; otherwise, replace as necessary.

disassembly

Figure 139



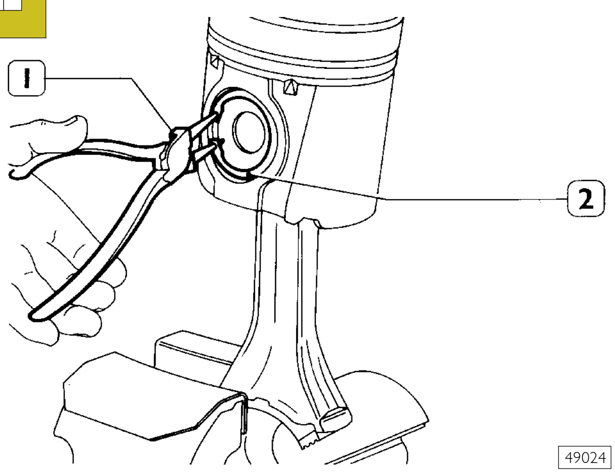
60608

Removal of the piston rings (2) using the pliers 99360183 (1).

Pistons are equipped with three circlips: the first, a sealing ring, with trapezoidal section; the second, a sealing ring, with chamfer cut; a scraper ring.

Pistons are grouped into classes A and B for diameter.

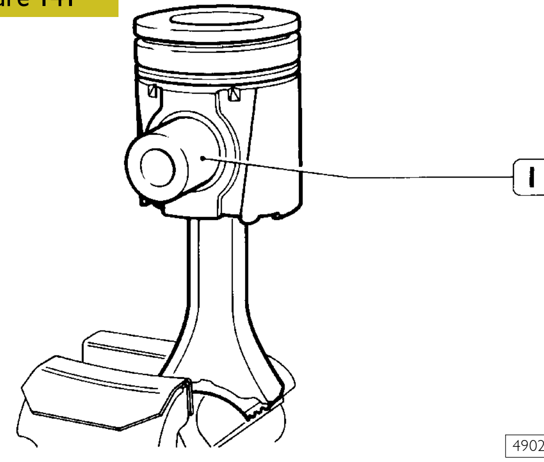
Figure 140



49024

Removal of piston pin Seeger ring (2) using the round tipped pliers (1).

Figure 141



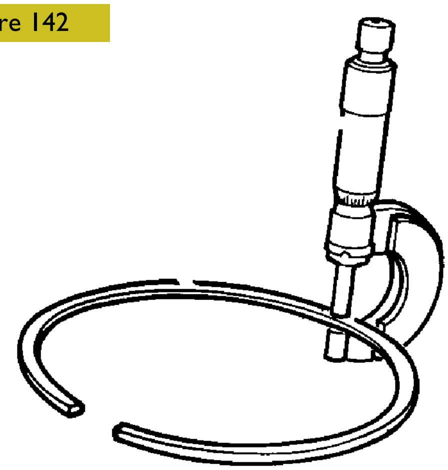
49025

Piston pin removal (1).

If removal is difficult use the appropriate driver.

Circlips and seats

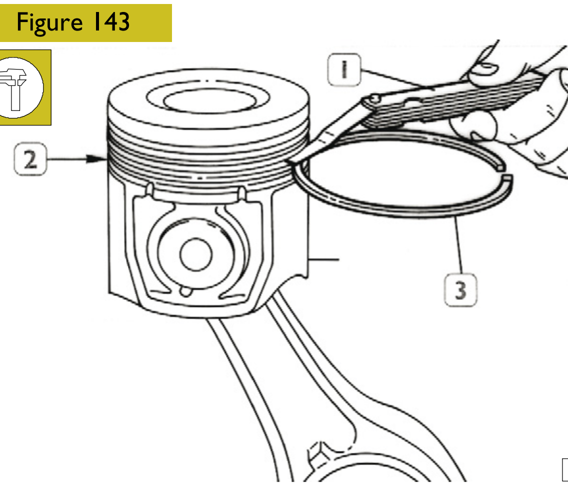
Figure 142



16552

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

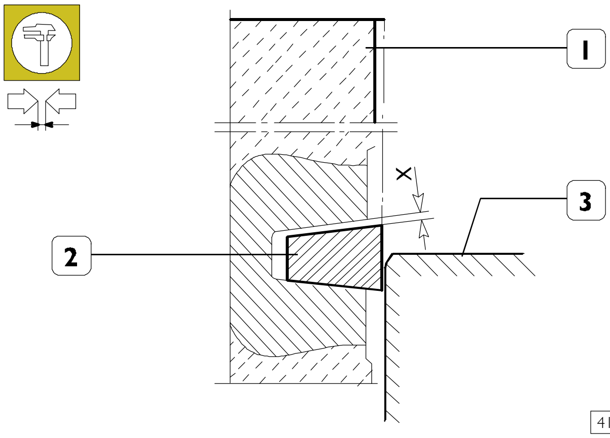
Figure 143



128140

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

Figure 144

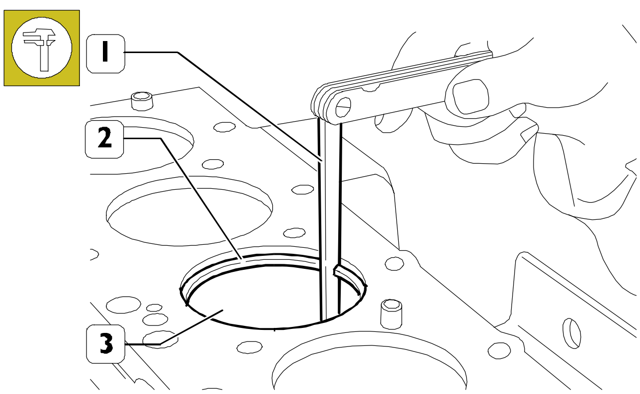


41104

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

Since the first seal section is trapezoidal, the clearance between the slot and the ring is to be measured as follows; make the piston (1) protrude from the engine crankcase so that the ring (2) protrudes half-way from the cylinder liner (3).
In this position, use a feeler gauge to check the clearance (X) between the ring and the slot: this clearance must be as specified.

Figure 145

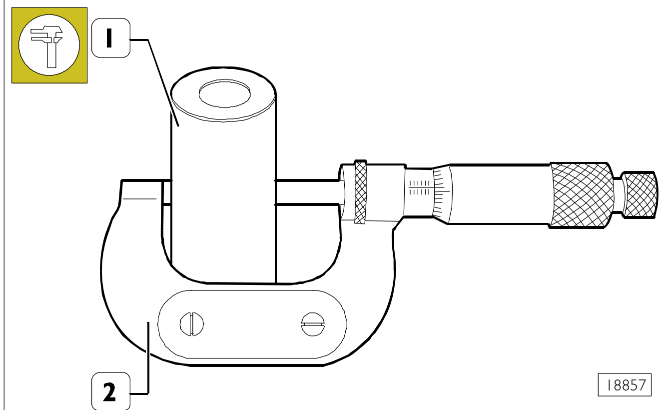


70194

Use feeler gauge (1) to measure the clearance between the end of the circlips (2) fitted into the cylinder liner (3).

Piston pin

Figure 146

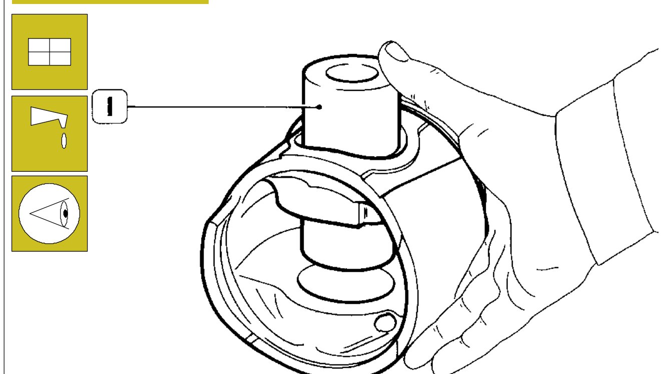


18857

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

Conditions for correct pin-piston coupling

Figure 147



49026

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

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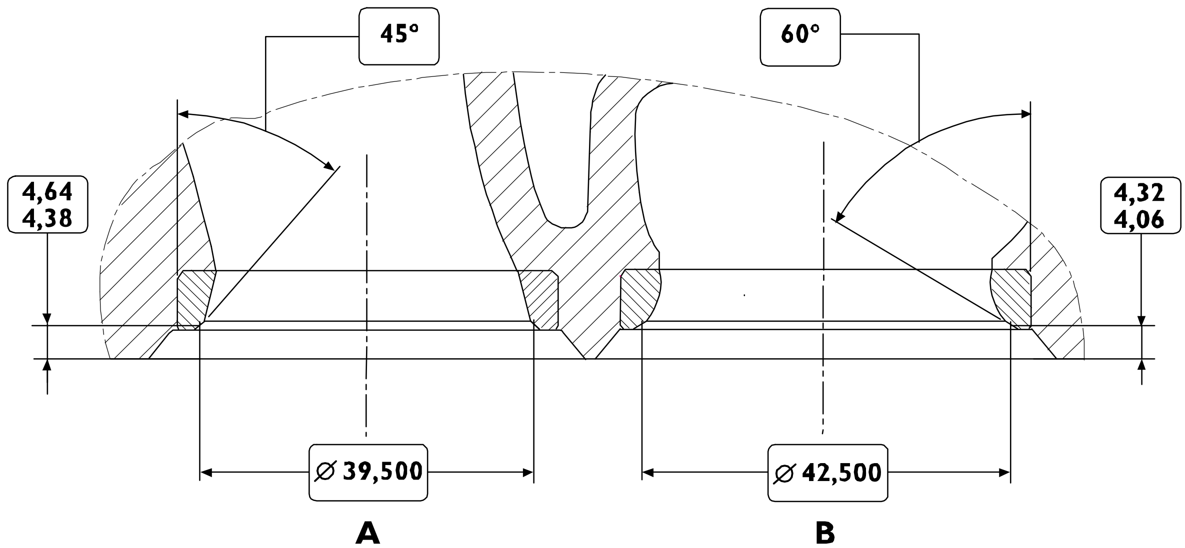
Bushings

Figure 148



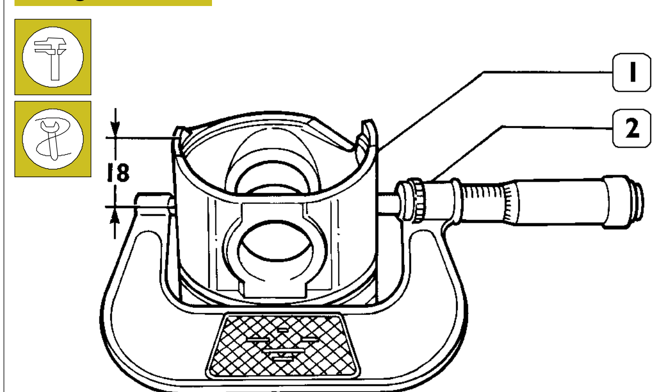
Check that the bushing in the connecting rod small end has not come loose and shows no sign of seizure or scoring. Otherwise replace it.

The bushing (2) is removed and fitted with a suitable driver (1).

When refitting take care to make the oil holes on the bushing coincide with those on the connecting rod small end. Use boring machine to go over the surface of the bushing in order to obtain the diameter of 40.987 ÷ 41.013 mm.

Pistons

Figure 149



Using a micrometer (2), measure the piston diameter (1) to determine the assembly clearance; The diameter has to be detected at the value indicated in figure.

Figure 150 NEF67 TM1F engine

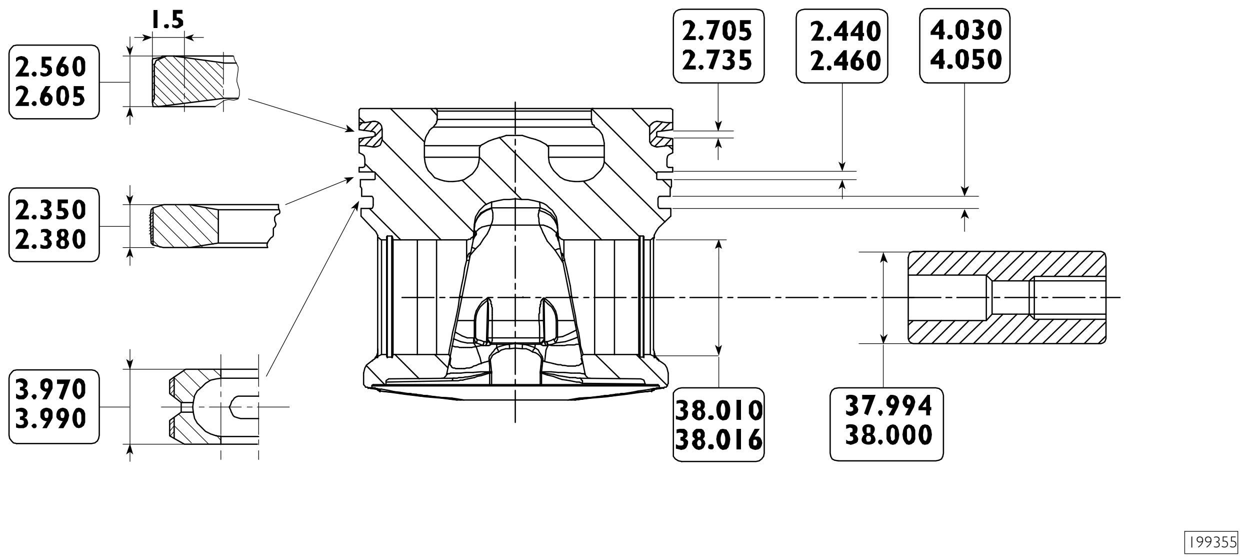
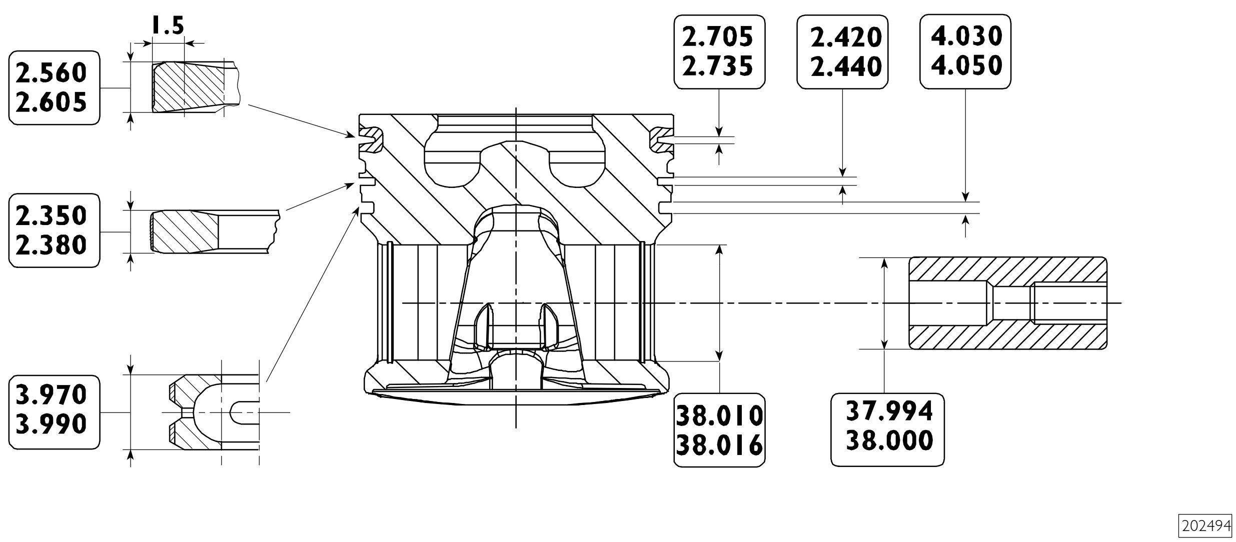


Figure 151 NEF67 TE1F/TE2F engine



MAIN DATA REGARDING KS PISTON, PIN AND CIRCLIPS

Connecting rods (For all engines)

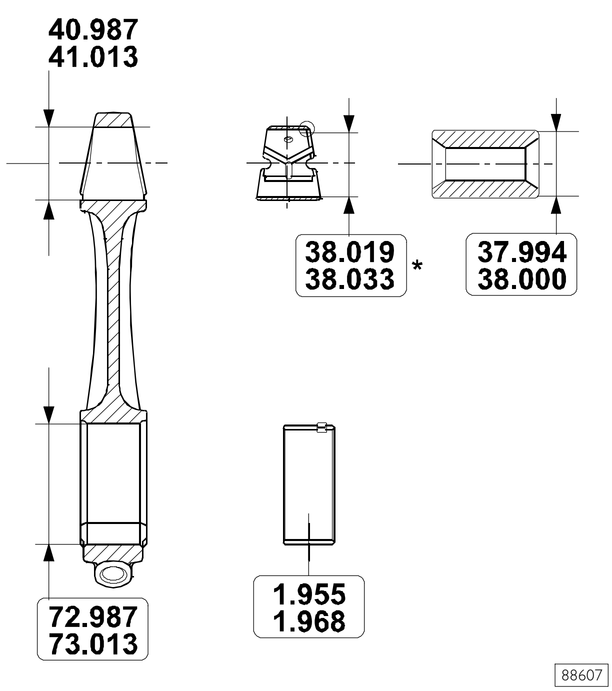
Every connecting rod is marked as follows:

- ❑ On the body and cap with a number showing their coupling and the corresponding cylinder into which it is to be fitted. In case of replacement it is therefore necessary to mark the new connecting rod with the same numbers of the replaced one.
- ❑ On the connecting rod body with a letter showing the weight of the connecting rod assembled at production:
  - V, 1560 ÷ 1600 g (marked in yellow);
    W, 1601 ÷ 1640 g (marked in green);
    X, 1641 ÷ 1680 g (marked in blue);

Replacement connecting rods are provided with class We marked in green.

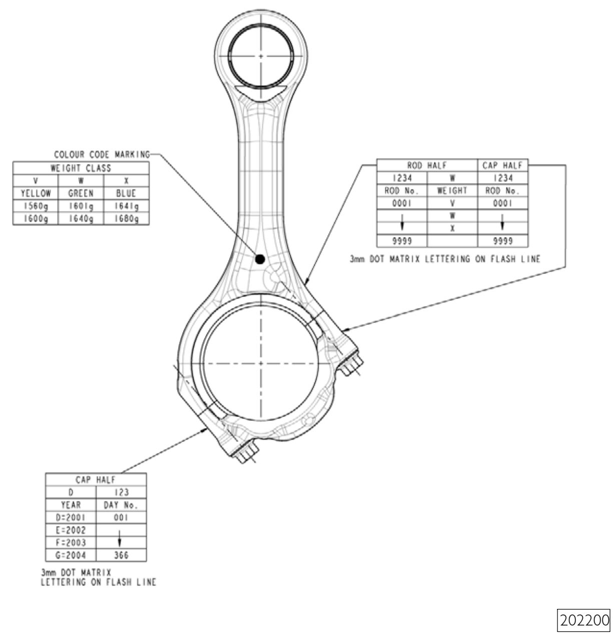
Removal of material is not permitted

Figure 152



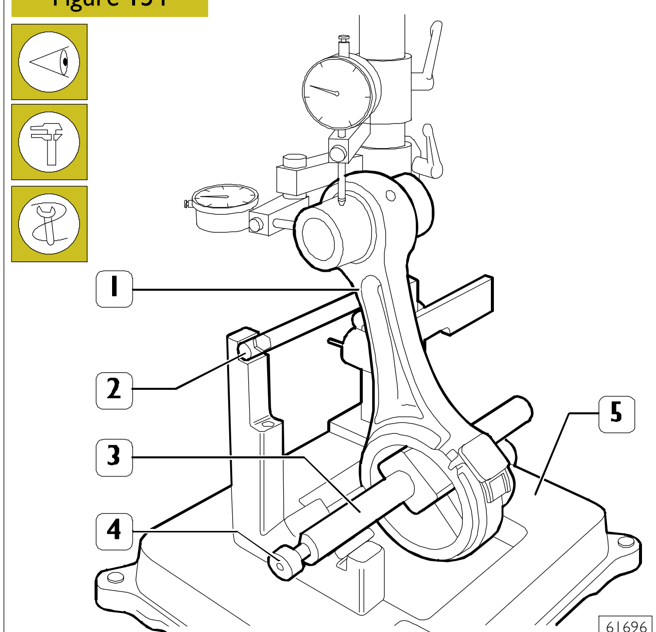
NOTE To obtain best coupling the connecting rod cap coupling surfaces are knurled. It is therefore recommended to not remove knurling.

Figure 153



Connecting rod check

Figure 154



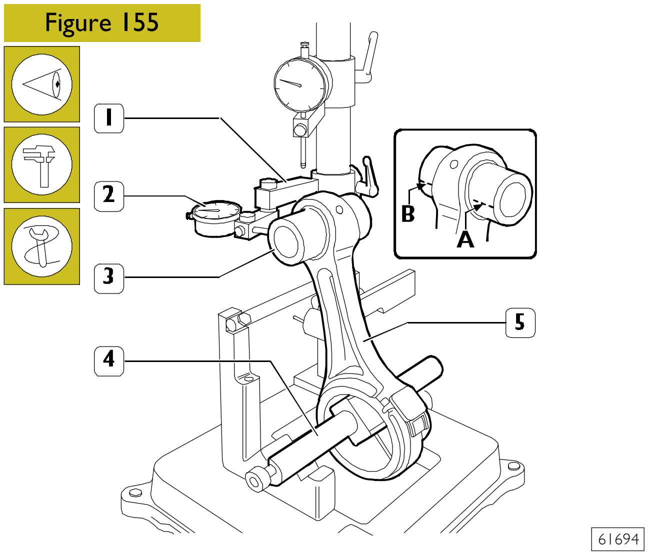
Checking axes alignment

Check the connecting rods axes for parallelism (1) using a suitable device (5) and proceeding as follows.

Fit the connecting rod (1) on the spindle of the tool (5) and lock it with the screw (4).

Place the spindle (3) on the "V" prisms supporting the connecting rod (1) on the stop rod

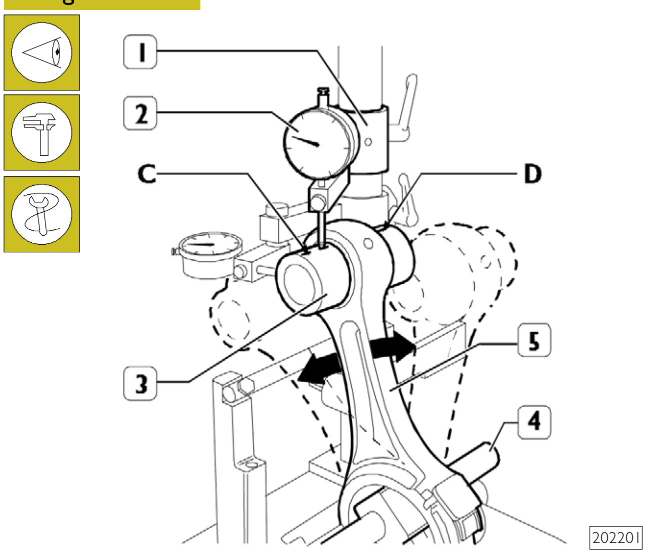
Figure 155



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

Position the dial gauge (2) support (1) to obtain a preload of ~ 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 must be no greater than 0.08 mm.

Figure 156



Bending check

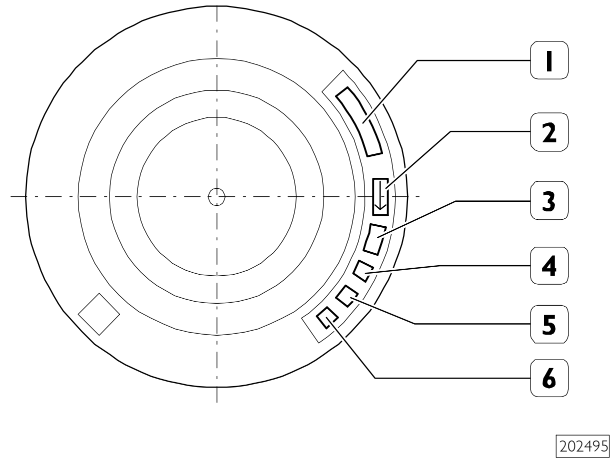
Check the bending of the connecting rod (5) by comparing two points C and D of the pin (3) on the vertical plane of the axis of the connecting rod.

Position the vertical support (1) of the dial gauge (2) so that it rests on the pin (3) at point C. Swing the connecting rod forward and backward to find the highest position of the pin and when that is reached, reset the dial gauge (2).

Move the spindle (4) with the connecting rod (5) and repeat on the opposite side D, controlling the highest point of the pin (3). The difference between point C and point D should not be greater than 0.08 mm.

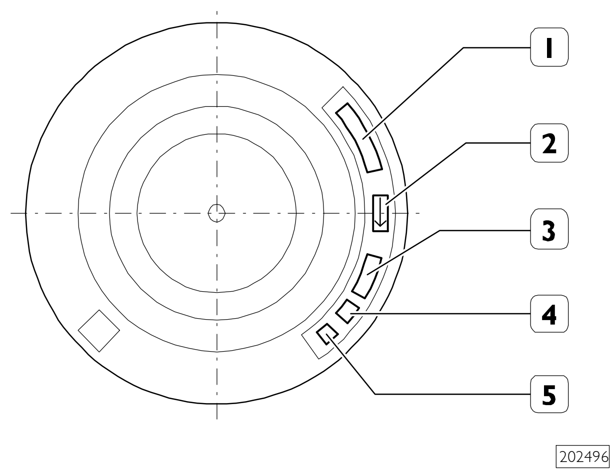
Connecting rod and piston assembly

Figure 157 NEF67 TM1F engine



1. Client Code - 2. Laser stamp "ARROW" - 3. Laser stamp Data - 4. Laser stamp "U" - 5. Laser stamp WORK SHIFT - 6. Laser stamp PRODUCTION LINE

Figure 158 NEF67 TE1F/TE2F engine



1. Stamp IVECO Part Number - 2. Stamp arrow - 3. Stamp date - 4. Stamp "U" for control of US insert attachment - 5. Mahle product tracking

Connecting rod-piston pairing

Box "I": month and year of registration;

Box "N": engine variant to be completed according to engine records (last three digits of the theoretical code);

Box "P": Serial number to be assigned in the manufacturing plant;

For the remaining data to be entered onto the plate, refer to the engine details of P.N. 504257007 (file in D.B. Matrix)

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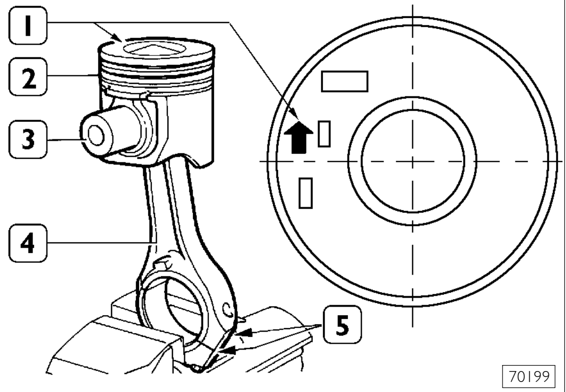
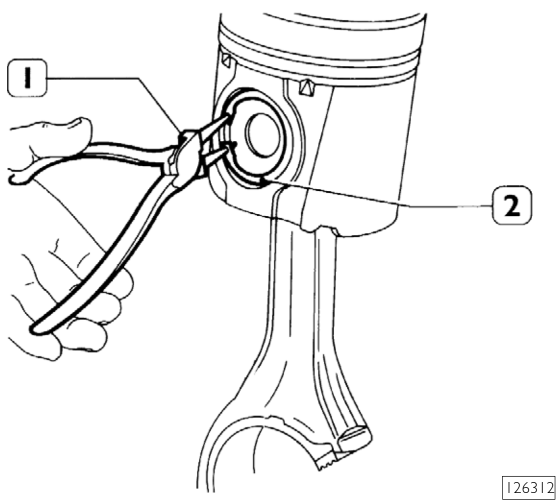
Figure 159 (For all engines)



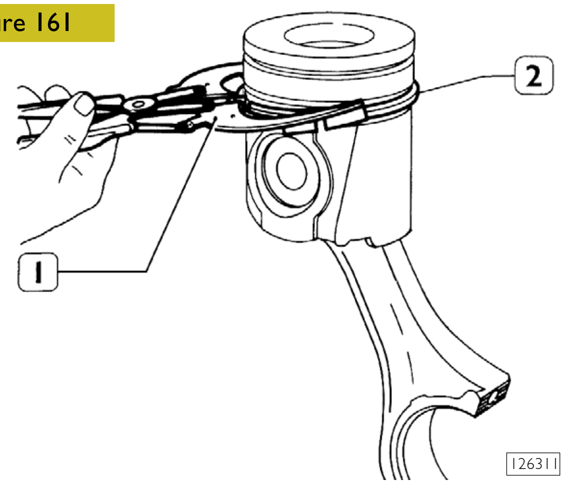
Connect piston (2) to the connecting rod (4) with pin (3) so that the reference arrow (1) for fitting the piston (2) into the cylinder barrel and the numbers (5) stamped on the connecting rod (4) are read as shown in the figure.

Figure 160



Fit the pin fastening circlips (2).

Figure 161



Fitting piston rings

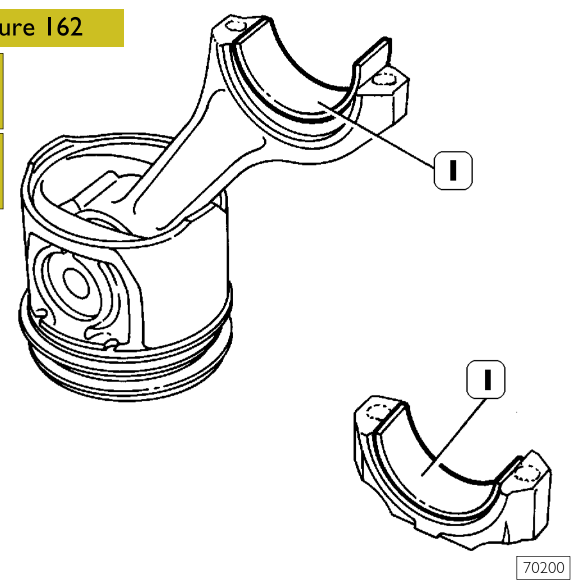
Use callipers 99360183 (1) to fit the circlips (2) on the piston.

Piston rings shall be fitted with the marking "TOP" facing upwards and their openings shall be displaced with each other by 120°.

NOTE Spare piston rings are supplied in the sizes below:

- ❑ standard;
- ❑ increased by 0.4 mm.

Figure 162



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

NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position as in removal. Do not make any adjustment on the half-bearings.

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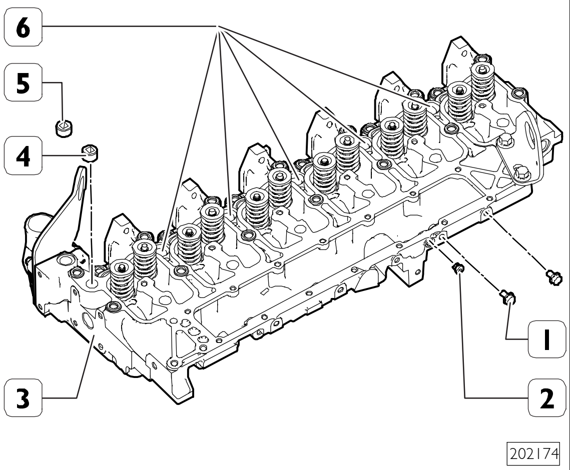
Cylinder head
Cylinder head assembly removal

Figure 163 NEF67 TM1F engine



☞ NEF67 TE1F/TE2F engine Page 60

- ❑ Unscrew the threaded plug (2).
- ❑ Check the hydraulic seal using a suitable tool. Pump in water heated to
  ~ 90°C at a pressure of 2-3 bar.

Hydraulic seal

- ❑ Replace the cast hole plugs (6) if leaks are found, use the proper driver for their removal/refitting.
- ❑ Undo the plug (2).
- ❑ Undo the conical threaded plugs (4 and 5) from the air bleed pipe.

Ref.	No.	Screws description
(1)	1	Plug
(2)	1	Plug
(4)	1	Plug
(5)	1	Plug 1/2"

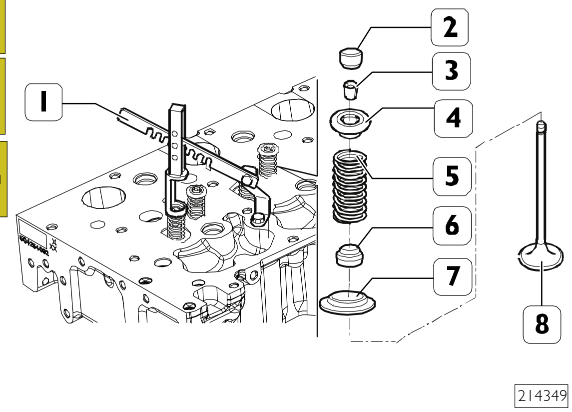
NOTE Before fitting the plugs, apply a layer of water-repellent sealant onto the seal surface.

Replace the cylinder head if leaks are found.

- ❑ Remove the core plugs (3 and 6).

Valve unit removal

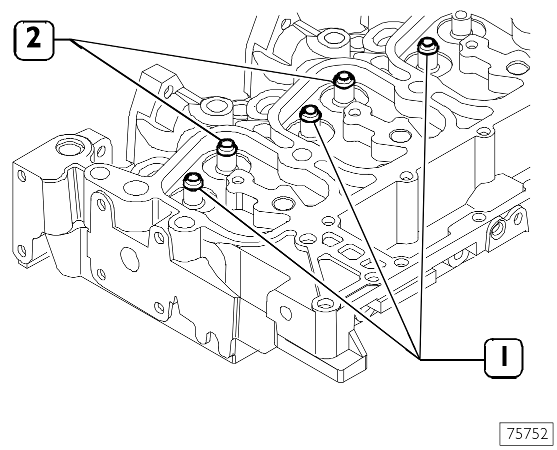
Figure 164



NOTE Before removing the valves from the cylinder head, number them so that they can be re-installed in the same positions they were removed from if they are to be re-used.

- ❑ Valve removal is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to remove the valve cap (2) and the cotters (3). Then remove: plate (4) and spring (5).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head, remove the valve (8), the lower spring seat (7) and the oil seal (6).

Figure 165



- ❑ Remove the sealing rings (1 and 2) from the relevant valve guides.

NOTE The seal rings (1) for the intake valves are yellow.

The sealing rings (2) for the exhaust valve are green.

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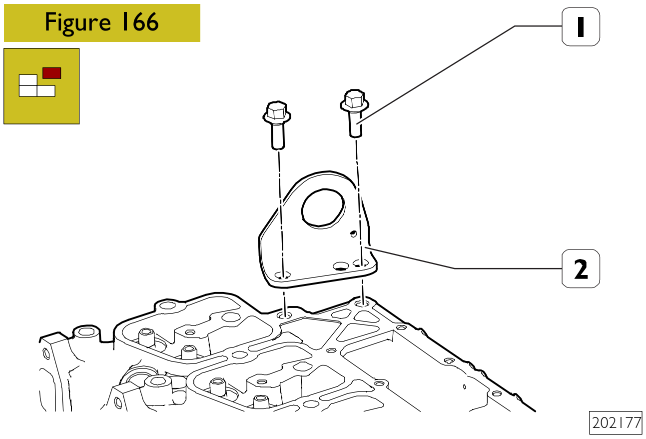
Removal of the second lifting eyelet

Figure 166



- ❑ Unscrew the screws (1).
- ❑ Remove the lifting eyelet (2).

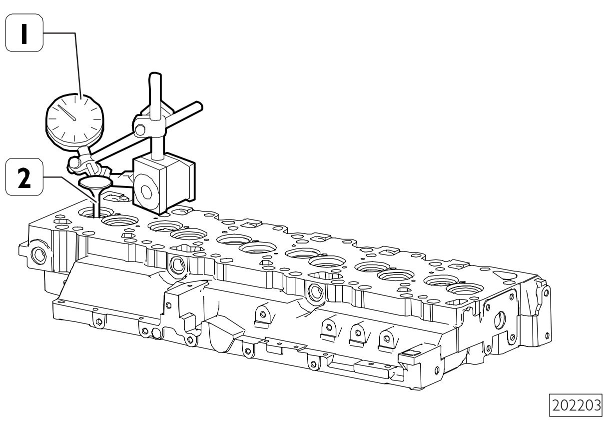
Ref.	No.	Screws description
(1)	2	Screw M12x1.75

Surfaces on lower side of cylinder head

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

If measurement results exceed this value, regrind the cylinder head according to the values and instructions provided in the figure below.

Figure 167

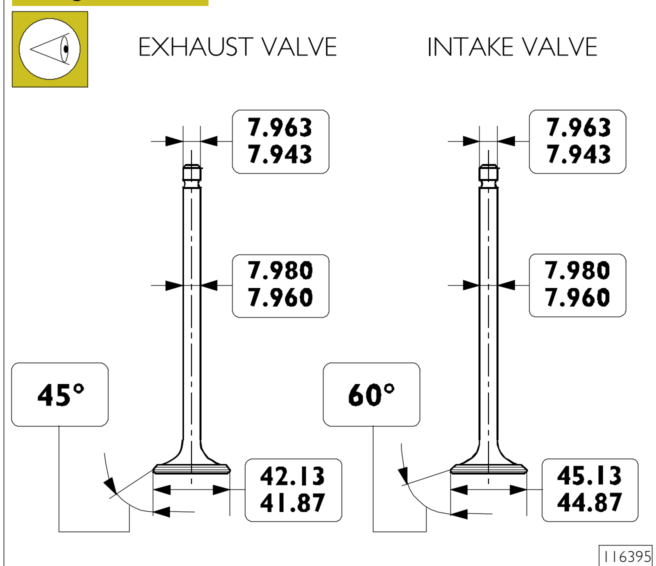


The rated thickness A for the cylinder head is 95 ± 0.25 mm, max. metal removal must not exceed thickness B by 0.13 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to meet the prescribed valve recess.

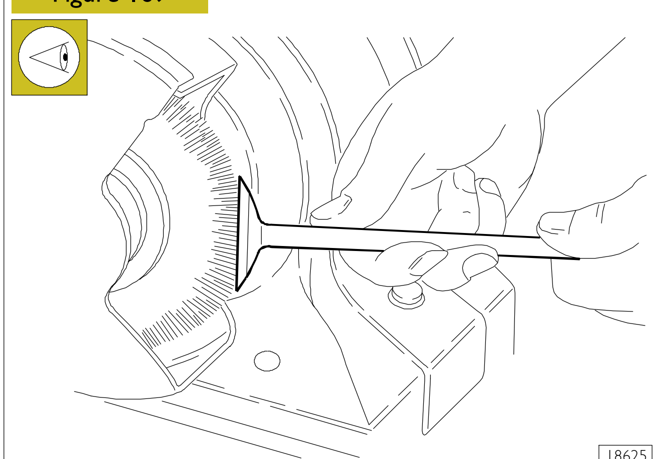
Intake and exhaust valves

Figure 168



INTAKE AND EXHAUST VALVE MAIN DATA

Figure 169

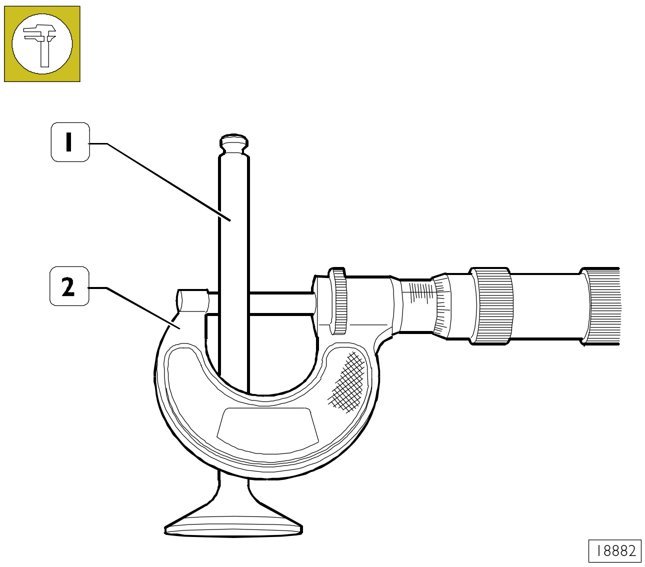


Valve descale, check and grind

Remove all carbon deposits from the valves using a wire brush. Check that the valves show no signs of seizing, cracks or burns.

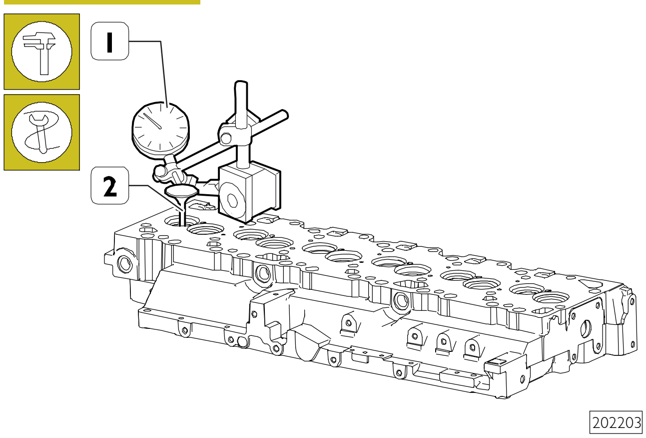
Regrind the valve seats, if required, removing as little material as possible.

Figure 170



Use micrometer (2) to measure valve (1) stem: it must be 7.960 - 7.980 mm.

Figure 171

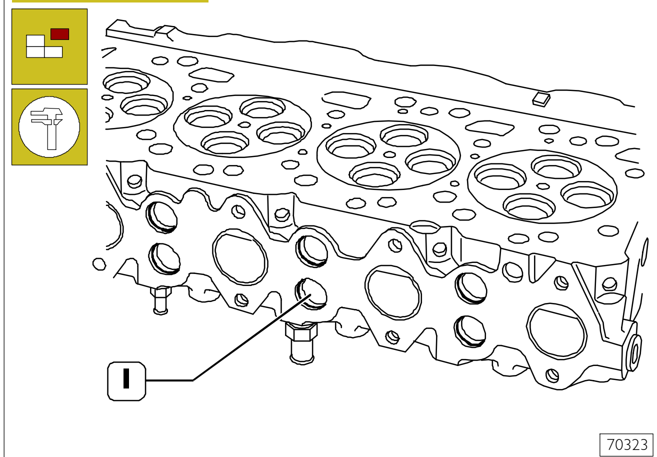


Checking clearance between valve stem, valve guide and valve centring

Use a magnetic-base dial gauge (1) set as shown, the assembling clearance must be 0.056 - 0.096 mm.

Making the valve (2) turn, check that the run out error is no greater than 0.03 mm.

Figure 172 NEF67 TE1F/TE2F engine



☞ NEF67 TM1F engine Page 63

Hydraulic seal

- ❑ Check the hydraulic seal using a suitable tool.
- ❑ Pump in water heated to ~ 90 °C at a pressure of 2 ÷ 3 bar.

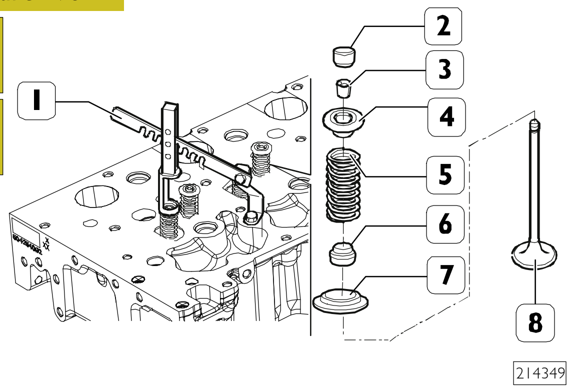
NOTE Before fitting the plugs, apply a layer of water-repellent sealant onto the seal surface.

Replace the cylinder head if leaks are found.

- ❑ Remove all the core plugs.

Valve unit removal

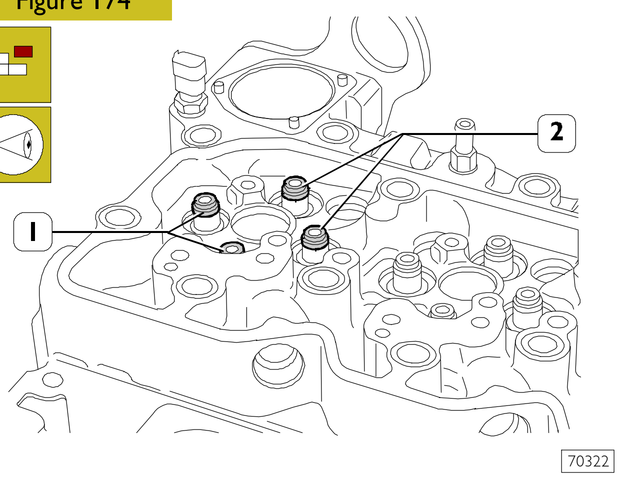
Figure 173



NOTE Before removing the valves from the cylinder head, number them so that they can be re-installed in the same positions they were removed from if they are to be re-used.

- ❑ Valve removal is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to remove the valve cap (2) and the cotters (3). Then remove: plate (4) and spring (5).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head, remove the valve (8), the lower spring seat (7) and the oil seal (6).

Figure 174



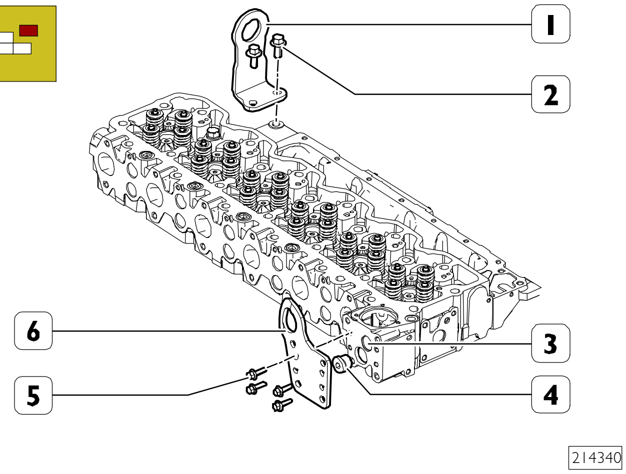
- ❑ Remove the sealing rings (1 and 2) from the relevant valve guides.

NOTE The seal rings (1) for the intake valves are yellow.

The sealing rings (2) for the exhaust valve are green.

Lifting eyelet removal

Figure 175



- ❑ Unscrew the screws (5).
- ❑ Remove the lifting eyelet (6).
- ❑ Unscrew the threaded plug (4) and the core plug (3).
- ❑ Unscrew the screws (1) and remove the lifting eyelet (2).

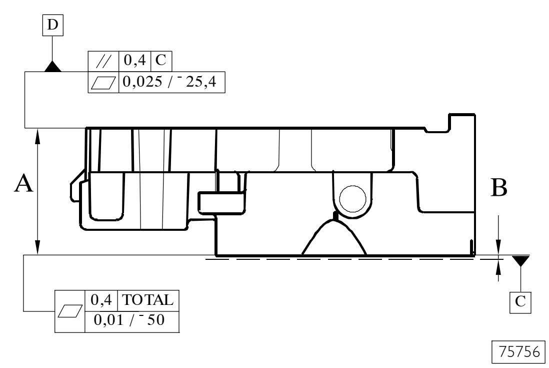
Ref.	No.	Screws description
(1)	2	Screw M12x1.75x25
(5)	4	Screw M12x1.25x25

Surfaces on lower side of cylinder head

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

If measurement results exceed this value, regrind the cylinder head according to the values and instructions provided in the figure below.

Figure 176

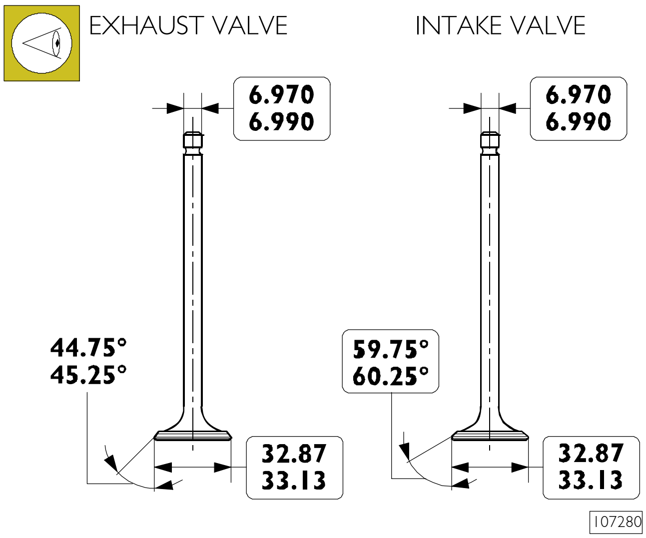


The rated thickness A for the cylinder head is 95 ± 0.25 mm, max. metal removal must not exceed thickness B by 0.13 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to meet the prescribed valve recess.

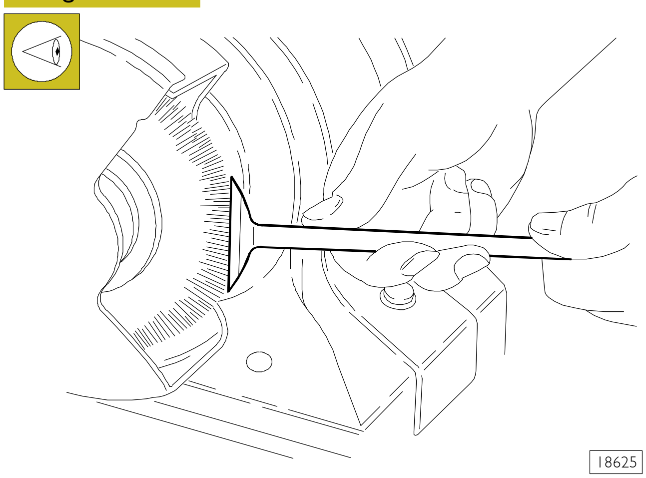
Intake and exhaust valves

Figure 177



INTAKE AND EXHAUST VALVE MAIN DATA

Figure 178

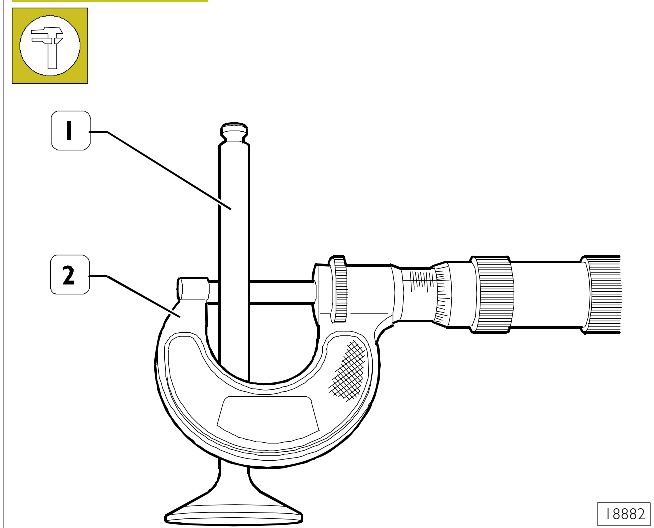


Valve descale, check and grind

Remove all carbon deposits from the valves using a wire brush. Check that the valves show no signs of seizing, cracks or burns.

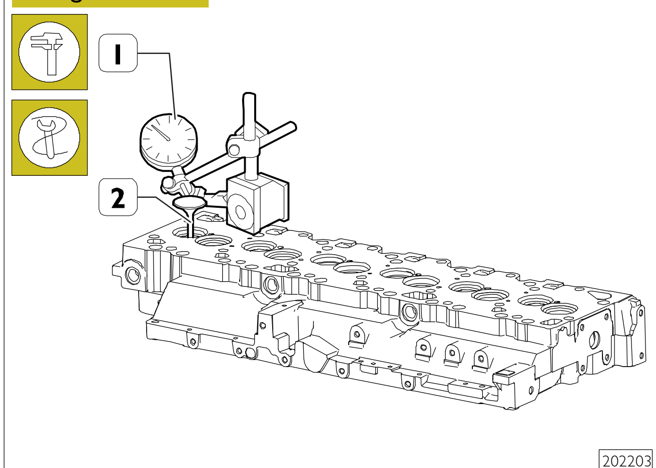
Regrind the valve seats, if required, removing as little material as possible.

Figure 179



Use micrometer (2) to measure valve (1) stem: it must be 6.990 ÷ 7.01 mm

Figure 180



Checking clearance between valve stem, valve guide and valve centring

Use a magnetic-base dial gauge (1) set as shown, the assembling clearance must be 0.056 - 0.096 mm.

Making the valve (2) turn, check that the run out error is no greater than 0.03 mm.

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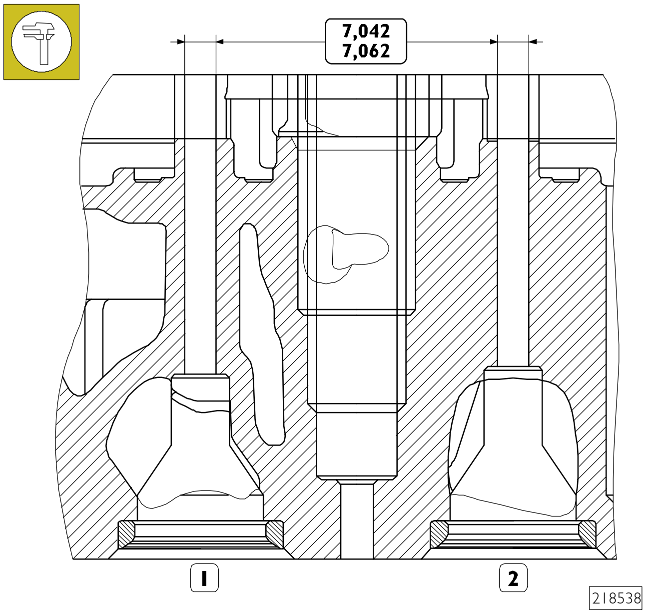
Valve guides

Figure 181 (For all engines)

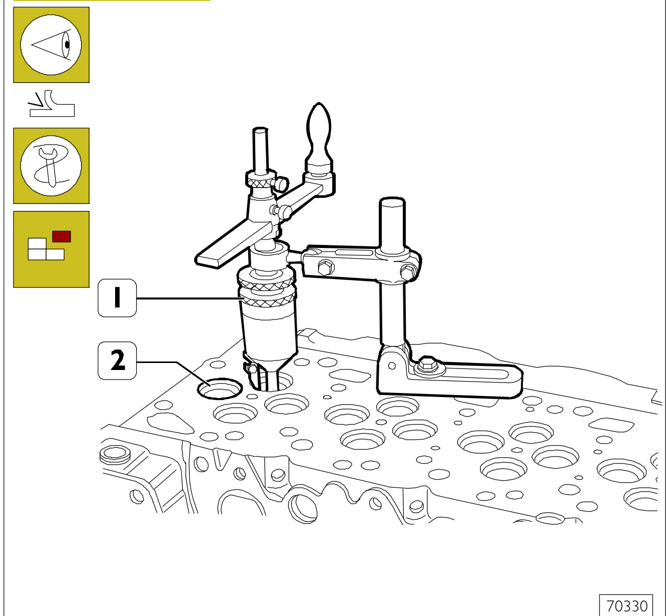


1. Exhaust - 2. Intake

Use a bore gauge, measure the internal diameter of the valve guides; it must be equal to the value shown in the figure.

Valve seats

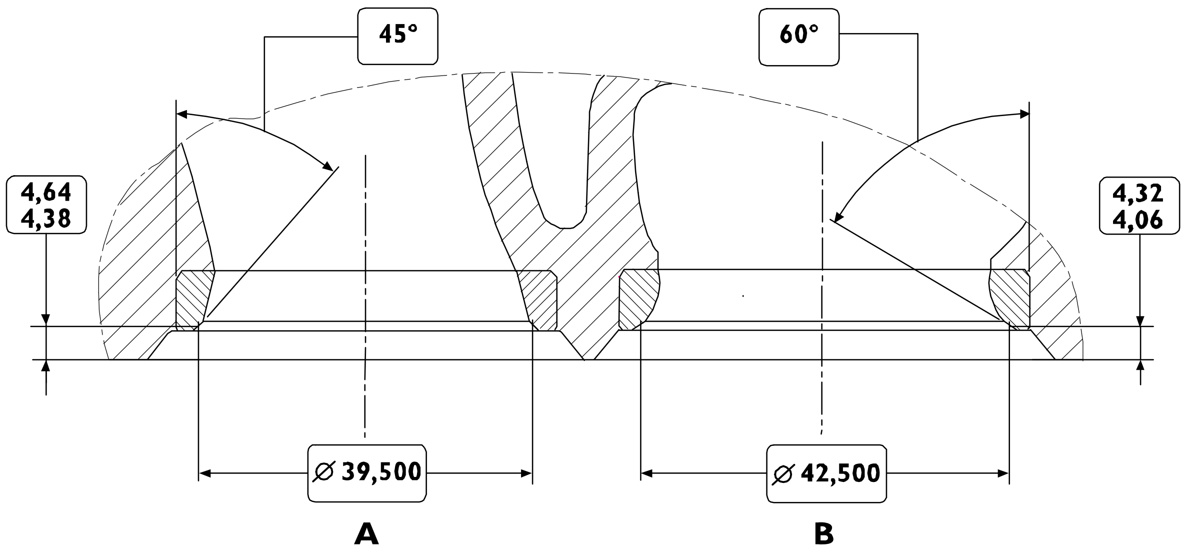
Figure 182



Regrinding - replacing the valve seats

Check the valve seats (2). If light scratches or burns are found, go over the surface with a suitable tool (1) according to the slope values given in Figure 183.

Figure 183



199356

VALVE SEAT MAIN DATA

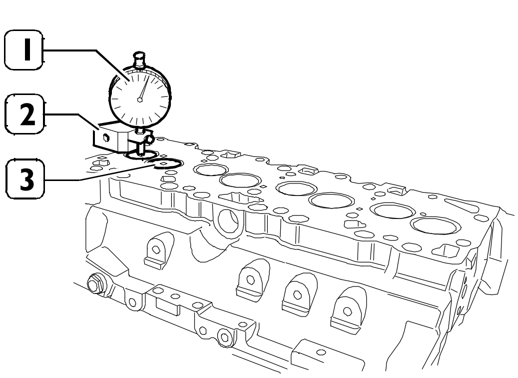
If valve seats cannot be restored just by regrinding, it is possible to replace them with spare seats.

Using a specific tool and taking care not to nick the cylinder head, remove as much material as possible from the valve seats until they can be removed from the cylinder head with a punch.

Heat the cylinder head to 80 ÷ 100° C and use a suitable driver to install new pre-cooled valve seats in it.

Then use a suitable tool to go over the valve seats according to the values shown in Figure 183.

Figure 184

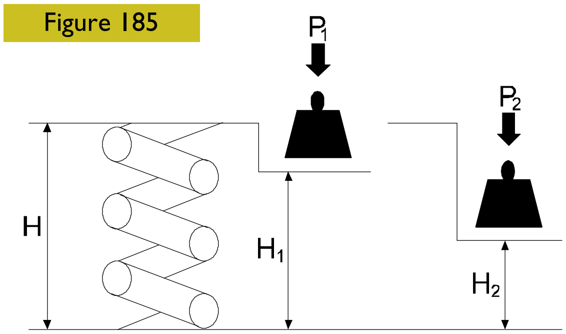


75758

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

Valve springs

Figure 185



50676

KEY DATA FOR CHECKING INTAKE AND EXHAUST VALVE SPRINGS

Before assembling, check the flexibility of the valve springs using the specific tool. Compare the elastic deformation and load data with those of the new springs shown in the following table.

NEF67 TM1F engine

Height	Under a load of
mm	N
H (free) 63.50	0
H1 49.02	329
H2 38.20	641

NEF67 TE1F/TE2F engine

Height	Under a load of
mm	N
H (free) 47.75	0
H1 35.53	339.8 ± 19
H2 25.2	741 ± 39

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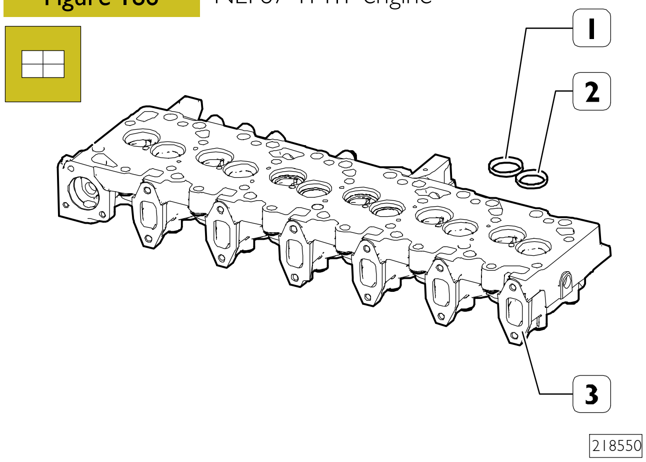
Cylinder head assembly fitting

Surfaces on lower side of cylinder head

Refitting of valve seats

Figure 186 NEF67 TM1F engine



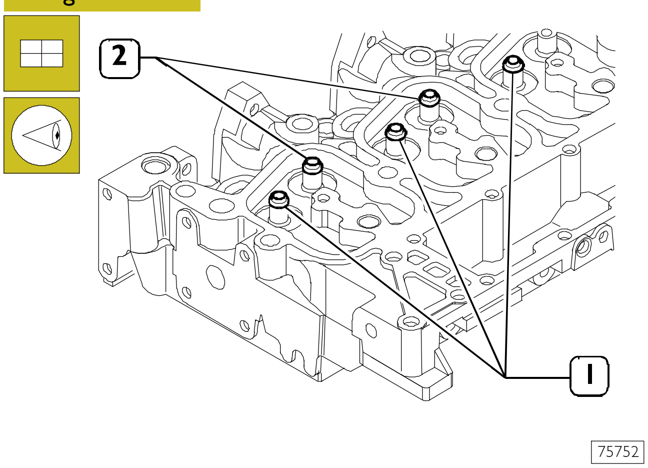
☞ NEF67 TE1F/TE2F engine Page 66

Position the valve seats, intake (1) and exhaust (2), on the bottom of the cylinder head (3).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75	77 ± 12 Nm

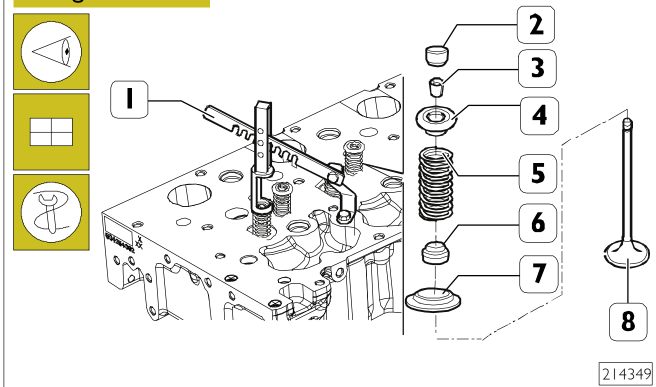
Refitting valve assembly

Figure 187



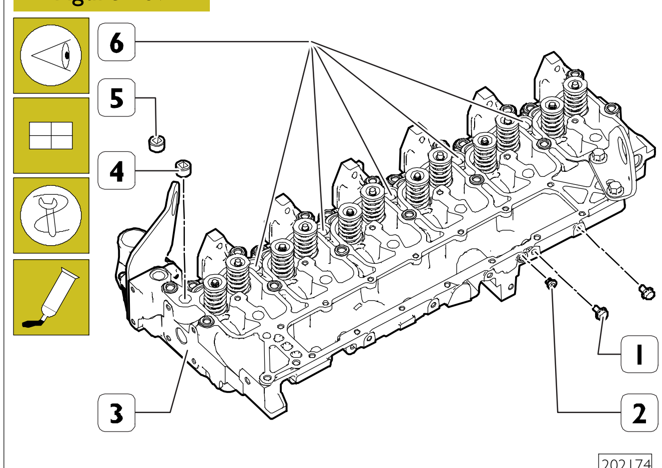
- ❑ Fit the seal rings (1 and 2) on the relative valve guide.

Figure 188



- ❑ Upturn the cylinder head and insert the oil seal (6), the spring seat (7) and the valve (8).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head and insert the spring (5) and the plate (4).
- ❑ Valve assembly is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to insert the cotters (3) and the valve cap (2).

Figure 189



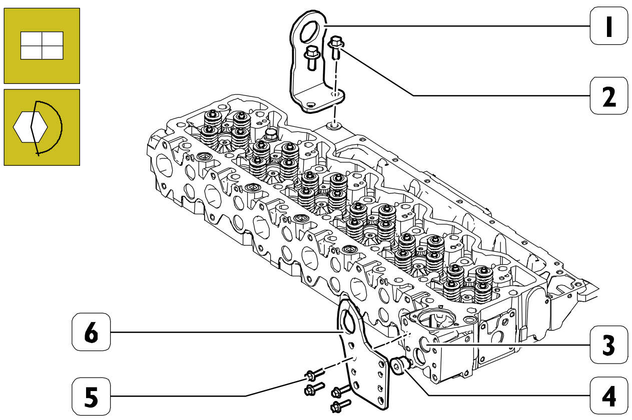
- ❑ Fit the core plugs (6) after having applied a water-repellent sealant onto the seal.
- ❑ Tighten the conical threaded plugs (4 and 5) from the air bleed pipe.
- ❑ Tighten the threaded plugs (1 and 2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Plug	
(2)	1	Plug	
(4)	1	Plug	
(5)	1	Plug 1/2"	

Surfaces on top of cylinder head

Lifting eyelet refitting

Figure 190 NEF67 TE1F/TE2F engine



214340

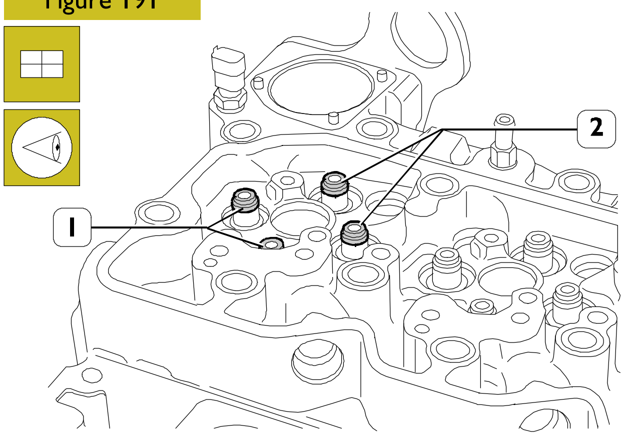
☞ NEF67 TM1F engine Page 67

- ❑ Position the lifting eyelet (2) and tighten the screws (1).
- ❑ Insert the core plug (3) and tighten the threaded plug (4).
- ❑ Fit the lifting eyelet (6).
- ❑ Tighten the screws (5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75x25	77 ± 12 Nm
(5)	4	Screw M12x1.25x25	36 ± 5 Nm

Refitting valve assembly

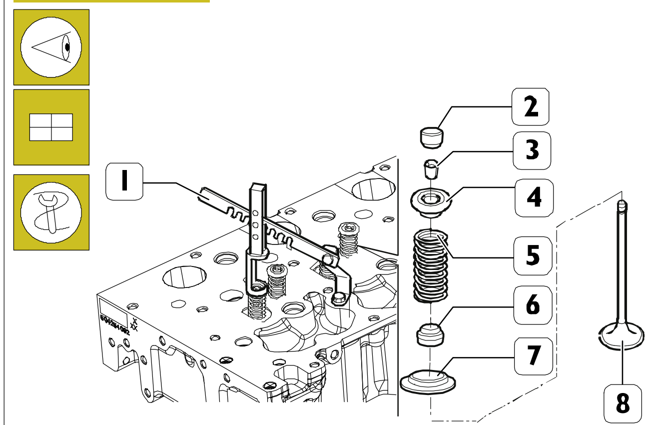
Figure 191



70322

- ❑ Fit the seal rings (1 and 2) on the relative valve guide.

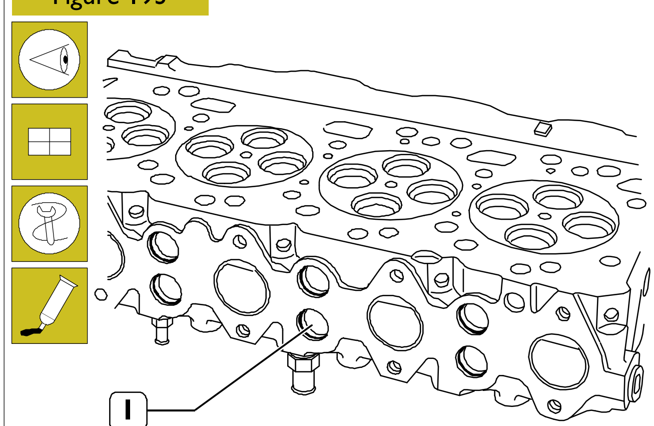
Figure 192



214349

- ❑ Upturn the cylinder head and insert the oil seal (6), the spring seat (7) and the valve (8).
- ❑ Repeat this operation for all the valves.
- ❑ Upturn the cylinder head and insert the spring (5) and the plate (4).
- ❑ Valve assembly is carried out using tool 99360268 (1) and applying pressure on the plate (4) so that by compressing the spring (5), it is possible to insert the cotters (3) and the valve cap (2).

Figure 193



70323

- ❑ Fit all core plugs after having applied a water-repellent sealant onto the seal.

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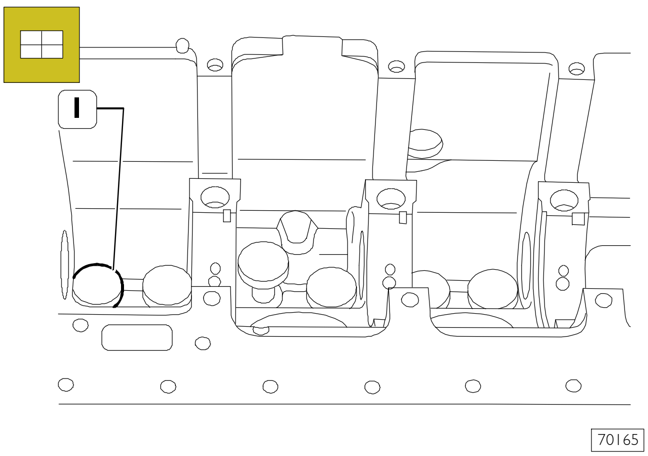
ENGINE ASSEMBLY AT BENCH (CRANKCASE COMPONENTS)

Refitting tappets

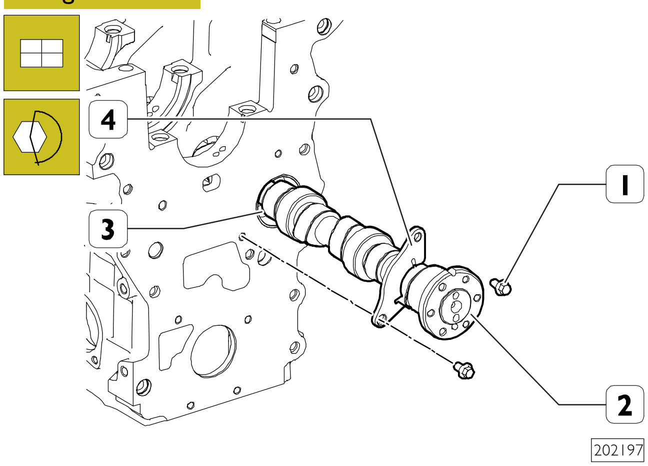
Figure 194 (For all engines)



❑ Fit the tappets (1) in the crankcase.

Refitting camshaft

Figure 195

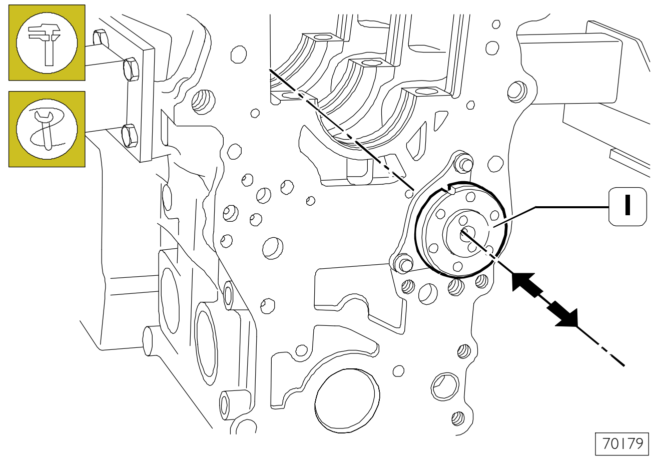


❑ Carefully insert the camshaft (2) together with the shoulder plate (4).

❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x16	24 ± 4 Nm

Figure 196

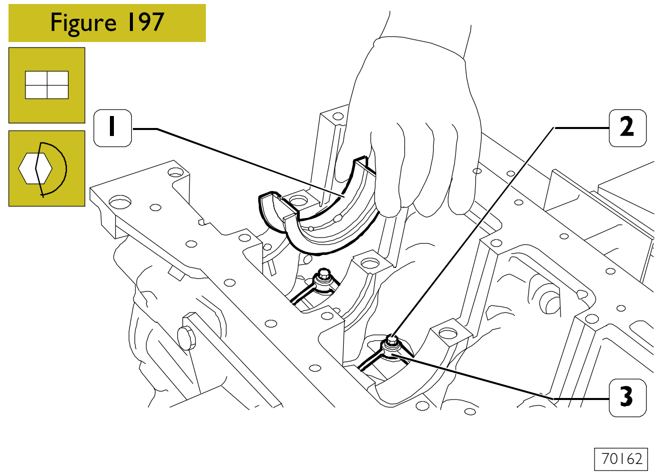


❑ Check the axial clearance of the camshaft (1) using tool 99395604.

❑ It must be 0.23 ± 0.13 mm.

Refit the oil sprayers and main half bearings

Figure 197



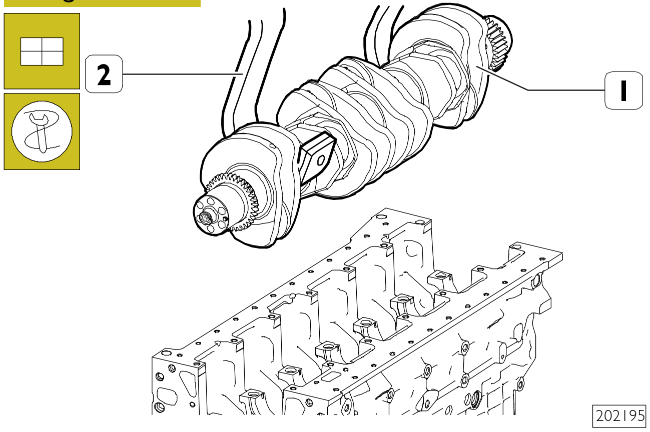
❑ Position the oil sprayers (3) and screw in the unions (2).

❑ Fit the main half-bearings (1).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	15 ± 3 Nm

Crankshaft refitting

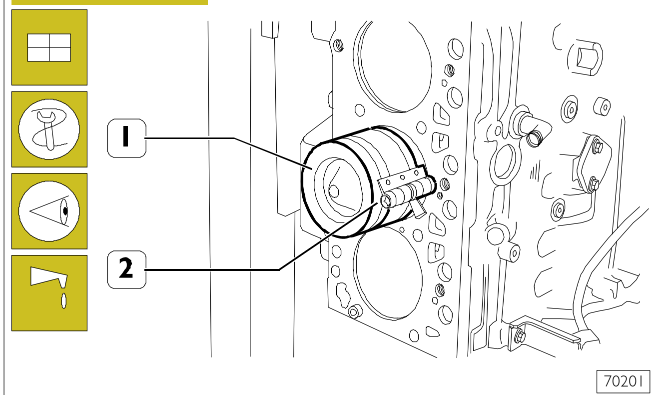
Figure 198



- ❑ Use tool 99360500 (2) to lift the crankshaft (1) and place it inside the crankcase.

Pisting-connecting rod refitting

Figure 199



Lubricate the pistons well, including the piston rings and the inside of the cylinder liners.

With the aid of 99360605 clamp (2), fit the connecting rod-piston assemblies (1) in the cylinder liners, checking that:

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

Figure 200

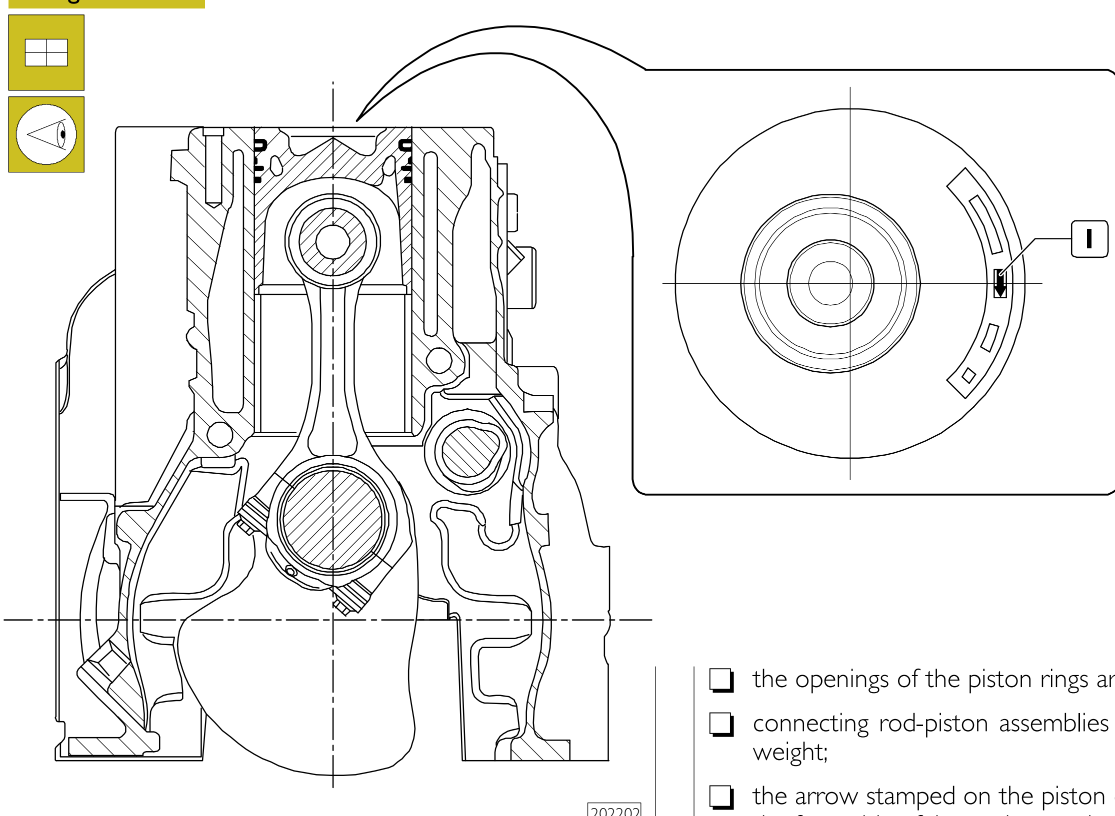
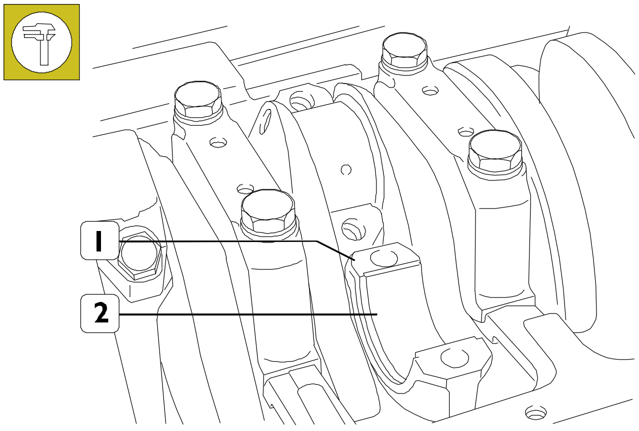


DIAGRAM FOR CONNECTING ROD-PISTON ASSEMBLY FITTING INTO CYLINDERS

- ❑ the openings of the piston rings are offset by 120°;
- ❑ connecting rod-piston assemblies shall have the same weight;
- ❑ the arrow stamped on the piston crown shall be facing the front side of the engine crankcase or the slot obtained on the piston skirt shall be corresponding to the oil nozzle position.

Figure 201



128170

Crankpins assembly clearance measurement

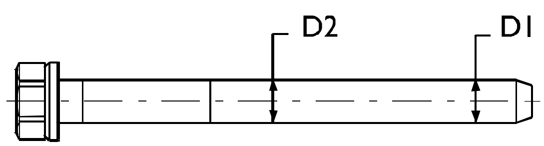
Carry out the following operations to measure the clearance:

- carefully clean the parts and remove any trace of oil;
- fit the connecting rod caps (1) with the relevant half bearings (2).

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

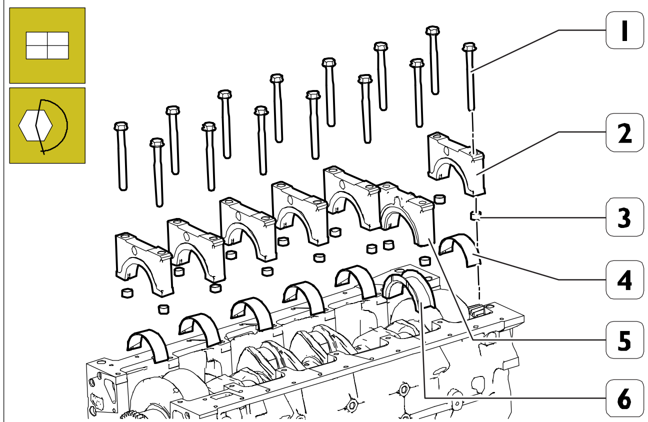
if D1 - D2 < 0.1mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced



75703

Figure 202



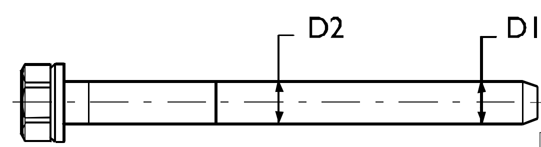
202193

- Fit the lower main half-bearings (4).
- Fit the cable reference dowel pins.
- Fit the main bearing caps (5).

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.

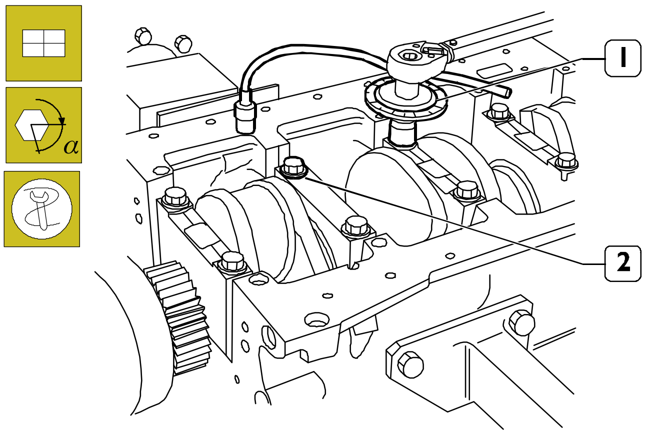


75703

- Tighten the main bearing cap screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M12x1.75x120	
		1^{st} step	80 ± 8 Nm

Figure 203



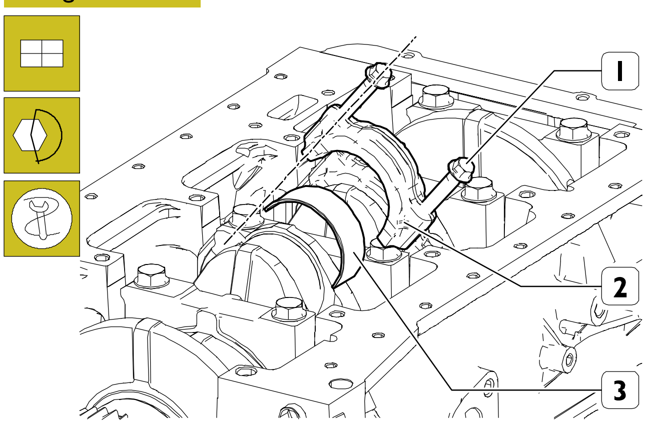
70188

- ❑ Further tighten the screws (2) with tool 99395216 (1).

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M12x1.75x120 2nd step	 90°

Connecting rod caps refitting

Figure 204

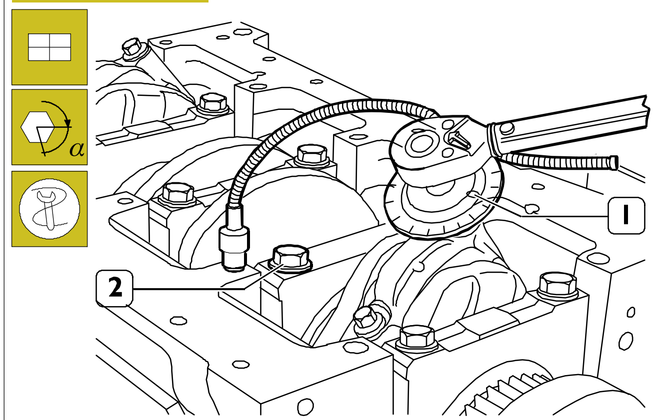


202488

- ❑ Position the connecting rod caps (2).
- ❑ Tighten the screws (1) with a torque wrench after lubricating them with engine oil.

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M10x1.25x52 1st step	 60 ± 5 Nm

Figure 205

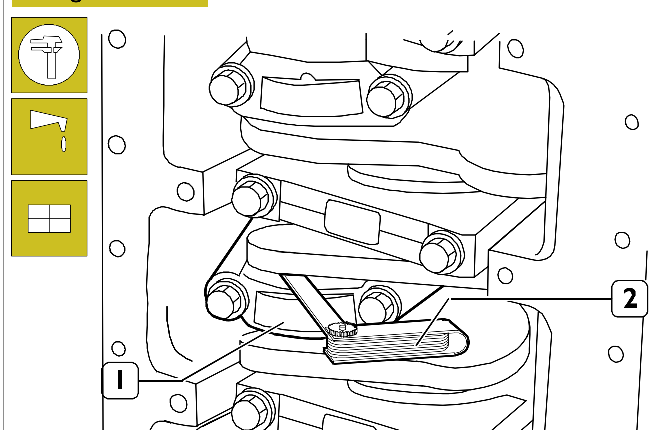


70205

- ❑ Further tighten the screws (2) with tool 99395216 (1).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M10x1.25x52 2nd step	 60°

Figure 206

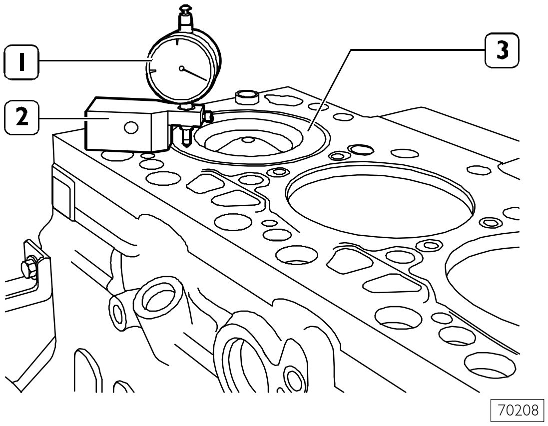


70207

Manually check that the connecting rods (1) are sliding axially on the crankshaft pins and that their end float, measured with feeler gauge (2), is 0.250 - 0.275 mm.

Piston protrusion check

Figure 207



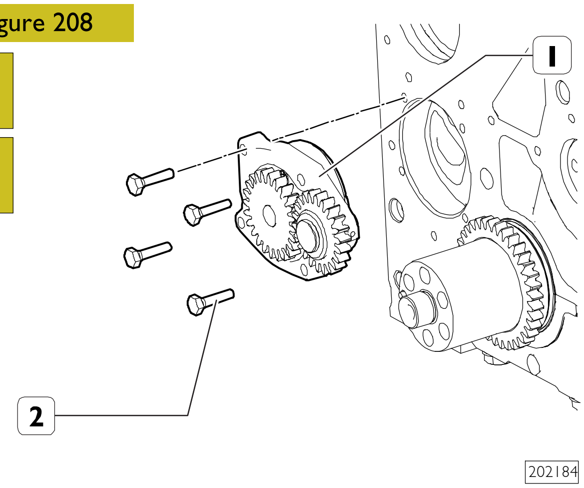
After fitting the connecting rod - piston assemblies, use the dial gauge 39395603 (1) fitted with base 99370415 (2) to check the protrusion of the pistons (3) at T.D.C. in relation to the top crankcase surface.

Procedure for calculating the thickness of piston No. 1:

- detect, as shown in the Figure, at the distance of 45 mm from the centre of the piston, protrusions S1 and S2 of the same compared to the upper level of the crankcase and then calculate the average protrusion;
- repeat the operation to calculate the average protrusion of pistons 2, 3, 4, 5 and 6, and then calculate the mean value of the protrusions;
- it must be 0.28 ÷ 0.52 mm.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)
Oil pump refitting

Figure 208

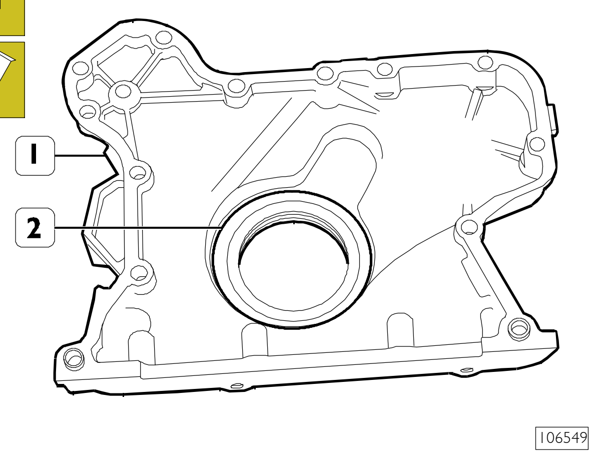


- Position the oil pump (1).
- Tighten the screws (2) of the support.

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	
		1st step	8 ± 1 Nm
		2nd step	24 ± 4 Nm

Removing the front cover sealing ring

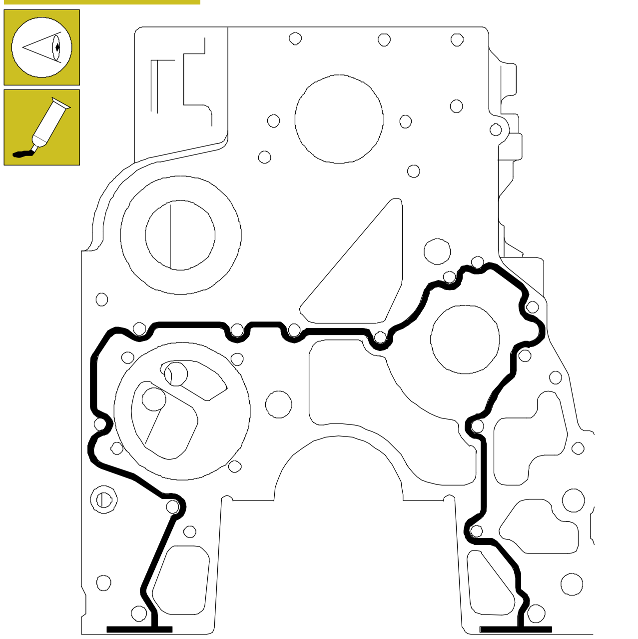
Figure 209



- Remove the sealing ring (2) from the front cover (1) and carefully clean the connection surfaces.

Refitting front cover

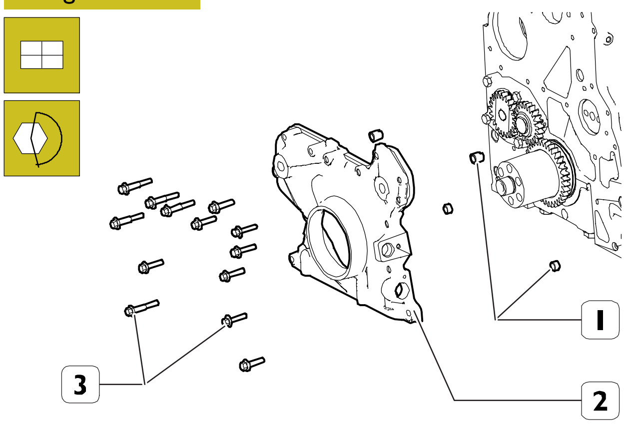
Figure 210



75710

- ❑ Thoroughly clean the contact surface on the engine block and apply sealant LOCTITE 5999 to form a uniform, continuous seam with no lumps.

Figure 211



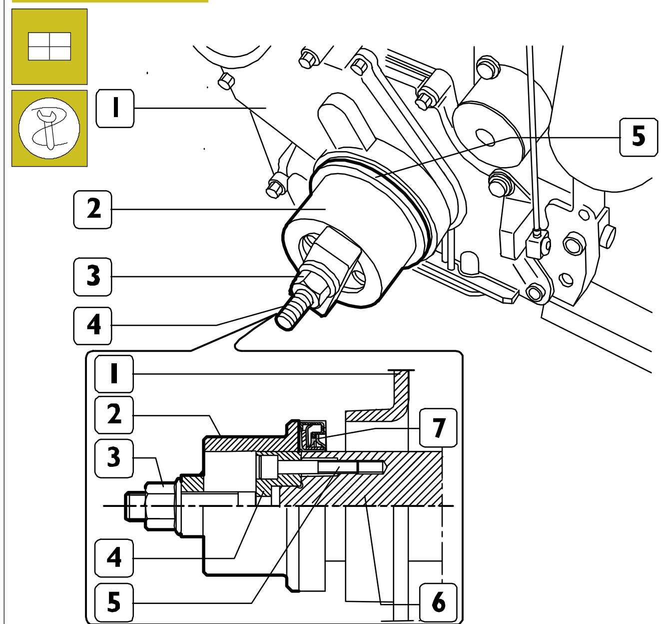
202183

- ❑ Fit the cable reference dowel pins (1).
- ❑ Position the front cover (2) in the relative seat.
- ❑ Tighten the front cover (2) fastening screws (3).

Ref.	No.	Screws description	Tightening torques
(3)	13	Screw M8x1.25	24 ± 4 Nm

Refitting the engine - front cover sealing ring

Figure 212



218549

- ❑ Apply tool 99346252 part (4) to the front crankshaft shaft (6), secure it by screws (5) and fit the new sealing ring (7).
- ❑ Position part (2) on part (4); screw down the nut (3) to fit the seal (7) fully inside the front cover (1).

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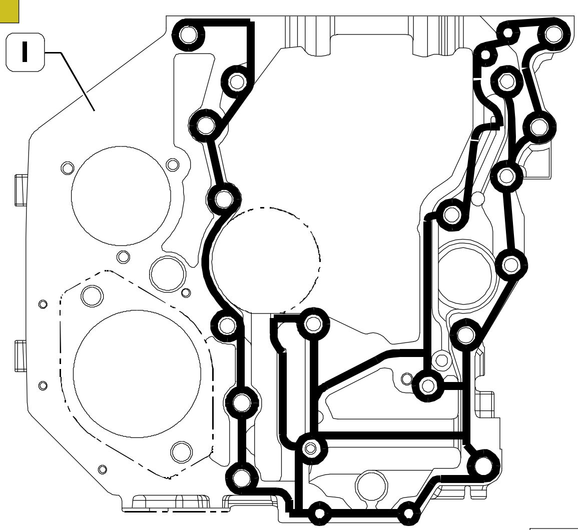
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Timing gear case refitting

Figure 213 NEF45 TE1F/TE2F engine



70209

☞ NEF45 SM1F engine Page 77

DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT ON THE GEAR CASE

❑ Carefully clean the timing gear case (1) and the crankcase.

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

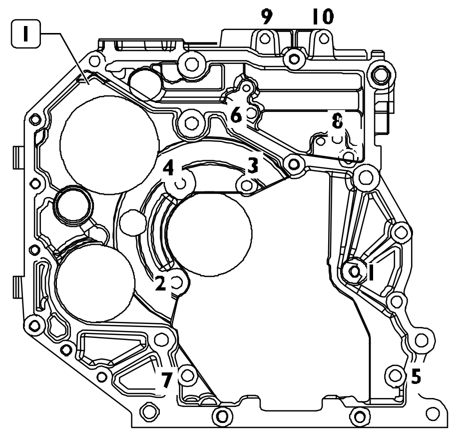
Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joints need to be assembled immediately (within 10 - 20 minutes).

Figure 214

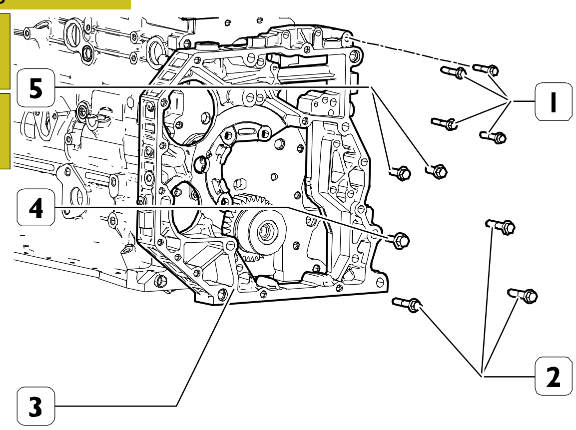


70210

DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

❑ Position the case (1) in its seat at the crankcase.

Figure 215



202487

❑ Screw the screws (1, 2, 4 and 5) in the position they were in at disassembly.

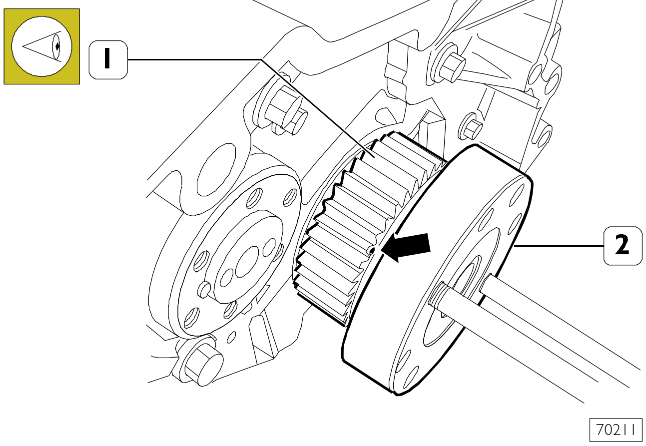
Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25	24 ± 4 Nm
(2)	3	Screw M10x1.5	47 ± 5 Nm
(4)	1	Screw M12x1.75	77 ± 12 Nm
(5)	2	Screw M10x1.5	47 ± 5 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Camshaft gear refitting

Timing procedure

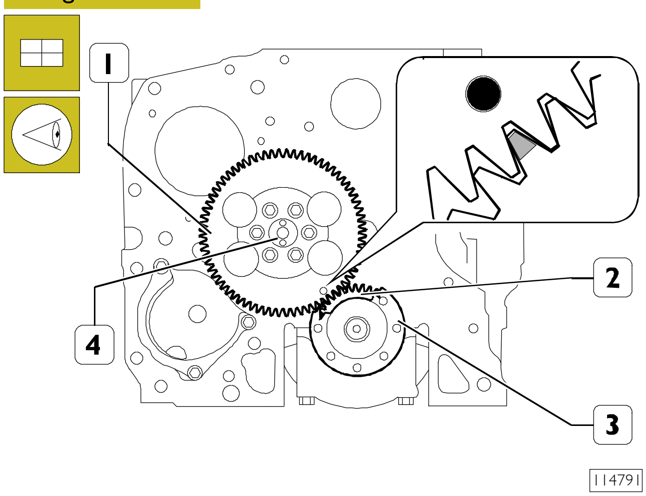
Figure 216



❑ Use a felt-tip pen to highlight the drive gear tooth (1) fitted on the crankshaft (2) with a chamfer (→) on its side for timing.

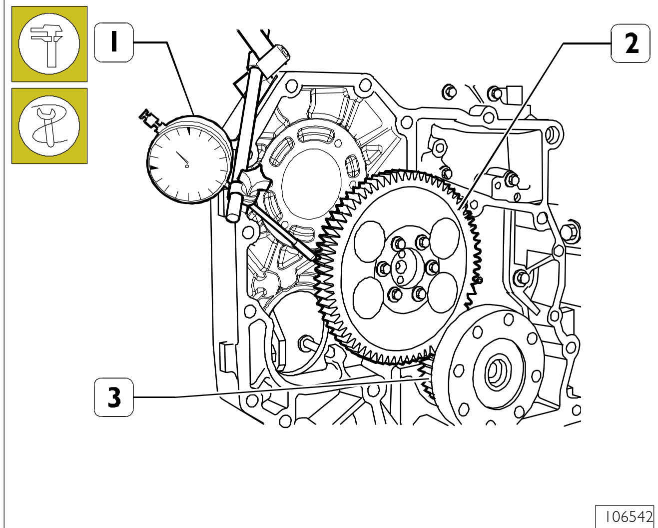
NOTE Screw in the two pins to facilitate crankshaft rotation.

Figure 217



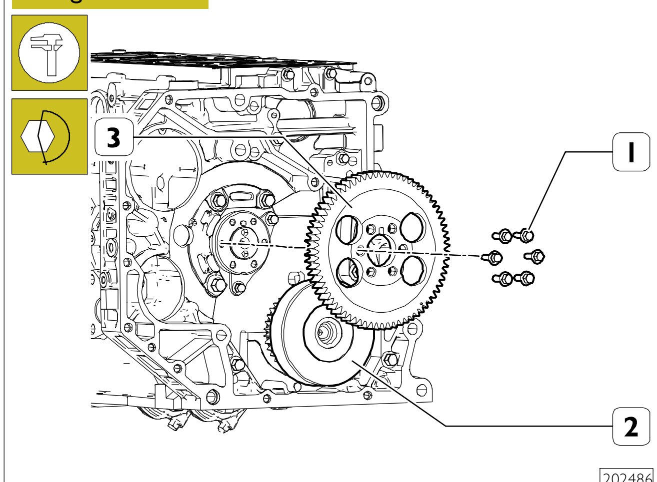
❑ Align the crankshaft (3) and the camshaft (4) so that when the driven gear (1) is mounted onto the latter, the sign stamped on the gear (1) coincides with the bevel gear tooth (2).

Figure 218



❑ Set the dial gauge (1) on the timing gear (2) and check that the clearance between the gears (2) and (3) is between 0.076 ÷ 0.280 mm.

Figure 219



❑ Place the collar (2) in its seat.

❑ Position the gear (3) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	36 ± 2 Nm

Refitting engine flywheel housing

Figure 220

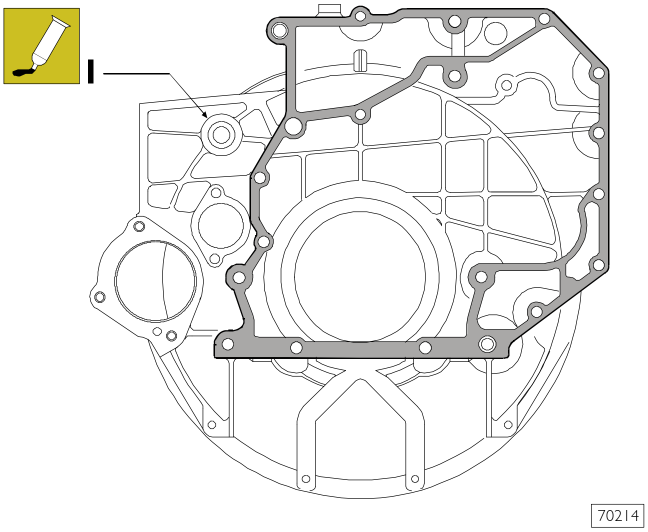


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

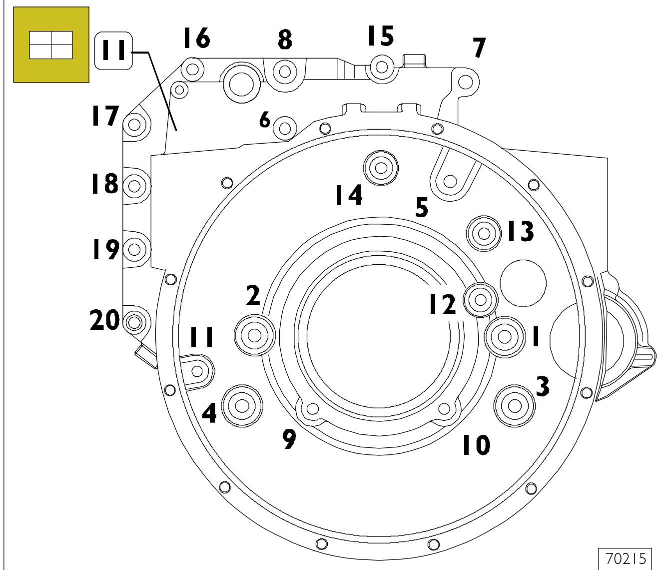
Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

After applying the sealant, the joints need to be assembled immediately (within 10 - 20 minutes).

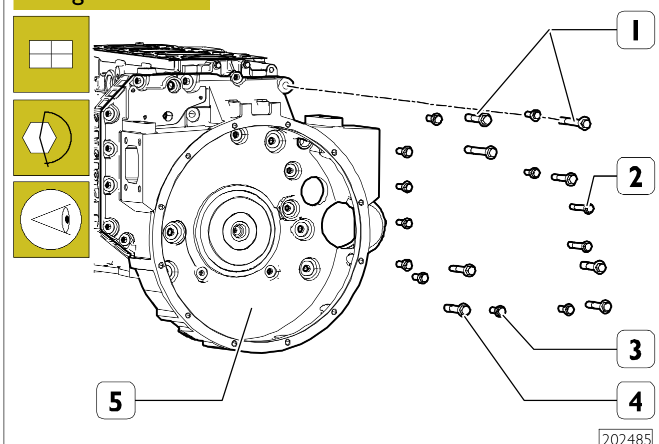
Figure 221



TIGHTENING SEQUENCE DIAGRAM OF FLYWHEEL HOUSING FASTENING SCREWS

❑ Position the flywheel housing (1) in its seat at the crankcase.

Figure 222



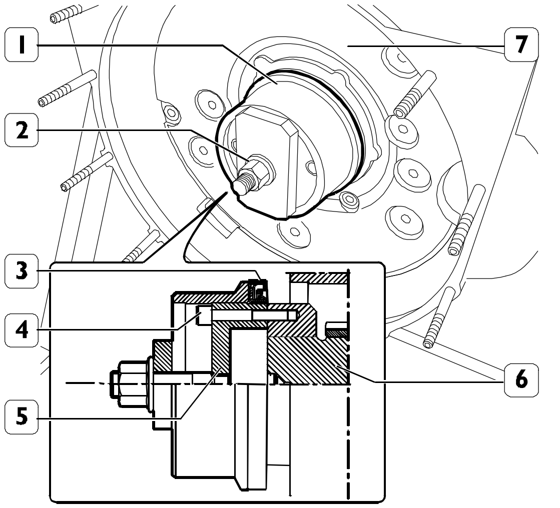
❑ Tighten the screws (1, 2, 3 e 4) fastening the flywheel housing (5).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M12x1.75	85 ± 10 Nm
(2)	2	Screw M10x1.5	49 ± 5 Nm
(3)	10	Screw M10x1.5	49 ± 5 Nm
(4)	6	Screw M12x1.75	85 ± 10 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Refitting flywheel cover housing sealing ring

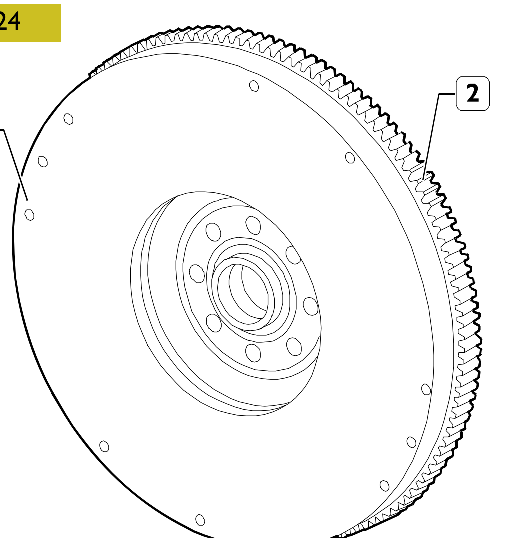
Figure 223



0901t

- ❑ Apply the tool 99340056 part (5) to the rear crankshaft tang (6), 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 224

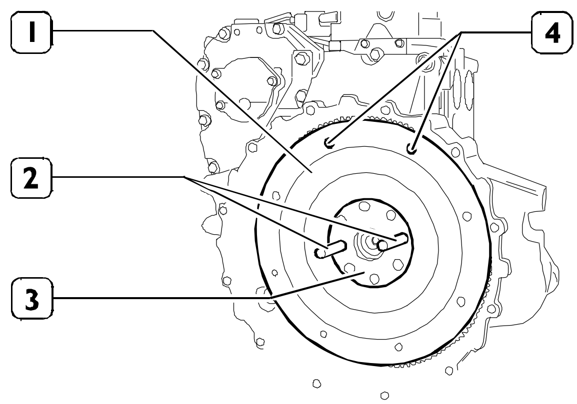


70217

- ❑ Check the clutch plate working surface (1) and turn it if scored.
- ❑ Check the condition of the ring gear teeth (2). If cracks or excessive wear of the teeth are found, remove it from the engine flywheel (1) with a generic driver and install the new one, previously heated to a temperature of 150° C for 15 to 20 minutes; chamfering on ring gear inside diameter shall be facing the flywheel.

Refitting engine flywheel

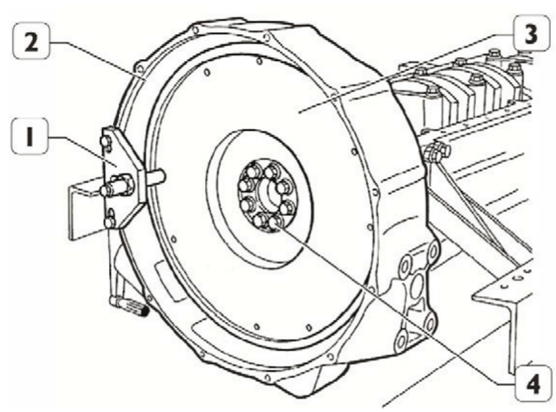
Figure 225



75690

- ❑ Using the two guide pins (2) previously screwed into the crankshaft holes (3) guide the engine flywheel (1) in with the help of the hoist.
- ❑ Remove the medium length screws from the holes (4), used to attach the flywheel.

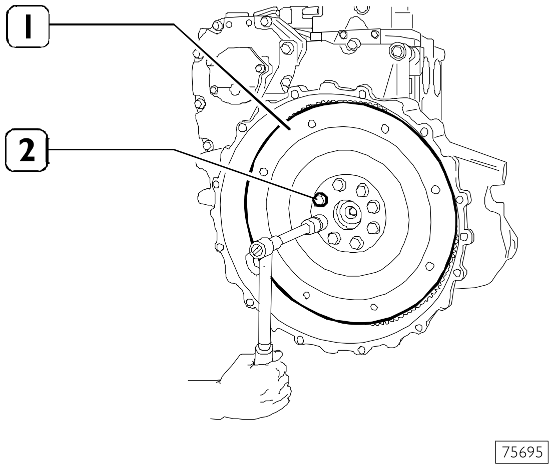
Figure 226



129299

- ❑ Position the flywheel locking tool 99360351 (2) to the flywheel housing (2).
- ❑ Tighten the screws (4) fastening the flywheel (3) to the crankshaft.

Figure 227



- ❑ Tighten the screws (2) securing the engine flywheel (1).
- ❑ Remove tool 99360351 from the flywheel housing.

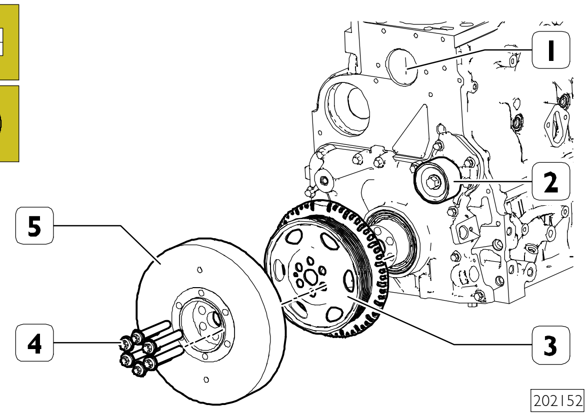
Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M12x1.25x30	
		1st phase 2nd phase	30 ± 4 Nm 60°

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Crankshaft pulley refitting

Figure 228 NEF45 SM1F engine



☞ NEF45 TE1F/TE2F engine Page 93

- ❑ Insert the core plug (1).
- ❑ Position the idler pulley and tighten the screw (2).
- ❑ Position the pulley (3) and the front hub (5).
- ❑ Tighten the screws (4).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M10x1.5	43 ± 6 Nm
(4)	6	Screw M10x1.25x40	68 ± 7 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Timing gear case refitting

Figure 229

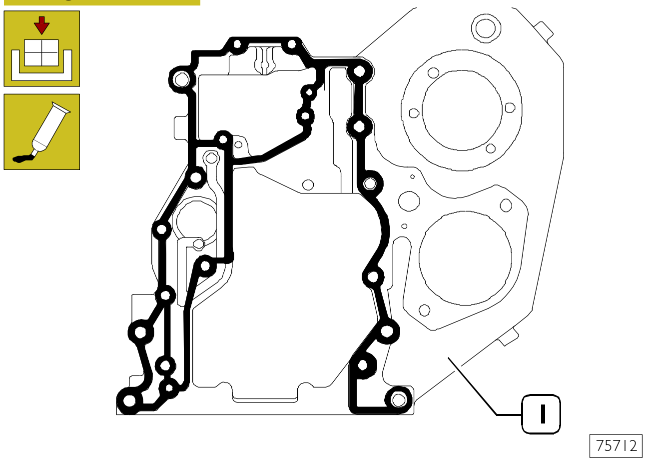


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT ON THE GEAR CASE

- ❑ Carefully clean the timing gear case (1) and the crank-case.

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

Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.

Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.

Any flaws must be corrected in as short a time as possible.

Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.

The joints must be assembled within 10 minutes after applying the sealant.

Figure 230

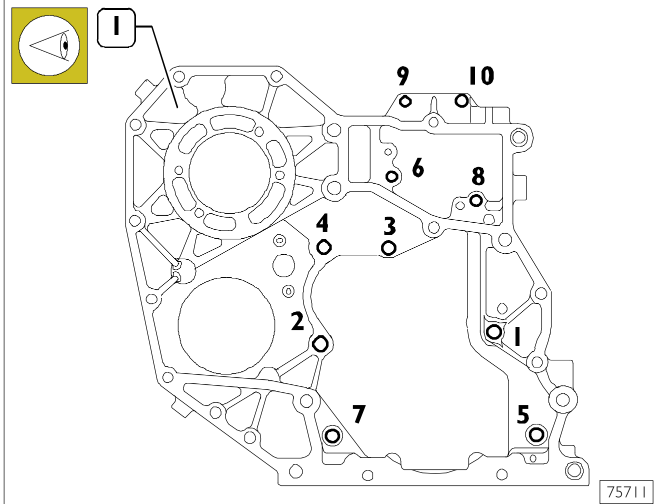
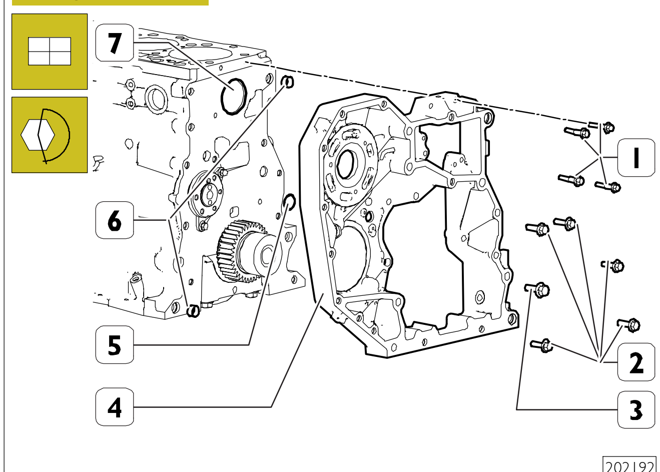


DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Figure 231



- ❑ Insert the core plug (7).
- ❑ Fit the cable reference dowel pins (6).
- ❑ Position the gasket (5) in the relative seat.
- ❑ Position the timing gear case (4).
- ❑ Tighten the screws (1, 2 and 3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M8x1.25x40	24 ± 4 Nm
(2)	5	Screw M10x1.5x30	47 ± 5 Nm
(3)	1	Screw M12x1.75x30	77 ± 12 Nm

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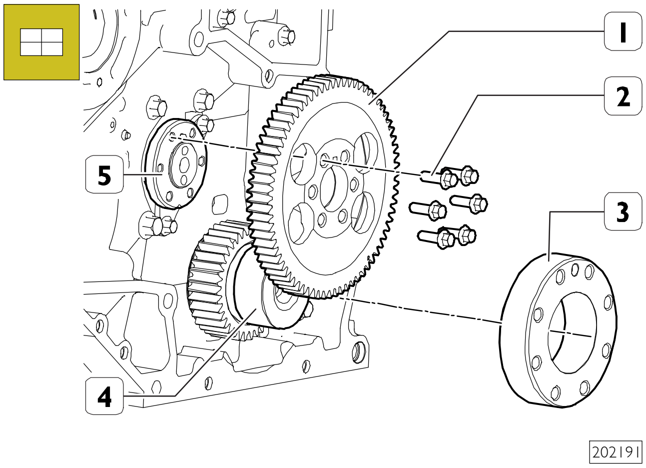
Camshaft gear refitting

Figure 232



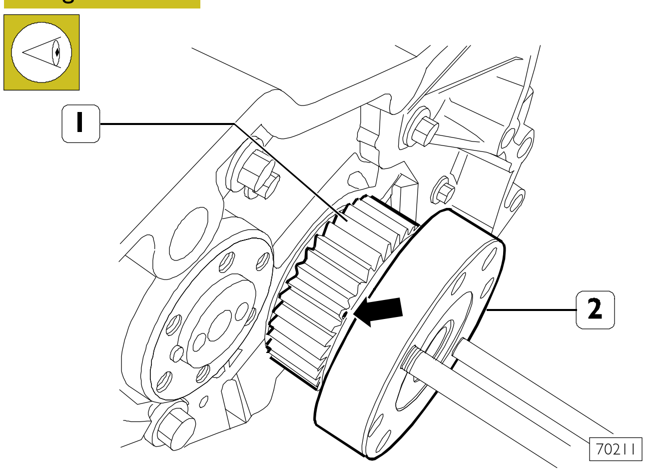
❑ Position the gear (1) on the camshaft (5).

❑ Screw in the screws (2) without tightening them.

❑ Position the collar (3) on the crankshaft (4).

Timing procedure

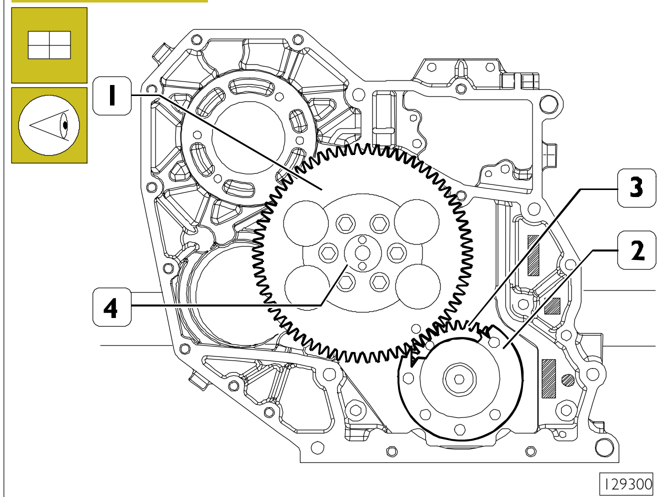
Figure 233



❑ Use a felt-tip pen to highlight the drive gear tooth (1) fitted on the crankshaft (2) with a chamfer (→) on its side for timing.

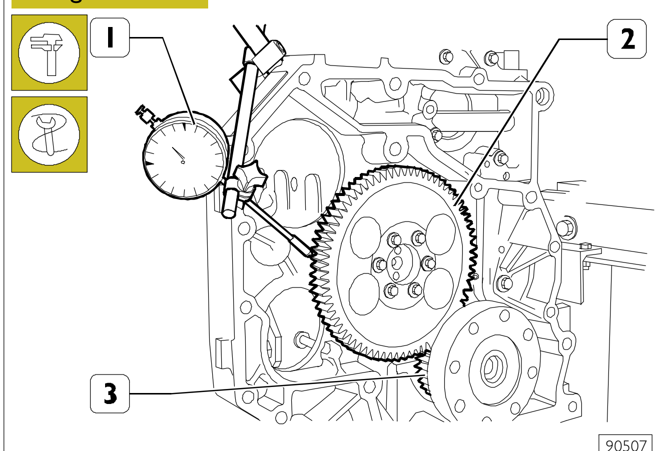
NOTE Screw in the two pins to facilitate crankshaft rotation.

Figure 234



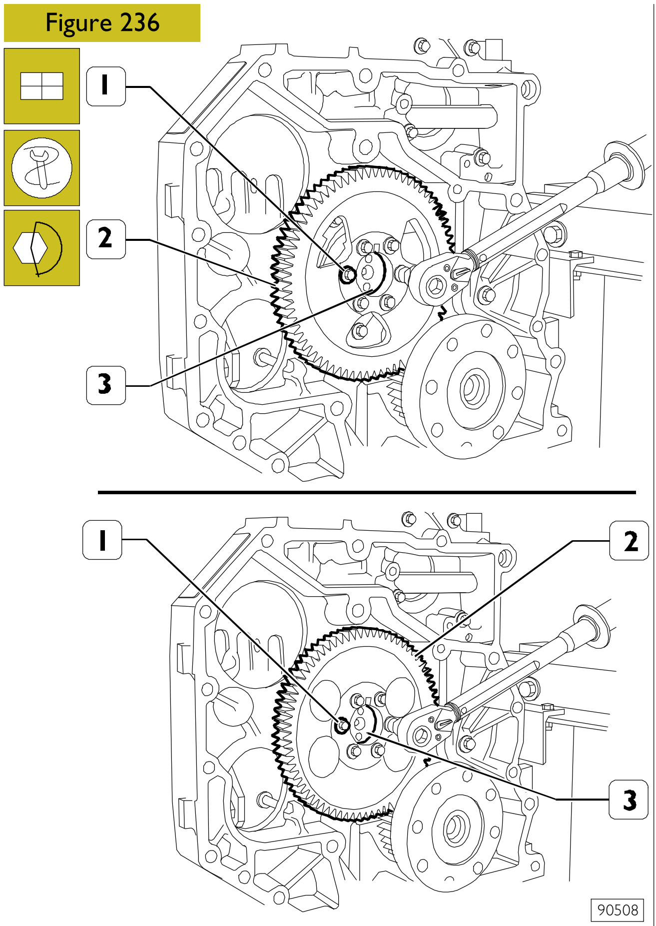
❑ Align the crankshaft (2) and the camshaft (4) so that when the driven gear (1) is mounted onto the latter, the sign stamped on the gear (1) coincides with the bevel gear tooth (3).

Figure 235



❑ Set the dial gauge 99395604 (1) on the timing gear (2) and check that the clearance between the gears (2) and (3) is between 0.076 and 0.280 mm.

Figure 236

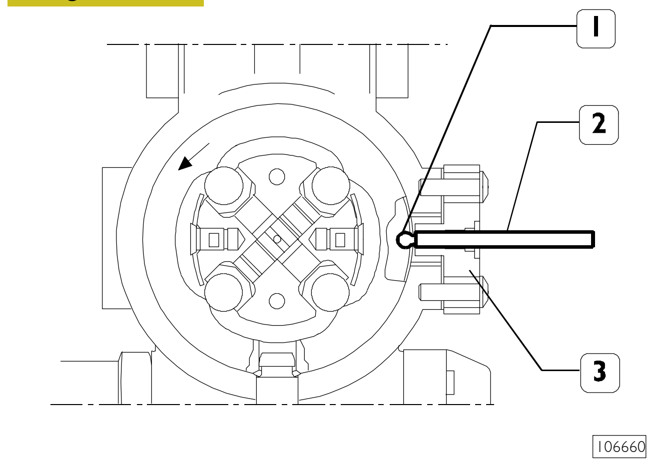


❑ Tighten the screws (1) fixing the gear (2) to the camshaft (3) using torque wrench 99389829.

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25	36 ± 2 Nm

Check correct setting of rotating feed pump

Figure 237



1. Slot on hydraulic rotor hub - 2. Synchronisation pin 99365196 - 3. Plate.

The synchronisation pin 99365196 (2) has been designed for use in the event that the rotor shaft has been accidentally released.

The correct pump/engine synchronisation is obtained when synchronisation pin 99365196 (2), inserted into the hole in the plate (3), engages in the slot (1) on the outside of the hydraulic rotor hub.

Therefore:

❑ Remove the screw plug (3) at the centre of the plate.

❑ Insert synchronisation pin (1) 99365196 into the hole in the plate (3).
The synchronized position is obtained when the synchronisation pin (2) is inserted in the slot on the hydraulic rotor hub.

❑ Lock the drive shaft in the correct position using the screw (1, Figure 240).

❑ Remove the synchronisation pin and fit the screw plug of the plate (3).

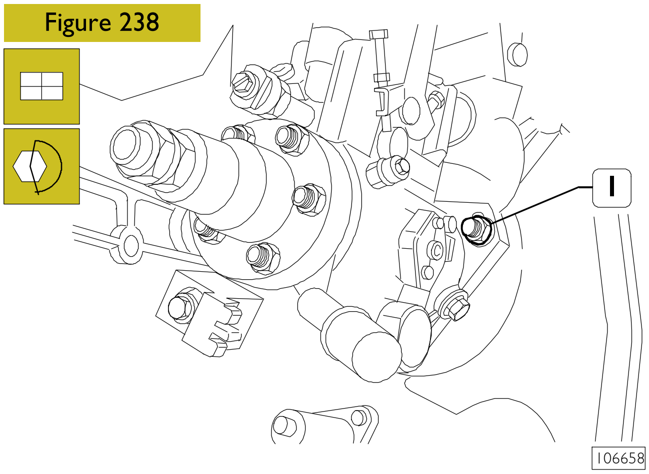
❑ Tighten the plug to a torque of 2.3 ÷ 3.4 Nm.

Ref.	No.	Screws description	Tightening torques
(3)	1	Plug M14x1.5	2.9 ± 0.5 Nm

NOTE Support the pump drive gear to prevent interference or sticking when the timing gears rotate.

Injection pump refitting

Figure 238



When fitting the feed pump on the engine, the conditions of the T.D.C at the 1st cylinder at the end of the compression stroke must be met.

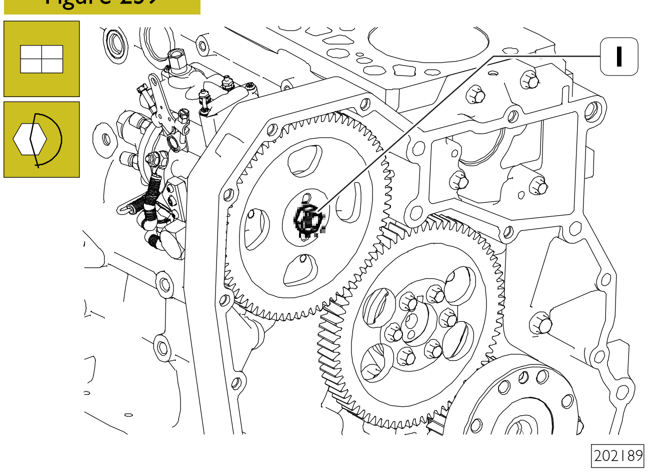
- Fit the preset pump into its seat on the engine, fitting the shaft into the hole of the gear (without key).
- Screw in the fastening nuts (1) locking the pump flange at the centre of the slot.

NOTE The gasket removed during pump disassembly must not be reused.

Always use original spare parts.

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M8x1.25	24 ± 4 Nm

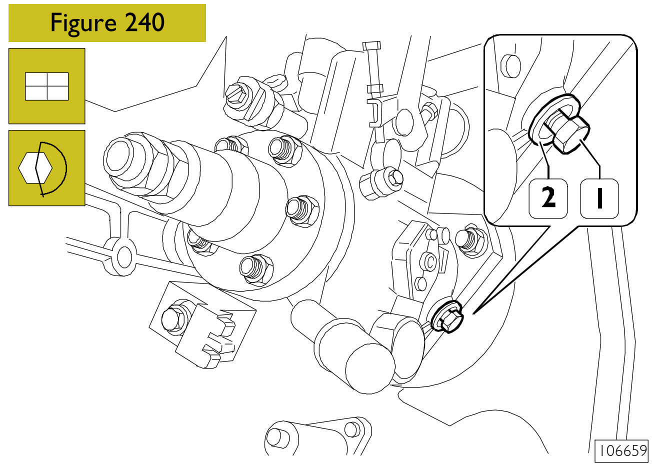
Figure 239



- On the side of the timing gear, fit the washer and tighten the nut (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M14x1.5	90 ± 5 Nm

Figure 240



- Tighten the screw (1) locking the pump spindle.
- Remove tool 99360339 of locking/rotation of flywheel.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M14x1.5	12.15 ± 0.125 Nm

Refitting engine flywheel housing

Figure 241

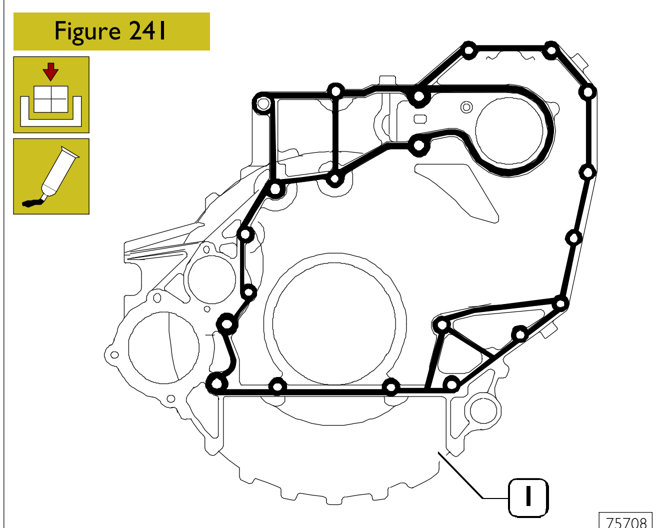
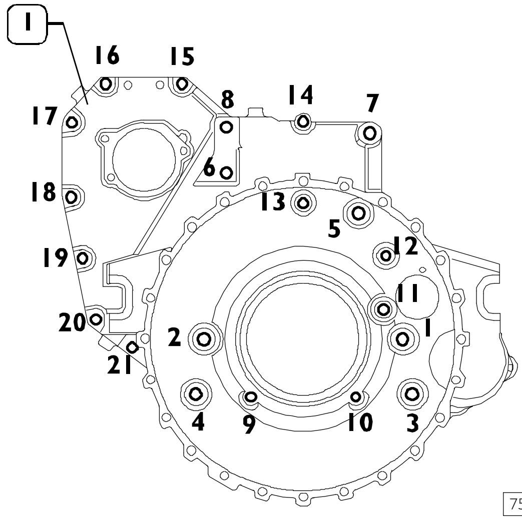


DIAGRAM OF AREA FOR APPLYING LOCTITE 5999 SEALANT

Perfect seal is only obtained by cleaning accurately the surface to seal.
Smear the case with LOCTITE 5999 to obtain a bead of few mm diameter.
Application must be uniform (no lumps), without any air bubbles, thin areas or gaps.
Any flaws must be corrected in as short a time as possible.
Avoid using too much material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging.
The joints must be assembled within 10 minutes after applying the sealant.

Figure 242



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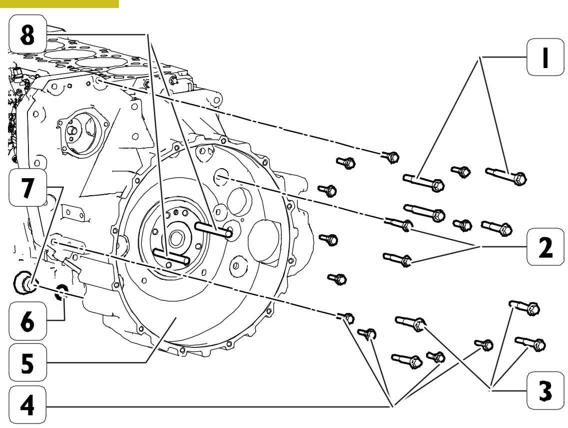
TIGHTENING SEQUENCE DIAGRAM OF FLYWHEEL HOUSING FASTENING SCREWS

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Figure 243

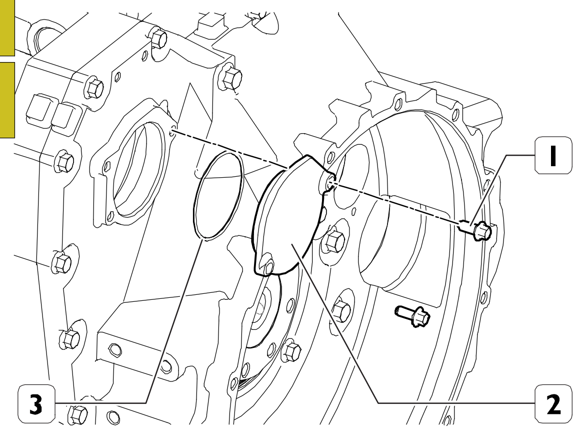


202187

- Position the flywheel housing (5) in the relative seat.
- Insert the gasket (6) and male (7).
- Tighten the screws (1, 2, 3 and 4).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	85 ± 5 Nm
(2)	2	Screw M8x20	-
(3)	5	Screw M10x1.5	49 ± 5 Nm
(4)	11	Screw	-

Figure 244



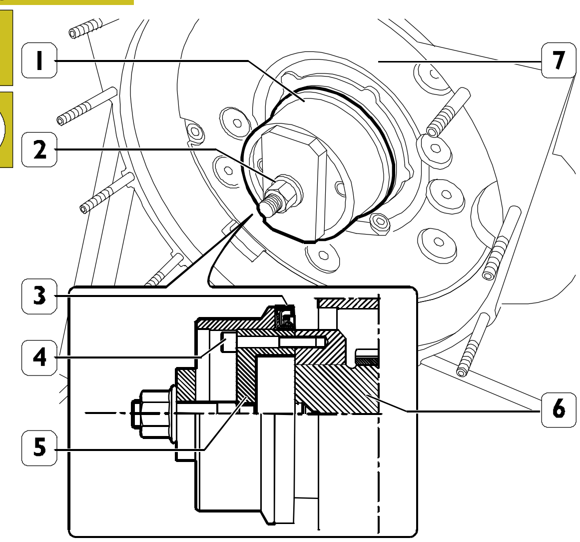
202186

- Fit the toroidal gasket (3).
- Position the cover (2).
- Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1	24 ± 4 Nm

Refitting engine flywheel

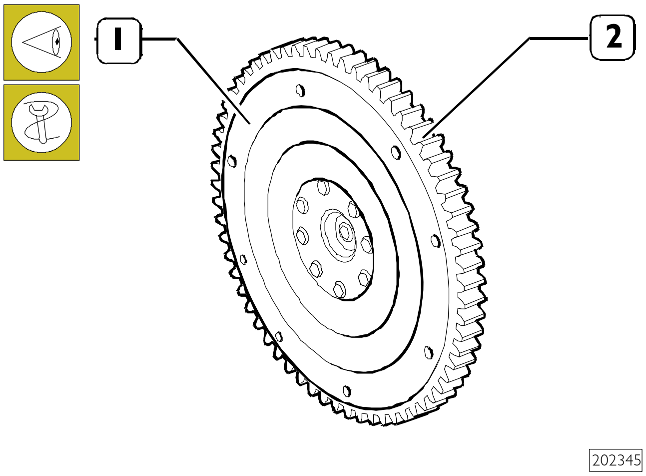
Figure 245



000901t

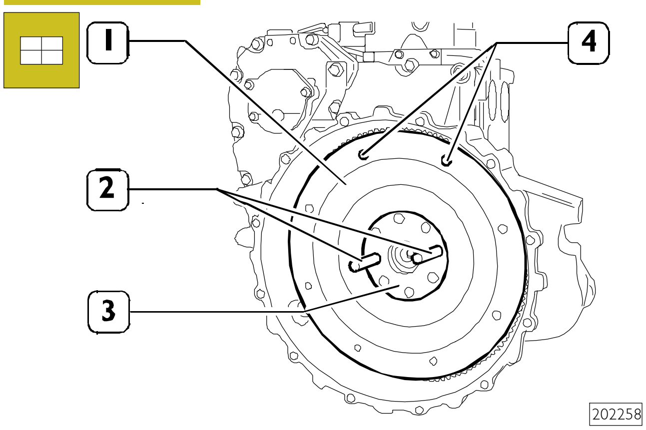
- Apply the tool 99346253 part (5) to the rear crankshaft tang (6), secure it by screws (4) and fit the new sealing ring (3).
- Position part (1) on part (5), fit the nut (2) until the seal ring (3) has fitted completely into flywheel housing (7).

Figure 246



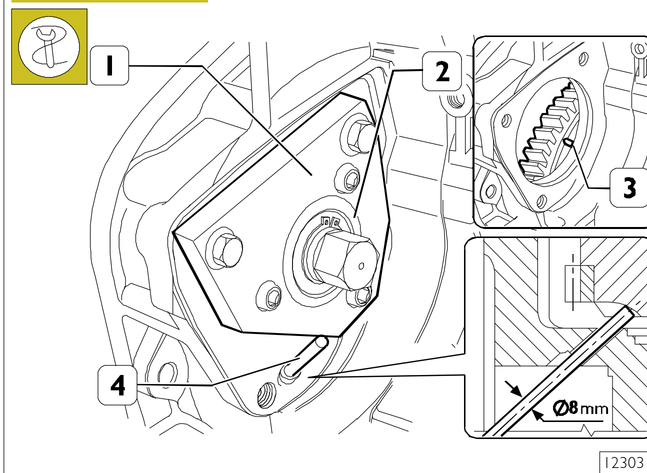
- Check the clutch plate working surface (1) and turn it if scored.
- Check the condition of the ring gear teeth (2). If cracks or excessive wear of the teeth are found, remove it from the engine flywheel (1) with a generic driver and install the new one, previously heated to a temperature of 150° C for 15 to 20 minutes; chamfering on ring gear inside diameter shall be facing the flywheel.

Figure 247



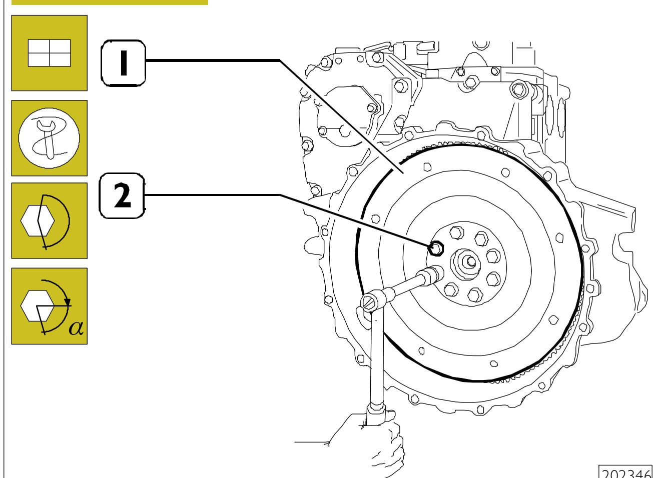
- Screw in two pull hooks or eyebolts in the flywheel (1) using the holes (4).
- Using a hoist, move the flywheel towards its seat inside the flywheel housing.
- Screw in two pins (2) of a suitable length into the shaft holes (3) and using them as a guide, fit the engine flywheel (1) positioning it correctly in the flywheel housing.

Figure 248



- Apply the tool 99360339 (1) to the flywheel housing to stop the rotation of the flywheel (3), using an adjustable wrench on the nut (2) and a pin (4).

Figure 249



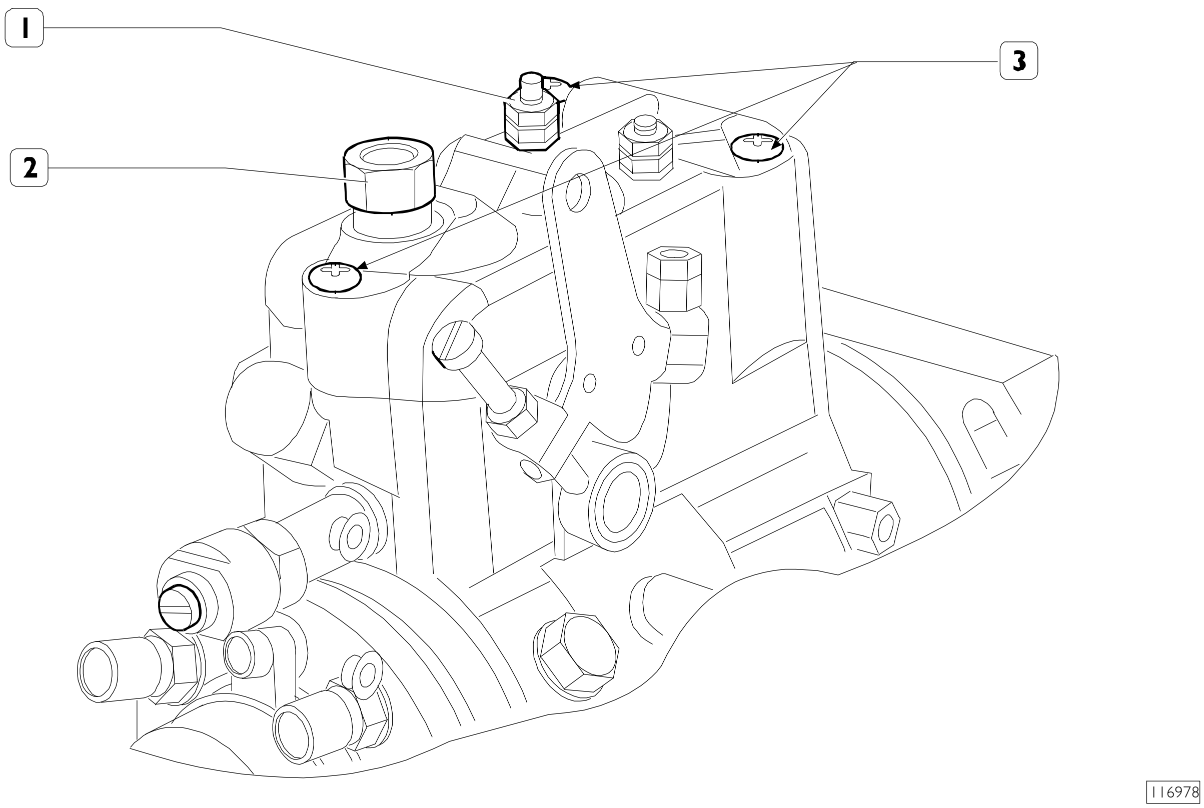
- Tighten the screws (2) securing the engine flywheel (1).

Ref.	No.	Screws description	Tightening torques
(2)	8	Screw M12x1.25x30 1st phase 2nd phase	 50 ± 5 Nm 60°

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

PROCEDURE FOR MOUNTING THE ”ADC100” ELECTRONIC ACTUATOR ON STANADYNE SERIES ”D” INJECTION PUMPS“

Figure 250



Before proceeding to the removal of the cover of the injection pump and its replacement with the electronic actuator, it is important to clean the external part of the pump, if necessary, using solvents.

This prevents contamination to the inside of the pump.

- Disconnect the wire of the solenoid valve to stop the terminal (1) on the cover of the pump, taking care to insulate it.
- Remove the fuel return pipe from the fitting (2).
- Remove the three screws (3) from the pump cover. The screws will be replaced with the screws supplied with the ADC100 actuator.
- Remove the injection pump cover making sure that no dirt gets into the inside of the pump.
- Remove the fuel return pipe fitting (2) and the gasket from the injection pump cover. Keep the fitting (2) and the gasket as they have to be fitted on the electronic actuator.

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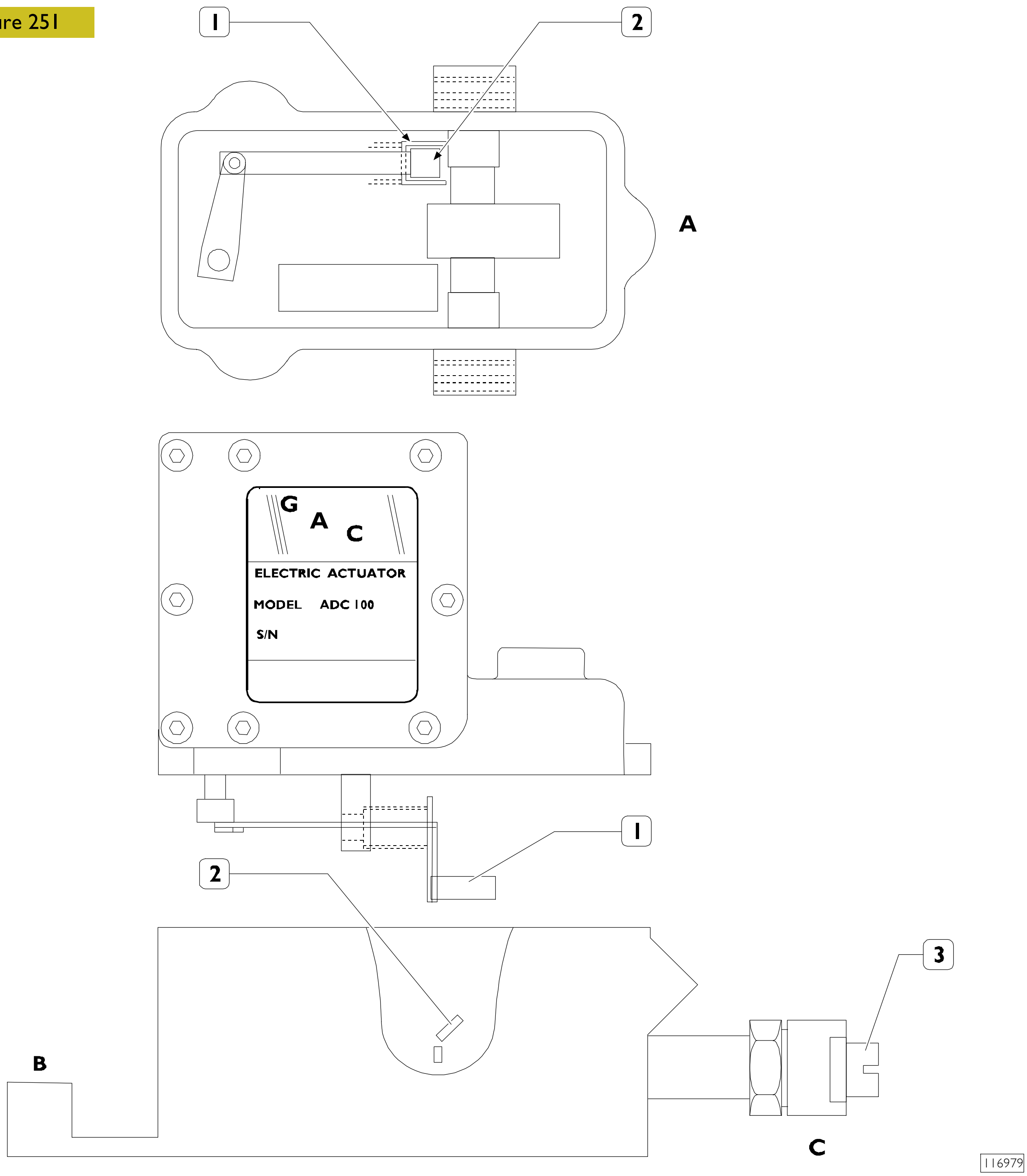
Figure 251



A. View from the top of the open injection pump - B. In front (guard side) - G Behind (injector side)
I. Electronic actuator "U" hook - 2. Injection pump lever - 3. Droop adjustment screw

Actuator assembly

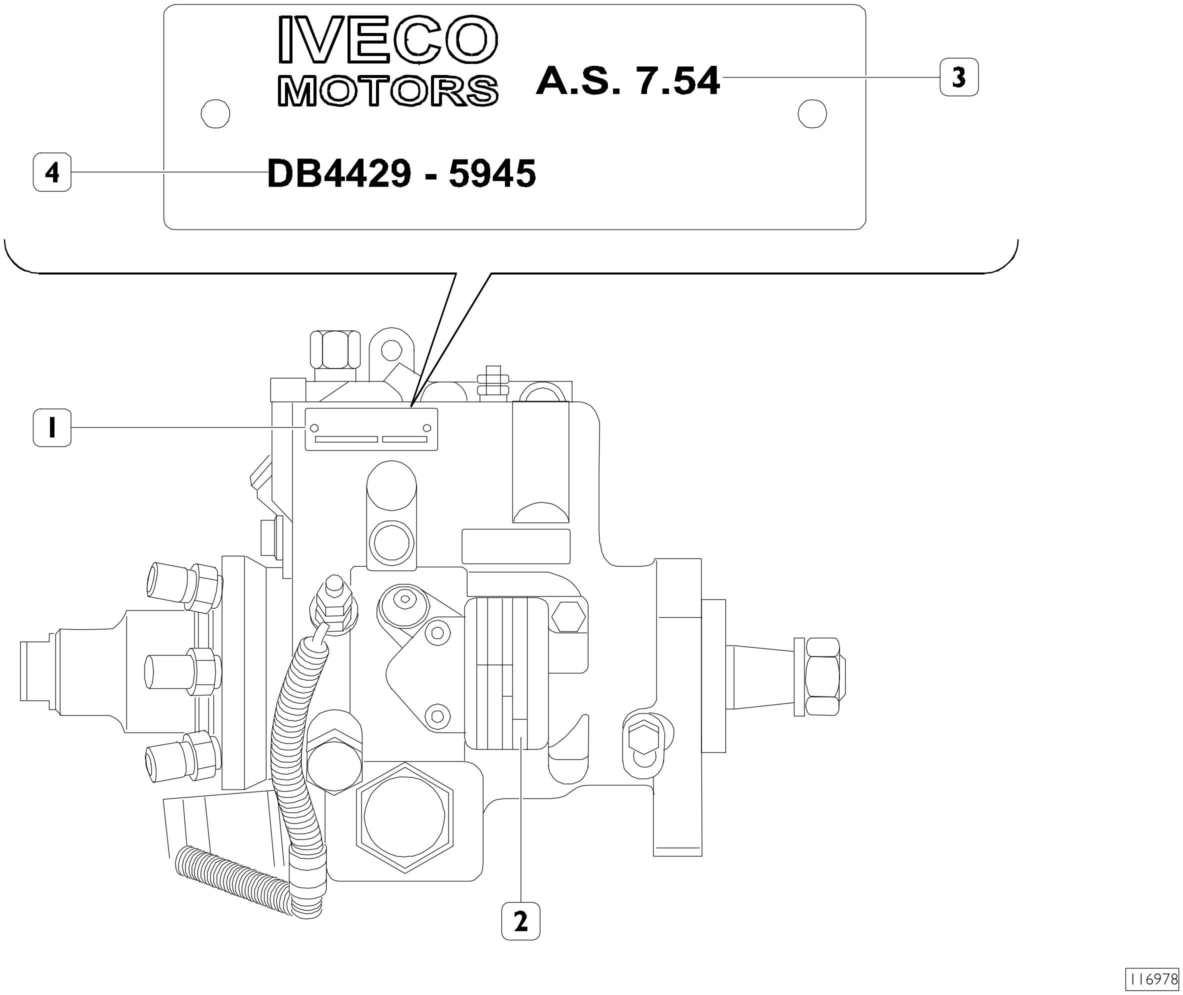
- Refit the fitting to the fuel return pipe and the original seal of the pump cover, on the electronic actuator ADC100.
- Position the electronic actuator on the injection pump with the higher part inclined slightly upwards.
- Let the electronic actuator slide towards the rear of the pump (injector side) until the "U" hook (1) of the actuator engages with the injection pump lever (2).

NOTE Incorrect couplings between the hook (1) of the actuator and lever (2) of the injection pump can cause engine overspeed conditions.

- Tighten the ADC100 actuator to the injection pump using the screws supplied with the actuator.
- Reconnect the fuel return pipe at the fitting located on the actuator.

PROCEDURE FOR MOUNTING THE "ADC100" ELECTRONIC ACTUATOR ON STANADYNE SERIES "D" INJECTION PUMPS"

Figure 252



Based on the specific operational requirements of the engine, it is possible to vary the adjustment of the Stanadyne pump so as to obtain a different operating frequency:

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

The procedures needed in order to carry out the following adjustments will be described:

- Switching from 50 Hz to 60 Hz and vice versa.
- Stabilisation of rotation speed.

NOTE If only the Stanadyne (2) identification plate is present, this means that the injection pump is calibrated at 50 Hz.

In the event of a factory modification of calibration from 50 Hz to 60 Hz, FPT applies an identification plate (1).

The FPT plate (1) will show:

- the injection pump model (4);
- an identification code (3) for the specific application for injection pump calibration, for example: A.S. 7.54 identifies calibration at 1800 rpm - 60 Hz.

Switching from 50 Hz to 60 Hz

To switch from 50 Hz to 60 Hz first of all:

- identify the injection pump code on the Stanadyne identification plate (2).

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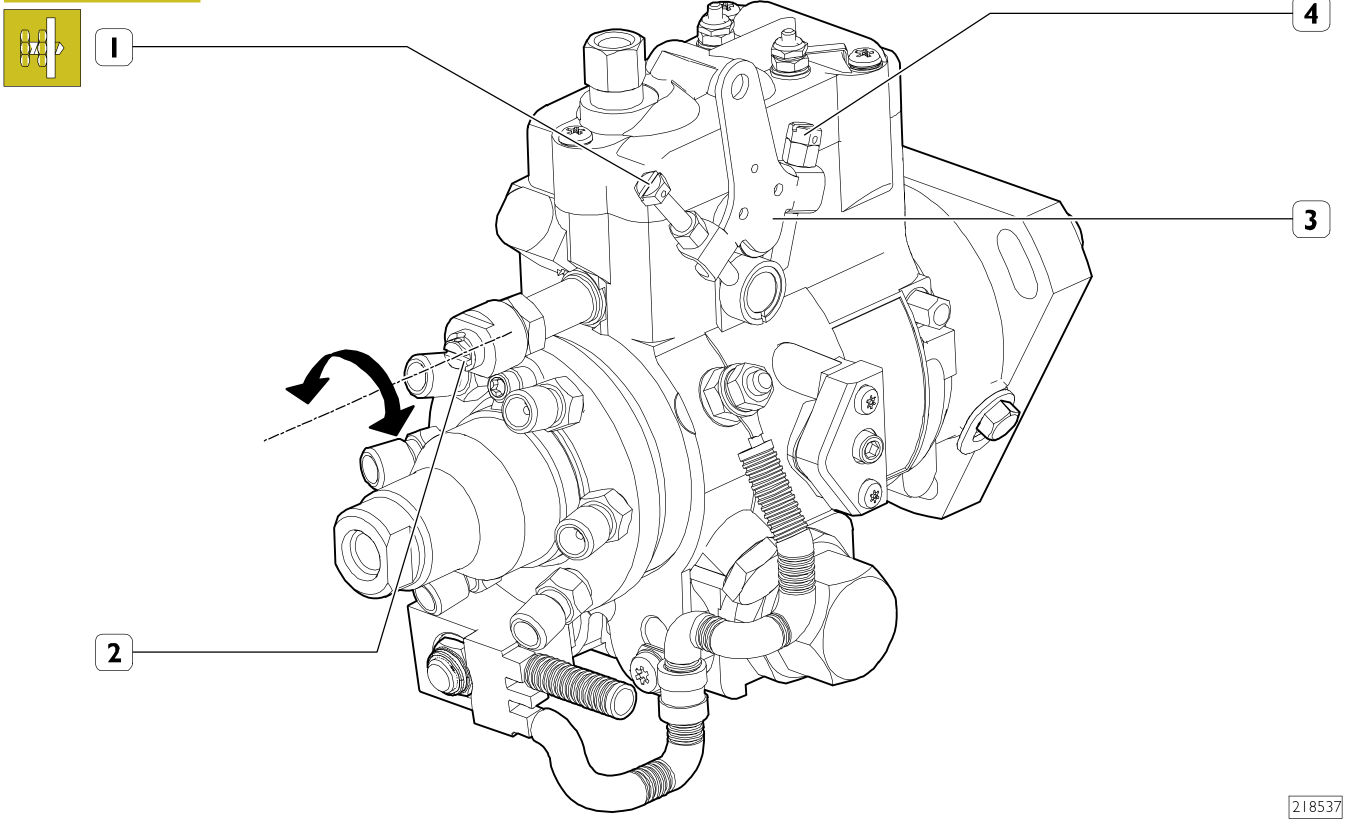
Figure 253



Injection pump type (Stanadyne identification plate)	Screw turns at 50 Hz from end of travel position (clockwise)	Screw turns at 60 Hz from end of travel position (clockwise)	Difference in turns 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 4629 - 6197			
DB 4429 - 5945	3	6	3
DB 4429 - 5954	2	8.5	6.5
DB 4429 - 5955	3	9	6

❑ Act the adjustment screw of the droopsetting (2), turning it clockwise in the number of turns shown in the table in the figure, starting from the position in which the screw is located.

NOTE If in doubt, you can always unscrew the adjusting screw of the droopsetting (2) counter-clockwise until you reach the end - do not force further, to prevent damage to the control system.

At this stage, and always with reference to the table in the figure, turn the droop setting screw (2) clockwise by the number of turns indicated for the 60 Hz setting from the end of stroke position.

If, for example, for an engine having a fuel injection pump with code DB 4429 - 5945, originally calibrated at 50 Hz, you want to switch to 60 Hz, which is sufficient to act on the adjustment screw of the droopsetting (2) by rotating it 3 turns clockwise from its position, start the engine, loosen the adjustment screw for maximum speed and accelerate with the accelerator lever until it gets to an idle rotation speed of 62 Hz (1860 rpm).

❑ Then adjust the minimum speed screw (4) to block the accelerator lever in the new position and block both adjustment screws using the specific counternuts (1 and 4) tightening torque 3.5 - 4 Nm).

NOTE The idling speed adjustment screw (4) does not allow achievement of the minimum in the "classic" sense of the term, as the injection pump regulator imposes a higher rotation speed since it is the injection pump for the generator unit.

Switching from 60 Hz to 50 Hz

To switch from a speed of 60 Hz to a speed of 50 Hz, operate similarly to what was seen above, remembering to turn the adjustment screw for the droopsetting (2, Figure 253), rotating it 3 turns counterclockwise from the position in which it is located for operation at 60 Hz.

Stabilisation of rotation speed

In case of instability of the engine rotation speed, turn the adjustment screw for the droopsetting (2, Figure 253) slightly rotating it clockwise/counterclockwise until the rotation speed of the engine is stabilised.

Identification plate

Figure 254

116976

If you do not find the FPT plate because it is an engine with the injection pump calibrated at 50 Hz, it is necessary to apply the plate to the area shown as in SENZA CODICE stamping it as shown in the figure.

Blank identification plates can be ordered through our Spare Parts Service.

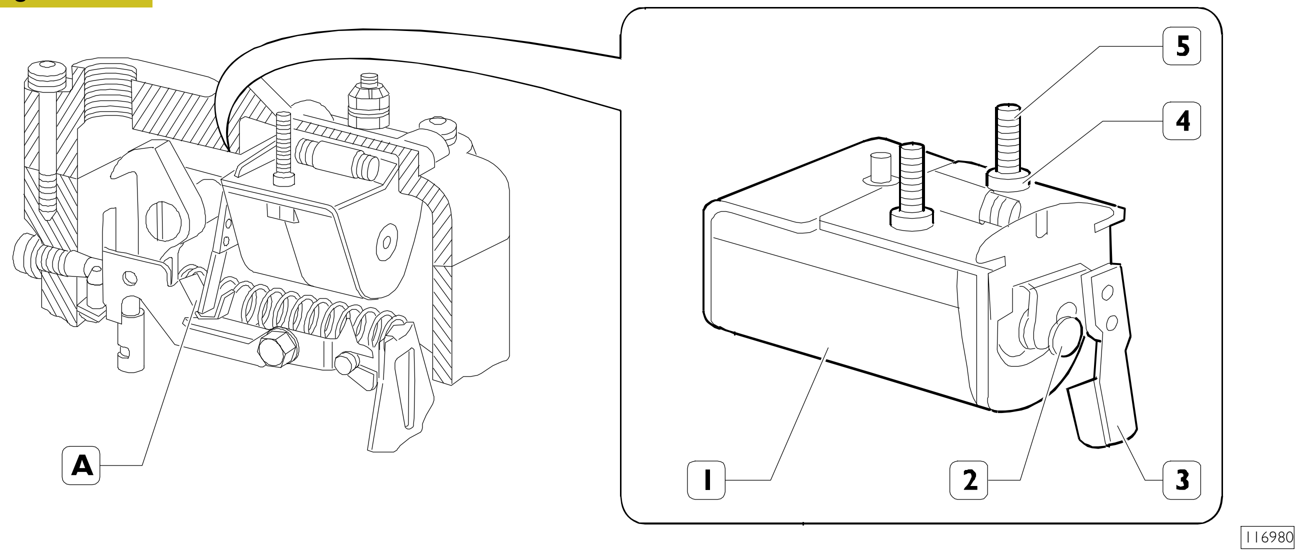
Figure 255

116977

If the FPT plate is already present on the injection pump, mark the new identification suffix for the new calibration and cancel the identification of the previous calibration, as shown in the figure.

REPLACING ELECTROSTOP AND COLD ADVANCE SOLENOID ON STANADYNE PUMP

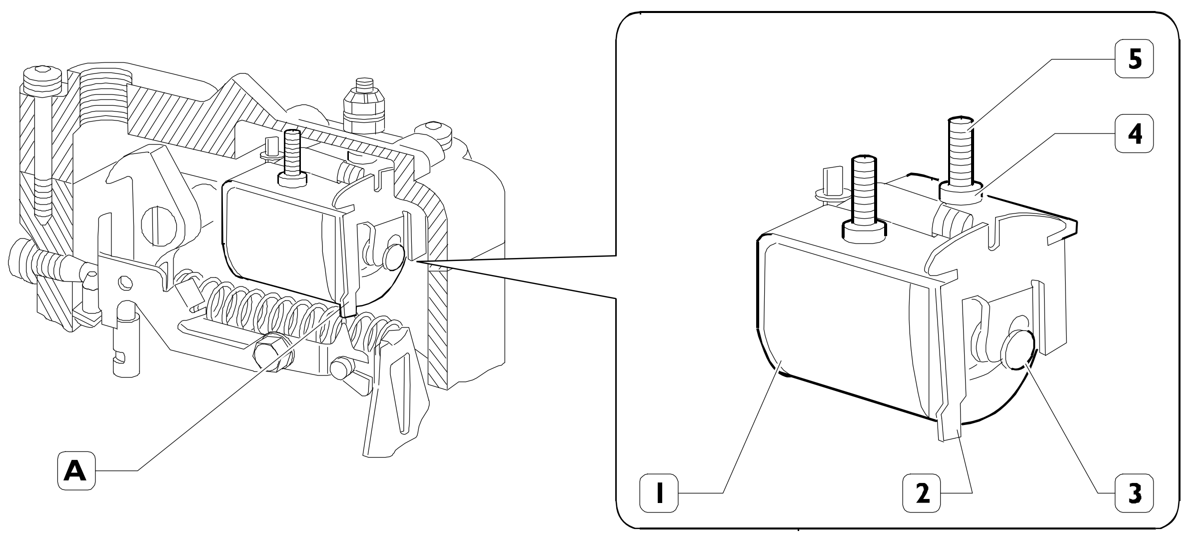
Figure 256



ETR

A. Position of the electrostop arm - 1. Encapsulated coil - 2. Electrostop mobile core - 3. Electrostop arm - 4. Insulator - 5. Solenoid terminals

Figure 257



ETSO

116981

A. Position of the electrostop arm - 1. Encapsulated coil - 2. Electrostop arm - 3. Electrostop mobile core 4. Insulator - 5. Solenoid terminals

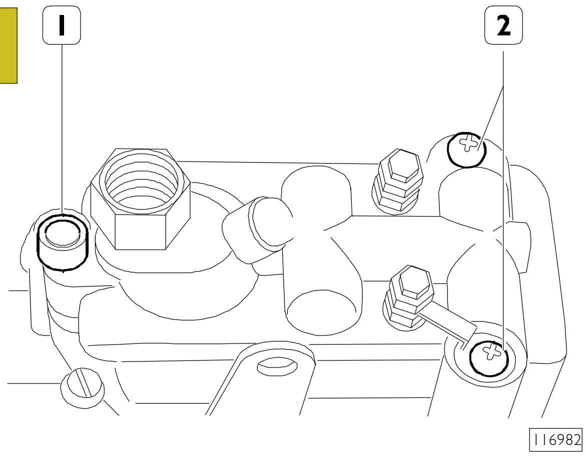
Two types of electrostops can be used on Stanadyne injection pumps:

- ETR (Energize To Run - stop in dexcitation)
- ETSO (Energize To Stop - stop in excitation).

In the figure, please note the different assembly position of the electrostop arm according to the ETR - ETSO functions.

Electrostop replacement

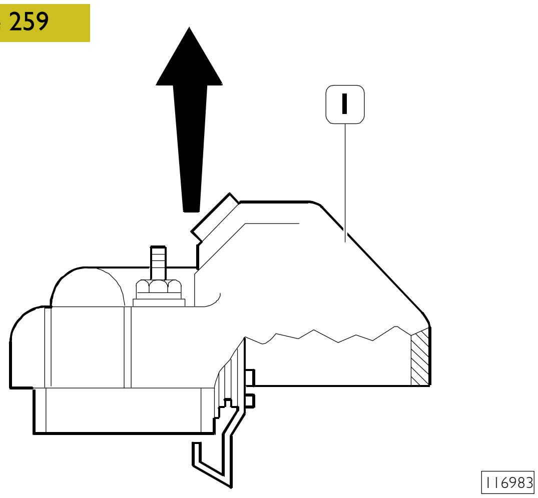
Figure 258



To replace the electrostop, remove the cover of the injection pump by loosening and removing the three fixing screws (1 and 2) of the cover and their washers.

NOTE The screw (1) has a seal which can be broken in order for it to be removed.

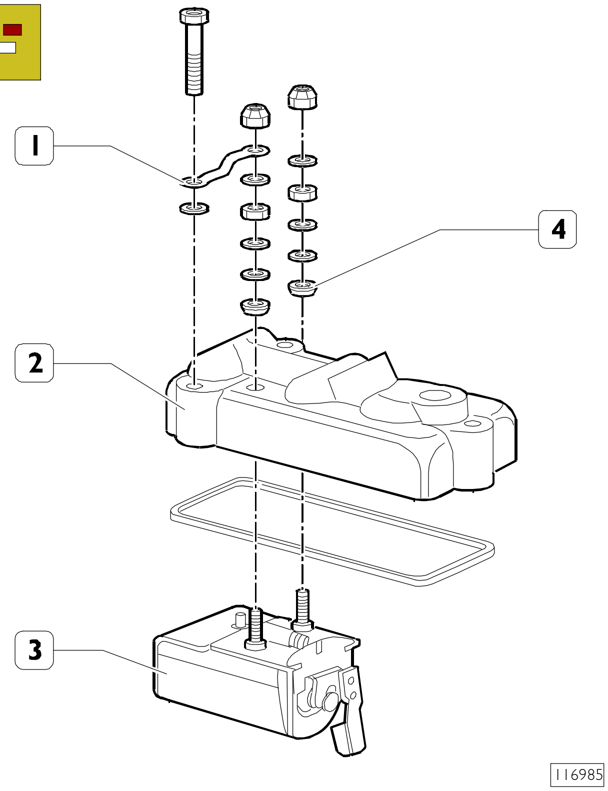
Figure 259



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

Be careful that nothing falls into the injection pump.

Figure 260



Remove the electrostop (3) from the cover (2).

NOTE Since the terminals of the component are electrically insulated from the cover, keep in mind the order of assembly of the nuts, washers and the components for the electrical connection of the electrostop terminals; one end is grounded through an appropriate element (1).

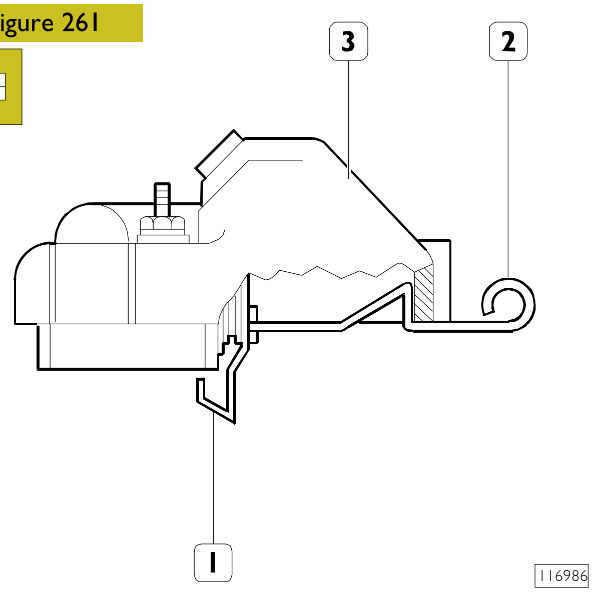
Pay attention to the position of the isolating element (4).

Fit the new electrostop on the injection pump cover using the specific kit:

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

In addition to the electrostop indicated, the kit contains all that is required for its assembling. The nuts securing the electrostop (3) to the cover (2) must be tightened to a torque of 1.1 ÷ 1.7 Nm.

Figure 261



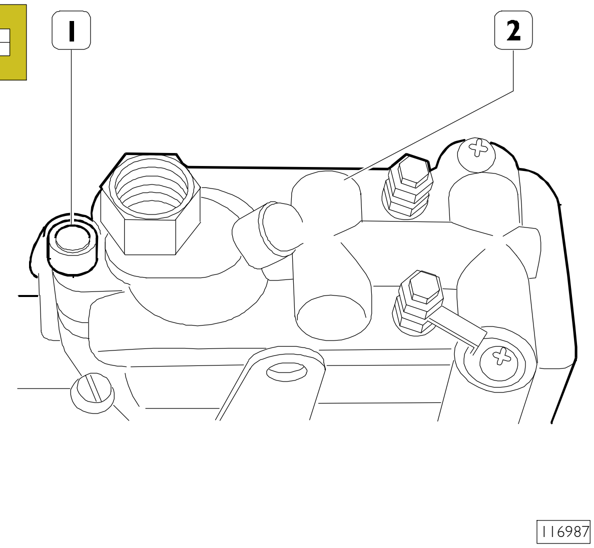
In the electrostop **ETR** kit there is the joint tool (1) which must be used to position the electrostop arm (2) correctly and to reassemble the cover on the injection pump.

NOTE This tool (1) allows to keep the arm of the electrostop (2) in the excitation position, allowing the correct assembling of the cover and avoiding dangerous overrevving when the engine is started.

Once the cover is put on the assembling seat and the relative screws are pointed on the injection pump, rotate the joint tool (1) and then pull it carefully from underneath the cover (3), making sure not to move or damage the gasket of the cover.

Proceed then to the closing of the screws, with a torque of 4.0 ÷ 5.1 Nm, being careful not damage the connecting element to ground of the electrostop terminal.

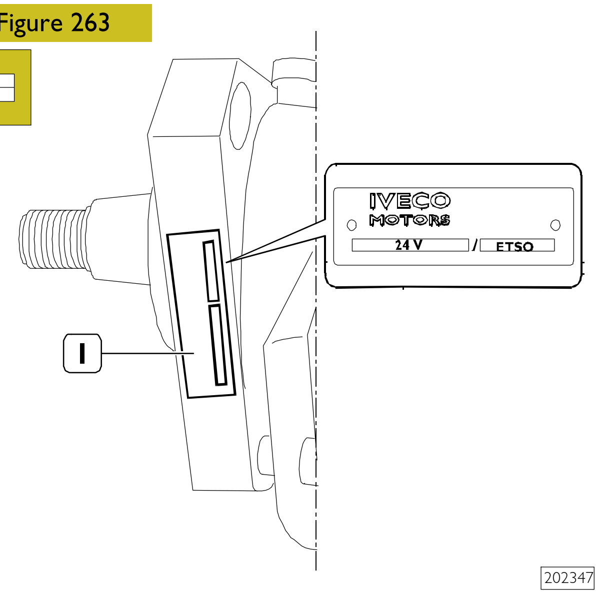
Figure 262



The placement of the cover (2) should be carried out in the reverse order to what is described about the disassembly, taking care that it fits perfectly on the mounting seat, without forcing (obviously for the ETR variant the pump cover will fit on the mounting seat only after the removal of the retaining tool).

NOTE A blue seal is included in the kit which has to be positioned on the screw (1), after the cover reassembling operations (2): when new, the seal is not blue.

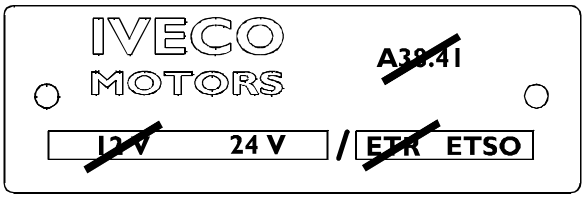
Figure 263



If replacing the electrostop originally supplied and changing the characteristics (different voltage, ETR rather than ETSO, etc.), you must apply a plate (1) identifying the area indicated.

The plate must be stamped (1) as shown in detail in the figure.

Figure 264



116989

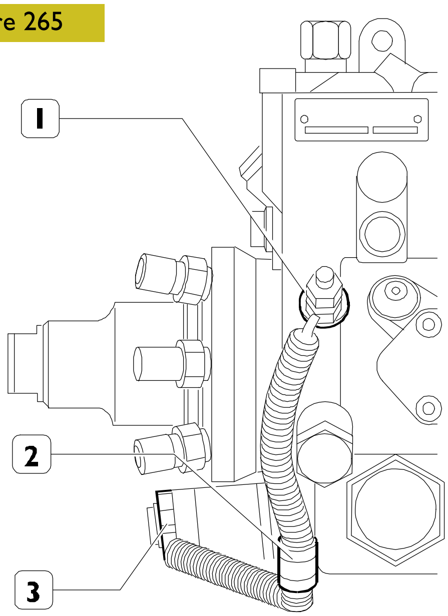
In some cases the plate may already be present.

If the plate is already present, the old identification elements must be cancelled and the new ones marked as shown in the example in the figure.

The electrostop and the cold advance solenoid on this injection pump must have the same operating voltage, therefore in the event of a modification in the engine operating voltage, they must both be replaced.

Cold advance solenoid replacement

Figure 265

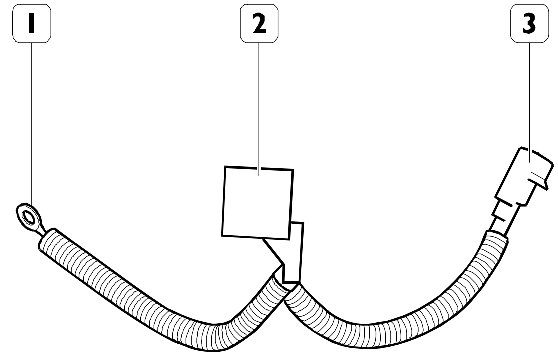


116990

Disconnect the connector from the temperature sensor on the engine, and then remove the fastening nut of the socket clamp (2) and the nut (1) of the cable assembly end, in order to release the cold advance solenoid cables.

Remove the fastening nut (3) from the solenoid and remove the component from its seat.

Figure 266



116991

Insert the connection lug (1) in the cable unit terminal and screw in the nut (1, Figure 265), tightening it to a torque of 5.7 ÷ 6.8 Nm.

Position the anchor clamp (2, Figure 265) and tighten the retaining nut to a torque of 7.9 ÷ 9.0 Nm.

Place solenoid in the seat and screw in the self-locking nut, supplied with the replacement kit, tightening it to a torque of 5.1 ÷ 5.7 Nm.

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

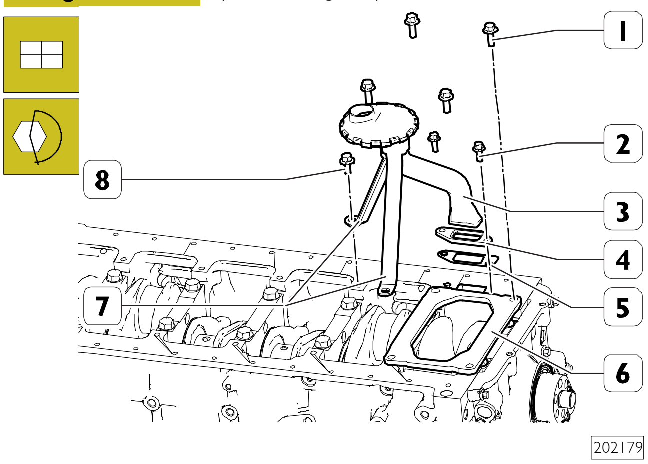
- BLACK for the 12V device
- RED: for the 24V device

The electrostop and the cold advance solenoid on this injection pump must have the same operating voltage, therefore in the event of a modification in the engine operating voltage, they must both be replaced.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE BOTTOM)

Sound-proofing plate and suction strainer refitting

Figure 267 (For all engines)

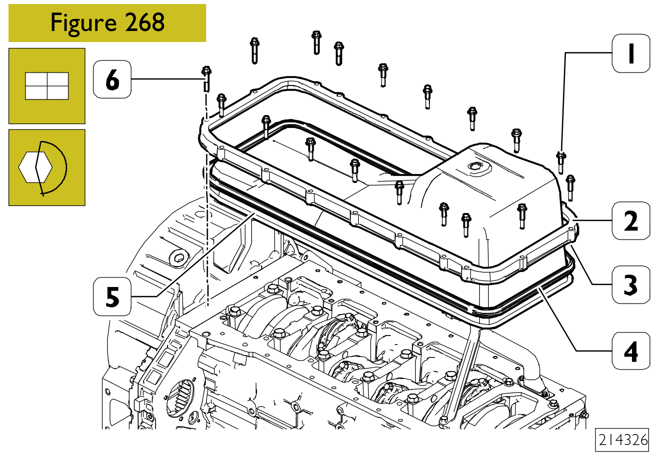


- Overturn the engine
- Position the sound-proofing plate (6).
- Position the gasket (5).
- Position the flange (4).
- Position the suction strainer (3) in the relative seat, together with the support brackets (7).
- Tighten the screws (8).
- Tighten the bracket (7) fastening screws (1).
- Tighten the suction strainer (3) fastening screws (2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M10x1.55	43 ± 5 Nm
(2)	2	Screw M8x1.25x20	24 ± 4 Nm
(8)	1	M8x1.25x45	24 ± 4 Nm

Oil sump refitting

Figure 268

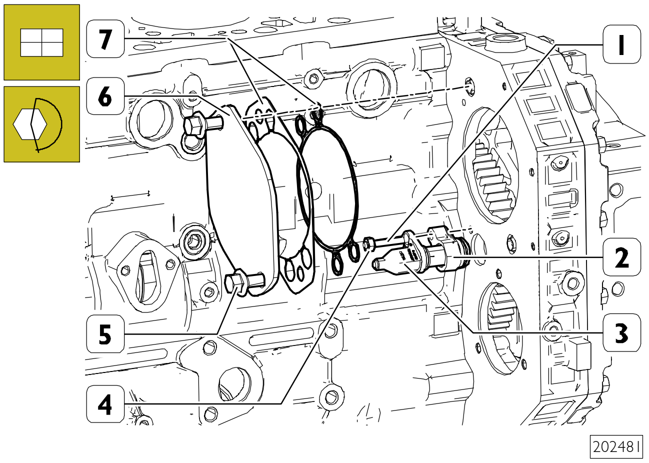


- Position the oil sump (3) in the relative seat.
- Position the new gasket (4) and the spacer (2).
- Tighten the screws (1 and 6) fixing the oil sump (3).
- Overturn the engine.

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M8x1.25x20	24 ± 4 Nm
(2)	4	Screw M8x1.25x45	24 ± 4 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

Figure 269 NEF67 TE1F/TE2F engine



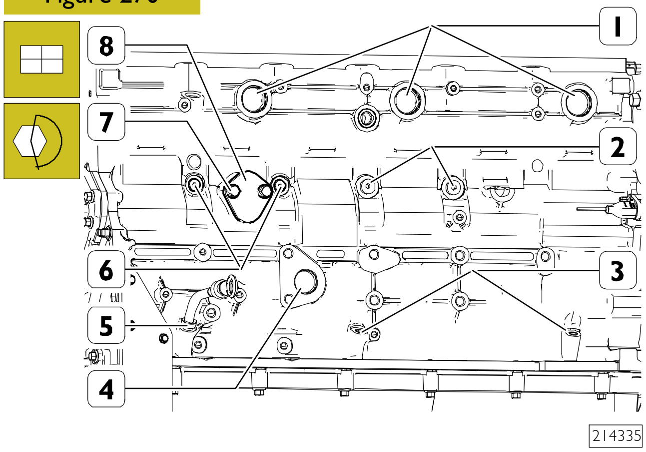
☞ NEF67 TM1F engine Page 103

- ❑ Position the support (2) and tighten the stud (1).
- ❑ Insert the camshaft rpm sensor (3) and tighten the nut (4).
- ❑ Insert the gaskets (7).
- ❑ Fit the control socket cover (6) and tighten the screws (5).

Ref.	No.	Screws description	Tightening torques
(1)	1	Stud M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	2	Screw. M12x25	65 ± 10 Nm

Oil level dipstick refitting

Figure 270

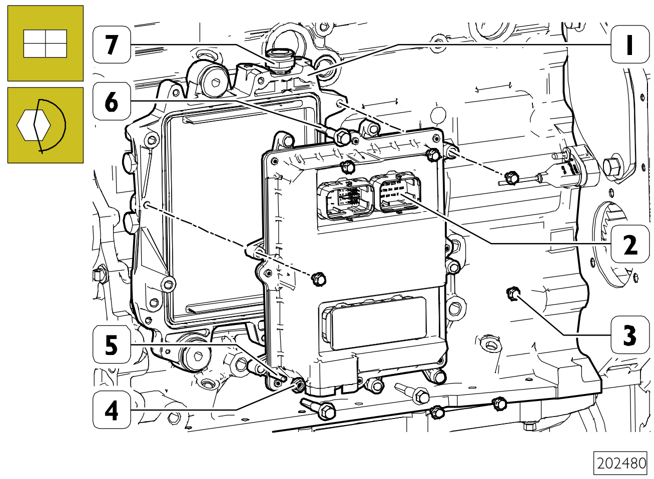


- ❑ Position the cover (8), together with the gasket, and tighten the screws (7).
- ❑ Insert the oil level dipstick (5).
- ❑ Tighten the plugs (2 and 6).
- ❑ Insert the core plugs (1, 3 and 4).

Ref.	No.	Screws description	Tightening torques
(2)	2	Plug M14x1.5	10 ± 2 Nm
(6)	2	Plug M10x1	10 ± 2 Nm
(7)	2	Screw M8x1.25,20	65 ± 10 Nm

Electronic Control Unit Refitting

Figure 271



- ❑ Position the support (1).
- ❑ Tighten the Voss fitting (7).
- ❑ Position the control unit (2) in its seat.
- ❑ Tighten the stud (5) and the corresponding nut (4).
- ❑ Tighten the screws (3 and 6).

Ref.	No.	Screws description	Tightening torques
(3)	7	Screw M6x1x30	10 ± 2 Nm
(4)	1	Nut M6x1	10 ± 2 Nm
(5)	1	Stud M6x1x25	10 ± 2 Nm
(6)	3	Screw M8x1.25x45	24 ± 4 Nm
(7)	1	Connector M12x1.25	12 ± 2 Nm

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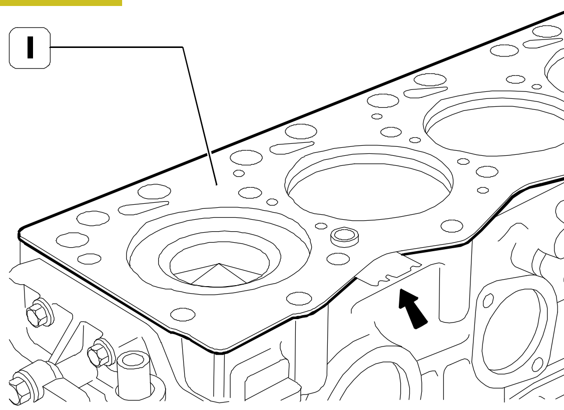
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE TOP)
Cylinder head assembly refitting

Figure 272



87759

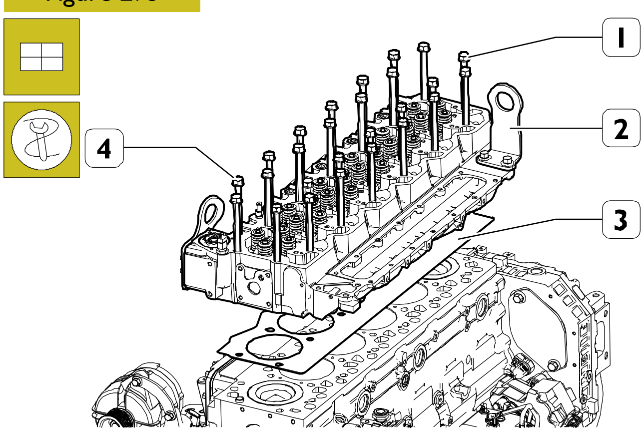
- Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

Figure 273



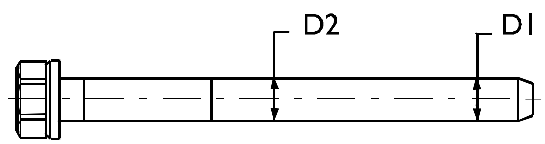
214305

- Using tool 99360595, by means of the lifting eyelets (3), position the cylinder head assembly, together with all the elements relating to timing:
  - Intake valves;
  - Exhaust valve;
  - Valve springs;
  - Plates;
  - Cotters.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

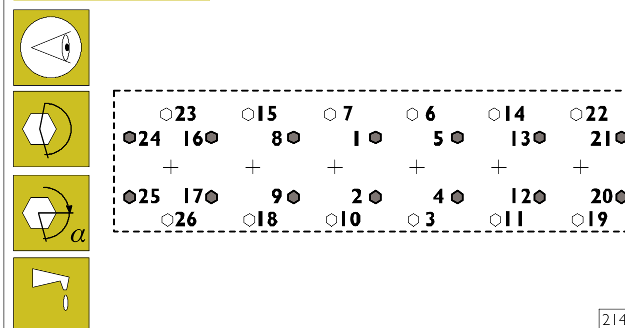
if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



75703

Figure 274



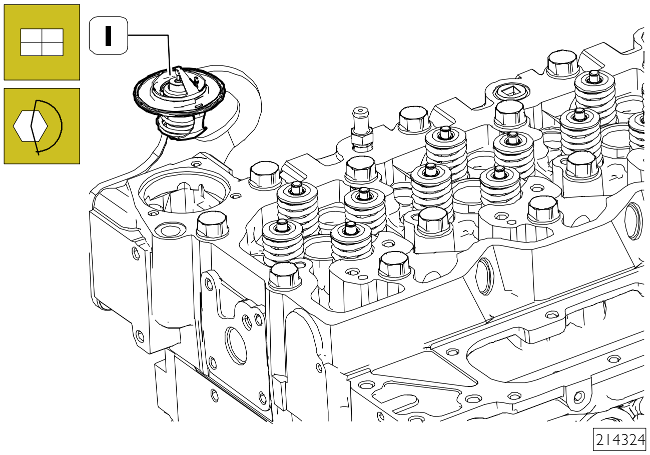
214306

- Lubricate the screws and fit them on the cylinder head.
- The screws must be tightened in a "stitch" pattern starting from the centre screws and moving outward.

Ref.	No.	Screws description	Tightening torques
(1)	14	Screw M12x1.75x150 1st phase 2nd phase	 55 ± 5 Nm 90° + 90°
(4)	12	Screw M12x1.75x130 1st phase 2nd phase	 35 ± 5 Nm 90° + 90°

Thermostat unit refitting

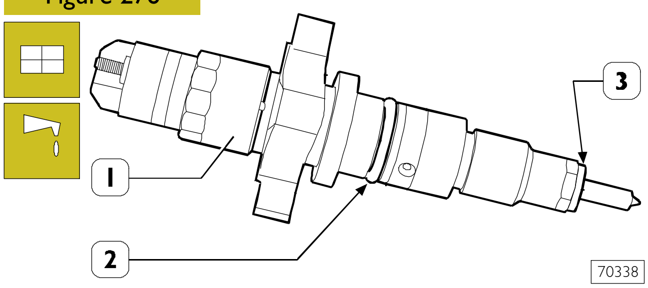
Figure 275



- Insert the thermostat assembly (1) into the relative seat.

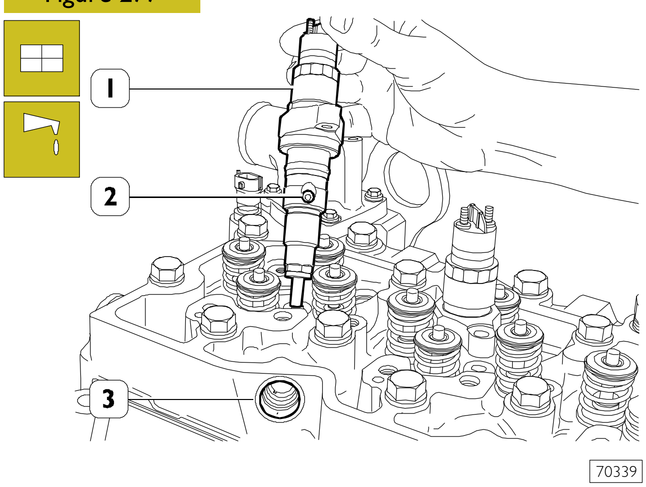
Refitting electro-injectors

Figure 276



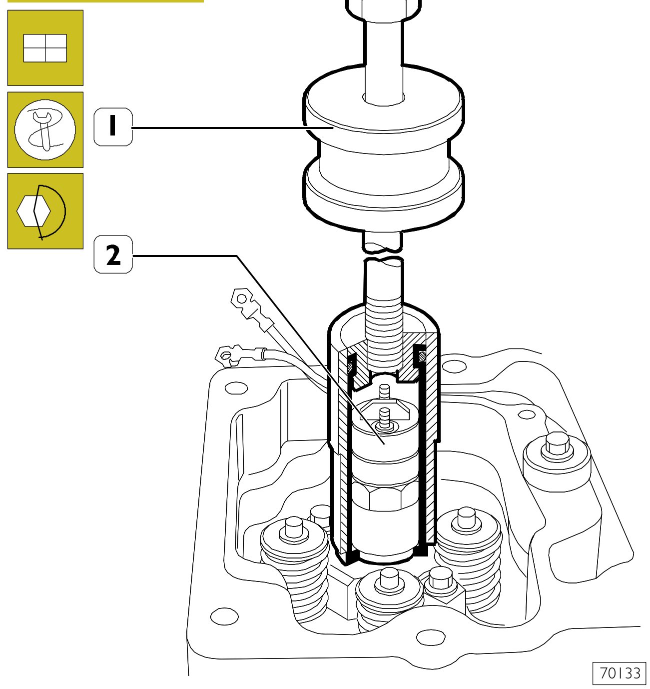
- Fit a new seal ring (2) lubricated with vaseline and a new sealing washer (3) on electro-injector (1).

Figure 277



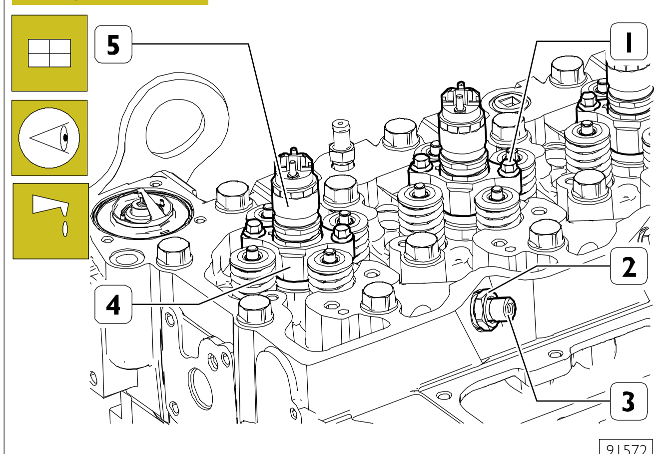
- Fit injectors (1) on the cylinder head seats, directed so that the fuel inlet hole (2) is facing the fuel manifold seat (3) side.

Figure 278



- Use tool 99342101 (1) to fit the electro-injector (2) into its seat.
- Screw injector fastening screws without tightening them.

Figure 279



- Fit a new sealing ring (3), lubricated with petroleum jelly on the fuel manifold (2) and place it in the seat of the cylinder head so that the positioning balls (5) coincide with the position of the housing (4).

NOTE Disassembled fuel manifolds (2) must not be used again, but however replaced with other new ones. The fuel manifolds (2) in the engines have 2 positioning balls.

- Screw the fastening nuts (2, Figure 280) without locking them.

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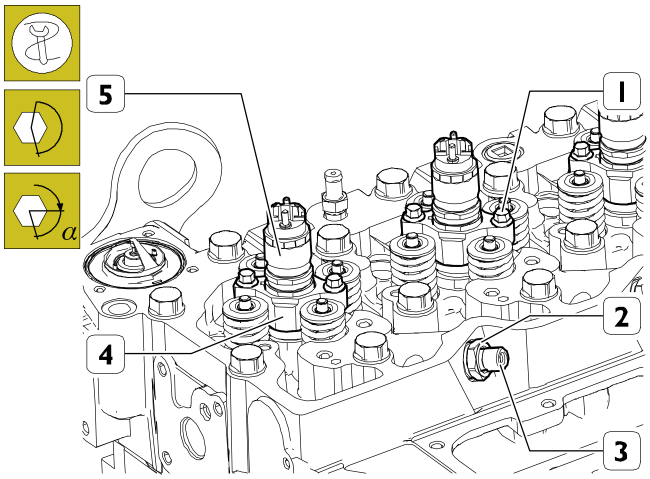
NOTE During this operation, the electro-injector (1) shall be moved so that the manifold (2, Figure 277) is properly inserted into the fuel intake hole (2, Figure 279).

Figure 280



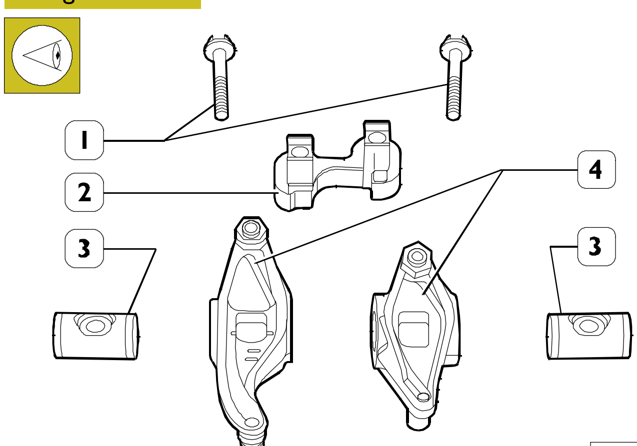
214323

- ❑ With coupling torque wrench 99389829 and gauges for angular tightening 99395216, gradually and alternately tighten the fastening screws (1).
- ❑ Tighten the nuts (2) fixing the manifolds (3).

Ref.	No.	Screws description	Tightening torques
(1)	8	Screw M6x1x35	
		1st phase	3.5 ± 0.18 Nm
		2nd phase	7.5 ± 2.5 Nm
		angle closure	25°+25°+25°
(2)	4	Ring nut M22x1.5	55 ± 5 Nm

Refitting rocker assembly

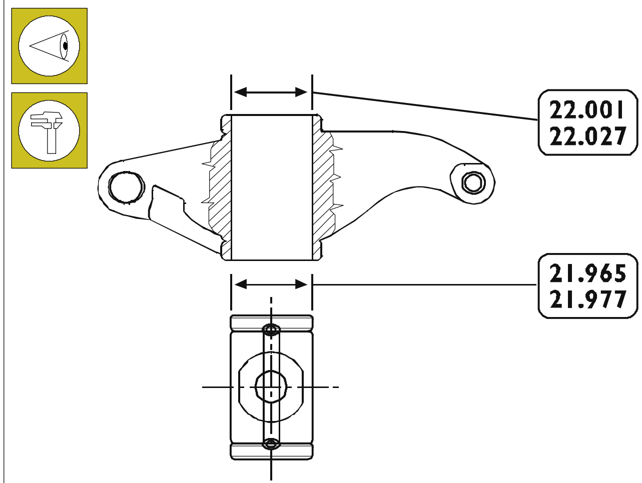
Figure 281



70343

ROCKER ASSEMBLY COMPONENTS:
1. Screws - 2. Support - 3. Shafts - 4. Rocker arms.

Figure 282

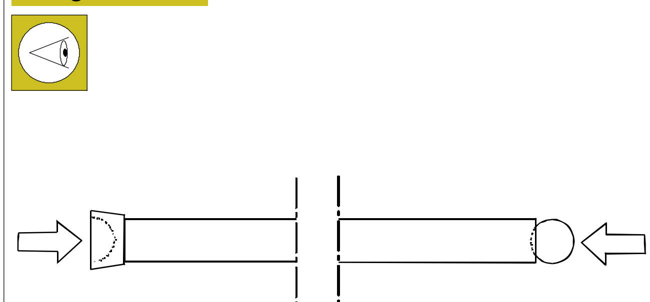


214258

SHAFT-ROCKER MAIN DATA

- ❑ Check that shaft/rocker arm surfaces are not excessively worn or damaged.

Figure 283

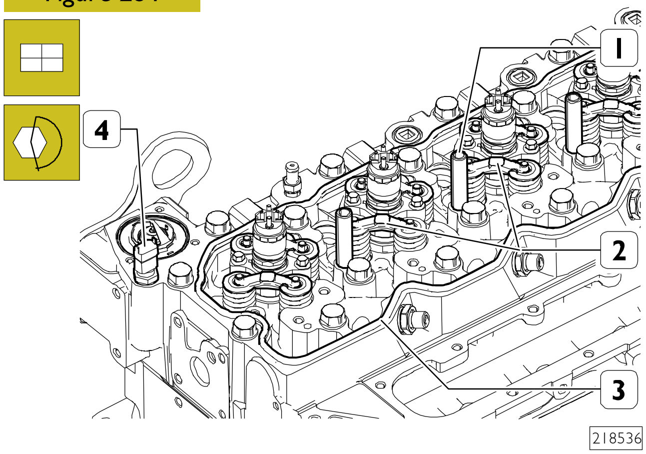


122587

Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them.

Intake and exhaust valve push rods are identical and are therefore interchangeable.

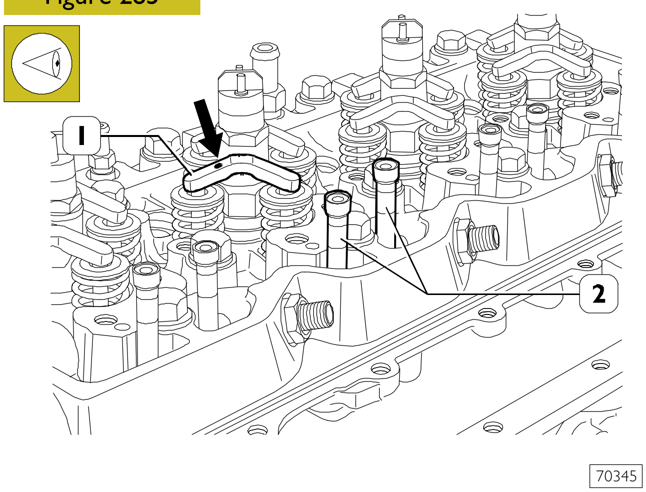
Figure 284



- Screw in the coolant temperature sensor (4).
- Insert the sheaths (5).
- Position the intake and exhaust crossbars (1).
- Insert the gasket (3).
- Insert the rocker arm control rods (2) together with the housing seats and the balls (3).

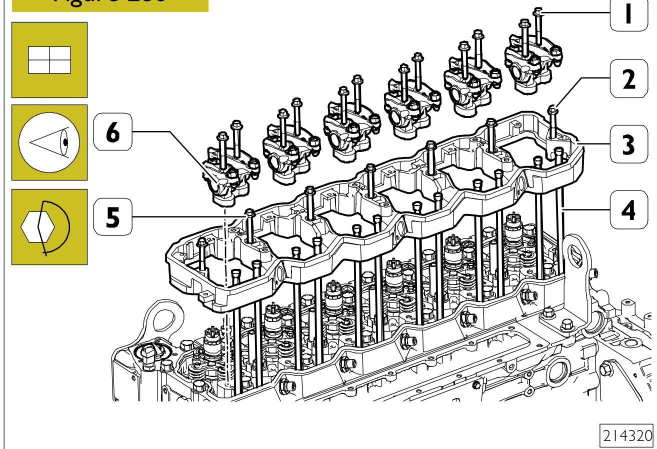
Ref.	No.	Screws description	Tightening torques
(4)	1	Sensor M14x1.5	24 ± 4 Nm

Figure 285



- Position bridges (1) on valves with marks (→) facing the exhaust manifold.

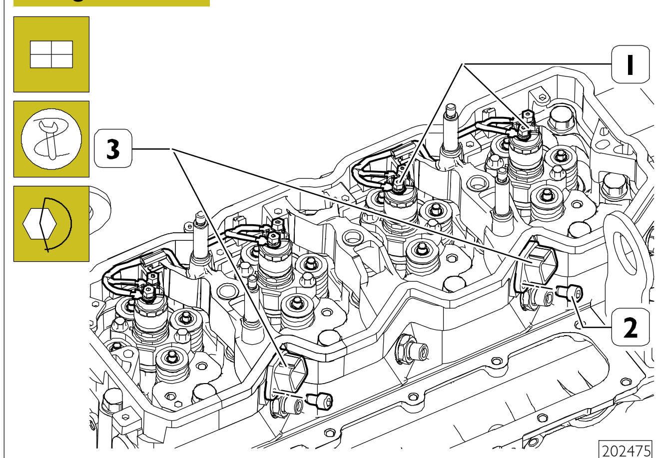
Figure 286



- Fit the rocker arm control rods (4) together with the seats and balls, and position the housing (3).
- Tighten the screws (2 and 5).
- Position the rocker arm units (6) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	12	Screw M8x1.25x55	36 ± 5 Nm
(2)	2	Screw M8x1.25x50	24 ± 4 Nm
(5)	5	Screw M8x1.25x70	24 ± 4 Nm

Figure 287

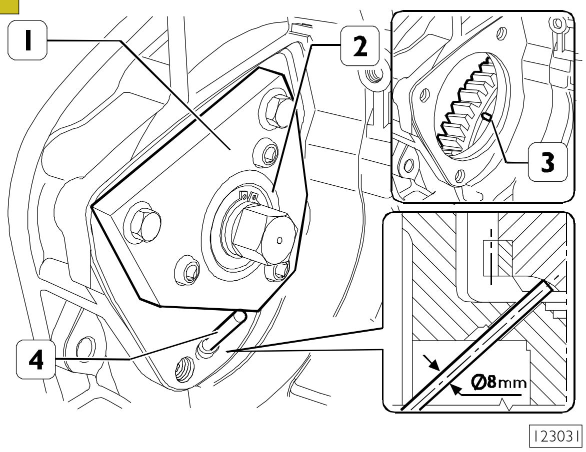


- Tighten the nuts (1) on the electro-injectors using torque wrench 99389834.
- Position the connectors (3) on the electro-injectors and tighten the screws (2).

Verify that tappet adjusters (1) are unscrewed to prevent their jamming on the rods (2, Figure E), when fitting the rocker arms unit.

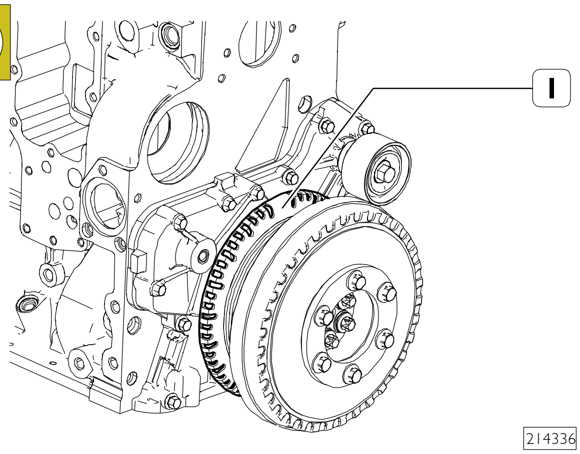
Ref.	No.	Screws description	Tightening torques
(1)	12	M4 nut	1.5 ± 0.25 Nm
(2)	2	Screw M6x1x16	10 ± 2 Nm

Figure 288



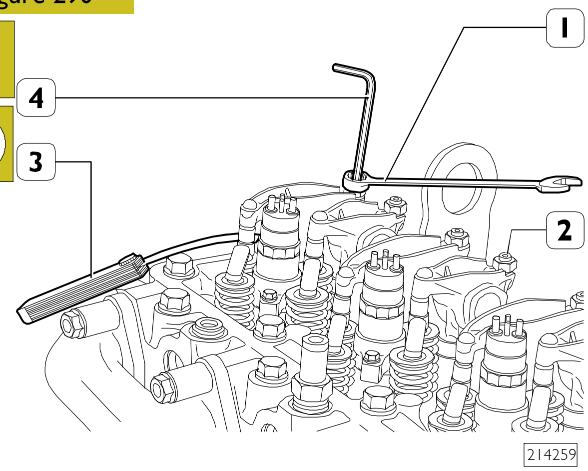
- ❑ Apply the tools 99360221 (1) and 99360222 (2) to the flywheel housing to stop the flywheel (3) rotation.
- ❑ Bring the 1st cylinder to the condition of TDC (top dead centre) at the end of compression by acting with an adjustable wrench on the tool 99360222 (2) and a pin (4).

Figure 289



- ❑ Make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis.

Figure 290



- ❑ Adjust the clearance between the rocker arms and valves using an Allen wrench (4), a box wrench (1) and feeler gauge (3).
- ❑ Tighten the nuts (2).

The clearance is:

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

NOTE In STAGE IIIA engines, due to the presence of the additional lobe for INTERNAL EGR, you cannot follow the procedure for adjusting the valve clearances which includes adjusting the clearance for all the valves by carrying out only 2 crankshaft placements.

Each cylinder must be controlled by bringing it to TDC (top dead centre) at end of compression and adjusting the clearance of both valves exclusively on the cylinder in question.

FIRING ORDER: 1 - 5 - 3 - 6 - 2 - 4

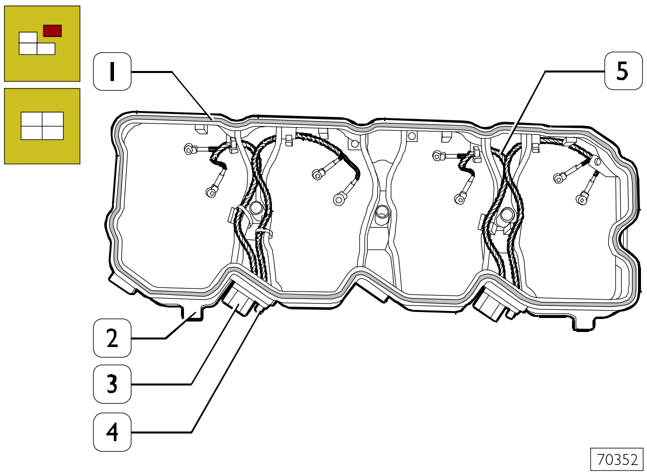
Start and rotation of crankshaft	Adjust clearance intake and exhaust valves - cylinder No.
1° at PMS	1
120°	5
120°	3
120°	6
120°	2
120°	4

Ref.	No.	Screws description	Tightening torques
(2)	8	Nut M8x1.25	24 ± 4 Nm

Remove tools 99360221 and 99360222, used to block flywheel rotation.

Refitting tappet covers

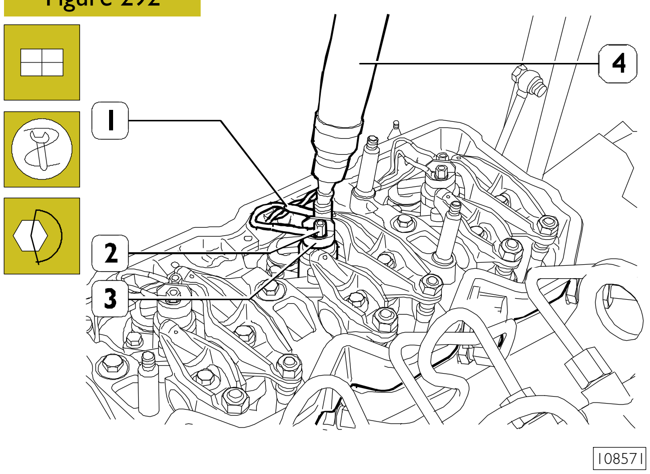
Figure 291



❑ Check electrical cable (5) conditions, replace if damaged by cutting the support (2) clamps and removing the screws (4) that secure it to the connections (3).

❑ Fit a new gasket (1) on the support (2).

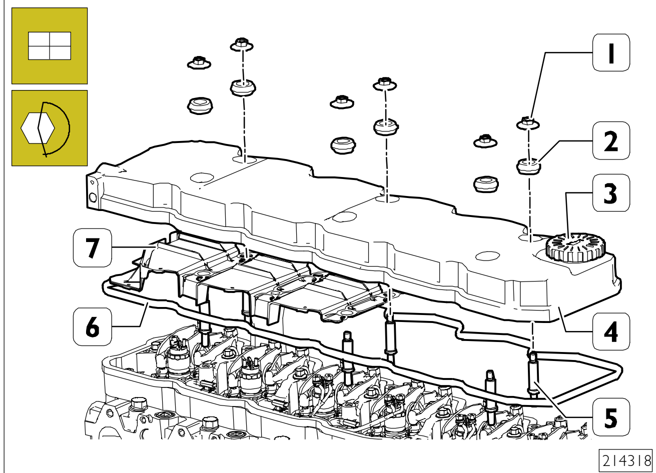
Figure 292



❑ Connect the electric cables (1) to the electro-injectors (3) and use the torque wrench 99389834 (4) to tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(1)	8	M4 nut	1.5 ± 0.125 Nm

Figure 293



❑ Tighten the double stem screws (5).

❑ Fit a new gasket (4) on the tappet cover (6).

❑ Position the sector (7) for oil vapour condensation.

❑ Position the tappet covers (4).

❑ Insert the elastic plugs (2) and tighten the flanged nuts (1).

❑ Close the oil filling cap (3).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M8x1.25	24 ± 4 Nm
(3)	1	Plug M38x3	-
(5)	4	Screw M8x1.25x17	24 ± 4 Nm

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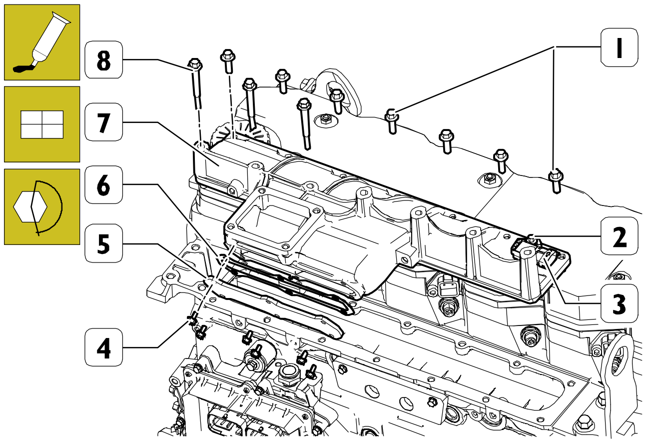
Refitting intake manifold

Figure 294



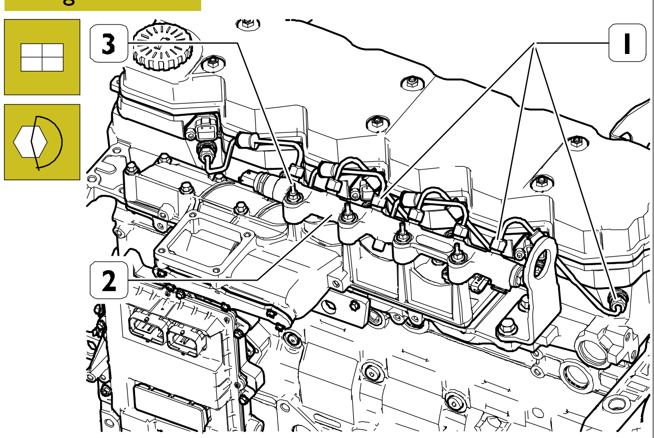
214317

- Apply a sufficient layer of LOCTITE 5999 to the connection surface of the intake manifold (7).
- Tighten the screws (1 and 8).
- Fit a new gasket (6).
- Position the cover (5) and tighten the screws (4).
- Position the air pressure sensor (3), insert a new gasket and tighten the screw (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x25	24 ± 4 Nm
(2)	1	Screw M6x1x20	10 ± 2 Nm
(4)	6	Screw M6x1x20	10 ± 2 Nm
(8)	1	Screw M8x1.25x70	24 ± 4 Nm

Common Rail Refitting

Figure 295



214316

- Position the Common Rail (2) and tighten the threaded double action screws (3).
- Tighten the nuts (1) connecting the high pressure pipes to the Common Rail (2).

Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M14x1.5	24 ± 4 Nm
(3)	3	Screw M8x1.25x125	36 ± 5 Nm

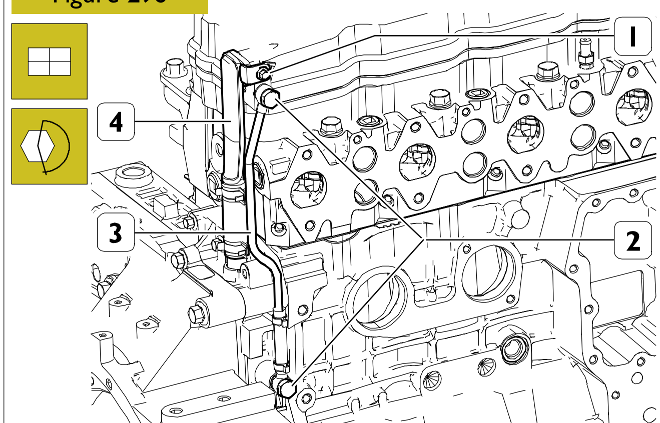
NOTE The pipe fittings must be tightened using the specific wrench and torque wrench 99389829.

The fittings (1) must be tightened using the specific wrench to hold the flow limiting valves.

The high pressure pipes must always be replaced.

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)
Oil vapour filter refitting

Figure 296



202471

- Position the pipe (3) and the threaded fittings (2).
- Insert the engine breather pipe (4).
- Tighten the support screw (1) to the clamp.

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1	10 ± 2 Nm
(2)	2	Coupling M12x1.5x11	20 ± 2 Nm

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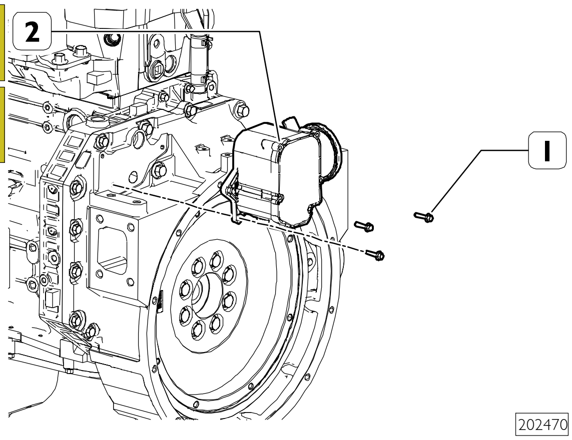
Figure 297

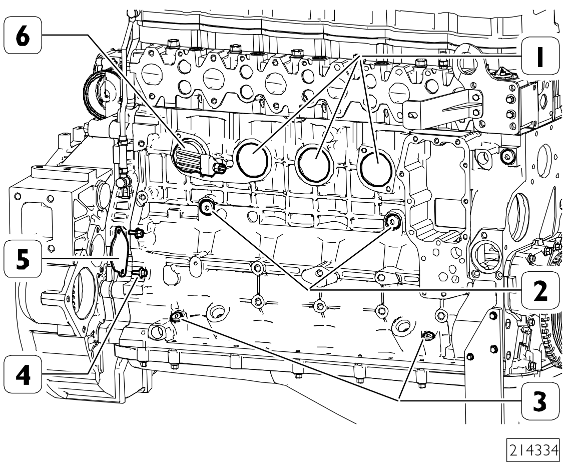


- Position the filter (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x25	10 ± 2 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Figure 298

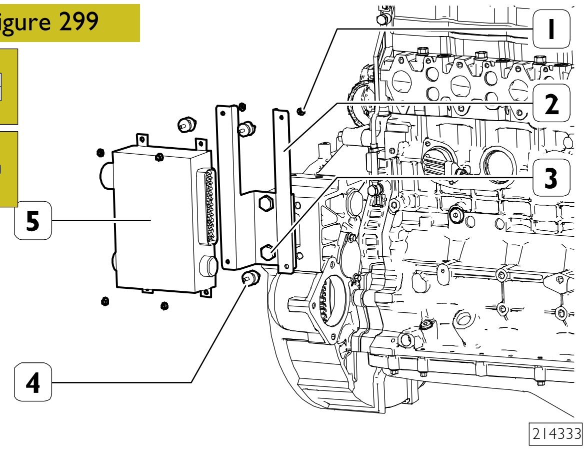


- Insert the water preheating resistor (6).
- Position the inspection cover (5) and tighten the screws (4).
- Tighten the plugs (2 and 3) and their relative gaskets.
- Fit the core plugs (1).

Ref.	No.	Screws description	Tightening torques
(2)	3	Plug M18x1.5	10 ± 2 Nm
(3)	3	Plug M12x1.5	10 ± 2 Nm
(4)	2	Screw M8x6	10 ± 2 Nm

Extension kit refitting

Figure 299

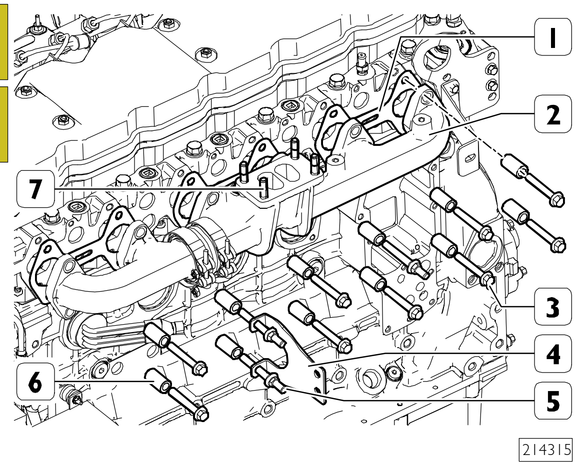


- Position the support (2) and tighten the screws (3).
- Position the extension kit (5), together with the elastic plugs (4).
- Screw the nuts (1) onto the elastic plugs (4).

Ref.	No.	Screws description	Tightening torques
(1)	4	Nut M6x1	10 ± 2 Nm
(3)	2	Screw M16x35	10 ± 2 Nm

Refitting exhaust manifold;

Figure 300



- Insert the new gaskets (1).
- Position the exhaust manifold (2) and fit the spacers (6).
- Position the support bracket (4).
- Tighten the screws (3 and 5) securing the exhaust manifold (2).
- Tighten the studs (7) for the turbocharger support.

Ref.	No.	Screws description	Tightening torques
(3)	9	Screw M10x1.5x65	53 ± 5 Nm
(5)	3	Screw M10x1.5x65	53 ± 5 Nm
(7)	4	Stud M10x1.5x42	43 ± 6 Nm

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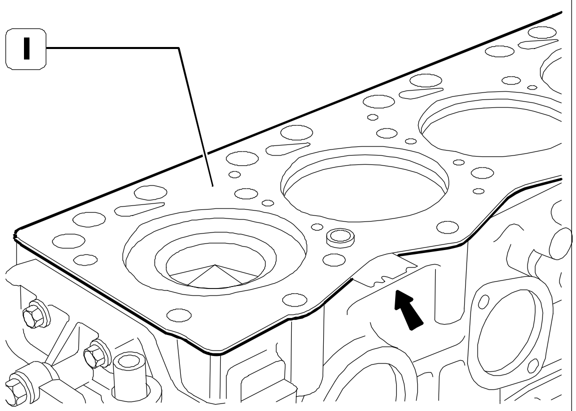
ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)

Cylinder head assembly refitting

Figure 301 NEF67 TM1F engine



87759

☞ NEF67 TE1F/TE2F engine Page 112

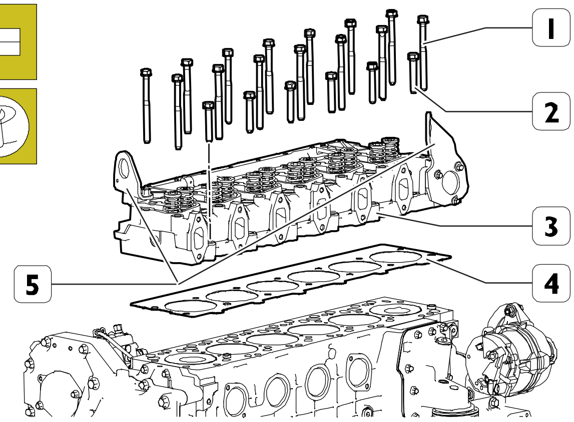
❑ Position the gasket (1) on the block.

NOTE Check that the block contact surface is clean.

Do not grease the gasket. It is advisable to keep the gasket within its housing until the fitting of the head.

The gasket is to be fitted in such a way that the writing on the gasket can be read as shown in the figure.

Figure 302



202142

❑ Fit the relative cable reference dowel pins (4) between the cylinder head assembly and the crankcase.

❑ Using tool 99360595, by means of the lifting eyelets (5), position the cylinder head assembly (3), together with all the elements relating to timing:

- Intake valves;
- Exhaust valve;
- Valve springs;
- Plates;
- Cotters.

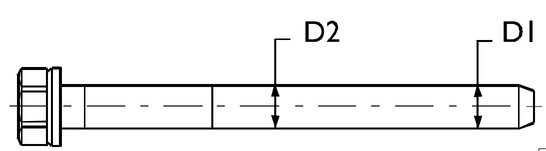
❑ Fit the screws (1 and 2) into the relative seats.

NOTE If the valves were removed from the head, they need to be refitted before fitting the head itself onto the block.

NOTE Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:

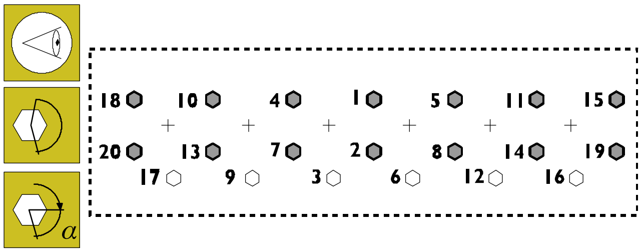
if D1 - D2 < 0.1 mm the screw can be reused

if D1 - D2 > 0.1mm the screw must be replaced.



75703

Figure 303



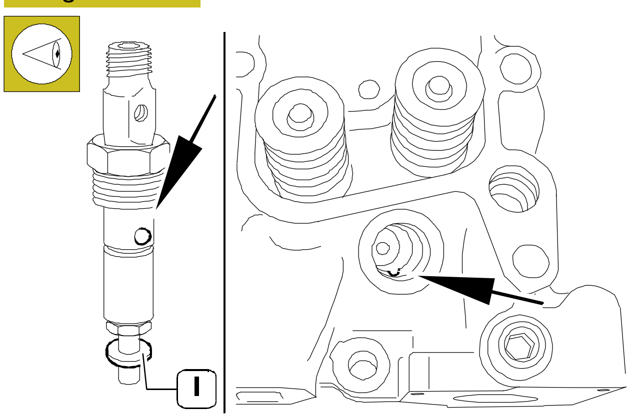
76214

- Lubricate the screws and fit them on the cylinder head.
- The screws must be tightened in a "stitch" pattern starting from the centre screws and moving outward.

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M12x1.75x70 1st phase 2nd phase	 60 ± 5 Nm 90°
(5)	14	Screw M12x1.75x140 1st phase 2nd phase	 40 ± 5 Nm 90° + 90°

Injector refitting

Figure 304



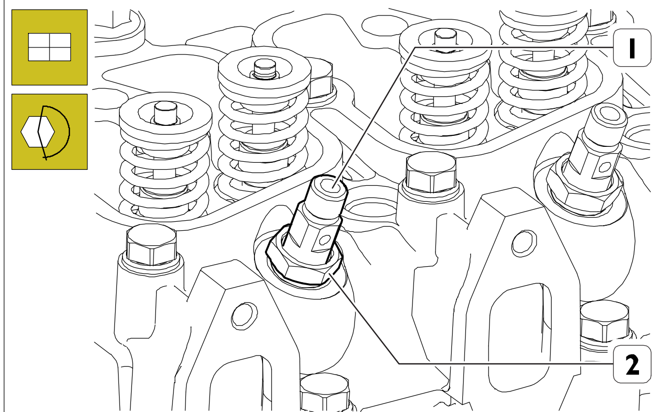
75707

NOTE If compression in the cylinders is to be checked, using tool 99360344, leave the injector disassembled.

- Only assemble the injectors after having replaced the sealing gasket (1).

NOTE While carrying out injector assembly operations, check that the ball on the injector is at the engine head seat.

Figure 305



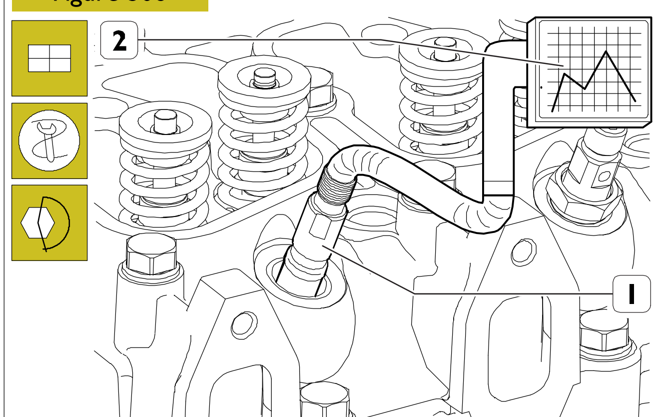
202172

- Tighten the ring nut (2) securing the injectors (1).

Ref.	No.	Screws description	Tightening torques
(2)	4	Ring nut M24x1.5	60 ± 5 Nm

Procedure for checking compression in the cylinders using tool 99360344

Figure 306

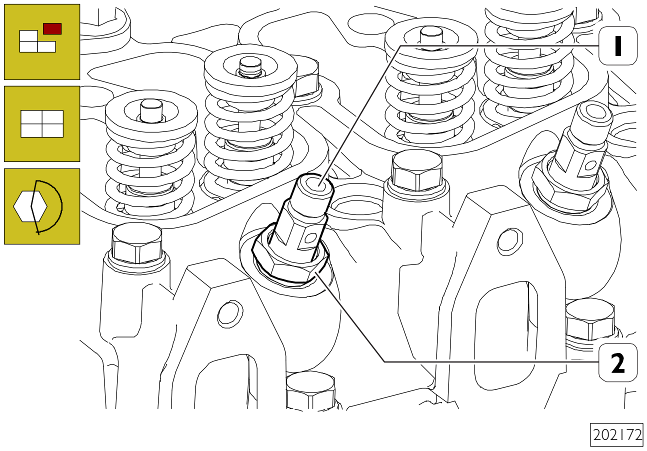


214341

- Fit tool 99360344 (1).
- Connect it to tool 99395382 (2).
- Manually actuate the engine flywheel in order to turn the engine.
- Tool 99395382 (2) traces the pressure trend inside the cylinder according to the combustion chamber.

Ref.	No.	Screws description	Tightening torques
(1)	1	Tool M24x1.5	60 ± 5 Nm

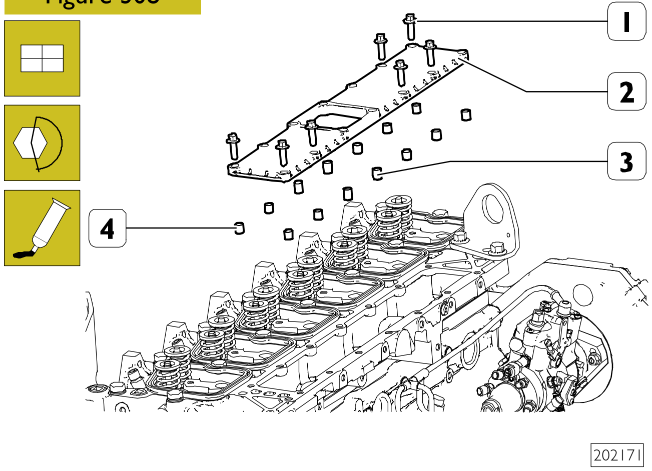
Figure 307



- ❑ Disassemble the tool 99360344.
- ❑ Tighten the ring nut (2) securing the injectors (1).

Refitting intake manifold

Figure 308



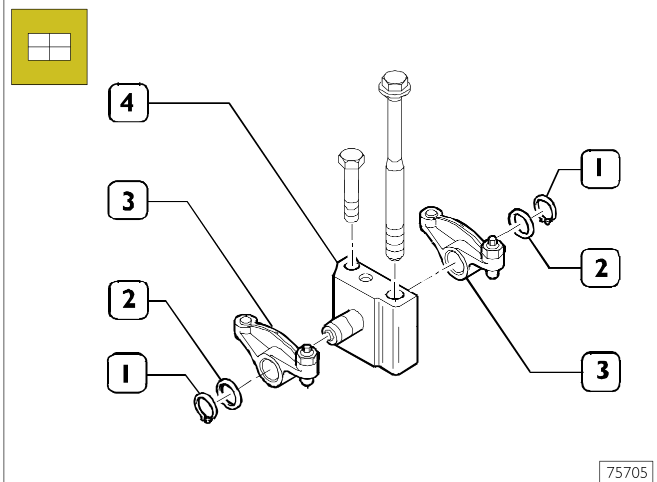
- ❑ Apply a bead of LOCTITE 5999 on the intake manifold plate mating surface (2).
- ❑ Insert 10 smooth bushings [h = 11 mm] (4) in their seats.
- ❑ Insert the 4 smooth bushings [h = 14 mm] (3) in correspondence with the intake manifold.
- ❑ Position the intake manifold (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	7	Screw M8x1.25x25	24 ± 4 Nm

NOTE Check that the intake manifold plate (2) is oriented correctly as shown in the figure (the shorter part near the air inlet hole must face the front end of the engine).

Refitting rocker assembly

Figure 309

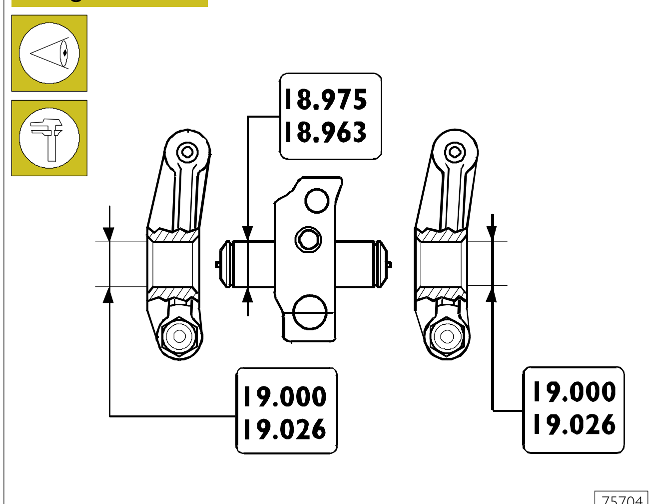


- ❑ Fit the rocker arm assembly after having checked the parts.

ROCKER ASSEMBLY COMPONENTS:

1. Circlip - 2. Spacer - 3. Rocker arms - 4. Support

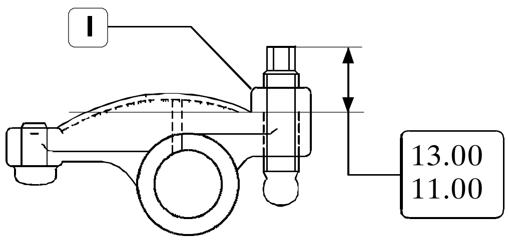
Figure 310



MAIN DATA FOR SHAFT-ROCKER ARMS

Check the coupling surfaces between the support and the shaft: there must be no sign of excessive wear or damage. Replace if necessary.

Figure 311

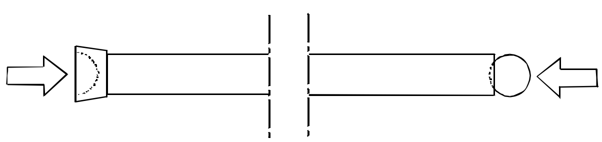


MAIN DATA FOR ROCKER ARM ADJUSTMENT SCREW

- ❑ If disassembled, check the adjustment dimension.
- ❑ Tighten the nut (1).

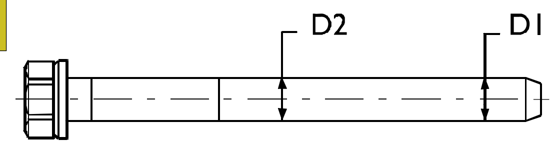
Ref.	No.	Screws description	Tightening torques
(1)	8	Nut M8x1.25	24 ± 4 Nm

Figure 312



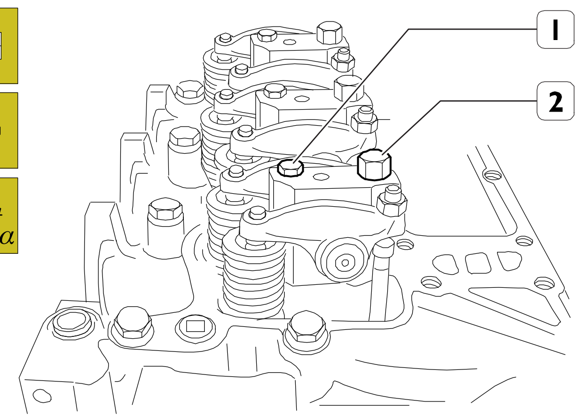
Before assembly, check the rocker arm rods: there must be no sign of any deformation; the spherical seats for contact with the rocker arm adjusting screw and with the tappets (arrows) must show no trace of seizure or wear; if they do, replace them. Intake and exhaust valve push rods are identical and are therefore interchangeable.

Figure 313



- ❑ Insert the rocker arm assembly and the tappet cover rods. Before re-using retaining screws take two measurements of the diameter as shown in the figure to identify diameters D1 and D2:
  if D1 - D2 < 0.1 mm the screw can be reused;
  if D1 - D2 > 0.1mm the screw must be replaced.

Figure 314

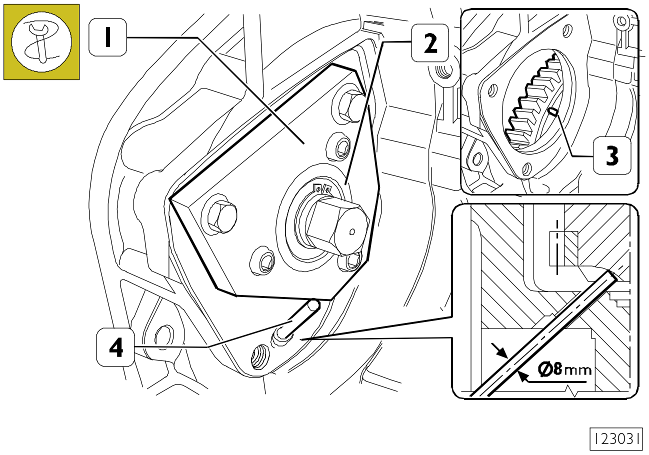


- ❑ Tighten the fastening screws (1 and 2).
- ❑ Repeat the operation for the remaining rocker arm units.

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M8x1.25x75	24 ± 3 Nm
(2)	6	Screw M12x1.75x180	
		1st phase	70 ± 5 Nm
		2nd phase	90° + 90°

Setting rocker free play
Preliminary operations

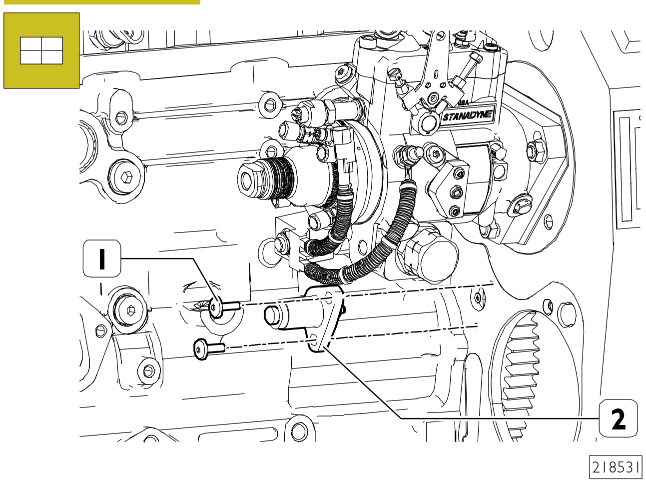
Figure 315



❑ Fit tool 99360339 (1) to rotate the flywheel with the help of a wrench.

Identifying top dead centre at end of compression stroke for 1st cylinder using timing system lock pin (99360616) - False injector

Figure 316

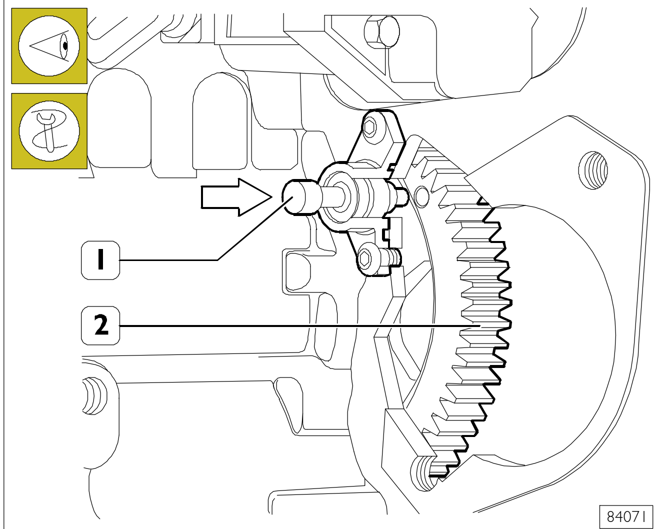


❑ Insert the plate (2) together with the centring pin.

❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M5x0.8x17	-

Figure 317



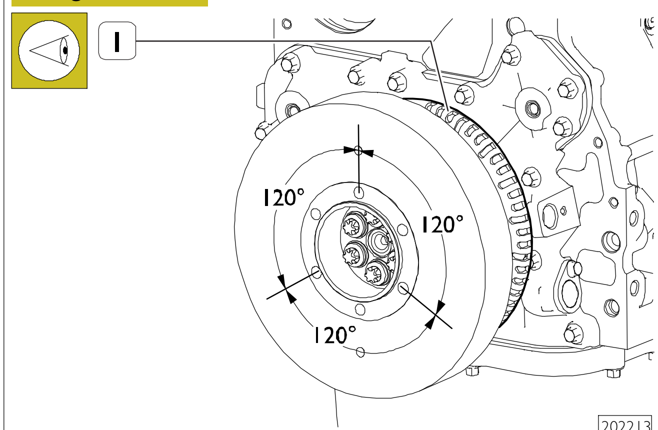
Identifying the 1^{st} cylinder top dead centre position at the end of the compression stroke:

❑ remove the cylinder rocker arm cover;

❑ turn the flywheel until it pushes the pin 99360616 (1), blocking the gear (2);

❑ make sure that the intake and exhaust valves of the 1^{st} cylinder are both closed and not balanced.

Figure 318



❑ Also make sure that the non-drilled part (1) of the phonic wheel is positioned at the top along its vertical axis (condition with cylinder n.1 at TDC) and the valves of cylinder n. 4 are balanced. If cylinder n.1 is balanced, turn the engine by 1 revolution to bring it into the required condition.

❑ Adjust the 1^{st} cylinder valve clearance as indicated in the relative paragraph.

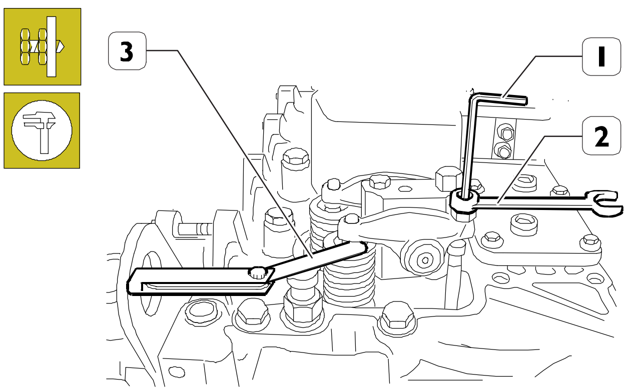
❑ At this point, appropriately turn the crankshaft as shown in the Table to adjust the rocker arm clearance of the other cylinders.

FIRING ORDER: 1 - 5 - 3 - 6 - 2 - 4

Start and rotation crankshaft	Rocker arm clearance adjustment intake and exhaust valves - cylinder n°
Cyl. no.1 at TDC	1
Turn 120°	5
Turn 120°	3
Turn 120°	6
Turn 120°	2
Turn 120°	4

Setting rocker free play

Figure 319



202214

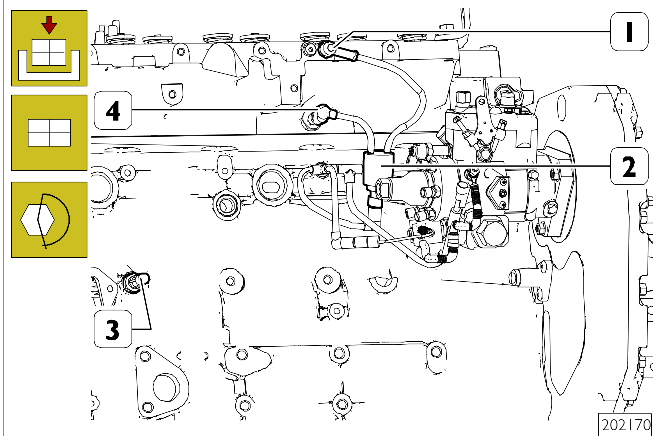
- ❑ Adjust the clearance between the rocker arms and valves using an Allen wrench (1), a box wrench (3) and feeler gauge (2).

The clearance is:

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

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON RIGHT SIDE)

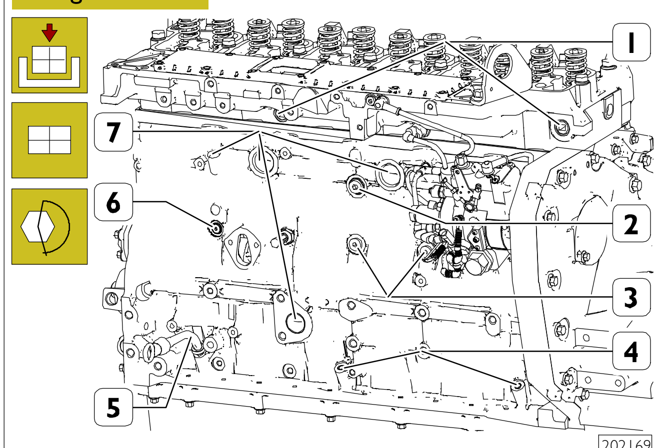
Figure 320



- ❑ Tighten the oil temperature sensor (3).
- ❑ Tighten the water temperature sensor (4).
- ❑ Connect all the electrical connections to the feed pump.
- ❑ Connect the connections (1) to the water temperature sensor (4).
- ❑ Connect the connections to the contactor (2).

Ref.	No.	Screws description	Tightening torques
(3)	1	Sensor M10x1	28 ± 2 Nm
(4)	1	Sensor 1/2 x14"	28 ± 2 Nm

Figure 321

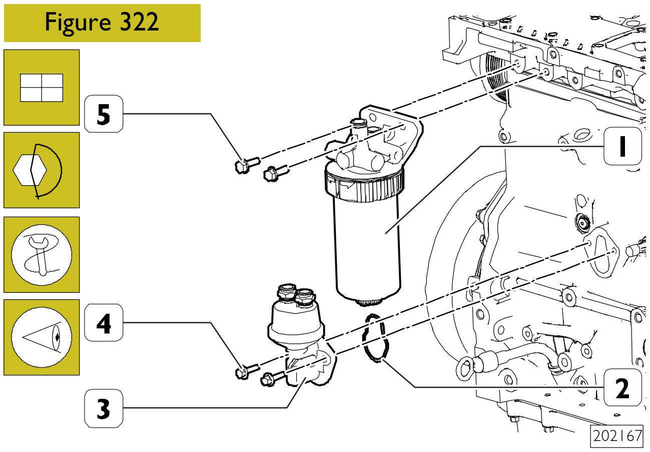


- ❑ Insert the oil level dipstick (5).
- ❑ Insert the core plugs (4, and 7).
- ❑ Tighten the threaded plugs (2, 3 and 6).
- ❑ Tighten the threaded plugs (1) on the ducts for water delivery to the heater.

Ref.	No.	Screws description	Tightening torques
(1)	2	Plug ½"-14 0.610	36 ± 6 Nm
(2)	1	Plug	14 ± 2 Nm
(3)	2	Plug M10x1	24 ± 4 Nm
(6)	1	Plug M18x1.5	35 ± 4 Nm

Refitting of fuel filter and priming pump

Figure 322



Do not smoke or use open flames during this operation.

Do not inhale the vapours that exit the filter.

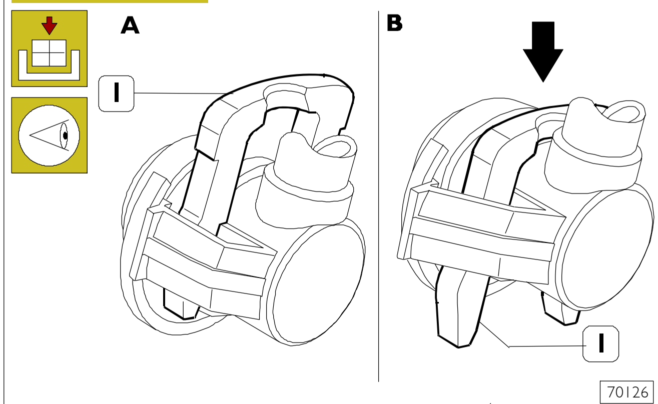
When replacing the filters, the feed system must then always be deaerated.

- ❑ Fit the new gasket (2).
- ❑ Position the priming pump (3) in the relative seat.
- ❑ Tighten the screws (4).
- ❑ Position the filter mount to the crankcase.
- ❑ Tighten the screws (5).
- ❑ Clean the gasket seat on the fuel filter support (1) and lightly oil the gasket on the new filtering cartridge.
- ❑ Manually tighten the new filtering cartridge until the gasket rests completely on its seat.
- ❑ Tighten further with the help of the tool 99360076 to the torque of 12.5 ± 2.5 Nm.

Ref.	No.	Screws description	Tightening torques
(4)	2	Screw M8x1.25x25	24 ± 4 Nm
(5)	2	Screw M12x1.75	80 ± 8 Nm

Refitting low pressure pipes

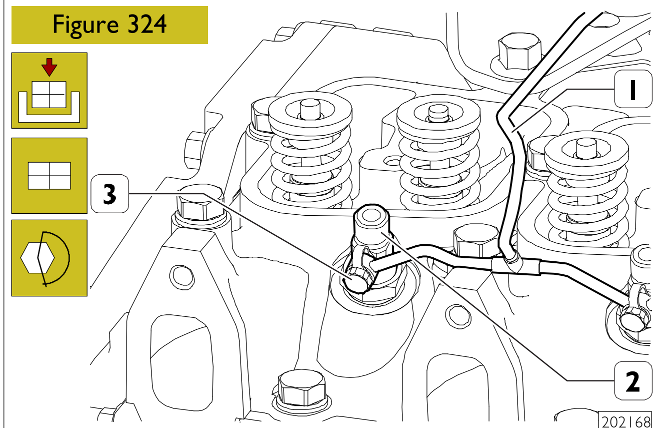
Figure 323



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.

After removing the pipe, move the clip (1) to the locked position (Figure A).

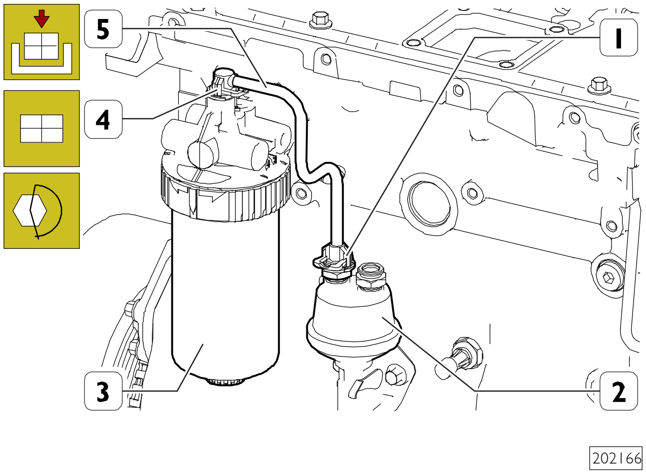
Figure 324



- ❑ Position the exhaust pipes (1) from the injectors (2).
- ❑ Connect the 6 threaded fittings (3) passing through the injectors (2).

Ref.	No.	Screws description	Tightening torques
(3)	6	Nut M6x1x10	80 ± 8 Nm

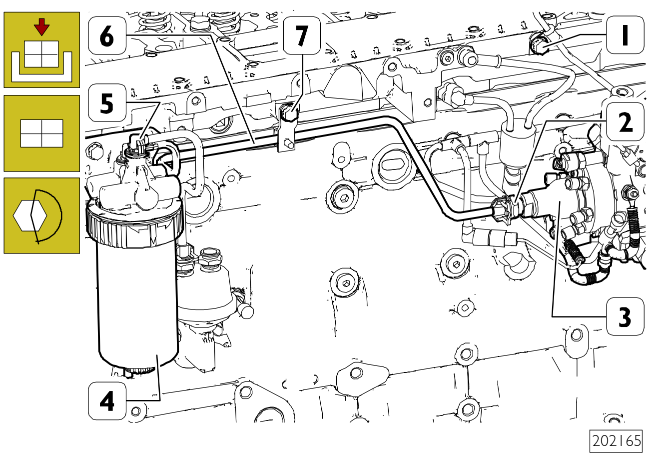
Figure 325



- ❑ Connect the pipe (5).
- ❑ Fit the quick-fit coupling (4) on the fuel filter (3).
- ❑ Tighten the connector (1) on the priming pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	1	Nut M12x1.5	80 ± 8 Nm

Figure 326

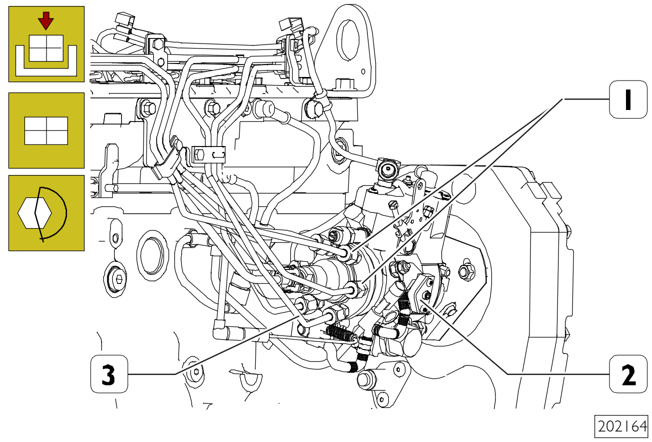


- ❑ Connect the quick-fit couplings (5) on the fuel filter (4) and connect the pipe (6).
- ❑ Connect the clip (2) from the injection pump (3).
- ❑ Tighten the support bracket fastening screws (1 and 7).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x16	80 ± 8 Nm
(7)	1	Screw M8x1.25x14	80 ± 8 Nm

Refitting high pressure pipes

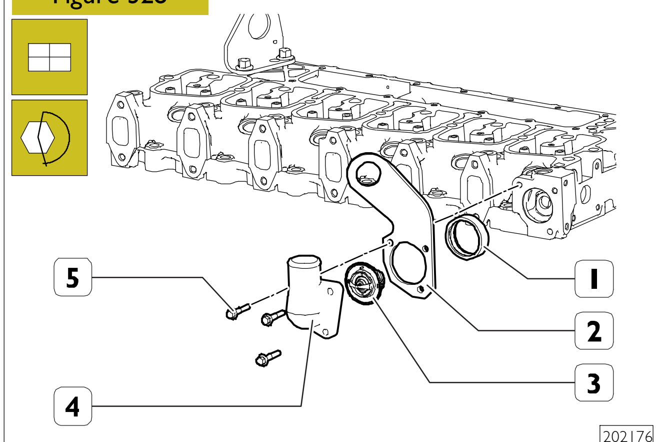
Figure 327



- ❑ Connect the high pressure pipes (3).
- ❑ Tighten the fittings (1) connecting to the injection pump (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M12x1.5	26 ± 1 Nm

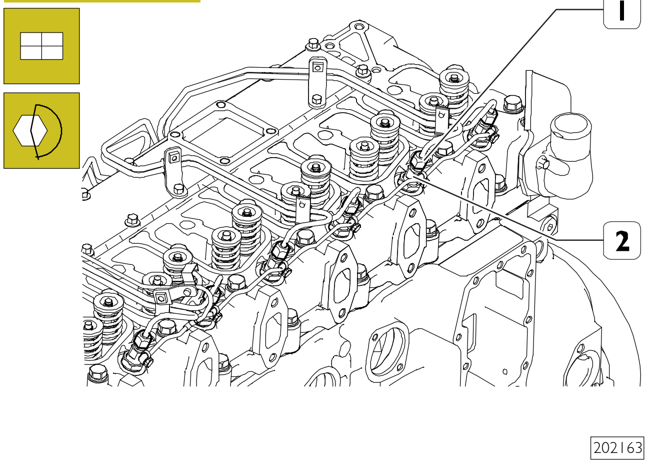
Figure 328



- ❑ Position the gasket (1) of the cover.
- ❑ Position the lifting eyelet (2).
- ❑ Insert the thermostat assembly (3) into the relative seat.
- ❑ Position the thermostat cover (4).
- ❑ Tighten the screws (5) securing the thermostat cover (4).

Ref.	No.	Screws description	Tightening torques
(5)	3	Screw M6x1	10 ± 2 Nm

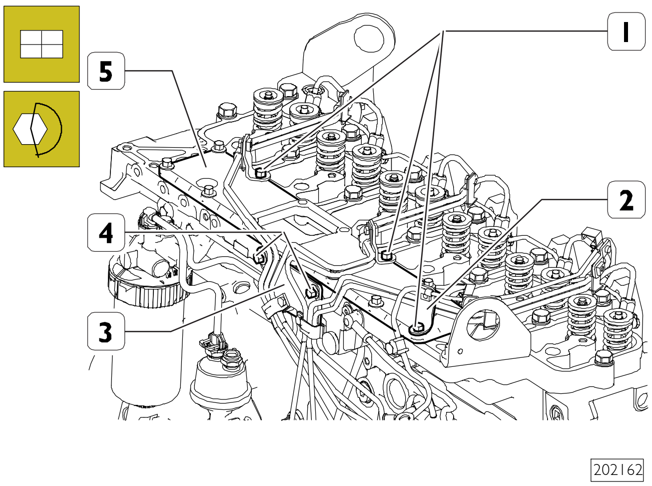
Figure 329



❑ Tighten the fittings (1) connecting to the injectors (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Nut M14x1.5	80 ± 8 Nm

Figure 330



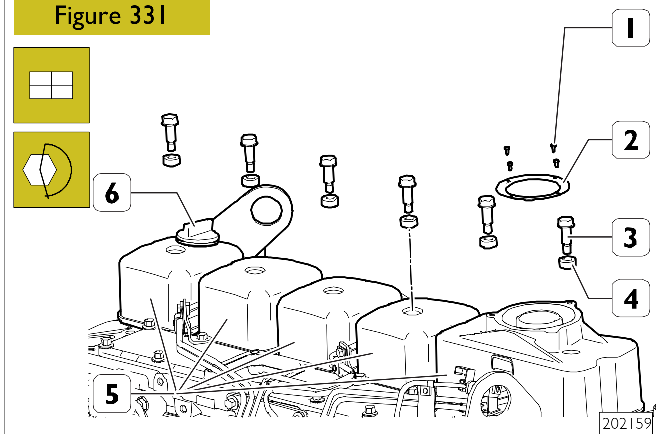
❑ Tighten the bracket (3) support screws (4).

❑ Tighten the support bracket (2) fastening screws (1) at the intake manifold (5).

Ref.	No.	Screws description	Tightening torques
(1)	10	Screw M8x1.25	24 ± 4 Nm
(4)	2	Screw M8x1.25x16	24 ± 4 Nm

Refitting tappet covers

Figure 331



❑ Position the new gaskets between the covers and the cylinder heads and screw in the oil filling cap (6).

❑ Position the tappet covers (5) in the relative seats.

❑ Fit the sound-proofing elements (4) and tighten the screws (3).

❑ Insert the baffle (2).

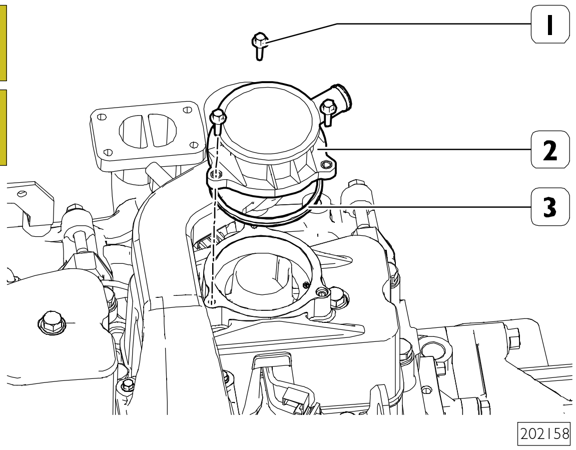
❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw T 2.9x6.5 F	24 ± 4 Nm
(3)	6	Screw M8x1.25	24 ± 4 Nm

NOTE Check the threading of the fastening screws: there should be no signs of wear or build-up of dirt. The seal plugs must not show any deformations. Otherwise, replace with new parts.

Oil vapour filter refitting

Figure 335

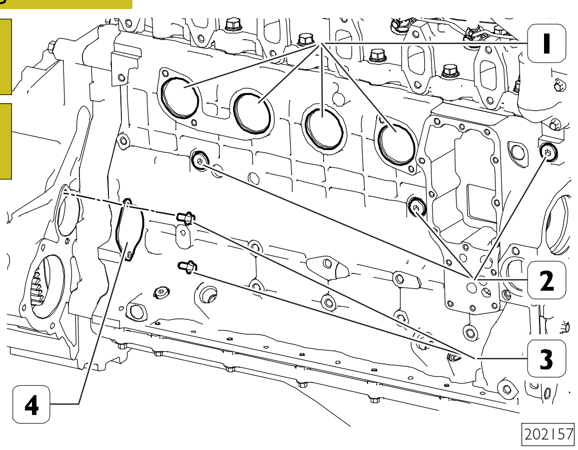


- ❑ Fit the new gasket (3) in the relative seat.
- ❑ Fit the oil vapour breather valve (2).
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M6x1x20	24 ± 4 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS ON THE LEFT SIDE)

Figure 332

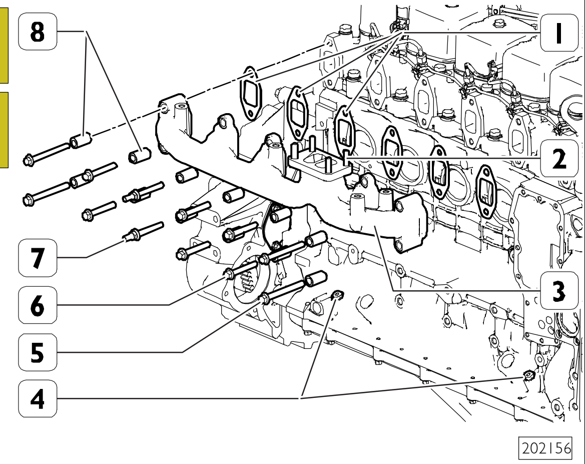


- ❑ Position the inspection cover (3) and tighten the screws (2).
- ❑ Tighten the plugs (1) after having inserted the relative gaskets.
- ❑ Position the inspection cover (5) and tighten the screws (3).
- ❑ Tighten the plugs (2).
- ❑ Fit the core plugs (1).

Ref.	No.	Screws description	Tightening torques
(2)	3	Plug M18x1.5	24 ± 4 Nm
(3)	2	Screw M8x6	24 ± 4 Nm

Refitting exhaust manifold;

Figure 333

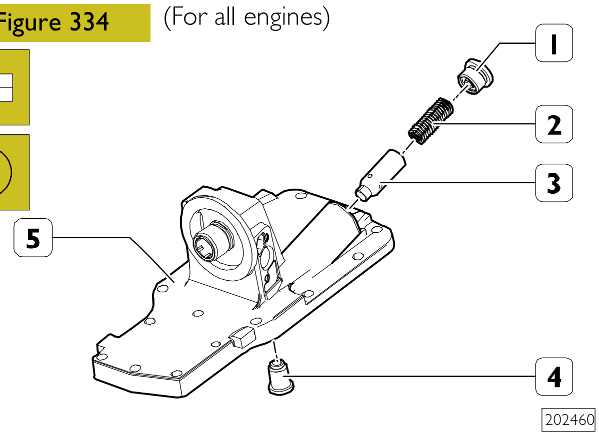


- ❑ Tighten the plugs (4).
- ❑ Insert the 6 new gaskets.
- ❑ Position the exhaust manifold (3), together with the spacers (8).
- ❑ Tighten the screws (5, 6 and 7).
- ❑ Tighten the studs (2) supporting the turbocharger.

Ref.	No.	Screws description	Tightening torques
(2)	4	Stud M10x1.5x42	43 ± 6 Nm
(4)	2	Plug M18x1.5	24 ± 4 Nm
(5)	4	Screw M10x1.5x95	53 ± 5 Nm
(6)	2	Screw M10x1.5x65	55 ± 3 Nm
(7)	6	Screw M10x1.5x65	55 ± 3 Nm

Refitting heat exchanger

Figure 334 (For all engines)

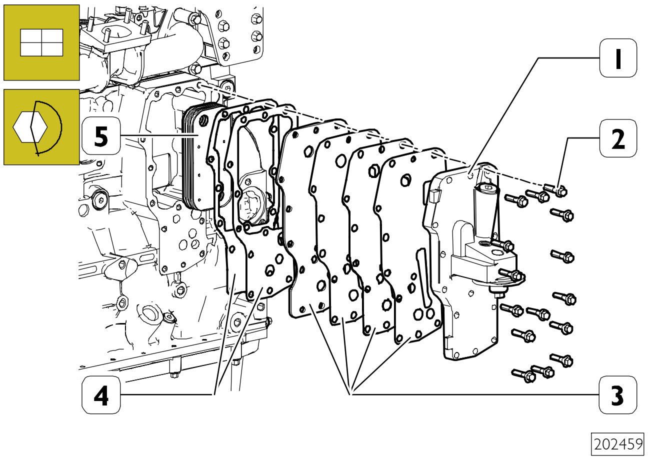


In the oil filter support (5):

- ❑ fit the oil pressure control valve (3), fit the compression spring (2) and tighten the plug (1).
- ❑ Fit the pressure control valve (4) in the relative seat.

Ref.	No.	Screws description	Tightening torques
(1)	1	Plug M22x1.5	80 ± 8 Nm

Figure 336

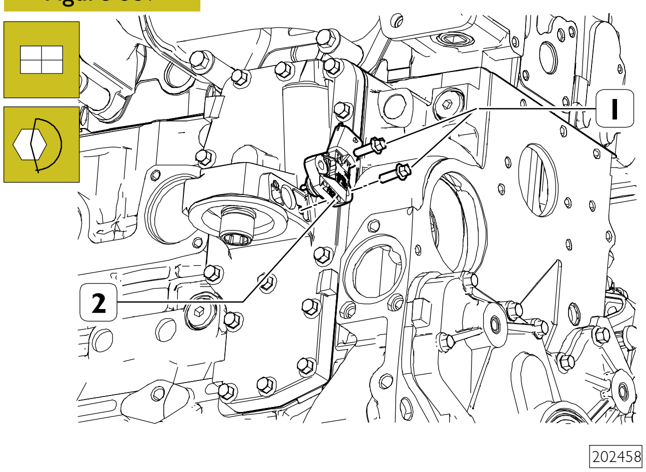


- ❏ Insert the two new sealing gaskets (4).
- ❏ Fit the heat exchange elements (5) in the relative seats.
- ❏ Fit the insulating plates (3).
- ❏ Position the oil filter support (1) in the relative seat and tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	15	Screw M8x1.25x35	26 ± 4 Nm

NOTE Before each assembly operation, check that the thread on the holes and the screws shows no sign of wear or dirt.

Figure 337

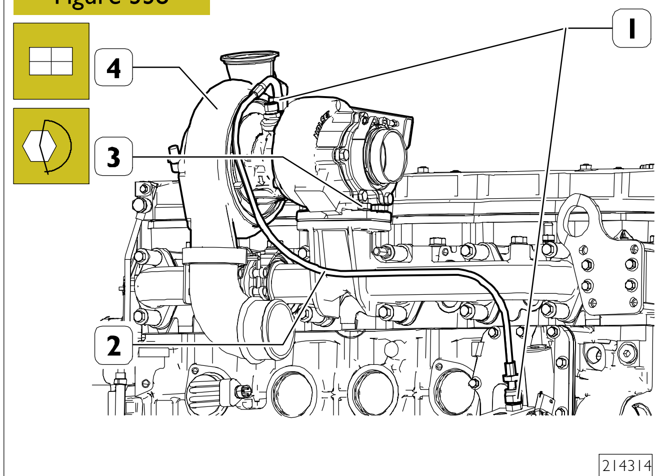


- ❏ Insert the oil pressure/temperature sensor (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x20	35 ± 4 Nm

Turbocharger refitting

Figure 338



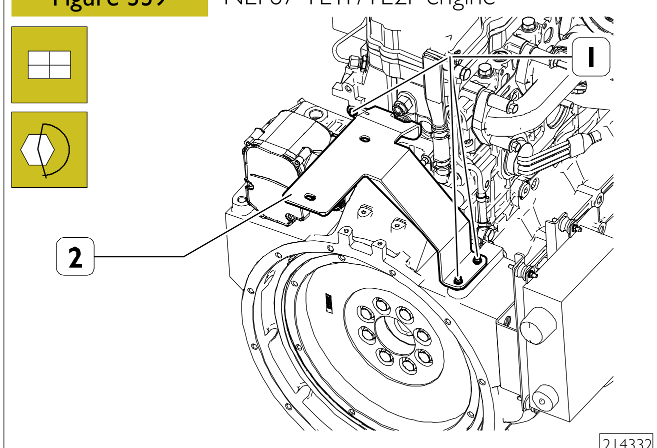
- ❏ Insert the new gasket on the exhaust manifold.
- ❏ Position the turbocharger (4) and tighten the nuts (3).
- ❏ Tighten the fittings (1) of the oil delivery pipe (2) to the turbocharger (4).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M10x1.25	36 ± 5 Nm
(3)	4	Nut M8x1.25	24 ± 4 Nm

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE REAR)

Air filter refitting

Figure 339 NEF67 TE1F/TE2F engine

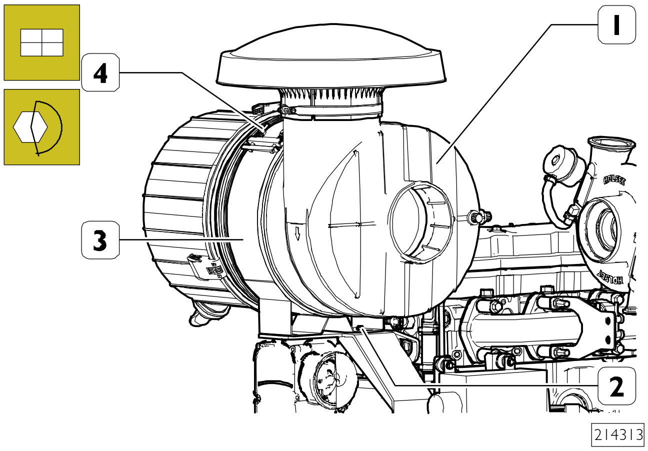


☞ NEF67 TM1F engine Page 114

- ❏ Position the mount (2) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M8x1.25x100	36 ± 5 Nm

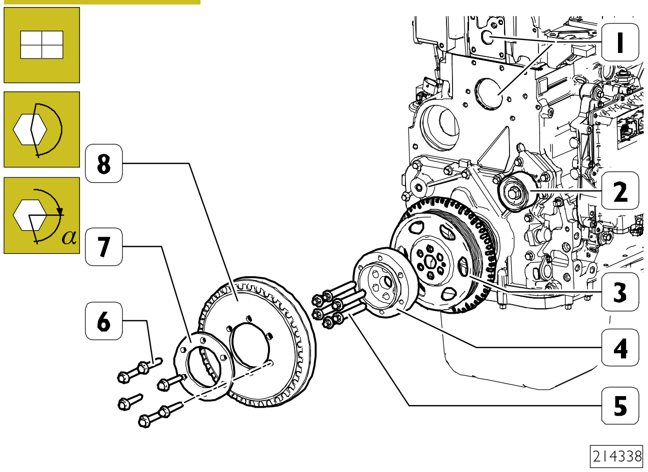
Figure 340



- Position the mount (3) and tighten the screws (2) together with the relative nuts.
- Position the air filter (1) and tighten the screws (4).

ASSEMBLY OF ENGINE AT BENCH (COMPONENTS AT THE FRONT)
Crankshaft pulley refitting

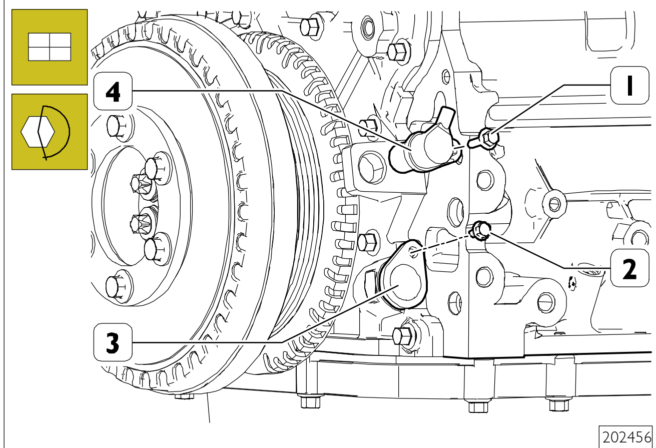
Figure 341 (For all engines)



- Insert the core plug (1).
- Tighten the screw (2) fixing the idler pulley.
- Insert the pulley (3) and the shaft spacer (4).
- Tighten the screws (5).
- Position the front hub (8).
- Position the flange (7) at the front hub (8) and tighten the screws (6).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M10x1.5	43 ± 6 Nm
(5)	6	Screw M12x1.25x78.5 1st step 2nd step	 50 ± 5 Nm 90°
(6)	6	Screw M10x1.25x40	24 ± 4 Nm

Figure 342

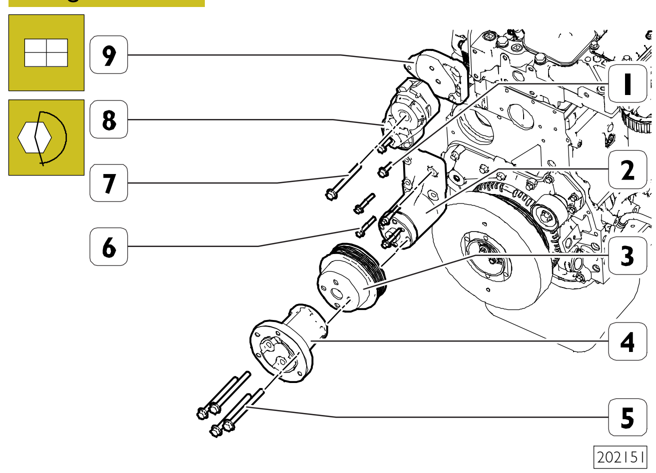


- Insert the plug (3) and tighten the screw (2).
- Insert the crankshaft rpm sensor (4) and tighten the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M6x1x20	24 ± 4 Nm
(2)	1	Screw	-

Refitting of automatic belt tensioner and fan mount

Figure 343



- Position the fan mount (2) in the relative seat and tighten the screws (6).
- Position the spacer (4) in its seat, together with the drive pulley (3) and tighten the screws (5).
- Position the belt tensioner mount (9) in the relative seat and tighten the screws (1).
- Position the automatic belt tensioner (8) in the relative seat and tighten the screw (7).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x30	43 ± 6 Nm
(5)	4	Screw M10x1.5x110	43 ± 6 Nm
(6)	4	Screw	43 ± 6 Nm
(7)	1	Screw M10x1.5x70	43 ± 6 Nm

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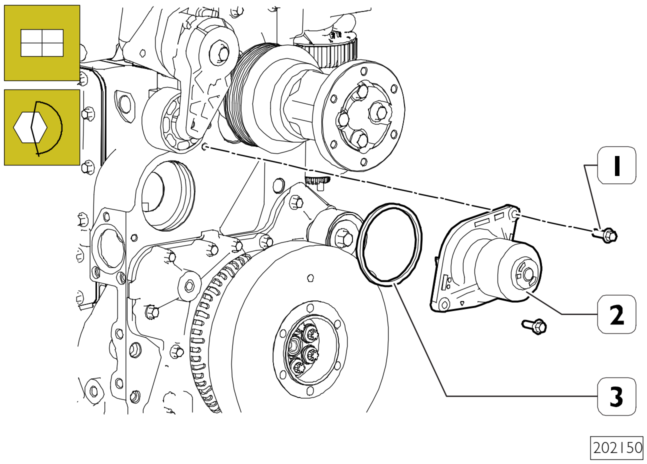
Refitting water pump

Figure 344

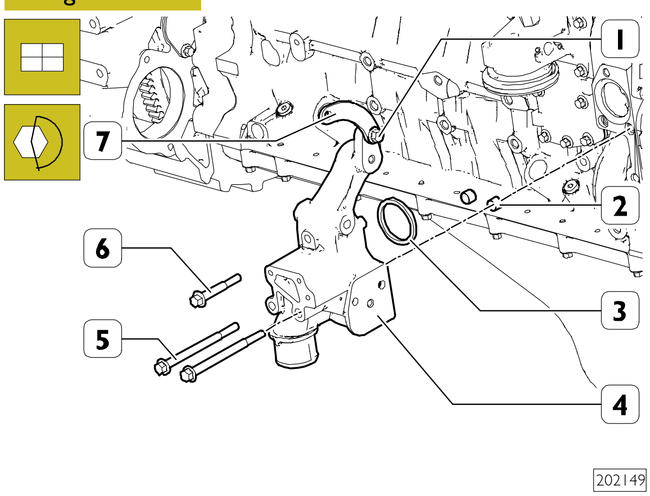


- ❑ Fit the new gasket (3).
- ❑ Position the water pump (2) in the relative seat.
- ❑ Tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M8x1.25x35	24 ± 4 Nm

Refitting alternator support

Figure 345

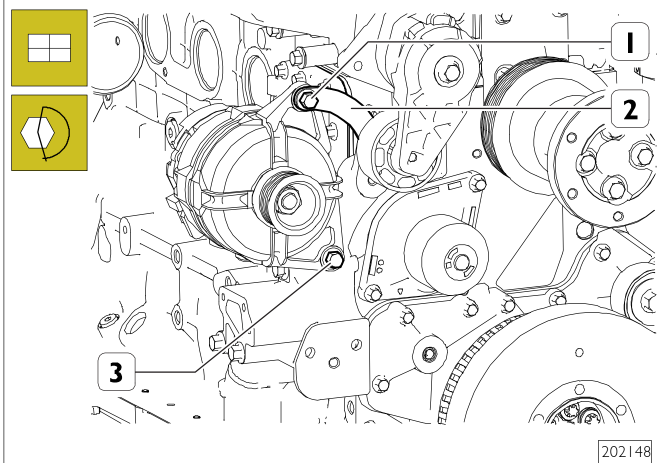


- ❑ Fit the cable reference dowel pins (2) and the new gasket (3) in their seats.
- ❑ Position the alternator mount (4) in the relative seat.
- ❑ Tighten the screws (5 and 6).
- ❑ Position the bracket (7) and tighten the screws (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5x20	43 ± 6 Nm
(5)	2	Screw M10x1.5x135	43 ± 6 Nm
(6)	1	M10x1.5x70	43 ± 6 Nm

Refitting alternator

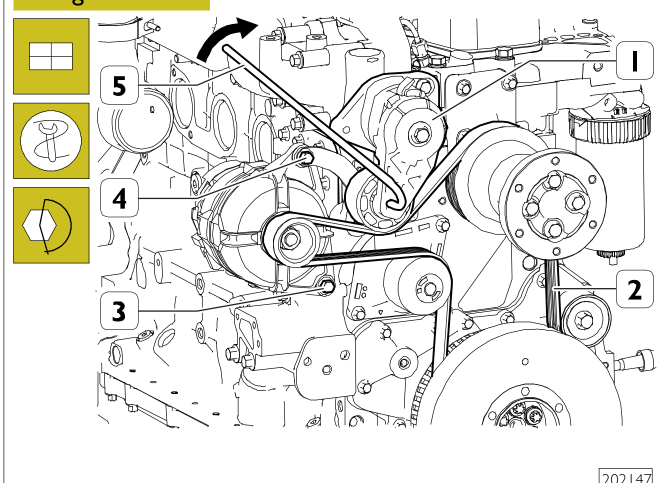
Figure 346



- ❑ Position the alternator in its seat, together with the bracket (2).
- ❑ Position but do not tighten the screw (3) anchoring the alternator to its lower mount and the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M10x1.5	-
(3)	1	Screw M10x1.5	-

Figure 347

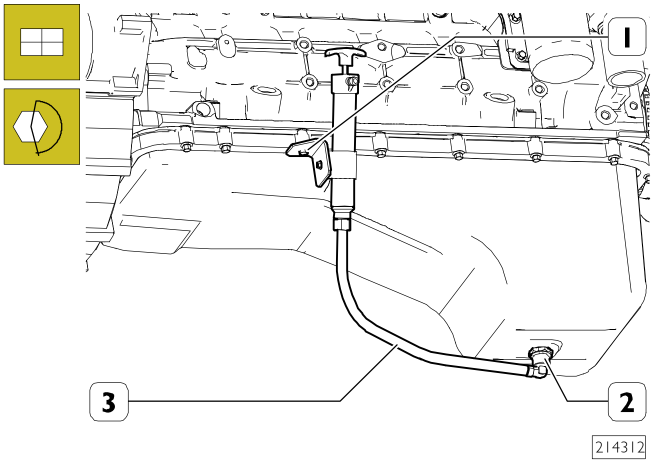


- ❑ Use the tool (5) to turn the automatic tensioner (1) in the direction of the arrow and put on the belt (2).
- ❑ Tighten the screw (4) securing the alternator to the bracket and the screw (3) securing the alternator to the lower mount.

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M10x1.5	43 ± 6 Nm
(4)	1	Screw M10x1.5	43 ± 6 Nm
(4)	1	Nut M10x1.5	43 ± 6 Nm

Oil discharge pump refitting

Figure 348



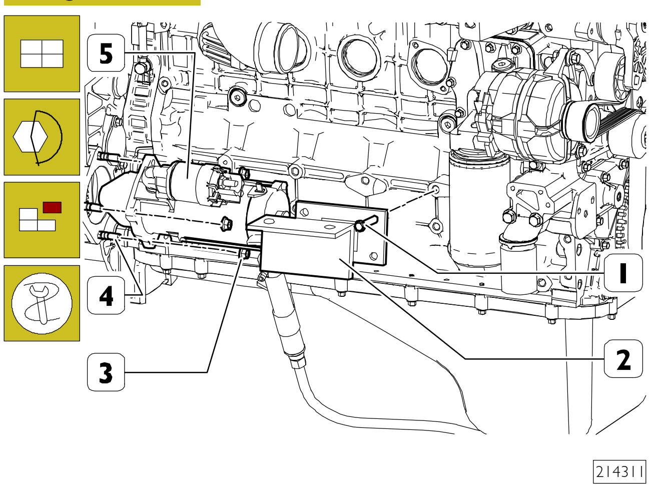
- ❑ Close the exhaust valve (2).
- ❑ Position the oil discharge pump (3) and tighten the screw (1).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M8x1.25x40	24 ± 4 Nm
(2)	1	Valve M22x1,5	60 ± 9 Nm

Engine completion

To complete the engine assembly operations, remove the rotating stand.

Figure 349

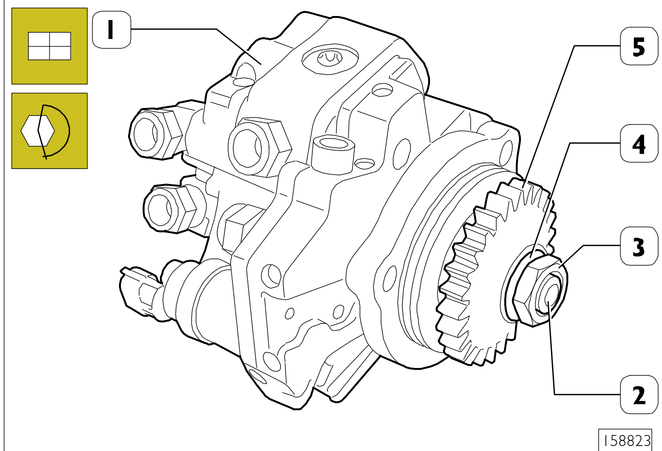


From the left side:

- ❑ Tighten the studs (4).
- ❑ Position the starter motor (5) in its seat and tighten the nuts (3).
- ❑ Lift the engine with arm 99360595 and remove it from the rotating stand 99322205.
- ❑ Unscrew the screws (1) and remove the bracket 99361037 (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Nut M10x1.5	43 ± 6 Nm
(2)	4	Screw M12x1.75	-
(4)	3	Stud M10x1.5x20	43 ± 6 Nm

Figure 350

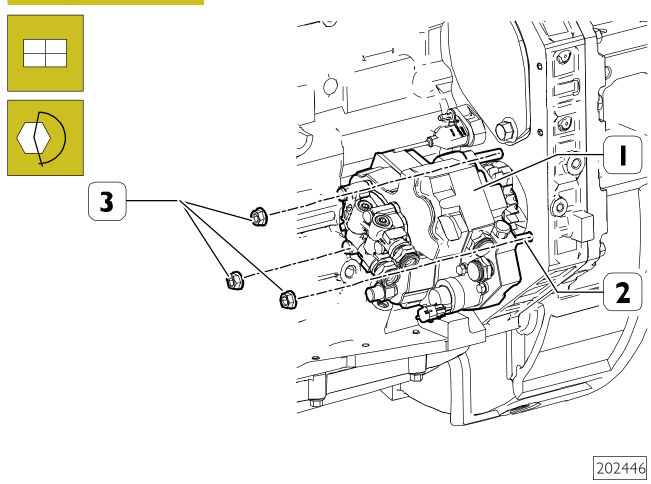


- ❑ Fit the gear (5) to the shaft (2).
- ❑ Lock rotation of the high-pressure pump (1) drive shaft (2).
- ❑ Tighten the nut (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Nut M18x15	105 ± 5 Nm

Supply pump refitting

Figure 351



- ❑ Tighten the studs (2).
- ❑ Position the supply pump assembly (1).
- ❑ Tighten the nuts (3).

Ref.	No.	Screws description	Tightening torques
(2)	3	Stud M8x1.25x5	24 ± 4 Nm
(3)	3	Nut M8x1.25	24 ± 4 Nm

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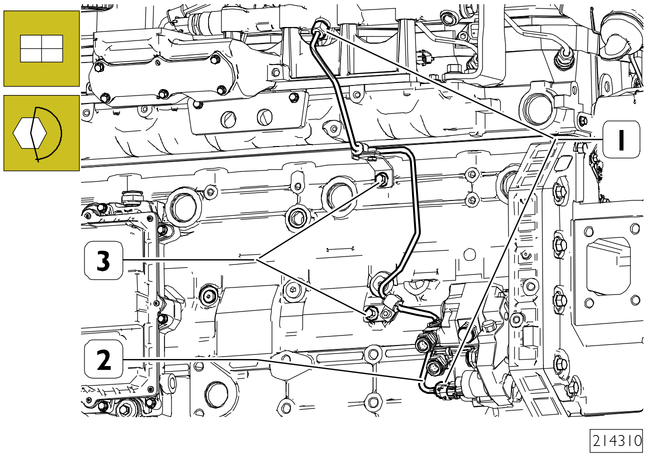
Figure 352

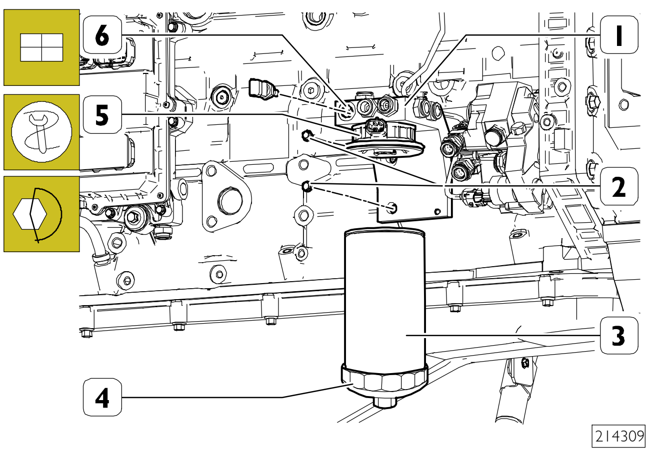


- ❑ Position the Rail supply high pressure pipe (2).
- ❑ Tighten the screws (3).
- ❑ Tighten the fittings (1).

Ref.	No.	Screws description	Tightening torques
(1)	2	Connector M14x1.5	24 ± 4 Nm
(3)	2	Screw M6x1x12	40 ± 5 Nm

Fuel filter refitting

Figure 353

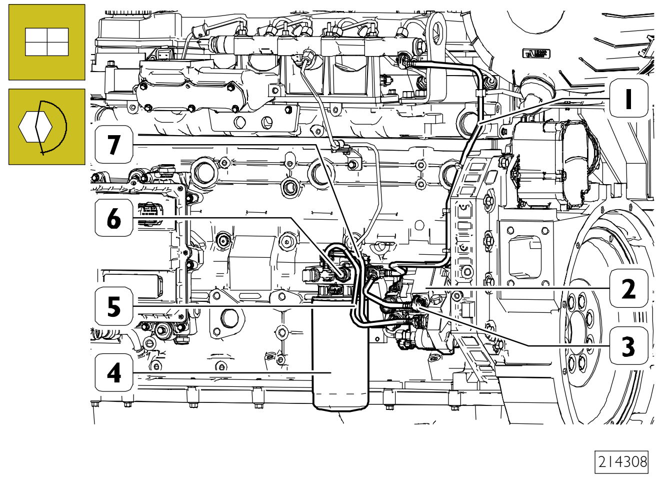


- ❑ Position the fuel filter support (1) together with the fuel preheating resistor (5).
- ❑ Tighten the screws (2).
- ❑ Tighten the cartridge (3) using tool 99360076 (4).
- ❑ Tighten the fuel temperature sensor (5).

Ref.	No.	Screws description	Tightening torques
(2)	2	Screw M12x1.75	80 ± 8 Nm
(3)	1	Cartridge M20x1.5	24 ± 4 Nm
(6)	1	Sensor M14x1.5	20 Nm

NOTE Do not refill the filter to prevent impurities from entering the supply circuit.

Figure 354



- ❑ Tighten the Voss fitting (6).
- ❑ Connect the fuel returning pipe (7) from the injection pump (2) to the filter (4).
- ❑ Connect the fuel arrival pipe (5) for the injection pump (2).
- ❑ Connect the fuel return pipe (3) for the injection pump (2).
- ❑ Connect the excess fuel return pipe (1) from the Common Rail.

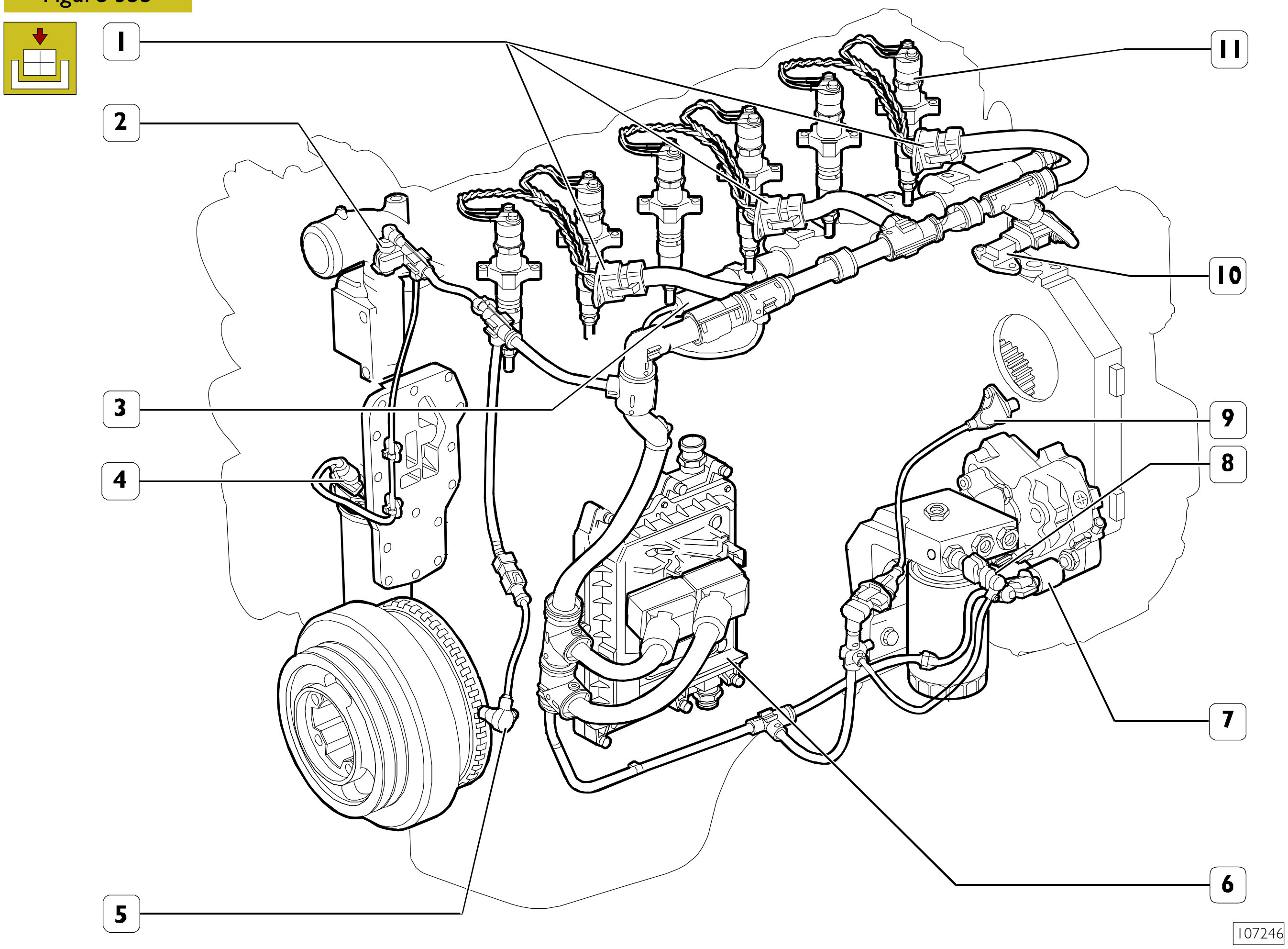
The pipes which were removed cannot be refitted.

They must be replaced.

Ref.	No.	Screws description	Tightening torques
(8)	1	Connector M12x1.5	22 ± 2 Nm

Refitting engine cable

Figure 355

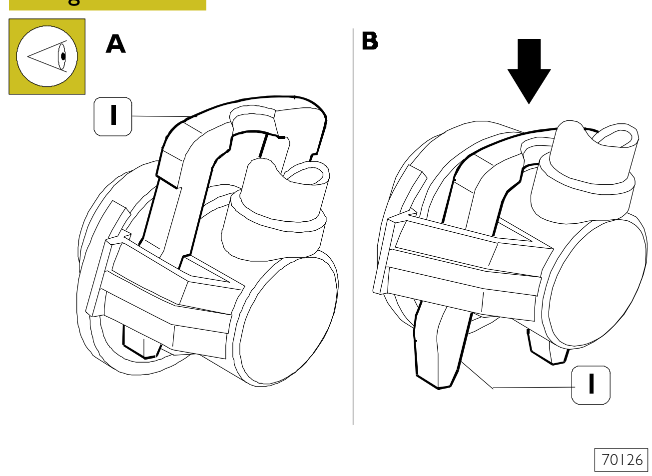


1. Connections for electro-injectors - 2. Engine coolant temperature sensor - 3. Fuel pressure sensor cable - 4. Engine oil temperature and pressure sensor - 5. Crankshaft sensor - 6. EDC control unit 7 - 7. Pressure regulator cable - 8. Fuel heater and fuel temperature sensor cable - 9 . Timing phase sensor - 10. Air temperature and pressure sensor - 11. Electro-injector.

Connect the engine cable from the connectors: electro-injector wiring (1); (10) air pressure/temperature sensor; (3) fuel pressure sensor; (6) control unit; (9) timing gear phase sensor; (2) engine coolant temperature sensor on thermostat; (5) engine rpm sensor.

Insert the clamps that hold it to the crankcase.

Figure 356



To connect lower pressure fuel pipes from their couplings, press clip (1) as shown in figure B.
After removing the pipe, move the clip (1) to the locked position (Figure A).

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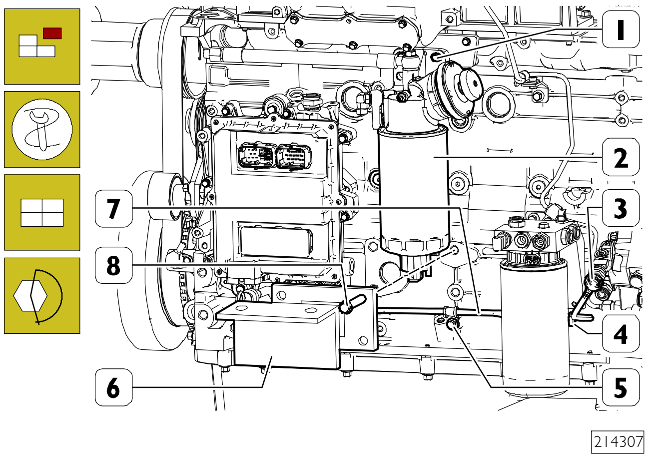
Figure 357



From the right hand:

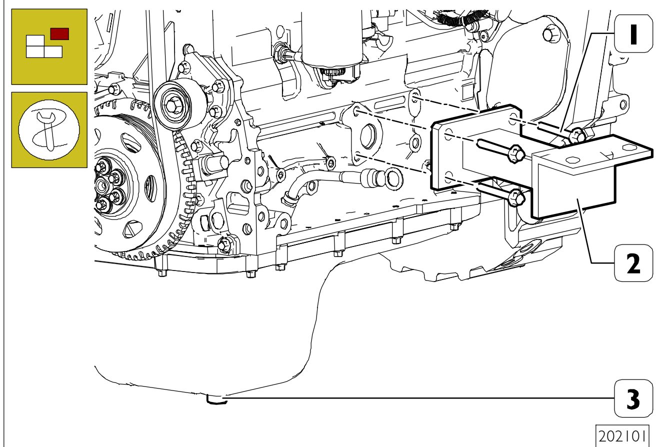
- ❑ Unscrew the screws (7) and remove the bracket 99361037.
- ❑ Position the low pressure pipe (6) and connect the quick-fit couplings (2).
- ❑ Tighten the screw (5).
- ❑ Connect the clamp (4) for supporting the pipe (6) in low pressure.
- ❑ Place the pre-filter (2) in its seat.
- ❑ Tighten the screws (1) and the relative nuts.
- ❑ Connect the fuel pre-filter (2) to all the pipes.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M20x1.5	43 ± 6 Nm
(5)	1	Screw M20x1.5	43 ± 6 Nm
(8)	4	Screw M12x1.75	-

Engine completion

To complete the engine assembly operations, remove the rotating stand.

Figure 358 NEF67 TM1F engine



☞ NEF45 TE1F/TE2F engine Page 120

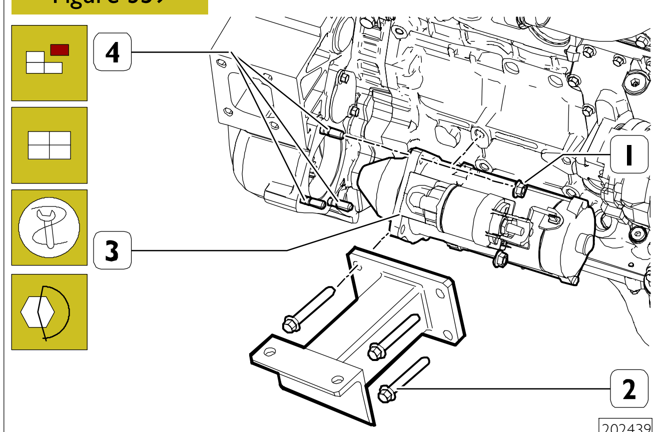
From the left side:

- ❑ Lift the engine with arm 99360595 and remove it from the rotating stand 99322205.
- ❑ Unscrew the screws (1) and remove the bracket 99361037 (2).

Ref.	No.	Screws description	Tightening torques
(1)	3	Screw M12x1.75	-

Refitting starter motor

Figure 359

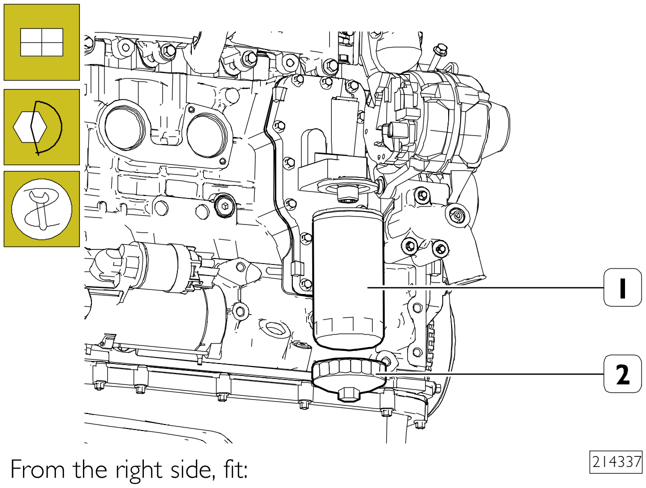


- ❑ Unscrew the screws (1) and remove the second support bracket 99361037.
- ❑ Tighten the studs (4) and position the starter motor (3).
- ❑ Tighten the retaining nuts (2).

Ref.	No.	Screws description	Tightening torques
(1)	4	Screw M12x1.75	-
(2)	3	Nut M10x1.5	43 ± 6 Nm
(4)	3	Stud M10x1.5x20	43 ± 6 Nm

Refitting oil filter

Figure 360



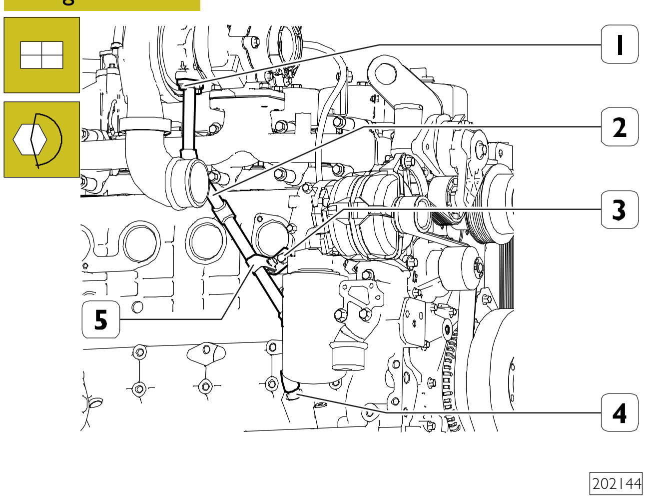
From the right side, fit:

- ❑ with tool 99360076 (2) fit the oil filter (1) on the support.

Ref.	No.	Screws description	Tightening torques
(1)	1	Cartridge M27x2	20 ± 2 Nm

Refitting lubricant oil return pipe from turbo-charger

Figure 361 (For all engines)



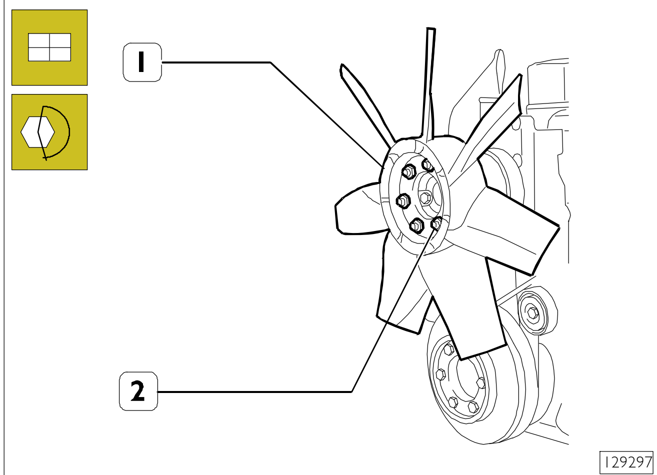
the lubricant oil drain pipe (2) from the turbocharger.

- ❑ Free the ends of the pipe and the exhaust on the turbo-charger. Fit the fitting (4) in the crankcase.
- ❑ Tighten the screw (3) securing the pipe to the crankcase via the fastening collar (5).
- ❑ Tighten the two screws (1) under the turbocharger.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x16	10 ± 2 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

Fan refitting

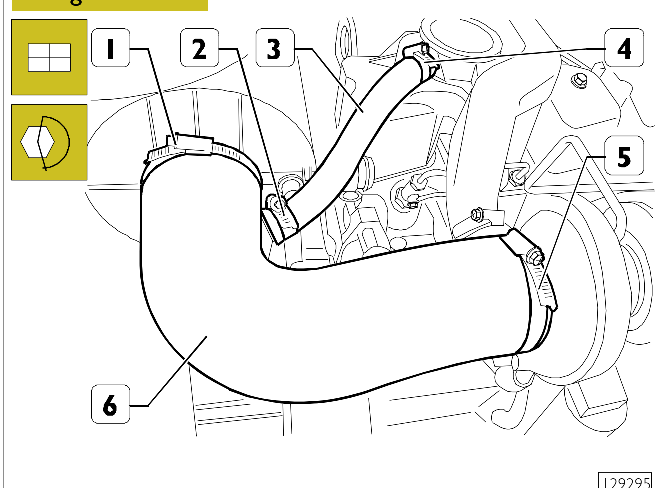
Figure 362



- ❑ Position the fan (2), complete with spacer.
- ❑ Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	6	Screw M8x1.25	24 ± 4 Nm

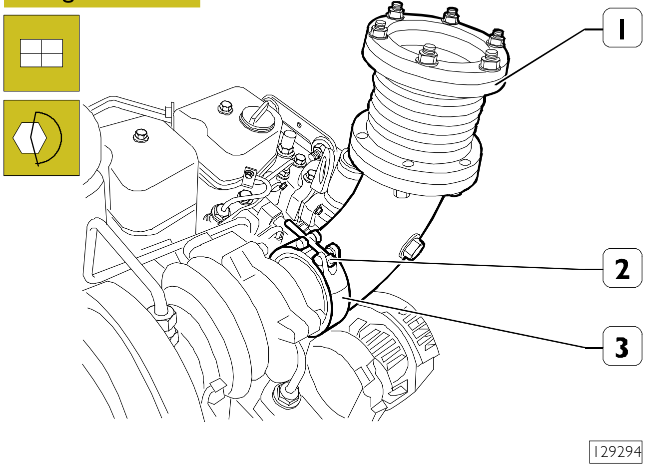
Figure 363



- ❑ Connect the air intake pipes (6), closing their clamps (1) and (5)
- ❑ Connect the oil vapour recovery pipes (3), closing their clamps (2) and (4).

Ref.	No.	Screws description	Tightening torques
(1)	1	Screw M7x1	13 ± 2 Nm
(5)	1	Screw M7x1	13 ± 2 Nm

Figure 364

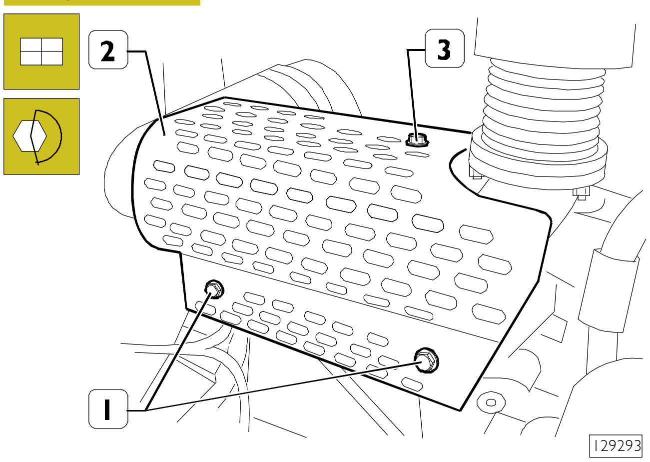


- ❑ Connect the discharge pipe (1), tightening the screw (2) to close the clamp (3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M7x1	13 ± 2 Nm

Refitting radiator assembly

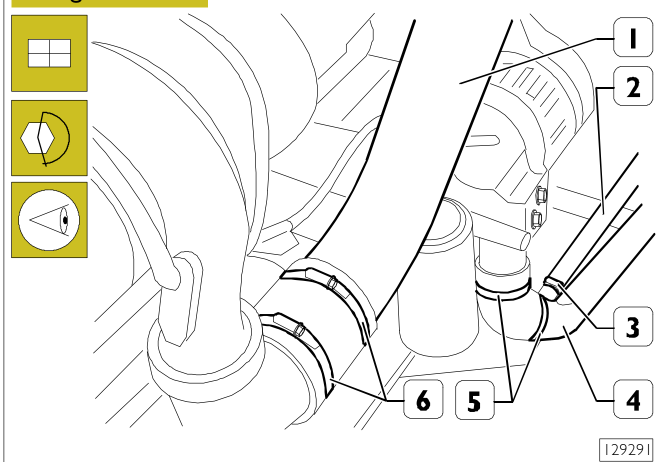
Figure 365



- ❑ If present, refit the turbine protection grille (2), restoring the relative mounting brackets.
- ❑ Replace the radiator unit on the crankcase, making sure to interference with the fan.
- ❑ Tighten the fastening screws (1 and 3) on both sides.

Ref.	No.	Screws description	Tightening torques
(1)	2	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

Figure 366

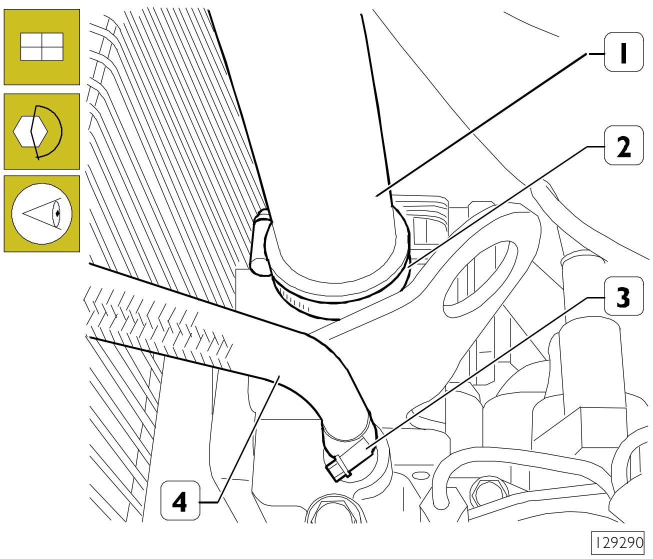


- ❑ Fit the pipe (4) complete with sleeves, from the engine side, acting on the relative clamps (5).
- ❑ Fit the pipe (2) complete with sleeves, from the engine side, acting on the relative clamps (3).
- ❑ Fit the pipe (1) complete with sleeves, from the engine side, acting on the relative clamps (6).

Ref.	No.	Screws description	Tightening torques
(3)	2	Screw M6x1x16	43 ± 6 Nm
(5)	2	Screw M8x1.25x16	43 ± 6 Nm
(6)	2	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 367

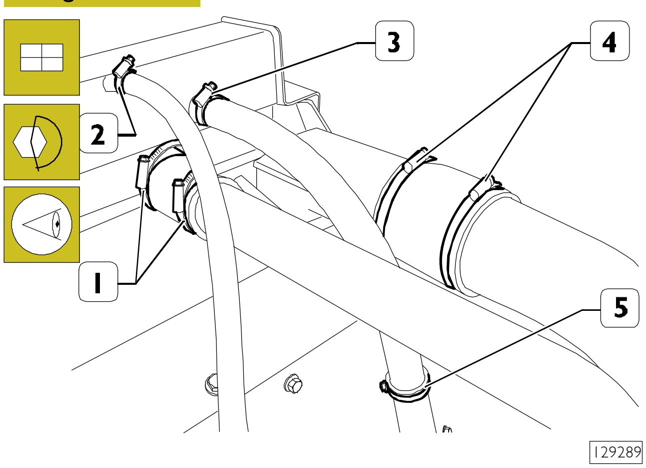


- ❑ Fit the pipes (1 and 4) complete with sleeves acting on the relative clamps (2 and 3).

Ref.	No.	Screws description	Tightening torques
(2)	1	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

Figure 368

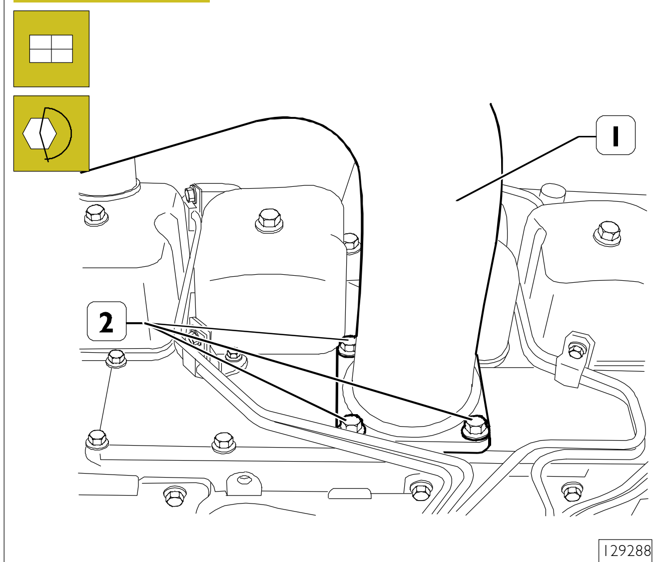


- ❑ Connect the air and water pipes to the radiator assembly using the clamps (1, 2, 3 and 4) and the mounting bracket (5).

Ref.	No.	Screws description	Tightening torques
(5)	1	Screw M6x1x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

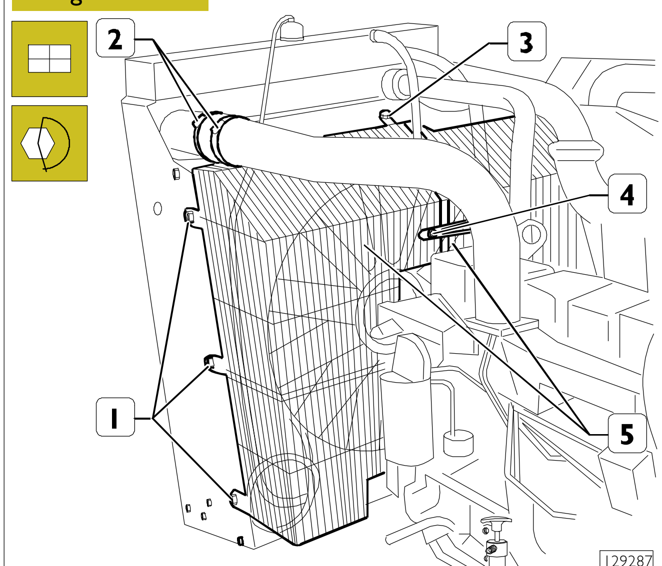
Figure 369



- ❑ Mount the pipe (1).
- ❑ Tighten the screws (2).

Ref.	No.	Screws description	Tightening torques
(2)	4	Screw M8x1.25	24 ± 4 Nm

Figure 370



- ❑ Mount the protection grilles (5) of the fan
- ❑ Tighten the relative fasteners (1, 3 and 4).
- ❑ Close the clamps (2).

Ref.	No.	Screws description	Tightening torques
(1)	6	Screw M6x1x16	43 ± 6 Nm
(3)	1	Screw M8x1.25x16	43 ± 6 Nm
(4)	1	Screw M6x1x16	43 ± 6 Nm

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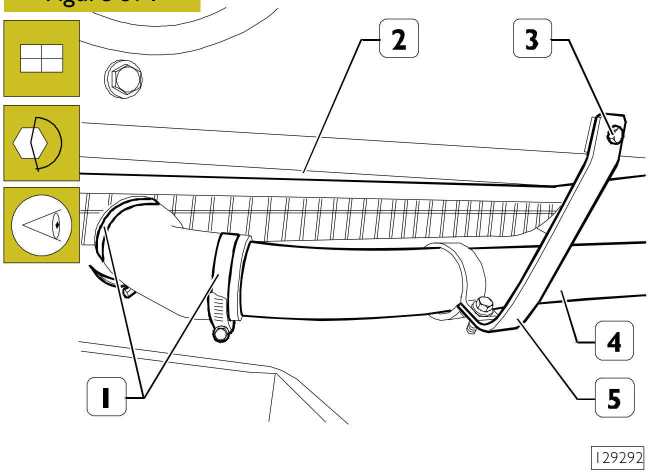
Figure 371



- ❑ Connect the pipe (4) complete with hoses and bracket (5) to the radiator assembly (2)
- ❑ Close the relative clamps (1).
- ❑ Tighten the screw (3).

Ref.	No.	Screws description	Tightening torques
(3)	1	Screw M8x1.25x16	43 ± 6 Nm

NOTE Check the state of wear of the rubber sleeves.

- ❑ Refill the cooling system with coolant.
- ❑ Bleed the air from the 'supply system as described in the relevant paragraph.
- ❑ Refill the engine oil as described in the relative paragraph.

SECTION 7

Technical specifications

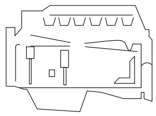
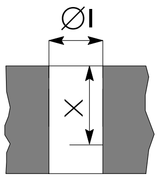
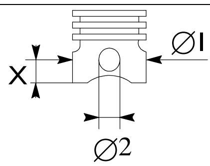
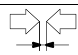
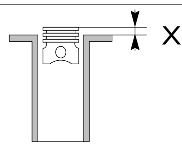
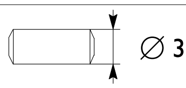
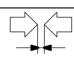
Page

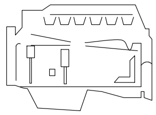
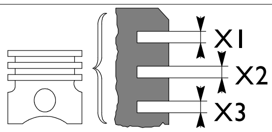
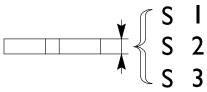
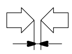
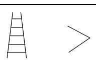
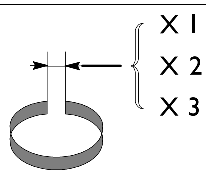
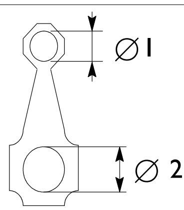
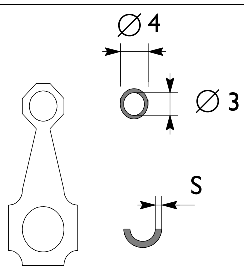
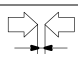
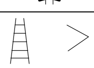
DATA - INSTALLATION CLEARANCES 3

TIGHTENING TORQUES (NEF67 TM1F) 9

TIGHTENING TORQUES (NEF67 TE1F/TE2F) . 11

DATA - INSTALLATION CLEARANCES

	Type		(NEF67 TM1F)	NEF67 TE1F/TE2F
CYLINDER ASSEMBLY AND CRANK GEARS			mm	
	Cylinder liners	Ø1 > Ø 1	104.000 ÷ 104.024 0.4	
	Pistons Measuring point Outer diameter Seat for pin	 X Ø 1 Ø 2	55.9 103.714 ÷ 103.732 38.010 ÷ 38.016	49.5 103.739 ÷ 103.757 38.010 ÷ 38.016
	Piston - cylinder liners		0.268 ÷ 0.310	0.243 ÷ 0.285
	Piston diameter	Ø 1	0.4	
	Piston position from crankcase	X	0.28 ÷ 0.52	
	Piston pin	Ø 3	37.994 ÷ 38.000	
	Piston pin - pin seat		0.010 ÷ 0.022	

	Type		(NEF67 TM1F)	NEF67 TE1F/TE2F
CYLINDER ASSEMBLY AND CRANK GEARS			mm	
	Circlip slots	X1 X 2 X 3	2.705 ÷ 2.735 2.440 ÷ 2.460 4.030 ÷ 4.050	2.705 ÷ 2.735 2.420 ÷ 2.440 4.030 ÷ 4.050
	Circlips	S 1 S 2 S 3	2.560 ÷ 2.605 2.350 ÷ 2.380 3.970 ÷ 3.990	
	Circlips - slots	1 2 3	0.100 ÷ 0.175 0.060 ÷ 0.110 0.040 ÷ 0.080	0.100 ÷ 0.175 0.040 ÷ 0.09 0.040 ÷ 0.080
	Piston rings		0.4	
	Piston ring end gap in cylinder liner:	X 1 X 2 X 3	0.30 ÷ 0.40 0.60 ÷ 0.80 0.30 ÷ 0.55	
	Connecting rod small end bush seat Connecting rod bearings seat	∅ 1 ∅ 2	40.987 ÷ 41.013 72.987 ÷ 73.013	
	Connecting rod small end bush diameter Internal  Connecting rod half-bearings	∅ 3 S	38.019 ÷ 38.033 1.955 ÷ 1.968	
	Piston pin - bushing		0.019 ÷ 0.039	
	Connecting rod half-bearings		0.250; 0.500	

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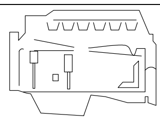
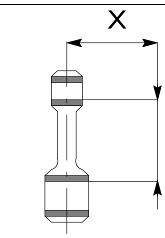
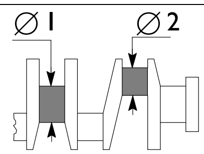
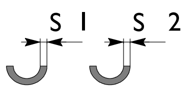
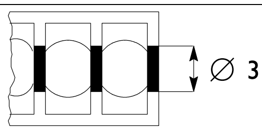
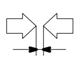
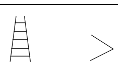
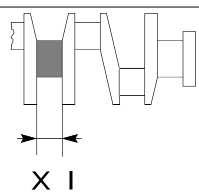
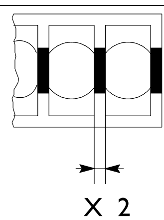
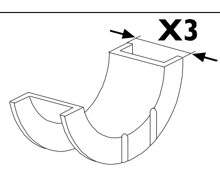
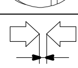
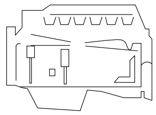
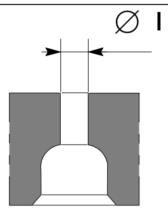
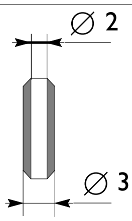
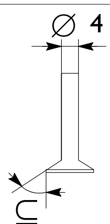
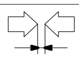
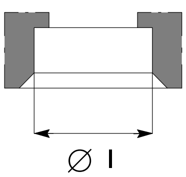
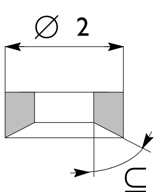
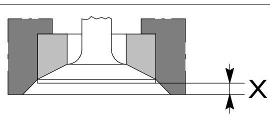
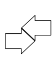
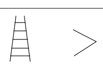
	Type	(NEF67 TM1F)	NEF67 TE1F/TE2F
CYLINDER ASSEMBLY AND CRANK GEARS		**mm**	
	Measuring point Maximum error on parallelism of connecting rod axles	- -	
	Main journals ∅ 1 Crankpins ∅ 2	82.99 ÷ 83.01 68.987 ÷ 69.013	
	Main half-bearings S 1 Connecting rod half-bearings S 2	2.456 ÷ 2.464 1.955 ÷ 1.968	
	Main journals No. 1-7 ∅3 No. 2-3-4-5-6 ∅ 3	87.982 ÷ 88.008 87.977 ÷ 88.013	
	Half-bearings - Main journals No. 1-7 No. 2-3-4-5-6	0.058 ÷ 0.121	
	Half bearings - crankpins	0.038 ÷ 0.116	
	Main half-bearings Connecting rod half-bearings	0.250; 0.500	
	Thrust main journal X 1	37.475 ÷ 37.550	37.475 ÷ 37.545
	Main journal support for thrust X 2	32.180 ÷ 32.280	
	Thrust half rings X 3	37.28 ÷ 37.38	
	Crankshaft thrust	0.095 ÷ 0.270	0.095 ÷ 0.265

	Type	**(NEF67 TM1F)**	**NEF67 TE1F/TE2F**
CYLINDER HEAD - TIMING SYSTEM		mm	
	Valve guide seats on cylinder head ∅ 1	8.019 ÷ 8.039	7.042 ÷ 7.062
	Valve guide ∅ 2 ∅ 3	- -	- -
	Valves: ∅ 4 α ∅ 4 α	7.960 ÷ 7.980 60°± 0° 7' 30'' 7.960 ÷ 7.980 45°± 0° 10'	6.990 ÷ 7.01 60°± 0° 7' 30'' 6.990 ÷ 7.01 45°± 0° 10'
	Valve stem and related guide	0.039 ÷ 0.079	0.032 ÷ 0.072
	Housing on head for valve seat: ∅1 ∅1	46.987 ÷ 47.013 43.637 ÷ 43.663	34.837 ÷ 34.863 34.837 ÷ 34.863
	Valve seat outside diameter; valve housing inclination on cylinder head: ∅ 2 α ∅ 2 α	47.063 ÷ 47.089 60°± 0.5° 43.713 ÷ 43.739 45°± 0.5°	34.917 ÷ 34.931 60°± 0° 7' 30'' 34.917 ÷ 34.931 45°± 0.5°
	X **Recessing** X	1.000 ÷ 1.520 1.000 ÷ 1.520	0.390 ÷ 0.910 0.760 ÷ 1.280
	Between valve seat and cylinder head	0.050 ÷ 0.102 0.050 ÷ 0.102	0.054 ÷ 0.094 0.054 ÷ 0.094
	Valve seats	-	

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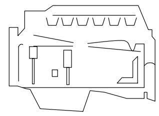
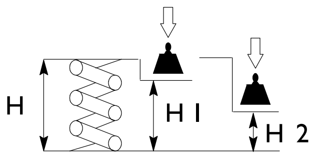
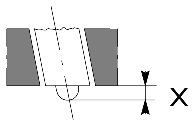
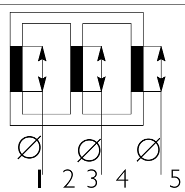
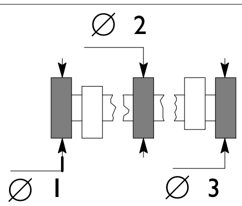
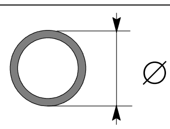
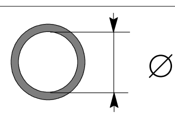
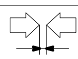
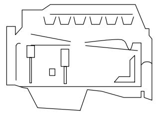
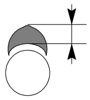
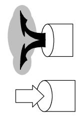
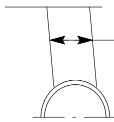
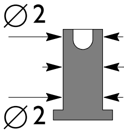
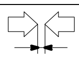
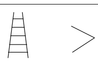
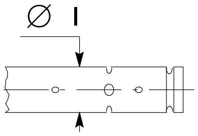
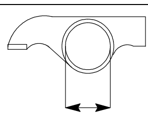
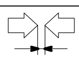
	Type	(NEF67 TM1F)	NEF67 TE1F/TE2F
CYLINDER HEAD - TIMING SYSTEM		mm	
	Valve spring height: free spring H under a load of: 329 N H1 641 N H2 339.8 ± 19 N H1 741 ± 39 N H2	 63.50 49.02 38.20 	 47.75 35.33 25.2
	Injector protrusion X	It cannot be adjusted	
	Seat for camshaft bushings timing system No. 1 (flywheel side) Camshaft seats n° 2-3-4-5-6-7	59.222 ÷ 59.248 54.089 ÷ 54.139	
	Camshaft journal diameter: 1 ⇒ 7	53.995 ÷ 54.045	
	Outer diameter of bushings ∅	-	
	Inner diameter of bushings ∅	54.083 ÷ 54.147	
	Bushings and supporting pins	0.038 ÷ 0.152	

	Type	(NEF67 TM1F)	NEF67 TE1F/TE2F
CYLINDER HEAD - TIMING SYSTEM		mm	
 H	Useful cam height:  H H	- -	
 Ø 1	Tappet washer seat in crankcase Ø 1	16.000 ÷ 16.030	
 Ø 2 Ø 3 Ø 2	Tappet outside diameter: Ø 2 Ø 3	15.929 ÷ 15.959 15.965 ÷ 15.980	15.924 ÷ 15.954 15.960 ÷ 15.975
	Between tappets and seats	-	
	Tappets	-	
 Ø 1	Rocker-arm shaft Ø 1	18.963 ÷ 18.975	21.965 ÷ 21.977
 Ø 2	Rocker arms Ø 2	19.000 ÷ 19.026	22.001 ÷ 22.027
	Between rockers and shaft	0.025 ÷ 0.063	0.024 ÷ 0.062

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TIGHTENING TORQUES (NEF67 TM1F)

DETAIL			TORQUE		
			Quantity	Nm	Kgm
Cooling nozzles	M8		6	15 ± 3	1.5 ± 0.3
Screws for camshaft shoulder plate	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws for main bearing caps	M12x1.75		14	80 ± 6 90 °	8.0 ± 0.6
Screw for timing gear case	M12x1.75		1	77 ± 12	7.7 ± 1.2
Screws for timing gear case	M8x1.25		4	24 ± 4	2.4 ± 0.4
Screws for timing gear case	M10x1.5		5	47 ± 5	4.7 ± 0.5
Screws for timing gear	M8x1.25		6	36 ± 2	3.6 ± 0.2
Screws for connecting rod caps	M10x1.25		12	60 ± 5 60°	6.0 ± 0.5
Nut for injection pump gear	M14x1.5		1	90 ± 5	9.0 ± 0.5
Nuts for securing injection pump	M8x1.25		3	24 ± 4	2.4 ± 0.4
Plug for heat exchanger valve	M22x1.5		1	80 ± 8	8.0 ± 0.8
Screws securing heat exchanger	M8x1.25		15	26 ± 4	2.6 ± 0.4
Screws securing cylinder head	M12x1.75	L = 70	26	60 ± 5 90 °	6.0 ± 0.5
		L = 140		40 ± 5 (90° + 90°)	4.0 ± 0.5
		L = 180		70 ± 5 (90° + 90°)	7.0 ± 0.5
Screws securing rocker arms	M8x1.25		6	24 ± 3	2.4 ± 0.3
Nuts for tappet adjuster	M8x1.25		12	24 ± 4	2.4 ± 0.4
Screws securing tappet cover	M8x1.25		6	24 ± 4	2.4 ± 0.4
Screws for sound-proofing plate	M10x1.5		14	43 ± 5	4.3 ± 0.5
Screws securing suction strainer	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws securing suction strainer bracket	M10x1.5		2	43 ± 5	4.3 ± 0.5
Screws fixing the oil pump	M8x1.25		4	8 ± 1	0.8 ± 0.1
				24 ± 4	2.4 ± 0.4
Screws securing front cover	M8x1.25		13	24 ± 4	2.4 ± 0.4
Screws securing flywheel housing	M12x1.75		8	85 ± 10	8.5 ± 1.0
Screws securing flywheel housing	M10x1.5		12	49 ± 5	4.9 ± 0.5
Screws securing oil sump	M8x1.25		18	24 ± 4	2.4 ± 0.4
Plug on oil sump	M18x1.5		1	65 ± 10	6.5 ± 1.0
Screws securing front hub	M12x1.25		6	50 ± 5 90 °	5.0 ± 0.5
Screws for pulley on front hub	M10x1.25		6	68 ± 7	6.8 ± 0.7
Plugs on cylinder head	½"		3	24 ± 4	2.4 ± 0.4
Plugs on cylinder head	¾"		2	36 ± 5	3.6 ± 0.5
Plug on cylinder head	¼"		1	12 ± 2	1.2 ± 0.2
Ring nut securing injectors	M24x1.5		6	60 ± 5	6.0 ± 0.5
Screws securing intake manifold	M8x1.25		8	24 ± 4	2.4 ± 0.4
Screws securing sling hook	M12x1.75		2	77 ± 12	7.7 ± 1.2
Screws securing sling hook	M8x1.25		4	36 ± 5	3.6 ± 0.5

DETAIL		TORQUE		
		Quantity	Nm	Kgm
Screws securing alternator	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nut for compressor gear control	M18x1.5 lh	1	165 ± 10	16.5 ± 1.0
Nut securing compressor	M12x1.75	2	77 ± 12	7.7 ± 1.2
Screws securing compressor support bracket	M8x1.25	4	24 ± 4	2.4 ± 0.4
Screws securing thermostat cover	M6x1	3	10 ± 2	1.0 ± 0.2
Nuts securing starter motor	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nuts securing turbocharger	M10x1.5	4	43 ± 6	4.3 ± 0.6
Screws securing exhaust manifold	M10x1.5	8	55 ± 3	5.5 ± 0.3
Screws for alternator mount	M10x1.5	3	43 ± 6	4.3 ± 0.6
Screws for oil pressure sensor	M6x1	2	10 ± 2	1.0 ± 0.2
Plugs to crankcase	M18x1.5	3	24 ± 4	2.4 ± 0.4
Screws for plate 4896952	M6x1	2	24 ± 4	2.4 ± 0.4
Screws for water pump	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screws for power steering pump	M10x1.5	2	43 ± 6	4.3 ± 0.6
Fitting for turbocharger oil delivery pipe	M16	2	36 ± 5	3.6 ± 0.5
Screws for turbocharger oil drain pipe	M8x1.25	2	24 ± 4	2.4 ± 0.4
Oil level sensor	M12x1.5	1	10 ± 2	1.0 ± 0.2
Screws securing oil level dipstick bracket	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for oil dipstick fastening clamp	M6x1	1	10 ± 2	1.0 ± 0.2
Oil filter	M27x2	1	20 ± 2	2.0 ± 0.2
Screw for crankshaft speed sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for fuel filter bracket	M12x1.75	2	80 ± 8	8.0 ± 0.8
Intake elbow clam	M7x1	1	13 ± 2	1.3 ± 0.2
Screws for exhaust elbow bracket	M8x1.25	4	24 ± 4	2.4 ± 0.4
Screw for belt tensioner	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4898548	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4892356	M10x1.5	1	43 ± 6	4.3 ± 0.6
Flywheel screws	M12x1.25	8	50 ± 5 60°	5.0 ± 0.5
Plug	M10x1	1	24 ± 4	2.4 ± 0.4

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TIGHTENING TORQUES (NEF67 TE1F/TE2F)

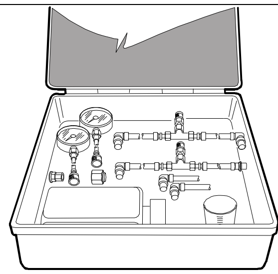
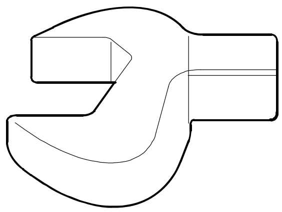
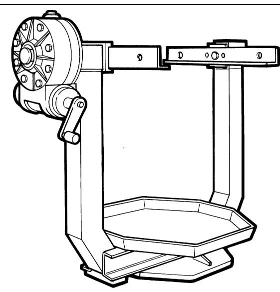
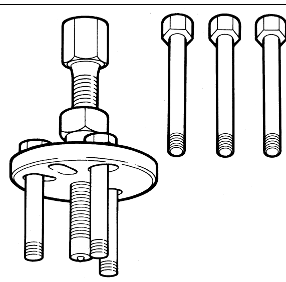
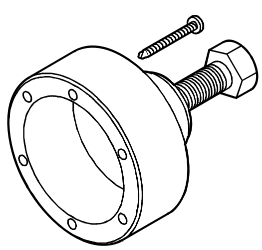
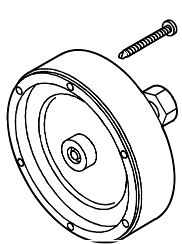
DETAIL			TORQUE		
			Quantity	Nm	Kgm
Cooling nozzles	M8		6	15 ± 3	1.5 ± 0.3
Screws for camshaft shoulder plate	M8x1.25		2	24 ± 4	2.4 ± 0.4
Screws for main bearing caps	M12x1.75		14	80 ± 6 90 °	8.0 ± 0.6
Screw for timing gear case	M12x1.75		1	77 ± 12	7.7 ± 1.2
Screws for timing gear case	M8x1.25		4	24 ± 4	2.4 ± 0.4
Screws for timing gear case	M10x1.5		5	47 ± 5	4.7 ± 0.5
Screws for timing gear	M8x1.25		6	36 ± 2	3.6 ± 0.2
Screws for connecting rod caps	M10x1.25		12	50 ± 5 60°	5.0 ± 0.5
Nut for injection pump gear	M18x1.5		1		
Nuts for securing injection pump	M8x1.25		3	24 ± 4	2.4 ± 0.4
Plug for heat exchanger valve	M22x1.5		1	80 ± 8	8.0 ± 0.8
Screws securing heat exchanger	M8x1.25		15	26 ± 4	2.6 ± 0.4
Screws securing cylinder head	M12x1.75	L = 130	26	35 ± 5 (90° + 90°)	3.5 ± 0.5
		L = 150		55 ± 5 (90° + 90°)	5.5 ± 0.5
Screws securing rocker arms	M8x1.25		12	36 ± 5	3.6 ± 0.5
Nuts for tappet adjuster	M8x1.25		12	24 ± 4	2.4 ± 0.4
Housing securing screws	M8x1.25		5	24 ± 4	2.4 ± 0.4
Nuts securing tappet cover	M10x1.5		6	24 ± 4	2.4 ± 0.4
Screws for sound-proofing plate	M10x1.5		14	43 ± 5	4.3 ± 0.5
Nuts fixing wiring on injectors	M4		12	1.5 ± 0.25	0.2 ± 0.03
Screws securing suction strainer	M8x1.5		2	24 ± 4	2.4 ± 0.4
Screws securing suction strainer bracket	M10x1.5		2	43 ± 5	4.3 ± 0.5
Screws fixing the oil pump	M8x1.25		4	8 ± 1	0.8 ± 0.1
				24 ± 4	2.4 ± 0.4
Screws securing front cover	M8x1.25		13	24 ± 4	2.4 ± 0.4
Screws securing flywheel housing	M12x1.75		8	85 ± 10	8.5 ± 1.0
Screws securing flywheel housing	M10x1.5		12	49 ± 5	4.9 ± 0.5
Screws securing oil sump	M8x1.25		18	24 ± 4	2.4 ± 0.4
Plug on oil sump	M18x1.5		1	60 ± 9	6.0 ± 0.9
Screws securing front hub	M12x1.25		6	50 ± 5 90 °	5.0 ± 0.5
Screws for pulley on front hub	M10x1.25		6	68 ± 7	6.8 ± 0.7
Plugs on cylinder head	½”		3	24 ± 4	2.4 ± 0.4
Plugs on cylinder head	¾”		2	36 ± 5	3.6 ± 0.5
Plug on cylinder head	¼”		1	12 ± 2	1.2 ± 0.2
Injector retaining screws	M6x1		12	3.5 ± 0.35 7,5 ± 0,35 25° + 25° + 25°	0.4 ± 0.04 0.8 ± 0.04
Connectors on cylinder head	M22x1.5		6	55 ± 5	5.5 ± 0.5
Screws securing intake manifold	M8x1.25		10	24 ± 4	2.4 ± 0.4
Screws securing sling hook	M12x1.75		2	77 ± 12	7.7 ± 1.2

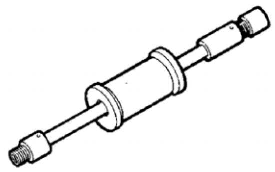
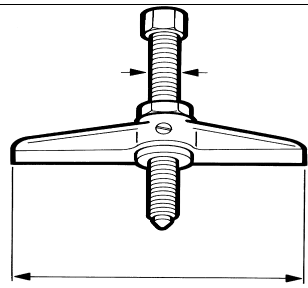
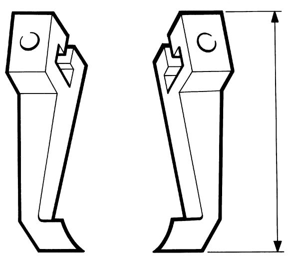
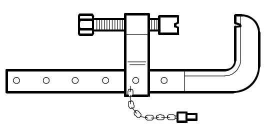
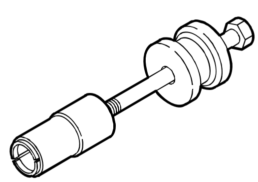
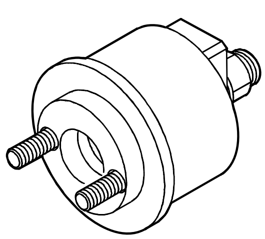
DETAIL		TORQUE		
		Quantity	Nm	Kgm
Screws securing sling hook	M8x1.25	4	36 ± 5	3.6 ± 0.5
Screws securing rail to intake manifold	M8x1.25	4	36 ± 5	3.6 ± 0.5
Screws securing alternator	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nut for compressor gear control	M18x1.5 lh	1	165 ± 10	16.5 ± 1.0
Nut securing compressor	M12x1.75	2	77 ± 12	7.7 ± 1.2
Screws securing compressor support bracket	M8x1.25	4	24 ± 4	2.4 ± 0.4
Screws securing thermostat cover	M6x1	3	10 ± 2	1.0 ± 0.2
Nuts securing starter motor	M10x1.5	3	43 ± 6	4.3 ± 0.6
Nuts securing turbocharger	M10x1.5	4	43 ± 6	4.3 ± 0.6
Screws securing exhaust manifold	M10x1.5	12	53 ± 5	5.3 ± 0.5
Screws for alternator mount	M10x1.5	3	43 ± 6	4.3 ± 0.6
Screws for oil pressure sensor	M6x1	2	10 ± 2	1.0 ± 0.2
Plugs to crankcase	M18x1.5	3	24 ± 4	2.4 ± 0.4
High pressure pipe fittings	M14x1.5	2	24 ± 4	2.4 ± 0.4
Rail pipe bracket screw	M10x1.5	1	40 ± 5	4.0 ± 0.5
Fittings 4896491 and 4897881	M16x1.5	4	24 ± 4	2.4 ± 0.4
Screws for plate 4896952	M6x1	2	24 ± 4	2.4 ± 0.4
Screws for water pump	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for camshaft rpm sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for power steering pump	M10x1.5	2	43 ± 6	4.3 ± 0.6
Sensor on cylinder heads (temperature)	M14x1.5	1	24 ± 4	2.4 ± 0.4
Union 4891285	¾" - 14	1	36 ± 4	3.6 ± 0.4
Screws for turbocharger oil drain pipe	M8x1.25	2	10 ± 2	1.0 ± 0.2
Breather plate screws	M6x1	3	10 ± 2	1.0 ± 0.2
Plate screw fixing breather on tappet cover	M6x1	3	10 ± 2	1.0 ± 0.2
Fittings securing breather 4899219	M12x1.5	3	20 ± 4	2.0 ± 0.4
Oil level sensor	M12x1.5	1	10 ± 2	1.0 ± 0.2
Screws securing oil level dipstick bracket	M8x1.25	2	24 ± 4	2.4 ± 0.4
Screw for oil dipstick fastening clamp	M6x1	1	10 ± 2	1.0 ± 0.2
Voss fitting 4896329 on cylinder head	M12x1.5	1	22 ± 2	2.2 ± 0.2
Oil filter	M27x2	1	20 ± 2	2.0 ± 0.2
Screw for crankshaft speed sensor	M6x1	1	10 ± 2	1.0 ± 0.2
Screws for fuel filter bracket	M12x1.75	2	80 ± 8	8.0 ± 0.8
Intake elbow clam	M7x1	1	13 ± 2	1.3 ± 0.2
Screws for exhaust elbow bracket	M8x1.25	4	36 ± 5	3.6 ± 0.5
Plugs securing the control unit	M8x1.25	3	24 ± 4	2.4 ± 0.4
Screw for belt tensioner 4898548	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4897031	M10x1.5	1	43 ± 6	4.3 ± 0.6
Screw for idler pulley 4892356	M10x1.5	1	43 ± 6	4.3 ± 0.6
Flywheel screws	M12x1.25	8	30 ± 4 60°	3.0 ± 0.4
Plug 4899009	M10x1	1	24 ± 4	2.4 ± 0.4
Screws securing control unit to support	M6x1	8	10 ± 2	1.0 ± 0.2
Nuts securing heater	M8x1.25	8	13 ± 3	1.3 ± 0.3
Voss fitting 4896542 on control unit supp.	M12x1.25	1	12 ± 2	1.2 ± 0.2
Screws securing sensor on intake manifold.	M6x1	2	10 ± 2	1.0 ± 0.2

SECTION 8
Tools

	Page
EQUIPMENT	3

EQUIPMENT

TOOL No.		NAME	F4GE	F4HE
99305453		Tool for checking diesel fuel system and common rail injection system		✓
99317915		Set of five 9x12 spintite wrenches (14 - 15 - 17 - 18 - 19)		✓
99322205		Revolving stand for overhauling units (capacity 1000 daN, torque 120 daNm)	✓	✓
99340035		Extractor for engine injection pump gear	✓	
99340055		Extraction tool for crankshaft front ring seal	✓	✓
99340056		Extraction tool for crankshaft rear gasket	✓	✓

TOOL No.		NAME	F4GE	F4HE
99340205		Percussion extractor with parts for extraction	✓	
99341001		Double-acting bridge		✓
99341009		Pair of brackets		✓
99341015		Clamp		✓
99342101		Extraction tool for injectors		✓
99346252		Key to fit crankshaft front gasket	✓	✓

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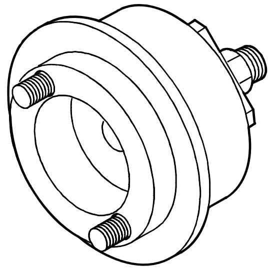
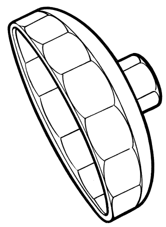
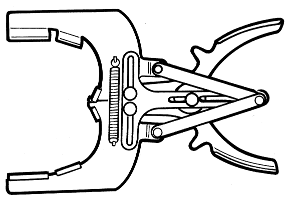
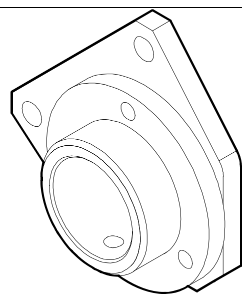
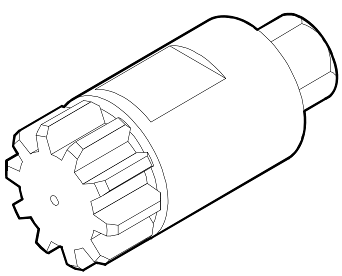
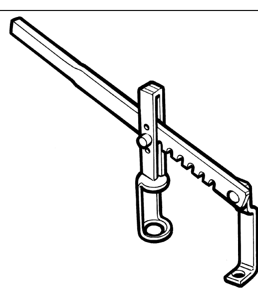
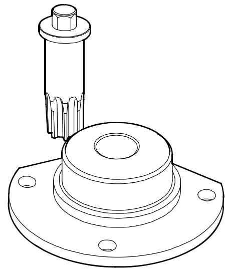
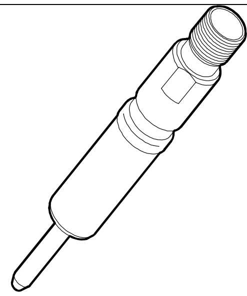
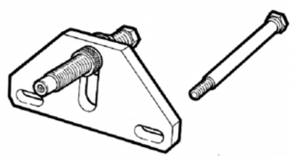
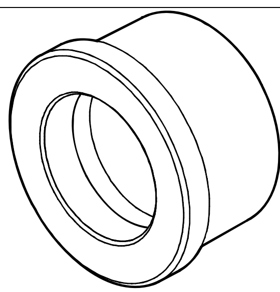
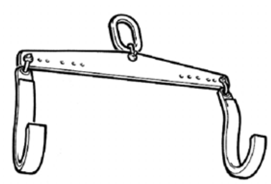
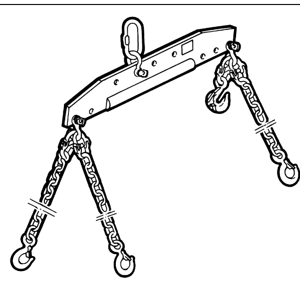
TOOL No.		NAME	F4GE	F4HE
99346253		Key to fit crankshaft rear gasket	✓	✓
99360076		Tool to remove oil filter (engine)	✓	✓
99360183		Tool for piston ring removal and assembly (65-110mm)	✓	✓
99360221		Engine flywheel rotation tool (use with 99360222)		✓
99360222		Pinion (use with 99360221)		✓
99360268		Tool to take down and fit back engine valves	✓	✓

TOOL No.		NAME	F4GE	F4HE
99360339		Tool to retain and rotate engine flywheel	✓	
99360344		Coupling for compression control in cylinders (use with 99395682)	✓	
99360351		Tool to retain flywheel	✓	✓
99360362		Drift tool for removing/fitting camshaft bushings (to be used with 99370006)	✓	✓
99360500		Tool for lifting the crankshaft	✓	✓
99360595		Arm for removing and refitting engine	✓	✓

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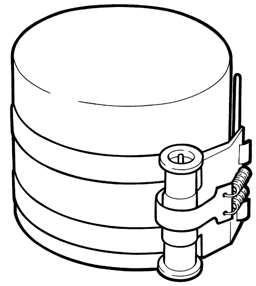
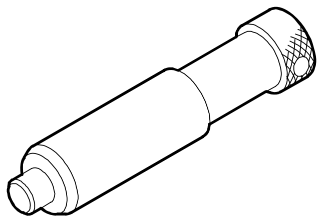
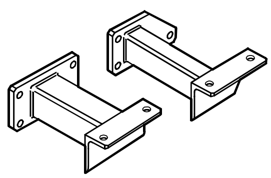
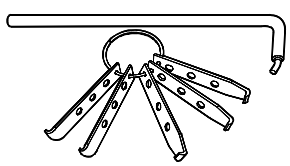
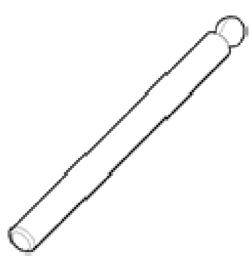
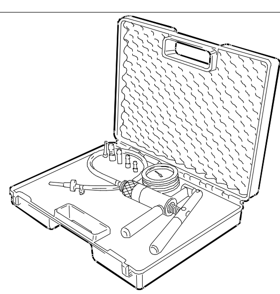
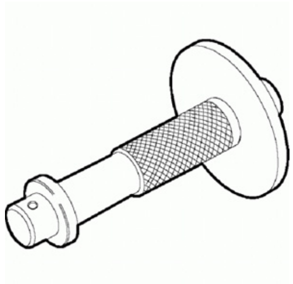
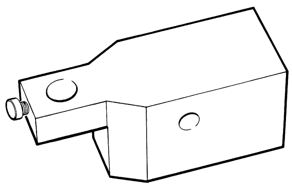
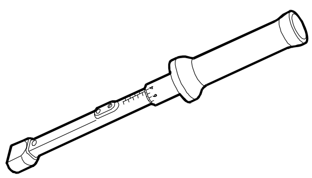
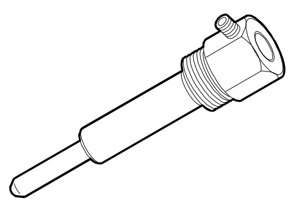
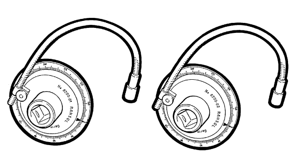
TOOL No.		NAME	F4GE	F4HE
99360605		Clamp for fitting piston into cylinder liners (60 ÷ 125 mm)	✓	✓
99360616		Tool for engine T.D.C. positioning	✓	
99361037		Brackets for fastening engine to 99322205 rotary stand	✓	✓
99363204		Tool to remove gaskets	✓	✓
99365196		Tool for positioning injection pump at delivery start	✓	
99367121		Manual pump for measuring pressure and vacuum	✓	✓

TOOL No.		NAME	F4GE	F4HE
99370006		Handgrip for interchangeable drift tools	✓	✓
99370415		Base of dial gauge for various measurements (use with 99395603)	✓	✓
99389829		9x12 coupling torque wrench (5-60 Nm)		✓
99389834		Torque screwdriver for connector retention nut adjustment injector solenoid valve (1- 6 Nm)		✓
99395097		Tool for top dead centre control (use with 99395604)	✓	
99395216		Pair of gauges for angular tightening with 1/2" and 3/4" square heads	✓	✓

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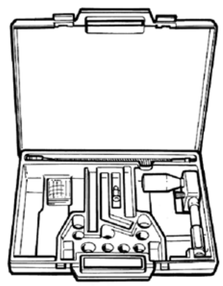
TOOL No.		NAME	F4GE	F4HE
99395603		Dial gauge (0 ÷ 5 mm)	✓	✓
99395604		Comparator gauge (0 ÷ 10 mm)	✓	
99395682		Diesel engine cylinder compression test device	✓	

Appendix

	Page
SAFETY REGULATIONS	3

SAFETY REGULATIONS

Standard safety precautions

We direct your attention on some precautions that must be necessarily followed in a regular work environment and, in case of non-compliance, any other precaution will not be sufficient to protect the safety of the staff in charge of maintenance.

- ❑ Please obtain information and inform the staff on applicable laws on safety, making the informative material available for consultation.
- ❑ Please keep the rooms as clean as possible and properly ventilated.
- ❑ Equip the rooms with specific, well-visible first-aid boxes, always stocked up with suitable medical aids.
- ❑ Be equipped with suitable fire extinguishing devices, properly signalled and never obstructed. Check their operation on a regular basis and train the staff on the intervention priorities and methods.
- ❑ Arrange meeting points for the evacuation of premises, signalling suitable escape routes.
- ❑ Absolutely prohibit smoking in the areas where the works subject to fire hazard are carried out.
- ❑ Draw the attention on prohibitions and indications with suitable signs, which are immediately comprehensible always in case of emergency.

Accident prevention

- ❑ Do not wear cloths with loose edges, rings and chains, while working near engines and moving organs.
- ❑ Use protective gloves and glasses when:
  - refuelling inhibitors or antifreeze;
  - replacing or refuelling lubricant oil;
  - using air or liquids under pressure (allowed pressure ≤ 2 bar).
- ❑ Wear a protective helmet if working in an area with suspended loads or overhead systems.
- ❑ Always wear safety shoes and cloths fitted to the body, better if equipped with rubber bands at the edges.
- ❑ Use protective creams for hands.
- ❑ Change wet clothes as soon as possible.
- ❑ In the presence of voltage higher than 48-60V, check the effectiveness of the ground electric connections. Make sure your hands and feet are dry and perform the work standing on insulating platforms.
  Do not proceed if not qualified!
- ❑ Do not smoke or spark free flames near batteries and any combustible material.
- ❑ Return oily rags or solvents to fire-proof containers.
- ❑ Do not perform operations without the necessary instructions.
- ❑ Do not use equipment to perform works other than those for which they have been designed, you may sustain accidents, even of serious type.
- ❑ In case of checks or calibrations that require the engine to be on, make sure that the room is properly ventilated and use proper fans to remove exhaust gases: intoxication and death hazard.

During maintenance

- ❑ Never open the filling cap of the cooling circuit when the engine is hot. The operating pressure will spill the high temperature liquid with serious risk of burns. Wait until the temperature drops below 50 °C.
- ❑ Never add coolant to an overheated engine and only use appropriate fluids.
- ❑ Always operate with engine off: if special circumstances require maintenance with the engine running, consider all risks these operations entail.
- ❑ Use adequate and safe containers for draining the engine fluids and exhaust oil.
- ❑ Keep the engine clean from oil, diesel and/or chemical solvents.
- ❑ The use of solvents or detergents during maintenance may develop toxic vapours. Always ventilate the work rooms. Use safety masks when required.
- ❑ Do not leave cloths soaked with flammable substances near the engine.
- ❑ When starting up the engine after a repair operation, arrange for suitable measures to stop air suction in case of over-revving.
- ❑ Do not use quick screwers.
- ❑ Do not disconnect the batteries whilst the engine is running.
- ❑ Before any interventions involving the electrical circuits, disconnect the batteries.
- ❑ Disconnect the batteries from the on-board network while charging.
- ❑ After each intervention, make sure the polarity of the battery's terminals is respected and the latter are well tightened and protected against accidental short circuits and oxidation phenomena.
- ❑ Do not disconnect and connect the electric connections when power is on.
- ❑ Before carrying out removal operations on pipes (pneumatic, hydraulic or fuel pipes) check the possible presence of fluid or air under pressure. Adopt the necessary precautions, exhausting the residual pressures or closing the shut-off valves. Always wear suitable masks or protective glasses. Failure to follow these rules may cause serious accidents and intoxication.

- Avoid improper tightening operations or out of torque. The engine's components may be damaged also seriously, thus prejudicing their life cycle.
- Avoid draughts from fuel tanks in copper alloy and/or pipes without filters.
- Do not apply changes to the cabling, their length must not be modified.
- Do not connect any utility to the engine's electric equipment, if not specifically approved by FPT.
- Do not modify the fuel or hydraulic systems without authorisation from FPT. Any unforeseen change will void the warranty and may prejudice the engine's duration and life cycle.

For engines equipped with electronic units:

- Do not carry out any arch welding without previously removing the electronic units.
- Remove the electronic control units in case of interventions in which the temperatures will exceed 80 °C.
- Do not paint the electronic components and connections.
- Do not modify or alter the data contained in the engine management electronic control unit. Any manipulation or alteration of the electronic components will totally void the engine's service guarantee and may prejudice the engine's duration and life cycle.

Protection of the environment

- Allows prioritise protection of the environment implementing all necessary precautions to protect the safety and health of staff.
- Make sure you and all staff are fully aware of current standards for the treatment and disposal of fluids and engine oils. Set up adequate signage and specific courses to ensure a full understanding of the rules and the basic prevention measures.
- Collect used oil in a suitable, airtight container and ensure storage environments that are properly marked, ventilated, away from heat sources and free of fire hazards.
- Handle batteries with care in well ventilated areas and in antacid containers. Beware of fumes coming from the batteries: they may pose a serious risk of poisoning and contamination of the environment.

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