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GENERAL WARNINGS



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

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

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

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

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

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

Keep personnel not authorised to operations clear of working area.

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

Do not leave the running assembly unattended when making repairs.

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

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

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

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

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

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

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LUBRICATION

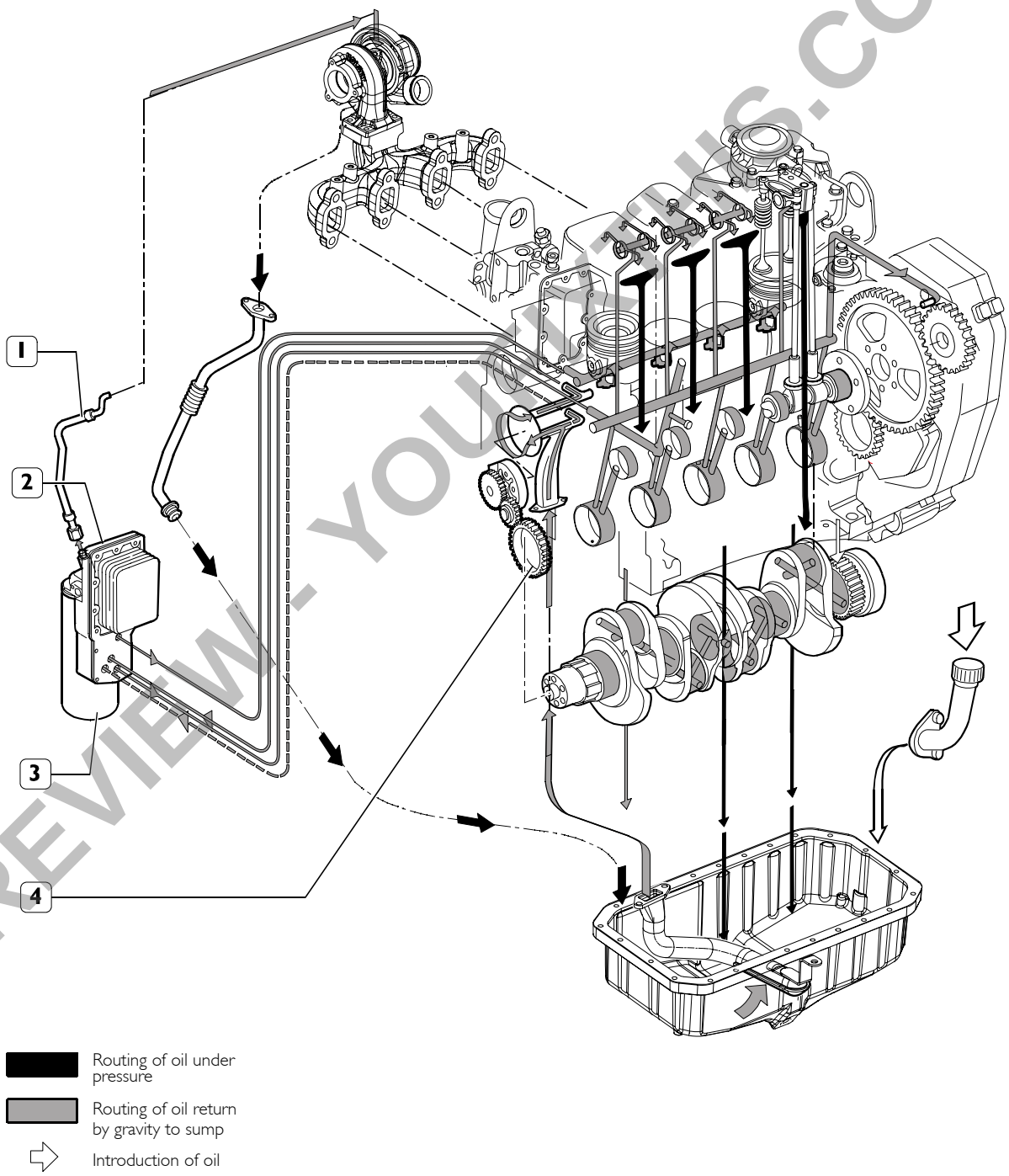
Lubrication by forced circulation is achieved through oil rotary expansion pump, placed in the front part of the basement, driven by the straight-tooth gear splined to the shaft's bar hold.

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

Lubrication involves the heat exchanger and the turboblower.

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

Figure 1



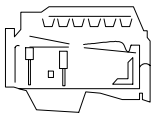
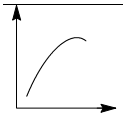
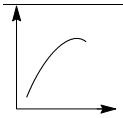
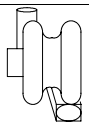
LUBRICATION SYSTEM LAYOUT

1. Lubrication oil pipe to supercharger - 2. Heat exchanger body - 3. Oil rotary expansion pump - 4. Oil filter.

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CLEARANCE DATA

	Type	F4GE9454J*604
ϱ	Compression ratio	17.5:1
 	Max. output kW (HP) rpm	66 (90) 2200
 	Max. torque Nm (kgm) rpm	400 (40.0) 1250
	Loadless engine idling rpm	950
	Loadless engine peak rpm rpm	2430
	Bore x stroke mm Displacement cm^3	104 X 132 4485
	**SUPERCHARGING** Turbocharger type	without intercooler Direct injection HOLSET HX25
	**LUBRICATION** **Oil pressure (warm engine)** - idling bar - peak rpm bar	Forced by gear pump, relief valve single action oil filter > 0.70 3.1
	COOLING **Water pump control Thermostat** - start of opening °C	By centrifugal pump, regulating thermostat, heat exchanger, intercooler Through belt 81 ± 2
ACEA: E3, E5, E7 URANIA LD7 20W40: 0°C to 40°C (Very hot countries, heavy mission)  15W40: -10°C to 40°C (Europa/Nord American mission) 10W30: -28°C to 35°C (Cold mission)	**FILLING** engine sump* liters engine sump + filter* liters * First filling operation	 13 14

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

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

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OVERHAUL OF THE ENGINE

Preface

Part of the operations illustrated within this section can be partially executed while the engine is assembled on the vehicle, depending on the room available for access to the engine and on the equipment application as well.

NOTE With regard to the engine disassembly operations, please apply for information consulting the specific manual. All operations of engine disassembly operations as well as overhaul operations must be executed by qualified engineers provided with the specific tooling and equipment required.

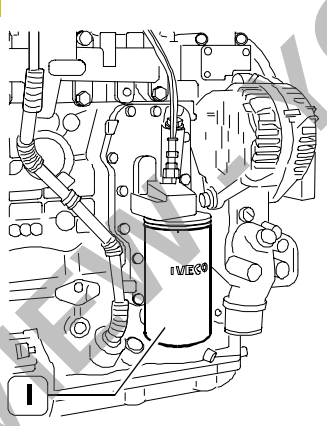
The following information relate to the engine overhaul operations only for what concerns the different components customising the engine, according to its specific duties.

NOTE For specific application exigencies, some units can be assembled to the engine in different positions.

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

Engine setting operations for the assembly on turning stand

Figure 2



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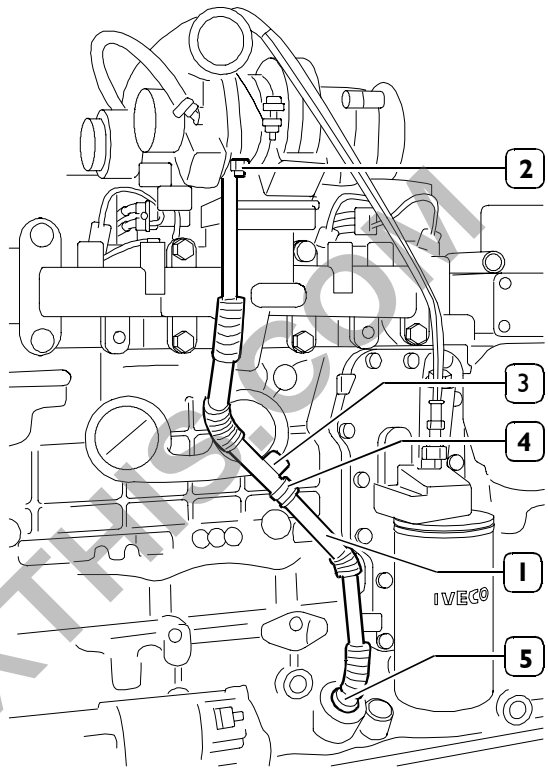
In order to apply the brackets 99361037 to the engine block to fix it on to the stand 99322205 for the overhaul, it is necessary to perform the following operations:

On the right hand side:

- ❑ disassemble pipes (1) from the union (2) fitting the lubrication oil filter (assembled on the opposite side): unlock the nuts fixing the pipes (1) and remove them from the union (2); drain the oil eventually still inside the pipes and plug them properly in order to avoid impurity inlet.

NOTE For some versions, the oil filter (3) is directly assembled on to the heat exchanger:in such case it shall be disassembled using tool 99360076.
Warning: the oil filter contains inside aprx. 1 kg. of engine oil. Provide for oil recovery and disposal in compliance with the law and regulations in force.

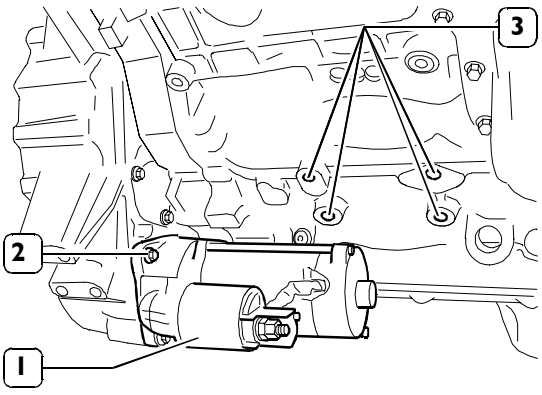
Figure 3



75671

- ❑ disassemble lubrication oil exhaust pipe from the turbo-blower:
Underneath the turbo-blower loosen the two screws (2), loosen the screw (3) fixing the pipe throughout the stop collar (4) fixing the block; finally loosen and remove the union (5) from the block; plug the pipe ends and the exhaust of the turbo-blower.

Figure 4



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- ❑ Disassemble the starter;
Properly hold the starter (2) and loosen the fixing screws (1);
assemble the supporting bracket (99361037) using the threaded ports on the basement.

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ANOMALY	POSSIBLE CAUSE	REMEDY	NOTE
The engine does not start	Battery flat or faulty.	Check and recharge battery. Replace battery if necessary.	
	Connections to battery terminals corroded or loose.	Clean, examine and tighten the nuts on the battery terminals. Replace the cable terminals and the nuts if excessively corroded.	
	Incorrect timing of injection pump.	Check and correctly time the injection pump.	See your FPT dealer.
	Deposits or water in the fuel tank.	Disconnect the hoses and clean them using a jet of compressed air. Dismantle and clean the injection pump. Remove water from tank and refuel.	Drain feed system.
	No fuel in tank.	Refuel.	
	No power supply.	Overhaul or replace the fuel or transfer pump.	
	Air bubbles in the fuel lines or injection pump.	Check the hoses to ensure that air is in fact present and also check the fuel pump. Eliminate the air from the injection pump by unscrewing the cap and working the fuel pump by hand.	
	Faulty starter motor.	Repair or replace the starter motor.	

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MAINTENANCE SCHEDULE

On purpose to guarantee the right engine use please follow the below indicated maintenance schedule.

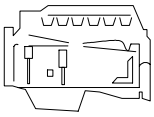
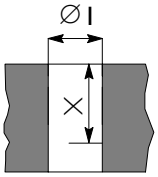
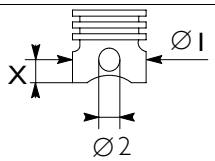
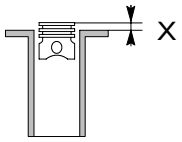
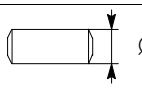
It is not only allowed but recommended that the staff in charge of the maintenance should also carry out the necessary maintenance and controlling operations even if not being included in the ones listed here below but that may be suggested by common sense and by the specific conditions in which the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

Maintenance operations	Frequency (hours)
Visual check of engine	Daily
Check presence of water in fuel filter or pre-filter	Daily
Check of belt wear status	-
Check and setting of tappet clearance	3600
Oil and filter replacement .	600
Fuel filter and prefilter replacement	600
Belt replacement	1800

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CLEARANCE DATA

	Type	4 CYLINDERS
CYLINDER UNIT AND CRANKSHAFT COMPONENTS		mm
	Cylinder barrels Ø1 >	104.000 to 104.024 0.4
	Spare pistons type: Size X Outside diameter Ø 1 Pin housing Ø 2	 55.9 103.714 to 103.732 38.010 to 38.016
	Piston – cylinder barrels	0.268 to 0.310
	Piston diameter Ø 1	0.4
	Piston protrusion X	0.28 to 0.52
	Piston pin Ø 3	37.994 to 38.000
	Piston pin – pin housing	0.010 to 0.022

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TIGHTENING TORQUE

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

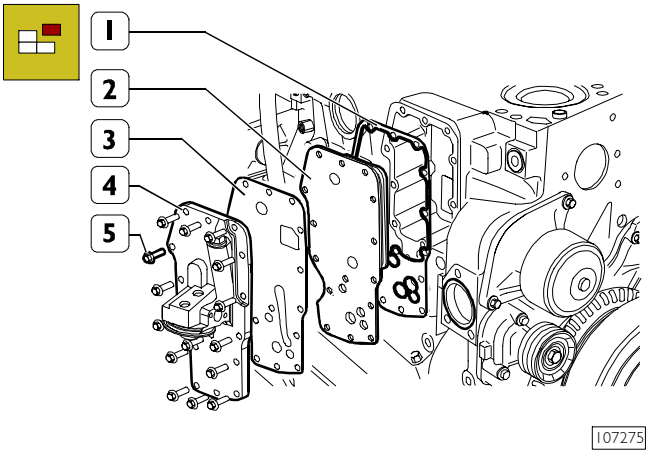
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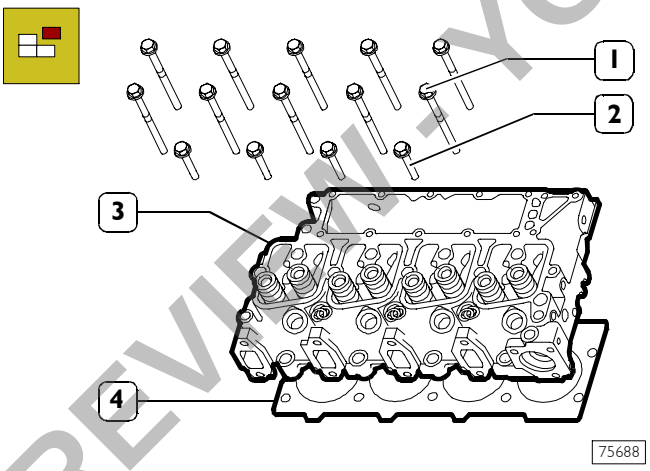
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Figure 21



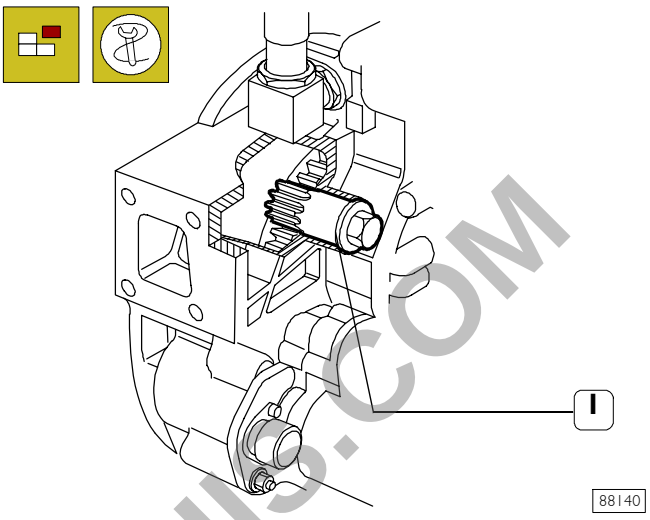
- ❑ Loosen the screws (5) and disassemble the oil filter/heat (2) exchanger bearing (4), interlayer plate (3) and relating gaskets (1).
- ❑ Disassemble injection pump (see specific procedure) and the power take-off underneath.

Figure 22



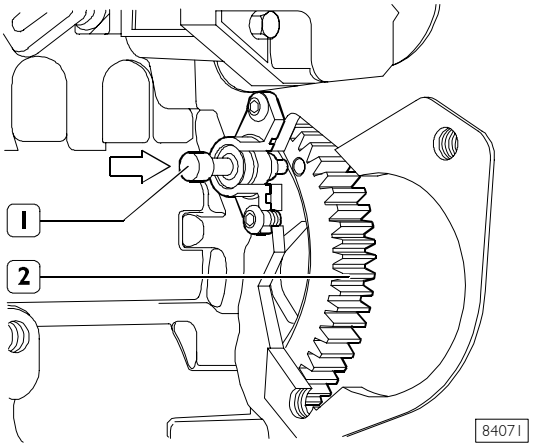
- ❑ Disassemble cylinder head;
  loosen the screws (1) and (2) fixing the cylinder head (3); hook the brackets with metal ropes and, throughout a hoist withdraw cylinder head from the block.

Figure 23



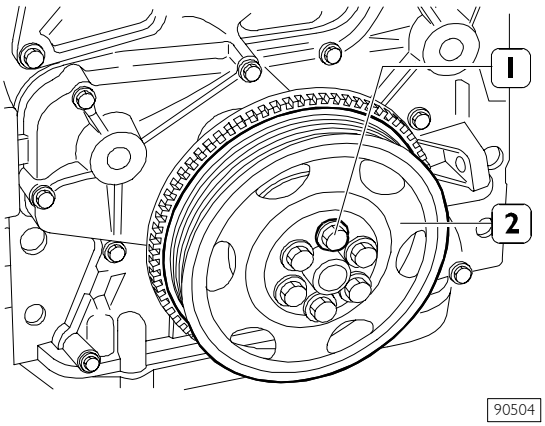
Fit tool 99360330 (2) in the starter motor housing to be able to rotate the flywheel.

Figure 24



Turn the flywheel until, when pushing the pin 99360616 (1), it blocks the gear (2).

Figure 25



- ❑ Loosen the screws (1) and disassemble the pulley (2).

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Check of drive belt tensioning

There is an automatic tensioner which corrects the belt tension.

Check of belt's tear and wear status

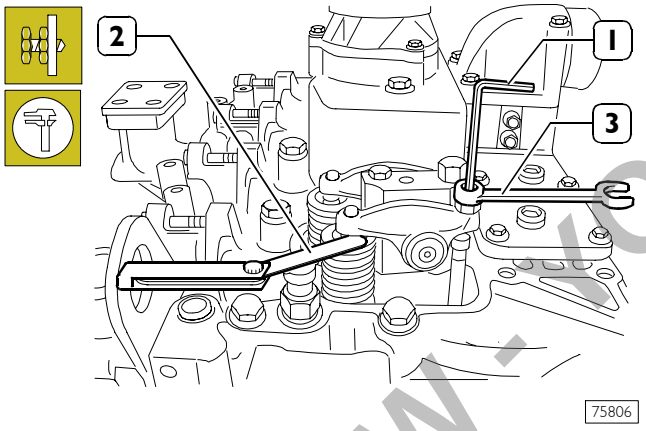
Carefully verify the belt's surface in order to detect any sign of incision, crack, excessive wear in correspondence of toothing; check end and surface grinding.

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

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

Check and setting of tappet clearance

Figure 117



On TIER 3 engines, due to the additional lobe for the INTERNAL E.G.R., it is not possible to use the valve clearance adjustment procedure that requires adjusting the clearance of all the valves by positioning the crankshaft 2 times only.

Each cylinder must be checked by taking it to the T.D.C. (top dead centre) at the end of compression and adjusting the clearance of both valves on the cylinder in question.

Remove the rocker covers of the cylinder; remove the injector and place the tool 99395097 (see Figure 98) to set the cylinder top dead centre position (end-of-compression phase). Pre-load the gauge.

The searched condition is obtained by rotating the engine shaft properly until you find the maximum value on the comparator and then checking that the intake and exhaust valves are both closed.

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

Correct slack is:
- suction valves 0.25 ± 0.05 mm
- exhaust valves 0.50 ± 0.05 mm.

IGNITION SEQUENCE: 1 - 3 - 4 - 2

Engine shaft starting and rotation	Bilance valves cylinder n°	Adjust intake and exhaust valves clearance cylinder n°
1° al PMS	1	1
180°	3	3
180°	4	4
180°	2	2

Oil motor and filter replacement

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

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

Due to the several applications, the pan shape and the oil quantity can change slightly. However, the following operations are valid for all applications.

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

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

The oil motor is very pollutant and harmful.

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

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

Dispose of the residual properly following the rules.

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