F1A engine

	Page
MAIN OPERATIONS ON ENGINE MOUNTED ON VEHICLE	291
ENGINE REMOVAL-REFITTING	293
❑ Removal	293
❑ Refitting	297
❑ Checks and tests	297
❑ Power steering system air bleed	297
REPLACING BELTS	298
❑ Replacing air-conditioning compressor drive belt (version with belt tensioner)	298
❑ Disassembly	298
❑ Assembly and adjusting belt tension	298
❑ Replacing air-conditioning compressor drive belt (version with elastic belt)	298
❑ Disassembly	298
❑ Assembly	298
❑ Power steering pump-alternator belt replacement	298
❑ Disassembly	298
❑ Assembly	298
❑ Replacing timing drive belt	299
❑ Disassembly	299
❑ Assembly	300
REPLACING ELECTRO-INJECTORS	301
❑ Disassembly	301
❑ Assembly	301
CYLINDER HEAD REMOVAL AND REFITTING	302
❑ Removal	302
❑ Refitting	304
REPLACING HIGH-PRESSURE PUMP CP3	305
❑ Removal	305
❑ Refitting	305
REPLACING WATER PUMP	305
❑ Removal	305

	Page
❑ Refitting	305
EMISSIONS	306
ENGINE IDENTIFICATION CODE	308
CHARACTERISTIC CURVES	308/1
GENERAL SPECIFICATIONS	310
ASSEMBLY DATA – CLEARANCES	313
TOOLS	318
EXPERIMENTAL TOOLS	323
TIGHTENING TORQUE	334
OVERHAULING ENGINE F1A	339
DISASSEMBLING THE ENGINE AT THE BENCH	339
REPAIRS	348
CYLINDER BLOCK	348
❑ Checks and measurements	348
❑ Checking head mating surface on cylinder block	349
CRANKSHAFT	349
❑ Measuring main journals and crank pins	349
❑ Checking crankshaft	350
❑ Replacing timing control gear	352
ENGINE ASSEMBLY	352
❑ Assembling main bearings	352
❑ Measuring main journal assembly clearance	352
❑ Checking crankshaft end float	353
❑ Assembling rear seal	354
❑ Replacing bearing supporting gearbox input shaft	355
ENGINE FLYWHEEL	355
CONNECTING ROD – PISTON ASSEMBLY	355
❑ Pistons	356
❑ Measuring piston diameter	356
❑ Piston pins	357
❑ Conditions for correct pin-piston coupling	357
❑ Piston rings	357
❑ Connecting rods	358
❑ Bushes	359
❑ Checking connecting rods	359
❑ Checking torsion	359
❑ Checking bending	359
❑ Assembling connecting rod-piston assembly	359
❑ Checking for connecting rod – piston distortion	360
❑ Assembling piston rings	360
❑ Assembling connecting rod – piston assemblies in cylinder barrels	360
❑ Measuring crankpin assembly clearance	361
❑ Checking piston protrusion	361
CYLINDER HEAD	362
❑ Disassembly	362
❑ Removing valves	362
❑ Checking cylinder head seal	363
❑ Checking cylinder head mating surface	363
VALVES	363
❑ Removing deposits, refacing and checking valves	363
❑ Checking clearance between valve stem and valve guide and centring valves	364
VALVE GUIDES	364
❑ Replacing valve guides	364
❑ Boring valve guides	364
VALVE SEATS	365
❑ Regrinding - replacing valve seats	365
VALVE SPRINGS	366
ROCKER ARMS – TAPPETS	366
❑ Checks	367
ASSEMBLING CYLINDER HEADS	367
❑ Overhead	368
❑ Overhead removal	368
TIMING SYSTEM	369
❑ Description	369
❑ Camshaft	370
❑ Checks	370
❑ Checking cam lift and pin alignment	370

Page

- Assembling overhead 371
- Assembling front seal ring 372
- Refitting cylinder head 375
- Adjusting air-conditioner – compressor drive belt tension 378
- Timing speed sensor 382
- Engine speed sensor 382

LUBRICATION 383

- General 383

OIL VACUUM PUMP ASSEMBLY (GPOD) 385

- Oil pump 385
- Characteristic data 385
- Vacuum pump 385
- Oil pressure control valve 386
- Oil filter 386
- Modine heat exchanger 386
- Oil vapour recirculation system 387
- Description 387

COOLING 388

- Description 388
- Operation 388
- Electromagnetic pulley 389
- Water pump 389
- Thermostat 389

TURBOCHARGING 390

- Description 390
- Turbocharger 391

REPAIRS 392

- Pressure relief valve 392
- Checking and adjusting pressure relief valve . . . 392
- Replacing pressure relief valve 392

EXHAUST GAS RECIRCULATION (EGR) SYSTEM 393

- EGR system operation 393
- Operating principles 393
- Air flow meter 394

FUEL SUPPLY 395

HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM (MS 6.3 - EDC 16) 395

- General 395

SYSTEM OPERATION 397

- Self-diagnosis – BLINK CODE 397
- Immobilizer recognition 397
- Checking fuel temperature 397
- Checking engine coolant temperature 397
- Checking quantity of fuel injected 397
- Checking idling adjustment 397
- Fuel cut-off in release phase 397
- Checking cylinder balancing on idling 397
- Checking regular engine rotation (anti-sawing) . 397
- Checking smokiness at exhaust on acceleration 397
- Checking exhaust gas recirculation (E.G.R. if present) 397
- Checking top speed limit 397
- Checking regular rotation on acceleration 397
- Checking glow plug control unit 397
- Checking activation of air-conditioning system . 397
- Checking fuel pump 397
- Checking diesel warming 398
- Checking cylinder position 398
- Checking pilot and main injection timing 398
- Checking injection pressure closed cycle 398
- Fuel supply 398
- Correcting flow rate according to water temperature 398
- Correcting flow rate to avoid noise, smoke or overloading 398

	Page
❑ De-rating	398
❑ Injection timing electronic test	398
❑ Speed governor	398
❑ Engine starting	398
❑ Cold starting	399
❑ Warm starting	399
❑ Run up	399
❑ After run	399
❑ Cut-off	399
❑ Cylinder balancing	399
❑ Synchronization search	399
OPERATION	401
HYDRAULIC SYSTEM	403
❑ Fuel pump	403
❑ Specifications	403
❑ Fuel filter	404
❑ Tightening torques	404
❑ Fuel pipes	404
❑ High-pressure pump	405
❑ High-pressure pump internal structure	407
❑ Working principle	408
❑ Pressure control valve	411
❑ Replacing pressure regulator.	411
MECHANICAL SUPPLY PUMP	412
❑ Hydraulic accumulator (rail)	413
❑ Overpressure valve (for forged hydraulic accumulator)	413
ELECTRO-INJECTORS	413
❑ Operation	414
ELECTRIC/ELECTRONIC COMPONENTS	414
❑ Electronic control unit MS6.3 or EDC 16	414
❑ Glow plug electronic control unit	415
❑ Glow plugs	415
SENSORS	415

	Page
❑ Engine speed sensor	415
❑ Camshaft timing sensor	415
❑ Air temperature and pressure sensor	415
❑ Fuel temperature sensor	415
❑ Fuel pressure sensor	415
❑ Atmospheric pressure sensor	415
❑ Engine coolant temperature sensor	416
❑ Throttle pedal position sensor	416
❑ Clutch pedal position sensor	416
❑ Brake pedal position sensor	416
❑ Vehicle speed sensor	416
ACTUATORS	416
❑ PWM (Pulse Width Modulation) controls	416
GUIDE TO TROUBLESHOOTING	417

MAIN OPERATIONS ON ENGINE MOUNTED ON VEHICLE

Keep to the following instructions before doing any work on the engine involving components of the fuel supply system.

- ❑ Before doing any work on the engine, perform the engine/vehicle fault diagnosis with specific IVECO diagnosis equipment and print out the results.
- ❑ Replacement of the MS6.3 or EDC 16control unit must be authorized by the **Help Desk.**
- ❑ Following components in feed system cannot be overhauled but have to be replaced: pressure relief valve, if present, fuel pressure sensor, hydraulic accumulator, complete CP1 high pressure feed pump, pressure control valve, electric injectors.
- ❑ All the parts of the Common Rail system are packaged by the supplier in sheets of oiled paper and are stored in cardboard boxes. They must therefore be protected against moisture and unpacked just prior to assembly.
- ❑ The greatest care must be taken over the cleanliness of parts, making sure that when handling or assembling (starting with straightforward filter and pre-filter replacement) no dirt of foreign bodies can get inside. For this reason, the plugs protecting the hydraulic parts and sensors must be removed just prior to positioning in their seats.
- ❑ Take care over the direction of assembly for all electrical connections.
- ❑ All threaded connections must be tightened to the prescribed torque.
- ❑ All the quick-coupling connectors (on the engine they are found on the high-pressure pump and on the diesel drain manifold) must be fully inserted. To drive them out, press on the tabs at the base of the connectors.

Electro-injector

None of the couplings/unions/nuts on the injector body may be handled. It is neither necessary nor permitted to dismantle the nozzle body or the electromagnet.
If working on the high-pressure pipe, the hexagon on the injector side must be kept stationary with a wrench.
Before working on pipes, make sure the injector is stationary in its seat on the cylinder head.
When assembling/disassembling the injector drain, the retaining spring must not be removed from its seat in the injector: pushing the spring towards the engine and applying a vertical force on the connector frees the recirculation. When assembling, rest the recirculation connector in its seat and apply a vertical force while keeping the retaining spring pressed in the direction of the engine. Fitting in has to be easy.

CP3 High-pressure pump

If working on the high-pressure pipe, the hexagon on the pump side must be kept stationary with a wrench.
Before working on the high-pressure pipe, make sure the pump is secured in its seat.

High-pressure pipes

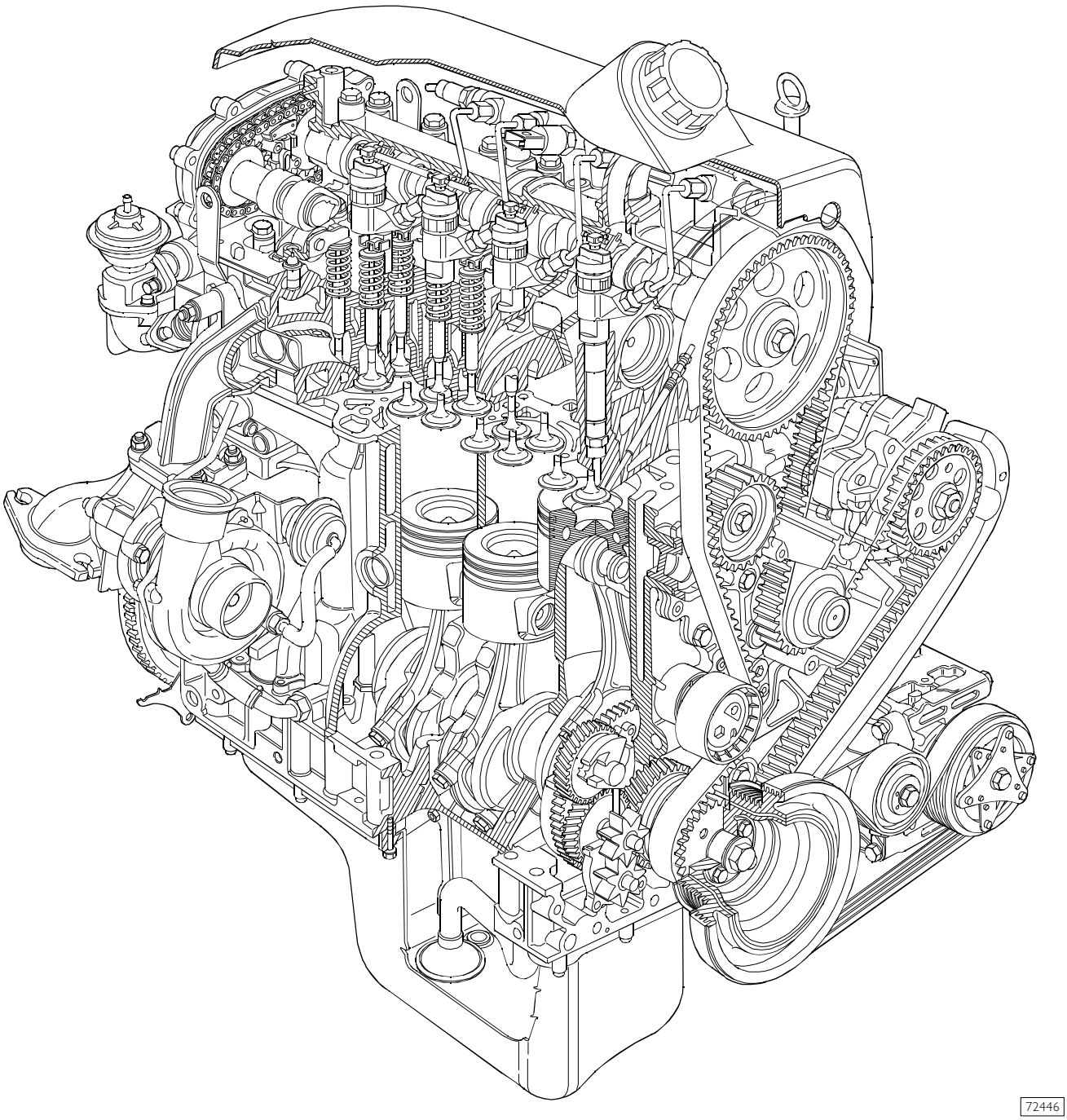
Each high-pressure pipe must be replaced after disassembly operations.
The couplings must be tightened or loosened with the injectors, hydraulic accumulator (rail) and high-pressure pump well secured and taking care to keep the hexagon on the component side stationary, space permitting.

Hydraulic accumulator (rail) and accessories

Pressure sensor, as well as pressure relief valve (if present) can be successively mounted 5 times. Thereafter, they need to be replaced. They must be lubricated with a thin layer of oil before being mounted.
Pressure relief valve, if present, must also be lubricated before being mounted and its gasket must compulsorily be replaced.

Toothed timing drive belt

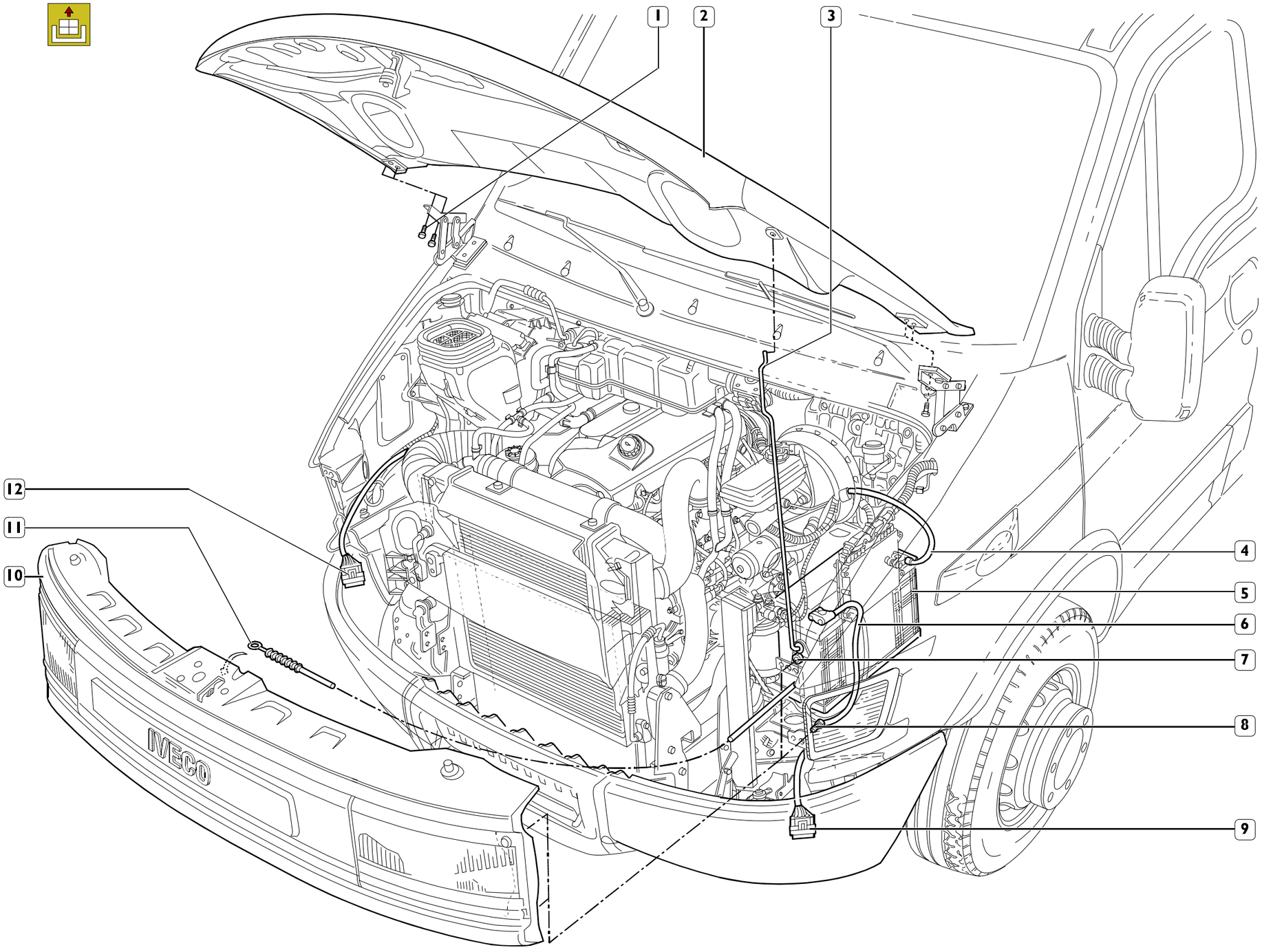
If the engine has run for a period equivalent to over 25,000 km, the toothed timing drive belt must be replaced with a fresh one, no matter what its state of wear, whenever it gets removed or any work is done on its automatic tightener.


72446

540110 ENGINE REMOVAL-REFITTING

Removal

Figure 1



Set the vehicle over the pit or on the lift.

Lift up the bonnet (2), unscrew the screws (1) securing it and take it off. Remove the prop (3).

Disconnect the negative cable (4) and the positive cable (6) from the battery (5) and detach this from the engine bay.

Unhook the cable (11) from the bonnet opening control devices.

Disconnect the electrical connections (12) of the front headlamps.

Unscrew the nuts (7) and screws (8), then remove the front cross member (10) with the light clusters.

Unscrew the screws (10, 12 and 14) and remove the bottom side guards (11 and 13).

Underneath the vehicle (see Figure 4):

- ❑ Unscrew the screws (⇒) and remove the central guard (12).

- ❑ Take the cap (2) off the expansion tank (4).
- ❑ Unscrew the coolant plug (16), under the radiator (17), and drain the cooling system.
- ❑ Disconnect the pipe (25) from the coalescence filter (26) and from the air intake pipe (14).
- ❑ Disconnect the pipes (12) and (13) from the heat exchanger, intake manifold and turbocharger.

NOTE Close the turbocharger air outlet appropriately to prevent foreign bodies accidentally getting inside and damaging it.

- ❑ Disconnect the coolant pipes (9 and 10).

NOTE Vehicles with an air-conditioner in the cab should have the electrical connection (15) disconnected from the drier filter.

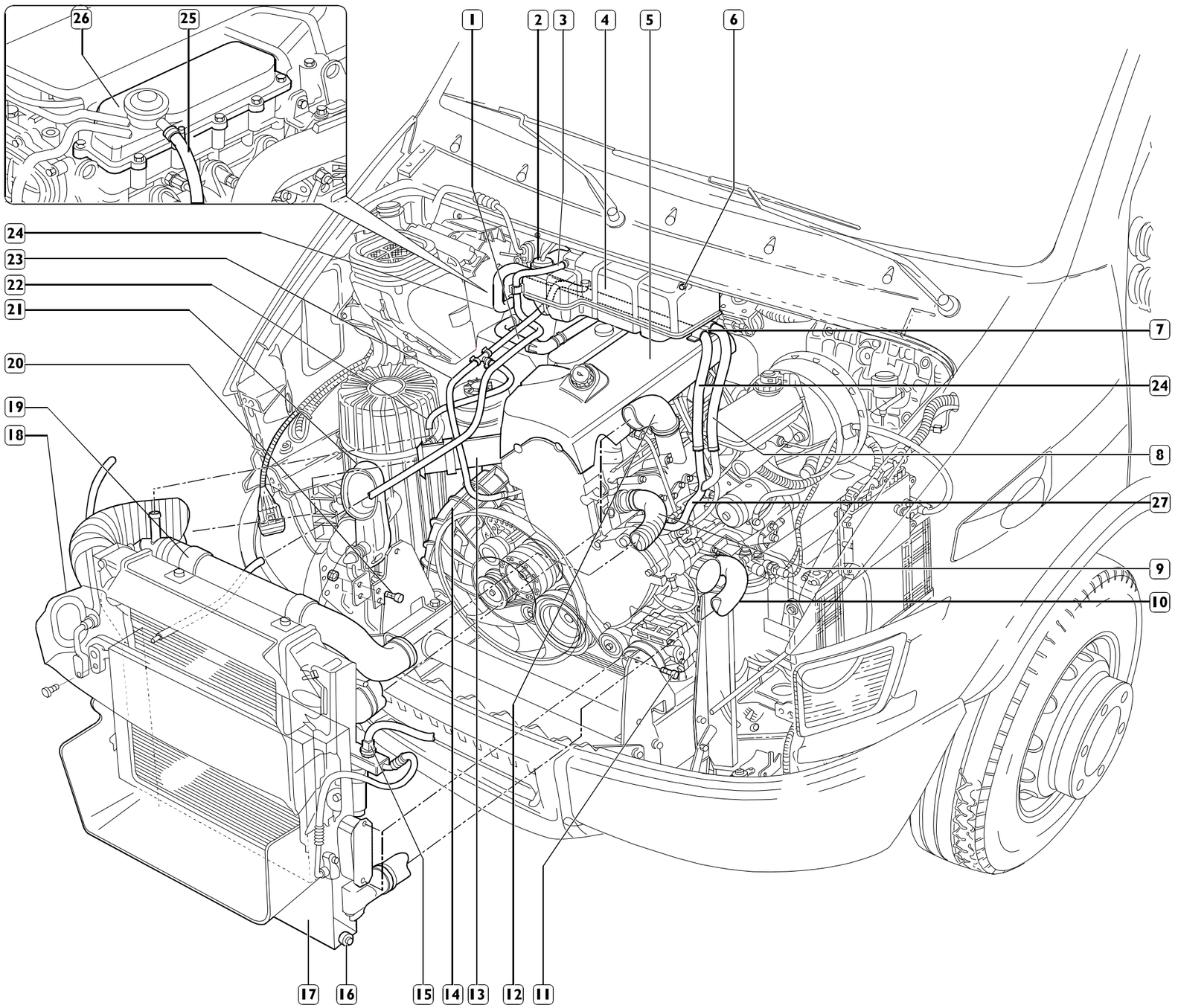
- ❑ Unscrew the air filter bracket fasteners (20) to help extract the air intake pipe (21) from the duct (18) on the radiator assembly.
- ❑ Disconnect the pipe (22) from the duct (19) and (23) from the engine.
- ❑ Disconnect the tube (3) from the expansion tank (4).
- ❑ Unscrew the screws (11) to remove the radiator assembly (17) together with the heat exchanger.

NOTE In case of vehicles equipped with cabin internal conditioner, proceed as follows:

- ❑ vehicles equipped with drying filter separated from the condenser:
  put the radiator (complete with the condenser and drying filter) back in the engine compartment, taking care not to subject the conditioning system pipes to tension;
- ❑ vehicles equipped with drying filter built into the condenser:
  blow gas off the air-conditioning system, as described in the relevant chapter in the "Bodywork and chassis" section, then disconnect the pipes from the condenser and seal both the pipes and their respective fittings on the condenser to prevent moisture and impurities from penetrating into the system.

- ❑ Disconnect the coolant pipes (8) and (24) from the rigid three-way pipe (27), freeing them from any clamps (7).
- ❑ Disconnect the heater delivery pipe (1).
- ❑ Unscrew the fasteners (6) to remove the expansion tank (4), disconnecting the level sensor's electrical connection.
- ❑ Take the soundproofing cover (5) off the cylinder head after removing the oil filler cap.

Figure 2



Place a container under the power steering pump to recover the oil from the system. Then disconnect the oil inlet and outlet pipes (16 and 17).

- ❑ Disconnect the pipes (7) recovering diesel from the high-pressure-pump.
- ❑ Disconnect the pipe (8) delivering diesel to the high-pressure-pump.
- ❑ Disconnect the vacuum pipe (23) from the vacuum pump.
- ❑ Disconnect the air intake duct (19).

NOTE Close the turbocharger air outlet appropriately to prevent foreign bodies accidentally getting inside.

- ❑ Free the wiring harness of the engine (15) from the clamps (←) on the timing cover, disconnect the connections of the alternator (21) and from the sensors on the thermostat (22), from the electromagnetic coupling of the fan hub (20) and move the wiring to one side so it will not interfere with the disassembly of the engine.
- ❑ Disconnect the wiring (2) from the water temperature and timing sensors, from the injectors, intake air temperature sensor and rail pressure sensor. Move the wiring to one side.
- ❑ Disconnect the high-pressure pump electrical connection (10).
- ❑ Disconnect the engine speed sensor (9).
- ❑ Disconnect the engine earth cable (6).
- ❑ Disconnect the positive cable from the starter motor (5).

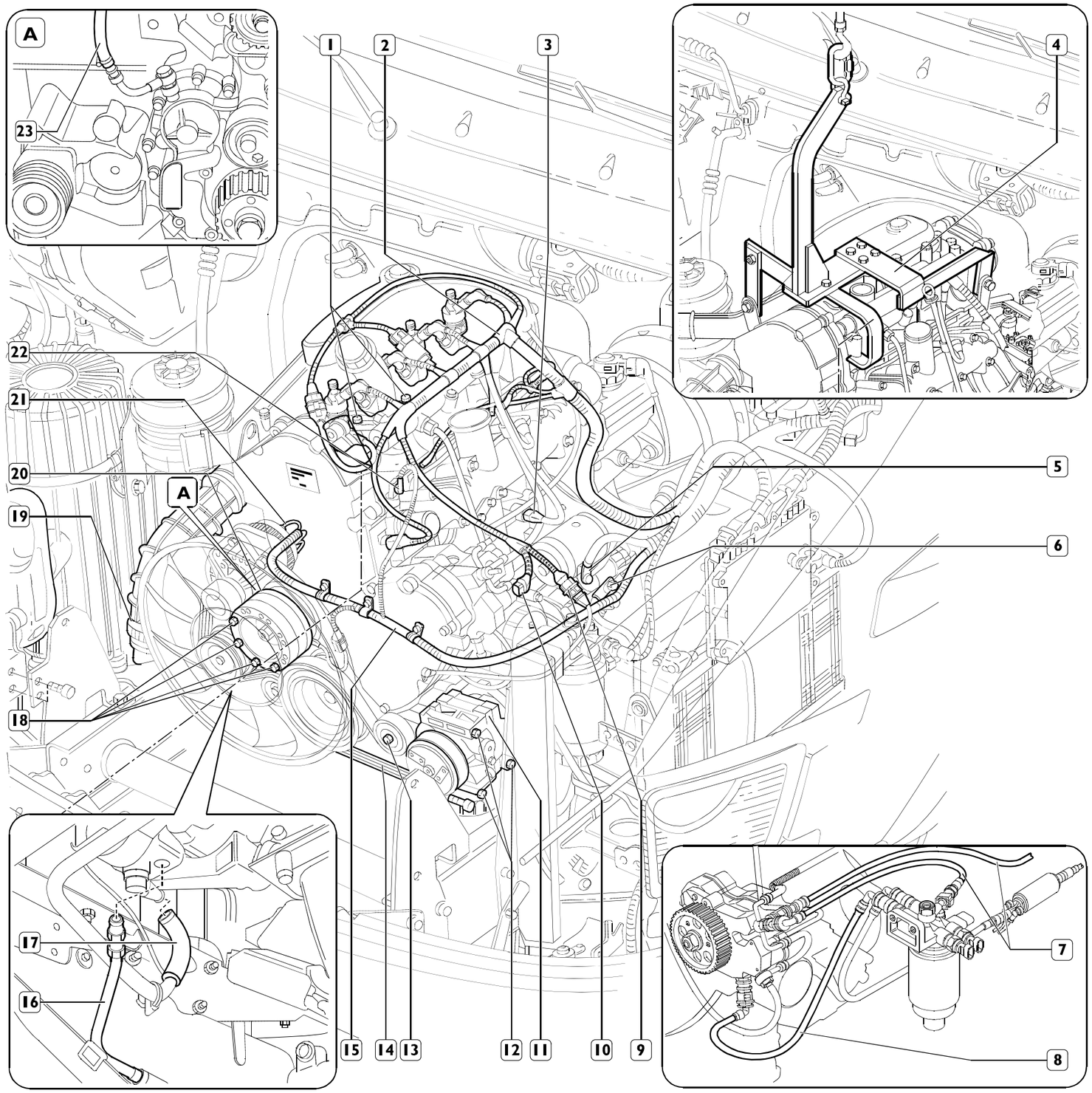
The remaining electrical connections of the engine cable are disconnected from the associated electrical components after removing the engine.

- ❑ Disconnect the oil fillpipe by undoing the fastenings (1).
- ❑ Undoing the fastenings (18), remove the fan from the electromagnetic coupling (20).
- ❑ Attach tool 99360544 (4) to the brackets on the engine to extract it from the engine bay and put it slightly under traction.

NOTE In case of vehicles equipped with conditioner, proceed as follows:

- ❑ as regards the vehicles equipped with drying filter separated from the condenser, remove compressor (11) by proceeding as follows:
  - loosen the belt stretcher by acting on screw (13), then remove belt (14);
  - act on fasteners (12) to remove compressor (11), then put the latter back into the compartment without disconnecting the pipes of the system itself;
- ❑ as regards the vehicles equipped with drying filter built into the condenser, disconnect the pipes from the compressor, then seal the pipes and their respective fittings on the compressor to prevent moisture and impurities from penetrating into the system.

Figure 3



- ❑ Disconnect the screws (16 and 20) securing the brackets (17 and 19) and disconnect the "bowdens" (18 and 21) from the gearbox.
- ❑ Unscrew the fixing screws (22), move the clutch control cylinder (23), with its bracket, and fasten it to the chassis frame appropriately.
- ❑ Remove the sealing from the ring nut (1), unscrew it and disconnect the speedometer control cable.
- ❑ Disconnect the electrical connection (4) from the reversing light switch.

NOTE As regards automatic transmission, disconnect gearbox-chassis cable connector (27) from the control unit.

- ❑ Disconnect the exhaust pipe (9) from the turbocharger outlet pipe.
- ❑ Put a jack under the gearbox to support it.
- ❑ Disconnect the bracket supporting the gearbox on the rear crosspiece by undoing the four screws (5).
- ❑ Unscrew the fixing screws (6) and remove the crosspiece (7) supporting the gearbox complete with the gearbox/support bracket.
- ❑ Remove nuts (14) securing elastic supports (13) to the chassis.
- ❑ Remove bolts (3) securing drive shaft (2) to the gearbox; remove, if necessary, screws (24) securing elastic support (25) to the chassis, then properly secure the drive shaft to the chassis.
- ❑ Take the jack out from under the gearbox.
- ❑ Lift the engine assembly and take it out of the engine bay.

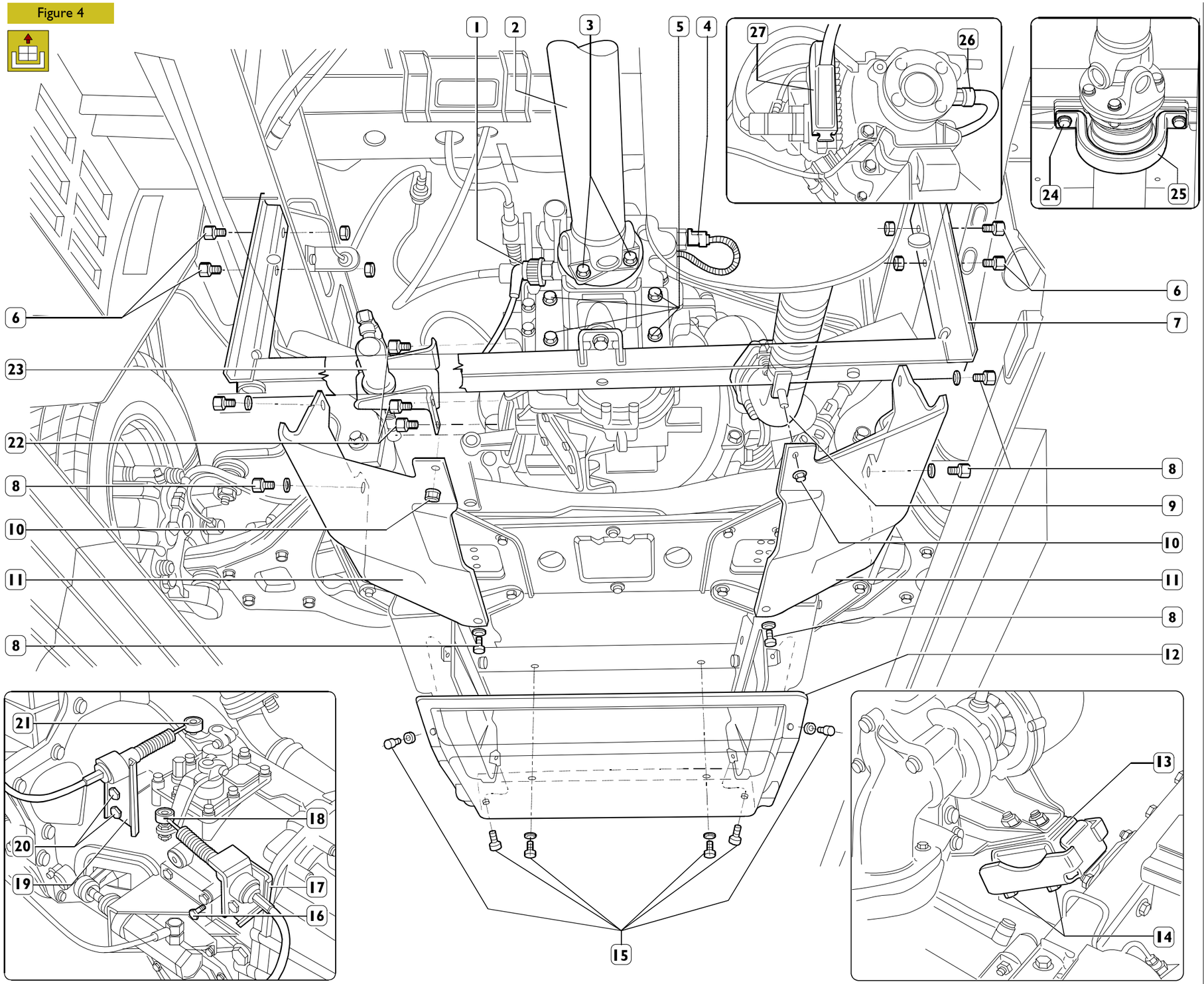
NOTE The power unit must be removed from the engine compartment with the greatest care, to avoid damaging the remaining parts on the vehicle, in particular the steering box oil pipes.

If it is necessary to detach the gearbox from the engine, take out the fixing screws and remove the starter motor.

Take out the fixing screws and detach the gearbox from the engine.

NOTE As far as automatic transmission is concerned, strictly adhere to the operations described in the relevant chapter in the "Gearbox" section.

Figure 4



Refitting

To refit the engine assembly, carry out the operations described for removal in reverse order, following these instructions:

- ❑ Before refitting the gearbox to the engine, it is necessary to remove the pressure plate bearing from the diaphragm spring by opening out the retaining circlip.
  Fit the pressure plate bearing on the sleeve of the drive input shaft cover, connecting it to the clutch release lever. Spread the gearbox input shaft with Molikote molybdenum disulphide grease.
  Engage a gear to let the main shaft turn, rotating the propeller shaft connecting flange. Push the gearbox fully in so that the pressure plate bearing couples with the diaphragm spring correctly.
- ❑ Pay special attention to the operations needed to install the engine assembly in the engine bay.
- ❑ Check the conditions of the coolant pipes or sleeves and of the air ducts. Replace them if they show any sign of deterioration.
- ❑ Check the flexible mountings of the assemblies: engine and gearbox. Replace them if they show any sign of deterioration.
- ❑ Check that the exhaust pipe members have not deteriorated and are not about to deteriorate. If this is so, replace them along with the flexible parts for securing them.
- ❑ Tighten the screws or nuts to the required torque.
- ❑ Meticulously check the state of the vacuum pipe. It must show no sign of cracking, cutting, scoring or of being crushed. Replace it if there is any doubt at all about its soundness. When mounting it, make sure the pipe does not come into contact with sharp metal parts or corners or with any particularly hot parts. In addition, after assembly, the pipe must have no bends or constrictions, its radius of curvature should be broad and it must be secured to the vacuum pump fitting with a suitable clamp.
- ❑ Make sure the quick-coupling fittings of the fuel pipes are thoroughly clean and, after connection to the relevant high-pressure pump unions or fuel filter mount, are fully inserted and do not come loose.
- ❑ Fill the cooling system with coolant.
- ❑ Fill the hydraulic power steering circuit and bleed the air as described under the relevant heading.
- ❑ Check the level of oil in the engine and gearbox.
- ❑ Adjust the tension of the drive belt of the compressor for the air-conditioner as described in "Replacing Belts" (if present).

NOTE When positioning the engine in the engine bay, take special care not to damage the top pipe of the power steering and the soundproof-heatproof cladding of the engine bay.
Once positioned, meticulously check that the top pipe of the power steering is sound.
Before using it again, check that the power steering oil and coolant contain no impurities. If they do, filter with suitable mesh filters. For any topping up, refer to the REPLENISHING FLUIDS table in the "GENERAL" section.

Checks and tests

Start up the engine, leave it running just a little faster than idling speed and wait for the coolant temperature to reach the value for opening the thermostat, then check that:

- ❑ No water leaks from the connecting sleeves of the engine cooling and cab heating circuit pipes; tighten the collars if necessary.
- ❑ No oil leaks from between the cover and cylinder head, oil sump and crankcase, oil filter and its seat, heat exchanger and crankcase or from between the various pipes of the lubricating circuit.
- ❑ No fuel leaks from injection pump and injector lines. Tighten fittings if necessary.
- ❑ Check the indicator and warning lights on the instrument panel and the devices disconnected on removing the engine all work properly.

501430 Power steering system air bleed

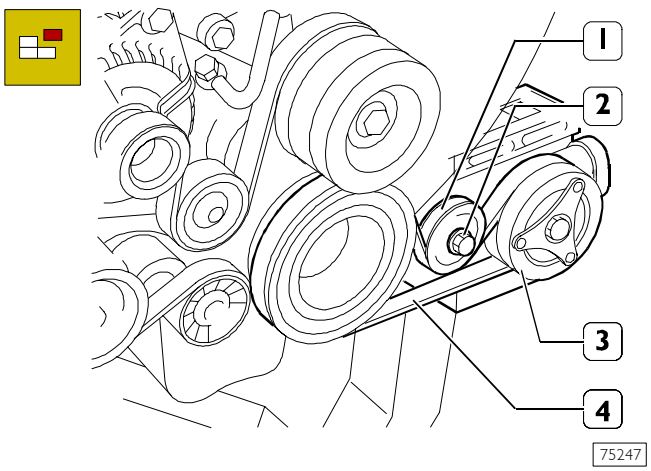
Check the level of oil in the tank and top it up if necessary.
Lift the vehicle at the front, start up the engine and let it idle for some time.
Check there is no oil leakage from the hydraulic circuit and check the level in the tank.
Slowly turn the steering wheel in both directions of steering so that the air in the hydraulic system comes out.
Check the level of oil in the tank again and top up if necessary.

REPLACING BELTS

543910 Replacing air-conditioning compressor drive belt (version with belt tensioner)

Disassembly

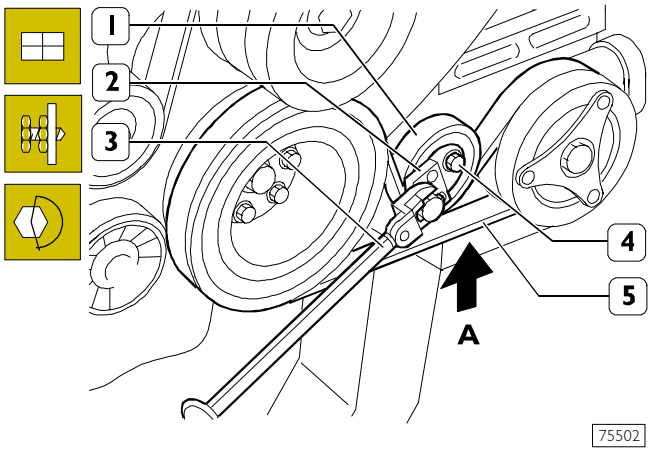
Figure 5



Set the vehicle on a lift or over a pit. From underneath the vehicle, detach the middle soundproofing guard.
Loosen the screw (2) fixing the tightener (1) and remove the belt (4) driving the air-conditioner compressor (3).

Assembly and adjusting belt tension

Figure 6

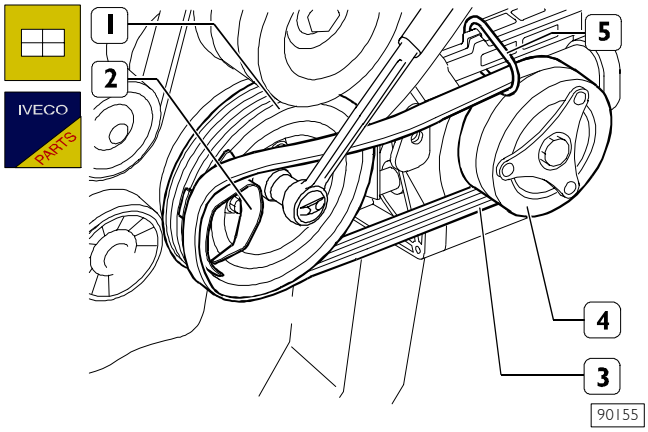


Mount the drive belt, taking care to position its ribs properly in the respective races of the pulleys.
With the tool SP.2341 (2) inserted in the holes of the tightener (1) and a torque wrench (3), turn the tightener (1) with a torque of 8.2-10 Nm; in this condition, tighten the screw (4) to a torque of 25 Nm.
Turn the engine in its direction of rotation to have the belt (5) make two full turns.
Using tool 99395849, measure the tension of the belt (5) in the section **A**, which must be 204 ± 10 Hz, corresponding to a load of 1010 ± 10 N on the tightener.
Fit the middle soundproofing guard back on.

543910 Replacing air-conditioning compressor drive belt (version with elastic belt)

Disassembly

Figure 7



Take elastic belt (3) off pulleys (1 and 4).

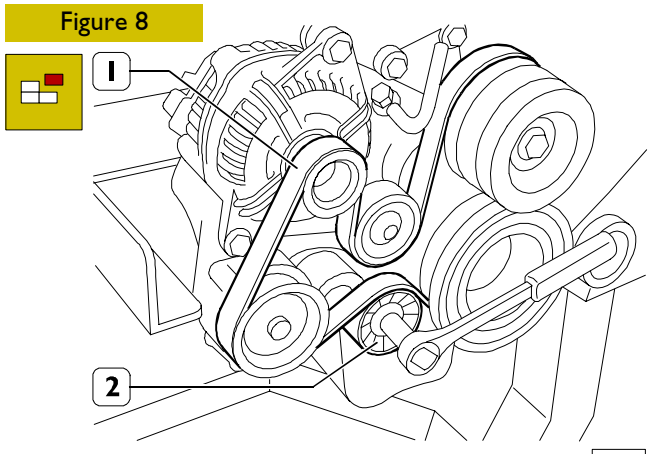
Assembly

Fit the flexible belt (3) equipped with tool 99360191 (2) on the pulley (4) and apply the tool on the pulley (1).
Fit the drive ring (5) on the flexible belt (3) and fasten the ring on the compressor support.
Turn the drive shaft clockwise until the belt fits perfectly on the pulley (1).

543910 Power steering pump-alternator belt replacement

Disassembly

Figure 8



Disassemble the compressor drive belt, if there is one, as described under the relevant heading.
Slacken off the tension of the belt (1) using a specific wrench on the automatic tightener (2) and remove the belt.

Assembly

Mount the drive belt (1) taking care to position its ribs correctly in the respective races of the pulleys.
Release the automatic tightener (2). Turn the crankshaft by one turn to settle the belt.
Mount the compressor drive belt, if there is one, and adjust the tension as described under the relevant heading.
Fit the middle soundproofing guard back on.

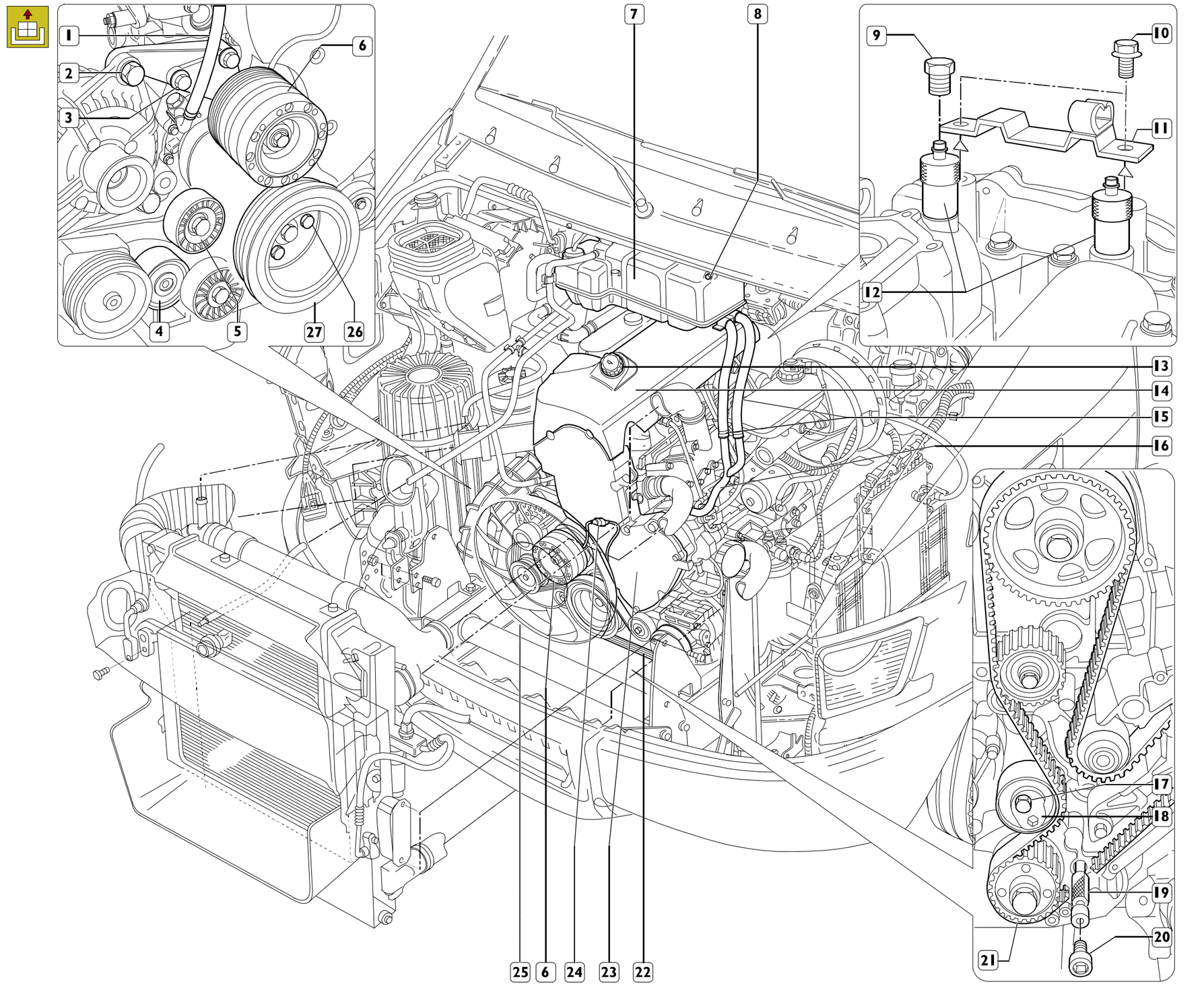
541257 Replacing timing drive belt

Disassembly

Following the procedures described for removing the engine, take out the radiator assembly without disconnecting the air-conditioning system pipes from the condenser or from the drier filter and put it appropriately aside in the engine bay.

Remove the air-conditioner compressor drive belt (22) (if there is one) and the water pump / alternator drive belt as described under the relevant headings.
Remove the fan (25) from the electromagnetic coupling (6).
Disconnect the electrical connection (24) from the electromagnetic coupling (6).
Take out the fixing screws (2) and (3) and remove the mounting together with the electromagnetic coupling (6).
Take out the screws and remove the fixed tightener (5) and the automatic tightener (4).
Remove screws (26), then disassemble pulley (27).
Remove the wiring from the timing cover (23) and dismantle this.
Take off the cap (13) and remove the soundproofing cover (14).
Disassemble valve gear cover (23).
Disconnect the pipes (15) from the pipe (16).
Take out the fixing screws (8) and remove the expansion tank (7); disconnect the electrical connection for the level indicator from the expansion tank and put the tank (8) aside appropriately.
Take out the screws (10) and remove the bracket (11) fixing the soundproofing cover (14).
Remove the plugs (9) from the overhead and the plug (20) from the oil pump – vacuum pump assembly mounting.
Turn the crankshaft clockwise so as to be able to insert the pins 99360614 (12) through the holes in the plugs (9) into the relevant holes of the camshafts and pin 99360615 (19) through the hole in the plug (20) into the crankshaft.
Loosen the screw (17) securing the automatic tightener (18) and remove the timing belt (21).

Figure 9



Assembly

Insert tool 99360608 (8) into the hole of the toothed pulley (7) and into the corresponding hole of the overhead to prevent changing the assembly position of the toothed pulley (7) in the following operations.
Loosen the screw (9) fixing the toothed pulley (7) and, using tool 99340028, drive the pulley (7) out of the camshaft.
Turn the automatic tightener (1) clockwise, positioning it as shown in frame **A**.
Turn the timing belt (10) as shown in the figure observing the precautions below.

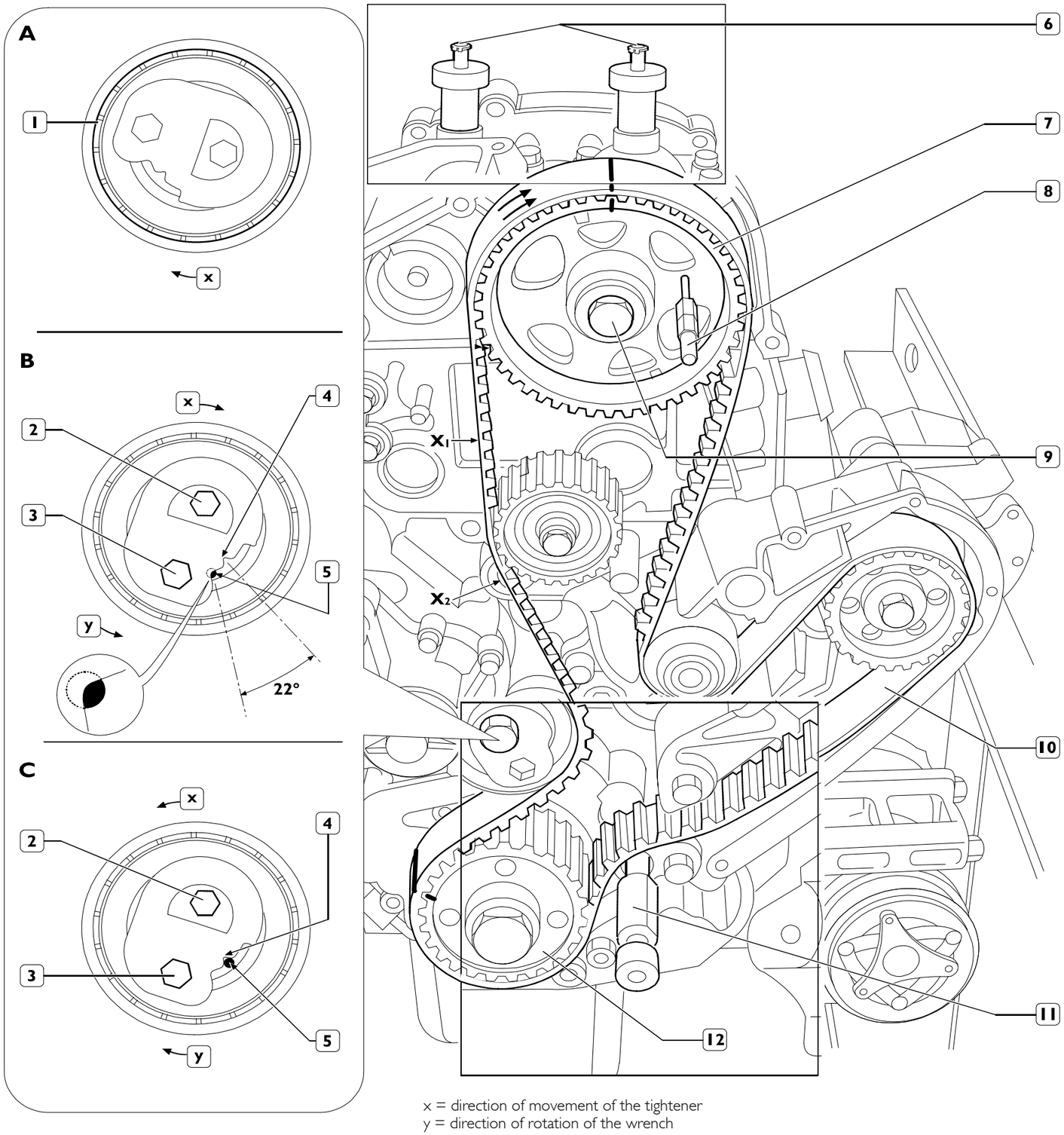
Do not bend the timing belt. Arrows indicating the direction of assembly of the timing belt on the engine are shown on the back of the belt. The arrows must correspond to the direction of rotation of the belt and the notches must coincide with those on the pulley (7) and the gear (12).
If required to fit the timing belt (10) on the pulley (7), remove tool 99360608 (8) and turn the pulley (7) clockwise by no more than half a pulley tooth.

On completing assembly, adjust the toothed pulley (7) to put the section **X** of the belt under tension and tighten the screw (9) to a torque of 90 Nm.
Keeping the screw (2) stationary and using a suitable wrench on the hexagon of the plate (3) of the tightener, turn it anticlockwise to cover the reference hole (5) located on the fixed portion of the tightener (see frame **B**).
In the above conditions, tighten the fixing screw (2) to a torque of 36 ± 4 Nm.
Remove the tools 99360614 (6) and 99360615 (11) for the timing.
Turn the engine in its direction of rotation by 8 turns to be able to put the tools (6) and (11) back in to do the timing.
In these conditions, the notches of the timing belt (10) must coincide with those of the pulley (7) and the gear (12).

NOTE Do not turn the engine in the opposite direction; if, on turning the engine, you pass the point for inserting the tools (6) and (11), turn the engine clockwise by another two turns.

See frame C: holding the tightener plate (3) stationary with the wrench inserted in its hexagon, loosen the fixing screw (2). Keeping the fixing screw (2) stationary, turn the plate (3) clockwise until its reference mark **Λ** (4) coincides with the reference hole (5) of the fixed portion of the tightener.
In the above conditions, tighten the screw (2) to a torque of 30 ± 4 Nm.
Then complete assembly by carrying out the steps described for disassembly in reverse order.
After assembly, the belt (10) tension measured using tool 99395849 must be as follows in the following points: X, 212 ± 12 Hz - X_1, 178 ± 10 Hz.

Figure 10

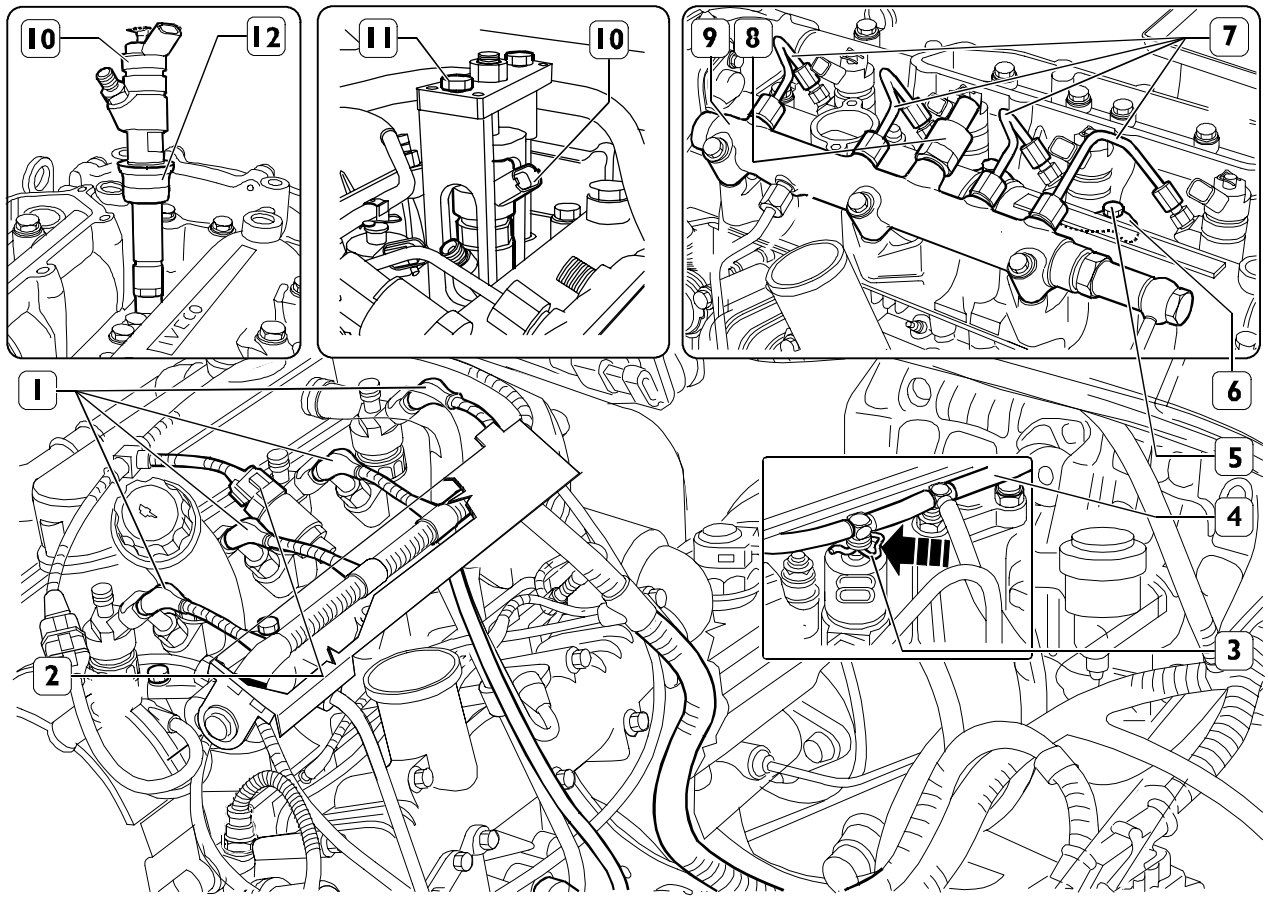


x = direction of movement of the tightener
y = direction of rotation of the wrench

85844

775010 REPLACING ELECTRO-INJECTORS

Figure 11



Disassembly

Partly drain the coolant off from the radiator.
Remove the plug (13, Figure 9) and detach the soundproofing cover (14, Figure 9).
Disconnect the pipes (15, Figure 9) from the pipe (16, Figure 9).
Take out the fixing screws (8, Figure 9) and remove the expansion tank (7, Figure 9). Disconnect the level indicator electrical connection from the expansion tank.
Disconnect the pipe (17, Figure 12) from the coalescence filter (2, Figure 12).
Disconnect the electrical connections (1) from the electro-injectors (10) and (2) from the fuel pressure sensor (8).
Press the springs (3) in the direction shown by the arrow and disconnect the fittings of the pipe (4) to recover fuel from the electro-injectors (10).
Disconnect the fuel pipes (7) from the electro-injectors (10) and from the hydraulic accumulator (9).
Take out the screws (6) and the brackets (5) fixing the electro-injectors (10) to the cylinder head.
Using tool 99342153 (11) extract the electro-injectors (10) from the overhead.

Assembly

Thoroughly clean the seat of the electro-injectors, taking care no foreign bodies get into the cylinder barrels.
Fit a fresh gasket (12) onto the electro-injector (10) and fit this in the overhead.

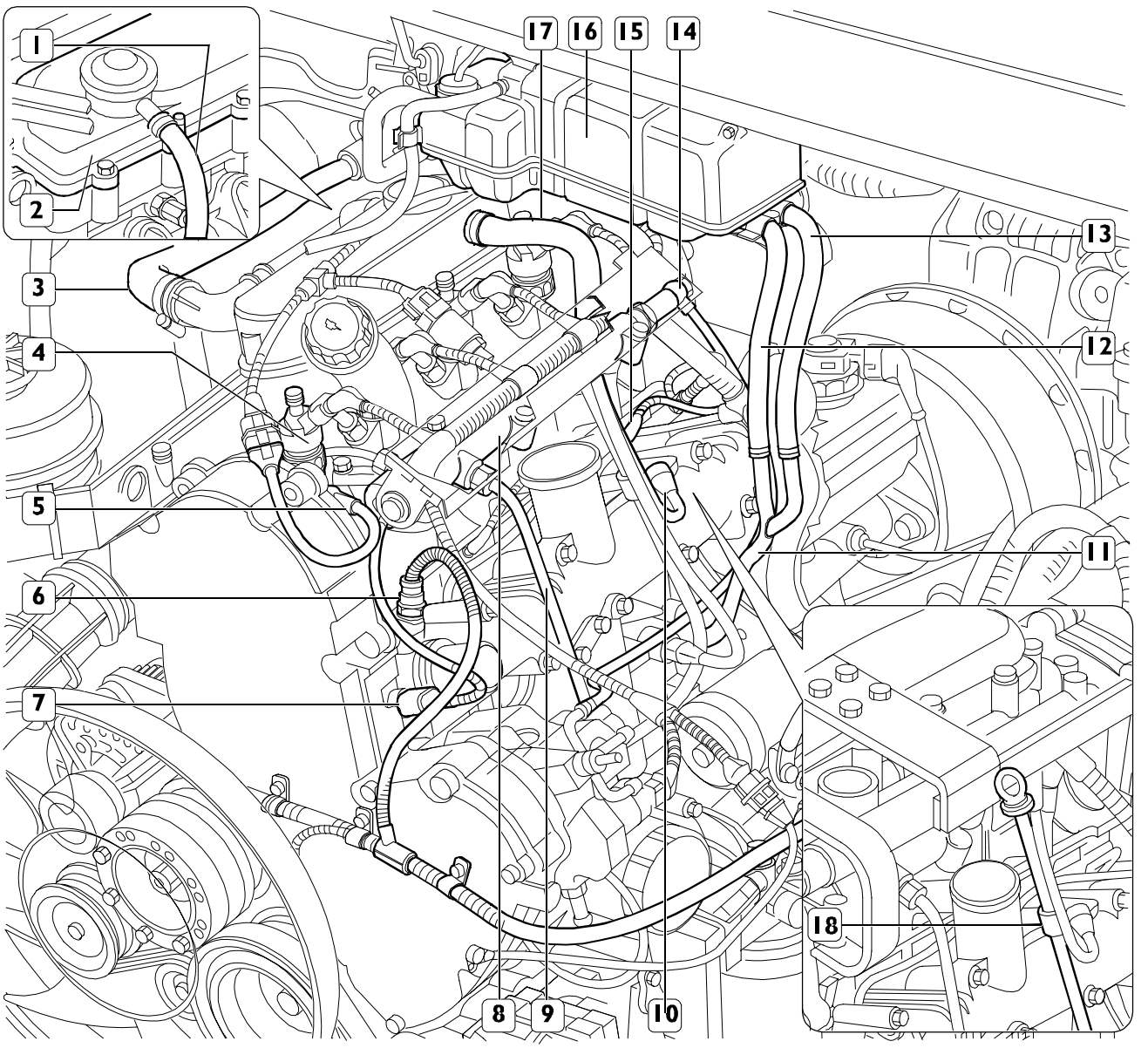
Complete assembly by carrying out the operations described for disassembly in reverse order, taking the following precautions:

- With each disassembly, the fuel pipes must be replaced with fresh ones.
- Tighten the nuts, screws and fittings to the prescribed torque.
- To tighten the fittings of the fuel pipes, use the wrench in the 99317915 series and the torque wrench 99389829.
- After assembly, replenish the coolant as described under the relevant heading.

Check assembly of the timing sensor as described under the relevant heading.

540610 CYLINDER HEAD REMOVAL AND REFITTING

Figure 12



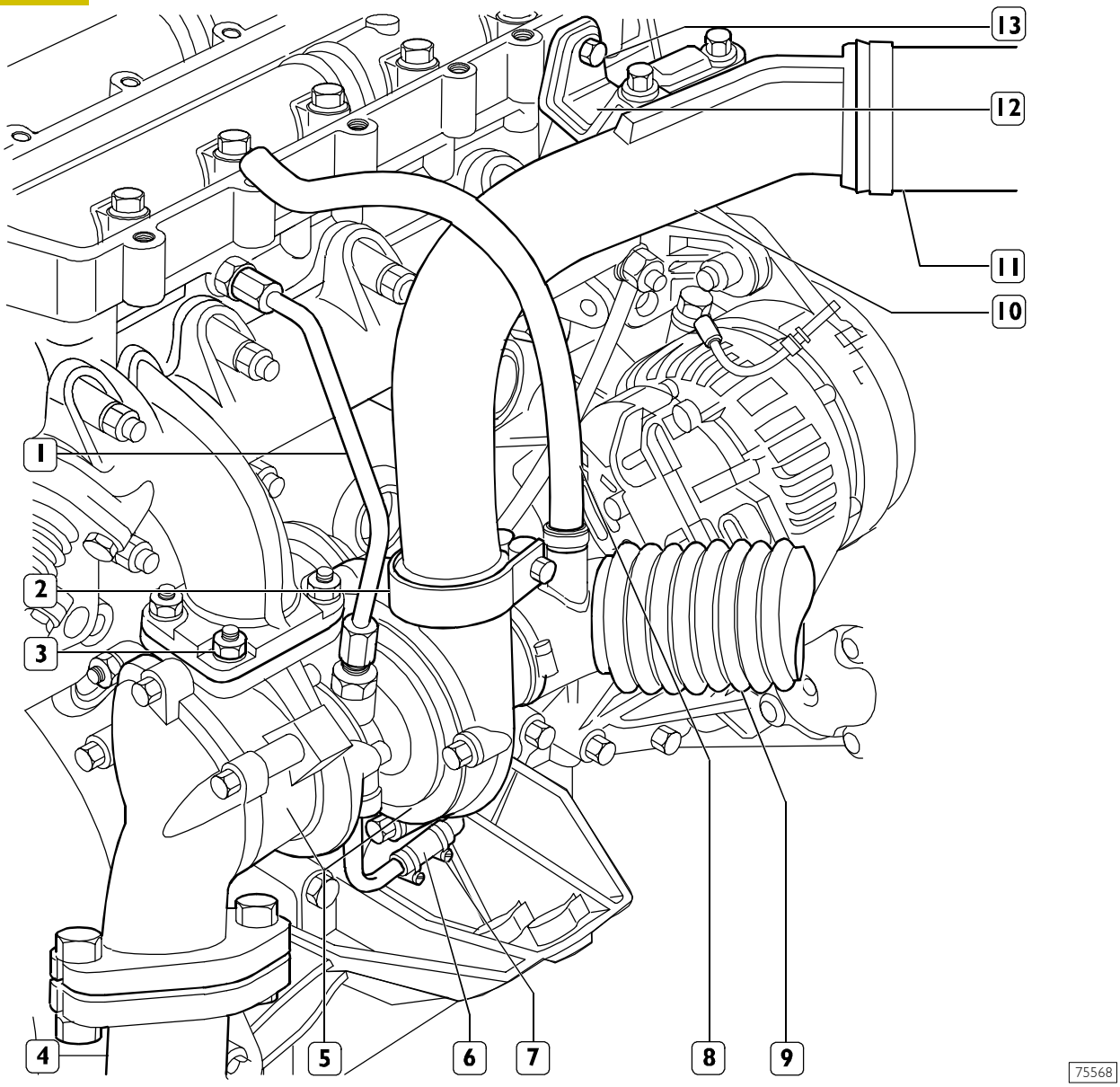
Removal

Remove the timing belt as described under the relevant heading (operation 541257).
Disconnect the coolant pipes (12) and (13) from the pipe (11).
Take out the fixing screws and remove the expansion tank (16), disconnecting the level sensor electrical connection from this.
Remove the pipe (18) for the oil dipstick from the intake manifold.
Disconnect the pipes (1) and (17) from the coalescence filter (2) and detach this from the overhead.

Disconnect the pipe (3) from the fitting.

Remove the electro-injectors (4) as described in "Replacing electro-injectors" (operation 775010).
Disconnect the electrical connections from: timing sensor (5) and remove this from the overhead, water temperature sensors (6) and (7), air pressure and temperature sensor (10), and glow plugs (15).
Detach the fuel pipe (9) from the hydraulic accumulator (8), from the high-pressure pump and from the intake manifold.
Disconnect the fuel return pipe (14) from the pressure relief valve of the hydraulic accumulator (8).

Figure 13



Loosen the clamp and disconnect the sleeve (11) from the air duct (10).
Loosen the collar (2), take out the screw (13) fixing the bracket (12) and detach the air duct (10).
Disconnect the oil vapour recirculation pipe (8) from the air intake sleeve (9) and disconnect this from the turbocharger (5).
Disconnect the oil pipe (1) from the cylinder head and from the turbocharger (5).
Loosen the clamp (7) and disconnect the oil pipe (6) from the crankcase union.
Take out the screws and disconnect the exhaust pipe (4) from the turbocharger (5).
Take off the nuts (3) and remove the turbocharger (5) with its gasket from the exhaust manifold.

NOTE Close the turbocharger air outlet/inlet appropriately to prevent foreign bodies accidentally getting inside and damaging it.

Take out the screws and remove the overhead together with the pins 99360614.

NOTE The pins 99360614 applied so as not to alter the timing after removing the timing belt must be removed from the overhead only if this is to be removed.

Take off the overhead gasket.
Take out the tappets and carefully put them aside.
Using the bushing 99355041, take out the glow plugs.
Take out the screws fixing the cylinder head and detach this from the crankcase.
Remove the cylinder head gasket.

Refitting

Refitting requires carrying out the operations for removal in reverse order, while taking the following precautions:
Check that the timing tools:

- 99360614 (6, Figure 10) and 99360608 (8, Figure 10) are inserted in the overhead;
- 99360615 (11, Figure 10) is inserted in the crankcase as described in "Replacing timing belt."

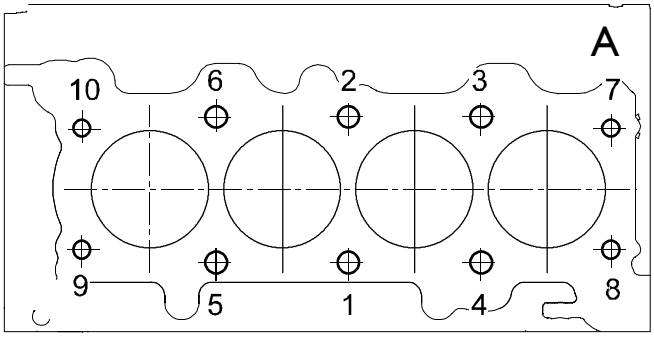
Check that the mating surfaces of the cylinder head and crankcase are clean.
Keep the cylinder head gasket clean.
Position the cylinder head gasket with the lettering "TOP" facing the cylinder head.

NOTE It is essential to keep the gasket sealed in its package until just before assembly.

Mount the cylinder head. Insert the screws and tighten them, in three successive stages, following the order and method shown in the following figure.

NOTE The angle closure is done with tool 99395216.

Figure 14



75494

Diagram of the tightening sequence for the cylinder head fixing screws:

- ❑ 1st phase: pre-tightening with torque wrench
  - screws 1-2-3-4-5-6 to a torque of 100 ±5 Nm;
  - screws 7-8-9-10 to a torque of 50 ±2.5 Nm.
- ❑ 2nd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.
- ❑ 3rd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.

A = flywheel side.

- Tighten the screws and nuts to the prescribed torque.
- The seals and gaskets must not be reused, but replaced with new ones.

NOTE If the engine has run for a period equivalent to = 25,000 km, the toothed timing drive belt must be replaced with a fresh one, no matter what its state of wear.

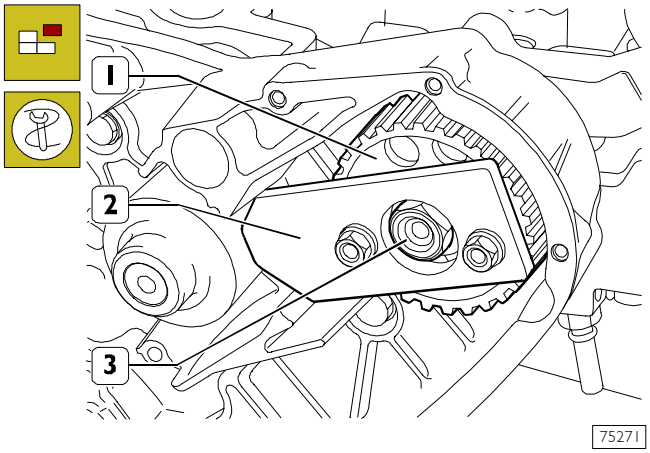
To tighten the glow plugs, use the bushing 99355041 and torque wrench 99389819.

771010 REPLACING HIGH-PRESSURE PUMP CP3

Removal

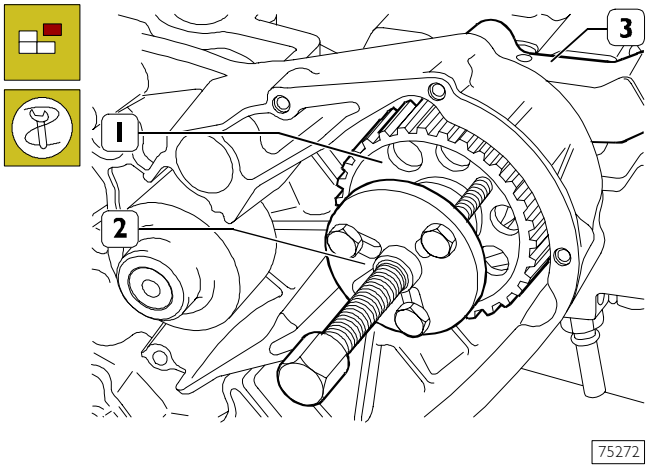
Remove the timing drive belt, as described in the relevant chapter (operation 541257).
Disconnect the following items:
- electric connection from the pressure sensor;
- fuel pipes from the high-pressure pump.

Figure 15



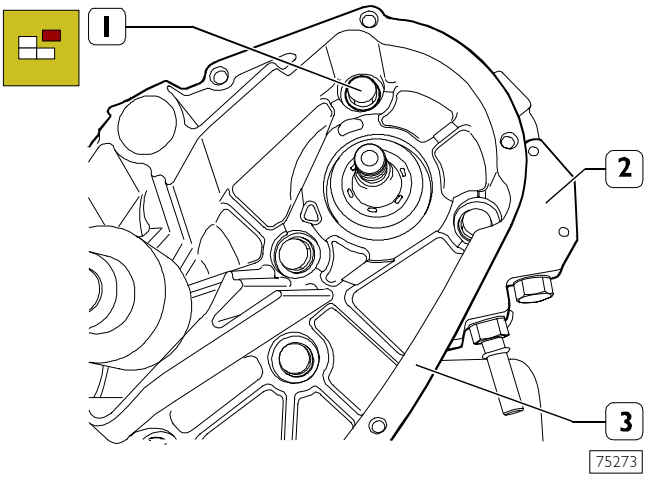
Lock rotation of the high-pressure pump gear (1) by applying tool SP. 2263 (2) as illustrated in the figure. Remove the nut (3) and take out the tool (2).

Figure 16



Using tool 99340035 (2) applied as shown in the figure, extract the gear (1) from the shaft of the high-pressure pump (3).

Figure 17



Take out the screws (1) and remove the high-pressure pump (2) from the water pump mounting (3).

Refitting

Re-attachment is carried out by reversing the order of detachment operations. In particular, take care of the following: replace the seal rings, gaskets and high-pressure pipe with new parts; tighten the nuts, screws and fittings to the specified torque values.

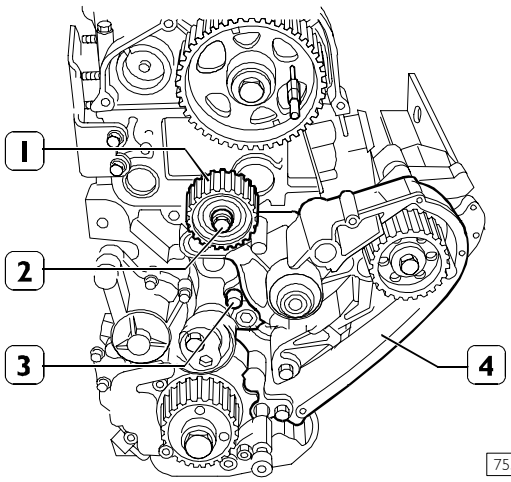
NOTE If the engine has run for a period equivalent to = 25,000 km, the toothed timing drive belt must be replaced with a fresh one, no matter what its state of wear.

543210 REPLACING WATER PUMP

Removal

Remove the high-pressure pump as described under the relevant heading.

Figure 18



Take out the screw (2) and remove the fixed tightener (1). Take out the screws (3) and remove the water pump mounting (4).

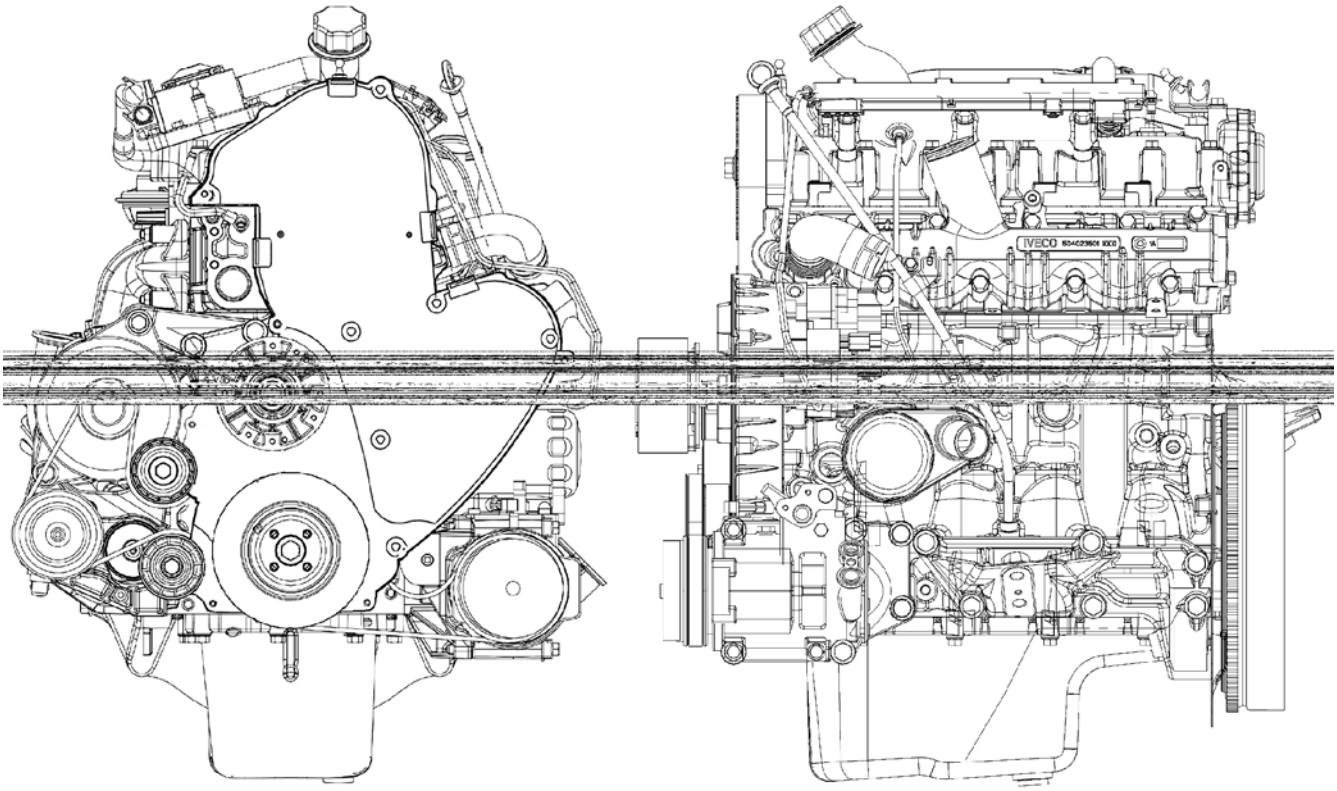
Refitting

Fit two new seals on the water pump and fit it back on the crankcase, carrying out the operations described for removal in reverse order and tightening the screws or nuts to the prescribed torque.

EMISSIONS

Engine F1AE0481A*A (96 HP) – Engine F1AE0481B*A (116 HP)

Figure 19



75570

Gas emissions

The engines conform to the Euro3 standards on gas emissions (measurement on engine bench according to OICA cycle), with the following limits fixed by the ESC and ELR 1999/96-2001/27 standards:

ESC:

- CO (carbon monoxide) < 2.1 g/kWh
- NOx (nitrogen oxide) < 5.0 g/kWh
- HC (unburnt hydrocarbons) < 0.66 g/kWh
- Particulate < 0.13 g/kWh

ELR: 0.8 l/m (opacity)

Test fuel: CEC RF03A084 – S ≤ 0.03%

Smokiness

The engines conform to the limits of smokiness required by EEC standards 72/306, updated 97/20 EC: 1.49 l/m with the following exhaust smoke values:

Maximum power (Bosch BSU opacimeter degrees)	1.5
Maximum torque (Bosch BSU opacimeter degrees)	1.5

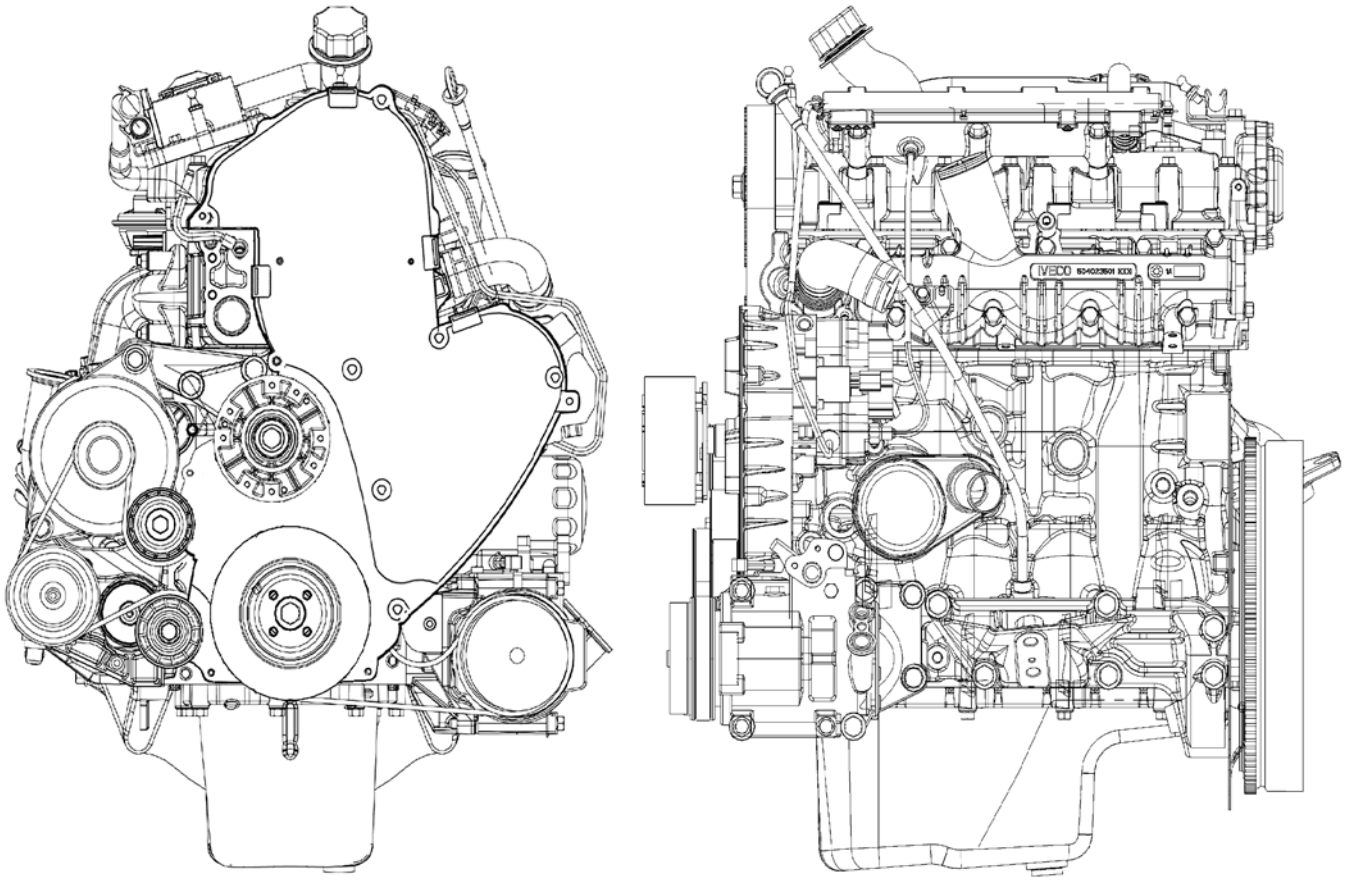
Noise emissions

Maximum mean noise level, Lpa, of the standard engines measured according to ISO Std. 3745 (microphones at 1 m from the engine surfaces):

Idling	(800 rpm)	76 dBA
Full power	(3800 rpm)	96 dBA.

Engine F1AE0481B*B (116 HP with EGR)

Figure 20



Gas emissions

The engine conforms to the Euro3 standards on gas emissions (measurement on engine bench according to OICA cycle), with the following limits fixed by the ESC and ELR 1999/96-2001/27 standards:

ESC:

- CO (carbon monoxide) < 0.95 g/kWh
- NOx (nitrogen oxide) < 0.78 g/kWh
- HC + NOx (unburnt hydrocarbons) < 0.86 g/kWh
- Particulate < 0.1 g/kWh

ELR: 0.8 l/m (opacity)

Test fuel: CEC RF03A084 – S ≤ 0.03%

Smokiness

The engine conforms to the limits of smokiness required by EEC standards 72/306, updated 97/20 EC: 1.49 l/m with the following exhaust smoke values:

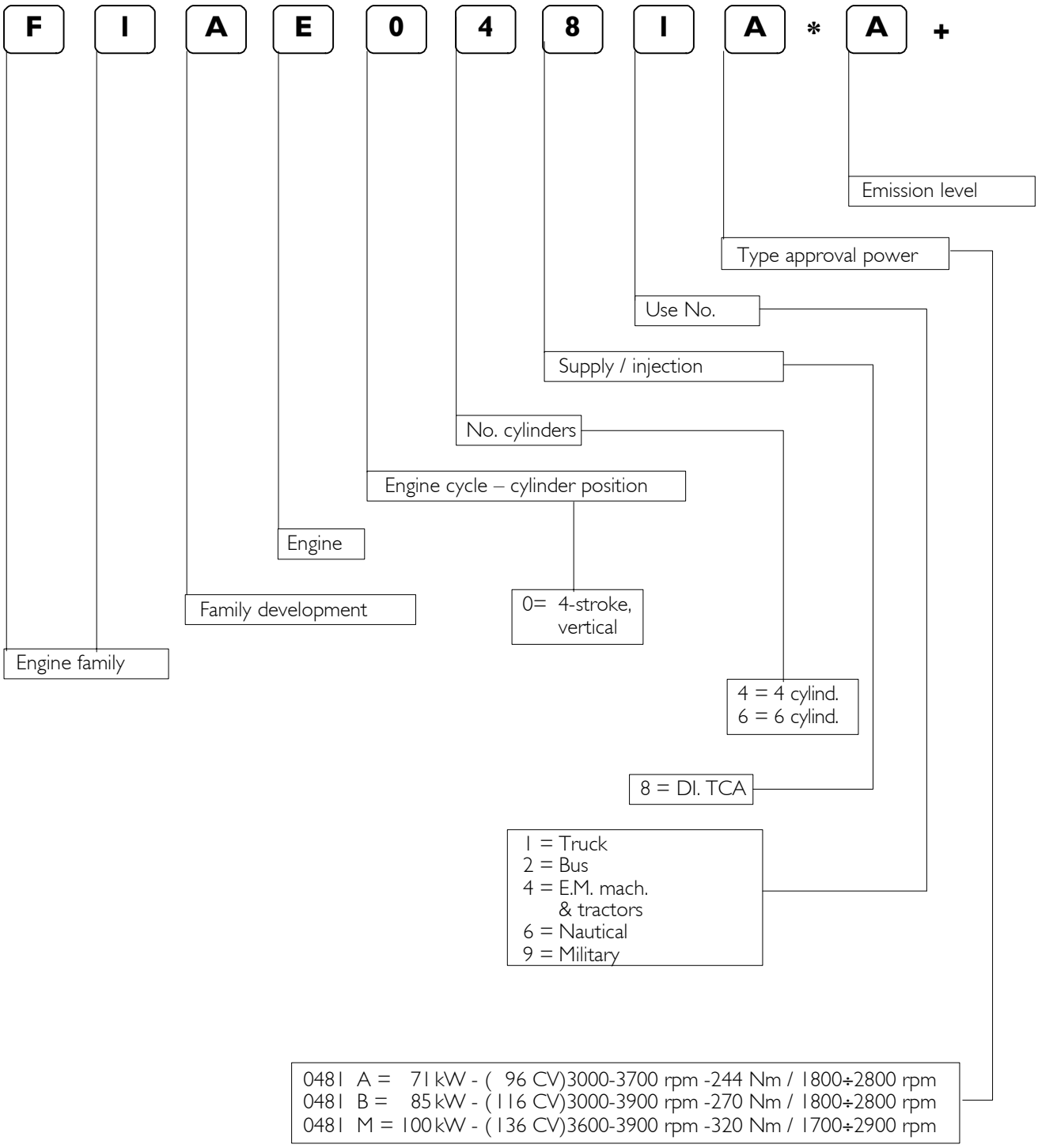
Maximum power (Bosch BSU opacimeter degrees)	1.5
Maximum torque (Bosch BSU opacimeter degrees)	2.5
Full load at 1000 rpm (Bosch BSU opacimeter degrees)	3.5

Noise emissions

Maximum mean noise level, Lpa, of the standard engines measured according to ISO Std. 3745 (microphones at 1 m from the engine surfaces):

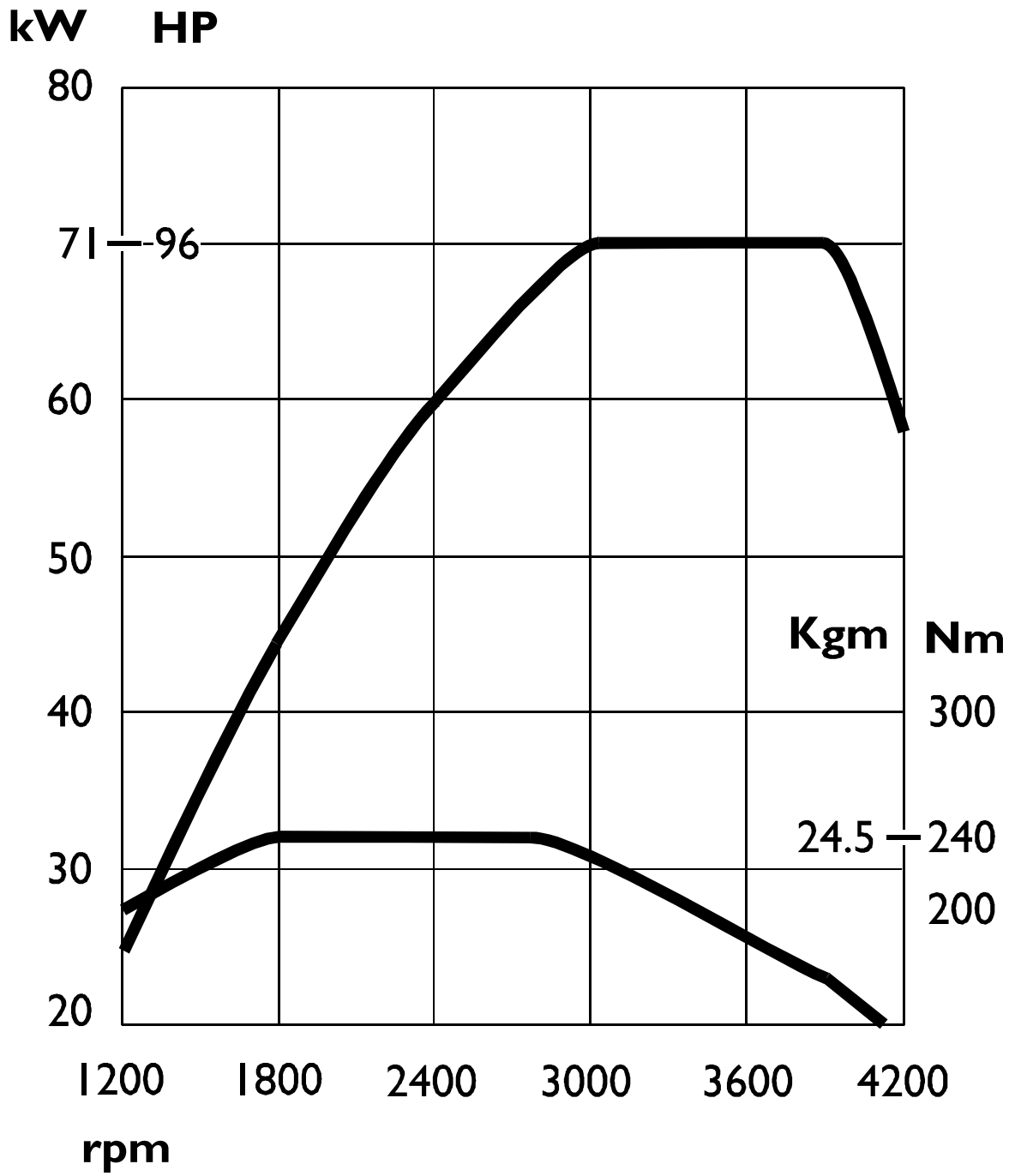
Idling	(800 rpm)	76 dBA
Full power	(3800 rpm)	96 dBA.

ENGINE IDENTIFICATION CODE



CHARACTERISTIC CURVES

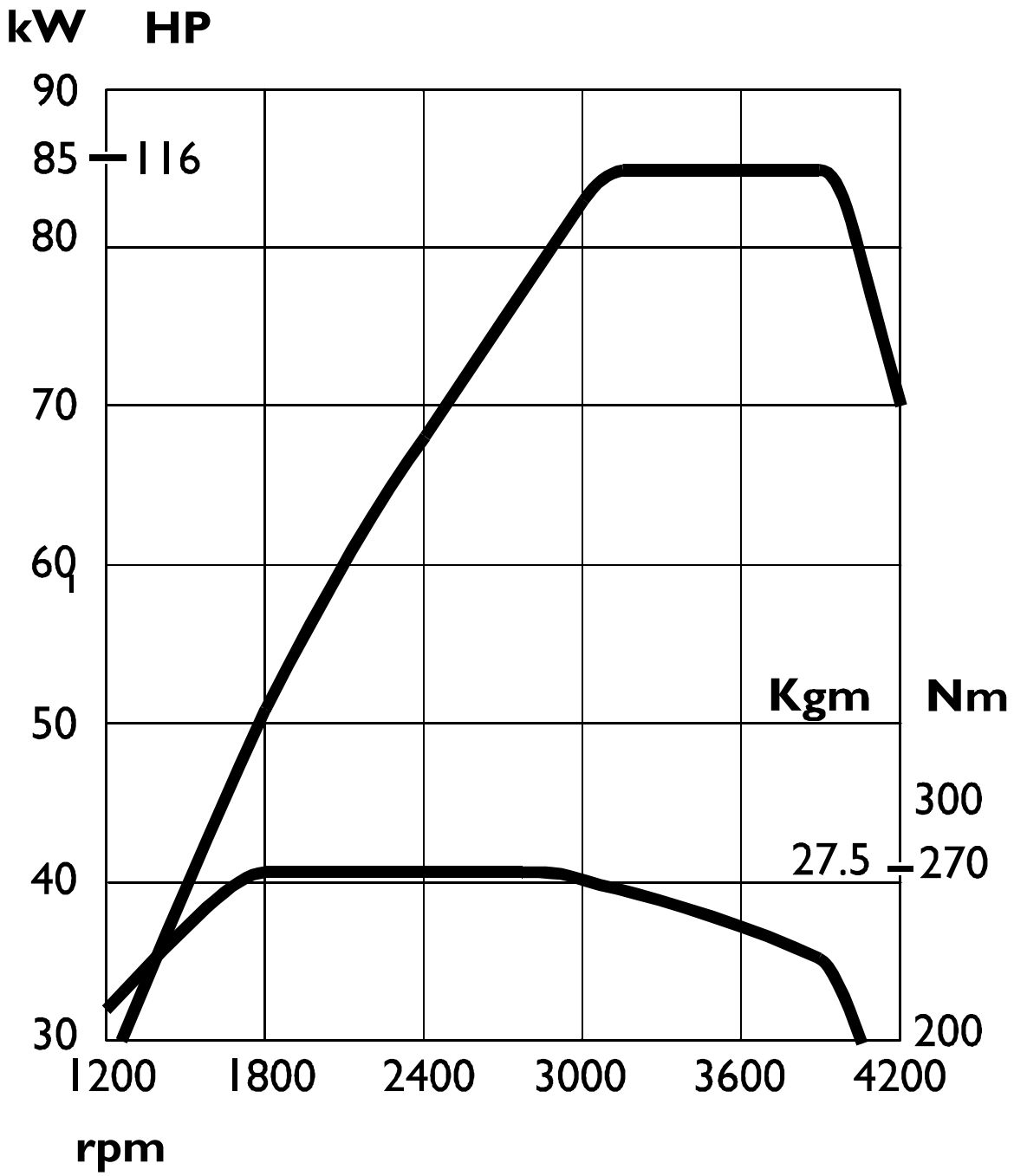
Figure 20/1



CHARACTERISTIC CURVES OF ENGINE F1AE 0481A

Max OUTPUT 71 kW	**96 HP**	**at 3000 ÷ 3700 rpm**
Max TORQUE 240 Nm	**24.4 kgm**	**at 1800 ÷ 2800 rpm**

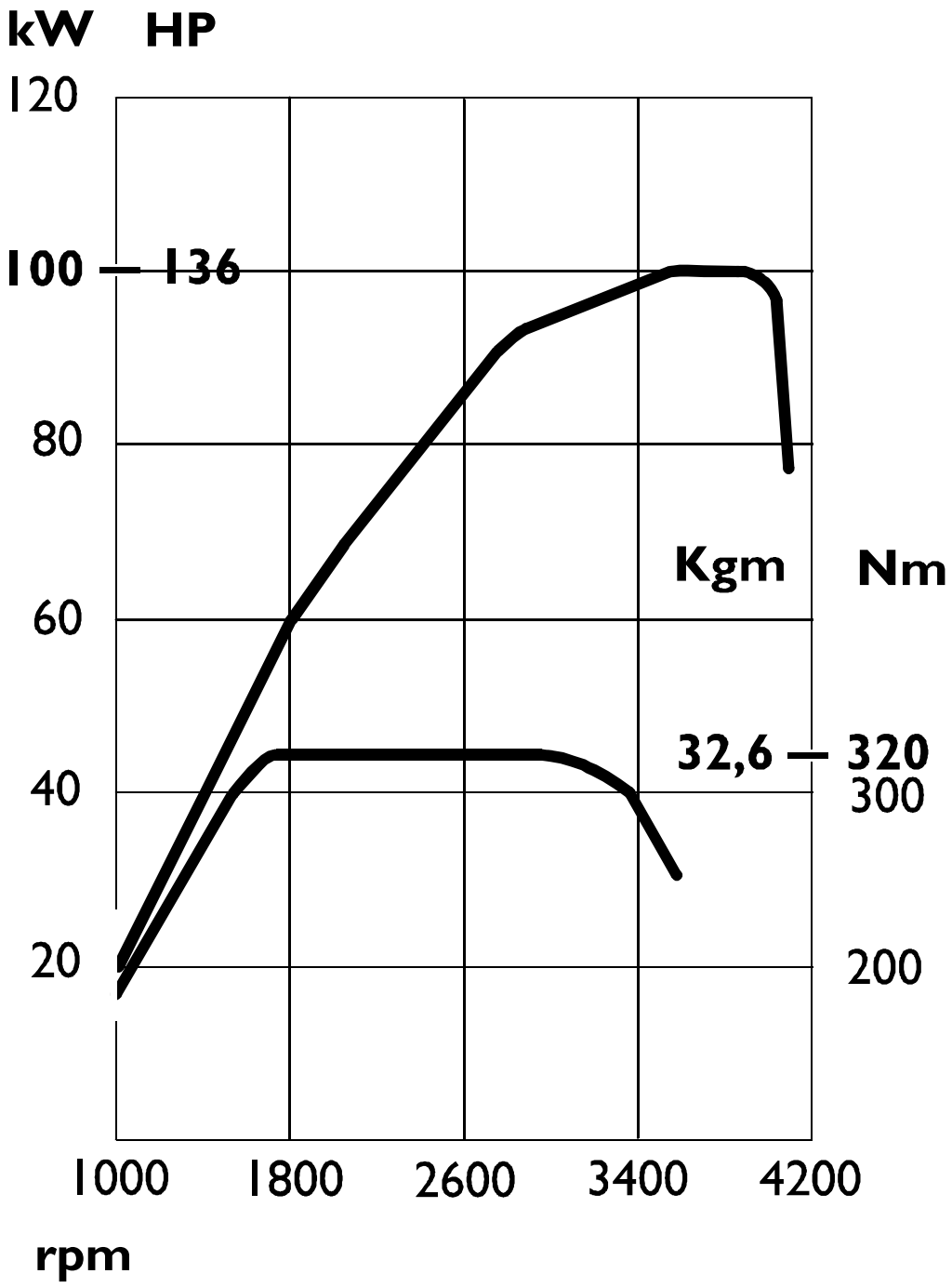
Figure 20/2



CHARACTERISTIC CURVES OF ENGINE F1AE 0481B

Max OUTPUT 85 kW	**116 HP**	**at 3000 ÷ 3900 rpm**
Max TORQUE 270 Nm	**27.5 kgm**	**at 1800 ÷ 2800 rpm**

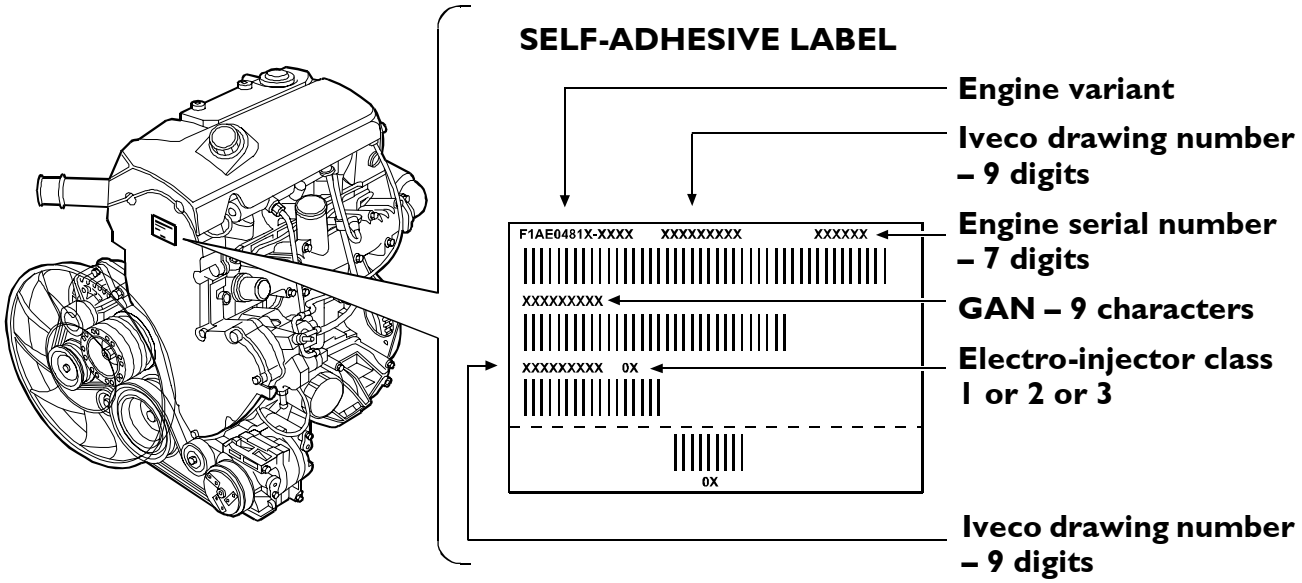
Figure 20/3



CHARACTERISTIC CURVES OF ENGINE F1AE 0481M

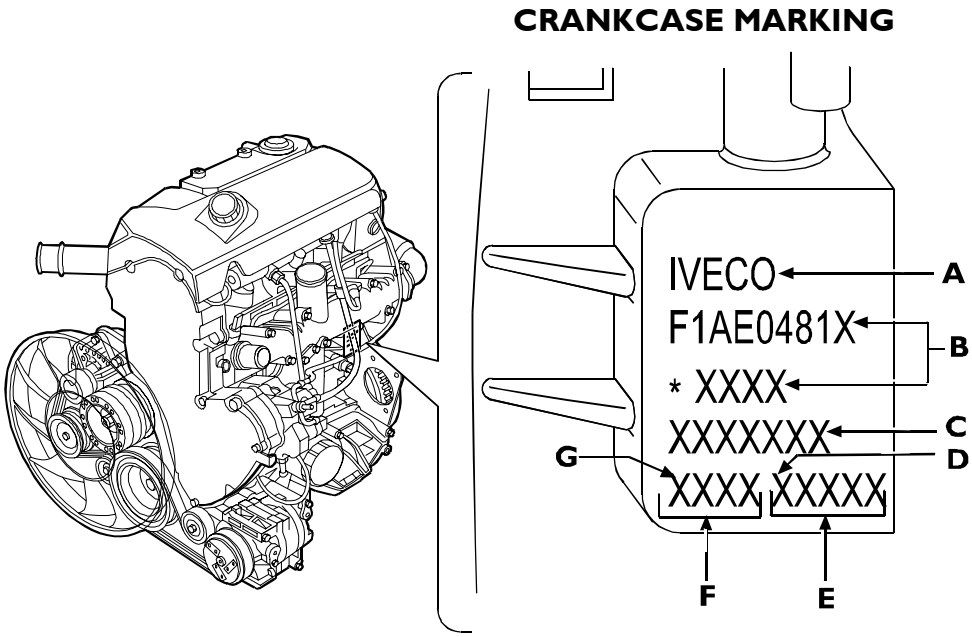
Max OUTPUT 100 kW	**136 HP**	**at 3600 ÷ 3900 rpm**
Max TORQUE 320 Nm	**32.6 kgm**	**at 1700 ÷ 2900 rpm**

Figure 21



75243

Figure 22

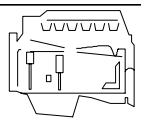
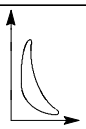
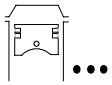
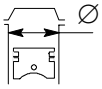
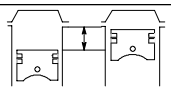
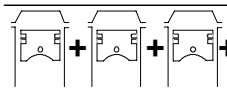
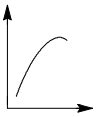
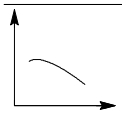


75244

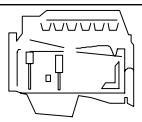
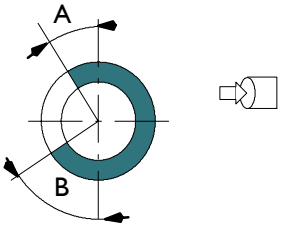
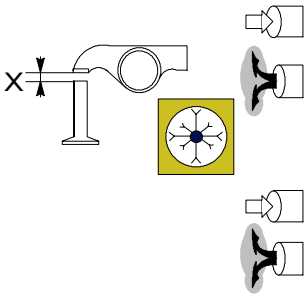
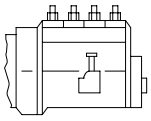
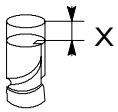
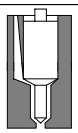
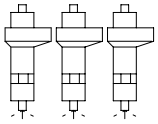
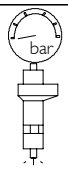
		EXAMPLE
A =	IVECO trademark	IVECO
B =	IVECO name of engine variant **	F1AE0481A * A001
C =	Engine serial number	1359862
D =	1st digit, main journal no. 1 (engine front)	
E =	Main bearing selection diameters	12345
F =	Barrel selection diameters	1234
G =	1st digit, cylinder no. 1 (engine front)	

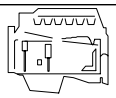
(**) Data obtainable from "XZ" engine ordering number information

GENERAL SPECIFICATIONS

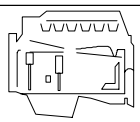
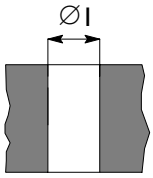
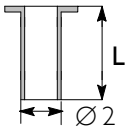
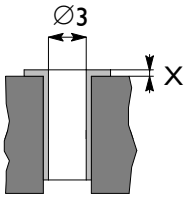
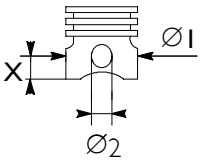
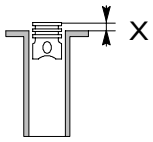
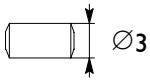
	Type		F1AE0481 A	F1AE0481 B	F1AE0481 M
	Cycle		Diesel 4 strokes		
	Supply		Turbocharged with intercooler		
	Injection		Direct		
	Number of cylinders		4 in line		
	Bore	mm	88		
	Stroke	mm	94		
	Total displacement	cm^3	2300		
	Compression ratio		18		
	Maximum power	kW (HP)	71 (96)	85 (116)	100 (136)
		rpm	3000 ÷ 3700	3000 ÷ 3900	3600 ÷ 3900
	Maximum torque	kW (HP)	240 (24.4)	270 (27.5)	320 32.6
		rpm	1800 ÷ 2800	1800 ÷ 2800	1700 ÷ 2900
	Slow running of engine with no load	rpm	800		
	Fast idling speed of engine with no load	rpm	4600		
	Pressure at T.D.C.	*bar	20 ÷ 26		
	Minimum permissible pressure at T.D.C.	*bar	16		

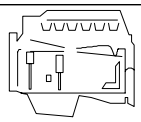
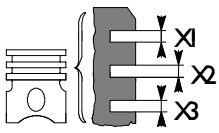
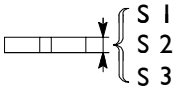
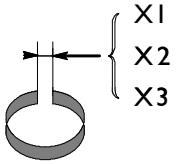
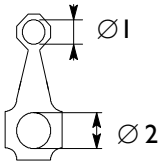
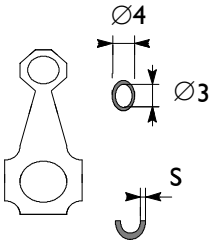
(*) The pressure is measured by setting the engine turning with the aid of just the starter motor, with an oil temperature of 40 – 50°C.

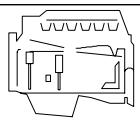
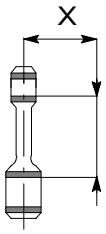
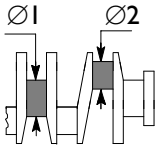
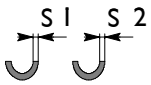
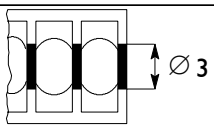
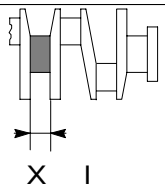
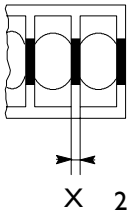
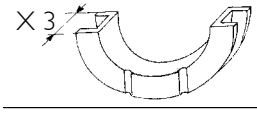
			F1AE0481 A	F1AE0481 B	F1AE0481 M
	Type				
	TIMING SYSTEM				
	Start before T.D.C.	A		14°	
	end after B.D.C.	B		27°	
	Start before T.D.C.	D		54°	
	end after B.D.C.	C		10°	
	For timing check				
	X	mm		-	
		mm		-	
	Operation				
	X	mm		-	
		mm		-	
	SUPPLY			High pressure electronic fuel feed system BOSCH MS6.3 to chassis number (...) and BOSCH EDC16 from chassis number (...). Composed of CP3 high-pressure pump, electro-injectors, hydraulic accumulator (rail), EDC control unit, pressure and temperature sensors	
	Pump setting With piston no.1 at T.D.C.			-	
	Start of delivery	mm		-	
	Electro-injectors type			BOSCH	
	Injection sequence			1- 3 - 4 - 2	
	Injection pressure	bar		1600	

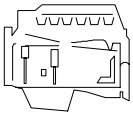
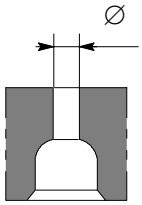
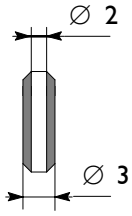
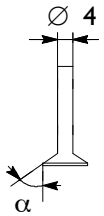
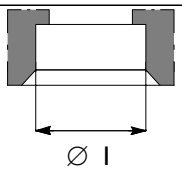
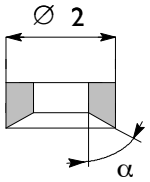
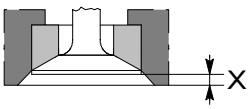
	Type	F1AE0481 A F1AE0481 B	F1AE0481 M
			
	TURBOCHARGING	With intercooler	
	Turbocharger type	KKK K03-2072-EDC 5.68	KKK
Turbocharger shaft radial play		-	
Turbocharger shaft end float		-	
Maximum stroke of pressure relief valve opening	mm	3.5 ±0.5	2.2 ± 0.5
Pressure corresponding to maximum stroke:	bar	1.5 ±0.002	1.4 ± 0.05
	LUBRICATION	forced by gear pump, pressure relief valve, oil filter with integral cartridge with total filtering	
 	Oil pressure with engine hot (100°C ±5°C):		
	at idling speed bar	≥0.6	
	at top speed bar	4	
	COOLING	by centrifugal pump, thermostat for adjustment, coolant temperature, fan with electromagnetic coupling, radiator, heat exchanger	
	Water pump control:	by belt	
	Thermostat:	N. I.	
	start of opening:	82 ±2°C	
	FLUIDS		
	Capacity:		
	engine sump		
	at minimum level liters	3	
	kg	2.65	
	engine sump		
	at maximum level litres	4.3	
 Urania Daily Urania LD 5	kg	3.78	
	quantity in circulation in cartridge filter and heat exchanger		
	litres	1.4	
	kg	1.23	
	quantity of oil for first filling liters	5.7	
	kg	5.02	

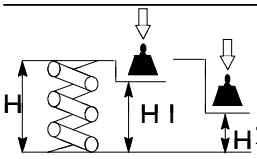
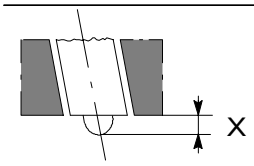
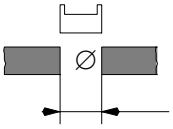
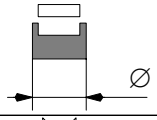
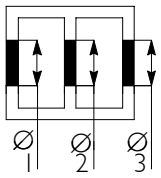
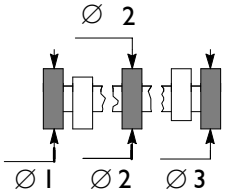
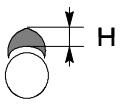
ASSEMBLY DATA – CLEARANCES

	Type		F1AE0481 A	F1AE0481 B	F1AE0481 M
CYLINDER ASSEMBLY AND CRANK MEMBERS				mm	
	Cylinder liners:				
		Ø 1		88.002 ÷ 88.022	
	Cylinder liners:		-	-	
	outside diameter	Ø	-	-	
	length	L	-	-	
	Cylinder liners – crankcase seats (interference)		-	-	
	Outside diameter	Ø 2	-	-	
	Cylinder liners: (protrusion from bottom of crankcase)		-	-	
	inside diameter	Ø 3	-	-	
	Pistons: supplied as spares type		FEDERAL MOGUL	MAHLE MONDIAL	
	measurement	X	46	45.5	
	outside diameter	Ø 1	87.801 ÷ 87.815	87.832 ÷ 87.846	
	seat for pin	Ø 2		31.003 ÷ 31.009	
	Piston – cylinder liners		0.187 ÷ 0.221	0.156 ÷ 0.190	
	Piston diameter	Ø 1		0.4	
	Piston protrusion from crankcase	X		0.3 ÷ 0.6	
	Piston gudgeon pin	Ø 3		30.990 ÷ 30.996	
	Piston gudgeon pin – pin seat			0.07 ÷ 0.019	

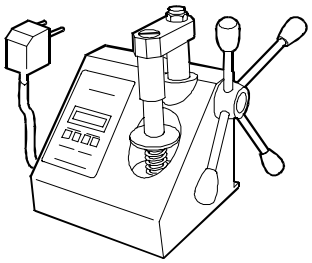
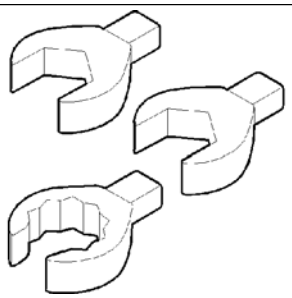
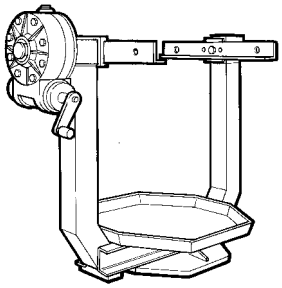
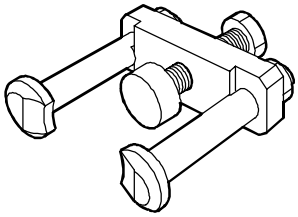
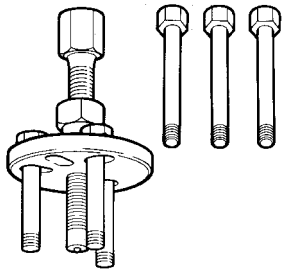
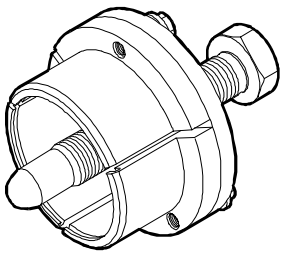
	Type	F1AE0481 A	F1AE0481 B	F1AE0481 M
CYLINDER ASSEMBLY AND CRANK MEMBERS			mm	
	Type of piston		FEDERAL MOGUL	MAHLE MONDIAL
	Piston ring slots X1*		2.197	2.200 ÷ 2.230
	Piston ring slots X2		2.040 ÷ 2.060	2.050 ÷ 2.070
	Piston ring slots X3		2.520 ÷ 2.540	2.540 ÷ 2.560
	* measured on Ø of 85 mm			
	Piston rings: S 1*		2.068 ÷ 2.097	
	Piston rings: S 2		1.970 ÷ 1.990	
	Piston rings: S 3		2.470 ÷ 2.490	
	* measured on Ø 85 mm			
	Piston rings – slots 1		0.103 ÷ 0.162	
	Piston rings – slots 2		0,060 ÷ 0.100	
	Piston rings – slots 3		0.050 ÷ 0.090	
IVECO PARTS 	Piston rings		0.4	
	Piston ring end opening in cylinder liner:			
	X1		0.20 ÷ 0.35	
	X2		0.60 ÷ 0.80	
	X3		0.25 ÷ 0.50	
	Small end bushing seat Ø 1		34.460 ÷ 34.490	
	Connecting rod bearing seat* Ø 2		62.833 ÷ 62.841	
	* connecting rod supplied as spare part			
	Small end bushing diameter			
	outside Ø 4		34.560 ÷ 34.585	
	inside Ø 3		31.010 ÷ 31.020	
	Big end bearing shells supplied as spare part S		-	
	Small end bushing – seat (interference)		0.07 ÷ 0.125	
	Piston gudgeon pin – bushing		0.014 ÷ 0.030	
IVECO PARTS 	Big end bearing shells		0.254 - 0.508	

	Type	F1AE0481 A	F1AE0481 B	F1AE0481 M
CYLINDER ASSEMBLY AND CRANK MEMBERS			mm	
	Measurement X		125	
	Maximum error on alignment of connecting rod axes =		0.09	
	Main journals Ø 1 No. 1-2-3-4 No. 5		71.182 ÷ 71.208 76.182 ÷ 76.208	
	Crankpins Ø 2		59.015 ÷ 59.038	
	Main bearing shells S1*		2.165 ÷ 2.174	
	Big end bearing shells S2*		1.883 ÷ 1.892	
	* supplied as spare parts			
	Main bearing housings Ø 3 No. 1-2-3-4 No. 5		75.588 ÷ 75.614 80.588 ÷ 80.614	
	Bearing shells - main journals		0.032 ÷ 0.102	
	Bearing shells – crankpins		0.035 ÷ 0.083	
	Main bearing shells		0.254 ÷ 0.508	
	Big end bearing shells		0.254 ÷ 0.508	
	Main journal for shoulder X 1		31.020 ÷ 31.170	
	Main bearing housing for shoulder X 2		25.790 ÷ 25.840	
	Half thrust washers X 3		30.810 ÷ 30.960	
	Crankshaft shoulder		0.060 ÷ 0.260	

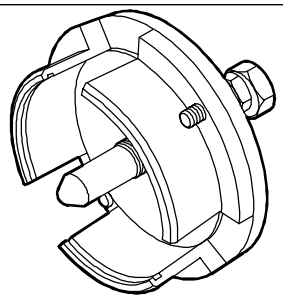
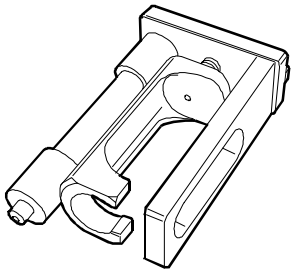
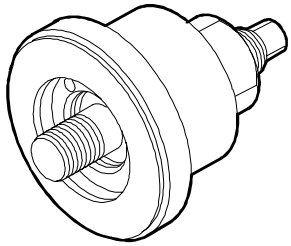
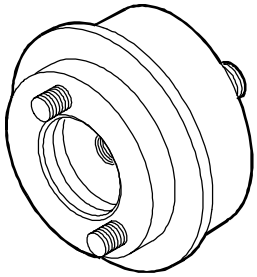
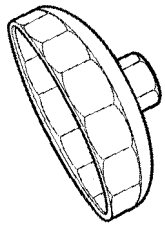
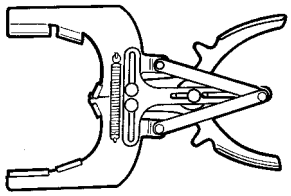
		F1AE0481 A	F1AE0481 B	F1AE0481 M
	Type			
CYLINDER HEAD – TIMING SYSTEM			mm	
	Guide valve seats on cylinder head Ø1		9.980 ÷ 10.000	
	Valve guides Ø2 Ø3		6.023 ÷ 6.038 10.028 ÷ 10.039	
	Valve guides and seats on head (interference)		0.028 ÷ 0.059	
IVECO PARTS	Valve guides		0.05 - 0.10 - 0.25	
	Valves: Ø4 α Ø4 α		5.975 ÷ 5.990 44°45' ± 7.5' 5.975 ÷ 5.990 44°45' ± 7.5'	
	Valve stem and relevant guide		0.033 ÷ 0.063	
	Seat on head for valve seat: Ø1 Ø1		31.390 ÷ 31.415 31.390 ÷ 31.415	
	Outside diameter of valve seats; angle of valve seats on cylinder head: Ø2 α Ø2 α		31.495 ÷ 31.510 44.5° ± 5' 31.495 ÷ 31.510 44.5° ± 5'	
	Recessing X X		0.5 ÷ 0.8 0.5 ÷ 0.8	
	Between valve seat and head		0.08 - 0.12 0.08 - 0.12	
IVECO PARTS	Valve seats		-	

	Type	F1AE0481 A	F1AE0481 B	F1AE0481 M
CYLINDER HEAD – TIMING SYSTEM			mm	
	Valve spring height: free spring H under a load of: N243 ± 12 H1 N533 ± 24 H2		54 45 35	
	Injector protrusion X		2.77 ÷ 3.23	
	Seats for tappets on cylinder head normal Ø		12.016 ÷ 12.034	
	Normal diameter tappets		11.988 ÷ 12.000	
	Between tappets and seats		0.016 ÷ 0.046	
	Camshaft pin seats in cylinder overhead 1 ⇒ 7 Ø 1 Ø 2 Ø 3		 48.987 ÷ 49.013 46.987 ÷ 47.013 35.987 ÷ 36.013	
	Camshaft supporting pins: Ø 1 Ø 2 Ø 3		 48.925 ÷ 48.950 46.925 ÷ 46.950 35.925 ÷ 35.950	
	Supporting pins and seats		0.037 ÷ 0.088	
	Useful cam height  H  H		 3.77 4.203	

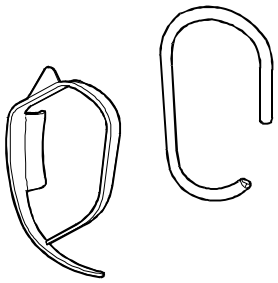
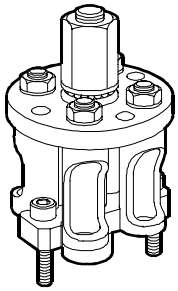
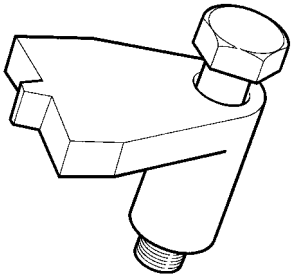
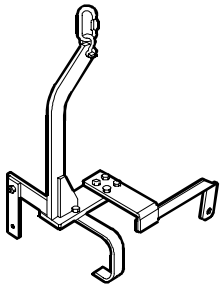
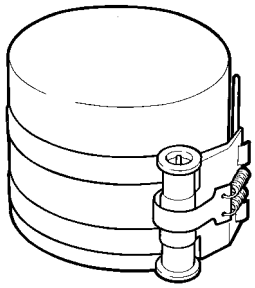
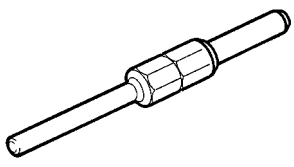
TOOLS

TOOL NO.		DESCRIPTION
99305047		Appliance to check spring loads
99317915		Set of six box-type wrenches (14-17-19 mm)
99322205		Rotary telescopic stand for overhauling assemblies (capacity 700 daN, torque 120 daN/m)
99340028		Extractor for camshaft pulley
99340035		High-pressure pump toothed pulley extractor
99340057		Tool to remove crankshaft front gasket

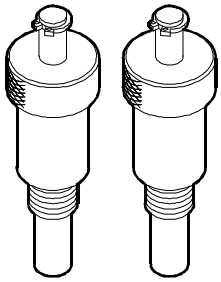
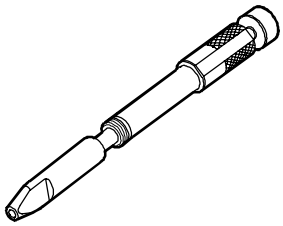
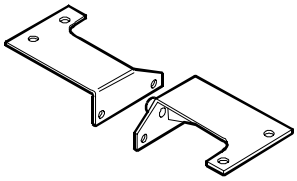
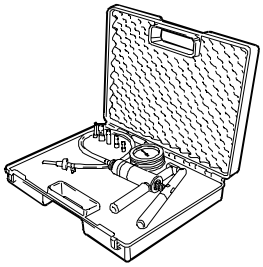
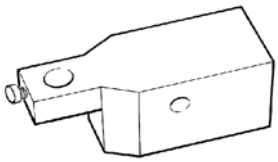
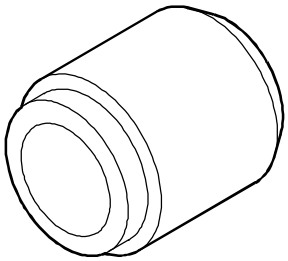
TOOLS

TOOL NO.		DESCRIPTION
99340058		Tool to remove crankshaft rear gasket
99342153		Tool to extract injectors
99346254		Keying device for mounting crankshaft front gasket
99346255		Keying device for mounting crankshaft rear gasket
99360076		Tool to remove cartridge filters
99360183		Pliers for mounting rings on engine pistons

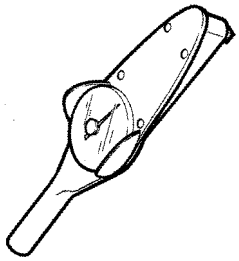
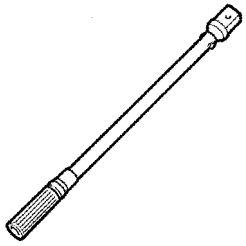
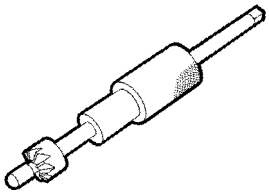
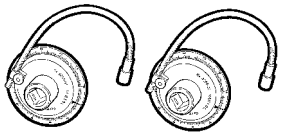
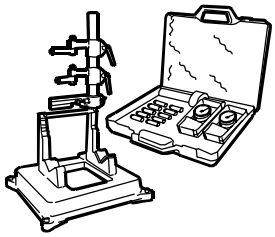
TOOLS

TOOL NO.		DESCRIPTION
99360191		Guide for flexible belt
99360260		Tool for removing and refitting engine valves
99360306		Tool to retain engine flywheel
99360544		Arm for removing and refitting engine
99360605		Band to insert standard and oversized pistons into the cylinders
99360608		Tool for positioning timing gear

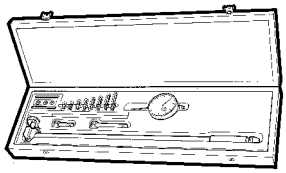
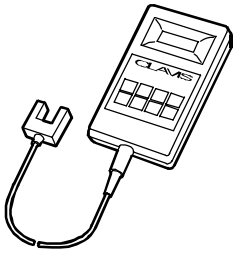
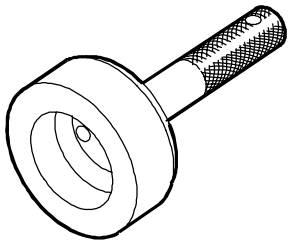
TOOLS

TOOL NO.		DESCRIPTION
99360614		Tool (2) for camshaft timing
99360615		Tool for crankshaft timing
99361038		Brackets securing engine to rotary stand 99322205
99367121		Manual pump to measure pressure and vacuum
99370415		Comparator holder base
99374458		Keying device for mounting oil seal gasket on camshaft front cover

TOOLS

TOOL NO.		DESCRIPTION
99389819		Torque wrench (0-10 Nm) with square 1/4" connection
99389829		9x12 coupling torque wrench (5-60 Nm)
99394038		Milling cutter to regrind injector seat (8140.63 engine excluded)
99395216		Pair of meters for angular tightening with square 1/2" and 3/4" connection
99395363		Complete square to check for connecting rod distortion
99395603		Comparator (0-5 mm)

TOOLS

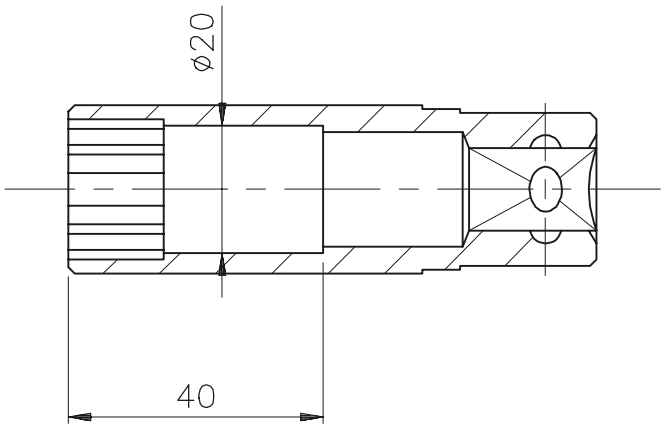
TOOL NO.		DESCRIPTION
99395687		Bore meter (50 – 178 mm)
99395849		Device for checking belt tension (frequency from 10.0 to 600 Hz)
99396037		Centring ring for crankshaft front gasket cover

EXPERIMENTAL TOOLS

This section shows the working drawings for the experimental tools (S.P.) used in overhauling the engine described in this section, which may be made by the repair shops.

VARIA DA ART. COMMERCIALE USAG cod.235L 1/2" – Ch.19

SOLO PER QUANTO INDICATO



Modification:

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

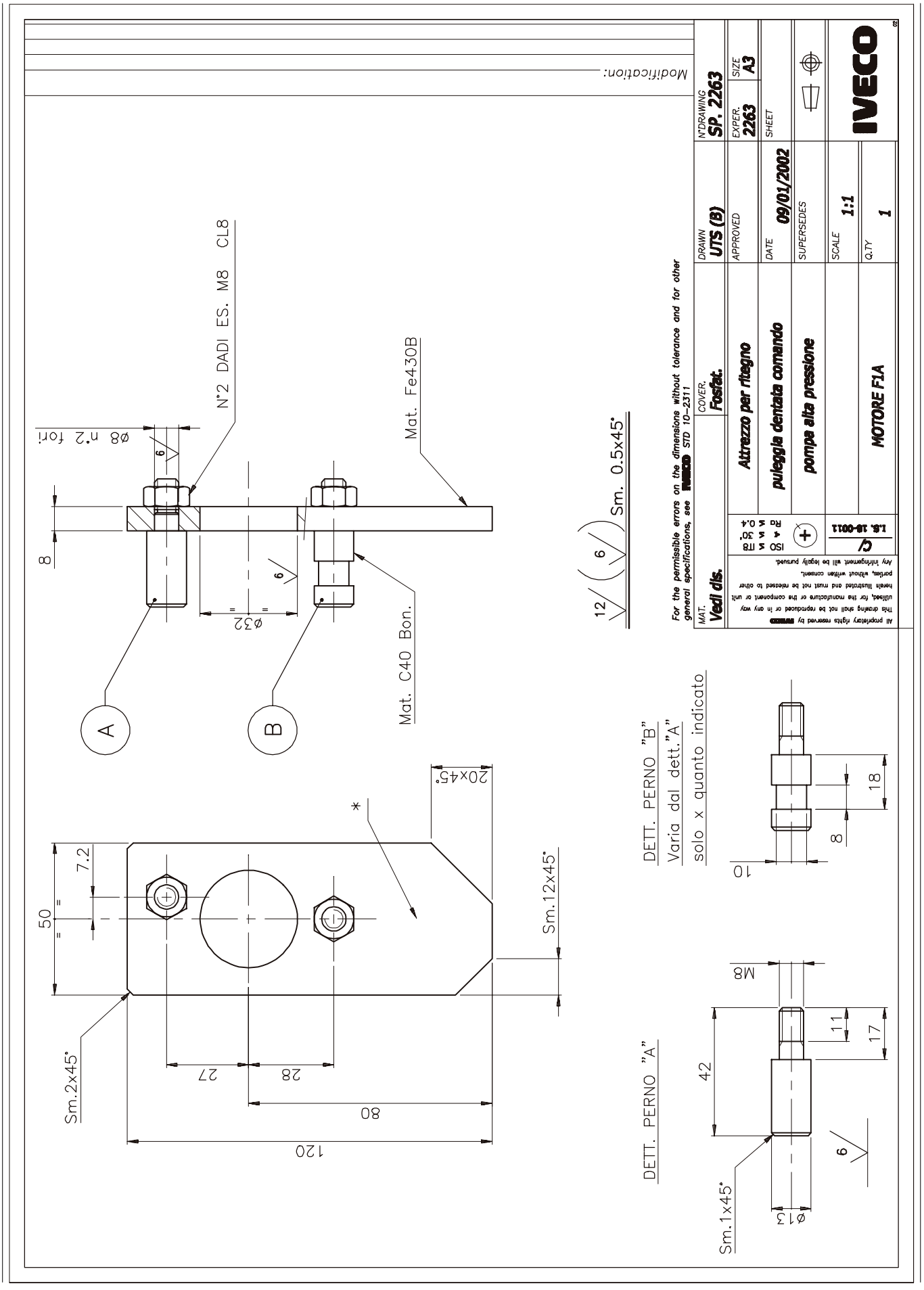
MAT.	COVER.	DRAWN	N°DRAWING
/	/	UTS (B)	SP. 2262

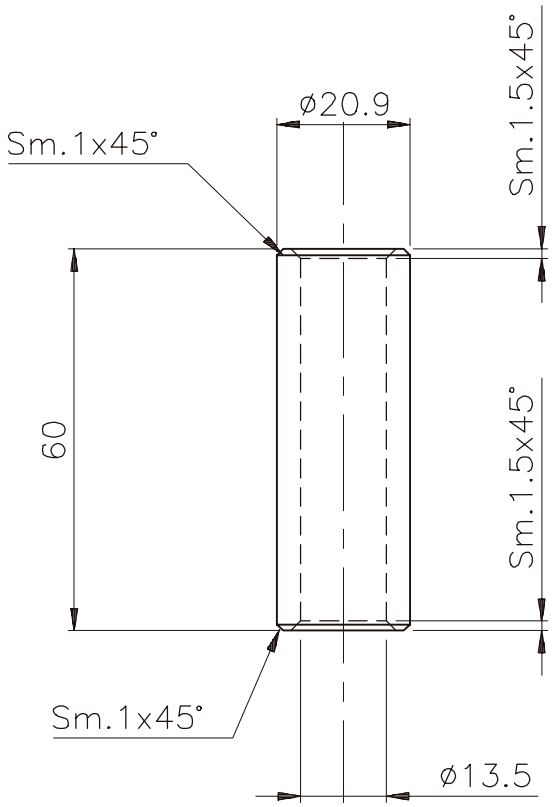
ISO ≤ IT8
∢ ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

Chiave poligonale (19mm)	APPROVED	EXPER. 2262	SIZE A4
per sensore pompa acqua	DATE 19/06/2001	SHEET	
	SUPERSEDES		
	SCALE 1:1	IVECO	
MOTORE F1A	Q.TY 1		

02


Modification:
N°DRAWING SP. 2263
SIZE A3
EXPER. 2263
SHEET
DRAWN UTS (B)
APPROVED
DATE 09/01/2002
SUPERSEDES
SCALE 1:1
Q.TY 1
IVECO
COVER. Fosfat.
MAT. Vedi dis.
Attrezzo per ritegno puleggia dentata comando pompa alta pressione
MOTORE F1A
I.S. 18-0011
ISO A ITB 4 A 30' Ra A 0,4
For the permissible errors on the dimensions without tolerance and for other general specifications, see STD 10-2311
All proprietary rights reserved by
This drawing shall not be reproduced or in any way utilized, for the manufacture or the component or unit herein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
N°2 DADI ES. M8 CL8
Mat. Fe430B
Mat. C40 Bon.
Ø8 n.2 fori
Ø32
Sm. 0.5x45°
Sm.12x45°
Sm.2x45°
Sm.1x45°
20x45°
DETT. PERNO "A"
DETT. PERNO "B"
Varia dal dett."A"
solo x quanto indicato
A
B
*



Modification:

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

MAT.	COVER.	DRAWN	N°DRAWING
Pom / Nylon	**/**	**UTS (B)**	**SP. 2264**

ISO ≤ IT8
4 ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

Perni di centraggio sovratesta

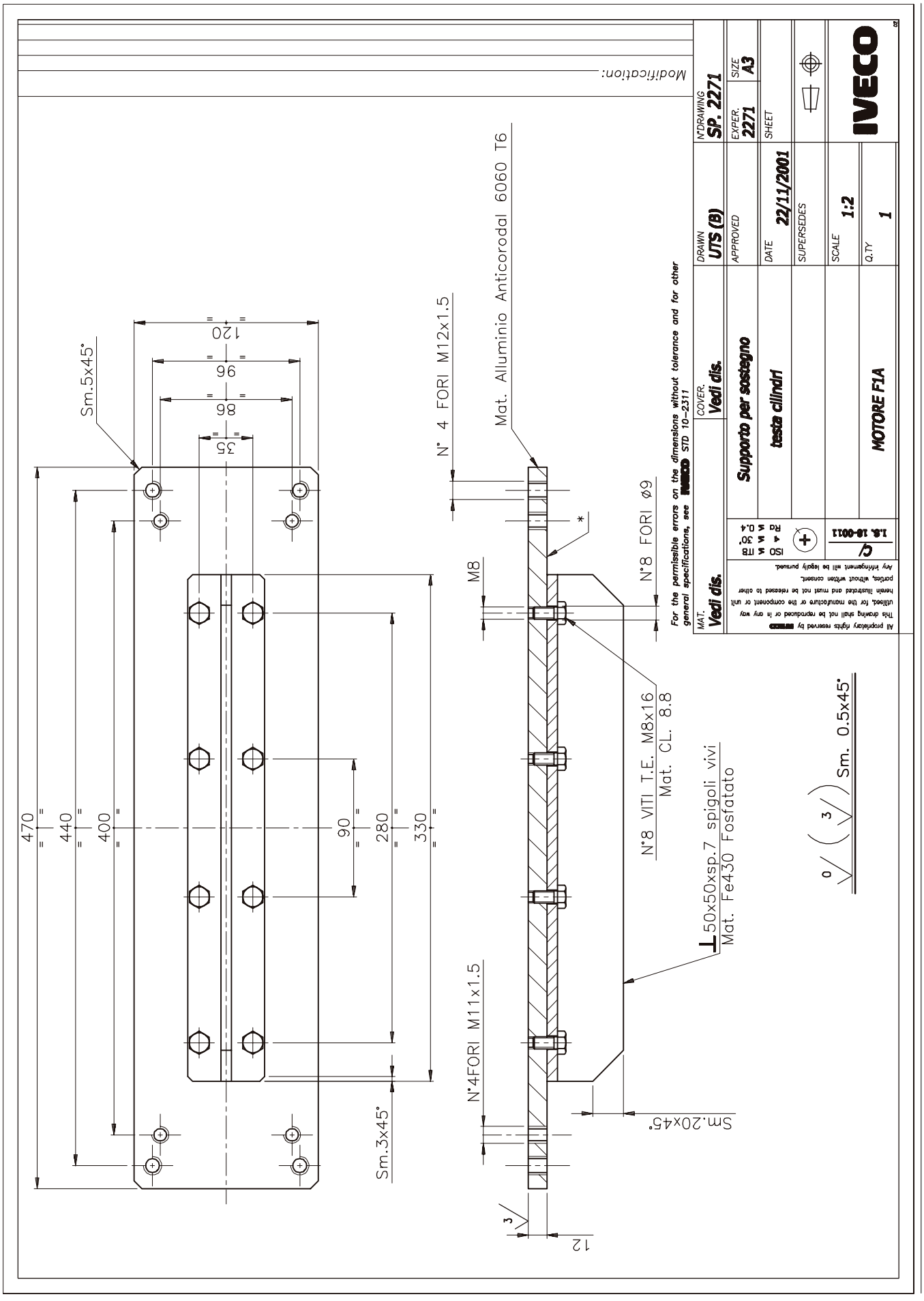
e per piantaggio guarnizione

guida valvole

MOTORE F1A

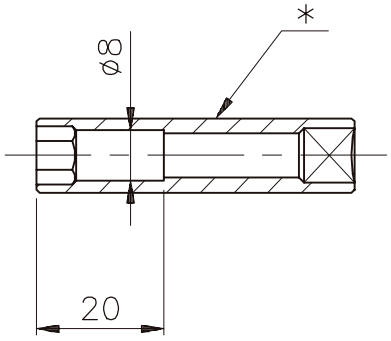
APPROVED	EXPER.	SIZE
	2264	**A4**
DATE **19/06/2001**	SHEET	
SUPERSEDES		
SCALE **1:1**	IVECO	
Q.TY **2**		

02


Modification:
N°DRAWING SP. 2271
SIZE A3
EXPER. 2271
SHEET
DRAWN UTS (B)
APPROVED
DATE 22/11/2001
SUPERSEDES
SCALE 1:2
Q.TY 1
MOTORE F1A
COVER. Vedi dis.
MAT. Vedi dis.
Supporto per sostegno
testa cilindri
I.S. 18-0012
ISO M TTR
Ra M M 30°
0,4
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
All proprietary rights reserved by IVECO
This drawing shall not be reproduced or in any way utilized, for the manufacture or the component or unit therein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
IVECO
N° 4 FORI M12x1.5
Mat. Alluminio Anticorodal 6060 T6
N°8 FORI ø9
M8
N°8 VITI T.E. M8x16
Mat. CL. 8.8
50x50xsp.7 spigoli vivi
Mat. Fe430 Fosfatato
N°4FORI M11x1.5
Sm.20x45°
Sm. 0.5x45°
Sm.5x45°
Sm.3x45°
120
96
86
35
470
440
400
90
280
330
12
3

VARIA DA ART. COMMERCIALE USAG cod.235EL 1/4" – Ch.8

SOLO PER QUANTO INDICATO



6 Sm. 0.5x45°

Modification:

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

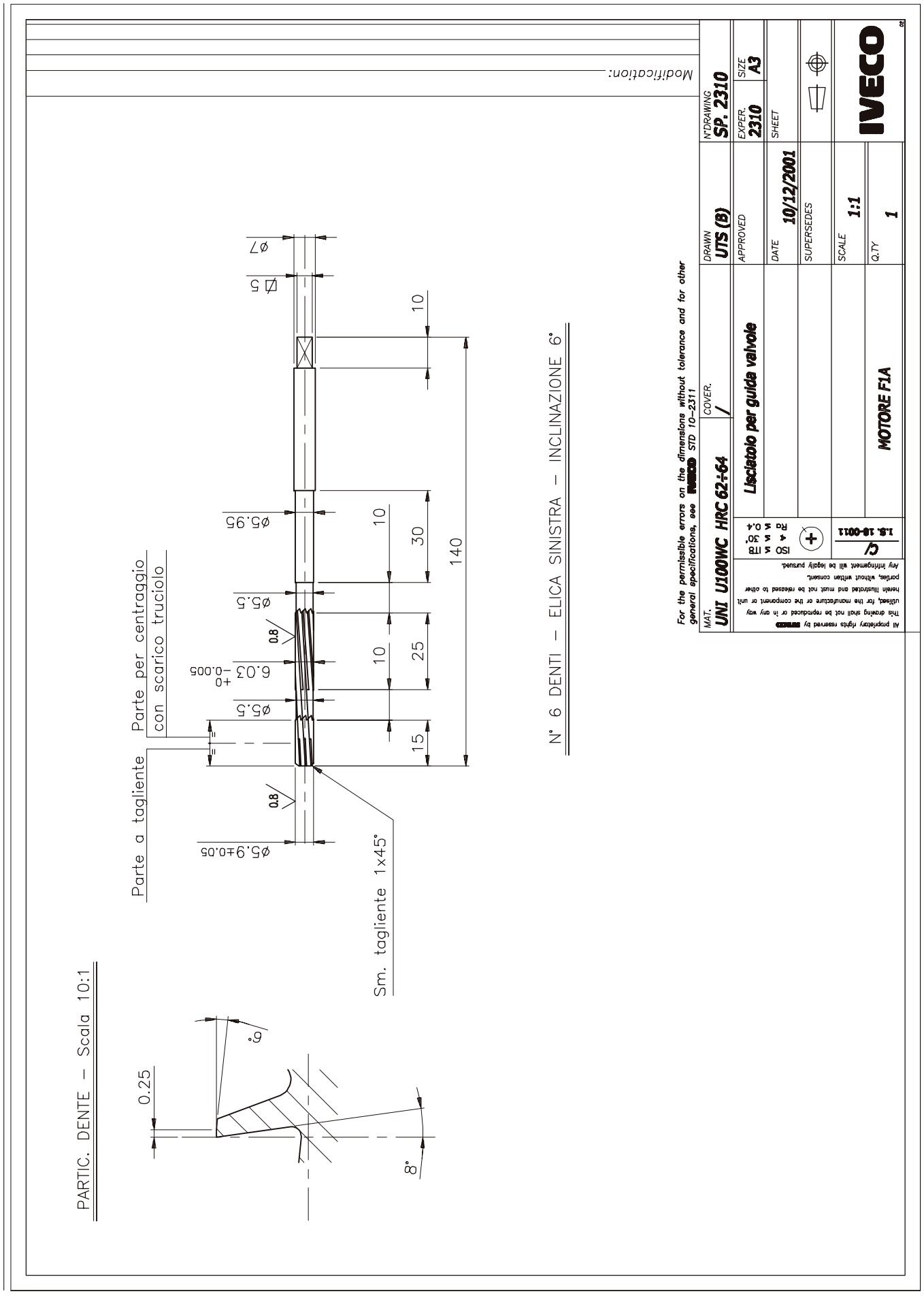
MAT.	COVER.	DRAWN	N°DRAWING
/	/	UTS (B)	SP. 2275

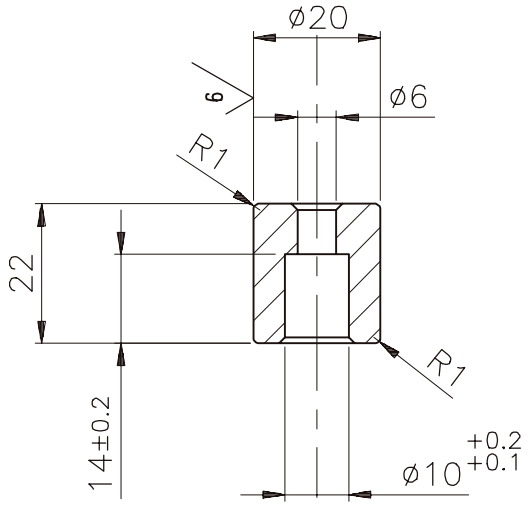
ISO ≤ IT8
4 ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

	APPROVED	EXPER.	SIZE
Bussola (8 mm) per montaggio/ smontaggio candelette		2275	A4
	DATE 25/07/2001	SHEET	
	SUPERSEDES		
	SCALE 1:1	IVECO	
MOTORE F1A	Q.TY 1		

02


Modification:
N°DRAWING SP. 2310
SIZE A3
EXPER. 2310
SHEET
DRAWN UTS (B)
APPROVED
DATE 10/12/2001
SUPERSEDES
SCALE 1:1
Q.TY 1
MOTORE F1A
IVECO
1.S. 18-0011
ISO ∧ ITB 4 ∧ 30' Ra ∧ 0.4
MAT. UNI U100WC HRC 62÷64
COVER. /
Lisciatoio per guida valvole
For the permissible errors on the dimensions without tolerance and for other general specifications, see IVECO STD 10-2311
All proprietary rights reserved by IVECO
This drawing shall not be reproduced or in any way utilised, for the manufacture or the component or unit herein illustrated and must not be released to other parties, without written consent.
Any infringement will be legally pursued.
N° 6 DENTI – ELICA SINISTRA – INCLINAZIONE 6°
Parte per centraggio con scarico truciolo
Parte a tagliente
Sm. tagliente 1x45°
PARTIC. DENTE – Scala 10:1
Ø7
□ 5
Ø5.95
Ø5.5
Ø5.9±0.05
6.03 +0 −0.005
0.8
10
30
25
15
140
0.25
6°
8°



Modification:

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

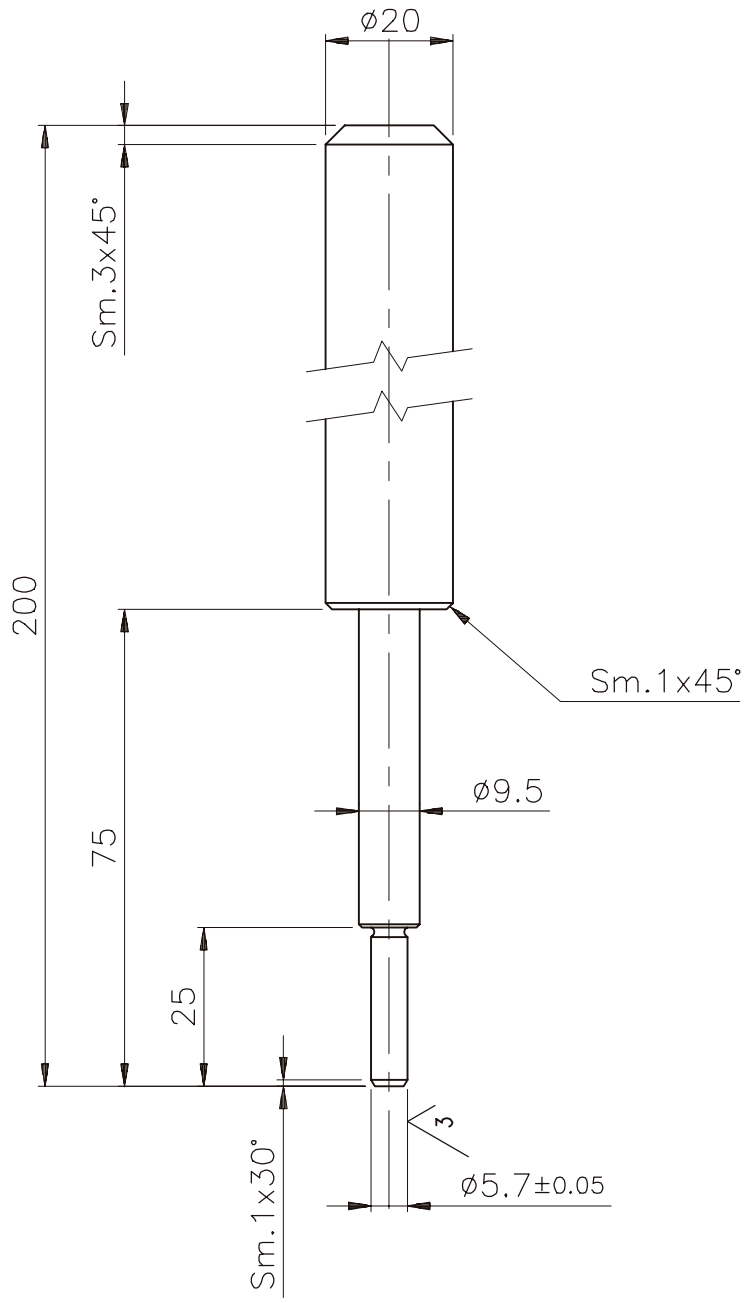
MAT.	COVER.	DRAWN	N°DRAWING
39NiCrMo3 Bon.	Fosfat.	UTS (B)	SP. 2311

ISO ≤ IT8
4 ≤ 30'
Ra ≤ 0.4

C/
I.S. 18-0011

Battitoio per piantaggio	APPROVED	EXPER. 2311	SIZE A4
guida valvole	DATE 10/12/2001	SHEET	
(usare con sp. 2312)	SUPERSEDES		
	SCALE 1:1	IVECO	
MOTORE F1A	Q.TY 1		

02



Modification:

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

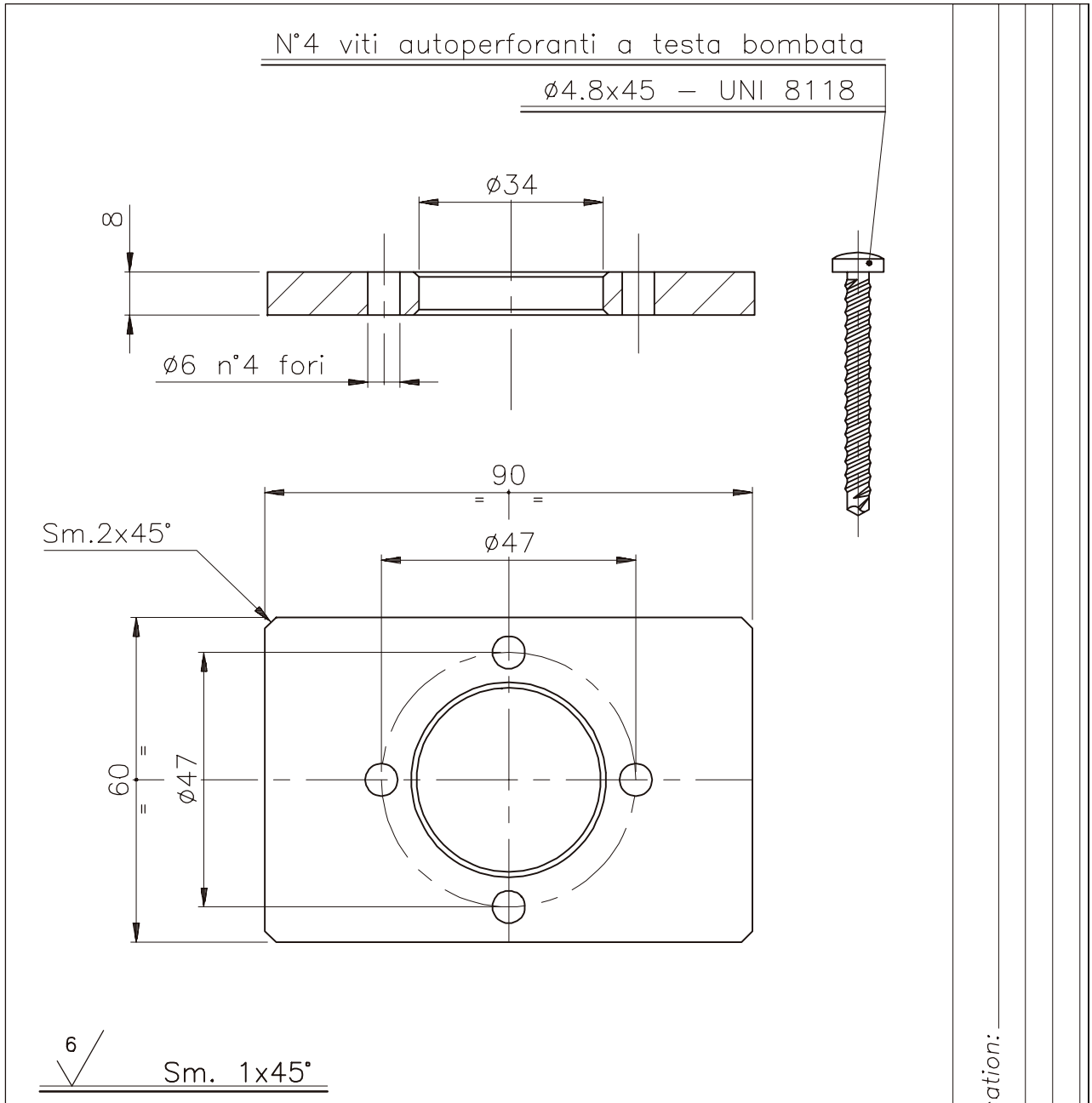
MAT.	COVER.	DRAWN	N°DRAWING
39NiCrMo3 Bon.	Fosfat.	UTS (B)	SP. 2312

ISO ≤ IT8
4 ≤ 30'
Ra ≤ 0.4

C/ I.S. 18-0011

Battitoio per spiantaggio	APPROVED	EXPER. 2312	SIZE A4
guida valvole	DATE 10/12/2001	SHEET	
	SUPERSEDES		
	SCALE 1:1	IVECO	
MOTORE F1A	Q.TY 1		

02



Modification:

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

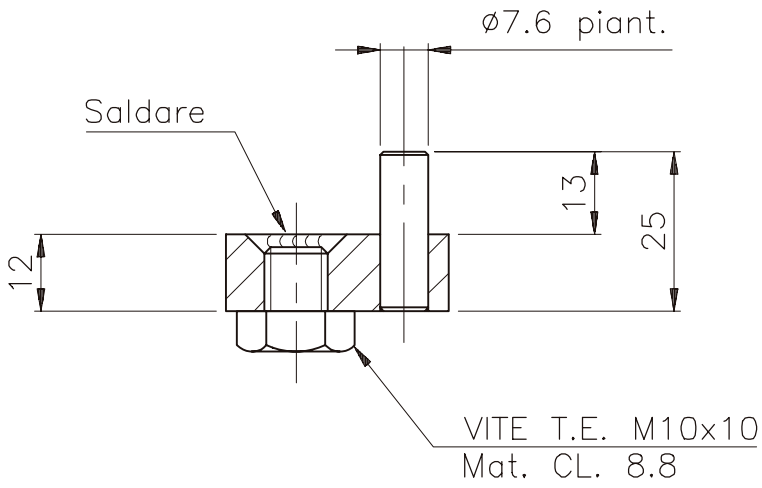
MAT.	COVER.	DRAWN	N°DRAWING
Fe430B	Fosfat.	UTS (B)	SP. 2325

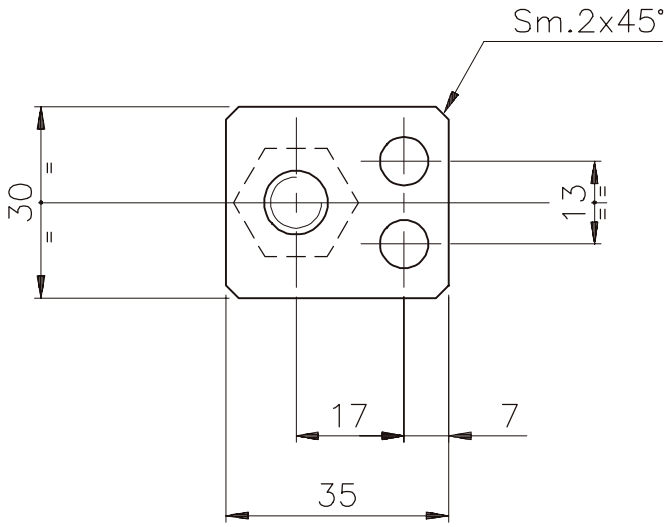
ISO ≤ IT8 ∢ ≤ 30' Ra ≤ 0.4

C/ I.S. 18-0011

Attrezzo per estrazione guarnizione albero distribuzione	APPROVED	EXPER. 2325	SIZE A4
	DATE 01/02/2002	SHEET	
	SUPERSEDES		
MOTORE F1A	SCALE 1:1	IVECO	
	Q.TY 1		

02





6 Sm. 0.5x45°

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

Modification:

MAT.	COVER.	DRAWN	N°DRAWING
C40 Bon.	Fosfat.	UTS (B)	SP.2341

ISO ≤ ITB 4 ≤ 30' Ra ≤ 0.4

C/ I.S. 18-0011

Chiave per tensionamento tenditore cinghia compressore condizionatore	APPROVED	EXPER. 2341 / SIZE A4
	DATE 05/03/2002	SHEET
	SUPERSEDES	
	SCALE 1:1	IVECO
MOTORE F1A	Q.TY 1	02

TIGHTENING TORQUE

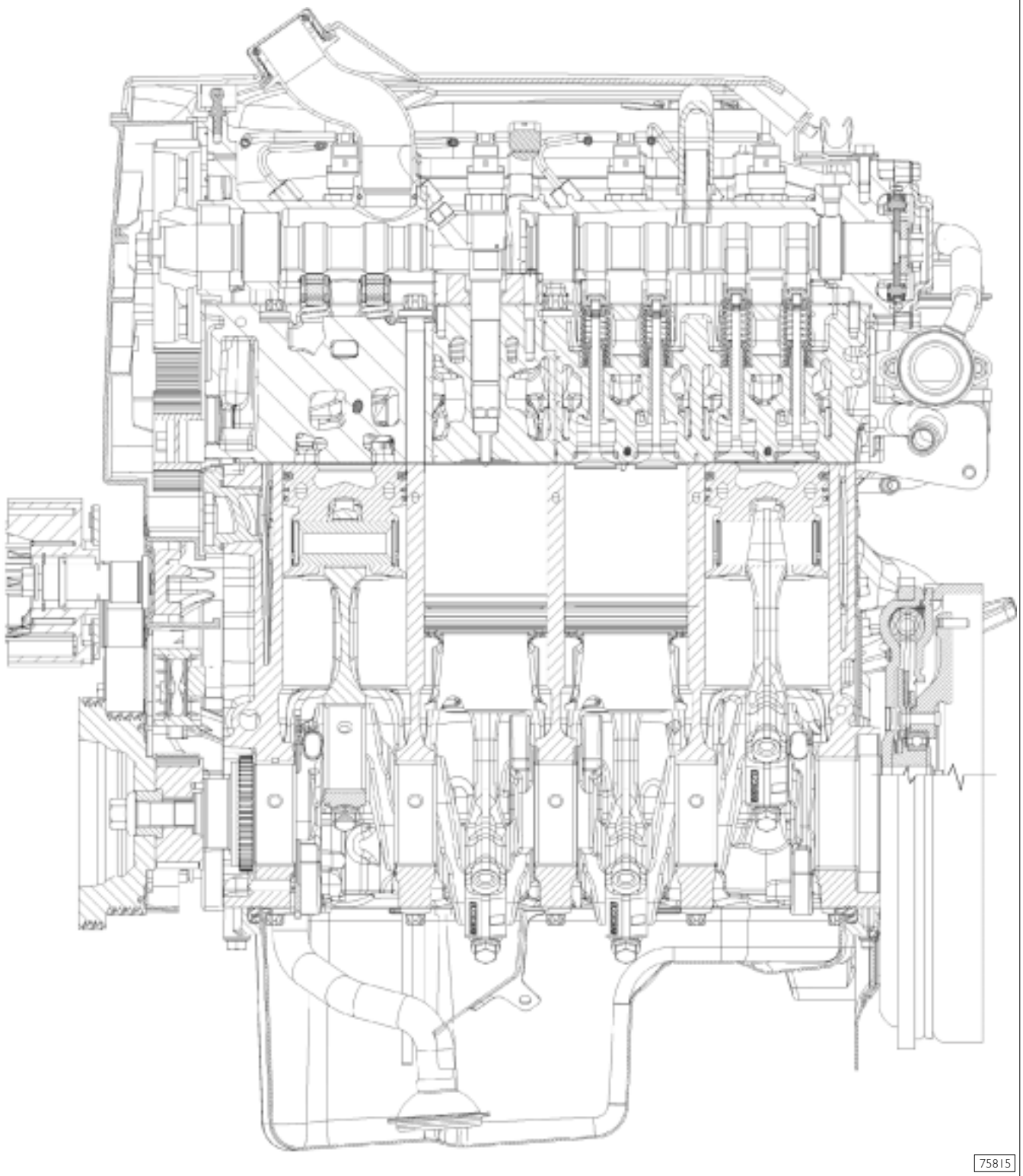
PART	TORQUE	
	Nm	kgm
Cylinder head central fixing screw		
first phase: pre-tightening	100	9.8
second phase: angle	90°	
third phase: angle	90°	
Cylinder head side fixing screw		
first phase: pre-tightening	50	4.9
second phase: angle	60°	
third phase: angle	60°	
Hex screw with flange M8x1.25 L 40 fixing overhead	25	2.5
Hex screw with flange M8x1.25 L 77 fixing overhead	25	2.5
Central base fastening screw		
first phase: pre-tightening	50 ± 5	5 ± 0.5
second phase: angle	60° ± 2.5°	
third phase: angle	60° ± 2.5°	
Outer base fastening screw	36 ÷ 30	3.6 ÷ 3
Connecting rod cap fixing screw		
first phase: pre-tightening	40	4
second phase: angle	60°	
Hex screw with flange M12x1.25 L 43 fixing engine flywheel		
first phase: pre-tightening	30	3
second phase: angle	90°	
Cylindrical socket head screw fixing phonic wheel to crankshaft •	15	1.5
Nozzle union	25	2.5
Tapered threaded socket plug R 3/8" x 10 oil circuit	22	2.2
Water drain plug M14x1.50 L 10	25	2.5
Union on crankcase for oil return from turbocharger R 3/8"	50	5
Screw M6x1 fixing suction strainer	10	1
Male threaded socket plug M28x1.5 L11 fixing	100	9.8
Hex screw with flange M8x1.5 L 35 fixing frame retaining oil sump	25	2.5
Hex screw with flange M6x1 L30 fixing frame retaining oil sump	10	1
Hex screw with flange M6x1 L25 fixing frame retaining oil sump	10	1
Tapered threaded socket plug M6x1x8.5*	2	0.2
Male threaded plug with O-ring M22x1.5 L16	50 ±10	5 ±1
Hex screw with flange M6x1 L20 fixing oil vacuum pump assembly	10	1
Hex screw with flange M6x1 L50 fixing oil vacuum pump assembly	10	1
Oil filter cartridge M22x1.5 L7	25	2.5
Union fixing heat exchanger M22x1.5	80 ± 5	7.8 ± 0.5
Hex screw with flange M12x1.25 L55 fixing toothed pulley controlling timing system	90	8.8
Hex screw with flange M18x1.5 L78 fixing pulley on crankshaft	300	30
Hex screw with flange M8x1.25 L45 fixing pulley on damper	30	3
Hex screw with flange M8x1.25 L60 fixing automatic tightener	36	3.6
High pressure pump gear fastening hex nut with flange M14x1.5	70	6.9
Fastener for complete guide pulley roller for timing belt M8x1.25 L45	25	2.5

• Thread pre-treated with Loctite.
* Apply Loctite on the thread.

PART	TORQUE	
	Nm	kgm
Tapered threaded socket plug R 3/8" x 10	17	1.7
Tapered threaded socket plug R 1/8" x 8	7	0.7
Tapered threaded socket plug R 1/4" x 9	9	0.9
Hex screw with flange M12x1.25 L65 fixing gear for camshaft chain	115	11.3
Hex screw with flange M6x1 L25 fixing chain cover	10	1
Hex screw with flange M6x1 L35 automatic tightener	10	1
Threaded plug M14x1.5 L10	25	2.5
Ball joint fastening screw M6x1x9	10	1
Hex screw with split washer and flat washer fixing water pump M8x1.25 L28	25	2.5
Hex screw with split washer and flat washer fixing water pump M6x1 L20	10	1
Flanged screw M8x1.25 fixing water outlet union	25	2.5
Flanged screw M8x1.25 fixing piezometric tube on intake manifold	25	2.5
Flanged nut M8x1.25 fixing piezometric tube on bracket	18	1.8
Self-tapping screw L16 fixing bracket on coalescence filter cover	6	0.6
Flanged screw M6x1x16 fixing piezometric tube	10	1
Self-tapping flanged screw L14 fixing piezometric tube on front cover	2	0.2
Coupling M10x1x10 fixing vapour outlet	12	1.2
Union M10x1x19 fixing vapour outlet	14 ÷ 16	1.4 ÷ 1.6
Hex screw with flange M8x1.25 L25 fixing thermostat	25	2.5
Hex screw with flange M8x1.25 L100 fixing air-conditioner compressor	25	2.5
Hex screw with flange M8x1.25 L120 fixing air-conditioner compressor	25	2.5
Hex screw with flange M8x1.25 L50 fixing air-conditioner compressor mounting	25	2.5
Cylindrical socket head screw M8x1.25x40 fixing air-conditioner compressor drive belt guide pulley	25	2.5
Hex screw fixing bottom of alternator M10x1.25 L40 and M10x1.5 L50	50	5
Hex nut with flange fixing top of alternator M10x1.25 L10	-	-
Fastener for complete guide pulley roller for timing belt M10x1.25 L50	40	4
Allen head screw fixing automatic tightener M8x1.25 L65	25	2.5
Hex screw with flange M8x1.25 L45 fixing pulley on damper	30	3
Screw plug with washer M12x1.5 L20	30	3
Vacuum pump coupling M10x1 on oil vacuum pump assembly	10	1
Flanged screw M6x1x27 fixing timing cover	7.5	0.7
Hex screw with flange M6x1 L27 fixing coalescence filter assembly	10	1
Screw M6x1 L12 fixing sump blow-by oil drain pipes	10	1
Union M20x1.5 blow-by breather socket	30	3
Hex screw with flange M8x1.25 L90 fixing intake manifold	30	3
Flanged nut M8x1.25 fixing exhaust manifold	25	2.5
Flanged screw M6x1 fixing oil fillpipe	10	1
Flanged screw M8x1.25 fixing oil dipstick pipe	18	1.8
Glow plug M8x1 L11.5	8 ÷ 11	0.8 ÷ 1.1
High-pressure injection system		
Hex screw fixing hydraulic accumulator M8x1.25 L50	28	2.8
Screw M8x1.25 L30 fixing high-pressure pump	25	2.5
Screw M8x1.25 fixing bracket anchoring fuel delivery pipe	25	2.5
Fitting for fuel pipe M14x1.50 (forged hydraulic accumulator)	25 ± 2	2.5 ± 0.2
Fitting for fuel pipe M12x1.50 (forged hydraulic accumulator)	25 ± 2	2.5 ± 0.2
Hex screw fixing electro-injector retaining bracket	28	2.8
Hex screw with flange fixing low-pressure fuel pipes M6x1 L30	10	1

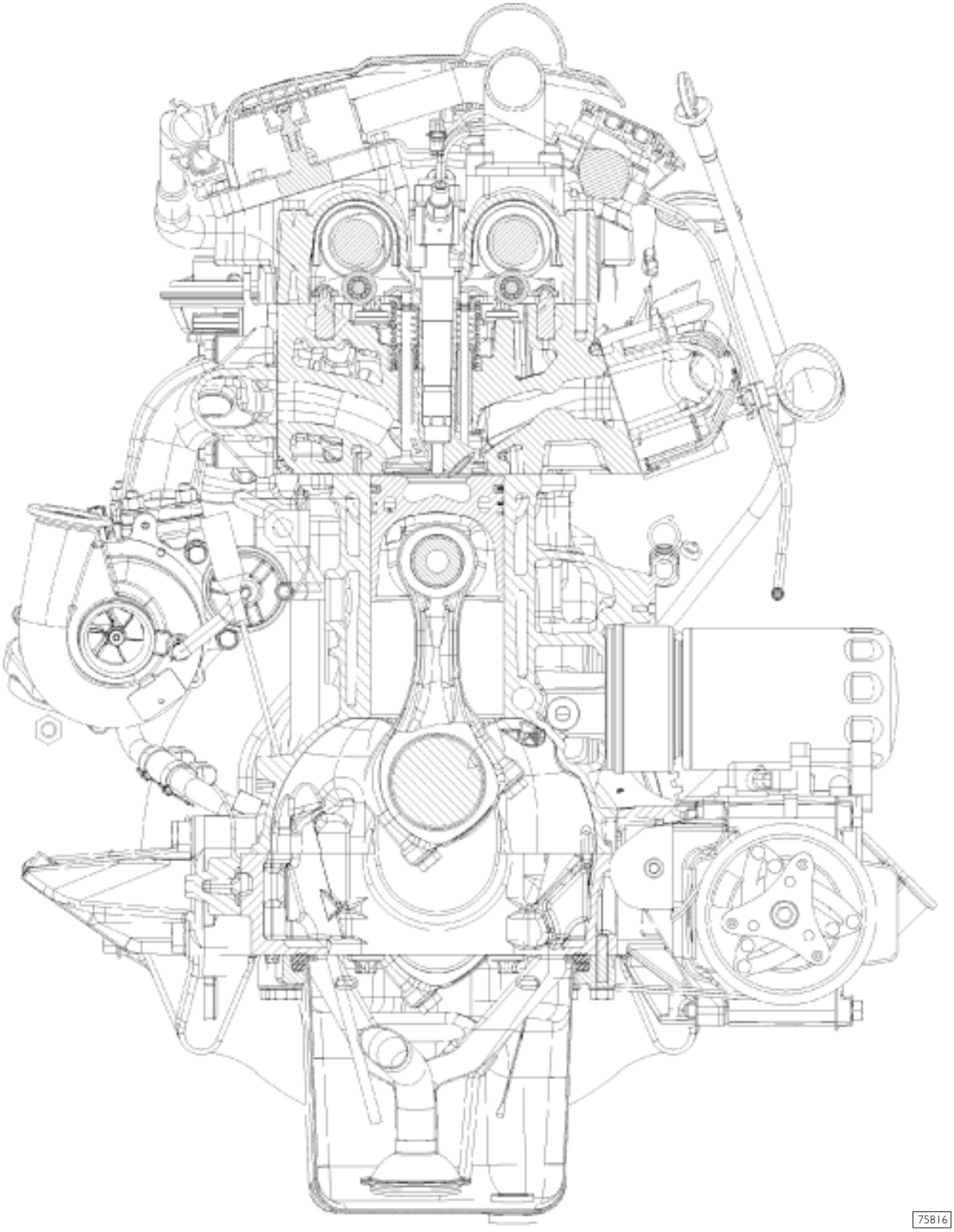
PART	TORQUE	
	Nm	kgm
Pipe fitting M12x1.5 to secure electric injectors side and high pressure pump side piping (welded hydraulic accumulator)	25 ± 2	2.5 ± 0.2
Pipe fitting M14x1.5 to secure hydraulic accumulator side piping (welded hydraulic accumulator)	19 ± 0.2	1.9 ± 0.2
Union M12x1.5 L23 - L24 and M12x1.5 L12 for fixing fuel pipes	25	2.5
Fitting for fastening multiple filler to high pressure pump M12x1.5 L24	25	2.5
Flanged screw M12x1.5 fixing water temperature sensor	30	3
Flanged screw M6x1 fixing air temperature sensor	10	1
Flanged screw M6x1 fixing engine speed sensor	10	1
Socket-head screw M6x1 fixing timing sensor	10	1
Screw M8x1.25 fixing air duct bracket	28	2.8
Screw M8x1.25 fixing air duct	25	2.5
Cylindrical socket-head screw M6x1 for V-clamp	8	0.8
Nut M8x1.25 fixing turbocharger	25	2.5
Flanged screw M8x1.25 fixing turbocharger outlet pipe	25	2.5
Fitting M14x1.5 or M12x1.5 for pipe delivering oil to turbocharger	35	3.5
Fitting M22x1.5 for oil return pipe from turbocharger	45	4.5
Flanged screw fixing oil return pipe from turbocharger	10	1
Hex screw with flange M8x1.25 L40 fixing power steering pump	25	2.5
Hex screw with flange M12x1.25 L155 fixing electromagnetic coupling mounting	90	8.8
Hex screw with flange M8x1.25 L20 fixing manoeuvring hooks	25	2.5
Flanged screws M10x1.25 fixing engine mounts	50	5
Oil level sensor M12x1.25	25	2.5
Thermometric switch/transmitter M16x1.5	25	2.5
Oil pressure switch M14x1.5	40	4
Cylindrical socket-head screw M8x1.25 fixing E.G.R. valve	25	2.5
Flanged screw M8x1.25 fixing E.G.R. heat exchanger	25	2.5
Flanged nut M8x1.25 fixing elbow	25	2.5
Compensator fastening nut M8x1.25	25	2.5
Oil pressure regulation valve cap	100	10
Power unit suspension		
Screw (M8x16) securing the elastic dowel to the gearbox cross-member	23.5±2.5	2.3±0.2
Nut (M12) securing the gearbox cross-member to the chassis	92±9	9.2±0.9
Nut (M12) securing the engine supports to the elastic dowels	49±4	4.9±0.4
Nut (M12) securing the gearbox bracket onto the rear cross-member elastic dowel	49±4	4.9±0.4
Locknut (M10) with flange, securing the engine supports to the chassis	52.5±5.5	5.2±0.5
Screw (M10x30) securing the gearbox support to the gearshift	46.5±4.5	4.6±0.4

Figure 23



LONGITUDINAL CROSS-SECTION OF ENGINE WITH E.G.R.

Figure 24

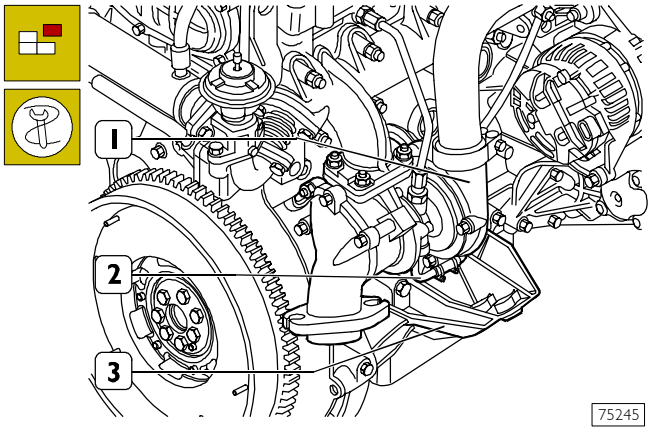


TRANSVERSE CROSS-SECTION OF ENGINE WITH E.G.R.

OVERHAULING ENGINE F1A

540110 DISASSEMBLING THE ENGINE AT THE BENCH

Figure 25



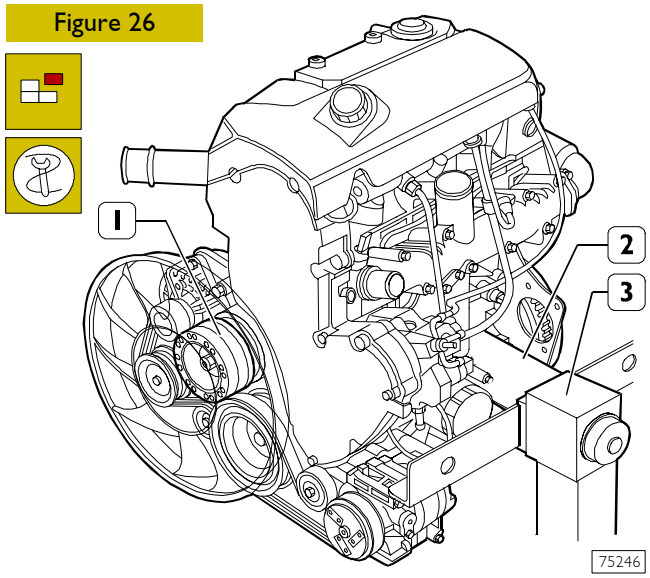
If the following parts have not already been removed, do so now:

- top soundproofing cover;
- rail guard;
- engine cable, disconnecting its electrical connections from: thermostat temperature sensor, timing sensor, engine speed sensor, pressure regulator, rail pressure sensor, intake manifold air temperature/pressure sensor.

To be able to fit the brackets 99361038 onto the crankcase to secure the engine to the stand for overhauling, it is necessary to remove the left and right engine mounts (3) and disconnect the oil pipe (2) from the turbocharger (1) and from the crankcase.

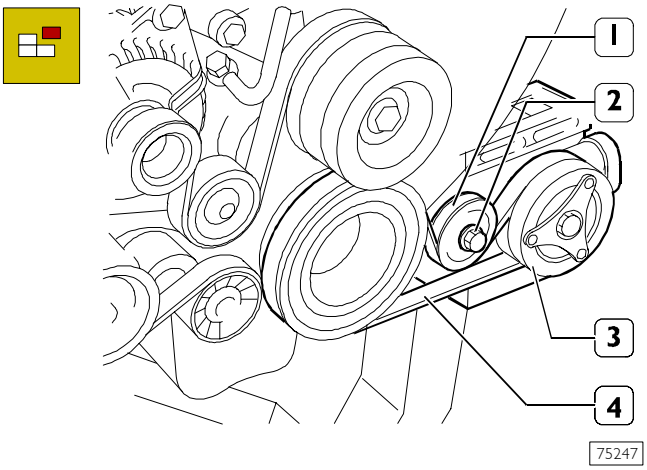
NOTE Block the turbocharger air/exhaust gas inlets and outlets to prevent foreign bodies getting inside.

Figure 26



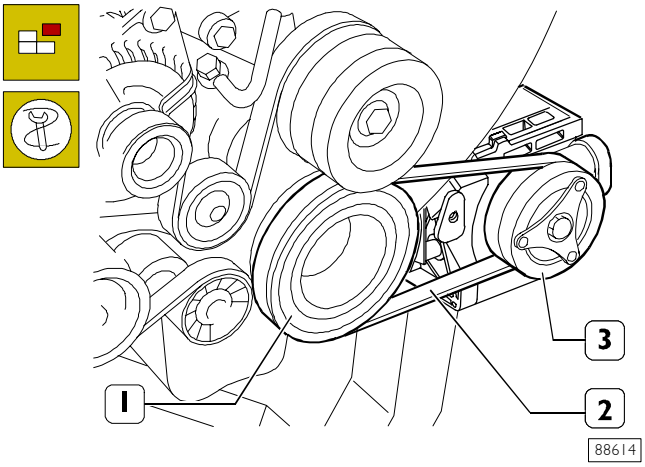
Fit the brackets 99361038 (2) to the crankcase and use these to secure the engine to the rotary stand 99322205 (3). Drain the oil from the engine by removing the plug from the oil sump.
Disconnect the fan from the electromagnetic coupling (1).

Figure 27



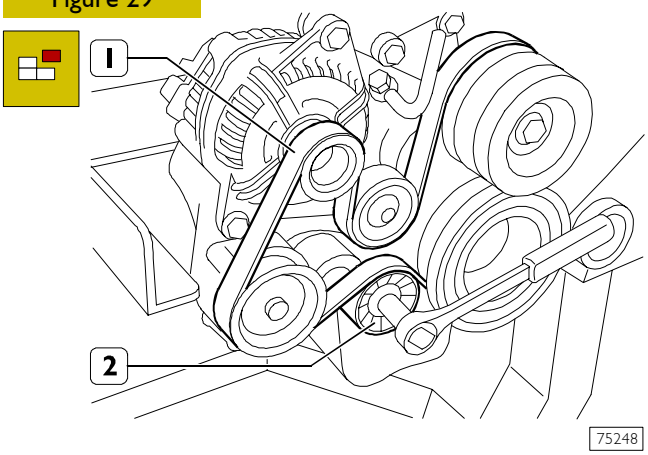
Take off screw (2), if present, and dismount belt tensioner (1). Take off the belt (4) driving the air-conditioner compressor (3).

Figure 28



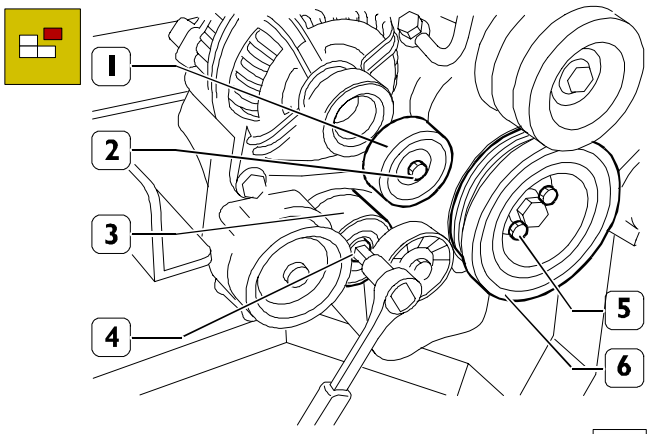
Or, on the engines with elastic belt (2), with a suitable tool, take the belt off pulleys (1 and 3).

Figure 29



Using the specific wrench on the automatic tightener (2), slacken the tension of the belt (1) and remove it.

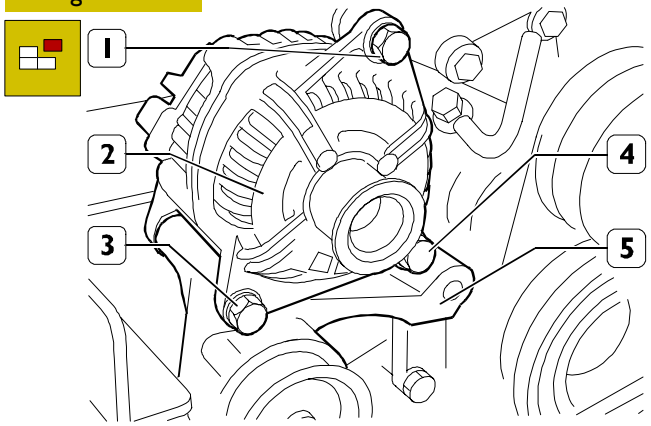
Figure 30



75249

Take out the screw (4) and remove the automatic tightener (3). Take out the screw (2) and remove the fixed tightener (1). Take out the screws (5) and remove the pulley (6).

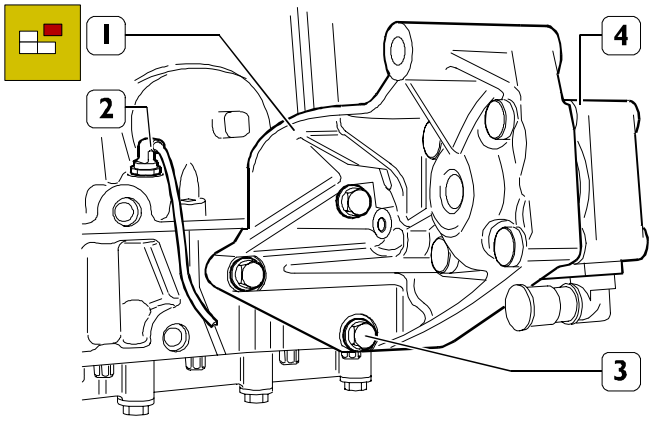
Figure 31



75250

Take out the bolt (1), the bottom screws (3 and 4) and remove the alternator (2) from the mounting (5).

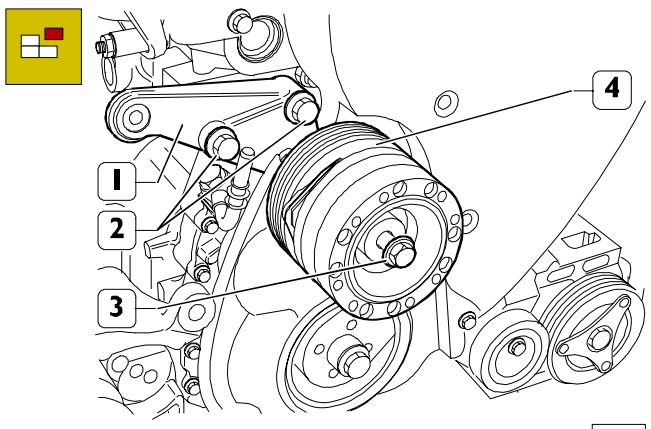
Figure 32



75251

Take out the screw (3) and remove the mounting (1) of the power steering pump (4). Using a suitable wrench, remove the oil level sensor (2).

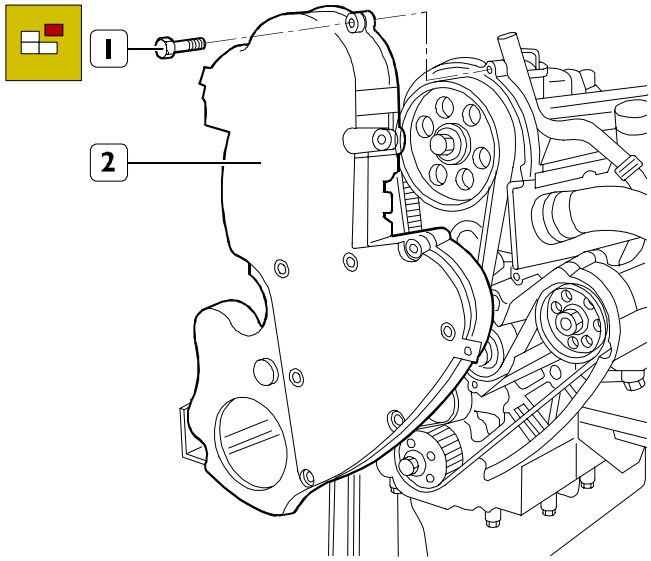
Figure 33



75252

Take out the screws (2) and (3) and remove the mounting (1) together with the electromagnetic coupling (4).

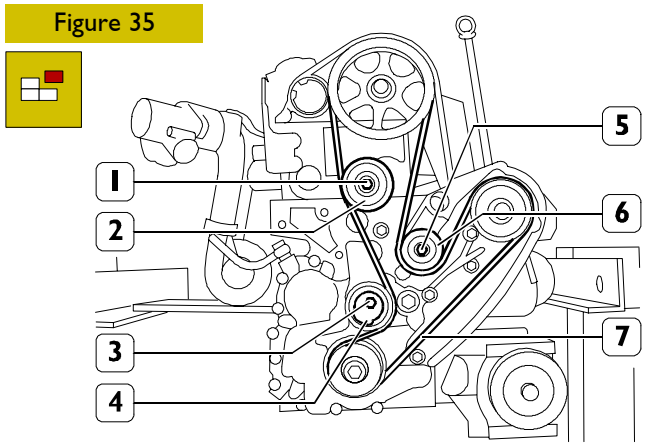
Figure 34



75253

Take out the screws (1) and remove the timing cover (2).

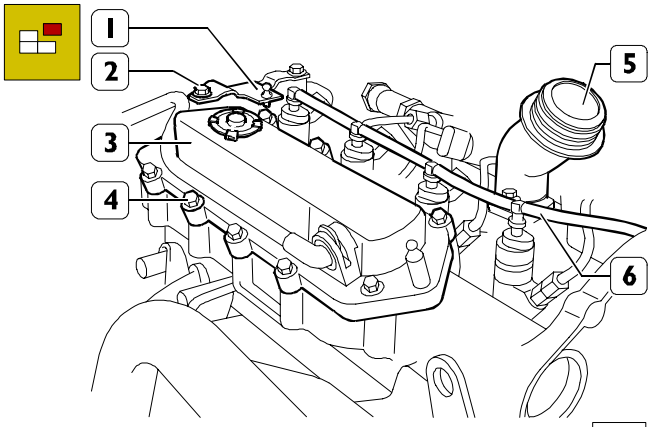
Figure 35



75254

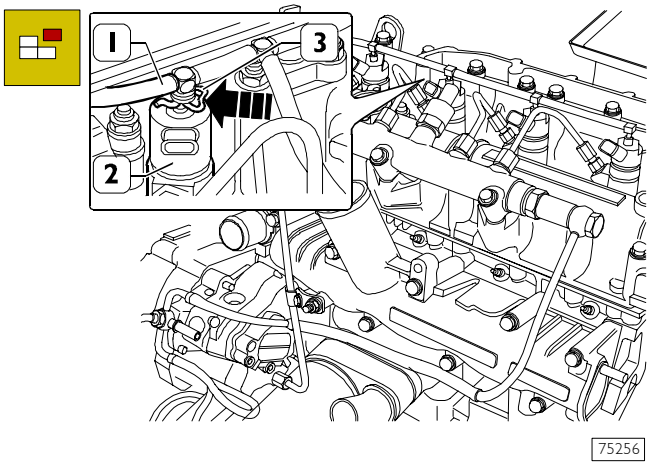
Take out the screw (3) and remove the tightener (4). Take out the screws (1) and (5) and remove the gears (2) and (6). Remove the toothed belt (7).

Figure 36



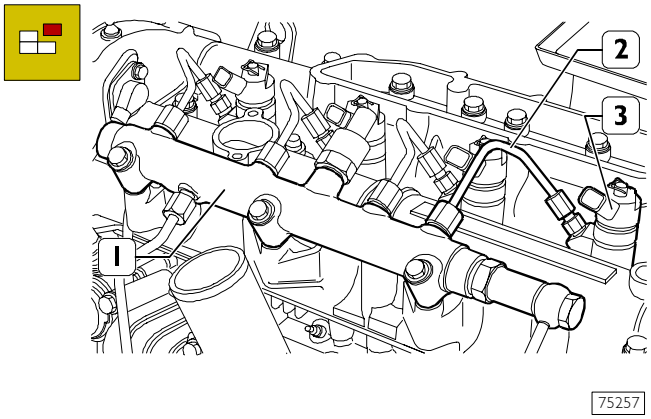
Take out the screws (2) and remove the bracket (1). Take out the screws (4) and remove the coalescence filter (3). Take off the nuts (6) and remove the oil fillpipe (5).

Figure 37



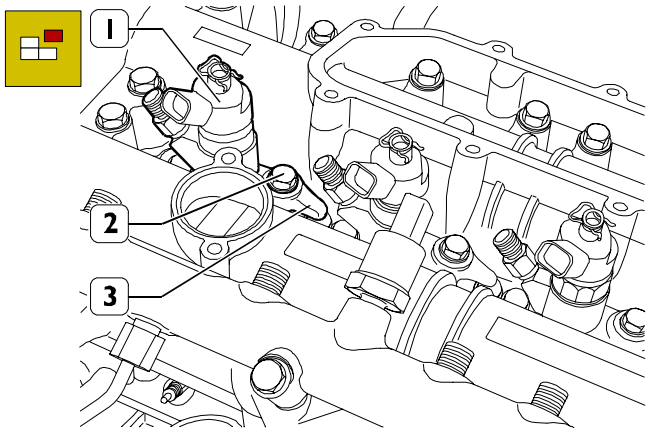
Press the springs (3) in the direction shown by the arrow and disconnect the fittings of the pipe (1) recovering fuel from the electro-injectors (2).

Figure 38



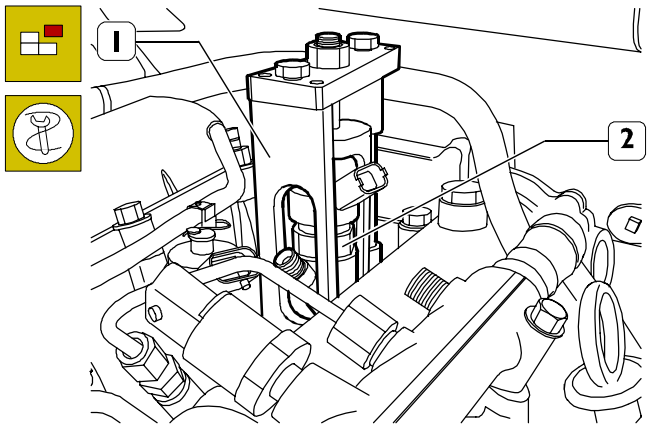
Disconnect the fuel pipes (2) from the electro-injectors (3) and from the hydraulic accumulator (1) (rail).

Figure 39



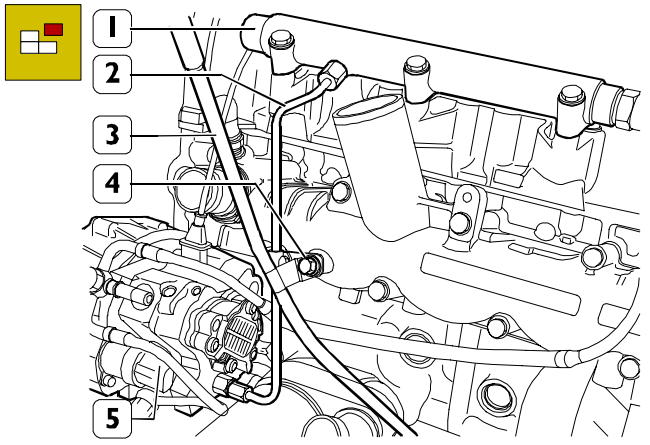
Take out the screws (2) and the brackets (3) fixing the electro-injectors (1) to the cylinder overhead.

Figure 40



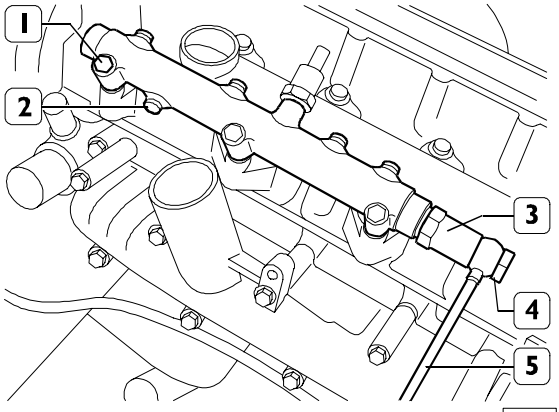
Using tool 99342153 (1) extract the electro-injectors (2) from the overhead.

Figure 41



Take out the screw (4) and extract the oil dipstick pipe (3) from the crankcase. Disconnect the pipe (2) from the hydraulic accumulator (1) and from the high-pressure pump (5).

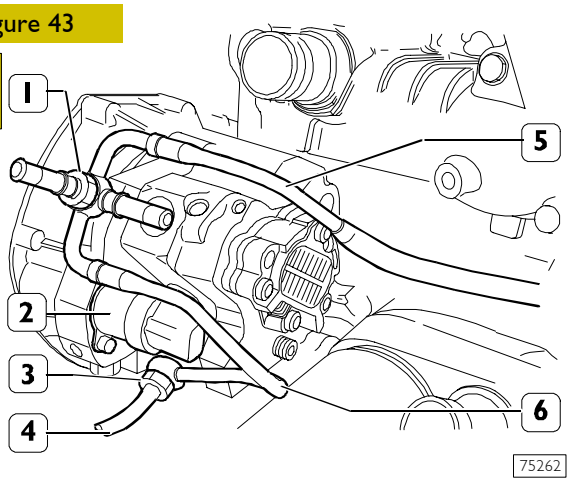
Figure 42



75261

Only for forged version hydraulic accumulator, take off pipe fitting (4) and disconnect piping (5) for fuel recovery from overpressure valve (3).
Take out the screws (1) and remove the hydraulic accumulator (2).

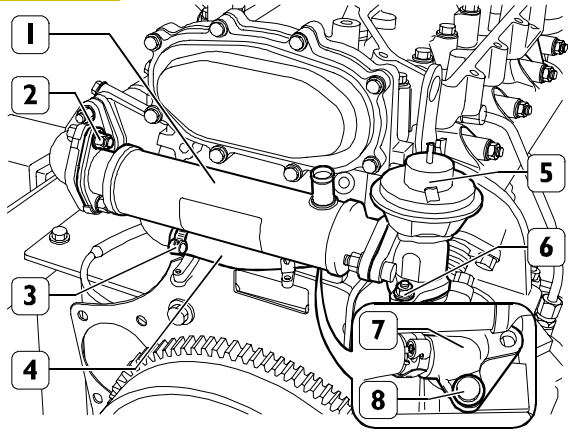
Figure 43



75262

Disconnect the fuel recovery pipes (4), (5) and (6) from the high-pressure pump (2), removing the couplings (1) and (3).

Figure 44

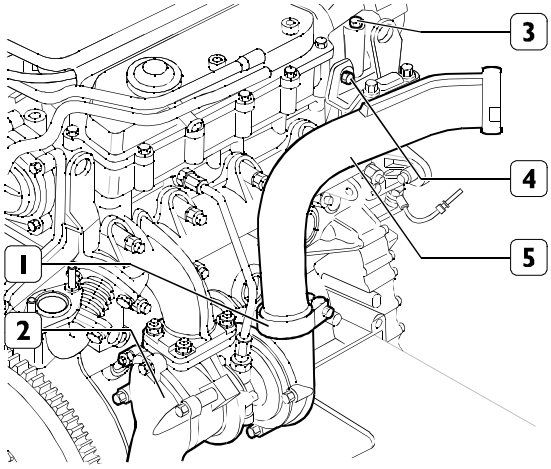


75263

For engines with E.G.R. only

Loosen the clamp (3) and disconnect the pipe (4) from the heat exchanger (1).
Take off the nuts (2) and (6) and remove the heat exchanger (1) together with the E.G.R. valve (5).
Take out the screws (8) and remove the flange (7).

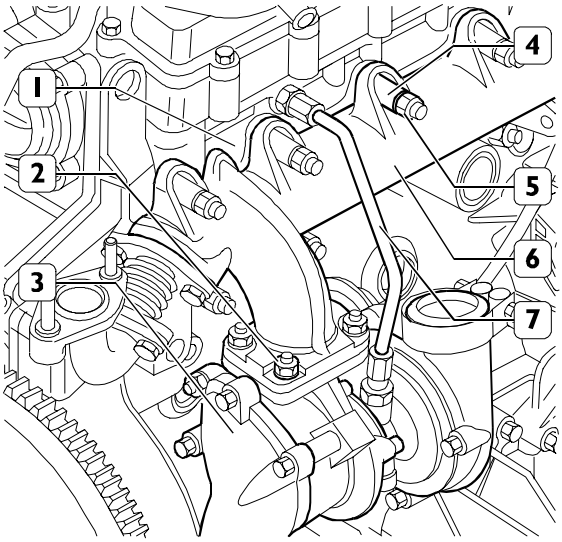
Figure 45



75264

Take out the screw (4), loosen the clamp (1) and disconnect the air duct (5) from the turbocharger (2) and from the overhead (3).

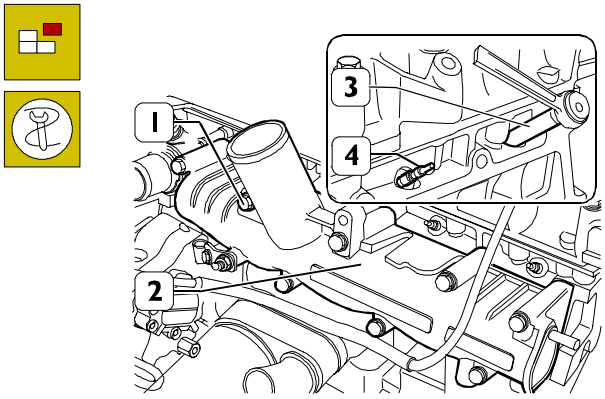
Figure 46



75265

Disconnect the oil pipe (7) from the coupling of the cylinder head (1) and from the coupling of the turbocharger (3).
Take off the nuts (2) and remove the turbocharger (3) with the associated gasket from the exhaust manifold (6).
Take off the nuts (5) and the spacers (4), remove the exhaust manifold (6) with the associated gasket from the cylinder head (1).

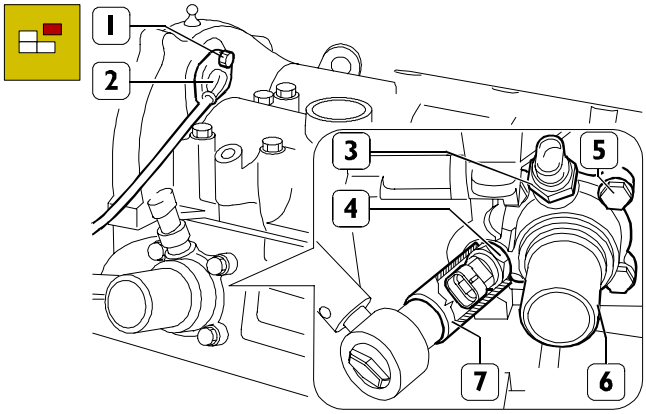
Figure 47



75266

Take off screws (1) and disconnect inlet manifold (2) with its gasket.
Using wrench SP.2275 (3), remove the glow plugs (4).

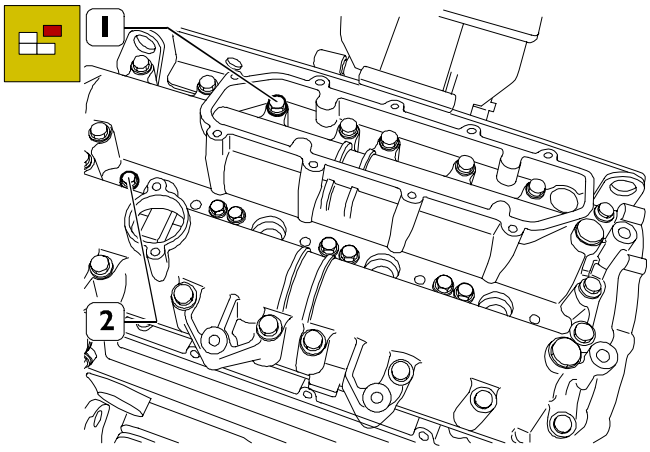
Figure 48



75267

Dismount sensor (3).
Take off the nut (1) and remove the timing sensor (2). Using wrench SP.2262 (7), remove the temperature sensors (4). Take out the screws (5) and remove the thermostat box (6).

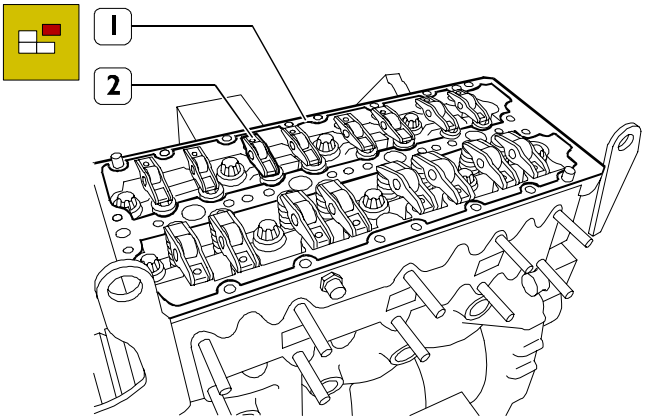
Figure 49



75268

Take out the screws (1) and remove the overhead (2).

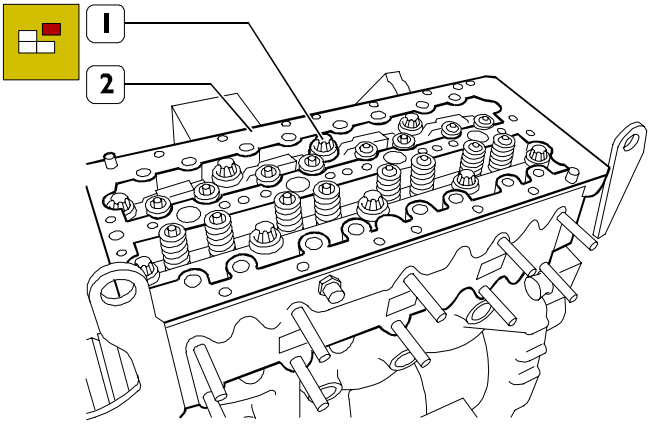
Figure 50



75269

Take off the gasket (1) and remove the hydraulic tappets together with the rocker arms (2).

Figure 51

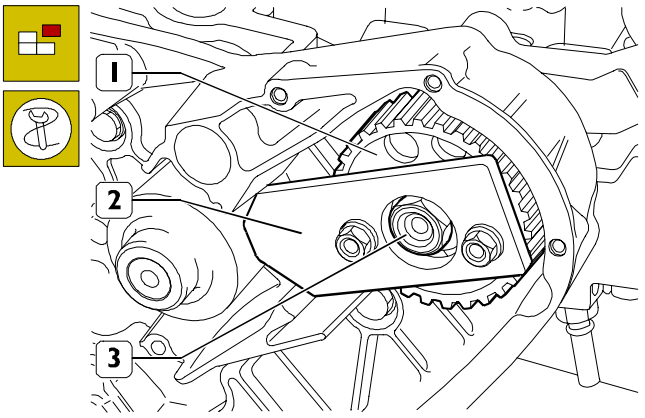


75270

Take out the screws (1) and remove the cylinder head (2).

NOTE Check the protrusion of the pistons as described under the relevant heading to check the possibility of facing the crankcase if it has deformed.

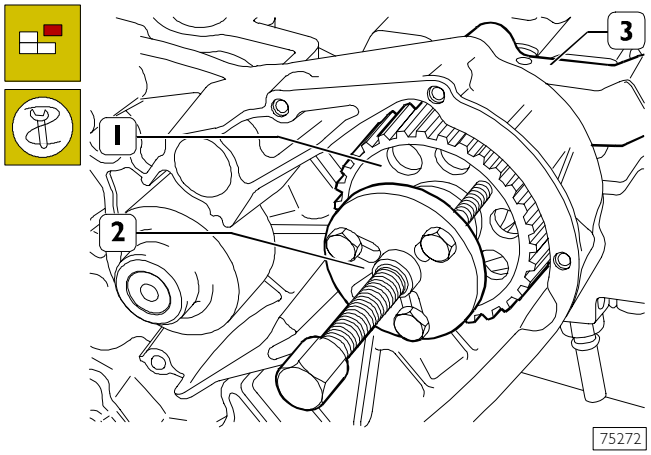
Figure 52



75271

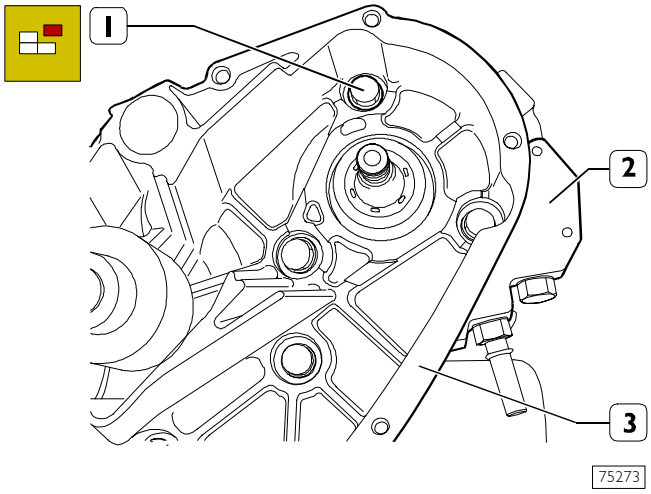
Block rotation of the high-pressure pump gear (1) by applying tool SP 2263 (2) as shown in the figure. Take off the nut (3) and remove the tool (2).

Figure 53



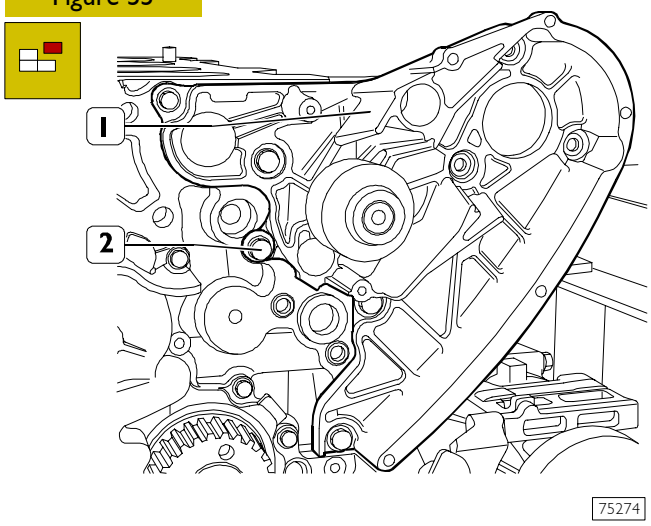
Using tool 99340035 (2), applied as in the figure, extract the gear (1) from the shaft of the high-pressure pump (3).

Figure 54



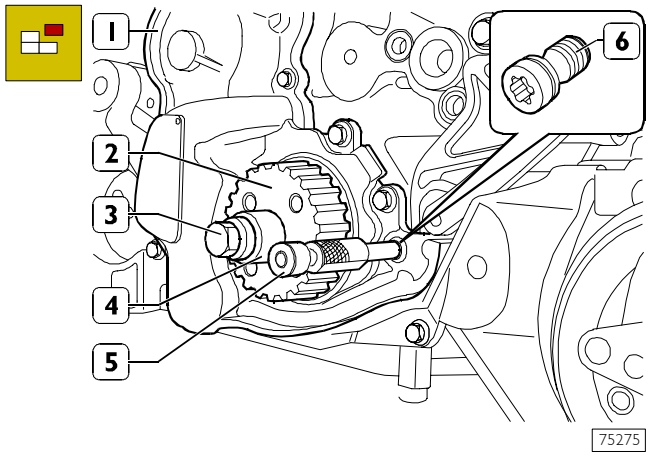
Take out the screws (1) and remove the high-pressure pump (2) from the water pump mounting (3).

Figure 55



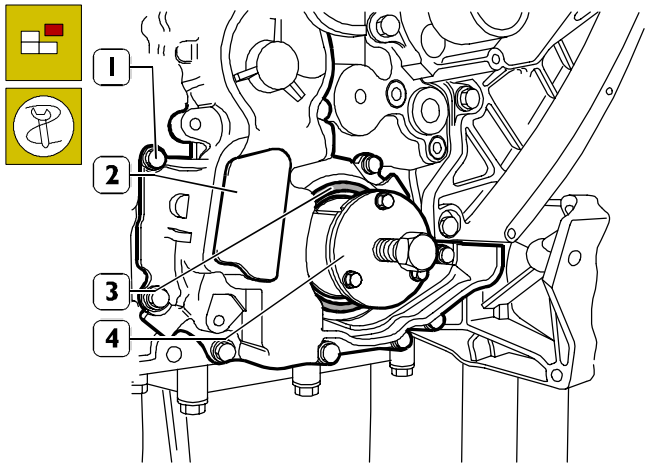
Take out the screws (2) and remove the water pump assembly (2).

Figure 56



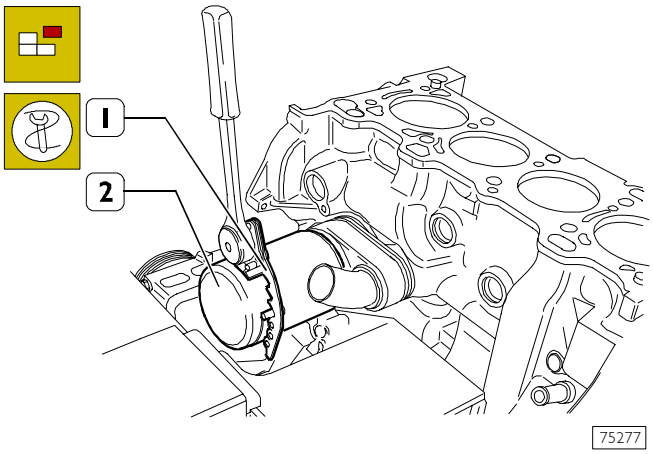
Remove the plug (6) from the oil pump – vacuum pump assembly (1).
Position the crankshaft so as to be able to insert tool 99360615 (5) into its hole through the hole in the plug (6) and block rotation of the crankshaft.
Take out the screw (3) with the spacer (4) beneath and remove the gear (2).

Figure 57



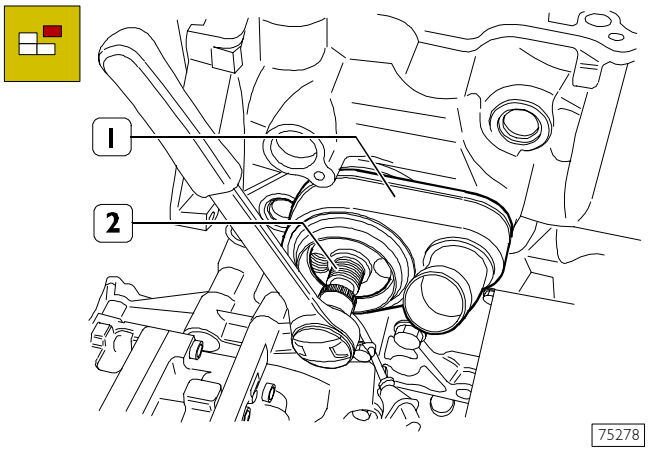
Apply tool 99340057 (4) to the front O-ring (3) of the crankshaft and remove it from the oil pump – vacuum pump assembly (2).
Take out the screws (1) and remove the oil pump – vacuum pump assembly (2).

Figure 58



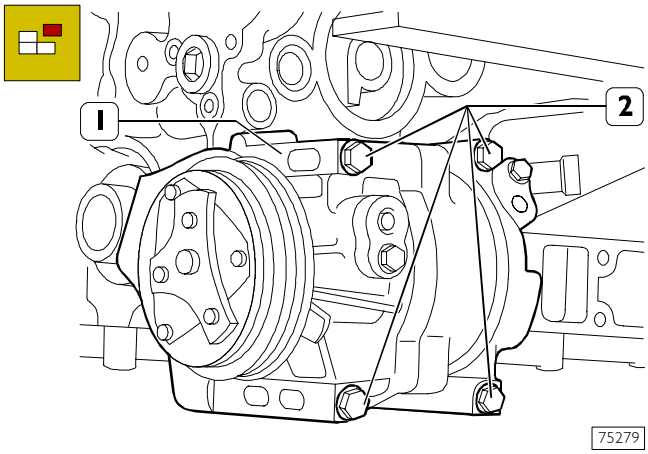
Using tool 99360076 (1), remove the oil filter (2).

Figure 59



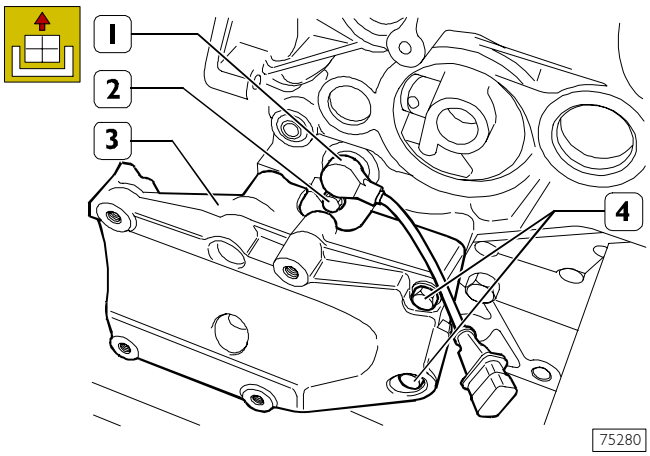
Take out the coupling (2) and remove the heat exchanger (1).

Figure 60



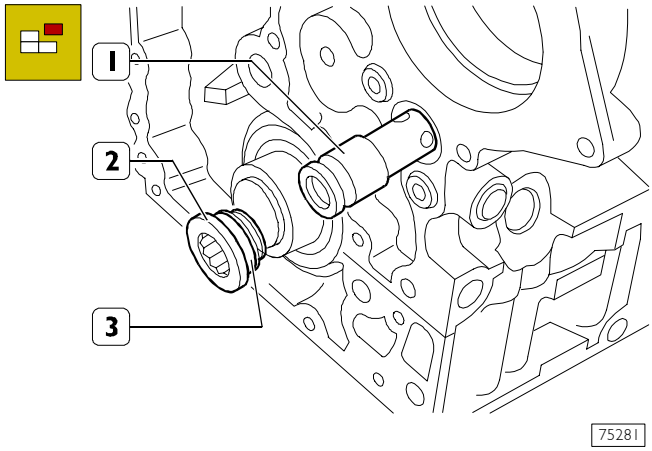
Take out the screws (2) and remove the air-conditioner compressor (1) (if applicable).

Figure 61



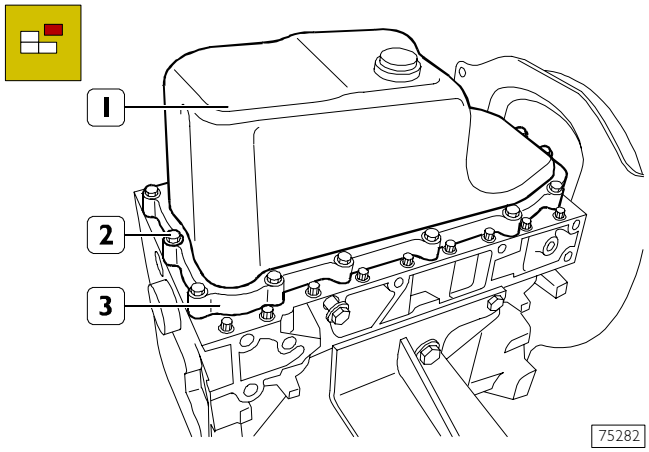
Take out the screw (2) and remove the speed sensor (1). Take out the screws (4) and remove the compressor mounting (3).

Figure 62



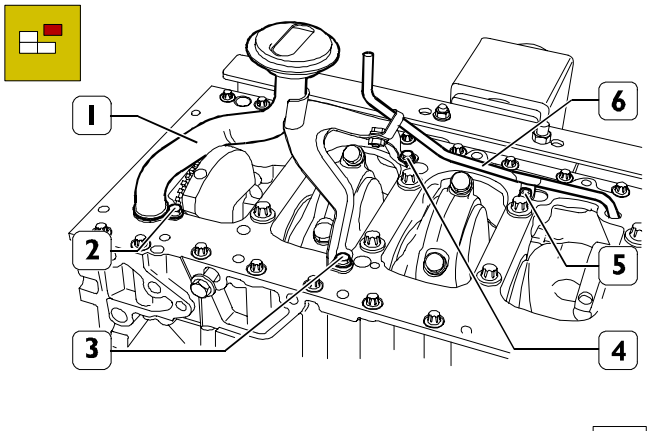
Take out the plug (2) with the seal (3) and extract the oil pressure control valve (1).

Figure 63



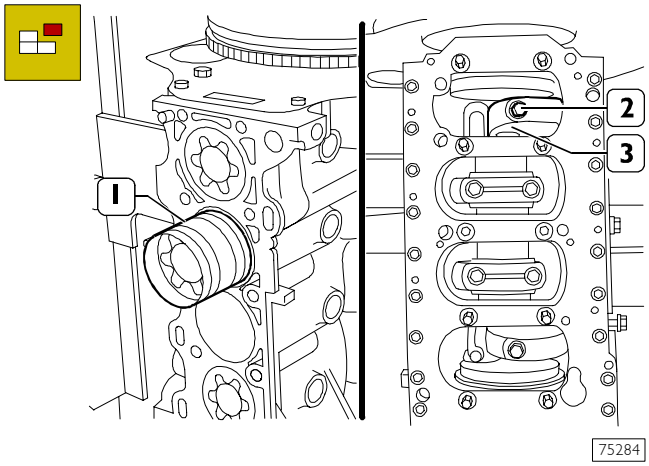
Undo the screws (2) and remove the oil sump (1) with the associated gasket and frame (3).

Figure 64



Take out the screws (2), (3), (4) and (5) and remove the suction strainer (1) together with the pipe (6).

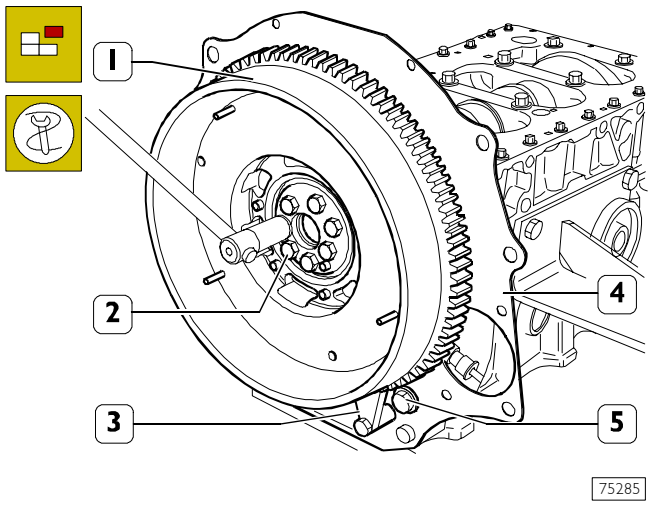
Figure 65



Take out the screws (2) and remove the connecting rod caps (3).
Extract the pistons (1) from the top of the crankcase.

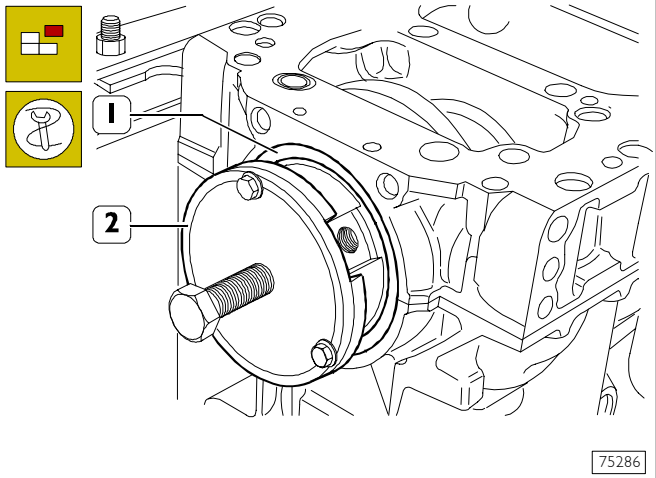
NOTE On the same side of the connecting rod and its associated cap, indicate the number of the cylinder from which the connecting rod has been removed. Keep the bearing shells in their respective housings since, if they are used, they will need to be fitted in the position found during removal.

Figure 66



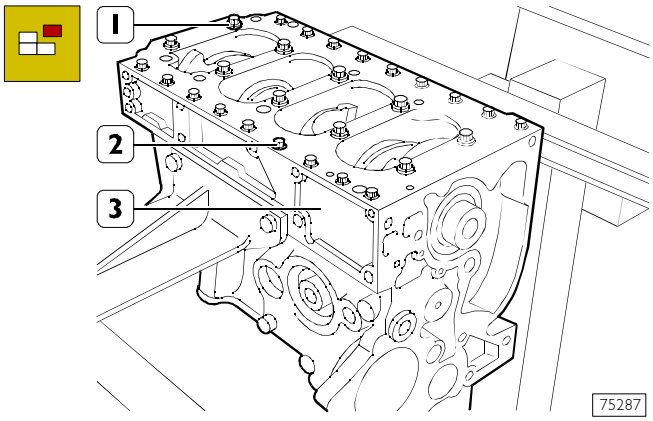
Block rotation of the flywheel (1) with tool 99360306 (3).
Take out the screws (2) and remove the engine flywheel (1).
Take out the screw (5) and remove the guard (4).

Figure 67



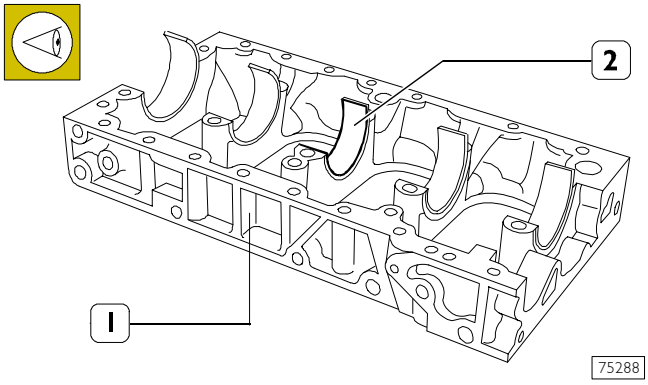
Apply tool 99340058 (2) to the rear O-ring (1) and extract it from the crankcase.

Figure 68



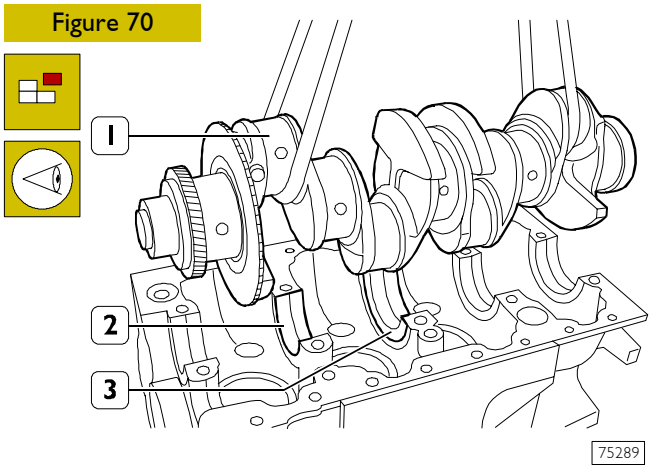
Using an appropriate wrench and a hex-fluted wrench, unscrew the screws (1) and (2) and remove the crankcase base (3).

Figure 69



NOTE Note the assembly position of the bottom main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

Figure 70

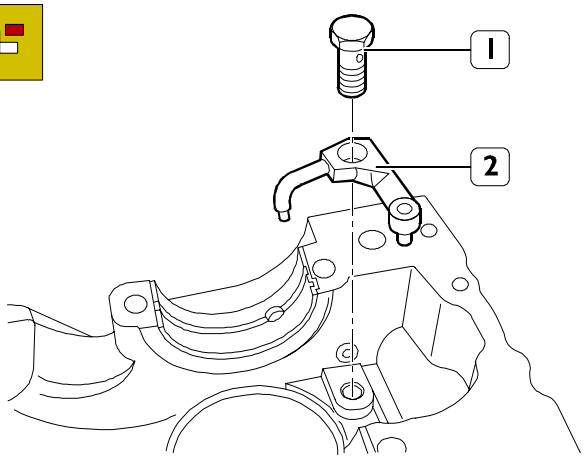


With the aid of a hoist and a rope, remove the crankshaft (1).

NOTE Note the assembly position of the top main bearing shells (2) since, if they are reused, they will need to be fitted in the position found during removal.

The central half ring (3) is fitted with thrust half-washers.

Figure 71

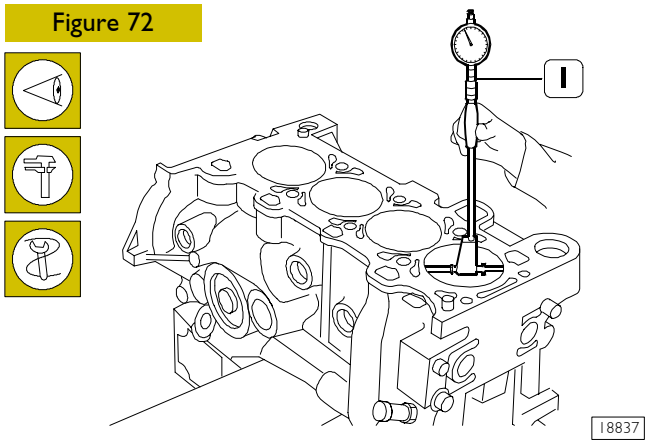


Take out the couplings (1) and remove the oil jets (2).

NOTE On completing engine removal, it is necessary to clean the removed parts thoroughly and check their integrity.
The following pages give the instructions for the main checks and measurements to make in order to determine whether the parts can be reused.

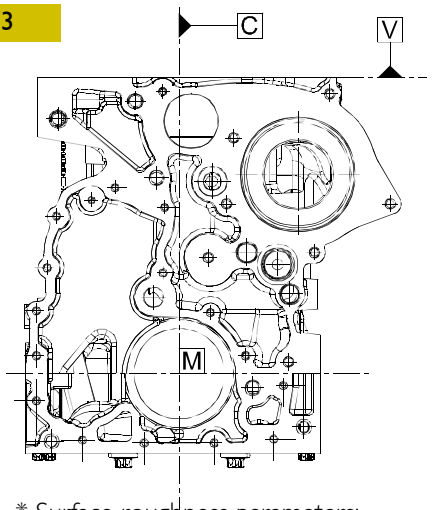
REPAIRS
CYLINDER BLOCK
Checks and measurements

Figure 72



After removing the engine, thoroughly clean the cylinder-crankcase assembly. Use the rings 99365508 to carry the cylinder block.
Carefully check that the crankcase has no cracks in it.
Check the state of the plugs. If they are rusty or there is any doubt about their seal, replace them. Examine the surfaces of the cylinder liners; they must show no sign of meshing, scoring, ovalization, taper or excessive wear. The inside diameter of the cylinder liners is checked, to ascertain the extent of ovalization, taper and wear, using the bore meter 99395687 (1) fitted with a dial gauge previously reset on the ring gauge of the diameter of the cylinder liner or on a micrometer.

Figure 73



* Surface roughness parameters:

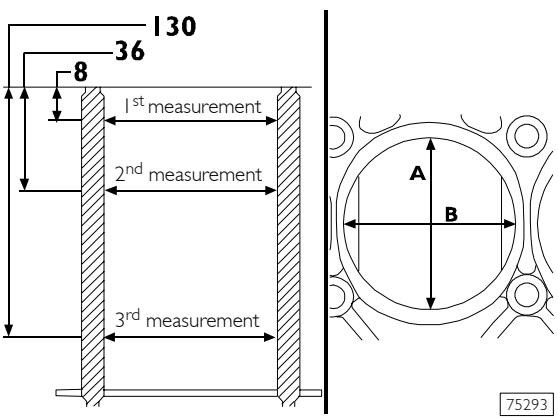
Rt = 4 ÷ 10 µm
Rz = 3 ÷ 8 µm
Ra = 0.25 ÷ 0.6 µm
Wt < 1.5 µm

Permissible surface porosity for machined cylinder (see Figure 75)

ZONE B1 = Area of greatest mechanical stress, segment/liner contact: No.2 non-continuous porosities are permissible max. 0.5x0.5. — C — 100%

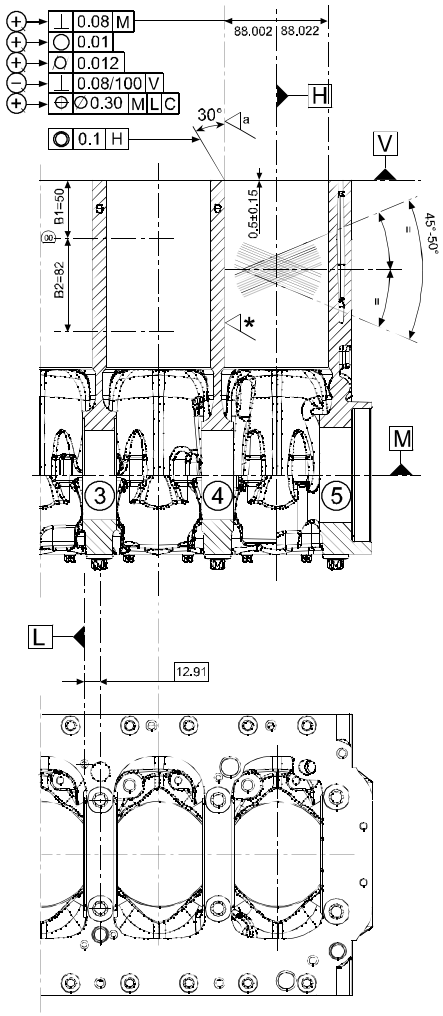
ZONE B2 = Surface involved in segment rubbing: No.2 non-contiguous porosities are permissible max. 1x0.8. — C — 100%

Figure 74



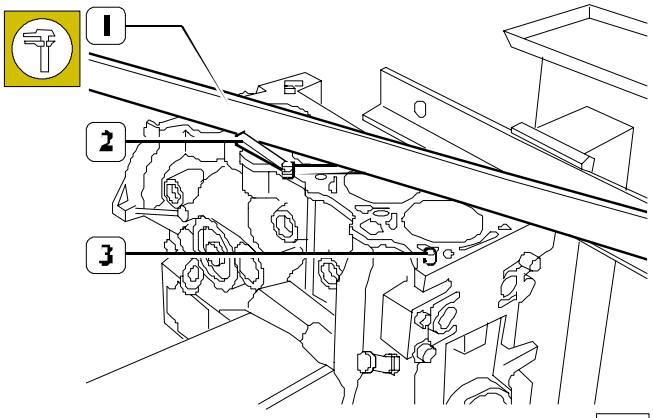
The measurements must be made for each single cylinder at three different heights up the liner and on two planes at right angles to each other: one parallel to the longitudinal axis of the engine (B) and the perpendicular (A); the greatest wear is generally found on this last plane with the first measurement.
On finding ovalization, taper or wear, go ahead and bore/grind and finish the face of the cylinder liners. The refacing of the cylinder liners should be done in relation to the diameter of the pistons supplied as spare parts oversized by 0.4 mm of the nominal value and to the prescribed assembly clearance.

Figure 75



Checking head mating surface on cylinder block

Figure 76

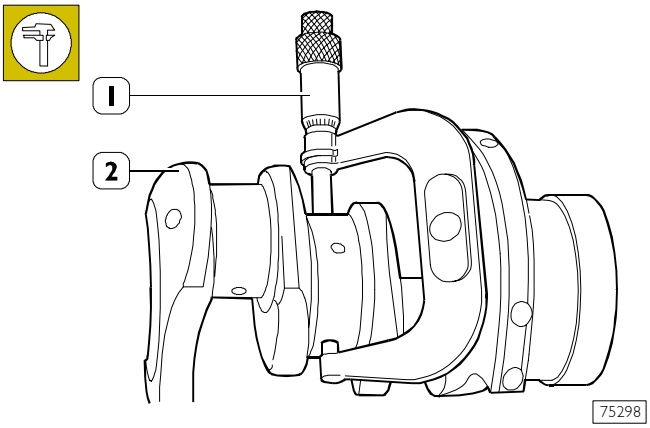


See that the head mating surface, on the cylinder block, has no deformation.
This check can be made, after taking out the grub screws (3), with a surface plate spread with carbon black or with a calibrated rule (1) and a feeler gauge (2). After ascertaining the areas of deformation, level the bearing surface with a grinding machine.

NOTE The crankcase can only be surfaced after making sure that, on completing the work, the piston protrudes from the cylinder liner by no more than the prescribed value.

5408 540810 CRANKSHAFT Measuring main journals and crank pins

Figure 78



On finding signs of seizure, scoring or excessive ovalization on main journals and crankpins, it is necessary to regrind the pins. Before grinding the pins (2), measure the shaft pins with a micrometer (1) to establish to what diameter it is necessary to decrease the pins.

NOTE It is advisable to enter the measurements in a table. See Figure 77.

Figure 77

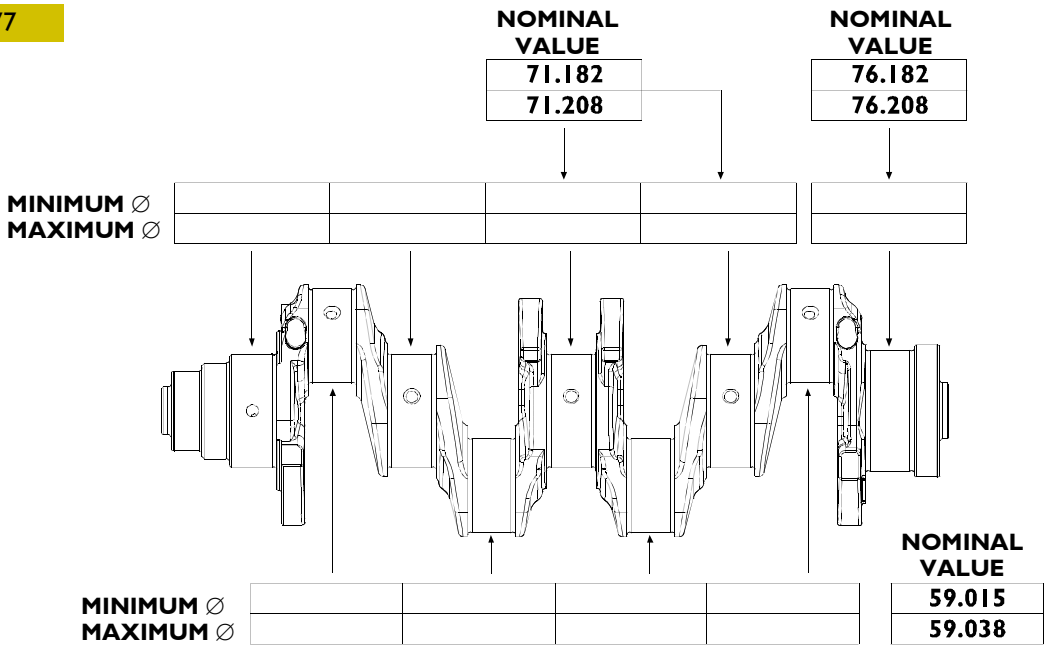


TABLE IN WHICH TO ENTER THE MEASUREMENTS OF THE CRANKSHAFT MAIN JOURNALS AND CRANKPINS

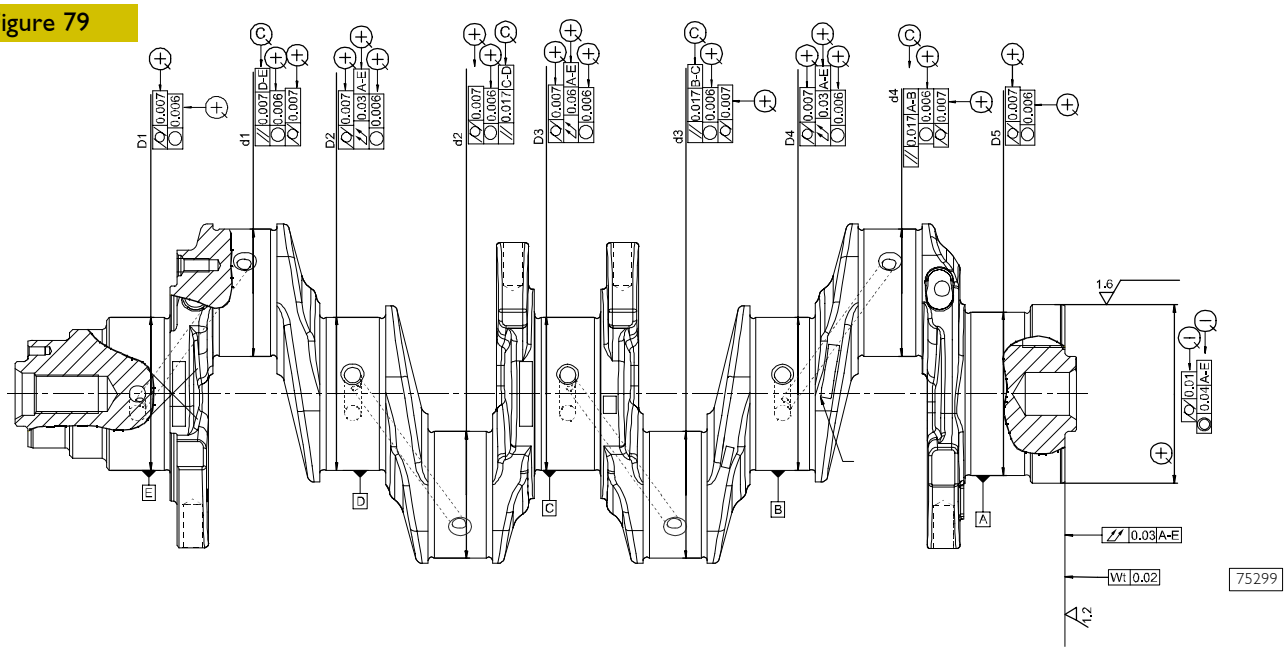
NOTE The main journals and crankpins must always be ground to the same undersize class.
The undersizing performed, on the main journals or crankpins, must be marked by punching on the side of crank arm no. 1.

For undersized crankpins, letter M.
For undersized main journals, letter B.
For undersized crankpins and main journals, letter MB.

The undersize classes are:
0.254 – 0.508 mm.

Checking crankshaft

Figure 79

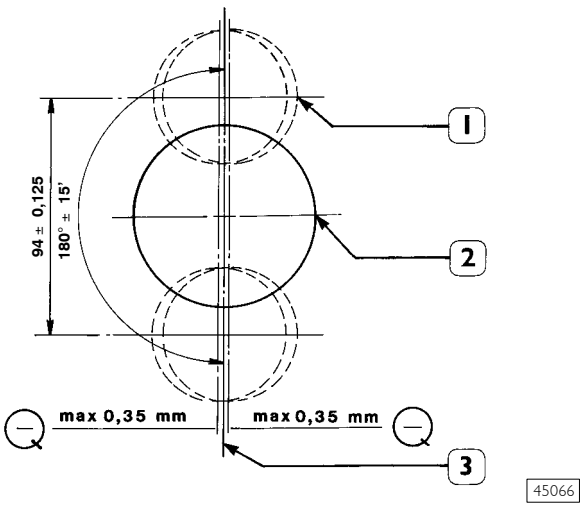


MAIN CRANKSHAFT TOLERANCES

TOLERANCES	TOLERANCE CHARACTERISTIC	SYMBOL
SHAPE	Circularity	○
	Cylindricality	⌭
DIRECTION	Parallelism	//
	Perpendicularity	⊥
POSITION	Concentricity or coaxiality	◎
OSCILLATION	Circular oscillation	↗
	Total oscillation	↗↗

CLASS OF IMPORTANCE ASCRIBED TO THE PRODUCT CHARACTERISTICS	SYMBOL
CRITICAL	Ⓒ
IMPORTANT	⊕
SECONDARY	⊖

Figure 80



NOTE The checks on the tolerances indicated in the figures must be made after grinding the crankshaft pins.

SYMMETRY BETWEEN MAIN JOURNALS AND CRANKPINS

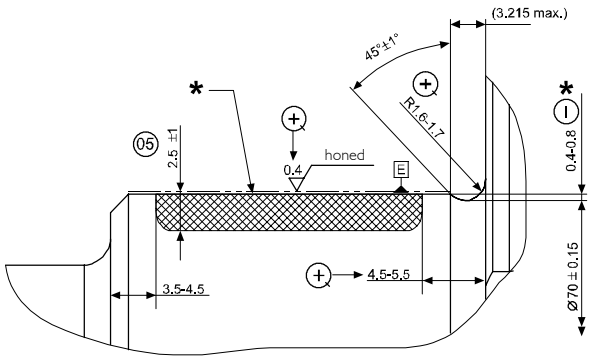
1. Crankpins
2. Main journals
3. Normal position

After grinding, keep to the following:

❑ Round off the edges of deburring the holes for lubrication of the main journals and crankpins.

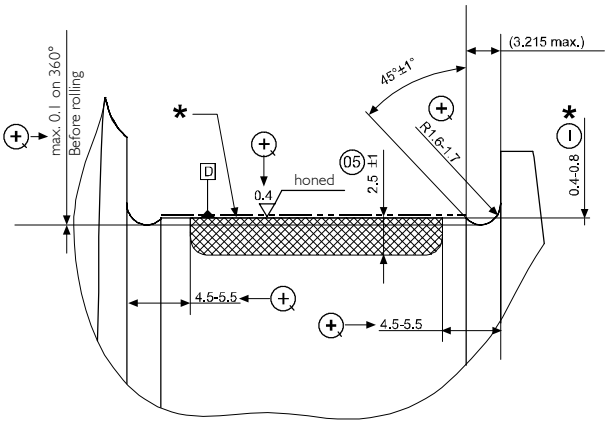
JOURNAL ON TIMING SYSTEM SIDE

Figure 81



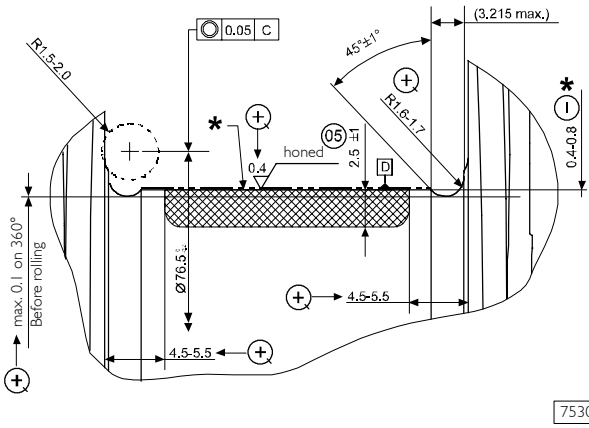
INTERMEDIATE JOURNALS No. 2-4

Figure 82



INTERMEDIATE JOURNAL No. 3

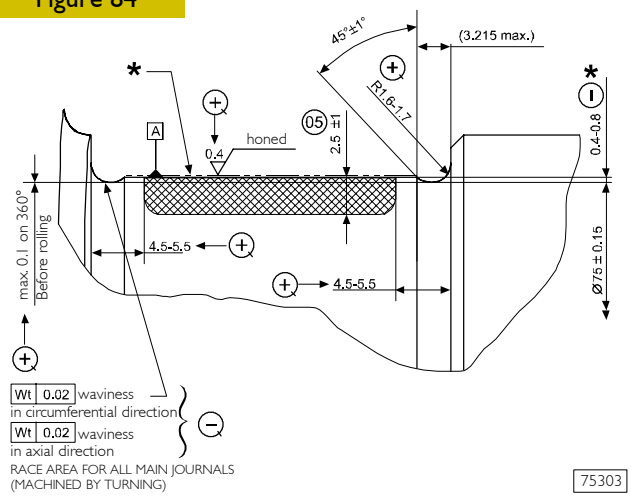
Figure 83



MAIN DATA OF MAIN JOURNALS AND CRANKPINS

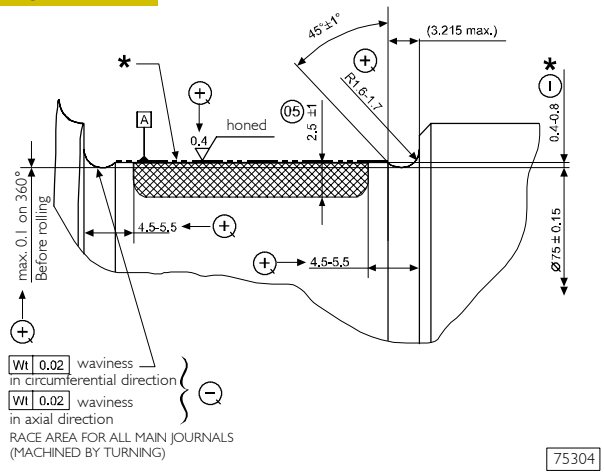
JOURNAL ON FLYWHEEL SIDE

Figure 84



CRANKPINS

Figure 85



* On both races, on all 360°.

NOTE Since, during the 0.254 and 0.508 mm undersizing on the diameter of the crankpins and main journals, the rolled portion of the side races of the pins may get involved, it is necessary to turn the races keeping to the data given in the figure and to do the rolling keeping to the following instructions.

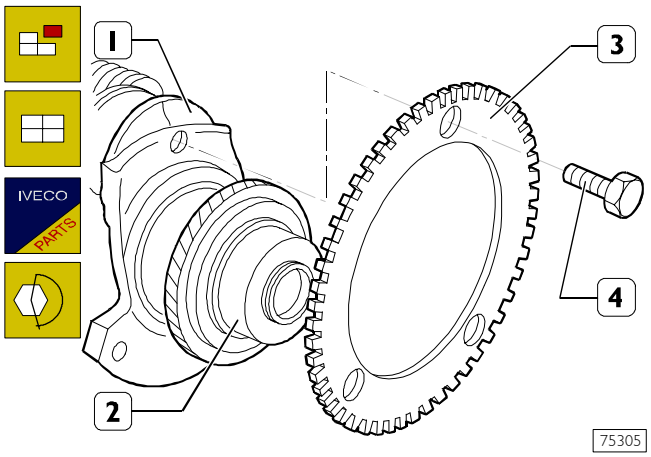
Rolling force:

- ❑ 1st main journal 925 ±25 daN.
- ❑ 2nd – 3rd – 4th – 5th main journal 1850 ±50 daN.
- ❑ crankpin 1850 ±50 daN.

- ❑ Rolling turns: 3 approach, 12 effective, 3 out.
- ❑ Rolling speed: 56 rpm.
- ❑ Decrease in crankpin race depth after rolling: 0.15 – 0.30 mm*.
- ❑ Decrease in main journal race depth after rolling: 0.15 – 0.30 mm*.

* Measured with calibrated rollers Ø 2.5 mm.

Figure 86



Take out the screws (4) and replace the phonic wheel (3).
The screws (4) are coated with LOCTITE 218 and must be replaced with fresh ones after each disassembly.
They must be tightened to a torque of 15 Nm.

Replacing timing control gear

On finding the timing control gear teeth (1) damaged or worn, remove them from the crankshaft (2) using a suitable extractor.

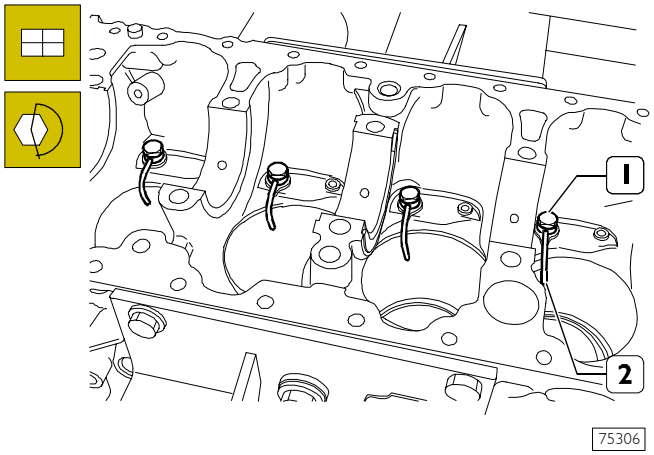
The new gear is fitted onto the crankshaft by heating it to a temperature of 200°C for no longer than 15 minutes.

On completing assembly and after the gear has cooled, it must withstand a torque of 150 Nm without slipping.

ENGINE ASSEMBLY

The following parts must be replaced with new ones at the time of assembly: retaining rings, seals and gaskets, screws whose thread is coated with sealant.

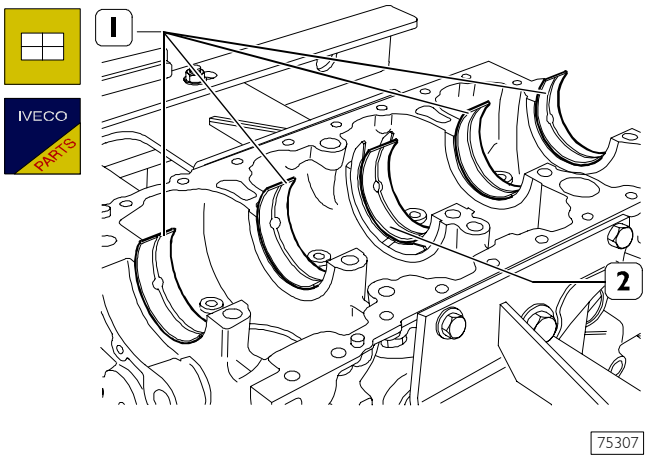
Figure 87



Fit on the oil spray nozzles (2) and tighten the couplings (1) to the prescribed torque.

Assembling main bearings

Figure 88



NOTE Not having found it necessary to replace the main bearings, they need to be fitted back on in the same sequence and position found upon disassembly.

The main bearings (1) are supplied as spare parts undersized on the inside diameter by 0.254 ÷ 0.508 mm.

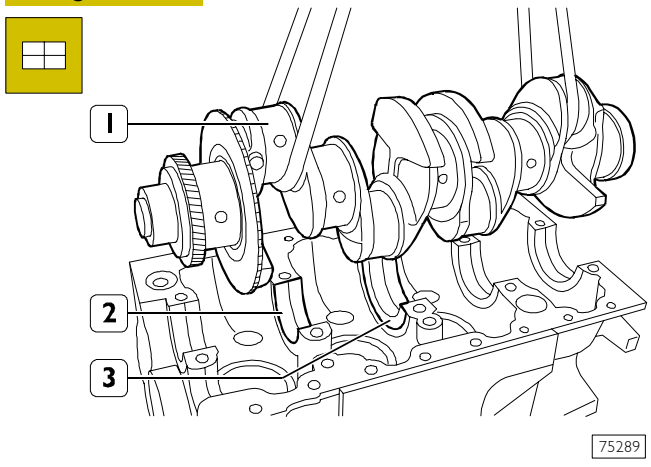
NOTE Do not do any accommodating on the bearings.

Thoroughly clean the top main bearing shells (1) and position them in the crankcase.

NOTE The middle half ring (2) is fitted with thrust washers.

540811 Measuring main journal assembly clearance

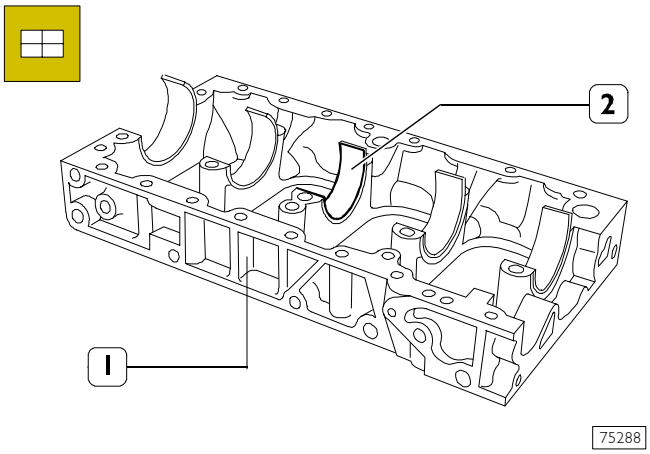
Figure 89



Mount the crankshaft (1).
Check the clearance between the crankshaft main journals and their respective bearings by proceeding as follows:

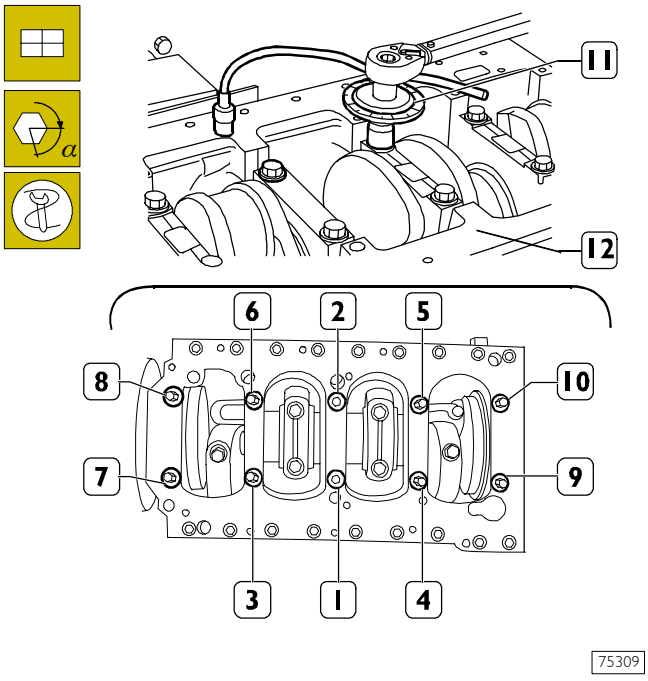
- ❑ Thoroughly clean the pins.
- ❑ Apply a calibrated wire onto the main journals.

Figure 90



Thoroughly clean the bottom main bearing shells (2) and mount them in the crankcase base (1).

Figure 91



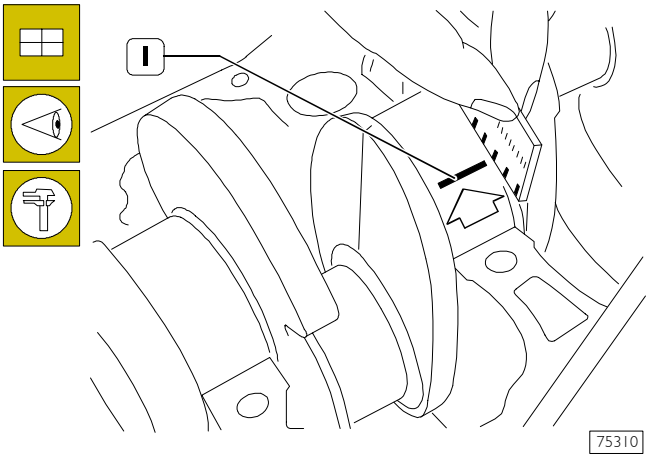
Mount the crankcase base (12).

Tighten the screws in the sequence shown in the figure in three steps:

- ❑ Step 1: with a torque wrench, to a torque of 50 Nm.
- ❑ Step 2: closing to an angle of 60°.
- ❑ Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

Figure 92

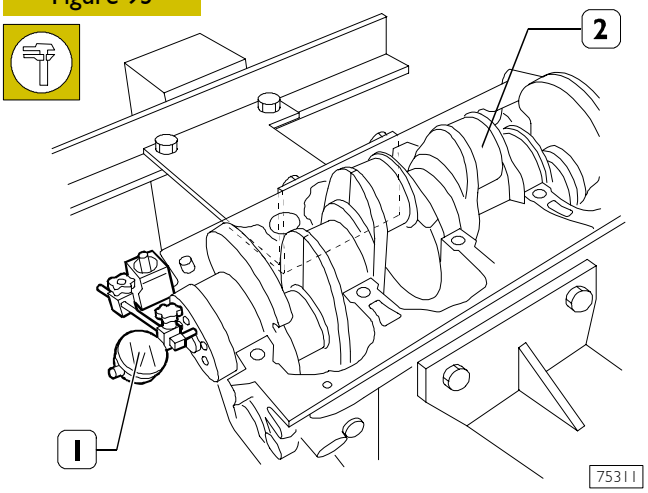


❑ Remove the bottom crankcase.

The clearance between the main bearings and their associated pins is measured by comparing the length of the calibrated wire (1), at the point of greatest crushing, with the graduated scale on the casing containing the calibrated wire. The numbers on the scale indicate the clearance of the coupling in millimetres, which must be 0.032 ÷ 0.102 mm. If the clearance is not as prescribed, replace the bearings and repeat the check.

Checking crankshaft end float

Figure 93



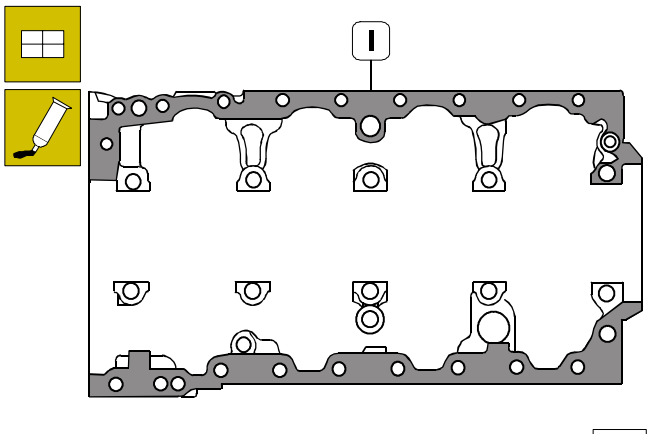
The end float is checked by setting a dial gauge (1) with a magnetic base on the crankshaft (2) as shown in the figure. The normal assembly clearance is 0.060 – 0.310 mm.

If you find the clearance to be greater than as required, replace the rear main bearing shells carrying the thrust bearings and repeat the clearance check between the crankshaft pins and the main bearing shells.

If the end float of the crankshaft does not come within the prescribed values, it is necessary to grind the crankshaft and accordingly change the main bearing shells.

NOTE: The middle main bearing has half thrust washers integrated in it, so it performs the function of a thrust bearing. It is supplied as a spare part only with the normal shoulder thickness.

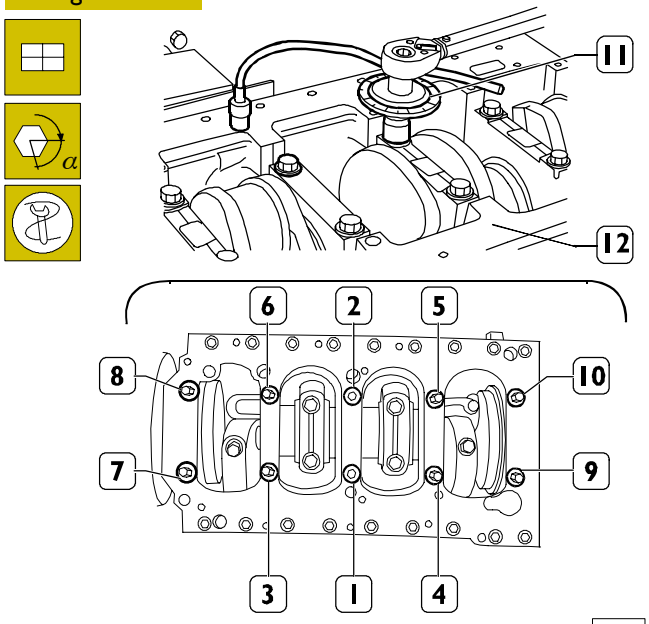
Figure 94



Thoroughly clean the crankcase / crankcase base mating surface.
Apply, on base, sealant LOCTITE 510 IVECO no. 93162432, as indicated in the scheme. The sealant must result to be even, not patchy.

NOTE Mount the crankcase base within 10 minutes of applying the sealant.

Figure 95

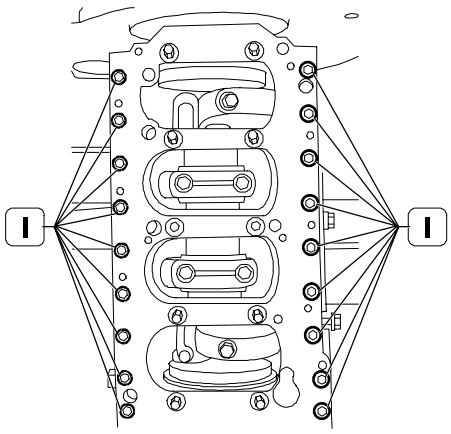


Mount the crankcase base (12) and tighten the fixing screws in three stages, following the sequence shown in the figure:

- ❑ Step 1: with a torque wrench, to a torque of 50 Nm.
- ❑ Step 2: closing to an angle of 60°.
- ❑ Step 3: closing to an angle of 60°.

NOTE Use tool 99395216 (11) for the angle closing.

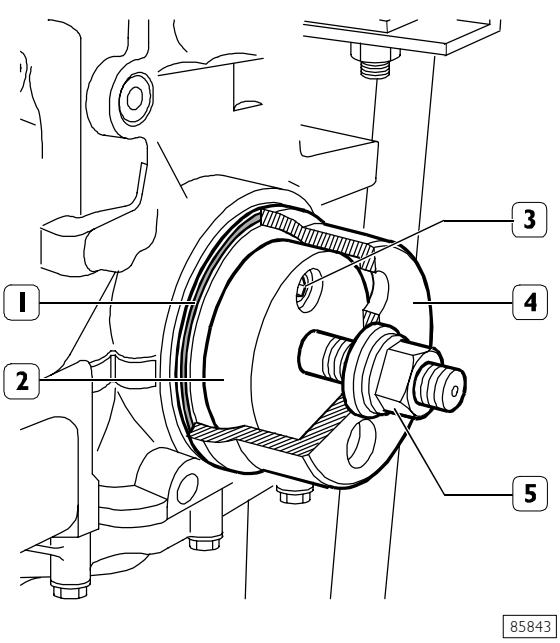
Figure 96



Then tighten the outer screws (1) to a torque of 36 – 30 Nm.

540460 Assembling rear seal

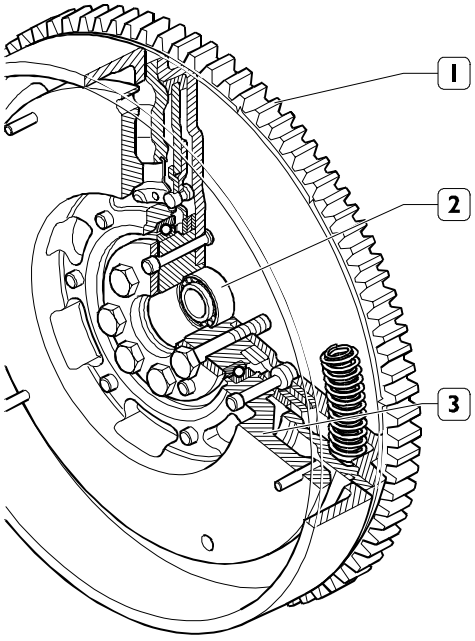
Figure 97



Carefully clean the seal seat. Apply LOCTITE 510 IVECO nr. 2992504 on the seal (1) for 30° in the points shown in the figure.
Lubricate the rear shank of the crankshaft with engine oil.
Fit part (2) of tool 99346255 onto the rear shank of the crankshaft; secure it with the screws (3) and key the fresh seal (1) onto it.
Position part (4) on part (2); screw down the nut (5) to fit the seal (1) fully inside the crankcase.

540850 ENGINE FLYWHEEL

Figure 98



75389

Check clutch disk rest surface: if it shows deep scoring, a replacement must be performed.

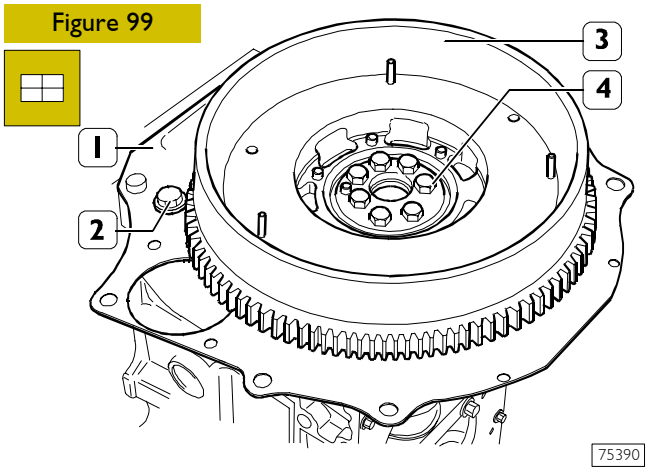
NOTE The nominal thickness of the engine flywheel is 50 ±0.6 mm.

540852 Replacing bearing supporting gear-box input shaft

The bearing (2) supporting the gearbox input shaft is removed and fitted using a general-purpose drift.

Check conditions of the teeth of crown wheel (1); where excessive cracking or wear is found, replace engine flywheel.

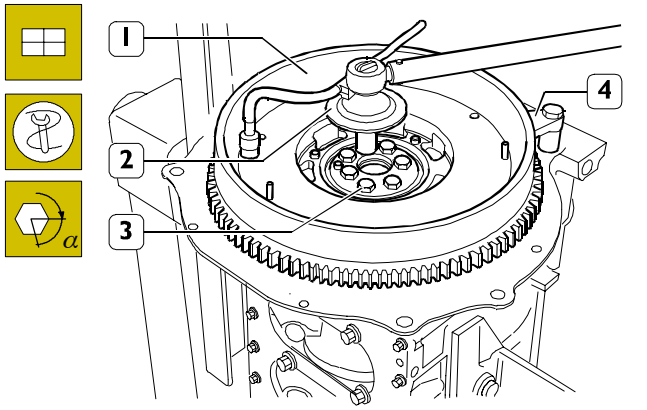
Figure 99



75390

Mount the sheet metal guard (1) and secure it to the crankcase tightening the screw (2) to the prescribed torque.
Mount the engine flywheel (3) and screw down the screws (4).

Figure 100



75391

Fit tool 99360351 (4) onto the crankcase to block rotation of the engine flywheel (1).

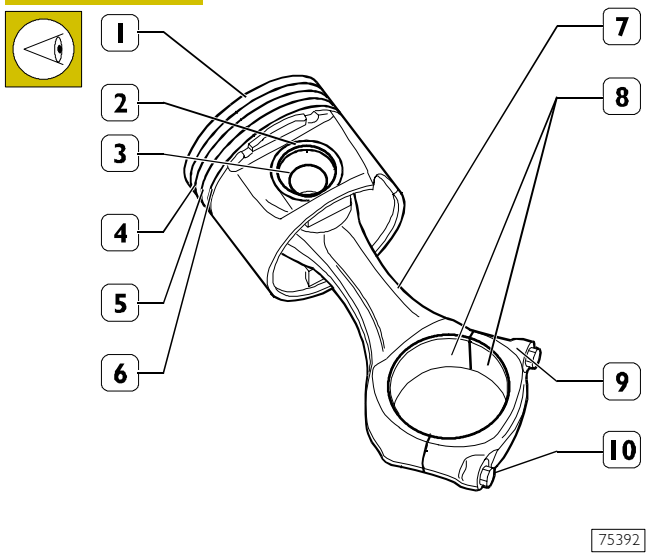
Tighten the screws (3) fixing the engine flywheel (1) in two steps:

- ❑ Step 1: with a torque wrench, to a torque of 30 Nm.
- ❑ Step 2: closing to an angle of 90°.

NOTE Use tool 99395216 (2) for the angle closing.

5408 CONNECTING ROD – PISTON ASSEMBLY

Figure 101

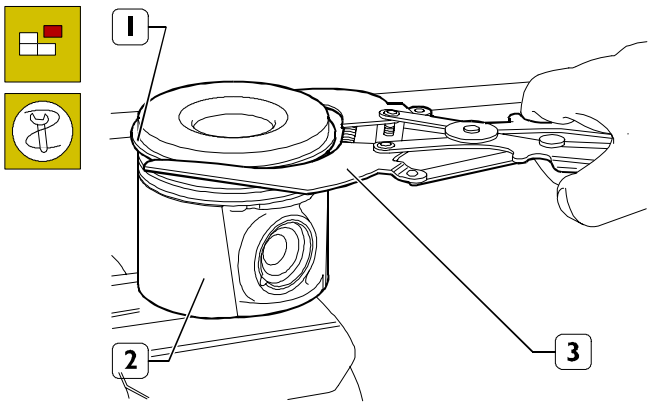


75392

PISTON – CONNECTING ROD ASSEMBLY
1. Piston – 2. Piston ring – 3. Pin – 4. Trapezoidal ring – 5. Oil scraper ring – 6. Slotted oil scraper ring with spiral spring – 7. Connecting rod body – 8. Bearing shells – 9. Connecting rod cap – 10. Cap fixing screws.

Check the pistons. They must show no signs of seizure, scoring, cracking or excessive wear; replace them if they do.

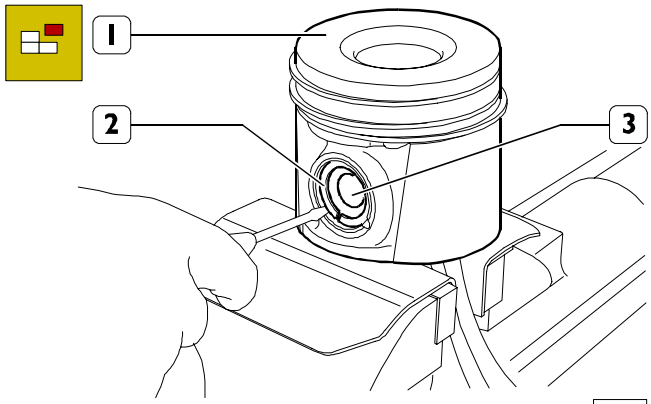
Figure 102



75393

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

Figure 103

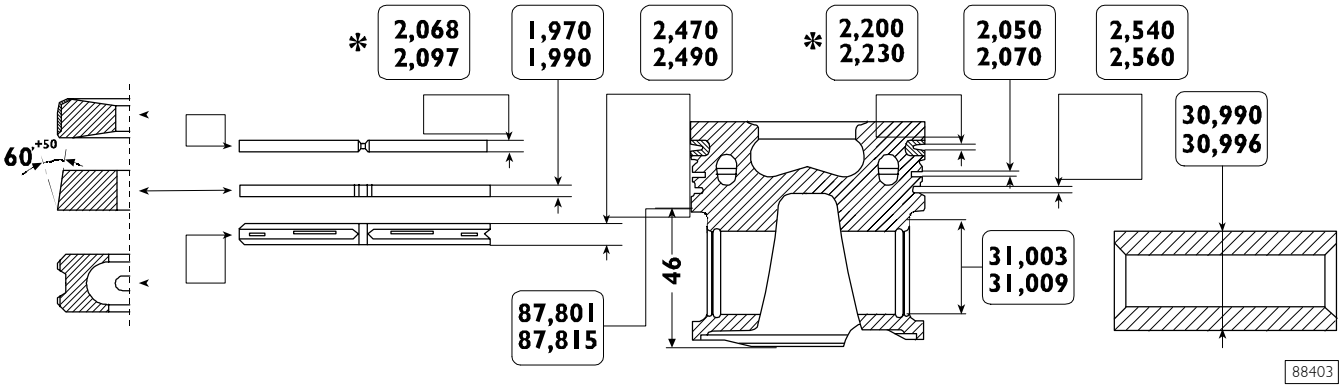


75394

Using a micrometer (2), measure the diameter of the piston (1) to determine the assembly clearance. The diameter has to be measured at the value shown.

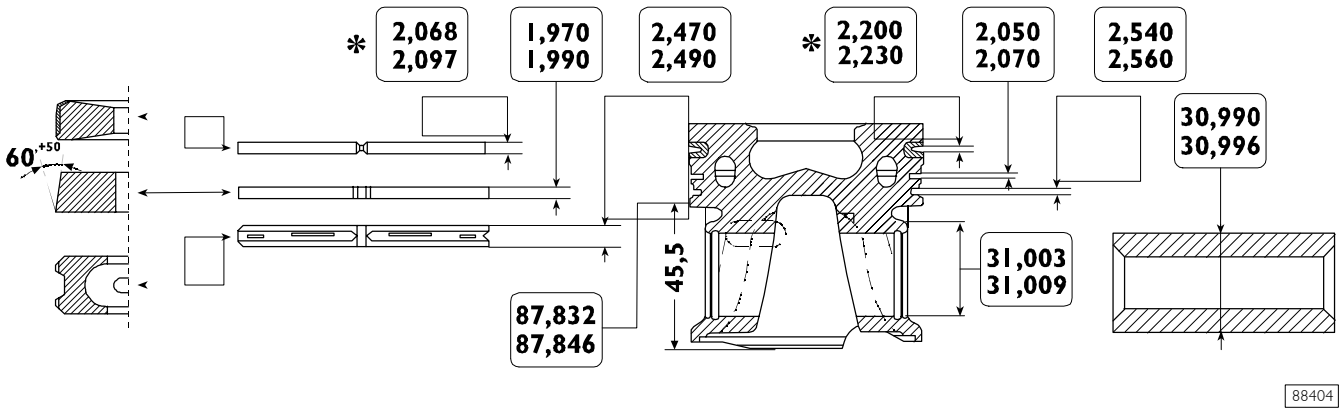
540840 Pistons
Measuring piston diameter

Figure 104



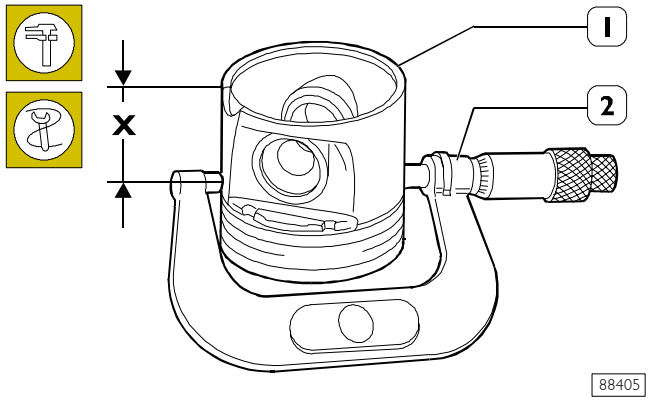
MAIN DATA ON PISTON FEDERAL MOGUL, PINS AND SPRING RINGS
ENGINE F1AE 0481A (96 HP)
* Measured on the diameter of 85 mm.

Figure 105



MAIN DATA ON PISTON MAHLE MONDIAL, PINS AND SPRING RINGS
ENGINE F1AE 0481B (116 HP)
* Measured on the diameter of 85 mm.

Figure 106

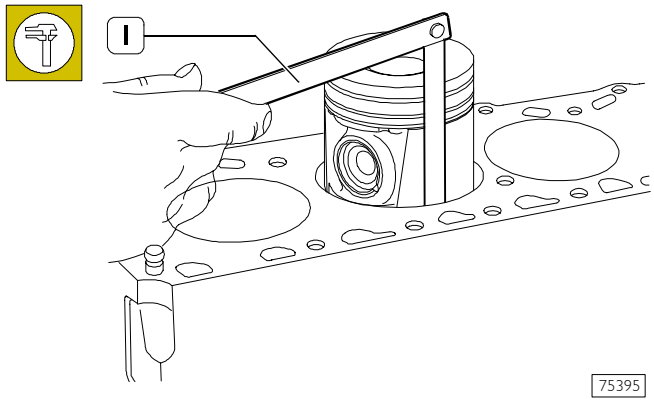


88405

By means of micrometer (2), measure the diameter of piston (1) to determine mounting clearance; the diameter must be detected at distance X from piston base:
- 46 mm - engine F1AE0481A (96 HP)
- 45.5 mm - engine F1AE0481B (116 HP).

NOTE The pistons are supplied as spare parts with the standard, normal and 0.4mm oversize diameters together with rings, pin and retaining rings.

Figure 107

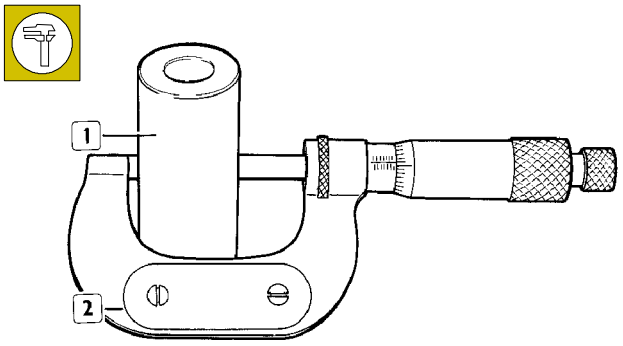


75395

The clearance between the piston and cylinder liner can also be checked using a feeler gauge (1) as illustrated in the figure.

540841 Piston pins

Figure 108

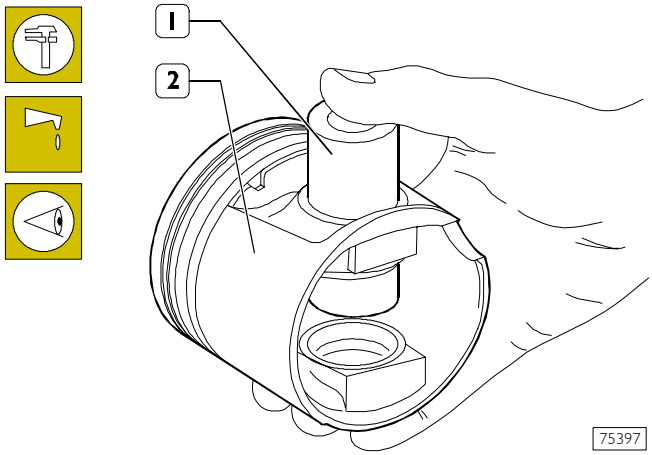


18857

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

Conditions for correct pin-piston coupling

Figure 109

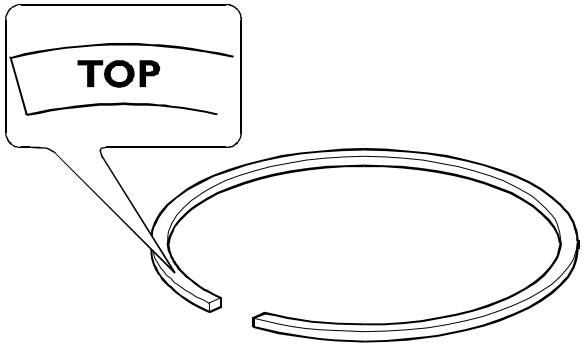


75397

Lubricate the pin (1) and its seat on the hubs of the piston (2) with engine oil. The pin must go into the piston by lightly pressing with the fingers and must not drop out by gravity.

540842 Piston rings

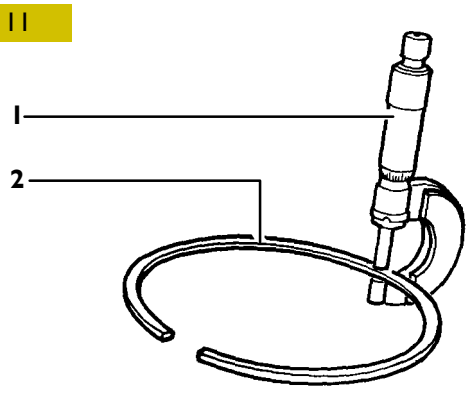
Figure 110



74947

The trapezoidal split rings (1st slot) and the oil scraper rings (2nd slot) have the word TOP etched in them; when fitting them on the piston, the word TOP must be facing upwards.

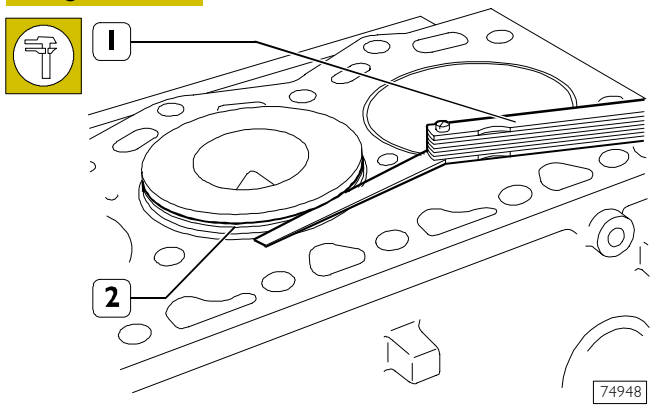
Figure 111



16552

Check the thickness of the piston rings (2) with a micrometer (1).

Figure 112



Check the clearance between the trapezoidal ring (2) (1st slot) and the associated slot on the piston with a feeler gauge (1), proceeding as follows: insert the piston into the cylinder liner so that the ring (2) comes approximately half way out of it.

Figure 113

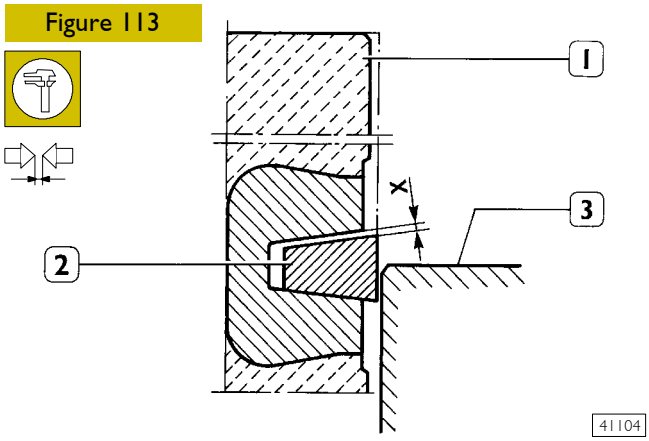
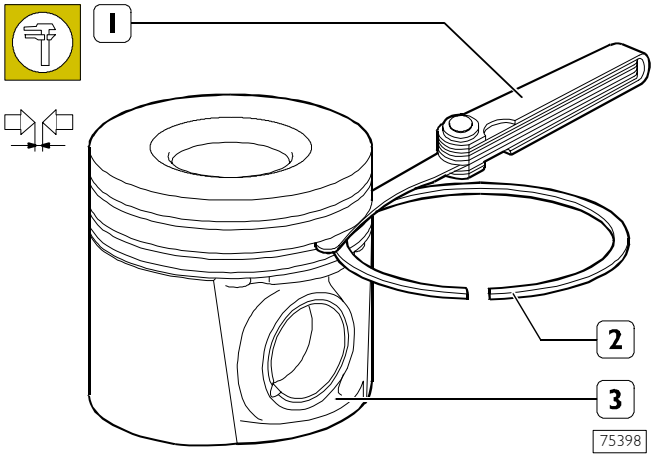


DIAGRAM FOR MEASURING THE CLEARANCE X BETWEEN THE FIRST PISTON SLOT AND THE TRAPEZOIDAL RING
1. Piston slot – 2. Trapezoidal piston ring – 3. Cylinder liner

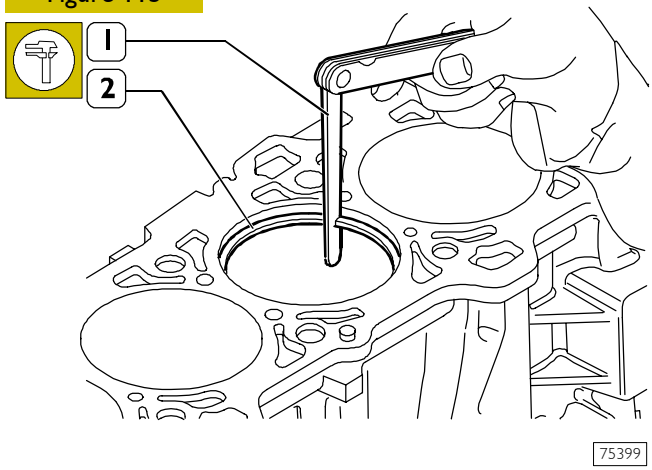
Using a feeler gauge (1, Figure 112), check the clearance (X) between the ring (2) and the slot (1); this clearance must have the prescribed value.

Figure 114



Check the clearance between the piston rings (2) of the 2nd and 3rd slot and the associated seats on the piston (3) with a feeler gauge (1).

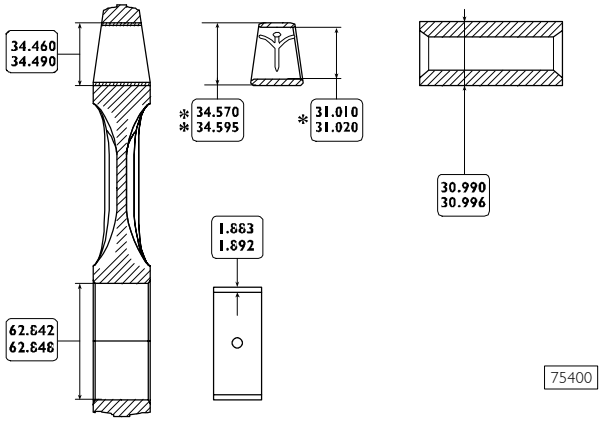
Figure 115



Check the opening between the ends of the piston rings (2) inserted in the cylinder liner using a feeler gauge (1).

540830 Connecting rods

Figure 116



MAIN DATA OF THE CONNECTING ROD, BUSHING, PISTON PIN AND BEARING SHELLS

* Internal diameter to obtain after driving into the small end and grinding with a reamer.
** Dimension cannot be measured in the free state.
*** Thickness of the bearing shell supplied as a spare part.

NOTE Each connecting rod has its cap marked:

- with a letter: O or X indicating the diameter class of the big end mounted in production;
- with a number indicating the weight class of the connecting rod mounted in production.

In addition, it could be stamped with the number of the cylinder in which it is fitted.

In the event of replacement it is therefore necessary to number the new connecting rod with the same number as the one replaced.

The numbering must be done on the opposite side to the bearing shell retaining slots.

The connecting rods are supplied as spare parts with the diameter of the big end 62.842 – 62.848 mm marked with the letter O and the weight class marked with the number 33.

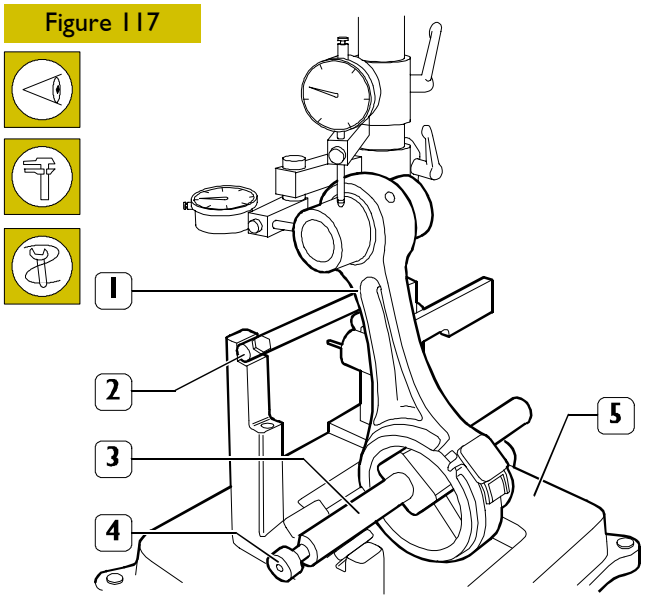
It is not permissible to remove material.

540834 Bushes

Check that the bush in the small end has not come loose and shows no sign of seizure or scoring. If it does, replace the complete connecting rod.

Checking connecting rods

Figure 117

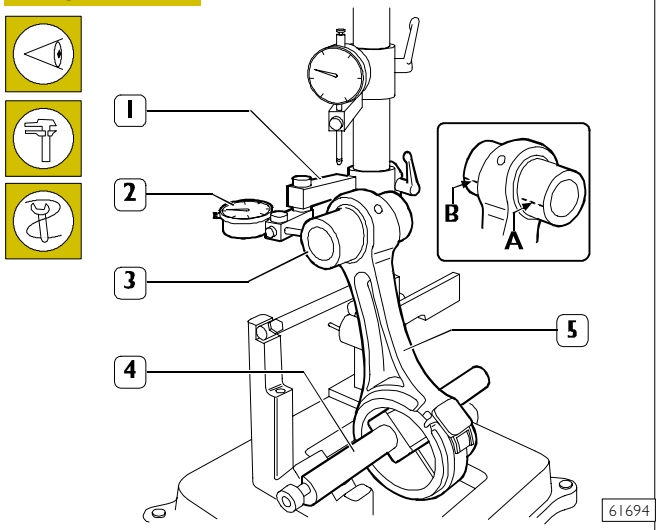


Check the alignment of the axes of the connecting rods (1) with device 99395363 (5), proceeding as follows:

- ❑ Fit the connecting rod (1) on the spindle of the tool 99395363 (5) and lock it with the screw (4).
- ❑ Set the spindle (3) on the V-prisms, resting the connecting rod (1) on the stop bar (2).

Checking torsion

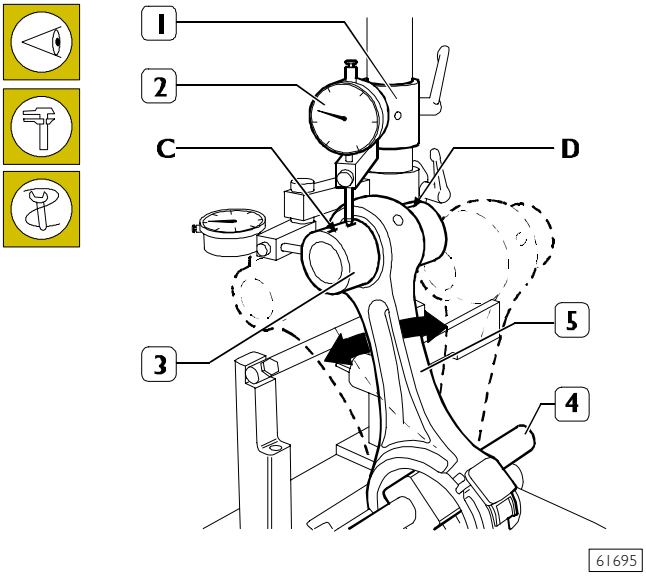
Figure 118



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

Checking bending

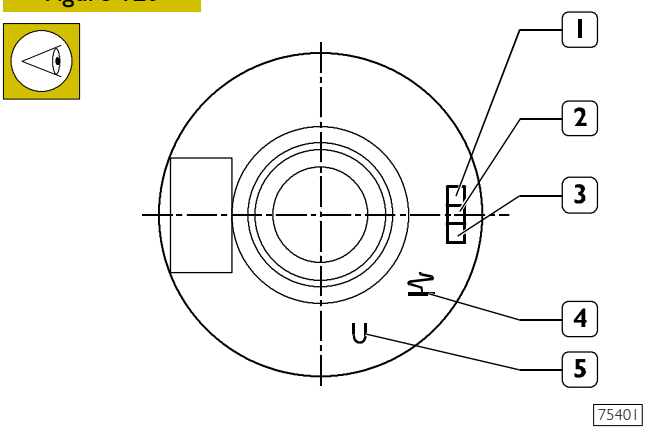
Figure 119



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

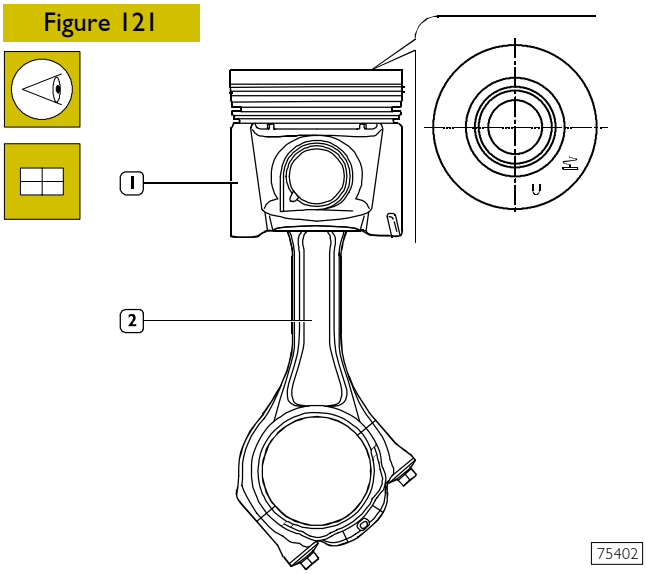
Assembling connecting rod-piston assembly

Figure 120



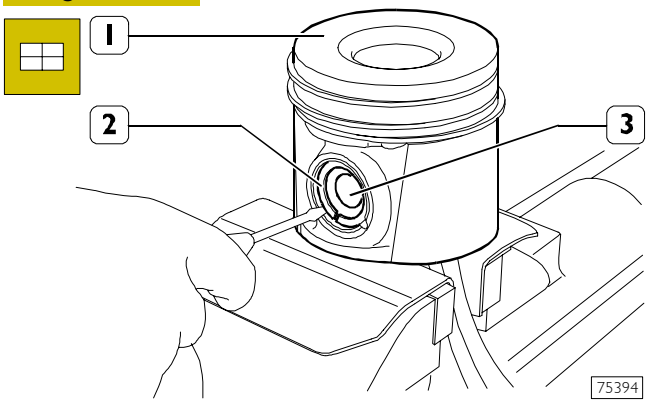
Etched on the top of the piston are: the type of engine (1), class selection (2) and supplier (3) as well as the direction of fitting the piston in the cylinder liner (4). The mark (5) is for passing the 1st slot insert adhesion test.

Figure 121



Connect the piston (1) to the connecting rod (2) together with its cap so that the piston assembly reference, position of the connecting rod and of the cap are observed as shown in the figure.

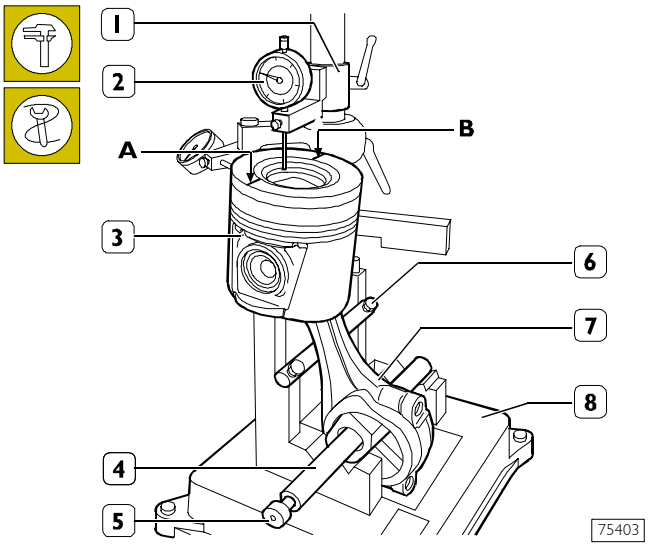
Figure 122



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

Checking for connecting rod – piston distortion

Figure 123

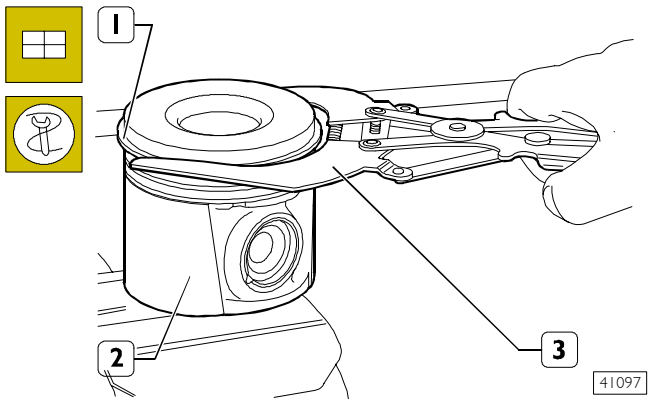


After fitting the connecting rod – piston assembly together, check for distortion with the tool 99395363 (8) as follows:

- ❑ Fit the connecting rod (7) together with the piston (3) on the spindle (4) of tool 99395363 (8) and lock it with the screw (5).
- ❑ Rest the connecting rod (7) on the bar (6).
- ❑ Position the mount (1) of the dial gauge (2) so that this is positioned at point A of the piston with a pre-load of 0.5 mm and zero the dial gauge (2).
- ❑ Shift the spindle (4) so as to position the dial gauge (2) at point B of the piston (3) and check for any deviation.

Assembling piston rings

Figure 124

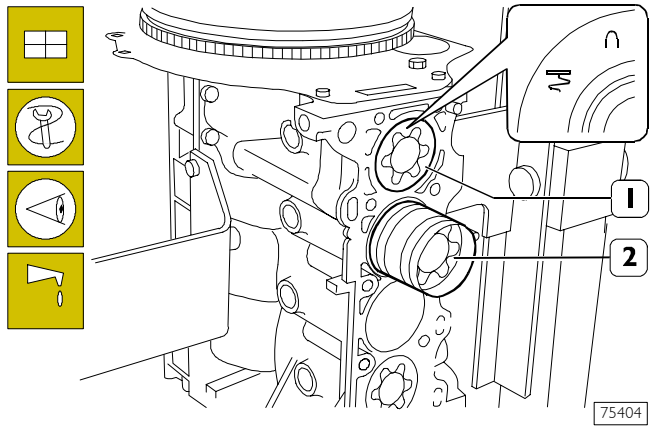


Fit the piston rings (1) on the piston (2) using the pliers 99360183 (3).

NOTE The 1st and 2nd slot rings need to be mounted with the word "TOP" facing upwards.

Assembling connecting rod – piston assemblies in cylinder barrels

Figure 125



Lubricate the pistons well, including the piston rings and the inside of the cylinder liners.
With the aid of the clamp 99360605 (2), fit the connecting rod – piston assembly (1) in the cylinder liners, checking that:

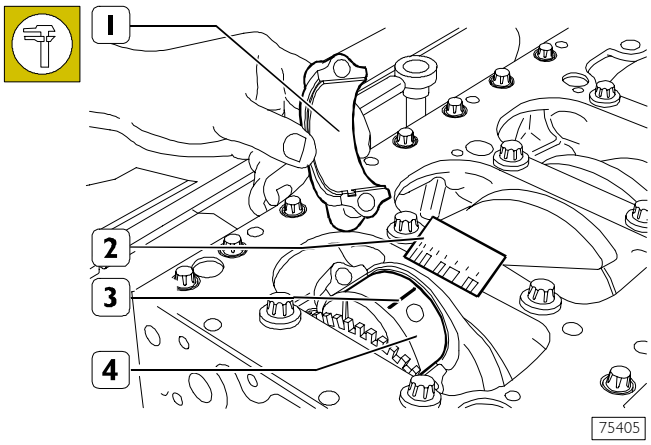
- ❑ The number of each connecting rod corresponds to the cap mating number.

- ❑ The openings of the piston rings are staggered 120° apart.
- ❑ The pistons are all of the same weight.
- ❑ The symbol punched on the top of the pistons faces the engine flywheel, or the recess in the skirt of the pistons tallies with the oil spray nozzles.

NOTE Not finding it necessary to replace the connecting rod bearings, you need to fit them back in exactly the same sequence and position found on disassembly.

540831 Measuring crankpin assembly clearance

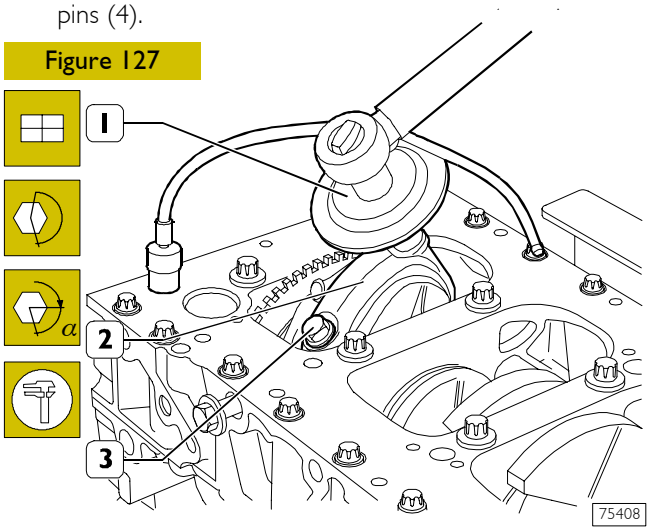
Figure 126



To measure the clearance, carry out the following steps:

- ❑ Thoroughly clean parts (1) and (4) and eliminate all traces of oil.
- ❑ Place a length of calibrated wire (3) on the crankshaft pins (4).

Figure 127



- ❑ Fit the connecting rod caps (2) with the associated bearing shells.
- ❑ Tighten the screws (3) in two steps:
  - Step 1: with a torque wrench, to a torque of 50 Nm.
  - Step 2: closing to an angle of 60°.

NOTE Use tool 99395216 (1) for the angle closing.

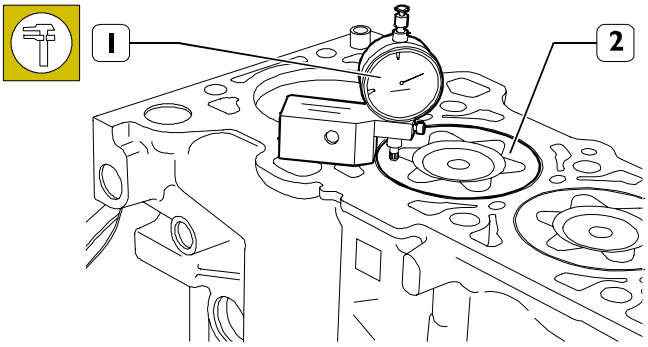
- ❑ Remove the cap (2) and determine the existing clearance by comparing the width of the calibrated wire (3, Figure 126) with the graduated scale on the case (2, Figure 126) that contained the calibrated wire. On finding a clearance other than as prescribed, replace the bearing shells and repeat the check.
  On obtaining the prescribed clearance, lubricate the connecting rod bearing shells and fit them permanently by tightening the connecting rod cap fixing screws as described.

NOTE The connecting rod cap fixing screws must always be replaced for permanent assembly.

Manually check that the connecting rods slide axially on the pins of the crankshaft.

Checking piston protrusion

Figure 128

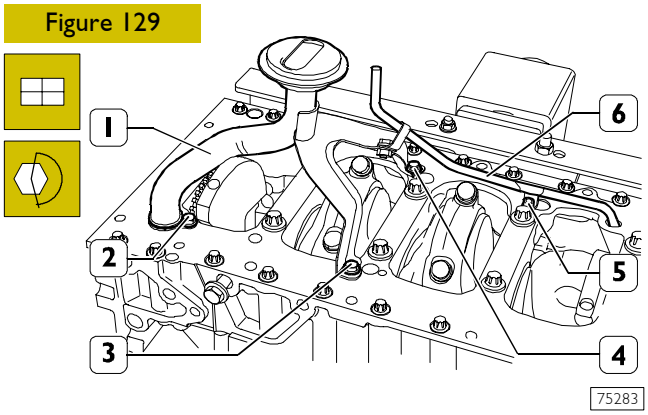


After mounting the connecting rod – piston assemblies, check the protrusion of the pistons (2) at the T.D.C. in relation to the top surface of the crankcase with a dial gauge (1).

NOTE The difference between the minimum and maximum protrusions of the four pistons must be = 0.15 mm.

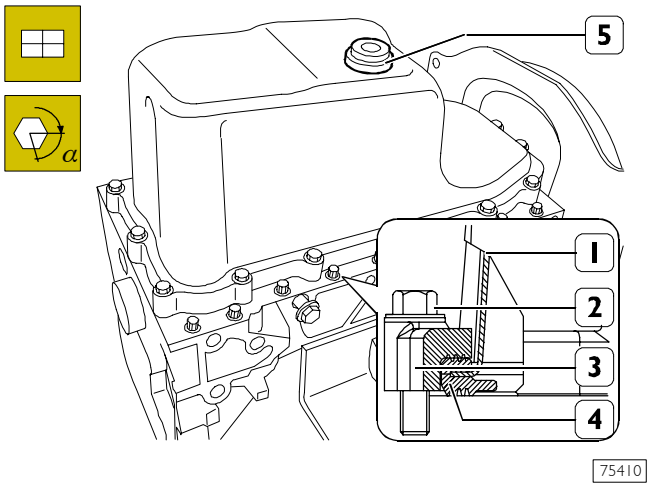
The cylinder head gasket in the set of spare gaskets needed for complete engine overhaul is supplied with a single thickness. Clearly, it is supplied separately too.

Figure 129



Mount the suction strainer (1) together with the pipe (6). Screw down the fixing screws (2-3-4-6) and tighten them to the prescribed torque.

Figure 130

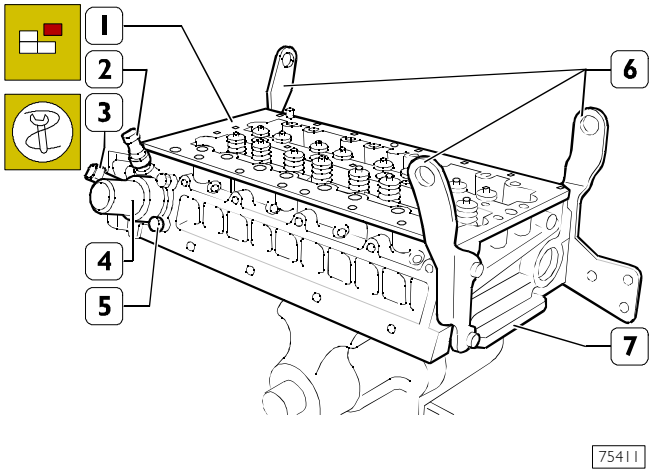


Fit the gasket (4) and the frame (3) onto the oil sump (1).
Screw down the fixing screws (2) and tighten them to the prescribed torque.
Screw down the oil drain plug (5) and tighten it to the prescribed torque.

560610 CYLINDER HEAD

Disassembly

Figure 131



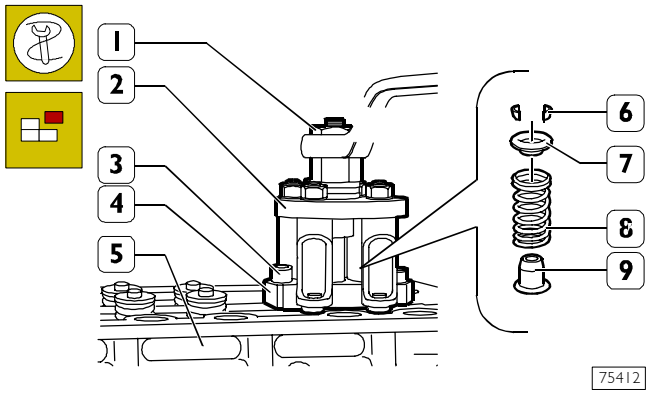
Place the cylinder head (1) on the mounting SP.2271 (7).
Remove the brackets (6) for lifting the engine.

Use the wrench SP 2262 to remove the timing sensors (2 and 3).

Take out the screws (5) and remove the thermostat casing (4).

541210 Removing valves

Figure 132



Fit part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

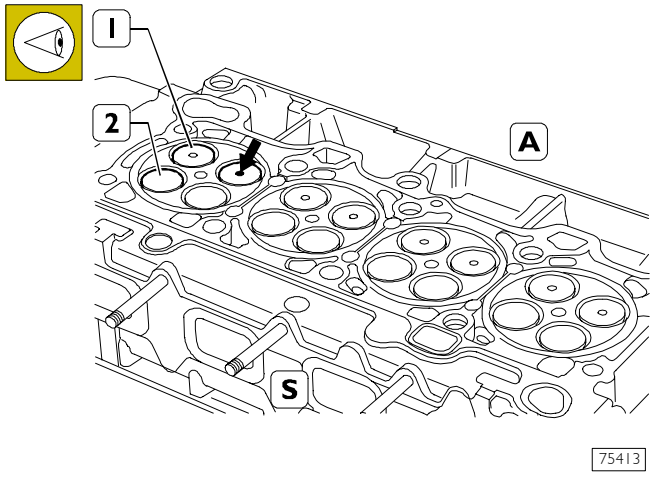
Fit part (2) of tool 99360260 onto part (4), screw down the nut (1) so that on compressing the springs (8) it is possible to remove the cotters (6). Then take out the plates (7) and the springs (8).

Using suitable pliers, remove the oil seal (9).

Repeat these operations on the remaining valves.

Turn the cylinder head over.

Figure 133



The intake (1) and exhaust (2) valves have the same diameter mushroom.

The central cavity (→) of the mushroom of the intake valve (1) is distinguished from that of the exhaust valve (2).

NOTE Before dismounting the valves from cylinder head, number them, to the purpose of being able to remount them in the position that was found on dismounting operation where they should not be replaced.

A = intake side – S = exhaust side

Remove the intake (1) and exhaust (2) valves.

Checking cylinder head seal

Check the hydraulic seal using a suitable tool.
Pump in water heated to approx. 90°C at a pressure of 2 ÷ 3 bars.

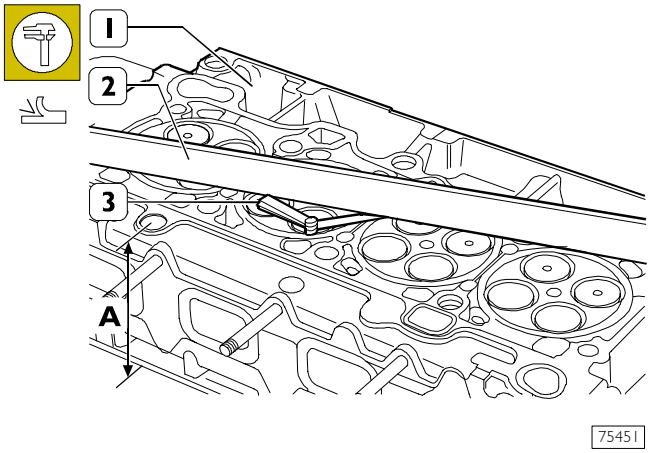
Replace the cup plugs if they are found to leak at oil, using a suitable drift for their removal – assembly.

NOTE Before mounting the plugs, apply LOCTITE 270 water-reacting sealant on their sealing surfaces.

If there is any leakage from the cylinder head, it must be replaced.

Checking cylinder head mating surface

Figure 134



75451

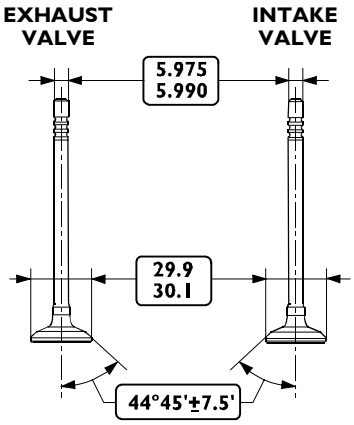
The mating surface of the head (1) with the cylinder block is checked using a rule (2) and a feeler gauge (3).
The deformation found on the entire length of the cylinder head must be no greater than 0.20 mm.
For greater values, regrind the cylinder head according to the values and instructions given in the following figure.

The nominal thickness A of the cylinder head is 112 ±0.1 mm; the maximum permissible removal of metal must not exceed a thickness of 0.2 mm.

NOTE After regrinding, check the valve recessing and if necessary regrind the valve seats to make the prescribed valve recessing.

540662 VALVES

Figure 135

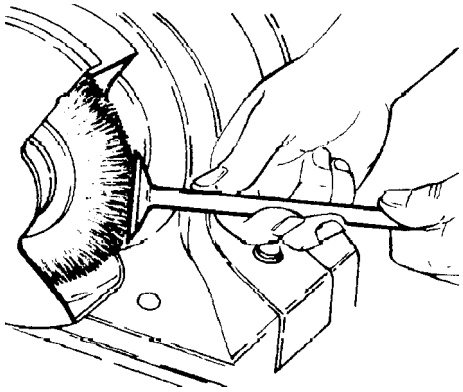


75452

MAIN DATA OF INTAKE AND EXHAUST VALVES

Removing deposits, refacing and checking valves

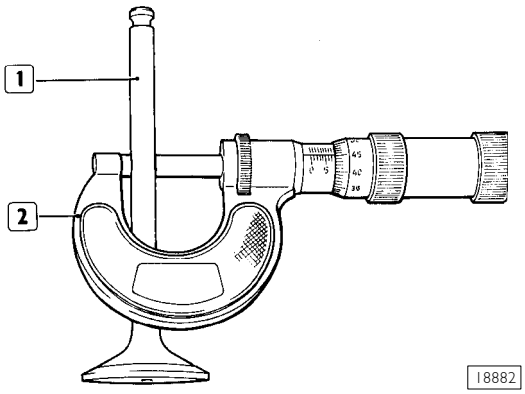
Figure 136



18625

Remove the carbon deposits on the valves with a wire brush. Check that the valves show no signs of seizure, cracking or burning.

Figure 137

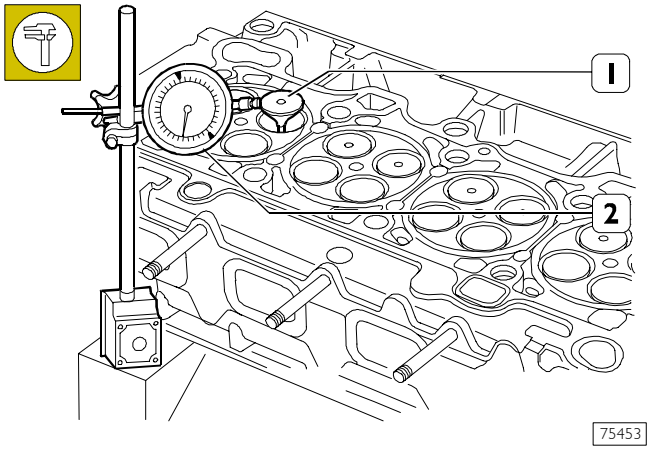


18882

Using a micrometer (2), measure the stem of the valves (1): it must be 5.975 – 5.990 mm. If necessary, regrind the seats on the valves with a grinding machine 99305018, removing as little material as possible.

Checking clearance between valve stem and valve guide and centring valves

Figure 138



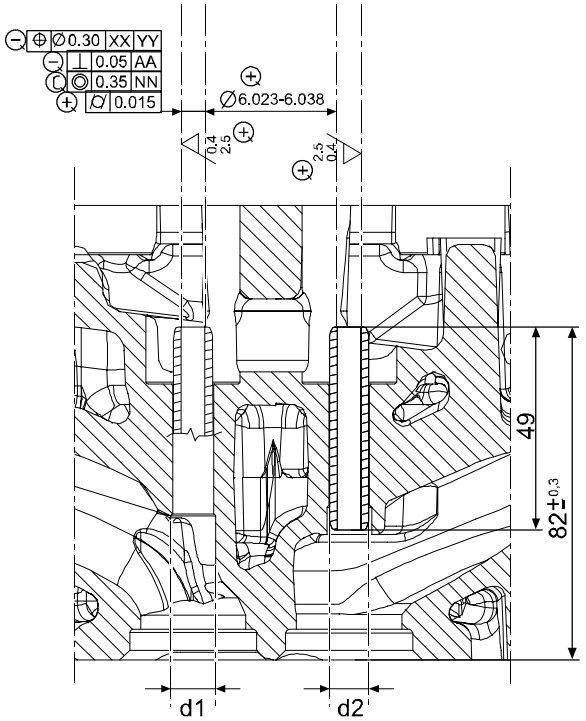
75453

The checks are made using a dial gauge (2) with a magnetic base, positioned as illustrated. The assembly clearance is 0.033 – 0.063 mm.
Making the valve (1) turn, check that the centring error is no greater than 0.03 mm.

540667 VALVE GUIDES

Replacing valve guides

Figure 139



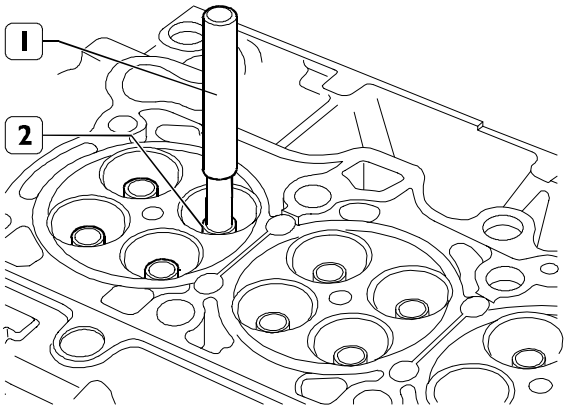
88774

MAIN DATA OF VALVE GUIDES – SEATS

Valve guide seat inside Ø	9.980 ÷ 10.000 mm
Valve guide outside Ø	10.028 ÷ 10.039 mm

* Measurement to be made after driving in the valve guides.

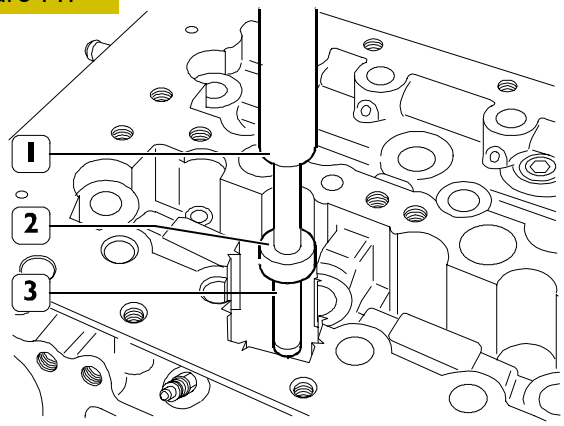
Figure 140



75455

Remove the valve guides (2) with the drift SP.2312 (1).

Figure 141

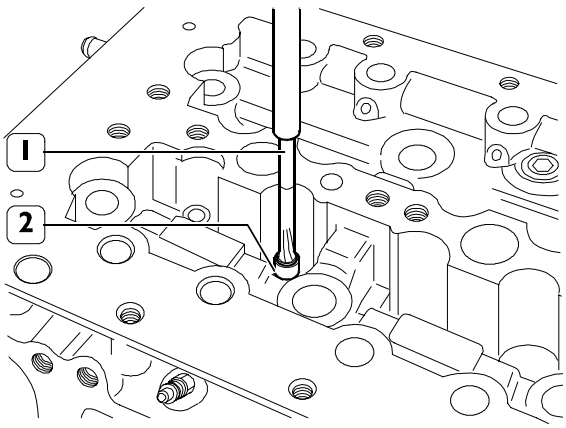


75456

Heat the cylinder head to 80 – 100°C and, using the drift SP.2312 (1) provided with part SP.2311 (2), mount the new valve guides (3) previously chilled in liquid nitrogen.
Where above indicated tools are not available, mount valve guides positioning them in cylinder head according to dimension indicated in Figure 139.

Boring valve guides

Figure 142



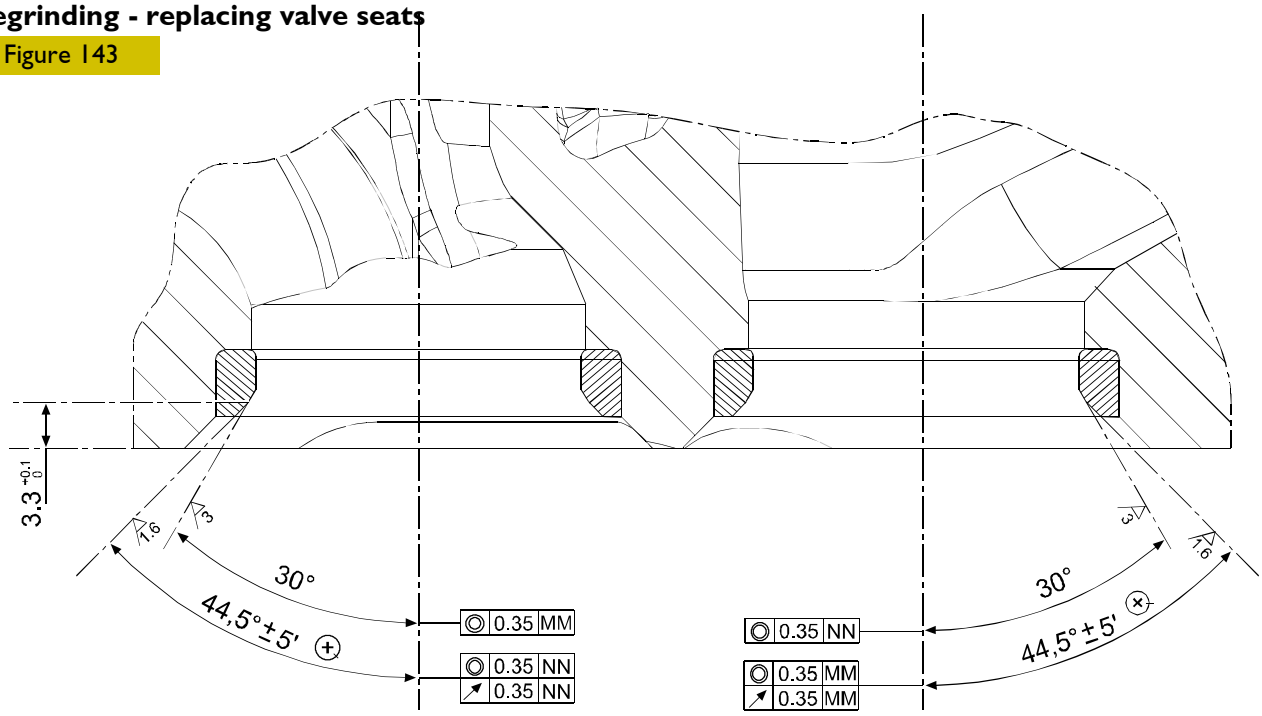
75457

After driving in the valve guides (2), regrind them with the smoother SP.2310 (1).

540661 VALVE SEATS

Regrinding - replacing valve seats

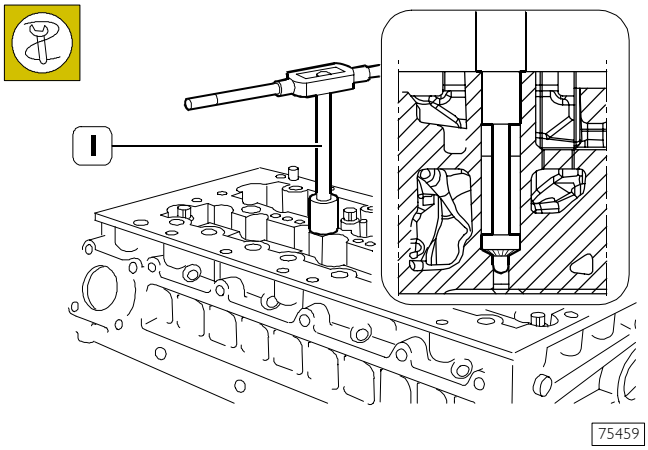
Figure 143



Check the valve seats. On finding any slight scoring or burns, regrind them with an appropriate tool according to the angles given in Figure 143.
Having to replace them, with the same tool and taking care not to affect the cylinder head, remove as much material from the valve seats as possible until, with a punch, it is possible to extract them from the cylinder head.

Heat the cylinder head to 80 ÷ 100°C and, using a suitable drift, fit in it the new valve seats, previously chilled in liquid nitrogen.
Using a specific tool, regrind the valve seats according to the angles given in Figure 143.

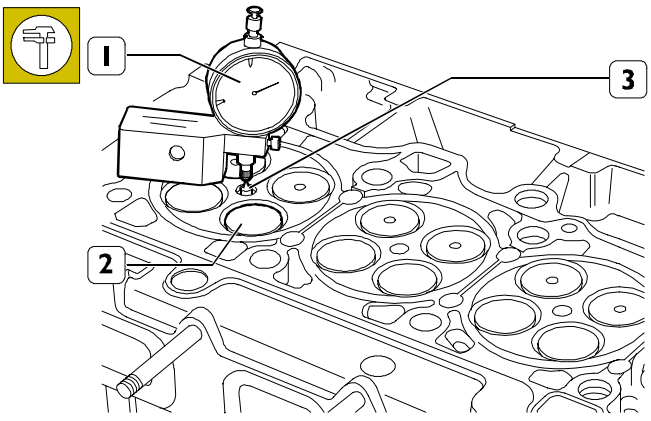
Figure 144



Using the milling cutter 99394038 (1), clean the injector seat of any deposits.

Mount the valves, block the seat of the electro-injectors and glow plugs; using a suitable tool, check the seal of the valves/seats.

Figure 145

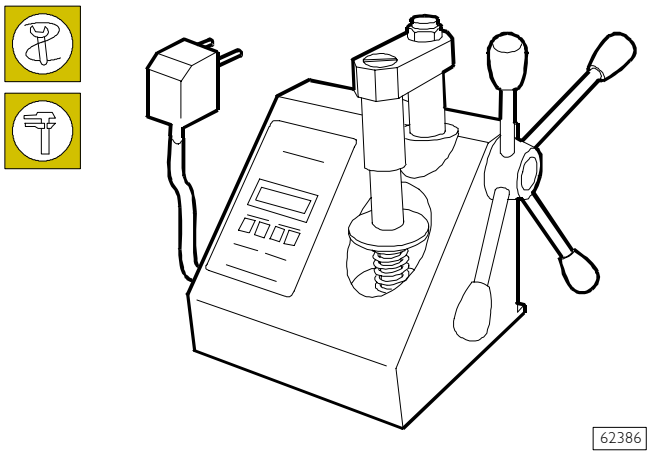


Using a dial gauge (1), check that, from the plane of the cylinder head, the valve recessing (2) and the protrusion of the injector (3) and of the glow plug have the prescribed value:

- Valve recessing: 0.5 ÷ 0.8 mm.
- Injector protrusion: 2.77 ÷ 3.23 mm.
- Glow plug protrusion: 3.78 mm.

540665 VALVE SPRINGS

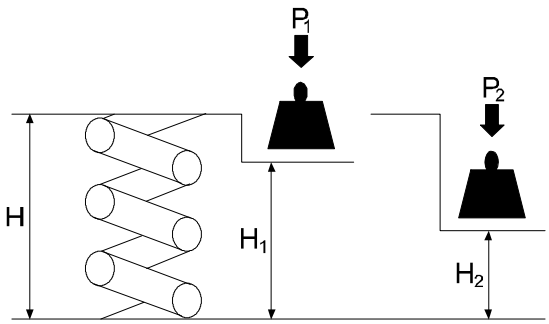
Figure 146



62386

Before assembly, check the flexibility of the valve springs with the tool 99305047. Compare the load and elastic deformation data with those of the new springs given in the following figures.

Figure 147



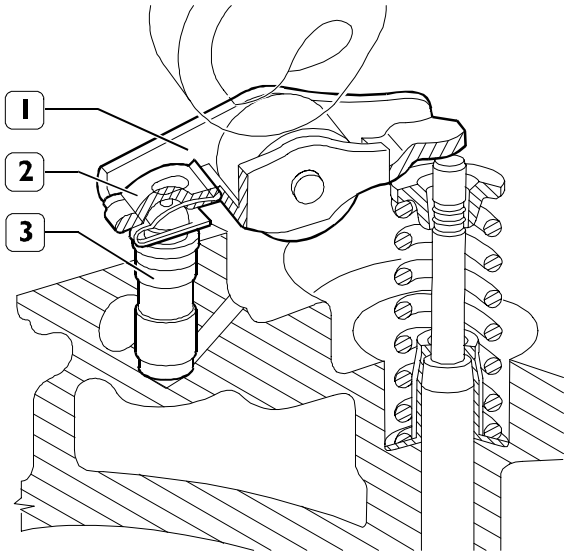
50676

MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Height	Under a load of
mm	kg
H 54	Free
H1 45	P 243 ±12
H2 35	P1 533 ±24

ROCKER ARMS – TAPPETS

Figure 148

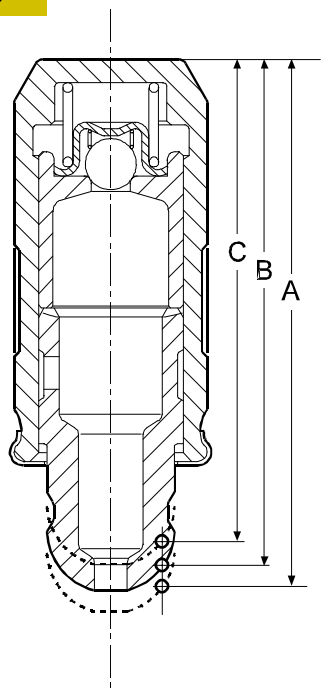


75461

COMPLETE ROCKER ARM ASSEMBLY

The rocker arm assembly is composed of the rocker arm (1), hydraulic tappet (3), made integral with each other by the clip (2).

Figure 149

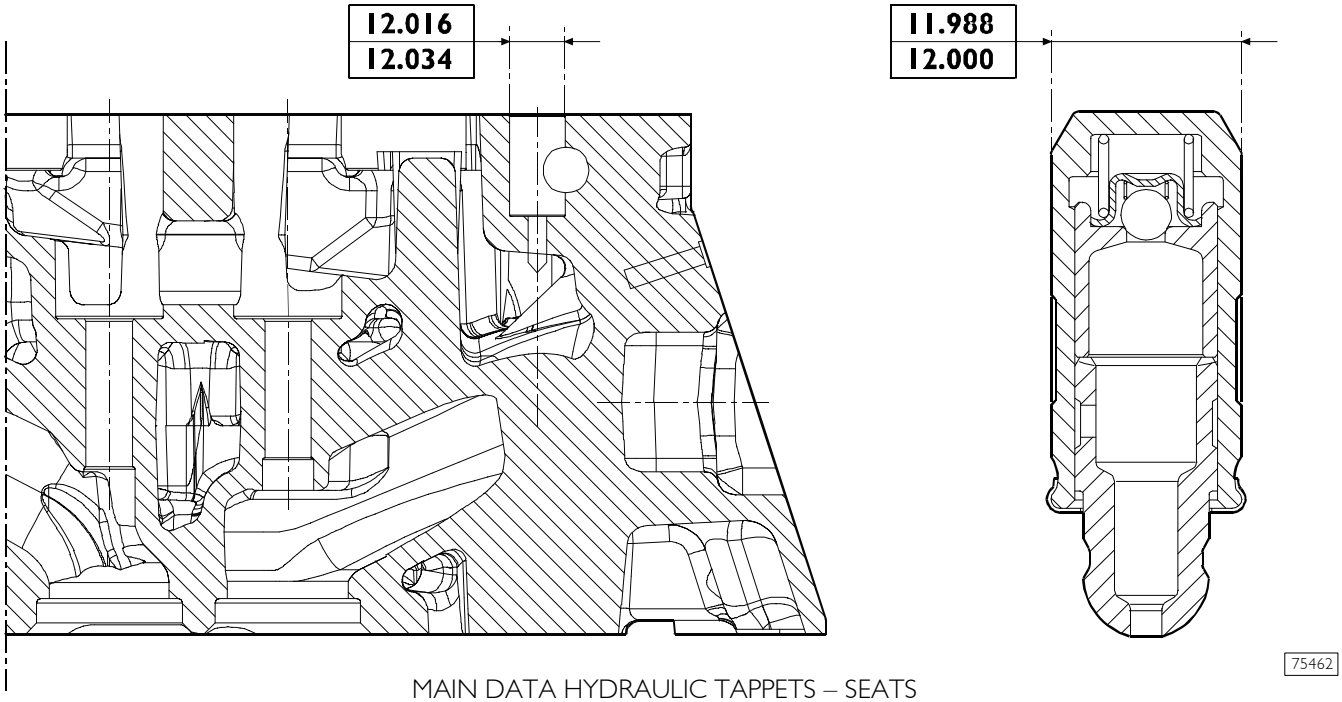


75942

CROSS-SECTION OF THE HYDRAULIC TAPPET

A = 32.44 ±0.3, end of stroke
B = 31.30, working position
C = 29.75 ±0.25, start of stroke

Figure 150



MAIN DATA HYDRAULIC TAPPETS – SEATS

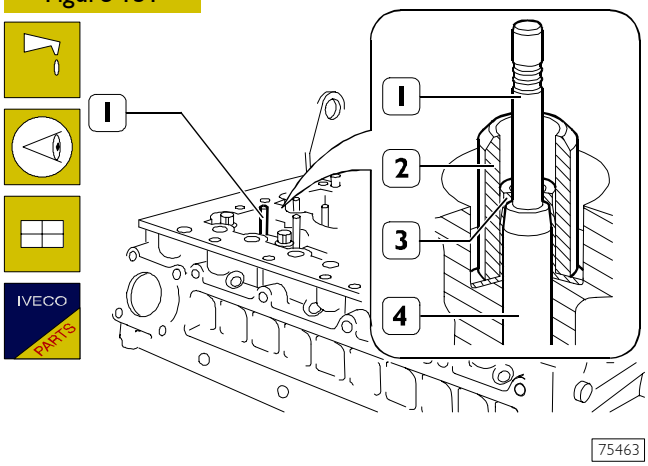
Checks

The sliding surface of the tappets must have no scoring/dents; replace them if they do.

Using a micrometer, measure the diameter of the tappets and, using a bore meter, measure the diameter of the seats in the cylinder head; the difference in the measurements will give the assembly clearance.

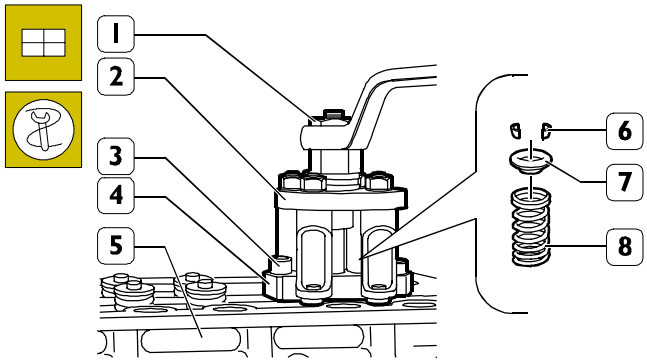
ASSEMBLING CYLINDER HEADS

Figure 151



Lubricate the stem of the valves (1) and insert them into the associated valve guides (4) according to the position marked during removal. Using tool SP.2264 (2), mount the oil seals (3) on the valve guides (4).

Figure 152



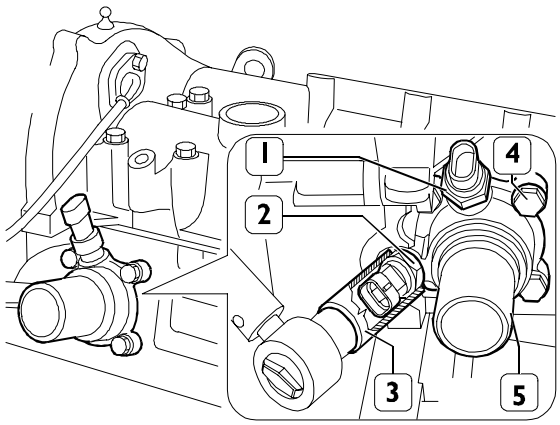
Position the springs (8) and plates (7) on the cylinder head (5).

Fit the part (4) of tool 99360260 onto the cylinder head (5) and secure it with the screws (3).

Fit the part (2) of tool 99360260 onto part (4), screw down the nut (1) so that by compressing the springs (8) it is possible to insert the retaining cotters (6); then unscrew the nut (1) checking that the cotters (6) have settled in correctly.

Repeat these operations on the remaining valves.

Figure 153



75464

Fit the thermostat casing (5) with a new seal and tighten the fixing screws (4) to the prescribed torque.

Mount temperature sensors (1 and 2), and tighten them at prescribed torque.

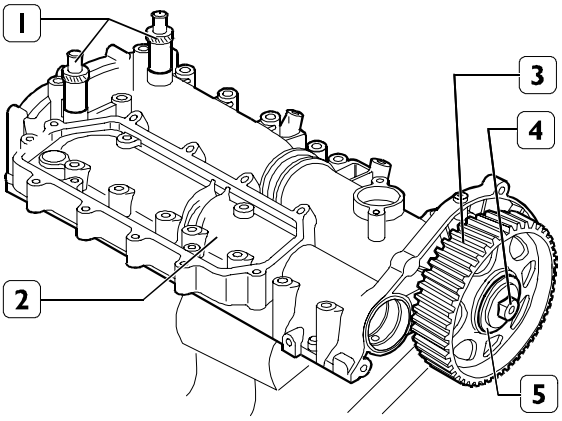
For tightening sensor (2), use wrench SP.2262 (3).

Mount the temperature sensors (1 and 2) and, using the wrench SP.2263 (3), tighten them to the prescribed torque.

540650 Overhead

Overhead removal

Figure 154

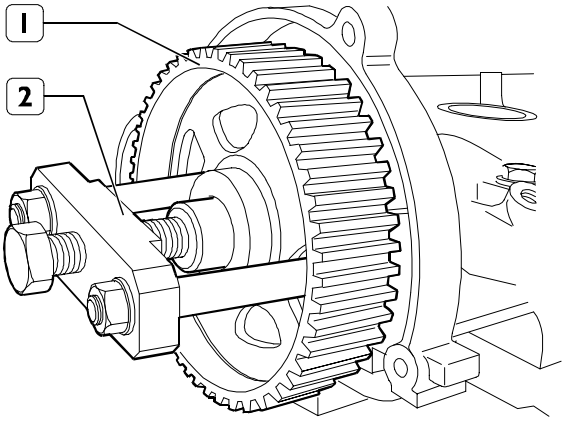


75465

Position the overhead (2) together with the pins 99360614 (1) on the mounting SP. 2271.

Take out the screw (4) with the washer (5) beneath fastening the toothed pulley (3).

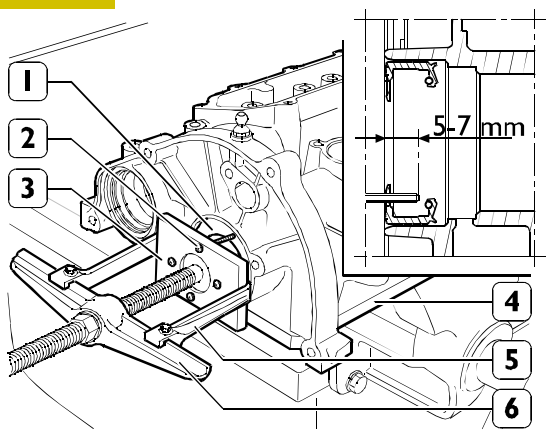
Figure 155



75466

Using the extractor 99340028 (2) extract the toothed pulley (1) driving the camshaft.

Figure 156

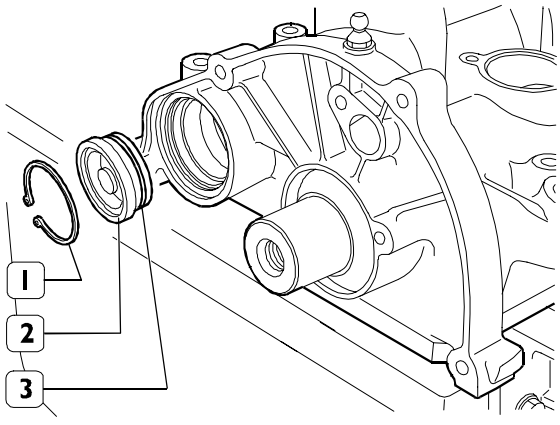


75467

Using four self-tapping screws (2), apply the tool SP. 2325 (3) to the seal (1) and with the extractor (5 and 6) remove the seal (1) from the overhead (4).

NOTE The screws (2) must be screwed down so they get positioned at the dimension shown in the figure.

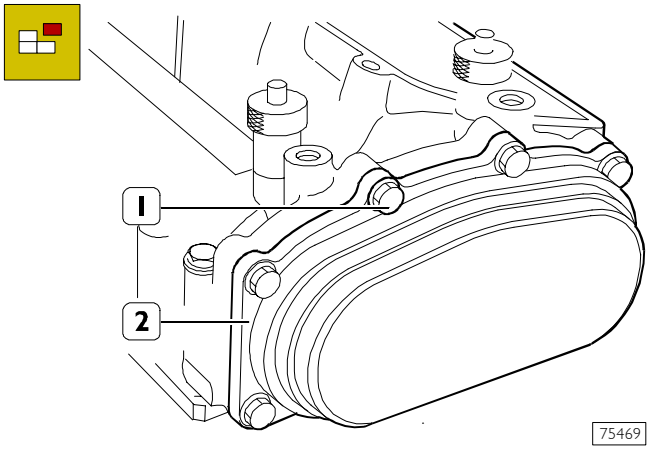
Figure 157



75468

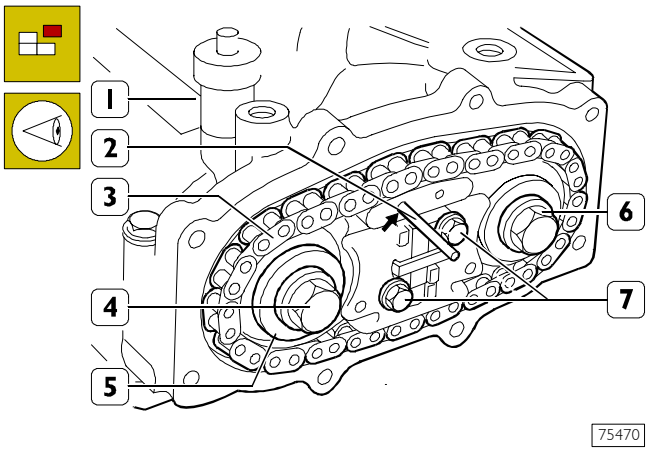
Remove the circlip (1) and take off the cover (2) together with the seal (3).

Figure 158



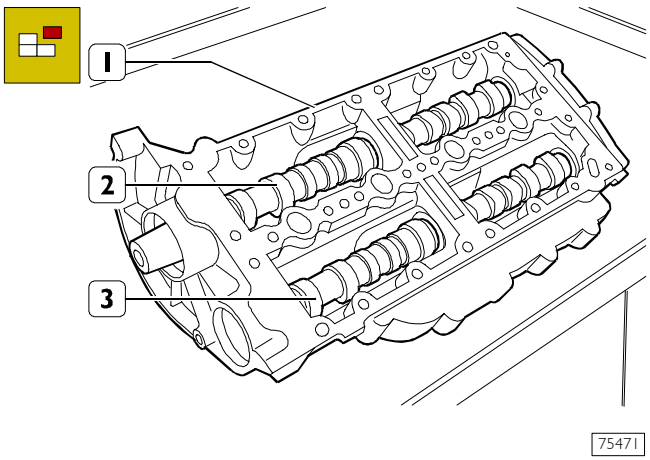
Take out the screws (1) and remove the rear cover (2) together with its gasket.

Figure 159



Insert a suitable pin (2) in the hole (⇒) of the chain drive (3).
Take out the screws (4) and (6) with their washers (5) for fixing gears to the camshafts.
Take out the screws (7) and remove the chain drive (3) from the overhead (1).

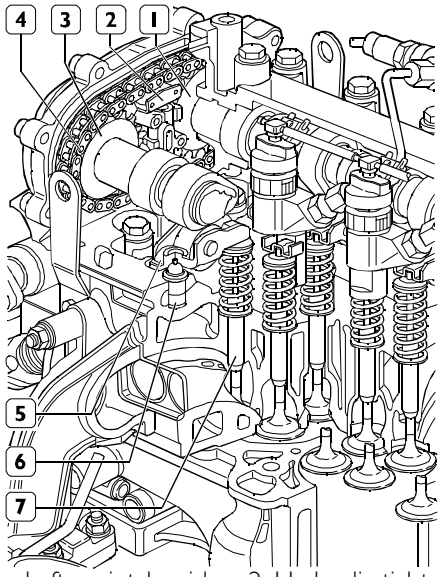
Figure 160



Turn over the overhead (1) and, taking care not to damage the seats, extract the camshafts (2) and (3) from it.

5412 TIMING SYSTEM

Figure 161

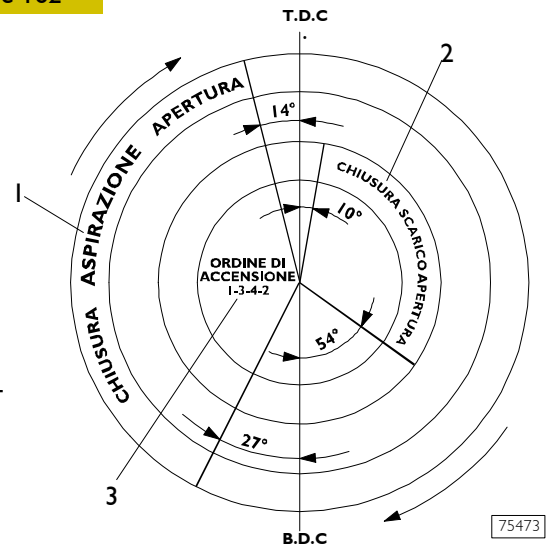


1. Camshaft on intake side – 2. Hydraulic tightener – 3. Camshaft on exhaust side – 4. MORSE chain – 5. Rocker arms – 6. Hydraulic reacting tappet – 7. Valve assembly.

Description

The timing system is the type with a twin camshaft in the head and four valves per cylinder with hydraulic tappets.
Motion is transmitted by the crankshaft, via a toothed belt, to the gear keyed onto the intake valve drive shaft. The drive transmission of the exhaust valve drive shaft takes place via a MORSE-type chain kept under tension by a hydraulic tightener.
The toothed belt, moreover, drives the water pump and the high-pressure pump CP3 and is kept at the right tension by an automatic tightener roller.
The four valves move by the action of the "free" rocker arms (with no supporting shaft).
The rocker arms, one per valve, are always in contact with the corresponding cam and are kept in this position by a hydraulic reacting tappet, thereby eliminating the need for periodical adjustment.

Figure 162



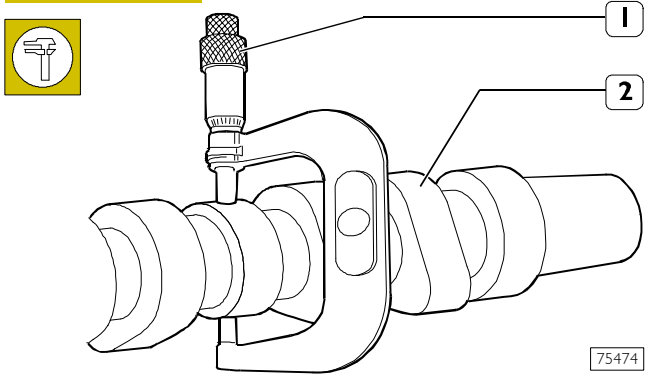
1 CLOSING INTAKE OPENING
2 CLOSING EXHAUST OPENING
3 FIRING ORDER 1-3-4-2

TIMING SYSTEM DIAGRAM

541210 Camshaft Checks

The surfaces of the shaft supporting pins and of the cams must be finely honed; if there is any sign of meshing or scoring, replace the shaft.

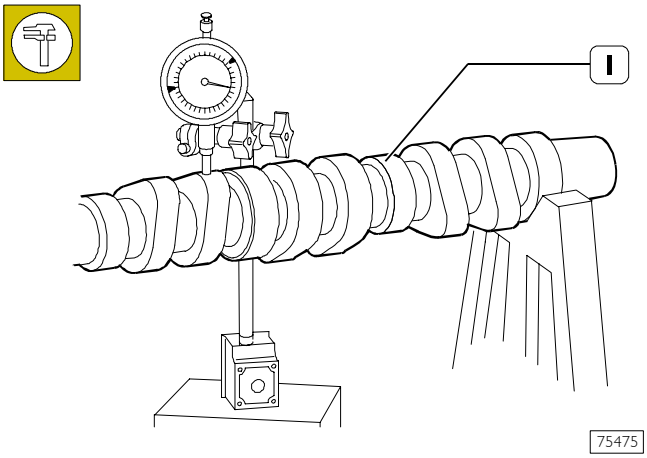
Figure 163



Using a micrometer (1), measure the diameter of the pins (2) of the camshaft and, using a bore meter, measure the diameter of the supporting seats in the overhead.
The difference between these two measurements gives the existing clearance.
The nominal assembly clearance is 0.037 ÷ 0.088 mm.

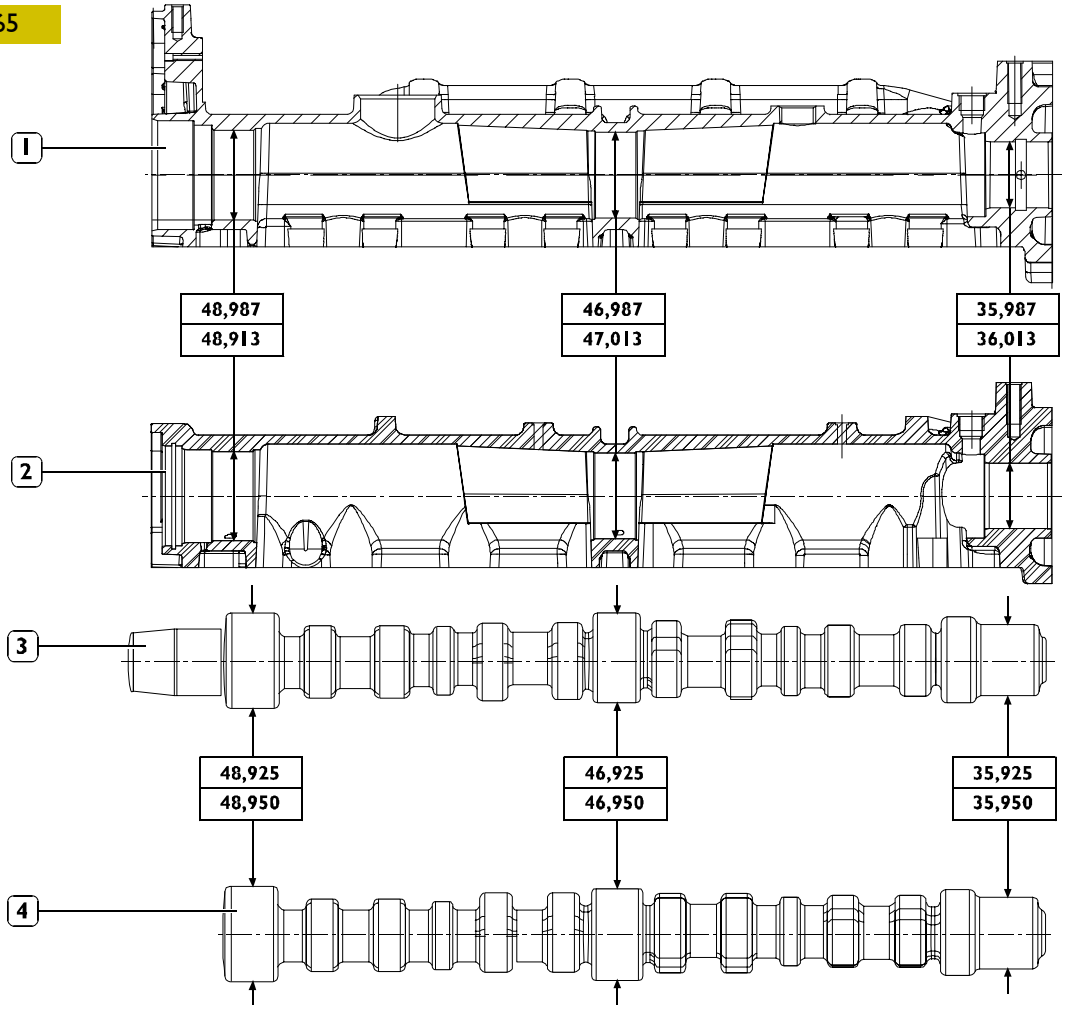
541211 Checking cam lift and pin alignment

Figure 164



Set the shaft (1) on tailstocks and, using a dial gauge on the middle mounting, check that the alignment error is no greater than 0.04 mm; replace the shaft if it is. In addition, check the cam lift: it must be as prescribed; replace the shaft if it is any different.

Figure 165

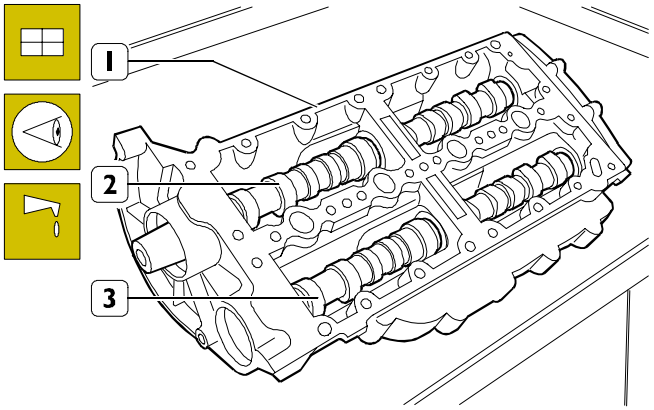


MAIN DATA, CAMSHAFT PINS AND SEATS

1. Intake valve camshaft seats – 2. Exhaust valve camshaft seats – 3. Intake valve camshaft – 4. Exhaust valve camshaft.

Assembling overhead

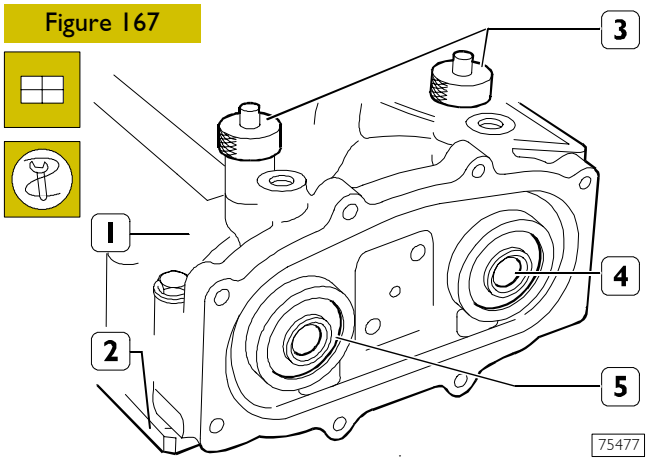
Figure 166



Lubricate the supporting pins of the shafts (2 and 3) and fit them in the overhead (1).

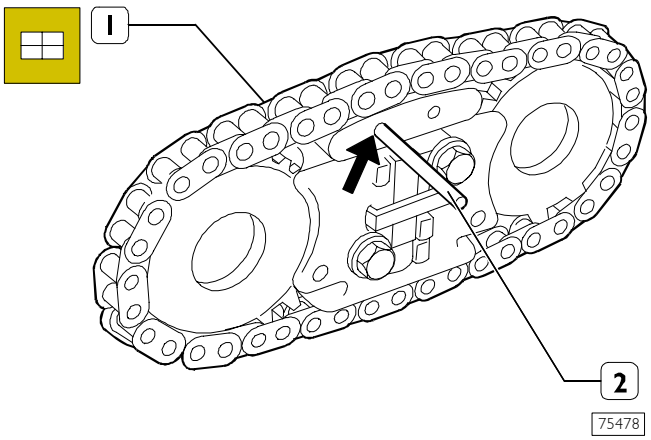
NOTE In this operation, take care not to damage the overhead supporting seats.

Figure 167



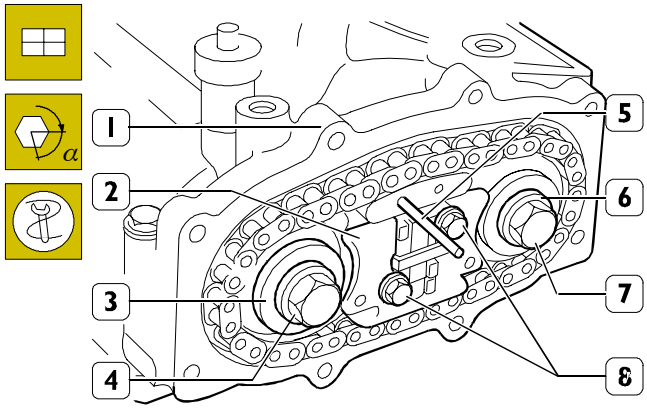
Position the overhead (1) and secure it on the mounting SP.2271 (2).
Position the camshafts (4 and 5) so as to be able to insert the pins 99360614 (3) into their radial holes through the threaded holes of the overhead.

Figure 168



Compress the tightener so as to be able to insert a suitable pin (2) into the hole (→) of the chain drive (1).

Figure 169



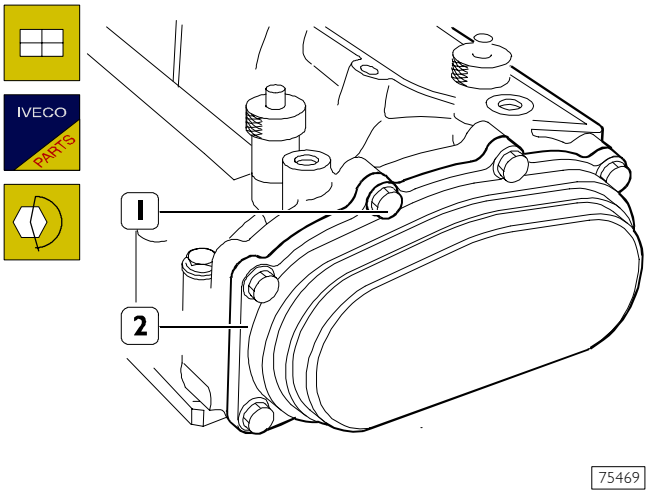
Fit the chain drive (2) on the camshafts and secure it to the overhead (1) tightening the screws (8) to the prescribed torque.

Screw down the screws (4) and (7) with the washers (5) and (6) and tighten them as follows:

- ❑ Tighten the screw (7) to a torque of 50 Nm.
- ❑ Close further with an angle of 60°.
- ❑ Take out the pin (5).
- ❑ Tighten the screw (4) to a torque of 50 Nm.
- ❑ Close further with an angle of 60°.

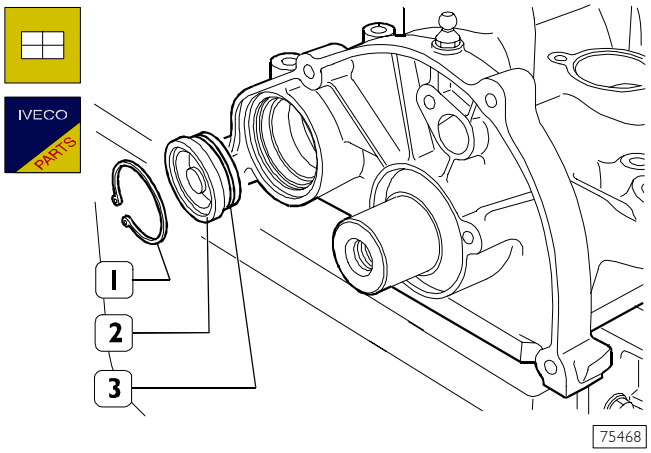
NOTE Use the goniometer 99395216 for the angle closing.

Figure 170



Fit on the rear cover (2) with a new gasket and tighten the fixing screws (1) to the prescribed torque.

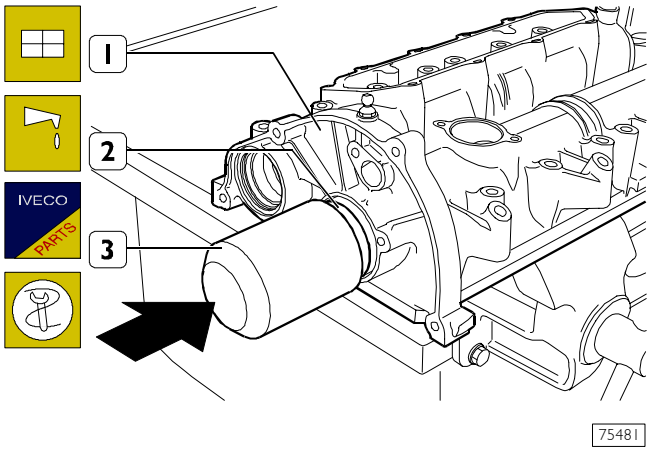
Figure 171



Fit a new seal (3) on the cover (2) and fit this in the overhead.

Fit on the seal (1).

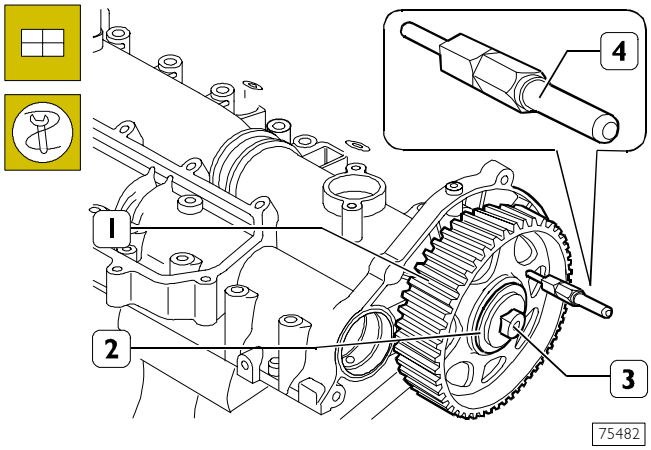
Figure 172



Lubricate the shank of the camshaft.

Using the keying device 99374458 (3), fit the seal (2) in the overhead (1).

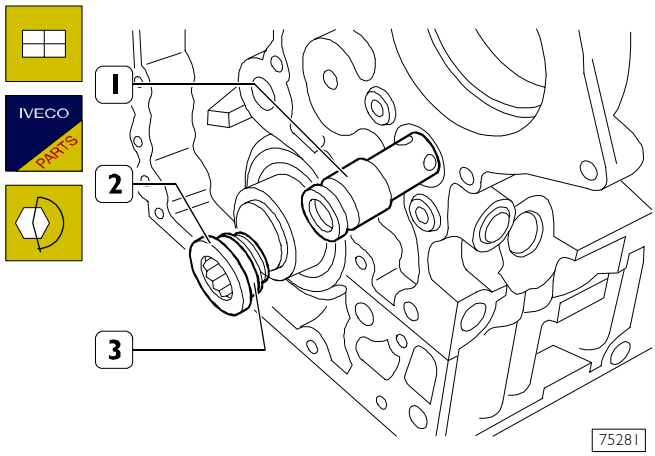
Figure 173



Fit the toothed pulley (1) onto the camshaft so as to align the hole of the pulley with that of the overhead and insert the tool 99360608 (4) into these holes. Screw down the screw (3) together with the washer (2) without tightening fully.

NOTE The toothed pulley (1, Figure 173) is not locked on the shaft since it must be able to turn when fitting and tensioning the timing belt. For the same reason, keep the tools 99360608 (4, Figure 173) and 99360614 (3, Figure 167) fitted.

Figure 174

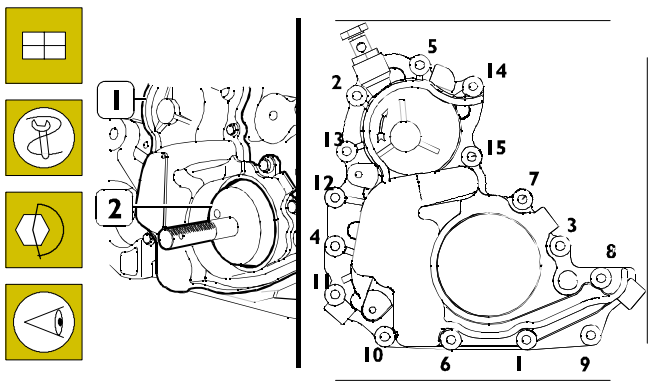


Fit the oil pressure control valve (1) in the crankcase.

Fit on the plug (2) with the seal (3) and tighten it to the prescribed torque.

540442 Assembling front seal ring

Figure 175

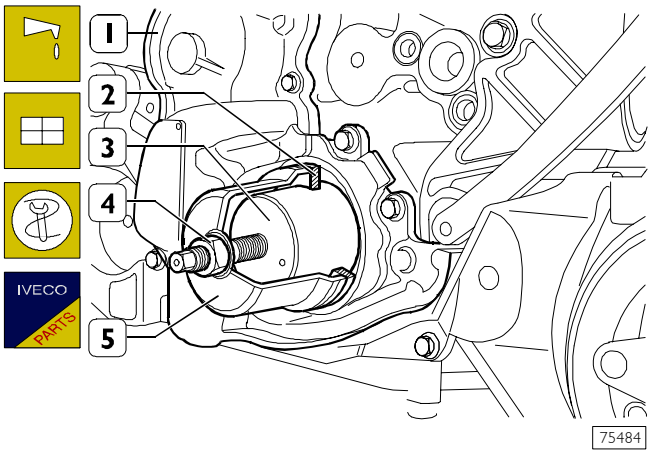


Fit the centring tool 99396037 (2) onto the shank of the crankshaft.

Mount the oil vacuum pump assembly (1) with a new gasket and tighten the screws (1-15) according to the following procedures:

- ❑ Tighten the screws from no. 1 to no. 6 to a torque of 5 ±1 Nm while checking that the tool 99360037 (2) turns freely.
- ❑ Tighten the screws from no. 7 to no. 15 to a torque of 10 ±1 Nm.
- ❑ Tighten the screws from no. 1 to no. 6 to a torque of 10 ±1 Nm.
- ❑ After checking that tool 99360037 (2) turns freely, remove it.

Figure 176



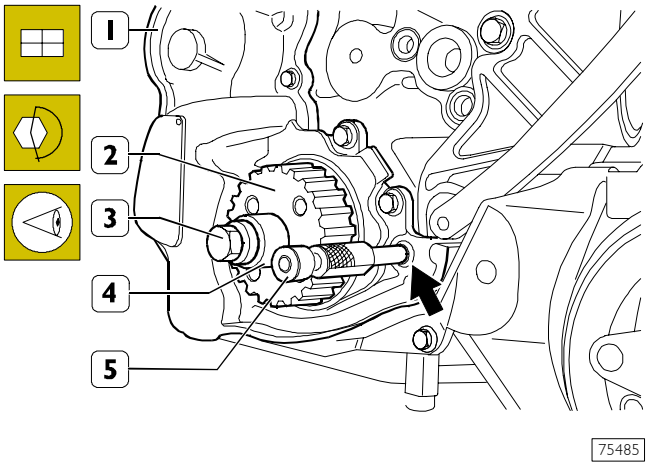
Lubricate the shank of the crankshaft.

Screw down part (3) of tool 99346254 in the crankshaft and place the seal (2) on the part (3).

Key part (5) of tool 99346254 onto part (3), screw down the nut (4) until the seal (2) gets into position in the seat of the oil vacuum pump assembly (1).

Take out the tool 99346254 (3, 4 and 5).

Figure 177

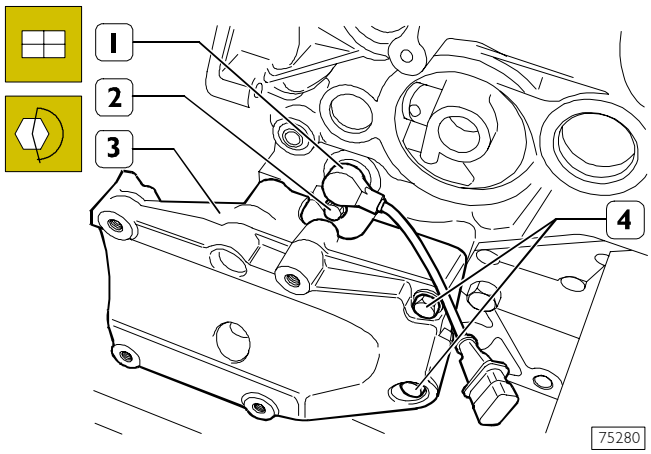


Turn the crankshaft so as to be able to insert tool 99360615 (5) into the hole in the crank of the crankshaft, through the hole in the oil vacuum pump assembly (1), to block crankshaft rotation.

Mount the gear (2), screw down the screw (3) together with the spacer (4) and tighten it to the prescribed torque.

NOTE Do not remove the tool 99360615 (5) as it will be needed for fitting the timing drive belt.

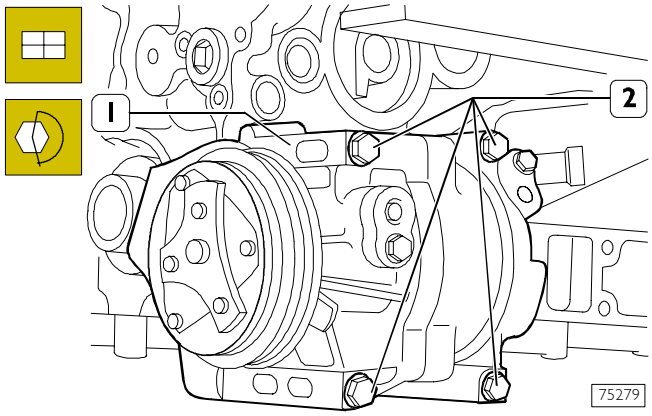
Figure 178



Mount the speed sensor (1) with a fresh gasket and tighten the fixing screw (2) to the prescribed torque (if applicable).

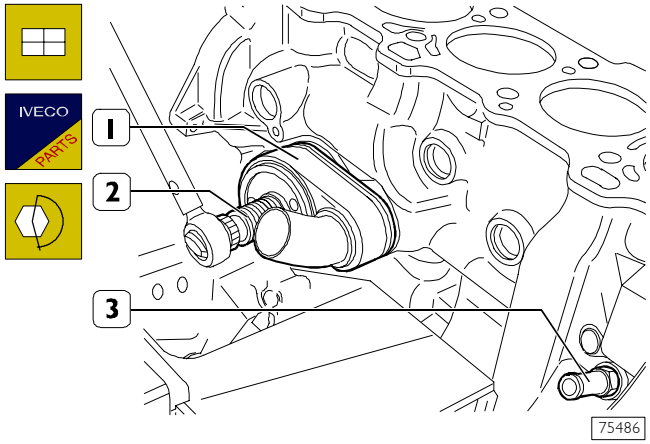
Fit on the compressor mounting (3) and tighten the fixing screws (4) to the prescribed torque.

Figure 179



Mount the air-conditioner compressor (1) (if applicable) and tighten its fixing (2) screws to the prescribed torque.

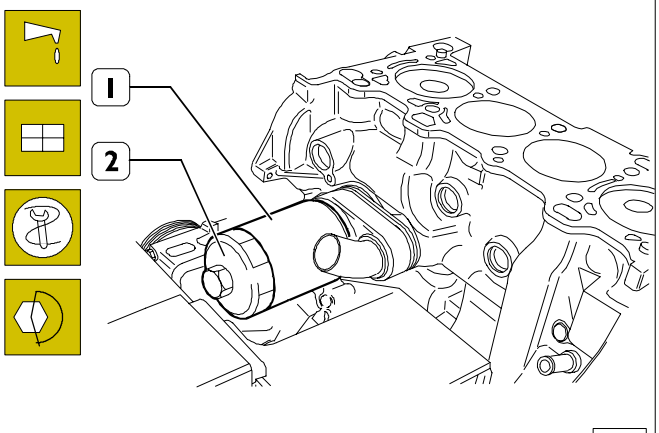
Figure 180



Mount the oil pressure transmitter (3) with a fresh gasket.

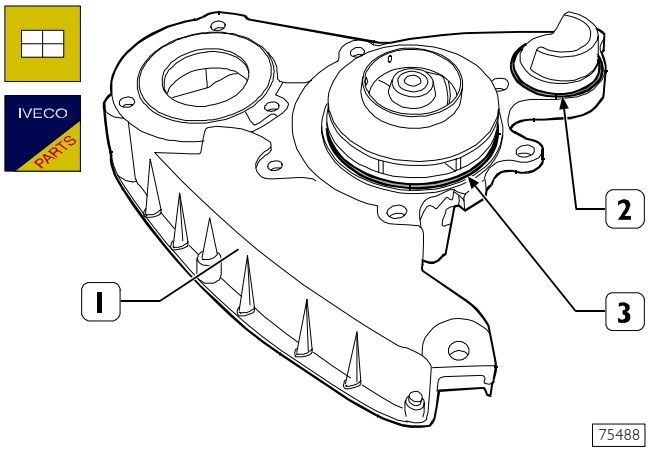
Mount the heat exchanger (1) with a fresh seal and tighten the coupling (2) to the prescribed torque.

Figure 181



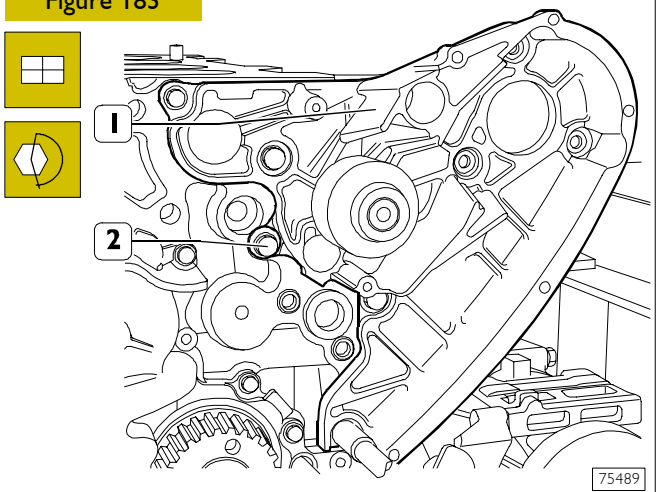
Lubricate the seal of the oil filter (1) with engine oil.
Using tool 99360076 (2), tighten the oil filter to the prescribed torque.

Figure 182



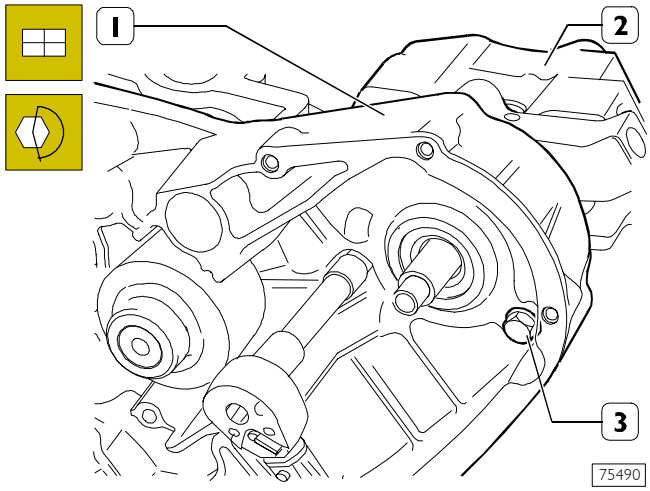
Thoroughly clean the mating surface (à) of the water pump (1) and position fresh seals (2 and 3) on it.

Figure 183



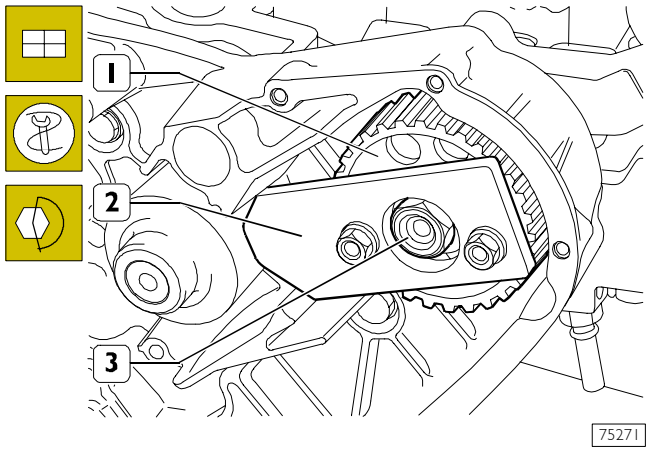
Mount the water pump (1) and tighten the fixing screws (2) to the prescribed torque.

Figure 184



Fit the high-pressure pump (2) onto the flange of the water pump (1) and tighten the fixing screws (3) to the prescribed torque.

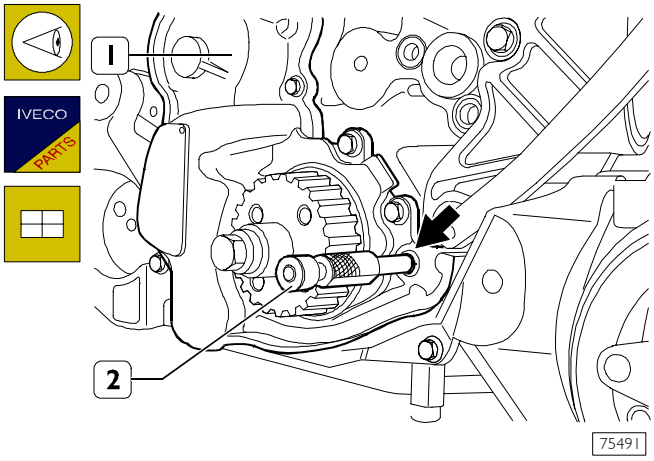
Figure 185



Fit the driving gear (1) onto the shaft of the high-pressure pump and block rotation of this shaft by applying tool SP.2263 (2) as illustrated in the figure. Tighten the nut (3) to the prescribed torque and remove the tool (2).

Refitting cylinder head

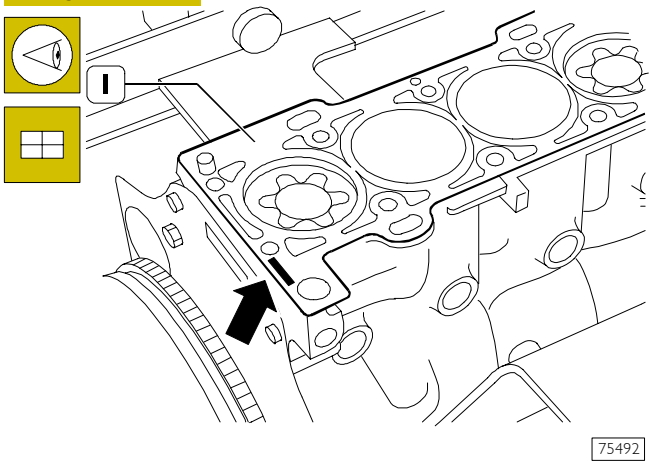
Figure 186



Check that tool 99360619 (2) inserted in the hole (→) of the oil vacuum pump assembly (1) blocks crankshaft rotation.

This condition is necessary for setting up the timing system and to prevent the valves interfering with the pistons.

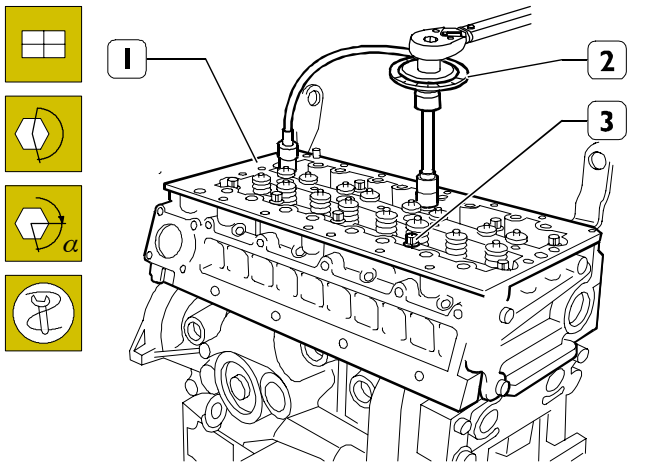
Figure 187



Check that the mating surfaces of the cylinder head and crankcase are clean.
Keep the cylinder head gasket clean.
Position the cylinder head gasket (1) of the thickness determined under the heading "checking piston protrusion" with the lettering "TOP" facing the cylinder head.

NOTE It is essential to keep the gasket sealed in its package until just before assembly.

Figure 188



Mount the cylinder head (1).

Screw down the fixing screws (3) and tighten them, in three successive stages, following the order and methods shown in the following figure.

NOTE The angle closure is done with tool 99395216 (2).

Figure 189

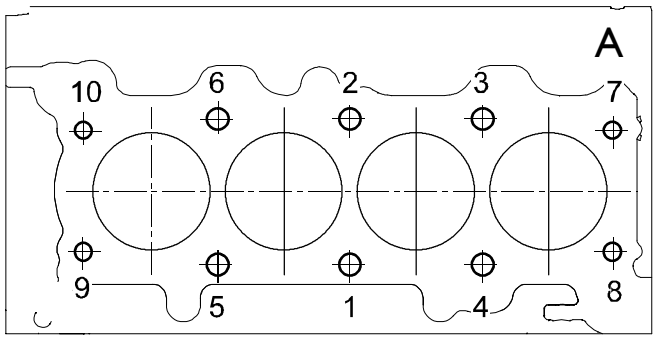
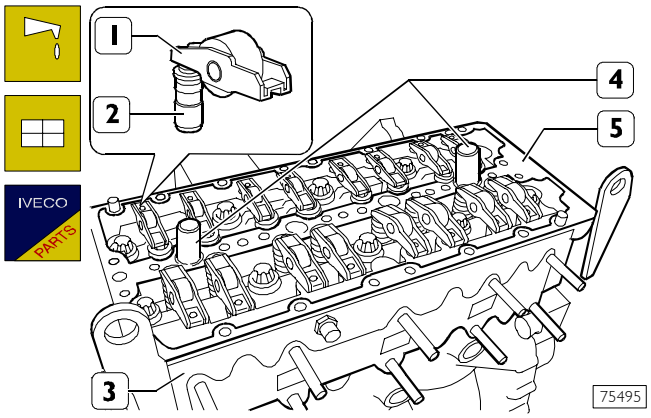


Diagram of the tightening sequence for the cylinder head fixing screws:

- ❑ 1st phase: pre-tightening with torque wrench
  - screws 1-2-3-4-5-6 to a torque of 100 ±5 Nm;
  - screws 7-8-9-10 to a torque of 50 ±2.5 Nm.
- ❑ 2nd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.
- ❑ 3rd phase: angle closing
  - screws 1-2-3-4-5-6 90° ±5°;
  - screws 7-8-9-10 60° ±3°.

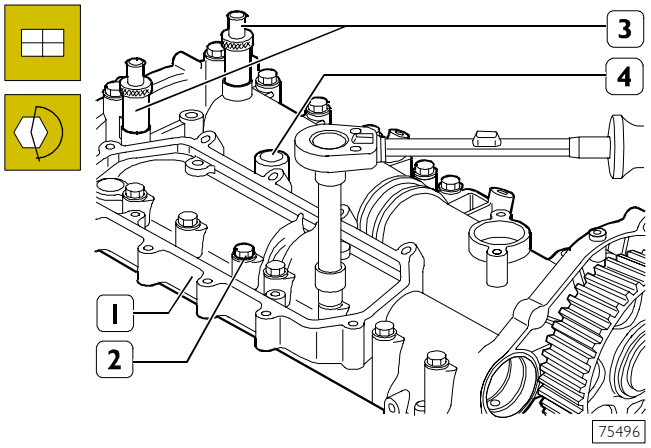
A = flywheel side.

Figure 190



Thoroughly clean the hydraulic tappets (2), lubricate them and fit them in the cylinder head (3), positioning the rocker arms (1) on the valves correctly.
Fit on the gasket (5).
Insert the two tools SP. 2264 (4) into the electro-injector seats for subsequent centring of the overhead on the cylinder head.

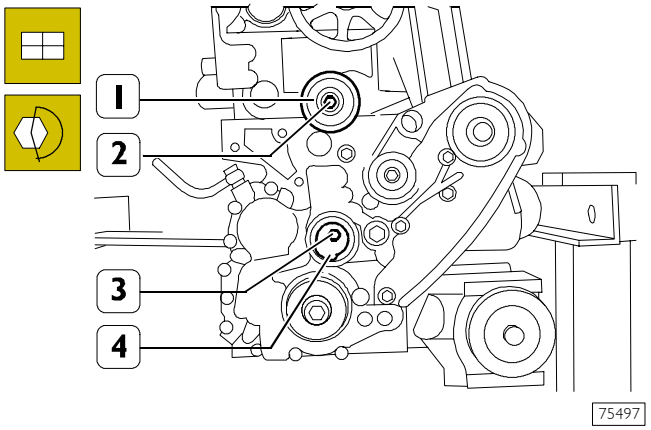
Figure 191



Mount the overhead (1) together with the tools 99360614 (3) for the timing and tighten the fixing screws (2) to the prescribed torque.

Take out the tools SP. 2264 (4).

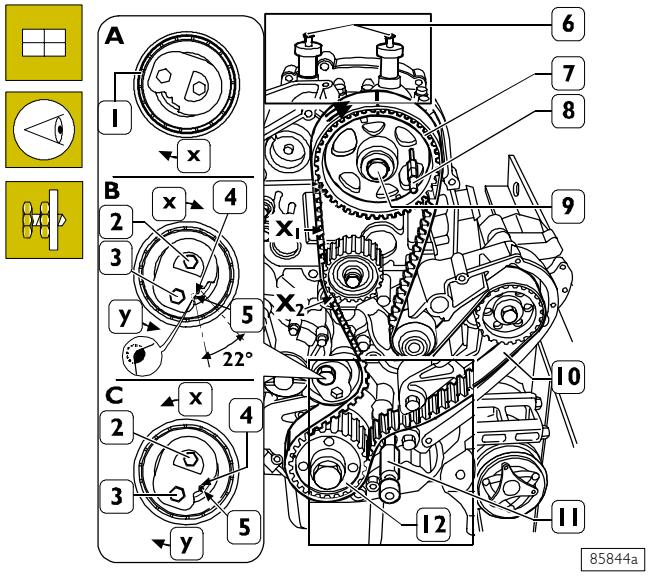
Figure 192



Mount the fixed tightener (1) and tighten the fixing screw (2) to the prescribed torque.

Mount the automatic tightener (4) without fully tightening the fixing screw (3), max. closing torque 5 Nm.

Figure 193



X = Direction of movement of the tightener – Y = Direction of rotation of the key.

Turn the automatic tightener (1) clockwise, positioning it as shown in frame A.
Turn the timing belt (10) as shown in the figure observing the precautions below.
Do not bend the timing belt. Arrows indicating the direction of assembly of the timing belt on the engine are shown on the back of the belt. The arrows must correspond to the direction of rotation of the belt and the notches must coincide with those on the pulley (7) and the gear (12).
If required to fit the timing belt (10) on the pulley (7), remove tool 99360608 (8) and turn the pulley (7) clockwise by no more than half a pulley tooth.

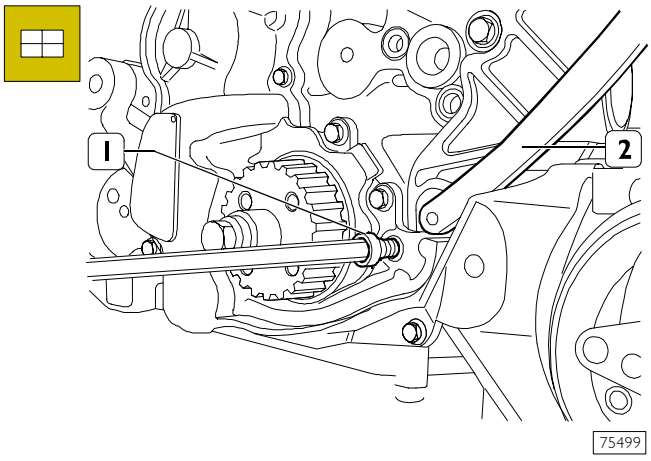
NOTE If the engine has run for a period equivalent to ≥ 25,000 km, the toothed belt must be replaced with a fresh one, no matter what its state of wear.

On completing assembly, adjust the toothed pulley (7) to put the section X of the belt under tension and tighten the screw (9) to a torque of 90 Nm
Keeping the screw (2) stationary and using a suitable wrench on the hexagon of the plate (3) of the tightener, turn it anticlockwise to cover the reference hole (5) located on the fixed portion of the tightener (see frame B).
In the above conditions, tighten the fixing screw (2) to a torque of 36 ± 4 Nm
Remove the tools 99360614 (6) and 99360615 (11) for the timing.
Turn the engine in its direction of rotation by 8 turns to be able to put the tools (6) and (11) back in to do the timing.
In these conditions, the notches of the timing belt (10) must coincide with those of the pulley (7) and the gear (12).

NOTE Do not turn the engine in the opposite direction; if, on turning the engine, you pass the point for inserting the tools (6) and (11), turn the engine clockwise by another two turns.

See frame C: Figure 193, holding the tightener plate (3) stationary with the wrench inserted in its hexagon, loosen the fixing screw (2). Keeping the fixing screw (2) stationary, turn the plate (3) clockwise until its reference mark (4) coincides with the reference hole (5) of the fixed portion of the tightener. In the above conditions, tighten the screw (2) to a torque of 36 ±4 Nm.
After assembly, the belt (10) tension measured using tool 99395849 must be as follows in the following points: X = 212 ± 12 Hz -X_1 = 178 ± 10 Hz.

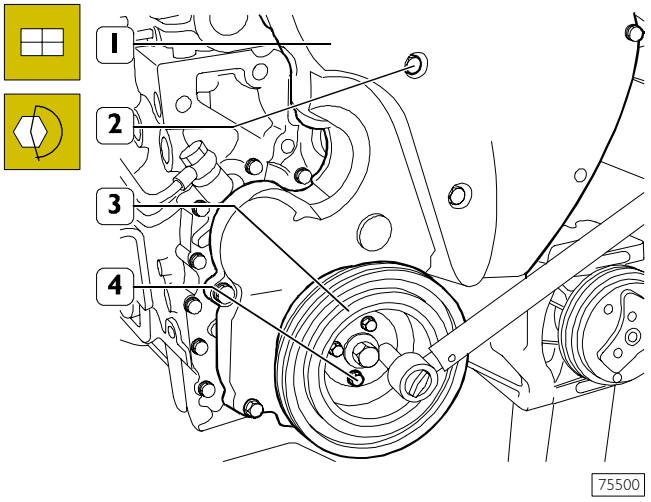
Figure 194



Remove the tools (6 and 11, Figure 193).

Screw the plug (1) into the oil-vacuum pump mounting (2) and the plugs on the holes of the overhead.

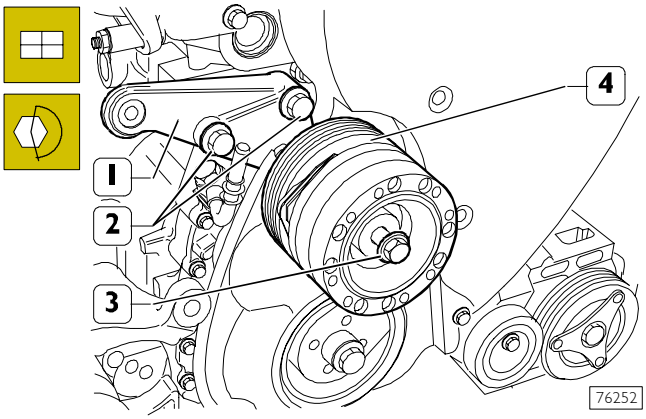
Figure 195



Mount the timing cover (1) and tighten the screws (2) to the prescribed torque.

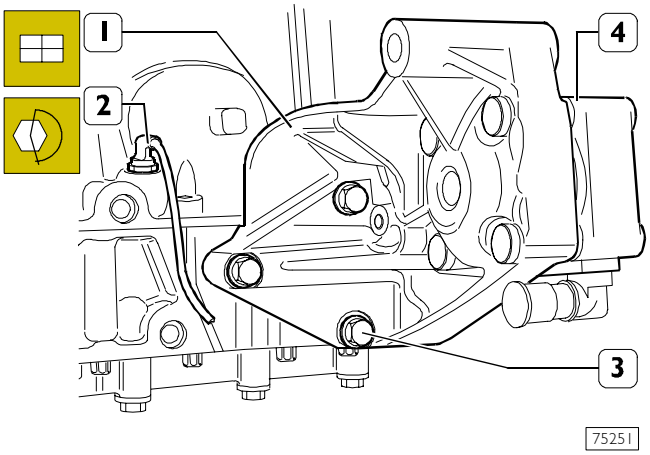
Mount the damper pulley (3) and tighten the screws (4) to the prescribed torque.

Figure 196



Fit on the mounting (1) together with the electromagnetic coupling (4) and tighten the fixing screws (2 and 3) to the prescribed torque.

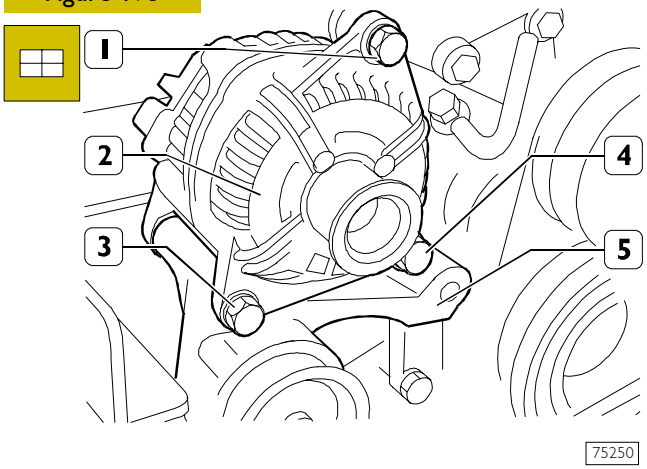
Figure 197



Mount the oil level sensor (1).

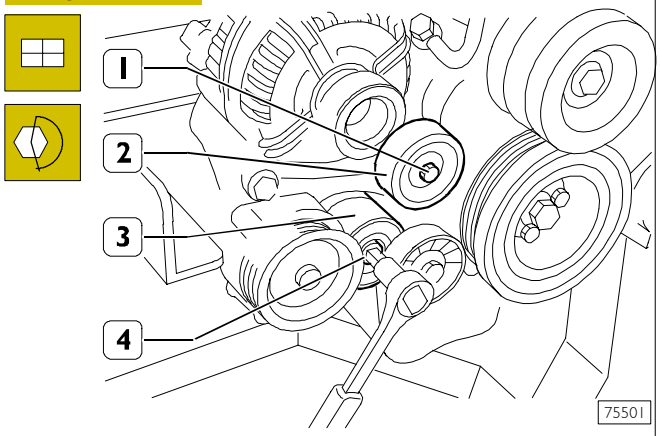
Fit on the power steering (2) pump mounting (4) and tighten the fixing screws (3) to the prescribed torque.

Figure 198



Position the alternator (2) on the mounting (5) and secure it with the bottom screws (3 and 4) and the bolt.

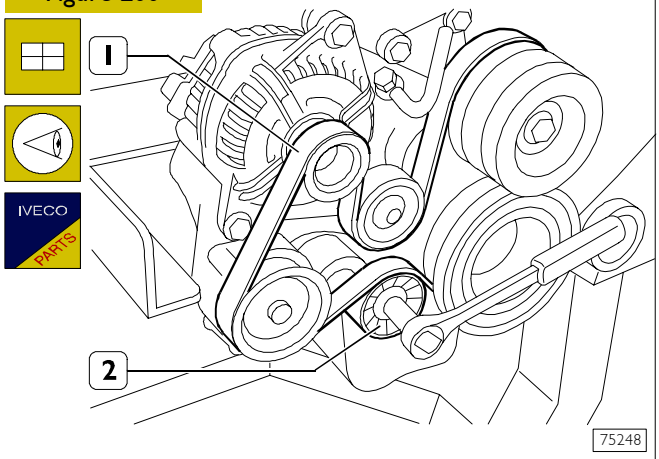
Figure 199



Mount the fixed tightener (2) and tighten the fixing screw (1).

Mount the automatic tightener (3) and tighten the screw (4) to the prescribed torque.

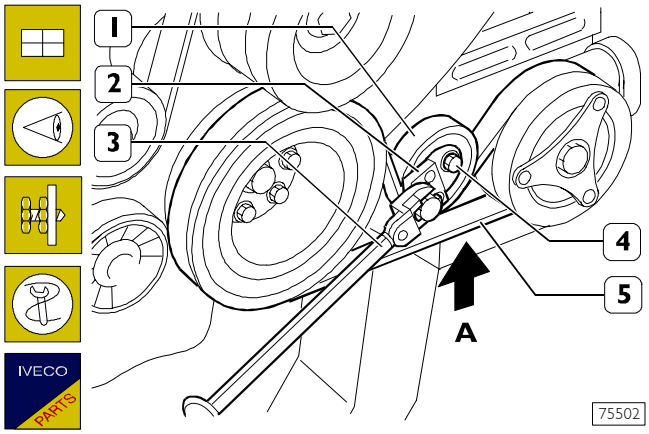
Figure 200



Using a wrench on the automatic tightener (2), mount the drive belt (1), taking care to position its ribs correctly in the respective races of the pulleys.

544035 Adjusting air-conditioner – compressor drive belt tension

Figure 201



Fit the tightener (1) without tightening the screw (4).
Fit the drive belt (5) taking care to position its ribs correctly in the respective races of the pulleys.

With tool SP. 2341 (2) inserted in the holes of the tightener (1) and torque wrench (3), turn the tightener (1) with a torque of 8.2 – 10 Nm; in this condition, tighten the screw (4) to a torque of 25 Nm.

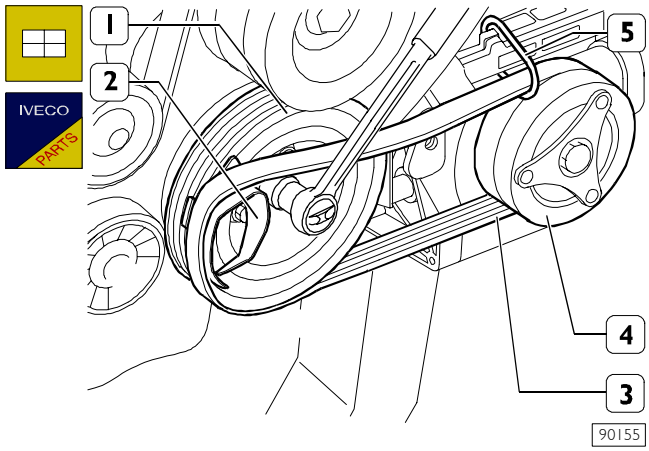
Turn the engine in its direction of rotation to have the belt (5) make two full turns.

With appliance 99395849, measure the tension of the belt (5) in section **A**, which must be 204 ±10 Hz corresponding to a load on the tightener of 1010 ± Nm.

In the case of engines with a compressor drive belt of elastic type, no tensioning is needed. For mounting, operate as follows.

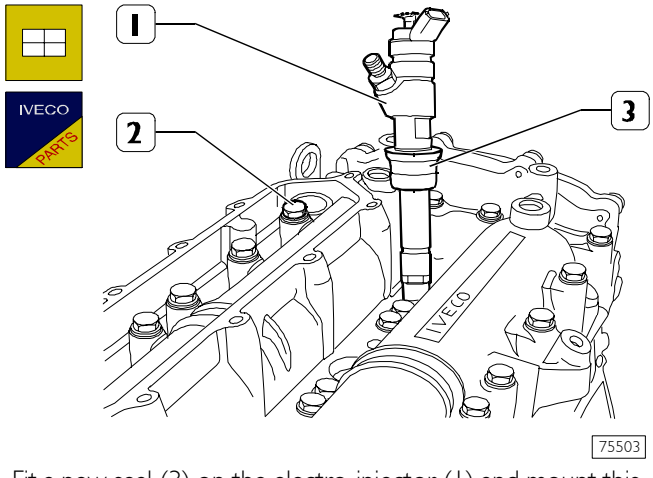
NOTE The elastic belt must be replaced by a new elastic belt at each dismounting operation.

Figure 202



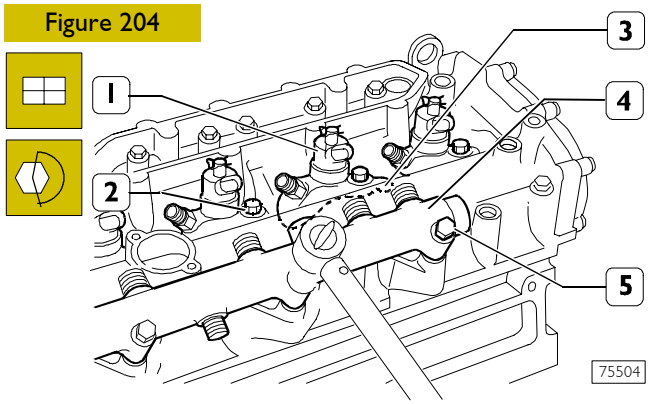
Fit the flexible belt (3) equipped with tool 99360191 (2) on the pulley (4) and apply the tool on the pulley (1).
Fit the drive ring (5) on the flexible belt (3) and fasten the ring on the compressor support.
Turn the drive shaft clockwise until the belt fits perfectly on the pulley (1).

Figure 203



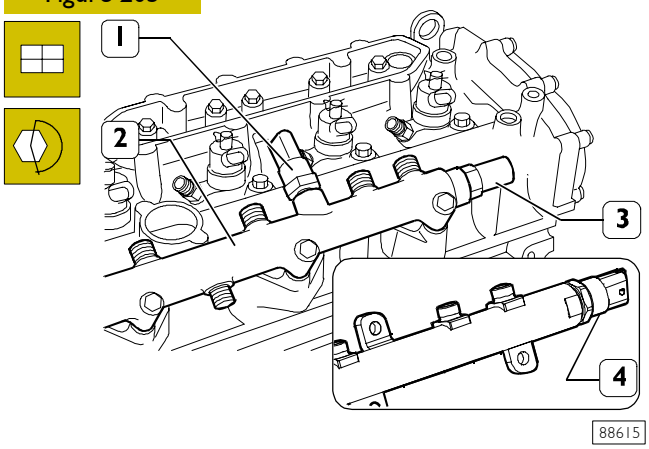
Fit a new seal (3) on the electro-injector (1) and mount this in the overhead (2).

Figure 204



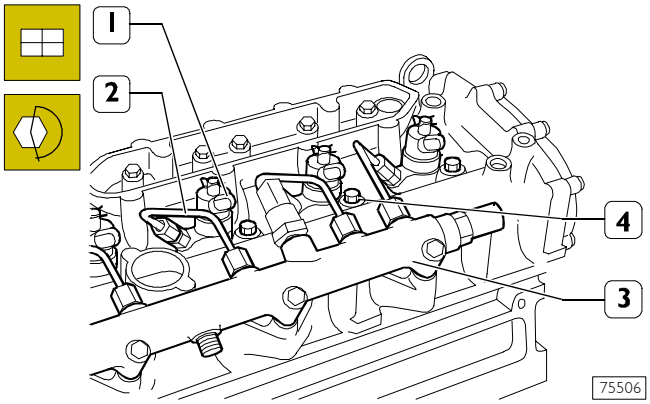
Mount the brackets (3) fastening the electro-injectors (1) and screw down the screws (2) without locking them.
Mount the hydraulic accumulator (4) and tighten the fixing screws to the prescribed torque.

Figure 205



Forged version: on hydraulic accumulator (2), mount: pressure sensor (1) tightening it at 35 ± 5 Nm torque, and pressure relief valve (3) tightening it at 27 ± 2 Nm torque.
Welded version: mount pressure sensor and tighten it at 70 ± 5 Nm torque.

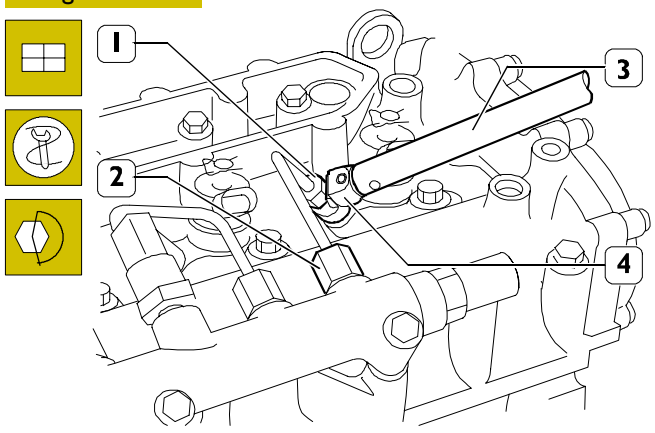
Figure 206



Connect the fuel pipes (2) to the electro-injectors (1) and to the hydraulic accumulator (3).
Tighten the screws (4) fixing the electro-injector brackets to the prescribed torque.

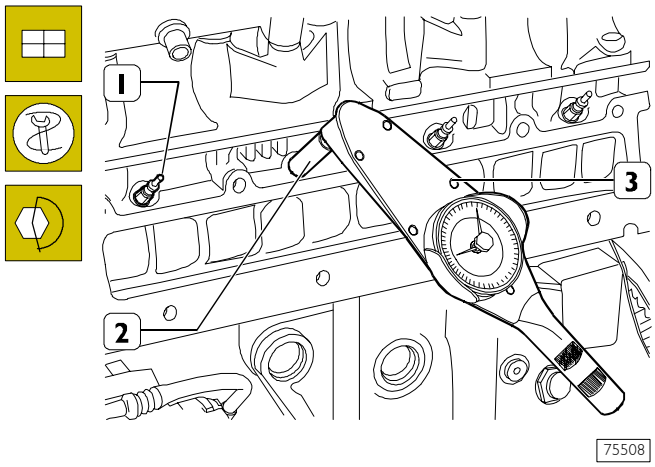
NOTE Whenever they get removed, the fuel pipes must be replaced with new ones.

Figure 207



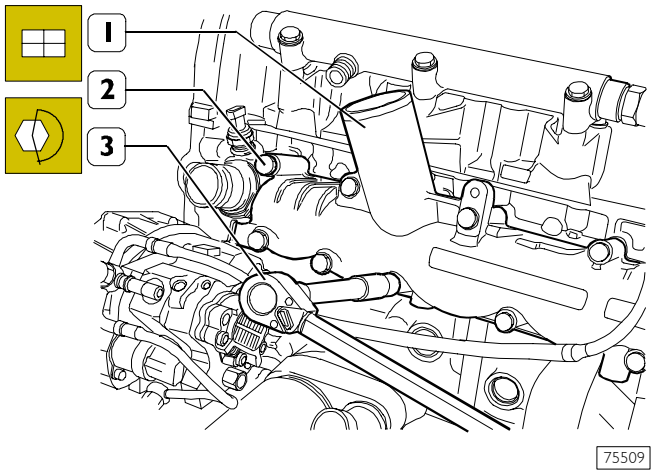
Using the wrench (4) of the 99317915 series and the torque wrench 99389829 (3), tighten the fuel pipe fittings (1) and (2) to the prescribed torque.

Figure 208



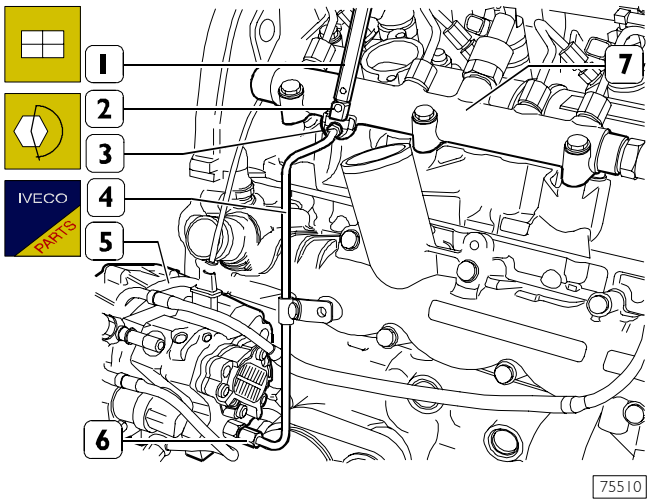
Mount the glow plugs (1) and, using the box-type wrench SP. 2275 (2) and torque wrench 99389819 (3), tighten them to a torque of 8 ÷ 10 Nm.

Figure 209



Mount the intake manifold (1) with a new gasket and, using a torque wrench (3), tighten the fixing screws (2) to the prescribed torque.

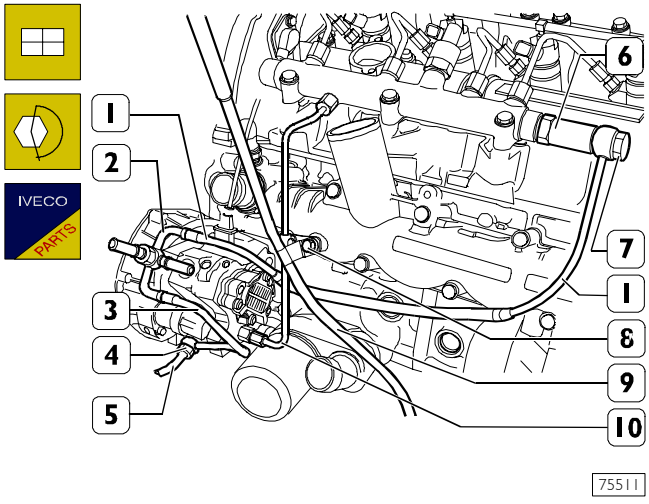
Figure 210



Connect the fuel pipe (4) to the hydraulic accumulator (7) and to the high-pressure pump (5).
With wrench (2) of series 99317915 and dynamometric wrench 99389829 (1), tighten pipe fittings (3 and 6) at prescribed torque.

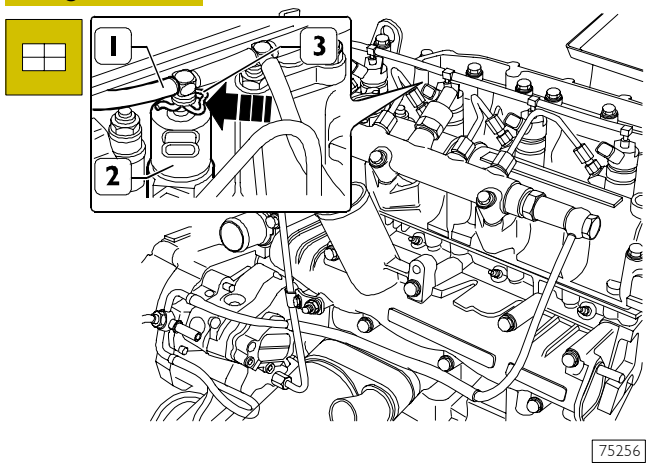
NOTE Whenever they get removed, the fuel pipes (4) must be replaced with new ones.

Figure 211



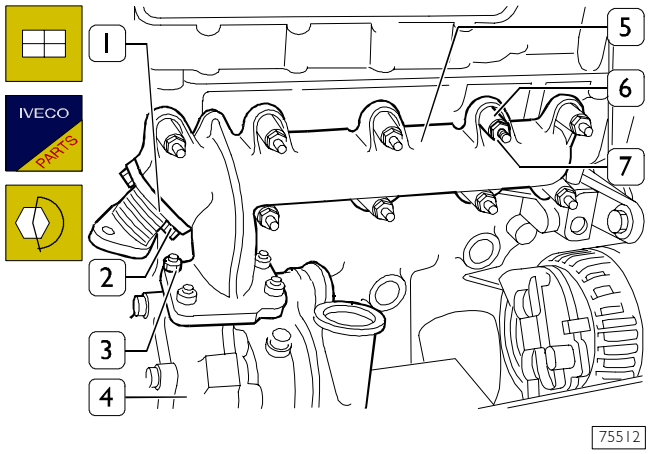
Connect the fuel recovery pipe (1) with new seals to the pressure relief valve (6) tightening the coupling (7) to the prescribed torque (only for forged version hydraulic accumulator).
Connect the fuel recovery pipes (1) and (5) with new seals to the high-pressure pump (2) with the couplings (3) and (4).
Insert the oil dipstick tube (9) with a new seal into the crankcase and secure it together with the pipe (10), using the screw (8) tightened to the prescribed torque, to the intake manifold.

Figure 212



Press the clips (3) in the direction shown by the arrow and connect the fuel recovery pipe fittings (1) to the electro-injectors (2).

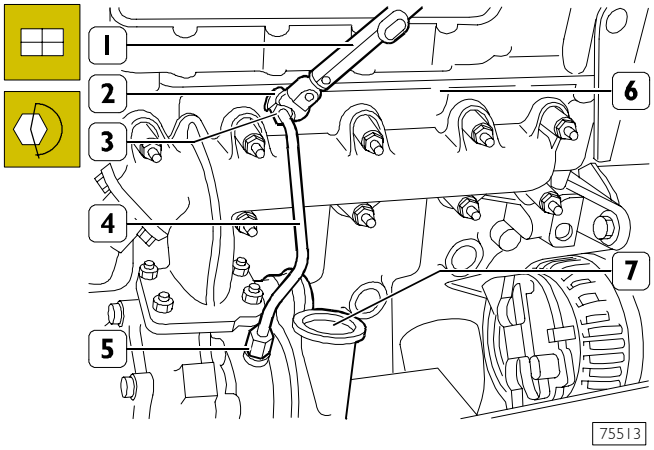
Figure 213



Fit the exhaust manifold (5) with a new gasket and the spacers (6) and tighten the nuts (7) to the prescribed torque.
On the exhaust manifold (6), mount: the turbocharger (4) with a new gasket and tighten the nuts (3) with washers to the prescribed torque, the compensator pipe (1) (if applicable) with a new seal and tighten the nuts (2) with washers to the prescribed torque.

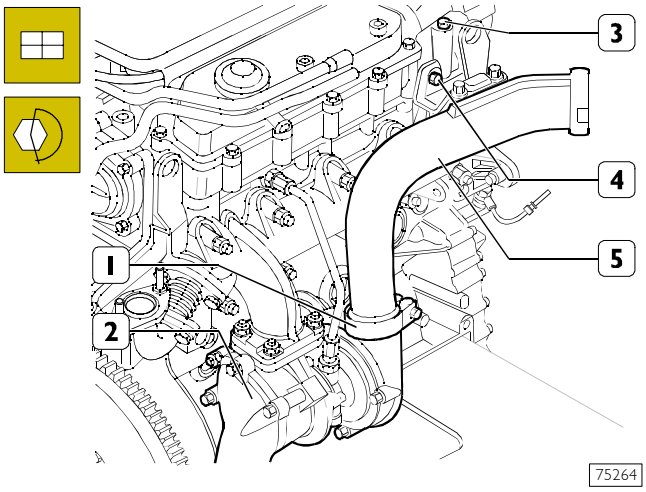
NOTE Before fitting the turbocharger on the engine, it is necessary to fill the central body with engine lubricating oil.

Figure 214



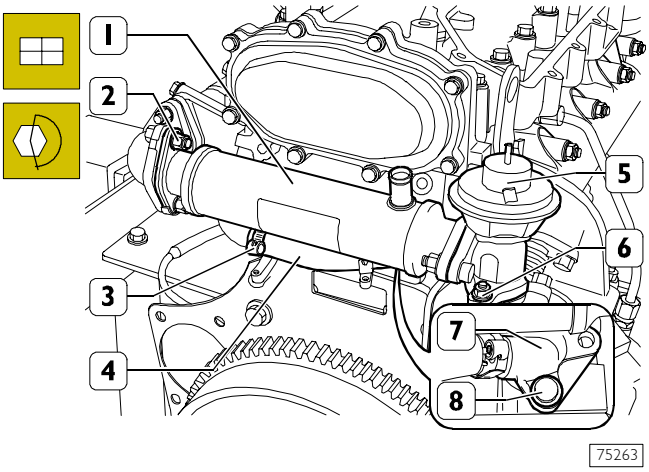
Connect the pipe (4) to the cylinder head (6) and to the turbocharger (7).
Using the wrench (2) in the 99317915 series and the torque wrench 99389829 (1), tighten the couplings (3 and 5) to the prescribed torque.

Figure 215



Connect the air duct (5) to the turbocharger (2) and to the overhead (3).
Tighten the clamp (1) and the screw (4) to the prescribed torque.

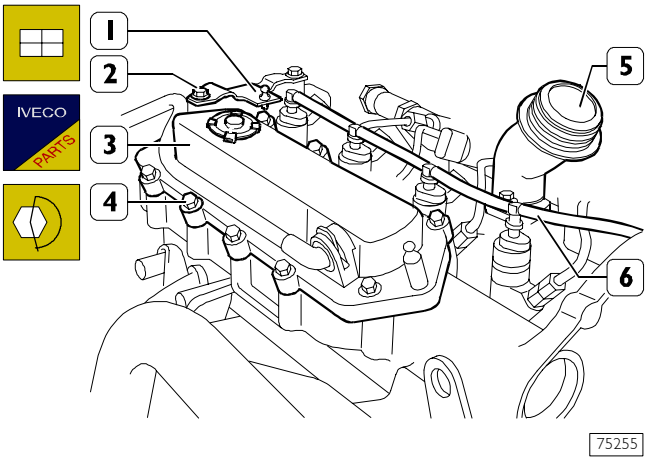
Figure 216



For engines with E.G.R. only

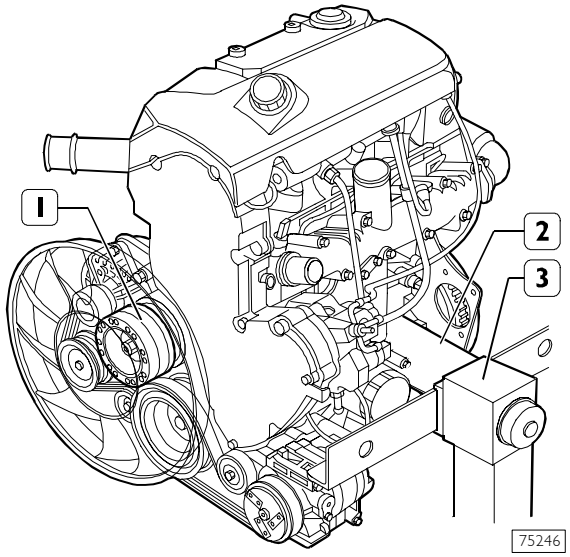
Mount the flange (7) with a new gasket and tighten the screws (8) to the prescribed torque.
Mount the heat exchanger (1) together with the E.G.R. valve (5) and new gaskets and tighten the screws (2 and 6) to the prescribed torque.
Connect the pipe (4) to the exchanger (1) and to the flange (7) securing it with the clamps (3).

Figure 217



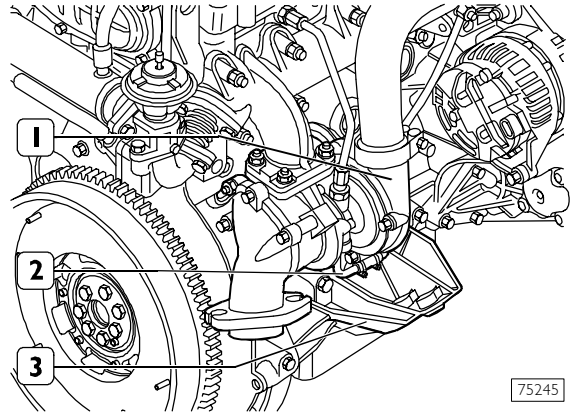
Mount the oil fillpipe (5) with a new seal and tighten the nuts (6) to the prescribed torque.
Mount the coalescence filter (3) and tighten its fixing nuts (4) to the prescribed torque.
Mount the bracket (1) and tighten the screws (2) to the prescribed torque.

Figure 218



Fit the cooling fan (1) back onto the electromagnetic coupling. Fit the arm 99360549 onto the engine lifting hooks. Hook the arm onto the hoist and remove the engine from the rotary stand (3). Take out the brackets 99361028 (2).

Figure 219

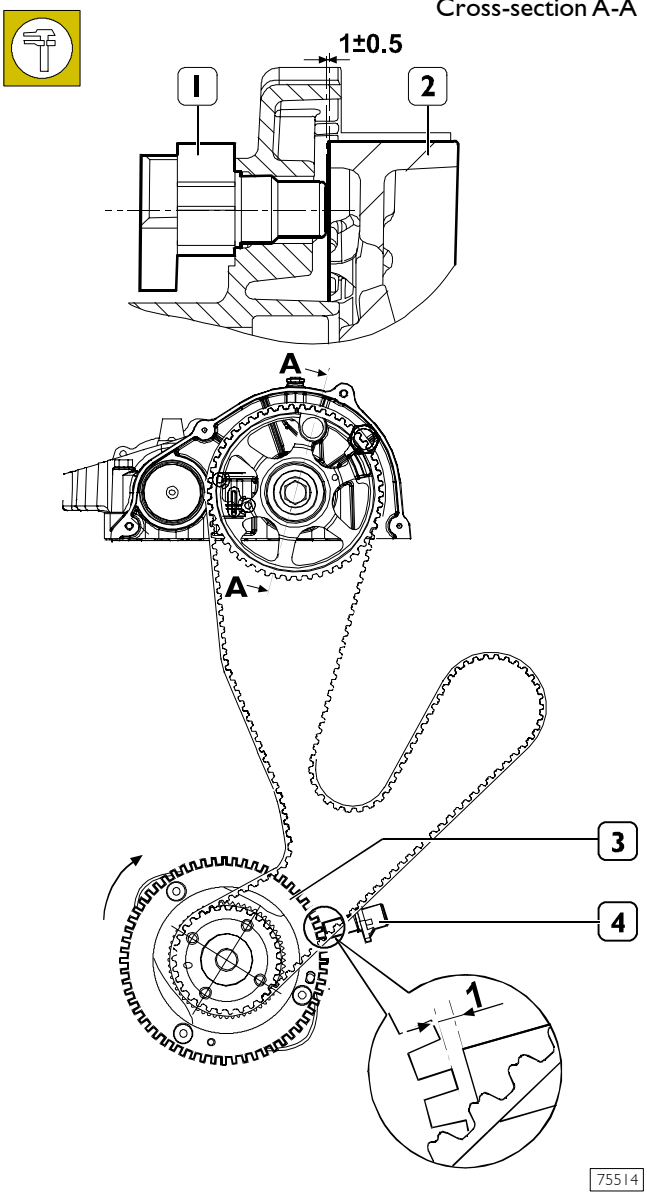


Complete engine assembly.
Fit on the left and right engine mountings (3) and tighten the fixing screws to the prescribed torque.
Connect the oil pipe (2) to the turbocharger (1) and to the crankcase and tighten the fixing screws and the coupling of the oil pipe (2) to the prescribed torque.
If applicable, mount the following parts:

- ❑ Engine cable, connecting its electrical connections to the thermostat temperature sensor, timing sensor, engine speed sensor, pressure regulator, rail pressure sensor and intake manifold air pressure/temperature sensor.
- ❑ Hydraulic accumulator guard.
- ❑ Top soundproofing cover.
- ❑ Add the prescribed grade and quantity of lubricating oil to the engine.

764264 Timing speed sensor
764266 Engine speed sensor

Figure 220



The sensor gap is:

- ❑ 1 ±0.5 mm, between the camshaft pulley (2) and timing sensor (1).
- ❑ 1 mm, between the phonic wheel (4) and speed sensor (3).

5450 LUBRICATION

General

The engine is lubricated by forced circulation performed by the following parts:

- An oil gear pump is incorporated in an assembly that also includes the vacuum pump (GPOD).
- A pressure control valve incorporated in the crankcase.
- A Modine-type heat exchanger with built-in safety valve.
- A double filtration oil filter with built-in safety valve.

Operation (see Figure 221)

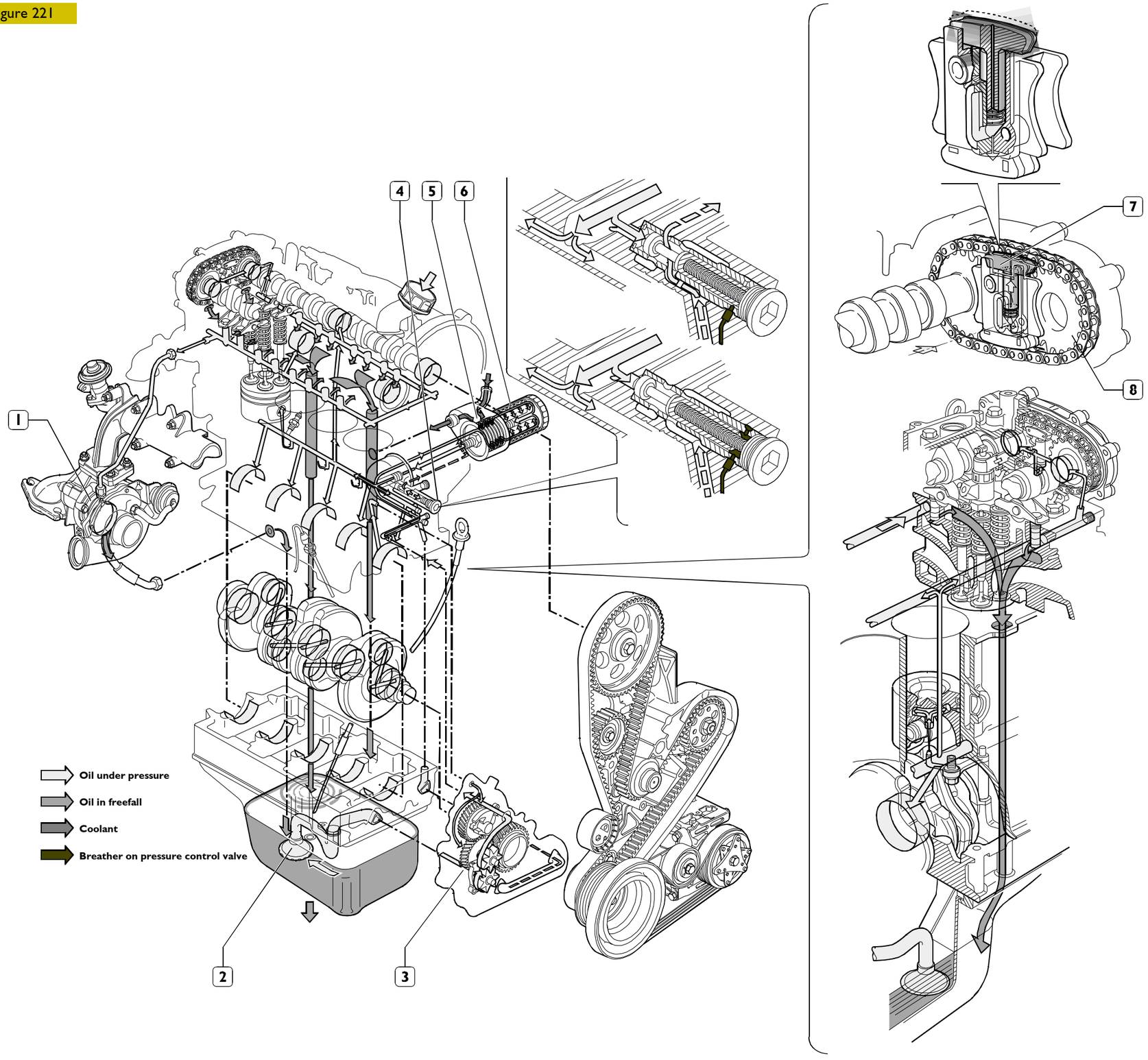
Engine oil is drawn up from the sump by the oil pump (3) via the suction strainer (2) and delivered under pressure to the heat exchanger (5) where it is cooled.

The oil continues through the oil filter (6) and goes to lubricate the relevant parts through ducts or pipes.

At the end of the lubrication cycle, the oil returns to the sump by gravity. The oil filter can be excluded by the safety valve built into it if it gets clogged. The heat exchanger is also excluded by a safety valve if it gets clogged.

In addition, the lubrication oil supplies the hydraulic automatic tightener (7) of the camshaft drive (8).

Figure 221



OIL VACUUM PUMP ASSEMBLY (GPOD)

Figure 222

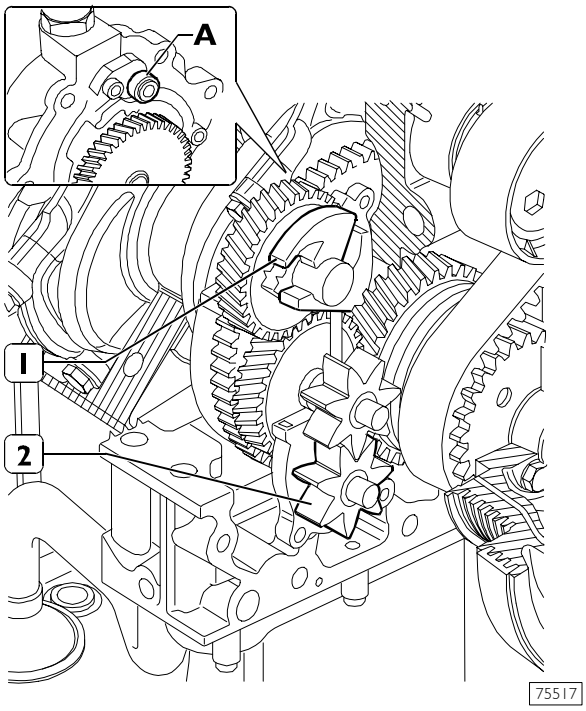


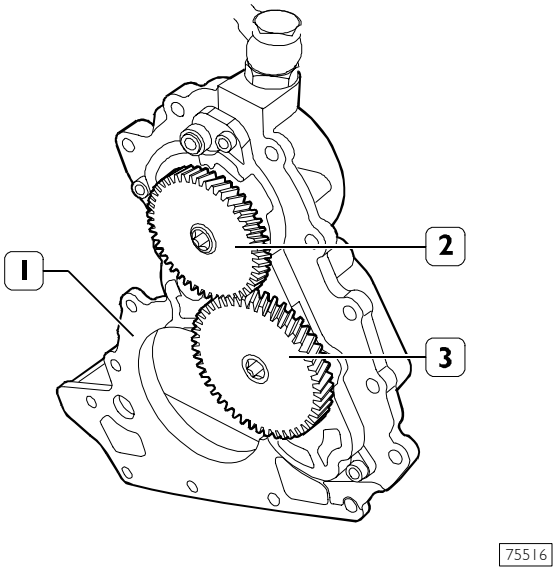
DIAGRAM OF GPOD ASSEMBLY ON ENGINE

1. Vacuum pump – 2. Oil pump – 3. Crankshaft – A. Vacuum pump oil supply hole.

Clearance between the crankshaft gear teeth and the oil pump drive gear 0.003 ÷ 0.2 mm.
The assembly must not be overhauled; in the event of defective operation, it must be replaced.

503010 Oil pump

Figure 223



The oil pump (3) is a gear pump driven directly by the crankshaft.

Characteristic data

transmission ratio	1.15	
displacement	16.2	cm^3
pumping diameter	49.5	mm
number of teeth	7	
height	11	
oil pump minimum speed	862	rpm
oil pump max. speed	4485	rpm
oil pump over-revs	5247	rpm
oil pump forced over-revs	6279	rpm
speed	2500	rpm
torque	2.1	Nm
power draw (calc.)	550	W

Oil temperature: 100°C – closed recirculation – max. outlet pressure 5 bars	
engine speed rpm (oil pump speed – rpm)	capacity (l/min)
750 (862)	12
3900 (4485)	68

Vacuum pump

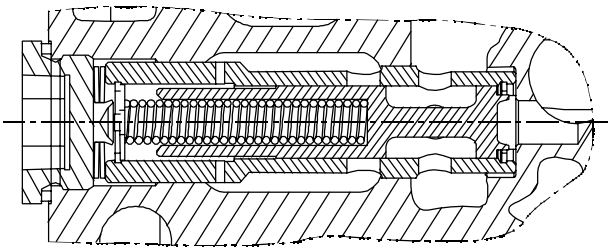
The vacuum pump (2, Figure 223), with radial blades, is also incorporated in the GPOD (1, Figure 223). It is driven directly by the oil pump.

transmission ratio	3.25	
displacement	86	cm^3
volume to drain	4.5	litres
volume to drain with EGR	9	litres
chamber diameter	65	mm
rotor diameter	50	mm
cam	7.5	mm
number of blades	3	
height	34	mm
vacuum pump minimum speed	994	rpm
vacuum pump max. speed	5168	rpm
vacuum pump over-revs	6046	rpm
vacuum pump forced over-revs	7235	rpm
theoretical flow rate at minimum (air)	85.5	l/min
actual flow rate at minimum (air) – at atmospheric pressure	46	l/min
Theoretical speed at max. speed – (air)	444.4	l/min
Actual flow rate at max. speed – (air) at atmospheric pressure	60	l/min
measured power draw (maximum)		
speed	2500	rpm
torque	2.1	Nm
power draw (calc.)	550	W

Oil temperature: 100°C – engine speed 750 rpm (pump speed 994 rpm)			
tank (litres)	vacuum (bar)	0.5	0.8
4.5	time (sec)	4.5	12.5
5.6		6.0	16.0
9		9.0	24.0

543475 Oil pressure control valve

Figure 224

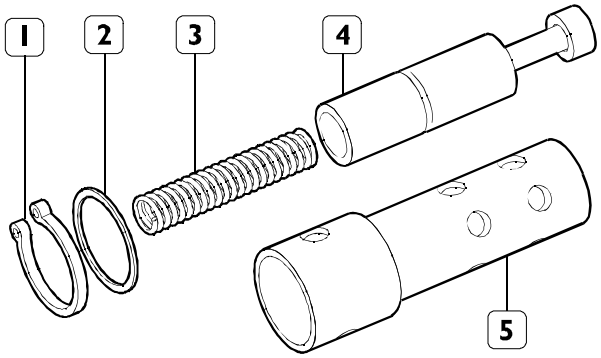


75520

CROSS-SECTION OF OIL PRESSURE CONTROL VALVE MOUNTED IN CRANKCASE

Valve removed from crankcase L = 51.75 mm.
Valve fitted in crankcase L = 50.75 mm.
Start of opening 4 bar L = 49.5
maximum opening 4.6 bar L = 44.

Figure 225

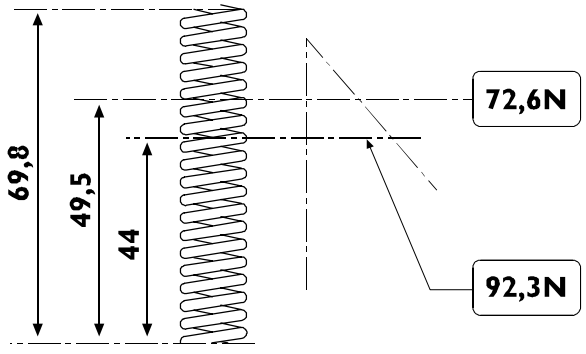


75521

PARTS COMPRISING THE OIL PRESSURE CONTROL VALVE

1. Split ring – 2. Washer – 3. Spring – 4. Valve – 5. Valve casing.

Figure 226

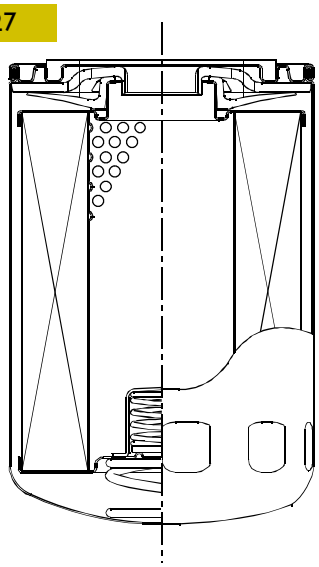


75522

MAIN DATA OF THE OIL PRESSURE CONTROL VALVE SPRING

543070 Oil filter

Figure 227

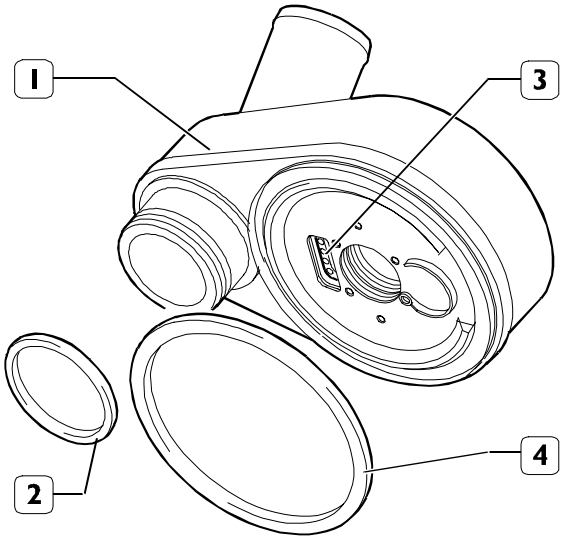


75523

Oil filter with single filtration with built-in by-pass valve – opening pressure 2.5 ± 0.3 bar.

543110 Modine heat exchanger

Figure 228



75524

Thoroughly clean the heat exchanger (1).
Always change the seals (2 and 4).
Built-in safety valve (3).
Opening pressure 0.82 - 1.03 bar

540480 Oil vapour recirculation system

Description

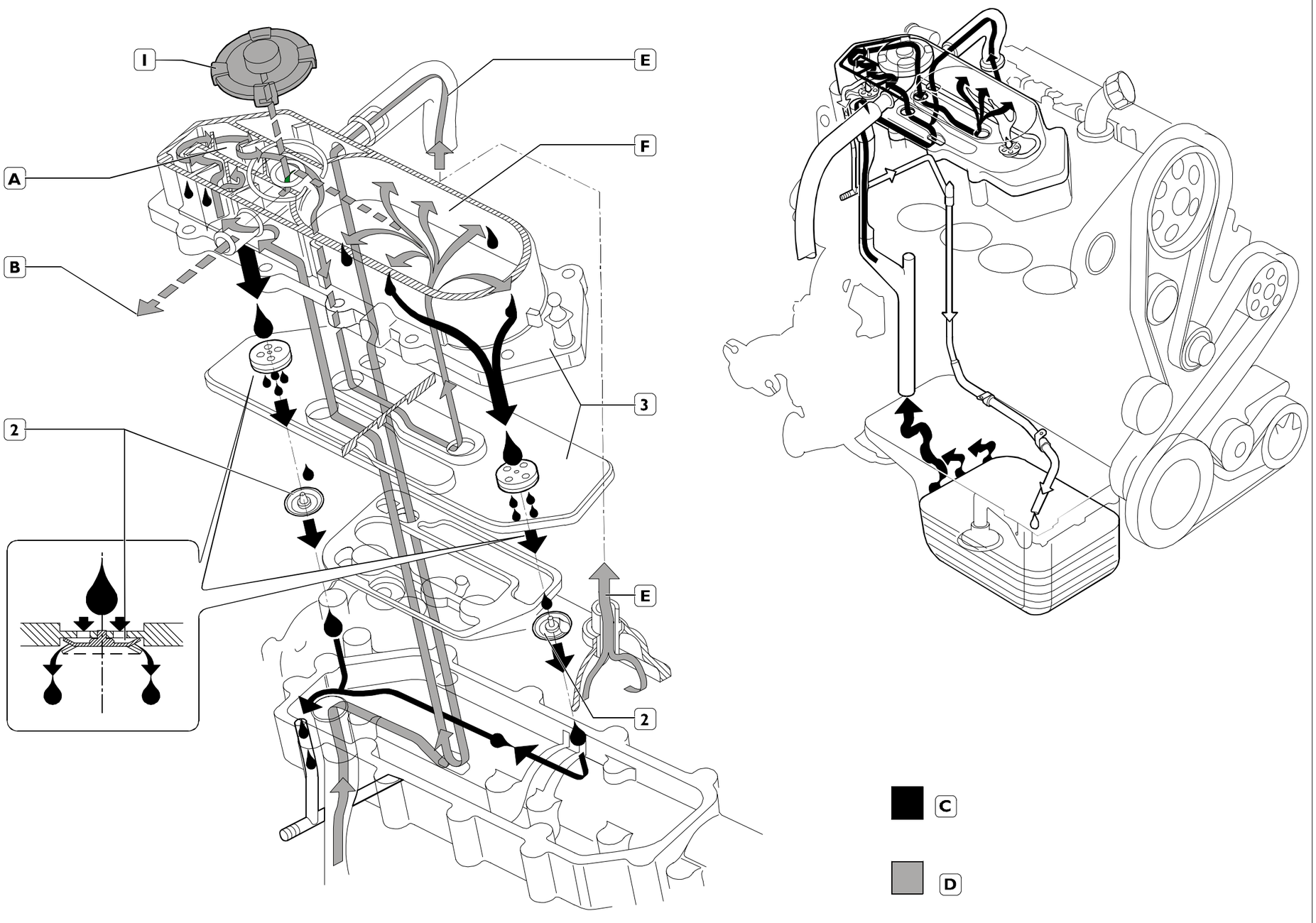
The oil vapours formed in the sump while the engine is running, passing through the overhead cover, are channelled into the separator / condenser filter known as the blow-by. The filter is structured in two sections:

- The first one with a labyrinth, where most of the vapours are condensed and return to the sump through an umbrella outlet valve.
- The second one includes a coalescence filter that condenses the remaining vapours that return to the sump through another umbrella valve.

The portion of vapour that has not condensed is sent, via a MANN-HUMMEL valve, to the intake duct and burnt during normal engine operation.

NOTE The blow-by filter cannot be taken apart and must therefore be replaced entirely.

Figure 229



OIL VAPOUR RECIRCULATION DIAGRAM

1. MANN-HUMMEL valve – 2. Umbrella valves – 3. Blow-by filter – A. Labyrinth – B. Intake oil vapour recovery flow – C. Oil return flow into sump – D. Flow of oil vapours from the sump – E. Flow of oil vapours from the overhead – F. Coalescence filter.

5432 COOLING

Description

The engine cooling system is the type with forced circulation in a closed circuit. It comprises the following parts:

- An expansion tank whose plug has two valves incorporated in it: an outlet and an inlet, which govern the pressure of the system.
- A coolant level sensor at the base of the expansion tank.
- An engine cooling module to dissipate the heat taken from the engine by the coolant with a heat exchanger for the intercooler.
- A heat exchanger to cool the lubricating oil.
- A heat exchanger to cool the exhaust gases (engines with EGR).
- A centrifugal water pump incorporated in the crankcase.
- An electric fan comprising an electromagnetic coupling on whose shaft a hub turns idle that is fitted with an axially mobile metal plate on which is mounted the impeller.
- A 3-way thermostat governing the circulation of the coolant.

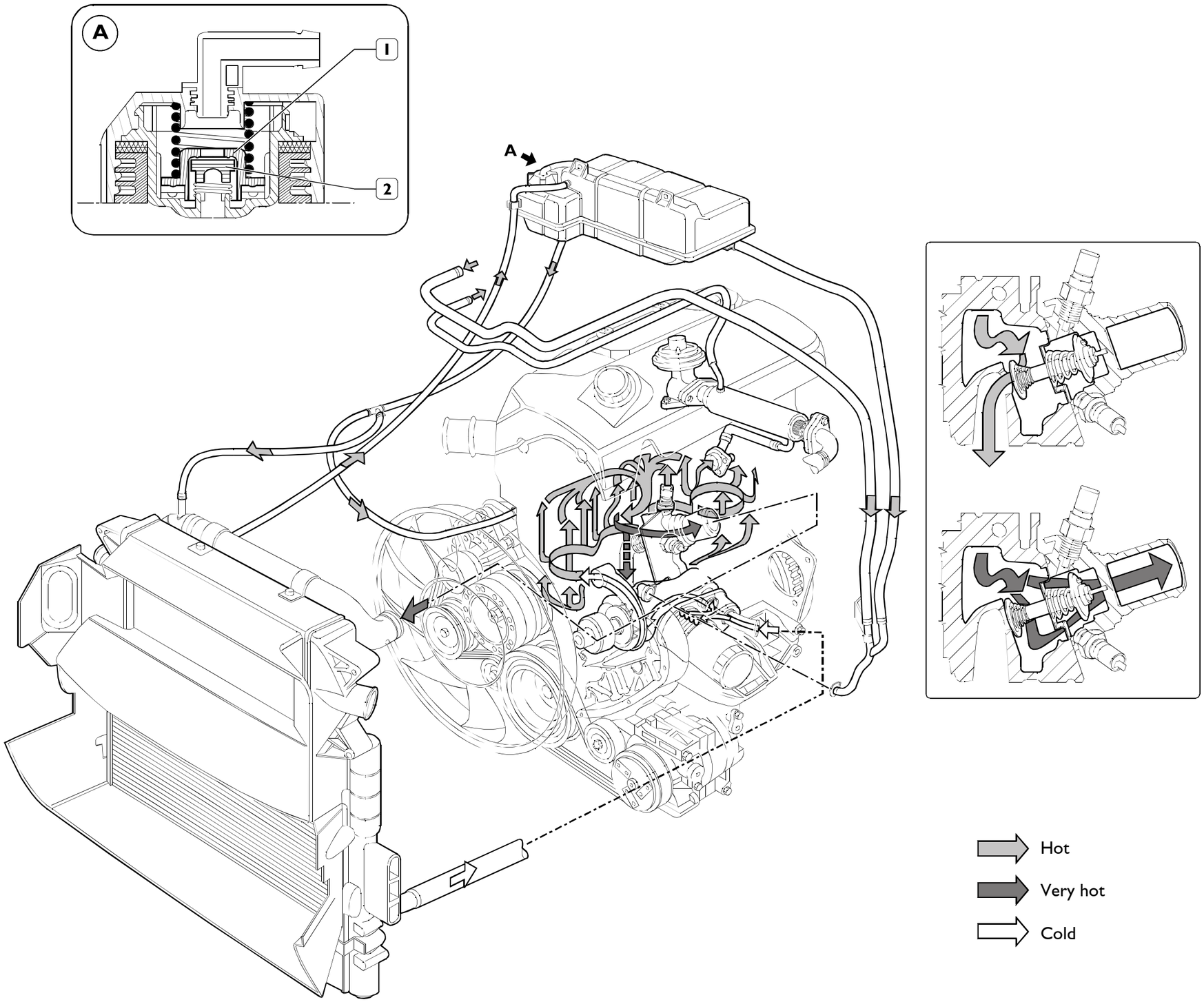
Operation

The water pump driven by a poly-V belt by the crankshaft sends coolant into the crankcase and with a greater head into the cylinder head.
When the coolant temperature reaches and exceeds the working temperature, it causes the thermostat to open and the fluid is channelled from here to the radiator and cooled by the fan.
The pressure in the system due to the change in temperature is governed by the outlet (2) and inlet (1) valves incorporated in the expansion tank filler plug (detail A).
The outlet valve (2) has a twofold function:

- to keep the system slightly pressurized so as to raise the boiling point of the coolant;
- to discharge into the atmosphere the excess pressure produced in case of high coolant temperatures.

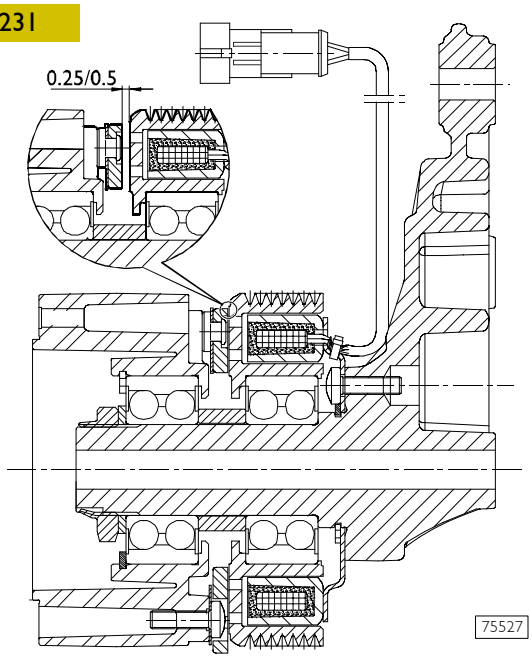
The function of the inlet valve (1) is to permit transferring the coolant from the expansion tank to the radiator when a lower pressure is created in the system due to the reduction in volume of the coolant as a result of its temperature lowering.
Outlet valve opening 1 ± 0.1 kg/cm^2.
Inlet valve opening 0.005 – 0.02 kg/cm^2.

Figure 230



543212 Electromagnetic pulley

Figure 231



CROSS-SECTION OF THE ELECTROMAGNETIC JOINT

Characteristics

Transmissible torque at 20°C with clutch run in	45 Nm
Voltage	12 Volts
Power input	26 W

The electric fan control relay is activated or deactivated according to the temperatures of: the engine coolant, the fuel supercharging air and the pressure of the air conditioner fluid (if present).

Coolant temperature
(if the sensor is not defective)
It activates at > 96°C and deactivates at < 84°C.

Turbocharging air temperature
It activates at > 75°C and deactivates at < 65°C.

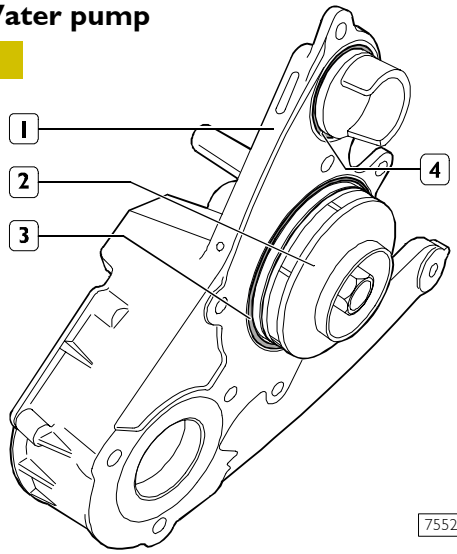
Fuel temperatures
(if the coolant temperature sensor is acknowledged to be defective by the EDC control unit)
It activates at > 20°C and deactivates at < 10°C.

With climate control system
With pressure in the system

it turns on	18.5 ± 0.98 bar
it turns off	14.58 ± 0.98 bar

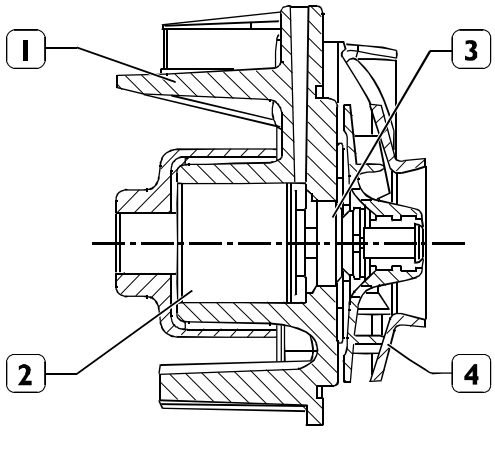
543210 Water pump

Figure 232



The water pump (3) cannot be overhauled. In case of coolant leaking from the seal or damage, it must be replaced. The water pump casing (1) is also used as a mounting for the high-pressure pump. The seals (3 and 4) must always be replaced.

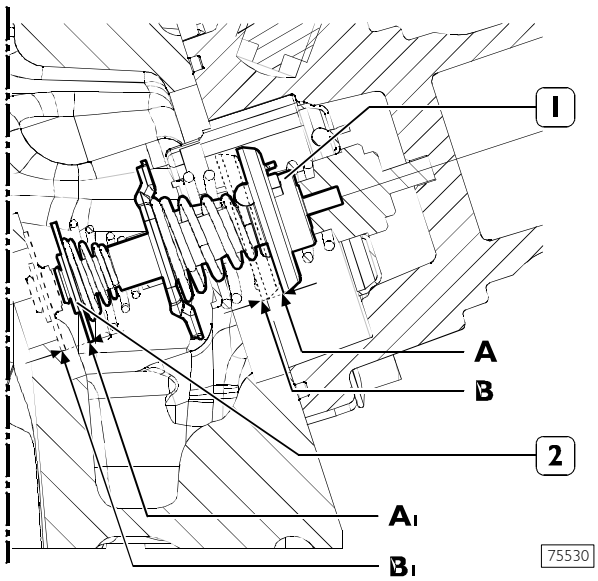
Figure 233



LONGITUDINAL CROSS-SECTION OF THE WATER PUMP
1. Pump casing – 2. Pump drive shaft together with bearing – 3. Seal – 4. Impeller.

543250 Thermostat

Figure 234

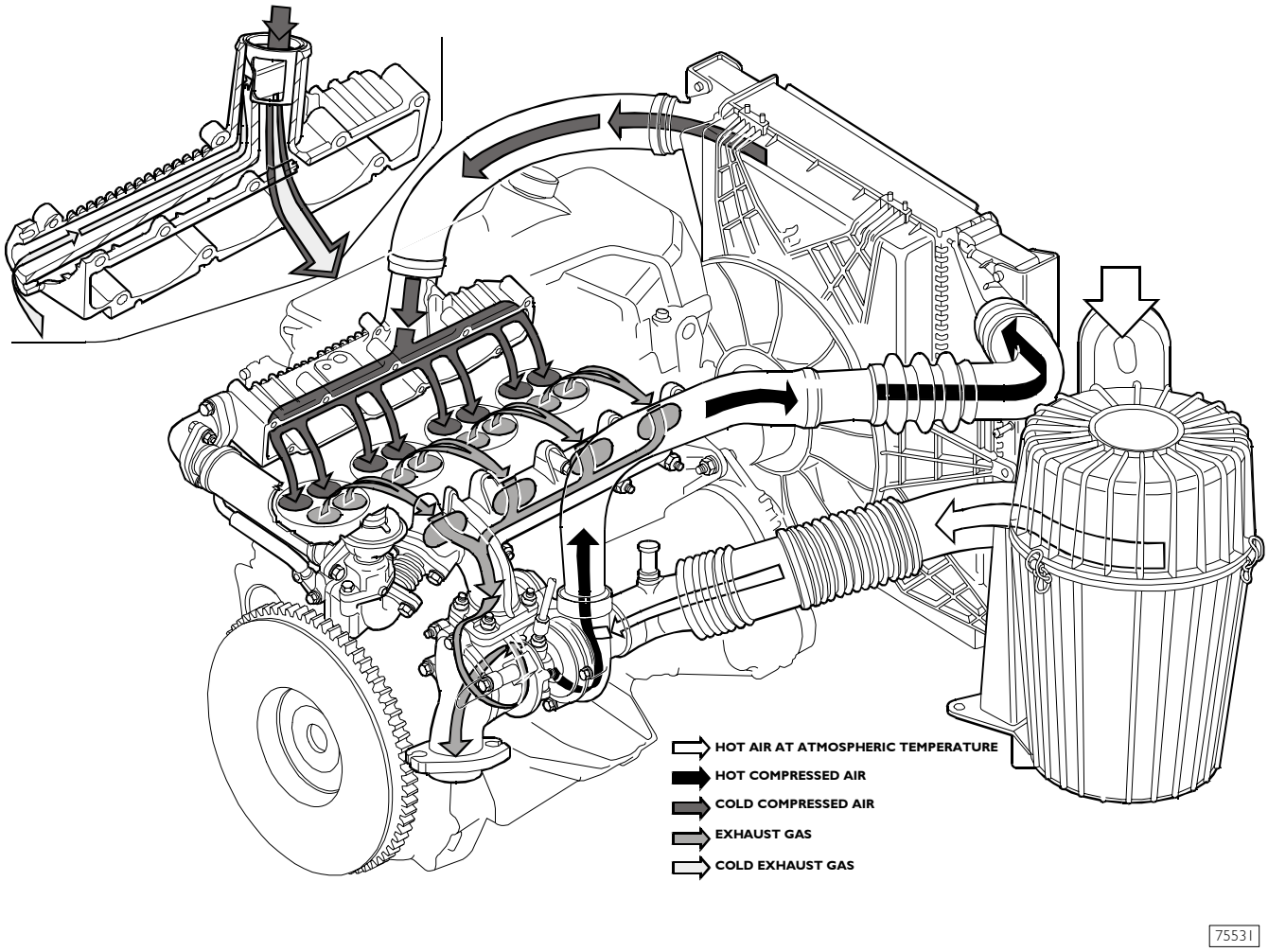


The by-pass thermostat (1) needs no adjustment.
If there is any doubt about its operation, replace it.
The thermostat casing is fitted with the thermometric switch/transmitter and water temperature sensor.

A. – A1 Start of stroke at 78°C ±2°C.
B. Valve (1) stroke at 94°C = 7 mm.
B1 Valve (2) stroke 94°C, 6.4 mm
The stroke of 7 mm less than 60".

TURBOCHARGING

Figure 235



TURBOCHARGING DIAGRAM

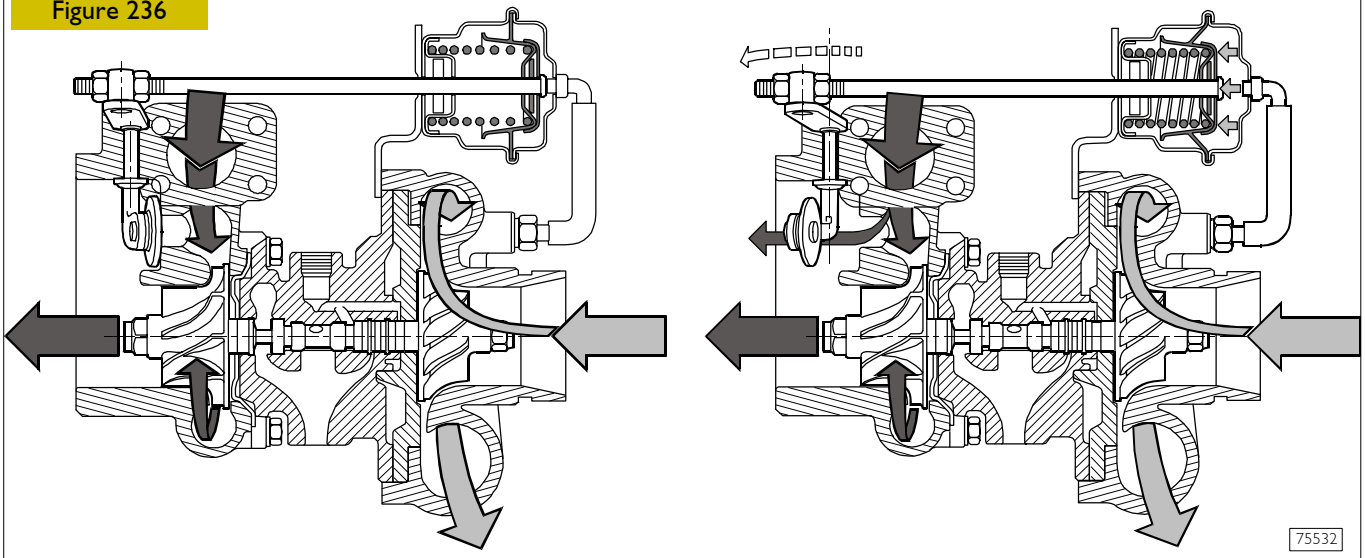
Description

The turbocharging system comprises an air filter, turbocharger and intercooler.
The air filter is the dry type comprising a filtering cartridge to be periodically replaced.

The function of the turbocharger is to use the energy of the engine's exhaust gas to send pressurized air to the cylinders.
The intercooler comprises a radiator included in the engine coolant radiator and its function is to lower the temperature of the air leaving the turbocharger to send it to the cylinders.

542410 Turbocharger

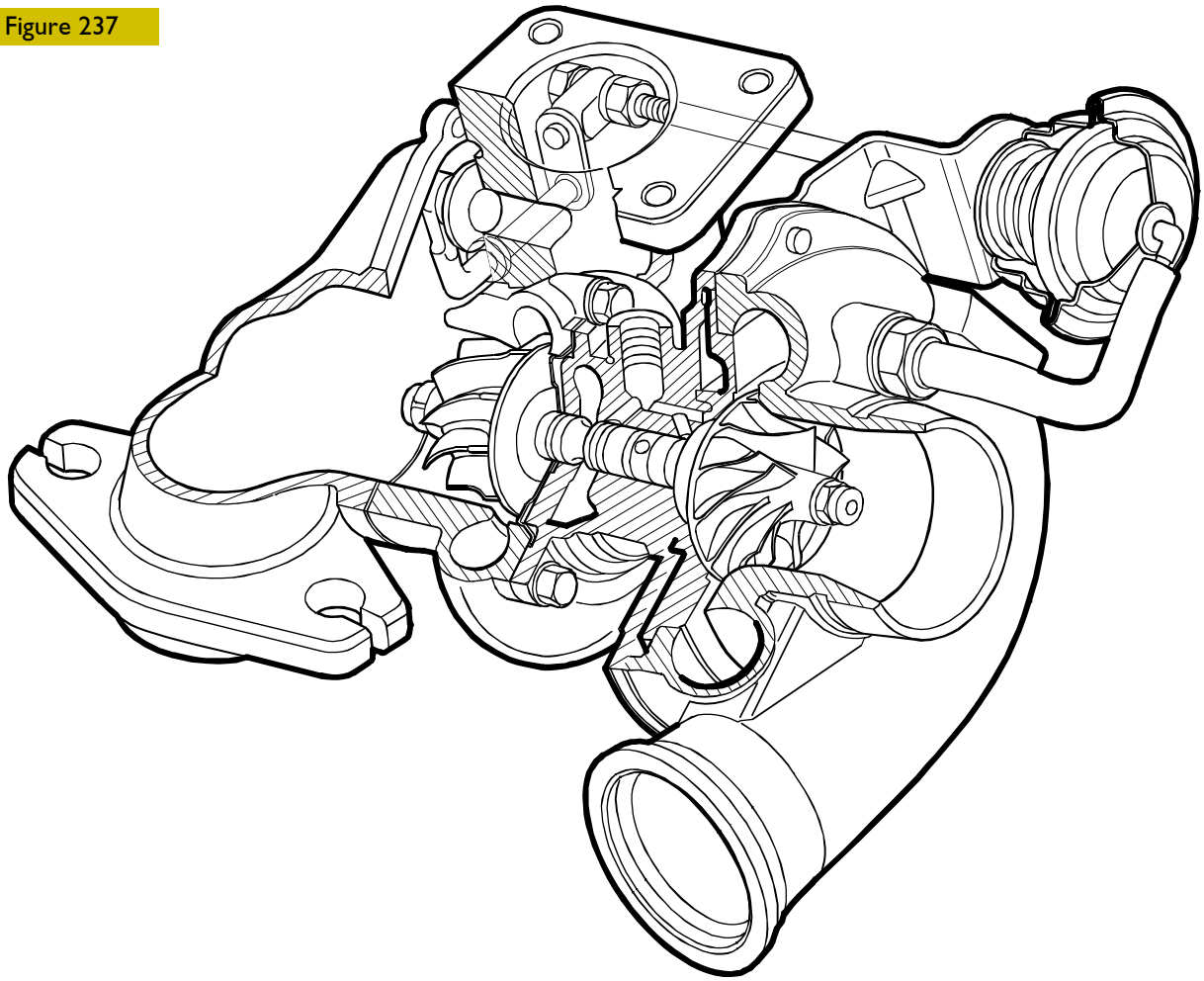
Figure 236



A. THROTTLE VALVE SHUT

B. THROTTLE VALVE OPEN

Figure 237



It is basically composed of:

- a central casing housing a shaft supported by bushings at whose opposite ends are fitted the turbine wheel and the compressor rotor;
- a turbine casing and a compressor casing mounted on the end of the central body;
- an overpressure relief valve fitted on the turbine casing. Its function is to choke the exhaust gas outlet (detail B), sending a portion of the exhaust gas straight into the exhaust pipe when the turbocharging pressure downstream from the turbocharger reaches the setting.

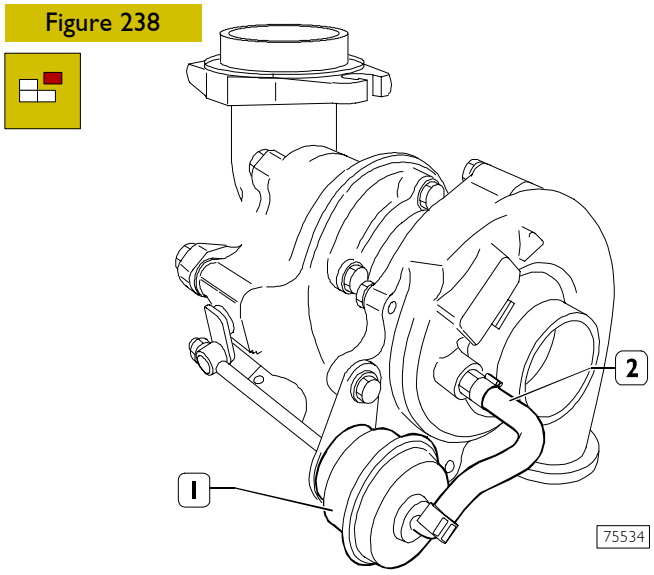
REPAIRS

NOTE On finding irregular engine operation due to the turbocharging system, it is first expedient to perform the checks on the turbocharger, check the efficiency of the seals and the fixing of the couplings, additionally checking there is no clogging in the intake sleeves, air filter or radiators. If the turbocharger damage is due to a lack of lubrication, check that the oil circulation pipes are not burst or clogged, in which case replace them or eliminate the trouble.

54249 Pressure relief valve

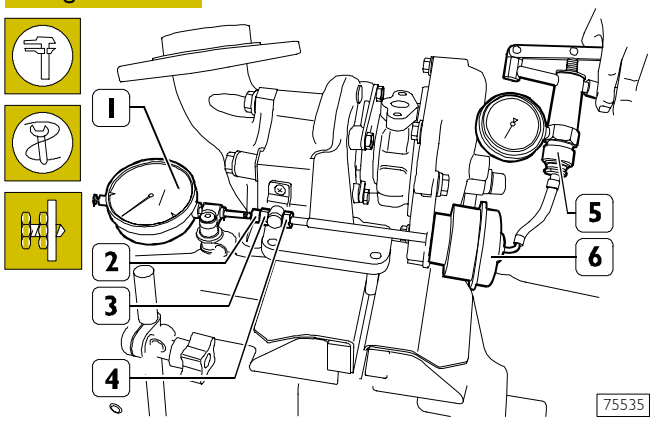
Checking and adjusting pressure relief valve

Figure 238



Cover the air, exhaust gas and lubricating oil inlets and outlets. Thoroughly clean the outside of the turbocharger using anticorrosive and antioxidant fluid. Disconnect the pipe (2) from the union of the pressure relief valve (1) and fit on it the pipe of the device 99367121 (1, Figure 239).

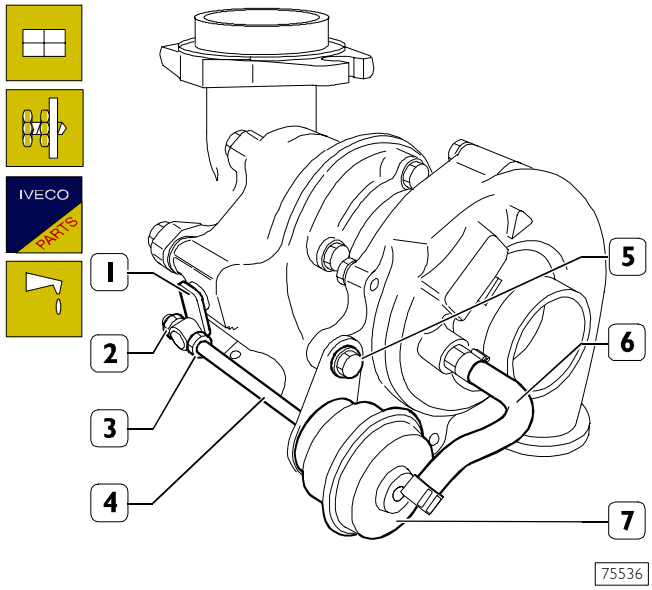
Figure 239



Rest the tip of the dial gauge (1) with a magnetic base on the end of the tie rod (2) and zero it. Using the device 99367121 (5), introduce compressed air into the valve casing (6) at the prescribed pressure and make sure this value stays constant throughout the check; replace the valve if it doesn't. In the above conditions, the tie rod must have made the prescribed travel. On finding a different value, use the nuts (3 and 4).

Replacing pressure relief valve

Figure 240

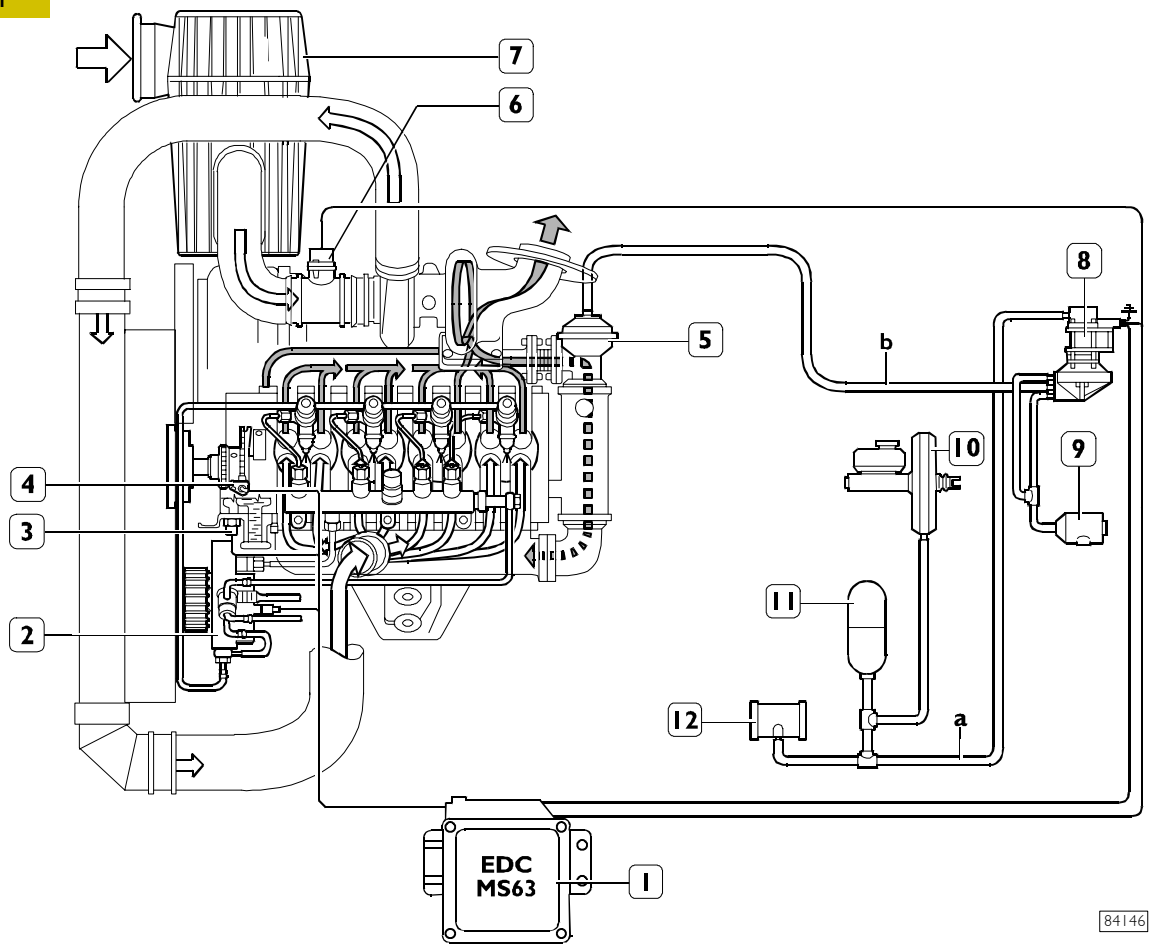


Take off the nut (2).
Take out the screws (5) and detach the bracket together with the relief valve (7) from the turbocharger.
Mount the new valve, performing the operations for disassembly in reverse order, and register it as follows:
Screw the nut (3) onto the stem (4) of the valve down to the end of the thread. Mount the lever (1) on the valve stem.
Using device 99367121 (5, Figure 239), introduce compressed air into the valve (7) at the prescribed pressure; in this condition, screw down the nut (2) until the throttle valve controlled by the lever (1) gets positioned in its seat.
Unscrew the nut (3) to bring it into contact with the lever (1) and at the same time block the nuts (2 and 3).
Adjust the pressure relief valve (7) as described under the relevant heading.
Afterwards, paint the nuts (2 and 3) with safety paint and connect the pipe (6) to the valve (7), securing it with a new retaining clamp.

NOTE Before fitting the turbocharger on the engine, it is necessary to fill the central body with engine lubricating oil.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Figure 241



a. Brake booster vacuum circuit - b. EGR modulated vacuum circuit
1. ECU - 2. High pressure pump - 3. Coolant temperature sensor - 4. Engine rpm sensor - 5. EGR pneumatic valve - 6. Flow meter - 7. Suction air cleaner - 8. Modulating solenoid valve - 9. Air cleaner - 10. Vacuum brake booster -11. Reservoir - 12. Vacuum unit.

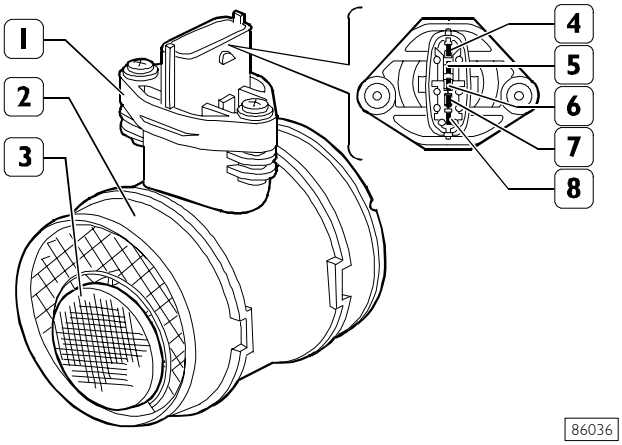
EGR system operation

The EGR system is similar to that fitted on 8140.63 engines and described in the specific system section.
Differences with respect to the previous version fitted on 8140.63 engines include: application of an exhaust gas heat exchanger and air flow meter, governing system implementing EDC MS6.3 or EDC 16, different modulating solenoid valve and pneumatic EGR calibration values.

Operating principles

The ECU (MS6.3 or EDC 16) processes the data from the atmospheric pressure sensor, coolant sensor, engine rpm sensor, accelerator pedal potentiometer and controls the modulating solenoid valve via a PWM signal according to programmed settings.
The control signal output by the ECU controls the modulating solenoid valve which puts the brake booster vacuum circuit into communication with that of the EGR. The vacuum created in the EGR circuit depends on the control signal.
The vacuum acts on the pneumatic EGR valve by recalling and lifting the shutter which normally closes the passage of exhaust gasses to suction.
This puts the exhaust manifold into communication with the suction manifold and part of the exhaust gasses flows into the intake manifold.
The control signal from the ECU to the modulating valve is cancelled during engine conditions not requiring exhaust gas recirculation (cranking, cold engine, idling, load request, high altitude). The solenoid valve closes the connection between the brake booster vacuum circuit and the EGR circuit; at the same time, atmospheric pressure is re-established in the EGR circuit by letting in air through the specific air cleaner.

Figure 242



Air flow meter

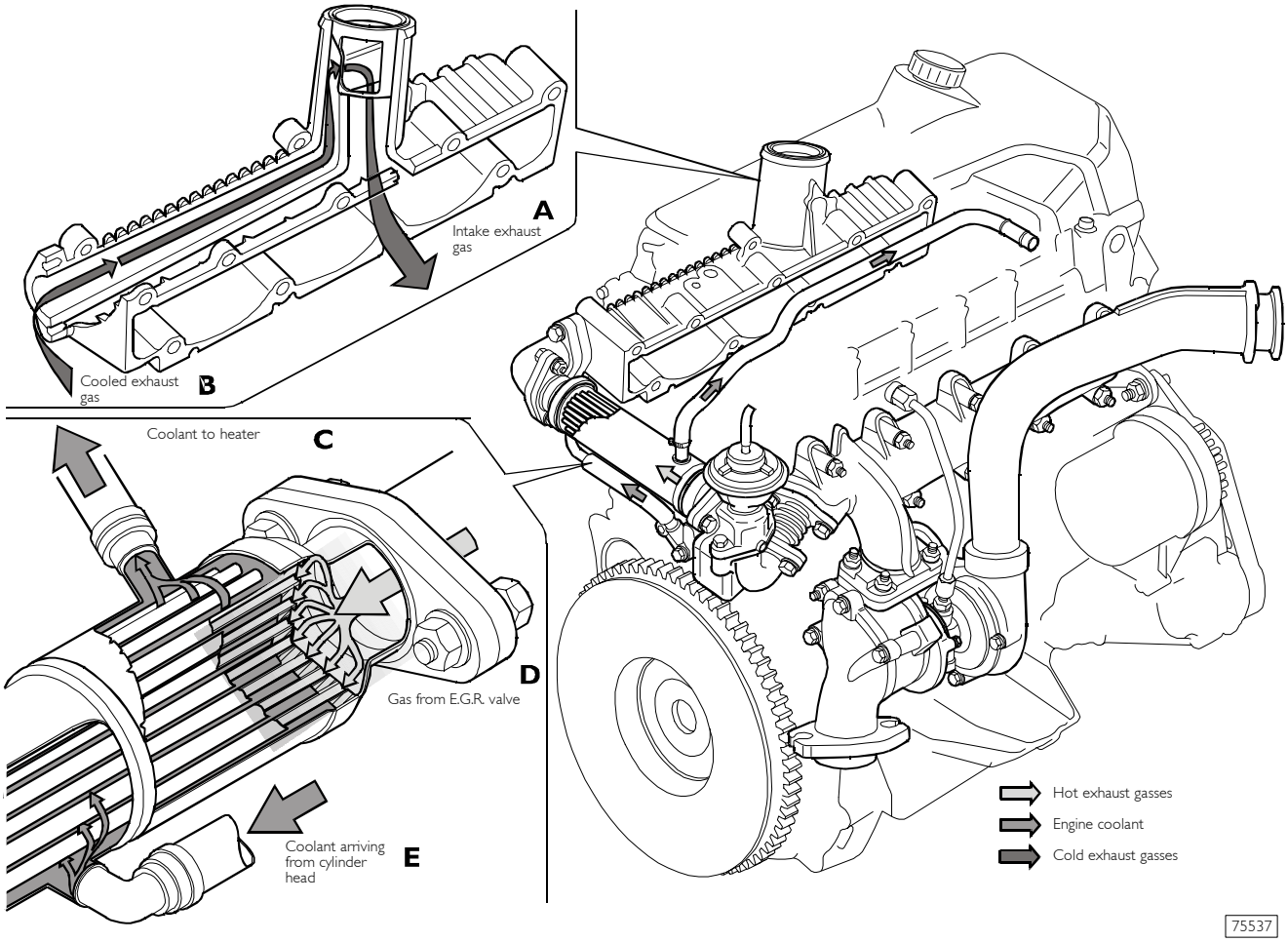
1. Connector - 2. Flow meter body - 3. Air and recirculated gas inlet mesh - 4. Suction air temperature sensor - 5. Power - 6. Ground - 7. Reference voltage - 8. Output signal.

The heated film flow meter is arranged between the turbine and the intercooler.
The suction air temperature sensor is built into the flow meter; the flow meter is connected to the ECU pins A5/A17/A18/A26/A28.

Operation

The hot film membrane temperature is kept constant (approximately 120 °C higher than suction air temperature) by a heating resistor.
The air mass crossing the duct tends to subtract heat from the membrane. Consequently more current is required through the resistor to keep the temperature constant.
Current uptake is proportional to the mass of air flowing into the engine. It is measured by a Wheatstone bridge and the resulting signal is sent to the ECU.

Figure 243



EXHAUST GAS COOLING
A. Intake exhaust gas – B. Cooled exhaust gas – C. Coolant to heater – D. Gas from E.G.R. valve – E. Coolant arriving from cylinder head.

FUEL SUPPLY
HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM (MS 6.3 - EDC 16)
General

Common Rail MS6.3 is a high-pressure electronic injection system for fast diesel engines with direct injection.
Its main features comprise:

- high injection pressures available (1600 bar);
- these pressures can be modulated between 150 bar up to the maximum operating pressure of 1600 bar, irrespective of the speed of rotation and engine load;
- capacity to operate at very high speeds (up to 6000 rpm);
- injection control precision (injection duration and advance);
- lower consumption;
- lower emissions.

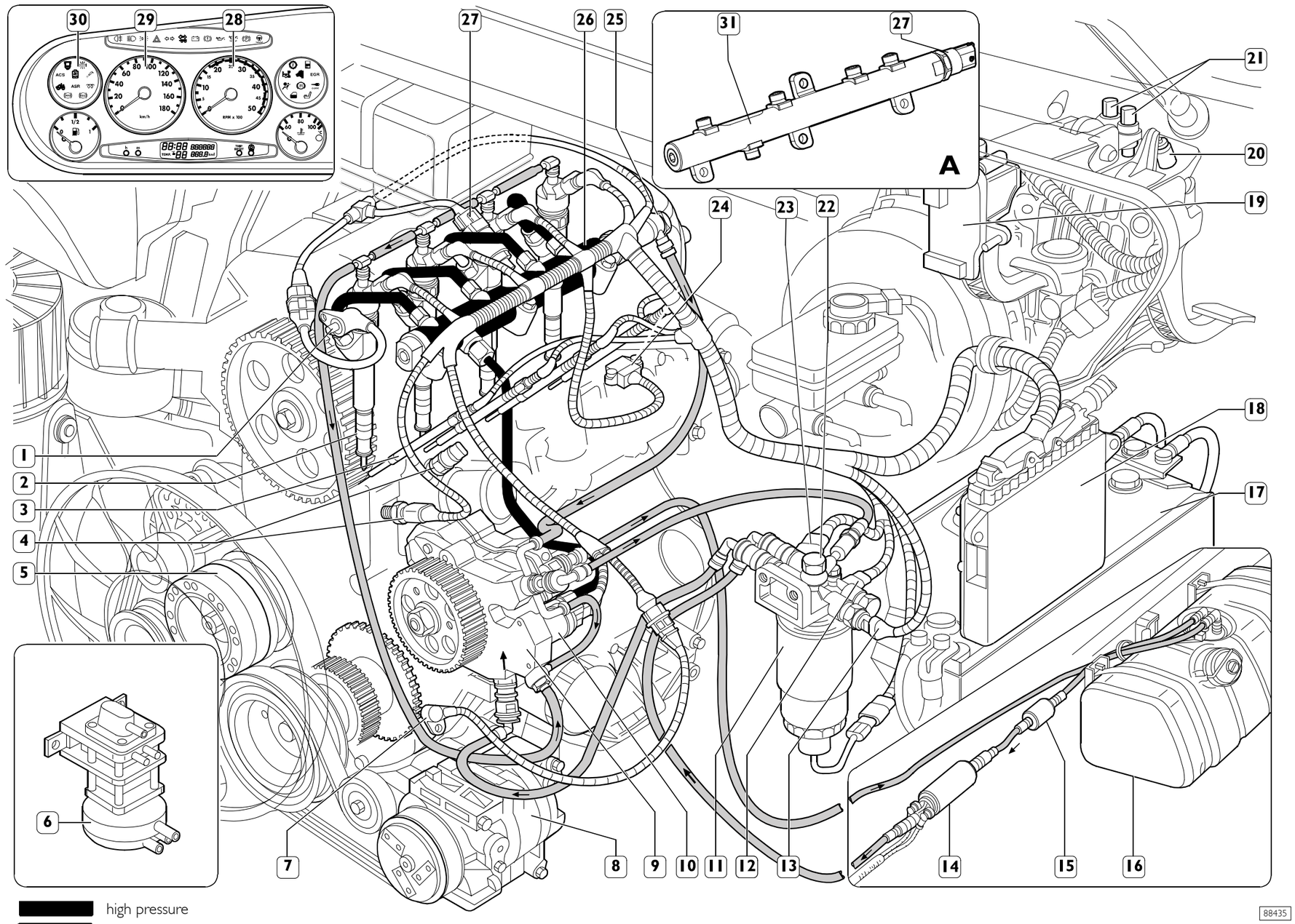
The main functions of the system are basically as follows:

- checking fuel temperature;
- checking engine coolant temperature;
- checking amount of fuel injected;
- checking idling speed;
- cutting off fuel in release phase;
- checking cylinder balancing when idling;
- checking anti-sawing;
- checking smokiness at exhaust on acceleration;
- checking exhaust gas recirculation (E.G.R. if present);
- checking top speed limit;
- checking glow plugs;
- checking activation of air-conditioning system (if any);
- checking auxiliary fuel pump;
- checking position of cylinders;
- checking main and pilot injection advance;
- checking closed cycle of injection pressure;
- checking turbocharging pressure;
- self-diagnosis;
- connection with immobilizer unit;
- checking maximum torque limitation.

The system makes pre-injection (pilot injection) possible before the TDC with the advantage of decreasing the derivative of the pressure in the combustion chamber, lowering the noise level of combustion, which is typical of direct injection engines.
The control unit checks the amount of fuel injected, adjusting the line pressure and injection times.
The information the control unit processes to regulate the amount of fuel to be injected comprises:

- engine speed;
- coolant temperature;
- turbocharging pressure;
- air temperature;
- intake air quantity;
- battery voltage;
- diesel pressure;
- position of throttle pedal.

Figure 244



HIGH-PRESSURE ELECTRONIC INJECTION SYSTEM COMPONENTS LAYOUT

1 Timing phase sensor – 2 Electro-injectors – 3 Glow plug – 4 Coolant temperature sensor – 5 Electromagnetic fan – 6 E.G.R. valve modulator (if present) – 7. Engine speed sensor – 8 Compressor (if present) – 9 High-pressure pump – 10 Pressure regulator– 11 Fuel filter – 12 Fuel temperature sensor – 13 Fuel filter clogging sensor – 14 Electric supply pump – 15 Fuel pre-filter – 16 Fuel tank – 17 Battery – 18 Control unit with atmospheric pressure sensor – 19 Throttle pedal sensor – 20 Clutch pedal sensors – 21 Brake pedal sensors – 22 Fuel check valve – 23 Heater – 24 Air temperature pressure sensor – 25 Hydraulic accumulator (rail) pressure relief device – 26 Forged version hydraulic accumulator (rail) – 27 Hydraulic accumulator (rail) fuel pressure sensor – 28 Engine rev counter– 29 Tachograph – 30 Starter heater indicator light - 31. Welded version hydraulic accumulator..
In box A, there is shown the variant with welded version hydraulic accumulator.

SYSTEM OPERATION
Self-diagnosis – BLINK CODE

The control unit self-diagnosis system checks the signals from the sensors, comparing them with the admitted limits (see relative heading):

Immobilizer recognition

When the control unit receives the signal of the key on "MAR" it communicates with the immobilizer control unit to enable starting.

Checking fuel temperature

With the fuel temperature greater than 75°C, detected by the sensor on the fuel filter, the control unit operates the pressure regulator to decrease the line pressure (injection times are not changed). If the temperature exceeds 90°C, the power is reduced to 60%.

Checking engine coolant temperature

The control unit, depending on the temperature:

- of the engine coolant, turbocharging air and fuel, operates the electromagnetic fan (Baruffaldi) and switches on the coolant temperature warning light.

Checking quantity of fuel injected

According to the signals from the sensors and the mapped values, the control unit:

- operates the pressure regulator;
- varies the "pilot" injection time to 2200 rpm;
- varies the "main" injection time.

Checking idling adjustment

The control unit processes the signals from the various sensors and regulates the amount of fuel injected:

- it operates the pressure regulator;
- it varies the injection times of the electro-injectors.

Within certain thresholds the speed takes account of the battery voltage.

Fuel cut-off in release phase

In the phase of releasing the throttle pedal the control unit actuates the following logic elements:

- it cuts off supply to the electro-injectors;
- it partially reactivates supply to the electro-injectors before reaching idling speed;
- it operates the fuel pressure regulator.

Checking cylinder balancing on idling

According to the signals received from the sensors, the control unit controls the regularity of the torque at idling speed:

- it varies the amount of fuel injected into the single electro-injectors (injection time).

Checking regular engine rotation (anti-sawing)

It ensures regular engine rotation at a constant rate while increasing revs.
The control unit processes the signals received from the sensors and determines the amount of fuel to be injected via:

- the pressure regulator;
- the electro-injector opening time.

Checking smokiness at exhaust on acceleration

With heavy acceleration, on the basis of the signals received from the air introduction meter and engine speed sensor, the control unit determines the optimum amount of fuel to inject:

- it operates the pressure regulator;
- it varies the electro-injector injection time.

Checking exhaust gas recirculation (E.G.R. if present)

Depending on the engine load and the signal from the accelerator pedal sensor, the control unit limits the amount of air taken in, actuating partial suction of the exhaust gases.

Checking top speed limit

Depending on the number of revs, the control unit actuates two action strategies:

- at 4250 rpm it cuts off the fuel, decreasing the electro-injector opening time;
- over 5000 rpm it deactivates the electro-injectors.

Checking regular rotation on acceleration

Regular progression is assured in all conditions by the control of the pressure regulator and the electro-injector opening time.

Checking glow plug control unit

The injection control unit, in the phase of:

- starting
- after-starting

times operation of the glow plugs according to the engine temperature.

Checking activation of air-conditioning system

The control unit operates the air-conditioning compressor:

- switching it on/off when the relative switch is pressed;
- momentarily turning it off (approximately 6 sec.) if the engine coolant reaches the set temperature.

Checking fuel pump

Irrespective of the speed, the control unit:

- supplies the auxiliary fuel pump with the key on MAR;
- cuts off auxiliary pump supply if the engine is not started up within a few seconds.

Checking diesel warming

It times operation of diesel warming in relation to ambient temperature.

Checking cylinder position

During each turn of the engine, the control unit recognizes which cylinder is in the power stroke and operates the injection sequence for the appropriate cylinder.

Checking pilot and main injection timing

According to the signals from the various sensors, including the absolute pressure sensor built into the control unit, the control unit determines the optimum point of injection according to internal mapping.

Checking injection pressure closed cycle

Depending on the engine load, determined by processing the signals from the various sensors, the control unit operates the regulator to obtain optimum line pressure.

Fuel supply

The fuel supply is calculated in relation to:

- accelerator pedal position
- engine speed
- quantity of air introduced.

The outcome may be corrected in relation to:

- the water temperature.

Or to avoid:

- noise
- smoke
- overloading
- overheating
- turbine over-revving.

The delivery can be modified in the case of:

- action of external devices (ABS), ABD, EDB
- serious trouble decreasing the load or stopping the engine.

After determining the mass of air introduced by measuring its volume and temperature, the control unit calculates the corresponding mass of fuel to inject into the relevant cylinder (mg per delivery) also taking into account the temperature of the diesel.
The mass of fuel calculated in this way is first converted into volume (mm^3 per delivery) and then into degrees of throw, or duration of injection.

Correcting flow rate according to water temperature

A cold engine meets with greater resistance during operation: friction is high, the oil is still very viscous, and the various clearances are not yet optimized.
In addition, the injected fuel tends to condense on the metal surfaces that are still cold.
The fuel supply for a cold engine is therefore greater than for a warm one.

Correcting flow rate to avoid noise, smoke or overloading

The behaviour that could lead to this kind of trouble is well known.

The designer has therefore included special instructions in the control unit to avoid it.

De-rating

In the event of the engine overheating, injection is modified, decreasing the delivery to a varying degree, in proportion to the temperature reached by the coolant.

Injection timing electronic test

The advance (start of delivery, expressed in degrees) may be different from one injection to the next, also differentiated from one cylinder to another. It is calculated, similarly to the delivery, in relation to the engine load (accelerator position, engine speed and air introduced).
The advance is appropriately corrected:

- in phases of acceleration;
- according to the water temperature.

And also to obtain:

- lower emissions, noise and overloading;
- better vehicle acceleration.

An extremely high advance is set on starting, depending on the water temperature.
Feedback from the start of delivery is supplied by the change in impedance of the injector solenoid valve.

Speed governor

The electronic speed governor has both features of governors:

- idling and top speed
- all speeds

It is stable in ranges where conventional, mechanical governors are imprecise.

Engine starting

During the first few turns of the engine, the timing and cylinder no. 1 recognition signals (flywheel sensor and camshaft sensor) are synchronized.
The accelerator pedal signal is ignored on starting. Starting delivery is set only according to water temperature, by a special map.
When the control unit detects such speed and acceleration of the flywheel as to be able to consider the engine started up and no longer driven by the starter motor, it re-enables the accelerator pedal.

Cold starting

If even just one of the three temperature sensors (water, air or diesel) records a temperature lower than 10°C, pre-post heating is activated.
When the key makes contact the pre-heating indicator light comes on and stays on for a length of time that varies in relation to the temperature (while the glow plugs in the cylinder head heat the air), then flashes. It is now possible to start up the engine.
When the motor is running this indicator light goes out, while the glow plugs continue to be powered for a certain length of time (variable) for post-heating.
If, with the indicator light flashing, the engine is not started up within 20-25 seconds (inattention time), the operation is cancelled so as not to run down the batteries pointlessly.
The pre-heating curve is also variable in relation to the battery voltage.

Warm starting

If the reference temperatures all exceed 10°C, when the key makes contact the indicator light comes on for approximately 2 sec., for a short test, and then goes out. It is now possible to start up the engine.

Run up

When the key makes contact, the control unit transfers the information stored in memory when the engine was last stopped into the main memory (see After Run) and makes a diagnosis of the system.

After run

Whenever the engine is switched off with the key, the control unit stays powered for a few seconds by the main relay.
This makes it possible for the microprocessor to transfer some data from the main memory (volatile) to a non-volatile memory, which can be erased and written over (EEPROM), so as to make it available at the next start up (see Run Up).

These data basically consist of:

- various settings (engine idling adjustment, etc.);
- settings of some components;
- fault memory.

The process lasts a few seconds, typically from 2 to 7 (depending on the amount of data to save), after which the ECU sends a command to the main relay and makes it disconnect from the battery.

NOTE It is extremely important for this procedure not to be broken off, for example by switching off the engine with the battery cut-out, or by disconnecting the battery cut-out before 10 seconds have passed since switching off the engine.
If this happens, the functioning of the system is ensured, but repeated interruptions may damage the control unit.

Cut-off

This function cuts off fuel delivery when the vehicle is decelerating (accelerator pedal released).

Cylinder balancing

Individual cylinder balancing contributes to increasing comfort and handling.
This function permits individual, customized control over the delivery of fuel and the start of delivery for each cylinder, even differently from one cylinder to another, to compensate for the hydraulic tolerances of the injector.

The differences in flow (delivery specifications) between the various injectors cannot be evaluated directly by the control unit. This information is supplied by Modus reading the bar code of each injector at the time of assembly.

Synchronization search

If there is no signal from the camshaft sensor, the control unit is anyhow able to recognize the cylinders into which the fuel is to be injected.
If this occurs when the engine is already running, the combustion sequence has already been acquired, so the control unit continues with the sequence on which it has already been synchronized.
If this occurs when the machine is at a standstill, the control unit energizes a single solenoid valve. Within at most 2 turns of the crankshaft, injection will take place in that cylinder, so the control unit just needs to get synchronized on the firing sequence and to start up the engine.

OPERATION

In this injection system, the pressure regulator, located upstream from the high-pressure pump, governs the flow of fuel needed in the low-pressure system. Afterwards, the high-pressure pump correctly supplies the hydraulic accumulator.

This solution, pressurizing solely the necessary fuel, improves the energy efficiency and limits heating the fuel in the system. The relief valve fitted on the high-pressure pump has the function of keeping the pressure, at the pressure regulator inlet, constant at 5 bars; irrespective of the efficiency of the fuel filter and of the system upstream. The action of the relief valve causes an increase in the flow of fuel in the high-pressure pump cooling circuit.

The high-pressure pump continually keeps the fuel at the working pressure, irrespective of the timing and the cylinder that is to receive the injection and accumulates it in a duct common to all the electro-injectors.

At the electro-injector inlet, there is therefore always fuel at the injection pressure calculated by the electronic control unit.

When the solenoid valve of an electro-injector is energized by the electronic control unit, fuel taken straight from the hydraulic accumulator gets injected into the relevant cylinder.

The hydraulic system is made out of a low-pressure fuel recirculation circuit and a high-pressure circuit.

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

- pipe connecting the high-pressure pump outlet to the Rail;
- hydraulic accumulator;
- pipes supplying the electro-injectors.

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

- fuel intake pipe from the tank to the pre-filter;
- pipes supplying the mechanical supply pump and the pre-filter;
- pipes supplying the high-pressure pump via the fuel filter.

The fuel system is completed by the fuel outlet circuit from the hydraulic accumulator and from the electro-injectors.

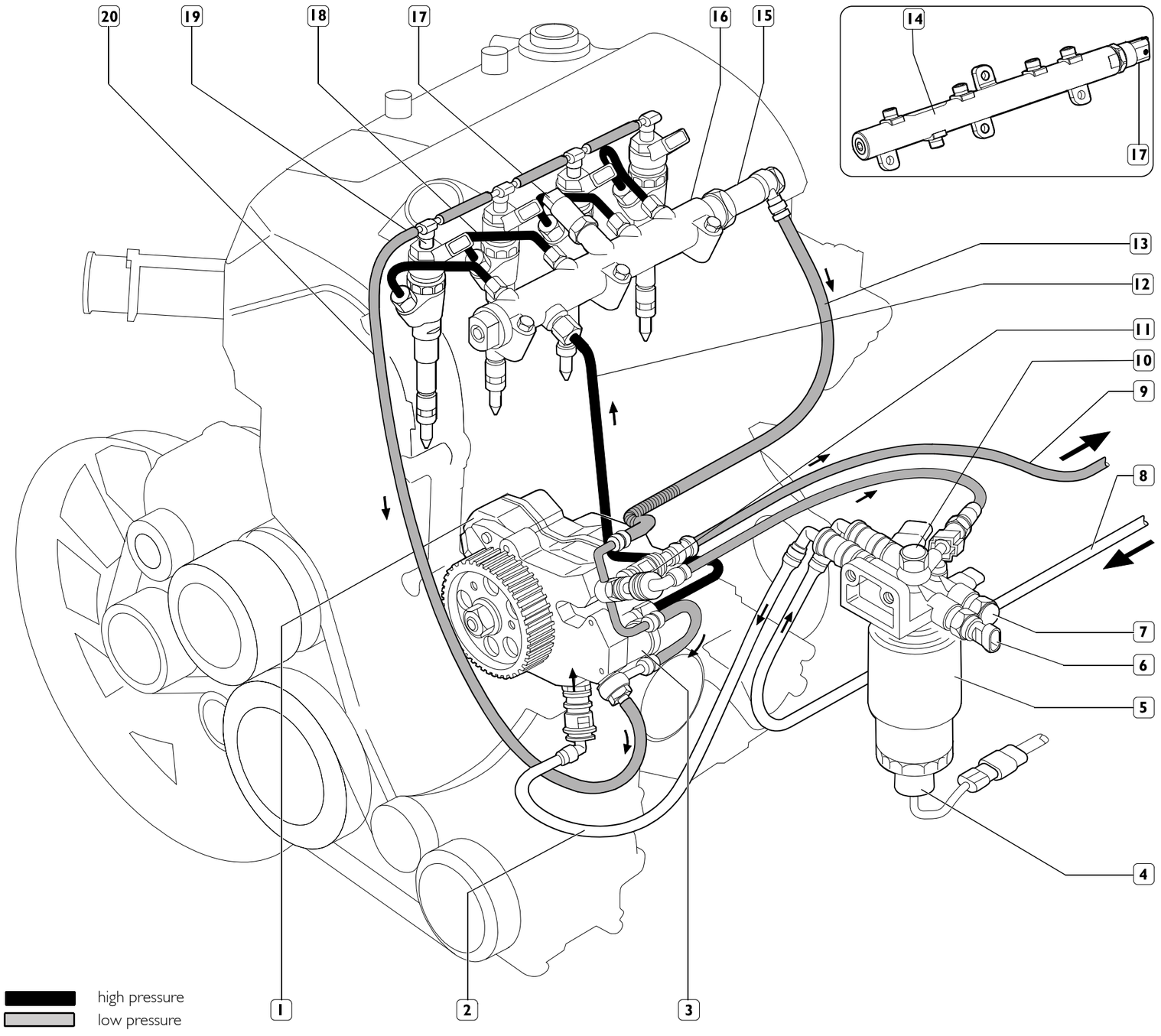
According to the high performance of this hydraulic system, for reasons of safety it is necessary to:

- avoid connecting high-pressure pipe fittings with approximate tightening;
- avoid disconnecting the high-pressure pipes with the engine running (NEVER try bleeding, which is both pointless and dangerous).

The integrity of the low-pressure circuit is also essential for the system to work properly; it is therefore necessary to avoid all manipulation and modifications and act only in the event of leakage.

NOTE The pipes connected to the fuel filter mounting are quick-coupling ones.
Before fitting them, make sure the couplings and the associated fittings on the mounting are clean.

Figure 245



FUEL RECIRCULATION AND SUPPLY SYSTEM DIAGRAM

1. CP3 high-pressure pump with integrated supply pump – 2. Fuel arrival pipe from the filter – 3. Pressure regulator – 4. Water in filter sensor – 5. Fuel filter with water separator – 6. Fuel temperature sensor – 7. Fuel warming – 8. Fuel delivery pipe to the filter – 9. Fuel return pipe to the tank – 10. Fuel check valve – 11. Multiple coupling – 12. Fuel return low pressure piping - 13. Welded version hydraulic accumulator - 14. High-pressure delivery pipe to the hydraulic accumulator – 15. Low-pressure return pipe from the hydraulic accumulator to the multiple coupling – 16. Overpressure valve – 17. Forged version hydraulic accumulator – 18. Pressure sensor – 19. High-pressure pipe between hydraulic accumulator and electro-injectors – 20. Electro-injectors – 21. Return pipe from the electro-injectors to the high-pressure pump CP3.

HYDRAULIC SYSTEM

The hydraulic system is composed of:

- tank
- pre-filter
- electric supply pump
- fuel filter
- high pressure supply pump with supply pump built inpressure regulator
- manifold (rail)
- electro-injectors
- supply pipes and fuel recirculation

773010 Fuel pump

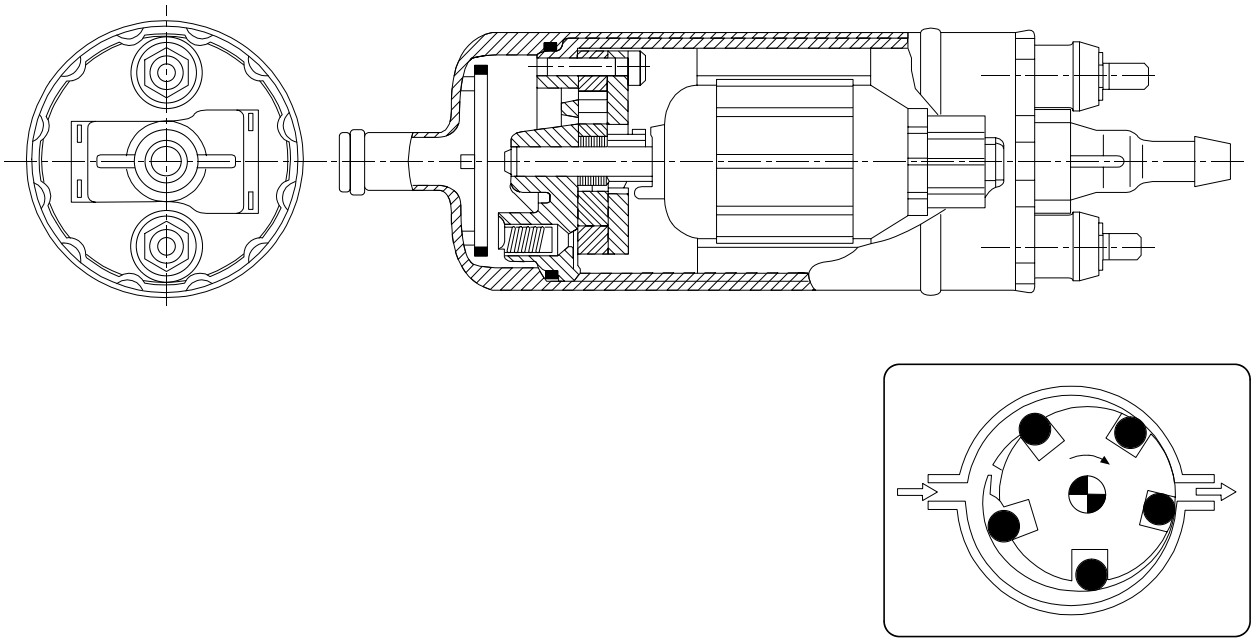
This rotary positive displacement pump with integrated by-pass is mounted on the suction pipe, on the left-hand side of the chassis frame.

The fuel pump is the roller-type with positive displacement, a brush motor with energizing by permanent magnets.
The impeller turns, driven by the motor, creating volumes that shift from the inlet port to the delivery port.
These volumes are defined by the rollers that stick to the outer ring when the motor turns.
The pump has two valves, a check valve to prevent the fuel circuit from emptying (with the pump stationary) and an overpressure valve that recirculates the delivery with the inlet when pressures over 5 bar are produced.

Specifications

Delivery pressure:	2.5 bar
Flow rate:	> 155 litres/h
Power supply:	13.5 V - < 5 A
Coil resistance at 20°C:	28.5 Ohms

Figure 246

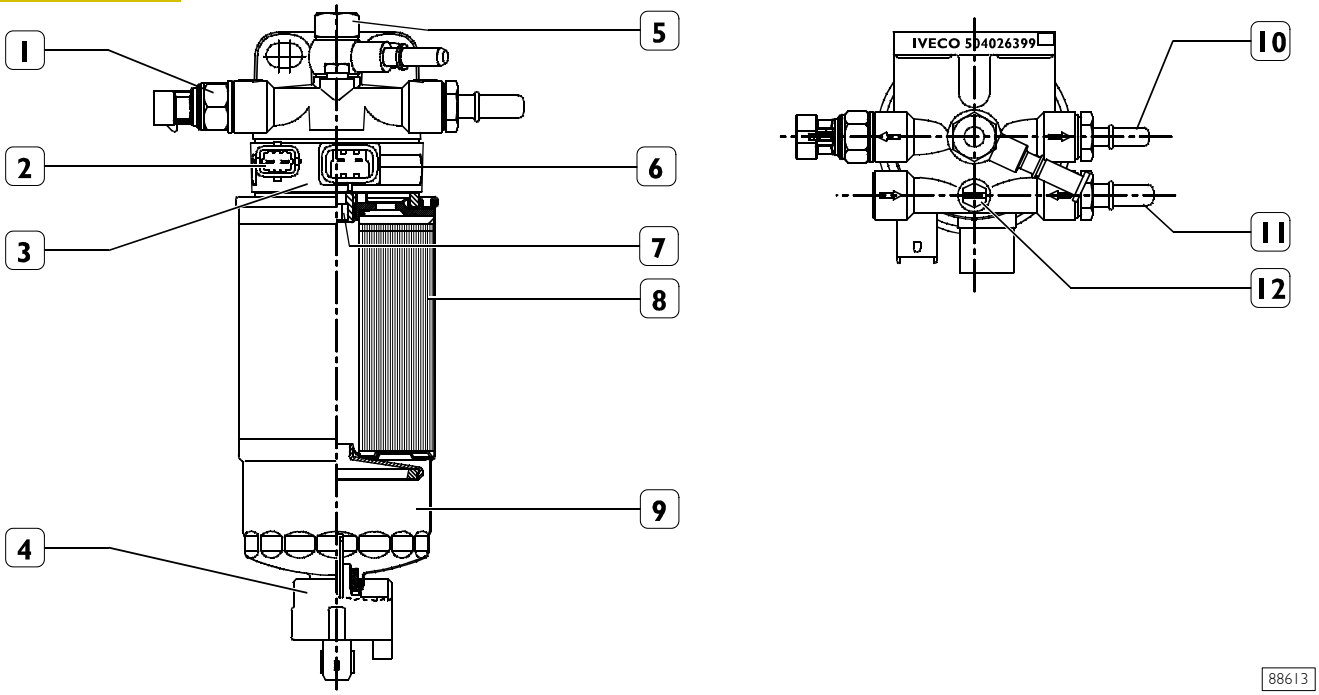


50707

CROSS-SECTION OF FUEL PUMP

542011 Fuel filter

Figure 247



1. Clogging signalling sensor - 2. Temperature sensor connector - 3. Heater support - 4. Water in signalling sensor - 5. Overpressure valve - 6. Heater connector - 7. Bending insert - 8. Fuel filter - 9. Water separator - 10. Connector - 11. Connector - 12. Purging screw.

The fuel filter is composed of a cartridge (8) equipped with a water separator (9).
The water accumulation capacity (A) of the filter is approx. 100 cm^3.
The water indicator (4) is mounted on the bottom end. Unscrewing the indicator (4) drains off any water.
Heater support (3) has an integrated temperature sensor.
On heater support (3) there are screwed up sensor (1) to signal filter clogging and non return valve (5).
When the temperature of the diesel is less than 6 °C, an electric heating element warms it up to at most 15 °C before sending it to the high pressure pump.

Check valve characteristics

opening pressure $0.5\ ^{+0.05}_{-0.1}$ bar

differential pressure less than 0.2 bar at 120 litres/h of fuel.

Clogging indicator characteristics

differential working pressure 1.1 bar

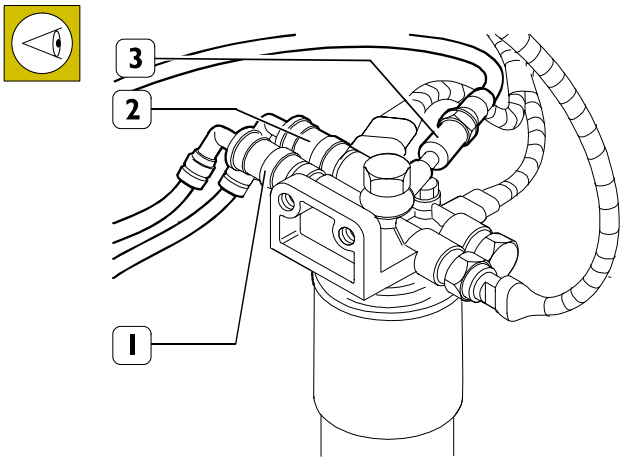
Tightening torques

1.	Tightening clogging signalling sensor	20±2 Nm
4.	Water in signalling sensor	0.8±1.2 Nm
5.	Check valve tightening	25±2 Nm
8.	Fuel filter tightening	18±2 Nm
10.	Connector	35±2 Nm
11.	Connector	35±2 Nm
12.	Bleed screw	4 Nm
7.*	Threaded insert	35±2 Nm

* Before mounting, apply thread holding down Loctite on thread.

Fuel pipes

Figure 248

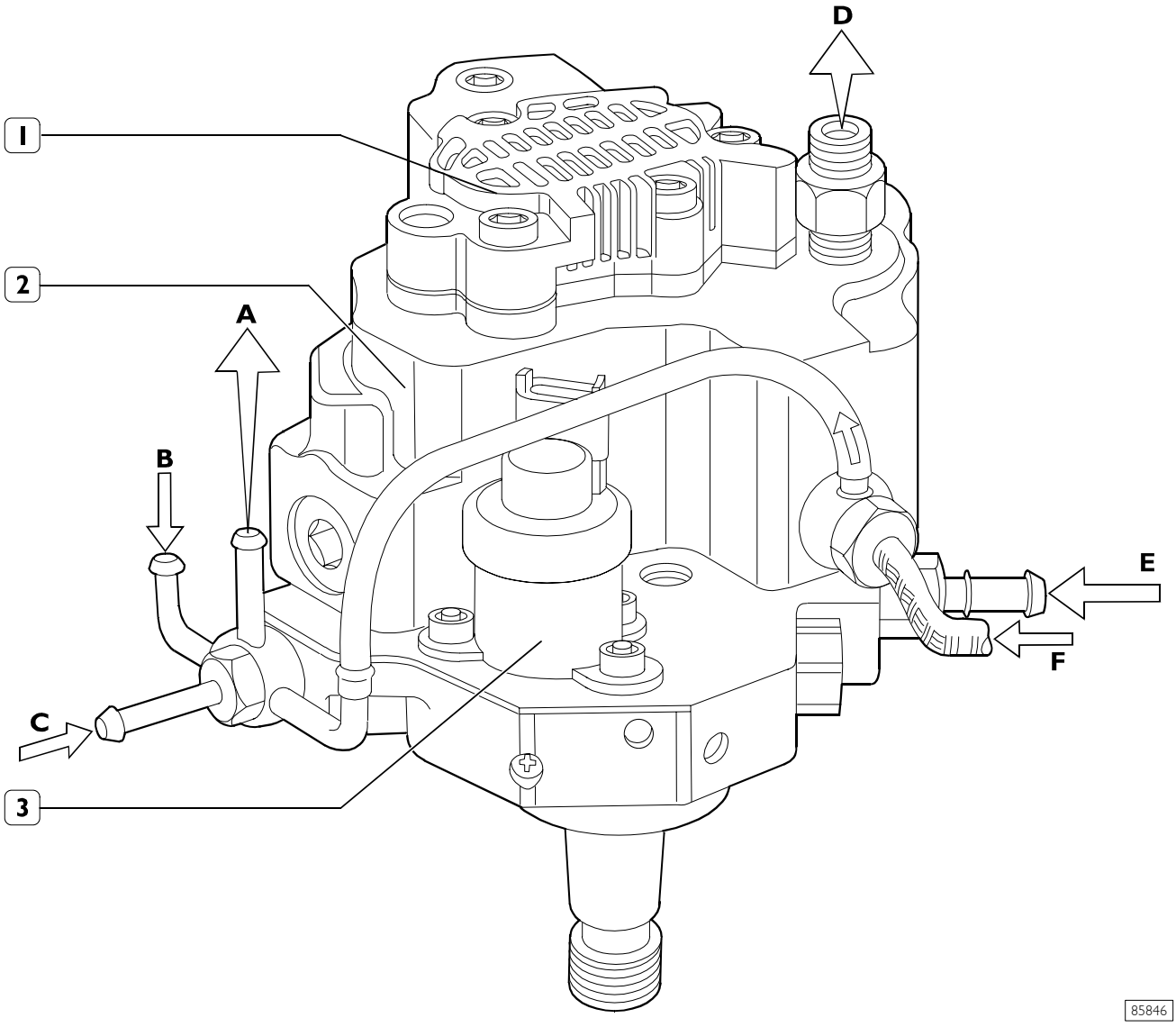


1. High-pressure pump supply pipe quick-coupling fitting – 2. Supply pipe quick-coupling fitting – 3. Fuel return pipe quick-coupling fitting – 4. Fuel filter mounting.

If disconnecting the fuel pipes (1-2-3) from the mounting (4), it is necessary, when refitting, to make sure their fittings are perfectly clean. This is to avoid an imperfect seal and fuel getting out.

775010 High-pressure pump

Figure 249

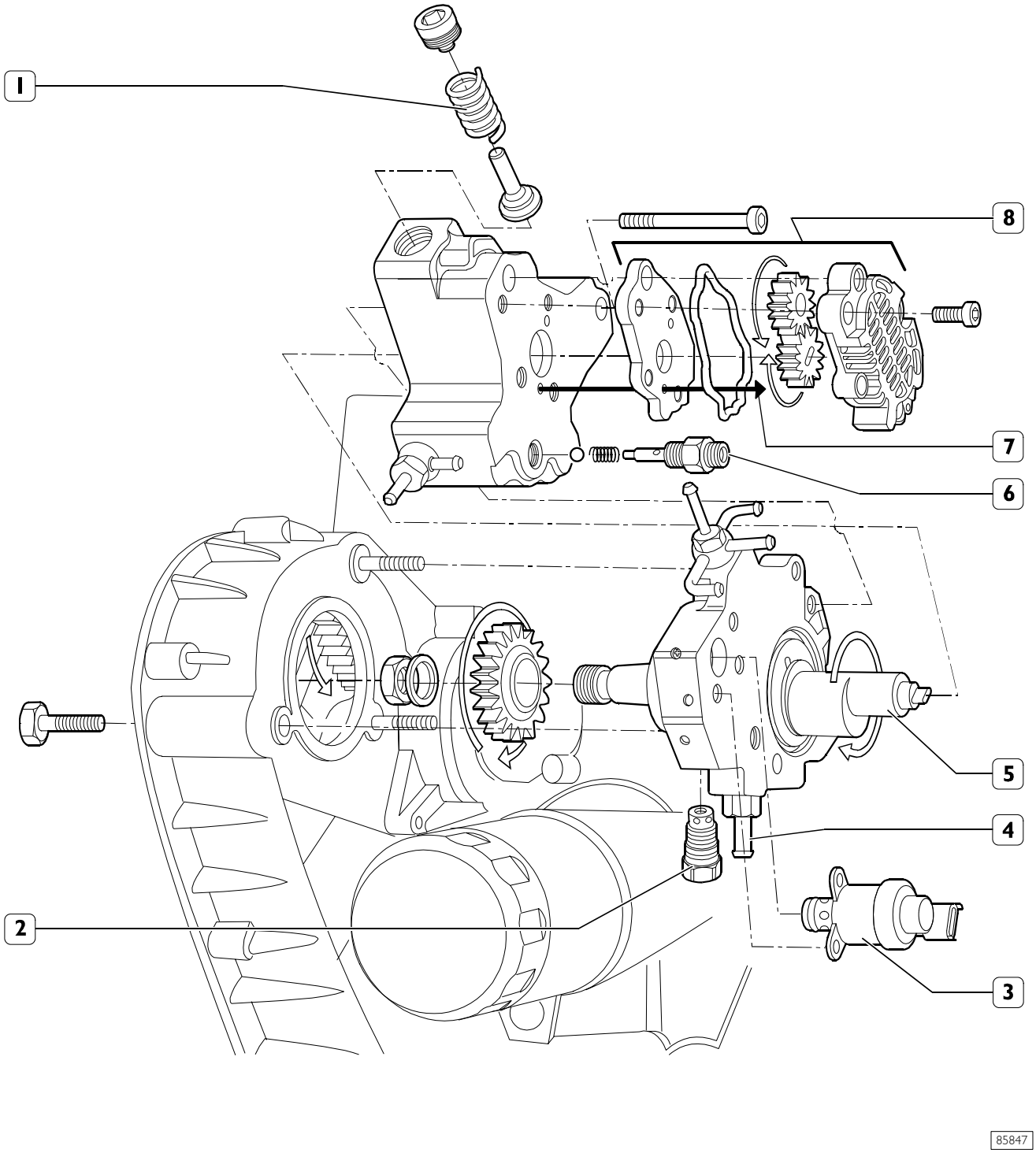


1. Mechanical feeding pump - 2. CP3 high pressure pump - 3. Pressure regulator A. To the tank - B. Return from rail - C. Return from fuel filter - D. Delivery to rail - E. From tank - F. Return to injectors.

Pump with 3 radial pumping elements controlled via a gear by the timing belt; it needs no timing. On the rear of the high-pressure pump there is the mechanical supply pump, controlled by the shaft of the high-pressure pump.
The pump is lubricated and cooled by the fuel.

NOTE The high-pressure pump – supply pump assembly cannot be overhauled and therefore the fixing screws must be neither removed nor tampered with. The only permissible job is replacing the driving gear.

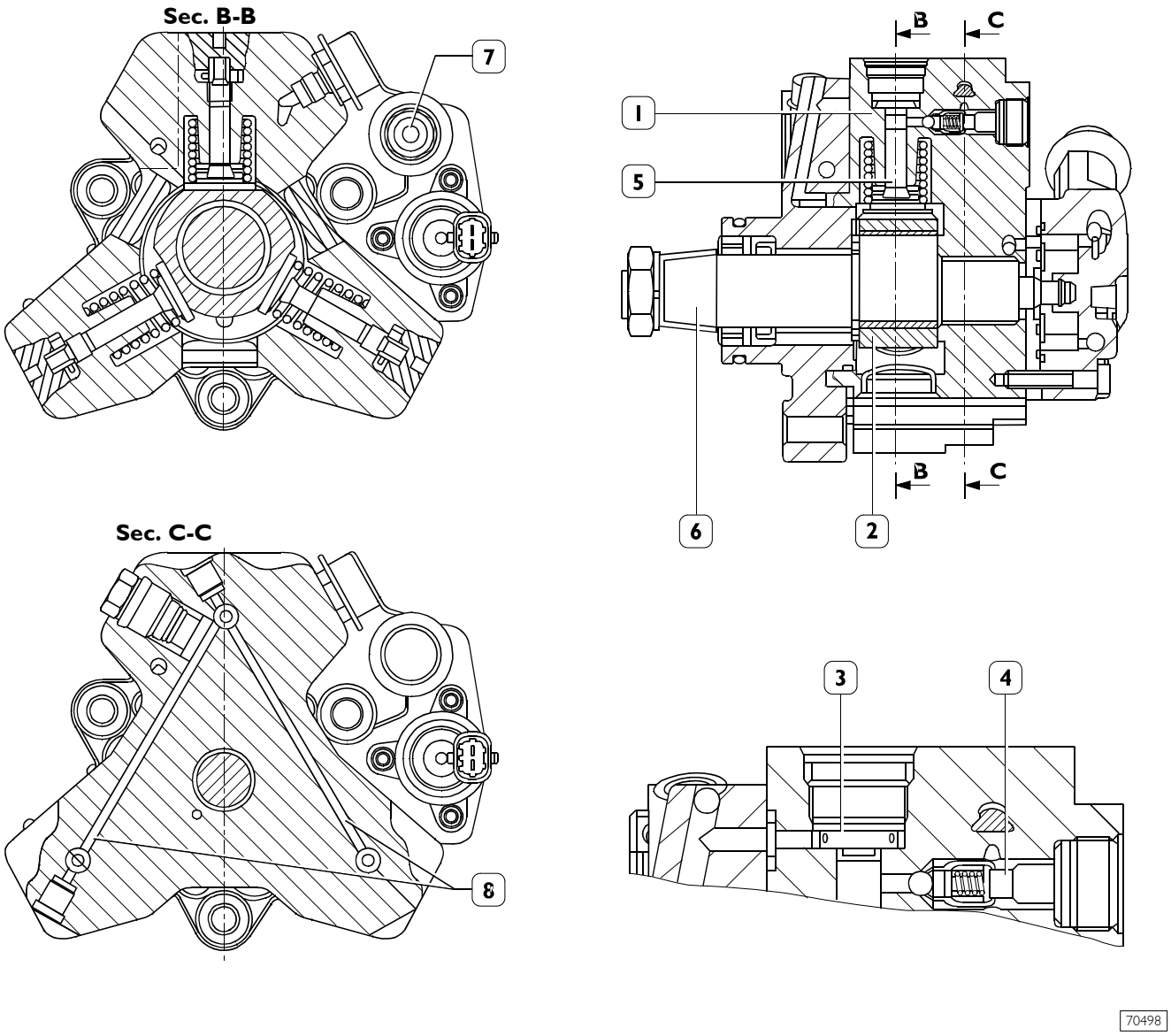
Figure 250



1 Delivery valve on single pumping element – 2. Relief valve 5 bar – 3. Pressure regulator – 4. Fuel inlet from filter – 5. Pump shaft – 6. Delivery valve to common rail – 7. Fuel return from high-pressure pump – 8. Mechanical supply pump.

High-pressure pump internal structure

Figure 251



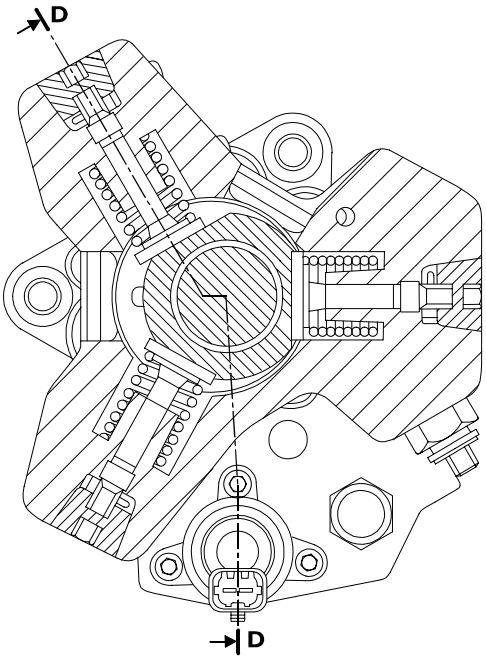
1. Cylinder – 2. Three-lobed element – 3. Plate intake valve – 4. Ball delivery valve – 5. Plunger – 6. Pump shaft – 7. Low-pressure fuel inlet – 8. Fuel ducts to supply pumping elements.

Each pumping assembly comprises:

- a plunger (5) operated by a three-lobed element (2) floating on the shaft of the pump (6). Since the element (2) floats on a misaligned portion of the shaft (6), during shaft rotation, it does not turn with it but is only shifted in a circular movement on a wider radius, with the result of working the three pumping elements alternately:
- a plate intake valve (3);
- a ball delivery valve (4).

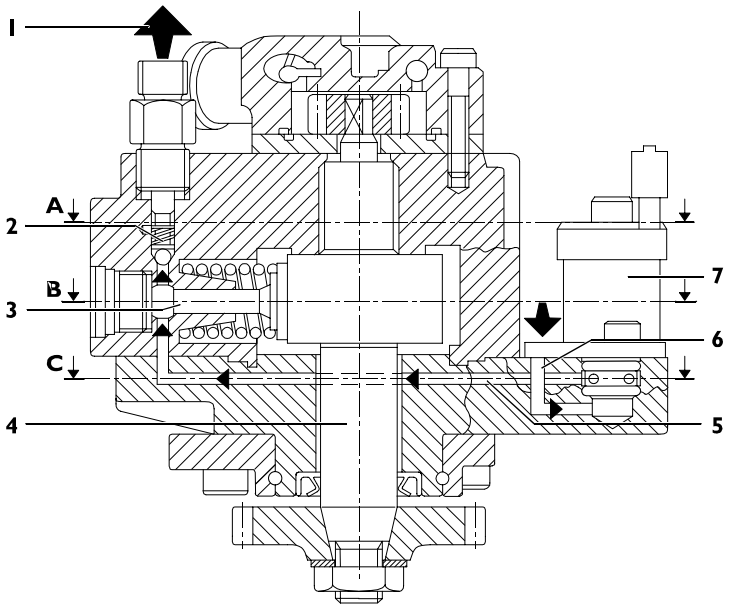
Working principle

Figure 252



Sec. B - B

Figure 253



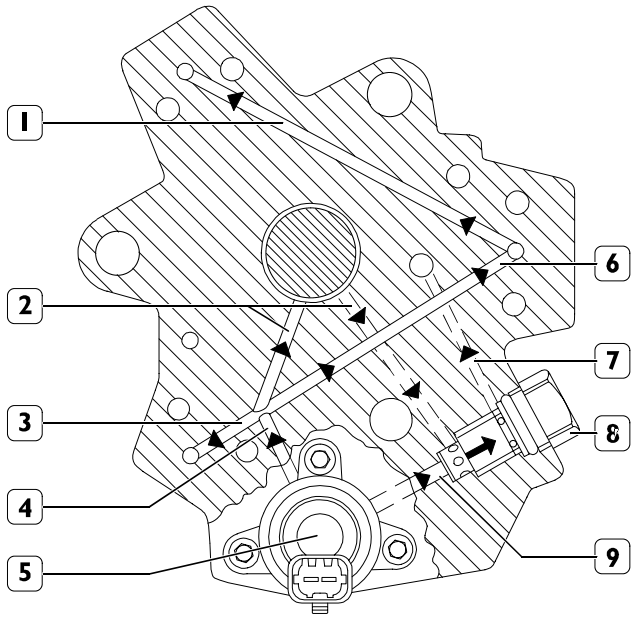
Sec. D - D

72597

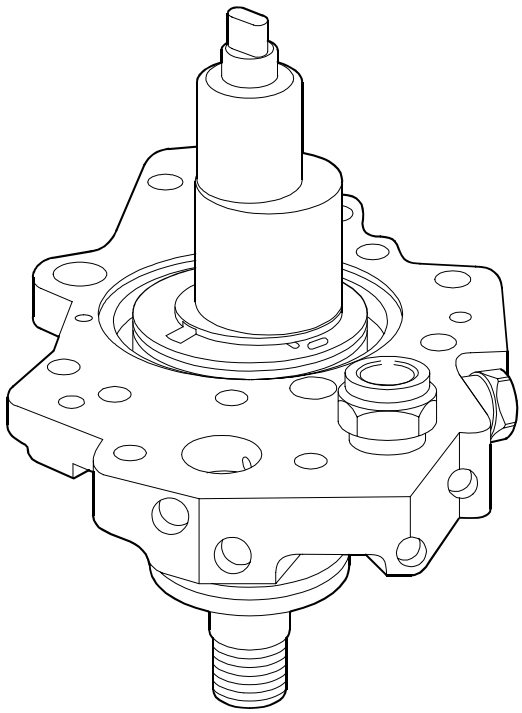
1. Outlet for delivery to rail – 2. Delivery valve to rail – 3. Pumping element – 4. Pump shaft – 5. Pumping element supply duct – 6. Pressure regulator supply duct – 7. Pressure regulator.

The pumping element (3) is arranged on the cam on the pump shaft. In the suction phase, the pumping element is supplied through the supply duct (5). The amount of fuel to send to the pumping element is determined by the pressure regulator (7). The pressure regulator, on the basis of the PWM command received from the control unit, chokes the flow of fuel to the pumping element. During the compression phase of the pumping element, the fuel, on reaching such a pressure as to open the delivery valve to the common rail (2), supplies it through the outlet (1).

Figure 254



72598



72599

Sec. C – C (Figure 253)

1, 3, 6 Pumping element inlet – 2. Pump lubrication ducts – 4. Main pumping element supply duct – 5. Pressure regulator – 7. Regulator outlet duct – 8. Relief valve 5 bar – 9. Fuel outlet from regulator inlet.

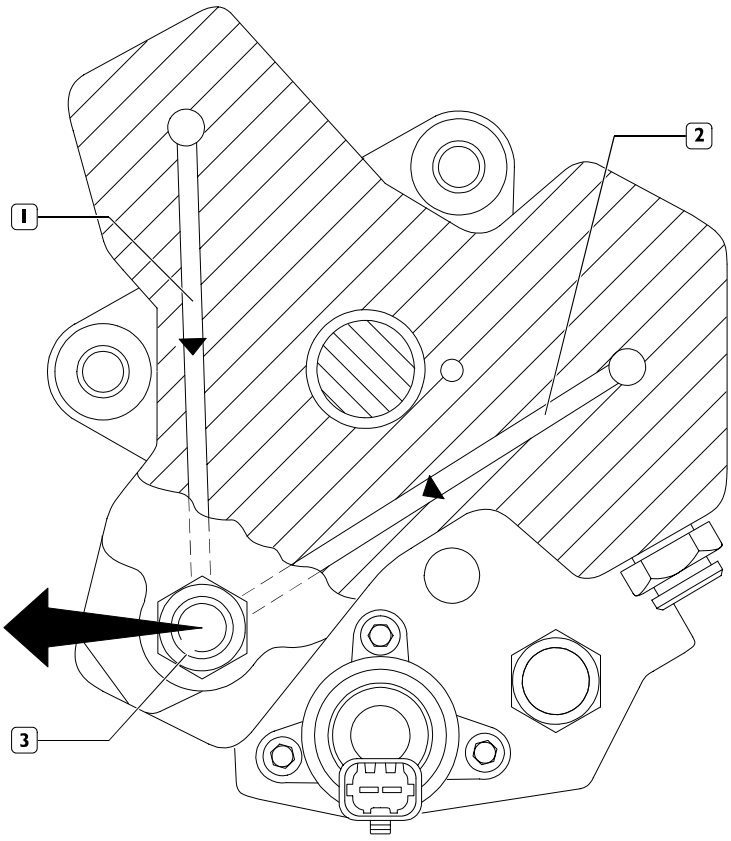
Figure 254 shows the low-pressure fuel routing in the pump; it highlights the main supply duct of the pumping elements (4), the supply ducts of the pumping elements (1-3-6), the ducts used to lubricate the pump (2), the pressure regulator (5), the 5-bar relief valve (8) and the fuel outlet.

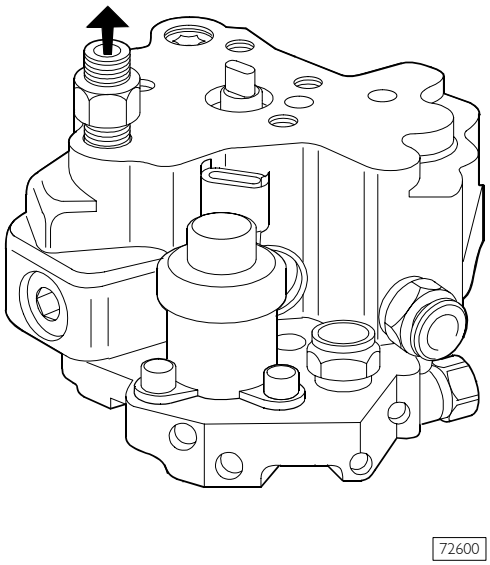
The pump shaft is lubricated by the fuel through the delivery and return ducts (2).

The pressure regulator (5) determines the amount of fuel with which to supply the pumping elements; excess fuel flows out through the duct (9).

The 5-bar relief valve, besides acting as a manifold for the fuel outlets, has the function of keeping the pressure constant at 5 bars at the regulator inlet.

Figure 255





Sec. A – A (Figure 253)

1, 2 Fuel outlet ducts – 3. Fuel outlet from the pump with coupling for high-pressure pipe for the common rail.

The figure shows the high-pressure fuel flow through the outlet ducts of the pumping elements.

771034 Pressure control valve

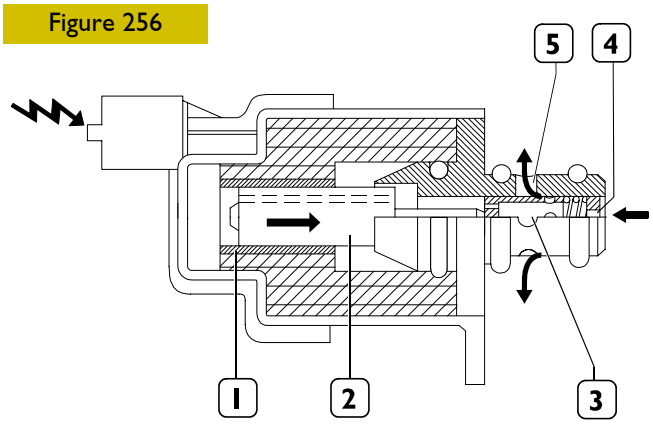
The fuel pressure regulator is mounted on the low-pressure circuit of the CP3 pump. The pressure regulator modulates the amount of fuel sent to the high-pressure circuit according to the commands received directly from the engine control unit. The pressure regulator is mainly composed of the following components:

- connector
- casing
- solenoid
- pre-load spring
- shutter cylinder.

When there is no signal, the pressure regulator is normally open, therefore with the pump providing maximum delivery. The engine control unit, via the PWM (Pulse Width Modulation) signal, modulates the change in fuel flow rate in the high-pressure circuit by partially closing or opening the sections of passage of the fuel in the low-pressure circuit.

Operation

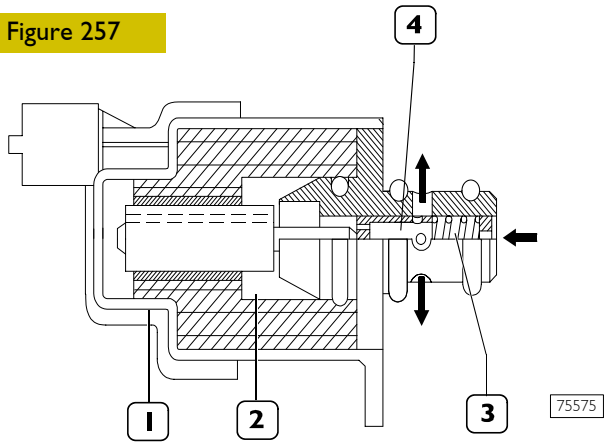
Figure 256



1. Solenoid – 2. Magnetic core – 3. Shutter cylinder – 4. Fuel inlet – 5. Fuel outlet.

When the engine control unit governs the pressure regulator (via PWM signal), the solenoid (1) is energized that, in its turn, generates the movement of the magnetic core (2). The shift of the core causes the shutter cylinder (3) to move axially, choking the flow of fuel.

Figure 257

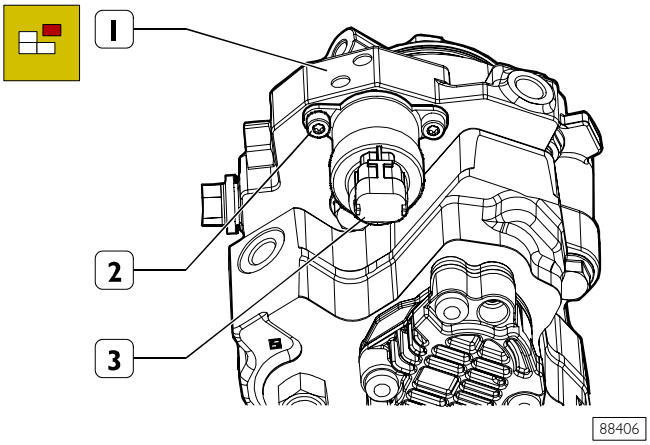


1. Solenoid – 2. Magnetic core – 3. Pre-load spring – 4. Shutter cylinder.

When the solenoid (1) is not energized, the magnetic core is pushed into the rest position by the pre-load spring (3). In this condition, the shutter cylinder (4) is in such a position as to offer the fuel the greatest section of passage.

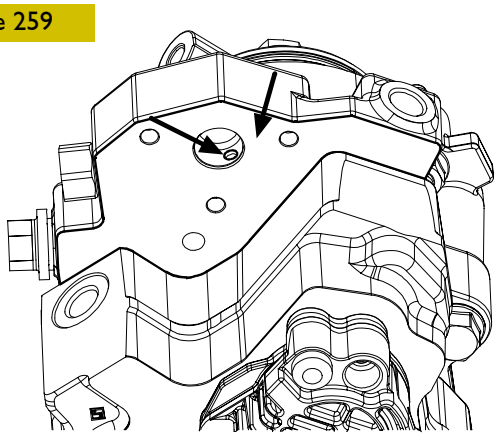
Replacing pressure regulator.

Figure 258



Accurately clean high pressure pump.
Take off screws (2) and unthread pressure regulator (3) from high pressure pump.

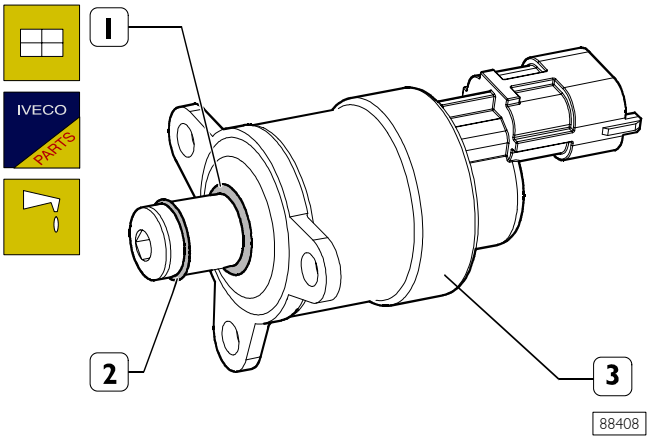
Figure 259



Accurately clean the seat (→) of pressure regulator and the connection surface (→) of the regulator.

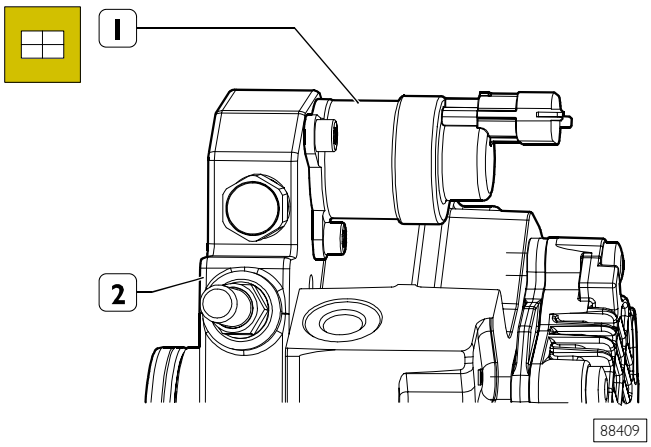
NOTE For cleaning, do not use a tool which could damage the surfaces and pay attention that impurities are not introduced into channels.

Figure 260



Mount new seal rings (1 and 2) on pressure regulator (3) and lubricate the rings with vaseline.

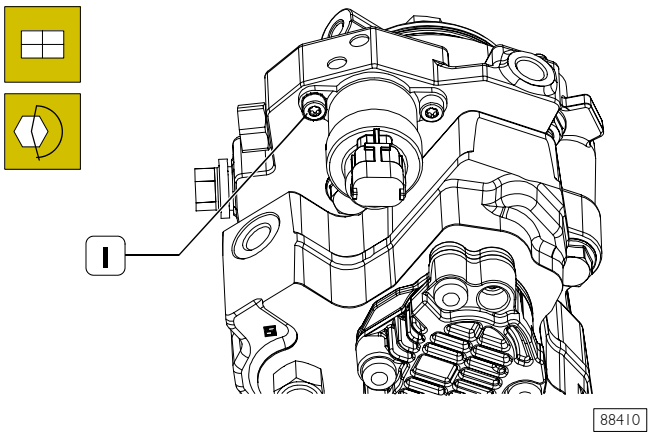
Figure 261



Mount pressure regulator (1) on high pressure pump (2).

NOTE Mounting operation must be performed keeping the regulator perpendicular to connection plane without angling it, in order not to damage seal rings (1-2, Figure 260).

Figure 262



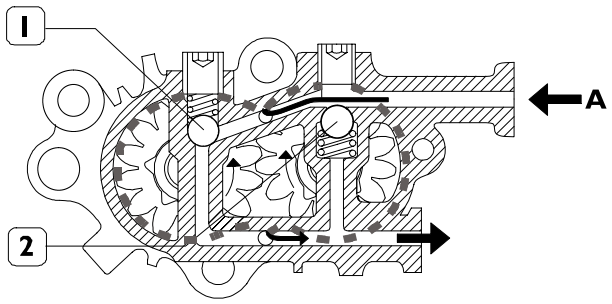
Screw up screws (1) and tighten them at 6 ÷ 7 Nm (0.6 ÷ 0.7 kgm) torque.

NOTE Where pressure regulator is replaced on the engine mounted on the vehicle, it is needed, after replacement, to check that there are no fuel leaks after an engine working period.

MECHANICAL SUPPLY PUMP

Normal working condition

Figure 263

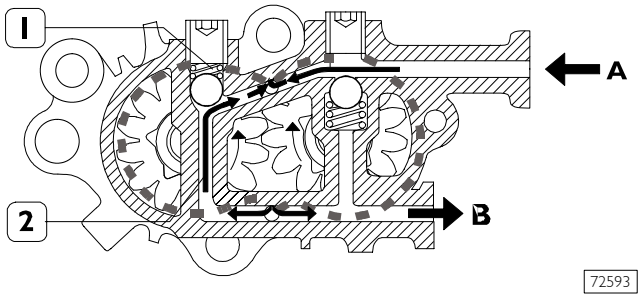


A. Fuel inlet from the tank – B. Fuel outlet to the filter – 1, 2 By-pass valves in closed position.

The function of the gear pump, mounted on the rear of the high-pressure pump, is to supply the high-pressure pump. It is governed by the shaft of the high-pressure pump.
In normal working conditions, the flow of fuel inside the mechanical pump is shown in the figure.

Conditions of outlet overpressure

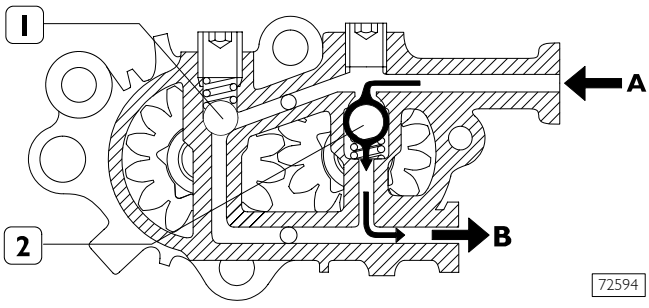
Figure 264



The by-pass valve (1) trips when overpressure is generated at the outlet B. The pressure, overcoming the elastic resistance of the spring of the valve (1), sets the outlet in communication with the inlet via the duct (2).

Conditions of bleeding

Figure 265



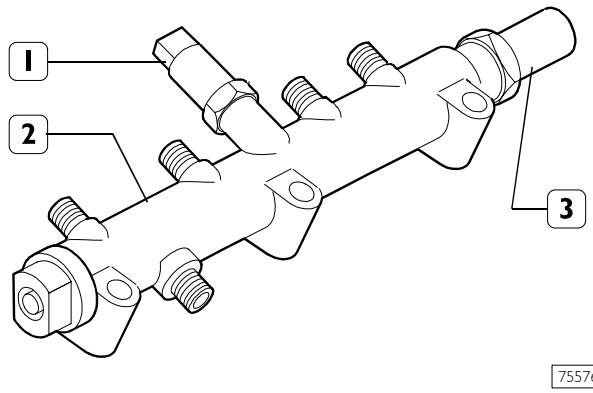
The by-pass valve (1) trips when, with the engine switched off, you want to fill the supply system via the priming pump. In this situation, the by-pass valve (2) opens, due to the effect of the inlet pressure, and the fuel flows out via the outlet B.

774510 Hydraulic accumulator (rail)

The hydraulic accumulator is mounted on aspiration side cylinder head.
Its task is to damp pressure oscillations caused:

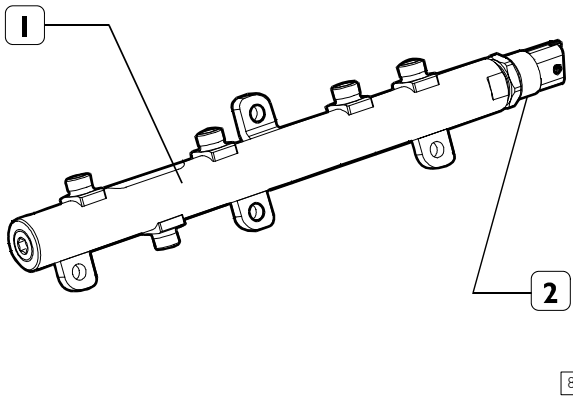
- the operation of the high-pressure pump;
- the opening of the electro-injectors.

Figure 266



1. Forged version hydraulic accumulator, inner volume ~ 22 cm^3 - 2. Fuel pressure sensor - 3. Overpressure valve.

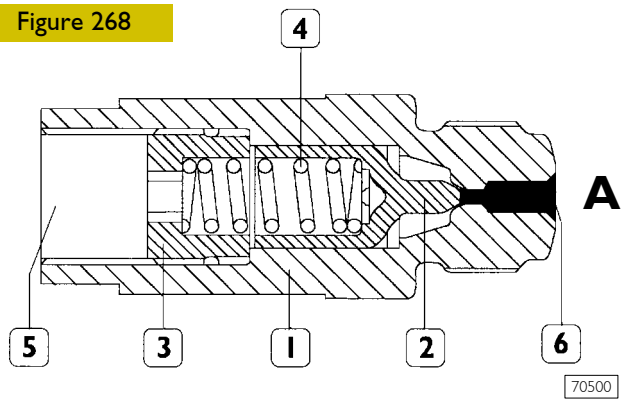
Figure 267



1. Welded version hydraulic accumulator, inner volume ~ 23 cm^3 - 2. Fuel pressure sensor.

Overpressure valve (for forged hydraulic accumulator)

Figure 268

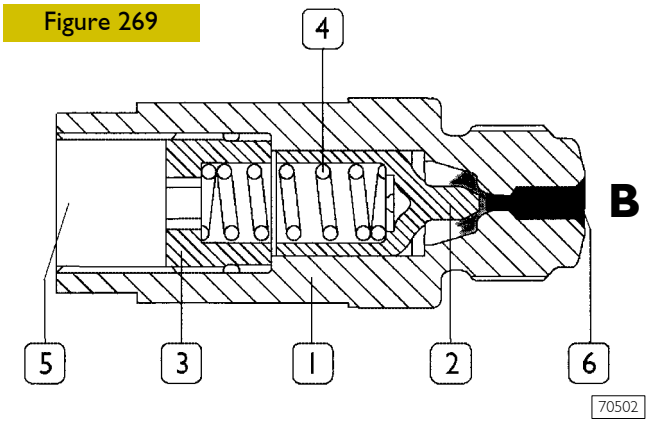


1. Casing – 2. Plunger – 3. Stop – 4. Spring – 5. Direct outlet to tank – 6. Seat on rail.

The pressure relief valve protects the system components if the fuel pressure exceeds the setting: 1750 bars.

A. The tapered end of the plunger normally keeps the outlet to the tank shut.

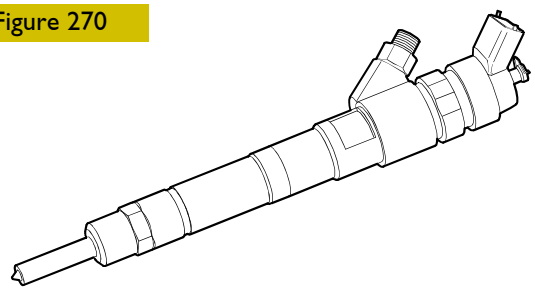
Figure 269



B. If the pressure of the fuel in the hydraulic accumulator exceeds 1750 bars, the plunger gets shifted and the excess pressure is discharged into the tank.

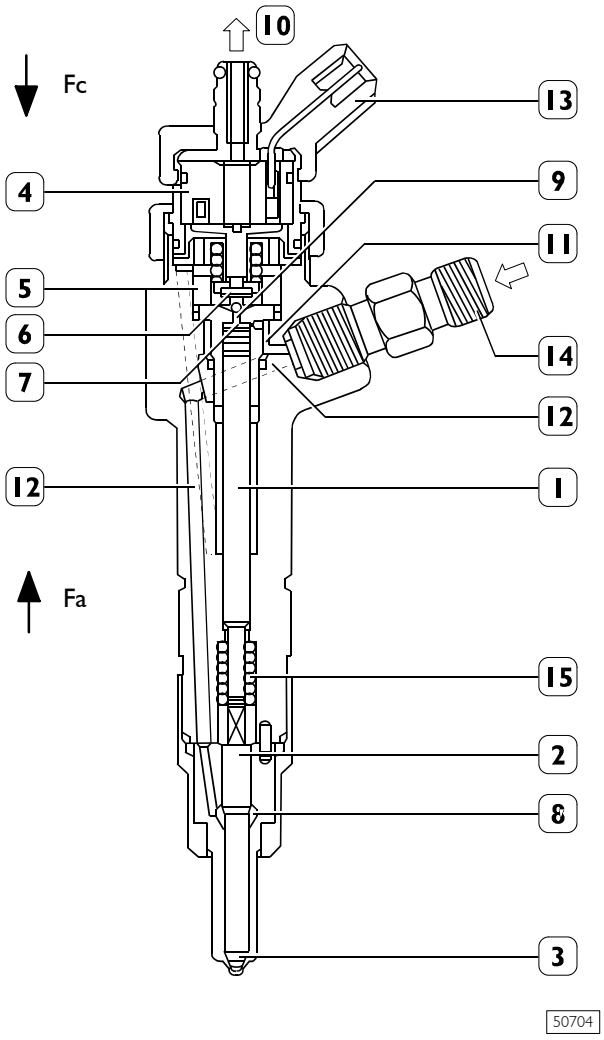
775010 ELECTRO-INJECTORS

Figure 270



The electro-injectors have high-pressure supply (up to 1600 bar) and recirculation at atmospheric pressure, necessary for the diesel used to operate the pilot valve.
The temperature of the diesel put back into circulation by the electro-injector can get very high (approximately 120°C).
The head of the electro-injector has a fitting for the electrical connector.
They are mounted on the cylinder head and operated by the injection control unit.

Figure 271



1 Pressure rod – 2 Pin – 3 Nozzle – 4 Coil – 5 Pilot valve – 6 Ball shutter – 7 Control area – 8. Pressure chamber – 9 Control volume – 10 Low-pressure fuel return – 11 Control pipe – 12 Supply pipe – 13 Electrical connection – 14 High-pressure fuel inlet fitting – 15 Spring.

The electro-injector can be divided into two parts:

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

Operation

Electro-injector operation can be broken down into three phases:

- "rest position"

Coil (4) is de-energised, and shutter (6) is in closing position and prevents fuel from being introduced into the cylinder, Fc > Fa (Fc: caused by fuel pressure acting on control area (7) of rod (1); Fa: caused by line pressure acting on pressure chamber (8).

- "start of injection"

The coil (4) is energized and causes the shutter (6) to rise. The fuel of the control volume (9) flows off towards the return manifold (10) causing a drop in pressure in the control area (7).
At the same time, line pressure through feed duct (12) applies a force Fa > Fc in pressure chamber (8) lifting peg (2), with fuel being consequently introduced into cylinders.

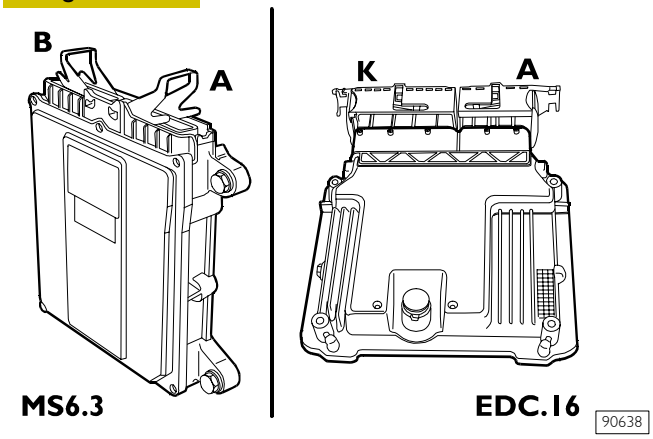
- "end of injection"

The coil (4) is de-energized and makes the shutter (6) return to its closed position. This recreates such a balance in the forces as to make the pin (2) return to its closed position and consequently end injection.

ELECTRIC/ELECTRONIC COMPONENTS

766161 Electronic control unit MS6.3 or EDC 16

Figure 272



The control unit is a "flash EPROM" and so it can be reprogrammed from outside without changing the hardware. It processes the signals from the sensors by applying software algorithms and controls the actuators (especially the electro-injectors and pressure regulator).
The injection control unit has the absolute pressure sensor built in to further improve the control of the injection system. The control unit is mounted on the left-hand side of the engine bay and is connected to the vehicle's wiring harness by two 43-pin connectors:

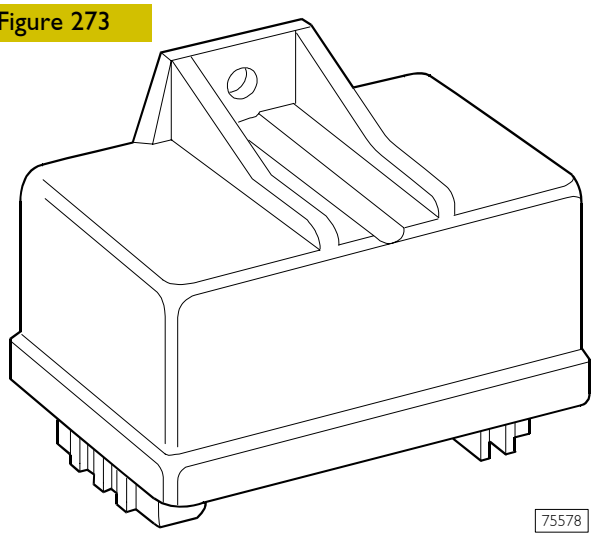
MS6.3:
– 43-pin connector **A** for the components on the engine
– 43-pin connector **B** for the components on the vehicle

EDC.16:
– 60-pin connector **A** for the components on the engine
– 94-pin connector **K** for the components on the vehicle

In addition to handling the operation of the system described under the relevant heading, the electronic control unit is interfaced with the other electronic systems on the vehicles such as ABS – EBD cruise control, speed limiting device, immobilizer (IVECO CODE), EGR and glow plugs.

761917 Glow plug electronic control unit

Figure 273



The engine control unit, in the phase of:

- starting
- after-starting

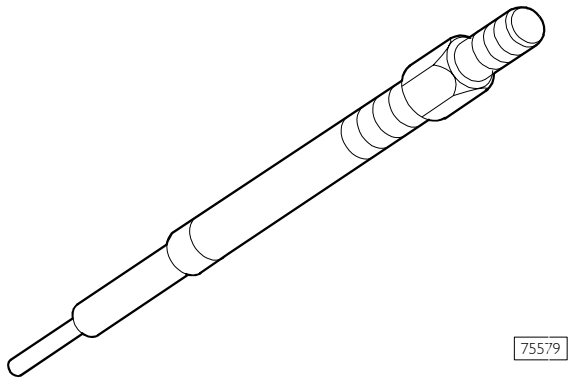
times the operation of the glow plug control unit according to the engine temperature.

Glow plugs drive is through glow plugs pre-heating central unit depending on engine temperature under close control of engine control central unit.

The pre-heating control unit contains an "intelligent" contactor that sends feedback to the control unit that is thus informed about any fault with the pre-heating control unit or shorting to earth of the glow plugs.

761915 Glow plugs

Figure 274



CONTROL VALUES

With a constant supply voltage of 11 V:

- max. current drawn	18 A
- in 5 sec.	11 ±1.5 A
- in 30 sec.	6 ±0.9 A
- temperature after 7 sec.	850°C
- tightening torque	8-10 Nm

SENSORS

Engine speed sensor

It is an inductive type sensor and is positioned on the phonic wheel mounted on engine shaft front end.
It generates signals obtained from magnetic flux lines which close through phonic wheel teeth. Teeth number: 58.

The electronic control unit uses this signal to measure the speed of rotation of the engine, its angular position and to operate the electronic rev counter.
If this signal fails the rev counter will not work.

Camshaft timing sensor

It is a Hall effect type sensor positioned on camshaft pulley.
It generates signals obtained from lines of magnetic flux that close through a notch in the pulley.
The signal generated by this sensor is used by the electronic control unit as a redundant signal to measure the different engine speeds.

772655 Air temperature and pressure sensor

Positioned on the intake manifold, it measures the pressure of the turbocharging air introduced into the intake manifold.
This value, together with that of the air temperature sensor, makes it possible for the electronic control unit to calculate the exact quantity of air introduced into the cylinders so as to operate the injectors adjusting the fuel delivery, limiting harmful emissions, improving consumption and performance.
The sensor contains an electronic temperature correction circuit to optimize the pressure measurement in relation to the temperature of the intake air.

772656 Fuel temperature sensor

Integrated in the fuel filter, it measures the fuel temperature and transmits it to the electronic control unit.
When the fuel temperature is too high (ambient temperature condition, engine at full load and tank in reserve), correct lubrication of the high-pressure pump is no longer assured. On the basis of the values received, the control unit determines the density and volume of the fuel, correcting the delivery limiting engine performance.

774511 Fuel pressure sensor

This is mounted in the middle of the hydraulic accumulator (rail) and it has the task of providing feedback for the injection control unit to:

- adjust injection pressure
- adjust the duration of injection.

766161 Atmospheric pressure sensor

This is integrated in the electronic control unit. It provides a criterion of correction for the measurement of the air flow rate and to calculate the reference air flow rate to check the EGR.

764254 Engine coolant temperature sensor

This provides the control unit with an index of the thermal status of the engine in order to determine corrections for the fuel delivery, injection pressure, EGR injection advance when starting cold (if mounted) and warm-up.

505910 Throttle pedal position sensor

The accelerator pedal position sensor provides the control unit with a voltage value in proportion to the angle of operation of the pedal determining fuel delivery.

772641 Clutch pedal position sensor

Mounted on the pedal board, it provides the control unit with a positive signal when the clutch is engaged (pedal released). Every time the clutch is disengaged to change gear, the control unit fails to receive this signal and deactivates the Cruise Control function.

772642 Brake pedal position sensor

There are two of these sensors mounted on the pedal board. With the brake pedal released, they provide the control unit with a positive signal that is used to detect brake operation so as to deactivate the Cruise Control function and stop delivery of fuel.
In addition, a sensor switches on the brake lights.

764261 Vehicle speed sensor

This sensor, mounted on the gearbox by the drive output shaft, transmits the vehicle speed signal, through the electronic tachograph, to the control unit.

ACTUATORS

The injection system comprises three classes of actuators interlocked with the electronic control unit:

- ❑ electro-injectors (see relevant heading);
- ❑ regulators (see relevant headings) requiring PWM control (Pulse Width Modulation):
  - for pressure
  - EGR (if mounted)
  - turbocharger with variable geometry (if mounted);
- ❑ actuators with continuous ON/OFF signal to:
  - engage electromagnetic coupling for radiator cooling fan;
  - turn on/off air-conditioner compressor (if mounted);
  - Cruise Control;
  - starter heater control;
  - fuel filter heating;
  - electric supply pump.

NOTE All the power controls are made with relays located in the cab.

PWM (Pulse Width Modulation) controls

A PWM control has an active and an inactive state that alternate within a constant set length of time. During the active state the actuator control circuit is closed, which is thus powered with the control voltage; whereas, during the inactive state the circuit is open.
The duration of the two states may be varied with the condition that the sum of the two times is equal to the length of the modulation delivery.
The duration of the active state determines the duty-cycle, which is normally expressed as a percentage of the total time. Therefore, if the duration of the two active and passive states are the same, the duty-cycle is equal to 50%.
For reasons of diagnostics, the duty-cycle is limited between 1% and 99%; the control resolution is equal to 0.005% (1/20000 of the time).
The time length has been chosen taking account of the dynamic actuator response specifications.
Too low a carrier frequency could cause oscillations in the actuator, while too high a frequency would decrease control resolution.
The E.G.R. and variable geometry turbocharger (if mounted) are controlled through a vacuum modulating valve.

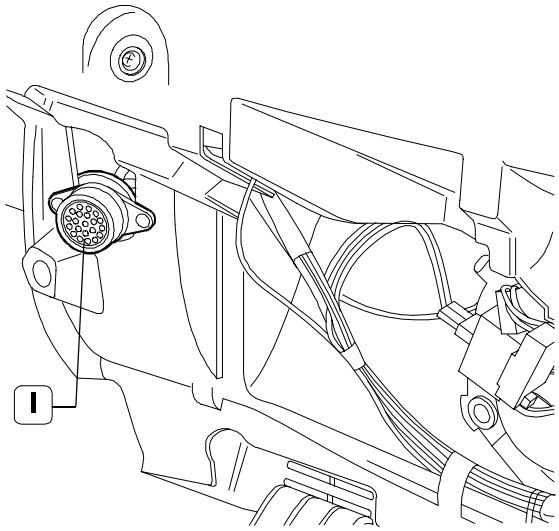
GUIDE TO TROUBLESHOOTING

INTRODUCTION

During vehicle operation, the control unit can detect a series of electric faults. Each fault is associated to a failure code that will be stored in the ECU memory.

Failure codes can be read by connecting IVECO test tools to 38-pole diagnostic socket.

Figure 275



1. 38-pole diagnostic socket.

For the MS 6.3 ECU there is a code for each failure called blink Code, whereas for EDC 16 ECU a double failure code, called DTC and FMI will be stored.

The DTC code represents the failing component whereas the FMI code identifies the failure type.

Good diagnosis is made above all with the electronic diagnosis instruments developed by Iveco (Modus / IT2000 / IWT).

When the vehicle comes into the garage, the information provided by the driver is given due consideration, but the first thing to do is to hook up Modus / IT2000 / IWT and carefully run a full diagnosis:

- reading fault memory;
- reading parameters;
- engine test;
- etc.

Print the entire diagnosis outcomes, specially when Help Desk assistance is required.

The Help Desk will actually reject any demand of assistance if the workshop does not comply with the above procedure.

Here follows a GUIDE TO TROUBLESHOOTING drawn up by the engineers that have designed and implemented the Common Rail with MS 6.3 and EDC 16 ECUs.

Troubleshooting consists of two different sections:

- the first one, organised by Blink Codes for engine versions with MS 6.3 ECU and DTC-FMI for engine versions with EDC 16 ECU, concerns electric-electronic failures that can be directly detected by the control units.
- the second one for troubleshooting by symptoms describes possible trouble that cannot be identified by the electronic control unit. This kind of trouble is chiefly of a mechanical – hydraulic nature.

1st Section
for engine versions with MS 6.3 ECU

Blink code (on vehicles up to chassis No. 5383302/D187233)

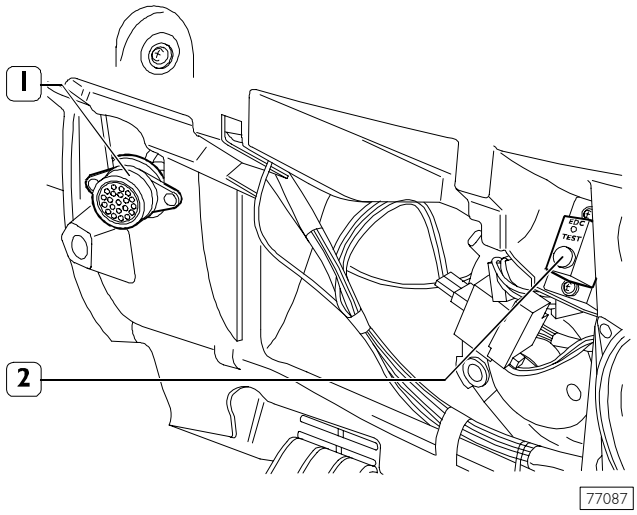
With the key turned off, press the diagnosis button.

- Two sets of flashes of the EDC warning light with a short pause in between indicate the code number of the first error stored in memory.
- Press the button again to pass on to the next error.
- After reaching the last error, the first one is repeated.
- The list of errors contains all the errors stored in memory and not only the active ones.
- The order of presentation of the errors respects the chronological order in which they appeared.

The table gives the error codes.
To delete the list of errors from the control unit memory, follow this procedure:

- with the key turned off, press the diagnosis button;
- keeping the button pressed, turn the key on;
- keep the button pressed for 5 seconds;
- let go of the button;
- turn the key off.

Figure 276



1. 38-pin diagnosis socket – 2. Blink code switch

The diagnosis socket (1) and the blink code switch are located in the glove compartment in front of the passenger's seat.

Blink code	Indicator light	Fault description	Power reduction
VEHICLE			
1.1	On	Vehicle speed	
1.2		(not used)	
1.3	Off	Cruise Control buttons	
1.4	Blinking	Throttle pedal	*
1.5	Off	Clutch switch	
1.6	On	Brake switch	
1.7	Off	Throttle/brake plausibility	Idling
1.8	Off	Main EDC / diagnosis indicator light	
1.9	Off	Air-conditioner control contactor	
ENGINE 1			
2.1	Blinking	Water temperature sensor	*
2.2	Off	Air temperature sensor	
2.3	On	Fuel temperature sensor	
2.4	Blinking	Turbocharging pressure sensor	*
2.5	Off	Atmospheric pressure sensor	
2.7	On	Fuel motor pump control contactor	
2.8	Off	Fuel filter heater control contactor	
2.9	On	Fan control contactor	
ENGINE 2			
3.1	Off	Cylinder 1 balancing	
3.2	Off	Cylinder 2 balancing	
3.3	Off	Cylinder 3 balancing	
3.4	Off	Cylinder 4 balancing	
3.5	Off	Battery voltage	
3.6	Off	Glow plug indicator light	
3.7	Off	Glow plug control contactor	
3.9	Off	Pre-heating monitoring	

Blink code	Indicator light	Fault description	Power reduction
ELECTRO-INJECTORS			
5.1	Blinking	Cylinder 1 injector solenoid valve	
5.2	Blinking	Cylinder 2 injector solenoid valve	
5.3	Blinking	Cylinder 3 injector solenoid valve	
5.4	Blinking	Cylinder 4 injector solenoid valve	
5.7	Blinking	Bank 1 (cylinders 1 – 4)	
5.8	Blinking	Bank 2 (cylinders 2 – 3)	
ENGINE SPEED			
6.1	Blinking	Crankshaft sensor	*
6.2	Blinking	Timing sensor	*
6.4	Off	Engine overspeed	
FUEL PRESSURE			
8.1	Blinking	Fuel pressure control	* or cutting out engine
8.2	Blinking	Fuel pressure sensor	*
8.3	Blinking	Pressure regulator solenoid valve	
8.5	On	EGR monitoring	
8.6	On	EGR solenoid valve	
8.7	On	Debimeter	
8.8	Off	Air temperature sensor (debimeter)	
CONTROL UNIT			
9.1	Blinking	Control unit error (Gate array)	* or cutting out engine
9.2	On	Control unit error (EEPROM)	
9.3	Blinking	EDC – Immobilizer communication	
9.4	On	Main contactor	
9.5	Off	After run test	
9.6	Blinking	Engine Stop Test (ECU)	
9.7	Blinking	Sensor power supply	* or cutting out engine
9.8	Blinking	Control unit error (Checksum)	Starting not possible
9.9	Blinking	Control unit error (Operating system)	Cutting out engine

(*) Cases when there is a power reduction.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.1	On	Vehicle speed sensor signal not plausible (circuit may be open or sensor defective).	The speedometer does not work (if the fault is between the sensor and the speedometer). Cruise Control / PTO are not working.	Read measurable parameters with the diagnostic instrument: when there is this error, the vehicle speed read on the control unit will be fixed on 5 km/h. Read fault memory with the diagnosis instrument: if the error is intermittent, check the connectors for an uncertain contact. If the error is present, perform the following checks: • If the speedometer doesn't work, use a multimeter to check the sensor power supply (12V) between its pin 1 and earth. If the power supply is correct, check the wiring between the sensor's pin 3 and the instrument panel's pin B1* (A22**), between the sensor's pin 2 and the instrument panel's pin B10* (A21**). • If the speedometer works but indicates an implausible speed, check the sensor is fitted properly, it is clean and its magnetic gap is correct. If the defect persists, check the wiring between the instrument panel's pin B5* (A20**) and the EDC connector's pin B14, and between the instrument panel's pin B13* (A1**) and the EDC connector's pin B4.	Error detected only with vehicle travelling and only in the event of a short circuit. If signal is not present no error is detected because the control unit considers vehicle to be at a standstill. * old code ** new code

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.3	Off	Cruise Control / PTO control buttons not plausible.	Cruise Control / PTO and idling adjustment fail to work.	Read status parameters with the diagnosis instrument to identify the defective control (does not switch ON-OFF). Check the wiring from OFF (pin 4 drive control system) to EDC connector pin B32, RESUME (pin 5 drive control system) to EDC connector pin B25, from SET + button (pin 6 drive control system) to EDC connector pin B33, from SET – button (pin 3 drive control system) to EDC connector pin B1. Check there is voltage (approximately 12V) between pins 1, 2 and earth of the Cruise Controls. If the voltage is right and the wiring sound, but the fault remains, change the right-hand lever of the drive control system.	Not plausible if Set+ and Set- or Resume and Off are activated at the same time.
1.4	Blinking	Throttle pedal potentiometer shorted.	Power loss. Engine runs at fast idle speed (1500 rpm) with throttle pedal in rest position. Pressing the pedal causes the engine rpm to increase progressively and uncontrollably up to a reduced top speed (3900 rpm).	Read measurable parameters with the diagnostic instrument to check potentiometer malfunctioning (the signal does not change from 0% to 100%). Check the integrity of the potentiometer (R total = approx. 1 kOhm between pins 4 and 6), check the linear change in resistance of the potentiometer between pins 5 – 6 and 5 – 4 between the minimum and the maximum. If the potentiometer is working correctly, check the wiring between the pedal connector pin 6 and the EDC connector pin B27, between the pedal connector pin 4 and the EDC connector pin B35, between the pedal connector pin 5 and the EDC connector pin B2.	
1.4	Blinking	No signal from the throttle pedal potentiometer (circuit may be open).	Fast idling 1500 rpm in any pedal position.	Check the integrity of the potentiometer. If the potentiometer is sound, check the wiring between the potentiometer and the EDC control unit connector.	

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.4	Blinking	Throttle pedal: implausible signal between idling switch and potentiometer.	Fast idling 1500 rpm in idling position and normal acceleration position when pressing the pedal.	Read status parameters with the diagnosis instrument to check the idling switch works properly. If the outcome is negative, use a multimeter on the component to check the integrity of the idling switch (ON-OFF switching between pins 3 and 2 of the pedal connector). If the switch is sound, look for a break in the wiring between the switch pin 2 and EDC connector pin B29, between switch pin 3 and EDC connector pin B13.	(The potentiometer signal is good and indicates the pedal has been released, but the switch status indicates the pedal is pressed.)
1.4	Blinking	Throttle pedal: implausible signal between idling switch and potentiometer.	Idling normal, but on pressing the pedal the engine speed settles on an intermediate fixed value.	Using a multimeter on the component, check the integrity of the potentiometer. If the potentiometer is sound, look for a break or short-circuiting in the wiring between the potentiometer and the connector.	(The potentiometer signal is good and indicates the pedal has been released, but the potentiometer signal indicates the pedal is pressed.)

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.5	Off	Clutch switch: signal not plausible (at the EDC control unit it seems the speed of the vehicle has changed from 0 to at least 30 km/h without the clutch getting pressed) or not present.	Cruise Control / PTO fail to work.	Read status parameters with the diagnosis instrument to check correct switchover on pressing the pedal. If the result is negative, use a multimeter on the component to check continuity and switchover on pressing the pedal between pins 1 and 2. If the switch is sound, check the continuity of the wiring between switch pin 2 and EDC connector B38. With the key ON, check there is voltage (approx. 12V) between EDC pin B31 and earth. Also check the fuse 24 and the wiring between the switch pin 1 and pin 13 of fuse 24.	If everything turns out satisfactory with the check, the trouble could be with not pressing the clutch fully down (it is sometimes possible to change gear without operating the switch).
1.6	On	Brake switch – signals not plausible between primary and secondary.	Brake lights might not work. The Cruise Control / PTO fails to work.	Read status parameters with the diagnosis instrument to check correct and simultaneous switchover of the primary and secondary brake switches. If the outcome is negative, use a multimeter to check the integrity and correct switchover of the switches (one between pins 3 and 2 and the other between pins 1 and 2). If the switches are sound, with the key ON and the pedal pressed (brake lights on), check for approx. 12V on EDC pin B26 (secondary switch) and on EDC pin B31 (primary switch). If there is no voltage, check the wiring and the relays between the switches and EDC connector.	Check the pedal switches are fitted correctly (they must activate at the same time). If the trouble occurs too frequently, change both switches.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.7	Off	Throttle / brake pedal plausibility: simultaneous brake and throttle activation.	Engine speed drops down to idling. If the brake is applied with the throttle pressed, the engine drops down to idling until the brake is released so it is possible to stop the vehicle even if the throttle pedal jams in an intermediate position. Whereas, it is possible to accelerate with the brake pedal pressed without any safety mechanisms tripping.	Read parameters with the diagnosis instrument, check that the throttle pedal potentiometer signal resets on release, otherwise the driver might have pressed the brake and the throttle together.	This error is stored in memory only if the brake and throttle signals are integral. If the error is saved to memory when the pedals are not pressed, it is likely that one of the brake switches is stuck or shorted to +Batt. Make the user aware about using the pedals correctly.
1.8	Off	EDC lamp shorted or circuit open.	The EDC lamp fails to come on when turning the key ON or it stays on even with the key OFF.	Check continuity between the instrument panel pin B17 and EDC connector pin B23. Check that with the key ON there is approx. 12V between the instrument panel pin B16 and earth. Check the LED works between B16 and B17 on the instrument panel. Check continuity between the instrument panel pin B17 and EDC connector pin B23.	The operation of the indicator light is extremely important for the operation and integrity of the system. Make the user aware to check the indicator light works properly with each ignition (if there are no faults in memory, it has to come on for 2 sec. and then go out).

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
1.9	Off	AC compressor control relay coil shorted to +Batt or to earth or circuit open.	The air-conditioning compressor is not disconnected when the EDC requires it.	Active diagnosis with the diagnostic instrument. If the outcome is negative, check that, with the key ON and engine off, between the EDC pin A35 and earth there is no voltage (if there is also 9.7, call the Help Desk to have the control unit replaced, if necessary). If the compressor does cut out, disconnect the relay 25337. If on disconnecting the relay the compressor stops, replace the relay. If the compressor never works, try replacing the relay and check continuity between the EDC connector pin A8 and earth.	If the circuit is open at pin A8 level 2.7-2.8-2.9 are saved to memory as well. The control unit only sees the integrity of the coil between pins 8 – 35 and not any stuck contacts. During active diagnosis, besides the relay tripping the compressor clutch must disconnect-reconnect.
2.1	Blinking	Water temperature sensor short-circuited or circuit open.	Less power (and noise as pre-injection is not implemented) in all cases. Engine cooling fan always on (if there is no temperature signal or it is not valid, in order to protect the engine the control unit turns on the fan).	Read measurable parameters with the diagnosis instrument to check plausibility between EDC water temperature and that signalled by the vehicle's instrument. Read parameters: if there is this error, the water temperature read on the control unit will be the same as that of the fuel. In the event of contrasting indications, use a multimeter to check the integrity of the sensor between its pins 1 and 2 (R = approx. 2.5 kOhm at 20°C). If the sensor is integral, check the wiring between the sensor and EDC connector pin A1-A30.	In the event of trouble with the wiring pin A30, simultaneous signalling of trouble with the fuel temperature sensor and indication (reading measurable parameters) of a fixed temperature of 60°C. In the event of a high temperature, check the engine cooling fan comes on and if necessary the contacts of relay 25336 and fuse no. 5.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
2.2	Off	Air temperature sensor on intake manifold short-circuited or circuit open.	The control unit calculates the fuel metering basing itself on a set temperature value. It is therefore possible to have slight decreases or increases in performance and smoke depending on the difference between the substitution temperature and the actual one.	Read measurable parameters with the diagnosis instrument: if there is this error, the turbocharging air temperature will be fixed at 20°C. If the temperature is fixed at 20°C, check the integrity of the sensor (R = approx. 2.5 kOhm at 20°C) pin 1 and 2. If the sensor is sound, check the wiring between the sensor and EDC connector pin A2-A19.	The temperature sensor is integrated with the pressure sensor.
2.3	On	Fuel temperature sensor short-circuited or circuit open.	The control unit calculates the fuel metering basing itself on the water temperature, but in this case there is no reaction the driver can detect.	Read measurable parameters: if there is this error, the fuel temperature will be the same as that of the water. If the temperature indicated has the same value as that of the water, check the integrity of the sensor (R = approx. 2.5 kOhm at 20°C). If the sensor is sound, check the wiring between the sensor and EDC connector pin A15-A30.	In the event of trouble with the wiring pin A30, simultaneous signalling of trouble with the water temperature sensor and indication (reading parameters) of a fixed temperature of 50°C. If the signal exceeds 85°C, reduction to 60% power, if it exceeds 90°C, reduction in injection pressure, if it exceeds 110°C, the error is stored in memory (even if the signal is sound). If the flight recorder reading detects too much time at high temperatures, make the user aware of not driving with the fuel tank level always low.

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
2.4	Blinking	Air pressure sensor on intake manifold short-circuited or circuit open. Or waste-gate valve malfunctioning.	Decrease in power. Possible oscillation while driving with engine at full load.	Read measurable parameters with the diagnosis instrument: if there is this error, the value read on the control unit will be fixed on 2000 mbar. If the indicated value is fixed at 2000 mbar, check the wiring between the sensor and EDC connector A3 – A34. If the wiring is sound: Check that the waste-gate valve is not jammed shut or open.	The pressure sensor is integrated with the temperature sensor. If the waste-gate valve is jammed shut, there may be surging with the engine under load because: - power limitation trips when accelerating under load; - the turbocharging pressure drops; - the engine goes back to normal operation and the pressure increases; - limitation trips again; - etc. If the turbocharging pressure really is too high, there is a risk of turbine over-revving with its associated damage.
2.5	Off	Ambient pressure sensor short-circuited or circuit open.	Possibly some black smoke at altitude, especially with EGR (it is not excluded at altitude).	The sensor is integrated in the EDC control unit and cannot be replaced on its own.	Any painting on the engine/control unit may prevent the ambient pressure getting measured correctly.
2.7	On	Fuel motor pump relay coil short-circuited or circuit open.	Fuel motor pump always on even with key OFF. The battery discharges. Early deterioration of the motor pump. Or	Active diagnosis of the relay with the diagnosis instrument. Take out the relay 25837, located in the contactor control unit (left-hand side of driver). If the pump cuts out, replace the relay. If the pump does not cut out, check the wiring between 87 of the relay and battery positive.	You hear the noise of the pump turning continuously, even with the key off.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
			The engine starts with difficulty and fails to reach its top performance.	If the motor pump fails to work, check the continuity of the coil between pin A7 and A8 of the EDC connector. In addition, check the wiring between the EDC connector pin A7 and relay 86, EDC connector pin A8 and relay 85.	
2.8	Off	Fuel filter heater relay defective.	Heater always on even with fuel temperature > 5°C. The battery discharges. Heater fails to come on even with fuel temperature < 5°C. Filter may be clogged due to the fuel paraffining with harsh outdoor temperatures (< -15°C).	Active diagnosis of the relay with the diagnosis instrument. Check continuity of the coil between the EDC connector pin A32 and relay pin A8. In addition, check the wiring between the EDC connector pin A32 and relay 86, EDC connector pin A8 and relay 85. Check the continuity of the coil between the EDC connector pin A32 and relay A8. In addition, check the wiring between pins A32 of the control unit and relay 86, control unit A8 and relay 85.	2.3 may get stored in memory since the fuel gets too warm. Starting may be difficult with very cold temperatures. Engine starting may produce too much smoke.
2.9	On	Fan relay coil short-circuited or circuit open.	Increase in fuel consumption. Engine cooling fan always on even with engine cold. Or	Active diagnosis of the relay with the diagnosis instrument. Check coil continuity between EDC connector pin A39 and relay A8. In addition, check the wiring between the EDC connector pin A39 and relay 86, EDC connector pin A8 and relay 85.	In active diagnosis, besides the relay activating, you hear the fan's electromagnetic clutch cutting in and out.

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
			Engine overheating and accordingly possible power limitation. Engine cooling fan fails to work.	Check coil continuity between EDC connector pin A39 and relay A8. In addition, check the wiring between the EDC connector pin A39 and relay 86, EDC connector pin A8 and relay 85.	
3.1	Off	Injector no. 1 unbalanced.	Injector inefficient. There may be irregular rotation and smoke.	Engine test, cylinder efficiency test. Check the wiring and connections between the injector and the EDC connector pin A12 and A40. If the wiring is good, perform the compression test with the diagnosis instrument. If the compression in cylinder no. 1 is OK, replace the injector.	The control unit has to modify the signal to injector no. 1 (Cylinder Balancing) too far beyond the normal value.
3.2	Off	Injector no. 2 unbalanced.	Injector inefficient. There may be irregular rotation and smoke.	Engine test, cylinder efficiency test. Check the wiring and connections between the injector and the EDC connector pin A10 and A43. If the wiring is good, perform the compression test with the diagnosis instrument. If the compression in cylinder no. 2 is OK, replace the injector.	The control unit has to modify the signal to injector no. 2 (Cylinder Balancing) too far beyond the normal value.
3.3	Off	Injector no. 3 unbalanced.	Injector inefficient. There may be irregular rotation and smoke.	Engine test, cylinder efficiency test. Check the wiring and connections between the injector and the EDC connector pin A23 and A42. If the wiring is good, perform the compression test with the diagnosis instrument. If the compression in cylinder no. 3 is OK, replace the injector.	The control unit has to modify the signal to injector no. 3 (Cylinder Balancing) too far beyond the normal value.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
3.4	Off	Injector no. 4 unbalanced.	Injector inefficient. There may be irregular rotation and smoke.	Engine test, cylinder efficiency test. Check the wiring and connections between the injector and the EDC connector pin A24 and A41. If the wiring is good, perform the compression test with the diagnosis instrument. If the compression in cylinder no. 4 is OK, replace the injector.	The control unit has to modify the signal to injector no. 4 (Cylinder Balancing) too far beyond the normal value.
3.5	Off	Battery voltage too low (or recognized as such by the EDC control unit).	Fast idling up to 1250 rpm (depending on the voltage detected) with pedal released.	Check the efficiency of the batteries and recharging circuit, the efficiency of the earth points and that there are no deposits or oxidation on the connectors.	The engine cuts out or fails to start if the battery voltage < 6.5V.
3.6	Off	Pre-heating indicator lamp short-circuited or defective.	a) Pre-heating indicator light always on. b) Pre-heating indicator light always off.	Perform active diagnosis of the indicator light with the diagnosis instrument. Check the wiring between the EDC connector pin B21 and the vehicle's panel B6* (A30**). Check for power between pins B16* (A14**) of the vehicle's panel and earth.	Even at low ambient temperatures, the driver fails to wait for pre-heating as no information is provided by the indicator light. * old code ** new code

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
3.7	Off	Glow plug relay short-circuited or circuit open.	Shorted to +Batt or circuit open: the glow plugs do not work, starting may be difficult and smokiness on starting. Shorted to earth: the glow plugs are always powered (short life).	Check the wiring of the EDC connector pin B42 to find the shorting to +Batt or to earth or the break in the circuit. Check the integrity of the pre-heating control unit. Check the 60A fuse connected between the battery positive and the pre-heating control unit connector pin 30. Check the power supply is correct on pin 86 of the pre-heating control unit and on the EDC connector pin B42. Check the earth connection of the pre-heating control unit pin 31.	
3.9	Off	Glow plugs short-circuited or circuit open.	Starting difficult with very rigid outdoor temperatures. Smokiness on starting.	Check the integrity of the single glow plugs. Check the glow plug power supply between the pre-heating control unit connector pin G1 – G2 – G3 – G4 and earth. If all OK, change the pre-heating control unit.	
5.1	Blinking	Electro-injector cylinder no. 1 shorted to +Batt. or shorted to earth or circuit open.	Drop in power made by the EDC control unit. The engine runs on 2 cylinders. Possibly 3.1. The engine runs on 3 cylinders.	Check the wiring and connections between the injector and the EDC connector pin A12 – A40. If the wiring is good, change the injector.	

Base - May 2004

Print 603.93.281

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
5.2	Blinking	Electro-injector cylinder no. 2 shorted to +Batt. or shorted to earth or circuit open.	Drop in power made by the EDC control unit. The engine runs on 2 cylinders. Possibly 3.2. The engine runs on 3 cylinders.	Check the wiring and connections between the injector and the EDC connector pin A10 – A43. If the wiring is good, change the injector.	
5.3	Blinking	Electro-injector cylinder no. 3 shorted to +Batt. or shorted to earth or circuit open.	Drop in power made by the EDC control unit. The engine runs on 2 cylinders. Possibly 3.3. The engine runs on 3 cylinders.	Check the wiring and connections between the injector and the EDC connector pin A23 – A42. If the wiring is good, change the injector.	
5.4	Blinking	Electro-injector cylinder no. 4 shorted to +Batt. or shorted to earth or circuit open.	Drop in power made by the EDC control unit. The engine runs on 2 cylinders. Possibly 3.4. The engine runs on 3 cylinders.	Check the wiring and connections between the injector and the EDC connector pin A24 – A41. If the wiring is good, change the injector.	
5.7	Blinking	Power stage to supply the electro-injectors of cylinders 1 and 4 (in control unit) defective.	Possibly 3.1 – 3.4. The engine runs on 2 cylinders	Delete the fault memory and try again. If the error remains and only after excluding the injector 1 or 4 defect, call the Help Desk and follow their instructions to replace the control unit if necessary.	

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
5.8	Blinking	Power stage to supply the electro-injectors of cylinders 2 and 3 (in control unit) defective.	Possibly 3.2 – 3.3. The engine runs on 2 cylinders	Delete the fault memory and try again. If the error remains and only after excluding the injector 2 or 3 defect, call the Help Desk and follow their instructions to replace the control unit if necessary.	
6.1	Blinking	Crankshaft sensor: no signal or implausible signal.	The engine will not start cold, it could start warm with difficulty. With the engine running, power reduction and increased noise.	Check the integrity of the sensor (R = approx. 850 Ohm). If the sensor is sound, check the wiring between the sensor and EDC connector pin A29 – A37. Check the sensor is fastened properly.	If there is no crankshaft signal, the camshaft sensor speed signal is used instead. Power reduction (and noise reduction because the control unit cannot manage advance and duration of injection and bases itself on a recovery map. Pre-injection is not implemented).
6.2	Blinking	Camshaft sensor: no signal or implausible signal.	The engine will not start cold, it could start warm with difficulty. With the engine running, power reduction and increased noise. False injections during starting and smoke at the exhaust.	Check the integrity of the sensor (R = approx. 850 Ohm). If the sensor is sound, check the wiring between the sensor and EDC connector pin A4 – A31. Check the sensor is fastened properly.	If there is no camshaft signal, the flywheel sensor timing signal is used instead.
6.4	Off	The engine has over-revved (over 5500 rpm), probably driven, or crankshaft sensor signal not plausible (in this case, error 6.1 signalled).	If the over-revving occurred when driven, the driver can detect no reaction (other than the indicator light blinking).	Data saved to memory, check the duration and frequency of the over-revving. Delete the fault memory.	Make the driver aware about using the vehicle correctly.

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
8.1	Blinking	Pressure in rail too great. The electric command fails to reach the pressure regulator.	The engine cuts out, loud noise before cutting out.	Check that the connector on the pressure regulator is connected. If it is connected, check the wiring between the regulator and the EDC connector pin A9 – A20.	After a few times, the pressure relief valve might remain open, in which case it has to be changed.
8.1	Blinking	Pressure in rail too great. Pressure regulator mechanically jammed open.	The engine cuts out, loud noise before cutting out.	Perform the high-pressure test with the diagnosis instrument. If the outcome is negative, replace the high-pressure pump – regulator assembly.	After a few times, the pressure relief valve might remain jammed open, in which case it has to be changed.
8.1	Blinking	Pressure in rail too low. Pressure regulator mechanically jammed shut.	The engine cuts out or fails to start.	Perform the high-pressure test with the diagnosis instrument. If the outcome is negative, replace the high-pressure pump – regulator assembly.	
8.1	Blinking	Pressure in rail too low. Shorting to +Batt. on the pressure regulator.	The engine cuts out or fails to start.	Check the wiring between the regulator and EDC connector pin A9 – A20.	
8.1	Blinking	Pressure in rail too low. High-pressure pump defective.	The engine cuts out or fails to start.	Perform the high-pressure test with the diagnosis instrument. If the outcome is negative, replace the high-pressure pump together with the regulator.	
8.1	Blinking	Injector mechanically jammed open.	The engine cuts out or fails to start.	Perform the cylinder efficiency test with the diagnosis instrument. If the outcome is negative, replace the defective injector.	
8.1	Blinking	Pressure in rail too low. Major fuel leak from the high-pressure circuit.	The engine cuts out or fails to start.	Check the high-pressure circuit and eliminate the leak (beware, there could be a leak inside the head between the high-pressure union and the injector).	

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
8.1	Blinking	Pressure in rail too low. Fuel supply problem in the low-pressure circuit.	The engine cuts out or fails to start.	Check the motor pump works properly, check for any clogging in the filter and pre-filter, crushed or leaking pipes, and check the fuel supply gear pump works properly.	
8.2	Blinking	Rail pressure sensor short-circuited or circuit open.	The engine cuts out.	Check the sensor is powered correctly. If the power supply is correct (approx. 5V) change the sensor. If it is greater than approx. 5V, check the wiring between the sensor and the EDC connector pin A33-A6.	
8.3	Blinking	Pressure regulator short-circuited or circuit open.	If shorted to +Batt., the pressure in the rail drops too much, the engine cuts out and fails to restart. Or If shorted to earth or the circuit is open, the pressure in the rail rises above the maximum value and the engine cuts out.	Check the wiring between the pressure regulator and the EDC connector pin A9 – A20. Check the wiring between the pressure regulator and the EDC connector pin A9 – A20.	8.1 – 8.2 may also be signalled. 8.1 may also be signalled.

Print 603.93.281

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
8.5	On	EGR monitoring: incorrect implementation of EGR percentage calculated by the control unit.	EGR is turned off. Emissions not conforming to legislation. Poor performance and smokiness at high engine speeds.	Check that the EGR pneumatic valve is not jammed shut or open (or intentionally tampered with). Check that the pipe between the solenoid valve and EGR pneumatic valve is not crushed, perforated or disconnected. Check the EGR solenoid valve works properly (active diagnosis with the diagnostic instrument). Using a multimeter, check the integrity of the solenoid valve. If the solenoid valve is sound, check the wiring between the solenoid valve and the EDC connector pin A25 – A8.	If there is a defect on the wiring of pin A8, the errors associated with all the devices connected to this pin will be saved to memory.
8.6	On	EGR solenoid valve short-circuited or circuit open.	EGR doesn't work or works constantly. Emissions not conforming to legislation. No reaction the driver can detect.	Check the EGR solenoid valve works properly (active diagnosis with the diagnostic instrument). Using a multimeter, check the integrity of the solenoid valve. If the solenoid valve is sound, check the wiring between the solenoid valve and the EDC connector pin A25 – A8.	If there is a defect on the wiring of the EDC connector pin A8, the errors associated with all the devices connected to this pin will be saved to memory.
8.7	On	Debimeter short-circuited or circuit open.	Power reduction and EGR function turned off.	Check the integrity of the debimeter and the wiring between the debimeter connector and the EDC connector pin A17 – A18 – A26 – A28.	
8.8	Off	EGR air temperature sensor short-circuited or circuit open.	No reaction the driver can perceive.	Read measurable parameters with the diagnosis instrument: in the event of this trouble, the ambient temperature read on the control unit will be fixed on 30°C. Check the wiring between the debimeter and EDC connector pin A5 – A18.	

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
9.1	Blinking	Defect inside the control unit.	The engine cuts out or fails to start. In some cases, it might not cut out, but go onto the power reduction level.	Delete the fault memory. If the error remains, call the Help Desk and follow their instructions to replace the control unit if necessary.	This may occur when the power supply to the control unit is cut off without using the key. Perhaps no defect has been saved to memory, it depends on the state of defectiveness of the control unit.
9.2	On	EEPROM defect in control unit.	The data are not saved to memory when turning off the engine. The fault memory is lost, it is only possible to read the faults that are present but not the intermittent ones. Any idling speed set with the Cruise Control commands is not stored in memory.	Delete the fault memory. If the error remains, call the Help Desk and follow their instructions to replace the control unit if necessary.	
9.3	Blinking	Communication trouble with the immobilizer; short-circuiting or circuit open on the CAN line.	The engine cuts out or fails to start.	Perform Immobilizer diagnosis and check the integrity of the CAN line.	
9.4	On	a) Main relay broken. b) Main relay short-circuited.	a) The control unit is not powered (the engine fails to start or cuts out). b) The control unit is constantly powered and the indicator light stays on even with the key turned OFF (the battery discharges).	Replace the main relay.	

Base - May 2004

Print 603.93.281

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
9.5	Off	After Run broken off several times.	Fault memory and other working data are not corrected saved in EEPROM. EDC inhibits starting the engine after a certain number of unsuccessful After Runs.	Check the control unit power supply wiring for any intermittent false contacts. If the wiring is good, replace the main relay.	Investigate any incorrect use of the vehicle.
9.6	Blinking	Failure of the internal test procedure that takes place in the control unit every time the engine stops.	The engine fails to stop in the set time when the +15 key is turned onto OFF.	This could occur if the engine is turned off but it continues to be driven (vehicle moving with gear engaged). Check the wiring between the key +15 and the control unit connector pin B20. Delete the fault memory: if in normal conditions of turning off the engine the error signal persists, call the Help Desk to have the control unit replaced if necessary.	
9.7	Blinking	Internal defect of the control unit in the sensor power supply circuit.	Reduction in power (and noise because pre-injection is not implemented). Irregular engine operation due to sensors not being powered correctly.	Call the Help Desk and follow their instructions to replace the control unit if necessary.	Defects may be signalled for various sensors powered by the control unit.

Print 603.93.281

Base - May 2004

BLINK CODE	EDC LAMP	POSSIBLE CAUSE	POSSIBLE TROUBLE	TESTS OR RECOMMENDED ACTION	NOTES
9.8	Blinking	Internal problem with the control unit software or an attempt to tamper with the data-set.	The engine fails to start or starts only occasionally.	Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to reprogram or replace the control unit if necessary.	
9.9	Blinking	Internal problem with the control unit software (operating system).	Possible short breaks in injection because the control unit resets irregularly while the engine is running. Other defects may be signalled.	Delete the fault memory: if the error remains, call the Help Desk and follow their instructions to replace the control unit if necessary.	If this error is signalled together with other defects, resolve this problem first as it could be the cause of the others.

1st Section

DTC-FMI error codes with EDC central unit

software version P 315 V32

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0D	02	EGR - AIR MASS SUPPLY TOO HIGH	BELOW LOWER LIMIT	EGR off. Emissions not compliant with law. Derated performance and smoke at high engine rpm.	EGR monitoring: incorrect EGR percentage actuation calculated by ECU.	Check, if the EGR pneumatic valve is not locked in Open or Closed-Position 2) Check, that the solenoid valve and the EGR pneumatic valve is not squashed or holed or detached 3) Check the EGR solenoid valve-functionality 4) Check the solenoid valve-integrity by means of a multimeter 5) Check the wiring harness between the solenoid valve and the EDC connector.				
11	01	ENGINE 1 - BOOST PRESSURE SENSOR	EXCEEDED UPPER LIMIT	Positive power reduction and smoke in exhaust.		Check wiring and connections. Possibly replace sensor. Check in "measurable parameter" environment that atmospheric pressure sensor and turbo charger air pressure sensor values are similar when engine is off.				Possible smoke in exhaust during acceleration. Replace if required.
11	02	ENGINE 1 - BOOST PRESSURE SENSOR	BELOW LOWER LIMIT	Positive power reduction and smoke in exhaust.		Check wiring and connections. Replace sensor if required.				Possible smoke in exhaust during acceleration. Replace if required.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
11	08	ENGINE 1 - BOOST PRESSURE SENSOR	SIGNAL NOT PLAUSIBLE	Positive power reduction and smoke in exhaust.	Faulty sensor.	Check wiring and connections. Replace sensor if required.				
12	01	ENGINE 2 - BATTERY VOLTAGE	EXCEEDED UPPER LIMIT	Problematic cranking.	Flat battery, interrupted wiring.	Check battery state with diagnostic tool (measurable parameters). Check wiring and connections.				Replace alternator, regulator or battery.
12	02	ENGINE 2 - BATTERY VOLTAGE	BELOW LOWER LIMIT	Engine does not start. Possible power reduction.	Faulty battery, faulty alternator, faulty ECU.	Check with diagnostic tool.				Replace battery, alternator or ECU if required.
13	08	VEHICLE - BRAKE PEDAL SIGNAL ERROR	SIGNAL NOT PLAUSIBLE	Brake signal plausibility, possibly no brake lights, Cruise Control / PTO not working.	The two switch states are different.	Check wiring and connections. Replace sensor if required.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
14	01	ENGINE 1 - COOLANT TEMPERATURE SENSOR	EXCEEDED UPPER LIMIT	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	
14	02	ENGINE 1 - COOLANT TEMPERATURE SENSOR	BELOW LOWER LIMIT	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
14	08	ENGINE 1 - COOLANT TEMPERATURE SENSOR	SIGNAL NOT PLAUSIBLE	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	
15	01	ENGINE 1 - COOLANT TEMPERATURE SENSOR (TEST)	EXCEEDED UPPER LIMIT		Faulty coolant temperature sensor.	Replace sensor.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
1E	08	VEHICLE - CLUTCH SIGNAL SUSPECT	SIGNAL NOT PLAUSIBLE	Clutch switch: signal either not plausible or not present. Cruise Control / PTO not working or engine revs up to maximum speed when clutch pedal is pressed and Cruise control / PTO is on.	Gear shift detected without pressing brake pedal.	Check wiring and connections. Replace sensor if required.				The anomaly caused by incomplete clutch operation if everything is OK.
20	01	EGR - EGR POWER ST. SHORT TO BATT.	EXCEEDED UPPER LIMIT		EGR solenoid valve short-circuit to battery.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
21	02	EGR - SHORT CIRCUIT TO GROUND ON EGR VALVE	BELOW LOWER LIMIT		Solenoid valve short-circuit to ground.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
22	04	EGR - OPEN CIRCUIT ON EGR VALVE	NO SIGNAL		EGR solenoid valve short-circuit or open circuit.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.

Print 603.93.281

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
22	08	EGR - OPEN CIRCUIT ON EGR VALVE	SIGNAL NOT PLAUSIBLE		EGR solenoid valve short-circuit or open circuit.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
24	01	ENGINE SPEED - CAMSHAFT SENSOR	EXCEEDED UPPER LIMIT	Possible problematic cold cranking.	No signal, open circuit.	Check wiring and connections.				Flywheel sensor timing signal adopted if camshaft signal is not correct.
24	02	ENGINE SPEED - CAMSHAFT SENSOR	BELOW LOWER LIMIT	Possible problematic cold cranking.	No signal, open circuit, faulty sensor.	Check correct assembly of sensor and phonic wheel, check engine timing.				Flywheel sensor timing signal adopted if camshaft signal is not correct.
25	01	ENGINE SPEED - CRANKSHAFT SENSOR	EXCEEDED UPPER LIMIT	Problematic cold cranking, power reduction (possible noise due to missed pre-injection).	Faulty sensor.	Check wiring and connections.				Camshaft sensor speed adopted if signal is not present.
25	02	ENGINE SPEED - CRANKSHAFT SENSOR	BELOW LOWER LIMIT	Problematic cold cranking, power reduction (possible noise due to missed pre-injection).	Faulty sensor.	Check wiring and connections.				Camshaft sensor speed adopted if signal is not present.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
26	01	ENGINE SPEED - FAULT BETWEEN FLYWHEEL SENSOR AND CAMSHAFT	EXCEEDED UPPER LIMIT	Possible power reduction.	Incorrect camshaft phonic wheel assembly.	Check wiring, connections and sensor, check that phonic wheel is fitted correctly.				Longer cranking time.
28	01	ENGINE 1 - FUEL TEMPERATURE SENSOR	EXCEEDED UPPER LIMIT	Possible power reduction.	Short-circuit to positive, excessively low temperature is detected.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (Ohm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A52 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A51 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
28	02	ENGINE 1 - FUEL TEMPERATURE SENSOR	BELOW LOWER LIMIT	Possible power reduction.	Short-circuit to ground, excessively high temperature is detected.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (Ohm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A52 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A51 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	
29	01	ENGINE 1 - FAN RELAY	EXCEEDED UPPER LIMIT	Fan relay not working.	Fan relay short-circuit to positive.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
29	02	ENGINE 1 - FAN RELAY	BELOW LOWER LIMIT	Fan relay not working.	Fan relay short-circuit to ground.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
29	04	ENGINE 1 - FAN RELAY	NO SIGNAL	Fan relay not working.		Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
29	08	ENGINE 1 - FAN RELAY	SIGNAL NOT PLAUSIBLE	Fan relay not working.		Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
2A	01	ENGINE 1 - PRE-HEATING RELAY FUEL FILTER	EXCEEDED UPPER LIMIT	Fuel filter pre-heater relay not working.	Filter heater relay short-circuit to positive - Heater always on also at fuel temperature > 5° C.	Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	02	ENGINE 1 - PRE-HEATING RELAY FUEL FILTER	BELOW LOWER LIMIT	Fuel filter pre-heater relay not working.	Filter heater relay short-circuit to ground.	Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	04	ENGINE 1 - PRE-HEATING RELAY FUEL FILTER	NO SIGNAL	Fuel filter pre-heater relay not working.		Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	08	ENGINE 1 - PRE-HEATING RELAY FUEL FILTER	SIGNAL NOT PLAUSIBLE	Fuel filter pre-heater relay not working.		Check wiring and connections. Replace relay if required.				Battery goes flat.
2F	01	ENGINE 2 - GLOW PLUGS RELAY	EXCEEDED UPPER LIMIT	Possible problematic cold cranking.	Short-circuit to positive, glow plugs always on also with ECU off, possible battery deployment.	Check wiring and connections. Replace relay if required.				
2F	02	ENGINE 2 - GLOW PLUGS RELAY	BELOW LOWER LIMIT		Short-circuit to ground, glow plugs always on.	Check wiring and connections. Replace relay if required.				

Print 603.93.281

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2F	04	ENGINE 2 - GLOW PLUGS RELAY	NO SIGNAL	Possible problematic cold cranking.	Faulty wiring.	Check wiring and connections. Replace relay if required.				Faulty diagnostic light.
2F	08	ENGINE 2 - GLOW PLUGS RELAY	SIGNAL NOT PLAUSIBLE	Possible problematic cold cranking.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
30	01	ENGINE 2 - GLOW PLUG W/LIGHT	EXCEEDED UPPER LIMIT	Warning light always off. Problematic cold cranking. Pre-heater warning light always on.	Short-circuit to positive.	Check wiring and connections. Replace sensor if required.				The driver does not wait preheating even when the room temperatures are low, because no warning light signal is enabled. Preheating works, but with cold start-up no indication is available that tells you when to start the motor because the light is always turned on.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
30	02	ENGINE 2 - GLOW PLUG W/LIGHT	BELOW LOWER LIMIT	Warning light always off. Problematic cold cranking. Pre-heater warning light always on.	Short-circuit to ground.	Check wiring and connections. Replace sensor if required.				The driver does not wait preheating even when the room temperatures are low, because no warning light signal is enabled. Preheating works, but with cold start-up no indication is available that tells you when to start the motor because the light is always turned on.
30	04	ENGINE 2 - GLOW PLUG W/LIGHT	NO SIGNAL	Warning light always off. Problematic cold cranking. Pre-heater warning light always on.		Check wiring and connections. Replace sensor if required.				Warning light off during pre-heating. Replace bulb if required.
30	08	ENGINE 2 - GLOW PLUG W/LIGHT	SIGNAL NOT PLAUSIBLE	Warning light always off. Problematic cold cranking. Pre-heater warning light always on.		Check wiring and connections. Replace sensor if required.				Warning light off during pre-heating. Replace bulb if required.
31	01	ENGINE 2 - GLOW PLUGS	EXCEEDED UPPER LIMIT	Possible problematic cold cranking.	Short-circuit to positive.	Check wiring and connections. Check electrical system between relay and glow plugs.				Relay unit always on also with ECU off, possible battery deployment.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
32	01	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	EXCEEDED UPPER LIMIT		Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
33	01	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	EXCEEDED UPPER LIMIT	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
33	02	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	BELOW LOWER LIMIT	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
33	04	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	NO SIGNAL	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
33	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
34	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
35	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
36	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
37	01	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	EXCEEDED UPPER LIMIT		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
38	02	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	BELOW LOWER LIMIT		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
39	01	ENGINE 1 - AIR TEMPERATURE SENSOR	EXCEEDED UPPER LIMIT	Problematic cranking, smoke, problematic acceleration.		Check wiring and connections. Replace sensor if required.	Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 2,5 KOhm;	Air temperature sensor and built-in pressure sensor. The sensor is fitted on flow meter in engines with EGR.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
39	02	ENGINE 1 - AIR TEMPERATURE SENSOR	BELOW LOWER LIMIT	Problematic cranking, smoke, problematic acceleration.	Short-circuit to ground, excessively high temperature is detected.	Check wiring and connections. Replace sensor if required.	Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 2,5 KOhm;	Air temperature sensor and built-in pressure sensor. The sensor is fitted on flow meter in engines with EGR.
3A	02	ELECTRONIC CONTROL UNIT - IMMOBILISER	BELOW LOWER LIMIT	The engine fails to start	Communication with Immobilizer ECU problems on CAN Line.	Check integrity of CAN Line, run Immobilizer ECU diagnostics and wait for indications provided.	Measure type: Resistance (Ohm) Measure point 1: Diagnostic socket. Pin: 21 Measure point 2: Diagnostic socket. Pin: 22	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm Ohm;	
3C	01	INJECTOR - BENCH 1	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3C	02	INJECTOR - BENCH 1	BELOW LOWER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to ground.	Check wiring and connections.				Only two cylinders running.
3C	08	INJECTOR - BENCH 1	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector electrical system failure.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3D	04	INJECTOR - BENCH 1	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring disconnected.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3E	01	INJECTOR - BENCH 2	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3E	02	INJECTOR - BENCH 2	BELOW LOWER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to ground.	Check wiring and connections.				Only two cylinders running.
3E	08	INJECTOR - BENCH 2	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector electrical system failure.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3F	04	INJECTOR - BENCH 2	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring disconnected.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
40	01	INJECTOR - INJECTOR A SUPPLY	EXCEEDED UPPER LIMIT	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
40	02	INJECTOR - INJECTOR A SUPPLY	BELOW LOWER LIMIT	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
40	04	INJECTOR - INJECTOR A SUPPLY	NO SIGNAL	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
40	08	INJECTOR - INJECTOR A SUPPLY	SIGNAL NOT PLAUSIBLE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	01	INJECTOR - INJECTOR B SUPPLY	EXCEEDED UPPER LIMIT	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
41	02	INJECTOR - INJECTOR B SUPPLY	BELOW LOWER LIMIT	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	04	INJECTOR - INJECTOR B SUPPLY	NO SIGNAL	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	08	INJECTOR - INJECTOR B SUPPLY	SIGNAL NOT PLAUSIBLE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
42	01	INJECTOR - INJECTOR 1	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.				Only three cylinders running.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	01	INJECTOR - INJECTOR 1	EXCEEDED UPPER LIMIT				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A47 Measure point 2: Injector Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A16 Measure point 2: Injector Pin: 1	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0.1 Ohm; 2- Min. value: 0.5 Ohm; Max. value: 0.9 Ohm; Typical Value: 0.7 Ohm; 3- Typical Value: 0,1 Ohm;	
42	04	INJECTOR - INJECTOR 1	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
42	04	INJECTOR - INJECTOR 1	NO SIGNAL				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A47 Measure point 2: Injector Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A16 Measure point 2: Injector Pin: 1	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0.1 Ohm; 2- Min. value: 0.5 Ohm; Max. value: 0.9 Ohm; Typical Value: 0.7 Ohm; 3- Typical Value: 0,1 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	08	INJECTOR - INJECTOR 1	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
42	08	INJECTOR - INJECTOR 1	SIGNAL NOT PLAUSIBLE				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A47 Measure point 2: Injector Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A16 Measure point 2: Injector Pin: 1	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0.1 Ohm; 2- Min. value: 0.5 Ohm; Max. value: 0.9 Ohm; Typical Value: 0.7 Ohm; 3- Typical Value: 0,1 Ohm;	
43	04	INJECTOR - INJECTOR 1	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
44	01	INJECTOR - INJECTOR 2	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.				Only three cylinders running.

Print 603.93.281

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	01	INJECTOR - INJECTOR 2	EXCEEDED UPPER LIMIT				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A17 Measure point 2: Injector Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A13 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	
44	04	INJECTOR - INJECTOR 2	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
44	04	INJECTOR - INJECTOR 2	NO SIGNAL				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A17 Measure point 2: Injector Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A13 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	08	INJECTOR - INJECTOR 2	SIGNAL NOT PLAUSIBLE				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A17 Measure point 2: Injector Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A13 Measure point 2: Injector Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	
44	08	INJECTOR - INJECTOR 2	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
45	04	INJECTOR - INJECTOR 2	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
46	01	INJECTOR - INJECTOR 3	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
46	04	INJECTOR - INJECTOR 3	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
46	08	INJECTOR - INJECTOR 3	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
47	04	INJECTOR - INJECTOR 3	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
47	04	INJECTOR - INJECTOR 3	NO SIGNAL				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Injector Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Injector Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	
48	01	INJECTOR - INJECTOR 4	EXCEEDED UPPER LIMIT	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
48	04	INJECTOR - INJECTOR 4	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.				Only two cylinders running.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
48	08	INJECTOR - INJECTOR 4	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
49	04	INJECTOR - INJECTOR 4	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
49	04	INJECTOR - INJECTOR 4	NO SIGNAL				1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A46 Measure point 2: Injector Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Injector Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Injector Pin: 1 Measure point 2: Injector Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	
4E	08	VEHICLE - CRUISE CONTROL SWITCH UNIT	SIGNAL NOT PLAUSIBLE	Cruise control / PTO not working.	Press SET+ / SET- and RESUME/ OFF at the same time.	Check correct operation of the switch by reading state parameters.				Replace wiring and connections if state does not change when Cruise Control buttons are pressed.

Print 603.93.281

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
50	01	ELECTRONIC CONTROL UNIT - MAIN RELAY DEFECT	EXCEEDED UPPER LIMIT	Engine does not start, ECU not powered or ECU always powered and EDC off also at key-on.	Main relay interrupted or short-circuit.	Check wiring and connections. Replace relay if required.				
50	02	ELECTRONIC CONTROL UNIT - MAIN RELAY DEFECT	BELOW LOWER LIMIT	Engine does not start, ECU not powered or ECU always powered and EDC off also at key-on.	Main relay interrupted or short-circuit.	Check wiring and connections. Replace relay if required.				
51	01	VEHICLE - MULTIPOSITION SELECTOR / PTO	EXCEEDED UPPER LIMIT	Incorrect PTO operation.	Voltage exceeding max. threshold, short-circuit to positive.	Check wiring and connections. Replace sensor if required.				
51	02	VEHICLE - MULTIPOSITION SELECTOR / PTO	BELOW LOWER LIMIT	Incorrect PTO operation.	Voltage under min. threshold, short-circuit to ground.	Check wiring and connections. Replace sensor if required.				
51	08	VEHICLE - MULTIPOSITION SELECTOR / PTO	SIGNAL NOT PLAUSIBLE	Incorrect PTO operation.	Faulty device.	Check wiring and connections. Replace sensor if required.				
52	04	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR	NO SIGNAL	Engine off.	Faulty MPROP.	Check wiring and connections.	Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A49 Measure point 2: ECU Pin: A19	Connector Not connected; Key +15 OFF;	Min. value: 3.2 Ohm; Max. value: 3.6 Ohm; Typical Value: 3.4 Ohm;	High noise.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
52	08	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR	SIGNAL NOT PLAUSIBLE			Check wiring and connections. Replace ECU if required.	Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A49 Measure point 2: ECU Pin: A19	Connector Not connected; Key +15 OFF;	Min. value: 3.2 Ohm; Max. value: 3.6 Ohm; Typical Value: 3.4 Ohm;	
53	01	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR (SHORT CIRCUIT TO POSITIVE)	EXCEEDED UPPER LIMIT		Short-circuit to battery, faulty MPROP.	Check wiring and connections. Replace MPROP if required.				
54	01	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR (SHORT CIRCUIT TO NEGATIVE)	EXCEEDED UPPER LIMIT		Short-circuit to ground. Faulty MPROP.	Check wiring and connections. Replace MPROP if required.				
56	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5A	01	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	EXCEEDED UPPER LIMIT		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5A	02	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	BELOW LOWER LIMIT		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5B	01	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	EXCEEDED UPPER LIMIT		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5E	01	ENGINE 1 - FUEL PUMP RELAY	EXCEEDED UPPER LIMIT	Fuel pump on always when engine is off.	Faulty relay, short-circuit to positive in wiring.	Turn key-on: pump must run for approximately 10 seconds (it should hum). Check pump relay if pump remains on. Check wiring if all checks are OK.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5E	02	ENGINE 1 - FUEL PUMP RELAY	BELOW LOWER LIMIT	Fuel pump not working.	Faulty relay, short-circuit to ground in wiring.	Turn key-on: pump must run for approximately 10 seconds (it should hum). Check the pump relay, protection fuse and wiring if this does not occur.				
5E	04	ENGINE 1 - FUEL PUMP RELAY	NO SIGNAL	Fuel pump not working.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				
5E	08	ENGINE 1 - FUEL PUMP RELAY	SIGNAL NOT PLAUSIBLE	Fuel pump not working.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				
5F	01	FUEL PRESSURE - RAIL PRESSURE SENSOR OR SIGNAL ERROR	EXCEEDED UPPER LIMIT		Short-circuit to positive. Faulty sensor. Rail pressure not regular.	Check wiring and connections. Replace sensor if required.				Check DTC 103 error.
5F	02	FUEL PRESSURE - RAIL PRESSURE SENSOR OR SIGNAL ERROR	BELOW LOWER LIMIT		Short-circuit to ground, faulty sensor.	Check wiring and connections. Replace sensor if required.				
60	01	FUEL PRESSURE - RAIL PRESSURE SENSOR OFFSET	EXCEEDED UPPER LIMIT		Faulty rail pressure sensor.	Replace sensor.				

Print 603.93.281

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
60	02	FUEL PRESSURE - RAIL PRESSURE SENSOR OFFSET	BELOW LOWER LIMIT		Faulty rail pressure sensor.	Replace sensor.				
62	01	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDED UPPER LIMIT		High pressure circuit fuel leakage.	Check fuel feed system.				Fuel management and pressure failure in rail.
62	01	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDED UPPER LIMIT		Injector jammed in fuel passage open position.	Check hydraulic and mechanical efficiency of injectors.				Fuel management and pressure failure in rail.
62	01	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDED UPPER LIMIT		MPROP adjuster open movement jammed.	Check efficiency of MPROP adjuster.				Fuel management and pressure failure in rail.
62	01	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDED UPPER LIMIT		Faulty high pressure pump.	Check efficiency of high pressure pump.				Fuel management and pressure failure in rail.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
63	01	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (NEGATIVE DEVIATION)	EXCEEDED UPPER LIMIT		MPROP adjuster open movement jammed.	Check efficiency of MPROP adjuster.				Fuel management and pressure failure in rail.
64	01	FUEL PRESSURE - RAIL PRESSURE ERROR: TOO LOW	EXCEEDED UPPER LIMIT		High pressure circuit fuel leakage.	Check high pressure system. Replace high pressure pump if required.				Fuel management and pressure failure in rail.
65	01	FUEL PRESSURE - RAIL PRESSURE ERROR: TOO HIGH	EXCEEDED UPPER LIMIT		MPROP regulator jammed.	Check MPROP regulator, replace if required.				
66	01	FUEL PRESSURE - ERROR ON THE RAIL PRESSURE (EXCESSIVE DUTY CYCLE)	EXCEEDED UPPER LIMIT	Negative vehicle reaction with smoke in exhaust during acceleration.	High pressure circuit fuel leakage.	Check fuel feed system, replace high pressure pump if required. Faulty fuel feed system (fuel pump and filter jammed).				
67	01	FUEL PRESSURE - ERROR ON THE RAIL PRESSURE (EXCESSIVE)	EXCEEDED UPPER LIMIT	Engine off.	MPROP regulator jammed.	Check MPROP regulator, replace if required.				Replace pressure relief valve.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
68	02	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	BELOW LOWER LIMIT			Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
68	04	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	NO SIGNAL		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
68	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
69	01	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	EXCEEDED UPPER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
69	02	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	BELOW LOWER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6A	01	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	EXCEEDED UPPER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.

Print 603.93.281

Base - May 2004

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6A	02	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	BELOW LOWER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6B	01	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	EXCEEDED UPPER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6B	02	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY	BELOW LOWER LIMIT	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6C	01	VEHICLE - EDC LAMP	EXCEEDED UPPER LIMIT	Warning light not working.	Short-circuit to positive.	Check correct operation of warning light using ''Active diagnostic'' procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6C	02	VEHICLE - EDC LAMP	BELOW LOWER LIMIT	Warning light not working.	Short-circuit to ground.	Check correct operation of warning light using "Active diagnostic" procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6C	04	VEHICLE - EDC LAMP	NO SIGNAL	Warning light not working.	Open circuit, bulb disconnected.	Check correct operation of warning light using "Active diagnostic" procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6C	08	VEHICLE - EDC LAMP	SIGNAL NOT PLAUSIBLE	Warning light not working.	Wiring problems.	Check wiring and connections. Replace sensor if required.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6D	08	ENGINE 2 - INTERNAL ECU FAULT (PLAUSIBILTY ERROR +15)	SIGNAL NOT PLAUSIBLE			Check wiring and connections.				Key 15 off during initialisation.
6E	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
75	01	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	EXCEEDED UPPER LIMIT	Speed of 170 km/h exceeded.		Check correct calibration of speedometer.				Encourage driver to use the vehicle correctly.
75	04	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	NO SIGNAL		Interrupted wiring between vehicle speed sensor and instrument panel.	Check wiring and connections between vehicle speed sensor and instrument panel.				
75	04	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	NO SIGNAL		Wiring interrupted between instrument panel and EDC ECU.	Check wiring and connections between instrument panel and EDC ECU.				Intervention required if instrument panel indicates vehicle speed.
75	04	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	NO SIGNAL		Vehicle speed sensor disconnected or failed.	Check correct assembly and efficiency of vehicle speed sensor.				
75	08	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	SIGNAL NOT PLAUSIBLE		Vehicle speed sensor disconnected or failed.	Check correct assembly and efficiency of vehicle speed sensor.				
75	08	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	SIGNAL NOT PLAUSIBLE	Vehicle speed on instrument panel does not increase sensibly.	Wrong speedometer setting.	Check correct calibration of speedometer.				
77	01	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	EXCEEDED UPPER LIMIT	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				
77	02	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	BELOW LOWER LIMIT	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				

DTC	FMI	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
77	08	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL	SIGNAL NOT PLAUSIBLE	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				
79	08	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

2nd Section
SYMPTOMS

The second section describes possible trouble that **is not identifiable by the control unit and is**

SPECIFIC TO THE COMMON RAIL SYSTEM AND THE NEW HW ENGINE

HYDRAULIC

ELECTRIC

MECHANICAL

other than conventional defects

(the aim is to guide the diagnostic approach to a new system, not to restate basic concepts that are considered to have already been acquired by the repairer).

The possible trouble already identified by the control unit, described in the 1st Section, is not repeated here (e.g., the engine cuts out as a result of defect 8.1).

If there are errors stored in the control unit memory, refer to the 1st troubleshooting section.

- ❑ The engine cuts out or fails to start.
- ❑ The engine fails to start (considerable exhaust smoke).
- ❑ The engine starts with difficulty.
- ❑ The engine fails to reach its top performance.

SYMPTOM	SYSTEM REACTION	POSSIBLE CAUSE	TESTS OR RECOMMENDED ACTION	NOTES
The engine cuts out or fails to start.	The EDC indicator light fails to come on. The starter motor turns but the engine fails to start.	EDC control unit not powered: fuse blown.	Check fuse No. 23 (25A). If the fuse has blown, find and eliminate the cause of the overload before replacing it.	
The engine cuts out or fails to start.	The EDC indicator light fails to come on. The starter motor turns but the engine fails to start.	EDC control unit not powered: the main relay is not powered.	Check the wiring upstream from the main relay to find any break in the circuit.	
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Air intake in the supply circuit between the tank and motor pump.	Check the integrity of the pipe and check that the quick couplings on the CILC (fuel level indicator assembly) and on the motor pump inlet are fitted properly. Replace any non-conforming parts.	
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Pre-filter clogged.	Inspect and replace the pre-filter if any debris is found inside.	The pre-filter is transparent and any debris is easy to see.
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Low-pressure pipe between motor pump and high-pressure pump inlet choked or with large leak.	Inspect the pipe and replace the relevant section.	
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Fuel filter greatly clogged (within certain limits it only involves difficult starting).	Replace the filter.	If the filter clogging indicator system has not worked, check the relevant electric circuit and restore its operation.

Print 603.93.281

Base - May 2004

SYMPTOM	SYSTEM REACTION	POSSIBLE CAUSE	TESTS OR RECOMMENDED ACTION	NOTES
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Rail pressure relief valve jammed open or lost its setting (continually discharges towards the tank).	If fuel has come out of the valve exhaust pipe while driving with the starter motor, change the valve.	
The engine cuts out or fails to start.	The EDC control unit is powered, the starter motor turns but the engine fails to start. The rail pressure does NOT reach 200 bar.	Mechanical defect in the gear pump, pressure regulator and the pumping elements of the high-pressure pump.	After checking there is fuel in the tank and excluding every other possibility (see 1st Troubleshooting Section), replace the high-pressure pump together with the pressure regulator.	
The engine cuts out or fails to start.	The starter motor turns but the engine fails to start. The rail pressure during starting regularly rises above 200 bar.	EGR pneumatic valve jammed open and air throttle valve jammed shut.	Check and replace the defective components.	
The engine starts with difficulty.	The EDC control unit is powered, the starter motor turns but the engine starts only after insisting a long time. Very slow increase in rail pressure.	The fuel motor pump is not powered (no buzzing is heard with the key ON for 9 sec.).	Check that no electric cable has disconnected from the motor pump. Check the wiring between the control relay and the motor pump to identify any break in the circuit.	After starting, with a load request the engine goes into recovery (if due to insufficient fuel reaching the high-pressure pump error 8.1 is detected, see 1st Section).
The engine starts with difficulty.	The rail pressure during starting regularly rises above 200 bar.	Injector mechanically jammed shut.	Perform the Engine Test (cylinder efficiency) to identify the defective injector and replace it.	Depending on the extent of the jamming, the control unit might detect a lack of balance between the cylinders (See error 3.1 – 3.2 – 3.3 – 3.4, 1st Section).
The engine starts with difficulty.	The rail pressure during starting regularly rises above 200 bar.	EGR pneumatic valve jammed open or air throttle valve mechanically jammed shut.	Check which component is defective and replace it.	

Base - May 2004

Print 603.93.281

SYMPTOM	SYSTEM REACTION	POSSIBLE CAUSE	TESTS OR RECOMMENDED ACTION	NOTES
The engine starts with difficulty.	The rail pressure during starting does not reach 200 bar immediately.	Air intake in the supply circuit between the tank and motor pump.	Check the integrity of the pipe and check that the quick couplings on the CILC (fuel level indicator assembly) and on the motor pump inlet are fitted properly. Replace any non-conforming parts.	
The engine starts with difficulty.	The rail pressure during starting does not reach 200 bar immediately.	The motor pump is not powered (no buzzing is heard with the key ON for 9 sec.).	Check the wiring between the control relay and the motor pump.	
The engine starts with difficulty.	The rail pressure during cranking does not reach 200 bar immediately.	Low-pressure pipe choked or broken or leaking.	Inspect the pipe and replace the relevant section.	
The engine starts with difficulty.	The rail pressure during cranking does not reach 200 bar immediately.	Fuel filter very clogged.	Replace the filter. If the filter clogging indicator system has not worked, check the relevant circuit and restore its operation.	
The engine fails to reach top performance	(with no derating implemented by the control unit)	Throttle pedal potentiometer does not go to the end of its travel.	Read parameters, check the signal reaches 100%. If it does not, check the physical integrity of the potentiometer and replace it if necessary.	If there are errors saved in the control unit memory, refer to the 1st Troubleshooting Section.
The engine fails to reach top performance	(with no derating implemented by the control unit)	EGR pneumatic valve jammed open or throttle valve jammed shut.	Check which is the defective component and replace it.	
The engine fails to reach top performance	(with no derating implemented by the control unit)	Injector jammed shut.	Find the defective injector (cylinder efficiency test with the diagnostic instrument) and replace it.	

Print 603.93.281

Base - May 2004

SYMPTOM	SYSTEM REACTION	POSSIBLE CAUSE	TESTS OR RECOMMENDED ACTION	NOTES
The engine fails to reach top performance	(with no derating implemented by the control unit)	Fuel filter greatly clogged.	Change the filter. If the filter clogging indicator system has not worked, check the relevant circuit and restore its operation.	
The engine fails to reach top performance	(with no derating implemented by the control unit)	The motor pump is not powered (no buzzing is heard with the key ON for 9 sec.).	Check the wiring between the control relay and the motor pump.	

Base - May 2004

Print 603.93.281

1st Section

EDT-FMI error codes with EDC 16 central unit

version software P315V4b

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
01	01	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 1)	EXCEEDING NORMAL RANGE	A/C compressor always on.	Short-circuit to positive.	Check wiring and connections. Replace relay if required.				
01	02	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 1)	EXCEEDING NORMAL RANGE	Check correct operation of warning light using "Active diagnostic" procedure.	Short-circuit to ground.	Check wiring and connections. Replace relay if required.				
01	04	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 1)	NO SIGNAL	A/C compressor not working.	Open circuit, relay disconnected.	Check wiring and connections. Replace relay if required.				
01	08	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 1)	SIGNAL NOT PLAUSIBLE	A/C compressor not working.	Open circuit, relay disconnected.	Check wiring and connections. Replace relay if required.				
02	04	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 2)	NO SIGNAL	A/C compressor not working.	No CAN line signal.	Check wiring and connections. Replace relay if required.				
02	08	19	VEHICLE - AIR-CONDITIONER COMPRESSOR RELAY (DTC 2)	SIGNAL NOT PLAUSIBLE	A/C compressor not working.	Non plausible CAN line signal.	Check wiring and connections. Replace relay if required.				
03	01	97	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 3)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
03	02	97	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 3)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
03	04	97	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 3)	NO SIGNAL		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
03	08	97	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 3)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
05	01	87	EGR - INCORRECT DEBIMETER SIGNAL	EXCEEDING NORMAL RANGE	Possible poor performance in acceleration.	Flow meter short-circuit or open circuit.	Check integrity of flow meter and wiring between flow meter connector and EDC connector.				Power reduction and deactivated EGR function.

Revi - February 2005

Print 603.93.281/A

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
05	02	87	EGR - INCORRECT DEBIMETER SIGNAL	EXCEEDING NORMAL RANGE	Possible poor performance in acceleration.	Flow meter short-circuit or open circuit.	Check integrity of flow meter and wiring between flow meter connector and EDC connector.				Power reduction and deactivated EGR function.
07	01	87	EGR - DEBIMETER SIGNAL OUT OF LIMIT	EXCEEDING NORMAL RANGE	Possible poor performance in acceleration.	Flow meter short-circuit or open circuit.	Check integrity of flow meter and wiring between flow meter connector and EDC connector.				Power reduction and deactivated EGR function.
07	02	87	EGR - DEBIMETER SIGNAL OUT OF LIMIT	EXCEEDING NORMAL RANGE	Possible poor performance in acceleration.	Flow meter short-circuit or open circuit.	Check integrity of flow meter and wiring between flow meter connector and EDC connector.				Power reduction and deactivated EGR function.
08	01	14	VEHICLE - ACCELERATOR PEDAL 1	EXCEEDING NORMAL RANGE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Short-circuit to positive, voltage exceeding 4700 mV.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
08	02	14	VEHICLE - ACCELERATOR PEDAL 1	EXCEEDING NORMAL RANGE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Short-circuit to ground.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.
08	08	14	VEHICLE - ACCELERATOR PEDAL 1	SIGNAL NOT PLAUSIBLE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Accelerator pedal potentiometer 1 and accelerator pedal potentiometer 2 values not plausible.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
09	01	14	VEHICLE - ACCELERATOR PEDAL 2	EXCEEDING NORMAL RANGE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Short-circuit to positive, voltage exceeding 4700 mV.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.
09	02	14	VEHICLE - ACCELERATOR PEDAL 2	EXCEEDING NORMAL RANGE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Short-circuit to ground.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.

Print 603.93.28 I/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
09	08	14	VEHICLE - ACCELERATOR PEDAL 2	SIGNAL NOT PLAUSIBLE	Incorrect accelerator pedal operation, engine idling at 1500 rpm.	Accelerator pedal potentiometer 1 and accelerator pedal potentiometer 2 values not plausible.	In "Measurable parameters" environment, check that the "accelerator pedal position" parameter changes proportionally to the position of the pedal from 0% to 100%. Check wiring and connections. Replace accelerator pedal if required.				Make sure that accelerator pedal travel is not hindered.
0A	01	25	ENGINE 1 - ATMOSPHERIC PRESSURE SENSOR	EXCEEDING NORMAL RANGE	Possible smokiness at high altitude. Problematic cranking at high altitude.	Faulty environmental pressure sensor in ECU.	Replace ECU.				
0A	02	25	ENGINE 1 - ATMOSPHERIC PRESSURE SENSOR	EXCEEDING NORMAL RANGE	Possible smokiness at high altitude. Problematic cranking at high altitude.	Faulty environmental pressure sensor in ECU.	Replace ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0B	08	17	VEHICLE - ACCELERATOR PEDAL/BRAKE PEDAL SUSPECT	SIGNAL NOT PLAUSIBLE	Power reduction: engine rpm drop to idling speed.	Press brake and accelerator at the same time.	Check wiring and connections. Replace sensor if required.				If the brake is actuated while the accelerator is pressed, the motor runs on slow idling until the brake is released, so that the vehicle can be stopped even if the pedal of the accelerator remains stuck on the intermediate position. Instead you can accelerate while the pedal is pressed without the interference of safety measures.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0C	01	44	EGR - AIR MASS SUPPLY TOO LOW	EXCEEDING NORMAL RANGE	EGR off. Emissions not compliant with law. Derated performance and smoke at high engine rpm.	EGR monitoring: incorrect EGR percentage actuation calculated by ECU.	Check, if the EGR pneumatic valve is not locked in Open or Closed-Position 2) Check, that the solenoid valve and the EGR pneumatic valve is not squashed or holed or detached 3) Check the EGR solenoid valve-functionality 4) Check the solenoid valve-integrity by means of a multimeter 5) Check the wiring harness between the solenoid valve and the EDC connector.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
0D	02	44	EGR - AIR MASS SUPPLY TOO HIGH	EXCEEDING NORMAL RANGE	EGR off. Emissions not compliant with law. Derated performance and smoke at high engine rpm.	EGR monitoring: incorrect EGR percentage actuation calculated by ECU.	Check, if the EGR pneumatic valve is not locked in Open or Closed-Position 2) Check, that the solenoid valve and the EGR pneumatic valve is not squashed or holed or detached 3) Check the EGR solenoid valve-functionality 4) Check the solenoid valve-integrity by means of a multimeter 5) Check the wiring harness between the solenoid valve and the EDC connector.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
11	01	24	ENGINE 1 - BOOST PRESSURE SENSOR	EXCEEDING NORMAL RANGE	Positive power reduction and smoke in exhaust.		Check wiring and connections. Possibly replace sensor. Check in "measurable parameter" environment that atmospheric pressure sensor and turbo charger air pressure sensor values are similar when engine is off.				Possible smoke in exhaust during acceleration. Replace if required.
11	02	24	ENGINE 1 - BOOST PRESSURE SENSOR	EXCEEDING NORMAL RANGE	Positive power reduction and smoke in exhaust.		Check wiring and connections. Replace sensor if required.				Possible smoke in exhaust during acceleration. Replace if required.
11	08	24	ENGINE 1 - BOOST PRESSURE SENSOR	SIGNAL NOT PLAUSIBLE	Positive power reduction and smoke in exhaust.	Faulty sensor.	Check wiring and connections. Replace sensor if required.				
12	01	35	ENGINE 2 - BATTERY VOLTAGE	EXCEEDING NORMAL RANGE	Problematic cranking.	Flat battery, interrupted wiring.	Check battery state with diagnostic tool (measurable parameters). Check wiring and connections.				Replace alternator, regulator or battery.
12	02	35	ENGINE 2 - BATTERY VOLTAGE	EXCEEDING NORMAL RANGE	Engine does not start.	Faulty battery, faulty alternator, faulty ECU.	Check with diagnostic tool.				Replace battery, alternator or ECU if required.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
13	08	16	VEHICLE - BRAKE PEDAL SIGNAL ERROR	SIGNAL NOT PLAUSIBLE	Brake signal plausibility, possibly no brake lights, Cruise Control / PTO not working.	The two switch states are different.	Check wiring and connections. Replace sensor if required.				
14	01	21	ENGINE 1 - COOLANT TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
14	02	21	ENGINE 1 - COOLANT TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
14	08	21	ENGINE 1 - COOLANT TEMPERATURE SENSOR	SIGNAL NOT PLAUSIBLE	Problematic cold cranking. Possible power reduction.	Faulty sensor, interrupted wiring.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
15	01	21	ENGINE 1 - COOLANT TEMPERATURE SENSOR (TEST)	EXCEEDING NORMAL RANGE		Faulty coolant temperature sensor.	Replace sensor.	1- Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A58 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A41 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Min. value: 0,11 KOhm; Max. value: 48,3 KOhm; Typical Value: 2,5 KOhm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	
1E	08	15	VEHICLE - CLUTCH SIGNAL SUSPECT	SIGNAL NOT PLAUSIBLE	Clutch switch: signal either not plausible or not present. Cruise Control / PTO not working or engine revs up to maximum speed when clutch pedal is pressed and Cruise control / PTO is on.	Gear shift detected without pressing brake pedal.	Check wiring and connections. Replace sensor if required.				The anomaly caused by incomplete clutch operation if everything is OK.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
20	01	86	EGR - EGR POWER ST. SHORT TO BATT.	EXCEEDING NORMAL RANGE		EGR solenoid valve short-circuit to battery.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
21	02	86	EGR - SHORT CIRCUIT TO GROUND ON EGR VALVE	EXCEEDING NORMAL RANGE		Solenoid valve short-circuit to ground.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
22	04	86	EGR - OPEN CIRCUIT ON EGR VALVE	NO SIGNAL		EGR solenoid valve short-circuit or open circuit.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
22	08	86	EGR - OPEN CIRCUIT ON EGR VALVE	SIGNAL NOT PLAUSIBLE		EGR solenoid valve short-circuit or open circuit.	1) Check integrity of solenoid valve with multimeter. 2) Check wiring between solenoid valve and EDC connector.				EGR either not working or always working. Emissions not compliant with law. No reaction perceivable by driver.
24	01	62	ENGINE SPEED - CAMSHAFT SENSOR	EXCEEDING NORMAL RANGE	Possible problematic cold cranking.	No signal, open circuit.	Check wiring and connections.				Flywheel sensor timing signal adopted if camshaft signal is not correct.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
24	02	62	ENGINE SPEED - CAMSHAFT SENSOR	EXCEEDING NORMAL RANGE	Possible problematic cold cranking.	No signal, open circuit, faulty sensor.	Check correct assembly of sensor and phonic wheel, check engine timing.				Flywheel sensor timing signal adopted if camshaft signal is not correct.
25	01	61	ENGINE SPEED - CRANKSHAFT SENSOR	EXCEEDING NORMAL RANGE	Problematic cold cranking, power reduction (possible noise due to missed pre-injection).	Faulty sensor.	Check wiring and connections.				Camshaft sensor speed adopted if signal is not present.
25	02	61	ENGINE SPEED - CRANKSHAFT SENSOR	EXCEEDING NORMAL RANGE	Problematic cold cranking, power reduction (possible noise due to missed pre-injection).	Faulty sensor.	Check wiring and connections.				Camshaft sensor speed adopted if signal is not present.
26	01	63	ENGINE SPEED - FAULT BETWEEN FLYWHEEL SENSOR AND CAMSHAFT	EXCEEDING NORMAL RANGE	Possible power reduction.	Incorrect camshaft phonic wheel assembly.	Check wiring, connections and sensor, check that phonic wheel is fitted correctly.				Longer cranking time.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
28	01	23	ENGINE 1 - FUEL TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Possible power reduction.	Short-circuit to positive, excessively low temperature is detected.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (Ohm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A52 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A51 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
28	02	23	ENGINE 1 - FUEL TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Possible power reduction.	Short-circuit to ground, excessively high temperature is detected.	Check wiring and connections. Replace sensor if required.	1- Measure type: Resistance (Ohm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A52 Measure point 2: Sensor Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A51 Measure point 2: Sensor Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Typical Value: 0,1 Ohm;	
29	01	29	ENGINE 1 - FAN RELAY	EXCEEDING NORMAL RANGE	Fan relay not working.	Fan relay short-circuit to positive.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
29	02	29	ENGINE 1 - FAN RELAY	EXCEEDING NORMAL RANGE	Fan relay not working.	Fan relay short-circuit to ground.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
29	04	29	ENGINE 1 - FAN RELAY	NO SIGNAL	Fan relay not working.		Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
29	08	29	ENGINE 1 - FAN RELAY	SIGNAL NOT PLAUSIBLE	Fan relay not working.		Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.
2A	01	28	ENGINE 1 - PREHEATING RELAY FUEL FILTER	EXCEEDING NORMAL RANGE	Fuel filter preheater relay not working.	Filter heater relay short-circuit to positive - Heater always on also at fuel temperature > 5° C.	Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	02	28	ENGINE 1 - PREHEATING RELAY FUEL FILTER	EXCEEDING NORMAL RANGE	Fuel filter preheater relay not working.	Filter heater relay short-circuit to ground.	Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	04	28	ENGINE 1 - PREHEATING RELAY FUEL FILTER	NO SIGNAL	Fuel filter preheater relay not working.		Check wiring and connections. Replace relay if required.				Battery goes flat.
2A	08	28	ENGINE 1 - PREHEATING RELAY FUEL FILTER	SIGNAL NOT PLAUSIBLE	Fuel filter preheater relay not working.		Check wiring and connections. Replace relay if required.				Battery goes flat.

Print 603.93.28 I/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
2F	01	37	ENGINE 2 - GLOW PLUGS RELAY	EXCEEDING NORMAL RANGE	Possible problematic cold cranking.	Short-circuit to positive, glow plugs always on also with ECU off, possible battery deployment.	Check wiring and connections. Replace relay if required.				
2F	02	37	ENGINE 2 - GLOW PLUGS RELAY	EXCEEDING NORMAL RANGE		Short-circuit to ground, glow plugs always on.	Check wiring and connections. Replace relay if required.				
2F	04	37	ENGINE 2 - GLOW PLUGS RELAY	NO SIGNAL	Possible problematic cold cranking.	Faulty wiring.	Check wiring and connections. Replace relay if required.				Faulty diagnostic light.
2F	08	37	ENGINE 2 - GLOW PLUGS RELAY	SIGNAL NOT PLAUSIBLE	Possible problematic cold cranking.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				Possible increased fuel consumption. Possible engine overheating and power reduction.

Revi - February 2005

Print 603.93.281/A

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
30	01	36	ENGINE 2 - GLOW PLUG W/LIGHT	EXCEEDING NORMAL RANGE	Warning light always off. Problematic cold cranking. Preheater warning light always on.	Short-circuit to positive.	Check wiring and connections. Replace sensor if required.				The driver does not wait preheating even when the room temperatures are low, because no warning light signal is enabled. Preheating works, but with cold start-up no indication is available that tells you when to start the motor because the light is always turned on.
30	02	36	ENGINE 2 - GLOW PLUG W/LIGHT	EXCEEDING NORMAL RANGE	Warning light always off. Problematic cold cranking. Preheater warning light always on.	Short-circuit to ground.	Check wiring and connections. Replace sensor if required.				The driver does not wait preheating even when the room temperatures are low, because no warning light signal is enabled. Preheating works, but with cold start-up no indication is available that tells you when to start the motor because the light is always turned on.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
30	04	36	ENGINE 2 - GLOW PLUG W/LIGHT	NO SIGNAL	Warning light always off. Problematic cold cranking. Preheater warning light always on.		Check wiring and connections. Replace sensor if required.				Warning light off during pre-heating. Replace bulb if required.
30	08	36	ENGINE 2 - GLOW PLUG W/LIGHT	SIGNAL NOT PLAUSIBLE	Warning light always off. Problematic cold cranking. Preheater warning light always on.		Check wiring and connections. Replace sensor if required.				Warning light off during pre-heating. Replace bulb if required.
31	01	39	ENGINE 2 - GLOW PLUGS	EXCEEDING NORMAL RANGE	Possible problematic cold cranking.	Short-circuit to positive.	Check wiring and connections. Check electrical system between relay and glow plugs.				Relay unit always on also with ECU off, possible battery deployment.
32	01	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 50)	EXCEEDING NORMAL RANGE		Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
33	01	92	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 51)	EXCEEDING NORMAL RANGE	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
33	02	92	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 51)	EXCEEDING NORMAL RANGE	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
33	04	92	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 51)	NO SIGNAL	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
33	08	92	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 51)	SIGNAL NOT PLAUSIBLE	The engine switching off-data are not memorized. The failures memory is lost, only the present failures and not the intermittent ones can be read, the idling speed, which can be eventually set by the Cruise Control commands, remains not memorized.	Faulty ECU EEPROM.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
34	08	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 52)	SIGNAL NOT PLAUSIBLE	There have been cases in which this fault is stored by the E.C.U. following after failures in engine speed measurement. Failure is usually associated to sudden ignition missing at >3000 rpm engine speed, with engine disconnection following. Reading failure memory, fault code DTC52 is displayed, sometimes followed by DTC56 (relating to fault on Immobilizer).	The fault is attributable to the gear wheel, which probably presents incorrect tooth shape.	Check there are no mechanical faults on the teeth of the gear wheel fitted to the engine drive shaft.				
35	08	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 53)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
36	08	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 54)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
37	01	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 55)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
38	02	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 56)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
39	01	22	ENGINE 1 - AIR TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Problematic cranking, smoke, problematic acceleration.		Check wiring and connections. Replace sensor if required.	Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 2,5 KOhm;	Air temperature sensor and built-in pressure sensor. The sensor is fitted on flow meter in engines with EGR.
39	02	22	ENGINE 1 - AIR TEMPERATURE SENSOR	EXCEEDING NORMAL RANGE	Problematic cranking, smoke, problematic acceleration.	Short-circuit to ground, excessively high temperature is detected.	Check wiring and connections. Replace sensor if required.	Measure type: Resistance (KOhm) Measure point 1: Sensor Pin: 1 Measure point 2: Sensor Pin: 2	Connector Not connected; Key +15 OFF;	Typical Value: 2,5 KOhm;	Air temperature sensor and built-in pressure sensor. The sensor is fitted on flow meter in engines with EGR.
3A	02	93	ELECTRONIC CONTROL UNIT - IMMOBILISER	EXCEEDING NORMAL RANGE	The engine fails to start	Communication with Immobilizer ECU problems on CAN Line.	Check integrity of CAN Line, run Immobilizer ECU diagnostics and wait for indications provided.	Measure type: Resistance (Ohm) Measure point 1: Diagnostic socket. Pin: 21 Measure point 2: Diagnostic socket. Pin: 22	Connector Connected; Key +15 OFF;	Typical Value: 60 Ohm Ohm;	

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3C	01	57	INJECTOR - BENCH 1 (DTC 60)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 4- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF; 4- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; 4- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.
3C	02	57	INJECTOR - BENCH 1 (DTC 60)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to ground.	Check wiring and connections.				Only two cylinders running.
3C	08	57	INJECTOR - BENCH 1 (DTC 60)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector electrical system failure.	Check wiring and connections. Replace injector if required.				Only two cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3D	04	57	INJECTOR - BENCH 1 (DTC 61)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring disconnected.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3E	01	58	INJECTOR - BENCH 2 (DTC 62)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 4- Measure type: Resistance (Ohm) Measure point 1: Injector 2 Pin: 1 Measure point 2: Injector 2 Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 OFF; 4- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm; 4- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
3E	02	58	INJECTOR - BENCH 2 (DTC 62)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to ground.	Check wiring and connections.				Only two cylinders running.
3E	08	58	INJECTOR - BENCH 2 (DTC 62)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector electrical system failure.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
3F	04	58	INJECTOR - BENCH 2 (DTC 63)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring disconnected.	Check wiring and connections. Replace injector if required.				Only two cylinders running.
40	01	57	INJECTOR - STAGE A INJECTORS CHECK (INTERNAL ECU) (DTC 64)	EXCEEDING NORMAL RANGE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
40	02	57	INJECTOR - STAGE A INJECTORS CHECK (INTERNAL ECU) (DTC 64)	EXCEEDING NORMAL RANGE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
40	04	57	INJECTOR - STAGE A INJECTORS CHECK (INTERNAL ECU) (DTC 64)	NO SIGNAL	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
40	08	57	INJECTOR - STAGE A INJECTORS CHECK (INTERNAL ECU) (DTC 64)	SIGNAL NOT PLAUSIBLE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	01	57	INJECTOR - STAGE B INJECTORS CHECK (INTERNAL ECU) (DTC 65)	EXCEEDING NORMAL RANGE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
41	02	57	INJECTOR - STAGE B INJECTORS CHECK (INTERNAL ECU) (DTC 65)	EXCEEDING NORMAL RANGE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	04	57	INJECTOR - STAGE B INJECTORS CHECK (INTERNAL ECU) (DTC 65)	NO SIGNAL	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
41	08	57	INJECTOR - STAGE B INJECTORS CHECK (INTERNAL ECU) (DTC 65)	SIGNAL NOT PLAUSIBLE	Engine off.	Internal ECU problem.	Clear failure memory. If the error persists, ensure that the failure does not concern the injectors and call the Help Desk for instructions on how to replace the ECU.				
42	01	51	INJECTOR - INJECTOR 1 (DTC 66)	EXCEEDING NORMAL RANGE							

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	01	53	INJECTOR - INJECTOR 1 (DTC 66)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A46 Measure point 2: Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	04	51	INJECTOR - INJECTOR 1 (DTC 66)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 4- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF; 4- Connector Connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm; 3- Typical Value: 0,1 Ohm; 4- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.
42	04	51	INJECTOR - INJECTOR 1 (DTC 66)	NO SIGNAL							

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
42	08	51	INJECTOR - INJECTOR 1 (DTC 66)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.	1 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3 - Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1 - Connector Not connected; Key +15 OFF; 2 - Connector Not connected; Key +15 OFF; 3 - Connector Not connected; Key +15 OFF;	1 - Typical Value: 0,1 Ohm; 2 - Typical Value: 0,1 Ohm; 3 - Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.
42	08	51	INJECTOR - INJECTOR 1 (DTC 66)	SIGNAL NOT PLAUSIBLE							
43	04	51	INJECTOR - INJECTOR 1 (DTC 67)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	01	54	INJECTOR - INJECTOR 2 (DTC 72)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A46 Measure point 2: Injector 2 Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Injector 2 Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Injector 2 Pin: 1 Measure point 2: Injector 2 Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.
44	01	54	INJECTOR - INJECTOR 2 (DTC 72)	EXCEEDING NORMAL RANGE							

Revi - February 2005

Print 603.93.281/A

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	04	54	INJECTOR - INJECTOR 2 (DTC 72)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3 - Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 4 - Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1 - Connector Not connected; Key +15 OFF; 2 - Connector Not connected; Key +15 OFF; 3 - Connector Connected; Key +15 OFF; 4 - Connector Not connected; Key +15 OFF;	1 - Typical Value: 0,1 Ohm; 2 - Typical Value: 0,1 Ohm; 3 - Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm; 4 - Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.
44	04	54	INJECTOR - INJECTOR 2 (DTC 72)	NO SIGNAL							

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
44	08	54	INJECTOR - INJECTOR 2 (DTC 72)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.
44	08	54	INJECTOR - INJECTOR 2 (DTC 72)	SIGNAL NOT PLAUSIBLE							
45	04	54	INJECTOR - INJECTOR 2 (DTC 73)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
46	01	52	INJECTOR - INJECTOR 3 (DTC 68)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.	1 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A46 Measure point 2: Pin: 2 2 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 3 - Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1 - Connector Not connected; Key +15 OFF; 2 - Connector Not connected; Key +15 OFF; 3 - Connector Not connected; Key +15 OFF;	1 - Typical Value: 0,1 Ohm; 2 - Typical Value: 0,1 Ohm; 3 - Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
46	04	52	INJECTOR - INJECTOR 3 (DTC 68)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 4- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Connected; Key +15 OFF; 4- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm; 4- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
46	08	52	INJECTOR - INJECTOR 3 (DTC 68)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.	1 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2 - Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3 - Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1 - Connector Not connected; Key +15 OFF; 2 - Connector Not connected; Key +15 OFF; 3 - Connector Not connected; Key +15 OFF;	1 - Typical Value: 0,1 Ohm; 2 - Typical Value: 0,1 Ohm; 3 - Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.
47	04	52	INJECTOR - INJECTOR 3 (DTC 69)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
47	04	52	INJECTOR - INJECTOR 3 (DTC 69)	NO SIGNAL							

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
48	01	53	INJECTOR - INJECTOR 4 (DTC 70)	EXCEEDING NORMAL RANGE	Engine not working properly, possible power reduction.	Short-circuit to positive.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A46 Measure point 2: Pin: 2 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
48	04	58	INJECTOR - INJECTOR 4 (DTC 70)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring short-circuit.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2 4- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF; 4- Connector Connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm; 4- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only two cylinders running.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
48	08	53	INJECTOR - INJECTOR 4 (DTC 70)	SIGNAL NOT PLAUSIBLE	Engine not working properly, possible power reduction.	Injector not working properly.	Check wiring and connections. Replace injector if required.	1- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A1 Measure point 2: Pin: 1 2- Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A31 Measure point 2: Pin: 2 3- Measure type: Resistance (Ohm) Measure point 1: Pin: 1 Measure point 2: Pin: 2	1- Connector Not connected; Key +15 OFF; 2- Connector Not connected; Key +15 OFF; 3- Connector Not connected; Key +15 OFF;	1- Typical Value: 0,1 Ohm; 2- Typical Value: 0,1 Ohm; 3- Min. value: 0,5 Ohm; Max. value: 0,9 Ohm; Typical Value: 0,7 Ohm;	Only three cylinders running.
49	04	53	INJECTOR - INJECTOR 4 (DTC 71)	NO SIGNAL	Engine not working properly, possible power reduction.	Injector wiring open circuit.	Check wiring and connections. Replace injector if required.				Only three cylinders running.
49	04	53	INJECTOR - INJECTOR 4 (DTC 71)	NO SIGNAL							
4E	08	13	VEHICLE - CRUISE CONTROL SWITCH UNIT	SIGNAL NOT PLAUSIBLE	Cruise control / PTO not working.	Press SET+ / SET- and RESUME/ OFF at the same time.	Check correct operation of the switch by reading state parameters.				Replace wiring and connections if state does not change when Cruise Control buttons are pressed.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
50	01	94	ELECTRONIC CONTROL UNIT - MAIN RELAY DEFECT	EXCEEDING NORMAL RANGE	Engine does not start, ECU not powered or ECU always powered and EDC off also at key-on.	Main relay interrupted or short-circuit.	Check wiring and connections. Replace relay if required.				
50	02	94	ELECTRONIC CONTROL UNIT - MAIN RELAY DEFECT	EXCEEDING NORMAL RANGE	Engine does not start, ECU not powered or ECU always powered and EDC off also at key-on.	Main relay interrupted or short-circuit.	Check wiring and connections. Replace relay if required.				
51	01	12	VEHICLE - MULTIPOSITION SELECTOR / PTO	EXCEEDING NORMAL RANGE	Incorrect PTO operation.	Voltage exceeding max. threshold, short-circuit to positive.	Check wiring and connections. Replace sensor if required.				
51	02	12	VEHICLE - MULTIPOSITION SELECTOR / PTO	EXCEEDING NORMAL RANGE	Incorrect PTO operation.	Voltage under min. threshold, short-circuit to ground.	Check wiring and connections. Replace sensor if required.				
51	08	12	VEHICLE - MULTIPOSITION SELECTOR / PTO	SIGNAL NOT PLAUSIBLE	Incorrect PTO operation.	Faulty device.	Check wiring and connections. Replace sensor if required.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
52	04	83	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR	NO SIGNAL	Engine off.	Faulty MPROP.	Check wiring and connections. Replace MPROP if required.	Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A49 Measure point 2: ECU Pin: A19	Connector Not connected; Key +15 OFF;	Min. value: 3.2 Ohm; Max. value: 3.6 Ohm; Typical Value: 3.4 Ohm;	High noise.
52	08	83	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR	SIGNAL NOT PLAUSIBLE			Check wiring and connections. Replace MPROP if required.	Measure type: Resistance (Ohm) Measure point 1: ECU Pin: A49 Measure point 2: ECU Pin: A19	Connector Not connected; Key +15 OFF;	Min. value: 3.2 Ohm; Max. value: 3.6 Ohm; Typical Value: 3.4 Ohm;	
53	01	83	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR (SHORT CIRCUIT TO POSITIVE)	EXCEEDING NORMAL RANGE		Short-circuit to battery, faulty MPROP.	Check wiring and connections. Replace MPROP if required.				
54	01	83	FUEL PRESSURE - PRESSURE MPROP REGULATOR ERROR (SHORT CIRCUIT TO NEGATIVE)	EXCEEDING NORMAL RANGE		Short-circuit to ground. Faulty MPROP.	Check wiring and connections. Replace MPROP if required.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
56	08	91	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 86)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5A	01	64	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 90)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5A	02	64	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 90)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5B	01	64	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 91)	EXCEEDING NORMAL RANGE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
5E	01	27	ENGINE 1 - FUEL PUMP RELAY	EXCEEDING NORMAL RANGE	Fuel pump on always when engine is off.	Faulty relay, short-circuit to positive in wiring.	Turn key-on: pump must run for approximately 10 seconds (it should hum). Check pump relay if pump remains on. Check wiring if all checks are OK.				
5E	02	27	ENGINE 1 - FUEL PUMP RELAY	EXCEEDING NORMAL RANGE	Fuel pump not working.	Faulty relay, short-circuit to ground in wiring.	Turn key-on: pump must run for approximately 10 seconds (it should hum). Check the pump relay, protection fuse and wiring if this does not occur.				
5E	04	27	ENGINE 1 - FUEL PUMP RELAY	NO SIGNAL	Fuel pump not working.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
5E	08	27	ENGINE I - FUEL PUMP RELAY	SIGNAL NOT PLAUS-IBLE	Fuel pump not working.	Faulty relay, wiring interrupted.	Check wiring and connections. Replace relay if required.				
5F	01	82	FUEL PRESSURE - RAIL PRESSURE SENSOR OR SIGNAL ERROR	EXCEED-ING NOR-MAL RANGE	Possible engine disconnection.	Short-circuit to positive. Faulty sensor. Rail pressure not regular.	Check wiring and connections. Replace sensor if required.				Check DTC 103 error.
5F	02	82	FUEL PRESSURE - RAIL PRESSURE SENSOR OR SIGNAL ERROR	EXCEED-ING NOR-MAL RANGE	Possible engine disconnection.	Short-circuit to ground, faulty sensor.	Check wiring and connections. Replace sensor if required.				
60	01	82	FUEL PRESSURE - RAIL PRESSURE SENSOR OFFSET	EXCEED-ING NOR-MAL RANGE	Possible engine disconnection.	Faulty rail pressure sensor.	Replace sensor.				
60	02	82	FUEL PRESSURE - RAIL PRESSURE SENSOR OFFSET	EXCEED-ING NOR-MAL RANGE	Possible engine disconnection.	Faulty rail pressure sensor.	Replace sensor.				
62	01	81	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CON-TROL OF THE RAIL (POSITIVE DEVIATION)	EXCEED-ING NOR-MAL RANGE	Possible engine disconnection.	High pressure circuit fuel leakage.	Check fuel feed system.				Fuel management and pressure failure in rail.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
62	01	81	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDING NORMAL RANGE	Possible engine disconnection.	Injector jammed in fuel passage open position.	Check hydraulic and mechanical efficiency of injectors.				Fuel management and pressure failure in rail.
62	01	81	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDING NORMAL RANGE	Possible engine disconnection.	MPROP adjuster open movement jammed.	Check efficiency of MPROP adjuster.				Fuel management and pressure failure in rail.
62	01	81	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (POSITIVE DEVIATION)	EXCEEDING NORMAL RANGE	Possible engine disconnection.	Faulty high pressure pump.	Check efficiency of high pressure pump.				Fuel management and pressure failure in rail.
63	01	81	FUEL PRESSURE - FAULT ON THE FUEL DRUCK CONTROL OF THE RAIL (NEGATIVE DEVIATION)	EXCEEDING NORMAL RANGE	Possible engine disconnection.	MPROP adjuster open movement jammed.	Check efficiency of MPROP adjuster.				Fuel management and pressure failure in rail.
64	01	81	FUEL PRESSURE - RAIL PRESSURE ERROR: TOO LOW	EXCEEDING NORMAL RANGE	Possible engine disconnection.	High pressure circuit fuel leakage.	Check high pressure system. Replace high pressure pump if required.				Fuel management and pressure failure in rail.
65	01	81	FUEL PRESSURE - RAIL PRESSURE ERROR: TOO HIGH	EXCEEDING NORMAL RANGE	Possible engine disconnection.	MPROP regulator jammed.	Check MPROP regulator, replace if required.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
66	01	81	FUEL PRESSURE - ERROR ON THE RAIL PRESSURE (EXCESSIVE DUTY CYCLE)	EXCEEDING NORMAL RANGE	Negative vehicle reaction with smoke in exhaust during acceleration.	High pressure circuit fuel leakage.	Check fuel feed system, replace high pressure pump if required. Faulty fuel feed system (fuel pump and filter jammed).				
67	01	81	FUEL PRESSURE - ERROR ON THE RAIL PRESSURE (EXCESSIVE)	EXCEEDING NORMAL RANGE	Possible engine disconnection.	MPROP regulator jammed.	Check MPROP regulator, replace if required.				Replace pressure relief valve.
68	04	96	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 104)	NO SIGNAL		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
68	08	96	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 104)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
69	01	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 105)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
69	02	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 105)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6A	01	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 106)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6A	02	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 106)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6B	01	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 107)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.
6B	02	97	ELECTRONIC CONTROL UNIT - SENSOR POWER SUPPLY (DTC 107)	EXCEEDING NORMAL RANGE	Anomalous engine operation due to incorrectly powered sensors. Reduced power.	Sensor power circuit fault in ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				Possible fault indications of various sensors powered by ECU.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6C	01	18	VEHICLE - EDC LAMP	EXCEEDING NORMAL RANGE	Warning light not working.	Short-circuit to positive.	Check correct operation of warning light using "Active diagnostic" procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6C	02	18	VEHICLE - EDC LAMP	EXCEEDING NORMAL RANGE	Warning light not working.	Short-circuit to ground.	Check correct operation of warning light using "Active diagnostic" procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6C	04	18	VEHICLE - EDC LAMP	NO SIGNAL	Warning light not working.	Open circuit, bulb disconnected.	Check correct operation of warning light using "Active diagnostic" procedure.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.
6C	08	18	VEHICLE - EDC LAMP	SIGNAL NOT PLAUSIBLE	Warning light not working.	Wiring problems.	Check wiring and connections. Replace sensor if required.				Warning light should come on for approximately 5 seconds at key-on. Check wiring and connections if this does not occur.

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
6D	08	38	ENGINE 2 - INTERNAL ECU FAULT (PLAUSIBILTY ERROR +15)	SIGNAL NOT PLAUSIBLE			Check wiring and connections.				Key 15 off during initialisation.
6E	08	99	ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 110)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/ off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				
75	01	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	EXCEEDING NORMAL RANGE	Maximum speed threshold has been exceeded.		Check correct calibration of speedometer.				Encourage driver to use the vehicle correctly.
75	04	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	NO SIGNAL		Interrupted wiring between vehicle speed sensor and instrument panel.	Check wiring and connections between vehicle speed sensor and instrument panel.				
75	04	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	NO SIGNAL		Wiring interrupted between instrument panel and EDC ECU.	Check wiring and connections between instrument panel and EDC ECU.				Intervention required if instrument panel indicates vehicle speed.

Print 603.93.281/A

Revi - February 2005

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
75	04	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	NO SIGNAL		Vehicle speed sensor disconnected or failed.	Check correct assembly and efficiency of vehicle speed sensor.				
75	08	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	SIGNAL NOT PLAUSIBLE		Vehicle speed sensor disconnected or failed.	Check correct assembly and efficiency of vehicle speed sensor.				
75	08	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 117)	SIGNAL NOT PLAUSIBLE	Vehicle speed on instrument panel does not increase sensibly.	Wrong speedometer setting.	Check correct calibration of speedometer.				
77	01	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 119)	EXCEEDING NORMAL RANGE	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				
77	02	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 119)	EXCEEDING NORMAL RANGE	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				
77	08	11	VEHICLE - VEHICLE SPEED SENSOR / SIGNAL (DTC 119)	SIGNAL NOT PLAUSIBLE	Wrong vehicle speed indication.	Wrong speedometer setting.	Check correct calibration of speedometer.				

DTC	FMI	BLINK CODE	Failing component	Type of Failure	Visible failure	Possible Cause	Repair action	Checks to be performed	Measuring conditions	Values to be detected	Remarks
79	08		ELECTRONIC CONTROL UNIT - INTERNAL ECU FAULT (DTC 121)	SIGNAL NOT PLAUSIBLE		Wrong ECU programming. Probable electromagnetic interference. Faulty ECU.	Switch key on/off and wait for a few seconds, clear failure memory. If the error persists, call the Help Desk for instructions on how to replace the ECU.				

Print 603.93.281/A

Revi - February 2005