# Workshop Repair Manual

## Technical Note 3736A

### Diesel Engine G9T - G9U

**High Pressure - Common Rail**

4 cast iron cylinders

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<td>G9U 754</td>
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- Espace (JE0X) XE0K - XE0S G9T 710
- Espace IV JK0H G9T 742, 743
- Laguna II XG0F G9T 700, 702, 703
- Vel Satis BJ0E - BJ0F - BJ0G - BJ0M
  - BJ0F - BJ0G
  - BJ0F
  - G9T 702
  - G9T 700, 701
  - G9T 703
- Avantime DE01 G9T 712
- Trafic XLXD G9U 730

Supersedes Workshop Repair Manual MOT. G9T 77 11 321 202

The repair methods given by the manufacturer in this document are based on the technical specifications current when it was prepared. The methods may be modified as a result of changes introduced by the manufacturer in the production of the various component units and accessories from which his vehicles are constructed.

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EDITION ANGLAISE

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USING THE MANUAL

There are two main sections in this manual:

- technical specifications,
- overhauling the engine.

For repairing vehicle components, refer to the Workshop Repair Manual and Technical Notes for the vehicle.

UNITS OF MEASUREMENT

- All dimensions are given in millimetres (mm) (unless stated otherwise).
- Tightening torques are expressed in decaNewtonmetres (daNm).

Reminder:

1 daNm = 1.02 m.kg.

- Pressures in bar.

Reminder:

1 bar = 100,000 Pa.

TOLERANCES

Tightening torques given without a tolerance must be accurate to within:

- in Degrees (±±±± 3°).
- in daNm (±±±± 10%).
OPERATION

The "Common Rail" high pressure direct injection system is a sequential diesel fuel injection system (based on the petrol engine multipoint injection system).

This new injection system reduces operating noise, reduces the volume of pollutant gases and particles and produces high engine torque at low engine speeds thanks to a pre-injection process.

The low pressure pump (also called the booster pump) supplies the high pressure pump via the pressure regulator filter then the fuel filter during the starting phase only, at a pressure of between 2 and 4 bar.

The high pressure pump generates the high pressure, which is transmitted to the injector rail. The pressure regulator located on the pump modulates the high pressure pump supply flow. The rail supplies each injector through a steel pipe.

The computer:
– determines the injection pressure value necessary for the engine to run correctly and then controls the pressure regulator. It checks that the pressure value is correct by analysing the value transmitted by the pressure sensor located on the rail,
– determines the injection timing necessary to deliver the right quantity of diesel fuel and the moment when injection should start,
– electrically controls each injector individually after determining these two values.

The flow injected into the engine is determined by:
– the duration of injector control,
– the injector opening and closing speed,
– the needle stroke (determined by the type of injector),
– the injector nominal hydraulic flow (determined by the type of injector),
– the high pressure rail pressure, regulated by the computer.

THE CLEANLINESS AND SAFETY ADVICE SPECIFIED IN THIS DOCUMENT MUST BE FOLLOWED DURING ANY WORK CARRIED OUT ON THE HIGH PRESSURE INJECTION SYSTEM.
The circuit comprises:

- A "pump-sender" supply unit (1), located in the fuel tank,
- A fuel filter (2),
- A high pressure regulator (3) mounted on the pump,
- A high pressure pump (4),
- An injector rail (5) fitted with a diesel fuel pressure sensor and a pressure limiter (6),
- Four solenoid injectors,
- Various sensors,
- An injection computer.

Dismantling the interior of the high pressure pump and the injectors is prohibited.
CLEANLINESS ADVICE THAT MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM

Risks relating to contamination

The system is highly sensitive to contamination. The risks caused by contamination are:

- damage to or destruction of the high pressure injection system,
- a component seizing up or leaking.

All After Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) should penetrate the system during dismantling or get into the circuits via the fuel unions.

The cleanliness guidelines must be applied from the filter through to the injectors.

WHAT ARE THE SOURCES OF CONTAMINATION?

Contamination is caused by:

- metal or plastic chips,
- paint,
- fibres;
  ● cardboard,
  ● from brushes,
  ● from paper,
  ● from clothing,
  ● from cloths.
- foreign bodies such as hair,
- ambient air,
- etc.

ADVICE TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM

- Protect the accessories and timing belts, the electrical accessories (starter, alternator, electric power assisted steering pump) and the mating face to prevent diesel fuel spilling onto the clutch friction plate.
- Ensure that you have the caps for the unions to be opened (bag of caps sold by the Parts Department - part no. 77 01 206 381).
- Caps are to be used once only. After use, they must be discarded (once used they are soiled and cleaning is not sufficient to make them reusable).
- Unused caps must be discarded.
- Ensure that you have resealable plastic bags for storing removed parts. Parts store in these will be less prone to contamination. These bags are single use; after use they must be discarded.
- Ensure that you have lint-free cleaning cloths (part no. 77 11 211 707).
- Using a normal cloth or paper for cleaning purposes is prohibited. These are not lint-free and may contaminate the system fuel circuit. Each cloth must be used once only.

WARNING

Cleaning the engine using a high pressure washer is prohibited because of the risk of damaging connections. Furthermore, moisture may collect in connectors and cause electrical connection problems.
CLEANING ADVICE TO BE FOLLOWED BEFORE CARRYING OUT ANY WORK ON THE FUEL CIRCUIT

- Use fresh thinner for each operation (used thinner is contaminated). Pour it into an uncontaminated container.
- For each operation, use a clean brush which is in good condition (the brush must not lose any hairs).
- Use a brush and thinner to clean the unions to be opened.
- Blow compressed air over the cleaned parts (tool and workbench, and the parts, unions and injection system area). Check that no bristles have been left behind.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover them with latex gloves.

ADVICE TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent system contamination. The caps to be used are available from the Parts Department (part no. 77 01 206 381). They must not be reused under any circumstances.
- Close the resealable bag, even if it has to be reopened shortly afterwards. The ambient atmosphere carries impurities.
- All components removed from the injection system must be stored in a hermetically sealed plastic bag once they have been plugged.
- Using a brush, thinner, air gun, swab or normal cloth is strictly prohibited once the circuit has been opened. These items could allow contamination to enter the system.
- If a component is being replaced, the new component must not be removed from its packaging until it is ready to be fitted on the vehicle.
RAIL PROTECTOR

Model 1

General information
The rail protector isolates the high pressure injection system from the engine compartment.

To fulfil its safety function, the rail protector must consist of:

- two soundproofing pads (1), to be replaced if they are damaged or soaked with diesel fuel,
- a lower metal protector (2) mounted between the rail and the cylinder head,
- a diesel fuel drain pipe (3), to be replaced if damaged or soaked with diesel fuel,
- a rubber flap (4) mounted on the metal protector and the rocker cover,
- two side partitions (5),
- a partition (6) mounted on the rocker cover (on some versions),
- two clips for fixing the side partitions to the rubber flap.

Whenever working on the rail protector, make sure the system components are fitted properly after refitting.

IMPORTANT
This rail protector ensures safe operation and requires special attention when being fitted.

IMPORTANT
Failure to comply with these instructions may have serious safety-related consequences.

[Image of rail protector components with numbers indicating parts]
General information

The model two rail protector fulfils the same function as model one. This protector is a development which optimises the protection function of the high pressure injection system.

To fulfil its safety function, the rail protector must consist of:

- two soundproofing pads (1) to be replaced if they are damaged or soaked with diesel fuel,
- a lower aluminium protector (2) mounted between the rail and the cylinder head,
- a diesel fuel drain pipe (3), to be replaced if damaged or soaked with diesel fuel,
- a plastic cover (4) mounted on the aluminium protector,
- a seal (5) to prevent leaks between the cover and rail protector.

Whenever working on the rail protector, make sure the system components are fitted properly after refitting.

IMPORTANT

The rail protector ensures safe operation and requires special attention when being fitted.

IMPORTANT

Failure to comply with these instructions may have serious safety-related consequences.
POST-REPAIR CHECK

Re-prime the circuit. To do this, turn the low pressure pump over by switching on the ignition several times, or turn the low-pressure pump over using the fault finding tool via the "Actuator commands" menu.

After any operation, check that there are no diesel fuel leaks. Run the engine at idling speed until the engine cooling fan is activated, then accelerate several times at no load.

The system can inject the diesel fuel into the engine at a pressure of up to 1350 bar.

Before any operation, check that the injector rail is depressurised.

It is vital that you observe the tightening torque:
- of the high pressure pipes,
- of the cylinder head injector,
- of the pressure sensor and pressure regulator.

When the high pressure pump, injectors and high-pressure supply, return and output unions are removed or repaired, all orifices should be fitted with appropriate new blanking plugs to prevent contamination entering.

When replacing a high pressure pipe, follow the method below:
- remove the high pressure pipe, holding the filter rod on the injector with a lock-wrench,
- insert anti-contamination plugs,
- loosen the high pressure rail,
- fit the new high pressure pipe,
- manually bring the unions together until they touch,
- tighten to torque:
  - the high pressure rail mountings,
  - the injector end union,
  - the high pressure rail end union.

WARNING
The engine must not run with diesel fuel containing more than 10% diester.

WARNING
All pipes removed must be replaced.

IMPORTANT
Dismantling the interior components of the pump is prohibited.

The fuel return pipe fitted to the injectors must be replaced when it is removed.

The diesel fuel temperature sensor cannot be removed. It is part of the fuel return rail.

Loosening a high pressure pipe union when the engine is running is prohibited.
ENGINE IDENTIFICATION

There are two means of identification:

A) A plate (1) riveted onto the cylinder block.
ENGINE AND PERIPHERALS
Engine Identification

A label (2) stuck onto the rocker cover.

A engine type,
B the engine approval letter,
E the engine rating,
F the engine fabrication number,
G the engine assembly factory,
H the assembled engine part number.
## Engine Identification

<table>
<thead>
<tr>
<th>Engine</th>
<th>Rating</th>
<th>Compression Ratio</th>
<th>Bore (mm)</th>
<th>Stroke (mm)</th>
<th>Cubic Capacity (cc)</th>
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<th>Rating</th>
<th>Compression Ratio</th>
<th>Bore (mm)</th>
<th>Stroke (mm)</th>
<th>Cubic Capacity (cc)</th>
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<td>Injector flange bolt</td>
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<td>Rocker cover bolt</td>
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<tr>
<td>Turbocharger oil supply nut on turbocharger</td>
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<td>Cylinder head support bolt</td>
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## ENGINE AND PERIPHERALS

### Tightening torques (in daNm and/or in degrees)

#### UPPER ENGINE (continued)

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<td>Power assisted steering pulley bolt</td>
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<tr>
<td>Accessories tension wheel bolt</td>
<td>2.1</td>
</tr>
<tr>
<td>Accessories pulley bolt</td>
<td>4.4</td>
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<tr>
<td>Engine lifting ring bolts</td>
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</tr>
<tr>
<td>- M 6</td>
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</tr>
<tr>
<td>- M 8</td>
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<tr>
<td>Timing belt cover bolt</td>
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<tr>
<td>Cylinder head mounting bolts *</td>
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<tr>
<td>Timing tension wheel bolt</td>
<td>2.5</td>
</tr>
<tr>
<td>Timing pulley mounting bolt</td>
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<tr>
<td>Protector bolts (M6 bolt)</td>
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</tr>
<tr>
<td>- M8 bolt</td>
<td>1.2</td>
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<tr>
<td>- M8 bolt</td>
<td>2.5</td>
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<tr>
<td>Lower metal protector bolt (M6 bolt)</td>
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### RAIL PROTECTOR: Model 2

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### RAIL PROTECTOR: Model 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Torque</th>
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## ENGINE AND PERIPHERALS

### Tightening Torques (in daNm and/or in degrees)

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<thead>
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<th>Description</th>
<th>Tightening Torque</th>
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<tr>
<td><strong>See tightening order</strong></td>
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<tr>
<td><strong>Important</strong>: left-hand thread.</td>
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<table>
<thead>
<tr>
<th>Description</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Sump bolts **</td>
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</tr>
<tr>
<td>Crankshaft pulley bolts</td>
<td>5 plus angle of 90° ± 6°</td>
</tr>
<tr>
<td>Flywheel bolts:</td>
<td></td>
</tr>
<tr>
<td>Classic</td>
<td>2 plus angle of 45° ± 6°</td>
</tr>
<tr>
<td>Dual mass flywheel</td>
<td>2.5 plus angle of 50° ± 6°</td>
</tr>
<tr>
<td>Clutch bolts</td>
<td>1.2</td>
</tr>
<tr>
<td>Oil pump bolts:</td>
<td></td>
</tr>
<tr>
<td>– M6</td>
<td>1.2</td>
</tr>
<tr>
<td>– M8</td>
<td>1.2</td>
</tr>
<tr>
<td>Anti-emulsion plate bolts</td>
<td>1</td>
</tr>
<tr>
<td>Bolts for split con rod caps</td>
<td>2.5 plus angle of 60° ± 6°</td>
</tr>
<tr>
<td>Crankshaft bearing cap bolts</td>
<td>2 plus angle of 150° ± 10°</td>
</tr>
<tr>
<td>Crankshaft bearing cap housing seam bolts</td>
<td>2</td>
</tr>
<tr>
<td>Water pump bolts</td>
<td>1</td>
</tr>
<tr>
<td>Water pump cover bolts</td>
<td>1</td>
</tr>
<tr>
<td>Water pump sprocket nut</td>
<td>5</td>
</tr>
<tr>
<td>Piston base cooling jet mounting bolts</td>
<td>2*</td>
</tr>
<tr>
<td>Timing cover bolt:</td>
<td></td>
</tr>
<tr>
<td>– M6</td>
<td>1.2</td>
</tr>
<tr>
<td>– M8</td>
<td>1.2</td>
</tr>
<tr>
<td>Alternator bracket mounting bolt</td>
<td>3</td>
</tr>
<tr>
<td>High pressure pump mounting bolt</td>
<td>3</td>
</tr>
<tr>
<td>High pressure pump rear support bolt</td>
<td>3</td>
</tr>
<tr>
<td>High pressure pump sprocket nut</td>
<td>9</td>
</tr>
<tr>
<td>Cylinder marking sensor mounting bolt</td>
<td>1</td>
</tr>
<tr>
<td>Intermediate shaft mounting bolts</td>
<td>2.5 plus angle of 30° ± 6°</td>
</tr>
<tr>
<td>Timing belt pulley bolt</td>
<td>3</td>
</tr>
<tr>
<td>Oil filter holder mounting bolt</td>
<td>2.2</td>
</tr>
<tr>
<td>Dipstick guide mounting bolt:</td>
<td></td>
</tr>
<tr>
<td>Lower mounting</td>
<td>2.5</td>
</tr>
<tr>
<td>Upper mounting</td>
<td>1</td>
</tr>
<tr>
<td>Oil level sensor mounting bolt</td>
<td>1</td>
</tr>
<tr>
<td>TDC cap mounting bolt</td>
<td>3.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant pipe bolts</td>
<td>3.1</td>
</tr>
<tr>
<td>Venturi mounting bolts</td>
<td>2.2</td>
</tr>
<tr>
<td>Catalytic converter mounting nuts</td>
<td>2.1</td>
</tr>
<tr>
<td>Catalytic converter stay mounting bolts</td>
<td>2.1</td>
</tr>
<tr>
<td>Relay bearing mounting bolts</td>
<td>6.2</td>
</tr>
<tr>
<td>Balance shaft cassette mounting bolts</td>
<td>1.5 ± 38° ± 6°</td>
</tr>
</tbody>
</table>

---

**Notes:**
- Torque values are in Nm.
- Angle values are in degrees.

---

**Additional Information:**
- Ensure all components are tightened to the specified torque and angle values for optimal performance and safety.
- Always use the correct tool for tightening to avoid damage to the bolts or nuts.

---

**Engine and Peripherals Specification:**
- Engine type: 10A
- Peripherals:
  - Coolant pipes
  - Venturi mountings
  - Catalytic converter mountings
  - Relay bearings
  - Balance shaft cassettes

---

**Tightening Torques (in Nm and/or in degrees):**
- Coolant pipe bolts: 3.1 Nm
- Venturi mounting bolts: 2.2 Nm
- Catalytic converter mounting nuts: 2.1 Nm
- Catalytic converter stay mounting bolts: 2.1 Nm
- Relay bearing mounting bolts: 6.2 Nm
- Balance shaft cassette mounting bolts: 1.5 Nm ± 38° ± 6°
Cylinder head bolts must always be replaced.

Cylinder head tightening procedure

- Tighten the cylinder head bolts to torque (3 daNm) and in order.
- Check that all the bolts are correctly tightened to 3 daNm then angle tightening (bolt by bolt) by ±6°.

**WARNING**

- Do not oil new bolts. Bolts must be oiled if reused.
- In order to ensure that the bolts are correctly tightened, use a syringe to remove any oil which may be in the cylinder head mounting holes.
- Do not retighten the cylinder head bolts after applying this procedure.
Cylinder head changes

Model 1
This cylinder head has lower washers on the valve springs.
Marking (1) is made directly on the newly cast cylinder head.

Model 2
This cylinder head no longer has valve spring lower washers.
Marking (1) is made after milling.
Cylinder head gasket thicknesses:

There are two cylinder head gasket thicknesses:

- Thickness of crushed gasket: 1.16 ± 0.05 mm
- Thickness of crushed gasket: 1.21 ± 0.05 mm

The thickness of the cylinder head gasket is measured at (1).
Specifications

**Cylinder head gasket thickness**

1.21 ± 0.05 mm

**Checking piston protrusion**

1. Clean the piston crowns in order to eliminate any scaling.
2. Turn the crankshaft by one revolution (in the operating direction, clockwise at the timing end) to bring piston no. 1 close to the top dead centre.
3. Put tool (Mot. 252-01) in position.
4. Insert tool (Mot. 251-01) equipped with a dial gauge on its pressure plate (Mot. 252-01), and find the top dead centre of the piston.
5. Reset the dial gauge on the front of the cylinder block.
6. Apply force to the piston to eliminate the various clearances (between pin and piston, between pin and con rod, etc.).
7. Take the protrusion value at both points (1) and (2), and take the average of the two measurements.
8. Measure the piston protrusion. The protrusion must be: 0.399 ± 0.065 mm.

**Note:**

When replacing:
- the crankshaft,
- the cylinder block,
- the con rods,
- the pistons.

The thickness of the cylinder head gasket must be calculated.

**Note:**

All measurements must be carried out along the longitudinal engine axis, in order to eliminate any errors due to tilting of the piston.

**WARNING**

The dial gauge feeler must not be in the valve clearance.
Cylinder head height (mm) \( H = 90.2 \)

Gasket face deformation (mm)
- Cylinder head: 0.05
- Cylinder block: 0.06

Test the cylinder head to detect any cracks using the cylinder head test tools, comprising a tray and a kit suited to the cylinder head (cap, sealing plate, blanking cover). The approval reference no. of the cylinder head test tray is 664 000 000.

Hydraulic tappet

These engines are equipped with hydraulic thrust bearings (1) and roller type rocker arms (2).
<table>
<thead>
<tr>
<th>Valve</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Stem diameter (in mm): 5.9675 ±±±± 0.0125</td>
</tr>
<tr>
<td></td>
<td>Diameter (in mm): 30.6 ±±±± 0.12</td>
</tr>
<tr>
<td></td>
<td>Mating face angle: 90°°°° 15'</td>
</tr>
<tr>
<td></td>
<td>Valve length (in mm): 123.2 ±±±± 0.15</td>
</tr>
<tr>
<td></td>
<td>Max valve lift (in mm): 7.8</td>
</tr>
<tr>
<td></td>
<td>No valve clearance adjustment.</td>
</tr>
<tr>
<td>Exhau</td>
<td>Stem diameter (in mm): 5.9575 ±±±± 0.0075</td>
</tr>
<tr>
<td></td>
<td>Diameter (in mm): 29.5 ±±±± 0.12</td>
</tr>
<tr>
<td></td>
<td>Valve length (in mm): 123 ±±±± 0.15</td>
</tr>
<tr>
<td></td>
<td>Max valve lift (in mm): 7.8</td>
</tr>
<tr>
<td></td>
<td>No valve clearance adjustment.</td>
</tr>
</tbody>
</table>

**Valve Seat**

<table>
<thead>
<tr>
<th>Valve</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet</td>
<td>Seat angle α: 89°°°° 30'</td>
</tr>
<tr>
<td></td>
<td>External diameter D (in mm): 32.31 ±±±± 0.01</td>
</tr>
<tr>
<td></td>
<td>Diameter of housing in the cylinder head (in mm): 32.228 ±±±± 0.0125</td>
</tr>
<tr>
<td>Exhau</td>
<td>Seat angle α: 89°°°° 30'</td>
</tr>
<tr>
<td></td>
<td>External diameter D (in mm): 31.11 ±±±± 0.01</td>
</tr>
<tr>
<td></td>
<td>Diameter of housing in the cylinder head (in mm): 31.032 ±±±± 0.0125</td>
</tr>
</tbody>
</table>
Valve guide specifications:

- **Valve guide length (in mm):**
  - Inlet and exhaust: 50 ± 0.15

- **Guide external diameter (in mm):**
  - Inlet and exhaust: 11

- **Guide internal diameter (in mm):**
  - Inlet and exhaust: Not machined: 5.5 + 0.12
  - Machined*: 6 + 0.022

- **Guides of guides fitting in the cylinder head:**
  - Inlet and exhaust: 11 + 0.039 + 0.028

Note:
- Do not lubricate the valve stem seals before fitting them.

Additional information:
- The inlet and exhaust guides have valve stem seals which must be replaced each time the valves are removed.
- The valve stem seals must be fitted using tool Mot. 1511-01 or other suitable equipment.

* This value must be obtained with the guide fitted in the cylinder head.
### Valve Specifications

**Angle of the inlet and exhaust guides (in degrees)**
- **Inlet:** 95° ± 0.1°
- **Exhaust:** 94° ± 0.1°

**Position of inlet and exhaust valve guides (mm)**
- **Inlet:**
  - *A* = 8.7 ± 0.15
- **Exhaust:**
  - *A* = 13.3 ± 0.15

**Valve Springs (mm)**
- **Free length:** 46.7
- **Length under load:**
  - 18.5 daN: 40.5
  - 21.5 daN: 39.5
  - 24.5 daN: 38.5
  - 35 daN: 35
  - 45 daN: 32
  - 48.3 daN: 31
  - 51.5 daN: 30

**Length of joined spires:** 28

**Wire diameter:** 3.2 ± 0.02

**Internal diameter:** 14.1 ± 0.2

**External diameter:** 20.9
ENGINE AND PERIPHERALS
Specifications

Specifications:

Camshaft

- The exhaust camshaft has the vacuum pump drive (1).
- The inlet camshaft has no vacuum pump drive.

Either by a marking (2):

- **B** gives the engine type,
- **C** identifies the camshafts (A = Inlet and E = Exhaust),
- **D** is used by the supplier only.

Longitudinal clearance (mm) 0.05 to 0.13

Number of bearings: 6

Diameter of camshaft bearings (in mm)

Timing diagram

- Inlet opening retardation (ROA) *         - 11
- Inlet closing retardation (RFA)           16
- Exhaust opening advance (AOE)           28
- Exhaust closing advance (AFE)**         - 13

* If the inlet opening retardation is negative, the valves open after top dead centre.
** If the exhaust closing advance is negative, the valves close before top dead centre.
ENGINE AND PERIPHERALS
Specifications

PISTONS
Fitting the free floating pin in the con rod and in the piston.
The gudgeon pin is retained by circlips.
These engines are fitted with KOLBENSCHMIDT pistons.
Piston marking:
1. Direction of fitting of the piston ("Λ" flywheel end)
2. Piston height category
3. Used by the supplier only
4. Used by the supplier only
5. Piston axis of symmetry
6. Gudgeon pin hole axis
7. Offset between axis (5) and axis (6). This offset is 0.5 mm

Table of gudgeon pin heights

<table>
<thead>
<tr>
<th>Pin height H (in mm)</th>
<th>Thickness of associated cylinder head gasket (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 54.48</td>
<td>1.16</td>
</tr>
<tr>
<td>F 54.52</td>
<td>1.16</td>
</tr>
<tr>
<td>J 54.56</td>
<td>1.16</td>
</tr>
<tr>
<td>K 54.60</td>
<td>1.16</td>
</tr>
<tr>
<td>L 54.64</td>
<td>1.16</td>
</tr>
</tbody>
</table>

* Mark on piston
Pin height H (in mm)
Thickness of associated cylinder head gasket (mm)
These pistons have ducting (oil circulation in the piston crown contributing to piston cooling).

Procedure for distinguishing between pistons with an identical mark but different pin heights:

Calculation: \( X = H - \frac{31}{2} \)

Example:
- Piston of category F with a pin height \( H = 54.52 \)
  
  \[ X = 54.52 - \frac{31}{2} \]
  \[ X = 39.02 \text{ mm} \]

- Piston of category F with a pin height \( H = 54.57 \)
  
  \[ X = 54.57 - \frac{31}{2} \]
  \[ X = 39.07 \text{ mm} \]

The tolerance on the pin heights is \( \pm 0.02 \text{ mm} \).

* The various gudgeon pin heights are exclusively reserved for the engine assembly factory. The Parts Department supplies only the following piston categories:

<table>
<thead>
<tr>
<th>Mark on Piston</th>
<th>Pin Height H (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A or T</td>
<td>54.53</td>
</tr>
<tr>
<td>B or U</td>
<td>54.57</td>
</tr>
<tr>
<td>C or W</td>
<td>54.61</td>
</tr>
<tr>
<td>D or X</td>
<td>54.65</td>
</tr>
<tr>
<td>G or Y</td>
<td>54.69</td>
</tr>
<tr>
<td>N</td>
<td>53.03</td>
</tr>
<tr>
<td>O</td>
<td>53.07</td>
</tr>
<tr>
<td>P</td>
<td>53.11</td>
</tr>
<tr>
<td>R</td>
<td>53.15</td>
</tr>
<tr>
<td>S</td>
<td>53.19</td>
</tr>
</tbody>
</table>
The piston diameter should be measured with:

- \( A = 49 \text{ mm} \) for G9T engines,
- \( A = 47 \text{ mm} \) for G9U engines.

**Piston diameter (in mm):**

- \( 86.806 \pm 0.007 \) for G9T engines,
- \( 88.81 \pm 0.007 \) for G9U engines.

**Gudgeon pin (in mm):**

- Length: 64.7 to 65
- External diameter: 30.994 to 31
- Internal diameter: 15.13 ± 0.1

**Rings:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Thickness (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>3</td>
</tr>
<tr>
<td>Sealing</td>
<td>1.75 to -0.01</td>
</tr>
<tr>
<td>Scraper</td>
<td>2.5 to -0.01</td>
</tr>
</tbody>
</table>

**Rings End clearance (in mm):**

- Compression ring: 0.2 to 0.35
- Sealing ring: 0.5 to 0.7
- Scraper ring: 0.25 to 0.5
The con rods are of the "SPLIT" type.

**Big end - small end centre-to-centre distance:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Distance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9T</td>
<td>149.8775 ± 0.0075</td>
</tr>
<tr>
<td>G9U</td>
<td>149.8925 ± 0.0075</td>
</tr>
</tbody>
</table>

The Parts Department supplies only the following con rod category:
- 3 for G9T engines
- 7 for G9U engines

**Big end diameter:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9T</td>
<td>51.587 + 0.019</td>
</tr>
<tr>
<td>G9U</td>
<td>56.587 + 0.019</td>
</tr>
</tbody>
</table>

**Small end diameter:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9T</td>
<td>33.5 + 0.025</td>
</tr>
<tr>
<td>G9U</td>
<td>31 + 0.025 + 0.013</td>
</tr>
</tbody>
</table>

**Lateral clearance of the big end:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Clearance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9T</td>
<td>0.22 to 0.482</td>
</tr>
</tbody>
</table>

**Big end diametrical clearance:**

<table>
<thead>
<tr>
<th>Category</th>
<th>Clearance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G9T</td>
<td>0.027 to 0.086</td>
</tr>
</tbody>
</table>

**Note:**

- The con rod small end bushes cannot be replaced.
- Coated bolts must be used when fitting the con rods on the engine.
- Positioning of the con rod caps on the body is ensured by textured mating faces.
- Impacts or a foreign body between the body-cap mating faces will cause a rapid fracture of the con rod.
- The mating faces must remain clean and dry.
- Do not oil the bearing shell pressure faces on the con rods when fitting.

**Specifications:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Con rods</td>
<td>Specifications</td>
</tr>
</tbody>
</table>
The maximum con rod weight difference for a given motor must be 25 grams.

WARNING
Do not use a sharp point to mark the big end caps in relation to their bodies, to prevent incipient breakage of the con rod.
ENGINE AND PERIPHERALS
Specifications

Direction of fitting of the con rod in relation to the piston

Position the "λ" (1) etched on the piston crown downwards and lubrication hole (2) on the small end to the right of the vertical axis (as shown on the diagram above). Also, the slot (3) should be positioned at the flywheel end.

Direction of fitting circlips on the piston

Fit the circlips on the piston as shown above.

CRANKSHAFT

Number of bushings
5

Crankshaft lateral clearance (mm)
0.06 to 0.232

Crankshaft diametrical clearance (mm)
0.036 to 0.071

Diameter of bushings
The bushing diameters are shown on the crankshaft by paint marks.

The lateral shims are located on bearing no. 2.

NO REGRINDING IS AUTHORISED

The lateral shims have changed: A foolproofing device has been added. They are not interchangeable. The foolproofing device helps fitting the lateral shims:

- Model 1 (1)
- Model 2 (2)

Paint mark

Blue

Red

Bushing diameter (mm)

57.98 inclusive to 57.99 exclusive

57.99 inclusive to 58 inclusive

Note:

This paint mark is used only by the factory for matching bearing shells and bushings. The Parts Department supplies only a single type of bearing shell.

Crankpin diameter (mm)

48 - 0.01
48 - 0.03
53 - 0.01
53 - 0.03
BEARING SHELLS

Crankshaft bearing shells
These engines are fitted with foolproofed bearing shells.

Direction of fitting:
– on the cylinder block, fit grooved bearing shells on all the bearings,
– on the bearing caps, fit non-grooved bearing shells.

The bearing caps and cylinder block bearings must be clean and dry before the bearing shells are fitted.

Con rod bearing shells
These engines are fitted with non-foolproofed bearing shells.

The bearing shells are fitted using tools Mot. 1492 and Mot. 1492-02 (with diameter 48 mm or 53 mm).

Note:
On a given bearing, fit an upper bearing shell and a lower bearing shell of the same colour.
WARNING
The piston base cooling jet mounting bolts have a left-handed thread.
PREPARING THE ENGINE TO BE MOUNTED ON THE SUPPORT

Before the engine is mounted on the support (Mot. 792-03), the engine's electrical harness must be removed and the engine oil drained. Remove the exhaust heat shield. Remove the turbocharger retaining strut from the cylinder block (if fitted).
Remove the turbocharger retaining strut and the pre-catalytic converter retaining strut from the cylinder block (if fitted).

Remove the turbocharger oil supply pipe.

Remove the turbocharger oil return pipe.

Remove the three turbocharger mounting bolts (1).
Remove:
- the exhaust manifold,
- driveshaft relay bearing.
Position the rods (D), (D1), and (T) of Mot. 1574 and (T) of Mot. 1301 in the cylinder block so that they fit into holes 19, 28, and 29 of the plate (Mot. 792-03).

Note: It is essential to remove the relay bearing centring dowel to enable stud D1 to be correctly positioned.
### WARNING

Parts to be replaced after removing:
- all seals,
- flywheel bolts,
- crankshaft bearing bolts,
- crankshaft pulley bolts,
- con rod cap bolts,
- injector holder copper washers,
- diesel return pipes,
- high pressure pipes,
- pipe caps,
- belts,
- timing tension wheel,
- timing pulley,
- exhaust gas recirculation pipe.

---

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Component concerned</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaner</td>
<td>77</td>
<td>Cleaning parts</td>
<td>01 421 513</td>
</tr>
<tr>
<td>DECAPJOINT</td>
<td>Coat</td>
<td>Cleaning sealing surfaces</td>
<td>01 405 952</td>
</tr>
<tr>
<td>RHODORSEAL</td>
<td>5661</td>
<td>Crankshaft bearing cap housing</td>
<td>01 404 452</td>
</tr>
<tr>
<td>LOCTITE FRENETANCH</td>
<td>1 or 2 drops</td>
<td>High pressure pump bolt</td>
<td>01 394 070</td>
</tr>
</tbody>
</table>

---

### WARNING

The cleanliness rules described at the start of this document must be strictly observed when working on the fuel supply system.

Excess sealant could be squeezed out when the parts are tightened; a mixture of sealant and fluid could damage certain components (engine, radiator, etc.).
The engine must be cleaned and drained (oil and water).

Leave on the used engine or include in the return box:
– the oil filter,
– the oil pressure switch,
– the water pump,
– the high pressure pump,
– the rail,
– the injectors,
– the heater plugs,
– the diesel fuel collector on rail protector model 2,
– the oil level sensor,
– the cylinder head plenum chamber,
– the water pump coolant inlet pipe,
– the rocker cover,
– the dipstick,
– the vacuum pump,
– the flywheel,
– the clutch.

Remember to remove:
– all coolant flexible pipes,
– the exhaust manifold,
– the alternator,
– the power assisted steering pump,
– the air conditioning compressor,
– the rail protector model 1 (entire system),
– the cover of model 2.

The used engine must be secured to the base under the same conditions as the overhauled engine:
– plastic caps and covers fitted,
– cardboard cover over the assembly.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10A</td>
<td>Crankshaft spigot extractor</td>
</tr>
<tr>
<td>251-01</td>
<td>Dial gauge support</td>
</tr>
<tr>
<td>252-01</td>
<td>Dial gauge support thrust plate</td>
</tr>
<tr>
<td>591-02</td>
<td>Magnetised flexible shaft for angle wrench</td>
</tr>
<tr>
<td>591-04</td>
<td>Angle wrench with index for tightening cylinder head</td>
</tr>
<tr>
<td>792-03</td>
<td>Engine support plate for Desvil engine stand</td>
</tr>
<tr>
<td>1301</td>
<td>Stud ref. “T” for Desvil engine stand</td>
</tr>
<tr>
<td>1313</td>
<td>Flywheel end crankshaft seal fitting tool</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>10A</td>
<td>Flywheel locking tool</td>
</tr>
<tr>
<td>10A-41</td>
<td>Depth gauge for measuring the</td>
</tr>
<tr>
<td></td>
<td>height of crankpins</td>
</tr>
<tr>
<td>10A</td>
<td>Pliers for removing valve stem seals</td>
</tr>
<tr>
<td>10A</td>
<td>Tool for fitting con rod bearing shells</td>
</tr>
<tr>
<td>10A</td>
<td>Tool for fitting bearing shells on split con rods - adaptor for</td>
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<tr>
<td>10A</td>
<td>∅ 48 mm and ∅ 53 mm</td>
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<tr>
<td>10A</td>
<td>Tool for fitting high pressure pump nut blanking cover</td>
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<td>10A</td>
<td>Inlet camshaft setting tool</td>
</tr>
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<td>Mot. 1573</td>
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<tr>
<td>Mot. 1577</td>
<td>Lip seal extractor from φ28 mm to φ50 mm</td>
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<tr>
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<td>Lip seal extractor from φ50 mm to φ75 mm</td>
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<td>Lip seal extractor from φ80 mm to φ95 mm</td>
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<tr>
<td>Mot. 1580</td>
<td>Set of 3 sleeves for fitting elastomer seals. This kit is needed for tools Mot. 1560, Mot. 1561 and Mot. 1562</td>
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<tr>
<td>Mot. 1660</td>
<td>Balance shaft setting tool</td>
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## Equipment required

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<tr>
<th>Description</th>
<th>Parts Code</th>
<th>Notes</th>
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<td>Water pump sprocket extractor</td>
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<tr>
<td>Standard 22 mm long &quot;1/2&quot; (12.7 mm square) drive socket for removing oil pressure checking gauge</td>
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<tr>
<td>Valve spring compressor</td>
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<tr>
<td>Cylinder head test tools from CULASSE EUROPE SERVICE comprising, for example, a tray and the various kits for each model of cylinder head (cap, sealing plate, blanking cover).</td>
<td>664000</td>
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<tr>
<td>Female torx socket 8/12/14, standard 1/2 (12.7 mm square)</td>
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<td>Angle tightening wrench</td>
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<td>Tool for fitting valve stem seals</td>
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<td>Cap tightening wrench</td>
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<td>Description</td>
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<tr>
<td>High pressure pipe wrench</td>
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<tr>
<td>Articulated wrench for removing and refitting heater plugs</td>
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<td>Crankshaft spigot bush extractor pliers</td>
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<tr>
<td>Dummy heater plug for measuring the pressure at end of compression</td>
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<tr>
<td>&quot;CROWFOOT&quot; socket for tightening high pressure pipes to torque</td>
<td>10A</td>
<td></td>
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</tbody>
</table>
Overhauling the engine

Removing the upper engine

1. Remove the accessories belt by turning it to the left to slacken the belt.
2. Lock the tension wheel by inserting a 4 mm Allen key in the hole (1).

Illustration: Upper engine removal process
Remove the cylinder head suspended mounting.
Overhauling the engine

Remove:
- the timing cover,
- the TDC setting rod cap (1).
ENGINE AND PERIPHERALS

Overhauling the engine

ADJUSTING THE TIMING

Position the top dead centre mark (1) almost vertically to the engine as shown in the following illustration.

Fit the TDC setting rod (Mot. 1536).

Turn the engine clockwise (timing end), while pressing down on the TDC setting rod (Mot. 1536) until it reaches the timing setting point.

Note:
The camshaft grooves must be vertical as shown in the following illustration (zoom or top view).
The inlet and exhaust camshafts are set using tools Mot. 1534 and Mot. 1537.

Place tools Mot. 1534 and Mot. 1537 in the camshaft grooves as recommended below.

For the inlet camshaft:

- Fit tool Mot. 1534 SCREWING IN THE BOLT (1) BY HAND.
- Loosen the three camshaft sprocket bolts (2) by up to one turn.
- Turn the inlet camshaft clockwise by the hub mounting bolt (3) using a 16 mm tubular hexagon box spanner, so as to pin the tool Mot. 1534 to the cylinder head.
- Then lock down the bolt (1) onto tool (Mot. 1534).
For the exhaust camshaft:

Loosen the three camshaft sprocket bolts (5) by up to one turn.

Turn the inlet camshaft clockwise by the hub mounting bolt (6) using a 16 mm tubular hexagon box spanner, so as to pin tool Mot. 1537 to the cylinder head.

Then lock down the bolt (4) onto tool Mot. 1537.
Slacken the timing belt by loosening the tension wheel bolt (1). Remove the three bolts (2), then remove the exhaust camshaft sprocket.

Remove:
- the timing belt,
- the inlet camshaft sprocket,
- the camshaft hubs by removing the bolts (3).
Overhauling the engine

Remove:
- the strut linking the multifunction support to the venturi unit,
- the power assisted steering pump rear bolt,
- the power assisted steering pump pulley.
Overhauling the engine

Remove:
- the power assisted steering pump,
- the accessories belt pulley,
- the accessories belt tension wheel,
ENGINE AND PERIPHERALS

Overhauling the engine

Remove the alternator.
Remove the air conditioning compressor.
Unclip the rail protector side partitions (1).

Unclip the rail protector from the rocker cover, pushing it as far back as possible.

Remove the sealing partition (2) attached by two nuts to the rocker cover, holding the stud in place (on some versions).

Remove the absorbent soundproofing pads (3).

**WARNING**
Pay strict attention to the rules regarding cleanliness (see start of document).
ENGINE AND PERIPHERALS
Overhauling the engine

disconnect the oil vapour rebreathing pipe (1).

unclip the protector plastic cover and remove it.

remove the diesel fuel drain pipe (3).

remove the heater plugs using the correct equipment.

**Warning**

When loosening the high pressure pipe nuts (7), hold the filter-rod retaining nuts (8) with a lock wrench.
10A-60

Remove the injector pipes using tool Mot. 1566 or other suitable equipment.

Remove the high pressure pipe between the high pressure pump and the rail (using a "CROWFOOT" socket).

**WARNING**
The clip (6) is very fragile.
Overhauling the engine

Remove:

- the fuel return pipe (be sure to replace it),*
- the oil vapour recirculation pipe (Model 1).

Fit the anti-contamination blanking covers on the high pressure pump, the injectors and the high pressure pipes (set of caps available from the Parts Department).

* To remove the return pipe, press on the clips then pull the pipe out vertically. It is not necessary to remove the clips. If removed, be sure to replace them.

REMOVING THE INJECTOR HOLDERS

Loosen the mounting bolts on each injector holder.

A special extractor must be used to remove the injectors.

Never attempt to remove an injector holder locked in its cylinder head well without using the tool described below.

Description of the extractor (Mot. 1730 and 1549).

1 Extractor support chassis (1).
2 Extractor (2).
3 Extractor bolt (3).

Apply release agent around the injector. Fit the extractor onto an injector holder. Tighten the knurled ring to bring the two jaws together on the flat surfaces without over-tightening.

Mount the tool (Mot. 1549 and 1730) chassis on the rocker cover mounting bolts. Tighten the extraction bolt until the injector is released from the cylinder head.

WARNING

Never reuse injector holder mounting bolts. A special set of studs is available from the Parts Department.
ENGINE AND PERIPHERALS

Overhauling the engine

1. Remove the washer from the bottom of each injector well.

2. Remove:
   - the two clips (2),
   - the engine lifting eye at the flywheel end,

3. RAIL PROTECTOR:
   - Remove:
     - the bolt from the clamp (3) securing the rail to the lower metal protector,
     - the three common rail bolts (4), then remove the rail.
Overhauling the engine

Remove:
- the side partition mounting bolt (5),
- the lower metal protector mounting bolt (6).

Remove the rail protector with the side partition.

Model 2
Remove both injector rail mounting bolts, then remove the rail.

Remove:
- the two aluminium protector mounting bolts,
- the rail protector.

Remove:
- the two aluminium protector mounting bolts,
- the rail protector.
ENGINE AND PERIPHERALS

Overhauling the engine

Remove:
- the rocker cover bolts,
- the vacuum pump,
- the cylinder head plenum chamber.
Overhauling the engine

1. Remove the coolant pipe.
ENGINE AND PERIPHERALS

Overhauling the engine

Remove the rocker shafts.
Mark the camshaft bearing caps.

Remove the camshaft bearing caps.

WARNING
Mark the position and direction of fitting of the bearings.
Overhauling the engine

Remove:
- the camshafts,
- the exhaust gas recirculation pipe.
Overhauling the engine

Remove the cylinder head.
ENGINE AND PERIPHERALS
Overhauling the engine

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DISMANTLING THE CYLINDER HEAD

Place the cylinder head on the cylinder head stand (Mot. 1573).

Remove the inlet manifold.

Remove the cylinder head suspended mounting.
Compression the valve springs using a valve-spring compressor.

Remove the keys.

Remove the springs' upper mounts.

Remove the springs.

Fit the pushrod (1) of Mot. 1511-01 on the valve stem seal.

In addition, the bottom of the pushrod must be snug to the metal upper section of the valve stem seal.

Note: Before removing the valves and the valve stem seals, be sure to mark the position (H) of one of the old seals in relation to the cylinder head using Mot. 1511-01 or other suitable equipment.

Note: The internal diameter of the pushrod must be identical to that of the valve.
Overhauling the engine

1. Insert the guide tube (2) in the top of the pushrod, until the guide tube comes into contact with the cylinder head.
2. Lock the pushrod with the tumblewheel.
3. Remove the guide tube-pushrod assembly, being careful not to loosen the tumblewheel.
4. Remove the valve guide seals using the pliers (Mot. 1335).
5. Remove the spring lower mounts (if fitted, see section "Cylinder head specifications").

Cleaning

Do not allow this product to drip on to the paintwork. Take care during this operation to prevent foreign bodies getting into the pressurised oil inlet pipes, paying attention to the following:
- hydraulic thrust bearings,
- camshafts (pipes both on the cylinder block and cylinder head).
- oil return pipes.
Failure to follow this advice could lead to the blocking of the various oil inlet ducts, resulting in rapid destruction of the engine.

Checking the gasket face

Check for gasket face deformation using a ruler and a set of shims.
Maximum distortion: 0.05 mm
Test the cylinder head to detect any cracking using the cylinder head test tools (comprising a tray and kit for the cylinder head: cap, sealing plate and blanking cover). The approval number of the cylinder head test tray is 664 000.

Important

Do not scratch the aluminium sealing surfaces. Wear goggles. Wear gloves during this operation. Clean the sealing surfaces with DECAPJOINT compound to dissolve any pieces of seal which are still bonded. Apply the product to the part to be cleaned, wait around ten minutes, then remove residue using a wooden spatula.
CHECKING CAMSHAFT LONGITUDINAL CLEARANCE

Refit:
– the camshafts, ensuring they are correctly positioned (see camshaft identification in the "Technical specifications" section),
– the camshaft bearing caps (without tightening to torque),
– the rocker shafts, without the rocker arms.

Tighten the camshaft bearing caps to a torque of 0.9 daNm.

Fit a cylinder liner retaining bracket (Mot. 588) so it be used as a support for the magnetic holder.

Check the longitudinal clearance, which must be between 0.05 and 0.13 mm inclusive.

Remove:
– the rocker shafts,
– the camshaft bearing caps,
– the camshafts.
Fit new valves. Gently grind them in on their respective seats. Clean all the parts thoroughly, mark them for identification purposes, then carry out the refitting operation.

Oil the inside of the valve guide.

Fit the lower valve spring mounts (if fitted, see section "Cylinder head specifications").

Valve stems seals must be fitted using Mot. 1511-01 or other suitable equipment.

Fitting new valve stem seals.

Place the valve in the cylinder head.

Fit the valve insert of Mot. 1511-01 on the valve stem (the diameter of the insert must be the same as that of the valve stem).

Keep the valve pressed against its seat.

Place the valve stem seal (not lubricated) over the valve insert.

Push the valve stem seal past the insert, then withdraw the insert.

Note: Do not lubricate the valve stem seals before fitting them.
Mount the guide tube-pushrod assembly on the valve stem seal.
ENGINE AND PERIPHERALS
Overhauling the engine

1. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube touches the cylinder head. Repeat these operations for aster stems.

2. Fit:
   - the springs,
   - the upper mounts, Compress the springs.
   - the keys.

3. Secure the cylinder head suspended mounting by tightening the bolts to a torque of 4.5 daNm.

4. Secure the inlet manifold without locking the bolts.
Removing the peripherals

- Fit the flywheel immobiliser (Mot. 1316).
- Remove:
  - the timing belt pulleys and tension wheels,
  - the water pump cover,
  - the crankshaft accessories pulley.
- Remove the timing gear cover.
1. Remove the seal (1).
2. Remove:
   - the high pressure pump sprocket nut (2),
   - the number 2 intermediate shaft disc (3),
   - the water pump nut (4).
Overhauling the engine

Remove the water pump sprocket using the extractor tool (U43L) for example.
Screw the pin (Mot. 1538) into the high pressure pump sprocket, to lock the automatic play compensation system.

Fit the extractor (Mot. 1548) on the high pressure pump sprocket by tightening the three bolts (5).

Then turn bolt (6) to remove the high pressure pump sprocket.
Fit Mot. 1539 on intermediate sprocket number 1. Bend the two tabs (7) against the sprocket and then lock them. Remove the mounting bolt (8) and the sprocket.
Remove:
- the crankshaft timing sprocket,
- intermediate sprocket number 1 pin and washer.

Remove intermediate sprocket number 2 by removing the mounting bolt (9).

Remove:
- intermediate sprocket number 2 pin,
- the water pump by removing both bolts (10).

Remove the venturi unit by removing the three bolts (11).

WARNING
When replacing intermediate sprocket number 1 (on its own) or intermediate sprocket number 2 (on its own), be sure to replace both sprockets in the cases listed below.

Engines concerned:
- G9T 710 up to the following engine number: C 064517
- G9T 720 all engines are concerned
- G9T 722 up to the following engine number: C 012789
- G9U 720 up to the following engine number: C 012204
ENGINE AND PERIPHERALS

Overhauling the engine

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Remove the three bolts (12) or the two bolts (14) from the high pressure pump rear support.

Remove the high pressure pump by removing the three bolts (13).

Remove the clutch mechanism and plate.
Remove the flywheel.
Remove the sump.
Remove the inner timing cover bolts, then remove the cover.
Overhauling the engine

Remove:
- the multifunction support,
- the oil level sensor,
- the oil filter holder.

Engine not equipped with balance shafts
Remove:
- the oil pump complete with its chain,
- the oil pump drive sprocket.
ENGINE AND PERIPHERALS
Overhauling the engine

Remove the anti-emulsion plate:

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Engine equipped with balance shafts

Remove the oil pump.

With the engine set to top dead centre and tool Mot. 1536 in position, set the balance shaft assembly using a 4 mm Allen key (2). Remove the balance shaft assembly.

Gently turn the engine over to drain the oil still in the cylinder block.
Remove the crankshaft bearing cap cover.

**WARNING**
Do not use a sharp point to mark the big end caps in relation to their bodies, to prevent incipient breakage of the con rod.

Use a permanent marker pen.
Overhauling the engine

Remove the con rod cap bolts and the connecting rod/piston assemblies.

Be sure to mark the position of the crankshaft bearing shells, as the category may be different on each bearing.

Remove the crankshaft bearing shells.

Remove the piston base cooling jets. The bolts have a left-handed thread.

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OVERHAULING THE ENGINE

Remove the crankshaft spigot bush using tool Mot. 11 or an extractor.

Clean:
- the stiffener baseplate,
- the cylinder block,
- the crankshaft.

EXTRACTING THE GUDGEON PINS

To extract the gudgeon pin, remove the circlip with a screwdriver and withdraw the pin.

FITTING THE CON ROD BEARING SHELLS

The main bearing shells are fitted using tool Mot. 1492 and Mot. 1492-02 (with diameter 48 mm or 53 mm).

Note:
Be sure to mark the con rod to match it to its piston, because the piston height categories on a given engine may be different (see Technical Specifications).

Note:
When fitting the bearing shells, make sure that all the parts are clean and dry.
Overhauling the engine

On the con rod body, slide the bearing shell support (1) of tool Mot. 1492-02 (using the 48 mm or 53 mm diameter bearing shell) into the groove (2) on the base of tool Mot. 1492.

Fit the rail (3) of Mot. 1492-02 (using the 48 mm or 53 mm diameter rail) on the base (as shown in the diagram).

Fit the body of the con rod on the base (as shown in the diagram). Ensure that the lower section (4) of the small end is in contact with the centring pin.

Fit the bearing shell (5) on the bearing shell support, then push it in the direction of the arrow (as shown in the diagram).
Overhauling the engine

1. Slide the bearing shell support to the end stop of the con rod body.
2. Then remove the support from the con rod body and repeat the operation for the other con rod bodies.

On the con rod cap:

- Fit the con rod cap as shown in the diagram.
- Push the rail (in the direction of the arrow) until the con rod cap is resting on the pins (6) on the base.

Note: Do not cause impacts on the split con rod breakage seams.
Fit the shell (7) on the shell support, then push it in the direction of the arrow (as shown in the diagram).

Remove the support from the con rod cap and repeat the operation for the other con rod caps.

Note: Do not cause impacts on the split con rod breakage seams.
Refit the piston base cooling jets, tightening them to a torque of 2 daNm. The bolts have a left-handed thread.
Overhauling the engine

Refit the crankshaft bearing shells on the crankshaft bearing cap cover.

Refit the grooved crankshaft bearing shells on the cylinder block bearings, checking that the lubrication holes in the bearing shells and the cylinder block crankshaft bearings are correctly aligned.

Apply a drop of oil on the crankshaft bearing shells.

Note: The bearing shells must be fitted on clean, dry surfaces.
Overhauling the engine

Refit the crankshaft lateral shims (1) on bearing No. 2 (grooves on crankshaft side).
Overhauling the engine

1. Refit the crankshaft.
2. Refit the bearing cap casing by tightening the centre bolts to a torque of 2 daNm, then angle tighten by 150° ±10° (use the old centre bolts).
Check the lateral clearance of the crankshaft, which must be between 0.06 and 0.232 mm.

Remove the crankshaft bearing cap cover. The crankshaft bearing cap cover is sealed with a bead of RHODORSEAL 5661 which must have a width of 2 ± 0.4 mm and follow the line shown here.

WARNING
Excess sealant could be squeezed out when the parts are tightened. A mixture of sealant and fluid could damage certain components (engine, radiator, etc.).
Overhauling the engine

1. Do not forget to replace the centre crankshaft bearing cap cover bolts.
2. Refit the crankshaft bearing cap cover by tightening the centre bolts to a torque of 2 daNm, then angle tighten by 150° ± 10°.
Refit the outer bolts of the crankshaft bearing cap cover in order and to torque (2 daNm).

Check that the crankshaft rotates freely.
Replacing con rods or pistons

When replacing con rods or pistons, determine the crankpin height "HM". This will enable you to choose an piston or a con rod that matches the original ones.

The crankpin height is measured using tool Mot. 1319 and tool Mot. 1319-01.

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Overhauling the engine

Measuring the crankpin height for cylinders 1 and 4:
– set the engine to top dead centre using Mot. 1536,
– fit Mot. 1319 in place of the “con rod -piston - bearing shells” assembly (use the appropriate depth gauge - Mot. 1319-01),
– calibrate the dial gauge (A) on the cylinder block,
taking the average of points C and E, then slide the dial gauge to measure the protrusion (D) of rod (B).

Measuring the crankpin height for cylinders 2 and 3:
– set the crankpin to approximately top dead centre,
– fit Mot. 1319 (using the appropriate depth gauge - Mot. 1319-01),
– calibrate the dial gauge (A) on the cylinder block,
taking the average of points C and E,
– place the dial gauge opposite the rod (B),
– turn the crankshaft to define the top dead centre of the crankpin and, at the same time, note the rod protrusion value (D).

Calculating crankpin height (HM)

\[ HM = \text{Length of } B - \text{Protrusion at } D \]

Example (all dimensions are given in mm):

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Length of B (mm)</th>
<th>Protrusion at D (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>177.973</td>
<td>0.500</td>
</tr>
<tr>
<td>2</td>
<td>177.486</td>
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</tr>
<tr>
<td>3</td>
<td>177.480</td>
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</tr>
<tr>
<td>4</td>
<td>177.443</td>
<td></td>
</tr>
</tbody>
</table>

To determine the piston category to be used, a formula is available:

\[ A = D - E + 26.9735 \]

A represents the gudgeon pin height in mm
D is the crankpin height measured in mm
E is the centre-to-centre distance between the big and small ends in mm

Note: The crankpin height must also be calculated when a cylinder block or crankshaft is replaced.
ENGINE AND PERIPHERALS
Overhauling the engine

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"CON RODS/PISTONS" ASSEMBLY

The pistons have a "Λ" mark etched on their crowns, indicating the flywheel end.

Oil the gudgeon pin.

Check that the gudgeon pins rotate correctly in the new piston and in the corresponding con rod.

Direction of fitting of the con rod in relation to the piston:

Position the "Λ" (1) etched on the piston crown downwards and the small end lubrication hole (2) to the right of the vertical axis (as shown in the diagram below).

Moreover, the slot (3) must be at the flywheel end.

Note:
Put the gap in the gudgeon pin locking spring ring on top, at ±45° to the vertical axis of the piston.
FITTING THE RINGS

The rings must be free within their grooves and at their original settings. Ensure the rings are fitted the correct way round with the word "TOP" pointing upwards.

Orientation of the rings in the piston

Ensure each ring's end clearance is correctly oriented as shown in the diagram below.

Lightly oil the pistons and barrels.

Fit the "con rod/piston" assemblies into the cylinder block using the ring, making sure they are fitted the right way round (the "Λ" towards the flywheel).

Fit the con rods onto the oiled crankpins of the crankshaft.

Fit the con rod caps, ensuring they are correctly matched (marks made when dismantling).

Tighten the con rod cap bolts to the required torque (2.5 daNm), then angle tighten by 55° ± 6°.

Check that the big ends have the correct lateral clearance of 0.22 mm to 0.482 mm.

Check the piston protrusion, which must be 0.399 ± 0.065 mm.

Reset the dial gauge on the front of the cylinder block. Apply force to the piston to eliminate the various clearances (between pin and piston, between pin and con rod, etc.)

Take the protrusion value at both points (1) and (2), then take the average of the two measurements (see technical specifications).

Note: Do not oil the ring grooves or the rings.
ENGINE AND PERIPHERALS
Overhauling the engine

Replacing the oil pump drive sprocket

The oil deflector is fitted using tool Mot. 1541. Arrange the parts as shown in the drawing, then tighten the bolt (1) until it locks.

Fitting the flywheel end crankshaft seal

This engine can be fitted with two different types of old and new seals are easily distinguished. The old elastomer seal is fitted with a spring (2) and has a V-shaped sealing lip (3).

Note: Never oil the seal mating faces; the parts must be clean and dry.
The new elastomer seal has a flat sealing lip (4) and a protector (5) which also fits the seal to the engine.

For the old seals, use tool Mot. 1313.

For the new seals, follow the method described below.

Fit tool Mot. 1564 on the crankshaft, securing it with bolts (6).

Put the protector with the seal on tool Mot. 1564, being careful not to touch the seal.
Mount the cover (7) and the nut (8) of tool Mot. 1564 (positioning the nut thread (9) towards the outside of the engine).

Tighten the nut until the cover touches the cylinder block.

Remove the nut, cover, protector and base of tool Mot. 1564.
Overhauling the engine

1. Clean the crankshaft mounting bolt threads.
2. Degrease the bearing face of the flywheel on the crankshaft.
3. Refit the flywheel, hand-tightening all the bolts.
4. Fit the TDC setting rod (Mot. 1536).
5. Turn the engine clockwise (timing end), while pressing down on the TDC setting rod (Mot. 1536) until it reaches the setting point.
6. Install the flywheel timing pin (Mot. 1665).
7. Install the flywheel immobiliser (Mot. 1316).
8. Tighten the bolts to a torque of:
   - 2.5 daNm plus 50°°°° angle for the dual mass flywheel,
   - 2 daNm plus 45°°°° angle for the classic flywheel.
9. Remove:
   - the flywheel timing pin (Mot. 1665),
   - the flywheel immobiliser (Mot. 1316).
Overhauling the engine

Refit the flywheel sensor.

Precautions to be taken when fitting the flywheel sensor:

– Position the clip and press at (1) to align the clip holes with the boss holes.

– Insert the sensor up to the stop on the flywheel target.

– The connector must be below the anti-rotation bracket.

– Release the clip.

Operations to be performed for fitting a sensor that has already been used:

– File down the flange and insert a 1.15 mm shim between the target and the sensor before releasing the clip.
ENGINE AND PERIPHERALS
Overhauling the engine

Special notes on engines equipped with balance shafts:
Fit the TDC setting rod (Mot. 1536).

Turn the engine clockwise (timing end), while pressing on the TDC setting rod (Mot. 1536) until it reaches the timing setting point.

How to determine the crankshaft - balance shafts backlash:
Clean the balance shaft assembly and cylinder block support points.
Degrease and then blow-clean the gearing:
– at the crankshaft end (1),
– at the balance shafts end (2).

To tighten the bolts properly, use a syringe to remove any oil found in the holes for mounting the balance shaft assembly on the cylinder block.

Take the two 2.22 mm calibration shims from the kit, clean them, and put them in position on the cylinder block.

Note: The shim thickness is etched on them at (3).
Make sure the balance shaft assembly is properly set. To do this, the hole position hole (4) in the balance shaft assembly vertically. Do not blow-clean the oil duct (5) to prevent any contamination from entering. Turn the shaft in the direction of the arrow until the 4 mm Allen key can be inserted in the flyweight hole (4).
Check that the crankshaft is set at top dead centre.

Refit the balance shaft assembly by tightening the old bolts in order and to torque (1.5 daNm), then angle tighten by ±6 °.

Fit the longitudinal clearance locking tool (Mot. 1660) on the balance shaft assembly.

Fit the radial clearance locking tool (Mot. 1660) on the balance shaft assembly after loosening the bolt.

Tighten bolt until it locks, then loosen bolt by approximately 45 °.
ENGINE AND PERIPHERALS
Overhauling the engine

Place measuring tool (2) of the tool (Mot. 1660) on the end of the drive shaft. Position tool (2) horizontally with a set of shims (3), then immobilise the tool with a lock bolt (4).

Remove the set of shims.

With a pencil, mark the starter ring gear teeth (one mark every 13 teeth).

Fit the dial gauge on the measuring tool.

WARNING
The drive shaft end can have one of two diameters: 12 mm or 14 mm. To mount the measuring tool on the end of the 14 mm shaft, remove the tool socket (5).
Determining the backlash

Pull lever (1) upward until the fixed pointer (2) is aligned with the lower part (3) of the lever. Then gently move the lever (1) back downward until the fixed pointer (2) is aligned with mark (4) on the lever. Holding the lever in this position, reset the dial gauge by pressing and holding the dial gauge button (5) for around 1 second.

Move the lever (1) downward until the fixed pointer (2) is aligned with the lower part (6) of the lever. Then gently move lever (1) back upward until the fixed pointer (2) is aligned with the mark (7) on the lever.
Read and note the value displayed on the dial gauge. Repeat the above procedure several times to confirm the reading. Release the measuring tool. Turn the crankshaft in the operating direction by 13 teeth on the starter ring gear. Position the measuring tool (Mot. 1660) horizontally with a set of shims, then lock it. Measure the backlash. Repeat the above procedure for every 13 starter ring teeth over a complete crankshaft rotation. Take the smallest readings to select the correct shims from the table below (for example, with a reading of 422 microns, use 2.06 mm thick shims).
Overhauling the engine

1. Remove the measuring tool (Mot. 1660).
2. Set the crankshaft at top dead centre with the rod (Mot. 1536).
3. Set the balance shaft assembly with a 4 mm Allen key.
4. Remove the balance shaft assembly.
5. Remove the 2.22 mm calibration shims.
6. Clean the balance shaft assembly and cylinder block support points.
7. Clean the shims.
8. To tighten the bolts properly, use a syringe to remove any oil found in the holes for mounting the balance shaft assembly on the cylinder block.
9. Make sure the crankshaft and balance shaft assembly are set.
10. Refit the selected shims.
11. Refit the balance shaft assembly by tightening the new bolts to a torque of 1.5 daNm, then angle tighten by 38° ± 6°.
12. Remove the locking tools (Mot. 1660), the TDC setting rod (Mot. 1536), and the 4 mm Allen key.
13. Refit the anti-emulsion plate, tightening the bolts to a torque of 1 daNm.
Refit the oil pump by tightening the M6 bolts to a torque of 1 daNm, and the M8 bolt to a torque of 2.5 daNm.
Special notes concerning engines not equipped with balance shafts
Overhauling the engine

Refit:
– the anti-emulsion plate without locking the bolts,
– the oil pump drive chain and sprocket.

Tighten the oil pump bolts in order and to torque (2.5 daNm).
Tighten the anti-emulsion plate bolts in order and to torque (1 daNm).
Clean the inner timing cover.

Check that the oil supply pipes (1) and (2) are not clogged.

Fit the seal between the cylinder block and the inner timing cover.
– bolts 19, 20, 21 are M6*100-20 bolts,
– bolts 1 and 2 are M8*125-20 bolts,
– the other bolts are M6*100-30 bolts.

Put all the bolts in position and then tighten in accordance with the table below.

<table>
<thead>
<tr>
<th>Operation No.</th>
<th>Assembly Bolt tightening order</th>
<th>Tightening torque (in daNm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7 - 18 - 5 - 14 - 10 - 3 - 16 - 20 - 12</td>
<td>1 (pre-tightening)</td>
</tr>
<tr>
<td>2</td>
<td>1 - 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21</td>
<td></td>
</tr>
</tbody>
</table>

1.2
Apply some RHODORSEAL 5661 at points (3).

Refit the oil sump equipped with a new seal. Pre-tighten the bolts in order and to a torque of 0.5 daNm, then perform the final tightening to torque (0.9 daNm).

Refit the multifunction support by securing it against both the cylinder block and on the inner timing cover. Tighten the bolts in order and to torque (3 daNm).

Refit:
- the oil level sensor to a torque of 1 daNm
- the oil filter support equipped with a new seal and a new filter element.

Tighten only the two bolts (7) to torque (2.5 daNm).

**WARNING**
Excess sealant could be squeezed out when the parts are tightened. A mixture of sealant and fluid could damage certain components (engine, radiator, etc.)
Refit the high pressure pump, applying one or two drops of LOCTITE FRENETANCH, then tighten the bolts to a torque of 3 daNm.

Refit the high pressure pump rear support, tightening the bolts to a torque of 3 daNm.

Refit the venturi unit, tightening the bolts to a torque of 2.5 daNm.
Fitting the intermediate shaft roll pins

Roll pins are fitted using tool Mot. 1542.

Intermediate shaft No. 1

Position the base (1) of tool Mot. 1542 in the vice. Offer up the intermediate shaft as shown in the diagram. The roll pin housing (2) must be facing upward and the shaft groove (3) must fit onto the lug on the base. Insert the roll pin into the hole (4) in the base.
Tap the roll pin punch with a hammer until the punch comes into contact with the base.

Intermediate shaft No. 2
Position the base (5) of tool Mot. 1542 in the vice. Offer up the intermediate shaft as shown in the diagram. The roll pin housing (6) should be facing upward and the shaft groove (7) should fit onto the lug on the base. Insert the roll pin into the hole (8) in the base.
Tap the roll pin punch with a hammer until the punch comes into contact with the base.

Lubricate the bores and the intermediate shafts with engine oil.

Refit intermediate shaft No. 1 (9), positioning the roll pin in the groove (10).

Refit intermediate shaft No. 2 (11), positioning the roll pin in the groove (12).

Refit the bearing washers (13).

Refit the water pump (fitted with a seal) by pressing down on the bosses (14) to properly secure the pump against the inner timing cover.

Tighten the bolts (15) to torque (1 daNm).
ENGINE AND PERIPHERALS
Overhauling the engine

REPLACING THE PLAY COMPENSATION SPROCKETS

For replacing intermediate sprocket No. 1 and the high pressure pump sprocket use tool Mot. 1540.

Method for replacing intermediate sprocket No. 1:
Place tool Mot. 1540 in a vice, then adjust the levers (1) and (2) as shown below:

– for lever (1), insert the pin (3) in the groove (4), then tighten the wing nut (5),
– for lever (2), insert the pin (6) in the groove (7), then tighten the wing nut (8).

Remove the two brackets from tool Mot. 1539.
Fit intermediate sprocket No. 1 on the locator (9).
Tighten the bolt with its washer (10), to prevent the sprocket slipping off the locator.
Push the toothed segment (11) in the direction of the arrow to immobilise the sprocket, then lock it with the wing nut (12).
Remove tool Mot. 1539, holding the levers (2) and then (1) in turn to facilitate removal of the tool and to prevent the gear tooth automatic compensation from relaxing suddenly.
Remove intermediate sprocket No. 1.

Note:
Special tooling is required for this operation.
Refit the new intermediate sprocket No. 1, locking it by means of the bolt (10) and the toothed segment (11).

Check that the locating pins (3) and (6) are in the middle of the grooves (4) and (7) on levers (1) and (2).

Turn the lever (1) in the direction of the arrow to align the teeth of the upper flange with those of the hub.

Mount tool Mot. 1539 down as far as the teeth of the lower flange.

Turn the lever (2) in the direction of the arrow to align the teeth of the hub with those of the lower flange.

Press on the tool (Mot. 1539) until the tool stops against the upper flange.

Remove intermediate sprocket No. 1 from Mot. 1540.

Refit the retaining brackets on tool Mot. 1539.
Method for replacing the high pressure pump sprocket.

1. Adjust lever (1) so that the locating pin (3) is in groove (13), then tighten the wing nut (5).
2. Fit the high pressure pump sprocket on the locator, then tighten bolt (10) with its washer, to prevent the sprocket slipping off from the locator.
3. Push the toothed segment (11) in the direction of the arrow to immobilise the sprocket, then lock the toothed segment with the wing nut (12).
4. Remove tool Mot. 1538, holding the lever (1) to facilitate removal of the tool and to prevent the gear tooth automatic compensation from relaxing suddenly.
5. Refit the new high pressure pump sprocket, locking it with bolt (10) and the toothed segment (11).
6. Check that the locating pin (3) is in the middle of groove (14) on the lever (1).
Overhauling the engine

1. Turn the lever (1) in the direction of the arrow to align the teeth of the upper flange with those of the hub.
2. Screw tool Mot. 1538 until it locks.
3. Remove the high pressure pump sprocket from tool Mot. 1540.

Set the crankshaft to top dead centre using tool Mot. 1536.

Refit the crankshaft sprocket (1); the key (2) must be located towards the top in the vertical axis of the engine.

Refit intermediate sprocket No. 2 without tightening the bolt (3).

**WARNING**

When replacing intermediate sprocket number 1 (on its own) or intermediate sprocket number 2 (on its own), be sure to replace both sprockets in the cases listed below.

- Engines concerned:
  - G9T 710 up to the following engine number: C 064517
  - G9T 720 all engines are concerned
  - G9T 722 up to the following engine number: C 012789
  - G9U 720 up to the following engine number: C 012204
Overhauling the engine

Refit intermediate sprocket No. 1, tightening the bolt (4) to torque (2.5 daNm) plus an angle of 30° ± 6°, then remove tool Mot. 1539.

Refit the flywheel immobiliser (Mot. 1316), making sure that the key (2) of the crankshaft sprocket is at the top and in the vertical axis of the engine. Then remove the TDC setting rod (Mot. 1536).

Refit the high pressure pump sprocket, aligning marks (5) and (6).

Refit the high pressure pump sprocket nut, tightening it to a torque of 9 daNm.

Refit the water pump sprocket, tightening the nut to a torque of 4 daNm.

Refit the timing gear housing seal, after degreasing the sealing surfaces.
Refit the timing gear housing cover, so that all the bolts are in contact with the cover.

Tighten to torque in the following order:
- the M6 bolts: 10, 4, 8, 7, 12 and 2 (0.8 daNm),
- the M8 bolts: 13, 14 and 15 (2.5 daNm),
- the M6 bolts: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 (1.1 daNm).

Fitting the Intermediate Shaft No.2 Seal and Timing End Crankshaft Seal.
This engine can be fitted with two different types of seal:
- Old and new seals are easily recognised.
- The old elastomer seal is fitted with a spring (2) and has a V-shaped sealing lip (3).

Note: Never oil the seal mating faces; the parts must be clean and dry.
The new elastomer seal has a flat sealing lip (4) and a protector (5) which also fits the seal to the engine.

Fitting the seal on intermediate shaft No. 2:

1. Remove bolt (6).
2. Screw the threaded rod (7) of tool Mot. 1561 into intermediate shaft No. 2.
For the new seal, put the protector with the seal on the intermediate shaft, taking care not to touch the seal.

For the old seal, place the protector marked B of tool (Mot. 1628) fitted with the seal on the intermediate shaft.

Mount the cover (8) and the nut (9) of tool Mot. 1561 (positioning the threaded part (10) of the nut towards the outside of the engine).

Note: Never oil before fitting; the parts must stay clean and dry.
Screw on the nut until the cover makes contact with the timing gear cover. Remove the nut, the cover, the protector and the threaded rod. Refit the intermediate shaft bolt, tightening it to a torque of 2.5 daNm plus an angle of 30° ± 6°.
ENGINE AND PERIPHERALS
Overhauling the engine

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Fitting the timing end crankshaft seal

Screw the threaded rod (11) of tool Mot. 1560 into the crankshaft.

For the new seal, put the protector with the seal on the crankshaft, taking care not to touch the seal.

In addition, position the groove (12) of the protector opposite the key on the crankshaft sprocket (13).

For the old seal, place the protector marked C of tool Mot. 1628 fitted with the seal on the crankshaft.

Note: Never oil before fitting; the parts must stay clean and dry.
Mount the cover (14) and the nut (15) of tool Mot. 1560 (positioning the threaded part (16) of the nut towards the outside of the engine). Screw on the nut until the cover makes contact with the timing cover. Remove the nut, the cover, the protector and the threaded rod.
Refit the cap on intermediate shaft No. 2 using tool Mot. 1488.

Refit the water pump cover fitted with the new seal, tightening the bolts to a torque of 1 daNm.

Refit the timing pulley, tightening the bolt to a torque of 3 daNm.

Refit the crankshaft accessories pulley, tightening the bolt to a torque of 5 daNm plus an angle of 90° ± 6°.

Fit the tension wheel again without locking the bolt, ensuring the roll pin (1) is correctly positioned in the groove (2).

Remove the flywheel immobiliser (Mot. 1316).

Note: Never oil before fitting; the parts must stay clean and dry.
To fit the cap on the high pressure pump, make a flat area of X = 17 mm and Y = 40 mm on tool Mot. 1503.

Assessing the rocker shafts.

WARNING: Do not reverse the rocker shaft spacers.
Overhauling the engine

Check that the lubrication holes in the rocker shaft, the rocker arms and the bearings are not blocked. To ensure the rocker shaft is correctly fitted, position the flat part (1) as shown in the diagram and then slide the rocker arms onto the shaft so that the lubrication holes (2) on the shaft coincide with those on the arms.

Mount:
- the spacer (3),
- the clip (4),
- the bolt (5).

Carry out the above operations for the other rocker arms.

Fit:
- the spacer (8),
- the clip (9),
- the bolt (10).

Carry out the above operations for the other rocker arms.

Fit the cylinder head gasket (with the markings facing upwards).

Mount the cylinder head.

Tighten the cylinder head (see Cylinder head specifications).
Apply some oil to the camshaft bearings on the cylinder head side.

Refit the camshafts, positioning them correctly (see "Camshaft identification" in the Technical specifications section).

Apply a drop of oil on each bearing.

Put a bead of **LOCTITE 518** 2 mm wide on:
- bearing cap number 6, inlet camshaft (1)
- bearing caps numbers 1 and 6, exhaust camshaft (2).

Note: The sealing surfaces must be clean, dry and free from grease (avoid finger marks).
ENGINE AND PERIPHERALS

Overhauling the engine

Refit:

– the camshaft bearing caps (in accordance with the marks made previously), tightening to a torque of 1.2 daNm only:

– the bolts (4) of inlet camshaft bearings 1 and 6,

– the bolts (5) of exhaust camshaft bearings 1 and 6,

– the rocker shafts, positioning them as follows:

  – for the exhaust camshaft, put the end of the rocker shaft with the flat part (7) at the timing end,
  – for the inlet camshaft, put the end of the rocker shaft without the flat part (8) at the timing end.
In order to tighten the rocker shaft correctly, you must start with:

- the inlet rocker shaft bolts, then those of the exhaust, tightening them in order and to torque (1.3 daNm).
- the inlet camshaft bearing cap bolts, then those of the exhaust, tightening them in order and to torque (1 daNm).
ENGINE AND PERIPHERALS
Overhauling the engine

Refit:
– the new exhaust gas recirculation pipe with new seals, and tighten the bolts to a torque of 2.5 daNm,
– the coolant pipe fitted with new seals (to be tightened later),
– the thermostat unit fitted with new seals, tightening the bolts to a torque of 1 daNm,
– the vacuum pump fitted with a new seal, tightening the bolts to a torque of 2.3 daNm,
– the coolant pipe bolt, tightening to a torque of 3 daNm.
Apply some RHODORSEAL 5661 to the corners of the camshaft bearing caps and in the half-shell. Timing end. Flywheel end. Fit all the new seals on the rocker cover. **WARNING** Excess sealant could be squeezed out when the parts are tightened. A mixture of sealant and fluid could to certain components (engine, radiator, etc.).
Refit the rocker cover, tightening the bolts in order and to torque (1.2 daNm). Note: Apply a drop of FRENETANCH LOCTITE on bolts 1-2-3-4-5-6-7-13.
ENGINE AND PERIPHERALS

Overhauling the engine

Tighten the inlet manifold bolts in order and to torque (1.2 daNm).

Refit:
- the flywheel end engine lifting eye
- the clips on the venturi unit sleeve.

Note:
- Check that the turbulence flap is operating correctly.
- Check that there is no hard point.
- Use a vacuum pump.

Note:
The sleeve bearing surfaces must be clean and dry.
Refit the heater plugs, tightening them to a torque of 1.5 daNm. Do not remove the protective caps from each component until the last moment.

Clean the injector sockets and the injector bodies as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose, part no. 77 11 211 207) soaked in fresh solvent. Dry off using a new cloth.

Clean one of the old injector mounting bolts and screw it down to the end of the mounting hole to clean out the threading.

Fit the new studs (1) and injector mounting spacers (2) after coating the threads with oil and screw them in as far as possible by hand (0.2 daNm). Always replace the studs and nuts after every removal.

Fit a new washer on each injector nozzle. Fit the injector with its bracket and locking spring ring. Oil the threads of the nuts.

Tighten nut (4) to torque (0.6 daNm), then tighten nut (5) to torque (0.6 daNm) (starting with the timing end and finishing at the flywheel end). Angle tighten nut (5) only by ±30° (flywheel end).

WARNING
Before mounting the stud on the cylinder head, make sure the nut (3) screws smoothly onto the stud (1); if not, replace both.

WARNING
Tighten the nut (4) on the timing end first, then the nut (5) on the flywheel end.
RAIL PROTECTOR
Model 1

Refit the rubber flap to the lower metal protector by pulling on the five rubber wall staples (4). Check that the wall staples are clipped on correctly.

Apply a bead of RHODORSEAL 5661 on the cylinder head at the point indicated by a black line in the diagram.

Refit the "rubber flap/lower metal protector" assembly to the engine by refitting the lower metal protector mounting bolt (3).

Refit the injector rail with its partition (5) without locking the rail mounting bolts.

WARNING
The cleanliness rules must be strictly observed (see start of document).

WARNING
Excess sealant could be squeezed out when the parts are tightened. A mixture of sealant and fluid could damage certain components (engine, radiator, etc.).
Overhauling the engine

Remove the caps from the rail, the injector holders, the pump and the injection pipes.

Fit the injection pipes between:
- the rail and the injectors,
- the rail and the pump.

Pre-tighten the high pressure pipe nuts by hand.

Tighten to a torque of:
- 2.5 daNm the rail mounting bolts,
- 2.5 daNm the injection pipe nuts at the injector end
- 2.7 daNm the injection pipe nuts at the rail and high pressure pump end.

Clip on the pump/rail pipe retaining clip and tighten the two mounting bolts.

Refit:
- the fuel return pipe*,
- the oil vapour recirculation pipe.

* To refit the return pipe, press on the clips and mount the pipe onto the injector head. Release the clip.
ENGINE AND PERIPHERALS

Overhauling the engine

Clean the RHODORSEAL 5651 between the rocker cover and the protector.

Apply RHODORSEAL 5661 to the rocker cover at the point marked on the diagram.

Refit the aluminium protector, finger tightening both mounting bolts.

Tighten bolt (1) to torque (0.4 daNm).

Refit the injector rail by finger tightening the two mounting bolts.

Remove the caps from the rail, the injector holders and the injection pipes.

Fit the injection pipes between the rail and the injectors, and pretighten by hand until they touch.

Tighten to torque in the following order:
- the injection pipe unions on the rail (2.2 daNm pretightening),
- the aluminium protector mounting bolt (1) (2.5 ±±±± 0.5 daNm),
- the two rail mounting bolts (2.5 ±±±± 0.5 daNm),
- the injection pipe unions on the injectors (2.5 ±±±± 0.7 daNm),
- the injection pipe unions on the rail (2.7 ±±±± 0.8 daNm).

WARNING
Excess sealant could be squeezed out when the parts are tightened. A mixture of sealant and fluid could damage certain components (engine, radiator, etc.)
Fit the injection pipe between pump and rail, and pretighten by hand until they touch.

Clip on the pump-rail pipe. Finger tighten the pump-rail injection pipe bracket bolt.

Tighten to torque:
- the pump-rail injection pipe unions (2.7 ± 0.8 daNm),
- the pump-rail pipe bracket bolt (0.3 daNm).
- the rail protector bolt (3).

Fit the sleeves on the injection pipes.

Refit the diesel drain pipe, checking that it is not capped. This pipe must be replaced if it has been in contact with diesel fuel.

Refit the soundproofing pads, replacing them if they are damaged or soaked with diesel fuel.

Refit a new diesel return pipe, ensuring that the mounting clips are properly fitted to the injectors and rail.
The engine can be fitted with different types of seal.

Old and new seals are easily recognised:
The old elastomer seal is fitted with a spring (2) and has a V-shaped sealing lip (3).
The new elastomer seal has a flat sealing lip (4) and a protector (5) which also fits the seal to the engine.

Note: Never oil the mating faces of the seal before fitting. The surfaces must remain clean and dry.
Screw the threaded rod (6) of tool Mot. 1562 into the camshaft. For the new seal, put the protector with the seal on the camshaft, taking care not to touch the seal. For the old seal, place on the camshaft the protector marked A of tool Mot. 1628 fitted with the seal. Fit the cover (7) and the collar nut (8) of tool Mot. 1562.
Overhauling the engine

Screw on the collar nut until the cover touches the cylinder head.

Remove the nut, the cover, the protector and the threaded rod.
Refit the camshaft hubs with the timing sprockets fitted.

Position the camshaft grooves vertically as shown in the following diagram (top view zoom).
Overhauling the engine

Fit tool Mot. 1534, screwing in the bolt (1) by hand.
Turn the inlet camshaft clockwise by the hub mounting bolt (3) (using a 16 mm tubular hexagon box spanner) in order to secure tool Mot. 1534 against the cylinder head, then lock the Mot. 1534 bolt (1).

For the exhaust camshaft:
Fit tool Mot. 1537, screwing in the bolt (4) by hand.
Turn the exhaust camshaft clockwise by the hub mounting bolt (6) (using a 16 mm tubular hexagon box spanner) in order to secure tool Mot. 1537 against the cylinder head, then lock the Mot. 1537 bolt (4).

Tighten the camshaft hub bolts (3) and (6) to torque (6 daNm).

Note:
Tools Mot. 1534 and Mot. 1537 must not be subjected to a force greater than the recommended torque on the hubs, or they could be destroyed.
ENGINE AND PERIPHERALS

Overhauling the engine

Refit the air conditioning compressor, tightening the bolts to torque (2.1 daNm).
Overhauling the engine

Refit the alternator, tightening the bolts to torque (2.1 daNm).
Refit the power assisted steering pump, tightening the bolts to torque (2.1 daNm).

Refit the accessories belt pulley, tightening the bolt to torque (4.5 daNm).

Refit the accessories belt tension wheel, tightening the bolts to torque (2.1 daNm).
Overhauling the engine

Refit the power assisted steering pump pulley, tightening the bolts to torque (1 daNm).

[Diagram of the engine and peripherals]
Refit the strut between the multifunction support and the exhaust gas recirculation valve support, tightening the bolts to torque (1 daNm).

Refit the power assisted steering pump rear bolt, tightening to torque (2.1 daNm).

Adjusting the timing method:

Set the crankshaft at top dead centre (the TDC mark (1) on the crankshaft accessories pulley must be in the vertical axis of the engine).

Remove the timing sprocket from the exhaust camshaft, to facilitate fitting of the timing belt.

Loosen the three inlet camshaft timing sprocket bolts by up to one turn.
Fit the timing belt, starting with:
- the intermediate sprocket (1),
- then the pulley (2),
- then the inlet camshaft sprocket (while trying to keep the bolts in the centre of the sprocket openings),
- and finally the tension wheel (3).

Fit the exhaust camshaft sprocket on the belt. Position it on the camshaft hub while trying to keep the bolts in the centre of the sprocket openings.

Reinsert the three sprocket mounting bolts without tightening them.
ENGINE AND PERIPHERALS
Overhauling the engine

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TIMING BELT TENSION

Check that the tab (1) of tool Mot. 1537 can move freely in the vertical axis.

Insert a 6 mm Allen key into the tension wheel cam opening (2).

Turn the tension wheel cam anticlockwise until the surface (3) of the tab (1) is aligned with the upper surface (4) of tool Mot. 1537.

The moving pointer (5) of the tension wheel must be aligned with the edge (6).

Check that the bolts (8) are not at the end stop of the camshaft timing sprocket openings.

Tighten to torque:
- the tension wheel bolt (7) (2.5 daNm),
- the camshaft timing sprocket bolts (8) (1 daNm).
ENGINE AND PERIPHERALS

Overhauling the engine

Overhauling the engine

Remove the camshaft setting tools Mot. 1534 and Mot. 1537, and the TDC setting rod Mot. 1536.

Turn the crankshaft clockwise through two revolutions at the timing end.

Set the crankshaft at top dead centre (the TDC mark on the crankshaft accessories pulley must be in the vertical axis of the engine).

The camshaft grooves must be positioned vertically as shown in the diagram (top view zoom).

Refit tools Mot. 1534 and Mot. 1537 in the camshaft grooves following the instructions below.

For the inlet camshaft:

Mount tool Mot. 1534, screwing in the bolt (1) by hand.

Loosen the three camshaft sprocket bolts (2) by up to one turn.

Turn the inlet camshaft clockwise with the hub mounting bolt (3) (using a 16 mm tubular hexagon box spanner) in order to secure tool Mot. 1534 against the cylinder head, then lock the Mot. 1534 bolt (1).
For the exhaust camshaft:

Mount tool Mot. 1537, screwing in the bolt (4) by hand. Loosen the three camshaft sprocket bolts (5) by up to one turn.

Turn the exhaust camshaft clockwise by the hub mounting bolt (6) (using a 16 mm tubular hexagon box spanner) in order to secure tool Mot. 1537 against the cylinder head, then lock the Mot. 1537 bolt (4).

Check that the tab (1) of tool Mot. 1537 can move freely in the vertical axis.

CHECKING THE TIMING AND THE TENSION

Undo the tension wheel bolt (7) while holding the cam with a 6 mm Allen key. Turn the tension wheel cam clockwise until the surface (9) of the tab (1) is aligned with the upper surface (4) of tool Mot. 1537.

The moving pointer (5) of the tension wheel must be located in the middle of the groove (10).
Tighten to torque:
- the tension wheel bolt (7) (2.5 daNm)
- the camshaft timing sprocket bolts (8) (1 daNm)

Remove the camshaft setting tools Mot. 1534 and Mot. 1537 and the TDC setting rod Mot. 1536.

Refit the TDC setting rod hole cap, applying a drop of RHODORSEAL 5661 to the thread and tightening to a torque of 3 daNm.
Overhauling the engine

Refit:
- the timing cover, tightening the bolts to a torque of (1 daNm),
- the lifting eye (1), tightening the bolt to torque (2.1 daNm),
Refit:
– the cylinder head suspended mounting, tightening the bolts to torque (2.5 daNm).

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Centre the clutch plate using the centring mandrels (Emb. 1518).

Refit the mechanism.

Self-adjusting clutch mechanisms must be compressed using the tool Emb. 1604, following the method described below.

Place the baseplate of tool Emb. 1604 in a vice.

Mount the mechanism and then the ball thrust bearing (4) and the nut (5) on the base.

Screw on the nut until it locks. Then insert a pair of circlip pliers at (6).
Compress the springs (7), then release the mechanism by completely unscrewing the nut (5) while keeping the springs compressed. Remove the mechanism from the base (checking that the springs are correctly compressed). Refit the mechanism on the flywheel, tightening the bolts to torque (1.2 daNm).
Overhauling the engine:

Refit the accessories belt by turning the key to the left to remove the 4 mm Allen key from the hole (2). Remove the engine from the support (Mot. 792-03).

**WARNING** Never rotate the engine with the crankshaft accessories pulley not fitted with the belt, to prevent internal destruction of the pulley.
Refit the exhaust manifold, equipped with a new seal (with the foolproof fitting holes (A) at the timing end), then tighten the nuts in order and to torque (2.7 daNm).

Refit the relay bearing, tightening the bolts to torque (6.2 daNm).
RAIL PROTECTOR
Model 1

Put some RHODORSEAL 5661 on the cylinder head at the point indicated by a black cross in the diagram.

To refit the side partition on the lower metal protector, be sure to follow the procedure below:

– mount the lower strap (5)
– mount the partition rubber ring (6) onto the lower metal protector
– then mount the upper section of the partition on the metal protector
– mount the upper strap (7)
– refit the partition mounting bolt (8)
– reconnect the diesel fuel drain pipe (9), checking carefully that it is not blocked.

Refit:
– the soundproofing pads, replacing them if they are damaged or soaked with diesel fuel.
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Refit the sealing partition, mounted on the rocker cover by two nuts.

Check that the mark (10) on the rail partition is positioned correctly (in the axis of the high pressure rail outlets).

Check that the new diesel return pipe is correctly attached to the injectors and to the pressure relief valve at the end of the rail.

Fold the rubber flap forward and clip the side sealing partitions to the flap.

Check that the clip buttons are correctly fastened to the partitions and that the rubber flap skirts are correctly positioned.

Clip the rubber flap onto the rocker cover and the engine mounting.

Check that the rubber flap is correctly fitted on the rocker cover and engine mounting points.

WARNING

Check that the diesel fuel drain pipe is correctly connected.
Refit the rail protector plastic cover.
Reconnect the oil vapour rebreathing pipe.
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Refit the turbocharger, tightening the nuts to torque (2.7 daNm).

Refit the turbocharger oil return pipe, tightening the bolts to torque (1 daNm).

Refit the turbocharger oil supply pipe, tightening the hollow bolts to torque (2.3 daNm).

Note: Check the turbocharger lubrication circuit, especially making sure that there is no contamination and checking the conformity of the hollow bolts.
Refit the exhaust heat shield, tightening the bolts to torque (1 daNm).