RENAULT

Workshop Repair Manual

Technical Note 3736A

Diesel Engine G9T - G9U
High Pressure - Common Rail
4 cast iron cylinders

Vehicle	*Type*	*Engine*
Master	**XDXG** **XDXN** **XDXN** **XDXM** **XDXU - XDXM** **XDXM** **XDXU** **XDXV**	**G9T 720** **G9T 722** **G9T 750** **G9U 720** **G9U 724** **G9U 750** **G9U 754**
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 **APRIL 2003** **EDITION ANGLAISE**

Contents

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**.

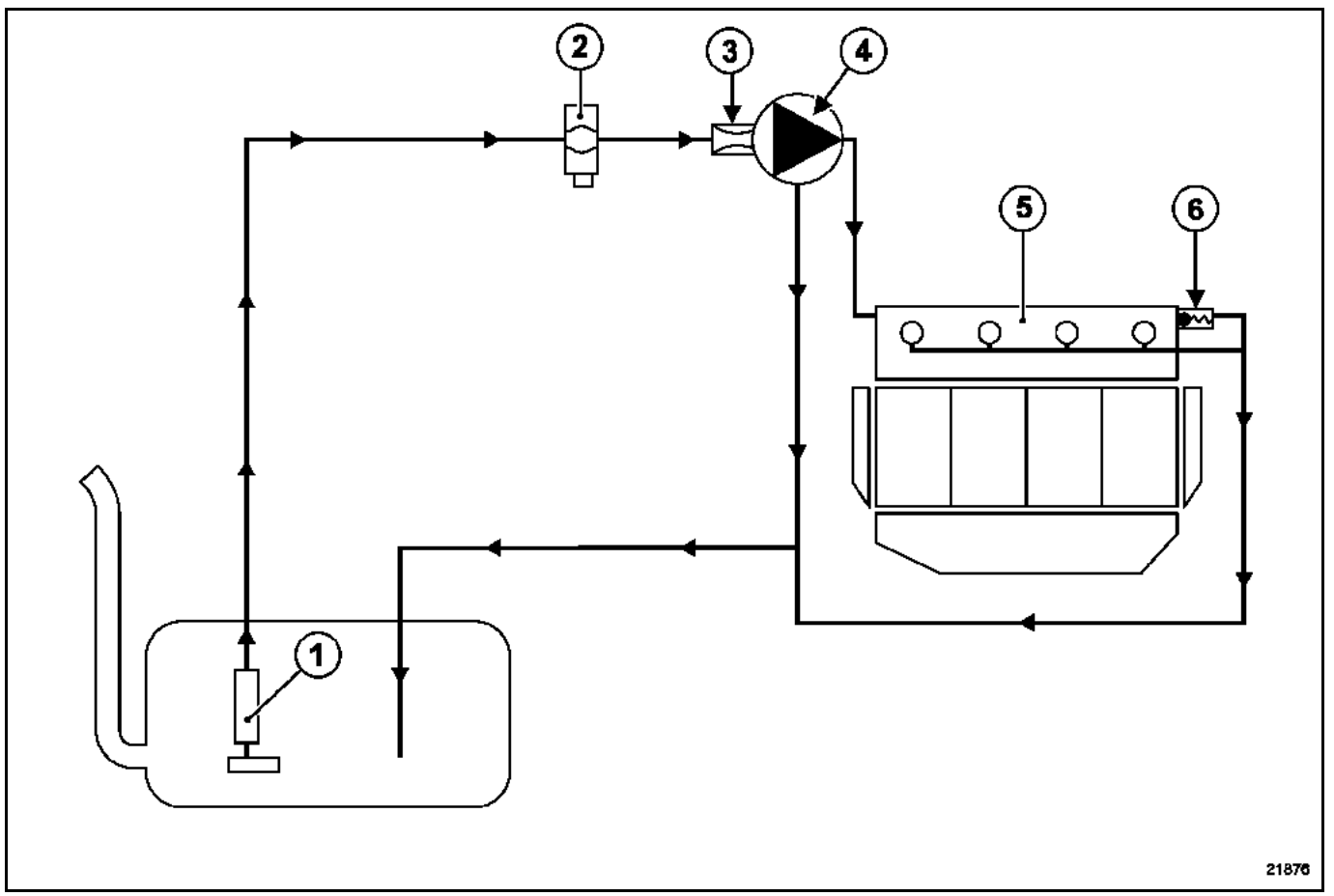
The **high pressure** pump generates the high pressure, which is transmitted to the injector rail. The pressure regulator located on the pump modulates the high pressure pump supply flow. The rail supplies each injector through a steel pipe.

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.

OPERATING DIAGRAM



DESCRIPTION

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.

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.

ADVICE TO BE FOLLOWED <u>BEFORE ANY WORK IS CARRIED OUT</u> 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.

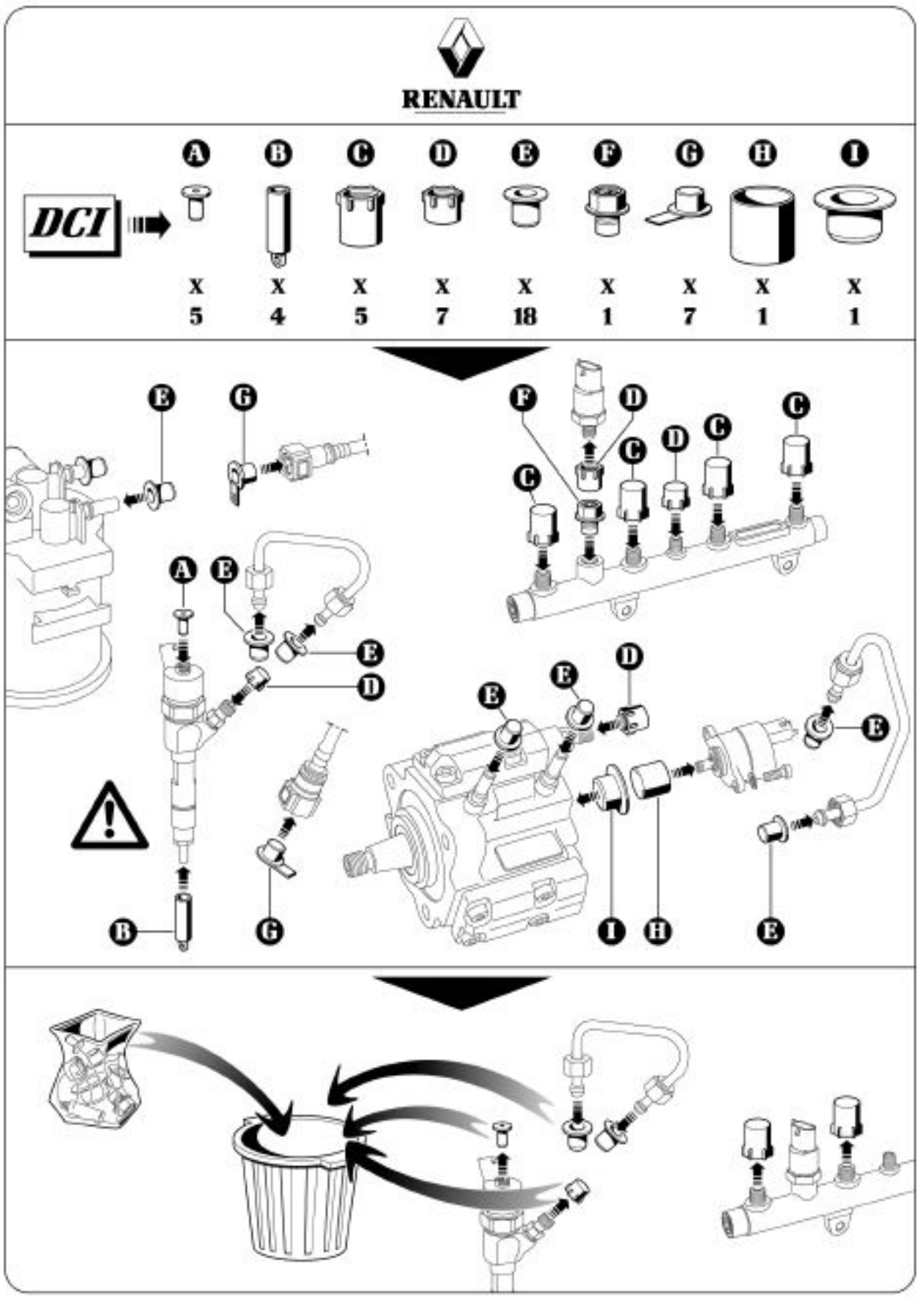
CLEANING ADVICE TO BE FOLLOWED BEFORE CARRYING OUT ANY WORK ON THE FUEL CIRCUIT

- 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.

CAP FITTING INSTRUCTIONS (part no. **77 01 206 381**)



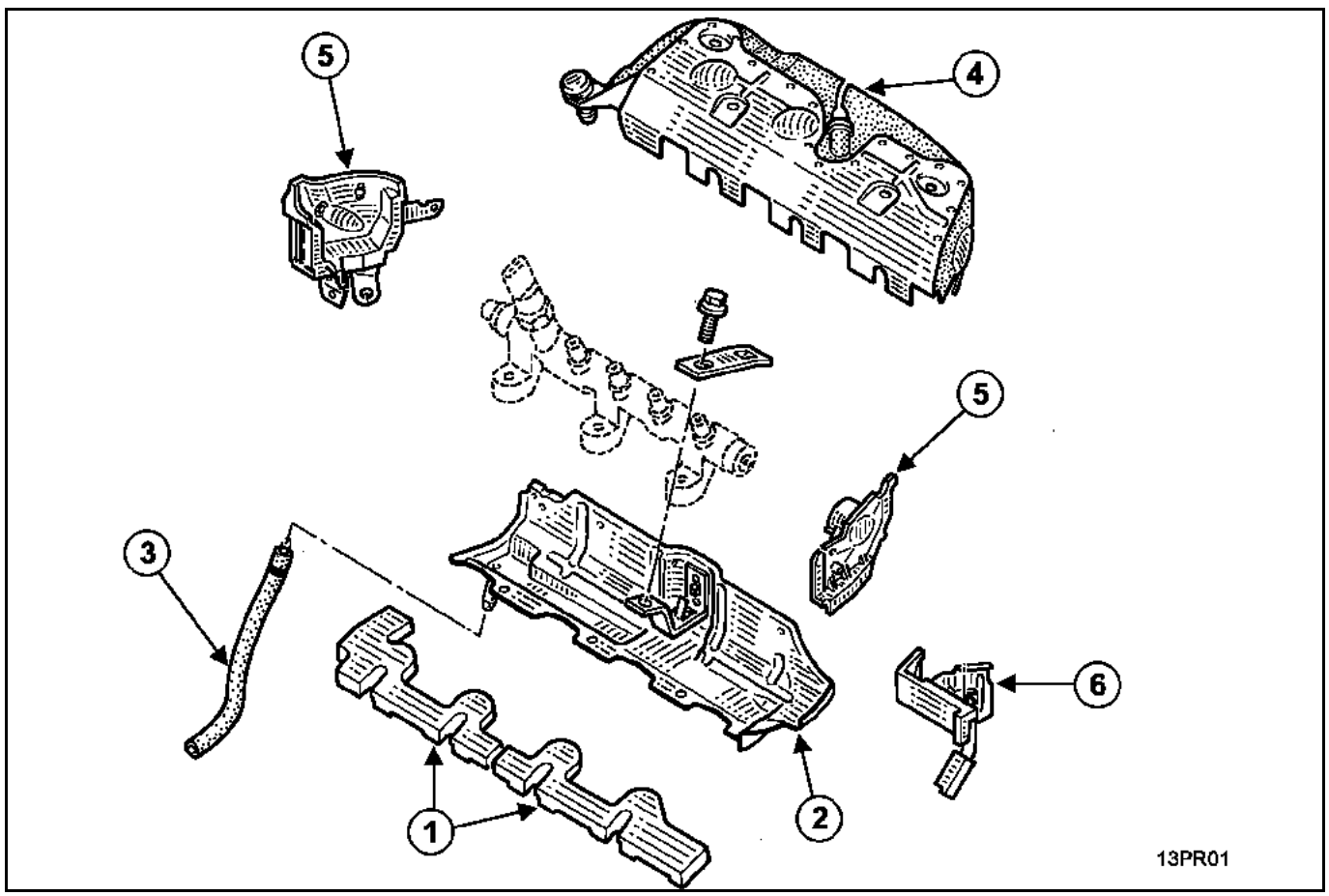
RAIL PROTECTOR

Model 1

General information

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

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



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.

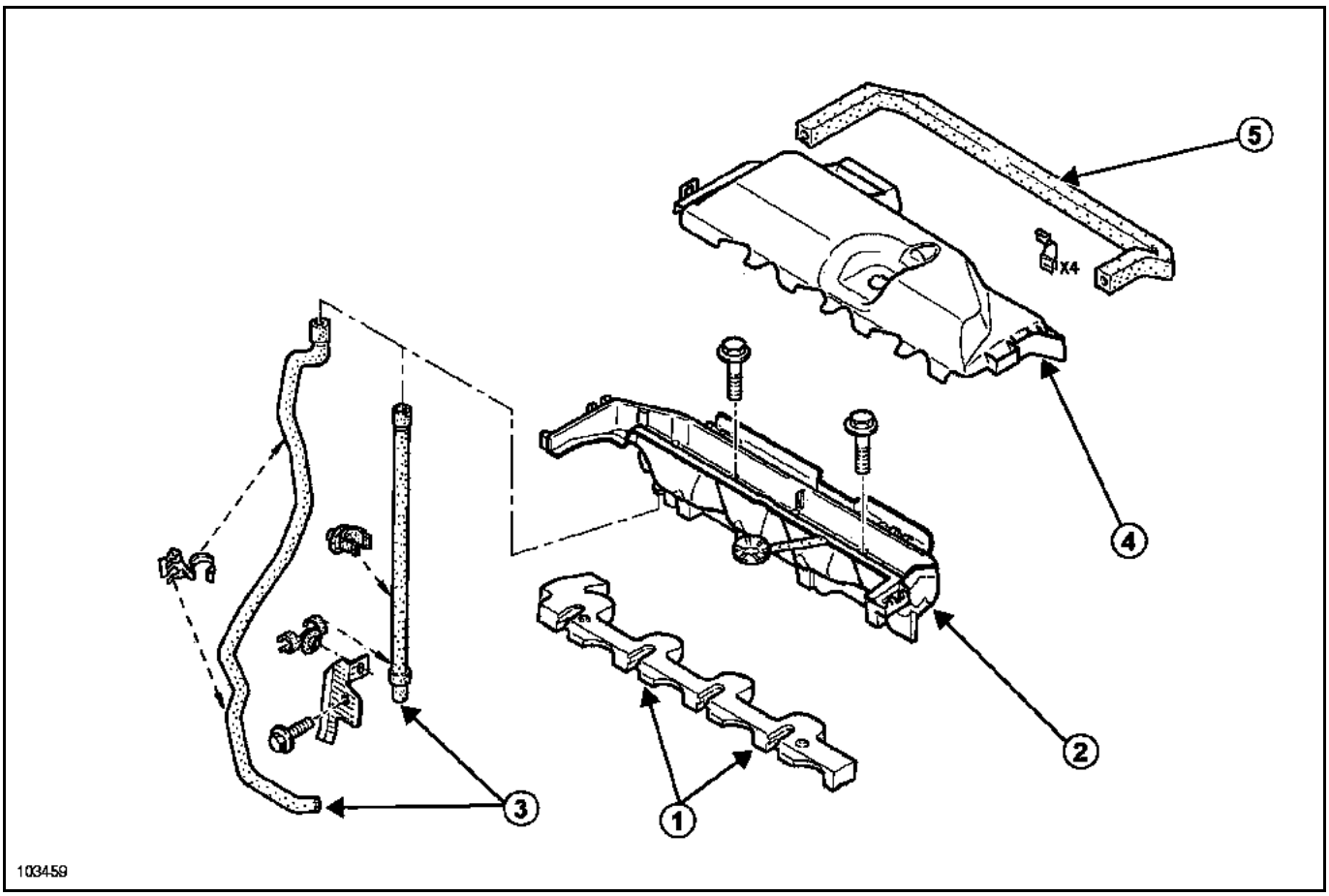
IMPORTANT
Failure to comply with these instructions may have serious safety-related consequences.

Model 2

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.

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



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
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.

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

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.

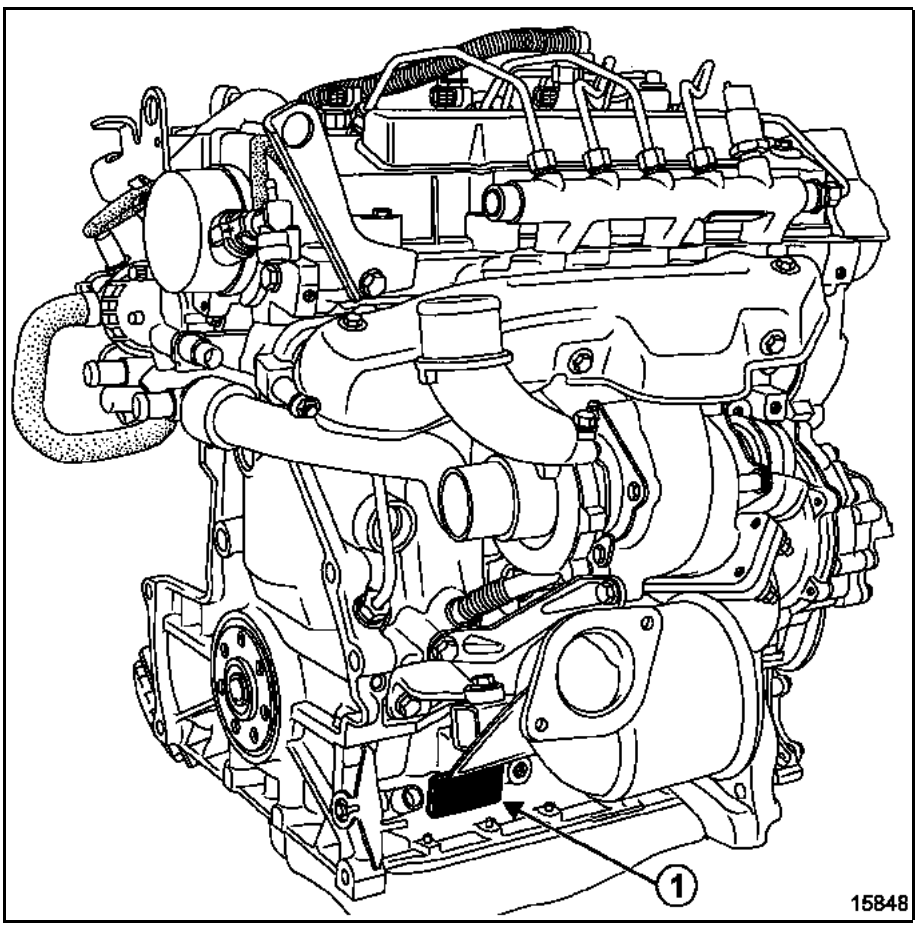
WARNING
All pipes removed must be replaced.

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**.

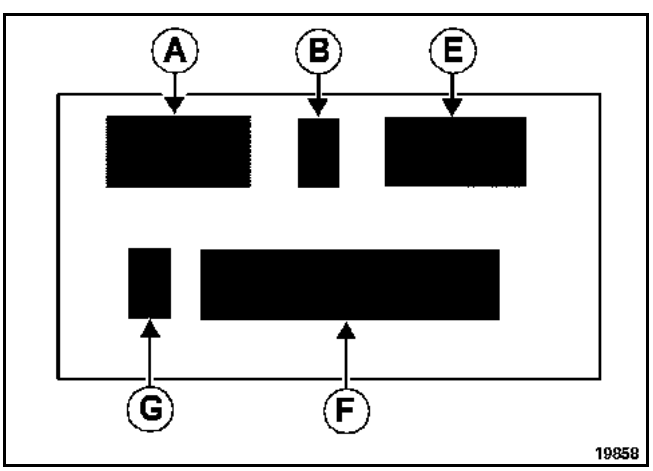
IMPORTANT
Dismantling the interior components of the pump is prohibited.
The fuel return pipe fitted to the injectors must be replaced when it is removed.
The diesel fuel temperature sensor cannot be removed. It is part of the fuel return rail.
Loosening a high pressure pipe union when the engine is running is prohibited.

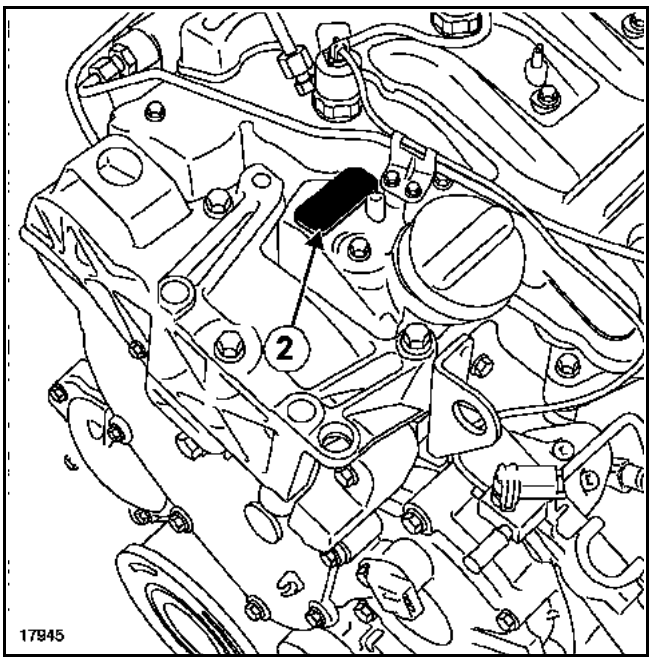
ENGINE IDENTIFICATION

There are two means of identification.



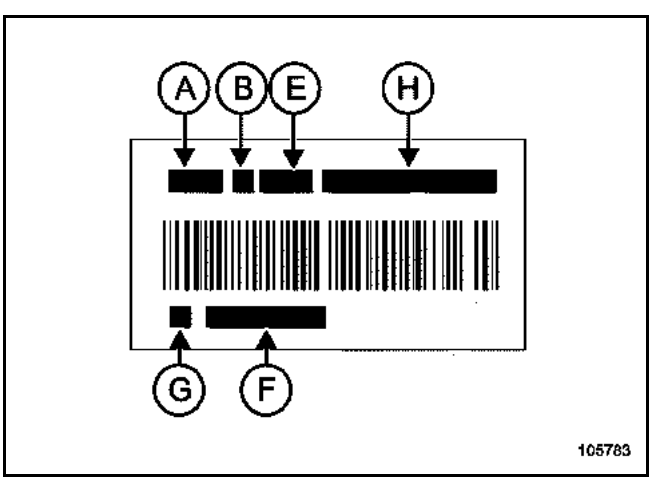
A) A plate (**1**) riveted onto the cylinder block.





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	Rating	Compression ratio	Bore (mm)	Stroke (mm)	Cubic capacity (cc)
G9T	700 701 702 703 710 712 720 722 742 743 750	18 / 1	87	92	2188
G9U	720 724 750 754 730	21.25 / 1	89	99	2463

UPPER ENGINE

Description	Tightening torque
Heater plugs	1.5
Injector flange bolt	*
Common rail mounting bolt	2.5
High pressure pipe nuts: – on injectors – on the pump and on the rail	 2.5 2.7
Camshaft bearing cap bolts	*
Camshaft hub bolts	6
Camshaft sprocket bolts	0.9
Hydraulic rocker shaft bolts	*
Vacuum pump mounting bolts	2.3
Inlet tract bolt on cylinder head	*
Rocker cover bolt	*
Exhaust manifold nuts	2.7
Cylinder head plenum chamber bolts	1
Turbocharger flange nut	2.7
Turbocharger oil return bolt	0.8
Turbocharger oil supply hollow bolt on cylinder block	2.3
Turbocharger oil supply nut on turbocharger	2.3
Exhaust gas recirculation valve bolt on venturi	1.5
Exhaust heat shield bolt	1
Cylinder head support bolt	4.4
Air conditioning compressor bolts	2.1
Alternator bolts	3

* See tightening procedure.

UPPER ENGINE (continued)

Description	Tightening torque
Power assisted steering pump bolt	2.1
Power assisted steering pulley bolt	1
Accessories tension wheel bolt	2.1
Accessories pulley bolt	4.4
Engine lifting ring bolts – M6 – M8	 1 3
Timing belt cover bolt	1
Cylinder head mounting bolts	*
Timing tension wheel bolt	2.5
Timing pulley mounting bolt	3

* See tightening procedure.

RAIL PROTECTOR: Model 2

Protector bolts	(M6 bolt) (M8 bolt)	1.2 2.5

RAIL PROTECTOR: Model 1

Lower metal protector bolt	(M6 bolt)	1

PERIPHERALS

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

** See tightening order
* Important: left-hand thread.

LOWER ENGINE (continued)

Description	Tightening torque
Coolant pipe bolts	3.1
Venturi mounting bolts	2.2
Catalytic converter mounting nuts	2.1
Catalytic converter stay mounting bolts	2.1
Relay bearing mounting bolts	6.2
Balance shaft cassette mounting bolts	1.5 plus an angle of 38° ±6°

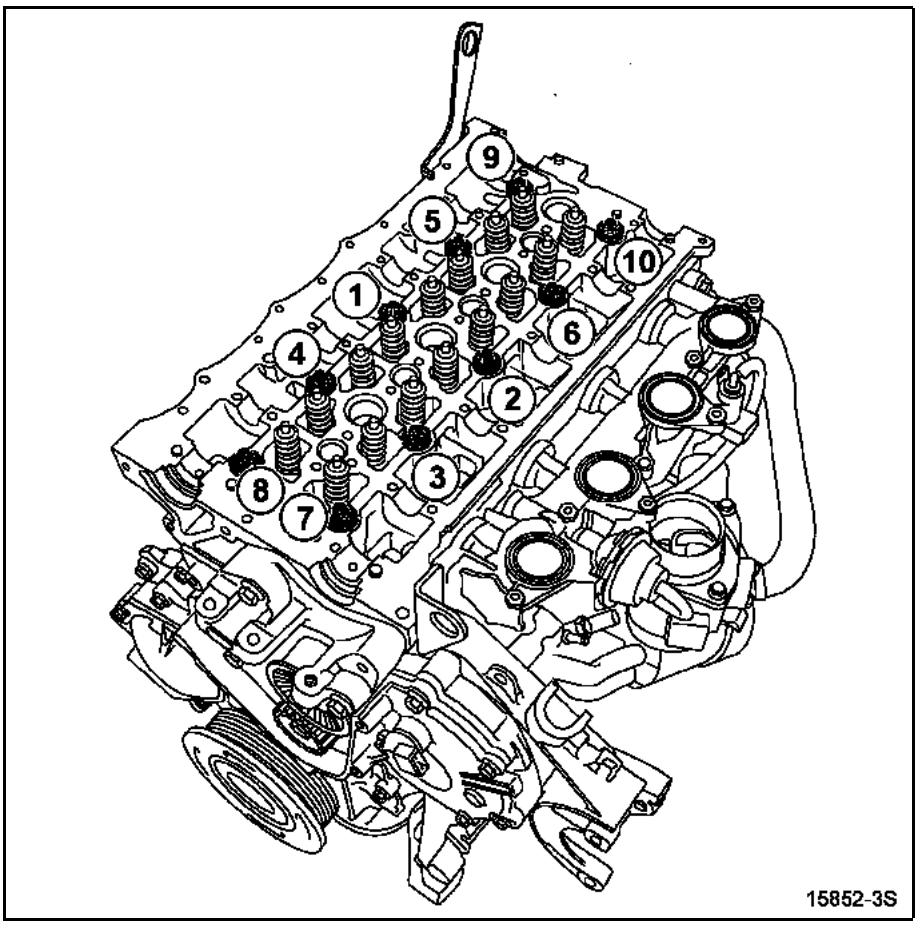
CYLINDER HEAD

Cylinder head bolts must always be replaced.

WARNING
Do not oil new bolts. Bolts must be oiled if reused.

Cylinder head tightening procedure

WARNING
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.



Tighten the cylinder head bolts to torque (**3 daNm**) and in order.

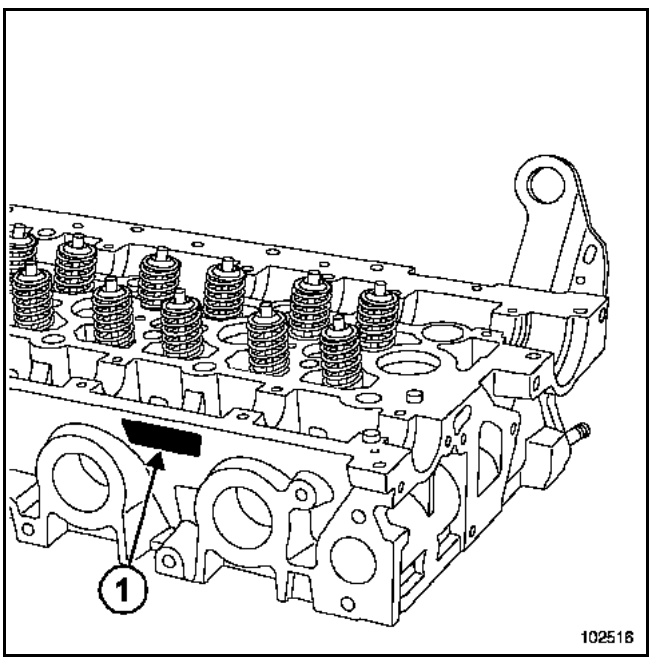
Check that all the bolts are correctly tightened to **3 daNm** then angle tightening (bolt by bolt) by **300° ± 6°**.

WARNING
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

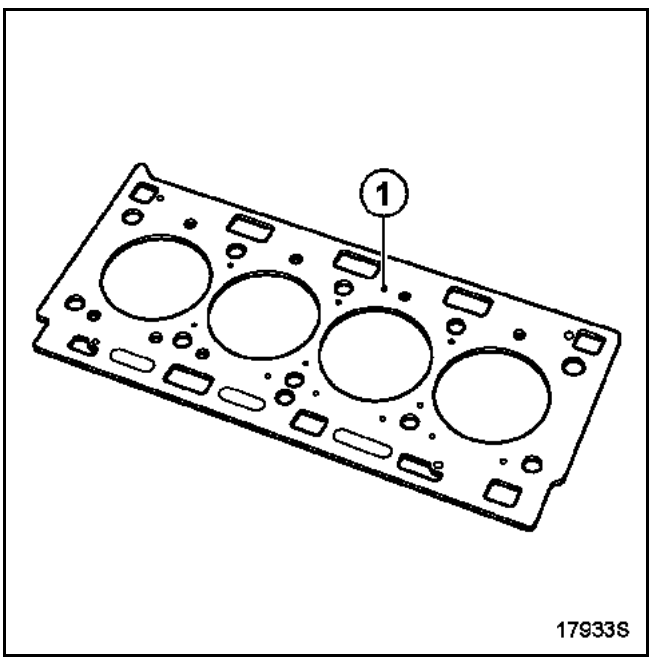
This cylinder head no longer has valve spring lower washers.

Marking (**1**) is made after milling.

Cylinder head gasket thickness

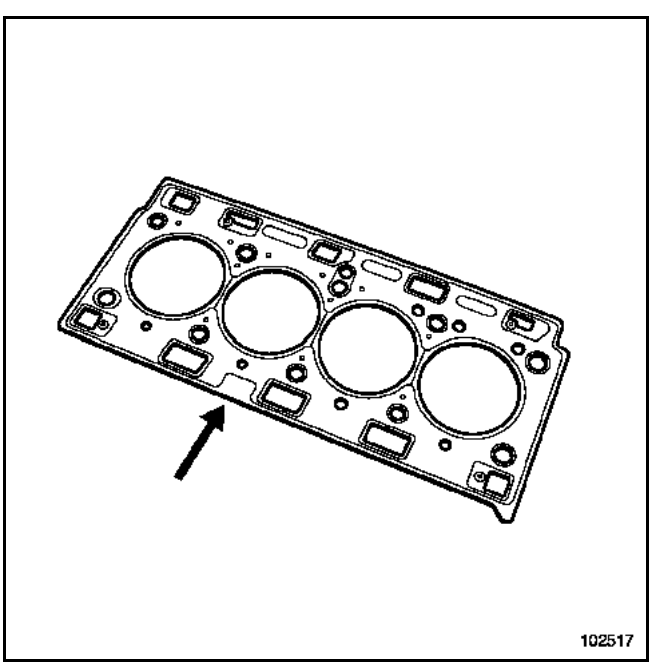
There are two cylinder head gasket thicknesses:

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

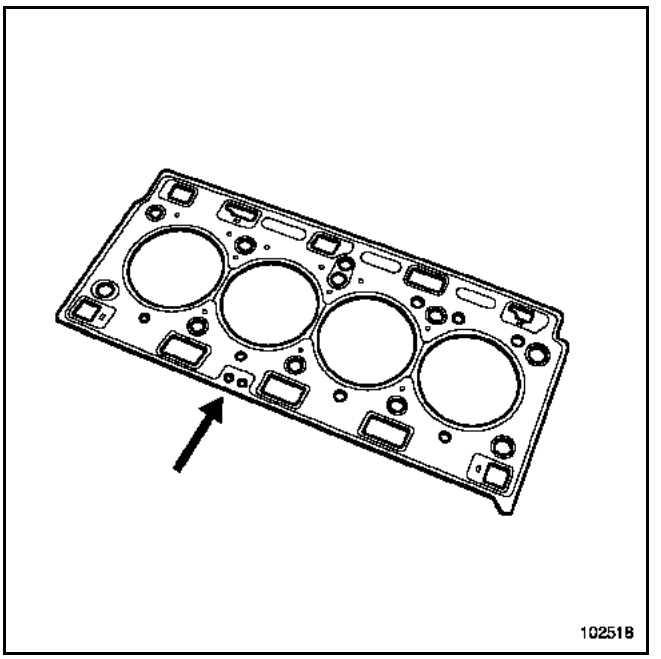


The thickness of the cylinder head gasket is measured at (**1**).

G9T engine



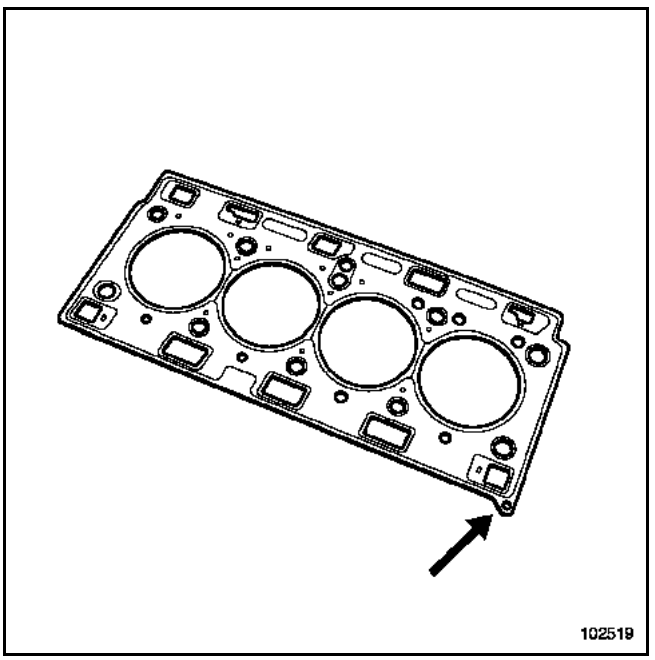
Cylinder head gasket thickness **1.16 ± 0.05 mm**



Cylinder head gasket thickness **1.21 ± 0.05 mm**

G9U engine

Cylinder head gasket thickness **1.21 ± 0.05 mm**



Note:
When replacing:
– the crankshaft,
– the cylinder block,
– the con rods,
– the pistons.
The thickness of the cylinder head gasket must be calculated.

Checking piston protrusion

Clean the piston crowns in order to eliminate any scaling.

Turn crankshaft by one revolution (in the operating direction, clockwise at the timing end) to bring piston **no. 1** close to the **top dead centre**.

Put tool (Mot. 252-01) in position.

Insert tool (Mot. 251-01) equipped with a dial gauge on its pressure plate (Mot. 252-01), and find **top dead centre** of the piston.

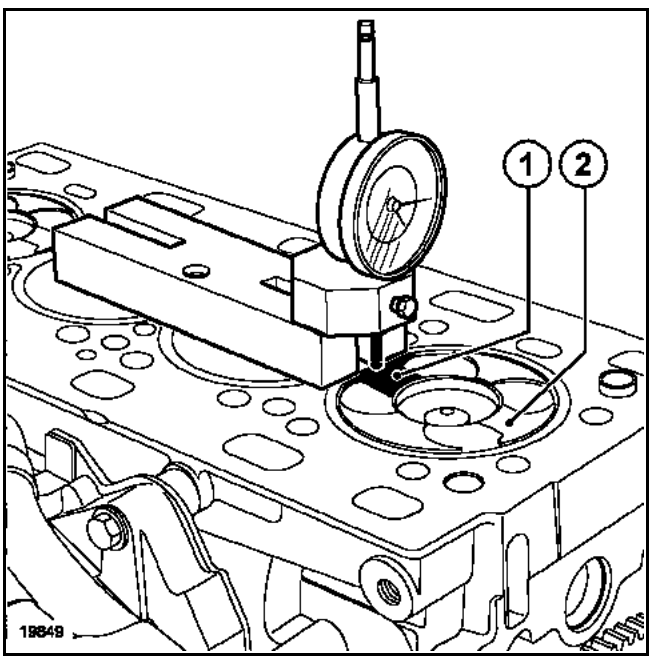
Reset the dial gauge on the front of the cylinder block.

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.

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

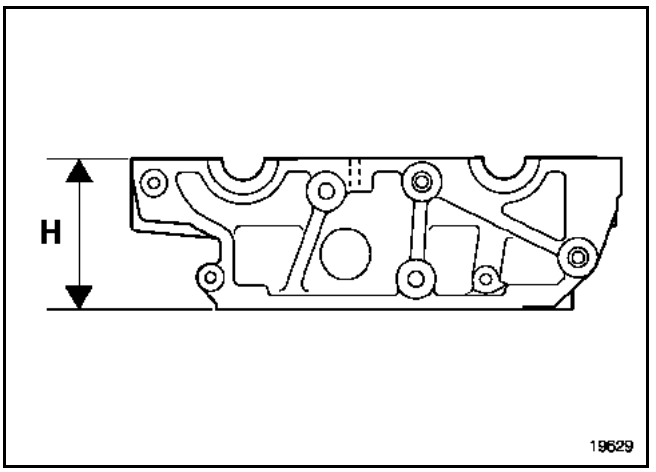
WARNING
The dial gauge feeler must not be in the valve clearance.



Measure the piston protrusion.

The protrusion must be: **0.399 ± 0.065 mm**.

Cylinder head height (mm) **H = 90.2**



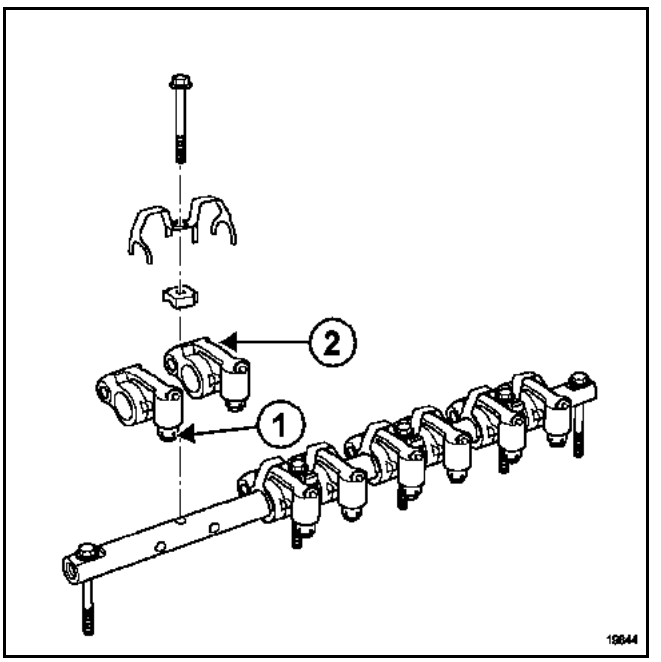
Gasket face deformation (**mm**)

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**.

Hydraulic tappet

These engines are equipped with hydraulic thrust bearings (**1**) and roller type rocker arms (**2**).



Valves

Stem diameter (in mm)

Inlet:	**5.9675 ± 0.0125**
Exhaust:	**5.9575 ± 0.0075**

Head diameter (in mm)

Inlet:	**30.6 ±0.12**
Exhaust:	**29.5 ±0.12**

Mating face angle

Inlet and exhaust:	**90°15'**

Valve length (in mm)

Inlet:	**123.2 ± 0.15**
Exhaust:	**123 ± 0.15**

Max valve lift (in mm)

Inlet:	**7.8**
Exhaust:	**7.8**

No valve clearance adjustment.

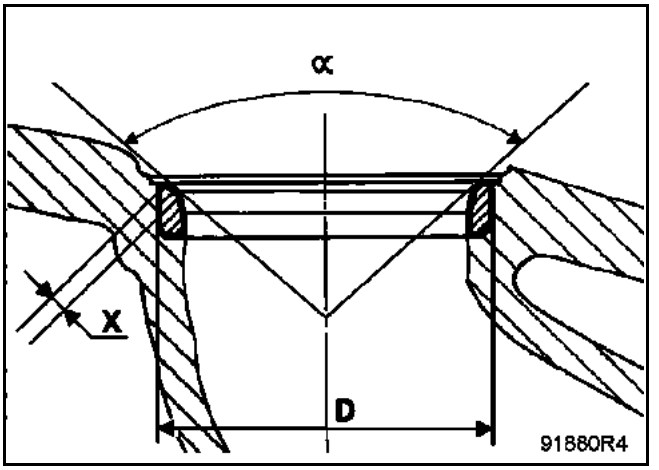
Valve seat

Seat angle ∝

Inlet and exhaust:	**89°30'**

External diameter D (in mm)

Inlet:	**32.31 ± 0.01**
Exhaust:	**31.11 ± 0.01**



Diameter of housing in the cylinder head (in mm)

Inlet:	**32.228 ± 0.0125**
Exhaust:	**31.032 ± 0.0125**

Valve guide

Length (in mm)

Inlet and exhaust:	**50 ± 0.15**	

Guide external diameter (in mm)

Inlet and exhaust:	**11**	+ 0.039 + 0.028

Diameter of guide housing in the cylinder head (in mm)

Inlet and exhaust:	**11**	

Guide internal diameter (in mm)

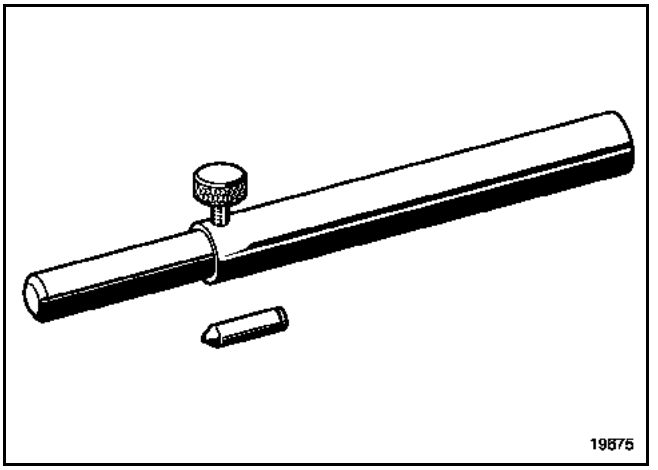
Inlet and exhaust:

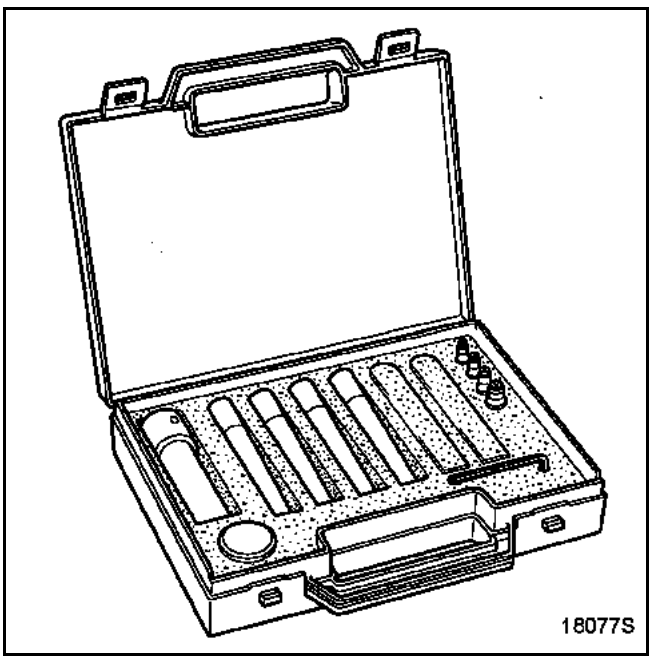
Not machined:	**5.5**	+ 0.12 0
Machined*:	**6**	+ 0.022 0

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

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.

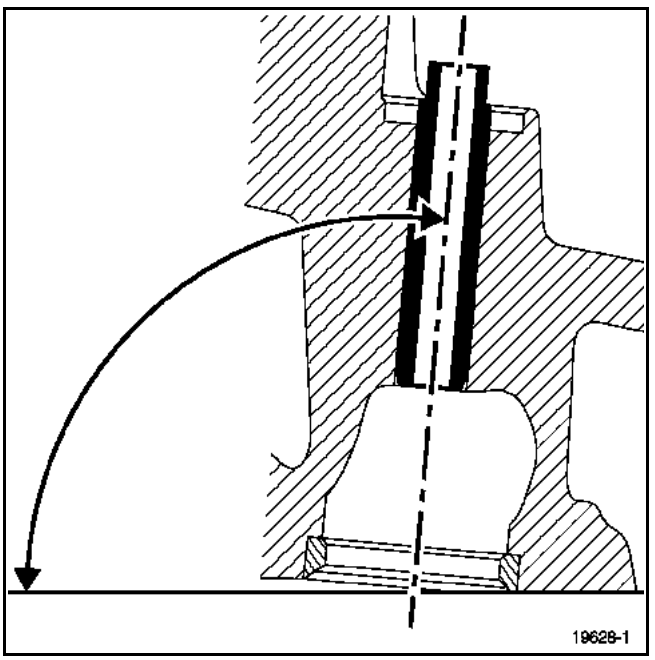




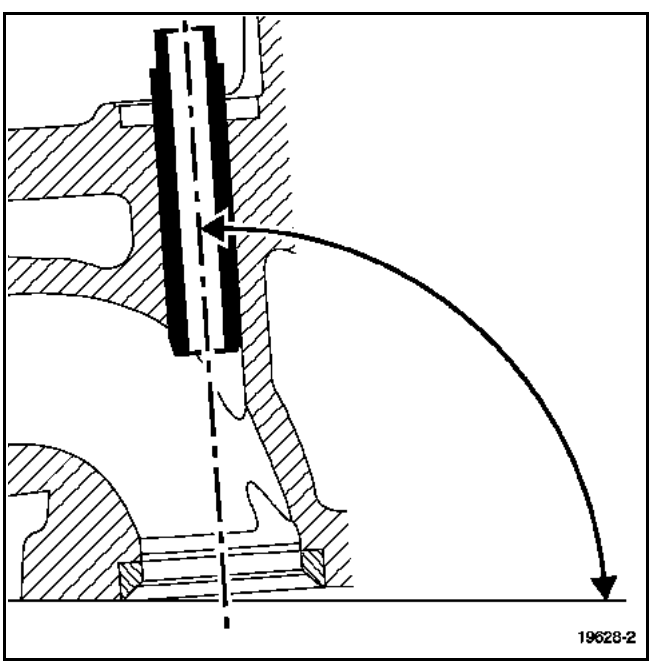
Note:
Do not lubricate the valve stem seals before fitting them.

Angle of the inlet and exhaust guides (in degrees)

Inlet: **95°**



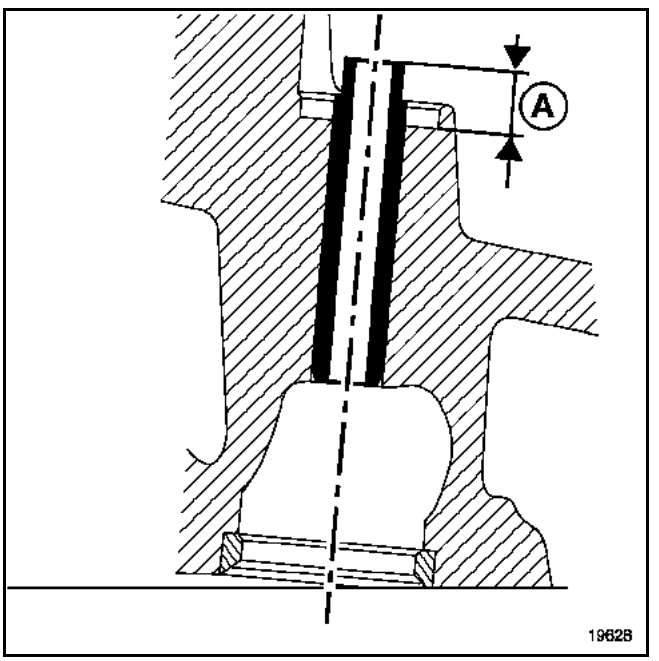
Exhaust: **94°**



Position of inlet and exhaust valve guides (mm)

Inlet: **A = 8.7 ± 0.15**

Exhaust: **A = 13.3 ± 0.15**

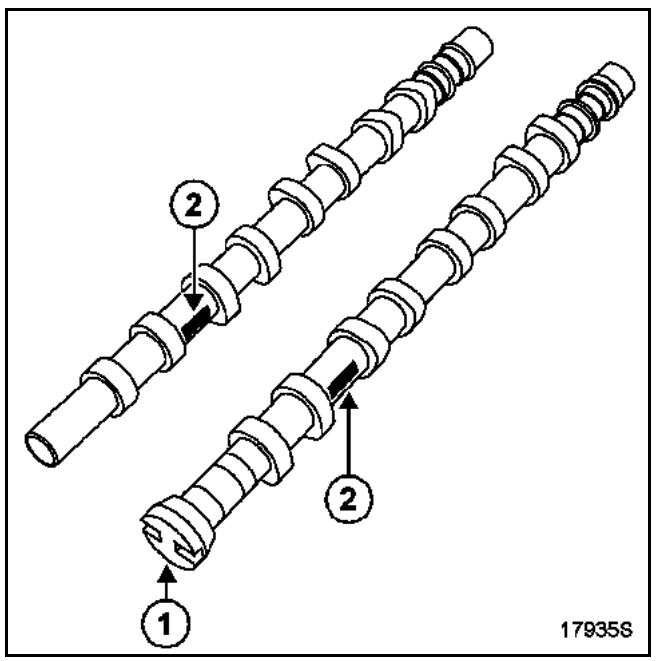


Valve springs (mm)

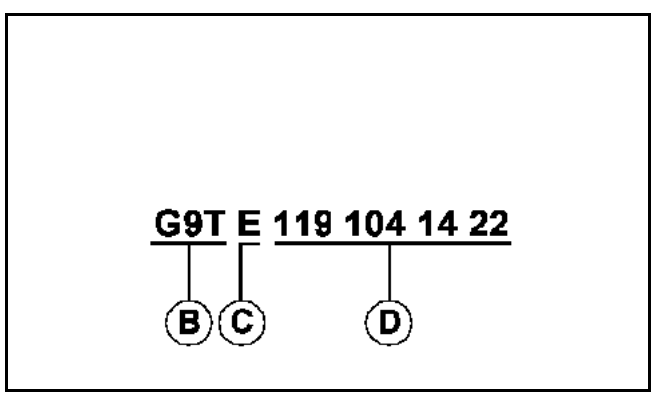
Free length:	**46.7**
Length under load	
18.5 daN	**40.5**
21.5 daN	**39.5**
24.5 daN	**38.5**
35 daN	**35**
45 daN	**32**
48.3 daN	**31**
51.5 daN	**30**
Length of joined spires:	**28**
Wire diameter:	**3.2 ± 0.02**
Internal diameter:	**14.1 ± 0.2**
External diameter:	**20.9**

Camshaft

How to distinguish between camshafts:
– the exhaust camshaft has the vacuum pump drive (**1**),
– the inlet camshaft has no vacuum pump drive.



Either by a marking (**2**): marking details:
- (**B**) gives the engine type,
- (**C**) identifies the camshafts (**A** = Inlet and **E** = Exhaust),
- (**D**) is used by the supplier only.



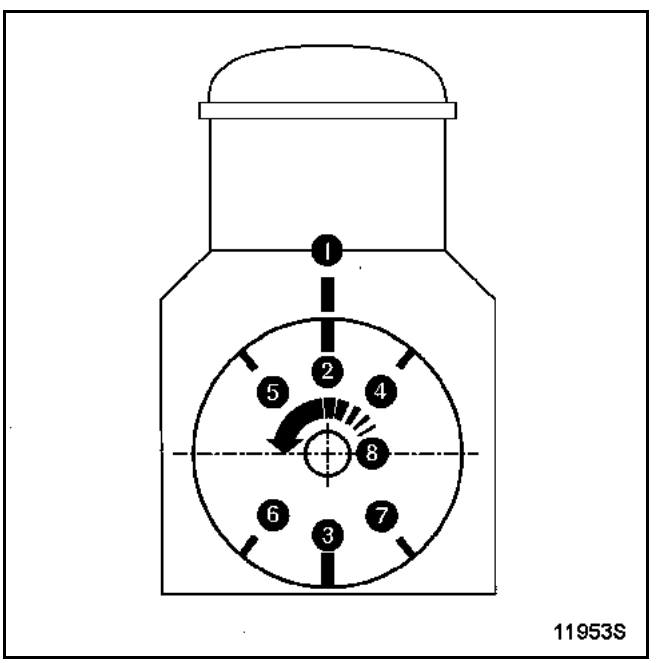
Longitudinal clearance (mm)	**0.05 to 0.13**	
Number of bearings:	**6**	
Diameter of camshaft bearings (**in mm**)		
on the camshafts:	**25**	- 0 - 0.021
on the cylinder head:	**25**	+ 0.061 + 0.040

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.



1 Cylinder block top dead centre fixed marking
2 Flywheel top dead centre moving mark
3 Flywheel bottom dead centre moving mark
4 Inlet Opening Retardation **ROA**
5 Exhaust Closing Advance **AFE**
6 Inlet Closing Retardation **RFA**
7 Exhaust Opening Advance **AOE**
8 Direction of engine rotation (flywheel end)

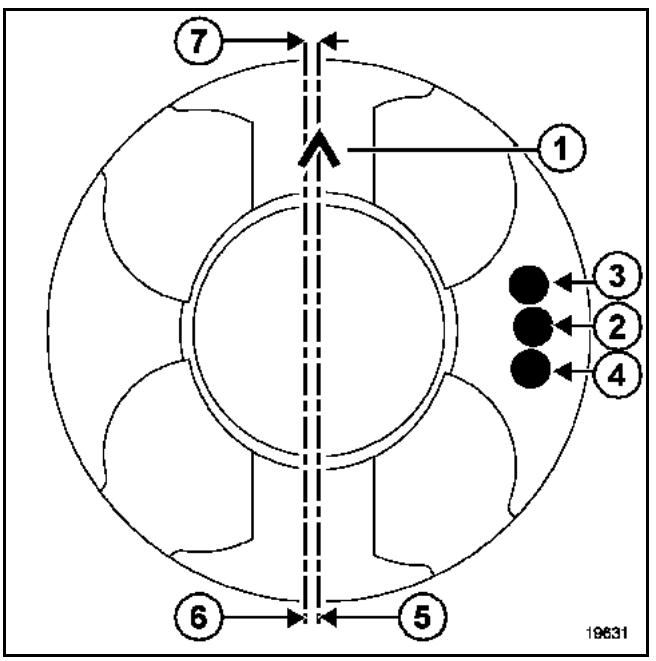
PISTONS

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

G9T

* Mark on piston	Pin height H (in mm)	Thickness of the associated cylinder head gasket (in mm)
E	54.48	1.16
F	54.52	1.16
J	54.56	1.16
K	54.60	1.16
L	54.64	1.16

These pistons have no ducting (oil circulation in the piston crown contributing to piston cooling).

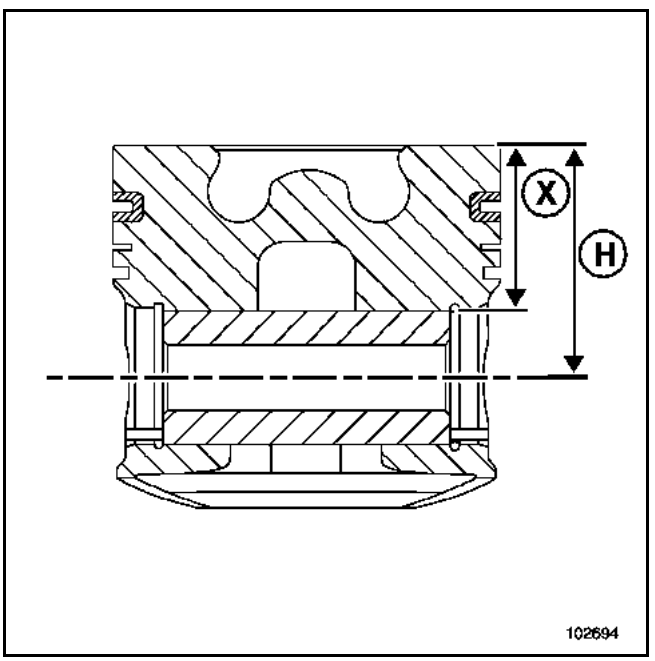
* Mark on piston	Pin height H (in mm)	Thickness of the associated cylinder head gasket (mm)
E	54.53	1.21
F	54.57	1.21
J	54.61	1.21
K	54.65	1.21
L	54.69	1.21

These pistons have no ducting (oil circulation in the piston crown contributing to piston cooling).

* Mark on piston	Pin height H (in mm)	Thickness of the associated cylinder head gasket (mm)
A or T	54.53	1.21
B or U	54.57	1.21
C or W	54.61	1.21
D or X	54.65	1.21
G or Y	54.69	1.21

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 - 31/2

Example:
– piston of category F with a pin height H = 54.52
Hence X = 54.52 - (31 / 2)
X = 39.02 mm

– piston of category F with a pin height H = 54.57
Hence X = 54.57 - (31 / 2)
X = 39.07 mm

G9U

* Mark on piston	Pin height H (in mm)
N	53.03
O	53.07
P	53.11
R	53.15
S	53.19

The tolerance on the pin heights is ± **0.02 mm**.

*** The various gudgeon pin heights are exclusively reserved for the engine assembly factory.**

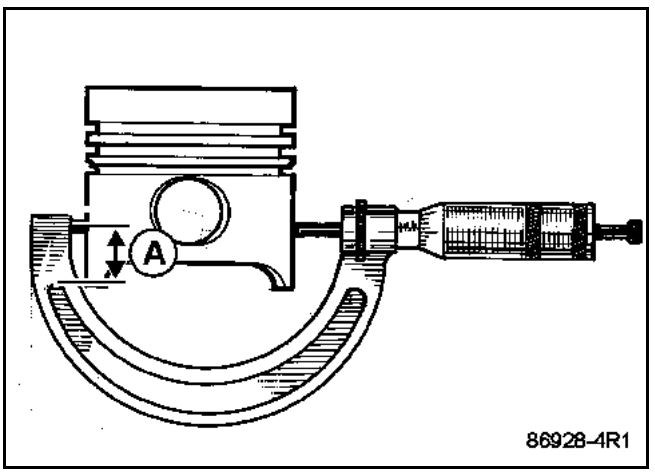
The Parts Department supplies only the following piston categories

F and K
U and X
O and R
B and D

Measuring the piston diameter

The piston diameter should be measured with
A = 49 mm for G9T engines,
A = 47 mm for G9U engines.

Piston diameter (**in mm**):
86.806 ± 0.007 for G9T engines,
88.81 ± 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

Three rings (**thickness in mm**)

Compression ring:	**3**	
Sealing ring	**1.75**	- 0.01 - 0.025
Scraper ring	**2.5**	- 0.01 - 0.03

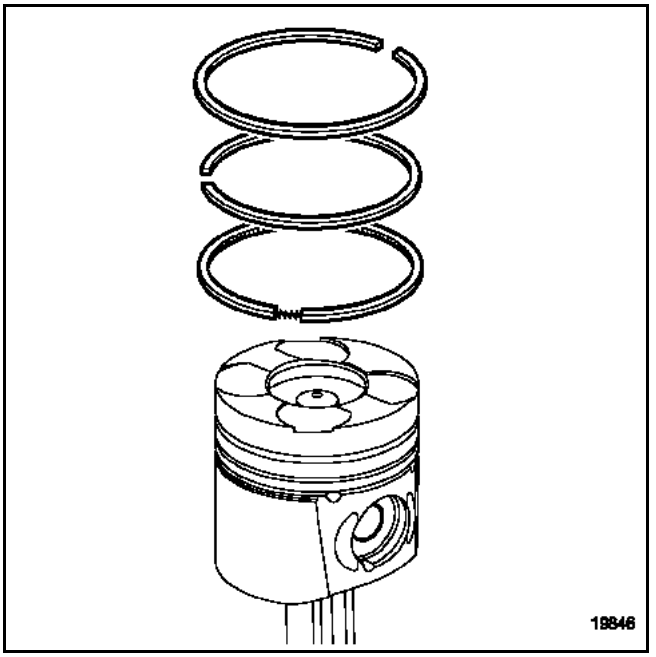
End clearance

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

Fitting the rings

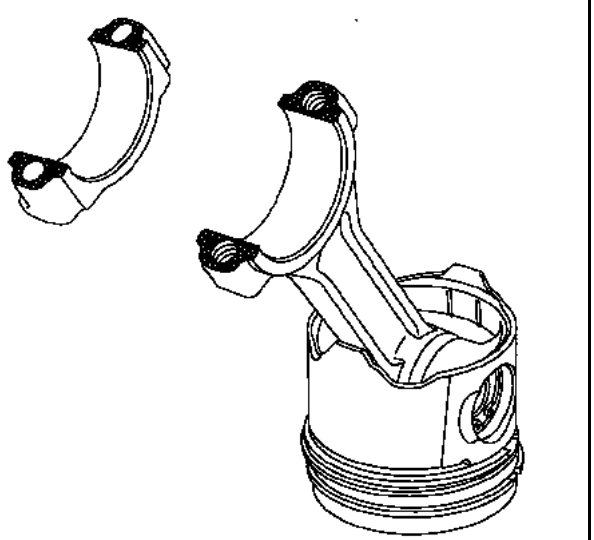
Rings are adjusted to their original fitting. They must be free in their grooves.

Ensure the rings' direction of fitting is correct.



CON RODS

The con rods are of the "SPLIT" type.



WARNING
- The bolts must be coated with engine oil under the heads and on the threads when the con rods are fitted 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.
- It is vital that the mating faces remain clean and dry.
- Do not oil the bearing shell pressure faces (cap side and con rod side).

Lateral clearance of the big end (**in mm**) **0.22 to 0.482**

Big end diametrical clearance (**in mm**) **0.027 to 0.086**

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

There are four categories of big end - small end centre-to-centre distance* (mm).

G9T

1	149.8775 ± 0.0075
2	149.8925 ± 0.0075
3	149.9075 ± 0.0075
4	149.9225 ± 0.0075

G9U

5	147.8775 ± 0.0075
6	147.8925 ± 0.0075
7	147.9075 ± 0.0075
8	147.9225 ± 0.0075

*** Marking of the rotating assembly on the original engine is reserved exclusively for the engine assembly factory.**

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

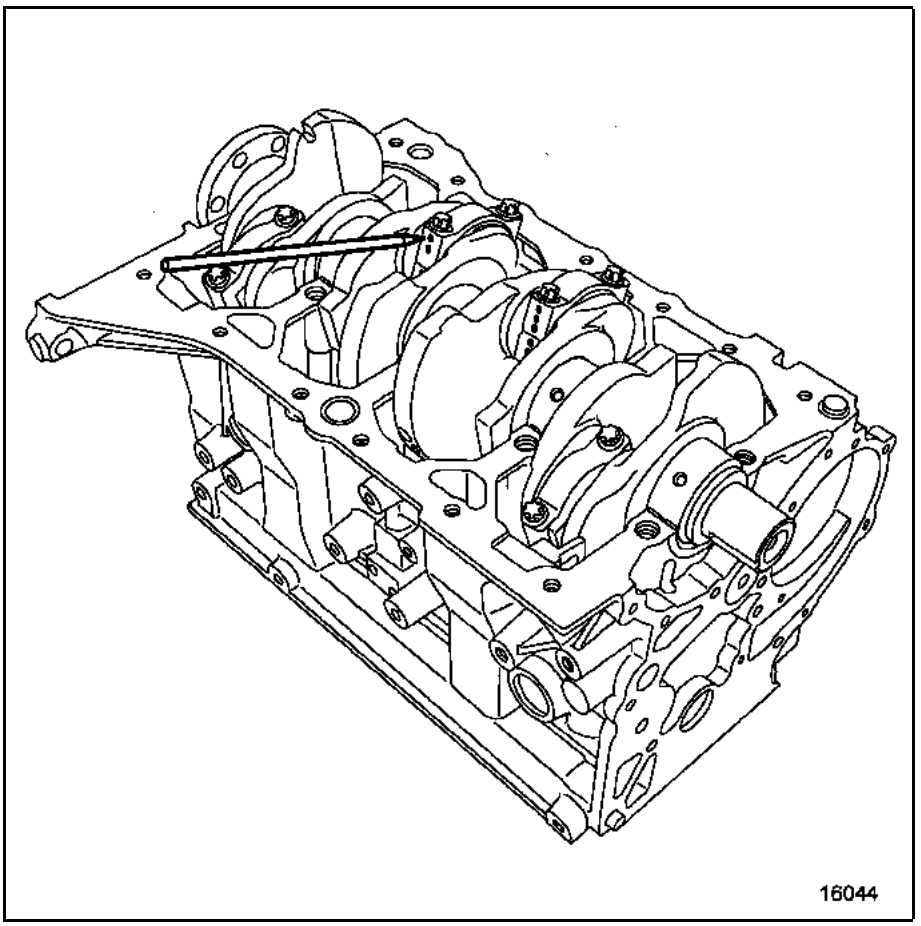
Big end diameter (**mm**)
(there are two big end diameters)

51.587 $^{+0.019}_{0}$
56.587 $^{+0.019}_{0}$

Small end diameter (**mm**)

(without bush) **33.5** $^{+0.025}_{0}$
(with bush) **31** $^{+0.025}_{+0.013}$

Note:
The con rod small end bushes cannot be replaced.

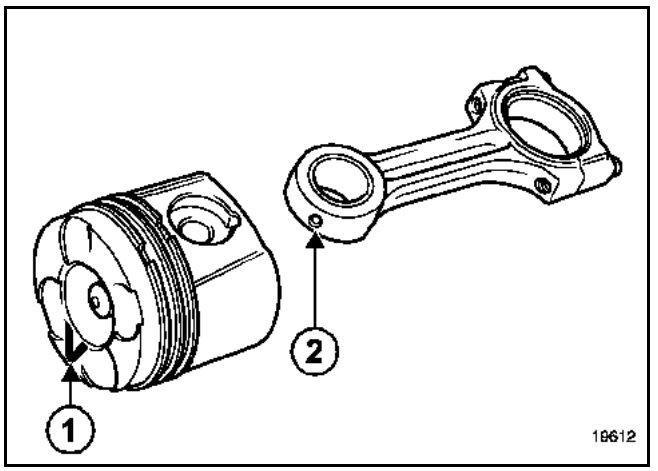


WARNING
Do not use a sharp point to mark the big end caps in relation to their bodies, to prevent incipient breakage of the con rod.

Use a permanent marker pen.

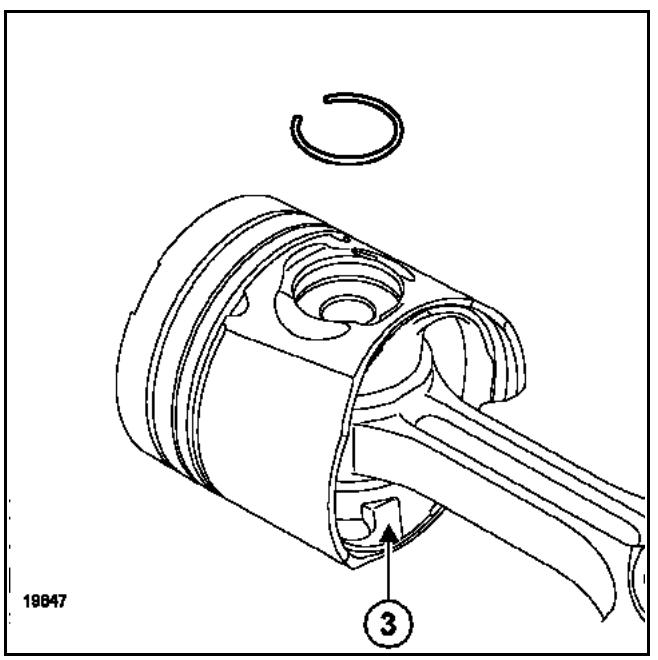
The maximum con rod weight difference for a given motor must be **25 grams**.

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.

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.

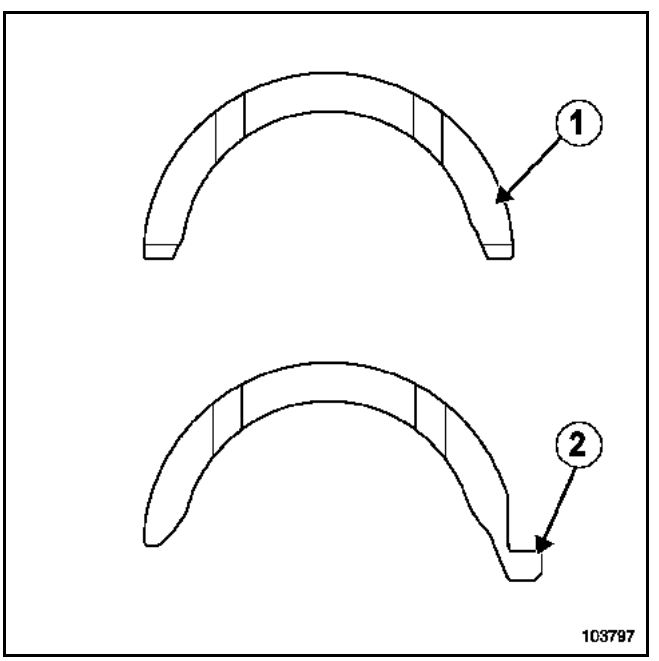
Crankpin diameter (**mm**) **48** $^{-0.01}_{-0.03}$

53 $^{-0.01}_{-0.03}$

The lateral shims are located on **bearing no. 2**.

NO REGRINDING IS AUTHORISED

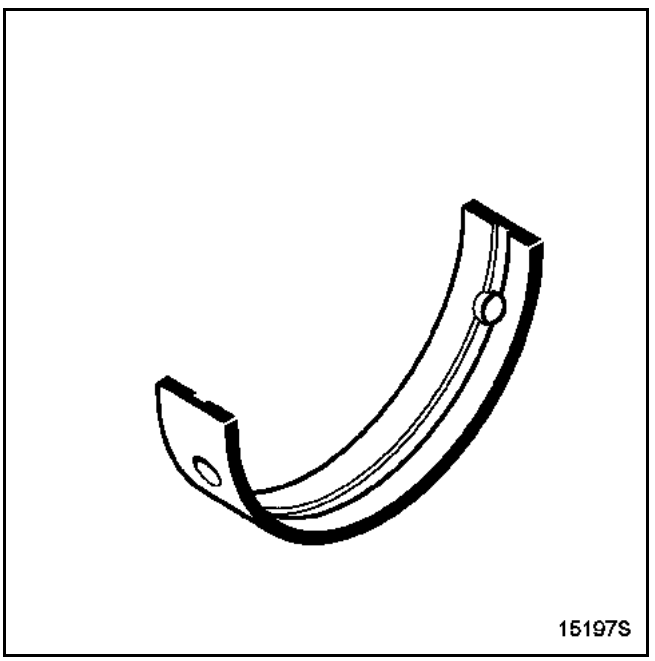
The lateral shims have changed: A foolproofing device has been added. They are not interchangeable. The foolproofing device helps fitting the lateral shims:
Model 1 (**1**)
Model 2 (**2**)



BEARING SHELLS

Crankshaft bearing shells

These engines are fitted with foolproofed bearing shells.



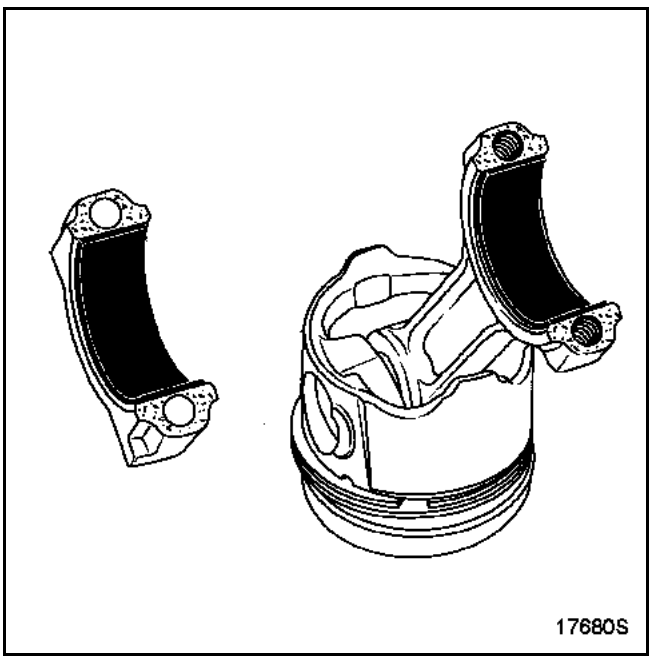
Direction of fitting:
– on **the cylinder block**, fit **grooved** bearing shells on all the bearings,
– on **the bearing caps**, fit **non-grooved** bearing shells.

Note:
On a given bearing, fit an upper bearing shell and a lower bearing shell of the same colour.

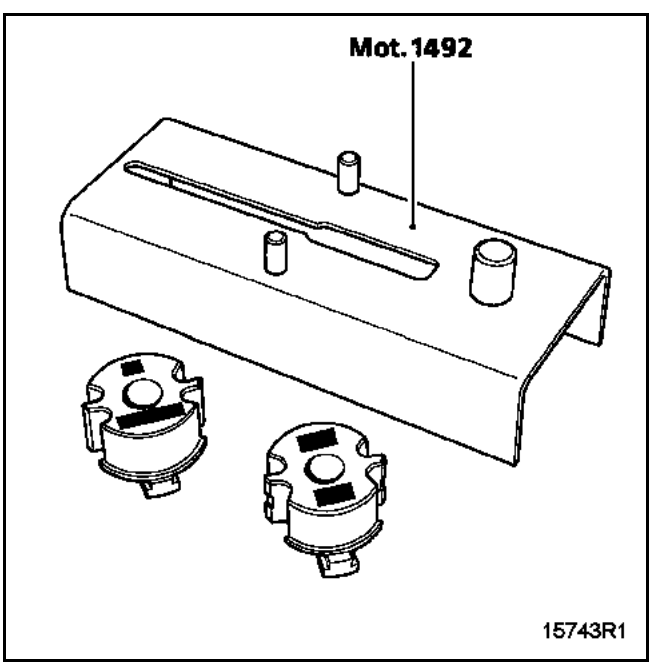
The bearing caps and cylinder block bearings must be clean and dry before the bearing shells are fitted.

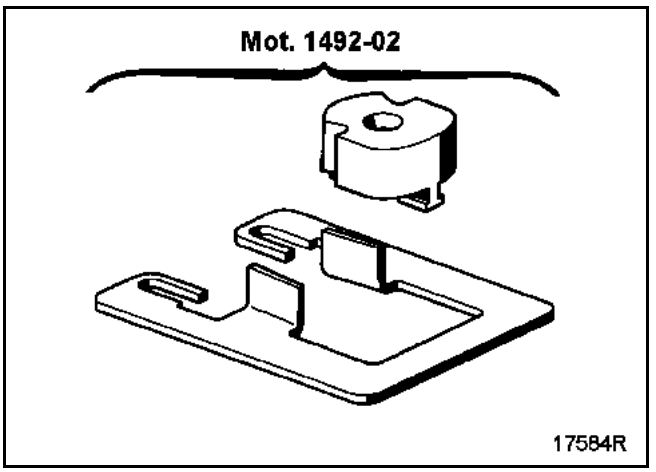
Con rod bearing shells

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**).

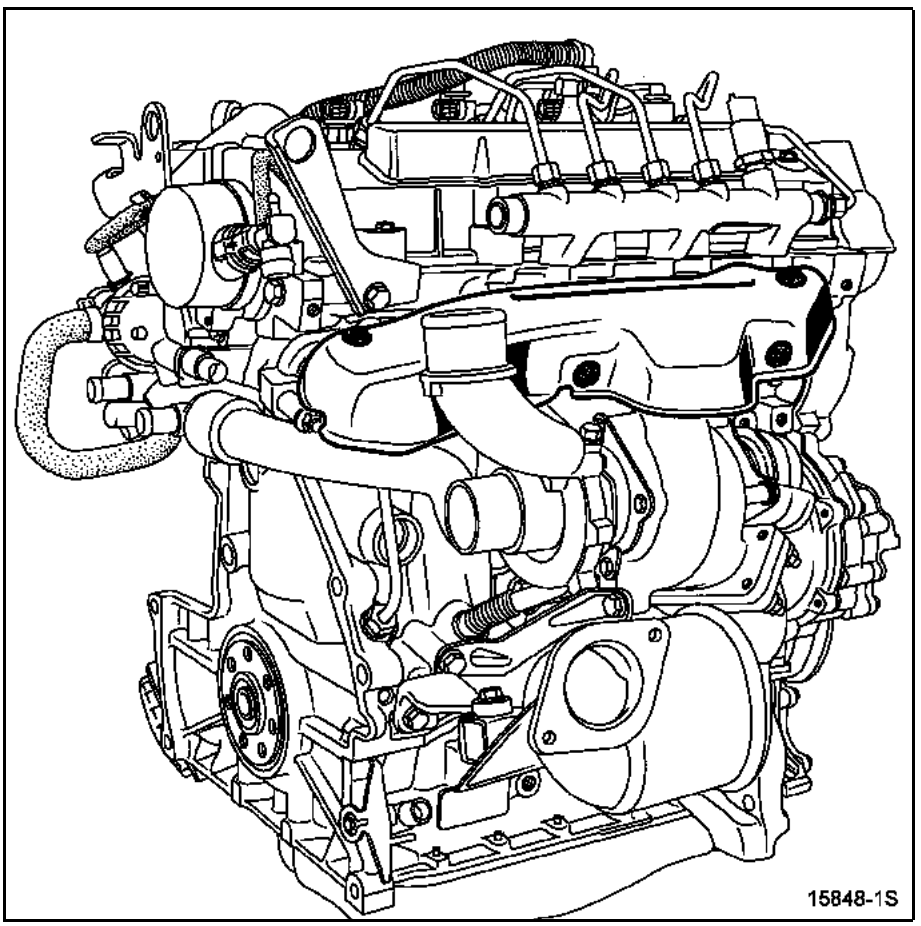




Piston base cooling jet

WARNING
The piston base cooling jet mounting bolts have a **left-handed** thread.

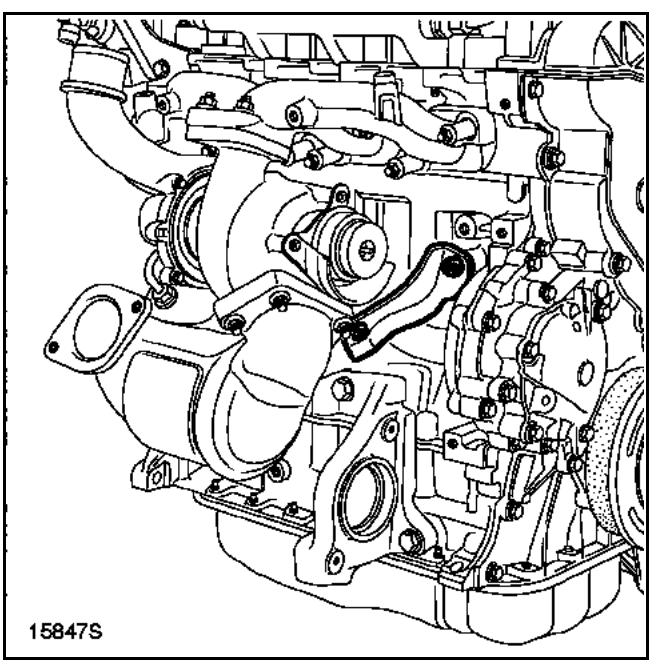
PREPARING THE ENGINE TO BE MOUNTED ON THE SUPPORT



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).

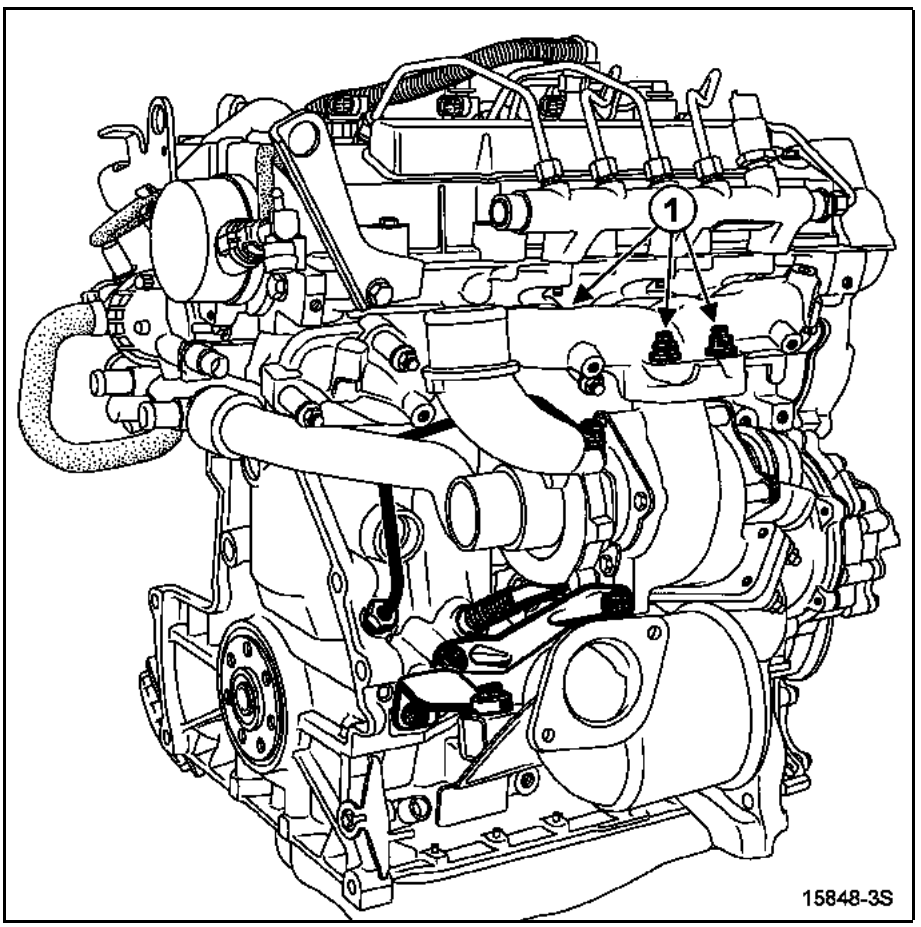


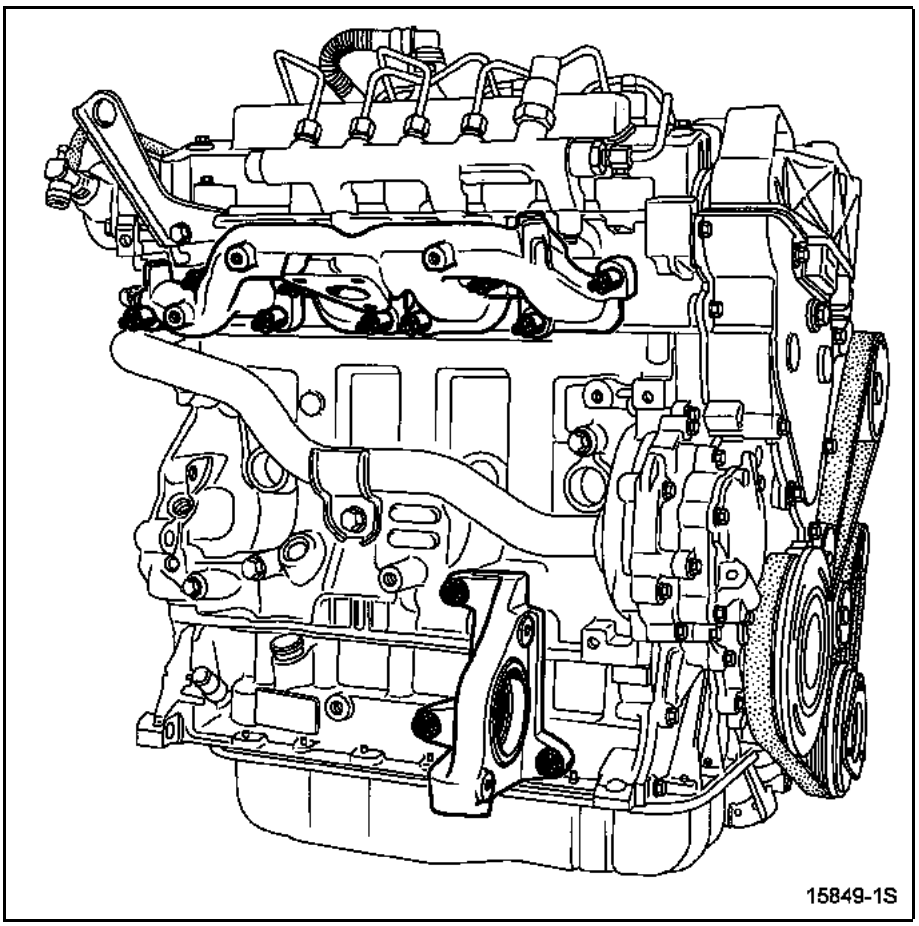
Remove the turbocharger retaining strut and the pre-catalytic converter retaining strut from the cylinder block (if fitted).

Remove the turbocharger oil supply pipe.

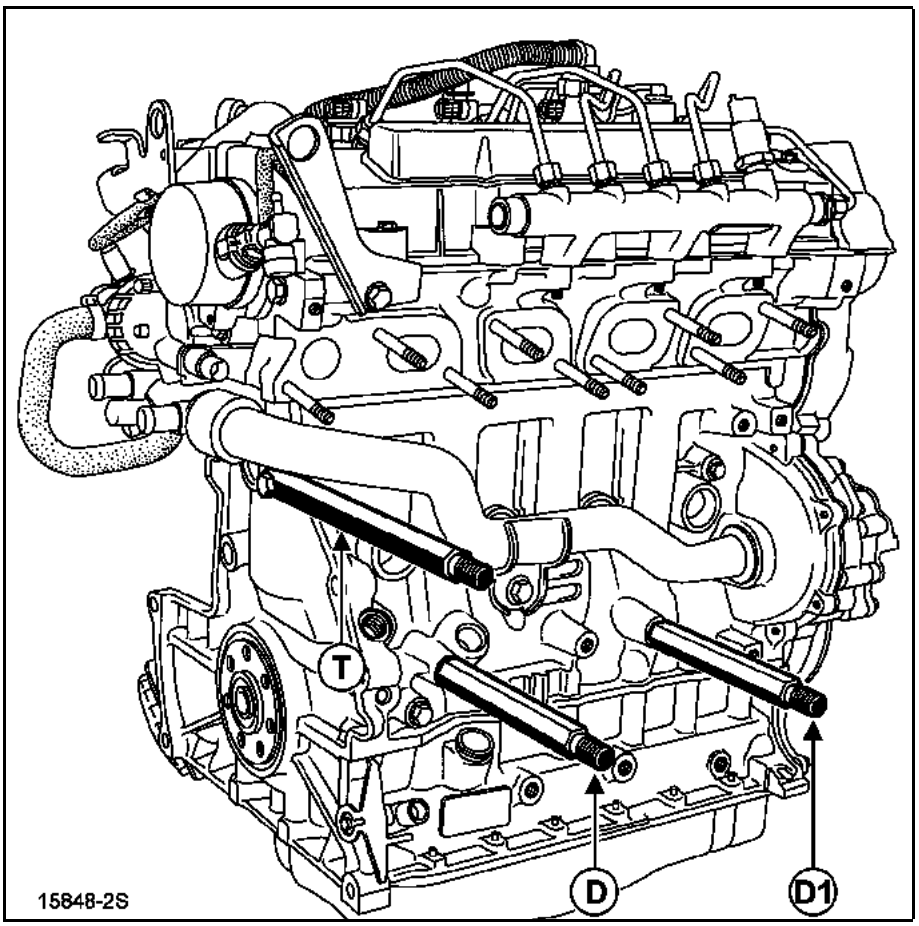
Remove the turbocharger oil return pipe.

Remove the three turbocharger mounting bolts (**1**).





Remove:
– the exhaust manifold,
– driveshaft relay bearing.



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

Position the rods (**D**), (**D1**) of tool 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).

CONSUMABLES

Type	Quantity	Component concerned	Part no.
Cleaner	-	Cleaning parts	**77 01 421 513**
DECAPJOINT	Coat	Cleaning sealing surfaces	**77 01 405 952**
RHODORSEAL 5661	Coat	Crankshaft bearing cap housing	**77 01 404 452**
LOCTITE FRENETANCH	1 or 2 drops	High pressure pump bolt	**77 01 394 070**

WARNING

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

PARTS TO BE REPLACED AFTER REMOVAL:

– 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.

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.)

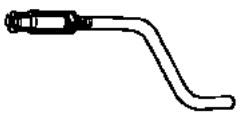
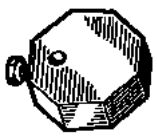
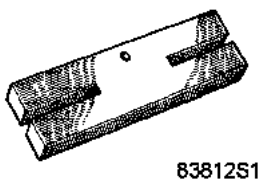
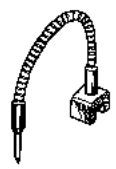
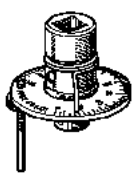
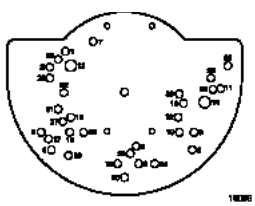
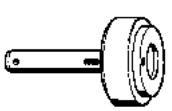
PREPARING USED ENGINE FOR RETURN

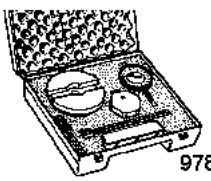
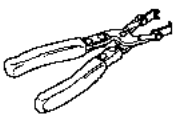
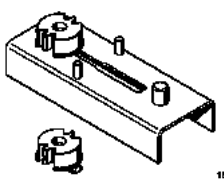
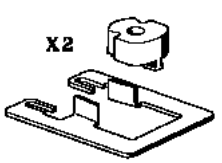
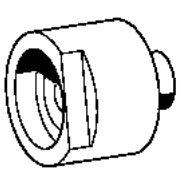
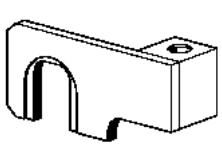
The engine must be cleaned and drained (oil and water).

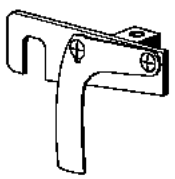
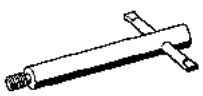
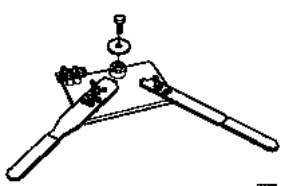
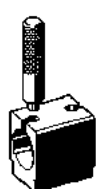
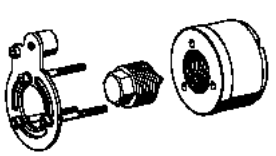
Leave on the used engine or include in the return box:
– the oil filter,
– the oil pressure switch,
– the water pump,
– the high pressure pump,
– the rail,
– the injectors
– the heater plugs,
– the diesel fuel collector on rail protector model 2,
– the oil level sensor,
– the cylinder head plenum chamber,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

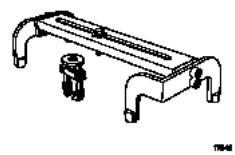
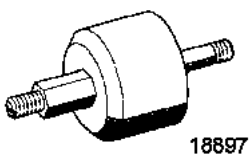
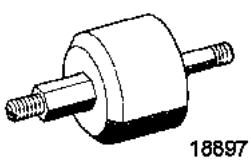
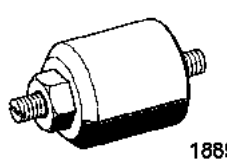
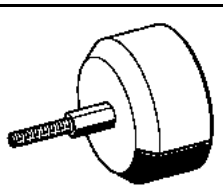
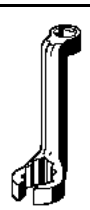
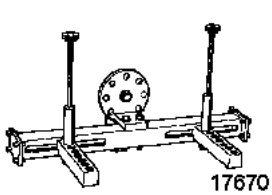
Remember to remove:
– all coolant flexible pipes,
– the exhaust manifold,
– the alternator,
– the power assisted steering pump,
– the air conditioning compressor,
– the rail protector model 1 (entire system),
– the cover of model 2.

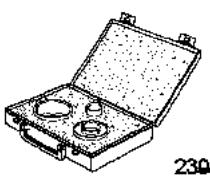
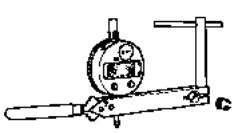
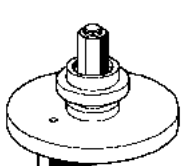
The used engine must be secured to the base under the same conditions as the overhauled engine:
– plastic caps and covers fitted,
– cardboard cover over the assembly.

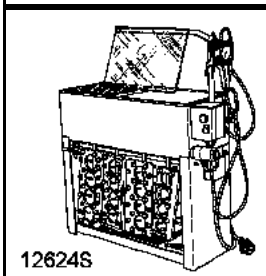
	Engineering reference	Parts Department part no.	Description
 68603	**Mot. 11**	**00 01 072 500**	Crankshaft spigot bush extractor
 83812	**Mot. 251-01**	**00 00 025 101**	Dial gauge support. Used with tool Mot. 252-01
 83812S1	**Mot. 252-01**	**00 00 025 201**	Dial gauge support thrust plate. Used with tool Mot. 251-01
 77889	**Mot. 591-02**	**00 00 059 102**	Magnetised flexible shaft for angle wrench for tightening cylinder head
 78181	**Mot. 591-04**	**00 00 059 104**	Angle wrench with index for tightening cylinder head (1/2" drive)
	**Mot. 792-03**	**00 00 079 203**	Engine support plate for Desvil engine stand (with studs A to W)
	**Mot. 1301**	**00 00 131 100**	Stud ref. "T" for Desvil engine stand Used with Mot. 792-03
 96898-1	**Mot. 1313**	**00 00 131 300**	Flywheel end crankshaft seal fitting tool

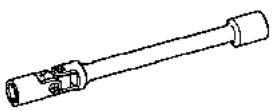
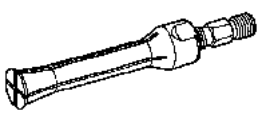
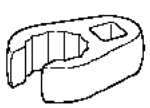
	Engineering reference	Parts Department part no.	Description
 97922-S1	**Mot. 1316**	**00 00 131 600**	Flywheel locking tool
 97857	**Mot. 1319**	**00 00 131 900**	Depth gauge for measuring the height of crankpins
 98503-S	**Mot. 1335**	**00 00 133 500**	Pliers for removing valve stem seals
	**Mot. 1492**	**00 00 149 200**	Tool for fitting con rod bearing shells
	**Mot. 1492-02**	**00 00 149 202**	Tool for fitting bearing shells on split con rods - adaptor for Mot. 1492 ∅ 48 mm and ∅ 53 mm
	**Mot. 1503**	**00 00 150 300**	Tool for fitting high pressure pump nut blanking cover
 19675	**Mot. 1511-01**	**00 00 151 101**	Tool for fitting valve stem seals
	**Mot. 1534**	**00 00 153 400**	Inlet camshaft setting tool

	Engineering reference	Parts Department part no.	Description
	**Mot. 1536**	**00 00 153 600**	Top dead centre locating pin
	**Mot. 1537**	**00 00 153 700**	Exhaust camshaft setting tool
 20329	**Mot. 1538**	**00 00 153 800**	High pressure pump sprocket immobiliser pin
 20328	**Mot. 1539**	**00 00 153 900**	Intermediate sprocket immobiliser tool
	**Mot. 1540**	**00 00 154 000**	Tool for aligning the play compensation sprocket teeth
 19674	**Mot. 1541**	**00 00 154 100**	Tool for refitting the oil deflector on the crankshaft sprocket
 19673	**Mot. 1542**	**00 00 154 200**	Tool for refitting the roll pins on the intermediate sprocket shafts
	**Mot. 1548**	**00 00 154 800**	High pressure pump sprocket retaining and extraction tool

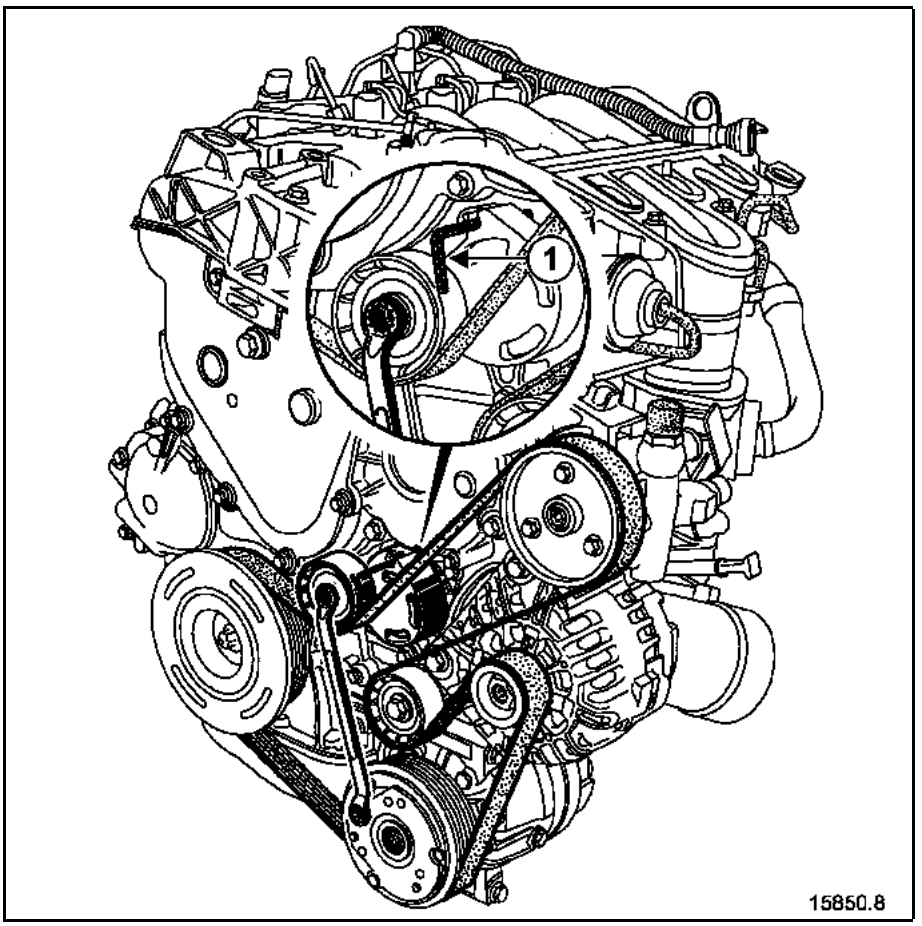
	Engineering reference	Parts Department part no.	Description
	**Mot. 1549**	**00 00 154 900**	Injector extraction tool
 18897	**Mot. 1560**	**00 00 156 000**	Tool for fitting timing end crankshaft seal
 18897	**Mot. 1561**	**00 00 156 100**	Tool for fitting intermediate shaft seal
 18895	**Mot. 1562**	**00 00 156 200**	Tool for fitting camshaft seal
	**Mot. 1564**	**00 00 156 400**	Flywheel end crankshaft seal fitting tool
 19672	**Mot. 1566**	**00 00 156 600**	Tool for removing high pressure pipes
 17670	**Mot. 1573**	**00 00 157 300**	Cylinder head support
	**Mot. 1574**	**00 00 157 400**	Stud ref. "D1" for Desvil engine stand Used with Mot. 792-03

	Engineering reference	Parts Department part no.	Description
40011	**Mot. 1577**	**00 00 157 700**	Lip seal extractor ∅ 28 mm to ∅ 50 mm
40012	**Mot. 1578**	**00 00 157 800**	Lip seal extractor ∅ 50 mm to ∅ 75 mm
40013	**Mot. 1579**	**00 00 157 900**	Lip seal extractor ∅ 80 mm to ∅ 95 mm
 23955	**Mot. 1628**	**00 00 162 800**	Set of 3 sleeves for fitting elastomer seals. This kit is needed for tools Mot. 1560, Mot. 1561 and Mot. 1562
 101777	**Mot. 1660**	**00 00 166 000**	Balance shaft setting tool
	Mot. 1665	**00 00 166 500**	Flywheel timing pin
	Emb. 1518	**00 00 151 800**	Set of clutch disc centring mandrels
 19919	**Emb. 1604**	**00 00 160 400**	Clutch compression tool for resetting the play compensation system

	Description
	Tool for fitting piston and rings into cylinder liner
	Manual extractor for removing the water pump sprocket
	Standard 22 mm long "1/2" (12.7 mm square) drive socket for removing the oil pressure checking gauge
	Valve spring compressor
 12624S	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). The approval number of the cylinder head test tray is **664000**
	Female torx socket **8/12/14**, standard 1/2 (12.7 mm square)
	Angle tightening wrench
 180775	Tool for fitting valve stem seals

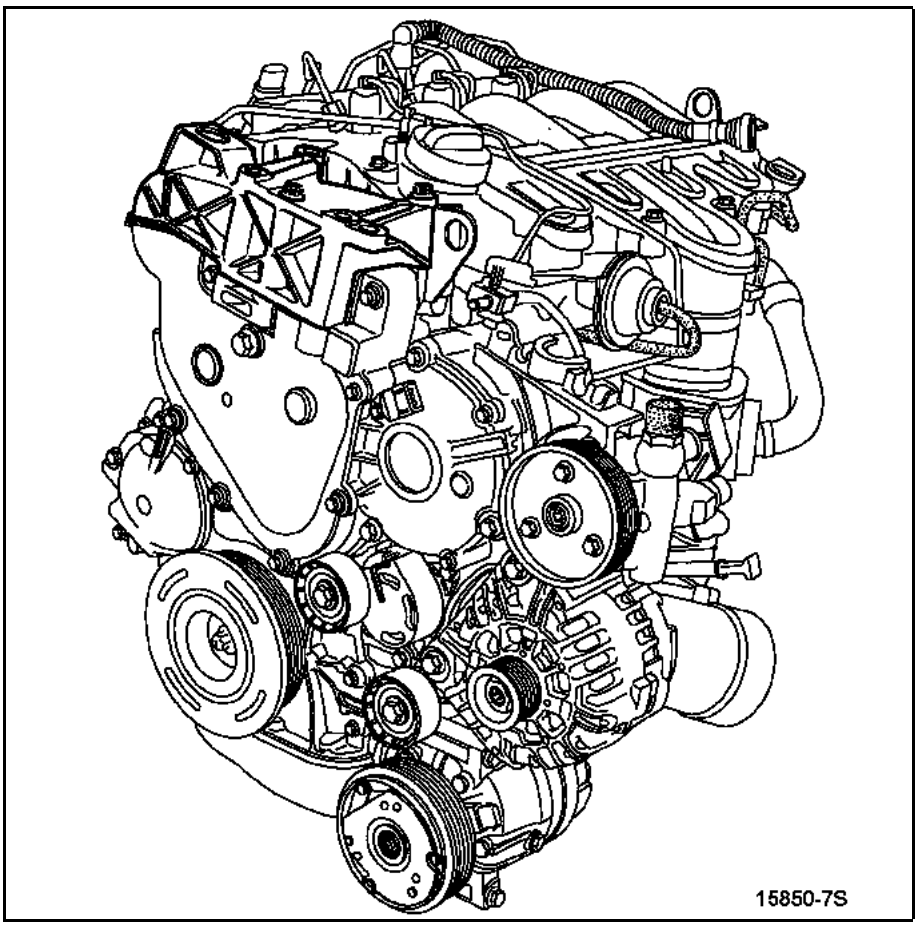
	Description
 19672	High pressure pipe wrench
 19688	Articulated wrench for removing and refitting heater plugs
 19669	Crankshaft spigot bush extractor pliers
 19671	Dummy heater plug for measuring the pressure at end of compression
 19670	"CROWFOOT" socket for tightening high pressure pipes to torque

REMOVING THE UPPER ENGINE

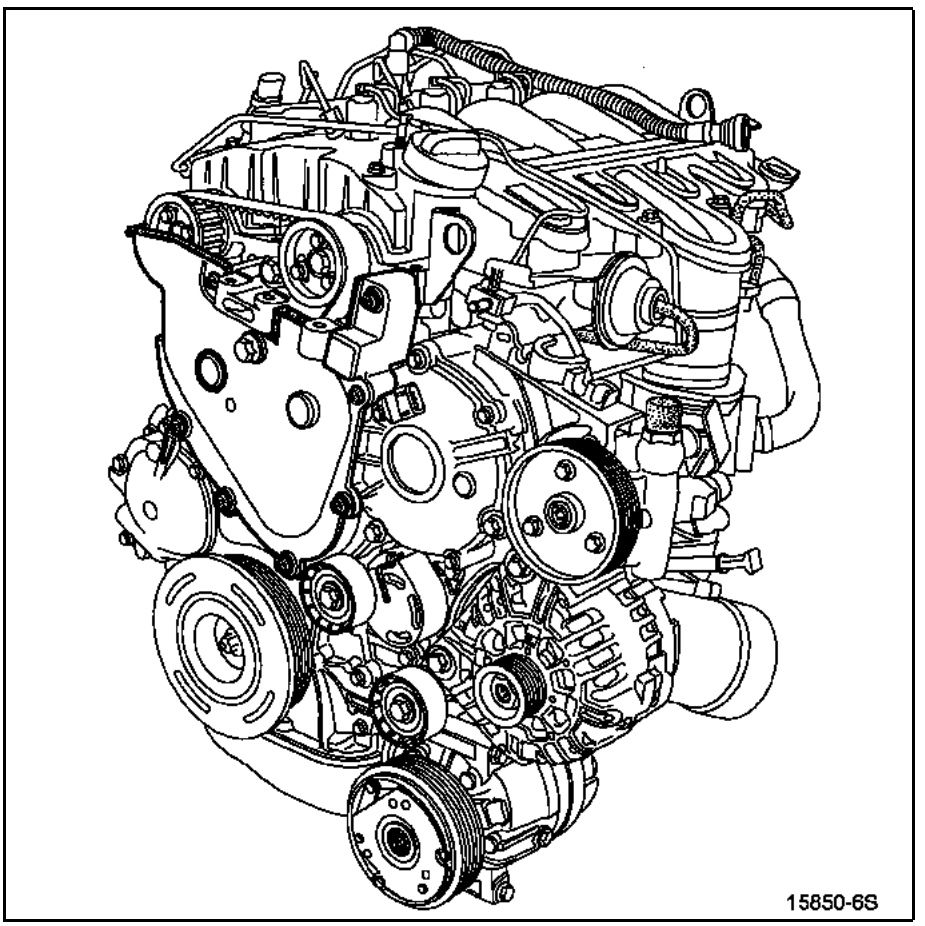


Remove the accessories belt by turning the spanner to the **left** to slacken the belt.

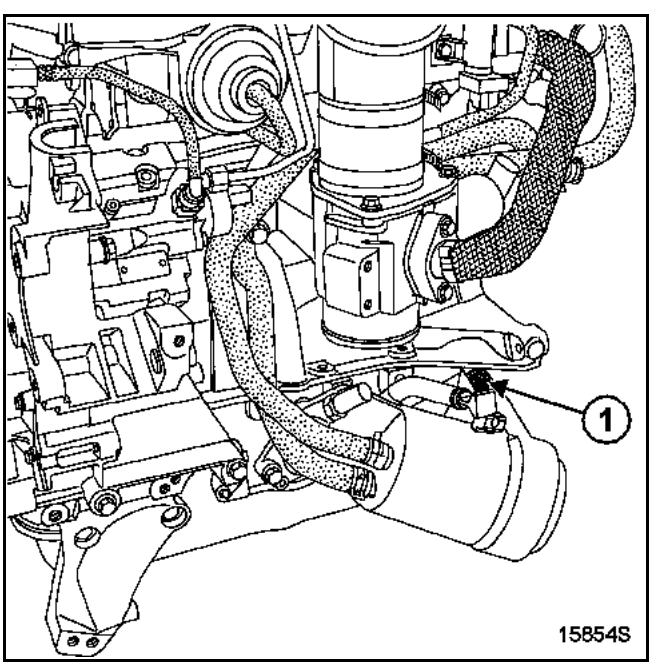
Lock the tension wheel by inserting a **4 mm** Allen key in the hole (**1**).



Remove the cylinder head suspended mounting.

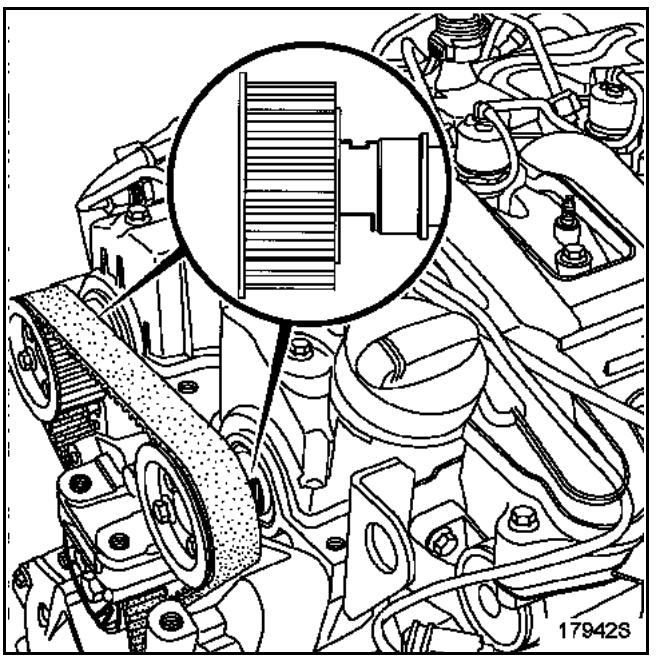


Remove:
– the timing cover,
– the TDC setting rod cap (**1**).

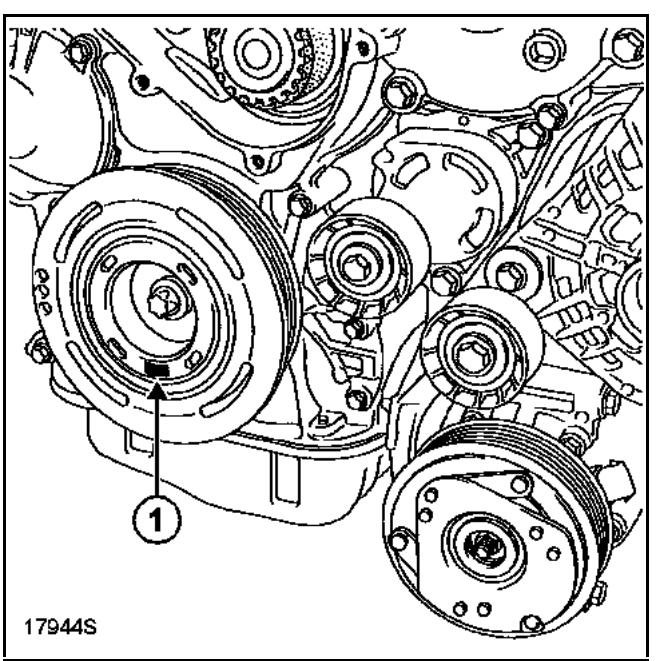


ADJUSTING THE TIMING

Note:
The camshaft grooves must be vertical as shown in the following illustration (zoom or top view).



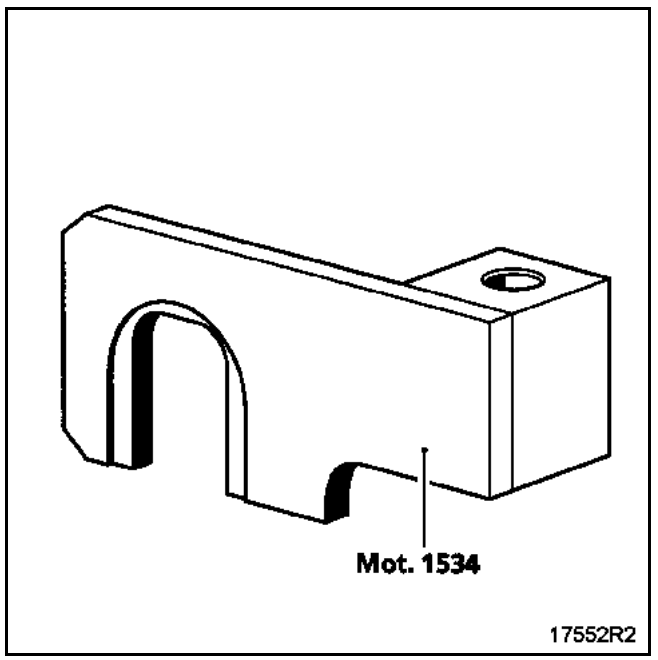
Position the top dead centre mark (**1**) almost vertically to the engine as shown in the following illustration.

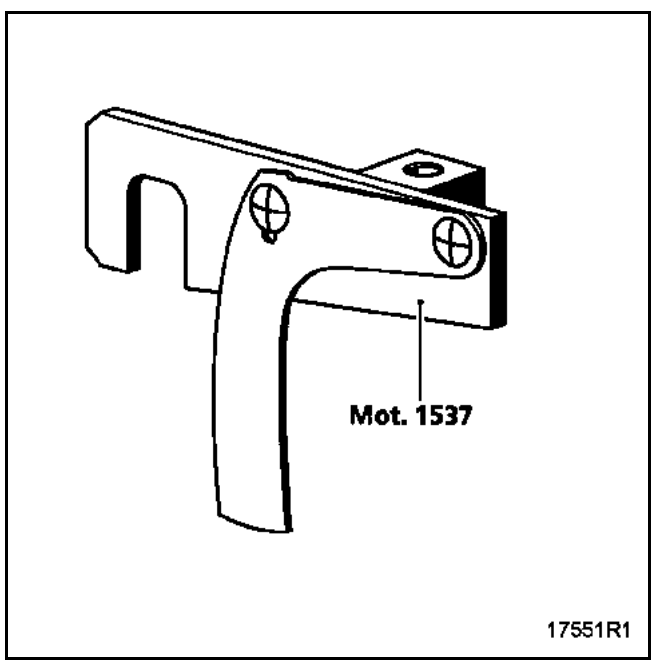


Fit the TDC setting rod (Mot. 1536).

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

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.

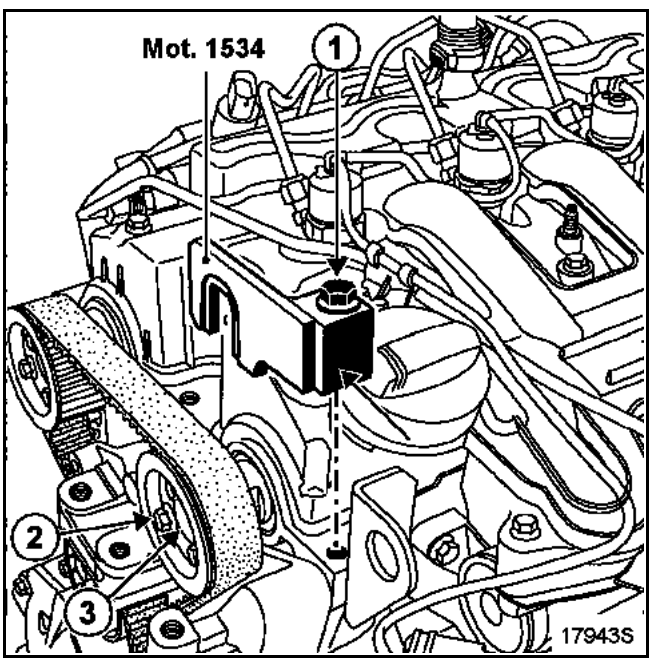
For the inlet camshaft:

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).



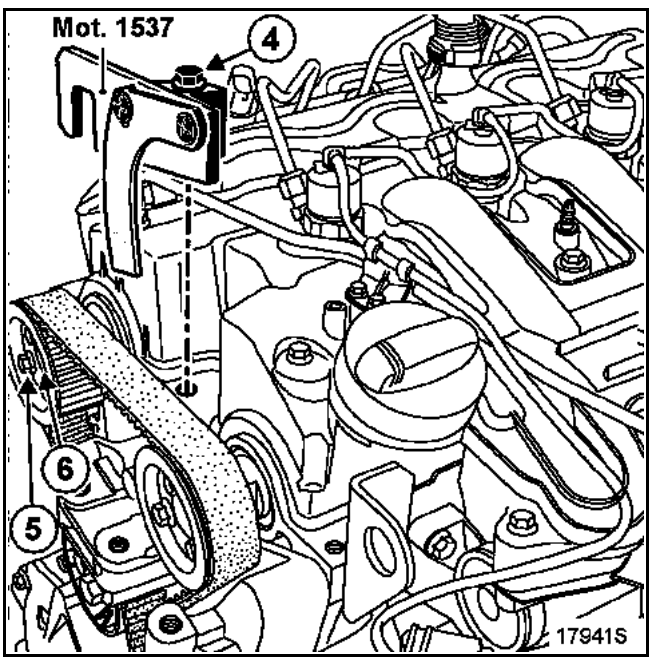
For the exhaust camshaft:

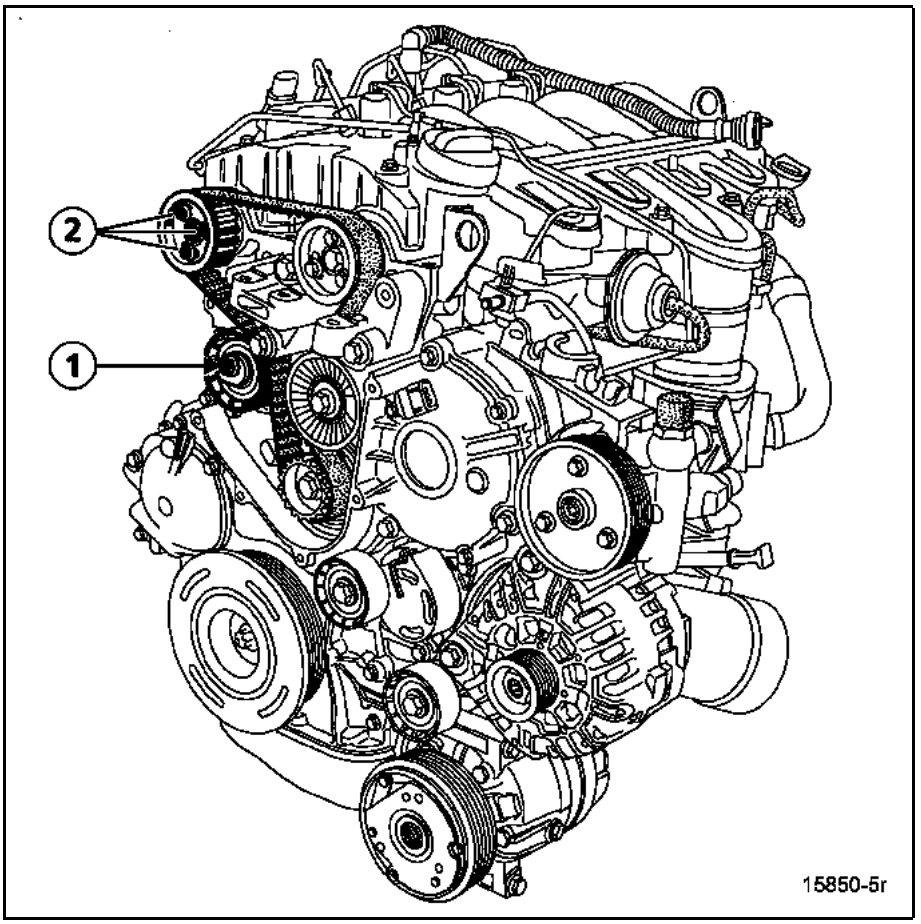
Fit tool Mot. 1537 **SCREWING IN THE BOLT (4) BY HAND**.

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.

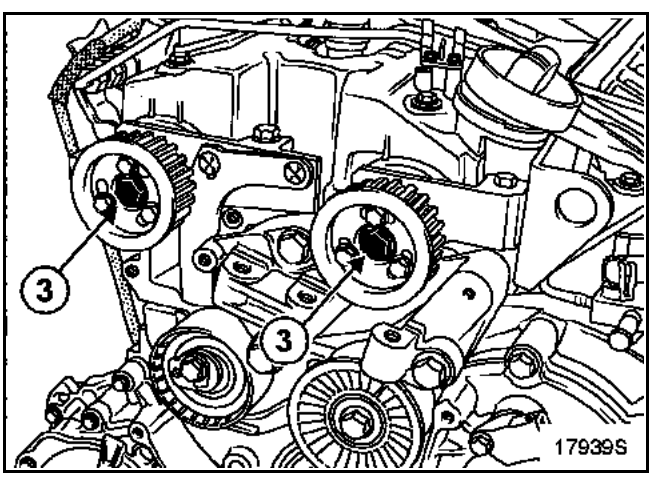




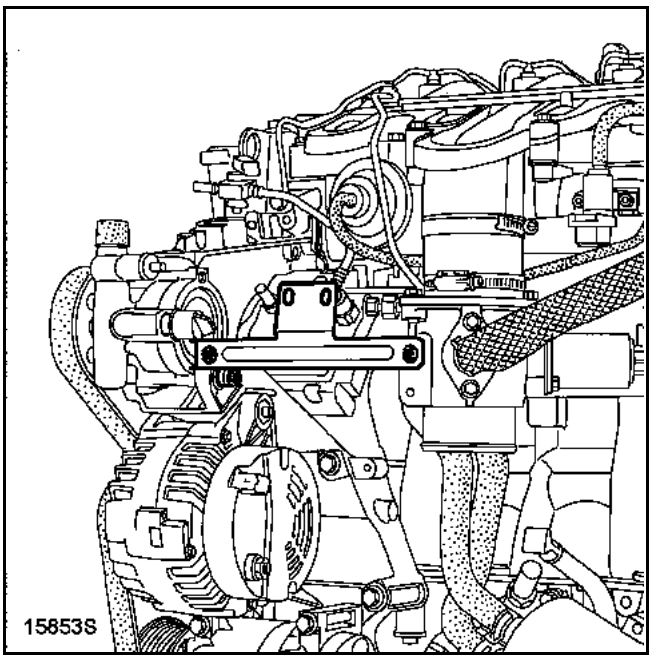
Slacken the timing belt by loosening the tension wheel bolt (**1**).

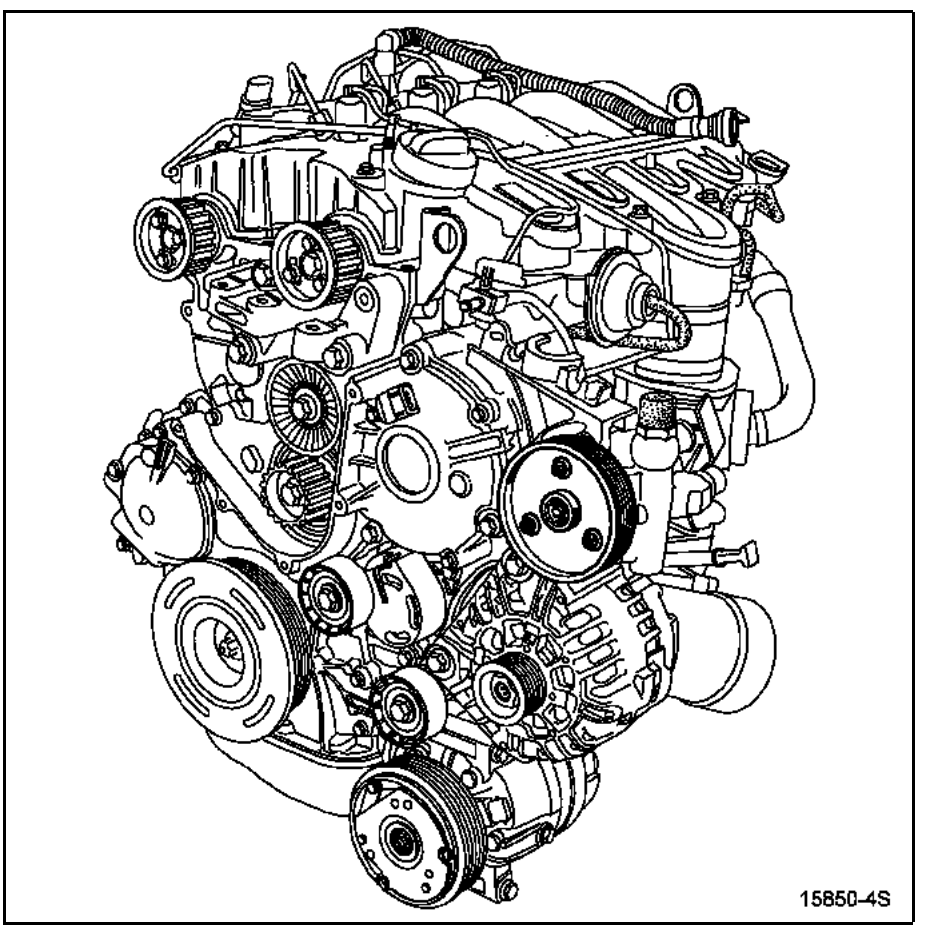
Remove the three bolts (**2**), then remove the exhaust camshaft sprocket.

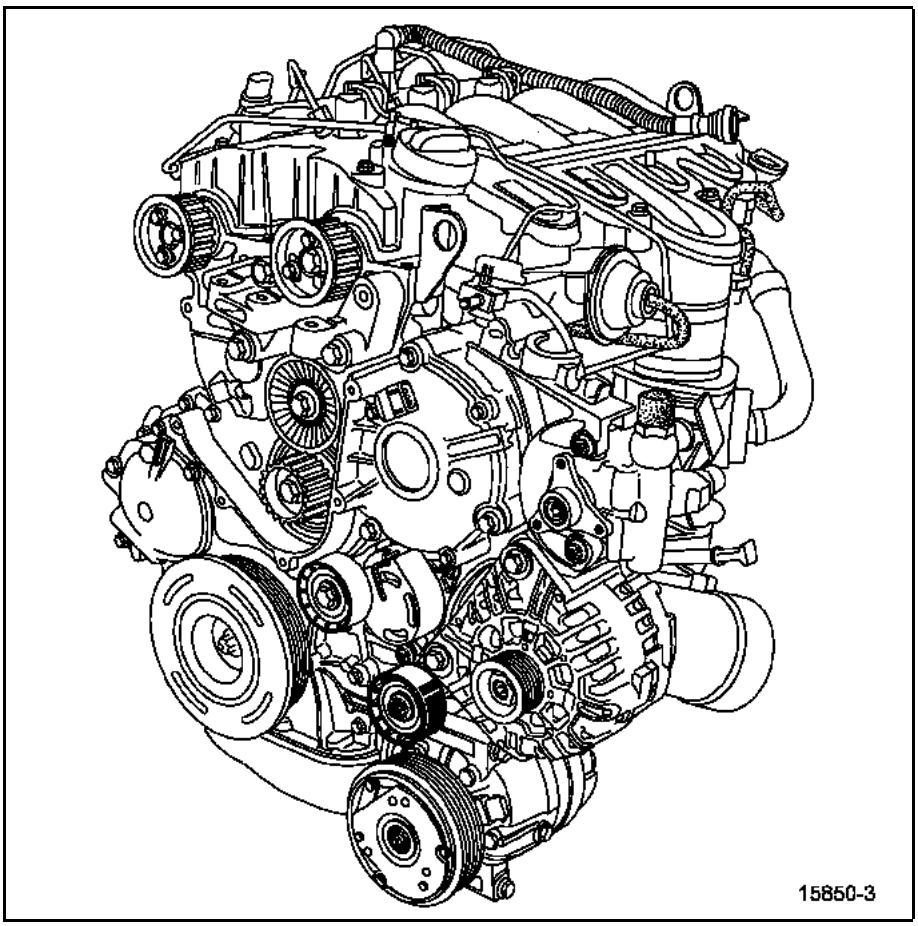
Remove:
– the timing belt,
– the inlet camshaft sprocket,
– the camshaft hubs by removing the bolts (**3**).



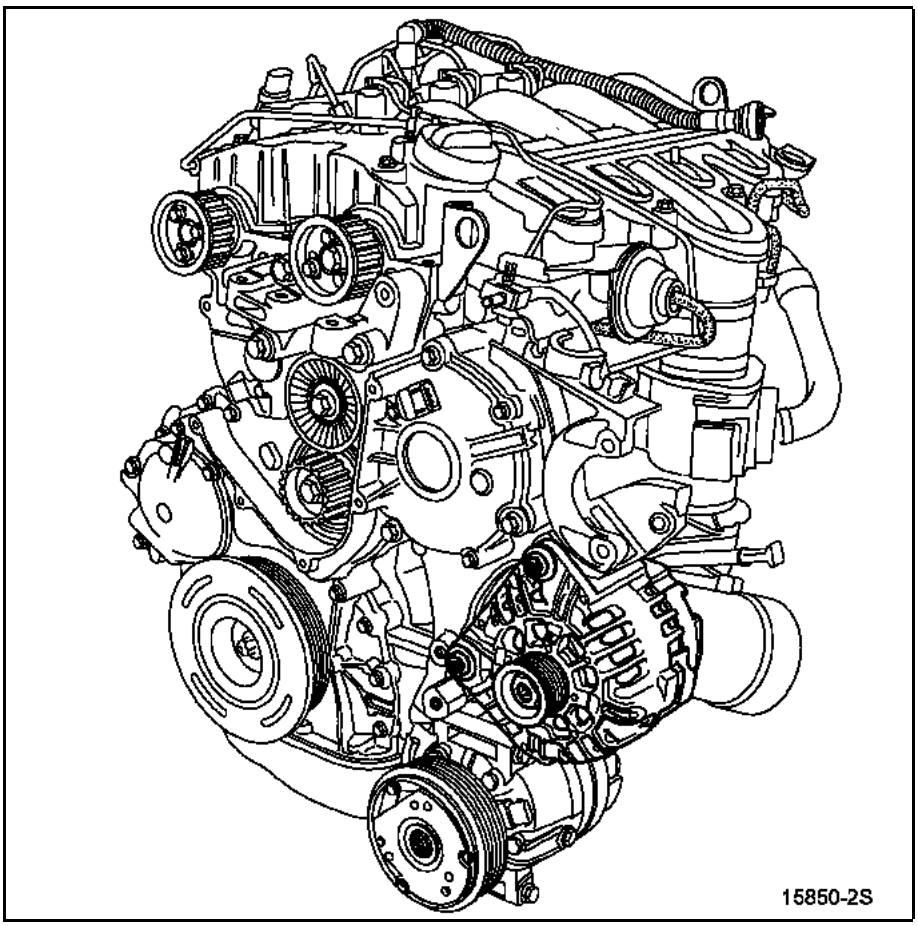
Remove:
– the strut linking the multifunction support to the venturi unit,
– the power assisted steering pump rear bolt,
– the power assisted steering pump pulley.



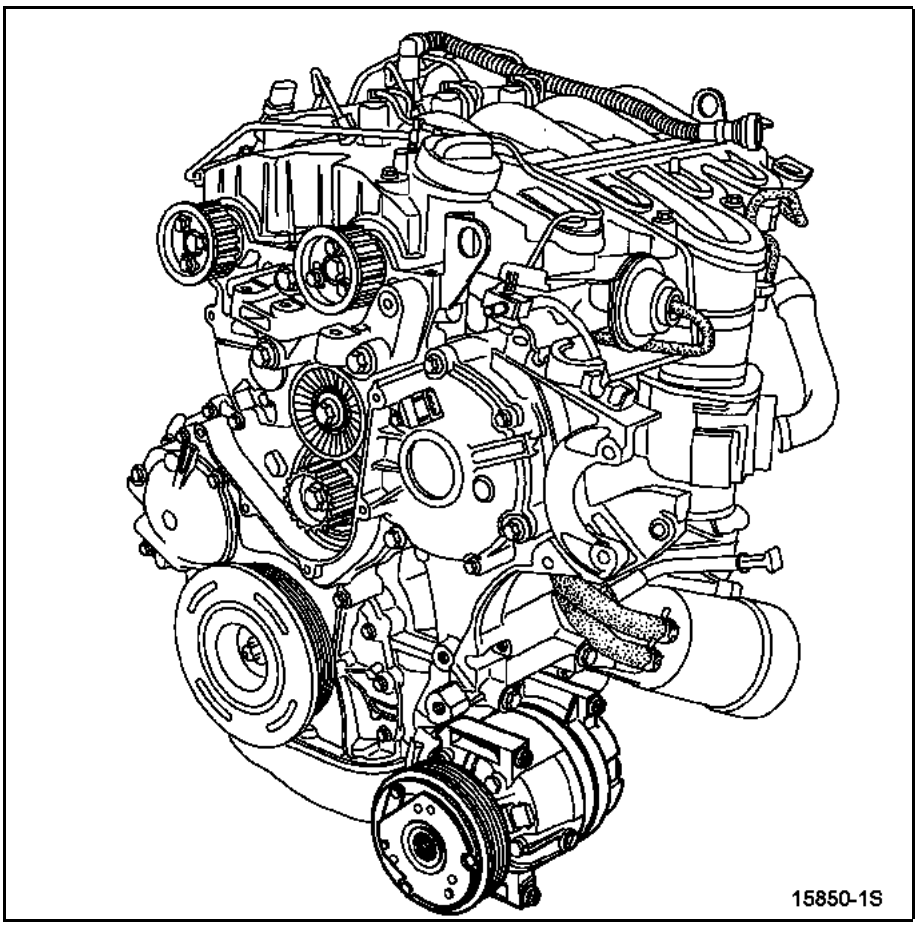




Remove:
– the power assisted steering pump,
– the accessories belt pulley,
– the accessories belt tension wheel,



Remove the alternator.



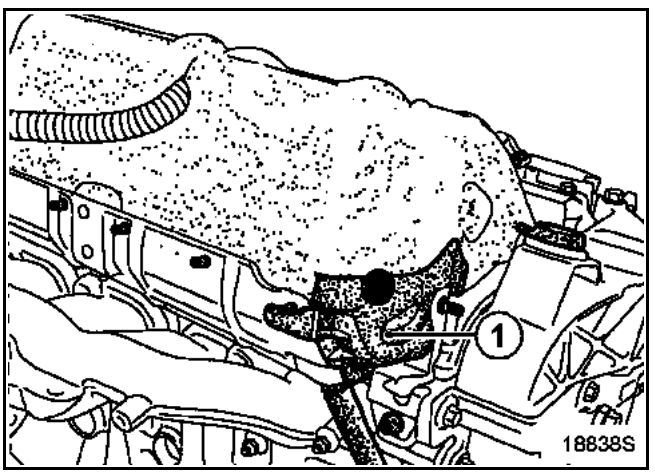
Remove the air conditioning compressor.

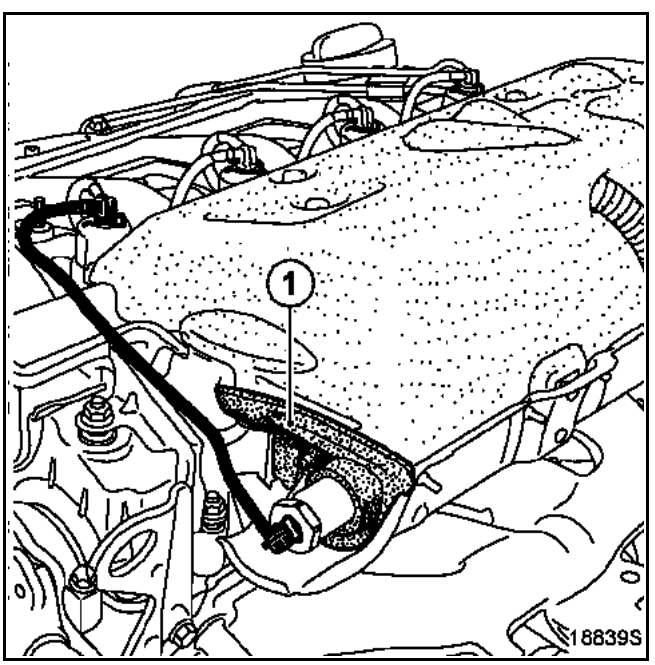
RAIL PROTECTOR

WARNING
Pay strict attention to the rules regarding cleanliness (see start of document).

Model 1

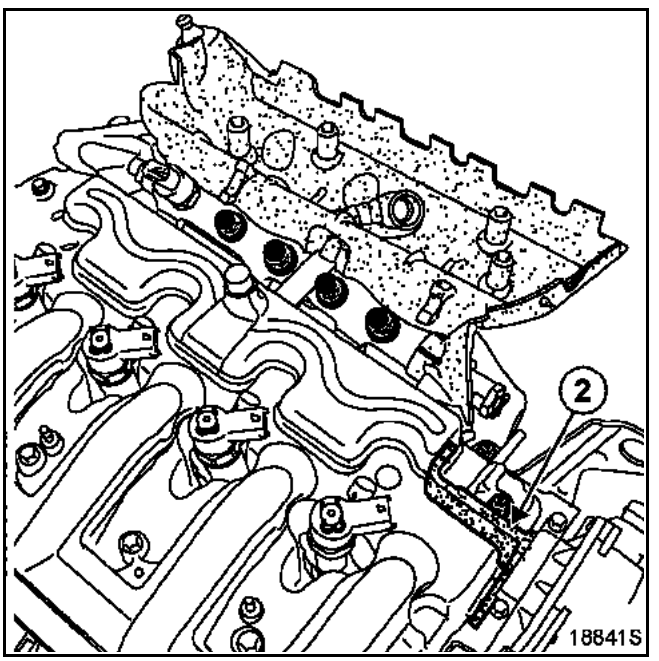
Unclip the rail protector side partitions (**1**).



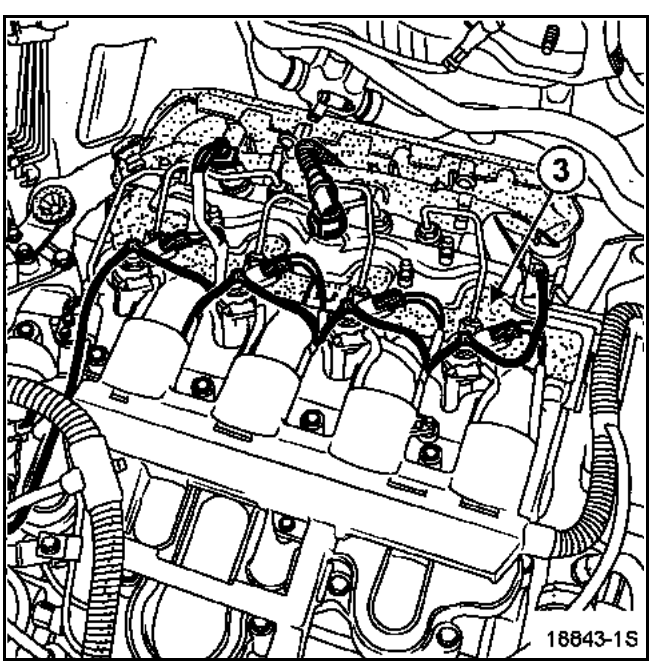


Unclip the rail protector from the rocker cover, pushing it as far back as possible.

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

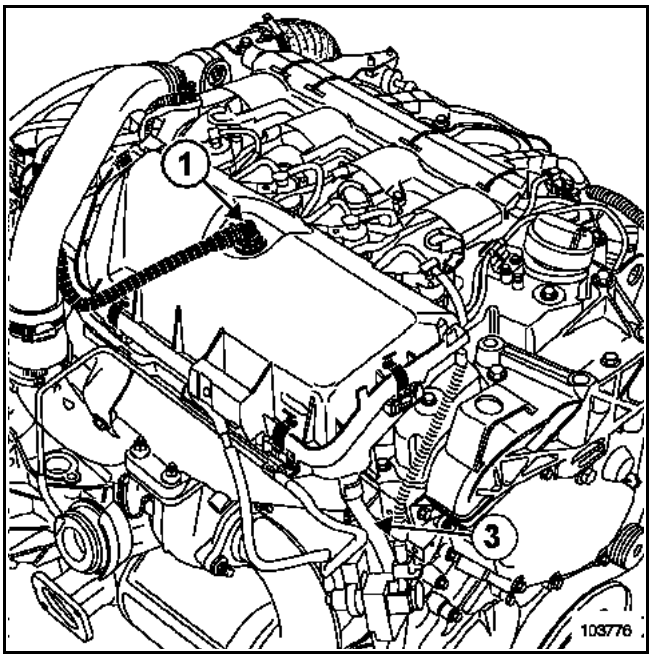


Remove the absorbent soundproofing pads (**3**).



Model 2

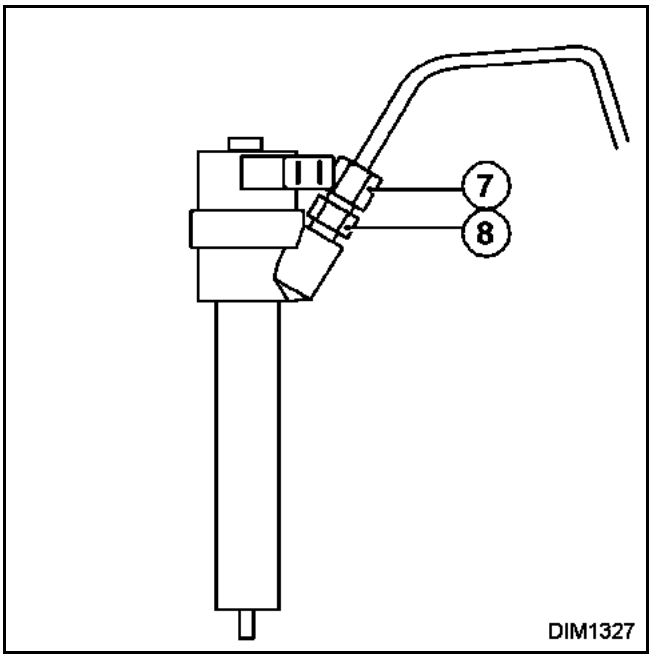
Disconnect the oil vapour rebreathing pipe (**1**).



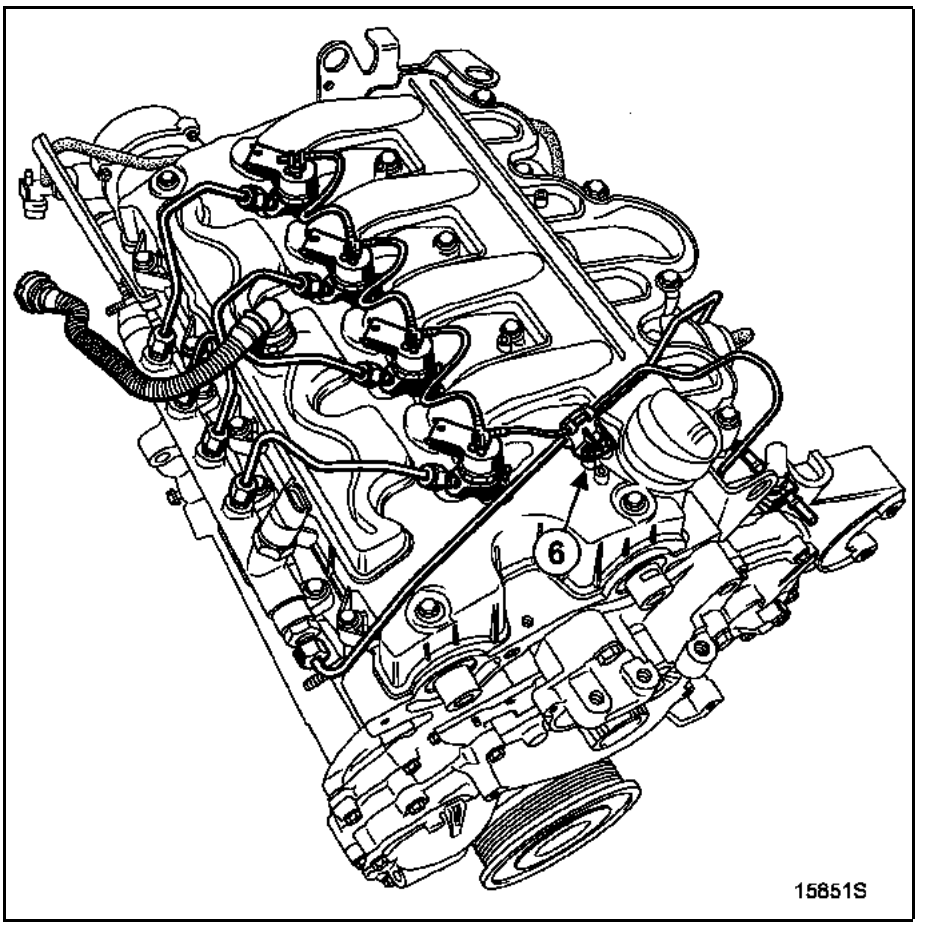
Unclip the protector plastic cover and remove it.

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.



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

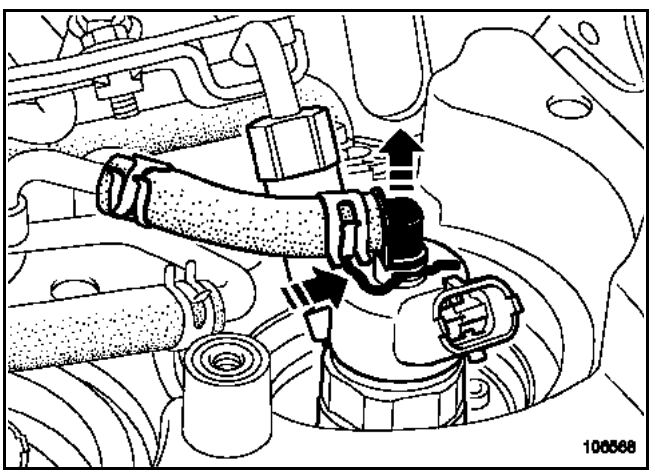
Remove the high pressure pipe between the high pressure pump and the rail (using a "CROWFOOT" socket).

WARNING
The clip (6) is very fragile.

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.



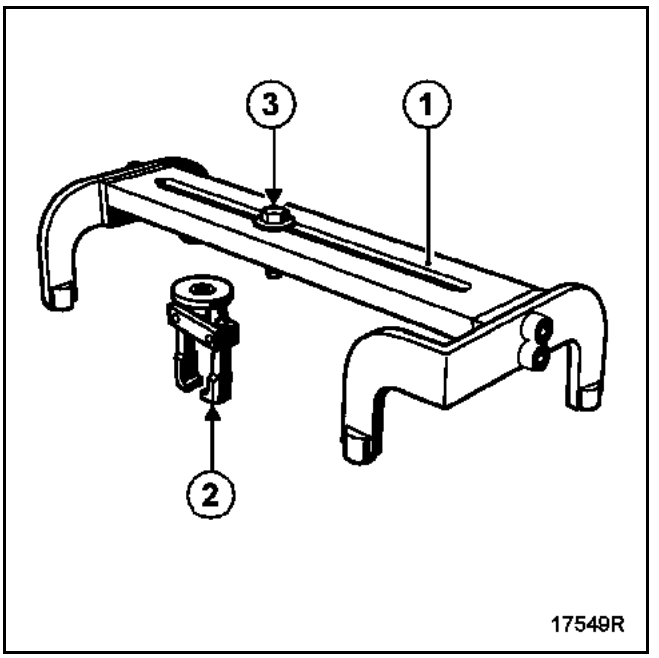
REMOVING THE INJECTOR HOLDERS

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.

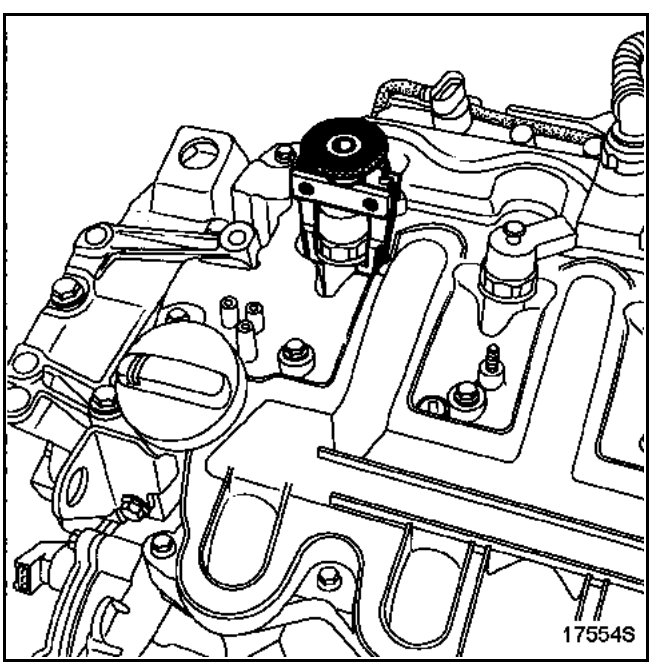
Description of the extractor (Mot. 1730 and 1549).
1 Extractor support chassis (**1**), which is mounted on the rocker cover mounting bolts. Check that it is positioned correctly before use.
2 Extractor (**2**).
3 Extractor bolt (**3**).



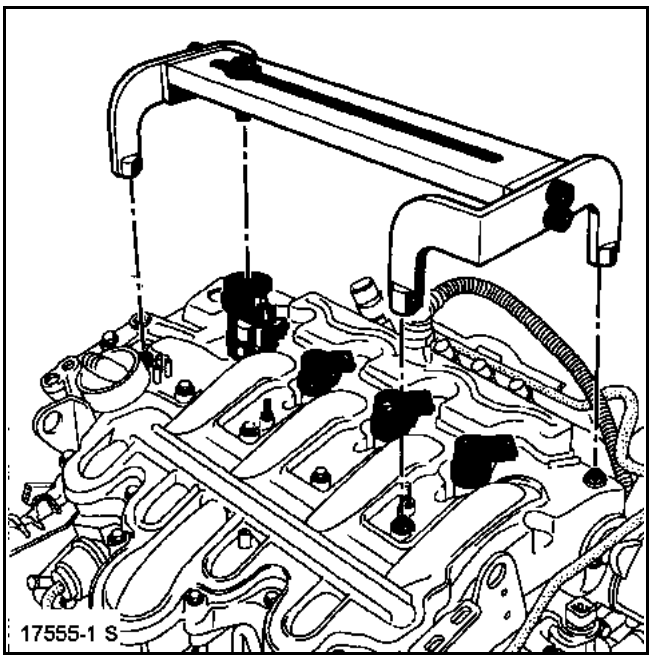
Apply release agent around the injector.

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

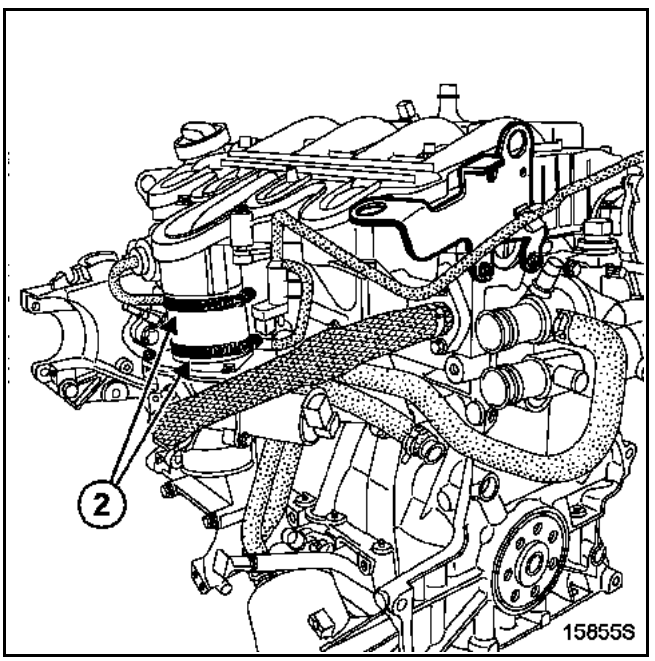
Fit the extractor onto an injector holder.
Tighten the knurled ring to bring the two jaws together on the flat surfaces **without over-tightening**.



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.



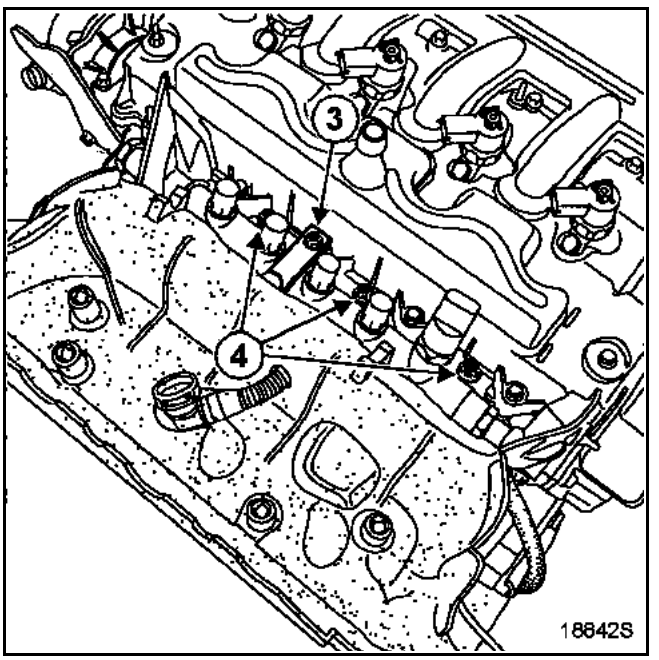
Remove the washer from the bottom of each injector well.



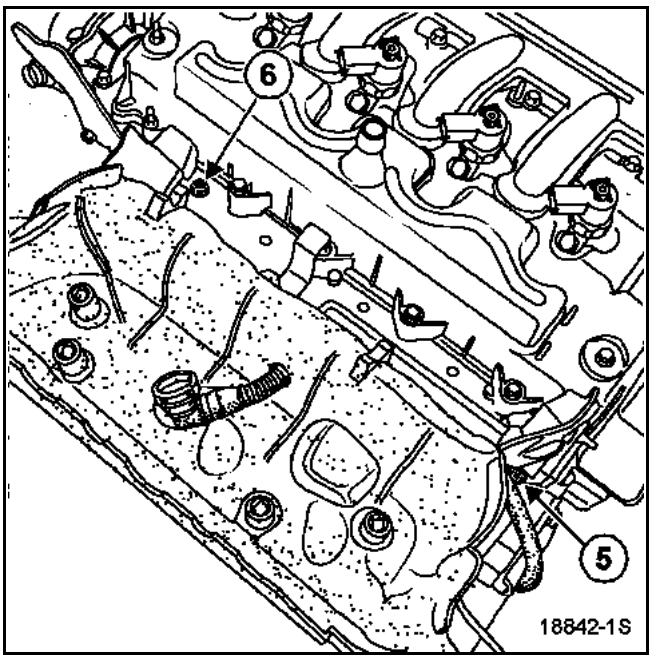
Remove:
– the two clips (**2**),
– the engine lifting eye at the flywheel end,

RAIL PROTECTOR:

Model 1



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.

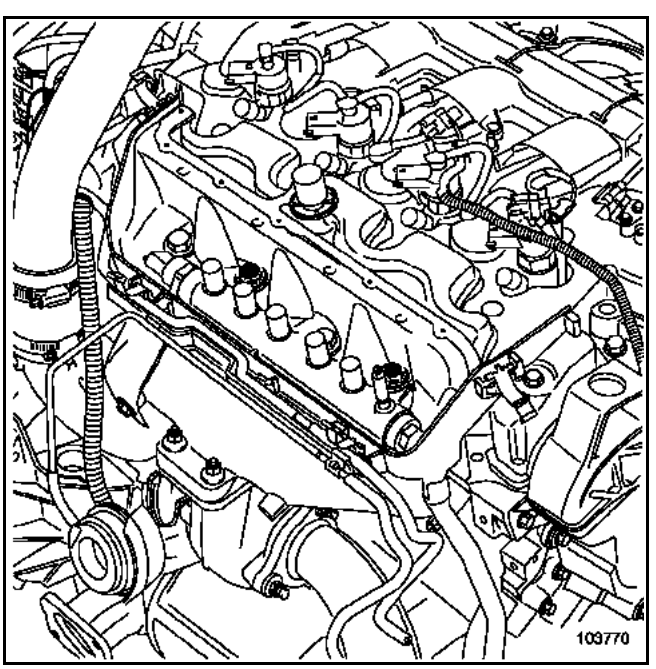


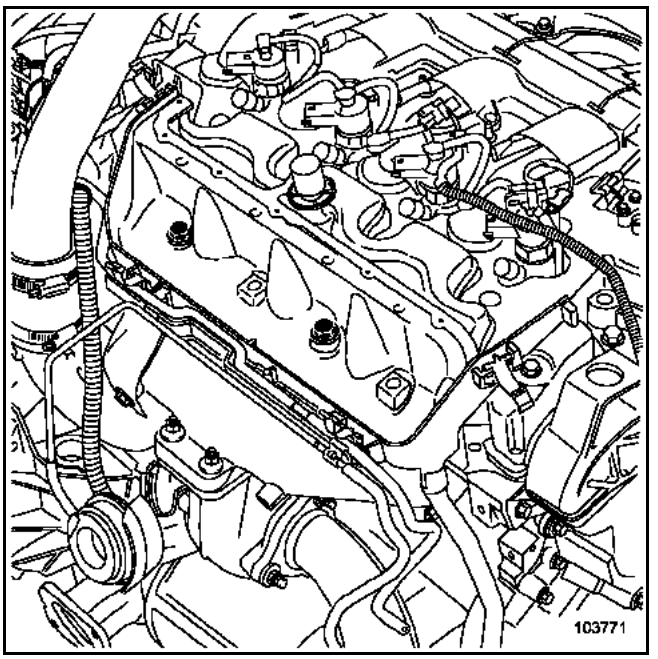
Remove:
– the side partition mounting bolt (**5**),
– the lower metal protector mounting bolt (**6**).

Remove the rail protector with the side partition.

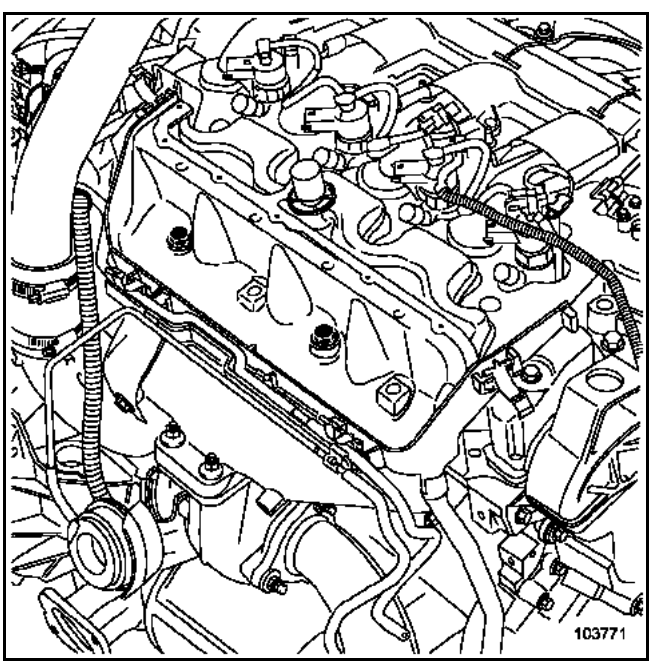
Model 2

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

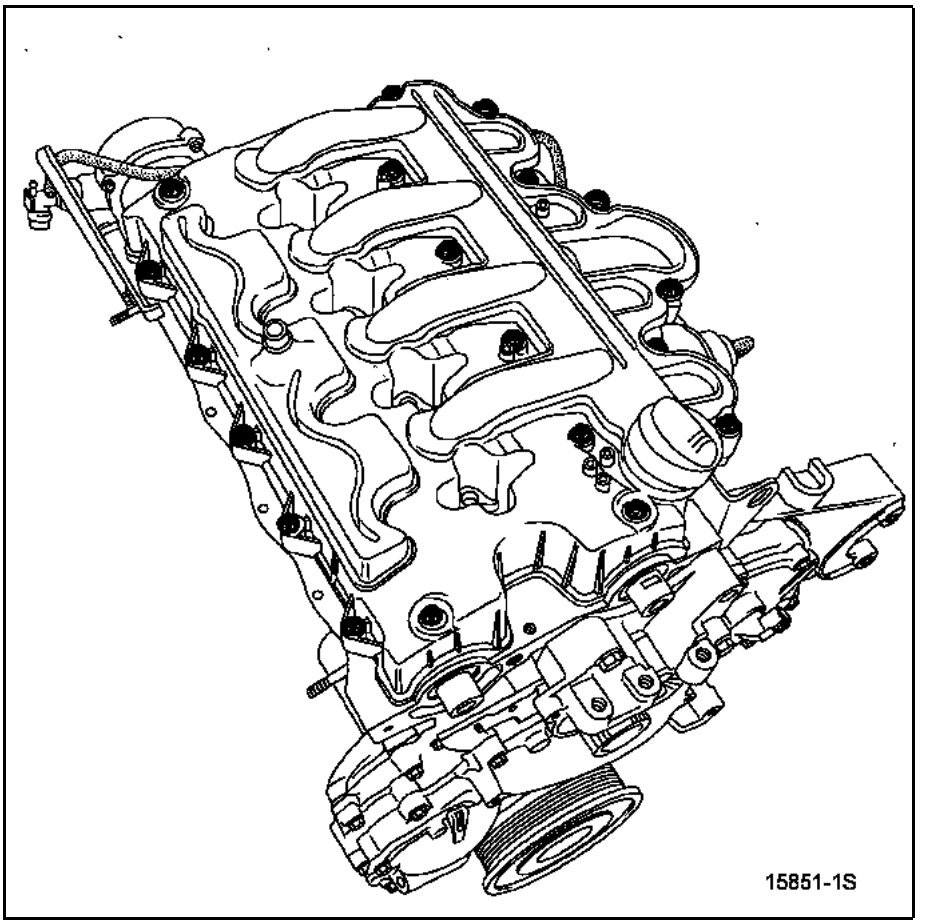




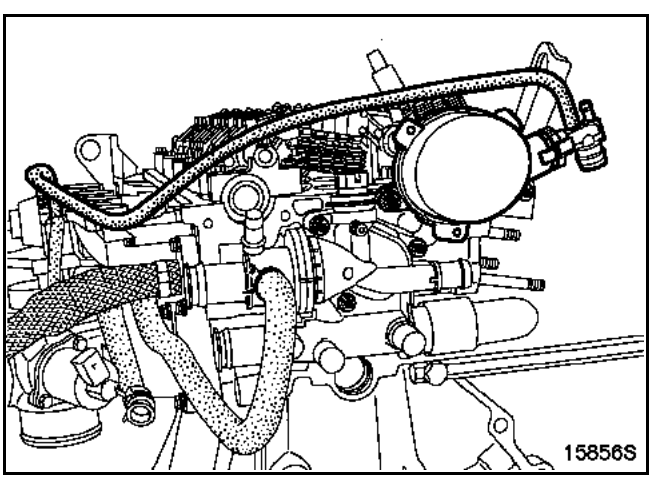
Remove:
– the two aluminium protector mounting bolts,
– the rail protector.

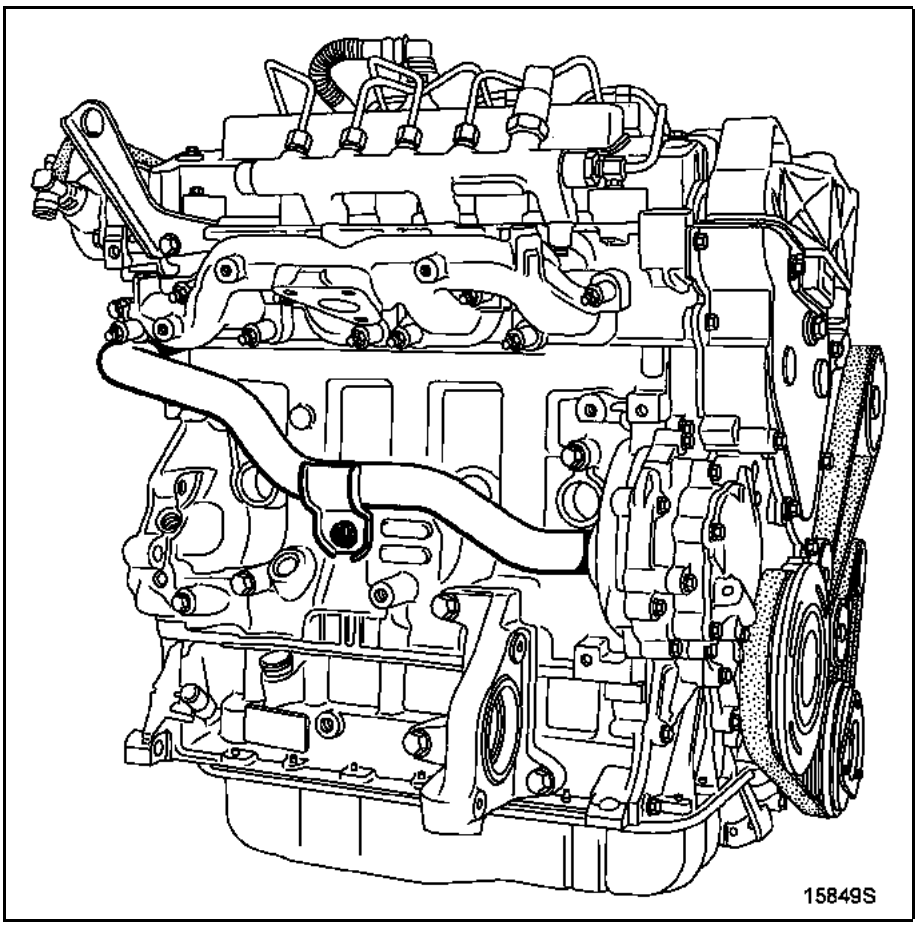


Remove:
– the two aluminium protector mounting bolts,
– the rail protector.

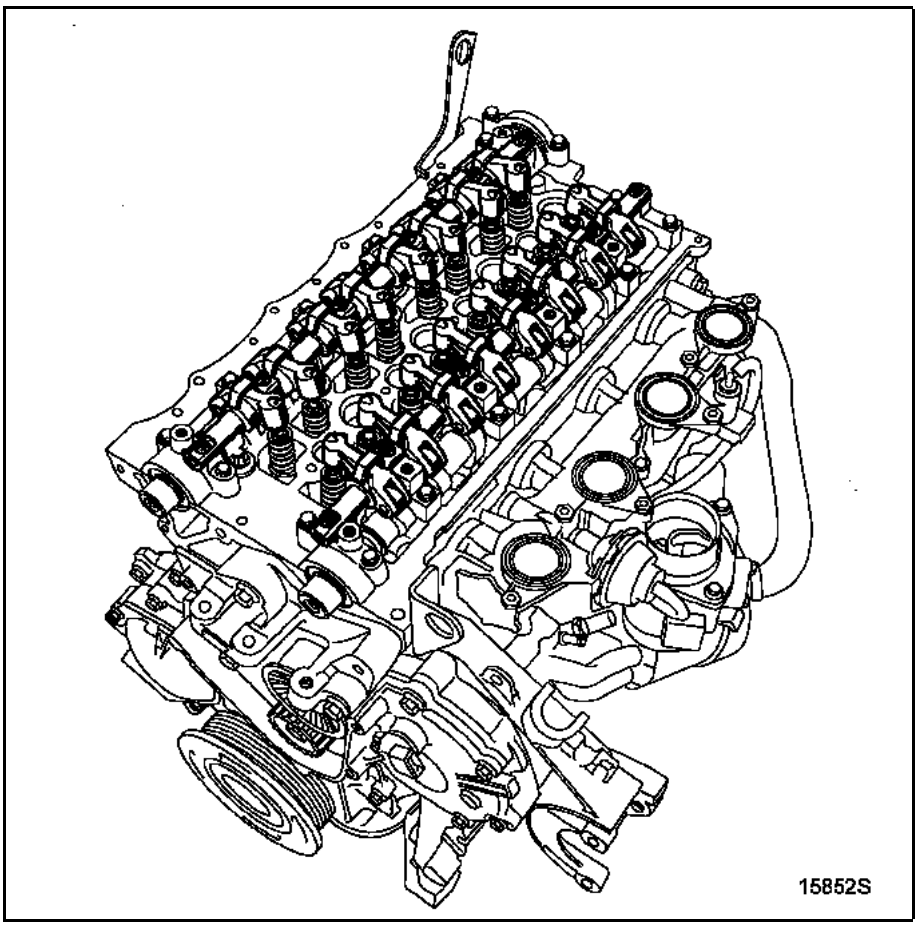


Remove:
– the rocker cover bolts,
– the vacuum pump,
– the cylinder head plenum chamber.





Remove the coolant pipe.

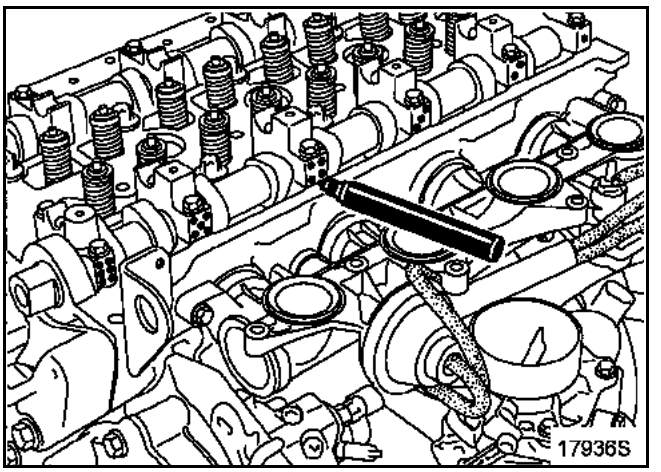


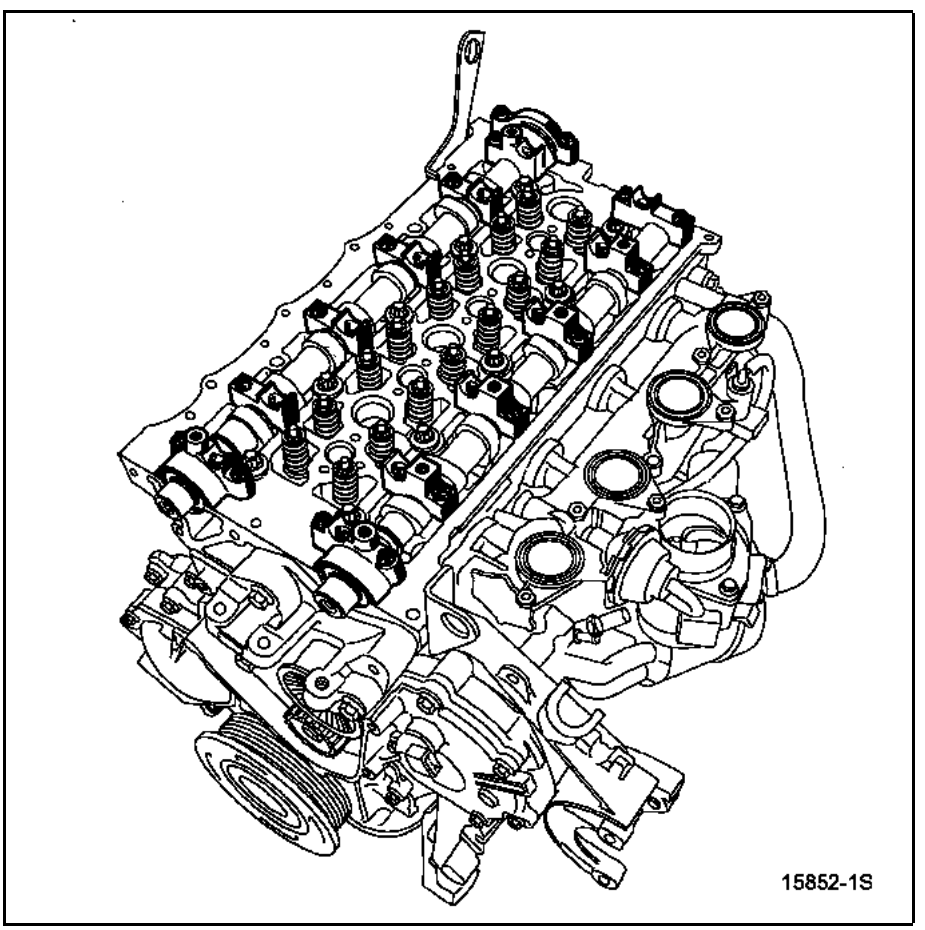
Remove the rocker shafts.

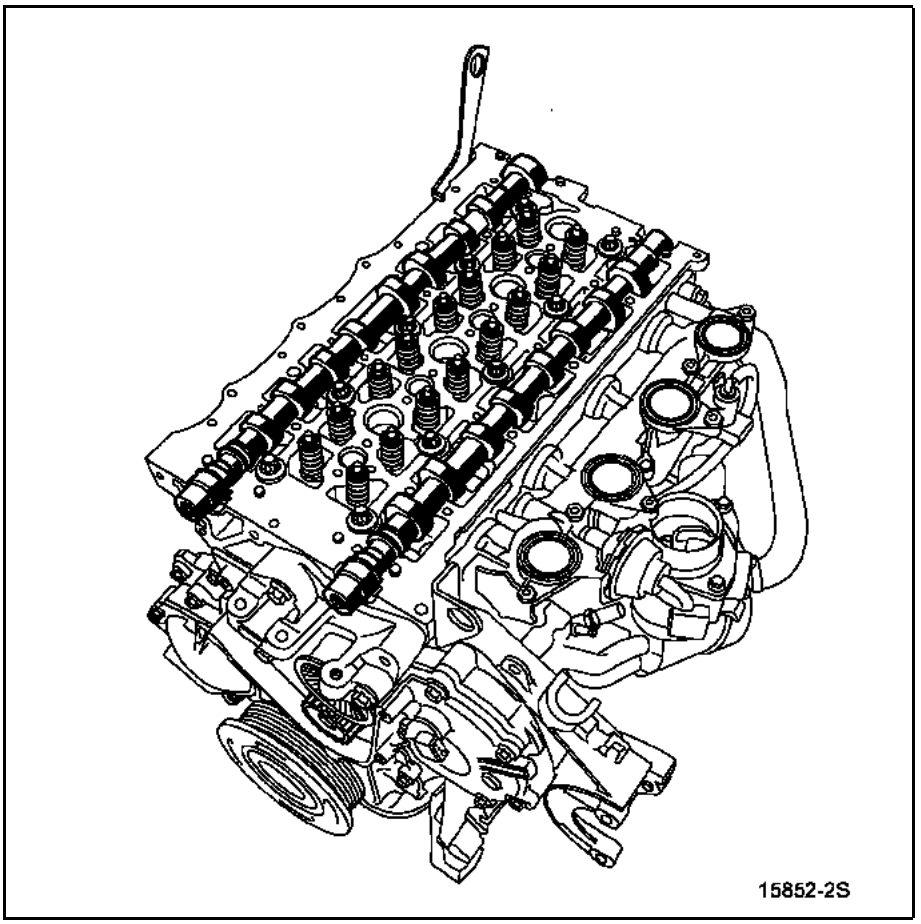
Mark the camshaft bearing caps.

Remove the camshaft bearing caps.

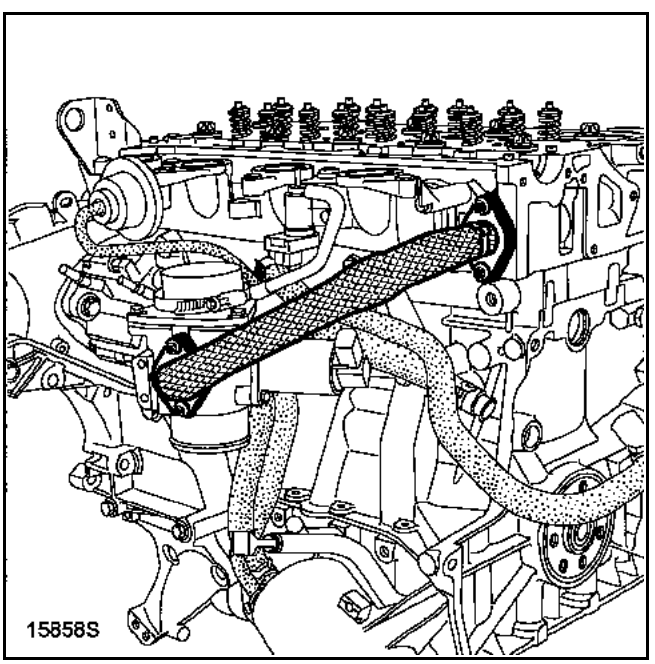
WARNING
Mark the position and direction of fitting of the bearings.

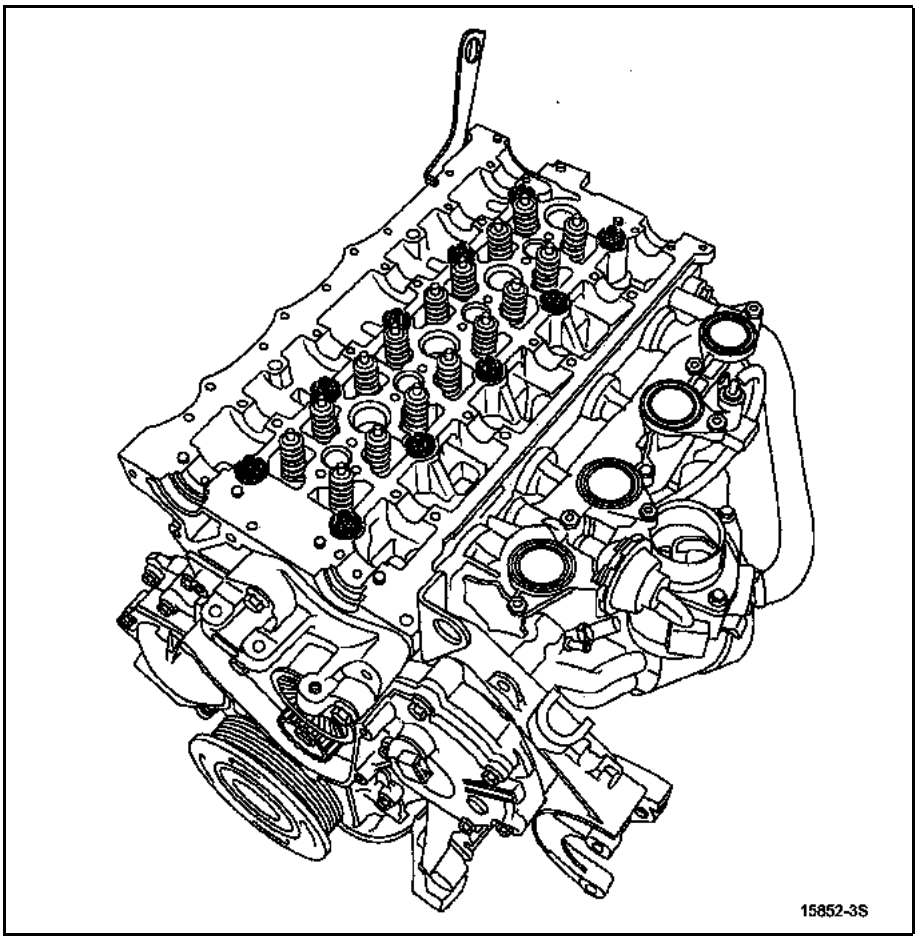






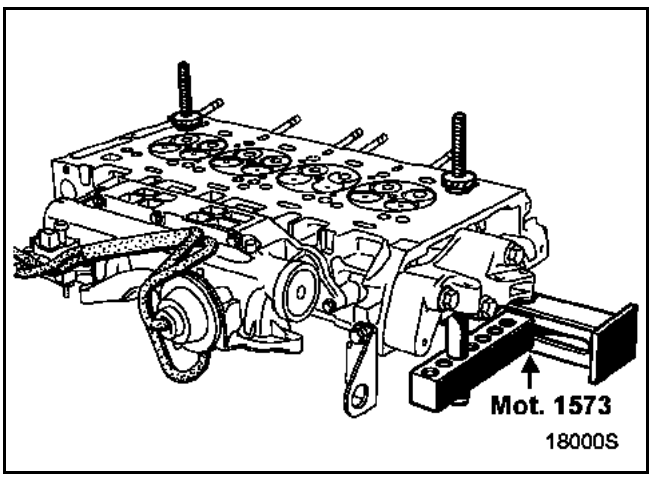
Remove:
– the camshafts,
– the exhaust gas recirculation pipe.



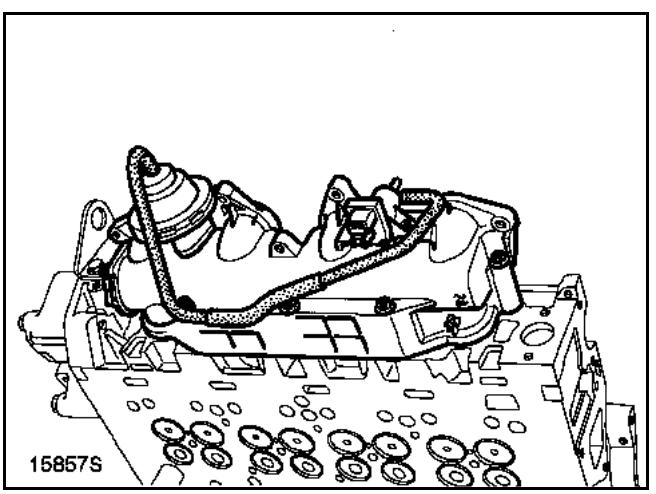


Remove the cylinder head.

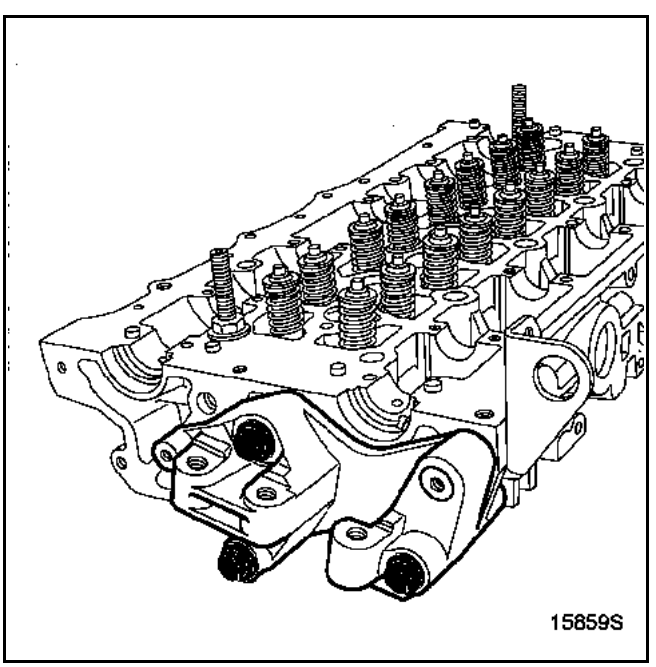
DISMANTLING THE CYLINDER HEAD



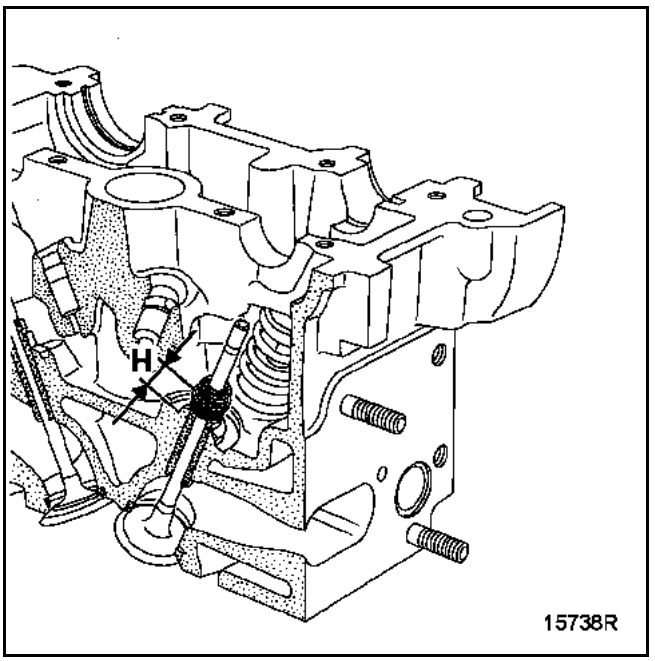
Place the cylinder head on the cylinder head stand (Mot. 1573).



Remove the inlet manifold.



Remove the cylinder head suspended mounting.



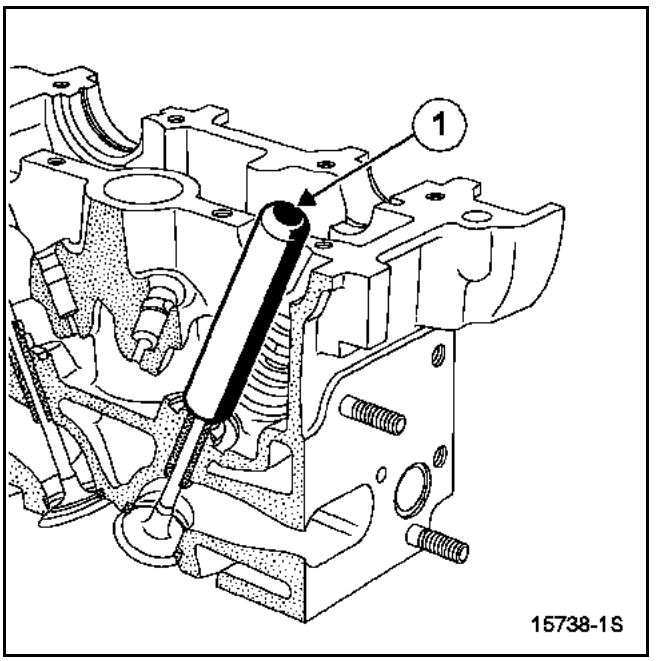
Compress the valve springs using a valve-spring compressor.

Remove the keys.

Remove the springs' upper mounts.

Remove the springs.

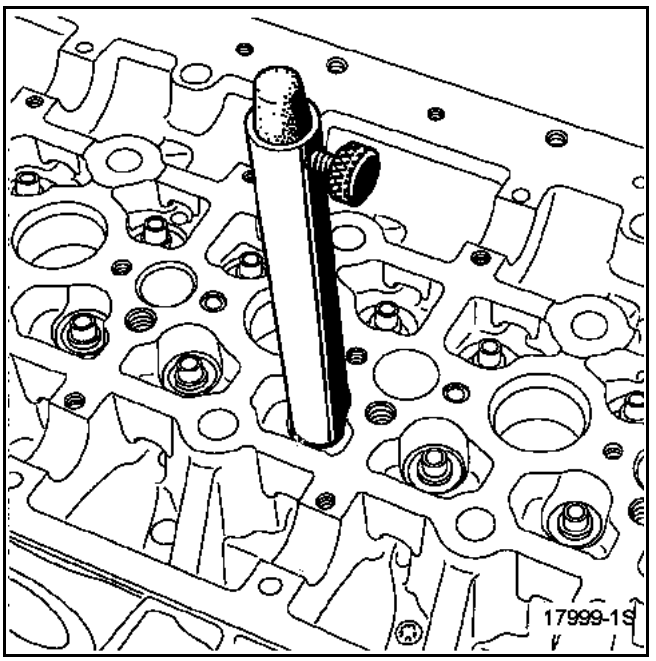
Note:
Before removing the valves and the valve stem seals, be sure to mark the position (**H**) of one of the old seals in relation to the cylinder head using Mot. 1511-01 or other suitable equipment.



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

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

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



Insert the guide tube (**2**) in the top of the pushrod, until the guide tube comes into contact with the cylinder head.

Lock the pushrod with the tumblewheel.

Remove the guide tube - pushrod assembly, being **careful not to loosen the tumblewheel**.

Remove the valve guide seals using the pliers (Mot. 1335).

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

CLEANING

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.

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**.

CHECKING CAMSHAFT LONGITUDINAL CLEARANCE

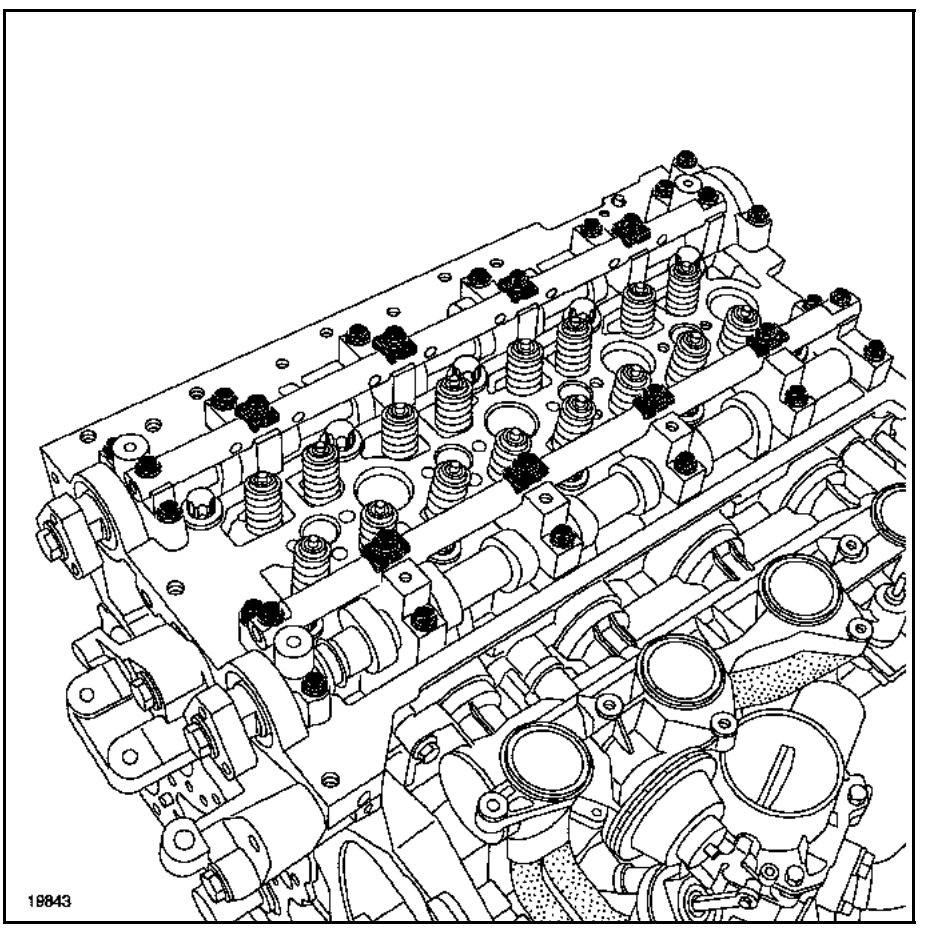
Refit:
– the camshafts, ensuring they are correctly positioned (see camshaft identification in the "**Technical specifications**" section),
– the camshaft bearing caps (without tightening to torque),
– the rocker shafts, without the rocker arms.

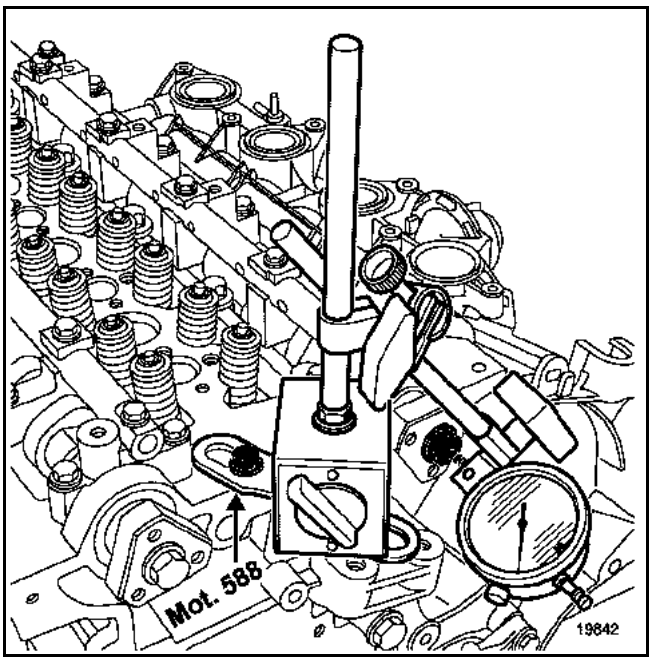
Tighten the camshaft bearing caps to a torque of **0.9 daNm**.

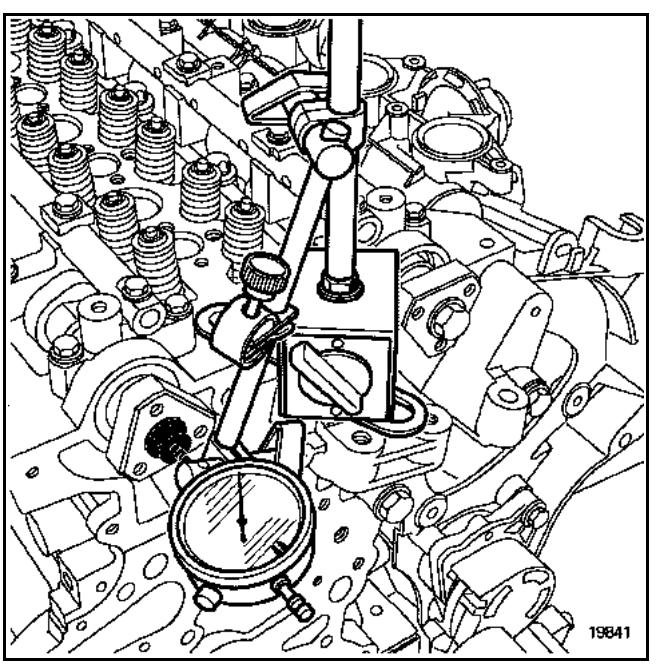
Fit a cylinder liner retaining bracket (Mot. 588) so it be used as a support for the magnetic holder.

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.




Mot. 588
19842


19841

REASSEMBLING THE CYLINDER HEAD

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.

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

Fitting new valve stem seals.

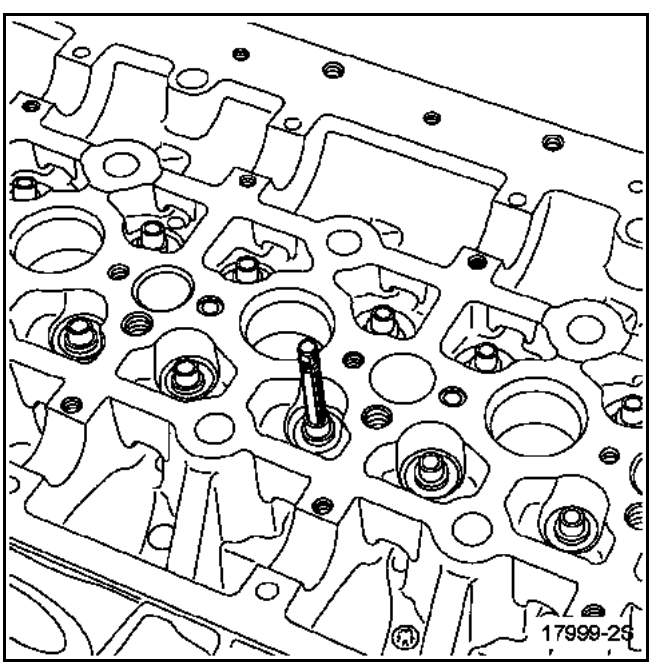
Place the valve in the cylinder head.

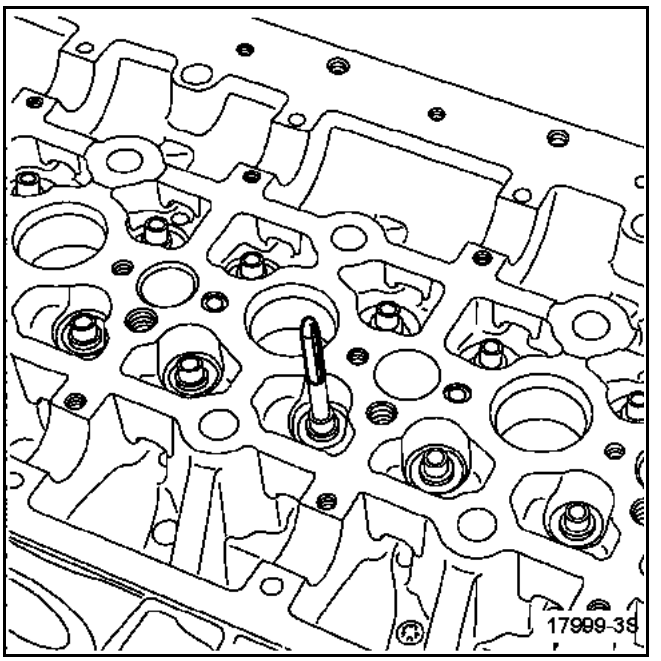
Fit the valve insert of Mot. 1511-01 on the valve stem (the diameter of the insert must be the same as that of the valve stem)

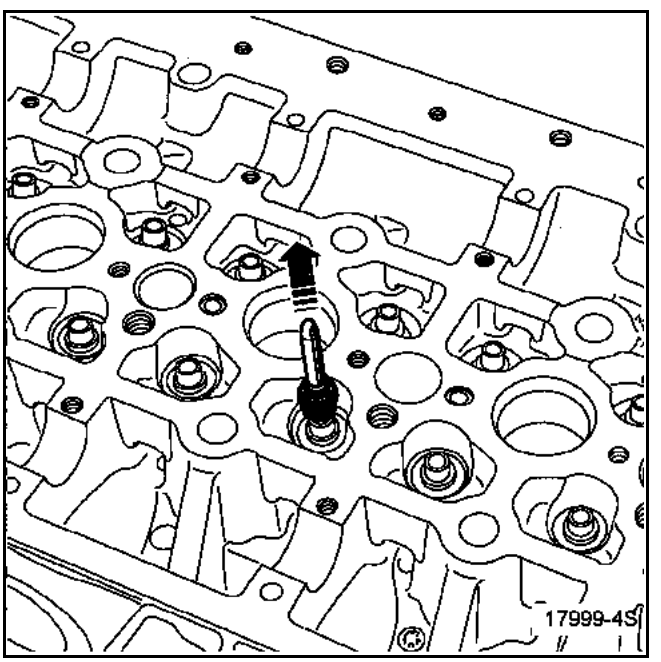
Keep the valve pressed against its seat.

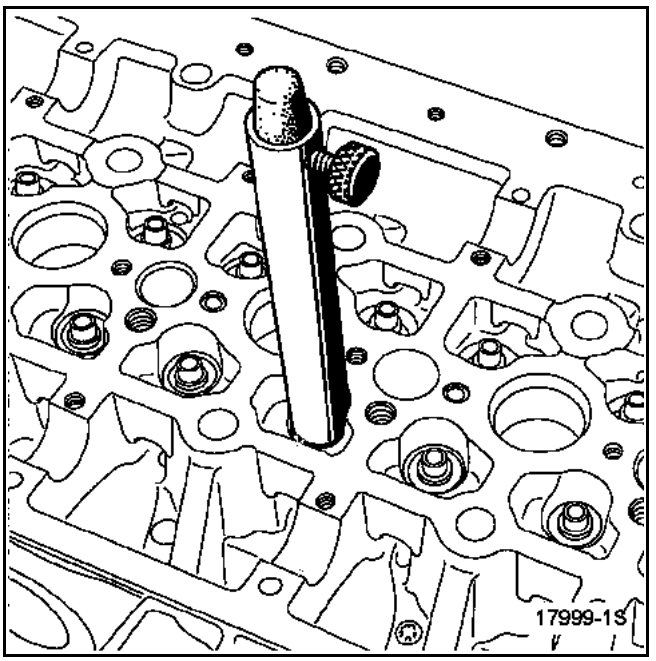
Place the valve stem seal (not lubricated) over the valve insert.

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

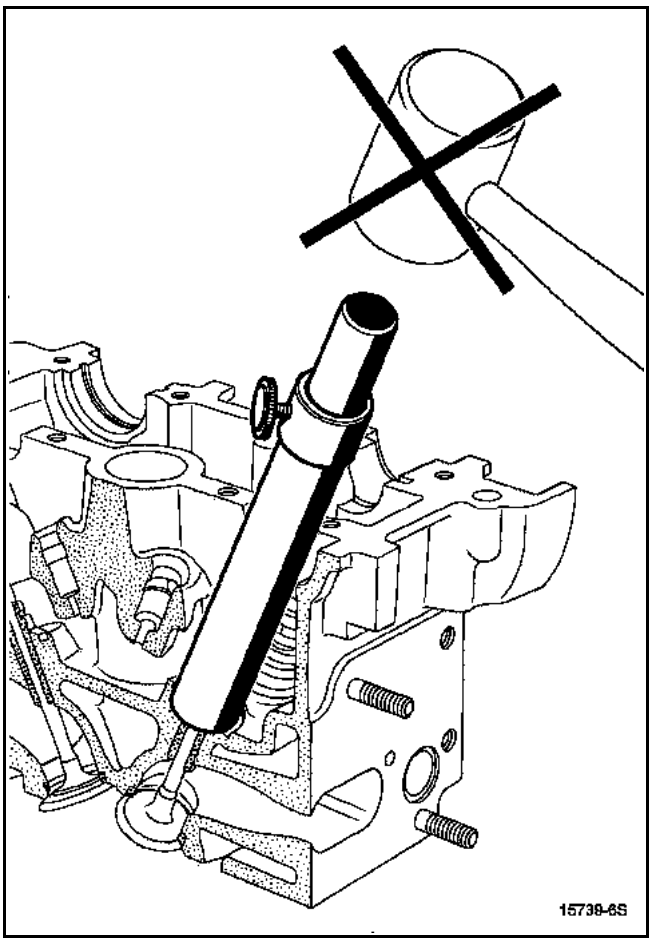








Mount the guide tube-pushrod assembly on the valve stem seal.



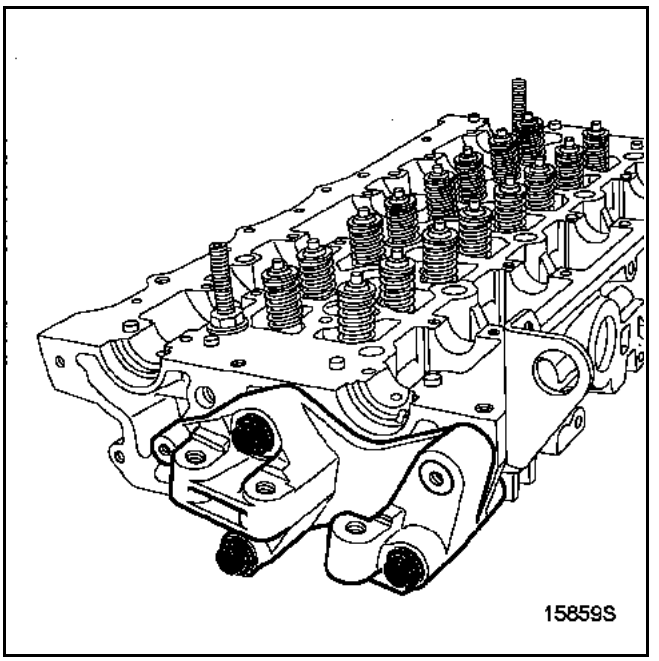
Push the valve stem seal down by tapping **the top of the sleeve with the palm of your hand** until the guide tube touches the cylinder head.

Repeat these operations for all the valves.

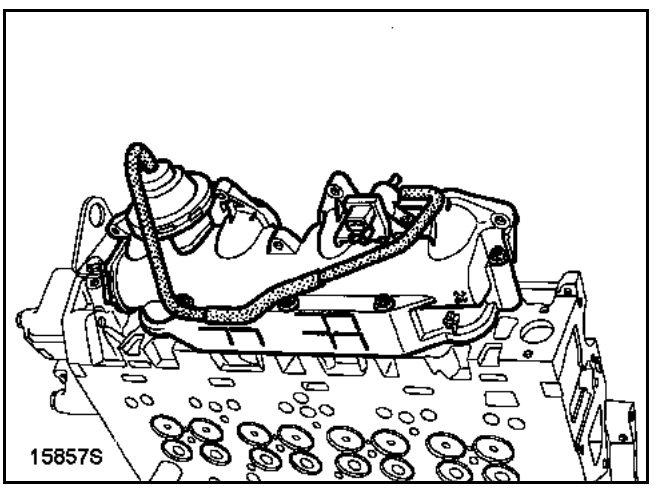
Fit:
– the springs,
– the upper mounts,

Compress the springs.

Fit the keys.

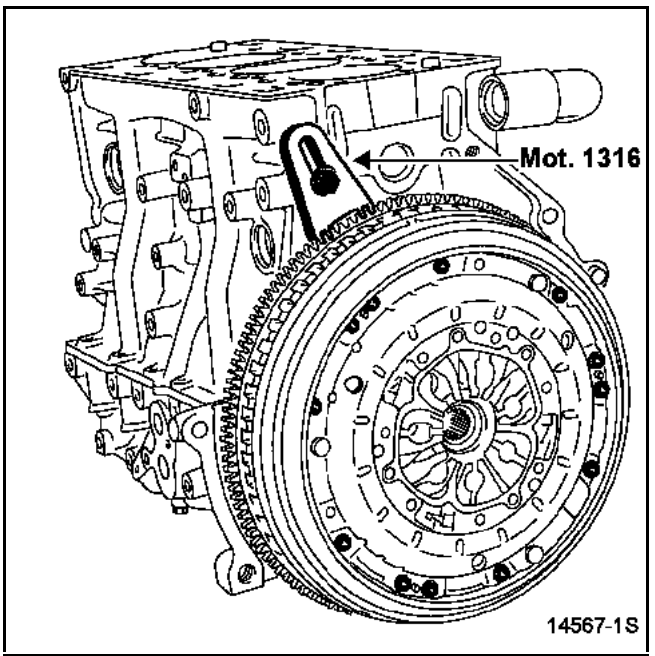


Secure the cylinder head suspended mounting by tightening the bolts to a torque of **4.5 daNm**.

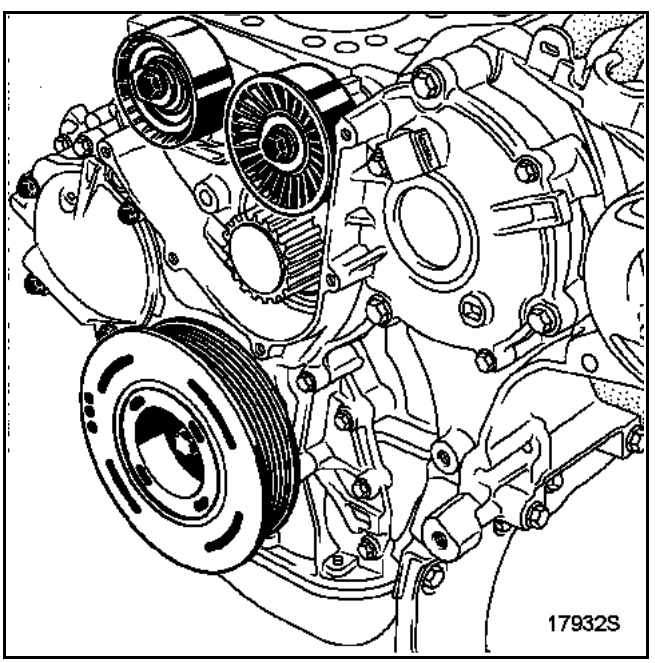


Secure the inlet manifold without locking the bolts.

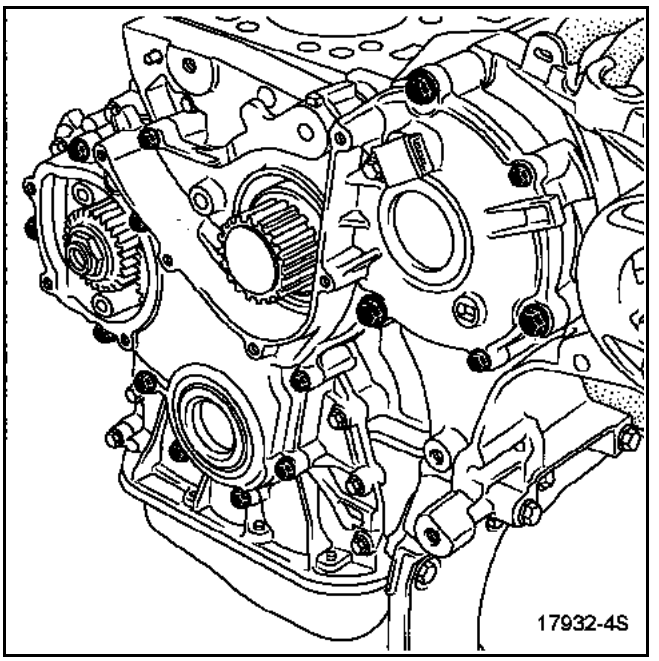
REMOVING THE PERIPHERALS



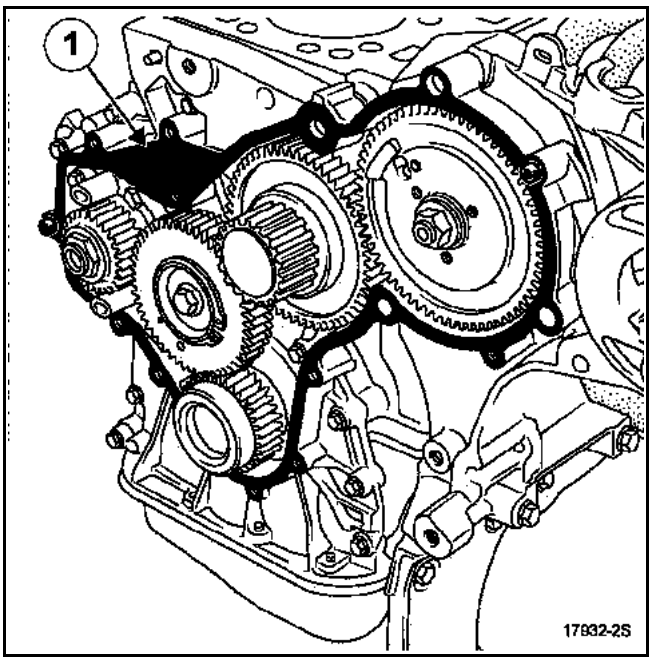
Fit the flywheel immobiliser (Mot. 1316).



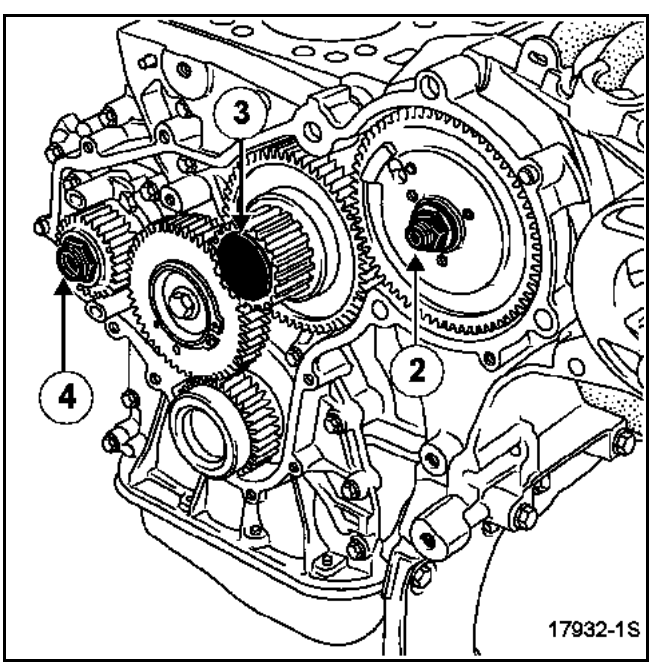
Remove:
– the timing belt pulleys and tension wheels,
– the water pump cover,
– the crankshaft accessories pulley.



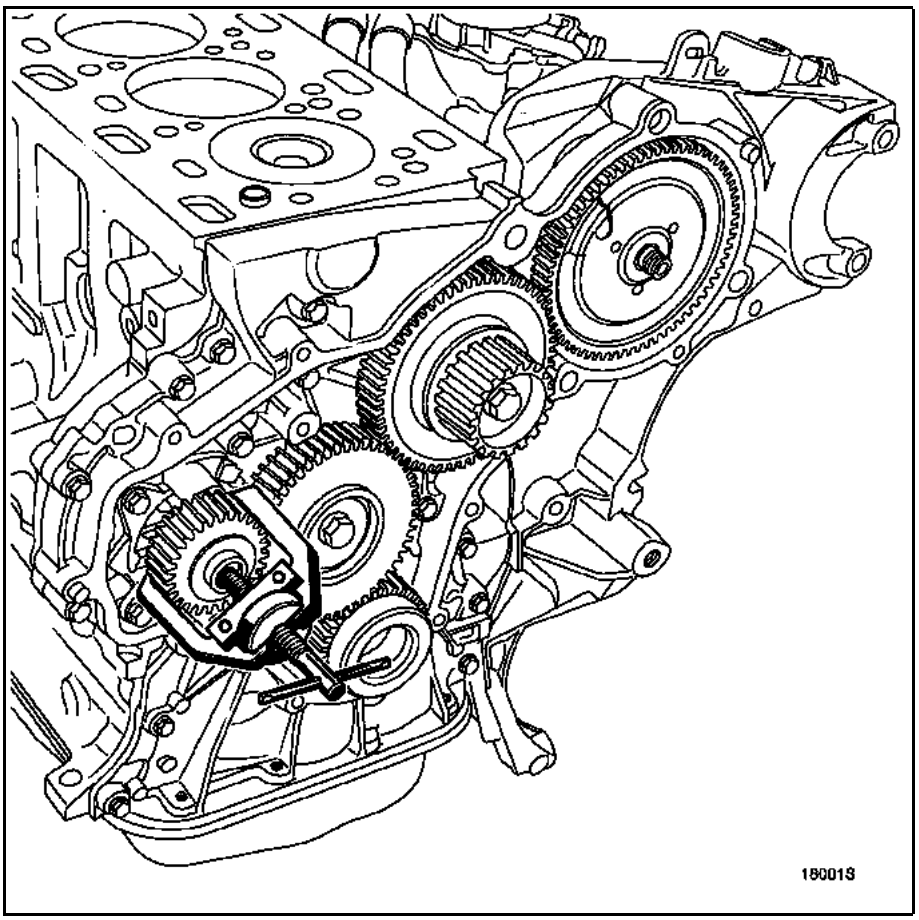
Remove the timing gear cover.



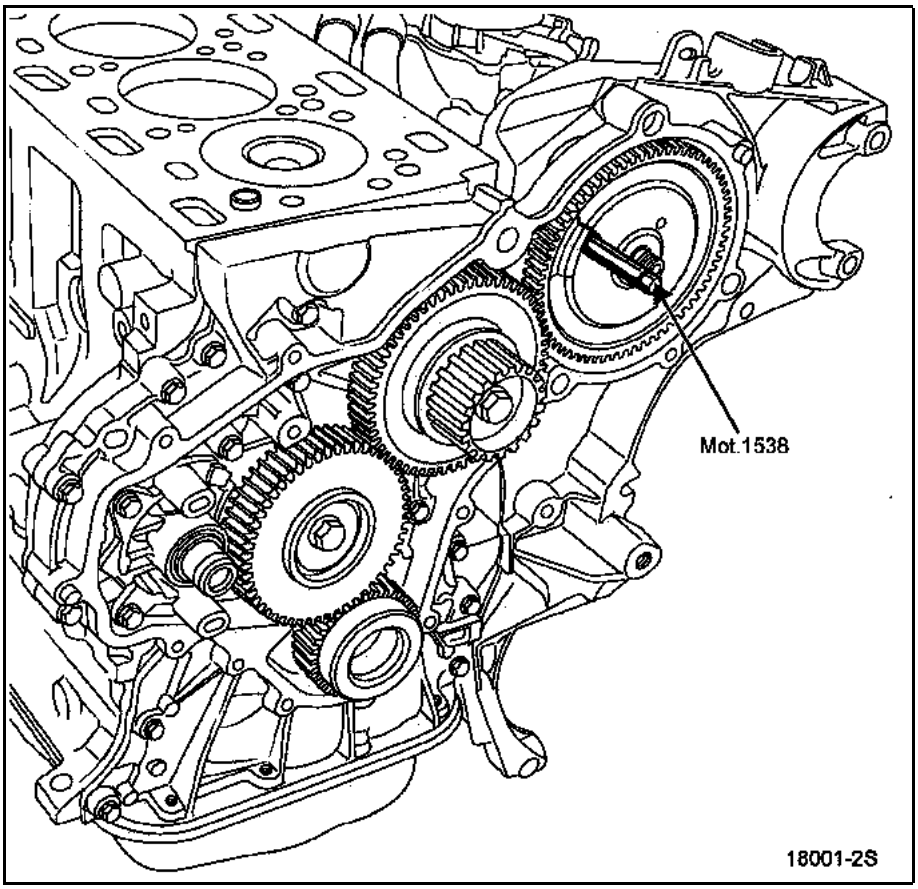
Remove the seal (**1**).



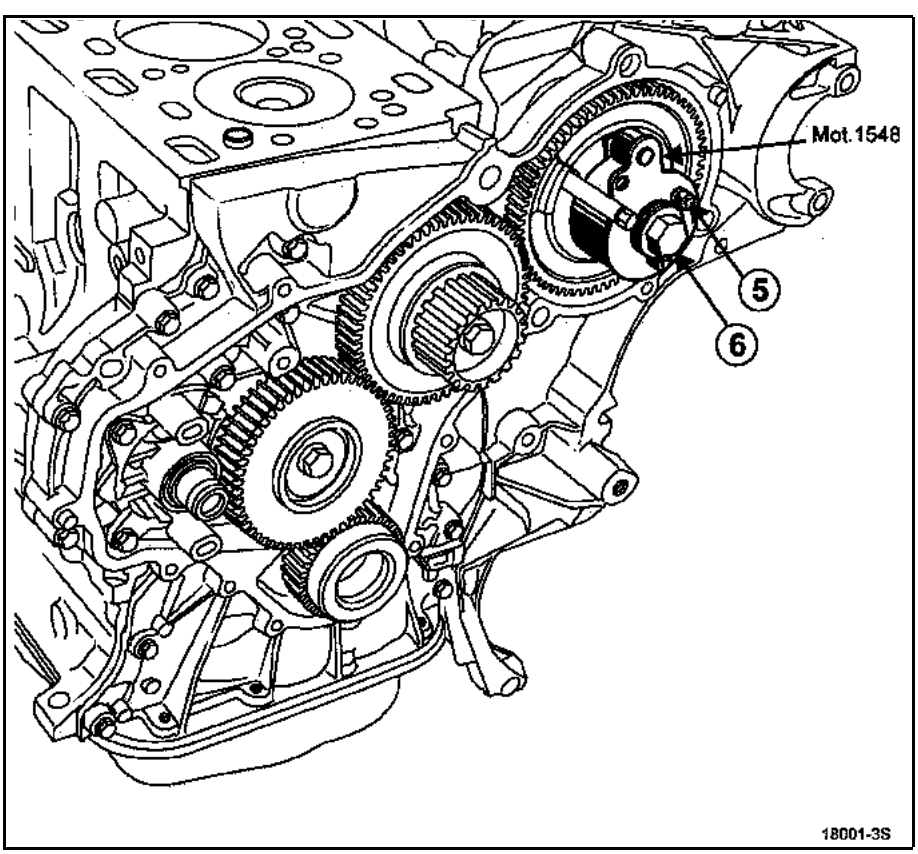
Remove:
– the high pressure pump sprocket nut (**2**),
– the number 2 intermediate shaft disc (**3**),
– the water pump nut (**4**).



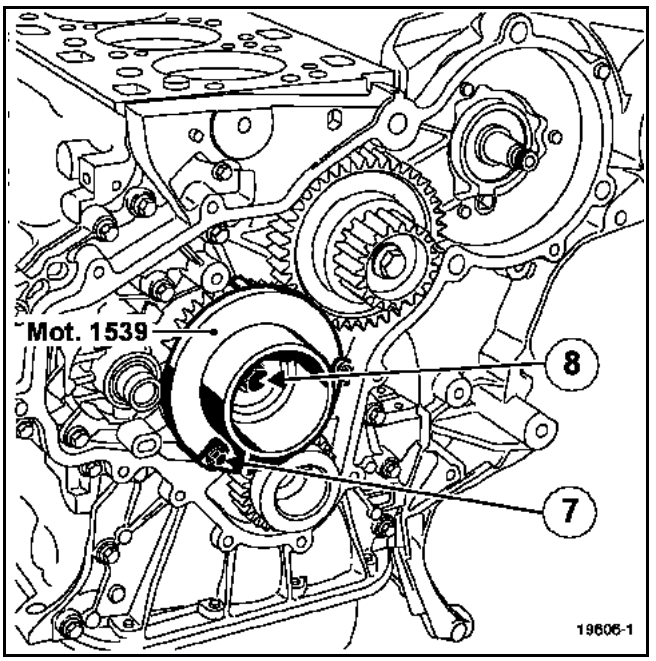
Remove the water pump sprocket using the extractor tool (U43L) for example.



Screw the pin (Mot. 1538) into the high pressure pump sprocket, to lock the automatic play compensation system.



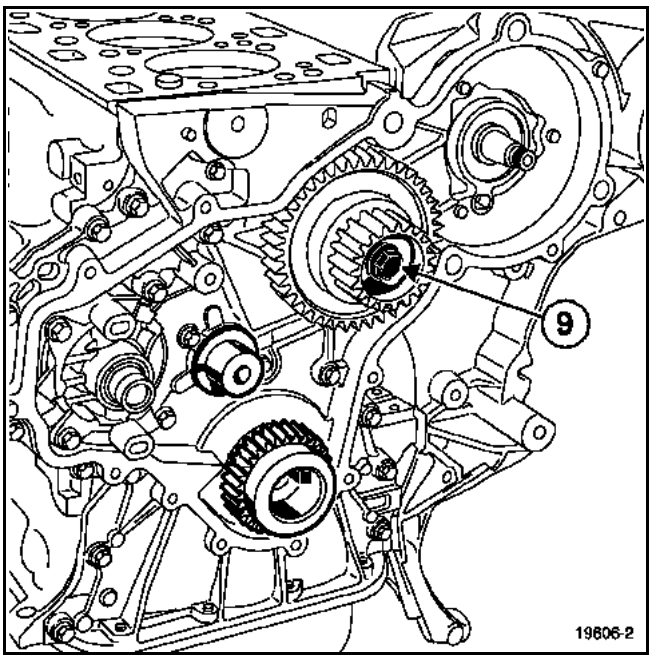
Fit the extractor (Mot. 1548) on the high pressure pump sprocket by tightening the three bolts (**5**).
Then turn bolt (**6**) to remove the high pressure pump sprocket.



Fit Mot. 1539 on intermediate sprocket number 1.

Bend the two tabs (**7**) against the sprocket and then lock them.

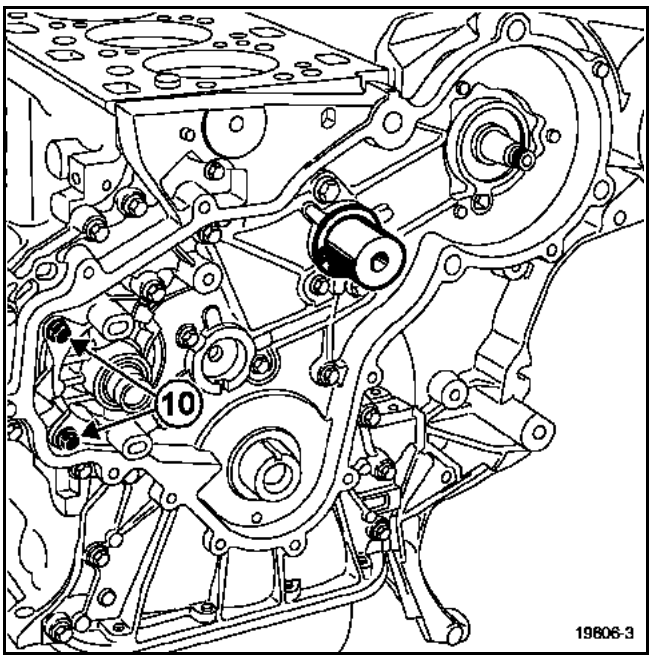
Remove the mounting bolt (**8**) and then the sprocket.



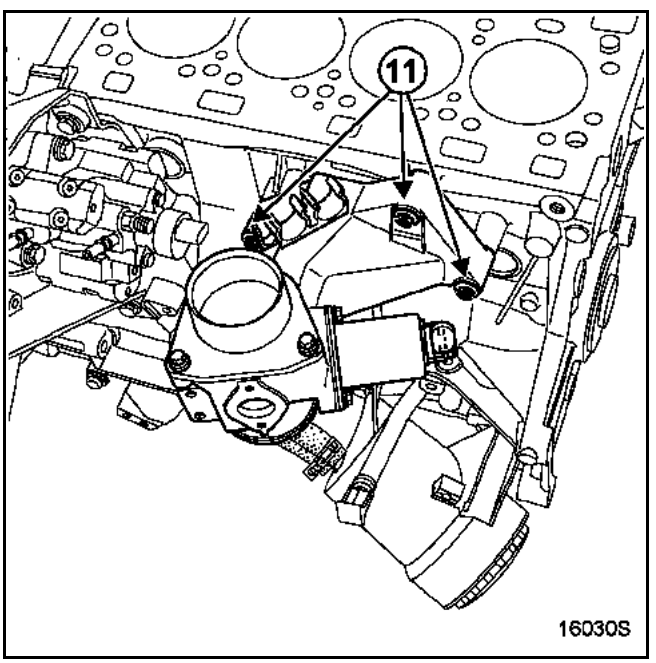
Remove:
– the crankshaft timing sprocket,
– intermediate sprocket number 1 pin and washer.

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

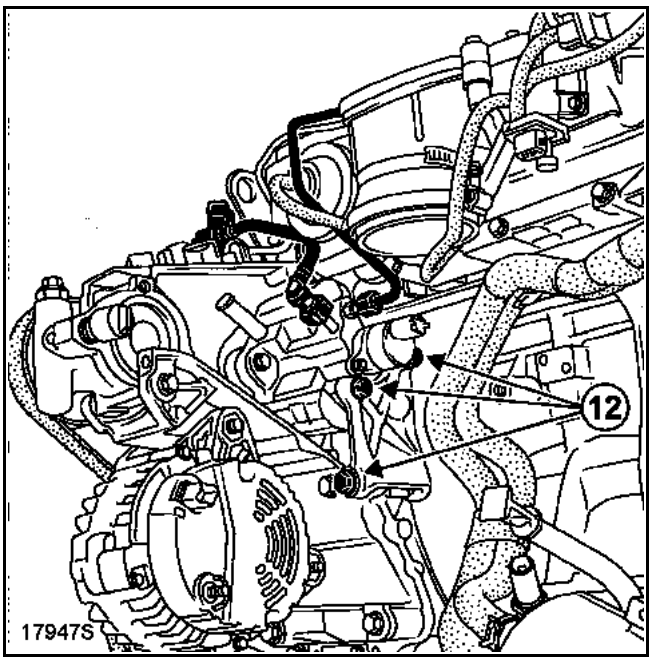
Remove intermediate sprocket number 2 by removing the mounting bolt (**9**).

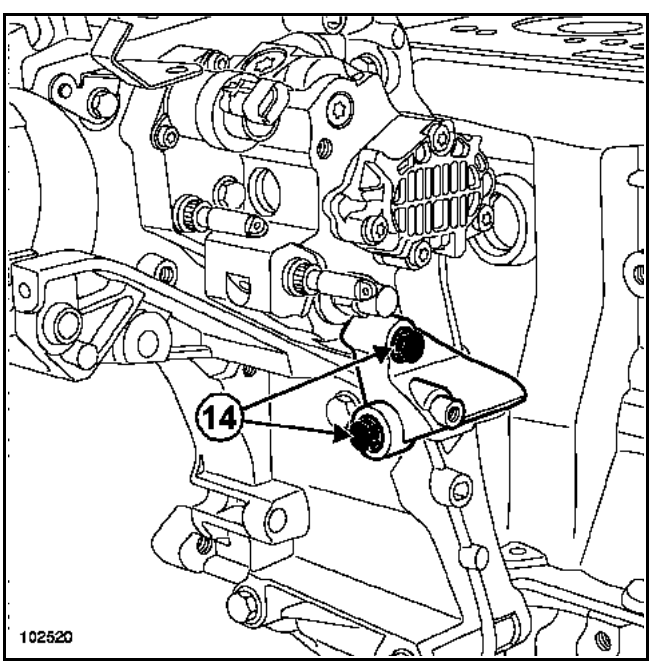


Remove:
– intermediate sprocket number 2 pin,
– the water pump by removing both bolts (**10**).

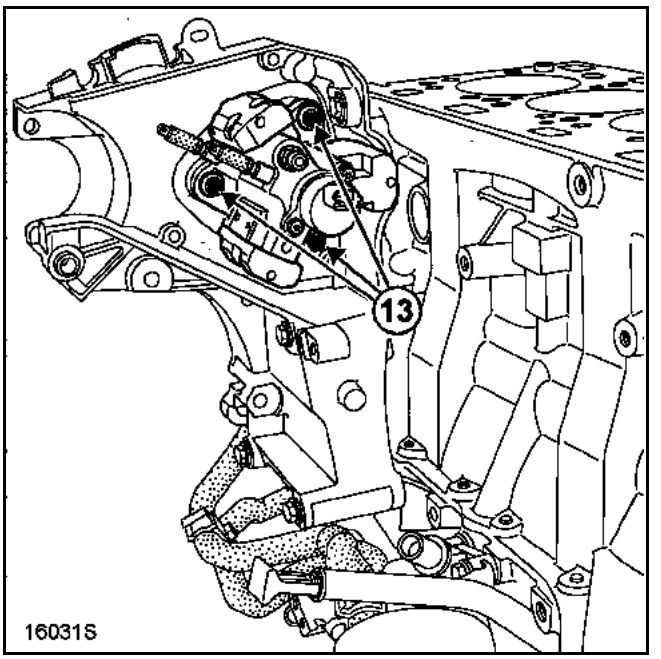


Remove the venturi unit by removing the three bolts (**11**).

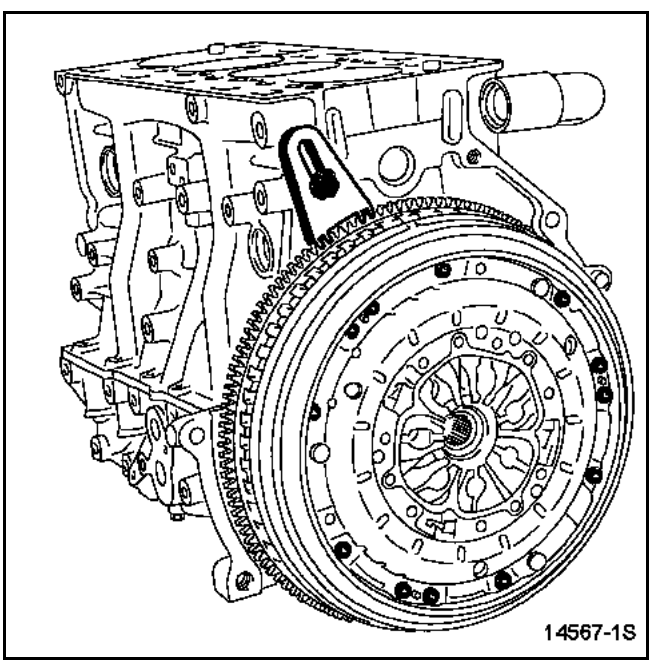




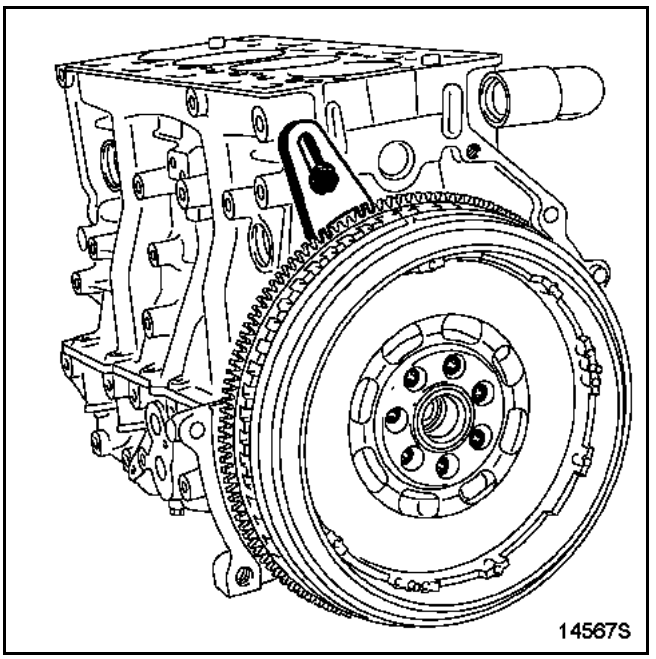
Remove the three bolts (**12**) or the two bolts (**14**) from the high pressure pump rear support.



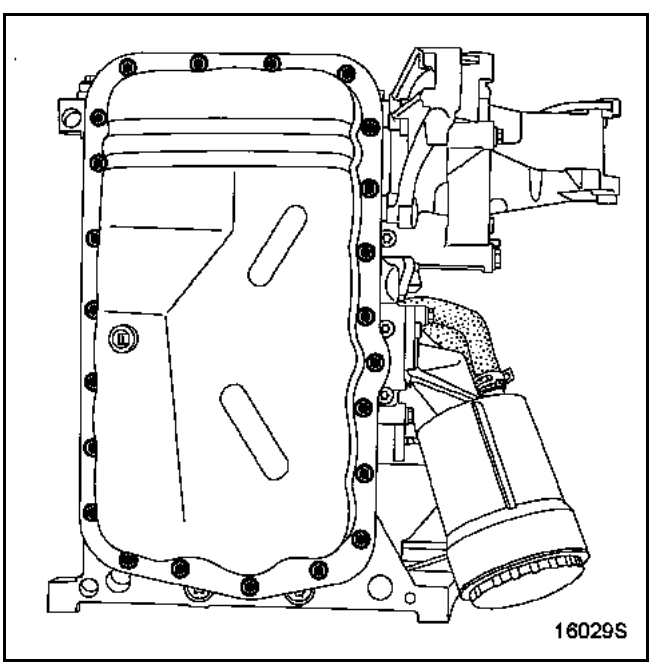
Remove the high pressure pump by removing the three bolts (**13**).



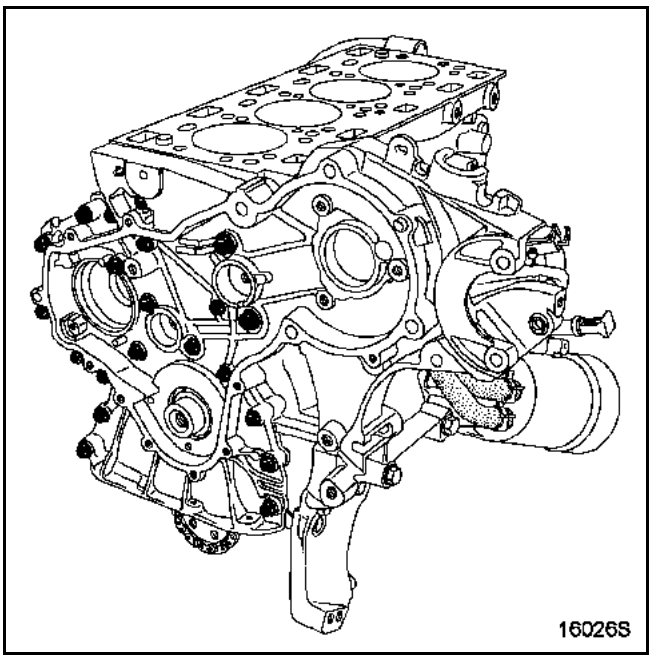
Remove the clutch mechanism and plate.



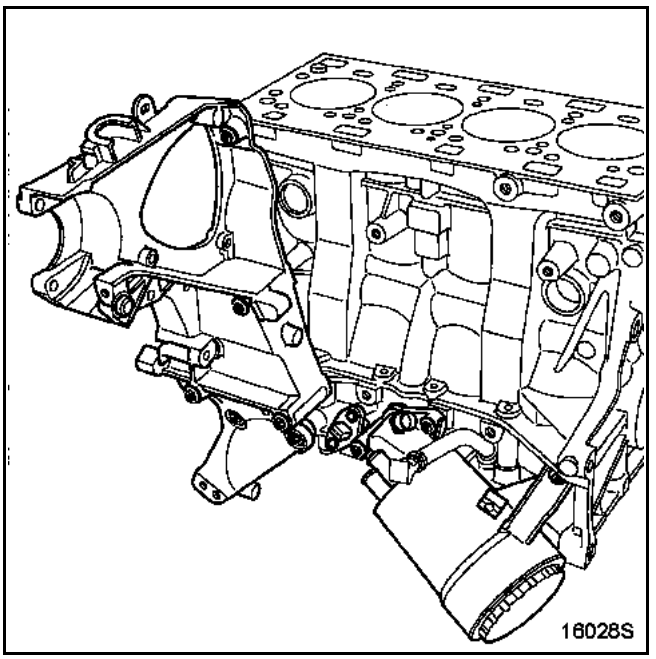
Remove the flywheel.



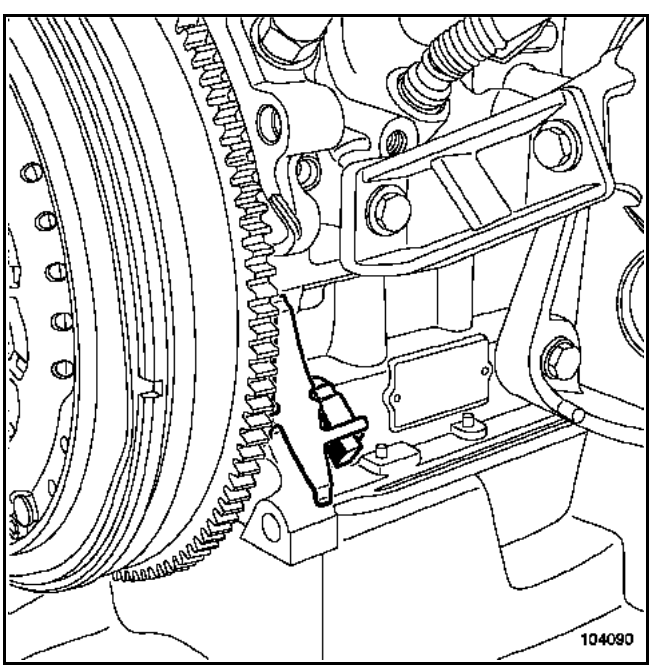
Remove the sump.



Remove the inner timing cover bolts, then remove the cover.

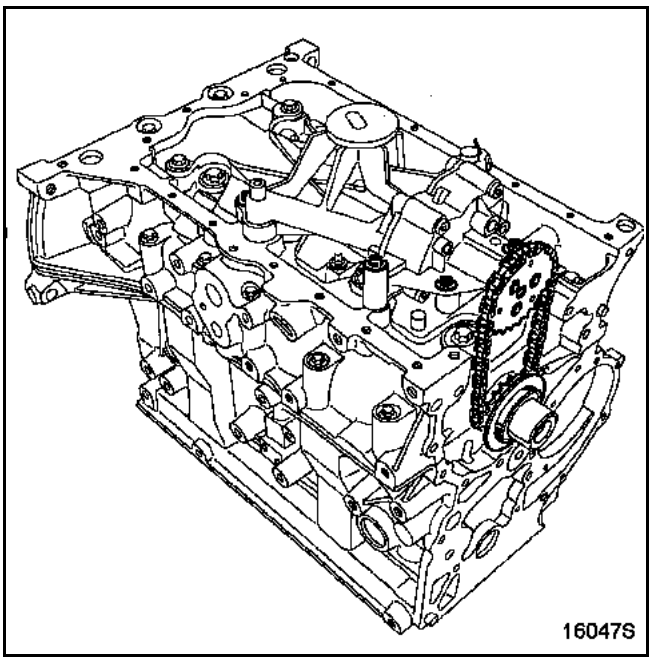


Remove:
– the multifunction support,
– the oil level sensor,
– the oil filter holder.



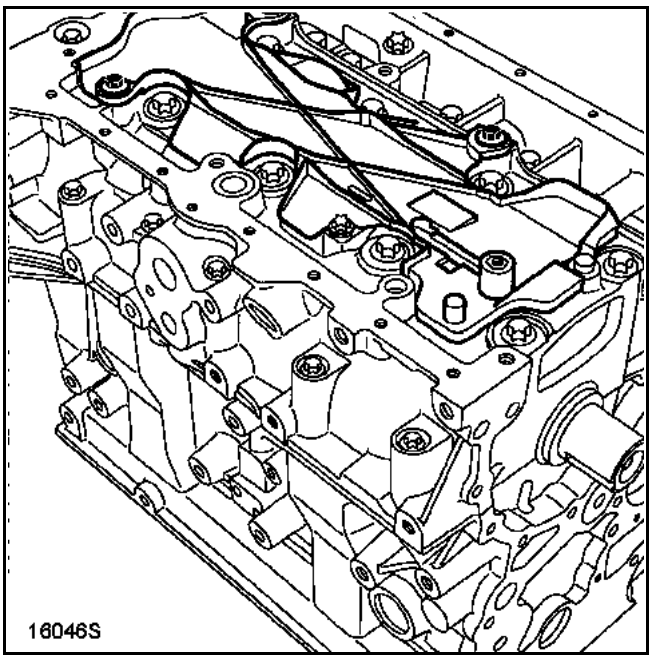
Remove the flywheel sensor.

Engine not equipped with balance shafts

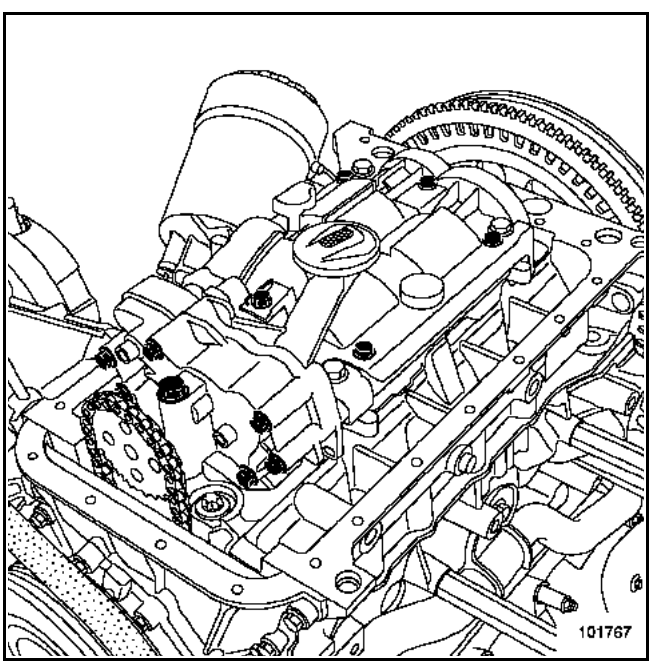


Remove:
– the oil pump complete with its chain,
– the oil pump drive sprocket.

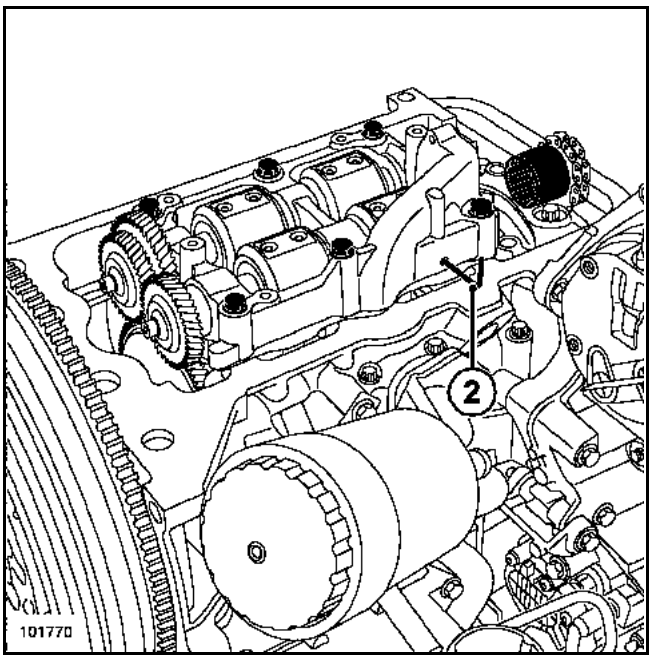
Remove the anti-emulsion plate:



Engine equipped with balance shafts



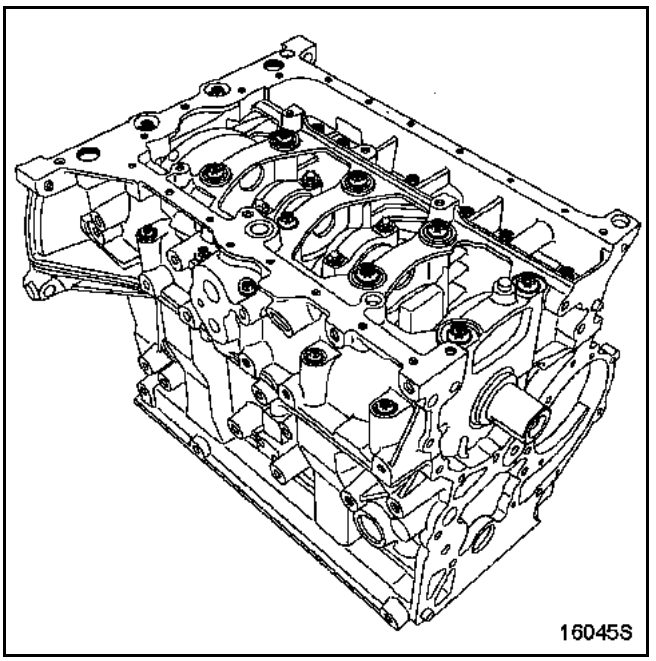
Remove the oil pump.



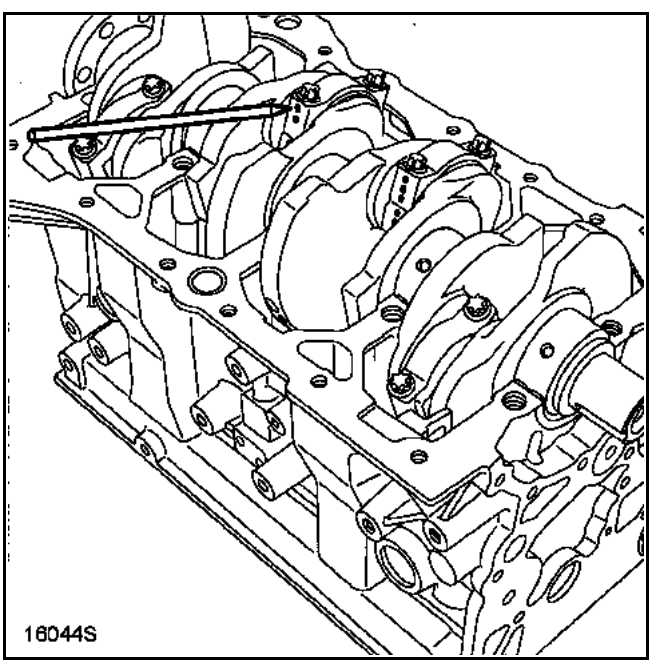
With the engine set to top dead centre and tool Mot. 1536 in position, set the balance shaft assembly using a **4 mm** Allen key (**2**).

Remove the balance shaft assembly.

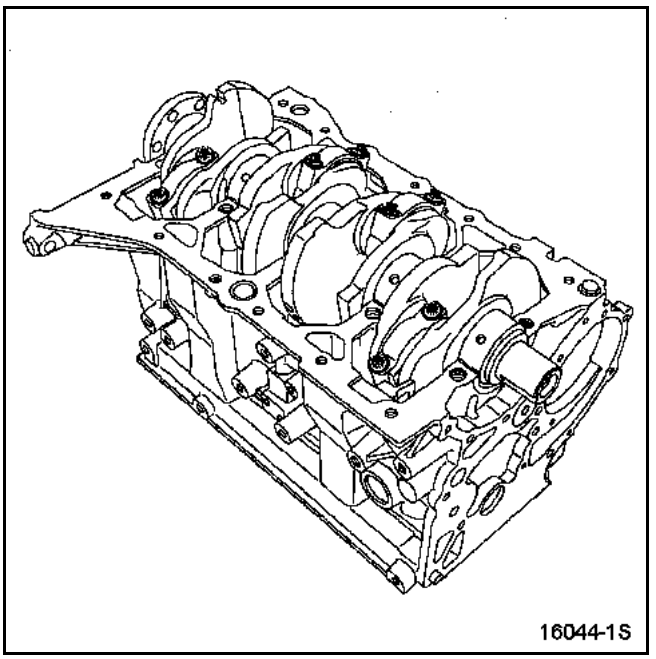
Gently turn the engine over to drain the oil still in the cylinder block.



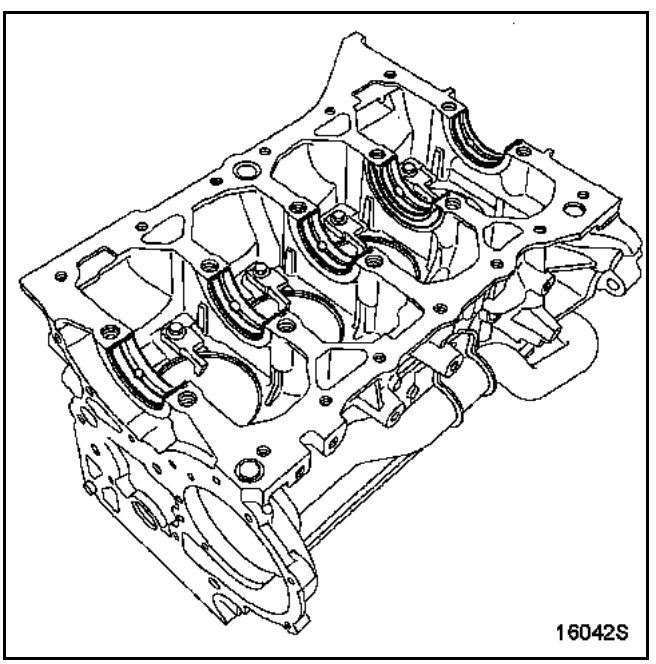
Remove the crankshaft bearing cap cover.



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.

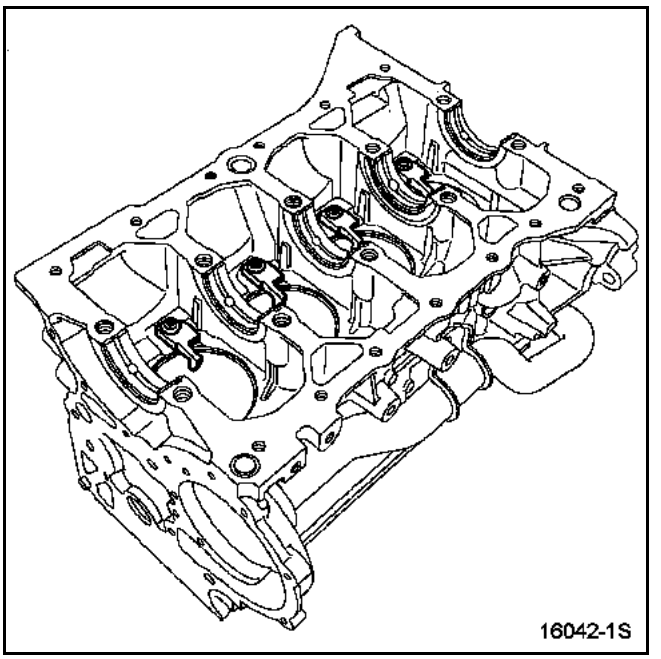


Remove the con rod cap bolts and the connecting rod/ piston assemblies.



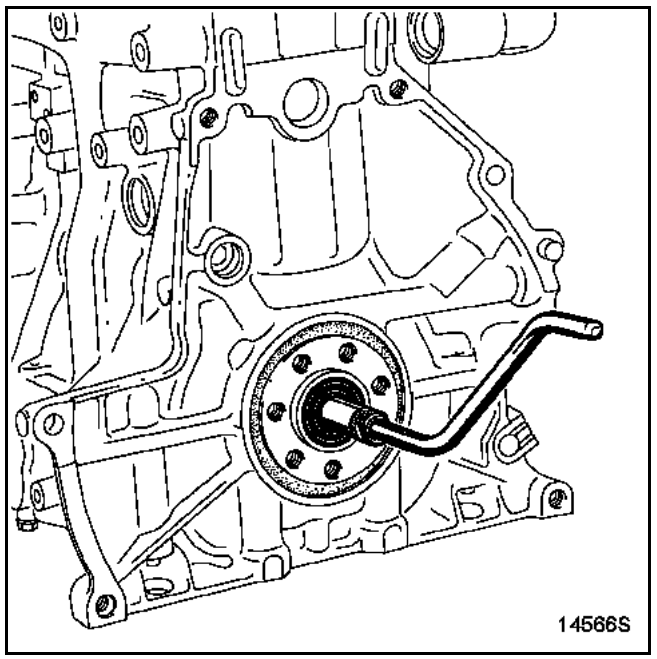
Be sure to mark the position of the crankshaft bearing shells, as the category may be different on each bearing.

Remove the crankshaft bearing shells.



Remove the piston base cooling jets.

The bolts have a left-handed thread.



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

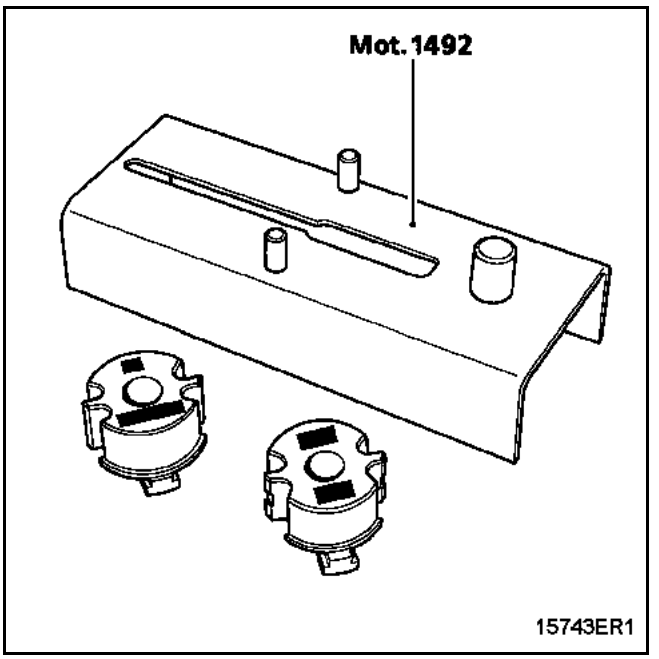
Clean:
– the stiffener baseplate,
– the cylinder block,
– the crankshaft.

EXTRACTING THE GUDGEON PINS

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**).

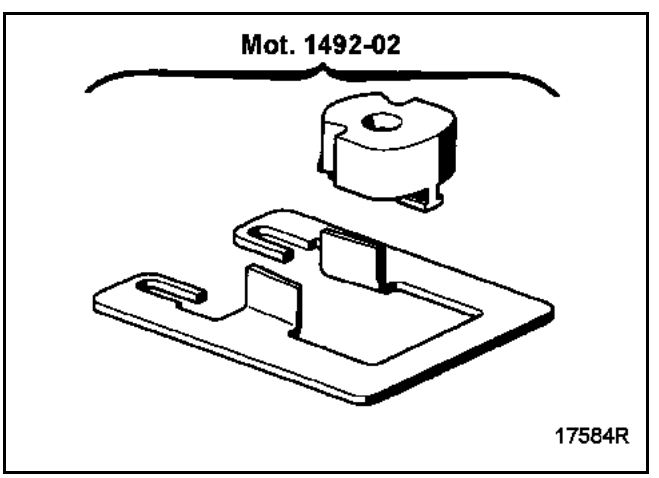
To extract the gudgeon pin, remove the circlip with a screwdriver and withdraw the pin.

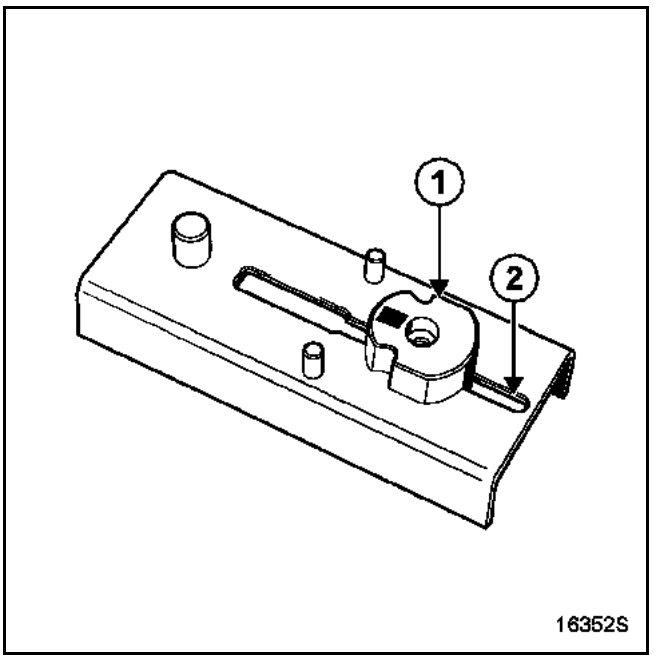
FITTING THE CON ROD BEARING SHELLS



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

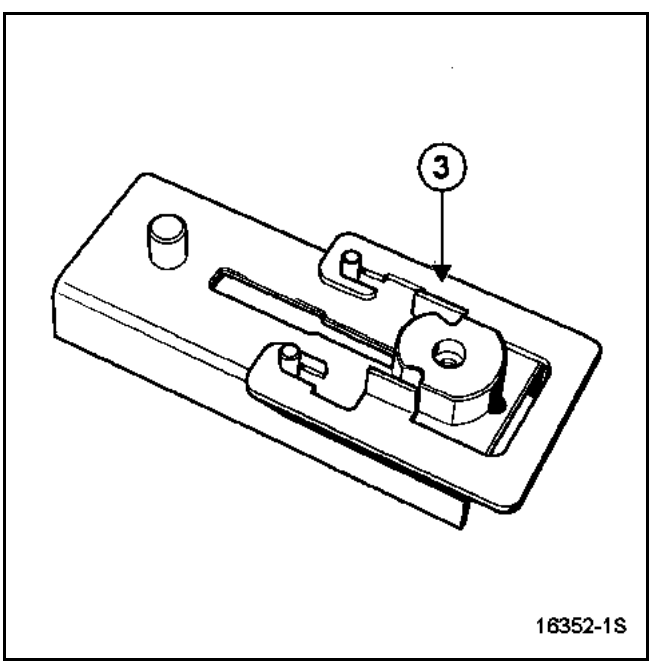
Note:
When fitting the bearing shells, make sure that all the parts are clean and dry.



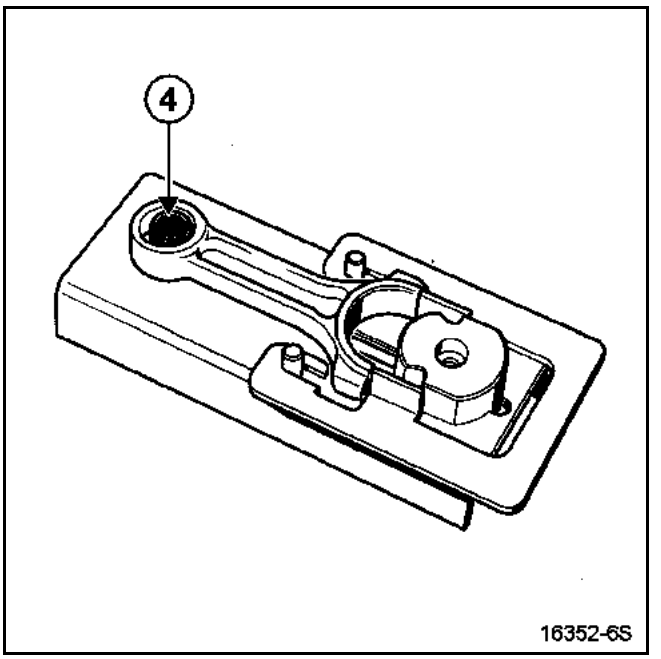


On the con rod body

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.

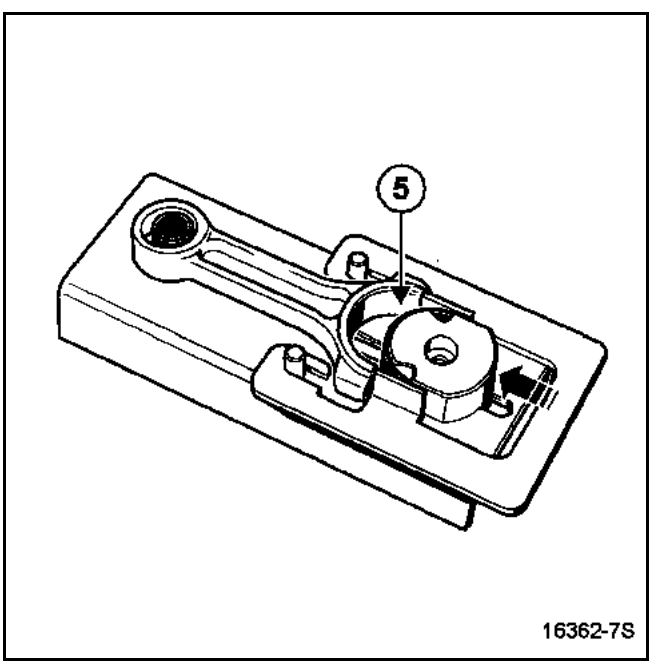


Fit the rail (**3**) of Mot. 1492-02 (**using the 48 mm or 53 mm diameter rail**) on the base (as shown in the diagram).

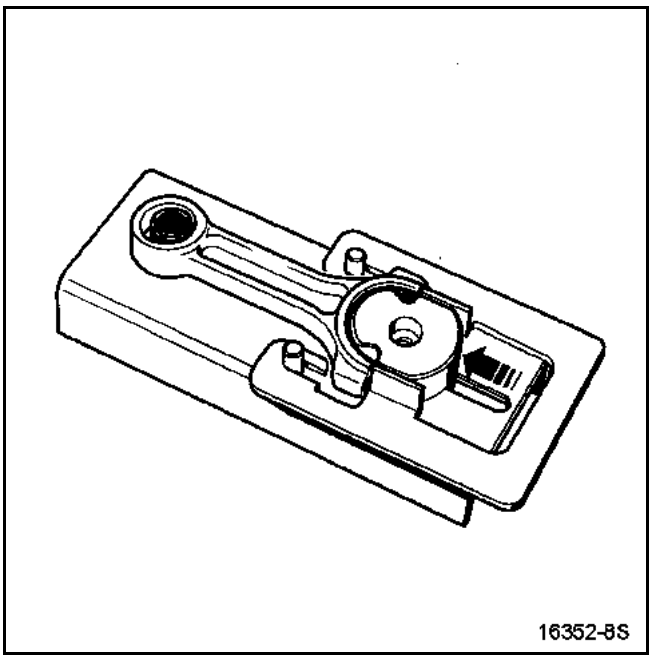


Fit the body of the con rod on the base (as shown in the diagram).

Ensure that the lower section (**4**) of the small end is in contact with the centring pin.



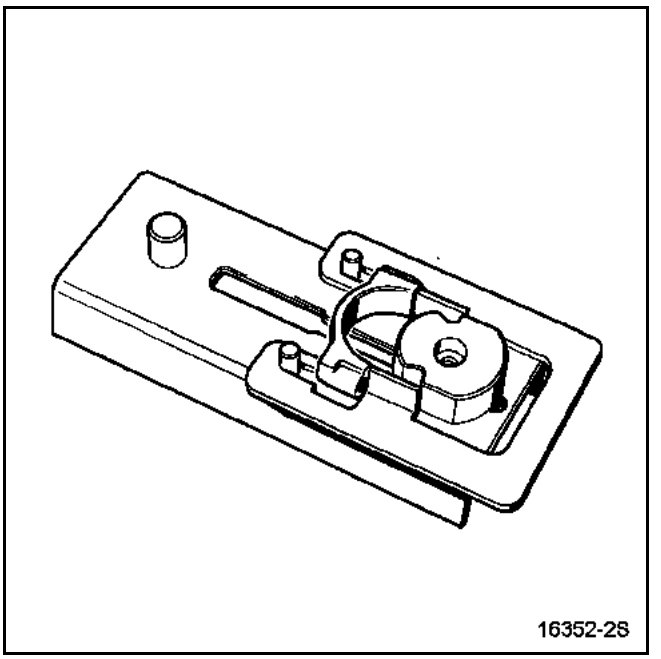
Fit the bearing shell (**5**) on the bearing shell support, then push it in the direction of the arrow (as shown in the diagram).



Slide the bearing shell support to the end stop of the con rod body.

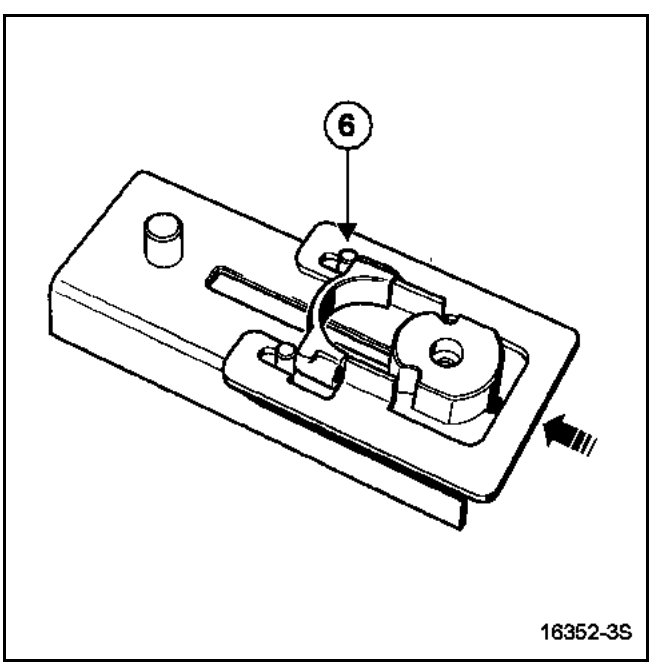
Then remove the support from the con rod body and repeat the operation for the other con rod bodies.

Note:
Do not cause impacts on the split con rod breakage seams.

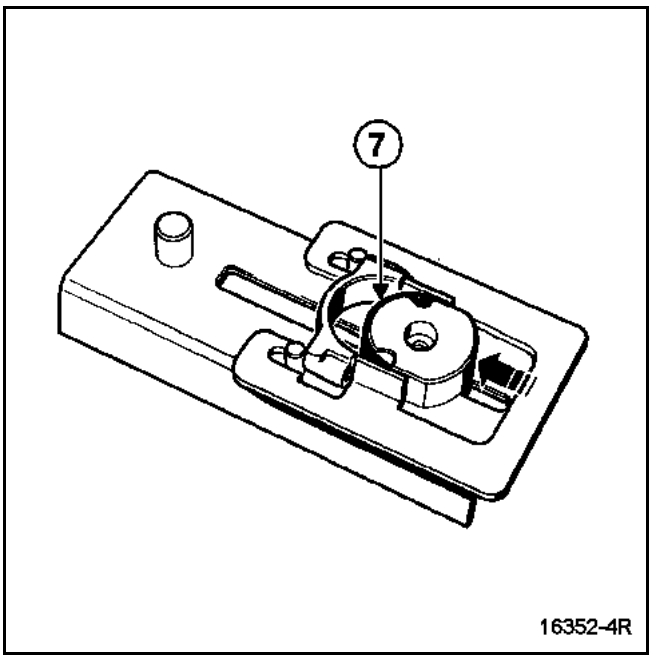


On the con rod cap

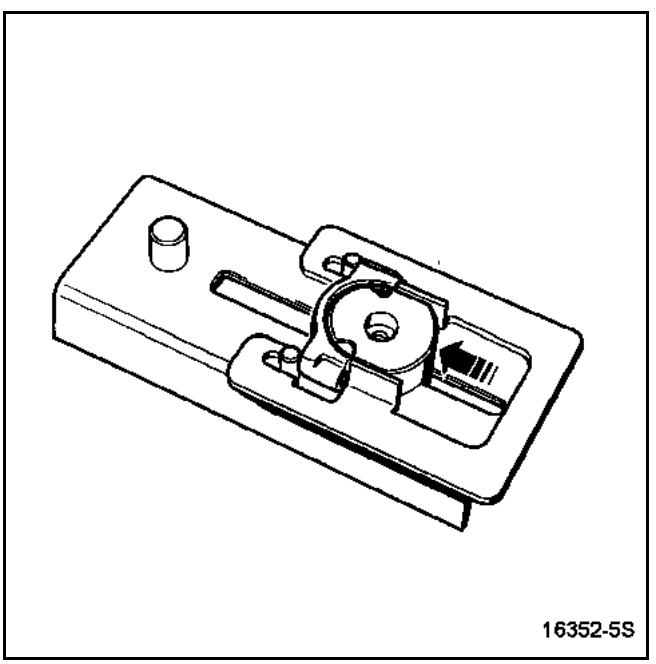
Fit the con rod cap as shown in the diagram.



Push the rail (in the direction of the arrow) until the con rod cap is resting on the pins (**6**) on the base.



Fit the shell (**7**) on the shell support, then push it in the direction of the arrow (as shown in the diagram).

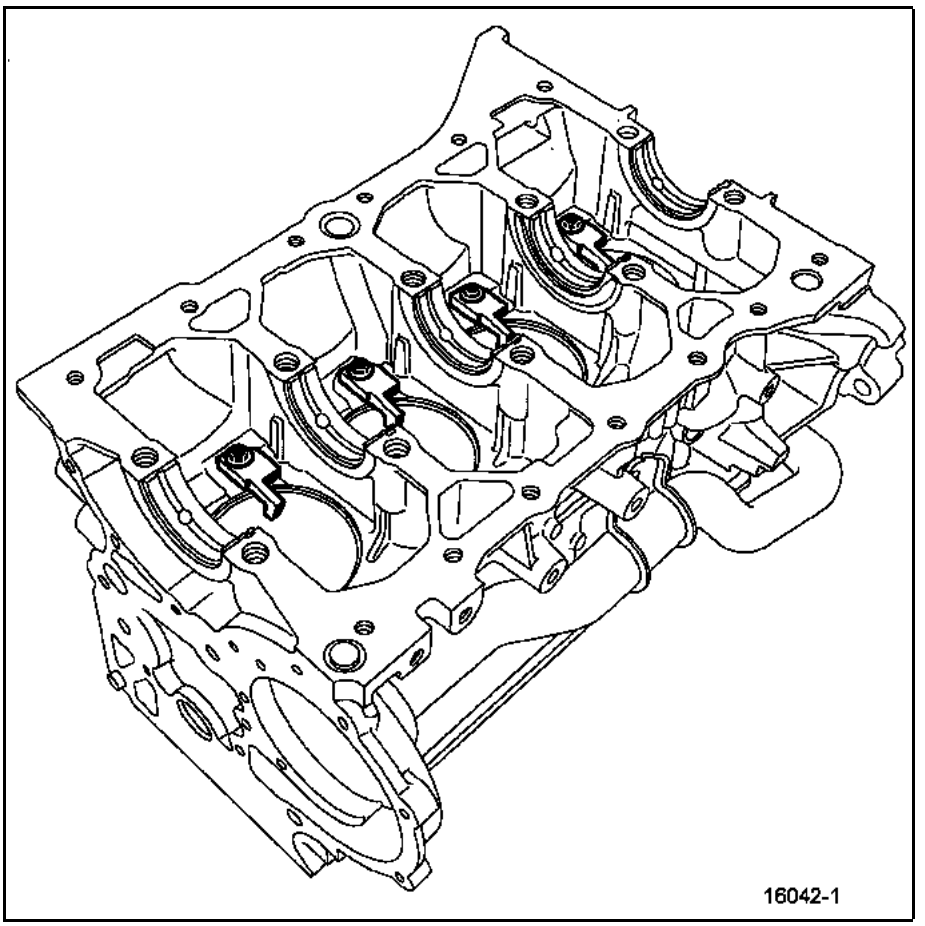


Slide the shell support to the end stop of the con rod cap.

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

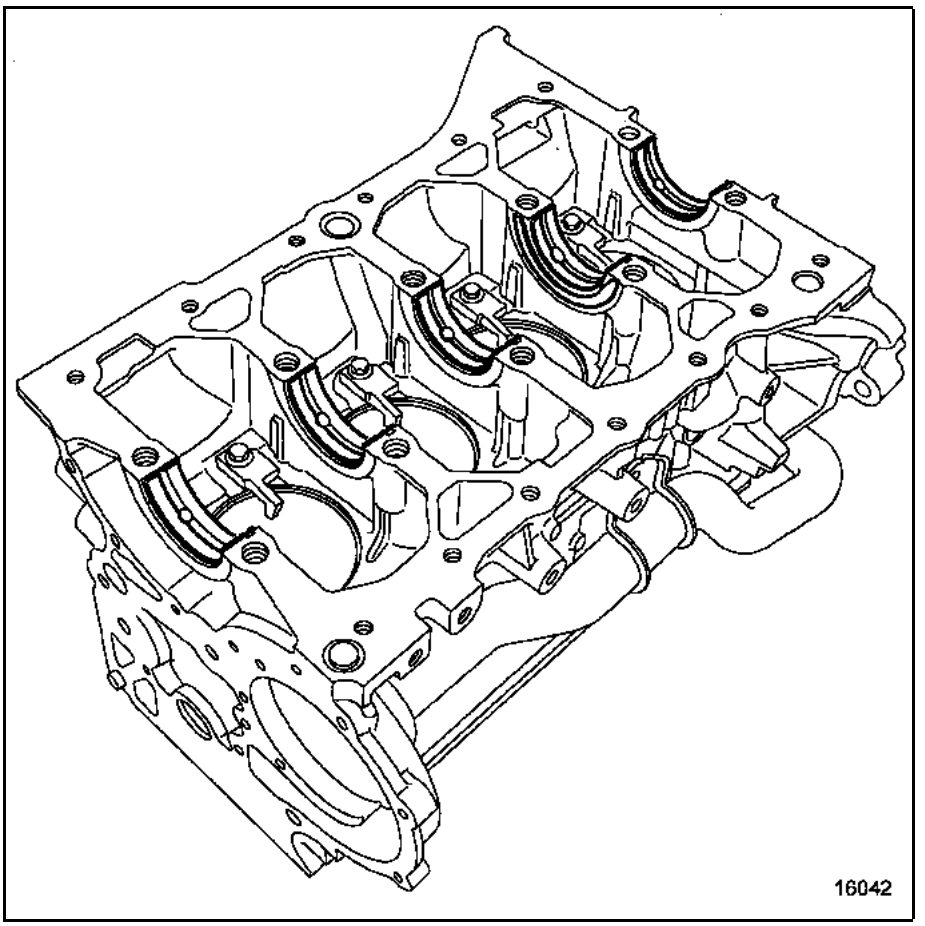
Note:
Do not cause impacts on the split con rod breakage seams.

REFITTING THE PERIPHERALS



Refit the piston base cooling jets, tightening them to a torque of **2 daNm**.

The bolts have a left-handed thread.

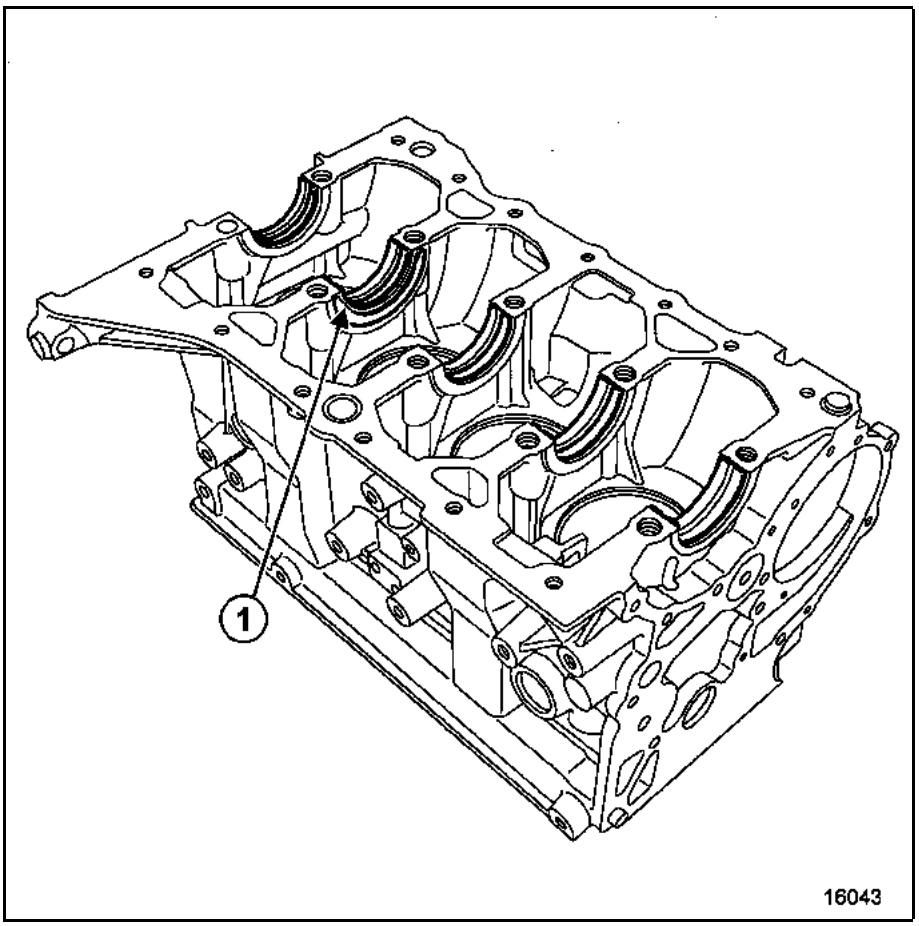


Refit the crankshaft bearing shells **non-grooved** on the crankshaft bearing cap cover.

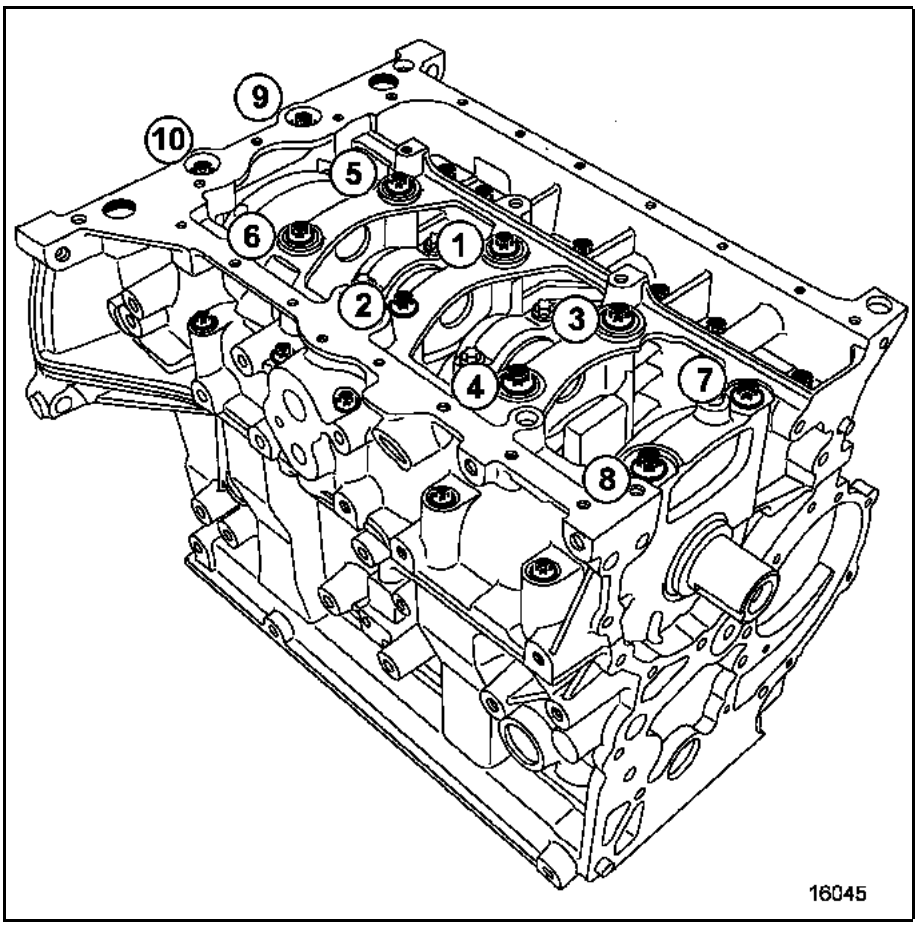
Refit the **grooved** crankshaft bearing shells on the cylinder block bearings, checking that the lubrication holes in the bearing shells and the cylinder block crankshaft bearings are correctly aligned.

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

Apply a drop of oil on the crankshaft bearing shells.

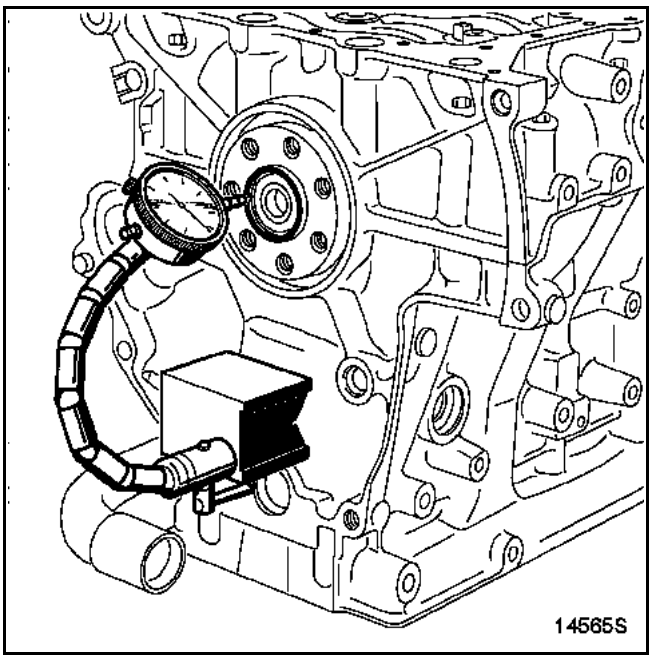


Refit the crankshaft lateral shims (**1**) on bearing **No. 2 (grooves on crankshaft side)**.

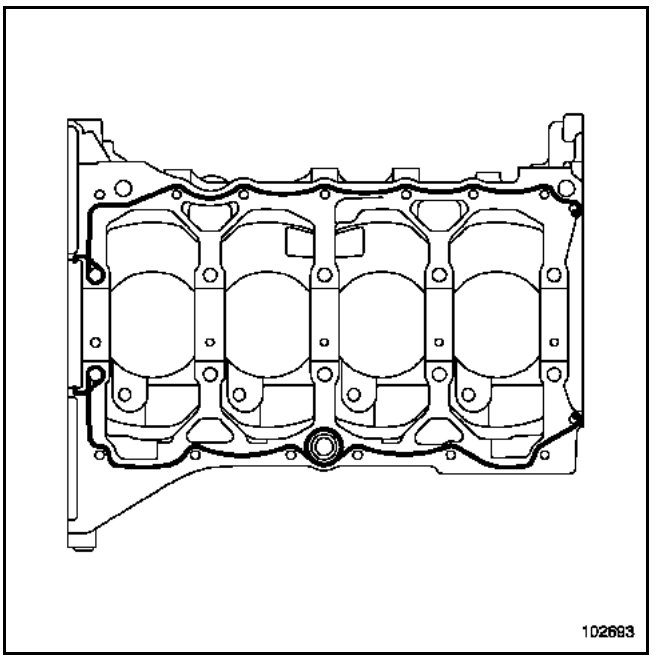


Refit the crankshaft.

Refit the bearing cap casing by tightening the centre bolts in order to a torque of **2 daNm, then angle tighten by 150° ± 10° (use the old centre bolts)**.



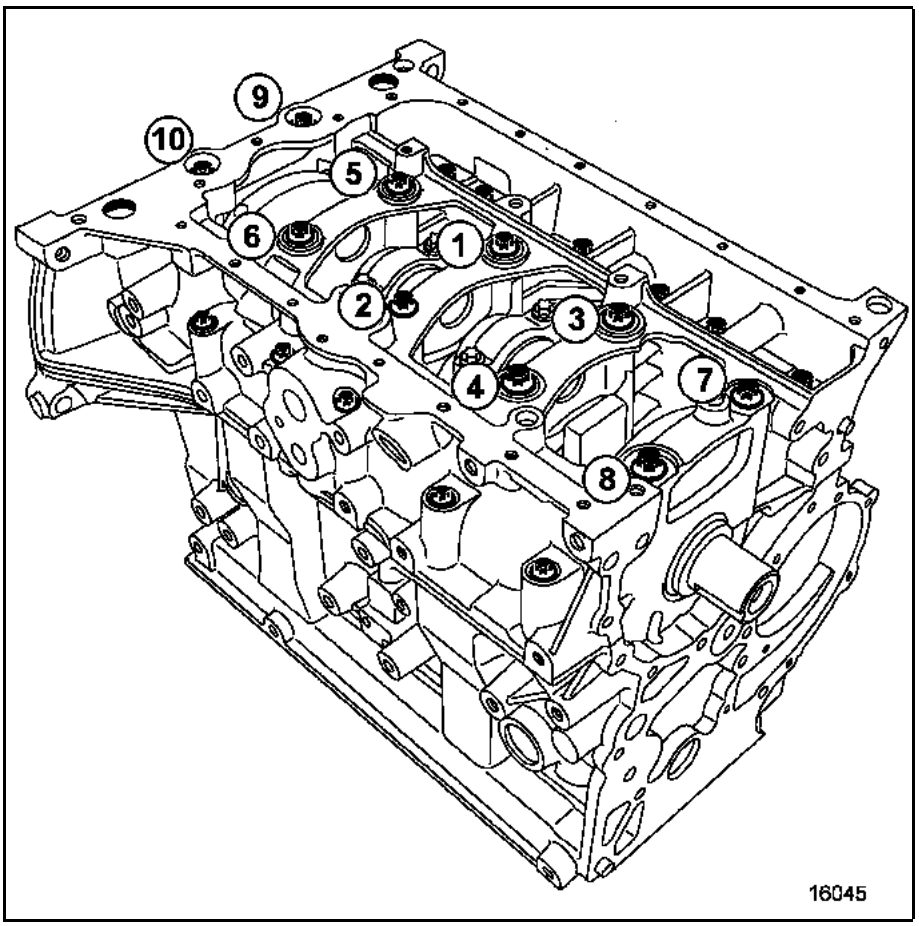
Check the lateral clearance of the crankshaft, which must be between **0.06 and 0.232 mm**.



Remove the crankshaft bearing cap cover.

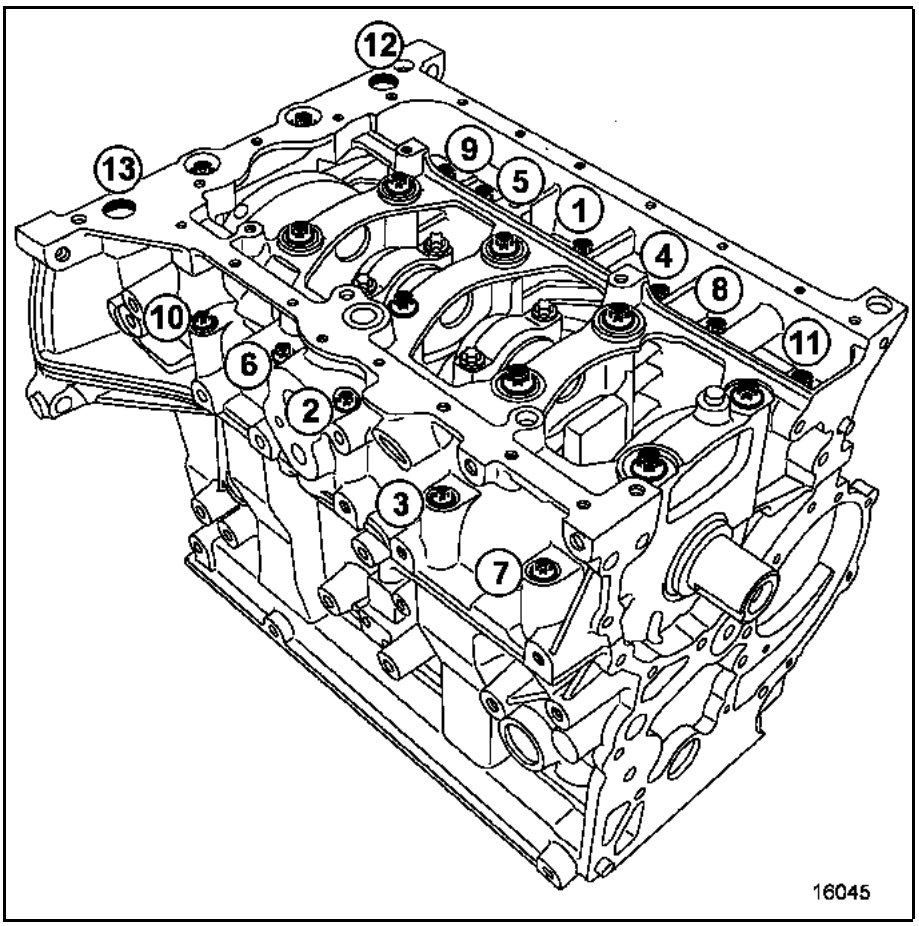
The crankshaft bearing cap cover is sealed with a bead of **RHODORSEAL 5661** which must have a width of **2 ± 0.4 mm** and follow the line shown here.

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.)



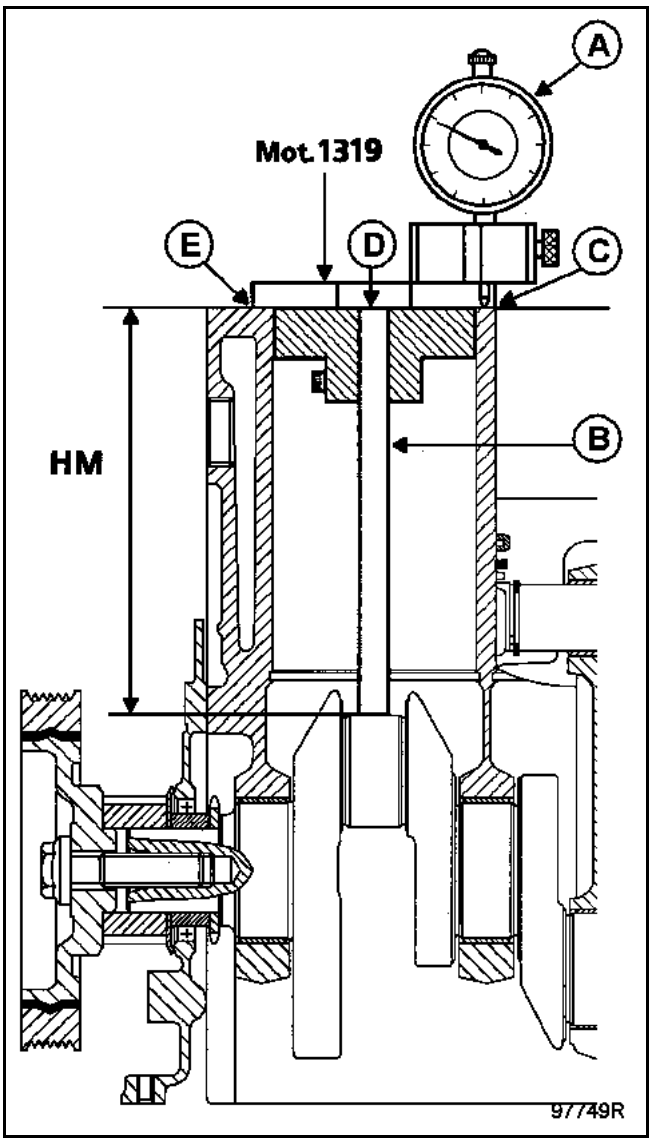
Do not forget to replace the centre crankshaft bearing cap cover bolts.

Refit the crankshaft bearing cap cover by tightening the centre bolts in order 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 pistons or con rods, determine the crankpin height "HM".

This will enable you to choose a piston matching the con rod on sale from the Parts Department, or matching the original con rods.

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

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 = Length of B - Protrusion at D

Example (all dimensions are given in mm):

Length of rod B = 177.973 (value noted in the Mot. 1319 and Mot. 1319-01 kit).

	Cylinder			
	1	2	3	4
Protrusion (**D**)	0.500	0.487	0.493	0.530

HM = 177.973 - 0.500 = 177.473 for cylinder 1.
HM = 177.486 for cylinder 2.
HM = 177.480 for cylinder 3.
HM = 177.443 for cylinder 4.

Note:
The crankpin height must also be calculated when a cylinder block or crankshaft is replaced.

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

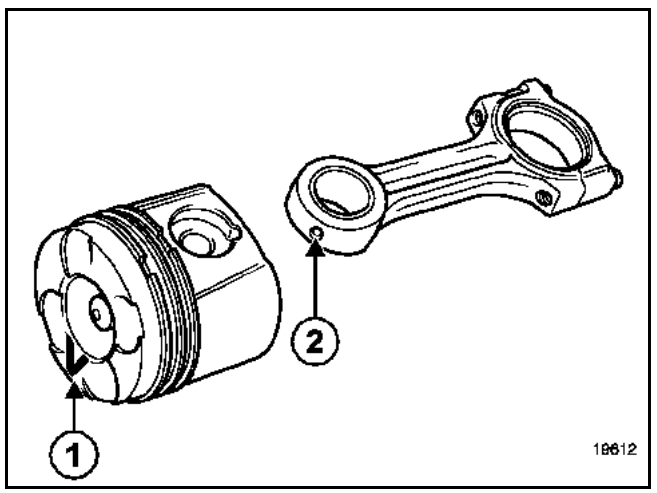
"CON RODS/PISTONS" ASSEMBLY

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.

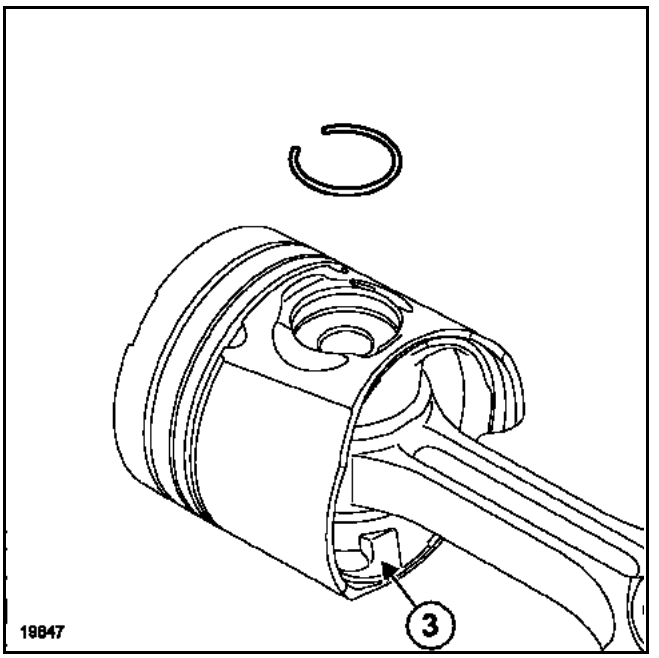
Direction of fitting of the con rod in relation to the piston



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

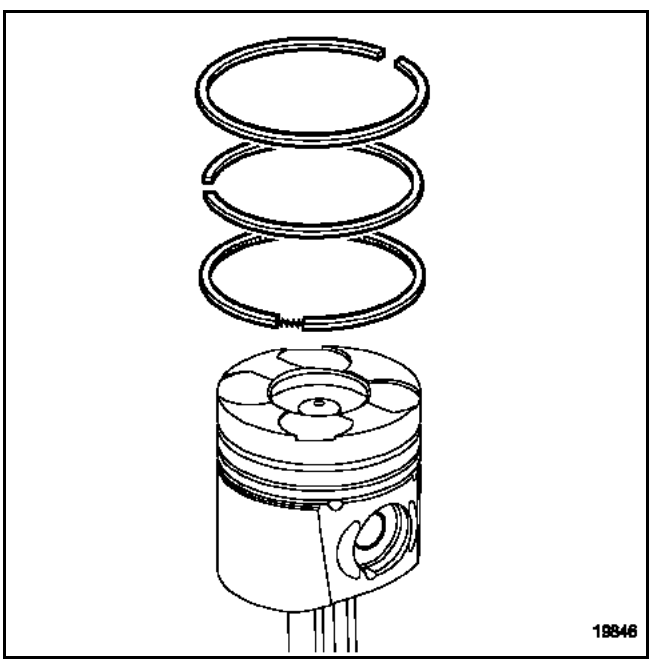
The rings must be free within their grooves and at their original settings.

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.

Note:
Do not oil the ring grooves or the rings.



Lightly oil the pistons and barrels.

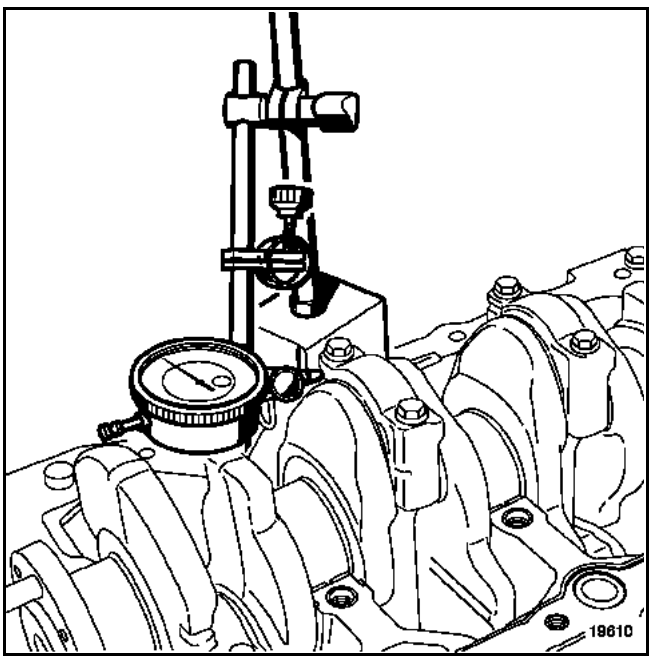
Fit the "con rod/piston" assemblies into the cylinder block using the ring, making sure they are fitted the right way round (the "Λ" towards the flywheel).

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

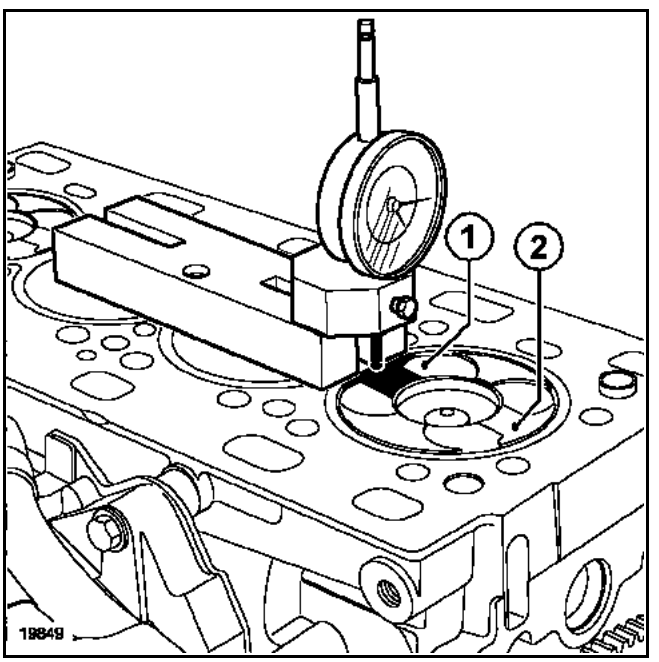
Fit the con rod caps, ensuring they are correctly matched (**marks made when dismantling**).

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.

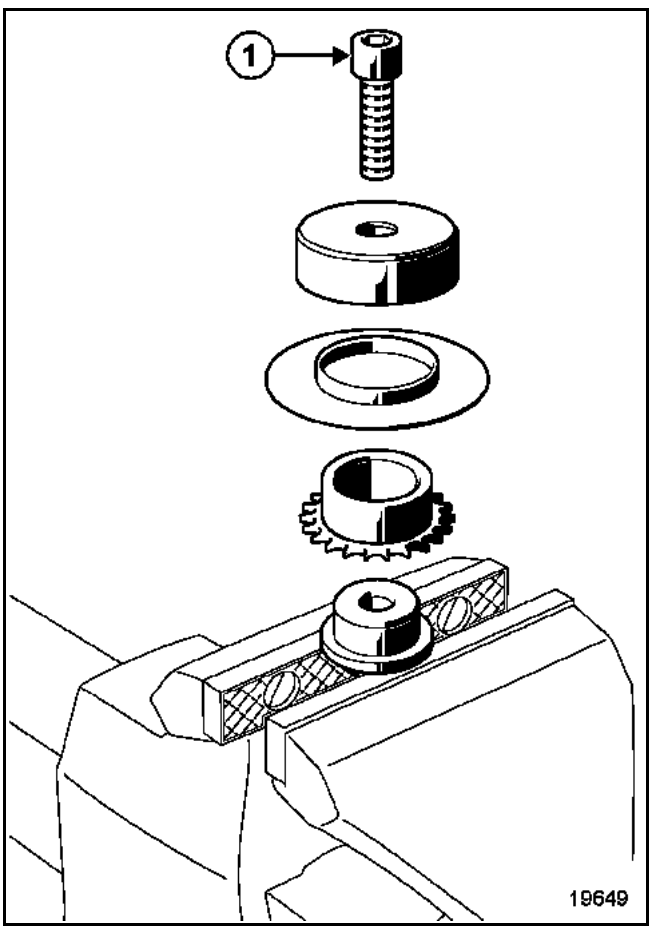
Apply force to the piston to eliminate the various clearances (between pin and piston, between pin and con rod, etc.)

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

REPLACING THE OIL PUMP DRIVE SPROCKET OIL DEFLECTOR

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.

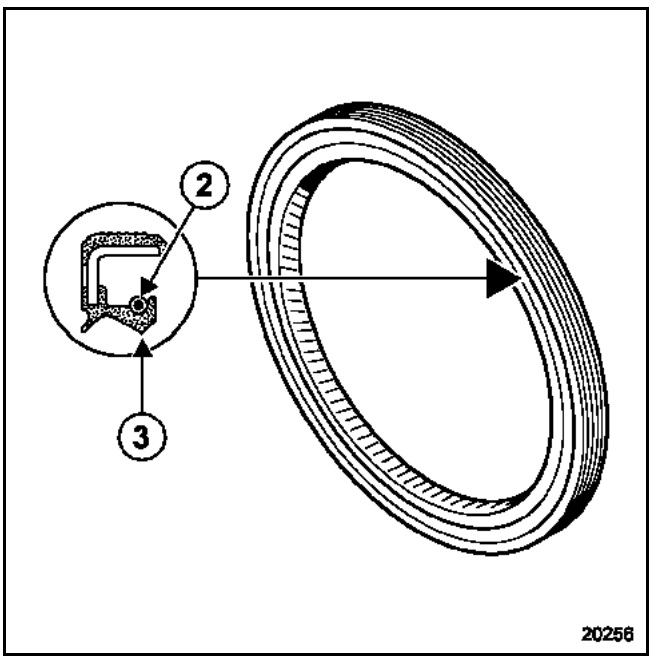


Fitting the flywheel end crankshaft seal

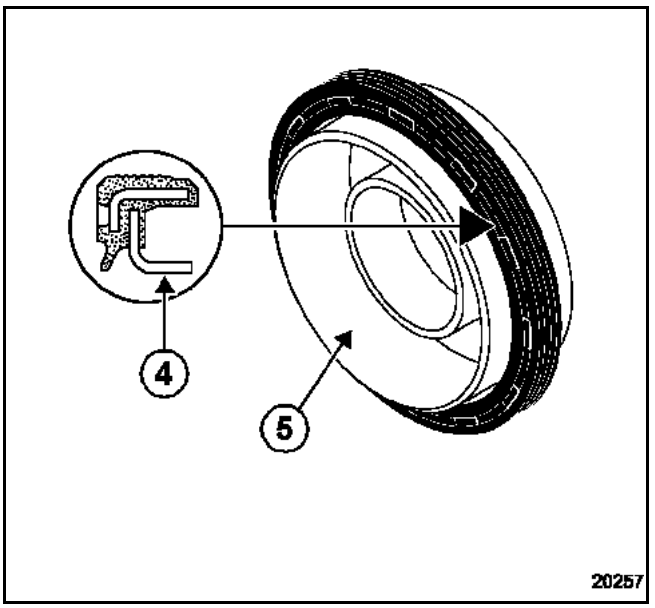
This engine can be fitted with two different types of seal.

Old and new seals are easily recognised.

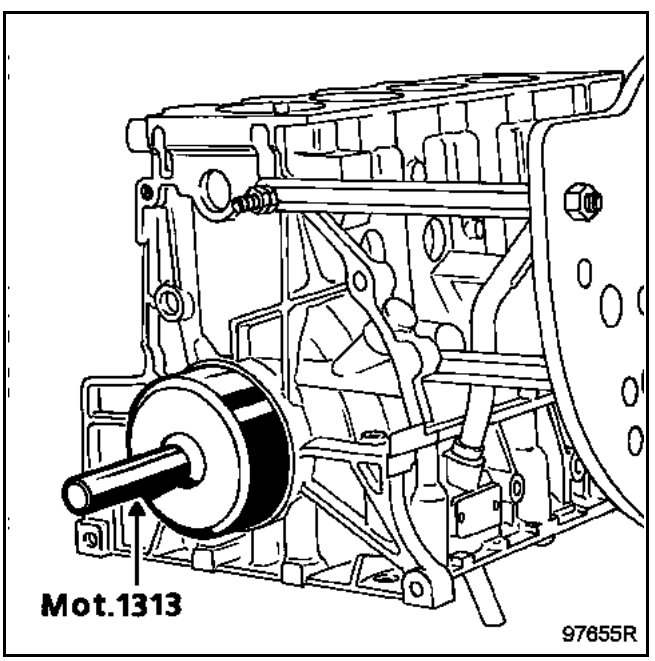
The old elastomer seal is fitted with a spring (**2**) and has a **V**-shaped sealing lip (**3**).



Note:
Never oil the seal mating faces; the parts must be clean and dry.

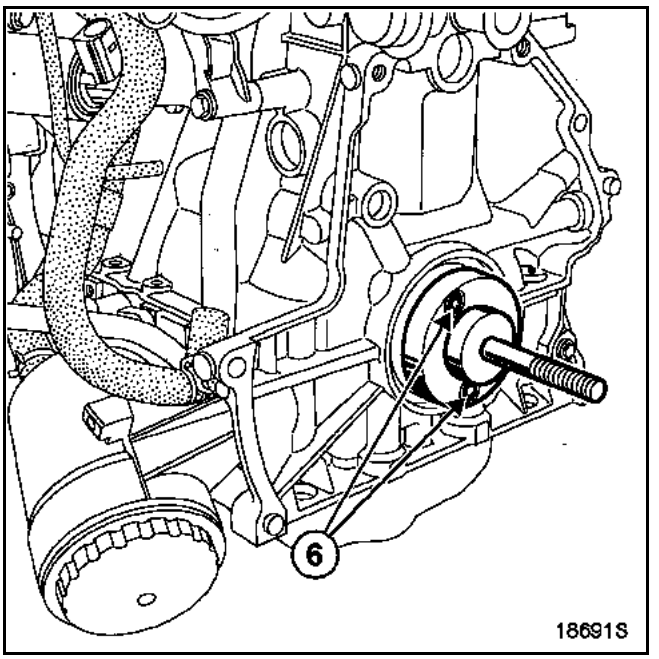


The new elastomer seal has a flat sealing lip (**4**) and a protector (**5**) which also fits the seal to the engine.

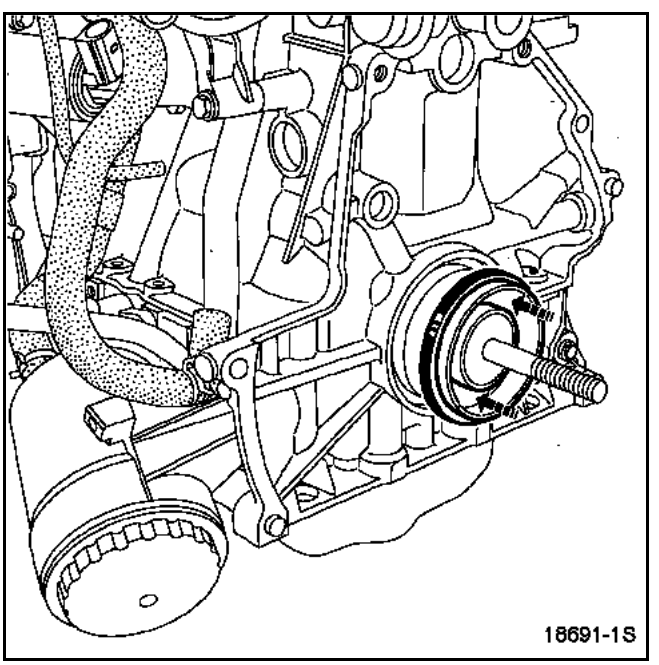


For the old seals, use tool Mot. 1313.

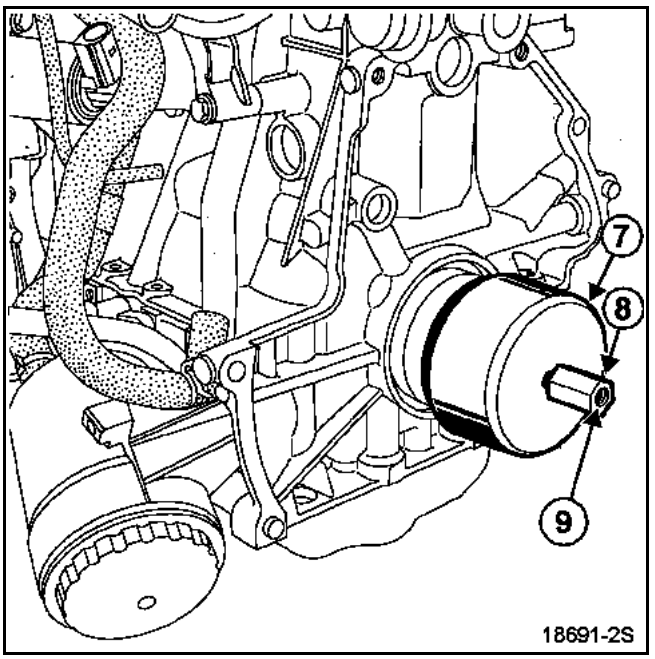
For the new seals, follow the method described below.



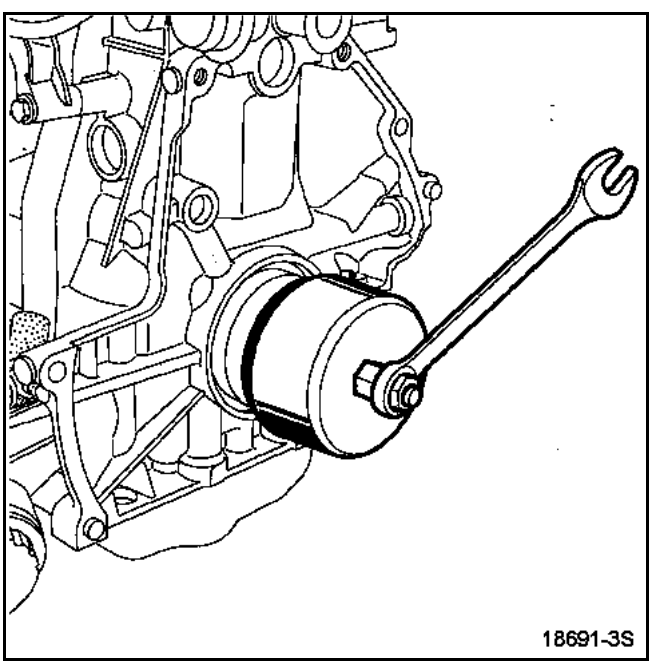
Fit tool Mot. 1564 on the crankshaft, securing it with bolts (**6**).



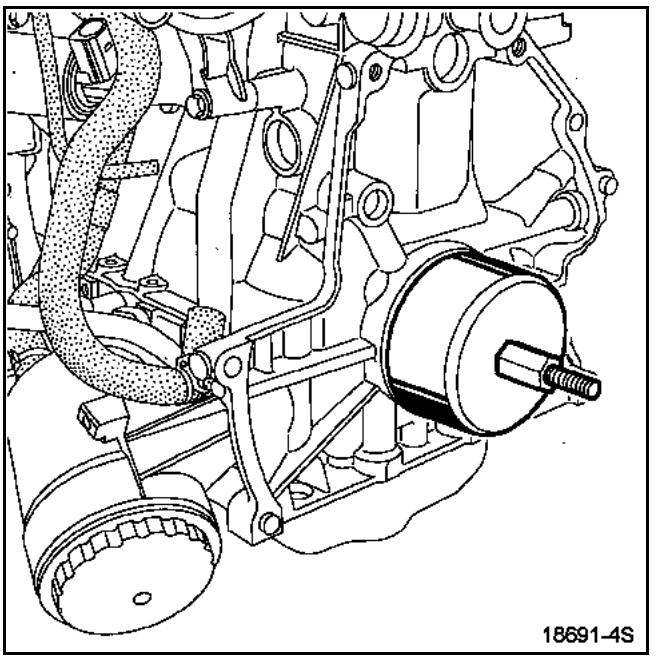
Put the protector with the seal on tool Mot. 1564, being careful not to touch the seal.



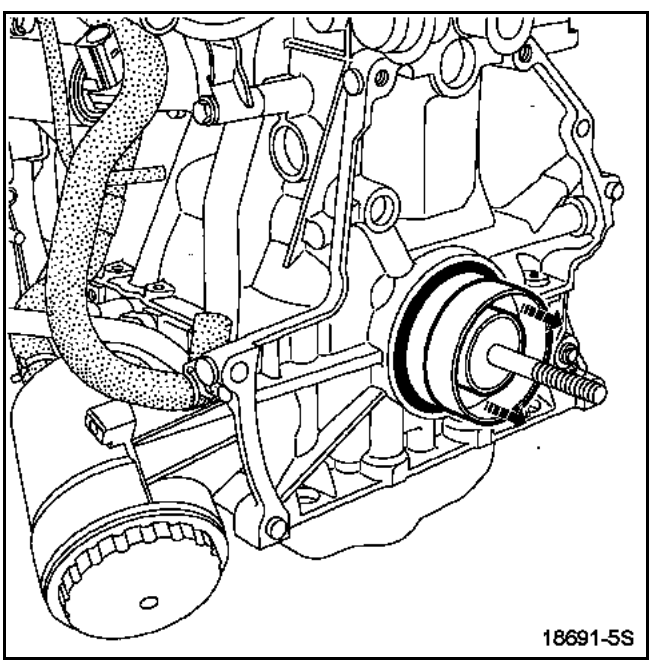
Mount the cover (**7**) and the nut (**8**) of tool Mot. 1564 (positioning the nut thread (**9**) towards the outside of the engine).



Tighten the nut until the cover touches the cylinder block.



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



Clean the crankshaft mounting bolt threads

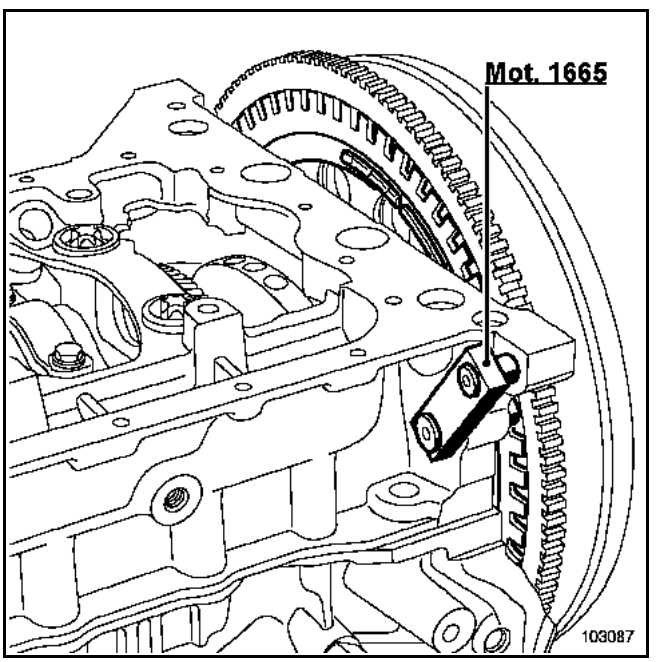
Degrease the bearing face of the flywheel on the crankshaft.

Refit the flywheel, hand-tightening all the bolts.

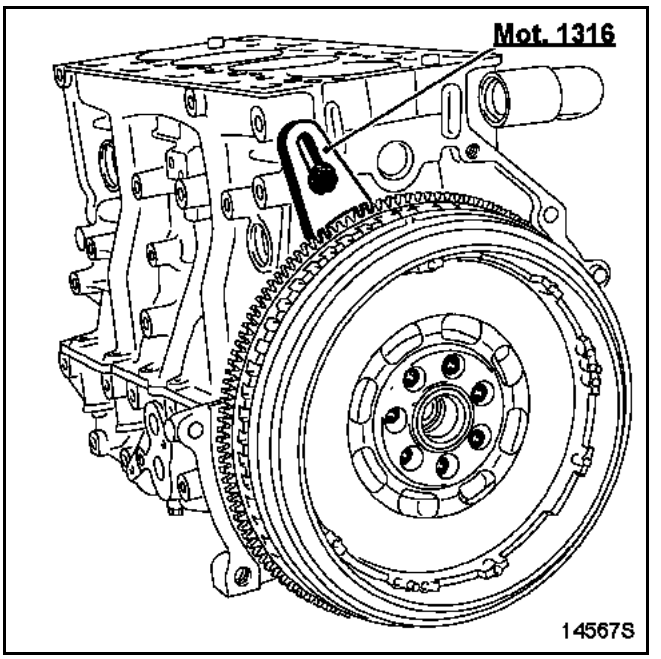
Fit the **TDC setting rod** (Mot. 1536).

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

Install the flywheel timing pin (Mot. 1665).



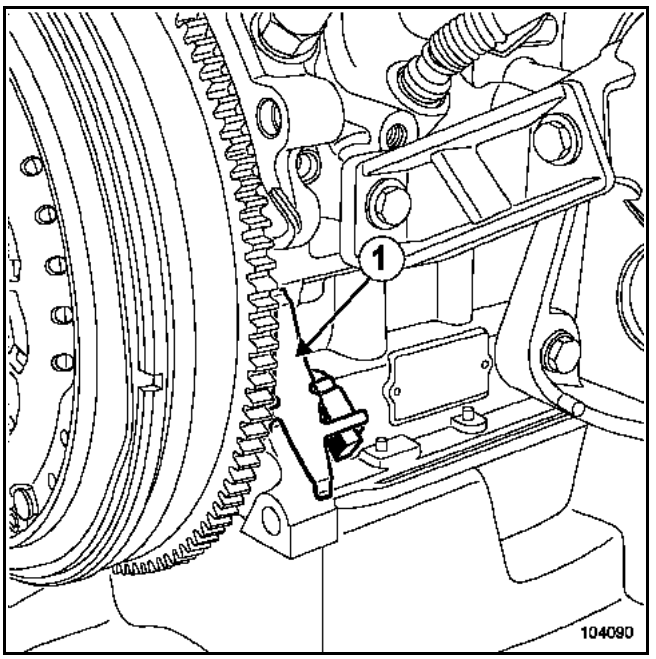
Install the flywheel immobiliser (Mot. 1316).



Tighten the bolts to a torque of:
- **2.5 daNm plus 50° ± 6° angle for the dual mass flywheel,**
- **2 daNm plus 45° ± 6 ° angle for the classic flywheel.**

Remove:
- the flywheel timing pin (Mot. 1665),
- the flywheel immobiliser (Mot. 1316).

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.

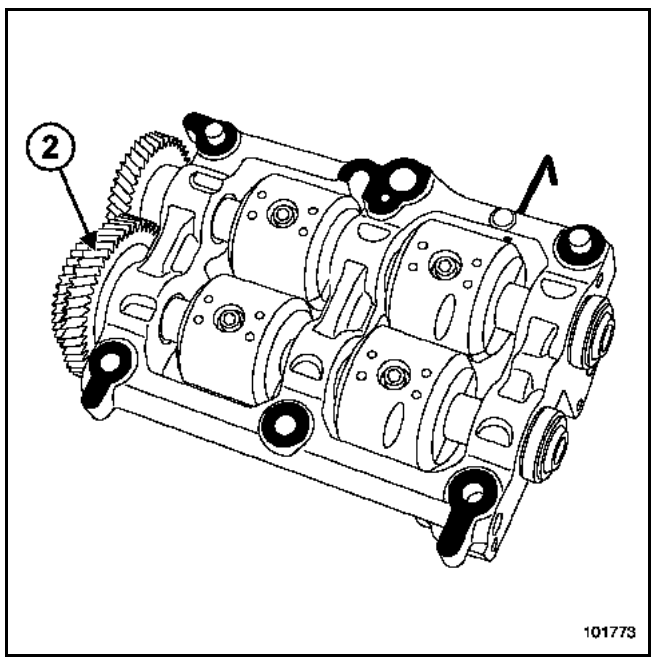
Operations to be performed for fitting a sensor that has already been used:
– file down the flange and insert a **1.15 mm** shim between the target and the sensor before releasing the clip.

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.

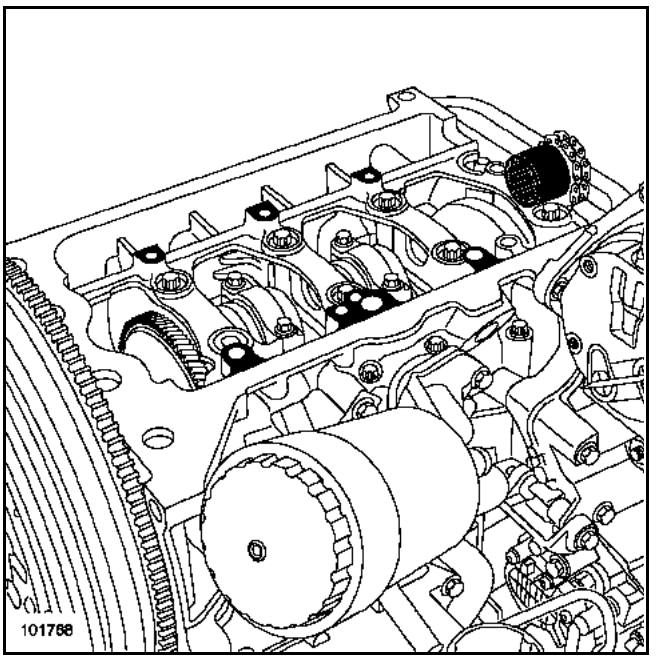
How to determine the crankshaft - balance shafts backlash



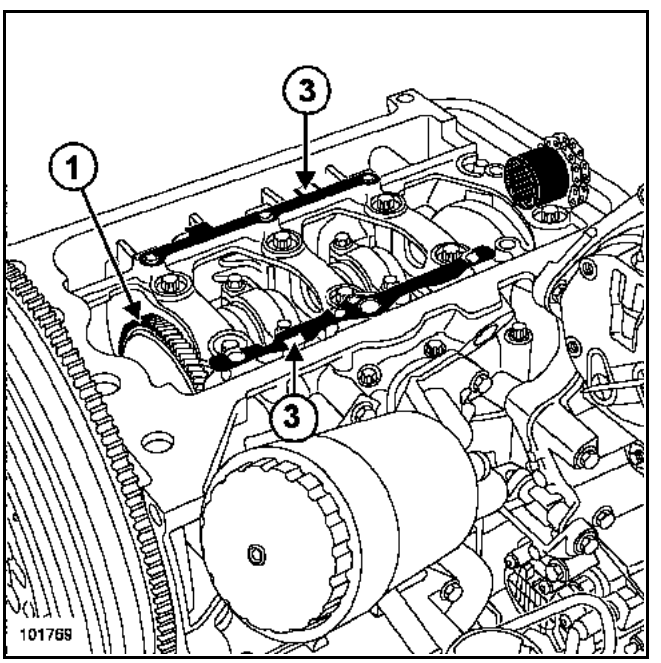
Clean the balance shaft assembly and cylinder block support points.

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.

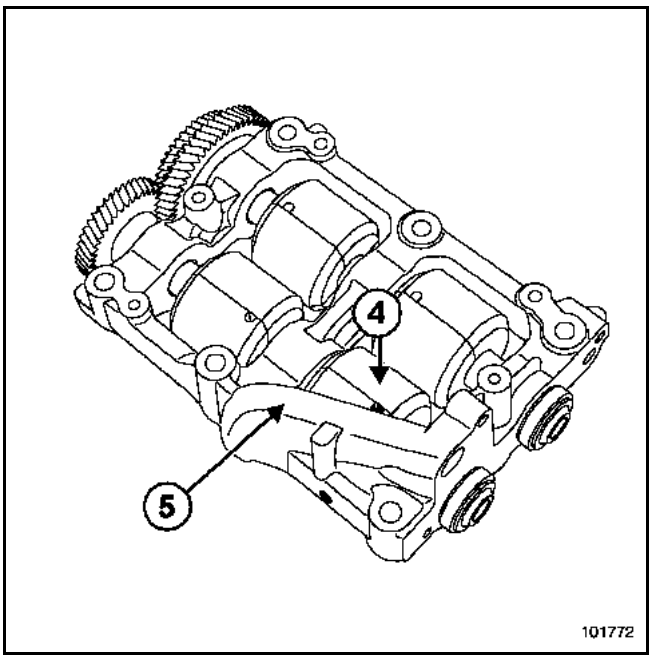


Take the two **2.22 mm** calibration shims from the kit, clean them, and put them in position on the cylinder block.



Note:
The shim thickness is etched on them at (**3**).

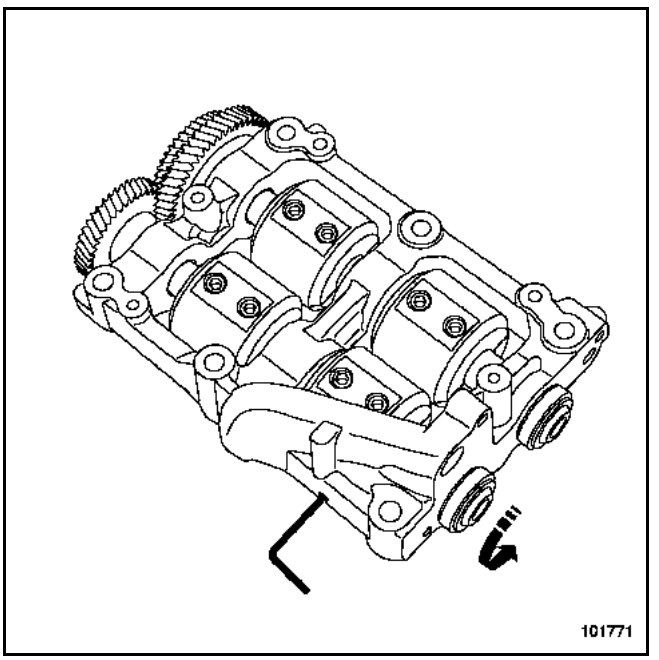
Make sure the balance shaft assembly is properly set.



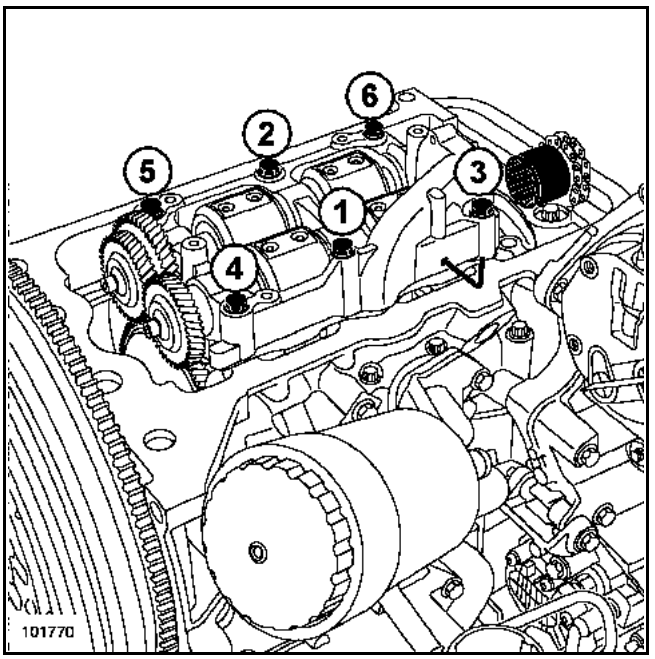
To do this, the hole position hole (**4**) in the balance shaft assembly vertically.

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**).

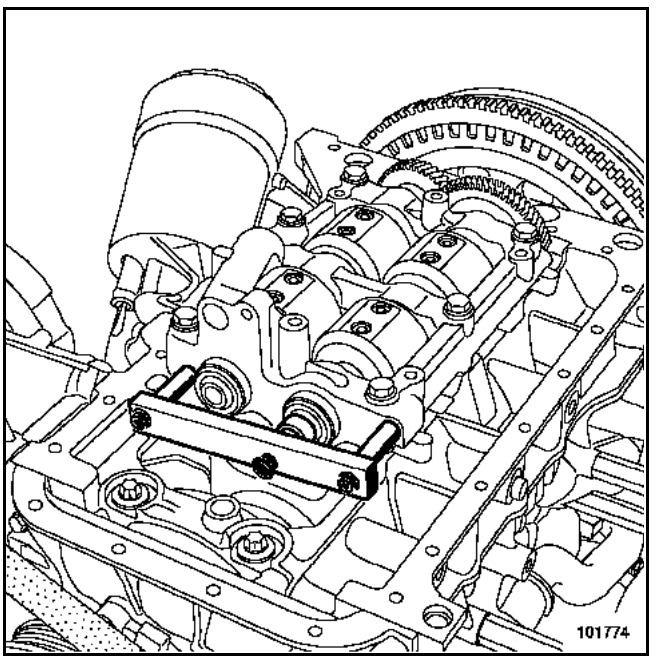


Check that the crankshaft is set at **top dead centre**.

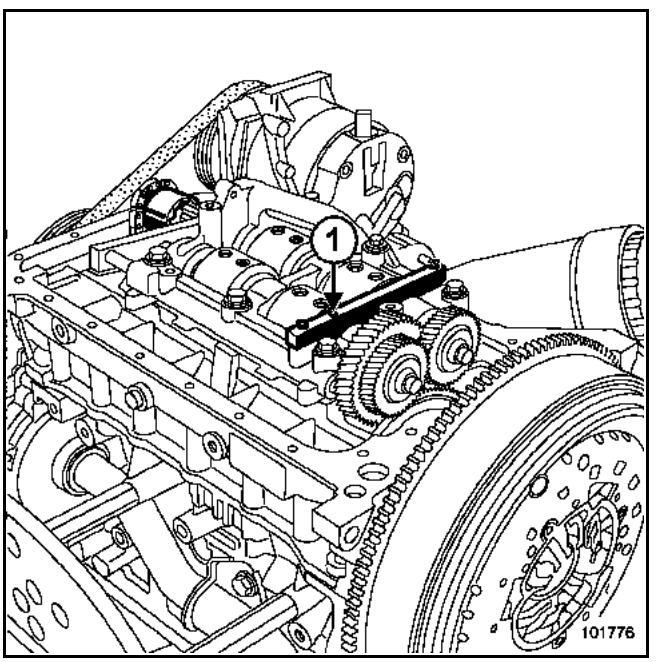


Refit the balance shaft assembly by tightening the old bolts in order and to torque (**1.5 daNm**), then angle tighten by **38° ± 6°**.

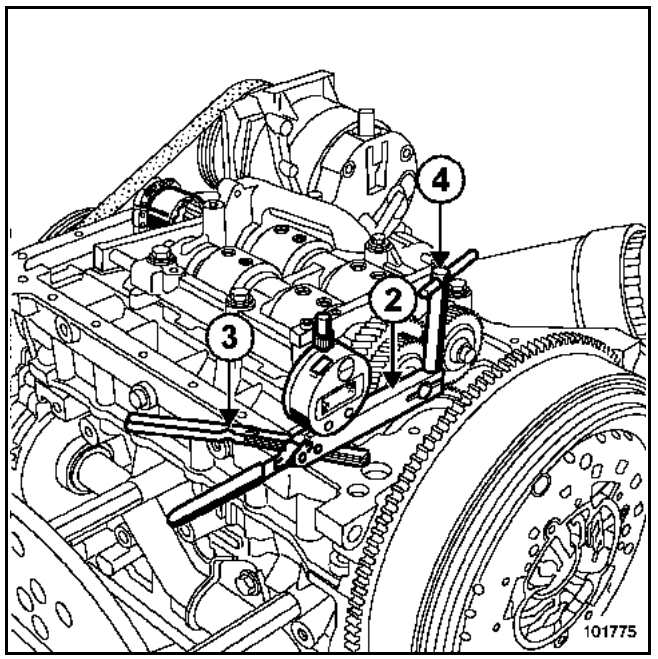
Fit the longitudinal clearance locking tool (Mot. 1660) on the balance shaft assembly.



Fit the radial clearance locking tool (Mot. 1660) on the balance shaft assembly after loosening the bolt (**1**).

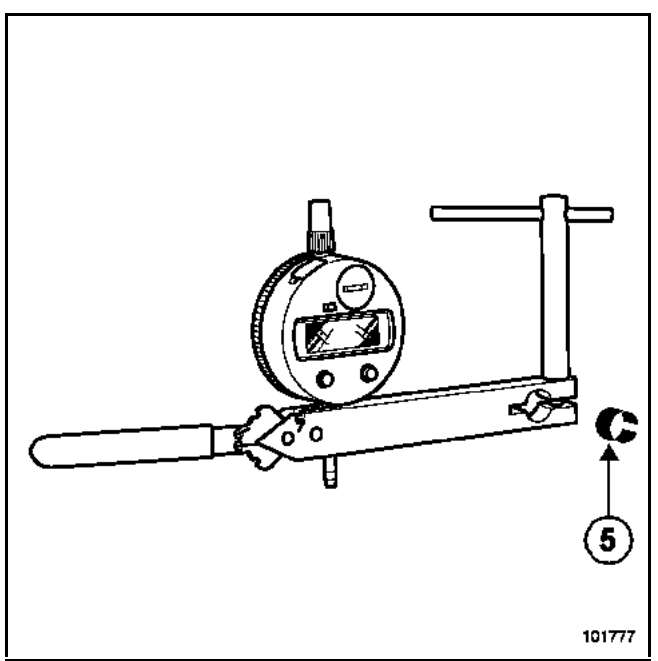


Tighten bolt (**1**) until it locks, then loosen bolt (**1**) by approximately **45°**.



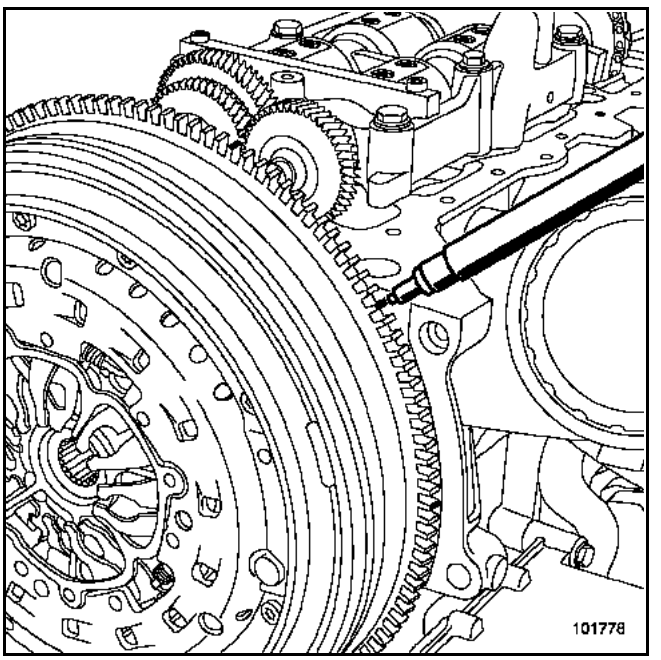
Place measuring tool (**2**) of the tool (Mot. 1660) on the end of the drive shaft. Position tool (**2**) horizontally with a set of shims (**3**), then immobilise the tool with a lock bolt (**4**).

Remove the set of shims.



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).

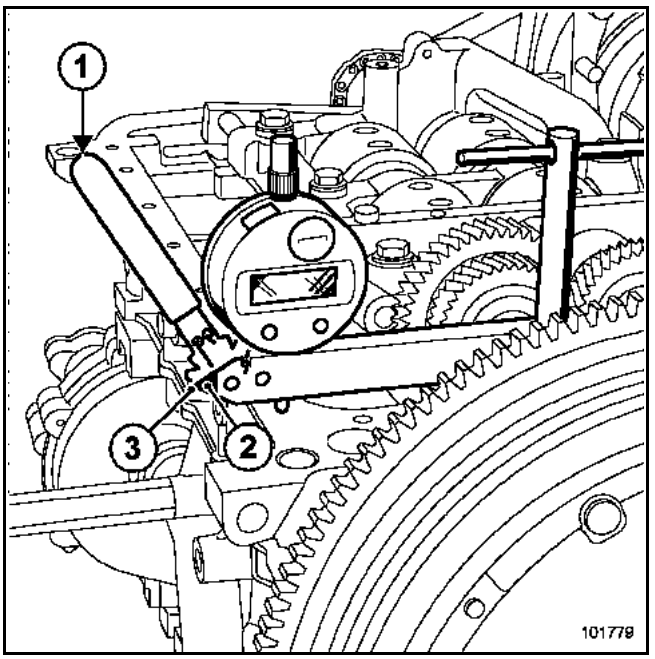
With a pencil, mark the starter ring gear teeth (one mark every 13 teeth).

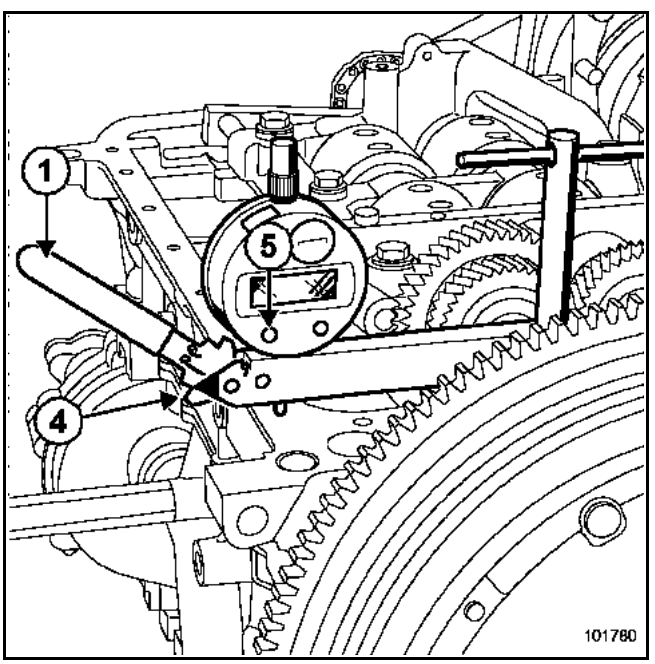


Fit the dial gauge on the measuring tool.

Remove the **TDC** setting rod (Mot. 1536).

Determining the backlash

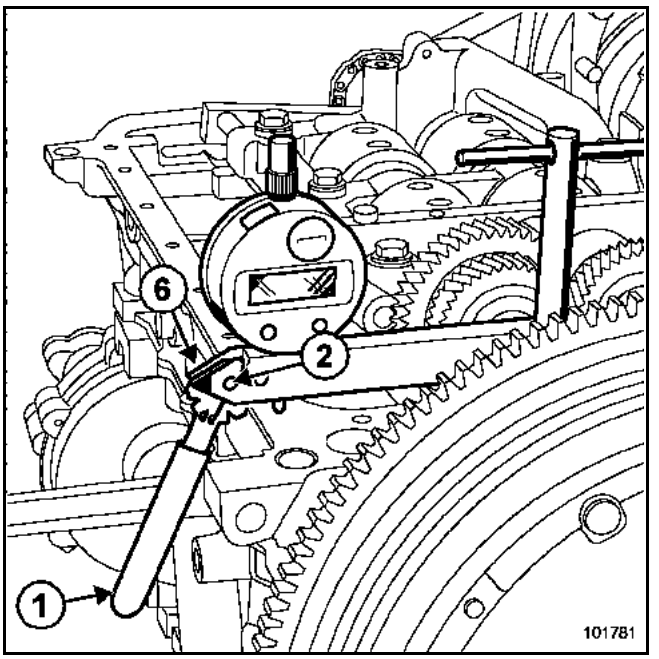


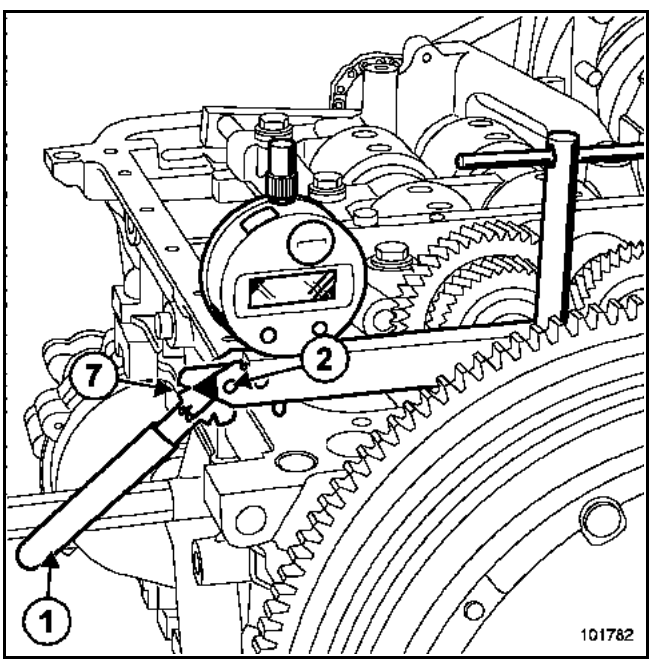


Pull lever (**1**) upward until the fixed pointer (**2**) is aligned with the lower part (**3**) of the lever.

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.

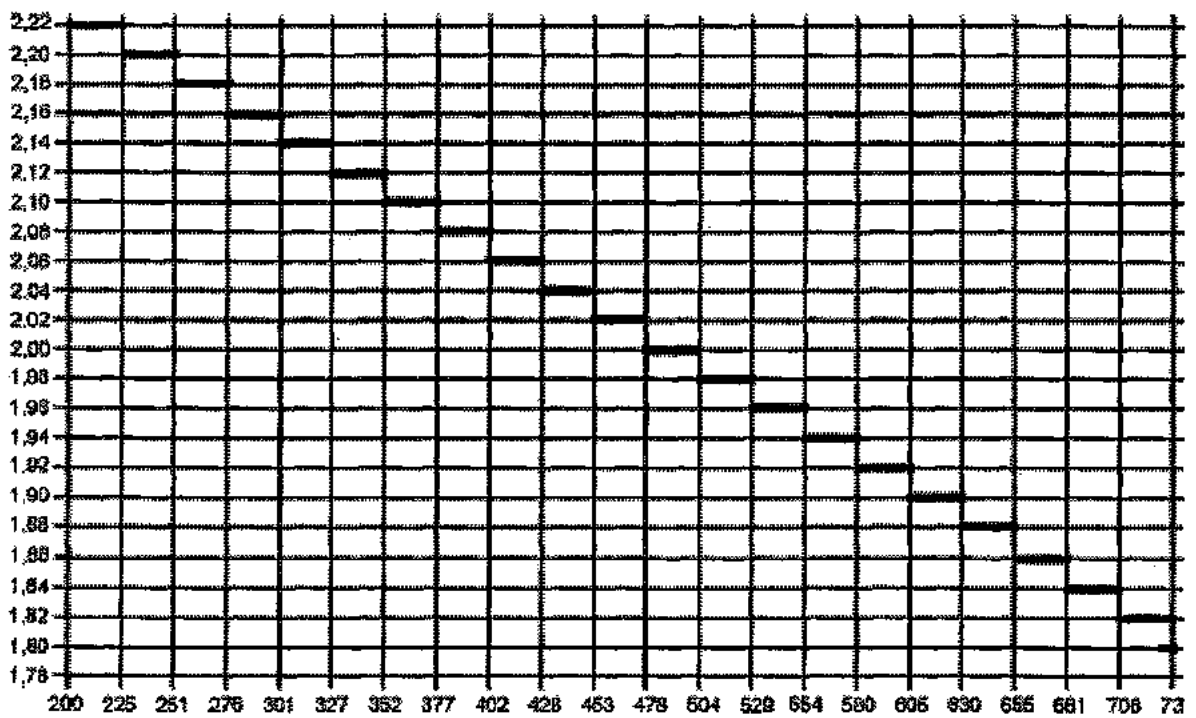
Position the measuring tool (Mot. 1660) horizontally with a set of shims, then lock it.

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).

Adjustment shim thickness based on backlash measured with the calibration shim



Dial gauge backlash reading (in µm)

Remove the measuring tool (Mot. 1660).

Set the crankshaft at **top dead centre** with the rod (Mot. 1536).

Set the balance shaft assembly with a **4 mm** Allen key.

Remove the balance shaft assembly.

Remove the **2.22 mm** calibration shims.

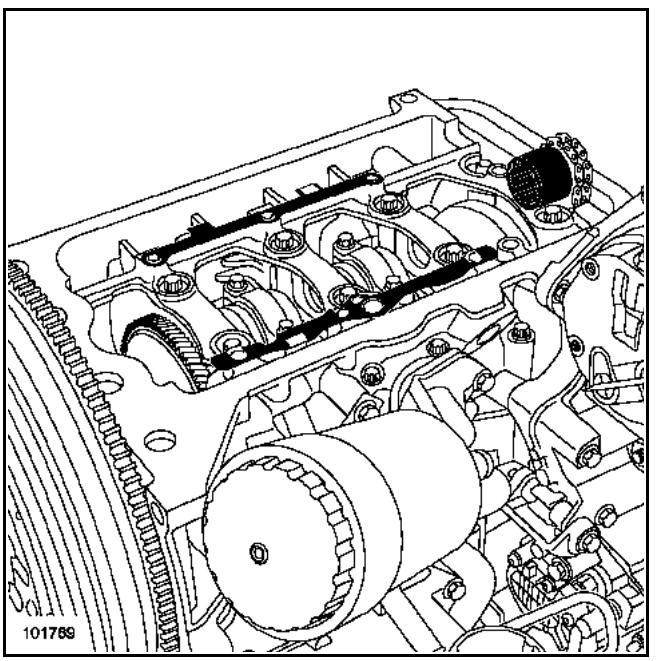
Clean the balance shaft assembly and cylinder block support points.

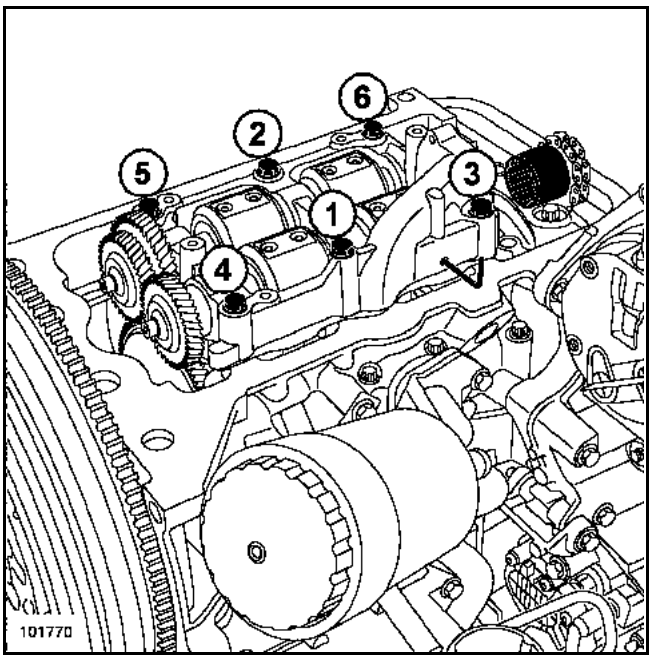
Clean the shims.

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.

Make sure the crankshaft and balance shaft assembly are set.

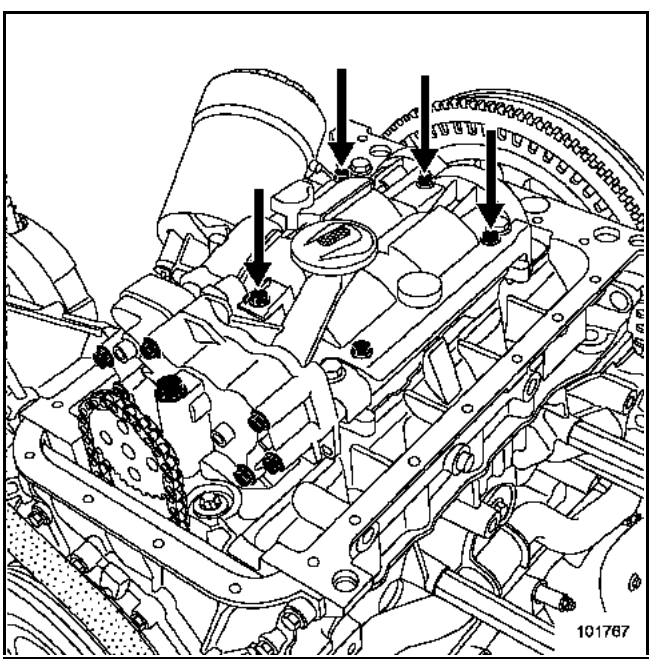
Refit the selected shims.



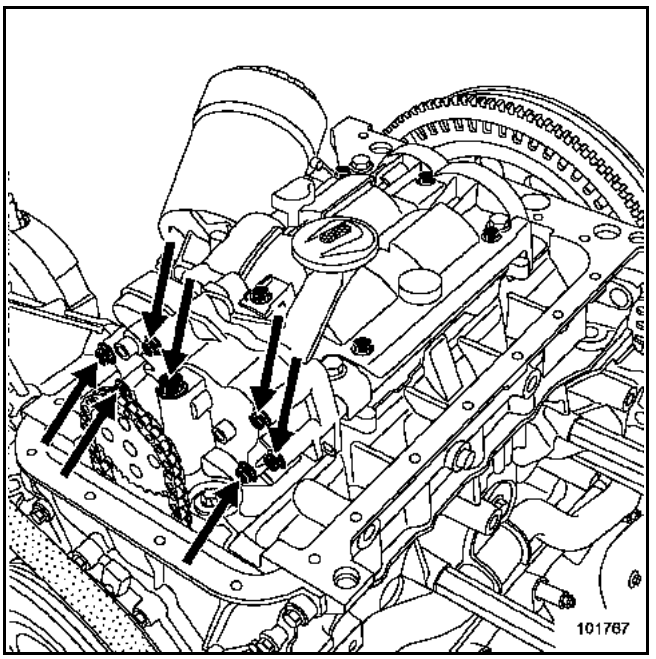


Refit the balance shaft assembly by tightening the new bolts in order to torque (**1.5 daNm**), then angle tighten by **38° ± 6°**.

Remove the locking tools (Mot. 1660) , the **TDC** setting rod (Mot. 1536), and the **4 mm Allen key**.

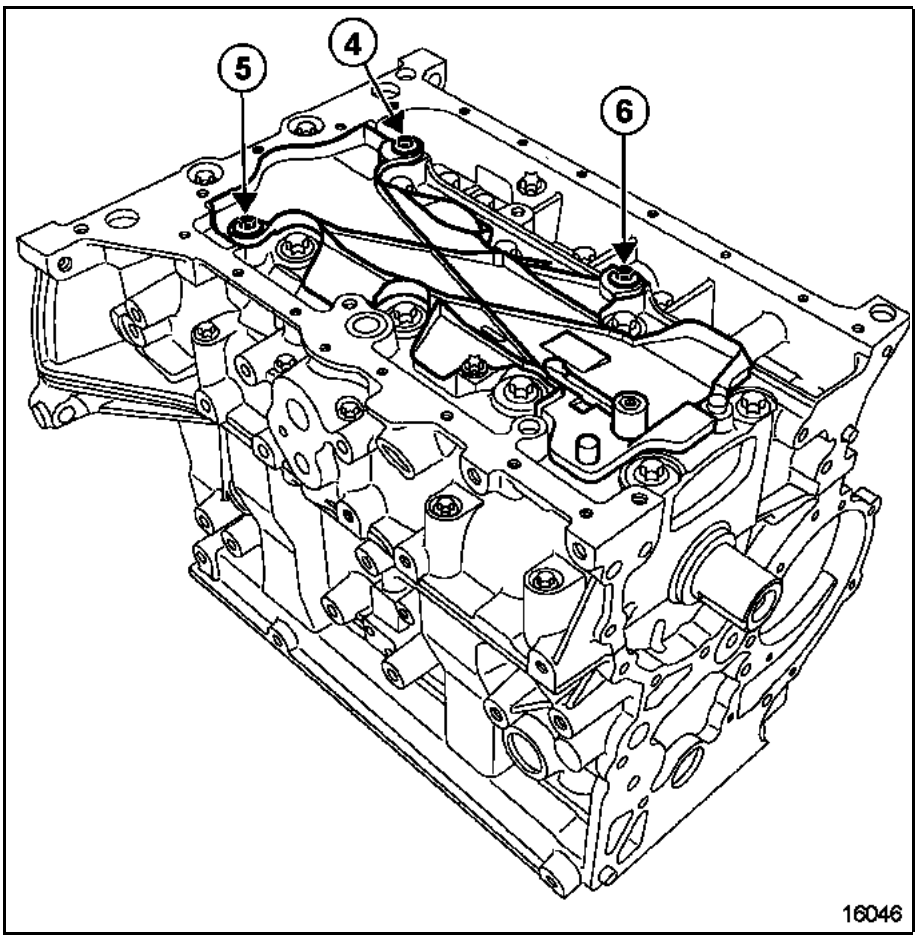


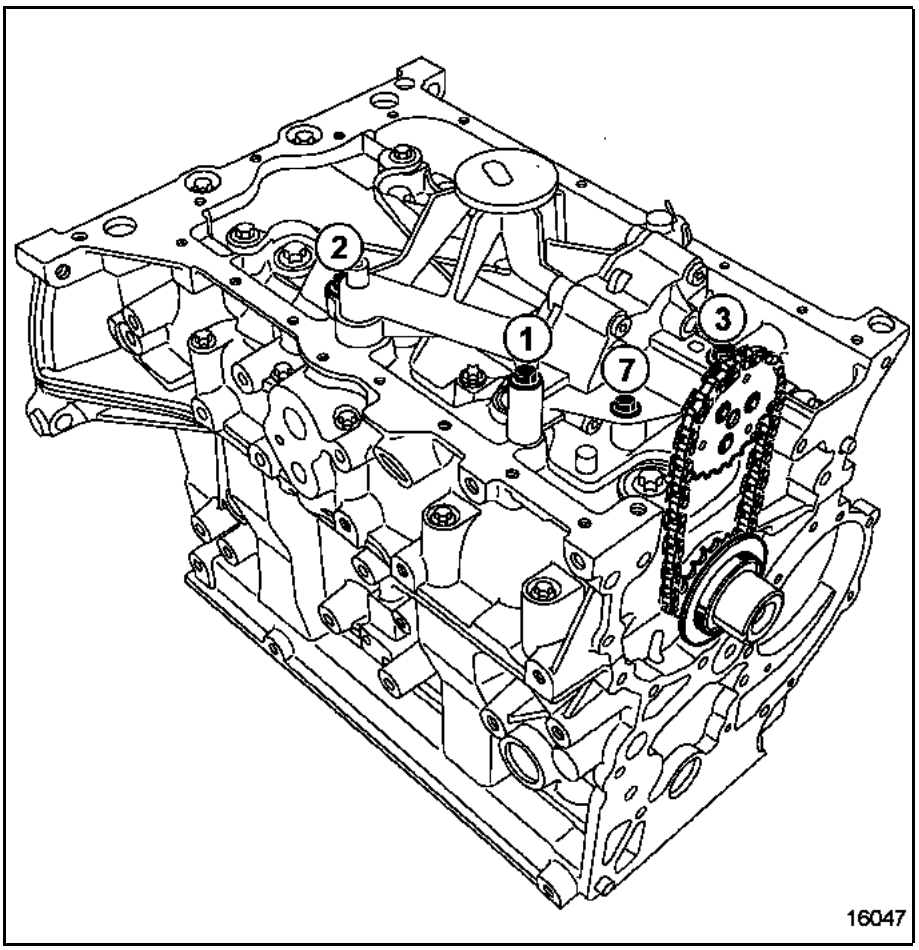
Refit the anti-emulsion plate, tightening the bolts to a torque of **1 daNm**.



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





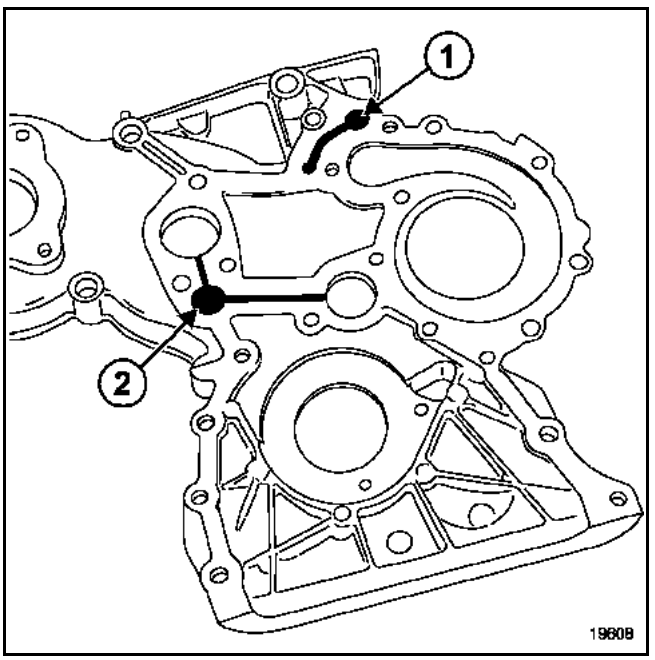
Refit:
– the anti-emulsion plate without locking the bolts,
– the oil pump drive chain and sprocket.

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**).

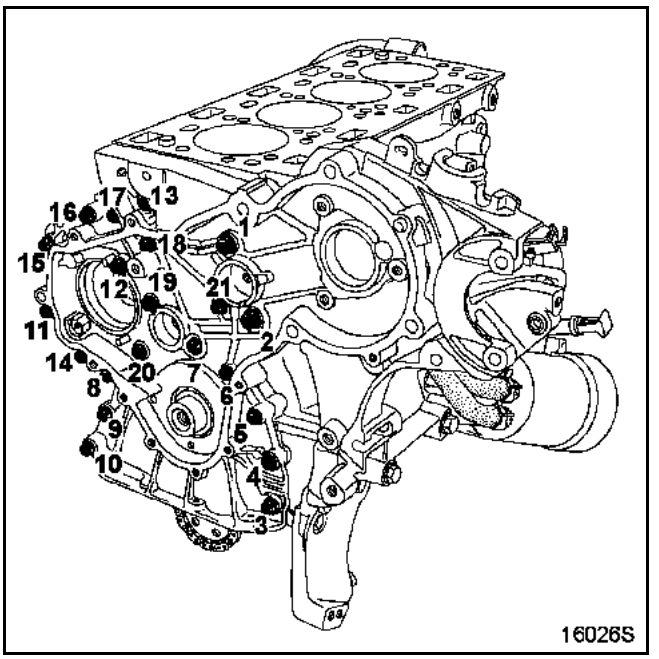
ALL TYPES

Clean the inner timing cover.



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

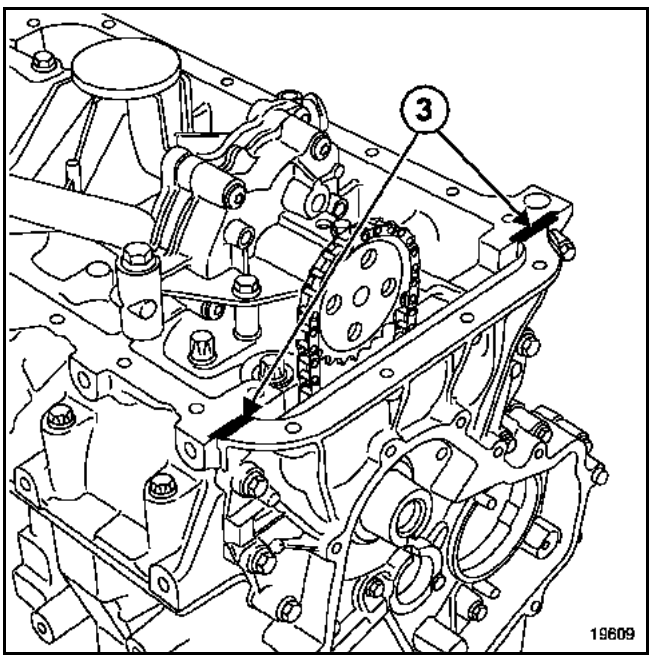
Fit the seal between the cylinder block and the inner timing cover.
– bolts **19**, **20**, **21** are **M6*100-20** bolts,
– bolts **1** and **2** are **M8*125-20** bolts,
– the other bolts are **M6*100-30** bolts.



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

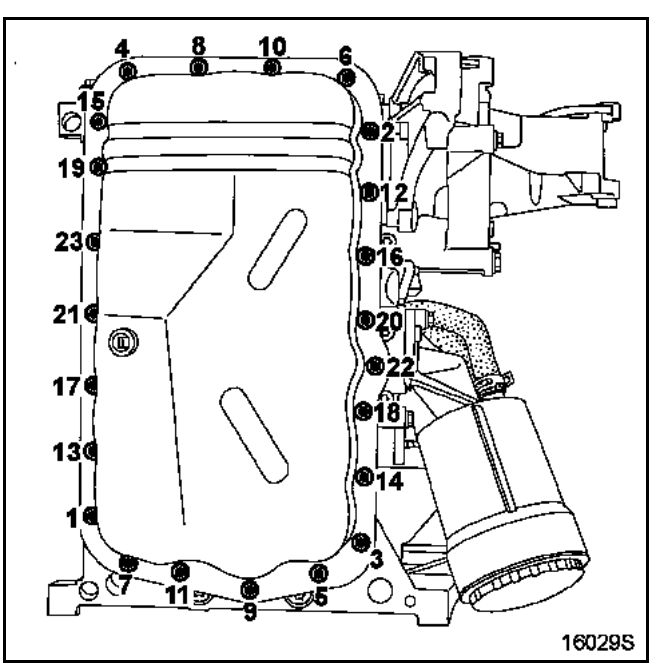
Assembly	Bolt tightening order	Tightening torque (in daNm)
Operation No. 1	7 - 18 - 5 - 14 - 10 - 3 - 16 - 20 - 12	1 (pre-tightening)
Operation No. 2	1 - 2	3
Operation No. 3	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21	1.2

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.)



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**).

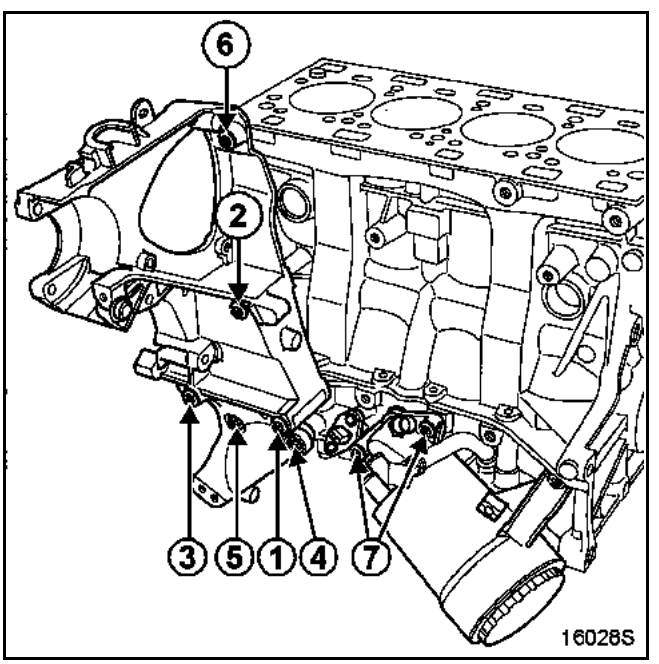


Refit the multifunction support by securing it against both the cylinder block and on the inner timing cover.

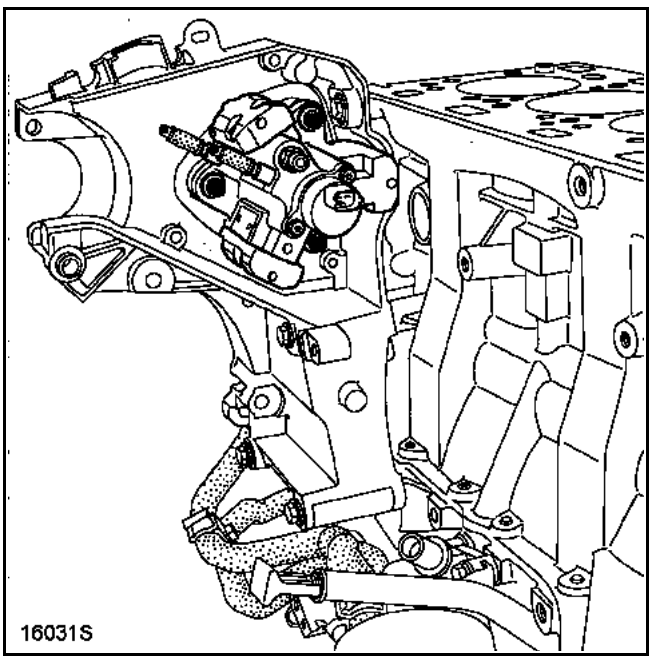
Tighten the bolts in order and to torque (**3 daNm**).

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**).

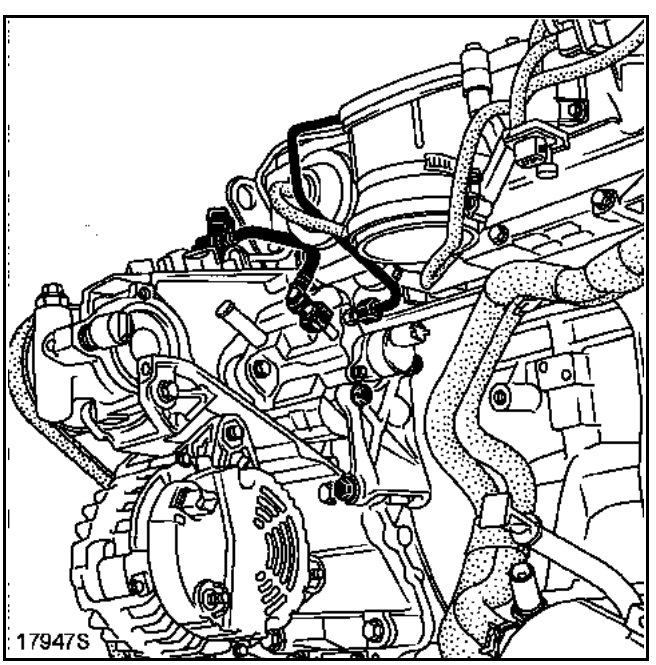


Refit the high pressure pump, applying one or two drops of **LOCTITE FRENETANCH**, then tighten the bolts to a torque of **3 daNm**.

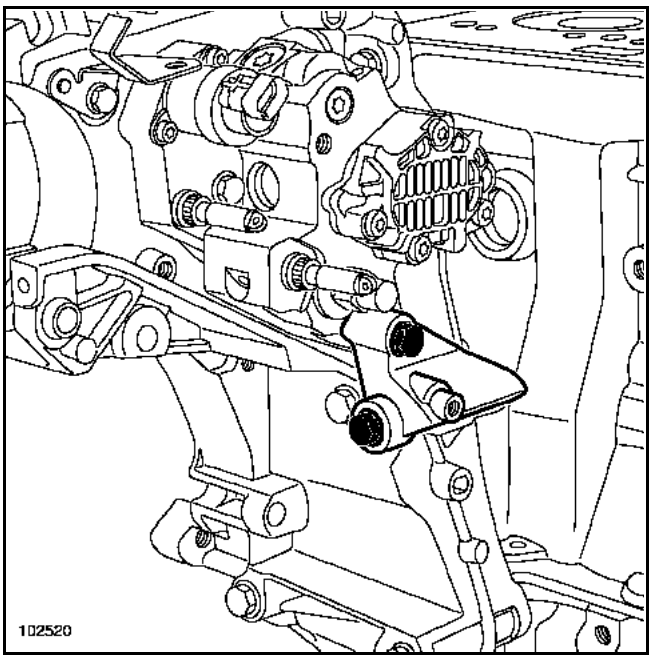


Refit the high pressure pump rear support, tightening the bolts to a torque of **3 daNm**.

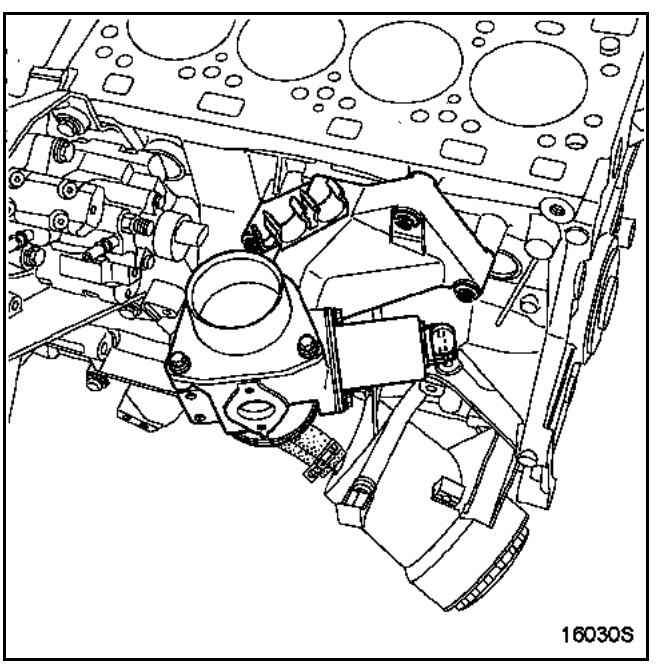
Model 1



Model 2



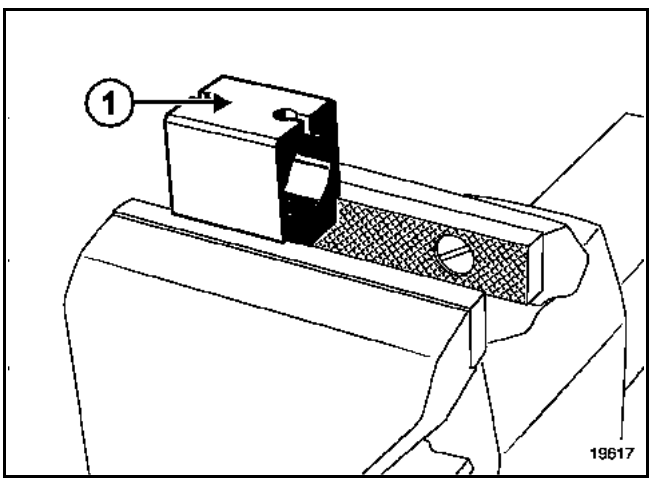
Refit the venturi unit, tightening the bolts to a torque of **2.5 daNm**.



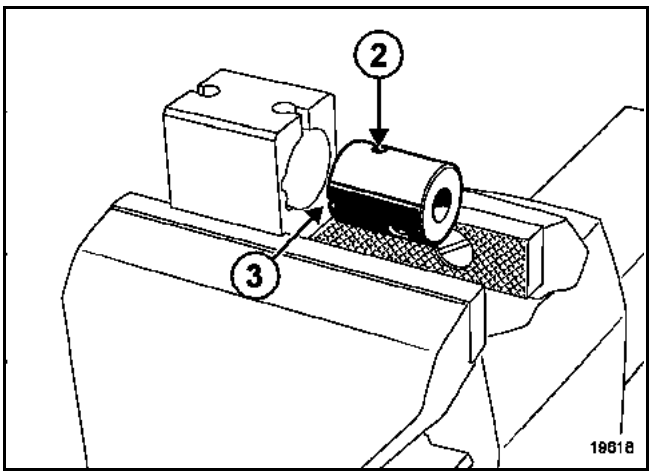
FITTING THE INTERMEDIATE SHAFT ROLL PINS

Roll pins are fitted using tool Mot. 1542.

Intermediate shaft No. 1



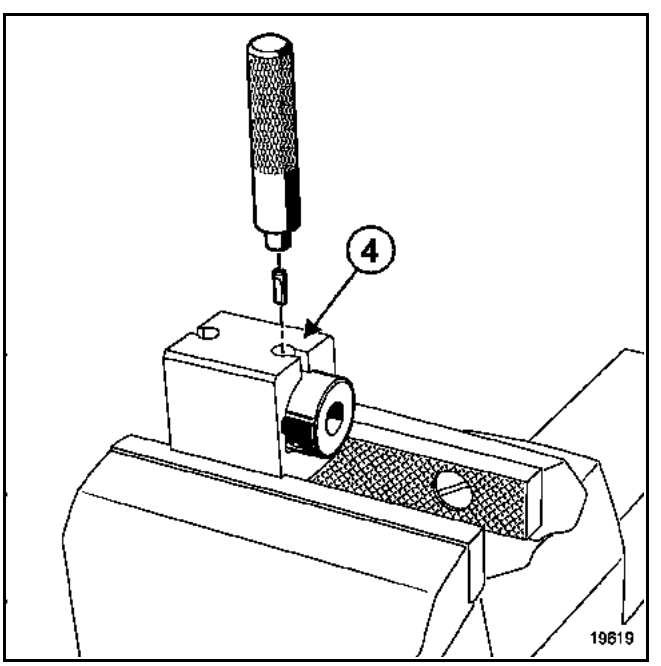
Position the base (**1**) of tool Mot. 1542 in the vice.



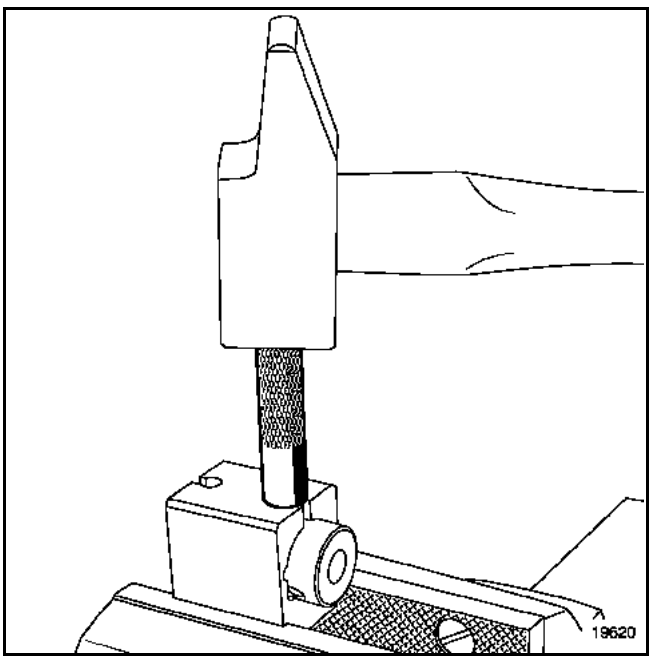
Offer up the intermediate shaft as shown in the diagram.

The roll pin housing (**2**) must be facing upward and the shaft groove (**3**) must fit onto the lug on the base.

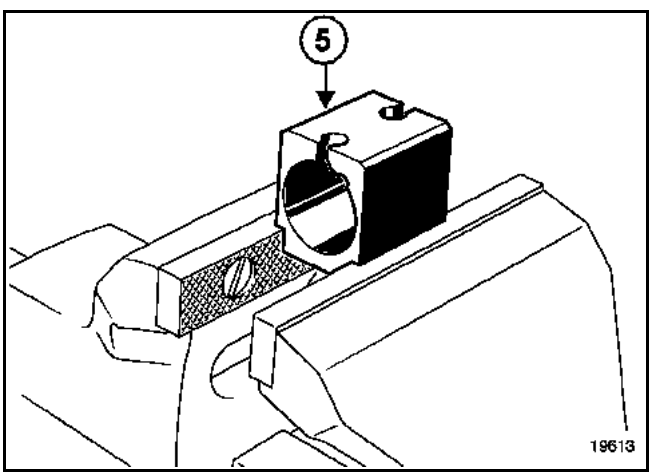
Insert the roll pin into the hole (**4**) in the base.



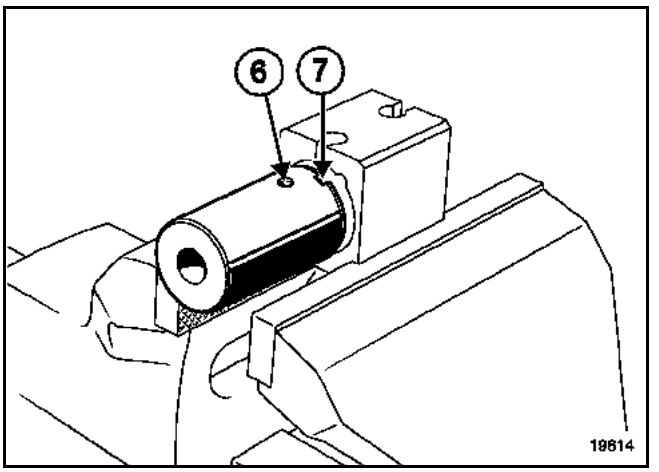
Tap the roll pin punch with a hammer until the punch comes into contact with the base.



Intermediate shaft No. 2



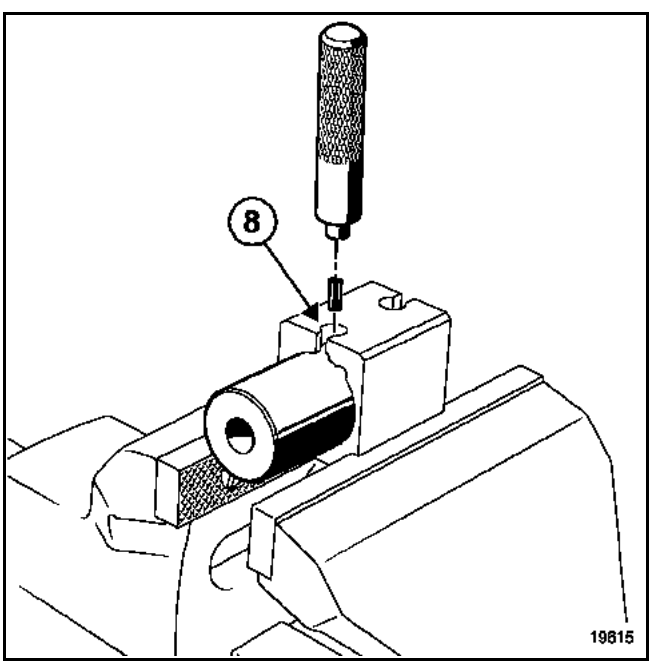
Position the base (**5**) of tool Mot. 1542 in the vice.



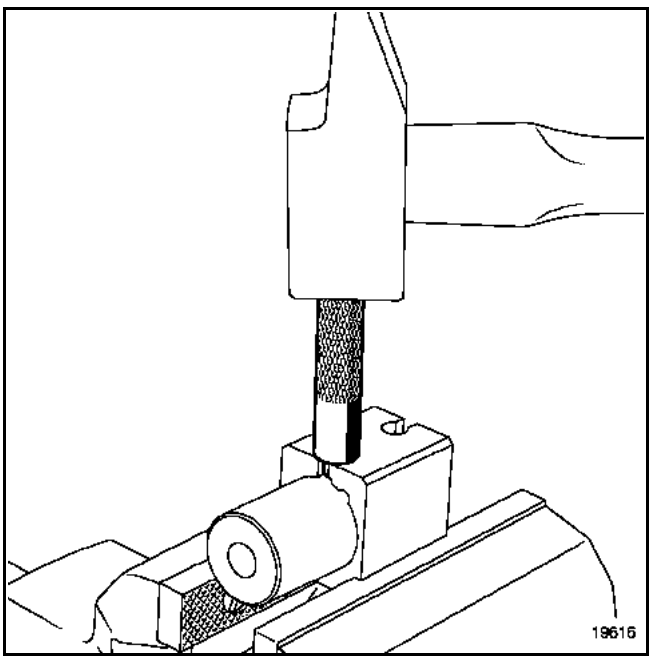
Offer up the intermediate shaft as shown in the diagram.

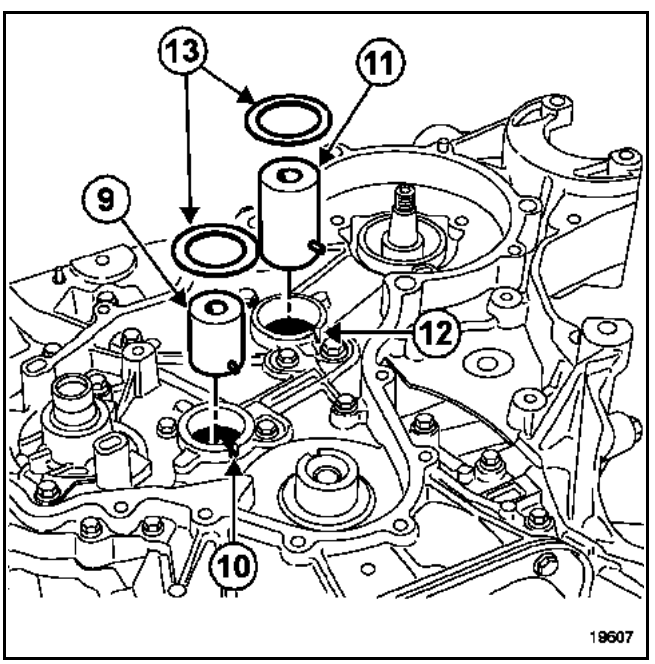
The roll pin housing (**6**) should be facing upward and the shaft groove (**7**) should fit onto the lug on the base.

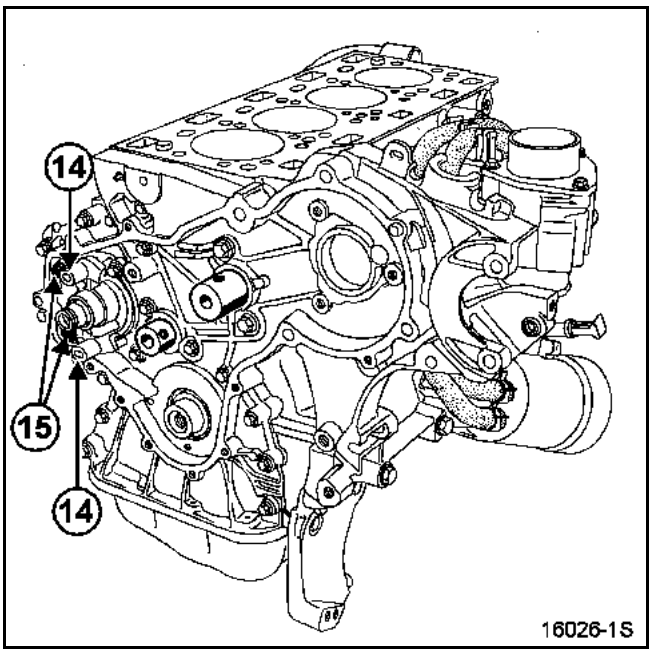
Insert the roll pin into the hole (**8**) in the base.



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.

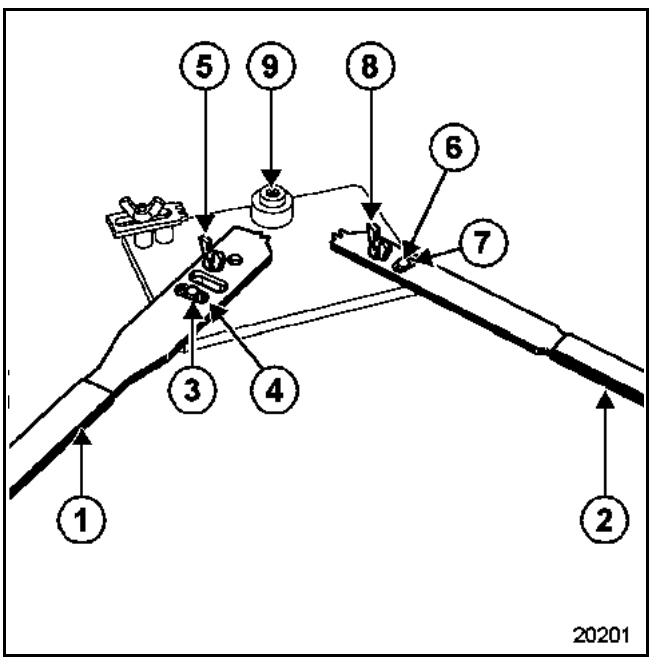
Tighten the bolts (**15**) to torque (**1 daNm**).

REPLACING THE PLAY COMPENSATION SPROCKETS

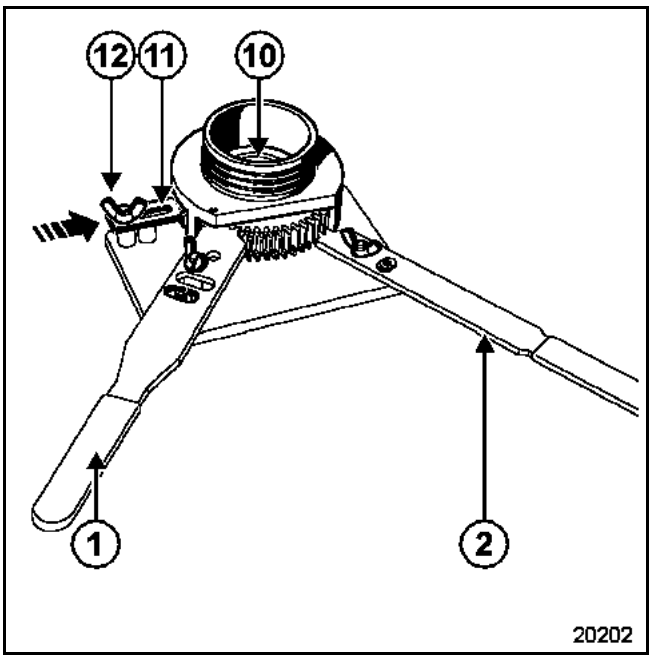
Note:
Special tooling is required for this operation.

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.

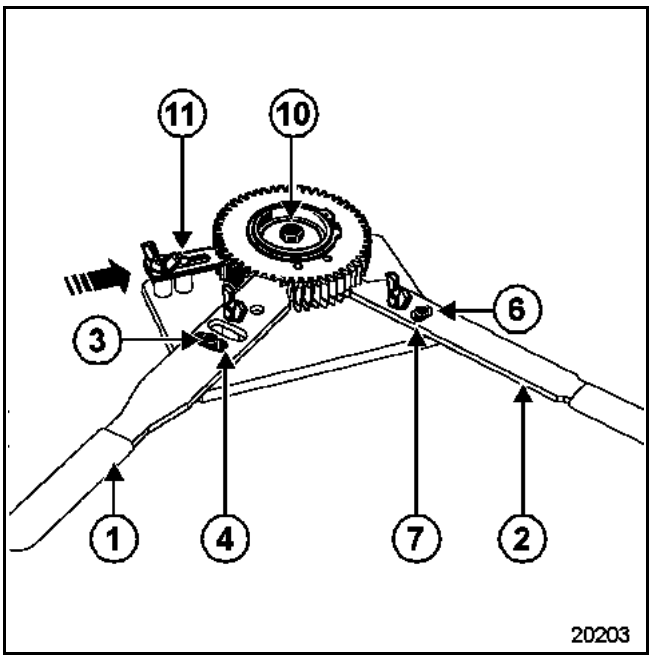
Fit intermediate sprocket **No. 1** on the locator (**9**).

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**).

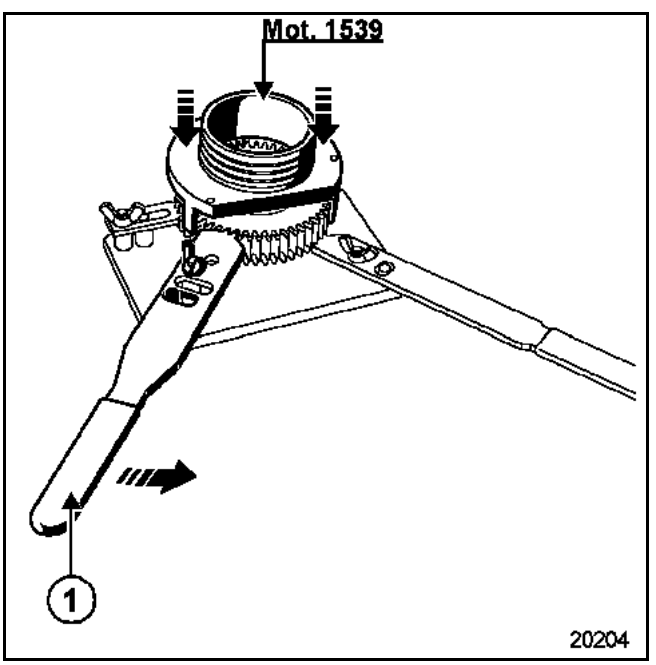
Remove tool Mot. 1539, holding the levers (**2**) and then (**1**) in turn to facilitate removal of the tool and to prevent the gear tooth automatic compensation from relaxing suddenly.

Remove intermediate sprocket **No. 1**.



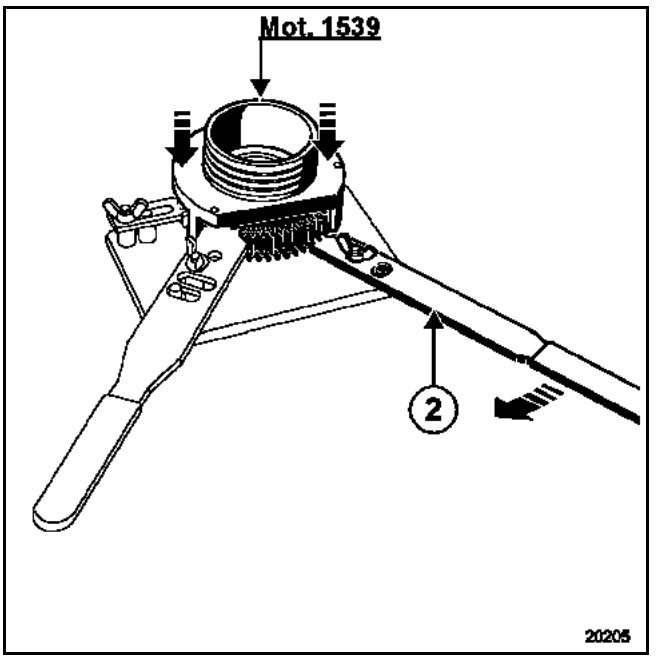
Refit the new intermediate sprocket **No. 1**, locking it by means of the bolt (**10**) and the toothed segment (**11**).

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.



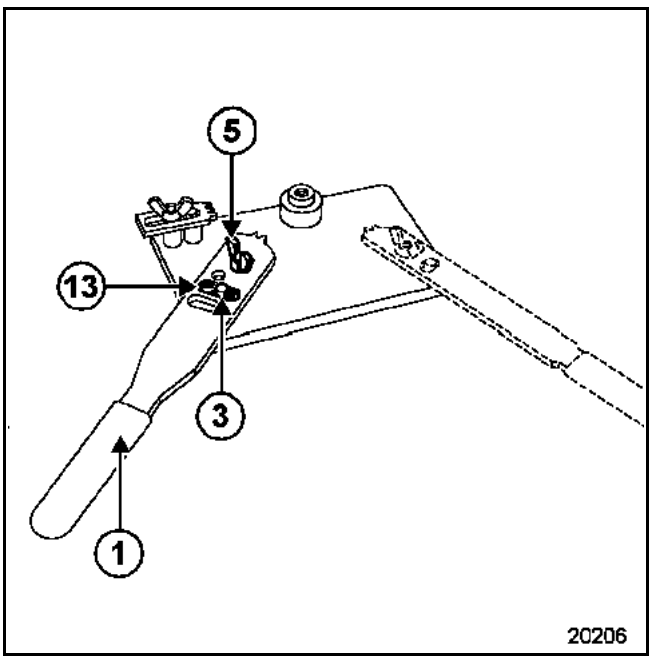
Turn the lever (**2**) in the direction of the arrow to align the teeth of the hub with those of the lower flange.

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.

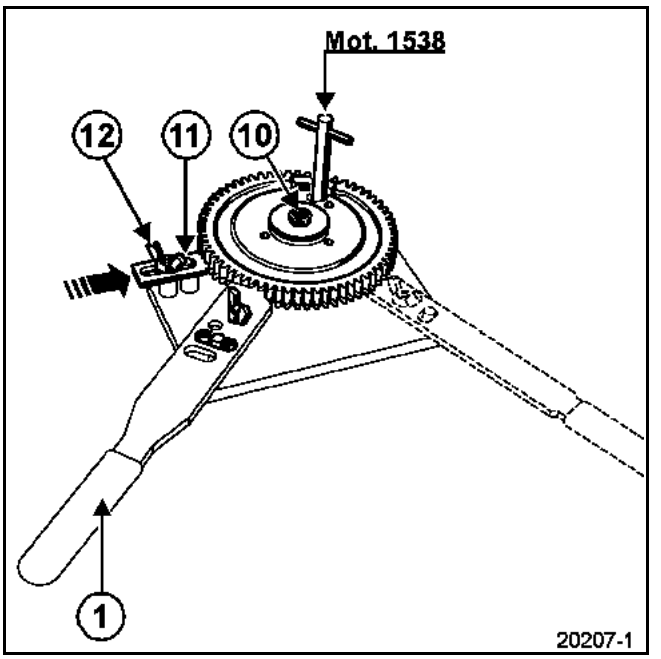


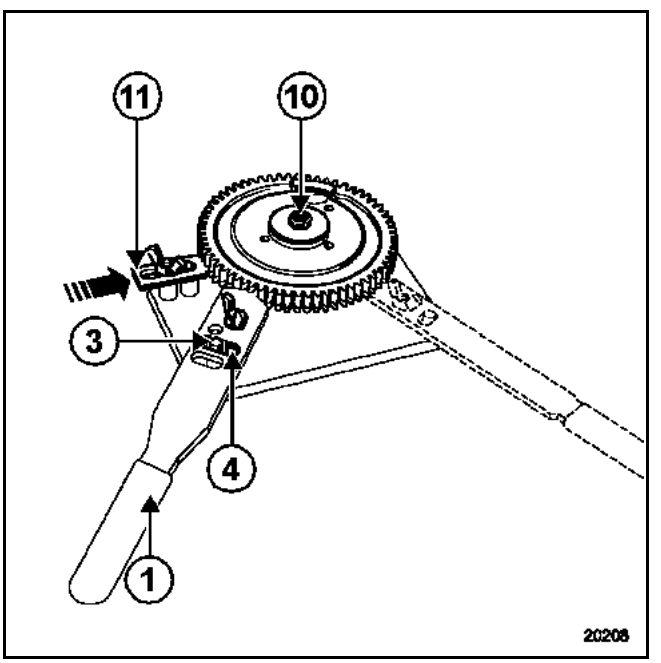
Adjust lever (**1**) so that the locating pin (**3**) is in groove (**13**), then tighten the wing nut (**5**).

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.

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**).

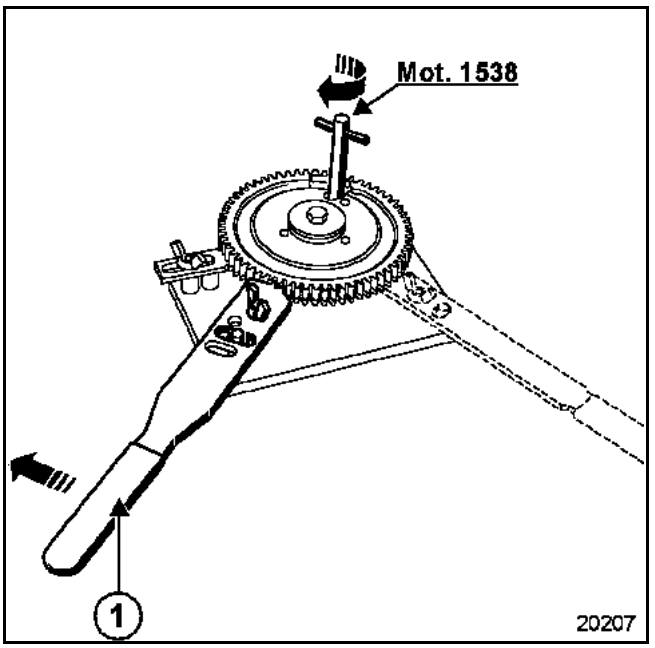
Remove tool Mot. 1538, holding the lever (**1**) to facilitate removal of the tool and to prevent the gear tooth automatic compensation from relaxing suddenly.





Refit the new high pressure pump sprocket, locking it with bolt (**10**) and the toothed segment (**11**).

Check that the locating pin (**3**) is in the middle of the groove (**4**) on the lever (**1**).



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

Screw tool Mot. 1538 until it locks.

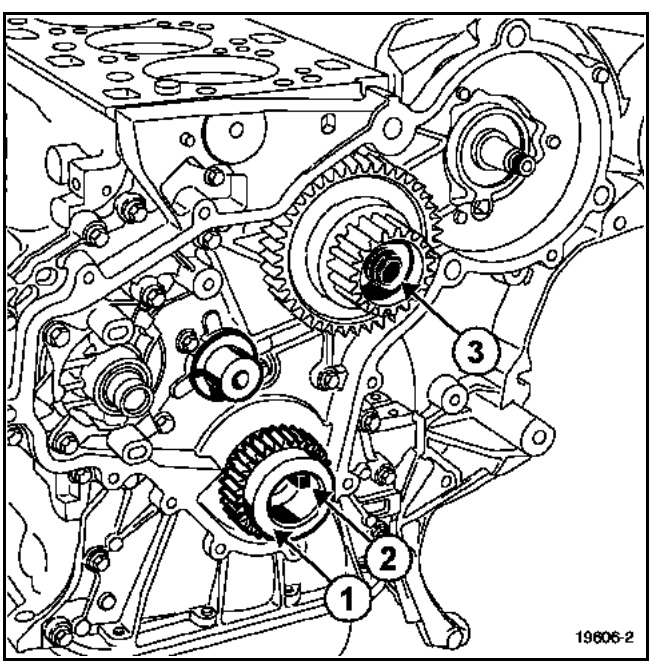
Remove the high pressure pump sprocket from tool Mot. 1540.

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

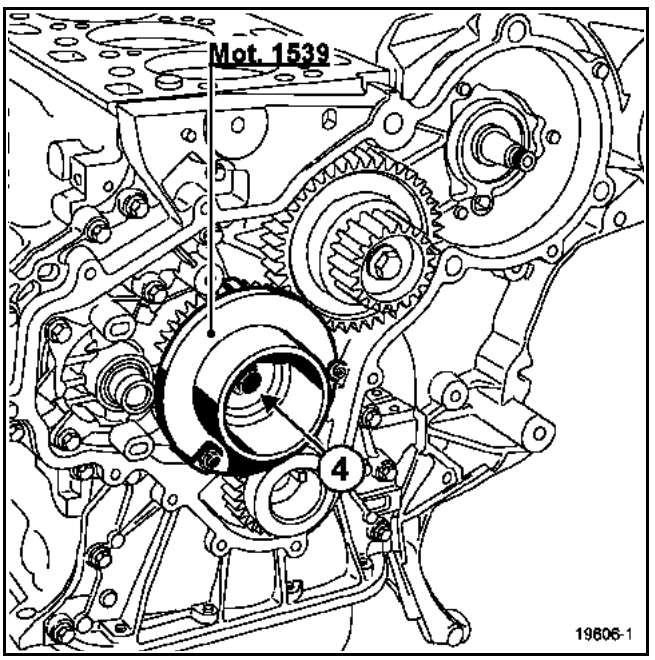
WARNING
When replacing intermediate sprocket number 1 (on its own) or intermediate sprocket number 2 (on its own), **be sure to** replace both sprockets in the cases listed below.
Engines concerned:
– G9T 710 up to the following engine number: C 064517
– G9T 720 all engines are concerned
– G9T 722 up to the following engine number: C 012789
– G9U 720 up to the following engine number: C 012204

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**).

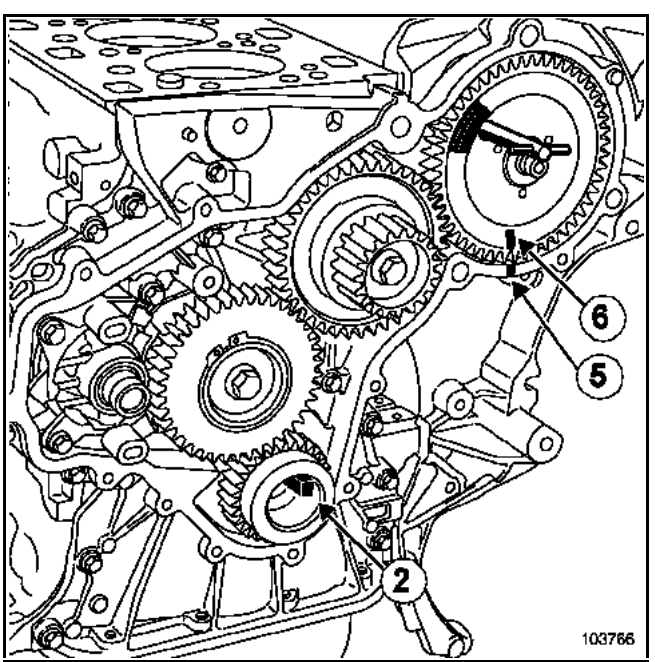


Refit intermediate sprocket **No. 1**, tightening the bolt (**4**) to torque **(2.5 daNm) plus an angle of 30° ± 6°**, then remove tool Mot. 1539



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.

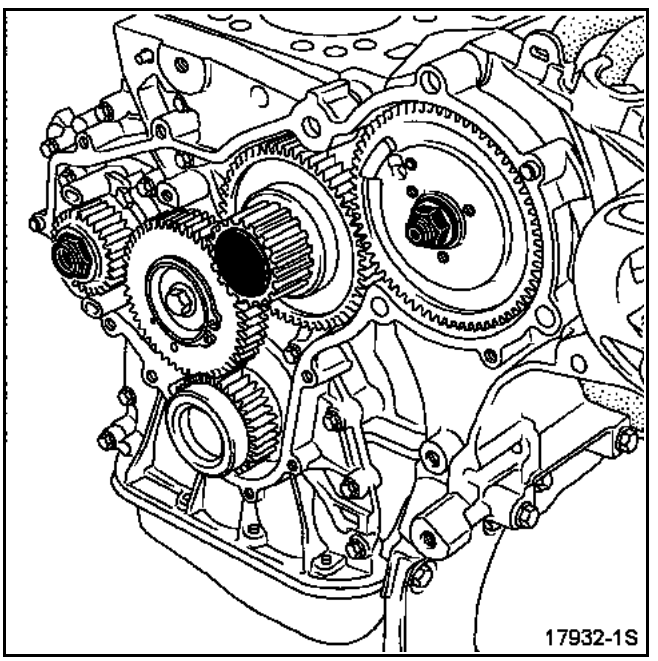
Then remove the TDC setting rod (Mot. 1536).



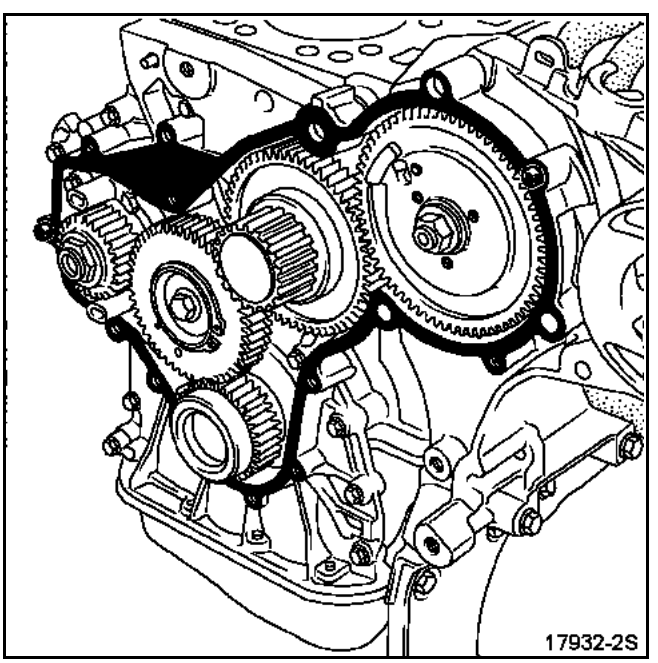
Refit the high pressure pump sprocket, aligning marks (**5**) and (**6**).

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

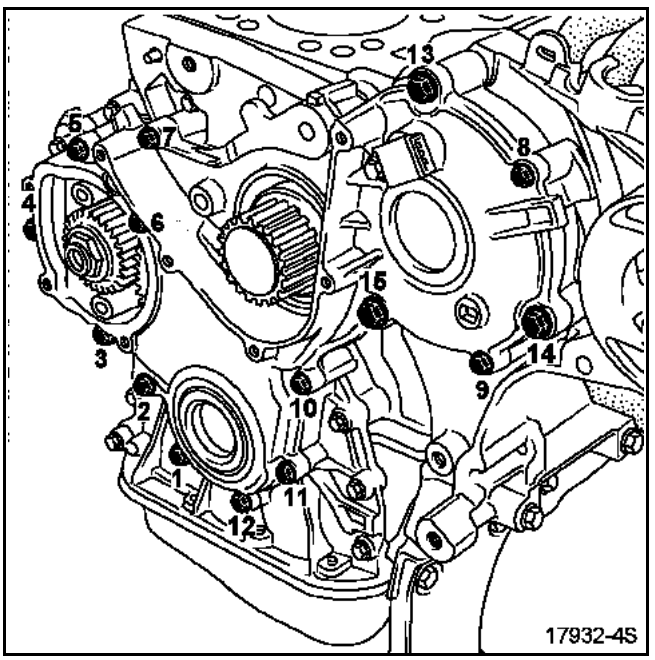
Refit the water pump sprocket, tightening the nut to a torque of **4 daNm**.



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.

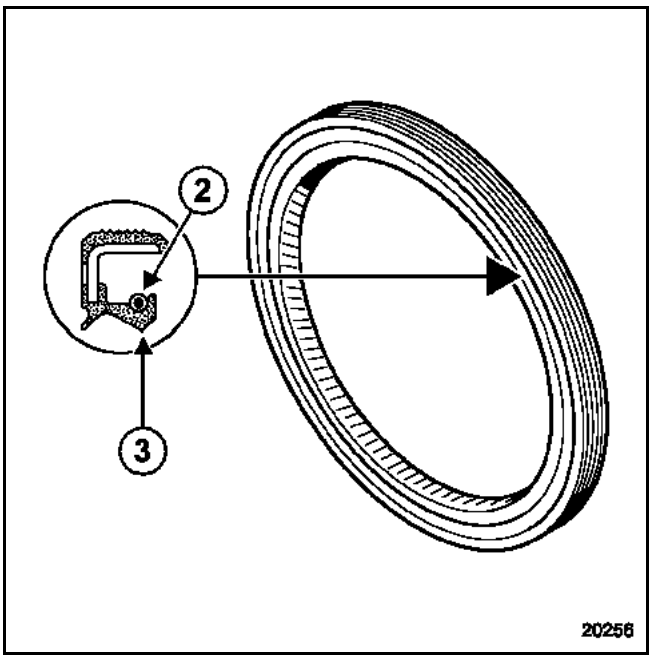


Tighten to torque in the following order:

- **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.

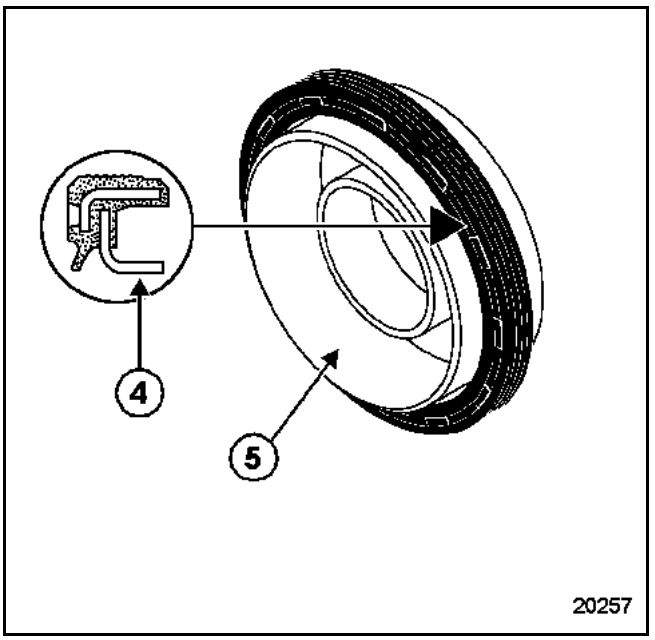
This engine can be fitted with two different types of seal.



Old and new seals are easily recognised.

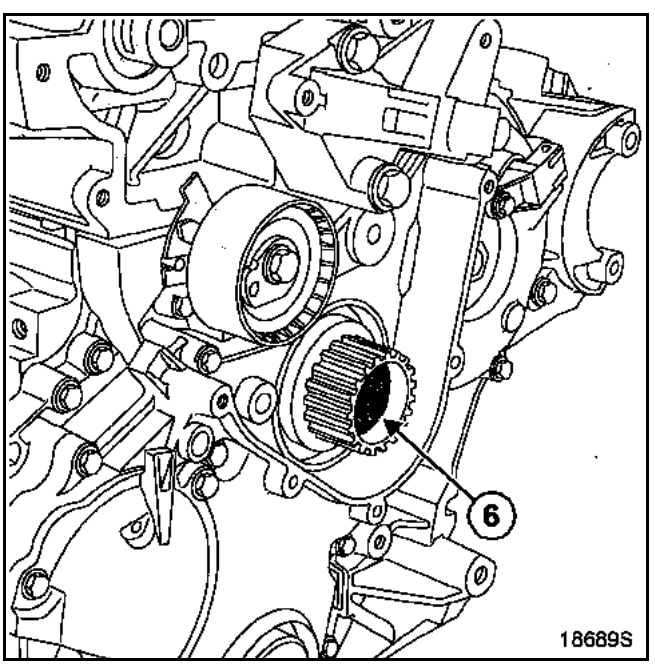
The old elastomer seal is fitted with a spring (**2**) and has a **V**-shaped sealing lip (**3**).

Note:
Never oil the seal mating faces; the parts must be clean and dry.

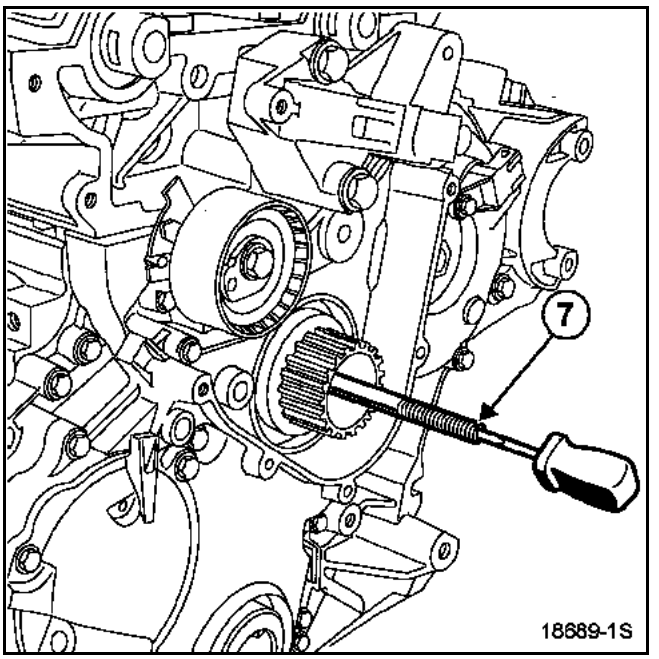


The new elastomer seal has a flat sealing lip (**4**) and a protector (**5**) which also fits the seal to the engine.

Fitting the seal on intermediate shaft No. 2:

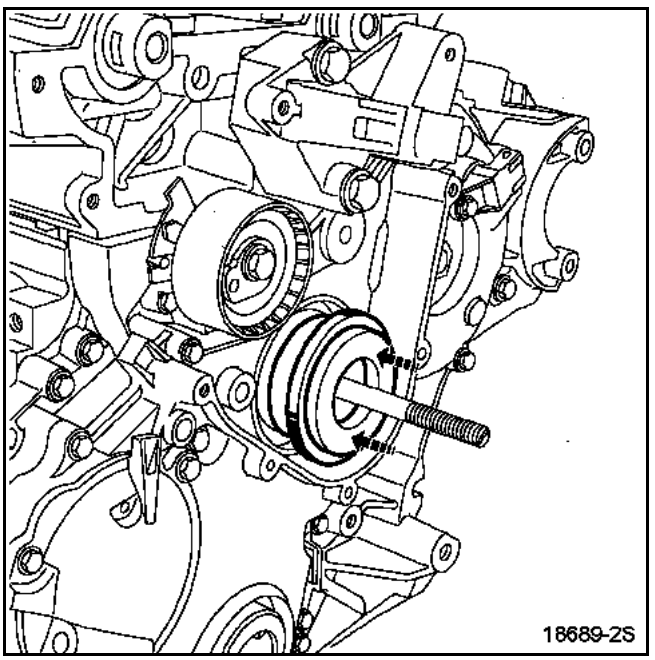


Remove bolt (**6**).



Screw the threaded rod (**7**) of tool Mot. 1561 into intermediate shaft **No. 2**.

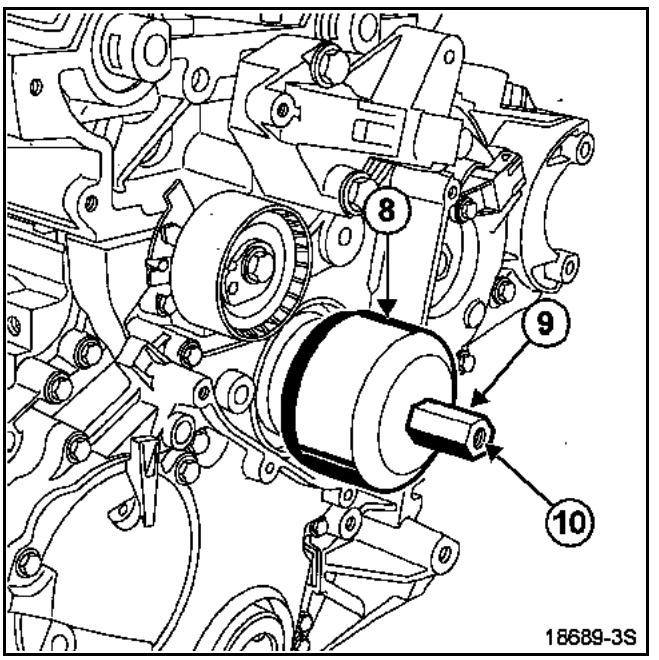
For the new seal, put the protector with the seal on the intermediate shaft, taking care not to touch the seal.



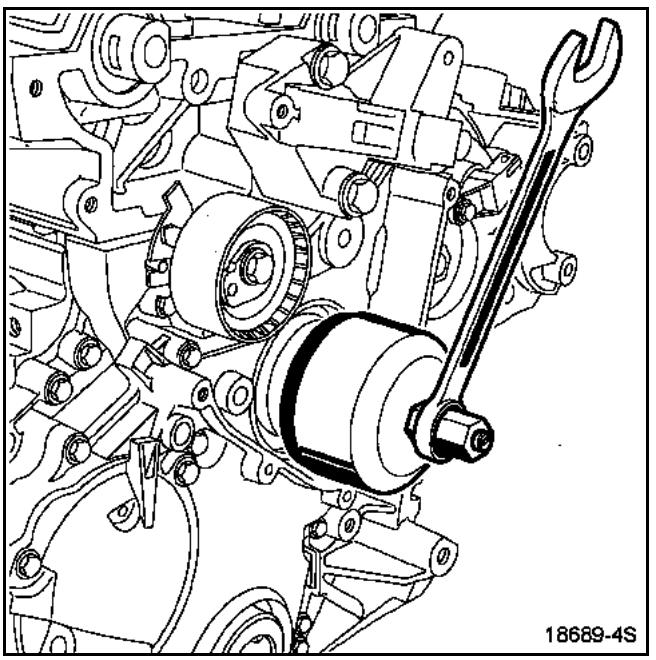
For the old seal, place the protector **marked B** of tool (Mot. 1628) fitted with the seal on the intermediate shaft.

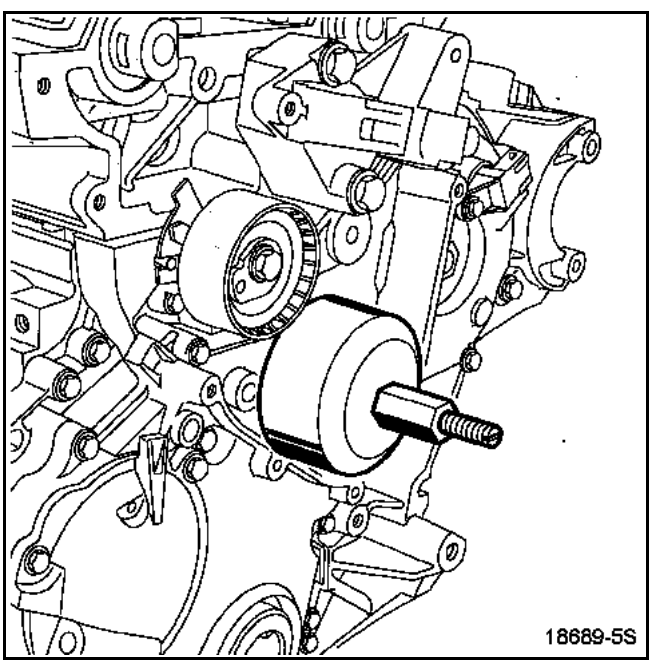
Note:
Never oil before fitting; the parts must stay clean and dry.

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).

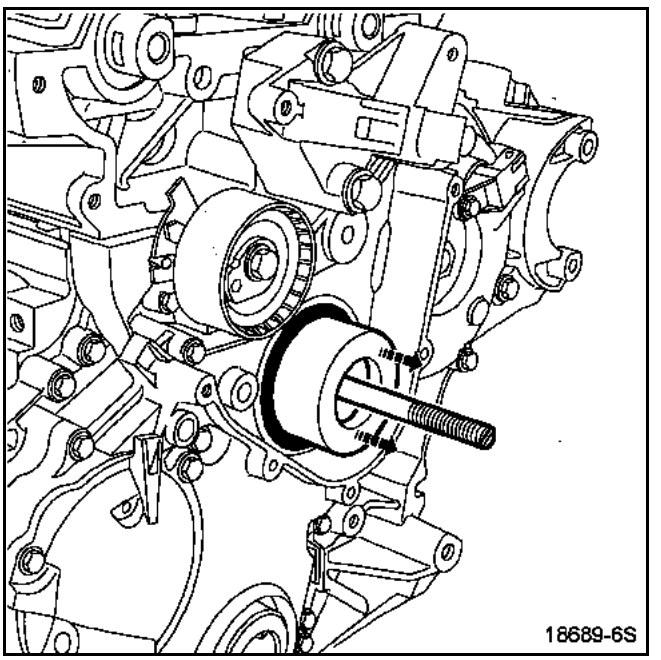


Screw on the nut until the cover makes contact with the timing gear cover.

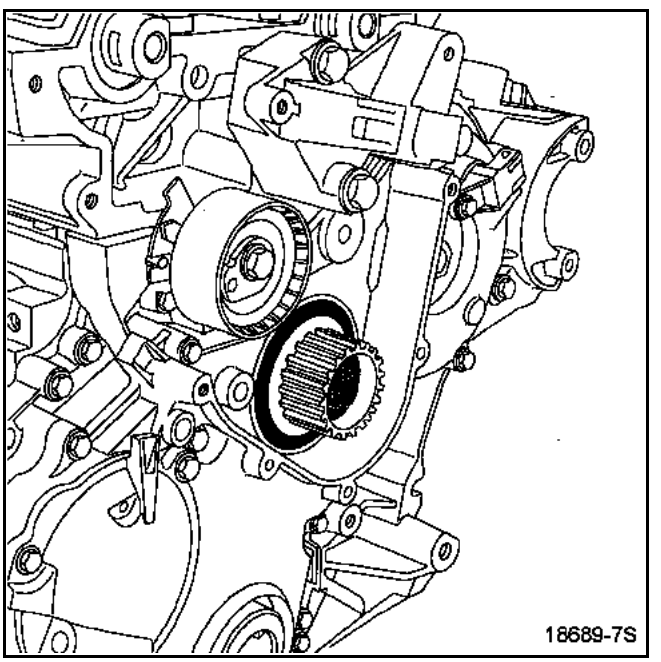




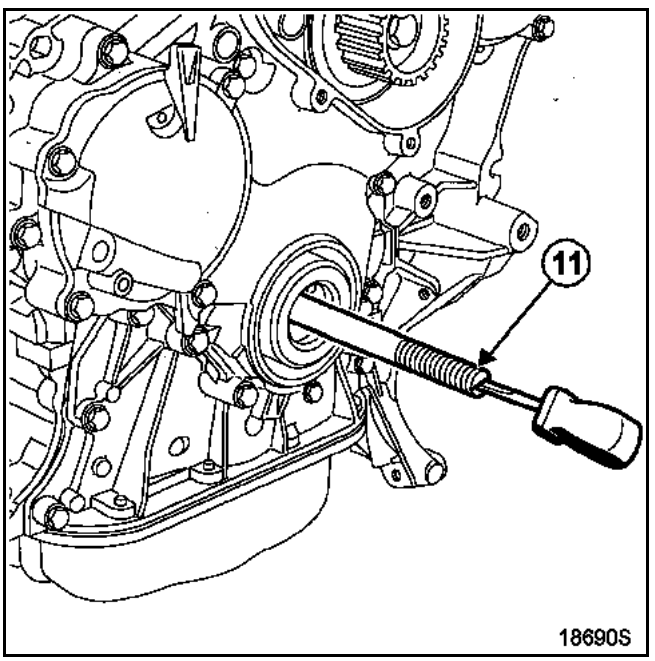
Remove the nut, the cover, the protector and the threaded rod.



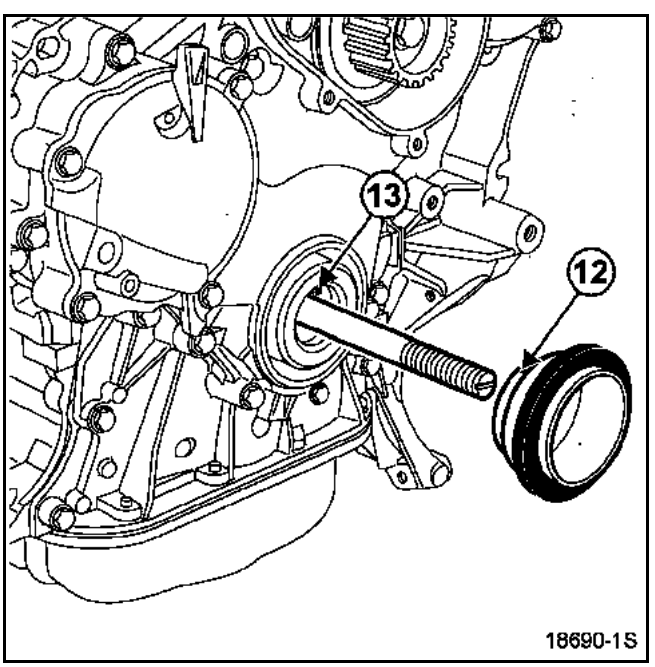
Refit the intermediate shaft bolt, tightening it to a torque of **2.5 daNm plus an angle of 30° ± 6°**.



Fitting the timing end crankshaft seal

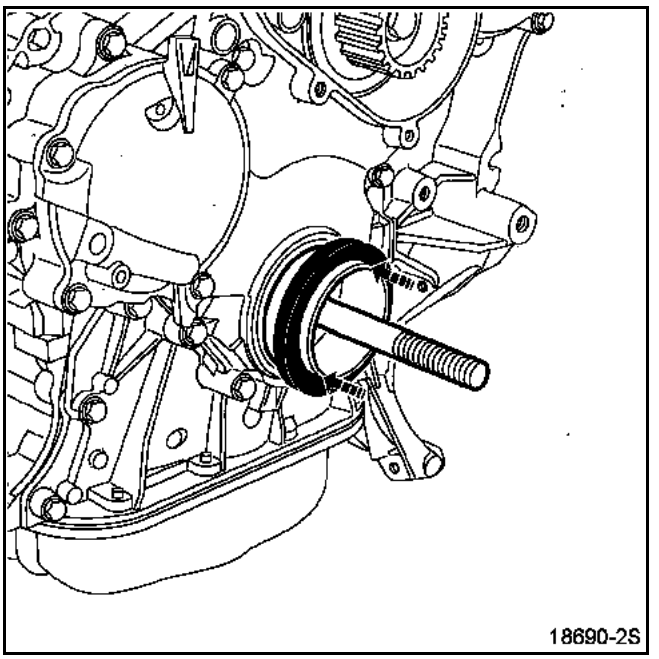


Screw the threaded rod (**11**) of tool Mot. 1560 into the crankshaft.



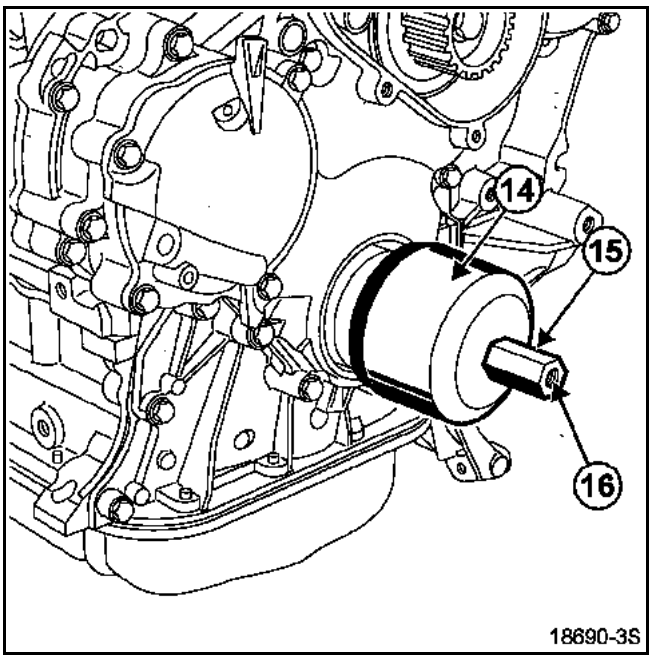
For the new seal, put the protector with the seal on the crankshaft, taking care not to touch the seal.

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

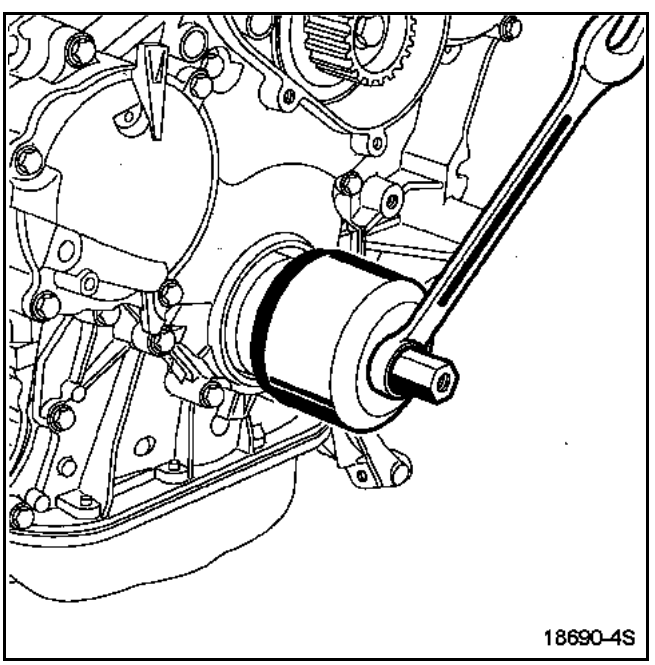


For the old seal, place the protector **marked C** of tool Mot. 1628 fitted with the seal on the crankshaft.

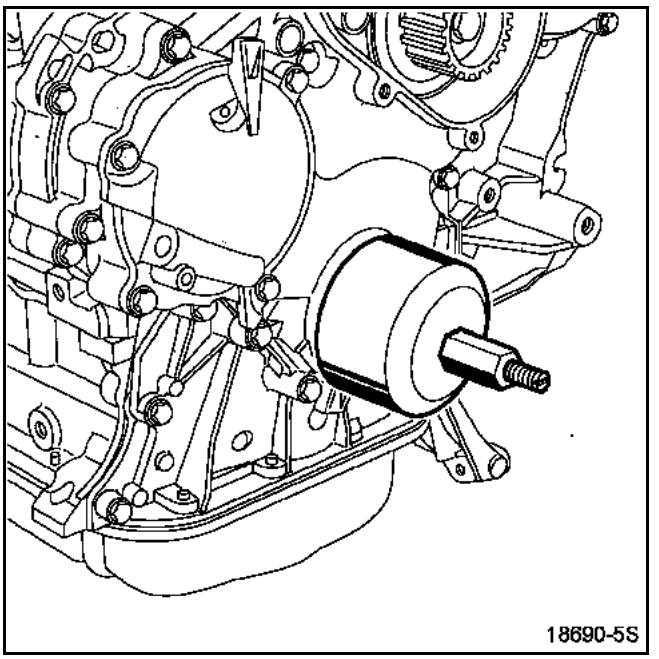
Note:
Never oil before fitting; the parts must stay clean and dry.



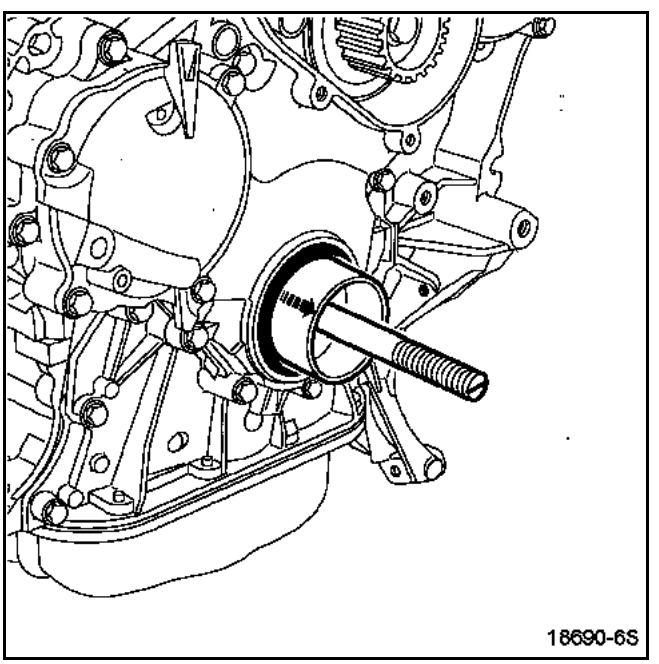
Mount the cover (**14**) and the nut (**15**) of tool Mot. 1560 (positioning the threaded part (**16**) of the nut towards the outside of the engine).



Screw on the nut until the cover makes contact with the timing cover.

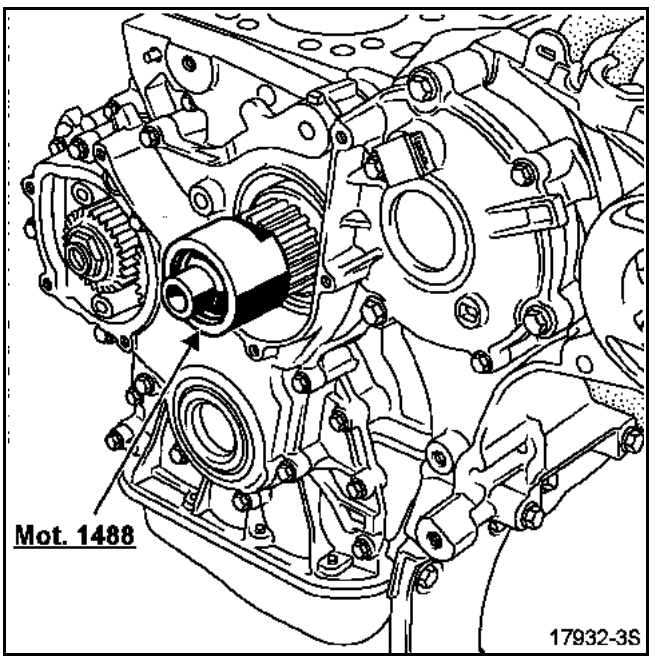


Remove the nut, the cover, the protector and the threaded rod.



Refit the cap on intermediate shaft **No. 2** using tool Mot. 1488.

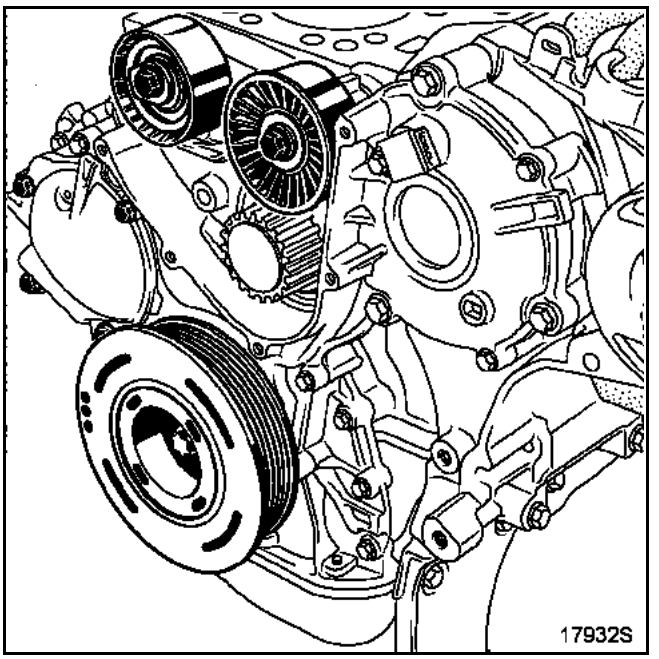
Note:
Never oil before fitting; the parts must stay clean and dry.

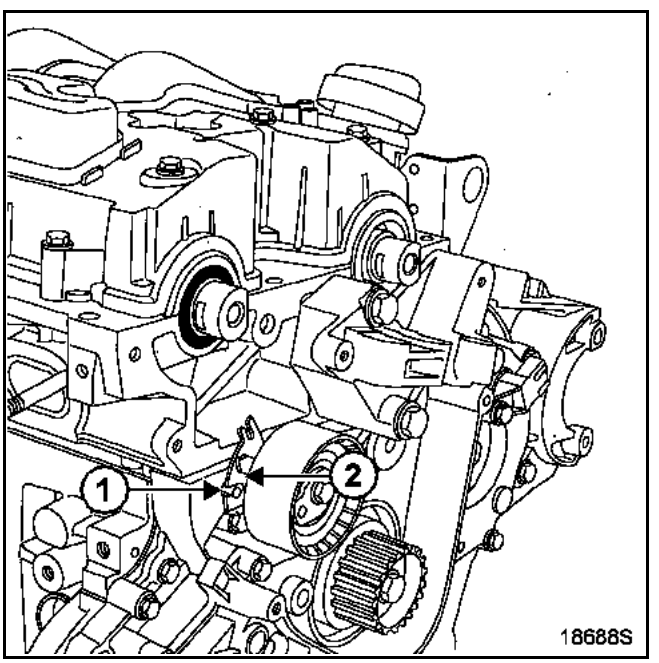


Refit the water pump cover fitted with the new seal, tightening the bolts to a torque of **1 daNm**.

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°**.

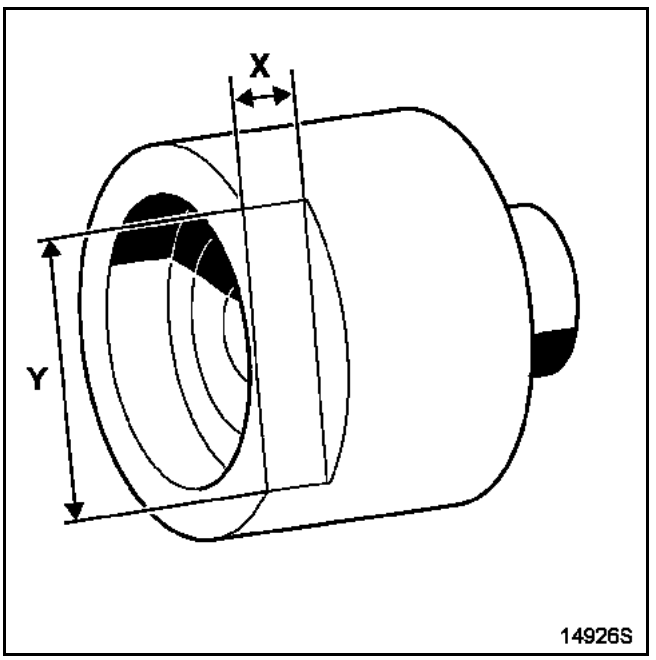


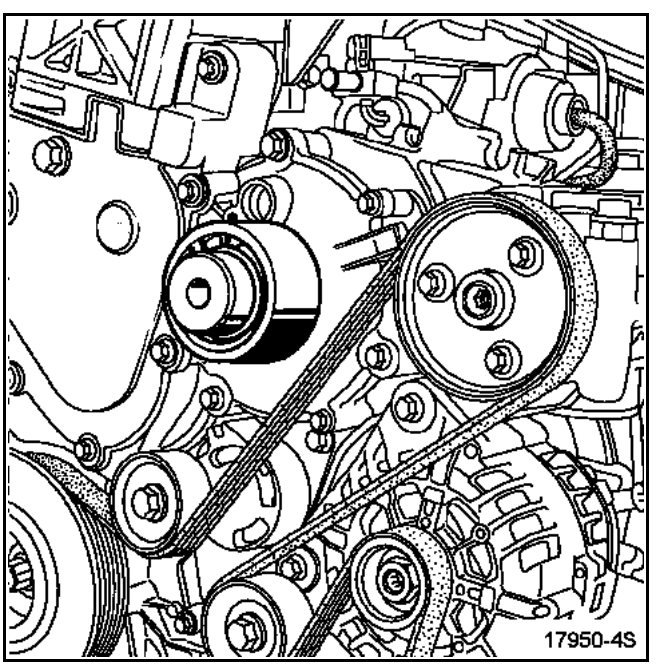


Fit the tension wheel again without locking the bolt, ensuring the roll pin (**1**) is correctly positioned in the groove (**2**).

Remove the flywheel immobiliser (Mot. 1316).

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.



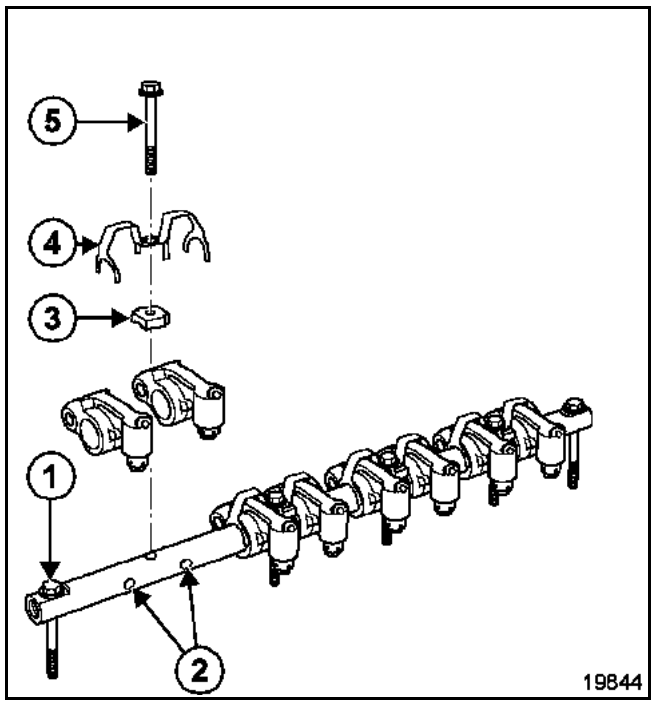


REFITTING THE UPPER ENGINE

Assessing the rocker shafts.

WARNING
Do not reverse the rocker shaft spacers.

INLET ROCKER SHAFT

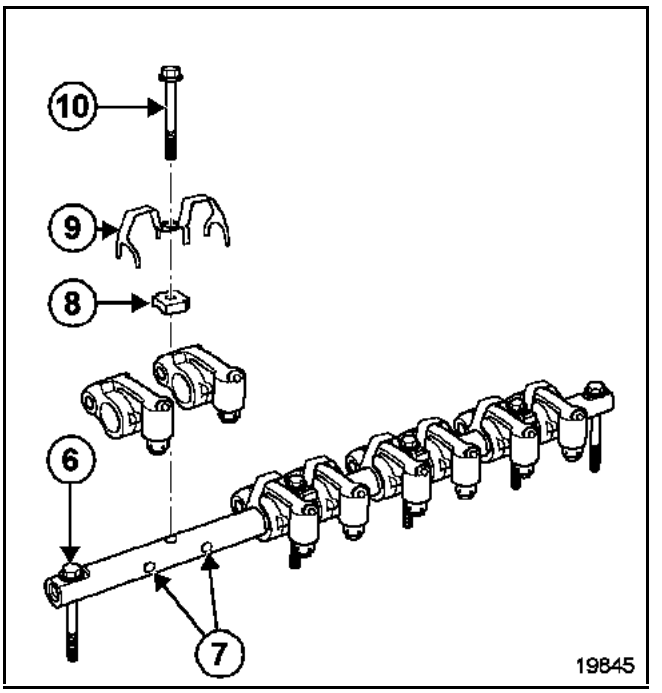


Check that the lubrication holes in the rocker shaft, the rocker arms and the bearings are not blocked. To ensure the rocker shaft is correctly fitted, position the flat part (**1**) as shown in the diagram and then slide the rocker arms onto the shaft so that the lubrication holes (**2**) on the shaft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

EXHAUST ROCKER SHAFT



Check that the lubrication holes in the rocker shaft, the rocker arms and the bearings are not blocked. To ensure that the rocker shaft is correctly fitted, position the flat part (**6**) as shown in the diagram and then slide the rocker arms onto the shaft so that the lubrication holes (**7**) on the shaft coincide with those on the arms.

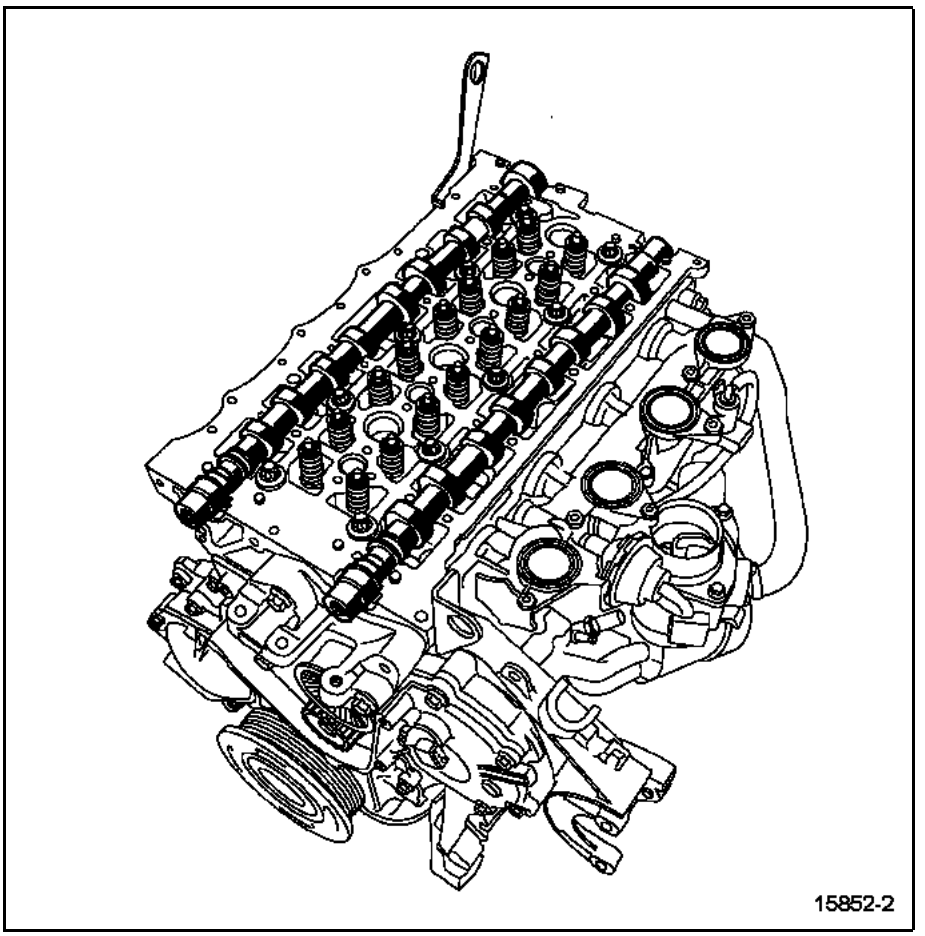
Fit:
– the spacer (**8**),
– the clip (**9**),
– the bolt (**10**).

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).



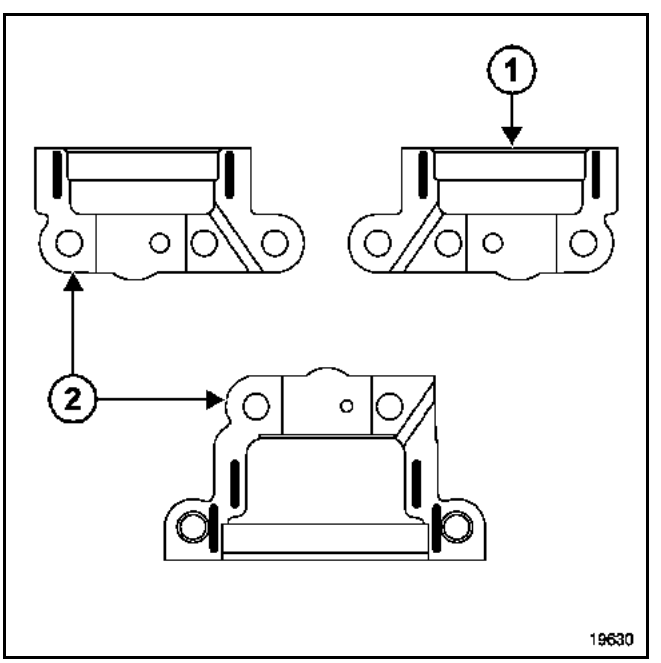
Apply some oil to the camshaft bearings on the cylinder head side.

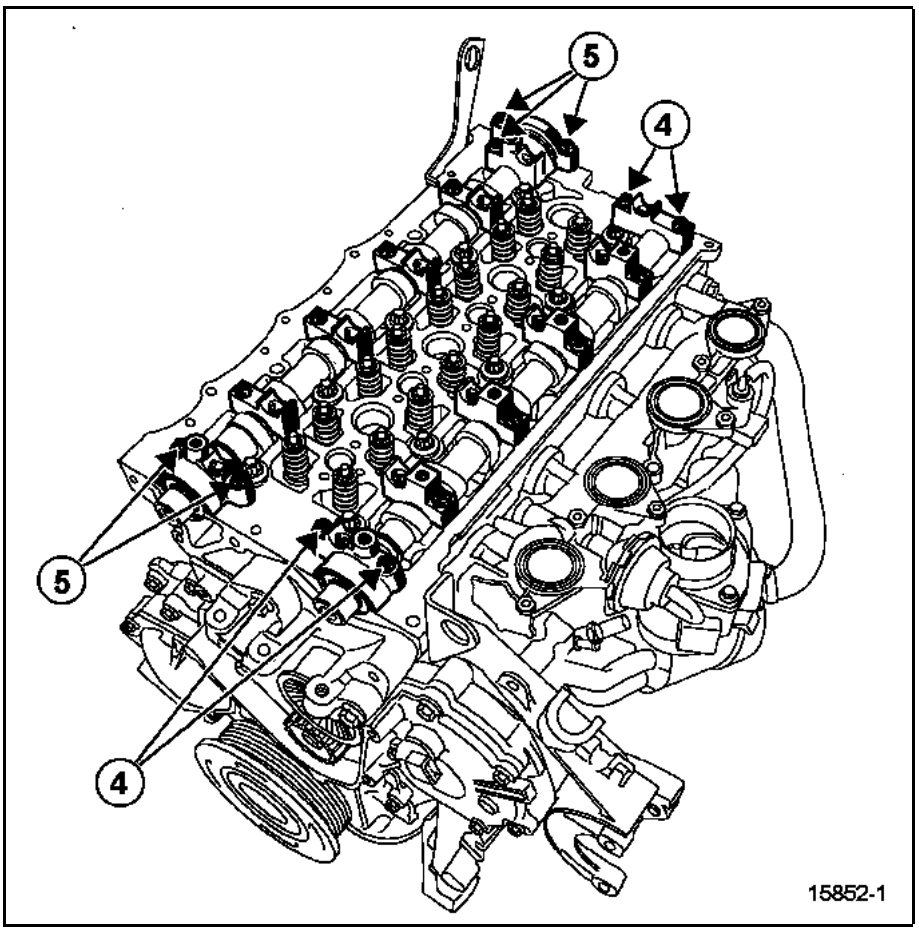
Refit the camshafts, positioning them correctly (see "**Camshaft identification**" in the **Technical specifications** section).

Apply a drop of oil on each bearing.

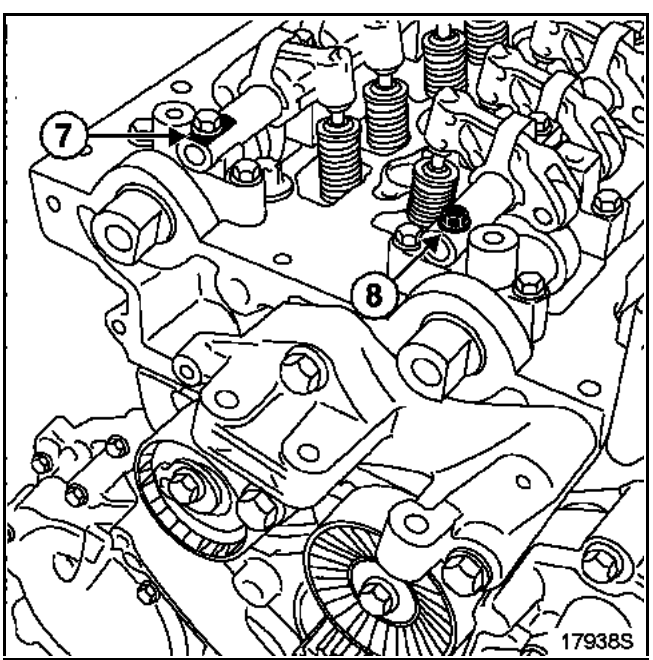
Note:
The sealing surfaces must be clean, dry and free from grease (avoid finger marks).

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)**.

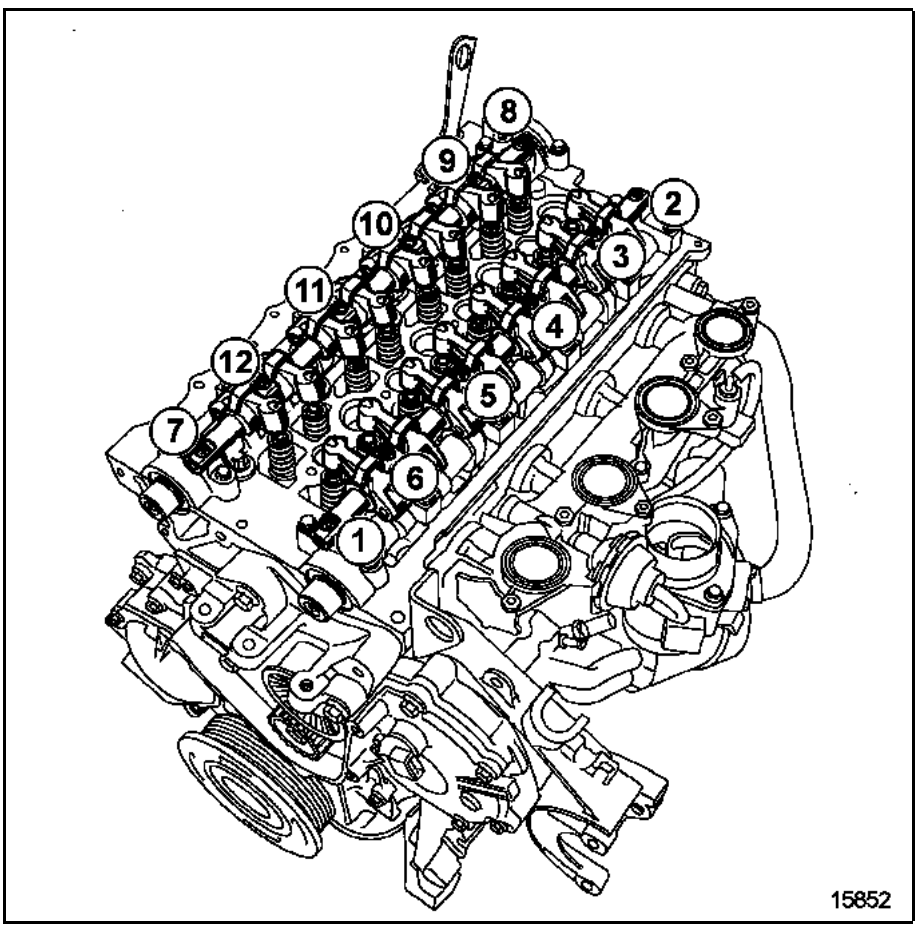


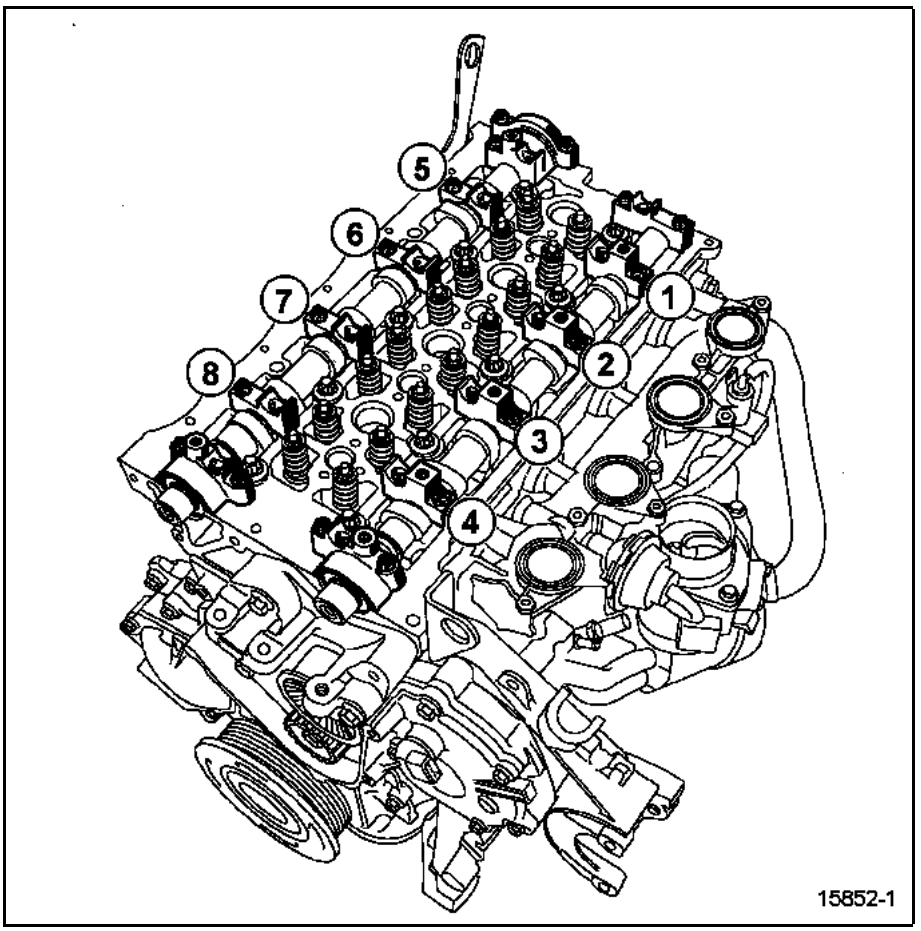


Refit:
- the camshaft bearing caps (in accordance with the marks made previously), tightening to a torque of **1.2 daNm only**:
- **the bolts (4) of inlet camshaft bearings 1 and 6,**
- **the bolts (5) of exhaust camshaft bearings 1 and 6,**
- the rocker shafts, positioning them as follows:
- for the 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**.

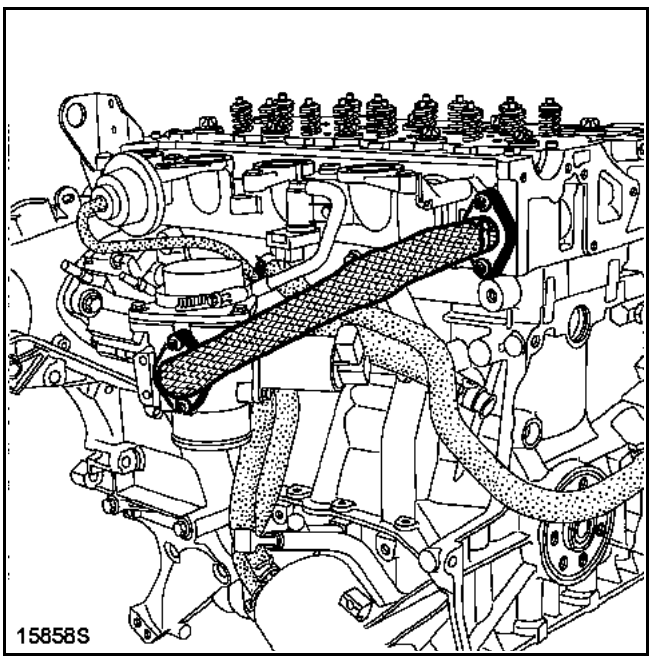


In order to tighten the rocker shaft correctly, you must start with:
– the inlet rocker shaft bolts, then those of the exhaust, tightening them in order and to torque (**1.3 daNm**).
– the inlet camshaft bearing cap bolts, then those of the exhaust, tightening them in order and to torque (**1 daNm**).

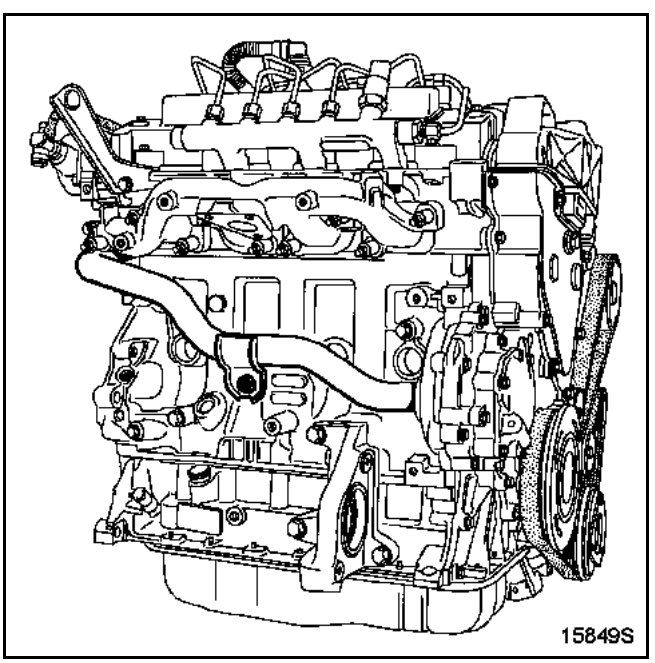



5
6
7
8
1
2
3
4
15852-1

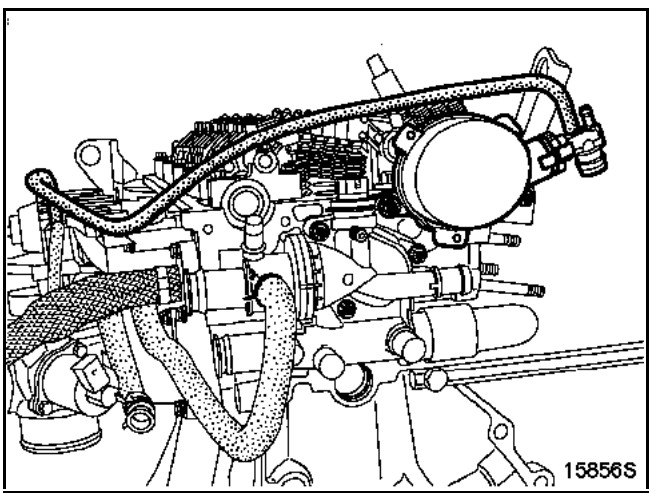
Refit:
– the new exhaust gas recirculation pipe with new seals, and tighten the bolts to a torque of **2.5 daNm**,



– the coolant pipe fitted with new seals (to be tightened to torque later),



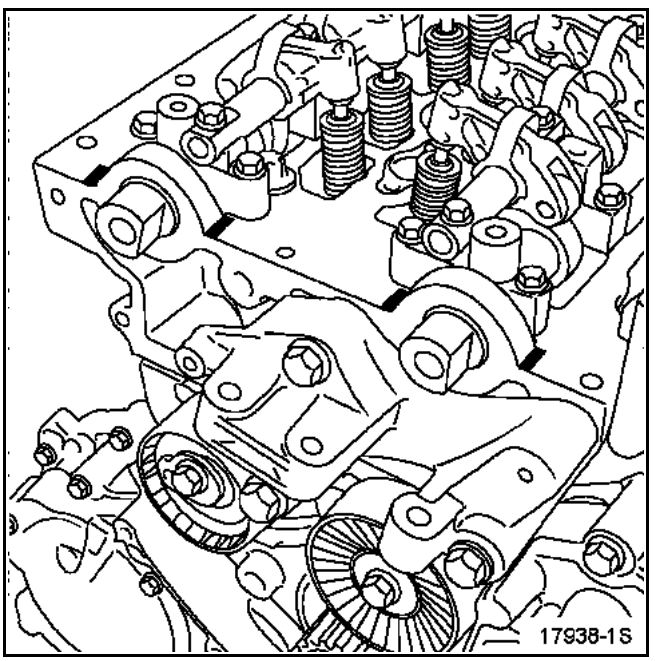
– the thermostat unit fitted with new seals, tightening the bolts to a torque of **1 daNm**,
– the vacuum pump fitted with a new seal, tightening the bolts to a torque of **2.3 daNm**,
– the coolant pipe bolt, tightening to a torque of **3 daNm**.



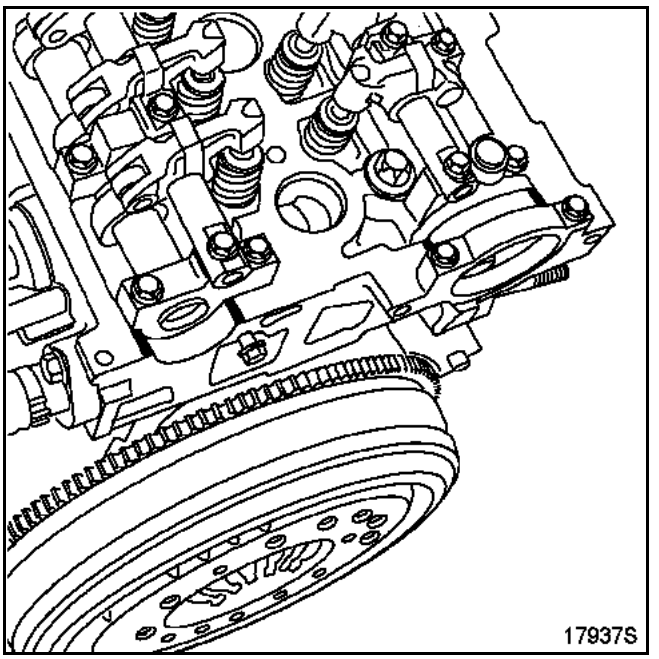
WARNING
Excess sealant could be squeezed out when the parts are tightened.
A mixture of sealant and fluid could to certain components (engine, radiator, etc.)

Apply some **RHODORSEAL 5661** to the corners of the camshaft bearing caps and in the half-shell.

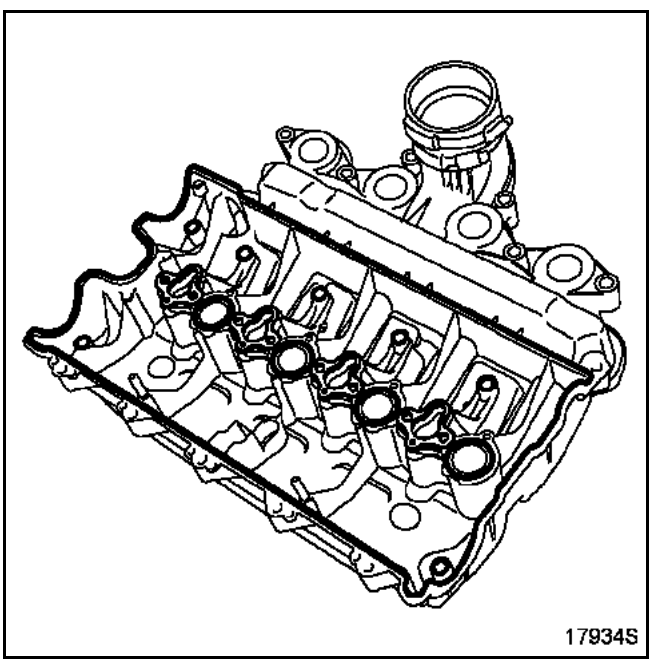
Timing end

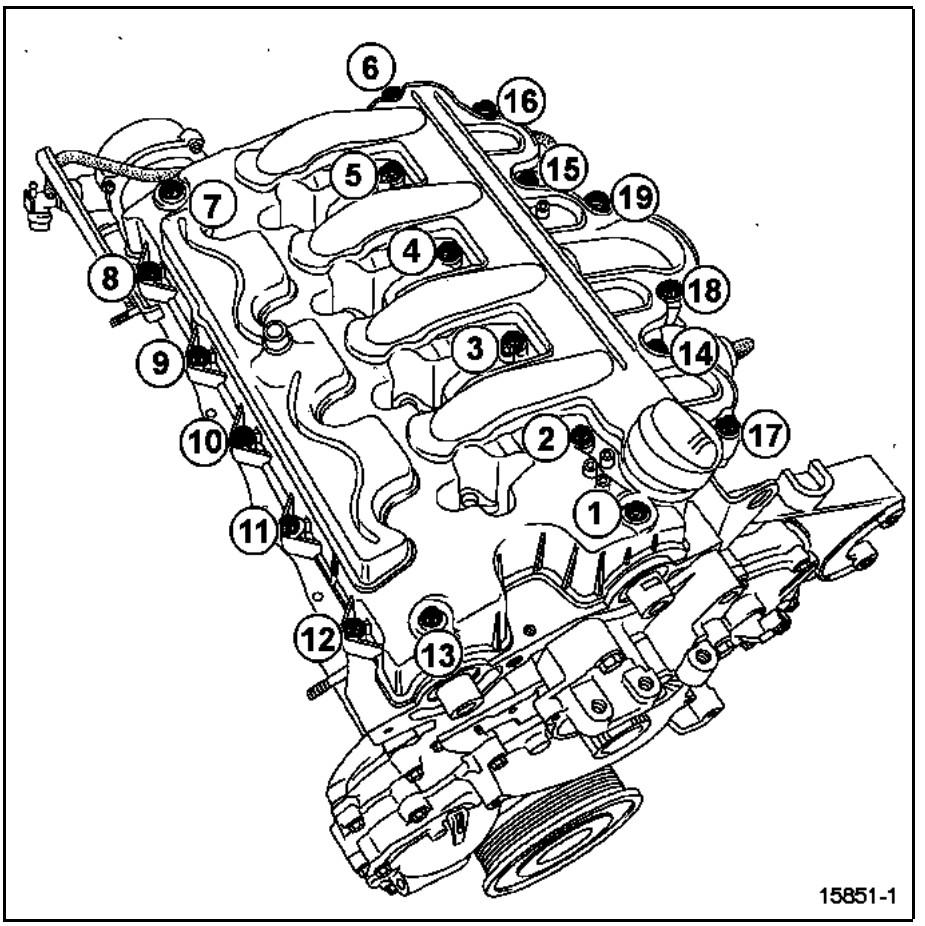


Flywheel end.



Fit all the new seals on the rocker cover.

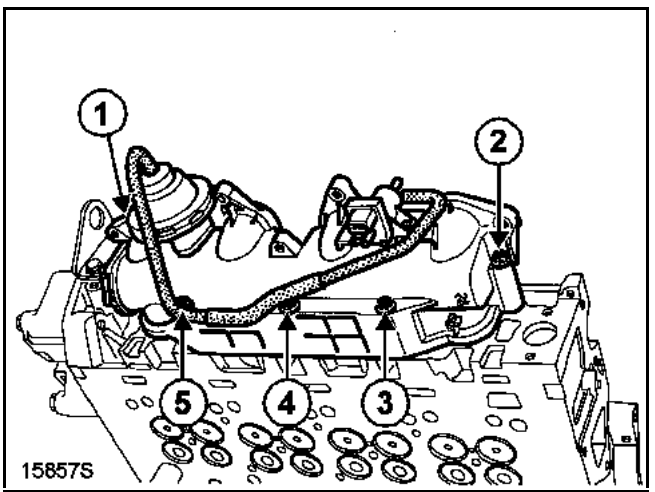




Note:
Apply a drop of **FRENETANCH LOCTITE** on bolts 1-2-3-4-5-6-7-13.

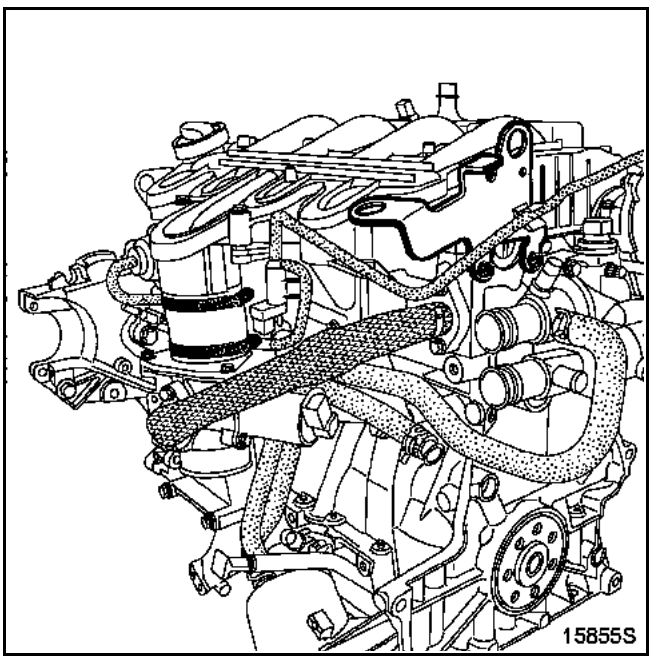
Refit the rocker cover, tightening the bolts in order and to torque (**1.2 daNm**).

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



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

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



Note:
The sleeve bearing surfaces must be clean and dry.

Refit the heater plugs, tightening them to a torque of **1.5 daNm**.

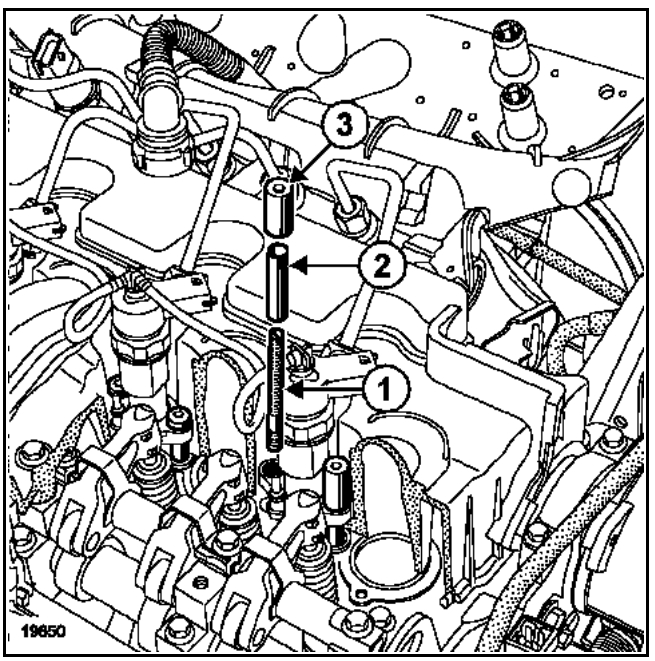
Do not remove the protective caps from each component until the last moment.

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.

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

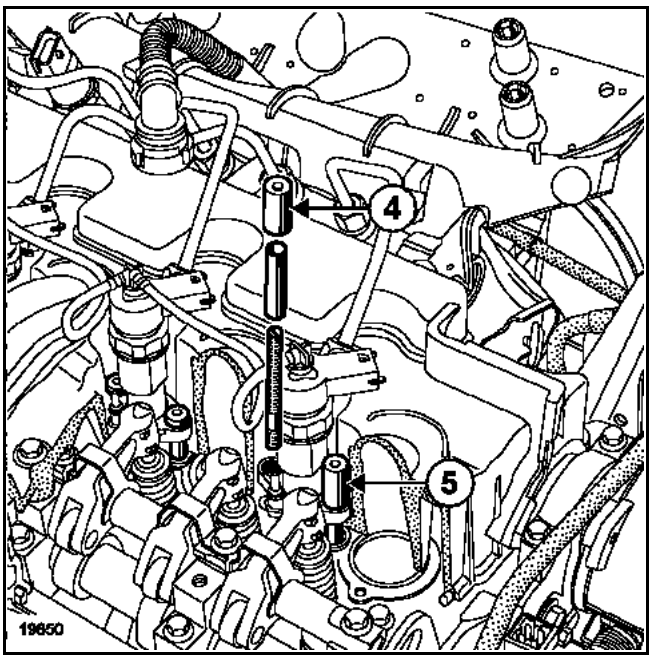


Fit the new studs (**1**) and injector mounting spacers (**2**) after coating the threads with oil and screw them in as far as possible by hand (**0.2 daNm**). **Always replace the studs and nuts after every removal.**

Fit a new washer on each injector nozzle.

Fit the injector with its bracket and locking spring ring.

Oil the threads of the nuts.



WARNING
Tighten the nut (**4**) on the timing end first, then the nut (**5**) on the flywheel end.

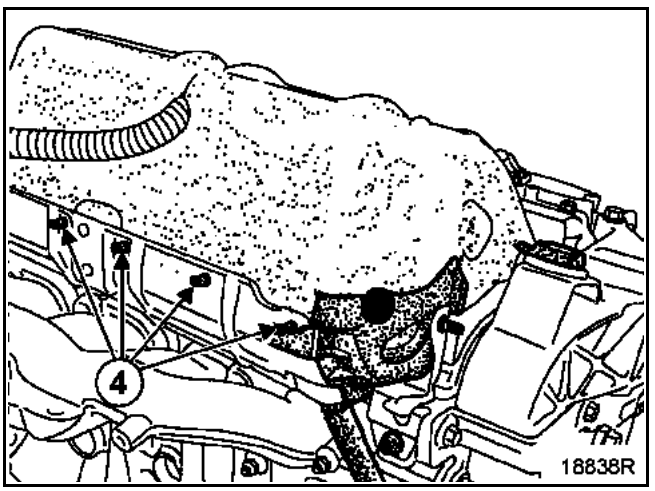
Tighten nut (**4**) to torque (**0.6 daNm**), then tighten nut (**5**) to torque **(0.6 daNm) (starting with the timing end and finishing at the flywheel end)**.

Angle tighten nut (**5**) only by **360° ± 30° (flywheel end nut)**.

RAIL PROTECTOR

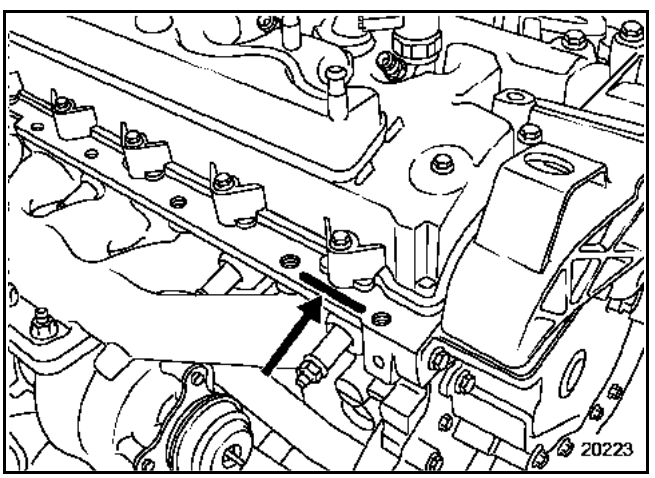
WARNING
The cleanliness rules must be strictly observed (see start of document).

Model 1

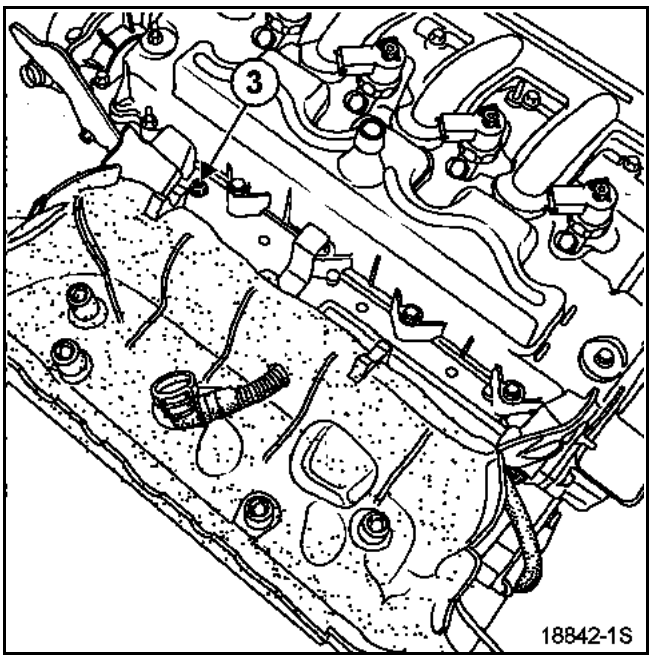


Refit the rubber flap to the lower metal protector by pulling on the five rubber wall staples (**4**). **Check that the wall staples are clipped on correctly.**

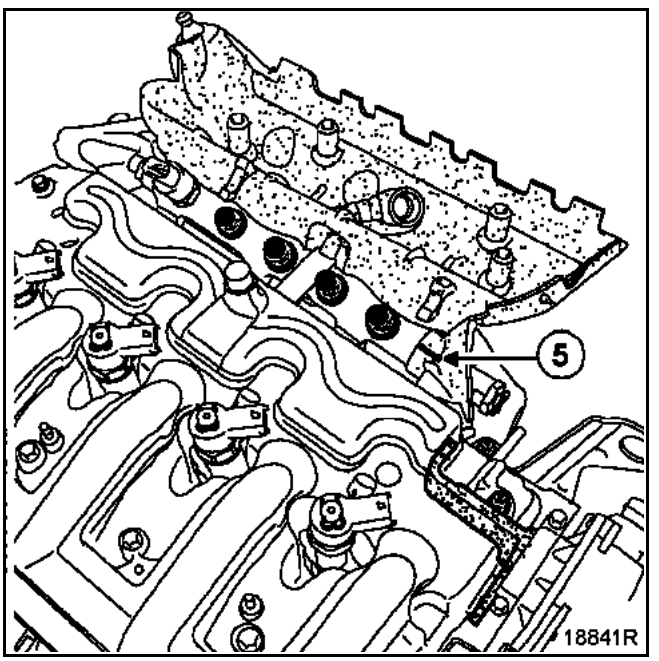
WARNING
Excess sealant could be squeezed out when the parts are tightened.
A mixture of sealant and fluid could damage certain components (engine, radiator, etc.)



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**).

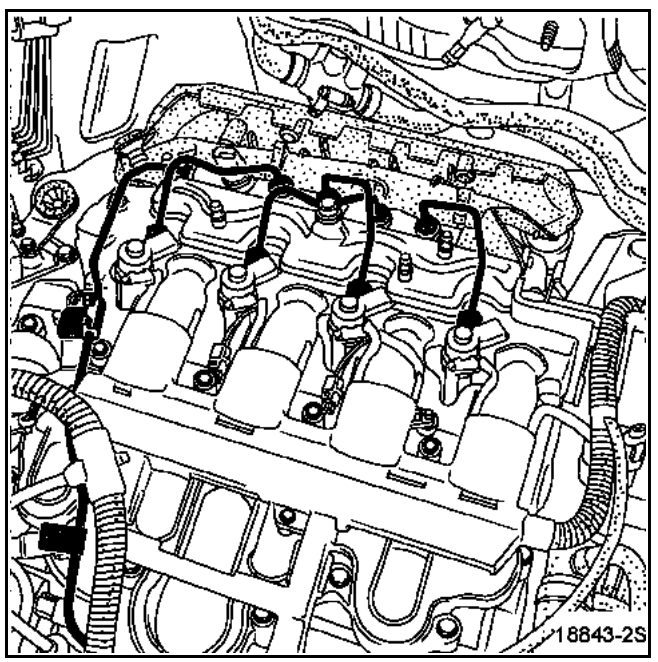


Refit the injector rail with its partition (**5**) **without locking the rail mounting bolts**.

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.

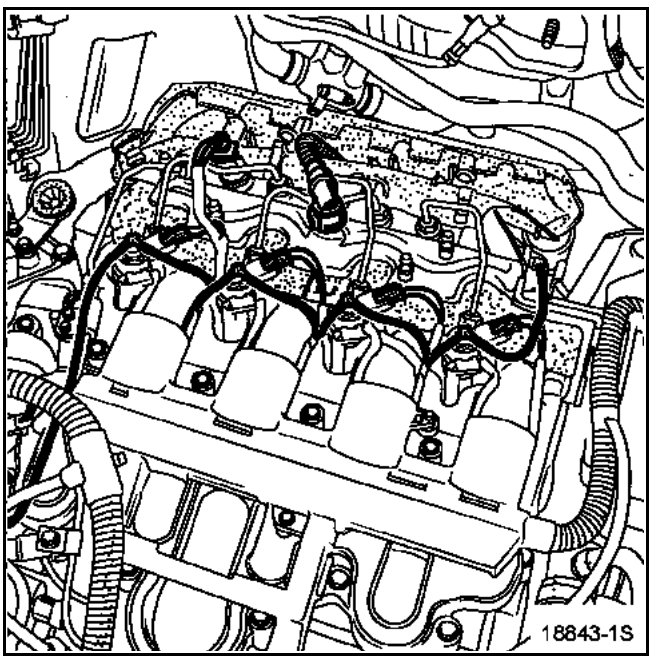
Pre-tighten the high pressure pipe nuts by hand.



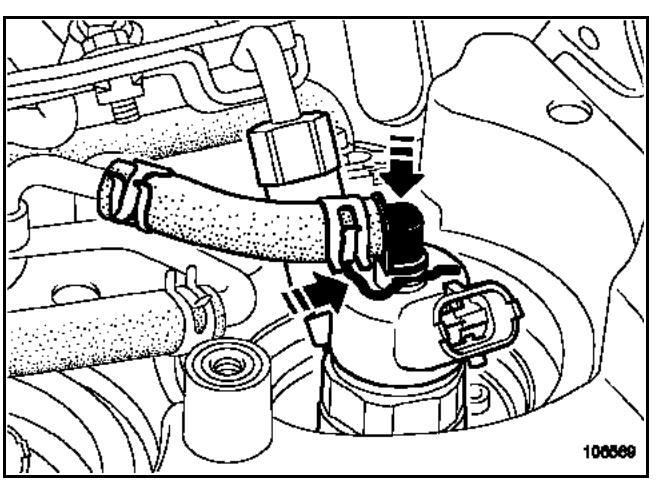
Tighten to a torque of:
– **2.5 daNm** the rail mounting bolts,
– **2.5 daNm** the injection pipe nuts at the injector end
– **2.7 daNm** the injection pipe nuts at the rail and high pressure pump end.

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

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



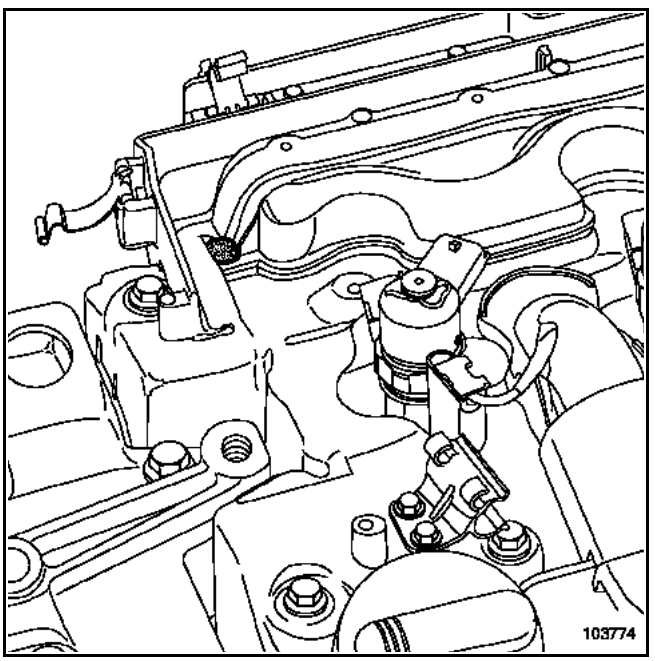
* To refit the return pipe, press on the clips and mount the pipe onto the injector head. Release the clip.



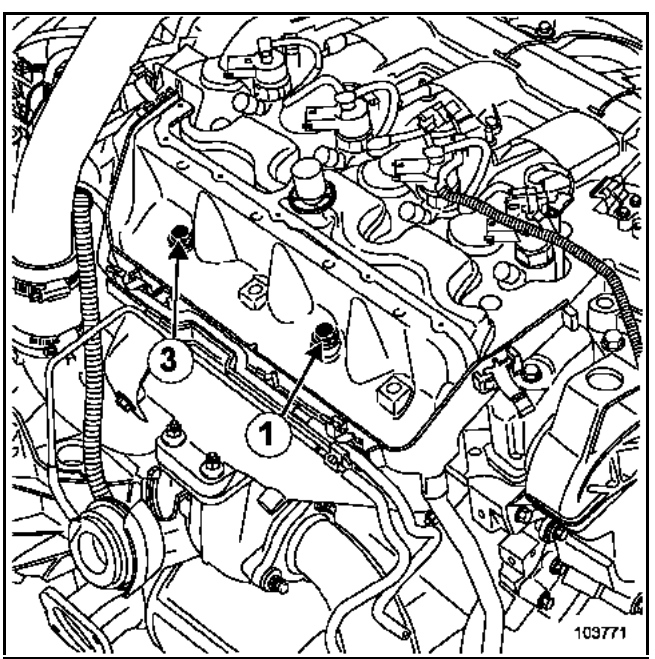
Model 2

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.)

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

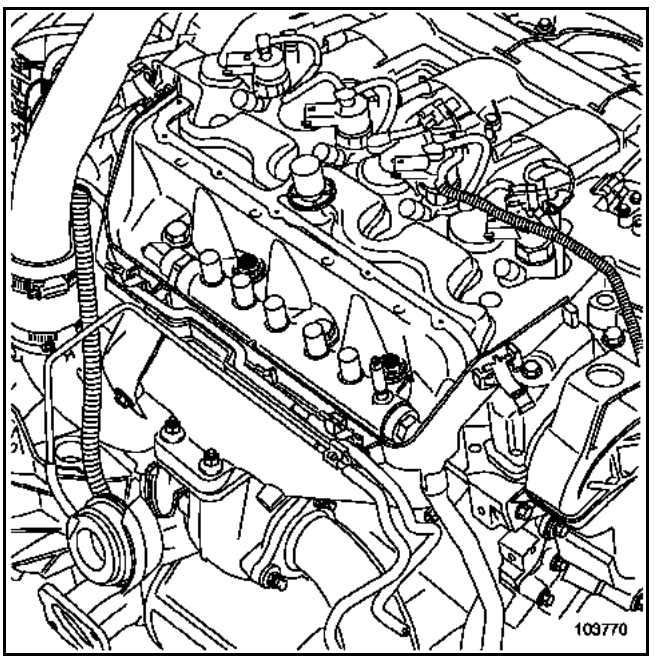


Apply **RHODORSEAL 5661** to the rocker cover at the point marked on the diagram.



Refit the aluminium protector, finger tightening both mounting bolts.

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

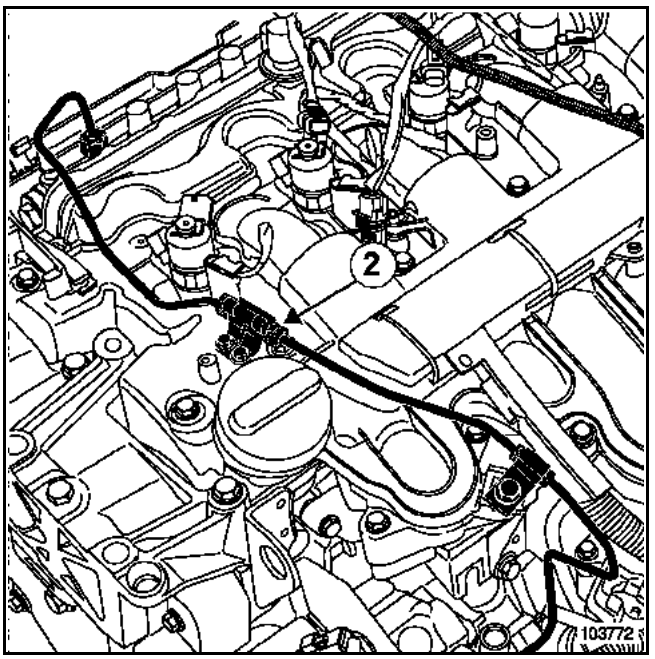


Refit the injector rail by finger tightening the two mounting bolts.

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**).



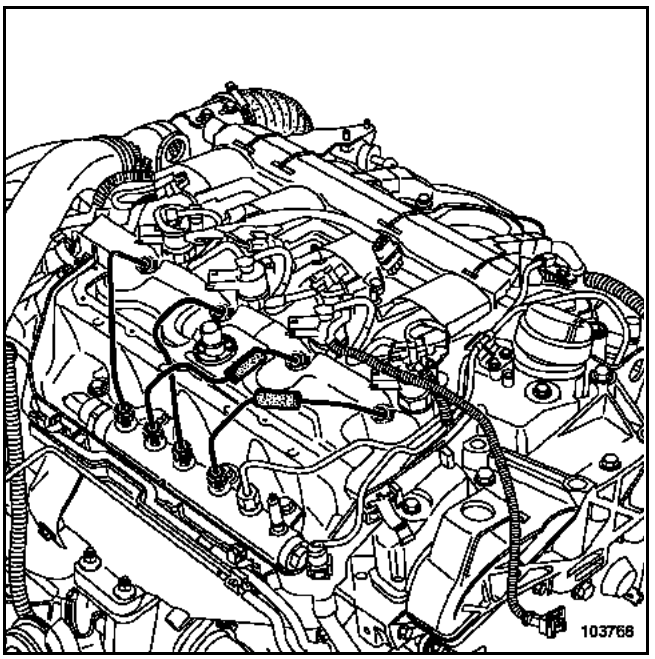
Fit the injection pipe between pump and rail, and pretighten by hand until they touch.

Clip on the pump-rail pipe (**2**).

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.

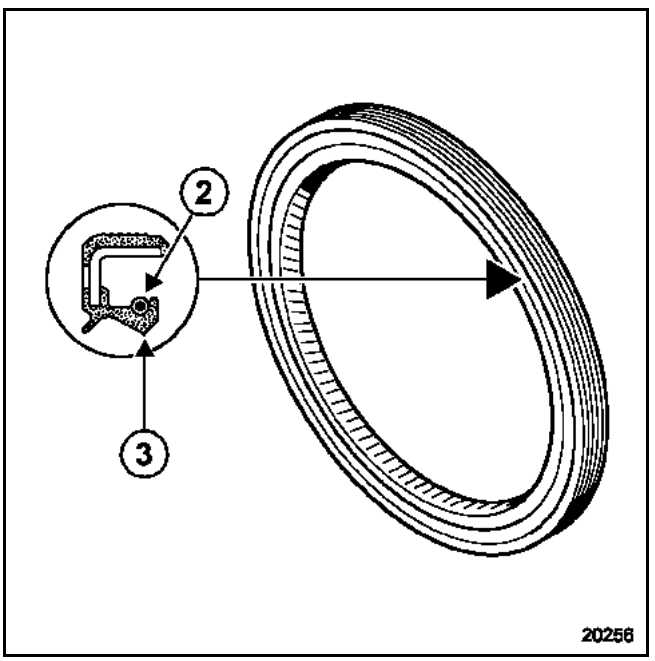
Refit the soundproofing pads, replacing them if they are damaged or soaked with diesel fuel.

Refit a new diesel return pipe, ensuring that the mounting clips are properly fitted to the injectors and rail.

FITTING THE CAMSHAFT SEALS

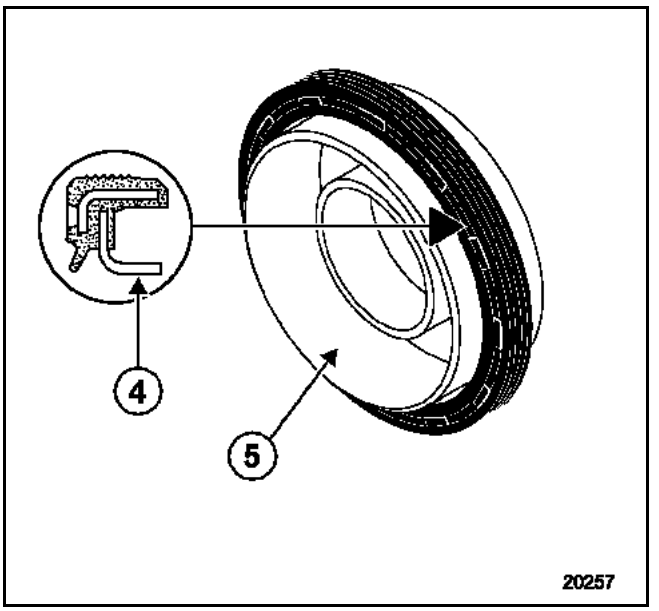
This engine can be fitted with two different types of seal.

Old and new seals are easily recognised.

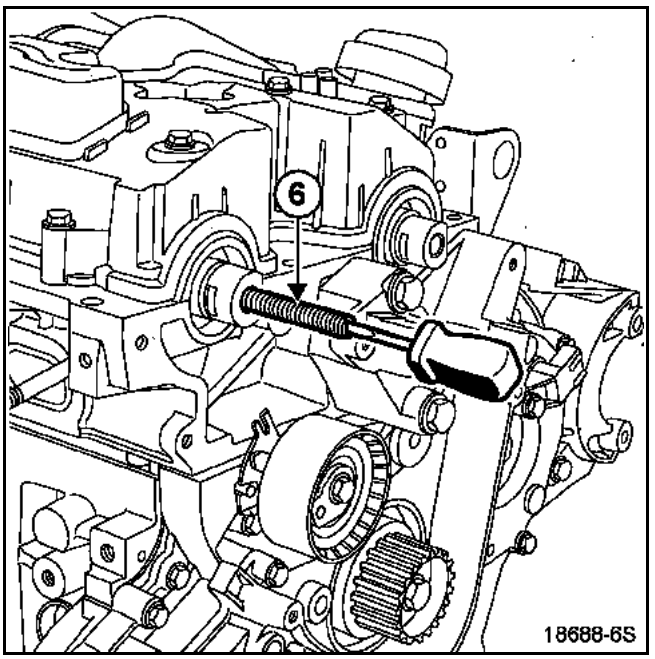


The old elastomer seal is fitted with a spring (**2**) and has a V-shaped sealing lip (**3**).

Note:
Never oil the mating faces of the seal before fitting.
The surfaces must remain clean and dry.

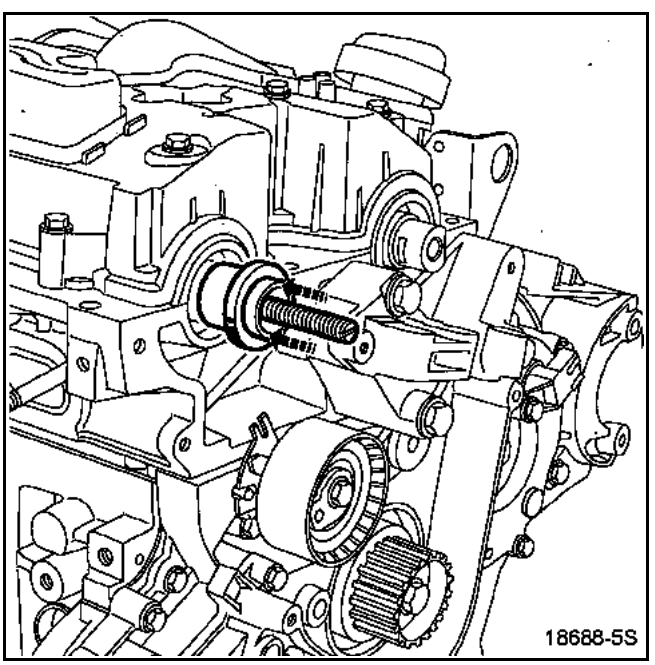


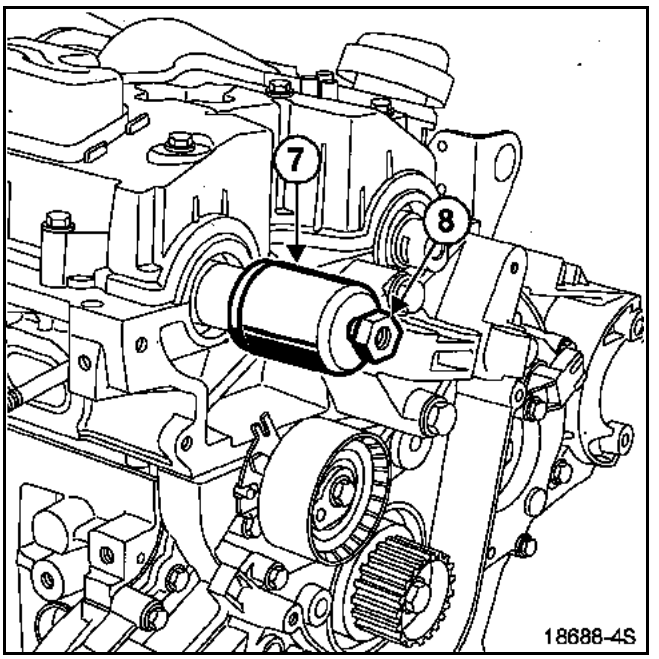
The new elastomer seal has a flat sealing lip (**4**) and a protector (**5**) which also fits the seal to the engine.



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.

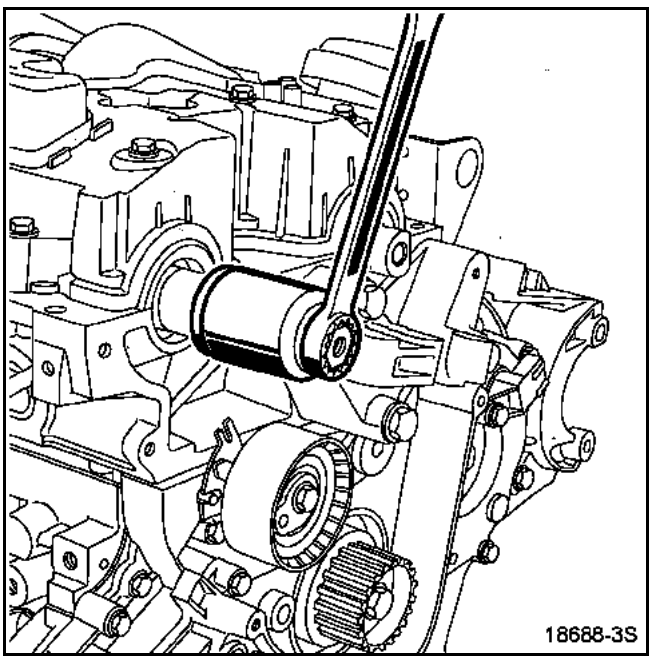


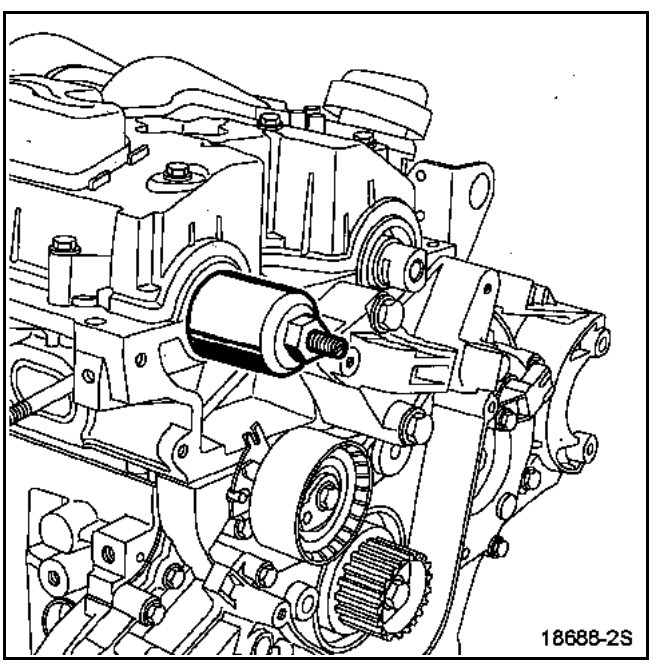


For the old seal, place on the camshaft the protector **marked A of tool** Mot. 1628 fitted with the seal.

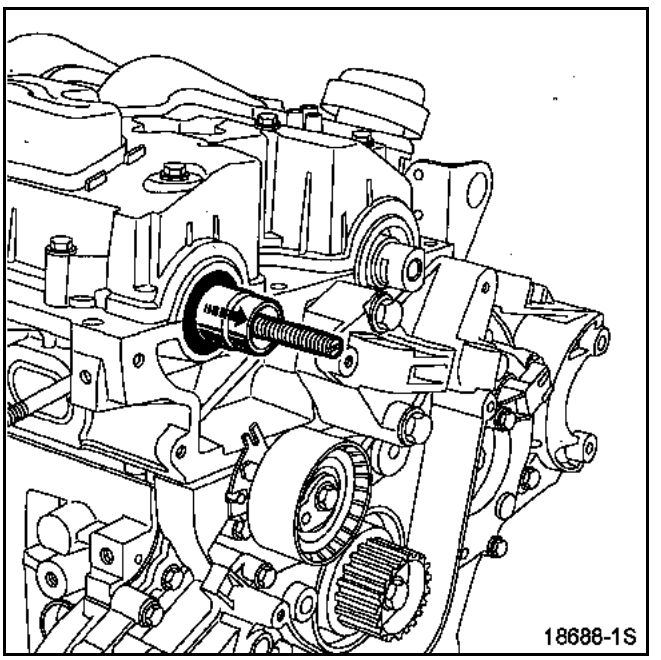
Fit the cover (**7**) and the collar nut (**8**) of tool Mot. 1562.

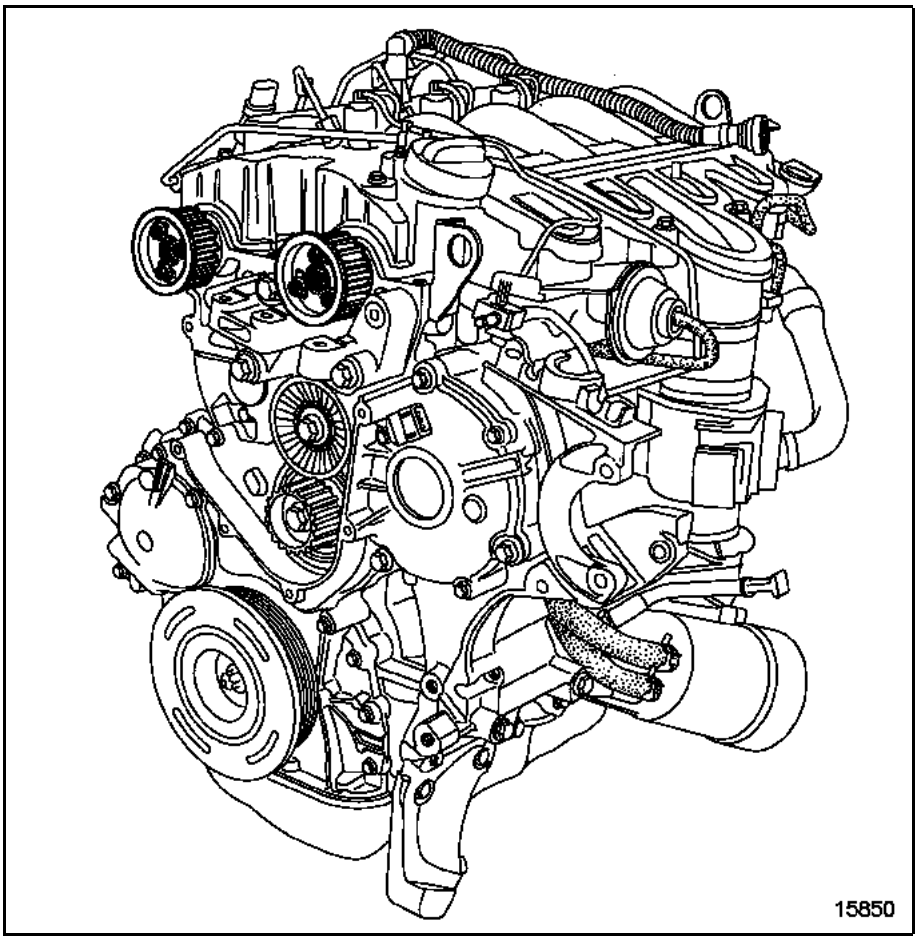
Screw on the collar nut until the cover touches the cylinder head.





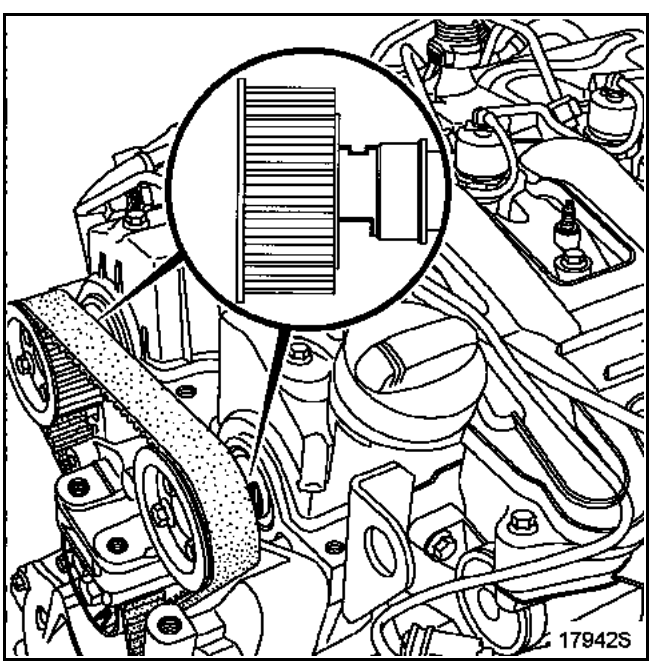
Remove the nut, the cover, the protector and the threaded rod.





Refit the camshaft hubs with the timing sprockets fitted.

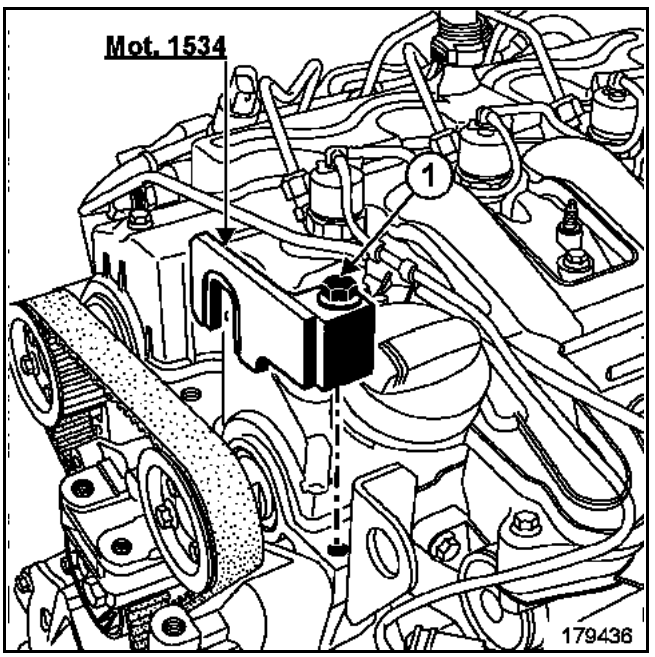
Position the camshaft grooves vertically as shown in the following diagram (top view zoom).

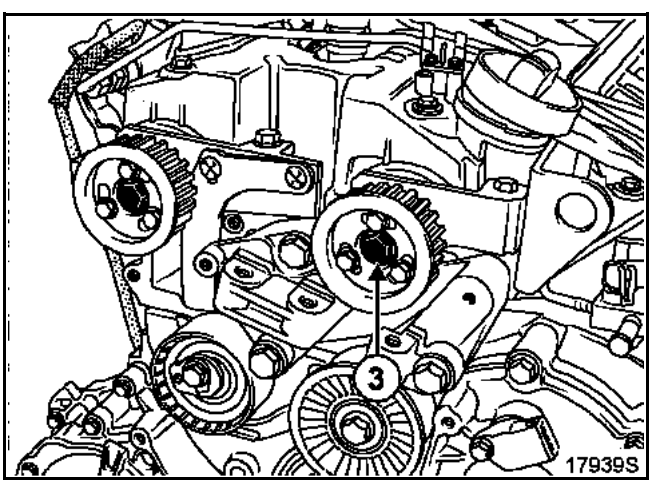


Position tools Mot. 1534 and Mot. 1537 in the camshaft grooves following the instructions below.

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.

For the inlet camshaft:

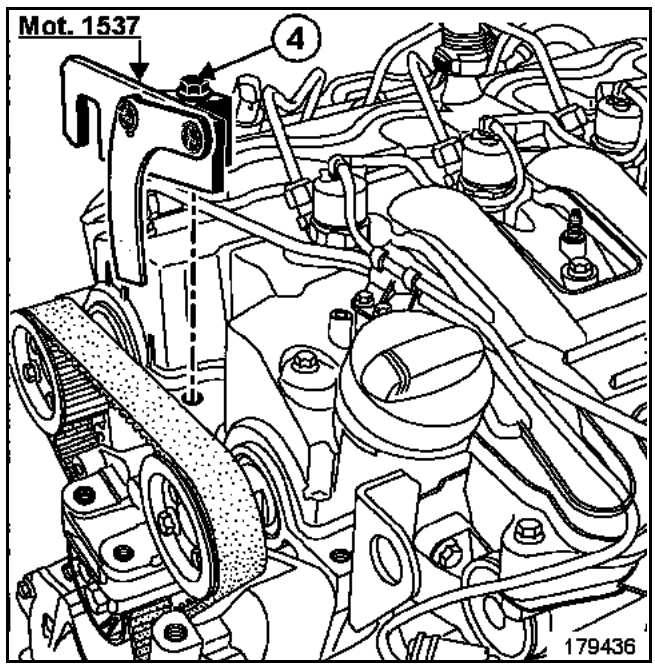


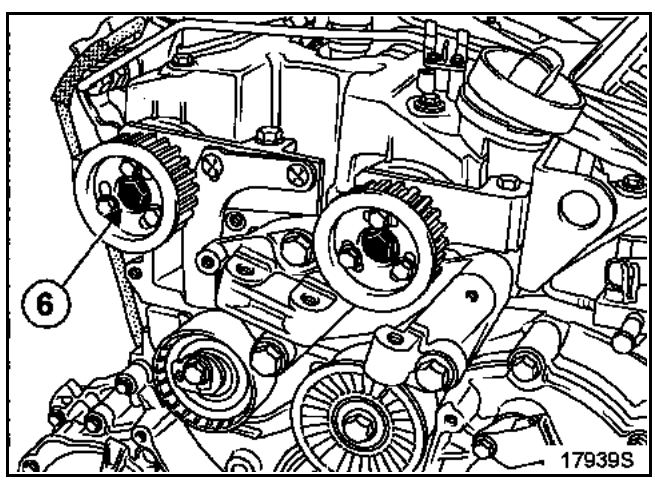


Fit tool Mot. 1534, screwing in the bolt (**1**) by hand.

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:

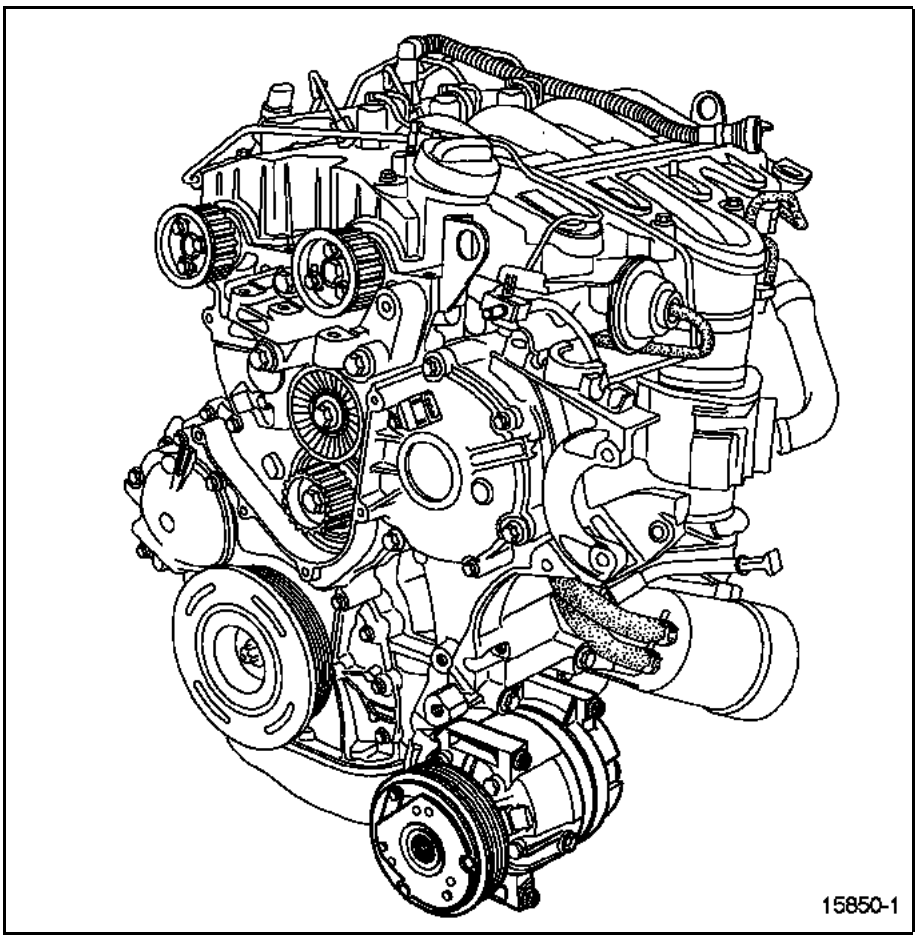




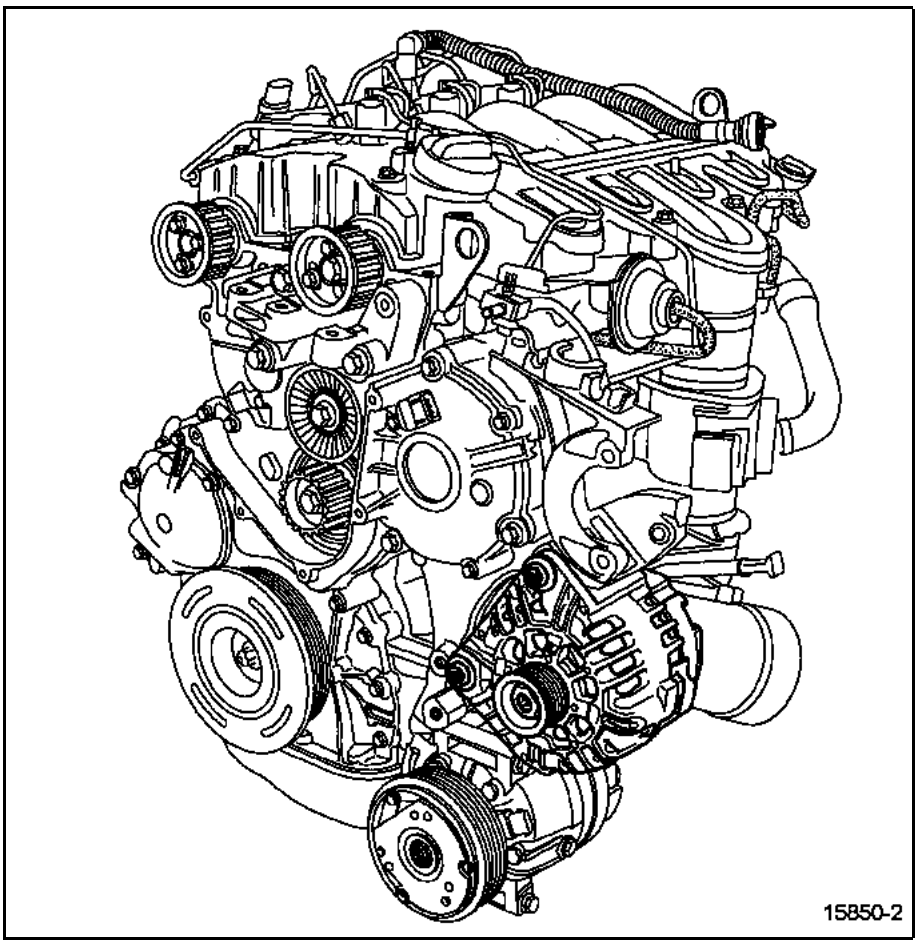
Fit tool Mot. 1537, screwing in the bolt (**4**) by hand.

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**).

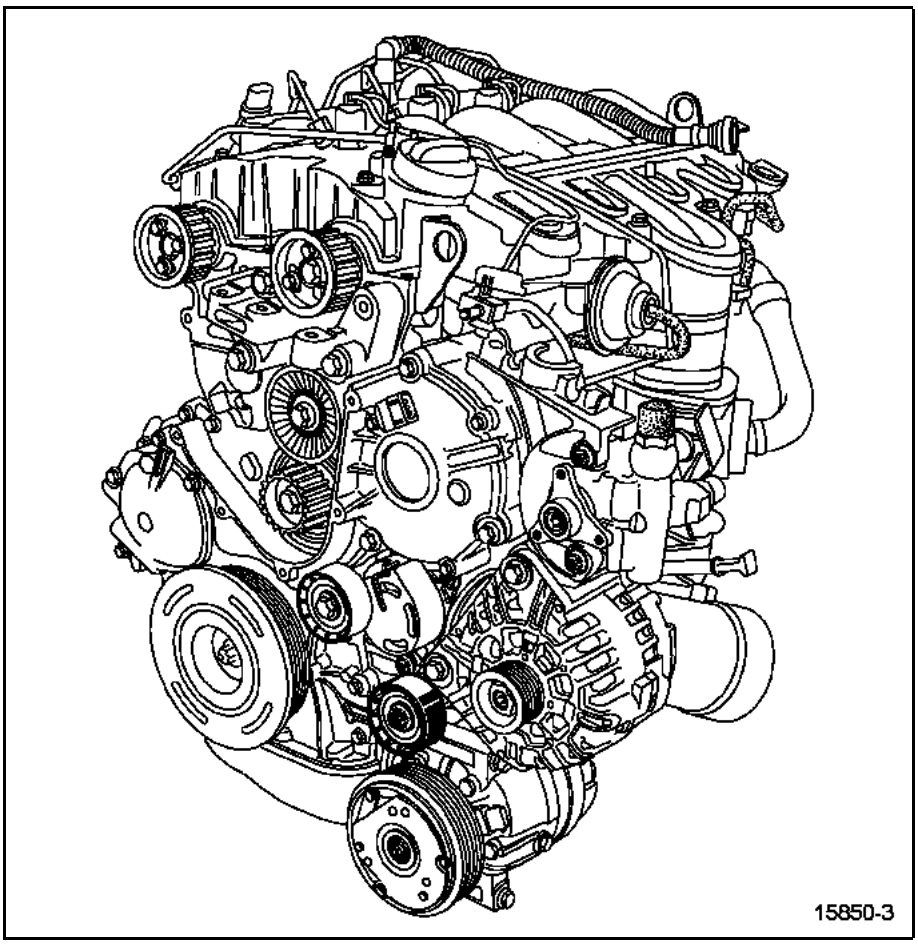
Tighten the camshaft hub bolts (**3**) and (**6**) to torque (**6 daNm**).



Refit the air conditioning compressor, tightening the bolts to torque (**2.1 daNm**)



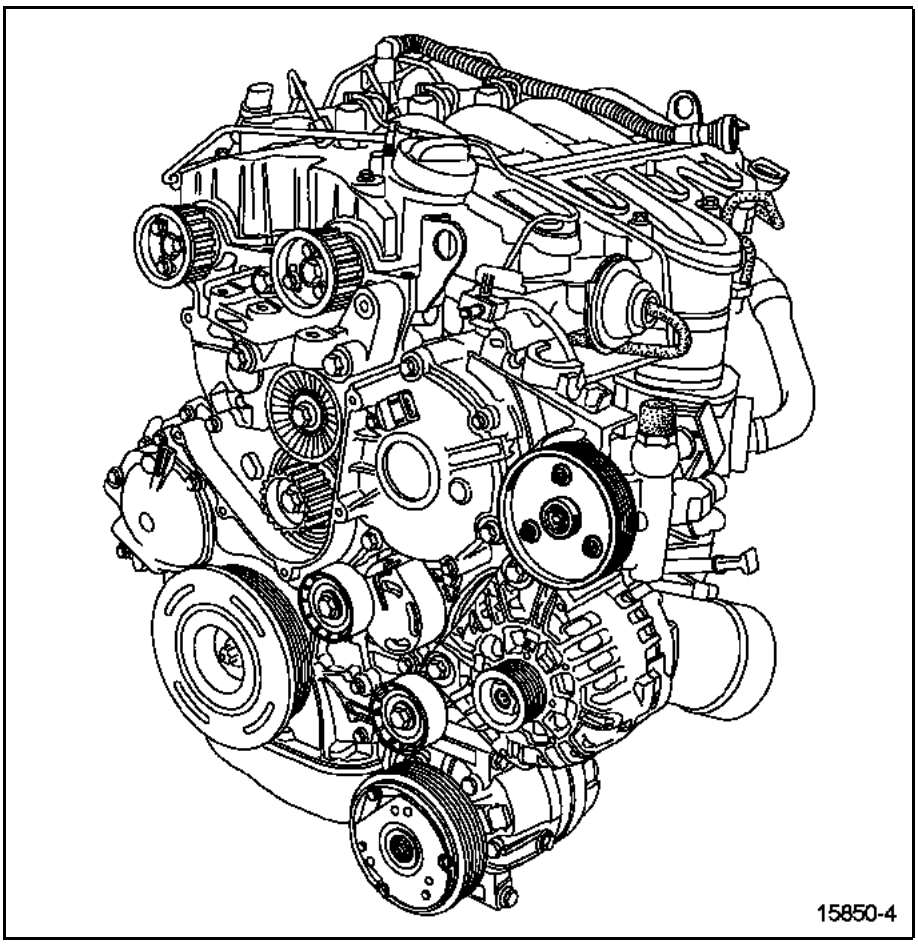
Refit the alternator, tightening the bolts to torque (**2.1 daNm**).



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**).

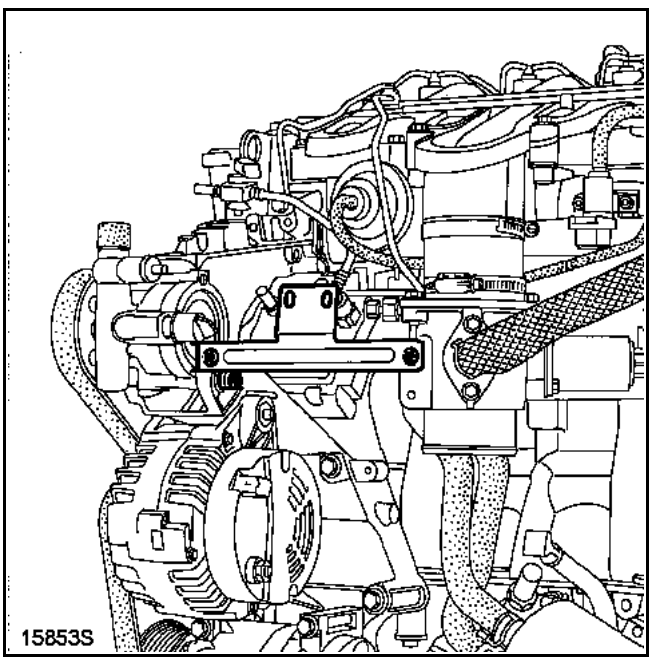
Refit the accessories belt tension wheel, tightening the bolts to torque (**2.1 daNm**).



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

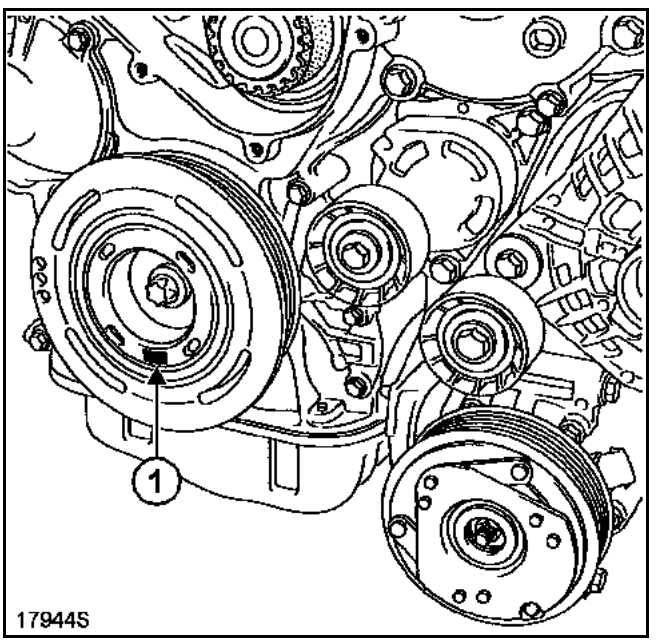
Refit the strut between the multifunction support and the exhaust gas recirculation valve support, tightening the bolts to torque (**1 daNm**).

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



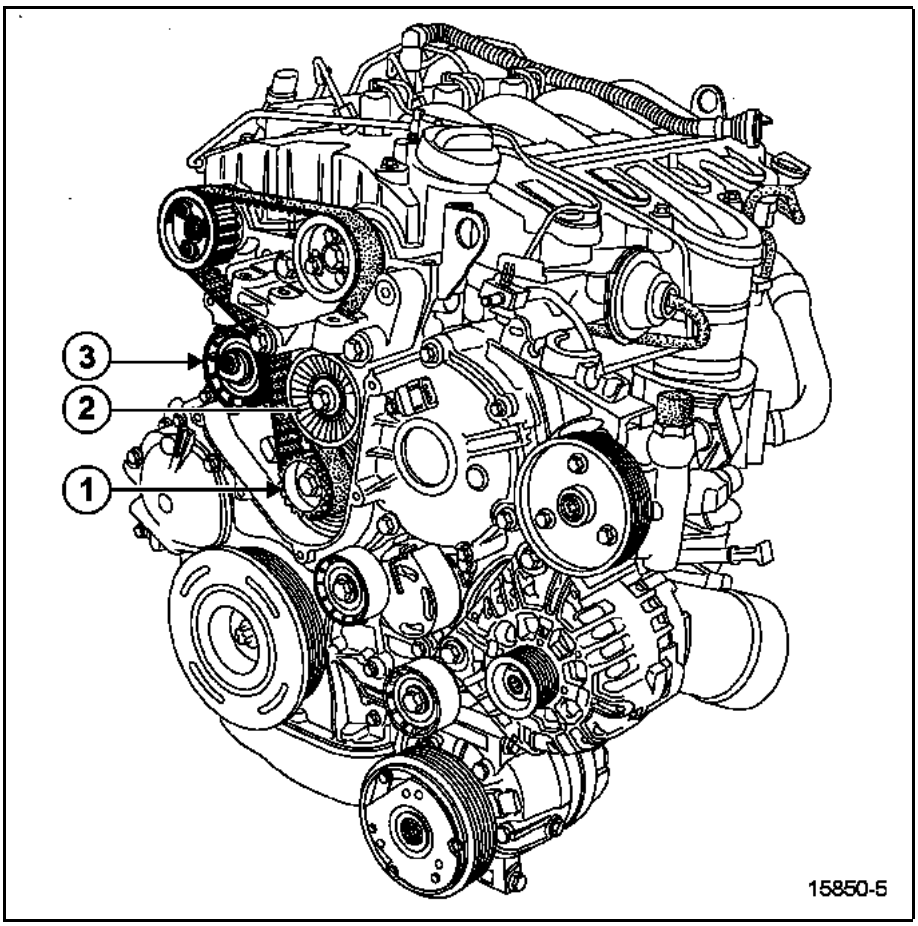
ADJUSTING THE TIMING METHOD

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).**

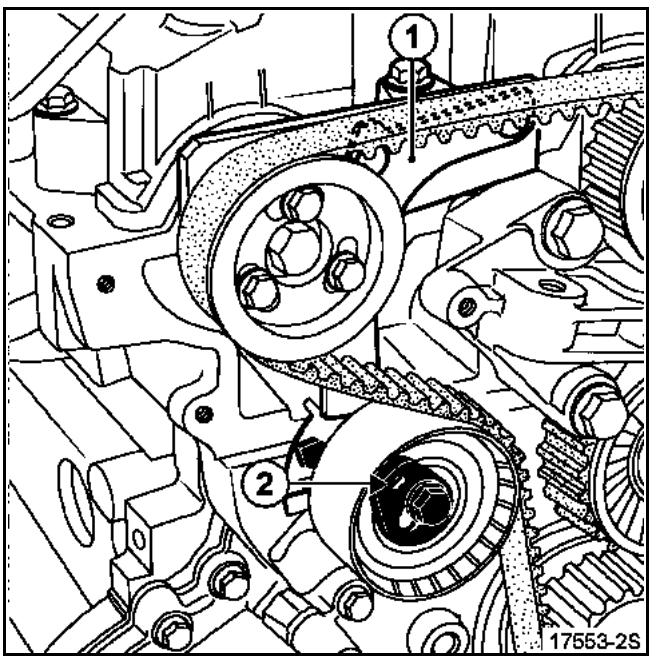
Fit the exhaust camshaft sprocket on the belt.

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

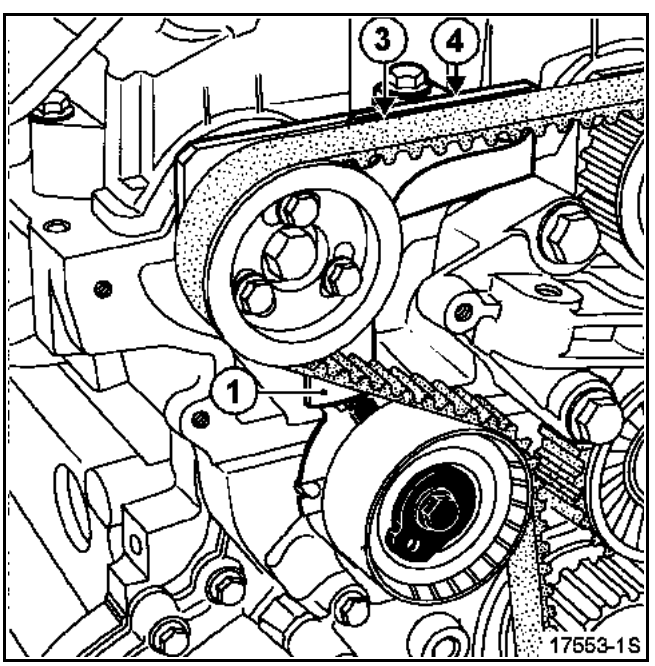
Reinsert the three sprocket mounting bolts without tightening them.

TIMING BELT TENSION

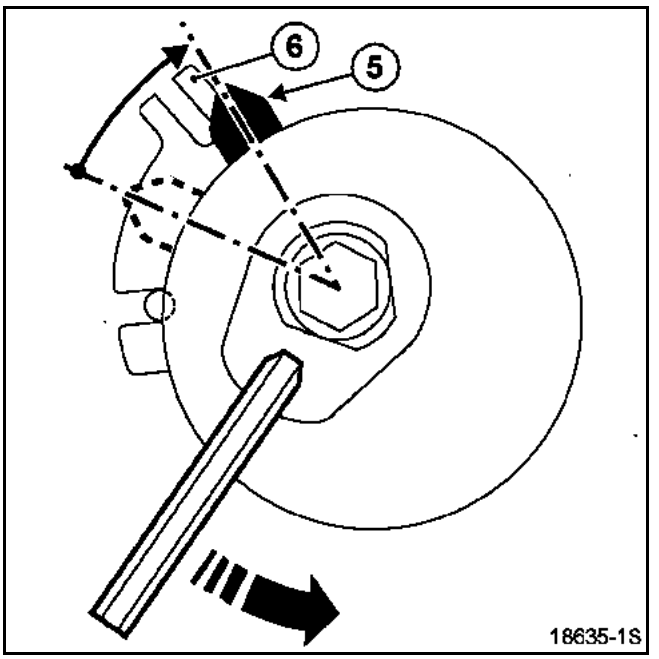
Check that the tab (**1**) of tool Mot. 1537 can move freely in the vertical axis.



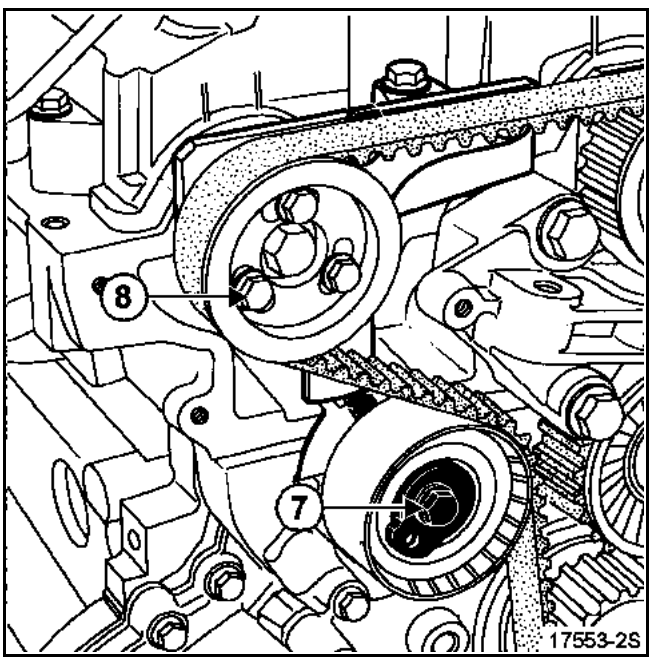
Insert a **6 mm** Allen key into the tension wheel cam opening (**2**).



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.

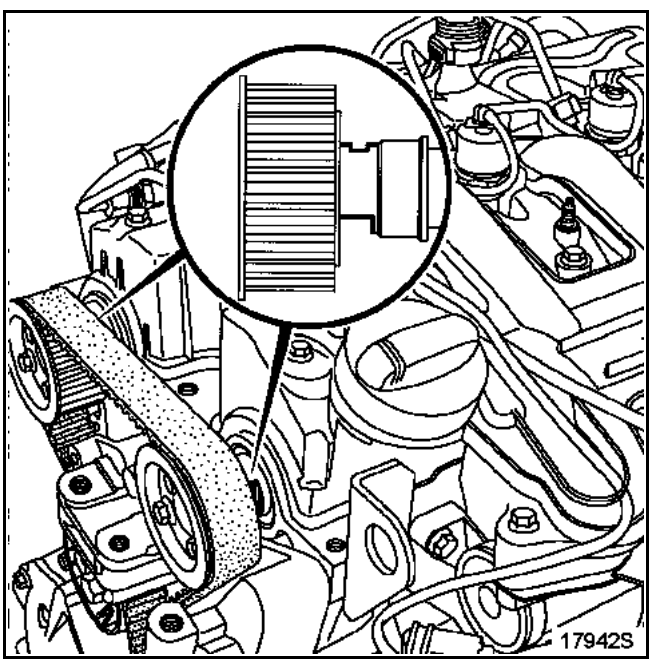
Tighten to torque:
– the tension wheel bolt (**7**) (**2.5 daNm**),
– the camshaft timing sprocket bolts (**8**) (**1 daNm**).

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.

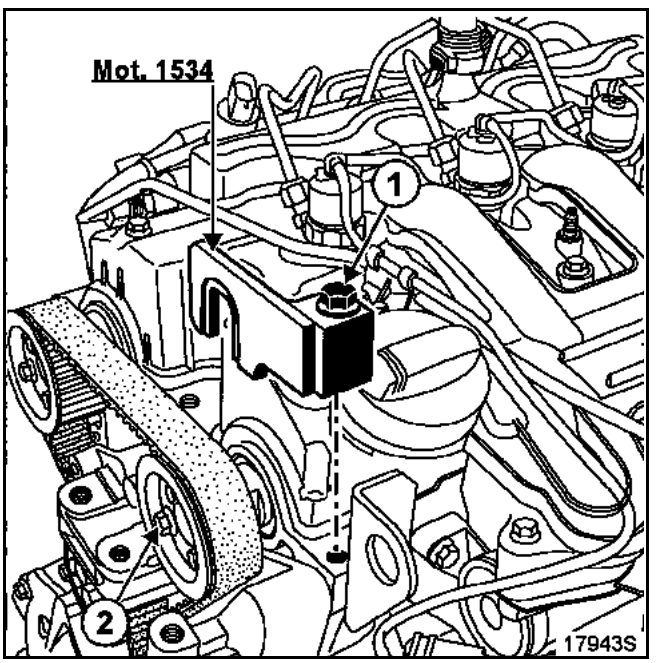
Set the crankshaft at top dead centre (the TDC mark on the crankshaft accessories pulley must be in the vertical axis of the engine).

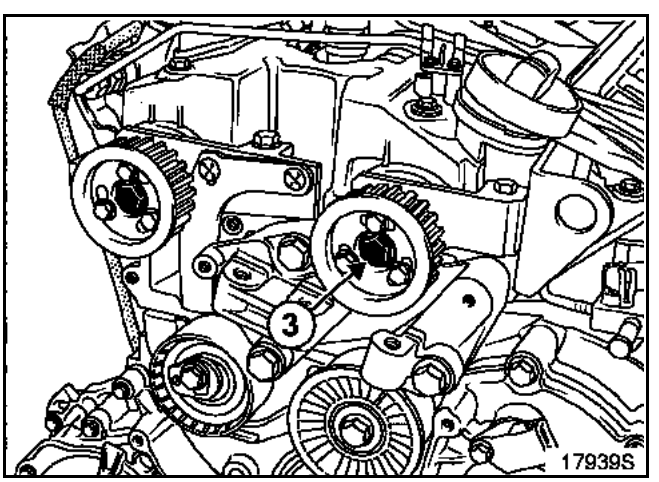
The camshaft grooves must be positioned vertically as shown in the diagram (top view zoom).



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

For the inlet camshaft:



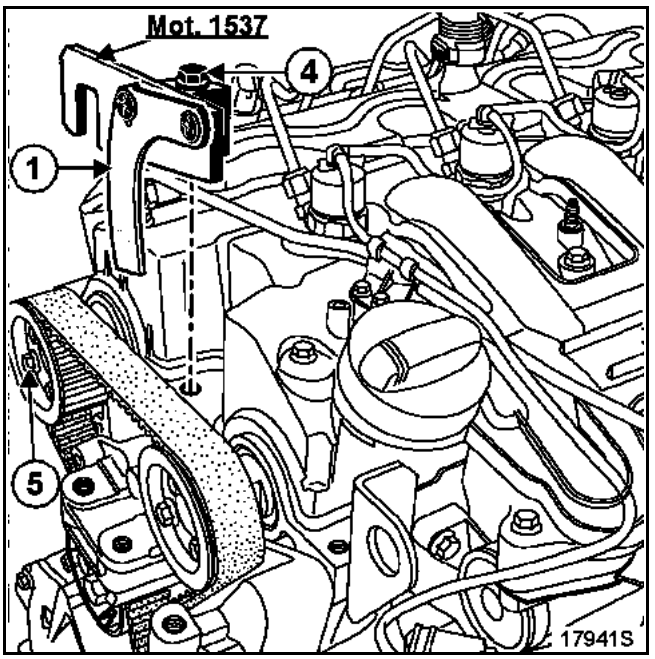


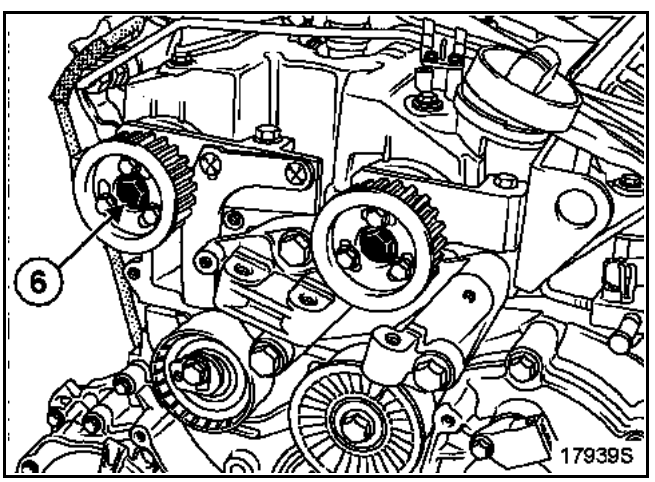
Mount tool Mot. 1534, screwing in the bolt (**1**) by hand.

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:





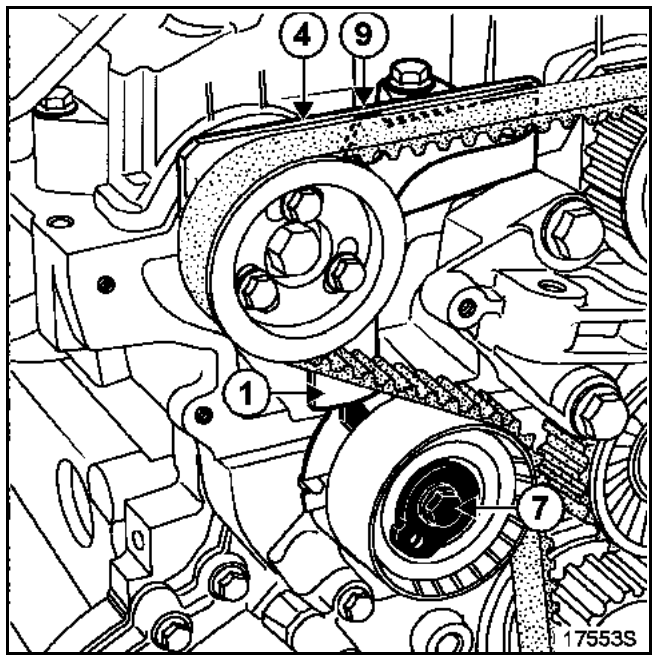
Mount tool Mot. 1537, screwing in the bolt (**4**) by hand .

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**).

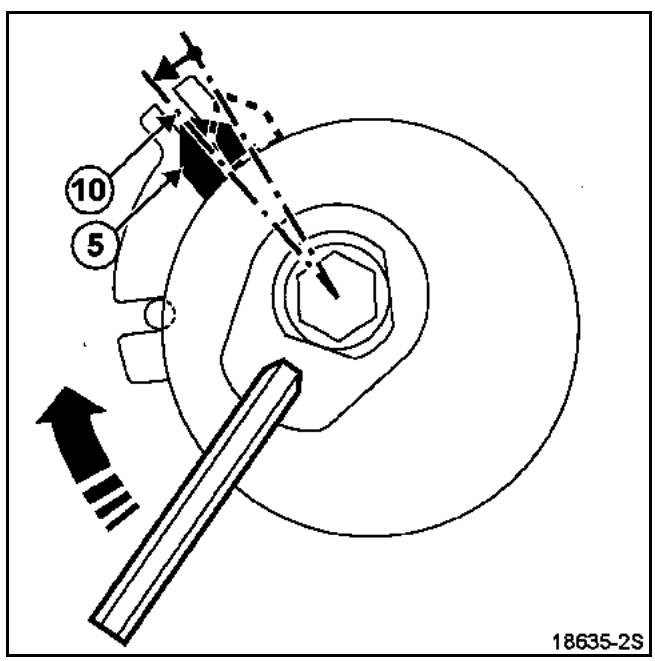
Check that the tab (**1**) of tool Mot. 1537 can move freely in the vertical axis.

CHECKING THE TIMING AND THE TENSION

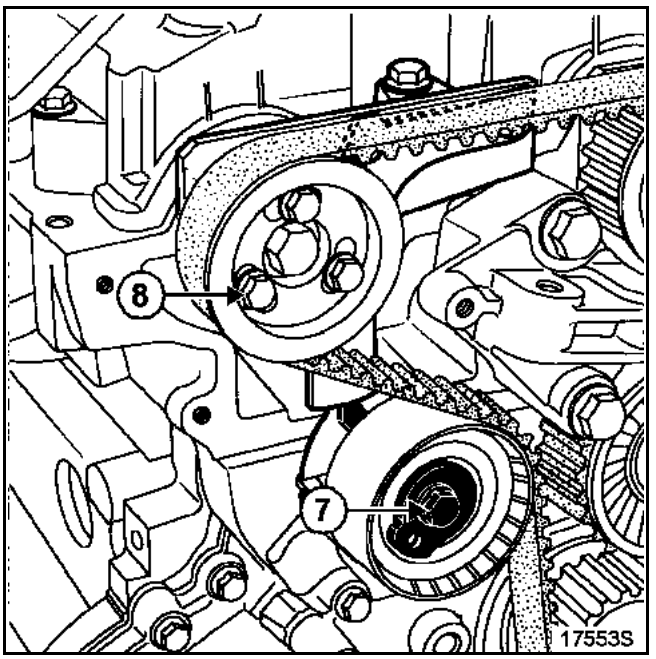


Undo the tension wheel bolt (**7**) while holding the cam with a **6 mm Allen key**.

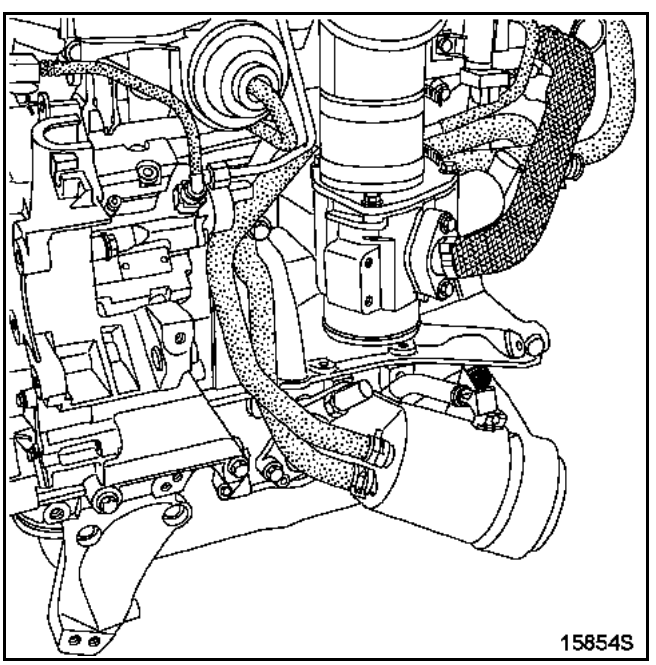
Turn the tension wheel cam clockwise **until the surface (9) of the tab (1) is aligned with the upper surface (4)** of tool Mot. 1537.



The moving pointer (**5**) of the tension wheel must be located in the middle of the groove (**10**).



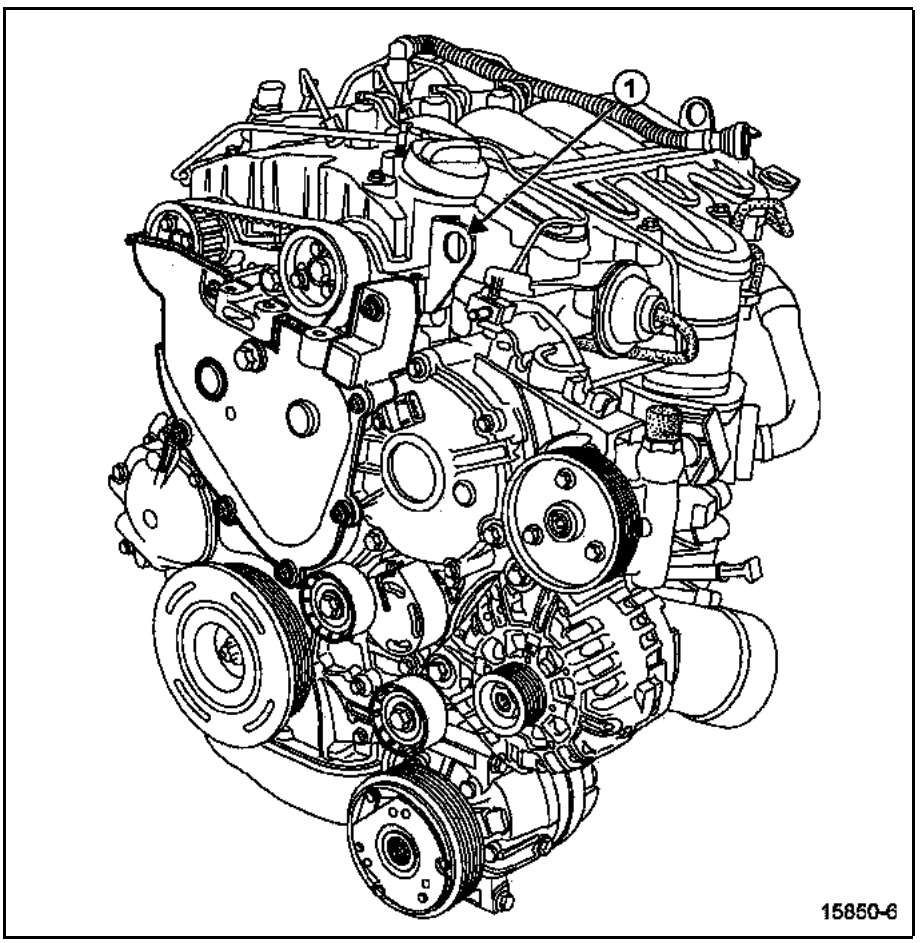
Tighten to torque:
– the tension wheel bolt (**7**) (**2.5 daNm**),
– the camshaft timing sprocket bolts (**8**) (**1 daNm**)



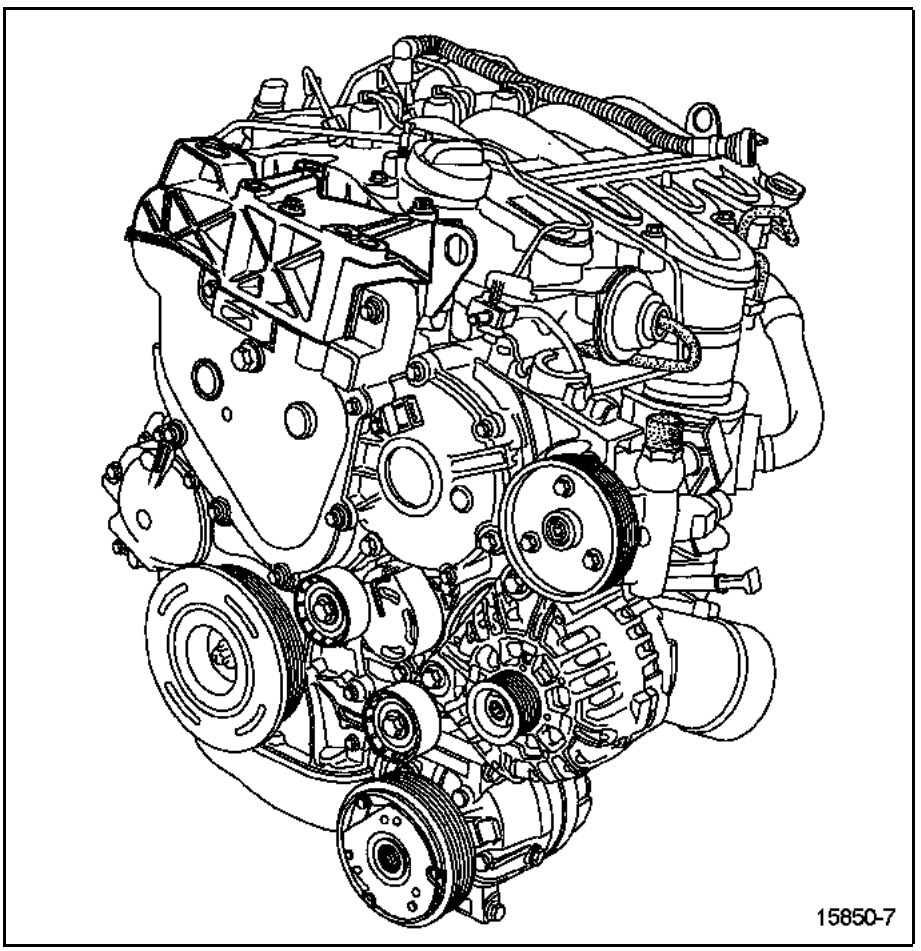
Remove the camshaft setting tools Mot. 1534 and Mot. 1537 and the TDC setting rod Mot. 1536.

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

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**).

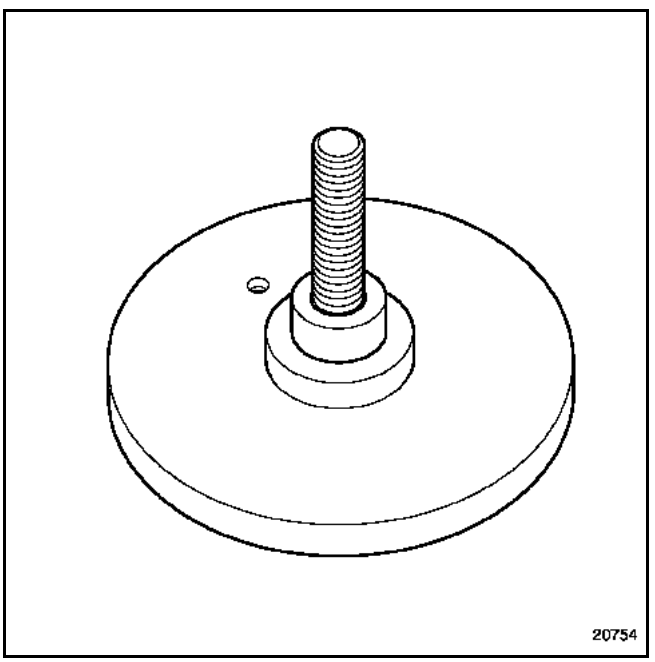


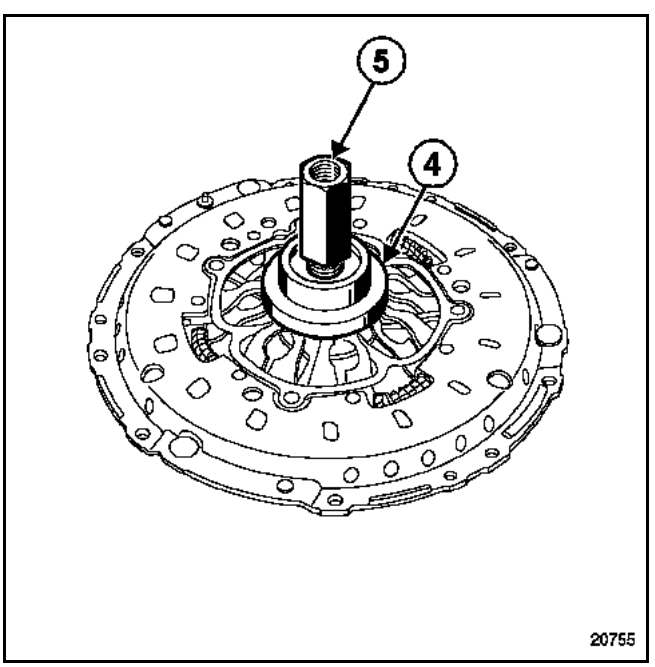
Centre the clutch plate using the centring mandrels (Emb. 1518).

Refit the mechanism.

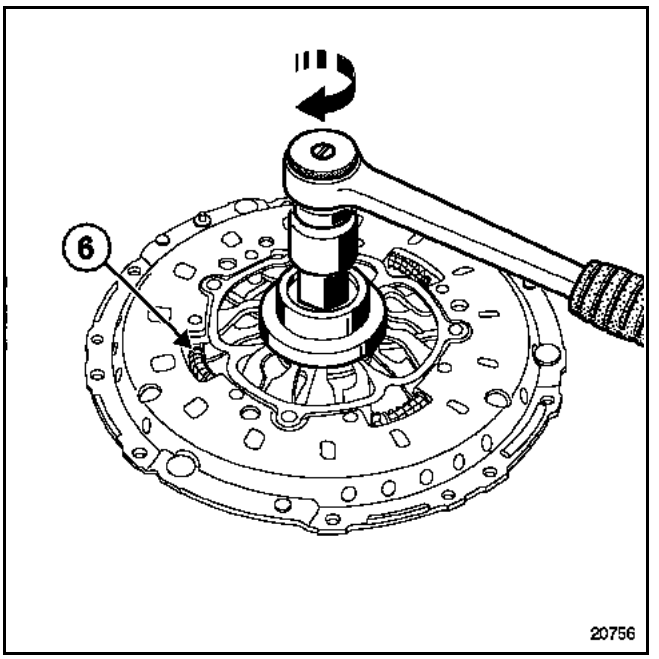
Self-adjusting clutch mechanisms must be compressed using the tool Emb. 1604, following the method described below.

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

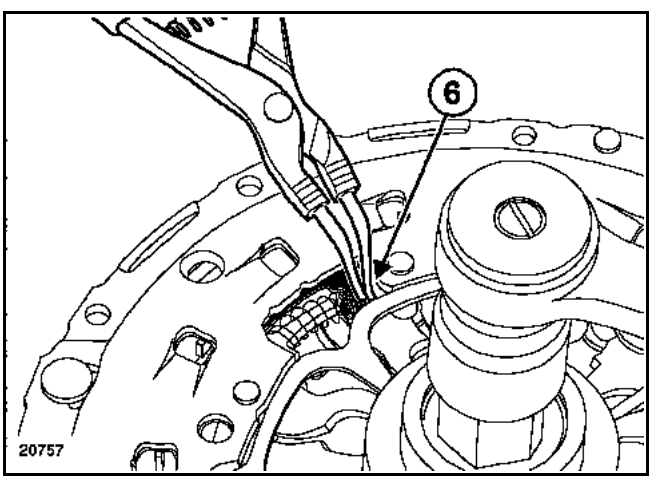


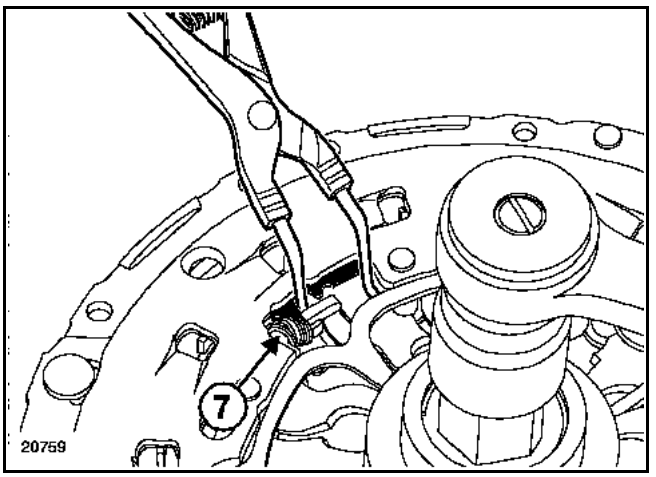


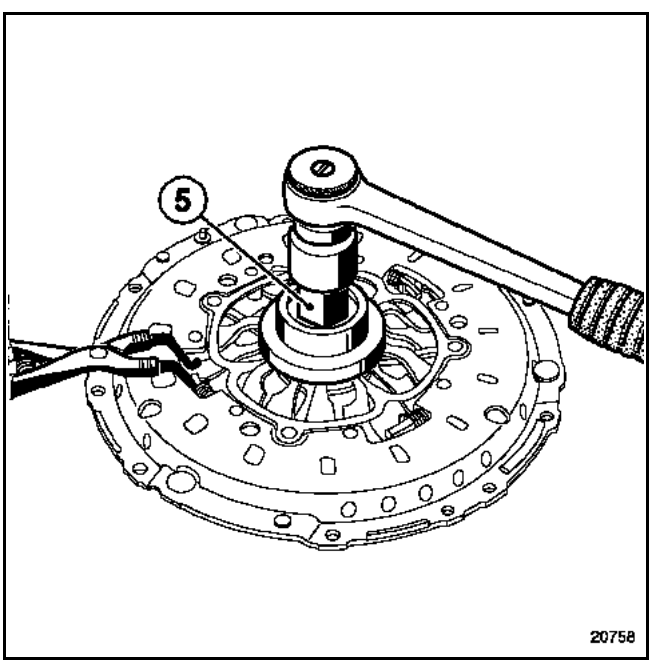
Mount the mechanism and then the ball thrust bearing (**4**) and the nut (**5**) on the base.



Screw on the nut until it locks. Then insert a pair of circlip pliers at (**6**).







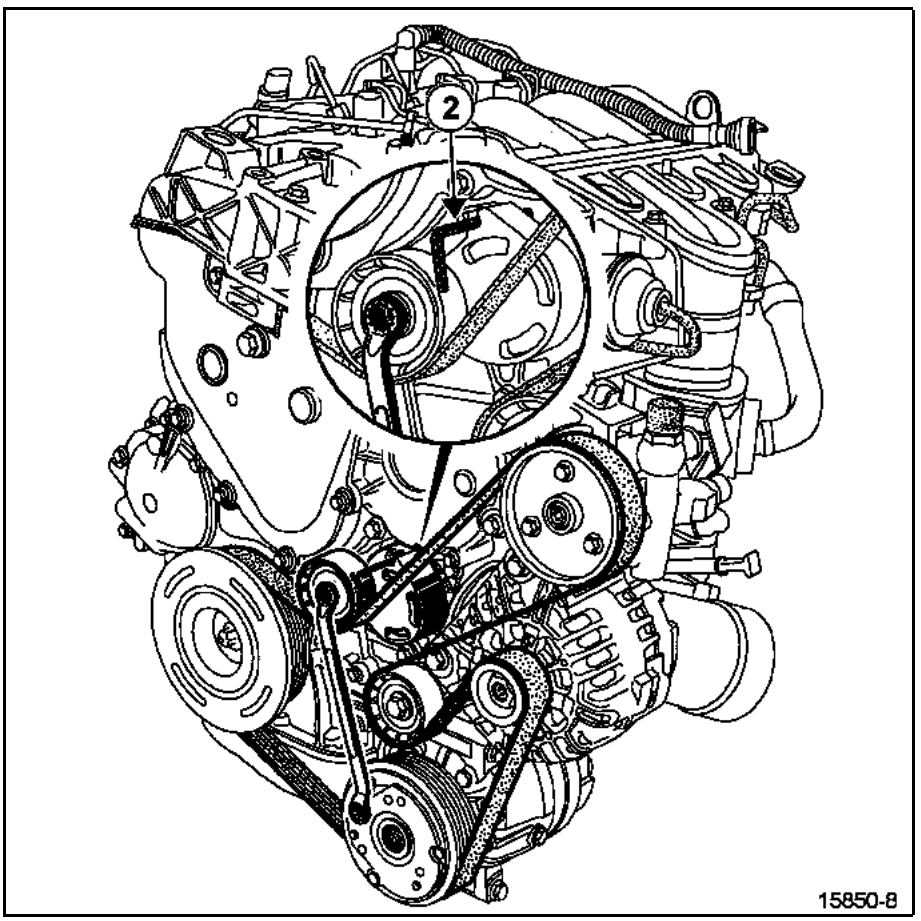
Compress the springs (**7**), then release the mechanism by completely unscrewing the nut (**5**) while keeping the springs compressed.

Remove the mechanism from the base (checking that the springs are correctly compressed).

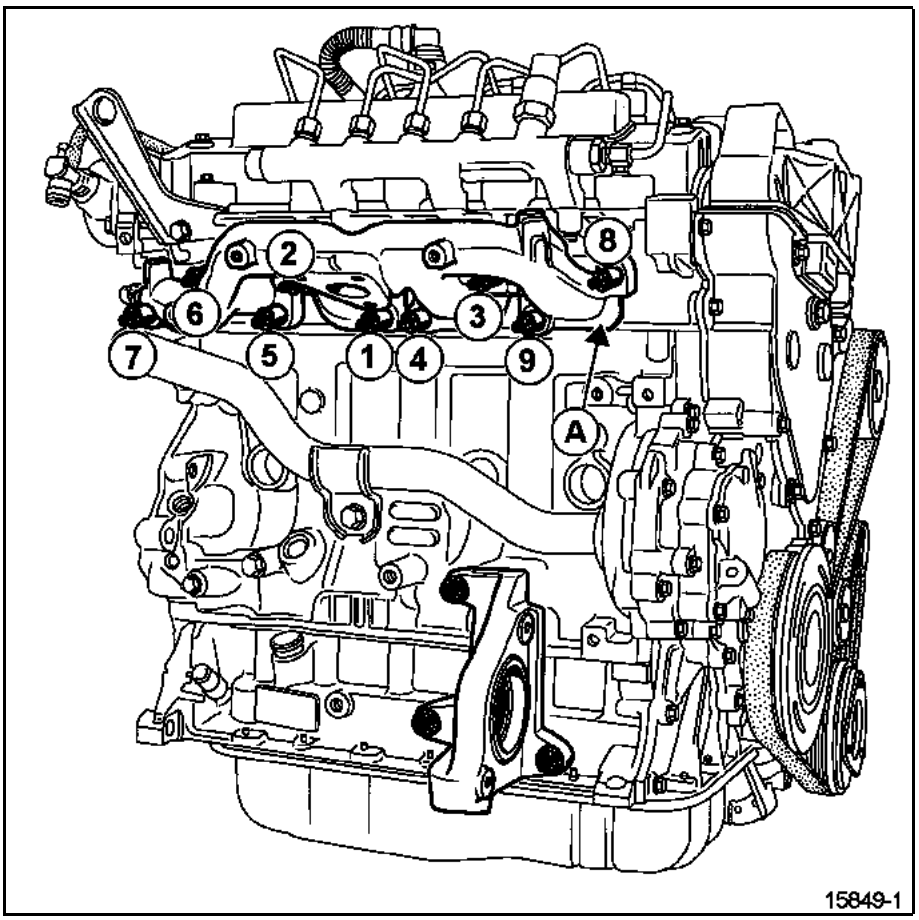
Refit the mechanism on the flywheel, tightening the bolts to torque (**1.2 daNm**).

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.



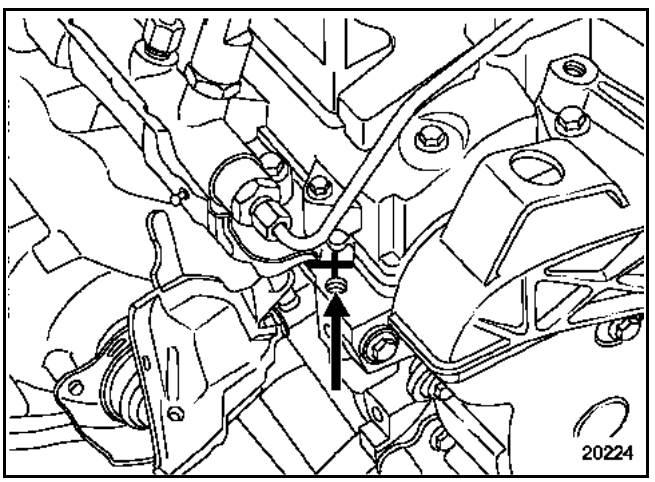
Refit the exhaust manifold, equipped with a new seal (with the foolproof fitting holes (**A**) at the timing end), then tighten the nuts in order and to torque (**2.7 daNm**).

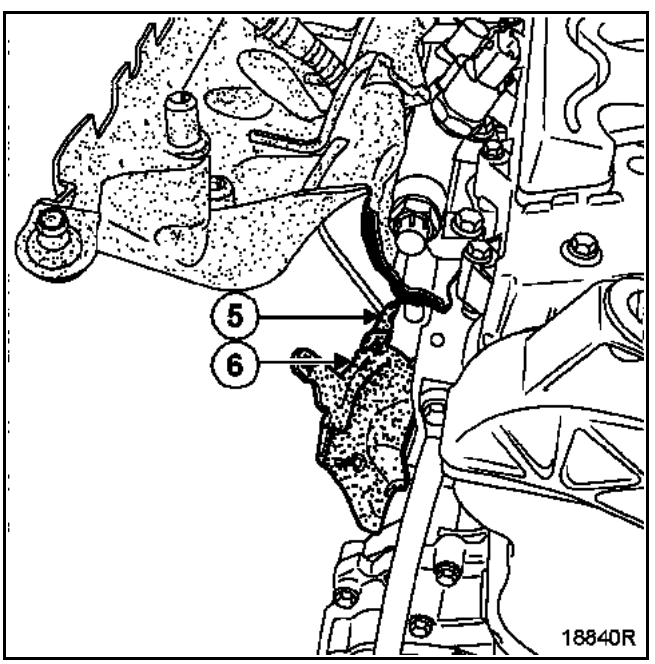
Refit the relay bearing, tightening the bolts to torque (**6.2 daNm**).

RAIL PROTECTOR

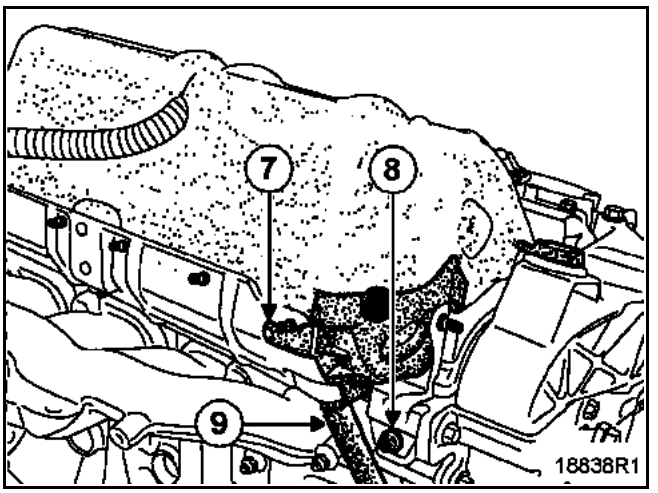
Model 1

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

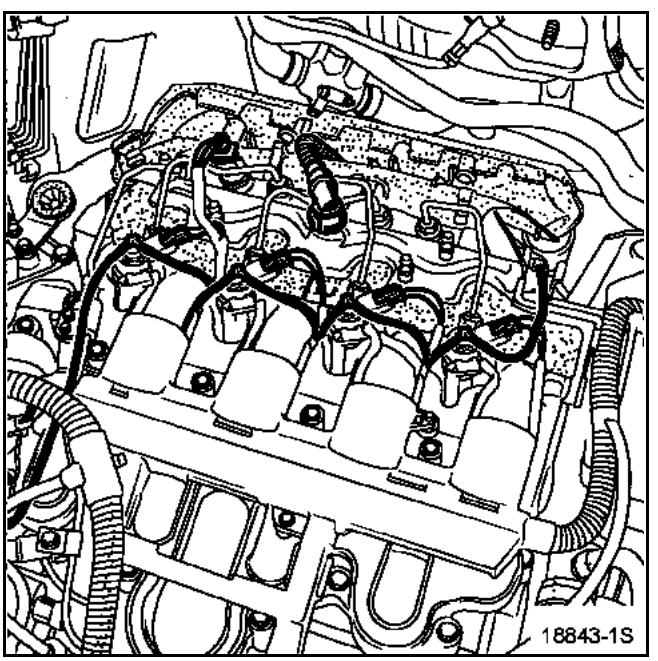




To refit the side partition on the lower metal protector **be sure to** follow the procedure below:
– mount the lower strap (**5**).
– mount the partition rubber ring (**6**) onto the lower metal protector,
– then mount the upper section of the partition on the metal protector,

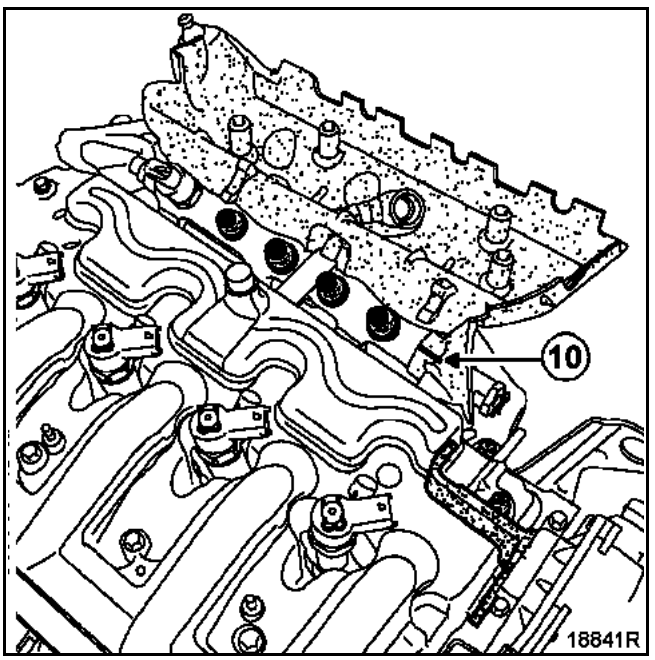


– mount the upper strap (**7**),
– refit the partition mounting bolt (**8**),
– reconnect the diesel fuel drain pipe (**9**), checking carefully that it is not blocked.



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

Refit the sealing partition, mounted on the rocker cover by two nuts.



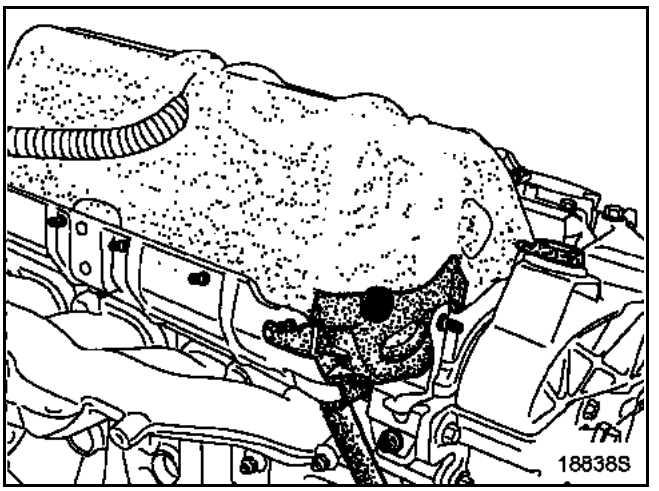
Check that the mark (10) on the rail partition is positioned correctly (in the axis of the high pressure rail outlets).

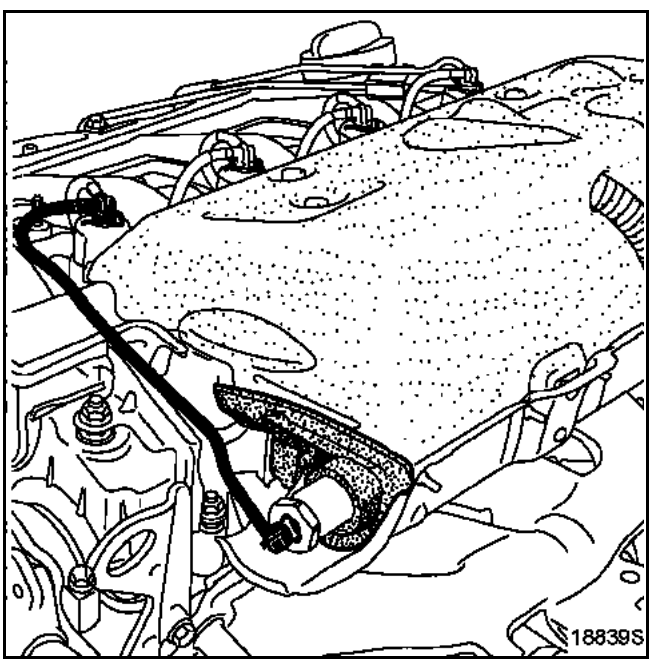
Check that the new diesel return pipe is correctly attached to the injectors and to the pressure relief valve at the end of the rail.

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.

WARNING
Check that the diesel fuel drain pipe is correctly connected.





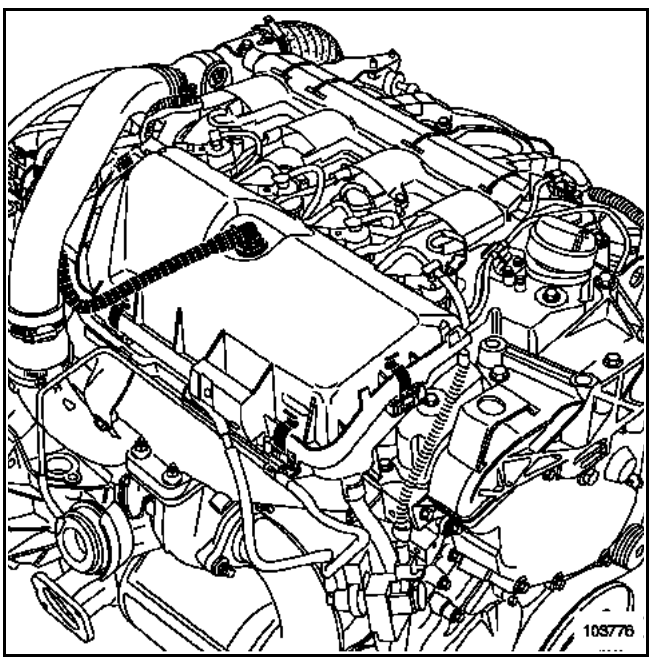
Clip the rubber flap onto the rocker cover and the engine mounting.

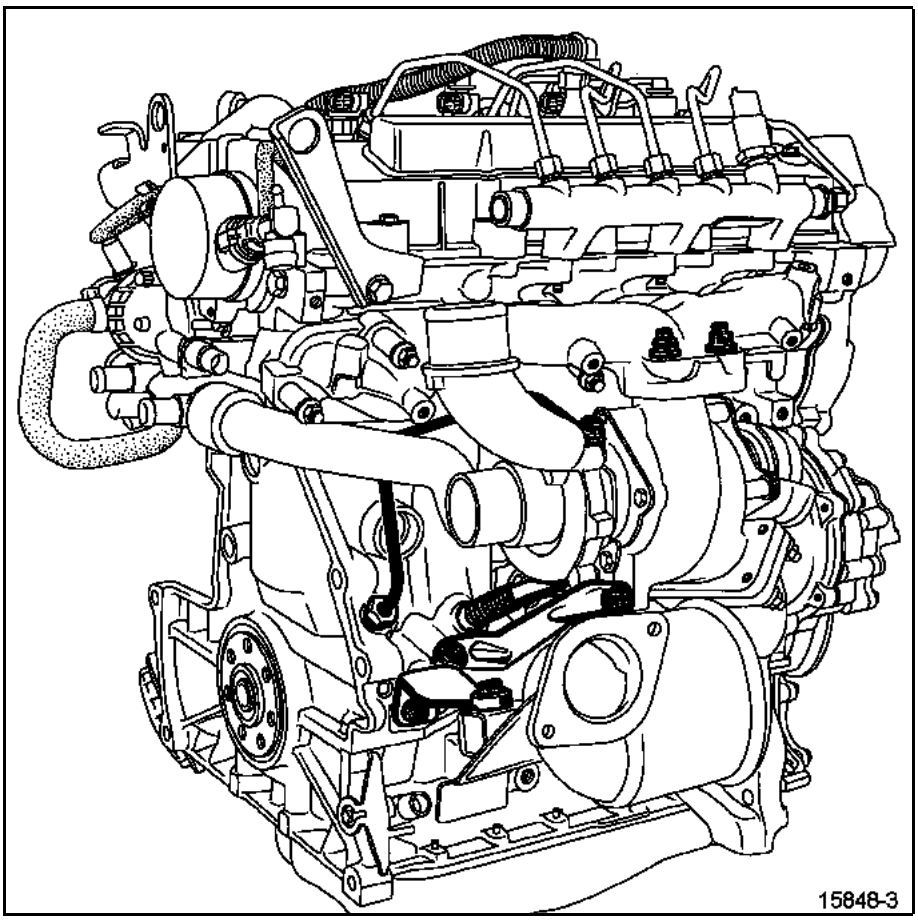
Check that the rubber flap is correctly fitted on the rocker cover and engine mounting points.

Model 2

Refit the rail protector plastic cover.

Reconnect the oil vapour rebreathing pipe.





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**).