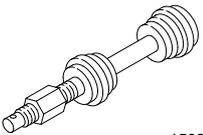
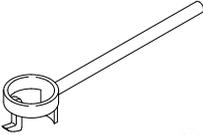
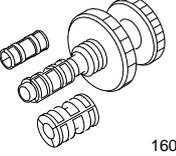
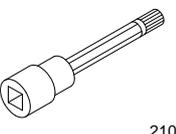
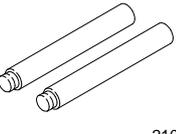
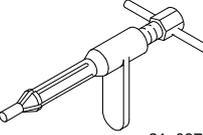
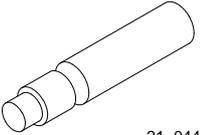
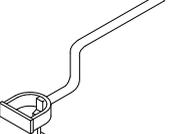
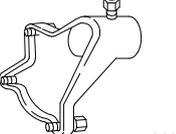
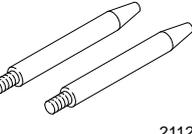
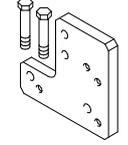
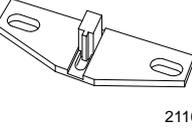
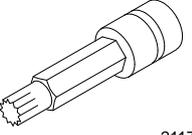
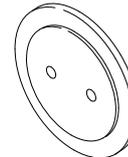
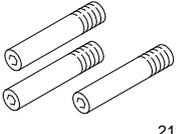
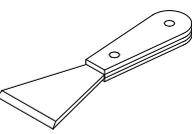
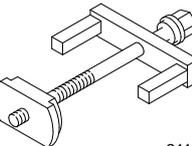
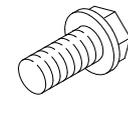
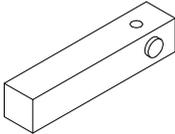
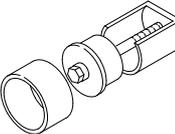
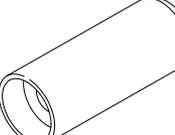
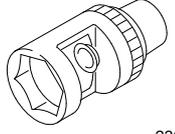
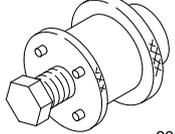
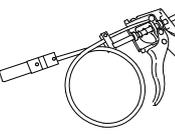
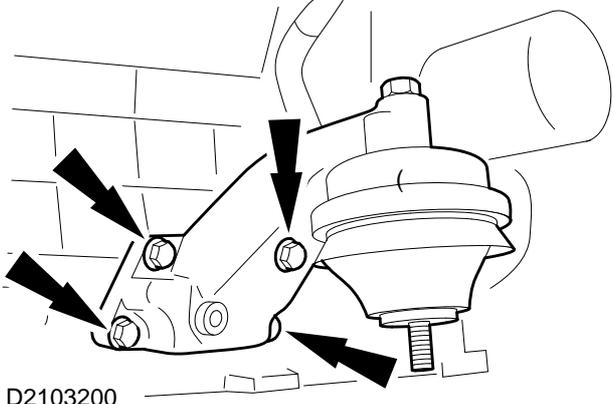


Engine – Dismantle and Assemble (21 134 8)

Special Tools

 15033	15-033 Remover/installer, crankshaft main bearing
 15072	15-072 Oil seal remover
 16067	16-067 Locator for clutch disc
 21002	21-002 Splined head socket, cylinder head bolts
 21003	21-003 Cylinder head locating studs
 21-037 B	21-037 B Pilot bearing remover
 21-044 A	21-044A Installer/aligner, pilot bearing/clutch plate
 21051	21-051 Oil seal remover
 21064	21-064 Mounting bracket
 21128	21-128 Cylinder head guide studs

 21150A	21-150A Mounting plate
 21153B	21-153B Remover for vibration damper
 21168	21-168 Crankshaft immobilising tool
 21175	21-175 Wrench for M14 cylinder head bolts
 21176	21-176 Installer, radial oil seal
 21177	21-177 Flywheel locating studs
 21178	21-178 Installer, radial oil seal
 21179	21-179 Separator, sump
 21181	21-181 Remover, cylinder liner
 21182	21-182 Cylinder liner clamping bolts

 21183	21-183 Measuring fixture, cylinder liner protrusion
 21185	21-185 Remover/installer, crankshaft main bearing
 21186	21-186 Crankshaft guide sleeve
 21540	21-540 Bolt tightening angle gauge
 23018	23-018 Dial indicator fixture for fuel injection pump timing
 23043	23-043 Wrench for injectors
 23044	23-044 Remover, injection pump timing pulley
 24003	24-003 Remover/installer, cooling hose clamp
 D2103200	

Proprietary Tools

Oil filter wrench
Dial indicators
Magnetic fixture
Internal gauge
Micrometer screw 50 – 75 mm
Micrometer screw 75 – 100 mm
Piston ring compressor
T30 bit with 1/4" bit holder and extension

Workshop Equipment

Assembly stand	
Workshop press	

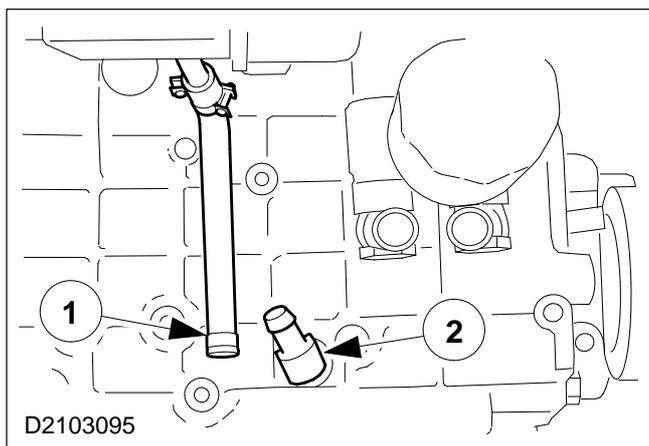
Materials

Plastigage	Obtainable through: Replacement Services Limited, 30 Euston Street, Freemans Industrial Estate, Leicester, LE2 7ST
Copper oil seals for injectors: 1,5 mm thick, with an internal diameter of 17,5 mm.	Obtainable through: Bosch authorised dealerships
Adhesive Loctite 222	WSK-M2G351-A4
Engine Oil	SAE 15W40
Lubricant	Hypoid oil SAE90
Lubricant	ESD-M1C220-A
Sealer	SLM-4G9111-A
Sealer	ESEAM-1C1014
Sealer	SPM-2G9121-A
Adhesive	WSK-M2G349-A7

Dismantle**1. General note.**

Use removal and fitting tool 24-003 to remove coolant and breather hoses if necessary.

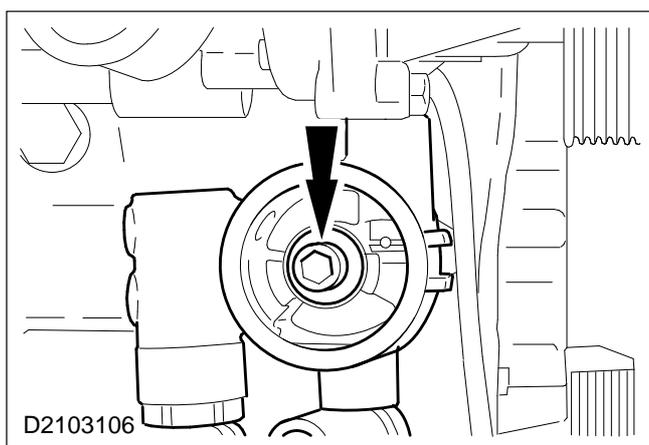
2. Remove the left-hand engine mounting bracket.



NOTE: Watch out for escaping oil.

3. Detach the turbocharger oil return hose.

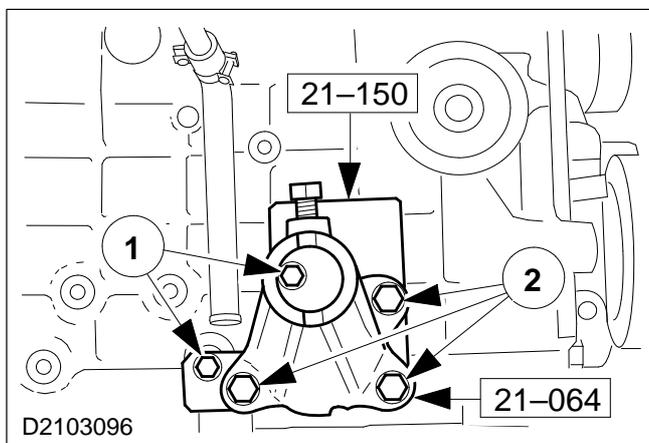
- 1 Detach the hose.
- 2 Remove the connector.



NOTE: Escaping oil.

4. Remove the engine oil filter.

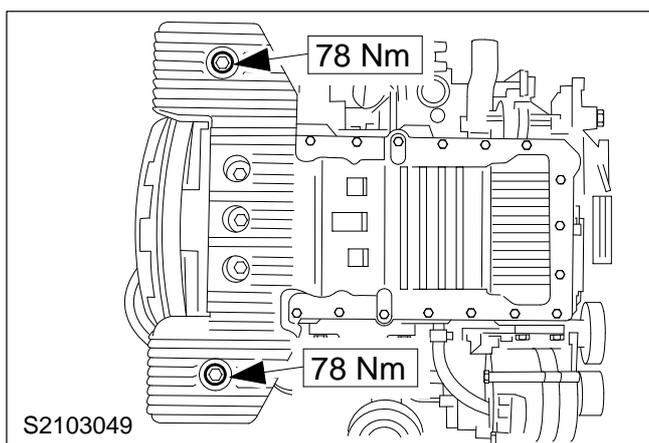
5. Remove the oil filter intermediate housing.



6. Mount the engine on an assembly stand.

- 1 Fit the mounting plate.
- 2 Fit the mounting bracket to the mounting plate.

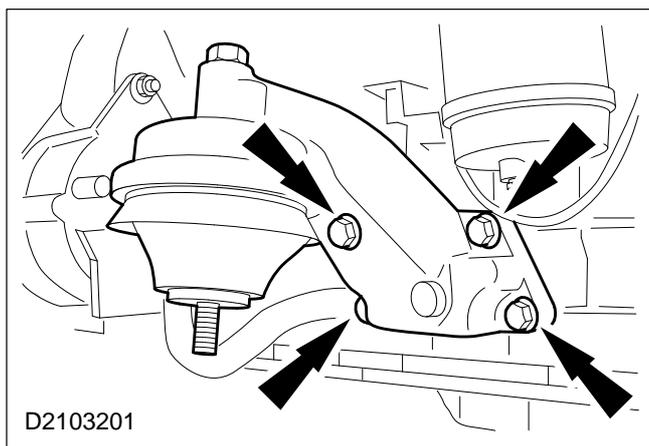
Mount the engine on the assembly stand



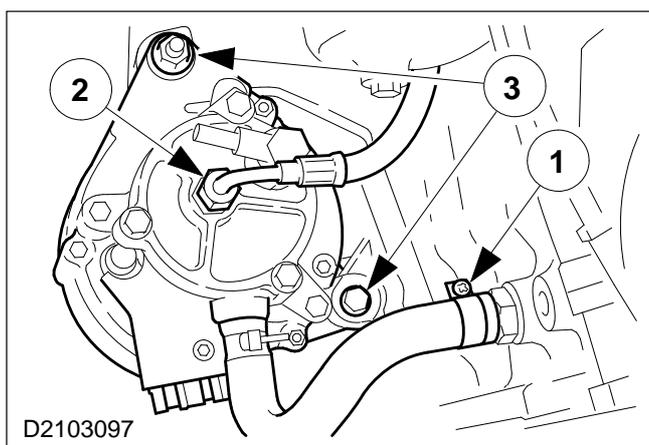
NOTE: Remove both oil drain plugs.

7. Drain off the engine oil.

Tighten the oil drain plugs with new oil seals once the engine oil has been removed.

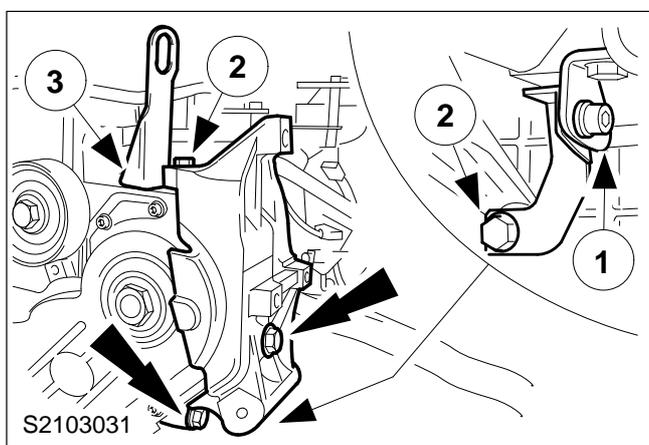


8. Remove the right-hand engine mounting bracket.



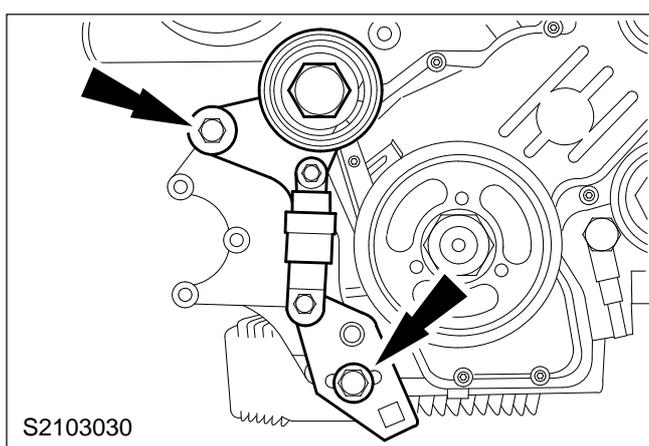
9. Remove the alternator with the vacuum pump.

- 1 Detach the vacuum pump oil return hose.
- 2 Detach the oil feed pipe.
- 3 Remove the alternator and vacuum pump.

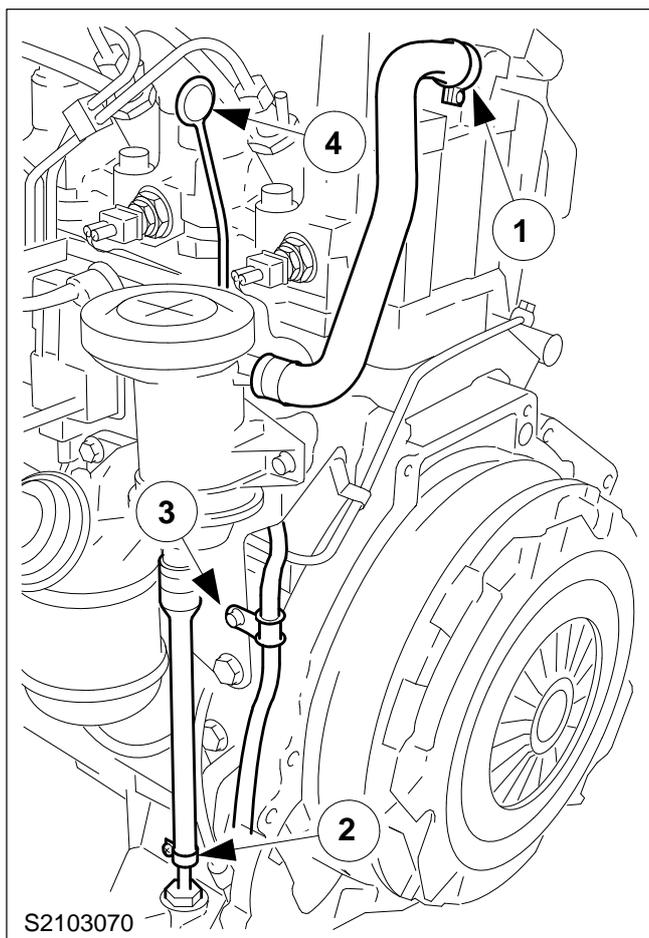


10. Detach the upper alternator bracket and the lower fuel injection pump bracket.

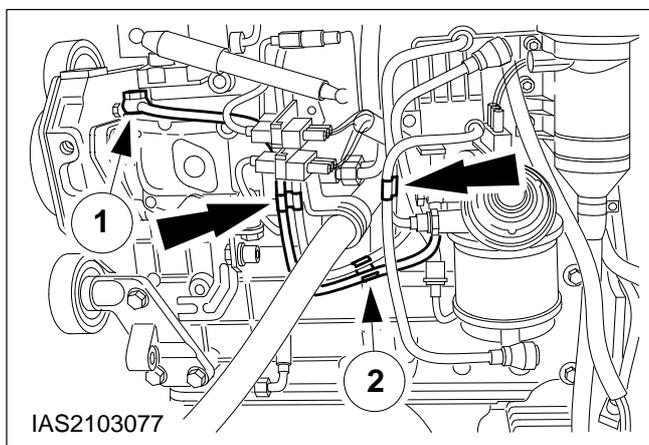
- 1 Undo the nut and bolt on the injection pump bracket.
- 2 Remove the alternator bracket.
- 3 Remove the engine lifting eye (one bolt).



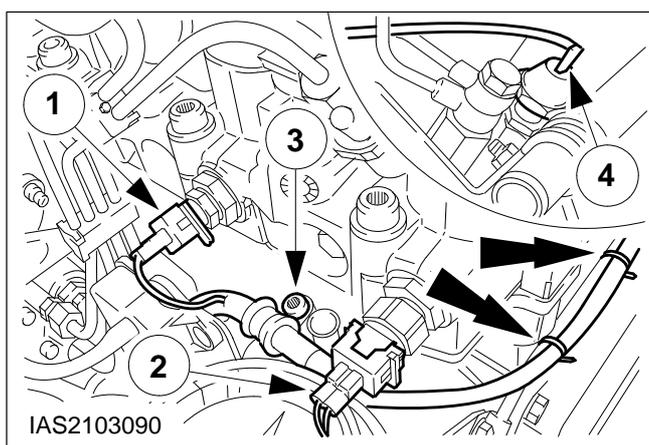
11. Remove the automatic belt tensioner.

**12. Disconnect the hoses.**

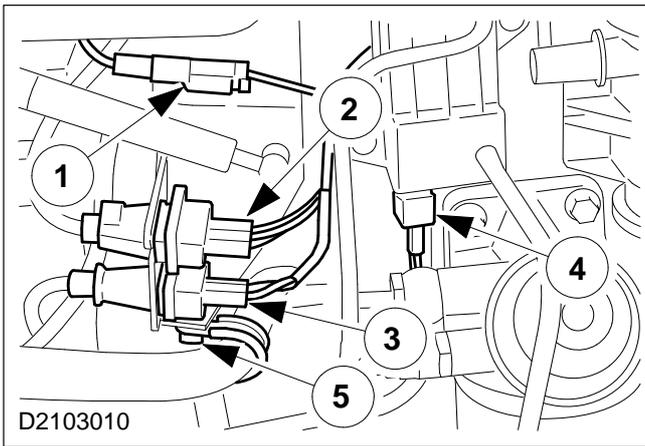
- 1 Crankcase ventilation hose.
- 2 Oil separator return hose.
- 3 Wiring loom retaining clamp.
- 4 Withdraw the oil dipstick.

**13. Disconnect the fuel return hose from the injection pump.**

- 1 Fuel return hose
- 2 Unclip the fuel pipes.

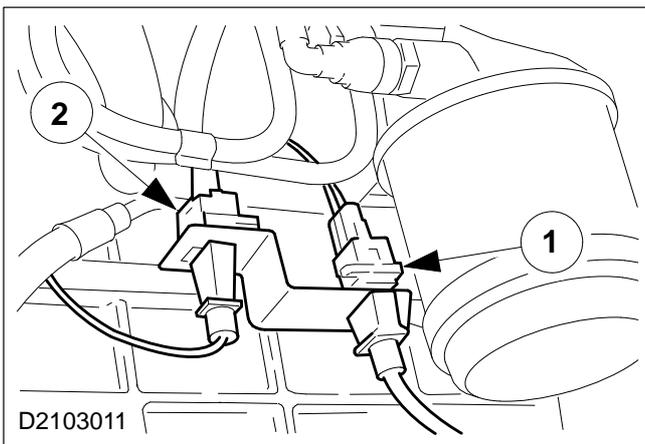
**14. Disconnect the plugs.**

- 1 Engine coolant temperature (ECT) sensor.
 - 2 Coolant temperature gauge sender
 - 3 Remove the wiring loom retaining clamp.
 - 4 Oil pressure switch.
- Undo the cable ties.



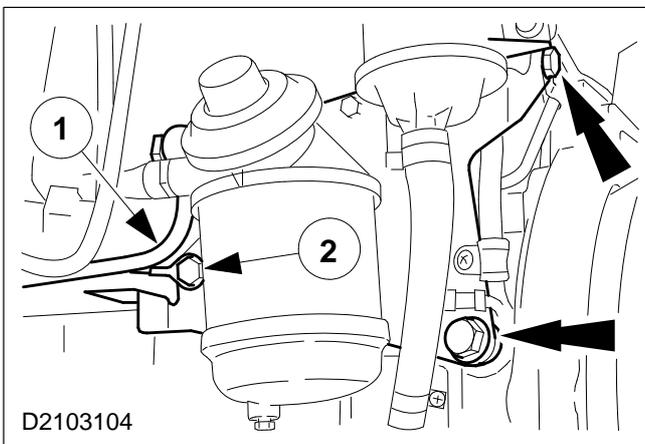
15. Pull off the connectors and detach the wiring loom.

- 1 Plug of fuel shut-off valve.
- 2 Fuel level variable resistor (FLVR) sensor connector
- 3 Fuel injection pump timing adjusting valve connector.
- 4 Fuel heater connector.
- 5 Detach the wiring loom retaining clip from the accelerator bracket.



16. Detach the connectors from the fuel filter mounting plate and disconnect them.

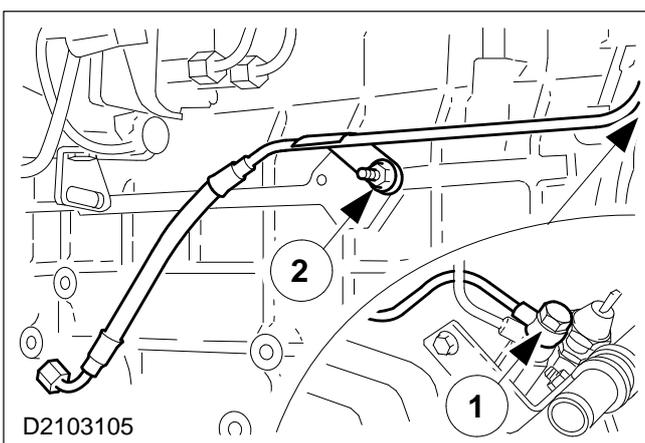
- 1 Crankcase position sensor (CKP sensor).
- 2 Fuel injector needle lift position sensor (NLS) connector.



17. Detach the fuel filter mounting plate complete with the fuel heater, oil separator and wiring loom.

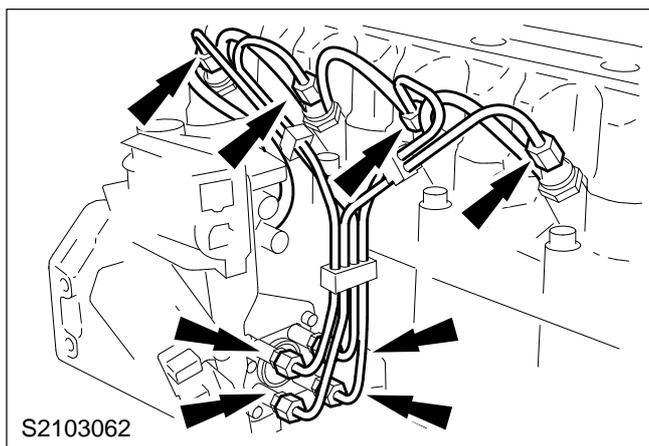
- 1 Detach the fuel feed pipe.
- 2 Detach the mounting plate with the oil feed pipe bracket.

18. Remove the wiring loom complete.



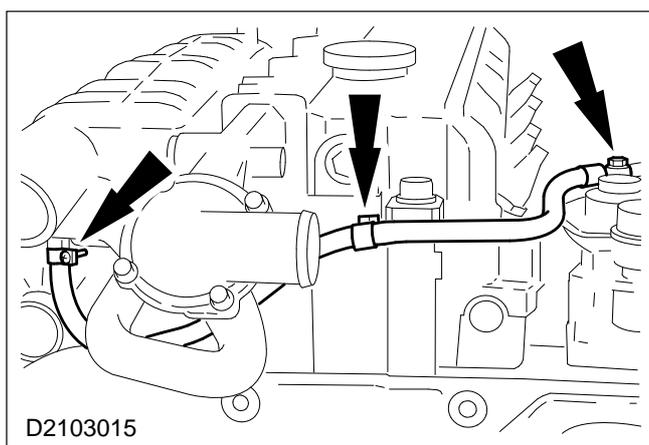
19. Disconnect the vacuum pump oil feed pipe.

- 1 Oil feed pipe.
- 2 Oil feed pipe bracket.

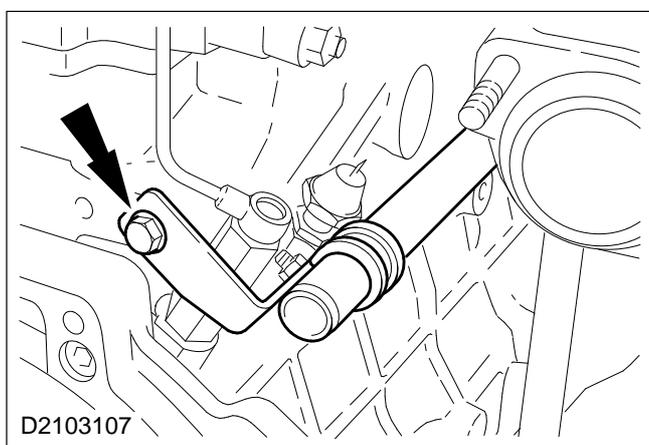


NOTE: Escaping fuel. Close off the openings in the injection pump and the injectors with suitable plugs.

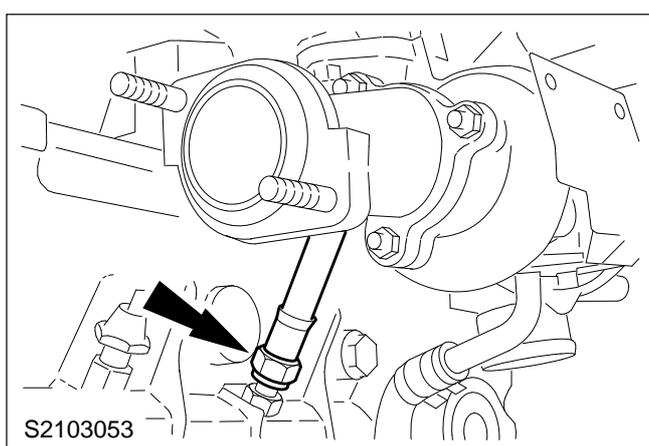
20. Remove the fuel injection pipes and pull off the leak off hoses.



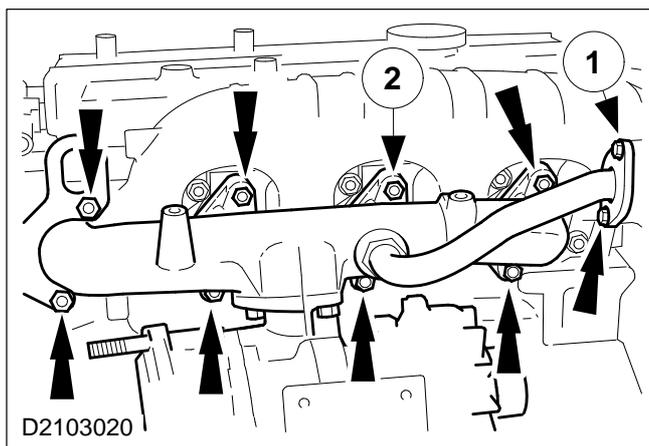
21. Remove the smoke pressure limiter (SPL) pipe.



22. Detach the coolant pipe bracket from the cylinder block.

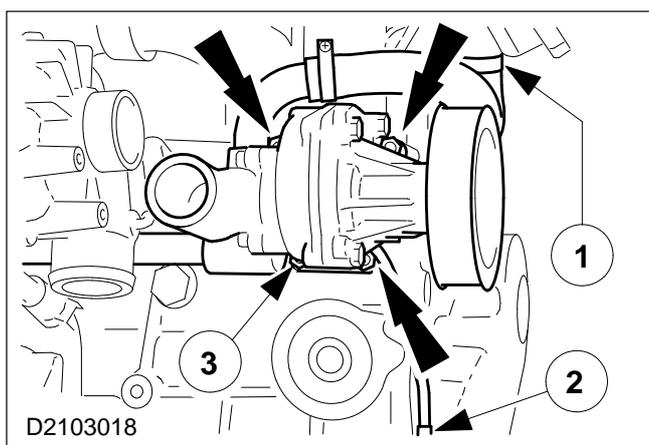


23. Disconnect the turbocharger oil feed pipe from the main bearing housing hollow locating screw.



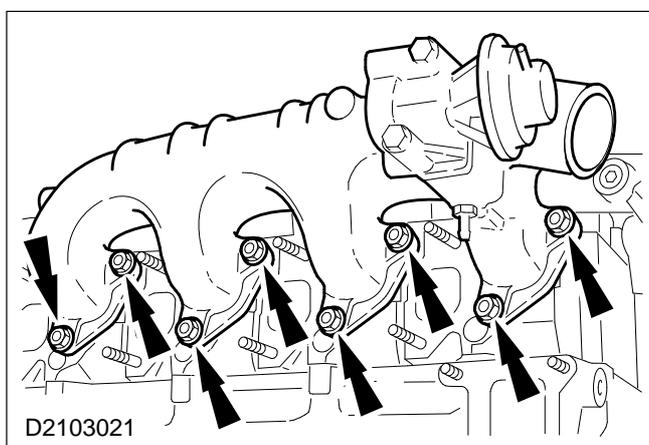
24. Remove the exhaust manifold with the turbocharger.

- 1 Detach the pipe flange from the exhaust gas recirculation valve (EGR valve).
- 2 Remove the exhaust manifold.



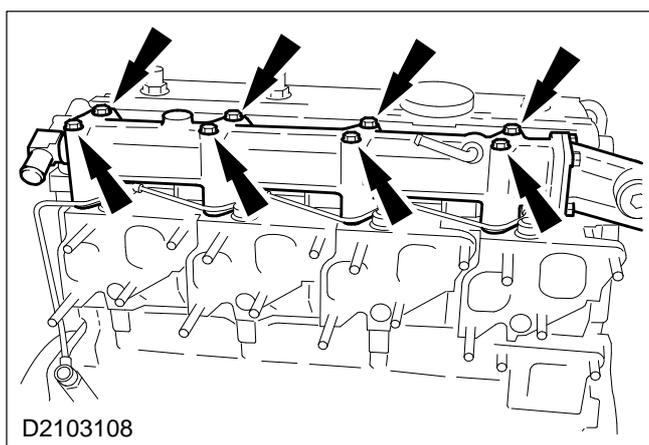
25. Remove the coolant pump.

- 1 Detach the coolant hose.
- 2 Withdraw the hose from the bracket.
- 3 Remove the bolts.



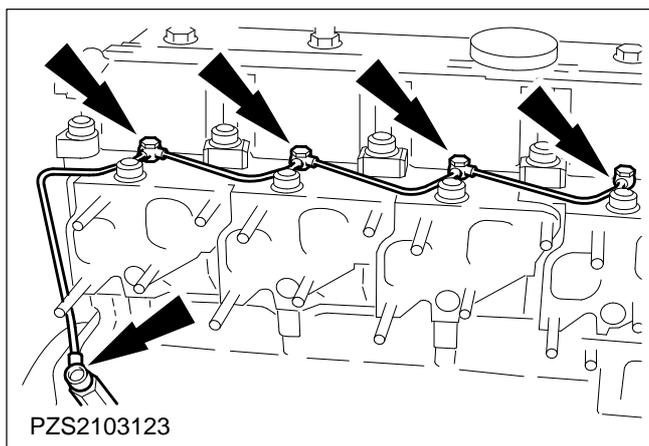
26. Remove the intake manifold with the EGR valve.

Take off the intake/exhaust manifold gasket.

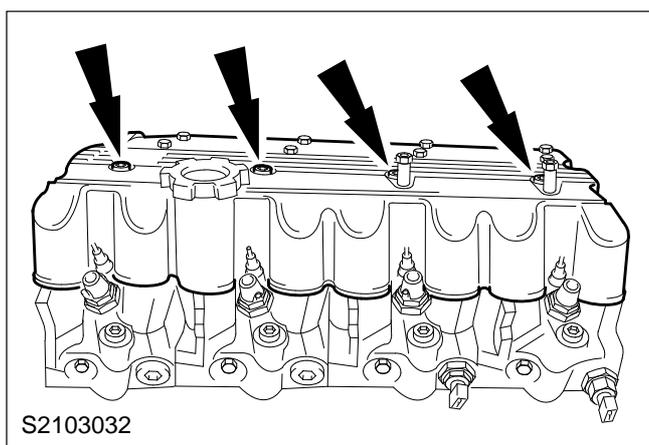


27. Remove the coolant collection tube with the thermostat housing.

Take off the gaskets.

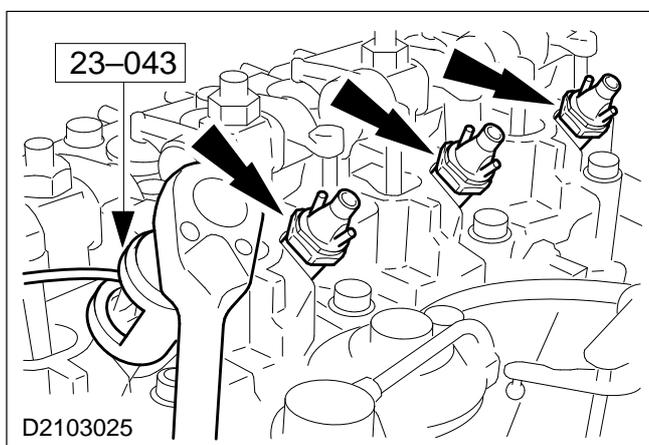


28. Remove the rocker arm oil feed pipe.



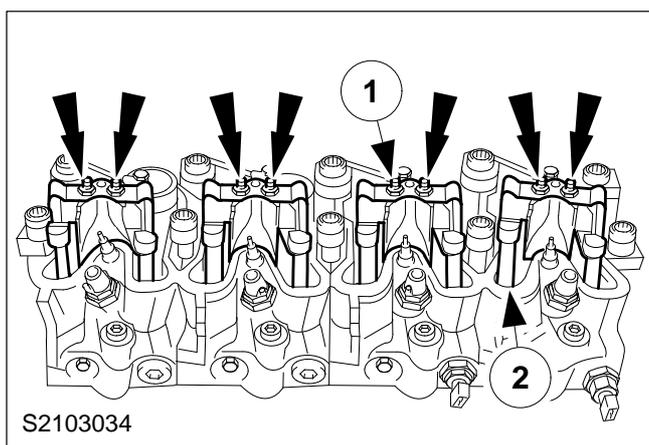
29. Remove the cylinder head cover.

Take off the gasket.



30. Remove the injectors using the special tool.

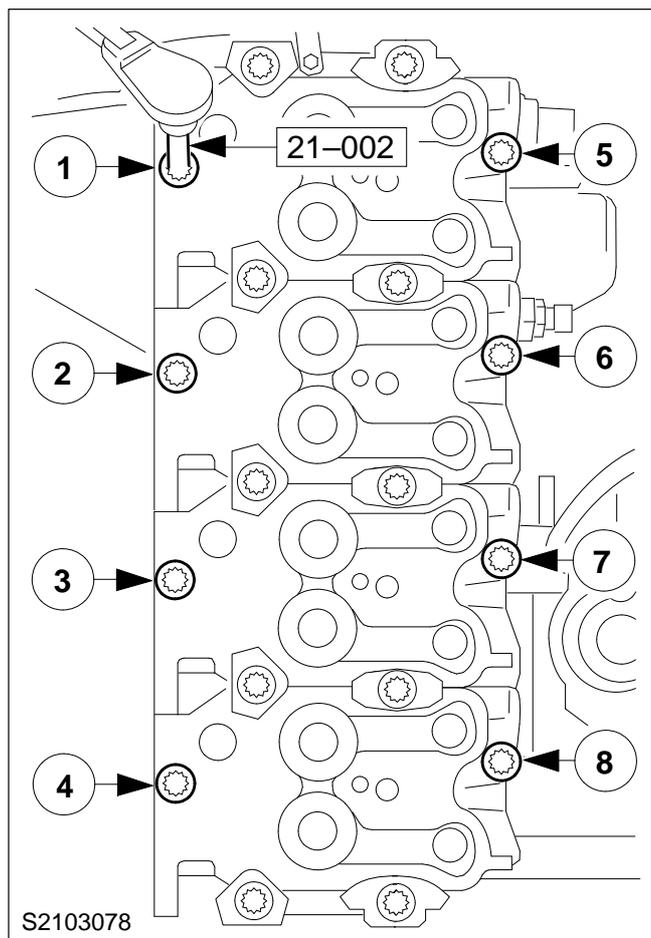
Cut through the old sealing rings and remove them.



NOTE: Keep the rocker shafts and push rods in order.

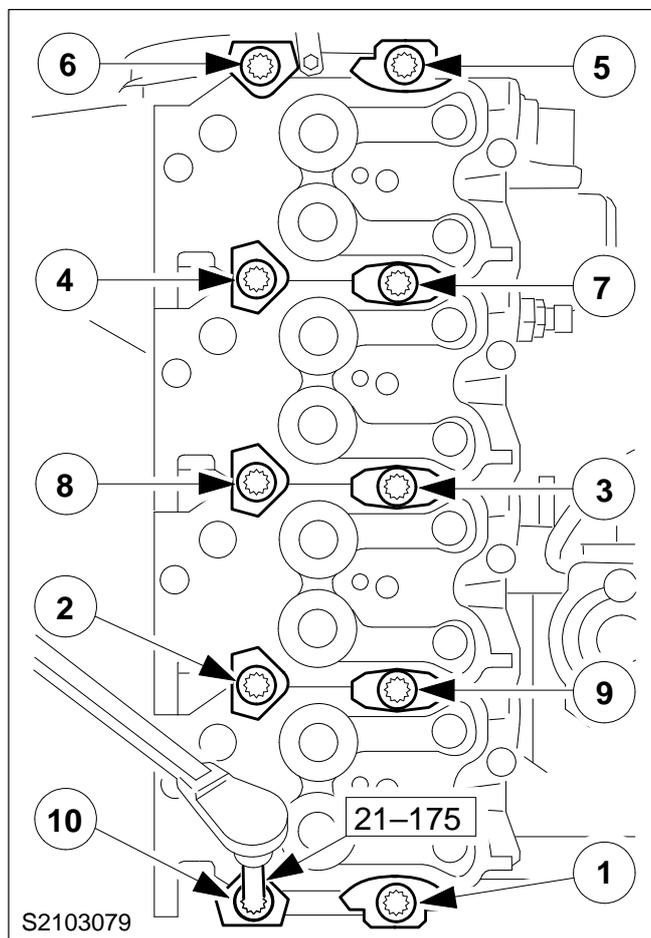
31. Remove the rocker shafts.

- 1 Rocker shafts.
- 2 Push rods.



NOTE: Bolt-slackening sequence.

32. Unscrew and remove the cylinder head outer bolts (M12).

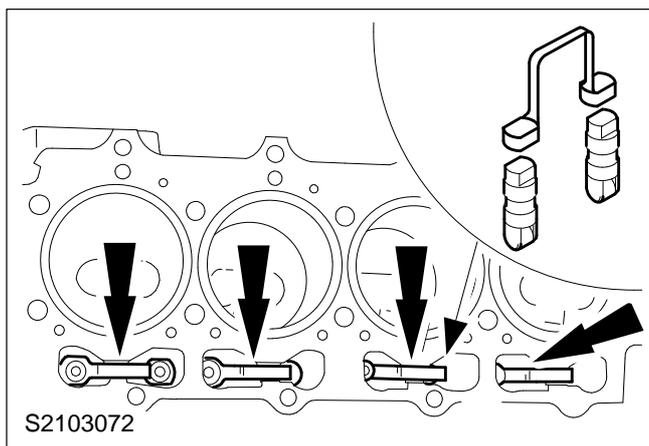


NOTE: Bolt-slackening sequence.

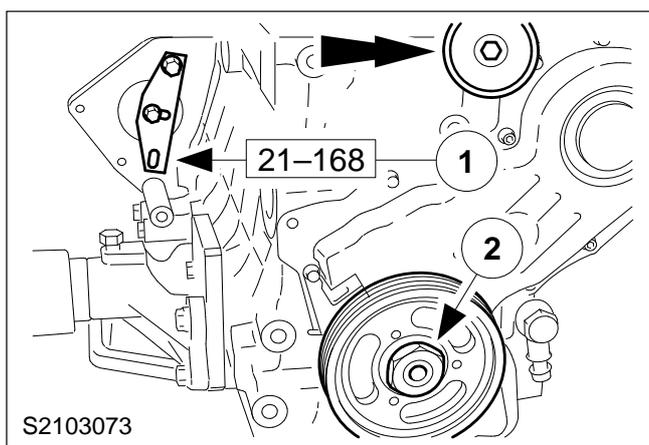
NOTE: Keep the cylinder heads and end spacers in order.

33. Unscrew and remove the cylinder head inner bolts (M14) and thrust elements.

- Remove the end spacers on the side.
- Remove each cylinder head in turn working from the flywheel end of the engine.
- Remove the cylinder head gaskets.



34. Remove the hydraulic tappets and aligning clips.



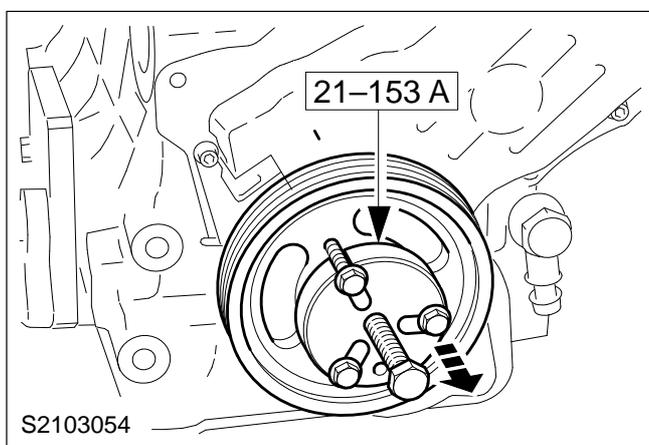
35. Remove the idler pulley.

36. Remove the crankshaft pulley/vibration damper bolt.

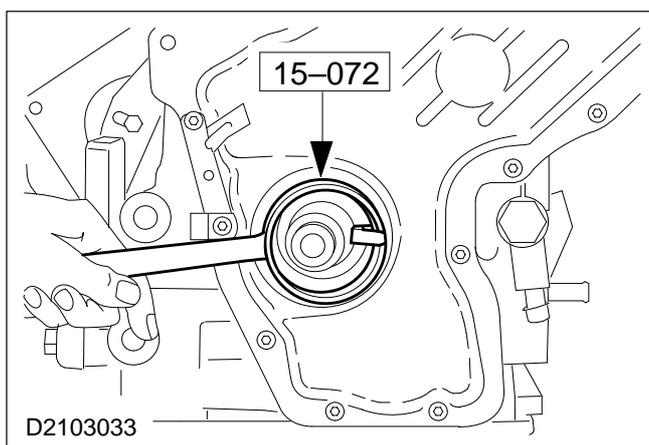
NOTE: If necessary reverse the locking tooth of the immobilising tool.

1 Fit an immobilising tool.

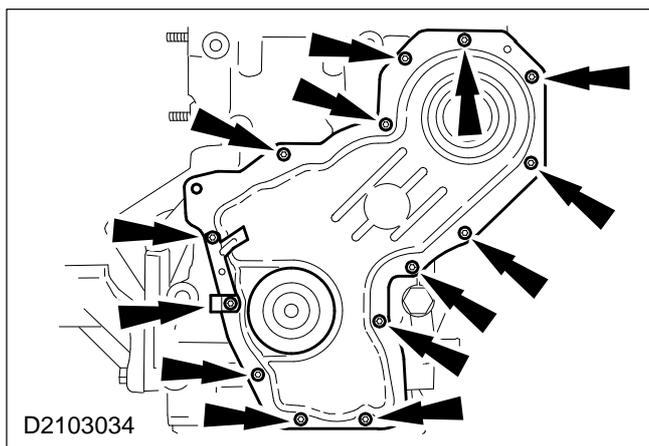
2 Crankshaft pulley/vibration damper nut.



37. Remove the crankshaft pulley/vibration damper.

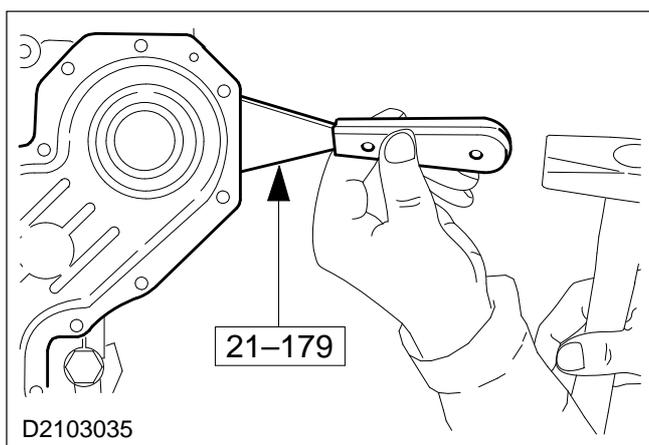


38. Remove the crankshaft front oil seal.



39. Unscrew and remove the timing cover bolts.

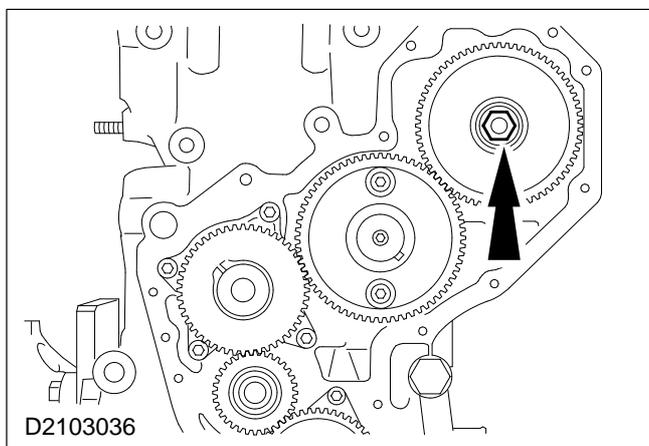
Remove the TDC mark and the hose retaining clip.



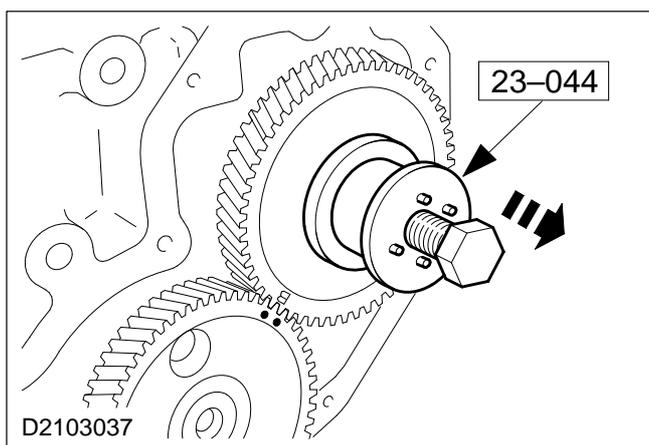
⚠ CAUTION: Take care not to damage the mating faces. The timing cover will be bent if any other tools are used.

40. Separate the timing cover from the cylinder block using the separator tool.

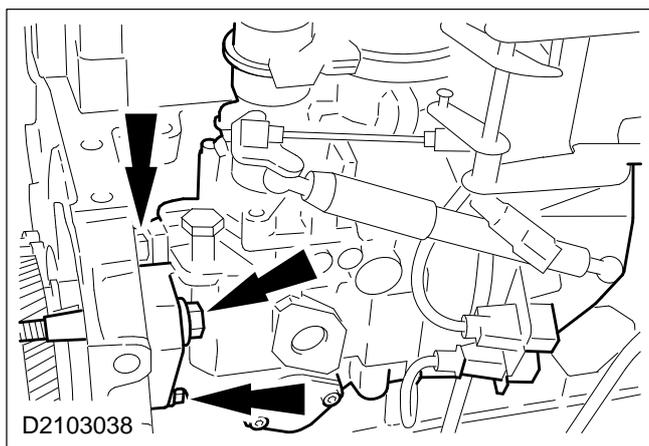
Remove any sealer residues.



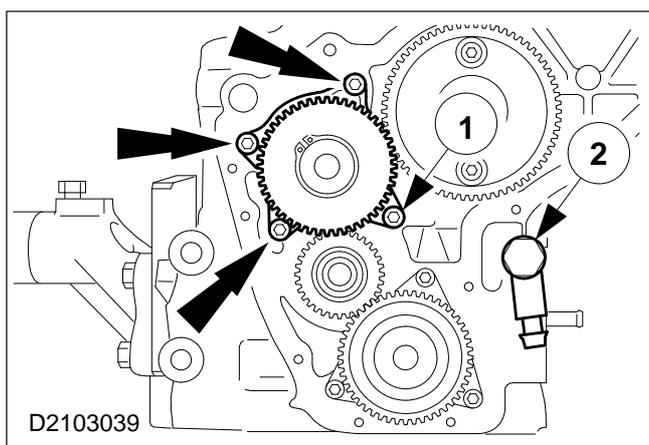
41. Remove the injection pump timing pulley nut.



42. Remove the injection pump timing pulley.



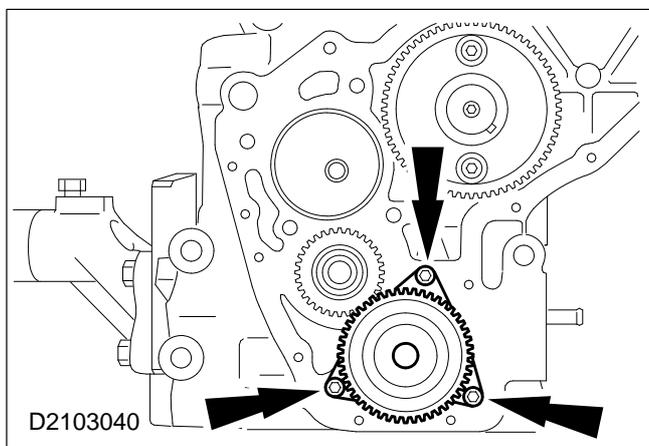
43. Remove the injection pump.



NOTE: The gear wheel is under spring pressure. Movable vanes can drop out.

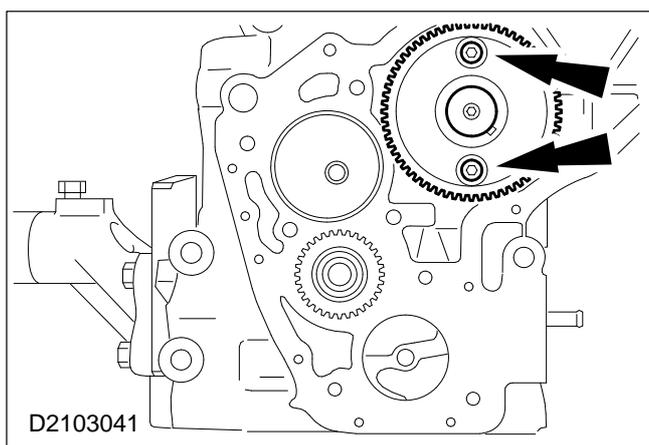
44. Remove the vacuum pump.

- 1 Remove the bolts.
- 2 Remove the vacuum pump connector.



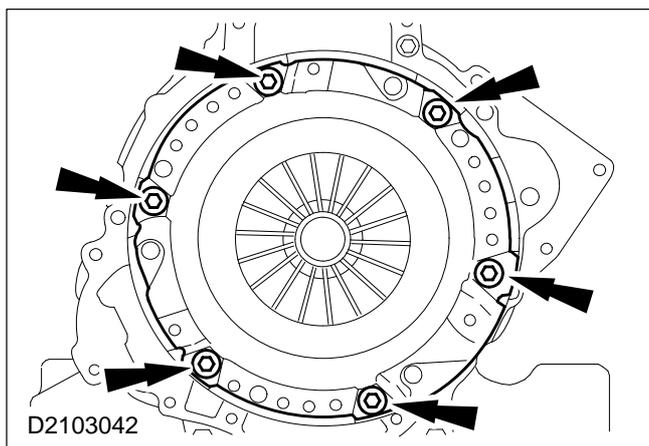
NOTE: The rotor can drop out.

45. Remove the oil pump.



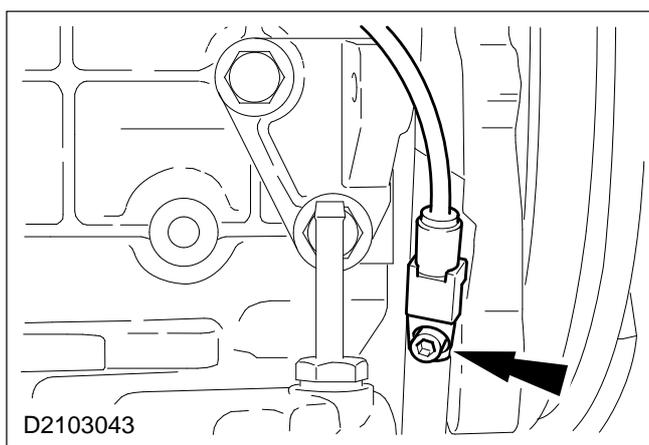
46. Remove the camshaft.

- Remove the camshaft thrust plate.
- Carefully pull the camshaft out of the cylinder block.

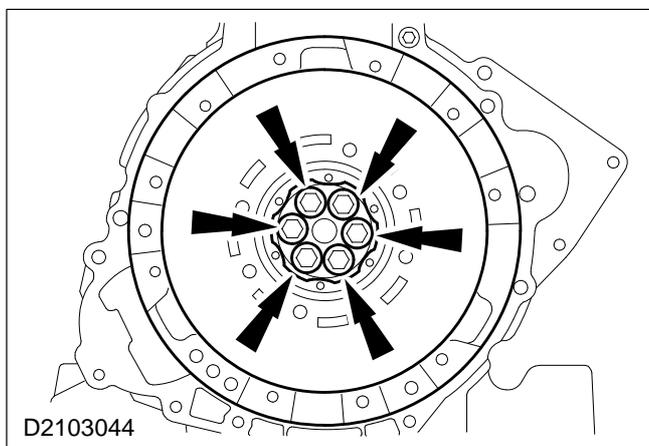


NOTE: Clutch disc.

47. Remove the clutch.



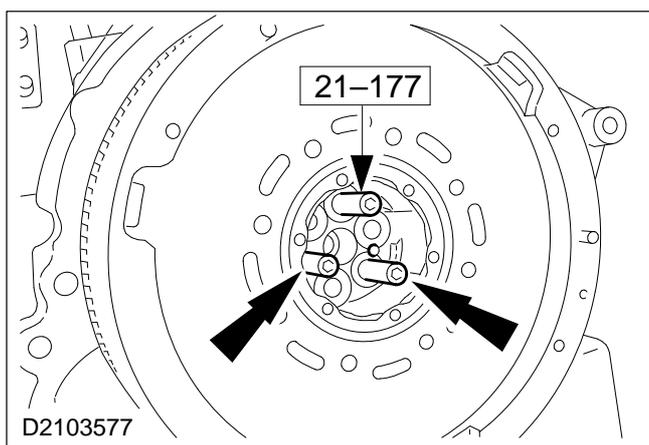
48. Detach the crankshaft position (CKP) sensor.



49. Remove the flywheel.

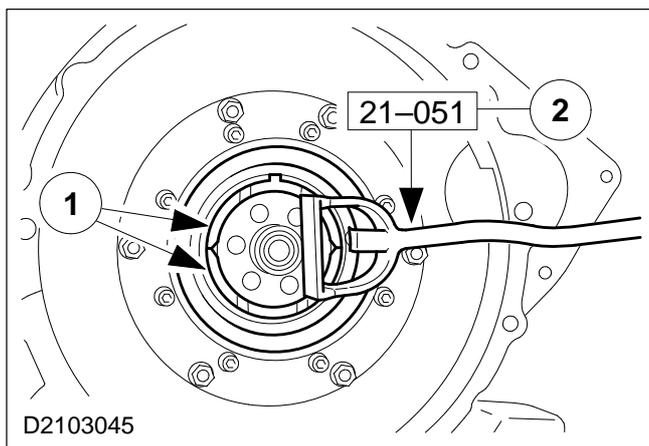
⚠ CAUTION: Do not remove the flywheel yet.

- Remove the bolts.
- Remove the immobilising tool.

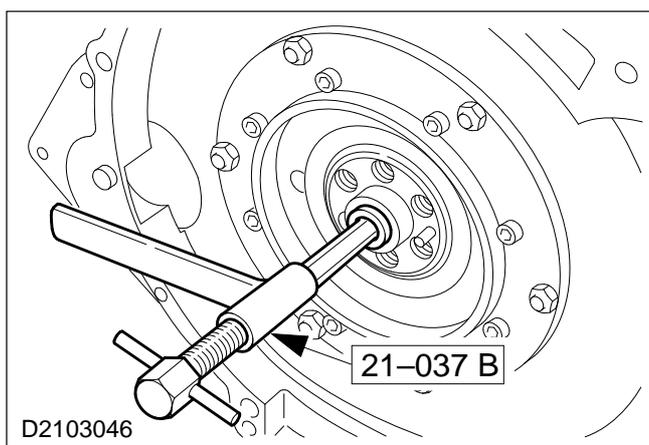
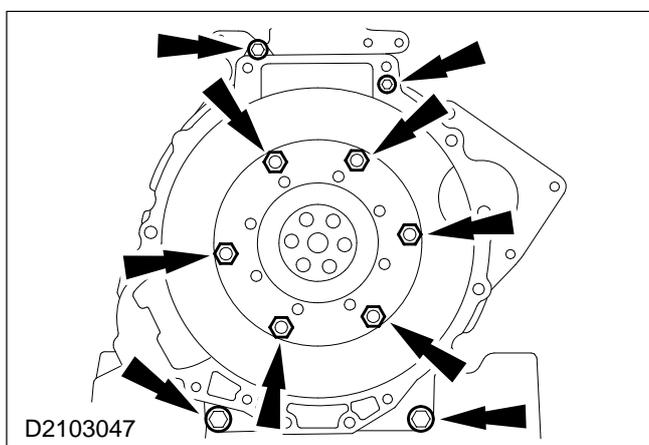
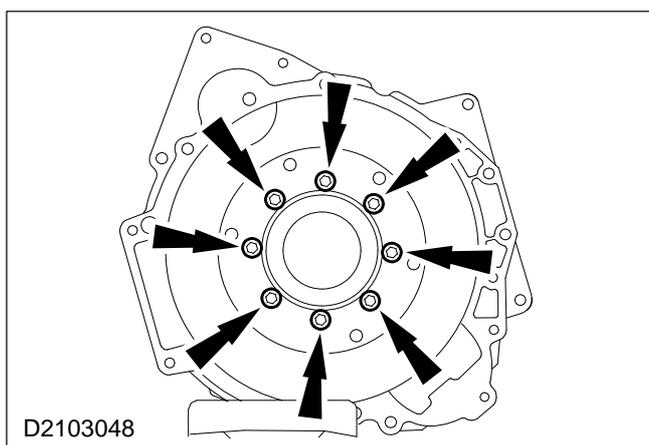


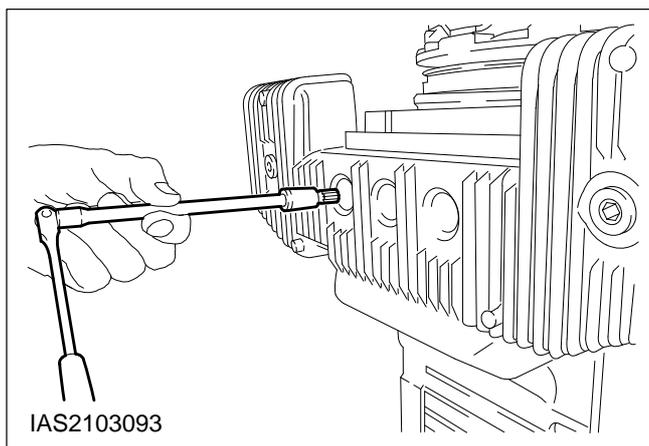
50. Remove the flywheel (cont.).

- Screw in the flywheel guide studs.
- Remove the flywheel.
- Remove the flywheel guide studs.

**51. Prise out the crankshaft rear oil seal.**

- 1 Remove the thrust washers.
- 2 Prise out the oil seal.

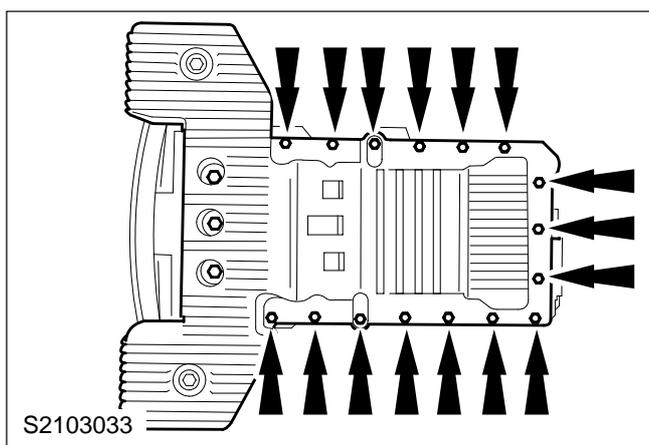
**52. Remove the crankshaft pilot bearing.****53. Remove the transmission intermediate flange with the oil seal housing and main bearing housing.****54. Remove the oil seal housing and main bearing housing.**



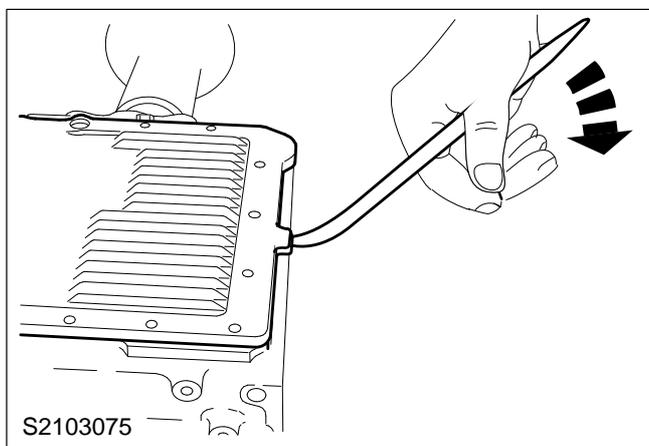
NOTE: Use a T30 bit, 1/4" bit holder and extension.

55. Detach the sump.

If the bolts are stiff, slacken them by tapping on them with a brass drift.



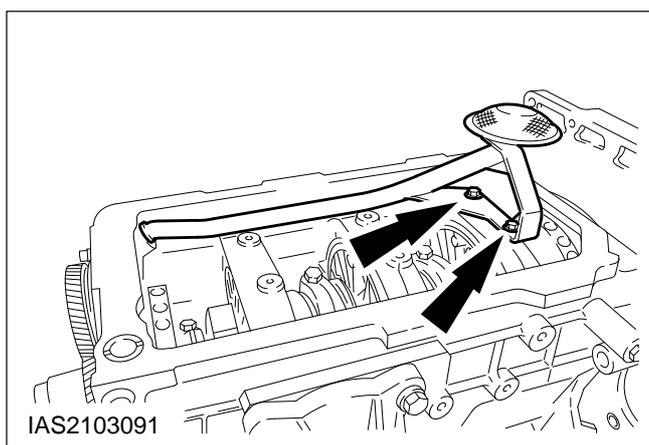
56. Detach the sump (cont.).



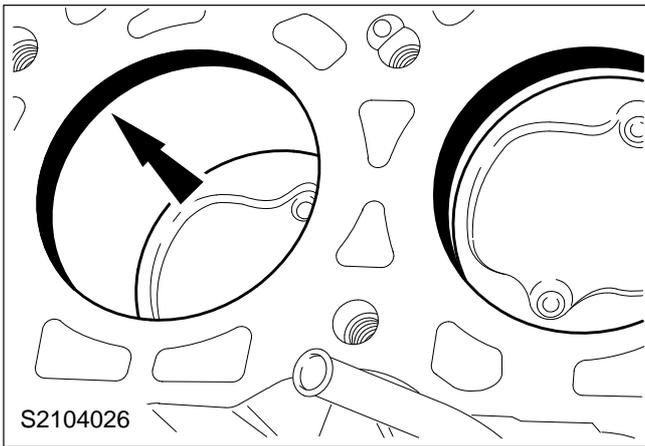
CAUTION: Take care not to damage the mating faces.

57. Separate the sump from the cylinder block.

Remove any sealer residues.



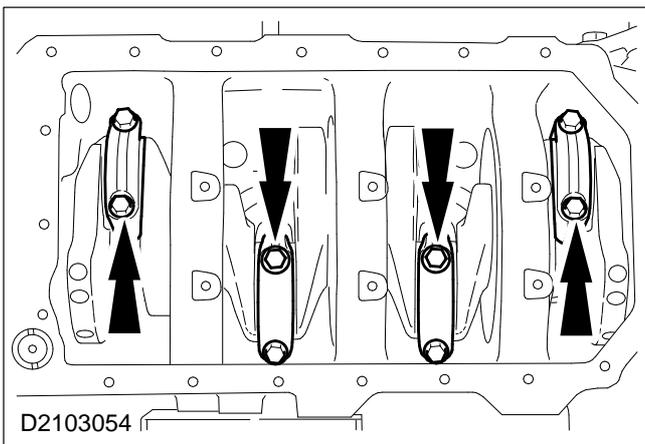
58. Remove the oil intake pipe and bracket.



⚠ CAUTION: Take care not to damage the cylinder liners.

59. Remove the carbon from the upper edges of the cylinder bores.

Remove the carbon ring from the top of the cylinder bore with a proprietary scraper.



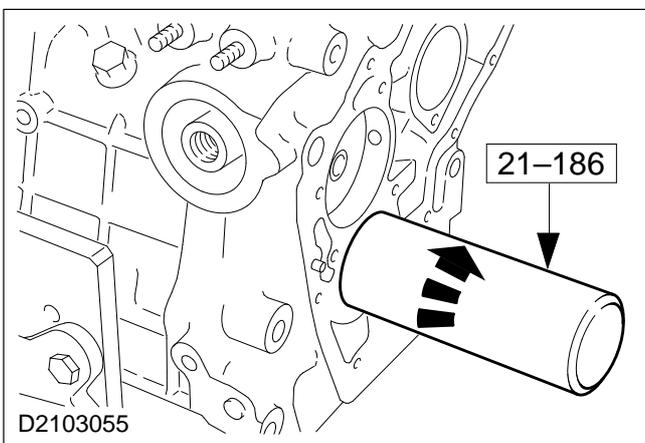
60. Remove the pistons.

NOTE: Keep the big-end bearing shells and caps in order.

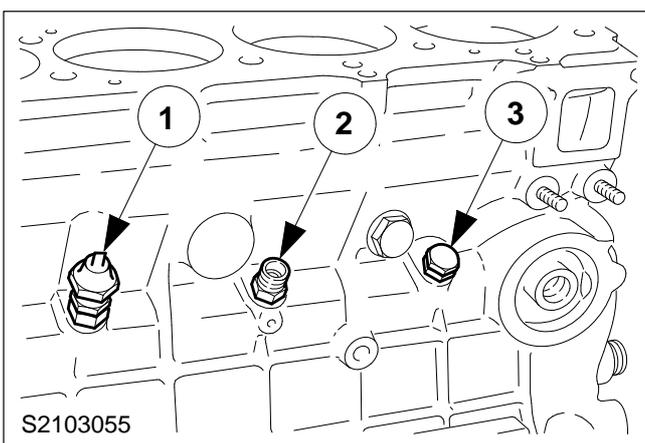
Remove the big-end bearing caps.

NOTE: Mark the pistons and cylinder liners.

Press out the pistons with the connecting rods and big-end bearing shells.



61. Fit the guide sleeve.



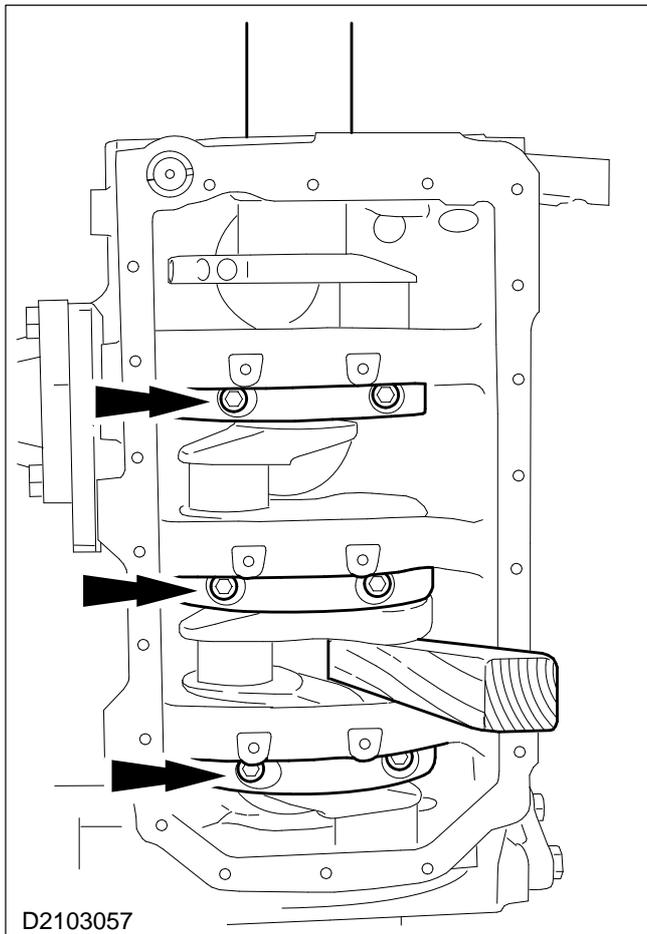
62. Remove the main bearing housing hollow locating screws.

1 Remove the oil pressure switch.

2 Remove the oil feed connection.

⚠ WARNING: Only slacken the hollow screw.

3 Slacken the hollow retaining screw.



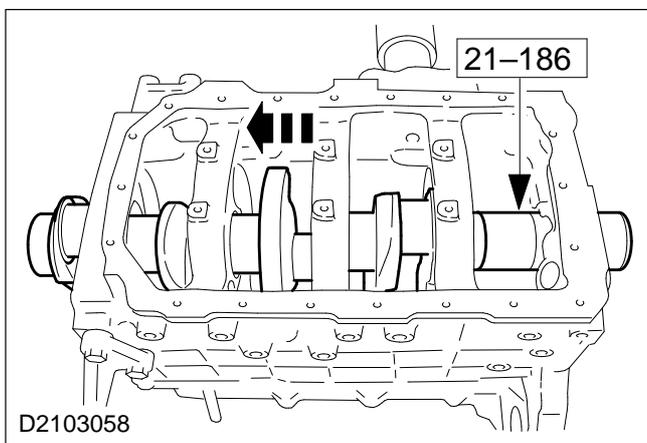
63. Remove the main bearing housings.

⚠ WARNING: Prevent the crankshaft from dropping out with a block of wood.

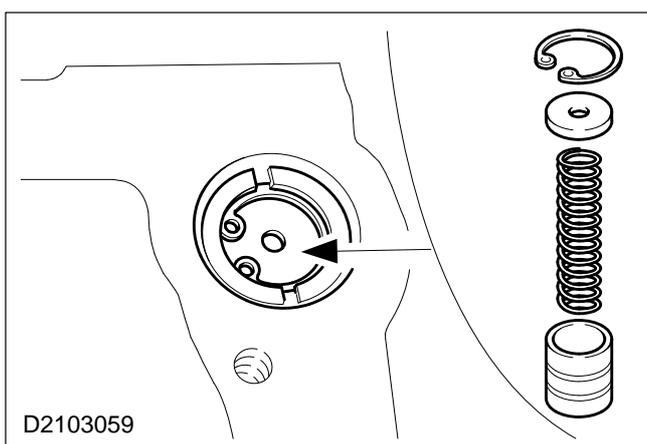
- Move the engine block so that it is vertical.
- Mark the installed position of each main bearing housing in relation to the cylinder block using centre punch marks.
- Remove the hollow locating screw.
- Push the crankshaft through until the main bearing housings are accessible.
- Turn the cylinder block until it is horizontal.

NOTE: Keep the main bearing housings and bearing shells in order.

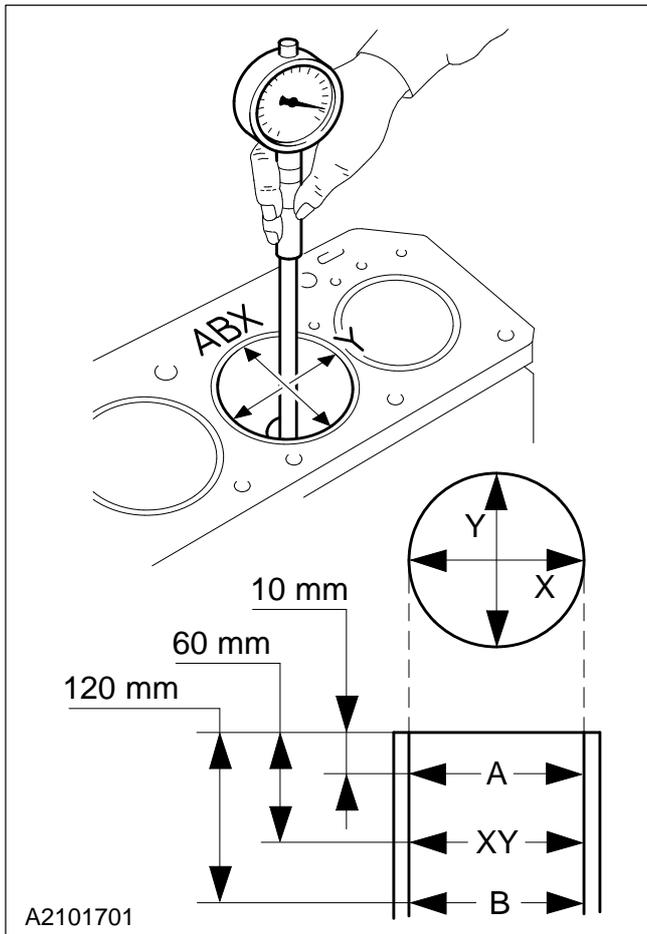
Remove the main bearing housings.



64. Guide the crankshaft carefully out of the cylinder block using the guide sleeve.

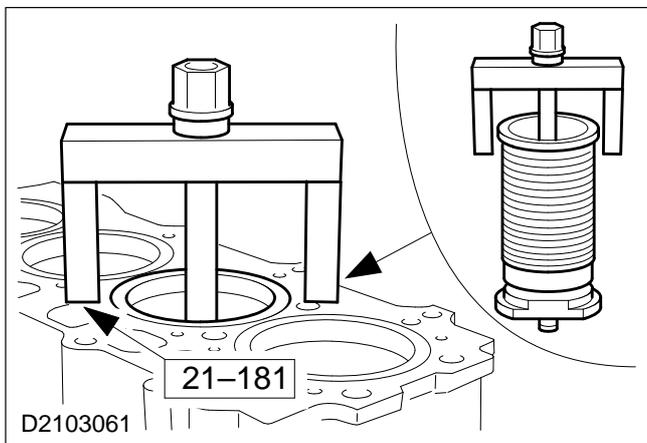


65. Remove the pressure relief valve from the cylinder block.



66. Measure the cylinder liners.

- Clean the cylinder liners.
- Measure the cylinder liner bore at the top, in the middle and at the bottom using a proprietary internal gauge.
- Change the cylinder liners if necessary.



67. Remove the cylinder liners.

NOTE: Mark the position of the cylinder liners in relation to the cylinder block.

CAUTION: Make absolutely certain that the extractor is correctly seated.

Withdraw the cylinder liners.

Assemble

68. General note.

- When installing ventilation or coolant hoses use Special Tool 24-003 if necessary.
- All self-locking nuts, gaskets and seals must be renewed.

69. Preparations.

- Clean all the mating faces thoroughly.
- Clean the piston cooling oil spray nozzles in the main bearing housings, the oilways and the pressure relief valve.
- Renew all seals and gaskets.

NOTE: Measure the cylinder liner protrusion separately for each cylinder.

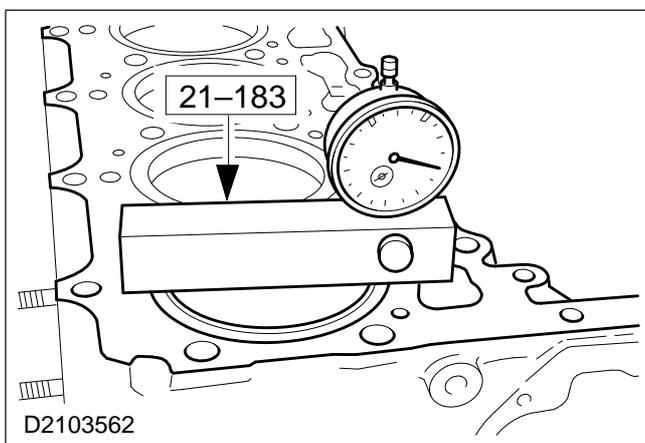
70. Measure the cylinder liner protrusion and determine the required shim.

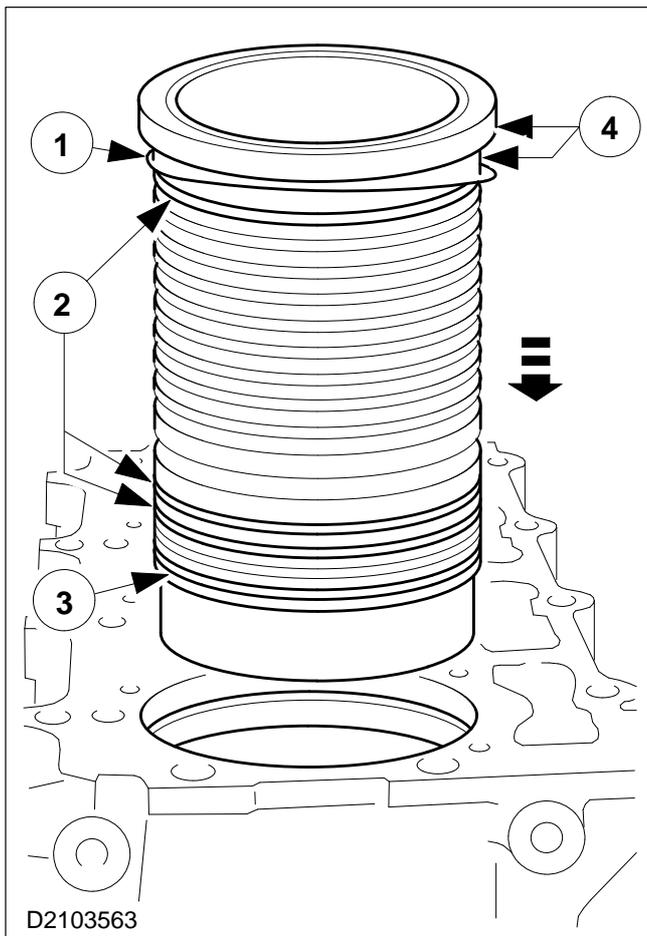
NOTE: The support and guiding surfaces of the cylinder liner and cylinder block must be free of dirt and oil.

- Insert the cylinder liner without the shim and O-rings.
- Measure the difference between the cylinder liner and the cylinder block using the special tool and a proprietary dial gauge.
- Choose a suitable shim according to the difference and the specified oversize.

Available shims:

- 0,15 mm
- 0,17 mm
- 0,20 mm
- 0,23 mm
- 0,25 mm





71. Fit the cylinder liners.

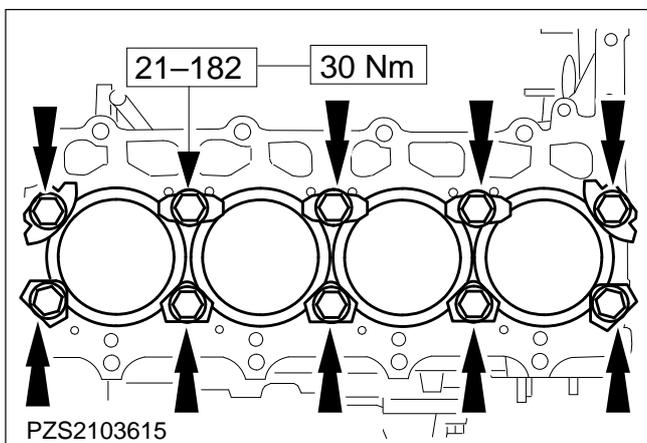
⚠ CAUTION: Extreme care and cleanliness are essential.
Do not damage the shim.

- 1 Fit the cylinder liner with a suitable shim as measured in sub-operation 70.
- 2 Fit new O-rings.
- 3 Fit a new oil proof O-ring.
- 4 Apply adhesive (WSK-M2G351-A4) to the liner upper guiding surfaces on the cylinder liners.

Apply engine oil (SAE 15W40) to the lower guiding surfaces for the cylinder liners on the cylinder block.

NOTE: Note the position mark when refitting the original cylinder liners.

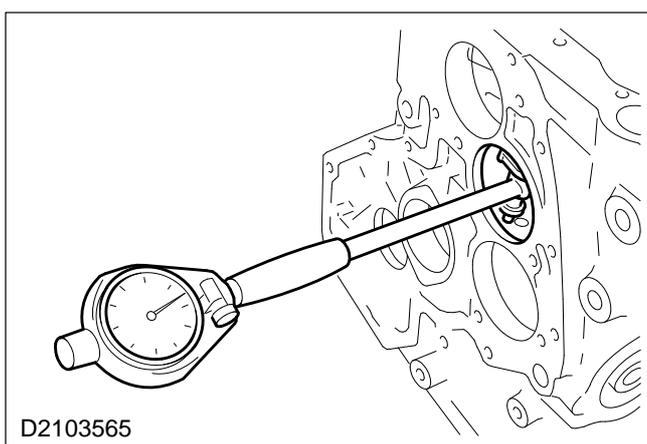
Fit the cylinder liners.



NOTE: The adhesive takes approx. two hours to harden.

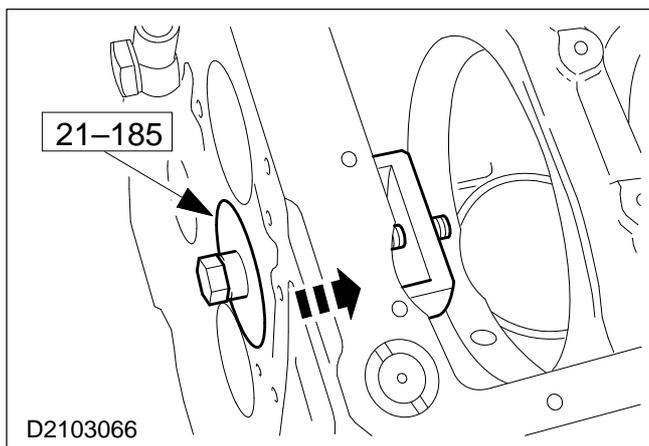
72. Clamp the cylinder liners.

Fit the cylinder liner pressure pieces with special bolts and tighten them.

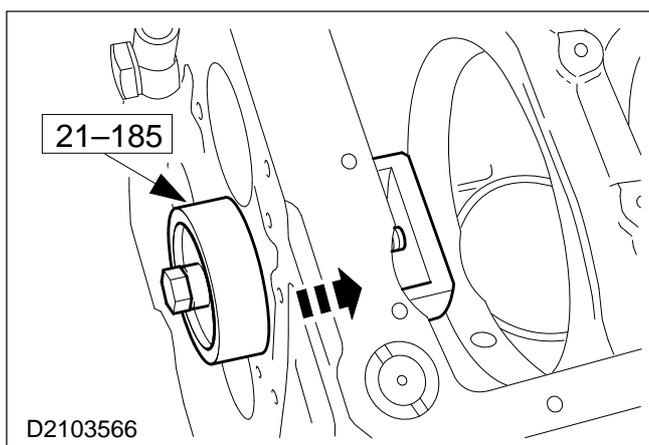


73. Measure the crankshaft main bearing shells in the cylinder block.

- Measure the bearing shells using a proprietary internal gauge.
- Renew the bearing shells as necessary (see steps 74. to 75.).



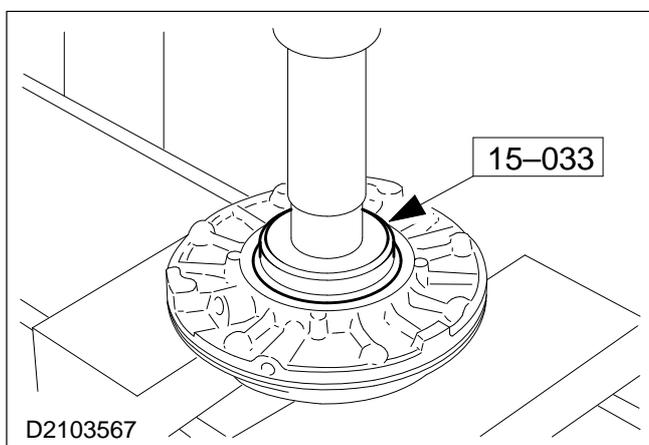
74. Pull the main bearing shells out of the cylinder block.



NOTE: The oil drillings in the main bearing shells and those in the bearing seats must line up.
Note the installation depth of the front face.

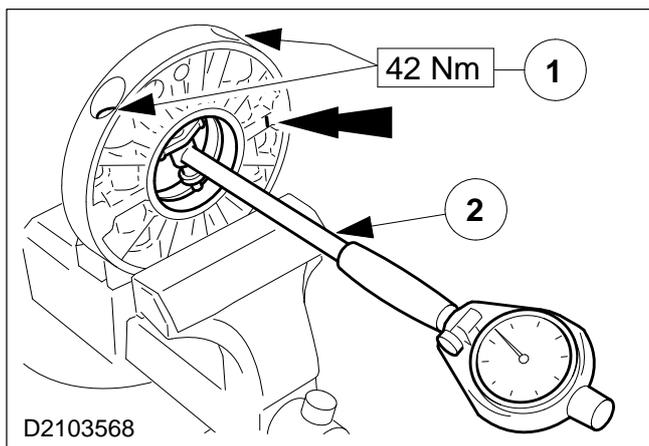
75. Draw the crankshaft main bearing shells into the cylinder block.

Measure the main bearing shells after they have been fitted (see step 73.).



76. Measure the main bearing shell in the oil seal/bearing housing and renew it if necessary.

- Measure the main bearing shell as described in step 73.
- Press out the main bearing shell using the remover/installer on a proprietary workshop press.
- Press in the new main bearing shell using the same remover/installer on a proprietary workshop press.
- Measure the main bearing shell after it has been fitted.



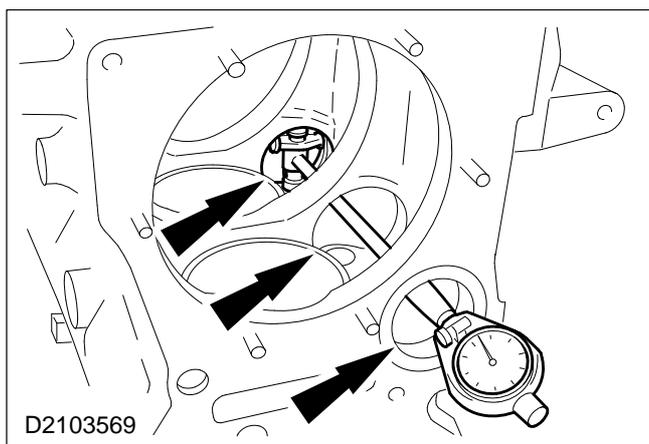
77. Measure the main bearing shells in their housings and renew them as necessary.

NOTE: There are notch marks. Do not assemble the main bearing housings back to front.

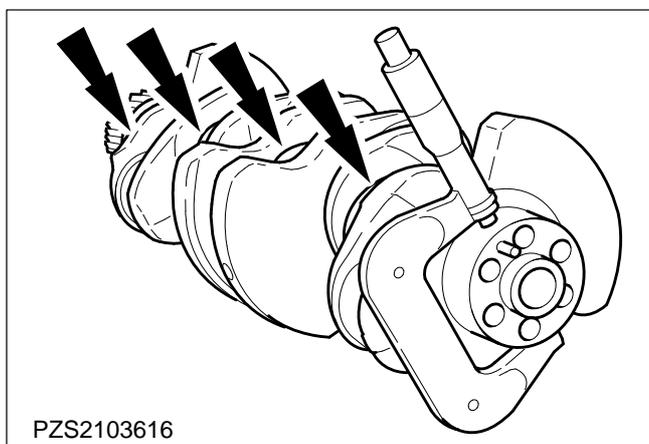
1 Lay the main bearing shells dry in the housing to which they belong and assemble the housing.

2 Measure the bearing shells using a proprietary internal gauge.

Renew the bearing shells if necessary.

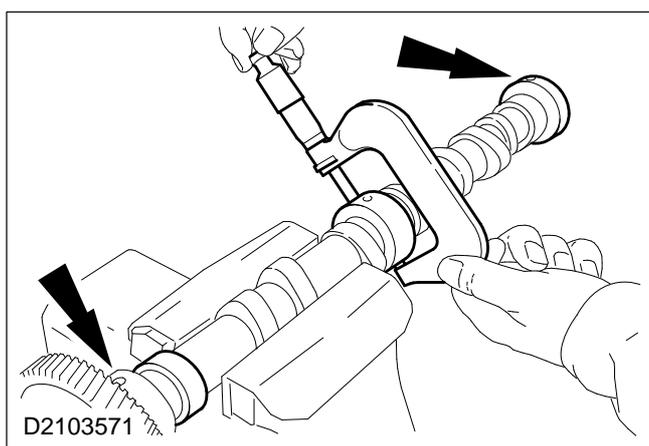


78. Measure the camshaft bearing shells in the cylinder block and renew them as necessary.

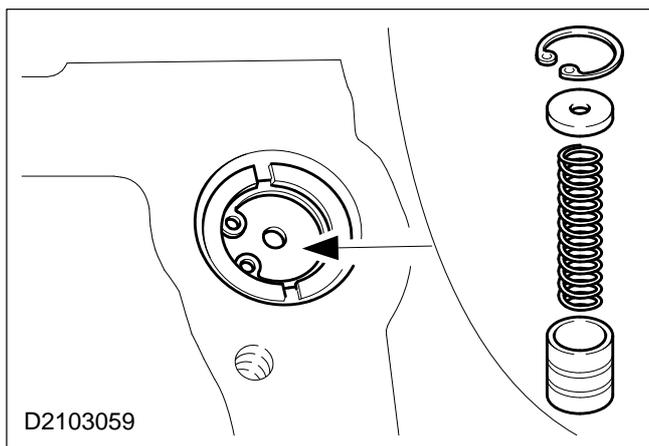


79. Measure the running surfaces of the main bearing journals using a proprietary micrometer.

Repeat the test at an angle of 90° .

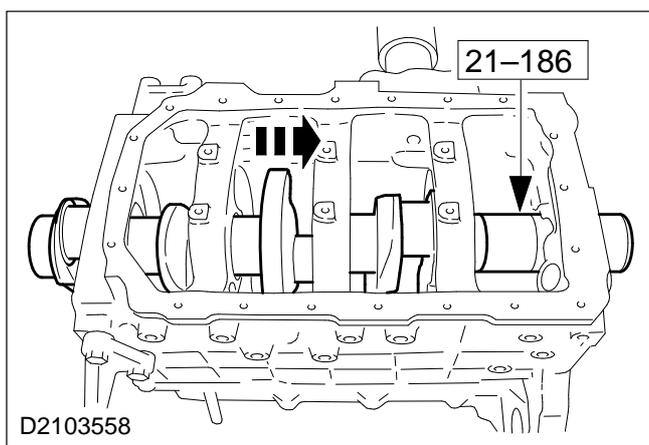


80. Measure the running surfaces of the camshaft journals using a proprietary micrometer.



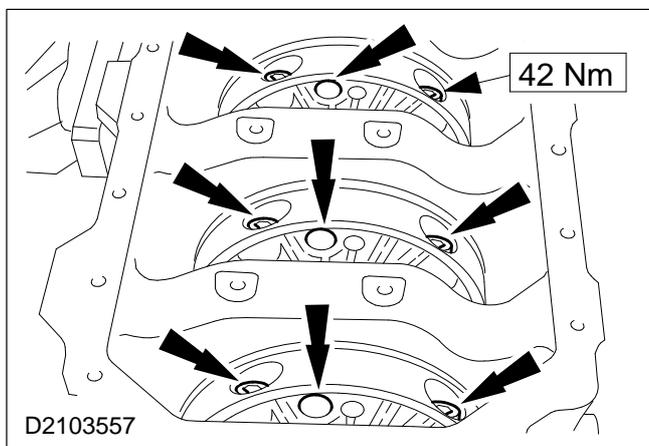
81. Install the pressure relief valve in the cylinder block.

Coat the sliding faces of the valve with engine oil (SAE 15W40).



82. Insert the crankshaft.

- Coat all main bearing shells and bearing journals with hypoid oil SAE90.
- Carefully guide the crankshaft into the cylinder block using the special tool.



83. Install the main bearing housings.

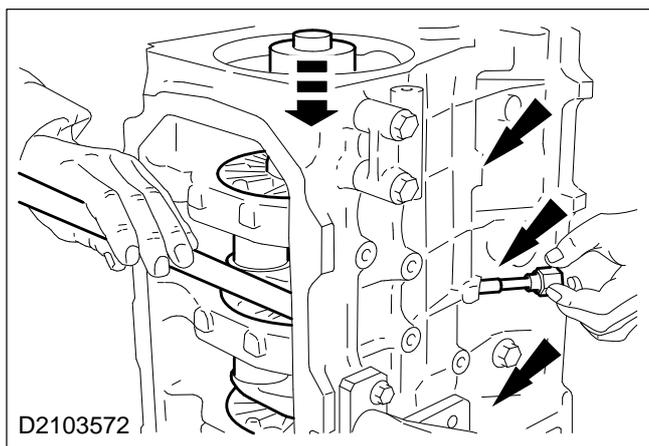
NOTE: Notch marks on the main bearing housing halves.

NOTE: Aim the piston cooling oil splash nozzles at the preceding cylinder.

Fit the main bearing housings and their corresponding lubricated main bearing shells.

NOTE: The hole in the main bearing housing must point upwards; the notch marks must line up.

Turn the bearing housings into position.

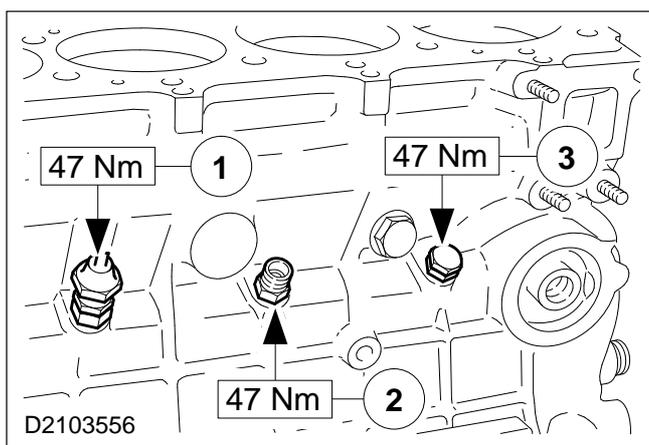


84. Fit the crankshaft in the cylinder block.

Turn the engine block so that it is vertical.

NOTE: The holes in the main bearing housings must line up with those for the hollow locating bolts.

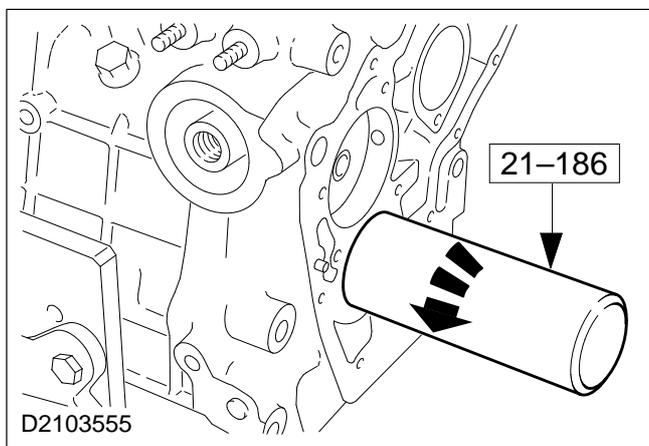
Install the main bearing housings using their own weight and light blows from a brass drift.



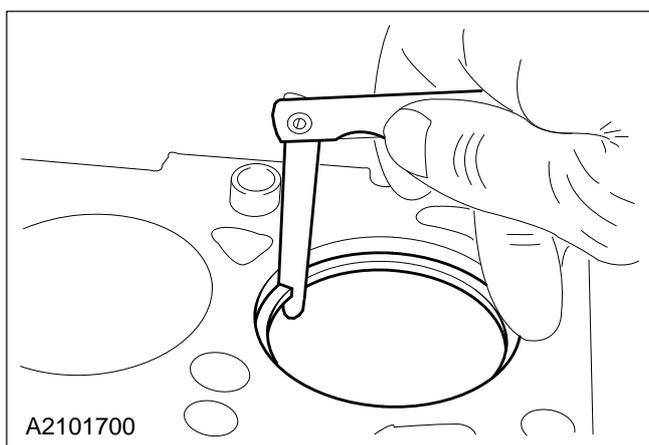
85. Install the main bearing housing hollow locating bolts.

NOTE: Use new seals.

- 1 Oil pressure switch.
- 2 Oil pressure connection.
- 3 Hollow locating screw

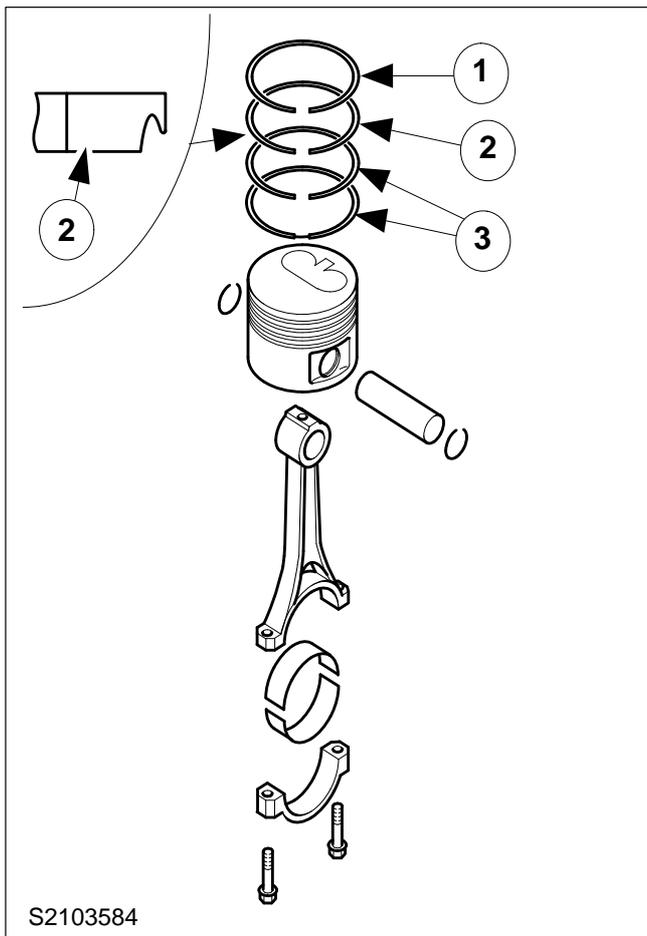


86. Remove the guide sleeve.



87. Check the piston ring gaps.

Renew the piston rings on reaching the specified maximum wear.

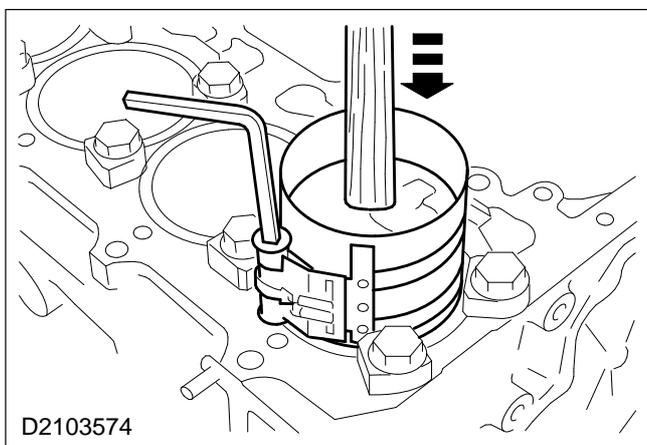


88. Dismantle and assemble the pistons and connecting rods.

NOTE: The piston pin “floats” in the piston and connecting rod.

- Remove the circlips and drive the piston pin out.
- Check that the pistons, piston pins and connecting rods measurements are within specification and renew as necessary.
- Insert the piston pin in the piston and connecting rod and fit the circlips.

- 1 Fit the trapezoid compression ring with the TOP marking uppermost.
- 2 Fit the stepped taper-faced ring with the step pointing downwards.
- 3 Assemble and fit the oil control ring.

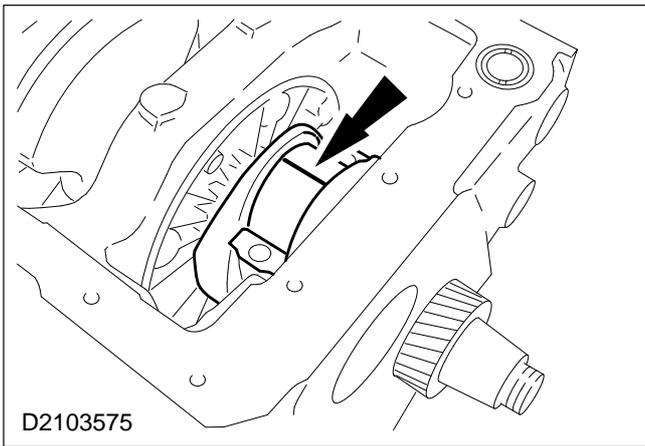


89. Install the pistons.

- Lubricate the pistons and cylinder liner bores with engine oil SAE 15W40.
- Spread the piston ring gaps evenly around the circumference. This also applies to the elements of the oil control ring.
- Compress the piston rings using a proprietary piston ring compressor.
- Press the piston into the cylinder liner with the handle of a hammer, guiding the connecting rod onto the big-end bearing journal.

NOTE: The combustion chamber in the piston and the matching numbering on the connecting rod should face towards the camshaft side.

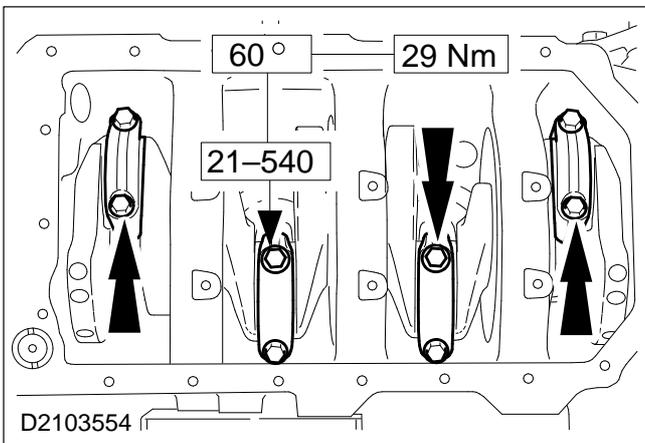
Make sure the bearing shells are clean and dry and place them in the connecting rod.



90. Preparation for measuring the big-end bearing clearance.

NOTE: The following steps must be carried out exactly as described.

- Measure each big-end bearing area separately with a length of Plastigage thread.
- Only fit the bearing cap to be measured, and tighten it to the specified torque.
- The measurement should be made as close as possible to the TDC position of that bearing.
- The big-end bearing shells and journals must be clean and oil free.
- Lay a length of Plastigage thread across the bearing journal.

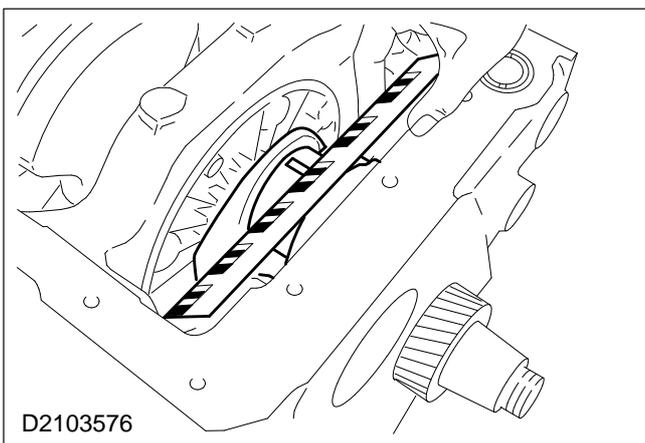


91. Measure the big-end bearing clearance.

Install the big-end bearing cap with the matching bearing shells as described in step 90. and torque it down in two stages.

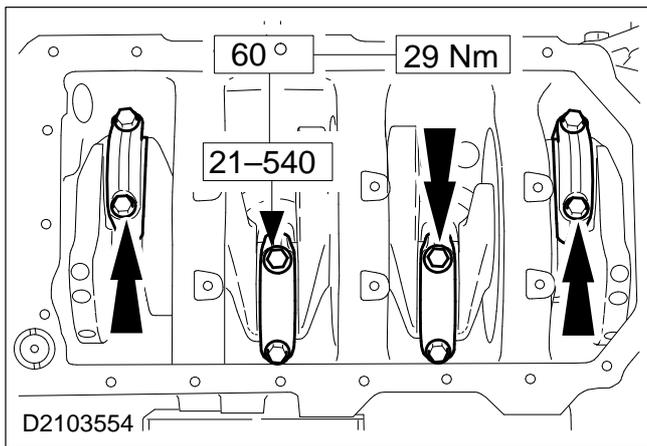
NOTE: The numbers on the connecting rod and bearing cap must match and must both point towards the camshaft side.

Remove the big-end bearing cap.



92. Compare the width of Plastigage thread with the Plastigage scale.

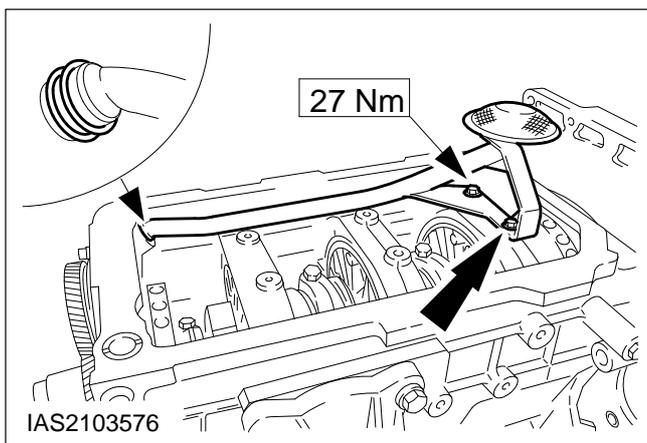
- The scale reading corresponds to the bearing clearance.
- Renew the big-end bearing shells and grind the bearing journals as necessary.



NOTE: The corresponding numbers on the connecting rods and the bearing caps point towards the camshaft side.

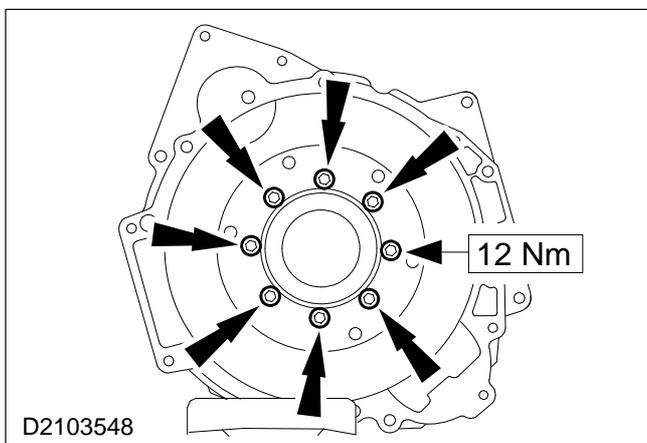
93. Fit the big-end bearing caps.

- Coat the big-end bearing shells and journals with hypoid oil SAE90.
- Tighten the big-end bearing shells and the matching bearing shells in two stages.



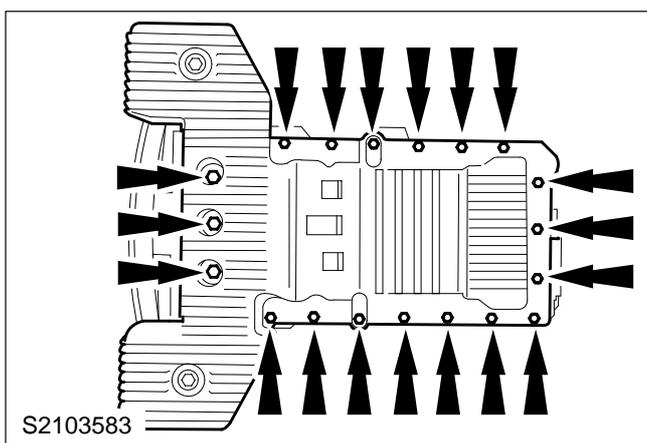
NOTE: The correct seating of the two O-rings.

94. Install the oil intake pipe and bracket.



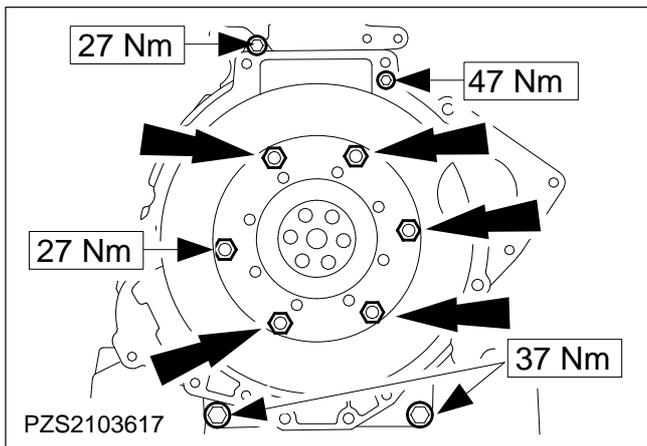
NOTE: The position of the piston cooling oil splash nozzle is determined by the location of the holes for the retaining bolts.

95. Fit the oil seal and main bearing housing to the transmission flange.



96. Fit the sump.

- Apply sealer (SLM-4G9111-A) to the cylinder block.
- Locate the sump in place and tighten the bolts finger tight.

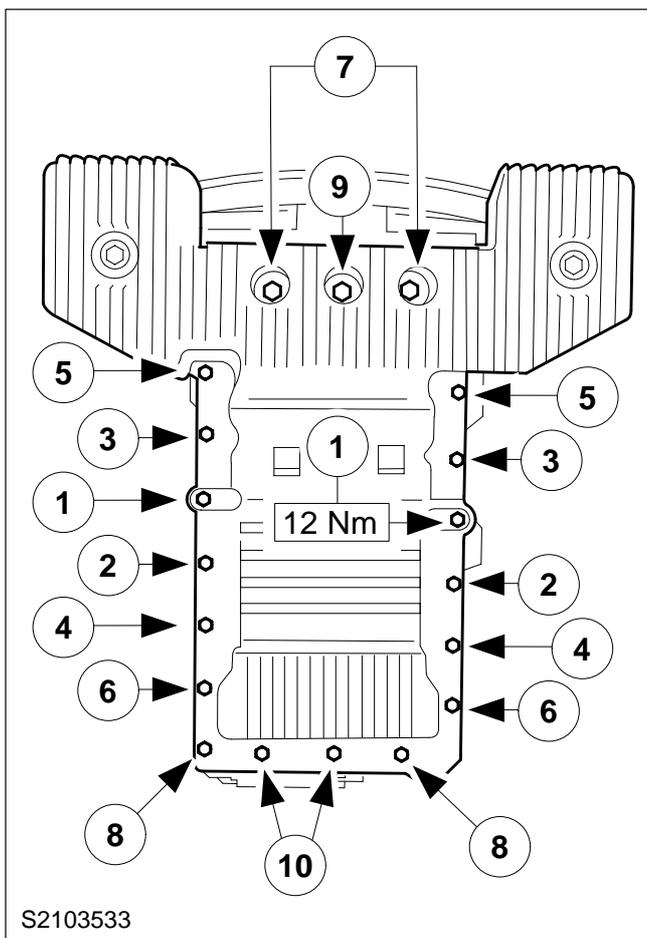


97. Fit the transmission intermediate flange with the oil seal/main bearing housing.

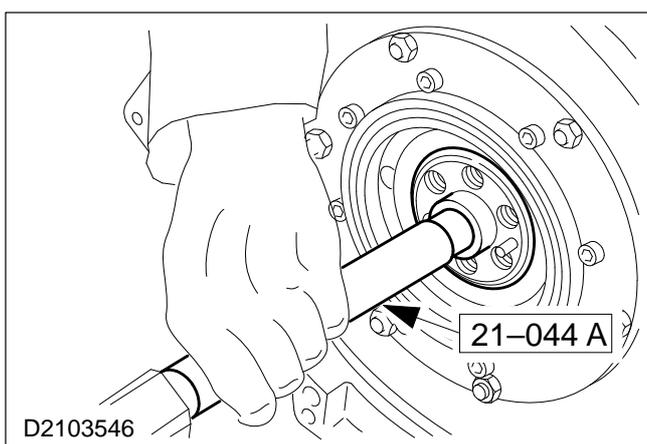
- Fit new O-rings for the oil seal/main bearing housing and the camshaft bearing.
- Apply lubricant (ESD-M1C220-A) to the camshaft bearings and O-rings.
- Centre the transmission intermediate flange with locating sleeves and secure it.

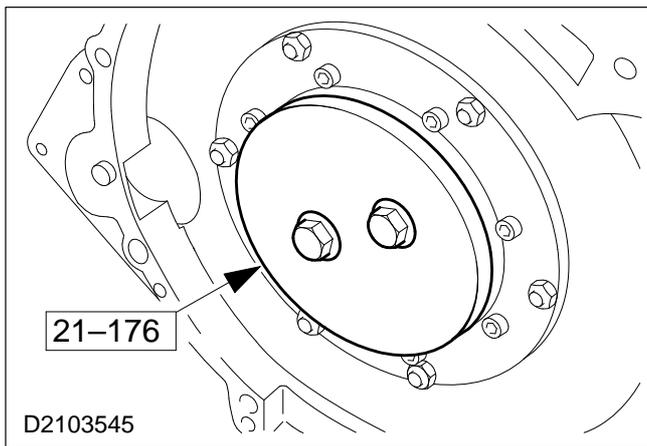
NOTE: Tighten the bolts, working diagonally from the centre outwards.

98. Tighten the sump bolts.



99. Fit a new crankshaft pilot bearing.



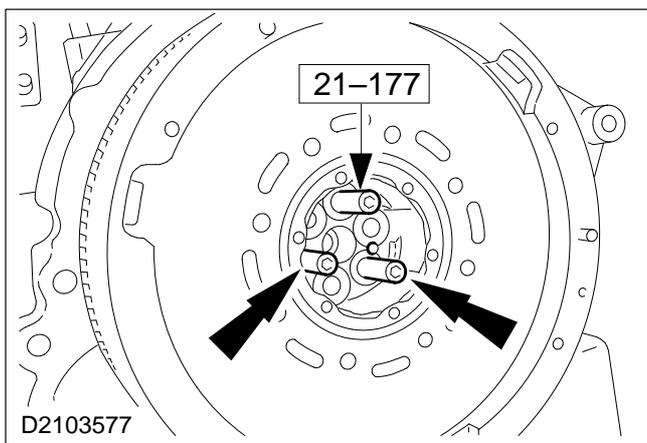


NOTE: The sealing lip must remain dry.

NOTE: Apply engine oil SAE 15W40 to the outer edge of the oil seal.

100. Fit the crankshaft rear oil seal.

Draw in the new oil seal evenly using the two flywheel bolts and the special tool.

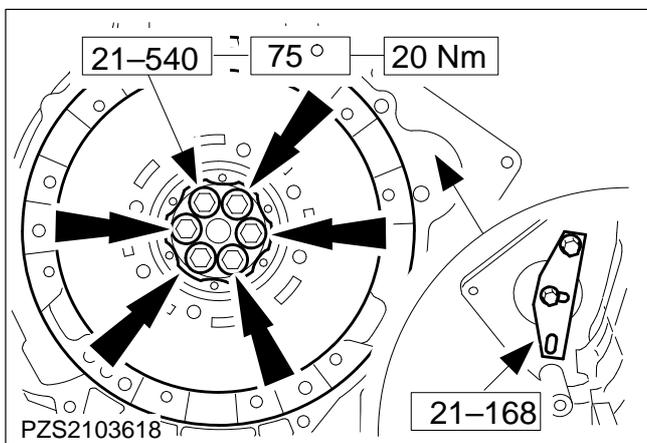


101. Fit the flywheel.

- Coat the thrust washers with lubricant (ESD-M1C220-A) and place them in the oil seal/main bearing housing with the lubricating groove facing outwards.
- Screw in the guide studs.

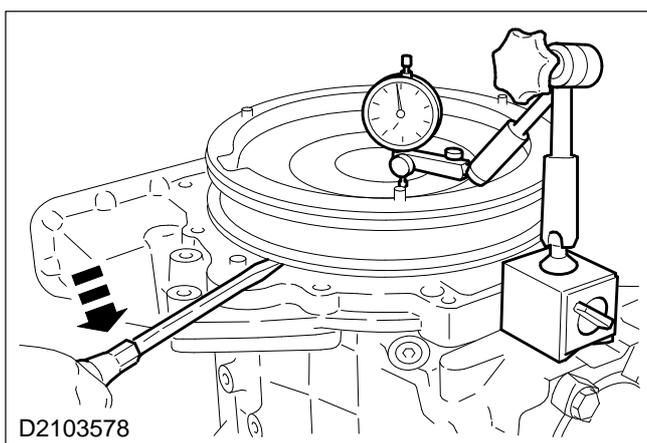
NOTE: The locating sleeve and hole must line up.

- Fit the flywheel in place using a new O-ring.
- Remove the guide studs.



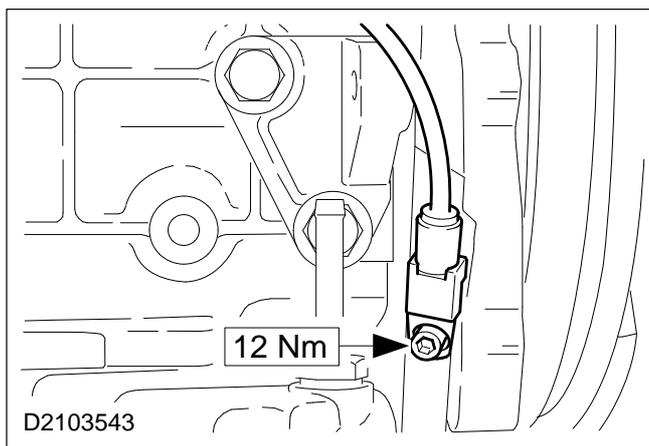
102. Tighten the flywheel bolts.

- Engage the locking tool in the flywheel teeth.
- Coat the bolts with engine oil SAE 15W40 and screw them in working diagonally.
- Tighten the bolts in two stages working diagonally.

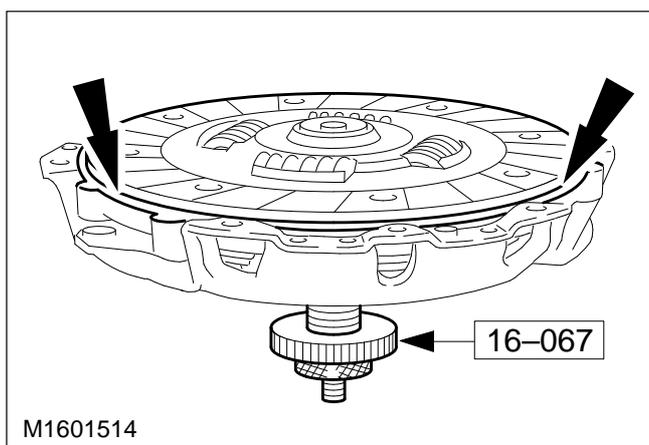


103. Check the crankshaft end float.

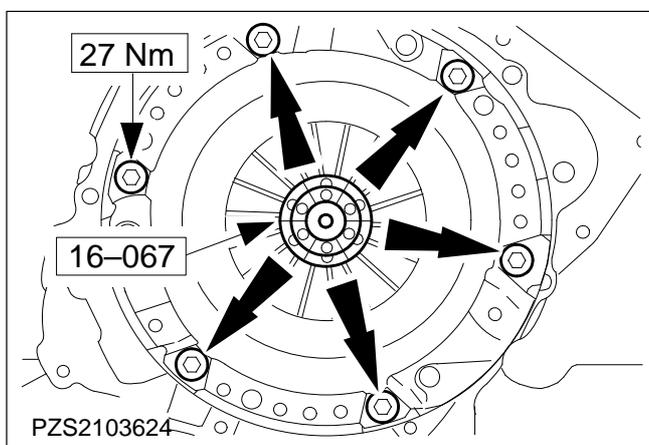
- Set up a dial indicator.
- Measure the end float by lifting the flywheel as shown.
- Adjust the end float as necessary using thrust washers at the oil seal/main bearing housing.



104. Fit the CKP sensor with a new O-ring.

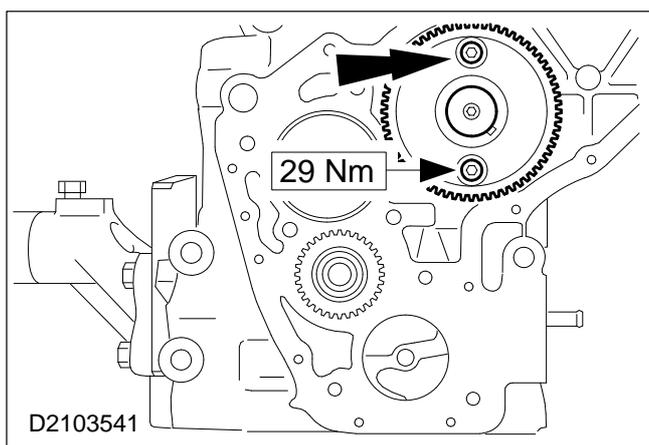


105. Centre the clutch disc on the pressure plate.



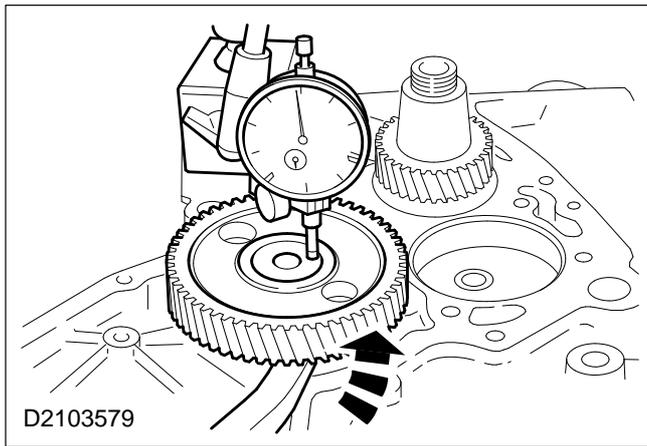
106. Fit the clutch.

- Fit the clutch pressure plate with the centred clutch disc.
- Tighten the bolts uniformly, working diagonally.
- Remove the centring tool.



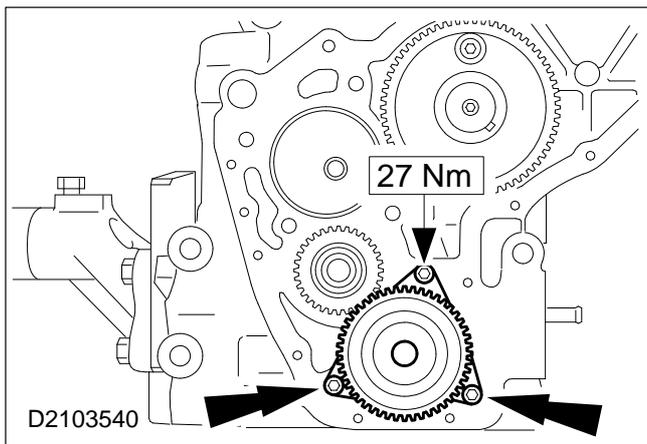
107. Install the camshaft.

- Coat the camshaft bearing and running surfaces with hypoid oil SAE 90.
- Carefully guide the camshaft into the cylinder block.
- Secure the camshaft in the cylinder block with the thrust plate.



108. Check the camshaft end float.

- Set up a dial indicator.
- Measure the end float by lifting the camshaft with a screwdriver.
- Adjust the end float as necessary by renewing the thrust plate.

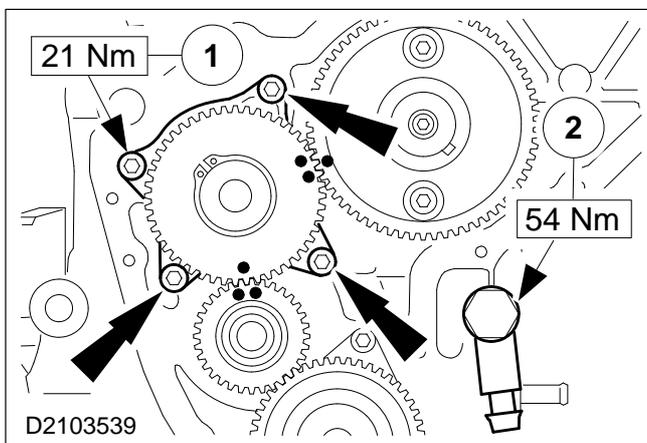


109. Fit the oil pump.

- Fit a new O-ring and oil it lightly.

NOTE: Install the rotor with the dot mark pointing towards the pump.

- Coat the oil pump shaft with hypoid oil SAE 90 and fit the oil pump.

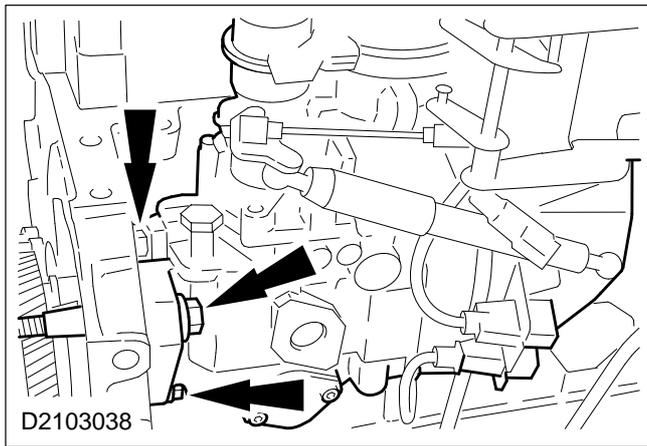


110. Install the vacuum pump.

Lightly oil the internal moving parts of the vacuum pump and coat the vacuum pump pivot pin with hypoid oil SAE 90.

NOTE: The teeth on the crankshaft, vacuum pump and camshaft gear wheels must be aligned so that each single dot is in between the corresponding two dots.

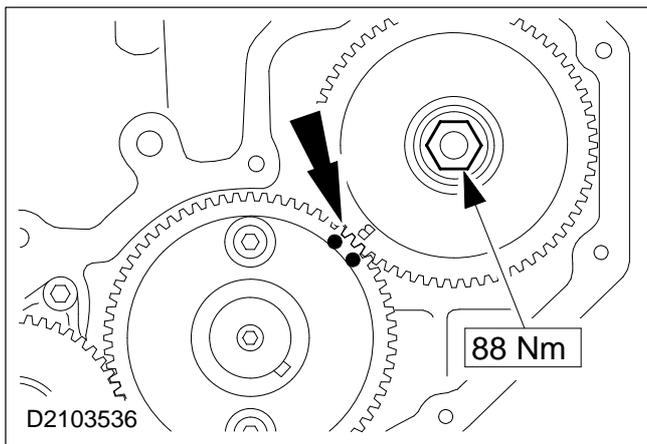
- 1 Install the vacuum pump using a new, lightly oiled O-ring.
- 2 Fit the vacuum pump connector with new seals.



111. Fit the injection pump.

NOTE: The key on the fuel-injection pump shaft must be at eleven o'clock.
Fit the gearwheel so that the injection pump shaft can be turned.

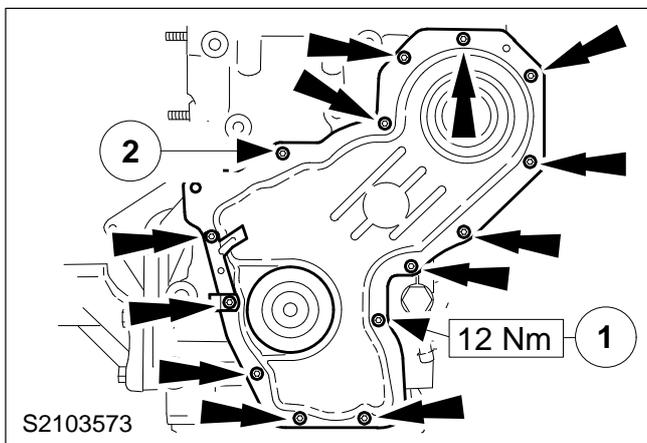
Put the injection pump in place using a new gasket and tighten the nuts finger tight.



112. Fit the injection pump gear wheel.

NOTE: The tooth with the B mark on the injection pump gear wheel must be exactly in between the two dot marks on the camshaft gear wheel.

Coat the timing gears with hypoid oil SAE 90.

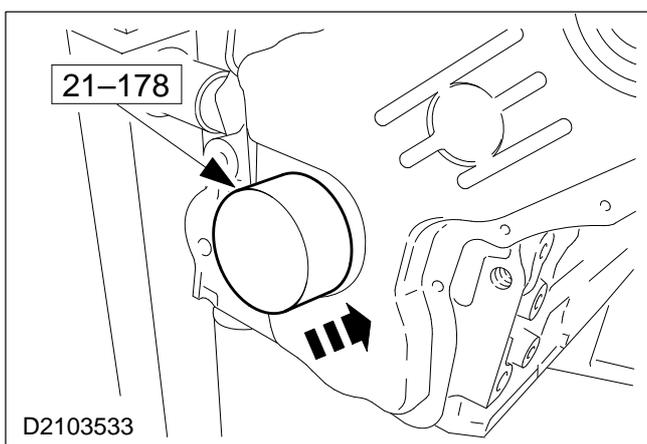


113. Fit the timing case with the TDC mark and the hose retaining clip.

- Apply sealer (SPM-2G9121-A) thinly to the cylinder block mating face.

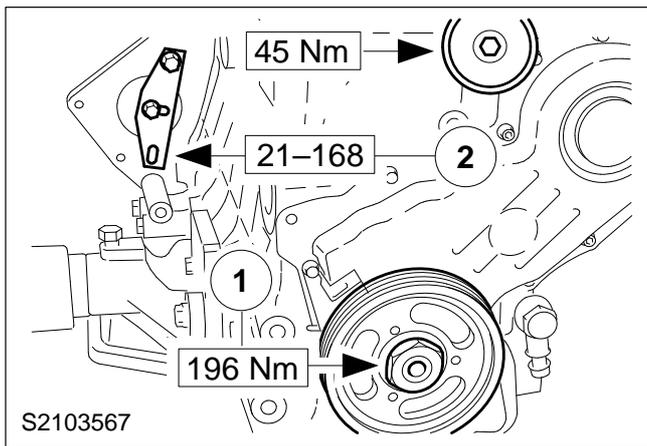
1 Bolts M6

2 Bolt M8



NOTE: Fit the seal dry.

114. Fit the crankshaft front oil seal.

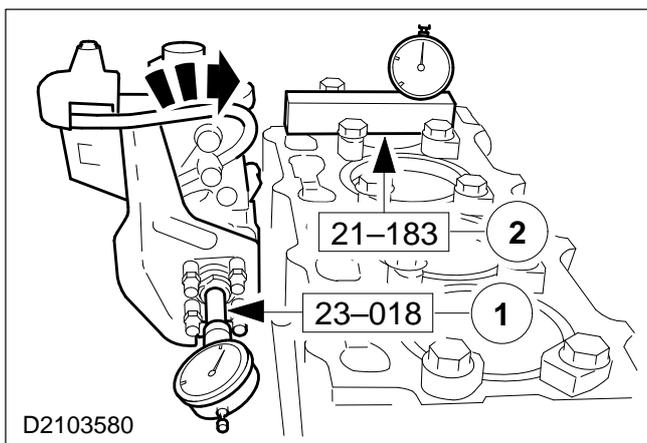


115. Fit the idler pulley.

116. Fit the crankshaft pulley/vibration damper.

NOTE: Coat the crankshaft thread with adhesive (WSK-M2G349-A7).

- 1 Install the crankshaft pulley/vibration damper.
- 2 Remove the immobilising tool.

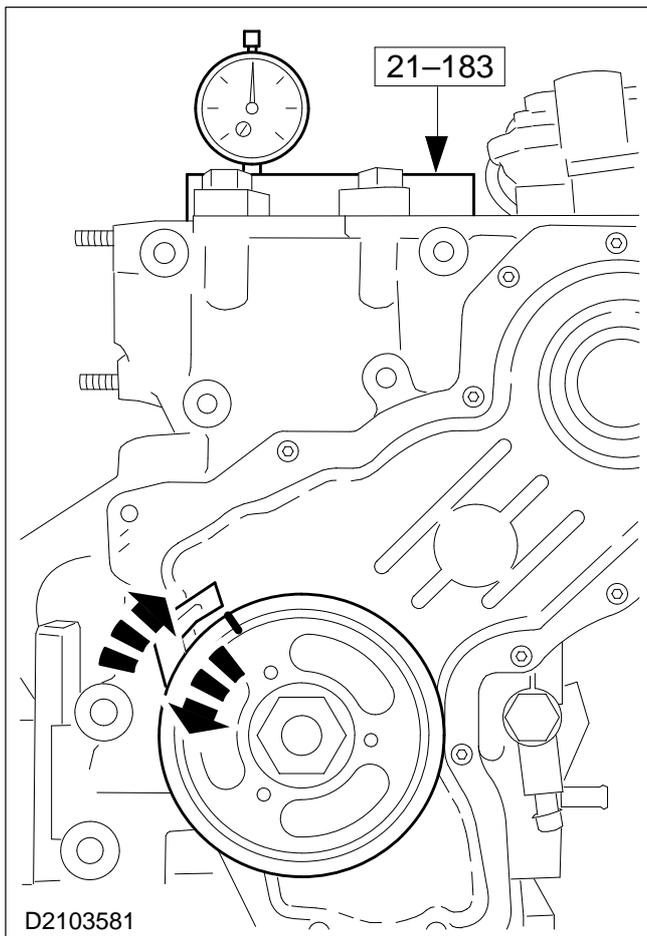


NOTE: The fixed TDC mark on the timing cover and the movable TDC mark on the crankshaft vibration damper must be checked to ensure that they are in the correct positions.

117. Preparations for adjusting the fuel injection pump timing.

Unscrew the pump timing blanking plug.

- 1 Screw in the special tool with the dial gauge.
Turn the injection pump towards the cylinder block.
- 2 Set the first cylinder to TDC using the special tool and the dial gauge.



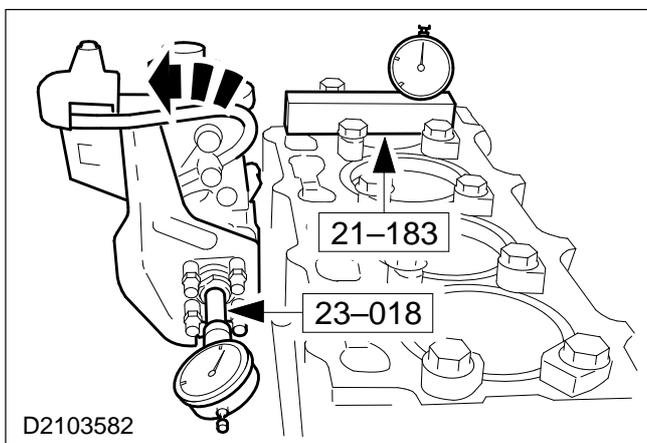
NOTE: Bearing clearance. The crankshaft must not be turned back to reach TDC position.

118. Adjust the fuel-injection pump timing

Rotate the crankshaft backwards through approximately 45°.

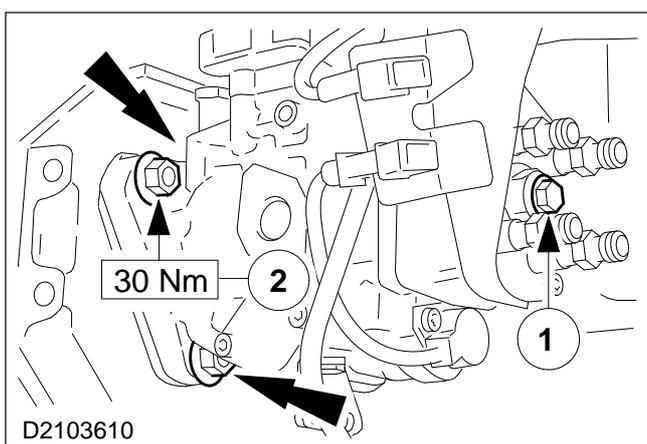
NOTE: The pointer on the pump timing dial indicator must not move further.

- Zero the pump timing dial indicator.
- Turn the crankshaft forwards to TDC position on the first cylinder.



119. Adjust the fuel-injection pump timing (cont.).

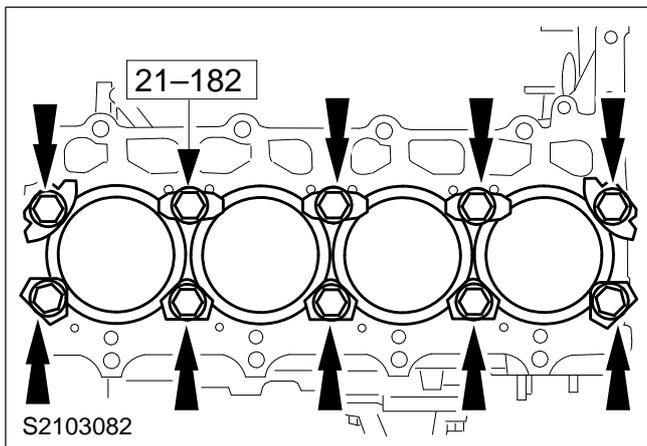
- Turn the injection pump until the fuel injection dial gauge reads 0,53 to 0,57 mm.
- Tighten the injection pump bolts.
- Check the setting at the fuel injection dial gauge by turning the crankshaft back and forth through the TDC position for the first cylinder; repeat the setting procedure if necessary.



120. Tighten the retaining nuts of the fuel-injection pump.

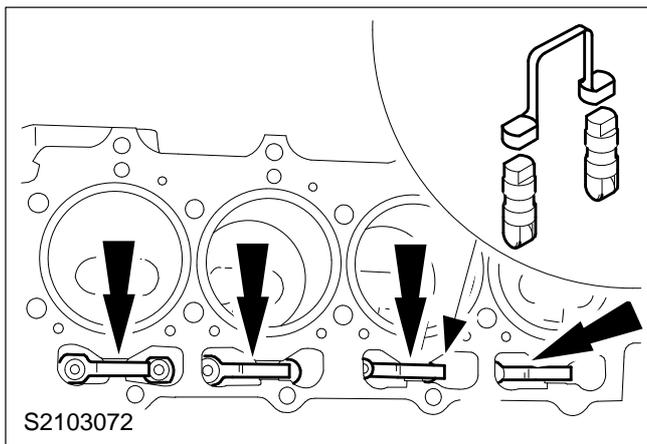
Detach the dial gauge bracket 23-018 and dial gauge.

- 1 Fit the blanking plug with a new oil seal.
- 2 Tighten the three retaining nuts of the fuel-injection pump.



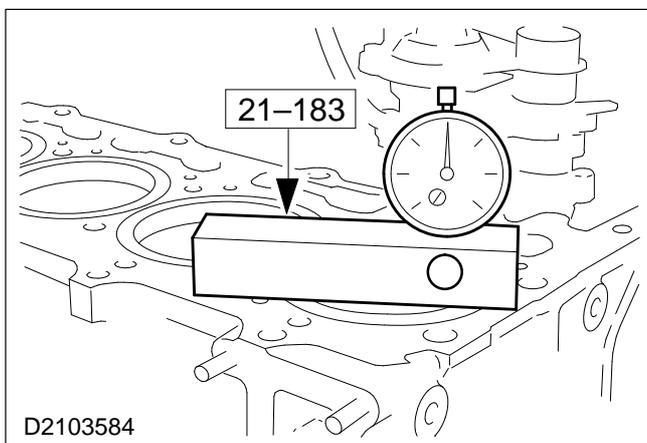
NOTE: The adhesive used to stick the cylinder liners must have had two hours to harden.

121. Remove the cylinder liner thrust elements.



122. Insert the hydraulic tappets and aligning clips.

Coat the tappets with engine oil SAE 15W40.



123. Measure the piston protrusion.

- Measure the piston protrusion of each individual cylinder at TDC using the measuring fixture and dial gauge.
- Measure the difference between the piston crown and the cylinder block.

NOTE: One measurement should be made for each cylinder on the axis of the piston pin at a distance of 5 mm from the edge of the piston.

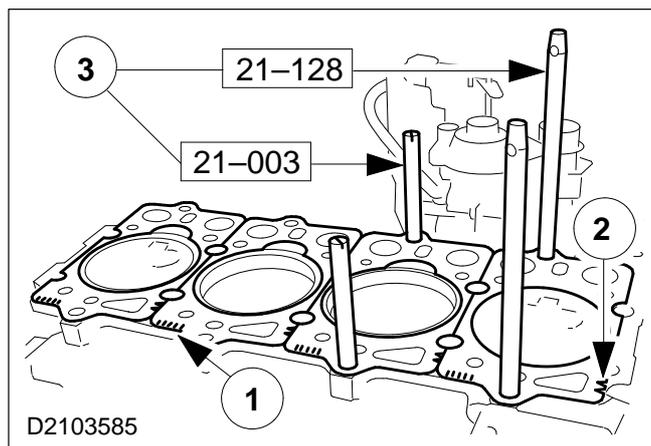
The largest measurement determines the choice of all four cylinder head gaskets:

Piston protrusion → Thickness of cylinder head gasket → No. of notch marks

0,53 – 0,62 mm → 1,42 → 1

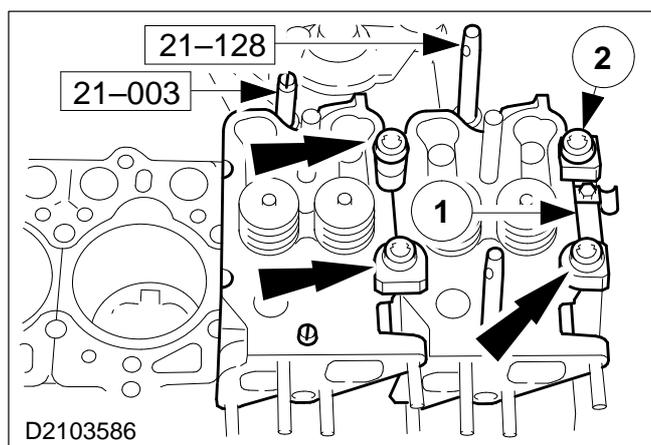
0,63 – 0,72 mm → 1,52 → 2

0,73 – 0,82 mm → 1,62 → 0



124. Fit the cylinder head gaskets.

- 1 Fit the new cylinder head gaskets with the inscription facing upwards.
- 2 Gasket thickness marking.
- 3 Screw in the guide studs.

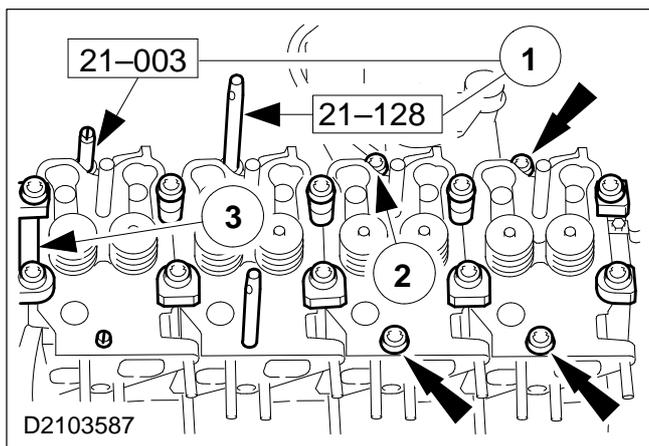


125. Fit the cylinder heads.

NOTE: Make sure that the thrust elements are positioned correctly. With used cylinder heads take the imprint as a guide.

- Fit the cylinder heads with the aid of the locating studs.
- Coat the cylinder head bolt heads and threads with hypoid oil SAE90.

- 1 Fit the end spacer.
- 2 Lay the thrust elements in place and screw in the inner M14 cylinder head bolts.

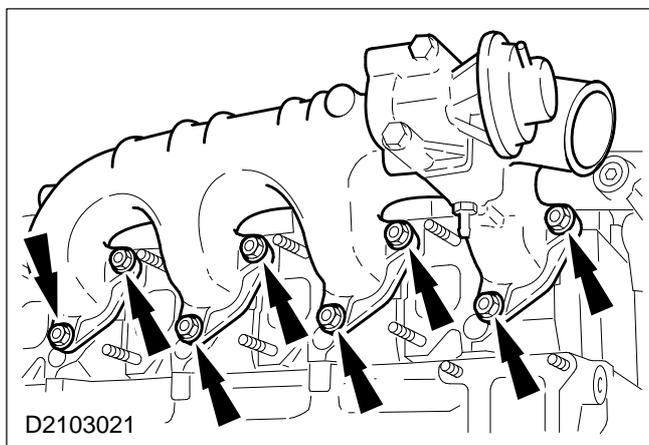


126. Fit the cylinder heads (cont.).

NOTE: Make sure that the pressure pads are positioned correctly. With used cylinder heads take the imprint as a guide.

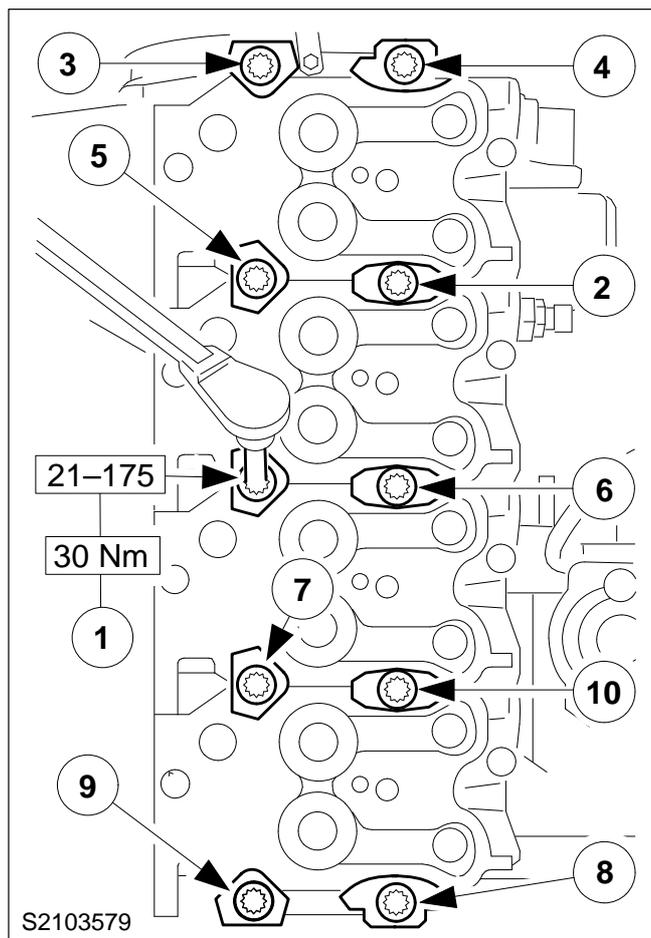
Coat the cylinder head bolt heads and threads with hypoid oil SAE90.

- 1 Transfer the locating studs and fit the cylinder heads.
 - 2 Screw in the outer M12 cylinder head bolts.
 - 3 Fit the end spacer.
- Lay the thrust elements in place and screw in the inner M14 cylinder head bolts.
 - Unscrew and remove the guide studs and screw in the outer M12 cylinder head bolts.



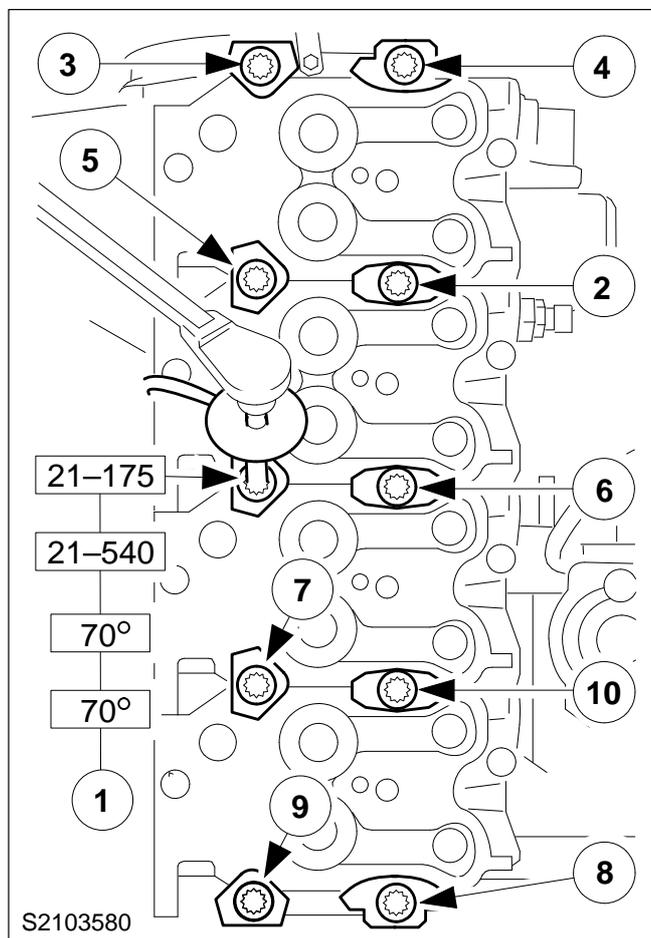
NOTE: Do up the retaining nuts lightly to align the cylinder heads.

127. Fit the intake manifold with EGR valve and the old gasket.



NOTE: Bolt-tightening sequence.

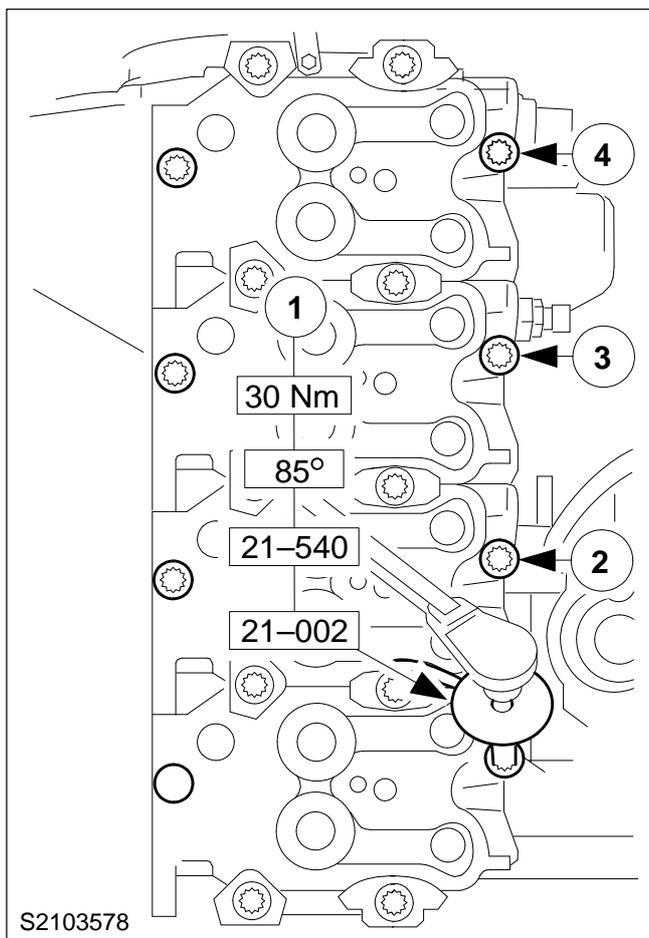
128. Pre-tighten the inner M14 cylinder head bolts.



NOTE: Bolt-tightening sequence.

129. Tighten the inner M14 cylinder head bolts in two stages.

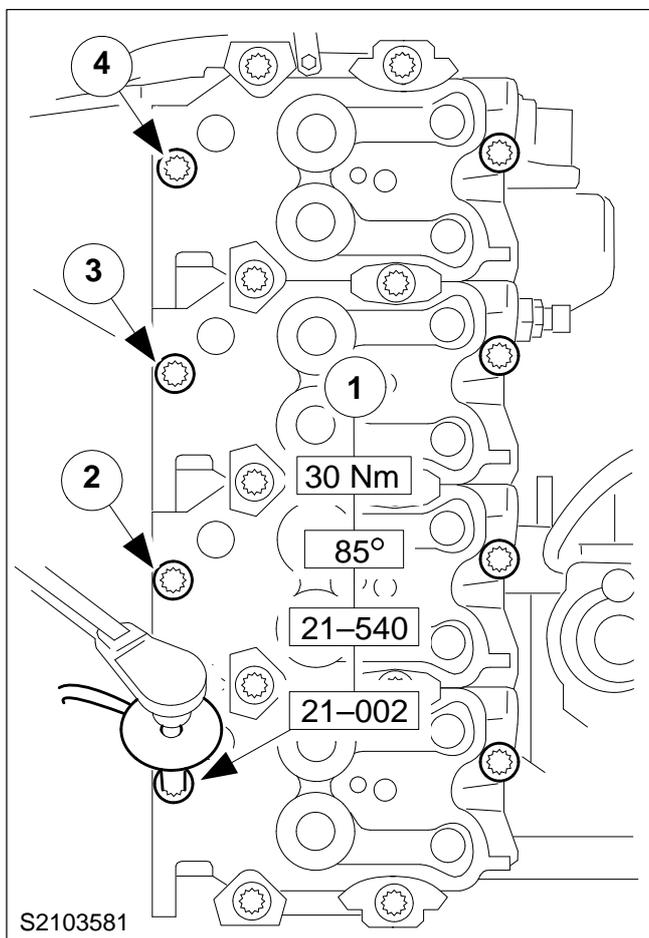
The cylinder head bolts should be retorqued after the engine has reached normal operating temperature.



NOTE: Bolt tightening sequence.

130. Tighten the outer M12 cylinder head bolts on the injection side in two stages.

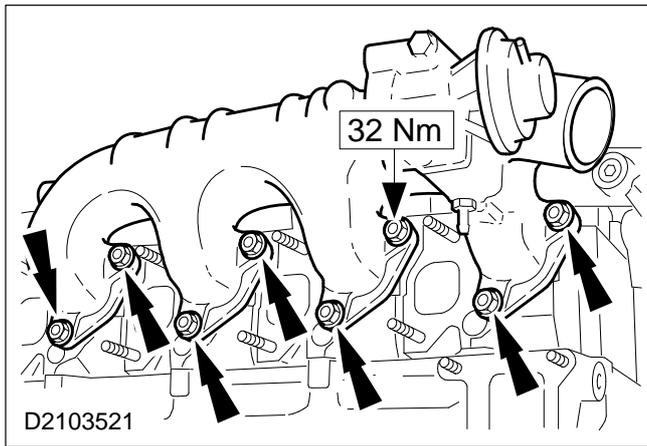
The cylinder head bolts should be retorqued after the engine has reached normal operating temperature.



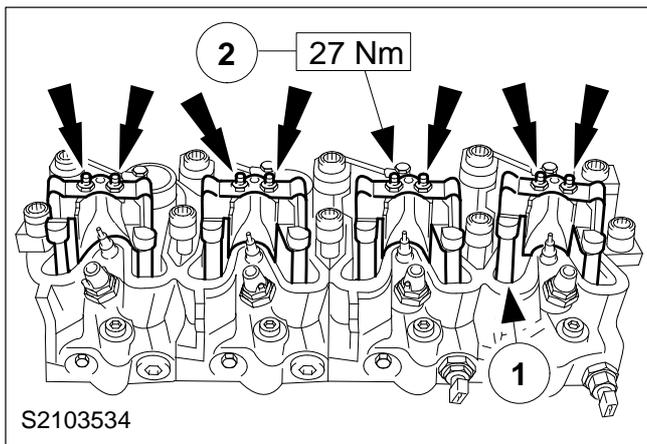
NOTE: Bolt-tightening sequence.

131. Tighten the outer M12 cylinder head bolts on the exhaust side in two stages.

The cylinder head bolts should be retorqued after the engine has reached normal operating temperature.



132. Remove the intake manifold, fit a new intake/exhaust gasket, fit the intake manifold and tighten the nuts.



⚠ CAUTION: Do not turn the engine for 15 minutes.

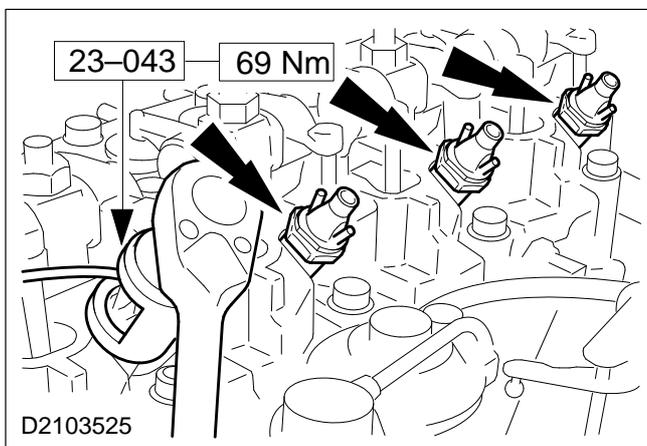
133. Fit the rocker shafts.

NOTE: Rotate the crankshaft to 20° before TDC.

NOTE: Keep to the removal sequence.

1 Insert the push rods.

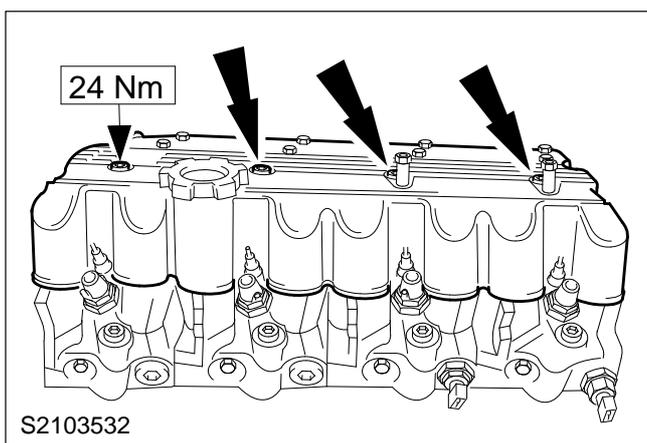
2 Coat the nuts with hypoid oil SAE 90 and tighten them.



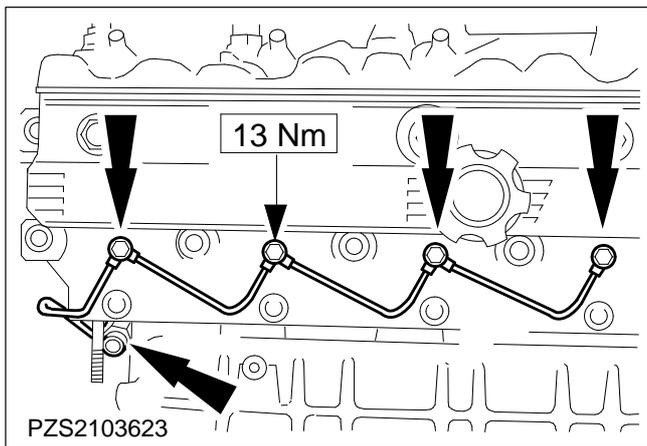
NOTE: Fit the injector with NLS in the first cylinder.

134. Fit the injectors.

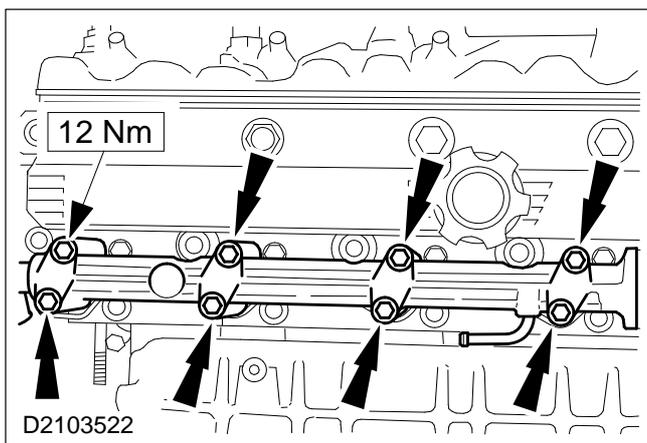
- Fit new copper sealing rings (1,5 mm thick and 17,5 mm inside diameter) on the injectors.
- Apply sealer (ESEAM-1C1014) to the injector threads.
- Install the injectors and new sealing rings.



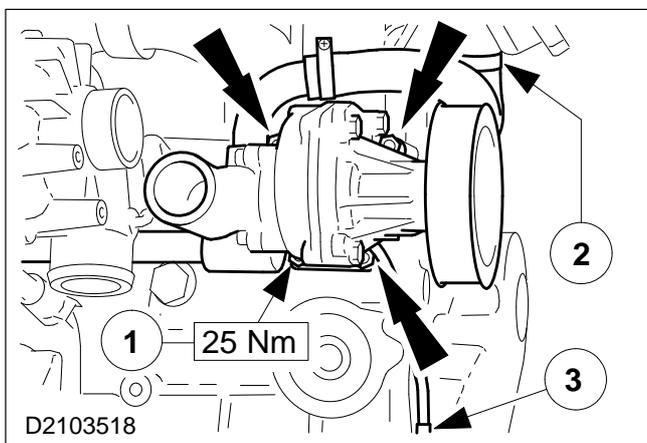
135. Fit the cylinder head cover with a new gasket.



136. Fit the rocker arm oil feed pipe using new seals.

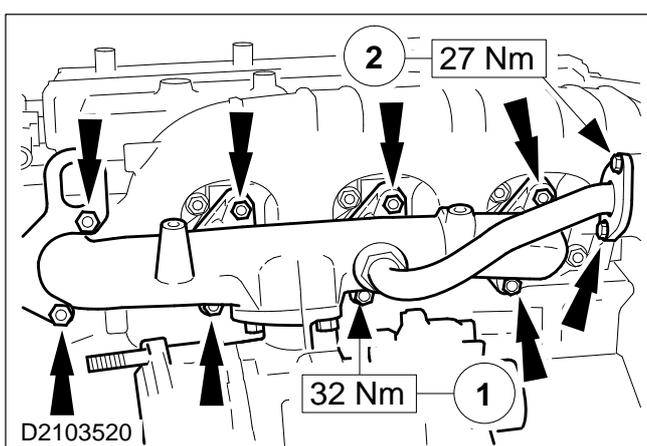


137. Fit the coolant collection pipe with the thermostat housing and new gaskets.



138. Fit the coolant pump.

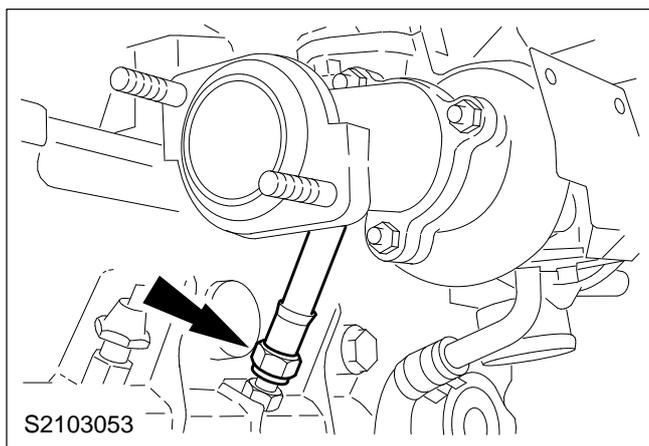
- 1 Install the coolant pump with a new gasket.
- 2 Connect the coolant hose to the thermostat housing.
- 3 Attach the hose to the bracket.



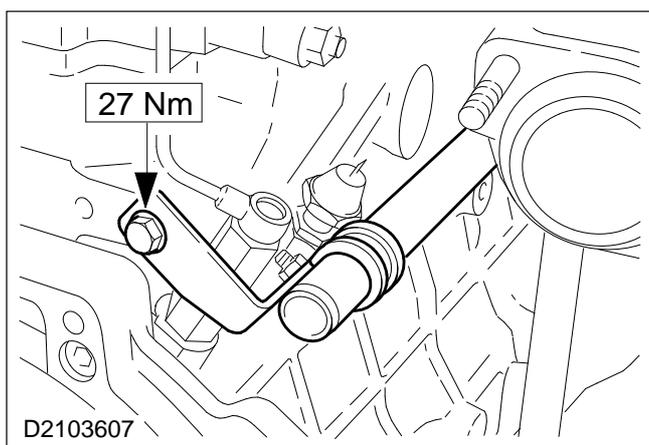
NOTE: The intake and exhaust manifolds use the same gasket.

139. Install the exhaust manifold with the turbocharger.

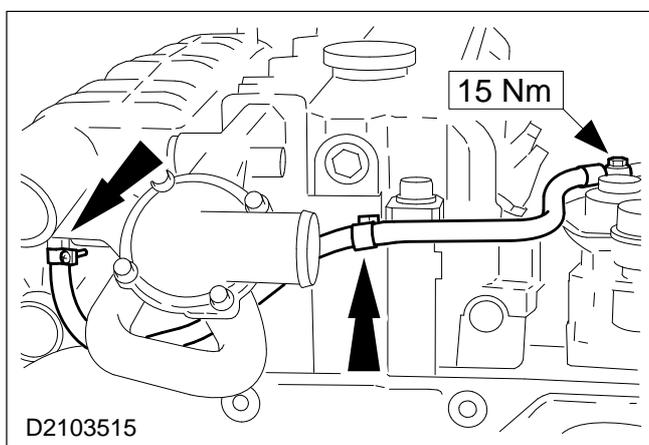
- 1 Tighten the exhaust manifold nuts.
- 2 Fit the pipe flange to the EGR valve.



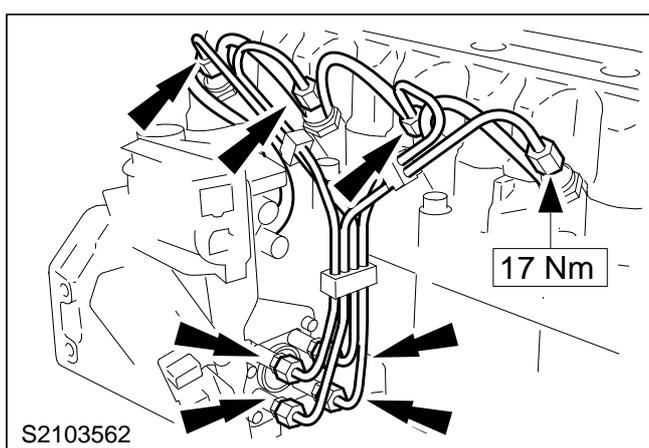
140. Fit the turbocharger oil feed pipe to the main bearing housing hollow retaining screw.



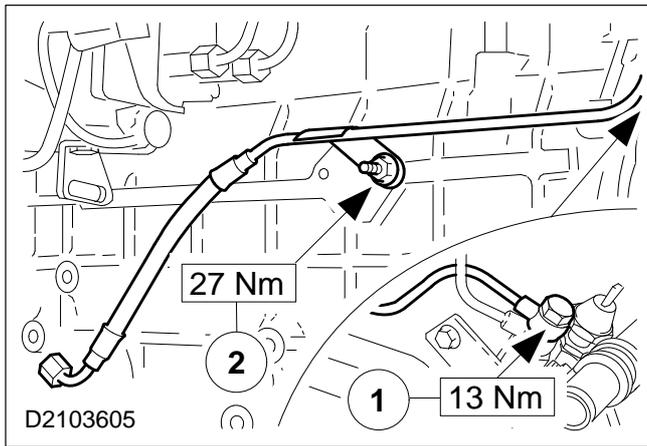
141. Fit the coolant pipe with the bracket.



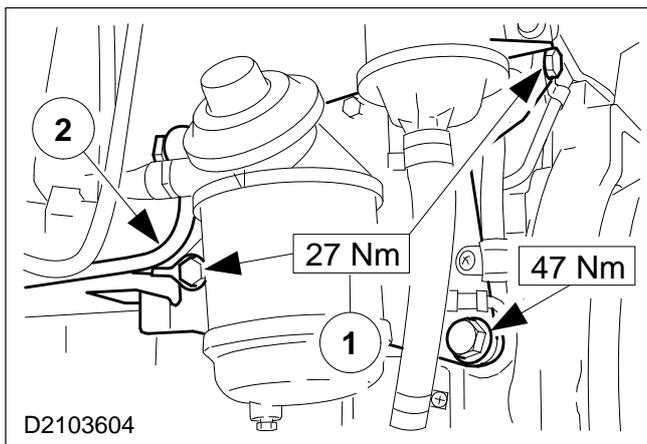
142. Fit the smoke pressure limiter (SPL) pipe using new seals.



143. Fit the injector pipes and the leak-off pipes.

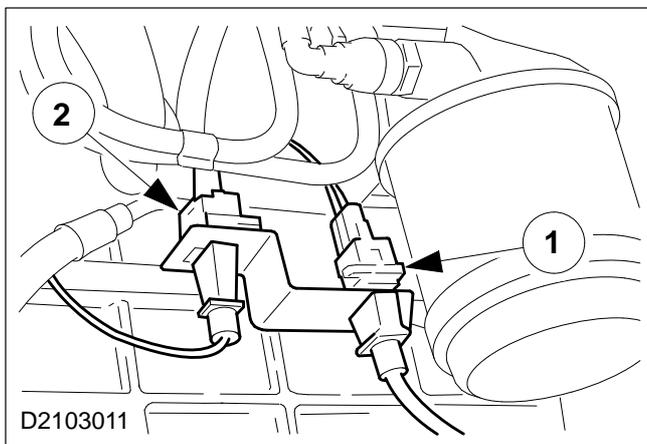
**144. Install the oil feed pipe using new seals.**

- 1 Fit the oil feed pipe to the connector using new seals.
- 2 Bracket of oil feed pipe

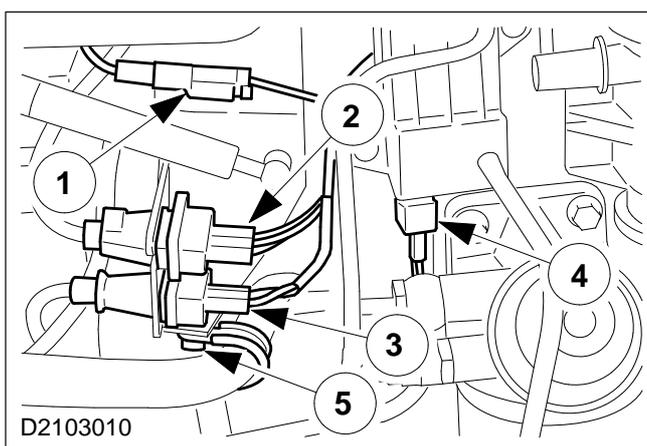
**145. Fit the fuel filter mounting plate complete with the fuel heater, oil separator and wiring loom.**

NOTE: The bolt holds the CKP sensor cable retaining clip in place.

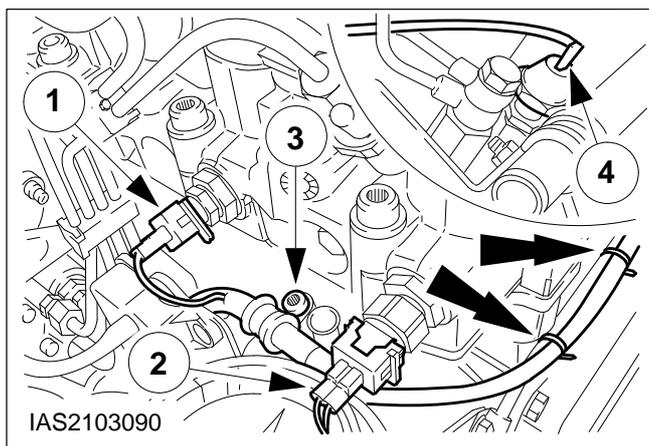
- 1 Fit the mounting plate with the bracket of the oil feed pipe (three bolts).
- 2 Fit the fuel feed pipe using new seals.

**146. Join the connectors and install them on the fuel filter retaining plate.**

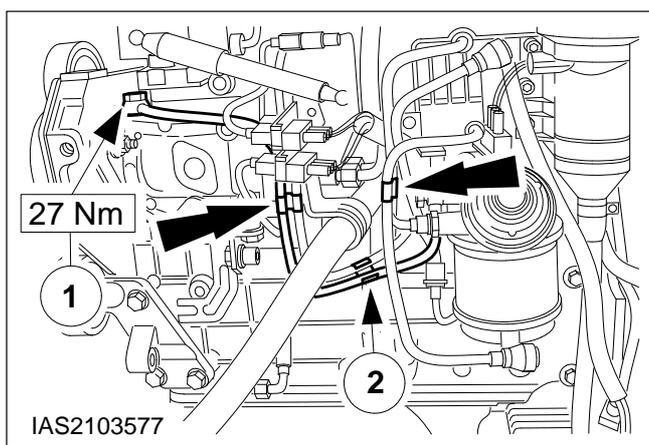
- 1 CKP sensor connector
- 2 NLS connector

**147. Connect the plugs to the fuel injection pump and the fuel heater and fit the wiring loom.**

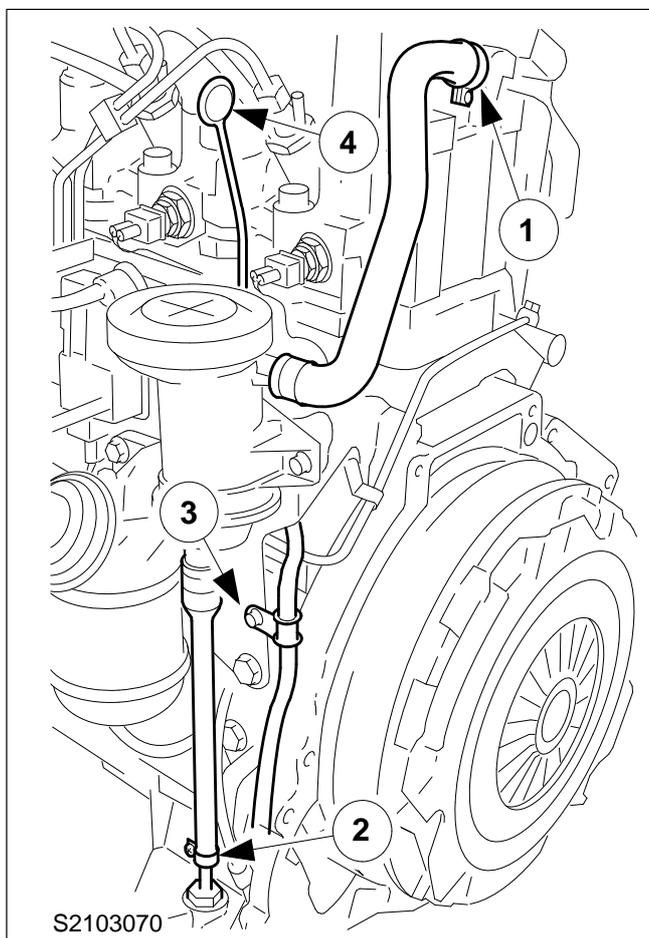
- 1 Connect the plug of the fuel shut-off valve.
- 2 Connect the plug of the FLVR sensor.
- 3 Connect the plug of the pump timing adjusting valve.
- 4 Connect the plug of the fuel heater.
- 5 Attach the wiring loom retaining clip to the accelerator cable bracket.

**148. Connect the plugs.**

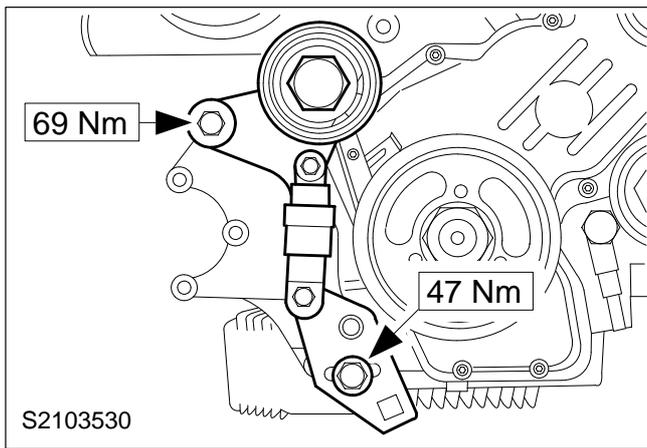
- 1 Engine coolant temperature (ECT) sensor connector.
 - 2 Coolant temperature gauge sender connector.
 - 3 Fit the wiring loom retaining clip.
 - 4 Oil pressure switch connector.
- Secure the lead using cable ties.

**149. Connect the fuel return pipe to the injection pump using new seals.**

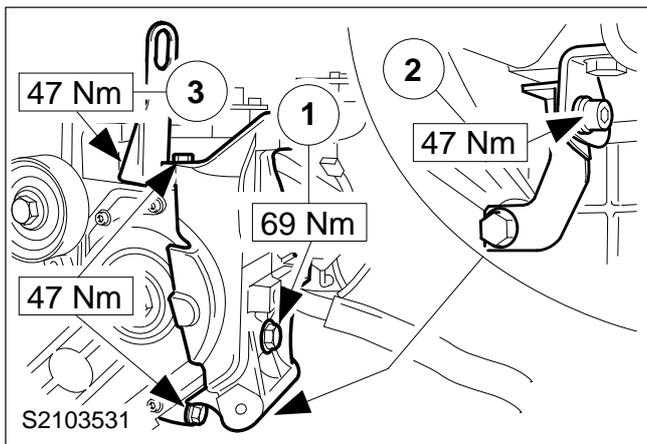
- 1 Fuel return pipe to fuel injection pump
- 2 Attach the fuel pipe retaining clips.

**150. Connect the hoses.**

- 1 Crankcase ventilation hose
- 2 Oil separator oil return hose to sump.
- 3 Attach the wiring loom retaining clip.
- 4 Insert the oil dipstick.

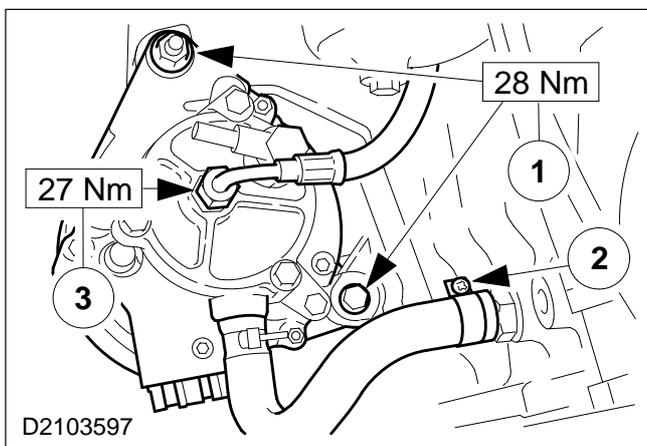


151. Fit the automatic belt tensioner.



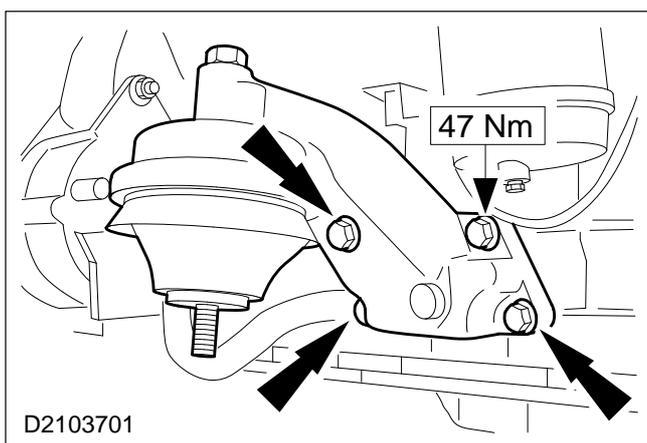
152. Fit the upper alternator bracket with the lower fuel injection pump bracket.

- 1 Alternator bracket (three bolts).
- 2 Tighten the bolt and nut on the fuel injection pump bracket.
- 3 Fit the engine lifting eye.

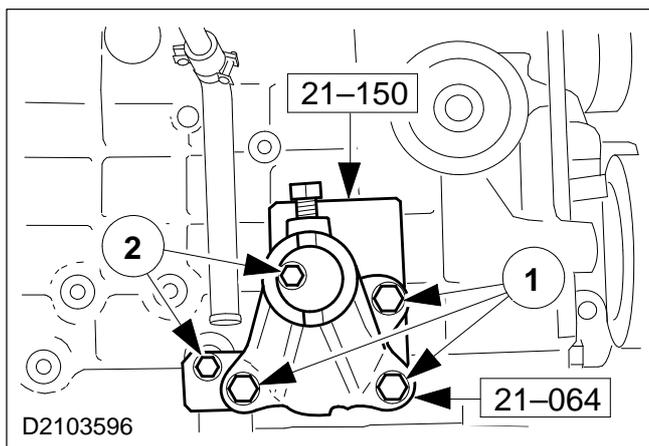


153. Fit the alternator with the vacuum pump.

- 1 Screw in the bolts.
- 2 Fit the oil return pipe.
- 3 Connect the oil feed pipe to the vacuum pump.

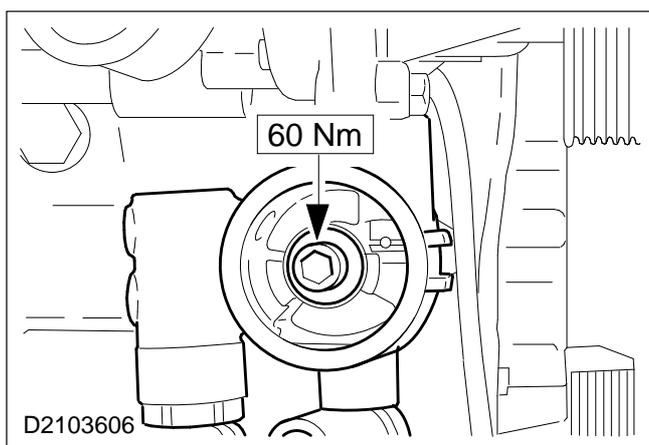


154. Install the right-hand engine mounting bracket.



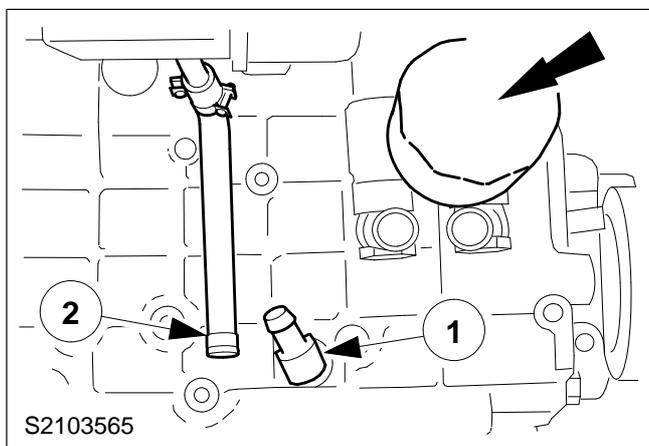
155. Detach the engine from the assembly stand.

- 1 Detach the mounting bracket.
- 2 Detach the mounting plate.



156. Install the oil filter intermediate housing.

Coat the new O-ring with engine oil SAE 15W40.



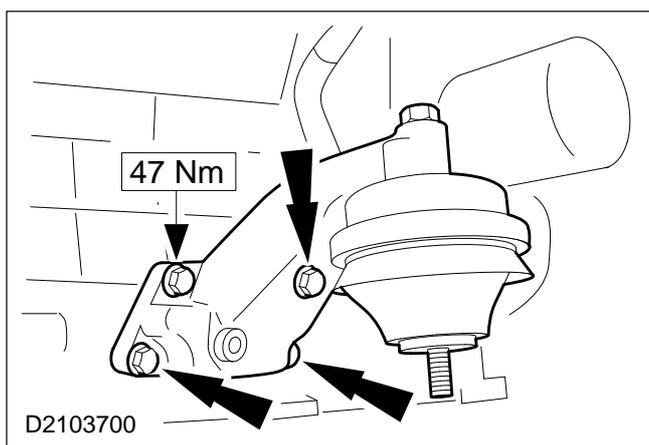
157. Install the engine oil filter.

Lubricate the rubber gasket of the new engine oil filter with engine oil SAE 15W40. Screw the oil filter on finger tight.

158. Fit the turbocharger oil return hose to the cylinder block.

NOTE: The connector must point towards the turbocharger oil return hose.

- 1 Fit the connector to the cylinder block.
- 2 Fit the hose to the connector.



159. Fit the left-hand engine mounting bracket.

160. Finishing operations

Turn the engine over three times to check there is no contact between the pistons and the valves.