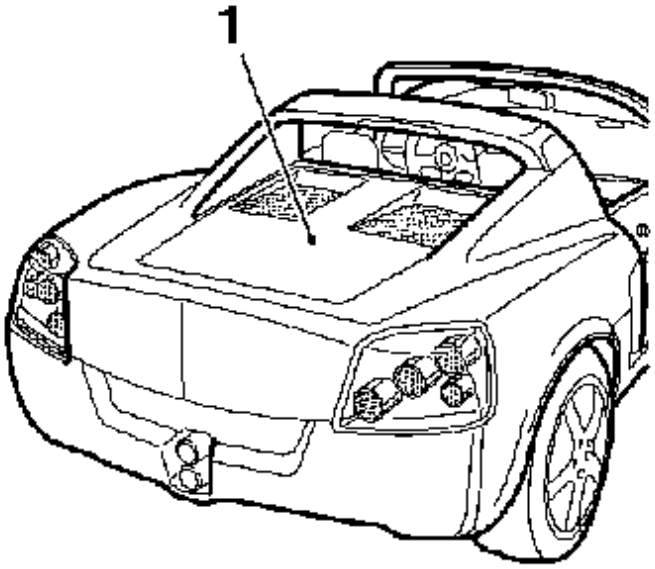
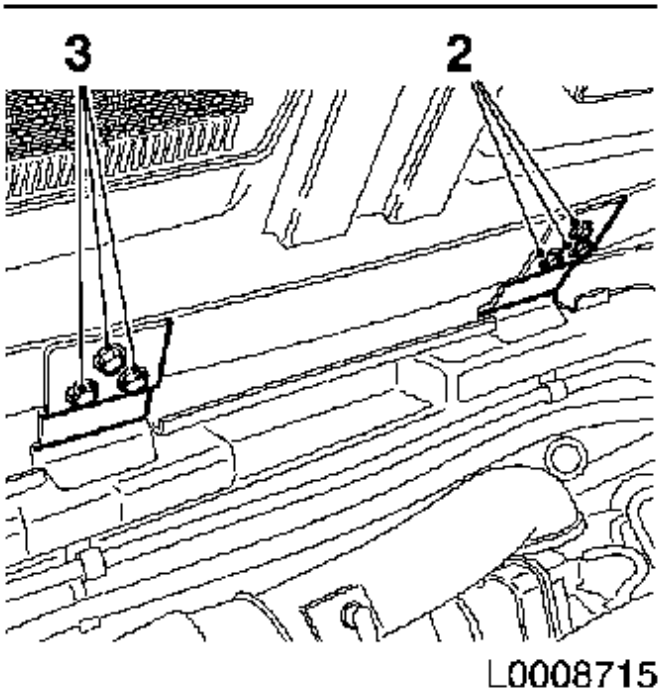
Pistons and Connecting Rods, Remove and Install

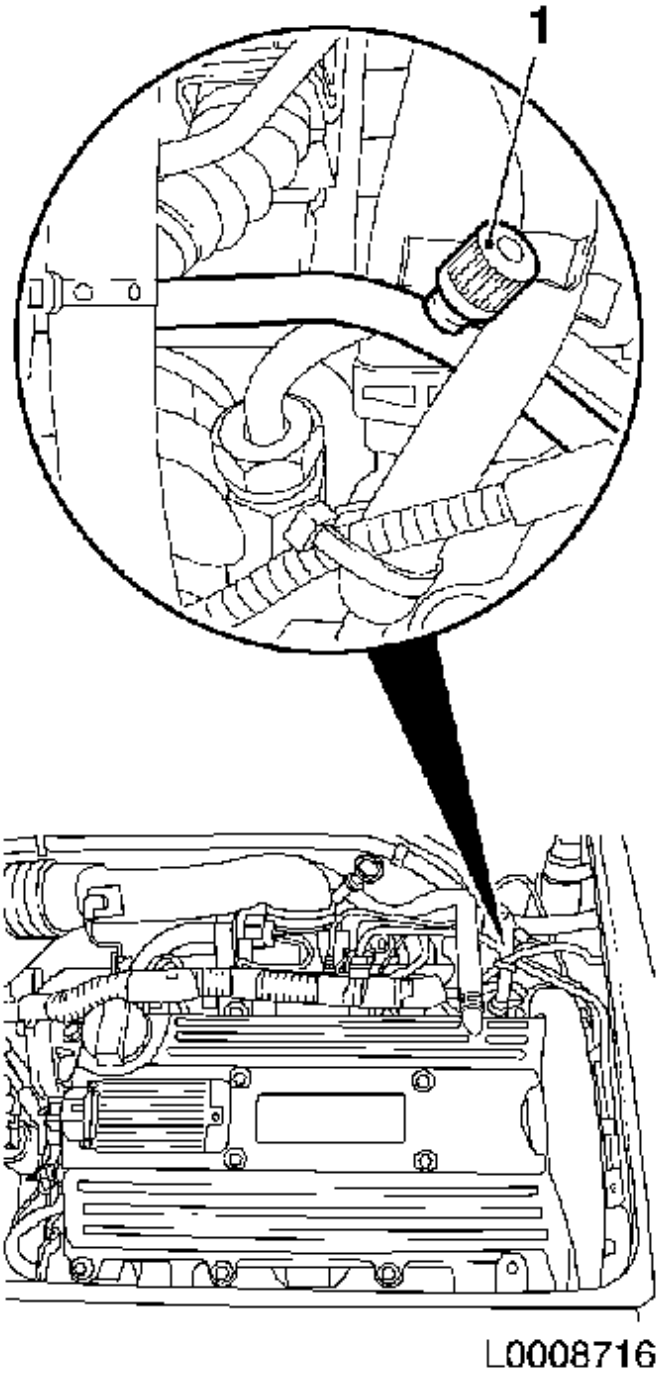
Remove

1. Open the bonnet.
2. Disconnect the battery.
3. Open the engine cover (1).
4. Detach the engine cover.
   - 6 bolts (2) and (3)



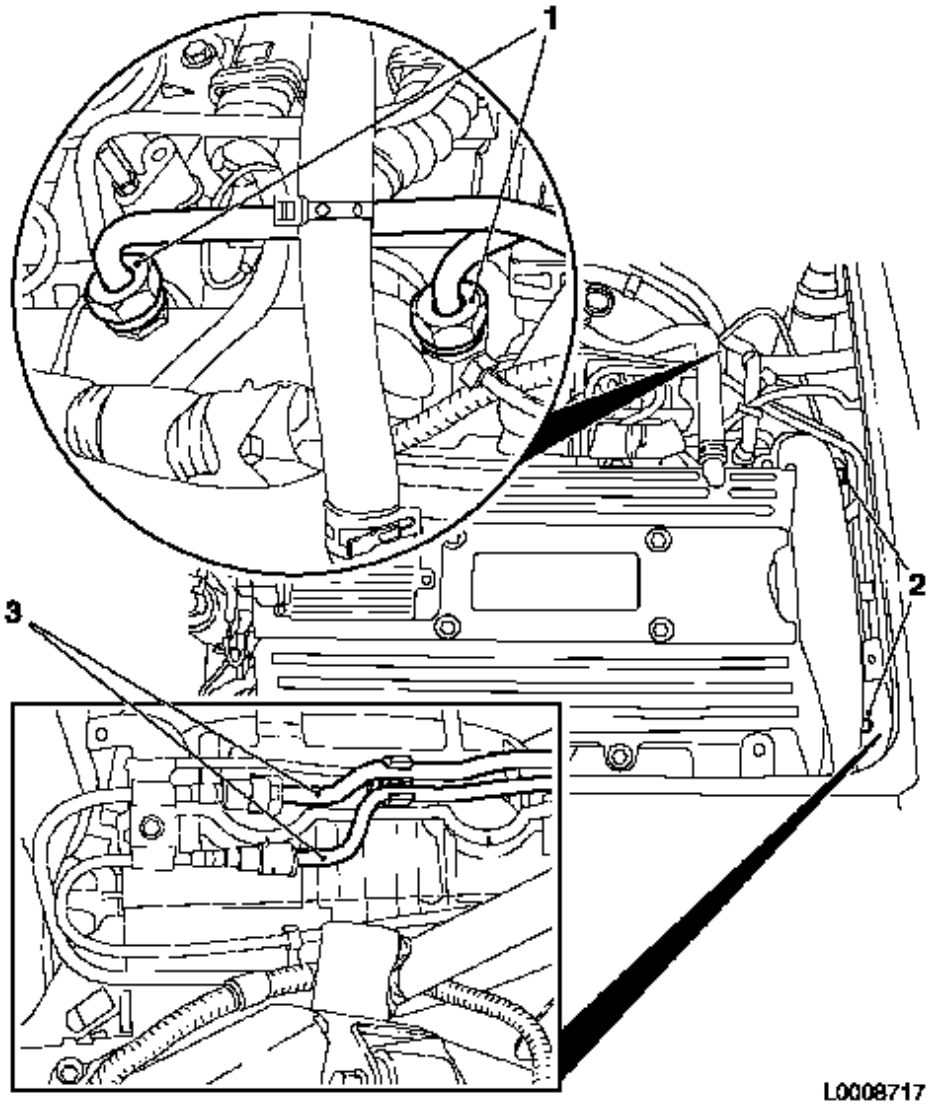


5. Release the fuel pressure.
   Important: Fuel may escape – observe the safety regulations and relevant national legislation.
   - Release the fuel pressure with the pressure tester **KM-J-34730-91** (1) via test connection (2).
     – Collect any escaping fuel in a suitable container.

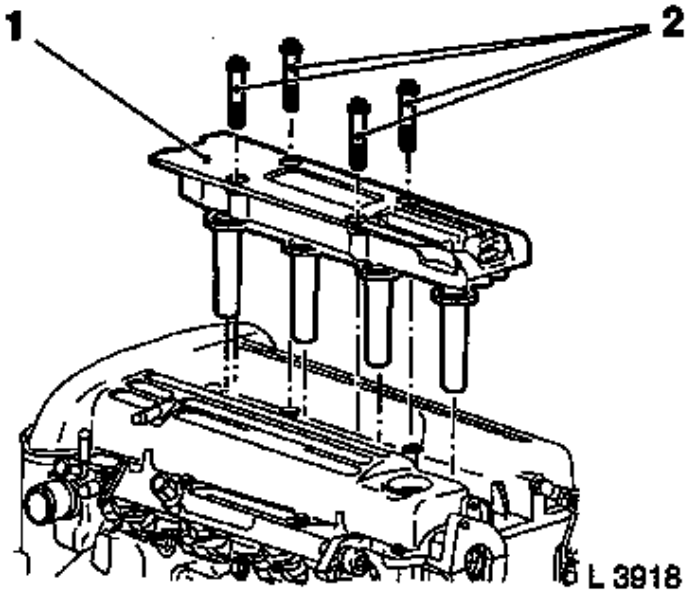


6. Disconnect the fuel lines.

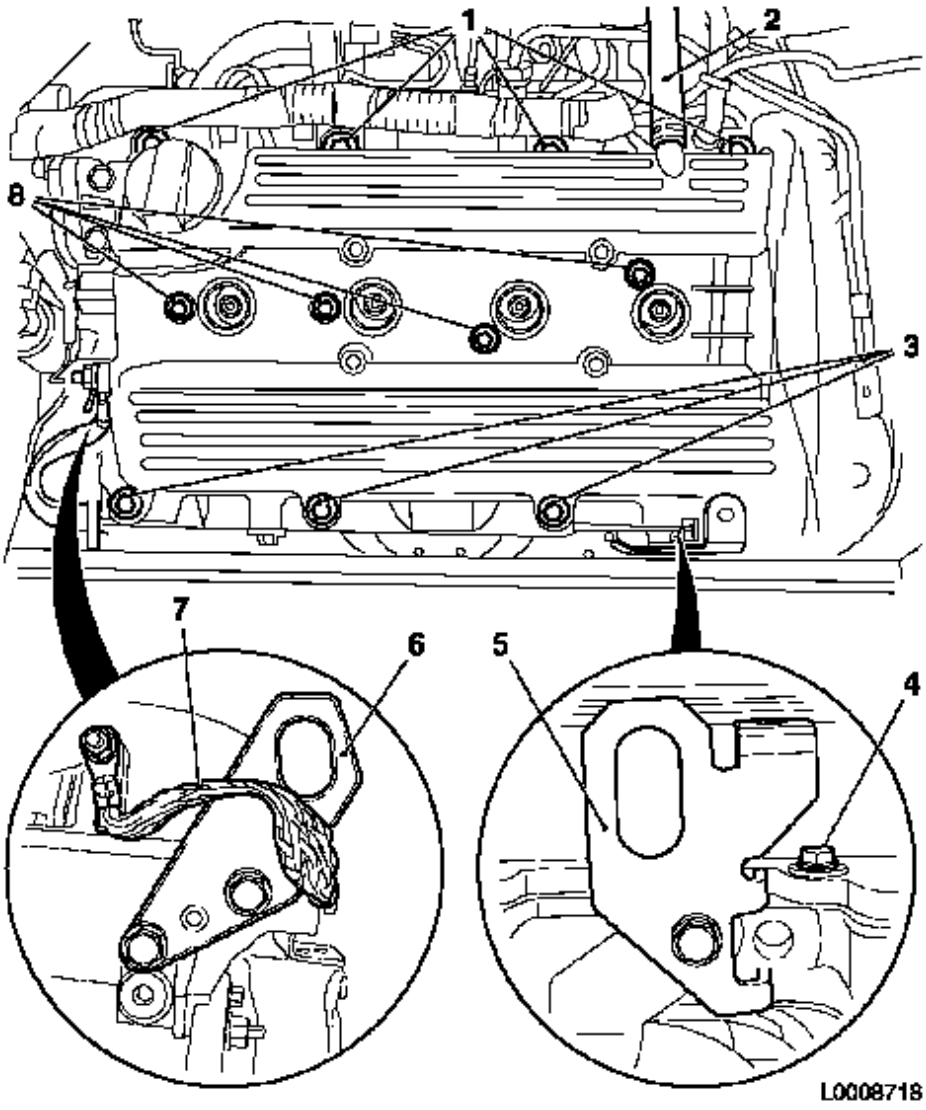
- 2 union nuts (1)
- 2 bolts (2)
- Reposition the fuel lines (3) to one side.



7. Detach the ignition module (1).
   - Release and detach the wiring harness connector.
   - 4 bolts (2)



8. Remove the cylinder head cover.
- Detach the engine breather hose (2).
- Detach the engine lifting eyes (5) and (6).
  – 2 bolts, 1 nut
- Detach the ground cable (7).
  – 1 bolt
- 12 bolts (1), (3), (4) and (8)



9. Remove the lower heat shield (1).
- 3 bolts

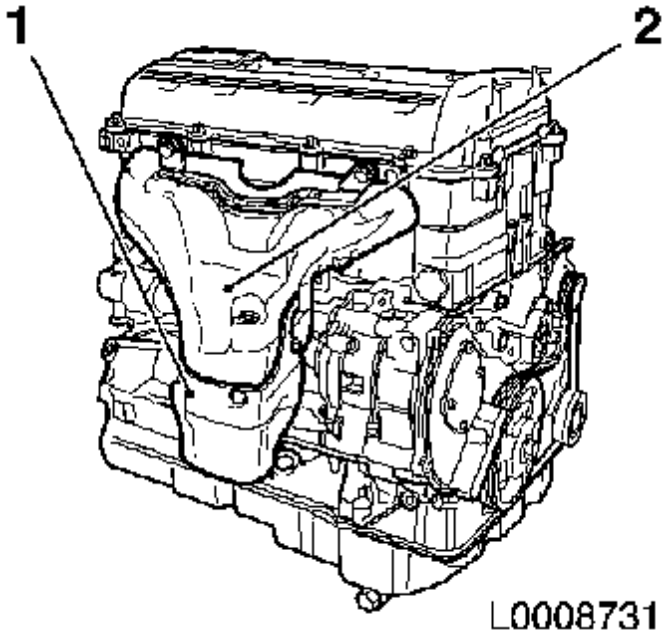
10. Detach the upper heat shield (2).
- 3 bolts

11. Undo the bolts on the rear wheels.

12. Raise the lifting ramp.

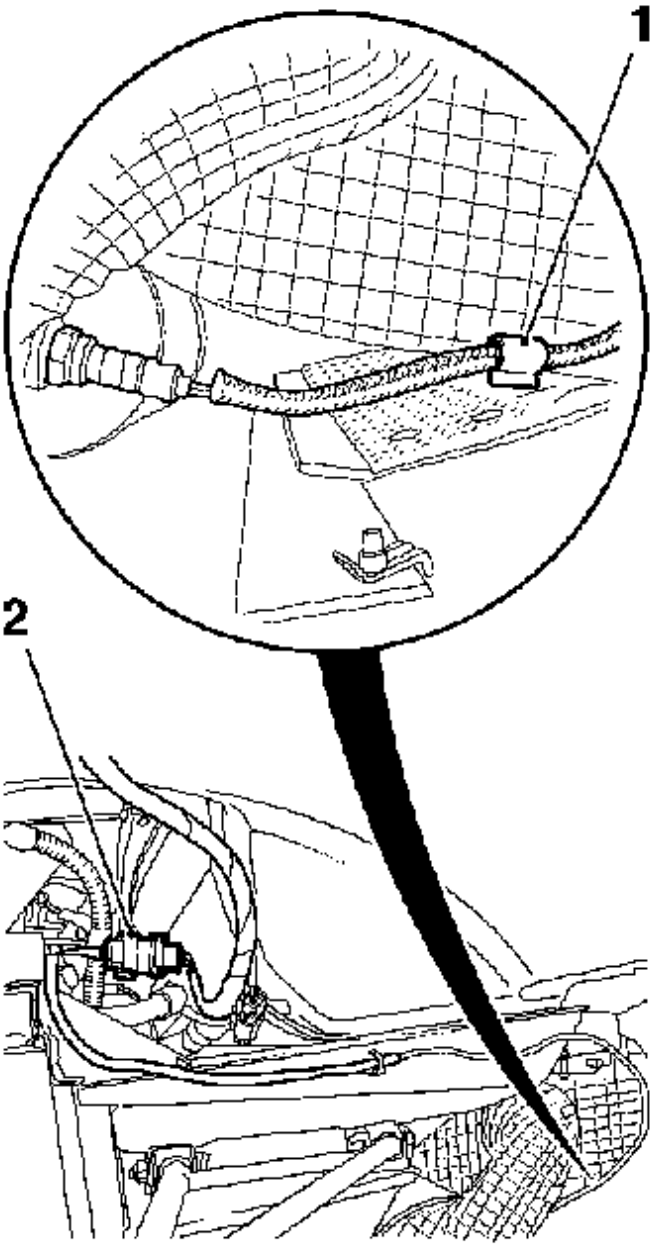
13. Detach the rear wheels.

14. Remove the wheel arch trim on the left and right–hand side.
- 12 bolts



15. Disconnect the lambda probe wiring harness connector (2).
- Expose the wiring harness.
- 5 clips, 1 retaining clip (1)

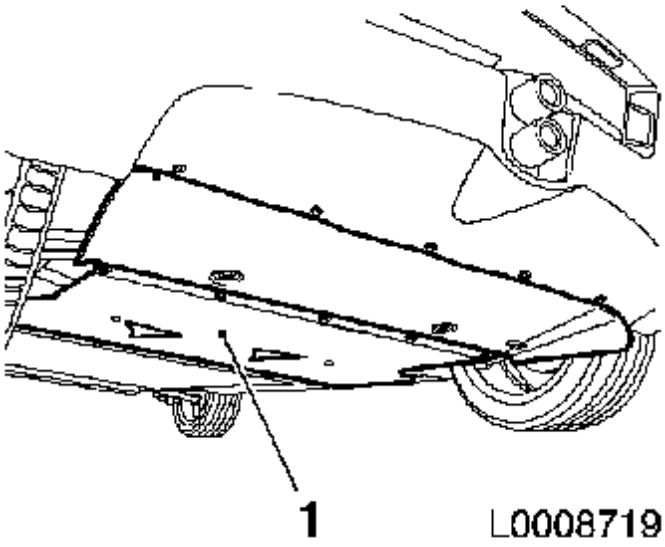
16. Raise the lifting ramp.



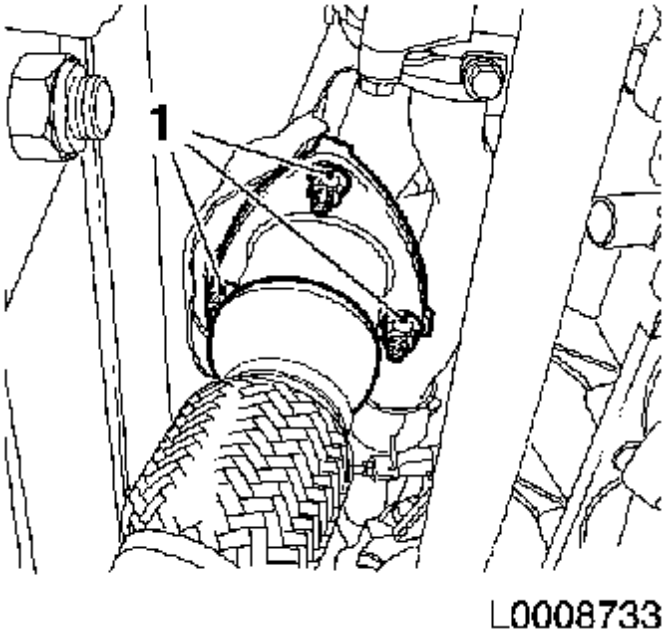
L0008732

17. Remove the lower engine splash shield (1).
- 13 bolts

18. Remove the cover from the exhaust system.
- 14 bolts

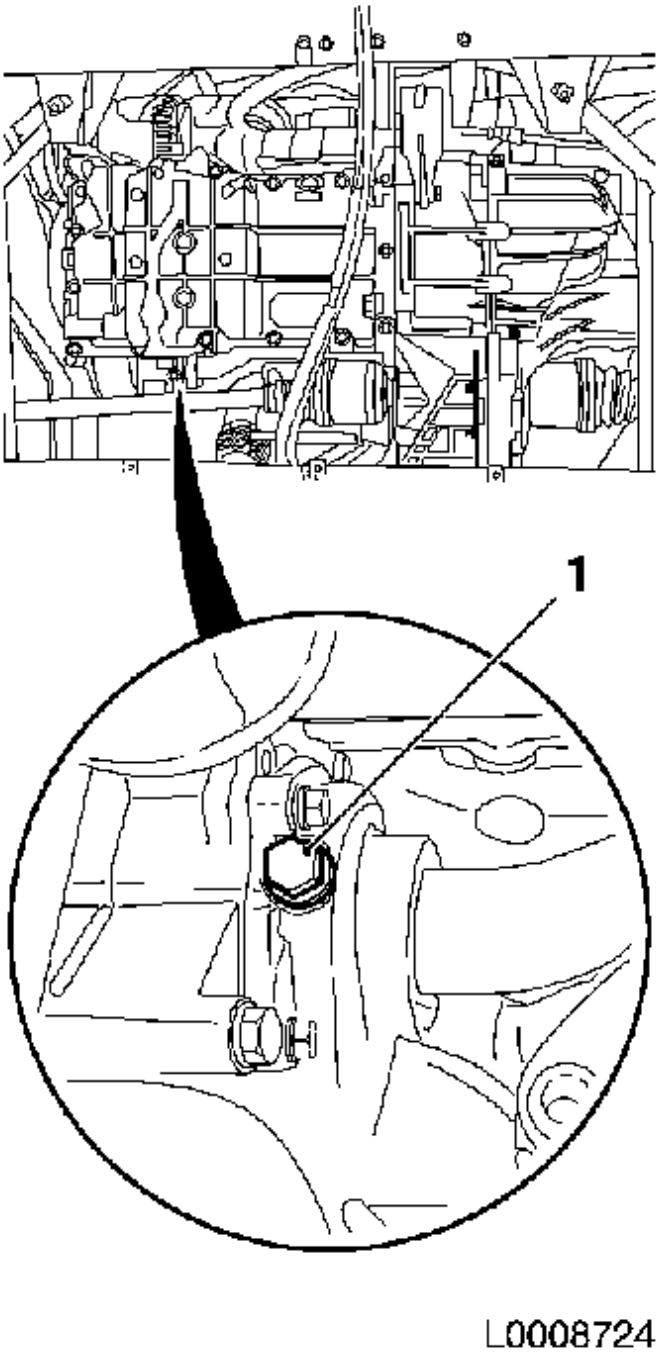


19. Detach the front exhaust pipe.
- 3 nuts (1)
- Remove the gasket.



20. Place a drip tray underneath.

21. Drain the coolant.
- Open the coolant drain plug at the radiator and the coolant pump (1).
- Tighten the coolant drain plugs.
  - Tightening torque **20 Nm**

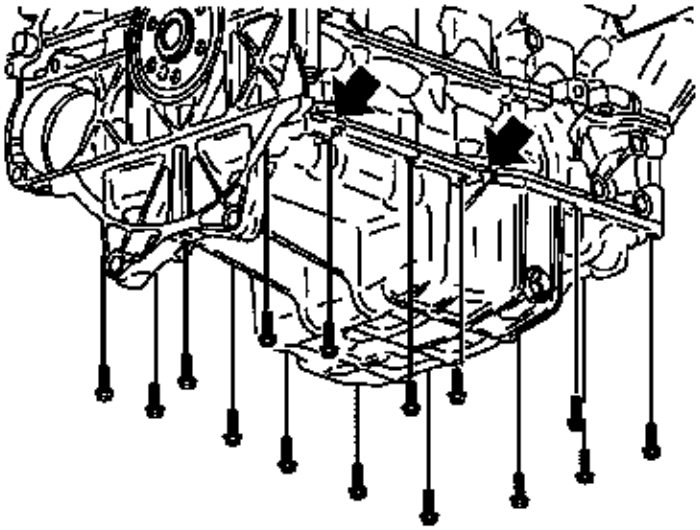


22. Place a drip tray underneath.

23. Drain the engine oil.
- Open the oil drain plug.
- Install the oil drain plug using a new oil seal.
- Tightening torque **25 Nm**

24. Remove the oil pan.
- 17 bolts
  Note: Use a suitable tool to evenly prise it off at the leverage points (arrow).

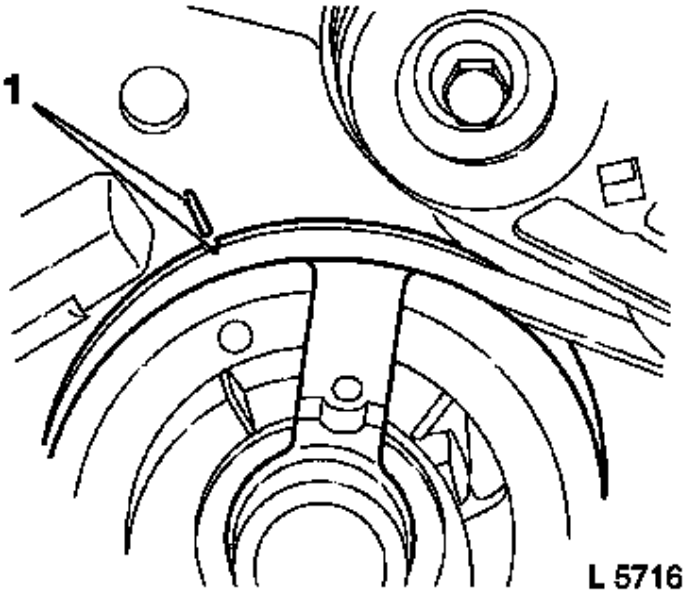
25. Place a drip tray underneath.



L 5721

26. Align the crankshaft.

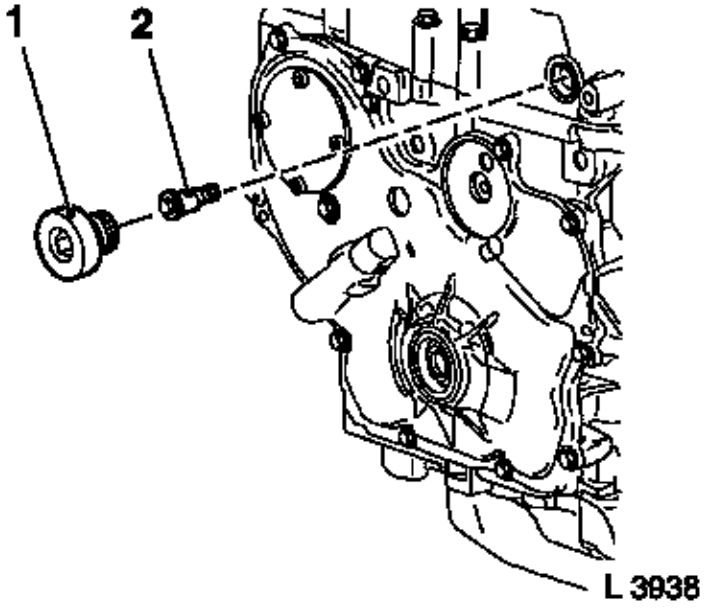
- Rotate the crankshaft in the normal direction of rotation to TDC on cylinder no. 4 (marking 1).
  Note: In this position the cams of cylinder no. 4 point upwards.



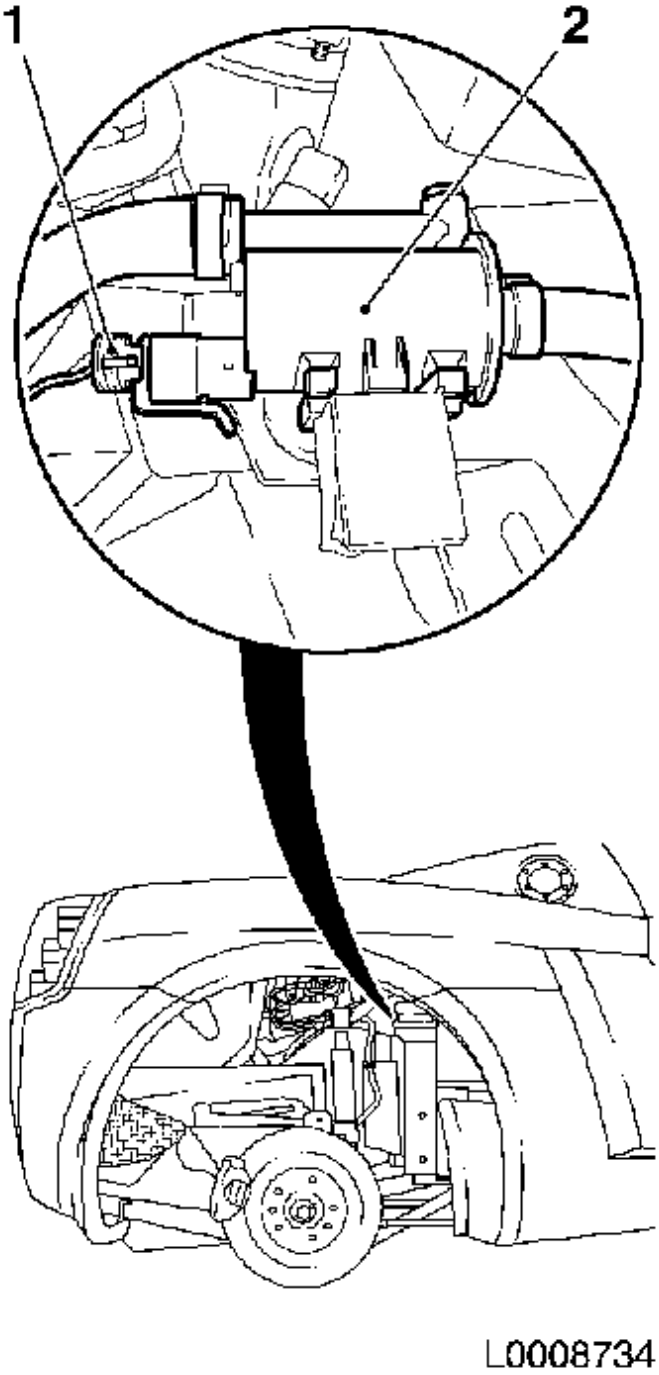
L 5716

27. Unbolt the camshaft timing chain guide rail.

- Remove the screw plug (1).
- 1 bolt (2)



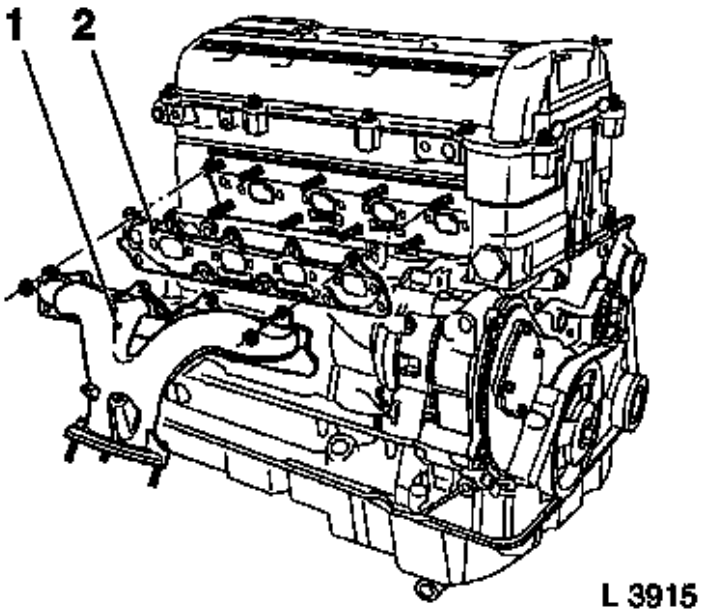
28. Disconnect the wiring harness connector (1) for the tank breather valve (2).



29. Lower the lifting ramp.

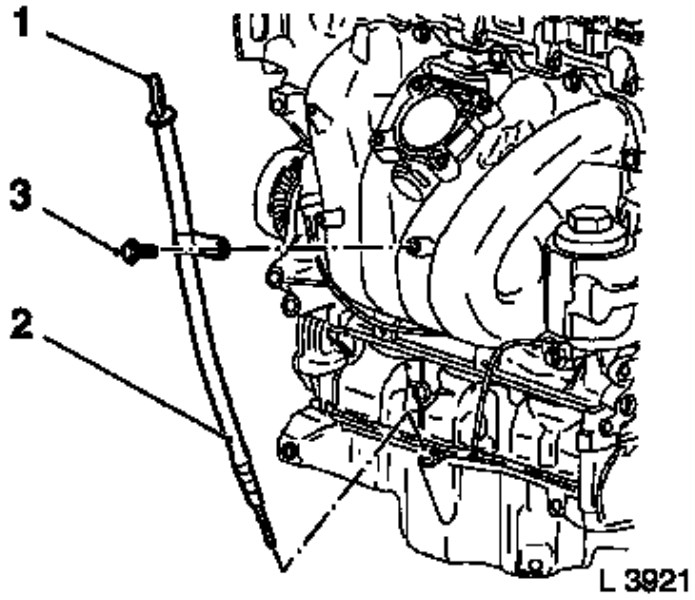
30. Remove the exhaust manifold (1).

- 10 nuts.
- Remove the gasket (2).

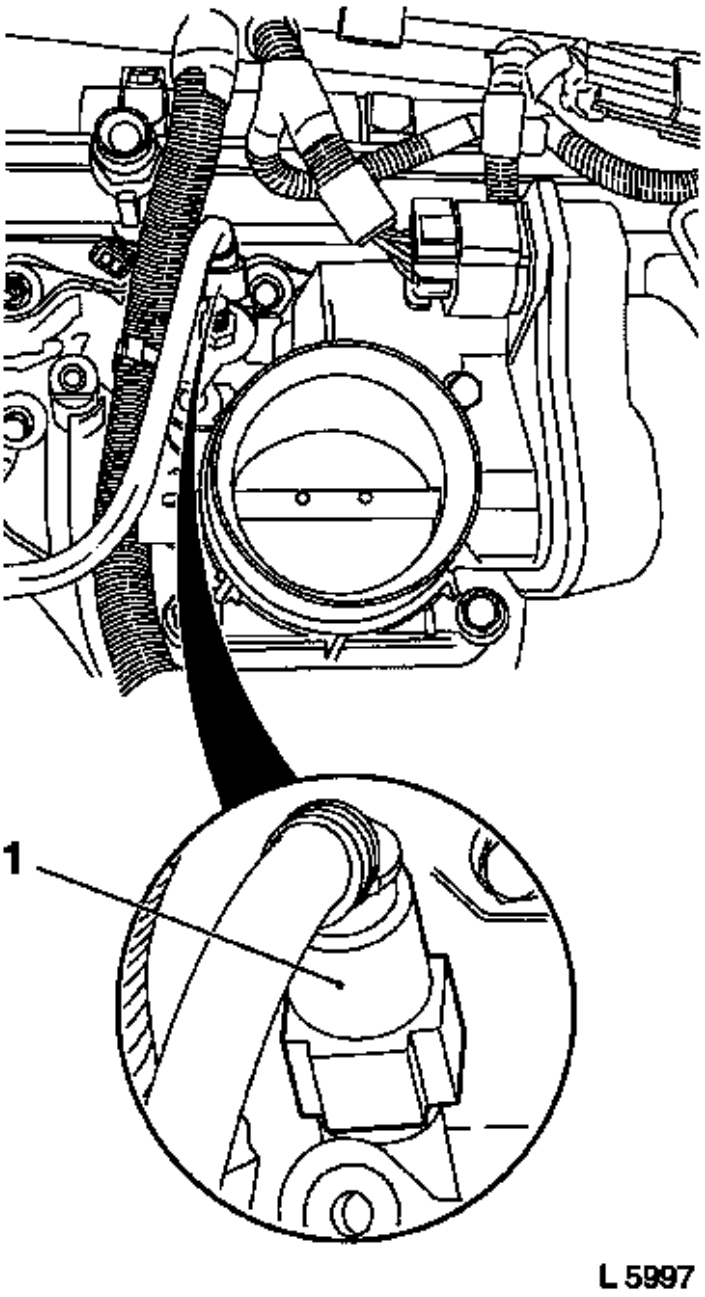


31. Undo the bolts on the oil dipstick guide tube (2).
- Pull out the oil dipstick (1).
- 1 bolt (3)

32. Remove the oil dipstick guide tube.
- Detach the knock sensor wiring harness connector.
- Pull the oil dipstick guide tube out from the oil pan and take it out to the bottom.



33. Detach the tank breather valve line (1).
- From the intake manifold.
  - Reposition the line to one side.



34. Drill out the shear bolt (4).
- Centre–punch
- Pre–drill
  - Use a 3 mm drill.
  - Max. depth 10 mm
- Drill out
  - Use a 6.5 mm drill.
  - Until the head of the bolt comes free.

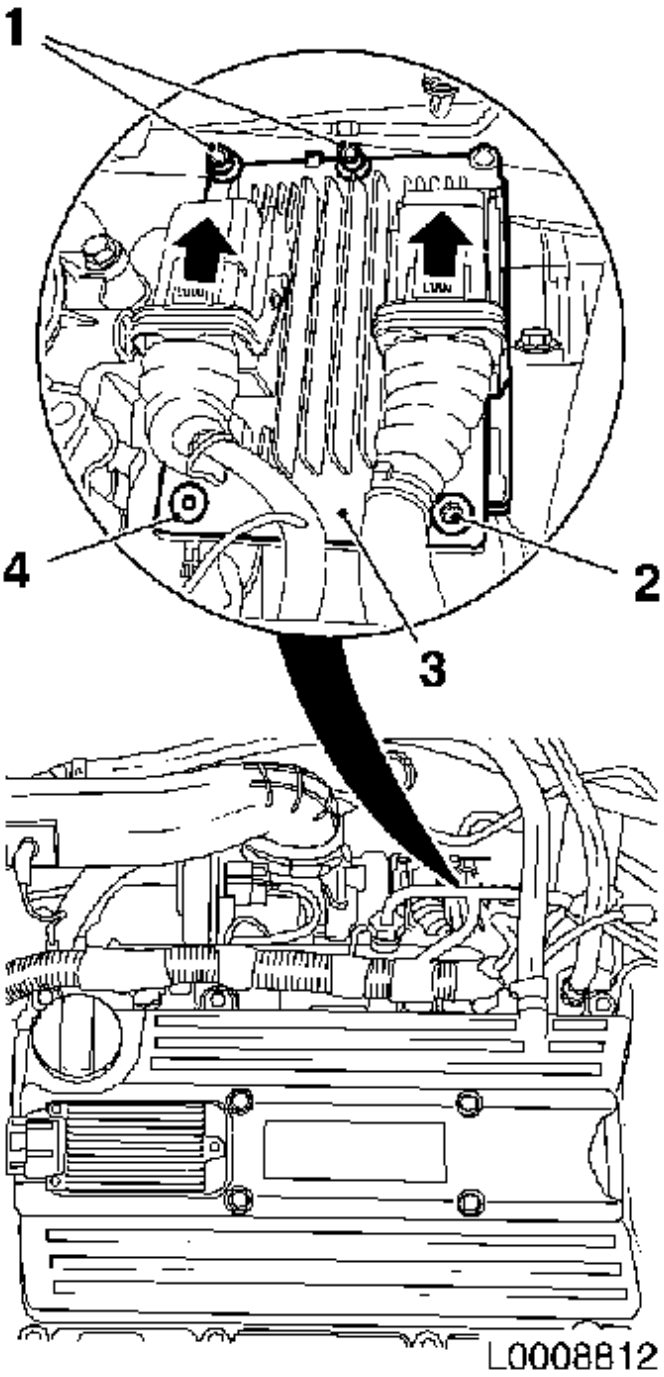
35. Remove retaining bolt (2).

36. Remove the bridge piece (3).
- Reposition the ground cable to one

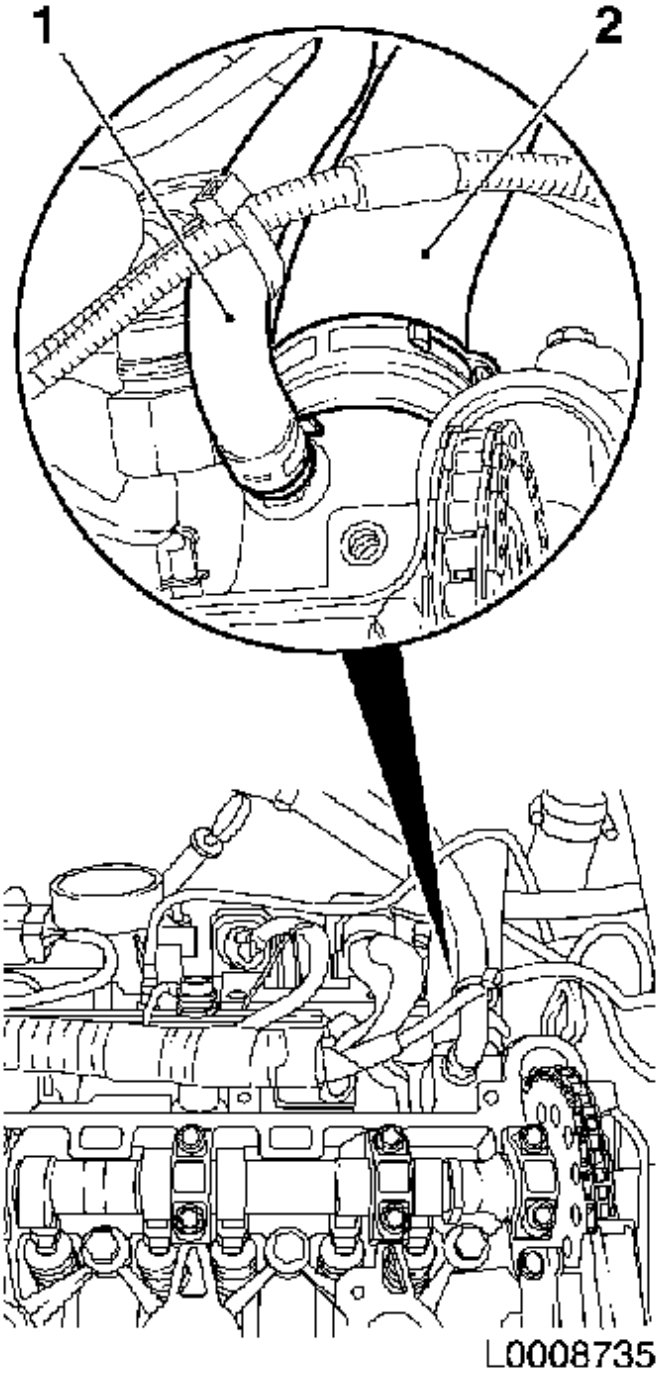
side.

37. Remove the retaining bolts (1).
- 2 bolts

38. Take out the engine control unit.



39. Detach the coolant hoses (1) and (2).
- 2 off



40. Detach the wiring harness connector (1) from the injectors (2).
- Release and detach the 4 wiring harness connectors.

41. Detach the MAP sensor wiring harness connector.

42. Detach the throttle body wiring harness connector.
- Release and detach the wiring harness connector.

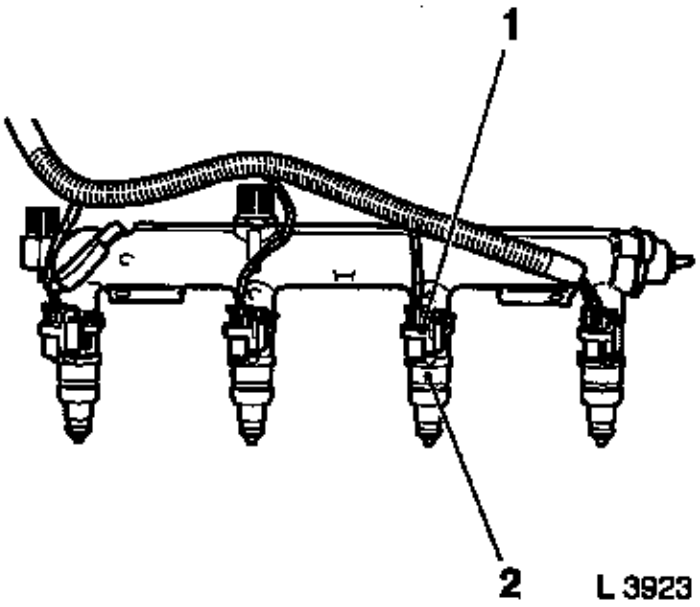
43. Detach the wiring harness.
- 2 clips

44. Disconnect the tank breather line from the

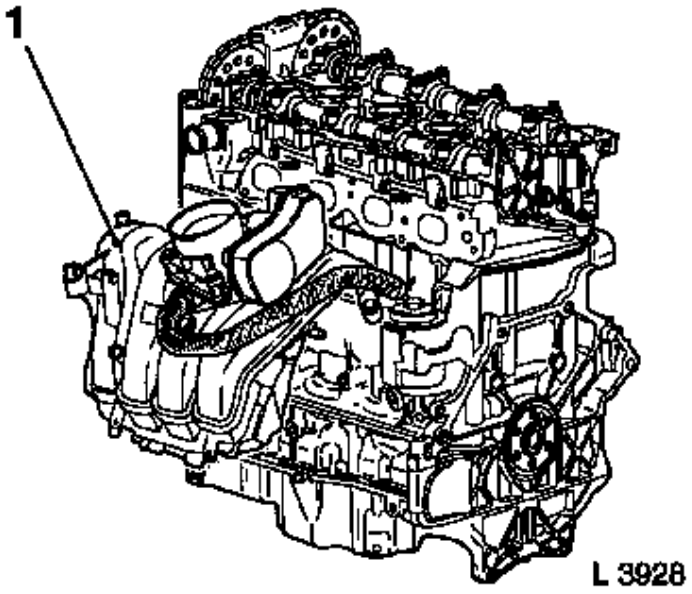
intake manifold.

45. Unbolt the exhaust gas recirculation pipe.
- 2 bolts

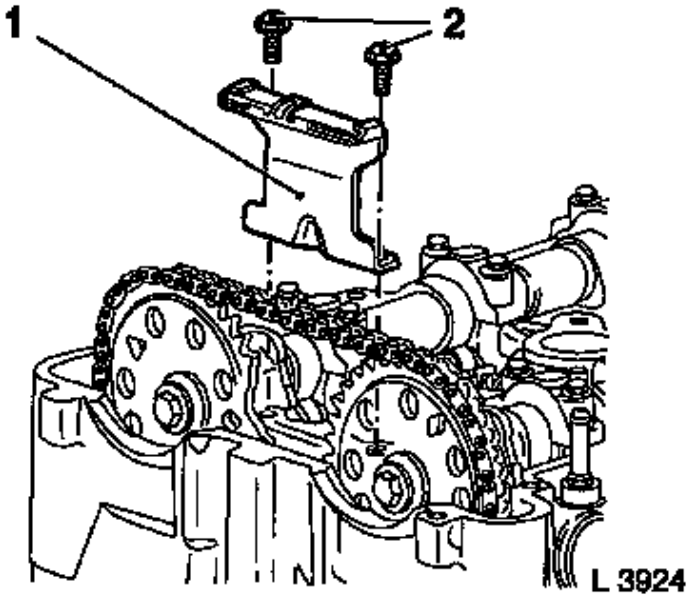
46. Detach the wiring harness connector from the exhaust gas recirculation valve.
- Release and detach the wiring harness connector.
- Reposition the wiring harness to one side.



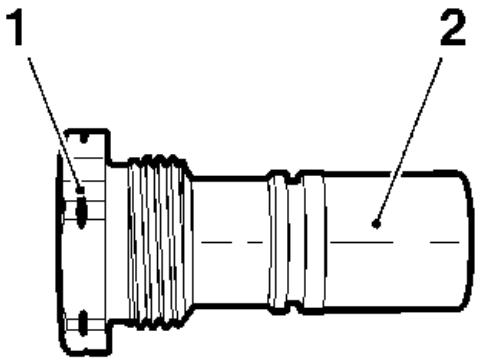
47. Undo the bolts on the intake manifold (1).
- 5 bolts, 2 nuts, 2 studs
- Lift out the intake manifold.



48. Remove the guide rail (1).
- 2 bolts (2)

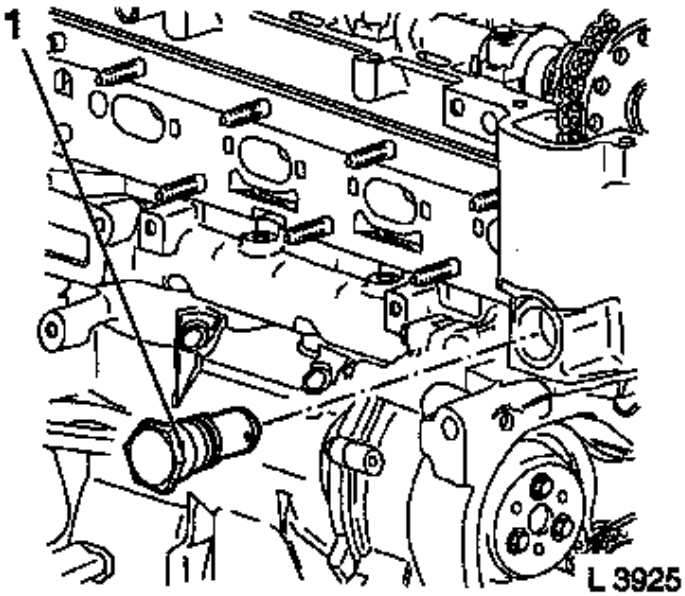


49. Note:
If there is no marking (1) on the camshaft timing chain tensioner (2), then it should be replaced with a new camshaft timing chain tensioner (part number 24 448 509) including a new camshaft timing chain tensioner rail (part number 24 449 448).



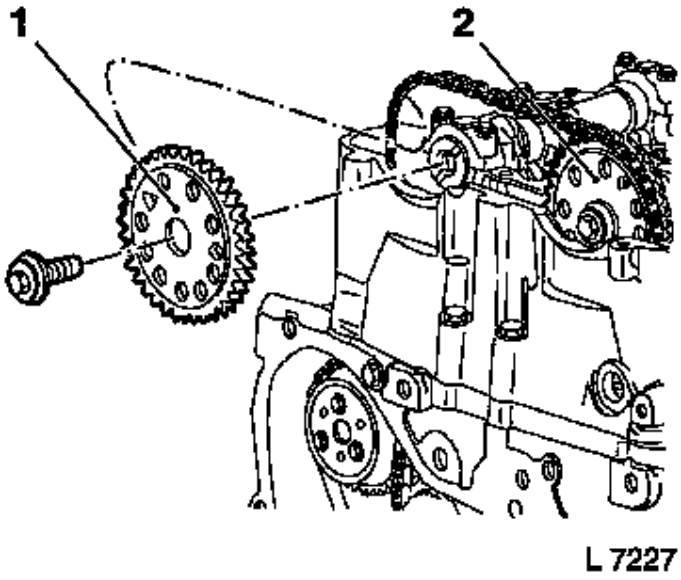
L0008542

50. Remove the camshaft timing chain tensioner (1).



51. Remove the exhaust camshaft sprocket (1).
- Hold the exhaust camshaft by the hexagon.

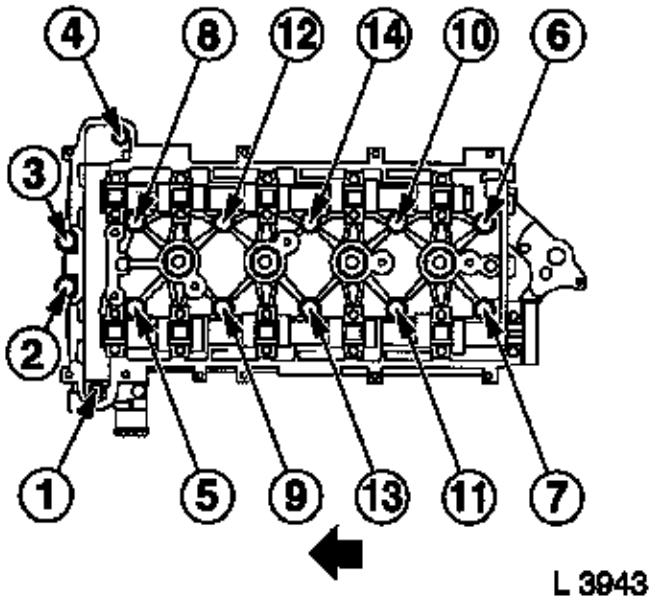
52. Remove the intake camshaft sprocket (2).
- Hold the exhaust camshaft by the hexagon.



53. Detach the cylinder head.

Important: The cylinder head must only be removed when the engine is cold (i.e. at room temperature).
- 4 Torx bolts and 10 hexagon bolts

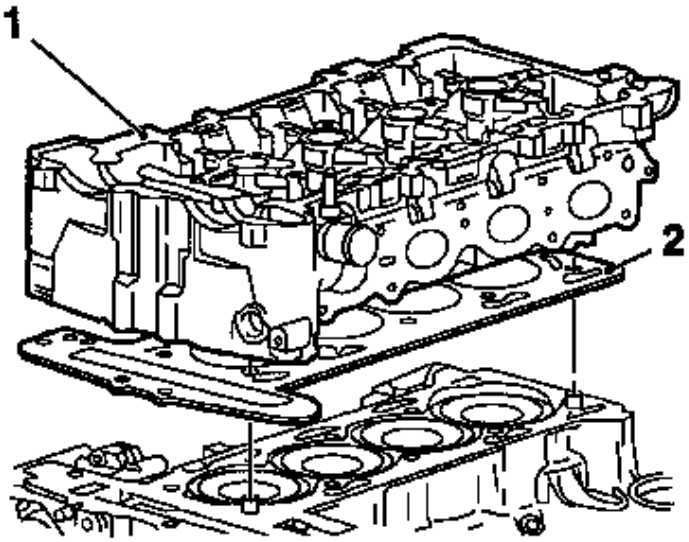
Note: Undo the bolts in the order shown.
  - Undo the bolts (**90°**)
  - Undo the bolts (**180°**)



L 3943

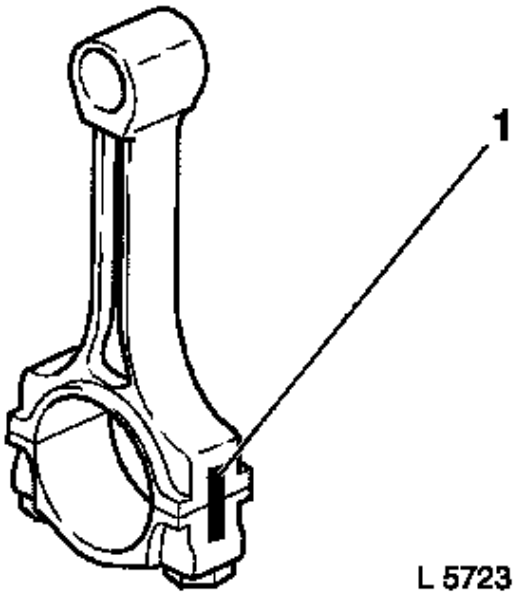
54. Remove the cylinder head (1).
Note: 2 technicians required
- Place the cylinder head on wooden blocks.
- Take off the cylinder head gasket (2).

55. Raise the lifting ramp.



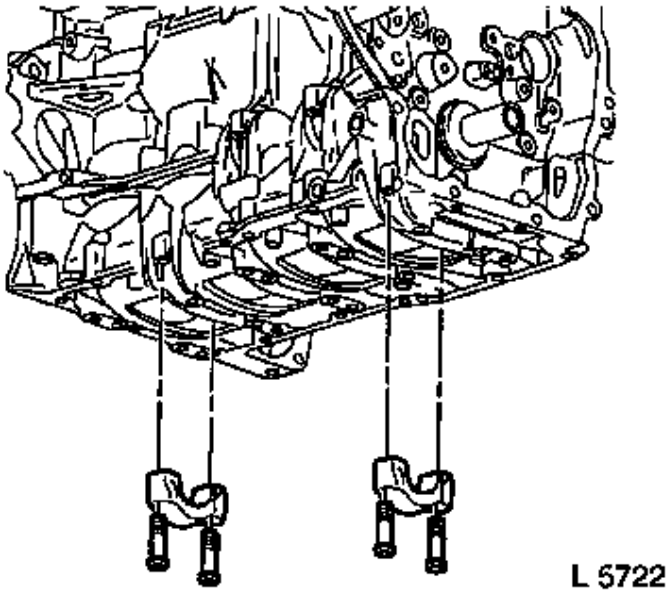
L 3944

56. Unscrew the bolts on pistons 1 and 4.
- Attach the rotational vibration damper to the crankshaft, and rotate the crankshaft in the normal direction of rotation until pistons 1 and 4 are at BDC.
- Mark the connecting rod and big–end bearing cap (1).
Note: Note the cylinder sequence.



57. Detach the big–end bearing caps.

- 2 off
- 4 bolts



Important: The broken surfaces of the connecting rods and the big–end bearing caps form a unique fit and must not be swapped or damaged. Do not put the parts down on the broken surfaces.

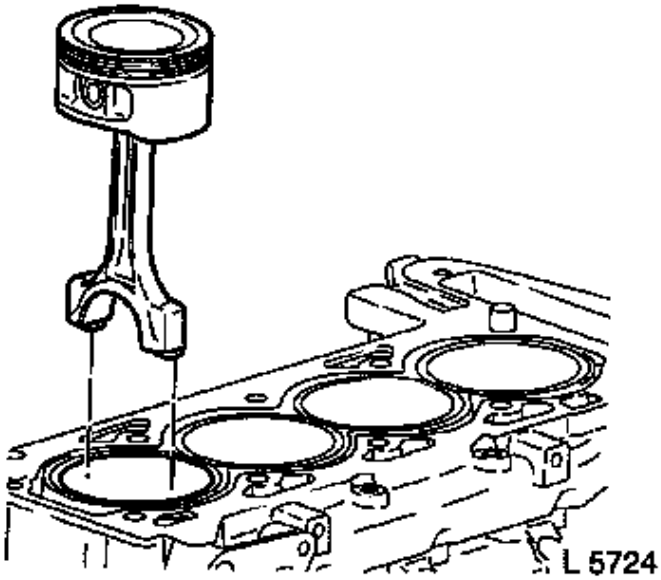
58. Press out the piston and connecting rod from the cylinder bore.

59. Lower the lifting ramp.

60. Remove pistons 1 and 4.

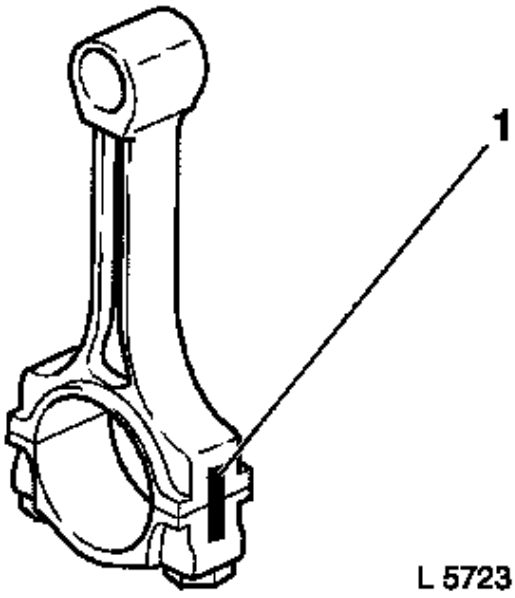
- Take out the pistons and connecting rods.

61. Raise the lifting ramp.



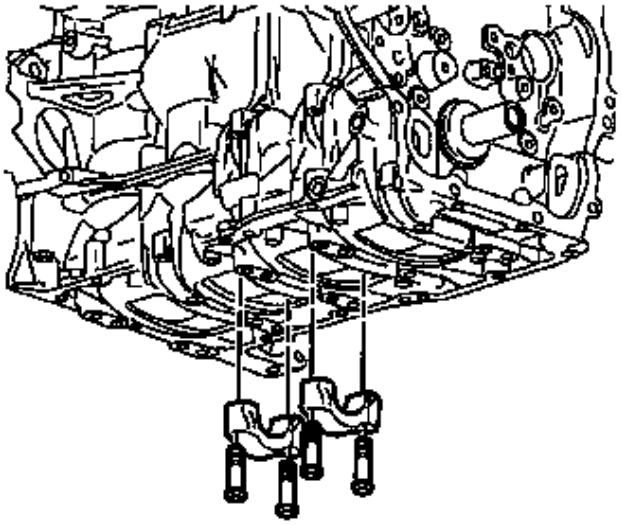
62. Unscrew the bolts on pistons 2 and 3.

- Rotate the crankshaft via the rotational vibration damper **180°** in the normal direction of rotation.
- Mark the connecting rod and big–end bearing cap (1).
  Note: Note the cylinder sequence.



63. Detach the big–end bearing caps.

- 2 off
- 4 bolts



L 5726

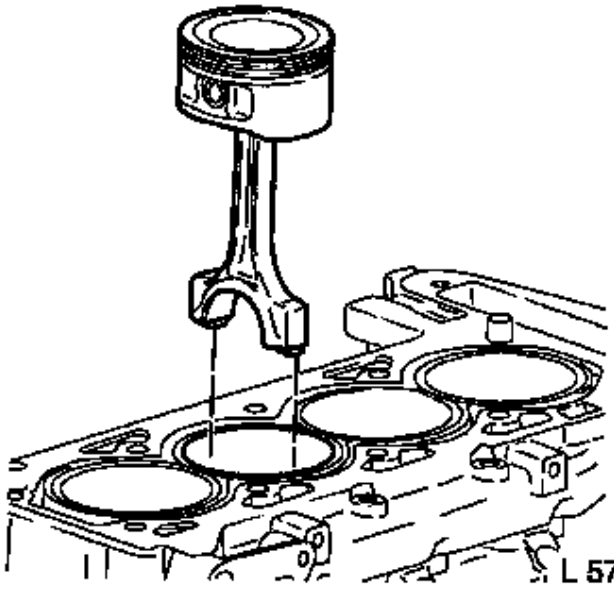
Important: The broken surfaces of the connecting rods and the big–end bearing caps form a unique fit and must not be swapped or damaged. Do not put the parts down on the broken surfaces.

64. Press out the piston and connecting rod from the cylinder bore.

65. Lower the lifting ramp.

66. Remove pistons 2 and 3.

- Take out the pistons and connecting rods.
  Note: Clean and visually inspect all components.

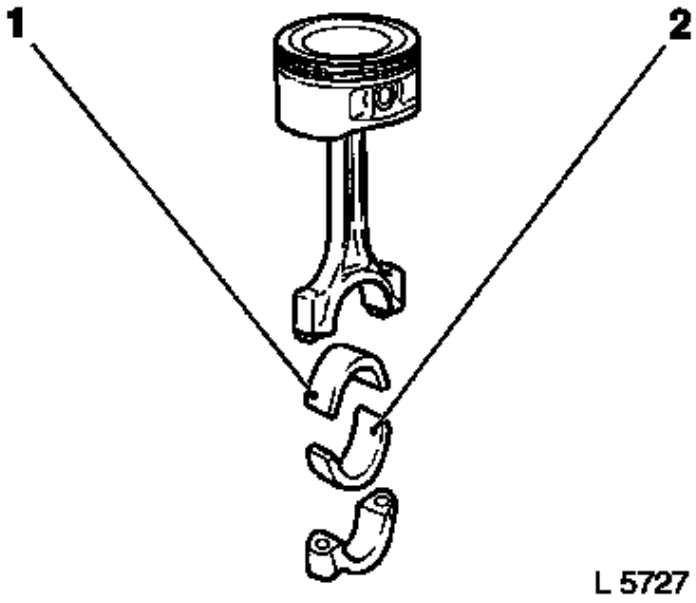


L 5725

Measure

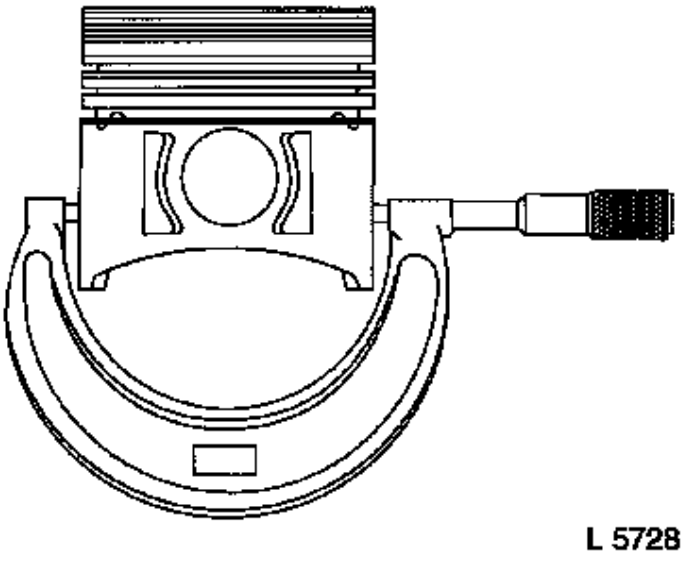
67. Take out the big–end bearing shells (1) and (2).
Note: Note the installation position and allocation.

- Visually inspect the components.



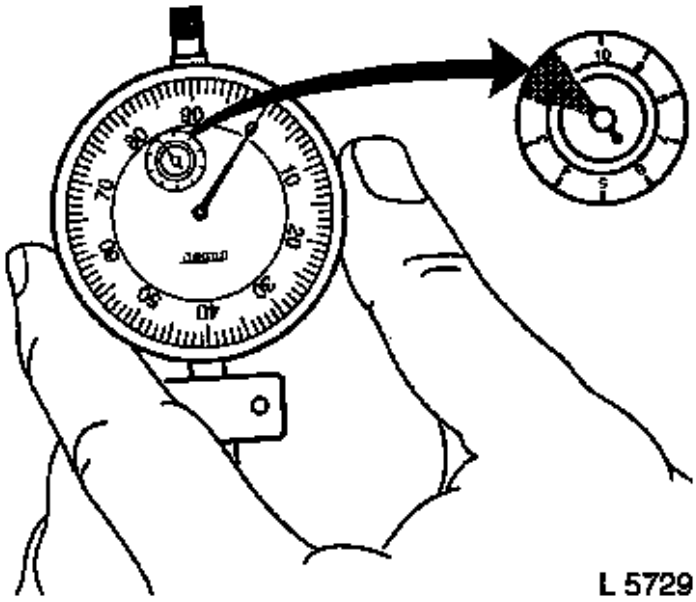
68. Measure the pistons.

- Determine the piston diameter with a micrometer.
  - Position the micrometer **90°** offset to the piston pin axis and 14.5 mm from the lower edge.
  - 4 off

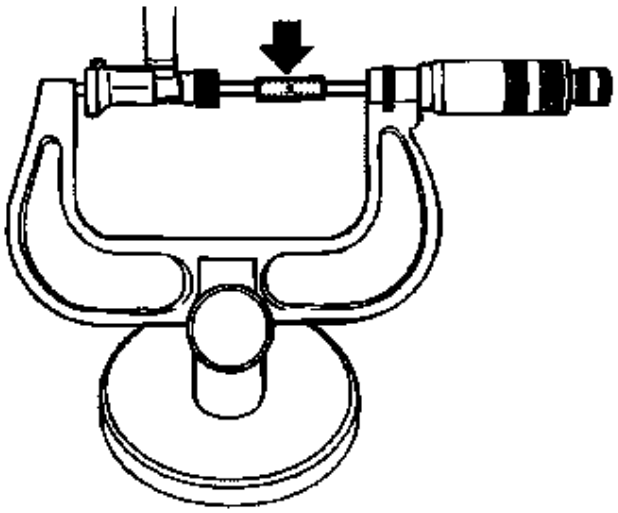


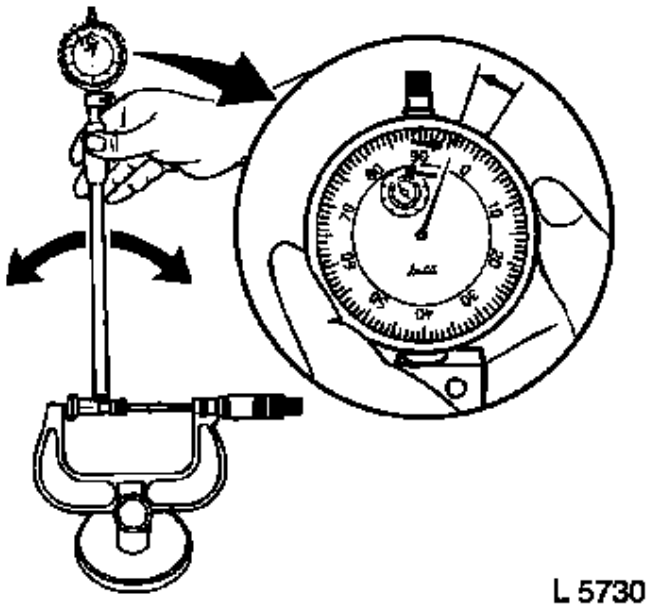
69. Set up the inside micrometer.

- Assemble the inside micrometer so that its span is greater than the size of the piston.
- Attach the dial gauge to the inside micrometer.
- Adjust the inside micrometer to the size of the piston.



70. Determine the turning point, zero the scale.
Note: The turning point of the pointer corresponds to the actual piston size.

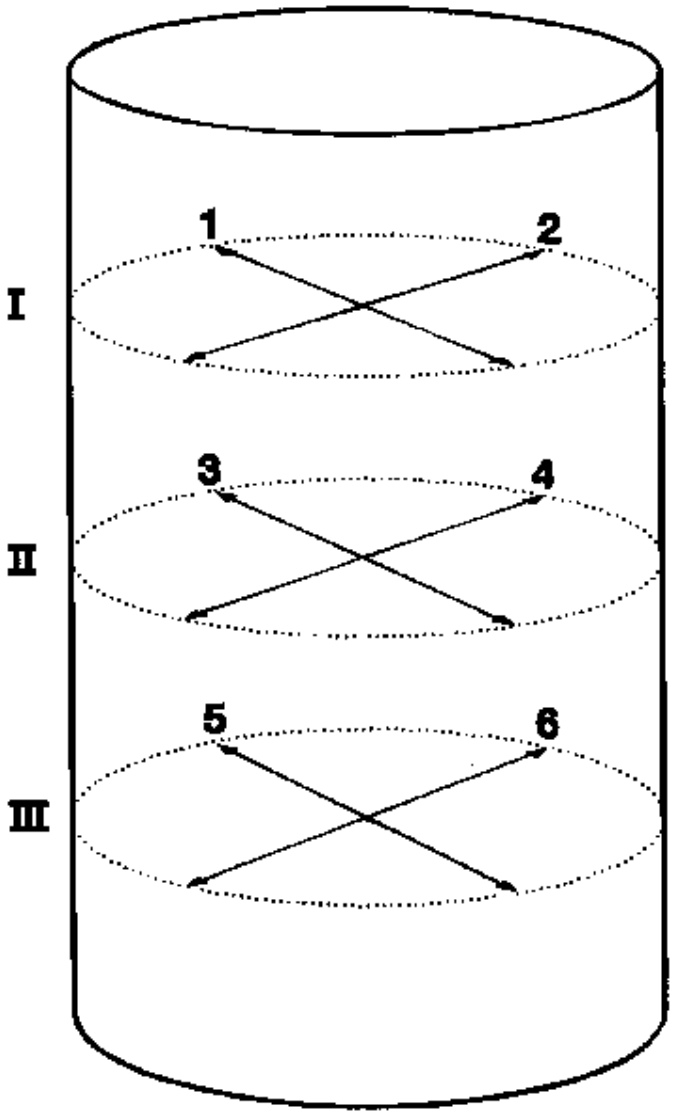




L 5730

71. Measure the cylinder bores.

- Insert the inside micrometer into the cylinder bores.
- Measure at three levels (I, II and III), working diagonally in each case (1 to 6).



L 5731

72. Tip back and forth to determine the turning point of the pointer.

- The difference between "zero" on the scale and the turning point of the pointer is the obtained running clearance.
- Make a note of the obtained values.

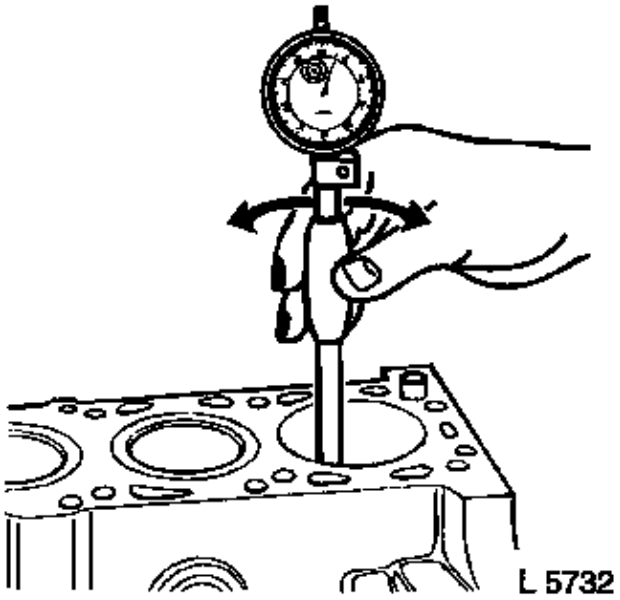
73. Comparison between specified values and actual values

- Use the largest value from measurements 1 to 6 as the basis for the wear calculation.
- Piston size + largest running clearance = cylinder diameter at the measuring

point

- Largest value of a measuring plane – smallest value of a measuring plane = ovalness of the cylinder in this measuring plane

74. Dismantle the inside micrometer.



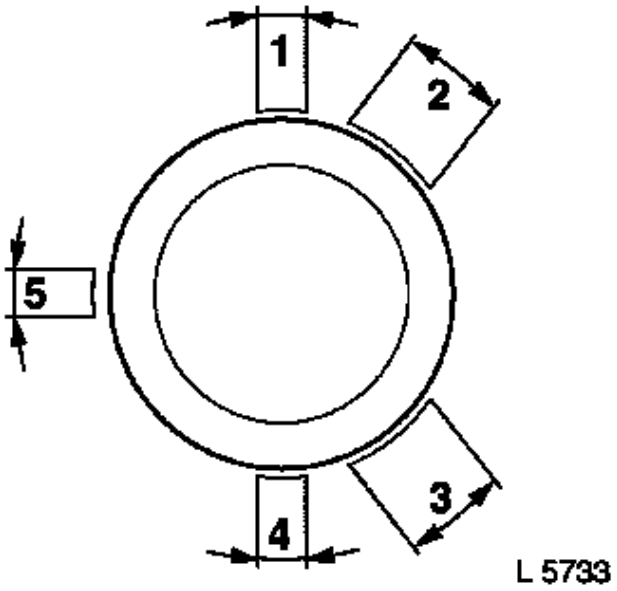
Install

75. Insert the big–end bearing shells.

- Into the connecting rods and the big–end bearing caps
  - Coat the big–end bearing shells with engine oil.

76. Adjust the piston ring gaps on piston 2.

- First piston ring (rectangular–section ring) in position (1)
  - Second piston ring (Napier ring) in position (4)
  - Intermediate ring of the oil scraper ring in position (5), steel band rings of the oil scraper ring in position (2) or (3)



77. Install piston 2.

- Coat the piston and the cylinder bore with engine oil.
- Compress the piston rings with a piston ring compressor.

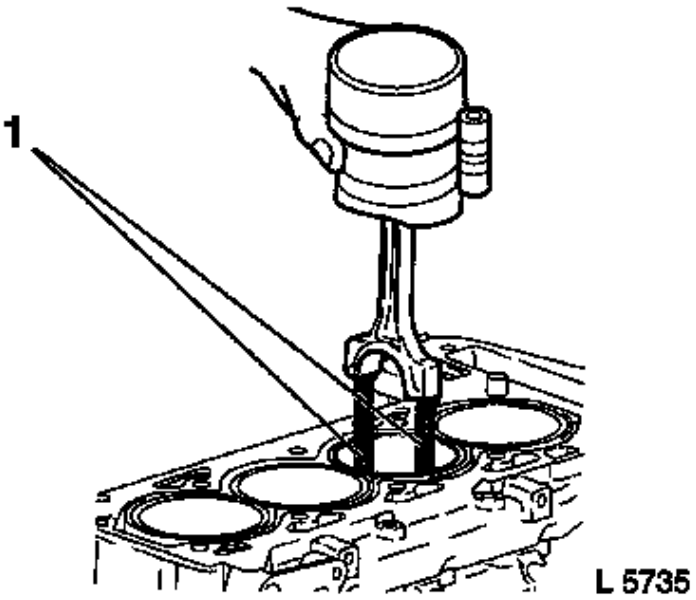
Important: The arrow on the piston crown points towards the timing chain end of the engine.

- Attach **KM-J-41742** (1) to the connecting rod and slide in the piston.

78. Raise the lifting ramp.

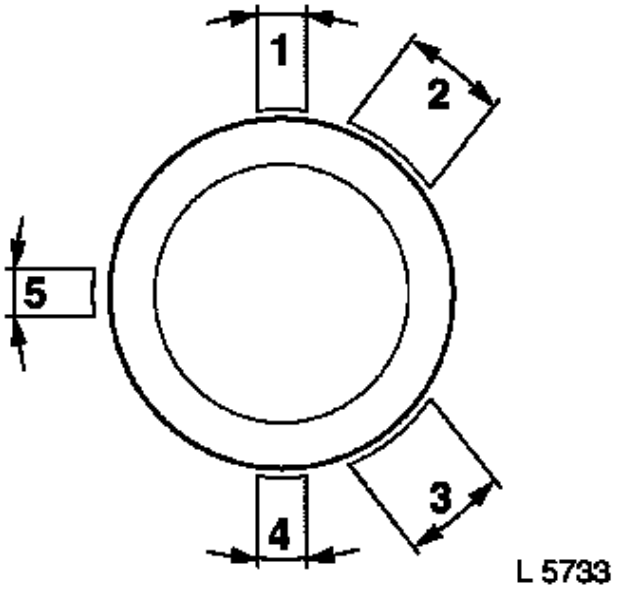
79. Detach **KM-J-41742**.

80. Lower the lifting ramp.



81. Adjust the piston ring gaps on piston 3.

- First piston ring (rectangular–section ring) in position (1)
  - Second piston ring (Napier ring) in position (4)
  - Intermediate ring of the oil scraper ring in position (5), steel band rings of the oil scraper ring in position (2) or (3)



82. Install piston 3.

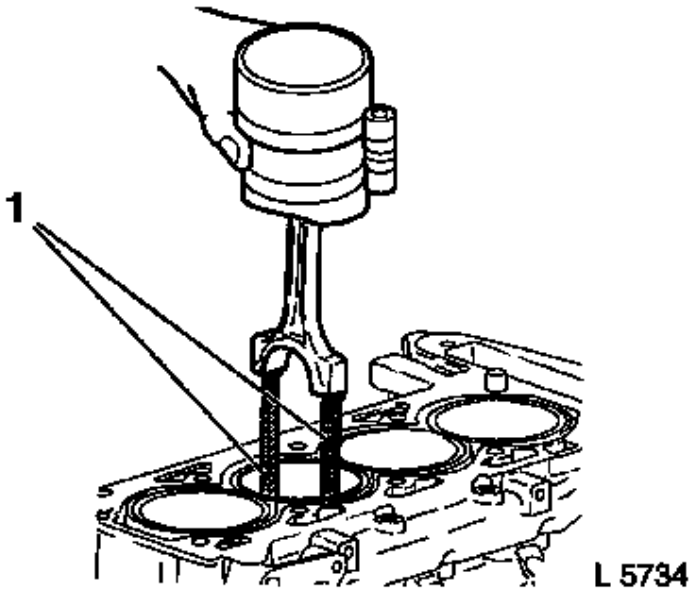
- Coat the piston and the cylinder bore with engine oil.
- Compress the piston rings with a piston ring compressor.

Important: The arrow on the piston crown points towards the timing chain end of the engine.

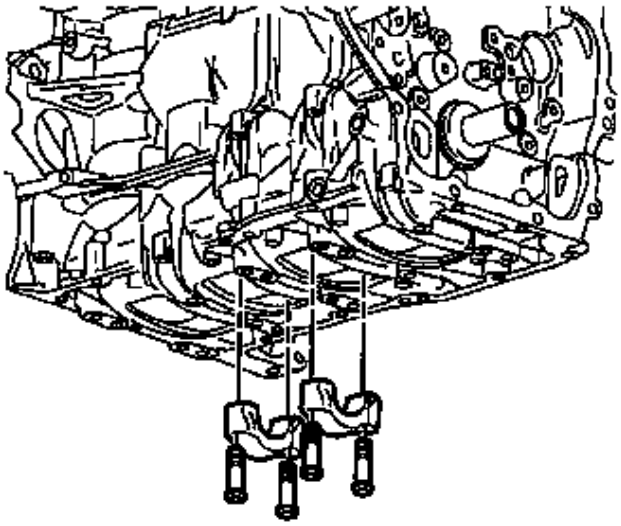
- Attach **KM-J-41742** (1) to the connecting rod and slide in the piston.

83. Raise the lifting ramp.

84. Detach **KM-J-41742**.



85. Install big–end bearing caps 2 and 3.

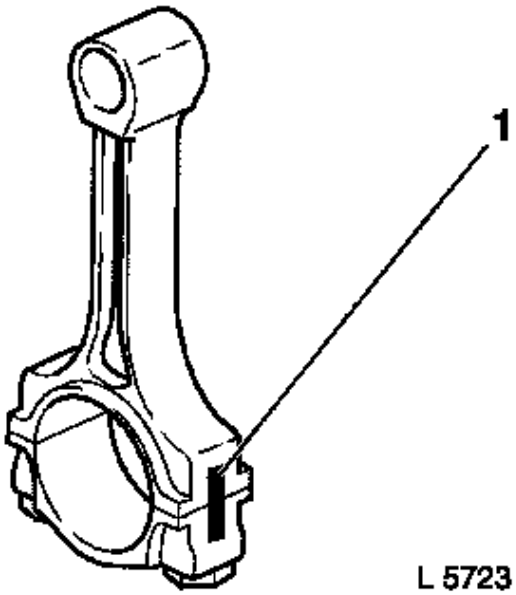


86. Coat the big–end bearing journals with engine oil.

Important: Note the applied markings (1).

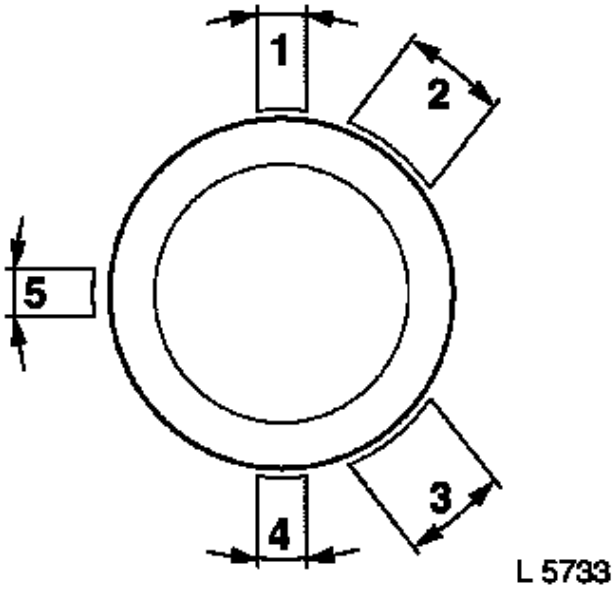
- Renew the bolts.
- Tightening torque **25 Nm + 50° + 50° + 10°**
- Rotate the crankshaft via the rotational vibration damper **180°** in the normal direction of rotation.

87. Lower the lifting ramp.



88. Adjust the piston ring gaps on piston 1.

- First piston ring (rectangular–section ring) in position (1)
  - Second piston ring (Napier ring) in position (4)
  - Intermediate ring of the oil scraper ring in position (5), steel band rings of the oil scraper ring in position (2) or (3)



89. Install piston 1.

- Coat the piston and the cylinder bore with engine oil.
- Compress the piston rings with a piston ring compressor.

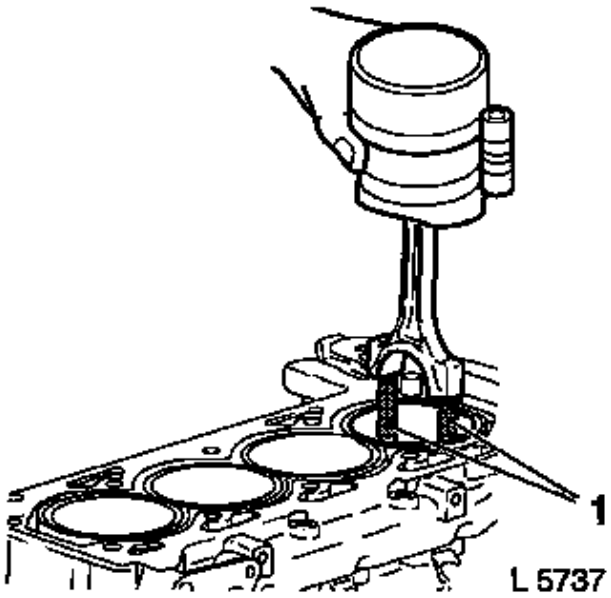
Important: The arrow on the piston crown points towards the timing chain end of the engine.

- Attach **KM-J-41742** (1) to the connecting rod and slide in the piston.

90. Raise the lifting ramp.

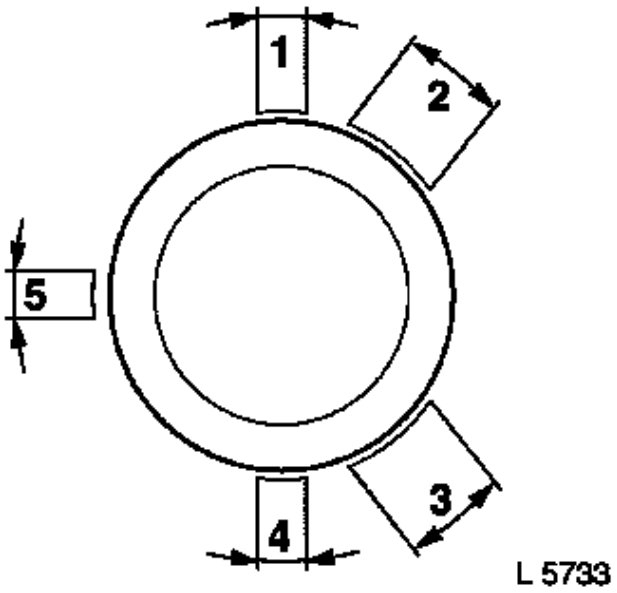
91. Detach **KM-J-41742**.

92. Lower the lifting ramp.



93. Adjust the piston ring gaps on piston 4.

- First piston ring (rectangular–section ring) in position (1)
  - Second piston ring (Napier ring) in position (4)
  - Intermediate ring of the oil scraper ring in position (5), steel band rings of the oil scraper ring in position (2) or (3)



94. Install piston 4.

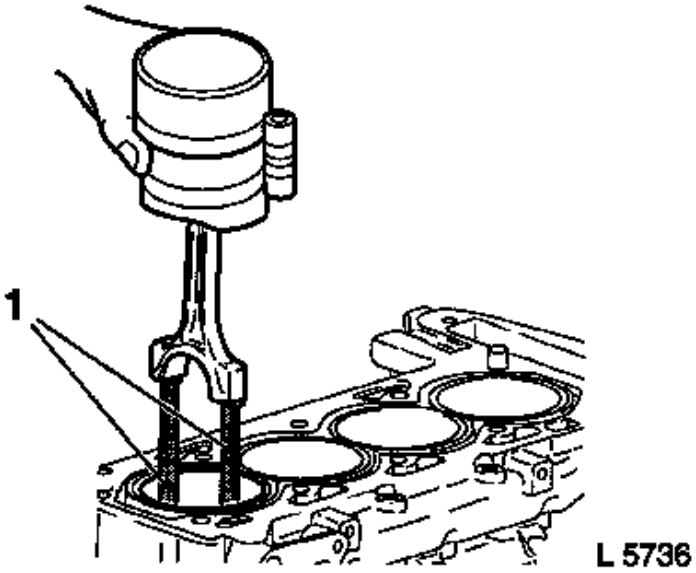
- Coat the piston and the cylinder bore with engine oil.
- Compress the piston rings with a piston ring compressor.

Important: The arrow on the piston crown points towards the timing chain end of the engine.

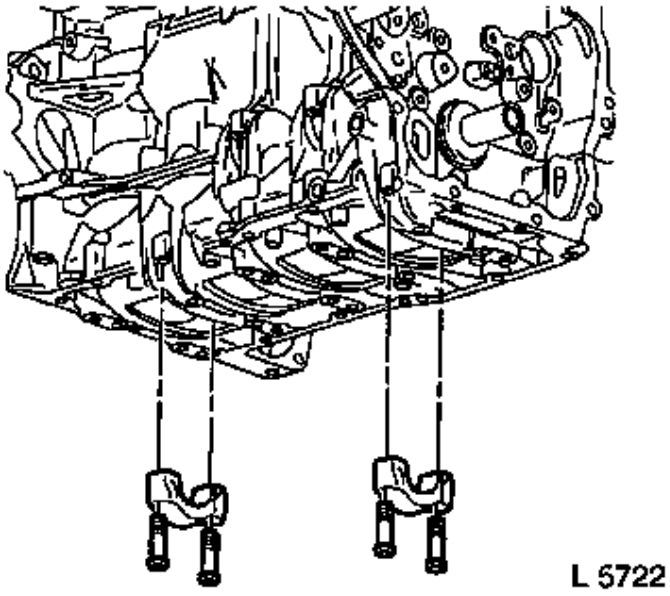
- Attach **KM-J-41742** (1) to the connecting rod and slide in the piston.

95. Raise the lifting ramp.

96. Detach **KM-J-41742**.



97. Install big–end bearing caps 1 and 4.



98. Coat the big–end bearing journals with engine oil.

Important: Note the applied markings (1).

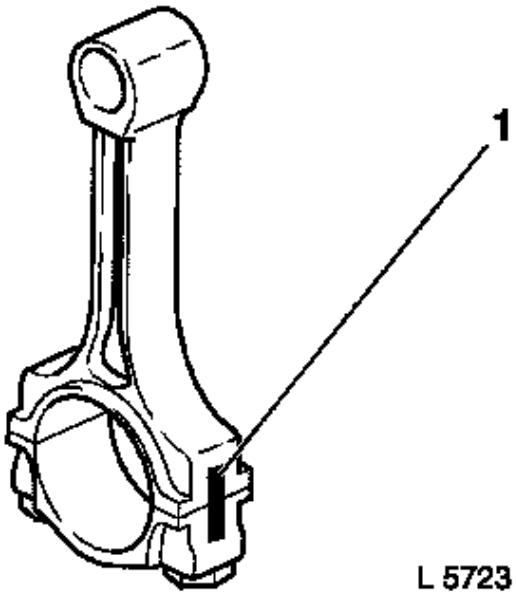
- Renew the bolts.
- Tightening torque **25 Nm + 50° + 50° + 10°**

99. Clean the sealing surfaces.

- Cylinder block base plate, oil pan

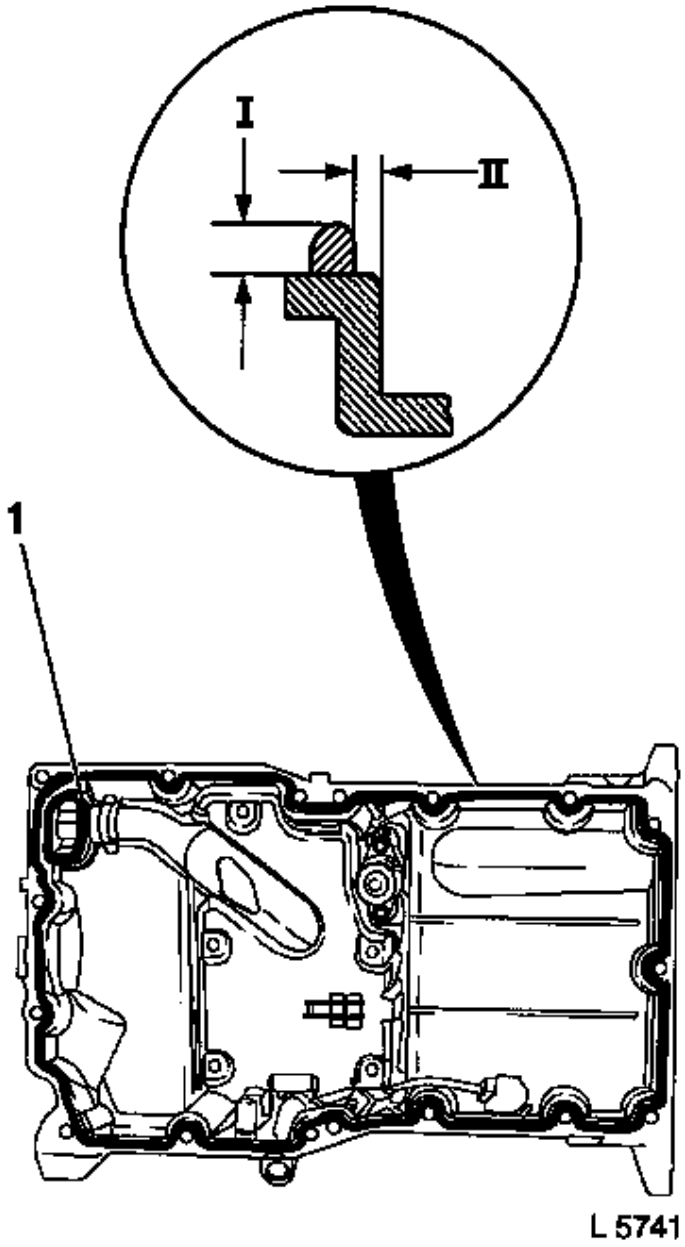
100. Recut the thread.

- 15 off

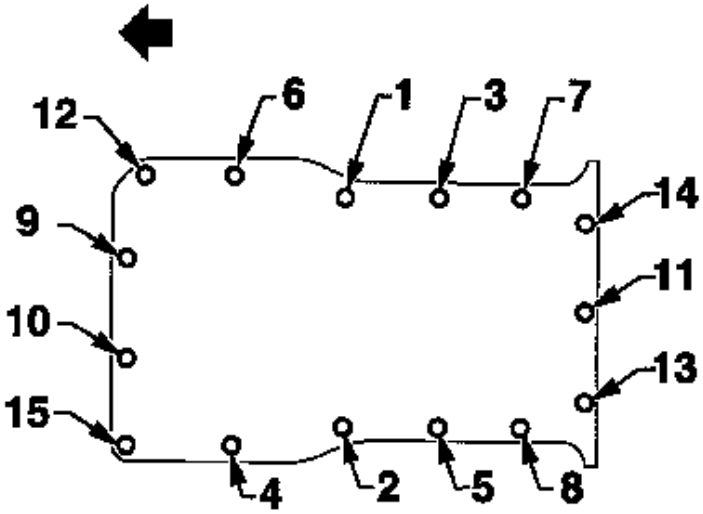


101. Install the oil pan.

- Apply a bead of silicone sealant (grey) (approx. **2 mm**to **2.5 mm** (dimension I) thick) at a spacing of **0.5 mm** to **1.5 mm** (dimension II) from the inner edge of the sealing surface to the sealing surfaces of the oil pan.
- Apply an additional bead of silicone sealant (grey) (approx. **2 mm** to **2.5 mm** (dimension I) thick) centrally to the oil intake pipe connection (1).



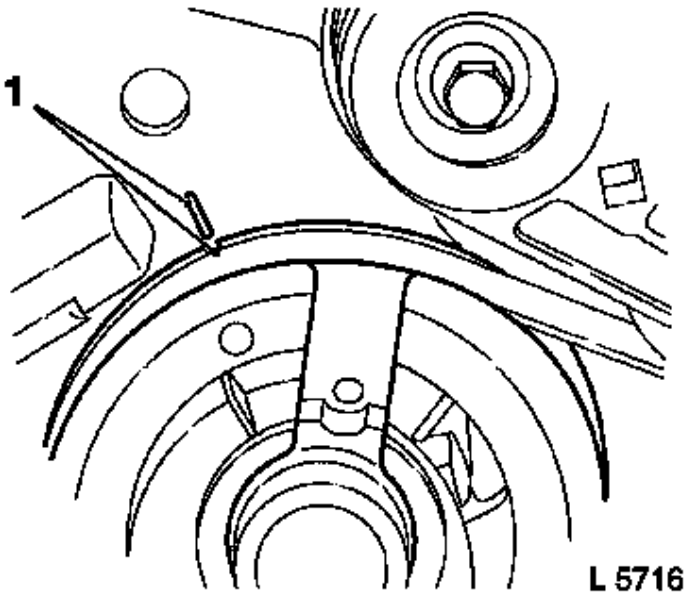
102. Tighten all bolts loosely.
Note: Observe the tightening sequence.
- To the cylinder block base plate – tightening torque **23 Nm**
- To the transmission housing – tightening torque **23 Nm**



L 5742

103. Rotate the crankshaft in the normal direction of rotation to TDC on cylinder no. 4 (marking 1).

104. Lower the lifting ramp.



L 5716

105. Install new intake manifold gaskets (1) and (2).

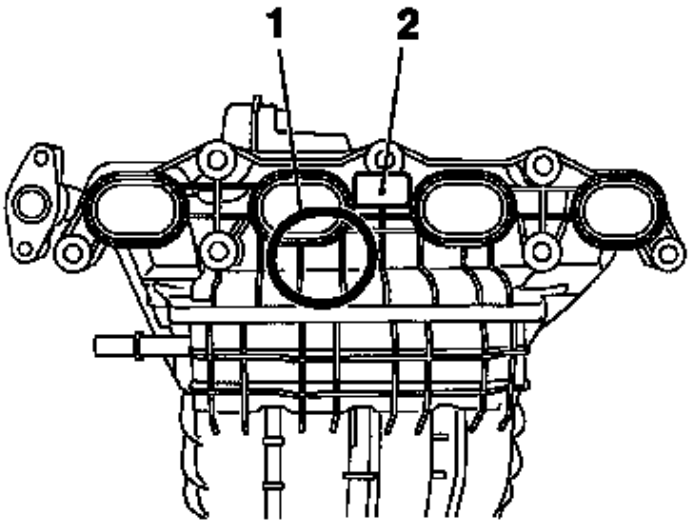
- 5 off

106. Recut the M8 thread.

- 4 bolts, 4 bores

107. Clean the sealing surfaces and bores.

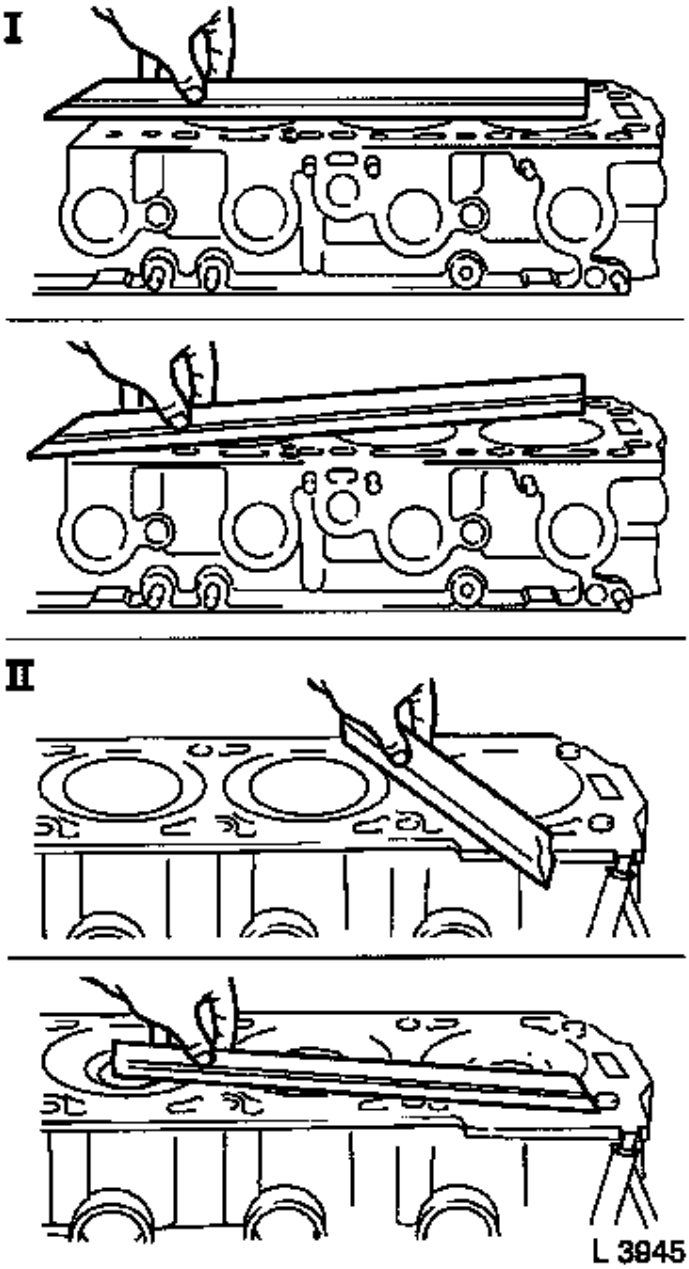
- Cylinder block, cylinder head, front exhaust pipe.



L 5738

108. Check for plane surface.

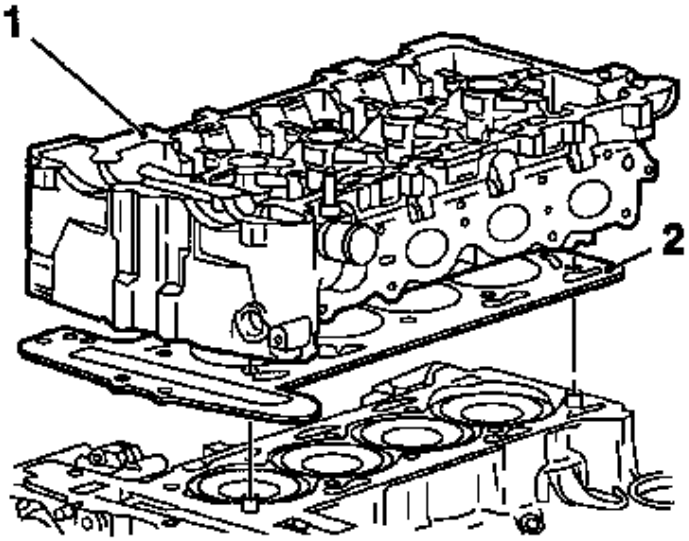
- Cylinder block (II), cylinder head (I)
- Use a straightedge, feeler gauges



109. Place the cylinder head (1) in place.
Note: 2 technicians required

- Fit a new cylinder head gasket (2).
  Note: The OBEN / TOP mark must face upwards.

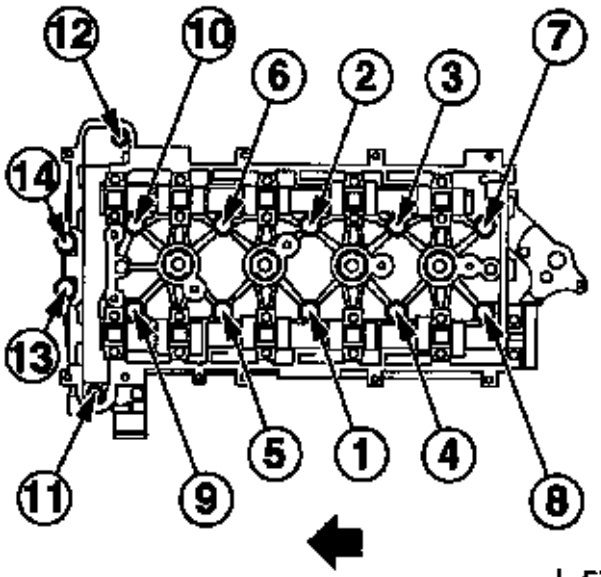
  When placing the cylinder head on the upper part of the cylinder block, guide the camshaft timing chain up through the timing case, e.g. with a bent piece of electrode wire (to be fabricated by the technician).



L 3944

110. Attach the cylinder head.

- Use new cylinder head bolts (hexagon bolts).
  Note: Observe the tightening sequence.
  – Tightening torque (M10) **30 Nm + 75° + 75° + 15°**
- Coat the M8 bolts with thread locking compound (red) and insert them.
  – Tightening torque **35 Nm**



L 5739

111. Install the intake camshaft sprocket.

- Use a new bolt.
- Tighten finger tight.

112. Attach **KM-6148** to the cylinder head.

113. Secure the intake camshaft sprocket.

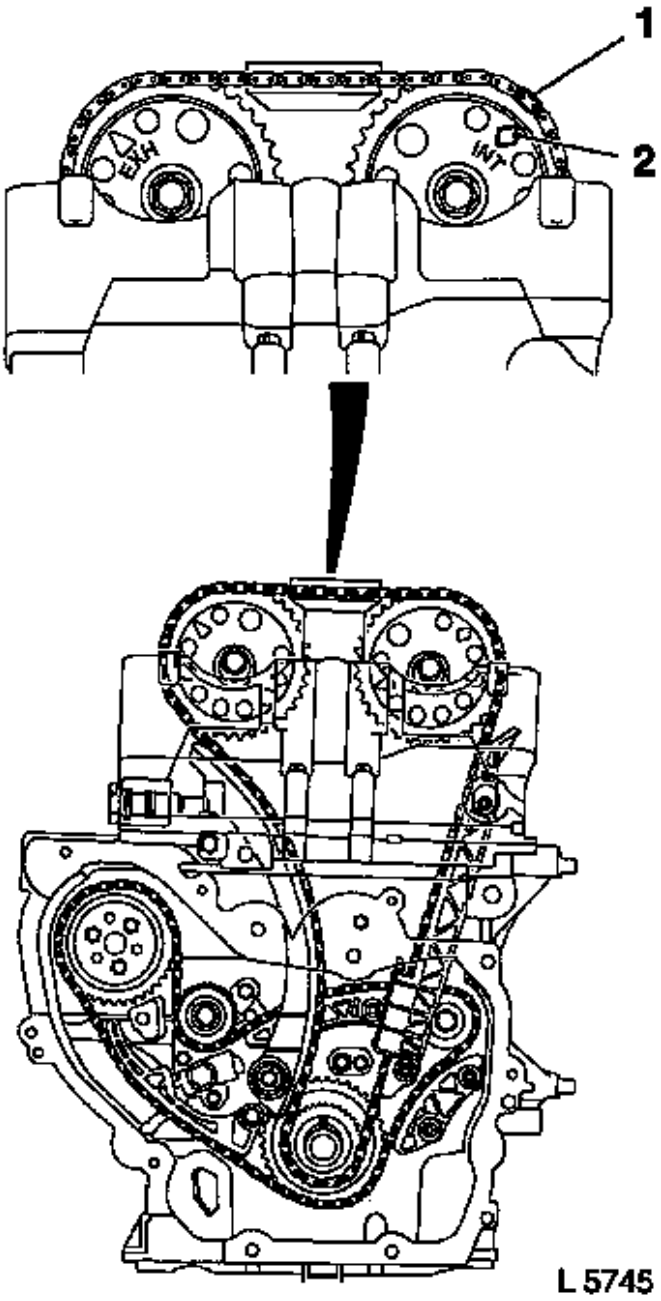
- Use the positioning bolt from **KM-6148** to secure it.

114. Fit the camshaft timing chain.

- Feed the camshaft timing chain by hand through the timing case.
  Note: The TDC reference points on

the timing chain are indicated by coloured links in the chain. These must line up with the markings on the chain links.

- Chain link (copper colour) (1) to INT marking (2) on the intake camshaft sprocket



115. Install the exhaust camshaft sprocket.

Important: Check that the TDC reference points line up.

- Chain link (1) to EXH marking (2) on the exhaust camshaft sprocket
- Pull back the positioning bolt from **KM-6148**.
- Rotate the exhaust camshaft by the hexagon until the exhaust camshaft sprocket is seated in the guide.
- Use a new bolt.

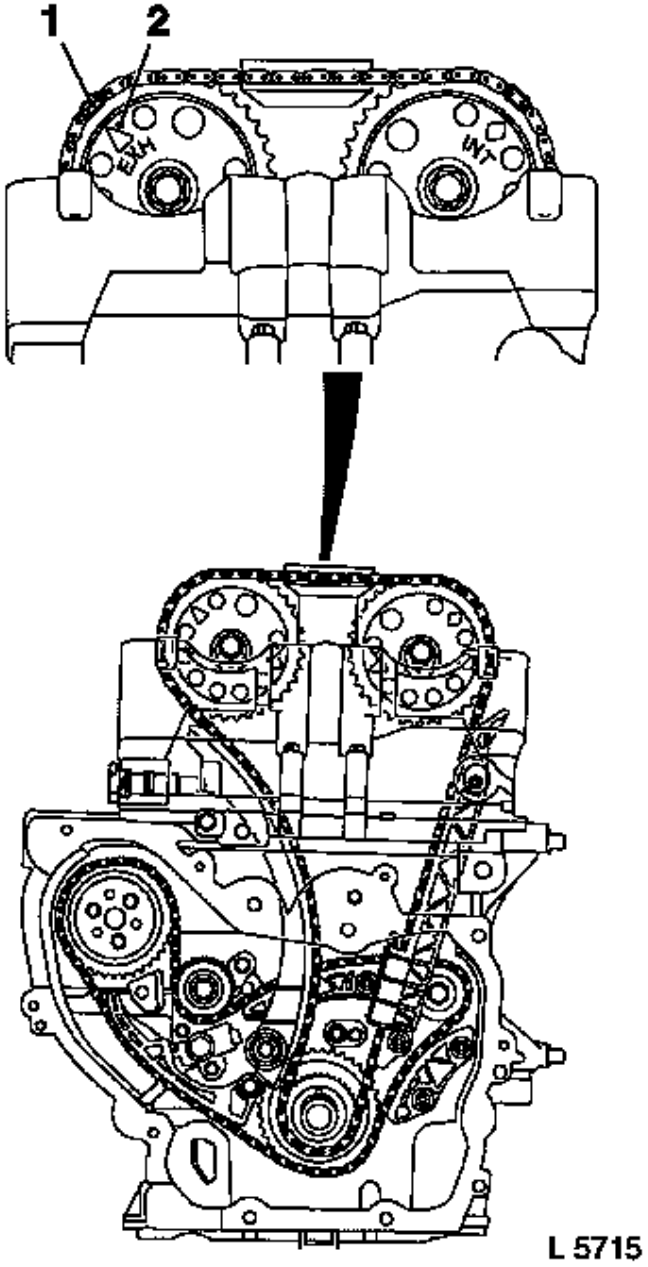
116. Detach **KM-6148**.

117. Tighten the camshaft sprockets.

- Hold the camshaft by the hexagon.
- Tightening torque **85 Nm + 30° + 15°**

118. Recut the thread.
- 2 off

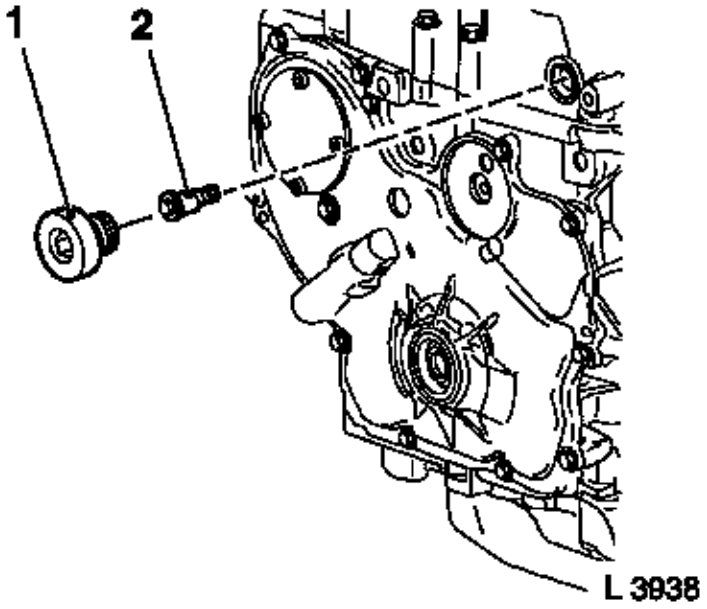
119. Install the guide rail.
- Coat the bolts with thread locking compound (red) and insert them.
  - Tightening torque **8 Nm**



120. Raise the vehicle.

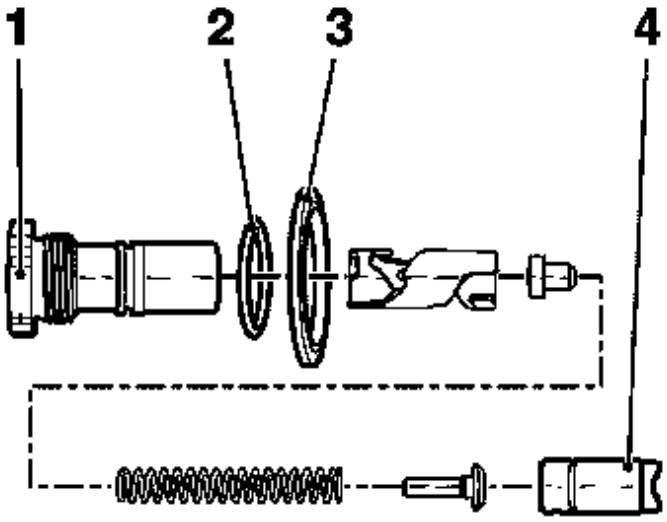
121. Attach the camshaft timing chain guide rail.
- 1 bolt (2)
  - Tightening torque **10 Nm**
- Install the screw plug (1).
  - Tightening torque **65 Nm**

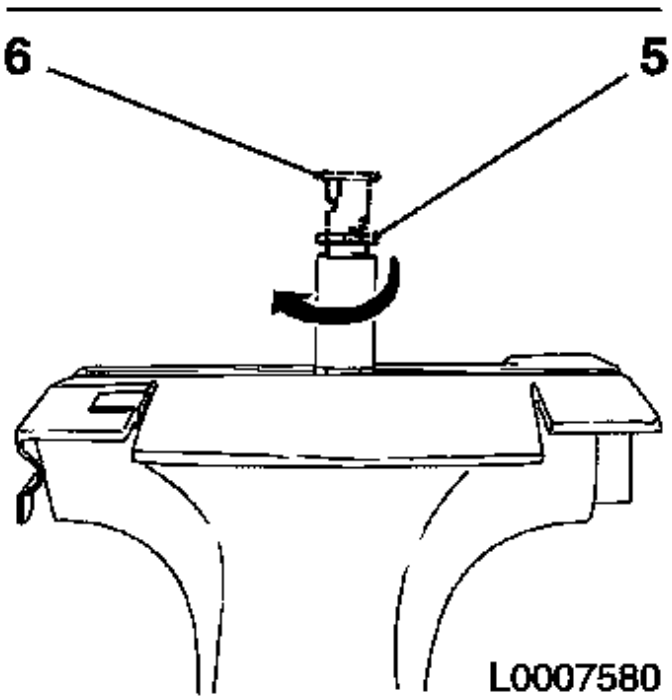
122. Lower the vehicle.



123. Install the camshaft timing chain tensioner.

- Pull out the piston (4) from the housing (1).
  - Clamp the piston at the square into a vice.
  - Turn clockwise to lock the internal piston (6) in the last latch position (5).
  - Insert the piston into the housing.
- Use new oil seals (2) and (3).
- Tightening torque **75 Nm**

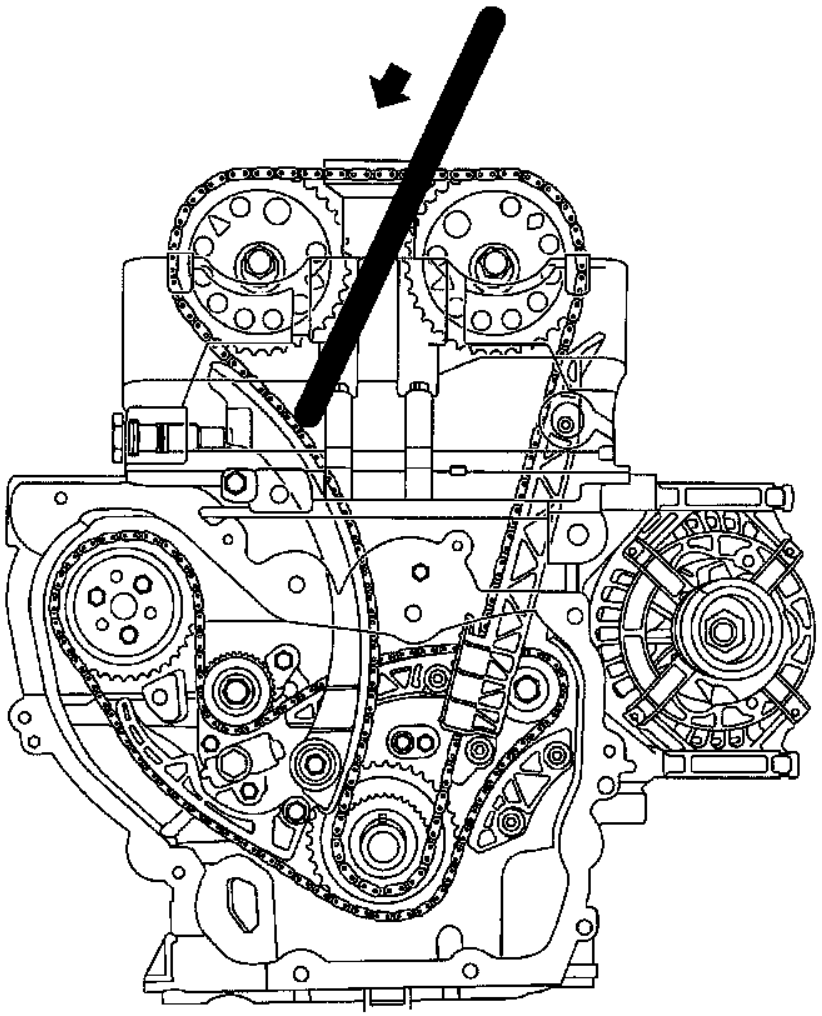




124. Important:
Failure to follow this instruction could cause the camshaft timing chain to jump.

125.
Release the camshaft timing chain tensioner by pressing on the tensioner rail or the camshaft timing chain (using a blunt tool – e.g. a rounded assembly lever).
Note: If the TDC

markings no longer line up with the coloured chain links, refit the camshaft timing chain. Once the crankshaft has been rotated another turn they will no longer line up.



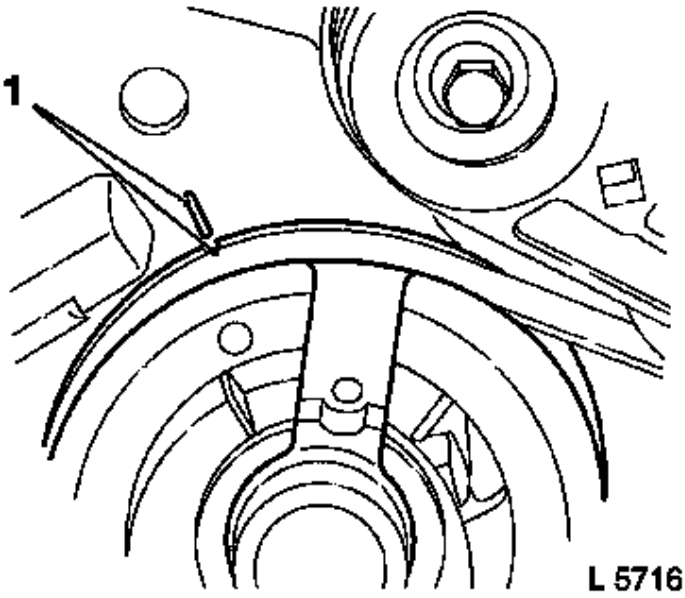
J 0935

126. Raise the lifting ramp.

127. Rotate the crankshaft**720** °.

- Rotate the crankshaft in the normal direction of rotation to TDC on cylinder no. 4 (marking 1).
  Note: In this position the cams of cylinder no. 4 point upwards.

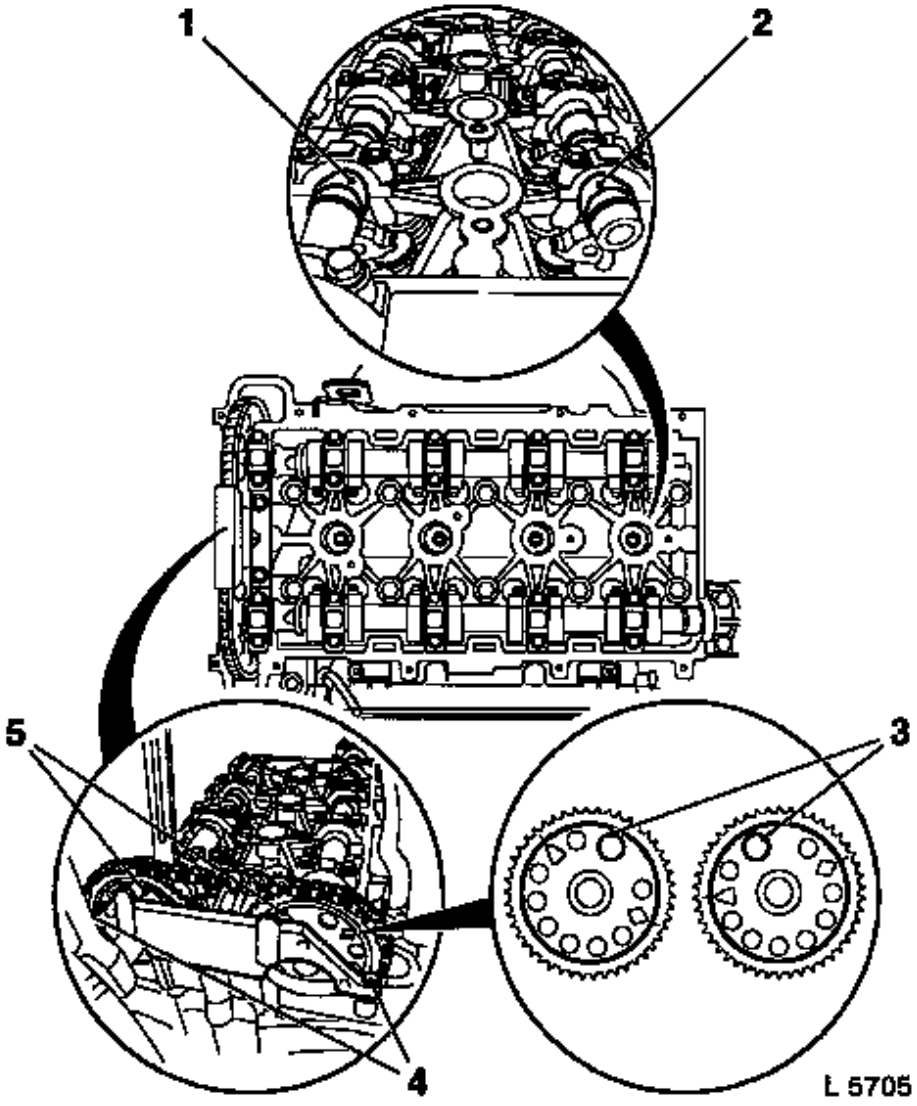
128. Lower the lifting ramp.



L 5716

129. Attach **KM-6148**.
Note: In this position the cams (1) and (2) of cylinder no. 4 point upwards.
- Attach **KM-6148** with the enclosed bolts (4).
- Slide the positioning bolts (5) into the designated bores (3) on the camshaft sprockets.

130. Detach **KM-6148**.



131. Attach the intake manifold.
- 5 bolts, 2 nuts, 2 studs
  - Tightening torque **9 Nm**

132. Route the tank breather valve wiring harness.
- 1 clip

133. Attach the exhaust gas recirculation pipe.
- Clean the sealing surfaces.
- Use a new gasket.
- Tightening torque **9 Nm**
- Attach the engine cover bracket.
  - Tightening torque **8 Nm**

134. Attach the tank breather line.

135. Attach the wiring harness.

136. Attach the wiring harness connector for the throttle body.
- Secure the wiring harness connector(s).

137. Attach the MAP sensor wiring harness connector.

138. Attach the injector wiring harness connector.
- Secure the 4 wiring harness connectors.

139. Connect the coolant hoses.
- 2 off

140. Clean the engine control unit.
- Clean the engine control unit and the plug contacts with compressed air.

141. Install the engine control unit.
- 2 bolts
  - Tightening torque **9 Nm**
- Attach and secure the wiring harness connector.
  Note: Check for proper seating and good electrical contact.
- Attach the bridge piece with a new shear bolt.
  - Route the ground cable.
- 1 bolt
  - Tightening torque **10 Nm**

142. Connect the tank breather valve line.
- To the intake manifold

143. Insert the oil dipstick guide tube.
- Use new oil seals.
  - Coat the oil seals with silicone grease (white).
- Insert the oil dipstick guide tube as far as the stop into the oil pan.
- Attach the knock sensor wiring harness connector.

144. Attach the oil dipstick guide tube.
- Tightening torque **9 Nm**

145. Insert the oil dipstick guide.
- Use new oil seals.
  - Coat the oil seals with silicone grease (white).
- Insert the oil dipstick guide tube as far as the stop into the oil pan.
- Attach the knock sensor wiring harness connector.

146. Attach the oil dipstick guide tube.
- Tightening torque **9 Nm**

147. Install the exhaust manifold.
- Use a new gasket.
- Use new nuts.
  - Tightening torque **12 Nm**
- Wait for 30 seconds.
  - Tightening torque **12 Nm**

148. Raise the lifting ramp.

149. Connect the tank breather valve wiring harness connector.

150. Attach the front exhaust pipe.
- Use a new gasket.
- Tightening torque **16 Nm**

151. Attach the cover for the exhaust system.
- 14 bolts

152. Attach the lower engine splash shield.
- 13 bolts

153. Connect the lambda probe wiring harness.

- Route the wiring harness.
- 5 clips, 1 retaining clip

154. Attach the wheel arch trim on the left and right–hand side.
- 12 bolts

155. Attach the rear wheels.

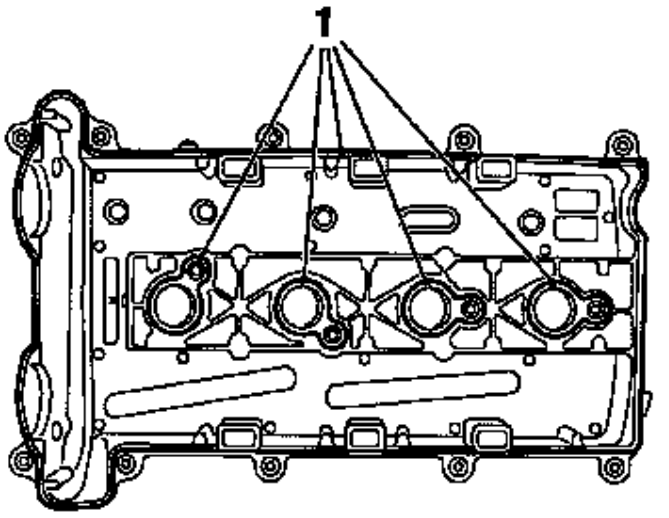
156. Lower the lifting ramp.

157. Tighten the rear wheels.
- Tightening torque **90 Nm**

158. Attach the upper heat shield.
- Attach the engine lifting eye.
  - 1 nut
- 3 studs
- Tightening torque **23 Nm**

159. Install the lower heat shield.
- Tightening torque **8 Nm**

160. Attach the cylinder head cover
- Clean the sealing surfaces.
- Use new gaskets.
  Note: The sealing lips of the seals (1) must be inserted into the groove on the cylinder head cover.
  - Tightening torque **9 Nm**
- Attach the ground cable
  - Tightening torque **9 Nm**
- Attach the engine lifting eyes.
  - 2 bolts, 1 nut
- Attach the engine breather hose.
- Attach the fuel line bracket.
  - Tightening torque **8 Nm**



L 5706

161. Attach the ignition module.
- Tightening torque **9 Nm**
- Attach and secure the wiring harness connector.

162. Connect the fuel lines.
- Insert the fuel lines into the clip.
- Tightening torque **10 Nm**

163. Fill up with engine oil and check the oil level.

164. Fill up with coolant and correct as required.

165. Install the rear engine cover.
- Check the alignment.
- 6 bolts, tightening torque **14 Nm**

166. Close the rear engine cover.

167. Connect the battery.

168. Close the bonnet.

169. Reprogram the volatile memories.