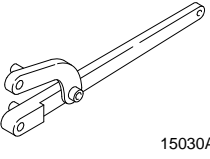
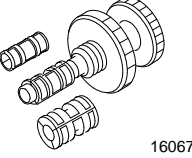
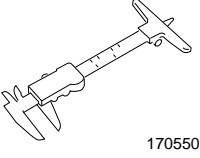
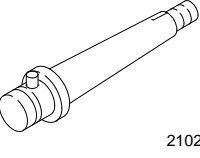
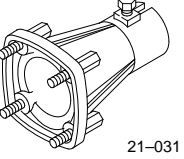
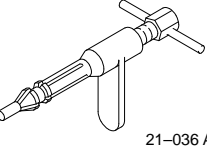
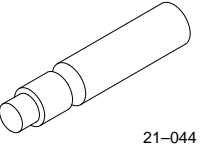
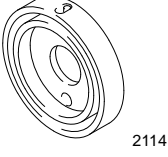
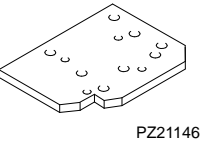
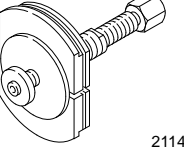
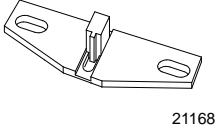
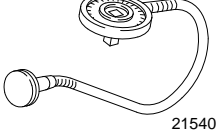


Engine – Dismantle and Assemble (engine removed) (21 134 8)

Special Tools

 15030A	15-030A Universal flange-holding wrench
 16067	16-067 Locator for clutch disc
 1705502	17-055-02 Depth gauge for reworking the cylinder head
 21023	21-023 Universal mounting spindle for assembly stand
 21-031 B	21-031B Mounting bracket
 21-036 A	21-036A Remover for pilot bearing
 21-044 A	21-044A Installer/locator for pilot bearing/clutch disc
 21141	21-141 Installer for radial oil seal
 PZ21146C	21-146C Mounting plate
 21147	21-147 Remover for vibration damper

 21168	21-168 Crankshaft immobilising tool
 21540	21-540 Angle gauge

Materials

Plastigage	Obtainable through: Replacement Services Limited, 30 Euston Street, Freemans Industrial Estate, Leicester, LE2 7ST.
Sealer for crankshaft front oil seal carrier (Loctite 518)	WSK-M2G348-A5
Sealer for sump (Hylosil 502)	WSK-M4G320-A
Sealer for oil pressure switch, coolant pump angle connector, coolant temperature sensor (Loctite 243)	WSK-M2G349-A7
Lubricant for O-ring of crankshaft position/speed sensor (CPS)	SM1C-115-A

Workshop Equipment

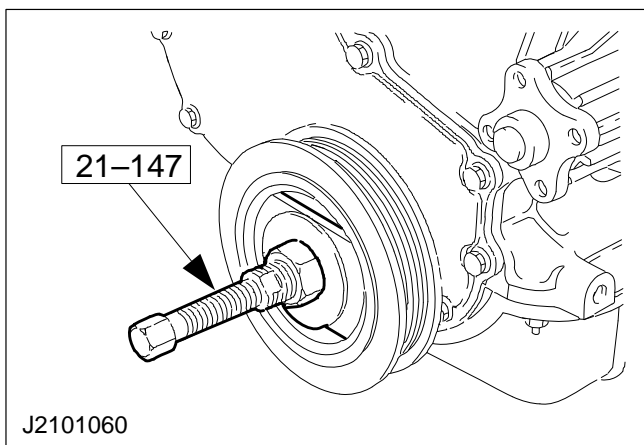
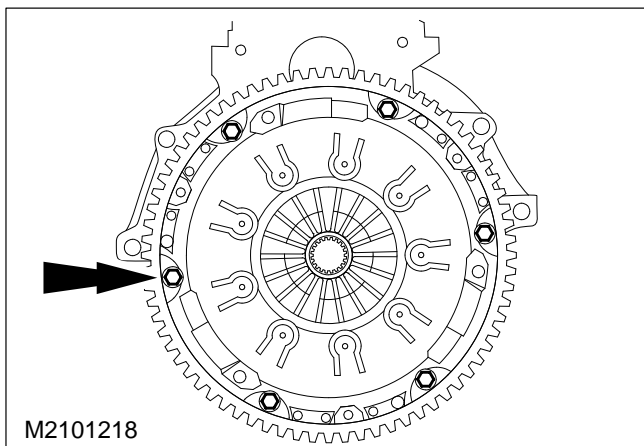
Mounting stand with geared drive	21-187
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Proprietary Tools

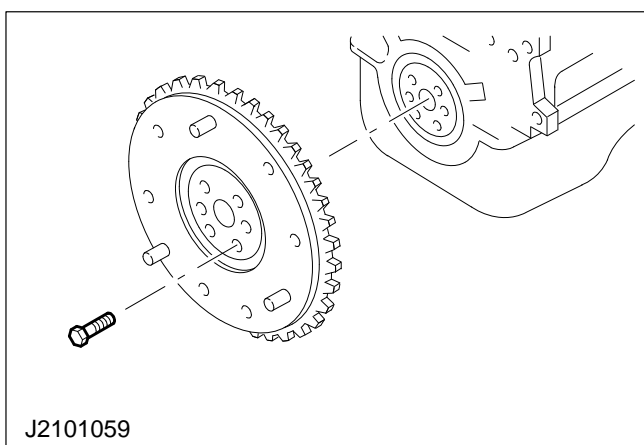
Dial indicator
Magnetic fixture
Piston ring compressor
Oil filter strap wrench
Internal gauge

Dismantle

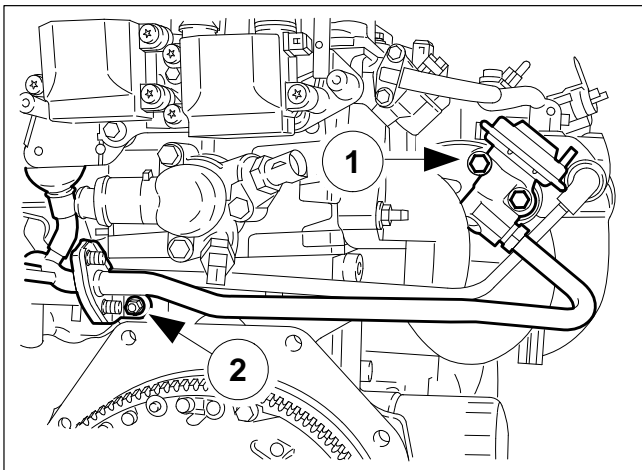
1. **Attach the engine to the engine stand using Special Tools 21-031B, 21-023 and 21-146C.**
2. **Preparatory measures.**
Drain off the engine oil.
3. **Detach the clutch assembly.**



4. **Detach the crankshaft belt pulley/vibration damper.**
 - Immobilise the flywheel using Special Tool 21-168.
 - Unscrew the retaining bolt.
 - Pull off the crankshaft pulley/vibration damper using the special tool.

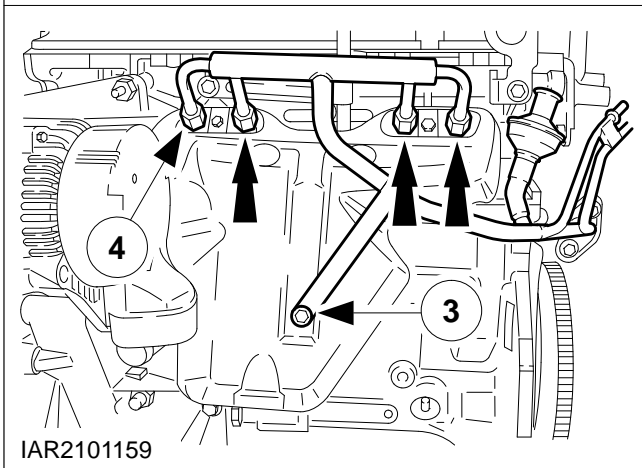


5. **Detach the flywheel.**
 - Undo the bolts.
 - Remove the flywheel.

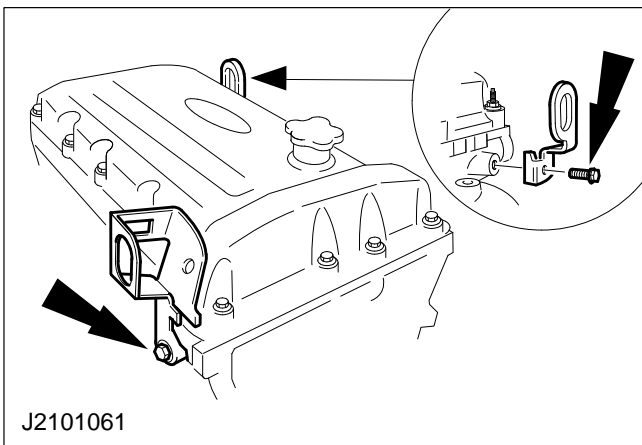


6. Disconnect the exhaust gas recirculation (EGR) pipe.

- 1 Remove the exhaust gas recirculation (EGR) valve from the inlet manifold.
- 2 Detach the bracket from the cylinder head.
- 3 Detach the bracket from the heat shield.
- 4 Detach the pipe from the exhaust manifold.



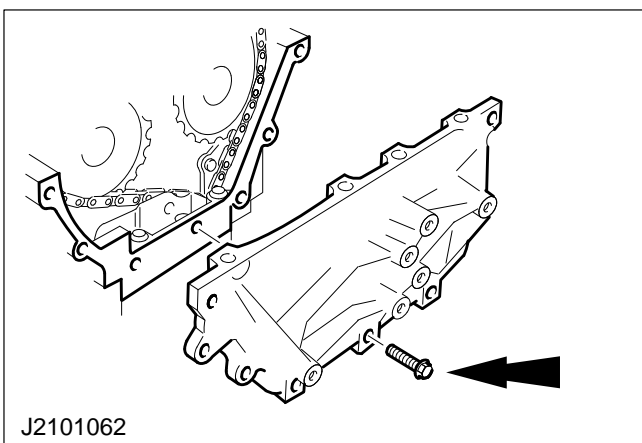
IAR2101159



J2101061

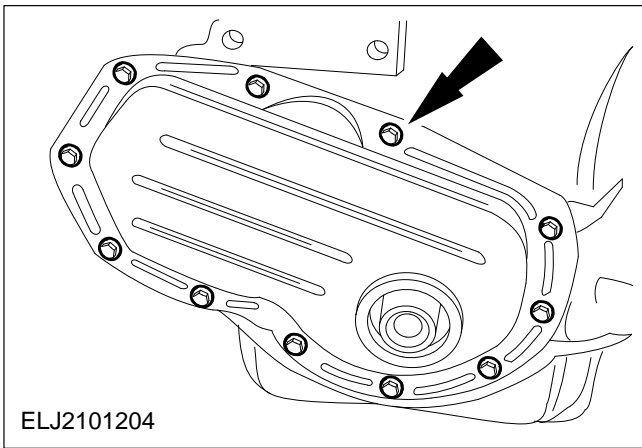
7. Detach the engine lifting eyes.

8. Detach the cylinder head cover (11 bolts and 4 nuts).

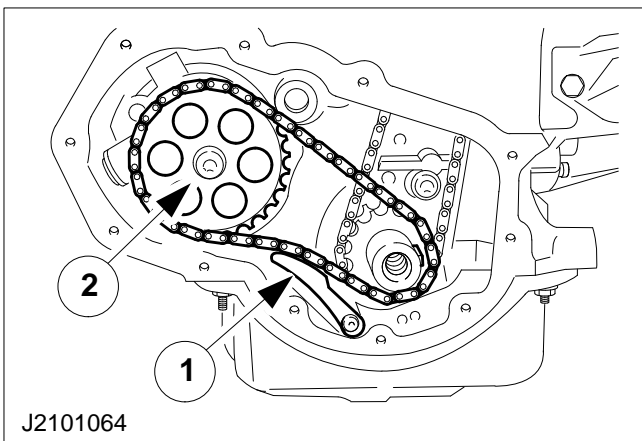


J2101062

9. Remove the upper timing chain cover.

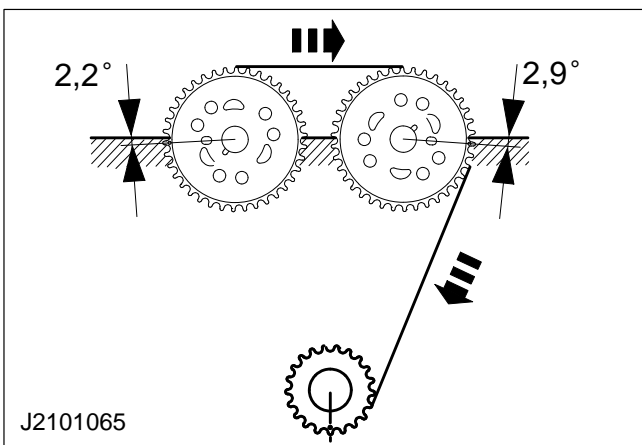


10. Remove the lower timing chain cover.

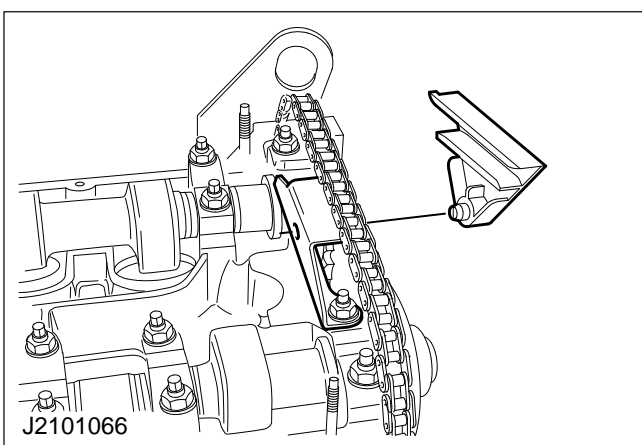


11. Detach the oil pump sprocket and chain.

- 1 Remove the oil pump chain tensioner.
- 2 Remove the oil pump chain sprocket and chain.

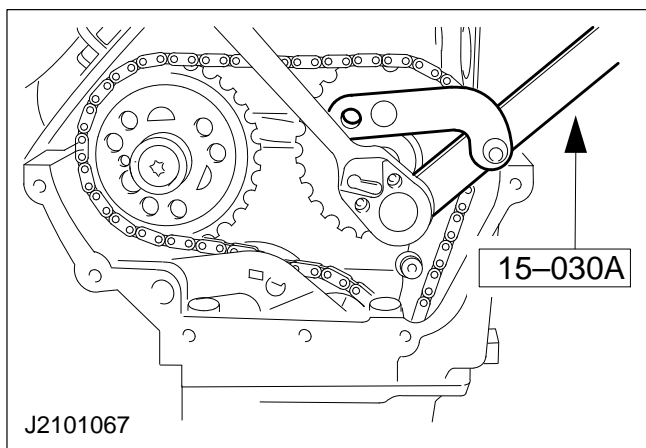


12. Line up the camshaft sprockets on the marks.

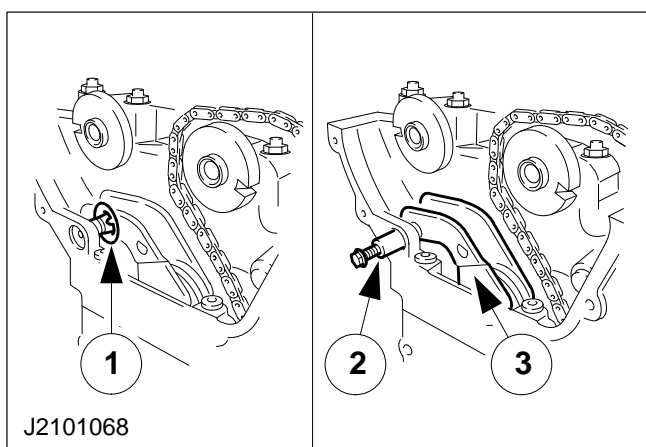


NOTE: The chain guide must be renewed on reassembly.

13. Detach the upper chain guide rail.

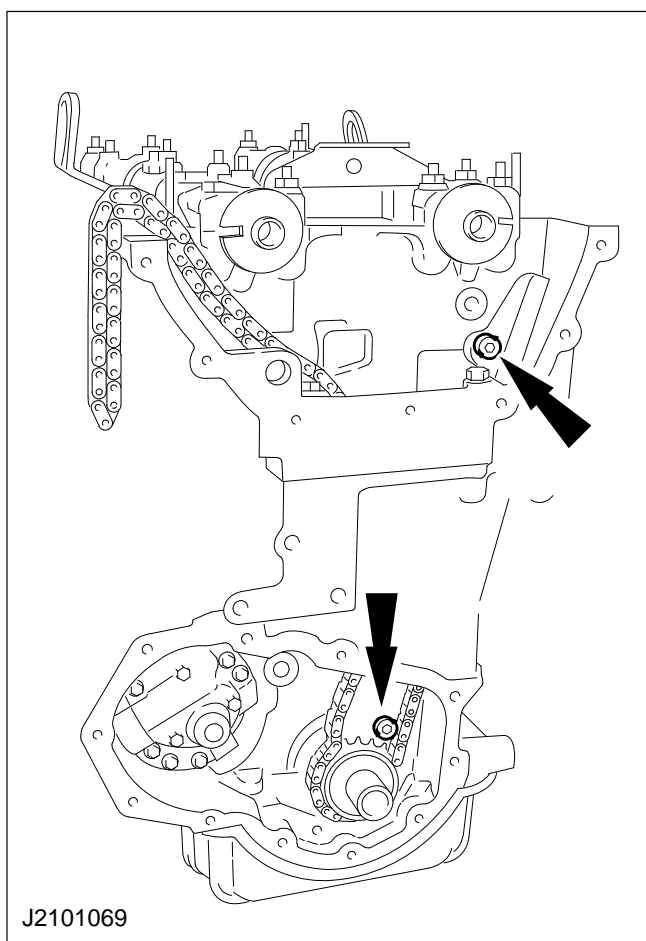


14. Detach the camshaft sprockets.

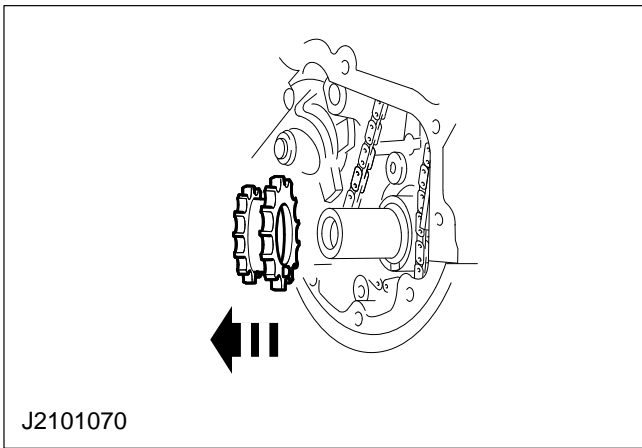


15. Remove the chain tensioner arm.

- 1 Pull off the circlip with pliers.
- 2 Withdraw the chain tensioner pivot pin with a bolt (M6).
- 3 Remove the chain tensioner arm from the housing.

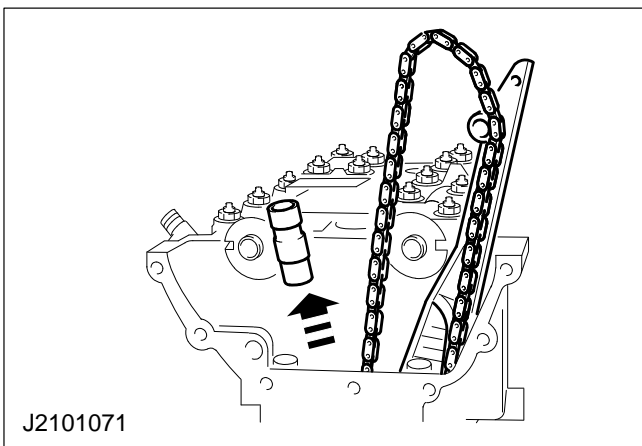


16. Release the chain guide.



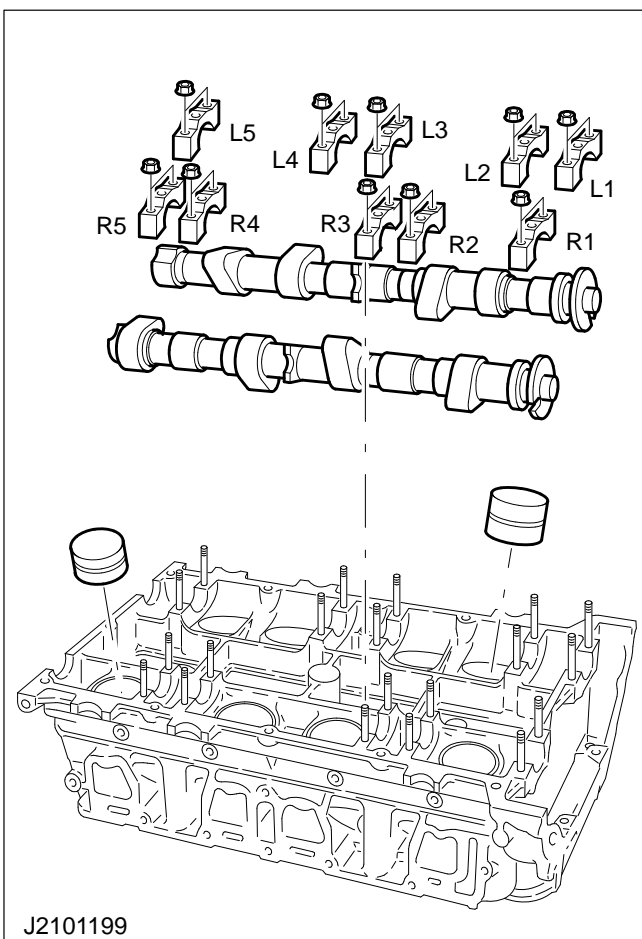
17. Remove the timing chain.

- Remove the Woodruff key from the crankshaft.
- Remove the crankshaft sprocket with the timing chain.



⚠ CAUTION: Do not reuse the oil-filled plunger.

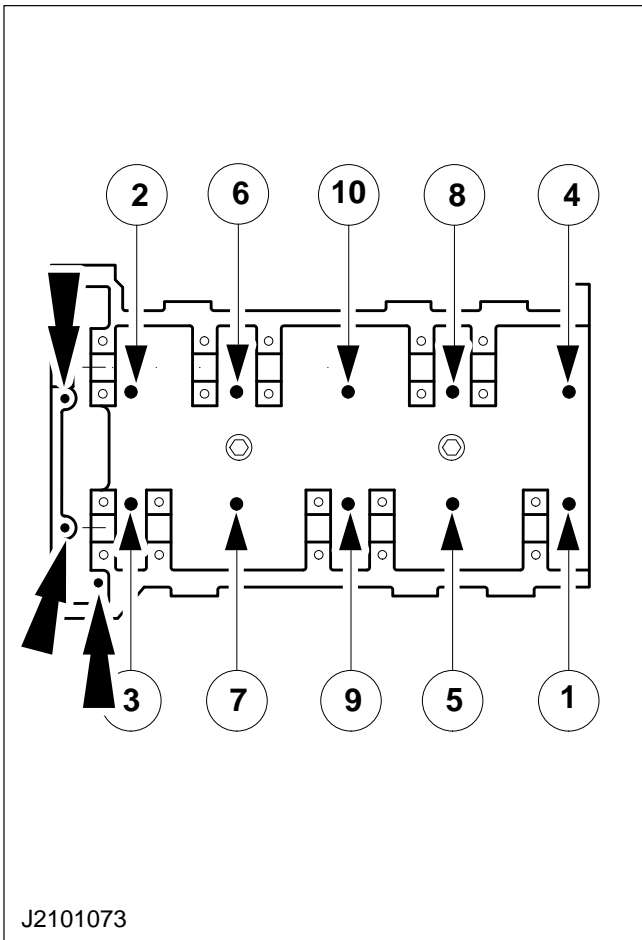
18. Remove the oil-filled plunger of the chain tensioner and the timing chain.



Remove the camshafts

19. Remove the camshafts.

- Detach the chain guide bracket with the front bearing caps.
- Remove the hydraulic tappets and keep them in order.



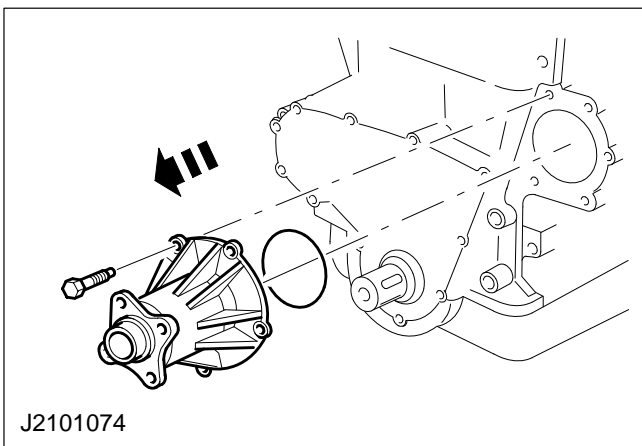
Remove the cylinder head

NOTE: Release the three auxiliary bolts first.

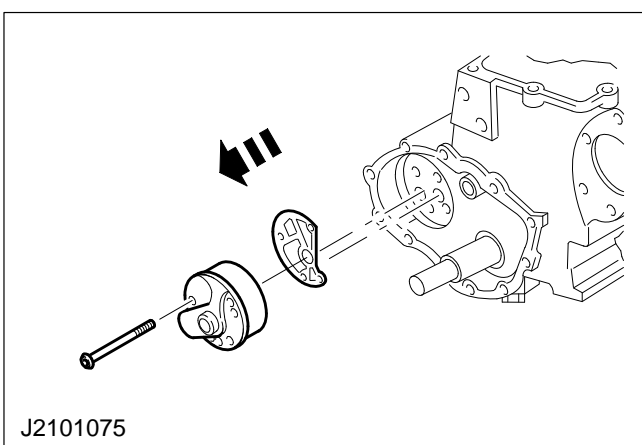
CAUTION: Do not reuse the cylinder head bolts.

CAUTION: The cylinder head should be left to cool down to ambient temperature before the bolts are slackened.

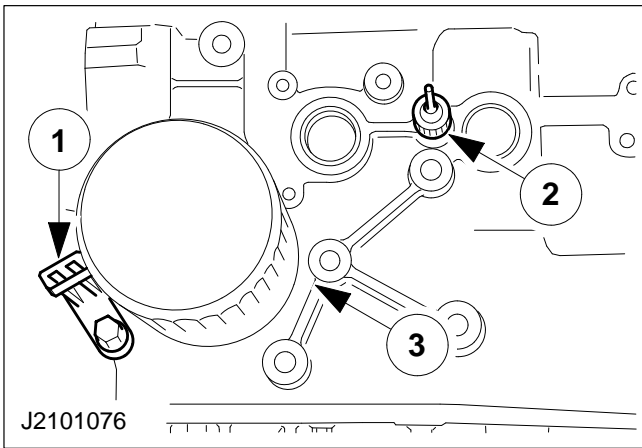
20. Remove the cylinder head.



21. Detach the water pump.

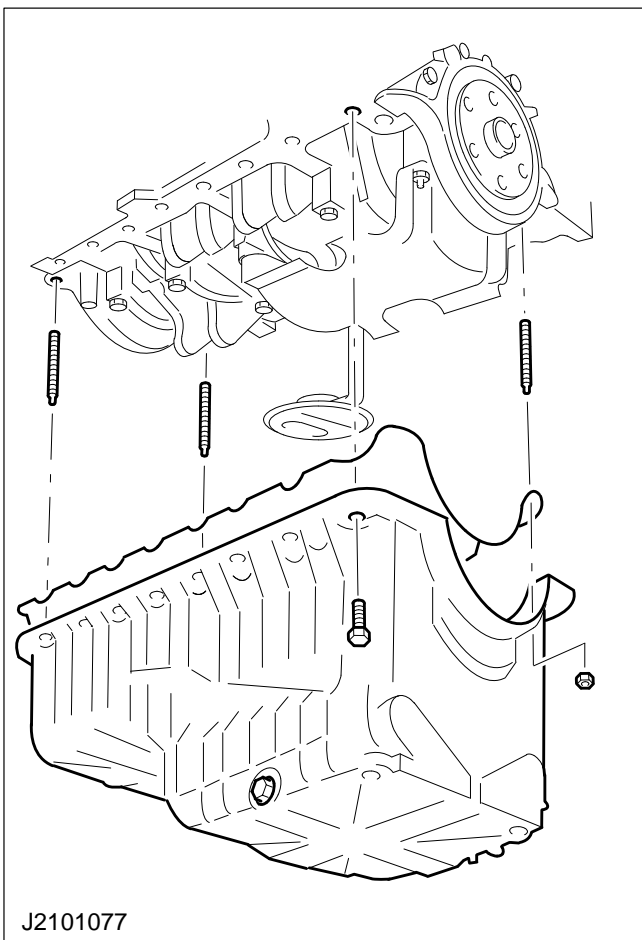


22. Detach the oil pump.



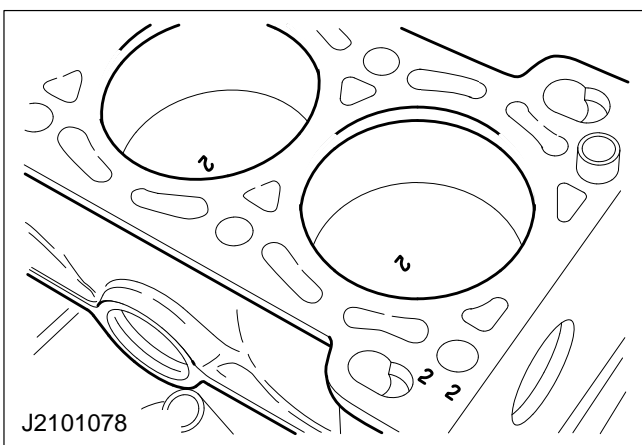
23. Detach the parts mounted on the left-hand side of the engine.

- 1 Crankshaft position/speed sensor (CPS)
- 2 Oil pressure switch
- 3 Oil filter



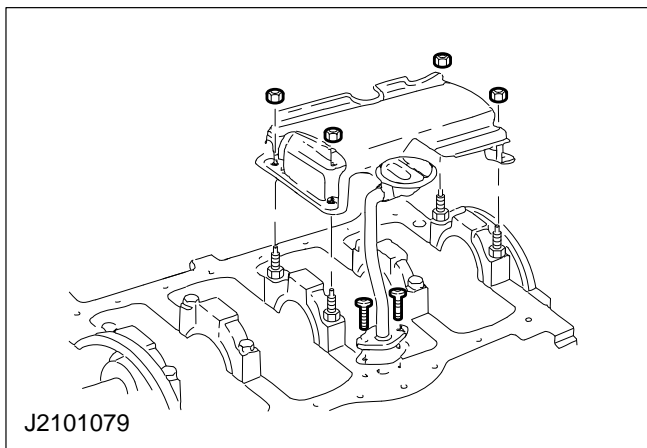
⚠ CAUTION: Oil sludge and abraded particles must not get into the engine.

24. Remove the sump downwards.

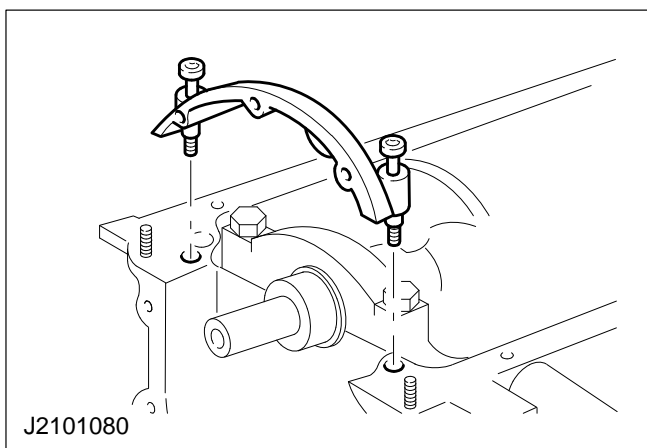


⚠ CAUTION: Do not damage the cylinder bores.

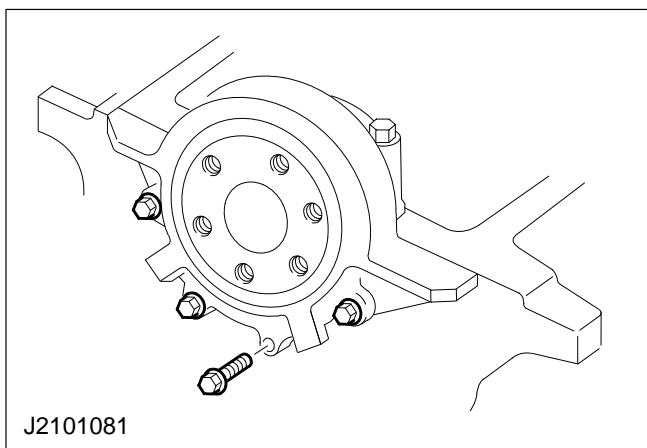
25. Remove the carbon from the upper edge of the cylinder bores.



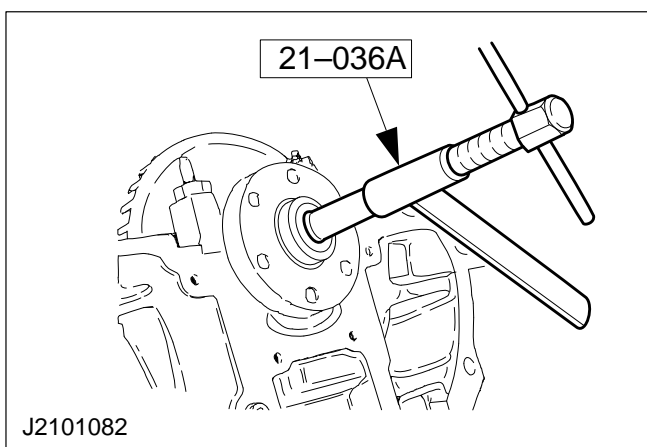
26. Detach the oil intake pipe and oil baffle.



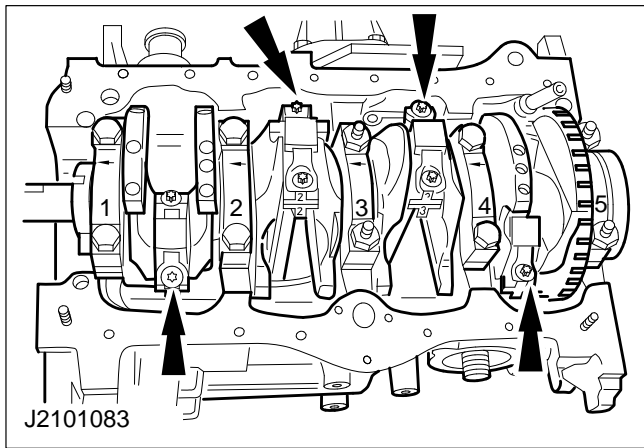
27. Detach the front oil seal carrier.



28. Detach the crankshaft rear oil seal housing.

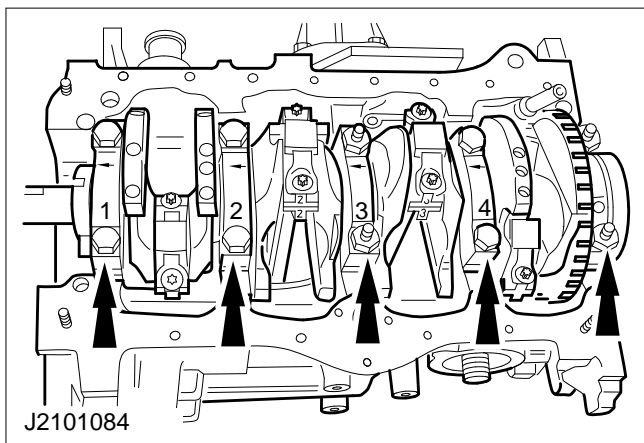


29. Remove the crankshaft pilot bearing.



30. Remove the pistons.

- Detach the big-end bearing caps.
- Remove the big-end bearing shells from the big-end bearing caps and connecting rods and mark them.
- Press out the pistons with the connecting rods.



31. Remove the crankshaft.

- Detach the main bearing caps.
- Remove the crankshaft.
- Remove the bearing shells and thrust half rings and keep them in order or mark them for further use.

Assemble engine

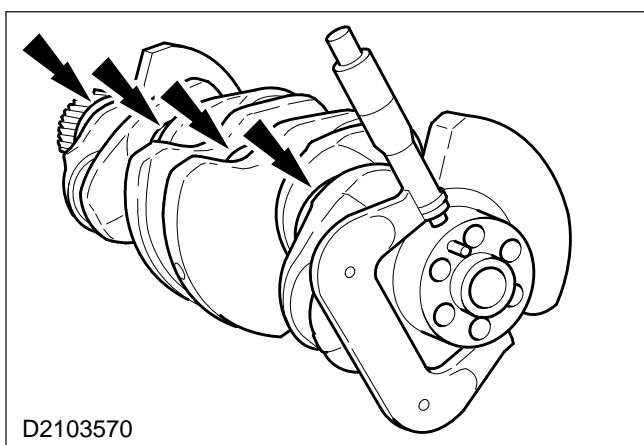
32. Preparatory measures.

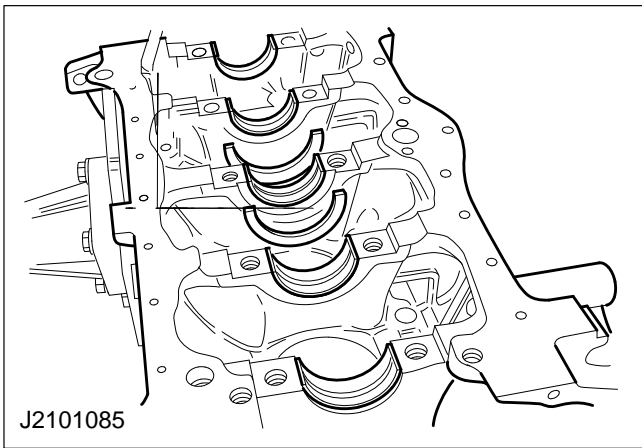
- Clean all the mating faces and reusable parts thoroughly and check them for damage.
- When applicable, the upper and lower timing chain covers are renewed complete with the radial oil seal in place.

NOTE: If the measurements are not as specified in the Technical Data, the crankshaft must be overhauled or renewed.

33. Measure the diameters of the main and big-end bearing journals using a proprietary micrometer screw.

Repeat each measurement at 90°.



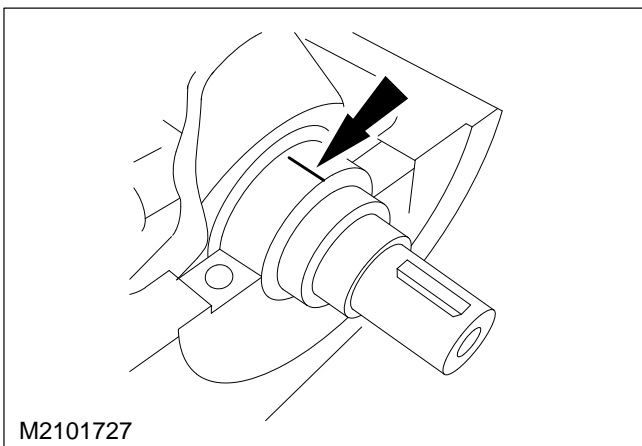


Measure the crankshaft main bearing clearance.

⚠ CAUTION: Do not damage the crankshaft bearings during fitment.

34. Fit the crankshaft.

- Place the grooved bearing shells in the cylinder block.
- Place the crankshaft dry in the cylinder block.

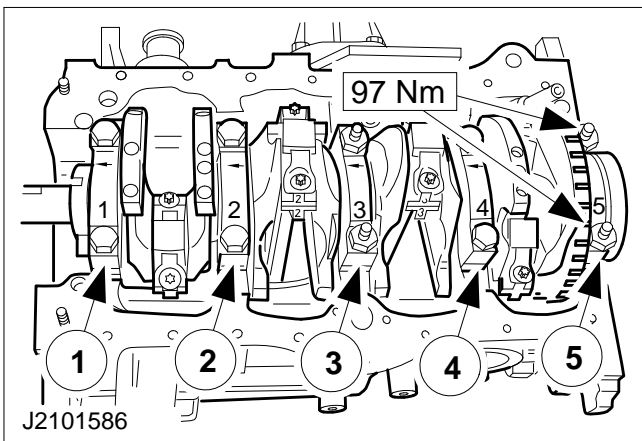


⚠ CAUTION: The crankshaft must not be turned during the measuring operation.

35. Measure the crankshaft main bearing clearance.

NOTE: The point at which the measurement is made must be dry.

- Lay a length of Plastigage thread on the bearing journal across the bearing.
- Fit the bearing cap (see sub-operation 36.).

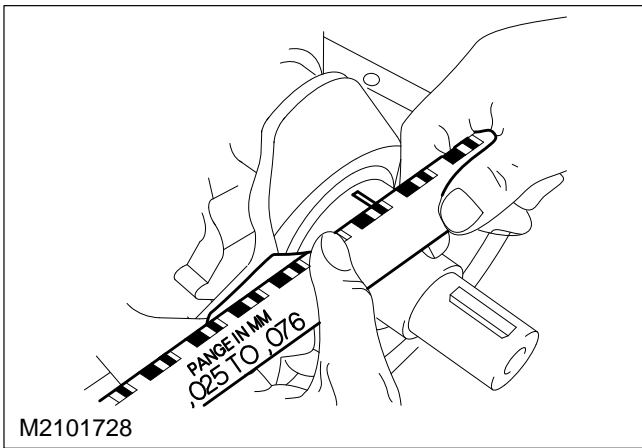


NOTE: Measure the clearance of the bearings in turn in numerical order (1 - 5).

36. Measure the crankshaft main bearing clearance (continued).

NOTE: The bearing cap numbering starts at the timing chain end.

- Fit the bearing cap with the associated bearing shell, with the arrow pointing towards the timing chain end, and secure it.
- Remove the bearing cap.

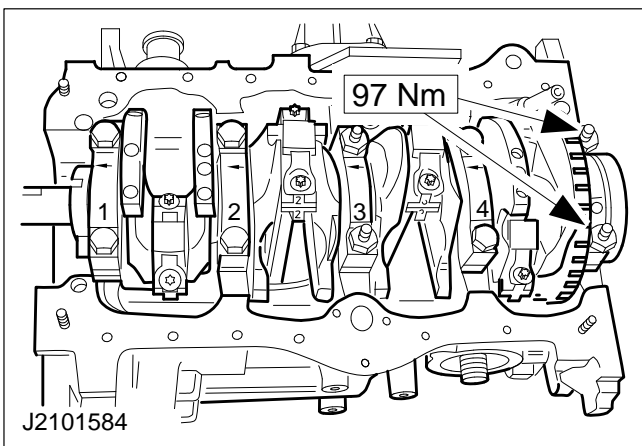


NOTE: If the required bearing clearance is still not achieved, then the next larger size of bearing shell can be fitted on standard size cylinder blocks with up to 0,02 mm undersize crankshafts. However the bearing clearance must not have been more than 0,098 mm.

37. Measure the crankshaft main bearing clearance (continued).

- Compare the Plastigage thread with the Plastigage scale.
- The reading corresponds to the bearing clearance.

NOTE: If the specified bearing clearance of 0,011 - 0,048 mm is not obtained, the bearing shells should be renewed and the measuring operation repeated from sub-operation 35. onwards.



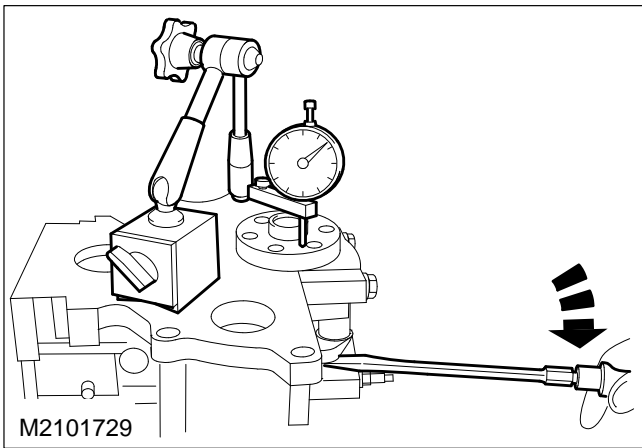
NOTE: Fit the bolts with the stud extensions in bearings 3 and 5.

38. Install the crankshaft.

- Lubricate the main bearing journals and bearing shells and the threads of all the bolts and bolt contact faces with engine oil.
- Fit the crankshaft.
- Fit the thrust half rings with the copper-coloured side facing the crankshaft.
- Coat the contact faces and the sides of the rear main bearing cap with sealer.

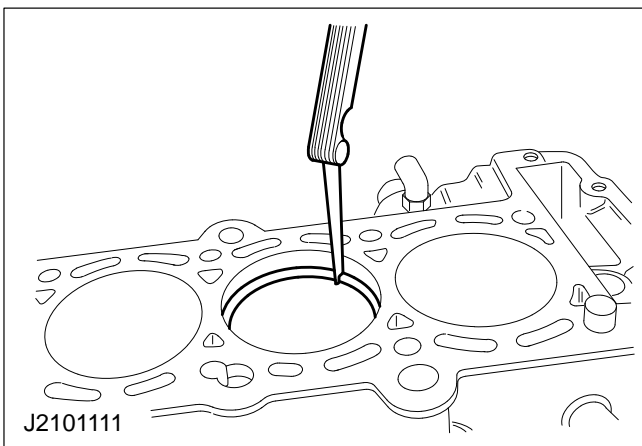
NOTE: The bearing cap numbering starts at the timing chain end, to which the arrows also point.

- Fit the crankshaft main bearing caps with the associated bearing shells.
- Tighten the bolts.



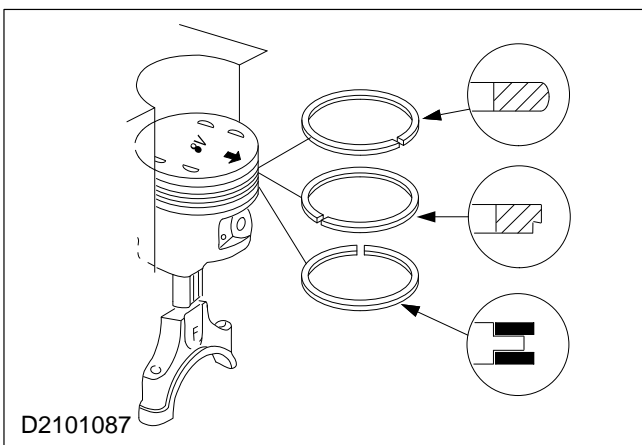
39. Check the crankshaft end float.

- Set up a dial indicator.
- Measure the end float by lifting the crankshaft with the aid of a screwdriver.
- Correct the end float as necessary by fitting thrust half rings to main bearing no. 3.



40. Check the piston ring gaps.

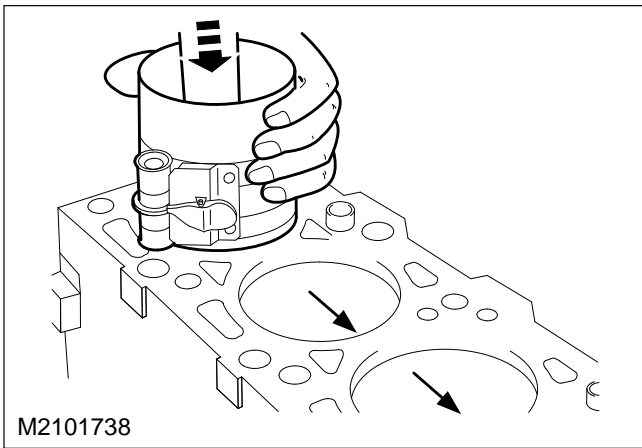
The figures indicated in the Technical Data are for a gauge ring used in production. The figures measured in the cylinder can exceed these by 0,15 mm.



⚠ CAUTION: The maximum width of the piston rings corresponds to the diameter of the cylinder bore + 1,7 mm.

⚠ CAUTION: The upper piston rings are coated with molybdenum. This coating must not be damaged.

41. Arrangement of the piston rings.



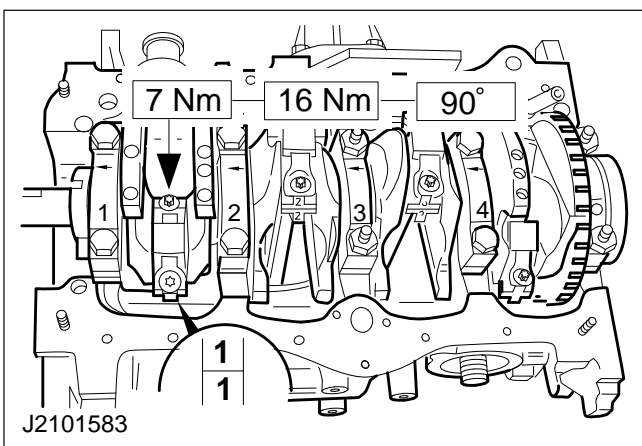
NOTE: The numbering on the connecting rods starts at the timing chain end. The arrow on the piston crown points towards the timing case.

42. Install the pistons.

- Lubricate the pistons and cylinder bores with engine oil.
- Distribute 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 pistons 1 and 4 into the cylinders using the handle of a hammer. The big-end bearing journal must be at BDC.
- Lubricate the bearing shells with engine oil.
- Place the appropriate bearing shells in the connecting rod and bearing cap.
- Fit the bearing caps.
- Turn the crankshaft 180°, fit pistons 2 and 3.

43. Measure the big-end bearing clearance.

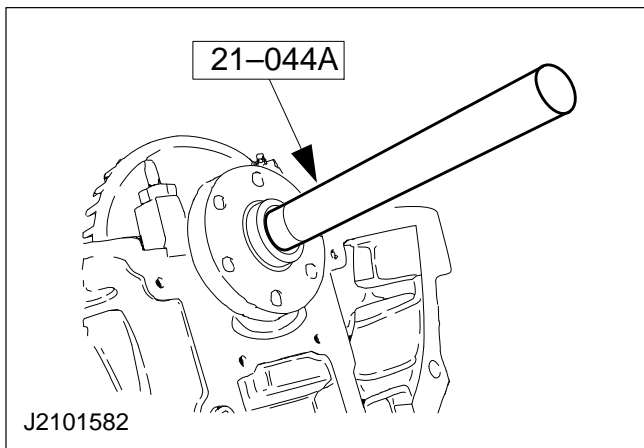
Measure the big-end bearing clearance as described in steps 35. to 38.



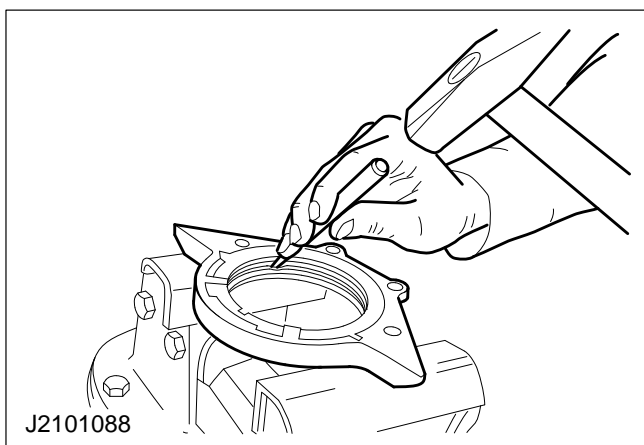
NOTE: The connecting rods and their bearing caps have the same numbers.

44. Fit the bearing caps.

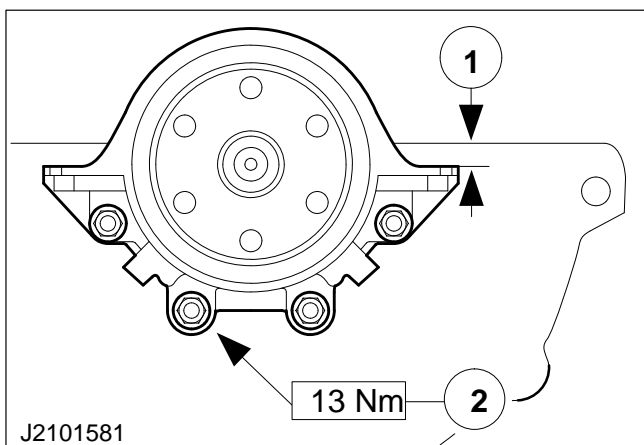
- Lubricate the bearing shells and bearing journals with engine oil.
- Fit the associated bearing caps and bearing shells and secure them.



45. Install the crankshaft pilot bearing.



46. Remove the oil seal from the rear oil seal housing.

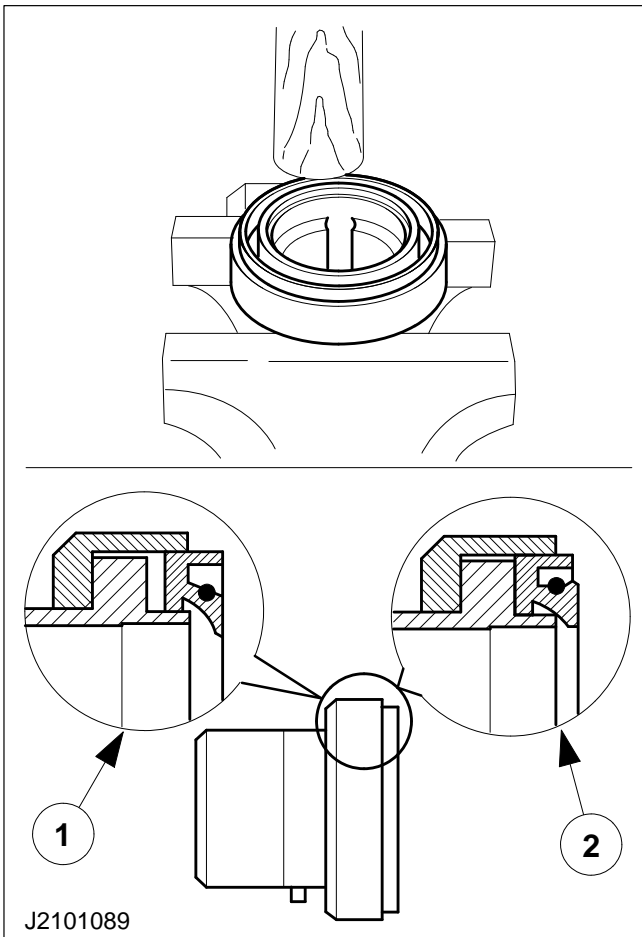


Install the rear oil seal housing

47. Align the oil seal housing.

Fit the oil seal housing using a new gasket and screw in the bolts loosely.

- 1 The mating face of the oil seal housing must be below the mating face of the cylinder block. The difference in height must not exceed 0,46 mm.
- 2 Tighten the bolts.

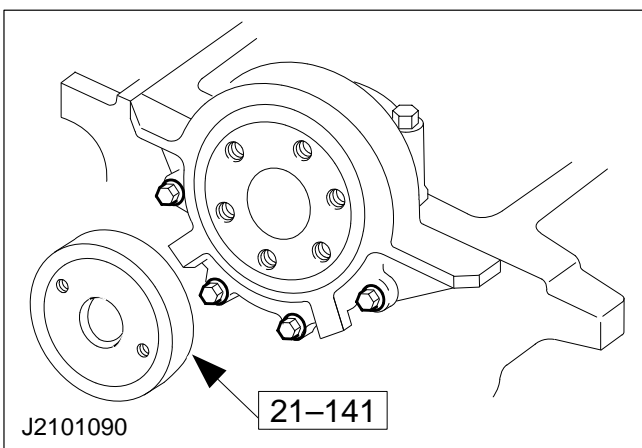


48. General description of the procedure for fitting a radial oil seal into a special tool with a guide sleeve.

⚠ CAUTION: The radial oil seal must be fitted into the tool as far as the shoulder.

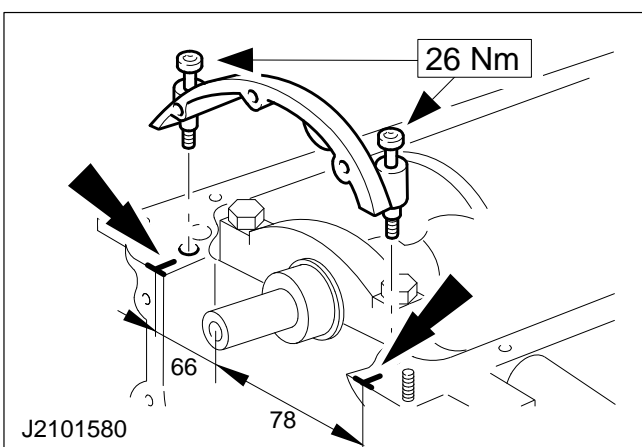
For correct fitment, the special tool is placed on a vice and the radial oil seal is pressed in using the handle of a hammer.

- 1 Incorrectly fitted.
- 2 Correctly fitted.



49. Fit the crankshaft rear oil seal.

Draw in the radial oil seal using two flywheel retaining bolts.

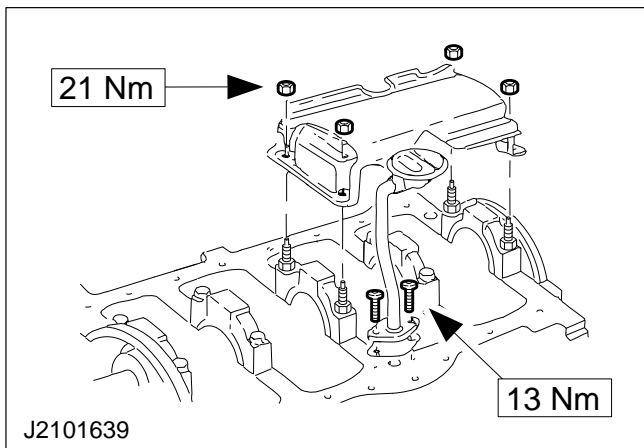


NOTE: Surplus sealer must not be removed before the sump is fitted.

50. Attach the front oil seal carrier.

- Apply sealer (WSK-M4G320-A) to the mating face intersections.
- Apply four beads of sealer with a diameter of 3 - 5 mm and a length of 10 mm.

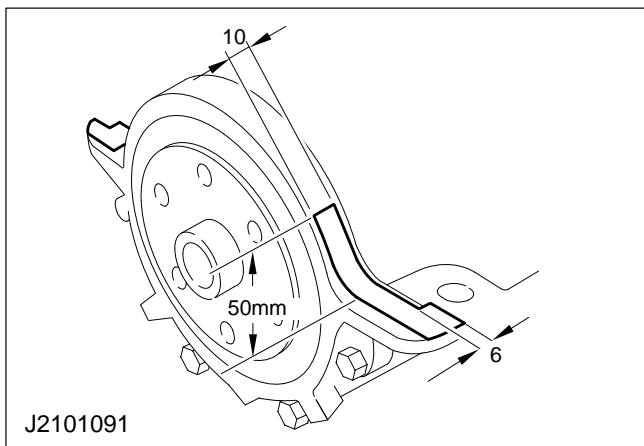
NOTE: The sealer must protrude sufficiently at the front and sides after fitment of the oil seal housing.



51. Fit the oil baffle.

NOTE: Fit the oil baffle so that the oil dipstick and oil strainer can be fitted.

52. Fit the oil strainer.

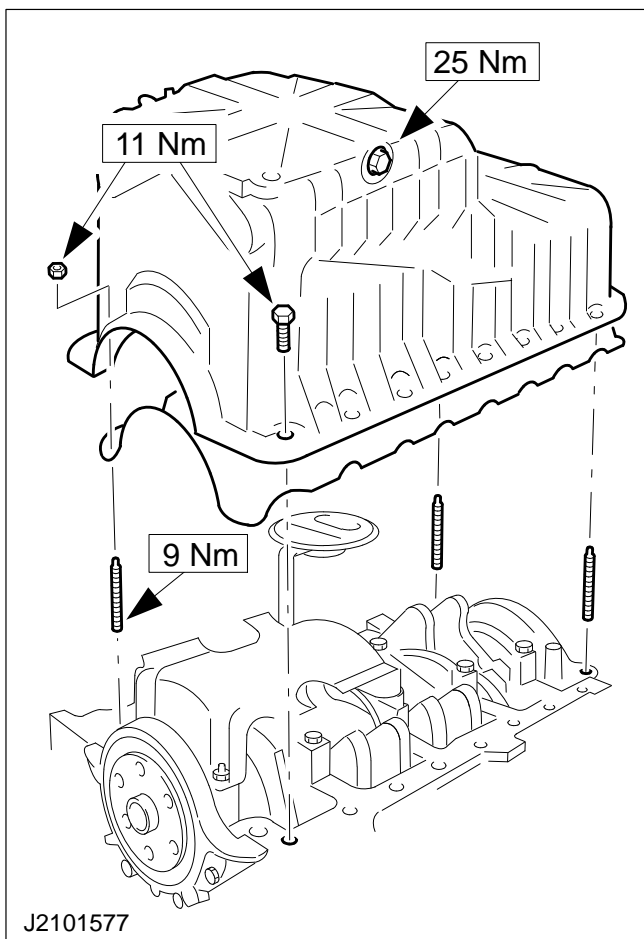


Install sump

NOTE: The bead of sealer must cover the mating face gaps.

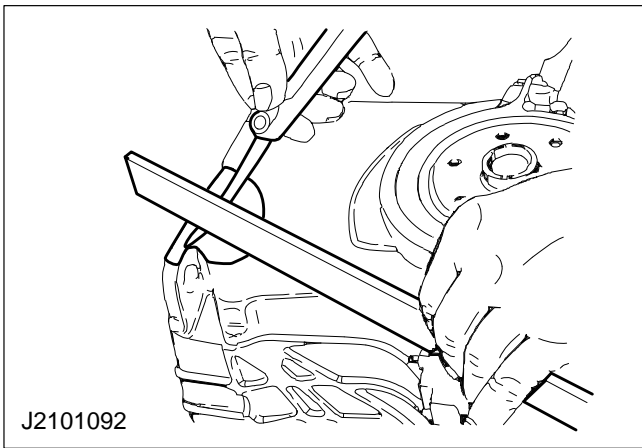
53. Apply sealer to the flywheel end of the cylinder block.

- Use Hylsil 502 (WSK-M4G320-A) sealer.
- Apply a bead of sealer with a thickness of 3 - 5 mm and a width of 10 mm on both sides.

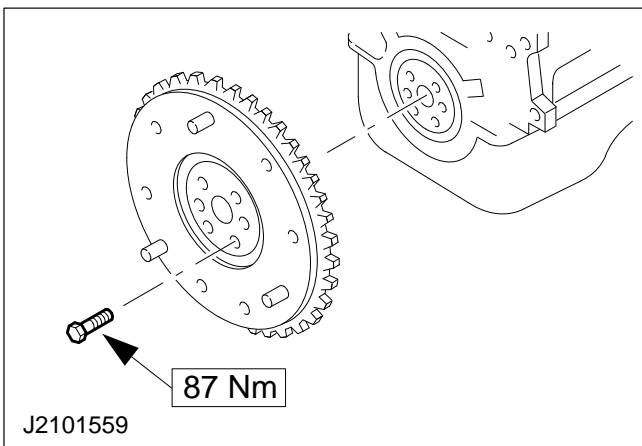


54. Fit the sump using a new gasket.

- Align the sump as described in sub-operation 55.
- Tighten the three nuts and the twelve bolts.

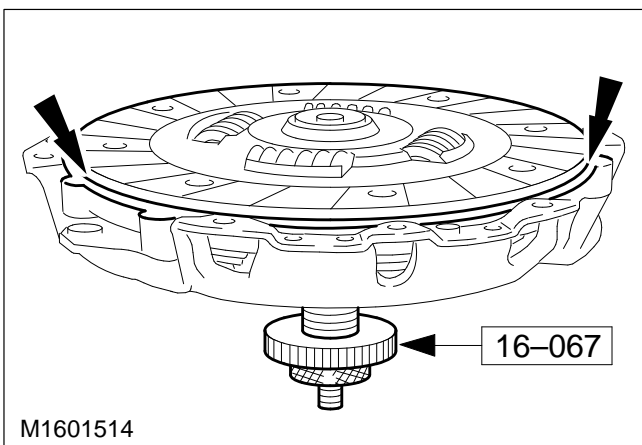
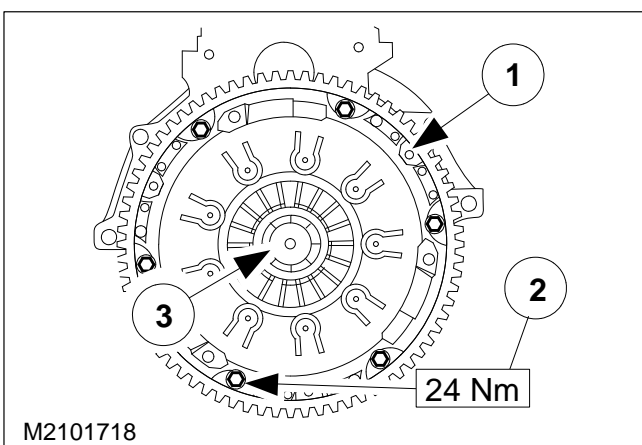
**55. Align the sump.**

- Align the sump so that it stands a maximum of 0,25 mm short or 0,1 mm proud.
- Measure the difference in height using a steel straight edge and a feeler gauge; make a note of the measurement.
- Eliminate the difference with shims (see Technical Data) when installing the engine.

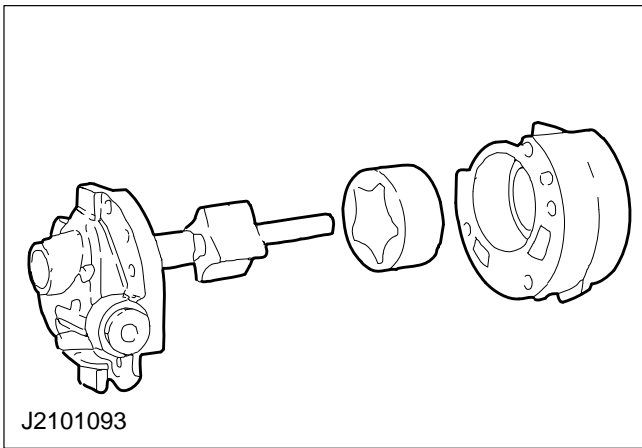


NOTE: It can only be fitted in one position.

⚠ CAUTION: Use new bolts.

56. Fit the flywheel.**57. Centre the clutch disc on the pressure plate.****58. Fit the clutch assembly.**

- 1 Fit the clutch pressure plate with the centred clutch disc.
- 2 Tighten the six bolts uniformly, one turn at a time, working diagonally.
- 3 Remove the special tool.



CAUTION: A new oil pump must be filled with oil and turned over by hand before it is fitted.

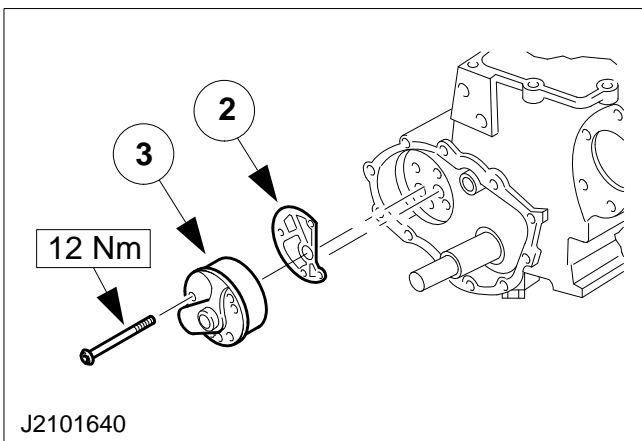
59. Clean the oil pump.

Dismantle the oil pump.

NOTE: If excessively worn, the oil pump is only renewed complete.

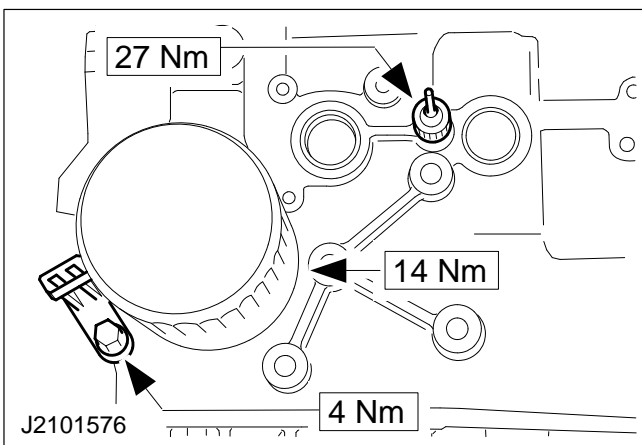
60. Reassemble the oil pump.

NOTE: The dot marks must face outwards.



NOTE: The passages of the oil pump must not be covered by the gasket.

61. Fit the oil pump using a new gasket.



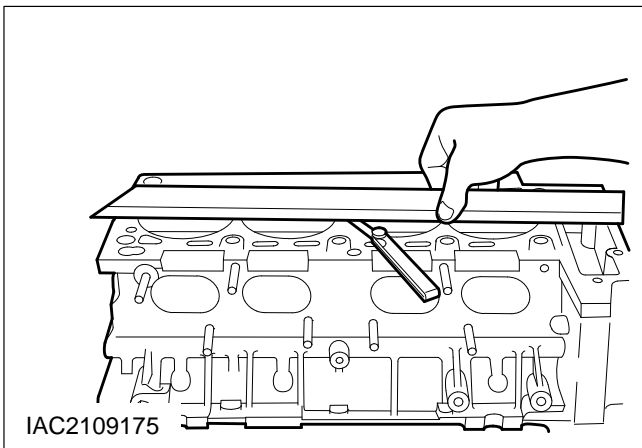
62. Fit the parts mounted on the left-hand side of the engine.

NOTE: Apply lubricant (SM1C-115-A) to the CKP sensor O-ring.

- Crankshaft position sensor (CPS)

NOTE: Apply sealer (WSK-M2G349-A7) to the thread of the oil pressure switch.

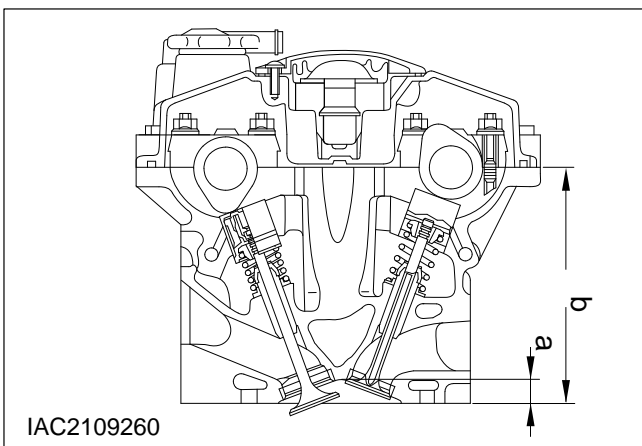
- Oil pressure switch
- Oil filter



Check cylinder head evenness.

63. Check cylinder head mating face for distortion.

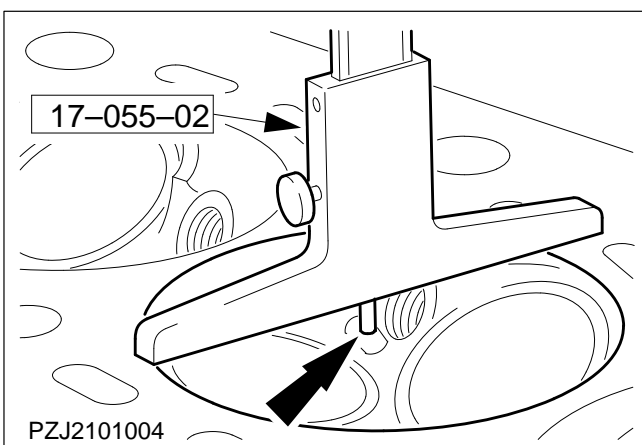
- The maximum acceptable distortion at combustion chamber lands is: transverse 0.05mm, longitudinal and diagonal 0.10mm.
- Place straightedge transversely across all combustion chamber lands and check at three locations.
- Place straightedge longitudinally across the cylinder head at three locations in the combustion chamber area and check at all combustion chamber lands.
- Place straightedge diagonally across the cylinder head and check at all combustion chamber lands.
- If necessary re-machine cylinder head as described in step 64.



64. Note: machining of cylinder head.

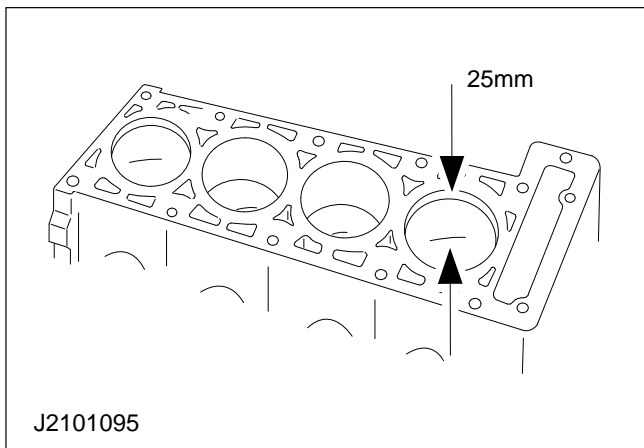
NOTE: Maintain peak-to-valley height Rz of 13,5 micrometres during machining.

The cylinder head may be machined (milled or surface ground) by a maximum of 0.20mm. During machining dimension "a" must remain at least 16,35 mm (see step 65.) and "b" at least 147,25 mm.



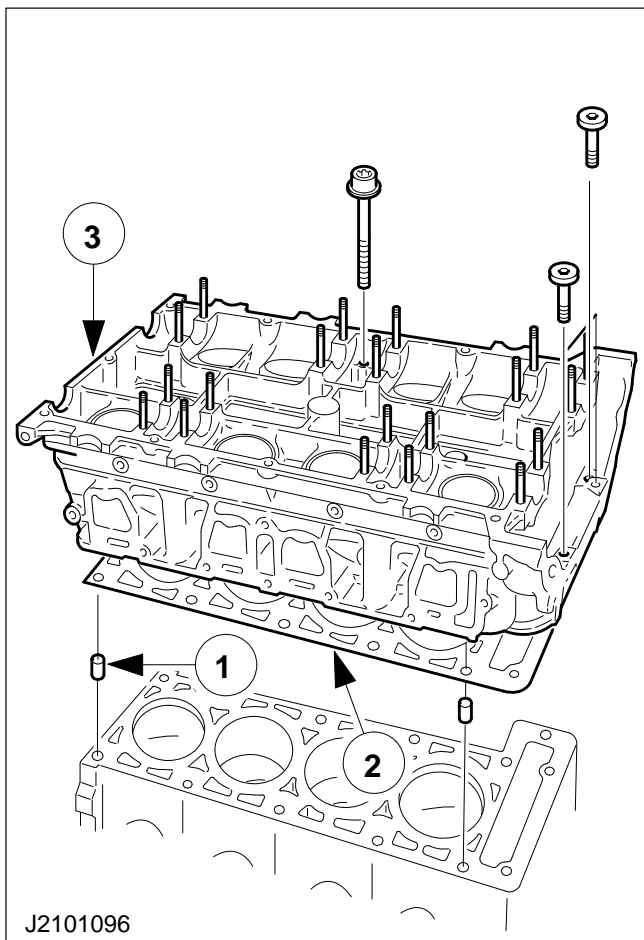
NOTE: Remove carbon deposits at the measuring site.

65. Location of measuring site for dimension "a" in the combustion chamber.



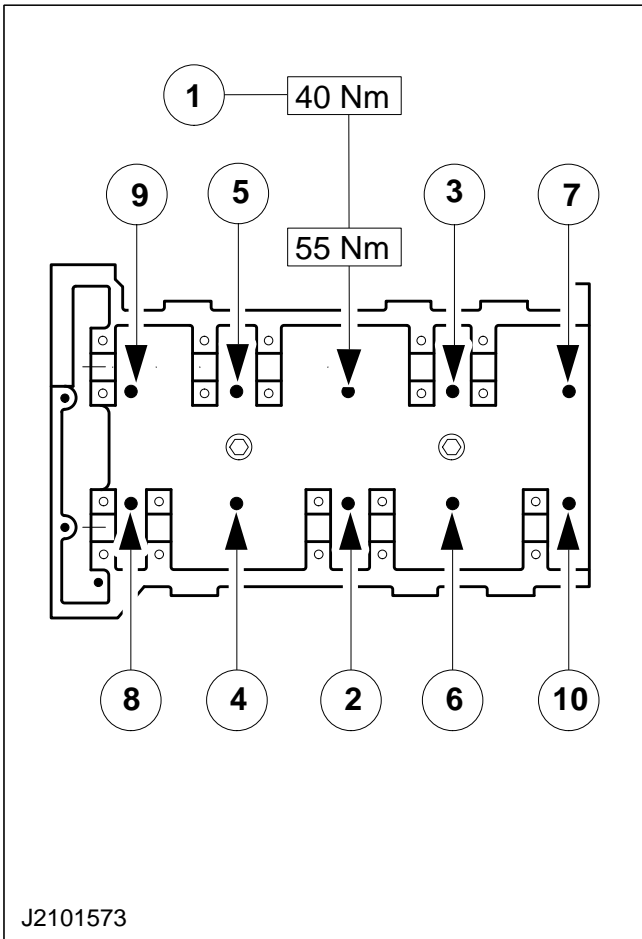
Install the cylinder head

66. Bring the piston of cylinder no. 1 to a point 25 mm before TDC.



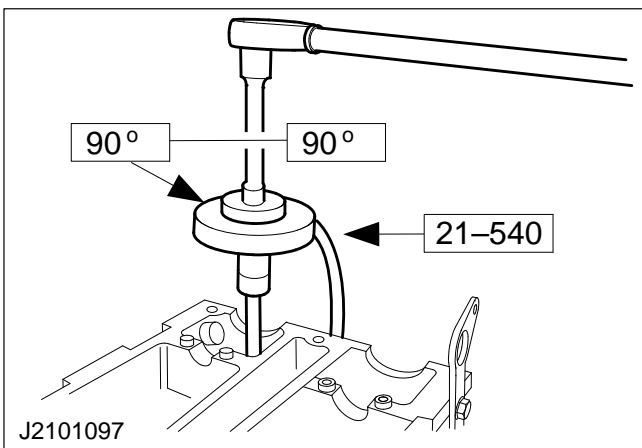
67. Fit the cylinder head.

- 1 Insert the locating bushes.
- 2 Fit the cylinder head gasket.
- 3 Fit the cylinder head.



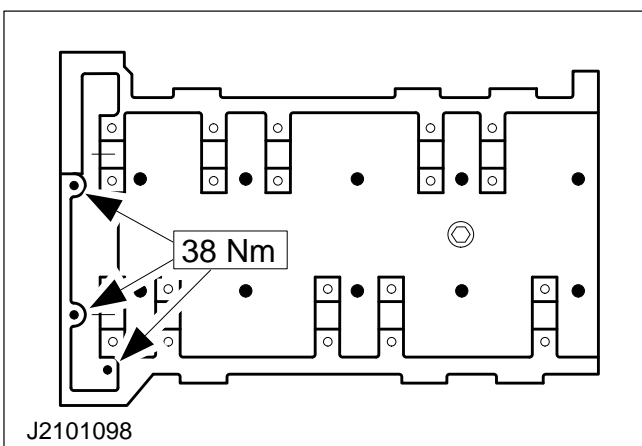
CAUTION: Use new bolts.

68. Tighten the cylinder head bolts.

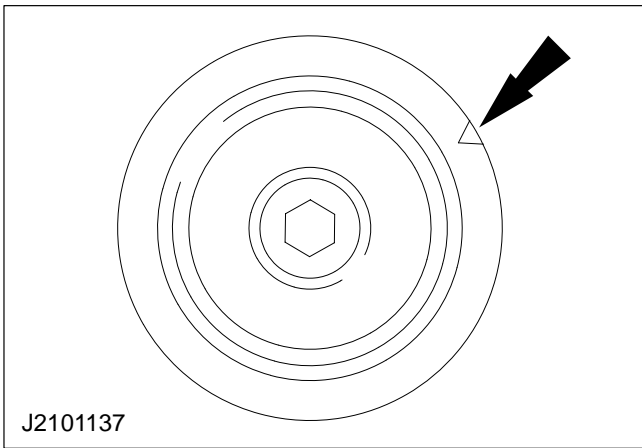


CAUTION: The cylinder head bolts must not be retorqued.

69. Tighten the cylinder head bolts (continued).



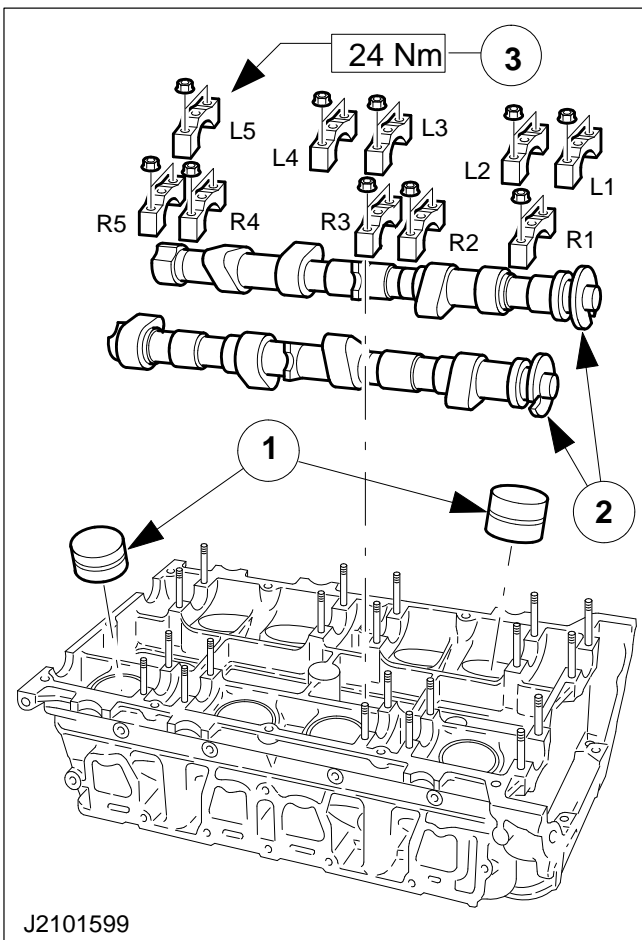
70. Tighten the auxiliary cylinder head bolts.



Install the camshafts

71. Bring the piston of cylinder no. 1 to a point approximately 25 mm before TDC.

Position of the crankshaft belt pulley/
vibration damper.



72. Install the camshafts.

CAUTION: Before the camshafts are installed, the piston of cylinder no. 1 must be at a point approximately 25 mm before TDC.

CAUTION: After installation of the camshafts, it is imperative to wait 15 minutes before the engine is turned.

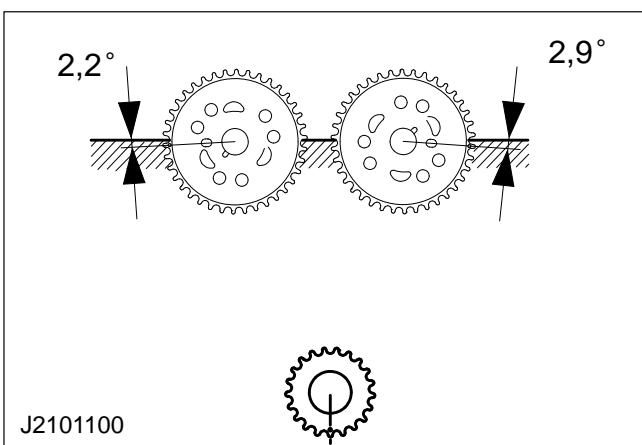
Oil the bearings.

- 1 Fit the hydraulic tappets.
- 2 Fit the camshafts so that none of the cams is at full lift.

NOTE: R is the inlet side, L is the exhaust side.

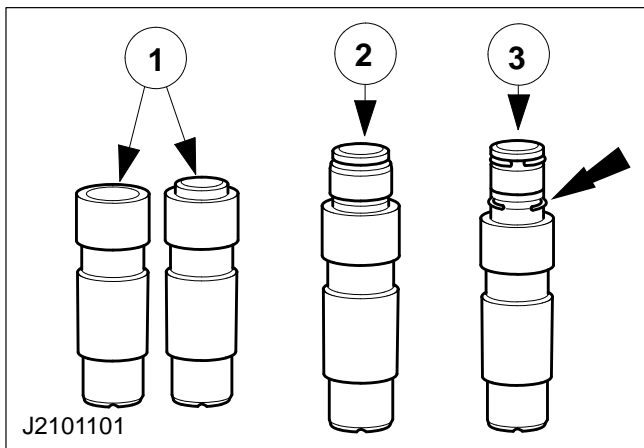
- 3 Fit the camshaft bearing caps so that the position markings can be read from the rear.

Fit the chain guide bracket with the front bearing caps.



Install the timing chain

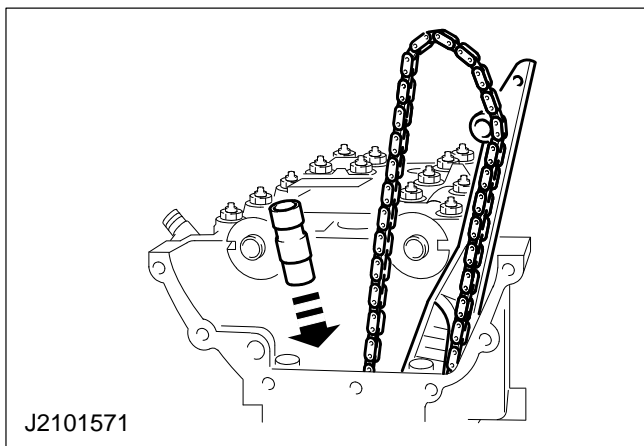
73. Bring the camshafts and crankshaft to TDC.



⚠ CAUTION: Fully and partially released plungers (whether new or used) must not be fitted.

74. Check the new chain tensioner plunger.

- 1 Plunger latched.
- 2 Plunger partly released.
- 3 Plunger fully released (the detent ring is visible).

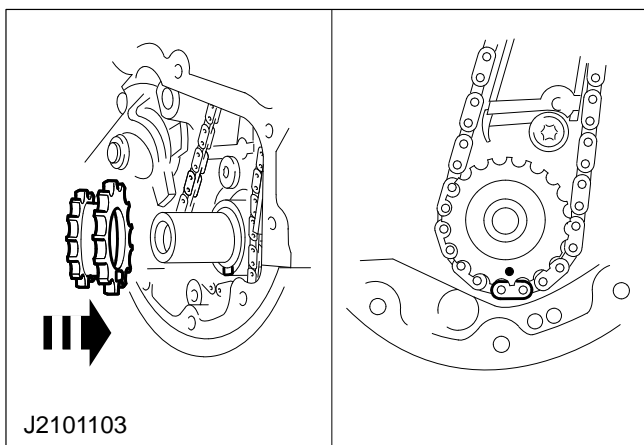


75. Install the chain tensioner plunger.

⚠ CAUTION: Only use a new latched plunger.

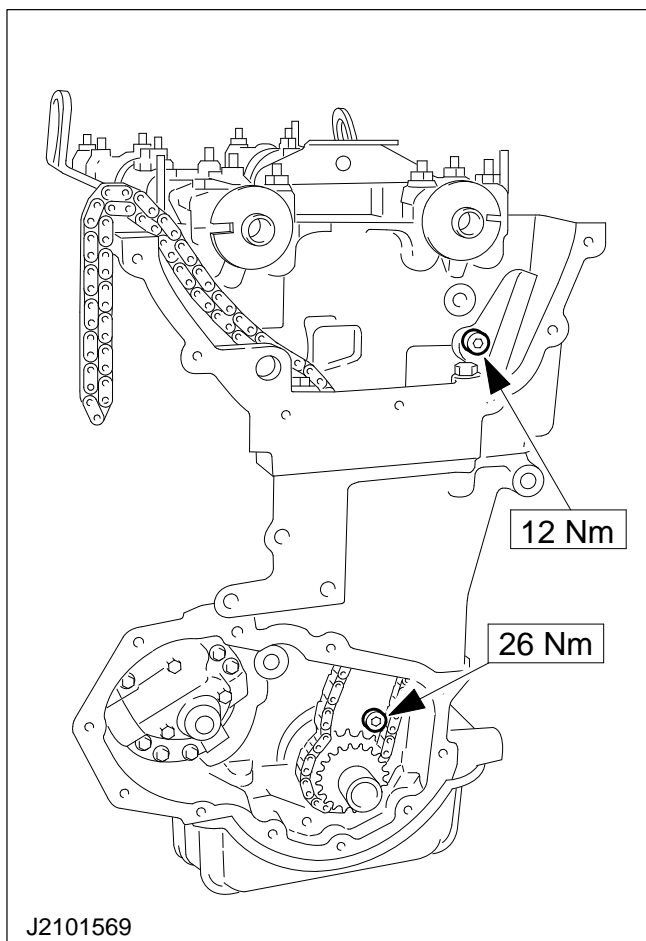
76. Insert the timing chain with the chain guide.

Do not secure the chain guide yet.

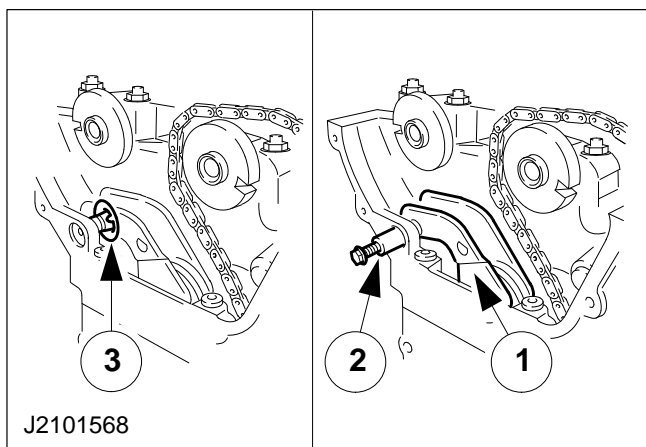


77. Fit the timing chain at the bottom.

- Slide the sprocket on approximately 10 mm.
- Lay the timing chain around the inner sprocket.
- Fit the Woodruff key in the crankshaft.

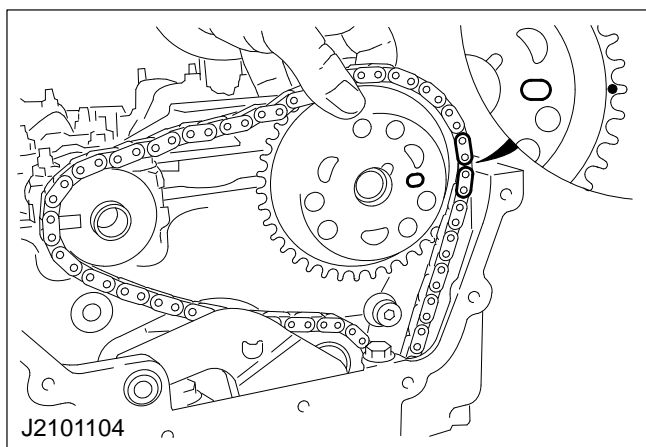


78. Tighten the chain guide bolts.



79. Install the chain tensioner.

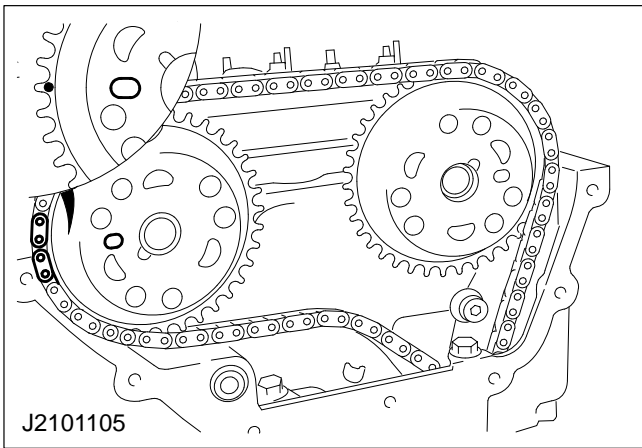
- 1 Insert the chain tensioner.
- 2 Insert the pin.
- 3 Fit the circlip.



80. Fit the timing chain at the top.

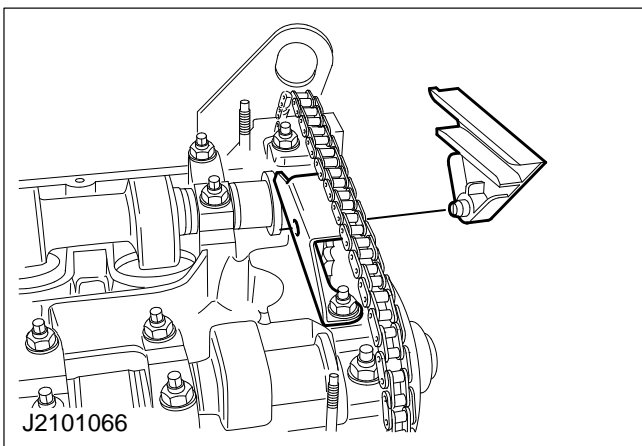
NOTE: The timing chain must be taut on the long side.

If necessary, turn the camshaft slightly.

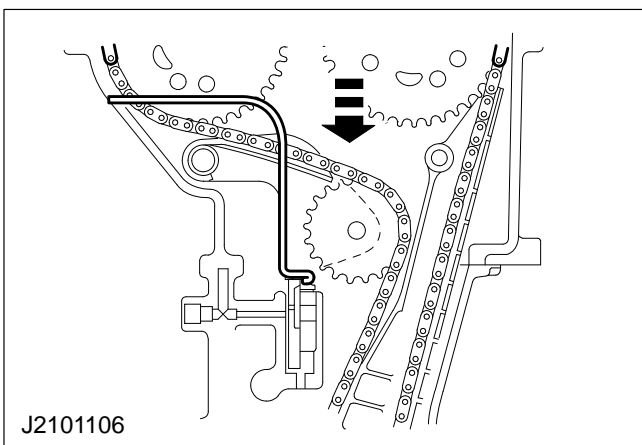


NOTE: The timing chain may sag slightly between the camshaft sprockets.

81. Fit the timing chain at the top (continued).



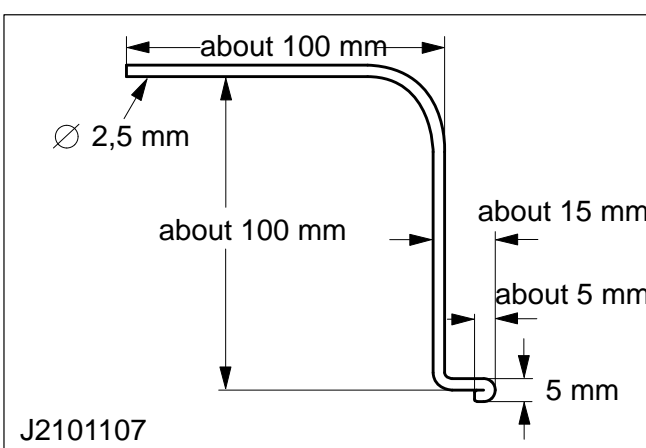
82. Clip a new upper chain guide into the bracket.



NOTE: If the chain tensioner arm does not reach the oil-filled plunger, the plunger must be released using an auxiliary tool.

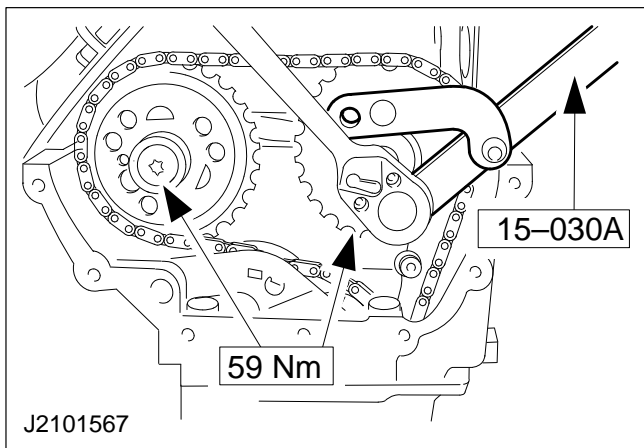
83. Release the chain tensioner plunger.

Press the chain tensioner arm down by hand and unlatch the oil-filled plunger.



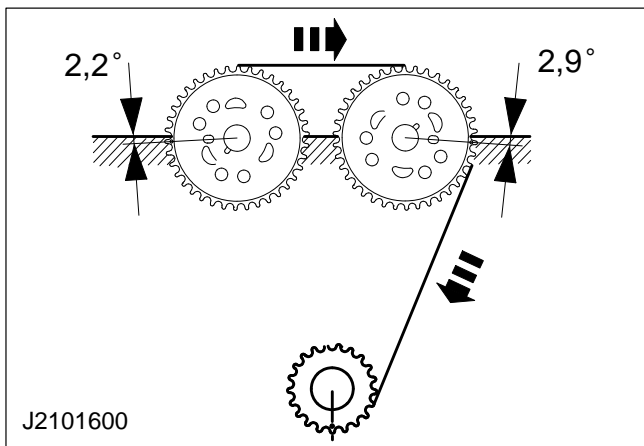
84. Fabricate an auxiliary tool.

Use a 220 mm length of 2,5 mm welding rod.



CAUTION: Before securing the sprockets, ensure that they have engaged in the camshaft groove.

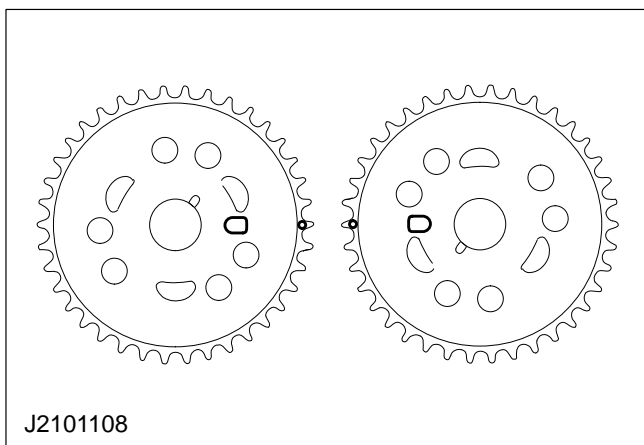
85. Secure the camshaft sprockets.



NOTE: If it is necessary to correct the valve timing, i.e. release the timing chain, a new oil-filled plunger must also be fitted for the chain tensioner.

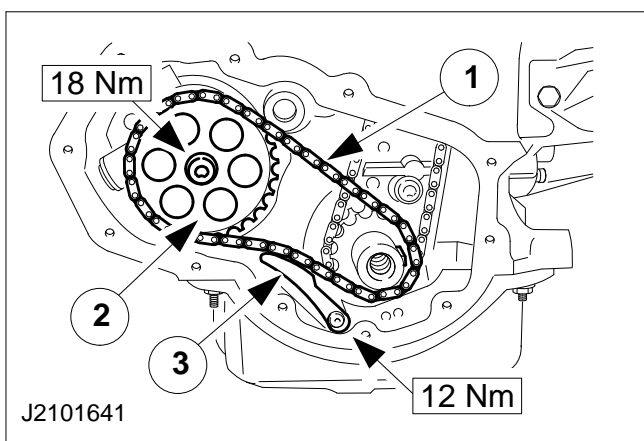
86. Checking the valve timing.

Turn the engine in the normal direction of rotation and line up the sprockets on the marks.



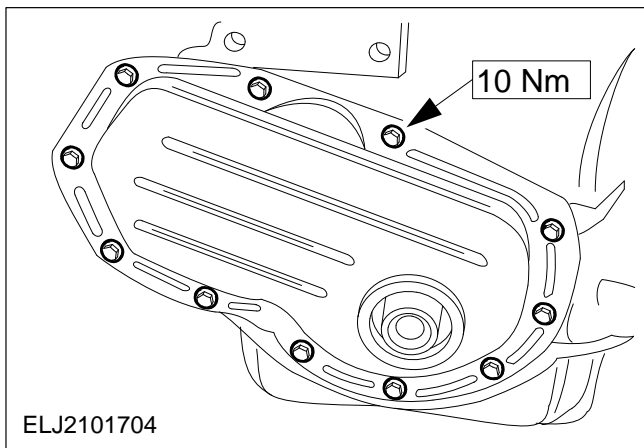
87. Additional check.

- 1 Turn the engine in the normal direction of rotation to the next TDC position.
- 2 The marks on the camshaft sprockets must face one another exactly level with the upper edge of the cylinder head.



88. Install the oil pump drive assembly.

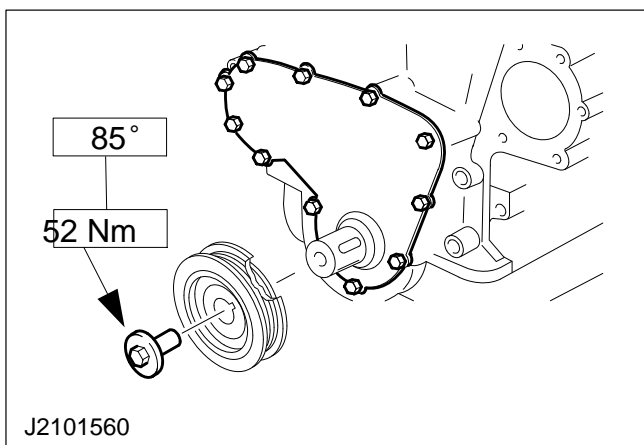
- 1 Lay the chain around the crankshaft driving sprocket.
- 2 Fit the oil pump sprocket with the chain to the oil pump.
- 3 Fit the chain tensioner.



89. Fit the lower timing chain cover.

NOTE: Use a new cover with an integral gasket and radial oil seal.

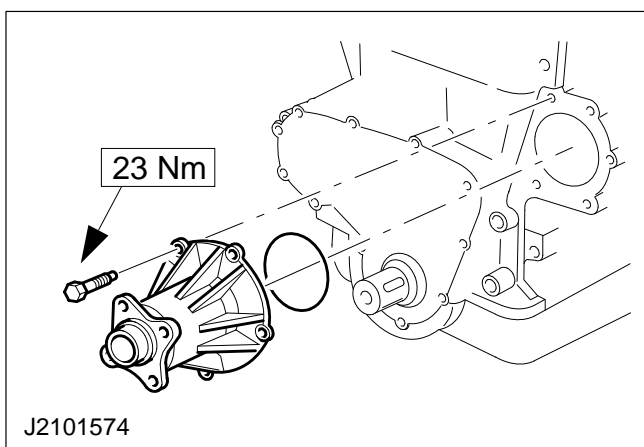
- Fit the cover with the centring cap.
- Tighten the bolts.
- Remove the centring cap.



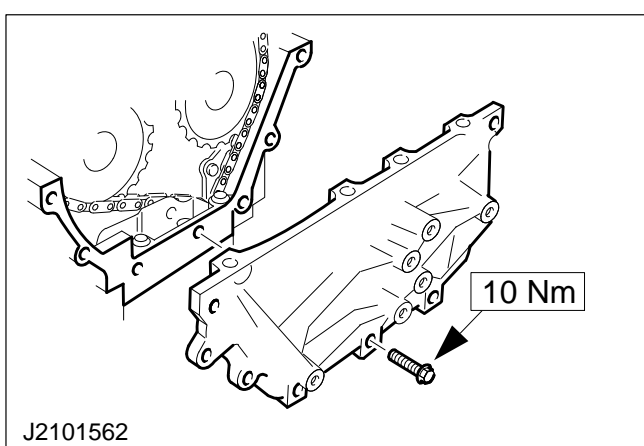
CAUTION: The tightening torque must be strictly adhered to. Use Special Tool 21-540.

90. Attach the crankshaft pulley/vibration damper.

Immobilise the engine using Special Tool 21-168.

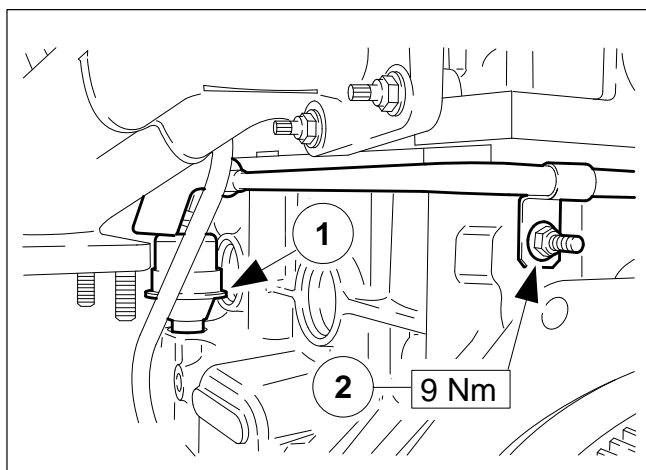


91. Fit the water pump with a new gasket.



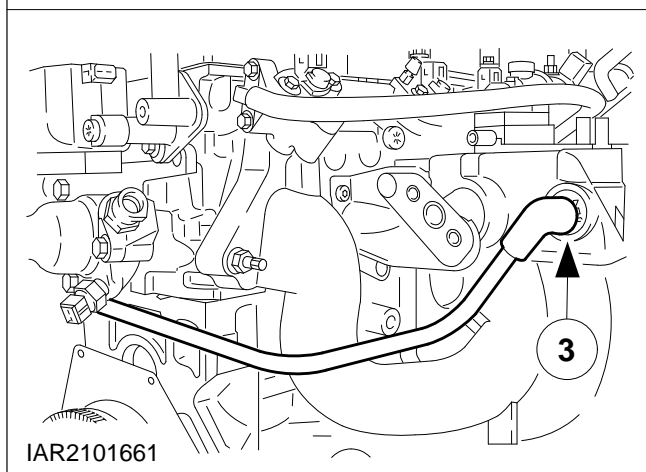
NOTE: The upper edge of the cover must be a maximum of 0,13 mm below the mating face of the cylinder head cover.

92. Fit the upper timing chain cover.

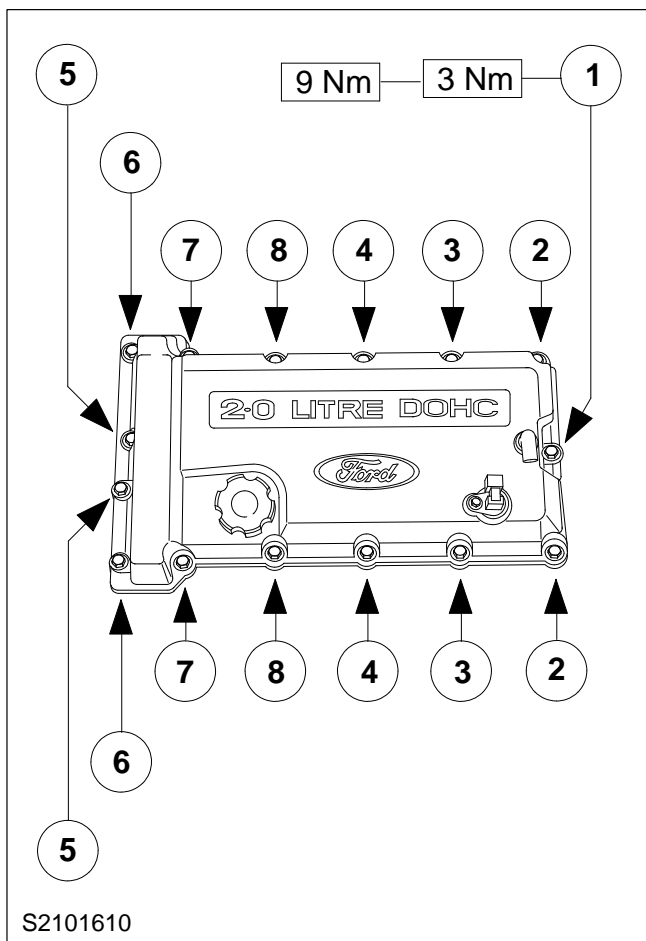


93. Attach the positive crankcase ventilation (PCV) hose.

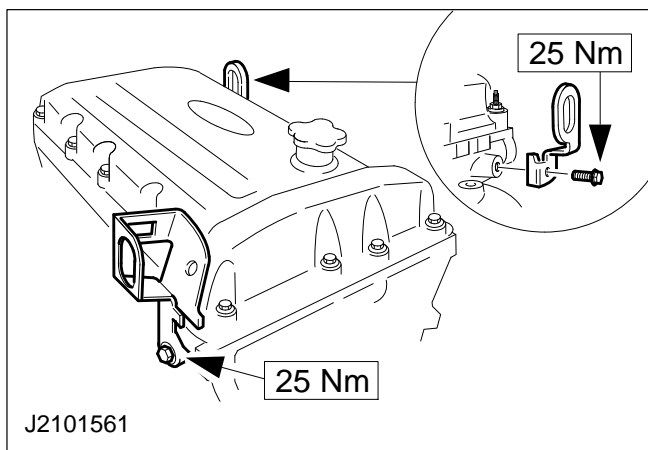
- 1 Push it into the exhaust manifold.
- 2 Attach the bracket to the cylinder head.
- 3 Connect it to the inlet manifold.



IAR2101661



94. Fit the cylinder head cover with a new gasket (11 bolts and four nuts).



95. Fit the engine lifting eyes.