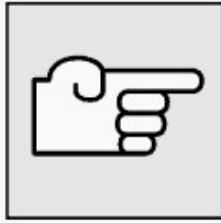


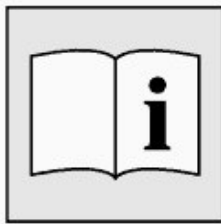
Read fault memory and make a documentary record.



Remove cylinder head.

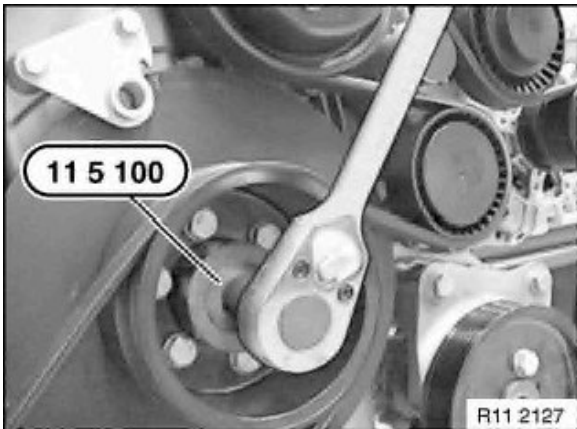
Remove all spark plugs.

Remove fan clutch with fan impeller and fan cowl.

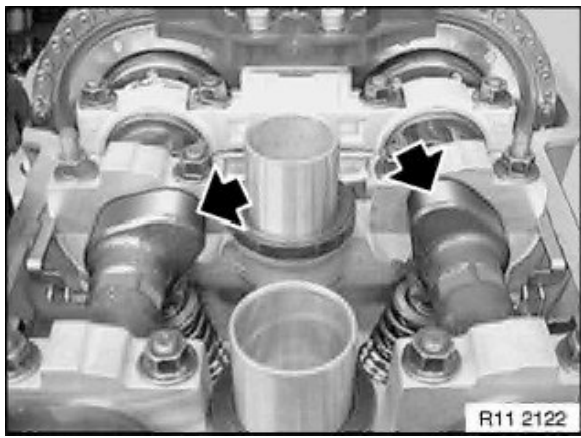


Removal:

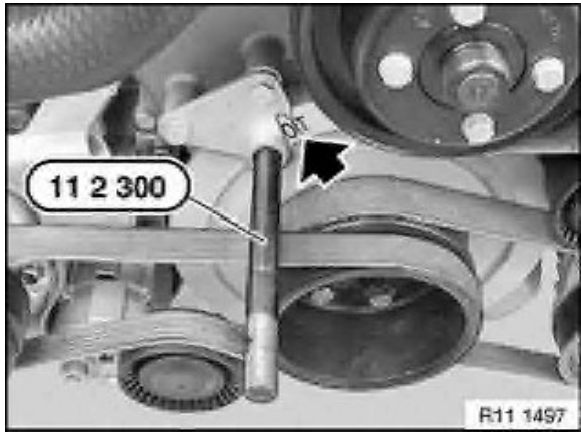
Removal of the VANOS adjustment unit and the camshafts is described separately from installation. The assembly sequence for removal and installation is different.



Fit special tool 11 5 100 to four screws on crankshaft hub.



Rotate crankshaft in direction of rotation as far as firing TDC position of 1st cylinder.



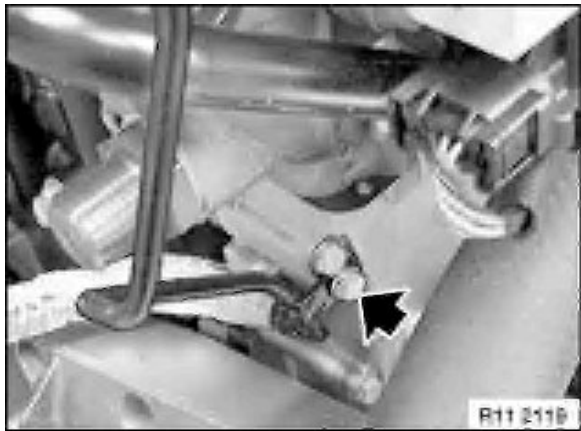
Rotate crankshaft in direction of rotation as far as ignition TDC position of cylinder 1. Secure vibration damper in position with special tool 11 2 300.



Caution!

When the engine is switched off, VANOS moves the camshafts to a position which is advantageous to engine starting.

The camshafts and the VANOS adjustment unit must be placed in the installation position before the VANOS adjustment unit is removed.



Detach bracket of oil line from timing case cover.



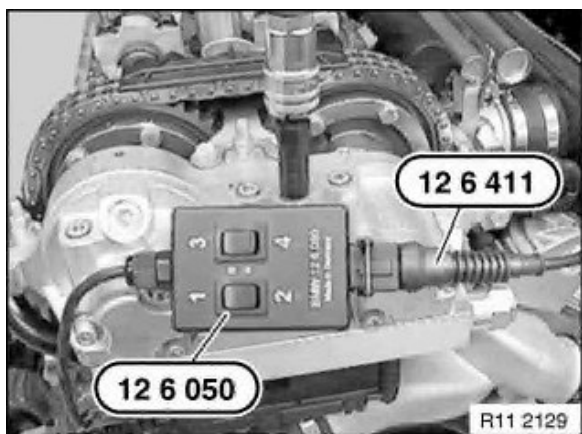
Remove oil line from VANOS adjustment unit.



Fit special tool 11 7 130 to VANOS adjustment unit.
Connect compressed air (2 to 8 bar).

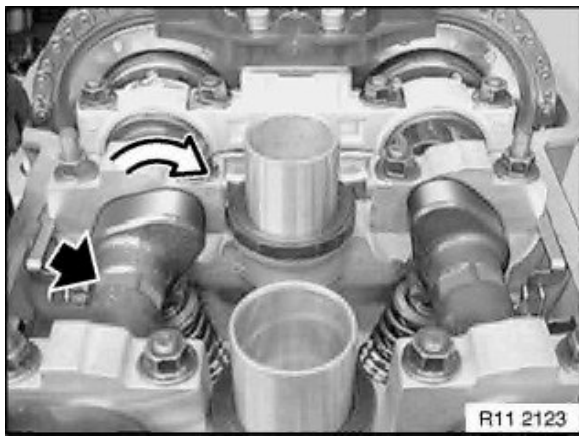


Disconnect plug connection on solenoid valve.



Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves. Connect special tool 12 6 411 to correct terminals on car battery.

Alternately press toggle switch buttons 1 and 2 several times on special tool 12 6 050.

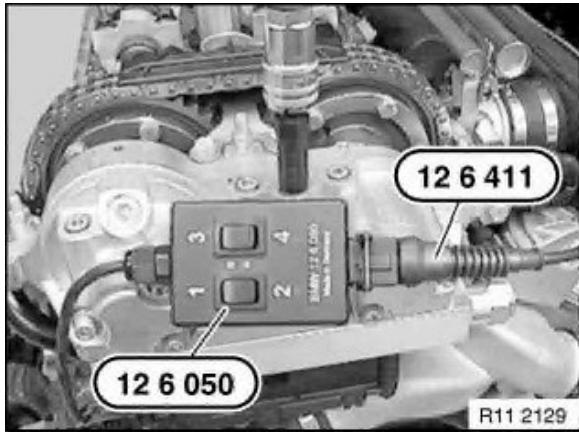


Press and hold down toggle switch button 1 on special tool 12 6 050.

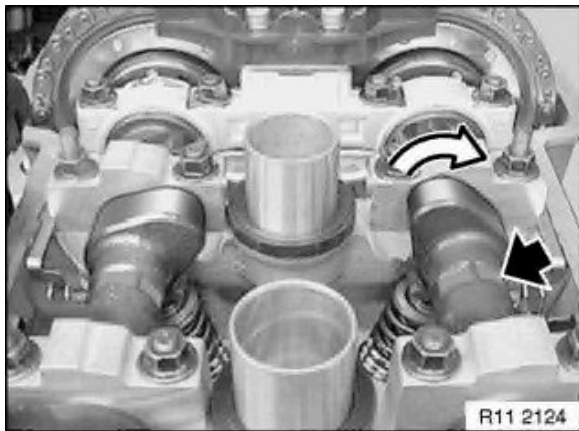
At same time, rotate inlet camshaft at hexagon drive against direction of rotation as far as it will go.

Note:

Spline teeth in VANOS gear are engaged; and inlet camshaft cannot be rotated further.



Alternately press toggle switch buttons 3 and 4 several times on special tool 12 6 050.

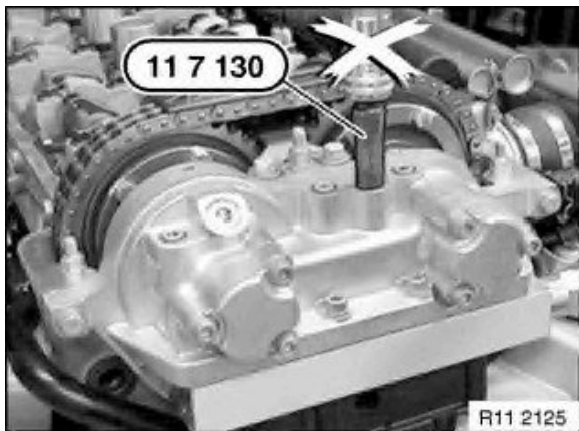


Press and hold down toggle switch button 3 on special tool 12 6 050.

At same time, rotate exhaust camshaft at hexagon drive against direction of rotation as far as it will go.

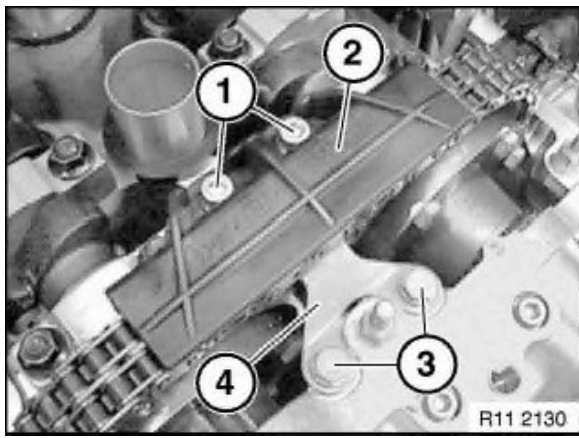
Note:

Spline teeth in VANOS gear are engaged; and exhaust camshaft cannot be rotated further.

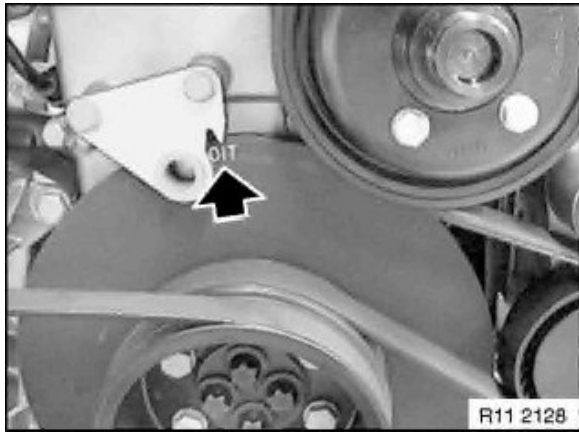


Disconnect compressed air from special tool 11 7 130.

Remove special tool 11 7 130.



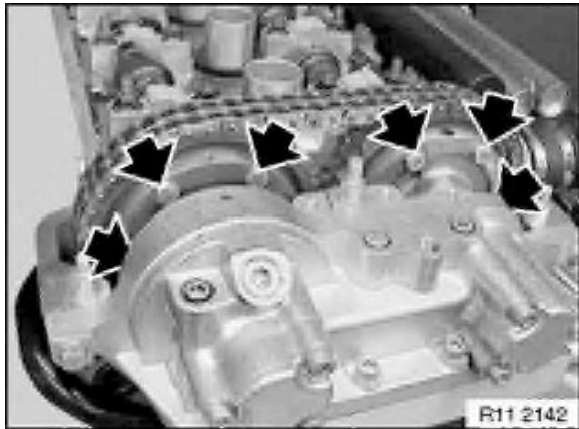
- Release screws (1).
- Remove sliding rail (2).
- Release screws (3).
- Remove holder (4).



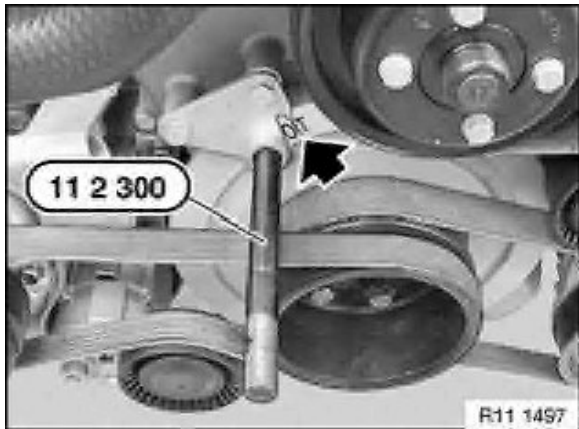
Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

Note:

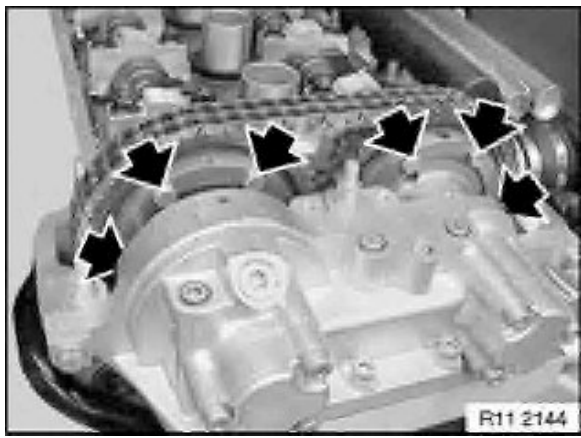
TDC allocation above marking on vibration damper is sufficient.



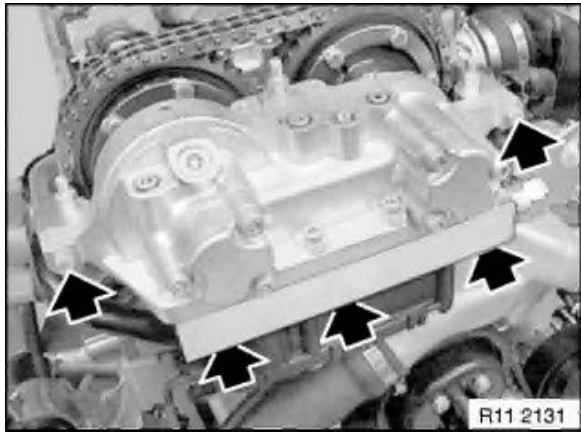
Slacken six accessible bolts two turns.



Crank engine at central bolt in direction of rotation until 1st cylinder is at TDC firing position. Secure vibration damper in position with special tool 11 2 300.



Slacken remaining six bolts two turns.

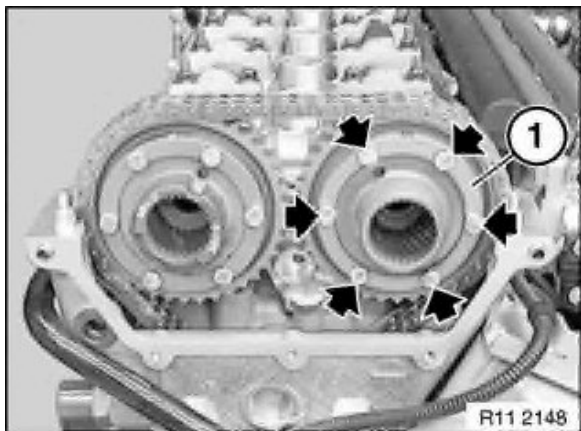


Release screws on VANOS adjustment unit.



Caution!

Do not damage VANOS adjustment unit.
Carefully detach VANOS adjustment unit.

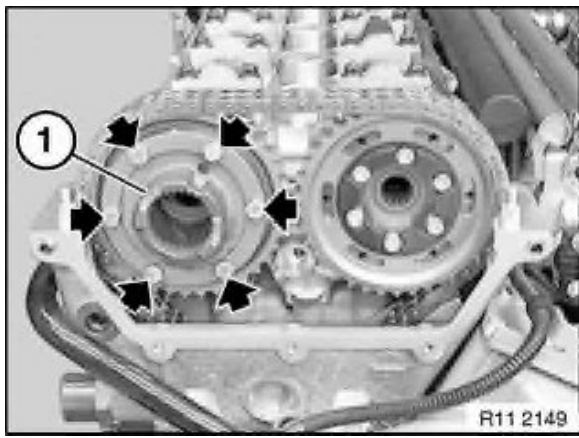


Inlet side:

Note:

The spline hub (1) accommodates a plate spring and a supporting ring.
Take care: the supporting ring can easily fall out when removed.

Remove slackened screws on inlet side.
Remove spline hub (1) with plate spring and supporting ring.



Exhaust side:

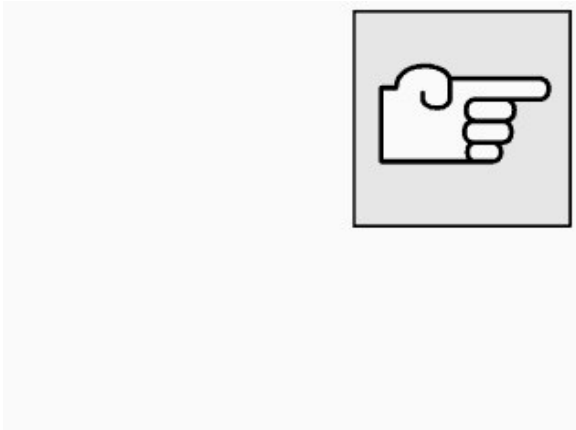
Note:

The spline hub (1) accommodates a plate spring and a supporting ring.

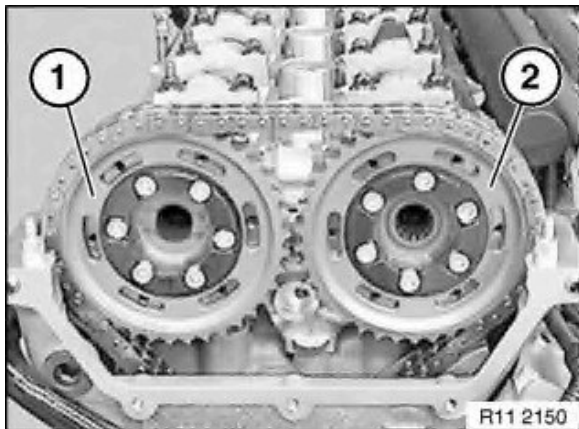
Take care: the supporting ring can easily fall out when removed.

Remove slackened screws on exhaust side.

Remove spline hub (1) with plate spring and supporting ring.



Remove chain tensioning piston.

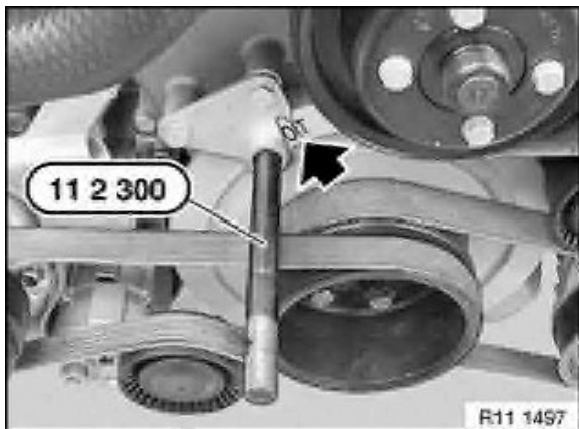


Detach sprocket wheel (1 and 2) from centering sleeve.

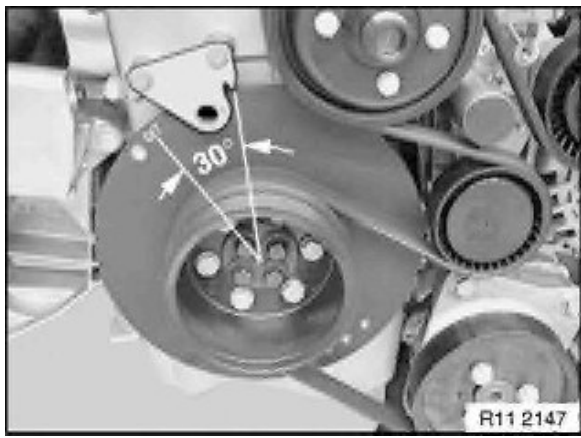
Hold timing chain under tension.

Feed out sprocket wheel (1 and 2).

Secure timing chain against slipping down.



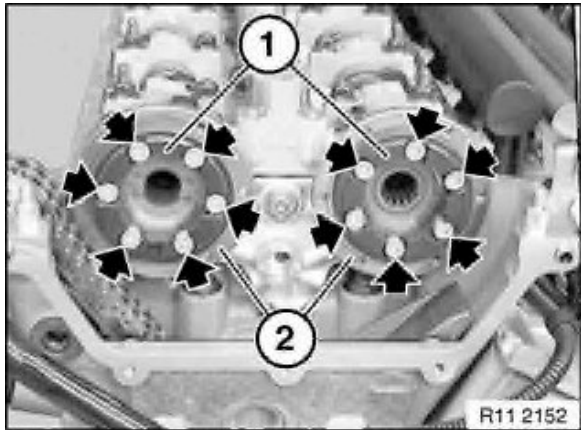
Remove special tool 11 2 300.

**Caution!**

No piston must be in the TDC position when the camshafts are removed.

Lift timing chain and hold under tension.

Crank engine at central bolt against direction of rotation to 30° before TDC position.

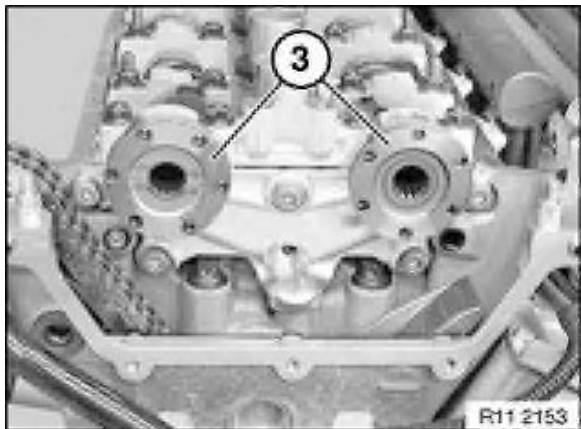
**Note:**

This work step is only necessary if the camshafts are to be replaced at a later stage.

Grip camshafts at hexagon head.

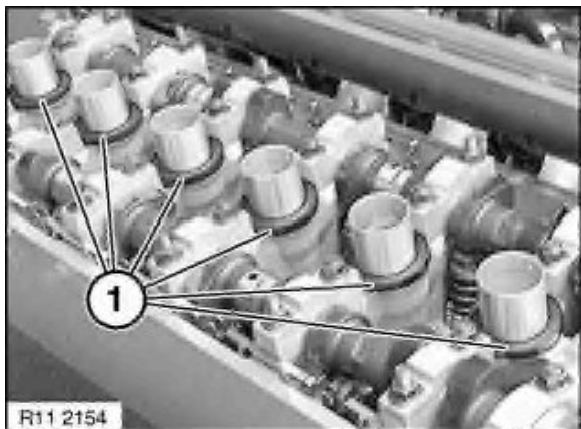
Release bolts on centering sleeves (1).

Remove centering sleeves (1) on exhaust and inlet sides with thrust washers (2).

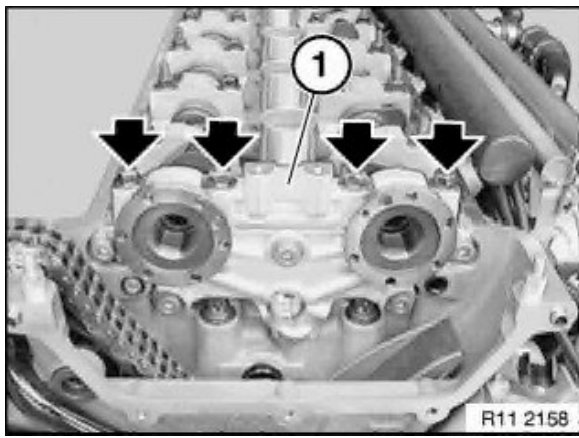
**Note:**

This work step is only necessary if the camshafts are to be replaced at a later stage.

Withdraw toothed sleeves (3) from exhaust and inlet camshafts.



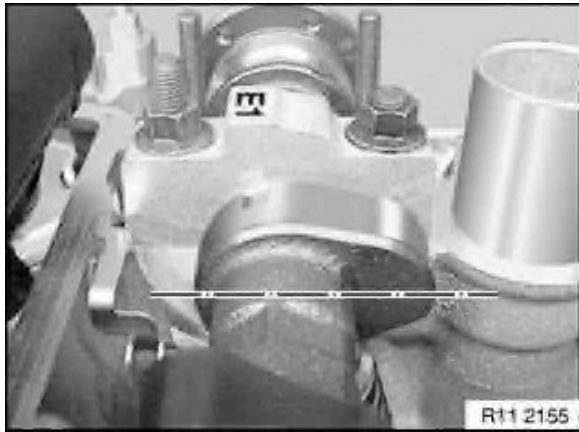
Remove profile seal (1).



Note:

Inlet and exhaust camshafts have a joint thrust bearing flange at 1st bearing seat. Thrust bearing flange is secured with adapter sleeves.

Release nuts and remove thrust bearing flange (1).

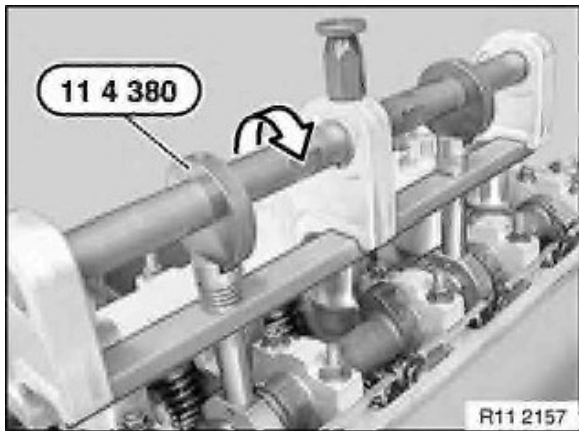


Removing inlet camshaft:

Caution!

Note direction and angle of rotation.

Rotate inlet camshaft at hexagon inwards until cam tips on 1st cylinder are horizontal.



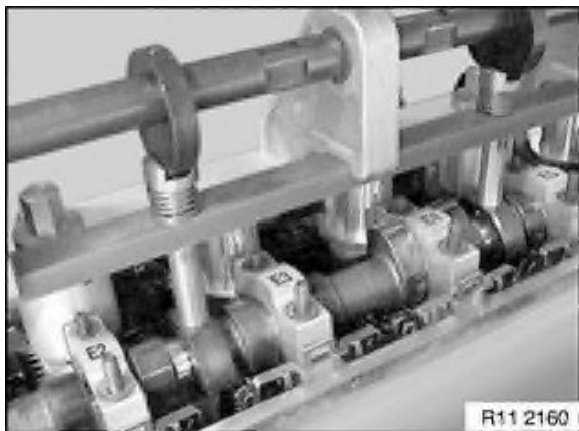
Inlet side:

Caution!

Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on inlet camshaft and screw into spark plug threads of cylinders 2 and 5.

Pretension inlet camshaft by rotating eccentric shaft. Release all nuts of bearing caps on inlet camshaft.



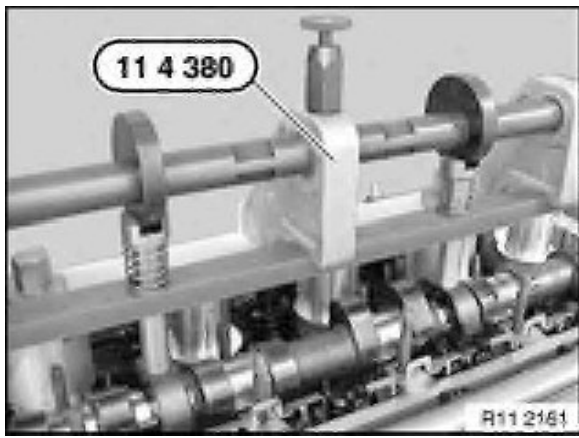
Inlet side:

Note:

Bearing caps are secured with adapter sleeves.

Bearing caps are marked E1 to E6 from inlet side.

Feed out bearing caps E1 to E6 and set to one side in order.

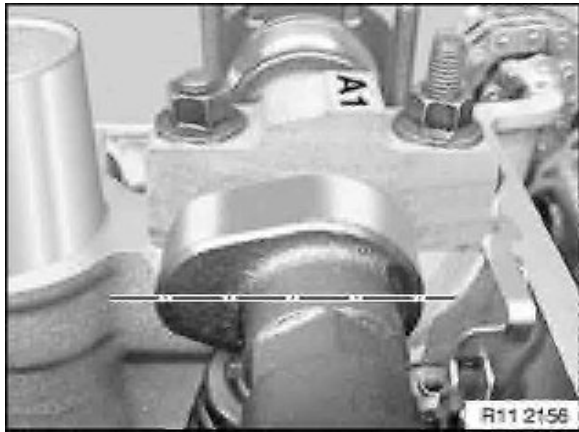


Inlet side:

Caution!

Inlet camshaft must not tilt when tension is relieved on special tool 11 4 380.

Relieve tension on special tool 11 4 380 and remove.
Lift out inlet camshaft.

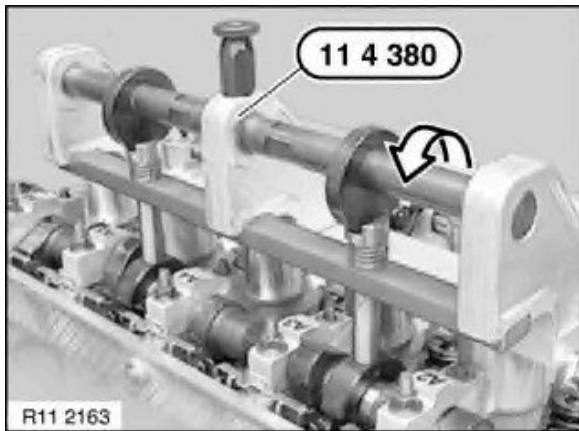


Removing exhaust camshaft:

Caution!

Note direction and angle of rotation.

Rotate exhaust camshaft at hexagon inwards until cam tips on 1st cylinder are horizontal.



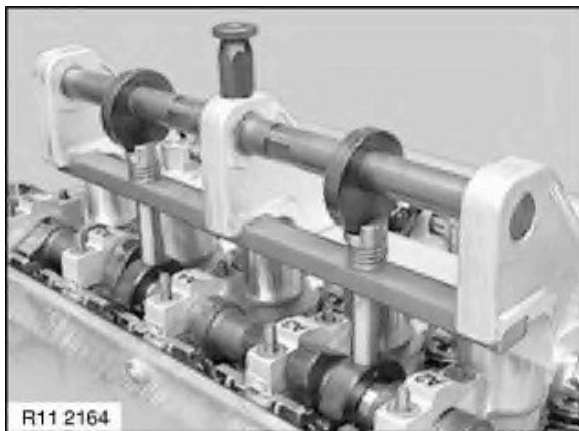
Exhaust side:

Caution!

Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on exhaust camshaft and screw into spark plug threads of cylinders 2 and 5.

Pretension exhaust camshaft by rotating eccentric shaft. Release all nuts of bearing caps on exhaust camshaft.



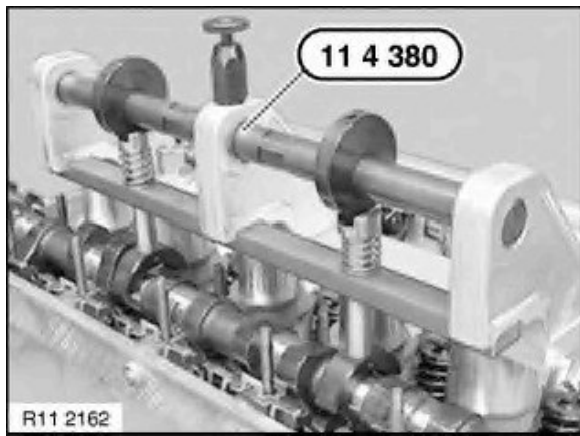
Exhaust side:

Note:

Bearing caps are secured with adapter sleeves.

Bearing caps are marked A1 to A6 from inlet side.

Feed out bearing caps A1 to A6 and set to one side in order.

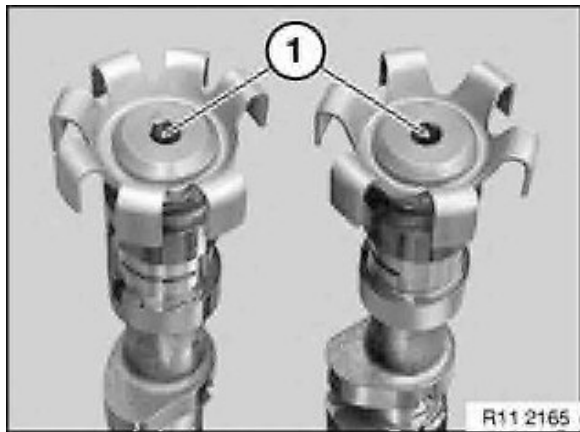


Exhaust side:

Caution!

Exhaust camshaft must not tilt when tension is relieved on special tool 11 4 380.

Relieve tension on special tool 11 4 380 and remove.
Lift out exhaust camshaft.

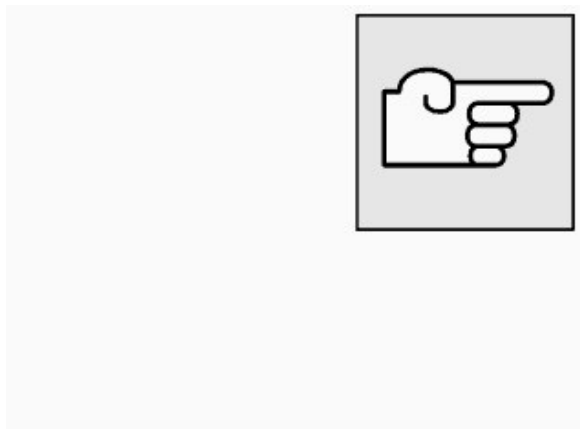


If necessary, removing signal disk of exhaust and inlet camshafts:

Caution!

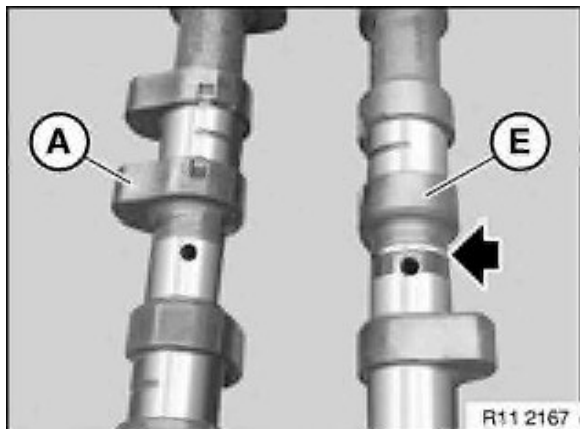
Do not damage camshafts. Use protective vise jaws.

Grip camshaft at hexagon in a vise and release banjo bolt (1).



Installation:

Installation of camshafts and the VANOS adjustment unit is described separately from removal. The assembly sequence for removal and installation is different.

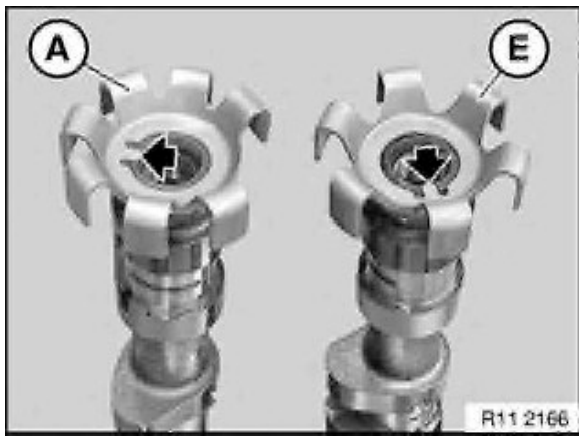


Caution!

Danger of mixing up

The inlet camshaft has an identifying groove behind the locating bore.

- (A) Exhaust camshaft without groove
- (E) Inlet camshaft with groove



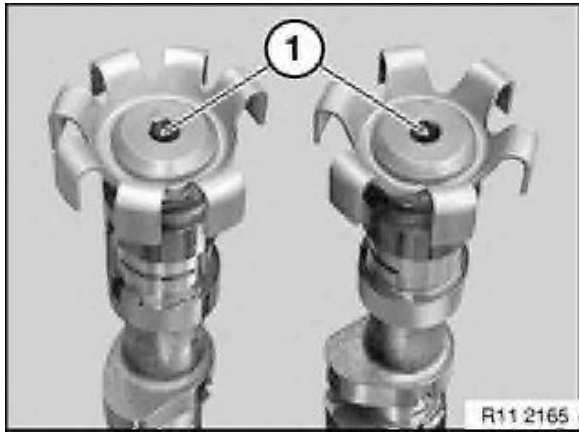
Note:

Signal rings of inlet and exhaust camshafts are different.

(A) Signal disk of exhaust camshaft with seven blades.

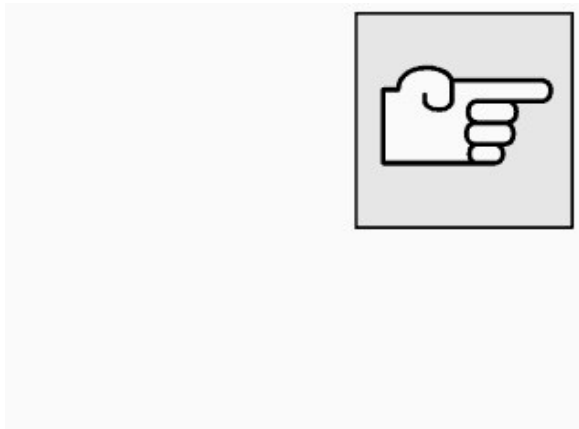
(E) Signal disk of inlet camshaft with six blades.

Fit signal disks, align locating lug to groove.



Install banjo bolt (1) and tighten down.

Tightening torque, 11 31 13AZ.

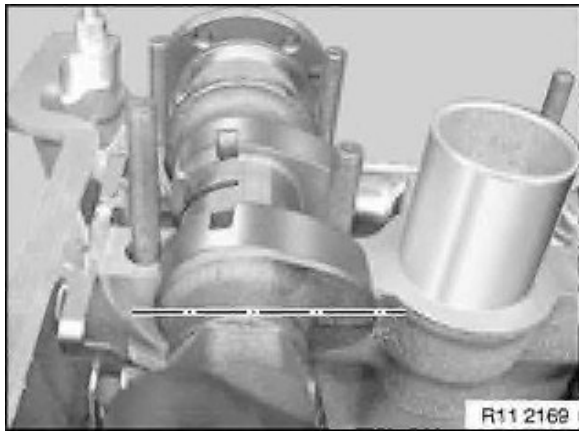


Note:

Clean dirty parts.

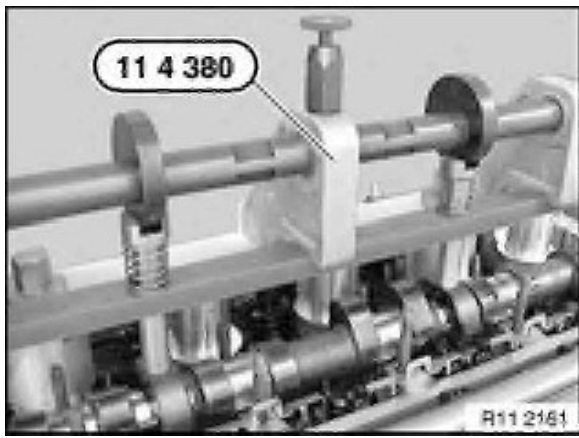
Oil following parts before installation:

- Contact faces of camshafts in cylinder head
- Rocker arm
- Cams and contact faces of camshafts
- Bearing cover



Installing inlet camshaft:

Install inlet camshaft in such a way that cams on cylinder 1 point horizontally inwards.

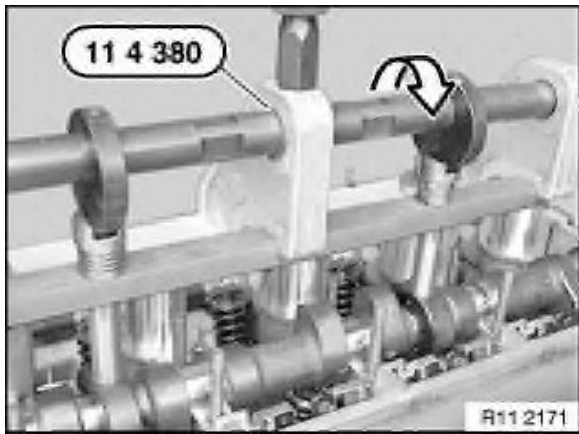


Inlet side:

Caution!

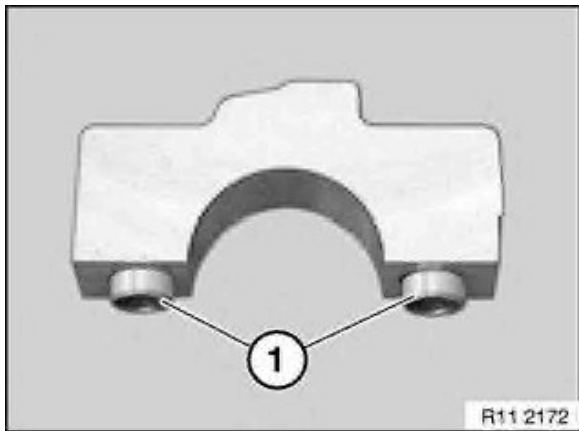
Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on inlet camshaft and screw into spark plug threads of cylinders 2 and 5.



Inlet side:

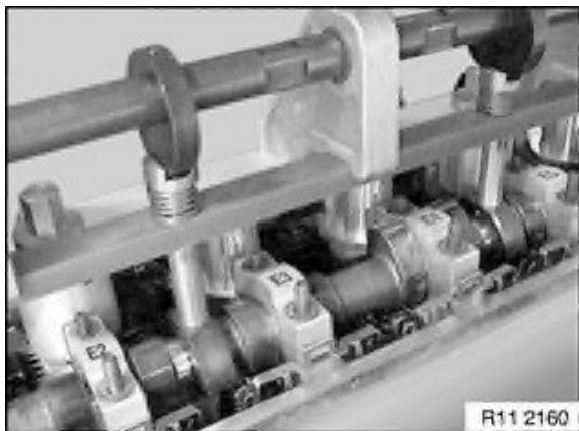
Pretension inlet camshaft by rotating eccentric shaft.



Note:

Bearing caps are secured with adapter sleeves (1).

Check dowel sleeves (1) for damage and correct installation position.

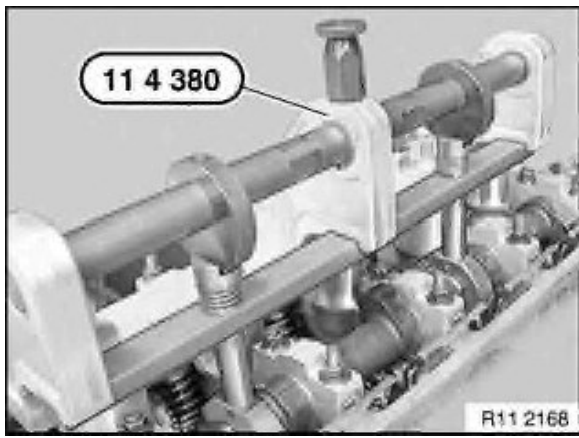


Inlet side:

Note:

Bearing caps are marked E1 to E6 from inlet side.

Install bearing caps E1 to E6.



Inlet side:

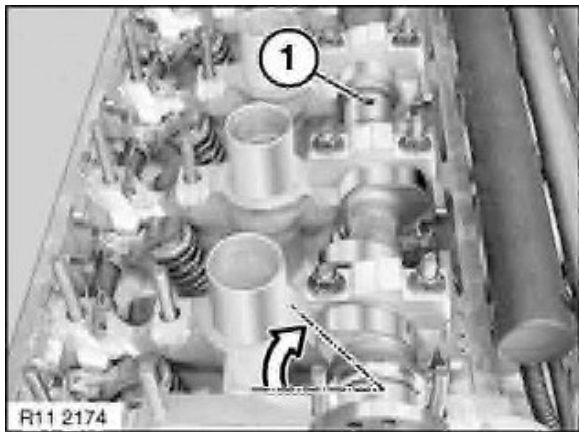
Align bearing caps by hand until they are secured by means of adapter sleeves.

Insert all nuts of bearing caps on inlet camshaft.

Manually tighten bearing cap nuts and then tighten down from inside to outside in 1/2 turn increments.

Tightening torque, 11 31 1AZ.

Remove special tool 11 4 380.

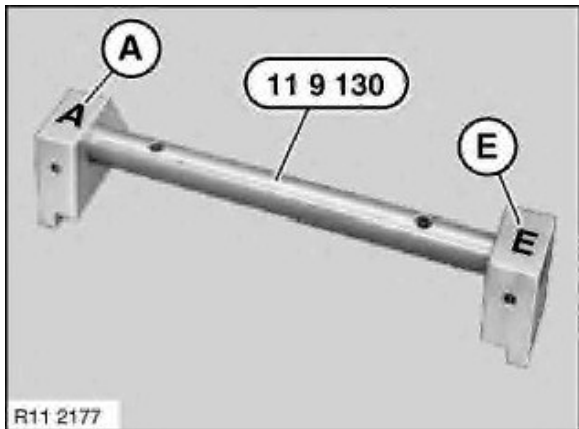


Inlet side:

Caution!

Note direction and angle of rotation.

Rotate inlet camshaft at hexagon from horizontal position upwards until locating bore (1) in camshaft is vertical.

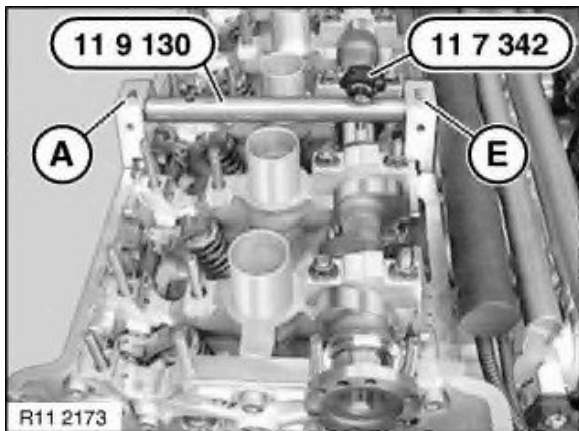


Caution!

Pay attention to installation direction of special tool 11 9 130.

(A) Exhaust side

(E) Inlet side



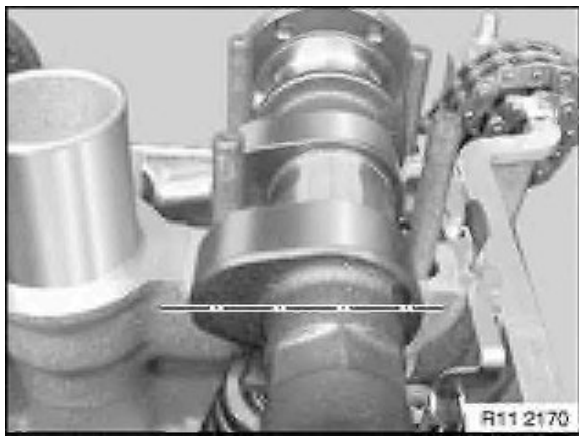
Inlet side:

Attach special tool 11 9 130 to cylinder head.

Align inlet camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head.

Remove special tool 11 9 130 and special tool 11 7 342.



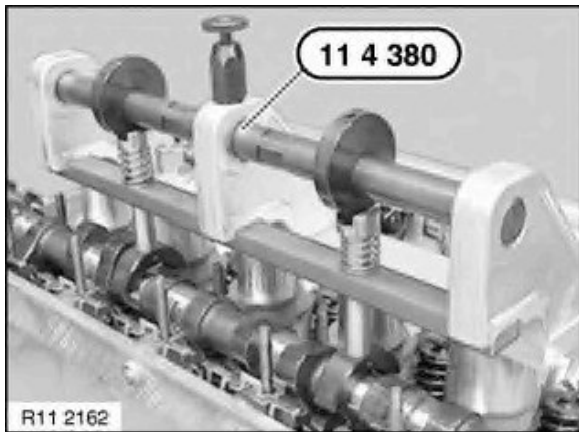
Installing exhaust camshaft:

Clean dirty parts.

Oil following parts before installation:

- Contact faces of camshafts in cylinder head
- Rocker arm
- Cams and contact faces of camshafts
- Bearing cover

Install exhaust camshaft in such a way that cams on cylinder 1 point horizontally inwards.

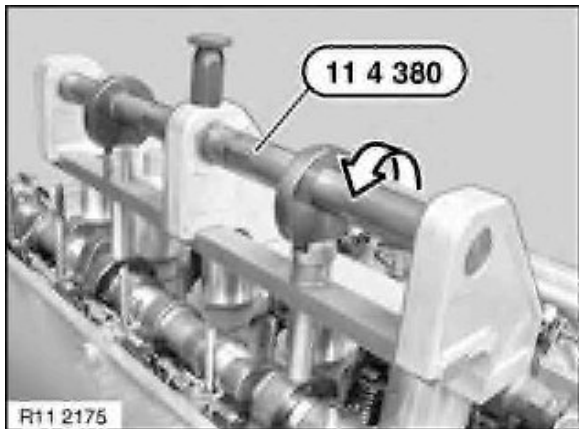


Exhaust side:

Caution!

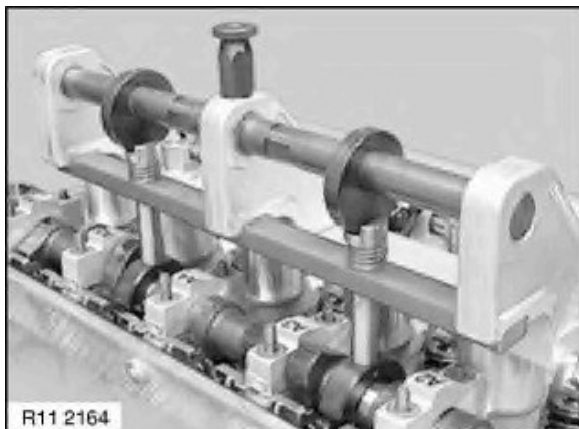
Incorrect removal/installation without a special tool exposes the camshaft to the risk of preliminary damage or breakage.

Fit special tool 11 4 380 on exhaust camshaft and screw into spark plug threads of cylinders 2 and 5.



Exhaust side:

Pretension exhaust camshaft by rotating eccentric shaft.



Exhaust side:

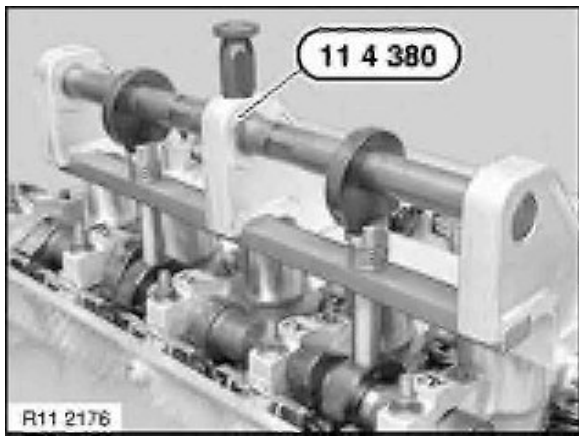
Note:

Bearing caps are secured with adapter sleeves.

Check adapter sleeves for damage and correct installation position.

Bearing caps are marked A1 to A6 from inlet side.

Install bearing caps A1 to A6.



Exhaust side:

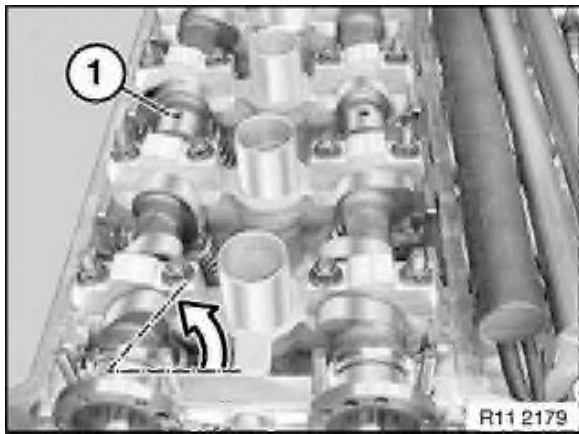
Align bearing caps by hand until they are secured by means of adapter sleeves.

Insert all nuts of bearing caps on exhaust camshaft.

Manually tighten bearing cap nuts and then tighten down from inside to outside in 1/2 turn increments.

Tightening torque, 11 31 1AZ.

Remove special tool 11 4 380.

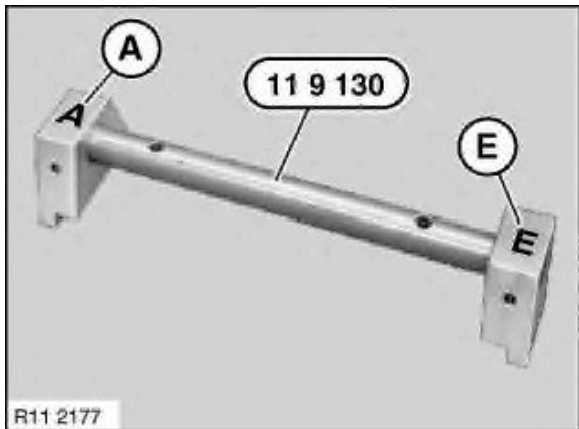


Exhaust side:

Caution!

Note direction and angle of rotation.

Rotate exhaust camshaft at hexagon from horizontal position upwards until locating bore (1) in camshaft is vertical.

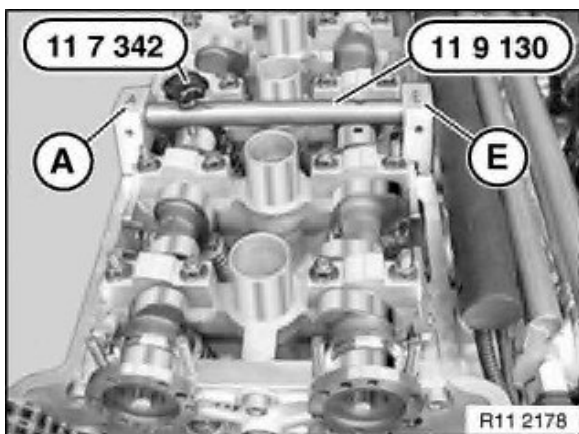


Caution!

Pay attention to installation direction of special tool 11 9 130.

(A) Exhaust side

(E) Inlet side



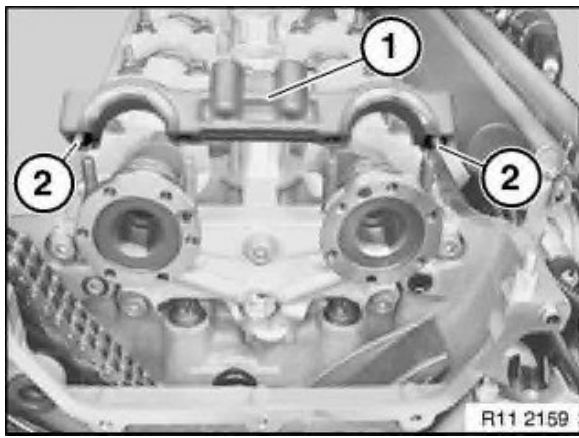
Exhaust side:

Attach special tool 11 9 130 to cylinder head.

Align exhaust camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head.

Remove special tool 11 9 130 and special tool 11 7 342.



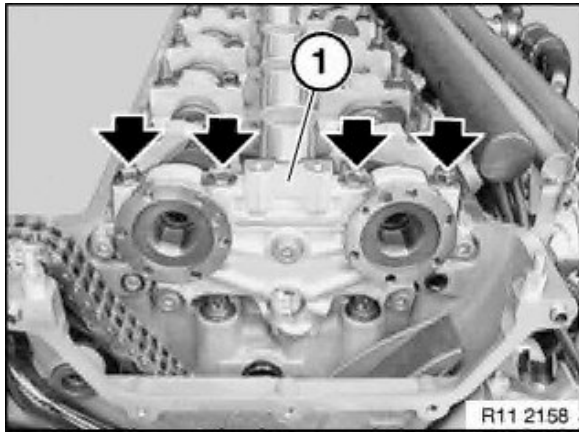
Note:

Inlet and exhaust camshafts have a joint thrust bearing flange (1) at 1st bearing seat.

Check adapter sleeves (2) for damage and correct installation position.

Observing installation direction:

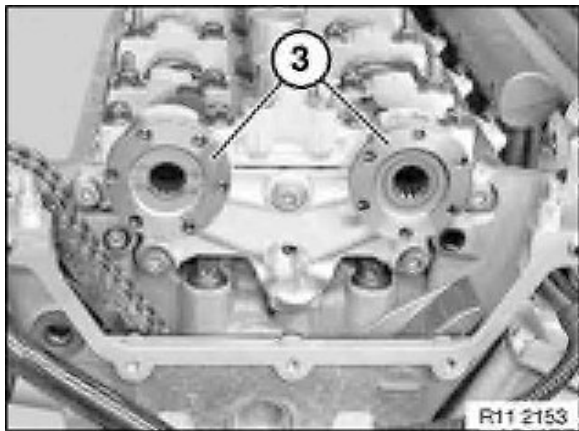
Fit thrust bearing flange (1) - as shown in illustration.



Align thrust bearing flange (1) by hand until it is secured to cylinder head by means of adapter sleeves.

Install nuts of thrust bearing flange (1).

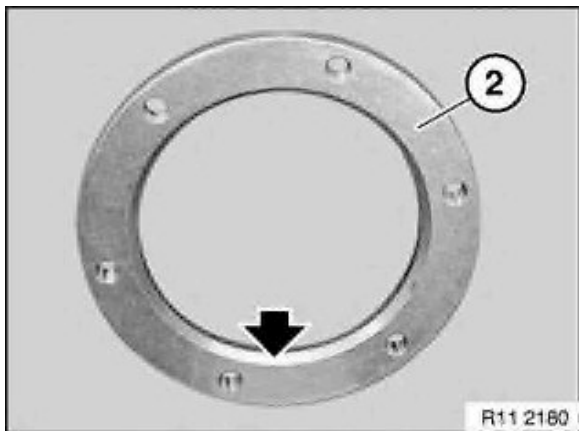
Manually tighten nuts and then tighten down from in 1/2 turn increments.



Coat splines of toothed sleeves (3) with engine oil as antiseize agent.

Install toothed sleeves (3) of exhaust and inlet camshafts.

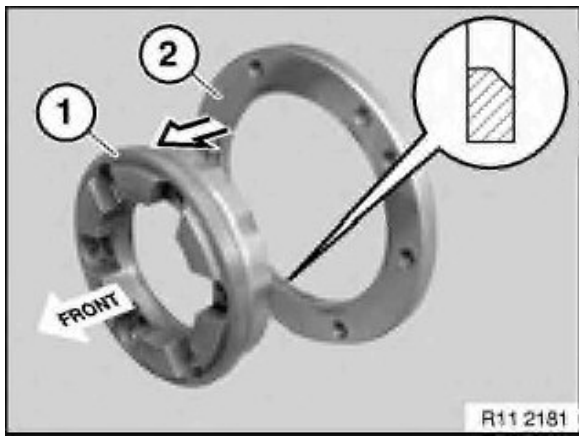
Align bores in toothed sleeves (3) to tapped holes in camshafts.



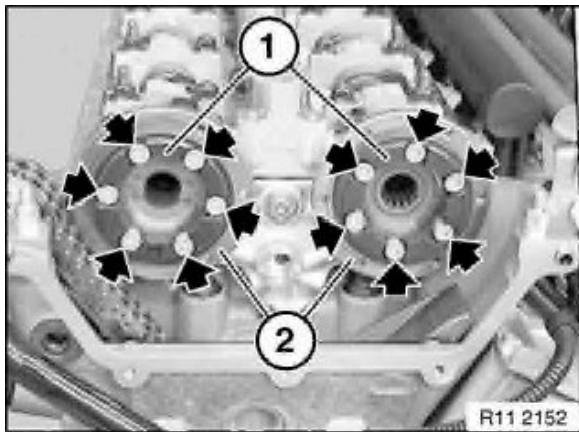
Caution!

Note installation direction of thrust washers (2).

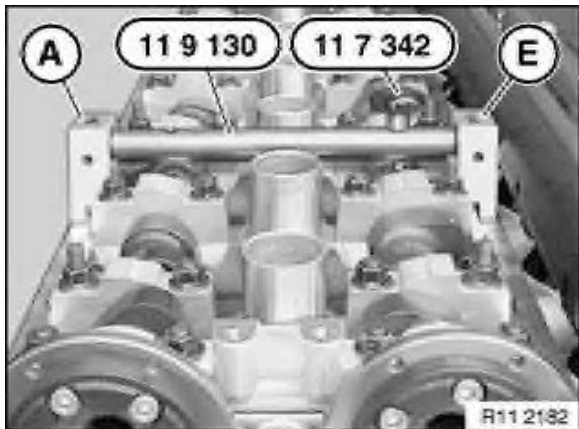
Large chamfer points to camshaft.



Note installation direction of thrust washers (2).
Fit thrust washers (2) on centering sleeves (1) in such a way that large chamfer points towards rear to camshaft.



Fit centering sleeve (1) on exhaust and inlet sides with thrust washer (2).
Grip camshafts at hexagon head.
Tighten down bolts on centering sleeves (1).



Inlet side:

Caution!

Pay attention to installation direction of special tool 11 9 130.

Attach special tool 11 9 130 to cylinder head. Align inlet camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

Special tool 11 9 130 must rest flat on cylinder head. Remove special tool 11 7 342.

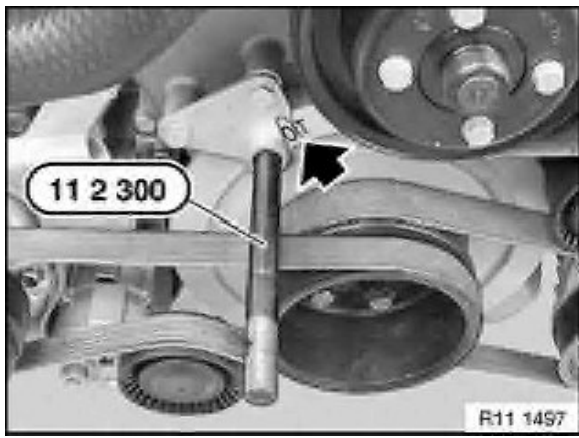


Exhaust side:

Align exhaust camshaft at hexagon until special tool 11 7 342 can be joined by means of special tool 11 9 130 in locating bore.

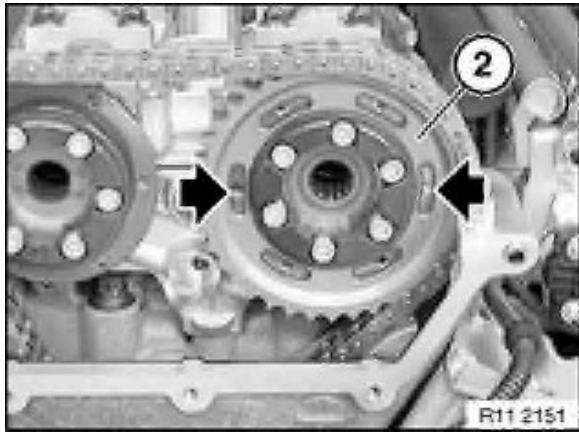
Special tool 11 9 130 must rest flat on cylinder head.

Remove special tool 11 9 130 and special tool 11 7 342.



Lift timing chain and hold under tension.

Rotate crankshaft from 30° before TDC position in direction of rotation as far as firing TDC position. Secure vibration damper in position with special tool 11 2 300.



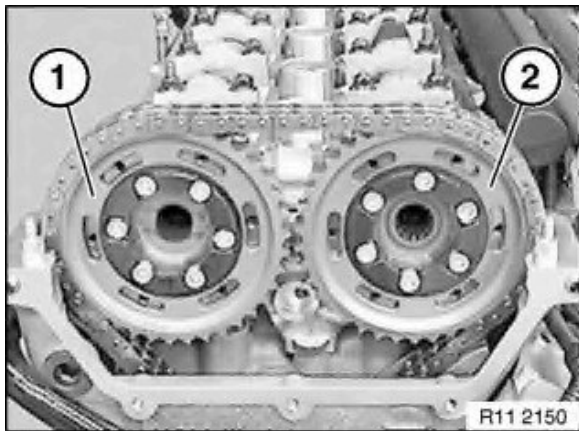
Hold timing chain under tension.

Position tapped holes of thrust washer horizontally -as shown in illustration.

Install sprocket wheel (2) on inlet side on centering sleeves in such a way that elongated holes are centrally located.

Note:

The position of the elongated holes is only important in terms of accessibility to the screws and does not affect operation in any way.

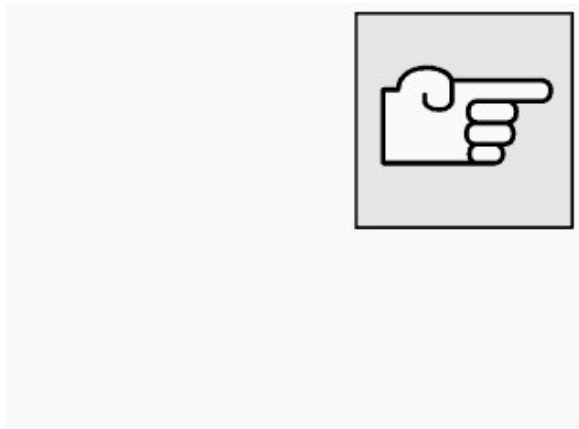


Hold timing chain under tension and feed on sprocket wheel (1). Install sprocket wheel (1) on exhaust side on centering sleeves in such a way that elongated holes of sprocket wheels (1 and 2) are centrally located.

Press tensioning rail against timing chain and check position of elongated holes.

Note:

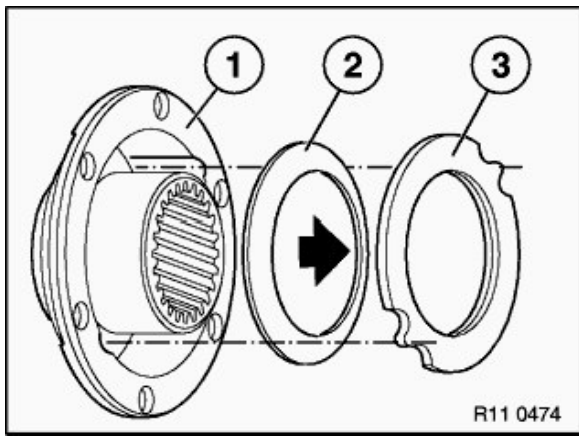
The position of the elongated holes is only important in terms of accessibility to the screws and does not affect operation in any way.



Install chain tensioning piston.

Note:

Coat all sliding surfaces on VANOS gear with engine oil as lubricant.

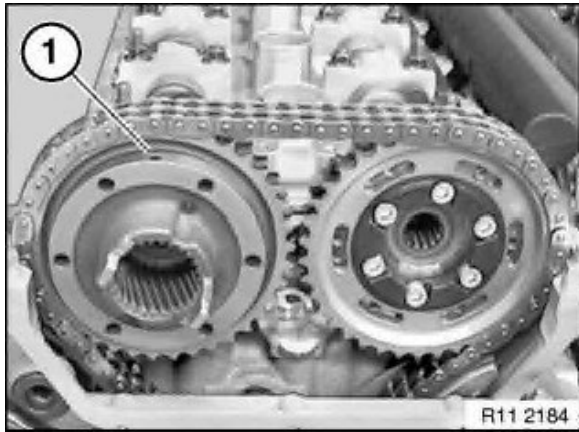


Exhaust side:

Note:

The small support diameter of the plate spring (2) points in the direction of the supporting ring (3). Supporting ring is supported with retaining lugs in spline hub (1).

Insert plate spring (2) and supporting ring (3) in spline hub (1).

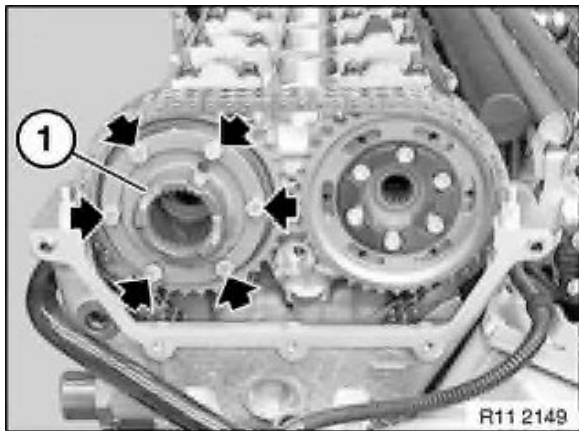


Exhaust side:

Take care: the supporting ring can easily fall out.

Remove spline hub with plate spring and supporting ring.

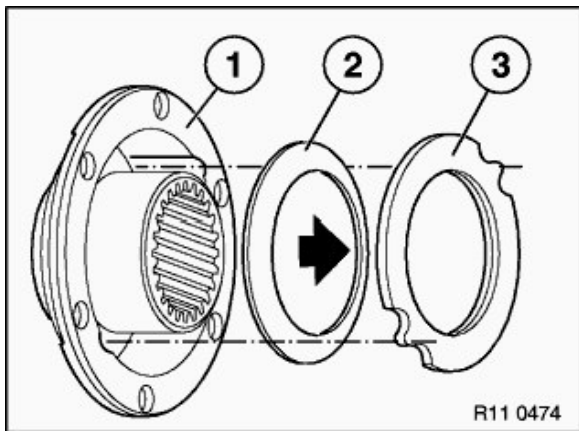
Bore hole (1) must - as shown in illustration - point upwards.



Exhaust side:

Insert all screws of spline hub (1) and tighten by hand until free of play.

Then slacken screws again until spline hub (1) can be moved with fingers.

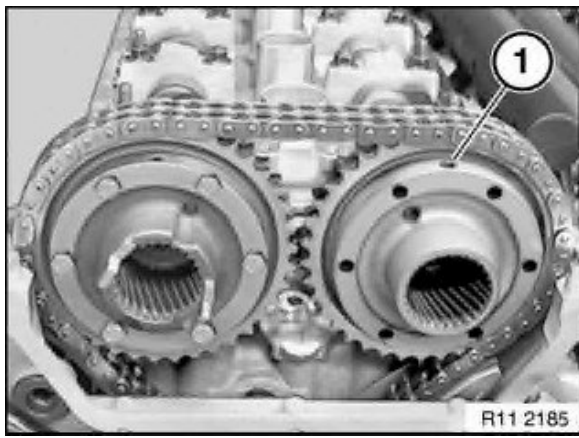


Inlet side:

Note:

The small support diameter of the plate spring (2) points in the direction of the supporting ring (3). Supporting ring is supported with retaining lugs in spline hub (1).

Insert plate spring (2) and supporting ring (3) in spline hub (1).

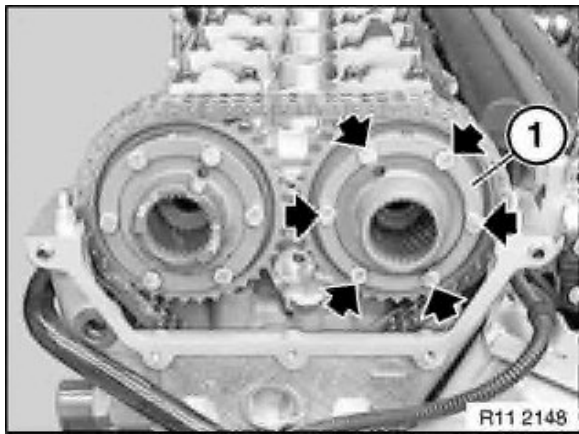


Inlet side:

Take care: the supporting ring can easily fall out.

Remove spline hub with plate spring and supporting ring.

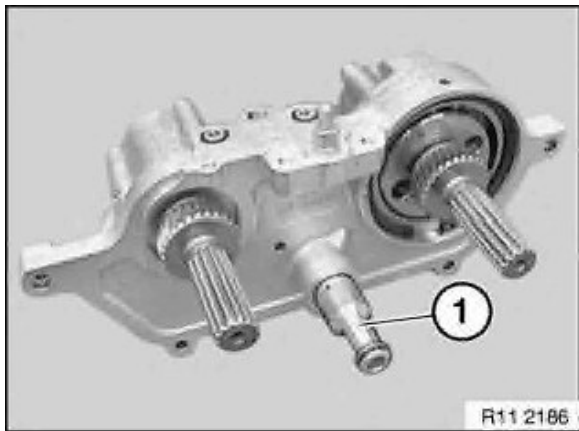
Bore hole (1) must - as shown in illustration - point upwards.



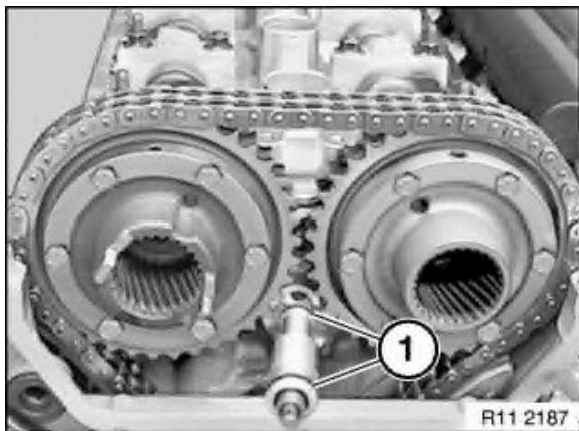
Inlet side:

Insert all screws of spline hub (1) and tighten by hand until free of play.

Then slacken screws again until spline hub (1) can be moved with fingers.



Detach control valve (1) from VANOS adjustment unit.



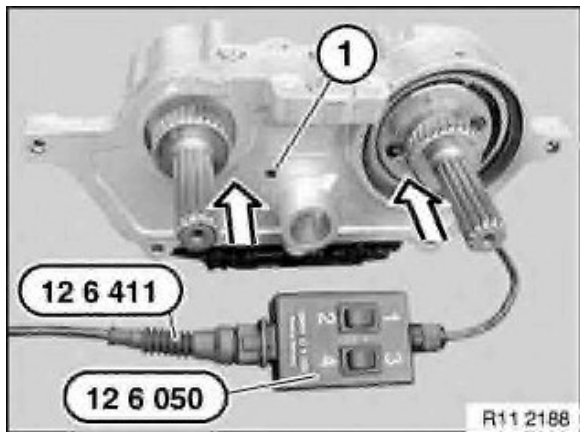
Note:

A filter is integrated in the control valve.

In the event of engine damage which suggests that the filter is contaminated with swarf/chips, it is essential to replace the control valve.

Replace sealing rings (1) and coat with oil as antiseize agent.

Preassemble control valve in cylinder head.

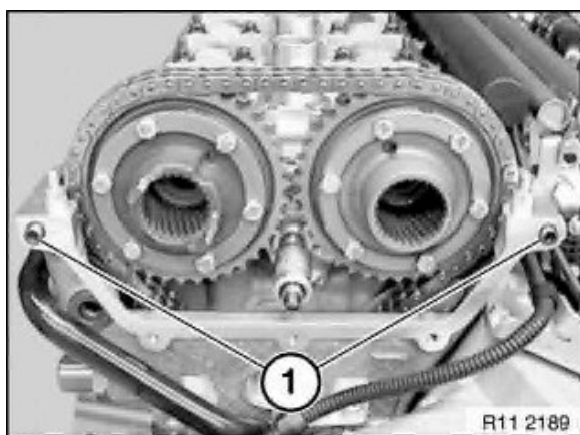


Oil is sprayed when splined shafts are pressed back. Cover bore (1) with a cloth.

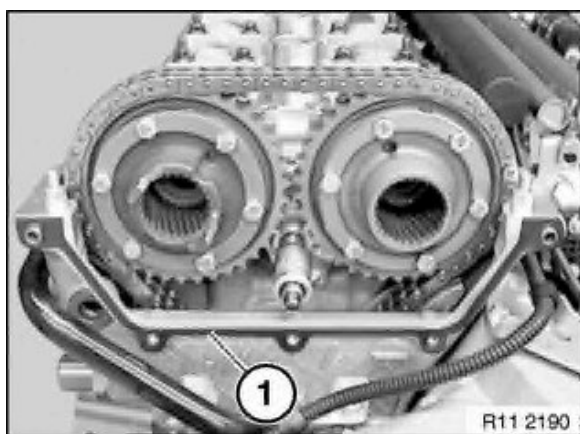
Connect special tool 12 6 050 in conjunction with special tool 12 6 411 (from special tool kit 12 6 410) to solenoid valves of VANOS adjustment unit. Connect special tool 12 6 411 to correct terminals on car battery.

Press buttons 1 and 3 on special tool 12 6 050 simultaneously. Solenoid valves are actuated.

Press splined shafts by hand up to stop into initial position.



Check dowel sleeves (1) for damage and correct installation position.



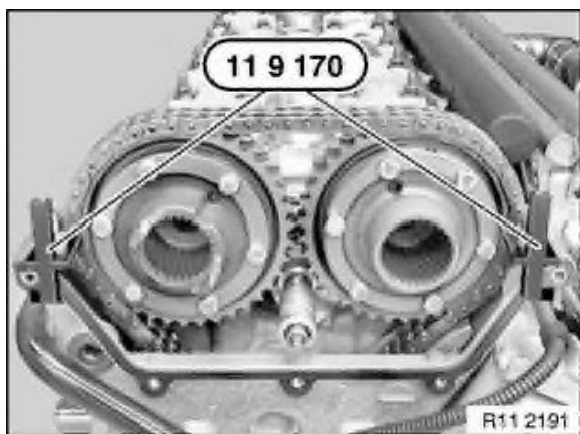
Replace gasket (1).

Caution!

Note direction of installation of gasket.

Install gasket (1) in such a way that beading points to VANOS adjustment unit.

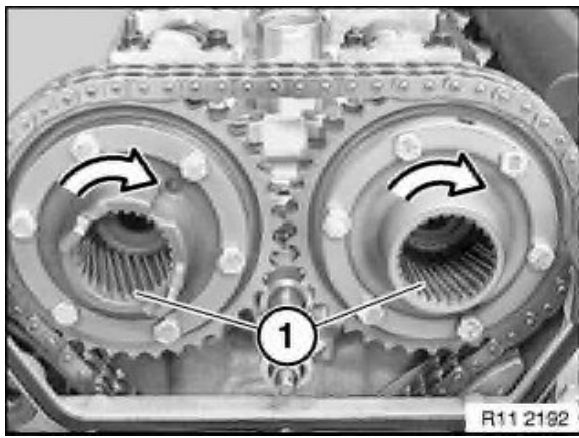
Secure gasket (1) with sealing compound on adapter sleeves.



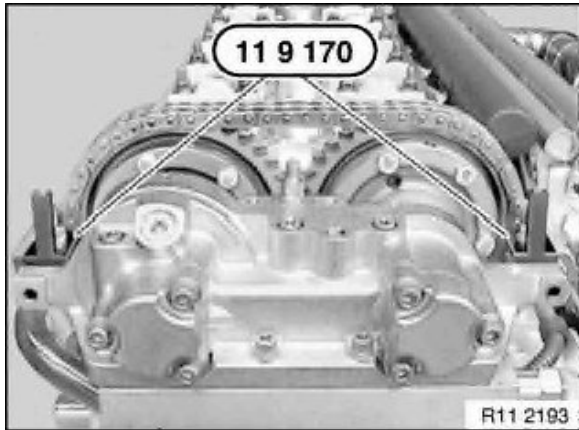
Secure special tool 11 9 170 - as shown in illustration - by means of stud bolt.

Note:

The special tool 11 9 170 serves to maintain a prespecified distance during the below-mentioned installation of the VANOS adjustment unit.



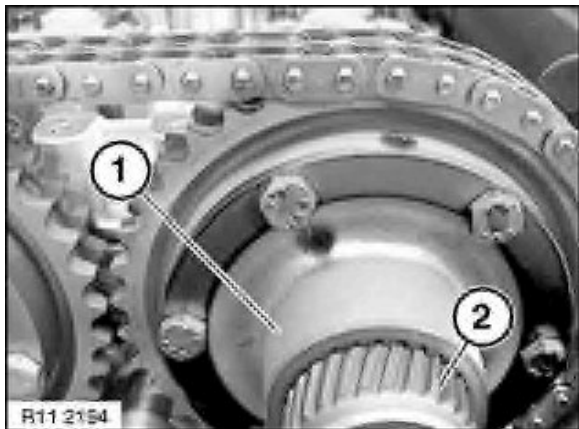
Turn spline hubs (1) of inlet and exhaust camshafts to right limit position.



Note:

Special tool 11 9 170 remains as a spacer element between cylinder head and VANOS adjustment unit.

Attach VANOS adjustment unit.

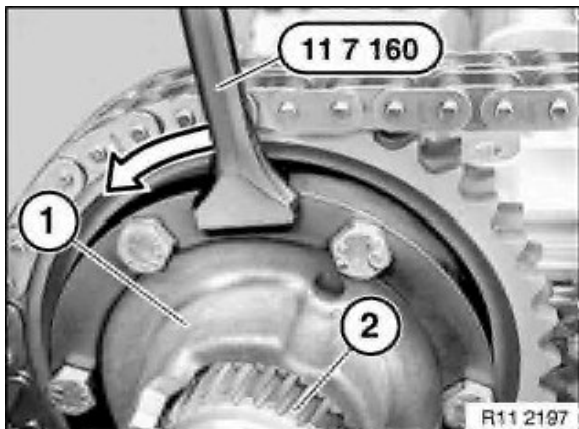


Caution!

Make sure both VANOS splined shafts remain in initial position during installation.

Rotate splined shafts of inlet and exhaust sides until spur tooting is engaged.

Push VANOS adjustment unit with splined shaft into VANOS gear until helical cut splines (2) are positioned shortly before meshing with spline hub (1).

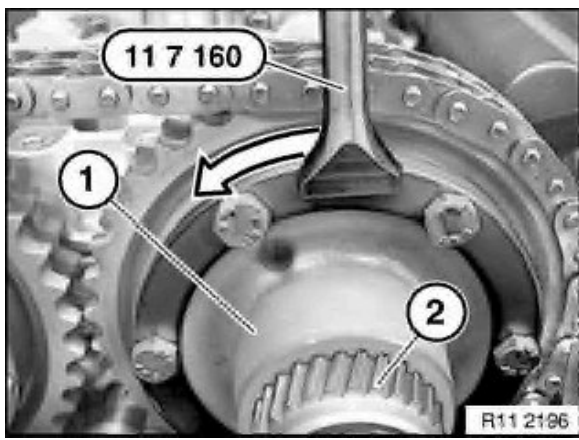


Exhaust side:

If the helical cut splines cannot be pushed into the spline hub (1): Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

Caution!

The "first" matching tooth must engage.

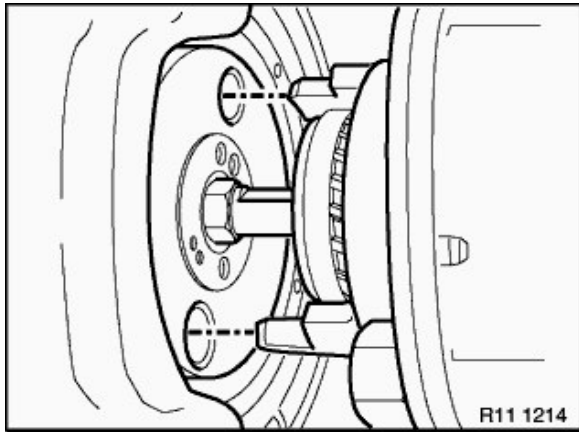


Inlet side:

Place special tool 11 7 160 on bore in spline hub (1). Rotate spline hub (1) against direction of rotation until splined shaft (2) is positioned with spline hub (1) exactly "tooth-to-tooth gap".

Caution!

The "first" matching tooth must engage.

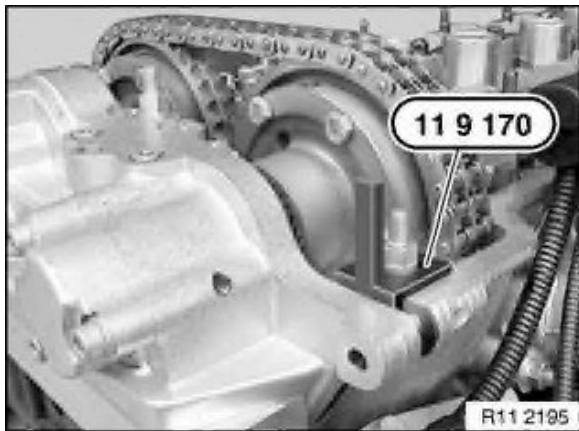


Exhaust side:

Align radial piston pump to driver on spline hub.

Note:

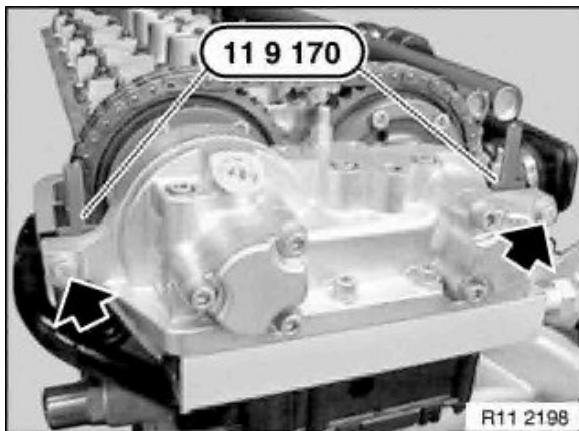
Picture shows a schematic representation.



Push on VANOS adjustment unit until it contacts special tool 11 9 170.

Caution!

If this position is not reached, realign position of radial piston pump to driver.



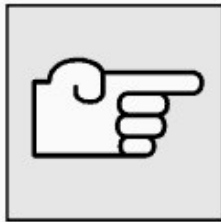
Caution!

Do not tighten down screws.

Note:

Screw on left and right serves to secure the VANOS adjustment unit.

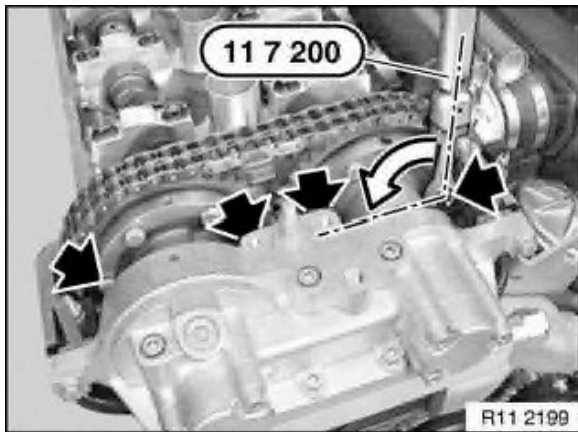
Insert a screw on left and right and tighten by hand until free of play.



Note:

The procedure described below helps to provide compensation for play.

Only with this compensation for play is the timing diagram correctly set.

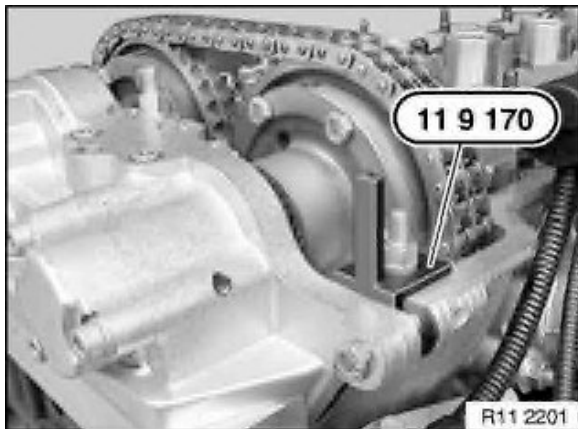


Note:

To tighten down screws on VANOS gear: Use special tool 11 7 200.

Tighten down the two opposing screws on the inlet and exhaust sides of the VANOS gear to 10 Nm.

Then slacken all four screws by a 1/4 turn.



Remove special tool 11 9 170 on left and right sides.



Caution!

Make sure that radial piston pump is aligned to driver on spline hub.

When the left and right screws are tightened down alternately, the exhaust and inlet camshafts must not rotate.

If the camshafts do rotate, this means that the screws on the VANOS gear were not previously released correctly.

Alternately tighten down bolts in 1/2 turn increments carefully and evenly until VANOS adjustment unit rests against timing case cover.



Insert remaining screws and tighten down.

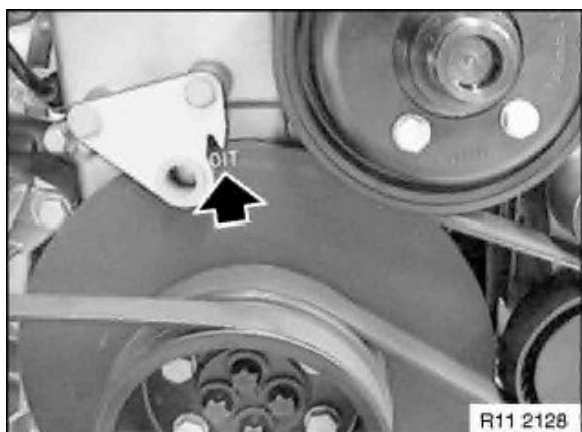


Note:

Use special tool 11 7 200 to tighten down bolts on VANOS gear.



Tighten down six accessible screws (three on exhaust side and three on inlet side) on VANOS gear to 10 Nm.



Remove special tool 11 2 300. Rotate crankshaft in direction of rotation a further revolution up to overlap TDC position.

Note:

TDC allocation above marking on vibration damper is sufficient.

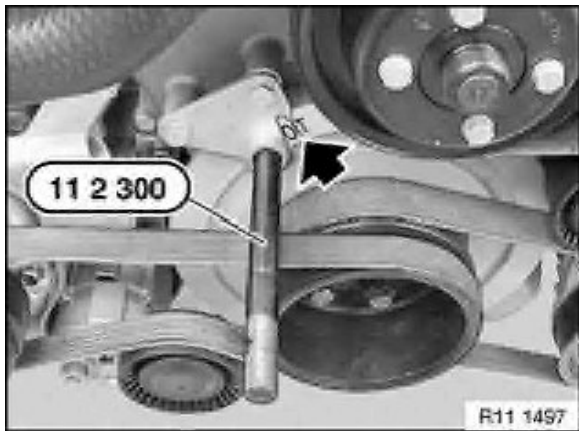


Note:

Use special tool 11 7 200 to tighten down bolts on VANOS gear.

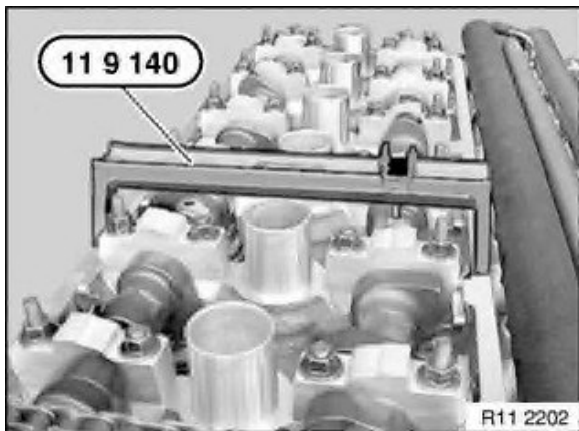


Tighten down remaining six screws (three on exhaust side and three on inlet side) on VANOS gear to 10 Nm.



Then crank engine again in direction of rotation until 1st cylinder is at TDC firing position.

Secure vibration damper in position with special tool 11 2 300.



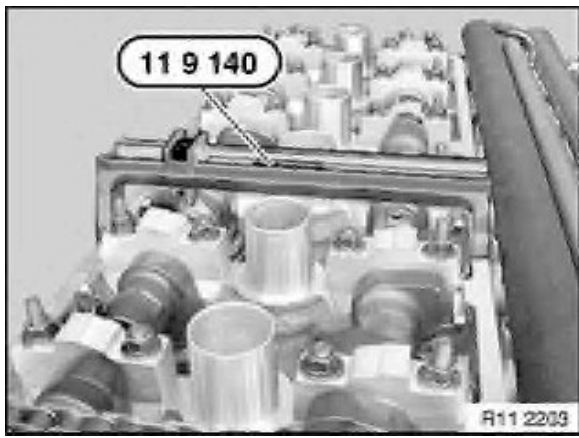
Check camshaft setting:

Attach special tool 11 9 140 and join in inlet camshaft.

Note:

The inlet camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.



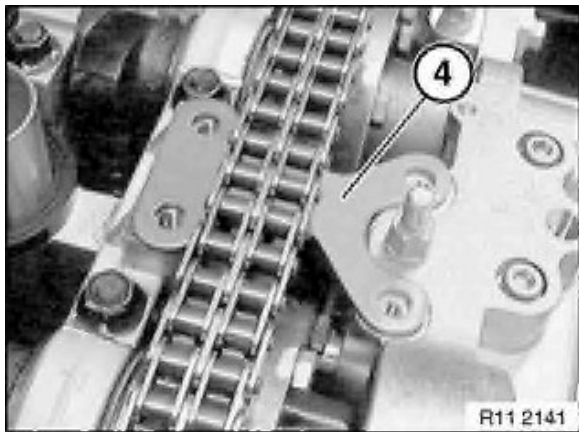
Join special tool 11 9 140 in exhaust camshaft.

Note:

The exhaust camshaft is correctly adjusted when special tool 11 9 140 rests flat on the cylinder head or protrudes by max. 0.5 mm to the exhaust side.

If the special tool 11 9 140 protrudes to the inlet side, the timing must be readjusted.

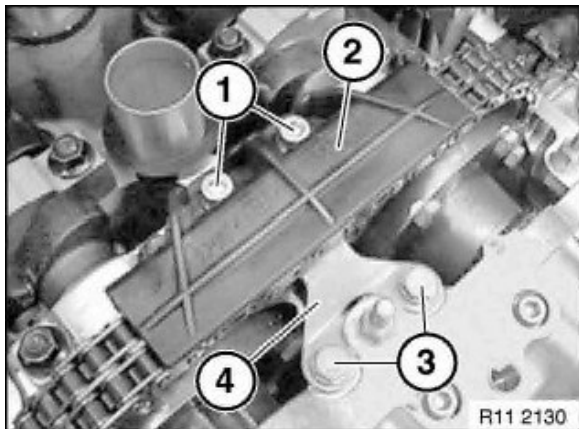
If necessary, adjust camshaft timing.



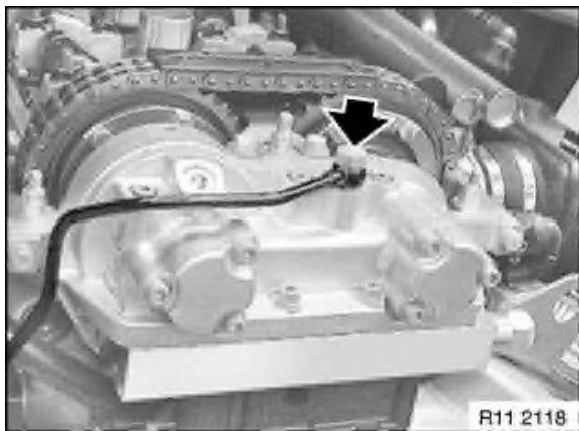
Note:

Check installed direction.

Install holder (4).

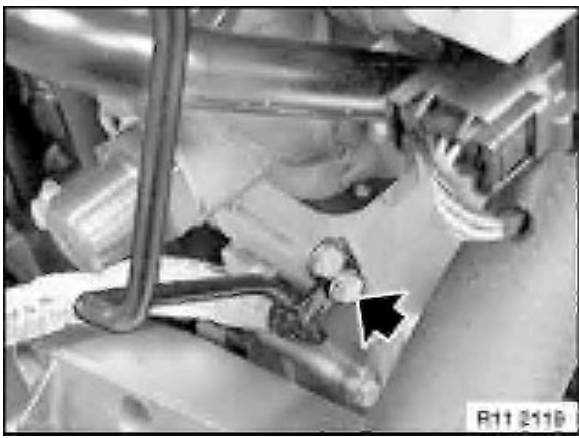


- Insert screws (3) and secure holder (4) (do not tighten down screws (3) yet)
- Install sliding rail (2).
- Insert screws (1).
- Tighten down screws (1) and screws (3).

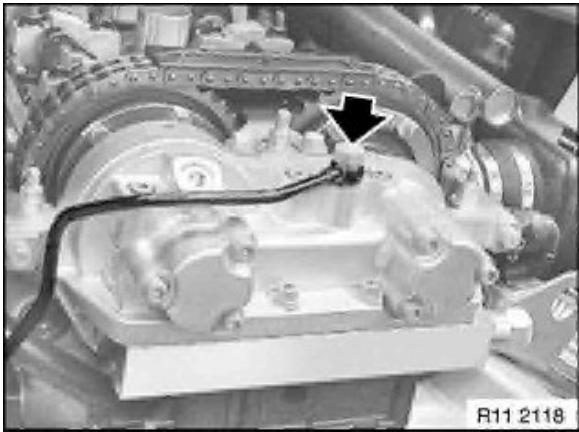


Replace sealing rings of banjo bolt.

Insert banjo bolt but do not tighten down yet.



Install bracket of oil line. Install screw and tighten down.



Tighten down banjo bolt of oil line.
Tightening torque, 11 36 9AZ.



Remove special tool 11 2 300.
Adjust valves.
Assemble engine.



Caution!

There is air in the VANOS system once it is opened.
In the first few seconds after startup this results in a clearly discernible "rattling noise".
This rattling noise does "not" indicate incorrect assembly.
The rattling noise will disappear as soon as the oil pressure has built up and the system has vented.