10 Camshafts and hydraulic lifters - removal, inspection and installation

Caution:
BMW tool 11 3 260 will be required for this operation. Do not attempt to remove and reinstall the camshafts without the aid of this special tool, as expensive damage to the camshafts and/or bearings may result.

Removal

1 Remove the VANOS adjustment unit (see Section 9).

2 Remove the secondary timing chain (see Section 7).

3 Remove the splined shaft and sleeve from the center of the exhaust camshaft sprocket.

4 Unscrew the four bolts and remove the secondary chain tensioner **(see illustration 7.28)** .

5 Remove the three screw-in pins from the exhaust sprocket, lift the chain and remove the sprocket from the end of the camshaft. Note which direction the sprocket is installed.

6 Remove the crankshaft locking pin then, holding the primary timing chain under tension with your hand, carefully rotate the crankshaft 30-degrees counterclockwise to prevent accidental piston-to-valve contact. Use a length of wire or a cable tie through the primary timing chain and secure it to the cylinder head to prevent the chain falling down into the timing cover and/or disengaging from the crankshaft sprocket.

7 If required, remove the three screw-in pins on the end of the intake camshaft and remove the thrust washer and camshaft sensor wheel **(see illustration)** .

10.7 Remove the screw-in pins from the end of the camshaft

8 Remove the template from the camshafts.

9 Unscrew the spark plugs from the cylinder head.

10 Check the camshaft bearing caps for identification marks. The caps are numbered from the timing chain end of the engine, and the marks can normally be read from the exhaust side of the engine. The exhaust camshaft bearing caps are marked A1 to A7, and the intake camshaft caps are marked E1 to E7.

11 Unscrew the four camshaft cover retaining studs from the center of the cylinder head **(see illustration)** .

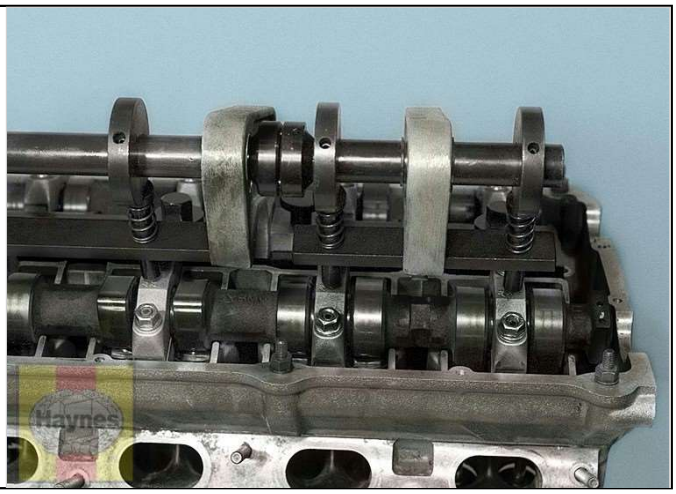
10.11 Unscrew the four camshaft cover retaining studs

12 As the intake camshaft No 1 bearing cap is located by adapter sleeves, unscrew the nuts and remove the cap to prevent the cap from binding while the camshaft is removed **(see illustration)** .

10.12 No 1 camshaft bearing cap is centered by adapter sleeves (this cap must be removed before the other caps are loosened)

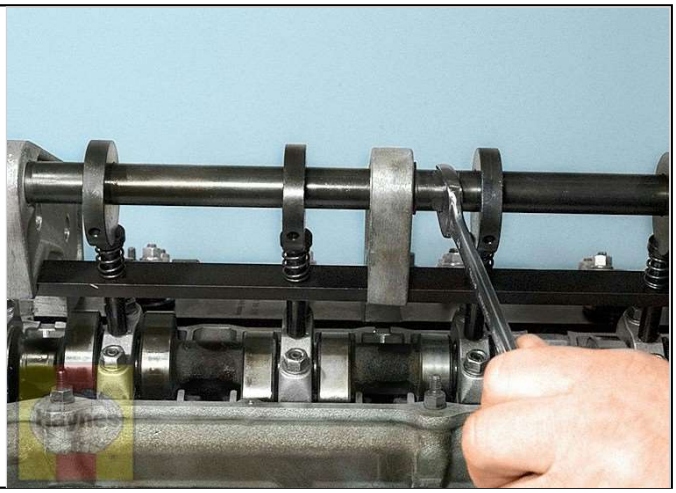
13 Assemble BMW special tool 11 3 260, and mount the tool on the cylinder head by screwing the mounting bolts into the spark plug holes. Position the tool so that the plungers are located over the relevant camshaft bearing caps (intake or exhaust camshaft) **(see illustration)** .

10.13 BMW special tool installed to the cylinder head



14 Apply force to the camshaft bearing caps by turning the eccentric shaft on the tools using a wrench **(see illustration)** .

10.14 Use a wrench to turn the eccentric shaft, and apply force to the bearing caps



15 Unscrew the remaining camshaft bearing cap nuts. **Caution:** *Do not attempt to unscrew the camshaft bearing cap nuts without the special tools in place, as damage to the camshaft and/or bearings may result.*

16 Slowly turn the special tool shaft to release the force from the bearing caps, then unbolt the tool from the cylinder head.

17 Lift off the bearing caps, keeping them in order, then lift out the camshaft.

18 The camshaft bearing casting can now be lifted from the cylinder head. This should be done very slowly, as the camshaft hydraulic lifters will be released as the casting is lifted off - if the casting is lifted off awkwardly, the camshaft hydraulic lifters may fall out. Do not allow the camshaft hydraulic lifters to fall out and get mixed up, as they must be installed to their original locations.

19 With the bearing casting removed, lift the camshaft hydraulic lifters from the cylinder head. Identify the hydraulic lifters for location, and store them upright in a container of clean engine oil to prevent the oil from draining from inside the hydraulic lifters.

20 Repeat the procedure on the remaining camshaft. Do not forget to mark the camshaft hydraulic lifters *Intake* and *Exhaust* .

Inspection

21 Clean all the components, including the bearing surfaces in the bearing castings and bearing caps. Examine the components carefully for wear and damage. In particular, check the bearing and camshaft lobe surfaces of the camshaft(s) for scoring and pitting. Examine the surfaces of the camshaft hydraulic lifters for signs wear or damage. Replace components as necessary.

Installation

22 If the camshaft lower bearing castings have been removed, check that the mating faces of the bearing castings and the cylinder head are clean, and check that the bearing casting locating dowels are in position on the studs at Nos. 2 and 7 bearing locations **(see illustration)** .

10.22 Bearing casting location dowel on the cylinder head stud at No 2 bearing location (there's one at No 7 location, too)

23 The bearing casting(s) and camshaft hydraulic lifters must now be reinstalled.

24 The simplest method of installing these components is to retain the camshaft hydraulic lifters in the bearing casting, and reinstall the components as an assembly.

25 Oil the bearing casting contact surfaces of the camshaft hydraulic lifters (avoid allowing oil onto the top faces of the hydraulic lifters at this stage), then install each follower to its original location in the bearing casting.

26 Once all the hydraulic lifters have been installed, they must be retained in the bearing casting, so that they do not fall out as the assembly is reinstalled to the cylinder head.

27 With the camshaft hydraulic lifters retained in the bearing casting, reinstall the casting to the cylinder head. Note that the exhaust side casting is marked A and the intake side casting is marked E. When the castings are reinstalled, the marks should face each other at the timing chain end of the cylinder head. **Caution:** *The camshaft hydraulic lifters expand when not subjected to load by the camshafts, and therefore require some time before they can be compressed. If the camshaft installation operation is carried out rapidly, there is a possibility that the closed valves will be forced open by the expanded camshaft hydraulic lifters, resulting in piston-to-valve contact.*

28 To minimize the possibility of piston-to-valve contact after installing the camshaft(s) observe the delays listed in the following table before turning the crankshaft back to the TDC position:

Temperature	Delay
Room temperature	
68-degrees F	4 minutes
50 to 68-degrees F	11 minutes
32 to 50-degrees F	30 minutes

29 First identify the camshafts to ensure that they are installed in the correct locations. The intake camshaft has a triangular front flange and the exhaust camshaft has a circular front flange. Ensure that the crankshaft is still positioned at 30-degrees counterclockwise from the TDC position.

30 Position the camshaft on the cylinder head, so that the tips of the front camshaft lobes on the exhaust and intake camshafts face one another. Note also that the square flanges on the rear of the camshaft should be positioned with the sides of the flanges exactly at right-angles to the top surface of the cylinder head (this can be checked using a set-square), and the side of the flange with holes drilled into it uppermost. Feed the primary timing chain over the end of the exhaust camshaft as it is installed.

31 Place the bearing caps in position, noting that the caps carry identification marks. The exhaust camshaft caps are marked A1 to A7, and the intake camshaft caps are marked E1 to E7. Place the bearing caps in their original locations as noted before removal.

32 Reassemble BMW special tool 11 3 260, and reinstall it to the cylinder head as during removal. **Caution:** *Again, do not attempt to reinstall the camshafts without the aid of the special tools.*

33 Apply pressure to the relevant bearing caps by turning the eccentric shaft on the tools using a wrench.

34 With pressure applied to the bearing caps, reinstall the bearing cap retaining nuts, and tighten them as far as possible by hand.

35 Tighten the bearing cap nuts to the torque listed in this Chapter's Specifications , working progressively in a diagonal sequence.

36 Once the bearing cap nuts have been tightened, unbolt the tool used to apply pressure to the bearing caps.

37 Repeat the procedure on the remaining camshaft.

38 Reinstall the spark plugs, and reinstall the camshaft cover studs to the cylinder head.

39 Reinstall the special tool/ camshaft holding fixture used to check the position of the camshafts. If necessary, turn the camshaft(s) slightly using a wrench on the flats provided until the fixture can be installed. **Caution:** *Note the caution in Step 27 before proceeding.*

40 Turn the crankshaft back 30-degrees clockwise to the TDC position, then re-engage the locking tool with the flywheel to lock the crankshaft in position.

41 Reinstall the camshaft sprockets and timing chains as described in Section 7 .

42 Reinstall the VANOS adjustment unit as described in Section 9 .

43 To minimize the possibility of piston-to-valve contact, after installing the camshaft(s), observe the following delays before cranking the engine:

Temperature	Delay
Room temperature	
68 degrees F	10 minutes
50 to 68 degrees F	30 minutes
32 to 50 degrees F	75 minutes