7 Timing chains - removal, inspection and installation

Secondary chain

Removal

1 Position the engine at TDC for cylinder no. 1 (see Section 3). Remove the VANOS adjustment unit (see Section 9).

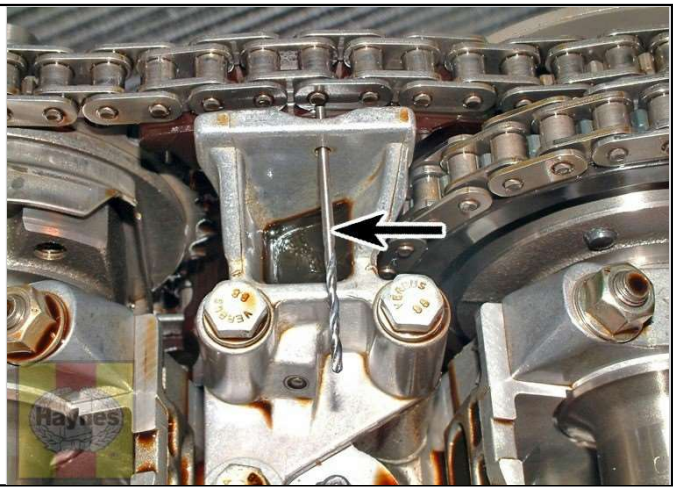
2 Unscrew the timing chain tensioner plunger from the right-hand side of the engine **(see illustration)** . Discard the sealing ring, a new one must be installed. **Warning:** *The chain tensioner plunger has a strong spring. Take care when unscrewing the cover plug.*

7.2 Unscrew the timing chain tensioner from the right-hand side of the engine

3 If the tensioner is to be re-used, compress and release the tensioner plunger a few times, to drain any oil inside.

4 Press down the secondary chain tensioner plunger and lock it in place by inserting a suitable drill bit **(see illustration)** .

7.4 Use a drill bit to lock down the secondary chain tensioner

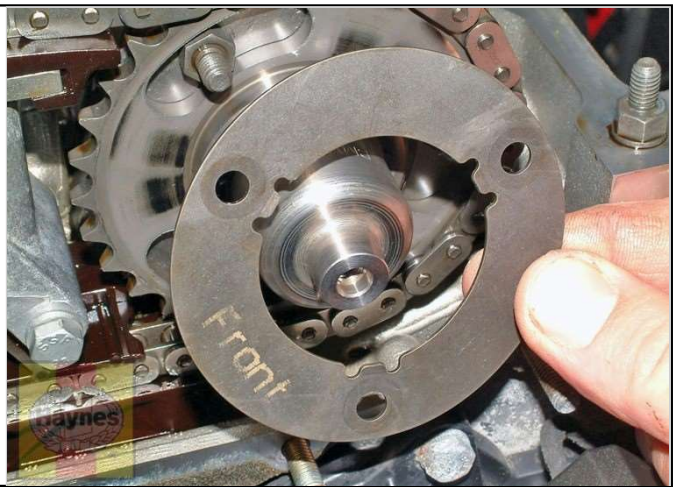


5 Remove the nuts and remove the camshaft position sensor wheel from the exhaust camshaft sprocket, then remove the plate spring **(see illustration)** .

7.5 Remove the camshaft position sensor wheel from the exhaust camshaft sprocket

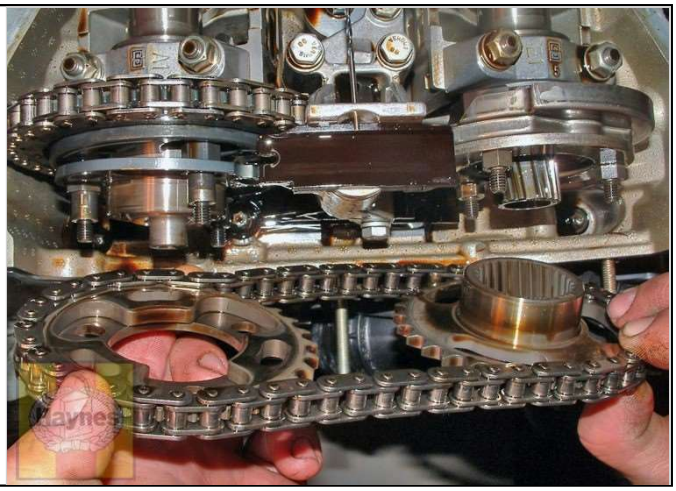
6 Remove the three intake camshaft sprocket nuts and remove the corrugated washer **(see illustration)** .

7.6 Remove the three nuts and remove the corrugated washer from the sprocket



7 Remove the three screws from the exhaust camshaft sprocket and lift away the secondary chain together with the sprockets, friction washer and intake camshaft splined shaft **(see illustration)** . If these items are to be re-used, store them together in order that they are reinstalled to their original locations.

7.7 Remove the exhaust sprocket with the chain, friction washer, intake sprocket and the intake camshaft splined shaft



Inspection

8 The chain should be replaced if the sprockets are worn or if the chain is worn (indicated by excessive lateral play between the links, and excessive noise in operation). It is wise to replace the chain in any case if the engine is disassembled for overhaul. Note that the rollers on a very badly worn chain may be slightly grooved. To avoid future problems, if there is any doubt at all about the condition of the chain, replace it.

9 Examine the teeth on the sprockets for wear. Each tooth forms an inverted V. If worn, the side of each tooth under tension will be slightly concave in shape when compared with the other side of the tooth (the teeth will have a hooked appearance). If the teeth appear worn, the sprockets must be replaced. Also check the chain guide and tensioner contact surfaces for wear, and replace any worn components as necessary.

Installation

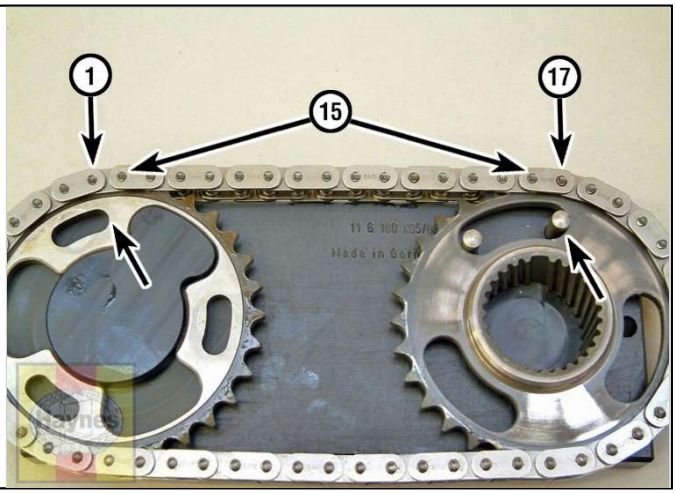
10 Ensure that Number 1 piston is still positioned at TDC, with the crankshaft locked in position. Check the position of the camshafts using the holding fixture described in Section 3 .

11 Check that the primary chain and sprocket on the exhaust camshaft is still in place. Install special tool 11 4 220 into the primary tensioner aperture, then turn the adjuster screw on the tool until the end of the screw just touches the tensioning rail **(see illustration)** .

7.11 Install the BMW tool into the tensioner aperture

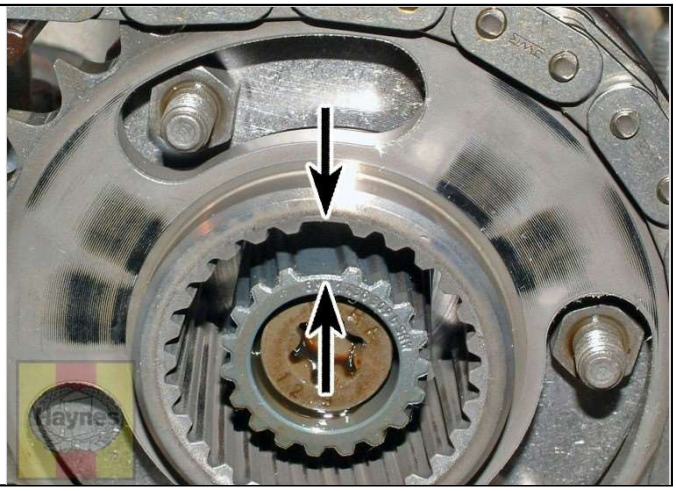
12 In order to establish the correct relationship between the two sprockets and the chain, use BMW special tool 11 6 180. Insert the two sprockets into the chain and lay the assembly in the special tool. In the absence of the special tool, arrange the sprockets so that there are 15 chain pins between the ends of the cutouts on the sprockets, as shown **(see illustration)** .

7.12 Insert the chain and sprockets into the special tool. If the tool is not available, arrange the sprockets so there are 15 pins between the positions indicated (and the ends of the cutouts in the sprockets aligned with pin 1 and pin 17)



13 Install the chain and sprockets over the end of the camshafts so that the alignment gap on the inner diameter of the intake sprocket splines aligns exactly with the alignment gap on the splined shaft protruding from the end of the camshaft **(see illustration)** .

7.13 The gaps in the intake sprocket and camshaft must align



14 Reinstall the splined shaft into the end of the intake camshaft, and make sure the large spline installs into the alignment gap in both the camshaft and sprocket **(see illustration)** . Push the splined shaft into the intake sprocket until approximately 1 mm of the splines can still be seen.

7.14 Insert the splined shaft locking pin or master spline into the tooth gaps

15 Reinstall the corrugated washer onto the intake sprocket with the FRONT marking forward. Reinstall the retaining nuts, but only hand-tighten them at this stage.

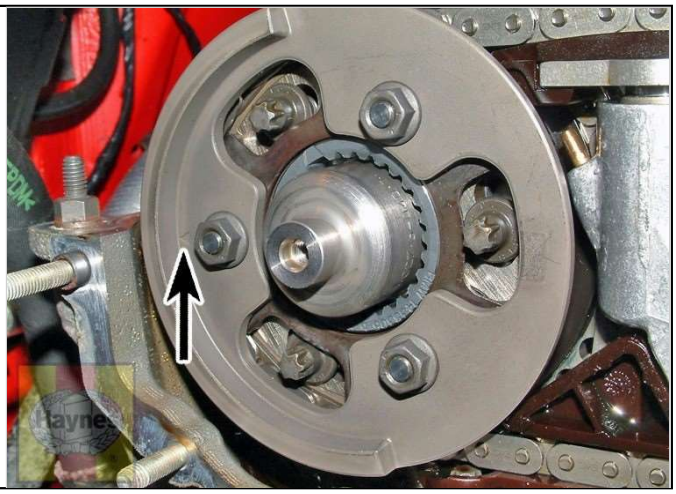
16 Reinstall the screws to the exhaust sprocket, tighten them to 44 in-lbs (5 Nm), then unscrew them 180-degrees.

17 Install the friction washer and plate spring to the exhaust sprocket. Note that the spring must be installed with the F mark facing forward. If the mark is no longer visible, install the spring with the convex side to the front **(see illustration)** .

7.17 Install the spring plate with the F at the front

18 Reinstall the exhaust camshaft position sensor wheel with the raised section to the right-hand side of the engine and the arrow aligned with the cylinder head upper gasket face **(see illustration)** . Hand-tighten the nuts only at this stage.

7.18 Install the sensor wheel so that the arrow aligns with the upper gasket surface



19 Pull out the exhaust splined shaft from the center of the sprocket as far as it will go.

20 Compress the secondary chain tensioner plunger and remove the locking pin/drill bit.

21 Using a torque wrench, apply a torque of 6 in-lbs (0.7 Nm) to the adjusting screw on the special tool 11 4 220 installed to the primary chain tensioner aperture. In the absence of a suitable torque wrench, turn the adjusting screw by hand just enough to remove any play in the chain. Check that all play has been removed by attempting to turn the primary chain sprocket on the exhaust camshaft by hand.

22 To ensure that the splined shafts in the sprockets, and the sprockets themselves are correctly centered, BMW tool 11 6 150 must be installed in place of the VANOS unit. Position the tool over the VANOS unit mounting studs (without the gasket), and evenly tighten the nuts until the tool is in full contact with the cylinder head. This tool positions the splined shafts, and holds them in place while the sprocket bolts/nuts are tightened **(see illustration)** . This tool is critical to the timing of the camshafts, and its use is essential.

7.22 Use the special BMW tool to center the splined shafts and sprockets

23 Evenly and progressively tighten the screw-in pins and sprockets nuts to the Step 1 torque listed in this Chapter's Specifications , beginning with the Torx screw-in pins of the exhaust sprocket, followed by the exhaust camshaft sprocket nuts, and then the intake sprocket nuts. Repeat the sequence tightening the screw-in pins and nuts to the Step 2 torque. With the sprockets tightened and the BMW tool 11 6 150 still in place, remove the crankshaft/flywheel locking pin and the locking tool from the rear ends of the camshafts. Using a wrench or socket on the crankshaft pulley bolt, rotate the crankshaft two complete revolutions clockwise until the crankshaft locking pin can be re-inserted.

24 Check the position of the camshafts with the locking tools/template, and ensure the camshaft timing is correct. **Note:** *Due to the rubber-insulated sprocket(s), tolerance in the VANOS unit and the splined shafts running clearance, the tool locking the intake camshaft may misalign by up to 1.0 mm with the square flange, but the timing would still be considered correct.*

25 Remove the splined shaft/sprocket centering/positioning tool, and reinstall the VANOS adjustment unit as described in Section 9 .

Primary chain

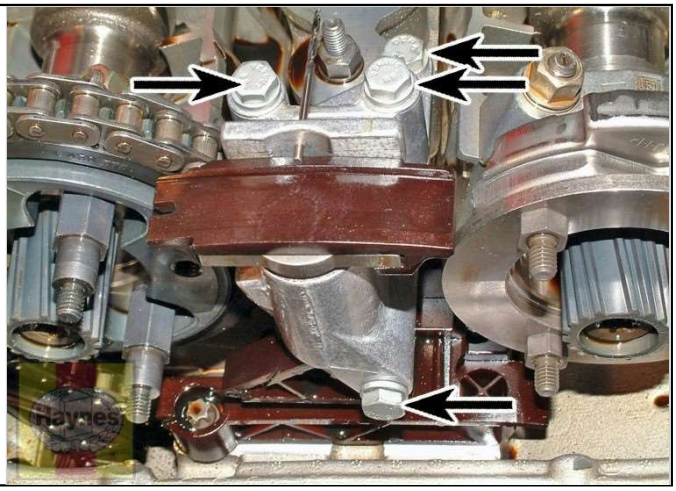
Removal

26 Remove the secondary timing chain as described previously in this Section.

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

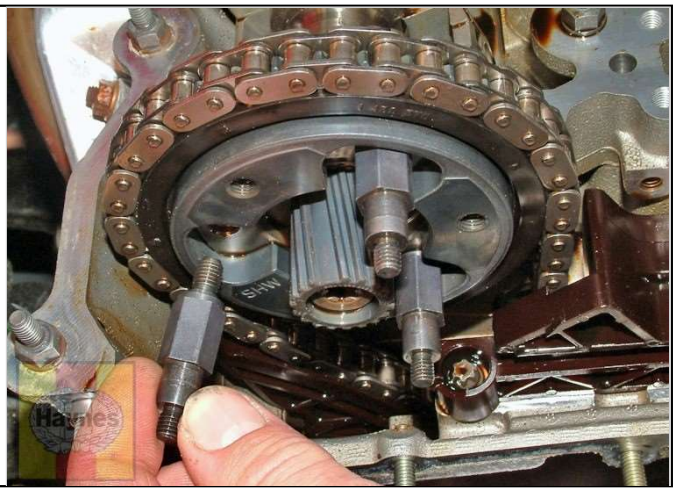
28 Remove the four bolts and remove the secondary chain tensioner **(see illustration)** .

7.28 Remove the secondary chain tensioner bolts



29 Remove the three screw-in pins from the exhaust sprocket, lift the chain and remove the sprocket from the end of the camshaft **(see illustration)** . Note which way round the sprocket is installed.

7.29 Remove the three screw-in pins from the exhaust sprocket



30 Remove the timing chain cover (see Section 6).

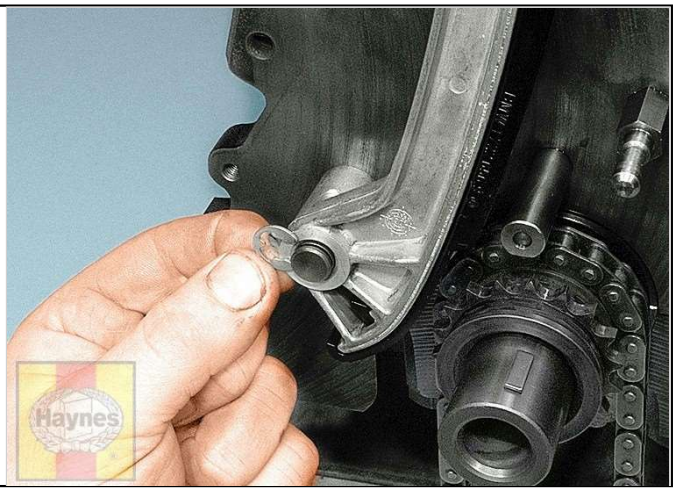
31 Note the routing of the chain in relation to the tensioner rail and the chain guide.

32 Manipulate the tensioner rail as necessary to enable the chain to be unhooked from the crankshaft sprocket and lifted from the engine **(see illustration)** . **Warning:** *Once the primary timing chain has been removed, do not turn the crankshaft or the camshafts, as there is a danger of the valves hitting the pistons.*

7.32 Unhook the chain from the crankshaft sprocket

33 The tensioner rail can now be removed after removing the clip from the lower pivot **(see illustration)** .

7.33 Remove the clip from the lower pivot to remove the tensioner rail



34 Similarly, the chain guide can be removed after releasing the upper and lower retaining clips. Take care when releasing the retaining clips, as the clips are easily broken **(see illustration)** .

7.34 Release the retaining clips to remove the chain guide

Installation

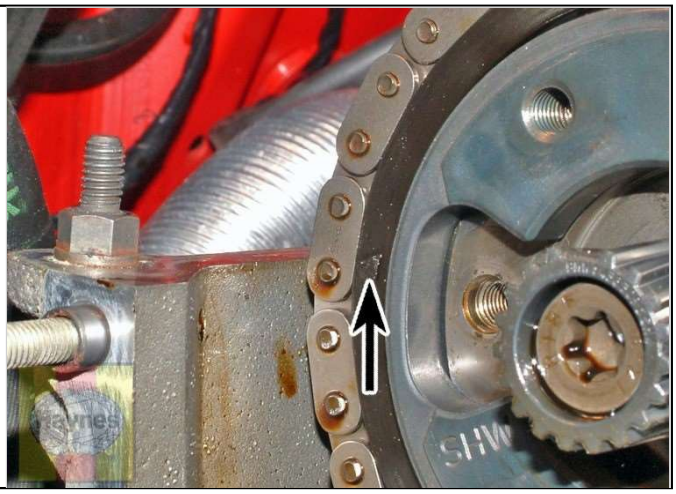
35 Ensure Number 1 piston is still at TDC, with the crankshaft locked in position. Check the position of the camshafts using the template.

36 Start installation by engaging the chain with the crankshaft sprocket.

37 Where applicable, reinstall the chain guide and the tensioner rail, ensuring that the chain is correctly routed in relation to the guide and tensioner rail, as noted before removal. Take care when installing the chain guide, as the clips are easily broken.

38 Manipulate the exhaust camshaft primary chain sprocket until the timing arrow on the sprocket is aligned with the upper edge of the cylinder head, then engage the chain with the sprocket **(see illustration)** . Install the sprocket to the exhaust camshaft. Ensure that the sprocket is installed the correct way as noted before removal, and that the timing arrow is still in alignment with the upper edge of the cylinder head.

7.38 Align the arrow on the sprocket with the upper edge of the cylinder head



39 Reinstall the timing chain cover as described in Section 6 .

40 Install special tool 11 4 220 into the tensioner aperture (see Section 9), then turn the adjuster screw on the tool until the end of the screw just touches the tensioning rail. Note that the exhaust camshaft sprocket may now have moved counterclockwise - if necessary reposition the sprocket in the chain so that the timing arrow re-aligns with the upper surface of the cylinder head **(see illustration 7.38)** .

41 Insert the three screw-in pins through the exhaust sprocket, and tighten them to the torque listed in this Chapter's Specifications .

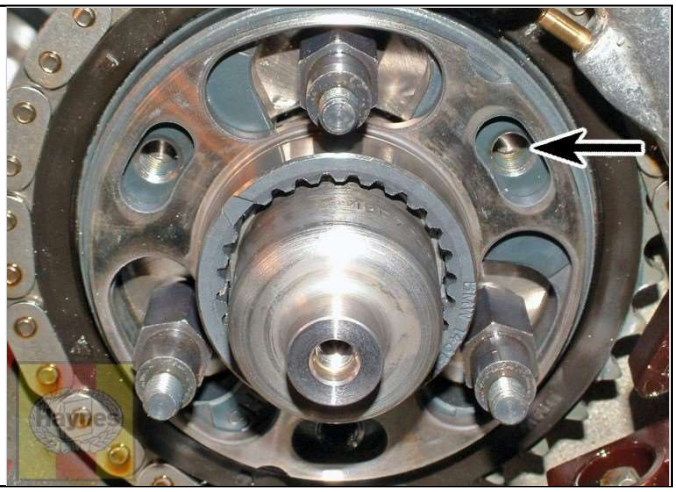
42 Reinstall the secondary timing chain tensioner and tighten the bolts securely.

43 Reinstall the splined shaft and sleeve to the exhaust camshaft sprocket so that the alignment gap in the sleeve aligns exactly with the corresponding alignment gap in the end of the camshaft. Note that the splined shaft incorporates a pin or large spline which must engage in both alignment gaps **(see illustration)** .

7.43 The large spline must engage with the corresponding alignment gaps in the camshaft and sleeve

44 Push the exhaust camshaft splined shaft in until the threaded holes in the camshaft sprocket are centered with respect to the oval holes in the tooth sleeve **(see illustration)** .

7.44 The holes in the sprocket must be centered in the oval holes in the splined sleeve



45 Reinstall the secondary timing chain as described in Steps 10 to 25 of this Section.