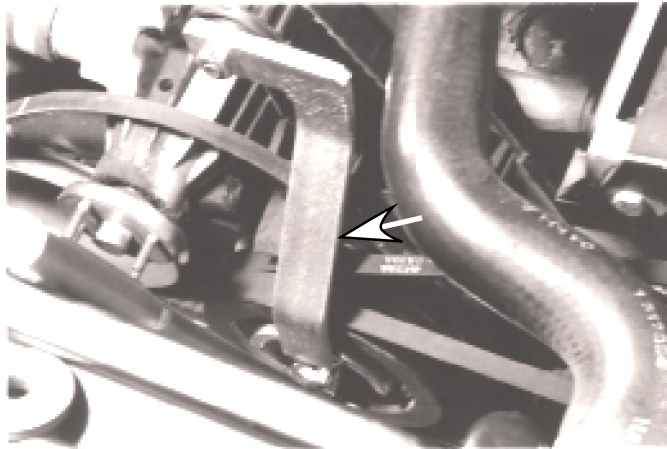


# **A Step-by-Step Guide to Changing the Timing Belt on the 240/740/940 Volvo, B230 Engine**

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**Volvo 5284 crankshaft pulley holder tool (arrow)  
in use.**

## **Additional instructions**

- **Appendix A: Replacing tensioner roller, with instructions for making a jig to pin the tensioner spring**
- **Appendix B: Replacing overhead camshaft seal, intermediate shaft seal, and crankshaft seal**

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# Introduction

**The timing belt should be replaced every 50,000 miles.**

The B230 engine is a non-interference engine, meaning if the timing belt breaks, the valves will not impact the pistons, causing great damage, headaches, and great loss of money and time. Still, if the timing belt breaks, it *will* leave you stranded.

**Test:** Remove the oil filler cap. While an assistant hits ignition “Start,” see if the overhead camshaft rotates. If the camshaft does not rotate, then most likely it is a broken timing belt.



**Volvo 5284 crankshaft pulley holder tool**

On the B230 series (240 late models/740/940 Volvo) engines, the crankshaft pulley is held in place by a highly torqued crankshaft bolt (unlike the lightly torqued 6 fasteners on the non-B230 engines of the 240 Volvo). This crankshaft bolt is difficult to loosen and remove unless you have the special crankshaft pulley holder tool shown at left. (Some die-hards prefer to remove the starter motor and have an assistant jam a heavy screwdriver into the flywheel teeth to stop the crankshaft pulley from moving while loosening the crankshaft pulley bolt. But this requires another person to help, adds extra work, and may damage the flywheel teeth.) Having the Volvo 5284 tool makes changing the timing belt a lot easier and is easily worth the \$48 cost ([www.ipdusa.com](http://www.ipdusa.com)). Moreover, while it isn't exactly necessary to remove the crankshaft pulley bolt with a torque wrench (you will need a long-handled wrench, cheater bar, and muscle power), you do need a torque wrench to properly set the tension on the crankshaft pulley bolt on installation and to set proper torque on the overhead camshaft and intermediate shaft pulley bolts if you decide to replace the oil seals.

**Other replacements:** Replace all the accessory drive belts. Usually, the tensioner roller should be replaced (**Appendix A**) every other time the timing belt is changed. Check that it spins freely with no noise. Also, check to see that there are no oil leaks around any pulleys. If there are no leaks, you may skip oil seal replacement. But the standard recommendation is to change the oil seals (**Appendix B**) every other time the timing belt is changed. Some people replace everything as a matter of course, every time. It's up to you.

**Caveats:** I've read of other people who have used (a) an impact wrench or (b) a long-handled wrench set hard against an obstruction, then hitting ignition “Start” to turn the crankshaft to loosen the bolt. Realize that the crankshaft pulley boss (the gear) is not as hardy as the old one on non-B230 engines, and its locking knob (for the crankshaft pulley/vibration dampener) may break off. Also, one DIY'er used an impact wrench to tighten the camshaft bolt and broke it off.

# Disassembly

These instructions were derived from a 1987 740 Turbo, B230 FT. Your vehicle may differ somewhat. For instance, some of the bolt sizes differ on the 940.

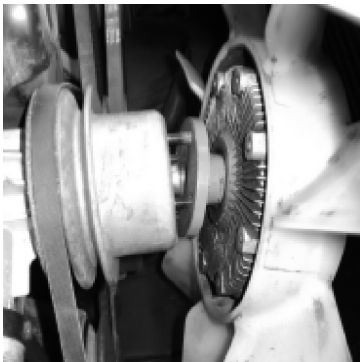
To begin with, drive the car up on ramps, chock the rear wheels, set emergency handbrake. Put car in neutral for manual transmission vehicles, Park for automatic transmission. Remove the underbelly pan. (Why? Because it's easier to work underneath the car when pulling the crankshaft pulley.)

Disconnect battery ground because you'll be working around some electrical components such as the alternator and air conditioning compressor.



**Note accessory belt positions:**

- (a)** middle groove of crankshaft pulley connects to front groove of alternator pulley
- (b)** front groove of crankshaft pulley to front groove of air conditioning compressor pulley
- (c)** back groove of crankshaft pulley to back groove of waterpump pulley and only groove of power steering pulley



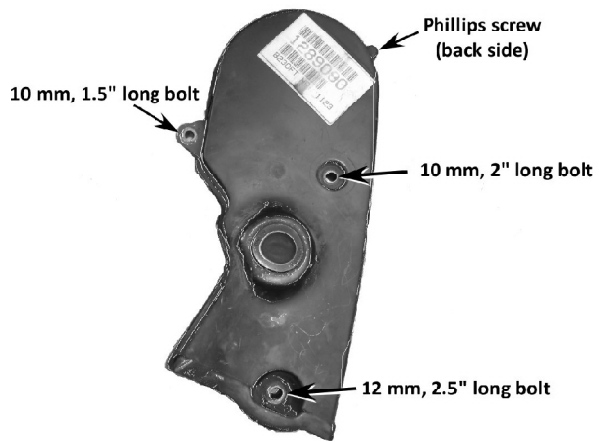
**Figure 1.** Take off the fan/clutch assembly by removing the 4 10-mm nuts. Pull assembly out.



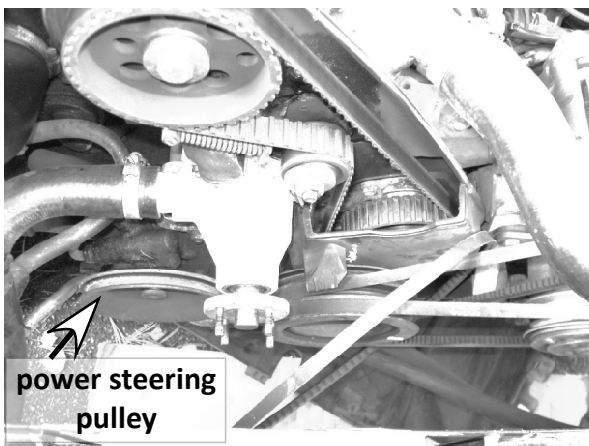
**Figure 2.** Remove the two 8-mm fasteners atop the fan shroud. Pull fan shroud out. Now you have more working room. (Some engines are different and may have more working room as a matter of design.)



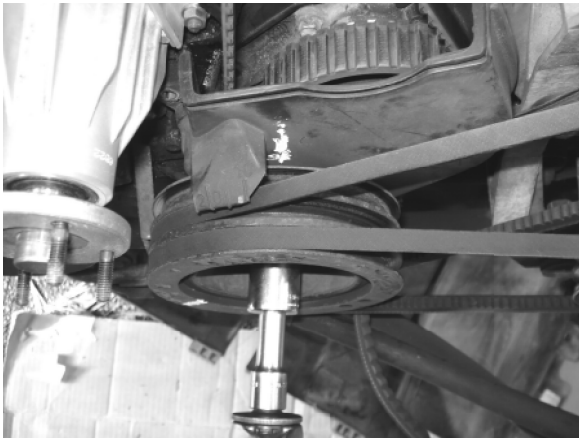
### Upper Timing Belt Cover



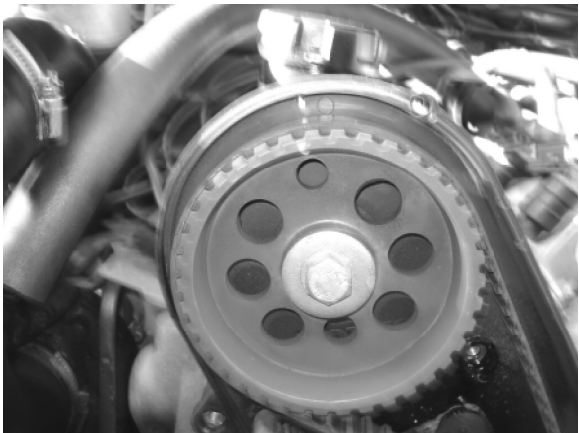
**Figure 3.** Remove all of the fasteners for the upper timing belt cover, as shown. During reassembly, this diagram will guide you as to which fastener goes where.



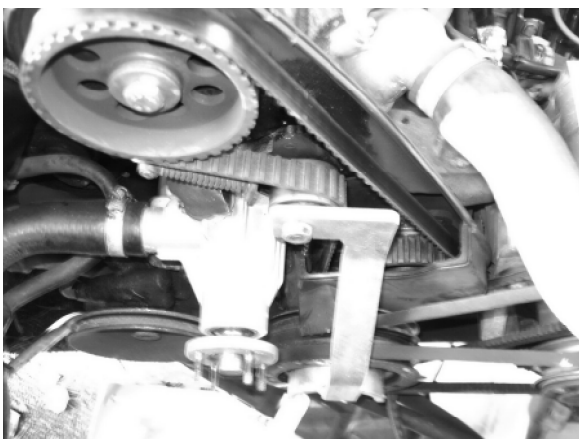
**Figure 4.** Upper timing belt cover removed. Note waterpump/power steering belt hanging over the alternator and air conditioning compressor belts. (Arrow shows power steering pulley.)



**Figure 5.** Use a 24 mm socket on the crankshaft bolt to rotate the crankshaft clockwise so as to . . .



**Figure 6.** . . . align dot of overhead camshaft gear with nub on back timing belt plate.



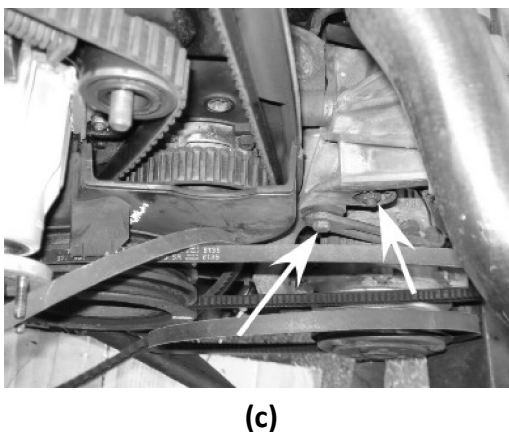
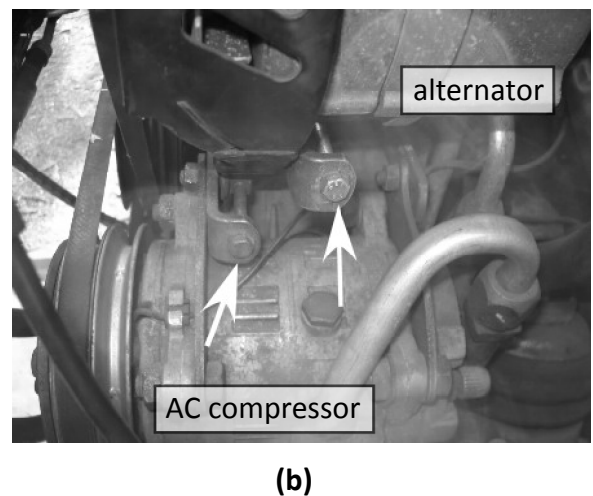
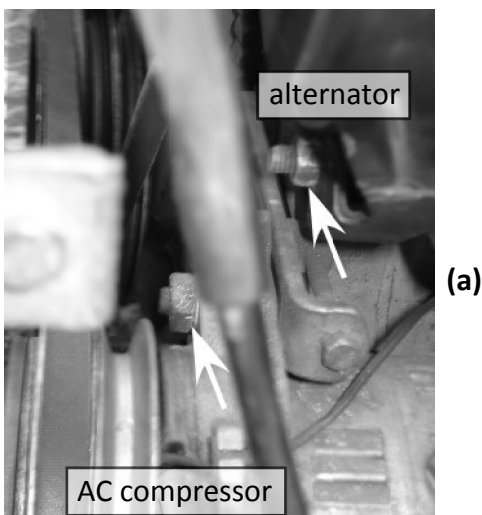
**Figure 7.** Remove the 17 mm nut and washer from the tensioner. Slip top of crankshaft pulley holder onto tensioner bolt, install the 17 mm nut, and finger tighten. Next, make sure the prongs on the bottom of holder catches the holes in the crankshaft gear/vibration dampener (hereafter called just crankshaft gear or pulley), turning the crankshaft with the 24 mm socket, if needed. Once the prongs catch, tighten the 17 mm nut on the tensioner.



**Figure 8.** Use a long-handled wrench with a cheater bar (iron pipe) and 24 mm socket to break free (counterclockwise) the crankshaft bolt. Remove the bolt.

[Also, if you plan to replace the overhead camshaft seal, now is the time to break free the 17 mm bolt holding the overhead cam gear in place.]

Next, in order to pull the crankshaft pulley off, you will most likely need to loosen and remove the alternator and AC compressor belts.



**Figure 9.** To slip the alternator and AC belts off, first loosen the 13 mm hold-down nuts [arrows in (a)] for alternator and AC. Loosen (CCW) the 10 mm tensioning bolts [arrows in (b)] for both. You may also have to loosen the 13 mm pivoting bolt and nut [arrows in (c)] of the alternator and AC. Slip belts off pulleys. (I had to remove the whole tightening assembly for the alternator, allowing the alternator to lean against the AC compressor. Only then could I get the alternator belt off.)

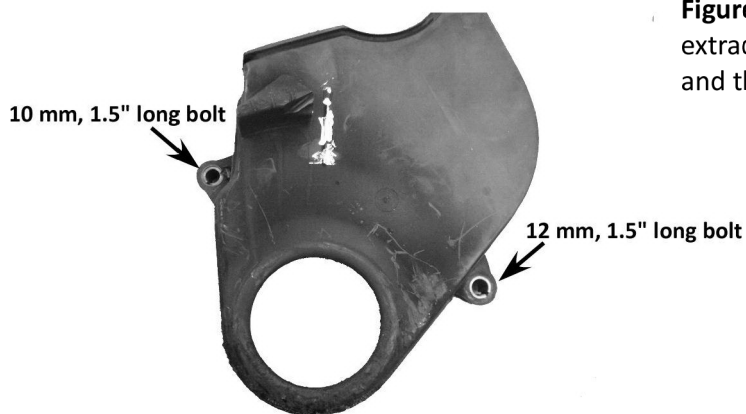


**Figure 10.** Without the belt tension, the crankshaft pulley should be easy to remove. Grab the pulley on opposite sides with both hands and rock it back and forth while pulling. If it is difficult to get off, gently pry in back with a flat-bladed screwdriver.

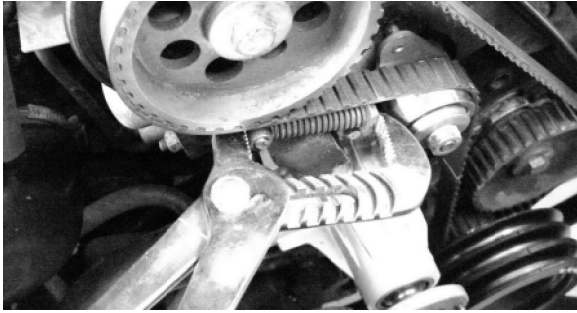


**Figure 11.** With the crankshaft pulley off, the front crankshaft shim and crankshaft end are exposed. (Note the oily residue at bottom of photo, which indicates a leaky crankshaft seal.)

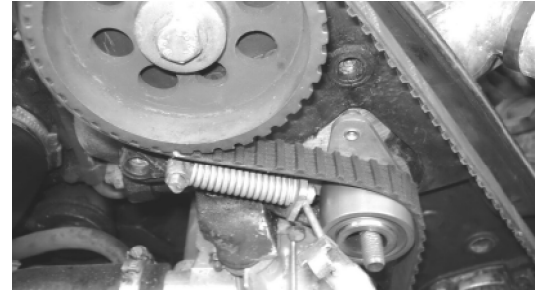
### Lower Timing Belt Cover



**Figure 12.** Remove the lower timing belt cover by extracting the 10 mm, 1.5" long bolt on the left and the 12 mm, 1.5" bolt on the right.

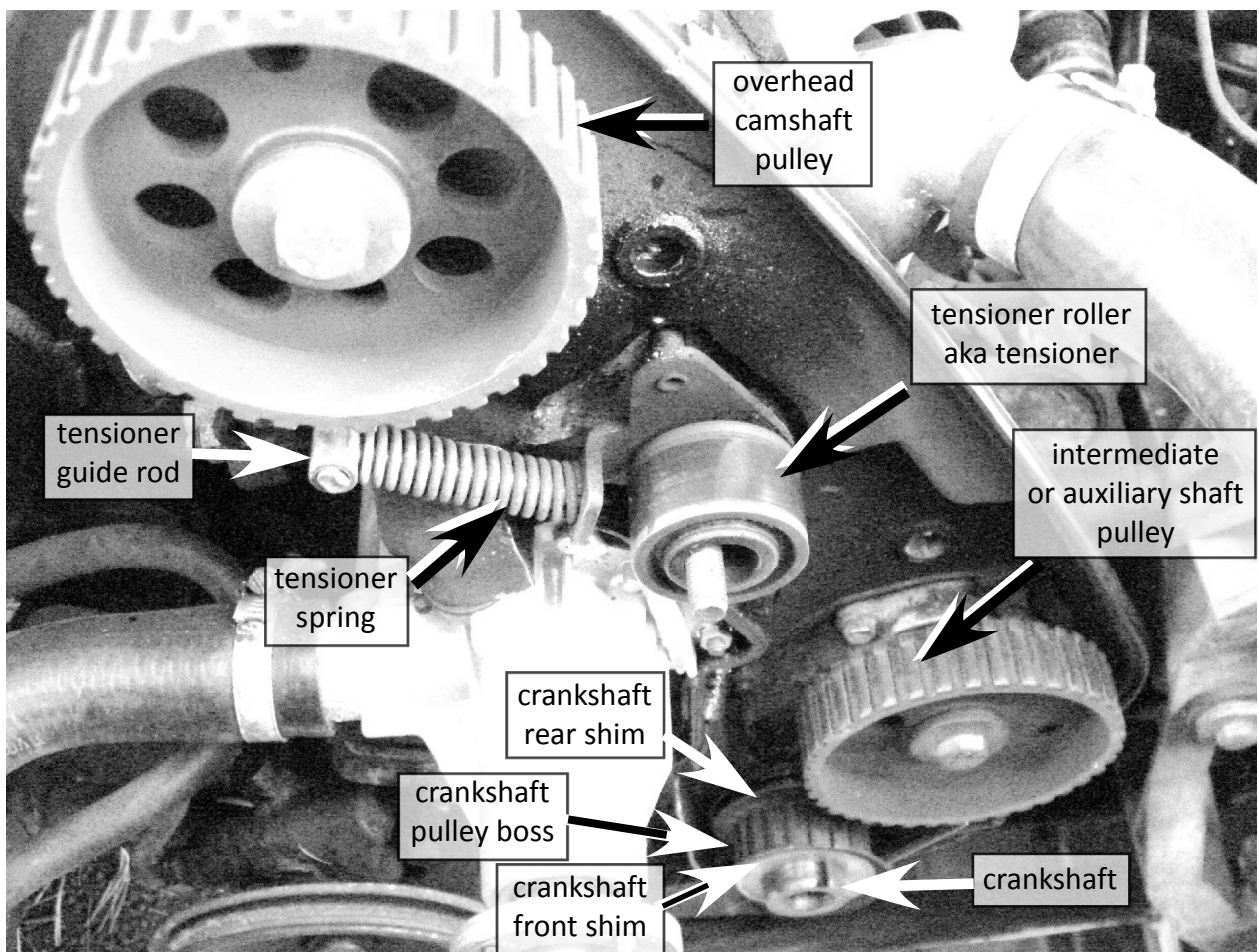


(a)



(b)

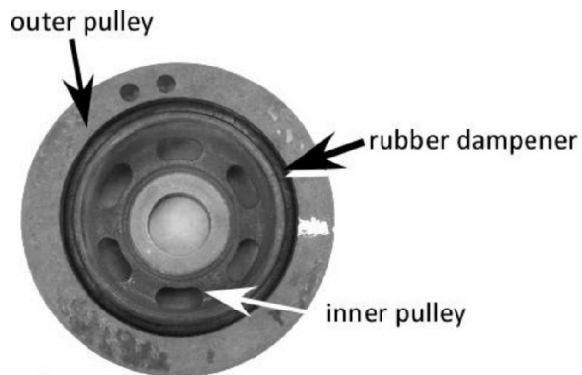
**Figure 13.** (a) Use a large pliers to squeeze the tensioner spring and insert a pin into the hole of the guide rod (b). Once the guide rod is pinned in place, compressing the spring, slip the old belt off. [If you are replacing the tensioner (**Appendix A**), pull that off now. Also, save old belt if you are replacing the oil seals. Why? See **Appendix B.**]



**Figure 14.** Everything exposed in all its glory!

If you choose to **not** replace the tensioner or the front oil seals, then go to **Figure 15**. Otherwise, to replace the tensioner, see **Appendix A**. To replace the oil seals, go to **Appendix B**.

### crankshaft pulley/vibration dampener



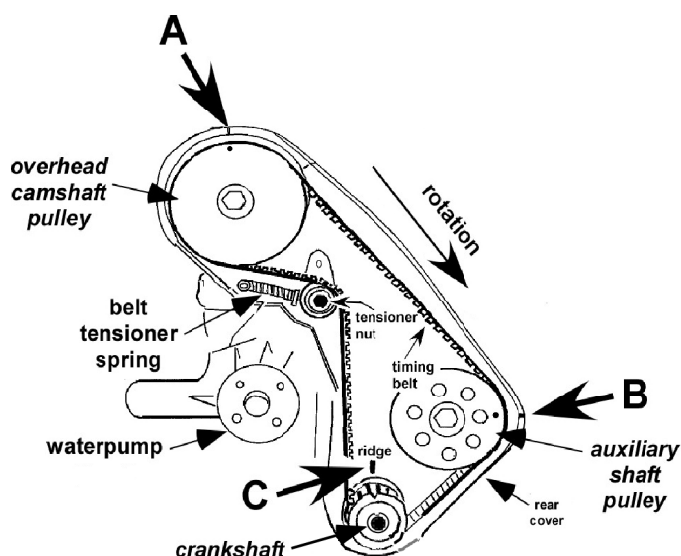
Shown: old OEM.  
Replacement part:  
Scantech. ~\$80 from IPD.

See <http://auto.howstuffworks.com/engine1.htm>  
for a nice graphic of how the gasoline internal  
combustion engine works.

**Figure 15.** On the B230 engine, the crankshaft pulley is composed of an inner and outer pulley with rubber sandwiched between them to help dampen engine vibration. Over time, the rubber deteriorates and the inner and outer pulleys tend to rotate independently. When you put a timing light on the crankshaft pulley, the marks will seem to “run,” rather than stay in one place. [If the pulleys are completely independent, the rotational energy of the crankshaft (inner pulley) will not be transmitted to the outer pulley, and thus the accessory pulleys: waterpump, alternator, power steering, and air conditioning. Failure of the waterpump pulley will seize your engine up; failure of the alternator will mean your fuel injection will not work.]

Once off the crankshaft, check to see that the inner and outer pulleys still turn together as one unit and that there is no play when you rock the two pulleys side to side. If fine, re-use. Otherwise, replace.

Also, while on engine, make sure that the tensioner roller spins freely with no noise. If it’s stiff or noisy, replace (**Appendix A**).



**Figure 16.** Most likely, if you had rotated the crankshaft per **Figure 6**, your alignment marks should align per **A**, **B**, and **C** of this figure. That is, **A** = dot on overhead camshaft pulley aligns to nub on rear plate, **B** = dot on intermediate shaft gear to nub on rear plate, and **C** = notch on front crankshaft shim to ridge on front of engine. (Also refer to **Figure 18**.)

If you have trouble aligning the marks per **A**, **B**, and **C**, then your timing belt has slipped. Not to worry; just make sure that these marks are aligned when you put on the new belt.

Clean area around **C** with solvent-soaked rag.

## Reassembly

Your new timing belt should have three marks: two single line marks align to the overhead camshaft and intermediate shaft respectively while the double line mark aligns to the crankshaft. The closest single line mark to the double line mark is that for the intermediate shaft, as shown in **Figure 17**.

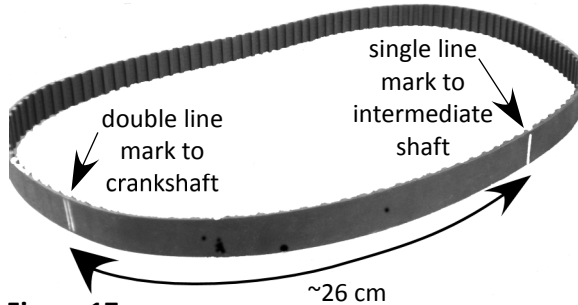


Figure 17.

There is more than one method to install the timing belt. I prefer the following technique.

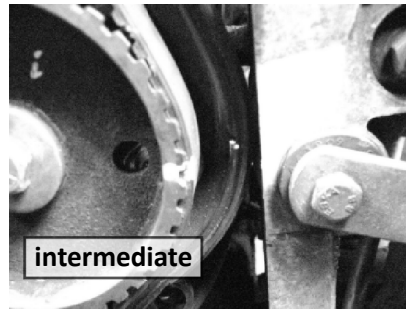
1. First, pin the tensioner spring, per **Figure 13b**.

2. Next, slip new belt over the crankshaft pulley boss, with the double lines of belt on left side of crankshaft pulley boss. Forget about the double lines for now, and instead, align the crankshaft per **Figure 18C**, notch of front crankshaft shim to nub on front of engine. (Disregard fact that crankshaft pulley has been installed in this photo; I forgot to take a photo with pulley off.)

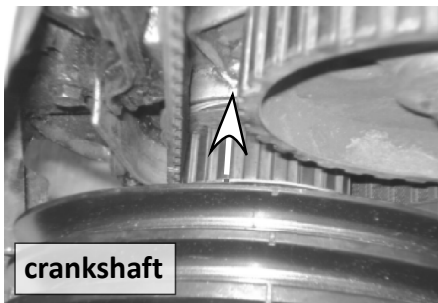
Figure 18.



(A)



(B)



(C)

3. Pull the belt up and around the intermediate shaft pulley and align the single line mark to the dot on the wheel and background nub at 3:00 per **Figure 18B**. This single line mark is about 26 cm from the double line mark (**Figure 17**). [It helps to mark the front edge of the belt adjacent to the line, as shown in **Figures 18A and B**.]

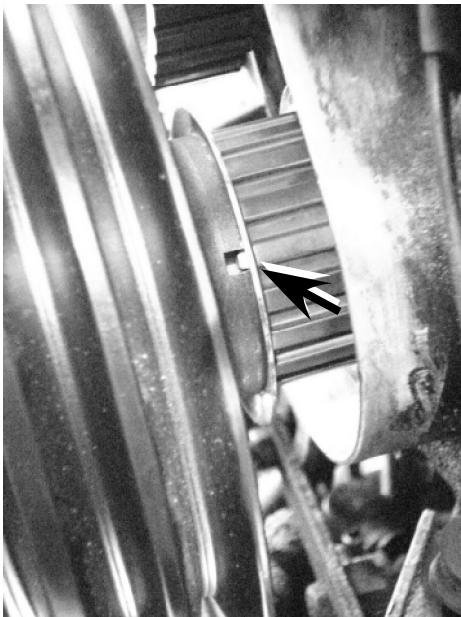
Once you align the single line mark to the intermediate shaft, then pull and stretch underside of belt tightly over the crankshaft pulley boss and over the tensioner roller. Then, pull the upper side of belt onto overhead camshaft gear such that the other single line mark lines up to the dot on the overhead camshaft gear and to the background nub on the rear plate, per **Figure 18A**. You may have to rotate the intermediate shaft either counterclockwise or clockwise, as needed, to align the teeth so as to ease the belt onto the overhead camshaft sprocket. Adjustment may also be needed at the crankshaft pulley boss.

A useful marking tool is a *Liquid Paper All Purpose Correction Pen*, especially for marking the background ridge for **Figure 18C**.





**Figure 19.**

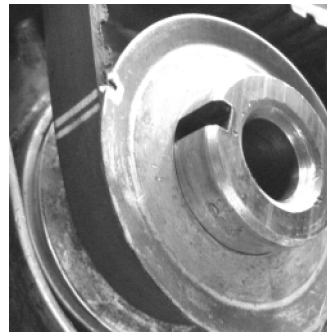


**Figure 20.**

4. Pull the pin to release the tensioner spring and install washer and 17 mm nut on the tensioner. Tighten. (**Figure 19.**)

5. Temporarily install the crankshaft pulley per **Figure 20**, making sure the notch on back of crankshaft pulley locks onto the knob (arrow) of the crankshaft pulley boss. Insert bolt and tighten a bit. (You're installing the crankshaft pulley here because you may need to use the pulley holder to remove the bolt after doing rotation of step 6.)

At this point, you can doublecheck that the double lines on the timing belt align to the u-notch on the front shim of the crankshaft pulley by turning the crankshaft gear *counterclockwise* ~60 degrees or so (if I remember right). It should align per **Figure 21** if alignments of **Figure 18A** and **C** were correctly made.



**Figure 21.** (The pulley is off for photo purposes.)

6. If you checked alignment per **Figure 21**, use the 24 mm socket wrench to turn the crankshaft back to position of **Figure 18C**. Now turn the crankshaft pulley 2X (i.e., 720°) clockwise and observe if the belt stays on the tensioner roller and all gears. (See sidebar next page.) **If it does, doublecheck and triplecheck that all the alignment marks of pulleys to background marks of Figure 16 (or Figures 18A, B, and C) still hold. Failure of alignment here means re-doing this whole process again later.** (We do not care about the alignment marks on the belt. They were only useful for the initial alignment and are nearly impossible to align again to the pulleys.) If pulley marks align to background, then pull the crankshaft pulley off (you may have to use the crankshaft pulley holder to loosen bolt).

7. Install the lower timing belt cover. Refer to **Figure 12** for correct bolts. Also, the bolts go through the holes for the back cover plate (**Figure B19, Appendix B**).

8. Put the crankshaft pulley back on, making sure the notch locks onto knob per **Figure 20**, and insert the pulley bolt. Set up the crankshaft pulley holder and torque the crankshaft pulley bolt to 44 ft-lbs.



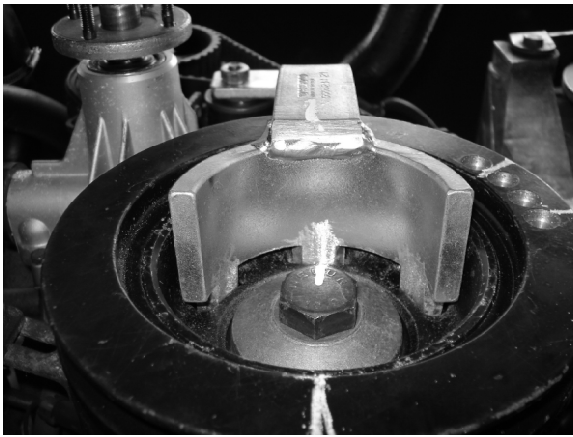


Figure 22.

9. After setting initial torque of 44 ft-lbs, make a vertical mark on the crankshaft bolt at 12:00 (**Figure 22**). The Bentley manual says that the correct torque means another 60 degrees of turning clockwise. I then used a torque wrench set at 150 ft-lbs and was only able to turn the bolt through ~40 degrees. Next, I used a long-handled wrench with cheater bar (**Figure 23**), but was only successful in turning the bolt an additional 8 degrees for a total of about 48 degrees (**Figure 24**). Good enough for me!

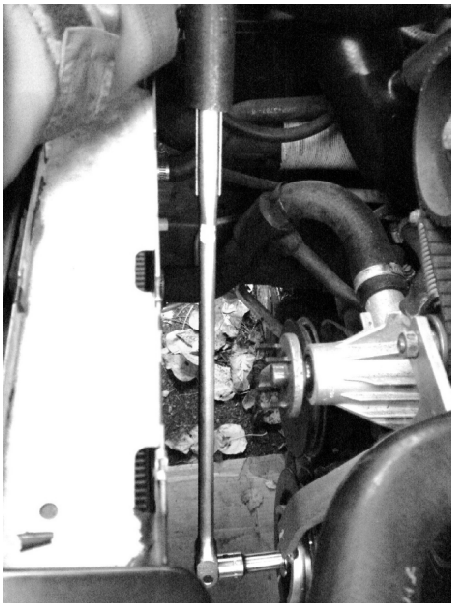


Figure 23.

10. Remove the pulley holder and replace with washer and 17 mm nut on tensioner roller. Tighten. Hook up battery ground cable. **With everything out of the way**, have someone start the engine and run it for 30 seconds to check that everything works. After engine stops, check for oil leaks.

#### Tightening torques:

- crankshaft bolt: 44 ft-lbs + 60°
- tensioner nut: 37 ft-lbs

**Tensioner roller:** Beware of no-name tensioners, most likely made in China. My new no-name tensioner's hanging plate pulled away from the roller bearing. Buy OEM or aftermarket European makes, such as INA.

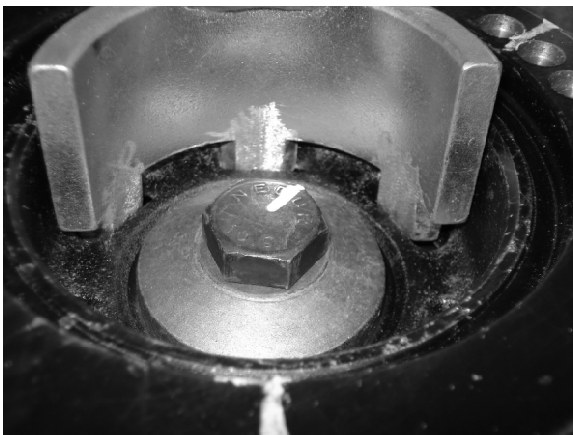


Figure 24.

**Problem:** Using the new INA tensioner roller, I could not get the belt to stay on the overhead camshaft gear and roller when I rotated the crankshaft 720°. The old roller's hanger plate had a slight bend to it while the new one did not. A professional mechanic said the hanger plate is supposed to be flat and that something is out of alignment. I couldn't figure out the alignment problem (it being late fall) and resorted to reusing the old tensioner. Hmmm, I wonder what happened, Volvo?

11. If everything checks out, disconnect battery ground. (You'll be working around the alternator.)
12. Slip new accessory belts onto grooves of crankshaft pulley and corresponding slave pulleys:

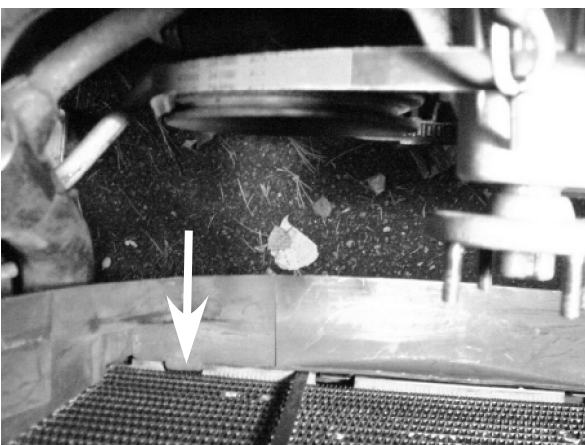
**But first, insert the alternator and AC belts *through* the waterpump/power steering belt and hang the latter over the alternator and AC belts per Figure 25.**

- (a) middle groove of crankshaft pulley connects to front groove of alternator pulley
- (b) front groove of crankshaft pulley to front groove of air conditioning compressor pulley
- (c) back groove of crankshaft pulley to back groove of waterpump pulley and only groove of power steering pulley



**Figure 25.**

13. Tension the alternator belt and AC belt using the nuts and bolts mentioned in **Figure 9**. Belts should depress about 5 mm in the middle when pushed with the thumb.
14. Install upper timing belt cover. Refer to **Figure 3**.



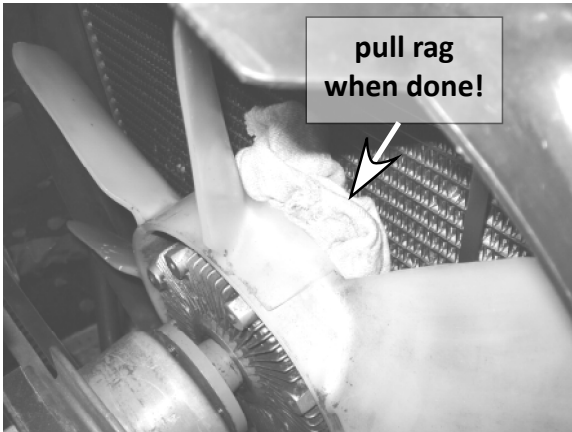
**Figure 26.**

15. Place fan shroud in position with the lower tabs set into the slots of the lower radiator frame (arrow, **Figure 26**).



**Figure 27.**

**16.** Slip the remaining belt over back groove of waterpump pulley, power steering pulley, and back groove of crankshaft pulley. Then, slide the waterpump pulley (**Figure 27**) over the studs of the waterpump. The belt is loose now, but will tighten as the fan/clutch assembly is installed.

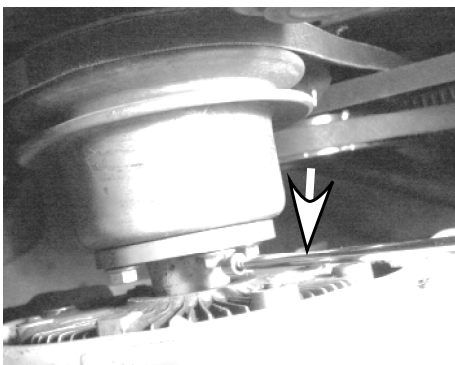


**Figure 28.**

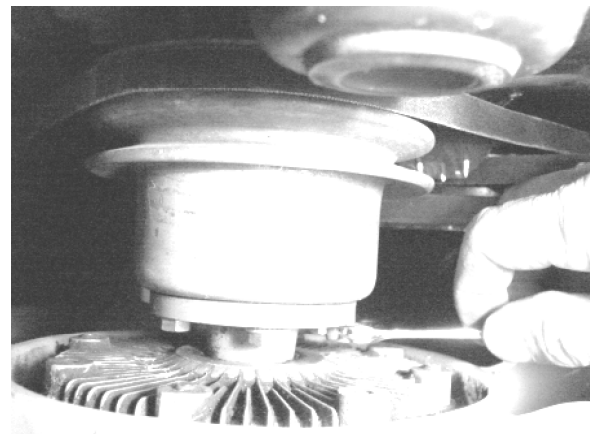
**17.** Put on the fan/clutch assembly. Stuff a rag between the fan and radiator to help hold the fan in place as you tighten the 10 mm nuts (**Figure 28**). A telescoping magnet (arrow, **Figure 29**) is useful for starting the nut on the stud, as space is cramped. Use a 10 mm wrench to tighten the nuts (**Figure 30**), working opposite sides as you go, to gradually pull the assembly firm against the waterpump pulley. This tightens the belt. **Remove rag!**

**18.** Insert fasteners atop fan shroud. Hook up battery ground. Install underbelly pan. (**You did remove the rag, right?**) Start engine.

**Congratulations! You're done!**



**Figure 29.**

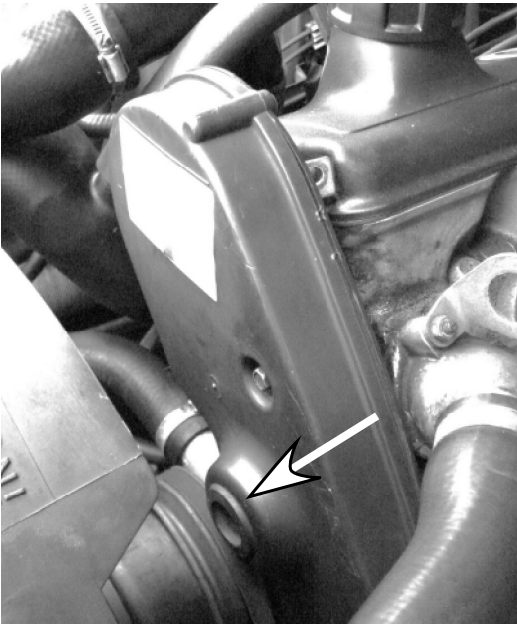


**Figure 30.**

# Epilogue

Test drive your car. If it feels sluggish, especially going up hills, then you may have messed up the alignment marks. You can check for correct alignment by pulling the upper timing belt cover off. Rotate the crankshaft so that the dot on the overhead camshaft aligns to the background mark (**Figure 6**). Shine a flashlight into the chasm of lower timing belt cover and see if the notch on the front crankshaft shim aligns to nub on front of engine (**Figure 18C**). If the marks do not align, you have no choice but to redo the whole procedure again.

Once 600 miles have passed on the new belt, it needs to be tightened. Pry the rubber plug (arrow) out in the upper timing belt cover (**Figure 31**). Loosen the 17 mm nut. Using the 24 mm socket, rotate the crankshaft 1X clockwise. Tighten the 17 mm nut. Press the rubber plug back in place. You're done until another 49,400 miles have passed.



**Figure 31.**

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