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## A Step-by-Step Guide to Changing the Timing Belt on the 240 Volvo non- B230 Engine

**Free!**

**Frederick Su**

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**1982 244 Volvo**

### **Parts needed:**

- timing belt
- fan belts (recommended)
  - Non-AC: alternator
  - waterpump
  - power steering
  - AC: add compressor
- tensioner roller bearing (optional)

### **Tools needed:**

- 10-mm thin box end wrench
- 10-mm open end wrench
- 8-mm wrench
- 1/4"-drive socket wrench with
  - 10-mm socket
  - 12-mm socket
- long handled, 1/2"-drive socket wrench with
  - 22-mm socket
- waterpump pliers (optional)
- 3/8"-drive socket wrench with
  - 17-mm socket
- 2 small spring clamps
- Phillips screwdriver (maybe)
- nail
- electric light
- safety glasses

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## Preface

We were driving our 1979 Volvo 245 in the North Cascades of Washington state, descending from Washington Pass (5,477') into Winthrop.

"Gee, this car is doing pretty well. No problems for over a year," I told my wife. Not five minutes later, the car died. The timing belt had broken.

To make a long story short, the closest Volvo dealer was over a hundred miles away. The next weekend, we went back and I put in the new timing belt myself (for the first time) in about 4 hours.

Volvo recommends changing the timing belt every 50,000 miles. Needless to say, we are pretty religious about this now.

I've changed a number of timing belts since then, but it seems that I always forget some fine point that the Haynes manual skipped over. Hence, this booklet. It is a step-by-step guide to changing the timing belt on the 240 series Volvo. It has plenty of photos to guide you through the process.

"How much does it cost to replace a timing belt for a 740 Volvo?" I asked.

"Two and a half hours," the service manager replied.

"How much do you charge per hour?"

Number crunching in background. "The total job is \$150.\*"

"What about replacing the belt for a 240 Volvo? It's simpler, isn't it?"

"No. Same engine. Still \$150."

Well, the guts of the engine may be the same, but the peripherals are different. It is easier to change the timing belt on the 240 Volvo rather than the 740 because you don't need to remove the crankshaft nut as part of the timing belt replacement.

\*Replacing the oil seals on the 240 is another matter. You'd have to remove the crankshaft nut to replace the crankshaft oil seal, which makes it much more difficult when you don't have the proper tools. And, yes, it costs more for a professional mechanic to do this task. Most people will go ahead and replace the oil seals because it's convenient to do so. This guide does not cover replacing the oil seals.

**Caveat and liability:** bytewrite LLC cannot be liable for any injuries or mechanical problems arising from use of this booklet. While changing *just* the timing belt on the 240 Volvo is an eminently doable procedure by any weekend mechanic, it is recognized that some people have trouble using a screwdriver and wrench.

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## **How do you know it's a broken timing belt?**

If the engine does not start: Remove the oil filler cap and look inside the valve cover while an assistant hits ignition "Start." If the overhead camshaft does not rotate, then most likely it is a broken timing belt.

### **Simplicity**

Volvos have always been, for me, sturdy, dependable work horses of transportation. When they broke down, they were reasonably simple to work on.

The 4-cylinder engine doesn't look like a jungle of wires and tubes. There's room to squeeze your hand in among the different engine parts and wiggle your fingers, which is really important for the do-it-yourselfer. The oil filter is easily accessible. So are the alternator, starter motor, distributor (mostly), and ignition coil. In some vehicles (a Japanese model), a professional mechanic once told me that it took him 3 hours just to access the starter motor!

And, importantly, in the not too distant past, the engines were non-interference engines.

### **Non-Interference**

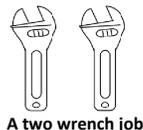
The B20, B21, B23, and B230 engines are non-interference engines, meaning that the camshaft can be rotated independently of the crankshaft and no damage will result to the engine. That is, if the timing belt breaks, the valves will not hit the pistons; the engine will simply stop.

On the other hand, the B234 16-valve engines and any of the other Volvo multivalve engines (the 5-cylinder engines of the 850 and 70 series and the 6-cylinder in the 900 series) are interference engines. Loss of the timing belt in these engines will result in severe or fatal engine damage.

### **Acknowledgment**

I would like to thank Steve Seekins, Technical Editor of Rolling, The Magazine of the Volvo Club of America, for his help in answering some technical questions and for reviewing this booklet. I would also like to thank Scott Hart, Volvo Division Leader, IPD, for his technical suggestions.

# A Step-by-Step Guide to Changing the Timing Belt on the 240 Volvo non-B230 Engine



**A two wrench job:** normal timing belt replacement, eminently doable by a backyard mechanic. Time ~3-4 hours.



**A two and 1/2 wrench job:** (1) replacing the tensioner roller of **Figure 20**. A bit tricky. Replace every other time you do the timing belt. (2) Air conditioning (AC). A little bit more involved because of shims and a split crankshaft pulley.



**A three wrench job:** replacing the front oil seals of the overhead camshaft, auxiliary shaft, and crankshaft when replacing the timing belt. Volvo recommends changing the oil seals every other time you do the timing belt. If the bottom or sides of the timing belt cover are oily, then most likely you've got a bad oil seal. Replacing oil seals can easily add another 4-6 hours to the project because most people don't have the specialized Volvo tools. If only the camshaft oil seals leak, those are easily replaced. The crankshaft oil seal, on the other hand, is more involved because you have to remove the crankshaft pulley nut. *Instructions for replacing oil seals not included in this guide.*

## Note:

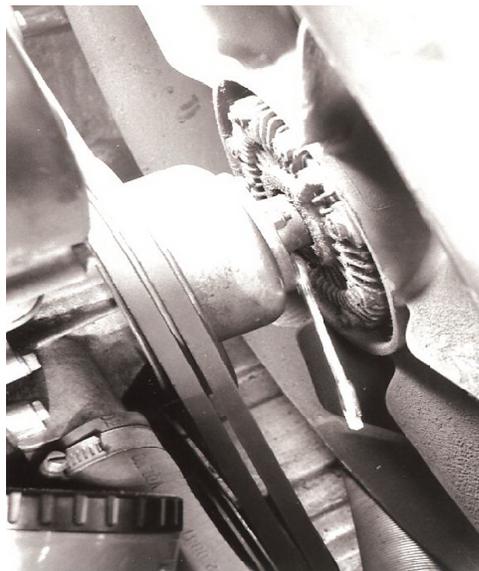
- i) Please read booklet beforehand.
- ii) **Non AC\***. I recommend replacing the fan belts at the same time you replace the timing belt. This is a straightforward job.
- iii) **AC**. Check tension of fan belt midway between AC compressor and crankshaft pulley. Belt should give  $\frac{3}{16}$ " -  $\frac{3}{8}$ " (5-10 mm) when pressed with thumb. Note the tension.

## Overhead camshaft engines

1. Put car in neutral (the crankshaft will be easier to turn). Set handbrake. Block wheels.

Remove the 4, 10-mm nuts that hold the cooling fan/clutch assembly to the waterpump pulley hub (**Figure 1**). Use a thin box-end wrench for initial loosening

\*AC = air conditioning.



**Figure 1. Removing the cooling fan/clutch assembly.**



Figure 2. Removing the fan shroud.

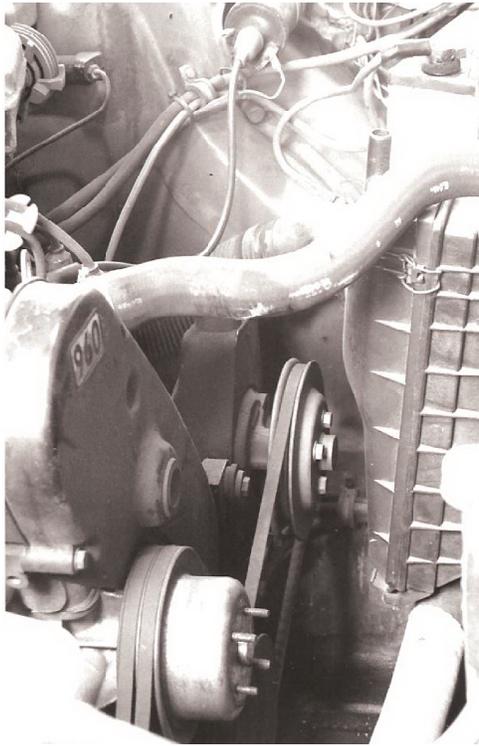


Figure 3. With the fan shroud removed, the front of the engine is visible.

(and final tightening), as the nuts are easily rounded. An open-end wrench is fine otherwise. (Sometimes a stud comes off. Use Loctite, medium strength, on the waterpump-pulley-side threads of any loosened stud when reassembling.) Pull fan assembly out.

2. Remove the 2, 8-mm nuts at top of fan shroud (**Figure 2**). These could be Phillips screws. Lift shroud out. Front of engine looks like **Figure 3**.

3. Remove the timing belt cover bolts. The top two 10-mm bolts are the same length, 1 3/4" (**Figure 4**). The left bottom bolt

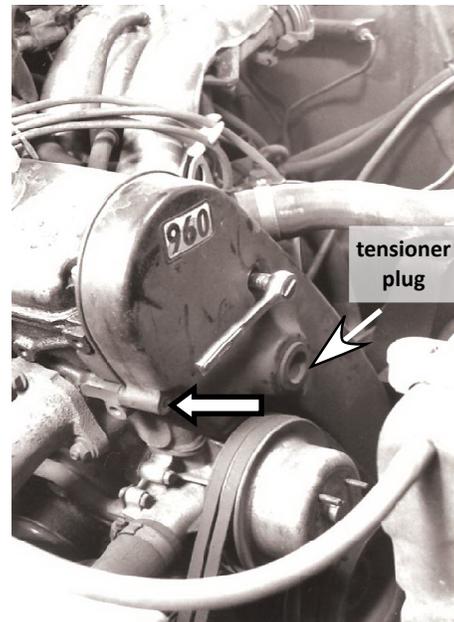


Figure 4. The two top 10-mm bolts, one already removed (arrow), the wrench on the other. Some models have Phillips screws. Both bolts are 1 3/4" long. Note tensioner plug.



Figure 5. The long 10-mm bolt (tip of screwdriver—arrow) on the middle left of timing belt cover.

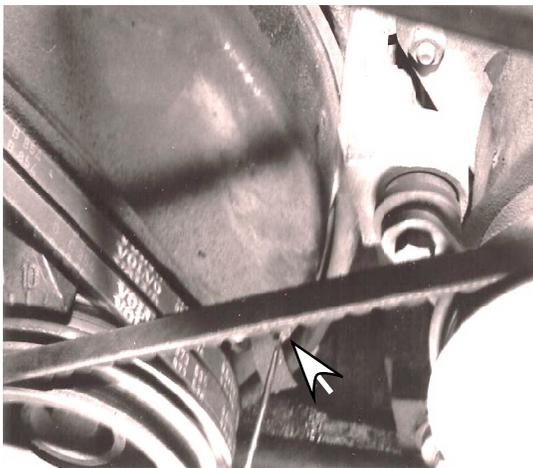


Figure 6. The 12-mm bolt (tip of screwdriver—arrow) at bottom right of the timing belt cover.

(**Figure 5**) has a 10-mm head and is  $2\frac{3}{4}$ " long. The bottom right bolt (**Figure 6**) has a 12-mm head and is  $2\frac{3}{16}$ " long.

For ease of installation, label bolts in some manner. One way: set bolts aside in order; once timing belt cover is off, insert appropriate bolt into its hole in the cover and tape over it.

**4.** Slip waterpump hub and fan belts off (**Figure 7**). Hang the two belts out of the way per **Figure 12** or **Figure 23**.

**5.** Pull timing belt cover off.

Note that in some years, the timing belt cover is in two pieces. For two-piece covers, the bottom half can only be removed when the crankshaft pulley is removed (see **Step 7**).

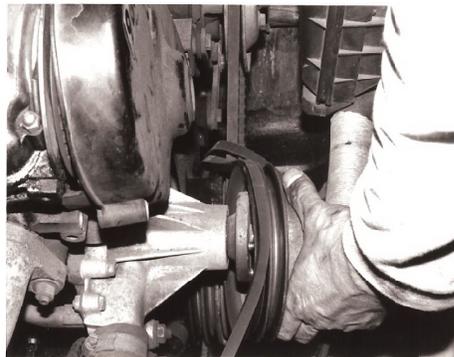


Figure 7. Removing the waterpump pulley hub and fan belts.

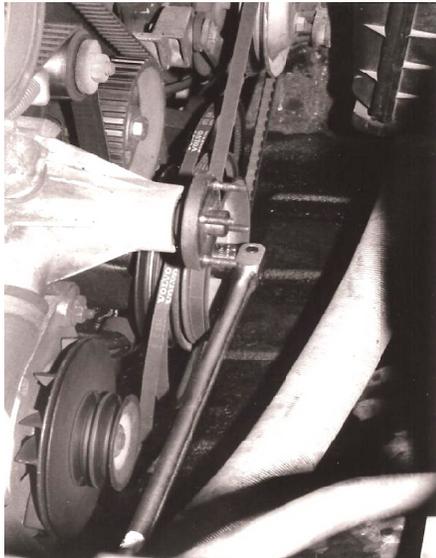


Figure 8. Turning the crankshaft to align the marks per Figure 9.

6. Use a 22-mm socket on the crankshaft pulley nut (**Figure 8**) to turn the crankshaft until the timing marks A and B are aligned as shown in **Figure 9\***.

(a) The notch on the overhead camshaft pulley aligns with the notch in the cam cover (**Figure 10**).

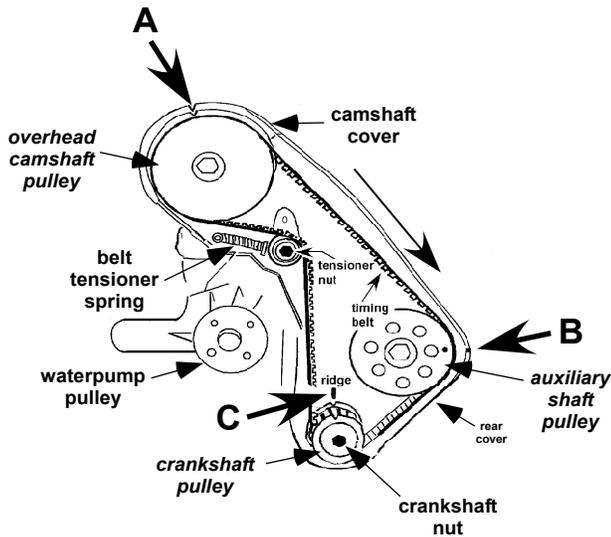


Figure 9. There should be a three point alignment, A, B, and C, between each pulley and a background mark. A: notch on back side of overhead camshaft pulley to notch on camshaft cover. B: dot on auxiliary shaft pulley at 3:00 to line on rear cover (may be hard to see—no matter, see Figure 22). C: notch on crankshaft rear guide plate to ridge on crank seal housing (cannot be seen until crankshaft pulley is removed and area cleaned with solvent-soaked rag—Step 7).

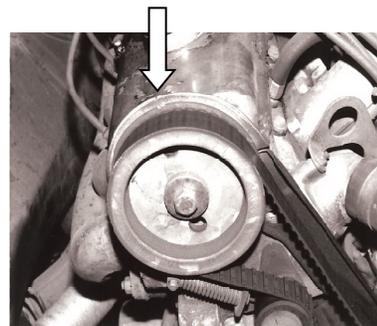


Figure 10. The notch on the back of the overhead camshaft pulley aligns to the notch (arrow) on the cam cover (and first single line mark of new belt when installed).

\*The engine is at piston #1, top dead center.

(b) The white dot on the auxiliary shaft pulley is at the 3:00 o'clock position. [Figure 11—there may or may not be a corresponding mark on the rear cover. Don't worry, we will be aligning to the new belt anyway (Figure 22)]

(c) Don't worry about alignment **C** of Figure 9 just yet. You'll have to remove the crankshaft pulleys first (next step).

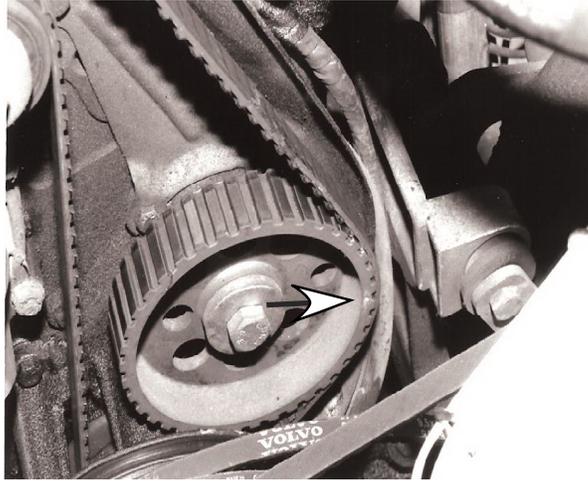


Figure 11. The white dot (arrow) on the intermediate or auxiliary shaft pulley should align at 3:00 o'clock (and onto the second single line mark of *new* belt when installed.)

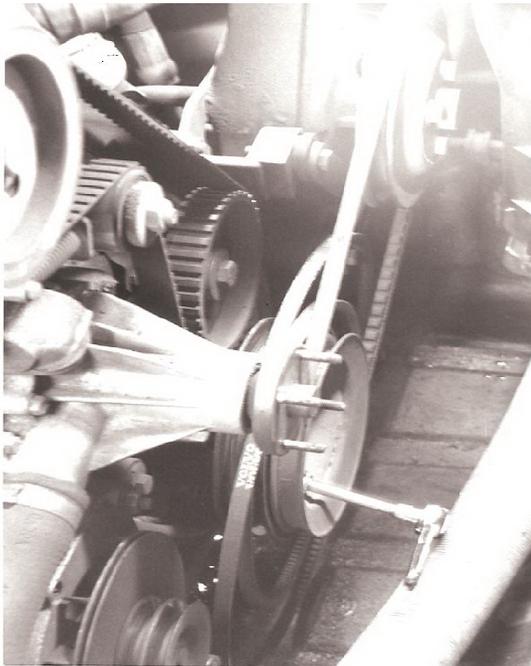


Figure 12. The outer and inner crankshaft pulleys are easily unbolted and removed. Inner fan belts hang loosely.

**7. AC:** Before removing the crankshaft pulley bolts, check and note the tension of the AC belt. Is it just right, too loose, or too tight? Proper tension is  $\frac{3}{16}$ "- $\frac{3}{8}$ " or 5-10 mm of give on belt when pressed with thumb midway between compressor and crankshaft.

Remove the 6, 10-mm bolts (or 2 nuts, 4 bolts) on the crankshaft pulleys (Figure 12) and slide the

two pulleys off the raised spline (Figure 13) of the crankshaft pulley boss.

**AC:** The tension for the AC compressor-crankshaft pulley belt is maintained by shims. When disassembling the crankshaft pulleys, note the number of working shims between the two halves of the outer crankshaft pulley. Extra shims are on the faceplate of the crankshaft pulley. More shims inserted between the halves dictate a looser belt (the belt rides lower in the groove); fewer shims mean a tighter belt (because the belt rides higher in the groove).

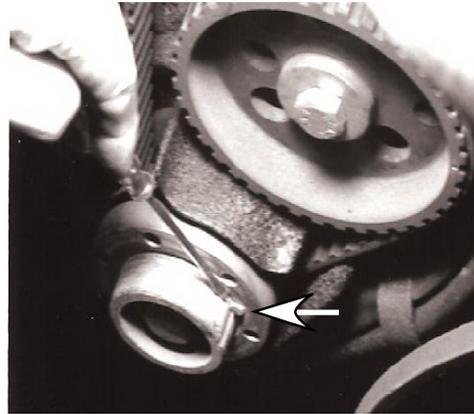


Figure 13. Close-up photo of raised spline (arrow) on the crankshaft pulley boss. Crankshaft pulleys of Figure 15 lock onto this when reassembling.

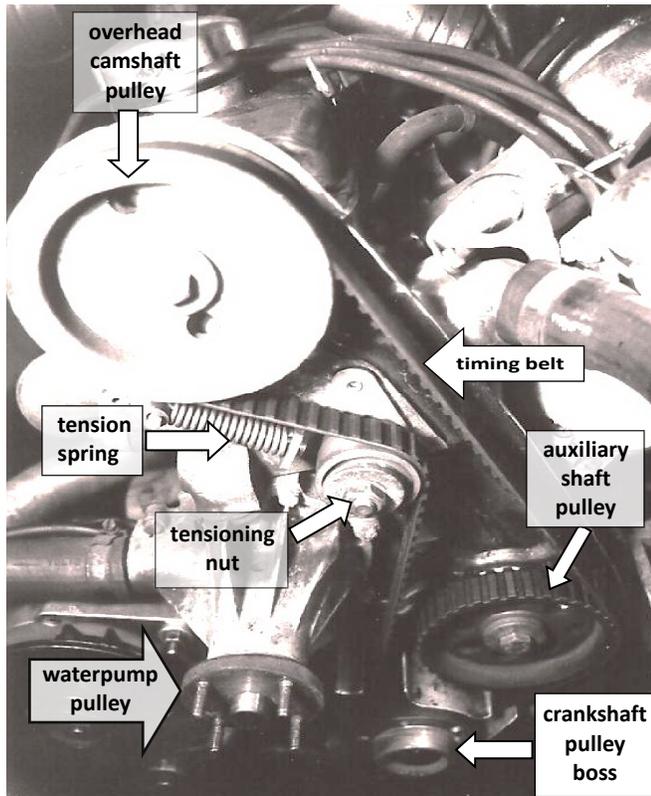


Figure 14. Everything exposed in all its glory!

When reassembling, make sure the notches in the crankshaft pulleys align with the raised spline.

8. The front of the engine looks like Figure 14.

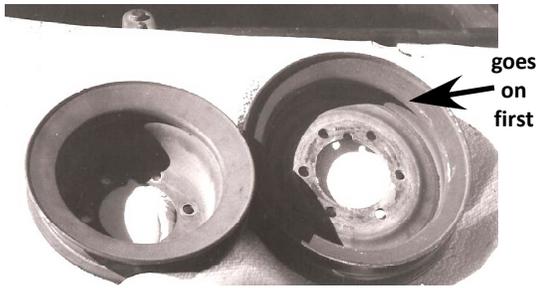


Figure 15. The outermost crankshaft pulley (which is deeper) is at left; the 2-grooved, inner crankshaft pulley is at right. Note the U-shaped notches that slip onto the raised spline of the crankshaft pulley boss. When reinstalling, these pulleys face outward as shown.

AC: The outer crankshaft pulley is split in half with shims fitted between the halves.

9. Figure 15 shows the outer and inner crankshaft pulleys, left to right, respectively.

10. As shown in Figure 16, the notch (deep squarish cut) on the crankshaft pulley boss and the notches (small u shape) on the crankshaft sprocket front and rear guide plates turn together and are at about the 11:30 position, aligned roughly with the lip (that straight edge intersecting the circle of Figure 16) of the timing belt guard. The notches are aligned precisely to the back 4-mm-long ridge of the crank seal housing on front of engine block (Figure 17).

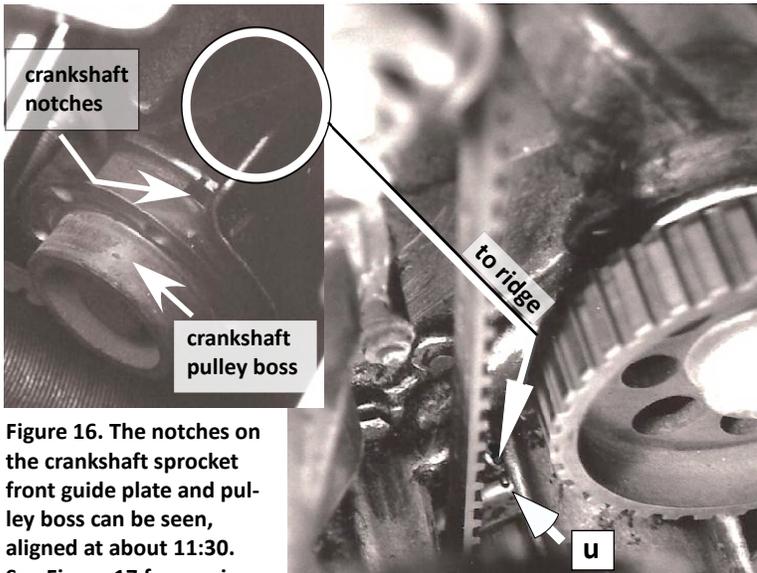


Figure 16. The notches on the crankshaft sprocket front guide plate and pulley boss can be seen, aligned at about 11:30. See Figure 17 for precise alignment.

Figure 17. Blow-up of circle of Figure 16. At back, the small u-shaped notch (u-arrow in photo) on the crankshaft sprocket rear guide plate must align to the 4-mm-long vertical ridge (long arrow) on the crank seal housing on front of engine block. Use a solvent-soaked rag to clean this area for better viewing.

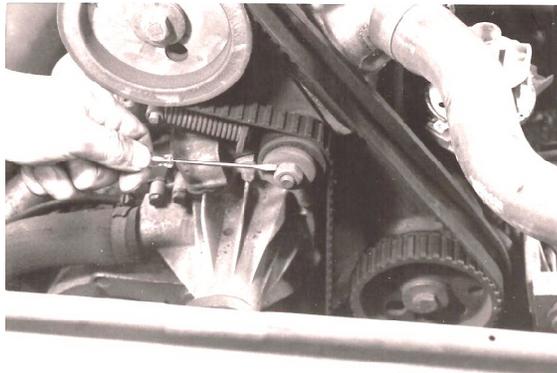


Figure 18. The 17-mm nut on the belt tensioner.

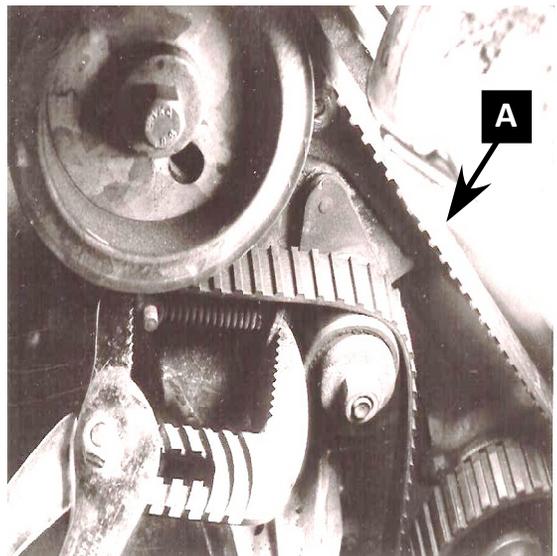


Figure 19. Squeeze the tensioning spring . . .

**11.** Loosen the 17-mm nut holding the belt tensioner spring (**Figure 18**). Do not remove.

**12.** With the belt tensioner nut loose, to remove the old belt, pull or push on the belt at **A** (**Figure 19**), then insert a restraining pin (**Figure 20**) or nail to keep spring compressed. Slide old belt off. (Sometimes it helps to use a large waterpump pliers to squeeze the spring and insert a pin.)

Check tensioner roller to see that it rolls freely. Check surface for damage; it should be smooth. If damaged, replace it. If you have more than 135,000 miles on your Volvo, replace it. Also replace every other time you change the timing belt. [It's easy to get the roller off. It is much trickier installing a new one, because you have to compress the spring through the spring guide hole of the roller frame. (**Use eye protection!**)

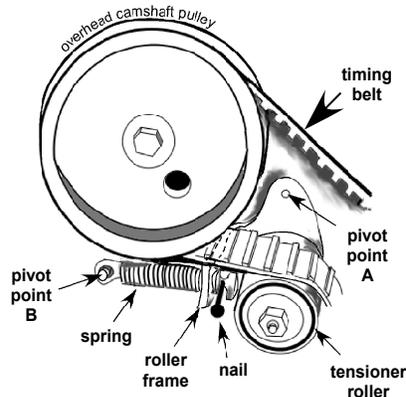
Some folks align the spring, guide hole, and roller frame in a

vise— tightening the vise to compress the spring—and then insert a pin to hold the spring in place. I could never get this to work. I just put the whole thing on the car and used a waterpump pliers to squeeze the spring, aligning it into the hole at the same time. Not easy! Use **Figure 20** as reference.]

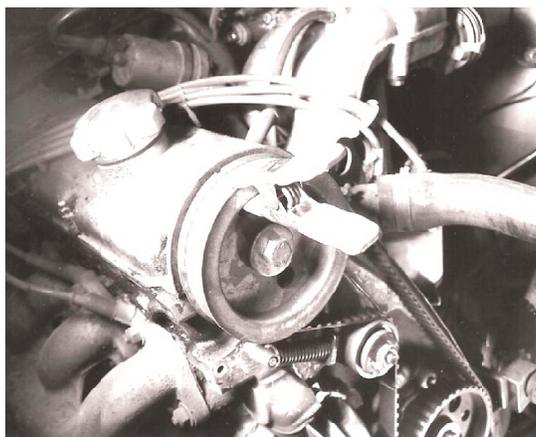
**13.** Put some solvent on a rag and clean area back of the crankshaft rear sprocket guide plate (circle, **Figure 16**) so that you can see the 4-mm-long ridge (**Figure 17**). This is the alignment mark **C** of **Figure 9**! The u-shaped notch of the crankshaft rear sprocket guide plate aligns to this ridge.

**14. Most important step!** Slip the new belt on with the first single line mark of the new belt aligned on the camshaft notch of **Figure 10**. Use a spring clamp to hold the belt onto the overhead camshaft pulley (**Figure 21**). Slide the belt over the tensioner roller and under the crankshaft pulley boss. Make sure there is no play on the belt between the camshaft and crankshaft. Grab the new belt at A, **Figure 19**, and pull up on it to work it over the auxiliary shaft pulley. Make sure the second single line mark aligns to the dot on the auxiliary shaft pulley per **Figure 11**. Double check that the precise alignment of **Figure 17** still holds. If it doesn't, slip belt off at the auxiliary shaft pulley. This time, move the crankshaft pulley boss clockwise a notch or two (while adjusting belt) so that when you pull up on the timing belt to fit it over the auxiliary shaft pulley, the u-shaped notch of the crankshaft rear sprocket plate will move counterclockwise to align with the 4-mm-long ridge. Fuss with it until you get it right!

**15.** With belt on, double check that you have alignment at points A, B, and C of **Figure 9** or **Figure 22**:



**Figure 20.** . . . to insert the restraining pin or nail. Then, remove old timing belt. If replacing roller, pull old one off. To install new roller, hang the roller at pivot point A. Next, hang the spring at pivot point B. Squeeze the spring with large pliers and guide it through the hole in the roller frame to abut the tensioner roller. Not easy, but doable. Then, insert nail to hold in place for installation of new belt.



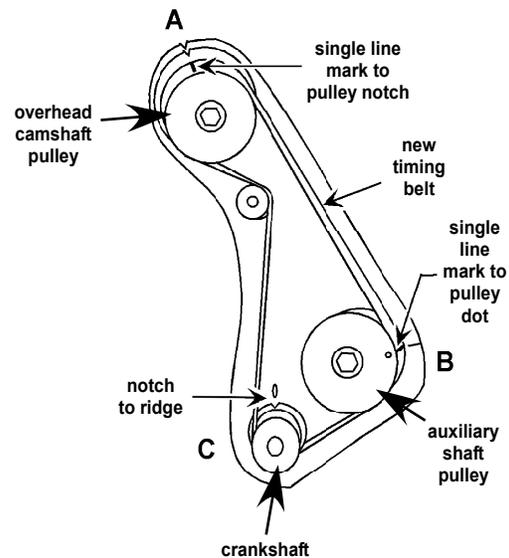
**Figure 21.** The clamp on the overhead camshaft pulley helps prevent the belt from slipping once the first single line mark of new belt is aligned to the camshaft notch.

- ❑ first single line mark of the new belt is aligned to the notch on the overhead camshaft pulley (**Figure 10**),
- ❑ the second single line mark of new belt is aligned to the dot on the auxiliary shaft pulley (**Figure 11**),
- ❑ and the u-shaped notch on the crankshaft sprocket rear guide plate is aligned to the 4-mm-long ridge on the crank seal housing (**Figure 17**).

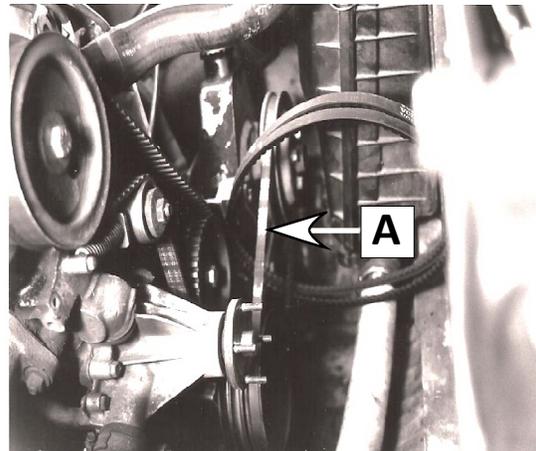
This is the 3-point alignment of **Figures 9 and 22**. *Being off by one notch can greatly affect your car's performance. Double check now or do double work later!*

**16.** Once all three points are aligned, pull nail of **Figure 20** to let the tension spring loose. Make sure the tensioner nut is loose. Use the 22-mm socket wrench to turn the crankshaft clockwise (as seen from the front of the engine) one 360-degree crankshaft rotation to tighten the belt. Then, tighten the tensioner nut.

**17. Check.** Slide two loose belts of **Figure 23** over steering assist or AC compressor and away from any moving parts. Keep loose clothing, long hair, and body parts away from moving parts! Start and run engine for 15 seconds, then stop. Re-examine alignment marks of **Figure 9** by rotating the crankshaft per **Figure 8**. Note that it will be almost impossible to line up the belt marks per **Figure 22**, but the pulley alignment marks per **Figure 9** should be easy to accomplish. Verify this. If not aligned, repeat **Step 14**. If good, your check is done. Start reassembly.



**Figure 22.** Align single line marks of new timing belt as shown, along with notch to ridge for crankshaft.



**Figure 23.** Laying out your new fan belts per above makes it easier to install them later. Caution: slip the two loose belts out of the way (atop either the steering assist or AC compressor) when turning the engine over for the quick test. And keep body parts away from moving parts!

## Reassembly

18. Reassembly is the reverse of disassembly and is, mostly, straightforward.

19. For two-piece timing belt covers, install the lower cover now.

### Non AC (Non Air-Conditioned):

20. Clasp the two crankshaft pulleys together, aligning holes and notches, making sure the shallow one is on the bottom (**Figure 15**).

21. Before sliding the crankshaft pulleys onto the crankshaft pulley boss, thread the outermost fan belt (**A, Figure 23**) through the two inner fan belts and hook one end of belt A to the power assist steering pulley and slip other end onto the outermost crankshaft pulley. The two inner fan belts should hang, as shown.

22. Install both crankshaft pulleys with the inner pulley keyed onto the raised spline of the crankshaft pulley boss. (Note that the spline is too shallow to lock securely onto the outer pulley.)

Rock the pulleys to make sure they don't slip on the pulley boss, i.e., they're locked to the spline. Insert a bolt. (This step may be a little tricky because of the tension of the fan belt. If you're having too much difficulty, loosen the tension bolt for the power assist pulley.) Insert remaining bolts opposite each other; finger tighten. Tighten each fastener diagonally from the last. Use short handled (4"-5" long),  $\frac{1}{4}$ "-drive socket wrench. Don't overtighten and strip the bolt or nut. Tighten to 5-6 ft-lbs or same torque you felt when disassembling

### AC (Air-Conditioned):

23. If the original AC belt had the proper tension,  $\frac{3}{16}$ " -  $\frac{3}{8}$ " (5-10 mm), use the same number of shims between the halves of the outer crankshaft pulley when re-installing. If the old belt seemed loose, take one shim out from between the halves. If the original AC belt seemed too tight, insert an extra shim between the halves. One shim alters the belt tension about  $\frac{3}{16}$ " or 5 mm. Left-over shims go on the faceplate of the outer crankshaft pulley.

Be sure to rotate the crankshaft during the process of installing and tightening the 6 pulley fasteners. (Don't forget to slip the 2 waterpump/alternator belts on first per **Figure 23**.) If you simply tighten the bolts with the belt deep in the "V" of the pulley, the belt will become sandwiched between the two

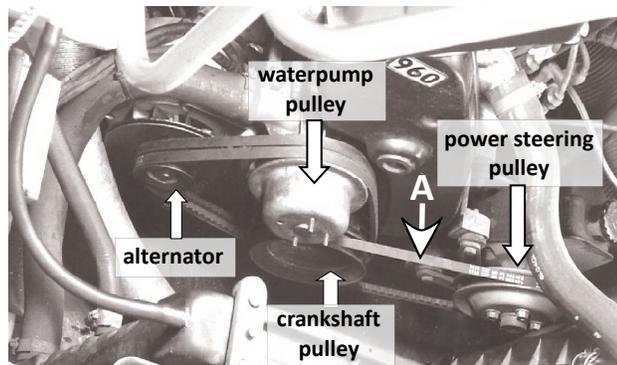
halves. The fasteners will be tight, but once the engine is started, they will become loose. Slowly tighten the bolts (in diagonal fashion) a few turns and then turn the crankshaft a half revolution (using the 22-mm socket wrench of **Figure 8**) to free the belt. Repeat this process until the fasteners are completely seated and tight (5-6 ft-lbs).

**24. Check.** Next, make sure the other belts are out of the way of any turning parts (See Caution, **Figure 23**). Start the engine for a moment. Then shut it off and doublecheck the fasteners and belt tension. The belt should give about  $\frac{3}{16}$ "-  $\frac{3}{8}$ " (5-10 mm) when pressed midway between the AC compressor and crankshaft pulley. It's a trial and error process.

#### Finish Assembly (both):

**25.** Finish assembling the timing belt cover.

**26.** Once the timing belt cover is on, slide the water-pump pulley onto the studs and slip the other two belts on as shown in **Figure 24**. These two belts go over the waterpump pulley, alternator, and inner crankshaft pulley, and should slip on easily. They will tighten when the fan/clutch assembly is installed. (In the unlikely event the belts are too tight and you're having trouble, you must loosen the tension bolt for each specific pulley and adjust.)



**Figure 24.** In this photo, there are 3 fan belts running as shown. If you have air conditioning, fan belt A would run from the outer crankshaft pulley to the air conditioning compressor pulley, and the power assist steering pulley would be right above the compressor, connected to it with a short belt.

**27.** Install fan shroud and cooling fan/clutch assembly. Don't overtighten and don't round off the 10-mm nuts when installing the fan.

**28.** Belts should give about  $\frac{3}{16}$ "- $\frac{3}{8}$ " (5-10 mm) when pressed midway between the waterpump and alternator. Loose belts squeal or otherwise make noise — continuously or intermittently. Tighten, if needed.

**You're done!**

### **Epilog**

After 500 miles, pry the rubber tensioner plug (as shown in **Figure 4**) out from the timing belt cover and loosen the 17-mm tensioner nut. With car in neutral, as shown in **Figure 8**, use the 22-mm socket to turn the crankshaft clockwise (as seen from front of engine) one 360-degree crankshaft rotation to tighten the belt. (No, you don't have to be at top dead center, as some manuals claim.) Tighten the tensioner nut. (Be careful when reinserting the rubber plug! If it falls into the hole, you'll have to disassemble almost everything to retrieve it.) You're all done.

**Note:** If your car runs great, you did the job correctly. If you have no power and acceleration, you're probably off by a notch or two on aligning the timing belt, most likely in aligning the small u-shaped notch of the crankshaft rear guide plate to the 4-mm-long vertical line on the crank seal housing (**Figure 17**).

### **Congratulations!**

You've done it. Pat yourself on the back! Keep this booklet handy. 50,000 miles and the next timing belt change rolls around before you know it.

### **About the Author**

Fred is a physicist turned writer who works on his Volvos when he has to. In his award-winning novel, *An American Sin* (ISBN13: 978-0-9711206-0-0, price \$15), the protagonist's 1970 145 Volvo breaks down outside Missoula, Montana, leading to a meeting with a pivotal hero of the Vietnam War. "Great book!" many have said. More info at [www.bythewrite.com](http://www.bythewrite.com).

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