

**1979 PORSCHE 928****TIMING BELT/WATER PUMP AND MISCELLANEOUS WYAIT PROCEDURES**

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This is a procedural write-up I created following my first DIY timing belt change. There wasn't a newbie rated procedural guide with pics for a 16V so I thought I'd put this together so I could use it when I do the job again and in case others would find it helpful. I am not a mechanic nor am I a 928 expert. One takes this job on at their own risk, but Roger Tyson (928sRus), Wally Plumely (928 Specialists), Jim Morehouse, and Dwayne encouraged me to do the job myself and I'm very thankful as I found it to be a lot of fun. I used Dwayne's (Dwayne's Garage: <http://dwaynesgarage.norcal928.org/>) pictorial write-up for his 32V 87 as my base, added in information from various other sources on the web (Pirtle, Bill Ball, Sharkskin, the FWSM, etc.), and then figured out the differences between my 16V and Dwayne's 32V as I completed the procedure. Huge thanks to Dwayne for his efforts in his write-up. I would not have undertaken the job without it. This write-up is essentially a 16V supplement to his, with additional information that I picked-up along the way. I have organized it exactly the same as Dwayne's and tried to keep everything (the text and pictures) as similar as possible so that interested readers can compare the differences between doing the jobs on the two different motors. The 16V job is simpler in several ways, and I'm hoping that other newbies will find this helpful because they won't have to go through the trouble of figuring out the differences between the 16V and 32V along the way. Having said that, Porsche was always making changes, and previous owners/mechanics may have made modifications, and so others' experiences with 16Vs may vary.

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## CHAPTER 1 PARTS, TOOLS AND PREPARATION

### Parts that I replaced

- Timing belt
- Water pump
- Water pump gasket
- Tensioner main roller
- Tensioner idler roller
- Tensioner bushings
- Oil pump o-ring
- Oil pump seal
- Cam gear seals (2)
- 13 M6 bolts (8 are longer and 5 are shorter; check with your parts supplier for the correct lengths) and 13 M6 washers (for the water pump)
- 8L Antifreeze/coolant (no phosphates nor silicates) and 8L distilled water
- 20w50 motor oil for the tensioner (alternatively 90w gear oil)
- Air conditioner compressor belt (there were two A/C belts of different lengths in MY 1979, so make sure you give your parts supplier your VIN so that you get the right one. I learned the hard way which is why the old belt went back on in this procedure)
- Air pump/fan belt
- Alternator belt
- Power steering pump belt

### Parts that you may need that I didn't use

- Coolant drain plug crush ring washer (2)—I would have replaced them if I'd had them.
- Oil dip stick tube crush ring washer—I would have replaced it if I'd had it.
- Tensioner boot and clamp—I probably should have replaced it.
- Oil pump bolt o-rings (3)—well, I tried to use them.....you'll see.
- Cam gear o-rings (4) (I forgot to use them, but if changing cam seals, should change these WYAIT).
- Front crank shaft seal
- Check with a magnet to see if your car has steel, rather than aluminum, gears. If so, they rarely wear out and likely don't need replacing. If not, you will need to inspect and replace if necessary. Apparently most early 928s had steel gears.

### Tools

- Timing belt tensioner tool (Kemph Tool)
- Flywheel lock tool
- 2-jaw pulley puller
- Torque wrenches (1/4"; 3/8"; 1/2"; 3/4"—which of these you need depends on the torque range of your wrenches)
- Breaker bar (and a piece of pipe for extra leverage if necessary)
- Medium sized Pry bar
- Gasket scraper

- Metric sockets, including a 27mm deep socket
- Metric wrenches, including a 32 mm (or can use a large crescent wrench, and risk skinning your knuckles)
- Long flathead screwdriver
- Small Snap-ring/circlips pliers
- Hammer
- Small punch
- Cordless Impact wrench
- Rubber mallet
- Seal puller

### **Lubricants and Solvents**

- Optimoly HT—copper anti-seize, used when differing metals are making contact (e.g., aluminum with steel)
- Optimoly TA—silver anti-seize, used when the same metals are making contact (e.g., steel with steel)
- Loctite 574—sealant for metal-to-metal seals
- Gasket sealant RTV (Room Temperature Vulcanizing)
- Blue threadlocker
- Penetrating grease
- Brake cleaner

### **Preparation**

- You need to lift and support the car. Search Rennlist for how to put a 928 on jack stands. I used my lift.
- Place a tarp/cardboard under the engine area to catch coolant, oil and dirt.
- Put on service covers (I bought mine from 928sRus before doing this job, wish I had them years ago. They're a God send. The tool compartment on the front looks gimmicky, but it's incredibly handy. Money very well spent).



- Next, disconnect the battery. I removed the spare tire and disconnected the negative battery cable from the post.



- Remove the belly pan (if you have one; mine doesn't at the moment).

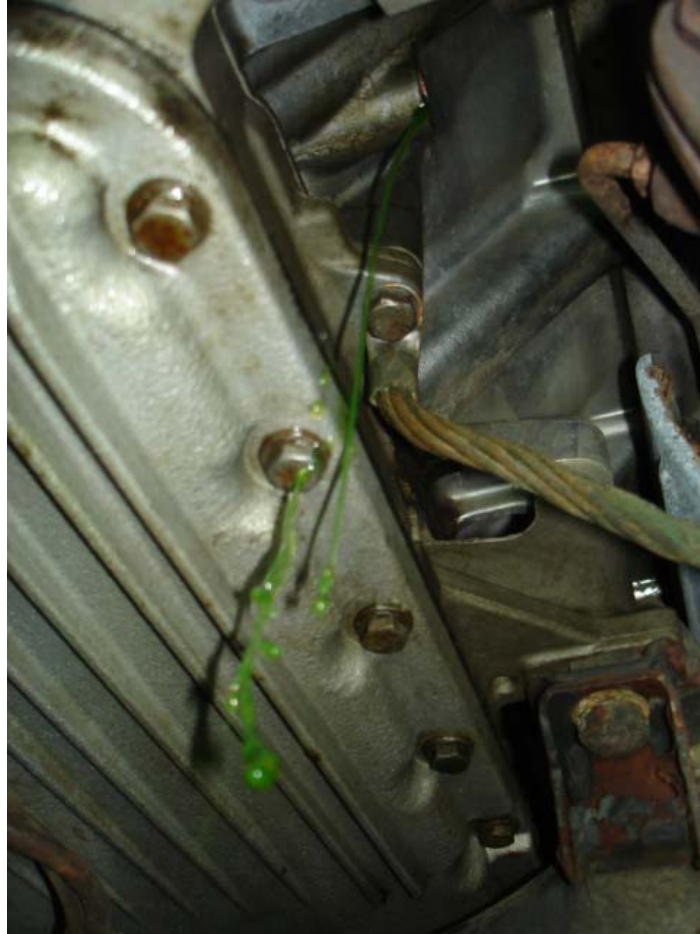
## CHAPTER 2

### DRAIN COOLANT AND REMOVE COOLANT HOSES

- First I drained the block of coolant. You need a suitable container to catch the coolant. Dwayne used a kiddy wading pool, which would be perfect, especially if using jack stands. I didn't have one, and since I had the height of a lift, I used two garbage cans. The drain plugs are located one on each side of the block about  $\frac{3}{4}$  toward the rear of the block. They are 13mm bolts with a crush ring washer.



- Position your catch can under the drain. When you remove the bolt the coolant will begin to slowly drain.



- Do this for both drains.
- Then open the coolant reservoir cap, allowing the coolant to drain more quickly.



- After the coolant has been fully drained from the engine block, reinstall the drain plug. The coolant bolt is coated with copper anti-seize (Optimoly HT or Permatex Copper anti-seize). It's a good idea to change the coolant bolt crush ring washer at this time. Torque to 25.8 ftlbs.



- Next, drain the radiator. The blue plastic drain plug is under the radiator on the left/passenger side. Use a large Phillips or Flat Head screw driver to loosen the bolt.



- Once the radiator is completely drained, reinstall the drain plug. I found it best to just hand tighten this nut with the screwdriver rather than using a torque wrench (1.1 ftlbs).

- Next, completely remove the air intake tubes from the engine compartment and set aside somewhere safe.



- Then loosen the upper radiator hose clamp at the engine. I started using an 8mm socket, but ended up just using a flat blade screwdriver for all of the hose clamps. After removing each hose end from its connection point, I tightened the clamp on the hose so it would go back from where it came and wouldn't get lost.



- Then loosen the upper radiator hose clamp on the radiator, and remove the hose.



- Next, loosen the clamp on the heater return hose from the thermostat housing....



- ...and remove the hose.



- Have your catch can ready as there is likely coolant still in this hose (same for the lower radiator hose). Place it downward toward your catch can to drain any coolant in the hose. Then disconnect it at the other end (so that it won't be in the way).



- Next, loosen the clamp at the engine on the lower radiator hose.



- Pull the hose off of the thermostat housing.



- Then loosen the clamp on the radiator. The clamp is probably positioned so that it can be loosened from underneath.



- And remove the lower radiator hose.



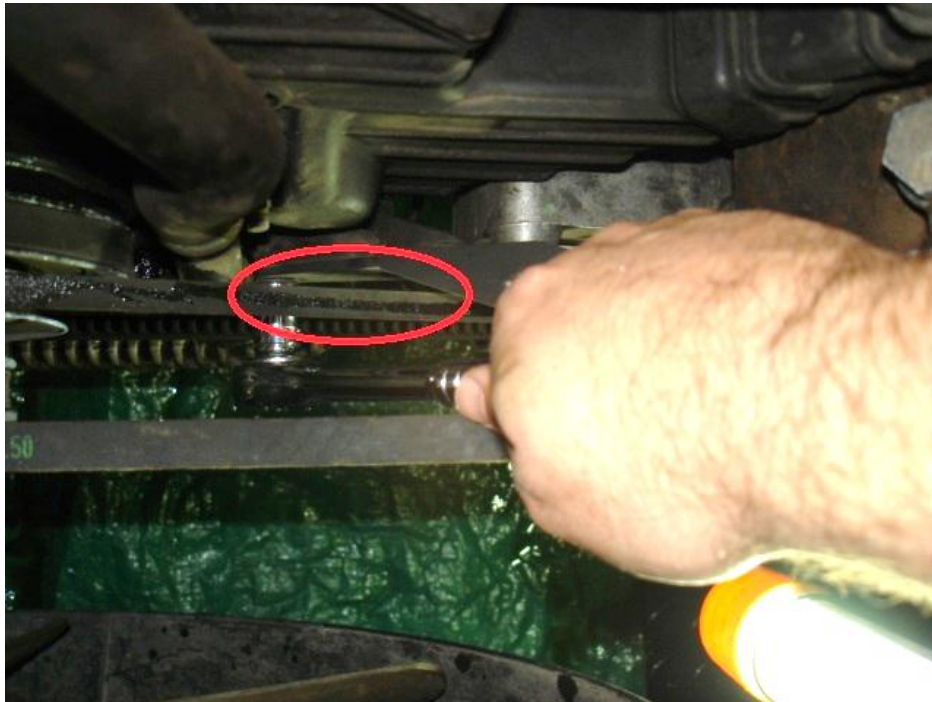
### CHAPTER 3

#### REMOVING ACCESSORY BELTS

- There are 4 accessory belts. On the 16V, from outermost to innermost is as follows: Power steering pump; Air pump and fan; Alternator; Air conditioner compressor.
- Start with the outermost belt and work inward.
- This is quite different from Dwayne's 87, and so I loosened a bunch of bolts to figure out how everything works. (Caution: there may be an easier way of doing this, but it worked for me. Also, I did it somewhat out of order which is why some belts are still on in the pics)
- The bolts for the accessories are 13mm, except for the air conditioner compressor which has 17mm bolts.

##### A. Power Steering Pump

- Loosen the two bolts on the front of the power steering pump bracket.



- Next, loosen the tension adjusting bolt on the power steering pump.



- Loosen the bolt on the back of the power steering pump (this may not be necessary).



- Then push the power steering pump toward the centre of the engine to release tension from the belt and remove the belt. It's a good idea to label each belt.



## B. Air Pump/Fan

- Begin by loosening the air pump pivot bolt.



- Then loosen the nuts that hold the position of the air pump.



- Push the air pump toward the centre of the engine to take tension off of the belt and remove the belt.



### C. Alternator

- Loosen the alternator pivot bolt.



- Loosen the bolt on the back of the alternator (sorry for the blurry pic)



- Loosen the tension with the tension adjusting bolt until the belt is loose enough to be removed from the pulley.



#### D. Air Conditioner Compressor

- Loosen the 17mm pivot bolts on the front and back of the air conditioner compressor.



- Then loosen the bolt at the top front of the of the air conditioner compressor.

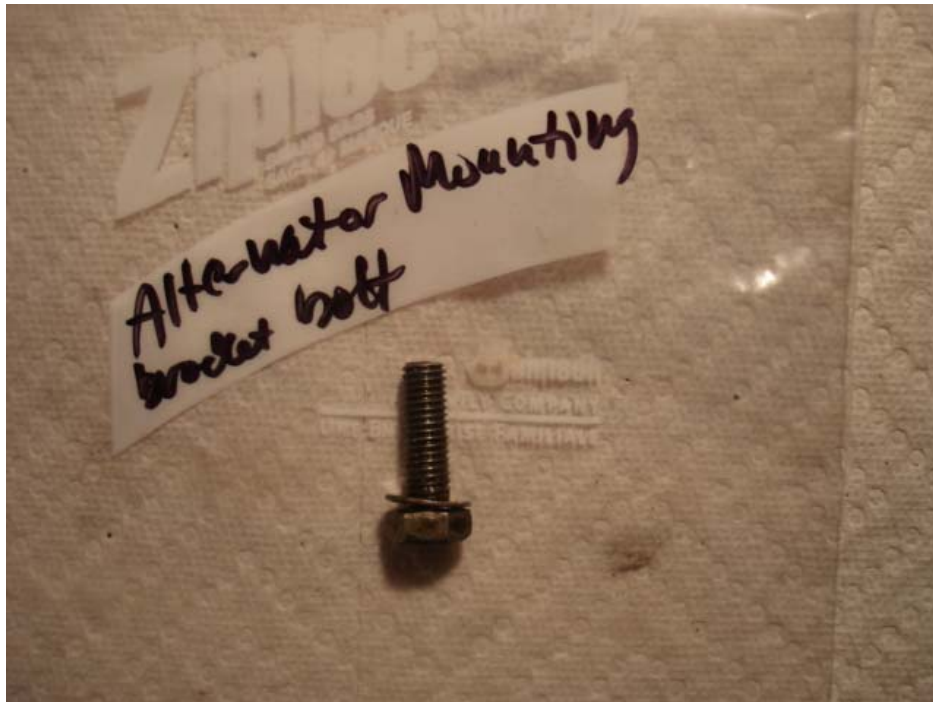


- Push the compressor toward the middle of the engine to loosen tension on the belt, and remove the belt.

## CHAPTER 4

### REMOVING THE FAN SHROUDS AND FAN

- Thankfully, there is far less to do in this step compared to the 32V. There's no need to mess with the power steering fluid reservoir, an air pump hose to the radiator (not present), the distributor cap, and the wiring harness for electric fans (not applicable).
- The fan shrouds are each held on with two 10mm screws and washers. Remove the two screws from the upper fan shroud. It's a good idea to put the various screws/bolts and washers belonging to each specific part in zip lock bags and label them as shown in the example below.





- Then simply lift the shroud out vertically (take note here how it fits into the lower fan shroud and clips over the radiator so you'll see how to put it in when it is time to replace it).



- Next, I removed the fan. It is held on by three 13mm bolts, each with one lock washer. Two on the top and one underneath the bracket. Note that the fan has a viscous (liquid

filled) clutch and must be kept in the vertical position at all times. So, ensure to keep it vertical when removing it and while it is set aside.



- I propped the fan on the floor and against the concrete foundation.



- Next, remove the two screws holding in the lower fan shroud (access from underneath on the inside facing out). There is enough room to work without removing this piece, but it's so easy to remove and there's no point in risking breaking it with a wrench etc.



## **CHAPTER 5**

### **LOOSENING POWER STEERING PUMP BRACKET, REMOVING ALTERNATOR, REMOVING OIL DIPSTICK AND TUBE, AND REMOVING OIL RETURN HOSE AND TUBE**

- Initially, I thought I might be able to do the job skipping this chapter (which is why some of the pics may appear out of order). However, I later realized that this needs to be done to remove the centre timing belt cover and to work on the oil pump. So, now is the time to do it.
- Remove the bolt holding on the power steering pump bracket. This, plus the other bolts on the bracket/pump being loose, will allow enough movement to remove the centre cover.



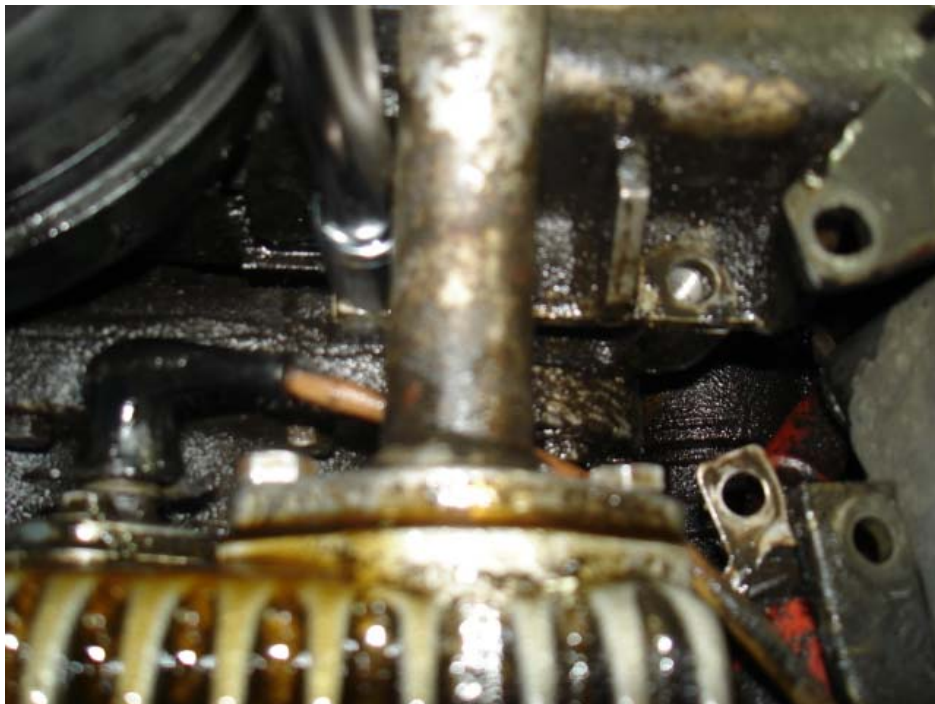
- Next, place something under the alternator to hold it so that there is no tension on the wires when it is removed. I used some wood in my jack tray.
- Remove the alternator cooling hose from the alternator air guide. It just slides off (see pic below of it removed)
- Remove the alternator pivot bolt (that was loosened earlier) and the bolt on the alternator tensioner arm that attaches to the engine.



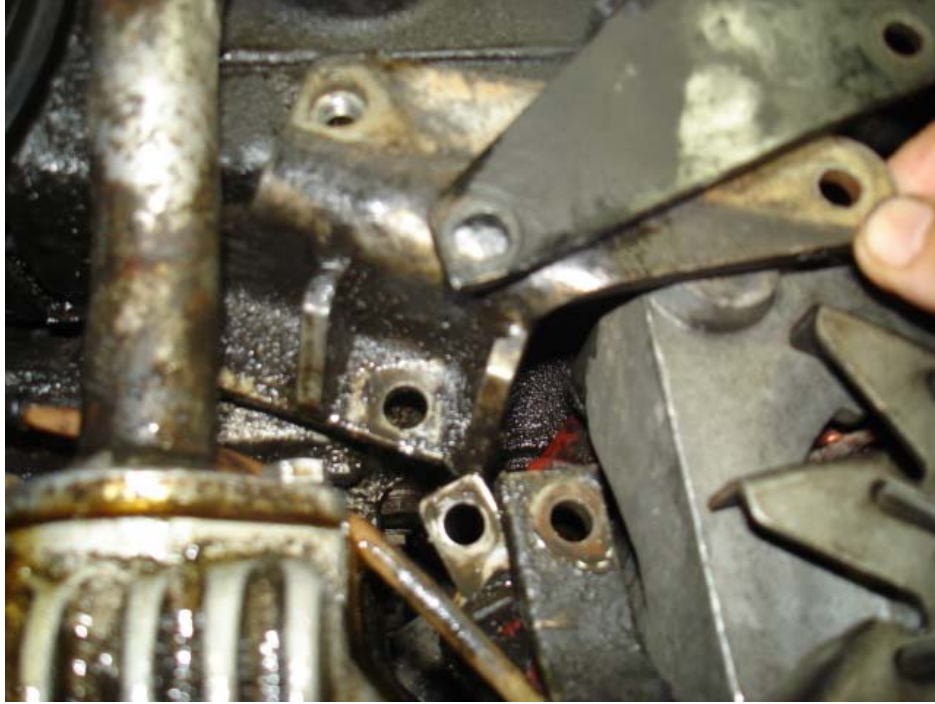
- And place the alternator at rest.



- Next, loosen the other bolt (behind the oil return tube) that holds the bracket in place to which the steering pump bracket bolts.



- This allows the bracket to slide down and out of the way of the centre timing belt cover.



- Now is a good time to remove the dipstick and set it aside, then remove the dipstick tube. The dipstick tube is held on by threads and has a built-in 17mm nut. Turn the nut counter-clockwise until the tube comes out and set it aside. Be sure to place a clean rag/towel in the hole in the engine block to keep dirt out. Also take care not to lose the crush ring washer for the dipstick tube (replace if necessary).

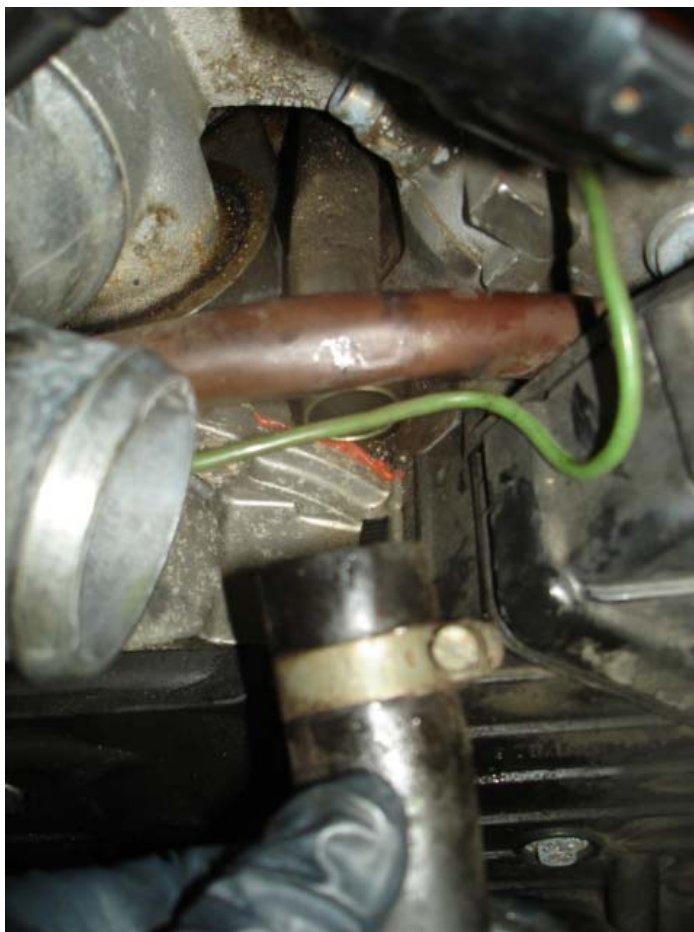




- Next, loosen the clamp holding the oil return hose to the top of the engine.



- And remove the hose.



- At this point I removed the hose from the tube that comes out of the oil sump. I do not advise this, so please ignore the tube sticking out of the sump in the rest of the pics. Instead, remove the two bolts where the tube enters the sump and remove the tube with hose completely. The problem is that one has to keep removing and inserting it, and every time this is done oil spills out of the sump and makes a mess. All of the removal and insertion also contributed to stripping the threads in one of the holes in the sump, which meant purchasing and installing an M6 Time-Sert insert. Eventually I tried putting some different types of tape over the hole, but the oil prevented good adhesion. There is a ridiculously overpriced cover that can be purchased from Porsche for this, which I currently have on order from Roger at 928sRus (price is not Roger's fault). The alternative would be to drain some/all of the oil out before starting the job. If you need an oil change, this is probably a good time to do it in case any dirt gets into the system. So, one could simply drain the oil before the job and place tape over the hole after removing the tube and cleaning off the oil. But, if one doesn't need an oil change and is able to do the job ensuring that no impurities enter the system full of oil, the price of the cover is less than an unnecessary oil change (at least with the price of oil in Canada).
- Below are pics of what the oil return tube looks like when it comes out and one of my attempts at using tape to cover the hole.



## **CHAPTER 6**

### **REMOVING THE UPPER CAM GEAR COVERS AND SETTING THE CRANK TO 0TDC**

- Disconnect the wire that goes in front of the right/passenger side cam gear cover and place the wire out of the way.



- Next, remove the 10mm bolt that holds on the right/passenger side cam gear cover.



- Remove the cam cover by lifting up a bit so that the plastic hook on the cover clears the rear cam cover plate.



- The left/driver's side cam gear cover is also held on with only one 10mm bolt. Remove the bolt.



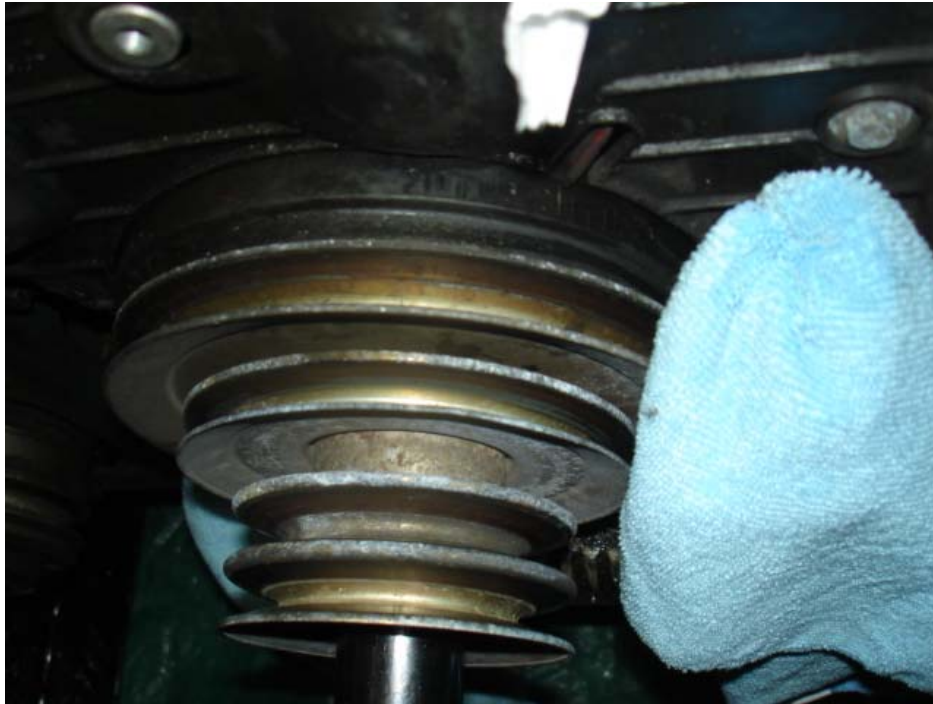
- It is a little bit tricky to remove the cover with the power steering pump in place, but it does come out.



- Next, turn the engine to 0 Degrees Top Dead Centre (0TDC) and check the alignment of the cam gear timing marks.
- Use a 27mm deep socket and ratchet to engage the crank bolt and turn the engine CLOCKWISE (never counter-clockwise). Turn the engine clockwise until the harmonic balancer/vibration damper is at 0TDC.



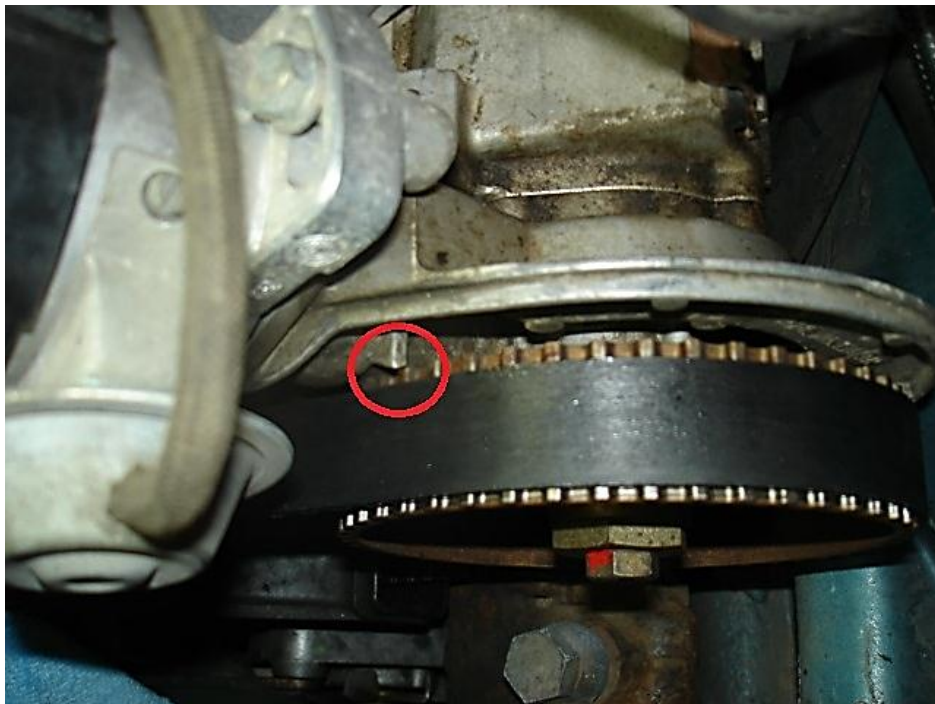
- Below is a pic of the 0TDC marker. Sorry it is hard to see (0|T).



- The crank turns twice for every one revolution of the cam gears, so one also has to check the timing marks on the cam gears to ensure that the engine is, in fact, at 0TDC. Additionally, 0TDC can be confirmed by removing the distributor cap and ensuring that the rotor is pointed toward cylinder 1 (compression stroke).
- Below is a picture of the right/passenger side timing marker on the back cam gear cover plate. There is a large V pointer built into the metal cam cover back plate. Each cam gear has a small V notch cut into the back side of the gear. These should line up very closely, as close to perfectly as possible, when the harmonic balancer is at 0TDC. Although blurry in the picture, the notch on the cam gear was about 1 tooth too far advanced (to the right of the marker when facing it). If the small V notches aren't visible, rotate the engine another revolution to the 0|T mark on the harmonic balance and the V notches should be visible and lined up with the V pointers on the metal cam cover back plates.



- Below is a picture of the left/driver's side cam gear V pointer. I couldn't get an angle where the v notch was visible, but it was lined up perfectly with the V pointer.



- If the cam gears don't line up to the V pointers on the back cam cover plate, to be safe one can use a marker, white out, or paint to put marks on the cam gears where they line up to the V pointers. Then, when putting on the new timing belt, one can first line up the

cam gears with the V notches, but if the engine doesn't run as well or better than before, then the cam gears can be returned to their original position.

- With a 32V motor, at this point one would move the crank to 45 degrees below TDC. This is to prevent the valves from hitting the pistons and bending the valves (also the danger in breaking a timing belt on an interference motor). The 1979 16V is a "non-interference" engine, meaning that the valves cannot make contact with the pistons. This means that the timing belt can be changed at OTDC (and timing belt failure is less of a concern compared to the interference engine). There is some debate in the 928 community about when the non-interference engine ends and the interference engine begins (also varies by whether or not the car is a Euro), so, if you don't know if your engine is interference or non-interference, consult the experts (e.g., Rennlist) before embarking on your procedure.
- Next, go underneath the car and remove the flywheel inspection plate if it's an automatic, or the clutch slave cylinder if it's a 5 speed. My car is a 5 speed. Remove the two 13 mm bolts.



The clutch slave cylinder simply pulls away and a rod comes out. Set the rod aside.



Next, insert the flywheel locking tool into the opening and secure it using the same 13mm bolts that held the clutch slave cylinder in place.





- By locking the flywheel in place, the crankshaft won't turn, allowing one to loosen the bolt that holds on the pulley assembly, harmonic balancer, and crank gear.

## **CHAPTER 7**

### **REMOVING THE ACCESSORY BELT PULLEY ASSEMBLY, CENTRE TIMING BELT COVER, AND HARMONIC BALANCER**

- I used a breaker bar and the 27mm deep socket to loosen the crankshaft bolt. To provide some extra leverage I put a piece of pipe over the handle of the breaker bar. Apply force counter-clockwise to break the bolt loose.



- Remove the crank bolt and large washer and set them aside.



- The accessory pulleys should easily pull off.



- Next, pull off the air conditioner pulley.



- Next, begin the process of removing the centre timing belt cover (note: it is possible to remove the centre timing belt cover without removing the accessory belt pulley assembly).
- It is held on with three 10mm bolts and one 13mm bolt, each shown in the order in which they affix the centre timing belt cover in the picture below.



- The two short 10mm bolts are in the middle of the cover. These bolts are identical each having one small and bigger washer. The right-most bolt is the long 10mm with a small and big washer.



- The 13mm bolt is at the left-most of the cover.



- With these four bolts removed, the timing belt centre cover will pull straight off.



- Next, remove the harmonic balancer. It should just wiggle off. Based on what I have read on the web, if one can feel any wiggle whatsoever, it will come off. It may take many minutes of wiggling, but it will come off. If having lots of trouble getting it off, one can use some penetrating grease and wiggle it slowly and gently. It is possible to damage the rubber that bonds together the inner and outer portion of the damper if it is forced. Mine wiggled off in only a few seconds of wiggling.



- There is a thin round piece of metal with a curved edge that sits between the harmonic balancer and the crankshaft gear. This is the outer timing belt guide. Note that the curve faces toward the harmonic balancer. Slide it off the crank shaft and place it with the harmonic balancer.

## **CHAPTER 8**

### **REMOVING THE TENSIONER ROLLER ASSEMBLY AND TIMING BELT**

- Begin by taking the tension off of the timing belt. First loosen the 17mm locking nut on the tensioner.



- Then loosen the 17mm tensioner bolt until there is sufficient slack in the belt to remove it from the right/passenger side cam gear.



- Next, remove the Tensioner Roller Assembly. The Tensioner Roller Assembly is held on with a single 15mm bolt that attaches to the water pump. This bolt is in contact with the coolant and so on reassembly gets coated to avoid a coolant leak. Remove the bolt and the tensioner assembly with the main roller will come off, as shown in the pictures below.





- The idler roller should simply pull off of the spindle on which it sits on the water pump.



Next, pull the timing belt out from crank gear, oil pump gear, left/driver's side cam gear to remove the belt...



- ...and do the timing belt boogie!!!!!!



## CHAPTER 9

### REMOVING THE WATER PUMP

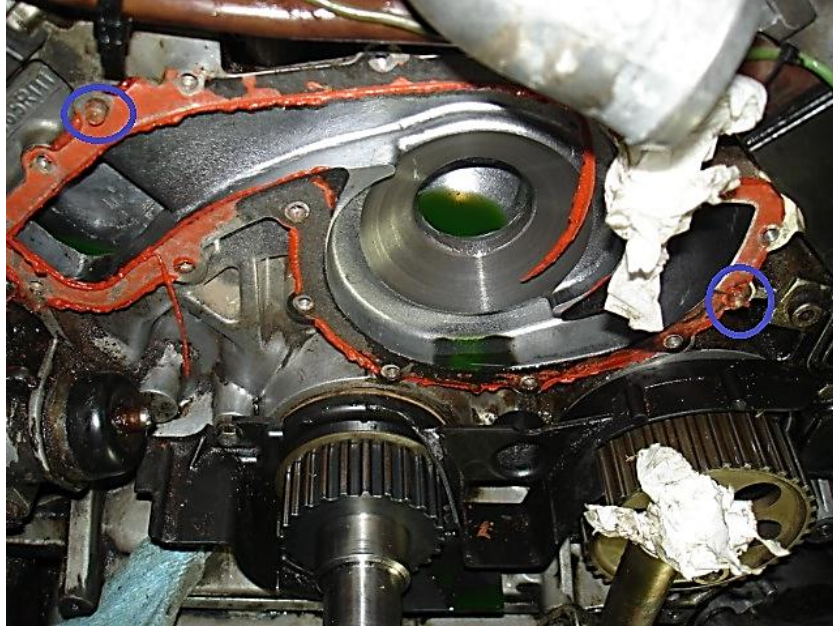
- I solicited opinions on Rennlist about whether to change the water pump. There is some disagreement about whether it needs to be done as part of the timing belt change. Some think that it became routine practice when owners were paying mechanics to do it because it was a lot cheaper to do it as a WYAIT than to go back in a second time just to replace the water pump. Porsche released a technical bulletin (#9110) stating that “The coolant pump only needs replacement if there is a noticeable leak, like coolant on the garage floor...” Bill Ball gave me some excellent points to use when evaluating a water pump:
  - The pulley should not spin freely. It should stop spinning after roughly a quarter of a turn.
  - There should be no radial or axial play in the main roller.
  - The impeller should be close to flush with the end of the shaft (would need to remove pump to check).
  - The clearance between the impeller and the pump body should be less than 0.005 of an inch (would need to remove pump to check).
  - The shaft will not move in or out or laterally.
- Although mine looked good, it had been 11 years since it was done and I decided to go ahead and change it as I wanted the experience.
- The water pump is secured with 13 M6 10mm bolts and M6 washers.
- As shown below, there are 8 bolts to the left of the pulley and 5 bolts to the right of the pulley. 8 bolts are long (circled in red) and 5 bolts are shorter than the others (circled in blue). The latter belong in the holes that are recessed in the water pump.



- An easy method for bolt placement is to place them in their correct position on the new water pump as they are removed from the old water pump. Then, once the old water pump has been removed, the bolts can be transferred back to their proper positions in the old pump. When the new pump is installed the bolts can be transferred from their correct position on the old pump to the new pump.
- It is a common problem for these bolts to break during removal. From various sources, the best approach is to squirt each bolt with a good penetrating grease, let them sit for a couple of hours, and give each bolt a sharp wrap on the head with a punch and hammer to break any corrosion. Then use a cordless impact gun to slowly remove them. The impact action of the impact gun will help to break the bolts free without breaking the bolts.
- I squirted the water pump bolts and let them soak overnight. Then squirted them again in the morning, let them sit for a couple more hours, and then gave them a sharp wrap with the hammer and punch. Then I used my cordless impact gun to remove the bolts, as shown below.



- This worked very well, as I did not break any bolts. If you have a stubborn bolt you can try to heat it in addition to the above treatments. If a bolt snaps and you can't remove it with the stub, use left-hand drill bits until a thin shell of the bolt remains. The stub may back out during the drilling or it can be picked out with a dental pick.
- Note as well that the engine block has guide pins to assist with installation of the water pump in the correct position. There is one on each side as shown below.



- These guide pins can be bent or broken off if the water pump is removed at an angle.
- Once the bolts have been removed, the water pump can be taken off. It should pull off the gasket with very little force. There are flanges on both sides of the pump from which to pull. If it doesn't move easily, ensure that all of the bolts have been removed. If it is stuck and needs to be pried, you can pry from the flanges (one of which is shown below) just enough to break the bond and gently wiggle the pump pulling on one side and then the other until it comes off of the guide pins. Alternately, one can pry in Dwayne's preferred location: between the engine block (where the engine block number is stamped) and the water pump housing. Dwayne's method worked well for me.



## CHAPTER 10

### REMOVING OIL PUMP GEAR AND REAR TIMING BELT COVER

- This is not a necessary part of the timing belt/water pump change, but if you need to replace the oil pump o-ring and seal now's a good time.
- If not working on the oil pump gear (or the cam seal as you'd have to remove the rear timing belt cover to do that job as well), skip to Chapter 13 on 'Repairing and Replacing the Tensioner Rollers and Tensioner Bushings'.
- The first step is to remove the oil pump gear, which is secured with a 17mm nut. Counter hold the gear using a large flat blade screwdriver or medium pry bar by inserting it into one of the gear holes and catching one of the casting ridges behind the gear as shown below.



- Remove the nut and washers



- Try to pull the gear off by hand, exerting pressure as evenly as possible. I could not get mine off that way, so I used a 2-jaw puller and it came off easily. No wrench was needed, I just turned it with my fingers and the gear came right off. It seemed to need the perfectly even pressure to come off.

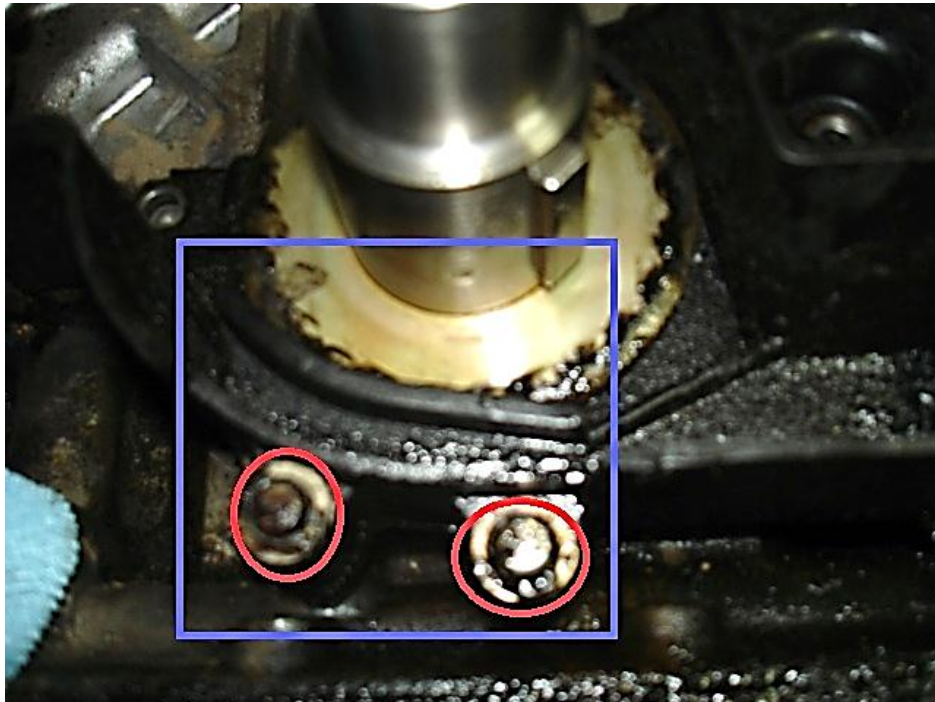




- Once the gear is removed the oil pump can be inspected for leaks. As you can see in the picture above, there was quite a bit of oil in the area.
- It may be possible to remove the oil pump without removing the rear timing belt cover, but, like Dwayne, I elected to remove it because I wanted to clean everything up and I also wanted to inspect the crank seal.
- First, remove the crank gear from the crankshaft. It should just slide over the woodruff key and off the shaft.



- Next there is a small, separate section of the rear timing belt cover (in the blue square in the pic below) that is held on by two very small circlips/snap-rings that needs to come off (circled in red below; sorry for the blurry pics). They are real suckers to get off and put on. Even with my smallest circlip plier I had to work it into the grooves, expanding the circlip a bit just to get the plier in.



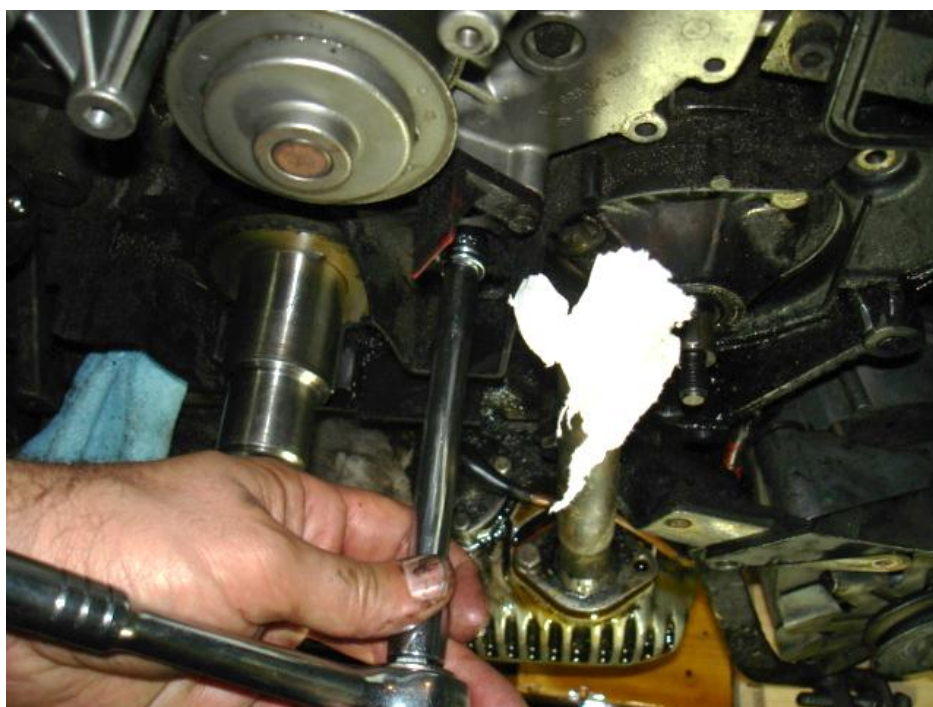
- Remove both of the circlips and the washers behind them and the piece will slide off the two pins on which it rests.



- Next, remove the inner timing belt guide from the crank shaft (note that the curvature points toward the engine).



- The rear timing belt cover is held on by 3 bolts (note that Dwayne had two additional 5mm allen head bolts on the back side of the metal cam cover backplate—see pp. 173-175 on his write-up. One had a ground wire under it. On the configuration for my car, there was only one 5mm allen head bolt, and it did not have a ground wire. It looked like it may have needed to be removed to release the plastic cover, but a previous mechanic may have cracked the plastic at the bolt so that it did not need to be removed. Or, it was made that way.)
- Remove the three 10mm bolts as shown below.





- Then remove the rear timing belt cover.



## CHAPTER 11

### REMOVING THE OIL PUMP, REPLACING THE O-RING AND OIL PUMP SEAL

- There was clearly a leak/weeping at the oil pump, and possibly the crank seal.



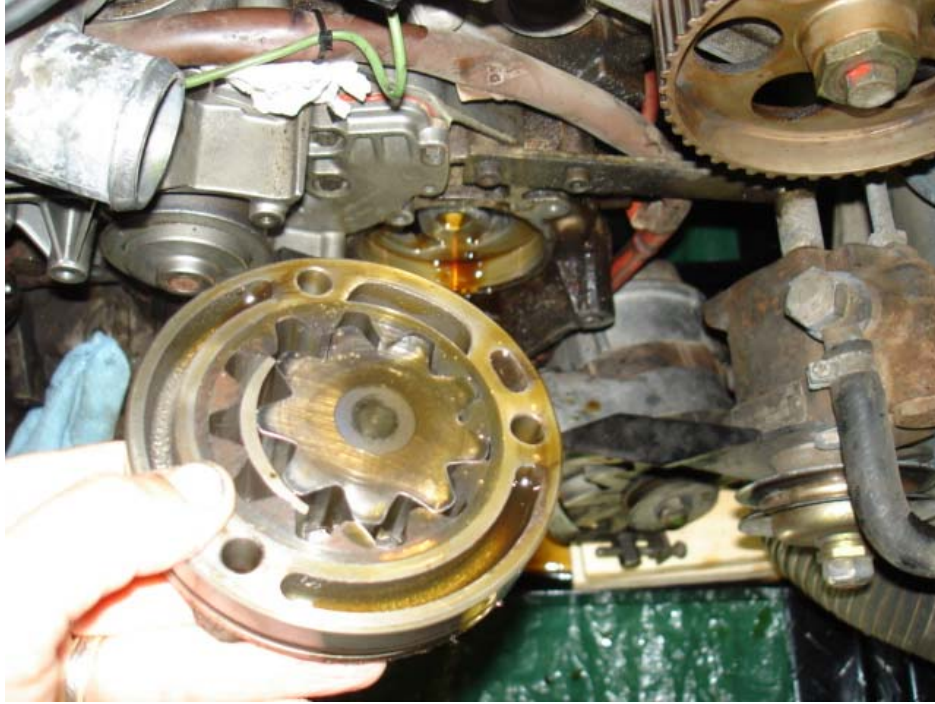
- I decided to change the oil pump o-ring and seal and to monitor the crank seal. If you decide to change the crank seal there is a canal cut into the engine block that will give you access to the pry the old seal out. Once the old seal is out a new one can be pressed in. A home-made tool will work for tapping in the seal to get it to seat flush with the block. A piece of correctly sized PVC with the cap will work. I was taking my vitamins one morning when, with this job on my mind, I realized that the vitamin bottle was about the right size for the seal and the right depth to accommodate the crank shaft, and I could use a hole saw to drill a hole in it to allow it to clear the shaft. Here it is ready for when the time comes.



- A much more detailed description of oil pump removal etc. can be found on Rennlist by searching "How to: OB Pump removal, Rehab & Install with pics." To remove the oil pump, remove the three 13mm bolts that secure the pump to the engine block.



- Before removing the pump, make note of the orientation of the pump. You can use something to make a mark lining up one of the bolt holes with the pump or take note of the orientation of the part number on the pump. E.g., as shown above, the part number on mine was on top between the two bolt holes.
- You will probably need to pry out the pump. For some reason I don't have a pic of that, but I followed Dwayne's method and it work perfectly: Put the gear washer and bolt back on the spindle, place a short piece of 2x4 against the engine block and use the pry bar to lever against the 2x4 and the washer and bolt to carefully pry the pump out.



- Use a small screwdriver or dental pick tool to remove the old o-ring, as shown below. Mine was so shot that it broke in two as I was removing it.



- Coat the new o-ring with some motor oil to help it slide on and install it.
- Next, I removed the two gears from inside of the oil pump housing and I pulled the seal with a seal puller, as shown below.



- Lube the new seal with motor oil and put it in place so that it is started evenly. Then use a socket or a seal pressing tool to press it into place.



- I then put the gears back in the oil pump housing. The outer ring gear must go in the housing the correct way. To check that it is correct, ensure that the small dots are visible on both internal gears (see the oil pump rehab source cited above for more details).
- Next, on the advice of the aforementioned Rennlist source, I preloaded the oil pump by pouring STP Oil Treatment into it and smearing it all over the gears. This is to prevent the pump from seizing.



- To install the oil pump, remove the washers and the o-rings from the oil pump bolts. The PET (Porsche Parts Program) shows cupped washers to accommodate rubber sealing rings. However, my car didn't have any sealing rings and the washers were flat.



- Use the bolts to line up the pump, ensuring that it is in the correct orientation as noted earlier. If the pump does not slide all the way in on its own, turn each bolt alternately 1-2 turns by hand to help it get fully seated. Then remove the bolts, put on the washers, lube the o-rings, put on the o-rings, and install the bolts to the proper torque. I had the o-rings so thought I'd give them a try with the flat washers, but, not surprisingly, the flat washers simply destroyed them. I'll keep an eye on it to see if it leaks and will order new washers and o-rings if necessary.



- There is a two stage torque procedure for torquing the oil pump bolts. On the first pass torque to 11 ftlbs, on the second pass torque to 14.75 ftlbs.



## CHAPTER 12

### INSTALLING THE REAR TIMING BELT COVER, CRANK GEAR, AND OIL PUMP GEAR

- Position the rear timing belt cover in place.



- Replace the three 10mm bolts (and 5mm if applicable) and tighten.



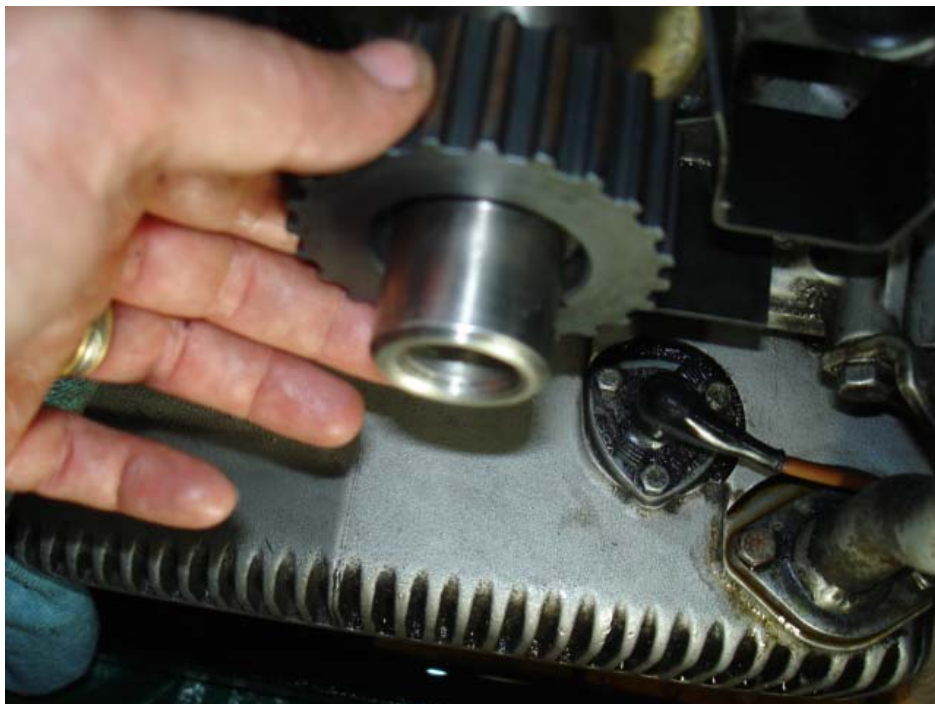
- Install the rear timing belt guide onto the crank shaft as shown below (curved edge facing toward the engine).



- Next, install the small piece of the back cover that rests on the two guide pins.



- Replace the washers and install the circlips. If the circlips are stretched out they can be carefully clamped back into shape with pliers. When putting on the circlips, I found it easiest to put the side being opened by the pliers in place first, then put the rounded side of the circlip in place with a finger, then release the pliers.
- Next slide the crank gear into place on the crankshaft (I cleaned between the teeth of all of the gears I removed with a paper towel).

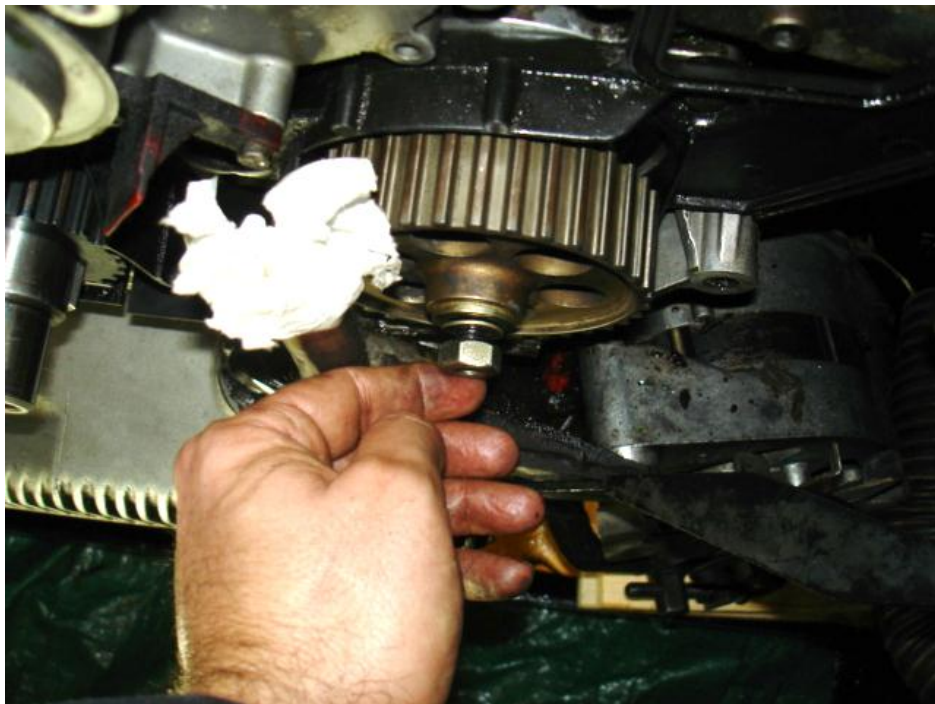


- Next, install the oil pump gear on its shaft as shown below.



- If the gear doesn't slide on all of the way, use a punch and hammer to gently tap it on both sides of the centre of the gear and the shaft slides on easily.
- Next, install the washers and gear nut.





- While counter-holding the gear, tighten the gear nut to 30ft lbs.



## **CHAPTER 13**

### **REPAIRING AND REPLACING TENSIONER ROLLERS AND TENSIONER BUSHINGS**

- The main roller (the big one) is mounted to the tensioner arm with a 13mm bolt and nut. Counter-hold the 13mm nut while loosening the 13mm bolt. Remove the nut and bolt from the tensioner assembly.





- The main roller was pretty shot. It made a little noise when spinning it and it would spin very freely. It was also stuck in the tensioner arm. I placed it in a vise and used a small punch and hammer to punch it out, as shown below.



- Once the main roller is off, transfer the circlip/snap-ring from the old roller to the new roller, ensuring the circlip is fully seated into the groove.





- Install the new main roller into the tensioner arm with the circlip facing/contacting the tensioner arm.
- Install the bolt from the front of the roller, and install the thick washer first, followed by the thin washer, then the nut.

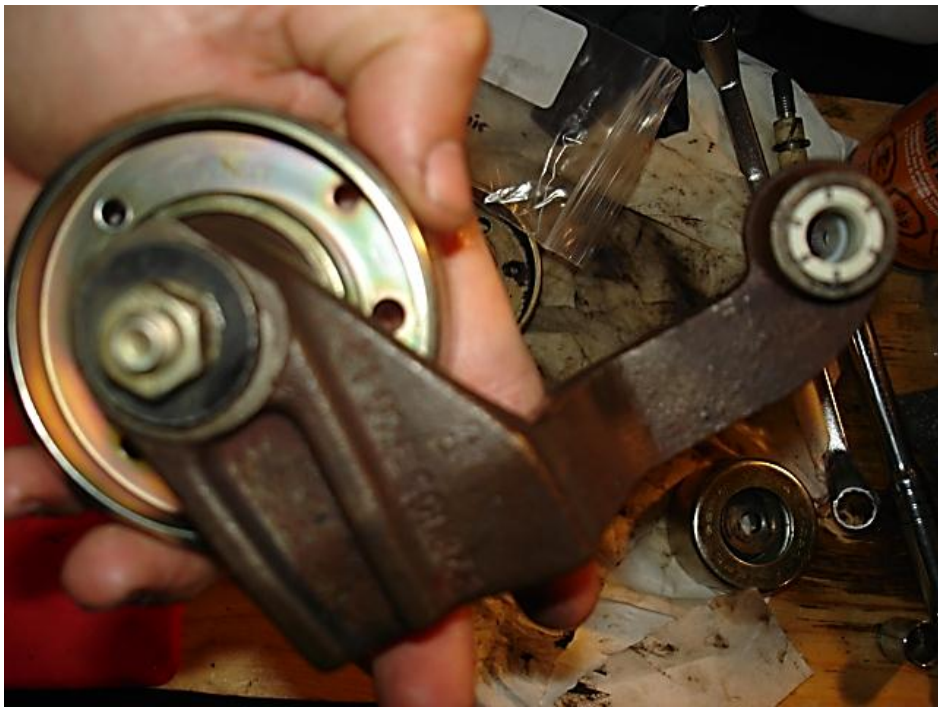


- Counter-hold the nut and torque the bolt to 15 ftlbs.



- Next, replace the two bushings that sit in either side of the tensioner arm where the bolt goes through to the spindle on the water pump (unlike Dwayne's 87 where one goes into the arm and the other goes into the idler roller). My old ones were very loose and just fell out. The new ones were just as loose, so I didn't need to use WD40 before installing them (didn't know that until after I had sprayed).





- Unlike Dwayne's 87, there is no circlip to hold the idler roller onto the tensioner assembly. Rather, on reassembly the idler roller is placed on the water pump spindle and then the tensioner is bolted to the spindle (with the big bolt rather than the little allen head bolt that often strips).

- For now, put the bolt, washer and idler roller on loose and set it aside so that it is ready in the correct order for installation.



## CHAPTER 14

### REMOVING AND REPAIRING THE TIMING BELT TENSIONER

- To remove the timing belt tensioner, the air pump needs to be removed from the tensioner bracket. Remove the 13mm air pump pivot bolt that was loosened earlier when removing the air pump belt.



- Wiggle the air pump out of the bracket, pushing it down enough so that the tensioner bracket can be removed.
- The tensioner is attached to the block with three 13mm bolts as shown below. Each bolt is a different length, so take note of which one goes where as they are removed.

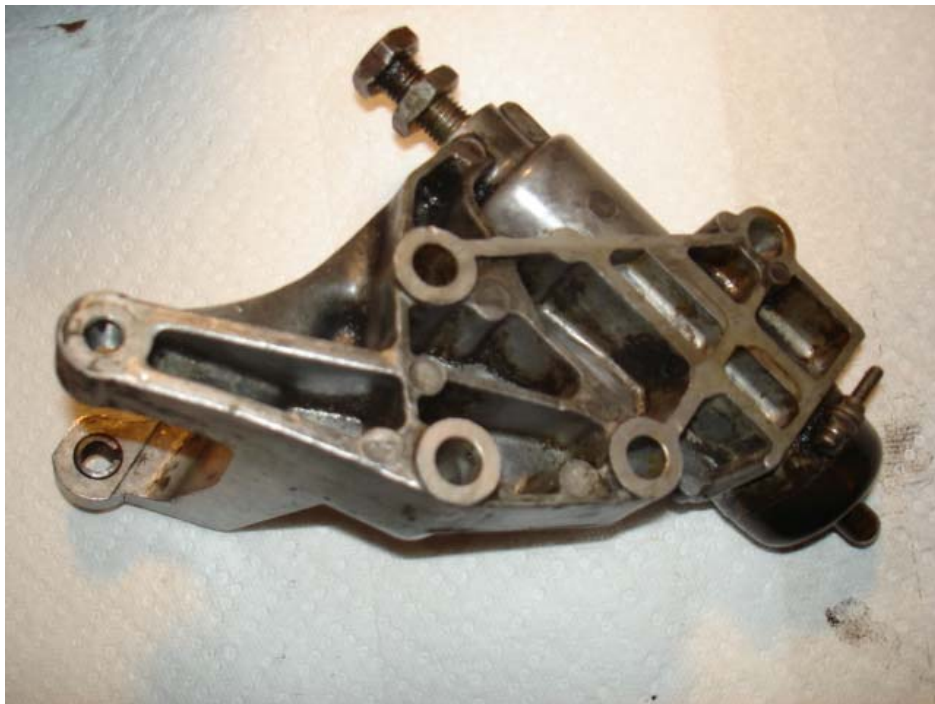


- Here is a pic of the three bolts in the same perspective that they are placed on the tensioner.



- The shortest bolt goes in the top right, the middle length bolt goes on the left side, and the longest bolt goes on the bottom right.

- Unlike the later cars, where the oil in the tensioner flowed to the block and so there was a gasket between the tensioner and the block, on the 79 the oil is only in the tensioner, and so there is no need for a gasket. Once the bolts were removed, the tensioner pulled right off. If it is stuck on you can refer to pp. 220-221 of Dwayne's write-up to see a technique for prying it off.



- To rebuild/repair the tensioner, first loosen and remove the boot clamp. Mine is the original boot and clamp, which requires a flathead screwdriver to loosen as shown below.



- The original boot is 'No Longer Available', so if your boot has previously been replaced you may have a different (larger) boot, a spacer to place under the boot, and crimp-style clamp. The picture below shows the difference in size between the two boots.



- See Dwayne's write-up (p. 224; pp. 240-242) to see how the new-style boot goes on (of course, you'll have to put the rubber spacer underneath first).
- Slide the boot off of the tensioner.



- The washer stack inside the tensioner is held in place by a circlip. Remove the circlip.



- Next, remove the tension adjustment bolt.



- Place a screwdriver inside the tensioner and gently push to remove the washer stack. Hold the washer stack carefully to ensure that it does not disassemble.



- The washer stack contains 8 groups (7 on later cars) of 5 concave washers, stacked in opposition to one another. It is not necessary to disassemble the washers unless they are caked and stuck together. Use some brake cleaner to clean the washer assembly.



- Unlike the later cars, there is no o-ring on the piston that needs to be changed. Instead, the piston is essentially just a thick washer.



- Clean the tensioner inside and out, as well as the boot and pin that goes through the boot.



- Next, fill about 1/3 of the tensioner housing with oil. It can be either 90w gear oil or motor oil. I used 20w50 motor oil.



- Hold the tensioner at an angle and slide the washer assembly roughly half way in.



- Next, cup your hand over the washer assembly and push it in, allowing any excess oil in the assembly to bleed out of the hole where the tensioner bolt goes, until the washer assembly is all the way in as shown below.



- Then re-install the tensioner bolt to keep oil from coming out.
- Next, replace the circlip that holds the washer stack in.



- Then replace the boot and pin, ensuring that the pin sits in the correct position on the washer stack.



- Next, replace the boot clamp. Before tightening it down, place the tensioner in the timing belt centre cover as it would sit when installed on the block. Orient the clamp (bolt or

crimp, depending on which boot you have) so that it is not interfering with the centre timing belt cover.

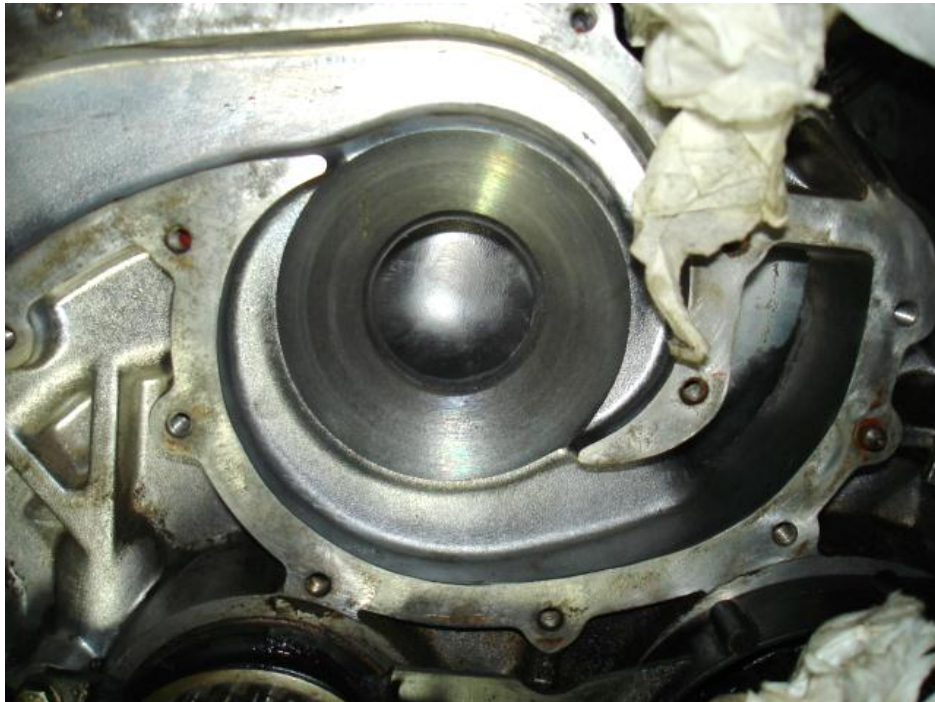


- Once confirmed that the clamp won't interfere, tighten it down with a flat blade screwdriver.

## CHAPTER 15

### INSTALLING THE WATER PUMP

- First clean the water pump gasket surface on the engine block. A gasket scraper does a good job, but be careful not to press too hard as you do not want to scratch the surface.



- My water pump was a new Laso with plastic impeller. According to Dwayne's write-up for the later cars, if one purchases a rebuilt water pump one may have to transfer the spindle that the tensioner bolts to and the red timing marker over from the old to the new pump. The spindle appears to be much longer for later model cars. As shown below, the spindle on both water pumps for my 79 was built into the pump.



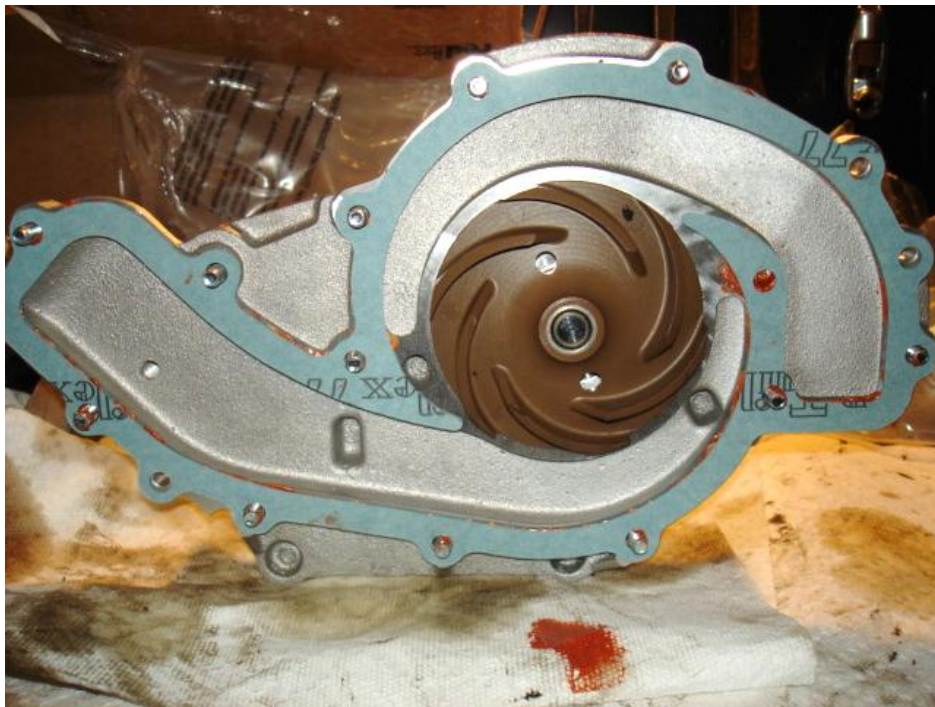
- There are some differences of opinion regarding whether or not to use water pump gasket sealant. It had been used previously on my car so I decided to use it. The advice I was given was to ensure that the sealant is RTV (Room Temperature Vulcanizing).



- Next, put a thin smear of RTV on the block, just enough so that a thin bead (about 1mm) will squeeze out upon tightening the bolts (although I didn't go around the bolt holes in the pic below, next time I will just to be safe).



- Then place the gasket onto the block using the locating pins as guides and to hold it on. Alternatively, one can put a thin smear of RTV on the water pump and put the gasket on the pump, as shown below.



- Next time I'll put the gasket on the block, just because I think it will be easier to have the guide pins holding the gasket in place. The pump didn't go on as easily as I had thought it would, and the gasket shifted, and I made a bit of a mess with the RTV.
- If you have put the gasket on the block, then next put a thin smear of RTV on the water pump and install the pump onto the guide pins.
- I used a rubber mallet to gently tap the water pump into place, but it may be more advisable to simply use the bolts to tighten the water pump into place once it's on the guide pins.



- Recall that there are 13 bolts, 8 longer and 5 shorter. Because of their risk for breaking, I replaced all of these M6 bolts and washers with new ones. It is also recommended to put copper anti-seize (Optimoly HT) on these bolts.



- Transfer the bolts from their positions on the old water pump to the new one, starting with the one on the far left and the one on the far right, then the others. Hand tighten the 10mm bolts using only the socket and extension bar.



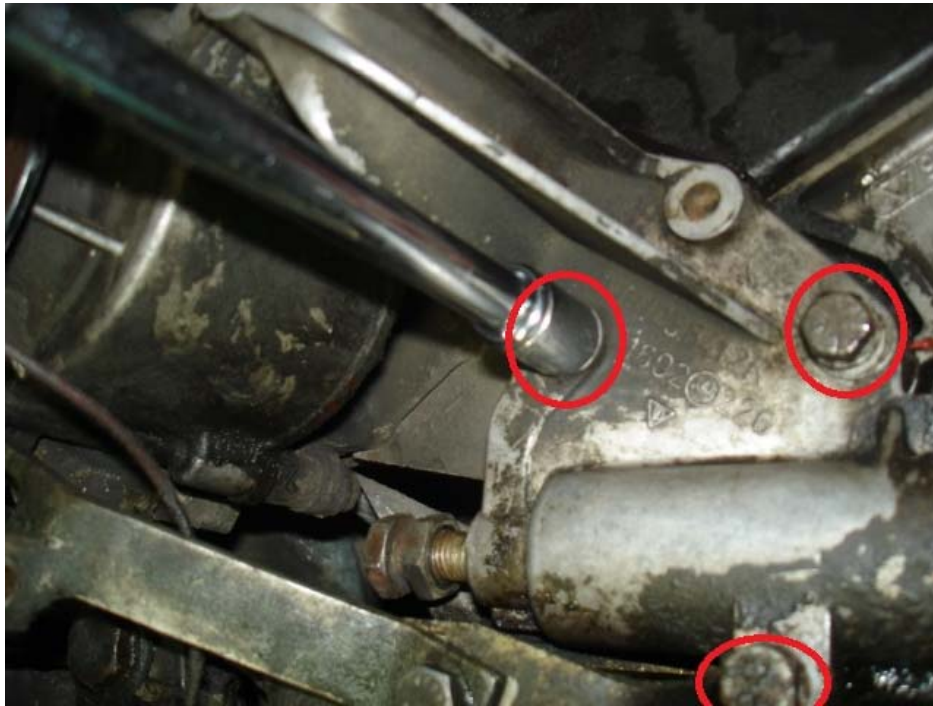
- Once all of the bolts are hand tightened, go back and torque all 13 bolts to 7 ftlbs (84 inlbs). It is very important not to over-tighten these bolts.



## CHAPTER 16

### INSTALLING THE TIMING BELT TENSIONER

- To install the timing belt tensioner, the three 13mm bolts need to be re-installed in their proper place. Recall from Chapter 14:
  - o Each bolt is a different length.



- o Here is a pic of the three bolts in the same perspective that they are placed on the tensioner.



- The shortest bolt goes in the top right, the middle length bolt goes on the left side, and the longest bolt goes on the bottom right.
- The bolt that goes in the top right position on the tensioner (the shortest one), protrudes into an oil galley. Indeed, oil kept running from that bolt hole after I removed the tensioner, as shown below.



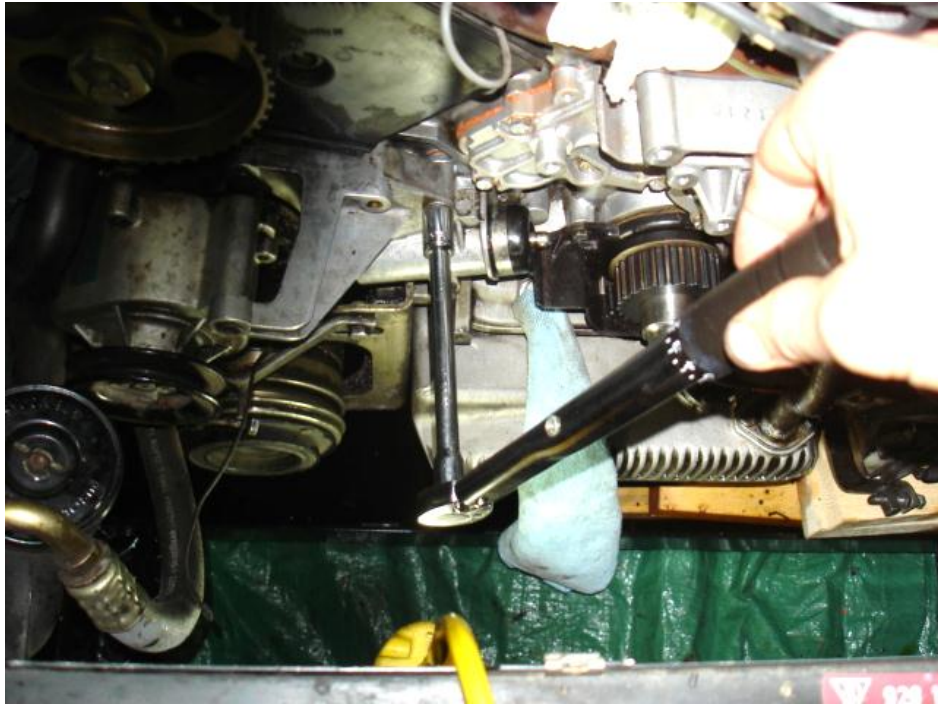
- The Factory Workshop Manual calls for Loctite 574 for this bolt (p. 15-11).



- Tighten the bolts by hand....



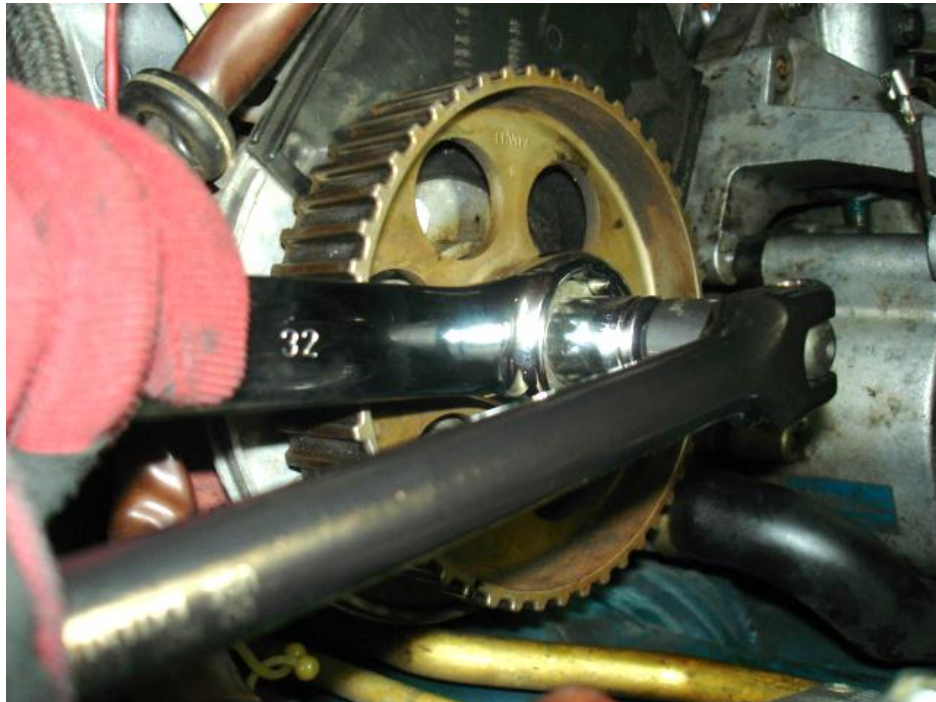
- ...and then torque each bolt to 15 ftlbs.



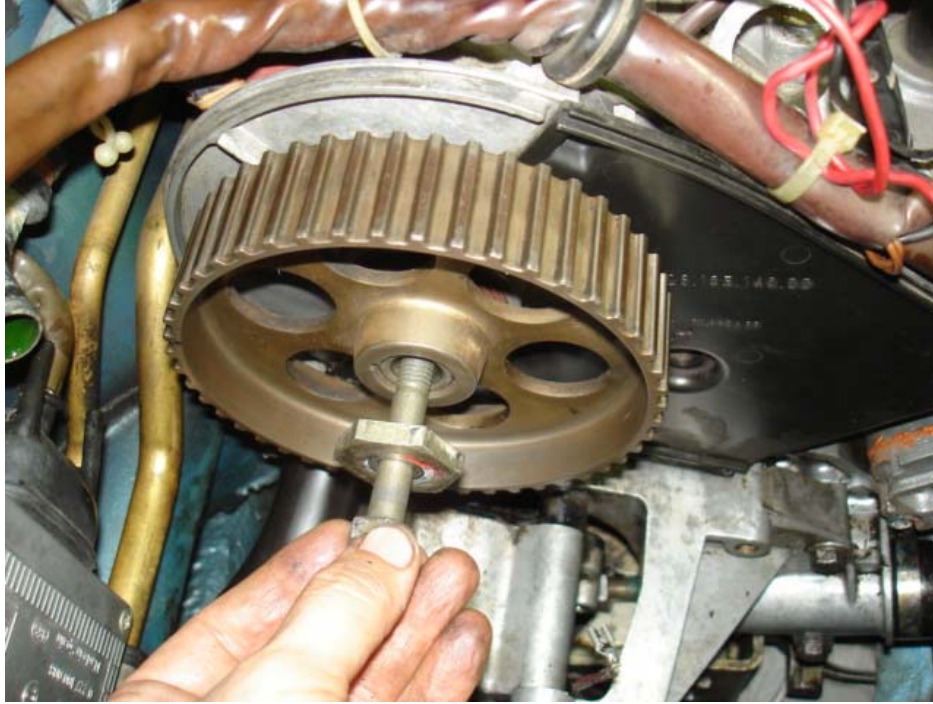
## CHAPTER 17

### CHANGING THE CAM GEAR SEALS

- I removed the cam gears to see if the seals needed changing. I forgot that there are two o-rings for each gear that should also be changed WYAIT. Next time I'm in there I'll do this over again and replace the o-rings. I included this chapter to illustrate not to make this mistake, and also to, at least, show how to change the cam gear seals.
- First, counter-hold the large nut with a 32mm wrench (or large crescent wrench, though it will be more likely to slip off), and apply force counter clockwise on the 17mm nut with a breaker bar and socket. I had tried with a ratchet instead of a breaker bar, but the breaker bar was required.



- Next, remove the 17mm bolt and 32mm nut.



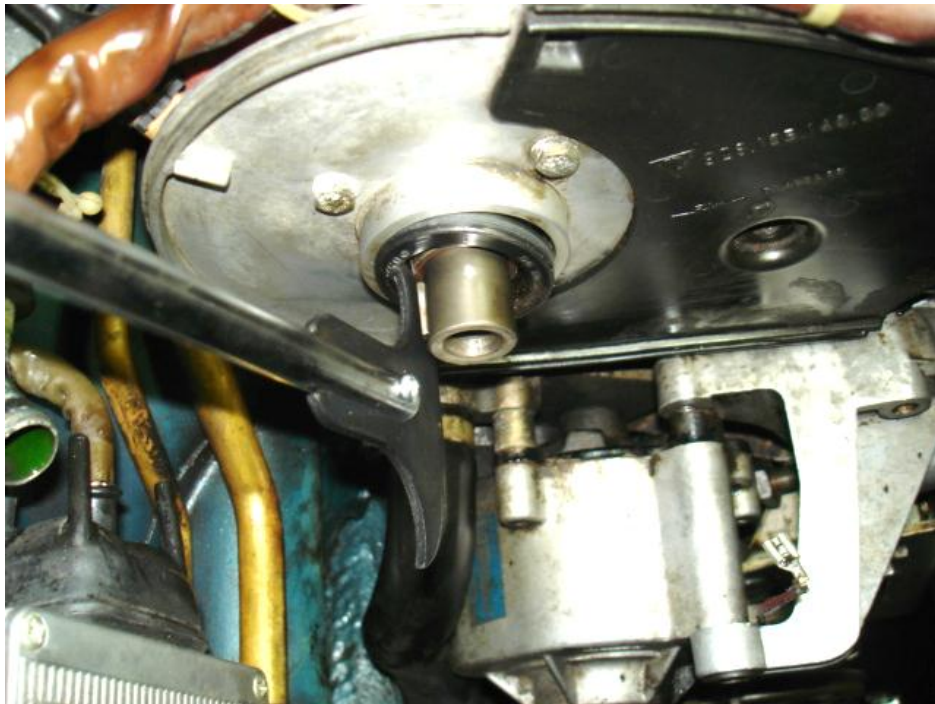
- The cam gears on the 79 have a Woodruff key, so it is not necessary to mark the position of the gears since they will go back on the cam shaft in exactly the same position as they were removed.
- I tried pulling the gear off with my hands, but it wouldn't budge. So, I partially re-installed the 17mm bolt (so that there would be room to pull the gear) and used a 2-jaw puller. The gear came off with very little effort with the puller. For illustration purposes, in the picture below I have a wrench on the puller, but in fact I was able to remove both cam gears by turning the puller bolt with my hand. They simply seemed to need perfectly even pressure on both sides to come off.



- There did appear to be weeping from the cam gear seals, shown below.



- I used a seal puller to remove the seal.





- Next, lube the new seal with motor oil and place it in position, so that it is started evenly.
- I then used a 1 and 5/16" socket and rubber mallet to tap the seal in flush.



- Below is the installed seal on the right/passenger side cam gear.



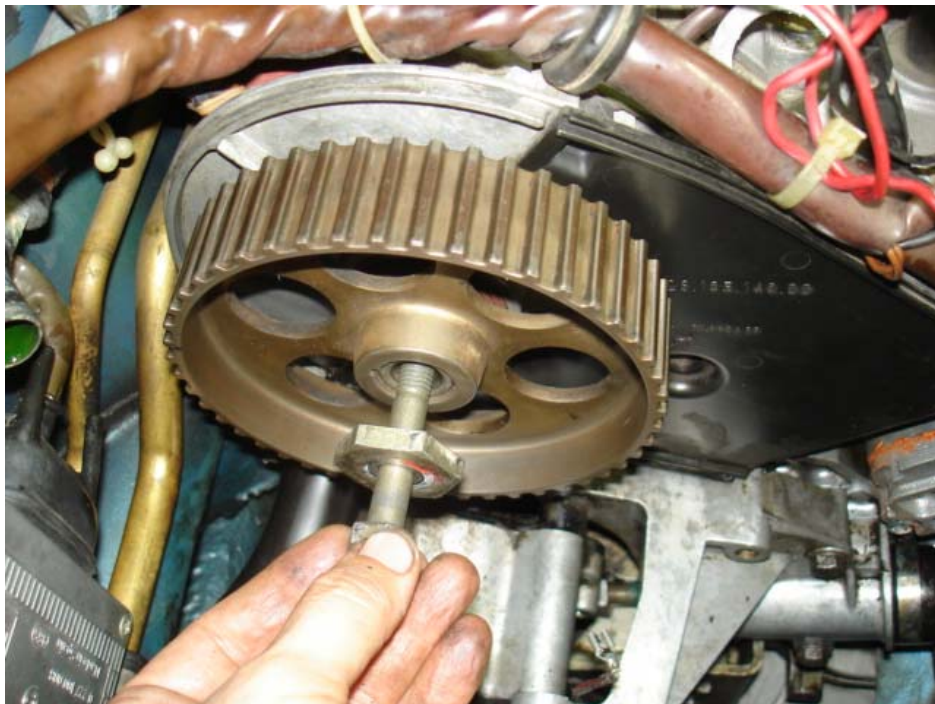
- And here is the replaced left/driver's side cam gear seal.



- Then, re-install the cam gear. I used a rubber mallet to gently tap the gears back into place.



- Then, reinstall the 17mm bolt with the 32mm washer. Ensure that the washer is on the correct way; with the flat-edged side facing toward the cam gear. Hand tighten.

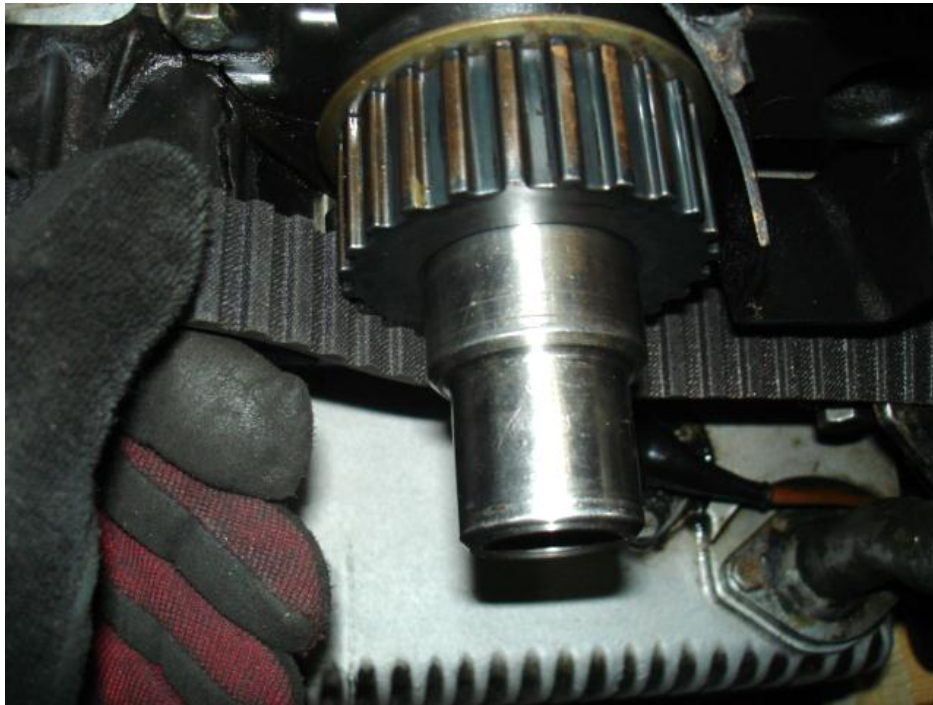


- Then counter-hold the 32mm nut and torque the bolt to 47 ftlbs.

## **CHAPTER 18**

### **INSTALLING THE TIMING BELT TENSIONER ROLLER ASSEMBLY**

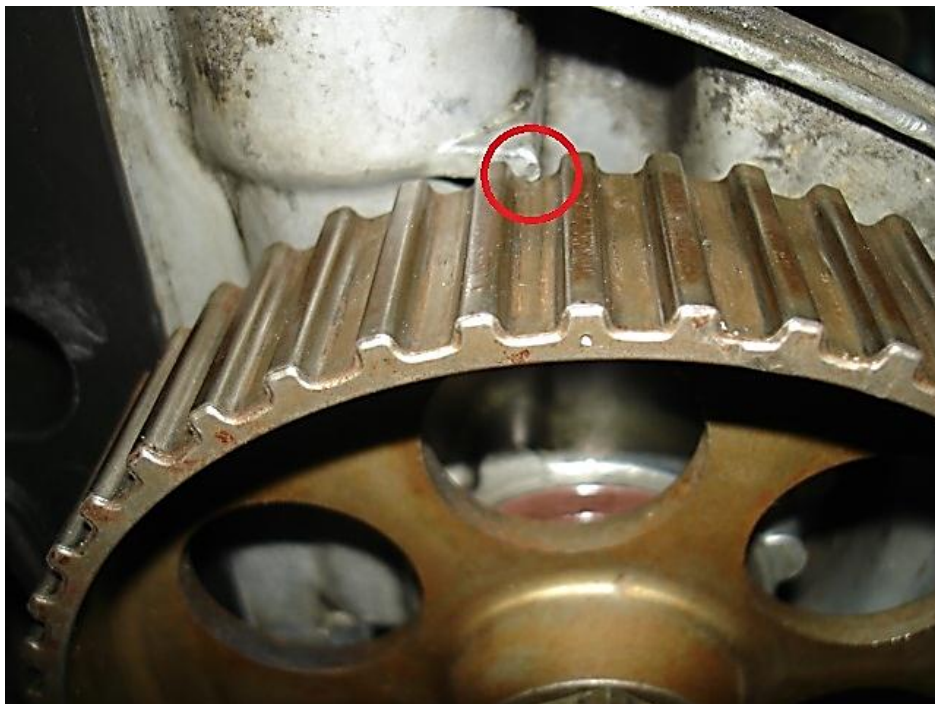
- Before installing the Timing Belt Tensioner Roller Assembly, it is necessary to partially install the new timing belt. Apparently, the timing belt is directional. That is, one should be able to read the lettering on the belt right side up when facing the engine from the front. So, orient the belt correctly. Begin by routing the new timing belt around the crank gear on the crank shaft.



- Pull the belt tight and route it around the oil pump gear.



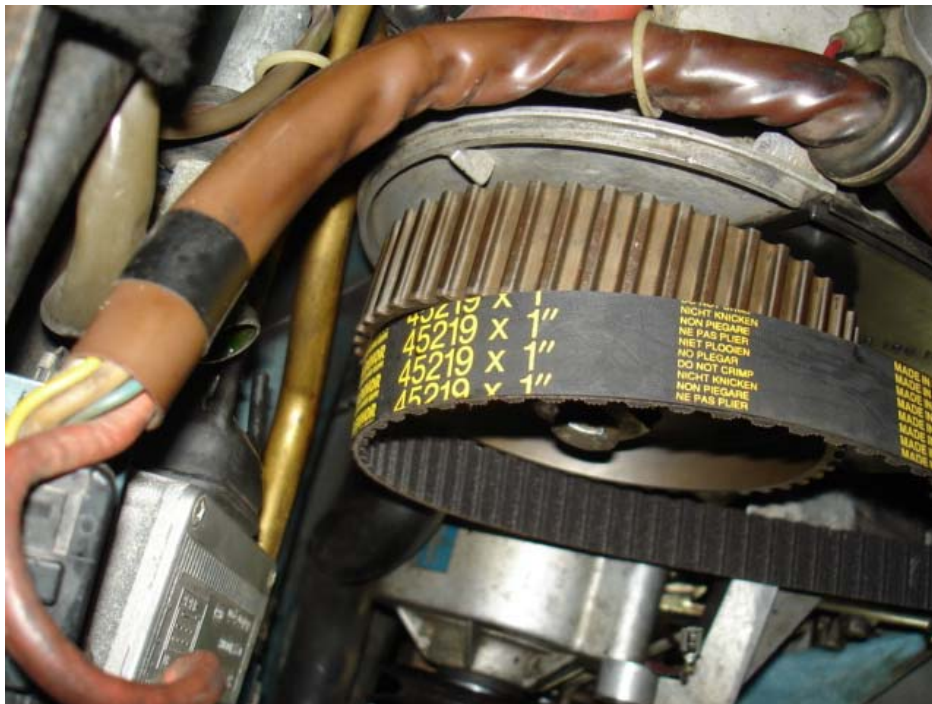
- Next use a 17mm wrench to set the left/driver's side cam gear V groove to correspond with the V pointer on the cam cover back plate. If the cam gear won't hold in place, you can hold it in place with the wrench while putting the belt on. In my case the cam gear sat in the correct position.



- Pull the timing belt as tight as possible and route it over the left/driver's side cam gear. To hold the belt in place, use a small C-clamp, as shown below.



- Route the belt under the water pump and let it rest on the right/passenger cam gear as shown below.



- Next, place some silver anti-seize (Optimoly TA) on the Tensioner Idler Roller Spindle, located on the water pump.



- Then place the idler roller on the spindle.



- It is common to replace the bolt that holds on the Tensioner Idler Roller Assembly, as it has a lot of stress on it and is prone to breaking. Recall that this bolt is exposed to coolant via the water pump spindle in which it sits. So, before installing the bolt, place water pump gasket sealant (RTV) on its threads, as shown below, and put it back into the tensioner roller arm.



- Place the top of the timing belt (the part that will go toward the right/passenger cam gear) above the idler roller, and the bottom of the timing belt (the part that will come from the right/passenger cam gear) below the idler roller.
- Next, place the roller assembly over the pin that protrudes from the tensioner, while routing the bottom of the timing belt over the main roller, as shown below.



- Hand tighten the bolt, ensuring that the large washer that rests between the tensioner roller assembly arm and the spindle on the water pump has remained in place.
- Torque the 15mm bolt to 15 ftlbs.



## CHAPTER 19

### INSTALLING THE TIMING BELT AND SETTING TENSION

- Before installing the belt, use a 19mm wrench to ensure that the tension adjustment bolt at the back of the timing belt tensioner is out as far as possible to allow maximum slack in the belt.



- Check the V groove on the right/passenger cam gear to see if it is aligned with the V pointer on the metal cam cover back plate.
- If it is not properly aligned, it should only be out by not more than a few teeth. If it is not lined up, use a 17mm wrench to line it up.
- Hold the cam gear in the correct position with the 17mm wrench while putting on the belt.



- On later cars the cams should only be turned clockwise. For the early cars, the Factory Workshop Manual states that “should the teeth of a hand-tightened camshaft drive belt not match the sprocket pitch accurately enough, turn pertinent camshaft sprocket counter-clockwise carefully until the teeth match.” This statement suggests two things: (1) Apparently it is okay on the early cars to turn the cam gear counter-clockwise for very small adjustments, and (2) If it is not possible to line the timing marks (V groove and V pointer) on the cam gear because the teeth on the gear and the teeth on the belt will not match up, move the cam gear counter-clockwise to the minimum required to get the belt and gear teeth to line up, thereby allowing the belt to be put on the cam gear. I had a difficult time to get my V groove and V pointer to line up with the teeth on the belt. Apparently, this is normal for the right/passenger side cam gear and the correct action to take, as the quote above suggests, is to error in the counter-clockwise direction (i.e., retard the timing on this gear). The thinking seems to be that expansion of the motor when hot, combined with the length of the timing belt between right/passenger side cam gear and the crank shaft, will advance that cam ~2degrees.



- Once the belt is on correctly, the next step is to tighten the Timing Belt Tension Adjustment Bolt. Use a 19mm wrench to turn the bolt clockwise until all of the slack is removed from the timing belt and the timing belt is snug around the tensioner roller assembly.



- For an accurate timing belt tension reading, the engine crank needs to be turned two revolutions before every tension reading. To prepare the engine for rotation, the harmonic balancer/vibration damper needs to be installed on the crankshaft. Prior to doing this, it is advisable to place a thin layer (I probably put on a bit too much) of silver anti-seize (Optimoly TA) to the portion of the crank where the harmonic balancer sits, as shown below.



- Next, install the outer timing belt guide onto the crankshaft as shown below (with the curve facing away from the crank gear).



- And place the harmonic balancer in its position, ensuring that it is put on in the right direction (so that the timing marks can be read right side up when facing the motor from the front of the car).





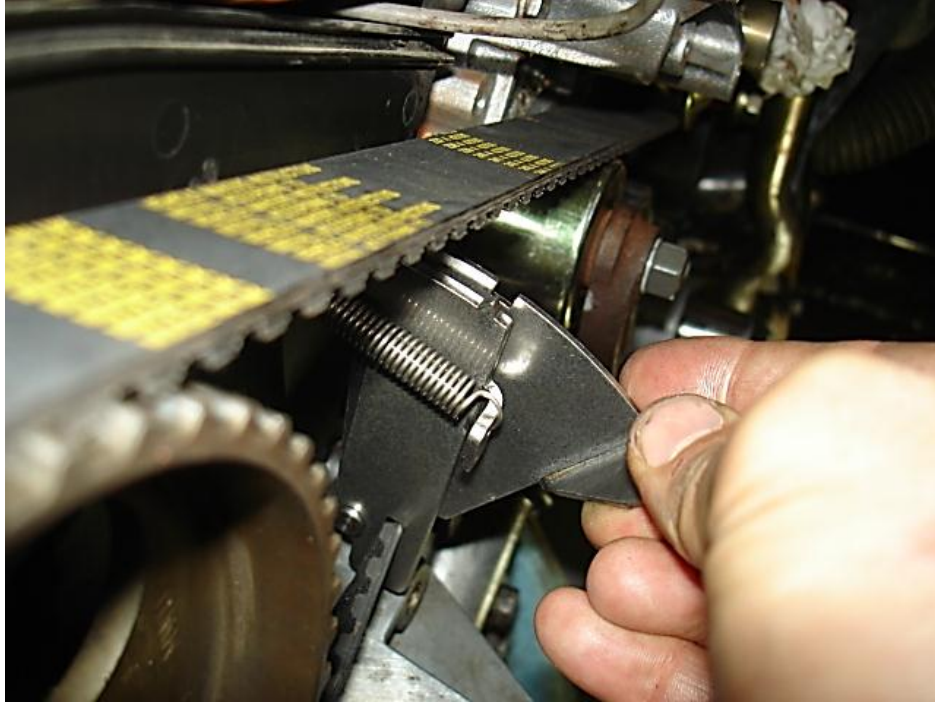
- Install the 27mm crankshaft bolt and washer, ensuring that the washer is on in the right direction, as shown below.



- Go underneath the car and remove the flywheel lock tool (13mm bolts).



- Using a 27mm socket and a ratchet, turn the engine clockwise two revolutions, so that the engine is once again at OTDC. While rotating the engine check the belt to make sure it is tracking correctly on the gears, water pump pulley, and tensioner roller assembly.
- Once at OTDC, verify that the V grooves in the cam gears line up at the V pointers as desired.
- Next check the belt tension with the Kempf tool (see the simple instructions that come with the Kempf tool).



- Adjust the belt tension until it is correct, rotating the engine two revolutions prior to checking belt tension after each adjustment.
- Optionally, before final tensioning, one can apply some Threadlocker Blue to the threads of the tension adjustment bolt.



- Once the tension is correct (i.e., the pointer is in the middle of the notch on the tool), tighten the 19mm locking nut on the tensioner adjusting bolt.



## CHAPTER 20

### INSTALLING THE CENTRE TIMING BELT COVER

- Recall that the centre timing belt cover is held on with three 10mm bolts and one 13mm bolt, each shown in the order in which they affix the centre timing belt cover in the picture below.



- The two short 10mm bolts are in the middle of the cover. These bolts are identical each having one small and one bigger washer. The right-most bolt is the long 10mm with a small and big washer.



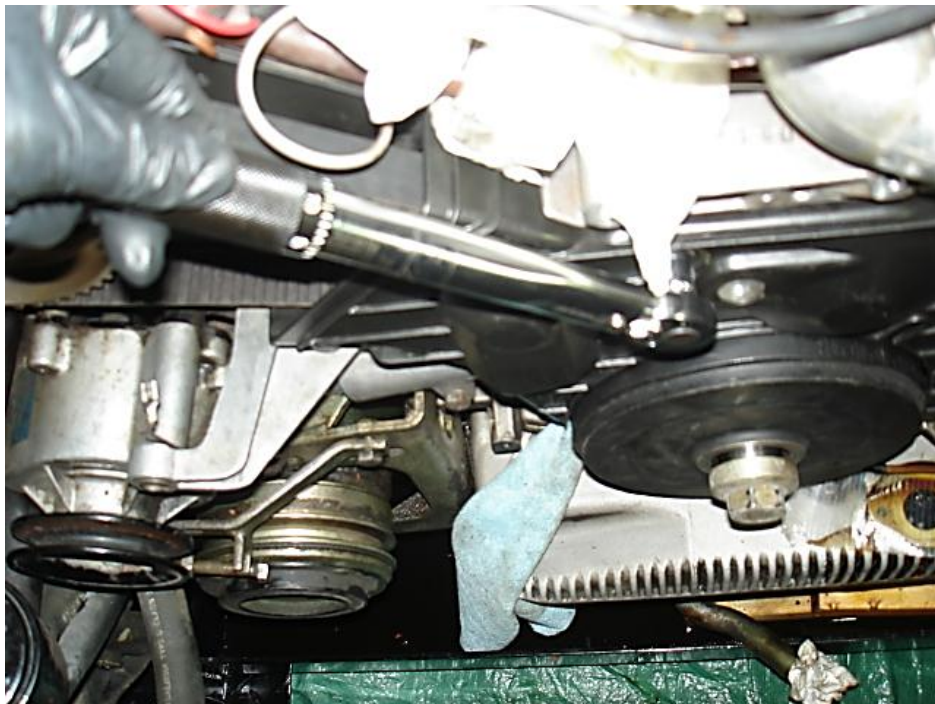
- The 13mm bolt is at the left-most of the cover.



- Install the bolts in their respective positions and hand tighten.



- Torque the three 10mm bolts to 7ftlbs (84 inlbs).
- Torque the 13mm bolt on the left side of the centre cover to 15 ftlbs.



- Next, install the air pump onto the tensioner bracket, insert and hand tighten the long 13mm pivot bolt as shown below.



## CHAPTER 21

### INSTALL UPPER CAM GEAR COVERS AND RECONNECT A/C COMPRESSOR WIRE

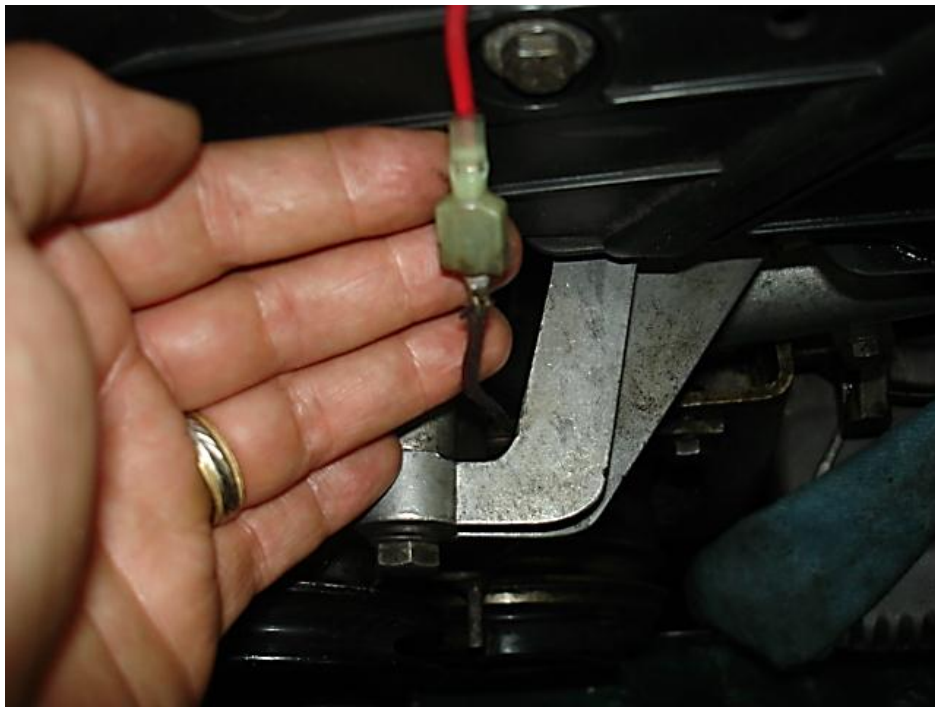
- Recall that each upper cam gear cover is held on with one long 10mm bolt (and a small and large washer).
- Place the respective cam cover in position, ensuring that the plastic hook on the cam cover hooks over the metal cam cover back plate.
- Insert and hand tighten the 10mm bolt.



- Torque the bolt to 7 ftlbs (84 inlbs).
- Install the other upper cam gear cover the same way.



- Finally, reconnect the air conditioner compressor wire that routes between the air pump and the air pump tensioner bracket with the other wire that routes from the top of the motor, down in front of the right/passenger cam cover.



## CHAPTER 22

### INSTALLING THE POWER STEERING PUMP BRACKET, ALTERNATOR, OIL DIPSTICK TUBE, OIL RETURN TUBE AND HOSE, AND FAN ASSEMBLY

- First, re-install the bolt with washer that holds on the power steering pump bracket, but do not tighten it yet.



- Lift up the bracket to which the steering pump bracket bolts, and start the alternator pivot bolt into the bracket through the bracket that holds on the power steering pump (ensure the bolt does not come out the other side of the bracket, so it won't be in the way of the alternator. Install the bolt that holds it in place, (I know it's still dirty in the pic, but I went back and cleaned up this and everything else).



- Next, lift the alternator into position, and insert the alternator pivot bolt, as shown below.



- Then place the electrical ground for the alternator and the alternator tensioner arm in position and install the bolt with washer as shown below.





- Then torque these four bolts to 15 ftlbs.



- Next, install the dipstick tube. Don't forget to ensure that the crush ring washer is present. Replace the washer if necessary.



- Carefully thread in the dipstick tube by hand, ensuring not to cross-thread. Then tighten with a 17mm wrench.



- Next, ensure the dipstick is clean, and insert it into the dipstick tube.



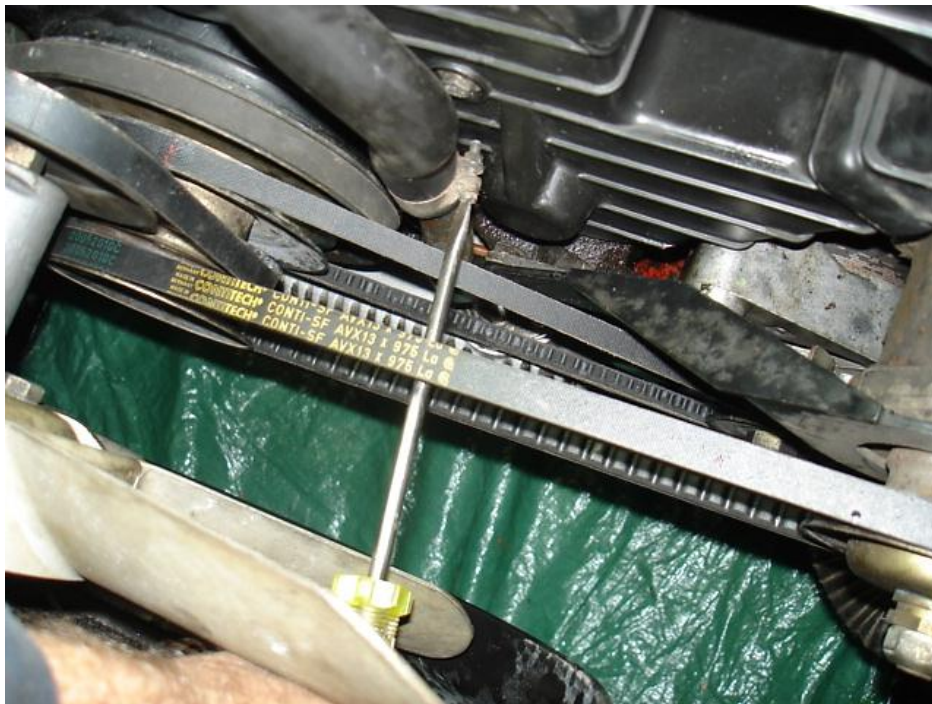
- Next, ensure the oil return tube is clean and install it.



- Install the two 10mm M6 bolts. Hand tighten. According to the 1978-80 'Models, Dimensions, Tolerances' booklet by Porsche, unless otherwise specified M6 bolts should be torqued to 4.4 ftlbs. Ensure not to over-tighten them.



- Next, install the oil return tube hose (As reflected in the pictures, I did it later but now would be a better time so that the oil system is buttoned up as soon as possible). If the clamp was tightened to prevent losing it, loosen it (of course, the same goes for the rest of the hoses). Insert the oil return hose onto the tube (if you disconnected it), orient the clamp so that it can be tightened from the front, and tighten the clamp.



- Then insert the oil return hose in its proper location on the block, orient the clamp so that it can be tightened from the top, and tighten it, as shown below.



- Next, install the fan assembly. Keeping it vertical while moving it, set it in place and install the three 13mm bolts with lock washers that hold it on. I torqued them to 15 ftlbs. My torque wrench was too thick to use on the bottom bolt, so I tightened it with a box end wrench.



## CHAPTER 23

### INSTALLING ACCESSORY BELTS AND PULLEYS

- Install the accessory belts from the inside out: Air conditioner compressor, Alternator; Air pump and fan; Power steering pump.
- First, remove the crank bolt and washer.
- I did the following out of order, which is why some of the pictures don't exactly reflect the text. Next time I'll try Dwayne's method as, in retrospect, it appears to be much easier (see Ch. 24 in his write-up). This involves putting the belts over the accessory pulleys first, without the crank bolt installed, such that the opposing forces of the belts hold the pulley assembly in place. Then install the crank bolt. Anyway, here's how I did it.
- Position the air conditioner compressor belt pulley into place.



- Next, position the rest of the pulley assembly into place and install the crank bolt and washer to hold it on (but do not tighten it yet; leaving it loose allows the pulleys to turn independent of the crank, which makes installation of the belts much easier).



- Then you can begin to install the belts.
- Place the A/C belt over the A/C pulley, then push the A/C compressor toward the engine and place the belt over the pulley on the compressor.



- Next install the alternator belt. Place the belt over the alternator belt pulley on the pulley assembly, and then over the pulley on the alternator.



- Then install the air pump/fan belt. Place the belt over the pulley on the fan, around the corresponding pulley on the pulley assembly, and then feed it over the Air Pump pulley while pushing the air pump toward the engine. On my car this belt is difficult to put on.

If yours is the same you may want to loosen the crank bolt enough to get some axial play in the pulley stack to make it easier to put the belt on.



- Finally, install the power steering pump belt. Place the belt over the pulley on the pulley assembly stack and then install it on the pulley on the power steering pump while pushing the pump toward the engine.



- Next, go underneath the car, re-install the flywheel lock tool and secure it with the two 13mm bolts from the clutch slave cylinder.



- Use a 27mm deep socket and torque wrench to torque the crank bolt to 190 ftlbs (On most MY 928s the torque spec. is 217 ftlbs. However, Chilton's 77-81 Repair and Tune-up Guide indicates 181 ftlbs, and the 78-80 Models, Dimensions, Tolerances booklet from Porsche suggests it should be 250 + 10 NM, or 184-191 ftlbs. So, I went with 190 ftlbs). Note in the picture below that I left the lower fan shroud off so that I could torque the crank bolt from underneath.



- Next, remove the flywheel lock tool and re-install the clutch slave cylinder (or flywheel inspection cover plate if an automatic). The rod for the clutch slave cylinder fits into a depression behind the flywheel, as shown below.



- Insert the rod into the depression, and then place the housing over the rod, insert the bolts and hand tighten them. It requires some pressure to hold the clutch slave cylinder in place while installing the bolts.



- I torqued the lower bolt to 15ftlbs, but my torque wrench wouldn't fit on the upper bolt so I tightened it with a socket to approximate 15 ftlbs.



- Now the belts can be tensioned. Chilton's Guide book is a bit contradictory on this. On p. 13 it says "By placing your thumb midway between the two pulleys, it should be possible to depress the alternator drive belt about  $\frac{1}{2}$  inch. The belts for the air conditioner, the vacuum pump and power steering pump run a little tighter than this. You should only be able to depress them between  $\frac{3}{16}$  and  $\frac{3}{8}$  of an inch. However, on p. 72 it says "Adjust the drive belts to have a deflection of  $\frac{1}{2}$  inch between pulleys." I decided to set the alternator at  $\frac{1}{2}$  inch, and the rest at  $\frac{3}{8}$  of an inch deflection.
- Where relevant, and physically possible, the 13mm bolts for the accessories can be torqued to 15 ftlbs (admittedly, I didn't use a torque wrench on these bolts).

#### **A. Tensioning the Air Conditioner Compressor Belt**

- Pull the A/C compressor away from the engine and, when you think you have the correct looking tension, snug one of the 17mm bolts on the front.



- Then check the tension. You can use a ruler, a tape measure, or a device for measuring gaps.





- Once the tension is correct, tighten the three 17mm nuts (2 on the front of the compressor, one on the lower back of the compressor).

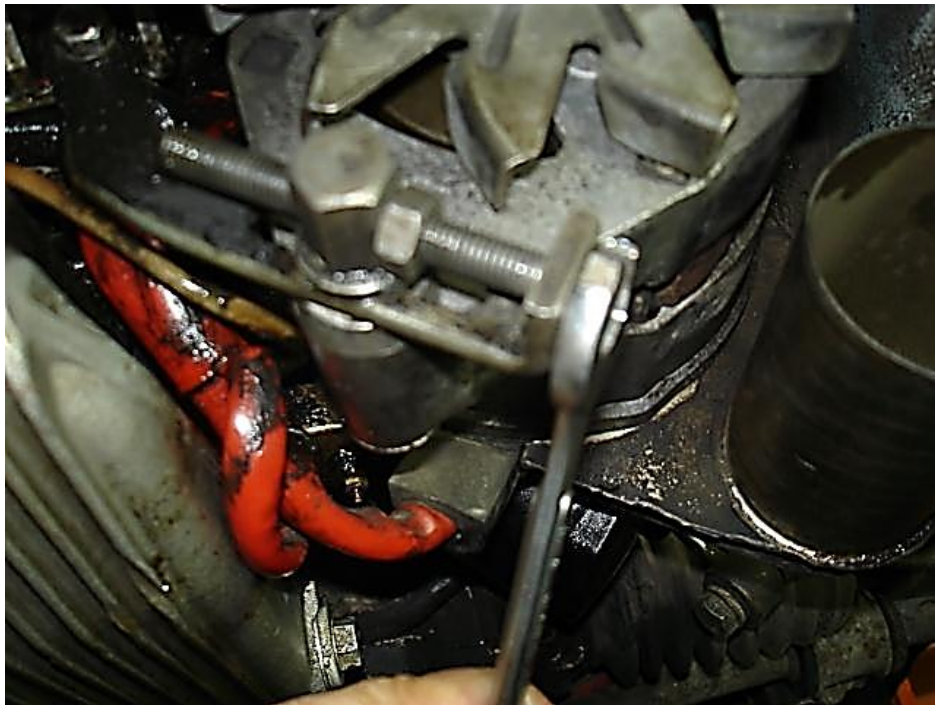




(Yes, I'm having the A/C compressor rebuilt this winter.)

#### **B. Tensioning the Alternator Belt**

- Tighten the 13mm tension adjustment bolt until the tension is correct.

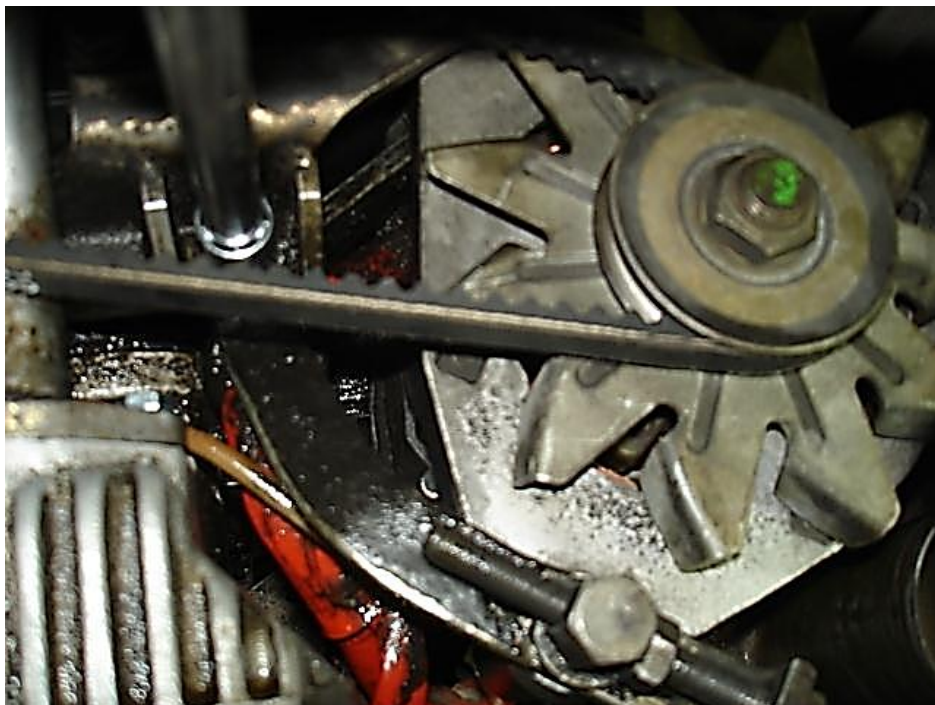


- Then tighten the 13mm adjustment bolt lock nut.

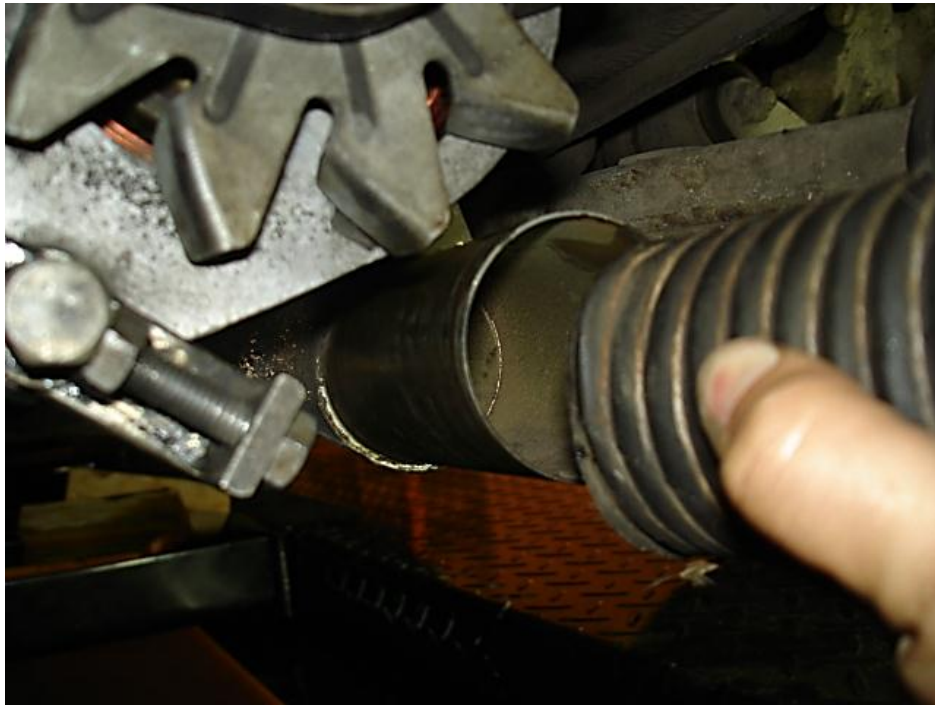
- Next tighten the lock nut on the lower back of the alternator, as shown below.



- If, when putting on the belt, you had to loosen the bolt on the alternator tension adjustment arm that bolts to the engine block, then tighten it.



- Now the alternator's air cooling hose can be re-installed onto the air guide.



### C. Tensioning the Air Pump/Fan Belt

- Adjust the 13mm adjusting nut until the tension is correct.



- Then tighten the adjustment locking nut (sorry for the blurry pics).



- Then tighten the three 13mm bolts on the front of the air pump.





#### **D. Tensioning the Power Steering Pump Belt**

- I used a small pry bar, levering against the alternator, to put enough tension on the power steering pump, as shown below.



- Then use a 13mm wrench to tighten the bolt on the front of the power steering pump, and the one on the back (if it needed to be loosened).

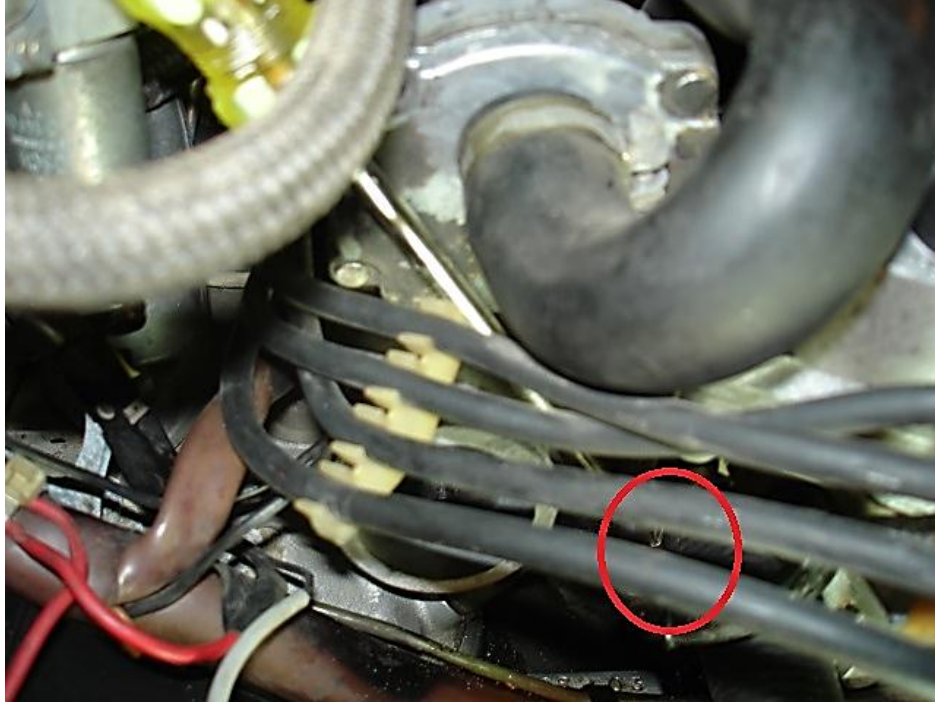


## CHAPTER 24

### INSTALLING COOLANT HOSES

- Begin with the heater return hose. Install the hose onto its fitting on the thermostat housing. Ensure that the clamp is oriented so that it can be tightened with a screwdriver from above. Also ensure to slide it all of the way onto the fitting at the thermostat housing, and that the clamp is very tight (I didn't install this clamp tight enough and had a coolant leak from this connection).





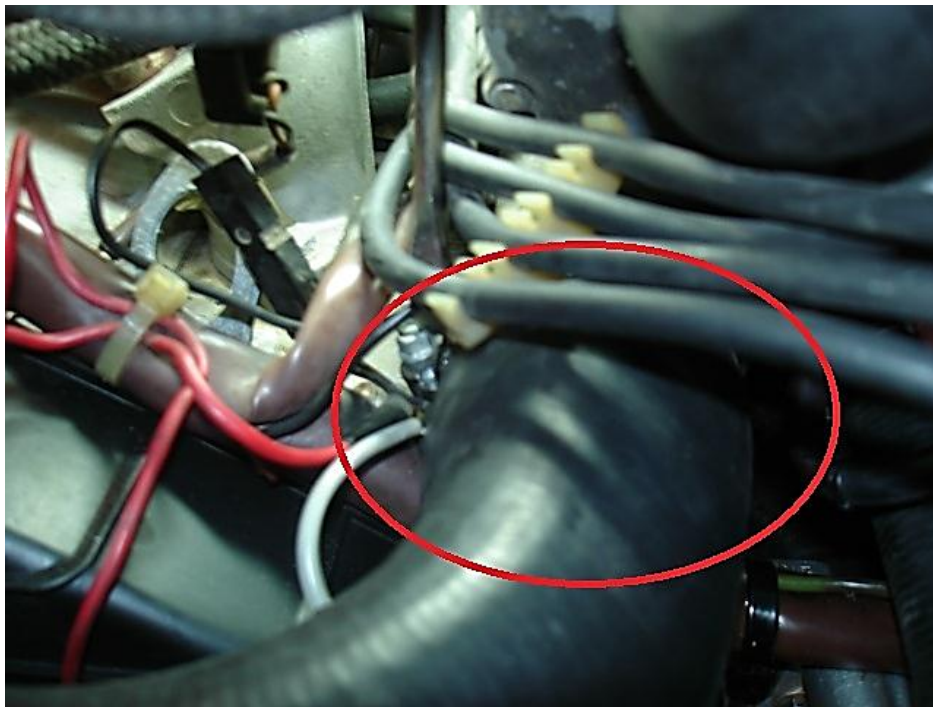
- Then install the other end of the hose, as shown below.



- Next, install the upper radiator hose. The smaller, less stretched end of the hose goes onto the radiator. You can also observe that, in the correct position, the hose hugs the right/passenger cam cover and inner fender. Install the hose on the radiator and ensure the clamp can be accessed from above. Then tighten the clamp.



- Attach the other end of the hose to the thermostat housing, ensuring that the clamp can be accessed from above.



- Next, install the lower radiator hose. Connect the upper end of the hose to the elbow on the thermostat housing. Ensure the clamp can be accessed from above, as shown below.



- Place the other end of the hose onto the radiator, orienting the clamp so that it can be accessed from underneath the car. Tighten the clamp.



## CHAPTER 25

### INSTALLING LOWER FAN SHROUD, UPPER FAN SHROUD, AND INTAKE TUBES

- From underneath the car, place the lower fan shroud in position, and install the two 10mm screws, each with one washer.



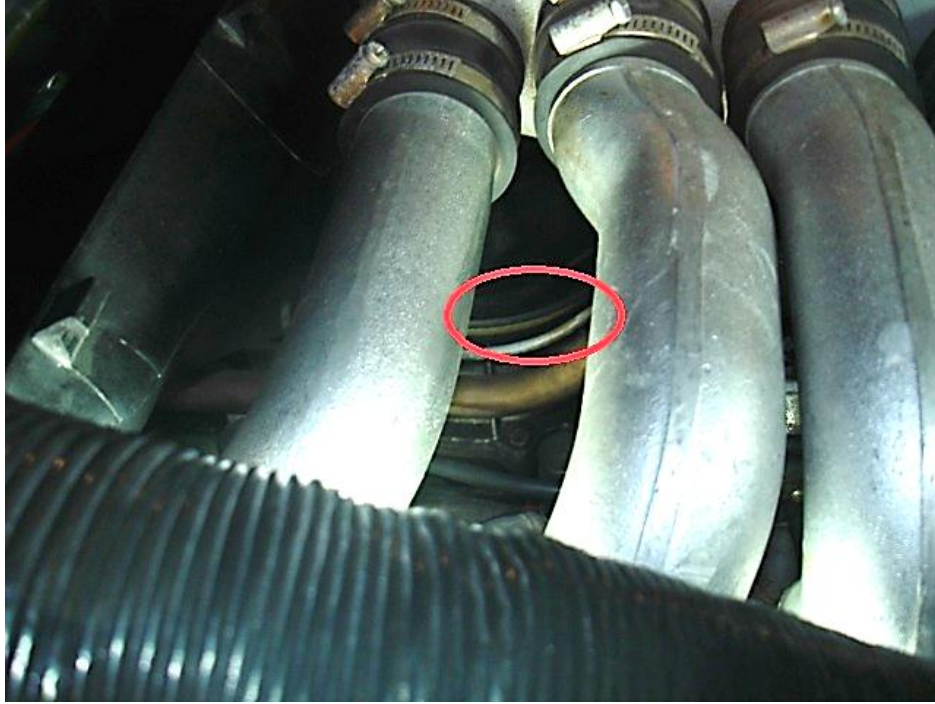
- Next, lower in the upper fan shroud into place, ensuring that the locking lips on both sides of the shroud engage the radiator, and that the tabs on the bottom edges of the shroud correctly engage into the lower fan shroud. Then tighten the two 10mm screws, each having one washer, as shown below.



- Finally, install the air intake tubes. Place a given tube into position, then place the tube onto the air cleaner, then onto the fan shroud, and pop it into the snorkel on the cam gear cover.



- Whenever I touch the air intake tubes or air cleaner I always check the connection between the air cleaner lower part and the sealing ring to ensure that air cleaner is correctly seated. Manipulation of the air cleaner can unseat it at the front, allowing unfiltered air into the motor. So, check it to make sure it is properly seated.



- If it is not properly seated, remove the air filter and re-seat it. Then replace the air filter.

## CHAPTER 26

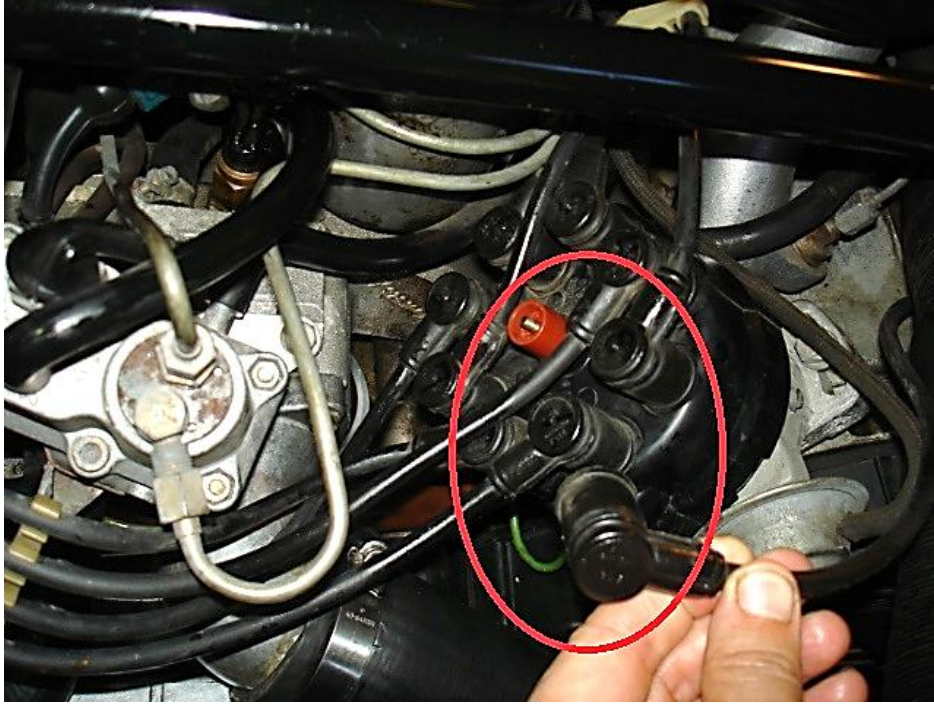
### WRAP UP

- Fill the engine block, radiator, and coolant reservoir with coolant. I used a 50/50 mixture of coolant and distilled water. The coolant must be free of both silicates and phosphates. Coolant capacity is about 16 litres. Note that it will take some time for air to bleed out of the system. Once it doesn't appear to take any more coolant, it is a good idea to leave the coolant reservoir cap loose for a few hours to ensure that all of the air is out of the system. When you come back to it, check it and top up if necessary. In my case the coolant didn't drop, but when I started the car and let it idle for a few minutes I saw the temperature gauge get warm. So I turned the engine off, let it cool down, and sure enough the reservoir was empty. So watch the coolant level and engine temperature gauge carefully until you are sure the coolant is at the correct level.
- The coolant mixture is filled at the coolant reservoir, as shown below.





- Next, if oil leaked out or if contaminants may have entered into the oil, or if you drained the oil, add/change the oil and oil filter accordingly. Oil changes are covered elsewhere.
- Reconnect the negative battery cable to the battery.
- While the car is still raised, check for coolant leaks or timing belt tensioner oil leaks. My tensioner was leaking a bit. This probably suggests that I should have used a new boot that would sit tighter around the pin. However, after a couple of short drives, it stopped leaking having lost only a minimal amount of oil. I will continue to monitor it and will replace the boot next time.
- Before starting the car, it is a good idea to build up oil pressure in the system. To do this, I remove the ignition lead (centre) from the distributor cap and tape it to the left/driver's side air intake tube such that it is not touching any metal (see pic below). In so doing, the car will turn over but it will not start.



- Then turn on the ignition and turn over the motor until you see the oil pressure gauge come up to pressure (5 bar).
- Then reconnect the ignition lead (centre) onto the distributor cap.
- Then start the car and let it run for a few minutes while checking for leaks. If there are no leaks, turn off the car and re-install the belly pan (if applicable).
- Take the car carefully down from the jack stands/lower it and take it for a test drive.
- Run/drive the car until the operating temperature is reached, turn on the heater to maximum heat and run it for a few minutes. After the car cools down, re-check the coolant level and top off, if necessary.
- Then admire your happy 928 smiling back at you!



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