

German Time Porsche 944 Timing Belts

It's not too often that you see an overhead cam engine equipped with two drive pulleys, four driven pulleys, two timing belts, three different types of timing belt tensioners, and five shafts.

But that's exactly what you'll find in the Porsche 944.

Although it may sound complicated, replacing the timing belts on a 944 engine is really not that hard. In fact this timing belt job is probably easier than others you may have done in the past. It is a little different, however, and can be a bit touchy. But with patience and a few tips, you can belt through this job in no time.



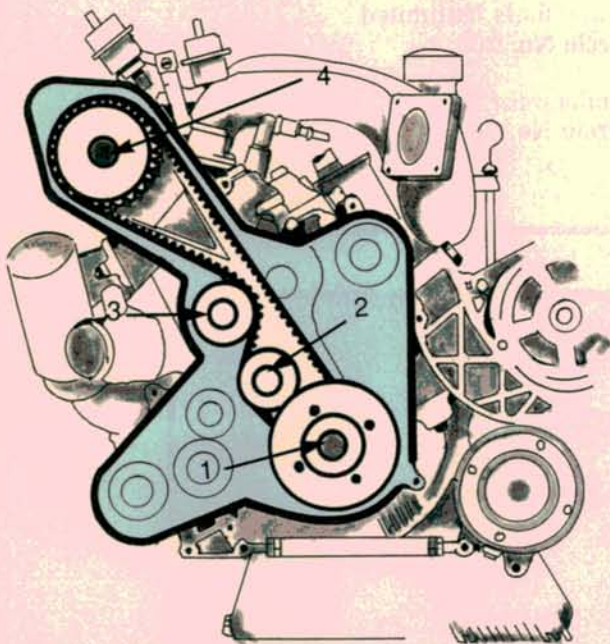
Sorting It Out

The first four shafts include the crankshaft, the single overhead camshaft, the upper balance shaft, and the lower balance shaft. The lower balance shaft rotates opposite crankshaft rotation. We're not forgetting the fifth shaft. It's really the water pump. The water pump also rotates opposite normal crankshaft rotation.

The balance shaft timing belt has teeth on both sides and turns both balance shafts. The teeth on the inner belt surface contact the crank pulley, the belt tensioner, the preload tensioner, and the upper balance shaft pulley. The balance shaft belt uses its outer teeth to turn the lower balance shaft pulley. The belt is routed past the inside of the lower balance shaft pulley, similar to a timing belt tensioner. This routing makes the lower balance shaft turn opposite crankshaft rotation.

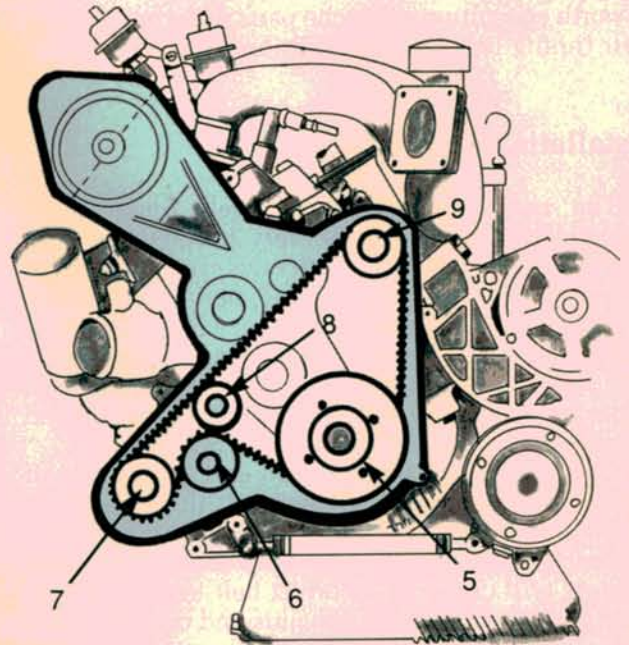
The camshaft timing belt is a conventional design. The toothed inner surface of the belt contacts the crank pulley, the spring loaded timing belt tensioner, and the camshaft pulley. The smooth outer surface of the timing belt turns the water pump.

The small inner crankshaft pulley drives the cam belt. The large outer crankshaft pulley drives the balance shaft belt. Because of the difference in the size between the crankshaft pulleys, as well as the driven pulleys, the balance shafts turn at twice crankshaft speed.



CAMSHAFT DRIVE BELT

1. Crankshaft Sprocket
2. Tensioner
3. Water Pump Pulley
4. Camshaft Sprocket



BALANCE SHAFT DRIVE BELT

5. Crankshaft Sprocket
6. Lower Balance Shaft
7. Tensioner
8. Idler
9. Upper Balance Shaft

Changing Times

The 944's timing belt design has been upgraded several times since the first car rolled off the assembly line. Some of these changes were field fixes and others were production updates. The updates began in the 944's first model year, with most updates occurring between 1984 and 1986.

Each of the following parts has been changed as part of the upgrade process:

- Belt design
- Camshaft belt tensioner
- Balance shaft belt preload tensioner
- One piece timing belt cover modification
- Two piece timing belt cover
- Shaft seals
- Water pump

Several update kits have been offered. You'll need to figure out which parts you need, depending on the vehicle's build date and also whether any modifications have already been performed. Any combination of new and old parts can be used. However, installing outdated parts may cause the timing belts to fail before their next replacement interval.

Porsche recently published a bulletin listing their timing belt design and manufacturer recommendations for 944 engines. While timing belts for these

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engines are available from a variety of sources, it might be worth consulting a Porsche parts department to get their timing belt recommendations.

Installation Recommendations

The recommended timing belt replacement interval for the 944 engine is every 30,000 miles. New belts should be retensioned after their first 2000 miles of use, and again after another 15,000 miles.

The 944 engine is definitely not a free wheeler. It comes to a crunching halt if the timing belt breaks. So if your customer waits until the timing belt breaks before he decides to replace it, tell him you'll need to pull the head to repair the bent valves too.

Due to the normal expansion and contraction of the 944 engine, Porsche recommends that the engine be at room temperature (68 degrees) when replacing the timing belts. Installing the belts at a different temperature will cause an incorrect belt tension adjustment because the engine expands and contracts as it heats and cools.

New timing and balance shaft belts must always be properly tensioned to prevent noise or premature wear. While some technicians claim they can adjust belt tension on the 944 engine by feel, others swear that the use of the factory recommended belt tension gauge is an absolute necessity.

The Porsche specialists we worked with for this article always use the belt tension gauge to check and adjust both belts, and strongly recommend that you do the same. The tool isn't cheap, but then neither is repairing a damaged 944 engine when an improperly tensioned belt goes south.

New balance shaft belts have a paint mark on one tooth. The marked tooth identifies the outer surface of the belt. A belt that is installed "inside out" will have a shorter than normal service life. Always replace leaking oil seals when you replace the timing belts. Oil leaks will destroy the new belts in short order.

We picked a 1987 944 turbo for our photos. Most of the updates, including the two piece timing cover, were already in place. Other than the extra plumbing in front of the timing cover on turbo models, the belt replacement procedure is the same on non-turbo models.

1987 and 1988 Porsche 924s use an engine that's very similar to the 944's, so timing belt replacement procedures and parts are also the same. 924s built before the 1987 model year used a different engine. Follow along as we replace the 944's belts in a timely fashion.

Torque Specifications

Balance shaft sprocket bolts: 45 Nm (33 ft-lbs)
Belt tensioner mounting bolts: 45 Nm (33 ft-lbs)
Camshaft sprocket dog: 64-69 Nm (47-51 ft-lbs)
Crankshaft sprocket bolt: 210 Nm (155 ft-lbs)

—By Ken Styer

Timing belt service tools are available through Porsche parts departments and:

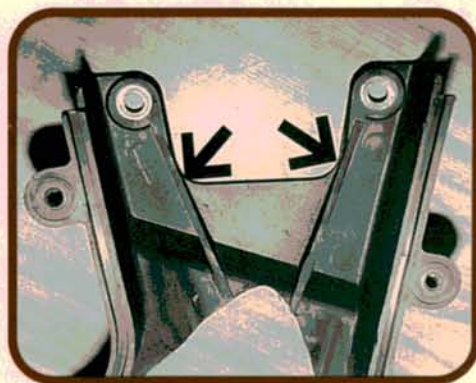
Baum Tools Unlimited
Circle No. 200

Pendergrass Tools
Circle No. 201



1

Remove the splash shields, alternator and air conditioning belt, crankshaft pulley, and timing belt cover. Timing belt cover designs have been changed several times. This cover was modified "in the field." The area marked was apparently cut away to prevent belt noise. We replaced this weakened cover.



2

Check for interference in the top area of the inner cover. Some early covers had two ribs molded into the inner surface (arrows). If your cover has these ribs, grind them flush with the cover's inner surface. This prevents the timing belt from rubbing the cover. Later models use a two piece outer cover.

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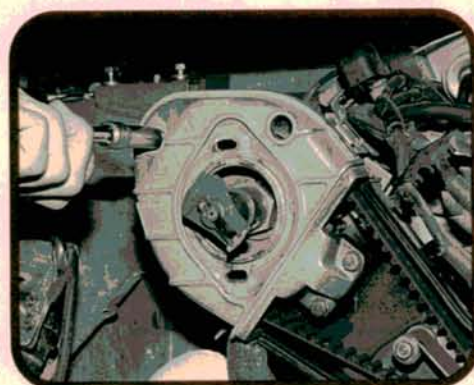
3

The engine must be set to top dead center before removing the old timing belts. Remove the access plug from the distributor housing/camshaft pulley cover. Look through the hole in the cover, then turn the engine until the camshaft sprocket timing mark aligns with the timing cover timing mark.



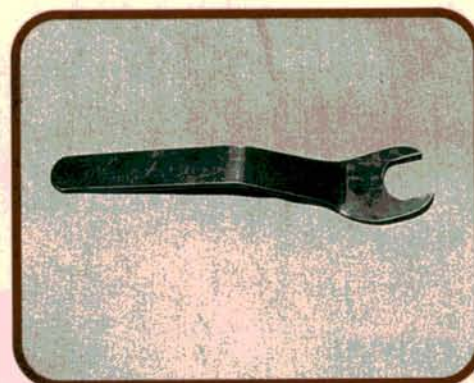
4

The crankshaft alignment marks are located at the rear of the engine, near the top of the clutch housing. Reach past the oil fill tube to remove the access plug. Make sure the flywheel timing mark is aligned with the housing mark. You may need a light to see the timing marks.



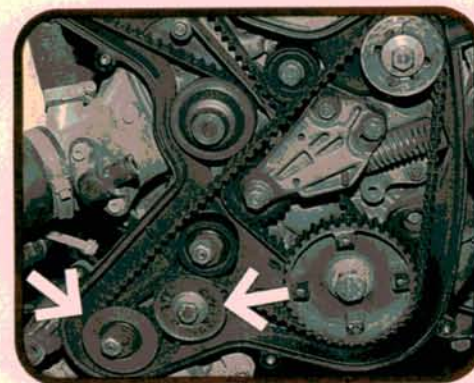
5

Remove the distributor cap and distributor housing. It isn't necessary to remove the rotor. Tilt the housing and "wobble" it past the rotor. There's no pickup inside the distributor, and there are no electrical connections. The primary ignition signal is supplied to the ECU by the crankshaft position sensor.



6

Porsche recommends several special tools for 944 timing belt service, some of which are essential. You can substitute standard hand tools for this tensonian adjustment wrench, but the job is more difficult without it. If you plan on doing this job more than once, the special tools are a worthwhile investment.



7

Loosen the balance shaft belt tensioner (left arrow), then remove the old belt. This belt has teeth on both sides because the lower balance shaft pulley is turned by the back side of the belt. This allows the lower balance shaft (right arrow) to rotate opposite the crankshaft's direction.



8

Remove the balance shaft belt preload tensioner. Two styles of preload tensioner have been used. Early tensioners have an offset round mounting hole (like a VW Rabbit). Unlike offset hole tensioners, newer tensioners have a slotted hole which slides against the bolt as well as pivoting against it.



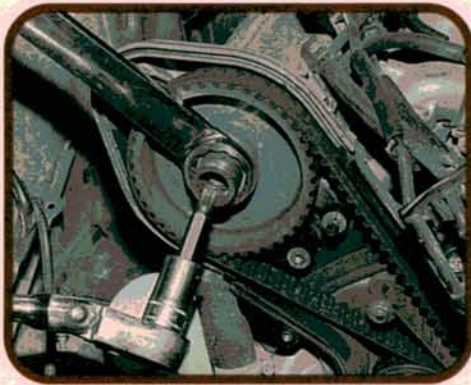
9

We removed the tensioner to show its adjustment and mounting points. Loosen the bolts holding the spring loaded tensioner in position (arrows). Push the tensioner back to compress the spring, then retighten the bolts. Remove the cam belt. Replace the tensioner if the pulley bearings are worn.



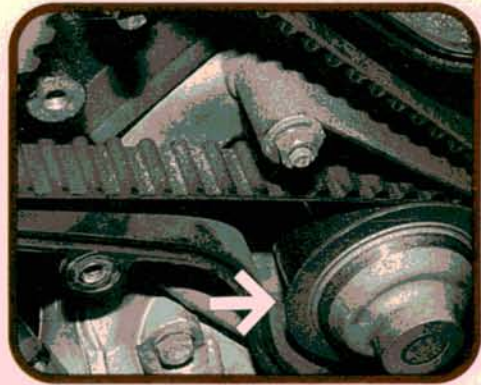
10

Remove the rotor and camshaft pulley if the camshaft seal is leaking. The rotor and stub shaft are driven by an adapter that's held in place by the camshaft retaining nut. Remove the rotor stub shaft retaining bolt, then the rotor and stub shaft. Use heat to release the stub shaft if it's stuck to the adapter.



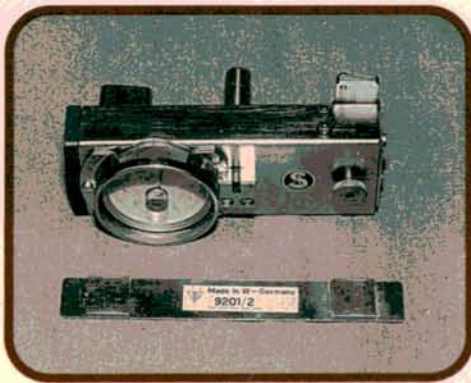
11

Removing the distributor rotor and stub shaft exposes a 12 point spline at the end of the camshaft. Use a 10 mm 12 point drive socket to hold the camshaft stationary, then remove the retaining nut with a box wrench. Retorque the retaining nut to 64-68 Nm (47-50 ft-lb) during reassembly.



12

The water pump (arrow) is turned by the flat outer surface of the cam belt. Replace early style, worn, or leaking water pumps. Install the camshaft belt. Loosen the tensioner retaining bolts and let the spring tensioner snug the belt. Early springless tensioners should be replaced with spring loaded tensioners.



13

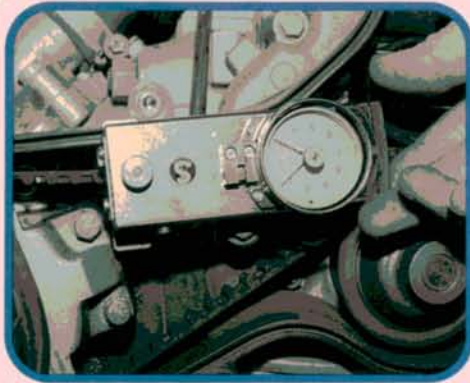
Proper belt tension is very important, Porsche techs tell us. You can't do this job properly without this belt tension gauge. Other belt tension gauges won't work because Porsche's tension specifications refer to the scale on this gauge. Use the metal calibration bar to test and recalibrate the gauge before each use.



14

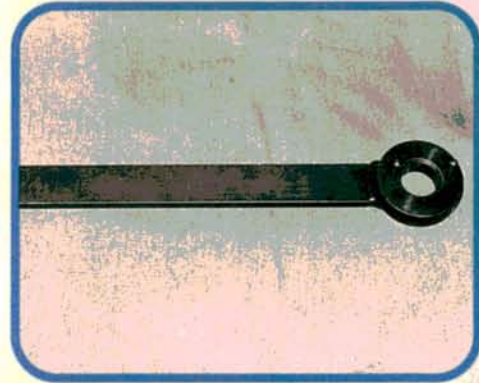
The gauge's flat shoes have a thin side to contact the balance shaft belt, and a thick side for the cam belt. Push the sliding shoe (right arrow) toward the outer edge of the tool, then set the lock. Slide the gauge over the belt with the shoes on the outer surface, and the pin (left arrow) in an inside belt notch.

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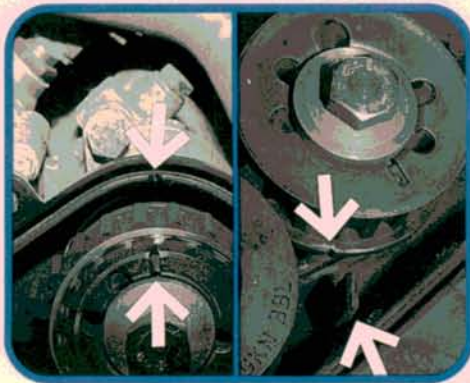
15

Release the gauge lock and check the reading on the gauge. New belts should read 2.7 to 3.2. Used belts should read 2.7 to 3.0. Overtightened belts will whine. Loose belts will rattle. If you get a low reading after releasing the spring loaded tensioner, replace the tensioner.



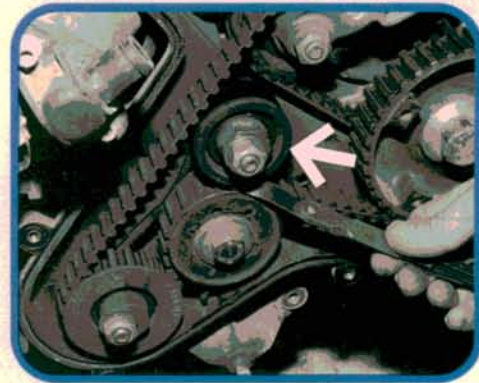
16

The spanner wrench is used to hold the balance shaft pulleys while removing the pulley retaining nuts. Pins in the spanner head match the pulley holes. The center hole allows access to the retaining nut. Balance shaft pulleys need to be removed only if you're replacing the balance shaft oil seals.



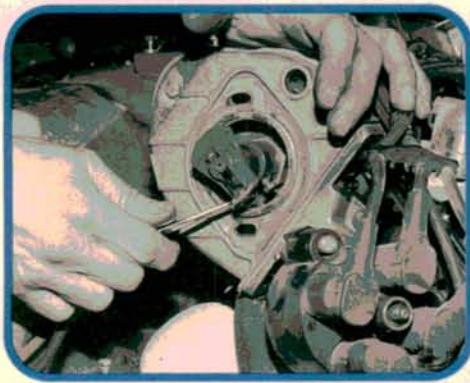
17

Align the upper balance shaft pulley notch with the pointer above the pulley (left photo). Align the lower shaft pulley notch with the pointer below the pulley (right photo). Install the new balance shaft belt. Rotate the balance shaft belt tensioner until the belt tension is between 2.7 and 3.2.



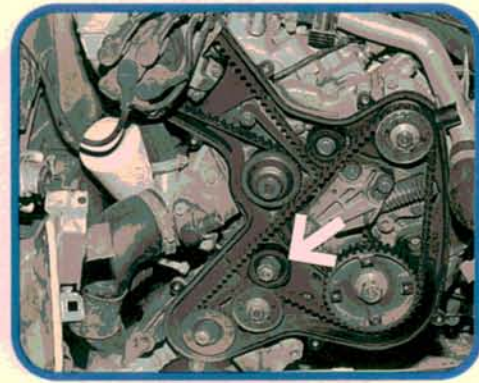
18

To adjust the balance shaft preload, place a 0.5 mm feeler gauge between the balance belt and the preload tensioner (arrow). Maintain this clearance as you pivot and slide the preload tensioner toward the belt. Keep adjusting the tensioner until it contacts the belt, then moves the belt 1 mm outward.



19

Reinstall the distributor housing and rotor. Don't drop the small bolt that holds the rotor stub shaft to the camshaft adapter. Install the distributor cap. Don't reinstall the timing belt cover if the preload tensioner has been replaced. We want to make sure it spins freely when the engine is started.



20

The tensioner barely touches the balance shaft belt, and a new one may not spin when the engine is first started. If it doesn't, carefully rotate the tensioner until it spins. Shut off, then start the engine to make sure the tensioner is turning on its own. Reinstall the timing cover, crank pulley, and drive belts.

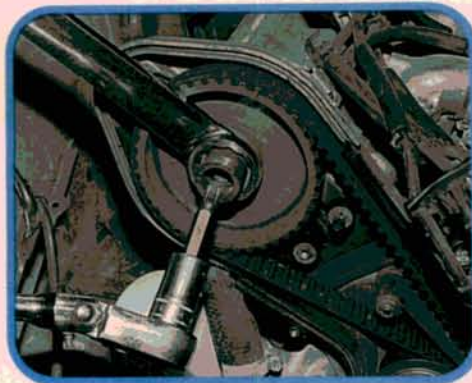
CORRECTIONS

Bob Tyrone of Bob Tyrone Automotive in Austin, Texas suggested that we had the tail wagging the dog in photo number 11 of the Porsche 944 timing belt article (page 14 of the February 1991 issue). In the photo caption we said that the 12 point socket holds the cam while the box wrench turns the nut.

It's just the opposite. You hold the cam stationary with the box wrench and unscrew the spline head bolt. Bob suggests that the spline head bolt is so stubborn that he routinely removes the entire cam tower, takes it to the work bench, and attaches the spline socket to an impact driver to break the bolt free. Removing the cam tower enables him to seal any leaks right at the tower itself.

You won't get too many chances with the splined teeth in the bolt. Make sure the splined bit has fresh teeth, and hold it square in the bolt hole. If you strip the teeth in the bolt, you end up removing the bolt with a drill and screw extractor.

We've reprinted the photo with it's corresponding number and a corrected caption. It's cut and paste time. Sorry about the mental dyslexia.



11

Photo 11

Removing the distributor rotor and shaft exposes the 12 point spline headed bolt in the end of the camshaft. Use a box wrench to hold the camshaft stationary, then unscrew the bolt. The bolts are stubborn and you may need an impact driver to break them loose. Retorque the bolt to 64-68 Nm (47-50 ft-lb).

German Time Revisited



We have additional information and a couple of corrections to the February 1991 "German Time" article on the Porsche 944 timing belt. As pointed out in the original article, several key components were changed or updated during the 944 production run. This can be very confusing when you try to keep track of all the possible combinations, so we've decided to supplement the original info.

It's important to note that all 944 engines built before the 1987 model year included the manually adjusted camshaft timing belt system. Several hundred 1987 engines were also equipped with the manual tensioner system before the switch to spring loaded tensioners. The tensioners are NOT interchangeable as stated.

Additionally, changes have been made to the design of the water pump, inner and outer timing belt covers, and balance shaft timing belt roller. Belt replacement and adjustment procedures are not the same for the early and late tensioner systems.

Let's also look at some clarifications needed to avoid some confusion about this repair.

- In photo 1, we mentioned that the cover had been modified. Some modifications were made using approved Porsche templates. What we failed to mention was that this particular cover had been weakened by an indiscriminate modification.
- In photo 3, it would have been a lot clearer if we had instructed you not only to set the engine at TDC, but that TDC number 1 was the place to be, and that the engine needs to stay there until the job is complete.

- The folks at Porsche prefer that we use the term "guide roller" instead of the word "tensioner" in photo 9. Even though a maximum deflection of 1 mm is allowed, they feel that the term tensioner is possibly misleading. Also note that the spring loaded tensioner must always be removed during a belt replacement since it straddles the belt.
- The tensioner bearing can be replaced without replacing the entire tensioner. One Porsche tech told us that some bearings were needlessly replaced under warranty because they made a slight rushing noise when spun. This does not necessarily mean the bearing is bad.
- Although Porsche says it is unnecessary to use the tension gauge on vehicles equipped with spring loaded tensioners, several Porsche techs said they double check the tensioners with the gauge—just to be safe. Another Porsche tech, fresh from a dealership, says he's seen used belts so stretched that the tensioner couldn't take up all the slack. New belt time.
- Our suggestion that the belt gauge shoes only fit one way was incorrect. It makes no difference which way the shoes face.
- In photo 17, add the word "clockwise" to our instructions for rotating the balance shaft tensioner. Rotating the tensioner counterclockwise may lead to interference between the belt and water pump. The correct balance shaft tension specs are 4.3 +/- .3 for early style belts, and 2.7 +/- .3 for later style belts using the slotted guide roller setup. The manual tensioner timing belt specs listed in the article should be changed to a belt tension of 4.0 +/- .3 for a new belt, and 2.7 +/- .3 for a used belt.
- Here's an added tip for Photo 19. Rotate the engine until the rotor faces up. This lessens the possibility of dropping the rotor stub shaft retaining bolt down behind the cover.
- Before starting and running the engine to check the guide roller, make sure you've reinstalled the crank (accessory pulley). You don't need to remove the pulley in the first place, but if you do, reinstall it before running the engine.
- There was no recommended timing belt replacement interval before the 1989 model year. Before that, belts were to be inspected and replaced when their condition warranted it. The 1989 belt replacement spec is now 45,000 miles. A Porsche tech had an opinion based on experience that time, customer driving habits, and overall maintenance make it difficult to accurately predict belt life on these engines.
- We'd also like to add the torque specs for the spring loaded tensioner which were omitted, (20 Nm or 15 ft-lb). The specs for belt tensioner mounting bolts listed in the article (45 Nm or 33 ft-lb) are for manual tensioners only.

Hope this helps, and we thank those of you who brought these clarifications and added information to our attention.