

ECS TUNING®

Installation Procedures



Part Number **ES6168**
for Audi
Ultimate Plus
Timing Belt Kit

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Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles as well as the personal safety of those performing the repairs. Standard safety procedures and precautions (including use of safety goggles and proper tools and equipment) should be followed at all times to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

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B5 S4 Timing Belt Kit Installation

ES6168



This tutorial takes you through a step-by-step procedure for installing a new timing belt and water pump on an Audi 2.7T in a 2001 B5 S4. Steps shown here also apply to 2.7T engines used in A6 and AllRoad models, and the 30v V6 in the B5 Passat.

This is a lengthy procedure. It requires above average repair skills and several professional automotive tools.

ECS tuning offers kits with the parts and fluids needed for this service, as well as a master kit with the special camshaft and crankshaft locking tools shown in this tutorial

ES6168
ECS Tuning Timing Belt Kit-
Ultimate Plus



ES7439
ECS Tuning Timing Belt Kit-
Ultimate Plus
with camshaft and crankshaft
locking tools



B5 S4 Timing Belt Kit Installation

ES6168



Tools we used:

- Schwaben camshaft/crankshaft locking tools - ES#2176242
- Schwaben crankshaft locking pin - ES#4865
- Schwaben ½" drive torque wrench - ES#2221244
- Schwaben hex head driver set ES#11420
- Schwaben Torx® driver set ES#11418
- AirLift cooling system bleeder and refill tool
- angle head die grinder with abrasive disc
- metric socket set
- miscellaneous ratchets, extensions
- impact gun or large breaker bar for loosening crankshaft main bolt
- three-jaw puller (generic)
- 32mm open end wrench (viscous fan clutch)

Torque Specifications:

- main crankshaft sprocket retaining bolt - 200 Nm + 180° (always replace TTY bolt)
- camshaft sprocket retaining bolts - 55 Nm
- timing belt idler pulley - 45 Nm
- tensioner roller - 20 Nm
- crankshaft drive pulley to sprocket bolts - 25 Nm
- hydraulic tensioner body bolts - 10Nm
- viscous fan clutch to accessory belt idler - 37 Nm
- accessory belt idler roller - 25 Nm: 8mm bolts -10 Nm: 6mm bolt.
- accessory belt tensioner bolt - 55 Nm
- thermostat housing retaining bolts - 10 Nm
- water pump bolts - 10 Nm

B5 S4 Timing Belt Kit Installation

ES6168



Our Audi B5 S4 comes to us with 106,000 miles on the odometer; the original timing belt, accessory belt, and water pump are still in place. (The recommended service interval is 105,000, so it's time!)

To expose the front of the engine so we can take photos, we remove the entire front end, including the lock carrier (front header) air conditioning condenser and fan, and radiator.

An alternative approach is to install lock carrier hanging bolts in special threaded holes on the bumper mounting tubes, then slide the lock carrier (header panel) assembly forward a few inches, making enough room to work (but not enough for photos!). General steps in this alternate procedure are outlined in a separate pdf, available on our site.



We will demonstrate the use of special camshaft and crankshaft locking tools, available separately from ECS Tuning, or as part of a complete service kit that includes special tools, parts, fresh antifreeze, seals, and belts. These tools make an otherwise difficult task easy and predictable, and take the guesswork out of cam/crank timing.

We'll start you off with a general repair outline and component overviews, then follow up with a photo sequence showing detailed procedures and helpful hints.

A note about disconnecting the battery.

We do **not** want the starter motor engaged at any time while the timing belt is removed, or while the crankshaft locking pin is installed. This is an interference engine; piston heads will strike open valves with the t-belt off, if the engine is cranked.

Disconnecting the battery prevents unwanted disasters like these, but beware: doing so erases any computer data in control modules with keep-alive memory. Lost data may include user presets and emissions data. If you choose not to disconnect the battery, make double sure the ignition key is in your pocket at all times. And don't leave your remote starter fob laying around where it can be triggered inadvertently.

B5 S4 Timing Belt Kit Installation

ES6168

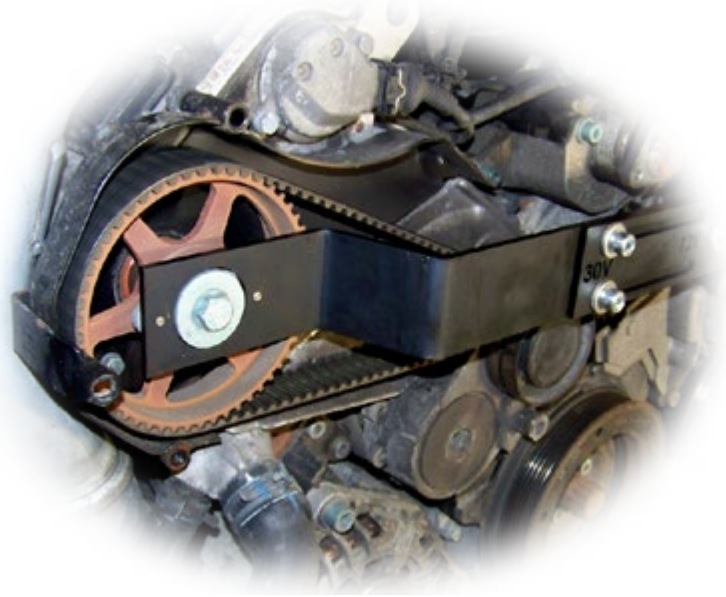


Repair Steps

These steps begin with the front of the car removed for access.

See pages 8-9 for engine images that identify component locations.

- 1) Remove the top engine beauty cover above the throttle body.
- 2) Remove the viscous fan clutch (left hand thread).
- 3) Loosen the air intake pressure pipe connection hose clamps. (These are the pressure ducts connecting the charge air coolers to the y-hose at the throttle inlet.) Remove the pressure pipes.
- 4) Loosen the power steering pulley bolts.
- 5) Rotate the accessory belt tensioner to release belt tension; remove the ribbed serpentine accessory belt.
- 6) Remove the power steering pump bolts. Leave the pump in place, with hoses attached. Remove the dipstick tube.
- 7) Remove the accessory belt tensioner.
- 8) Remove the top camshaft sprocket timing belt covers (left and right).
- 9) Using a 24mm 12-point socket and a long wrench, bar the engine over until the TDC marks on the front cover and crankshaft damper pulley align.
- 10) Make sure the **larger holes** in the propeller-like securing plates at the cam sprockets **face toward the center** of the engine. If they do not, turn the engine 360° and align the crank marks again. Install the cam locking tool temporarily to check correct cam position.
- 11) Remove the access plug on the left rear of the engine block, just above the oil pan seam, and insert the crankshaft locking tool. Screw it in all the way to lock the crankshaft in place at TDC.
- 12) Unbolt the crankshaft pulley (vibration damper) from the crankshaft sprocket. Remove the belt guard behind it. Remove the main crankshaft sprocket retaining bolt.
- 13) Remove timing belt tensioner components (tensioner, relay pivot, and tensioner roller) and the timing belt.



B5 S4 Timing Belt Kit Installation

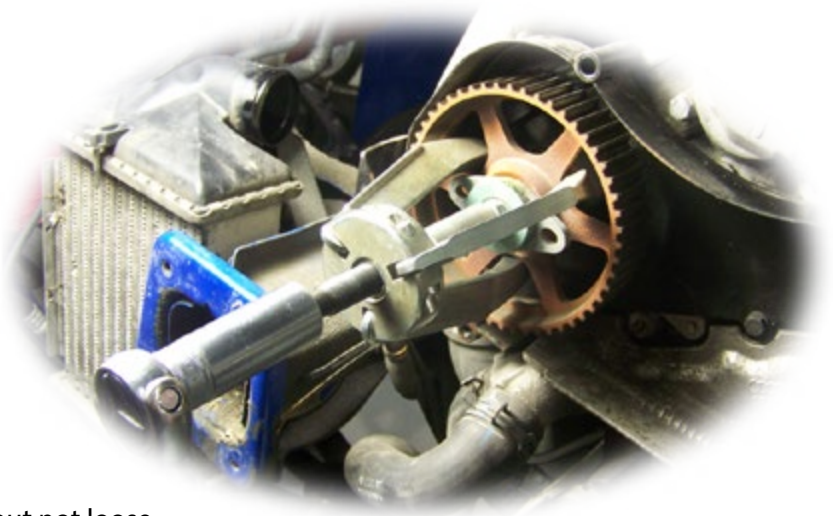
ES6168



Repair Steps

See pages 8-9 for engine image maps that identify component locations.

- 14) Remove the cooling fan support/accessory belt idler pulley.
- 15) Remove the crankshaft sprocket.
- 16) Replace the crankshaft seal.
- 17) Reinstall the crankshaft sprocket using the new crankshaft center bolt in the kit.
- 18) Install the camshaft locking tool. Loosen the retaining bolts at the cam sprockets 5-6 turns, but do not remove the bolts yet.
- 19) Using a puller, pop the camshaft sprockets loose from the camshaft snouts. Sprockets are a tapered interference fit on the camshaft snouts and will pop off with a bang when they let go. Remove the camshaft bolts the rest of the way, and take off the sprockets.
- 20) Remove the inner belt covers. Replace both camshaft seals.
- 21) Reinstall the cam bolts and snug them by hand. The cam sprockets should be just tight enough to spin on the cams but not loose enough to wobble. **Do not turn the camshafts as you snug the bolts.**
- 22) Loosen and remove the water pump bolts; remove the pump.
- 23) Clean the water pump gasket surface on the engine block and install the new water pump, using the new gasket in the kit.
- 24) Remove the thermostat housing cover bolts. Install the new thermostat and new o-ring. Keep the thermostat vent valve (jiggle valve) at 12 o'clock when installing the thermostat.
- 25) Bolt down the power steering pump. Reinstall the dipstick tube.
- 26) Install the new tensioner roller, relay tensioning lever (pivot arm), and tensioner on the front of the engine. Replace the idler roller.



B5 S4 Timing Belt Kit Installation

ES6168



Repair Steps

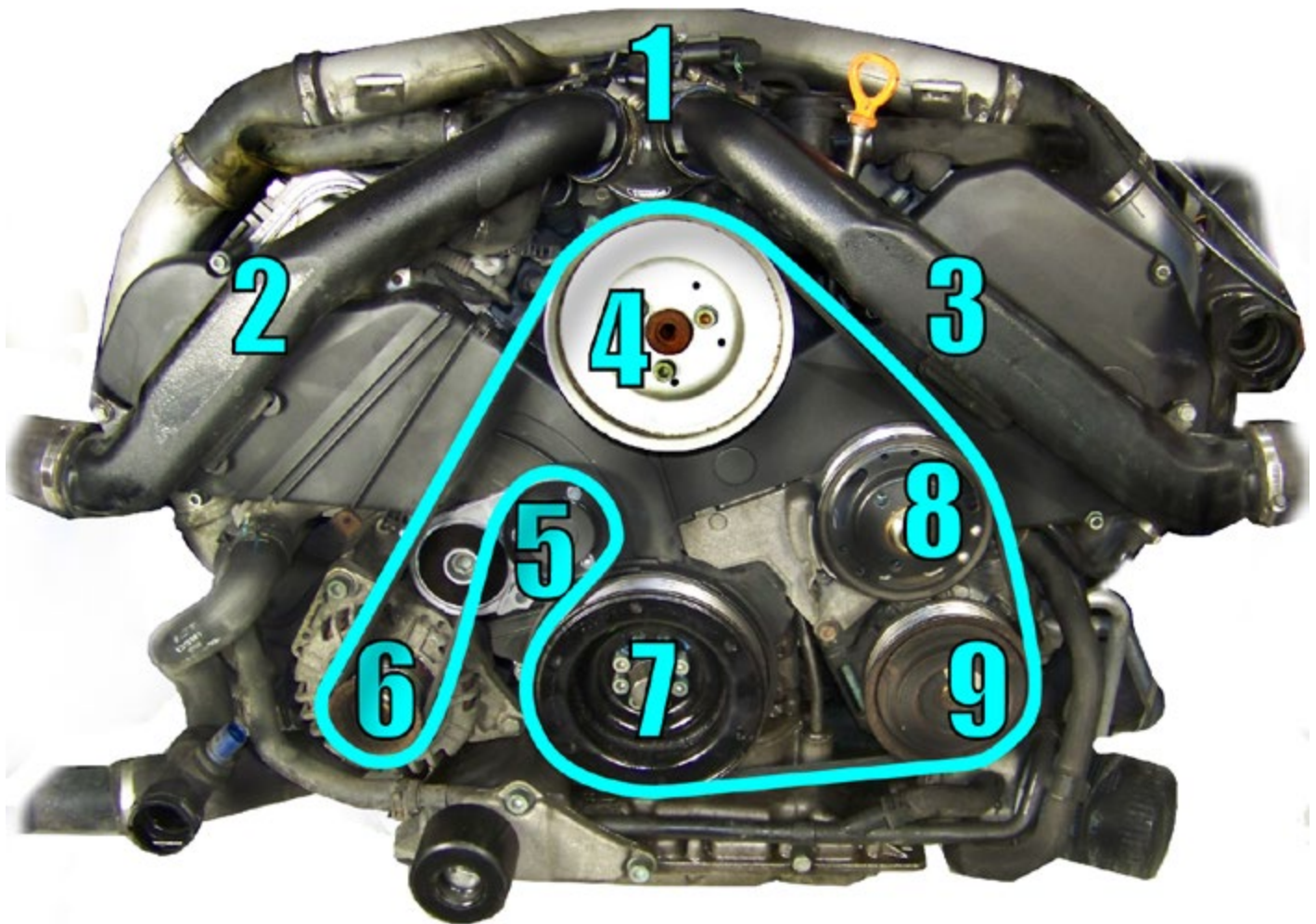
See pages 8-9 for engine image maps that identify component locations.

- 27) Install the new timing belt tensioning components (tensioner, tensioner roller, relay pivot).
- 28) Install the new timing belt.
- 29) Using an 8mm hex driver, turn the tensioner roller **clockwise** until the added belt tension compresses the belt tensioner piston far enough that the tensioner locking pin can be pulled out by hand.
- 30) Using a hex driver and torque wrench, turn the tensioner roller **counterclockwise** until a torque of 15Nm is applied to the belt.
- 31) Torque the camshaft sprocket retaining bolts before removing the camshaft locking tool.
- 32) Remove the camshaft and crankshaft locking tools. Replace the timing hole plug in the engine block.
- 33) Reinstall the inner timing belt cover and crankshaft pulley on the crank sprocket.
- 34) Bar the engine over two complete turns by hand, rotating the crank clockwise. Using the camshaft locking tool and crankshaft pulley timing marks, double check cam/crank timing.
- 35) Reinstall the front timing covers.
- 36) Reinstall the power steering pump pulley. Install the accessory belt tensioner.
- 37) Route the accessory belt. Remove the roll pin from the tensioner to release it.
- 38) Reinstall all body components removed or moved to provide working access to the front of the engine.
- 39) Fill the system with the correct water/antifreeze mixture needed to achieve a 50/50 mixture.
- 40) Bleed the cooling system as needed to remove all air pockets.



B5 S4 Timing Belt Kit Installation

ES6168



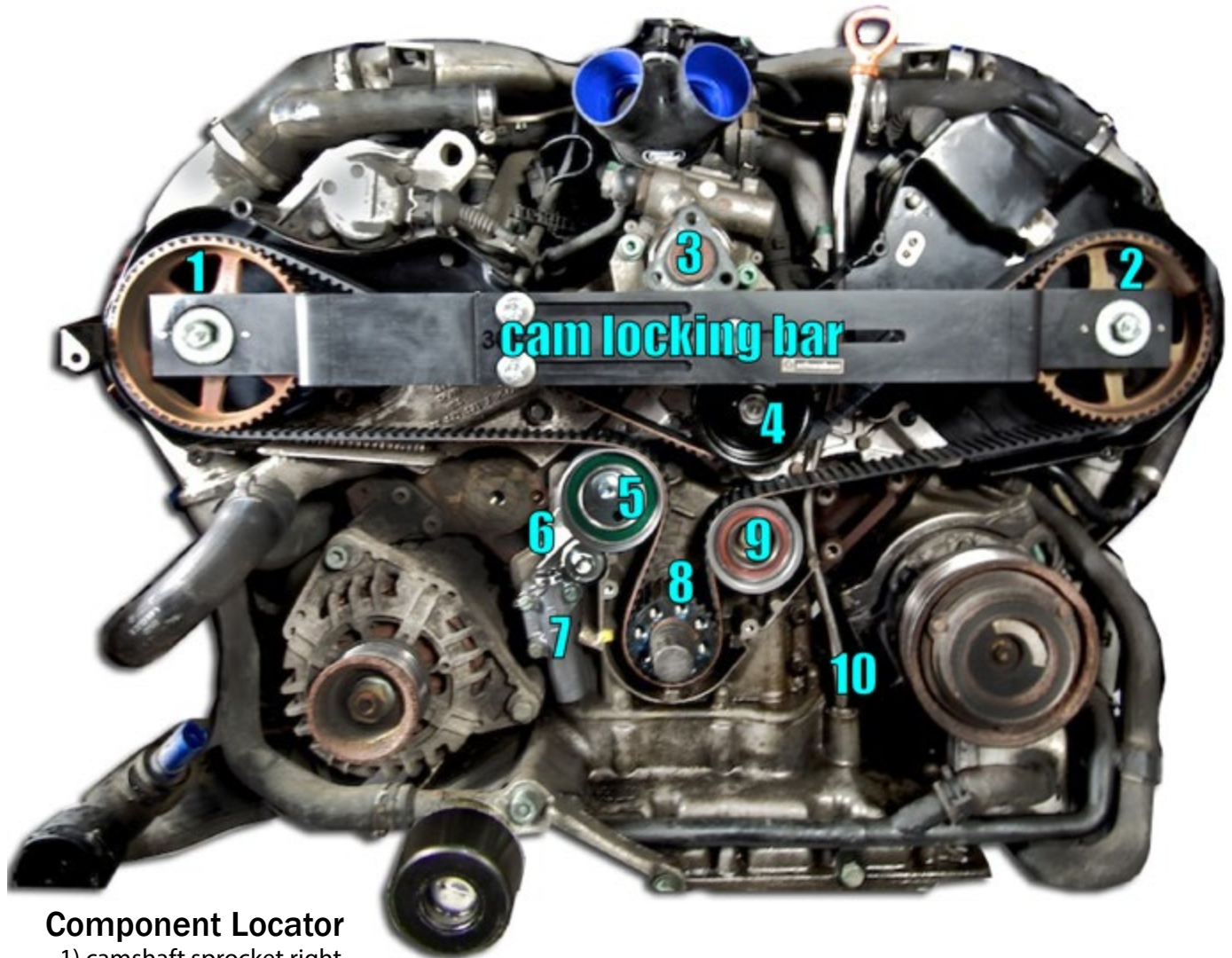
Component Locator - Accessory Belt Routing

- 1) throttle inlet
- 2) pressure pipe right
- 3) pressure pipe left
- 4) power steering pump pulley
- 5) accessory belt tensioner
- 6) alternator
- 7) crankshaft pulley
- 8) idler pulley/viscous fan clutch mount
- 9) AC compressor

Refer to this component map to identify major components and their locations.

B5 S4 Timing Belt Kit Installation

ES6168



Component Locator

- 1) camshaft sprocket right
- 2) camshaft sprocket left
- 3) power steering pump
- 4) water pump
- 5) timing belt tensioner roller
- 6) tensioner relay lever (pivot)
- 7) tensioner
- 8) crankshaft sprocket
- 9) timing belt idler roller
- 10) dipstick tube

Refer to this component map to identify major components and their locations.

B5 S4 Timing Belt Kit Installation

ES6168



Step 1.

Remove the top engine cover above the throttle inlet.

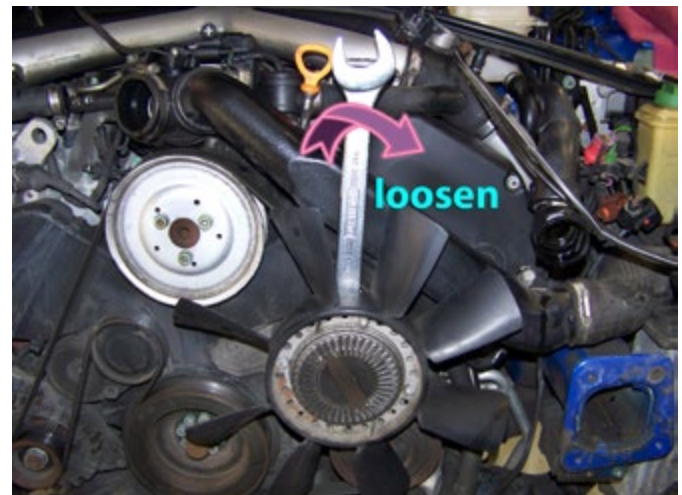


Step 2.

Remove the viscous fan clutch. The fan clutch assembly screws on to a threaded shaft on the accessory belt idler pulley.

This is a left hand thread: to loosen it, rotate the fan nut *clockwise* using a 32mm (1 $\frac{1}{4}$ ") open end wrench. Hold the pulley behind the fan nut stationary while you break the nut loose.

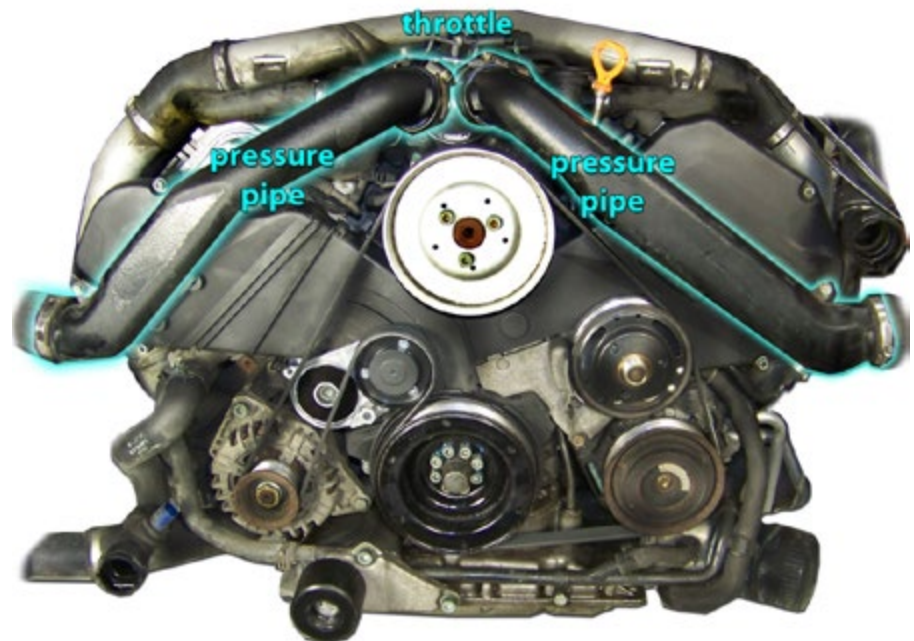
Unscrew the viscous fan clutch and lay it aside.



Step 3.

Remove the hose clamps from the pressure pipes.

Remove the pressure pipe attachment bolts from the front covers; remove the pipes and lay them aside.



B5 S4 Timing Belt Kit Installation

ES6168



Step 4.

Loosen the power steering pump bolts. (If you are doing it by hand without air tools, having the accessory belt in place helps hold it stationary as the bolts are cracked loose.)



Step 5.

Rotate the accessory belt tensioner hex with a 17mm socket and long handled ratchet to relax the belt tension. Peel the old accessory belt off the pulleys and discard it.

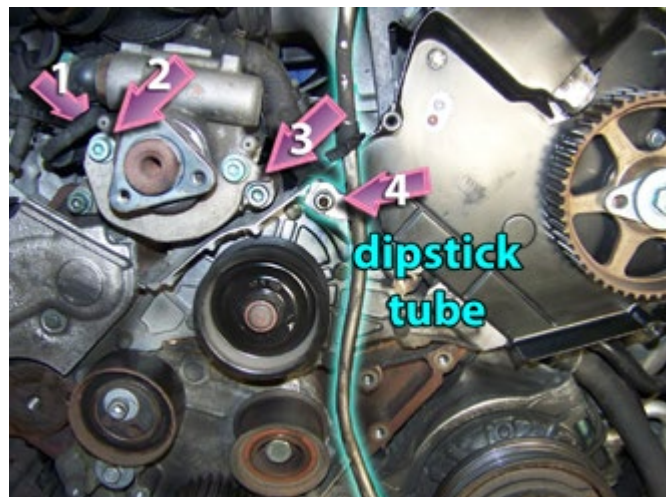
Finish removing the power steering pump bolts loosened in the previous step. Remove the power steering pump pulley.



Step 6.

Remove the three water pump bolts, marked 1, 2, and 3 in our photo. Bolt 1 is located on the back end of the pump body. Use a flex head extension with hex driver or a ball head hex driver to loosen and remove it.

Remove the dipstick tube attachment nut (4) and pull the dipstick tube from the engine. The lower end of the tube is sealed in its hole with an o-ring; after 100k miles, you may need to forcibly evict it with prying and wiggling.



B5 S4 Timing Belt Kit Installation

ES6168



Step 7.

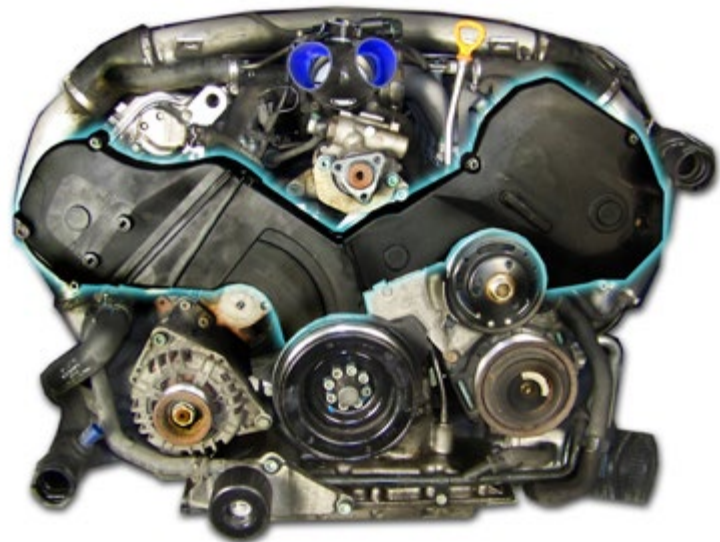
Unbolt and remove the hex socket accessory belt tensioner bolt (arrow). Remove the tensioner from the engine.

FYI: Check the tensioner bearing for noise or looseness. The bearings in our old tensioner growled when we spun the roller. We recommend replacing the roller as part of this service to ensure that it will last as long as the new belt, and continue to apply the proper tension for maximum power transfer from the crankshaft to all accessory pulleys.



Step 8.

Remove the top timing belt covers (highlighted in a blue glow in this image). The covers are held in place by bolts and snap clips. Pay close attention to the interlocking tabs and slots that join them for future reference during reassembly.



Step 9.

Use a 24mm 12-point socket on a long handled ratchet to bar the engine over until the crank is at TDC. Align the marks on the pulley and timing cover as shown.



B5 S4 Timing Belt Kit Installation

ES6168



Step 10.

With the crank at TDC, make sure the larger holes in the cam alignment plates face toward the center of the engine. If not, rotate the crankshaft another complete turn until the TDC marks align again. Then fit the camshaft tool pins into the cam alignment plates.



Step 11.

With cam and crank marks aligned, install the crankshaft locking tool.

Remove the plastic plug located in the side of the engine. It is held in place by a single 6mm bolt, and seals to the block with an o-ring.

With the plug removed, screw the threaded locking tool into the block until it engages the crankshaft, locking it in place.



Step 12.

Here's a shot from under the car that shows the locking tool installed in the block. The access hole for the tool is on the left side of the block, slightly above the oil pan, near the bell housing.

Tighten the lock with a 10mm wrench; don't overtighten, just snug it.



B5 S4 Timing Belt Kit Installation

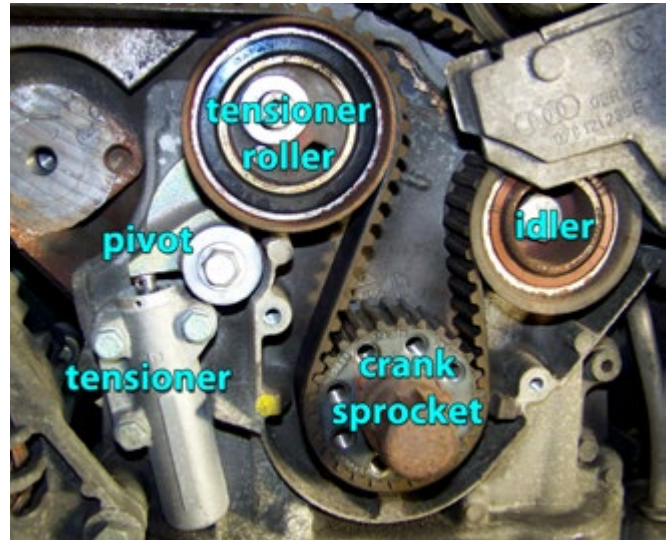
ES6168



Step 13.

Remove the vibration damper (main crank pulley) and the belt cover behind it to expose the crank sprocket and tensioner components.

- Remove the tensioner, pivot, and tensioner roller.
- Remove the timing belt.

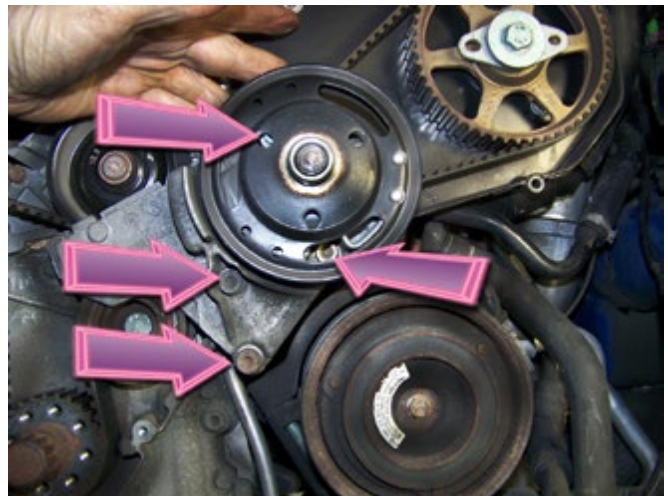


Step 14.

Remove the accessory belt idler. Arrows indicate the bolt locations.

Note that two of the bolt heads are accessed through slots in the pulley (upper arrows).

With the accessory belt idler removed, go back and remove the timing belt idler.



Step 15.

Remove the crankshaft bolt using a strong 24mm 12-point socket. A $\frac{3}{4}$ " impact gun is our favorite way to remove the center crankshaft bolt, since it gets the job done—right now.

If you are working with a smaller impact gun or breaker bar, expect to grunt getting this one out. Heating the bolt head first can ease the process with stubbornly tight bolts.



B5 S4 Timing Belt Kit Installation

ES6168



Step 16.

Pull the crankshaft sprocket off the crank snout by hand, and flip it over. Make sure the locator tab that indexes the sprocket to the crankshaft is not damaged (arrow). Improper installation of the sprocket has smashed the tab on some vehicles, so it pays to check it.



Step 17.

Remove the old crankshaft seal using a seal puller.

Be careful not to damage the crankshaft or front engine case sealing surfaces.



Step 18.

Use a seal installer, large socket, or length of tubing to tap in the new seal. Drive it in flush and level with the face of the raised boss on the cover.



B5 S4 Timing Belt Kit Installation

ES6168



Step 19.

Slide the crank sprocket back on to the crankshaft snout. Make sure the raised alignment tab inside the sprocket (Step 16) is properly engaged in the mating slot of the crank.

With the sprocket properly aligned, hold it in place until the new crank bolt is screwed all the way down by hand. That way, the sprocket won't shift out of location as the bolt is torqued.



Step 20.

Tighten the main crankshaft retaining bolt to 200 Nm, plus an additional 180 ° (148 ft-lb, plus an additional 180°). The added half turn stretches the torque-to-yield bolt for added clamping.

(This explains why a new bolt is included in your kit. Some forum posters have mentioned problems with crank bolts coming loose. Old bolts and/or improper tightening may be the cause.)



Step 21.

Replace the camshaft seals. Install the camshaft locking tool. Loosen the camshaft retaining bolts at both cams. Back them off 3-4 turns.



B5 S4 Timing Belt Kit Installation

ES6168



Step 22.

Install a gear puller on the sprocket. (The puller shown here was originally designed for crank pulley removal on Chryslers, but does a great job here.) Many common gear pullers will do the job.

Leave the loosened bolt in place. Use it as your press point. The pulleys are an interference fit on the cam snouts and will let go with a loud “pop” when they break loose.



Step 23.

Before we remove the cam seals, we unbolt and remove the inner rear cam cover and remove it.



Step 24.

Remove the old camshaft seal.

Tap a new cam seal using a suitable driver.



B5 S4 Timing Belt Kit Installation

ES6168



Step 25.

Repeat the cam seal replacement process on the left bank camshaft.

- Remove the cam gear and rear timing cover.
- Remove the old cam seal, and install a new seal from the kit.



Step 26.

Reinstall the timing belt metal covers and sprockets on both camshafts.

- Align the flat in the securing plate hole with the flat on the cam snout, as shown here (arrow). The larger hole in the cam plate should still face the center of the engine.
- Hand snug the cam bolt by hand, just far enough to seat it.
- DO NOT TURN THE CAMSHAFT.



Step 27.

At this point, the cam sprockets should be loose enough to rotate by hand, but not so loose that they wobble on the cam snout.

The cam sprockets will “float,” rotating slightly as the timing belt tension is adjusted. This ensures even tensioning across the entire length of the belt.

The cam retainer bolts will be torqued only after the timing belt is installed and adjusted.



B5 S4 Timing Belt Kit Installation

ES6168



Step 28.

Replace the water pump. Loosen and remove all the perimeter bolts, including the one hiding beneath the power steering pump (arrow). This is the reason we loosened the power steering pump way back in Step 6.

Pry the pump away from its gasket. Have a drain pan ready to catch any coolant that escapes.



Step 29.

Clean away all old gasket material and dirt. An angle head die grinder with an abrasive disk does a good job of getting things clean for the new pump and gasket.



Step 30.

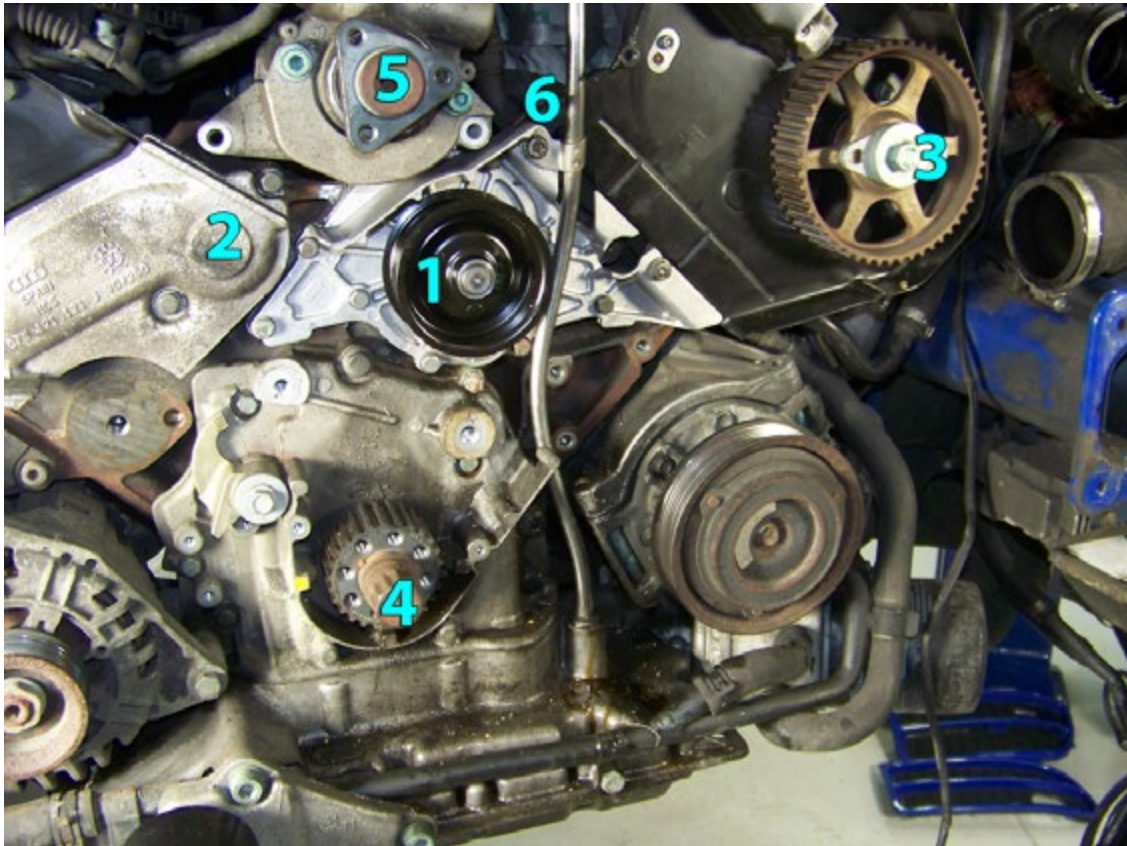
Unbolt the thermostat cover housing from the front of the engine. Remove the old thermostat and o-ring. Install the new thermostat and o-ring from your kit. Make sure the thermostat is installed with the jiggle (bleed valve) at 12 o'clock.

Reinstall the water pump using the new gasket contained in the kit.







B5 S4 Timing Belt Kit Installation

ES6168



Step 31.

Quality Control: Let's pause and review.

- 1) Water pump installed? 
- 2) Thermostat installed? 
- 3) Cam seals installed? 
- 4) Crankshaft seal installed and crank bolt tightened? 

Reinstall the three power steering pump bolts and tighten them (5), and reinstall the dipstick tube (6).

Note: Replace the o-ring at the base of the dipstick tube if it is cracked or heat hardened.

B5 S4 Timing Belt Kit Installation

ES6168



Step 32.

Install the timing belt tensioning components on the front of the engine. All of these parts are included in your Ultra kit.

Torque specs in parentheses.

- 1) tensioner (10 Nm)
- 2) tensioner relay (pivot arm) (20 Nm)
- 3) tensioner roller (20 Nm)
- 4) idler wheel (45 Nm)

Quick notes:

- We always apply a few drops of medium strength thread locker (blue) to all of these fasteners.
- Do not pull the “grenade” pin from the tensioner yet.



Step 33.

Tensioner note:

Your new tensioner ships with a retainer pin holding the tensioner piston in its retracted position. Do not remove this pin yet. We'll get to it in a minute after the timing belt is installed.



Step 34.

Tensioner roller note:

Your new tensioner roller ships with a plastic retaining tube on the attachment bolt to hold it in place, and also to secure a flat washer on the back of the roller.

This washer must be installed.

Do not lose it.



B5 S4 Timing Belt Kit Installation

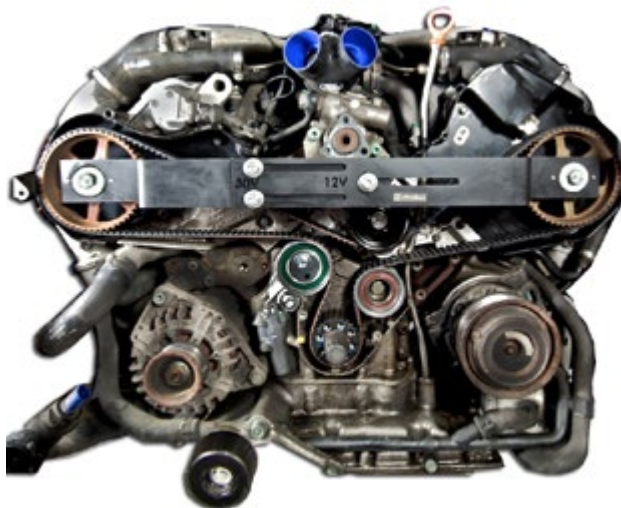
ES6168



Step 35.

Place the cam locking tool on the cam alignment plates. Route the timing belt around all sprockets.

Make sure the belt teeth fully engage all mating teeth on all sprockets or the belt will not go on. If it will not go on easily, check that the belt and crank sprocket teeth are fully engaged. It is easy to get them “stacked,” tooth-to-tooth when the belt is first routed.



Step 36.

With the belt fully routed, **adjust timing belt tension.**

Using an 8mm hex driver, rotate the head of the tensioner *clockwise*. Doing so tightens the timing belt.

Rotate the wrench until just enough tension is applied to the head of the tensioner piston by the belt that the “grenade pin” (see Step 33 for close up image) can be removed with your fingers.



Step 37.

Pre-tension the belt for initial startup.

With your 8mm hex driver connected to a torque wrench, rotate the head of the tensioner *counterclockwise* until a force of 15 Nm is applied to the belt.

This removes belt slack for initial startup.



B5 S4 Timing Belt Kit Installation

ES6168



Step 38.

With the cam locking tool installed, torque the cam retaining bolts to 55 Nm (40 ft-lb).

Remove the cam locking fixture when both sprockets are tightened.



Step 39.

- Remove the cam locking tool.
- Remove the crankshaft locking tool and reinstall the timing hole plug removed in Step 11.
- Reinstall the lower timing cover.



Step 40.

Install the crankshaft pulley on the crank sprocket. Align the tabs and notches as shown to properly index the pulley to the sprocket.



B5 S4 Timing Belt Kit Installation

ES6168



Step 41.

Install the crankshaft pulley retainer bolts and torque them to 20 Nm.



Step 42.

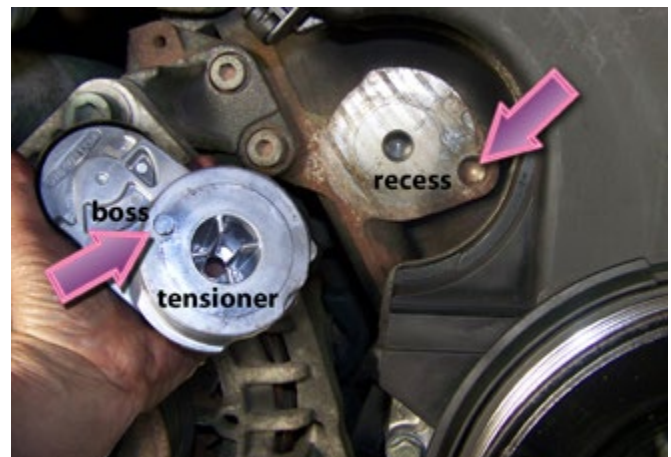
Quality Control: Bar the engine over two complete revolutions (720°), returning to TDC. Using the cam locking tool and crankshaft pulley timing marks, double check camshaft/crankshaft timing. Remove the camshaft locking tool.

- Install the pulley on the power steering pump.
- Install the belt tensioner on the front of the block in the location indicated by the arrow. (See next step for details.)



Step 43.

We always install a new accessory belt tensioner as part of this service. The tensioner has a raised boss that aligns with a blind hole in the block.



B5 S4 Timing Belt Kit Installation

ES6168



Step 44.

Make sure the tensioner boss and blind hole are aligned.

Screw the mounting bolt to the block and torque it to 55 Nm (41 ft-lb).

If your tensioner shipped with a locking pin (arrow), leave it in place until you route the accessory belt.

See next page for accessory belt routing.



Step 45.

Forgetting how the accessory belt is routed is an easy thing to do.

We include this image for your convenience.



Step 46.

With the accessory belt routed, pull the roll pin from the tensioner body. The tensioner spring will move the roller against the new belt to properly tension it.



B5 S4 Timing Belt Kit Installation

ES6168



Step 47.

Ready to button things up. Replace the front end components, including the lock carrier (header panel) radiator, condenser and condenser fan — anything removed to access the front of the engine.

Fill the cooling system. We prefer using an AirLift cooling system vacuum test and refill tool.

The AirLift has a cone shaped rubber snout that we insert into the coolant bottle fill neck, as shown.



Step 48.

Connect a shop air source to the tool and open the valve. This pulls a partial vacuum in the system. (Note the gauge reading.)

You'll see the radiator hoses collapse as the vacuum builds inside the cooling system. This is normal.

Close the Airlift valve and disconnect the air source. If the vacuum doesn't hold, you'll know there is a leak *before* you fill the system.



Step 49.

Leak free? Great. Mix your 50/50 mix of water and antifreeze in a clean bucket. Dip the AirLift fill hose into the liquid and open the valve.

Atmospheric pressure will push coolant into the lower pressure inside the cooling system, filling it without air pockets. You won't need to bleed the system, saving a lot of time.

You can fool around bleeding the system manually if you choose, but we suggest this approach as a much faster and more efficient alternative.



B5 S4 Timing Belt Kit Installation

ES6168



Coolant Mixing

- Mix pure antifreeze with distilled or demineralized water for best results. Local water supplies, even from potable sources, may contain high concentrations of minerals that will collect and harden into heavy deposits inside the cooling system, restricting coolant flow.
- The ideal coolant for temperate climates is a 50/50 mixture of pure antifreeze and water that provides freeze protection to -34 degrees F.
- Mixtures greater than 60 percent antifreeze to 40 percent water transmit heat energy less efficiently, and may gel, blocking coolant passages.



This completes our installation of the ECS Tuning Ultra Timing Belt Kit on an Audi B5 S4.