

Wagon 09.10.21. Check Crankshaft woodruff key and change Timing belt.

General.

1. Both rocker covers leaking very small amount of oil. Left it just now.
2. NS inner drive shaft CV boot gone. Replaced.

Relevant torques.

- Timing belt cover bolts = 5 Nm.
- Timing belt pulleys (large ones) A, B & splined = 39 Nm 28.9 ft-lb.
- Small idler = 18 Nm.
- Timing belt tensioner = 39 Nm 28.9 ft-lb.
- Crankshaft timing belt guide = 9.8 Nm 7.2 ft-lb. Clearance of 1.0 mm +or- 0.5 mm.
- Intake VVT cover 3.4 Nm or 2.5 Lbs/ft. This needs to be removed on the LBI to allow access to 10 mm hex for the purpose of inserting the camshaft locking tool. Factory service manual says to replace the O rings on the covers when replacing the timing belt. I just check and re-oil. Note: Always remove the O ring from the cover, insert it the camshaft groove (ensure it is properly seated), then reinstall the cover.
- Alternator adjuster bolt = 8 Nm. Locking bolt = 25 Nm. Refer to manual print offs and my personal sketch for full details.
- AC belt. The top 2 bracket bolts that hold the idler pulley in position = 25 Nm. Pulley lock nut = 23 Nm. Just leave the adjuster bolt. Refer to manual print offs and my personal sketch for full details.
- *Need to check this as Subaru provide different torques in their manuals for both the older and newer cars, yet they are exactly the same components used * – now checked. Regardless of which Subaru (EJ255 2006 Hawkeye or older Classic 1999 EJ205) we will go with 180 Nm from now on full stop! Crankshaft bolt: refer to 2006 Hawkeye Subaru manual for procedure i.e. 2 stage 44 Nm then **180 Nm** 132.8 ft-lbs following the 65 degrees or more rule. **127 Nm** 94 ft-lb is torque given in the Subaru manual for my old classic UK 1999 turbo. Ashley Wilks engine builder stated 120 to 130 ft-lbs = 162 Nm to 176 Nm. What one is correct? *7 years ago I did my old turbo to 125 lbs/ft 170 Nm.*
 - 14.10.21. After belt change I torqued the cleaned and oiled crankshaft bolt to 180 Nm. This was as per specification taken for the 2.5 litre engine directly from the manual. I used my Britool strap wrench to hold the pulley. I used a scissor action, had the torque wrench and the strap wrench 45 degrees apart☺. Next time order the crankshaft 4 pin spanner from ICP. It is about £35 – Subaru OEM Part number 499977100 for search purposes. Note: I also had wheels chocked and blocked with handbrake on, and car in 3rd gear as a back up to the strap wrench. Better to have the torque arrested by the 4 pin spanner than the timing belt through drivetrain.

Tips/reminders.

- When you remove the small coolant hoses between expansion tank and radiator ensure you plug/bung them (rubber glove finger), then orientate them so they are pointing in an upwards direction and tie them off towards the back of the engine. You don't want any coolant to leak onto the timing pulleys, in turn contaminating the new timing belt. Check

and clean all pulleys prior to timing belt installation – compressed air works well for this purpose. I had coolant spill from the small coolant hoses onto my right bank pulleys. I had to clean then with soapy water in plastic water bottle (squirting – good for aim in awkward areas) and a tooth brush. Then rinse with clean water from bottle. I then blew the excess water off with compressed air. I removed the rubber end cap from my gun and fitted a length of long plastic flexi pipe. This allowed me to get into the more awkward areas.

- Prior to installing the new timing belt clean off the radiator top mounts area, oil cooler modine cross over pipe ect, install plywood board on the floor. This is to stop the new belt from becoming contaminated with coolant, oil, and dirt and such like. The last time I installed the belt I let it drop down into these aforesaid areas. Then through experience I came up with a better technique which was to drape the belt onto the front bath towel at the top of the engine. Much better.
- Prior to refitting timing belt tensioner ensure the small O ring, washers, sleeve ect are in place.
- Collapse timing belt tensioner in the vertical position. Don't collapse piston laterally. Watch time & pressure criteria. Use manual Irwin clamp rather than my hydraulic press. Refer to my video. Note: Remember and check rod stick up measurement if you are reusing the same tensioner, Refer to manual for relevant measurement. My tensioner has only 15,000 miles on it so will reuse it.
- Leave radiator top mount bolts tight until all the hoses have been removed. Makes it much easier as hoses can be tight-ish – vent radiator (newer models) and expansion tank by removing caps, break vacuum on hoses with picks.
- Always keep eye on lights & bonnet rope before lowering the car.
- Coolant sign on steering wheel.
- When installing the timing belt if the belt ends up out by 1 tooth on left hand bank exhaust cam (which it quite often does) then simply remove the belt from the offside bottom large plain idler pulley by pulling it back over the pulley to the wrong side of the pulley. This in turn will introduce some slack back into the system. Then just slip the cam 1 tooth by hand preferably. If struggling to slip the pulley by hand then you can use a 10 mm allen key socket. Then simply pull the belt back up over idler to the correct position. It is a bit tight to pull the belt back and forth over the pulley but definitely manageable. In previous timing belt changes I have loosened the plain idler pulley bolt to introduce some slack into the system to make it easier to slip the belt. Note: I never loosened it enough as to do any damage to the threads in the block. Regardless, there is no need, you can slip the belt back and forth over the pulley with the pulley bolt fully torqued.
 - **Top Tip:** RBE. You nearly always seem to end up 1 tooth out, and end up having to slip the belt as per the procedure detailed above. The reason this always happens is because you line up the double score marks as you should between the RBI and RBE, these are the 12 o clock and 6 o clock position marks, and the 9 o clock timing mark on the RBE pulley to the inner timing belt cover. Then when you pull the belt over the bottom OS large plain idler pulley, which in turn takes up all the slack out of the belt system. When this happens the movement is enough to turn the RBE pulley 1 tooth in movement terms. Remedy is to position the RBE pulley 1 tooth out (I think it is clockwise – double check the next time you perform a timing belt change) so

when you slip the belt to the correct side of the pulley, in turn taking up the slack, the marks align perfectly. ☺ You live and learn with experience.

- Even with the camshaft locking tool in place sometimes the pulleys move slightly on the left bank cams when installing the timing belt. If this happens then adjust them accordingly using 19 and 12 mm spanners on locking tool whilst still in position – simple! Note: Make sure you keep good tension on your wrist whilst performing this task. Remember the valves are in a partially lifted position so there will be tension present from the valve springs.

The replacement timing belt should have 281 tooth!! Checked.

10.09.21. Removal of Crankshaft pulley to determine if the woodruff key is broken. There is a possibility that this is causing my not run issue – Post job, woodruff key was fine☺. Whilst in there it would be rude not to change the timing belt.

Not going to write an installation how to as that would be a waste of time, just follow this procedure backwards. For this reason I will include some additional installation information i.e. torques etc in this job folder. I will also include some additional information from my mechanical procedures folder relating to my old car (my Classic UK Turbo) when I have been replacing timing belts, water pumps ect in the past. There are some useful videos to watch for refresher purposes.

1. Remember and tie the knot for the bonnet to the trusses with the car on the ground. We wouldn't like it if the roof came crashing down or, the bonnet was ripped off☺.
2. Installed towels x 3 with magnets.
3. Removed battery and battery under tray.
4. Remove front air scoop duct, snorkel, maf, air filter housing and air filter.
5. Remove alternator plastic cover.
6. Chocked and blocked back wheels. Jacked up car and installed ramps. I left the ramps in the retracted position as there is plenty of height. Removed engine and gearbox under trays.
7. When I am changing a timing belt I prefer to remove the radiator and fans for a better view. Remove the 2 electrical connectors from the radiator fans before the coolant shower starts☺. Utilise small blade screwdriver – my yellow one works perfect. Bag and tie wrap connectors to stop coolant ingress.
8. Drain coolant and remove the radiator. It is a pain to drain the coolant from the small radiator drain cock, plus you are unnecessarily disturbing the O ring. This car being the newer Hawkeye model has the uprated U bracket to provide extra rigidity to the chassis. This gets right in the way of catch pan placement. I find it better and much faster to just drain the coolant at the large diameter (45 mm) radiator suction hose.
 - a. Slide back the 2 tab clip from the radiator side (ears are in the 6 o clock position). Break the vacuum on the hose with the pick. Position the catch pan (ferret tray) across the way, the same direction as front drive shafts – from OS to NS. This is much better than positioning the pan along the cars length as it catches much more coolant i.e. much less mess. Tip: To save getting a wet sleeve when you remove the radiator suction hose from below. Stand on your small green stool, lean in over the top of the engine bay and remove the hose from the top – bone dry☺. Drain the

coolant fully – remove expansion tank and radiator caps to vent vacuum and aid with faster drainage.

- b. Remove the jubilee clamp from the water pump side, and completely remove the radiator suction hose out of the way. Much easier when you are reinstalling the radiator if the hose is out the way. Lesson learned: The less up and down movement on the radiator during reinstallation and removal, the less chance of you have of damaging the core – been there and got the T shirt☺.
 - c. Remove the power steering hydraulic oil hose to facilitate easier removal of the radiator. Fold up a clean rag and place it over the power steering, alternator serpentine belt. This is to save it from power steering hydraulic fluid contamination. Remove the hose from the power steering pump, elevate it and tie out of the way (bonnet stay) with piece of string. There is only a small amount of fluid discharge which the rag will catch and keep the belt pristine.
 - d. Remove the large diameter return hose from radiator side only and the 2 small hoses from radiator to plastic expansion tank.
 - e. Then remove the 2 top mount radiator retaining clamps M12/8 mm. Position catch pan close by and remove radiator, be careful not to damage radiator during removal. After removal immediately tip radiator up to one side and drain the remainder of the coolant into catch pan. Note: Remember to scribe hoses and clamps prior to removal – just easier.
9. Slacken off the locking and adjuster bolts on the alternator, power steering belt and remove. Do the same for the AC belt. Note: I like to measure the thread stick up on both these adjusters with a steel rule or vernier prior to removal. It gives you a close bench mark when re-installing, prior to final tensioning. Refer to additional hand drawings☺.
 - a. Power steering/alternator belt is 5 rib serpentine belt. Remember and scribe direction prior to removal.
 - b. Ac belt is 4 rib serpentine belt. Remember and scribe direction prior to removal.
 - c. Tension for both should be roughly between 9-11 mm if you are reusing the original belts. Less if you are replacing the belts with brand new ones.
10. Removed large diameter radiator discharge hose from cross over pipe side to give me a better view of the timing system when looking down from above. Torque: Jubilee on Radiator side has 18 indentations.
11. Little note on forward prep for re-assembly. Now in a position where we are ready to take off the timing belt covers and harmonic balancing pulley. Scribe harmonic balancing pulley (orange oil based marker) to the 30 degree mark on plastic casing. Also once the side covers are removed highlight timing marks on all 4 cams with the fluorescent orange marker – just easier for an old blind buggar like me☺. This is good for when you retighten the crank bolt back up on job completion as the cover will be in place on the crank so you wouldn't see if it jumped a tooth after re-torqueing. This is also why it is best to leave the cam covers off until post harmonic balancing bolt re-torqueing too. You can double check all you marks. Note: When re-torqueing I have no one to hold the brake, I put the car in third gear with the handbrake on, with the wheels chocked and blocked too. Then recheck marks post torque wrench work to ensure I haven't jumped a tooth. On this occasion I used my Britool strap wrench rather than going against the drivetrain.

12. Position engine in timing position with piston #1 at TDC – scribe all your marks. Remove OS & NS timing belt covers. The reason for removing the side covers before breaking the crankshaft pulley bolt was purely curiosity so that I could see after breaking the bolt if the cams had jumped a tooth. Broke 22/14 mm bolt with facom air impact gun on highest setting 3 – don't wind right out as you could puncture the AC condenser – back out fully using your fingers. I was unable to use my metabo battery impact due to space out back to AC condenser. When I broke the bolt the car was in third gear with handbrake on. Neither the crank nor the cams moved/jumped a tooth. This is the beauty of the impact gun. Note: On reassembly clean bolt with HP air and oil prior to installation.
13. Removed the HB pulley. Once the HB pulley & middle timing cover was removed the crankshaft pulley was still in the correct timing position. Repainted all my timing marks, all timing marks were dead on correct. Note: The RBI is the only cam pulley timing mark that is ever so slightly to the RHS of the inner plastic cover mark, not enough to even think about going to the next wrong tooth, refer to video to see scenario. Middle timing belt cover has 5 x 10/6 mm double shouldered bolts on the top, and 3 x 10/6 mm bolts on the bottom, 2 are the double shouldered type, and the one located next to the oil cooler modine is a standard type bolt.
14. **Eureka!** This was when I had my eureka moment pertaining to the left and right bank exhaust valve timing marks.
 - a. LBE cut out on the timing cover at the 3 o'clock position. I use my small 6inch welders square with my small magnetic spirit level to over-bone through the marks. They never line up. They are always just about a tooth out, but not quite, plus the double score 12 o'clock mark is always in line with the double score mark at the 6 o'clock position on the intake cam. I could never understand it, eureka: The engine is sitting at 16 degrees and I have **been levelling** my spirit level prior to the over-bone☺. I moved my square and level to the idle control valve surface on top of the inlet manifold. I could then establish the rough angle from there. I then located my square in the timing cover cut out and replicated the angle the best I could, bingo – spot on. Love that one☺.
 - b. RBE, same as above but cut out in timing cover is in the 9 o'clock position. Superb!
15. For Learning purposes: For every 2 turns of the crankshaft the cams rotate 1 full circle 2:1 ratio. 1 full turn of the crank equals half a turn on the cams. Another reason for performing this rotating of the engine was to get a feel for the pressure required to turn the engine over the TDC point. After I install the new belt and turn the engine over to check for any collision I will know if a higher force is required i.e. valves, colliding, piston crowning ect!! If your timing is out by over 3 teeth the engine will be damaged. You need to rotate the cams the correct way when lining back up. When the belt is removed all the valves will be held by the springs in the zero lift position. When installing the new belt you need to proceed as follows.
 - a. Left bank intake. **Turn clockwise only:** don't go counter clockwise unless you want to damage your engine! Take the short route which should only be roughly 45 degrees to return the valve from the zero lift position to the partially lifted timed position. If you take the long route, you are in trouble! But you should feel it before any damage.
 - b. Left bank exhaust. **Turn counter clockwise only:** don't go clockwise unless you want to damage your engine! Take the short route which should only be roughly 45

degrees to return the valve from the zero lift position to the partially lifted timed position. If you take the long route, you are in trouble! But you should feel it before any damage.

- c. If you purchase the camshaft locking tool you don't have to worry about it. It will hold both the left bank intake and exhaust camshafts in their timed partially lifted correct positions prior to the timing belt removal. So no worries, think they are about £20 from ICP.
 - d. Right bank. Both cams are floating as both valves are in the fully closed (zero lift) position, so no worries there.
16. Removed the 3 x 8/5 mm setscrews on the VVT LBI cover come with O ring. This is to facilitate the use of the camshaft locking tool. Refer to red bullet point under the Relevant torques heading pertaining to O ring replacement.
 17. Locked left bank intake and exhaust with my cam lock tool – superb! When installing the locking tool, for some odd reason, the exhaust cam is a little bit fussy in what magnet it prefers in relation to smooth fitment for swallow, ensure you have the correct magnet placement – there is no need to use the spare spacer you get with the tool for this application. I place the tool with the curve of the bracket facing inwards towards the crankshaft pulley. I prefer this orientation rather than outwards towards the cams. It gives a better view keeping the tool further away from the cams. When installing the tool firstly thread up the bolts by hand until the plate is tight against the magnet body. Then tighten both bolts in sync 2 flats at a time until really tight. If you don't pull it up evenly one of the magnets has a tendency to jump out. Magnet is 19 mm bolt is 14 mm. Tighten as much as you can with 14 mm combination spanner as I have seen it slip before when the belt tension is removed.
 18. Remove horse shoe crankshaft guard. Checked with feeler gauge prior to removal. A snug popping good fit☺.
 19. Marked the old timing belt (keep as spare as only 15 k) at both intake cams at 12 o'clock position, and crank – (3 orange paint scribes total) and direction arrow between crank and left bank intake cam.
 20. Removed the hydraulic tensioner. Ensure you retain the O rings and washer off the back. The o ring can be left against the block and the washer can fall off.
 21. Removed the timing belt. Note: I never removed any idler pulleys, the belt slipped off a treat. Note: Never allow the closed angle of the bend on the belt to go past 2.36 inches or, 60mm. This can damage the belt. You get new hardened PTFE belts now. They are a bit more expensive, last longer, but are also noisier.
 22. Removed the crankshaft pulley. The woodruff key was spot on☺. Prior to removing the crankshaft pulley I measured the stick out from the outside face of the pulley to the end of the shaft using my hycalog 6 inch drill bit ruler. It was 9 mm. Crankshaft oil seal still spot on as changed that 17 k ago.
 23. Collapsed the hydraulic tensioner as per stated time/pressure procedures (refer to video in my old car collection included in this job folder) using Irwin wood clamp. Installed grenade pin. Now ready for refitting. Note: Prior to collapsing the piston rod remember to check piston rod stick out within specification if reusing the tensioner.
 24. Checked all the idler pulleys, hydraulic tensioner, and water pump for end float, runout, wear, noise, pitting. All spot on, will refit same – only done 15 k. Note: Water pump will have

to be changed in about 20,000 miles, as this is the original with 100 k on it. Probably my next 5 year timing interval.

25. Installed new timing belt. Removed locking tool from left banks. Turned engine over firstly with tensioner pin still in to check for collision, and correct orientation of timing marks. Then pulled tensioner pin & turned engine over 2 more times to obtain proper force setting on tensioner piston prior to initial start-up. Used special tool for turnover rather than threading back in the crankshaft bolt.
26. Reassemble in opposite order😊.