

BHW Engine Balance Shaft Module Replacement

Change from chain driven to gear driven module.

2/10/2009

This document is a procedure to replace the chain driven balance shaft module in a Volkswagen BHW engine with a gear driven balance shaft module. This procedure does not include a timing belt replacement procedure, nor other procedures as already found in the VW repair information. Anyone attempting this procedure should already know how to do procedures not covered here, or they should not begin this. This procedure can be used on other engines of similar design used throughout the world, but the part numbers referenced will be different.

This procedure is based on the methods used by TDICLUB (www.tdiclub.com) members oilhammer and MOGolf. It was performed on the 2004 Passat Variant owned by MOGolf. Special service tools were used and are described below. We do not recommend trying this procedure without them (unless otherwise noted). Part and tool numbers are for reference. VW may change them at any time.

FOLLOW ALL COMMON SENSE SAFETY PROCEDURES. YOU WILL BE WORKING UNDER THE CAR AND THE ENGINE WILL BE SUSPENDED FROM ABOVE.

RIGHT and LEFT references are as if you are sitting in the driver's seat.

Required parts:

- 03G 103 295 Q – differential case with gears, shafts and oil pump (balance shaft module)
- 03G 105 212 C – replacement gear for crankshaft
- 03G 103 305 C – balance shaft drive gear
- N 911 213 01 – bolts to attach balance shaft drive gear – quantity 4 total required
- N 106 014 02 – balance shaft bolts (#1-4, 8) – quantity 5 total
- N 910 512 01 – balance shaft bolt (#6)
- N 911 234 01 – bolt for balance shaft front near drive gear (#5 in the procedure)
- N 909 775 02 – bolt for balance shaft front near oil pump (#7 in the procedure)
- 038 103 085 E – crankshaft seal
- 045 105 229 – crankshaft pulley bolt
- N 908 897 01 – bearing cap bolts (optional, see procedure description) – quantity 2 total

Recommended parts:

- 3B0 823 593 D 01C – hood release rod (this may break when removed for grille removal)

Shop supplies:

- D 176 404 A2 – Oil pan and seal flange sealant, or equivalent
- G 012 A8F A4 – G12/G12+ coolant
- Distilled water – obtain locally – 1 gallon (3.8 L)
- 505.01 or 507.00 spec (or better) oil – owner's choice/shop supply

Special service tools:

- T10050 – crankshaft lock tool
- T10053 – crankshaft seal installer with shaft protector /1 and bolt /2
- T10255 – balance shaft locking tool
- T40001 – puller with /3 and /5 claws
- Or T10392 – puller – modified to fit the holes of the BHW crankshaft sprocket (see procedure description) – Our preferred puller for this.
- 30-11 – thrust plate for the T40001 bolt to press on
- 3411 – lock carrier support pins (or M8x1.25 bolts at least 160mm long)
- 10-203 – cylinder piece only (optional: use a large deep socket – test fit before removing old chain gear)
- 3359 – camshaft locking pin or MN3359 from Metalnerd (www.metalnerd.com)
- 3393 – subframe alignment pins, or equivalent
- MNYANK-4CYL – Metalnerd crankshaft counterhold tool, or equivalent
- MOTOOL-GH0002 and OHTOOL-BJ0002 – wood 2x4 blocks, or equivalent
- OHTOOL-BJ0001 – oven, or equivalent
- MOTOOL-GH0001 – heat resistant gloves, or equivalent – quantity 1 or 2 as required

Standard shop tools:

- Metric wrenches and sockets.
- XZN socket bits
- Torx socket bits up to T45
- Torque wrenches
- Engine support such as VW 10-222A, engine hoist, or equivalent

Procedure:

Prepare above the engine by removing the engine cover, and installing a support bridge or other tool adequate for suspending the engine. There are lifting eyes secured to the engine that allow a supporting device to be attached. You'll be disconnecting the engine cradle support below.

Remove front grille and front bumper cover. The hood release rod must be released from the latch. Caution: it may break.

Drain engine oil and coolant. Coolant is easily drained while putting the lock carrier into the service position. There is a drain valve located in the front lower corner of the radiator. Open it using a screwdriver and allow the coolant to drain from there. After coolant has drained, close the valve being careful to not over tighten (it is only plastic!).



Follow the standard procedures for putting the lock carrier into service position on support pins 3411 (or M8X1.25 bolts of adequate length). This procedure is easily performed if the entire lock carrier assembly is removed. Use the bolts if you intend to remove the lock carrier. The carrier will slip over the heads of the bolts, but won't clear the knobs on the 3411 pins. In order to completely remove the lock carrier you need the proper equipment to evacuate the AC system, disconnect the AC lines, block open lines and ports., and later recharge the AC system, and also to replenish drained automatic transmission fluid (G 052 162 A2).

Ensure the engine is at TDC for cylinder number one. The camshaft lock tool and crankshaft locking tools should be installed. This is covered in the standard timing belt replacement procedure.

Follow the procedure for removing the timing belt.

Counterhold the crankshaft sprocket and remove the bolt. Note this is on very tight. You must not allow the engine to turn while loosening.

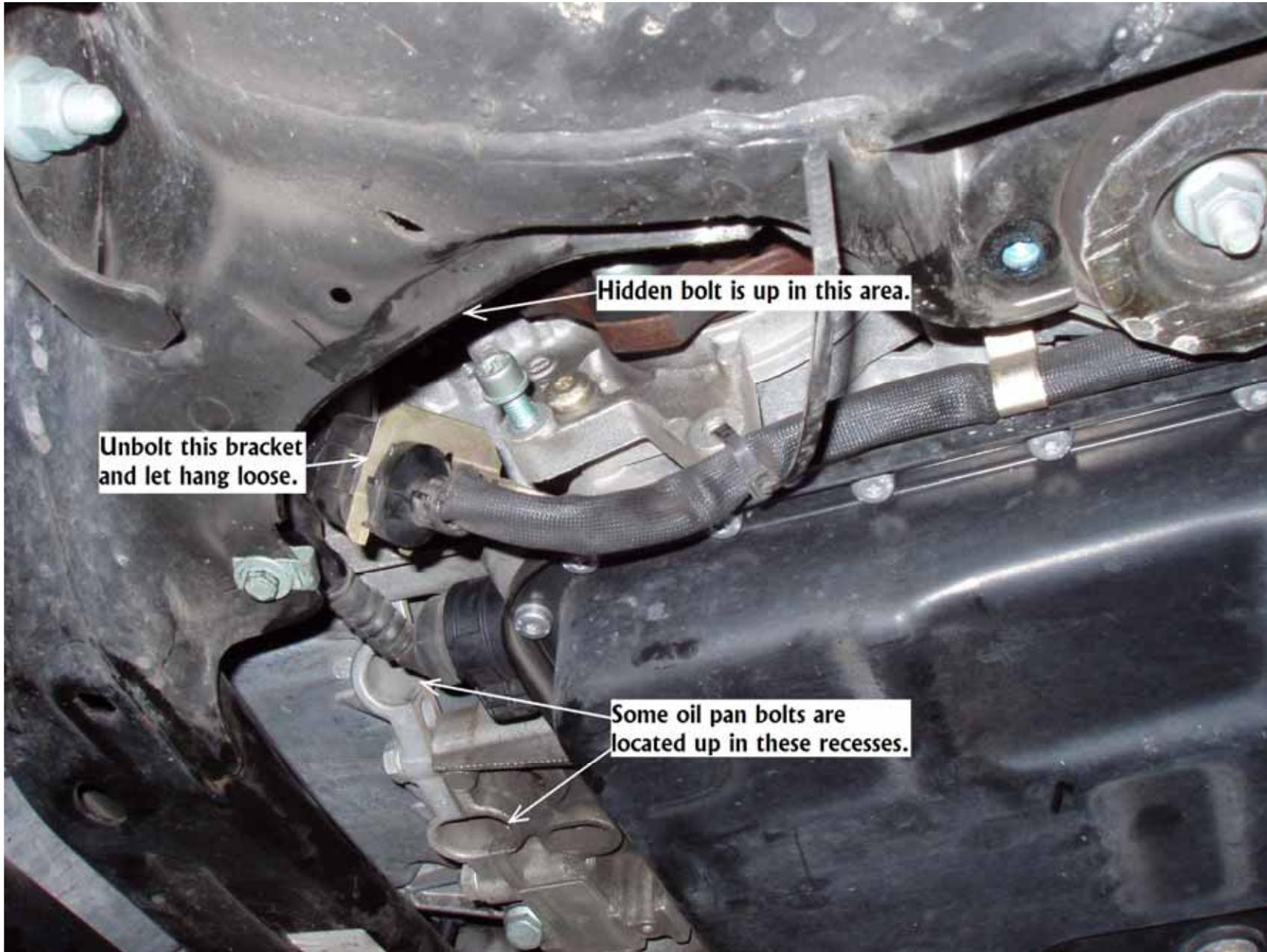
Ensure the vehicle is properly supported at a comfortable working height and the engine is prepared to be hung from above.

Remove front torque limit stop from engine.

Remove the bolts attaching the oil pan along the rear edge. A 10 mm swivel socket or 5 mm ball long hex bit can be used.

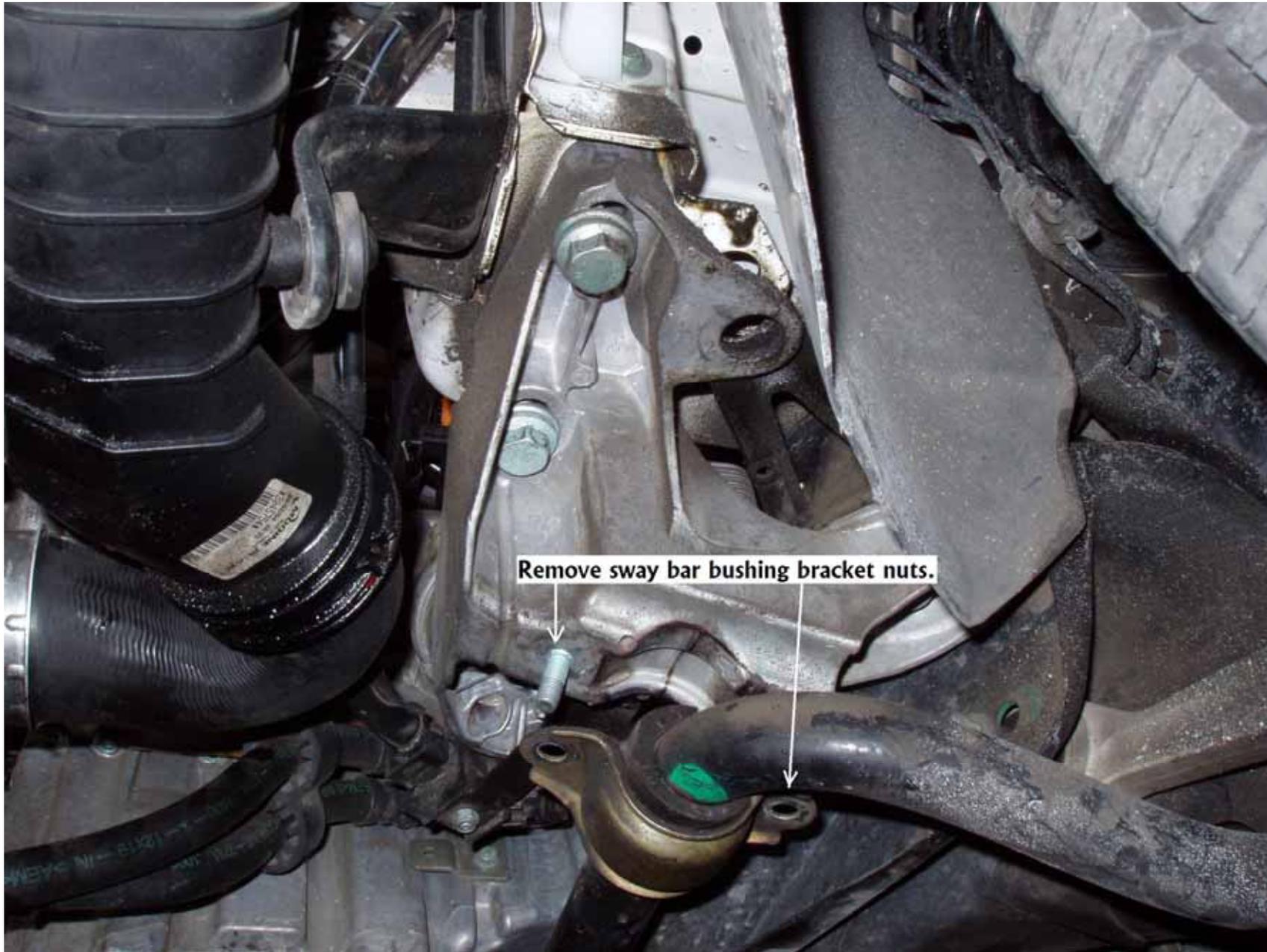
Remove the bolt attaching the transmission wiring bracket and move the bracket aside.

Above this bracket, locate the one horizontal bolt with a nut that attaches the oil pan to the transmission and remove.



Support the subframe from below before proceeding further.

Remove bolts attaching sway bar bushing brackets from both sides.

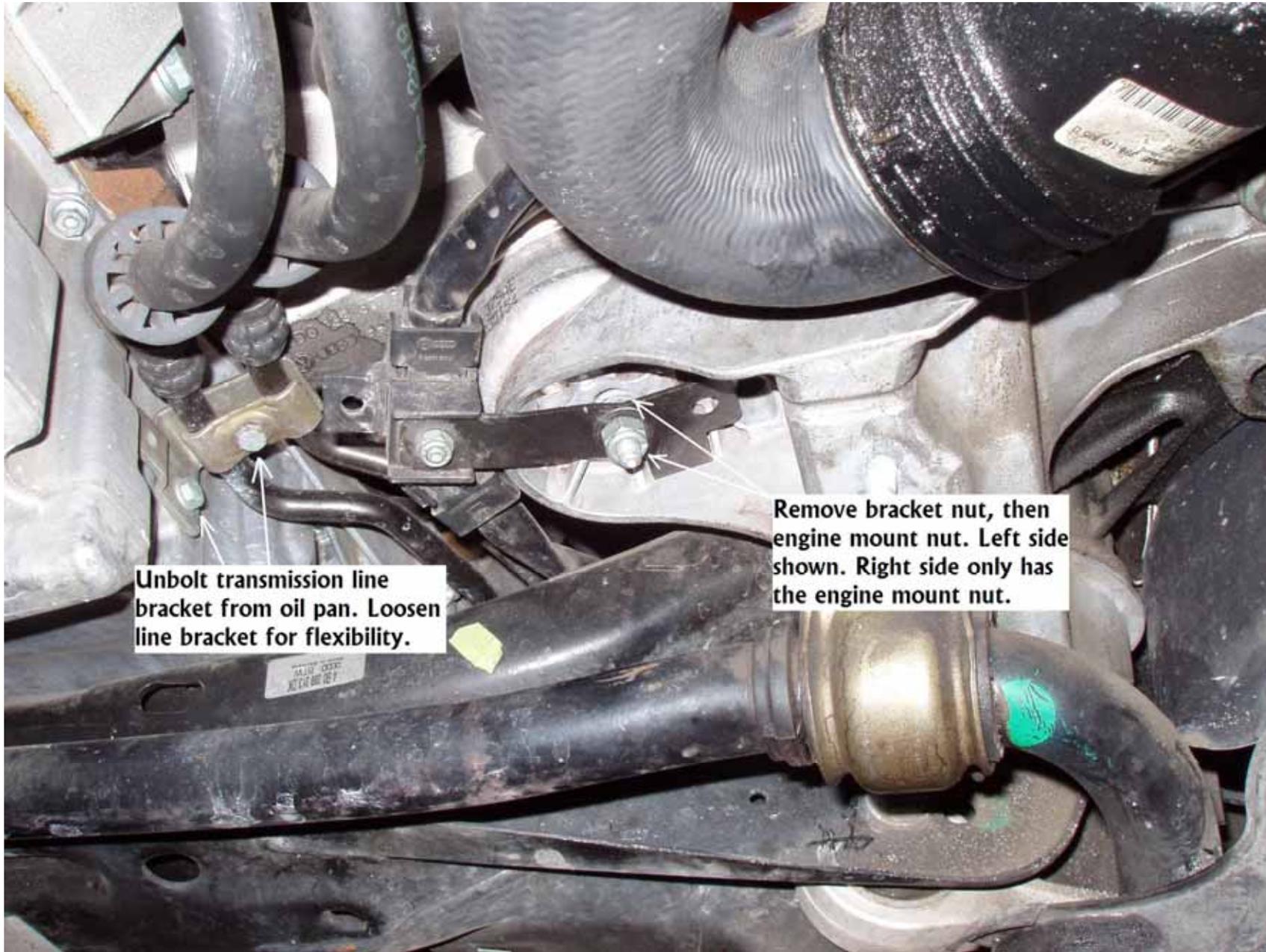


Remove the two bolts attaching the subframe rear support to the underside of the body (triangular shaped pieces). Repeat for the other side.



Remove nut attaching bottom of engine mount to bracket on the right side.

Remove the nut attaching bracket to engine mount stud on the left side, then remove the nut attaching bottom of engine mount to the bracket on the left side.

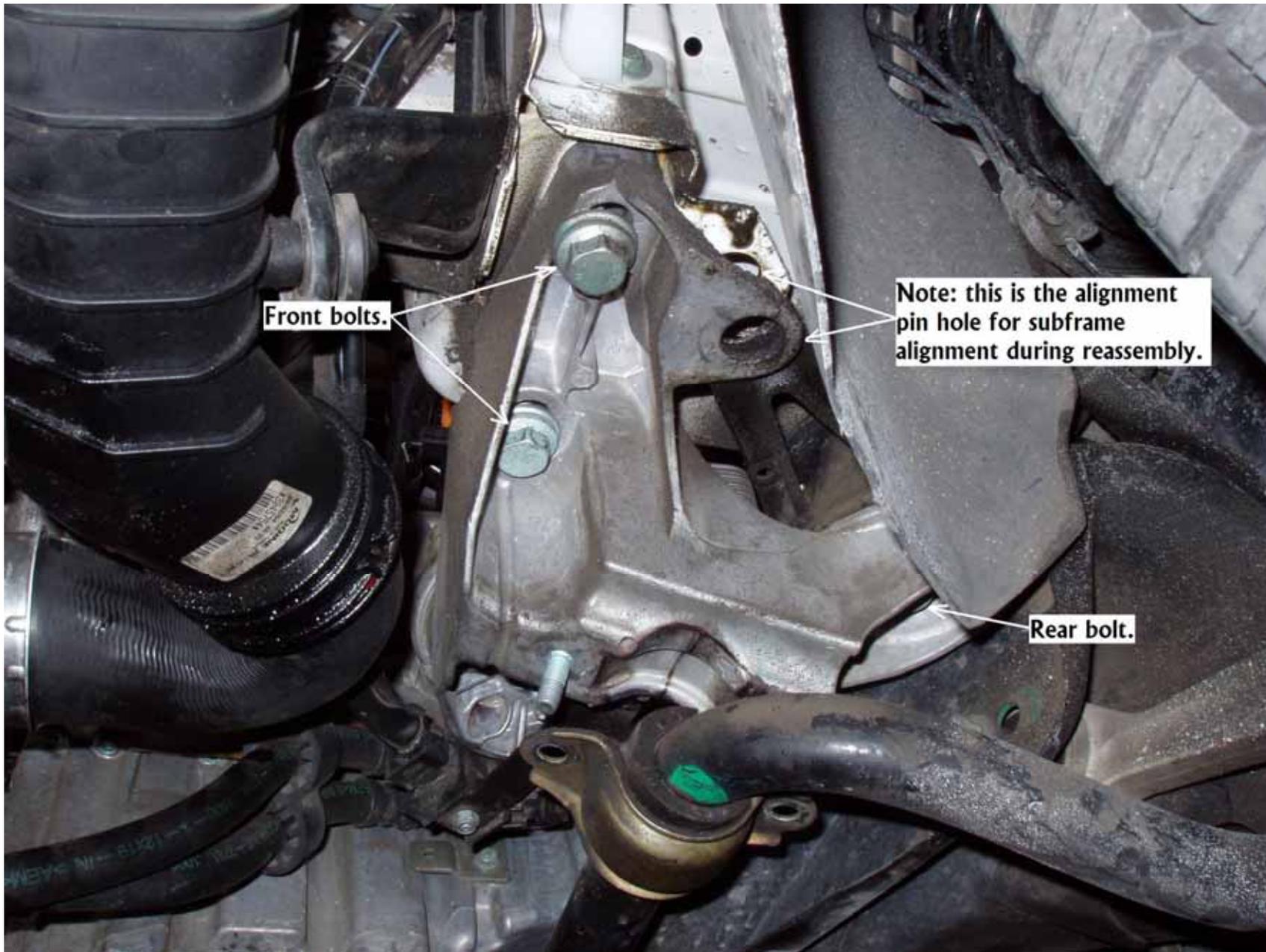


Unbolt transmission line bracket from oil pan. Loosen line bracket for flexibility.

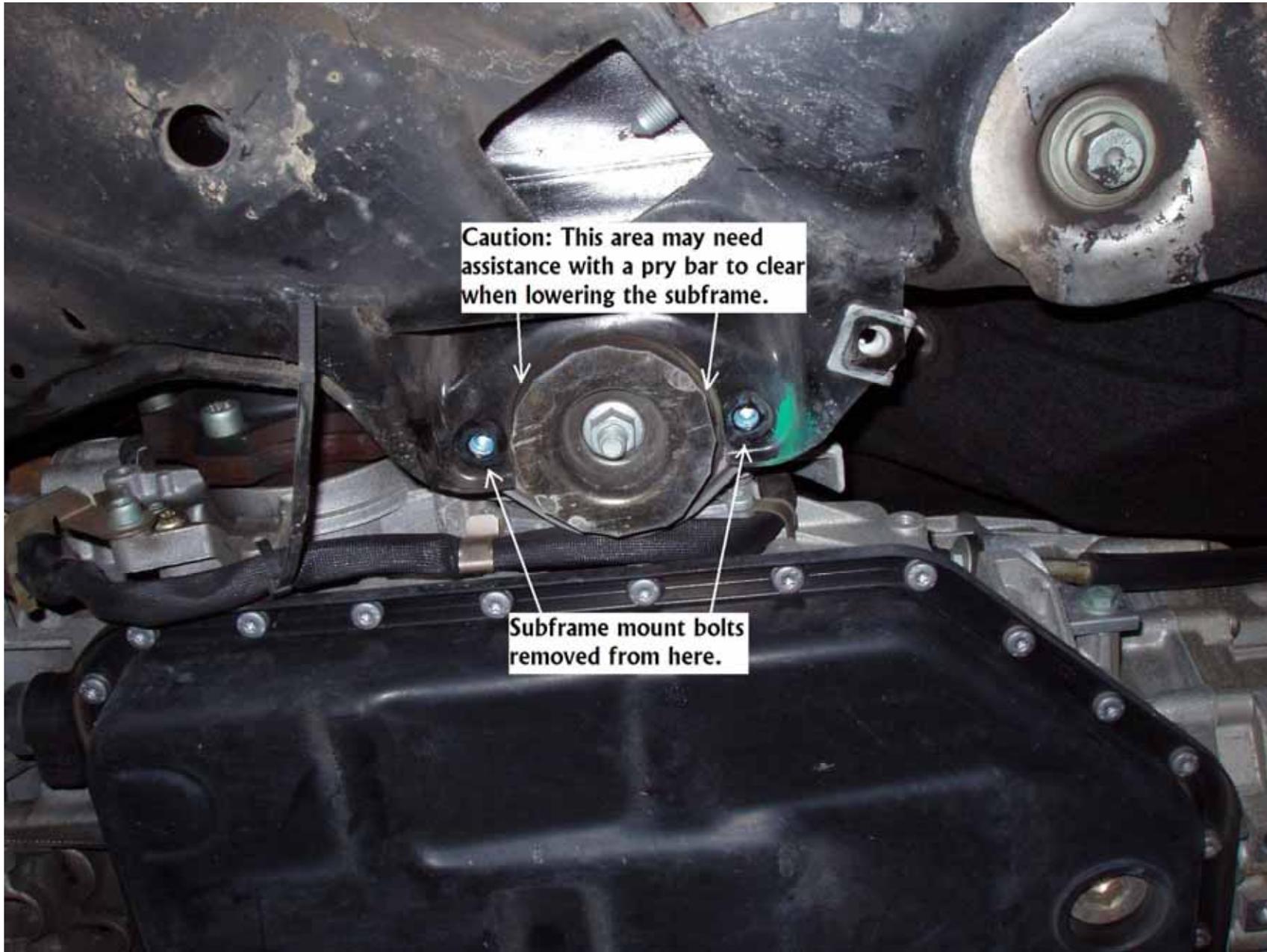
Remove bracket nut, then engine mount nut. Left side shown. Right side only has the engine mount nut.

Remove bolts attaching ATF lines and bracket to oil pan

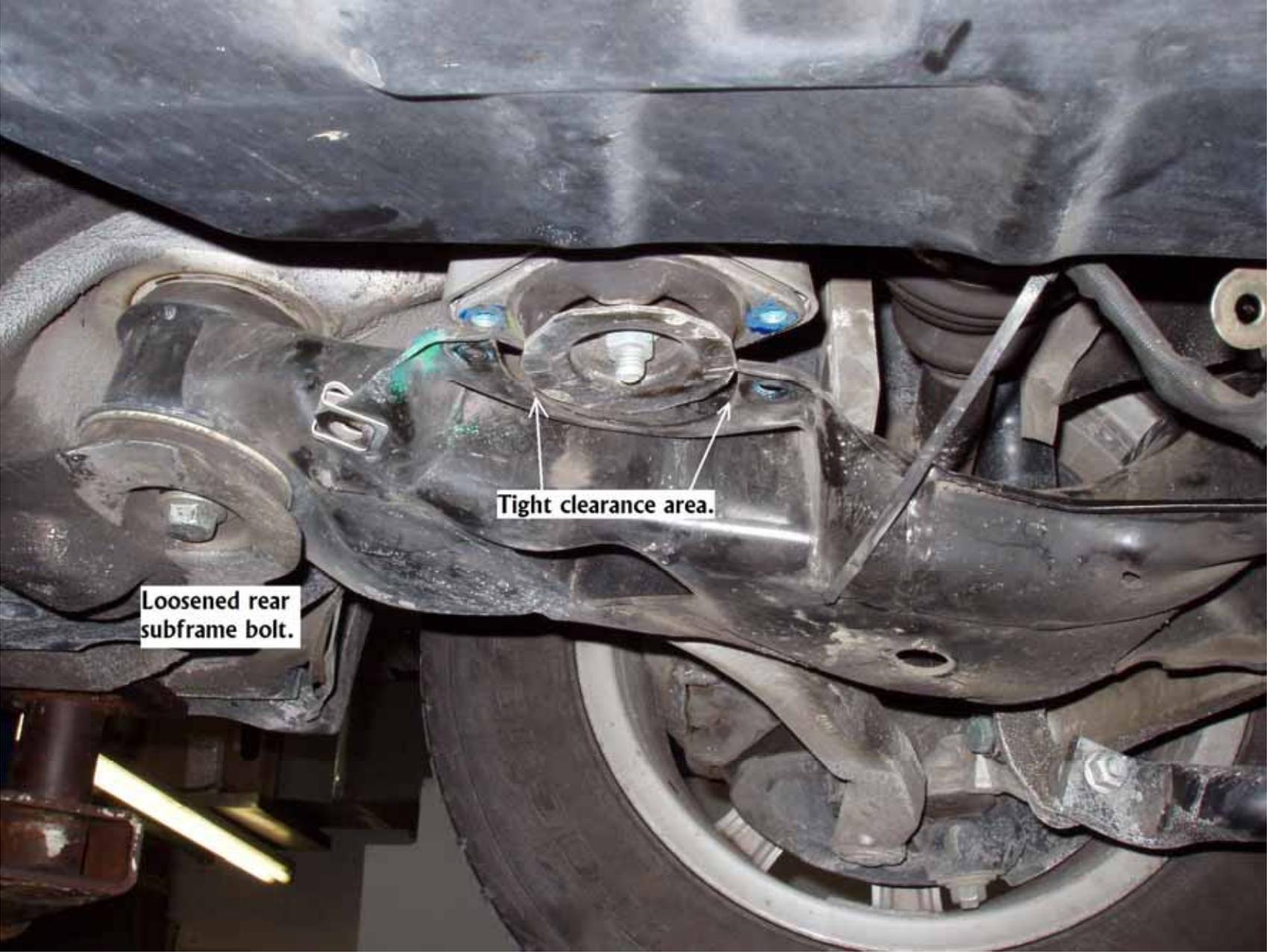
Remove front bolts attaching an engine mount bracket, then remove the rear bolt for the bracket. Repeat for the other side. The left side bracket can be removed completely. The right side can hang free, or cut wire ties attaching starter wiring support and remove the bracket.



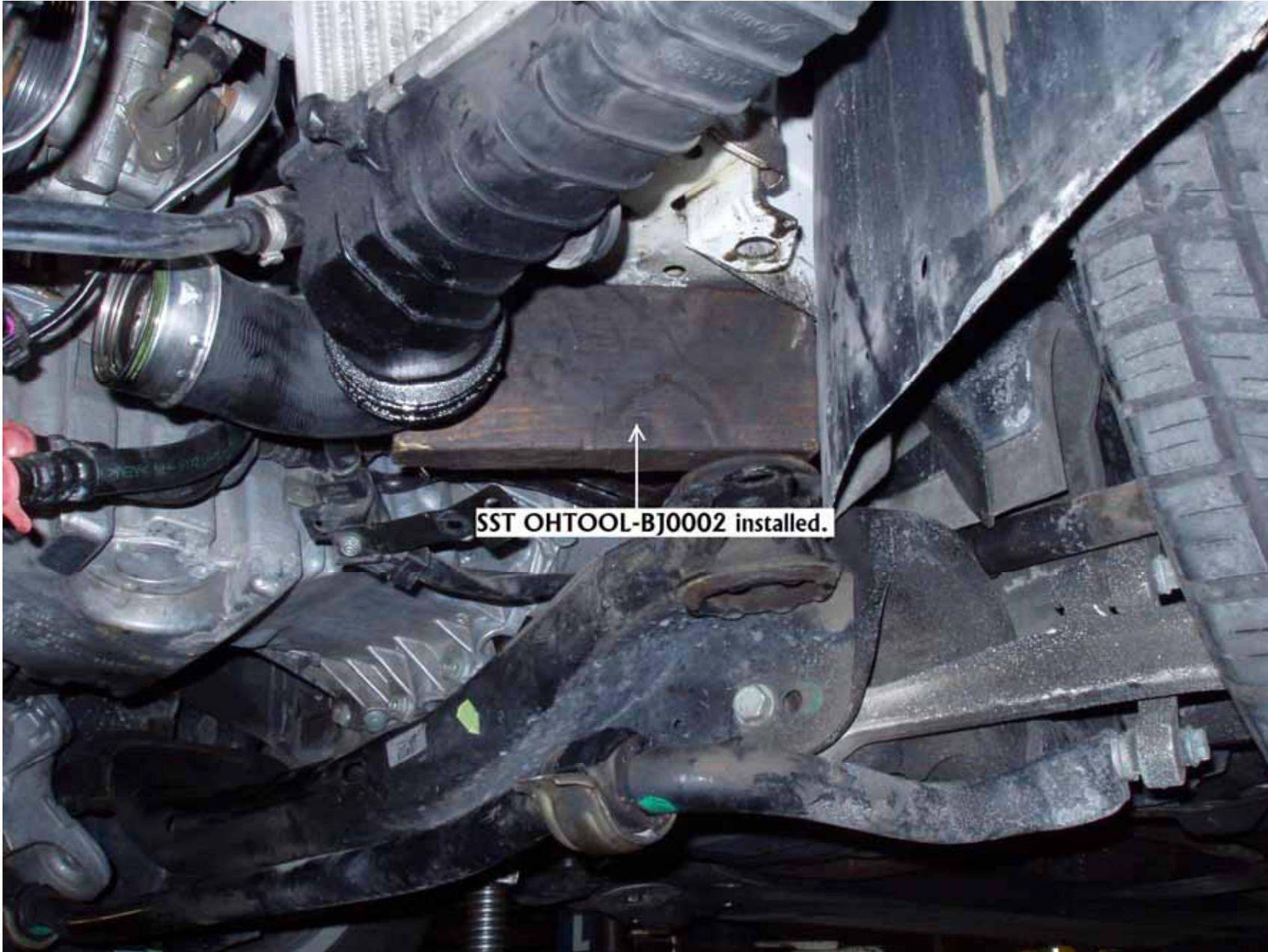
Remove bolts from subframe on either side of the transmission mount. Repeat for other side.



Loosen but do not remove the rear subframe mount bolt. Loosen only enough to allow subframe to hang from the front as necessary when the support is removed.



Lower the subframe support slowly and make sure the subframe clears the transmission mounts. The subframe should drop enough so that SST OHTOOL-BJ0002 can be inserted as shown between the subframe and the body.



Remove the remaining oil pan bolts.

Remove the oil pan with light blows from a rubber mallet, or pry in provided locations with an appropriate tool. Do not damage the sealing surfaces of the pan and block. You will need to angle it and remove towards the front of the car.

Once you remove the oil pan, oilhammer says this is the only time you're allowed to make a paint reference mark for the engine if you want too. We found it didn't move anyway and wasn't needed.



Remove the sealing flange from the front of the engine. Clean off old sealant from flange and engine block. Remove old crankshaft seal.

Remove the two screws for the timing chain cover and remove the cover. These will not be needed on the new module.

Remove the bolts for the chain tensioner. Remove the tensioner. It will not be needed on the new module.

Remove four bolts attaching the small sprocket to the balance shaft. Remove sprocket and chain. These will not be needed on the new module.

Remove the eight bolts attaching the balance shaft module to the bottom of the engine and remove the module.

Remove the dowel pins from the old balance shaft module.



Remove dowel pins from old balance shaft module.

Clean off old sealant from the pan and engine block.

Place gear 03G 105 212 C in SST OHTOOL-BJ0001 (or equivalent) with lettering up. Bake until at least 175 C and no more than 240 C (347 F – 464 F). Measure the temperature at several locations on the inside surface of the crankshaft hole using a multimeter with temperature probe, or equivalent. It takes about 20 minutes to fully bake in OHTOOL-BJ0001.

The next step is to remove the crankshaft sprocket. At the suggestion of another TDICLUB member, we recommend using puller T10392. Puller T40001 with claws was the recommended tool in the Volkswagen procedure. Both methods are shown. Puller T10392 must be modified to fit the holes of the BHW crankshaft sprocket. Grind the pulling legs for a 58mm spacing between opposite pulling legs and round slightly to fit the holes of the sprocket. Grinding must be even on opposite legs so that the center pressure bolt is still centered. There is no need to modify the screw pins on the puller.

While the gear is baking install the puller you have available.

Using the modified T10392.

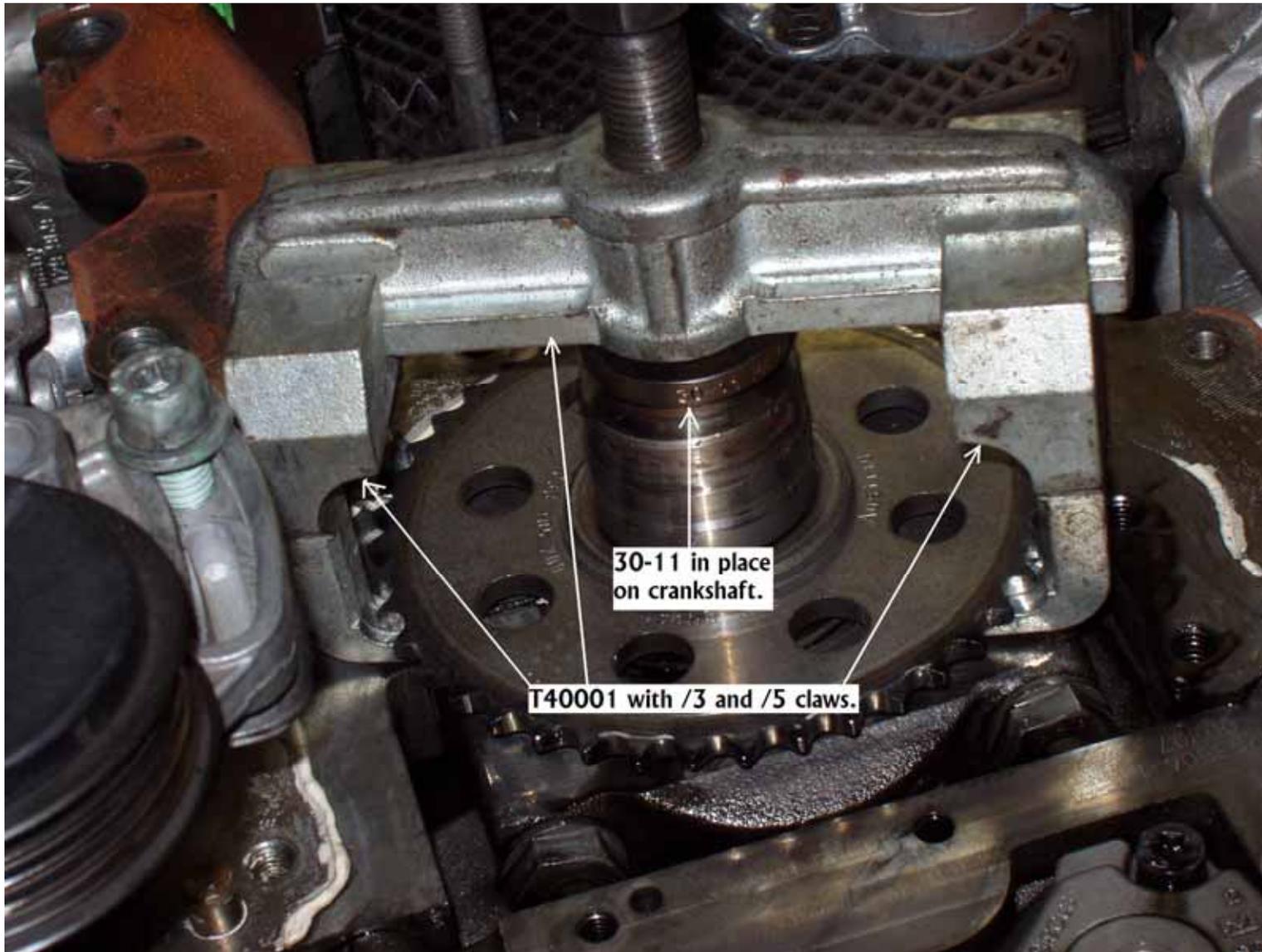
Install the T10392/1 pressure plate in the crankshaft bolt hole. Install the puller onto the crankshaft and sprocket. Turn to engage the pulling legs and screw in the pins to lock the puller onto the sprocket.



Counter hold the puller with a 32mm wrench (or an adjustable wrench), and use a 24mm socket or wrench to tighten the pressure screw. There will be a loud snap when the gear releases from the crankshaft. You will need to continue turning the pressure screw until the sprocket is complete free of the crankshaft.

Using puller T40001.

Attach puller T40001 with claws T40001/3 and /5 to the existing crankshaft sprocket. Position the bar of T40001 in a horizontal position as shown. Place thrust plate 30-11 over the crankshaft bolt hole (it does not fit in the hole), and screw in the pressure screw of T40001 to fit into the depression in 30-11.



Slowly turn the screw to apply a pulling force on the sprocket. We have never been able to pop one off the crankshaft in one piece. The sprocket will break. Lightly grease the end of the crankshaft. Remove crankshaft bearing cap #1. Use an air hammer with light pressure from behind to knock the sprocket off.

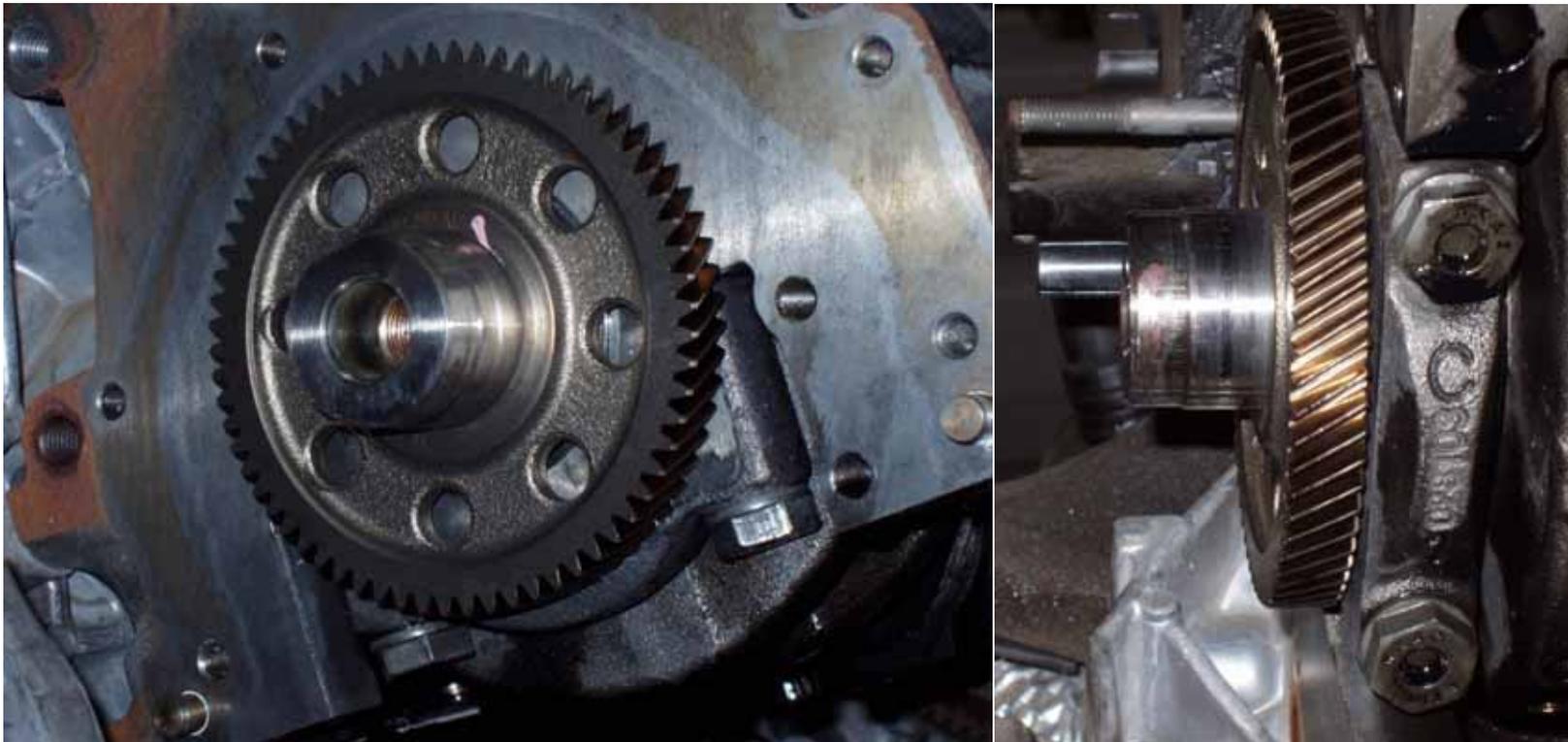
Alternatively use a brass drift and hammer to knock it off. Be sure that the sprocket comes off evenly from the crankshaft. Be sure that the crankshaft is not damaged from any tool used. Reinstall the bearing cap in the original orientation using new bolts N 908 897 01. Tighten them to 65 Nm plus ¼ turn.



(note: yes, picture was staged after we actually got the sprocket off.)

When gear 03G 105 212 C has fully baked to the recommend temperature range, put on heat resistant gloves such as SST MOTOOL-00001. Grasp the gear and quickly place on the crankshaft. Push it fully onto the crankshaft until it doesn't go any farther. Hold it there until it cools sufficiently to contract onto the crankshaft. You can use the cylinder piece of seal installer 10-203 (or an equivalent deep socket), to press the gear on evenly and hold it until cool.

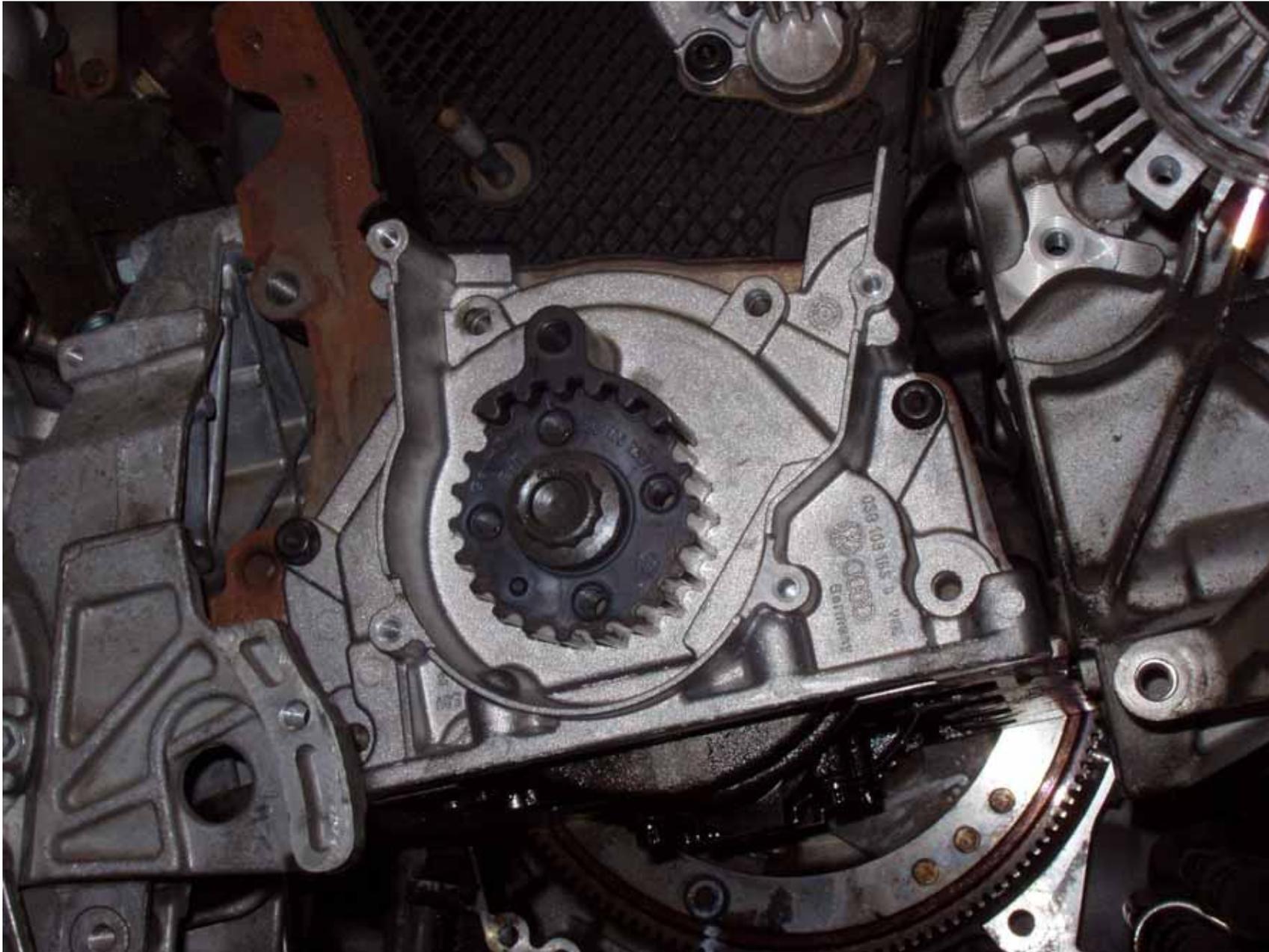
This is how it should look when cooled.



Install the front seal flange without sealant using a couple of bolts.

Install the toothed belt pulley onto the crankshaft with a bolt finger tight.

Install crankshaft locking tool T10050.

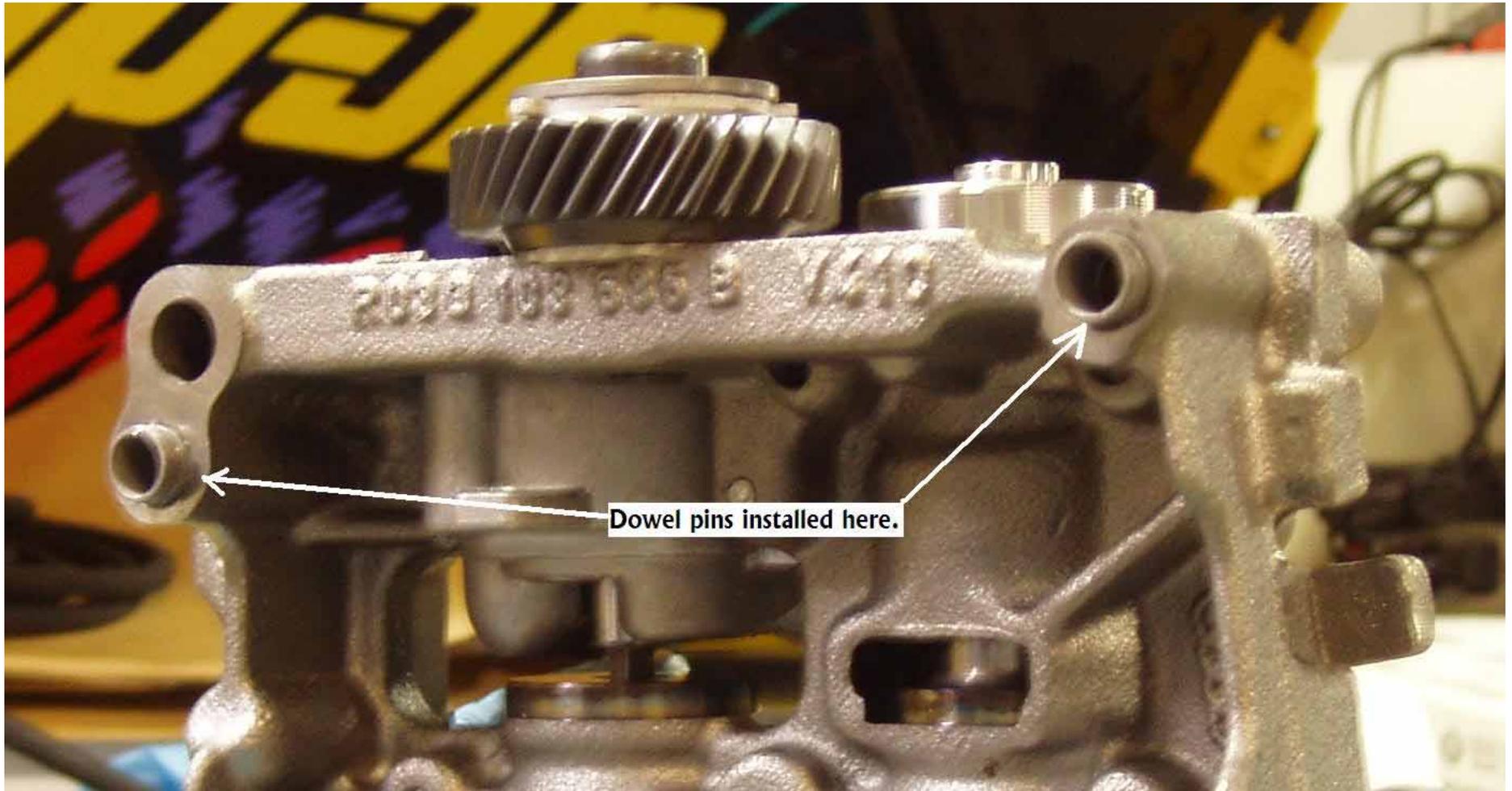


Note that the intermediate gear has a coating. **Do not damage this coating** while handling the balance shaft module.

Turn the new balance shaft module over and install locking tool T10255. Hold it in place with a sticky substance as shown, or you will need an assistant to hold it in place while the module is installed on the engine.



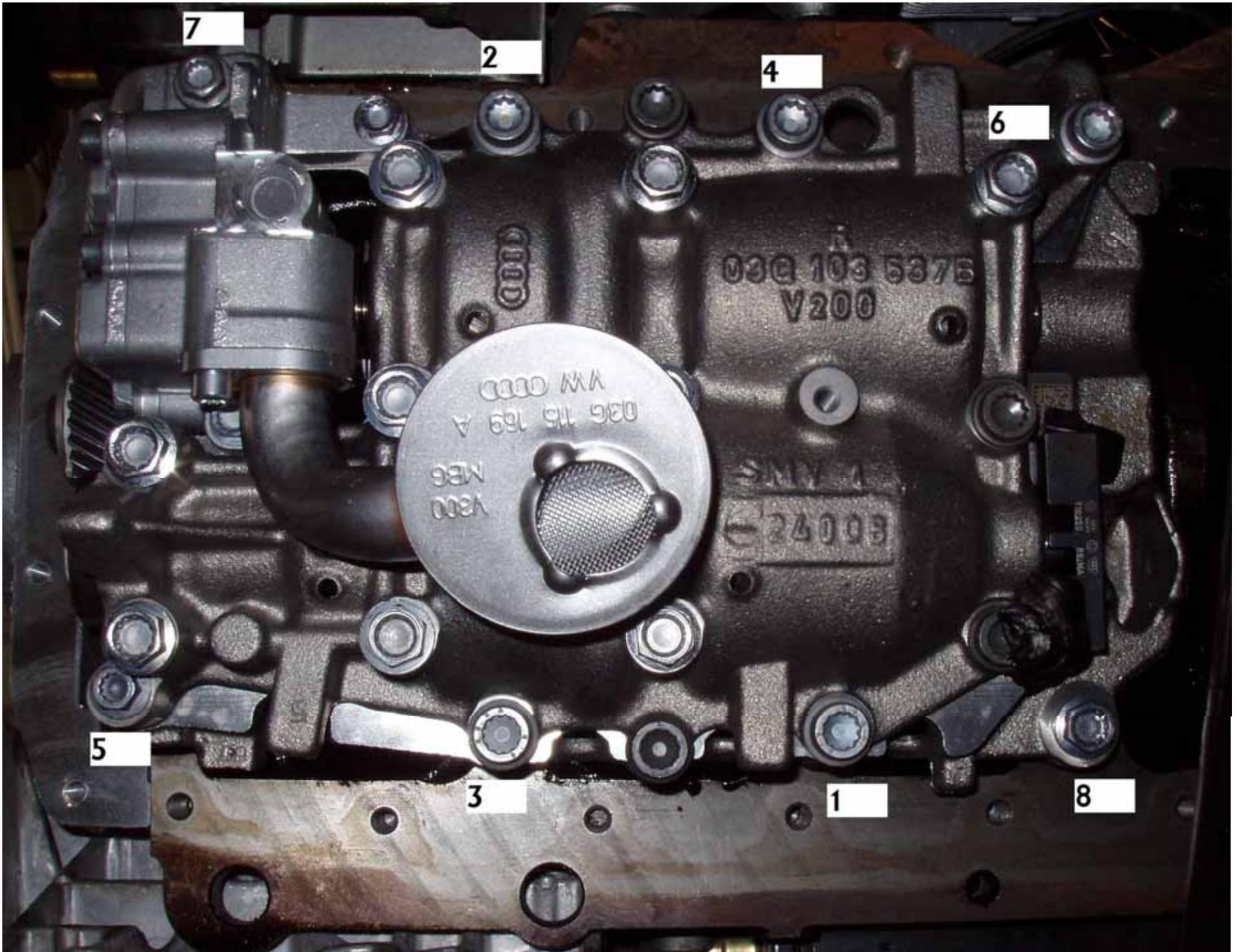
Install the previously removed dowel pins into the new balance shaft module.



Make note of the position of the thrust washers on either side of the intermediate gear attached to the module. These have ears. The ears of the washer between the gear and the module fit into depressions on the module body.

The bolt for the intermediate gear is not installed tight, but loosen it further 1/8 turn.

Install the balance shaft module to the bottom of the block. If the intermediate gear has a white dot, that dot must be positioned centrally in line with the crankshaft. If no white dot, the position of the gear does not matter. The gear should mesh with the crankshaft gear.



Install all the bolts lightly finger tight. Refer to the picture for bolt sequence numbers.

Tighten bolts in sequence to 6 Nm.

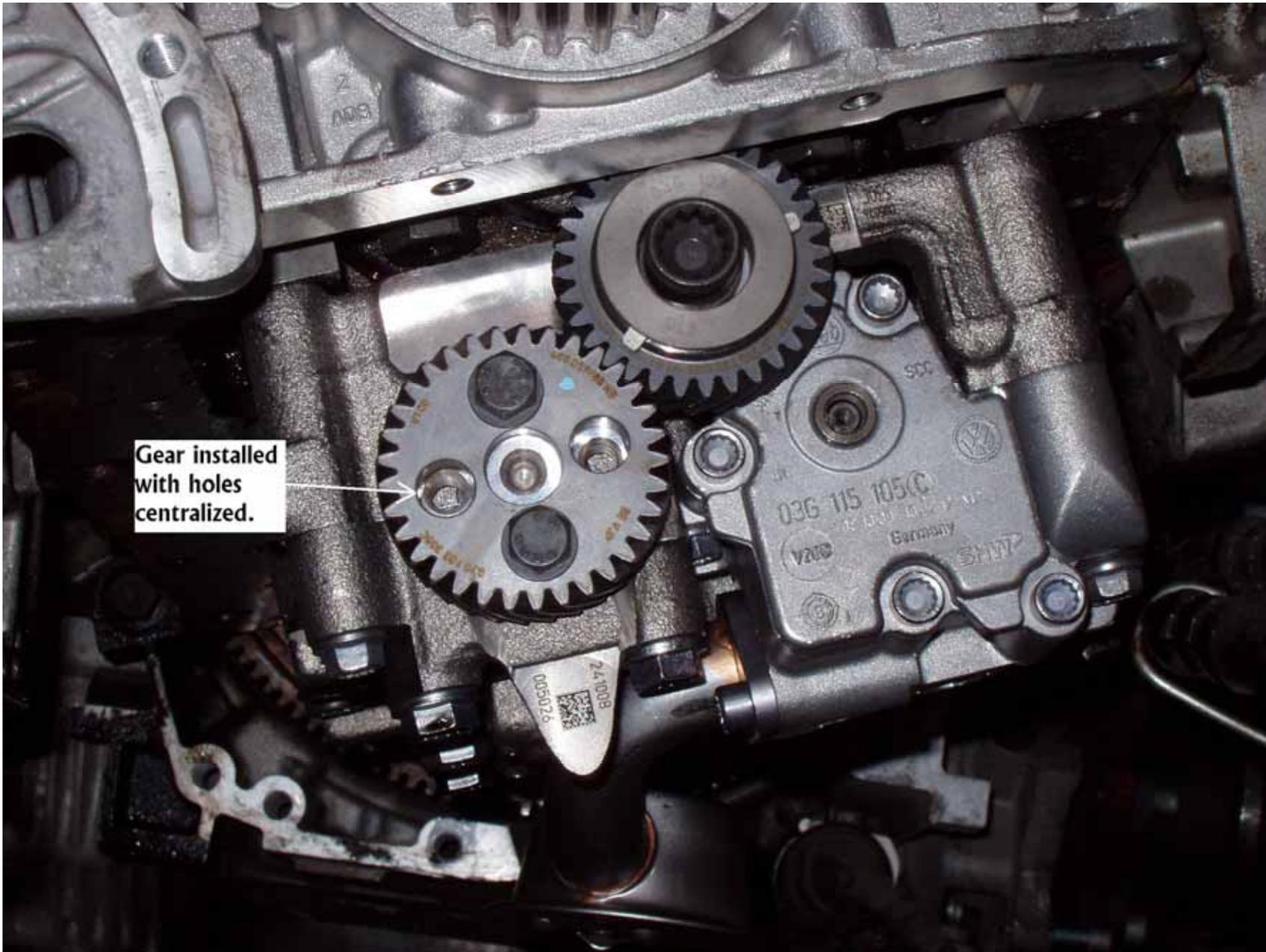
Tighten bolts 5 and 7 to 13 Nm.

Tighten bolts 5 and 7 a further 90 degrees.

Tighten bolts 1, 2, 3, 4, 6 and 8 to 20 Nm.

Tighten bolts 1, 2, 3, 4, 6 and 8 a further 90 degrees.

Fit balance shaft gear 03G 103 305 C onto balance shaft with holes centrally aligned with thread holes in balance shaft. Push aside intermediate gear if necessary.



Install bolts N 911 213 01 in balance shaft gear and tighten to 20 Nm plus ¼ turn.

Remove balance shaft locking SST T10255.

Use SST MOTOOL-GH0002 to press forcefully against the intermediate gear as depicted in the picture.



Tighten the intermediate gear bolt to 20 Nm plus ¼ turn with a 14mm XZN bit.

Remove crankshaft lock, crankshaft pulley and front seal flange. Verify that there is no perceptible backlash using light hand force.

Apply a 2-3mm bead of sealant to the flange. Install the sealing flange and lightly install bolts. Tighten bolts to 15 Nm in a diagonal sequence. After doing a couple of these repairs you will know how the gears look and feel. You might change the installation to applying the sealant and installing the sealing flange just once instead of removing and checking the gears at this point.

Install new crankshaft seal using the SST T10053 tools.

Install the crankshaft pulley with new bolt 045 105 229. Counter hold the pulley and tighten the bolt to 120 Nm plus ¼ turn.

Apply a 2-3mm bead of sealant to the oil pan around the inside of the bolt holes. Install the oil pan. Lightly install all fasteners. Tighten oil pan bolts in a diagonal sequence to 15 Nm, then tighten M10 oil pan/cylinder block bolts to 40 Nm, then tighten oil pan/transmission bolts to 45 Nm.

Reassemble the vehicle in reverse sequence of disassembly. **Be sure to align the front alignment holes and brackets.** Use SST 3393, or equivalent. Failure to align the subframe properly will cause handling issues, excessive tire wear and an unhappy driver. **Be sure to remove after bolts are tightened.**



Right side:



Left Side:

It is recommended that you use SST MOTOOL-GH0002 on a support under the oil pan to lift the engine a little higher before lifting the subframe into position. This makes it easier to lift the subframe into position without the weight of the engine resisting your efforts.

Complete the timing belt installation.

Replace oil filter and refill with oil.

Refill with coolant. Mix with distilled water according to the directions on the container. Release air from the system using the bleed hole in the hose attached to the heater core in the plenum, next to the battery.

Replenish ATF if necessary.

Recharge AC system if necessary.

General tightening torque values:

M6 bolts and nuts – 10 Nm

M8 bolts and nuts – 20 Nm

M10 bolts and nuts – 45 Nm

M12 bolts and nuts – 60 Nm

Stop/torque bracket – 30 Nm

Refer to repair manual for current torque value for all bolts and nuts.

Pictures of some of the SSTs.

SST 10-203



SST MOTOOL-GH0001



SST 3411



SST MOTOOL-GH0002 (note: SST OHTOOL-BJ0002 is similar but longer)



SST OHTOOL-BJ0001



SST T10058



SST T10050



SST T10255



SST T40001 and 30-11



Multimeter with temperature sensor



SST 3393 alignment pins



SST T10053, T10053/1 and T10053/2



T10392 Puller – modify for 58mm spacing between pulling arms and round for the sprocket holes.



Personal Notes:

T10392/1 Pressure insert

