

Aisin-Warner AW55-50SN valve body replacement in 2002 V70-XC

Overview: *This is an update to the previously published procedure.* I have performed this procedure twice, first on my 2002 V-70 XC and later on my 2002 V-70 T5. I removed and re-installed the valve body on the Aisin-Warner AW55-50SN transmission. The valve body was rebuilt both times by Valve Body Builders (<http://www.valvebodybuilders.com/index.html>)

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The local dealer re-set the transmission fluid life counter, verified that I have the latest software and placed the transmission in adapt mode following the valve body replacement.

Some important overall points:

1. This is a complex transmission, controlled by computer, actuated by hydraulics. The replacement or rebuilding of the valve body solves some of the common hydraulic problems with the transmission; wear inside the valve body itself. The computer will need to be placed into adapt mode after the valve body work to complete the repair.
2. I can't guarantee that this fix will solve the problems with your particular transmission. My XC transmission suffered from harsh garage shifts (P-R-N-D), harsh engagement after prolonged coasting and occasional awkward shifts in 3rd and 4th. The T-5 suffered from the harsh garage shifts and a 3-4 shift "bump". All were indicative of low line pressure.
3. I recommend replacing the B-4 Servo cover prior to this repair to preclude problems with that component. That fix takes 15 minutes. The cover is available from IPD (<http://www.ipdusa.com/Volvo-V70XC70-2001-2007/Transmission-&-Drive-Train/B4-Servo-Cover-Update/p-127-389-5212/>) for about \$20.
4. This is a potentially dangerous procedure in that the engine has to be raised and the sub-frame lowered and there are large forces required.
5. The transmission internals must be kept absolutely clean. No dirt, debris, particles or even rag lint can be allowed to circulate in the transmission. Many of the passages are only thousands of an inch in size and will be plugged or damaged by the slightest dirt.
6. What is needed:
 - Transverse engine lift (see pictures)
 - Ramps or suitable jack stands
 - Good selection of tools
 - Transmission Drain Plug Sealing ring (same as oil drain plug sealing ring)
 - 12-16 Quarts of JWS-3309 spec transmission oil (e.g. Mobil 3309)
 - O-rings and clips for transmission cooler fittings in radiator (<http://www.ipdusa.com/Volvo-V70XC70-2001-2007/Transmission-&-Drive-Train/Transmission-Cooler-Hose-Seal-Kit/p-127-389-4899/>)
 - O-ring for transmission cooler line in transmission (extra o-ring from IPD kit fits)
 - Transmission Control System Seal kit (Volvo PN 274470, which consists of Volvo PN 30651154, gasket and 2 of Volvo PN 6843829 O-rings)
 - Good quality RTV sealer (personal favorite is Permatex ultra black)

7. Recommended:

- Volvo blue-green coolant (coolant must be drained during the procedure – you may choose to replace with fresh coolant)

To begin: wash the engine thoroughly. Open coolant expansion tank cap.

Raise the vehicle. I used ramps, but a frame lift would be preferable.



Remove the splash guard under the engine. Remove the splash guard under the radiator. It consists of 3 pieces. There are two screws that attach the center of the guard to the two edge pieces. T-25.



There are two clips that attach the edge pieces to the inner fender liner.

The center splash guard is held in place by a 10MM bolt on either side and two catches on the front of the cover. Press the catches up with a long screwdriver and pull it rearward to remove.



Catch location looking up and forward.



Catch detail

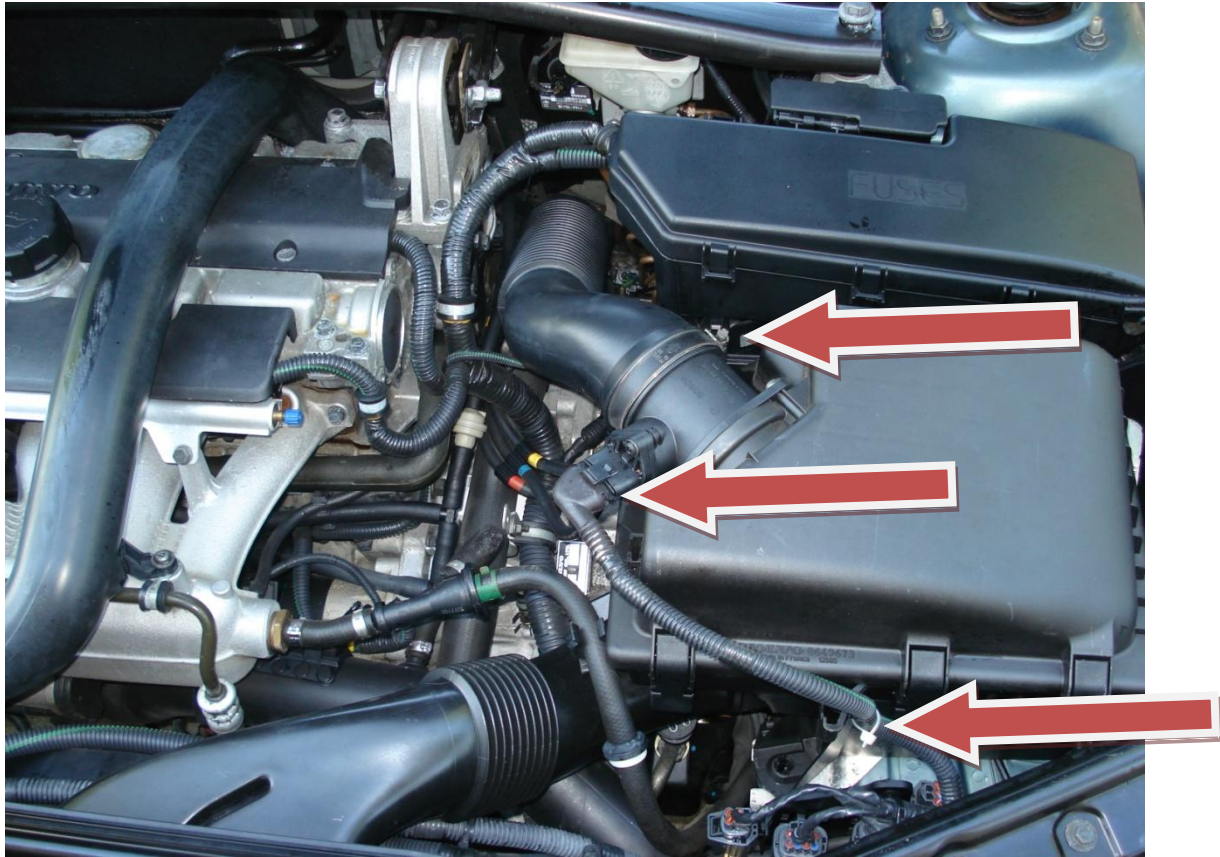


10MM bolt location. Passenger side shown.

Drain the transmission fluid. 24 MM wrench required for the drain plug. Measure the amount of fluid (in my case, about 3 ¼ Qts.) Install a new sealing ring when re-installing the plug (same ring as the oil plug). Drain plug torque 40NM. It's important not to overfill the transmission when refilling later.



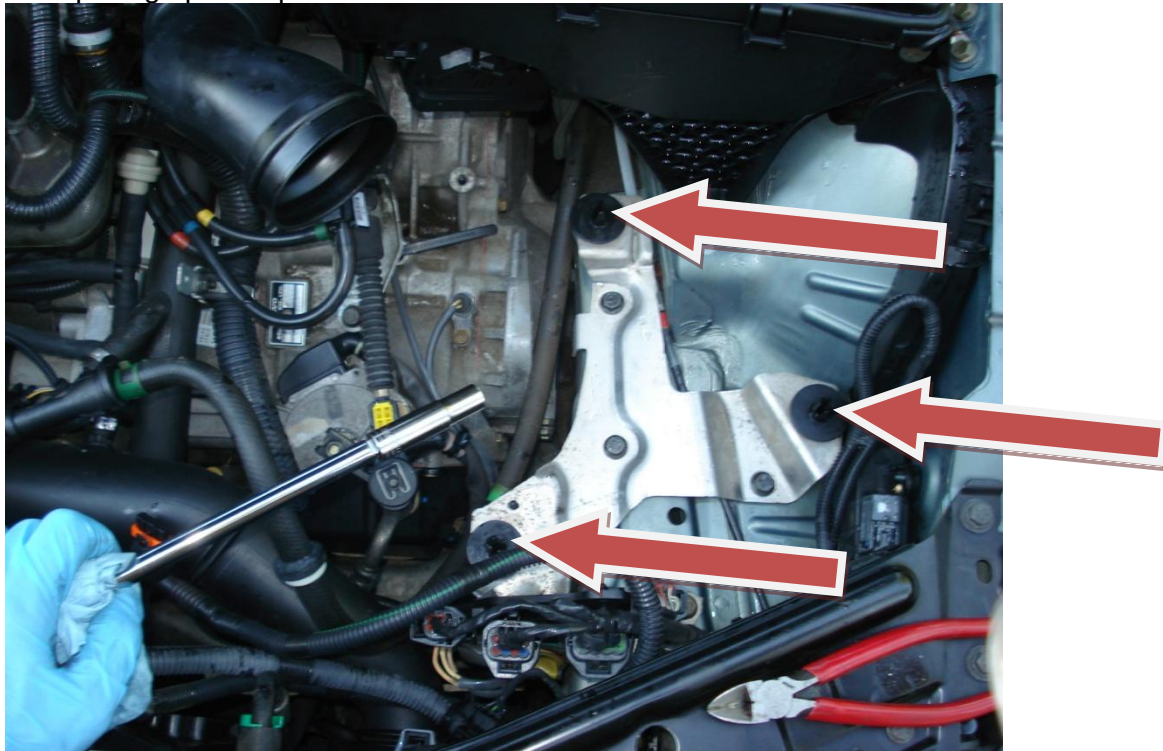
It was not recommended by the manual but I found it very helpful to remove the airbox. Release the hose clamp from the turbo inlet pipe and disconnect the pipe from the airbox lid. Disconnect the air flow sensor. Cut the zip tie to free the cord from the airbox.



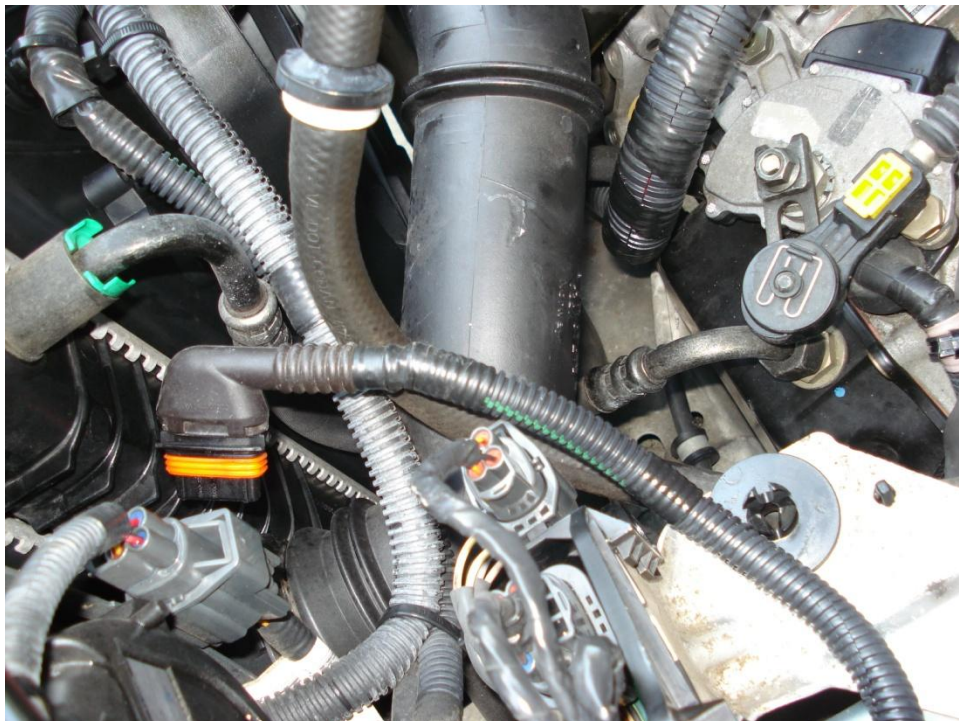
Remove the airbox lid. Then remove the ducting to the front of the radiator support from the airbox.



The next step is to remove the airbox base by releasing 3 clips. The manual says “pull up sharply”. My method is to use a 10 MM socket (shown) to compress the fingers of the clips while pulling up. 3 clip locations shown with the airbox removed.



With the airbox removed, you have much easier access to the top of the valve body cover and transmission lines.



Release the cable harness clamp on the control system cover by lifting up on the little tab to slide out the length of the clamp. It is reusable. Move the cable harness to the side.

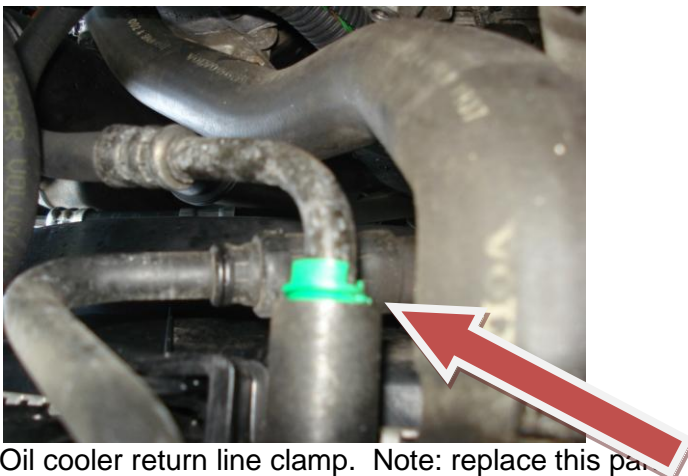


Disconnect the oil cooler return line from the cover. 22MM wrench. If you removed the airbox, you may be able to use an open-end wrench, as I did on the XC. On my T5, the line was frozen ...requiring the use of a crow's foot flare nut wrench for the line and a 7/8" tappet wrench (thin profile) to hold the transmission cover fitting in place. The cover fitting would turn if torque was applied only to the line, precluding loosening the line and potentially damaging the seal in the cover, *which is not replaceable*. Note that 22MM is precisely 7/8".

Example of a crow's foot flare nut wrench:

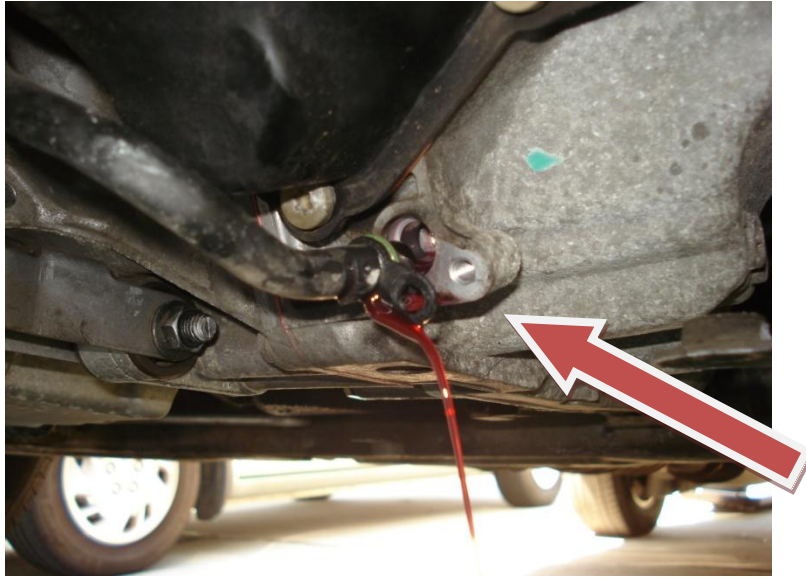


Squeeze the oil cooler line clamp and slide the other end of the cooler line out of the radiator.

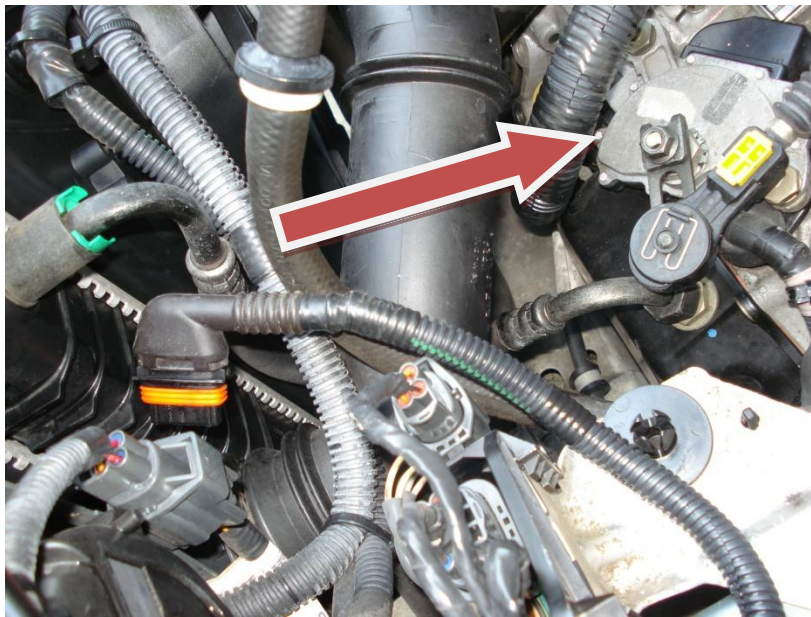


Oil cooler return line clamp. Note: replace this part.

Place a pan to catch the oil under the transmission. Disconnect the oil cooler line from the transmission. It is a 10MM bolt that holds it to the transmission housing.



Remove the 12MM bolt that retains the bracket on this line and the dipstick tube to the transmission case.



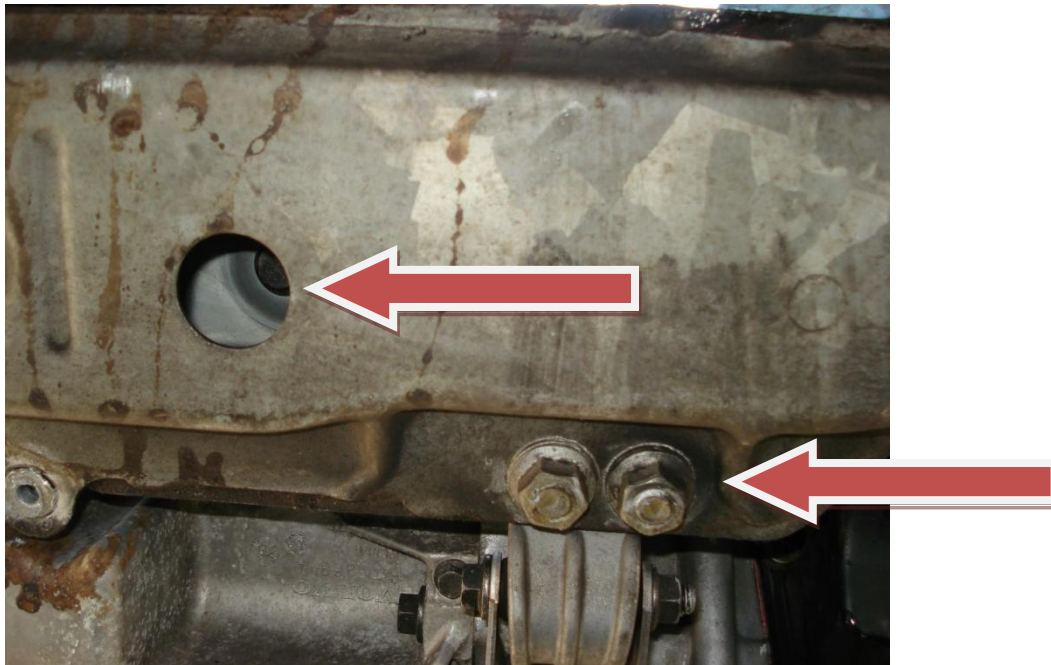
12 MM bolt is not visible here but located just under the dipstick. Not easy to get to. Bracket shown on hose.



Seal the transmission case with a plastic plug (or lint-free cloth) to prevent dirt entry and to prevent leaks.

Place a catch pan under the radiator drain cock and drain the coolant. Close the drain cock when complete. Remove the lower radiator hose from the radiator and move it towards the center of the car to increase clearance. This is a necessary step.

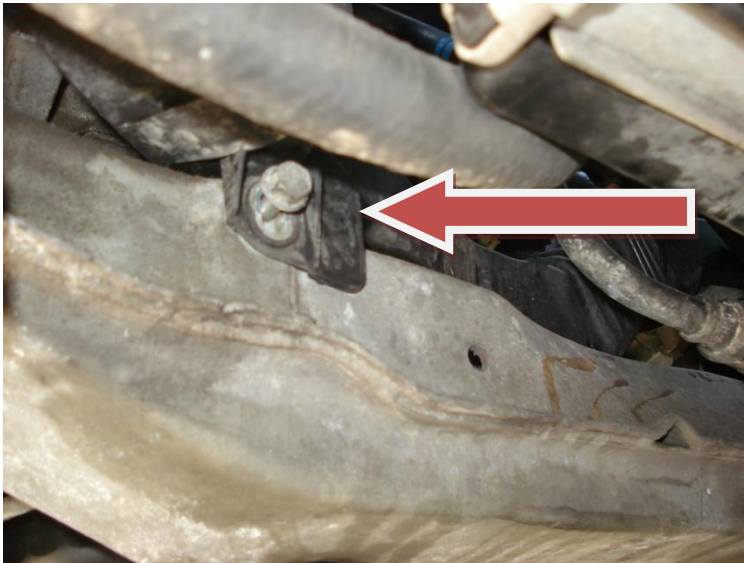
Remove the bolt (14MM) for the front engine mount. Remove the two bolts for the transmission brace (18MM).



Remove the 10MM bolt that holds the ground wire to the sub-frame.



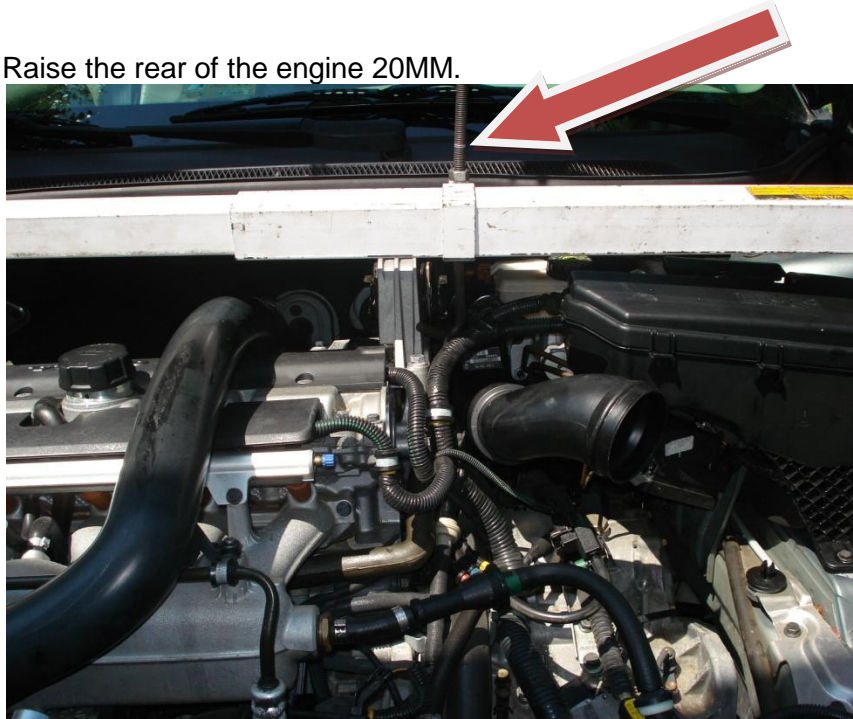
Remove the 10MM bolt that holds the wiring harness to the subframe on the passenger side.



Install the Transverse engine lift. Volvo sells one...for about \$600. I borrowed one.

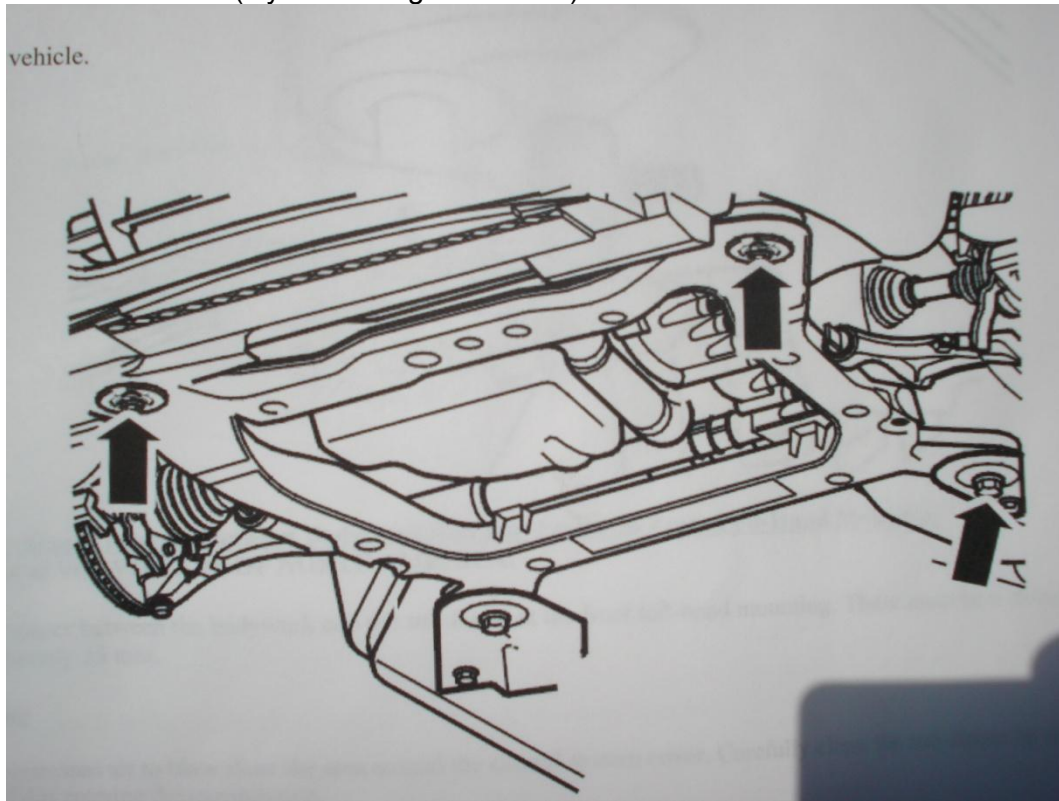


The lift is the white bar across the engine bay. The threaded rod hooks into the lift bracket on the engine.



I used a mark on the threads to measure engine lift.

Raise the vehicle (if you're using a frame lift) or work underneath.



Loosen the front subframe mounting bolts (18MM). Remove the left front bolt. Loosen the right front bolt until approximately 5 threads remain engaged. Loosen the left rear bolt two turns. Note: these bolts are tightened to 105 NM, then tightened further 120 degrees. They have thread locking compound on them. An impact wrench and sockets are recommended to loosen them.

Important: Volvo recommends that these bolts be replaced.

Using a pry bar, insert a spacer of 55MM between the left front of the subframe and the frame. I used a socket that happened to be 55MM in length. There is a lot of force on the subframe, so the spacer must be strong and sit squarely.

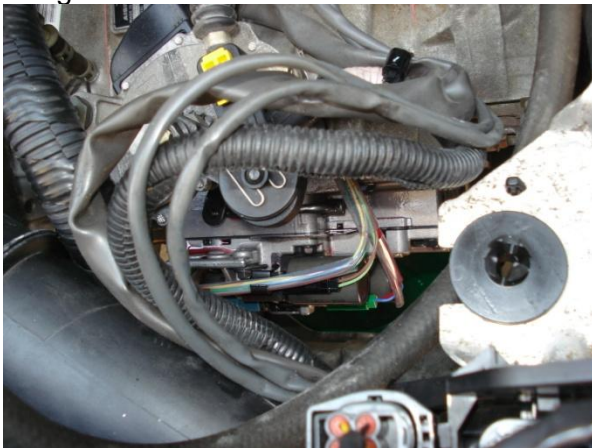


Clean the area around the cover to prevent dirt from entering the transmission.

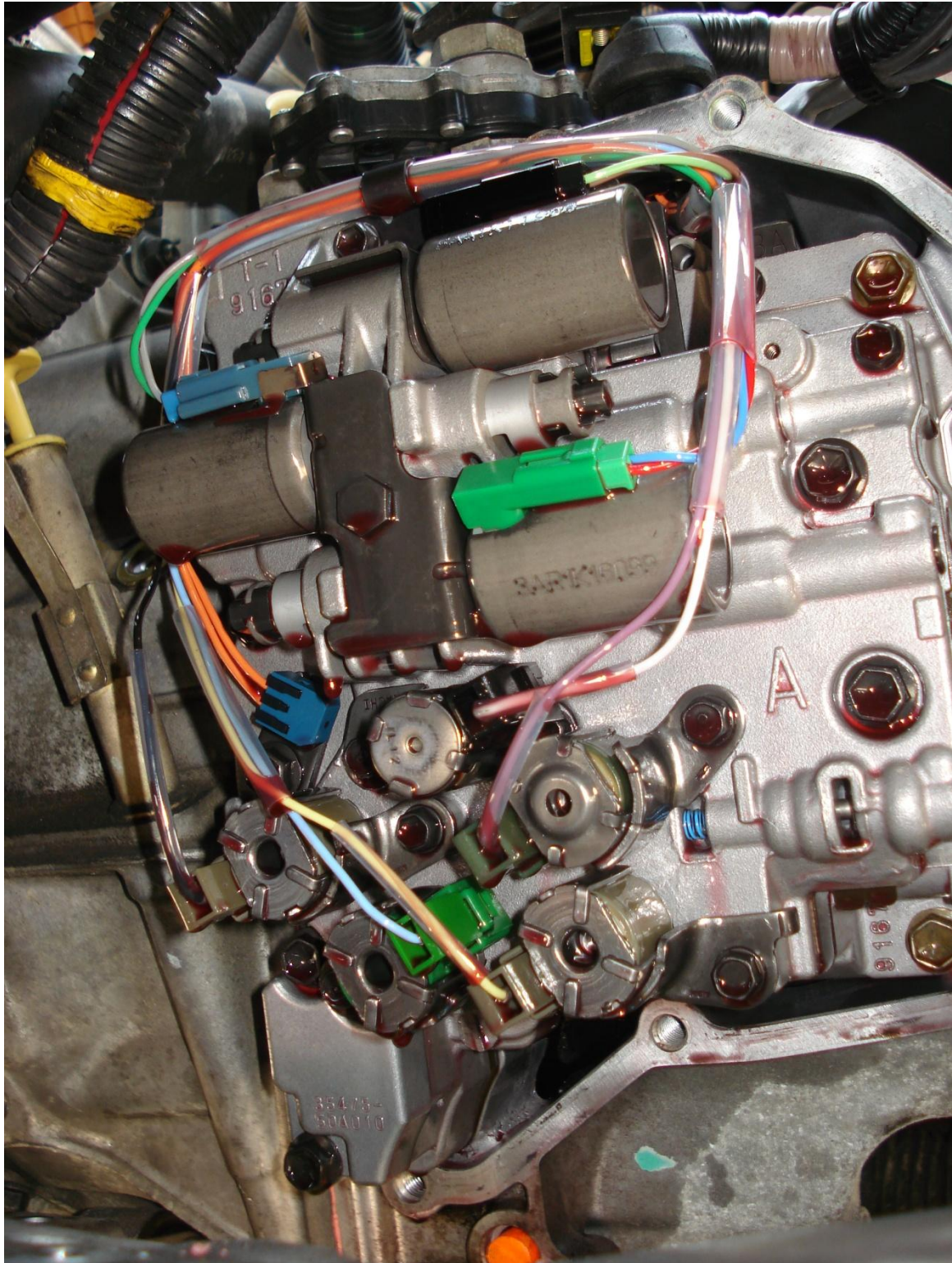
Remove the 9 bolts retaining the cover (T-40). Clean the threads with a tap M8x1.25 to prevent sealant from entering the transmission.

Then, gently tap a putty knife or other thin, wide tool between the cover and the transmission to release the cover. Be careful not to bend or deform the cover.

Slide the cover between the subframe and the radiator to remove it. Carefully clean the gasket residue on the transmission case and cover. Permatex gasket remover or chlorinated brake cleaner work well at dissolving the cured RTV...but they are both pretty toxic. Eye protection and gloves recommended. With the cover removed, the valve body is visible.

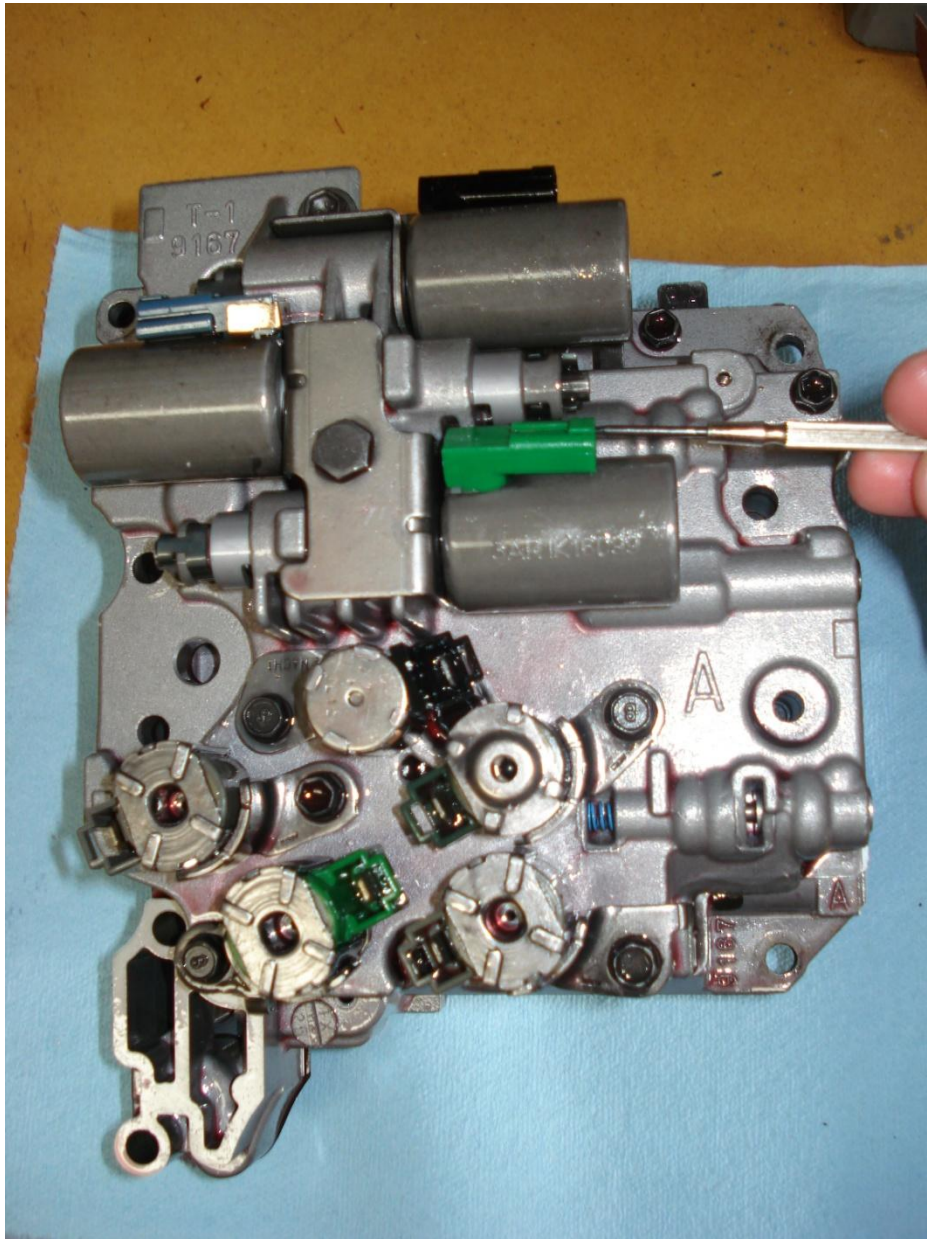


View of valve body from above with cover removed.



Valve body close up showing wiring and attachment details.

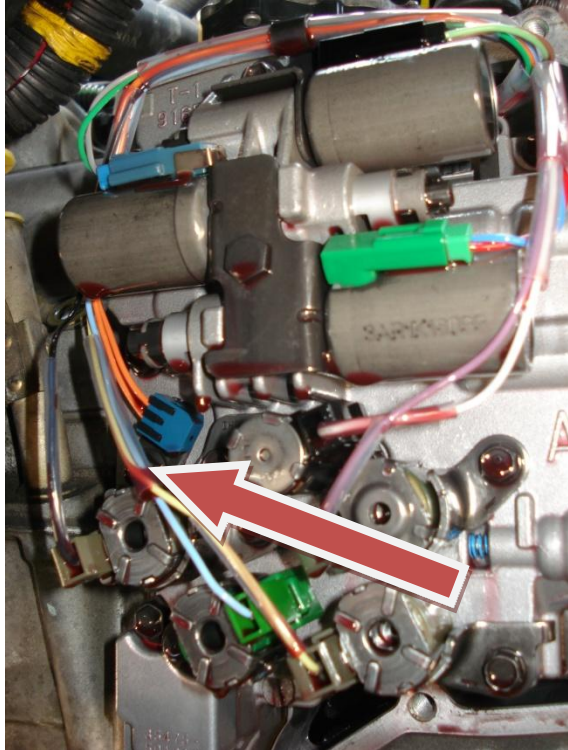
Disconnect the wires for the solenoids. I used a micro screwdriver (5/64") inserted in the connector to release the clip holding the connector to the solenoid. I recommend taking a good digital picture to ensure that the wiring is routed and connected correctly on installation.



Screwdriver shown in position to release clip (valve body on bench)

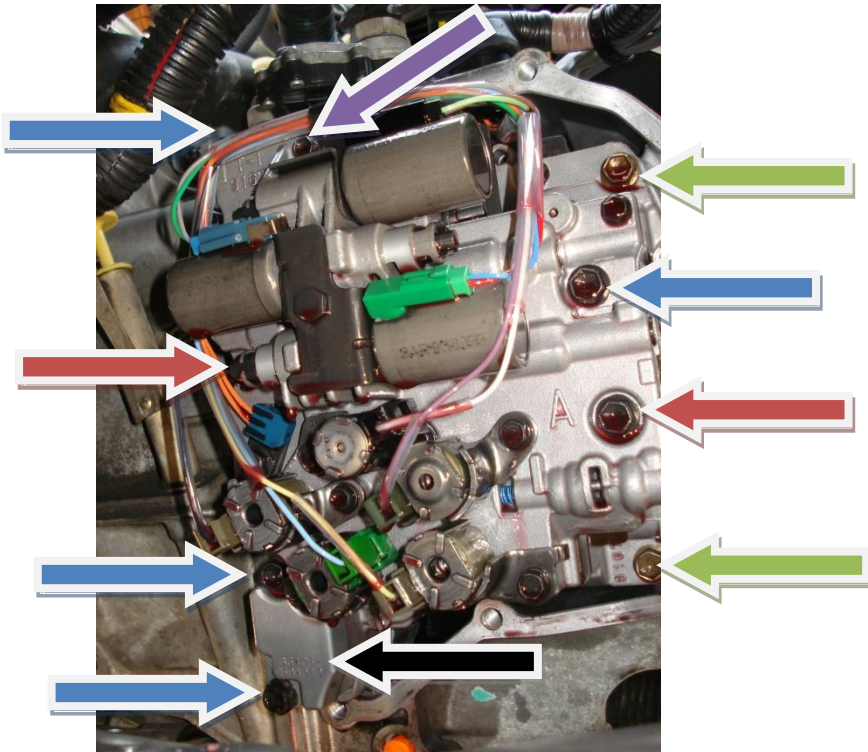
Remove the bolt holding the oil temp sensor (10MM) and remove the sensor and its retaining clip. I used a hook tool (old screwdriver – very useful) to gently pull the sensor.





Oil Temp Sensor bolt location (55MM)

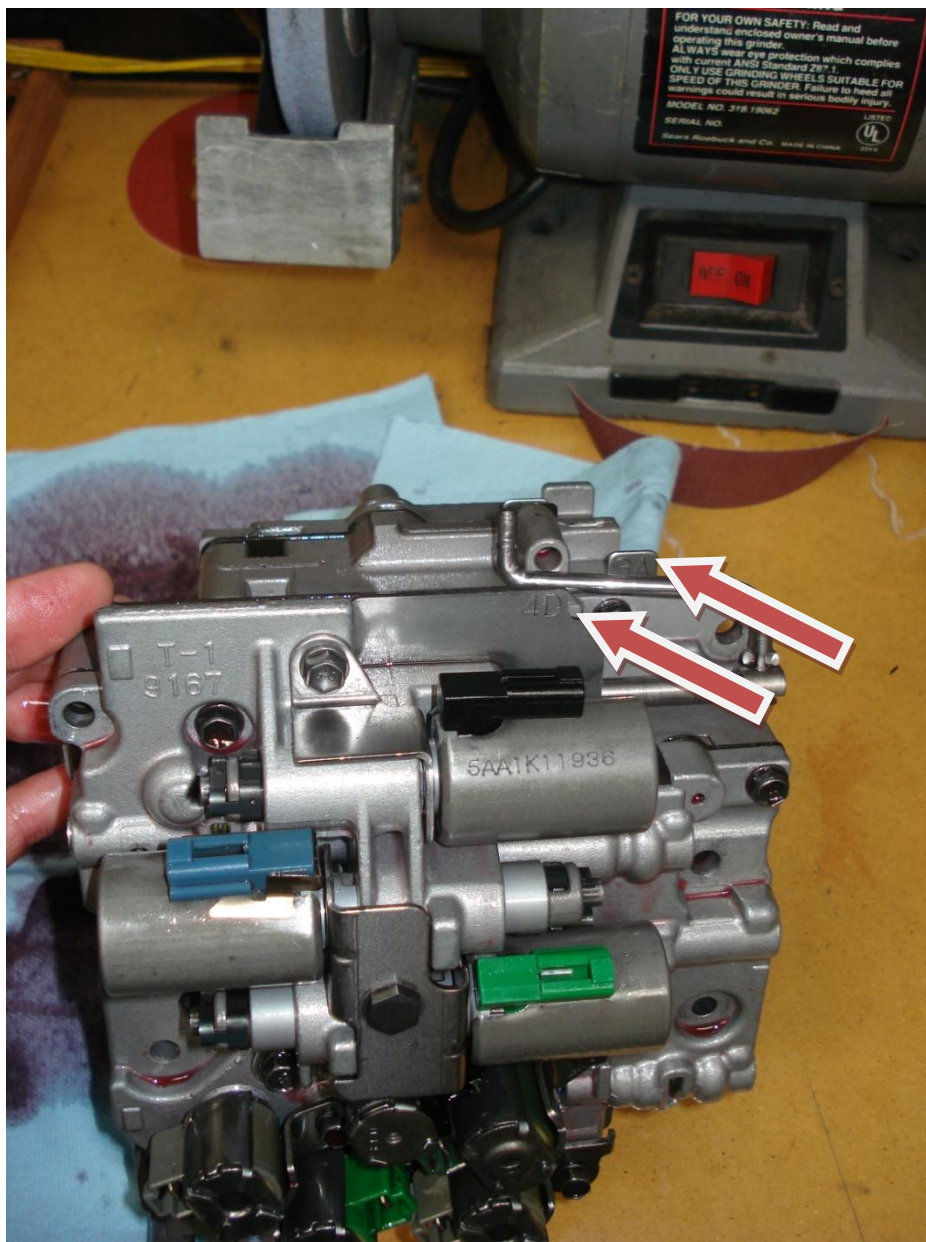
There are 3 lengths of bolts: 55MM, 50MM and 16MM. The sensor bolt is 55MM (shown)
Remove the solenoid retaining bracket on the top (8MM bolt – purple arrow) in order to remove wiring harness. Replace bolt. 7NM torque. Remove the 8 bolts remaining in the valve body. Red arrow is 55MM. Blue arrow is 50MM. Green arrow is 16MM.



The cover indicated by the black arrow is separate from the valve body and is held in place by the 2 50MM bolts. Be careful when removing the body that it is not dropped or damaged.

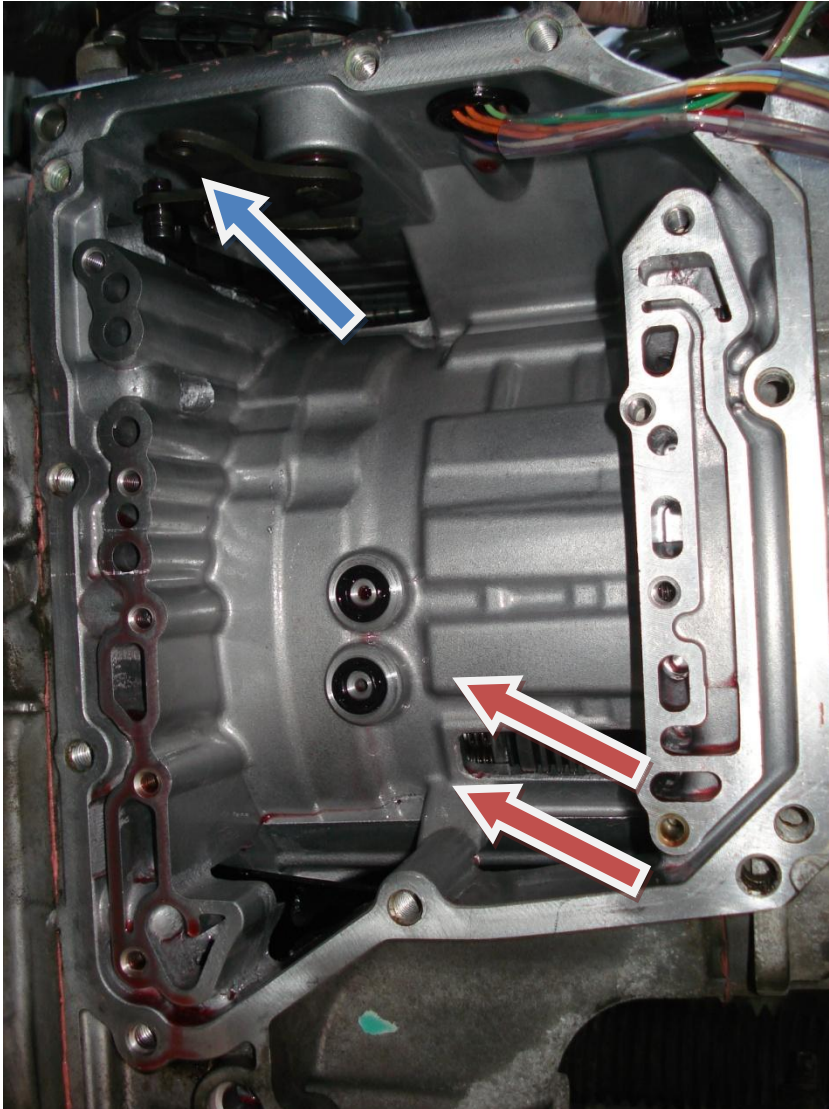
With the bolts removed, remove the valve body via the gap between the radiator and subframe.

On the bench, the valve body plate codes are visible (red arrows). Due to running changes in the transmission, these plate codes and the type of B5 release valve are needed to accurately replace the body. The Volvo dealer uses the VIN to determine this and they will sell you a new body (called a Transmission Control System) for about \$1400. For Valve Body Builders, they can send one that they have in stock (if you've got the codes and the type of valve) or you can send them your body and have them rebuild it. They finished mine in one day for \$495 CDN. Contact them for shipping details into Canada. Rebuilding takes a day or two, but shipping adds considerably.



Re-installing the Valve Body:

Remove old sealing rings from transmission body.



Sealing rings shown. Also visible in picture are the mating surfaces for the valve body and threaded holes for the mounting bolts.

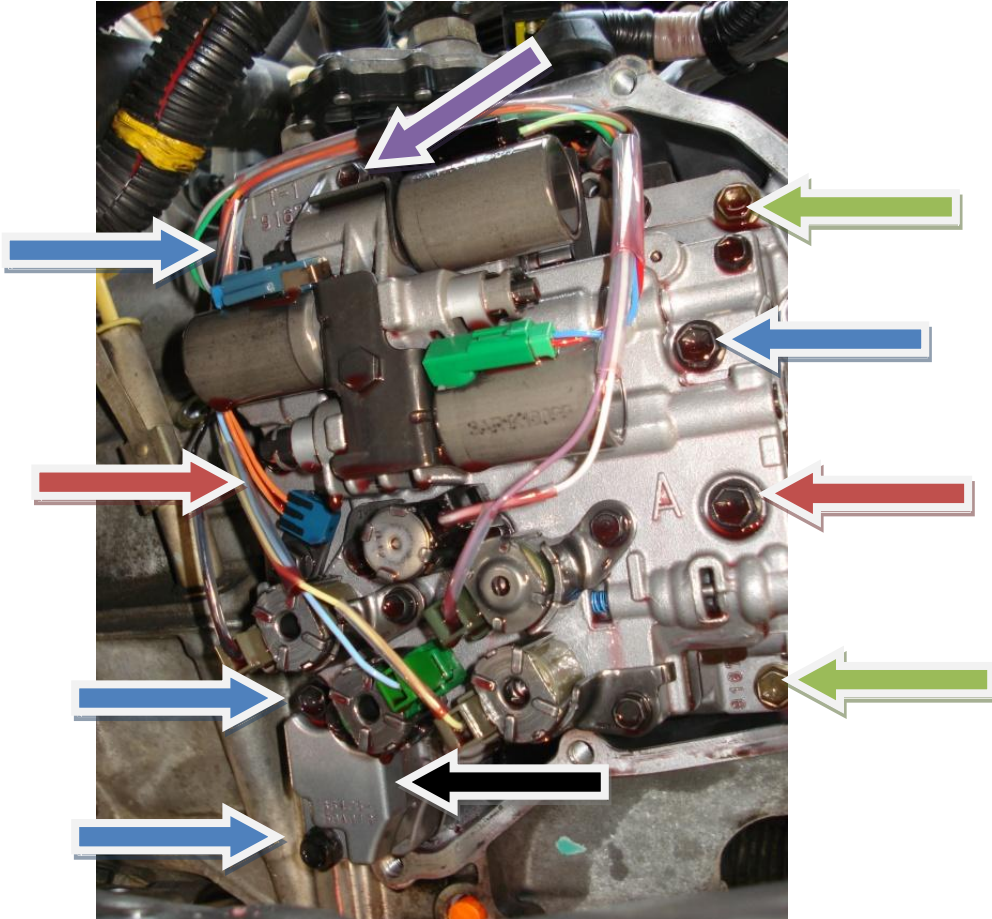
Install new seals (from Volvo sealing kit) in the transmission. Use petroleum jelly to hold the seals in position while valve body is installed.

Check that the lever for the gear selector slider (L-shaped sliding lever on top) is correctly positioned to engage the hole in the gear selector shown by the blue arrow above.

Carefully maneuver the valve body between the radiator and subframe to reinstall, taking care not to damage any gaskets or introduce any dirt.

Align the valve body on the gear selector lever. Install the bolts, noting the correct length for each bolt. Install a new gasket for the small cover on the lower left (from Volvo Sealing kit). Tighten each bolt by hand, then gently tighten alternately. Tighten all to 10NM.

Red arrow is 55MM. Blue arrow is 50MM. Green arrow is 16MM.



Remove the solenoid retaining bracket on the top (8MM bolt – purple arrow) in order to reinstall wiring harness bracket. Replace bolt. 7NM torque.

Install the cable harness and connect each solenoid. Press the connectors in until they click.

Install the Oil Temp Sensor, bracket and bolt (55MM). Tighten to 10NM.

Check that the mating surface and the inside of the cover are completely clean. Apply a 1/8" bead of RTV silicone (best quality you can find to preclude leaks) to the mating surface, going around each bolt hole completely.

Install new o-rings and clamps on oil cooler line and oil cooler return line.



Gasket material shown on cover along with new o-rings and clamps on lines. Note the cleanliness of the cover.

Reinstall cover on transmission, being careful not to bump the fresh gasket material as the cover is maneuvered in place.

Install the 9 cover bolts. Tighten gently. (I could not find a torque spec on this. I used 12NM as a reasonable tightness that won't distort the cover. If anyone can find the specified torque, I would appreciate knowing that value).

Install the oil cooler line on the transmission using a new o-ring. Install other end into oil cooler (radiator). I prefer to place a drop of trans fluid on the new o-rings so that they slide into the oil cooler easier.

Install the oil cooler return line on the transmission cover using a 22MM wrench. Install other end into oil cooler (radiator). I lubricated the o-rings with a drop of clean transmission fluid.

Note: The subframe shifted on my XC during this procedure due to the slope of my driveway and the downhill pressure on the car while it was on the ramps. This did not happen when I performed it on my T5 in the same driveway with the ramps positioned so that the car was level.

Remove the 55MM spacer from the subframe. Install new bolts. Tighten to 105 NM, then tighten further 120 degrees.

Install bolt for front engine mount. 14MM. tighten to 50 NM.

Install bolts for transmission torque mount. 18MM Tighten to 35NM, then a further 90 degrees.

Install bolt for grounding wire on subframe.

Install bolt for wiring harness on passenger side.

Reconnect radiator hose.

Install front splash guard center section. Press clips into slots. Install 10MM bolts.

Install front splash guard side sections. Install T-25 screws and clips to fender liners.

Remove transverse engine mount.

Top up coolant with 50/50 mix of Volvo blue-green coolant. Approximately 4 quarts needed.

Reinstall airbox by pressing bottom onto the three clips. Attach ducting to front of car. Install air filter and airbox cover, reconnect air inlet pipe and clamp. Reconnect air flow sensor. Clamp air flow sensor wiring to airbox with new zip tie.

Fill transmission with JWS-3309 fluid. I added 3.5 quarts to ensure that it was not overfilled (initial drain was 3.25 quarts. A bit more leaked from cooler lines and body removal. Total was about 4 quarts removed.) Check fluid level with car on level ground, engine running and transmission in Park.

Let the engine idle for a minute or two to get the fluid circulating before moving the transmission selector. This will preclude diagnostic codes resulting from low fluid pressure.

Recommended: Flush the transmission. This way, any dirt will have the best chance of being removed immediately and the adapts will be performed with fresh fluid in the trans. IPD sells a flush kit that includes the o-rings and clamps for the cooler lines and a hose that fits over the oil cooler line with good, clear directions. <http://www.ipdusa.com/Volvo-V70XC70-2001-2007/Transmission-&-Drive-Train/Automatic-Transmission-Flush-Hose-Kit/p-127-389-1052/>

The flush procedure: Disconnect the lower oil cooler (pressure) line fitting from the radiator (the clamp and o-rings should be brand new in this particular case). Place the line in a clear, graduated container. I use an old Windshield washer fluid bottle with markings. Start the engine and allow it to idle until 2 qts have been pumped out. Stop the engine and add 2 qts to the transmission. Repeat these steps until the fluid is a clear, bright red. Reconnect the cooler line. Start the engine and check the fluid level. Note: oil will be spilled when the line is disconnected. Place a catch pan or rags under the car.

The Gibbons method on the XC.com forum is very similar and both will work.

With the flush complete, I drove the car to warm up the transmission and adjusted the level once warm (it was 0.2 liters low, but low is easier to fix than high...)

Adaptation procedure.

Any time major transmission components are replaced, this must be performed. VIDA is the only way to place the transmission in the adapt mode.

Note: I asked the dealer to verify that I had the most recent software for the Transmission Control Module (TCM), to reset the fluid service counter and then place the transmission in Adapt mode and that I would do the driving. The fluid service counter monitors how much time the fluid has exceeded 150° C and will warn the driver if the limit is exceeded. Since the fluid is fresh and the car was hooked up, resetting the counter made sense.

Adapt mode. In adapt mode, the "transmission temp/trans oil hot" message is displayed in the information window the entire time it's in that mode...even though the trans is at normal temp...that's how the latest version of VIDA displays the mode apparently. Further, the actual gear will be displayed in the dashboard while in drive (instead of the usual D) so that you can track what shifts are taking place. Adapt mode will not work if the winter mode or the manual gear mode is selected. The transmission fluid temp must be between 65° C and 110° C or the TCM will not remain in adapt mode.

The flash of the orange triangle indicates that adapt is complete for that particular gear change.

Note: do not switch off the engine or adapt mode ends.

Upshifts: the first set of shifts are done at 15% throttle opening (approximately 1400 RPM) Hold the throttle position constant. The car will accelerate very slowly and 5th gear will not be reached. Stop the car and repeat the procedure until the orange triangle lights after each shift. It may take several runs through. The triangle does not have to flash after every shift in sequence but only after each distinct gear change (e.g; once you see the triangle after 2-3, that particular shift is adapted for that throttle position.)

Carry out another set of runs, this time using 25% throttle opening (approximately 1800 RPM). Hold the throttle position constant. Stop the car and repeat the procedure until the orange triangle flashes after each shift. It may take several runs through.

Carry out a third set of runs, this time using 2500 RPM. Hold the throttle position constant. Stop the car and repeat the procedure until the orange triangle flashes after each shift. It may take several runs through.

Note: the TCM adapts continuously. Not all shifts will be perfect. For example, the orange triangle may not light after each 1-2 shift. The lamp only needs to have lit once for each particular shift at each engine speed to be sure that the adaptation has reached target value.

Downshifts: Drive the car at approximately 45 MPH. Release the accelerator completely and brake gently to a stop. Repeat the procedure until the orange triangle flashes after each downshift. It may take several runs through and varying brake pedal pressure may be required to achieve the correct result for each gear change.

Garage shifts: Run the engine at idle and hold the brake pedal. Move the gear selector to N. Wait 5 seconds. Move the gear selector to R. Wait 5 seconds, then move it back to N. The adaptation for R is complete when orange triangle flashes when the selector is in R.

Run the engine at idle and hold the brake pedal. Move the gear selector to N. Wait 5 seconds. Move the selector to D. Wait 5 seconds. Then move the selector back to D. Continue. The adaptation for D is complete when orange triangle flashes when the selector is in D.

Personal observations:

I went through the 1400 RPM, 1800 RPM and 2500 RPM upshifts. Dealing with traffic while crawling along at 1400 RPM was an issue, and I was not able to complete up to 4th gear every time, so the 3-4 shift took a while to get the orange triangle. Subsequent higher RPM shifts were easy. Down shifts were trickier, had to play with deceleration rate to get an orange triangle for each gear. I did run the trans through a set of 3000 RPM upshifts and it only took one run to get it the orange triangle...meaning that the trans was pretty well adapted from the 2500 RPM runs.

Total time for adapts was about 40 minutes the first time I tried it. Don't start this on an empty fuel tank.

Remember, turning the car off ends the mode...important when picking the car up from the dealer. *Ensure that the tech leaves it running* (which is not normal for them.)

I now have over 5,000 miles on the XC since this was completed. The transmission continues to work perfectly. Frankly, the car shifts like new...my wife is delighted with her XC-70 that drives like new.

The T5 has 900 miles on it since completion, it works perfectly as well.

One final note on transmission fluid; I bought a case of T-IV from the Toyota dealer for this job since I did not have enough Mobil 3309 on hand for the flush. Smell, color, everything are identical to the Mobil 3309. The T-IV meets the JWS-3309 spec that's required for this trans and it's available locally. I get my Mobil 3309 from: <http://store.avlube.com/info.html> Good price (on sale as of this writing for \$53.34/case) and shipping is reasonable.

I can't say that this will work for your personal transmission. But with all the parts and supplies included, I spent a total of about \$750. That is a far less than the \$6100 I was quoted at the dealer and far less than any transmission shop that wanted about \$3,000 for a used trans to be installed.