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ABS MODULATOR ELECTRICAL FAULT REPAIR

11/2009

Introduction:

The Land Rover Discovery Series II uses the same ABS MODULATOR as the H1 Hummer. The company that manufactures it is **WABCO** (<https://web.archive.org/web/20170730071921/http://www.wabco-auto.com/>) (Meritor WABCO (https://web.archive.org/web/20170730071921/http://www.meritorwabco.com/Page.aspx?page_id=1)). If you have been experiencing an intermittent fault causing your ABS, HDC, and TC lights aka *Three Amigos*, your problem may be a result of a bad electrical connection.

The faults associated with this fix are:

- 1.6 - Shuttle valve switch (SVS) long term supervision failure
- 11.1 - One sticking SVS
- 11.4 - SVS electrical supervision failure

Disclaimer:

Use this guide at your own risk!!!!

Before attempting this repair, read the ABS trouble codes stored on the SLABS ECU to verify it is not another issue. A specialized scanner is required to read and clear the code(s). An intermittent fault will clear itself after shutting the engine off and restarting it. It will not however clear the faults from the SLABS ECU memory. Having intermittent codes stored in memory will not cause the three amigos to come on. Only current active faults cause them to display. See Diagnostics (<https://web.archive.org/web/20170730071921/http://www.landroverclubvi.com/diagnostic.html>) for more information about the scanner(s).

I REPEAT, use this guide at your own risk!!!! This FIX is not the "CURE ALL" for the THREE AMIGOS but has helped many get rid of them. If you have any questions or if after performing this fix the THREE AMIGOS return, please email me at josh@landroverclubvi.com. Be patient as I get MANY emails regarding the fix. =)

Options for fixing the SVS fault:

Option A: This is the popular Hummer fix as written out by a Hummer enthusiast where you repair a faulty solder at the pins of the SVS circuit board.

Option B: This is the bypassing of the SVS circuit board and straight wiring into the external connector on the outside of the modulator. I HIGHLY RECOMMEND THIS! (I messed up the circuit board while cutting off the hard black plastic doing Option A resulting in the research, testing, discovery and documentation of option B. Consider this method over OPTION A.)

Option C: This is removing the electric pins on the SVS circuit board and solder in wire and connect them to the SVS wires removing the SVS plug entirely. (No instructions for this method)

Note: For all options, the pump side of the ABS Modulator does not need to be removed although I have illustrated the steps to remove the entire unit. For option A, the modulator side does need to be removed. Option B can be carried out by only removing the SVS (Shuttle Valve Switch)

UPDATE** 03/2011: Correctly doing Option A or Option B in no way affects the function of the ABS Modulator nor the SLABS' effectiveness in monitoring the SVS.**

Read the following:

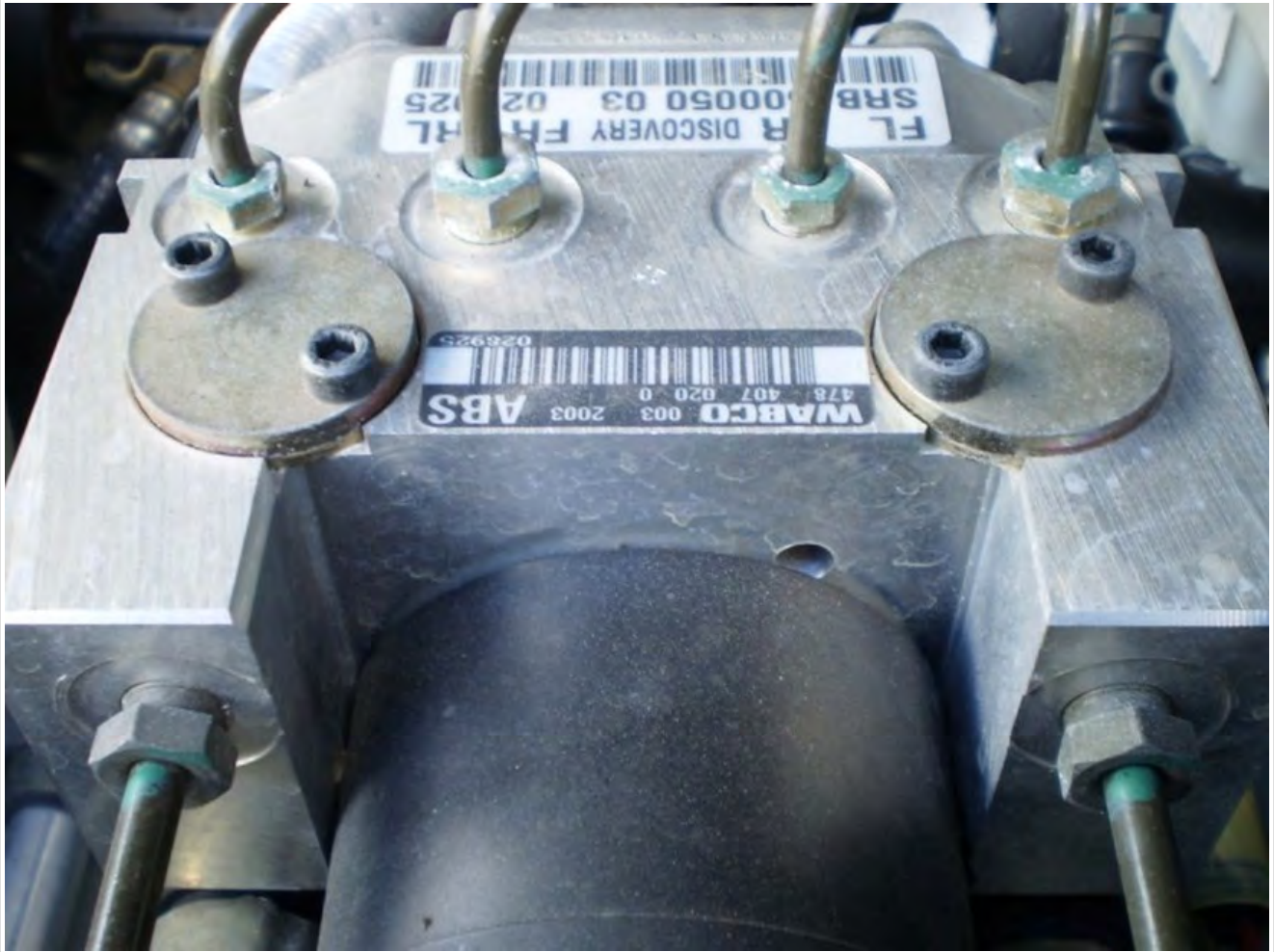
1. **Shuttle Valve Switch Related ABS-TC-HDC Warning Lamp Illumination Troubleshooting** (https://web.archive.org/web/20170730071921/http://www.landroverclubvi.com/uploads/2/3/9/8/2398536/shuttle_valve_switch_related_abs-tc-hdc_warning_lamp_illumination_troubleshooting.pdf)
2. **70/07/04/NAS -- Troubleshooting_ABS-HDC-TC_Warning_Lamp** (https://web.archive.org/web/20170730071921/http://www.landroverclubvi.com/uploads/2/3/9/8/2398536/troubleshooting_abs-hdc-tc_warning_lamp.pdf)
3. How ABS Modulator/Pump Works (Coming soon)

This write-up is split into four sections

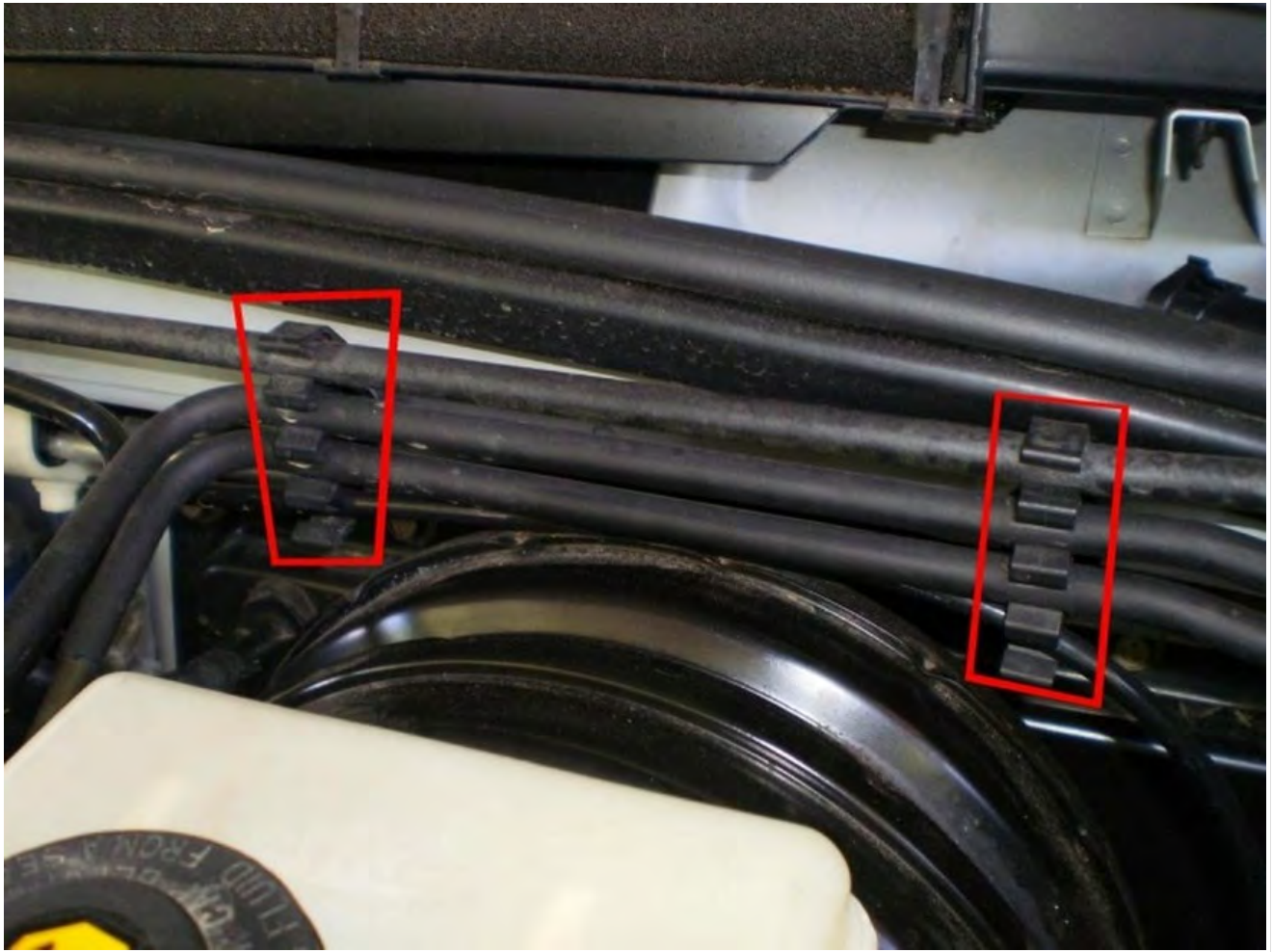
- **Instructions For Removing Entire ABS Unit** (Steps 1- 14)
- **Instructions For Removing Modulator Side Only** (Steps 19 - 30)
- **Instructions For Option A.** (Steps 31-36)
- **Instructions For Option B.** (Steps 37 - 45)

INSTRUCTIONS FOR REMOVING ENTIRE ABS UNIT

1. Spray Liquid Wrench on the 6 brake line nuts (4 on top and 2 on the side).
2. Also spray the four hex screws on the cover plates. Removal of the screws and plate will help remove the brake lines but it is not required.



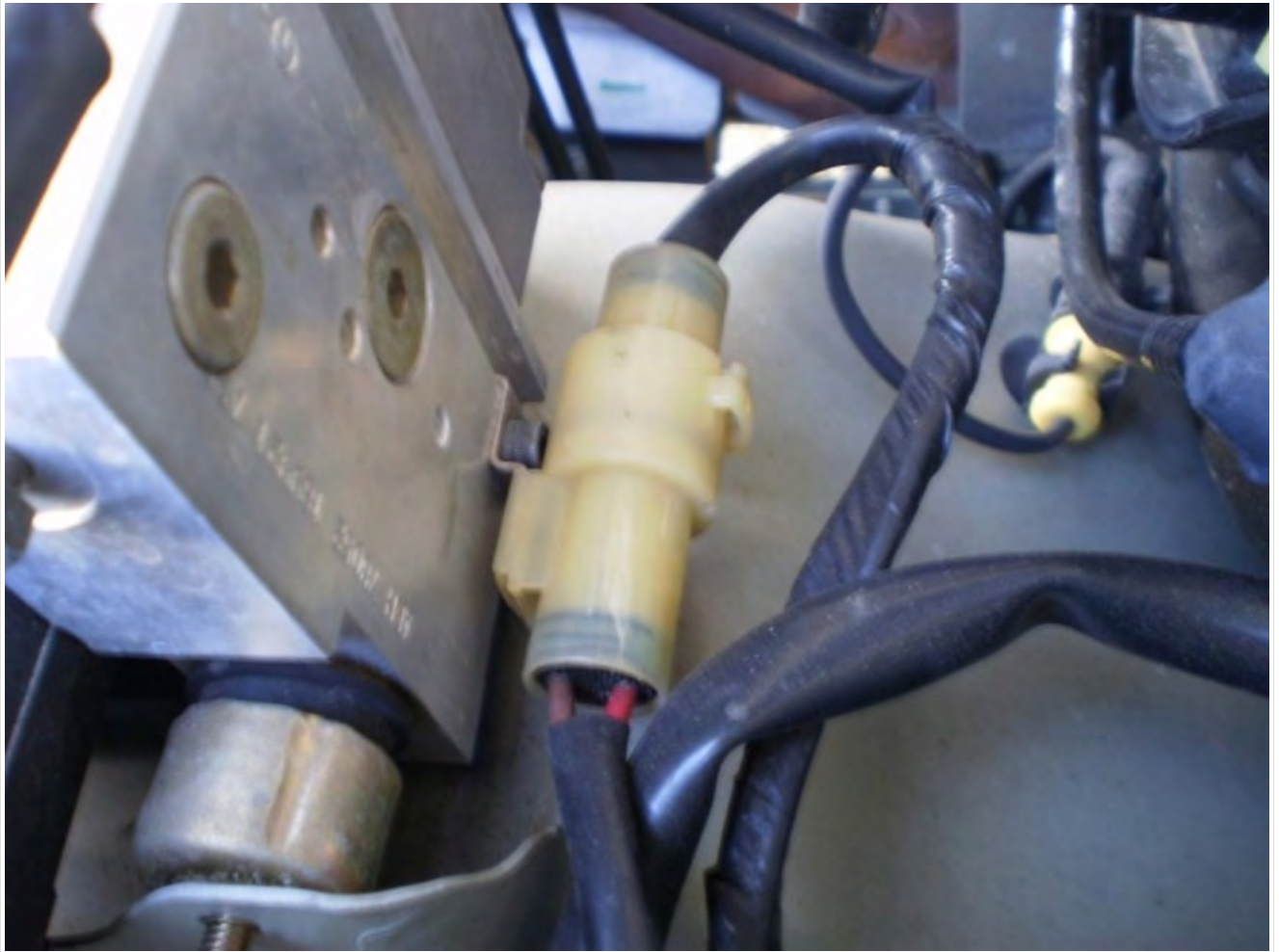
3A. While the Liquid Wrench is soaking the nuts and screws, remove the air intake arm and release the brake pipes from the clips on the bulkhead.



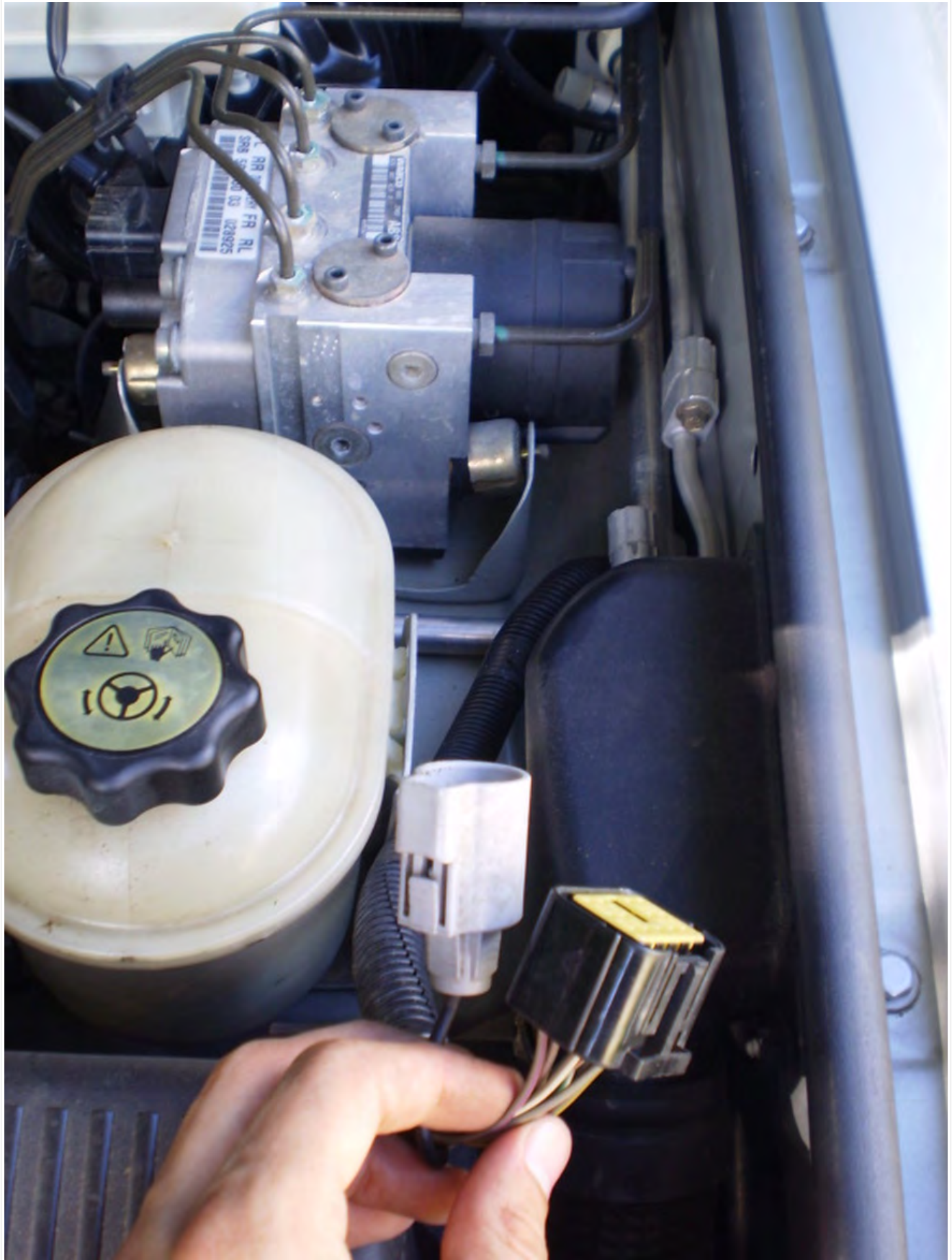
3B. Remove the 3 electrical connectors form the modulator. Two on the front and one on the side.



Removing black connector C0501 and grey connector C0500

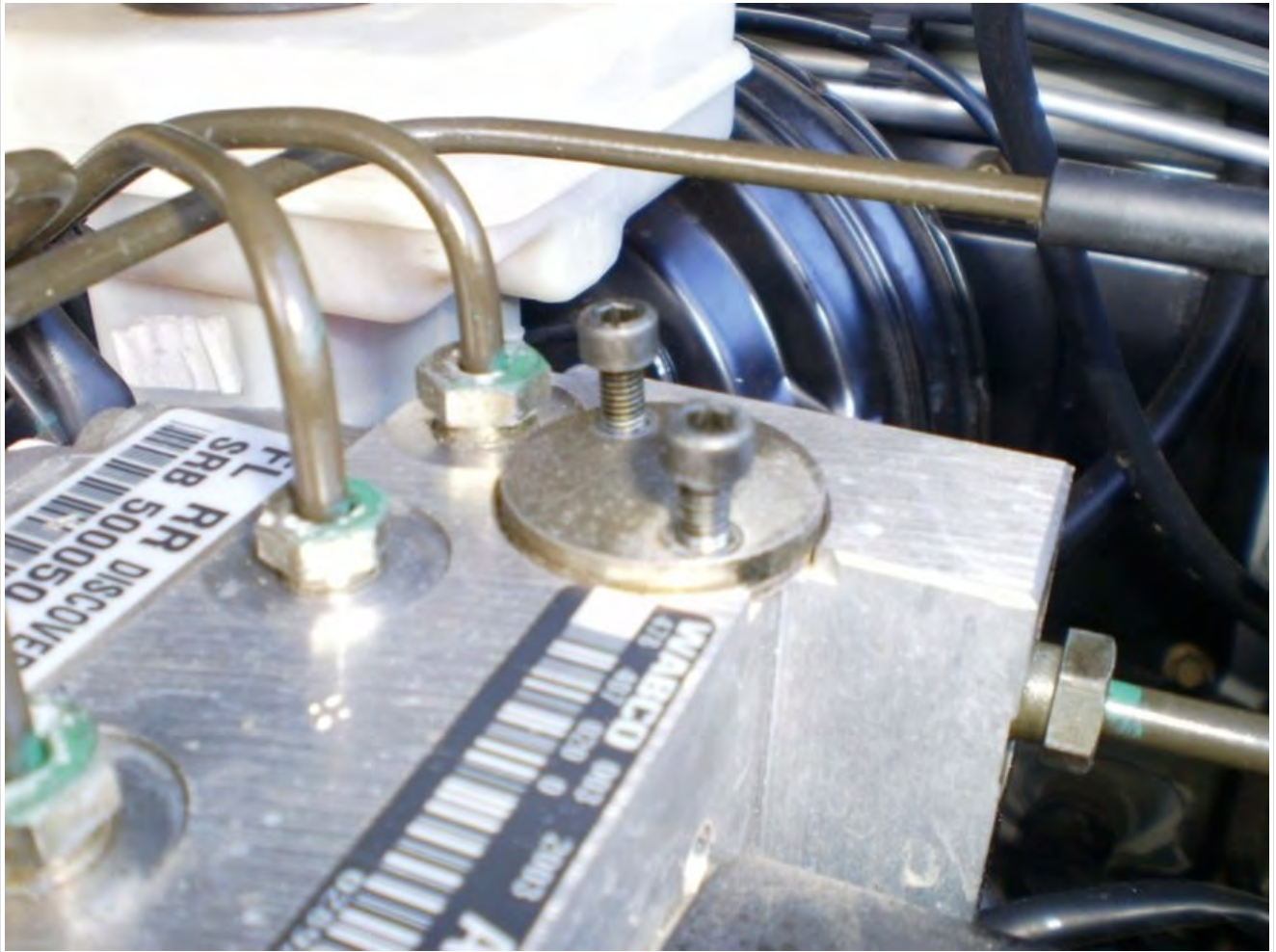


Side connector C0507

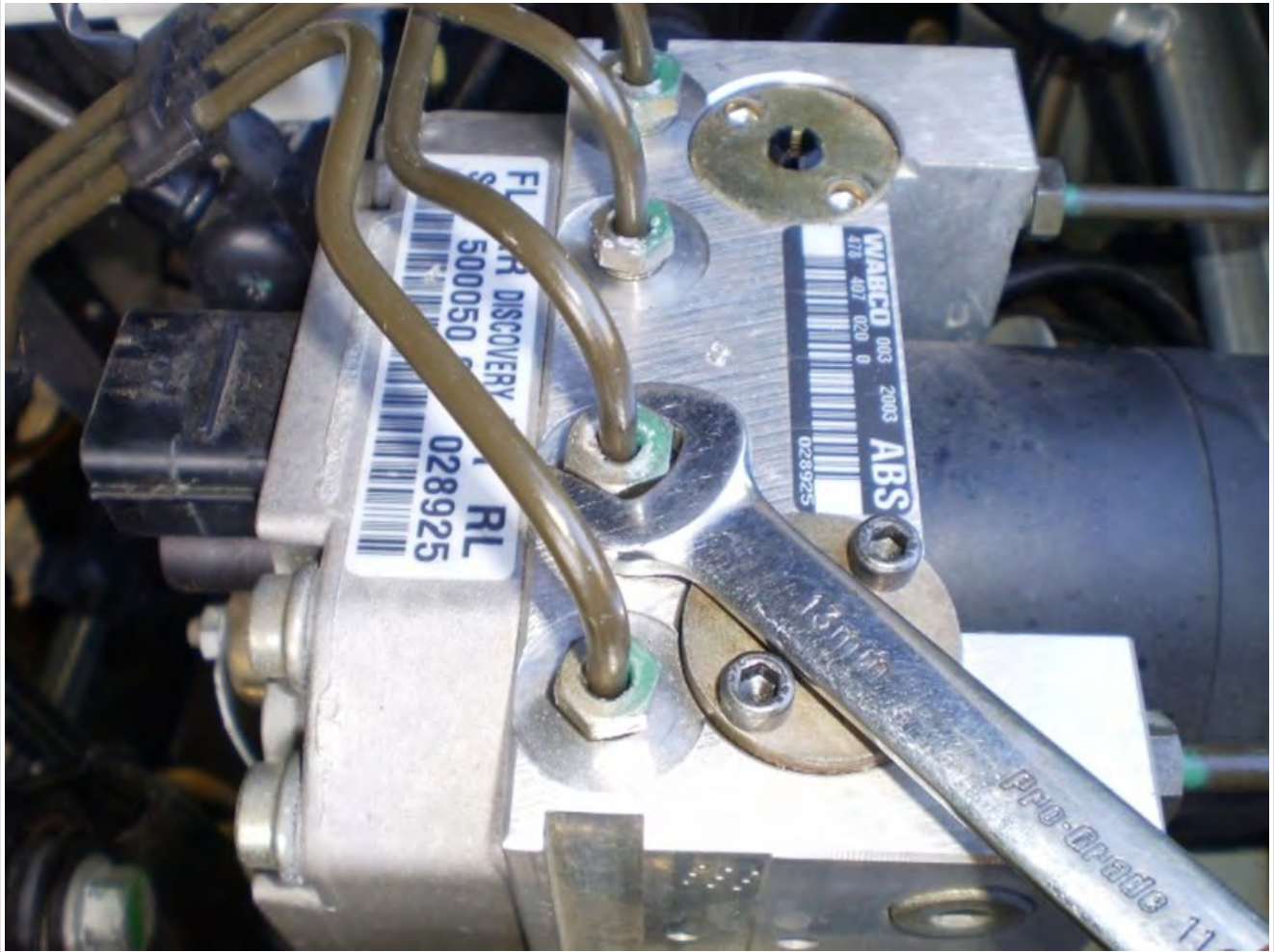


Place harness between intake and steering fluid reservoir

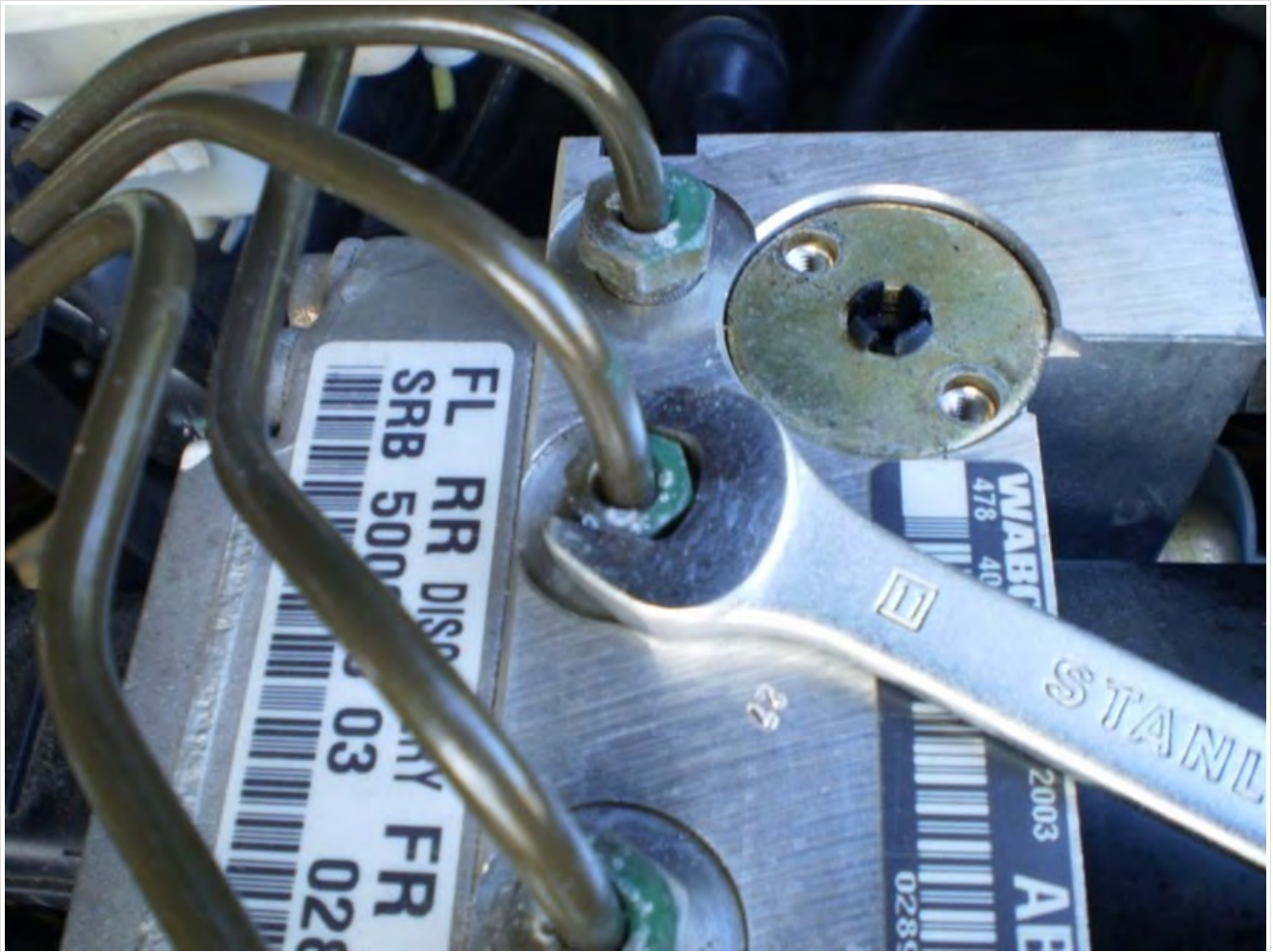
4. Using a 4mm hex bit, remove the two hex screws and cover plate.



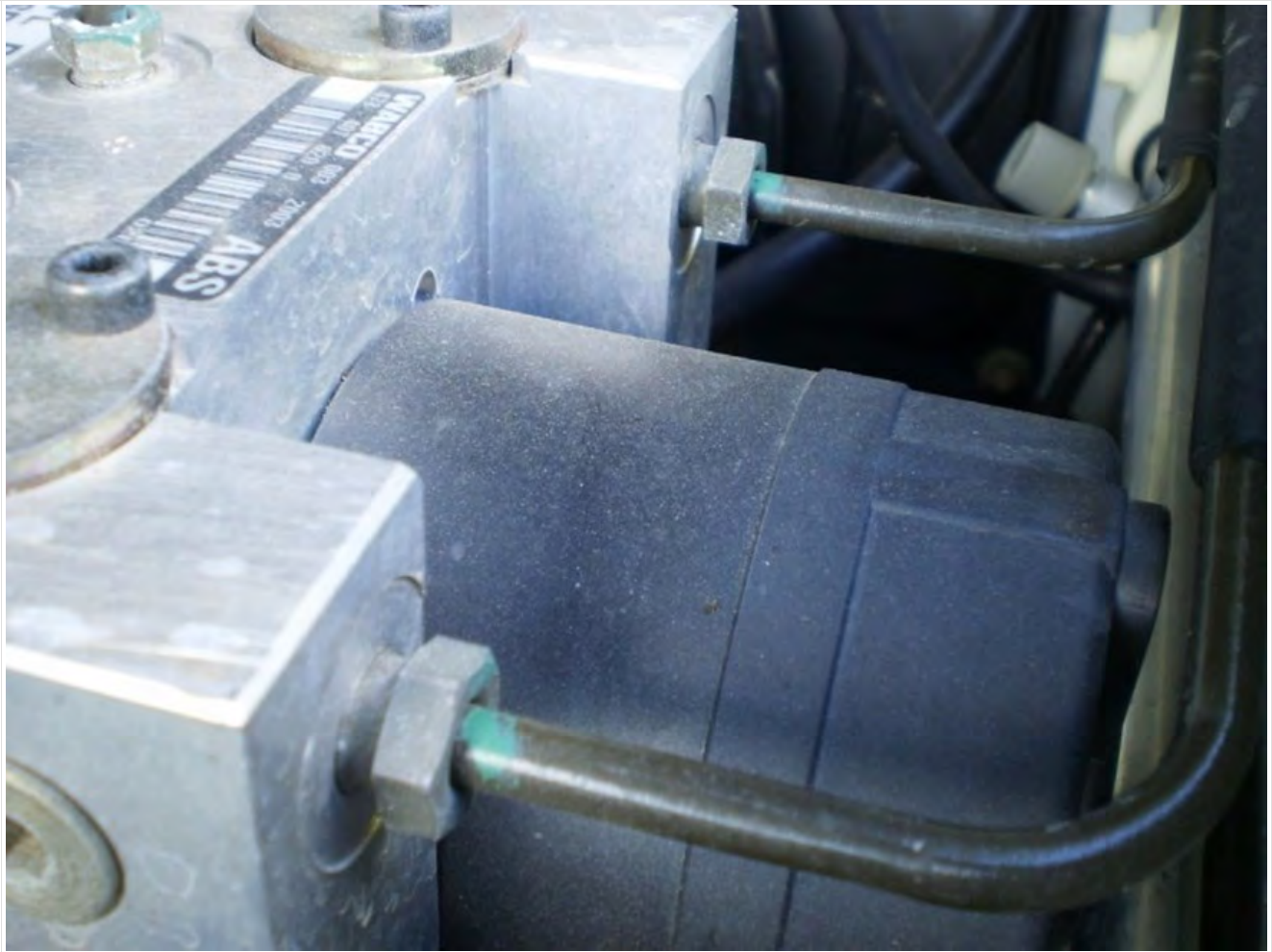
5. Brake loose the two bigger flare nuts using a 13mm wrench.



6. Brake loose the two smaller flare nuts using a 11mm wrench.



7. Brake loose the two side mounted brake line nuts using a 13mm wrench.



8. Once all 6 brake lines are broken loose, remove the 3 nuts securing the modulator on to its mounting bracket using a 10mm wrench.



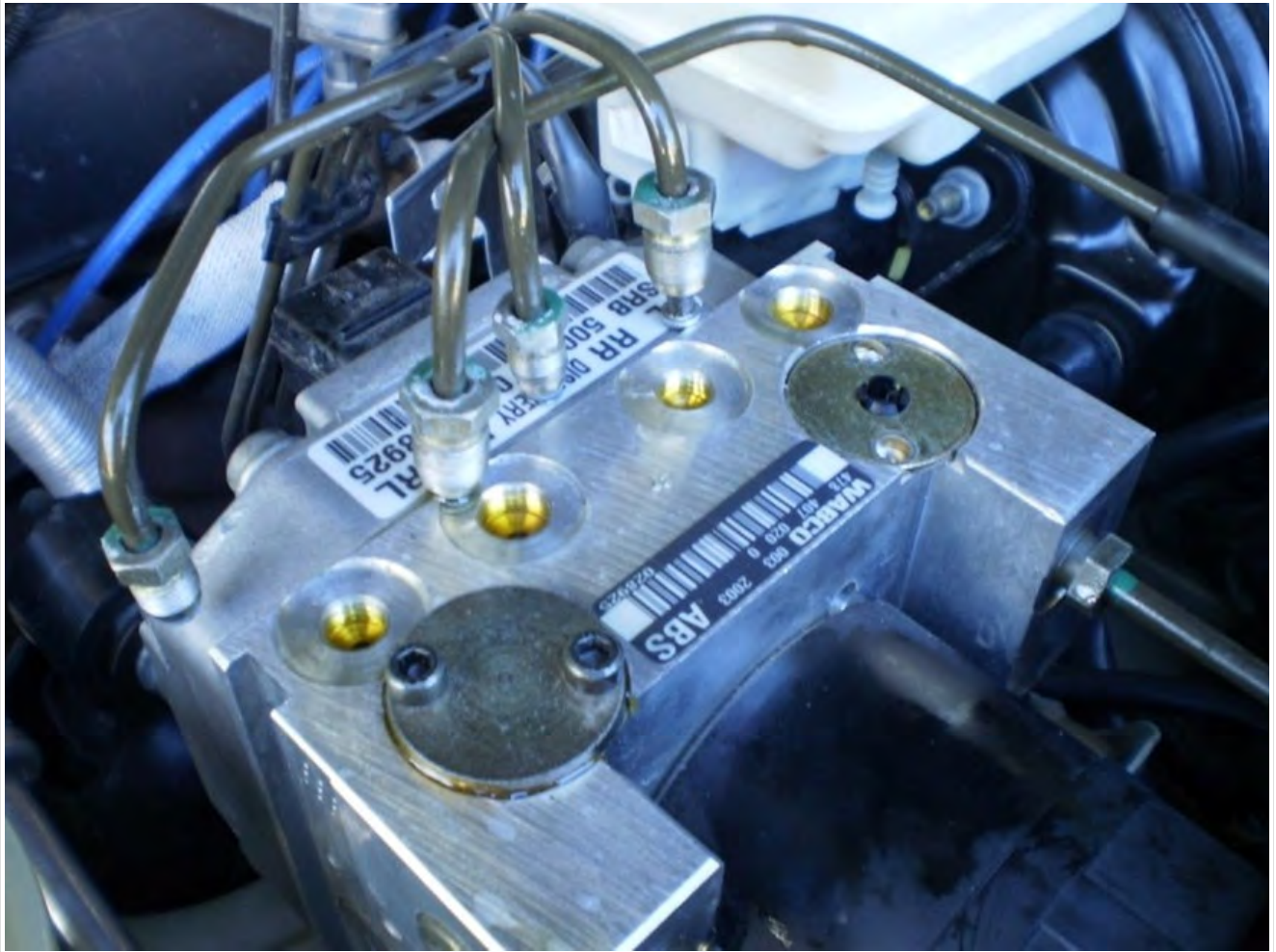


Note: Before fully disconnecting the brake lines from the modulator, clean up any excess Liquid Wrench so that it does not get inside.

9. Unscrew and disconnect the two bigger brake lines. Brake fluid will be dispensed from both the lines and pump side. Have a shop towel nearby.



10. Unscrew and disconnect the two smaller brake lines. Brake fluid will be dispensed from both the lines and pump side. Have a second shop towel nearby.



Luckily I had a second ABS modulator/pump that had plugs for all 6 brake line ports so I plugged them up. I also cut the fingers off a disposable rubber glove to keep the lines from dust contamination. It also helped catch some brake fluid. I recommend using a syringe or turkey baster to suck out the residual brake fluid from the modulator if you do not have brake plugs.

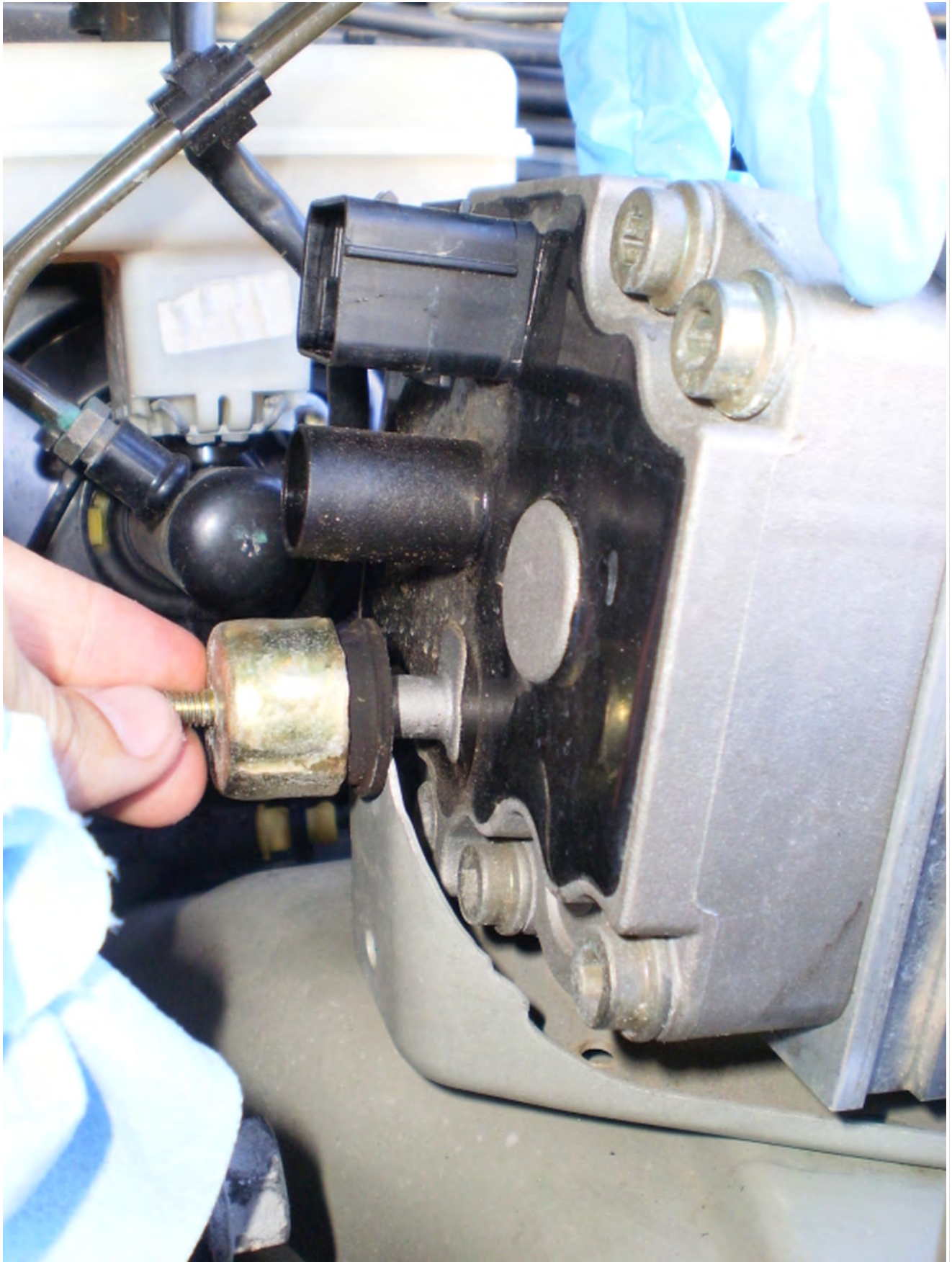


11. Disconnect the two side lines. Brake fluid will be dispensed from the lines and pump side. Have that third shop towel nearby.

Because of the slight incline on my drive way, it was necessary for me to elevate the two side brake lines coming from the master cylinder to prevent brake fluid from continuing to pour out. I used a hammer at first and wedged it between the inside of the quarter panel.



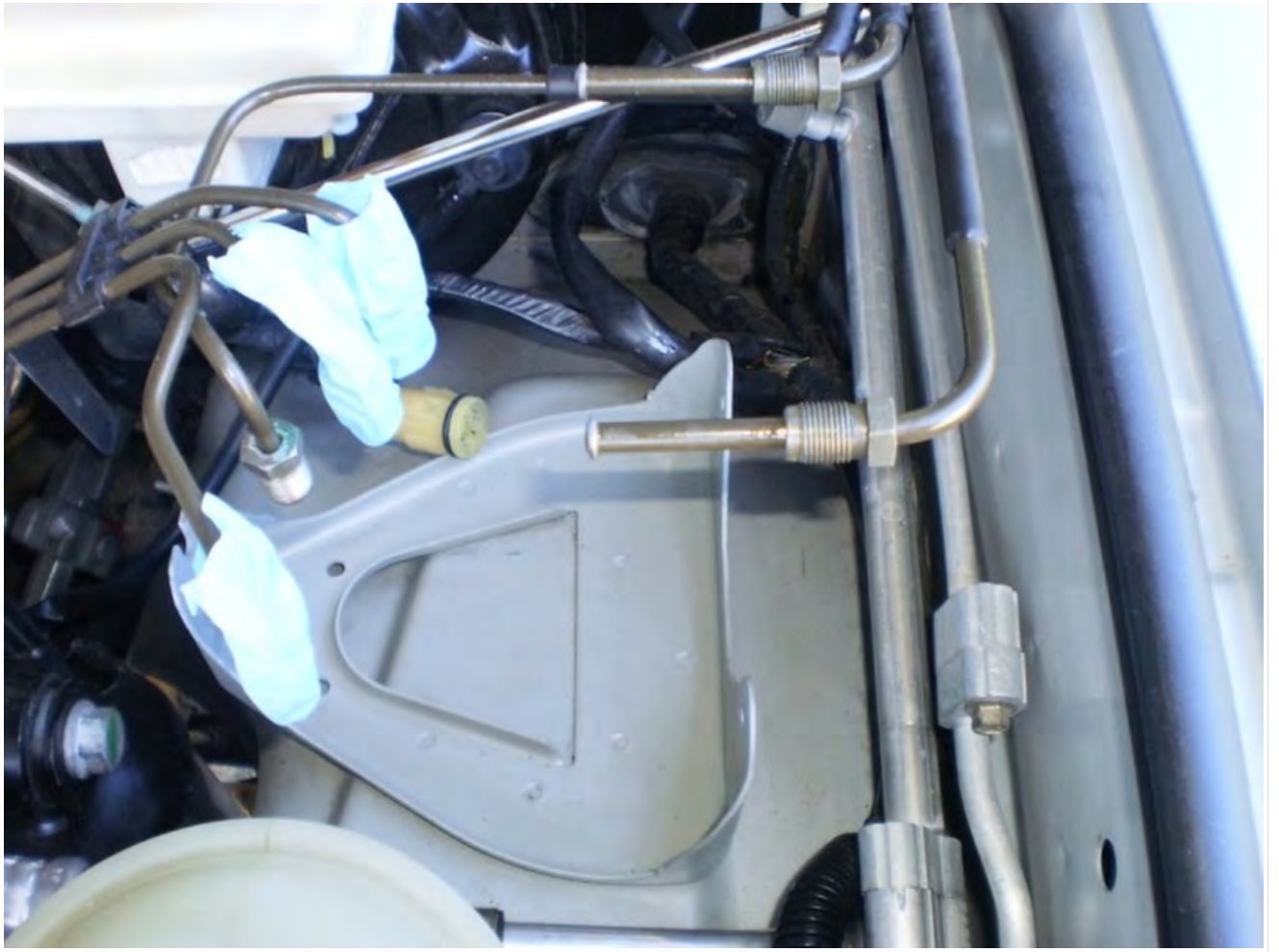
12. Lift the front of the modulator and remove the front rubber mount.



13. Carefully remove the ABS unit paying closing attention to the brake lines.



14A. Once removed, clean the area to prevent paint damage from spilled brake fluid. Place an absorbent shop towel or cloth to catch any brake fluid while you continue to work.





14B. Installation is the reverse of removal. However, when installing the 4 brake lines on top, ensure that they are screwing in flush and not cross threading. It took a couple of tries to get them seated right.

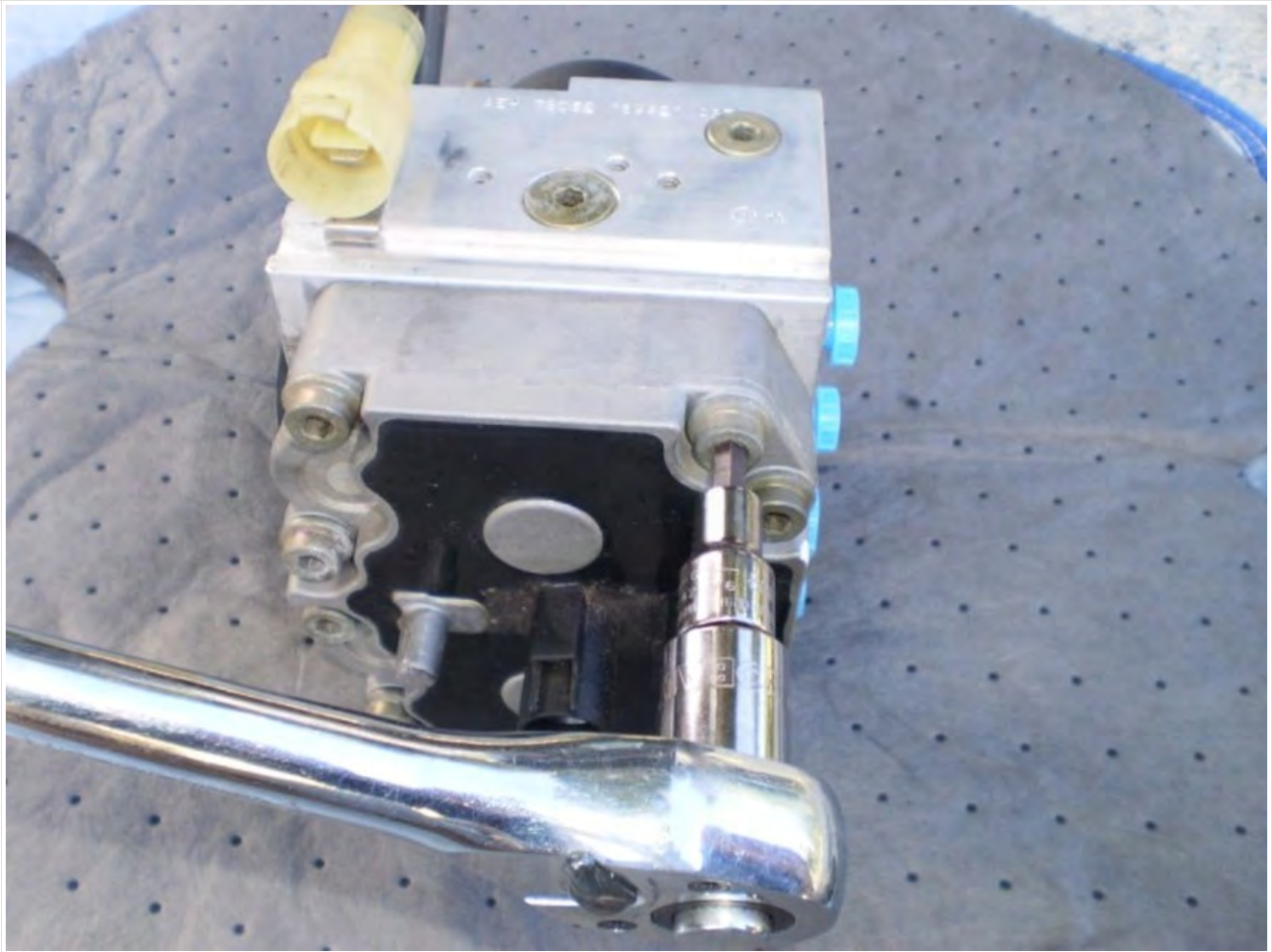
14C. Bleed the brakes. You can use the traditional method with a helper following this sequence: Rear Right, Rear Left, Front Right, Front left. Pedal may still feel spongy.

14D. Go for a test drive and try to get the ABS and TC to kick on. Find a good incline to test HDC or on a flat ground, accelerate and let off the Pedal and HDC should kick in, slowing you down. This MAY help get some trapped air out.

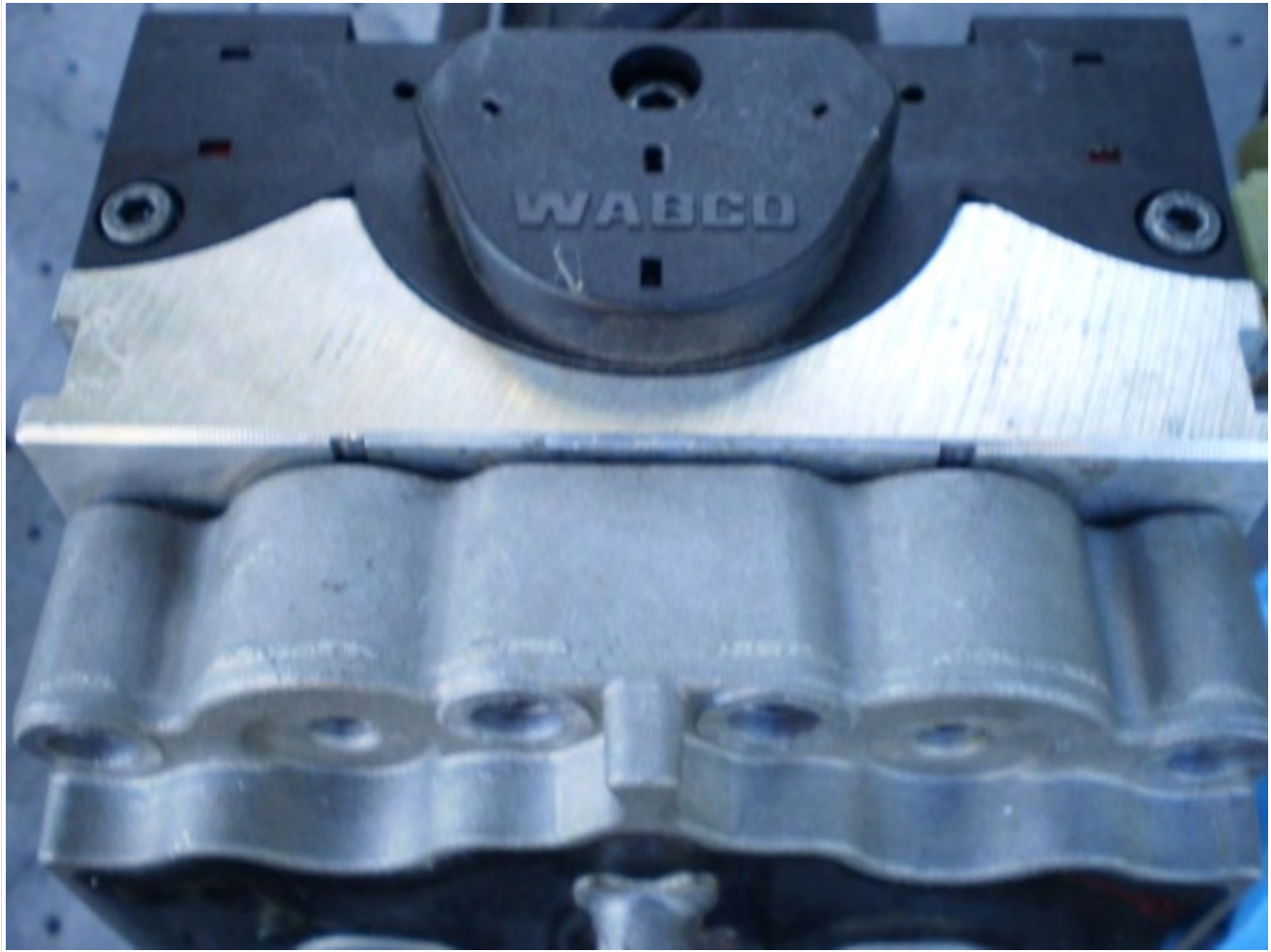
14E. Re- bleed the brakes.

STEPS 15 - 18 IS THE CONTINUATION FOR PERFORMING OPTION A OR B WITH ENTIRE UNIT REMOVED.

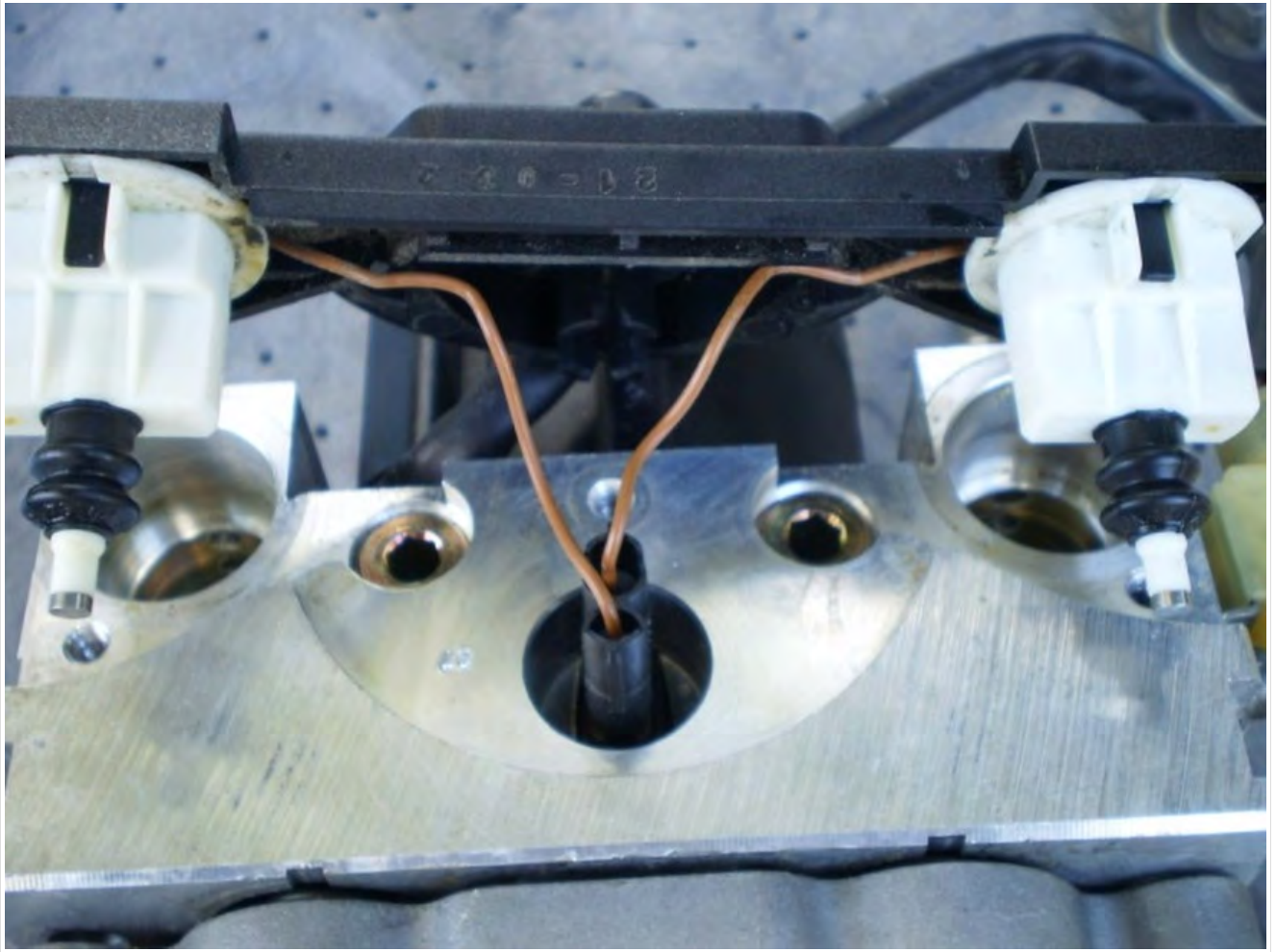
15. Clean off the modulator. Using a 6mm hex tool, remove 8 bolts on the modulator.

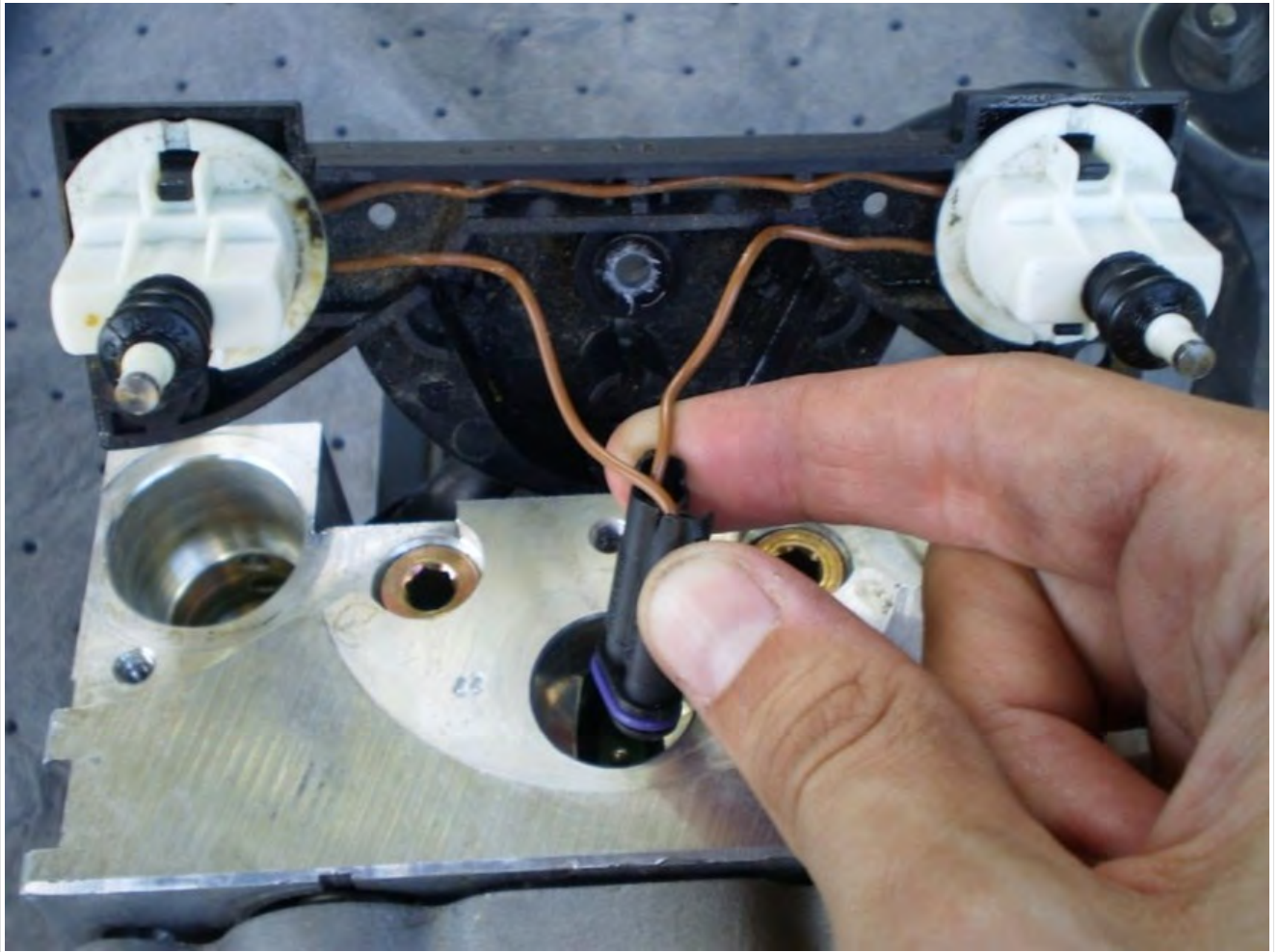


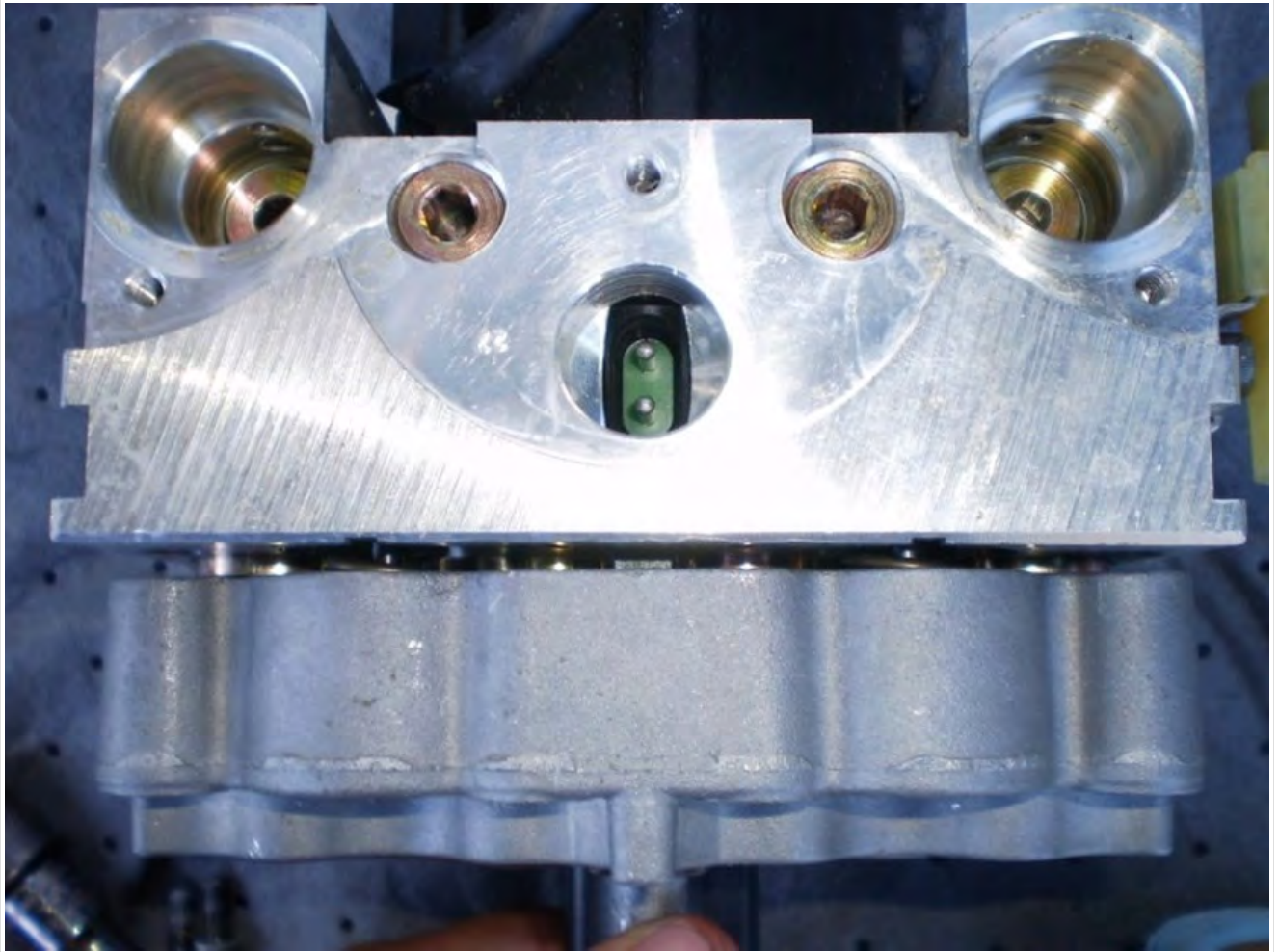
16. Turn the unit upside down. The SVS cover plate reading "WABCO" should now be on top. Using the 4mm hex bit, remove the 3 hex screws. They are installed with blue or red loctite, so let them soak in penetrating fluid to ease removal and prevent stripping.

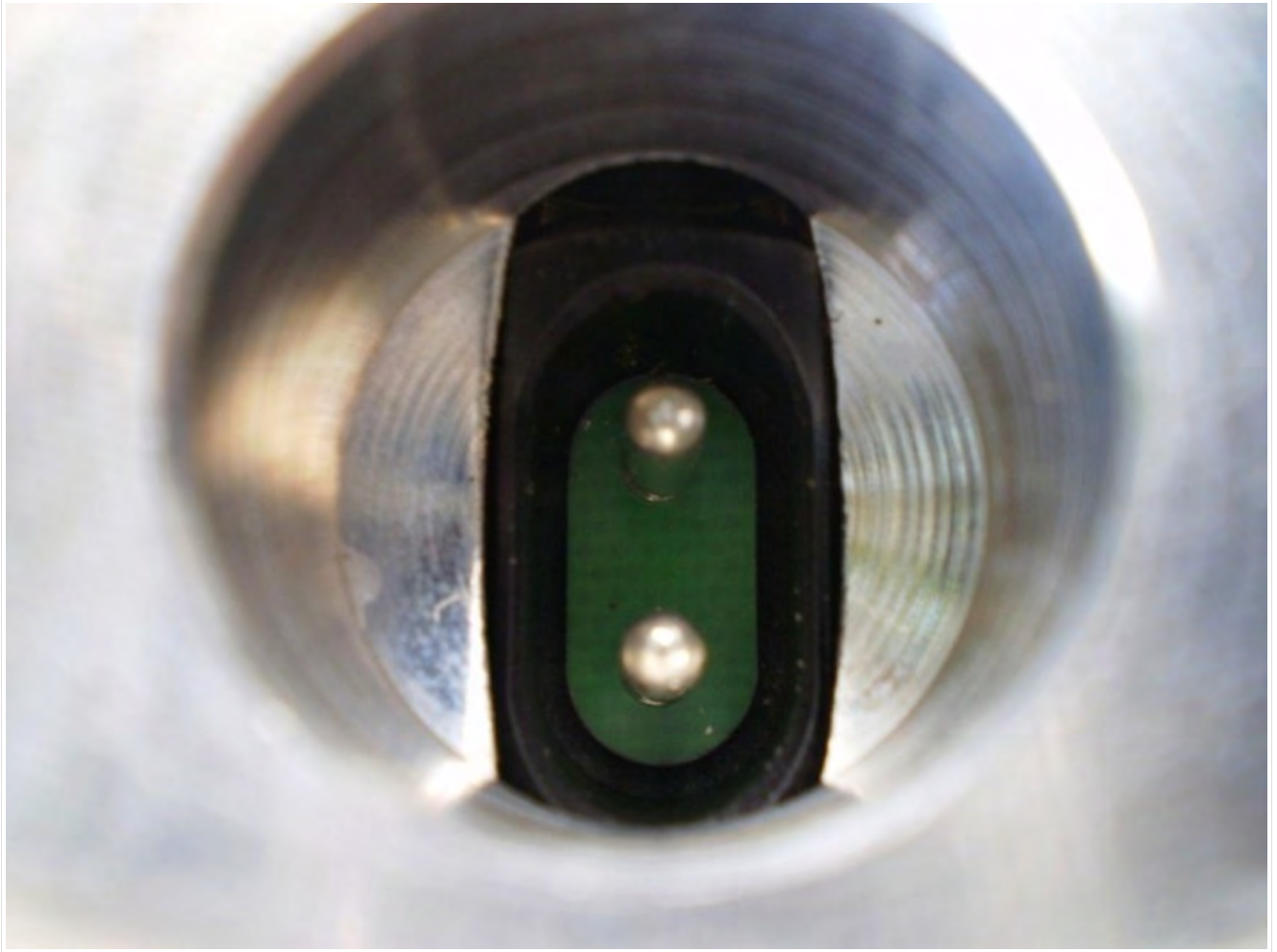


17. Carefully remove the SVS cover plate and disconnect the SVS plug. The plug should dislocate from the cover plate with minimal effort or hold it in place as you pry the cover out. If you find that a pin is lodged in the plug upon removal, and it did not remain in the SVS circuit board then you may have found your intermittent fault.

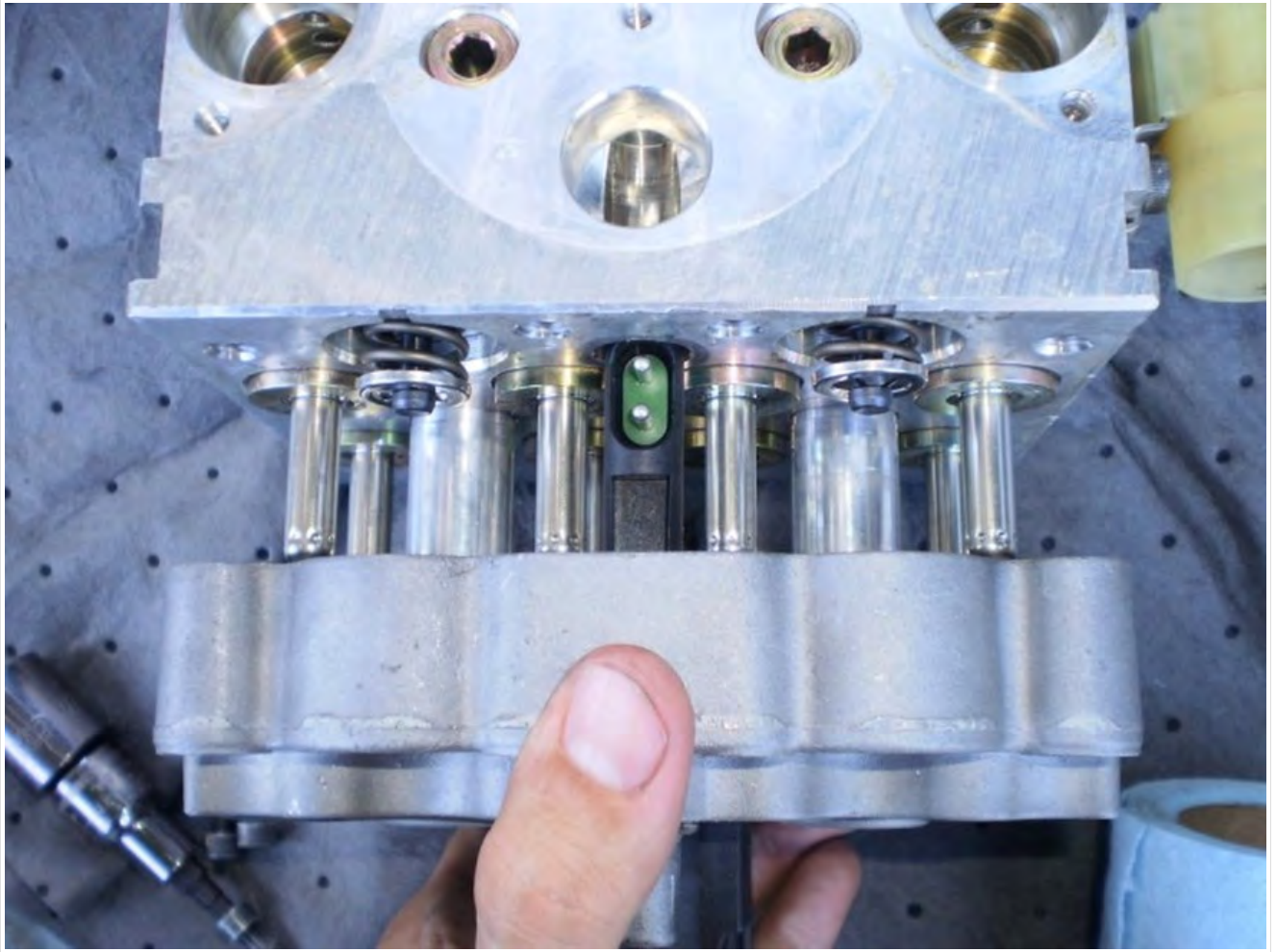


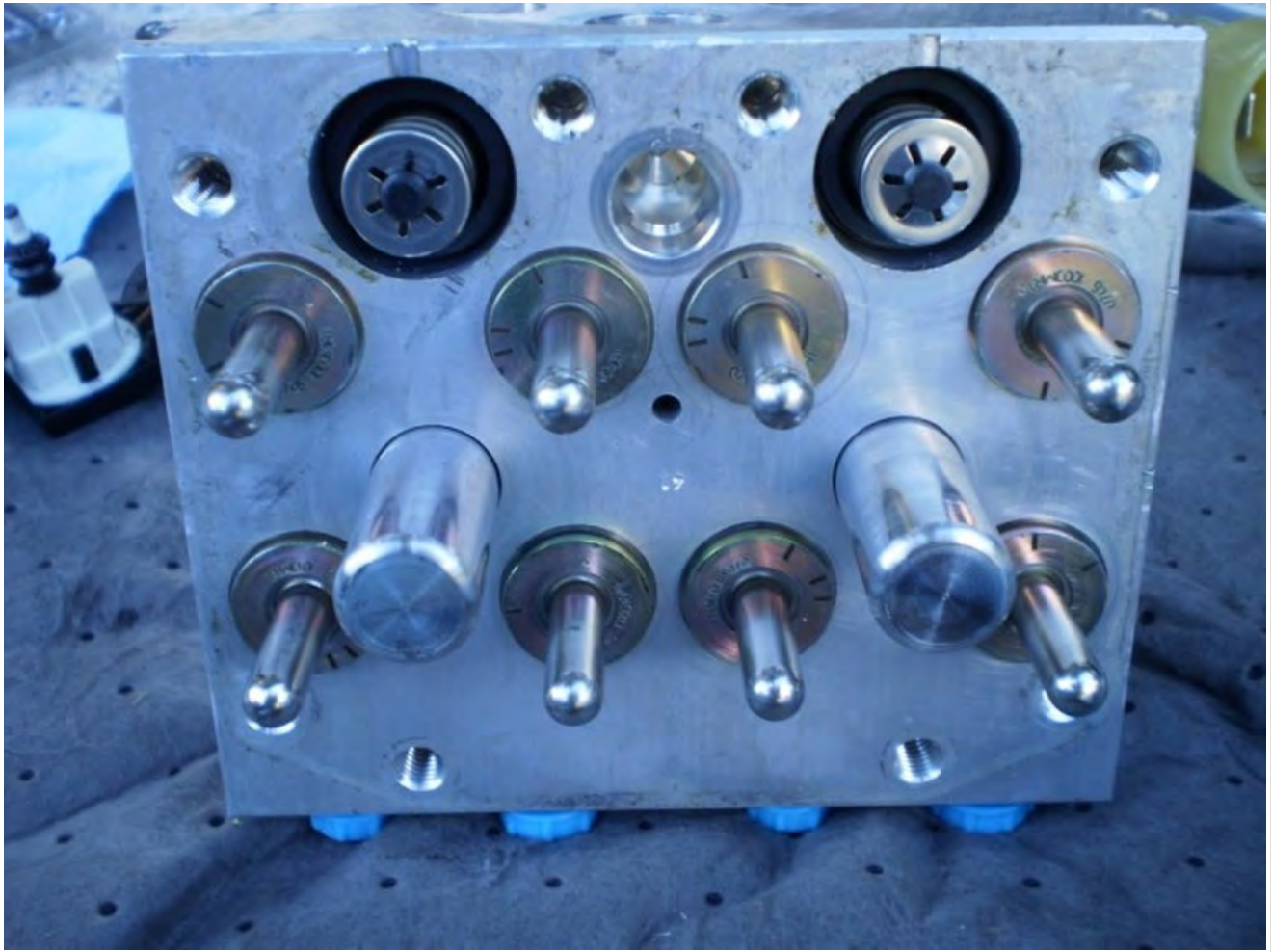




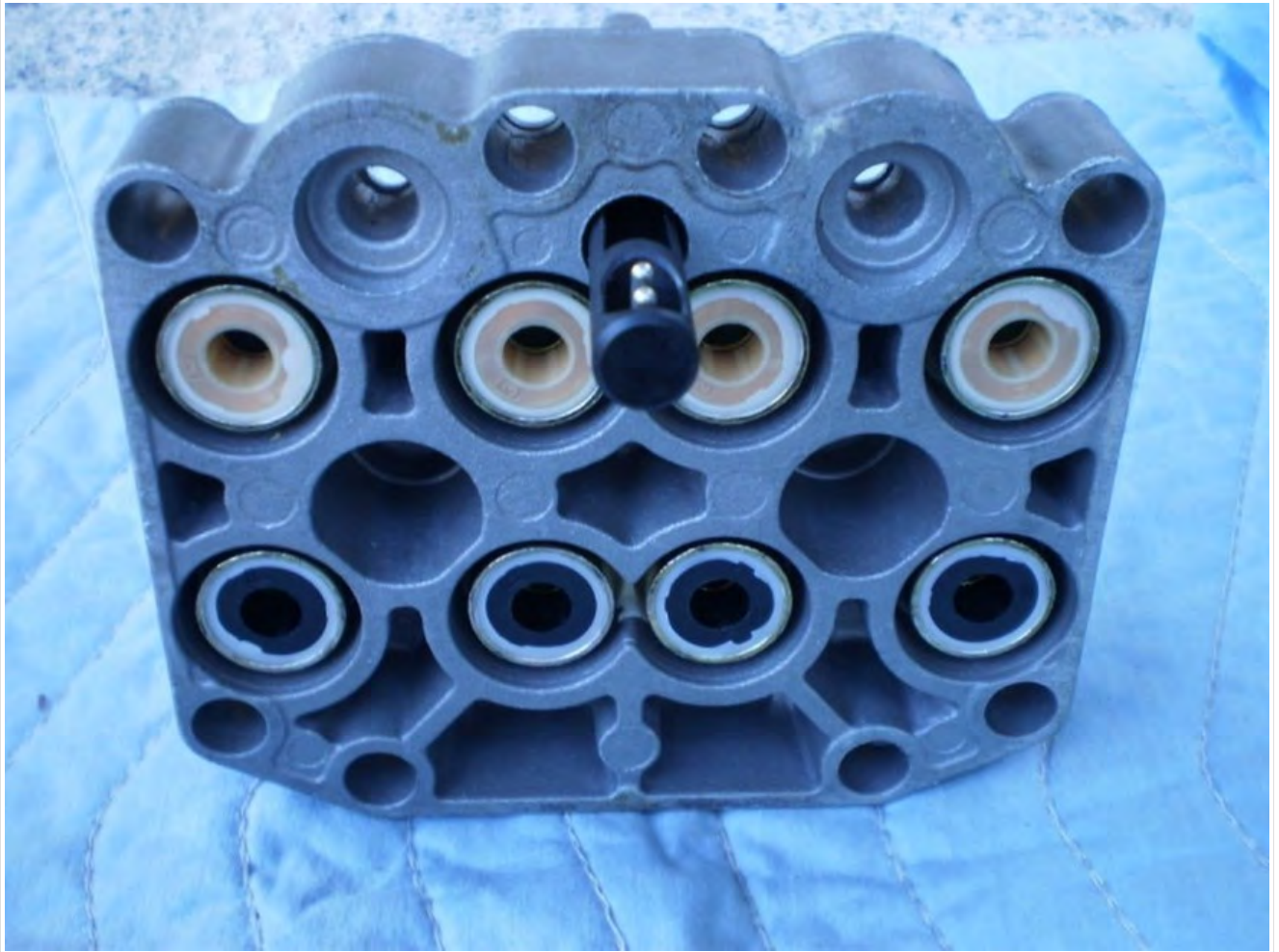


18. Continue to remove the two halves.

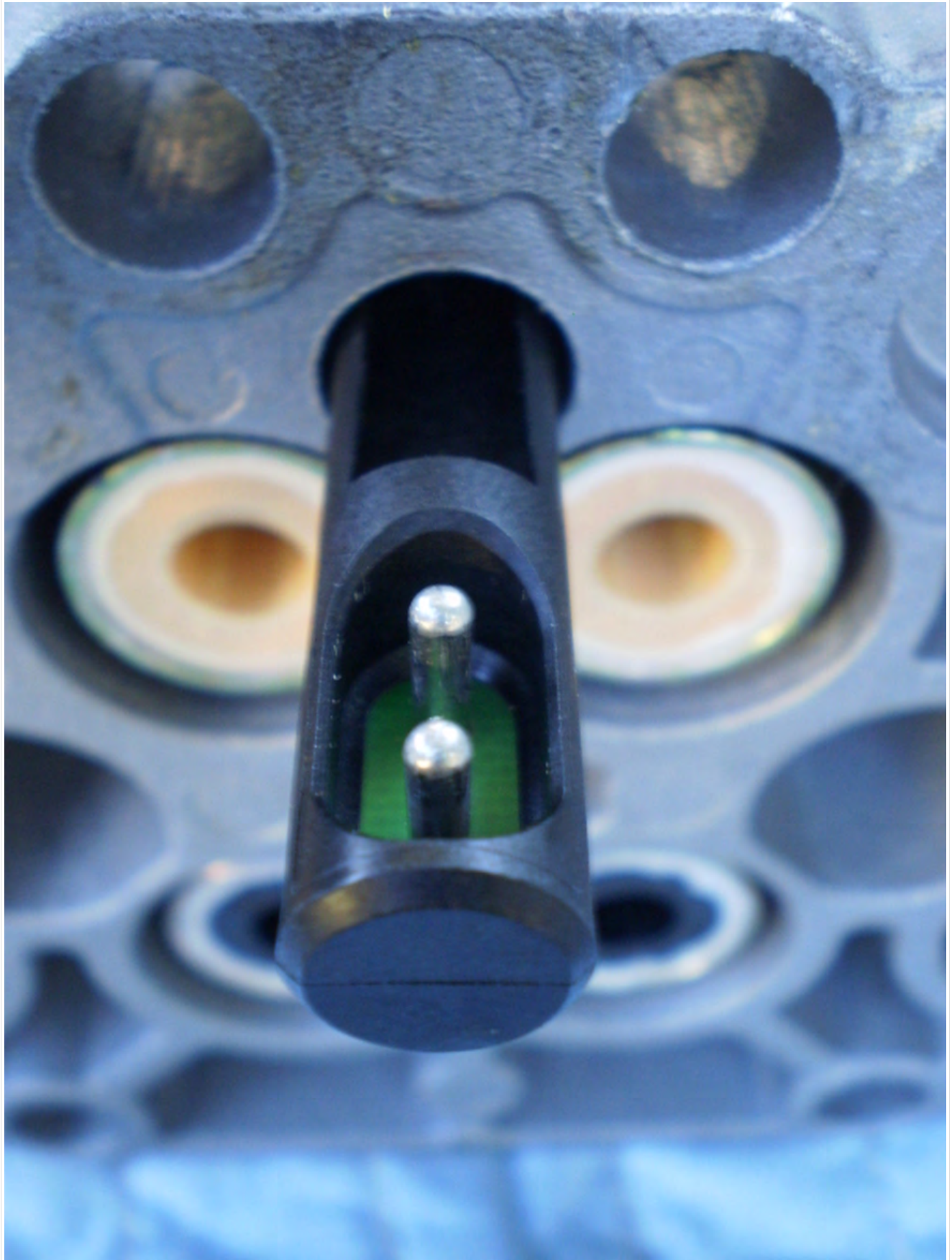




Pump side of the unit. Unit is upside down. Notice the brake line plugs at bottom.



Modulator side of the unit



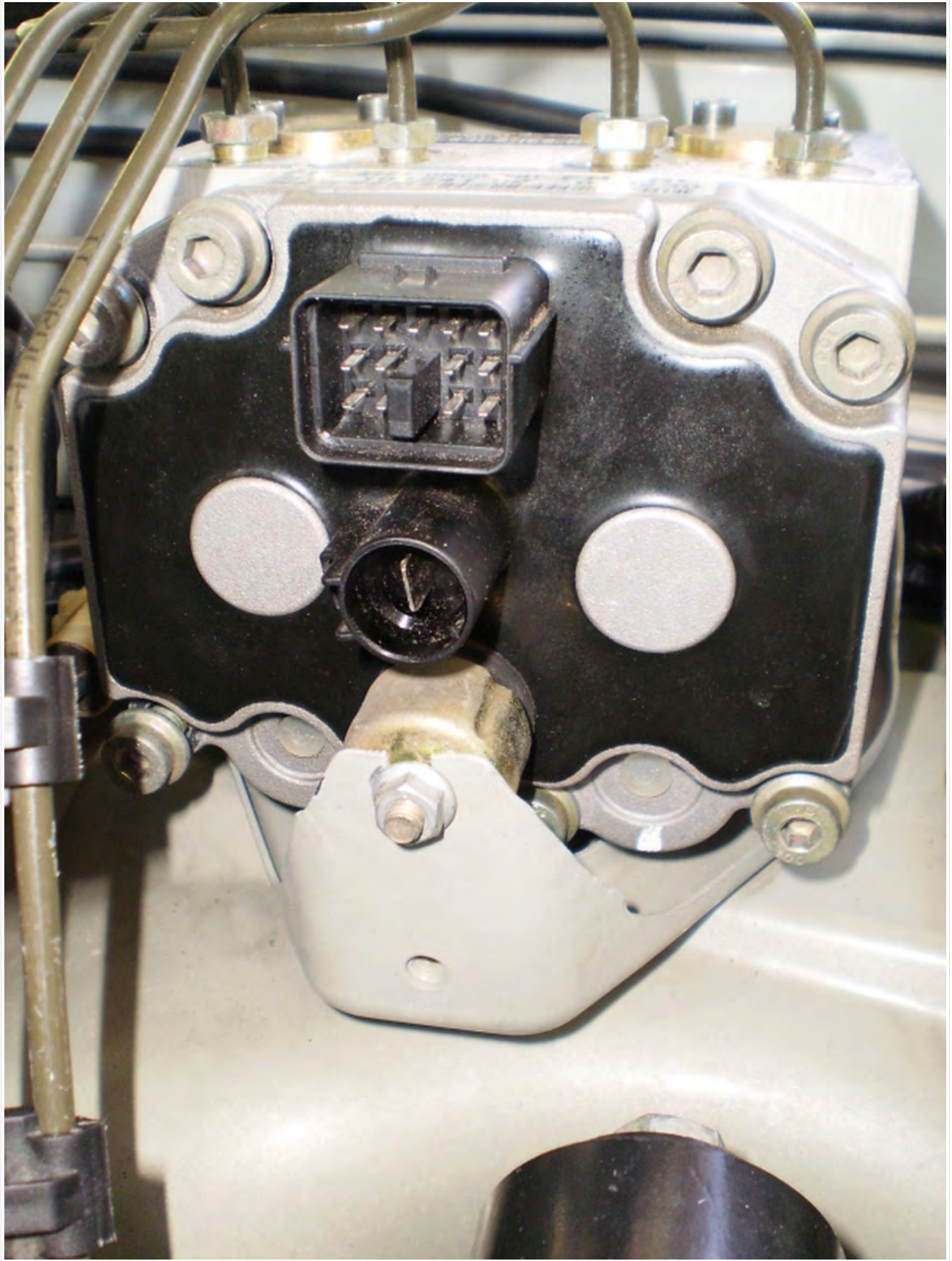
SVS modulator plug circuit board.

*If doing option A, the base of these pins need to be re-soldered. Underside of circuit board is what needs to be shaved off.
Installation is reverse of removal.*

INSTRUCTIONS FOR REMOVING MODULATOR SIDE ONLY

STEPS 19 - 30

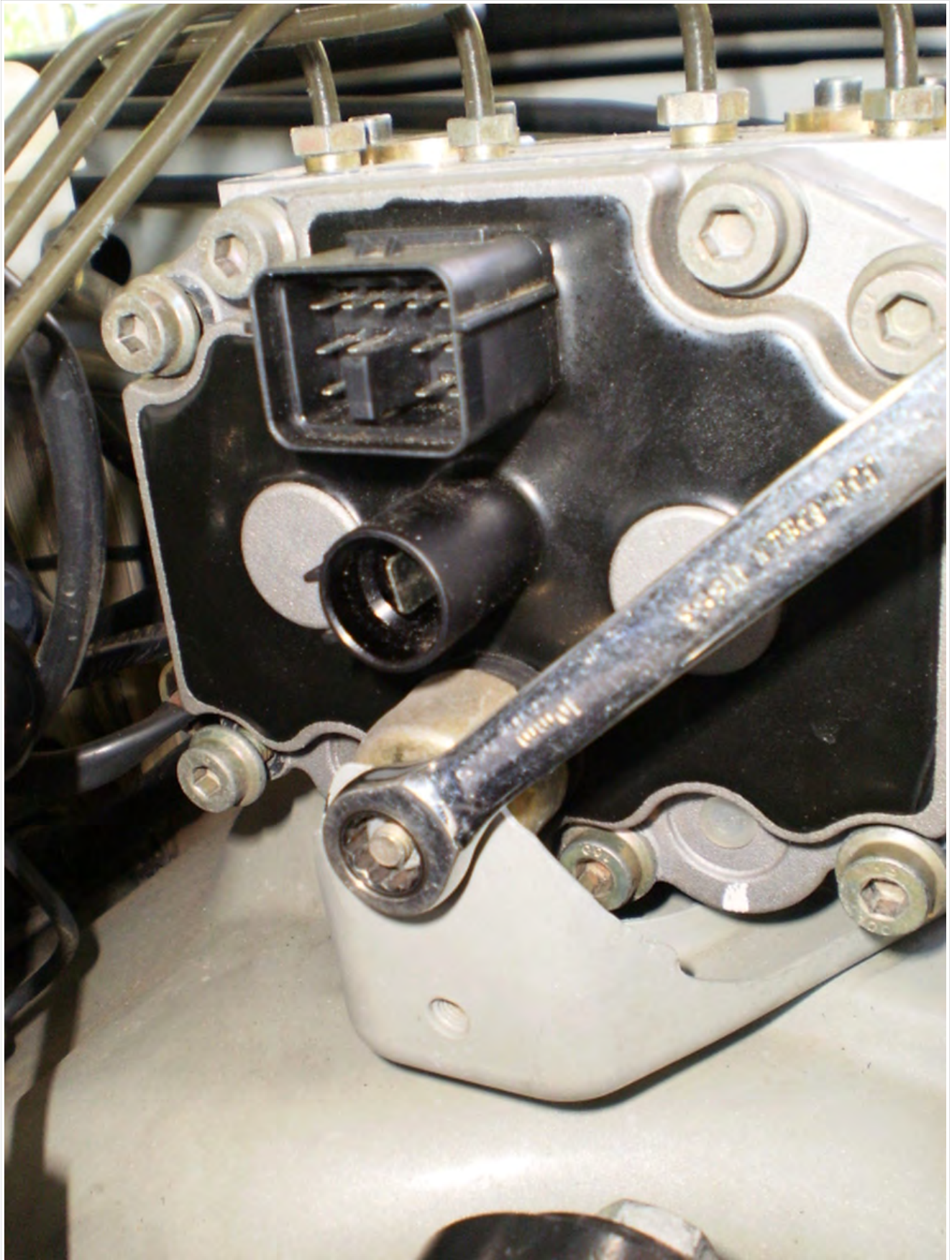
19. Remove two electrical connectors on modulator side.
20. Release the brake pipes from the clips on the bulkhead. Remove intake arm.
21. Brake loose 6 of the 8 modulator bolts (That is the TOP 4, and the BOTTOM 2 on the OUTSIDES). The two closest to the rubber mount will need to be removed later.



22. Remove two clips from the brake lines.

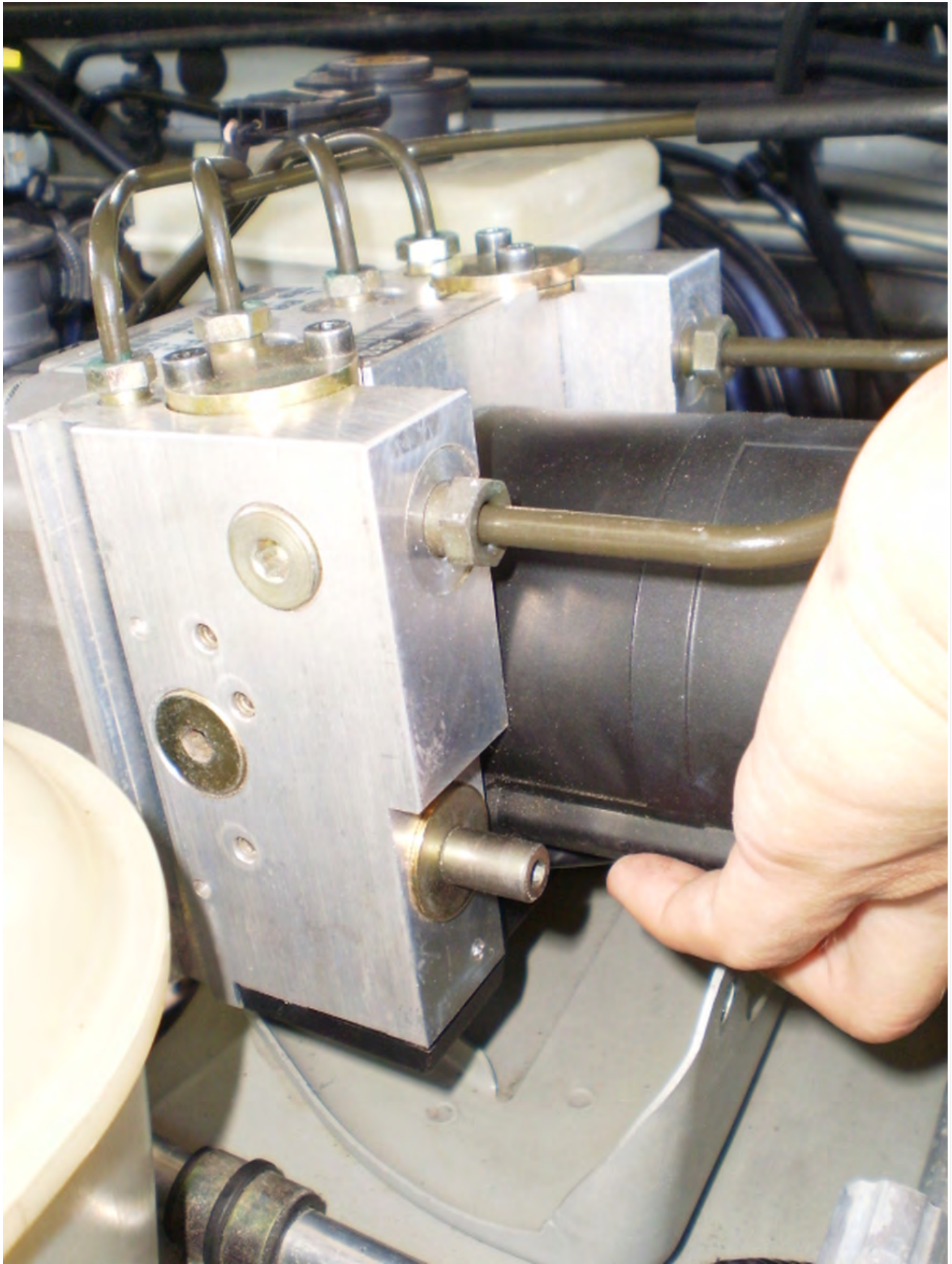


23. Remove the three rubber mounts. One front and two rear.

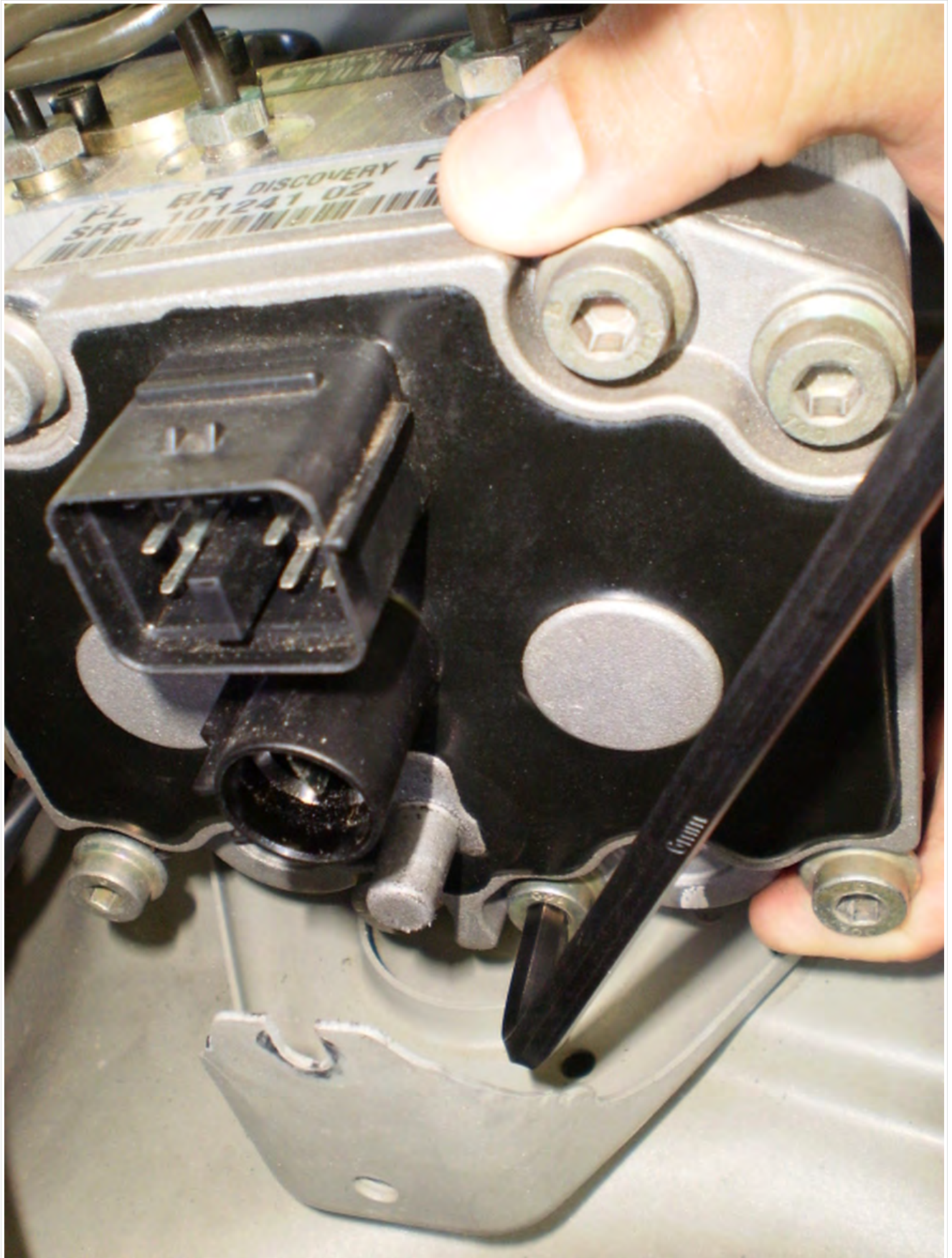


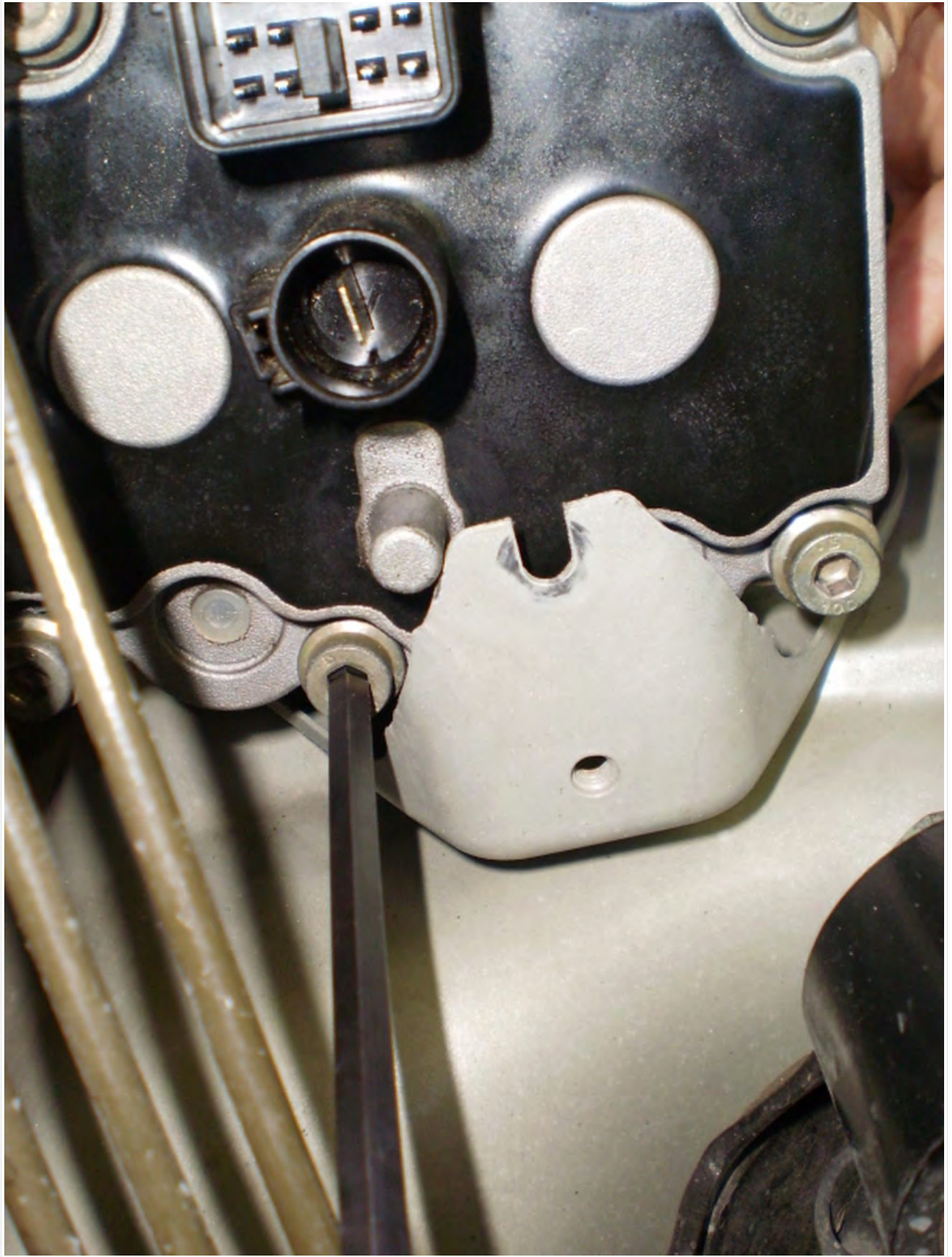
You will now have enough room to position the unit to remove the last two bolts.

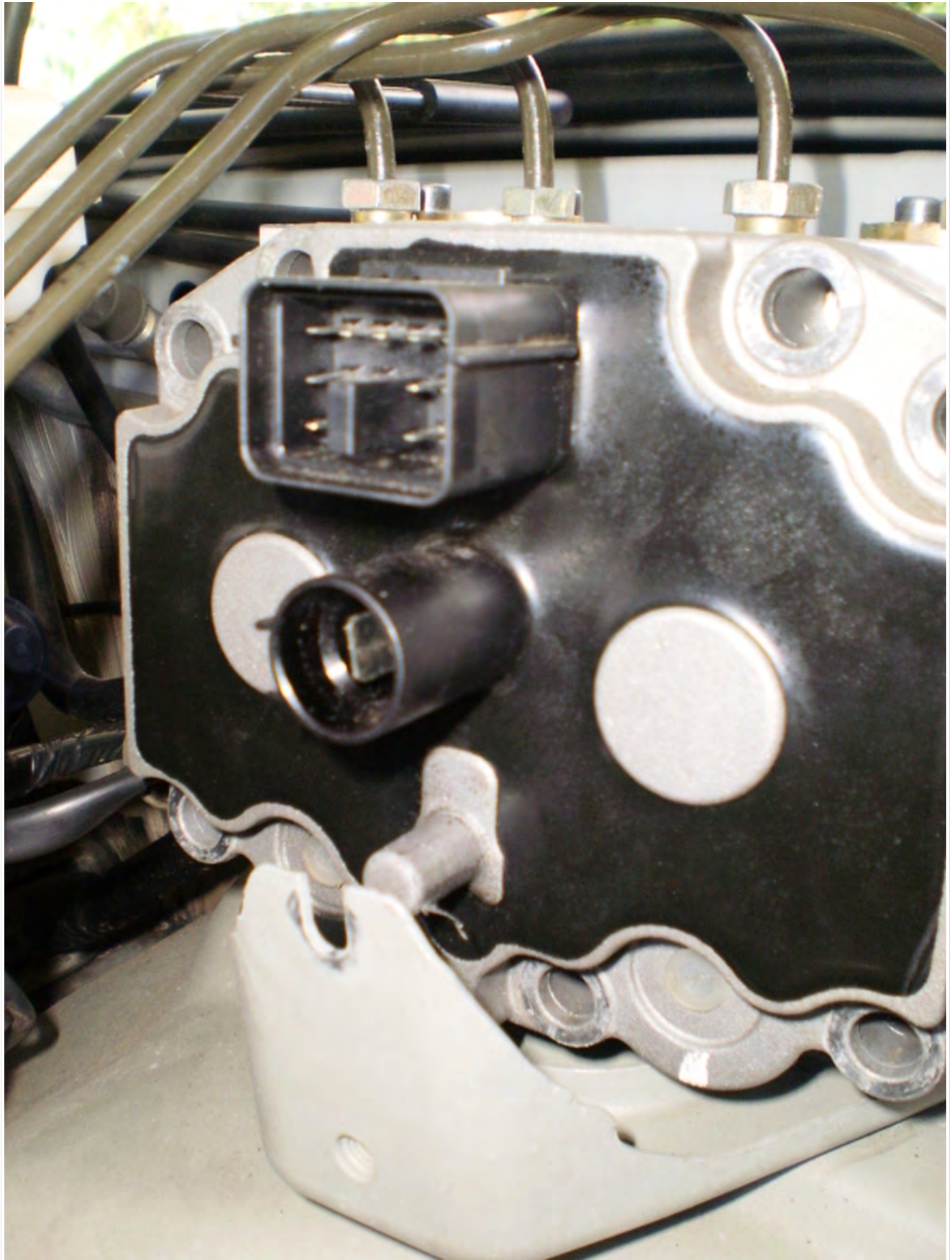




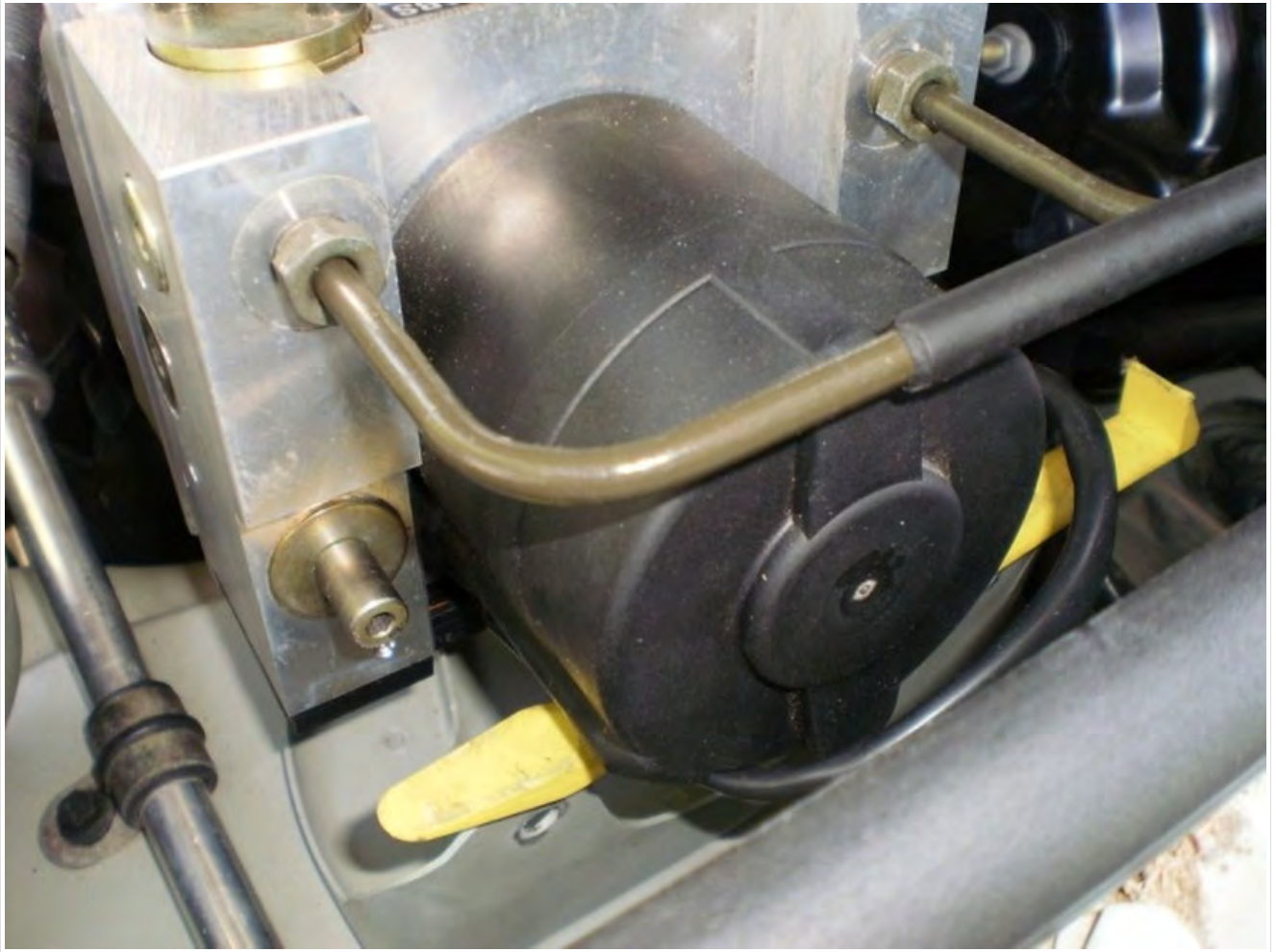
24. Remove the two bolts nearest front mount.





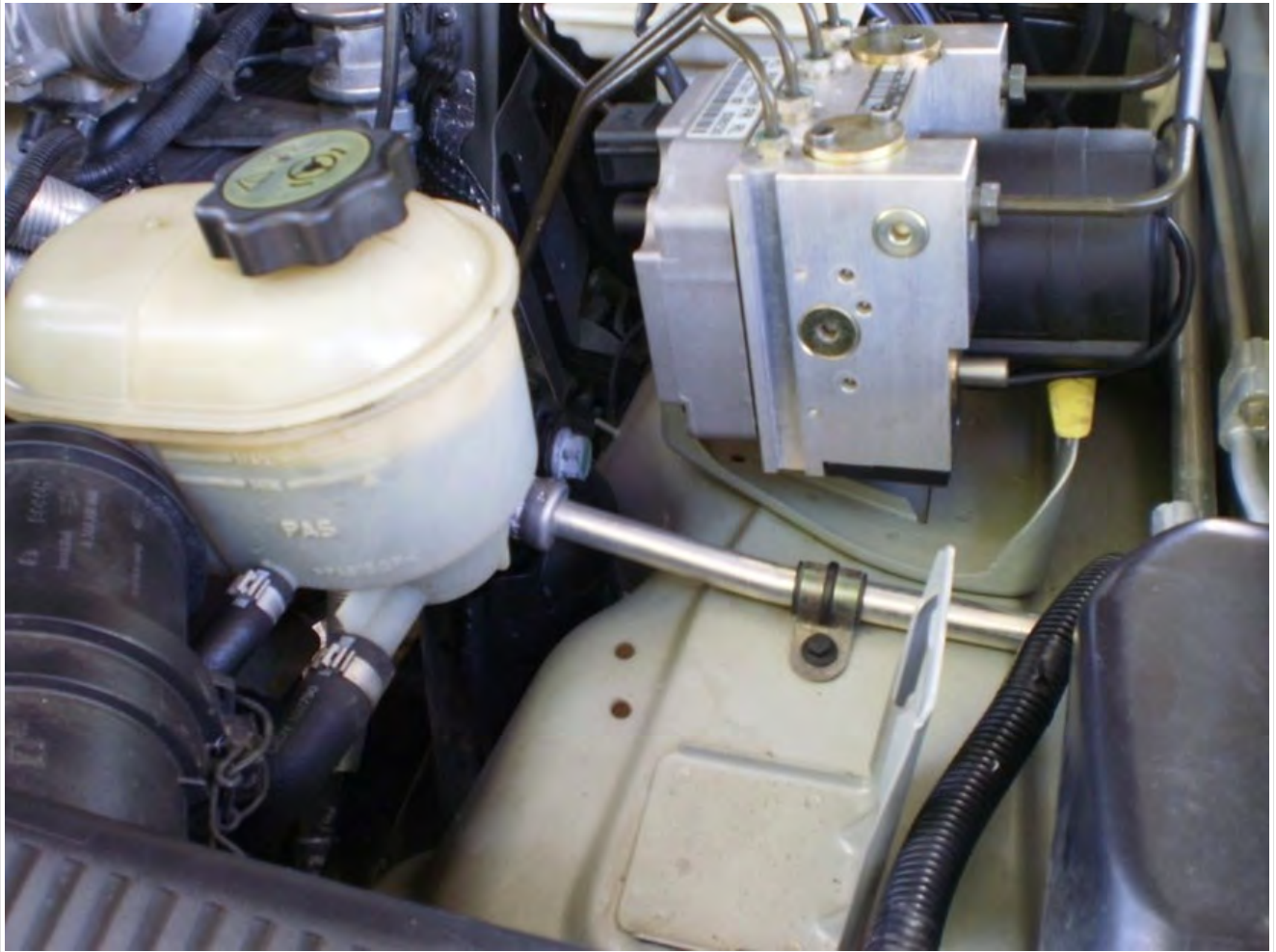


25. In order to have room underneath the ABS unit to access the SVS cover plate screws, raise the pump side of the unit and support it using the top of the rear side of the mounting bracket. I used a plastic trim removal tool to rest it on.

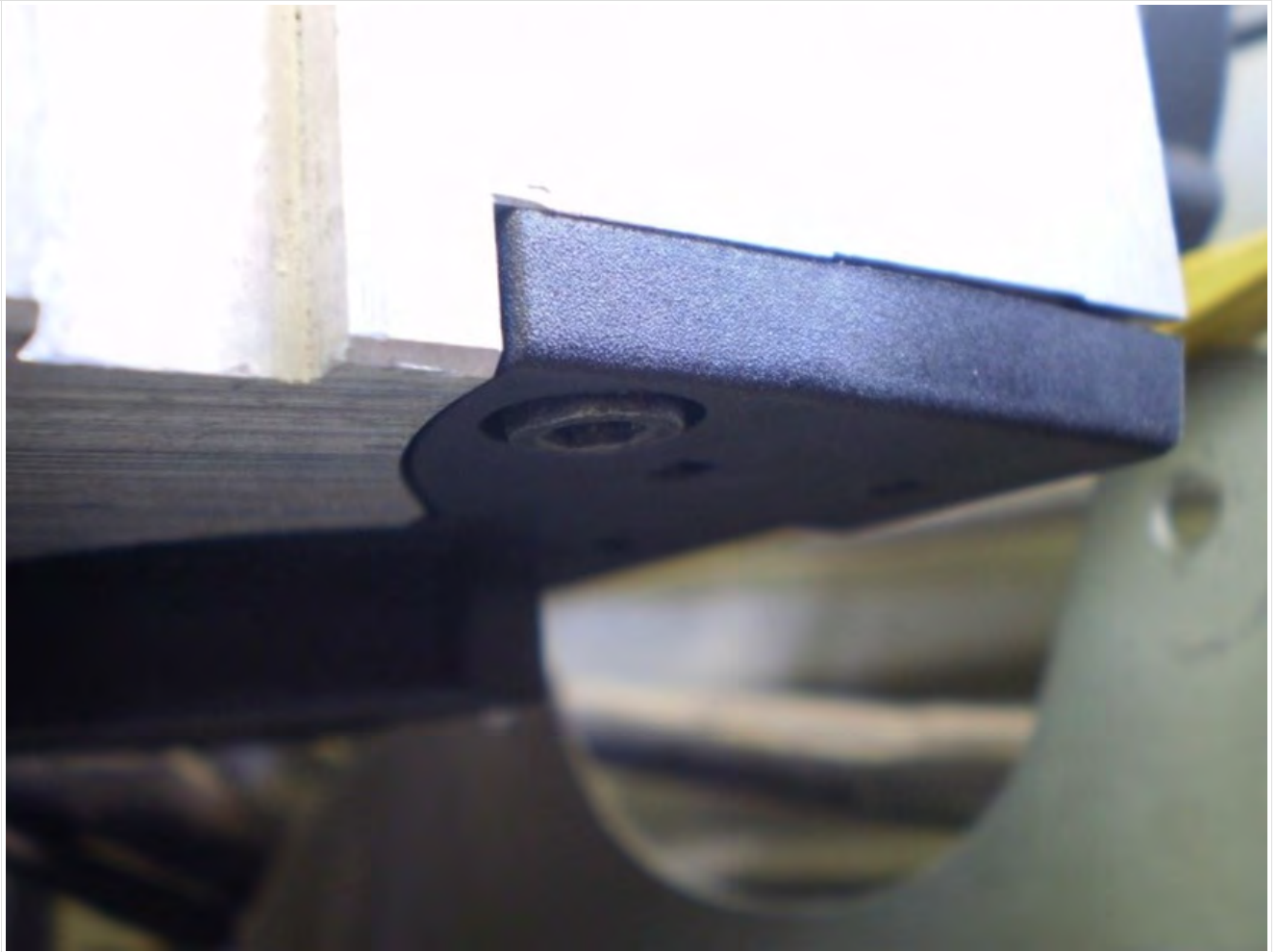


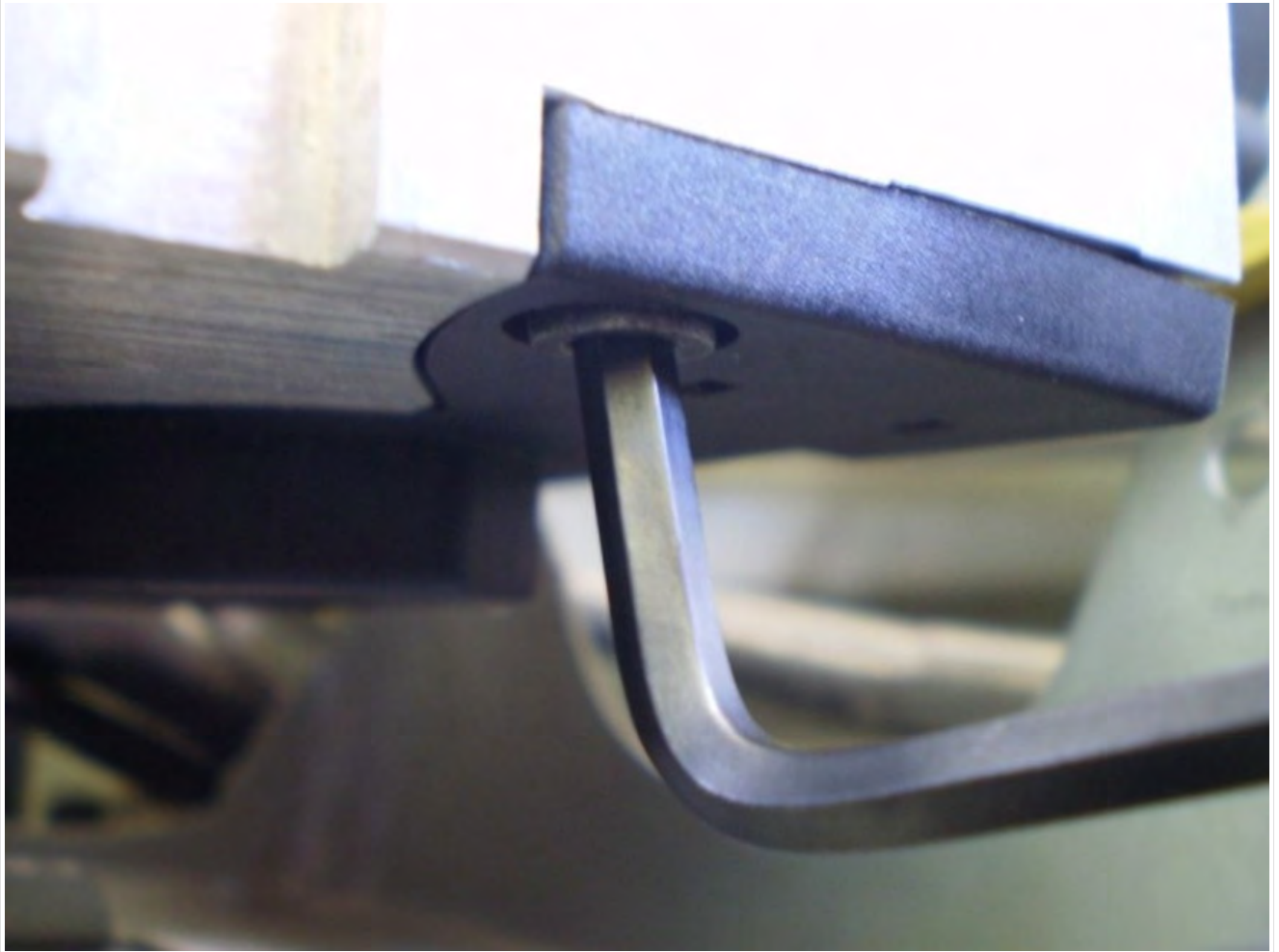


26. Reposition the PAS Fluid reservoir.

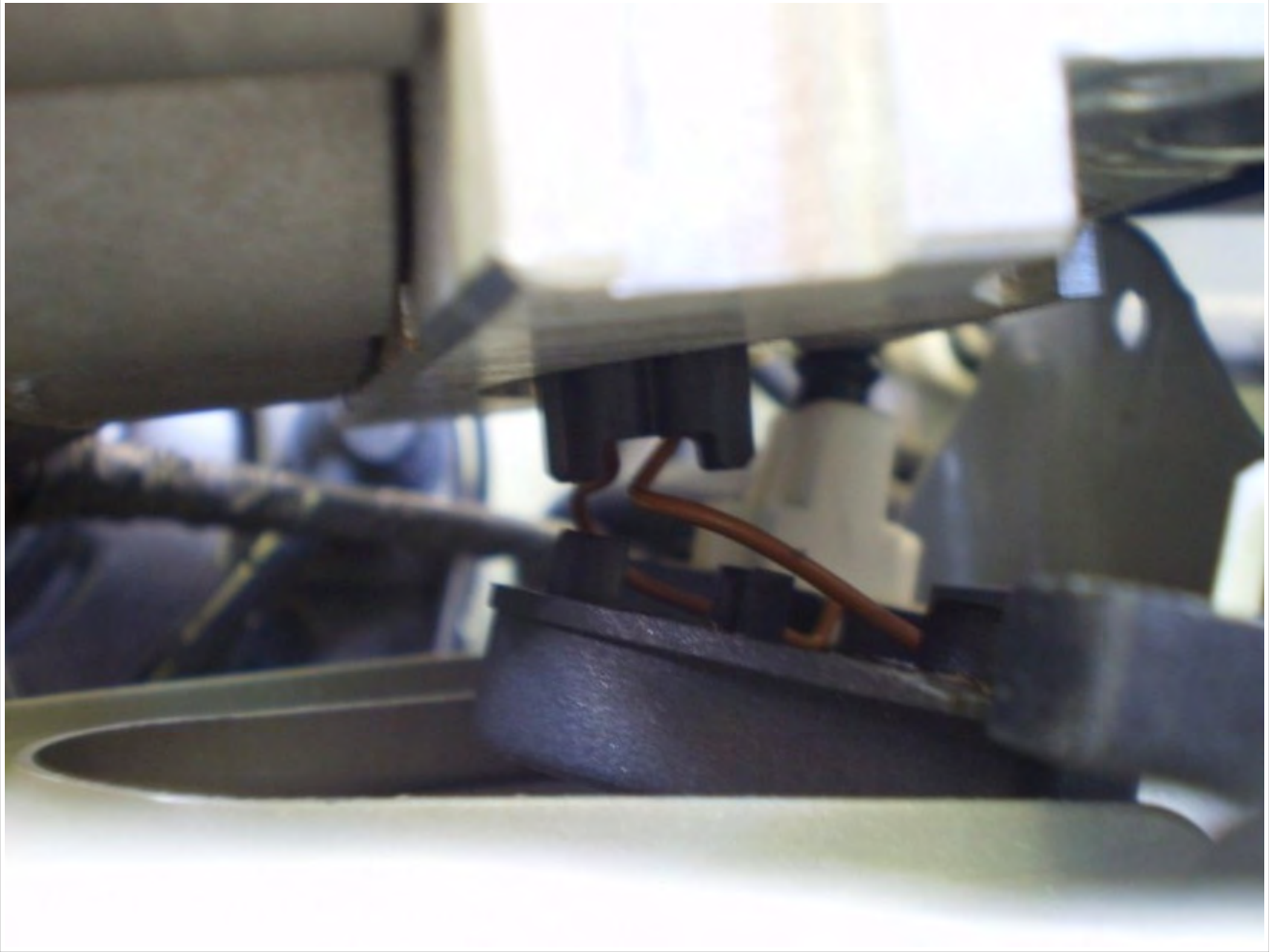


27. Using a 4mm hex key, remove the three SVS cover plate screws. The shorter the hex key the better, as it will allow you to spin around without having to take the key out the screw head.

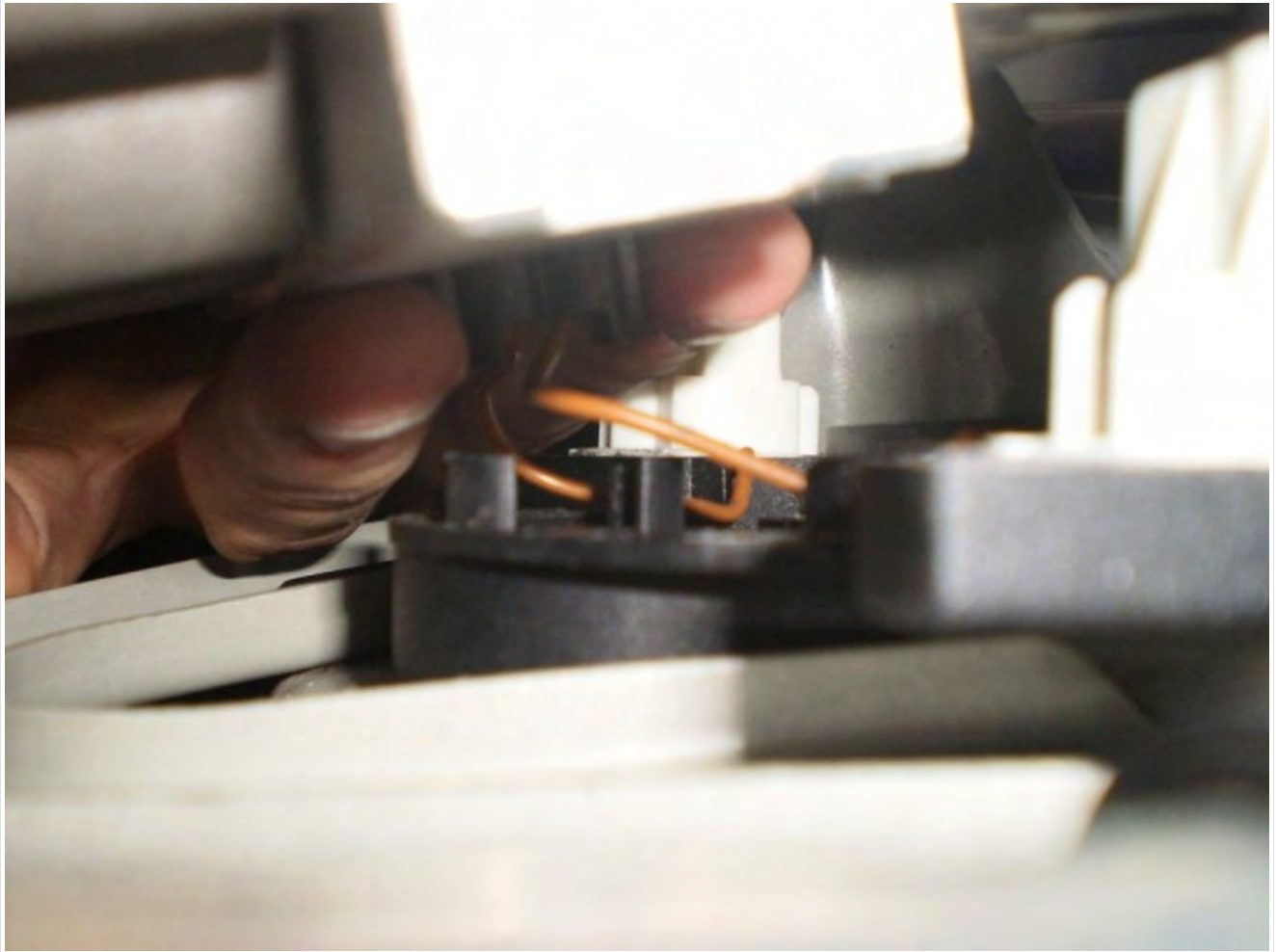




28. Once all three screws are out, carefully pry down the SVS cover plate.



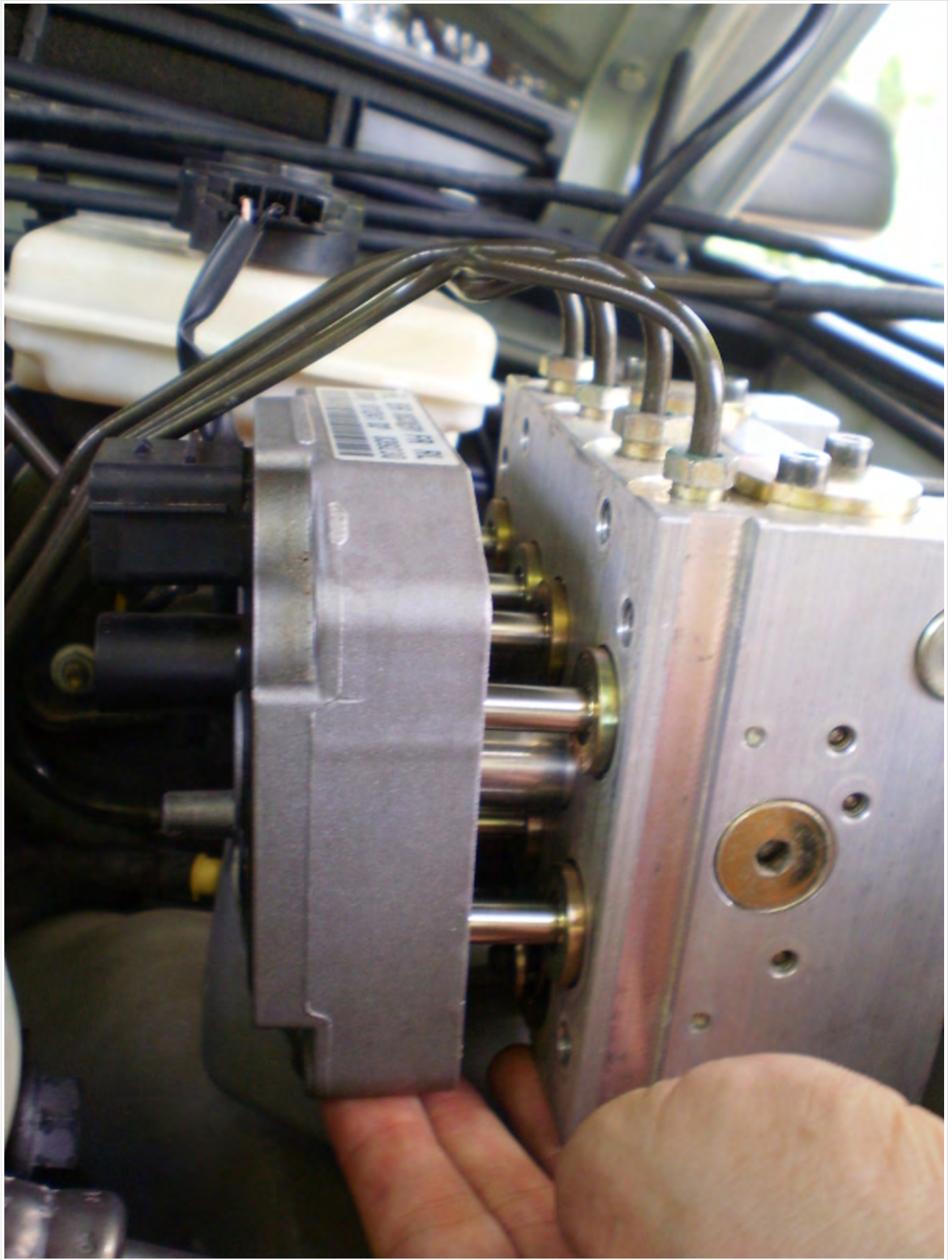
29. You should have enough room to get your fingers underneath and pull the SVS plug down. I needed my assistant to raise the ABS modulator/pump an inch or two so I could use my thumb to unplug it.

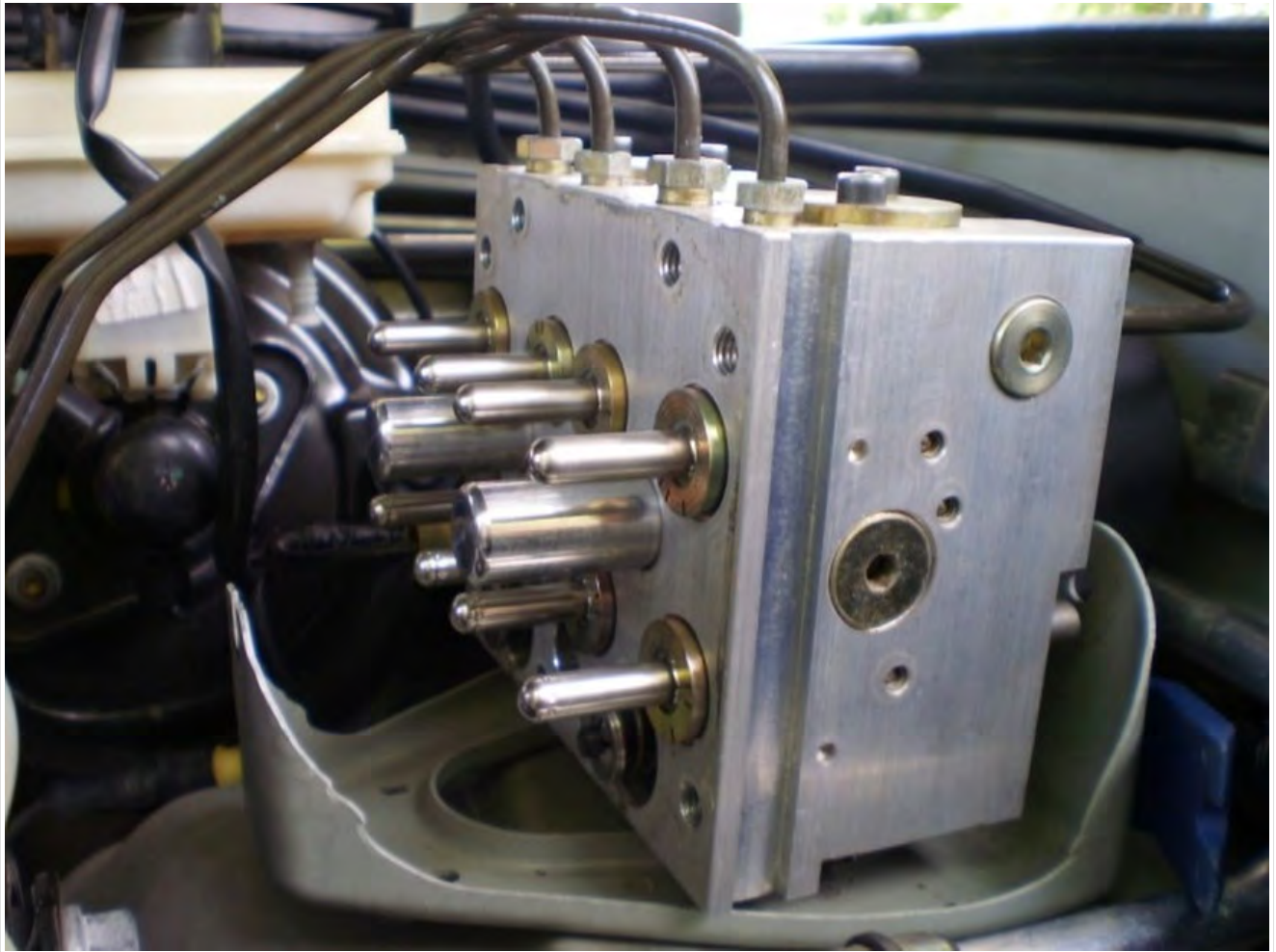


You can see the SVS plug between my fingers

Once unplugged, carefully remove the SVS assembly out from under the unit.

30. The modulator side can now be removed. Slide it out until the SVS plug circuit board is completely out of the pump side being cautious not to bend it or remove it at an angle.





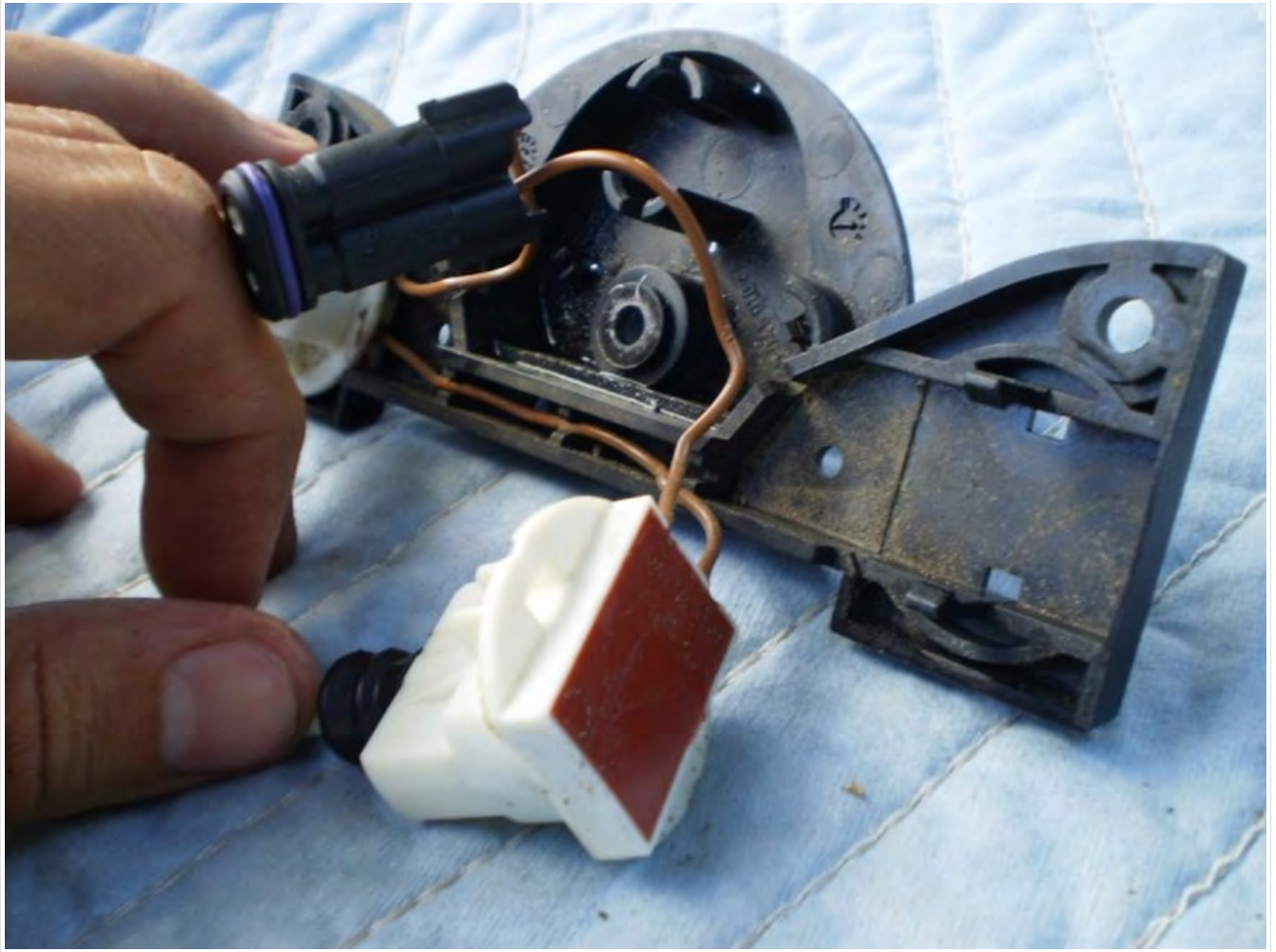
No need to bleed the brakes now....

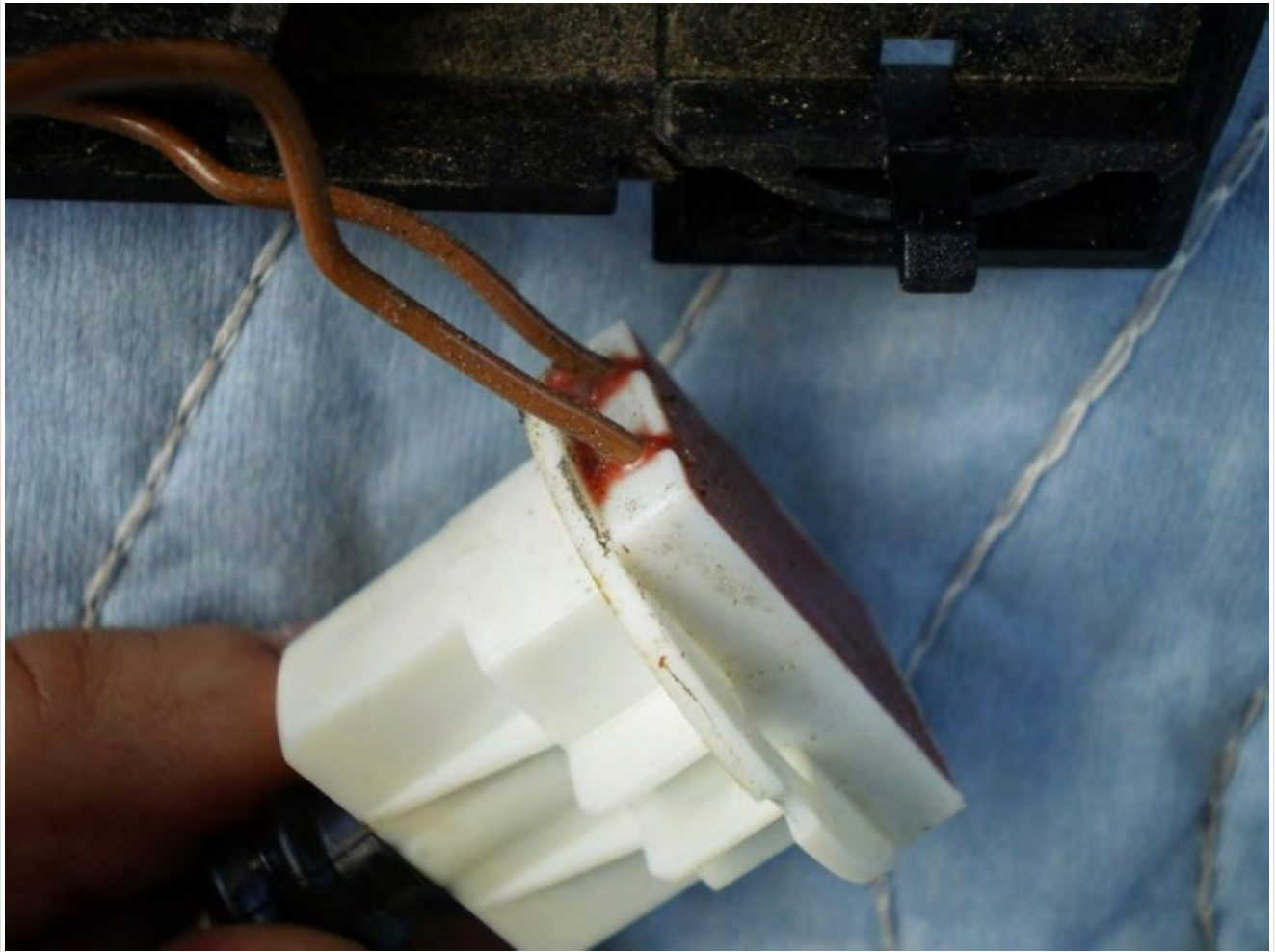
Installation is the reverse of removal.

A CLOSER LOOK AT SVS (SHUTTLE VALVE SWITCHES) AND SV (SHUTTLE VALVES)



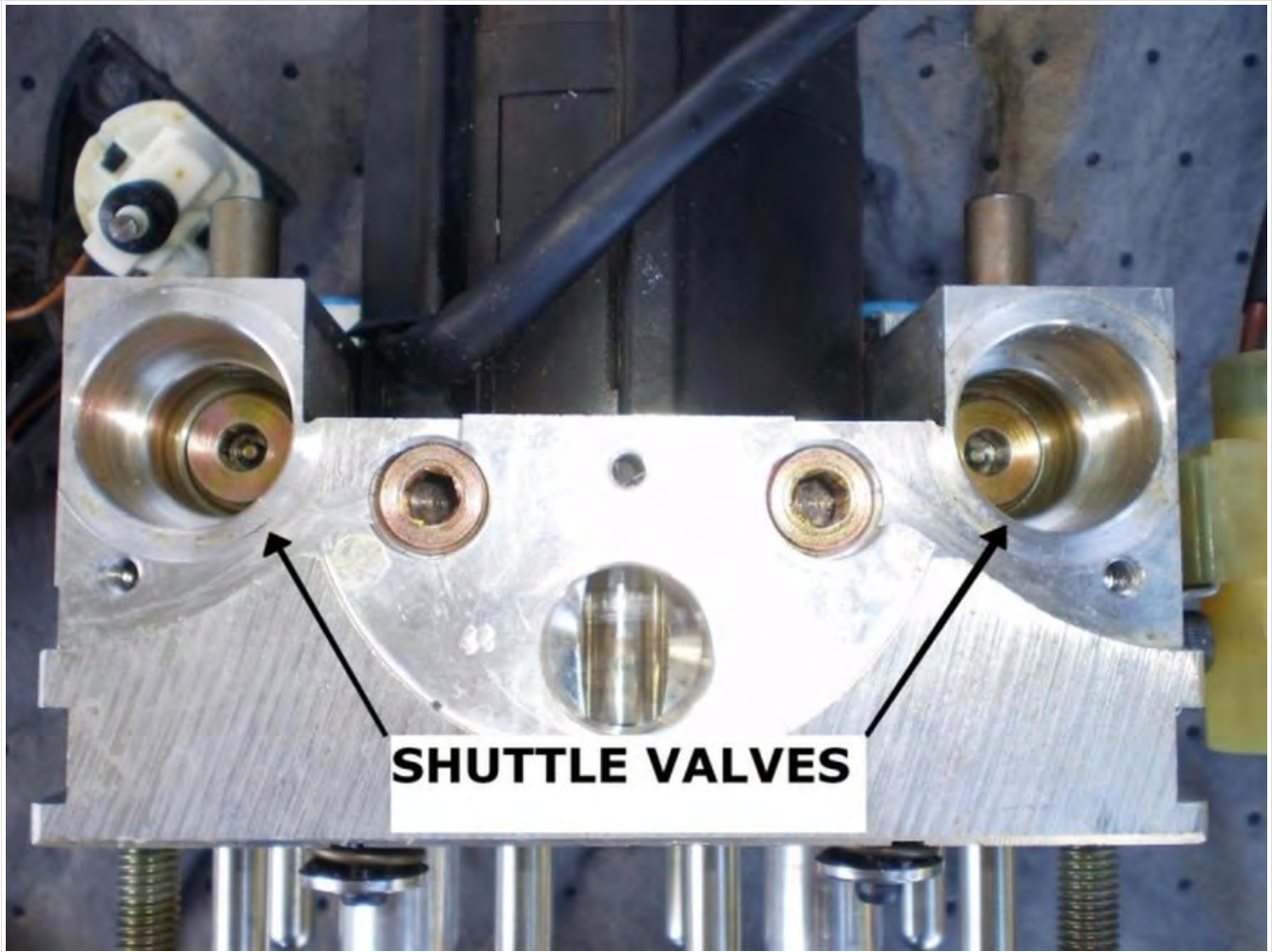


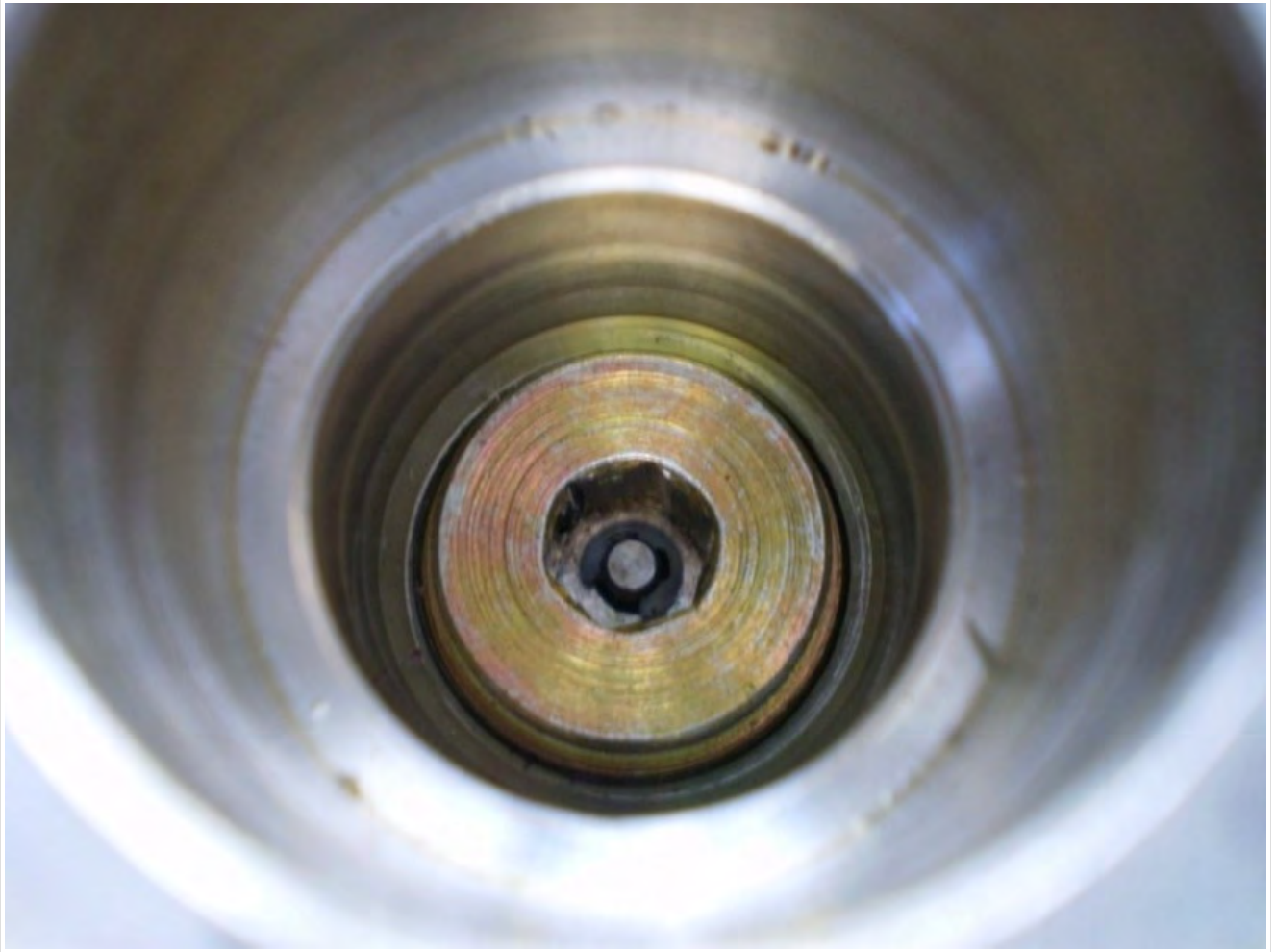




The rubber boot is what prevents brake fluid from seeping out of the shuttle valves and getting inside fouling the switch. If the shuttle valves are leaking, they may be the cause of your THREE AMIGOS, you can replace the seals with this Shuttle Valve seal KIT from Falconworks in Arizona (https://web.archive.org/web/20170730071921/http://www.jewellameroil.com/sales/index.php?main_page=product_info&cPath=65_67&products_id=247)

UPDATE July 2011: See my ABS SVS SEAL replacement guide ([/web/20170730071921/https://landroverclubvi.weebly.com/abs-svs-seals.html](https://web.archive.org/web/20170730071921/https://landroverclubvi.weebly.com/abs-svs-seals.html))

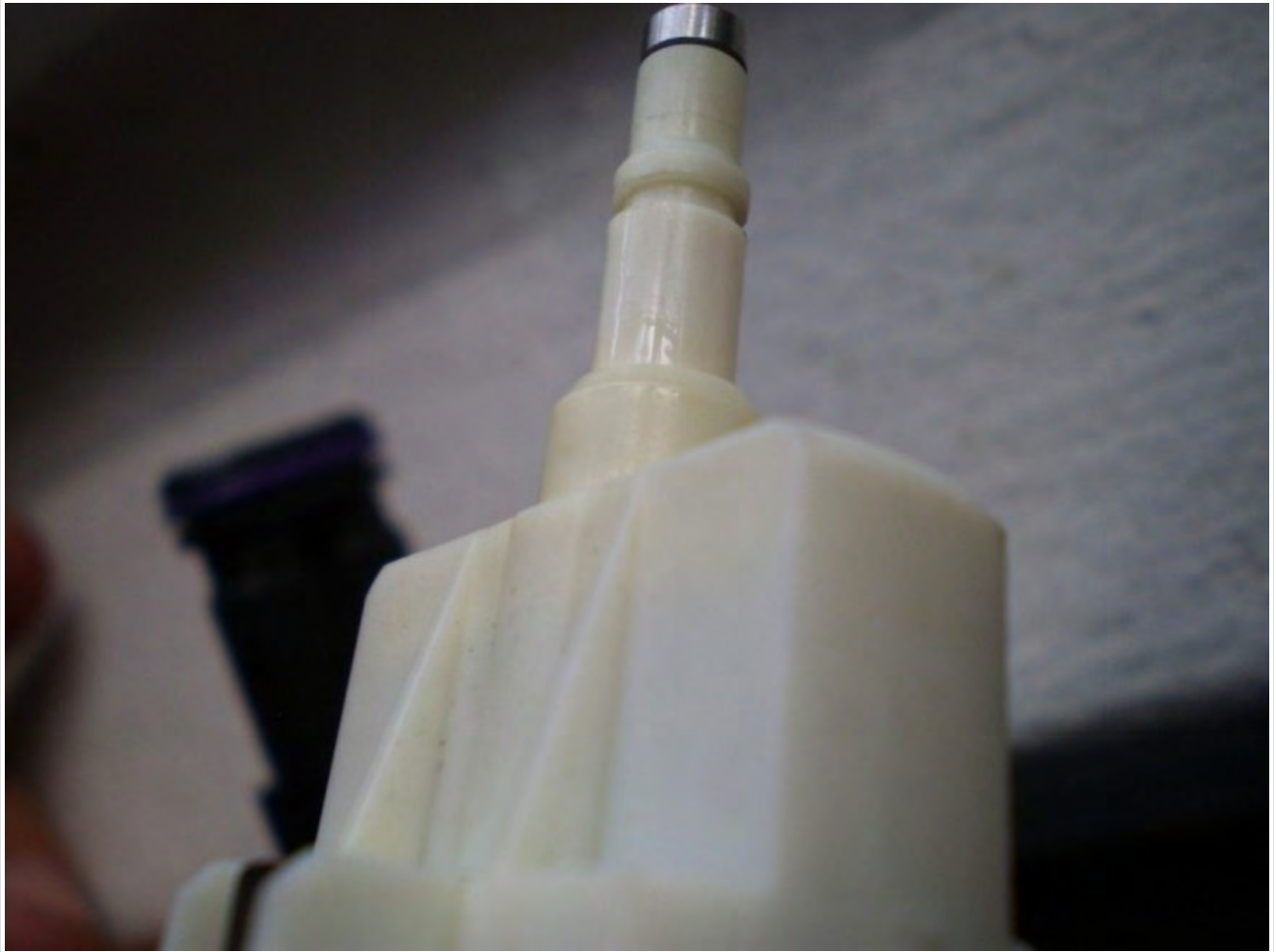




Shuttle Valve. You can see the SMALL circlip that comes in the kit mentioned above.



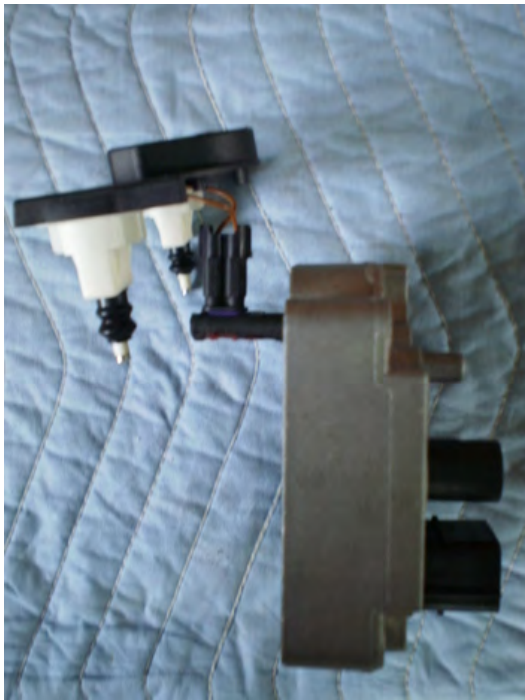
Upon removing the boot I did find some fluid but not enough to cause any problems since they tested withing normal range.



OPTION A

31. Since you are repairing the electrical fault at the SVS circuit board you need to test the SVS at the modulator side of the unit.

Connect the SVS plug to the SVS circuit board like pictured below.

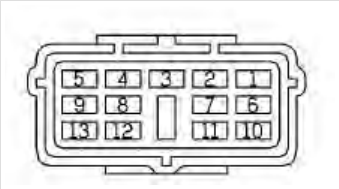


Then turn it over on its side.



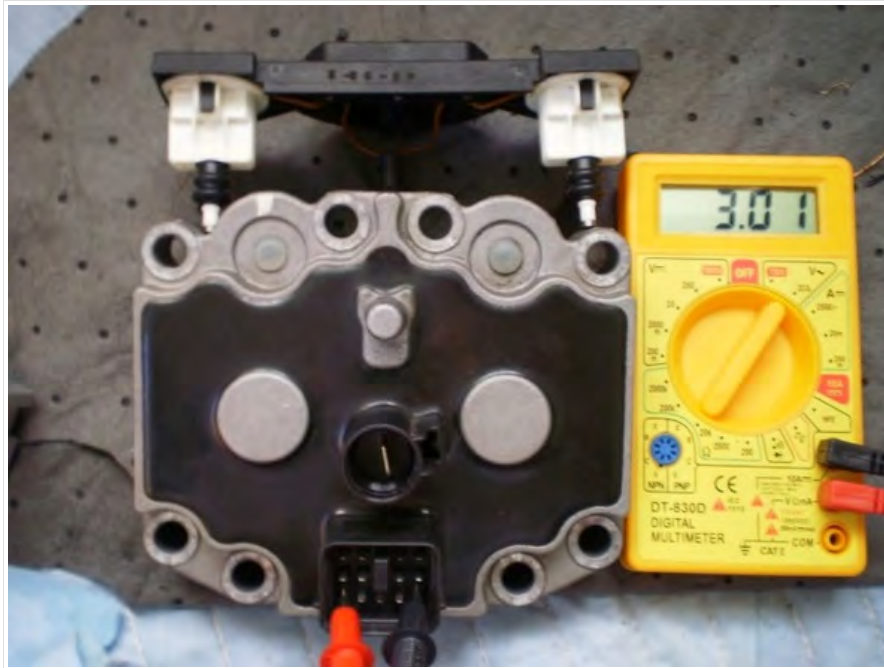
Get your handy DMM and check ohms between pin 9 (red) and 6 (black) All you need to do is have a helper push the switches while you get the readings.

Component	Resistance, ohms
Shuttle valve switches, both open (brakes off)	2977 - 3067
Shuttle valve switches, both closed (brakes on)	1007 - 1037
Shuttle valve switches, one open, one closed	1992 - 2052



Connector C0501

BOTH OPEN ----- PASS



I had my DMM set at 20k

BOTH CLOSED ----- PASS

ONE CLOSED ----- PASS



If you didn't pass the test, your SVS may be faulty and may need replacing.

32. Disconnect the SVS plug. Flip the modulator side "right side up" so the SVS circuit board is at the bottom with the pins facing down. This is the part that requires surgery.



33. Now there are many different ways you can remove the VERY HARD plastic on the underside of the SVS plug circuit board. You can use a small torch and heat up a razor blade or an X-ACTO blade. You can bite it off but that didn't work. I used an X-ACTO blade.

My surgery worked SO well that I cut too deep into the circuit board lines which made this whole repair worthless. FAIL....



The new challenge I had was that I completely destroyed the circuit board and even straight wiring it (Option C) would not work.

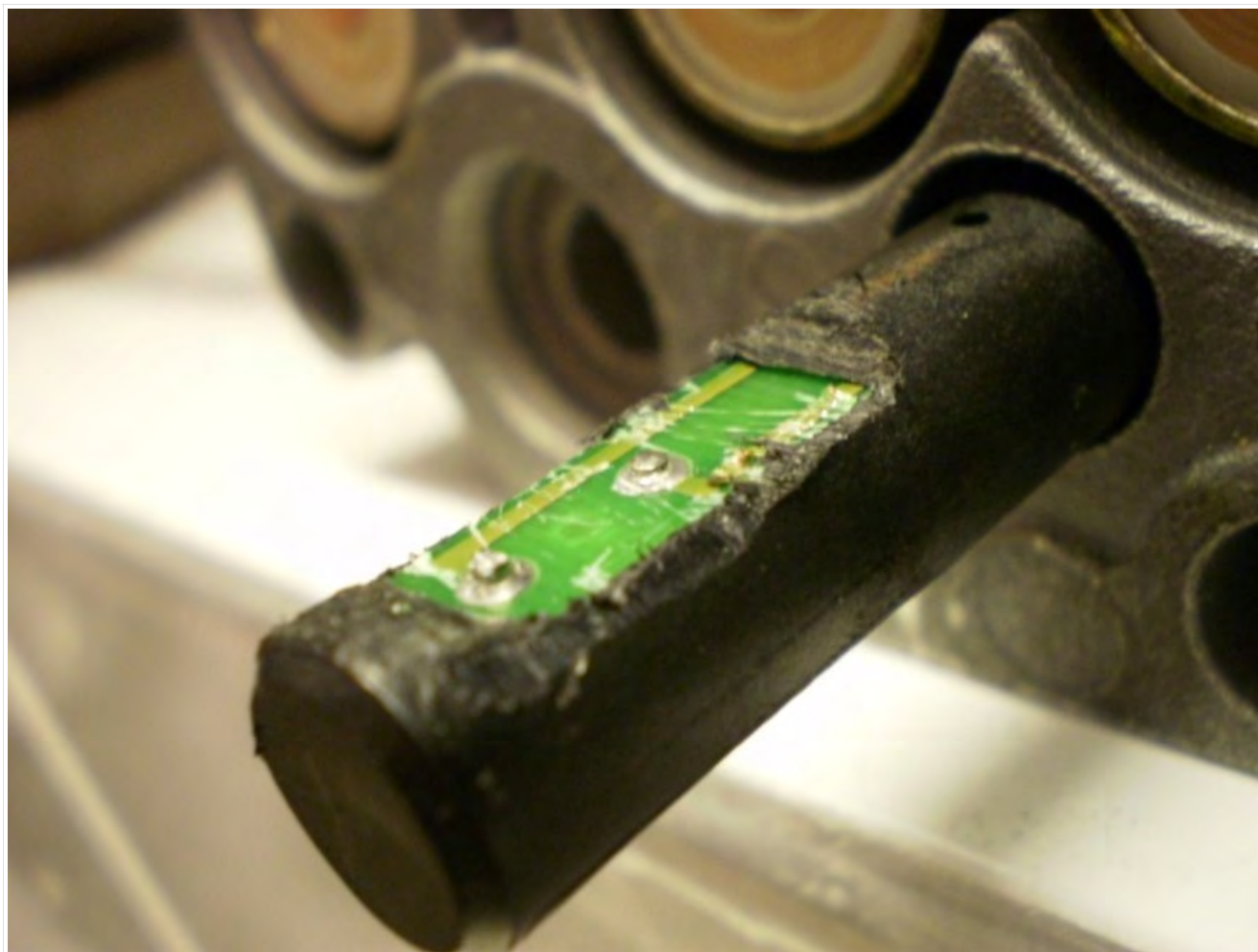
So why does it not work? Well if you remember the SVS ohm test procedure, you place the DMM prongs onto pins 9 and 6 on the modulator to test ohms on the SVS various positions. As it so happens, the SLABS ECU detects and monitors the ohms using ONE wire which turned out to be the YG wire on connector C0501- pin 9. Pin 9 continues

on to meet the SVS harness via that circuit board encased in hard plastic then through the SVS plug. Pin 6 is grounded internally within the modulator so there is no wire going to that pin via connector C0501- pin 6. (Hence the discovery of Option B)

Since I severed the connections on the SVS circuit board, I created a permanent open scenario resulting in a permanent SVS Electrical Fault. The fix? Option B.

Re-doing the SVS ohm test after surgery is a good idea to make sure you didn't cut anything..... and of course I failed the test..

If you accidentally cut too much... go to Option B (# 37) If not, read on.



34. Luckily I had that spare modulator and I continued on with the repair. Except this time I used a very sharp serrated steak knife. **WHAT A DIFFERENCE!!!** I basically shaved it of little by little.

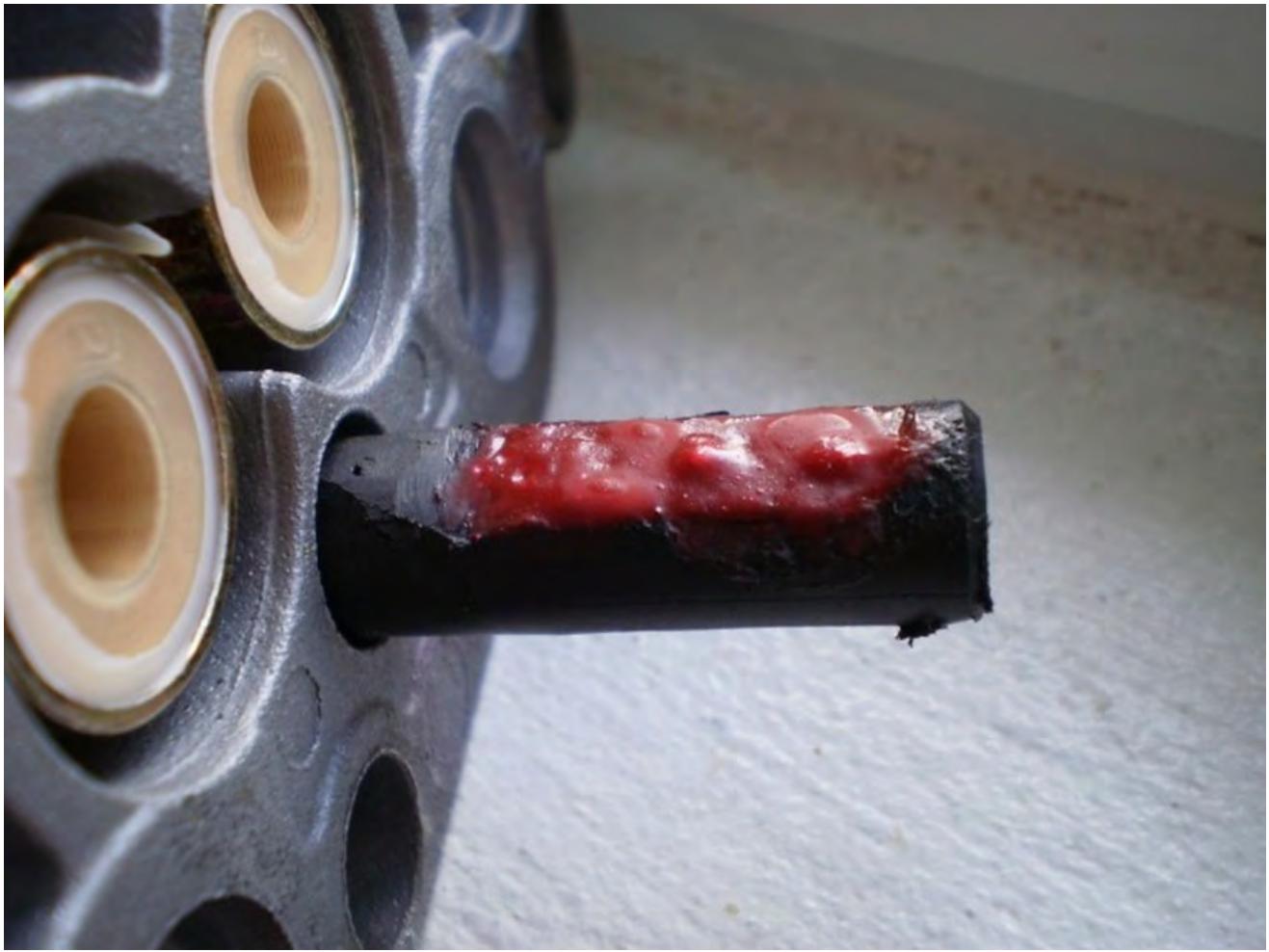


35. Upon inspection of my circuit board and that of the spare's, I found it very hard to tell if the soldered joints were bad. Both pins remained on the circuit board when I removed the SVS plug but I could tell they weren't 100% solid. I re-soldered the pins on the spare unit. Be careful as the pins may fall out. while soldering. One did fall out but I was able to reinsert it with pliers and re-soldered it. I re-tested the SVS on all three positions and passed.

I was concerned that the fallen pin would not be soldered strong enough but surprisingly it held very well and it passed the ohm tests after about 10 tries plugging and unplugging the SVS plug just to make sure.



36. A few coats of liquid electric tape and done. The store only had red liquid electric tape.



OPTION B

This option is my favorite. It allows one to fix their SVS fault the fastest and is a more permanent repair compared to OPTION A.

So how does this work?

Answer: *The SLABS ECU uses one wire to get a signal from the SVS. The signals the SLABS ECU monitors are; SVS CLOSED, OPEN, or ONE OPEN, ONE CLOSED. If the SLABS ECU senses an open in the circuit, the Three Amigos pay a visit. So having messed up the SVS plug circuit board I needed to find a way to replicate this "monitoring" by bypassing the circuit board completely. I needed to figure out the missing link between the YG wire and the two pins on the circuit board. As it turned out, one SVS pin went to ground, and the other went to the YG wire. THAT WAS IT!*

I tested it using a customer's DII. I took my SVS and placed it on the customer's ABS pump. I cut into his YG wire, ran a wire from there to the SVS plug, then ran another separate wire from ground to the other pin on the SVS plug. I tested for Ohms and boom... I passed at OPEN, CLOSED, and ONE Open.

That told me that I don't need to do OPTION A.... EVER... I don't need to mess with that little SVS circuit board and risk cutting it up. It became clear this method was better. Hopefully I have won you over on your decision to do option B.... so let's do it!

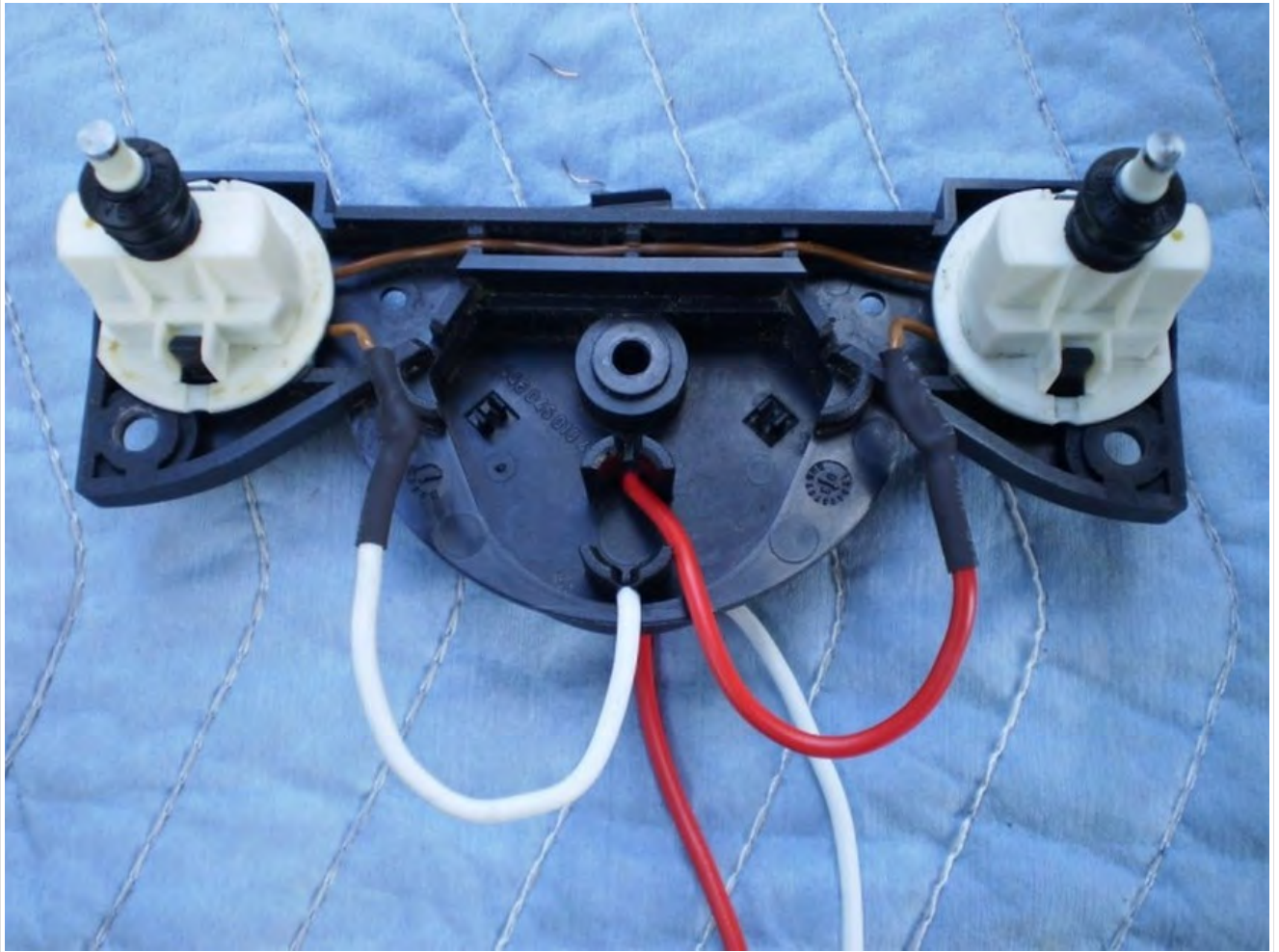
37. You need to decide how you want to connect and run the wires. Read through all of OPTION B to get a better understanding. I chose a trailer connector harness for a few bucks. I cut my connector 3/4 of the length.

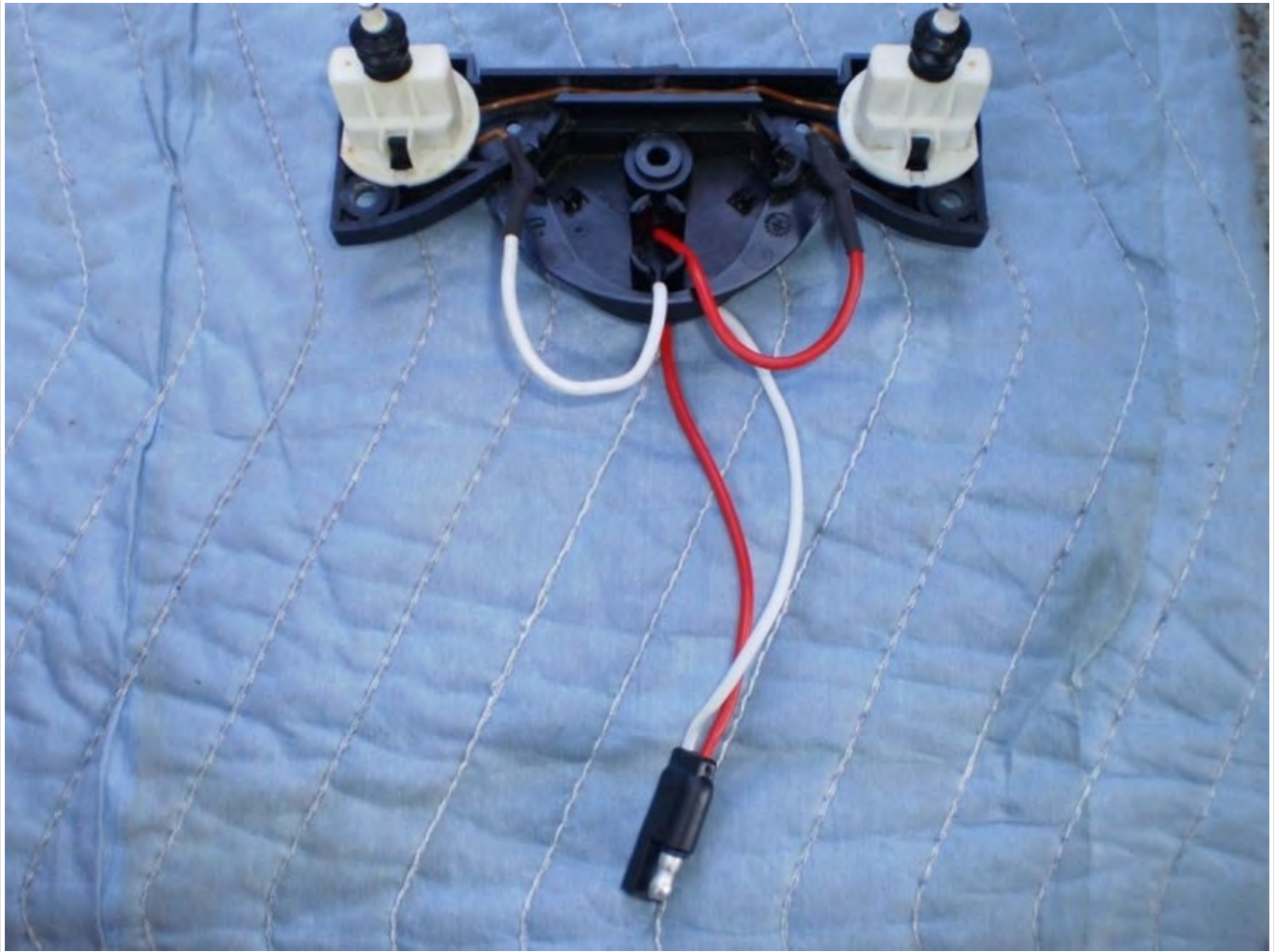


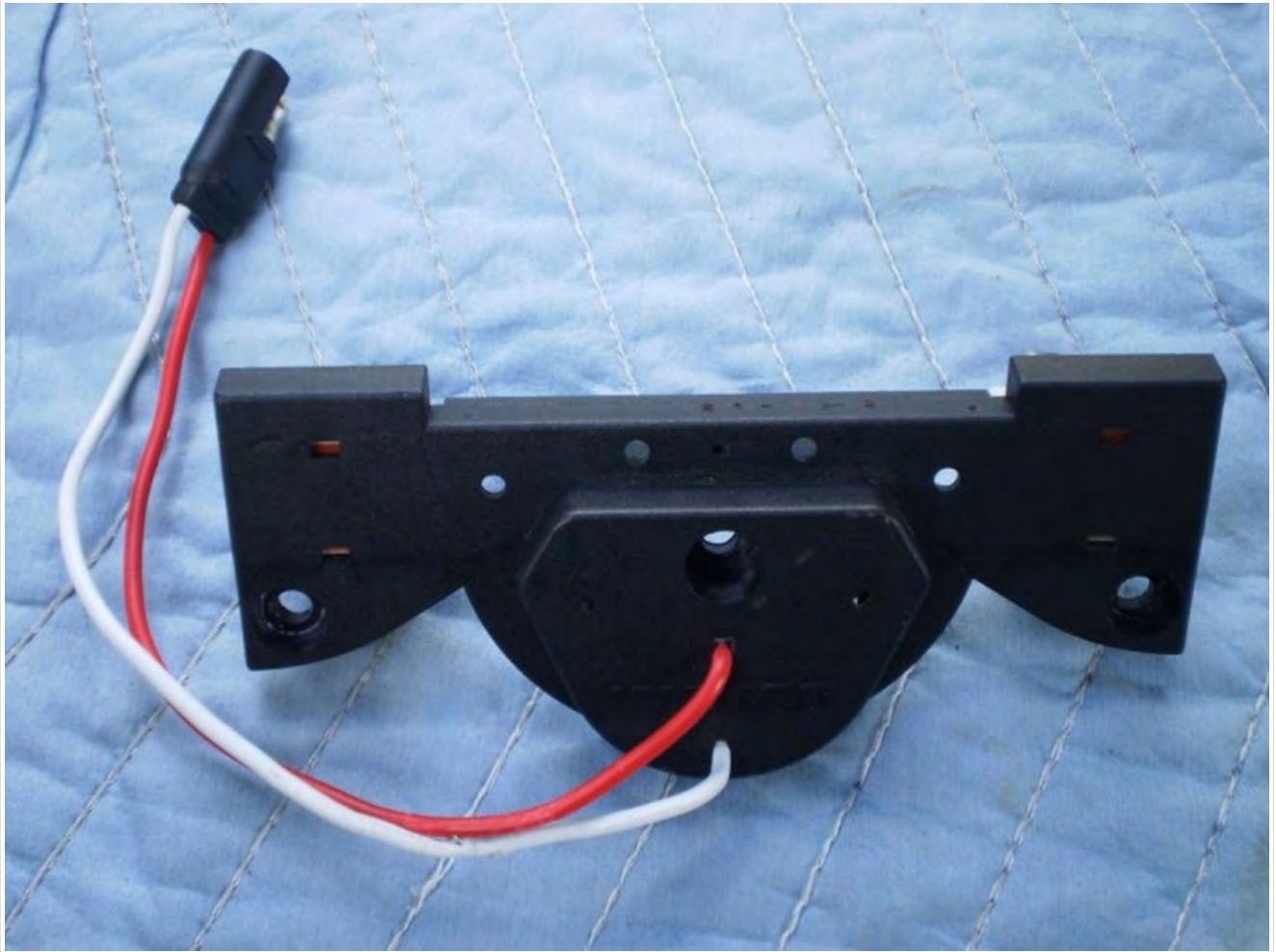
38. Remove your SVS any method you desire, Option A, or Option B without removing the modulator side (see steps # 25 through # 29) Cut SVS plug, but unlike my cut illustrated below, cut as close to the plug as possible.



39. Splice, solder, and heat shrink the longer end of the trailer connector to the SVS wires and run them through the SVS cover plate.







40. Now to test the connections.



BOTH open, PASSED.



ONE Closed, PASSED.

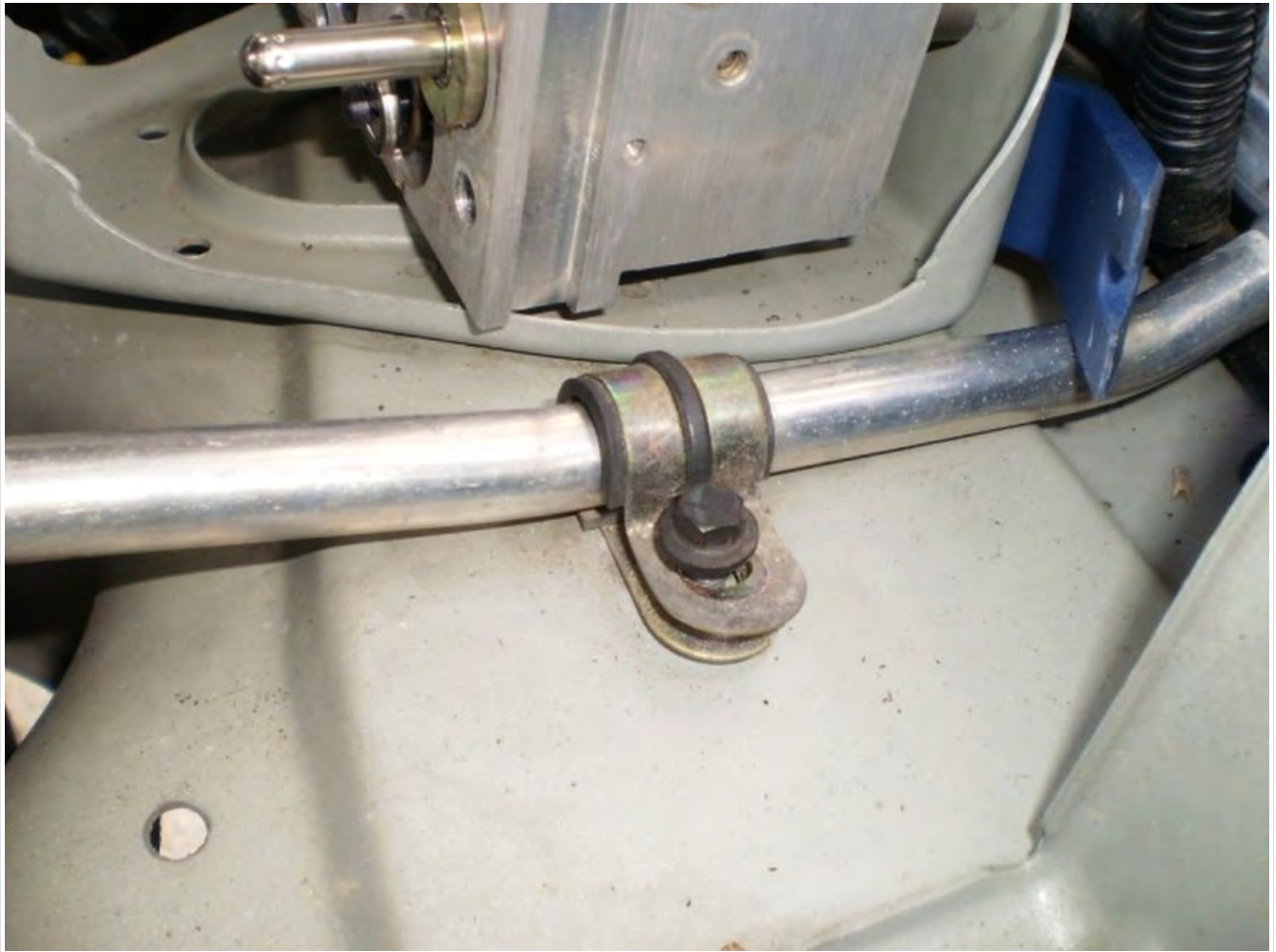


BOTH Closed, PASSED.

41. Now to find a close ground.... Since the YG wire we need to tap into runs along side the A/C line bracket retaining bolt.. Why not use it?

****UPDATE April 22, 2010****

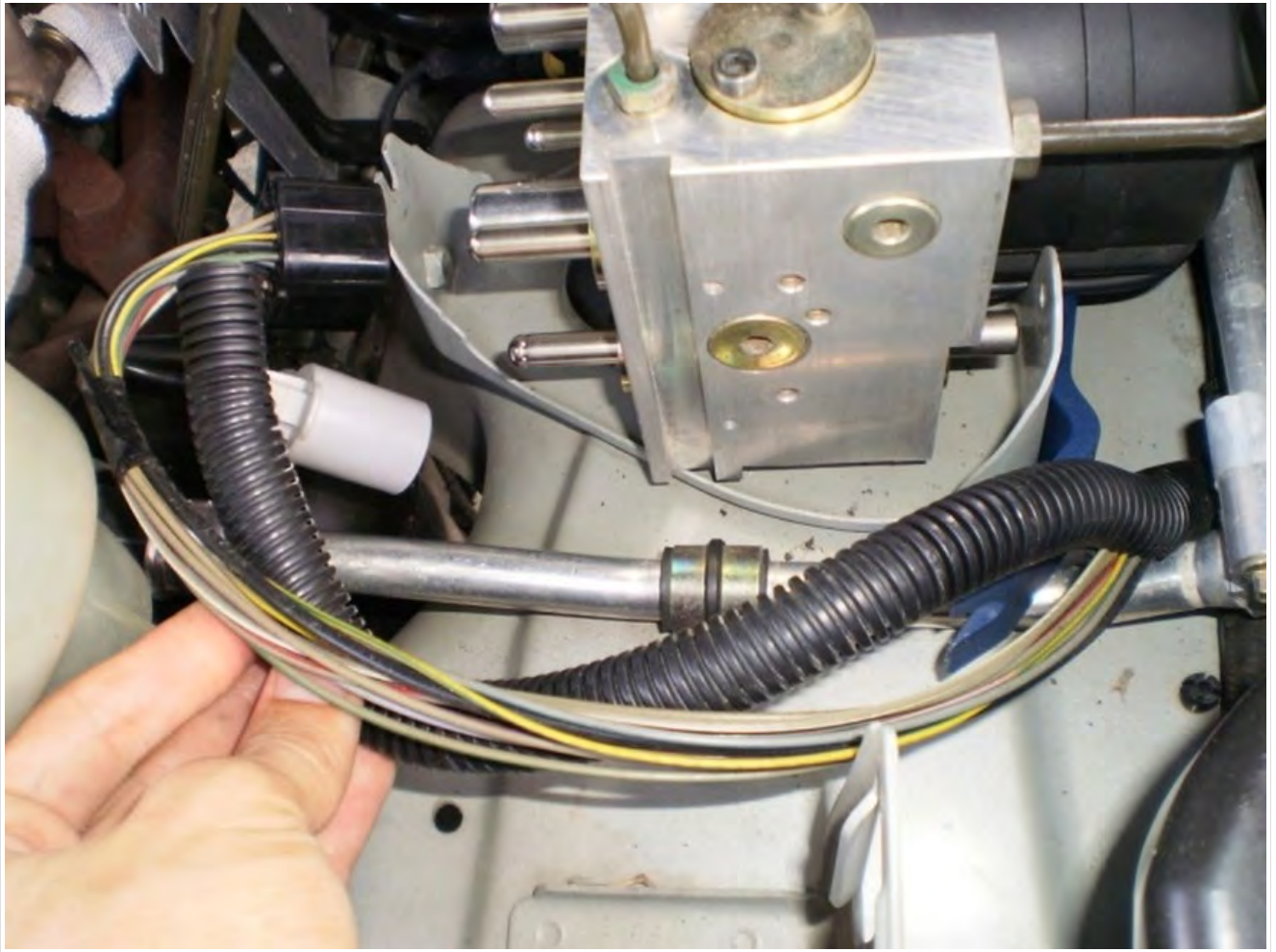
The Three Amigos returned in April 2010 as a result of this bolt coming loose. I may not have tightened it well when I did it the first time back in November 2009 so torque it good, and add loctite. I plan to check the bolt every oil change. In addition to using that bolt as a ground, ensure that it is free of dirt or rust or anything that would diminish a good electrical contact.

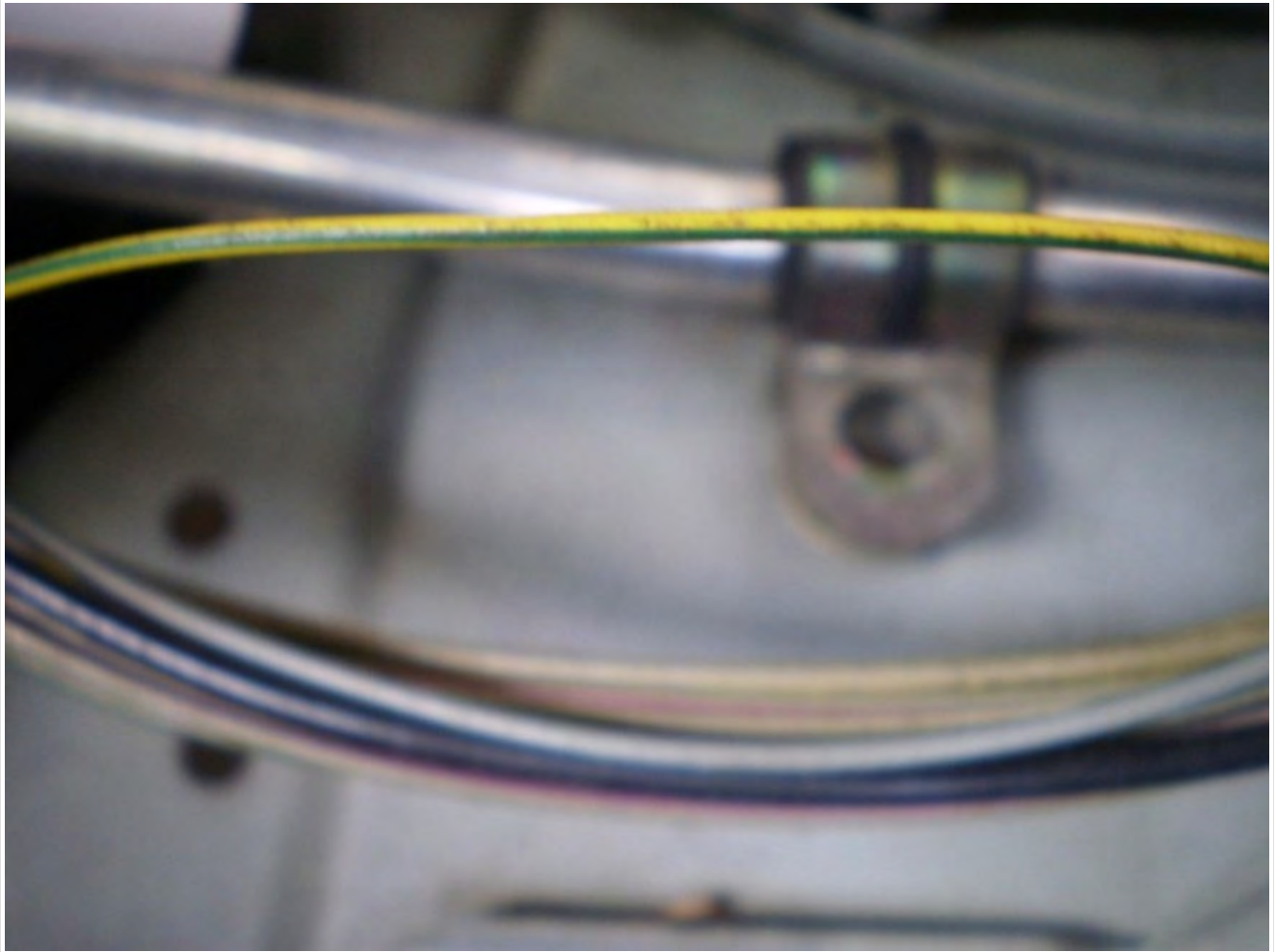


42. Take your other end of the harness and crimp a connector to secure to the ground bolt. Heat shrink it to provide better protection and it also just looks better.



43. Peel off the wire loom shield off of the ABS Modulator wire harness. Locate the YG wire. Cut it in half but in such a way to leave enough length for your harness.



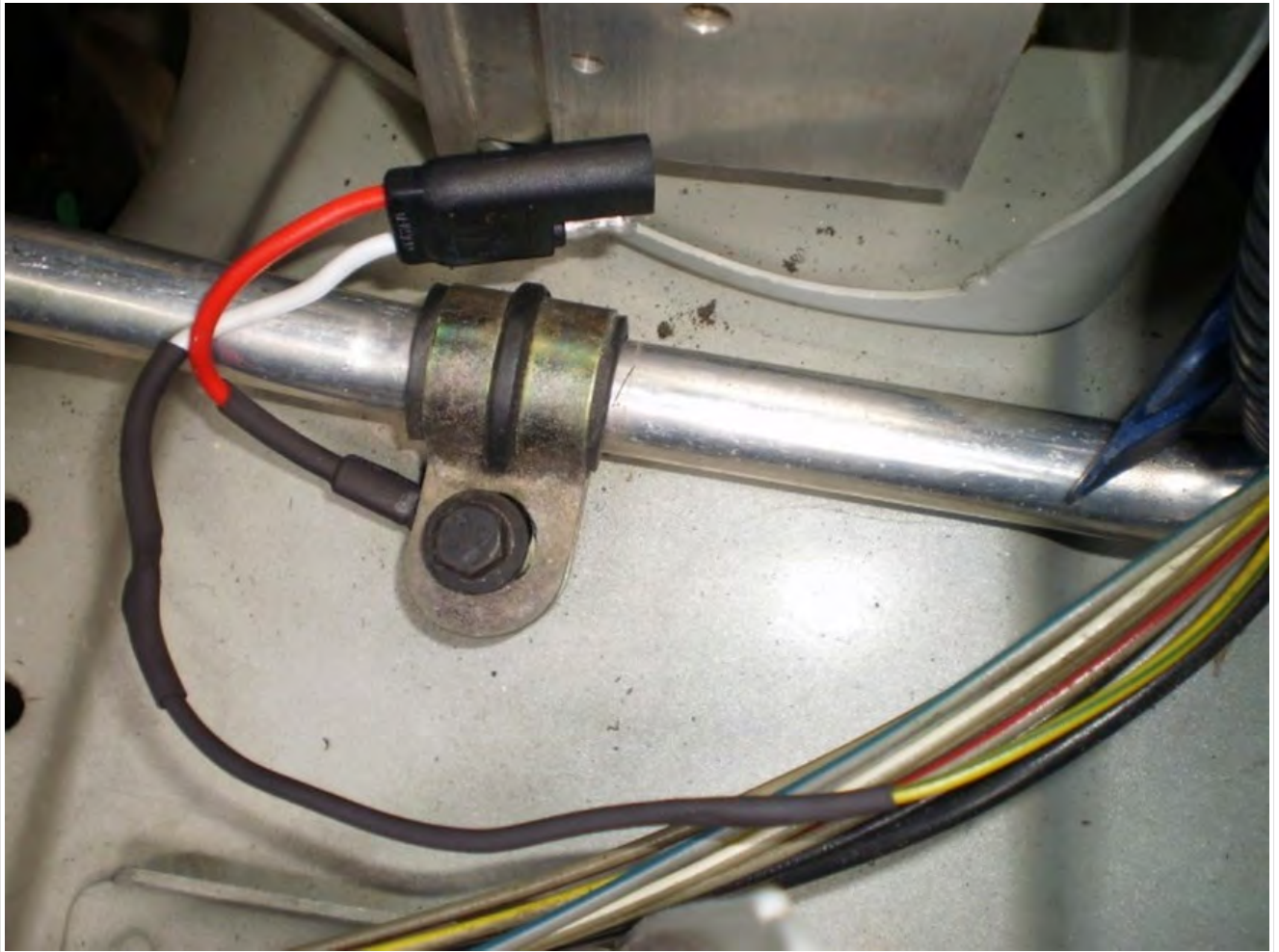


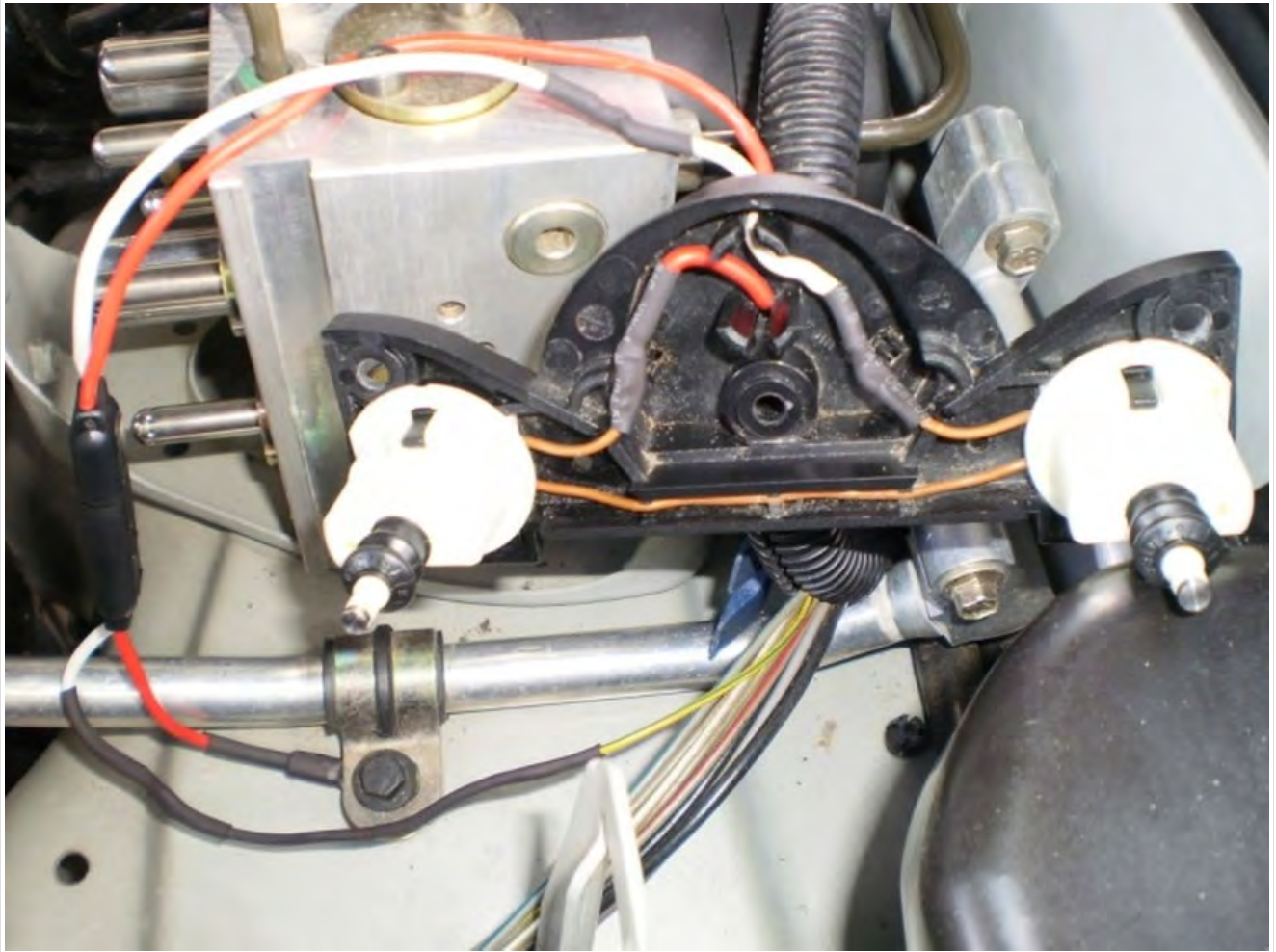
44. Take the second wire from your trailer harness and splice, solder, and heat shrink it into the YG wire coming from the main harness end NOT the end going back to the modulator plug.

Connect the ground wire to the ground bolt.

Based on comments and feed back, I should add and clarify that the remaining end of the YG wire (the end attached to the plug) will just get tucked back into the loom as it is now dead.

*Note** It does not matter which wire of the Trailer harness goes to ground or the YG wire. In other words, it doesn't matter which wire from the SVS goes to either GROUND or the YG wire as long as ONE goes YG wire, and the SECOND to GROUND. (So in my case I could have chosen either white or red wire)*






This is what it looks like plugged up.

45. Everything installed, tested, no Amigos, no SLABS trouble codes. Installation is the reverse of removal for any method chosen to remove the SVS.

46. After everything is re-installed, turn the engine on and look at your dash board. You shouldn't have any lights on. Congratulations if you don't. If you DO, double check your work and connections. Re-scan for codes.

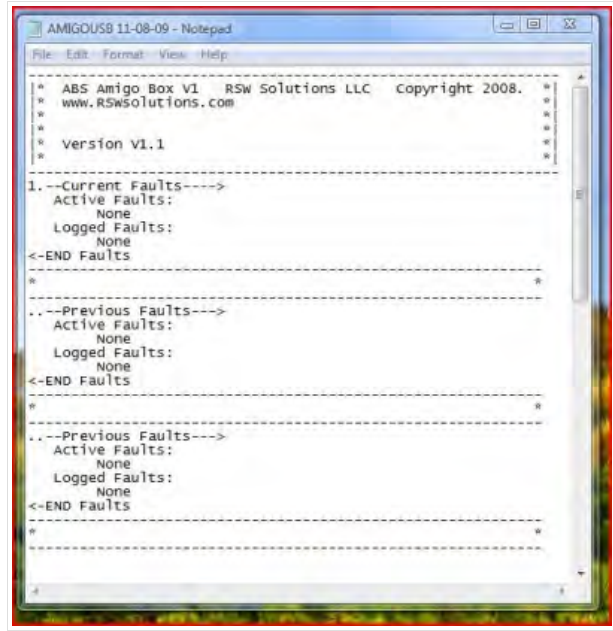
47. If you have access to an ABS capable scanner, get a reading and clear any current and/or historical faults. Any faults that reappear should not be related to the shuttle valves. If your only fault was the 114 SVS Electrical Failure, like mine, then you know it only appears when the SLABS ECU picks up an OPEN circuit signal and resets itself after the engine is shut off. No need for an ABS code scanner.

FROM THIS.....



```
AMIGOUSB 09-23-09 - Notepad
File Edit Format View Help
* ABS Amigo Box V1 RSW Solutions LLC Copyright 2008.
* www.RSWsolutions.com
*
* Version V1.1
*
-----
1.--Current Faults---->
Active Faults:
None
Logged Faults:
114:Shuttle Valve Electric Failure
<-END Faults
-----
..--Previous Faults---->
Active Faults:
None
Logged Faults:
114:Shuttle Valve Electric Failure
<-END Faults
-----
..--Previous Faults---->
Active Faults:
None
Logged Faults:
114:Shuttle Valve Electric Failure
None
<-END Faults
-----
```

TO THIS



```
AMIGOUSB 11-08-09 - Notepad
File Edit Format View Help
* ABS Amigo Box V1 RSW Solutions LLC Copyright 2008.
* www.RSWsolutions.com
*
* Version V1.1
*
-----
1.--Current Faults---->
Active Faults:
None
Logged Faults:
None
<-END Faults
-----
..--Previous Faults---->
Active Faults:
None
Logged Faults:
None
<-END Faults
-----
..--Previous Faults---->
Active Faults:
None
Logged Faults:
None
<-END Faults
-----
```

48. If you disconnected brake lines...

Bleed the brakes. You can use the traditional method with a helper following this sequence: Rear Right, Rear Left, Front Right, Front left. Brake pedal may still feel spongy.

49. Go for a test drive and try to get the ABS and TC to kick on. Find a good incline to test HDC or on a flat ground, accelerate and let off the pedal and HDC should kick in, slowing you down. You must actuate these functions in order to get the trapped air out during the final bleed.

50. Re- bleed the brakes. It is very important to do this last step after you successfully activate TC/HDC/ABS so that the trapped air in the modulator is expelled.

.....Enjoy!

03/2011 Correctly doing Option A or Option B in no way affects the function of the ABS Modulator nor the SLABS' effectiveness in monitoring the SVS.

Please use the below form for feedback, comments, and suggestions only. Direct all questions regarding this write-up through email or forum communication for others to get involved and answer questions. I will reply to them as soon as I can. ***** Hummer owners please leave feedback also! *****

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josh@landroverclubvi.com

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Forum Screen Name or Name

Comment / Feedback *

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READ PREVIOUS FEED BACK ([/web/20170730071921/https://landroverclubvi.weebly.com/abs-mod-feedback.html](http://web/20170730071921/https://landroverclubvi.weebly.com/abs-mod-feedback.html))

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ABS MOD SURVEY

Have you performed this repair on your Discovery? *

If someone else did it for you, who was it?

How long did it take to do? *

What year is your Discovery? *

How long has your Three Amigos been visiting due to this fault? *

How often are the Three Amigos visiting? *

Submit