



# Small Car Performance EJ25 Installation Instructions

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# Subaru EJ25 Drive By Wire Vanagon Installation

## SCP Drive-By-Wire Vanagon Complete Installation

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### Philosophy of Installation

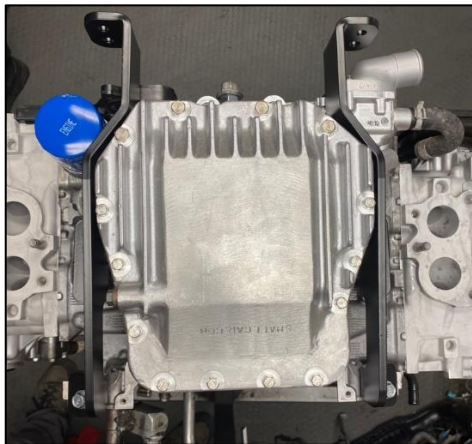
As a matter of practice, the Subaru EJ25 engine conversion is the most practical choice for upgrading the Volkswagen Vanagon. The water boxer engine operates on the same principles of combustion of the original Volkswagen Vanagon engine. These are four cylinder horizontally opposed piston engines that fit as a perfect replacement for the original equipment. Volkswagen created these vans with a multi-decade service life and a robust aftermarket for these vehicles exists to upgrade from a reliability, and environmentally friendly perspective. This engine conversion using the Subaru EJ25 takes circa 1980-1991 combustion engines and replaces them Subaru PZEV (partial zero emissions) motors from 2006-2012. Not only do the vehicles pollute less, but they are also safer, more reliable.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Engine Mounting System

Small Car's Engine Mount integrates with the original Volkswagen rear crossbar (mustache bar) and inner and outer engine mounts. The engine mounts can be bought as a kit but there are two different variations depending on whether the van is a 2WD van or a 4WD van. *2WD Part Number: M4-2WDPC. 4WD Part Number: M4-4WDPC.*

1. Secure the Small Car Engine Mounts to the bottom of the Subaru engine with the provided 10mm flanged bolts. Torque to 40ft-lbs. For best clearance install the 10 x 30mm bolts with the nuts toward the front of the van.
2. The dipstick tube goes through a hole in one of the side rails. This means that either the oil pan needs to come off or the dipstick and tube must be removed. The small dipstick tube support bracket on the oil pan must be removed as well. Reference **Figures 1 and 2** below.



**Figure 1:** Installed engine mount side rails.



**Figure 2:** Passenger side engine mount and Small Car oil pan must be installed/removed at the same time.

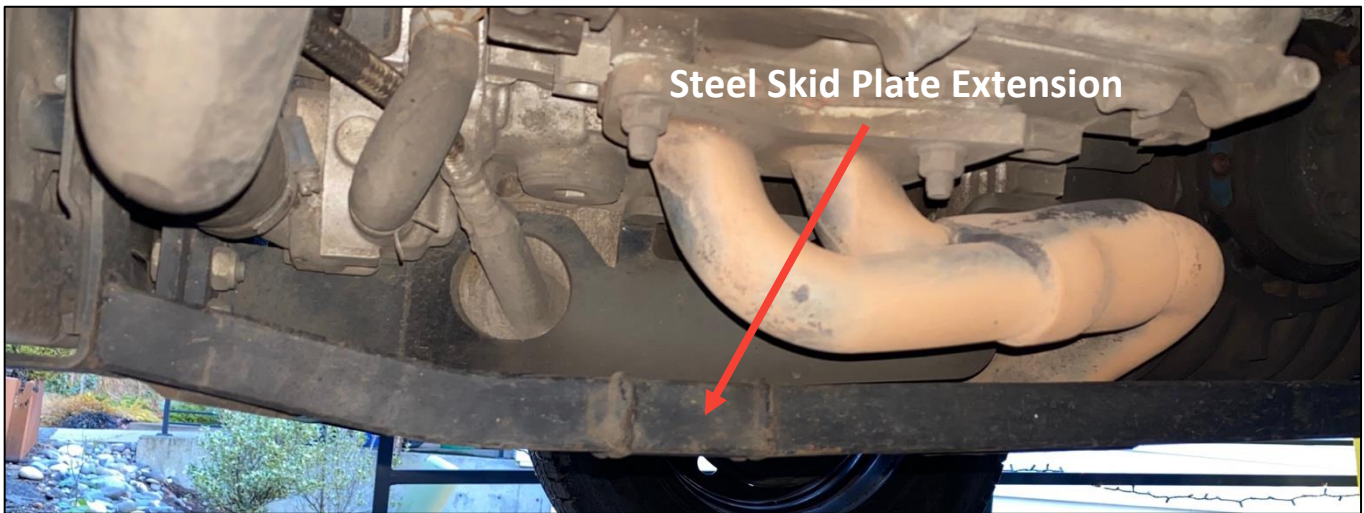
3. Mount the two stock Vanagon inner and outer engine mounts to the Small Car engine carrier.
4. Secure the Volkswagen rear crossbar to the Small Car engine carrier and mounts. See **Figure 3** below.



**Figure 3:** Installed EJ25 motor with Small Car Motor Mounts and stock Vanagon rubber mounts.

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5. Before securing the engine to the vehicle, new holes need to be drilled where the Volkswagen rear crossbar bolts to the frame rails. Secure the engine and transmission with the stock transmission mount so that you can determine the location of new mounting holes.
6. If you are working with a 4WD Vanagon, both sides of the skid plate must be extended to fit the new crossbar position. See **Figure 4** below for an example of a 4WD Vanagon skid plate extension.



**Figure 4:** 4WD Vanagon skid plate extension.

7. With the transmission secured, raise the engine so that the Volkswagen rear crossbar is flush with the frame rails.
8. Drill holes in the frame rails and secure with the provided hardware. A 4WD Vanagon Volkswagen crossbar is different than a 2WD and can be mounted directly to the frame rails. See **Figure 5** for a 4WD Vanagon example. Consequently, a 2WD Vanagon requires spacers so that the intake clears the engine decklid. See **Figure 6** for a 2WD example. *2WD Spacer Part Number: DBWEMS.*



**Figure 5:** 4WD Vanagon rear crossbar install without spacers.



**Figure 6:** 2WD Vanagon rear crossbar install with spacers.

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### Small Car Aluminum Oil Pan with Small Car Engine Mount Installation Instructions

Small Car's Aluminum Oil Pan is a direct replacement for the original Subaru oil pan. However, our oil pan provides more ground clearance than the Subaru oil pan would in a Vanagon. The Small Car Oil Pan is available as a kit with the necessary oil pickup and hardware. We also offer a Flexible Dipstick Kit which allows you to relocate the Subaru oil dipstick. *Oil Pan part number: OPSV45. Flexible Dipstick Kit part number: DSK5.*

Note: The installation instructions below assume the engine has already been installed into the van with an original Subaru oil pan. Installation of the Small Car Aluminum Oil Pan with the engine out of the vehicle is similar but slightly easier.

1. Drain the oil from the engine.
2. Remove the dipstick tube from the oil pan.
3. Remove the oil pan bolts.
4. Support the right side of the engine from above or from below. See **Figure 7**.



**Figure 7:** Unbolted Subaru oil pan and right side engine mount. Engine is supported by jack.

5. Remove the two bolts holding the right-side engine mount to the motor and the two bolts and nuts holding that part to the back plate.
6. Pry the oil pan loose from the engine and remove the oil pan and the engine mount part together.
7. Clean the engine surface of any remaining sealant.
8. Remove the oil pickup tube and install the tube that came with the aluminum pan. Don't forget to place a new O-ring on the base of the pickup tube.
9. 2010-2012 Legacy engines will require taping the holes for the oil pan securing bolts. Tap size 6 x 1.0 mm. Tap just enough be careful not to let metal fall into the engine.
10. Install the original short 6mm oil pan bolts. Tighten to 7 lb-ft.
11. Use an even coat of a silicone sealant like Permatex Ultra Grey on the sealing surface of the new pan.
12. Place the round opening of the engine mount over the dipstick snout of the pan and install the oil pan using the supplied 6mm bolts and washers. See **Figure 8** below. Torque to 7 lb-ft. (Note: Some bolt holes toward the front of the engine block may not be tapped deep enough. If bolt is too long and sticks out, use one extra washer provided on that bolt.

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**Figure 8:** Small Car Aluminum Oil Pan dipstick tube being installed to EJ25.

13. Reinstall the bolts and nuts for the engine mount. Torque to 40 lb-ft.
14. Install new O-rings onto the dipstick tube and insert the tube into the pan. If you are using the stock dipstick tube, it may be necessary to use washers or a spacer at the top mounting tab.
15. Torque oil drain plug to 15 lb-ft.
16. Pour in your new oil and note the position on your dipstick for future reference. We recommend a minimum of 4 quarts of oil and a maximum of 5 quarts of oil. See **Figure 9** below for a completed oil pan install.



**Figure 9:** Installed Small Car Aluminum Oil Pan.

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### Clutch Installation

The Subaru EJ25 requires a Stage 2 Clutch. The components installed in this section can be purchased in a kit.

*Part number: CPPD02525STAGE2.*

1. Apply thread locker (we prefer Loctite®) to the eight flywheel bolts.
2. Secure the flywheel to the engine using the flywheel bolts. Torque to 55 ft-lbs. See **Figure 10** below for an installed flywheel.



**Figure 10:** Flywheel install

3. Insert alignment tool into the clutch disc and insert into the flywheel.
4. Align pressure plate with the two dowel pins on the flywheel.
5. Before torquing down six M8 bolts – make sure the alignment tool has some play and moves freely in and out. See **Figure 11** below for a clutch install example.



**Figure 11:** Clutch install

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6. Torque bolts to 20 ft-lbs.

The stage 2 clutch installation is now complete.

### Small Car Bellhousing Installation: Manual Transmission

Manual transmissions require the use of our Small Car Bellhousing. The bellhousing can be bought with the other necessary hydraulic components. *Part Number: BHV025.*

1. Drain the transmission gear oil and remove the four 10 mm bolts holding the stock Volkswagen bellhousing to the transaxle.
2. Clean input shaft and then grease it to allow for proper input shaft seal lubrication. We recommend white lithium grease.
3. Install the new input shaft seal into the Small Car bellhousing using a tool that will not damage the seal. We recommend a large socket to tap the seal in. If your seal is damaged upon install you must replace it. Replacement seals are available on our website. See **Figure 12**. *Part Number: 043.605.*



**Figure 12:** A mated bellhousing with a properly installed input shaft seal

4. Clean the transmission sealing surface and apply a thin coat of room temperature vulcanizing sealant (we prefer Permatex Ultra Grey) to the Small Car Bellhousing. See **Figure 13** below.



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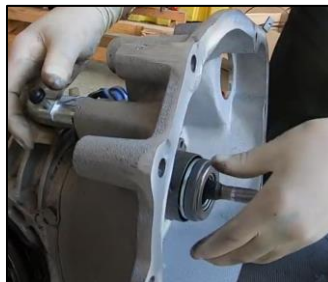
**Figure 13:** Permatex Ultra Grey applied to the mating surface of the Small Car Bellhousing.

5. Install the bellhousing onto the transaxle using the original bolts and washers. Be sure to lube the input shaft seal before installing. Torque bolts to 20 lb-ft.
6. Install the oil drain plug into the bellhousing.
7. Grease the release bearing assembly and fit through the bellhousing. See **Figure 14** below.



**Figure 14:** Release bearing install into bellhousing.

8. Lubricate O-ring on hydraulic release fitting, then slide and snap on the release bearing hydraulic fitting onto the now protruding release bearing shaft. See **Figure 15**.



**Figure 15:** Release bearing hydraulic fitting being slid onto end of release bearing shaft.

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9. Fasten the slave cylinder with the three supplied 6mm bolts to the bellhousing. Be sure to apply thread locker to the bolts (we prefer Loctite®) and tighten to 10 ft-lbs.
10. Lubricate input shaft and mate the bellhousing and transmission onto the engine. Be sure to align with the two dowels located on the engine's mounting surface. These dowels should be smooth and without burrs or other damage.
11. The slave cylinder assembly may create a small amount of resistance, but the two parts should go together smoothly and completely. If you don't get alignment, spin the transmission output flanges ever so slightly to change the main shaft orientation.
12. Secure the transmission to the engine using the stock Subaru 10mm bolts. The starter will also be installed at this time. Torque bolts to 30 lb-ft. See **Figure 16** below for a completed transmission install.



**Figure 16:** Completed installation of a manual Vanagon transmission to an EJ25 using Small components.

13. **Allow 1 hour for sealant to cure on bellhousing and do not forget to fill your transmission with gear oil.** We prefer SWEPCO 210. Fill your transmission until just before oil weeps out of the fill hole. Refer to your shop manual for additional details.

The Small Car Bellhousing installation is now complete.

### Clutch Line and Spacer Installation

Once the engine and transmission are bolted into the van you must install the clutch line and a clutch master spacer. Unless you chose to do otherwise you will use your original Vanagon clutch line. These components are included in the Small Car Bellhousing Kit. *Part Number: BHV025.*

1. This install will vary depending on the year of your van.  
Pre-1985: Your van will have a metal clutch line with a flared fitting on the end. Thread this fitting into the end of the of the slave cylinder.  
Post-1985: Your van will have a plastic clutch line with a banjo fitting in the end. Install this banjo fitting using the banjo bolt that was on your original slave cylinder. See **Figure 17** below for a post-1985 example.

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**Figure 17:** Post-1985 Vanagon with banjo fitting installed onto release bearing hydraulic fitting.

2. You must install the clutch master cylinder spacer included in your kit. **This is ESPECIALLY important. Missing this step can cause failure of the throw out bearing via over extension.** *Spacer Part Number: Spacer Clutch Master.*
  - a. Remove the mounting bolts and clutch master cylinder. Do not remove the clutch lines. These lines are flexible enough to be manipulated.
  - b. Remove the boot from master cylinder. The boot is removed to give room for the spacer and it can be discarded. **Figure 18** below shows the spacer sitting on the master cylinder with the boot removed.



**Figure 18:** Master cylinder with boot removed and spacer placed in position for illustration purposes only.

- c. Insert spacer onto the shaft that pushes the master cylinder. The shaft mentioned is shown in **Figure 19** below.

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Figure 19: Clutch master cylinder shaft.

- d. Reinstall master cylinder and clutch hydraulic lines.

### First-Fill: Bleeding Hydraulic System Options

Once you have installed all of your clutch components the system must be bled. Below are three options for bleeding the system. All options are acceptable.

1. Option 1: Pre-fill Slave Cylinder Assembly: Collapse the bearing portion of the hydraulic release bearing and place the nose into a container of brake fluid. Release the bearing and the slave cylinder will fill with brake fluid. Proceed to option two or option three.
2. Option 2: Gravity Fed Fill: When you fill the hydraulic system with brake fluid, leave the bleeder valve open. The head pressure of the reservoir will fill the throw out bearing and almost the entire hydraulic system if left for about fifteen minutes. Close bleeder, pump the clutch to move the remaining air in the system through the lines before closing the bleed valve.
3. Option 3: Speed Bleed: Use a hand vacuum pump to push the hydraulic fluid through your system. Once the air is removed from the system close the bleeder valve.

### Clutch Adjustment Tips

1. Why is my clutch release right on the floor?
  - You need to adjust the pedal push rod into the master cylinder.
2. Van will not go into gear while running, but you can shift gears with the van off?
  - Try lifting your foot off the floor 1-2 inches with the van running and shift.
  - If that works, you will still need to adjust the shift rod out to push the release point closer to the floor.
3. I can't remember if I installed the spacer?
  - Immediately stop and confirm the spacer is installed correctly.

### Adaptor Plate Installation: Automatic Transmission

Automatic transmissions require the use of our Small Car Adapter Plate. The adapter plate can be purchased with all the necessary components for installation. *Part Number: 091AT.*

1. Bolt the adaptor plate to the Subaru engine using the supplied bolts.

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2. Fit the flex plate onto the crankshaft and check for clearance.
3. Bolt the flex plate in place.
4. Set the converter in place on the transaxle. Press on it and rotate it until you are certain it is fully engaged on the splines.
5. Slide the engine and transaxle together ensuring the splines of the main shaft are aligned. Once you are sure you have alignment, tighten both the nuts and bolts. This can take some strength to ensure proper alignment.
6. When the engine and transmission are mated together, torque the four nuts holding adapter to the transmission to 35 ft/lb.
7. After the assembly is bolted together, install the three original Volkswagen flex plate bolts to the torque converter. To do this it is necessary to rotate the engine. This can be done by a helper at the front of the engine, or by prying on the starter gear teeth up in the starter pocket with a large screwdriver.
8. Mount the dust shield on lower portion of bellhousing with the two small bolts.
  - a. Torque Specifications:
    - Adapter plate: 25 ft/lb.
    - Flex plate/crank bolt: 55 ft/lb. with Loctite®
    - Torque converter bolt: 20 ft/lb with Loctite®

The Small Car Adapter Plate installation is now complete.

## Wiring Harness

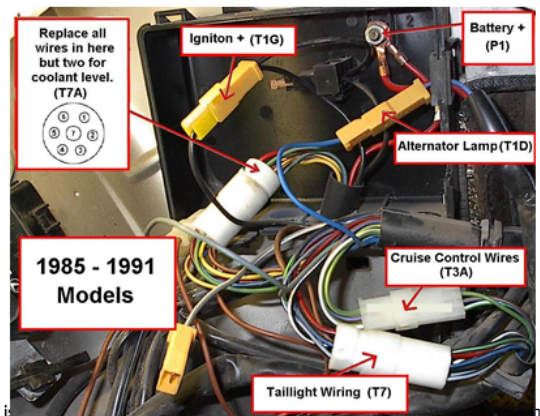
You will either have a modified Subaru harness or you will have a Small Car EJ25 Harness. The installation process for both harnesses will be similar and all connections will be the same but we have added wires to the Small Car EJ25 Harness to make installation easier. If you have a modified Subaru harness you may need to splice and/or add wires. *Small Car Harness part number: SCP-ENG-007-00.*

### Installation:

1. Run the harness through your vans firewall under the rear seat. New vans will already have this hole while older vans (pre-1985) will not. If your van was manufactured prior to 1985 you will need to drill a hole. Once run through, install a grommet.
2. Route your harness cleanly throughout the engine bay and make all necessary connections to your engine. Ensure all sensors are connected. Pay extra attention to emission components. Ensure that connectors are properly seated.
3. You will now connect your harness to the Vanagon wiring harness. Reference the information in the image below to do this.

## Subaru EJ25 Drive By Wire Vanagon Installation Subaru Vanagon Connections

		1985-1991	1983-1984		
		Conn. L #	Conn. L #	Note	
In Connector Housing (wiring box left front eng.)	Oil Pressure	Blue/Black	T7A / 1	T2E	To Subaru Harness
	Coolant Temp	Yellow/Red	T7A / 2	T2G	To Subaru Harness
	Coolant Level	Blue/Green	T7A / 3	T2G	Leave alone
	Coolant Level Ground	Brown	T7A / 4	N/A	Leave alone
	Tachometer *	Green	T7A / 5	N/A	To Subaru Harness *
	Starter	Red/Black	T7A / 6	T1B	To Subaru Harness
	High Pressure Oil Sender **	Yellow	T7A / 7	N/A to 85	Ground here or at dash **
	Ignition +	Black	T1G/Yellow	T1A	To Subaru Harness
	Battery +	Red	P1		25A fuse to Subaru Harness
	Check Eng. Light				See Below
	Fuel Pump +	White			To Subaru Harness
	Fuel Pump - ***	Brown			Ground ***
	A/C Compressor	Red/Blue	T2F	T1B	
	Alternator	Blue	T1D	T1C	D+ warning lamp
	Alternator	Red	B+	B+	Wire to B+ on alternator



\* Tachometer - SVX models will need an 8k rpm tach face. 4 cylinder models - if the ECU output is... See both on our website (part numbers KTF8, VGF-33, and VTACH on [www.smallcar.com](http://www.smallcar.com))

\*\* High Pressure Oil Sender - The high press warning system must be disabled by grounding the signal at the dash or by removing the tach signal from the control unit.

\*\*\* Fuel Pump - If you have a WRX or 3.0L model with a Fuel Pump Controller, wire the [Fuel Pump -] to the Subaru Harness.

Check Engine Light (required in California) - If a check engine light at the dash is desired, use the OXS light in the Vanagon gauge cluster, or a separate lamp or LED. The Subaru ECU provides a ground signal at the check engine light wire. Small Car provides a replacement sticker to change the OXS light into a check engine light in all California customers kit's.

At the Subaru coolant manifold, we recommend using a VW temperature sender (part number 049-919-501). This must be connected to the Subaru harness on top of the engine by repositioning the original Subaru wire onto the VW sender. On the later Subaru engines with a three pin connector to the original sender, the wire must be cut and a proper terminal should be installed to allow the wire to be attached to the VW sender. Run separate wire for 05- Legacy, 08- Impreza and Forester.

The common colors for this wire are: Pink/white White/green Black/blue Violet SVX- Yellow/green

Alternator - The alternator harness is separate from the engine harness on the Subaru, therefore the following connections need to be made after installation of the engine.

1. From the alternator B+ post to the Vanagon starter terminal B+. Very often the original Vanagon wires are long enough, or part of the Subaru harness can be spliced in.
2. From the alternator D+ to the dash warning lamp Vanagon connector T1C/T1D (blue wire) is located near the alternator OR in the connector housing. The Subaru D+ wire from the alternator should be attached to this wire on the Van.
3. Some of the Subaru alternators require an ignition + connection. In this case a wire should be run from the alternator to the ignition + source in the connector housing (black wiring box).

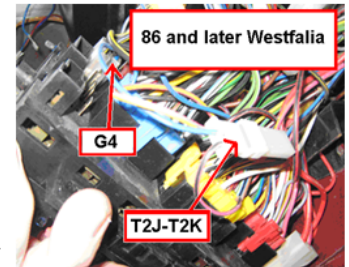
For Campers - Wiring for Westfalia Refrigerator and/or Auxiliary Battery Relay - The Van has a blue wire coming from the alternator to the dash where it connects to the warning light. In a Westfalia, this blue wire also connects to and controls a relay under the driver's seat that provides 12V power to the refrigerator. If an auxiliary battery has been added, there may also be a relay supplying power to the extra battery.

The Subaru alternator D+ terminal will correctly operate the warning lamp but will not power these additional relays, so the alternator D+ wire needs to be disconnected from the relay or relays, and another method is needed to control them.

On the 86 and later Westfalia, find connector T2j or T2k near the fuse box where the wire from the relays connects to the system. The T2 connector should have a red wire with a black trace and a blue wire. The blue wire goes from the T2 connector to the fuse box, usually to G4. This connector can be unplugged from G4 and reattached to an ignition + source.

Check G1 or G2 with a test light, plug in the connector then cut and ground the red/black wire and you're done.

On the 85 and earlier Westfalia, find the blue wire near the fuse box where it arrives from the under seat relay, cut the wire and connect to an ignition + source.



4. Once the engine bay work is completed move to the cabin and connect your ECU to the harness under the rear bench seat. This should be straight forward as each connector that plugs into the ECU is unique.
5. The remaining wires under the rear bench seat will go to the Small Car Interface Board.

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### Interface Board & Handshake Board Installation

The table below shows how to connect the Small Car Interface Board and Handshake Board to your harness. If you have purchased a Small Car EJ25 Harness, then these wires will all be labeled. If not, then you must reference Subaru wiring schematics to determine which wire goes where. **Small Car Interface Board Deluxe PN: SCP-ENG-008-00, Small Car Handshake Board: SCP-ENG-015-00.**

Terminal	Abbreviation	Description	Notes	Connector	Terminal	OEM Wire Color
1	TGO	Vanagon temperature gauge out		Vanagon Round White Connector T7a	2	Yellow/Red
2	TGI	Vanagon temperature gauge in		Sensor on reverse coolant manifold	-	
3	TPS	Fuel tank pressure sensor		B135(B)	32	Brown
4	FLS	Fuel level sensor		B135(B)	10	Yellow
5	FTS	-	Not used.	-	-	-
6	PCS	Pressure control solenoid valve	Not used.	-	-	-
7	IPCS	Internal pressure control solenoid		B136(C)	28	Red
8	TDV	Tank drain valve		B136(C)	17	Light Green/Black
9	FR1	Fan relay 1		B136(C)	18	Blue/Red
10	FR2	Fan relay 2		B136(C)	29	White/Red
11	CEL	Check engine light	California customers will not use this terminal as their check engine light will be on the instrument cluster. See below.	B136(C)	11	Orange/White
12	TSI	Tach signal wire in	Post-1985 Vanagons only.	B136(C)	22	Pin
13	TSO	Tach signal wire out	Post-1985 Vanagons only.	Vanagon Round White Connector T7a	5	Green

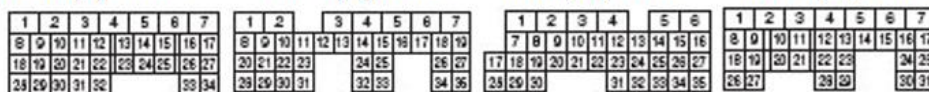
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14	PP	Pedal position in		B135(B)	31	Red
15	NSOM	-	Not used.	-	-	-
16	NSOA	Ground for neutral circuit		B136(C)	31	Green/Black or White/Blue
17	GND	Ground for Interface Board Deluxe	Connect to chassis ground	-	-	-
18	GND	Ground for Handshake Board	Connect to chassis ground			
19	VIN	Power to Interface Board Deluxe		B134(A)	7	Yellow/Blue
20	VOLTAGE OUT	Power to Handshake Board	Connect the red wire from the Handshake Board here.			
21	CAN_L_OUT	CAN low to Handshake Board	Connect the green wire from the handshake board here.			
22	CAN_L_IN	CAN low from ECU		B136(C)	35	Blue
23	CAN_H_OUT	CAN high to Handshake Board	Connect the yellow wire from the handshake board here.			
24	CAN_H_IN	CAN high from ECU		B136(C)	27	Red

Note:

1. Terminals are listed from left to right with terminal 1 being on the bottom left and terminal 24 on the upper right.
2. The abbreviations are listed on the interface board above the terminals.
3. The image below shows the ECU connector pinouts.

**B134 (A) White      B135 (B) White      B136 (C) White      B137 (D) White**



Once the interface board is installed you will need to use the small thumb screw on the side of your interface board to adjust the position of your dash temperature gauge needle. Follow the proceeding steps to do this.

1. Bring your van up to operating temperature and confirm that it has reached temperature using a measurement tool or by connecting a scanning tool to the OBD2 port.





## **Subaru EJ25 Drive By Wire Vanagon Installation**

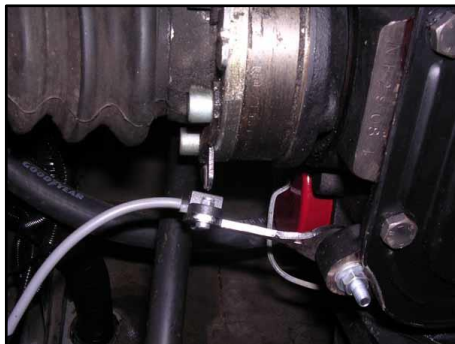
2. Once operating temp is reached turn the thumb screw on the interface board until the needle sits at the desired location. We prefer to have the needle sitting on top of the LED when at operating temperature.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Hall Effect Speed Sensor Kit Installation

Speed sensors are required for the installation of most new modern OBD2 vehicles with a host of computer managed systems based on speed. If the speed sensor is not hooked up the engine will not run properly and will enter “limp mode” where the vehicle will not operate above 4000 RPM as a safety cut-out. It is **imperative** to this conversion that the speed sensor is used as designed. *Hall Effect Speed Sensor Kit part number: SSK5.*

1. Remove the bolts that secure the driver’s side CV joint to the transmission.
2. Take the provided magnet ring and place it between the bolts and the CV joint. Reinstall the CV to the transmission.
3. Bend the provided bracket slightly over 90 degrees so that it sits like the bracket shown in **Figure 20** below when installed.
4. Install the bracket with an 8mm bolt into the empty hole on the automatic transmission. This hole will be obvious.
5. Install the sensor into the bracket and adjust the gap from the sensor to the magnet to maximum of 1/16 inch. The sensor can be installed with the wires going in either direction.
6. The center of the square area is the spot of highest sensitivity and should be aimed at the magnets.
7. The black lead goes to ground, the red to ignition + and the blue to the ECU speed sensor terminal.
8. Be sure to use a wire tie as a strain relief so that the wires into the sensor are protected. **Figures 20 and 21** below show completed speed sensors for automatic and manual Vanagons respectively.



**Figure 20:** Installed speed sensor on an automatic Vanagon transmission.



**Figure 21:** Installed speed sensor on a manual Vanagon transmission.

### Speed Sensor Tips

- There should 4-5 volts at the blue wire when the sensor is connected, and the ignition is on. Voltage is from the ECU.
- When operating correctly, the hall sender is activated by the magnets (south pole only) and the sensor pulls the voltage at the blue wire to ground.
- If after completing your installation your van goes into limp mode it is likely due to your speed sensor being too far from the magnets on the axle.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Manual Accelerator Pedal Installation

Our kit uses the original Subaru accelerator pedal. Manual and 4WD Vanagons will follow the instructions below. Those instructions are in work and will be added to this document shortly. *Drive-by-Wire Pedal Kit: M/T 2WD and 4WD part number: DBWPK4WD. Drive-by-Wire Pedal Kit: A/T Vanagon part number: DBWPK4AT.*

1. Remove your spare tire then remove the accelerator pedal linkage cover at the front of the van. **Figure 22** shows this cover.



**Figure 22:** Accelerator pedal linkage cover.

2. Loosen the barrel nut holding the end of the throttle cable and pull the throttle cable out of the nut. **Figure 23** shows the throttle cable after it has been removed from the barrel nut.



**Figure 23:** Throttle cable end removed from barrel nut.

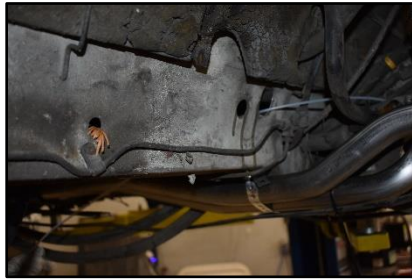
3. Near the center of the van you will find a bracket holding the throttle cable up. Remove the bolt holding this bracket on. **Figure 24** shows the removal of this bracket.



**Figure 24:** Throttle cable bracket removal.

## Subaru EJ25 Drive By Wire Vanagon Installation

- Assuming you have already removed the engine you can now pull the old throttle cable out. The throttle cable and a plastic sleeve should come out. The large diameter plastic sleeve that runs from the bracket in step 3 to the front of the van should remain in place.
- Now feed the new throttle cable assembly into the hole shown below (**Figure 25**) and then into the large diameter plastic sleeve mentioned in step 4 (**Figure 26**).



**Figure 25:** Throttle cable being fed through designated hole.



**Figure 26:** Original Vanagon throttle cable tube and new cable.

- Install the supplied section of fuel line between the plastic tubing and the throttle cable assembly. Then zip tie the cable into place as shown in **Figure 27**.



**Figure 27:** Fuel line installed to act as a coupling between new and old throttle cable tubing.

- Install the provided barrel nut onto the front end of the throttle cable as shown in **Figure 28**.



**Figure 28:** Throttle cable end being slid into barrel nut.

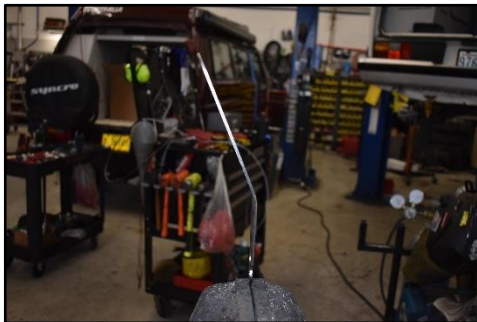
## Subaru EJ25 Drive By Wire Vanagon Installation

- Slide the barrel nut into the pedal mechanism assembly and tighten down the bolt. This is the reverse of step 2. **Figure 29** shows an installed throttle cable.



**Figure 29:** Installed throttle cable into pedal mechanism.

- Reinstall the pedal mechanism cover.
- Take the provided throttle pedal bracket and bend it as shown below (**Figure 30**). Then hold your throttle pedal to the bracket and mark which holes will be used for mounting the throttle pedal to it (**Figure 31**).



**Figure 30:** Bent throttle pedal bracket.



**Figure 31:** Throttle pedal bracket with holes that will be used marked.

- Remove the passenger side tail light. Hold your bracket in place as shown below, mark your holes, then drill. See **Figures 32 and 33**.



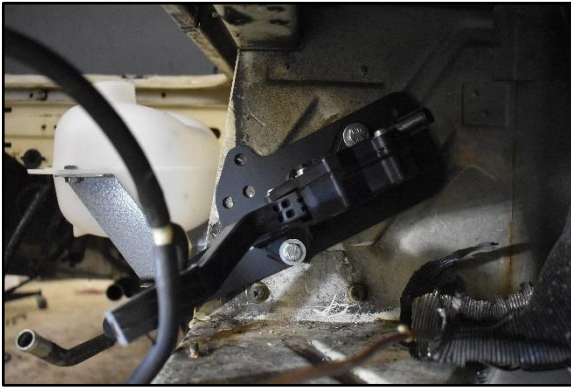
**Figure 32:** Marking holes to be drilled for plate mounting.



**Figure 33:** Drilling holes for plate mounting.

## Subaru EJ25 Drive By Wire Vanagon Installation

12. Your bracket and accelerator pedal will use the same bolts to mount to the body. Use the provided bolts to mount it as shown. The nuts can be installed from the wheel well. You'll notice that we cut our accelerator pedals. This is optional. See **Figures 34 and 35** for an installed pedal example.



**Figure 34:** Mounted accelerator pedal.



**Figure 35:** Wheel well view of bolts used to mount accelerator pedal.

13. Install the throttle cable into the circular hole on the bracket. The cable is retained with a C clip. The second hole is used for cruise control. **Figure 36** shows an installed throttle cable.



**Figure 36:** Throttle cable installed to bracket.

14. Now drill a hole down through the accelerator pedal as shown below. We have drilled two holes as this van will have cruise control. **Figure 37** below shows the throttle cable fed through the accelerator cable.



**Figure 37:** Cut and drill Subaru accelerator pedal.

## Subaru EJ25 Drive By Wire Vanagon Installation

15. Install the two provided barrel nuts. **Figure 38** below shows a barrel nut installed to the accelerator pedal.



**Figure 38:** Installed barrel nut.

16. Pull the cable so that there is no play, cut the cable to length, and install the cable into the end of the barrel nut. **Figure 39** shows an engine bay view of a completed accelerator pedal install.



**Figure 39:** Completed accelerator pedal installation.

### Automatic Accelerator Pedal Installation

Our kit uses the stock Subaru accelerator pedal for automatic transmissions, The following instructions address how this is done. *Drive by Wire Pedal Kit A/T PN: DBWPKAT*

1. The stock Vanagon accelerator cable is left in place with its connection to the automatic transmission.
2. The automatic transmission kickdown lever is removed from the automatic transmission, and the Kick Cable Bracket (**PN: AAB**) is bolted to the Vanagon Transmission. See **Figure 11-1**.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 11-1:** Kickdown cable bracket installation.

3. Attach the Kickdown Cable (**PN: K286507C**) to the Kickdown Cable Bracket by removing one of the stop nuts from the threaded cable and securing to the bracket. See **Figure 11-2** and **11-3** below for installation images.





**Figure 11-2:** Cable being inserted into bracket.



**Figure 11-3:** Installed cable.

4. The cable shortener (PN: 00-3170-0) is attached to the end of the cable as seen in **Figure 11-4**.



**Figure 11-4:** Barrel clamp is attached to the end of the cable

5. Next, take the barrel connector (PN: 251721577) and insert it into the stock VW kickdown lever. You may need to drill out the hole on the lever to fit the barrel connector. Once you've inserted the barrel connector into the kickdown lever you must insert the previously installed cable shortener into the barrel connector and tighten its set screw. See **Figure 11-5** below for a complete install.



**Figure 11-5:** Barrel connector is connected to the kickdown lever.

6. Take the provided throttle pedal bracket (PN: PDBMTNEW) and bend it as shown below (**Figure 11-6**). Then hold your throttle pedal to the bracket and mark which holes will be used for mounting the

## Subaru EJ25 Drive By Wire Vanagon Installation

throttle pedal to it (Figure 11-7).

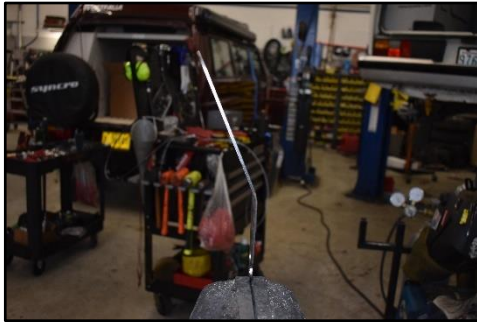


Figure 11-6: Bent throttle pedal bracket.



Figure 11-7: Throttle pedal bracket with holes that will be used marked.

7. Remove the passenger side taillight. Hold your bracket in place as shown below, mark your holes, then drill. See **Figures 11-7 and 11-8**.



Figure 11-7: Marking holes to be drilled for plate mounting.



Figure 11-8: Drilling holes for plate mounting.

8. Your bracket and accelerator pedal will use the same bolts to mount to the body. Use the provided bolts to mount it as shown. The nuts can be installed from the wheel well. You'll notice that we cut our accelerator pedals. This is optional. See **Figures 11-9 and 11-10** for an installed pedal example.



Figure 11-9: Mounted accelerator pedal.



Figure 11-10: Wheel well view of bolts used to mount accelerator pedal.

## Subaru EJ25 Drive By Wire Vanagon Installation

9. Install the kickdown cable into the circular hole on the bracket. The cable is retained with a with a lock nut. The second hole is used for cruise control. **Figure 11-11** shows an installed throttle cable.



**Figure 11-11:** Throttle cable installed to bracket.

10. Now drill a hole down through the accelerator pedal as shown below. We have drilled two holes as this van will have cruise control. **Figure 11-12** below shows the throttle cable fed through the accelerator cable.



**Figure 11-12:** Cut and drill Subaru accelerator pedal.

11. Install the provided barrel connector (**PN: 251721577**) into the accelerator pedal. Then, install the remaining cable shortener (**PN 00-3170-0**) into the barrel nut. **Figure 11-13** below shows a barrel nut and cable shortener installed to the accelerator pedal.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 11-13:** Installed barrel nut.

12. Pull the cable so that there is no play, cut the cable to length, and install the cable into the end of the barrel nut. **Figure 11-14** shows an engine bay view of a completed accelerator pedal install.



**Figure 11-14:** Completed accelerator pedal installation.

The Drive-by-Wire throttle pedal install is now complete.

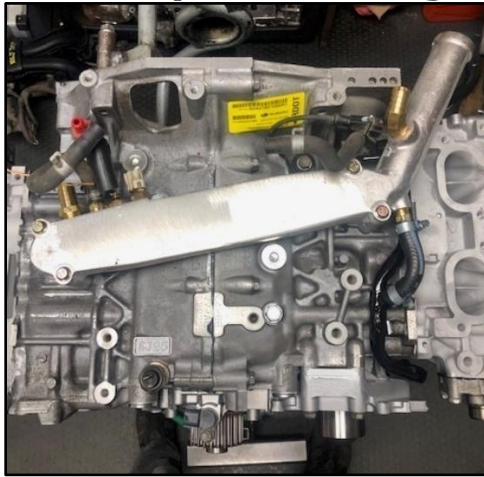
The Drive-by-Wire throttle pedal install is now complete.

### Cooling System

Small Car has refined the Subaru coolant system over 10 years with thousands of vehicles converted using our coolant system design. As the installer of this conversion kit proceeds through the install, it is important to note that not following this installation could lead to engine failure over time due to inefficient and excess temperatures. You will need a Reversed Coolant Manifold and Heater Pipe Kit as well as a Coolant Hose Kit. *Reversed Coolant Manifold and Heater Pipe Kit part number: MANCSV. Coolant Hose Kit part number: CHK.*

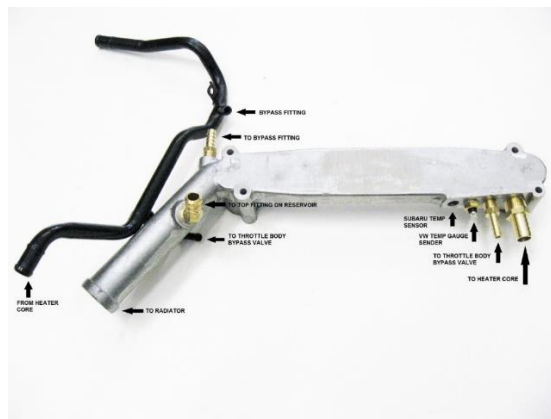
1. Remove the intake manifold and hoses from the top of the engine.
2. Install reverse coolant manifold and heater pipe (black pipe) assembly. See **Figure 40** below for installed example.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 40:** Installed reverse coolant manifold and heater pipe.

3. Torque coolant manifold bolts to 7-10 ft-lbs.
4. **Figure 41** below illustrates where sensor and coolant hoses must be installed.



**Figure 41:** Reverse coolant manifold and heater pipe schematic.

5. Use thread sealant when installing the fittings and temperature sensors.
6. Now connect the Subaru temperature sensor to the original connector on the Subaru engine harness.
7. The Vanagon temperature gauge sender now needs to be wired. You can do either of the following:
  1. Connect a pigtail to the temperature gauge sender so that it can later be connected to the original Vanagon wire for the temperature gauge sender.
  2. Connect a wire to your temperature gauge sender then splice that wire into the Subaru engine harness. Once the engine is installed you can splice the original Vanagon temperature gauge sender wire into the bulkhead harness.

\*\*Please note: Option 1 and option 2 both have the same outcome. Option 1 is easier but option 2 may lead to a cleaner looking install.
8. Once the motor is installed in the van you will need to make all the cooling system connections. **Figures 42 and 43** are included below to help you with this process.

## Subaru EJ25 Drive By Wire Vanagon Installation

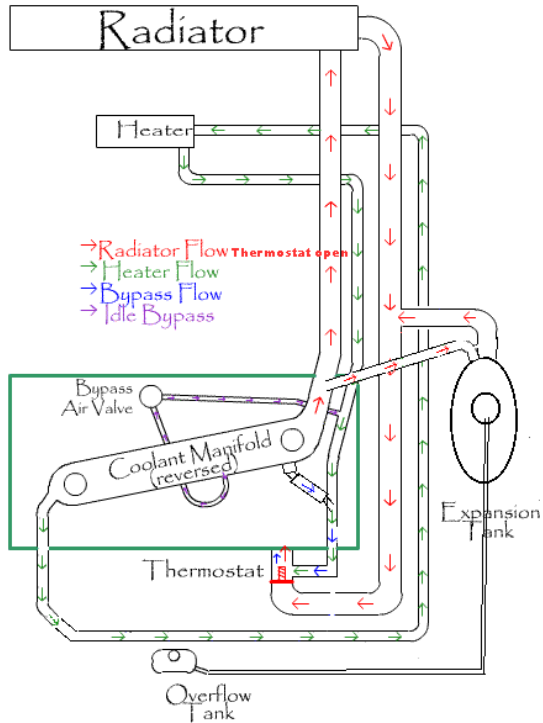


Figure 42: Cooling system schematic.

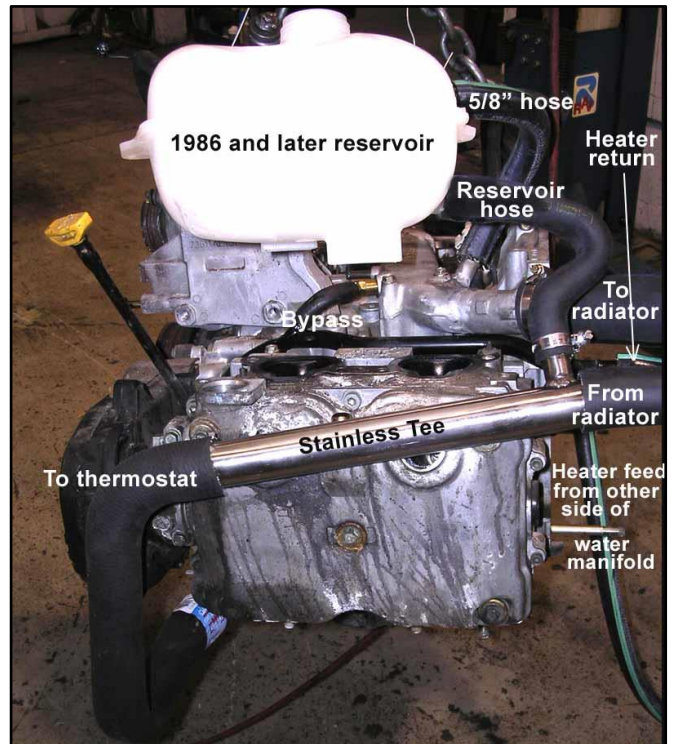


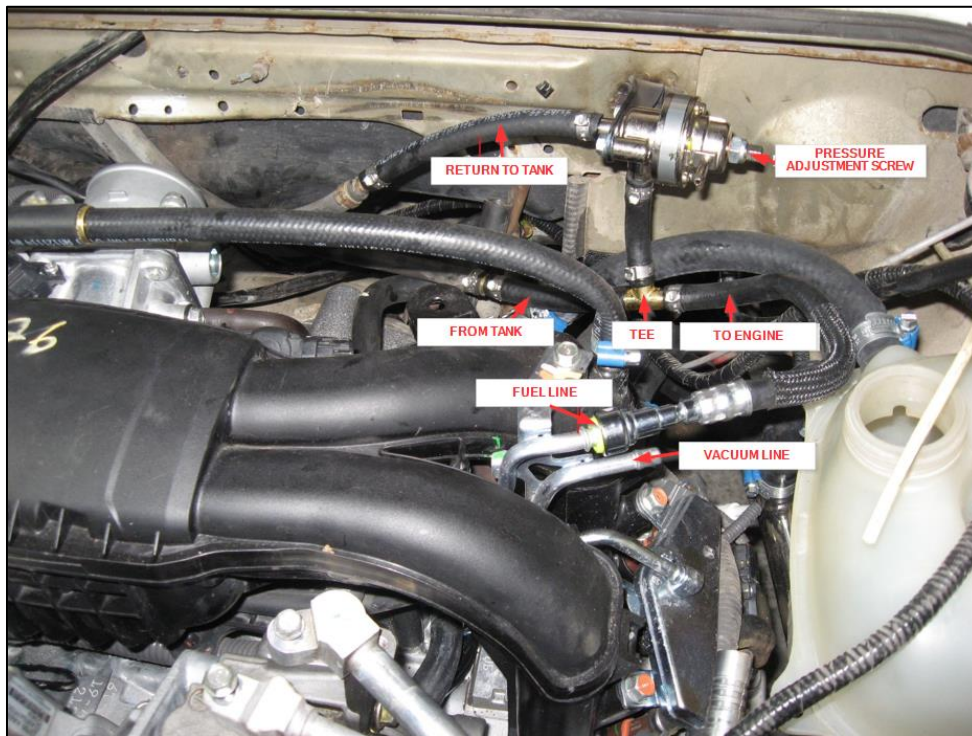
Figure 43: Installed coolant hoses.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Fuel System

The stock Vanagon fuel system must be updated to receive the Subaru EJ25 to ensure proper functionality. The Subaru engine requires a higher fuel pressure which means an adjustable regulator from Small Car must be used to ensure proper fuel/air mixture to optimize power and efficiency of the system. The adjustable fuel pressure regulator is available from Small Car. Fuel line must be sourced elsewhere. *Adjustable Fuel Pressure Regulator part number: FPR1065.*

1. Fuel Pressure Regulators will come preset from Small Car. Pressure should be set between 49 and 52 PSI which is the Subaru requirement.
2. The fuel pressure regulator must be bolted to the firewall near the location shown in **Figure 44**.
3. The fuel system should be connected exactly as illustrated below in **Figure 44**.



**Figure 44:** Fuel system connections.

Note: 4WD Vanagons have rear mounted tanks so the Fuel Pressure Regulator should be mounted to the left side of the engine bay to ensure the tank is not punctured. We usually mount them near the location of the old Vanagon ignition coil.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Evaporative Emissions System

Ensuring the Vanagon evaporative emissions systems is functioning properly and well is key to improving on the environmental impact of your vehicle. Please refer to the **Figures 45 and 46** for reference. In order to do this you will need to have the original Volkswagen charcoal canister, vacuum shutoff valve, and the associated plastic tubing. Small Car provides a kit that allows you to hook up your evaporative emissions system. *Evap Line Kit part number: SCP-ENG-006-00.*

### Crank Case Ventilation

1. Take a small section of 12 mm evap hose and connect it to the outlet of your PCV.
2. Take the full length of 12 mm evap hose and connect one end to the passenger side crank case ventilation nipple on the valve cover.
3. Install the supplied ½" tee barb fitting into the hose coming off of the PCV.
4. Cut the 12 mm evap hose coming from the valve cover to length then connect it to this tee.
5. Now connect the remaining 12 mm evap hose to the drive side crank case ventilation nipple on the valve cover.
6. Cut this so that it is long enough to reach the nipple that is coming out of the Small Car MAF coupling.
7. Install the second supplied ½" tee barb fitting into the end of the hose you just cut.
8. Run a piece of 12 mm tubing between the two tee fitting you just installed.
9. Finally, run a piece of 12 mm tubing between the tee closest to the Small Car MAF coupling and the barb fitting on the Small Car MAF coupling.
10. This is a low-pressure system so hose clamps are optional.

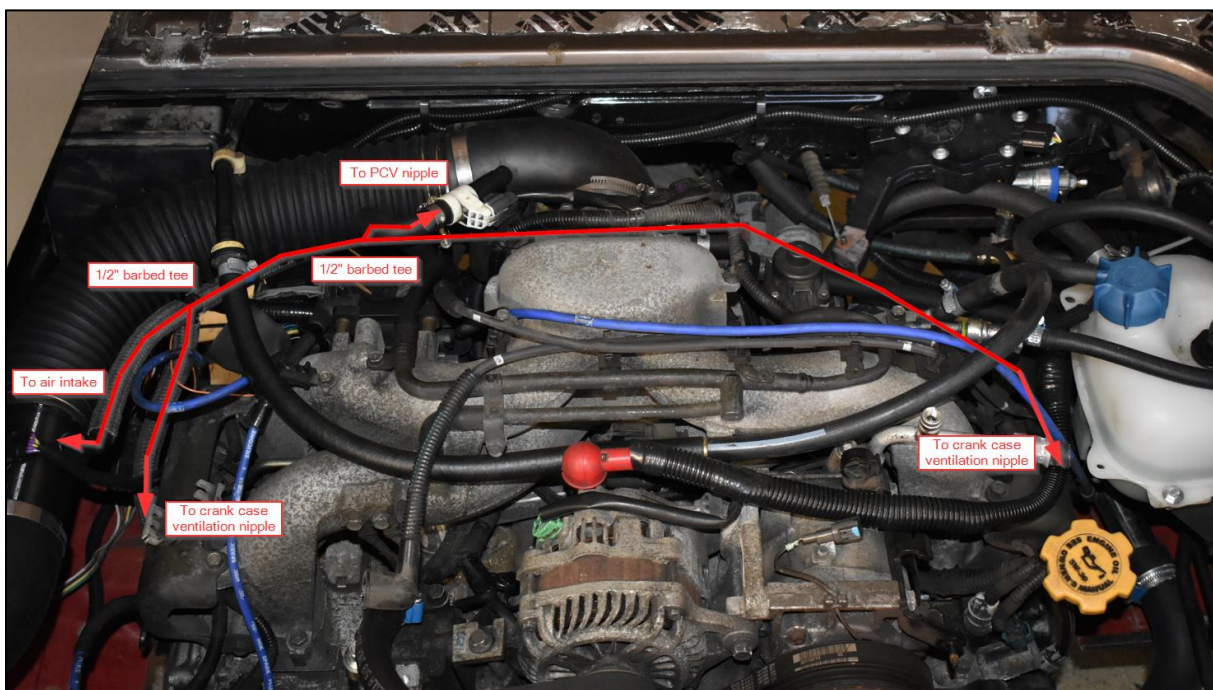


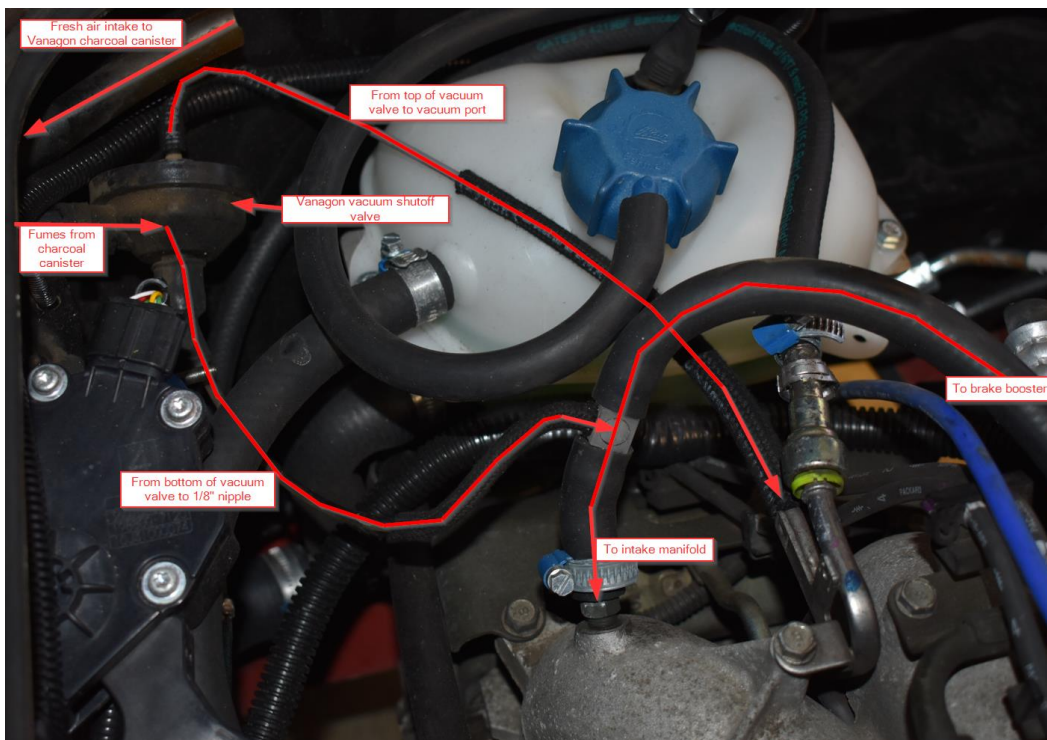
Figure 45: Crank case ventilation schematic.



## Subaru EJ25 Drive By Wire Vanagon Installation

### Fuel Tank Evaporation System

1. Take the supplied 3/8" X 1/8" X 3/8" tee barbed fitting and splice it into the brake booster vacuum line where shown in the figure below.
2. Take about 9 inches of 7 mm evap line and connect it to the evap vacuum port on your engine.
3. Take the other end of that line and connect it to the top of the vacuum valve.
4. Take the 3.5 mm evap line and a small 3 inch section of 7 mm evap line. Slide the 3.5 mm line inside of the 7 mm line so that you get about an inch of overlap.
5. Connect the 7 mm section of this assembly to the bottom of the vacuum valve.
6. Connect the 3.5 mm section of this assembly to the 1/8" nipple on the tee you previously installed.



**Figure 46:** Fuel tank evaporative system hookup schematic.

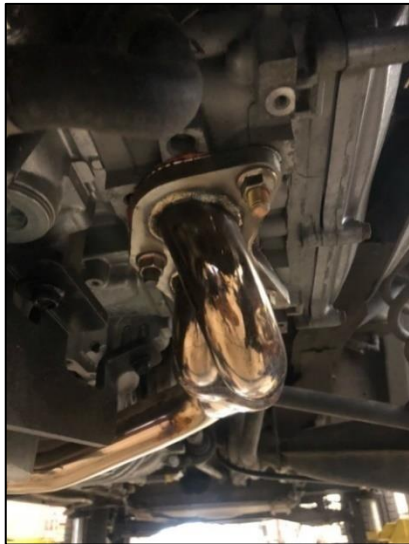
You have now adapted the Subaru to work with the original Vanagon evaporative emissions system.

## Subaru EJ25 Drive By Wire Vanagon Installation

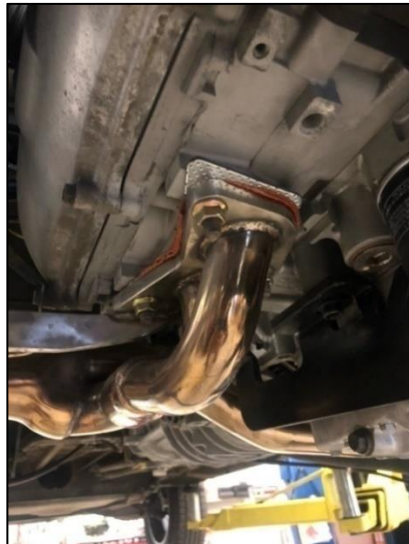
### Small Car Exhaust System

Small Car offers a high quality exhaust kit that integrates into the Vanagon body just as the original exhaust did. *Vanagon Stainless Steel Exhaust part number: 025ESSNC. 321 Stainless Steel Header part number: H025SS.*

1. Pre-lubricate all the original Vanagon exhaust nuts and bolts with liquid wrench or a similar product.
2. Remove the old muffler, collector or "J" pipe, catalytic convertor, muffler, and tailpipe. You can sometimes remove the whole thing as a unit.
3. Lube all stainless fasteners with anti-seize or another lubricant as they tend to freeze up once tightened.
4. Install the exhaust header assembly to the engine as shown below. There should be a gasket installed at each exhaust port and the copper lock nuts should be used on the exhaust studs. **Figures 48 and 49** show a completed header install from each side of the vehicle.



**Figure 48:** Passenger side headers installed.



**Figure 49:** Driver's side headers installed.

5. Install both muffler brackets onto the Small Car engine mount. There is a left and a right bracket. The tabs on each bracket should point outward if installed correctly. Just finger tighten these bolts for now. **Figure 50** below illustrates this temporary install.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 50:** Muffler brackets loosely installed.

6. Now take your two muffler clamps and slide them over your muffler, lift your muffler into place and slide the muffler clamps over the tabs on the brackets you installed in the previous step.
7. Fully torque the bolts on the muffle clamps.
8. While pushing up on your muffler to nest it under the van tighten the bolts that you left loose on the muffler brackets in step 5. **Figure 51** below shows a completed muffle install.



**Figure 51:** Installed muffler.

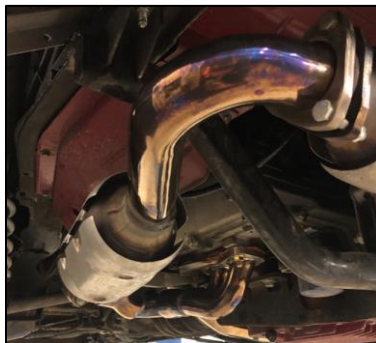
9. Install the Subaru oxygen sensor into the output end of the second catalytic converter.
10. Bolt the output of the second catalytic converter to the input of the muffler with a gasket in between. Bolts and gaskets are supplied in our kit. See **Figure 52** for a complete second catalytic converter install.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 52:** Installed second catalytic converter with Subaru oxygen sensor installed.

11. Install the Subaru air/fuel sensor into the bung on the input of the first catalytic converter. Install the “J” pipe/catalytic assembly between the output of the header assembly and the input of the second catalytic converter. In each of these joints there should be a donut metal exhaust gasket. Bolts and gaskets are supplied for these joints. If more room is needed for the “J” pipe the muffler clamps can be loosened and the muffler can slide left and right. See **Figure 53** below for a completed “J” pipe install with a catalytic converter.



**Figure 53:** Installed “J” pipe/catalytic converter assembly.

12. The tail pipe is installed to the end of the muffler with the supplied fasteners and gasket. The muffler should be at roughly 45 degrees from parallel with the ground. **Figure 54** illustrates this angle.

## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 54:** Installed tail pipe.

13. Tighten all bolts and nuts to about 20 lb/ft.
14. Connect the air/fuel sensor and the oxygen sensor to the engine harness.

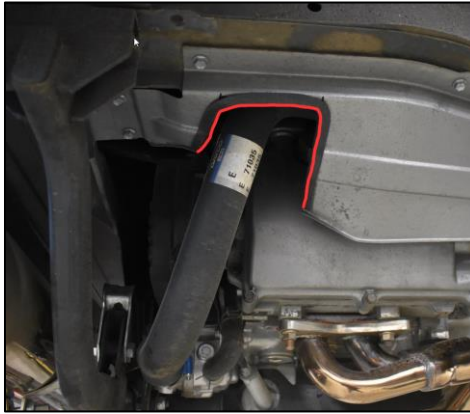
Exhaust install is now complete.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Engine Tin

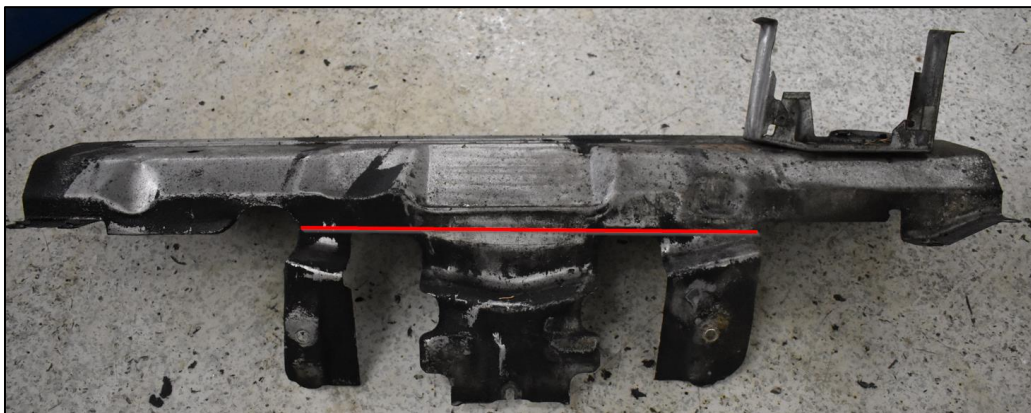
The Small Car system allows for the re-use of the stock Vanagon engine compartment tin with minimal modifications. The modifications that must be made are detailed below.

1. A cutout must be made to the passenger side tin to allow the thermostat coolant hose to clear. See **Figure 55** below.



**Figure 55:** Passenger side tin cutout for thermostat coolant hose.

2. The three long tabs must be cut off the center tin in order to fit. See **Figure 56** below. Cut along red line.



**Figure 56:** Illustration of the cut line on the center engine tin.

## Subaru EJ25 Drive By Wire Vanagon Installation

### Small Car Air Intake Assembly

The Small Car Air Intake Assembly is designed to replace the Subaru air box with a system that functions the same but fits the Vanagon better. Everything you need is included in the Air Intake Kit. *Air Intake Kit part number: SCP-ENG-004-00-A.*

1. Take the supplied reducer elbow and spray it with your choice of lubricant.
2. Install this elbow onto the intake of your engine. Install stainless hose clamp.
3. Install one of the 3 inch aluminum couplings into the end of the reducer elbow then install stainless hose clamp. See **Figure 56**.



**Figure 56:** Installed reduce elbow and aluminum coupling. Elbow must point towards driver's side.

4. Assemble cone filter, 3 inch elbow, and 3 inch aluminum coupling. Half of the 3 inch couple should be slid into the cone filter and the other half should be slid into the elbow. Install stainless hose clamps on both the cone filter and the elbow. See **Figure 57**.



**Figure 57:** Cone filter, plate, and elbow subassembly.

5. Now take the two supplied M6 bolts and washers and bolt the air intake panel into the cavity behind the driver tail light. There are existing threaded holes that will line up with the panel. See **Figure 58**.

## Subaru EJ25 Drive By Wire Vanagon Installation



Figure 58: Air intake panel installation.

6. Install your MAF sensor into your MAF coupling using the supplied screws. Your sensor can only go on one way so don't worry about installing it backwards. See **Figure 59**.

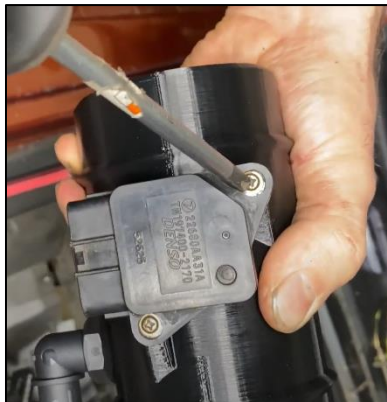


Figure 59: MAF Sensor installation.

7. Now, take your 3 inch tubing and first connect it to the aluminum coupling coming out of the reducer elbow on the engine and then to the MAF coupling. See **Figure 60**.
8. Install the two ring style hose clamps on the tubing. See **Figure 61**.



## Subaru EJ25 Drive By Wire Vanagon Installation



**Figure 60:** 3 Inch intake tubing install to intake manifold elbow.



**Figure 61:** 3 Inch intake tubing install to MAF Sensor coupling.

- Slide the MAF coupling into the 3 inch elbow coming off of the block off plate and install the final 3 inch stainless hose clamp. See **Figure 62**.



**Figure 62:** MAF Coupling install to air intake boot.

- Take the supplied 1/2 inch evaporation line, cut it to length, and connect it from the rest of your evaporation system. If you have plumbed the Vanagon evap system to your Subaru then you may have a tee installed. If not, just plumb the evaporation line to the nipple on your PCV valve.
- Connect your MAF. See **Figure 63**.

## Subaru EJ25 Drive By Wire Vanagon Installation



Figure 63: MAF sensor connection.

The Small Car Air Intake install is now complete.

### Conclusion

This concludes the Subaru EJ25 Drive By Wire Vanagon instructions.