

Installation of the FSM

By Had Robinson

Updated April 20, 2026 – Pilots install the FSM at their own risk!

The purpose of the FSM is to transport 100% liquid fuel to the carburetor fuel inlet at a constant low pressure of about 0.2 PSI (1.4kPa). The major benefit of this is to end fuel starvation at high throttle openings and “4 cycling” in the midrange caused by overly rich main jet settings.

The FSM is sensitive to air or fuel vapor entrapment in the lines that may enter the fuel systems. *Every line must have a slope “up” in the direction of fuel movement unless specifically instructed otherwise.* In order to function as designed, every part of the FSM is necessary especially in regards to safety. Do not substitute parts as it may create a hazard!

Requirements for the FSM installation:

- A cylinder head temperature gauge and tachometer
- An external pulse port fitting of 5/32" (4mm) ID or greater on the engine. We can supply a pulse port kit of this size. Smaller ID port sizes may work but will reduce fuel pump capacity. Larger engines may not achieve maximum performance.
- The carburetor should be an OEM.
- The exhaust system must be free of obstructions to keep crankcase pressure as low as possible.
- There must be at least (2) **independent** methods to shut down the engine! See this link www.southwestairsports.com/ppgtechinfo/emergency/emergency_engine_kill_cord.htm

Special tools and supplies needed:

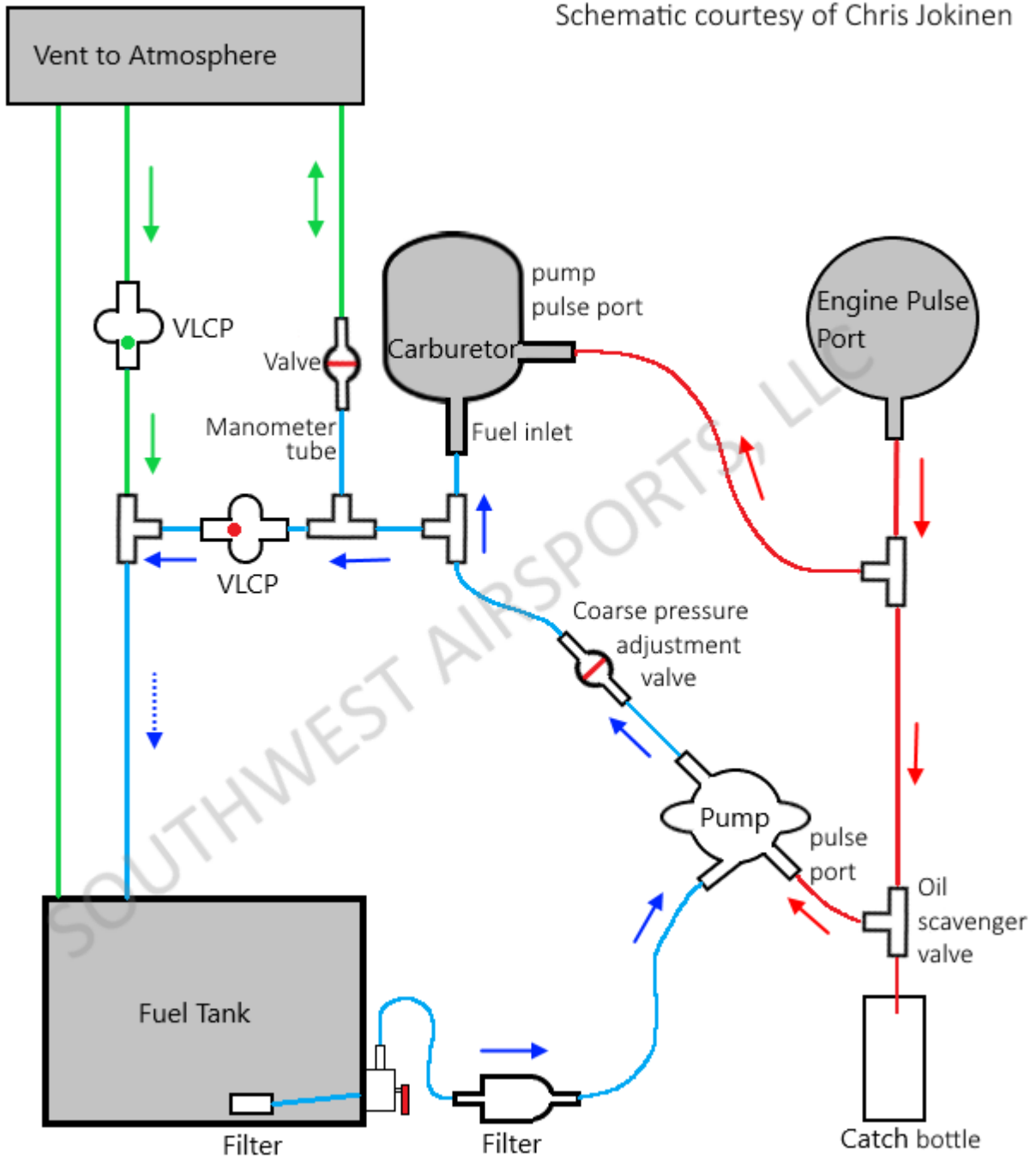
- Hot air gun
- (2) fuel line clamps (for performing routine maintenance and testing of the FSM)



This particular clamp from Lisle will **not damage** fuel lines - <https://www.lislecorp.com/>

Study this schematic carefully – you must understand the basic function and parts location of the FSM

Schematic courtesy of Chris Jokinen



- **blue** lines – contains gasoline. Note: gasoline between the pump and the coarse pressure adjustment valve is pressurized to 7 PSI. Clamps and lines must be correctly installed!
- **red** lines – pulses that power the carburetor and Walbro fuel pumps (some engines will not have a pulse line going to the carburetor)
- **green** lines – air
- green, red, or blue dots/arrows indicate flow direction. The dotted arrow is fuel + air
- VLCP's – Very Low Constant Pressure regulators, red or green type (different crack pressures)

All line/tubing used in the FSM is 3/16" (5mm) ID except the fuel overflow line #15 (figures 3 and 5) which is 1/4" (6mm) ID. Line/tubing may be supplied in one or more sections.
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Additional couplings will be included. Note: 1/4" (6mm) line may sometimes be substituted for 3/16" line. Accordingly, supplied clamps will be 10mm.

Fitting size is 1/4" (6mm) and works well with 3/16" (5mm) *premium* fuel line. Barbed fittings should have a small amount of silicone grease smeared on them before pushing on a line. Heat the line *slowly* until it is almost too hot to touch just before installation. These two steps will ensure that the line goes on easily and *does not split* nor cause *damage to the barbed fitting*. Great care must be used when handling and installing fuel lines. Your safety depends on it.

Per the available options, the line from the tee above the coarse pressure adjustment valve (CPAV) to the manometer tee and carburetor (#20 in figure 2) can be 3/16 (5mm) or 1/4" (6mm) depending on the size of the carburetor inlet fitting. Some carburetors have a 1/8" (3mm) ID inlet so a short piece of 1/8" (3mm) line with a reducer fitting is supplied and must be used.

Note: the test engines in the figures may have lines without clamps, of different color, in different locations, and sizes. ***Always default to the instructions in this manual.***

Note: the fuel tank must always have an *unrestricted vent to the atmosphere*. It does not matter if the FSM is installed or not. If the vent should become clogged, the FSM will not function correctly. In addition, the tank could *rupture* from excessive pressure created by the vapor pressure of the gasoline and cause a serious hazard. The vent tubing must be HDPE, the same material of which the fuel tank is made. Other materials could collapse and block the vent.

(Please study figures 1-6 in the following pages to get some idea of part location. The instructions are specific but it helps to know the general layout before beginning the install.)

Parts ID – figure 1 on page 4

Note: the (5) red dots indicate a required 9mm hose clamp at that location.

1. Catch bottle for scavenged oil
2. Scavenged oil drain line
3. Fuel filter (this filter is critical to the proper functioning of the FSM – do not substitute)
4. Fuel tank fitting with an in-tank clunk attached
5. Oil drain valve for the fuel pump (modified tee marked w a white dot on the drain leg)
6. Auxiliary fuel pump (actual installation location should be close to the bottom of the tank)
7. Pulse port line
8. Pump output fuel line to CPAV (#9 in figure 2)

Parts ID – figure 2

- 7. Pulse line from engine crankcase
- 8. Auxiliary pump output fuel line
- 9. CPAV (Do **NOT** substitute a Chinese clone for this valve!)
- 10. Crankcase pulse port
- 11. Carburetor pump pulse inlet
- 12. Fuel line from manometer tee to carburetor fuel inlet – this line is 1/4" (6mm) but can be different for your engine per the size of the carburetor fuel inlet size.
- 13. Manometer tube
- 20. Fuel line from the carburetor to the manometer tee

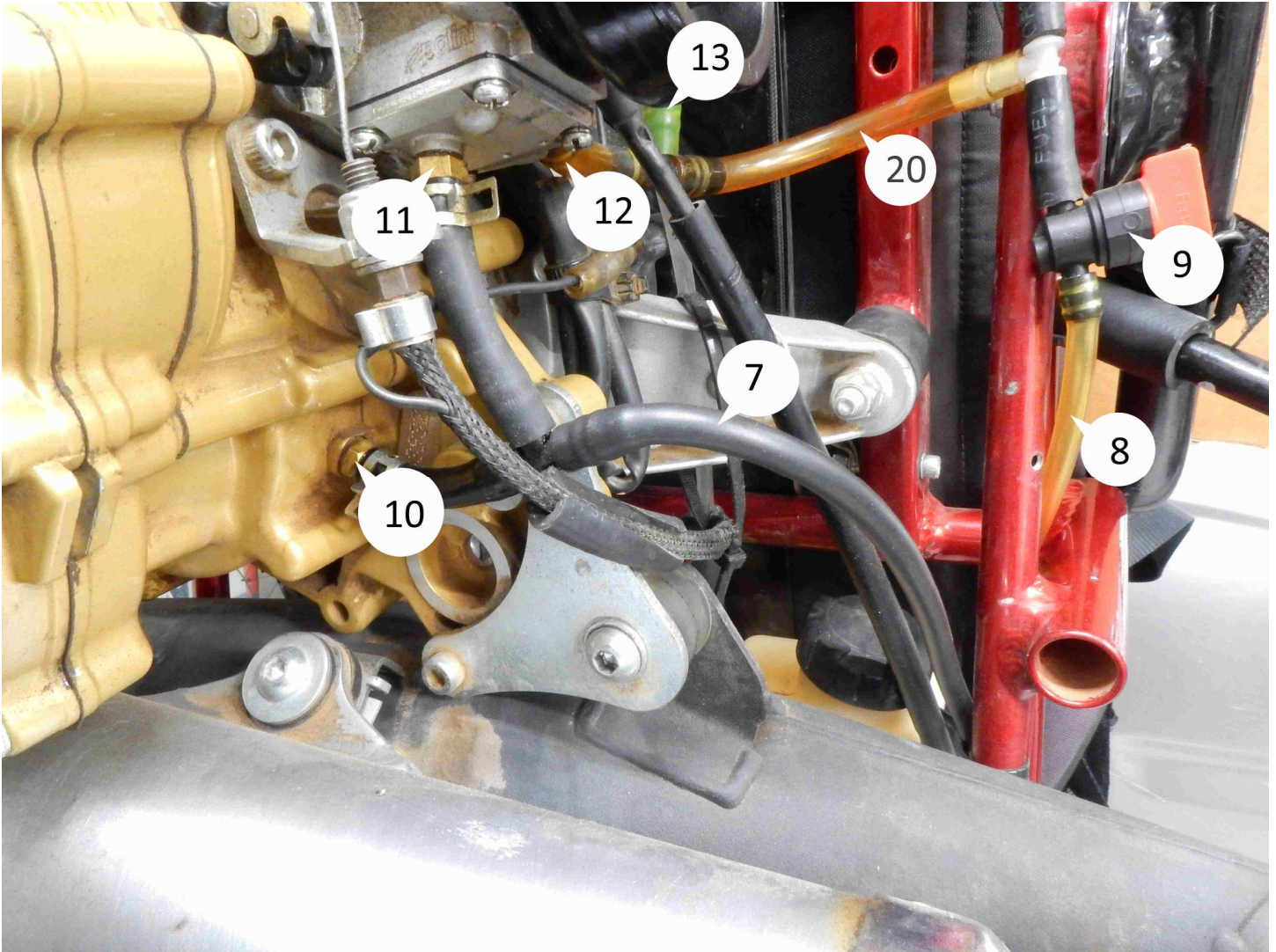


Figure 2 DSCN1340

Parts ID – figure 3

Note: the red dot indicates that a 9mm hose clamp is required on the carburetor fuel inlet.

- 8. Auxiliary pump output fuel line
- 9. Coarse pressure adjustment valve (CPAV)
- 11. Carburetor pump pulse inlet
- 12. Fuel line from manometer tee to carburetor inlet
- 13. Manometer tube

Note: the VLCP's are different in resistance to ethanol and cracking pressure

- 14. VLCP regulator type red
- 15. 1/4" (6mm) fuel overflow line to fuel tank
- 16. VLCP regulator type green
- 17. Manometer tube shutoff (clone valves OK)
- 18. Manometer tube vent to fuel tank
- 19. Vent for VLCP regulator green
- 20. Fuel line to manometer tee

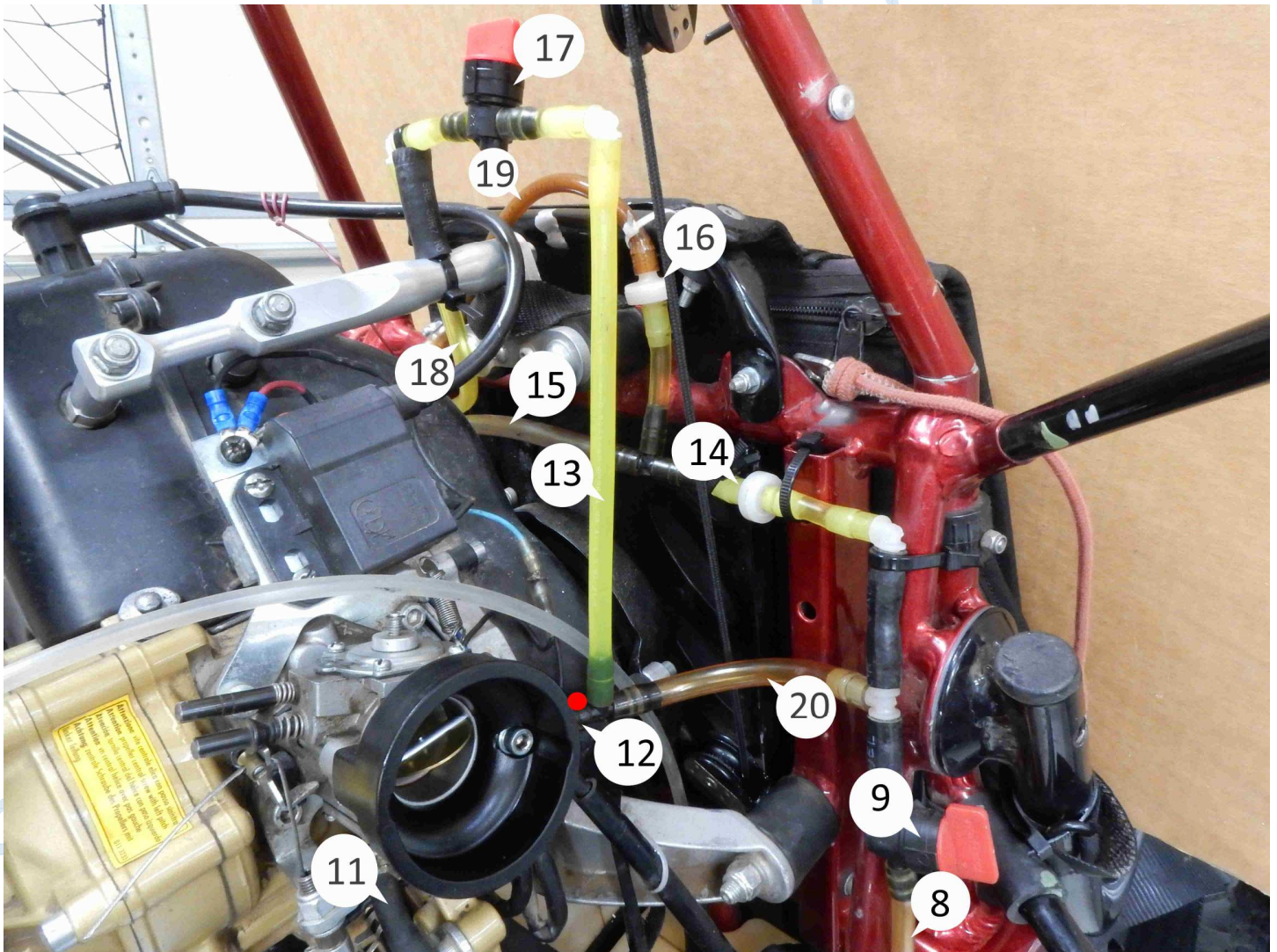


Figure 3 DSCN1336

Parts ID – figure 4

- 13. Manometer tube
- 16. VLCP regulator green
- 17. Manometer tube shutoff (clone valves OK)
- 18. Manometer tube vent to fuel tank
- 19. Vent for VLCP regulator green
- 20. Fuel line to manometer tee

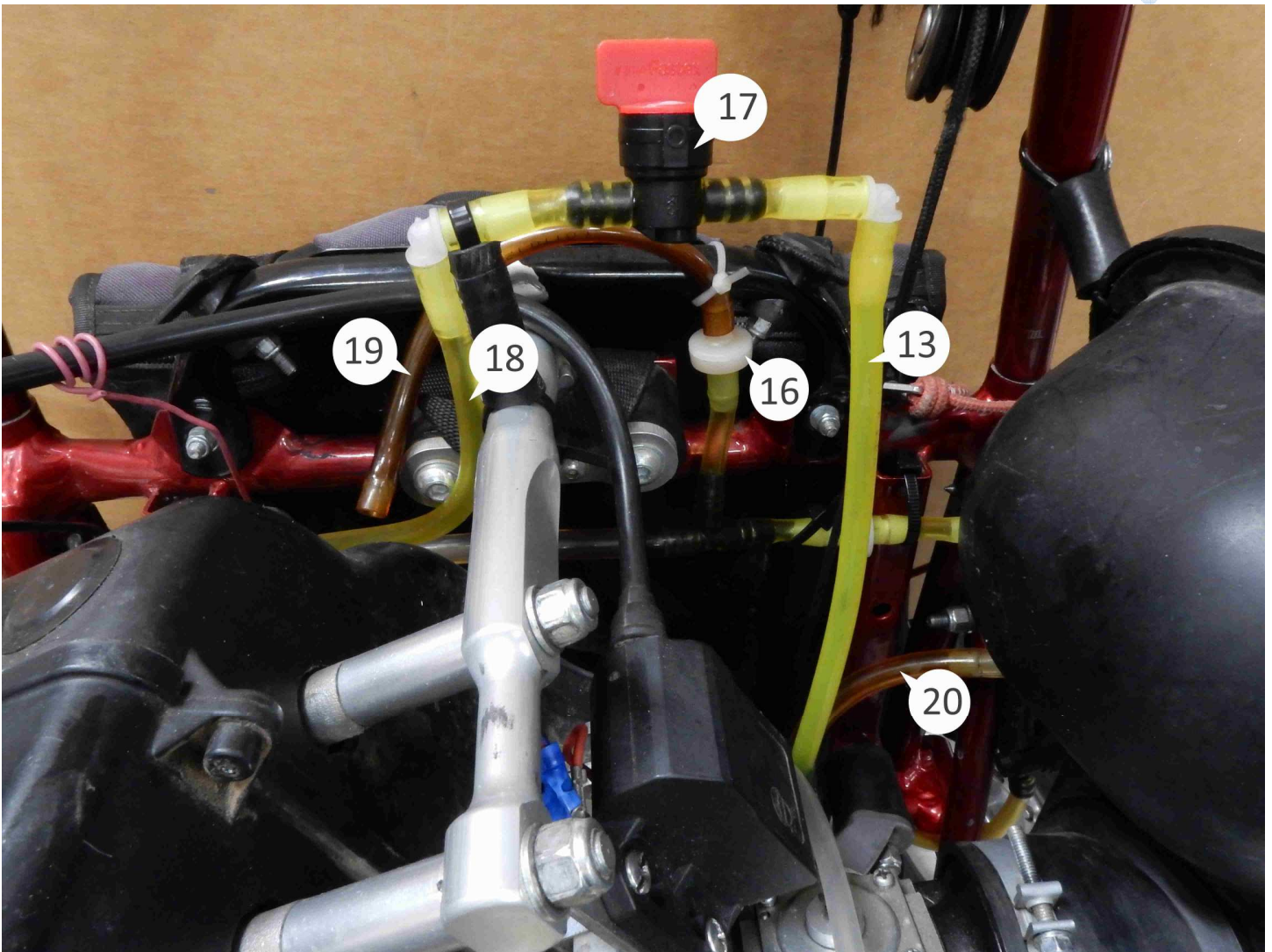


Figure 4 DSCN1335

Parts ID – figure 5

Note: the (2) red dots indicate that a required 10mm hose clamp is required at those locations.

15. 1/4" (6mm) fuel overflow line to fuel tank **(CRITICAL ATTACHMENT)**

18. Manometer tube vent to fuel tank **(CRITICAL ATTACHMENT)**

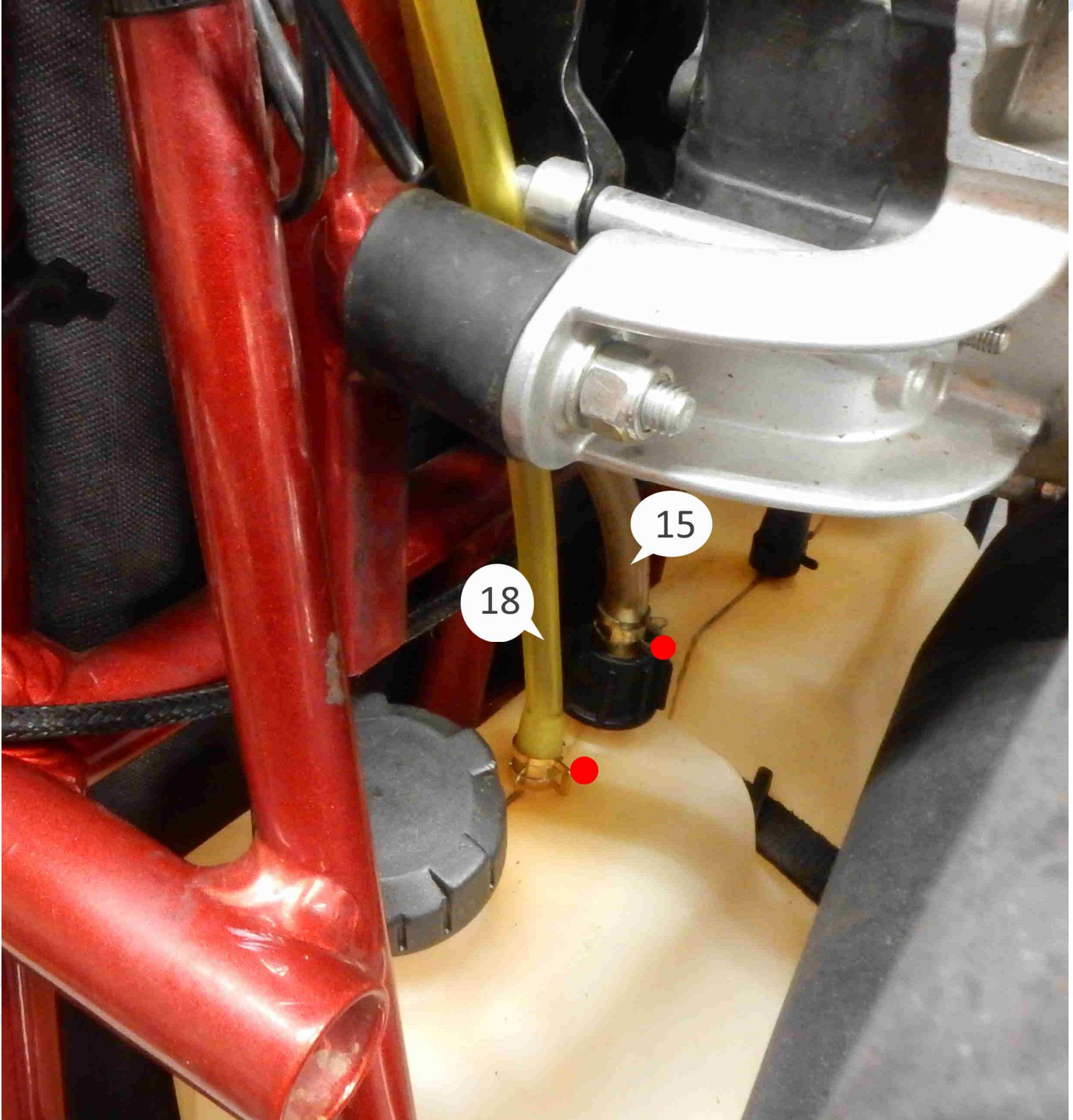


Figure 5 DSCN1328

Parts ID typical fuel tank – figure 6

Below is a typical fuel tank.

Note: the overflow tube/venturi MUST have a straight and dedicated run from the VLCP's to the fuel tank. It cannot be combined with other parts of the fuel system including the manometer tube vent. If your tank needs additional openings, leak-proof fittings may be ordered. Contact us.

1. Fuel tank fill opening
2. Extra tank fitting – for manometer tube vent. Note: contact us if additional leakproof fittings on top of the tank are needed.
3. Original fuel outlet (attached to the tank clunk) – for fuel overflow line (#15 figure 5) ONLY
4. Vent and priming tube fitting (if not present can be combined with #2 by using a tee)
5. Fuel tank fill opening

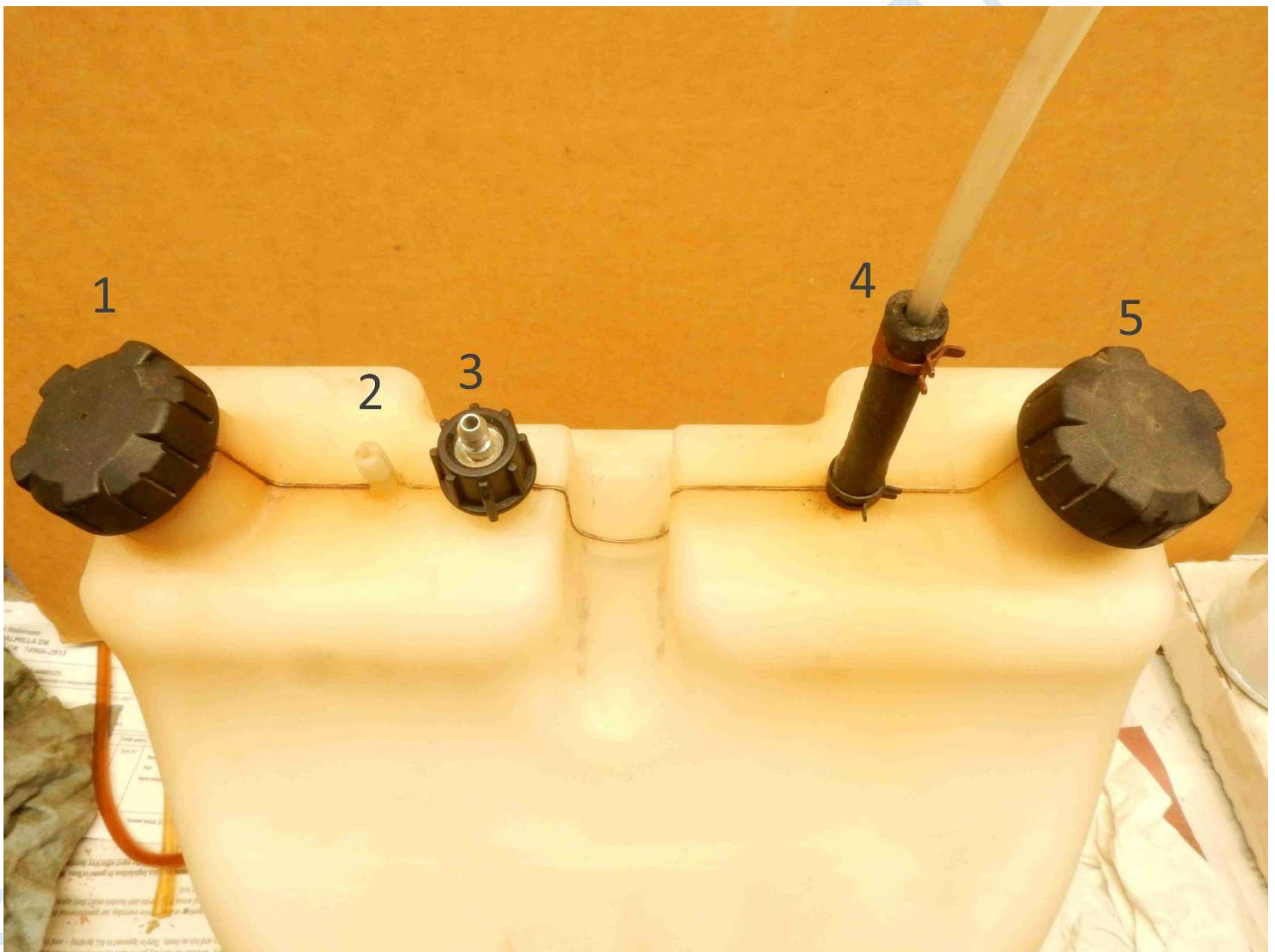


Figure 6 DSCN1319num

STEPS FOR INSTALLATION

Study these installation instructions **FIRST** before beginning the actual installation!

1. Remove and drain the fuel tank Figure 6 above is a typical tank. #2 can be capped off or used for the manometer tube vent #18 (figures 3,4,5). #3 is the recommended fitting for the fuel overflow line #15 (figures 3,5) because it is barbed.

Remove other parts of the engine, as needed e.g., the air box, exhaust system, etc. At this time, make sure there are enough openings in the fuel tank to install the FSM. If more openings are needed, please contact us to purchase additional fittings, if desired.

2. Priming Options If applicable, remove the existing inline primer bulb. To prime the system install a method to pressurize the fuel tank. The best and typical method is a long piece of HDPE tubing connected to the vent fitting #4 (figure 6). Use a piece of HD 1/4" (6mm) ID fuel line be used to attach the priming tube to the tank as shown in figure 6 above.

The existing brass double barbed fuel outlet fitting #3 (figure 6) may be used for the fuel overflow line. It is safer than using the formed HDPE fitting #2 that is next to it. If fitting #3 is used, remove the fuel line and the attached clunk.

The OEM clunk cannot be used because it is too restrictive to the high rate of fuel flow in the FSM. Use **ONLY** the supplied clunk in the FSM kit.

3. Install an external pulse port on the engine, if needed. See this page for info:

https://www.southwestairsports.com/ppgtechinfo/top80/hrservicenotes/ext_pulse_port/Ext_PP.htm

The existing pulse fitting on the crankcase may have to be enlarged in order to handle the additional fuel pump. The auxiliary fuel pump should be able to pump 0.8-1.0 liters/min at idle. Pump capacity decreases as engine speed increases and why the initial capacity must be as high as possible!

4. Cut hole in tank Cut the hole on a flat surface of the tank about 1.5" (4cm) above the lowest corner of the tank. The entire edge of the round grommet must contact a flat surface on the tank. Note: the mounting spot may have to be higher in order to avoid any non-flat areas on the tank (the higher the location, the less output of the pump and the greater the chance of putting a negative pressure on the gasoline). Drill the hole using the special cutter included in the FSM kit. The cutter should be turned slowly (100-200 RPM) with light pressure. Be certain that you are drilling perpendicular to the tank surface. Note: Unless this special rotary cutter is used, the fuel tank fitting will leak. Use a plastic tool or a fingernail to remove any burrs from the wall of the hole. Do not nick or cut the wall of the hole when removing burrs! It must be perfectly cylindrical and smooth. If the burrs are not removed, they can catch under the grommet and may

cause a leak. **Note: if the fitting leaks because the hole was drilled incorrectly, you will have to purchase a new tank!** If you have doubts of your ability to do this task, we will do it for you at no charge – you will only have to pay shipping.

5. Fuel tank fitting Having a valve on this fitting is not necessary. Some versions of this fitting may have a valve, some not. Smear a small amount of silicone grease around the flanged area of the grommet, the inside of the grommet, and the hole in the tank. Gently work the grommet into the hole in the tank. The piece of 3/16" (5mm) fuel line with the clunk must be fished down to and through the installed grommet. A piece of wire can be used to do this. Pull the fuel line out through the grommet. The clunk should remain inside the tank. Connect the fuel line and clunk to the tank-side barbed connector on the fuel tank fitting. Smear the tank-side part of the fuel tank fitting with a small amount of silicone grease and gently work it into the grommet. The fitting will expand the grommet and create a leak-proof joint. Do all of this slowly and with care. **DO NOT FORCE ANY PART OF THE FUEL TANK FITTING!**

6. Test tank for leakage Use one of the green silicone caps to seal off the fuel tank fitting or just close the valve, depending on which type of fitting that was supplied in the kit. Fill the tank half full of fuel and wait 5-10 minutes to be sure there are no leaks. If possible, pressurize the tank as when priming the system (via the mouth ONLY). **NEVER USE COMPRESSED AIR TO TEST A TANK FOR LEAKS!**

7. Reinstall tank Reattach the OEM fuel system so that the engine can run. The next steps will allow the testing of the newly installed auxiliary fuel pump which is not possible unless the engine is running.

8. Mount the Walbro fuel pump and the pulse line (but not the fuel lines). Keep the pulse line as short as possible. See figure 1 for the approximate location of the fuel pump. Although the pump has bolt holes, use only nylon zip ties and small pieces of 1/4" (6mm) ID heavy duty automotive-grade fuel line for mounting the pump to the engine frame. If you need to clock the fittings on the pump, the pulse port fitting must always POINT DOWN! If this is not done, the pump will fill with oil! The pump should be mounted below or about level with the bottom of the fuel tank, if possible. Figure 1 is of a test engine and the pump is a few inches above the bottom of the tank. However, it is better to have it the same height as the fuel tank fitting. The goal is to have as little negative pressure as possible on the fuel from the fuel tank fitting to the auxiliary fuel pump.

Note the position of the oil drain valve/tee #5 (figure 1). It must be mounted below the auxiliary pump #6 (figure 1) and positioned so that the pulse lines to the pump are higher than the center of the tee. The oil **must** be able to drain towards the center of the tee and pool in this area. This will help the oil drain completely when the paramotor is at rest. Retained oil in the pump or pulse lines will stop pump operation. Any loops in the pulse lines that might capture the oil and form a trap must be avoided.

9. When installing the fuel lines Coat the inside of the line and the outside of the fitting with a thin coating of silicone grease. A toothpick works well for this task. Use a heat gun to warm the fuel line until it is warm but not too hot to touch before pushing it on a fitting. If this is not done, the strength of the line material may be weakened and result in the line splitting and leaking at an inconvenient time.

Be careful to only expand clamps just enough to fit over the lines and fitting. Excessive or careless opening of clamps can damage them and cause a leak!

Test the auxiliary pump In order to test the auxiliary fuel pump, install the fuel lines from the tank valve fitting to the inline filter and then to the auxiliary fuel pump. See figure 1 for the details, if needed. Attach one end of the remaining fuel line supplied in the kit to the auxiliary pump output. Secure the other end to an empty fuel container. Start the engine in the usual way. As soon as fuel starts to fill the container, start a timer. After one minute, stop the engine and measure the fuel in the container. It should be 0.8 liters or more. If it is less than this, find out why. If you need help, contact us via text or email. Do ***NOT*** proceed with the rest of the installation unless the auxiliary pump output is satisfactory. If all is OK, remove the line from the pump output and continue with the fuel line installation.

For the rest of the fuel line installation, match the general layout shown in figures 1,2,3. The photos are of a test engine so the dimensions may appear different than those specified in these instructions and why you should keep to the dimensions given in the steps below in order to have the FSM performs its best.

When using nylon zip-ties to secure fuel lines to the engine frame, be careful to tighten them only enough to keep the fuel lines from moving horizontally. Do not overtighten zip ties! The following line connections must have clamps. If 1/4" (6mm) fuel line is supplied, use 10mm clamps.

- a.) inline fuel filter – 9mm clamp, input & output
- b.) auxiliary pump – 9mm clamp, fuel input & output (it will leak without clamps)
- c.) carburetor fuel inlet 9mm or 10mm (for 1/8" (3mm) line use a 2.5mm nylon zip-tie double wrapped)
- d.) fuel overflow line – 10mm clamp on end connected to the fuel tank

KEEP FUEL LINES AWAY FROM ANYTHING THAT CAN CHAFE THEM AND 6" (15cm) FROM *ANY* HOT SURFACES.

10. Install the Coarse pressure adjustment valve (CPAV) #9 (figures 2,3) in fuel line #8 (figure 1,2,3). Its location should be 3" (7.5cm) or more below the carburetor fuel inlet #12 (figures 2,3). Fuel line #8 can be any convenient length but it must not have any loops which could trap a bubble and create a vapor lock.

If there is an inline primer bulb installed in your system, remove it. Its presence will decrease the fuel capacity of the auxiliary pump. The system will now have to be primed by a primer tube connected to one of the fittings on top of fuel tank.

However, some engines have a primer bulb that pumps fuel directly into the airbox connection on the intake of the carburetor or connects directly to the pump diaphragm chamber. These priming systems are OK to use with the FSM.

Install the tee that goes to the manometer tube above the CPAV #9 (figures 2,3). The length of the fuel line from the valve #9 to the tee should be cut so that the center of the tee is located 1/2" (12mm) or so higher than the fuel inlet fitting on the carburetor. If the tee is lower than the carburetor inlet fitting, vapor lock can occur!

The correct placement of parts in the FSM helps ensure that any air or vapor bubbles will harmlessly move through the system into the manometer or overflow line and then back to the tank.

Normally, there should be no bubbles in the fuel until it reaches the last tee in the system. Faults in the FSM due to leaks, clogged or restricted filters and valves can create bubbles. However, the FSM is engineered to handle many different faults without causing additional problems.

11. The manometer tube – see figures 3,4,5 for details. Cut an 8" (20cm) piece of 3/16" (5mm) ID fuel line, insert a tee in the bottom end and insert a barbed ell into the top of the manometer tube. Using a Sharpie make a mark on the tube 5" (13cm) above the center of the tee. Connect the shutoff valve #17 to the barbed ell and another barbed ell fitting to the opposite side of the valve (see figures 3,4). Cut a section of 3/16" (5mm) fuel line and connect the last barbed ell fitting to an HDPE fitting on the top of the fuel tank.

The fuel in the manometer tube will act as a small reservoir when the throttle is opened quickly. However, if the shutoff valve #17 is closed, this feature will not be available.

If some part of the FSM become clogged and the shutoff valve is open, the carburetor will suck air rather than fuel and the engine will stop. This is not a hazard but just an inconvenience.

Connect the tee on the bottom of the manometer tube to a short piece of fuel line and connect it to the tee above the CPAV #9 (figures 2,3). The fuel inlet line must be cut so as to locate the manometer tee close to the carburetor inlet #12 (figures 2,3). This will allow stray bubbles of fuel or air to be captured and vented that might be present in the fuel system.

The fuel line from the manometer tee to the carburetor inlet should also be short, as shown in figures 2,3. The tee must be vertical. **Leave the fuel line going to the carburetor inlet disconnected at this time.** The system must be purged first and is a step in the "FSM Operation Instructions – first time use".

For carburetors with a 1/8" (3mm) ID line, a 1/4" (6mm) x 1/8" (3mm) adapter is supplied with the FSM kit when the appropriate option is chosen. Cut a short piece of 3/16" (5mm) fuel line and connect it to the adapter. The other end connects to the manometer tee. Cut a short piece of 1/8" (3mm) line and connect it to the adapter. **Leave the other end of the 1/8" (3mm) line disconnected.** The system must be purged first and is a step in the "FSM Operation Instructions – first time use".

12. Fuel line from the tee above the CPAV to the first ell fitting The piece of fuel line from the CPAV to the first ell fitting should be cut long enough so that the center of the ell is 4-6" (12-15cm) above the height of the carburetor inlet fitting. If this dimension is greater than 6" (15cm), the FSM may not be able to regulate pressure in the system correctly.

Note: The VLCP's are marked with the direction of flow by colored dot (red or green) on the output side of the VLCP. (Note: some older versions of the VLCP can have the mark on either side.) It is recommended that the flow direction be verified by blowing on the end of the VLCP. The FSM will only function correctly if steps 13, 14, & 15 are followed exactly. Figure 3 on page 6 is the most important because it gives the correct placement of the VLCP's and fuel lines. **The orientation and placement of these parts cannot be changed!**

13. VLCP Red #14 (figure 3) must be installed horizontally and be the same height above the carburetor inlet as the ell fitting in step #12. The flow direction is **away** from the CPAV #9 and towards the Fuel overflow line #15 (the red dot should be towards the Fuel overflow line). Note: on older FSM versions the dot may be on either end.

14. Install the tee below VLCP Green #16 (figure 3) in a convenient location after VLCP Red. It, too, should also be 4-6" (12-15cm) higher than the carburetor inlet. It must be oriented as shown in figure 3 with the leg of the tee facing up (which will be connected to VLCP Green). The venturi will not work properly unless the fuel flow is STRAIGHT through the tee with the air from VLCP Green entering through the leg.

15. Install VLCP Green #16 (figure 3) above the tee, as shown. The VLCP must be in a vertical position. The flow direction is **down** (the green dot should be down). Note: on older FSM versions the dot may be on either end. Use a nylon zip tie to hold any part of the fuel lines connected to VLCP Green so that VLCP Red is the same height as the ell fitting. In figure 3, a white nylon zip tie holds the vent line #19 (figure 3) so that the VLCP's are in the correct orientation with respect to each other and to the ell fitting from the CPAV.

The length of the vent line connected to the top of the VLCP can be any value greater than 4" (10cm). For safety it is recommended to extend the vent line (any sort of inexpensive tubing may be used) to the bottom of the engine frame in case the regulator fails and leaks gasoline if a malfunction occurs.

16. **Fuel overflow line and venturi** #15 (figures 3,5) is 1/4" (6mm) ID. This line must be 1/4" (6mm) ID or larger for the venturi to function properly and **not** cause back pressure in the system. It must be a dedicated line from the VLCP's to the fuel tank with no other fittings. I.e., it cannot be combined with other parts of the fuel system or have a tee in it. If the tank fitting has a smaller ID, for example, it must be enlarged or an additional fitting added to the top of the fuel tank. (Contact us for more info if another fitting needs to be added to the tank. Leakproof fittings are available and are installed in the same manner as the fuel tank fitting at the bottom of the tank.)

This line begins at the same height as the ell fitting in step #15 and continues directly to the original fuel outlet fitting #3 (figure 6) which is the best attachment point. It may be attached to the formed HDPE fitting #2 (figure 6) in the top of the tank but this fitting is not as secure as a brass barbed fitting. The line cannot contain any loops and must slope down to the tank. The line in test engines is about 18" (47cm). If the length is longer, the fuel pressure at the carburetor inlet will be higher. The line should not be near any hot parts of the engine. *Use a 10mm clamp to secure the line to the tank fitting.* If this line becomes disconnected while the engine is running, gasoline will stream out and cause a hazard. When you make this connection, pull on the installed line to be **certain** that it will not come loose. Typically, the fittings on paramotor fuel tanks are single barbed and/or flimsy. Extreme care must be exercised when connecting this line to the tank. Contact us if you are unsure about the installation of this CRITICAL line.

17. **Install the oil drain catch bottle**

The HDPE catch bottle must be installed below the oil drain valve.

An important feature for having the catch bottle is to monitor pressure in the crankcase. For example, a clogged muffler will increase the pressure and cause a significant increase in the amount of scavenged oil.

Higher crankcase pressure will also affect the function of both the auxiliary pump and the internal pump in the carburetor. Setting the idle becomes difficult or impossible.

The bottle #1 (see figure 1) is installed using a zip tie, a piece of bicycle inner tube supplied in the kit, and a short piece of automotive fuel system hose. The piece of inner tube will hold the lid of the bottle firmly. With this arrangement, the bottle can be easily unscrewed from the secured lid and the oil disposed of.

The catch bottle must have the drain line sloping $>40^\circ$ towards the bottle's cap. Push the drain line into the hole in the cap. If there is a loop in the drain line, the oil will build up in the loop and not drain properly.

Scavenged oil will slowly drip into the bottle while the engine is running. If the bottle is not drained when full, the auxiliary pump will quit working. See the "Troubleshooting manual" if this happens.

18. **Review these installation instructions** to be sure you have installed everything correctly. When the installation has been completed and reviewed, refer to the “Operating instructions – first time use”.

END OF INSTALLATION

SOUTHWEST AIRSPORTS, LLC