

INSTALLATION INSTRUCTIONS

FUEL CELL SURGE TANK

DOCUMENT #19-0079

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READ AND UNDERSTAND THESE INSTRUCTIONS COMPLETELY BEFORE BEGINNING INSTALLATION

WARNING: DO NOT SMOKE WHILE WORKING ON FUEL SYSTEM. KEEP SPARKS AND OPEN FLAMES AWAY FROM FUEL SYSTEM. DISCONNECT BATTERY BEFORE BEGINNING WORK. FOLLOW FUEL CELL MANUFACTURER INSTRUCTIONS FOR REMOVING TOP PLATE.

The Radium Engineering Fuel Cell Surge Tank (FCST) is designed to enhance the fuel system by providing resistance to starvation (from fuel slosh) and by increasing the fueling capability of the system. It is compatible with 6"x10" 24-bolt fuel cell fill plates only. The FCST can be configured with up to 3 pumps inside the surge tank.

When the surge tank is full, excess fuel from the lift pump and fuel pressure regulator return is drained back into the fuel cell through passages machined into the underside of the fill plate.

The lift pump runs continuously and is used to fill and maintain the level of fuel in the surge tank. Keep in mind, this fuel pump will now operate at a low pressure (less than 5psi) and therefore will not draw significant electrical current.

The pump(s) inside the surge tank will be the high pressure source for the engine's fuel demand.



Assembly

If the FCST was purchased without fuel pumps included, follow the steps below for installation.

1. The FCST will be partially assembled, as shown. Use a 3mm Allen wrench to remove the 9 screws holding the surge tank canister to the top plate.

Note that there are O-rings underneath these screws. Even though they will likely remain pressed into the machined counterbores, be careful not to lose them.



2. The lift pump's fill hose rests in a channel machined into the fill plate. The tube is secured in place with a small 2-bolt bracket. NOTE: This tube can be adjusted later depending on the depth of the fuel cell.

Remove the surge tank canister and the fill hose, as shown. This exposes the 3-pump internal hanger. This is where the high pressure surge tank fuel pump(s) will be installed.

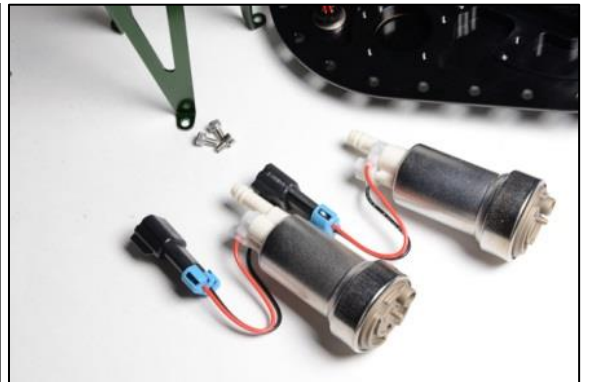


3. Remove the three bolts holding the internal fuel pump hanger to the fill plate using a 4mm Allen wrench.



4. This manual will cover the installation of two Walbro F90000274 E85 fuel pumps. Assembly is similar for other pump models. If not done already, install the proper amount of green port to barb adapter fittings to the fill plate using a $\frac{3}{4}$ " wrench. **To prevent failure, all O-rings MUST be lubricated prior to assembly.**

Use the engraved labeling to signify each pump used (PUMP 1, PUMP 2, PUMP 3). Use included port plugs in the unused port(s).



5. Prepare the electrical connectors on the FCST.

If using a pump that has a sealed electrical connector, remove the rubber seals (shown in orange) from any pump connectors that will not be used. If using a 3 pump configuration, leave all seals installed. This will eliminate the chance of the seal falling off and potentially getting stuck somewhere in the fuel system.

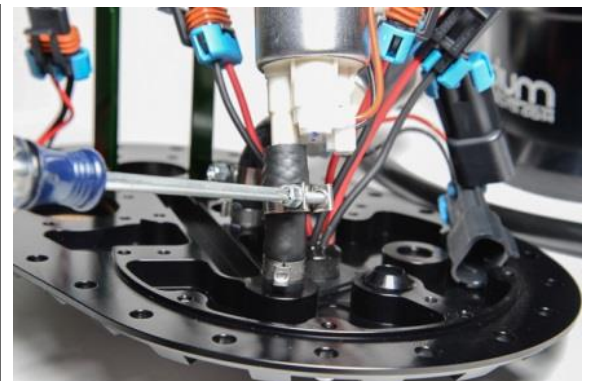
This example will utilize 2 surge tank pumps.



6. Cut the included hose to length for each surge tank pump used:

- 2.25" (57mm) -> AEM 50-1000 Gas / Walbro GSS342
- 2.19" (56mm) -> AEM 50-1200 E85 / Walbro F90000262 Gas
- 1.97" (49mm) -> Walbro F90000274 E85

This submersible rubber hose should not be substituted with any other type. Lubricate the inside of the hose with oil, then insert the fuel pump outlet barb. Install both EFI hose clamps onto the hose. Next, push the hose onto the green barb fitting. Do not tighten the hose clamps yet.



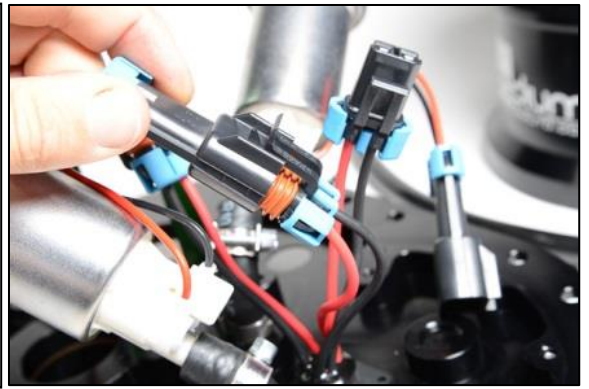
7. Use the wiring diagram towards the end of this manual to connect each pump used to the corresponding external wire. The Walbro F90000274 E85 fuel pump is shown. Process will vary slightly depending on the fuel pump brand/model.

Red/Black = Pump 1

Orange/Gray = Pump 2

White/Brown = Pump 3

For older style AEM 50-1200 E85 fuel pump wiring, see the information at the back of this manual.



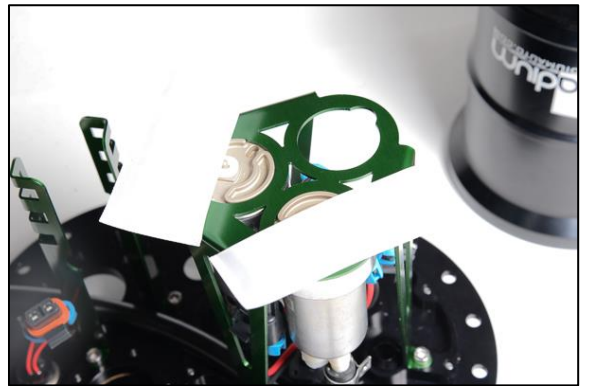
8. Fit the fuel pump mounting bracket around the pump(s). Align the bottom of the pump(s) with the cut-outs in the bracket, as shown. It may be necessary to rotate the fuel pumps within the fuel hose to achieve proper alignment. Tighten the EFI hose clamps after the alignment is complete.

Align the fuel pump mounting bracket's 3 mounting tabs to the threaded holes in the FCST fill plate. Install the three bolts removed in step 3 using a 4mm Allen wrench.



9. Install the inlet filter socks onto the surge tank pump(s).

Do not reinstall the canister yet.



10. Prepare the lift pump. This example will use a Walbro F90000274 E85 fuel pump. This process will differ slightly for other brand/models of pumps.

Install the plastic tubing and hose clamp onto the lift pump outlet. Secure in place with the included EFI hose clamp, as shown. Tubing may differ in appearance from what is shown in this picture.



11. Insert the lift pump in between the two mounting posts with the tube curved toward the surge tank pumps, as shown.

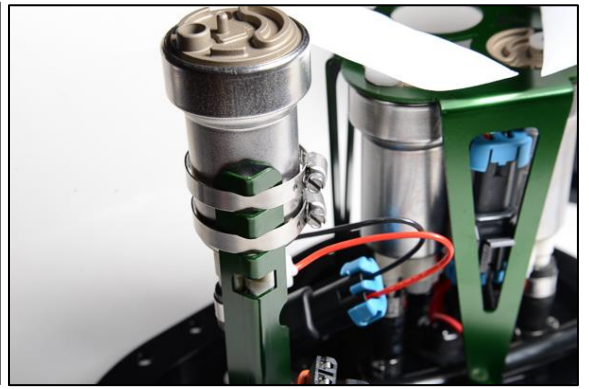
The tube should sit into the machined channel in the underside of the FCST fill plate.

Rotate the lift pump for the largest tubing bend radius to prevent kinking.



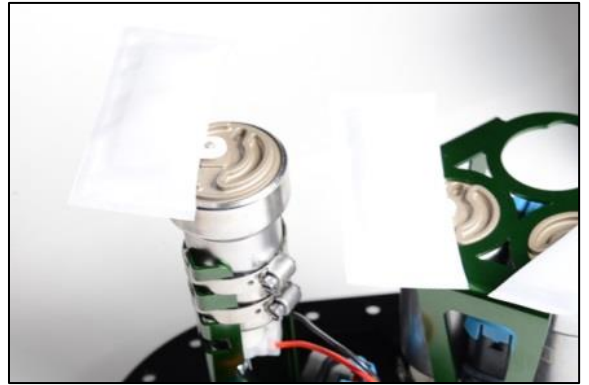
12. Measure the internal depth from the fill plate flange to the fuel cell bottom. Align the hose clamps with 2 of the 3 slots in the posts. Test fit the assembly to check the height. Readjust if necessary.

NOTE: Space is required between pump inlet and fuel cell floor to prevent restriction and allow room for the lift pump filter sock. For shallow fuel cells, it is not uncommon to cut the bottom slot off each post. For cells deeper than 9.5", Radium has a 20-0214 lift pump extension brackets available (sold separately).



13. Install the inlet filter sock onto the lift pump (as shown). Next, plug in the electrical connection.

For AEM 50-1200 E85 fuel pump wiring, see the information at the back of this manual.

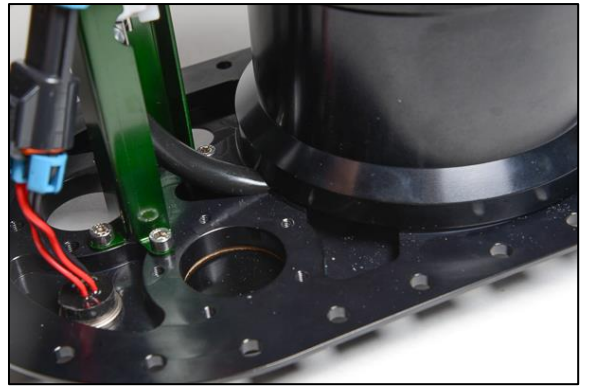


14. Slide the canister over the surge tank pump(s).

Ensure the tubing for the lift pump is seated in the groove, as shown.

Once the lift pump is height-adjusted, reinstall the small 2-bolt bracket to secure the lift pump's outlet tube into the channel.

Allow a little bit of slack to prevent tension on the lift pump.



15. When the canister is fully seated, rotate it so the threaded holes line up with the holes in the FCST fill plate.

Install the screws removed in step 1. Using a 3mm Allen wrench, tighten to 25 in-lbs in an alternating cross pattern. Do not over tighten the screws as it will damage the O-rings.

The assembly is now complete and the unit is now ready for installation into the fuel cell.



16. **If the fuel cell very deep or has a complex shape** then it is recommended not to use any brackets to attach the lift pump the fuel cell fill plate. The lift pump, instead, should be placed at the lowest point in the cell, preferably secured to a collector box. Then a submersible fuel hose should be routed from the lift pump to the surge tank fill passage. An extended electrical harness for the lift pump may be needed.



Installing FCST into Fuel Cell

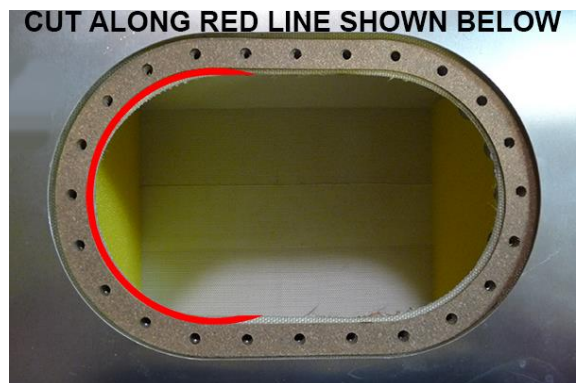
1. Make sure all ancillary components are installed to the Radium fill plate, ie: fuel fill neck, fuel level sensor, etc. If needed, remove the current fill plate from the fuel cell by disconnecting all electrical wires, fuel lines, and vent hoses from fuel cell fill plate. Discard the 24 bolts and fill plate. Inspect the gasket and replace if necessary.

Note: Depending on the fuel cell type, the 24-bolt nut ring may or may not be glued to the underside of the bladder.



2. Test fit the FCST into the fuel cell. Because the diameter of the surge tank canister is 6 inches, some minor trimming of the opening of the fuel cell bladder may be required (as pictured). *Reconfirm that the lift pump is positioned at an optimal height and adjust if necessary.*

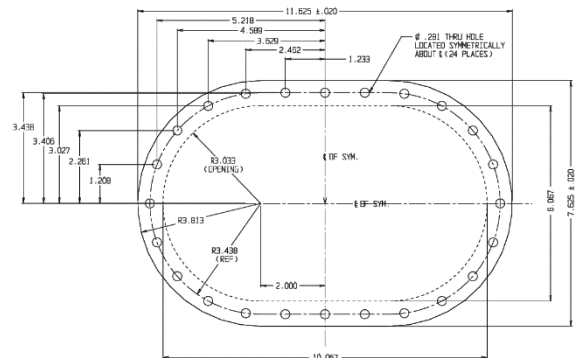
While test fitting, pay close attention to the arrangement of the foam inside the fuel cell (if equipped). Trim the foam to fit around the FCST components, as necessary.



3. There are a couple different 24-bolt flange patterns on the market. The Radium FCST pattern (pictured) was designed to mimic nut rings found on the most common and popular fuel cells.

Up to 4 holes in the FCST plate may need to be enlarged in order to be compatible with other fuel cell manufacturer's nut rings.

Note: Depending on the fuel cell type, it may be easier to remove the fuel cell's top cover and install the FCST to the bladder first.



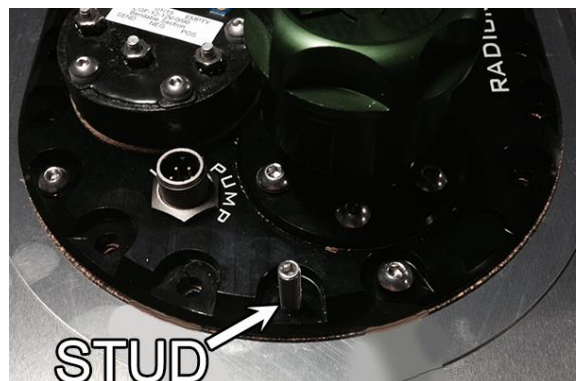
4. For mounting, place 24 of the nylon washers onto the fill plate mounting holes. Line-up the 2-piece mounting plates (pictured) to the Radium fill plate without disturbing the 12 nylon washers underneath. Next, place the last 12 nylon washers on top of the 12 mounting plate holes. Lastly, torque all 24 of the supplied Allen head screws to 65 in-lbs using a 5/32" Allen wrench.

NOTE: if your nut-ring uses stainless steel nut inserts, apply anti-seize to the stainless steel bolt threads to prevent galling.



5. Additional Notes

As shown, the use of long 1/4-28 threaded studs (not provided) may help with the assembly, especially when using a non-glued nut ring. Remove the studs after a few bolts have been started.



Connections

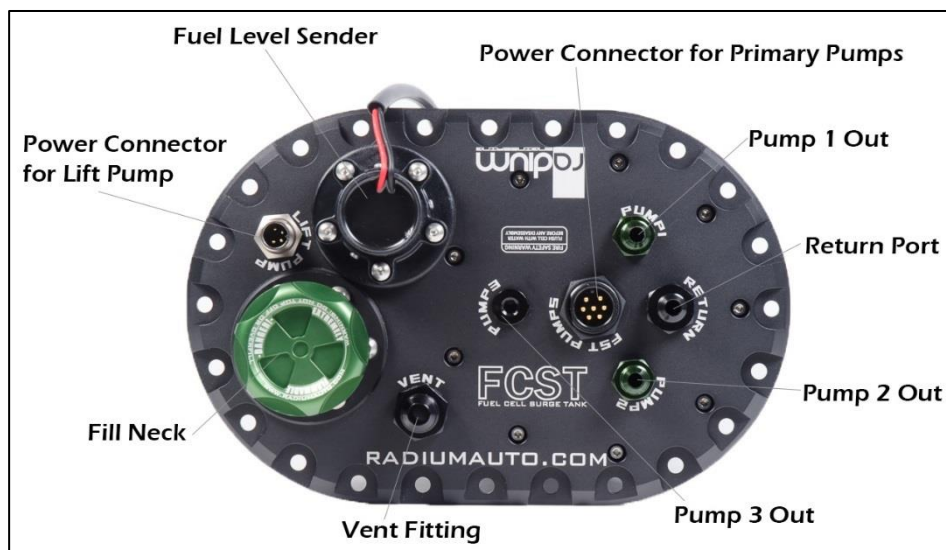
Fuel Return Port: The fuel returning from the fuel pressure regulator should be connected to the “RETURN” port. This comes standard with a -6AN male fitting. Larger size adapter fittings are available.

Pump Outlet Ports: These are the surge tank pump high pressure outlets that are the main fuel feeds to the engine. These green port fittings are always -6AN male, alternative sizes are not available.

These locations are labeled “PUMP 1”, “PUMP 2”, “PUMP 3”. The outputs can be “Teed” together into a single line if necessary.

Fill Neck Flange: Install a 6-bolt (2.18” bolt center) direct fill neck or remote fill neck adapter (sold separately). Thread size is ¼-28, plastic washers must be used under the heads of each bolt.

Fuel Level Sender: A fuel level sender can be added as an optional accessory. The 5-bolt pattern is an industry standard for fuel level senders. A gasket must be used as well as nylon or rubber washers under the heads of each bolt.



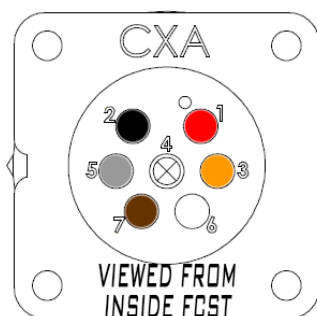
WIRING

The lift pump and surge tank pump(s) should be connected like any standard automotive EFI fuel pump. Each fuel pump should have a dedicated wiring circuit containing a relay and fuse. The engine control unit (ECU) should trigger all fuel pumps. ECUs have a built-in safety feature which primes for a few seconds after the ignition key is turned ON and also deactivates the fuel pump when the engine stalls. Make sure to check and understand what kind of signal will be used to activate the relays for the fuel pumps. ECUs commonly either send a ground or 12V trigger signal. However, some modern ECUs send a square wave trigger for pulse modulation fuel pumps.

The lift pump will operate at low pressure and thus lower current so a 15-20A fuse can be used. The included flying lead wiring harness for the lift pump (shown at right) is easily identified by the nickel-plated housing with 2 wires: red (12V) and black (ground).



Pump	Pin	Wire Color	Function
1	1	Red	12V Power
	2	Black	Ground
2	3	Orange	12V Power
	5	Gray	Ground
3	6	White	12V Power
	7	Brown	Ground



Some of the available surge tank pumps can draw up to about 20A at high pressure, so fuses and wiring should be sized accordingly for these pumps. The larger 6 wire flying lead harness (shown below) is used for the surge tank pump(s). It has color-coded wires that correspond to each pump.



Depending on how many surge tank pumps will be used some wires may not be used.

Fuel Cell Venting

The Radium Engineering Fuel Cell Surge Tank (FCST) includes a vent for the fuel cell. This allows for air to escape as the fuel cell is filled and allows the tank “breathe” during normal operation and avoid pressurization of the fuel cell. The vent is clearly labeled on the FCST top plate and features an 8AN male fitting. This vent is NOT designed for use with a quick fill system. It is NOT able to bypass air fast enough to allow quick filling.

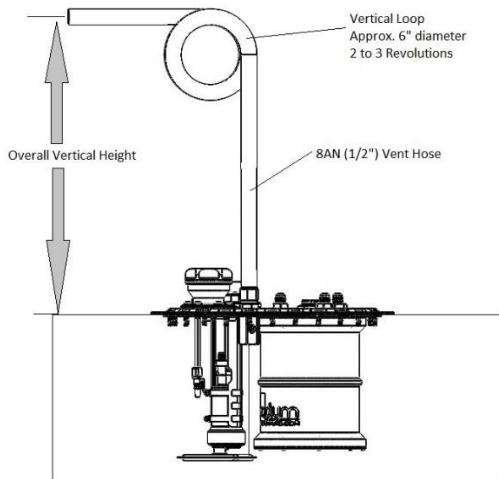
The vent also features a nylon ball that will close off the vent in the event that the fuel cell is ever inverted. This prevents the fuel cell from emptying it's contents in the event of a vehicle roll over.



Vent Hose Routing

It is important to properly route the vent line to avoid unwanted fuel loss through the vent line. The vent should always terminate OUTSIDE the vehicle and away from the exhaust system.

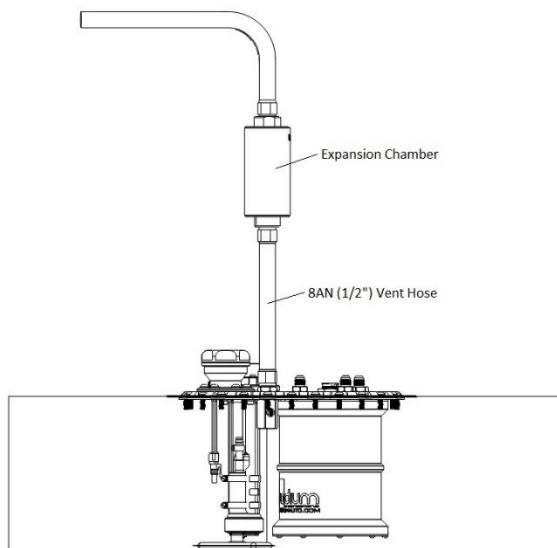
For DIRECT FILL applications (where filling of the fuel cell is done directly through a neck on the FCST plate):



The vent line should be run vertically upward to prevent fuel from sloshing out the vent line. It also allows any fuel captured in the vent line to drain back down into the cell.

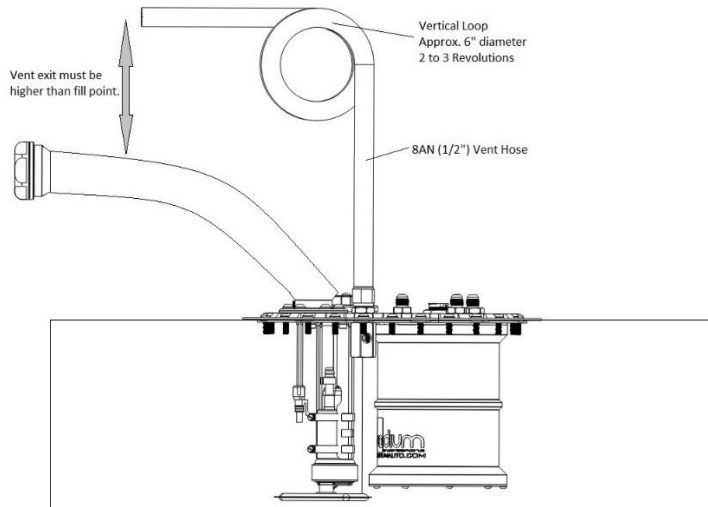
Vertical loops should be added, which act as a make-shift “expansion chamber” and allow the air to escape and any fuel to drop to the bottom of the loops.

The overall vertical height should be at least 12” but can also be higher as needed for the particular application.



If vertical looping of the vent line is not effective, an expansion chamber device can be used. This can be any chamber that is larger in diameter than the vent hose, such as a Radium in-line fuel filter (minus filter element) or something similar. This allows venting air to get past any trapped fuel in the vent line.

For REMOTE FILL application (where filling done through a tube attached to the fill neck on the FCST):



With a remote fill system, it is possible to completely fill the cell beyond the top of the FCST plate and up into the fill neck. Because of this, it is important to have the vent line terminate higher than the fill point.

The same principles regarding looping and an expansion chamber discussed above, also apply in this case.

If fuel is still escaping through the vent line, even after following the steps above, it may be necessary to install a discriminator valve. A discriminator valve allows air to vent but prevents liquid fuel from escaping. These specialty devices are available from Fuel Safe Systems and other suppliers. Follow the installation instructions provided by the manufacturer.



Note: AEM 50-1200 E85 Pumps Only

In June 2016, AEM Inc. made an electrical connector change to their 50-1200 fuel pumps. All 50-1200 fuel pumps purchased directly from AEM after May 2016 now use the same 2-pin connector found on their 50-1000 fuel pumps (also common to the popular Walbro 255LPH fuel pumps). All Radium FCSTs purchased after June 2016 are preconfigured to adapt to the new 50-1200 electrical connector. If an older AEM 50-1200 fuel pump was purchased separately, internal wire splicing modifications will be required to connect to the FST wires.

INITIAL START UP

The surge tank portion of the kit must be fully primed with fuel before the engine will start. To do this, remove the surge tank pump fuse(s) and cycle the vehicle's ignition power several times. This will activate the lift fuel pump for a few seconds each time. After 3-4 cycles it should be ready to start. Replace the surge tank pump fuse(s). Check all fittings and hoses for leaks and fix immediately if any are found. Check again for leaks after initial test drive.