

INSTALLATION INSTRUCTIONS

20-099X-XX FUEL CELL SURGE TANK

For older versions of the FCST, see PDF links on product page on radiumauto.com

Document: 19-0290
Support: info@radiumauto.com

The RADIUM Engineering Fuel Cell Surge Tank (FCST) flange is only compatible with fuel cells that utilize a 6" x 10" (24-bolt) fill plate.

CAUTION



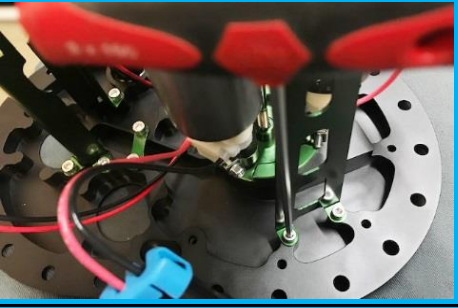



Only a qualified technician following applicable safety procedures should perform the installation of this product. One must have knowledge in repair and modification of fuel systems and general vehicle modifications to install this product. **Gasoline and other fuels are flammable and can be explosive.** Only install in a well-ventilated location to minimize buildup of fuel vapors. No sparks, open flames, smoking or other ignition sources are to be present. Draining and removal of all fuel from the fuel system is recommended. Proper eye and personal protection is required at all times during installation.

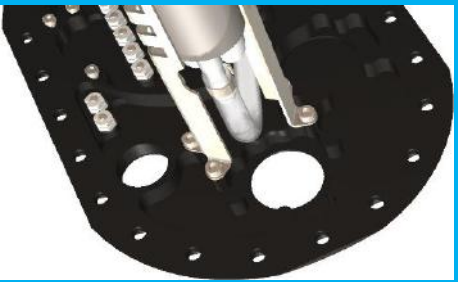



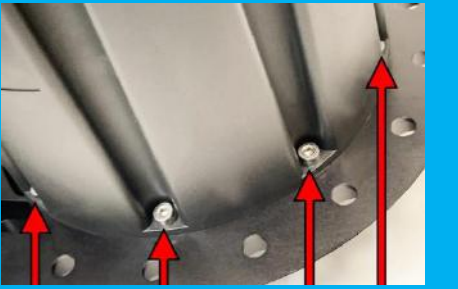

WARNING


The fuel system is under pressure! Do not loosen any connections until relieving the fuel system pressure. Consult a service manual for instructions on relieving fuel pressure safely. This product is designed for off-highway and racing use only. Fuel system components may not be legal for sale or use on emissions controlled motor vehicles. Consult local, state, and federal laws.







STEP	TOOLS NEEDED	INSTRUCTIONS	PHOTO
1		Read and understand these instructions before beginning the work. If purchased with fuel "pumps included", the FCST will be delivered ready to be installed into the fuel cell. Start at step 57.	
		Fuel pump assembly is required: For 20-099X-XX Standard Pump versions, follow steps 2-21. For 20-0695-00 External Pump version, follow steps 22-28. For 20-0693-00 E5LM Brushless Pump version, follow steps 29-52. For fuel level switch installation follow steps 53-56. For final assembly into the fuel cell, follow steps 57-67.	
	3mm Allen Wrench	<u>20-099X-XX FCST fuel pump assembly (excluding TI Automotive E5LM)</u>	
		NOTES: 1. The fuel pumps specified in the part number short description must be used as the provided components and the assembly procedure are specific to the pumps. 2. Only the "lift" pump will require a fuel pump inlet filter sock.	
		The FCST will be partially assembled. First, remove the fuel surge tank (FST) canister by unscrewing the nine M5 bolts on the underside of the top plate.	
2			
	3mm Allen Wrench	Unscrew the four M4 bolts that secure the fuel pump cradle support to the underside of the FCST fill plate.	
3		Remove the fuel pump cradle/filter assembly, as shown.	
4			

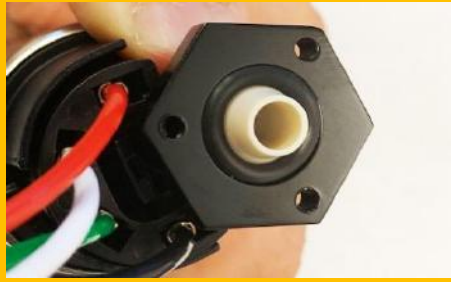





5	3/8" Socket Wrench	Determine how many surge tank pumps will be installed. Attach the corresponding number of fuel pump connectors to the electrical wiring studs (shown).	
		NOTE: Red wires are positive (+) and black wires are negative (-). Reference the top of the FCST plate.	
6	Oil Lubrication	Follow this step only if installing 1 or 2 Walbro F90000267 / F90000274 / F90000285 FST pumps. The triple pump collector must be green color.	
		Block-off the unused port(s) on the underside of the triple pump block using the included 2AN ORB plug fitting(s). Lubricate the O-ring(s).	
		-If installing 1 FST pump, use 2 plugs (shown).	
		-If installing 2 FST pumps, use 1 plug.	
		-If installing 3 FST pumps, do NOT install any plugs. Any of the 3 ports can be used as they share the same external outlet.	
7	4mm Allen Wrench	Follow this step only if installing 1 or 2 Walbro GSS342 or AEM 50-1200 FST pumps. The triple pump collector must be black.	
	Oil Lubrication		
	1/8" Allen Wrench	Remove the 6 fill plate bolts that secure the triple pump block collector. Install the included 2AN ORB plug(s) to any of the 3 threaded holes.	
		-If installing 1 FST pump, use 2 plugs (shown).	
		-If installing 2 FST pumps, use 1 plug. -If installing 3 FST pumps, do NOT install any plugs. Properly seat the gasket and reinstall all pieces. NOTE: The 6-bolt flange cannot be improperly orientated as the bolt spacing is not symmetrical.	
8		The provided tubing is pre-cut to an exact length to match the specific pump noted in the kit. NOTE: Walbro GS342 255LPH fuel pumps require the long tubing. AEM pumps require the provided short tubing.	
		For proper fitment, the tube must be pushed as far down the barbs as possible. Care must be taken not to kink the tubing. If too much force is applied, replace the tube.	
		NOTES:	
		1. Extra tubing is provided in case of damage during assembly.	
		2. The brushless ESLM fuel pump does not require tubing.	
9	Oil Lubrication	To install the submersible fuel tubing, first apply oil lubrication to all associated barbs and to both inner ends of the tubing.	
		FOR 300/320/340LPH PUMPS ONLY	
		To soften the tubing, low heat is required for these pumps specifically. Be careful not to over-heat and melt the tubing. If the tubing becomes too soft and deformed, replace it with a new piece.	
10		Push the tubing onto the fuel pump outlet barb. Walbro F90000267/274/285 fuel pump shown.	


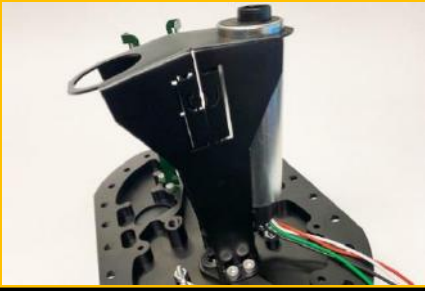


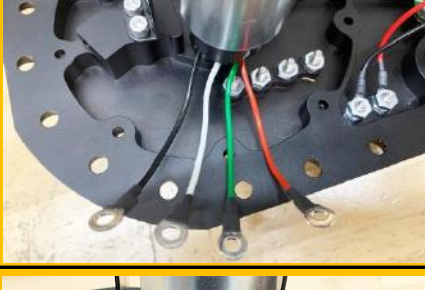

11	9/32" Nut Driver	Secure using the included EFI clamp, as shown.	
		NOTE: Fuel pump hose barbs can fracture if not treated with extra care.	
12	Oil Lubrication	Slide a second hose clamp onto the tubing attached to the fuel pump. Use lubrication as previously mentioned and push the tube over the barb until it is fully seated.	
	9/32" Nut Driver	NOTES: 1. Do NOT apply heat on this side of the tubing connection. It is NOT required. 2. If using less than 3 fuel pumps, ensure a fuel pump is not accidentally installed into a plugged port.	
		Rotate each pump so the wire connectors are facing outwards. Make sure the clamp(s) do not interfere with the triple pump block then tighten.	
13	3mm Allen Wrench	Reinstall and tighten the 4 fuel pump cradle bracket bolts.	
14	3/32" Allen Wrench	Make sure the stainless mesh screen is preinstalled to the green filter mount. If not, there are 3 tabs that the mesh screen simply slips into. Place the green filter mount onto the black fuel pump cradle. Rotate the green filter mount so the 3 tabs (not shown) fall in place. Apply a medium-strength thread locker to each of the provided 6 small screws and secure, as shown.	
	Threadlocker		
15		Plug in the fuel pump connector(s).	
		For Walbro F90000267/274/285 fuel pumps (shown), lubricate the connector seal(s) prior to connecting.	
		Do not reinstall the FST canister yet.	
16	Heat Gun	To prepare the lift pump, push the provided convoluted tubing to the fuel pump outlet barb. Depending on the fuel pump, it may be necessary to soften the tube material slightly with a heat gun or hot water.	
	9/32" Socket Wrench		
		Secure with the included EFI hose clamp using a 9/32" nut driver or Phillips screw driver.	
		Install the fuel sock filter to the lift pump.	





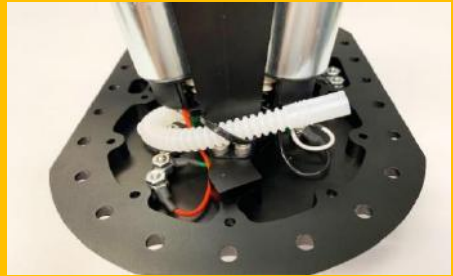

17		As shown, insert the lift pump in between the 2 mounting posts with the convoluted tube curved towards the FST pumps. The tube should sit into the machined channel.	
		Rotate the lift pump for the largest tubing bend radius possible to prevent kinking.	
18	1/4" Nut Driver	Dislodge the worm drive hose clamps.	
	Flathead Screwdriver	Align the worm drive clamps with 2 of the 3 slots in the posts. Tip: To make thread engagement easier, give the worm drive tails a slight bend inwards as shown. Do not tighten the clamps just yet.	
19	1/4" Nut Driver	Measure the depth from the FCST flange to the fuel cell bottom and adjust the depth of the lift pump. Test fit for proper height. Next, tighten the worm drive clamps to secure the lift pump in place. NOTES: 1. Allow some convoluted hose slack to prevent lift pump tension. 2. To prevent restriction and allow room for the lift pump filter sock, space is required between the pump inlet and the fuel cell floor. 3. Although not likely, the posts may need to be cut shorter for extremely shallow cells. 4. For cells deeper than 9.5", use Radium P/N 20-0214 (sold separately).	
	Flathead Screwdriver		
	4mm Allen Wrench		
20		Wrap the convoluted tubing around the pumps tangentially. This will help prevent potential fuel agitation in the surge tank.	
		Tip: Where the convoluted tubing ends will depend on the depth of the fuel cell. A cable zip-tie can secure the convoluted tubing in place.	
		Plug in the lift pump connector. For Walbro F90000267/274/285/295 fuel pumps (shown), lubricate the connector seal prior to connecting.	
21	3mm Allen Wrench	Slide the canister over the FST pump(s) and line up the 9 holes.	
	Torque Wrench	Reinstall the screws and tighten in an alternating cross pattern. .	
		The assembly is now complete and the unit is now ready for installation into the fuel cell.	
22	3mm Allen Wrench	20-0695-00 External Pump FCST assembly	
		NOTES:	
		1. The kit is designed to be used with a Walbro F900002XX lift pump.	
		2. The lift pump will require an inlet filter sock. See Radium 14-0143.	
		3. One 10AN fuel pickup is preinstalled and one pickup is loose.	
	First, remove the fuel surge tank (FST) canister. There are eight M5 bolts on the top plate. Note that there are O-rings (shown red) underneath the bolt heads. Do not to lose them.		

23	Allen Wrench	<u><i>If not installing a second fuel pickup, skip the next couple of steps.</i></u>	
	1" Wrench	Remove the 10AN ORB plug installed into the "FUEL PICKUP 2" port, as shown.	
		Next, install the provided green 10AN ORB bulkhead fitting.	
24	Pinch Clamp Pliers	From underneath, slide the black tubing over the green barb.	
		Cinch the included clamp. NOTE: diagonal cutters (shown) can be used if pinch clamp pliers are not available.	
25	3mm Allen Wrench	Press the included filter sock onto the end of the black tubing.	
26	Heat Gun	Push the provided convoluted tubing to the lift pump outlet barb.	
	9/32" Socket Wrench	Depending on the pump, it may be necessary to soften the tube material slightly with a heat gun or hot water. Secure with the included EFI hose clamp. Install the sock filter to the lift pump.	
		Insert the lift pump in between the 2 mounting posts with the convoluted tube curved towards the FST canister. The tube should sit into the machined channel. Rotate the lift pump for the largest tubing bend radius possible to prevent kinking.	
27	3mm Allen Wrench	Loosely install the hose clamps into 2 of the 3 slots in the posts. Measure the depth from the FCST flange to the fuel cell bottom and adjust the depth of the lift pump. Test fit for proper height.	
	Torque Wrench	NOTES:	
	1/4" Nut Driver	1. Allow some convoluted hose slack to prevent lift pump tension.	
	Flathead Screwdriver	2. To prevent restriction and allow room for the lift pump filter sock, space is required between the pump inlet and the fuel cell floor.	
		3. For extremely shallow cells, the posts may need to be cut shorter. 4. For cells deeper than 9.5", use Radium P/N 20-0214 (sold separately).	
	Tighten the worm drive hose clamps to secure the lift pump.		
28	3mm Allen Wrench	Plug in the lift pump connector.	
	Torque Wrench	Slide the canister over the fuel pickup(s) and line up the 8 holes. Reinstall the screws and tighten to 13 in-lbs. in an alternating cross pattern. Do not overtighten the screws as this can damage the O-rings.	
	1/4" Nut Driver		
	Flathead Screwdriver		
		The assembly is now complete and the unit is now ready for installation into the fuel cell.	

29	3mm Allen Wrench	20-0693-00 FCST assembly for E5LM "Pumps Not Included"	
		The FCST will be partially assembled. To remove the fuel surge tank (FST) canister, remove the eight M5 bolts on the top plate. Note that there are O-rings (shown) underneath these bolts. Even though they will likely remain pressed into the counterbores, be careful not to lose them.	
		Lift the top plate straight up (as shown) and set the FST canister aside.	
30	4mm Allen Wrench	Remove the 4 fuel surge tank pump bracket screws and set aside.	
31	1/4" Allen Wrench	If installing 2 fuel surge tank pumps, remove the 6AN ORB plug, as shown.	
		If installing 1 fuel surge tank pump, make sure there is a 6AN ORB plug in either one of the ports.	
		Perform the following procedure for both pumps.	
32		Inspect the pump outlet hose barb. If deformed or damaged, the Radium check valve pump adapter will NOT attach properly.	
		The Ti Automotive E5LM 4-pin wiring connector MUST first be installed to the electrical terminals, as shown.	
33		To install the check valve, first slide the black collar over the pump outlet with the flat surface upward, as shown.	
34		Next, slip the stainless steel retainer under the hose barb ridge closest to the end of the pump outlet opening. Be patient as this will take a little bit of work.	
		NOTE: Prior to March 2020, the retainer will be C-shaped. If purchased after March 2020, the retainer will be 2-piece half circles as shown.	
		Pull the collar up to confirm the retainers lock into place as depicted.	

35	Oil	Place the included O-ring on the pump outlet. Apply a petroleum-based lubricant to the O-ring.	
		Slide the black collar upward and tuck the O-ring into the groove, as shown.	
36		Place the O-ring onto the check valve plunger groove, as shown.	
37		Place the provided spring around the plunger rod, as shown.	
38		Insert the plunger rod through the internal center hole of the green adapter fitting, as shown.	
39	2.5mm Allen Wrench Thread Locker	Apply a high strength thread locking compound to the threads on the 3 included bolts. Line up the green fitting holes to the black fitting threads.	
40		After tightening all bolts evenly, inspect the internal side of the green fitting. When installed properly, the plunger should be slightly sticking out of the center hole at rest, as shown.	

41	Oil	Apply a petroleum-based lubricant to the check valve O-ring.	
	1" Wrench	Tighten the fuel pump check valve(s) to the 6AN ORB port(s).	
		NOTE: these 6AN ORB ports are intentionally at a slight angle.	
42	4mm Allen Wrench	Rotate the fuel pump(s) so that the connector(s) are the furthest outside away from the center of the surge tank. Single pump shown.	
		Secure the fuel pump bracket.	
43		Press the fuel filter sock(s) down onto the fuel pump inlet(s) until fully seated. Dual pump shown.	
		NOTE: Depending on the brand or style of strainer(s), the orientation may need to be adjusted with respect to the surge tank canister.	
44	Diagonal Cutters	Cut the wires to lengths around 3.5" (89mm).	
	Wire Strippers	Strip the wires.	
		Slide the provided heat shrink to each wire as shown.	
45	Wire Crimpers	Crimp the provided ring terminals to the end of each wire.	
	Heat Gun	Slide the heat shrink over the crimped area. Apply heat to shrink the insulation.	
46	3/8" Wrench	Connect each ring terminal to the corresponding wire color terminal depicted on the top of the FCST plate.	
		R = Red	
		G = Green	
		W = White	
		B = Black	
		Do not reinstall the FST canister yet.	

47	Heat Gun	To prepare the lift pump, push the provided convoluted tubing to the fuel pump outlet barb. Depending on the fuel pump, it may be necessary to soften the tube material slightly with a heat gun or hot water.		
	9/32" Socket Wrench			
48		Secure with the included EFI hose clamp using a 9/32" nut driver or Phillips screw driver.		
	1/4" Nut Driver	Dislodge the worm drive hose clamps.		
	Flathead Screwdriver	As shown in the following picture, insert the lift pump in between the 2 mounting posts with the convoluted tube curved towards the FST pumps. The tube should sit into the machined channel. Rotate the lift pump for the largest tubing bend radius possible to prevent kinking.		
		Align the hose clamps with 2 of the 3 slots in the posts. Tip: To make thread engagement easier, give the worm drive tails a slight bend inwards as shown. Do not tighten the clamps just yet.		
49	1/4" Nut Driver	Measure the depth from the FCST flange to the fuel cell bottom and adjust the depth of the lift pump. Test fit for proper height. Next, tighten the worm drive hose clamps to secure the lift pump in place.		
	Flathead Screwdriver			
				NOTES: 1. Allow some convoluted hose slack to prevent lift pump tension. 2. To prevent restriction and allow room for the lift pump filter sock, space is required between the pump inlet and the fuel cell floor. 3. For extremely shallow cells, the posts may need to be cut shorter. 4. For cells deeper than 9.5", use Radium P/N 20-0214 (sold separately).
50		Position the convoluted tubing through the channel. This will "lock" it in place, as shown.		
51		Wrap the convoluted tubing around the pumps tangentially. This will help prevent potential fuel agitation in the surge tank.		
		The depth of the fuel cell will determine where the convoluted tubing ends. Tip: A cable zip-tie can secure the convoluted tubing in place.		
		Plug in the lift pump connector. Tip: For Walbro F90000267 / F90000274 / F90000285 / F90000298 fuel pumps, lubricate the orange connector seal(s) prior to connecting.		
52	3mm Allen Wrench	Flip the FCST over and insert the FST pumps into the canister.		
	Torque Wrench	Line up the holes and torque the 8 screws to 13 in-lbs in an alternating cross pattern. Do not over-tighten the screws as this can damage the O-rings under the bolt heads.		
		The fuel pump assembly is now complete.		

53	1/8" Allen Wrench	20-0461 Fuel Level Switch and Indicator Installation Instructions (steps 46-49)	
	PTFE Sealing Paste	<p>The float can be flipped for Normally Open (NO) or Normally Closed (NO) configuration by removing the E-clip. To be closed during low fuel, the float arrow should be pointing downward.</p> <p>Remove the 2AN ORB plug from the top plate. Apply PTFE paste to the threads of the float switch. Route switch wires through the top plate's threaded hole from underneath.</p> <p>To screw in the switch, first hand tighten. Then add another 1.5 to 3 turns with a wrench until tight and sealed.</p> <p>The 2 wires can be routed for the installer's specific purposes. The switch will trigger when fuel level drops by 20% or more.</p>	
	1/4" Wrench		
54	Diagonal Cutter	20-0508 Diagnostic Indicator Kit	
	Oil	Route the 2 pink wires (from the 20-0461 fuel level switch) through the included black aluminum tube.	
	1/2" Wrench	Lubricate the O-ring and thread the tube into the top plate and tighten.	
	Wire Stripper	Route 1 of the switch wires back down into the tube and out 1 of the side holes of the aluminum tube. Pull slack out.	
	Solder Station	Route 1 of the switch wires back down into the tube and out 1 of the side holes of the aluminum tube. Pull slack out.	
	Heat Gun	Cut the other switch wire and red LED wire to length and solder together. Cover this connection with the included shrink tube.	
55		20-0508 Diagnostic Indicator Kit	
		Route the LED black wire down into the tube and out the same hole as the other level switch wire.	
		Push the LED down into the tube until it is fully seated, as shown.	
		Cover both loose wires with the protective sleeving and route to the power source. For simplicity, this can be the lift pump power terminals.	
56	Wire Stripper	20-0508 Diagnostic Indicator Kit	
	Crimper	Crimp the ring terminals to the power and ground wires. Connect the red to the positive terminal and black to the negative terminal. Use heat shrink on the ring terminal crimps.	
	Heat Gun		
		NOTE: The wiring described above puts the switch on the positive side of the LED. However, the switch can also be put on the negative side of the LED, as shown in the wiring diagram.	
57		Fuel Cell Installation	
		Make sure all ancillary components are installed to the Radium fill plate, i.e.: fuel fill neck, fuel level sensor, etc. If needed, remove the current fill plate from the fuel cell. Discard the 24 bolts, fill plate, and gasket.	
		NOTE: The 24-bolt nut ring on all RA-series fuel cells is secured to the bladder. However, depending on other brand fuel cell bladders, the nut ring may or may not be glued to the underside of the bladder.	
58		No trimming is required on RA-series fuel cells. But with other fuel cell manufacturers, minor trimming of the fuel cell bladder opening may be required. Test fit to confirm.	
		Reconfirm that the lift pump is positioned at an optimal height. Adjust if necessary.	
		Also, 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.	

59		There is a different 24-bolt flange pattern on the market. The Radium FCST pattern (pictured) was designed to mimic nut rings found on the most common and popular fuel cells.	
		Although uncommon, up to 4 holes in the FCST 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 outer shell and install the FCST to the bladder first.	
60		Install all 24 of the provided O-rings onto the 24 bolts, as shown.	
61	5/32" Allen Wrench Torque Wrench	There are 2 types of fuel cell outer shell cans (new and old). If there aren't 24 holes in the outer shell, you have an "old" version (pictured). Radium Engineering has always used the new style outer shell can.	
		With "old" outer cans, place the provided 24 bolt gasket directly onto the bladder (not shown). Next, insert the FCST assembly. Using the included bolts, torque to 65 in-lbs.	
		NOTE: In some cases, 1/4"-28 all-thread rods can make installation easier. Also, if your nut-ring uses stainless steel nut inserts, apply anti-seize to the threads to prevent galling. Radium uses anodized aluminum nut rings.	
62	5/32" Allen Wrench Torque Wrench	If the can has 24 holes in the outer shell (pictured), you have a "new" version. All Radium Engineering fuel cells use the "new" version.	
		For the outer shell cans that use the "newer" style, place the gasket down onto the outer shell can, then install the FCST assembly. Insert all 24 bolts into their respective holes and torque to 40 in-lbs in an alternating cross pattern.	
		NOTE: if your nut-ring uses stainless steel nut inserts, apply anti-seize to the bolt threads to prevent galling. Radium uses aluminum nut rings.	
63	Wire Terminal Crimper Heat Gun	Terminate the pump power wires (not included) with the ring terminals supplied in the kit. Apply the shrink tube to the terminals to prevent shorting of the wires to the plate.	
		Secure the ring terminals to the FCST studs using the included acorn nuts.	
64		Fuel pump controlling is left up to the installer. However, the lift pump and at least 1 of the FST pumps should use the (priming/safety) fuel pump output strategy from the engine control unit.	
		Optionally, an adjustable pressure switch, such as Radium Engineering P/N: 20-0236 (shown), can trigger the secondary pump(s) based on intake manifold pressure.	

65		<p>Important steps to properly route the vent line:</p> <ol style="list-style-type: none"> 1. From the fuel cell, the hose must first run upwards allowing any fuel captured in the vent line to drain back down into the cell. 2. After ascending vertically, the line should briefly route towards the front of the vehicle to prevent fuel from sloshing out. 3. Vertical loops should be added to act as a "make-shift" expansion chamber and allow air to escape and any fuel to drop to the bottom of the loops. 4. Depending on the application, the overall vertical height of the vent hose should be at least 12". 	
66		<p>continued...</p> <ol style="list-style-type: none"> 5. For remote fuel fill applications, the vertical loops must be higher than the fill point. 6. The vent hose should terminate below and behind the fuel cell outside of the cabin away from the exhaust system. 7. Utilizing an expansion chamber that is larger than the vent hose diameter will further aid in preventing liquid fuel from escaping. <p><i>NOTE: There are vent kits available. P/N: 20-0484-08 (shown) is used for standard filling. P/N: 20-0484-12 is used for quick filling.</i></p>	
67		<p>When fueling, do not top-off or overfill unless a vented fill cap is installed.</p> <p>Because the bottom of the FST canister uses 1-way fill valves, fuel will make it's way into the surge tank when the fuel cell is simply filled. Lift pump priming is no longer necessary for this FCST specifically.</p> <p>After starting the engine, monitor all fittings and hoses for leaks and fix immediately. Check again for leaks after initial test drive.</p> <p>Installation Complete</p>	