

## INSTALLATION INSTRUCTIONS 20-199X-0X FUEL CELL SURGE TANK

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

**Document:** 19-0390

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## **CAUTION**

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

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	РНОТО
1	3mm Allen Wrench	If purchased with fuel "pumps included", the FCST-X will be delivered ready to be installed into the fuel cell. Skip to step 44  For fuel level switch installation, follow steps 54-57.  For final assembly into the fuel cell, follow steps 58-68.  If purchased with fuel "pumps not included", the FCST-X will be partially assembled. Fuel pump assembly is required. First, remove the nine M4x0.7mm screws (depicted) that hold down the fuel surge tank (FST) hat and the lift pump hat. Grab the handle and carefully pull upwards.	TOTAL PARTY ST. X ELEMENT
2		For 20-1990/1/2-00 versions, follow steps 3-19 and 44-68. For 20-1993-00 E5LM Pump version, follow steps 20-36 and 44-68. For 20-1995-00 External Pump version, follow steps 37-68.  NOTE: The fuel pumps specified in the part number short description must be used as the provided components and the assembly procedure are specific to those pumps.	
w	4mm Allen Wrench	20-1990/1/2-00 FCST-X FUEL PUMP ASSEMBLY Unscrew the three M5x0.8mm bolts that secure the fuel pump cradle support to the underside of the FCST-X top plate. As shown, remove the fuel pump cradle/filter assembly.	HONOTON MILANDIA
4	3/8" Socket Wrench Wire Stripper Wire Crimper Heat Gun	Determine how many surge tank pumps will be installed. Attach the corresponding electrical connectors to the wiring studs (shown).  NOTES:  1. Red wires are positive (+) and black wires are negative (-). Reference the top of the FCST-X plate.  2. If the provided electrical connectors do not plug into the fuel pump being installed, the flying lead harness that comes with the fuel pump will need to be modified. Use the ring terminals and heat shrink included in the FCST-X kit to terminate the ends.	

	Oil Lubrication	20-1992-00 ONLY	
5	1/8" Allen Wrench	Skip this step if installing 3 Walbro F90000267/274/285 FST pumps.  As shown, block-off the unused port(s) on 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 plugIf installing 3 FST pumps, do NOT install any plugs.  Any of the 3 ports can be used as they share the same external outlet.	
6	Oil Lubrication  1/4" Allen Wrench	20-1991-00 ONLY  Skip this step if installing 3 Bosch BR540 or DW400 FST pumps.  As shown, block-off the unused port(s) on the triple pump block using the included 6AN 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 Oil Lubrication 1/8" Allen Wrench	20-1990-00 ONLY  Skip this step if installing 3 Walbro GSS342, AEM 50-1200 or DW440 FST pumps.  These pumps require an additional step compared to the others. First, remove the 6 screws that secure the triple pump block collector. Next, 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 plugIf installing 3 FST pumps, do NOT install any plugs.  Lastly, seat the gasket and reinstall all pieces. NOTE: The 6-bolt flange cannot be improperly orientated as the bolt spacing is not symmetrical.	
8		20-1990-00 ONLY  The pre-cut lines are used to match the specific FST pump.  -Walbro GS342: Requires the mid length plastic tubing.  -AEM 50-1200: Requires the shortest plastic tubing.  -Deatschwerks DW440: Requires the rubber hose.  NOTES:  1. Extra lines are provided in case of damage during assembly.  2. The long rubber hose and long plastic tube will be cut to length in a later step for the lift pump.	WALBRO GSS342 DEATSCHWERKS DW440 AEM 50-1200 WALBRO GSS342 DEATSCHWERKS DW440 AEM 50-1200 FST PUWPS
9		20-1991-00 ONLY  Because the Bosch BR540 (DW400) pumps are so tall, the pump outlet adapters (shown) will be used for the FST pump(s).  NOTE: The long plastic tube (not shown) will be cut to length in a later step for the lift pump.	
10		20-1992-00 ONLY  The pre-cut lines are used to match the specific FST pump.  -Walbro F90000267  -Walbro F90000274  -Walbro F90000285  NOTES:  1. Extra tubes are provided in case of damage during assembly.  2. The long plastic tube will be cut to length later for the lift pump.	

	Oil Lubrication	20-1990-00 ONLY	
	Heat Gun	NOTE: Fuel pump hose barbs can fracture if not treated with extra care.	
	Screwdriver	For Walbro GSS342 and AEM 50-1200:	and the second
11		Lubricate and apply a small amount of heat to one side of the <i>plastic tubing</i> . Push the tubing onto the fuel pump outlet barb. Find the small ID EFI hose clamp in the kit and	
11		secure the tubing, as shown.	
		For Deatschwerks DW440 Only:	
		Lubricate one side of the <i>rubber hose</i> . Push the hose onto the fuel pump outlet barb. Find the large ID EFI hose clamp in the kit and secure.	
		and the large to Ethnose clamp in the kit and secure.	
		20-1991-00 ONLY	
		First inspect the pump outlet hose barb. If the hose barb is deformed, modified or damaged, the pump outlet adapter will not install correctly and	
		the fuel pump cannot be used.	
12		First, slide the black collar over the pump outlet with the flat surface	
12		upward, as shown.	
		22 4224 22 2344	
		20-1991-00 ONLY Slip the stainless steel retainers between the 2 large hose barbs. When	
		assembled, it will lodge itself under the hose barb ridge closest to the end of	******
		the pump outlet opening.	6 . 60
13		Pull the collar up to confirm the retainers lock into place, as depicted.	
	Oil Lubrication	20-1991-00 ONLY	
		As shown, place the included O-ring on the pump outlet while applying a	2000
		small amount of pressure upwards on the black collar.	
14		Press the O-ring down into the groove.	
14		Drop a small amount of the lubrication on the O-ring.	
	2.5mm Allen Wrench	20-1991-00 ONLY Line up the green fitting holes to the black fitting threads.	
		ente de the green fitting holes to the black fitting threads.	
		As shown, secure and tighten all screws evenly.	
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	011.	20-1992-00 ONLY	
	Oil Lubrication	Lubricate and apply a small amount of heat to one side of the plastic tubing.	
	Heat Gun Screwdriver	Push the tubing onto the fuel pump outlet barb, as shown. Use one of the	
	Screwariver	supplied EFI hose clamps to secure the tubing. NOTE: Fuel pump outlet barbs can fracture if not treated with extra care.	
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17	Oil Lubrication	20-1990-00 and 20-1992-00 ONLY  Slide a second hose clamp onto the line attached to the fuel pump(s). Lubricate the inside of the fuel line(s). Push the fuel line(s) over the triple pump barb(s) until fully seated. Do NOT tighten the clamp(s).  NOTES:  1. Ensure pump(s) are not accidentally installed into a plugged port. 2. For the Walbro GSS342 and AEM 50-1200 pumps, be sure to use the small ID EFI clamp(s) provided in the kit. 3. For the DW440 pump, be sure to use the large ID EFI clamp(s).	CONTRACTOR OF THE PARTY OF THE
18	15mm Wrench	20-1991-00 ONLY Lubricate the external O-ring on the male 6AN green fitting. Install the fuel pump(s) into any of the available ports on the triple pump block.	
19	Screwdriver 4mm Allen Wrench	Rotate each fuel pump so the wire connectors are facing outwards. Make sure the EFI clamp(s) do not interfere with the triple pump block. Once positioned correctly, tighten the EFI clamps.  Reinstall and tighten the 3 fuel pump cradle bracket screws.  Plug in the electrical fuel pump connector(s).	HOSERTIME
	4mm Allen Wrench	<b>20-1993-00 ONLY</b> To remove the fuel surge tank pump cradle, remove the four M5x0.8mm	
20		screws from the top plate and set aside.	
20	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.	

23		To install the check valve, first slide the black collar over the fuel pump outlet barb with the flat surface upward, as shown.  Next, slip the stainless steel retainers under the hose barb ridge closest to	
24	Oil Lubrication	the end of the pump outlet. Be patient as this will take a little bit of work.  Pull the collar up to confirm the retainers lock into place as depicted.  Lubricate and place the included O-ring on the fuel pump outlet.	
25	On Edulication	Slide the black collar upward and tuck the O-ring into the groove, as shown.	
26		Place the O-ring onto the check valve plunger groove, as shown.	
27		Place the provided spring around the plunger rod, as shown.	
28		Insert the plunger rod through the internal center hole of the green adapter fitting, as shown.	

	2.5mm Allen Wrench	Apply a high-strength thread locking compound to the threads on the 3	
		included screws. Line up the green fitting holes to the black fitting threads.	
	Thread Locker	-	
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		After tightening all screws 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.	
30			
	Oil Lubrication	Lubricate the external O-ring on the 6AN side of the check valve.	
	1" Wrench	Tighten the fuel pump check valve(s) to the 6AN ORB port(s).	
31		NOTE: these 6AN ORB ports on the FCST-X plate are intentionally at a slight angle.	2000
0 _		ungic.	
		Rotate the fuel pump(s) so that the electrical connector(s) are on the	
	4mm Allen Wrench	outside, furthest away from the center of the FST. Single pump shown.	
		Secure the fuel surge tank pump cradle.	
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		Press the fuel filter sock(s) down onto the fuel pump inlet(s) until fully	
		seated. Dual fuel pump shown.	
		NOTE: Depending on the brand or style of fuel pump filter sock(s), the	
22		orientation may need to be adjusted with respect to the FST canister.	
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			air and a second
	Diagonal Cutters	Cut the wires to lengths around 3.5" (89mm).	
	Wire Strippers	Strip the wires.	
		Surp the wires.	7 6 6 6
2/		Slide the provided heat shrink to each wire as shown.	
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	Wire Crimpers	Crimp the provided ring terminals to the end of each wire.	
35	Heat Gun	Slide the heat shrink over the crimped area. Apply heat to shrink the insulation.	
36	3/8" Wrench 4mm Allen 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 Shared Ground= Black  Lastly, reinstall and tighten the four FST pump cradle screws.	
37		20-1995-00 ONLY  NOTES:  1. Designed for a Walbro F90000267/274/285/295 lift pump.  2. Can be used with a combination of 1 or 2 pickup tubes.  3. As depicted, a single 10AN pickup (with filter sock) is preinstalled.  4. Another 10AN pickup tube and corresponding fitting is included.  5. A 16AN pickup tube and corresponding fitting is also included.  6. If using the 16AN pickup tube, an external (high micron) filter will need to be purchased separately. See Radium P/N: 20-0220-04.  If using the preinstalled fuel pickup, skip all of these steps.	TAN ORD FUEL PICKS
38	3/8" Allen Wrench Oil Lubrication Adjustable Wrench	To install a second 10AN pickup, remove the 10AN ORB plug installed in the "10AN ORB FUEL PICKUP" port.  Next, install the provided green 10AN ORB bulkhead fitting, as shown.	THE LANGE FOR STATE OF THE PARTY OF THE PART
39	Oil Lubrication Pinch Clamp Pliers	From underneath, slide the provided black tubing over the green barb.  Cinch the included pinch clamp. NOTE: diagonal cutters (shown) can be used if pinch clamp pliers are not available.	
40		As shown, press the included filter sock onto the end of the new black pickup tube.	

41	Oil Lubrication	To install a 16AN pickup, loosen the black 16AN ORB bushing and remove the pickup assembly from the top hat, as shown.  As shown, install the large black bulkhead fitting to the top hat.	- Canual Canada
42	Adjustable Wrench		
43	Oil Lubrication Pinch Clamp Pliers	From underneath, slide the provided large black tubing over the black barb.  Cinch the included pinch clamp. NOTE: diagonal cutters can be used if pinch clamp pliers are not available.	
44		There are 2 sets of lift pump ladders included (shallow and mid depth).  Shallow depth lift pump ladder (preinstalled) compatibility: Radium Engineering 6 Gallon, 10 Gallon, and 10.5 Gallon Fuel Cells  Mid depth lift pump ladder compatibility: Radium Engineering 14 Gallon and 22 Gallon Fuel Cells  NOTE: The lift pump ladders provided in 20-1991 are specific to 46mm Bosch BR540 (DW400) pumps. All others are for 39mm pumps (shown).	
45	Tape Measure	Measure the depth from the FCST-X flange to the fuel cell floor. Calculate the required length of fuel line for the lift pump. Test fit for proper height.  NOTES:  1. To prevent pump cavitation, space is required between the fuel pump inlet and the fuel cell floor.  2. If installing into a Radium Engineering fuel cell, use the cut lengths listed.  3. Although not likely, the lift pump ladders may need to be cut shorter for extremely shallow fuel cells.  4. For fuel cells deeper than 9", use Radium P/N 20-1214 (sold separately).	Radium   20-0612   Radium   20-0612   Radium   162mm   147mm   182mm   133mm   158mm   164mm   20-0622   Radium   20-0622   162mm   147mm   182mm   133mm   158mm   164mm
46	Oil Lubrication Heat Gun Screwdriver	NOTE: Fuel pump hose barbs can fracture if not treated with extra care.  Lubricate and apply a small amount of heat to one side of the plastic tubing. Push the tubing onto the fuel pump outlet barb. Secure using an EFI clamp. Loosely insert another EFI clamp onto the line, as shown.  For Deatschwerks DW440 Only:  Lubricate one side of the rubber hose. Push the hose onto the fuel pump outlet barb. Find the large ID EFI hose clamp in the kit and secure. Loosely insert another large EFI clamp onto the fuel hose.	

	Oil Lubrication	Lubricate and apply a small amount of heat to the open end of the plastic	
	Heat Gun	tubing. Push the tubing onto the fuel hat barb. Secure the EFI clamp. Walbro	
	Screwdriver	GSS342 fuel pump shown.	
		For Deatschwerks DW440 Only:	
47		Lubricate the open end of the rubber hose. Push the hose onto the fuel hat	
		barb. Secure the EFI clamp.	
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		As shown, install the sock filter to the lift pump.	
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		legart the large sin ties into 2 of the lift summer leaders date	
	Flathead Screwdriver	Insert the large zip ties into 2 of the lift pump ladder slots.	
	Cutters	NOTE: Using a blunt object to the hold the zip tie lock in place will permit	
		the maximum amount of pull force.	A CONTRACTOR OF THE CONTRACTOR
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		1	
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		NOTE: When installing a Bosch BR540 (DW400) lift pump into a Radium	A STATE OF THE PROPERTY OF THE PARTY OF THE
		Engineering fuel cell, notice how the supplied ladders cover the length of the fuel pump (shown).	
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		NOTE: If the provided electrical connectors do not plug into the fuel pump	
		being installed, the flying lead wiring harness that comes with the fuel pump	AT COLOR
		will need to be modified. Use the ring terminals and heat shrink included in the FCST-X kit to terminate the ends.	
51		Plug in the electrical lift pump connector. The Ti Automotive ESLM pump is	
		very tall and does not leave much room for wiring. But as shown, it is easily manageable.	
		If using a Walbro F90000267/274/285/295 lift pump, the large Delphi connector will need to be strategically located above the pump. If not, the	
		lift pump assembly will not fit through the small opening in the FCST-X when	
		servicing.	
52		In the example shown, the pump connector is gently pressed into the area	
-		diagonally.	
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53	3mm Allen Wrench	Prior to dropping-in the complete pump module, be sure the two O-rings are placed down in both FCST-X openings.  Reinstall the 9 screws and tighten in an alternating cross pattern.  The assembly is complete and the unit is now ready for installation into the fuel cell.	O-RINGS
54	1/8" Allen Wrench PTFE Sealing Paste 1/4" Wrench	20-0461 Fuel Level Switch and Indicator Installation  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.  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. To screw in the switch, first hand tighten. Then add another 1.5 to 3 turns with a wrench until tight and sealed.  The 2 wires can be routed for the installer's specific purposes. The switch will trigger when fuel level drops by 20% or more.	
55	Diagonal Cutter Oil 1/2" Wrench Wire Stripper Solder Station Heat Gun	20-0508 Diagnostic Indicator Kit  Route the 2 pink wires (from the 20-0461 fuel level switch) through the included black aluminum tube.  Lubricate the O-ring and thread the tube into the top plate and tighten.  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.  Cut the other switch wire and red LED wire to length and solder together. Cover this connection with the included shrink tube.	
56		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 pump power terminals.	
57	Wire Stripper Crimper Heat Gun	20-0508 Diagnostic Indicator Kit  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.  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.	HEAT SHRINK INDICATOR BODY  2AN ORB  1/8 NPT  FLOAT SWITCH
58		Fuel Cell Installation  If needed, remove the older fill plate from the fuel cell. As shown, discard the 24 bolts, fill plate, and gasket as they will NOT be reused.  NOTE: The 24-bolt nut ring on all RA-series fuel cells are 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.	

59		No modifications are required on RA-series fuel cells. However, bladder trimming may be required for other fuel cell manufacturers.  Now is a perfect time to 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-X components, as necessary.	CUT ALONG RED LINE SHOWN BELOW
60		Shown are the flange hole pattern dimensions for the FCST-X.	DIMENSIONS: INCHES  142  3.44  3.43  3.44  3.43  4.0  0.0  0.0
61		Install all 24 of the provided O-rings onto the 24 screws, as shown.	
	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 fuel cell can, you have an "old" version (pictured). Radium Engineering has ALWAYS used the new style outer shell can.	THE REAL PROPERTY AND ADDRESS OF THE PERSON
62		Place the provided 24 bolt gasket directly onto the bladder (not shown). Next, insert the FCST-X assembly. Using the included bolts, torque to 65 in-lbs.  NOTE: 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 so this is not required.	ALGU TATALAN ALGU
63	5/32" Allen Wrench Torque Wrench	FCST-X assembly. Using the included bolts, torque to 65 in-lbs.  NOTE: 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	

65	Fuel pump control is left up to the installer. However, the lift pump and at least 1 of the FST pumps should use the normal (priming/safety) fuel pump output strategy from the ECU.  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.	<b>C</b>
66	Vent hose routing  1. From the fuel cell, the vent hose should first run upwards allowing any fuel captured in the vent line to drain back down into the cell.  2. After ascending vertically, the vent hose should briefly route towards the front of the vehicle to prevent fuel from sloshing out.  3. Vertical loops can 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".	
67	continued  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.  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.	
68	When fueling, do not top-off or overfill unless a vented fill cap is installed. All Radium Engineering fill caps are vented.  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-X specifically.  After starting the engine, monitor all fittings and hoses for leaks and fix immediately. Check again for leaks after initial test drive.  INSTALLATION COMPLETE	