














IMPORTANT SAFETY INFORMATION

The installer should make sure to read, understand, and follow all of the instructions in this manual before operating the Fuel Level Sender equipment to prevent the risk of fire, electrical shock, personal injury, or damage when using the equipment. This manual does not cover all of the possible conditions that may occur. Always contact Livorsi Marine if a problem occurs that you do not understand or are not clear on a particular procedure.

Warnings and Important Safety Instructions in these installation instructions do not cover all possible conditions and situations that may occur. It is the installer's responsibility to use common sense, caution, and instructions provided in this manual when installing and servicing the equipment.









IMPORTANT SAFETY SYMBOLS AND PRECAUTIONS

The following symbols and their meanings are used throughout this manual:

	Hazards or unsafe practices that may result in minor personal injury or property damage .
	To reduce the risk of fire, explosion, electrical shock, or personal injury, follow these safety precautions.
	Hazards or unsafe practices that may result in severe personal injury or death .
	Do NOT attempt.
	Electrostatic Sensitive Device. The installer should follow proper electrical ground procedures to eliminate potential Electro Static Discharge (ESD) which may damage equipment .
	Do NOT disassemble to avoid damage to the equipment, severe personal injury, or death .
	Follow installation instructions specifically to avoid damage to the equipment, severe personal injury, or death .
	All battery voltage must be disconnected during the installation to avoid damage to the equipment, severe personal injury, or death .
	Do NOT touch to avoid damage to the equipment, severe personal injury, or death .
	Note.
	Call Livorsi Marine for information or installation help.
 	



FOR YOUR SAFETY

When installing or servicing the Fuel Level Sender, basic safety precautions must be followed including:

	The installer should thoroughly read and understand all instructions in this manual before attempting to install or service the Fuel Level Sender.
	If any installation or service instructions in this manual are unclear or questions arise, the installer should stop work and immediately call Livorsi Marine at 847-752-2700.
	The Fuel Level Sender should only be installed and used for its intended purpose as described in this manual.
	After installation, the entire fuel system should be checked to ensure there are no leaks which could cause an explosion hazard
	The Fuel Level Sender is installed in a fuel laden environment. Proper care should be taken when installing or servicing components that have been exposed to fuel including proper ventilation and respiratory equipment. Only non-ferrous tools should be used to avoid causing a spark during installation.
	During installation and service, all power sources should be disconnected including shipboard batteries, generators, and any off-ship power sources.
	The Fuel Level Sender contains electronic components and as such, the installer should be properly grounded before handling or maintaining any portion of the system.
	The main controller and fuel shutoff solenoid of the Fuel Level Sender contains no installer serviceable parts and should not be disassembled. Disassembly of the unit will void any and all warranties.


FUEL LEVEL SENDER

The Fuel Level Sender (FLS) is a state of the art fuel level sending device that measures and reports a fuel level in a tank. The installation is performed with common hand tools.

	When handling the FLS, the installer should be properly grounded in order to avoid any unnecessary static electricity discharge which can damage the unit and possibly cause an explosion hazard when dealing with fuel.
	If any installation or service instructions in this manual are unclear or questions arise, the installer should stop work and immediately call Livorsi Marine at 847-752-2700.

THE FLS CONTROL UNIT

The FLS Control Unit contains the main controller circuit board which measures and reports the fuel level within a fuel tank from empty to full and points in between. The FLS Control Unit is designed to be a drop in replacement for the standard fuel sender on the fuel tank equipped with a standard SAE bolt hole pattern. The FLS Control Unit has several key parts as noted in Figure 1.

	The FLS Base and the FLS Cap are constructed of a fuel compatible, durable nylon and cannot be separated by the installer. Failure to comply with these instructions may damage the FLS and will void any and all warranties.
---	---

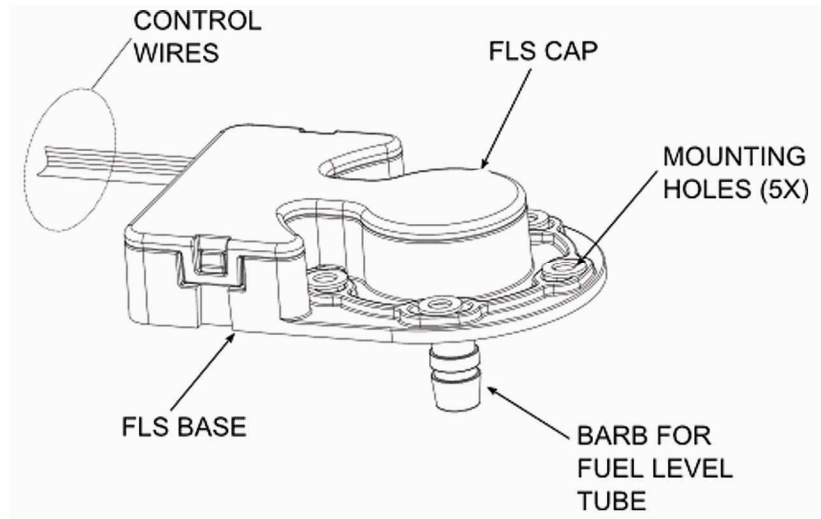


Figure 1

Depending on the configuration, up to five (5) control wires coming from the back of the unit may or may not have one or more connectors on the bundle of wires. This will depend on how the FLS will interface into the wiring harness.



Inspect the control wires to ensure there are no cuts, scrapes, or breaks prior to installation.

A hose barb protrudes from the FLS Base. The barb is designed for $\frac{3}{8}$ " ID tubing and is used to measure the fuel depth which is reported back to the fuel gauge. Its length is also determined by the configuration of the fuel tank and vessel. Instructions for determining the length of this tube and installation methods are covered later in this manual.

PRE INSTALLATION INSTRUCTIONS

Prior to installation, the installer should take the necessary steps to gather the proper tools, associated installation hardware, and to measure the critical measurements in order to determine the proper installation lengths of the tubing.

REQUIRED TOOLS AND HARDWARE FOR INSTALLATION

Installation Hardware Required:

- ☐ FLS Control Unit
- ☐ FLS $\frac{3}{8}$ " Fuel Level Tube (cut to installed length)

Installation Tools Required:

- ☐ Measuring device (tape measure or equivalent)
- ☐ Nylon tubing cutter
- ☐ Approved Cyanoacrylate Adhesive (CMS recommends Loctite Prism 401) or Super Glue

FLS CONTROL UNIT TANK ENGAGEMENT DEPTH

The FLS Control Unit extends slightly into the tank. This depth will vary depending on the wall thickness of the specific tank, but, generally, tank wall thickness will range from $\frac{3}{16}$ " to $\frac{1}{4}$ " in thickness. A calculation must be performed to determine the proper length of the fuel measuring tube. This calculation refers to the length measurement performed as shown in Figure 4.

Fuel Level Tube Length = Tank Depth – Empty Offset

The Fuel Level Tube Length determines the range of fuel levels that the FLS will report back to the fuel gauge. The Tank Depth is measured from the top of the tank to the bottom. Typically, the EMPTY value for the tank is anywhere from $\frac{1}{2}$ " to 1" from the bottom of the tank to leave a slight amount of fuel even when the gauge is reading empty. This Empty Offset is then subtracted from the Tank Depth to determine the Fuel Level Tube Length.



Some installed items have been removed from this figure for clarity. Normal installations should use all of the required parts specified in this instruction manual.

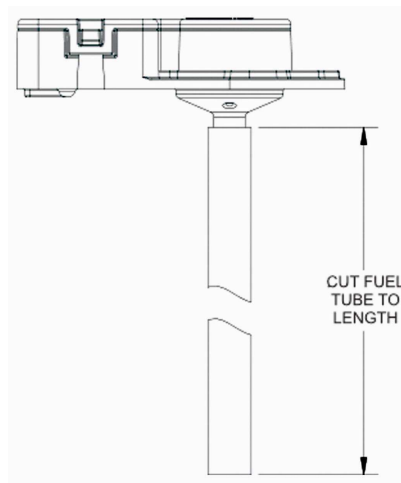


Figure 2

CUTTING AND INSTALLING THE TUBES

The next step is to cut the fuel level tube whose measurements were calculated in the last section. Based off of these calculations, the tube should be measured and cut to that length. The ends of the nylon tubes should be cut as square and smooth as possible as shown below in Figure 3.

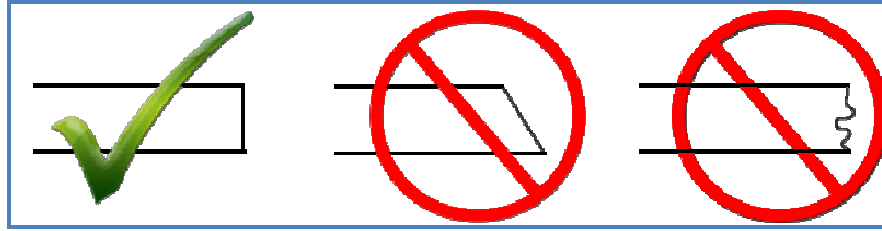


Figure 3

Once the tube has been cut to the proper length, the tube will then be installed on the barb located on the underside of the FLS Control Unit. Both the tubing and the barb are made of a fuel compatible nylon material and Cyanoacrylate adhesive is used to mechanically bond the tubing to the barbs. Additional mechanical clamps are not necessary and may harm the nylon tubing or barbs if installed.



It is suggested to warm the end of the tube with hot water to flex the tubing and allow easier installation. A heat gun may be used ONLY if on the lowest setting and without prolonged heat applied.

Prior to installing the tube onto the barb, the barb should be completely coated with the cyanoacrylate adhesive or Super Glue in the areas shown in Figure 4. Good practice is to fill the groove in between the high points of the barb with adhesive. The adhesive work time is approximately 15 seconds. The adhesive will act as a lubricant allowing the tube to easily slide onto the barb to its final position as shown in Figure 5. The tube should not come into contact with fuel for approximately 24 hours to allow proper cure time. The tube can be handled safely and installed after 5 minutes of cure time.

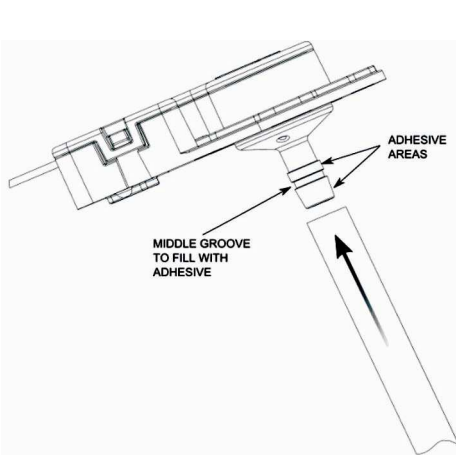


Figure 4

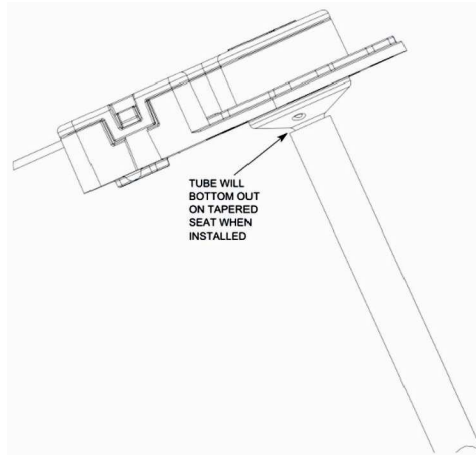


Figure 5

INSTALLING THE FLS CONTROL UNIT ON THE FUEL TANK

The installation of the FLS Main Control Unit to the tank requires access to the fuel tank's top surfaces.



The installation should be performed on a new, never fueled tank. If the tank contains fuel or has ever contained fuel, it should be drained and proper safety precautions should be used when working around fuel vapors. Failure to adhere to proper safety precautions can cause a fire and/or an explosion.



If any installation or service instructions in this manual are unclear or questions arise, the installer should stop work and immediately call Livorsi Marine 847-752-2700.

REQUIRED TOOLS AND HARDWARE FOR INSTALLATION

Installation Hardware Required:

- ☐ FLS Main Control Unit
- ☐ FLS Tank Sealing Gasket
- ☐ 10-24 x 1" Cap Screws, Stainless Steel, Nitrile coated, quantity five (5)
- ☐ #10 flat washers, stainless steel, quantity five (5)

Installation Tools Required:

- ☐ $\frac{5}{32}$ " Allen Key
- ☐ Inch-pound torque wrench
- ☐ Fuel Tank Pressure tester to 3 psi
- ☐ Soapy water solution

PRE INSTALLATION PREPARATION

All mating surfaces must be cleaned prior to installation to ensure a good, leak free seal. Livorsi recommends a soapy water solution to avoid harming the FLS Main Control Unit, the rubber gasket, or the fuel tank material. Acetone, alcohol, and other chemical based cleaners should be avoided. The FLS Tank Sealing Gasket should be inspected for any rips, tears, or surface anomalies. If any are detected, the gasket should be discarded and another gasket should be used. The gasket should also be used as a template to check to make sure that the five bolt holes in the gasket line up with those in the fuel tank flange. If they do not line up, the fuel tank manufacturer should be contacted immediately before the installation can continue.

MOUNTING THE FLS MAIN CONTROL UNIT TO THE FUEL TANK

The design of the FLS Main Control Unit allows the installation of the unit to be clocked at whatever position is easiest within the vessel. Not only can the FLS Main Control Unit be clocked at any position, the slots in the housing allow for an additional 15° of rotational adjustment before tightening the unit. To make the installation easier, Livorsi recommends installing the FLS Tank Sealing Gasket onto the FLS Main Control Unit and using the 10-24x1" cap screws to line up the holes. Once all five holes are sufficiently lined up between the FLS Main Control Unit and the FLS Tank Sealing Gasket, the entire assembly can be moved onto the fuel tank and tightened down.



Livorsi does not recommend the addition of any sealant between the FLS Main Control Unit, the FLS Tank Sealing Gasket, and the fuel tank mounting flange. Proper installation should result in a sufficient seal between all three parts.

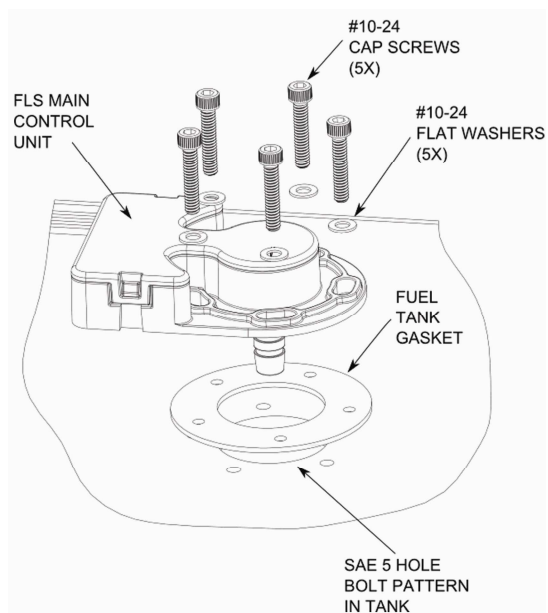
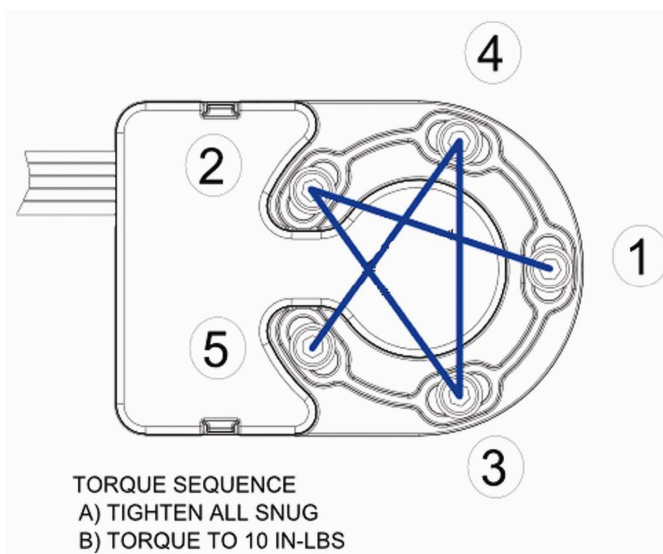


Figure 6



The five (5) #10 flat washers must be installed between the cap head screw and the FLS Main Control Unit in order to provide proper clamping pressure on the gasket surfaces. Failure to include these parts will result in damage to the units and possible vapor leaks.



Do not exceed 15 in-lbs of torque on the #10-24x1 cap screws as damage can occur to the screws, FLS Main Control Unit, FLS Tank Sealing Gasket, and/or fuel tank mounting flange which may result in a vapor leak.

Inspecting the FLS Main Control Unit for Leaks

In order to ensure that the installation of the FLS Main Control Unit has not introduced any possible vapor leaks, a standard fuel tank pressurization test should be administered. Following the guidelines for the setup of the pressurization test, the tank should be pressurized to 3 psi (20.6 kPa). Soapy water should be brushed/sprayed around the sealing area of the FLS Main Control Unit as shown in

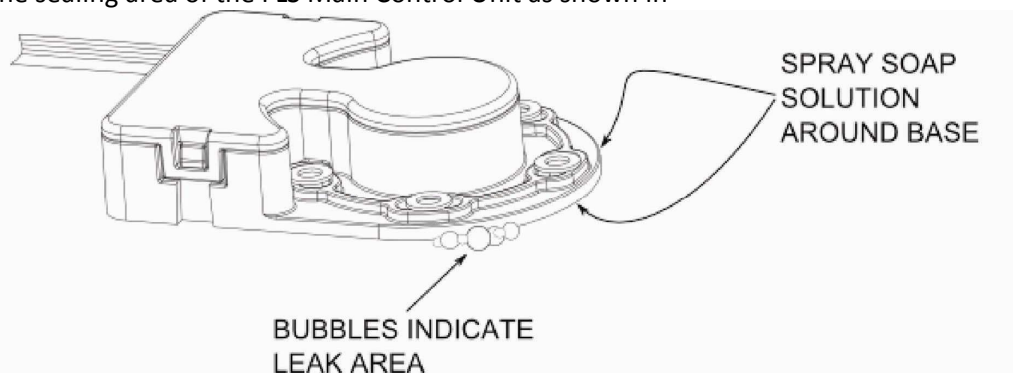


Figure 7. Inspect area for any bubbling in the soapy solution and/or a loss in pressure of the test apparatus. Any leaks should immediately be attended to and fixed prior to filling.

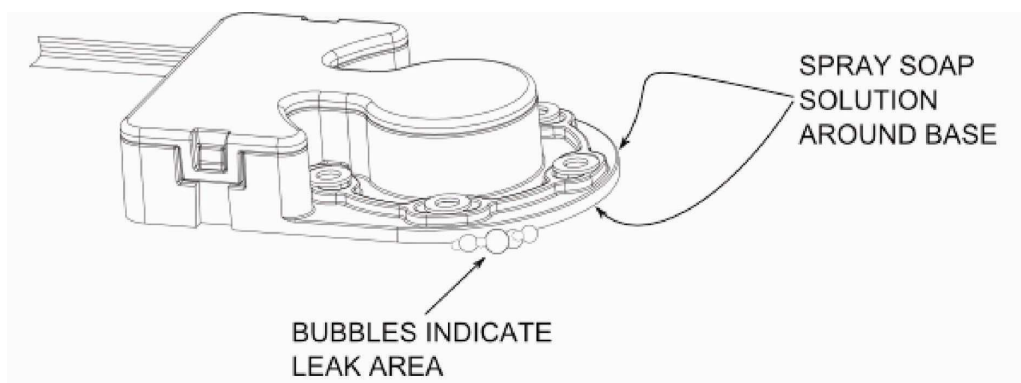






Figure 7

FLS ELECTRICAL CONNECTIONS

	WARNING <i>Installing any electronically controlled device on a vessel should be performed by a qualified electrical installer and all safety protocols must be followed in order to prevent injury to the installer or damage to the FLS and/or other electronic components on the vessel.</i>
	CAUTION Livorsi requires that the 12V DC power signal be run through a minimum 1A fuse panel dedicated to the FLS electronics.
	When handling the FLS, the installer should be properly grounded in order to avoid any unnecessary static electricity discharge which can damage the unit and possibly cause an explosion hazard when dealing with fuel.
	If any installation or service instructions in this manual are unclear or questions arise, the installer should stop work and immediately call Livorsi Marine 847-752-2700.



Soldered connections give the best conductivity when splicing wires together. If solder is not used, a heat shrinkable butt-splice connector is recommended by Livorsi. A wire nut should never be used on any splice connections. All connections should be finished as to protect from water infiltration.

The electrical connections for the FLS are broken down into three categories: power, shutoff control, and output. There is also an additional reset line which is not hooked up to anything during the installation and is used to reset the FLS back to factory specifications if required at some point.

Signal Type	Signal Name	Signal Function	18ga Wire Color
Power	+12V	+12V DC Constant power source	Red
	GND	Ground	Black
Output	GAUGE	Ohm Based Fuel gauge	Pink

REQUIRED TOOLS AND HARDWARE FOR INSTALLATION

Installation Hardware Required:

- ☐ Butt-splice connections for waterproof splices
- ☐ Zip ties or Adel clamps for securing wires after installation

Installation Tools Required:

- ☐ Wire cutters
- ☐ Splice crimp tool
- ☐ Heat gun or other heat generation device for shrinking splices

WIRING SCHEMATIC

The block level wiring schematic is shown in Figure 8. If the vessel is equipped with a pre-fabricated wiring harness, then the connections should splice into the harness. If no pre-fabricated harness is employed, then wiring should be done point to point. All wiring should be 18ga fuel compatible, marine grade wiring.

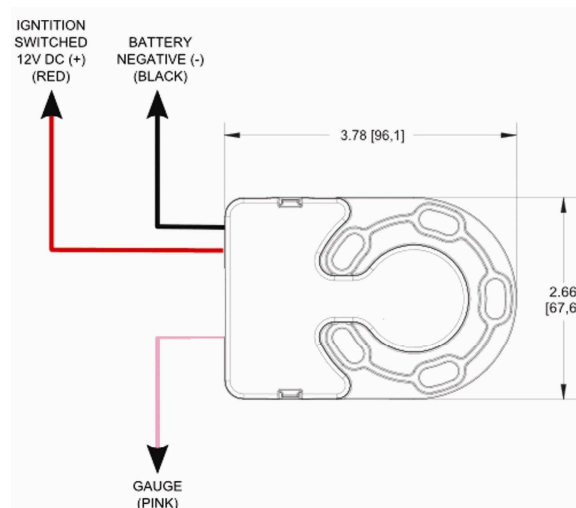


Figure 8

FLS OPERATING MODES

The FLS is an intelligent fuel level sensor that has the capability to automatically learn both the empty and full points which are then relayed back to the sender. When the units are initially shipped from the factory, they do not have a full calibration learned yet. The benefit of the intelligent learning capability is that the FLS will adapt to any size or depth of fuel tank without any additional programming or user interaction.

FIRST TIME POWER UP OR POWER UP AFTER RESET

During the first time the FLS is powered up after installation or when the unit is reset, the FLS will go into empty learn mode. For the first power up or after a reset, the fuel tank must be empty, or the FLS must be removed from the fuel tank in order for the empty (in air) calibration to be properly set and saved within the FLS. To denote that the unit is in empty learn mode, the connected fuel gauge will be set to empty, and then every five seconds, the gauge will sweep from empty to full and back to empty.

SETTING THE FULL LEVEL

If the first fuel fill after installation or a reset is not a complete capacity fill, the FLS will learn this as the new full level and this fuel level will be shown on the fuel gauge as full. Until the tank is completely full to capacity, the fuel gauge will only show full based on the greatest capacity level that it has measured after the ignition is switched on.

Whenever +12V DC power is applied to the FLS, the unit will take the measurement of the fuel level and compare that with the stored full level in the FLS's memory. If the level exceeds that which is in the FLS, then a new full level is saved to the unit and the entire empty to full scale is recalibrated automatically. This check occurs any time the unit is powered, which in most application is when the vessel's ignition is switched on.



*If the fuel tank is filled while the FLS has power, it **WILL NOT** learn the new capacity level unless the ignition is cycled. The US Coast Guard does not allow filling a fuel tank while the ignition is on.*