

Canard Fuel Probe System Installation

By Nick Ugolini



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Background

These probes are designed to be quickly and easily installed in any Rutan or Velocity strake of a new construction or completed canard aircraft.

The probe length has been sized for the average depth of the strake the aircraft. They can be adjusted shorter if needed. If you need a longer one, it will have to be custom made.

7 3/8" long - Varieze, LongEZ, Cozy 3 and 4:
8 1/2" long - Velocity:
9 3/4" long - Velocity XL
11 1/4" long - Defiant:

The probe measures .25" from the flange to the top of the probe sense wire and can easily fit within the 10 mm (3/8") foam core of the strake. Once placed in the strake the probe is completely encapsulated in wet flox to seal the probe to the structure. The fuel does not need to be drained from the tank and if properly installed, leak retesting of the fuel tanks should not be required.

The following epoxies have been tested and approved for the installation of the fuel probes. WEST, MGS and E-Z Poxy.

- West and MGS can be used with AVGAS and non-ethanol MOGAS fuels.
- E-Z Poxy can be used with any fuel. When in doubt I always recommend using E-Z Poxy.

1. Electronic Modules

Electronics for the probes are designed, supported, supplied and warrenteed by Princeton Technology. Contact Todd Stehouwer at: tstehouwer@sbcglobal.net) or phone (616 243-8800) for warentee or technical questions regarding the modules.

These electronic modules are specifically designed to work with the shorter canard style probes and can be used with any electronic flight systems or fuel gauge which utilizes a 0-5 volt fuel voltage input signal (0 is empty, 5v is full).



The electronic modules can be easily configured or reconfigured at any time by the user for three different types of outputs profiles. See the attachment at the end of the installation instructions on how to do so.

Single set point. The easiest to calibrate and is used for displays such as Grand Rapids EFIS and Dynon or any display that uses internal software to map the shape of the fuel tank. You only need to fill the empty tank to the desired “empty” point (low fuel reserve) and set the empty point. There is no need to fill your tank, calibrate the probe in steps or set the “full” point. Mapping of the tank is done at the display. The drawback is a very slight reduction in accuracy.

Two set point: Is used for displays such as Grand Rapids EFIS and Dynon and any display that uses internal software to map the shape of the fuel tank. You need to fill the empty tank to the desired “empty” point (lowest fuel reserve) and set the empty point. You must then FILL the tank to the “Full” point and set the level in the module. There is no need to calibrate the probe in steps. Mapping of the tank is done at the display.

There is a slight improvement of the system accuracy as opposed to the 1 set point module but take a bit more effort to set up.

Five set point: Is used for direct readouts on equipment which does not have tank mapping capability such as when using the Grand Rapids Engine Monitor, the Aircraft Extras AG6 display or other types “non-calibratable” displays. The 5 set point module electronically maps the shape of the fuel tank for the readout display. The module adjusts the voltage output depending on the shape of the fuel tank at specific points (Empty, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and Full) as determined during the initial calibration of the module when filling your tank. You will need to fill the empty tank to the desired “empty” point (low fuel reserve) and set the empty point. Then fill the tank in steps to the “Full” point. This will “map” the tank for the display. Calibration points are stored in the module's non-volatile memory.

If you have any questions about the modules, PLEASE contact Princeton, as I only build the mechanical probe assembly and can not provide you any help on module configuration selection, trouble shooting, electrical issues, etc.

1.1 Fuel Selection Calibration

The modules can be calibrated for your choice of AVGAS, MOGAS or Diesel (Jet A). You have to choose one fuel as the primary fuel since each one has different dielectric characteristics. The fuel level will not read accurately (30-40% error) if calibrated for AVGAS and you put in a tank of MOGAS.

NOTE: These probes are difficult but not impossible to remove. Once installed they should be considered a permanent part of your structure. Due to the simple design there should never be a need to remove them. If you accidentally cut and can not repair the signal or ground wire, you will have to install a new probe (you can still use the same electronics). You will have to purchase a new signal wire from Princeton.

NOTE: It is possible to remove the probe without damaging the plane structure. You will end up destroying the probe which can be replaced. The need to do so has only occurred once when a builder used too much flux and obstructed the vent hole. Contact me privately for instruction on how to remove the probe.

2. Installation Time

Installation of the two probes should take less than 8 hrs for a flying plane depending on the type of finishing you want to do. This is a generalized installation instruction since every plane is built slightly different by the original builders.

3. Inspection Of Probe Vent Hole

If you purchased your probes before May 2013, inspect the probe to see if it has a small 1/16" vent hole. If YES, you must preform the **Mandatory** change as detailed at the end of the instructions to reduce the possibility of epoxy obstruction during installation.

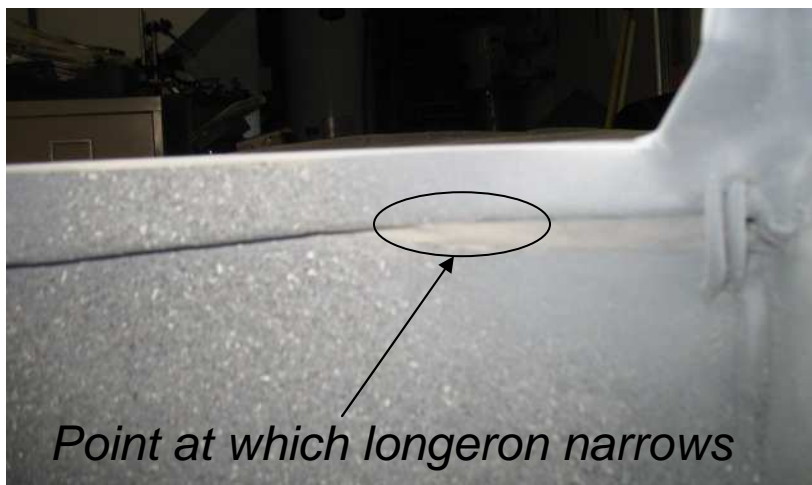


4. Retrofitting a Completed Strake

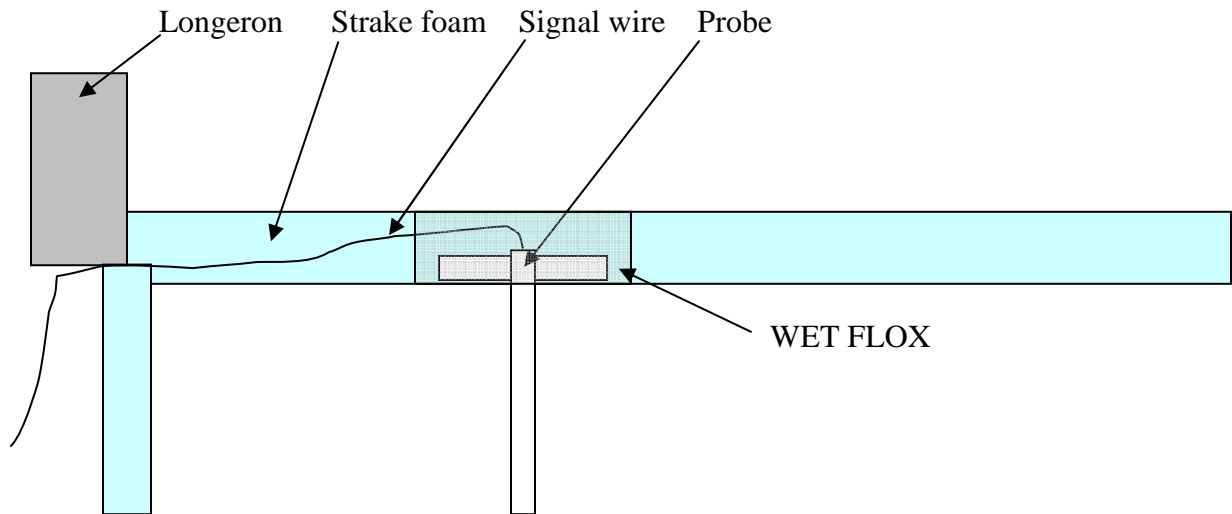
NOTE: Select a location that does not interfere with the fuel strainer when inserted.

You should also choose a location for the probe which allows you to thread the signal wire through the strake foam into the cabin area. The ideal spot would a location which does not impact the fuel strainer, and is close to the sight glass.

For the installation in my plane, I selected a point 15" forward of the aft end of the spar and 5" outboard of the canopy sides. This spot is close to where my sight glasses are located so the visual fuel level and the indicated level would more or less correspond. The wire chase was drilled in at an angle such that the wire exited at the point which the longerons narrow. The electronics were placed in the passenger headrest area. Where you install your fuel probes and electronics is entirely your choice.



A cut away view this is what the installation would look like.



4.1 A couple of considerations for installation of the probes

- IF you do NOT wish to immediately repaint,
 - Just protect the paint around your hole with some tape prior to cutting the hole and install as shown. When cured, remove the protective tape/paper for an unblemished paint job. Make a painted Alum cover (like wing bolt covers) and RTV it over the probe hole. Save the painting till later.
 - As an alternative, you could mask the area off, carefully cut an opening with a Fein saw, pry up the small square of strake skin, and then carefully reposition the skin when floxing the probe into place leaving a small thin line cut line when finished.
- IF you wish to immediately repaint the area, first mark the opening, take a sander and feather the micro back from the opening a 1/2" or so, THEN cut the hole.

5. INSTALLATION IN AN EXISITING PLANE

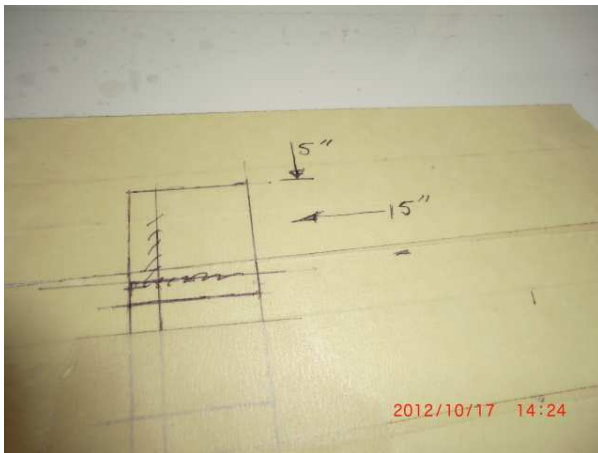
The following pictures and installation shown was performed on my LongEZ which will not be repainted and the strake skin will be reused as a cover.

5.1 Preparation:

Wax the area around where you'll be working to prevent epoxy from sticking to your paint. Then tape off the area with clear tape, box tape, etc to protect the finish.



Decide on where to cut the hole. There is no magic answer for the exact location. The choice depends on the configuration of your plane.



The measurements are 5" from the longeron and 15" from the aft end of the spar as measured from the cowl lip.

6. Preparing The Strakes Opening

When you have selected the location for your probe, mark and cut the outer skin of the strake. I would suggest about a 1 1/4" opening. Remove the outer skin and the foam to the inner skin.

Hint: If you put some tape your Fein saw 1/4" bade away from the edge it will create a depth gauge on the blade. This will ensure you will not cut into the inner skin of the tank.



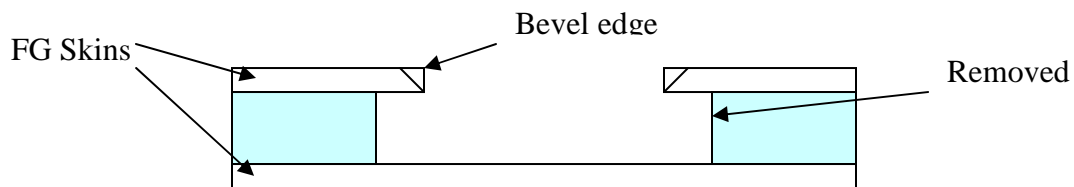
After you cut the skin, take a razor knife and check the cut to ensure the square is free all the way around the perimeter.

Then stick the blade under the edge and pry the square off the foam.



Remove about 1/4" of foam from the underside of the hole. Bevel the upper skin at a slight angle if you intend to use a layer of BID after floxing the hole (if you wish to

repaint the area otherwise level it square cut). Leave the edge square if you intend to replace the skin cutout as I did on my installation.



Next you'll have to feed the wires through the foam.

BE CAREFUL you do not drill into your fuel tank.

7. Fishing the wires

Before fishing your wires through the hole, carefully remove all remnants of the strake foam from the inner skin of the full tank. I found a flat 1/2" wood chisel ideal for scraping the inner skin to remove the foam and micro and finally vacuum the surface.

I would suggest taking some 1/8" welding wire and flatten then file the end into a wedge and drill a small hole in the flattened area so later you can insert some safety wire into the little hole to use to pull your wires through the hole.



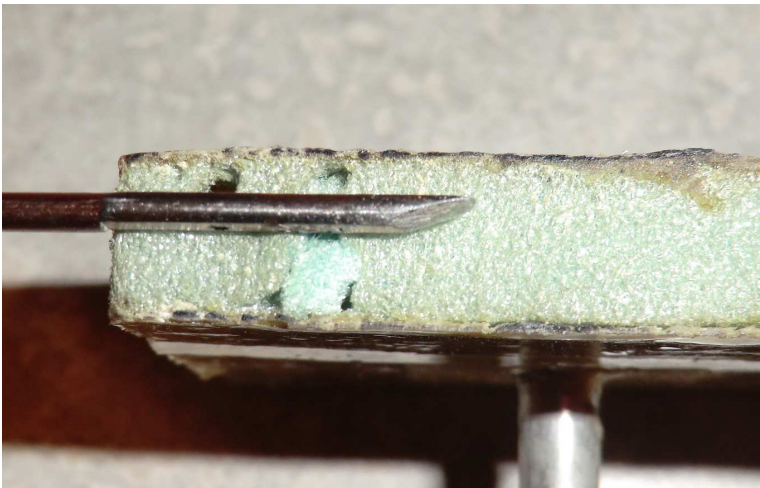
Small hole drilled for safety wire.



When you push the welding wire through the foam depending how you orient the wedge, you can steer the wire. If you keep the wedge oriented with the sharp point near the upper shin, when you push the wire through the foam, the wedge will force the wire upward and follow the upper skin. You steer the wire using the same technique as used in directional drilling.

Hint: The direction of the wire can easily be monitored by taking a small magnet (like a small high strength rare earth magnet) and placing it near the tip as you push the wire through the foam. I used a magnet which was intended to hold on a shirt name tag. It will easily track the steel wire under the skin.

This is how the wire would look as it travels through the foam. The wire will be forced upward (due to the wedge) to travel just under the upper skin.



To drill through the side wall skins, I used the other end of the wire which was ground to a shallow point and sharpened using a file to look like the end of a drill bit.

Now insert your home made drill bit into the channel you just made and you can easily bore through the exterior and interior glass sides of the fuselage (2 layers of UNI per side). You might also just try spinning the wedge with the drill motor. It should drill through the glass.



Attach some .020" safety wire into hole which was drilled in the wedge and pull it back through the hole you just created (from the cabin to the hole). You may have to enlarge the hole in the cabin slightly as the welding wire is only 1/8" in diameter. I used a 3/16" bit to enlarge the hole.



Then attach some Teflon wire to be used as the ground (I used #24) to the safety wire and pull it back through the hole (from the outside hole to the cabin). I made a loop of the Teflon wire so there would be two wire through the hole. One will be the ground and the other will be used to pull the coax wire.



Now what you have 2 wires fished through the opening, cut one and solder it to the coax wire and pull it back though the hole (from cabin to cut hole).



If you are installing the probe in a new construction, it is much easier as you have complete access to the foam of the strake before you put on your outer top skin of the strake.

After installing the wires you are now ready to cut the hole, test for probe length, connect the wires and install the probes.

8. For New Strake Installation

Installing the probes in a new installation is extremely easy and requires much less effort than retrofitting a completed plane.

Mark your probe location. Be sure you have sufficient clearance away from the fuel strainer and vent lines to prevent the probe from touching them.



Drill a 3/16" hole into the cabin. Ensure you do not drill into your fuel tank.



Remove the foam.



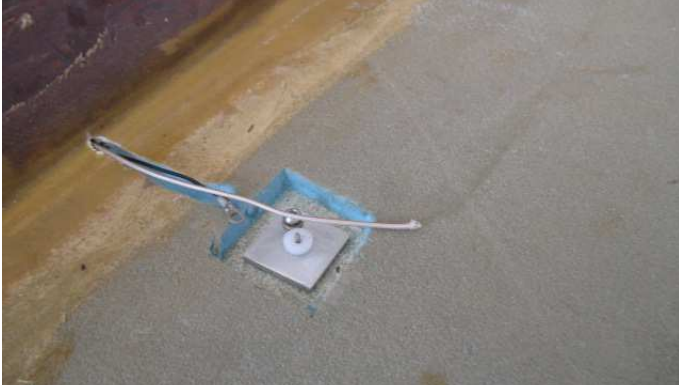
Create a channel for the wires.



The prep work is finished. Now use a razor knife to cut your hole for the fuel probe.



Wire the probe and you are done. Total for this install time was about 15 minutes. Now you are ready to complete the probe installation by verifying probe length and testing the probes electronics prior to final glassing the outer skin of the strake.

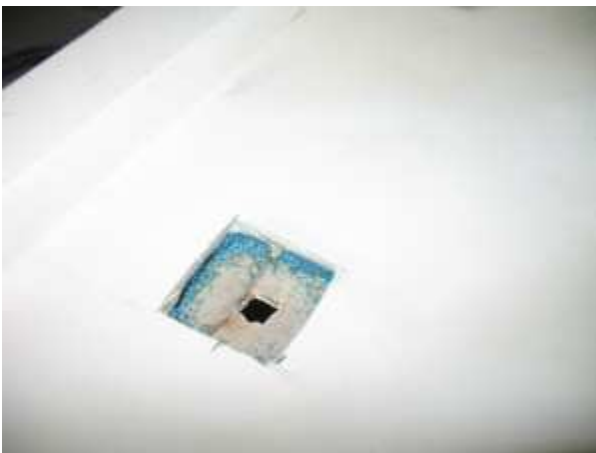
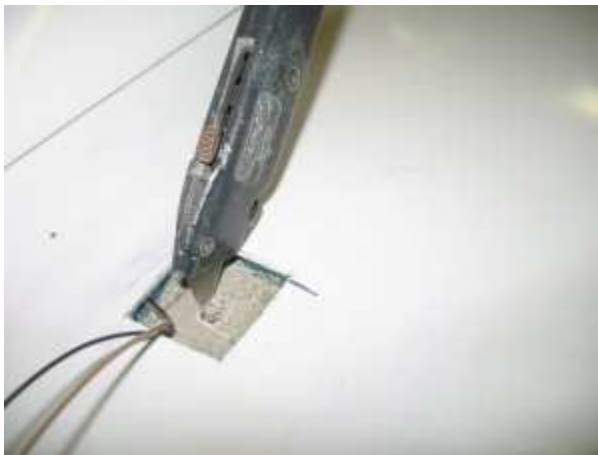


NOTE: Be sure the probe is completely encapsulated with flox when glassing the strake to prevent fuel leaks.

9. Opening The Tanks

CAUTION: I have installed the probes (cutting open the tanks) with fuel in the tank. I do recommend draining and venting the fuel tank. Be aware that an empty tank with fuel vapors is just as dangerous as a partially full tank. Be sure to not use any electrical equipment while the small hole is open in the strake and keep your fire extinguisher close at hand.

Using a razor knife, cut a square opening in the glass inner skin of the strake for the probe tube. The razor knife is used to prevent getting chips into the tank which would invariably happen if a hole is drilled. After you cut the 3 sides of the hole, bend the tab up and break it off.... no chips.



10. Probe Measurement/Installation

After the hole is cut in the tank to ensure the length of the probe is appropriate for your strake (since each strake thickness is different). Take a piece of welding rod (or coat hanger) and insert it into the hole to the bottom of the tank to test the depth of the strake at your installation location. The probes are exactly 7 3/8" long and will fit a standard Rutan strake. Velocity probes are 8.5" long. Contact me if you need a custom size.

Measure the depth of the tank and compare it to the length of the probe. If necessary, disassemble and shorten the probe by using a disk sander to allow for about 1/4" clearance from the bottom of the tank,

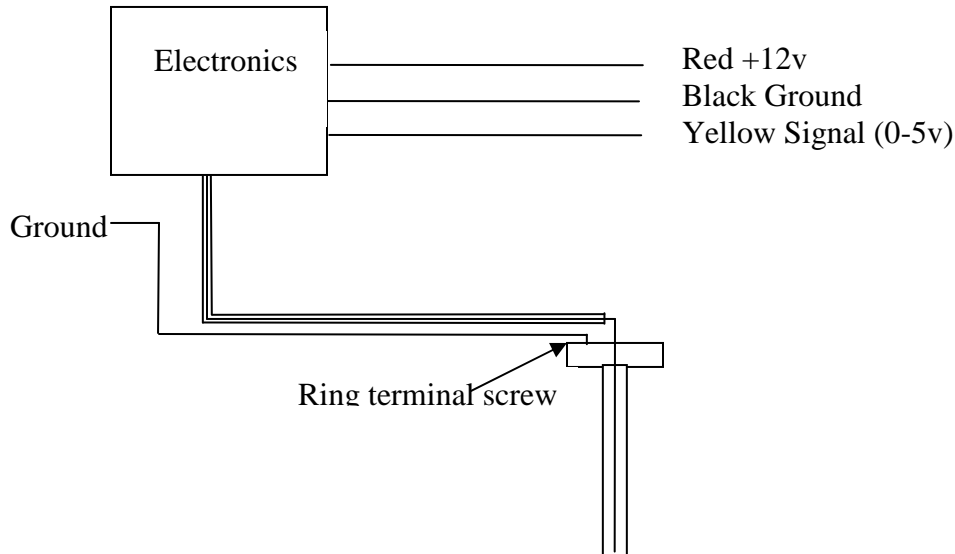


TIP: An easy way to shorten the probe is to remove the center electrode from the main probe, slide all the small triangular spacer toward the connection end (to prevent melting), and reinsert the center electrode back into the probe. Sanding both tubes at the same time supports the inner tube with the outer tube and they will both end up exactly the same length.

After shortening, disassemble the probe and reposition the spacers and check the length.

If you need reposition the bottom triangular separator after shortening the probe. Position the separator about 1/8" from the bottom and carefully crimp both sides of the tube adjacent to the separator to hold it in position.

11. Wiring The Electronics



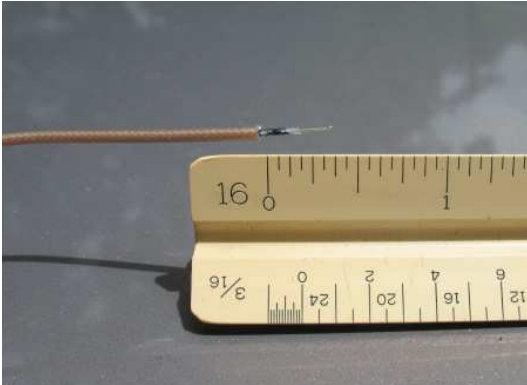
Note: The shield of the coax wire is not used and should not be connected!

Note: A 36" coax signal wire is supplied with the Princeton electronics module. You can shorten the coax wire as necessary to fit your installation.

Strip off about 3/8" of the braided shield off the probe wire. A razor knife rolled around the conductor works well. You will easily feel when it contacts the metal shield.

Remove just a small amount (about 3/8 – 1/2") of the shield such that the braid will not contact or short out with either the center conductor or the grounded mounting base. Be sure to remove any stray wires from the shield. Place a piece of supplied shrink tubing over the wire to prevent any contact of the braid to the base.

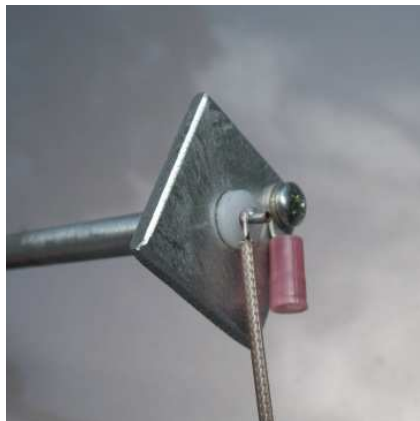
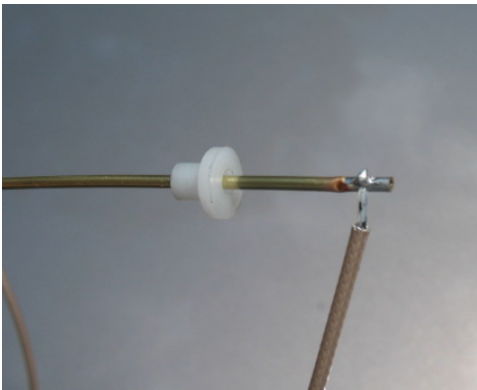
Expose about 1/8" of the center conductor. It is easier to solder the coax if you pre-tin the wire prior to attaching on the probe center conductor.

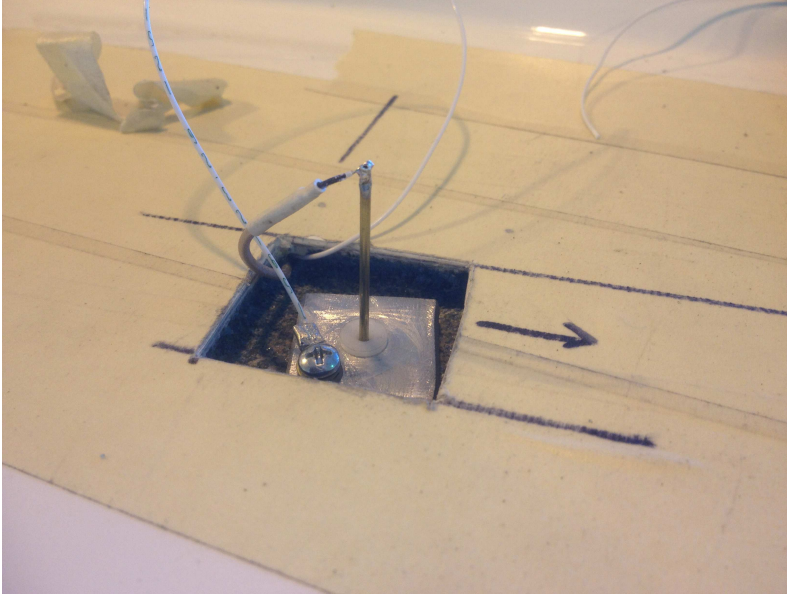


Note: Be sure to gently push the center insulator down on the center electrode to keep from overheating and melting the plastic prior to soldering. There is a recess pocket on the insulator and a crimp on the electrode to keep it from going down too far into the insulator.

Note: The center probe tube is pre-tinned to facilitate the soldering.

After soldering, position the shrink tubing over the shield wire near the center probe and shrink it. Push the insulator back up the electrode until it stops (don't force it too hard. It has a crimp to ensure it is at the right position).





The probe uses the screw crimp connector with either a #22 or #24 wire as a ground, which is attached to your plane's system ground.

Note: Prior to permanently attaching the ring terminal to the probe, sand both sides of the ring terminal and the probe area under the ring terminal to remove any Al oxide. Be sure to use the supplied star washers on the top and bottom of the ring terminal. This will ensure the best possible electrical connection for the probe ground.

If the screw sticks out too far from the base which could prevent the base from sitting flat on the inner skin, you can either add another washer or use a Dremel tool with a sanding disk to grind down the screw.

12. Testing The Electronics (CRITICAL OPERATION)

BEFORE you flox the probes in you MUST test them to ensure they are properly wired and operational. It is important to check out the wiring and soldered connections prior to floxing them permanently in.

1. Temporarily connect up the wires: Red to 12+, Black (of the module) and probe base wire to ground and begin the calibration procedure per the Princeton instruction.
2. If properly wired, the left LED will flash indicating the system is working and the system is beginning the start of the calibration procedure.
3. Press the calibration switch the left LED will light change from blinking to steady indicating it is calibrated for an EMPTY tank. After a few seconds go out indicating it is waiting for next set point. IF you have the 1 set point module it will begin to flash very slowly (heartbeat) indicating it has gone into normal operation.
4. If you get to this step, then your system is properly wired and working normally. Just disconnect the power and ground and complete the installation.
- 5 IF you get an error code on the module then there is a problem with the wiring which needs to be corrected prior to permanently floxing the probe into the tank. If you are unable to figure the problem out, please contact Princeton to identify what steps may be necessary to correct the electrical issue. For electronic/electrical issues, I can not help you and you need to contact Princeton directly for assistance.

13. Floxing The Probes In Place



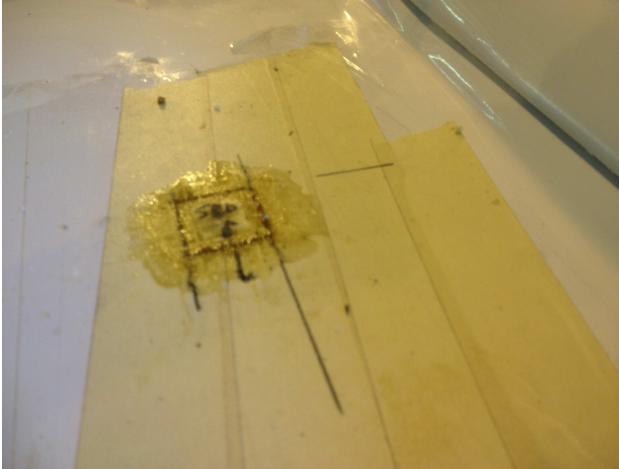
Mix some very dry flox, and put a small amount just at the outside edge of the of bottom side of the probe to create a seal to prevent the wet epoxy from flowing under the base.

NOTE: Be very careful not use too much flox on the base which could squish out into the tank and obstruct the vent hole located at the top of the probe.

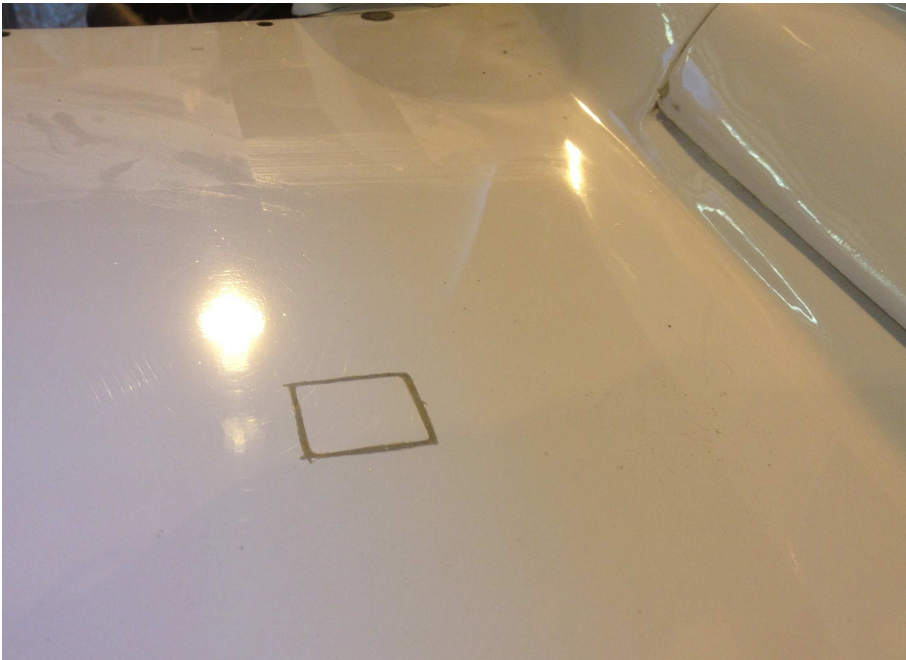
The purpose of the dry flox on the bottom of the probe is to hold the base in position and to prevent the wet flox which seals the probe in place to not flow into the tank thus obstructing the vent hole.

Install the probe into the tank and fill the entire cavity with wet flox. The probe/wires should be completely encapsulated (potted) into the tank with wet flox. Be sure to allow enough contact area of the inner skin beyond the probe to allow for a good seal around the probe perimeter.

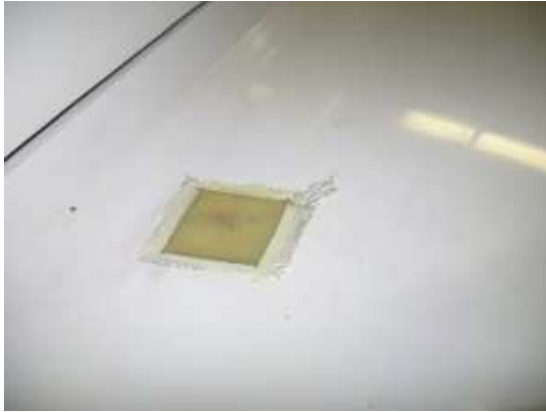
After filling the probe area, you can reposition your square cutout of the strake back into the hole. I would recommend allowing the flox cure until it is a bit firm before you put the cover in place. This way the cover will not settle into the wet flox and makes positioning it easier.



After curing, remove all the protective tape, sand the area with 1200 grit, buff it out and it will look great!



If you are not using the cutout, put 1 layer of BID in the wet flox and let all cure. The BID will attach the beveled edge of the opening and the undercut you made in the foam.



If you plan to repaint the plane, just sand the area flush after cure, micro, sand and paint.



After installation a little paint they are completely gone.



Alternatively, until you repaint the area you could make a cover out of some thin aluminum painted to match your plane and RTV it in place if you don't use the skin piece you removed at the start of the installation.

14. Purchasing

If you are interested, my contact email is unick3@yahoo.com You can also call me at 843-608-9250

- A standard system (VariEZE, LongEZ, Cozy 3 and 4) sells for **\$165 per side**.
- A extra long system (Velocity XL and Defiant) sells for **\$170 per side**.
- The Princeton electronic modules are only available from me for \$100 each if you purchased your probes without electronics.
- Shipping is a flat \$10

Example: Total cost of the a standard two probe system shipped anywhere in the US is \$340.00. Shipping to foreign countries will be slightly higher to cover the additional cost.

15. Mandatory Change for probes purchased before May 2013

Due to some installers inadvertently plugging the vent hole at the top of the probe during installation, it is mandatory that you enlarge the vent hole to reduce the possibility of the hole being plugged with wet flox. If for any reason you feel your probe is plugged, I will supply a new probe free of charge. You must return the removed probe to me.

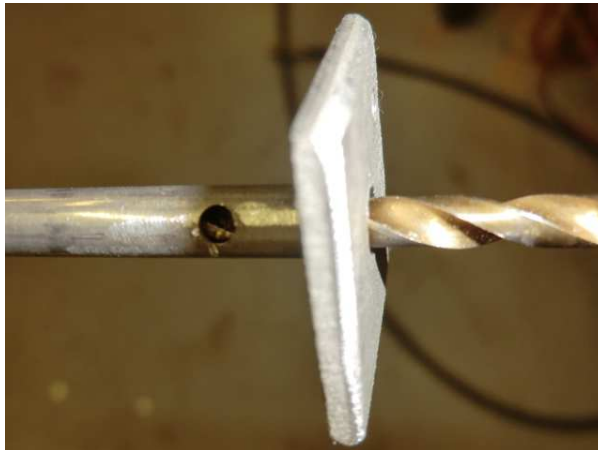
All probes shipped after 5/1/2013 have the larger vent holes and this AD does not apply

Procedure:

1. Remove the center electrode from the probe
2. Use a 1/8" drill to enlarge the vent hole



3. Remove all burs, both on the outside and the inside of the tube. Use a slightly undersized drill and HAND scrape the inside of the tube to remove burs.



Inspect for burs after cleaning, reassemble probe and install in the plane.

16. Changing Set-point Modes

The Princeton configuration setup instructions applies to the new multi-set point modules which became available after Oct 2012. For modules purchased prior to Oct 2012, the module has to be sent back to Princeton to change set point modes.

LongEZ Multi Set-point Supplemental Instructions

The multi set-point feature of this probe allows the selection of 1S, 2S and 5S modes.

1S (Calibrate Empty).

- The output will be 0 volts for empty and approximately 1.5 to 3.5 volts for full.
- Used by Dynon and Advanced Flight EFIS systems.
- Can be used by Grand Rapids Technologies EFIS also.
- Has the advantage of not having to empty the tanks to calibrate the EFIS.

2S (Calibrate Empty and Full)

- The output is 0 volts for empty and 5 volts for full. It is linear between.
- Grand Rapids Technologies and Chelton EFIS systems.
- Used with analog gauges, and some EFIS systems that use a calibration table.
- Gives greater voltage range on the output.

5S (Calibrate Empty, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and Full)

- Used with analog gauges, and some EFIS systems that use a calibration table.
- Grand Rapids Technologies and Chelton EFIS systems.
- Linearizes the output for analog gauges.
- For an EFIS enter a linear chart in the table.
- Gives greater voltage range on the output.

To select the set-point setting:

- 1) Power off to the module.
- 2) Short the output (Yellow wire) to ground.
- 3) Press and hold down the button.
- 4) While holding the button down turn power on.
- 5) After 10 seconds the lights will turn off. Keep button pressed.
- 6) The left light will come on, then it will shift to the middle, then the right light, then all lights off. It will repeat this continually until you let go of the button.
- 7) Release the button when the appropriate light is on.
- 8) Turn off the power and remove short to ground from the output.

Left light = 1S

Middle light = 2S

Right light = 5S

1. Attachment: Calibration instructions

This instruction is to be used for all electronic modules (new and old)

PRINCETON CAPACITIVE FUEL LEVEL PROBES

3133 Madison Ave, Wyoming, MI 49548 (616) 243-8800

Theory of operation

The probe senses a change in fuel level using a capacitive sensor formed by two metal conductors. No current passes through the fuel. The aluminum outer tube is at ground potential through an isolation capacitor. The inner brass rod has a signal on it through a 1 Meg ohm resistor. There is a digital microprocessor that filters and conditions the signal providing a very stable fuel level reading.

The leads from the probe are protected from miss wiring of the probe. The supply voltage can be from 10 to 28 volts continues.

Probe operation

The probe has two modes of operation, calibration and run. The probe comes from the factory in the calibration mode. To calibrate the probe see the calibration instructions.

When power is applied and the probe has been calibrated the probe will perform a self-test sequence. The middle light flashes quickly while this process takes place. The output of the probe will go to full for 1 second and then empty for 1 second. This allows a visual test of both the gauge and the probe for proper operation. The output is filtered with a RC network and therefore does not change rapidly. The gauge will read full very briefly. After the self-test a heartbeat will flash every 2 seconds on the middle light. The current level is updated without averaging to get a reading quickly at power-up.

The output of the probe is digitally filtered by two methods. The first is an averaging function. Readings are averaged for 60 seconds before being passed to the second digital filter. This type of filtering works well with fuel because of low frequency sloshing. With float type probes this is seen in the indicator rocking back and fourth. The averaging method eliminates this.

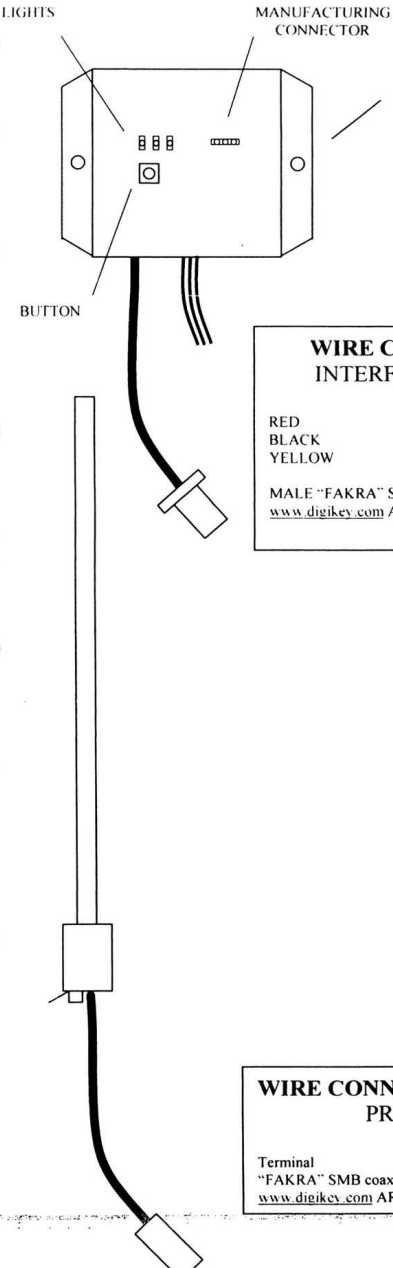
The second digital filter is a low pass filter that behaves like a RC filter with a long time constant. The output will change slowly. The main benefit from this filter is the elimination of high frequency oscillations.

Because of the filtering used the fuel level reading will be very stable. It can take up to 120 seconds to update an actual change in fuel quantity. Even while filling the tank this is not a problem.

LIGHTS

MANUFACTURING CONNECTOR

BUTTON



WIRE CONNECTIONS INTERFACE MODULE

RED	- +12V to +28V
BLACK	- Ground
YELLOW	- Signal (0 to 5V)

MALE "FAKRA" SMB - Probe
www.digikey.com ARF1253-ND

WIRE CONNECTIONS PROBE

Terminal	- Ground
"FAKRA" SMB coax connector	- Electronics

www.digikey.com ARF1250-ND

PRINCETON CAPACITIVE FUEL LEVEL PROBES

1840 PEMBROKE DR SE, KENTWOOD, MI 49508 (616) 281-5193

General Calibration Information

- ❑ The probe can be recalibrated an unlimited number of times.
- ❑ The calibration sequence is **empty** first then $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and **full** for **5 set point** models, **empty** then **full** for **2 set point** models.
- ❑ Calibration can be entered or restarted at any time.
- ❑ Probes are shipped with calibration activated. When power is applied the left light will be flashing.
- ❑ To enter calibration mode, hold the button down while turning on the power.
- ❑ Power can be removed during the calibration process after any set point (lights flashing). When power is returned the probe will continue.
- ❑ The empty set point can take as long as 16 seconds. All other set points are less than 2 seconds.
- ❑ Water affects the probe giving a reading of full. Water will not hurt the probe. The surface tension of water will make it hard to be removed from the probe. Gently tapping the probe will help.
- ❑ The likelihood of ever getting water in the probe other than deliberately exposing the probe to water is remote. There would have to be significant amount of water in the fuel tank (the unusable portion) to reach the bottom of the probe. The probe should be at least a $\frac{1}{4}$ of an inch above the bottom of the tank.

Calibration (2SP & 5SP)

- ❑ Hold down the button while turning the power on. (If the left light is not already flashing.)
- ❑ **5 set point** models - all three lights will be on while holding the button down.
- ❑ **2 set point** models - both outer lights will be on and the center light will be flashing.
- ❑ Release the button. The left light will be flashing. Indicating **Empty** set point.
- ❑ Place the amount of fuel you want to read **Empty** in the tank.
- ❑ Press the button. The left light will stay on (stop flashing) while the initial calibration is performed. This can take as long as 16 seconds. The rest of the set points will take less than 2 seconds.
- ❑ **2 set point** models - The right light will be flashing. Place the amount of fuel you want to read **Full** in the tank. Press the button. The light will stay on for a second. The probe is now calibrated.
- ❑ **5 set point** models - Place the amount of fuel that you want to read for the next set point. Refer to table 1. Press the button. Continue until done.
- ❑ After the **Full** set point has been entered the middle light will flash about every five seconds. This indicates the probe is functioning and outputting fuel level information.

● Flashing ○ Off	
●○○	EMPTY SET POINT
●●○	$\frac{1}{4}$ SET POINT
○●○	$\frac{1}{2}$ SET POINT
○●●	$\frac{3}{4}$ SET POINT
○○●	FULL SET POINT
Table 1 Set point modes	

● ON ○ OFF	
●○○/○○○	DATA ERROR
●●●/○○○	SHORT
●●○/○○○	UNSTABLE
Table 2 Error codes	

Error Codes

- ❑ **DATA ERROR** - The data stored in eeprom is not valid. Action to take: Recalibrate. If the error persists contact technical support.
- ❑ **SHORT** - This error can only happen during empty set point calibration. It indicates that the probe could not be calibrated. Most likely cause is contact between the copper and aluminum tubes from shortening. The presence of water or alcohol in the probe would act the same as a short. Action to take: Check for any contact between the rods, remove any water, and recalibrate.
- ❑ **UNSTABLE** - This error can only happen during empty set point calibration. It indicates that the fuel level was not stable. Action to take: Recalibrate while insuring that the level of the fuel is not changing during calibration.

Limited Lifetime Warranty

Princeton Electronics, Inc. will repair or replace any probe found to have a manufacturer defect. Probes that have been shortened, or the leads cut cannot be exchanged or returned for credit unless they are found to have a manufacturer defect.

Disclaimer

This fuel probe is for reference only, the operator is responsible to visually inspect fuel quantities prior to use. Relying solely on a fuel gage could result in unexpected engine stoppage.

Because Princeton Electronics, Inc. does not install the fuel monitoring system, we rely solely on the installer to insure proper installation.