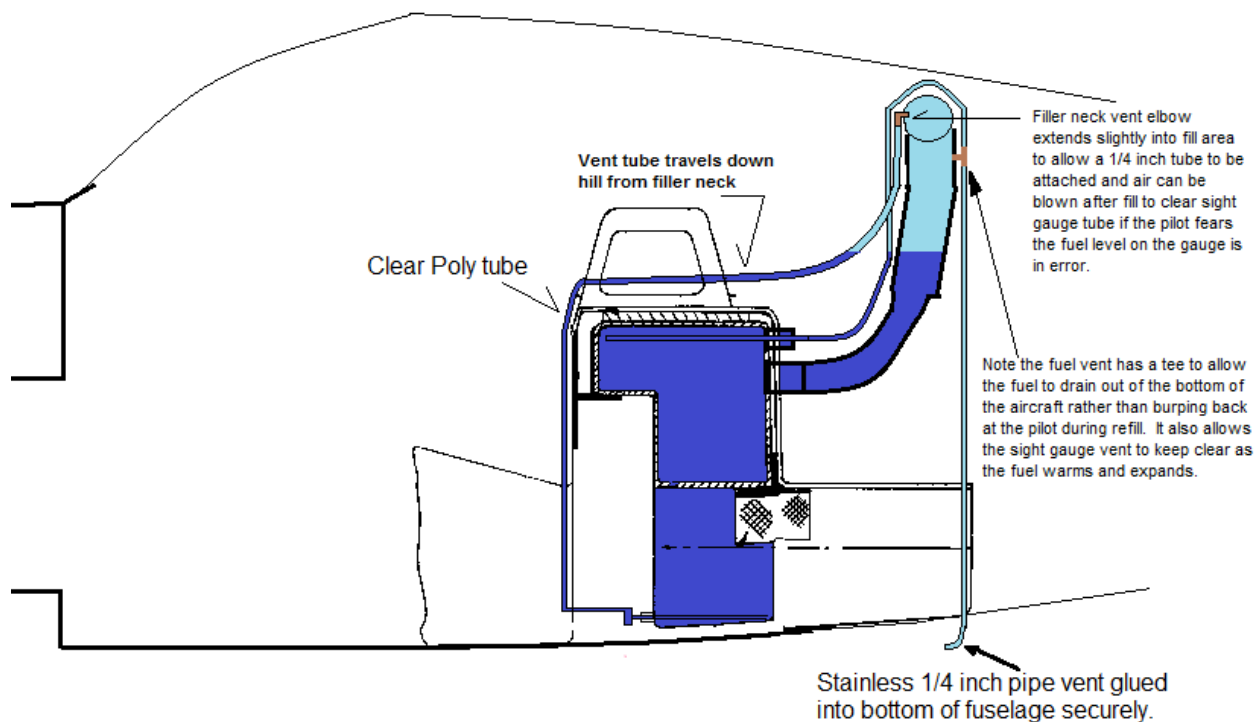


How To Make A Europa Kit Aircraft Sight Gauge That Really Works and a vent system that doesn't stain the aircraft and remains clear of clogging.

For a fuel or any sight gauge to work, the principle is very simple. Put the gauge tube to vent at the top of the tank, and the other end at the bottom of the tank. "But wait you say, on my offices 5 gallon coffee pot, the level goes to the bottom of the gauge, and changes every time I get a cup and bounces for a while." That is correct, so there are some rules to making a sight gauge.

First, the top vent must always be higher than any part of the system and at the highest point of the system and be mounted in stagnant air space. Any fuel that sloshes into it must drain back to the tank. One can put a tee in the vent line or in the fuel neck of the filler tube as shown below.

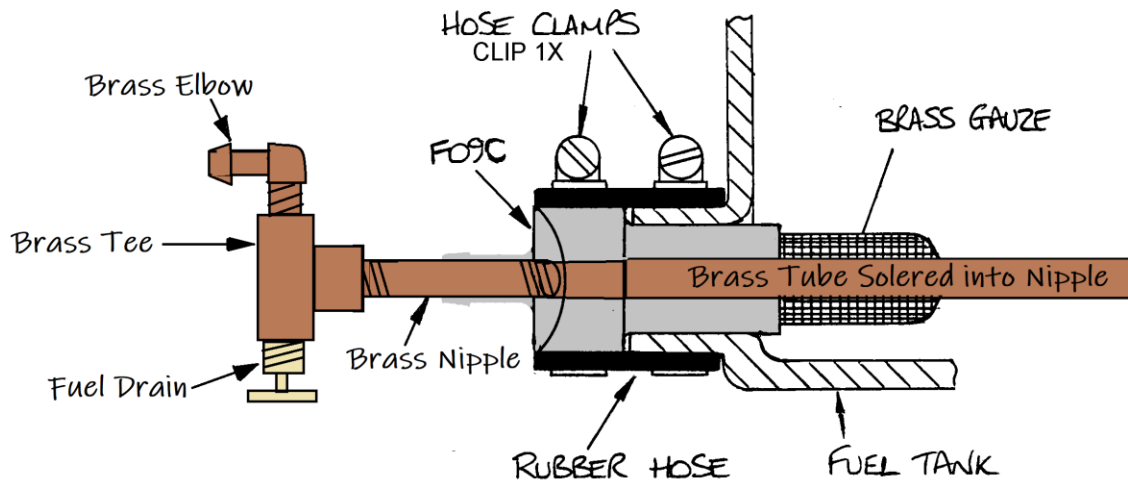
Basic Sight Gauge System



Second, the supply or bottom side of the sight gauge must not be located in a feed or return line or fitting. Any flow through the fitting will pull or push the level of the gauge up or down as fuel flows through the line or fitting. An excellent place is to hook the sight gauge lower line to the fuel tank drain fitting. Either hook it into a street Tee or brass tee and nipple screwed into the FS09 tank boss at the bottom front of the tank, or into the drain line.

Pictured below is one way to modify the Europa F09C fuel boss with a drain and port for the sight gauge. The procedure is simple, just like making the F09C 5/16 barbed fitting with the copper pipe sweat soldered into the fitting.

Modified F09C for Tee



The typical fuel boss attachment must be at a bottom of the tank, and if there is a drain there, it is an excellent static pressure point perfect for a tank drain and a sight gauge. To prevent rapid oscillations in the gauge, the supply line should have a restrictor installed to help stabilize the flow in the gauge. Place the restrictor in the bottom of the sight gauge fuel tank attachment, or put it into the top side near the vent. I have found that normally a restrictor is not necessary if the upper end of the sight gauge is at a stagnant air point such as the filler neck. Hooking a sight gauge to an external vent elbow puts pressure on the fuel level in the sight gauge and causes erroneous indications.

Third, the entire sight gauge vent side must be made to allow any trapped fuel to drain fuel from any point out as any, loop or kink in the line will cause fuel to puddle and give you an erroneous indication. Bottom line, the upper portion or vent side of the sight gauge must be down hill all the way from the top of the fuel system to the bottom.

Finally, the gauge must be made of a clear, non-breakable tubing that will not yellow. Good luck on that with today's fuels. So, make the tube easily replaceable. Tygon tubing is pretty good for about 5 years, and is UV resistant, and Polyurethane is clearest but yellows in three years or in UV exposed light. Glass breaks, but I've used it in a protective fiberglass sleeve, but the fuel will stain the inside anyway and require cleaning in a couple years. If ethanol fuel is used, it attacks just about everything over time and

stains glass, so try to make any sight gauge system with tubing that is easily changed out on a replacement time basis. Aircraft Spruce carries an excellent very clear fuel safe polyurethane line.

Specific to the Europa, the Europa manual has the builder install a vent on the top of the aircraft just behind the canopy door, which is just aft of the lowest area of pressure on the fuselage. This causes the tank to read poorly. On the ground, if the fuel tank is full, in a tail dragger, the fuel expands and dribbles down the back of the aircraft staining the paint. In a right slow speed turn, fuel gets pulled into the vent and out the aircraft due to the low pressure area on the top of the aircraft and pulls the sight gauge from its true static pressure value at low speeds, and at high speeds makes it read low.

So, why not move the vent to the bottom, keep the aircraft free of fuel stains, and any over fill will drain the fuel to the ground. Make the vent as the plans call for and just put it on the bottom. If you operate in muddy conditions, be sure to drill a couple of holes on the back side of the stainless vent tube to prevent clogging. I attach the stainless vent tube on the forward side of the rear bulkhead between the X braces on a tri-gear, and on the mono wheel I attach my stainless vent line on the baggage bay vertical floor supports. I keep it offset from the nose or main wheel to prevent mud and debris from clogging it up. I advocate one vent tube normally, but you can use two. Just don't attach the vent line directly to the sight gauge line as it may induce ram pressure into the tube and push the fuel level in the sight gauge lower than actual. Attaching an elbow to the cobra neck or fuel fill neck works well because this is basically stagnant air.

On the bottom side, one should use an FS09 restrictor for your fuel stabilization (or use a .020 -.025 carb jet or similar small restrictor) in the fuel fitting or hose to keep oscillations damped.

I prefer to attach the sight gauge to the aluminum 1/8 NPT outlet nipple using a brass tee and 1/4 inch 1/8 NPT on a FS09C fuel fitting (to clear the molded 8mm or 5/16 machined in feed fitting of the FS09C) for the lower attachment. I have been known to drill out the brass 1/4 inch fitting and insert a restrictor in it so fix it in the system solidly. One can fit the sight gauge to a Tee to go to the fuel drain line of the main side of the tank. The upper part of the sight gauge I attach to the plastic Cobra neck with a barbed elbow (that stagnant air again). The main tank vent I will run over the top of the Cobra neck and attach it to a lower point in the cobra neck to allow expanding fuel to drain, and the other side of the Tee continues down to the vent on the bottom of the plane. Finally, consider putting the sight gauge on the seat back bulkhead, run the line between the pilot and passenger or so it is easy to see. That way acceleration forces are minimized.



As for the placement of the sight gauge, it is imperative that the vent side of the sight gauge be completely free of fuel. Any fuel trapped in the sight gauge will affect the reading. This is a common problem if during fueling, especially if the cobra neck is filled to the top. To avoid this, the vent of the sight gauge can be installed near the fuel cap. The overboard vent is placed well below the cap so as the fill line and cobra fills, it will begin dripping fuel on your feet. As you can see in the drawing, expanding fuel from the tank will vent overboard, but not in the sight gauge vent line, (hopefully) but if the line is looped and twisted through the cockpit module any fuel that enters the gauge vent side will have to be able to drain out. As stated before, if there is a loop or low spot in the upper sight gauge line the fuel level indication will be inaccurate.

The above drawings do not give a path for the gauge line, but to be sure, the gauge vent line must follow from the cobra neck in a continuous downward path to the bottom of the tank.

As shown in the drawing below, it does not give a desired vent line path. I prefer my sight gauge to be on the inboard side of the passenger seat. The vent side travels up to the top of the module then into the headrest and up to the cobra neck. In tri-gear installations, it can be run on top of the fuel tank between the tank and the fiberglass if room allows. In mono wheel aircraft, it is better to run the vent side up into the passenger headrest, on an uphill all the way to the cobra neck. If clear polyurethane tubing is used in the vent line, it is easy to determine if fuel is trapped. In our installations, we put the vent fitting in the cobra neck for the sight gauge line in a position where one can put a small piece of surgical or tygon tubing on the vent line with the fuel cap removed and blow air by mouth into the vent to purge any fuel that the re-fueler may have forced into the vent line of our sight gauge. If the builder is careful to bring the vent line down on a consistent downward slope with no loops in the vent line, the vent line will self clear.



In flight, the gauge is easy to read when put between the seats. Lift your arm and read it. On some I put it down the pilots or passengers shoulder to the bottom of the seat, but for me I put it in the middle into the cockpit module back. I know this point is about 7.5 gallons total (5 in the main side) and I need to land. I have a map case installed in my center console which when open has a clear plexiglass back panel allowing me to see the sight gauge to the bottom. I have a door on my map case that is hinged forward, with a switch to illuminate my sight gauge, and I can open the case to see my gauge all the way to the bottom of the tank if I need to well lit. I manufacture a small fiberglass tube guide holder to keep the polyurethane tube nice and neatly tucked, but plane old P clips will work as well. Some like to use reflective tape to see the fuel better or even put a light tape behind the fuel line for easy vision. Just remember, when attaching the do dads, don't put a screw through the tank top or hit the spars. If you are a zealot as I am, install an electric fuel sender as well and then put in a fuel totalizer to measure the flow, or a pressure transducer at the bottom of the sight gauge to weigh the fuel column. You will surely be the department of fuel gauge redundancy.