Installing a Fuel Flow/Fuel Pressure Instrument in a Twin Comanche

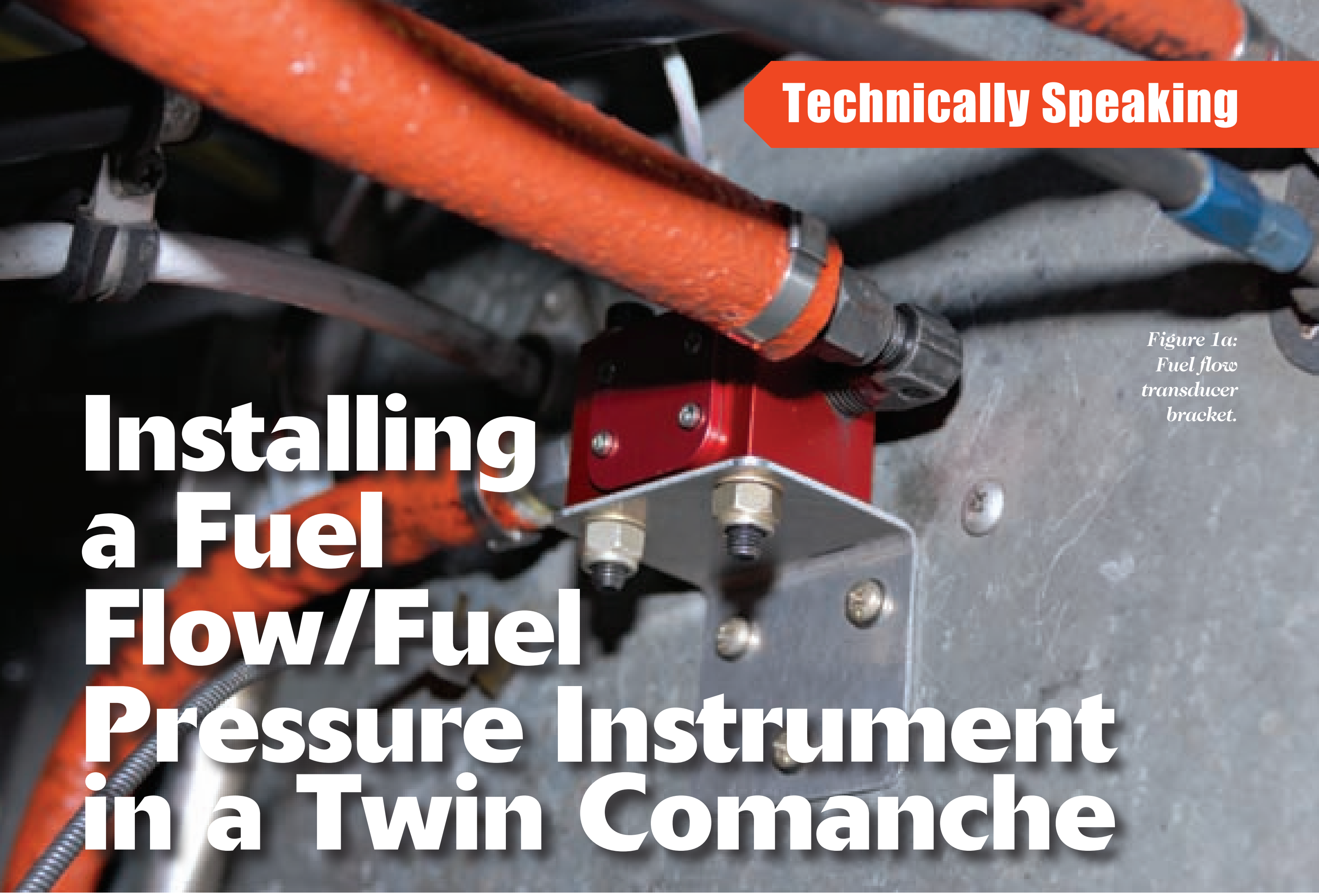

Figure 1a: Fuel flow transducer bracket.

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When I decided to install a fuel flow monitor system in my Twin Comanche, there were a number of decisions to be made. First, I had to choose either a single instrument with dual readouts or two separate instruments, i.e., one for each engine. To be sure, both systems have a separate fuel flow transducer for each power plant and thus measure their respective *rates* of fuel burn. However, the dual instrument only computes the combined total fuel used by both engines, whereas the single instrument will display the amount of fuel that has been used from each wing. The *fuel remaining* function *calculates* the amount of fuel unused from the last time you either reset the instrument to a user pre-programmed "full tanks" quantity, or entered some lesser amount of fuel added. But the instrument *does not directly measure* the fuel in the tanks and must be placarded as such. It is not to be regarded as a replacement for the fuel tank gauges.

Figure 1b: Top view of the transducer.

Figure 2: Routing for fuel lines in and out of the fuel flow transducer.

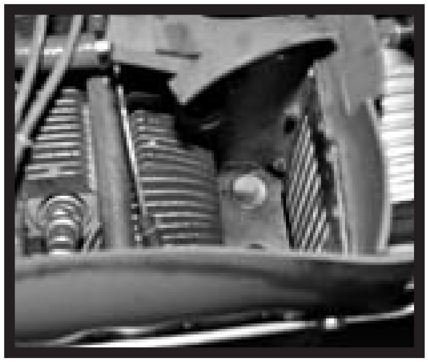

Figure 3 (left): Short fuel line with 45-degree adaptor and bulkhead union.
Figure 4 (right): Hole plug in shroud.

Another decision was whether to incorporate the fuel flow information into a graphic engine monitor such as the JPI EDM 760 or into a GPS. The fuel flow data from most modern instruments can be imported to a number of different GPS's, and likewise, many GEMs will interface with the popular fuel measuring systems. I spoke with the sales people at several companies, discussing what I wanted to do. One was downright unaccommodating when I told them I wanted to purchase two of their single instruments and put them into a twin. In the end, I elected to get two Electronics International FP-5L instruments. The "L" designates that the input from the transducer can be imported to a GPS to keep track of how much fuel is required to the destination. I do not plan to connect the FP-5Ls to my GEM, but will eventually connect them to my new GPS when it is installed.

If you elect to do as I did, make sure that the manufacturer knows that you are installing these instruments in a twin so that, if the wiring is of a special type, they will prepare the proper length cables for your airplane. The cable that they normally sell with a single instrument is about eight-feet long and is more than enough for a single engine plane. For a twin, you will need two nearly 20-foot cables to reach out into the wings. Tech support at EI was most helpful and told me that their cable was "shop wire" (unlike the special wiring with many GEM installations), and that I could make my own harnesses with some insulated 22g gauge aircraft grade wire such as MIL-W-22759/16. This was much less expensive than the $60 per side they would charge for 20-foot harnesses.

Next, I had to decide whether I wanted to remove the Piper dual fuel flow gauge, which is essentially a fuel pressure instrument that does an internal conversion to read out fuel flow in gallons per hour. In recent years my OEM gauge was getting less accurate, and I didn't want to spend a lot of money refurbishing that "old technology." When acquiring the EI fuel flow system, you can elect for either a *primary* or *secondary* instrument. With the primary instrument, you are sent not only a fuel flow transducer, but a fuel pressure transducer, as well. In replacing the Piper *fuel flow* gauge, you are, in reality, replacing a *fuel pressure* gauge; therefore to remove this primary instrument, you must use another fuel pressure gauge. Thus, the FP-5 *primary* series instruments (either with or without GPS capability) can legally replace your old fuel flow gauge.

Installation Decisions

The first decision was where to place the fuel flow transducers. The EI installation manual gives several suggested locations including a fabricated bracket on the engine firewall. Ideally the manufacturer would have you install the transducer between the engine driven fuel pump and the fuel servo or anywhere downstream from there. I have seen transducers installed on top of the engine near the fuel divider block, as well as further upstream on that same fuel line, but this often creates more problems than it solves. Unfortunately, the area at the bottom rear of the engine where much of the fuel system is located is very crowded and too close to the exhaust pipes. To put the transducer anywhere down in that area would mean having to wrap it in fire sleeve and suspend it by its hoses using Adel clamps, rather than mounting it on something solid.

To try to avoid those technical difficulties, I opted to make a small L-shaped bracket out of .063 thick 2024 T3 aluminum and mount it fairly high up on the firewall (see Figure 1a). After measuring, cutting, and bending the metal for the bracket, I drilled the two 0.25-inch diameter mounting holes for the transducer itself. Then using a #40 drill, I pre-drilled three holes in the other arm of the bracket for attaching it to the firewall. I made sure that the location on the firewall had no conflicting structure behind it, and that it was easy to reach to put on locknuts. I next marked the intended position of the bracket on the firewall with a pencil through the pre-drilled holes. I drilled the first hole from just the pencil mark and attached the bracket using a Cleco fastener. Then I was able to finish match-drilling the other two holes using the bracket as a template. Because of the lack of room, I used a 90-degree drill to make these holes. Once all three holes were completed, I enlarged them to accommodate the mounting screws. I used #8 screws to mount the bracket on the firewall and some ¼-inch cap screws to attach the transducer (see Figure 1b).

With this configuration, I could now run a flexible fuel line from the bottom of the fuel servo (see Figure 2) immediately aft and then up the firewall making gentle bends in the hose before swinging it to the left (with regard to the plane), and attaching it to the input side of the transducer. I inserted a steel 90-degree AN822-4-4 fitting on the output side to direct the outgoing fuel line forward to the rear of the "humpback." I drilled a hole in that structure and used an AN832-4 bulkhead union to couple the hose from the transducer to the hose that goes forward to the fuel divider block. This last connection was quite short, and there was concern that it might exceed the minimum bend radius for the fuel hose. However, this was not the case. In order to minimize curves in that fuel line, I replaced the straight fitting on the fuel divider block with a 45-degree fitting AN823-4. I initially considered making the bulkhead union a 45-degree adaptor also, but this was ruled out. It was too challenging to align the fitting correctly because one must first turn the fitting itself to attach it to the hose coming in from the transducer and then use it again to tighten the jam nut (see Figure 3). Since the original hose that went through a hole in the engine shroud at the bottom front of the oil cooler had been removed, I had to insert a plug in that opening (see Figure 4). A few strategically placed Adel clamps were used sparingly to keep the hoses from rubbing against other objects, keeping in mind that the purpose of *flexible* fuel lines is to be able to *flex*.

I found that I would have to fabricate three fuel hoses for each side in this installation. I purchased some Aeroquip 303-4 medium pressure fuel line from my local aircraft parts house. The short hose on top of the engine was approximately six inches in length, and the other two hoses were about 18 inches. Since the fittings required for this project can be somewhat expensive, I was fortunate that I was able to get most of them from Air Salvage of Dallas for just pennies on the dollar.

Naturally I had to run some wiring into the wings. At annual time, when the floor is out of the plane, is an ideal opportunity to accomplish this. Since I was also installing a graphic engine monitor, I was going to take out the old EGT system and its associated wiring. I used the double stranded EGT wire that I was removing to pull a piece of nylon cord through the wing root wiring conduit. Then I was able to attach all the wires I intended to pull for both systems at the same time. This proved to be much easier than expected, but I did spend some time preparing the end of the wiring bundle with tape to make it as streamlined as possible. A caveat: One end of the cable that you pull will have a factory-installed connector on it which goes to the instrument panel. Study the route that the other "bare" end of the cable will take as it leaves the panel and winds its way toward the wing root. Then make sure that you push this cable through all the grommeted openings in the sidewalls or flooring BEFORE attaching it to the nylon cord and pulling it through the wiring conduit into the engine nacelle. Once I had pulled the wiring into the nacelle compartment behind the firewall, I created a service loop in the wire. Next I drilled a hole in the top of the firewall, placed a rubber grommet in it, and fed the rest of the wire through that hole. After figuring out how much wire I would need to reach the connector on the transducer wire, I cut the wire and put on the connectors. Although the manufacturer supplied blade connectors for the wiring, I chose to employ Mate-n-Lock type connectors which are easy to plug/unplug and thus make it difficult to confuse the leads. I used these on both the fuel flow and fuel pressure transducer wiring.

The last major concern was where to place the fuel pressure transducers. According to EI, they can be attached to the existing 1/8-inch copper lines anywhere from the fuel divider blocks to near their former termination behind the instrument panel. I chose a convenient location on the firewall inside the nose compartment. I snipped the copper line just where it emerged from the cabin into the nose and then made a measurement to incorporate a loop in it just below its intended connection to the transducer. Using a tubing cutter and a 37-degree flaring tool, I prepared the end of the tubing, but not before placing a B nut over the end of the line. I then attached the transducer to the firewall with an Adel clamp (see Figure 5). By putting the transducer in the nose compartment, I sidestepped the necessity of having to pull any additional wires through the wing roots. Running the wiring from the transducer to behind the instrument panel proved easy because I used one of several pre-existing holes, made for other harnesses, in the firewall.

This suggested installation is not intended to be "the way," but rather "a way" to install a fuel flow/fuel pressure instrument in a Twin Comanche. During this project there was a moderate amount of engineering "on the fly." I consulted shamelessly with my IA hangar neighbor, Bob Lakey, and I got a very good idea from John Chestnut, another neighbor. Although the focus of the article is on the Twin, much of the information herein also applies to a single-engine Comanche.

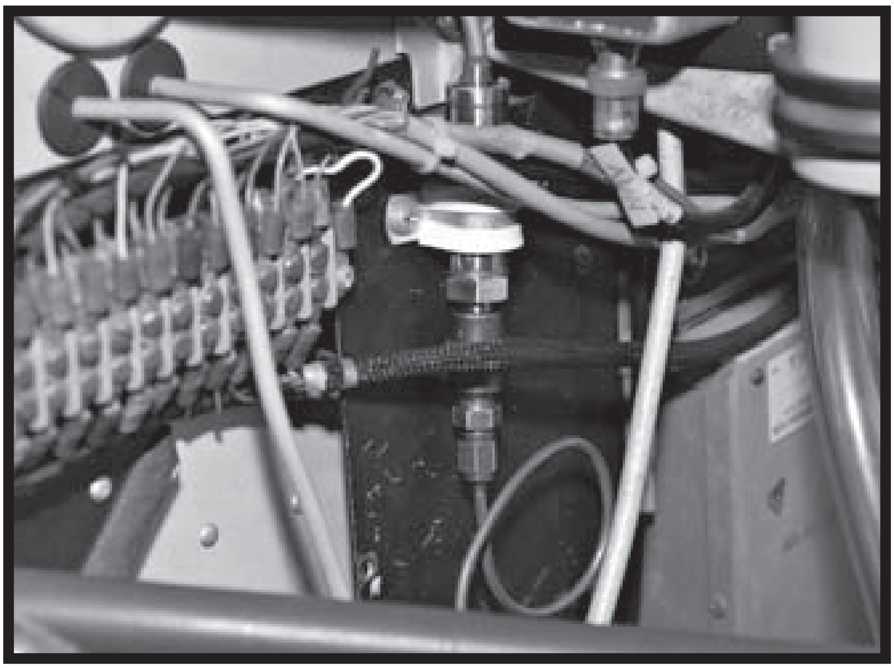

Figure 5: Fuel pressure transducer on nose compartment firewall.