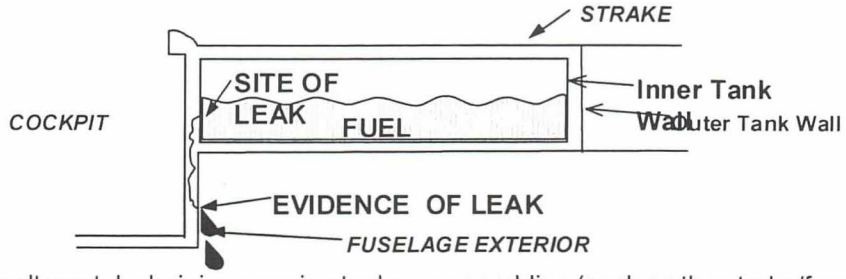
Finding and Repairing Fuel Leaks

Tom Staggs (WA) - When I first purchased my Long-EZ in 1990, the cockpit always had an odor of Avgas to it. The previous owner said that he didn't know where it came from but that there had been no sign of any leaks. What's the old saying? Ignorance is bliss.

About a year later, I started to notice a bluish stain on the right side of the nose on the outer skin of the plane. This stain was the color of the blue dye in 100LL fuel, and the stain definitely had the odor. I couldn't figure out was how fuel got there; there were no fuel lines in the vicinity and the nearest fuel tank was over four feet away. Where was the fuel coming from, and how would I stop it? The answers were "capillary flow" and "much more easily than the first methods I tried."



By alternately draining my wing tanks and changing positions on the fuel selector, I was able to confirm that the leak was somehow coming from the tanks in the strake, but I had no idea how. I spoke with several experienced EZ "old timers", as well as those who had tracked down similar problems in the past. The consensus seemed to be to drill a series of very small holes (#50) in the outer skin of the plane a couple of inches apart and "trace" the leak back to its origin. Believe it or not, I did this starting in the nose, where the leak was evident, and trying to trace it back along my fuselage. No one said I was the bright one in the family.....

About all I got from this method was a Swiss-cheese appearance to an otherwise pretty paint job. Each hole I drilled emitted a smell of 100LL; there didn't appear to be any pattern to the path of the leak.

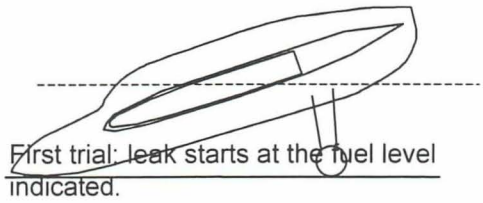
The next set of recommendations was to tear open the offending strake and re-seal them, a process that I wanted to avoid at all costs.

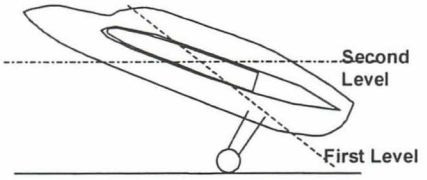
After thinking about the problem for a few months, I realized a couple of things about our planes and how they are constructed. First, our fuel tanks are effectively "double-hulled". In other words, fuel has to leak through two fiberglass barriers before we see it: the inner wall of the tank, and the skin (either inside the cockpit or the outer surface of the plane). Secondly, fuel can leak "uphill" through capillary flow, which is the property of liquids that they can migrate up very narrow tubes, much as in the same way that moisture flows up the trunk of a tree.
The fuel is able to leak through a wide range of places, from seams where you slurried two sheets of foam together to the joint between two major assemblies (such as the strake/fuselage joint). A path the diameter of a human hair, over time, can transport fuel to other places in the plane, creating the fuel odor and stain, not to mention a potential safety hazard due to fuel contamination of something that wasn't designed to have fuel in it.

The solution was simple (ever notice we never realize the simple solution until we have tried the hard one?). Find the inner leak and ignore the path of the leak once fuel escaped the inner wall of the tank, as long as fuel didn't come into contact with foam that would dissolve.

Finding the inner leak actually turns out to be quite easy, if somewhat time consuming. The concept is to gradually fill up the leaking tank until signs of the leak appear, regardless of where they appear. Once this occurs, draw a line along the fluid level of the tank. Drain the plane and set it in a different attitude (such as nose high versus nose low), and repeat the process. Where the two fluid levels intersect is where the inner leak (the one you need to fix) is located! By repeating the process a third time, you can eliminate the two solutions of where a leak is located (there are two intersections, one on the inboard wall of the tank, another on the outboard wall). The third level line will also diminish the error in your location of the leak.

Below are a couple of sketches that illustrate the point:



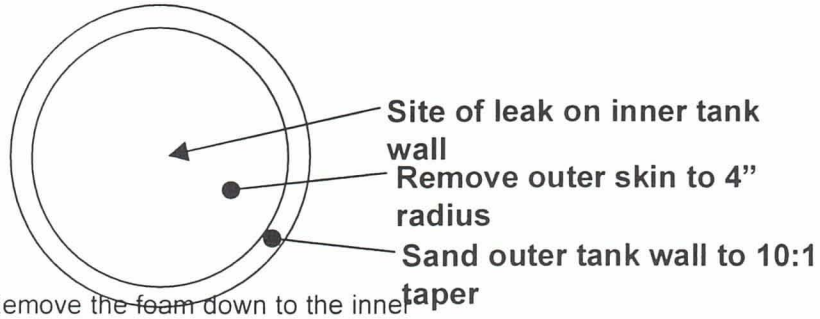


sect on the inner wall of the tank.

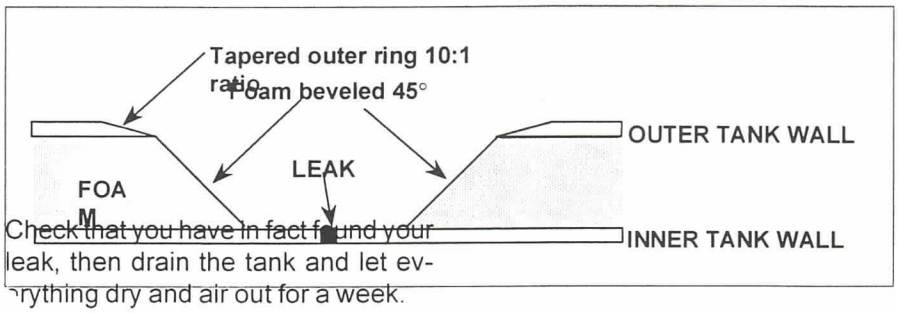
Once you find the leak, then what do you do? I have found that by carefully cutting through the outer skin over the point of the leak, then removing the intervening foam, I was able to first confirm the leak (fill it up to the level and watch fuel squirt through the hole), then repair it.

Danger Fuel vapors are an explosive mixture with air. Be very careful about sparks, including those in devices like drills and vacuum cleaners.

The repair process was simple:
Draw two circles on the outer skin with 4" and 5" radii centered on your assumed leak's position. Cut and remove the inner circle, then taper the glass in the 1"-wide band down to the underlying foam.



Remove the foam down to the inner fiberglass wall, leaving a 45° beveled edge to the foam.



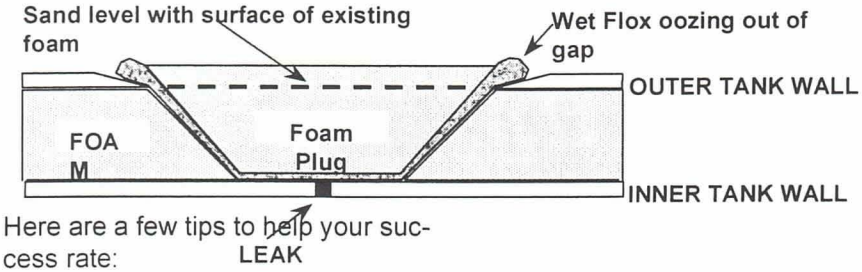
Check that you have in fact found your leak, then drain the tank and let everything dry and air out for a week.

Carefully sand the outer surface of the inner tank wall as smooth as possible (the better the job you did microing the foam when you made the tank, the harder this will be to do). Be careful not to sand through the inner wall, or you will be in a BIG mess.

Cut a foam plug that is slightly larger than the hole it will plug. Match the same 45° edges as the hole. Ensure that it is the same kind of foam as used in the original construction. For fuselage sides, 0.8" thick Dark Blue PV core was originally specified, while the surfaces of the strakes and baffles from Type 45R Rigid PV core.

Apply a wet slurry of flox to the entire inner surface of the repair area, then gently push the foam plug into the hole. Squeegee away the excess flox. Apply gentle pressure to the foam plug while allowing the repair to cure.

Sand the excess foam flush with the surrounding surface. Apply an appropriate number of layers of glass to the outer surface, feather sand the edges smooth, and re-finish. Enjoy your leak-free plane!



Here are a few tips to help your success rate:

Once you figure out which tank is the culprit, empty it and allow the tank and plane to air out for a week or two. This will make detecting the return of the leak that much easier, both through your sense of smell and by visual means.

The smaller the increment of fuel you add each time, the more accurate your locating the leak will be, as it represents a smaller rise in the fuel level. I've found that 2 gallons at a time works pretty well.

Be patient – allow enough time after adding fuel for the leak to reappear. In my case, it took about 4 hours for the fuel to migrate from the tank to where I could see it by the nose. Had it migrated all the way to the forward part of the nose, I would have had real problems, as the urethane foam would have dissolved if exposed to fuel.

The more extreme the differences in the plane's attitude between leak detection efforts, the more accurate your location of the leak. I jacked up the wheels to increase the nose-down attitude, as well as to achieve side-to-side angles.

Using water to find the leaks didn't seem to work as well as fuel. I believe their different surface tensions make it so that fuel is able to migrate more effectively through small capillaries.

If you are like me and had the "Explosafe" mesh in your tanks, you can use a variation on this process to open holes into your tanks through the baggage areas inside.

Information Needed

Bruce Hughes (WA) - Does anyone know details on the U.S. Army experimental project done at Fort Lewis, WA about 20 years ago using a Long-EZ to fly reconnaissance missions? Contact B.Hughes at 808-250-0939 or abrucehughes@yahoo.com or av8ryx@yelmtel.com

Alternator Noise
<Canard.Com>

Scott Derrick (NM) - Here's an article on alternator noise and how to troubleshoot it.
http://avionicswest.com/snap.html#Alternator%20Noise