Fuelling problems and solutions

After the last meeting I was asked by Keith Stevens how I pipe in my fuel tanks without pressure and short while ago another member asked about the filters I use. As there also seem to have been several recent fuelling related problems at the field I thought it may be useful if I describe my overall approach to fuel. It's certainly not the only way to approach this but, touch wood; it does seem to work most of the time.

Fuelling problems and dirt go together so what are we dealing with here? I measured one of my needle valves. The diameter tapered by 0.9 mm over a 6 mm length and the thread pitch was 0.5mm. At the pretty standard "2-turns out" setting the radial gap around the needle will be just 0.075mm or about '3 thou'. That's virtually as fine as a human hair, dirt bigger than this will begin to block the jet. It's worth remembering.

1) Old fuel

Fuel you buy is almost certainly pretty clean but I've heard that fuel that's been sitting for a long time can develop small transparent lumps of material. I don't know if this is true, I've never seen it, and I don't know what constitutes "old" in this case, but if you seem to have a fuelling problems and elderly fuel get some new stuff for starters.

2) Fuel handling

It's no good transferring fuel using a dirty funnel or pipe work. Make sure these are scrupulously clean. Wash and dry funnels before use but don't wipe them with a cloth that leaves bits small bits of material behind. If there's dust around the neck of any fuel container you're moving fuel from, or to, wipe it off before unscrewing the cap. If you're doing the transfer outside, watch out for dust raised by the wind.

3) Filling the model

Have somewhere on your flight box where the end of the filling pipe lives and only take it off when filling your model. Replace it immediately afterwards. Don't chuck the pipe on the ground. Even if it's off the ground, but open, just imagine how much dust etc. is being thrown into the air by another engine running near you.

4) What not to do

If you've a model that's been running ok and suddenly starts cutting out or behaving strangely then it's pointless to start wildly adjusting the needles to see if it fixes the problem. You just loose whatever working settings you had. If you have to remove, or open, a needle to clear possible dirt make sure you check first how many turns it's normally open and replace it near to that position.

5) Is the needle mechanically secure?

Needles usually have a ratchet, make sure this is positive. If the engine is mounted on a flexible (i.e. non-metal) mount make sure any engine vibration will not cause the needle to rub against its cowl access hole and wind itself open or closed in flight.

6) Flushing the jets

One way to clear a suspected blockage is to remove the main needle completely and fill the tank until fuel floods out of the carb for a few seconds. This may displace any dirt but the problem may reappear soon after if other dirt is still present in the tank.

7) To filter or not to filter ?

There are many opinions about where a filter can be placed in the fuel system and two extreme schools of thought are:

i) Filter everything at the outset i.e. make sure the fuel is filtered and is absolutely clean when it enters your flight box then there's no need to filter anywhere else.

ii) Filter only where the fuel enters the engine, then it doesn't matter how much dirt has got into the fuel as it's all going to be removed here anyway.

If only life were so simple. In the first case there are many ways dirt can get into the fuel after it's been put in the flight box and into the tank. Some are described above, others in the following. And filters in the fuel line to the engine can get blocked if not cleaned properly. The mesh of the gauzes typically used is often quite large compared to the dirt size mentioned above.

What I do is start by fitting a cheap car type *paper* filter (about 30mm dia, 40mm long, £1.88 or so from Ebay, cheaper by the dozen) in the flight box outlet pipe. The fuel then entering the tank is probably as clean as it can be. Then, if there is room I also fit a similar filter between the tank and the engine.

I rarely fit one of the small r/c type filters between the tank and the engine not because I think they do any harm but because I don't think they're really fine enough to trap all the dirt that can block the needle valve.

I do replace the filler pipe properly on the flight box when finished filling the tank.

8) Can filters cause rather than cure problems ?

Yes. For example, if you have a filter on the outlet of the flight box and you pick up dirt in the fuel tank (see later) then draining the tank by reversing the pump will draw this dirt into the tank side of the filter where it sits until you come to fly the next time when you immediately flush this dirt back into the tank.

9) Unexpected sources of dirt

If the fuel entering the tank is scrupulously clean where else can dirt come from? If we can solve that problem, or those problems, it would make things a lot easier.

Many years ago I noticed that later on in each flying session the engine would begin to act as if it was running rich, it would loose just a bit of power and smoke a bit more, but it wouldn't respond to leaning out on the needle, it would just tend to stop. The next day, after a good night's sleep, the engine was fine again.

Eventually (bit slow you know) I think I figured out what was happening. On each flight I would usually use most of the fuel in the tank, rarely all of it. I was using exhaust pressure and this, obviously, replaces the fuel used with exhaust gas. This gas contains not only products of combustion but exhaust residue such as drops of unburnt oil. Over a flight, as the fuel level falls, the oil concentration in the tank rises. Because the tank is not fully emptied on most flights, at the next refill the oil content in the tank is just that little bit higher both at the start and at the end of the flight. This trend continues with every flight, giving the appearance of a rich trend. The only thing that going home did was to ensure the tank was fully emptied and its oily contents transferred back into the flight box where the contribution of the oil was negligible.

The exhaust of an engine contains not just oil but tiny flecks of carbon. Strip any well used engine down and you'll see carbon. This builds up in the combustion chamber and tiny fragments are knocked or blown off all the time. Normally these just get blown out the exhaust but some will be carried into the tank as well, via the pressure pipe. They can be quite visible and were very apparent in the tank of a member who was having problems recently. These, too, will build up over a number of flights but, unlike the oil, they are likely to remain in the bottom of tank even after emptying.

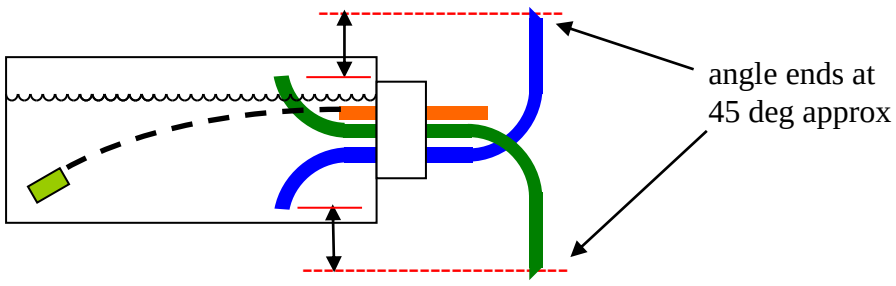
So I stopped using pressure a long time ago and these problems seemed to disappear.

10) Life without pressure

Model engines don't need exhaust pressure to run, they ran for about 50 years before silencers became common and, in fact, pressure can actually be detrimental to throttle response. The tank takes a time to vent or fill via the pipe in response to a change in throttle so fuel flow changes lag throttle changes. This makes the mixture go lean as the throttle is opened and rich when it is closed, not a desirable effect. Few engine manufacturers acknowledge this, Neil Tidy of Laser Engines being one exception.

A typical tank installation consists of a clunk and two pipes angled upwards to the top of the tank. One is the pressure pipe, the other a filling pipe that is capped when the tank has been filled. Once in the air, no fuel can come out, apart from the engine feed, at any model attitude. Simply removing the pressure pipe from this setup will cause venting problems when inverted, causing the engine to run lean.

This can be prevented by adopting the tank layout shown below, familiar to those who did their apprenticeship on control line models.



The significant points are that the layout is symmetrical whether it's upright or inverted and that the external ends of the pipes finish above or below the max and min fuel levels, as shown by ------- , in order to prevent fuel outflow whilst stationary.

These ends must be chamfered as shown, or be bent to face forwards or, at least, have a piece of fuel tubing fitted with the end angled. This provides enough air pressure to prevent the fuel running out when the model is flying on its side.

The pipes supplied with commercial fuel tanks can usually be arranged in this manner by rotating the filler bung to raise or lower them. The external pipe work can, of course, be fuel tubing.

The above, on its own, will not solve problems due to dirt pumped into the tank from the flight box or filler pipe work but I believe that, used together with effective filters and good fuel-handling practice, it may solve many fuelling problems. It's easy to try.

Other factors

There are, of course, many other things apart from dirt that can cause, or give the appearance of, fuelling problems (e.g. carburetor, engine or exhaust mechanical problems, vibration, pipe work air and fuel leaks, engine rebuild errors, scrapings of fuel tubing, even a dicky glow plug) and these can drive a member to despair, but engines are relatively simple devices. If it was once working ok and now, suddenly, isn't then there will be a reason. Don't give up.

And, finally …….

I'll include a tale to show that you never really know all there is to know about fuel problems. I was flying one winter's day. Each flight the engine started fine and the model flew perfectly but, after a couple of minutes, it would hesitate and die. I'd land, check it, start it up and it would run perfectly but a couple of minutes into the next flight it would cut out, every time.

Eventually I spotted some strange tiny white specks in the fuel line. These turned out to be ice crystals. Methanol is hygroscopic (it literally attracts water) and the small amount dissolved was freezing out at the low temperatures. In the cold air the carburetor was very cold and the crystals were building up in the jet and causing the engine to stop. By the time I got to the plane, heat had soaked from the engine into the carb and melted the blockage and all was well, for the next couple of minutes anyway.

At the time the air temperature was about -15 deg C (I can't remember the year), way below the temperature at which normal carburetor icing occurs, so don't ignore your engine if it keeps stopping, it may just be trying to tell you something:
e.g. "Go Home you idiot!". I know I did.

John Corkill
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