Fuel for Thought

Running out of fuel is not only embarrassing, it is also potentially dangerous. **Richard Boswell** gives some advice to help you avoid the situation

I have a rule which I always follow. Whenever I read an incident report or hear a story about how a pilot got it wrong, I never ridicule, I never say "that could never happen to me". It's not only that behaviour such as this is tempting fate; it's also a fact that incident reports are published to give pilots the opportunity to learn from the experiences of others, not as a reason for smugness or mockery. However every time I read an incident report in which an aircraft lands prematurely because of lack of fuel I shake my head in amazement, especially those reports in which there are no other extenuating circumstances such as poor weather or a fuel leak. How do pilots let this happen, and more importantly how can you insure that it will never happen to you?

The view of the ministry

Now I am not anti-CAA. Indeed, some departments are run in a very efficient and friendly manner (well played the medics); however, I have been known to voice the odd criticism concerning the way certain other sections operate. But they appear as bemused as me by the fact that pilots can knowingly run out of fuel, and it is common knowledge that if a commercial pilot runs out of gas they will prosecute. This is one of the matters on which the men at the ministry and I do see eye to eye. But do not think that as a holder of a PPL you are immune from prosecution: there have been a few cases recently in which the CAA had wanted to take further action but the evidence had either been destroyed or sunk to the bottom of the sea.

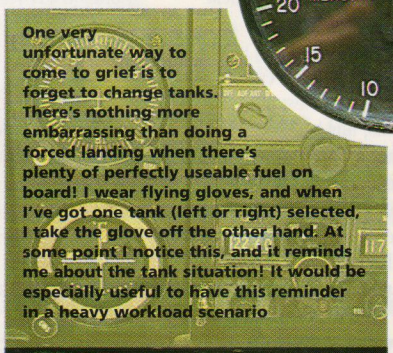
This is where I begin to diverge from my previous position of agreeing with the 'subsidised lunch club.' If some low experience pilots are prone to running out of fuel then we need to spend more time in educating them and less in punishing them. After all private pilots fly for fun. If the CAA exists to protect the public from pilots (it has stated this in two recent court cases) then prevention of incidents must make more sense than punishment after they have occurred.

Fuel policy and planning is a very big part of both military and commercial flying. The attitude in the military tends to be 'fill the tanks up and then operate the aircraft such that you can go as far, or for as long as possible, depending on the mission'. In this case a detailed knowledge of how much fuel you will be burning and how much further you can travel with that which is remaining is vitally important.

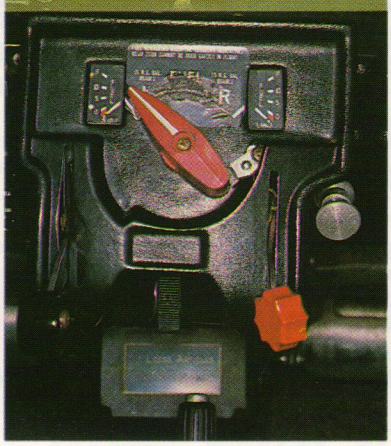
The commercial sector looks at it from a different angle: they know how far they have to go so the pilot accurately calculates how much fuel to take in order to ensure that the flight can be completed safely, leaving enough for a diversion and hold at the other end. Taking too much fuel means that the aircraft is being operated inefficiently and that's one of the reasons airlines go bust. Working close to minimum fuel all of the time it is important that the crew closely monitors the fuel burn and fuel remaining to ensure that there is enough gas left in the tanks to complete the flight and land with the minimum legal fuel.

Fuel policy

There are no laid down fuel policies for the private pilot to follow, so it is pretty much up to the individual to make his/her own decisions on how much gas to take. This is perhaps where the



One very unfortunate way to come to grief is to forget to change tanks. There's nothing more embarrassing than doing a forced landing when there's plenty of perfectly useable fuel on board! I wear flying gloves, and when I've got one tank (left or right) selected, I take the glove off the other hand. At some point I notice this, and it reminds me about the tank situation! It would be especially useful to have this reminder in a heavy workload scenario



problems start. No pilots will need telling that fuel gauges in light aircraft are notoriously inaccurate, or that the fuel burn figures quoted in the manuals are taken under the best possible circumstances and normally bear little resemblance to the figures actually realised in the dented club aeroplane with its 2,000 hour engine. But it goes further. It is difficult for the private pilot to gain an accurate weather picture, so it is difficult to know if the weather at your intended destination is suitable – or indeed how far away the nearest suitable diversion is. And I don't care what anyone says, Notams are not (or haven't been until now!) easily accessible to the private pilot. The private pilot is not playing on a level field. If no guidance is given to us on fuel calculations and policy, and if weather and Notams are not readily available then it suddenly becomes slightly clearer as to why some pilots find themselves running short of petrol.

So let's start by looking at how much fuel we will burn on a flight from A to B. To do this we need to know the track miles and wind, so that we can calculate how long the flight will take. Once this has been ascertained we then need to know how much our aircraft actually burns at the desired cruise level to calculate the 'trip fuel' for the cruise part of the trip. That's the easy bit. But we are also going to burn fuel in the climb and in the start up and taxi, so we will need to allow for that, and that's not forgetting a little for the descent and circuit, so the total amount of fuel that we expect to actually burn can be reasonably accurately calculated.

But how much do we need to take as a minimum? Obviously more than this, so we will need to add a little more as contingency fuel, giving us a little flexibility to manoeuvre around weather or cope with slightly stronger than expected winds – Boswell's Fifth Law of Aviation dictates that winds are only stronger than forecast when they are head winds. How much you should add on as an extra is debatable, but why not say 10% of the total of the above figures? After all, this is a nice easy number to calculate. But what happens if we get to the destination and find that an aircraft has broken down on the runway or that they have just fogged out? We need to ensure that there is enough gas in the tanks to fly somewhere else, so have a look on the map and actually nominate a diversion. Be sensible about this: don't pick the little grass strip next door which is too short for you to safely get and out of – and which will probably be fogged out as well.

At the other end of the scale don't glibly say that you will divert to Heathrow if the runway at White Waltham is blocked because, trust me, they will not let you in. Pick a diversion which is sensible and then calculate how much fuel you need to get there from your destination airfield. Add this

to your total and you now have a figure which is an absolute minimum. If you don't have this much fuel or more in the aircraft, don't make the trip: go and refuel.

It all sounds so simple. But how do we know how much fuel will be burnt in the climb, or what the fuel burn actually is during the cruise? The performance manuals will give you an idea but your aircraft will burn more, trust me. One idea is to add 10% to these figures and you will probably be pretty near the mark. Another idea is to work out some figures for yourself. Fill the tanks up to the gunnels, fly a decent trip and refill the tanks to ascertain exactly how much you have used. Compare this figure to the calculated book figures and see how they differ. I know that I am telling grandma how to suck eggs, but never trust the fuel gauges when trying to work out exactly how much fuel you have used: they do, and will, lie. As a little safety feature, dipping is always preferable to checking the gauges when looking at the fuel on board at the start of the flight. Whilst dipping is not possible on all types, it's rather like going flying itself: if you can, then do.

Never pass gas

'Never Pass Gas' was a slogan on a military flight safety poster which I remember from my flying training days. The message was simple: if you got the chance to get some fuel, take it. This is all very well for the military pilot who doesn't have to dip into his pocket and produce £20 in landing fees before paying for the fuel, but there is something in there for the private pilot. Taking the time to fill the tanks at your home airport may alleviate the need for an unnecessary stop somewhere else to prevent embarrassment – after all there is nothing more useless to a pilot in the air than Avgas on the ground. In addition, even though you may have round trip fuel, it might not be such a bad idea to consider filling the tanks up at your destination before starting the return flight. At least that gives you a few more options.

I realise that it is easy for me to sit in front of a keyboard and glibly say that you should always try and depart with full tanks, but we all know that life is never as simple as that. You may not be able to fill the old girl up without leaving one of your passengers behind; alternatively old Pat may not be prepared to come and refuel you until he has finished his lunch, and you have an important meeting to attend. So there will be times when you are departing on or near minimum fuel, and these are the situations when detailed calculations need to be made and the fuel closely monitored throughout the flight to ensure that you are not caught short.

Fuel monitoring

Modern airliners have very clever systems which monitor the fuel remaining and at the same time calculate how much fuel should have been burnt. If there is a discrepancy between these two figures then something is obviously awry, be it a fuel leak or a problem with the engine. It would be nice to fit one of these systems – they even tell you whether you have enough fuel to complete the journey and if so, how much gas you will land with – in every aircraft. But this is not possible – you could buy a new Cessna with the money it would cost to install.

Therefore we need to calculate a few figures ourselves to help with the mental gymnastics while airborne. I still use a system which was taught to me during my basic training: have a look at the route and select a few points at which you don't expect to be changing radio frequencies or looking for a turning point. Now calculate how much fuel you expect to have at the first of these points (simply the fuel that you started with minus the fuel that you estimate that you will have used), and the fuel that you will require to complete the journey from that point, leaving enough in reserve for the diversion. The fuel planner on page 35 will help you with this. Now annotate your chart with these figures at the point at which you are going to check the fuel.

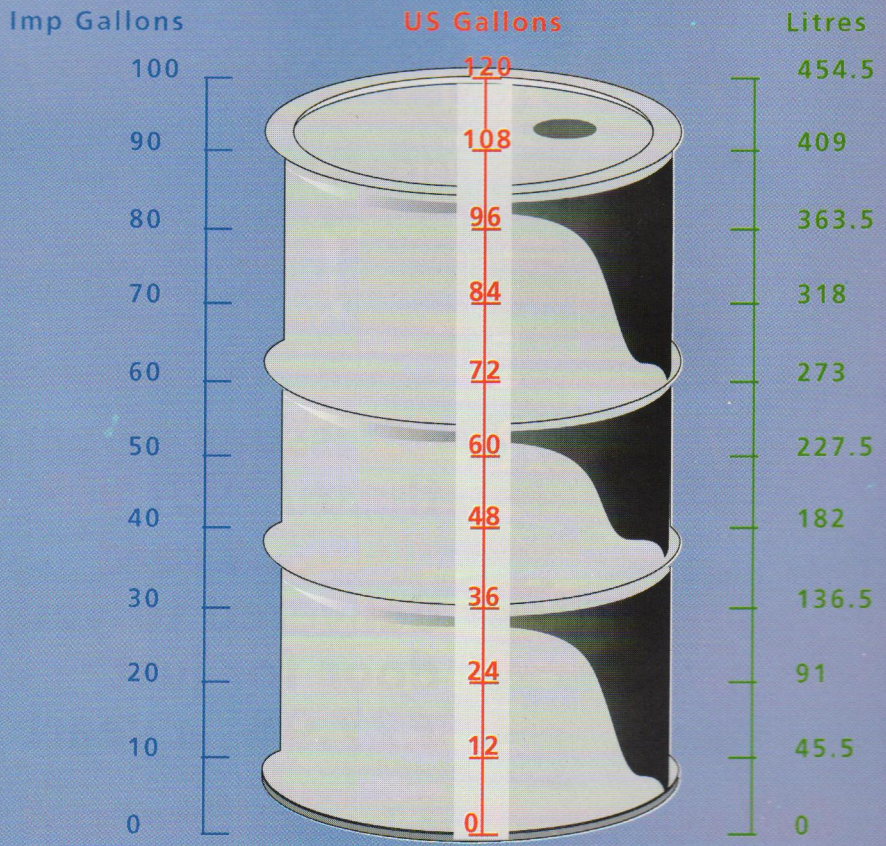
As you approach this first fuel check point note how much gas you have. If it's around the figure that you expected then no worries; if it's less than the figure that you calculated then there is still no problem as long as it's above the 'fuel required' figure, but this will awaken you at an early stage to a potential problem developing. The problem may be that the wind is a little stronger than expected, or the fuel gauge is a little inaccurate. However, there may be something more sinister developing: perhaps you do have a fuel leak or the wind is significantly stronger. If, at the next fuel check point the fuel on board is closer still to the fuel required figure, then now is the time to make an early decision to resolve the problem. If at any time you go below the fuel required figure than divert to a closer airfield at once.

Once you have used this system a couple of times you will quickly get a feel for how your aircraft is burning fuel and any problems will become glaringly apparent, and that's why I like it. It takes all of the "Have I got enough fuel to get there? – I will push on for a while and see" bad airmanship out of the equation.

Preaching to the Conversions

A problem which has occurred before, and will undoubtedly occur again, is that of pilots carefully working out how much fuel is required in one unit, and then filling up in another. The most publicised example of this type of mistake is that of an American registered Boeing 767: the pilots carefully worked out how many gallons of fuel they required to complete the trip and

A HANDY FUEL QUANTITY CONVERSION CHART



Conversion Factor: 1 Litre = 0.21997 Imp Gallon = 0.26417 US Gallon
1 Imp Gallon = 4.5460 Litre = 1.20093 US Gallon
1 US Gallon = 3.78541 Litre = 0.83269 Imp Gallon

then used this figure to fill up in litres. Not surprisingly they ran out of fuel (although they did manage to save a little face when they recovered the potentially catastrophic situation by executing a perfect glide approach into a disused military airfield when both engines flamed out).

But let us not mock: it is not surprising that errors such as these occur when you work out the fuel required in gallons, the aircraft fuel system is calibrated in tonnes and the fuel is uplifted in litres. The bottom line for the GA pilot is to make sure that you know what units you are working in, and fortunately most aircraft that you will fly on a PPL are likely to have the fuel calibrated in terms of volume – gallons or litres – so there are no complex calculations involving specific gravity of fuel. To help you convert from one unit to another, use the conversion table on page 33; place it in the front of you logbook for easy access.

Most of us, most of the time, will not have to get to excited about detailed fuel planning. A quick jaunt around the local area does not require anything more complicated than a check to see how much fuel you have on board and then keeping a weather eye on the gauge whilst airborne to ensure that you have enough remaining to get you home safely. However, when flying cross country you are trying to get the most out of your aircraft, so you really do need to look at the fuel equation in a little more detail.

Once you are used to doing this it takes only a matter of minutes to complete the fuel planning. Not only is it good airmanship, but flying is so much more enjoyable if you do not have to spend the whole trip worrying whether you have enough fuel to get there. ◆

THE *FLYER* FLIGHT AND FUEL PLANNER

As a useful aid to flight planning, cut out the '*FLYER* Planner', photocopy it and keep a few copies on your kneeboard. The planner should be completed as follows:

1 Start off by using the matrix on the right hand side to calculate your heading and time for each leg, including the diversion

2 From these figures work out the fuel that you are expecting to use for each leg and annotate these figures in the 'Fuel used' boxes

3 Add up the 'Fuel used' figures to calculate the 'Trip fuel'

4 Add the 'Trip fuel', contingency and extra totals (figures such as the minimum landing fuel plus extra fuel you expect to use in a long climb should be added here) to give a 'Total required' figure. Place this figure in the 'Fuel required' box for leg 1

5 Subtract the 'Fuel used' value from this figure and put the result in the next 'Fuel required' box, as shown by the arrow

6 Work down the page repeating the process, following the lines

7 Fill in the top 'Fuel on board' box with your actual start up fuel. Check that it is greater than the 'Total required' figure

8 Work down the page subtracting the 'Fuel used' figures

9 For the start of each leg you now have an expected 'Fuel on board' figure and a minimum 'Fuel required' to continue. If necessary, annotate these figures on your chart

FLYER Flight and Fuel Planner

Aircraft Reg	Trip wind	Weather - Departure	Arrival

Leg	Fuel on board		Fuel used		Fuel required	From	To	Dist	Trk	Hdg	GS	Time
1		minus		equals								
2		minus		equals								
3		minus		equals								
4		minus		equals								
5		minus		equals								
6		minus		equals								
7		minus		equals		Dest	Div					

Trip fuel +
10% cont +
Extra =
Total required

Agency	Frequency

Outward	Chocks on		Land	
	Chocks off		Airborne	
Return	Chocks on		Land	
	Chocks off		Airborne	