Instrument Pilot

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VFR navigation in the 21st century

By Jim Thorpe

CONTENTS

PPL/IR EUROPE

Most people decide to learn to fly with the idea that they will go places. At some point in the process, be it pre- or post-license issue, it starts to dawn on them that actually a light aircraft is pretty useless for getting from A to B even in VMC. Unsurprisingly a very large percentage let this hard won license lapse. There are a number of issues but the most fundamental is that the way we teach and implement VFR navigation was never very adequate and now is entirely unfit for purpose. Take a quote from one of the standard PPL navigation texts 'visual navigation is not a practical proposition in much less than 5km visibility unless you know the area well'. Does that sound promising when VFR is legal down to 1,500 metres.

Take one piece of ancient equipment which is to be admired, a CAA half-million chart. First we draw lines along the route we want to take. Then we draw five and 10 degree drift lines. Then we are taught a system which assumes that we will get well off track and then use a complicated method to calculate the magnitude of the error to enable us to reach our destination. We didn't want to get off track in the first place.

> *Visual navigation is not a practical proposition in much less than 5km visibility unless you know the area well*

In many areas of the UK we must not deviate from our track because of danger areas or controlled airspace. This largely inappropriate method is abandoned by 99% of pilots as soon as they leave the training environment.

In other countries simpler methods are taught which are known disparagingly in the UK as track crawling. Well track crawling works a lot better than our method

P 3 ►

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IP Editor required

David Bruford has retired after many years of sterling service and we are looking for a volunteer to take on the role. Please don't be put off taking on the job by thinking that great literary skills are needed. We have divided the tasks involved in producing our journal and the Editor's role is now one of coordination and gently chasing contributors to ensure that promised articles arrive on time. Of course if you want to write articles yourself that's fine but it's not a core task. Paul Turner produces the magazine and does the entire layout. Others deal with distribution. The Editor, helped by one or two regulars, carries out some basic proof reading and then sends the raw material to Paul.

Several contributors take responsibility for producing their own pages so a certain proportion of the 16,000 words each bimonthly issue needs is always in the bag. The Chairman or other committee members produce material on current issues of concern. That leaves space for three or four substantial ad hoc articles for each issue. The Editor keeps an overall eye on the content and if there is too much of a good thing in one month an article may be carried over. Sometime we have the opposite problem and the stock of articles looks a bit sparse. Here the Editor is expected to identify the lack in good time and encourage regular contributors to knock something out.

Of course if you want to get deeper into the role, any additional contribution to making our magazine even better is welcome but that's beyond the basic requirement. About three times a year the Editor attends committee meetings to represent the editorial team.

That's it then. A role that's interesting but which does not make too much of a demand on your time or require any special skills. Hey, I'm managing to do it this month so there is irrefutable proof no skills are needed. Please give me a call or email me.

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continued from page 1

so let's stop failing people in their flight tests for using it. In the IFR world RNP, Required Navigation Performance, is what defines capability. The VFR pilot needs to be in a known position plus or minus say one nautical mile and how they achieve this is secondary.

While we are discarding things which don't help us perform as required, consider the circular slide rule or whiz wheel. What encapsulates better both complexity and total irrelevance?

Everyone can agree that complexity and mental overload are the deadly enemies of pilot performance and enjoyment. Set Regional QNH, Set QFE to cross my MATZ. Why? No utility whatsoever. Get a local airfield QNH and leave it there. The rest of the world manages perfectly well with this system. You must speak to London information. Why? I don't want any information and they cannot possibly give me meaningful traffic information. There are very few locations in which all aircraft are talking to a single controller. It's just a distraction under the pretence that it enhances safety. In reality the main function of London Information is to enable people who are incompetent on the radio to practice and thus amuse or enrage the few pilots who actually do need something useful such as weather information or to open a flight plan.

I am extremely sympathetic to trainee pilots who find radio transmission (RT) a difficult skill to master. Indeed this carries over into IR training. I guess I was not alone in being terrified prior to copying and reading back my first real world airways clearance. RT is a skill which is just made to be taught on procedural simulators. Current RT training is very poor indeed. It should be taught properly on the ground and there is no reason this could not be done at reasonable cost.

GPS

OK let's get down to the biggie, GPS. This is how the real world navigates. It's not a supplementary method it's the number one, the numero uno, the primary means of navigation. You can plaster the boxes, the manuals and the instruction books with statements that contradict this. You can run safety evenings, you can shout from the rooftops that GPS should not be, but you are wasting your time. GPS is where it's at. It's the best thing since sliced bread. It's the greatest flight safety aid there has ever been. It's the single most important thing making purposeful enjoyable GA navigation possible.

Given it's new and so important we are of course training people to use this equipment. Well no. Are we enabling good VFR GPS units to be permanently installed in our aircraft at reasonable cost? Well no. What we are doing is preaching that overdependence on GPS is dangerous and the prime means of navigation is watch, map and compass. Well actually the watch map and compass is about as reliable as an ADF especially in inexperienced hands.

Do I hear the cry that we won the war using this method? My spry 87 year old father-in-law flew in Wellingtons and Mosquitos as a navigator. He had the great advantage of a desk to work on, lots of training from Her Majesty and a pilot to fly him. Of course there was the rather serious distraction of some people trying to shoot him down.

GPS is the greatest flight safety aid there has ever been

He cheerfully admits regularly to being lost. His generation worked on the principal that there were lots of airfields in the UK (assuming they were sure it was the UK, which was not always the case) so they just landed and asked where they were. I discussed this with a PPL/IR Europe colleague who flew jets for her majesty in the post war period. He explained that the training and techniques had moved on tremendously in the post war airforce. They got lost even quicker thanks to jet speeds and, having far less fuel endurance, they also landed anywhere they saw an airfield but did so speedily and with more panache. However, being better trained they never asked where they were. They avoided embarrassment by walking about looking purposeful until they saw the airfield name over the squadron office!

Training

The GPS is a fantastic piece of equipment and yes it can be misused. The answer is training. Consider flaps. One stage for take-off, three for landing is good. One stage for landing, three for take-off is very bad. Obviously we should never touch the flaps because they are dangerous. This would work as long as runways were always very, very long. An alternative strategy is to train pilots to understand the purpose of flaps so they understand the advantages and dangers. No one suggests that pilots should not use flaps so why do this with GPS. Actually that statement is not quite true. When flaps were first introduced they were regarded as a marketing negative implying a 'hot ship' which was too dangerous to fly flapless as nature intended. Maybe the Luddites have always been with us.

OK that's a lot of mostly negative stuff. What about some positive suggestions. What can we probably all agree on?

- GPS is very accurate.
- Airspace in Europe is complex and sometimes transit routes for GA are narrow.
- Complexity detracts from enjoyment and performance.
- Pilots generally want to get from A to B without being lost, scared or dead.

Should the circular slide rule finally be thrown on the fire?

Fixed routes

In the IFR world navigation is still largely by fixed routes. Someone did the thinking and on a chart laid out routings with details on radio procedures, safe altitudes and other useful information. Why cannot the basic method of VFR navigation be by published VFR or V routings? There is no suggestion that these routings would be compulsory. They are just routes which experienced pilots and planers have studied and decided will work. The legs are defined by waypoints which are to be found in the databases of the GPS.

In the pre-flight planning stage, let's keep it simple. We do need to draw the lines on a current chart because the standard route chart may not be updated with the same frequency. We probably do need to measure track distances and magnetic headings to give us a gross error check against the GPS but an alternative strategy would be to use flight planning software. Either method is fine. What we don't need are leg times or true headings. We do need some idea of the wind and the maximum drift likely for an aircraft with our cruising speed. We also need the total track miles for a simple nil-wind time en route/fuel required calculation.

That's it then we are ready to go. An idea that we may need to allow five or 10 degrees left or right for drift and a clear idea that this is a one hour nil-wind flight and we have two hours fuel or whatever. Most or even all this information can be written on the chart

so there is one less piece of paper to fall on the floor, but if you prefer a flight log that's up to you.

Before take-off, we load the first waypoint into the GPS and do a gross error check. We do make a very careful note of brakes-off and take-off times because fuel endurance matters and we won't be noting any other times. Many cross countries get off to a disastrous start on the first leg. What with the radio and airfield departure procedures, doing cockpit checks and messing with QNH settings the hapless pilot never really gets properly established on the first leg. An examiner friend of mine described a competent glider pilot doing a navigation flight test for a PPL conversion. Given their diversion they whipped out one of those combined protractor scale rule devices, calculated the track to the diversion superbly to the nearest degree and promptly took up the reciprocal heading. When you are throwing away the whiz wheel don't forget to add every item you were tempted into buying from the pilot catalogue gizmo section.

Now all we need to do after compliance with local procedures is turn onto a very approximate intercept heading for the initial track. Get sorted out in the cruise at the appropriate altitude and then establish from the GPS map if the intercept is working. If it's not working alter course a little till the aircraft symbol is on the magenta line. Then we fly the track or, if feeling smart, allow some drift but if not, just wait till the aircraft leaves the track and then turn as required. It's all pretty intuitive and if you cannot mange that then you probably should not be flying.

Example route

To make this a more real example imagine a short flight from somewhere in the Banbury area such as Hinton in the Hedges to say Thurrock east of London. From the V route chart we see that DCT Upper Heyford-HEN-BNN-BPK-VRP waypoint north of Gravesend.

Returning to our novice he is now approaching the first true V route waypoint, Upper Heyford. He turns onto the next track as given on the V chart. He might allow something for the wind but this is not vital. Then when settled down going roughly the right way at the correct level he punches direct to HEN into the GPS. Then he does a gross error check for bearing and distance and that's navigation dealt with. There is plenty of time to do en route FREDA checks but mainly he keeps his head out of the cockpit, cross checking map

Example v-routes marked on a half-mil map

to GPS to ground features and keeping a good look out. Actually map reading skills will improve more quickly because almost all the time the pilot is sure of what he is seeing and will learn what different sized towns, disused airfields etc really look like. Flying will be more accurate because he is relaxed and sure of his position. There is more time to remember and actually do proper cockpit checks.

Transponder and listening watch

Our hero remembers that V routes involve a system of squawking a defined code and requires him to maintain listening watch on a specified frequency. This is a 'transponder required' leg so he dials up 1234 mode C and selects the appropriate regional London Information frequency on box 1. If Luton radar needs to speak to him they can communicate via London Information.

There is very little radio traffic because no one needs to speak except when they actually want some information

So far the pilot has spoken to no one on the radio since leaving Hinton. At HEN it's the same procedure for the leg to BNN but keeping aware that he needs to be sharp as it's a short leg and very close to Luton. He maintains an altitude of 2,300 ft on the London QNH which was obtained by listening in to another aircraft speaking to London Information. 2,300 ft is the advisory level for this leg and direction. Pilots are aware that this level separation is not perfect but understand that they are VFR. Look out and traffic avoidance is their responsibility. There is very little radio traffic because no one now needs to speak to London Information except when they actually want some information. What a revolutionary concept!

Past BPK he knows from the warning on the V chart that he needs to look out for Stapleford traffic. He won't call them because he has been taught that this would be additional work, unproductive and potentially distracting. This stress free and efficient flight is nearly over. He selects Thurrock radio on box 2 but maintains his squawk and listening watch. At the last VRP he squawks 7000, selects DCT Thurrock on the GPS, selects box 2 and calls Thurrock on their frequency for joining information. Sadly the GPS will be no help whatsoever in delivering a good landing.

Collision risks

Of course no system is perfect. The available airspace is effectively only 500 ft as GA traffic is squeezed between Air Traffic Zones and the lowest TMA levels. If everyone is navigating known routes perfectly accurately there is a tiny additional collision risk. It has been suggested that flying slightly off track helps. I feel this is an additional complication and will be dealt with anyway by what the CAA refers to as Flight Technical Error (FTE), which we know as sloppy flying. One might be reassured to think that the greatest collision risk through aircraft following the same track is on a final approach to land and no one suggests we should all land in random directions.

GPS failures

What if the GPS fails? I have about 2,000 flight hours and have had four engine failures. I would guess that about 1,200 of those hours have been behind a GPS and I have never had a sustained GPS failure other than those brought about by the aircraft electrical system failing which has happened twice. We need to teach GPS failure procedure in the same way we teach forced landings. Something to know about and practice but not something we expect to happen regularly. The V route guide gives suggestions on actions in the event of loss of GPS. This is location dependent and might involve an immediate radar service, the use of other radio aids if pilot skills allow, or adopting a heading to a really major line feature. Basic training and testing would involve some navigation exercises without the use of GPS. GPS failure would be an emergency procedure albeit a minor emergency in most circumstances.

To summarise then a much simplified navigation system using GPS and standard routes should be adopted. This would be well taught in basic training and because it actually worked would still be used after qualifying. This would make flying more useful and enjoyable. It would significantly reduce controlled airspace infringements and encourage pilots to continue flying. Of course they would then discover that poor weather demands an instrument qualification but that's another story.

Self-flown GA IFR transport in Europe: a User's Guide Part 1 of 4

By Vasa Babic

Figure 1

Vasa Babic presents the first of a four-part series on self-flown GA IFR transport in Europe

Much of the time and effort we put into GA IFR is ultimately about transport; being able to go places more safely and reliably than under VFR, faster than by surface transport and more flexibly than airline schedules permit. During the last year, my GA flying met two distinct, travel-related criteria for the first time:

- A relatively large number of sectors (50) were flown to meet personal or business transport requirements which determined the destination and timing. These were mostly routes from the south of England to major European international airports, where the only alternative to flying myself would have been airline travel or a business charter. The 50 sectors do not include training and currency flights, short trips between smaller GA airfields or travel where a major part of the purpose was flying rather than getting there (e.g. a cross-channel lunch in France, or a touring trip across Europe).
- All of my European air travel was self-flown; the only airline flights I took were long-haul ones.

This article summarises my experience over these 50 sectors; to review how effective GA was as a mode of transport, and to provide elements of a "how-to-guide" for the less experienced IFR pilot.

The aircraft used was a Cessna 421C, a six to eight seat pressurised piston twin with known-ice certification.

The 50 sectors were flown between the aircraft's base at Bournemouth [EGHH] and 20 different destinations (a few were repeated). Three sectors were fuel stops, so the total was 47 actual point-point legs; a few of the trips involved multiple legs to more than one destination. Statistically, I've treated them as 25 simple round trips.

The mix of personal and business travel was about half and half. In almost every case, there was little or no time flexibility in the schedule (e.g. I needed to arrive outbound on a given evening and return home the next evening).

In Figure 1, the average flight time and airways distance are estimates based on logged time minus 0.1 hours, and great circle distance plus 10%. The average block speed of 188kts was achieved with typical true airspeeds of 150kts in the climb, 205kts cruise and 220kts in the descent. Cruise levels were FL140-170 below 400nm and FL180-240 above.

The distances flown were fairly evenly distributed from 100nm to 1,000nm. There is a small distortion in Figure 2, because six of the points in the 400-600nm range represent three legs of approximately 1,000nm in which a fuel stop was made.

Destinations		Month	No. of sectors
LYBE	Belgrade	Jan	0
LEBL	Barcelona	Feb	2
EGSC	Cambridge	Mar	3
LFMD	Cannes	Apr	13
EGNC	Carlisle	May	6
EGPN	Dundee	Jun	7
LSGG	Geneva	Jul	7
EGPF	Glasgow	Aug	5
EFHF	Helsinki	Sep	0
LEIB	Ibiza	Oct	0
EGJJ	Jersey	Nov	4
LFPB	Le Bourget	Dec	3
LPPT	Lisbon		
LEMH	Menorca		
ENGM	Oslo		
LEPA	Palma		
LIRZ	Perugia		
EHAM	Schiphol		
LFTZ	St Tropez		
LSZH	Zurich		

Summary

Sectors	50
Average Airborne time	2.5hrs
Average Airways distance	470nm
Average block speed	188kt

P 6 ▶

Overall Reliability - How practical was it to plan on going places by GA IFR?

I think Figure 3 is one of the most interesting results from this set of data. It shows that of 50 IFR sectors, only one was subject to a major delay and a further six were delayed one to three hours. 43 sectors (86%) arrived within 30 minutes of my planned time.

I'll describe the delays in some detail, to illustrate the kind of issues than can arise.

Weather

Sector five was a return flight from Cannes [LFMD] to Bournemouth, departing late afternoon. There was a forecast band of thunderstorms running across southern France, and I planned to try and find a way through using weather radar and stormscope. This did not prove possible; I gave up and returned to Cannes after about 30 minutes outbound and completed the flight the next morning. Half a business day was lost as a result; the alternative would have been to take an evening airline flight from Nice to London and to recover the aircraft later.

Sector 43 involved a two-hour delay returning from La Mole-St Tropez [LFTZ] on a bank holiday Monday. The airport has a wind limit of 15kts (due to terrain-induced wind shear) and the wind was above limits for almost all of the day. We were able to depart during a brief lull in the late afternoon, because four passengers and I had waited at the airport ready to go; few other aircraft left that day.

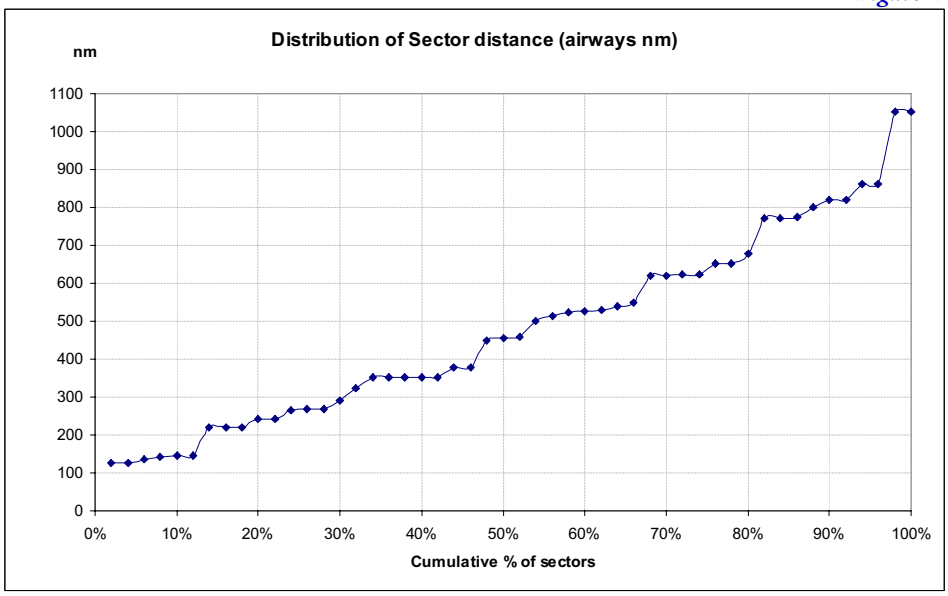
ATC

Sector three was a departure from Perugia [LIRZ] in Umbria, about 150 km north-west of Rome. Some slow airport bureaucracy when paying for fuel and landing fees and slot times led to a one-hour delay. In general, I received remarkably few airway slot times (never more than a 30 minute delay) and no en-route or arrival delays. I only flew holds once, for about ten minutes, when I arrived at St Gallen whilst it was closed for lunch. Barcelona, Palma, Helsinki, Schiphol and Zurich were the destinations requiring airport slots, but I used commercial handlers in each case, and they managed the process so that I never experienced any arrival or departure time restriction.

Ground Delay

The two hour delay at Belgrade (LYBE) was because paying fees, flight planning, fuelling and de-icing was a convoluted process involving two escorted trips through main terminal security and to and from the aircraft (a dedicated GA terminal opened at Belgrade a few months later and this process is now fast and convenient). All the remaining ground delays were Avgas supply-related.

Figure 2



Of 50 IFR sectors, only one was subject to a major delay and a further six were delayed one to three hours

The 1.5 hours delay in Sector 32 was due to repositioning from Helsinki Vantaa [EFHK], the main commercial airport which did not have Avgas, to the nearby Helsinki Malmi [EFHF] the GA airport which did, but was closed at the time I arrived the previous day. The two hour delay in Sector 33 was because I had to stop for fuel at Lelystad [EHLE] on an Oslo [ENGM] to Bournemouth leg. Despite confirming the availability of Avgas at Oslo, the bowser ran dry whilst I was fuelling, and no delivery was available for several days. The Sector 50 delay was Palma de Majorca at a peak Sunday afternoon time for airline departures, when the sole Avgas supplier was too busy to serve the GA apron for a couple of hours.

Maintenance

There were no maintenance-related cancellations or delays, or periods when the aircraft was unavailable other than a three week annual inspection. The interim 50 hour inspections and ad-hoc defect work were conducted between planned flights.

I'll discuss each of these factors in more detail below, but, overall, I think the statistics are representative of what is achievable in this kind of operation. I think it was a good year for weather and maintenance, offset by some delays (Belgrade, Palma, and Perugia) that were down to inexperience and which I could avoid in the future.

The IMC experience

The following is a summary of weather-related statistics for the 50 sectors, they are my estimates based on memory and logbook records of instrument flight time.

Flight in IMC

I found it quite surprising how little actual IMC was encountered:

- 12% of the flight time took place in IMC (i.e. an average of eighteen minutes per 2.5 hour sector).
- Only six sectors (12%) had more than 30 minutes in IMC.

The 50 sectors were somewhat concentrated in Spring/Summer (see Figure 1), but the worst weather encountered, by far, were thunderstorms over the French Alps in summer and frontal weather in the UK this June.

Instrument Approaches

Every sector terminated at an airport with a published instrument approach procedure, however most approaches were flown entirely in VMC:

- Seventeen out of 50 (34%) encountered IMC beyond the initial approach fix.
- Eight of these (12%) involved a ceiling below 1,000 ft.

Figure 3. Experience of delays relative to planned departure and arrival time

Sector	WX	ATC	Grnd	Sector	WX	ATC	Grnd	Sector	WX	ATC	Grnd
1	None	None	None	17	None	None	2hr	34	None	None	None
2	None	None	None	18	None	None	None	35	None	None	None
3	None	0.5hr	0.5hr	19	None	None	None	36	None	None	None
4	None	None	None	20	None	None	None	37	None	None	None
5	12hrs	None	None	21	None	None	None	38	None	None	None
6	None	None	None	22	None	None	None	39	None	None	None
7	None	None	None	23	None	None	None	40	None	None	None
8	None	None	None	24	None	None	None	41	None	None	None
9	None	None	None	25	None	None	None	42	None	None	None
10	None	None	None	26	None	None	None	43	2hrs	None	None
11	None	None	None	27	None	None	None	44	None	None	None
12	None	None	None	28	None	None	None	45	None	None	None
13	None	None	None	29	None	None	None	46	None	None	None
14	None	None	None	30	None	None	None	47	None	None	None
15	None	None	None	31	None	None	None	48	None	None	None
16	None	None	None	32	None	None	1.5hr	49	None	None	None
				33	None	None	2hr	50	None	None	3hr

- Two of these (4%) involved a ceiling below 500 ft.

None of the 50 sectors resulted in a missed approach or diversion, and only one required changing a planned destination because of forecast weather – this was a fuel stop that made no difference to the overall journey. In fact, one period of several months involved my flying so little actual IMC (and no "real" approaches) that I chose to do a day of FNPT2 simulator training to keep current.

Icing

Even given the fairly low incidence of IMC, surprisingly little ice was encountered:

- 25 sectors (50%) involved some flight in visible moisture at an OAT of +5°C or less.
- Twelve sectors (24%) resulted in some visible traces of airframe ice.
- Six sectors (12%) resulted in ice that could be heard impacting the fuselage from the prop-deice, and the un-heated P2 windshield becoming iced over.
- No sectors required activation of the surface de-ice boots.

Since almost all the cruise flight was above FL160, only a small fraction of the lower level en-route weather was encountered, during the climb and descent. At these cruise levels, icing did seem fairly "binary": it was either trace icing which could be managed indefinitely using only pitot heat and prop deice, or, on a few occasions, rapid icing near a CB which needed immediate avoidance.

Turbulence

No significant turbulence was encountered, except momentarily during storm avoidance. Most of the 12% of flight time that took place in IMC was 'averagely bumpy'; OK for a typical passenger, but enough to worry an anxious one. A couple of sectors experienced ten to twenty minutes of light clear air turbulence. The departure from La Mole, in winds just below the airport limit, encountered enough wind shear to firmly convince me that the limit was not an overly conservative one.

Storms

A significant minority of flights had some form of CB forecast or probable along the route, but I estimate that:

- Only five sectors (10%) required an ATC deviation for weather avoidance, four in the cruise and one in the approach phase.
- For two of these, the avoidance was in VMC.
- For another two, the avoidance was in IMC and based entirely on radar and stormscope data.
- In the final case, avoidance was not possible, and a return to the departure airport was made.

Most of these cases involved entering some bumpy but not hazardous conditions. There were a few other occasions in which I requested non-essential avoidance to make the flight smoother, but would have been prepared to fly through the weather if necessary. ATC are unfailingly helpful in these situations. I think it is fair to distinguish between essential and preferred avoidance when making a request; and to avoid the latter in a busy zone. CB tops are routinely above FL300 and sometimes above FL400. The altitude capability of an advanced piston aircraft like the 421C does not get you over CBs, but it does sometimes make avoidance easier, if you can climb above the layer CBs are embedded in and steer around them visually.

Night flight

All the night flying (one hour after sunset to one hour before sunrise) took place from November to March. Of the total 50 sectors and 125 hours:

- Night flight time was fourteen hours (11%) over nine sectors (14%), of which four (8%) where wholly at night.
- Most of the night sectors encountered ten to twenty minutes IMC, one 1.5 hour sector was wholly in IMC.

Of the thirteen sectors and 25 hours during November to March:

- 56% of hours, 30% of take-offs and 70% of landings were at night.

To regain currency prior to the first of these night sectors (with four passengers), I found it useful to do a short solo night IFR trip to Jersey and back, so that I practised cruise flight and two ILS approaches at night, rather than just the 3 full stop landings required. A few brief circuits would not have let me properly check all the aircraft, cabin and panel lighting or get fully comfortable with the aircraft at night.

Weather planning

The WAFC/ICAO FL100-450 Europe Sig Wx chart, Spot Wind charts and TAFs are all that I found necessary for weather planning. No adverse, unforecast weather was encountered. As mentioned above, one fuel stop did require a diversion, and one trip diverted back to its origin due to thunderstorms. Both these outcomes were predicted by the forecasts used.

- Sig Wx Charts generally proved very accurate in terms of regional patterns

P 8 ▶

The future of the IR and IMC ratings

Update from Jim Thorpe

EASA is in the process of taking over pilot licensing from the National Airworthiness Authorities (NAA) and this will ultimately determine the future of the IR and IMC ratings. First we need a little historical background. The basic standards for most licenses are set by ICAO. These represent an agreed minimum standard and any ICAO state issuing a license which meets these criteria can, in theory at least, expect worldwide acceptance. Over time NAA's adopted their own criteria usually adding requirements to the ICAO specification. Then the JAA tried to standardise licenses but did so on the basis of negotiated consent between countries. They had no legal authority and the predictable results were qualifications which incorporated many of the restrictive quirks of individual countries. Recent research would seem to indicate that the whole JAA process did little for safety but did a lot to complicate the lives of pilots making ratings and licenses more expensive and difficult to achieve.

Hence in our own specialisation the CAA IR became the JAA IR. Although one might question elements of the flight training the main issue is the theory content. This has a very large element of knowledge which relates to commercial operations rather than IFR operations. All this made the FAA IR with perhaps 20% of the JAA theory content more attractive with predictable outcomes in the relative uptakes of the two qualifications. The IMC rating falls outside the ICAO or JAA framework and is known as a sub-ICAO rating. It is regulated by the CAA and has no validity outside the UK.

EASA rationalisation

EASA is presently attempting to rationalise the whole range of pilot licenses. This covers a vast range from microlights and balloons to the full gamut of commercial licenses. Understandably, while not prohibiting national variations, they would prefer not to have them. There is therefore a process underway of reviewing all the national ratings with the intention of adopting them as European-wide licenses, adopting them as European-wide ratings or abandoning them altogether. The IMC has been considered in this way. The initial reaction, and I emphasise it is only an initial reaction, to a CAA proposal for European-wide acceptance was very negative.

We support keeping the standard of flight test equivalent to that required for a commercial pilot

PPL/IR Europe has for a considerable time been advocating the simplification of the JAA IR. A sub group consisting of Roger Dunn, Anthony Mollison and Vasa Babic have produced a long and detailed report. It is not my intention to even try to do justice to the document in this outline. There has been considerable acceptance of its suggestions by the CAA and there are hopes that these proposals will be adopted at the European level. Very briefly the aim is to have a much shorter theory syllabus clearly focussed on IR topics, a more flexible examination system for both theory and flight tests and less focus on compulsory training hours and more on students demonstrating competence to their instructor and then confirming this competence by way of test or examination. We must emphases that we have no quarrel with the standard of the flight test and support keeping this as a rigorous exercise entirely equivalent to the test a commercial pilot takes for initial IR issue.

There is absolute agreement within the committee that this is excellent work. There are shades of opinion as to the likely final outcome. At the very best this simplified EASA IR could be quite close to an FAA IR in terms of accessibility and flexibility.

Another possibility is that while an EASA IR will emerge which is a significant and worthwhile improvement, vested interests will add a little here and there and generally impede it being truly equivalent to the FAA style IR. The end point will be complications which do not contribute to the quality and basic objective of the rating.

If there was an EASA IR which was as accessible as an FAA IR then it is probably fair to say that we see no role for the IMC. After all, the USA with the largest number

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Self-flown GA IFR transport

continued from page 7

of cloud and weather. Cloud tops were occasionally understated. The icing and turbulence forecasts are not specific enough to be meaningful. The key item I look for is forecasts of CBs.

- Spot Wind Charts were broadly accurate, and I found long sector flight times could be planned with 5% or better accuracy. The wind at individual points, observed by air data computer, varied a fair amount from the forecast (by 30 degrees and/or 30% of speed) but always seemed to even out over a sector.
- TAFs proved conservative much of the time, but actual conditions varied from "quite a lot better" to "slightly worse" than forecast. I follow the FAA rules for destination and alternate weather planning, and find them efficient and safe in practice.

I spend no more than a few minutes weather planning for >90% of trips. For a morning flight, I check 24 hour TAFs, Sig Wx and Spot Winds the night before, and then get the 9hr TAFs before departure. For an afternoon or evening flight, I do the first stage in the morning – the charts are available only twelve hours in advance. A large band of "FREQ" CBs on the Sig Wx forecast or TAFs below minima are the only potential "no go" items, since I have not found en-route ice or turbulence that are beyond the aircraft's legal and practical capabilities, except in CBs. Storms in Europe are usually "ISOL" or "OCLN" and thus adequately spaced for avoidance. I don't really use the various multi-day forecasts or websites, because I don't find they can predict the relatively rare "no-go" weather conditions with any useful specificity.

Continued in the next edition of Instrument Pilot

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of private pilots and by far the largest number holding instrument ratings has functioned well on this basis. If the EASA IR remains unnecessarily difficult to achieve then there may well be an argument for some lesser instrument qualification.

European licenses

We need a small aside here to explain the wider context of pilot licensing. There has been a movement to offer a simple European-wide pilot's license similar to the UK NPPL. At one stage EASA was suggesting that this license might be eligible to have ratings attached, one of which was a simple instrument qualification. Along the way, the nature of this basic Euro PPL, now known as the Light Aircraft Pilots License (LAPL), changed. The license structure now envisaged, although nothing like finalised or agreed, can be thought of as follows expressed in very simple terms as hours of required training.

- Basic Microlight, solo privileges, flight within a fixed radius of base, 10 hours.
- Full Microlight, unrestricted, 25 hours.
- Basic LAPL, restricted radius of base with one passenger, 15 hours.
- Full LAPL, unrestricted, maximum four-place, simple aircraft, 35 hours.
- JAA PPL, 45 hours.

The LAPL in this incarnation has much reduced training as compared with the JAA PPL. Obviously some parts of the current PPL syllabus must be omitted since experience indicates that most students need 45 hours to achieve the necessary JAA PPL competences. It is therefore hard to see how advanced ratings can be attached to a LAPL without additional core training which would in effect make it a JAA style PPL and hence defeating the object. Anyway this situation is still evolving but the concern PPL/IR Europe has is that any IMC style rating, particularly if attached to a licence which delivers fairly minimalist basic training is hardly likely to deliver competent instrument pilots.

UK IMC rating

It can be argued that the fifteen-hour IMC course in the UK has been a success. It is in fact hard to prove whether the IMC has been a boon or a curse. There has always been a contradiction. The CAA advice to IMC holders is not to use the privileges the licence grants for intentional IFR. They advocate its use as a "get-out-of-trouble" rating and indeed it seems likely that most IMC holders regard it in this way and have no intention of intentionally flying in IMC.

In the UK this issue has been sidestepped because IMC holders are not allowed into class A airspace and this is a useful way of separating them from most commercial traffic. However in a European context this tidy separation does not work because airspace classification differs so much between countries. There is elsewhere in Europe considerable opposition from airlines, pilots and others to a Euro IMC. These countries have no experience of such a qualification and see it as a threat to the safety of commercial air traffic.

If we consider the selfish viewpoint of existing holders of the full IR this debate is dangerous as it is not impossible that our own rights in controlled airspace could come into question. For example one easy way for our opponents to attack us is to suggest that only pilots holding a CPL should be allowed in controlled airspace. It is fair to say that within your committee there is a considerable divergence of opinion as to the degree of effort we should put into supporting the Euro IMC and indeed whether this is a good concept at all.

Australian example

For completeness I should also mention the Australian instrument rating system and the basic instrument flying module. The latter is likely to become part of the EASA IR. This is a course of about ten to fifteen hours which concentrates on radio navigation, basic instrument flying and an understanding of the IFR system. In the Australian context a similar basic module allows pilots to fly in IMC above the local safe altitude. It does not allow them to perform instrument approaches or fly in IMC below the safe altitude. In Australia, with better weather and more space, this enables pilots to file IFR but fly largely in VMC. Modules can be added over time and build up to a full Australian national IR which gives considerable credit towards a full ICAO IR. This system certainly has merit but it becomes hard in a European context to see how privileges could be expanded in any simple modular manner that was consistent between countries. It is really the same problem as transitioning the UK IMC into Europe.

The 'dream ticket' on which we could all agree would be as follows:

- A high quality EASA IR which is as attractive as the FAA IR is at present.
- A basic instrument flight module which counted towards an IR and allowed flight in IMC above the safe altitude in class G airspace but did not train for instrument approaches other than an emergency SRA.
- The ability to convert an FAA IR to an EASA IR on the basis of a test in Air law and spoken English plus possibly some minimum total flight time criteria.

This would address the needs of the majority of IMC holders who just want to fly VFR in poor visibility and have some skills to deal with emergencies. It would bring the flying schools onside as they would have an attractive post PPL module to teach. It would have a useful role in improving navigation competence and use of GPS. Anyone wanting to fly serious IFR would have an appropriate and achievable qualification which could stand up to hostile scrutiny from commercial air transport interests.

The more difficult situation will arise if we end up with a much improved EASA IR which is still sufficiently complex as to discourage large scale take up. If some Euro IMC was then proposed or adopted the devil will be in the detail. Obviously we would want to become very involved in the consultation process. We will be faced with the difficult task of trying to help create something which is workable but does not expose us to the risk of inadequately trained pilots causing significant disruption to commercial air transport with all the potential threat that implies to the privileges we now have.

Please understand that this whole note is an oversimplified synopsis of a complex and fluid situation. At the time of writing there are meetings being held in Europe which may render some of the above redundant or incorrect.

Stop Press. Since writing the above a most important meeting was held between PPL/IR Europe committee members and senior EASA officials. A full report is on the website. While there were some very positive aspects with long-term potential, the short-term result is very poor. The IMC looks almost certain to go with strong opposition from almost every country other than the UK. The IR will not be simplified at all at the European level but the JAA IR will be adopted as is. This is not the fault of EASA but a result of strong lobbying by National Airworthiness Authorities, airlines and professional pilots who essentially didn't want anything in the JAA IR to change. The opportunity to create some simpler European instrument qualification was on the table but was sidelined by the representatives of GA in the EASA consultations. Their total focus was on light sport aviation and especially gliders, and wider GA interests were sidelined.

Oilternatives

to the internal combustion engine

By David Bruford

According to the Institute for the Analysis of Global Security, from now to 2020, world oil consumption will rise by about 60%. Transportation will be the fastest growing oil-consuming sector. By 2025, the number of cars will increase to well over 1.25 billion from approximately 700 million today. Global consumption of gasoline could double.

The two countries with the highest rate of growth in oil use are China and India, whose combined populations account for a third of humanity. In the next two decades, China's oil consumption is expected to grow at a rate of 7.5% per year and India's 5.5% (compared to a 1% growth for the industrialized countries). It will be strategically imperative for these countries to secure their access to oil.

Proved oil reserves are those quantities of oil that geological information indicates can be with reasonable certainty recovered in the future from known reservoirs. Of the trillion barrels currently estimated, 6% are in North America, 9% in Central and Latin America, 2% in Europe, 4% in Asia Pacific, 7% in Africa, and 6% in the Former Soviet Union. Today, 66% of global oil reserves are in the hands of Middle Eastern regimes: Saudi Arabia (25%), Iraq (11%), Iran (8%), UAE (9%), Kuwait (9%), and Libya (2%). Because reserves in non-Middle East countries are being depleted more rapidly than those of Middle East producers, their overall reserves-to-production ratio - an indicator of how long proven reserves would last at current production rates - is much lower (about 15 years for non-Middle East and 80 years for Middle East producers). If production continues at today's rate, many of the largest producers in 2002, such as Russia, Mexico, USA, Norway, China and Brazil will cease to be relevant players in the oil market in less than two decades. At that point, the Middle East will be the only major reservoir of abundant crude oil.

From now to 2020, world oil consumption will rise by about 60%

An obvious conclusion to draw from these statistics is that energy consumers must embark pre-emptively on a revolutionary change that will lead them away from oil dependency rather than drag their feet and suffer the ramifications of becoming growingly dependent on a diminishing resource. Unless an alternative power source for light aircraft is invented very rapidly, pilots are going to be grounded by a fuel shortage well before old age tells them that it's time to become surface based.

The oil alternatives

We can pretty much ignore batteries as a power source. Although we have nuclear power stations and enough coal to last the electricity generators for the next fifty-seven years, the existing battery technology does not offer an efficient enough power to weight ratio product. The world's first manned flight powered by regular dry-cell batteries took place north of Tokyo in July 2006 when the Panasonic and Tokyo Institute of Technology got together to pack 160 AA Oxyride batteries into an experimental aircraft. The aircraft and its 63kg pilot were aloft for one second shy of a minute, covering 391.4 metres at a height of 20 feet at Okegawa Airport in Saitama. This however was a super-lightweight experimental aircraft. What we need is technology that can be fitted into the existing GA fleet, much as diesel engines are now doing.

The world's first manned flight powered by regular dry-cell batteries

You might consider that it would be possible to take out the great lump of iron and aluminium from the front of a Cessna 172 and replace it with an electric motor and some conventional batteries but with present technology the amount of batteries required to produce just 50% of the required thrust/endurance power would make the aircraft overweight before it left the hangar.

Fuel cell technology

Designing the first fuel-cell manned intercity aircraft is the goal of a recently launched EU-funded project.
The Environmentally Friendly Inter City Aircraft powered by Fuel Cells (ENFICA-FC) project is receiving €2.9 million, two-thirds funding from the EU as part of the aeronautics and space priority of the Sixth Framework Programme (FP6).

The aircraft used for the Enfinca-FC project

The Polytechnic of Turin is leading the project, the goal of which is to develop an intercity aircraft that uses fuel cell technology for the propulsion system, and hydrogen storage. I hope this won't be another Galileo, it shouldn't be, but the aim of the project presents formidable challenges. "No other project funded by the European Commission promises such ambitious results," says the coordinator of the project, the Full Professor of Airplane Design and Aerospace Structures from the Turin Polytechnic University, Romeo Giulio. "hydrogen and fuel cell power technologies have now reached the point where they can be exploited to initiate a new era of propulsion systems for light aircraft and small commuter aircraft" according to Professor Giulio.

The fuel cell system will be installed in a light single engine aircraft, which will be flight and performance tested as a proof-of-concept for future applicability in inter-city aircraft.

Biofuels

Biofuels offer a good possibility for powering traditional fossil fuelled engines but are an absolute farce from an energy efficient aspect. Extracted from a briefing document on Abelard.org comes the statement that:

"The rush to make energy from vegetable oils is being driven in part by European Union laws requiring conventional fuels to be blended with bio fuels, and by subsidies equivalent to 20 pence a litre. In 2007 the British government announced a target for bio fuels to make up five per cent of transport fuels by 2010. The aim is to help meet Kyoto protocol targets for reducing greenhouse-gas emissions."

"Rising demand for green energy has led to a surge in the international price of palm oil, with potentially damaging consequences. The expansion of palm oil production is one of the leading causes of rainforest destruction in south-east Asia. It is one of the most environmentally damaging commodities on the planet," says Simon Counsell, director of the UK-based Rainforest Foundation. "The main alternative to palm oil is soybean oil. But Soya is the largest single cause of rainforest destruction in the Brazilian Amazon." Sugar cane is also an important bio fuel crop, especially in Brazil but the amount of power, from traditional sources, required to produce the final, usable, product, vastly outweighs the energy produced by the bio fuel itself.

But hell, if governments can ignore these facts, I'm sure a humble light aircraft operator can. So, the big question is; if bio fuel is going to be plentiful in 2050 and petrol/Avgas/Jet A1 non-existent, can we fill our wing tanks with it? Bio fuel is very similar to diesel so at least for diesel engined aircraft the process seems straightforward. Well, not quite.

The Development Centre (RAFDC) at Baylor University has concluded a programme sponsored by the Texas Alternative Fuels Council (TAFC), to test blends of renewable fuels such as biodiesel, ethanol and ETBE (an ethanol derived fuel that can be blended with gasoline). Two types of biodiesel fuel produced from different feedstocks were evaluated in the testing. One was derived from waste cooking oils, the other from rendering plant animal wastes. It was determined, by testing small bench samples, that both materials do splash blend with Jet A1 (and Avgas – but the study concentrated on jet fuel), whether as Biodiesel-into-jet or jet-into-biodiesel. At a mix of 70-30 with Jet A1 and biodiesel there was no discernable drop in performance. The study didn't conclude that diesel engines will run on 100% Biodiesel but it did demonstrate that technology is moving in the right direction. The old chestnut of a higher freezing point was also discounted. It appears that the presence of lighter, more volatile components tends to retard freeze point behaviour. Among the standard jet fuels, the so-called wide-cut fuels tend to have lower reported freeze points than do the (narrower-cut) kerosene-base fuels. Similarly, upon adding the volatile biodiesel blends, the character of freezing behaviour was substantially altered; the deposition freeze point was not only retarded, but also reduced to a trivial risk, and replaced by the much lower slush point behaviour.

The test rig used in the Baylor University study, complete with PT6A-6 turbine engine

There is another emissions benefit not directly assessed during this project; the carbon content of a biodiesel is not fossil carbon. It may be vegetable or animal, but it is surface biosphere carbon, not petroleum carbon, and therefore should not count against the global warming carbon emissions limits of the recent Kyoto Accords.

Other benefits appear to be of a pollution and unexpected maintenance benefit aspect. The soot trails deposited on the nacelle surface from the exhaust plumes were substantially reduced when operating on biodiesel blend. Of more interest to pilots of antique aircraft, as they will then be as fossil fuels expire, is the fact that the fuel bladders in nearly all piston and turbine aircraft today are made of Goodyear BTC-85 compound, which is rated for both gasoline and turbine fuels. Dry-out and hardening of rubber compounds is thought to be caused by a loss of "oily volatiles" due to surface evaporation or chemical extraction over time. Products purported to be "rejuvenators" (such as "Armor-All") act by temporarily restoring similar oily volatiles to the damaged surface. In aircraft fuel bladders, this dry out mechanism is the main failure mode for over-age materials: a dry brittle material is susceptible to cracking when flexed.

It appears that the neat biodiesels, and the biodiesel content in the blend fuels, may act on the BTC-85 material in the same way that commercial rejuvenators do. In short, it appears that biodiesel exposure may actually be good for aircraft fuel bladders. From a personal perspective I can assert that a lack of engine failures due to fuel starvation is certainly good for pilot's bladders.

P 12 ▶

GPS Approaches

Update on the current Position and future Developments

From Jim Thorpe

Members will be aware that some four years ago we applied for the first GPS approach in the UK at Gloucester. After some years of prodding the infamous GPS trials resulted. There was some dispute as to whether these trials were needed and in particular dismay that N-registered aircraft were excluded. Predictably there was very poor initial take up. PPL/IR Europe put its concerns behind it and was very active in encouraging members to participate.

Test results

77 pilots carried out 171 approaches. 85 were carried out at Gloucester, 37 at Shoreham, 22 at Exeter 15 at Blackpool, 11 at Durham and 1 at Inverness. I suspect that a very large percentage of these were PPL/ IR Europe members and others who we encouraged at Gloucester. The report

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Oilternatives to the internal combustion engine
continued from page 11

Nuclear power

A nuclear reactor engine that would provide the right amount of energy for a car or light aircraft could be built, produce the required power and require refuelling only every five or 10 years. The main drawback problem is that it would kill the pilot/driver, the passengers, and contaminate anyone that got too close. Nuclear reactors produce neutrons, which are very penetrating particles and cause radiation sickness if the exposure is substantial. Nuclear power reactors have several feet of concrete shielding between the active part of the reactor and the operators. A big enough vessel like an aircraft carrier or a submarine can afford the shielding. In the 1950s some thought that nuclear aircraft were feasible but all such projects have long since been abandoned.

Negative conclusions

So as technology presently exists there is no alternative to the engine technology first designed around 100 years ago. However, invention is often spurned on by necessity, as we approach a real time of oil shortage, heads will likely be pulled out of the sand and a miraculous alternative power source created. Until then we can reflect on some wonders of the past, the total denigration of cold fusion will be familiar to many but perhaps only our older readers will recall Josef Papp's Noble Gas Engine. It received a glowing write-up in a 1968 issue of the USA's Private Pilot magazine. Under the title of 'No Fuel Engine', Bob Said wrote "*A revolutionary engine that operates for 15 cents per hour without gasoline, air, combustion or exhaust may be near. Revolutionary developments have a way of creeping up on you in a technologically advanced society. This is the most technologically advanced society there ever was, and it may be that we have just been crept up on.*

How would you like an airplane engine of, say, 300-hp, weighing half as much as existing ones? What if it used no consumable fuel, and therefore required no fuel tanks, lines, pumps, carburettor or injection pump, intake valves, spark plugs, or exhaust system? What if it did not use air, and could operate at 30,000 feet - or 300 feet underwater - as efficiently as it did at sea level? What if it generated no heat, and therefore needed neither a water-cooling jacket nor air-cooling fins?

Such an engine may exist. I have seen it, and talked to the people who are developing it. The unit is in the earliest stages of prototype test, but if it turns out to do all the things their patent application says it will, it is bound to join the Wright Brothers and the turbine as one of the three greatest things to happen to aviation.

Consider this: with such an engine, every Aeronca, Cherokee, and Skyhawk in the land would have the range to fly non-stop to Europe, Hawaii or Japan. Or anywhere else, for that matter. Military patrol planes could stay aloft as long as the crew could hold out. You could "gas up" the family light plane once every 4 or 5 years. On a Skyhawk, for example, your takeoff weight might be as much as 500 pounds less than it is now, because you'd be lifting about half as much engine weight, no gasoline supply, no tanks, fuel accessories, etc. That would leave weight allowance for a couple of more passengers, and you'd still have unlimited range. Nobody would ever "run out of gas" again. The astonishing possibilities go on and on."

Strange that we have heard nothing of this engine since 1968. There was speculation that the big oil companies bought up the patents and buried the invention but it's more likely that it was a confidence trick that never paid off. Either way, whatever is invented to replace the combustion or jet engine will have to be as radical as Papp's claimed to be.

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from Imperial College was produced in the spring of this year. One surprise was that someone did a trial approach in a BAE146. It was not surprising to find that Garmin are top dogs and 76 % of all trials were carried out using some model of Garmin equipment. It emerged that although CAA staff design the approaches they are coded by the chart providers and they have scope for interpretation. This leads to the anomaly that Jeppesen data bases count down to an intermediate fix and not the threshold which has the same potential for disaster as the old VOR/DME approaches which counted up from a remote VOR rather than down to the runway threshold.

76% of all GPS trial were carried out using some model of Garmin equipment

The overall outcome was very favourable with few if any participants having serious problems. It then emerged that each airfield would have to present an individual safety case for a published GPS approach at its airfield. This is a complex process with a long and quite mathematical Civil Aviation Publication (CAP) explaining what's required. We were represented at a whole-day meeting at Gloucester where several CAA specialists helped local ATC to understand what was required of them. It was obvious that the CAA representatives were trying very hard to find ways to ensure a positive outcome. We had some concerns that the methods adopted would be unhelpful in the future but it seemed unwise to air these concerns when there was such obvious goodwill in attaining the short term objective.

Fate took a hand and there was some considerable delay due to illness of ATC staff at Gloucester. It would appear that this safety case is now in the final stages of being agreed. This will then act as a model for other airfields and presumably simplify their task considerably.

GPS Approval

The other issue is getting GPS boxes approach-approved. There are no approach-approved GPS units in G-reg aircraft, they are only BRNAV approved. If you have an N-registered aircraft it is likely that your installation will already be approach-approved. You need to read the flight manual supplement to confirm your situation. Flight manual amendments are normally an EASA major modification. Major modification means you need to use a design organisation and the application costs with fees will be several thousand pounds. The CAA has been helpful and after some consultation has suggested to us a procedure by which an amendment might be accepted as a minor mod. We are presently facilitating a trial application on this basis. There are, however, no guarantees and the final decision will rest with EASA.

As the timescale on these matters is so long we have already got the next stage of the process underway. This is an attempt to get GPS approaches into licensed airfields without ATC present and unlicensed airfields. As an aside anyone purchasing a Garmin GPS at the moment needs to be very cautious. In the USA a new box would be WAAS capable but the WAAS box is not yet approved in Europe. It is likely to be some time before you can use WAAS in Europe but there are different installation criteria. This means that at the moment you have the potential for an expensive error in at least three ways:

1. Buy a non WAAS box just before it is superseded by a WAAS capable unit.
2. Buy a WAAS box and not be able to install it at all.
3. Buy a WAAS box and install it to non-WAAS standards and then have to recertify it in the future.

Approaches without ATC

Returning to the future expansion of GPS approaches we believe it is essential to have them at airfields where ATC are not present. It is likely that there will be serious obstacles to this and only by making credible applications can we flush out the real issues. There are quite real problems and in this case US experience is not entirely relevant. While in the USA it is normal practice to land via a published procedure at uncontrolled fields making blind calls on common frequencies, the difference is that there is a countrywide system which feeds aircraft under radar control into the airspace block round the airfield. In the USA, ATC will not allow a second aircraft into this airspace block until the first cancels IFR either by phone or by radio, possibly using a repeater station on the ground.

In Europe this all encompassing radar service is not available. However there are precedents for conventional approaches without ATC. Typically this involved allowing the pilot to just get on with things making blind calls having obtained the QNH from the nearest available airfield with minima adjusted for any potential additional error this implied.

We are in the process of developing what we believe will be a credible and safe system in which the GPS approach is essentially a long extended centre line. Aircraft will intercept this centre line a considerable way from the threshold arriving from any direction at an altitude above the MSA. There seems no value in the T or Y layout as the IAF at the extremity of the T or Y only serves a purpose if there is ATC to orchestrate arrivals and holding.

In a simple system aircraft make blind calls on a designated frequency. If other traffic replies they self separate by continuing to fly appropriate quadrantals or by horizontal distance separation. There is no need for a hold as multiple approaches would be banned. You fly in, join further out if spacing is needed and if you go missed you go elsewhere flying quadrantals at a safe altitude as at present. In practice it's a little more complicated than this but not by much.

Aircraft will make blind calls and if other traffic replies, they self separate

Minima would be quite high and the procedure would only be suitable for low traffic densities. However it appears possible to design these approaches in full compliance with PANS OPS criteria and we have a qualified designer doing exactly this. Don't get over excited, this will take years to come to fruition.

Complex airspace

This system will not work for airfields close to complex airspace; however that's the next problem. We want to overcome difficulties in a manageable way so we have deliberately selected locations with few if any airspace issues. Later we can try to move on to airfields with more complex airspace. By definition if an airfield has complex airspace close by there will be a potential radar service so possibly something along the lines of the US model might then be feasible.

I think you will see that we are being very active indeed on your behalf. Possibly some of this work will only benefit the next generation of instrument pilots but it does show that practical use of light aircraft for travelling across Europe could be a lot easier in the future.

EUROSTUFF

By John Pickett

CAA allocates Modes 2 Addresses

The UK CAA has allocated unique ICAO 24-bit address codes to all UK registered aircraft. Previously, aircraft owners needed to apply to CAA for a 24-bit address. All the addresses are available on the CAA database of aircraft registration G-INFO.

Problems with sat nav...

The Operational Manager of the Vale of Glamorgan Council in Wales, Mr Paul Gay, recently stated, "The increasing use of satellite navigation devices is a widespread problem both locally and nationally". The Council has introduced the use of "anti sat nav" signs showing a lorry being zapped by a satellite.

And the Right Honourable Mrs Yvette Cooper, UK Minister of Housing, in a recent Radio 4 radio programme, said that in place of Guy Fawkes being burnt on November the 5th she would like to see "sat nav" being put on the bonfire instead. Meanwhile the British Daily Telegraph newspaper is publishing the so-called deficiencies in "sat nav".

The problem, of course, is not that of GPS receivers but the way that the manufacturers present the largely menu driven route options. Fastest Route, Shortest Route, etc.

A recent study for insurers has shown that eleven million motorists are unable to read a map. Apparently 16% of drivers do not keep a map in their cars and are heavily reliant upon "sat nav".

Whilst not being a great fan of the CAA or the JAA, the CAA is to be complimented on the production of CAP773 (see below). Perhaps Europe's "sat nav" dedicated motorists, and Ministers of the Crown, should have a similar but simpler document available for use.

...but GPS sales soar

Meanwhile sales of GPS based devices continue to rocket. In the second quarter of 2007, 7.4 million devices, yes 7.4 million devices were delivered. 60% of these devices were sold in Europe.

In some schools in Japan GPS tracking devices have been incorporated into school uniforms. This allows schools to keep a closer watch on the whereabouts of their students! The devices have, apparently, the potential to reduce truancy?

GPS used to in speeding trials

Motorists may soon have more to consider about GPS than planning a route. The Direccion General de Traffic (DGT) in Spain is conducting tests using an EC135 helicopter and GPS. The tests involve measuring the speeds of cars up to 800 metres away. A photograph is taken of the number plate of the car and relating it to indicated speed readouts. The data from the prototype equipment is being used to establish the viability of legally awarding penalties for speeding on Spain's roads!

GPS approach guidance

As reported in *Pilots' Talk* in *IP63*, the UK CAA has recently published CAP773 "Flying RNAV (GNSS) Non Precision Approaches in Private and General Aviation Aircraft.

Whilst the document has a strong regulatory bias it does provide good quality information on how to fly GNSS based approaches.

Intriguingly there is no mention in the Glossary of Minimum Safe Altitude (MSA). Neither is MSA is mentioned elsewhere in the document. The words "safety altitude" appear several times. This includes the phrase "pilots can calculate safe altitudes more easily". The calculation of safe altitudes is highly complex and prone to errors.

It is believed that the CAA is very coy about using MSA because in British Law there is no definition of "Minimum Safe Altitude". The calculation of MSA is left to the pilot whilst flying an aircraft over the UK.

AERAD and Jeppesen charts give various information about safe altitudes; the published figures, predominately, allow 1,000 feet above the highest obstacle within a specific area. Whereas the CAA published topographical charts give maximum heights of obstacles and terrain to which pilots must add a factor.

CAP773 goes on to say, "Conventional pressure altimetry, and the current local topographical chart, should always be used as the primary terrain references".

In the not too distant past the writer was flying an aircraft, using GPS, over a so-called "underdeveloped country" where the **latest** topographical chart was based upon survey data gained in **1929**. A Jeppesen En-Route chart was also in the cockpit. Guess which chart was used to determine MSA?

An interesting recommendation, in the document, is that pilots are advised, where practical, to set the Horizontal Situation Indicator/ CDI display to VOR/LOC mode prior to take-off. The reason given "This helps avoid confusion in the event of an unexpected return for conventional instrument approach (such as ILS) should this be necessary immediately following departure."

The writer has found that this technique can be confusing, particularly when flying a Standard Instrument Departure or a non-published departure procedure.

If an ILS was available, why would one be using GPS?

From an ecological viewpoint the 56-page document would benefit from less "INTENTIONALLY LEFT BLANK" pages.

CAP773 can be downloaded free of charge from the CAA website and is highly recommended www.caa.co.uk/docs/33/cap773.pdf.

Unmanned UAV record

Qinetiq has unofficially broken the world record for the longest duration unmanned flight with their Zephyr lightweight solar powered aircraft. It flew for a staggering 54 hours. It is believed that Zephyr is the first aircraft to have flown under its own power through two nights.

One wonders how long it will be before this solar technology can be applied to light aircraft. At the time of writing oil had reached $95.93 a barrel. The pundits are forecasting that a barrel of "Brent Crude" will reach $100 within the foreseeable future.

JAA licensing fails to improve safety

Recently published figures of fatal accidents and fatalities show a steady increase since the end of March 2006. Both the number of fatal accidents and the number of fatalities continue to increase. The figures to June 2007 show that more accidents have occurred in 2007 than in the whole of 2006.

The impact of the Joint Aviation Authorities – Joint Aviation Requirements (JARS) in 1999 appear to have had little effect on the fatal air accident numbers.

The member countries of ICAO all require their pilots to demonstrate knowledge, competence and skill before a licence or rating is issued. The JARs require that potential pilots require a high standard of knowledge to be demonstrated. This standard of knowledge is determined by ground examinations. This emphasise on theoretical knowledge appears to be to the detriment of standards of competency and skill.

A report published by the Safety Regulation Group of the UK's CAA has stated that the introduction of the JAR Flight Crew Licensing (FCL) requirements has had no significant effect on the number of serious incidents and accidents involving fixed wing GA (Single Engine Piston) aircraft.

So what have the JARS FCL1 and FCL2 achieved? It is hoped that EASA will in future focus on competency of piloting rather than increased academic knowledge.

GA lobbying sees results in the USA

The House of Representatives in the USA recently passed the FAA Reauthorization Bill. An aggressive programme of lobbying by General Aviation pilots and aircraft owners resulted in substantial changes to the Bill. There will be no user fees for GA aircraft, a slight increase in fuel duty, up by 4.8 cents per gallon, and money will be made available for improvements to small GA airports.

What a contrast to Europe! As reported in *IP62* and *IP63* the number of Instrument Ratings issued to PPL holders continued to fall. Information recently published shows the trend is still downwards. In the UK the number of IMC Ratings issued by CAA also continues to fall.

EASA has a very large task ahead. Existing regulation has not reduced the fatal accident rate, fuel prices are rising dramatically, the European Commission is trying to impose increased duty on AVGAS, and it is becoming increasingly difficult to gain an Instrument Rating. Surely, intensive lobbying of EASA is demanded?

EASA launches GA safety initiative

EASA has launched a "safety initiative" for General Aviation. The creation of the European General Aviation Safety Team (EGAST), the European Commercial Aviation Safety Team (ECAST), and the European Helicopter Safety Team (EHEST) as part of European Strategic Safety Initiative (ESSI) is announced.

Apart from swelling the list of acronyms, EASA is to be congratulated on seeking to establish a detailed and comprehensive insight into General Aviation in Europe. Something that the JAA did not achieve in its reign.

GA definition excludes private flying?

The debate about the scope of General Aviation continues. However, has the UK CAA decided unilaterally? A recently published document addresses "*Private and General Aviation Aircraft*".

Leader for CAA review announced

Sir Joseph Pilling has been tasked with leading a review into the UK CAA. "The review will cover the structure, scope and organization of the CAA with a view to ensuring that the UK's arrangements for aviation regulation and policy making are fit for purpose and able to meet current and future challenges". As the UK Secretary of State for Transport, Ruth Kelly said "The aviation world has changed considerably since 1971 when the CAA was established". The review will take into account the regulatory framework of the EU and the creation of EASA.

UK pilot appointed judge

Her Majesty the Queen has appointed the pilot, barrister and recorder His Honour Judge Tudor Wyn Owen to be a Circuit Judge in the South Eastern Circuit based in London. Congratulations to His Honour who is a competent and experienced pilot.

Anomalies of avgas prices

It may be remembered that, earlier this year, the EC ordered member states to apply a minimum of Euros 0.45 per litre tax on Avgas. The EC rejected requests from France, the UK, Portugal, Sweden and Malta for "derogation".

Whilst the consultation process on the derogation of duty on Avgas continues comparisons can be made on the prices across Europe and the USA. The information is as the result of a quick "straw" poll at the time of writing in early November.

Country	Price in euros per litre	Notes
Germany	2.120	
France	1.652	
Ireland	1.490	Duty Free
Netherlands	2.470	
Belgium	1.950	
UK	2.002	
USA	0.790	

It can clearly be seen that one reason for the migration of flying training across the Atlantic is the cost of AVGAS in the USA.

However, there could be a light at the end of the tunnel for European flying schools. There is a move to establish a different definition for AVGAS. This would allow a different tax level to be established removing the link to motor fuel.

Pilots' Talk

Compiled By David Bruford

Dates for your diary

PPL/IR Europe AGM 19 April 2008 (provisional)

The provisional date for PPL/IR Europe's 2008 Annual General Meeting is 19 April, to be held at Liverpool John Lennon Airport. The day will offer the usual opportunities to listen to a couple of interesting speakers and make or renew friendships with other members over an excellent buffet lunch. All members are very welcome. Confirmation of the date will be published in the next edition, contact Steve Dunnett dunnettsb@cardiff.ac.uk for more information.

PPL/IR Europe at AeroExpo, London 13-15 June 2008

PPL/IR Europe has been invited by the organisers of the highly successful AeroExpo to arrange and manage a seminar program for the event. The Expo is held annually at Wycombe Air Park and the 2007 event had 140 exhibitors and attracted over 11,000 visitors. For more information on the 2008 event see: http://www.expo.aero/london/.

We are planning an exciting seminar program that will appeal to maintenance engineers and pilots at all levels. Some of the topics being considered include Advanced Avionics, Maintenance, Obtaining the IR, IR Touring, Very Light Jets, VLA and the European Recreational Pilot License. If there is a topic you would like to see included or if you would be willing to speak please contact Andrew Lambert at andrew.lambert@ems-uk.com. This is a fantastic opportunity for PPL/IR Europe to attract members and promote Instrument Flying / European Touring to the wider GA community. We need volunteers to man the stand, talk to prospective new members to act as stewards for the seminar hall. If you are able to help please contact Andrew at the email address given above.

Please put the dates in your diary now!

Chairman's Note. We would like at least 50% of our total membership to support Andrew's efforts by at least passing by our stand during the three days of the show and saying hello. For those able to give some direct assistance we envisage evening social events for those staying overnight and perhaps a priority look at any exhibits of special interest. If we have lots of volunteers the workload will be light and it should be a really enjoyable social occasion. Please do support us in this and send Andrew an email now for more information.

Farming funds plundered for Galileo

Financial straws clutched and appropriated in a funding frenzy

Brussels, 19th September 2007 - The EU today announced plans to use almost £1.8 billion to bail out Galileo, the ailing satellite navigation system. Most of this money will come from unspent Common Agricultural Policy funds. The money was originally to have come from a private consortium, but disagreements between companies from France, Germany and Italy left the project with a major budget deficit for the period 2007-2013.

Conservative Spokesman on Defence, Geoffrey Van Orden MEP, who earlier met officials from the UK Department of Transport, has strongly questioned the justice of the proposed diversion of funds. He said: "*The Commission has acted with a tactless indifference to the sufferings of British farmers, who are already struggling with the combined pressures of foot-and-mouth, Single Farm Payment delays, and a supermarket squeeze on profit margins. Raiding funds that were specifically set aside to help the farming industry is entirely the wrong approach to Galileo's budgetary crisis.*

One of the key difficulties with the Galileo project all along has been that while nations such as Britain see a primarily civilian use for the satellites, a hard-line faction led by France has demanded an additional, military purpose. Others have even more ambitious aims in terms of boosting the EU's foreign and military policies. Private investors are understandably concerned to ensure the primacy of a commercial application, and so long as reassurance is not forthcoming they will continue to be wary."

Giles Chichester MEP, Conservative Research Spokesman, commented: "*I am concerned about the impact of the Commission's latest proposals on existing research programmes. I also share anxiety about the defence implications, not just on political grounds but also because of lack of additional funding for this purpose. We in the UK need to support our own space and defence industries. Those behind Galileo need to recognise that the world does not revolve around the EU. If collaborative ventures are required there are other more attractive possibilities.*" Shutting the white elephant of a project down and saving the European taxpayers €billions sounds like a simple, basic and over-obvious solution. More molar grinding detail at http://www.pcworld.com/businesscenter/article/137354/ec_funds_galileo_project.

Denmark's aircraft tax loophole closing

The Danish government is preparing to impose a 25-percent VAT sales tax on imported aircraft to close a loophole that has allowed owners to bypass taxes due in other European Union countries. Aircraft imported for "personal transportation" are currently zero-rated for VAT purposes in Denmark, and this has exempted just about all aircraft applications apart from gliders and other forms of recreational flying. A spokeswoman for Denmark's taxation ministry confirmed that it is conducting a consultation process and that new legislation should be drafted by the end of November and take effect on January 1st. Denmark has been obliged to introduce VAT on aircraft imports after the European Union court found the country to be in breach of EU tax rules. The Danish aircraft sales and support industry is concerned that it stands to lose substantial business from the rule change because their services are currently competitively priced for customers from surrounding EU states such as Germany and other Scandinavian countries.

Manx register may provide a useful bolthole

It will be interesting to see how the Manx registry develops given that the EU is likely to bring in legislation to prevent foreign registered aircraft operating within the EU, i.e. an anti-N register. According to Manx resident Geoffrey Boot "*If this legislation is enacted then we expect to see a massive migration to the Manx registry as they will validate an FAA licence for use in a Manx registered aircraft and issue registration if the aircraft is on the N registry so that it can be transferred to the Manx registry and then maintained in accordance with the FAA schedules.*"

However, Brian Johnson, Director of Civil Aviation, Isle of Man Government Department of Trade & Industry issued a qualifying statement: "*The Isle of Man Aircraft Registry was established as the first dedicated high quality business aircraft register in Europe. We have received a large number of enquiries from European aircraft owners requesting to register light aircraft. Unfortunately we do not have the resources to register aircraft below 5,700kgs other than for residents or businesses operating from the Isle of Man. We are sorry if this is disappointing, but European National Aviation Authorities are better resourced to oversee locally based light aircraft.*" This information came to me via Charles Strasser who further commented that the Manx Air Navigation Order 2007 specifies the register is only for aircraft not used for public transport or airwork.

So, if the register is not enough to encourage you to become a resident, how about no capital gains tax, inheritance or estate tax, wealth tax, property tax or stamp duty, very low personal income tax rates (10%/18%), generous tax-free personal allowances, no restriction on the purchase of property and no restriction on immigration for UK or European Economic Area nationals? Aviation friendly utopia? Surely there must be a down-side?

Airworthiness Directives

The FAA runs a free email service to send ADs and Special Airworthiness Information Bulletins on your aircraft. New releases are said to reach subscribers earlier than through their current source of information. Go to http://rgl.faa.gov and enter your email address in order to register for the service. The extensive list of aircraft makes and models includes airships, balloons, gliders, rotorcraft, and large and small aeroplanes, as well as engines and propellers.

CAA GA safety evenings

Please note the following programme of GA Safety Evenings for the coming season. These are open to all, no matter which organisation may be hosting the event (although the military venues probably require prior notification of visitors), and we encourage everyone involved with general aviation to attend and actively participate. The evenings commence at 7.30 pm unless otherwise stated, and include guest speakers from the CAA. They aim to finish around 10.15 pm with a raffle of prizes donated by kind sponsors.

The list shows venues that have been positively confirmed for the season. There should be more to add as the winter draws on, and an updated list will appear on the CAA web site http://www.caa.co.uk/default.aspx?catid=224&pagetype=69.

Date	Area/airfield Location	Phone
03/12/2007	Derby Aerodrome	01283 733803
04/12/2007	Lydd Airport Restaurant	01797 320734
06/12/2007	Netherthorpe Sheffield Aero Club	01909 475233
24/01/2008	Belfast Civil Service Club, Stormont	02891 813327
06/02/2008	Stapleford Restaurant	01708 688380
07/02/2008	Fenland, Fenland Aero Club	01406 540461
04/03/2008	Sleap, t.b.a.	01939 232882
05/03/2008	Caernarvon Aerodrome (Check web site)	01286 830800
06/03/2008	Swansea t.b.a. (Check web site)	07919 661200
12/03/2008	Perth t.b.a. (Check web site)	07785 244146

Airfield Updates – courtesy of the Airfield Research Group

At **Cambridge Airport**, Cambridgeshire it has been announced that Marshall Aerospace is to invest £4.5m in developing a new hangar to provide a business and executive jet centre. The 25,000 sq ft hangar will provide maintenance, repair and overhaul facilities as well as executive lounges for customers and rest areas for flight crew. The company will also provide a limousine service to take customers to their final destinations. There has been a significant increase in executive jet movements into and out of Cambridge Airport in the past few years, with roughly twelve executive jets using the airport every day. It is interesting to note that Marshall Aerospace is embarking on this development when the local regional authority expects to start building the first of 16,000 houses on the airport site within the next ten years.

At Condover, Shropshire, elements of the former **Condover airfield** near Shrewsbury were offered for sale by tender in June 2007. The area being sold amounted to 103 acres and included the former control tower. In pictures which accompanied the advertising material, the control tower seemed to be in reasonable condition and it was being offered for sale with some 6.6 acres of pasture at a guide price of £75,000. According to the sale particulars, in correspondence dated January 2005 the local authority indicated that the control tower was of historical interest and worthy of retention.

Davidstow Moor

Down my way at **Davidstow Moor**, Cornwall, the rumours are rife of the intention to build 20 wind turbines on the disused WW2 airfield site. Official planning permission has not been applied for yet and the idea is being floated. The wind turbines will each be 414 feet high and the company Community Power of Cheshire is behind the plan. The project will be subject to a lot of opposition, being adjacent to an Area of Outstanding Natural Beauty and already having two existing wind farms and several others planned within a five mile radius of the site.

Members of the **Moorland** (Microlight) Flying Club have been given notice by the "Commoners" who own the site that their lease on the runways and some airfield buildings will not continue beyond 2008.

Following an unsuccessful treatment two years ago, parts of the **Duxford** runway were being resurfaced during August.

At **Finningley**, Yorkshire (now known as **Robin Hood Airport**, Doncaster Sheffield), recent press reports show that Marshall Aerospace of Cambridge has teamed with a company to open an aviation training

school linked to an aircraft maintenance organisation. Supported by Government regional assistance, the company is able to provide training in many aspects of aircraft operations and engineering, including training for cabin crews as well as maintenance staff. The company has available the fuselage from a Boeing 727 and a complete HS 748 for use as training aids.

Perranporth, Cornwall was being offered for sale at the end of May 2007. The offer period was due to close on 26th June but the selling agents reported that the vendors had accepted an offer some two weeks before that date.

The freehold of **Tollerton (Nottingham) Airport** has been purchased by Truman Aviation Ltd along with Nottingham City Airport PLC. The intention is to redevelop the airport with a multi-million pound investment to replace the older buildings. Consideration is being given to reopening the north/south runway to reduce the impact of noise on local communities.

The days are numbered for 121.5 MHz ELTs such as this

FAA ELT recommendation

The day after the NTSB issued a recommendation that the FAA require that all aircraft be equipped with 406 Mhz Emergency Location Transmitters (ELT), the FAA issued a safety bulletin reminding pilots that as of February 1st, 2009, search and rescue satellites will no longer scan 121.5. However, the agency doesn't seem to be in a hurry to require that the much more accurate and less nuisance-prone 406 models be made mandatory. While this debate has been going on for some time, the pending loss of satellite detection has raised some interesting questions among those who use the signals to find people. The US Civil Air Patrol's public forum has no shortage of opinions, including the fear that search and rescue officials will grow complacent about 121.5 signals because so many are false. The 121.5 ELTs that most of us have are notoriously inaccurate and prone to false alarms, according to the FAA. The safety bulletin says 98 percent of alarms are bogus. The 406 ELTs include information about the aircraft in which they are installed in their broadcast, making it much easier for rescuers to determine whether an alarm is genuine. The consensus on the CAP forum is that 121.5 calls will still be answered but there will be fewer of them because of the lack of satellite coverage on that frequency. The military 243 frequency will also drop off the satellites.

Very light jet market (VLJ) market looking brighter

A European company that has studied the emerging VLJ market says it's painting a rosier outlook for the sector than it has in the past. Phillip Butterworth-Hayes, of PMI Media says that interest in VLJs seems to be sustained and new market possibilities are opening up but the next 12 months will likely be the harbinger of things to come, especially in the air taxi business. "A lot will depend on just how robust the aircraft are. They're going to be called upon to fly far more hours in more rugged conditions than business jets are normally flown and many are far less expensive than the low-end business jets."

He said the other significant factor will be the world economy. Traditionally, companies buy jets when times are good. He said all indicators point to a downturn and that will likely mean the red-hot market for jets will soften. Butterworth-Hayes maintains that the models most likely to fly out of the uncertainty and market saturation that's looming will come from companies that already build, certify and support fleets of jets.

Be ready for ADS-B by 2020

The FAA has announced that it wants all aircraft flying in controlled airspace to have satellite-based avionics by 2020, so air traffic controllers can track them using Automatic Dependent Surveillance Broadcast (ADS-B). The agency issued a Notice of Proposed Rulemaking that says the equipment will allow controllers to handle more traffic more safely with less separation. "Aviation must take the big step into the next generation of technology," said Acting FAA Administrator Bobby Sturgell. "It's safer and more accurate. Satellite technology is here to stay." Pilots with ADS-B cockpit displays can see, in real time, their location in relation to other aircraft, bad weather and terrain. In Southwest Alaska, the fatal accident rate for ADS-B-equipped aircraft has dropped by 47 percent, the FAA said. Aircraft that don't fly in controlled airspace will not be required to have ADS-B avionics, the FAA said.

New Legal Service for PPL/IR Europe Members

We are delighted that one of our members, Ian Gee, has agreed to become our honorary solicitor. Ian holds a UK PPL/IR and an FAA CPL/IR. He is part of a group flying a Cessna 340. Members can call him for a free 30 minute consultation on any matter. It does not have to be aviation related. He can only advise on matters under the law of England and Wales. If the issue is outside his own specialisations he will refer you to other partners in his firm. The objective of the initial consultation is to give members a chance to clarify their options without incurring any obligation. That said, Ian has to buy lots of fuel for the Cessna 340 and members should expect to pay for any advice beyond the initial 30 minute telephone consultation. Doubtless in these circumstances Ian will make clear his business terms. If using this service you should expect to be able to provide your membership details and confirm that your subscription is up to date. His contact details follow. ***Jim Thorpe***

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Fuel Management

By Peter Holy

This is my first contribution to the magazine since I was kindly invited to write a regular column, so I have picked a topic which hopefully is relevant to all pilots.

All my contacts with other PPLs suggest that fuel management is poorly addressed in PPL training, and my own experience confirms this. However, there is a justifiable reason for this practice: the aeroplanes are generally old, few of them have any fuel flow indication, and fuel gauge accuracy usually verges on useless. As a result, PPL training practices err on the safe side and most flying is done with the mixture set to fully-rich and few pilots are taught about leaning. Much reliance is placed on using ground based logs of flight times to determine the remaining fuel on board (FOB). This generally works because conservative fuel consumption figures are used and most training flights are short. The downside of this system is that a large part of the aeroplane's real range is not available and a pilot wishing to embark on a long flight is venturing into unfamiliar territory, and quite spectacular fuel planning related incidents do happen.

One way to find out the actual fuel consumption is to look into the Pilot's Operating Handbook (POH; also known in US aviation speak as the Aircraft Flight Manual or AFM). However, for the typical training aeroplane's engine which has been around the clock several times, this data will bear only a passing resemblance to reality and on occasions the propeller fitted on the aircraft is not the one which the POH data refers to. In any case the POH assumes that there is a method for setting the engine to the specific operating point; for example peak EGT. In all my training I never saw an EGT gauge, and the only method offered was to lean until the RPM drops, then advance the mixture a little, and apply carb heat to ensure the RPM still drops when carb heat is applied. I wouldn't like to guess how accurate this method is but I think one would be lucky to get within 20% of the book fuel flow figure.

On such an aeroplane, there is only one way to determine the actual cruise fuel flow and that is to do two flights, with identical climb/descent profiles but with the cruise sections differing by say 1 hour. Starting each flight with an accurately filled tank, and filling to the same point afterwards, one can easily work out the difference between the two flights. The process should be repeated at several different altitudes. All one then needs is consistency in setting the engine operating point... Pilots who are renting have little choice but for the others there is fortunately a much better way.

Picture 1. Shadin fuel computer from a TB20

Picture 2. Fuel flow readings can be included as an optional addition to the popular JPI EDM-700 engine analyser

Picture 3. Dedicated fuel flow readings can also be provided with the JPI 450

The Electronic Fuel Flowmeter

Liquid flow measurement is a very old craft with many methods ranging from mechanical to ultrasonic/doppler. The several products on the aviation market use a miniature turbine which contains a magnet and the passage of the magnet past a fixed coil generates a pulse which is amplified, shaped and sent to a panel mounted instrument which converts the pulse rate to a direct indication of fuel flow in litres or gallons per hour.

Most if not all products used in GA use a turbine sensor made by Flo-Scan, P/N 201B which was designed for the boat business and is resold with "aviation paperwork" and at the customary inflated price by the flow indicator manufacturers. The 201B generates around 30,000 pulses per USG/hour; the actual figure (called the "K-factor") is supposed to be individually measured and marked on each unit. This K-factor is configured in the instrument, and the result should be an accurate fuel flow indicator system.

The K-factor is configured using some method documented in the Installation Manual and it may not be legal for the pilot to do this himself.

Several panel mounted indicator instruments are available. The leading maker of dedicated flow indicators is Shadin, whose Microflo product is probably the most popular retrofit and over the years and has appeared in several versions like the one from a TB20 shown in picture 1.

The well known manufacturer of EGT/CHT indicators, JP Instruments, offers a fuel flow option on their popular EDM-700 engine analyser (picture 2) plus a dedicated EDM-450 (picture 3).

continued from page 19

There are also many other instruments which combine fuel flow with all kinds of other functions e.g. air data.

These instruments will all indicate the current fuel flow rate. However, the real advantage of accurate flow measurement is obtained when the instrument is linked to a GPS, and the GPS (if programmed with the route being flown) then displays constantly updated fuel on board based on the current ground speed (GS) and the remaining distance to run. All modern IFR GPS units have this feature.

Installation

Ideally, setting the instrument to the K-factor of the transducer yields an accurate installation. In practice, one needs to make adjustments to the K-factor to achieve good accuracy.

A major potential problem with the turbine flow transducer is that it must be mounted in the correct place in the fuel pipework. Obviously, the flow rate must be identical anywhere along a particular pipe, but there can be considerable turbulence around bends in the pipe and the transducer is severely affected by such turbulence.

This turbulence initially manifests itself in the form of a K-factor which is some 10% to 30% away from the figure marked on the transducer. On many installations this problem has been "covered up" by setting an appropriate K-factor to compensate, but this is not the answer since the turbulence increases greatly with the flow rate, and the overall accuracy thus varies according to one's mix of short and long flights – on a short flight one spends relatively more time with a high flow rate.

I fly a 2002, TB20GT which had the transducer incorrectly placed at the factory. It was claimed this was done at the insistence of the DGAC (the French "CAA") which required it to be located on the cockpit side of the firewall, in breach of the Shadin STC which was quite specific as to the location. The result was that every aircraft made had a flowmeter reading around 25% off, with another unpredictable 10% error according to flight duration, with a further huge error when the electric fuel pump was running. With no help from the factory many pilots just gave up on it. Unfortunately, on a G-reg aircraft, the error could not be legally corrected and it was only after a few years when I transferred to the N register that I was able to move the transducer in accordance with the Shadin STC; Shadin granted the permission to use their STC without charge.

Another aircraft dependent factor is that some engines have a bypass which returns fuel directly to the fuel tanks; installing the transducer in the wrong place is going to yield interesting results!

Accuracy

The accuracy quoted for the whole system is normally around 1% to 2% which is much better than any fuel gauge. Despite efforts, I have found it difficult to get better than this, due to a combination of small errors. For example, a standard tactic to avoid departure delays is to fill up immediately after landing but this enables some fuel to be lost through expansion out of the overflow vents; avgas expands about 0.1%/°C so in a hot location one can lose 1-2% in this way and may prefer to under-fill very slightly. The turbine flowmeter measures volume flow and does not correct for density variations due to temperature, and it's quite possible for the fuel temperature to fall from +30C on the ground to -20C in the air; this amounts to an amazing 5% "shrinkage". Filling the tanks accurately can be difficult unless the aeroplane is exactly level. Occasionally, one detects discrepancies which can be explained only by an optimistic airport pump!

Typical fuel flow transducer used in light aircraft

Shadin Microflo-L

Usage

One could debate the extent to which one should use this data but I would hope that, as with GPS, serious pilots are no longer interested in traditionalist views and wish to embrace the best technology for the job, provided any caveats are understood.

Obviously, it is necessary to preset the initial FOB value into the flowmeter when filling the tank to a known point. If this is done incorrectly, the FOB value will be wrong from then onwards – the instrument merely measures fuel flow and has no way of knowing how much fuel is actually in the tanks!

For any long flight, it is wise to generate a plog with the planned FOB figure at each waypoint – Flitestar can do this easily if you configure the aircraft data properly - and during the flight the figure for each waypoint is compared with the computed FOB from the flowmeter. If the FOB figure falls below the budget, this should correlate with stronger than expected headwind, but it could equally have been caused by a climb to a higher than planned altitude (for example, to get above weather). In these situations, the GPS-calculated FOB at destination can be invaluable in deciding whether one should still proceed to the destination, or divert to somewhere nearer.

However, it is vital that the accuracy of the system is regularly checked, and this should be done at each and every fill-up. The amount pumped into the tanks should be within around 1% of what the flowmeter says it should be, and this should hold for all types of flights; both long and short.