Instrument Pilot

The *PPL/IR Europe* Magazine No 92 July–August 2012

Zeppelins at Friedrichshafen

Following on from a visit to the Friedrichshafen Expo earlier in the year Steve Hallas describes how both modern and historic airship technology thrive there

Airships have been built again in the Zeppelin town of Friedrichshafen since 1993. Modern, innovative, unique: the Zeppelin NT. Its quiet, smooth floating gives the feeling of lightness, and its superior flight characteristics open the door to many different fields of operation.

The concept of the semi-rigid airship was redefined with the development of the Zeppelin NT. It is the only kind of airship worldwide that has a rigid internal structure, in contrast to a blimp (non-rigid airship). The maiden flight of the Zeppelin NT was on September 18, 1997. The shape of the aircraft is unique, but the Zeppelin NT is completely different from earlier airships in several ways. The ZLT Zeppelin Luftschifftechnik GmbH & Co KG combined experience with state-of-the-art technology to get the Zeppelin airship airborne again.

PPL/IR EUROPE

Maximisation of safety and comfort is the most important feature of the design concept. NT means New Technology. It stands for a high-tech approach that has set new standards. The rigid structure has a triangular shape and is made of aluminium and carbon fibre. With its very low weight of 1,000 kg (2,205 lbs), it meets the highest demands concerning stability and manoeuvrability. The lift is provided by non-flammable helium, which is contained in an envelope made of extremely tear-resistant material. Thanks to an innovative propulsion concept employing swiveling propellers and the latest avionics equipment with fly-by-wire flight controls, pilots can conduct manoeuvres similar to a helicopter. Furthermore, a ground holding crew is unnecessary during take-off and landing. And even lightning strikes have hardly any influence on flight characteristics—an uncompromising safety concept, which is part of every technical detail.

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PPL/IR EUROPE

Membership of PPL/IR Europe is open to any pilot interested in the operation of light aircraft under IFR in Europe. The annual subscription is GBP65 and further details are available from the membership secretary.

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Annual accounts for the company are available on the website – see *www.pplir.org* > About Us

For reports on meetings, conferences and other activities attended in the last 12 months by directors and members of the executive on behalf of PPL/IR Europe members see *www.pplir.org* > Lobbying

Aircraft advertisements

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Chairman's corner

Anthony Bowles

The Executive Committee met recently on a fine Sunday (the second one so far this year?) at Gloucestershire Airfield for a review of our organisation's strategy—are we doing the right things and/or what would our members wish us to be doing differently? We were helped in this exercise by the attendance of a number of members who had responded to Jim Thorpe's forum post on the subject. I will report on the outcome in more detail in my next chairman's corner but suffice to say, the conclusion is more towards tweaking what we do presently rather than adopting any radically new policies.

This edition of IP is edited for the last time by Stephen Niechcial who then hands over the editorship reins to Ben Hines; Ben has some interesting ideas for our house periodical but as ever, it is to you the membership to whom he must look for the majority of material. Collectively over a flying year there will be all sorts of circumstances and experiences that deserve a write-up so that others may benefit in the future; the write-up need not necessary be long and if there is a photograph which illustrates the point being made, then send that in too. I detect that there is a certain reluctance from some members to recount matters of interest because, for one reason or another, they think it may display a lack of knowledge or experience but in truth, while collectively our knowledge base may be large, individually we always have something to learn.

On this note, I recount below a recent experience of mine. Some members may recall that I recently wrote an article on flying in potential icing conditions. I did make it clear that my article was in a UK context as weather conditions in other parts of the world are not necessarily so benign—something I was soon to find out. I wrote up the report shortly after the event in late May and have only edited it subsequently to add some necessary detail so that readers can understand a little more of the background.

The flight was from LBWN (Varna) in Bulgaria to LOWS (Salzburg) in Austria, an airways distance of around 775 nm, so a fair cross country. The circumstances were the conclusion of the COPA annual migration E10 with around 15 in a departure sequence of well over an hour. Most were routing to LHPP (Pecs) in Hungary for refueling and then onto dispersal to a variety of airfields. All the aircraft except for mine were SR22's. Because of bad weather over the meeting weekend in SE Europe, all VFR only aircraft had cancelled so all outbound flights from Varna were IFR.

Departure and en route weather for the first part of the flight was poor. Although no closed isobaric depression was shown on the forecast chart, there was widespread convergence in the east Balkan

area leading to cloud bases of around 700 feet in light rain at LBWN with tops of around FL200. Freezing level was forecast at FL80 in the east rising to around FL100 in the Salzburg area. Minimum airway level was generally FL100 in the east falling to FL80 over Hungary and then rising to FL120 over Austria. MSA was around 6,000 feet in the east rising to around 9,500 feet in Serbia, falling to low level over the Hungarian plains before rising again approaching the Austrian border.

To get flight plans into the system we all filed for FL100 and then asked to stop climb at FL80 to keep just below the freezing level. Bulgarian ATC and indeed all ATC were very helpful in accommodating these non-standard requests. Towards the Serbian border, around 175 miles from LBWN, the rain stopped and the cloud began to dissipate enabling climbs to standard airway levels. At the border the stratiform cloud cleared to scattered cumulus. It is worth mentioning that the ELR (environmental lapse rate) was significantly greater than the SALR (saturated adiabatic lapse rate) with a noticeably cold pool of air over Hungary, so considerable convective instability was expected.

Cumulus began to build so that a climb to FL120 and later FL140 was necessary to find sufficient clear air to deviate round rapidly building TCU and later CB's. With heavy CAT light GA aircraft were making continuous requests for route deviations all of which were granted. Some SR22's reported picking up ice at relatively low levels and decided to descend to MSA or below. One SR22 pilot described his rudder as "completely iced up".

While the flight had been relatively undemanding until then, it became increasingly difficult to avoid cloud entry; some twenty minutes or so into Hungarian airspace I entered what I suspect was a decaying TCU for a five-minute transit with no icing pickup and minimal turbulence. Shortly afterwards I entered another amorphous cloud mass. OAT was around -14° C. Within a short period of time—perhaps two minutes—I entered heavy rain and started to pick up heavy ice rapidly and requested an immediate descent to FL70, which was granted within a few seconds. I disconnected the autopilot and trimmed the aircraft nose down to start the descent. Nothing happened; indeed we started to go up. I then noticed that the trim was almost fully nose up. I dropped the gear and first stage flap and with both hands heaved the control column forward. A lot of push was required to do this but eventually the aircraft started to descend. I asked my wife to push as well and we got a descent going at around 1,000 to 1,500 feet a minute. I did not change engine power as I did not want to introduce another variable into the equation at that point and IAS anyway was low. Airspeed in the descent, once established, was around 130 KIAS so no problems about over speeding. In the middle of all this we got a frequency change which I acknowledged and asked my wife to remember it as changing frequency at that stage was impossible, both hands still being required to push hard on the control column to ensure continued descent. We emerged from cloud at around FL80 and the ice began to disappear; shortly afterwards the trim control came back into life and normal service was resumed as they say. We levelled out at FL70, called control on the new frequency and the rest of the flight was uneventful. We later climbed back to FL100 as we neared the Austrian border and higher ground; there was still considerable connectivity around, but we were able to keep out of any significant cumulus.

In fright measurement terms, this incident comes high on a short list of unpleasant experiences in 41 years of flying, possibly second to an EFATO around 25 years ago. That experience while challenging was short lived—around the 30 seconds it took to glide down the 300 feet into a sports field positioned slightly off the westerly climb-out from Elstree. This incident went on for, I guess, around eight to ten minutes from the onset of heavy icing until the bottom of the descent when normal control of the aircraft was restored. Control of the aircraft was never lost although at one moment I was concerned that it could be. In a Cirrus, I seriously wonder whether it would have been possible to have exerted the required degree of force on the sidestick, which is essentially a one-handed wrist operation.

Analysing the position it is possible (but I think unlikely) that I did not disconnect the autopilot and therefore was effectively over-riding it for the descent. I suspect that on onset of the heavy icing, the autopilot started trimming the aircraft up to maintain level flight and this accounted for the high nose up trimming, and then the trim froze preventing any attempt to trim down. My "amorphous" cloud turned out to be an active cell and I should not have been there. At that stage, high MSA was not an issue and, once I could no longer maintain VMC around buildups, I should have descended to a lower level where I would either have been VMC with a positive OAT or within a thousand or two feet from this. I wonder also if I should have disconnected the autopilot on entry into the cloud since any altitude change resulting from picking up ice would have immediately become apparent leading to earlier remedial action.

On my return, I discussed this incident with a friend whose skills and views I value highly. He wondered whether I was correct to drop the gear and first stage flap. On reflection he is probably right about the flap but, caught as we were initially in a strong updraft, dropping the gear added drag to counterbalance this. Why did I not reduce power to idle I hear you all ask? The answer was that airspeed was low and dropping and I left power reduction until we were in a reasonably stabilised descent. Indeed reflecting now on the incident some two months later, I find it hard to believe that an aircraft could go from normal cruise configuration to near loss of control within such a short time. It is also a lesson that in central Europe far away from the calming influence of cool northern waters in late spring, deep convection set off by a hot sun in an unstable airmass can lead to much more widespread and vigorous TCU and CB than would happen in similar conditions in the UK, something that I as a student of meteorology for rather longer than my aviation life should have remembered. Fortunately everyone made it safely home.

Well, there you are—a classic "I learnt about flying from that episode" and I am sure there are more out there which can be told so the rest of us can learn something, so I encourage you all to put pen to paper and ease the new editor's task by providing lots of material. Incidentally, it should be added that ATC in SE Europe from Slovenia, Croatia, Serbia and Bulgaria were first class throughout the entire trip, and it was only a pity that bad weather prevented us from seeing more of the countries we were overflying—in the UK you were enjoying the late May heat wave!

And finally, many thanks to Stephen for minding the IP editorial office for the past couple of years.

PPL/IR Europe visits

For some time PPL/IR Europe has arranged occasional members' visits to places of aviation interest—in recent years we have been to the Britten Norman Islander and Cirrus lines in Bembridge, AAIB Farnborough, NATS Swanwick, and BAe's research facility at Filton. At a special ExCo meeting in July we considered possible new and return destinations for visits over the next year or two, including AAIB (again), NATS in Prestwick and an engine rebuild shop.

I would welcome any and all suggestions which you may have of other destinations for future visits, along with any local or personal contact details if available.

On a related point, I would also value suggestions of seminar topics and speakers for the next AGM or for a separate full-day seminar (weather and avionics are two popular themes), as well as interesting destinations for future two/three-day more social fly-outs.

Please feel free to reply to the parallel thread on the website forum or to email me directly at meetings@pplir.org.

With many thanks, Steve Dunnett
Meetings Secretary

Whither the IR skill test of the future?

Jim Thorpe represents PPL/IR Europe on a CAA group aimed at modernising the IR skill test. The following extract is taken from PPL/IR's input to the CAA. It shows that there is some scope for adapting the style of test within the current EASA regulations and explains how the group may put forward proposals to EASA for future changes.

The structure of training

We have moved over several decades from a situation where anyone with 700 hours could present themselves for the skill test to a situation where the only route is a 50 hours course (SEP) in an approved training organisation (ATO). Over this period we have reduced the private pilots attaining the IR annually to numbers bordering on single figures. This is self-evidently a spectacular systemic failure. Nevertheless, the CAA's starting point in our discussions implicitly assumed a full time course in the highly supervised and regulated environment of an ATO. It seems to be taken as read that this is a structure that produces quality.

Contrastingly, in the USA there has been a very flexible training model based on minimal regular involvement by the regulator. Only where there is evidence of real issues is there intervention which is prompt and decisive. The basic assumption of the FAA is that schools and instructors are honourable people trying to do a good job. Training can take place with individual instructors or in schools, and the schools and independent instructors have coexisted without difficulty. The result has been that the percentage of US PPL holders with an IR is twenty to thirty times larger than in Europe. Even more dramatically European pilots have responded to the inflexibility of the European system by qualifying in the USA and flying N-registered aircraft in their home countries. They have overcome financial and practical hurdles to do so to the extent that much PPL IR flying in Europe takes place in foreign registered aircraft. This is vivid proof that the JAA system as implemented throughout Europe fails to promote PPLs' attainment of the IR.

Within the UK there is even more stark evidence. Over the period of this decline in the PPL IR, many thousands of pilots have obtained the IMC rating after a 15 hour course in an almost completely unregulated environment. Thus we have in the UK an instrument qualification which allows the holder effectively the same privileges as the IR (outside Class A airspace) in which they are typically trained by less experienced instructors to fly less capable aircraft in the most demanding environment. They fly at low levels where the CFIT risk is greatest, outside controlled airspace where ATC services are limited and use the less well equipped airfields. Not only has this lightly regulated training environment caused few if any problems, but the CAA is also aggressively championing retaining the IMCr on the basis of its contribution to enhanced safety in face of its probable loss under EASA.

Thus the CAA is arguing for two entirely contradictory concepts. This was pointed out quite forcibly during the EASA review of the proposals for the new-style instrument qualifications when the CAA came down in support of the IMCr and the flexible IR/EIR.

The future

To their credit, EASA accepted that the existing IR training system was wholly inappropriate. Under their proposals, now well on their way to becoming law in late 2013, there will be a very flexible training structure. For an SEP IR in broad terms a candidate will require 40 hours of instruction of which only ten need to be in an ATO. As many hours as may reasonably be utilised can be flown in an appropriate simulator. In addition there will be the en route instrument rating (EIR) requiring 15 hours training (including at least ten with an ATO). This will allow flight in any class of airspace in the en route phase of flight and will provide a seamless step to a full IR.

I suggest that the CAA needs to embrace this change in training philosophy and bring its huge experience to bear in helping formulate ways in which the skill test might encourage schools to take advantage of this flexibility. Their objective should be to revitalise the IR training industry and facilitate a large increase in the number of European PPL IR holders. There is not, and never has been, a desire for dramatic changes to the skill test content or any desire for an "easy" IR. The objective is to increase safety and utility by encouraging larger numbers of pilots to obtain advanced qualifications.

European realities

The CAA faces a difficult organisational problem. Whilst its responsibilities and the income gained from them have changed substantially, the financial constraints imposed by the UK government have not. It will be tempting for the CAA to attempt to bridge this gap by making charges for regulatory actions which address non-issues. All this will do however is drive training outside the UK, and there will be little left to regulate. The UK already has a poor aviation infrastructure and high costs, but it has the advantage of an English language training environment. It is self-evident that most current ATOs struggle to remain viable businesses. The best of them are often small, existing against the odds thanks to the efforts of committed individual owners. The CAA focus should be on helping schools to take advantage of the potential stream of new business that the EASA changes represent. This offers the greatest possible contribution to enhanced training standards. Only a business making a decent return can invest in staff training, sensible instructor salaries and modern aircraft.

No compromise on quality

There should be no negative impact whatsoever on quality from our proposed changes. Indeed from a PPL IR perspective the opposite is the case. There need be no contradiction between the detailed concerns of the skill test review group and this new situation. Having a clear syllabus and performance standards is helpful. Having systems in place to deal with changing navigational technology is desirable. Having sample lesson guidelines or plans is helpful as long as they remain only guidelines. There seems to be no difficulty in achieving all this within the EASA legal framework. What I think would be counterproductive is expressing in a prescriptive way how the training process delivers these competences. Below I try to cover some of the detailed concerns of group members and how they might be addressed in the EASA framework.

Background knowledge

The concern is that pilots lack a grasp of how the material they learn in their theoretical knowledge (TK) training applies to the practicalities of flying. In short they evidence poor airmanship. The current TK syllabus and exam system is not fit for purpose. The content, the nature of questions, the structure of the exams and—above all—the obvious irrelevance of much of the material has produced exactly what one might expect. Those who suffer the process see it as simply an obligatory hurdle en route to the desired objective. It is something with limited relevance to be dealt with by rote learning. And such pearls of wisdom as the TK does contain tend to be lost along with the dross.

The new EASA TK will be much more focussed on the needs of the PPL IR and is a step forward. A group of hardened IR examiners and instructors had no difficulty in eliminating 50% of the existing IR syllabus; however, this review had to accept the existing learning objectives and question database. I think it doubtful therefore that future prospective IR pilots will be able to acquire ideal theoretical background knowledge but the hope is that we will have moved forward; and with less unnecessary subject matter, pilots will have more interest in and better recall of the new TK. It is interesting in this context that the IMCr has a rather good TK syllabus. One of the standard PPL IMCr texts has most of the core knowledge an IR candidate might need.

PPL/IR Europe came into existence originally because newly qualified PPL IRs felt so ill-equipped to deal with the real IR world. Nothing has changed. We still fulfil this function, albeit mostly for FAA IR holders. I entirely accept that there is a need to remedy this deficiency by integrating some "practical theory" into the IR course. This is done to some extent in the ATOs but it forms no part of the skill test. Perhaps all that would be needed is a comprehensive topic list and some high quality, pragmatic learning materials. If there were a real chance of such questions forming part of the skill test, candidates' motivation would be assured.

Training for the test

Given the very prescriptive nature of the current test, the cost of the training and the dire financial hardship suffered by many airline cadet candidates, "test focus" is hardly surprising. Indeed it is entirely rational. In my view the solution is a top-down one. We have accepted that we can and must live with the JAA skill test format which has been adopted unchanged by EASA. The solution is "top-down" in the sense that if the way the skill test was administered were changed significantly, instructors and schools would adjust their training to suit.

The role of the instructor

In the UK the instructor is at the bottom of the hierarchy and is made to feel this. They are expected to teach to SOPs but the more exaggerated SOPs (often deriving from an airline environment) are abandoned when the needs of the school demand this. They have very limited authority and responsibility. Authority resides up the chain with the chief instructor, the examiner and the CAA. Typically they are not very well paid, with career opportunities and working conditions being less than ideal. This is hardly the way to inculcate a sense of self-worth and responsibility or to breed instructors who radiate a commitment to, and belief in, their teaching.

Contrast this with the USA where an instructor is effectively on his own. They can take a candidate through the whole course in the way that they believe works best. They make the decision as to the candidate's fitness for test. The self-employed examiner audits the competence of this instruction and signs the candidate off for their IR. However, all is not perfect. Instructors pay and working conditions may still be poor but their sense of self-worth and integration into the real world of GA flying is much greater. Market forces and word-of-mouth have as much if not more impact on quality than any regulatory process. The experience of *PPL/IR Europe* members is that in general the US model works better and fits them better for their subsequent flying. Of course there are bad experiences but these happen with variations in standards within the current European system too. I believe that instructors can be trusted to take more responsibility and sign off competences within the EASA system.

What PPL IR pilots really need

There is a marked mismatch between what is hard in the skill test and what is hard in everyday single pilot instrument flying. This is partly inevitable as it is important for the basic skills achieved in training to be of a high level since they are unlikely to improve over time. However some of this mismatch is less defensible. It must be wrong that a key feature of testing in one country (very low asymmetric committal heights) is regarded as actively dangerous in another, or that a method of navigation derided in one (track crawling) is the preferred system in another. Surely what we are looking for is safe outcomes which, except in emergency situations, do not inconvenience others and facilitate the smooth working of the system. There are only a few issues such as busting minima and infringements where no latitude is possible. In almost all other situations anything which achieves the desired outcome safely should be acceptable. Most of all the single pilot faces difficult decision making while under time pressure:

> *"What speed can you give me to the marker?"*
>
> *"Sorry plan B. Runway changed to 06 radar heading 240 degrees keep your speed up call Director on 123.45 with the heading"*

Single pilot IFR is not about perfectly planned routes perfectly flown. It's about adequately but safely flown routes coping with unexpected events. I suggest that the test should reflect this. Threat and Error Management (TEM) is now in favour. The practical application of this in the GA context is by giving candidates emergency and abnormal scenarios and assessing their response. This is entirely in keeping with developing decision making skills for single pilot IR flying; however all this is the complete antithesis of the current teaching and examining process where everything is pre-briefed in minute detail.

Test standards

The formal performance standards are laid down in law and are reasonable. The reality is that examiners are far more real-world than some candidates or flying schools realise. There is a difficult balance to be drawn. Examiners cannot say that the legal standards will be ignored, but it is the examiners problem to find ways in which the performance they are really looking for is promulgated. Candidates should have an intelligent understanding that a momentary encounter with half-scale deflection on the ILS promptly and smoothly corrected is preferable to an unstable ILS with desperate inputs to avoid half-scale deflections. Examiners face the problem that they want unarguable fail points, when the reality is that the candidates overall performance and airmanship was poor. That is the examiners' problem, not the candidates. I suggest there is little evidence worldwide of successful legal action by failed candidates and the issue is exaggerated. If the reality is that they failed because their overall flying skills, spatial awareness and decision making was poor, then that should be the reason given for failure.

Aircraft equipment

It is not legally supportable for any examiner to refuse to test on an aircraft which is airworthy and legal for instrument flight in general. If a candidate appears to be abusing this flexibility then it is reasonable that other elements of the test will be more demanding to compensate. I suggest that market forces will ensure all aircraft are appropriately equipped. For example, if an aircraft operates out of an airfield with both a GPS and NDB/DME procedure but the aircraft has no ADF then, unless the candidate has a convincing rationale in the oral, it is likely that they will experience a simulated GPS failure scenario and a demanding diversion in the skill test.

A possible test format

Here is a model test process for consideration:

1 The candidate can select any examiner they want but the CAA are informed in advance and always have the option of taking over the test with a staff examiner on identical terms.
2 Any legal aircraft and airfield may be used.
3 Several days in advance of the test the school or candidate makes their training record available to the examiner together with all relevant paperwork for the candidate and for the aircraft. This enables issues to be identified in advance and avoids waste of candidate, instructor or examiner time.
4 It is clearly understood that any deficiency in the aircraft, training records or location may, at the examiners discretion, be compensated for by a more extensive flight test. For example, if a candidate is located at a quiet airfield the expectation would be that busy airfields would have been visited during the course. If the aircraft has no ADF then this limitation should have been addressed in the training.
5 The day before the test the examiner gives the candidate a route to plan. It will not be flown—it is "real-world" designed to utilise the capability of the test aircraft to the maximum. Using the weather of the day will be the focus of an oral examination before the flight test. This can bring a reality to issues such as range, C of G, freezing levels etc, each of which will be of later benefit.
6 Much of the briefing and administrative actions which presently take up time before a test will have been dealt with well in advance, thus leaving more time for the oral.
7 Assuming that the candidate has provided excellent evidence of appropriate and varied training, the examiner can then seek the minimum snapshot which is ICAO/EASA compliant. If this is all possible at the base airfield without entering CAS, it will be a big plus for everybody. The examiner takes responsibility for navigation whenever outside CAS.
8 Walk out to the aircraft. Pre-flight checks appropriate to the circumstances. Unless it is the first flight of the day a transit check is acceptable. Focus is on critical checks rather than exaggerated long checklists.
9 The examiner briefs the departure at the holding point simulating an ATC clearance of whatever kind the examiner requires. They can privately pre-brief ATC if this is helpful.
10 The candidate navigates to a general handling area at an appropriate level by whatever means the examiner chooses to specify. Once there they carry out the usual limited panel and handling exercises.
11 At the examiner's discretion the hold can be en route on a GPS point, a VOR radial or back at the beacon.
12 Precision and non-precision approaches with missed approach are flown as required with instructions given to the candidate by the examiner after the general handling. This again simulates the typical real situation when arriving at an airfield with multiple procedures.
13 At any stage during the flight the examiner will simulate selected emergencies and abnormalities taken from a published list.
14 Pass/fail arrangements and the debrief remain unchanged.

I suggest that such a process would not only have no negative impact on quality but would encourage instructors and schools to deliver training which is of a high standard with a much greater focus on issues of relevance to PPL IR holders' future flying. It will make the course and the skill test more likely to be perceived as relevant, perhaps even enjoyable! And last but not least, in combination with the proposed EASA flexibilities, it will stand a real chance of reversing the decline in PPL IR numbers and make a real contribution to the viability of UK training organisations.

Pilots' talk

Compiled by Sahib Bleher

Australia relaxes PPL medical requirements

Australia's Civil Aviation Safety Authority (CASA) has announced liberalised flight medical standards for private and recreational pilots which include a 3,200-pound maximum weight for aircraft and allow pilots to register their medical fitness online. In a newsletter to Australian pilots, John McCormick, CASA's director of aviation safety, said the idea was to make it easier for pilots to maintain medicals without sacrificing safety. "Having robust medical standards is a key element of aviation safety and this initiative ensures safety standards remain high while making the system simpler" McCormick said. Pilots will still have to get regular medical assessments (every two years for those 65 or younger, and every year after that) but they're based mostly on driver's licence standards and can be done by their family doctor. Australia requires all drivers to self-declare medical fitness to maintain their licenses. After being signed off by a GP, the pilot registers his or her medical fitness online and keeps the printed copy with him or her while flying.

Avidyne launches IFD440 touchscreen FMS/GPS/NAV/COM upgrade

Avidyne Corporation has introduced the IFD440 FMS/GPS/NAV/COM system with Hybrid Touch user interface, adding to its full line of plug-and-play avionics. Avidyne comments, "As a plug-and-play replacement for legacy GNS430-series navigators, the IFD440 can reduce installation cost and downtime for customers looking to add touch screen, or who are upgrading their aircraft to meet the higher-precision requirements for Satellite-Based Augmentation Systems/Localizer Performance Vertical Guidance (SBAS/LPV) and Automatic Dependent Surveillance-Broadcast (ADS-B)."

Avidyne previously announced a full stack of plug-and-play panel-mounted avionics including the larger-screen IFD540 FMS/GPS/NAV/COM, the AMX240 Audio Panel, the AXP340 Mode S ADS-B Transponder, and the DFC90 digital Autopilot with Envelope Protection and Envelope Alerting. The IFD440 and IFD540 are based on Avidyne's award-winning Entegra Release 9 flight management system (FMS).

UAV test flights in UK airspace

A pilotless aircraft is being tested out in preparation for its maiden flight in shared UK airspace later this year. The aircraft, a BAE Systems Jetstream aircraft—The Flying Test Bed—is being put through its paces in a series of at least 20 flights over the Irish Sea and through UK airspace. Although it will be pilot-free during the tests, there will be people on board able to take the controls if the need arises. The aim of the trials is to demonstrate to regulators such as the Civil Aviation Authority and air traffic control that unmanned aerial vehicles (UAVs) will be able to be used safely in UK airspace.

The tests are part of a long-term research project called ASTRAEA—which stands for Autonomous Systems Technology Related Airborne Evaluation and Assessment. A statement from ASTRAEA explains that the trials will include "the world's first use of autonomous, vision-based weather-avoidance routing and the first UK surrogate flight of a fully functional visual sense-and-avoid system which includes collision avoidance tests using a second aircraft".

Drone concerns across the pond

In the USA, UAVs have already been used for fire fighting and crop management and are being tested for search-and-rescue missions. Elsewhere they're being deployed to shoot video for television news and conduct law-enforcement surveillance. The Federal Aviation Administration estimates that by 2015, more than 30,000 unmanned aerial vehicles will be flying through US skies. Ambitious as these estimates sound, the related problems have not yet been resolved. For example, the vulnerability of UAVs to hacking can present many dangers, says Todd Humphreys, a professor at the University of Texas, Austin. "I'd like to see the problem solved at the source, at the GPS satellites themselves" Humphreys said. "They're transmitting an open civilian GPS signal that's easy to hack." With regard to the risk of collisions, the US government is soliciting proposals from applicants seeking to host one of six national test sites, where researchers will figure out how to make safe, integrated flight in the civil airspace a reality. About 30 states are vying for selection in December.

The accident rate with drones is seven times that of general aviation and more than 350 times higher than commercial aviation, FAA officials said in testimony before Congress in 2010. There are also some privacy concerns. A recent poll showed 42% of Americans were "very concerned" about their privacy if law-enforcement agencies use drones with high-tech cameras. Researchers at Monmouth University found strong support for drone use in search-and-rescue missions, tracking fugitive criminals and controlling illegal immigration, but strong opposition to using them to issue speeding tickets. The American Civil Liberties Union (ACLU) warned that once law-enforcement agencies acquire drones, they'll be tempted to use them for unauthorised surveillance. The ACLU also warned of the potential of widespread intrusion into daily life. Among the concerns were UAVs with night-vision equipment, emerging technology which can "see through" walls, and video analytics which can track individuals using facial-recognition software. Video also can be streamed live on the Web, drone pilots say. "These vehicles are like flying robotic video cameras: they're small, cheap and portable, and allow for pervasive surveillance in ways that aren't possible with helicopters" said Alessandra Soler, executive director of the ACLU of Arizona. Meanwhile, the Association for Unmanned Vehicle Systems International (AUVSI) published a set of guidelines to help ensure that drone aircraft are operated in a "safe, non-intrusive" manner. "By proactively adhering to these guidelines, we want to demonstrate how the rights of individuals and the safety of all users of civil airspace are our top priority, as we work to unlock the incredible potential this technology holds" said Michael Toscano, president of AUVSI. Their code proposes that all UAV operations should promote "safety, professionalism, and respect".

Garmin's new GLO GPS for tablets

If Garmin is feeling the heat from GPS-enabled tablets and smartphones, it's not taking the competition lying down, having just launched its GLO—a new self-contained GPS receiver which links wirelessly to Android and iPad tablets via Bluetooth, providing position updates up to ten times a second. Remote GPS gadgets for tablets aren't new, but Garmin has equipped GLO not just with GPS, but with a receiver for Russia's GLONASS system. That puts another 24 satellites on the table for rapid time to first fix and more robust position sensing once the location has been calculated.

Patented Smart Recovery System

Aviation Safety Resources (ASR) has earned a patent for what it calls the Smart Recovery System for General Aviation Aircraft, which "automatically deploys the appropriate device" for a given emergency situation. The company says it is using sensor systems currently available in commercial and military aircraft. It "detects the environment" and "makes decisions based on monitoring data." In practice, this would translate into a system that could deploy verbal warnings (if available), fire extinguishers, the autopilot, flight control, airbag and ballistic parachute recovery systems in response to diagnostic parameters. According to ASR the system evaluates conditions, identifies an emergency situation, and automatically commands available systems on the aircraft—unless overridden by the pilot.

Garmin digital weather radar

Garmin has developed a new digital radar with sophisticated display and analytical capabilities. The GWX70 is Doppler-capable and thus able to detect turbulence as well as precipitation. In the design of the new unit Garmin has ditched the expensive and occasionally troublesome magnetron tube, meaning that long-term maintenance of the system should be less onerous. The GWX70 will be suitable for 10, 12 and 18-inch antennas and will be compatible with a range of Garmin displays including the G1000, G2000, G3000 and G5000, plus lesser systems like the G500/G600 and the MX20. Of course, it's expensive and is unlikely to find its way into cheaper airframes.

Report on Air France crash urges better pilot training

French air crash investigators urged enhanced pilot training, improved cockpit instrumentation and better search-and-rescue procedures in their final report on the 2009 crash of an Air France Airbus A330 into the Atlantic Ocean, which killed all 228 people on board. "The crew never realised that the plane had stalled" chief investigator Alain Bouillard told a news conference. The causes of the accident—one of the worst ever for a French-registered aircraft—were well-documented in a previous report by the French Bureau d'Enquêtes et d'Analyse a year ago, after recovery of the aircraft's flight recorders from the ocean bed following a two-year long search. The crash has already prompted sweeping changes in pilot training at Air France, as well as inside many other carriers around the world. The cockpit voice recorder and the flight-data recorder revealed that the aircraft got into difficulty as its speed bled off when it crossed a zone of air turbulence en route to Paris from Rio de Janeiro, ending up in a free fall after it stalled in a nose-up attitude.

Contributing factors to the accident which had already been identified included the freezing of pitot tubes, which temporarily provided incorrect air speed data to the aircraft's pilots and computers; a disorganised response by the pilots to the erroneous readings and warnings received from their instruments; and gaps in pilot training on how to deal with a high-altitude stall such as the one encountered by Air France Flight 447. The cockpit crew failed to respond to repeated loud warnings from the aircraft's stall warning system. According to the report, after the autopilot disconnected the co-pilot at the controls failed to follow the basic airmanship rule: keep the aircraft flying safely and then troubleshoot. The 32-year-old co-pilot at the controls failed to "indicate his intentions or objectives with respect to the control and stabilization of the flight path". For the first time, the report also raises pointed questions about the captain's decision to leave the cockpit for a routine rest period while the flight was crossing an area renowned for major, high-altitude storms. In its interim report last year, the BEA issued recommendations for pilot training, notably handling aircraft without using computers, and saw a need for the installation of an angle of attack indicator in A330 cockpits so that pilots can visualise the extent to which an aircraft is nose-up or nose-down.

New technology for ice-repellent wings

A research team from Harvard University has developed a treatment for metal surfaces to keep them free of ice and frost, the Harvard Gazette reported. "The technology prevents ice sheets from developing on surfaces, and ice that is present slides off effortlessly" the Gazette reports. The researchers' new technology, called Slippery Liquid Infused Porous Surfaces (SLIPS), uses nanostructures to create an ultra-smooth, slippery surface. "This new approach to ice-phobic materials is a truly disruptive idea" said Joanna Aizenberg, leader of the research group. "We are actively working with the refrigeration and aviation industries to bring it to market."

Aizenberg and her team developed a way to coat metal with a rough material that locks in the lubricant. It can be applied over a large area, and it's non-toxic and anti-corrosive. Their tests have shown that surfaces coated with the material remain "essentially frost-free" in conditions where conventional materials accumulate ice. "These results indicate that SLIPS is a promising candidate for developing robust anti-icing materials for broad applications, such as refrigeration, aviation, roofs, wires, outdoor signs, railings and wind turbines" the researchers said.

Changes to Dartmoor MoD danger area

The CAA has given support to a Ministry of Defence (MoD) plan to alter the way the Dartmoor military Danger Area is managed. Whilst freeing up a substantial amount of Class G airspace for use by General Aviation, the new arrangements are not expected to generate any fundamental change to aircraft movements within the Dartmoor region. The Danger Area airspace will be sub-divided into three new smaller Danger Areas (set within the present lateral dimensions) which will allow greater flexibility as each individual area will have its own operating hours. Each mini Danger Area will be closed as and when required by the military, possibly leaving the other two open to other airspace users. Currently, the whole Danger Area is closed, regardless of how much is actually being used. Closures will be notified by NOTAM.

NTSB warns pilots: Weather radar can be misleading

The "age indicator" on some in-cockpit weather displays can show a time stamp that's off by as much as 20 minutes, the NTSB warned in a safety alert. "Even small time differences between the age indicator and actual conditions can be important for safety of flight" the safety alert says, "especially when considering fast-moving weather hazards, quickly developing weather scenarios, and/or fast-moving aircraft". The NEXRAD "age-indicator" on the cockpit display indicates the time the mosaic image was created, not the time of the actual weather conditions. The NEXRAD image is always older than the actual weather conditions, the NTSB said.

The NTSB said it has investigated two fatal weather-related aircraft accidents in which NEXRAD images displayed to the pilot were presented as one minute old on the age-indicator, but contained information that was up to five to eight minutes behind the real-time conditions. The mosaic images, which are available to pilots via flight information service-broadcast (FIS-B) and private satellite weather service providers, are created with radar data from multiple radar ground sites. When a mosaic image is updated, it may not contain new information from each ground site.

EU abandons plan to end liquids ban on aircraft

The European Union has abandoned a plan that would have ended a ban on liquids at airport security checkpoints by April. Moving forward with the change would "represent a considerable operational risk mainly due to the scale of the change" an EU statement says. The EU will consider new legislation on the liquid ban in the autumn and indicated that a "phased approach" is necessary for allowing liquids through security. The irony is that the restrictions only apply to the "export" of liquids from within the EU on scheduled passenger flights. Flying with the same carrier into Europe from destinations in Africa or Asia, liquids can be "imported" freely without being intercepted at airport security. Maybe their water is simply much safer!

Getting down*

Rod Machado

Reasonable people can disagree about how to fly an instrument approach, with both sides of the argument having some merit. This applies to a discussion I had with an experienced instrument flight instructor about how to descend to the minimum descent altitude (MDA) on a non-precision instrument approach. We disagreed over two approaches to approaches. The constant airspeed technique (my recommendation) has a pilot making a descent to the MDA, leveling off, and flying to the missed approach point (MAP). If the pilot has the required visibility and identifiable runway environment, he descends and lands, but only after reaching the visual descent point (VDP). The constant rate technique (the alternate recommendation) has a pilot flying a constant-rate descent in hopes of reaching the MDA at the precise point where it intersects the VDP. At that time and place, the pilot decides whether or not he has the required visibility and identifiable runway environment sufficient to land the airplane. If not, he executes a missed approach.

When I ask instructors why they support the constant-rate technique, they typically say that a quick, rapid descent directly to the MDA increases the chance of controlled flight into terrain (CFIT). They assume that a pilot shouldn't be trusted to quickly descend to an altitude that's relatively close to the ground. So here's the truth about CFIT accidents. They are rarely caused by pilots descending through the MDA and into the ground after leaving the final approach fix. Instead, most CFIT accidents are caused by pilots leaving the MDA prematurely after sighting the runway environment (often way before reaching the VDP). Perhaps influenced by approach illusions or attempting to duck under a cloud layer, some pilots end up flying an abnormally shallow glidepath, which can turn a perfectly good airplane into a dirt bike. CFIT accidents have dramatically decreased over the years, primarily because of the increased use of VDPs found on many instrument approach charts. If a pilot waits to descend from the MDA until reaching the VDP (as he should), he can expect to make a normal, obstruction-free descent to the runway's touchdown zone.

The problem with using the constant-rate technique for non-precision approaches, however, is that it doesn't give you the best chance of landing under low-visibility conditions. Proponents of the constant-rate technique want you to treat your simultaneous arrival at the MDA and the VDP (which is seldom simultaneous) as a decision altitude, as if you're flying an ILS approach. Since no electronic glideslope is involved, your ability to reach the MDA and VDP at the same time is only as accurate as the least predictable variable influencing your descent (which is typically the wind, thus your groundspeed). This assumes, of course, that you precisely control your airspeed and descent rate, too. In most instances, you're as likely to arrive at the MDA beyond the VDP as you are to arrive at it prior to reaching the VDP. The former might place you at an excessively high altitude for landing. The latter might place you at an excessive distance from the threshold, making it more difficult to assess the in-flight visibility and runway environment.

Standalone non-precision approaches seldom have an approach lighting system (ALS)—the ALS is associated with ILS approaches. These lighting systems extend 1,400 to 3,000 feet from the runway environment, making it easier for a pilot to evaluate his landing requirements on an ILS approach. The lighting typically associated with non-precision approaches is runway lighting (typically MIRL, REIL, and some type of VASI), which is located on the landing side of the threshold. When making your decision about whether or not to land, the farther you are from the runway and its lighting, the more difficult that decision will be in low-visibility conditions.

The constant airspeed technique also keeps you above the MDA until reaching the VDP. Certain VASIs, however, are designed to be seen better at lower altitudes. For instance, with one mile visibility during the day in fog, the PAPI can be seen at a distance of 1.5 miles from the threshold at 480 feet agl. Under the same conditions, at 700 feet agl, you'll need to be 0.9 mile from the runway threshold to identify the PAPI.

There's little or no advantage to remaining higher on a non-precision approach during low-visibility conditions. The advantage lies in getting down to the MDA quickly where you'll have more time to watch for the runway lighting to appear. Of course, you should always wait until reaching the VDP before beginning your landing descent. Descending at 800 fpm at 90 to 100 knots should get you down to the MDA in plenty of time to help you identify the runway environment. Strangely, some instructors refer to this descent rate as "diving and driving" to the MDA, but it's hard for me to imagine why, especially when you consider that the FAA's maximum descent rate for an approach is 1,000 fpm when less than 1,000 agl. Ultimately, non-precision instrument approaches were originally designed to be flown by descending and tracking, which isn't diving and driving. This is why the Air Force Instrument Flying Manual says that you should "arrive at the MDA with enough time and distance remaining to identify [the] runway environment and depart [the] MDA from a normal visual descent point…"

Rod Machado is a flight instructor who owns a Cessna 150. Rod Machado's training books are available in iPad format.

How to help your wife enjoy flying and keep flying yourself

Judith Niechcial offers some practical tips from her experience as a flying non-pilot partner

It is almost a truism that pilots who gain their PPL—at great expense of time, money and effort—tragically give up flying quite soon if they cannot engage their spouses/partners in their flying adventures. Time out of a busy week to escape to the airstrip for a flying fix can go down very badly with a partner who does not enjoy and/or understand what the attraction is. This may be especially the case when there are young children in the family, and maybe two careers to manage. As for going off for a week at a time with a mate or a fellow owner of a group aircraft, forget it!

Achieving the PPL is not, of course, the end of the story. What about the exciting challenges of that night rating, that IMC, that twin licence, or even that Instrument Rating? How can the huge expense of these be justified in the household budget if only one member of the family is going to benefit from these ratings? As a partner who finds going around the UK and Europe in the right hand seat beside my pilot husband a huge joy, I decided to put forward a few suggestions which I hope may help new pilots keep their flying in the family, and therefore keep flying. I am aware that what follows may be seen as giving credence to conventional gender expectations, but it could also be gender-reversed if the pilot is the woman and the partner a man (or indeed if we are talking about a same sex couple).

To start with, when you first get that shiny new PPL do not be tempted to show off to your partner right away. First gain confidence, and consolidate your skills thoroughly. Nothing is more off-putting to a nervous first-timer in a light aircraft than a pilot who is not rock-solid in radio communication, navigation, familiar with every aspect of the cockpit, and able to be calm and collected if the unexpected does happen, which it often does when you are newly minted at either PPL or IR level. When you get her in the cockpit for the first time, give a thorough cabin-crew type briefing, explain about thermals, and how a light aircraft generally wobbles more than an airliner, and is much noisier. Execute the gentlest of turns and do not be tempted to impress with your side-slipping skills. Choose a day with calm and sunny weather. Never even think of leaving the ground if there is the slightest possibility of cloud at the wrong flight level, let alone rain. Don't attempt short runways with a passenger until you are ultra-confident. Careering into the hedge at the end of the grass runway is likely to put her off flying for ever (as it did when a member of our group did just that several years ago at Barton. Another group member's wife was put off for ever by a sudden gust and consequent go-around at Popham). Always remember that what might be routine for you (eg a large crab angle on approach, or a sudden sink with extra power on short final) can be very daunting for someone who has only ever experienced the airlines Also never be tempted to put the kids, let alone the dog, in the back seat until you are sure she is confident and happy in the front.

After all these potential negatives, here are some positives to help her get enthusiastic. Emphasise the huge benefit of getting where you

want to go quickly and the ability to visit places you would never otherwise be able to reach easily unless in a light aircraft—the possibility of a trip around the Western Isles of Scotland was a big draw for me early in my flying days. Try out several touring airfields yourself and, before choosing where to take her to, check out one with a good restaurant near interesting tourist destinations or access to something of particular interest to her. A trip to a vintage aircraft museum or a race track, however unmissable for you, is unlikely to appeal. Sea crossings, even for lunch at Le Touquet, should be left until you feel really confident in her peace of mind. Remember to emphasise the long gliding capacity of your aircraft and the comforting accident statistics.

Okay. Once you have engaged her in the process, here are some tips for keeping her involved. Explain the basic instruments: the DI; the altimeter; the transponder; and ask if she would like to help by, for example, keeping a look out for other aircraft. She could keep track of your position on the VFR chart. Even if you have a GPS, and especially if you're using an IFR chart, that is a useful job. With very little induction she will be able to set the squawk, set the QNH on the second altimeter, dial in the radio frequencies, and double check altitude clearances. With a little more guidance she will be able to monitor the autopilot or hold the aircraft straight and level while you have a head-down task to do. My husband has a P2 checklist for me which I call out on final—a real boon to safety at a flight critical time. All these jobs free up your workload and help her to feel that she is involved and contributing to the success of the flight. On longer trips the labour can be successfully divided. You are responsible for the flight planning and the weather decisions, she for booking hotels, restaurants, and taxis. In this way you both have equal status as trip organisers and are set fair for a great holiday. That will keep her coming back for more. Happy family flying!

Gaining TB20 KLN94 GPS approach approval (FAA)

Peter Holy describes both the technical and bureaucratic aspects of gaining this approval

Before an IFR GPS can be used for flying GPS/RNAV approaches it needs to be approved for this purpose by the aircraft's certification authority. Merely installing an IFR GPS with the required separate annunciator is not enough. This is true for USA (FAA N-reg) and European (EASA G-reg etc) aircraft, although the process is different between the two. This article describes the process of obtaining such an approval. It was done with a new AFMS (approved flight manual supplement) for a KLN94 GPS in a US registered Socata TB20GT.

The KLN94

The Honeywell (formerly Bendix-King) KLN94 is a good basic IFR GPS which does everything operationally relevant to flying IFR around Europe. Many thousands were installed (by both new aircraft manufacturers and for upgrades) during the 1990s and up to around 2003 until production was finally discontinued in 2011. It interfaces to many industry standard fuel totalisers and airdata computers, and also interfaces elegantly to the KMD550 MFD (the upper unit in the picture on the following page) which delivers excellent IFR+VFR mapping (including European visual reference points). The KLN94 is authorised *by the manufacturer* for all LNAV-only IFR operations including GPS/RNAV approaches. The KMD550 in turn interfaces to standard TCAS products such as the Avidyne 600 series up-market GPWS systems, and its NTSC video input supports weather radar, or whatever can output NTSC video.

Surprisingly for an IFR approved GPS, the KLN 94 database does not contain any RNAV SIDs/STARs, which therefore precludes its legal use for such procedures. Bizarrely, however, the database appears to contain all their individual waypoints which can easily be manually inserted into a flight plan. It is a mystery why Honeywell introduced that limitation, but it is not currently operationally relevant, not least because most if not all airports that publish all-RNAV terminal procedures do not operate them and use radar vectoring instead. The database does contain non-RNAV SIDs/STARs. The KLN94 has no vertical (VNAV) signal output and it does not support LPV (GPS/RNAV with a synthetic glideslope) approaches or variations thereof. This is also not operationally relevant in Europe, where almost no LPV approaches exist, and I am not expecting this to materially change for perhaps ten years. Due to a lack of a specific Letter of Authorisation (LoA) from the manufacturer, the KLN94 will never be approved for PRNAV, even though it is perfectly capable of the required accuracy (RNP 1.0). This legal technicality is yet another mysterious Honeywell decision. PRNAV is perhaps the biggest cloud on the horizon for European IFR GA, and this aspect alone may force an expensive avionics refit one day. But not yet!

Europe has been gradually introducing ordinary GPS/RNAV approaches, but it is more than 15 years behind the USA. Progress in the UK remains crippled by the legal requirement for ATC to be in place for any instrument approach, which prevents instrument approaches (of any kind) being introduced at nearly all airfields that would benefit from them most. I cannot recall a single instance of an airport outside the UK which has Customs (required for any flight between the UK and the rest of Europe) and whose only instrument approach is a GPS approach. But GPS approaches are slowly becoming operationally relevant because older navaids (NDBs etc) are sometimes out of action—airfields with funding issues can be slow to repair them—and GPS approaches tend to offer a small improvement on the decision height.

Unfortunately for me the aircraft was originally delivered (2002) with a KLN94 AFMS from Socata which approved only IFR en route (BRNAV) operations, not SIDs/STARs or GPS approaches. Every TB20GT came with the now infamous GPS supplement and the following placard was present:

It is not known why this restriction was imposed, but enquiries via Socata suggest it was at the insistence of the DGAC. The same "certification authority" also demanded that the WX500 Stormscope display does not rotate according to the aircraft heading because, if it did, the pilot might use it to avoid thunderstorms. The certification authority also demanded that the Shadin fuel totaliser transducer be mounted on the passenger side of the firewall, in breach of the Shadin STC, where its reading was sufficiently affected by turbulence to result in errors of 20–30%. To be fair to Socata, there were no GPS approaches in Europe (or probably anywhere in the world outside the USA) in 2002, and aircraft which they exported to the USA were modified locally, as mentioned below. The actual aircraft and the GPS installation have always been fully capable of flying GPS approaches, so this was only a legal (paper) restriction which meant the aircraft, as delivered, could not legally fly standard GPS approaches such as Shoreham's. However, because there is no law prescribing the method used to actually navigate, the GPS can 100% legally be used to fly the NDB/DME approach to the same runway. In the USA, on such approaches, the GPS may similarly be used in lieu of DME, ADF, or VOR, but is not authorised for the final approach segment.

It is very unlikely that one would be picked up for flying a GPS approach using an unapproved GPS, but where is one to draw the line? This could be debated for ever but in this case the request to fly the GPS approach is made openly on the radio and someone familiar with the aircraft who happens to be listening on the frequency could report it or otherwise cause trouble. A worse case scenario might be where an IFR flight plan is filed to an airport whose only instrument approach is a GPS one—the flight would be illegal before departure and this would impact the insurance.

Changing the AFMS

Fortunately an AFMS can be changed, or a completely new one can be created, but this is a not a trivial job because under FAA (and to some degree similar EASA) rules, changing an AFMS is a major alteration. In FAA-land this is done with a Form 337 supported by approved data. In my case, the lack of an aircraft-specific STC (the KLN94 STC is for a Beech Baron) meant that this had to be done as a field approval using a Form 337 (with some supporting documents) which has to be FAA approved (signed). In the case of a "field approval" one submits any data which the FAA finds acceptable and when the FAA inspector signs block 5 on the 337, that makes the data "approved data" for that installation. The AFMS is custom written for the particular aircraft and is specific to its registration number. Generally, a specimen text of the supplement is provided in the back of the installation manual (IM) for the particular GPS and this is used as the template for the new AFMS. The installation manuals are not in general circulation and only authorised dealers are supposed to have them, but they are easy enough to find on the internet. Assuming the GPS installation was done correctly, nothing physical on the aircraft changes; all this is purely paperwork! The exception to this may be where the GPS is initially configured for VFR-only (possible with the KLN94) in which case one needs the IM for the special key sequence required to enter the configuration page where IFR operation can be enabled. And the application for the modification should state something like "Placard stating 'GPS to be used VFR only' to be removed".

Over a period of several years I had contracted no less than four UK avionics shops to produce the custom AFMS for the KLN94. All had agreed to do it within a budget of £500. The first three got bogged down in technicalities and after some months each of them gave up. The fourth started on it and stopped when it got busy on other projects. All tried to sell me avionics replacements. There is little doubt that even a used GNS430 or GNS430W will make approvals easier, and they can be approved for PRNAV. Coming bang up to date, a GTN650 comes with an AML STC which makes the whole "Euro IFR GA paper collection exercise" trivial. However my KMD550 MFD is not Garmin compatible (in the OBS mode, in particular) so it would be a big job, changing the whole centre stack and installing a GTN750—perhaps £30,000. Once you have flown with an MFD, you will never want to fly without one; all the screens on the aforementioned GPSs are too small to be used alone. Conversion is also a job involving considerable downtime, which only one or two UK avionics installers are capable of doing well, so I am leaving it until it becomes absolutely necessary. I would also prefer others to wring the various issues out of the new GTN650/750 first. At time of writing, the GTN650 is unaware that Europe works in litres, for example. The reality is that the KLN94 does everything needed for European IFR.

Eventually, ten years into my ownership of the aircraft, I decided to have a go at it myself. A field approval is a lot easier if one can find a previous field approval for an identical aircraft and GPS. I tried to obtain a 337 plus AFMS, or even just the AFMS for another US registered TB20/KLN94 installation by contacting some US TB owners and some US Socata dealers. It is known that many TB20s/TB21s exported to the USA had this modification done by the Socata dealer in Florida. Despite there being perhaps 100–200 such aircraft "out there", I never managed to find anybody willing or able to supply the documents. Many pilots had apparently never even opened their flight manual. I did find some US pilots who thought they had a fully-IFR KLN94 installation, but it turned out they had the standard Socata AFMS. I did not get the slightest co-operation from Socata USA who should have the records but they are prohibited by the factory from supporting European owners. All very frustrating. Had I been able to locate even just the N-XXXX tail number of an aircraft with the correct paperwork, there is an easy process whereby for about $10 one can get a CD from the FAA with all 337s filed for that aircraft, but I had no obvious way of locating the tail numbers. There is a database out there (compiled by a very thorough plane spotter) of TB aircraft which is current to maybe 2009, but it provides no clue as to which ones are located in the USA and if so which US dealer might have sold them. I did in fact get an FAA approved KLN94 AFMS from the one US Socata dealer who could help—complete with tail number—but stupidly I lent it to one of the above mentioned avionics shops (without keeping a copy) and they lost it! So instead, I had to follow the more complex route and collect as much "supporting documentation" as I could.

My first attempt at a new AFMS was using an FSDO which I had used for a previous field approval (a Sandel EHSI installation). Unfortunately, the very helpful FAA inspector there had recently retired and I spent several months educating several of his colleagues on avionics trivia. Initially, one inspector claimed that a KLN94 is not IFR approved. How many thousands of Cessnas, Pipers, Beech, and other fully IFR approved FAR Part 23 aircraft were shipped with a KLN94? I sorted that one by sending them the installation manual and several FAA approved AFMSs for other aircraft (the Beech Baron for example). Then they found something else, and then something else… Eventually I almost got there and airmailed a 337 with all the supporting documents to the FSDO, but when I started chasing it a couple of months later it turned out they had lost the package! So I then emailed them the documents, which the inspector rejected, mostly because various signatures were missing—this was my fault because the documents I emailed were not the signed originals. At this point it became obvious that this FSDO was going to be very hard work. It's apparent that there is a lot of variation in FSDO expertise, but how does a European pilot find a helpful one? The aviation approval business runs on relationships built over time.

The FSDO officially responsible for Europe (the NY IFU) told me in 2010 they no longer do avionics approvals, which is scandalous. EASA does not make this any better. You get essentially a single point of contact but you never know what they will object to when you send in the application. However, out of my numerous aviation contacts I found a very experienced retired US avionics engineer, and with his help I was able to move forward. He visited his local FSDO and quickly sorted out what was required. He then presented the documents to them on my behalf. Some edits to the Honeywell sample AFMS were requested by the FAA. The 337 went back and forth several times to get the wording consistent. Clearly there is a business opportunity for a US-based avionics "agent" who can act in this way, on behalf of European owners. The FAA process is the same regardless of where in the world a US registered aircraft spends its time. It would not surprise me if some European avionics shops already have such a contact.

Due to all these hassles, many European avionics installers sidestep the unpredictable FSDO field approval process by paying a DER to generate the approved data. He generates an FAA 8110-3 form which is sent off with the 337 to the FAA in Oklahoma for filing. No FAA field approval is then needed. However, while this process produces a 337 supported by high quality approved data which nobody is likely to argue with (albeit at a hugely inflated cost to the end customer), very few DERs are authorised by the FAA to generate an AFMS. This is where Garmin, with their FAA AML STCs which include a pre-approved AFMS, have a huge commercial advantage. Now that Garmin have an EASA AML STC (GTN650/GTN750 products) they are obliterating the competition in Europe. In any major alteration scenario, most European avionics shops are simply not interested in installing anything other than AML STC products, and most of those are from Garmin.

Checking Proper GPS Operation

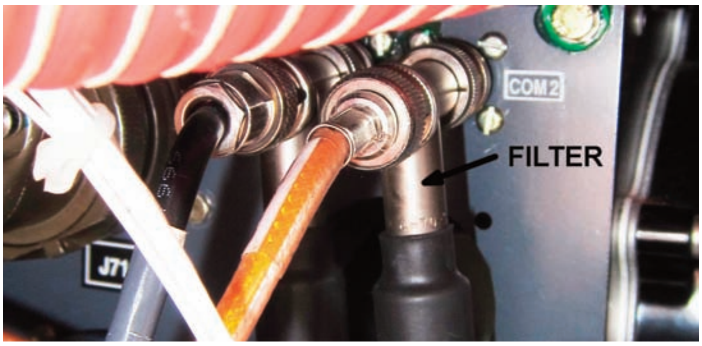
This is only the first step. The approach approval requires the GPS installation to be checked for proper operation and immunity from potential interference sources in the aircraft. The basic document for IFR GPS approval for both en route and approaches is FAA AC20-138A. Various local CAAs have developed their own procedures from the predecessor AC20-138. The current version is AC20-138C which doesn't appear to add anything relevant in this case. The most notable requirement is a test for interference from VHF transmitting equipment, on specific frequencies: 121.150, 121.175 and 121.200 MHz, and 131.250, 131.275 and 131.300MHz.

These frequencies are, in general, the ones whose 13th or 11th harmonic (respectively, for the two lines of frequencies above) lies on or around the L1 GPS frequency of 1575.42 MHz. Interestingly, the common BRNAV approval involves similar interference tests so any GPS installation which was properly BRNAV approved shouldn't have any problems.

VHF Interference

I quickly found that a transmission (pressing the PTT switch) lasting more than a few seconds from either of the KX155A radios on 121.150, 121.175 and 121.200MHz affected both the KLN94 IFR GPS and the yoke-mounted Garmin 496. Both COM1 and COM2 radios did it, with COM1 (which is mounted directly below the KLN94 GPS) being slightly worse than COM2. Although both GPS receivers recovered within a few seconds, such a gap in reception could have inconvenient effects. A loss of GPS reception is never useful, but it could result in a real jump in pilot workload if flying with the autopilot, in NAV mode, tracking a GPS track (which could be en route or when flying a SID/STAR/approach procedure). Here the loss of GPS signal would terminate the autopilot's NAV mode and return it to (probably) a simple wings-level mode. This discovery was surprising since the GPS installation was BRNAV (en route only) certified from the French factory (by the French DGAC) under the TB20 Type Certificate. I have no idea what (if any) VHF immunity tests the DGAC had specified; page six of the original Socata AFMS references AC20-138. More significantly, this particular aircraft was manufactured for the US market where the Socata dealers were routinely doing the full-IFR field approvals. When I bought it, it already had the N-number on it. So, either there is something odd on my particular aircraft, or Socata France skipped the immunity test in their original BRNAV compliance tests, and when Socata USA did their customised GPS flight manual supplements they either did not do the immunity testing or they developed a fix which never found its way into the Socata maintenance documentation. Enquiries to the usual contacts drew a blank.

A swap-over of the two KX155A radios eliminated the possibility of a faulty radio, and an installation of a brand new KX165A (8.33) radio did not eliminate the interference either. To the limited extent I was able to enquire via contacts at Honeywell, they were unaware of any relevant modifications (SBs etc) on the radios. However, there is much anecdotal evidence that there was a major redesign between the older KX155/165 and my KX155**A**/165**A** radios; the non-A versions were notorious for GPS interference. Unfortunately an upgrade to the 'A' versions is a re-wire because the rear connections are different. There is a general awareness in the avionics business of this issue; for example Collins sells VHF radios with claimed low GPS interference. The KLN94 installation manual also has a section on VHF interference. It lists a TED GPS filter P/N 4-70-54 inline notch filter which is installed in the VHF antenna cable, as close to the radio as possible. It costs from $80-$500 depending on where it is purchased from. An alternative and slightly more compact and cheaper filter is sold by Garmin. Note that the issue can also be caused by an ELT's output filter resonating around the 121.xx frequencies and re-radiating the transmission at a sufficiently high power to overcome the GPS receiver. The installation instructions suggest installing the filter as close as possible to the radio(s). Unfortunately, on the TB20, there is no easy way to do this given the way the radios and the GPS are located (the bottom three items in the centre avionics stack in the picture on the following page)



There is around 50cm of RF cable running from the output of each radio to bulkhead-mounted BNC connectors. This cable is not accessible short of extracting the entire centre avionics stack. On the TB20GT, the centre stack is actually cleverly done, with all of the connections passing through large circular mil-spec connectors and can be extracted whole in about one hour; this assumes the installer is familiar with the procedure, and that no previous installer has done any bodges. A common bodge is running wires directly out of the stack to the rest of the aircraft, without passing through any connectors, which makes it impossible to remove the stack without cutting those wires. If one extracted the centre stack, one could replace those cables with a higher grade type (the state of the art solution would be a mil-spec semi-rigid coax eg RG402) with the GPS filters installed very close to the radio outputs. On a Garmin avionics stack, the filter can be plugged directly into the other side of the floating RF connector which the radio plugs into, but Honeywell stacks use a hard-wired connector. A skilled installer could access the back of the radios without removing the centre stack by pulling out the KMD550 MFD, removing its connector backplate, and sticking his arm in through that hole. Very very tricky. A quick and interesting test was to temporarily fit standard 50 ohm terminators at these bulkhead connectors, to see if the elimination of most of the antenna cable runs and the antennae itself reduced the interference. It didn't. This proved that the radiation was coming out of that inaccessible cable run inside the centre stack, and also eliminated the possibility of ELT resonance as the cause.

The breakthrough was eventually made by fitting the notch filters to both radio outputs, not just the worse offending one. This reduced the problem to a level where GPS reception was not affected. Clearly there is some cross-coupling involved. The nearest location to the radio outputs that the notch filters can be fitted into easily is at the bulkhead connectors, where it is a one-minute job.

The picture shows the filters in place. The filters are free to rotate around their BNC connectors, and their resonant cavities (the bits that stick out at 90 degrees to the filter body) could end up touching each other. It is not 100% clear from an inspection of the filter whether every part of its casing is actually a continuous ground with the BNC connectors. Therefore, black heatshrink sleeving (visible in the picture) was placed over each filter's resonant cavity to prevent such contact. The filters need a logbook signoff—a minor alteration.

Generating the new AFMS

The new AFMS is most easily done by taking the above mentioned one from the back of the KLN94 IM and annotating it using the full version of Adobe Acrobat and under Comment/MarkUp Tools use the TextBox tool or some similar method. The original AFMS is a PDF made from a scanned document and is not editable, but that doesn't matter because most of the editing is blanking-out or replacing small amounts of text. Alternatively one could OCR the original and edit that. The edits were done as per the Honeywell instructions at the start of the document in the IM, with several edits which were requested by the FSDO. One of these was a new placard specifying no "precision" (ie LPV) GPS approaches, and no RNAV SIDs/STARs. On advice from the avionics specialist I changed a paragraph on page six of the PDF (page three of the AFMS) from *"Instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the KLN 94 data base. The KLN 94 aeronautical data base must incorporate the current update cycle"* to *"Instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the KLN 94 data base. GPS instrument approaches using the KLN94 are prohibited, unless the KLN94 unit's approach data is verified by the pilot or crew to be current".*

This is consistent with the AFMSs for other GPSs in the USA and permits eg the flying of a GPS approach using a non-current database provided the pilot has verified that the latest approach plates for that airport pre-date the GPS database. The final 337 form can be found online at `www.peter2000.co.uk/aviation/kln94-gps-approach-afms/KLN_94.pdf`. I have removed stamps, signatures etc whose publication is inappropriate.

When the 337 has been approved by the FSDO, it is signed by the A&P/IA and returned to the FAA for filing. With a normal avionics installation, the IA has to check that the installation conforms to the text of the FAA-approved 337. In this case, he only had to check the new placard:

GPS NOT APPROVED
FOR IFR PRECISION APPROACH
OR RNAV SID, STAR, ODP

In accordance with FAA procedures, these two documents (in their final FAA-approved form with all the signatures, which I can supply to someone embarking on a similar project) can be directly used to support a field approval for another TB20 aircraft with a KLN94.

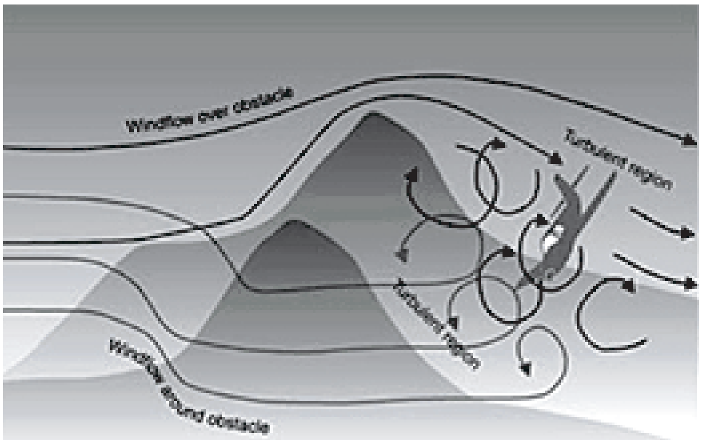
Mountain wave turbulence

Mountain waves and "rotors" are commonly experienced over and to the lee of mountain ranges and can occur in any part of the world where mountains exist. Mainland Europe, with its massive mountain ranges are where you would expect such activity, but the UK's Welsh and Scottish mountain ranges can also create the phenomenon if the conditions are right.

Mountain waves and "rotors" are among the more hazardous phenomena aircraft can experience. Understanding the dynamics of the wind is important in improving aviation safety. Glider pilots learn to use mountain waves to their advantage however some aircraft have come to grief. Encounters have been described as similar to hitting a wall. In 1966, a mountain wave ripped apart a BOAC Boeing 707 while it flew near Mt Fuji in Japan. In 1968, a Fairchild F-27B lost parts of its wings and empennage, and in 1992 a Douglas DC-8 lost an engine and wingtip in mountain wave encounters.

Mountain waves

Mountain waves are the result of flowing air being forced to rise up the windward side of a mountain barrier, then as a result of certain atmospheric conditions, sinking down the leeward side. This "bounce" forms a series of standing waves downstream from the barrier and may extend for hundreds of kilometres, which can be felt over clear areas of land and open water.



Turbulence forming downstream of a mountain

Formation of mountain waves relies on several conditions. The atmosphere is usually stable and an inversion may exist. The wind has to be blowing almost constantly within 30 degrees perpendicular to the barrier at a minimum speed of about 20 to 25 knots at the ridge-line. Wind speed increases uniformly with height and blows in the same direction. Wave "crests" can be upwind or downwind from the mountain range and their amplitude seems to vary with the vertical stability of the flow. The crests of the waves may be identified by the formation of lens-shaped or lenticular clouds, depending on sufficient moisture in the air. Mountain waves may extend into the stratosphere and become more pronounced as height increases. Some pilots have reported mountain waves at 60,000 . The vertical air-flow component of a standing wave may exceed 8,000 /minute.

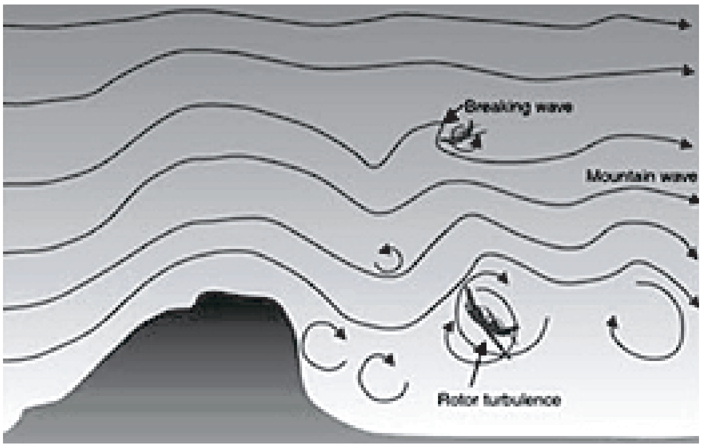
Rotors

Rotors or eddies can also be found embedded in mountain waves. Formation of rotors can also occur as a result of down slope winds. Their formation usually occurs where wind speeds change in a wave or where friction slows the wind near to the ground. Often these rotors will be experienced as gusts or wind-shear. Clouds may also form within a rotor. Many dangers lie in the effects of mountain waves and rotors on aircraft performance and control. In addition to generating turbulence that has demonstrated sufficient ferocity to significantly damage aircraft or lead to loss of aircraft control, the more prevailing danger to aircraft in the lower levels seems to be the effect on the climb rate of an aircraft.

General aviation aircraft rarely have performance capability sufficient to enable the pilot to overcome the effects of a severe downdraft generated by a mountain wave or the turbulence or wind-shear generated by a rotor. In 1996, three people were fatally injured when a Cessna 206 encountered lee (mountain) waves. The investigation report concluded, "It is probable that the maximum climb performance of the aircraft was not capable of overcoming the strong downdrafts in the area at the time". Crossing a barrier into wind also reduces the groundspeed of an aircraft and has the effect of keeping the aircraft in the area of downdraft for longer. An aircraft flying downwind is likely to place an aircraft in an updraft as it approaches rising ground.

Low level

Rotors and turbulence may also affect low level flying operations near hills or trees. In 1999, a Kawasaki KH-4 hit the surface of a lake during spraying operations at 30 . The lack of sufficient height to overcome the effects of wind eddies and turbulence was implicated as a factor involved in the accident.



Rotors are often associated with high ground, but not always

Research into mountain waves and rotors or eddies continues but there is no doubt that pilots need to be aware of the phenomenon and take appropriate precautions. Although mountain wave activity is normally forecast many local factors may effect the formation of rotors and eddies. When planning a flight a pilot should take note of the winds and the terrain to assess the likelihood of waves and rotors. There may be telltale signs in flight, including the disturbances on water or wheat fields and the formation of clouds, provided there is sufficient humidity to provide for cloud formation. Some considerations include allowing for the possibility of significant variations in the aircrafts altitude if up and downdraughts are encountered. A margin of at least the height of the hill or mountain from the surface should be allowed. Ultimately, it may be preferable for pilots to consider diverting or not flying, rather than risk flying near or over mountainous terrain in strong wind conditions conducive to mountain waves and rotors.

The main text of this article first appeared in the Australian Flight Safety Board's December 2001 Fact Sheet.

Two-axis autopilots: a blessing or menace?

Whether or not you are on autopilot, Nigel Everett explains why the primary task at all times remains the same: FLY THE AEROPLANE! (Copyright 1999 aopa online gallery.com)

The UK Aircraft Accident Investigation Branch (AAIB) report on the fate of G-BYEG on 12 May 2001 makes chilling reading. You can read all about it on www.aaib.co.uk, but briefly, this Cessna 182S with two pilots on board, husband and wife, took-off from their base at Leicester on the first leg of a trip to Copenhagen. The husband was in the left hand seat for this leg. Between 100 feet and 300 feet AGL in VMC, the aircraft adopted an increasingly nose high attitude, stalled and crashed, killing both on board.

This Cessna 182 was a 1998 model with a factory fitted two-axis Bendix/King KAP 140 rate-based digital system autopilot. After extensive consideration, the AAIB concludes that it is likely that any one of three buttons on the autopilot control panel had been inadvertently pressed after the trim position had been checked as part of the pre take-off checks. Full nose up trim would then have been applied insidiously with very little indication of this happening. After take-off the pilot may not have recognised in time what the nature of the problem was, or may have been physically unable to overcome the out of trim force.

AAIB recommendations

The AAIB has recommended that:

- *UK owners of aircraft with the Bendix/King KAP 140 should be informed of the potential problem,*
- *Cessna should revise its check list,*
- *The US FAA should ensure that effective action is taken to address the dangers associated with inadvertent engagement of the Bendix/King KAP 140 in altitude hold mode before take-off.*

The responses of Cessna and the FAA have been less than fully compliant with the AAIB recommendations.

Autopilot accidents

Instrument Pilot readers may recall the publication in the April/May 2001 issue of a report by Jack Lipscomb and Paul Bray Jr taken from ISASI Forum and entitled *The Mystique of Autopilot Accidents*. This drew attention to the alleged failure of many accident investigators to give sufficient attention to the possibility of the autopilot having been involved in many inadequately explained accidents. The report highlights the Mooney trim system because this has a screw jack actuator which is unlikely to move its position in a crash. Consequently the incidence of accidents to Mooneys where the autopilot appears to have been involved is much higher than it is in other types where evidence as to the pre-crash pitch trim setting is usually much less reliable because of the possibility of the setting having been moved by the impact. The report suggests that it is probable that the Mooney is no more subject to autopilot induced accidents than other types—it simply reveals this condition more readily.

Some readers may also recollect an article in the January 1997 issue of NETWORK where various experienced charter pilots offered their advice on the use of autopilots. There were various tales of autopilot control buttons being inadvertently switched on or off and of runaway autopilots. Reference was made to the crash of a light twin at night in the south east of England where it was thought likely that the pilot had inadvertently switched off altitude hold while searching visually for Blackbushe.

A gradual loss of power that went undetected in the climb out at about 2,500 feet in IMC was thought to be the likely cause of a fatal accident involving a Mooney from Sherburn-in-Elmet. The autopilot had been set to maintain the initial rate of climb and as the power gradually decayed the autopilot commanded more and more pitch up until the aircraft stalled. It is probable that if the pilot had been hand flying, at least so far as pitch was concerned, the existence of a problem would have become apparent far sooner. The aircraft broke out of cloud at low level apparently out of control.

Altitude hold

We must all be aware of the precept that altitude hold should not be used in potential icing conditions and this is because hand flying will make the pilot aware of the trim changes that icing will cause, while altitude hold will mask them from the pilot. Furthermore, when altitude hold corrects for a large trim change there may be large and unexpected out of trim forces to cope with either when the pilot deselects autopilot or if the autopilot should deselect itself automatically.

Instrument scan

Some of the earlier members of PPL/IR Europe may remember the two-day seminar at Maastricht given by Rod Machado and organised by Willem van Rijk. According to Rod Machado, one of the leading flight safety experts in the United States, US statistics indicate that a pilot flying with a two-axis autopilot engaged is far more likely to lose touch with the progress of the flight than one flying with a single-axis autopilot only. The reason offered for this is that having to monitor constantly the level or the rate of climb/descent keeps the pilot's attention sufficiently on the instrument scan.

Two-axis complexity

My own experience of two-axis autopilots is very limited and I am in no position to offer any detailed advice. In the light of the recent AAIB report, however, coupled with the substantial body of previous evidence, I should be very chary about operating an aircraft with a two-axis autopilot and I should want to address very thoroughly the multitude of possible inadvertent switchings and malfunctions and their possible consequences. I should want to know how to recognise these and how to deal with them promptly and effectively. I am a considerable fan of the single-axis autopilot for single pilot IFR, but I do not find maintaining pitch by hand at all taxing and I seriously doubt whether, for our sort of flying, altitude hold is ever worth the considerable risks that seem to come with it.

The views of other members, especially those with altitude hold experience, would be of great interest.

PPL/IR summer visit to the understated Viking City of Waterford

Sarah-Jane Richards reports on this summer's fly-out to Ireland

With previous trips headed for continental Europe, July 2012 saw this year's annual PPL/IR social weekend head westwards for Ireland. Thirteen members and partners attended the fly-out in five aircraft, with local welcome provided by our members from Dublin, David and Hilary Abrahamson. For most of us signed up to the summer 2012 weekend trip to Waterford, it was a wet departure leaving behind a sodden and flooded British landscape. Yet, in defiance of meteorological predictions, the skies cleared over the Emerald Isle permitting landings for most in dry conditions and an exploration of the city's historical gems in sunshine.

For those unfamiliar with Waterford, the City takes its name from the old Norse word of *Vedrarfjiordr* or windy fjord—a port which offered Viking ships safe haven from the tempestuous Irish seas. Here they established a settlement on the confluence of the rivers Suir and St John, with a circular defensive tower remaining today as Reginald's Tower. Founded in 914 AD, Waterford is considered to be the oldest settlement in Ireland.

Our tour of Reginald's Tower informed us of conflicts and of marriages between Norse warriors and monarchy, eventually seeing King Henry II retaining lands won by Strongbow—the armour clad leader of an Anglo-Norman invasion—in return for conferring upon Waterford the status of a Royal City. This paved the way for English and French merchants to transform Waterford, making it Ireland's chief port—a buzzing tableau of wine importation and exportation of wool and hides. This flourishing port witnessed a change of fortune in the 14th Century with the plague wiping out a third of the city's population. In 1495, a canon installed in front of Reginald's tower successfully repelled an attack by the young pretender to the throne of Henry VII, thus earning the city the name *"urbs Intacta Manet"*—Waterford, the Loyal City. A canon ball still remains lodged in the masonry of the tower as a relic of the battle.

Photograph Courtesy of Department of Arts, Heritage & Gaeltach

Reginald's Tower not only has a rich defensive history, but it also has been a mint, prison and military store.

Like many cities during the Reformation, Waterford witnessed political and religious upheaval. Patrick Walsh was consecrated the first post-reformation Bishop of Waterford and Lismore—the two names which have become synonymous with the City's world famous glass production.

A tour of the Waterford Glass Factory was, for most of us, the highlight of the weekend. Although glass making had already been established in Éire from the 13th Century, it was only in 1783 that the Penrose brothers William and George announced their vision "to create the finest quality crystal for drinking vessels and objects of beauty for the home". In fulfilment of this vision, cargoes of crystal left the port of Waterford bound for Spain, the West Indies, America and Canada. However, high taxes pushed profitability to the brink causing this illustrious enterprise to collapse in the mid-19th century. Its revival in 1947 with inspirational designs, clear cuts for which Waterford Crystal is renowned and a purity of colour, took world markets by storm.

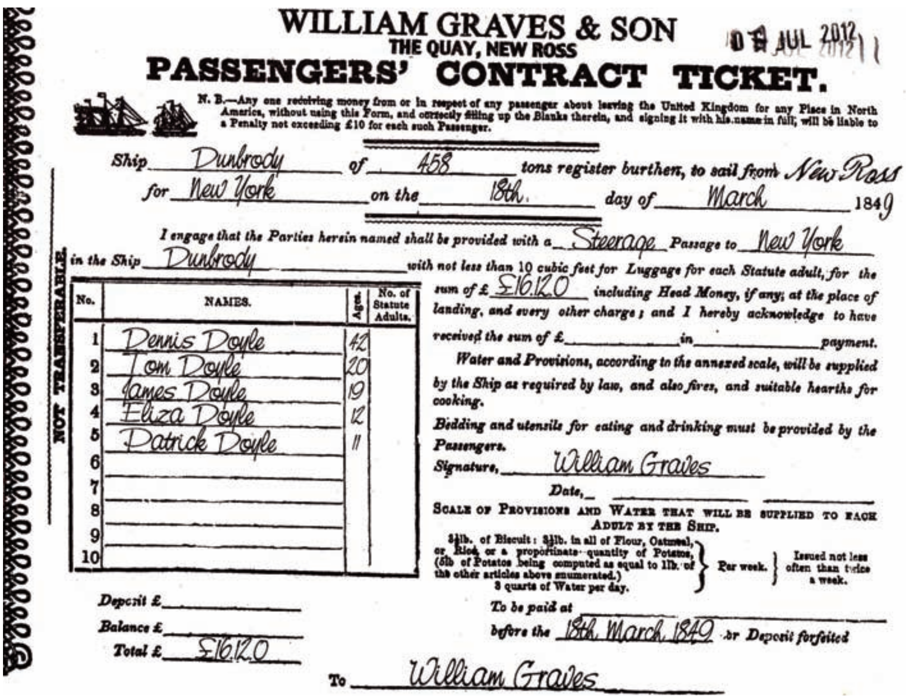
We watched as molten glass was collected at the end of a "blowing-tube" and inserted into a wooden mould. The glass was blown until the shape of the mould was assumed. Experienced glass cutters judged the depth of each cut ensuring an even pattern without puncturing the glass. The Olympian trophy designed for the London 2012 Games (shown above) is testimony to the workers' skill and craftsmanship.

Such fine crystal stood in contrast to the bleak conditions of Irish tenant farmers during 1845 and the following years when airborne fungal spores, originating from the holds of merchant shipping travelling between North America and England, fired a potato blight of unprecedented proportions. The fungus reduced potatoes to a foul-smelling, putrefying mass and, with a working man eating up to 14lbs of potatoes a day, famine soon struck and families had little choice but to leave their homes for the workhouse. When these overflowed, the choice became emigration or starvation.

Emigration was not without it's risks, with one in five passengers dying of typhus in cramped and filthy conditions on board boats constructed as vessels for merchant shipping. The replica Dunbrody moored just a few miles further up the estuary at New Ross, left us acknowledging this was no Atlantic cruise liner. Once on board, we were invited to "get into role" with performing artists complaining of the stench, lack of privacy, space and fresh air. The payment of a £16 12s 0d ticket secured a slightly more comfortable passage, at least more time spent on deck. It was noted that the Dunbrody had a good survival rate compared to the "coffin ships" which sailed to Quebec City and Montreal and from which those who succumbed to typhus were rapidly dispatched to the bottom of the St Lawrence River.

From Viking origins, through famine to the City's magnificent 18th Century Robertsonian architecture and the splendour of crystal glass, Waterford welcomed and delighted. Then, when we thought our explorations were drawing to an end, our spirits were raised by the triumph of Bretonne chef, Eric Théze and his first-rate cuisine at La Bohème. He explained that he had always wanted to be a chef but without people, food was nothing. *"It must be shared to be enjoyed. Fine dining is more than fine food; it's good company".*

This view could equally be applied to PPL/IR—flying may be the passion, but without the camaraderie of fellow pilots along with the opportunity to share experiences and explore exciting new venues with family and friends, the enjoyment would be greatly diminished.



WILLIAM GRAVES & SON
THE QUAY, NEW ROSS
0 8 JUL 2012

PASSENGERS' CONTRACT TICKET.

N. B.—Any one receiving money from or in respect of any passenger about leaving the United Kingdom for any Place in North America, without using this Form, and correctly filling up the Blanks therein, and signing it with his name in full, will be liable to a Penalty not exceeding £10 for each such Passenger.

Ship Dunbrody of 458 tons register burthen, to sail from New Ross for New York on the 18th. day of March 1849

I engage that the Parties herein named shall be provided with a Steerage Passage to New York in the Ship Dunbrody with not less than 10 cubic feet for Luggage for each Statute adult, for the sum of £ £16.12.0 including Head Money, if any, at the place of landing, and every other charge; and I hereby acknowledge to have received the sum of £______ in ______ payment.

Water and Provisions, according to the annexed scale, will be supplied by the Ship as required by law, and also fires, and suitable hearths for cooking.

Bedding and utensils for eating and drinking must be provided by the Passengers.

Signature, William Graves

Date, ______

NOT TRANSFERABLE.

No.	NAMES.	Ages.	No. of Statute Adults.
1	Dennis Doyle	42	
2	Tom Doyle	20	
3	James Doyle	19	
4	Eliza Doyle	12	
5	Patrick Doyle	11	
6			
7			
8			
9			
10			

SCALE OF PROVISIONS AND WATER THAT WILL BE SUPPLIED TO EACH ADULT BY THE SHIP.

3½lb. of Biscuit: 3½lb. in all of Flour, Oatmeal, or Rice or a proportionate quantity of Potatoes, (5lb of Potatoes being computed as equal to 1lb. of the other articles above enumerated.) Per week. Issued not less often than twice a week.
3 quarts of Water per day.

Deposit £______
Balance £______
Total £ £16.12.0

To be paid at ______ before the 18th. March 1849 or Deposit forfeited

To William Graves

Zeppelin Museum

The Zeppelin Museum Friedrichshafen is unique in Germany. It houses the world's largest collection on aviation. In addition, it is the only museum in Germany which combines technology and art. The museum was (re)opened in 1996 in its new home—the Hafenbahnhof (harbour railway station). Since then, 3.5 million visitors have come to see its permanent collections and special exhibitions. Professor HG Merz of Stuttgart (who later became known to a larger public through his redesign of the Alte Nationalgalerie public art gallery in Berlin) designed the exhibition architecture, whilst the local office of Jauss+Gaupp was responsible for the conversion of the old harbour railway station building into a modern museum. The Zeppelin Museum has a total floor area of 4,000 sq m.

The Zeppelin Museum is something special because it houses the world's largest collection on the history of airship building. Together with the LZ Archives it forms the competence centre on the history of German airship aviation. It watches over a myth which has lost nothing of its original fascination for young and old. The museum is also dedicated to the art of the Lake Constance region and owns valuable works of art, among others the Otto Dix Collection.

The fact that the museum shows both technology and art collections accounts for its singular position among German museums. No other museum in Germany is dedicated to two such different subjects. This offers important creative potential for collecting and presenting the collections and for the exhibition strategy. The aim is not to try to integrate works of art into the Zeppelin department or vice versa as this would only be a superficial link, but rather to shift the emphasis and concentrate on the thematic common denominators of the museum's two subject areas. The museum therefore presents themes from the history of technical developments and studies how these found their way into the creative arts such as painting, architecture, design. In addition, the museum's collection and exhibition policy also deals with artistic positions based on scientific and technological knowledge. In addition to the history of industry and technology, and the culture and arts of the Lake Constance region, the museum will thus develop a third sector of interest, making the connection between the two. Visitors will then not move abruptly from Zeppelin to art history, but will be guided almost imperceptibly from one to the other.