WHAT IS A REPORTABLE ACCIDENT?

What we need to do when things have really gone wrong

I shouldn't really be starting this feature right now as I am far too cold to think; I need to go to the loo.

Confused, can't see the connection?

I need to pop 'down the corridor' not, as you might immediately think, for a comfort break, but to warm up. I can almost hear you thinking. 'Has Malcolm completely lost the plot?' or 'What's he on about?' Well, we've had the heating engineers in to 'fix' the heating system here at the (pretty chilly) LAA HQ. In fairness, the temperature in my office is tolerable providing you are not too far off the floor. I've learnt that you mustn't use too much shoe polish (as the heat from the Romanesque under-floor heating tends to melt it and it leaves a mess) and it's worth wearing two jumpers. The loo, being a confined space I suppose, provides a near sub-tropical environment. The heating engineer said that, "The loo's valve has stuck open and a new part is on order." I hope that it doesn't get here too soon!

Oh well, March is now upon us and the average temperature is rising; the fields are full of daffodils and spring lambs… Mmmmm, and of course, there's the longer evenings… lots to look forward too. Time for a bit of flying after work? Better start thinking about a bit of pre-season maintenance.

Jed, my septuagenarian collie, has suddenly lost the ability to jump the fence into the sheep field at the end of our lane – nothing to worry about, just a bit of age related decrepitude. His days of pretending that he's a sheepdog are now sadly over and he's been relegated to a walk 'round the block' with the other dogs in our village. If he finds this demeaning he hasn't said so. Anyway, enough of my woes, Ken Craigie, the LAA's Chief Inspector, has asked me to remind aircraft operators about what they need to do when things have really gone wrong.

I did a double take when I first saw the cover of the AAIB's 2011 Annual Safety Report and wondered about the significance of choosing a picture of a line squall. It's very atmospheric in both the usual meanings of the word, hats off to the creator of this cover; I remember (rather foolishly) dabbling about the edge of one of those things in a K8 in my youth! In my view the Air Accident Investigation Branch (AAIB) of the Department of Transport is a jewel in the crown of the UK's Air Safety policy where 'recommendations' often have a higher value than rules. The 2011 report can be downloaded in pdf format from the AAIB's website and it's worth a look. Remember, the Commander of an aircraft has both a moral and a statutory duty to report an accident involving the aircraft to the AAIB. *(Photo: AAIB)*

ACCIDENT REPORTING

I am not entirely sure why it is that, as a species, we find the imposition of rules so enjoyable; we must do, for we seem to be addicted to their creation. There are some who would suggest that vested interest plays a part (where there's a rule, there's a pound), certainly, the negativism of over-active self-interest infects our culture fairly widely. Others offer more sinister reasons; the suggestion of 'big brother' often results in an eye-oscillating, but never too enthusiastic, nod. Perhaps the creation of a rule by some specialist body plays a subtle role in defining a culture, satisfying some instinctual urge to be shackled by others' instruction. Who knows? One thing that I have noticed, in my years of association with the aviation community, is that aviators tend not to like rules they don't understand. Could it be that barrel-rolling around a forming cumulous cloud a few thousand feet above the ground shows the aviator a different perspective?

Naturally, working for a regulator (some would say poacher turned gamekeeper) I have to defend many of the rules that have been made regarding the airworthiness of our aircraft. I genuinely don't have a problem with this because I have learnt that almost every aviation rule was created following a real incident, many of which cost people their lives.

For example, there's a fairly new rule that prevents us from using fuel containing alcohol in our aircraft; there are a lot of reasons why this rule was put into place and many of these reasons are fairly easy to understand. Nobody wants their fuel tank to dissolve. Some of the reasons are more subtle, hiding in the shadows of complex physics and chemistry: reductions in energy density and changes in vapour pressure to name just two.

We, as a community, trust that a rule is a sensible one if we fully understand the reason for it; in this respect rules are like signposts towards our safer future. Some, perhaps thinking that they understand all the issues involved in the creation of a rule, might choose to shake off the 'shackle' and simply ignore it. As an aviator, when you do this, you could be travelling in dangerous territory, for this can be a place without signposts.

Later in this month's Safety Spot I will tell the tale of an owner who decided to use an unapproved fuel in his aircraft and was lucky to get away with it. He's an expert in the field of fuel chemistry and has openly written of his experience so that we, as a community, can learn from his near miss. There was no damage to his aircraft and therefore the owner had no statutory reason to alert the authorities. He let us know about it nonetheless, which was, in my view, the right thing to do because, without overstating the obvious, others can learn from his experience.

Another member had a near miss recently when his aircraft unexpectedly started with a very high throttle setting. He wasn't injured, but the aircraft was fairly extensively damaged as it crashed into a structure nearby. This was a reportable accident but, perhaps because the owner thought that as the aircraft wasn't actually in the air it wasn't important, or perhaps that it was simply his fault and there was nothing anybody else could learn from it. We only got to hear about the incident from the inspector charged with the subsequent repair; in other words, if the damage hadn't been so extensive we wouldn't have learnt anything from its possible causes.

It's true that there are very few of us that really enjoy admitting to making an error of judgement. I certainly don't but I owe the people I've known who have admitted their mistakes, because I've been able to avoid making them again. That, in my case, is a big debt. So, what is a reportable accident? Well, I might just quote from the LAA Technical Leaflet produced on the subject TL 2.16 – available on the LAA website *www.laa.uk.com*

'A Reportable Accident is any aircraft accident where a person suffers a fatal or serious injury, or where the aircraft sustains damage or structural failure (except engine failure or damage limited to the engine, its cowlings or accessories, propellers, wing tips, antennas, tyres, brakes, fairings, or small dents and punctures in the aircraft skin).'

Ken is worried about the fact that we do sometimes only hear of an incident from a third party report, often detailing an incident that occurred some time previously. It should be noted that the legal responsibility for the notification of a Reportable Accident rests with the commander of the aircraft or, if he or she be killed or incapacitated, then the operator or other responsible person must assume this role. If the accident occurs on or adjacent to an aerodrome, then the aerodrome authority is also required to notify the accident. A call should be made immediately following an accident to the AAIB. It is not legally required to report an accident to the CAA, but nevertheless it makes a lot of sense to let us at Engineering HQ know that there's been a problem if it relates to an LAA aircraft.

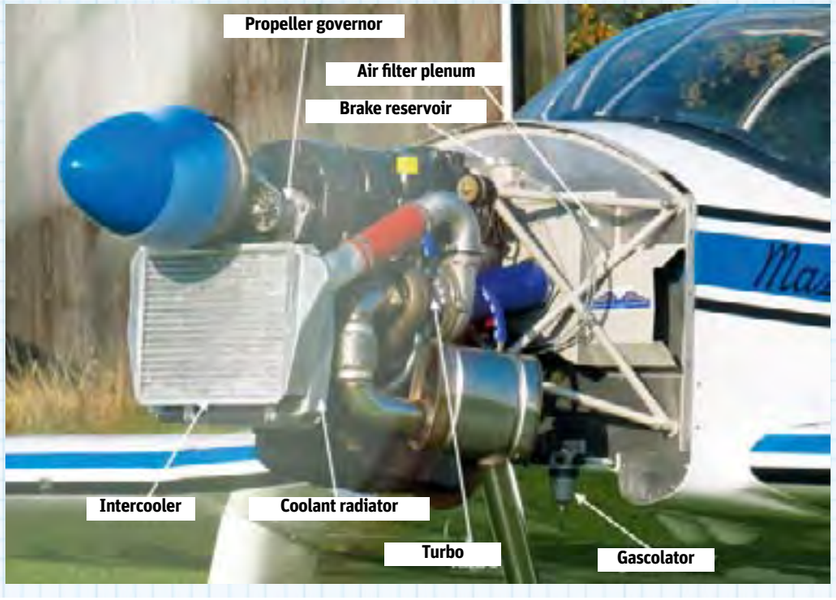
The philosophy with regard to the incidents and accidents that occur to the aircraft in the LAA's family is straightforward. We believe in and fully support a 'Just Culture' where, and I quote the Chief Executive of the CAA as he writes in a recent CAA document about the Mandatory Occurrence Reporting system (MOR), *'…individuals are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training but which result in a reportable event; but where gross negligence, wilful violations and destructive acts are not tolerated.'*

The operation of an aircraft requires great skill and judgement, we all get it a little bit wrong now and again, that's just human and a pilot or engineer will not be castigated for it, but not reporting an incident is definitely frowned upon.

JODEL D153 MASCARET FUEL FILTER BLOCKAGE

Over the last few years there has been a lot written about the subject of aircraft fuel and the recent changes introduced into both the supply chain and its constituents. The dust seems to have settled and the initial panic has subsided; LAA members have got used to the fact that, because of the nearly universal introduction of alcohol into motor fuel, mogas is, for the time being (with the exception of microlight aircraft), a thing of the past. The LAA specialist fuels team, headed by Barry Plumb, has been working extremely hard to establish a sensible way that motor fuel ➡

Here's a picture of Peter just about to three point the diesel powered Jodel D-153 Mascaret. This is, in my view, a fantastic looking machine and one of the best 'diesel' cowls around. This is what home building is all about. *(Photo: Nigel Hitchman)*



Here is a picture of Peter Fines' Wilksch WAM-120 engine installation. Diesel engines have taken some time to take off in the home-builder marketplace, perhaps because the miserly fuel consumption figures are offset by an increase in complexity. Hats off to Peter for this brilliant installation; this is a lot of engineering to squeeze under an engine cowl. In this picture the principle components in the induction system can be seen; exhaust gas drives a turbine which, in turn drives a compressor which boosts manifold pressure. Because this pressure rise is accompanied by a temperature increase an intercooler is required to cool the charge back down again to maximise the engine's thermal efficiency. The WAM-120 is still under development and its successor, the GEN II engine, is going through its final bench testing phase. *(Photo: Peter Fines)*

SAFETYSPOT

With Malcolm McBride
Airworthiness Engineer

This is the filter element as discovered by Peter after his emergency land at Sywell. Peter noticed that the fuel pressure was quickly dropping and got back on the ground as soon as he was able. You can see that the sides of the filter itself have been sucked together because the pours of the element have been blocked by a greenish-brown mush. *(Photo: Peter Fines)*

containing alcohol can again be used in some of our smaller types but there is still a lot of test work and report writing to get through before the CAA is likely to review its alcohol ban in UK piston-engined aircraft.

The recent acceptance by the LAA of the new ramp fuel produced by Total as an alternative to avgas 100LL, called UL 91, does at least mean that there is an alternative fuel available for the engines that don't like (or need) the tetraethyl lead in leaded avgas.

I recently received a call from LAA member Peter Fines letting me know about a problem that he recently had with the fuel system on his aircraft. I've not met Peter personally but, having had the pleasure of chatting with him on the telephone recently about this issue, I don't think that he would mind me calling him an experimentalist!

Peter wrote a report about the incident which, in a slightly edited form, I will share. Peter's words are italicised, my comments aren't. Before I start cutting and pasting, I should say that Peter built his Jodel D150 from plans, a real achievement. The keen-eyed among you will notice that the title of this piece defines the aircraft as a Jodel D153, the additional 3 was added, with the Monsieur Delemontez's permission, because Peter's engine choice was the Wilksch WAM-120 two-stroke diesel.

It might be worth pointing out here that the LAA has about 36 Jodel D-150s on its books; like many in the Jodel family, this two-seater was available both as a factory-built machine (at the SAN factory in Bernay) and as a plans-build. I've just checked our database and we've still got 12 projects registered with us; I would expect some of these to be rebuilds, but the majority will be aircraft being built from plans.

Normally, the 150 would be powered by the ubiquitous Continental O-200A but we do look after a couple of aircraft fitted with the Lycoming O-235 112hp unit, this engine has a similar power v. weight to the WAM-120. So that you get your mental geography in place, Peter lives in Lincolnshire:

A flight was planned to Popham in the Mascaret for the Jodel Rally. My passenger cried off at the last minute for a family reason so I went solo. Fuel for the Wilksch WAM-120 diesel engine was white diesel – winter grade – and starting fuel state was wing tanks both full – 42 litres each, and fuselage tank empty.

The flight from Strubby to Popham, 142nm via Daventry and Compton VORs was good, departing at 09:30 and engine off at 11:00. Port tank used except for circuit and landing at Popham which was by normal practice on the full starboard tank. Fuel usage would have been approximately 26 litres.

The only abnormality noted was a slight drop in fuel pressure on arrival, 80-90kPa instead of normal 90-100 without the back-up electric Facet pump. The Rally was excellent. Departure from Popham was at 15:20. The aircraft had been standing in full sun for over four hours and the day was unseasonably clear and warm. Take-off on the nearly full starboard tank with changeover to port during the climb-out. Climbed to 4,000ft in superb conditions. Fuel pressure 80-90kPa and responded well to the addition of the Facet [Pump], giving 110kPa. The fuel in the tank in use is also warmed by a continuous return spill flow from the injector pump.

There was initially a slow loss of pressure and around Turweston the pressure was down to 70kPa. I tried the starboard tank with no change, and returned to the port tank on the basis that the fuel was warmer. The rate of pressure loss progressively increased and the CI-log warning came up at 60 – 65kPa. I put the electric pump on and diverted south of Northampton for Sywell. Within five minutes the warning light was on again, despite the electric pump. I declared the problem, injected engine and falling fuel pressure, to Sywell and asked for a precautionary landing. Sywell ATC was splendid and cleared me straight in by holding two aircraft on the ground and one above the field. All the runways were at my disposal, 03 hard, 03 grass and 05 grass. I retained a lot of height until field in sight and arrived on short final at 3,000ft. A figure eight on base leg brought me to final at 800ft from which a sideslip put me on the ground just after the 'numbers' on 03 grass.

The fire truck followed me and the engine continued to run OK although fuel pressure when taxying in was only 25kPa. Difficult afterwards to imagine how the engine kept running with a flow resistance equivalent to a 12 metre head of fuel. I thanked the kind lady on ATC. 45 minutes Popham to Sywell.

I checked the fuel drains on the two tanks and the gascolator. All were spotless. I pulled the gascolator filter (Andair) and found a thick coating of greenish-black deposit on the gauze. The pleats of the element were squashed to a sharp crease (see photo above).

The fire truck crew/refuellers were very helpful and provided a sample of petrol and a small brush which served well to clean the filter. A short engine run showed the pressure to be back to normal and the cowlings replaced. After thanking the Sywell personnel I left for a satisfyingly boring 50 minutes flight to home. Post flight checks showed no deposits in the tanks or the gascolator.

At this point I will briefly break into Peter's tale to offer a few words of explanation.

For those of you that are not familiar with the Wilksch WAM-120 diesel engine, you should know that this engine has been designed to run on Jet A1 fuel and not road fuel. There is quite a significant difference in the make up of these primarily similar fuels which I won't go into here fully as it would take too long and, if you're interested, further study is always worthwhile. One big difference that should be mentioned is that road fuel has components in it to improve the fuel's 'lubricity', and one of these components can be unextracted sulphur, although tighter regulations around the world has meant that the lubricity of many road fuels is now enhanced by other additives.

Automotive diesel comes from a different point in the extraction chain and has different temperature properties. During discussions with Peter about this, he pointed out that road diesel is blended differently in the summer than in the winter. Summer diesel is OK down to -5°C whereas winter supplies are OK down to about -15°C; if the respective fuels drop below these numbers, then the fuel's heavier molecular weight components, essentially the waxes, come out of solution. This is why Peter was talking about the temperatures of the fuels.

When Peter arrived home he started researching what may have happened to the fuel to cause this sudden fuel blockage. He could rule out low temperature waxing – what on earth could the 'greenish-black' deposits be? Peter continues:

Searching the internet revealed that petroleum oils contain asphaltenes. They are a huge range of different polycyclic aromatic hydrocarbons with a relative molecular mass (RMM) from 800 to 6,000 compared with a normal fuel molecule, say decane with an RMM of 142. They occur in distilled fuels in small, unquoted amounts. They are better known for causing blockages in crude oil pipelines.

Depending on the particular chemical composition of the fuel, and its temperature, the asphaltene molecules can agglomerate to form colloidal-sized particles called micelles, whose formation is promoted by the presence of water in the fuel and increased temperatures (above 60°C is quoted). The formation is also favoured by a reduced concentration of aromatic hydrocarbons (benzene and similar).

Colloidal particles so formed can be 20 to 30µ diameter. The gascolator filter is a 70µ stainless mesh coated with ptfe.

It now appears that the EPA regulations have conspired to give us this phenomenon. In days of yore diesel oil had about 3,000ppm of sulphur. For road use this was reduced to 500ppm in 2004 in the USA. Low sulphur diesel at 50ppm sulphur was introduced in around 2005. Ultralow, sometimes called no-sulphur, at <10ppm was introduced in the USA in 2006 and in Europe in 2009. Other changes were introduced to reduce the aromatic hydrocarbon content (carcinogens), and to allow bio oils to be introduced, up to 8% today without having to label the fuel bio-diesel. Unfortunately bio oils can absorb 1% of water compared with 200ppm for petroleum distillates – just 50 times. 8% bio-diesel saturated with water will contain 0.1% water – five times as much as saturated petroleum distillate.

The sources of bio-diesel include algae, Chinese tallow, palm oil, coconut, rape seed, soy, peanut, sunflower, hemp, field pennycress, jatropha, flax, chicken fat and fish oil, so we should not expect 8% to be the maximum. Additional consequences of the changes include a reduction in lubricity of the fuel and a reduction in calorific value.

The bulk of the information on asphaltenes comes from the USA, perhaps because they have longer experience of ultralow sulphur diesel fuel. They certainly have a lot of experience of blocked filters. The greenish-black deposits are still commonly reported as being caused by algae, usually associated with advertisements for biocide fuel additives.

I discussed the event with a petroleum chemist at Lindsey Refinery; he had never heard of a problem of asphaltenes in distilled fuels but was very aware of the problems of blockages in crude oil pipelines.

I informed Wilksch Airmotive and four French pilots that I know who have diesel-powered aircraft. The aircraft was drained, flushed and a new gascolator filter fitted. It has since been fuelled exclusively with Jet-A1.

I spoke to Martin Long from Wilksch who explained that there is a common myth that diesel engines can 'run on anything'. Actually, this is becoming less true as time passes, primarily because these compression ignition engines are becoming more and more dependent on electronics to manage and control them. Martin explained proudly that the WAM-120 has been designed to run without any 'computer assistance' and could, with some small adjustments to injector output, clearly operate using road fuels. "The problem is," Martin continued, "we have no control over the manufacture of these fuels and therefore cannot completely predict all the possible problems that operators might encounter if they use them. This is a good case in point, and emphasises the reason why the Wilksch Wam-120 is only approved to use Jet A1 or an equivalent."

Readers will of course appreciate that when an engine is accepted for use in an LAA machine, the types of fuel allowed will be defined. The LAA, being at its heart an experimentalist/home-builder organisation, appreciates that some of its members will want to explore different ways of doing things; we haven't had a 'snake spit' fuel additive (formulated to give that extra zing!) yet, but if you really want to test this or that there is a correct way of doing it… and your first port of call should be LAA Engineering.

If you decide to go it alone then you are at risk of invalidating your Permit to Fly and that could have disastrous consequences if you need to get help from your insurance company if something goes wrong.

Thanks Peter for letting us know that, after your testing, road diesel is not suitable for the WAM-120; mind you, judging by the per litre price of the stuff at the moment I wonder a bit why anybody would want to use it in an aeroplane.

PIETENPOL AIR CAMPER OLD FUEL/NEW AIRCRAFT

I think that it is true to say that the act of building an aircraft can become a way of life; cars come and go, children grow up and even addresses can change during the meticulous process of manufacture. This 'in it for the long haul' approach is especially true for the plans builder. Often a project may lie dormant, the wings, nearly completed, lying in the shed's roof space, perhaps half a fuselage tied to a garage wall. Sometimes a project may be owned by a series of members, ➡

Who would have thought that, after only ten years of standing in a hangar, fuel would have more or less written off the fuel tank outlet filters in Keith's Pietenpol? *(Photo: Keith Hodge)*

SAFETYSPOT

With Malcolm McBride
Airworthiness Engineer

finally being finished by the third or fourth owner.

There can be no doubt though that as soon as the first two pieces of lovingly shaped wood are glued together the aircraft, as an entity, exists and scarcely a day will pass from this moment of conception when it won't occupy a space in the builder's mind. Such is the lot of an aircraft home-builder.

I received a letter a couple of days ago from just such a man and, as this month's Safety Spot seems to have centred upon fuel blockage issues, I thought that I'd share it with you. The builder that sent the extraordinary pictures is LAA member Keith Hodge, he, again for those with a geographical bent, lives in North Wales. Keith started thinking about the engine that he was going to use in his Pietenpol back in 1996 and he eventually decided on a BMW K100 in-line four, out of a motorcycle. This choice of engine will be a first for the Pietenpol as far as I am aware and Keith made a dummy firewall to get things right up front before actually fitting the engine into his build.

About ten years ago Keith finally got the engine into the airframe (minus the wings) and did a bit of taxying about... then he had to build a new home so he had to wait for his retirement before starting up the project again. Keith explains what happened next:

'After refitting the development engine, the fuel tank was topped up with a gallon of fresh mogas as no fuel was visible above the baffle plate which separates the sump from the main tank. The engine was given a quick run up (but not for too long as it is water-cooled and there was no coolant system plumbed in). I was able to confirm that all the aircraft systems (fuel injection and electronic ignition, etc) were working before I set about removing the old engine and preparing my shiny 'zero timed' engine and fitting it.

One thing that I did notice during the engine run was that the No.1 fuel isolation valve was very difficult to operate...'

Liquid fuel changes over time! *(Photo: Keith Hodge)*

I'm not all that surprised, take a look at the pictures sent in by Keith who, in his letter, explained that: *'In view of the long storage time (and the fact that the tank filler neck seemed corroded) I decided that it would be prudent to have a good look in the tank and at the fuel system in general. I had missed the corrosion on the filler neck because, during the top up, I had removed the filler cap and fitted a large funnel which prevented the rust from being seen.'*

I am glad that Keith is doing a complete overhaul of the fuel system, it's probably time! What amazes me is that the engine actually started with n-year-old fuel... they don't make it like that any more.

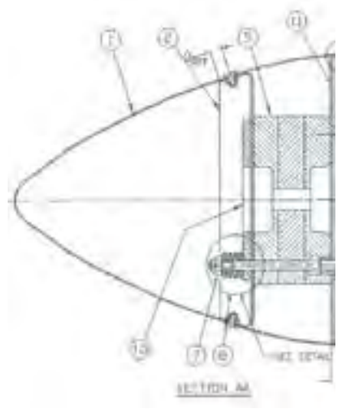
I spoke to Keith on the telephone to thank him for taking the time to write to me about this and he asked me to remind all the builders 'out there' that the clock is always ticking and that many of the items used in the construction of an aircraft will degrade, even before the machine takes to the air. I'm really looking forward to seeing the BMW-powered Pietenpol fly... the engine runs like a sewing machine they tell me. Fair Winds. ■

I think that it's fair to say that if you were to open this fuel cap on an aeroplane you might think twice about flying it. Not that the owner had any intension of getting airborne... his aircraft hasn't been completed yet, the corrosion that glued the cap to the tank is the result of many years standing about in his hangar. *(Photo: Keith Hodge)*

GALVANIC CORROSION

Many thanks to Gary Cotterell for sending in this great example of the effects of galvanic corrosion and its strange, often unpredictable, consequences. These aluminium propeller drive lugs both come from the same propeller hub, one has failed and the other, working just next door, hasn't. The material used for these lugs has been changed to a stainless steel by the manufacturers, not because aluminium alloy is not strong enough, but because it sits too far away from the steel in which it is fitted in the Galvanic Series. As a Current is created the aluminium is sacrificed in the same way as the zinc casing of a common torch battery is. *(Photo: Malcolm McBride)*

This picture shows well the in-situ position of the Propeller attachment lugs; in this case the lugs can easily be inspected for signs of trouble. *(Photo: Gary Cotterell)*



This general arrangement drawing of the propeller hub and spinner clearly shows the location of the drive lugs.

LAA ENGINEERING SCALE OF CHARGES

LAA Project Registration	
Kit Built Aircraft	£300
Plans Built Aircraft	£50
Issue of a Permit to Test Fly	
Non-LAA approved design only	£40
Initial Permit issue	
Up to 390kg	£320
391 - 499kg	£425
500kg and above	£565
Three seats and above	£630
Permit renewal	
Up to 390kg	£105
391 - 499kg	£140
500kg and above	£190
Three seats and above	£210
Modification application	
Prototype modification	£45
Repeat modification	£22.50
Transfer	
(from CofA to Permit or CAA Permit to LAA Permit)	
Up to 499kg	£135
500 kg and above	£250
Three seats and above	£350
Four-seat aircraft	
Manufacturer's/agent's type acceptance fee	£2,000
Project registration royalty	£50
Category change	
Group A to microlight	£135
Microlight to Group A	£135
Change of G-Registration fee	
Issue of Permit Documents following G-Reg change	£45
Replacement Documents	
Lost, stolen etc (fee is per document)	£20

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