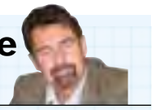
With Malcolm McBride
Airworthiness Engineer

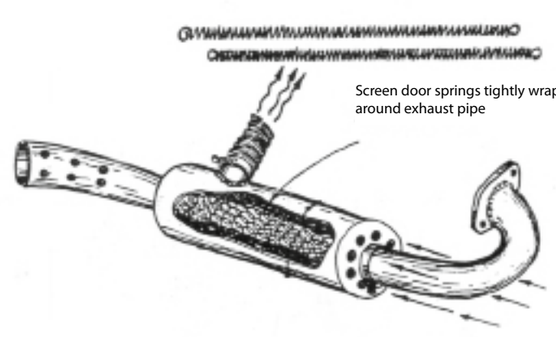


BROKEN 'HEATER' SPRING

Small section of spring jams the carburettor butterfly valve causing lose of power and subsequent forced landing

After Alan James had a partial engine failure overhead White Waltham he checked all the usual likely culprits – fuel system, ignition system – and he did a compression pull through. All A-OK. Finally, he took the carburettor off and found this spring jamming the butterfly valve, which had prevented it from fully opening. He had to scratch his head a bit to work out how this spring had found its way into the induction system then, before causing damage to his scalp, he remembered that he had taken a tip out of Tony Bingelis' excellent book *Firewall Forward* when he originally built the machine and the origin of the broken spring became clear. *(Photo: Alan James)*

Here is a picture of the starboard side of Alan's tidy Continental C-90 engine installation in his Pietenpol Aircamper. You will note, if you follow the systems path, that the exhaust system carries hot exhaust gas from each cylinder down to the underside of the aircraft and away to the atmosphere. Normally, induction air is taken through a front-mounted air filter straight into the carburettor. Should there be a risk of carburettor icing then air that has been pre-heated by passing it through a muffler fitted around the exhaust can be selected by the pilot. In the photo, the path for this hot air is through the orange pipe which, in the trade, is known as scat hose. The two big downsides to hot air selection are that one, the air through the hot air system is not normally filtered and two, hot air is far less dense than cold air and its selection will normally be accompanied by a small power loss. *(Photo: Alan James)*



Here is a sketch showing how, by wrapping springs around the exhaust pipe inside the muff, the efficiency of the muff can be theoretically improved. First, the springs increase the surface area of the heat exchanger itself and, second, it is thought that the increased contact time due to the turbulence created by the springs, has a part to play. It should noted that, if this type of exhaust heat exchanger is used in a cabin heater application, then it needs to come apart annually for checks (because of the carbon monoxide risk). I certainly think, in the light of Alan's experience, it's worth checking inside the carburettor heater muff during your annual inspection as well. If you find that 'Bingelis' springs are fitted, it might be worth running some lock wire through the centre of the spring so, if they do eventually break, the bits cannot travel to the carburettor. If you find that the springs are corroded then definitely replace them; Alan was lucky that the butterfly valve stopped the broken spring in its tracks; had the part entered the engine it could have wrecked it. *(Picture: Tony Bingelis)*

Now that we're all back on BST, I suppose it's official, summer is back with us, and thank goodness for that. It's not that I don't like the winter, actually all the seasons have their good points but, as the sun rises higher in the sky day by day, the urge to aim skyward becomes steadily unbearable.... well, you get my drift. I'd better get on with this month's discussion about safety matters before I lapse into poetry; and the sun hasn't quite fallen below the yard-arm.

I must admit to being a bit of a fan when it comes to getting new gizmos, I delight in opening the box and relish learning all the new tricks my new acquisition can perform. These days the boxes are often very slim and contain incredibly difficult puzzles, which I know I will never quite complete. The manufactures of these puzzles call them programs or, sometimes, applications; they claim that, 'just by their installation onto your computer's hard drive you (yes, you) will become fantastic at photo-editing' or, in one recent purchase, a brilliant composer... Swing band arrangements? No problem!

Ah, if only this were the reality. The truth is that everything is pretty complicated these days and it can be difficult to find the time and, perhaps, raise the intellectual capacity to fully get to know your new whateveritmightbe. I, in my usual agitated sort of way, will almost invariably plump for the 'quick start' option, filing the inch-thick training manual on the 'read later' shelf. This learn-on-the-job option is all very well when the worst that can happen is that you give the oboist a bagpipe part or, slightly more dangerously, adjust the wife's colour tone so she looks like she's on a couple of bottles of wine a day.

When it comes to complex machinery, like motorbikes and aeroplanes, a more considered approach would be in order. Later in this month's 'Safety Spot' I will recount the tale of a member who, because he had a considered approach to learning about his new aircraft, found a serious problem with the control system, which may have led to trouble later on, that's an aeroplane story. For the motorbike near-miss read on.

I've mentioned before that I enjoy a two-wheeled approach to travel. I think that I had my first motorised machine when I was about 11. It was, as far as I remember, a stripped-down moped that was shared with a friend. We used to, in the language of the day, 'bomb' around a local allotment, mostly using lawnmower fuel, pinched as necessary. I remember that we wore down a pretty good track, which had a number of jumps in it; we used to race against the clock and worked up some reasonable times. That was before we were, almost inevitably, thrown off by an irate onion fancier.

I'm not sure how we learnt about the actual mechanics involved in keeping the engine running, indeed, I really cannot remember who it was who taught us how the engine actually ran, I think that we just learnt by osmosis – a good process on an allotment with a moped.

I got a new bike last year and, well to be truthful, I've never really felt at home on the machine at any speed. In my view the cornering was atrocious and I quietly resolved to get rid of it at my earliest opportunity. Naturally, I spoke with other enthusiasts who explained that this particular machine was notorious for its bad handling and I started to feel like a bit of a mug for spending rather a lot of money on it.

Anyway, to cut a short story completely to the bone, I put the bike into the shop for its MOT the other day. I asked the mechanic to change the oil and filters and let him know about a dodgy bulb; he agreed to do this maintenance/rectification work and suggested that I pop down to the local café while he did the jobs and subjected the machine to its annual grilling. After a couple of pots of tea, perhaps half-an-hour, I returned and noticed the pinched lipped mechanic at the window moving his head from side to side and my heart sank.

"You're a lucky fella," he said, with that feigned look of sadness peculiar to MOT testers after they've spotted some or other fault. "It's a wonder that you were able to keep the bike straight." I started to get concerned and noticed that the salesman, who had sold me the bike, was moving towards us looking equally alarmed. "Somebody's fitted the rear suspension unit incorrectly. It's a wonder," he said, shaking his head slowly from side to side, "that it didn't come to bits. It would have done if you had gone over a big bump."

At this point the salesman intervened and, with one side of his face looking desperately at the clearly off-side engineer and the other with a becalming smile directed at me, suggested that I "pop back down to the café for another cup of tea and I will personally sort this out for you."

He did and, after a further hour of waiting, yours truly, with a very much reduced bill, a big discount on a new helmet and a new MOT test pass in my pocket, enjoyed the very much improved handling qualities of my bike on the ride home. A few lessons learnt.

Before I relate the aforementioned control system tale, let's warm ourselves up with a recent report sent in by LAAer Alan James, concerning a carburettor heater.

PIETENPOL AIRCAMPER CARBURETTOR HEAT MUFF

I think that I've said it before, but it's worth saying again: I've got a soft spot for the Pietenpol Aircamper. OK, I know that it's a fairly long-winded affair building one, and yes, it's not the fastest machine in the world, but if you're a softy for that nostalgic look and enjoy the wind on your face, you would have to travel far to beat this little two-seater.

Alan built his machine, G-BUCO, almost exactly 20 years ago and intends to celebrate the anniversary of his first flight in her sometime next month at a fly-in breakfast. I've been sworn to secrecy about the whens and wheres but I hope that the weather will be as good as early morning bacon butties always are. Alan has flown just over a thousand hours in Charlie Oscar, which is quite an achievement when you think about it. Alan, in his report, tells the story.

'I had an engine problem with G-BUCO last weekend that I'd like to relate to other homebuilders. All was fine until the third flight of the day when, climbing out of White Waltham for the return to base (about five minutes into the flight) the engine very gradually lost 100rpm. I watched the rpm gauge as it reduced to a ragged 1,900 rpm at full throttle.

'I made a PAN call whilst doing a 180 and returned to the

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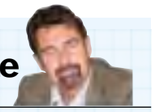


overhead for a glide approach. The engine kept running at idle until I turned off the runway but refused to pick up, so I shut it down and the fire crew pushed me back to the line.

'After a check of ignition and timing, I removed and cleaned all filters, checked fuel flow, emptied the tank and refreshed it with avgas – but it made little difference.

'I finally got down to removing the carburettor last night and found, to my amazement, a rusty spring trapped between the top of the main jet and the carburettor body. I was completely floored for a few moments until I realised what it was.

'I have always had long springs wrapped around the exhaust pipe under the hot air shroud to increase the temperature – as copied from Tony Bingelis' book Firewall Forward *– and one of them had broken up into several pieces. I found more parts of the same spring rattling around in the casing. I have now removed all the springs and funnily enough, I still have the same rpm drop when selecting hot air, so they are probably not necessary.*

'It was just luck that the broken spring didn't get past the venturi and get ingested, otherwise it could have been very nasty and quite expensive! If anyone else has something similar, best check it out or chuck it out.

'PS. Many thanks to the management, staff and fire crew at White Waltham for their help and hospitality, plus LAA Inspector Pete Cunniff for his wisdom and lift back home.

'Kind regards, Alan James.'

I think that the pictures tell the story quite well, and I agree with Alan that he was lucky that the broken parts of the spring didn't end up wrecking his engine; thanks Alan for the report and well done for getting your fantastic aircraft back on terra firma without breaking her.

Here is a picture of the general installation of the control stick on Tim's Rans S-10; the rollers have been refitted correctly and no longer restrict the up elevator movement. *(Photo: Tim Wood)*

Right or wrong? (1) This picture shows the modified control system well... the only problem is that the roller assembly has been fitted the wrong way round. As fitted, up elevator movement has been severely restricted. *(Photo: Tim Wood)*

Right or wrong? (2) Here the rollers are the right side of the lower link attachment. This sort of information is often lost to history; it certainly took me a long time to work out what was actually going on. Very well done to Tim Wood (and, of course, Tony Hewitt) for getting to the bottom of this problem. *(Photo: Tim Wood)*

RANS S-10 RESTRICTED ELEVATOR

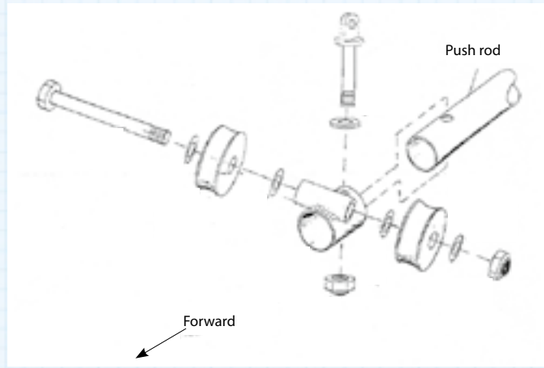
From the aircraft maintenance engineer's point of view, one of the most important jobs during an annual inspection is the control system check. I generally treat this inspection on two levels, with the emphasis oscillating between each. Level one could be described as a detailed, or perhaps better, an individual component inspection. Level two really requires the inspector to look at the control system in its entirety.

To inspect an aircraft's control system it will be almost certainly necessary to remove the aircraft inspection panels to see every part of the system. The first thing to do is check that all the controls are operating in the correct sense, and are free from any obvious problems like, just as an example, binding. My next job will be to look at the components in each of the individual systems. It's true that you do a bit more walking this way but, by separating out each job, you are much less likely to overlook something... especially if you're distracted during the inspection task.

An example of a component check would be the detailed examination of a turnbuckle; ask yourself, does it still work (within the constraints of the lock wire of safety clips)? Is the turnbuckle adequately locked? Are the threads in safety? What about corrosion? It's necessary to check each component in this detailed way because, in any chain, it only takes one weak link to fail.

You won't be able to check some components on your own. A good example of this is the checking of a pulley attachment. For a thorough check you will need an assistant to operate the control hard against its stops so that you can check for loose rivets or cracking in the pulley bracket assembly. Whatever you do, don't fall into the trap of looking at something in a cursory way... you might as well not bother; there is a big difference in the pre-flight general inspection and a thorough maintenance system check.

When you've looked at the individual components and rectified as needed, it's necessary to check the functioning of the control system both as individual circuits and as interactive elements within the complete system. For example, check that with full-rudder, full-up (or -down) elevator can be applied without fouling between the control surfaces. Most people would see this as an obvious check but have you checked the turnbuckles within the system, are they completely able to move together freely right through their range? I have recently seen an elevator turnbuckle that was fouling a bulkhead and found that I could easily simulate an up-elevator jam... just what you don't need during the last phase of a landing!



This picture shows a sketch of the anti-deflection rollers for which, after discussions with the PFA, the manufacturer issued an Airworthiness Directive mandating their fitment. The mod itself strengthens the assembly to prevent bending of the push rod. In the directive, the manufacture also prohibited any changes to the length of the connecting link. *(Picture: LAA Library)*

LAA member, Tim Wood, has been renovating a Rans S-10 pretty much from the wheels up. The aircraft type was, when he first got the machine, completely new to him so he called on the services of another LAAer, Tony Hewitt, for his advice. Tony has owned an S-10 for over twenty years and was the original builder of his aircraft, so he knew what to look out for. I wish I had done a similar thing with my Triumph, but there you go! Here's Tim's tale in his own (slightly abridged) words.

'Dear Malcolm, as promised, here are some photos of the control tube assembly. As I mentioned, G-BSMT is the first aircraft that I have wholly owned and the first Permit aircraft that I have been involved with. Tony Hewitt built his S-10 over 20 years ago and is still operating it,

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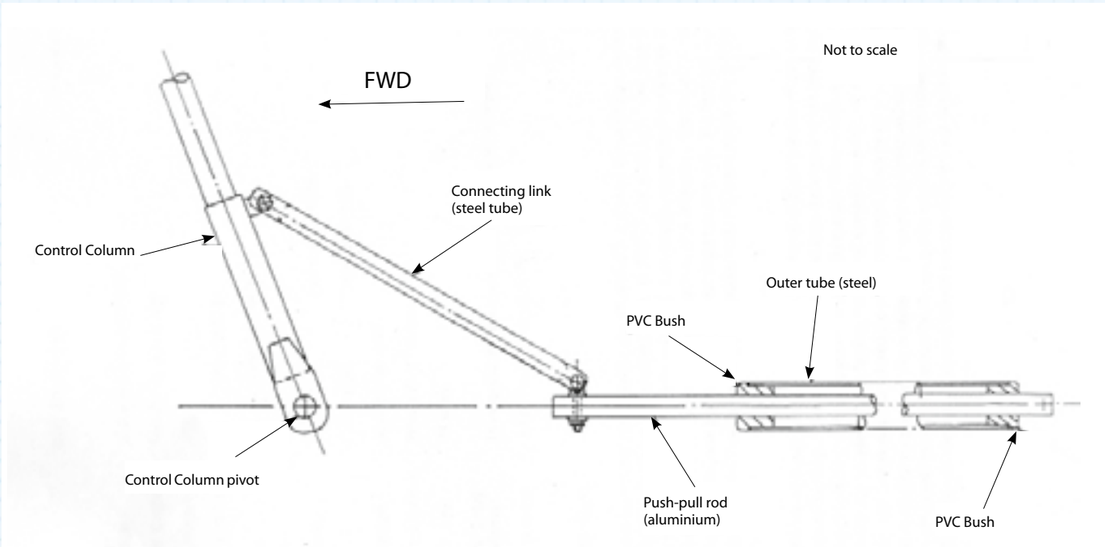

This sketch shows quite clearly the general arrangement of the Rans S-10 pitch control mechanism before the strengthening modification was incorporated. In the accident aircraft discussed in the text it was found that the connecting link had been reduced in length from 9 1/4in to 8in. You can see, I hope, that this will have changed the geometry between the control column and the push-pull rod. The normal angle for the connecting rod would be about 30° to the push-pull rod which relates, in applied force terms, to about a 50:50 split between downloads and effective loads. By shortening this link, the AAIB calculated that the effective push-pull loads were reduced by about 25% and, perhaps more importantly, the down loads on the push-pull rod would have been increased accordingly. This would have led to the rod being bent in the fully extended position, which would lead to an elevator jam. One other undesirable feature with this sort of installation is that the pilot is quite likely to stand on the connecting link/push-rod assembly and could easily bend it. The modification that was introduced added a pair of rollers, which supported the end of the push-pull rod and prevented it from bending down, however large the overload. *(Picture: AAIB)*

SAFETYSPOT

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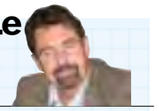
Airworthiness Engineer



FUEL – NOW IT'S GETTING WARMER

I RECEIVED AN email from a member in response to the March Safety Spot feature about the use of unapproved fuel, saying that he was still buying motor fuel that was ethanol free. It soon became apparent that what he was buying was a Super-Unleaded fuel but we must emphasise that Super-Unleaded and similar fuels available at the pumps are not legal to use in aircraft in the UK because they do not conform to the EN228 standard, and for very good reason as they are definitely not suitable.

Barry Plumb, the LAA's fuels expert writes. "Super plus unleaded fuels (generally of between 96 and 98 RON) are generally blended to standard BS7800 rather than EN228. The absolutely crucial difference between these two standards is the vapour pressure of the blend. EN228 limits for vapour pressure are 45 to 60 kPa (summer) and 60 to 90 kPa (winter). However, BS7800 limits for vapour pressure are 45 to 70 kPa (summer) and 70 to 100 kPa (winter). The higher vapour pressure will allow the onset of vapour locking at lower fuel temperatures or lower aircraft altitude than with fuels conforming to EN228. Therefore the use of super fuels to BS7800 is MORE HAZARDOUS than using EN228 and is not approved by CAA or LAA. By comparison, Avgas vapour pressure limits are 38 to 49 kPa".

Francis Donaldson, LAA's Chief Engineer explained. "Our work on lifting the ban on Mogas containing alcohol is not just about trying to persuade a few technocrats that these new motor fuels are safe. Any significant amount of ethanol in the fuel is going to need an aircraft with a fuel system specially tailored to accept it, which means tackling material compatibility, vapour locking, phase separation and all the other challenges that these fuels introduce."

and has very kindly been assisting me in numerous ways, including sharing with me the experience he has amassed in operating this type of aircraft. Consequently, he has guided me through a very thorough examination of the aircraft.

'As part of this initial inspection, he noticed that the 'up' elevator range appeared to be overly limited compared to his aircraft, so I referred to the build manual for how the 'up' elevator range is defined. The manual indicates that the 'up' stop is set by the elevator rod drive pin. It also provides details of a template to check the range of 'up' elevator movement, so I made one up and it confirmed that the 'up' movement was indeed somewhat less than the design intention.'

I will jump in here if you will forgive the intrusion, only to say that when Tim bought the aircraft it had recently had an annual inspection and that the Certificate of Validity for the Permit to Fly was in date. Checking the range of movement on an aircraft is an annual inspection requirement. Anyway, back to Tim...

'The double roller, and the sleeve to which it is mounted, can be seen in the photographs but are not mentioned in the build manual. Tony advised that the sleeve and roller assembly was a modification mandated by the LAA; his aircraft also has the sleeve and roller assembly fitted. However, though it provides the 'up' elevator movement required in the build manual, we noticed that Tony's installation differed slightly from mine in that the roller was forward of the drive pin rather than aft of it.

'Whilst it did seem likely that the restricted elevator control range on G-BSMT could be due to the incorrect fitment of the roller and sleeve, we felt it appropriate to fully investigate the situation to be sure, so I removed the control assembly from the aircraft for detailed examination.

'It is obvious from the wear marks on the side tubes that the roller assembly has been fitted in this orientation for quite some time, although simulating the extremes of elevator control motion quickly showed that whilst the 'down' stop is not impacted by the addition of the sleeve and roller assembly, the 'up' stop is. With the sleeve as fitted the 'up' elevator stop occurred around 10~15mm before the point that would have occurred if set by the drive pin.

'It is immediately obvious that, by reassembling the sleeve and rollers such that the rollers are forward of the drive pin (rather than aft of the pin), that the sleeve would have minimal impact on the 'up' stop. Indeed, on reassembling in this manner and checking the control movement, it can be seen that the 'down' stop is unchanged.

'I refitted the control tube assembly to the aircraft with the rollers forward of the drive pin and checked the elevator range and this now matches that defined in the build manual. I am confident that the sleeve was indeed incorrectly fitted.

Kind regards, Tim.'

I did a bit of checking to find out about the LAA mod that Tim had mentioned and, thanks to the elephant-like memory of Ken Craigie, the Chief Inspector, I was able to find the air accident report that led to some control system changes required by the then PFA, when the aircraft was a fairly new type.

Tim's aircraft was originally built from a kit in 1990; in fact it first flew in September of that year, some three months after a tragic fatality involving a similar type, a Rans S-5.

Ken actually remembered the event as it occurred just before he had joined the PFA as Chief Inspector. The Rans S-5 looked, during the take-off that led to the crash, as if it was having a problem lifting off the runway and, after eventually getting airborne, had only reached an estimated 200ft before it went out of visual range. A few minutes later the aircraft was seen to 'suddenly pitch down into a vertical dive and impacted on a golf course'. The pilot, the only occupant, was killed.

Inspection of the wreckage showed that the control stick had broken in the impact 'whist the stick was in the fully forward position'; it certainly looked to the investigators as if the pitch control mechanism had jammed. Subsequent investigation led to the conclusion that the control system had been modified at some time during the recent past and this had led to the jam, the pictures and sketches included in this 'Safety Spot' show what probably happened here. The LAA looked closely at the mechanism and decided that the strength of the control torque tube assembly was not sufficient even in an unmodified form and therefore required a mod to beef it up. The manufacturer of the aircraft agreed and the mod actually became mandated worldwide by a factory Airworthiness Directive (082890-1). It was the incorrect fitment of this mod that had created the control system restriction that was eventually found by Tim, and very well done to him for spotting the problem. Just for your information, at the time of writing, the LAA has 28 Rans S-10 aircraft on its books but, sadly, only six of them are currently flying so, if you're looking for an inexpensive two-seater there might be a bargain about!

This aileron hinge was changed pretty quickly once the crack had been spotted; two of the three hinges were cracked so the aileron itself could have easily been lost in flight. The reason why the damage wasn't seen earlier was because the area was covered liberally in grease. Part of the annual inspection routine must include a good clean... in fact, I think that the act of cleaning something almost requires you to inspect thoroughly. *(Photo: Malcolm McBride)*

RYAN PT22 AILERON BRACKET CRACK

A while ago now I received a small parcel from LAA Inspector Andy McCluskie in which were two aluminium aileron brackets, both badly cracked at the aileron attachment end. There was no note so I gave Andy a call. "Could we be discrete about this?" Andy asked. "I think that there are one or two embarrassed faces about over this!"

Andy went on to describe what had happened and I promised to be discrete, limiting the tale to within our little airworthiness club. Well, that's only 8,000 or so LAA members plus the web readers. Andy found these cracks during one of his very thorough annual inspections; the important point is that without cleaning off the grease from the bearing surface these cracks weren't visible. After a bit of digging, Andy discovered that the aircraft's wing had been inadvertently reversed into the side of the hangar. Apparently it was a gentle bash and, after a quick look, it was decided that they had got away with the faux pas in the ground-handling department.

Looking at the crack, I think that they were quite lucky not to lose an aileron in flight! So, good spot awards to Andy, Tim and Tony, but 'could do better' on my card. Oh well, after all nobody's perfect. ■

LAA Inspector Neil Spooner came across this turnbuckle a while ago and sent me a picture. What amused Neil was the 'very weird' wirelocking, but you'll notice; I'm sure, that corrosion is also evident. I'm not sure about that pipe squashed through the bulkhead either... I know, I know, it's easy to find fault! *(Photo: Neil Spooner)*

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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