



TAILORED

With Malcolm McBride
Airworthiness Engineer

MAINTENANCE

Some aircraft are more complex than others; perhaps this is obvious, but it's important to consider this and the flying life of your aircraft when creating your Tailored Maintenance Programme

I'm thinking, 'What should my first words be?' No doubt you know the feelings generated when staring at a very empty page that needs filling. I know! I'll seek some inspiration from our Chief Inspector, Ken Craigie; he's just sitting the other side of the office here at LAA HQ Engineering at Turweston Aerodrome... OK, the look said it all; he's buried in, well, Chief Inspector things. Instead, I shall just start off this July 'Safety Spot' with, as usual, a warm welcome to this mid-summer edition, I hope all's very well with you.

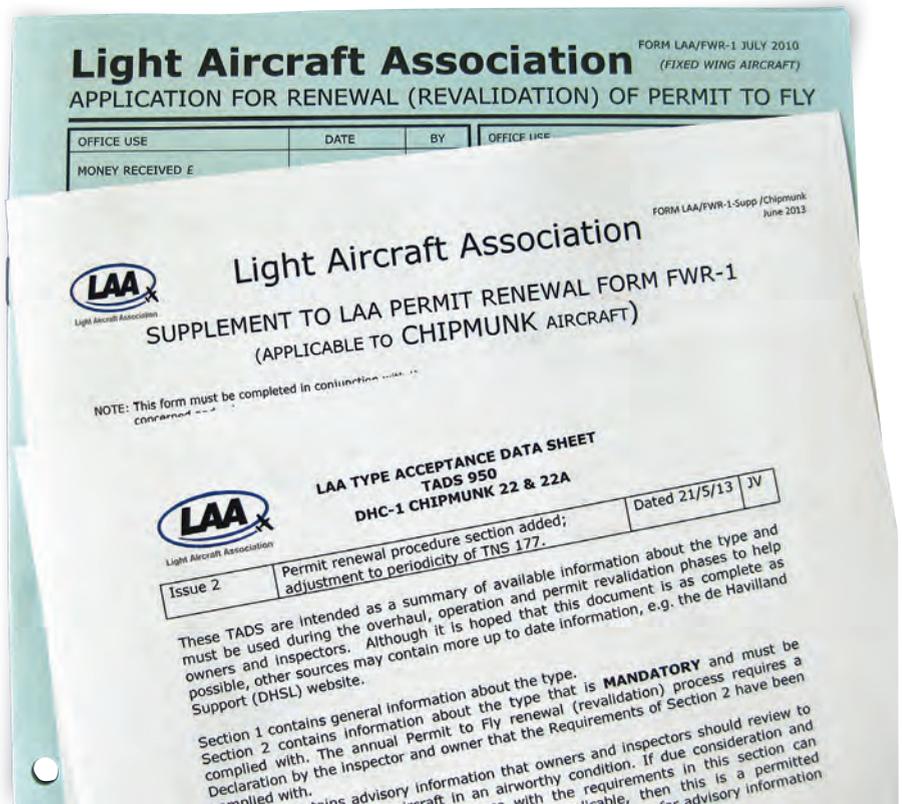
There, it's not a blank page any more.

Actually, as you are reading this at, hopefully, the beginning of July, I bet I'm warmer than you; at least I hope so as I shall be off, politics permitting, on my annual leave... yes, sailing the Aegean (off Turkey) again... I can hardly wait, mmmm, I'm off tomorrow, so a little less chat and a bit more content is probably sensible.

This is a very busy time for all of us here at Turweston for, I suppose, the very good reason that everybody is out there doing lots of flying. The stop/start nature of the weather this year has meant that the Permit renewal applications appear to be arriving in waves – indeed, for a couple of weeks earlier in the month one wave caught up with another and we were rather overwhelmed by a tsunami of blue forms. Well done to all of you for spending time getting these forms filled in correctly, this season has seen the smallest number of rejections ever and this has meant that we've been able to meet our (rather self-imposed) target of reissuing expired Certificates of Validity within three days... we don't like the thought of members being stuck on the ground for paperwork reasons and try to avoid this wherever possible but it can be hard graft, especially at the beginning of the season.

Whilst I'm on the subject of Permit renewals, I should let you all know of a slight tweak in the renewal process. Actually, this is a continuance of our drive towards the adoption of Tailored Maintenance Programmes for aircraft operating under an LAA Permit to Fly, and, at this moment, this small tweak won't affect any of you unless you are operating a Chipmunk... I know, I should be so lucky.

What's really happened is that we've



LAA Engineering is quietly (and carefully) introducing a new TADS based system to help manage continuing airworthiness issues on a type by type basis; our ultimate goal is that every aircraft type will have its own TADS. This web-based document will define the maintenance requirements, provide links to information necessary to the owner/Inspector 'in the field' and list pertinent ADs, SBs, AILs and, when appropriate, manufacturers' service letters and advice. (Photo: Malcolm McBride)

accepted that some aircraft are, for all sorts of specific reasons, more complex than others. You might say that this is a rather obvious statement but, historically, the LAA has adopted a rather hands-off approach to maintenance oversight on our aircraft and, at least for Certificate of Validity renewal purposes, all we've needed for the renewal is the general maintenance list (Page 2 of the Renewal form) being signed off by the maintainer and the LAA Inspector. We've recognised that, as LAA aircraft increase in complexity, get older and, to some extent,

are better supported by manufacturers' maintenance recommendations, our one-stop annual maintenance programme needs looking at... hence the tweak.

We chose the Chipmunk to officially start this process because the Chief Engineer, Francis Donaldson, considered this aircraft to be, at least in maintenance terms, 'complex'. Those of you flying around in aircraft with variable-pitch propellers, retractable undercarriages and up-to-date flat screen avionics might, perhaps rightly, raise your eyebrows at this statement so, before you all write in, I should



Here's a close-up of the leading edge of the failed propeller at the point of the failure; you're looking from front to back. Initially, this looked like the point of an impact but, by looking very closely at the shape of the damaged leading edge protection strip, we think that the actual impact was further outboard; notice the symmetry created as the leading edge strip was ripped apart.
(Photo: Malcolm McBride)

Here's a close-in shot showing point where the Lodge propeller as fitted to the Aeronca failed; the important point is that the grain of the wood used in the propeller's construction is straight and perfectly orientated along the length of the propeller, just as it should be. Chris Lodge, the original manufacturer of this propeller, always used either Brazilian or Honduran mahogany in the manufacture of his propellers; when we chatted about the possible causes of a propeller failure like this, Chris explained that it was almost certainly due to leading edge impact damage, but this would need to be confirmed by a close look at the leading edge to establish in which direction the blade actually failed. I asked Chris why, after making over a thousand propellers for the sports aviator and with such an excellent reputation for quality, he's decided to retire. He explained simply, "You just cannot source this type of wood any longer and the available hardwood, principally European Ash is too hard for my (hand made) manufacturing process". Good luck

Chris, thanks for your help and advice over the years and, naturally, enjoy your retirement... you'll be able to get a bit more time in your Taylor Monoplane!
(Photo: Malcolm McBride)



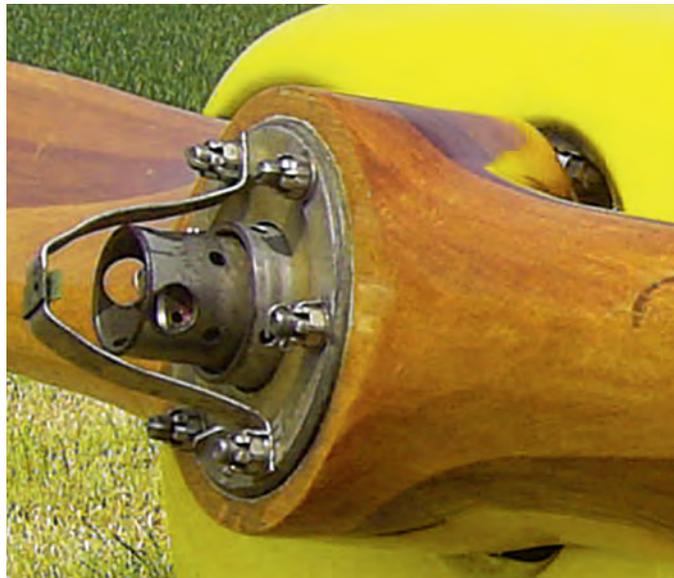
explain Francis' reasoning for this specific 'grading' decision.

While we're used to seeing important but relatively small items on LAA aircraft having a mandatory life limit, such as the tie-rods in Tiger Moths and Sutton seat harnesses, the Chipmunk is the first type of aircraft to come onto the LAA fleet in any numbers where major airframe components are life-limited, such as for example both wings and the attachments for the wings and tailplane. Historically, when the Canadian Chipmunk design was being adopted by the Royal Air Force as a primary trainer (in the late 1940s) the 'safe component life' concept was in its infancy. As engineers started to learn of the effects of metal fatigue (after a series of well-documented aircraft accidents), a fatigue life was calculated for the quite highly stressed aluminium alloy fuselage centre section lower tie bar. Since then, other critical components in the Chipmunk have been tested and given safe (fatigue) lives, in this case by Hawker Siddeley Aviation in 1959 after their post-war adoption of de Havilland Aircraft Co, and more recently by de Havilland Support at Duxford.

Naturally, especially if you are a regular Safety Spotter, you will know that the number of 'cycles to failure' depends enormously on the degree of regular stress (as a percentage of limit load) the component has to resist. An aircraft completing regular aerobatics will clearly be under greater stress than an aircraft off on a Sunday afternoon jolly with Grandma in the back; hence a further complication and the need for applying a 'role factor' to the hours flown, depending on usage.

All this, I appreciate, is hugely complicated and space doesn't allow me to go into greater depth on this very interesting subject so it will have to be enough to say that, because some components on the Chipmunk have fatigue lives we need to tweak our systems to ensure that these lives are managed carefully.

OK, I hear you thinking, what's the tweak? Well, firstly, we've introduced a central document to manage the type; we call this the TADS (Type Acceptance Data Sheet) and the aircraft must be maintained in accordance with the rules laid out in this



What came first, chicken or egg? Early thoughts were that the failure of the propeller led to sufficient vibration to dislodge the spinner; now we've had a closer look at the failed propeller we think that the first thing to fail was the PK screw holding the spinner on... It's certainly worth checking the security of a spinner during the pre-flight walk around.

(Photo: James Day)

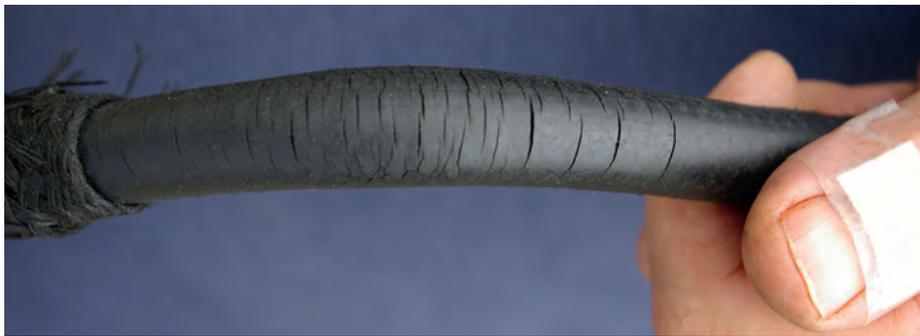
document. Secondly, so that we can 'adopt' the Chipmunk into our fleet without changing all of our process across the board, we've introduced the concept of a 'Supplement' to the renewal form itself; this supplement records specific information pertinent to the applicant's aircraft. If you take a look at the LAA's revamped website at www.laa.uk.com you can find the Chipmunk TADS in the Data Library under Aircraft Datasheets. In the TADS there are all sorts of interesting links, including one to the de Havilland Support Technical News Sheet No 138, which defines the rules about fatigue, lives on the Chipmunk. It makes interesting reading.

In the last 'Safety Spot' I discussed a propeller failure that occurred on an Aeronca 7AC Champion, we weren't certain then what caused the incident but ran with the story because it reinforced the need for pilots, when faced with an emergency, to 'first fly the aircraft' – a message that regular readers will know we've been pushing. In any event, the owner, LAAer James Day, brought the broken propeller over to Turweston for us to take a closer look, so, for the second time:

AERONCA 7AC CHAMPION PROPELLER FAILURE (II)

When we get a report of a failure of any component, normally, once we've worked out what's actually happened, we'll speak to the manufacturer of the component in question. In this case, the propeller that failed was manufactured by the LAA's very own Chris Lodge, so the conversation discussing the possible reasons for this unusual failure was particularly enjoyable. Chris, who's now retired from the prop-making business, has hand-made over a thousand propellers, all individually crafted for the engine-airframe combination. I can remember chatting to Chris in the early 80s when trying to put together a sensible engine/propeller combination for a single-seater Fuji Robin-powered microlight; the results were brilliant as I well recall and I've been in awe of the propeller maker's art ever since. Chris is a regular flyer and owns a Taylor Monoplane and, as a pilot of a fairly low-powered type himself, appreciates the variety of parameters that a good propeller design must satisfy; many owners of LAA aircraft will testify that Lodge props seem to tick all the boxes.

SAFETY SPOT



Here's a picture of the fuel hose that started to leak one evening at Haverfordwest airport, note that the outer braid has been pulled back to reveal the reason for the leak; this hose has completely perished, and it's only been in use for a couple of years. This fuel hose appears to be of the correct specification and has been supplied as fuel hose and this surprise premature failure should encourage us all to consider reviewing the time between checks of fuel system components when creating our Tailored Maintenance Schedules. (Photo: John Jones)



Some time ago I did a solvent wash of a fuel filter that was used on an aircraft that had never used fuel containing alcohol, the filter had prematurely blocked and the owner of the aircraft was concerned that his tanks were disintegrating... if you look closely at these particles, and the biggest is about 1/10 mm across, you will see that they're actually an agglomeration of all sorts of still smaller bits and pieces; that's, after all, why designers fit filters into their fuel systems. (Photo: Malcolm McBride)



I asked Chris what he felt was the most probable reason for the propeller to fail and he, without hesitation said, "The spinner coming off and striking the leading edge." I suggested that the owner felt that it might have been a bird strike and that the spinner was lost because of the ensuing vibration after the propeller failed. Chris thought this unlikely although blood spatters found on the engine cowlings certainly, at least initially, pointed to this as the root cause. I agree though with Chris, the most likely cause of this propeller failure is the premature departure of the spinner; this suspicion has been reinforced by the subsequent discovery of a pair of minute translucent wings in one of the blood spatters, suggesting the marks being testament to the demise of insects having created a red herring.

We've taken a close look at the broken propeller here at Turweston and the failure shows all the hallmarks of a leading-edge strike so, perhaps, the lesson here is that, during your pre-flight walk around, always check the spinner for security. This one was only held on with a single self-tapper through a U-type Tinnerman nut and any aero engineer will tell you that this isn't the trustworthiest of fixings, especially in areas where there might be vibration.

REALITY ESCAPEE FUEL LEAK

This story started, as do so many these days, with an email from an owner who'd got a problem with his aircraft, a UL 260i powered Reality Escapade, with the (in this case) rather unfortunate registration of G-LEEK! OK, crass, but I couldn't help it!

Anyway, this aircraft is, like an increasing number in the LAA fleet, operated by a syndicate. Three people share ownership. In every syndicate we ask that somebody takes the lead role with regard to engineering matters and, in the G-LEEK syndicate, Dr John Jones has been promoted to this position. John writes:

Hi Malcolm,

After a very pleasant flight from our base aerodrome at Haverfordwest to North Wales and back the aircraft was put away in the hangar and everybody went home happy in the fact the aircraft was going well.

Later on, I had a phone call from the airport manager saying that the aircraft was leaking fuel. Upon returning to the airport and removing the cowlings, it was noted that the fuel hose from the firewall to the pre-filters (that feed the dual high pressure pumps) was leaking all along its length.

Here's a similar photo of that on p47 of the inside/outside (i.e. pump side/engine side) of the element from the high pressure section of the fuel system discussed in the text. You can see that the filter has been doing its job well but surface build-up has restricted the flow severely... to such an extent the pump was 'struggling'. (Photo: Malcolm McBride)

After removing the hose and stripping back the cotton braid around it, the photographs show what we found. The hose has completely cracked but is not hardened, it's as soft and supple as it was when new; the aircraft was first flown in 2010 and has run about 115 hours.

There were still sufficient marks on the braid of the hose to make out the make and specification – it is manufactured by a company called COHLINE, it's a COHLINE 2122 and this is manufactured to DIN 73379 B spec. The fuel used has been mostly mogas but also some avgas has been used. The hose on the cockpit side is also the same spec hose but is by a different manufacturer SYTEC also DIN 73379 B; this hose seems to be fine.

Why this has happened? The hose is not close to any high heat source – only the normal heat of firewall forward components, but as this particular make has only been used firewall forward; we're going to replace this suspect hose with SYTEC manufactured type as we still have some of this left over from the aircraft's initial build. We intend to keep a close eye on the entire fuel system.

Regards,
John.

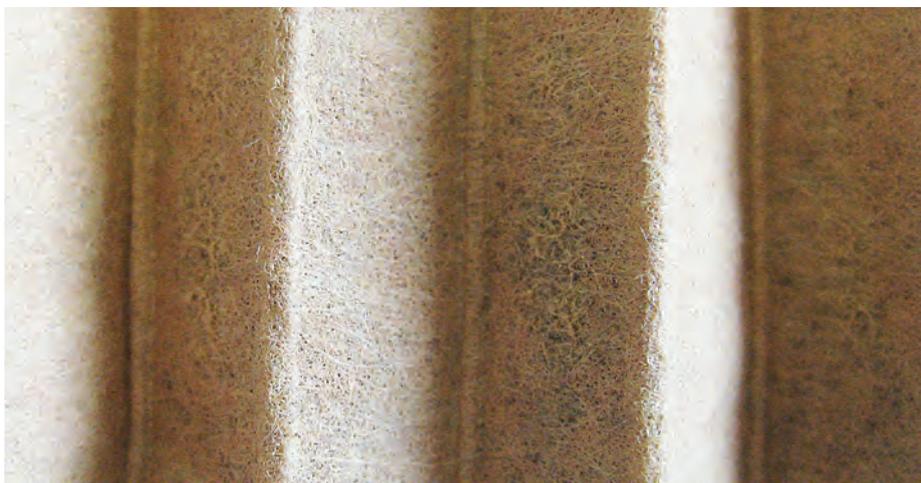
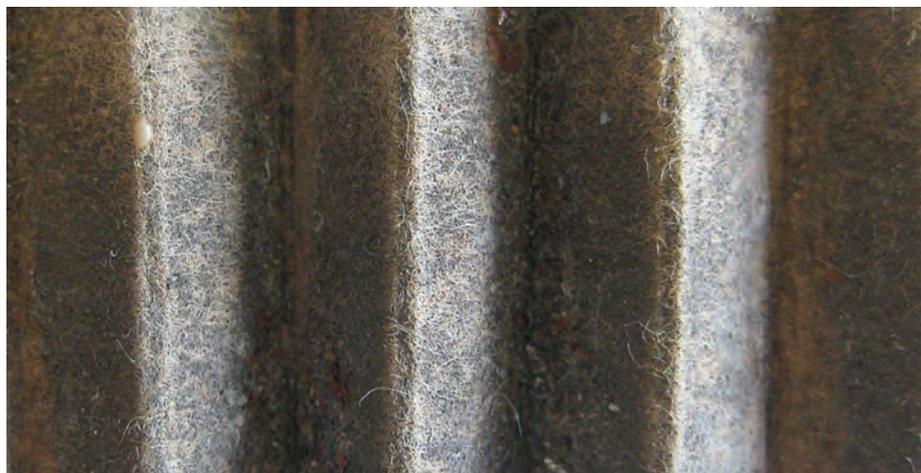
I wrote back to John thanking him for the email and explaining that I hadn't seen this Cohline hose before and that it looked unusual in that it appeared to be homogeneous through its cross-section. I asked if he could send a sample for us to look at here at LAA HQ. What I mean by 'a homogeneous cross section' is that the whole hose appears to be manufactured from one specific rubber-based compound; the braiding, folded back in the attached photo, is not integral to this compound being woven around the outside.

One issue we had some time back has led to the requirement for repetitive inspection (monthly) of one type of fuel hose, Trelleborg Hydro K, commonly used in microlight aircraft. We noted during our investigation that this hose was actually manufactured with three distinct layers, which makes sense when you consider what a hose has to do. First, it has to be fuel-proof and therefore completely fuel-proof material needs to form the inside of the hose. The second job is to resist the internal pressures the system develops; this is the middle (bulk) layer, which is selected for enhanced strength. The third job is to resist surface abrasion from the outside environs... this is often done by including a woven thread in the outer rubber material.

Interestingly, when I finally managed to speak to the manufacturers of the Trelleborg hose they told me that, "Yes, all of our hose is fuel-proof on the inside as we only use one material for all our hoses but Hydro K hose, as perhaps the name implies, is actually water pipe, so the outside isn't fuel proof." We decided that the cracking must have been caused by the fuel vapour surrounding the hose and, perhaps, this is the same problem with the Cohline-manufactured product.

In any even, after a short time a parcel from John arrived at my desk and I looked within with interest. There was a bit of pipe which, as suspected, looked homogeneous... and some horrible looking bits of filter. Perhaps John's letter, also enclosed, will shed some further illumination.

Dear Malcolm,
Please have a look at the hose sample from



These pictures show the inside and outside of the pre-filter element from a UL260i engine that has run for 115 hours. The owner found that it was nearly impossible to blow through this 'large particle' filter and, after it was changed, the fuel pump sounded 'far more relaxed'. It is my opinion that fuel filters on aircraft operating in the Permit to Fly environment should be changed at least every 50 flying hours or at the annual, especially if the aircraft is being operated on Mogas. (Photo: Malcolm McBride)

G-LEEK; unfortunately I destroyed the outer casing with the manufacturer's name on it (Cohline) and I don't have any more of this type to hand. Also enclosed is a section of the innards of the fuel pre-filter and the high-pressure filter, the pre-filter being the small pleated section. When I took the pre-filter off during the hose replacement I did the usual thing and blew through it by mouth to see how restrictive it was and was quite alarmed at how blocked it was (very difficult to blow through) and as it has an all-metal case one can't see the element.

After cutting it open there was no sign of any debris within but the element is coated with some brown goo which has seriously closed the pores of the filter. Likewise with the main high pressure filter the blow-through test was the same; it was very hard to blow through it. This filter is also coated with a brown substance only it seems finer, the fuel pressure up to this point was not affected still holding a steady 40psi although after fitting the new filters the fuel pump now runs a lot quieter.

The engine manufacturer states that the filters should be changed every 200 hours but with hindsight I think perhaps 75 hours would be more appropriate, at least until everything is settled down – these filters have run about 115 hours.

The question is, what is the brown material? The main fuel tanks are fibreglass resin, could this be just something washing off the tanks and once settled down will disappear? Or is there something in mogas affecting the tanks? In the USA there have been problems with the tanks on the Escapade and Highlander in the past with resin breaking down.

Thanks

We don't have the equipment here to isolate the chemistry of the, to use John's description, brown goo, but I think that it is likely that this will be microscopic amounts of fibreglass resin, or perhaps tank sealant that's being washed off the surface of the fuel system's internal components, probably the tanks. If the G-LEEK syndicate has been using mogas, there's a very good chance that they've been inadvertently operating with alcohol in their fuel system but, even if this isn't the case, modern motor fuels vary considerably in their make-up and that's why it is essential that if you're using motor fuel in your aircraft you take this into account when designing your Tailored Maintenance Schedule (TMS).

Certainly 200 hours between service intervals on fuel filters, regardless of manufacturer recommendations, is too long in my view – perhaps as this incident perhaps demonstrates. >

SAFETY SPOT



STREAK SHADOW FAILED FIN POST

We received an email from an old friend of mine, Fiona Luckhurst, now an acclaimed Shadow expert and co-owner of the Shadow Flight Centre at Old Sarum. Her letter explains all so, as usual, I'll let her initial letter relate the facts.

*Dear Malcolm and Ken,
Unfortunately I have to report an occurrence concerning a fin post on a Streak Shadow.*

Attached photos of the Fin Post (T147) from a Streak Shadow showing cracks found by the owner when he noticed an unusual movement in the fin post when he was preparing for flight. Historically MPD 1998 -013 R1 was raised after cracks had appeared at the top of the fin post where it enters the boom and mandated the fitting of the additional inner sleeve. The inner sleeve (T188) is intact in this case and has done its job.

Interestingly, the failure on this fin post was not at the top by the first line of rivets securing the wooden gusset as had been seen before but at the second, lower, set of rivets. This machine has flown nearly 700 hours and has a Rotax 618 fitted. This is a heavier engine than the standard R582. She also has a fixed rudder trim which was found to be very loose on inspection the week before. (A possible suspect for the unusual damage?)

*Best wishes,
Fiona Luckhurst,
LAA Inspector.*

Certainly a crack like this is serious as progression of the crack could lead to the complete fin and rudder assembly separating from the aircraft. The Streak is a famously benign handling aircraft, but losing the fin and rudder would be likely to result in pretty disastrous directional instability. We discussed this failure at one of our regular engineering meetings and the Chief Engineer suggested that I ask the aircraft's designer, another old friend, David Cook, what he thought about it.

Here's the reason why a good walk-round inspection could prevent a good day from becoming a bad one. This is a picture of the Fin Post (less the fabric covering) from a Streak Shadow complete with a nasty crack near the point where the fin post enters the fuselage boom. The owner only noticed it because he felt an unusual movement in the fin... well done to him for having a good feel. Humour, such as it is, aside... I think that it's always a good idea to have a good pull and prod on bits of the aircraft to check whether one bit is moving correctly against another and to detect whether there's movement where their shouldn't be. (Photo: Fiona Luckhurst)



Because of the nature of the design, the Shadow series of aircraft rest on their tail when the pilot's weight is removed; you can see that it would be easy to inadvertently impart quite large loads through the fin post into the fuselage boom and it's definitely worth taking this into account when pull starting the engine. (Photo: Richard Hamblin)

“By this time the wings were at a 60% nose-down angle when I felt a jolt and heard a horrible noise”

David is retired now and, like so many retired chaps, doesn't sit still for long, so it took me a while to make contact... it was good to hear, when we finally touched base, that he hadn't lost any of his east country humour.

“I agree with Francis,” David explained, “and it wouldn't be good if a pilot lost his fin, that's why we reinforced it with the extra internal tubework early on.” David continued, “I think that it's most likely that the reason for this fatigue failure is that, either the aircraft sits outside and is being blown from side to side by the wind or, and this is the most likely, the owner is starting the aircraft with the tail still on the ground.”

I admitted that I've done this myself. David said that he would send me the correct starting procedure and, “While I think about it, there was a case where a South African chap lost his fin and rudder. I'll see if I can dig out the report that he sent me. It was a few years ago now.”

Next day, David sent through, as promised, the starting instructions and the letter from the South African pilot – I extracted the pertinent portion (dated 2010) and copy it below:

(I) wound up the Rotax 912 engine on the runway pointing towards 'Lite Flite' (about 2nm away) opened the throttle and away we went. As the nose lifted, I saw a bunch of birds about 200 metres from my nose, but by this time I was already committed and the Grassroots runway was very short and by now there was no runway left to abort.

I tried to out-climb the birds at 1,700fpm, but the birds were scattered all over the sky in front of me. At that time I was about 600ft above

ground. I veered to the left to avoid the birds but they were there as well; I then veered to the right, but they were there as well. At this stage the birds were about 10ft in front of me and at a height of 700ft, I shut the throttle down, pushed the Streak's nose down and switched the mags off as I knew I was going to fly into the birds.

By this time the wings were at a 60% nose-down angle when I felt a jolt and a horrible noise, something like when your wife is cross with you and slams the door in your face – and then the hand of God took over.

I push the ailerons left to bring the wings horizontal, push the rudder to the left, for a left into-wind approach for Runway 19 at 'Lite Flite', BUT, there was no rudder response.

I pushed the nose down further to gain more speed and aimed for Lite Flite's runway. With no direction control and hard rudder control and full aileron control I put the Streak down in the middle of the runway at the edge of the runway at a speed of 60 to 65kt.

When the Streak's back main gear touched the ground, I applied right brake to steer the Streak down the runway, but I was too fast and, with no rudder, the Streak had just one direction and that was straight forward, I went across the runway ran into the rough on the other side of the runway and just before the Streak came to a standstill the main undercarriage collapsed.

Jas van Wyk

What had happened was the fin and rudder had been removed because of the impact with a large bird... unspecified. This rather catastrophic event though does reinforce Francis' worries about the lack of directional stability with the fin missing.

We'll be discussing the way forward with this issue at the next Airworthiness Review Meeting, but meanwhile this cracking does provide a timely reminder of the need for careful pre-flight checks and always being on the alert for anything that doesn't look or feel as it should, especially with the very lightweight structures on microlight and similar airframes which, designed for flight loads, may not be too tolerant of ground abuse.

Oh well, it's a couple of minutes to five and I've just made the 'Safety Spot' deadline, next deadline, the Aegean...

Fair winds! ■

Sussex flyer Carl Meek, who owns and operates one of the two Tecnam P2002 RG Sierra's operating within the LAA Permit to Fly scheme, sent in this picture of a recently refurbished petrol pump from his local Sussex garage (right).

What's this, UL97 to EN228 Spec? We spoke to the LAA's fuels

expert, Barry Plumb and he explains: “You will recall that the CAA General Concession on the use of Mogas (CAP 747, GC5) states that fuel must comply with specification EN228, and that the fuel must contain no alcohol. Alcohol-free fuel is now difficult to obtain and an alternative possibility was to use Super Plus unleaded fuels. However these were generally blended to comply with BS 7800, which was not covered by GC5 in CAP 747.

Specification BS 7800 has now been withdrawn, and BS EN 228 has been revised to include super plus unleaded fuel of minimum 97 RON. Therefore the super plus unleaded fuels will now be blended to comply with BS EN 228, and are therefore now covered by GC5 in CAP 747.

The vapour pressure limits for 95RON and 97+RON fuels are identical.

Therefore we can revise our advice to pilots that if they can no longer source ethanol free 95RON fuel but can obtain 97+RON fuel which complies with BS EN 228, then it is a legally acceptable alternative.

Again the only proviso here is that the fuel must contain no alcohol.

So, it looks like Mogas is back on the menu for aircraft that are cleared to use it.

(Photo: Carl Meek)



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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