SAFETY SPOT

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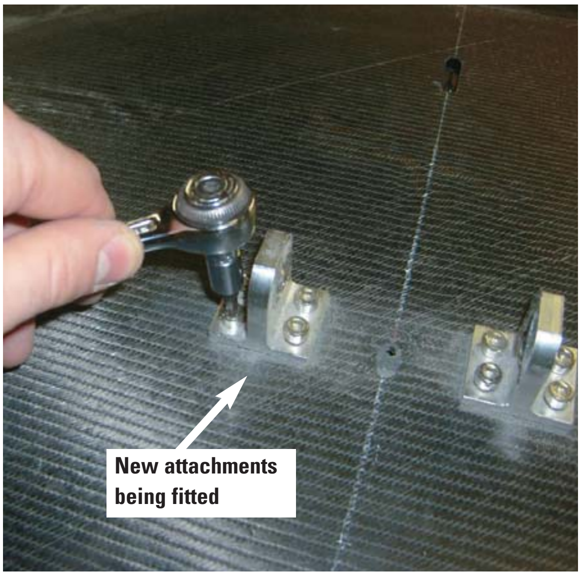
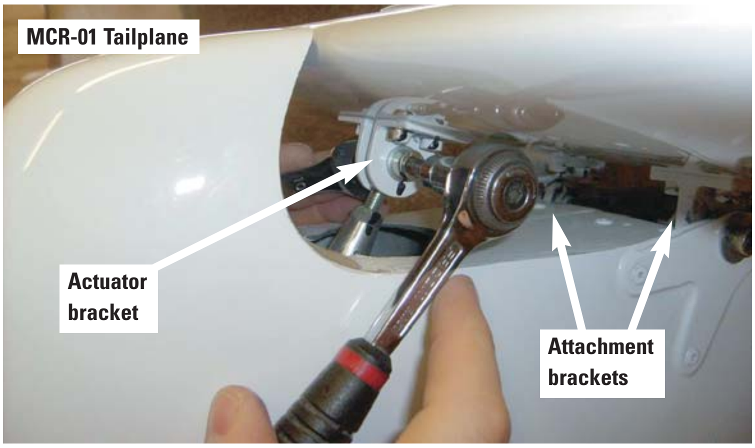
Yet again I have allowed time to get the better of me; "next month", I thought, "I'm going to get Safety Spot done early, give myself a good run at it, maybe try to up the English a bit, be less stressed". Then, my nemesis appears (in the form of the Editor of the magazine) who, in a suitably nemesis-like voice, informs me that the article has got to be written early ……. It's all about Easter apparently ….. and the Moon, and the alignment of Jupiter. So what's new?

MCR-01 UPDATE

As I write this article the LAA is in the throws of clearing the modifications required to the MCR-01 tailplane attachments. There are basically two distinct types of tailplane attachment which, because of the UK agent's mathematics background (sorry Jerry), have been named type one and type two. The type two brackets are being replaced with stronger brackets (made from stainless steel instead of aluminium alloy) supplied as a direct replacement from Dyn-Aero. Once



these brackets have been changed, and subject to the usual inspections, these type two aircraft should soon be back in the air -that's about two thirds of the MCR-01 fleet. The type one fix is a little bit more involved and requires Dyn-Aero to do some further load testing on a modified tailplane; we need to be sure that if a type one bracket fails the additional support, provided by the factory mod, will be sufficient to stop the tailplane from flying off; there's no point in fitting it otherwise.



Photographs: Jerry Davis

RANS S6 AND QUAD CITY CHALLENGER STRUCTURE PROBLEMS

It is a fairly rare thing to have a bit of major structure fall off in flight, and the consequences are almost always dreadful. I was alerted by our Canadian colleagues about a failure event to make your hair curl.

The Pilot of a Challenger aircraft suffered a complete failure of the forward lower lift strut bracket; the Canadian Pilot survived the incident because he had, and deployed, a BRS chute. There is a message here somewhere and I would definitely welcome comments about the fitment of this type of parachute, but I digress … in fact, let's digress further! Regular readers will know that some models in the Rans S6 fleet have been required to carry out a full 'under the skin' fin inspection; this inspection came about because of cracking in one of the aluminium alloy structural tubes that make up the structure of the fin and, so far, we have had half a dozen positive responses to this inspection, so the AIL (Airworthiness Information Leaflet) was definitely worthwhile. Talking to owners of Rans S6 aircraft, the general view is that these cracks are caused by overstressing during ground handling; lifting a tailplane and squeezing an aircraft into a hanger by the tailplane's leading edge probably introduces more load into an airframe than flying around ever could, even allowing for the quite severe gust case factors added during the design process. I think that these owners have a point, and it is definitely true that a lot of damage could be 'Hanger Rash', but I still think that there is more to it. As Aviators, we are in a fairly unique point in history, nobody has any experience of middle-age Aluminium tube/Dacron aircraft. My advise to owners of this type of aircraft is 'know your aircraft', do not become complacent, and as I've said before, build in full inspection checks at reasonably regular intervals, say each 25 hours. Back to the Challenger mid-air failure, this is a good example of why regular airframe checks are necessary.

We've got about 14 of these microlight aircraft flying within our fleet, the machine is of a similar vintage to the Rans S6, and the kind of construction is broadly similar but, in this country at least, never proved to be as popular. The aircraft has a good safety record and there are many hundreds flying in the USA and Canada, although many of them, according to my opposite number in Canada, fly well overweight, with floats and all sorts of other extras. Take a look at the picture and you will note that this type of bracket is ubiquitous amongst aircraft of this type and, remember while you are looking at the picture that this bracket failed in flight … and the aircraft's wing fell off!

I have contacted the manufacturer who tells me that this bracket should be inspected "every 50 hours" which is something that we didn't know. When the Challenger was first certified in the UK a number of modifications were required (12 in all), one of these modifications was the incorporation of a large washer under the bolt head on this bracket. The idea of this mod was to spread the load more evenly across the bracket, the problem is that it becomes difficult to inspect this bracket for cracks. The LAA has called for a thorough inspection of these brackets (by removal) by publishing an Airworthiness Information Leaflet. All Challenger owners should have received this by the time that this mag has been published, if you should need a copy and weren't sent one, give me a call and I will get a copy in the post.

Photographs: Richard Yates

LETOV SLUKA MAIN BOOM CRACKS

It's not just the extremities that take punishment in an airframe, take a look at the picture of another crack, this time on the main boom of a Letov Sluka. The Letov Sluka is a mid 90's Czech design, it's a single seat rag and tube high wing monoplane modelled on Mike Whittaker's MW4 and 5 excellent designs; the LAA fleet comprises only eight aircraft and my thanks go to Richard Yates, one of our inspectors, for this report. Note that this crack is under the forward wing hinge attachment bracket, it's easily seen with the bracket removed, but could easily be missed with the bracket in place….Good Spot Richard. We've seen cracking on these mono-boom type fuselages before, so if you fly this type of design be mindful that during flight the tube is continually being subjected to torsional loads which can cause internal structure changes to the material at stress points. Remember, minimum aircraft mean minimum structure, there is almost never redundancy built in to the design so you're in trouble if something fails, "if in doubt – check it out".

Luscombe 8F – Access is sometimes difficult!

Photograph: Mat Pettit

LUSCOMBE 8E TAILPLANE ATTACHMENT

Generally speaking, I think that it is true to say that there is no such thing as a sudden crack; often the cause of a component failure is obvious, the part was simply under-designed and failed, or it failed because it encountered loads that it wasn't designed to take. In sheet material, or for that matter rounded sheet, i.e. tubes, this failure may look like a crack, but it may not be, physically, it's more like a tear … This sort of failure is caused by the load exceeding the material's yield point. Lifting an aircraft by the tip of a tailplane and swinging it in or out of that 'difficult' corner, or for that matter, pulling an aircraft out of the hanger by the tip of the propeller, will not cause a crack … It may cause the component to fail, but, that's not necessarily because of cracking … Cracks are more subtle and may take years to propagate. The Letov Boom crack, well that's a crack, no question, this next example, well, I'm not so sure.

Sometimes the cause of a crack can go way back in the aircraft's history, right back to 1946 in the case of a problem ▶

Internals of the Luscombe

De-lamination of lower port spar

Photograph: Mat Pettit

that was discovered during the annual inspection of a Luscombe 8E (metal skinned version) which was reported by Mathew Pettit, another LAA inspector.

Crack hunting is the sport of choice for many aircraft engineers, it takes years of practice to perfect the art; Mathew obviously treats the sport of 'crack hunting' very seriously, and, is not frightened to use advanced techniques, many of which require special dexterity. The equipment required consists of a torch (easily sourced form the more up-market outlets), and a mirror (the best ones are fitted to the end of a telescopic handle), and a good imagination (difficult to source)!

Our story starts in 1946 because that was the year in which the aircraft in question was built. Shortly after the aircraft was manufactured it was noticed that some examples leaving the Dallas factory had developed cracks around the forward stabilizer (tailplane) attachment. It was found, on investigation, that many of the attachment bolts were over-tightened during assembly. This over-tightening caused crushing of the front spar of the tailplane and distortion of the forward attachment spacers. A US AD (Airworthiness Directive) was produced by Airworthiness Authorities (49-43-02) requiring all Model 8 series aircraft to be checked for distortion of the attachment, fittings and spar. This inspection was a one off and our aircraft passed this initial check; the AD was re-visited when the aircraft was imported into the UK in 1991, at this time it was noted that there was some deformation of the tailplane spar, but that this was not considered 'excessive' and that there were no cracks.

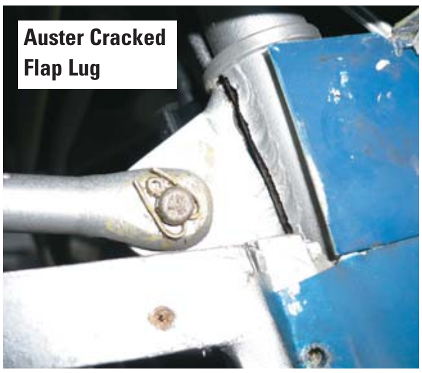
When Mathew saw the first signs of cracking, he called us at HQ and we suggested that it would be a good idea to remove the tailplane completely; you can see what he found by referring to the pictures. What he thought was a crack was actually a join in the spar material, but the delamination and pulled rivets are all too apparent. Tailplane spars are important parts of an aircraft's structure and hats off to Mathew for a brilliant Spot, "well done that man".

Incidentally, for your information, of the 81 aircraft originally on our books 48 of them are still flying around with Permits. I know that arguments persist about the Luscombe 8 and the Cessna 120 regarding their relative merits but as Bruce Forsyth might say "They're both my favourites!"

ABOUT CRACKS

For those new to the pursuit of crack hunting, here are a few tips. First, and perhaps foremost, you will not see a crack under grease, mud or any other accumulated detritus. The first thing that should be done is to thoroughly clean the area to be inspected, use a good light, don't be afraid to move the light around as this can sometimes form shadows or strange diffraction patterns which can highlight a crack. Another good tip is anticipation; think about where you might expect a crack to form, welds are a good example of a stress raiser. Take a look at the picture of the Auster (J1N) fuselage attachment lug sent in by another one of our inspectors, Hugh Jones; thanks Hugh for this 'text book quality' photo. As they say a picture is worth a thousand words and this one says it all, so I will waffle on about it no longer except to say that welds are always good places to 'bag' a crack.

As we have seen with the MCR-01 tailplane failure, cracks do not always



Auster Cracked Flap Lug

Photograph: Hugh Jones

propagate along the surface of the material, they can, actually almost always do, spread into the actual structure. This sort of cracking is very hard to spot but often originated at the surface, often at a point of oxidation. So, get rid of corrosion before it compromises the structural integrity of the material; take a look at the picture from Francis Donaldson of the Auster tailplane bracing wire attachment, another 'no words required' photo! This component is suffering the multiple whammy of corrosion, complex strain paths and vibration.

To try to understand what causes a crack in a material, and therefore become adept at finding them, you need to understand that the component can crack even if it isn't overloaded; actually just about anything will fail eventually if it is continually taken through an on-load/off-load cycle …. It may take a lot of cycles, or just a few, how many cycles will depend upon the percentage of the yield strength of the material that is in question. Design engineers call this kind of effect fatigue; take the Sluka boom again, you can see that the part of the boom that has failed is having to react the loads from the engine. Forget about the weight of the engine, and G forces for that matter; these forces are there during normal operation, they are completely predictable and must have been taken into consideration through the aircraft's approval process. It's other, as I have said, more subtle forces at work causing cracking.

Think about the piston flying up and down the cylinder barrel; at five and a half thousand RPM, roughly normal cruise for the Rotax 447. That piston goes up and down

Three hundred and thirty thousand times per hour, and there are two of them so that's more than half a million pulses! The purpose of the engine mount is to isolate these pulse loads, created by the pistons, from the airframe; the best will do this almost completely, the worst might as well not be there. All isolation systems, which is what an engine mount is, fit somewhere between these two extremes. It is true that the energy in an individual pulse is pretty small, but, as you have seen, there are a lot of them. In short, if a component is vibrating it will eventually fail …. The biggest cause of cracking is therefore cycles, and on that note, I shall 'get on me bike'. Fair winds. ■