TAKE TIME TO CHECK

Don't take things at face value... check again

Spring is sprung, the grass is riz, I wonder where the birdies is? I think I can answer that almost timeless question on behalf of LAA aircraft owners... "They're being taken out of their hangars, cleaned up, and serviced ready for the 2010 flying season!"

I don't think I would get too much of an argument if I said it's been quite a winter, 'just like the ones I used to know', to parody the old song known well by some of our older members and, of course, me as I love the music from that period. I must say that a little bit of sun goes a long way in improving the constitution of the author and I hope that all's well with you the reader and the recent reappearance of our celestial master has souped you up a bit.

I've just had my annual medical and I was shocked to be told that I was "miles over-weight", which mixes up quantities a bit, and that my 'BMI' puts me as borderline obese. Naturally, in the privacy of my bedroom, I stripped off and cast a quick glance at my frame in the mirror. I just couldn't see what they were talking about, OK, I wouldn't feature in 'Hello' but I didn't look too bad... even after I stopped holding my stomach in. Well, nobody was looking.

I asked the surgery to send me my results through the post, which they duly did and, guess what, the super dooper automatic height measuring device logged me as 5ft 6in and, as I am about 5ft 11in 'in me socks', the declared 'overweightness' disappeared. Just goes to show you, 'measure twice, cut once'.

In all seriousness, it's worth taking a bit of extra care before you fly if you haven't taken the aircraft out of the hangar for a while. I like to sniff about for ages checking everything after a bit of a lay off.

Never get complacent when operating an aircraft; check everywhere, small creatures like to take refuge in the spaces afforded by aircraft structures and, whilst that family of mice living behind the rear fuselage bulkhead would probably enjoy a quick trip around the circuit (one can almost imagine a tiny eye peering through a drain hole ("Mum, you wouldn't believe what's going on out here, we've suddenly got really big"), their enjoyment, and yours, would be curtailed if their nest found its way into the elevator control and jammed it. "Er, which way was it that you have to move the trim when the elevator gets stuck?"

I had an email from a Turbulent owner who lives nearly north of the border in Cumbria the other day. He couldn't get his machine started and, after checking around, noted there was no spark from either magneto. He telephoned us here at HQ and asked what could be going on and, as they were pretty old Lucas magnetos, did I know where I could get them serviced?

Naturally, I offered a few suggestions as to the problem and, a few days later he sent me the following email which may serve to explain one of the reasons why I like this job so much:

"Listen ye to me right well my lad and I shall tell ye what to do! The problem is those Lucas mags, they resist not moisture in due season. If ye wouldst fly before mid summer then take this magic potion, kiss an ugly maiden three times under an oak tree, take off the cover from those awful Lucas mags and spray the potion liberally all over the innards making sure you reach the lower bowel.

"Next, take ye dry wood and set a roaring flame directly beneath the mags and then, only once the embers have died down, reassemble the recalcitrant mags making sure to chant 'LAA LAA LAA' in a constant monotone whilst doing so... and then when all is secured, remove the top four plugs, connect them, ground them on the cylinder head.

"Next ye must switch on both mags. Then, taking a deep breath call upon the god of Veewees in a loud voice uttering the incantation, 'Go ye wee xxxtard' and make a sharp spin of the propeller four times in the wise of a clock and ye shall see blue sparks begin to appear as if by magic... and once they do all will be well!

"I did... and they did... so I can fly again. The problem that affected BOTH at the same time was simply DAMP!

Cheers!

If you can understand this strange language, and thanks go to the LAA'er who sent it in for introducing me to it, you had better keep it to yourself! Even if you didn't follow the complete text I hope you will pick up that damp can affect all parts; don't be shy with the oil can, check carefully for corrosion.

What about the tyre pressures? I remember one chap landing white-faced once explaining the engine was 'terribly down on power' and that he had 'only just cleared the far hedge'. The aircraft hadn't been flown for ages. It didn't take too long to establish the problem; there was about ten gallons of water trapped in each of the wings because the drain holes were completely blocked, and the tyres were looking a bit glum which upped the wheel drag quite a lot.

I will be talking about one of the effects that moisture has on aluminium components later in this month's Spot but for now, rumours abound, what's actually going on with the Eurostar?

EV97 Eurostar: Material quality issues

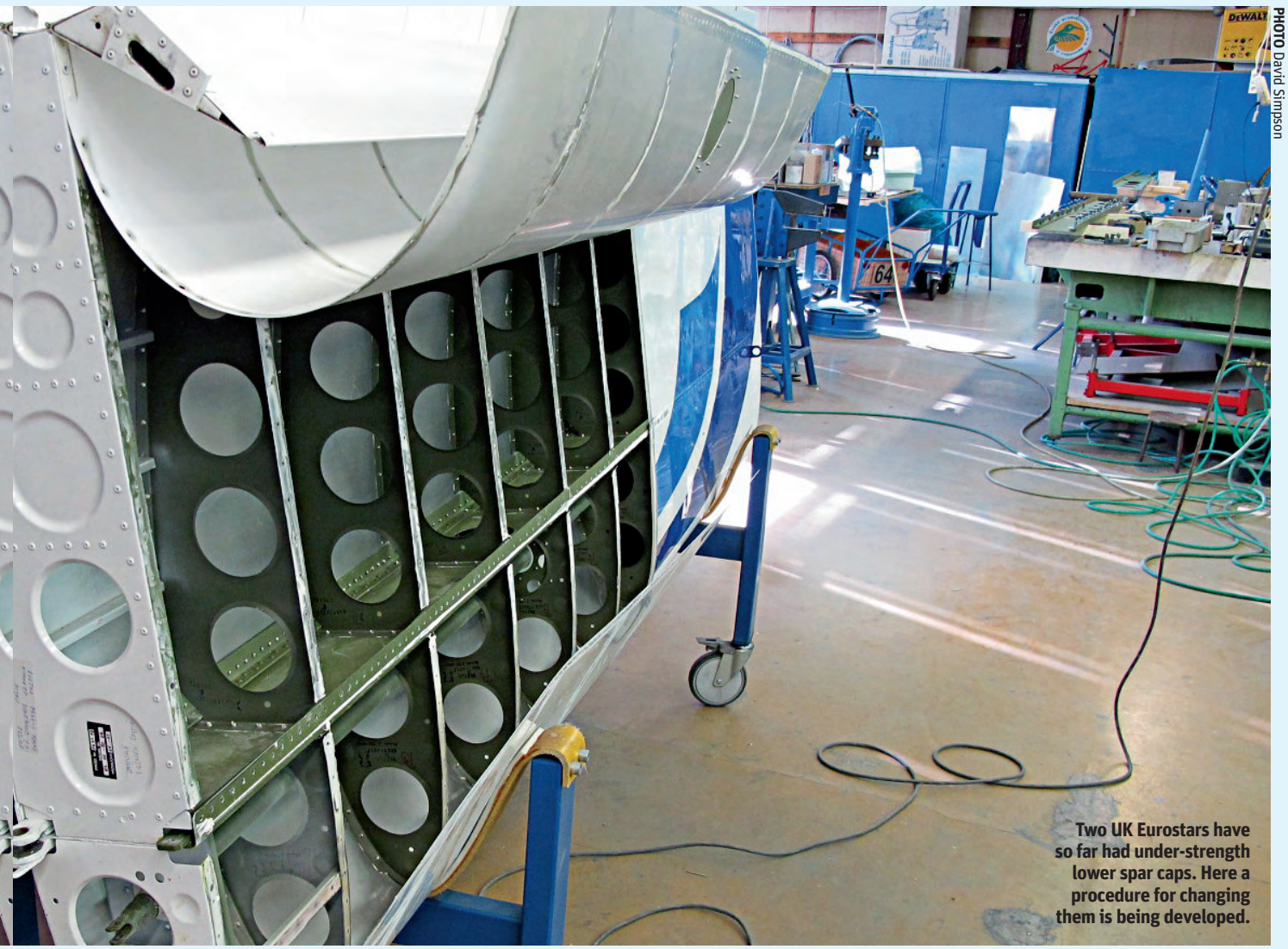


PHOTO David Simpson

Two UK Eurostars have so far had under-strength lower spar caps. Here a procedure for changing them is being developed.

Regular readers will know I have discussed the problem that has befallen the owners of the Eurostar before in Safety Spot (January 2010). If you are not a regular reader of the 'Spot' and therefore haven't read about this issue, it is worth reminding you that you can review all the old 'Spots' on the LAA website. Just click on 'Engineering' and check out the Safety Spot archive on the right of the page.

As your eyes pass from left to right you may notice 'Airworthiness Alerts', it's worth stopping and browsing here for a minute or two to see what's going on with the latest bulletin issues. I have made it a priority to get airworthiness concerns up as an ALERT as soon as I can. Anyway, all the old Safety Spot issues can now be reviewed online.

In early December, when the January issue of Safety Spot was being written, we suggested that a Mandatory Permit Directive (MPD) would be raised to limit the speeds of the Eurostar as an alternative to an out and out grounding. This was due to the fact that, after extensive testing, some of the material used in the main spar caps on the type was found to be under strength. I talked about the difference in material quality control procedures and requirements between 'Certified' and the so-called, 'Commercial' supply routes in the January Safety Spot and I won't labour the point here.

One of our big worries at the time was that the extrusions had been made as a continuous process and that the differences in the materials' grain structure were due to some sort of 'fusion' weld occurring during the changeover of the feedstock billets (called 'logs' in the trade). If what we were looking at was a fusion weld then the whole fleet of Eurostars would have had to have been immediately grounded.

The LAA's Chief Engineer, Francis Donaldson, along with Dave Simpson, Cosmik's Design Engineering Consultant, and other stakeholders visited the mill in Poland responsible for the extrusion and was impressed by the staff's care and attention to detail.

Whilst he was there he was able to establish that a continuous process is never used and therefore the unusual grain structure found must have another cause. In fact the engineers at the mill could not account for the reduction in strength of some of the extrusion tested at the Swiss facility and, to date no reason for this reduction in strength has been established.

The under-strength material itself was actually found on a previously crashed aircraft (nothing to do with the spar cap - engine failure, landed in a lake) and the origin of ➠

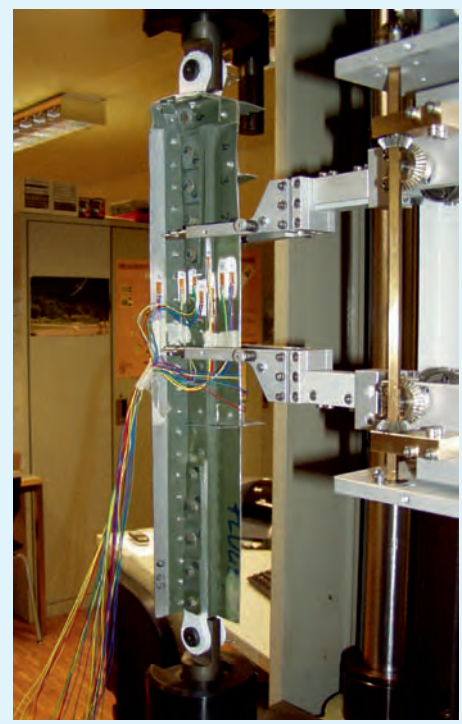


PHOTO Swiss AAIB

Elaborate set-up required to test the strength of the EV-97 Eurostar wing spar by the Swiss AAIB.

EV97 Eurostar cont.

the extrusions on this machine have been established as Russian and didn't originate from the Polish mill at all. It goes without saying it is a fundamental tenet of any aircraft design engineer that the material used matches the specifications laid out in a data sheet.

Late December, just before the Christmas festivities had fully started, the CAA published the MPD (MPD No 2009-010) requiring a temporary reduction of Va (Maximum Manoeuvring Airspeed) and Vne (Never Exceed Speed). This reduction has the effect of reducing the maximum load that could be placed into the airframe, actually from 4g to 3g.

The following few months have been a very busy time for the aircraft's manufacturer Evektor), the UK agent (Cosmik Aviation), the CAA, and the LAA, and, after many tests and discussions, a method for bringing the type back to full airworthiness has been established for new build aircraft. The programme involves the introduction of comprehensive in-house material acceptance checks on each

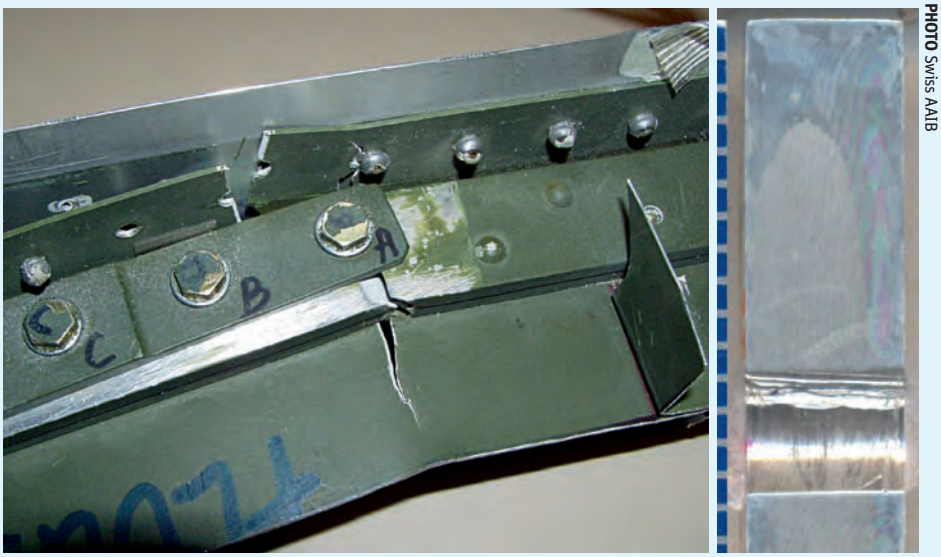


PHOTO Swiss AAIB

Left: resulting failure identifies the assembly's weak point. Note 45° failure after overload tension. Right: sectioned extrusion from EV-97 lower spar cap – note finger-like projection and huge variability in visual texture of the material. Each of the divisions on the left is 0.1in.

Dyn Aero MCR-01: Flap bracket failure

I received a call from one of our most experienced Inspectors, Mike Smart, who thought I ought to take a look at a couple of pictures he took of a flapperon attachment bracket from an MCR-01 he was inspecting as part of the Permit Renewal process. After checking-out his photographs, I could see why Mike was concerned.

These brackets are not easy to inspect at the best of times as they are buried within the flapperon. By moving the control surface to its full deflection most of the bracket can be seen, but the area around the actual bearing, and, indeed, the bearing itself is hidden. Mike had checked the very comprehensive Maintenance Manual for the type and had noted the flapperon itself did not need to be removed at this annual as the aircraft had completed less than 200 hours. Dyn Aero specifies in the manual that removal of this flight control surface is not required until the aircraft reaches 1000 hours – clearly, they have a lot of faith in their design.

The construction of this particular homebuilt was started in March 01. It took about two years to build, with the Initial Permit being issued in May 03 so, averaging about 30 hours a year, this component would need to be removed and checked in 2036; pretty nuts, I am sure that you would agree.

I expect you get fed up with me bashing on about the need for regular thorough inspections, and by regular, I don't mean a strip down check every 30 years or so!

Very light aircraft, like the MCR 01 types, are built down to a weight, which is fantastic when it comes to efficiency but not so good when structure margins are considered. I have just read Francis' brilliant second instalment about

PHOTO Malcolm McBride

Debonding discovered by Mike Smart during his renewal inspection.

aluminium [in this issue] and its alloys. If this article does nothing else but explain the reason why your inspector becomes tachycardic whenever he or she sees the telltale signs of corrosion, it has served a good purpose.

The reason why Mike asked for the flapperon to be removed was because he was concerned that the flapperon's skin appeared to becoming detached from the rib; everything looked pretty normal apart from this. Once the flapperon had been removed the extent of the problems with the brackets and the bearings that support the flapperon became apparent and, as I explained, Mike took some photographs and got in touch.

It is clear we are looking at two separate areas of concern here, and we have come across both issues before. Both problems are connected with corrosion, but the origin of this corrosion is not the same in both cases. As an hors d'oeuvres, let's look a little more closely at this skin separation.

You can see from the photograph taken of

of the critical extruded aluminium wing spar components in the Evektor factory, before the spars are built up, to verify that each piece of material meets the design's original strength criteria. These tests are in addition to the checks already carried out by the material manufacturers themselves.

For the existing fleet of over 700 Eurostars worldwide, the spar material strength of each aircraft is being spot-checked at the four most critical locations by taking measurements of the materials local conductivity; these measurements must be carried out by Evektor-trained personnel and require specialist measuring equipment.

There is a very good correlation between tensile strength of this particular alloy and its local electrical conductivity so this test is proving to be a good non destructive test to establish the quality of the material. The UK CAA, as a further precautionary measure, has looked at the data spread of the results taken so far (MPa -vs- % i.a.c.s.) and has carried out the appropriate statistical analysis. As a result, they have raised the bar a bit higher for UK machines, further improving safety.

'Impressed by the way Evektor and Cosmik have handled this'

If a spar cap fails the test then all is not lost but the effected spar caps will have to be changed. To accomplish this the bottom skins need to be 'opened up' which is a fairly specialised job as you can imagine. I have just got off the telephone from Nigel Beale, boss of Cosmik, and he told me the MPD is imminent and that, in the next couple of weeks, specialist engineers are coming over from Evektor to train up UK personnel to be able to replace under-strength spar caps. Nigel explained that Cosmik will be picking up the tab for this work provided the wings are brought down to his facility near Banbury. You cannot beat that for service.

Of over 100 sets of wings tested to date throughout Europe, around 15 percent have had the wing spar material replaced because the material was marginally below the minimum acceptable strength figure. But this minimum acceptable strength figure is one proposed by Evektor and has been upped a little by the authorities as I have explained earlier. At the time of writing we're waiting for the actual protocol to be agreed and the reissue of the MPD giving us a legal route back to full airworthiness for the EV97.

I have to say here that I am impressed by the way Evektor and Cosmik have handled this situation. They have come across a problem and they are dealing with it efficiently and effectively. Often, when things go wrong, commercial types are reluctant to come clean thinking, wrongly in my view, that any negative issue will have a detrimental effect on sales. In my job I know problems surface with all new products from time to time, everything is a compromise and nothing is ever perfect. My measure of a company's worth is based on their performance when they're up against it, and both Evektor and Cosmik score really well in this regard. If I could afford it, I would buy a Eurostar tomorrow.

the end of the flapperon that the skin has separated from the rib. Initially, when Mike inspected the flap, this separation only extended a few inches from the trailing edge. It was decided to remove all the paint from the flapperon, both to fully inspect, but also to provide a good key for re-painting. Unfortunately, and there is a lesson here, the effect of sanding off the paint further caused a lot of vibration, damaging the remaining bond between the skin and the rib, effectively writing off this flapperon.

The owner 'bit the bullet' and bought, at a cost of about £800, a couple of new carbon flapperons. I benefited from this as I was able to get my hands on the old flapperons and take a few pictures.

I will let the accompanying text tell the story, but it is worth mentioning two things here. The first is when you are working with very light structures, bear in mind it is very easy to damage them, you need to be particularly careful when you prepare surfaces for painting or strip away old paint. One of the best ways to un-bond a glued joint within a structure is to heat it up and vibrate it! The second is to bear in mind that once corrosion has started it's very difficult to stop without taking a structure to pieces, naturally, with a bonded structure, this is close to impossible.

If I had to take a guess I would imagine this corrosion is what we call electrolytic corrosion. The ribs are made from carbon fibre which is electrically active and notoriously difficult to get metals to bond to, which I suspect, is one of the reasons why Dyn Aero have gone over to carbon skins where the carbon-carbon joint will present no difficulties and should be very strong. Once moisture gets between the bonded surfaces, corrosion starts and creates a path along which corrosion progresses. I am sure

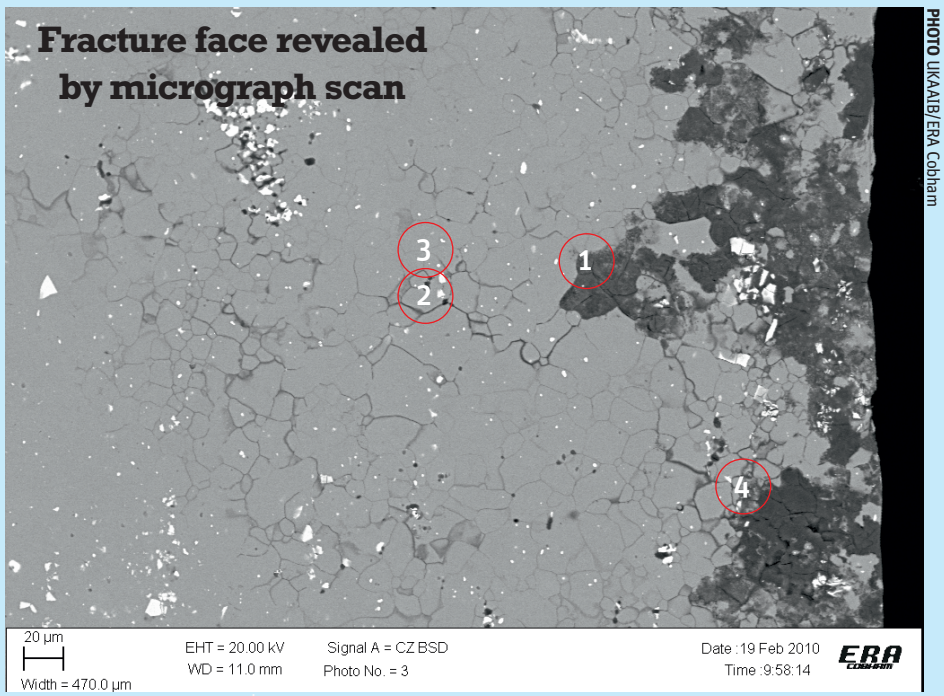


PHOTO UKAAIB/ERA Cobham

This is what's known as a scanning electron micrograph (SEM) taken by scientists at ERA. To put the size this image represents into context, the whole width of the picture represents a little less that 0.5mm. Modern technology allows us to identify the elements present in the sample by using a technique called Energy Dispersive X-ray analysis (EDX).
SEM-EDX of the intergranular cracks and pitting showed the oxide formation and evidence of sulphur and chlorine. Both these environmental contaminants could enhance the rate of corrosion. Note the table below which gives you the actual numbers and corresponds to the areas circled above.

AREA	O	Al	S	Cl	Ca	Mn	Fe	Cu	Total
1	60.7	33.4	0.7	0.8				4.4	100.0
2	29.5	67.6		0.6				2.4	100.0
3	3.8	89.7				0.9	1.4	4.1	100.0
4	66.2	32.9			0.9				100.0

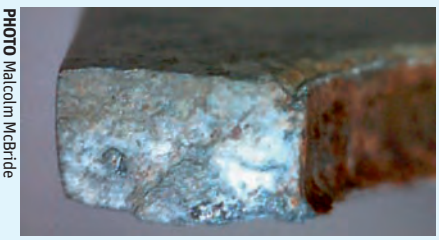
SAFETYSPOT

Dyn Aero MCR01 cont.

PHOTO Shorland Hosking

Failed flap bracket – crack at three o'clock.

PHOTO Malcolm McBride



Fracture face of the MCR-01 flap bracket. Note corrosion (white stuff), fatigue beach marks (left lower corner), and the typical 'cup and cone' (cone showing, lower centre).

you can see the metal was well protected with etching primer in this build, note the worm-like tell-tales in the picture.

Once the flapperon had been removed Mike was quite shocked to see one of the supporting brackets had actually failed. He sawed off the brackets and sent them to us here at HQ to have a closer look.

I have to say I am quite worried by this failure. The flapperon on this type is supported by three brackets; with one having failed the other two bearings continued their support. On later models, where a more conventional flap and aileron arrangement is used, there are only two brackets per control surface and an in flight failure of one of these could lead to the loss of the aircraft.

Newer models of the MCR-01 are fitted with 'carbon' control surfaces and these rely on specially developed 'carbon' hinges which, I have been told by the UK agent Jerry Davies, of Lyndhurst Touchdown Services, are showing excellent wear characteristics.

We sent the parts away for a metallurgical examination and it is looking very likely that our old friend 'stress corrosion' is back in town. It's been popping up quite regularly recently and, if you want to know a little more about its modus operandi, take some time to read Francis's article. You will see the reasons for this particular failure I'm sure.

'It's looking very likely that our old friend Stress Corrosion is back in town'

One of the great strengths of the LAA is that it is not tied down to proscriptive operating methods. Maintenance schedules, for example, can (actually should) be tailored to suit the actual operation of a particular aircraft.

I hope you agree with me the reason for the failure of this part could be laid at a number of doors. It's never a great idea to have a steel bearing in close proximity to highly corrodible aluminium structure without appropriate electrical insulation, but for me the big fall down here is the flapperon hadn't been off for ages and the problems of corrosion weren't spotted sooner.

LAA Engineering is in discussions with Dyn Aero and the UK agent, Lyndhurst Touchdown Services, about what needs to be done to ensure this failure cannot happen again. One thing we'll do as soon as possible is to make changes to the maintenance schedule requiring annual removal of these flight control surfaces.

Good Spot Mike.

Leburg ignition system: Loose circuit board

You may remember Neil Spooner's fantastic article in the January 2009 issue of 'Light Aviation' where he describes a rather scary spinning incident he had in his Tipsy Nipper. In his article Neil offers the very good advice, "Never assume the manoeuvre you are about to perform will end in the usual way."

Neil found his Volkswagen engine always started misfiring after inverted flight or aerobatics. He explained he's got an Ellison Throttle Body Injector (TBI) instead of the more normal Stromberg carburettor. TBIs can be a bit fickle to set up, especially at full power where the mixture can go a bit rich if you're not careful.

PHOTO Neil Spooner

At first this rough running was intermittent but became more regular and started to concern Neil, so he took a closer look at the ignition system. After disconnecting the ignition control box and removing it he was quite surprised to hear a rattling from within. What Neil found was that the nuts that hold the printed circuit board down had become loose and a couple of them were 'floating around' in the control box.

Neil suspects the nuts were intermittently shorting out the controller, hence the misfire. The Ellison isn't in the frame this time. We're going to produce an Airworthiness Information Leaflet (AIL) requiring a drop of threadlock on these nuts... we wouldn't want Neil's engine to stop again during aerobatics now would we?

Fair Winds.

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	£50
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
Replace documents	*£20*