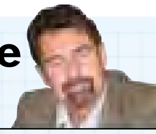
With Malcolm McBride
Airworthiness Engineer



CABLES AND SPRINGS

The LAA has to ground all Aeroprakt A22L Foxbats due to severe rudder flutter issues

'This is the dawning of the age of Aquarius, the age of Aquarius…' I've finally sat down to write this month's 'Safety Spot' after a mad day upgrading my home computer system. It certainly feels a bit strange writing on a screen that's nearly as big as my television. I'm wondering if the zillions of wobblies per millisecond claimed by the computer salesman will help to make this 'Safety Spot' feature any more interesting. Let's see…

Quite a few years ago I had the opportunity to fly with the designer of a small, two-place sports aeroplane that the firm I worked with at the time was interesting in marketing for the UK. We got on very well and the aircraft was a delightful machine, I well remember looping and rolling over the Texas countryside. This particular designer had built a few aircraft himself over the years and liked to work to the limits of the technology available; perhaps quite rightly when it comes to designing aeroplanes, he was always looking for ways to save weight. One weight-saving idea he came up with was a one-sided elevator control circuit. His idea was that, by replacing one side of the control circuit with a spring attached to the control surface, the weight of the control cable could be saved. He did, he explained, consider the safety angle – what for example, would happen if the spring broke? "Well, I thought about this… remember, an elevator will naturally try to find the point of least resistance and, obviously really, as the control cable is fitted on the 'up elevator' side, a failure of the spring wouldn't be that big a problem because, if the spring failed, you would still be able to flare for landing."

I'd never heard of such an idea and, as I listened, I thought initially that this sounded like a pretty neat way of doing things (well, I was a very young chap). I asked the designer why the aircraft we had just danced across the skies with wasn't configured this way. If it was such a good idea, certainly a unique selling point, what changed his mind? I'd done the pre-flight and noted that the elevator system was completely conventional. "Well," he said, with what I though was just the slightest hint of a smile, "I fell out of love with the idea after breaking the US record for the number of loops in a single flight."

He went on to describe a flight he'd made in the prototype when, after completing a loop, he moved the control stick forward to regain level flight but the aircraft continued skywards determined to complete another loop. Then another, then another. Naturally, each loop, caused because the elevator was jammed up, cost a little height so, running out of fuel aside, this was a finite process. He went on to explain, "I worked out that if I pulled the power back at exactly the right moment at the top of the loop it gave me a few moments respite and, by applying power at the right time, I could minimise the height loss per loop to some extent. Of course the loops weren't very round!"

I pointed out that, as we were actually chatting, he must have got away with it and asked how.

"Mmm, I'm not really sure, I think that God had a hand in it, but on one of the loops, I left it a bit late to re-apply power. I remember stalling inverted, hearing a loud bang and the next thing I knew I was back in level flight and the elevator control appeared to be working again."

What had caused his near accident was that, after a fair number of flights, the spring, which as you will remember replaced one side of the elevator control circuit, had become slightly weakened and, when one of the elevator bearings became partially jammed (for unknown reasons) the spring-return force was not able to overcome the partial jam. A narrow escape for him and a lesson learnt which he was able to share.

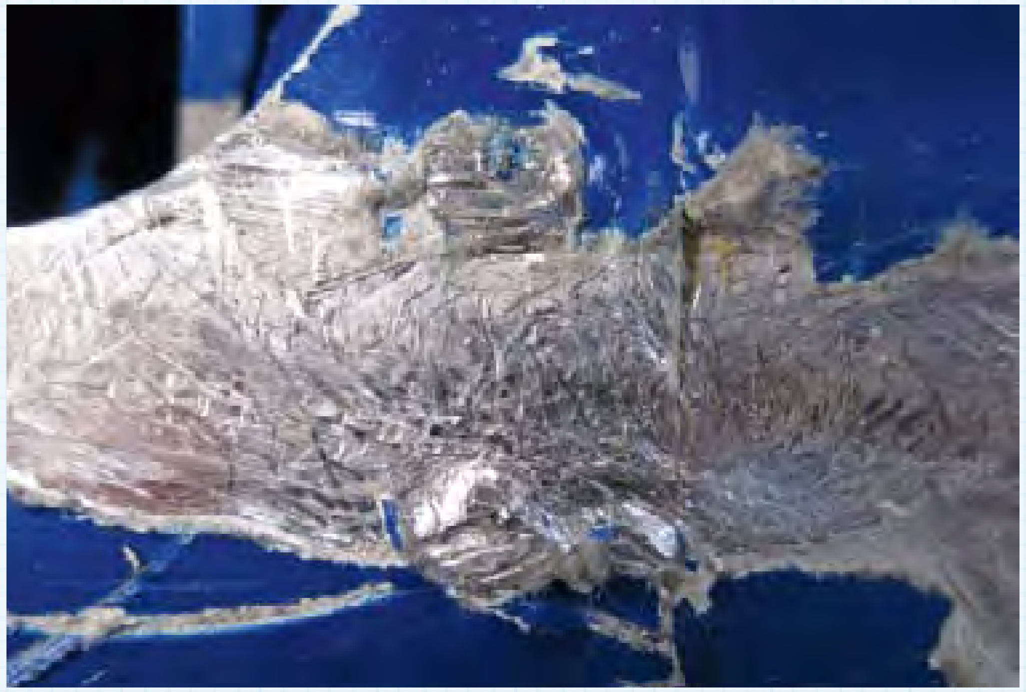
It's definitely a truism that the same old problems in engineering design keep surfacing and, similar spring-return systems have been used fairly extensively, albeit not in quite such a critical system, in the microlight and very small aircraft design communities. Look in many engine bays, just as an example, and the throttle control is very likely operated with a Bowden cable acting against a spring. Regular readers will recall that problems have surfaced with the rudder anti-balance tab on an Aeroprakt A22L Foxbat microlight aircraft; this is a flight control system that partially relies on a torsion spring. I wrote about this in the December 2011 *Light Aviation* and we did hope that the issuance of an LAA Airworthiness Information Leaflet (AIL), requiring full inspections of the rudder and its anti-balance tab before every flight, would solve the problem. Unfortunately, despite these pre-flight checks, we've since had another incident of severe rudder flutter. Faced with what was fast becoming a spate of serious incidents, the LAA airworthiness team have therefore had to ground the A22L type in the UK while we review what's going on (and why) and, of course, try to come up with a solution.

Here is the story of the latest incident.

AEROPRAKT A22L FOXBAT SERIOUS CONTROL FLUTTER

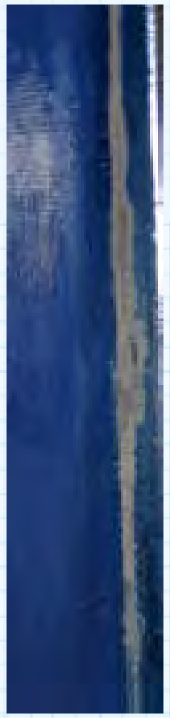
I received a call from Foxbat owner, Peter Goff, which rather changed my plans for the day. Peter had just had a frightening experience where, after a short bout of rudder flutter, he had lost both rudder and elevator control. I asked him whether he had seen the latest AIL requiring pre-flight checks of the anti-balance system and he said that he had and could 'absolutely guarantee that the system on his aircraft was working perfectly before the flight'. You will recall that this anti-balance system is operated by a single cable acting against a torsion bar type spring which doubles as the tab's hinge pin – it's an interesting example of a single component having two functions and so saving weight and cost. ►

Left: in this picture, which focuses on the empennage of the Aeroprakt A22L Foxbat, you can see that the rudder anti-balance tab lower (of three) hinge attachment has failed. The exact reason for this bolt failure is not clear, in fact it is not possible to determine conclusively whether this attachment bolt failed and initiated the flutter event or the 3mm screw failed because of the flutter event. You can see clearly that the damage to the top of the elevator, caused by the rapid oscillation of the tab and the rudder, is restricted to an area over the elevator's aluminium leading-edge. It's likely that the rudder/elevator jam was caused because the failed anti-balance tab drive horn buried itself into the fabric skin of the elevator; the rear of the two holes fits the shape of the bent drive horn nearly exactly. Remember, the elevator would be slightly up during level flight. *(Photo: Malcolm McBride)*



Above: here is a portion of the top of the leading-edge of the aircraft's elevator; you can see that a lot of energy has gone into creating this deep scarring. The initial warning was a severe vibration and the pilot felt sure that his engine was failing… this confusion is useful in that it gives us a rough estimate of frequency which, in aerodynamic flutter terms, is quite low. I haven't actually counted the fissures but I hope that you will agree that this initial vibration couldn't have lasted very long and probably relates to the time to failure of the restraining Bowden cable or (possibly) hinge attachment screw. *(Photo: Malcolm McBride)*

In the pictures left and above, both ends of the Bowden cable can be seen. Note that the cable has failed at a point nearest the tab but the other end of the cable is undamaged. This suggests that the cable failed due to fatigue created as a result to the extreme (and rapidly changing) bending loads and not because of a tensile overload. When this cable failed the tab itself was free to move backwards and, at this point, the vibration stopped and the controls jammed. *(Photo: Malcolm McBride)*



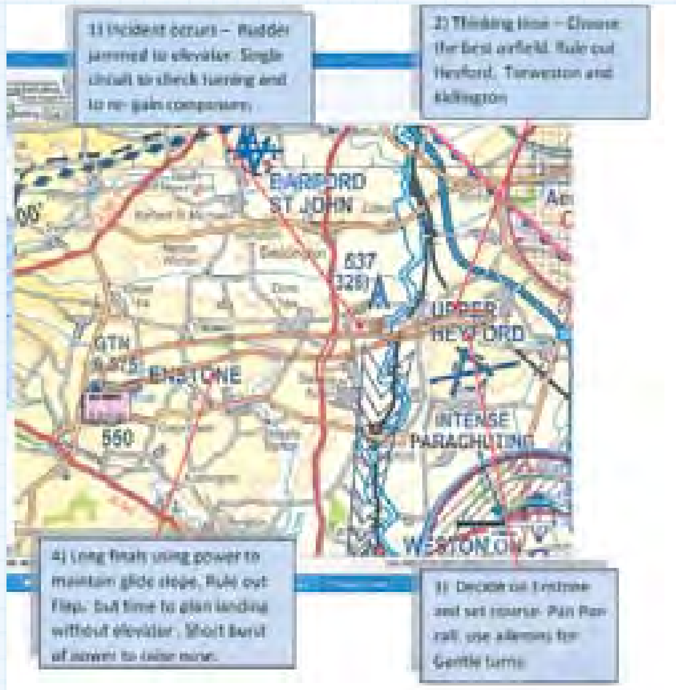
Here is a picture of the leading-edge of the anti-balance tab after it was removed completely from the rudder. There are similar witness marks on the trailing-edge of the rudder. Because the tab had become bent during the failure event, it was not possible to establish if the hinge itself was stiff; certainly this rubbing would have reduced the return spring's effectiveness and may have lead to a null position at, or close to, full right rudder. *(Photo: Malcolm McBride)*

While this system has been in service for a few years, recently there have been two reports of instances of rudder flutter; in the last event, featured in December's 'Safety Spot', the pilot experienced a loss of rudder control after the initial flutter but landed the aircraft safely. We are certain that the oscillations felt by the pilot are triggered by flutter in the anti-balance tab. The suspicion is that, while the spring-return tab system works OK generally, because it's not a positive drive arrangement, under certain circumstances the air loads on the tab can take over and the tab may decide to do its own thing.

The reason for the last incidence of rudder flutter was determined to have been lack of lubrication in the torsion bar spring/hinge; the LAA, in response, issued an AIL requiring full inspections of the rudder and its anti-balance tab before every flight. Unfortunately, despite these pre-flight checks, we've since had another incident of severe rudder flutter which left the pilot with limited control of his aircraft.

I am sure that you will be pleased to hear that we have identified a number of reasons for this latest event. Ray Everett, the UK agent for the type, is developing a simple fix and expects to supply a small kit of parts for owners which will replace the tab spring-return drive system with a positive push-pull rod. Another mod has been developed by a Foxbat owner working independently, which LAA Engineering has already approved. We at LAA Engineering never like to see one of our aircraft types grounded for any length of time and one way or another, A22L owners will hopefully be able to get back in the air again before the start of the new flying season.

I've received numerous telephone calls from members questioning the need for an anti-balance tab on this machine; it's only a fitted to UK examples of the Foxbat. One member commented that, "Surely this so-called safety device is making the aircraft less safe." I have some sympathy with his view – adding anything to an aeroplane brings with it additional opportunities for failures to occur. I did speak to one overseas member though who had flown the aircraft without the tab fitted and he confirmed the UK test pilot's report that the directional stability of the type did not meet the requirements of BCAR Section S. In the UK, it is a requirement that microlight aircraft meet these requirements. I have flown the type myself, albeit briefly, and my two overriding impressions were that the machine is rather overpowered (a personal opinion) and, even with the anti-balance tab fitted, rudder feel is very light. With the benefit of the anti-balance tab, however, in my judgement it did just meet the requirements of Section S.



Here's a screen-print of Peter's flight, taken from the aircraft's GPS. His track across the ground is painted in brown; start at Enstone and follow the loop clockwise. The comments in the blue boxes are Peter's own. The approach chevrons are for the (fairly) new ILS for R20 at Oxford; Upper Heyford is no longer active. I know this area pretty well and I can say that it's not the best for a forced landing. Peter found himself in an aeroplane with limited controllability and, in my humble opinion, made all the correct decisions which enabled him to land the aircraft safely. (*Picture: Peter Goff*)

Quite a few people couldn't understand what an anti-balance tab's role is, so a few words about what it does wouldn't go amiss here. In short, fitting an anti-balance tab to a control surface increases the feedback force proportionally as the angle-of-control deflection is increased. It's a certifying requirement that an increase in angle of a control surface is accompanied by an increase in feedback force to the pilot. A well-designed aircraft, from a feel point of view will have control feedback forces balanced against the relative physiological power normally available to the pilot.

Legs are generally stronger than arms and have a different mix of muscle tissue, which is able to resist applied load for longer periods, hence rudder input (displacement) loads should, in a well-designed system, be quite high. Remember, this is not a discussion about control response rate, it's about how much load needs to be applied by the pilot relative to the angular displacement but, if the designer gets it right, then the response rate will increase with the applied load. Ideally, in the case of a rudder, if the feet are removed during flight the rudder should return to its neutral position.

It's the anti-balance tab's job to increase this return-to-neutral force. The return force from a tab is proportional not only to the angular displacement but also to the square of the airspeed, in other words, the faster you're going, the heavier the controls get – a definite safety feature as it helps prevent the pilot from inadvertently overstressing the aircraft.

I can almost hear you asking, "How come the rudder forces are so light? Surely if you deflect a control into an 80kt wind it's bound to return to the point of least resistance?" Well, this is true to some extent, but the actual point of least resistance may not be always where you think it should be! Once the aircraft has yawed, the 'trailing' position in the airflow is no longer with the rudder central but off to one side. With a more or less neutrally directionally stable aircraft, a 10° rudder deflection may result in a 10° yaw angle – so the deflected rudder is aligned with the flow and there's no rudder centring effect at all.

Another difficulty faced by the designers of very small aircraft is that the resultant force (back through to the pedals) may not start out being that large and other forces within the aircraft, or inherent to its design, may conspire to reduce them still further. First, there are the aerodynamic issues that always surround short-coupled aircraft; in effect, in this regard, short-coupled means that the empennage is close to the back of the wing and resides in pretty turbulent flow, so you often don't get what you design for! Second, fins and rudders are generally too small. This is a huge subject in its own right and, sadly, there's not enough space here to talk about it in this feature. There's a third factor and, before I leave the design difficulties completely, a brief comment about this wouldn't go amiss.

The Foxbat is a nosewheel aircraft and the nosewheel is connected to the rudder control system. This almost inevitably adds a great deal of friction into the system, which often masks the weak aerodynamic centring force from the rudder itself. The result is perceived by the pilot as 'the rudder stays where it's put'.

All a bit bamboozled? Let's hear LAA Foxbat owner, Peter Goff's account of the rudder tab incident on 10 January that lead to us grounding the fleet.

Dear Malcolm,

This aircraft was Permitted to fly in late July 2011. It has completed around 60 hours flying with no significant problems. I have 60 hours flying experience in a Foxbat and 320 hours in total on fixed-wing microlights.

1) Background *Following the recent issue of a safety bulletin from LAA regarding the balance tab on the Foxbat, I have checked this before every flight. On receipt of the bulletin I had also protected and lubricated the hinge mechanism using ACF 50 at three hinge points attached to the rudder, and applied some grease to the bottom hinge and tab edge to ensure free movement as it was touching the rudder very slightly at the bottom. This treatment appeared to significantly improve the movement of the hinge and I repeated this.*

One week before the incident the tab was moving freely and on all subsequent checks and I had no concerns that it felt stiff.

2) On Monday 10th *I initially flew the aircraft from Little Gransden to Bakersfield to meet with friends. The rudder tab had been checked as part of the pre-flight inspection and was free moving. On arriving at Bakersfield, I found I had a puncture in the front tyre and this was removed and repaired. Once replaced, the rudder tab was checked carefully again for free movement before flying on to Enstone. The flight and landing at Enstone was normal. We had encountered 25mph headwinds and some turbulence but the weather conditions were well within the aircraft's capabilities.*

3) Incident at Enstone Take-off
At 3pm I prepared to leave Enstone – I specifically checked the front tyre was still OK and held down the tail to make sure the rudder was free. I checked for full and free movement on all controls. The aircraft taxied and steered freely and everything appeared normal; I had applied flap and the trim was set nose down. At 3.05pm take-off was on R26 with a right-hand turn for circuit after take-off. The wind was brisk (12-14mph) westerly, straight down the runway.

Climbout. Initial problem
I removed flap as normal at around 300ft after take-off and climbed to 1,400ft on maximum revs before turning right and reducing power to 5,000rpm. I adjusted the trim and continued to climb to 2,000ft. I was heading due east with a tailwind. I maintained 5,000rpm in total for around two minutes; my indicated airspeed at this point was 105mph (with a 25mph tailwind in addition). I was using a little right-hand pedal to counteract the torque and was about to reduce revs for cruise when the aircraft began to shudder violently. I thought at first this was an engine problem so reduced revs immediately. The shuddering continued for about six seconds then stopped. The aircraft was yawing to the right (?) at this point and I realised there was a rudder problem. I tried to turn the rudder to the left when I heard a violent bang as it broke free. I then completed a full orbit to the left.

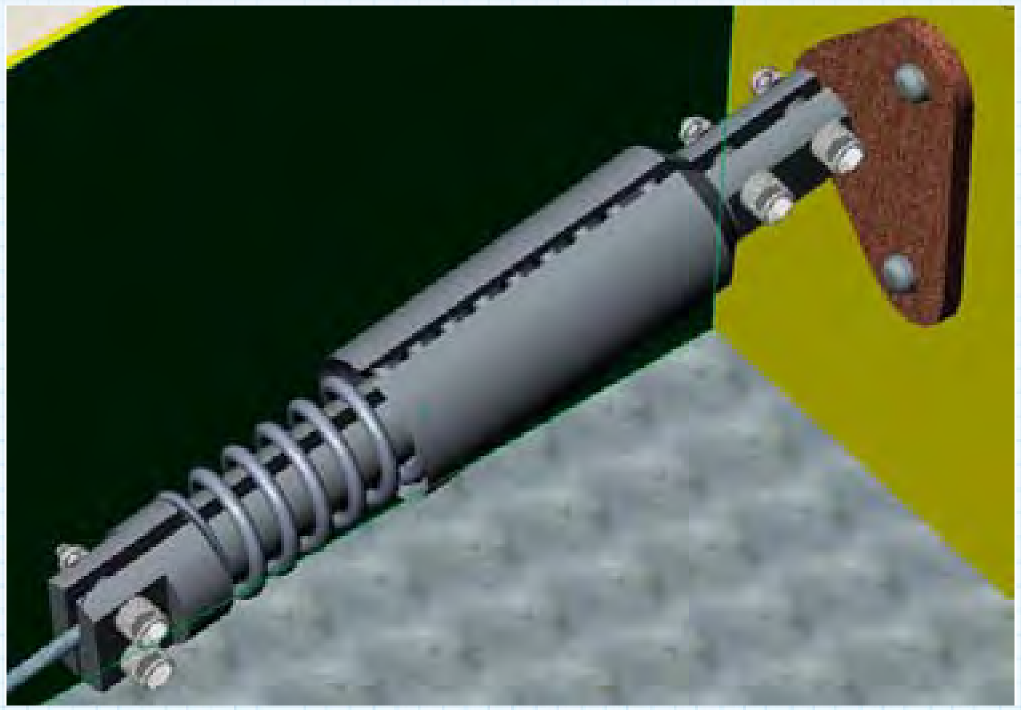
Return to Enstone *The aircraft was now stable, flying straight and no further shuddering, but I realised I had no rudder movement. I could turn using ailerons and control descent with power, so I checked for alternative landing sites. Upper Heyford (disused) was in view, however I was uncertain of the state of the runways. Oxford and Turweston were unfamiliar, so I opted to return immediately to Enstone where I knew the layout and knew that the wind was straight down the runway. Maintaining around 3,600rpm, I made a pan call to alert Enstone of my rudder problem and then set course for long final on R26 . After considering the pros and cons, I opted not to use flap to avoid introducing any trim changes or instability, but around one mile from Enstone did set trim for maximum nose up (not sure if it made much difference). I had not realised that I had limited or no elevator movement at this point.*

Approach and landing *On the approach, shuddering occurred again for around three-four seconds. As I made my final approach with a shallow glideslope at 65mph and with power on, I then ascertained I had no elevator movement for round-out. I chose not to try and free this by force as it might introduce instability and opted to continue the approach. Near the ground I applied a small amount of power to lift the nose then cut the power at 60mph. At around 55mph the aircraft flared close to the ground and held off for a few seconds then landed on its rear wheels as normal; the nose came down lightly. At this point I had no steering as the rudder appeared to be stuck on the elevator so the aircraft ran off the hard runway to the grass on the left where it stopped, sustaining no further damage. At this point the steering appeared to be restored.*

After landing *I checked the damage and realised the trim tab had broken loose, the cable snapped and the metal horn had dug into the elevator. Further damage to the elevator had possibly occurred when this broke free on landing. There was no other damage apparent from the landing and no-one was injured . I was then able to taxi the aircraft with ground steering to the hangar at Enstone Microlights.*

I was unable to ascertain the full extent of the damage and was not able to check if the rudder was free, immediately, or if the elevator was now working correctly . The aircraft was parked in exactly the state it was in on landing.

Regards, Peter Goff



Because of a number of failures in service, we have decided that the Bowden-cable-operated anti-balance tab is not safe to use on the Aeroprakt A22L Foxbat. Independent further flight testing has confirmed though that the aircraft's directional control is, in effect, only neutrally stable. What this means is that, if you were to apply full right rudder and then take your feet off the control, the rudder would remain fully deflected. The rudder return therefore does not meet the required 'proportional force' requirements of BCAR Section S. Here is one solution, devised and made by LAA member Paul Trimble, which has been approved by the LAA's Design Department. This little unit provides a spring force which returns the rudder back to the neutral position. (*Photo: Paul Trimble*)

Thank you, Peter, for a very comprehensive and well-written report... and well done! Not to panic in circumstances like this is, well, the word 'incredible' comes to mind, and following the custom for English understatement, certainly deserves a mention in dispatches.

A day or two later, I met Peter at Enstone, along with the LAA's Chief Engineer, Francis Donaldson, and the UK agent for Aeroprakt aircraft, Ray Everitt, to look at the aircraft and see if we could come up with an explanation as to what had happened. I will admit that my first thought, as I read Peter's account, was that the use of an anti-corrosion spray rather than a conventional lubricant such as a light machine oil may have increased the friction within the hinge. This is a possibility, but I could find no evidence of this during my visit. I did notice that the rudder control cable tensions were a little on the low side, although we didn't feel that this by itself was likely to have been a significant factor. One thing that Peter did say was that he had noticed a clicking when he checked the rudder anti-balance tab during the normal pre-flight. During our close inspection

With Malcolm McBride
Airworthiness Engineer

we were able to simulate this clicking by rotating the spring/hinge one way, then the other. This might indicate that there was some extra resistance in the hinge at one point in its range of movement, which might have upset the dynamics of the system enough to cause the servo tab to flutter.

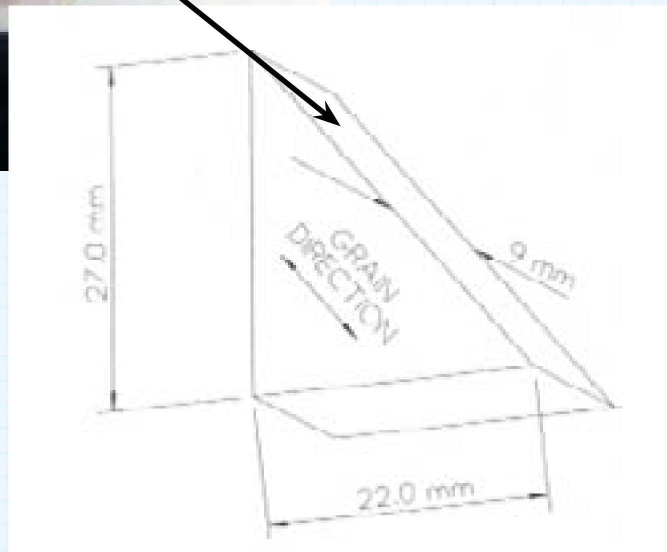
Another thing that was immediately obvious was that the tab's bottom hinge attachment screw was missing. It is possible that this broke during the flutter event but my view is that it could also have been the initiating failure. If this screw were to fail (or the nut become loose and fell off) then the bottom of the tab would have been free to flail around in the air stream. If this screw had failed then spring tension would become very much reduced and we already know that, when the spring becomes ineffective, tab flutter will result.

One further thing that might be relevant was that the leading-edge of the tab itself had been rubbing on the trailing-edge of the rudder. This may have been due to an over-close fitment when the aircraft was manufactured but, in my view, it's more likely to be a result of the loose hinge fittings found. I think that this looseness was due to the trailing-edge of the rudder itself yielding against the reacting hinge loads.

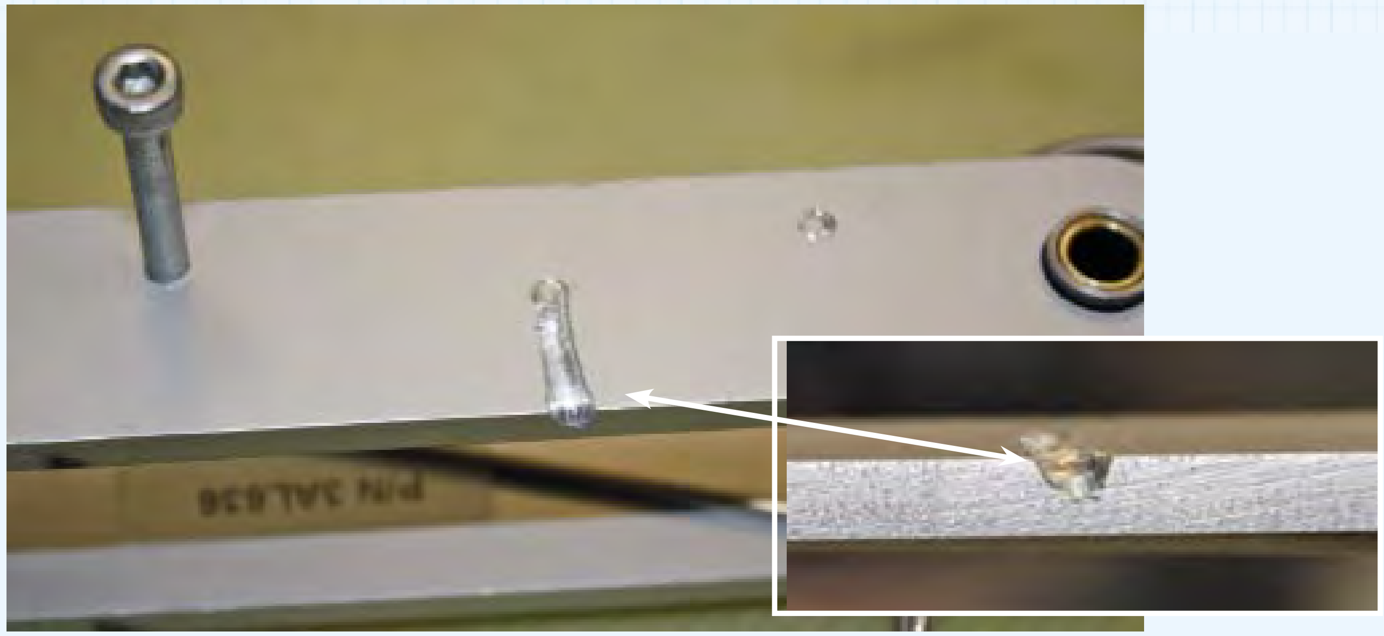
Any modification will require an improvement here.

I think that you will now see the relevance of my introductory 'multiple loops' story; this is, after all, a one-sided control system working against a spring. I've been aching to tell the story to somebody and this event has given me the perfect excuse!

The pictures and my text describe the damage found and the possible interpretations as to cause and effect. Either way, enough is enough and the LAA Engineering team elected to publish an AIL grounding the machine immediately until a more robust design of rudder centring system can be fitted.



Pioneer specialist, Tim Skinner, has noticed that a number of aircraft he's worked on recently have suffered from separation of the inner wing rib to spar joint. There have been various suggestions as to why this particular joint is failing but, whatever the reason, the LAA's Design Engineer, Andy Draper, wants this weak joint beefed up a bit. Here is a picture of the solution, a small gusset. *(Photo: Tim Skinner)*



Toby, from Targett Aviation, found this gouge in a Pioneer 300 main undercarriage side stay while he was fitting assist springs to aid the over-centre lock. The damage was caused because the screws holding the DOWN indicator microswitch were too long and, each time the undercarriage was operated, material was removed in a machining action from the side stay. It's essential that operating mechanisms on aircraft are checked regularly on the ground and this is especially true when fitting a new component (in this case a microswitch). When you are designing the Maintenance Schedule for your aircraft, build into it regular 'panels off' inspections so that the normally hidden parts can be checked and, where necessary, lubricated. *(Photo: Toby at Targett Aviation)*

Incidentally, you will recall that Peter talked about the use of trim as a secondary method of control if a control surface jams. I am sure that you will remember that this is a favourite question in examinations. In this case the trim didn't make much difference, what did impress me was Peter's cool and calculating approach to the problem as he saw it. He could have tried to force the jammed elevator control to free it, but not knowing just what had gone on down the back end, this might have had disastrous consequences. The aircraft was controllable up to a point so he chose not to rock the boat by trying brute force, but just guided the aeroplane gently back to a safe emergency landing. Well done again.

PIONEER 300 INNER WING RIB JOINT

This item involves a recurring problem with the leading-edge root rib on the wooden Pioneer 300 suffering a glue joint failure causing the rib to lose some of its rigidity. This particular joint failure has been seen on a number of Pioneer aircraft so we will be issuing an AIL requiring checks and strengthening in this area at (or before) the next Annual. The reason why I write about it here is that I know that many Pioneer owners will be having their wings off shortly to replace the suspect fuel fitting (See 'Safety Spot', May 2011) and that will be an ideal time to do this minor repair/strengthening job.

There are a couple of possible explanations as to why the glued connection between the bottom of the inner wing rib and the spar is coming adrift, and it has been the subject of hot debate. I spoke to the UK's design consultant for Alpi aircraft, Dave Simpson, and he did some maths to demonstrate that the aircraft's structure wasn't in any danger. One suggestion as to cause is that the joint cannot tolerate the loads imparted to it if people sit on the wing leading-edge to reach into the cockpit – the hardened walkway is to the rear of the wing and the leading-edge is not designed to take heavy point loads.

Another reason might be the fact that the fuel tanks, which are fitted inside the wing leading-edges, might under some circumstances apply a point load right at the joint itself. Either way, we're going to require the fitment of a small gusset to strengthen this area a little.

PIONEER 300 UNDERCARRIAGE SIDE STAY

This 'Spot' was sent to me by Toby, an aero engineer working at Targett Aviation based at Nympsfield. At this point, it's probably worth viewing the picture which shows a large gouge in one of the undercarriage side stays. Note that a considerable amount of the material has been lost and there will have been a consequential loss of strength in this component. Toby tells me that the cause of the damage, which had it not been spotted would most likely have continued until the part was seriously compromised, was that as the retractable undercarriage cycled, the part was rubbing against the end of an overlong screw used in the fitment of an 'undercarriage down' indication microswitch. Toby wouldn't have spotted this fault but for the fact that he had to remove the wings to change the fuel outlet.

Regular readers and of course Pioneer owners, will remember that initially the Pioneer was fitted with one 'down and locked light' which was, unusually, connected to the power supply of the mechanism's electric motor. In effect, the green light showed when the system thought that the undercarriages should be down rather than when they were actually down. I heard of one aircraft that had three green lights wired in series and connected to the motor limit switch circuit. The owner said that he always called, "Three greens," on the approach not realising that it didn't actually reflect much about the state of the individual legs.

After a number of incidents where only two of the three legs had actually locked over-centre, but with a green 'down and locked' light illuminated, Pioneer UK issued *Service Bulletin (09/04)* requiring rigging checks to be conducted and undercarriage down and locked indication microswitches to be fitted at each individual leg. It's not uncommon, in this essentially simple system, to operate the undercarriage and for only two of the three undercarriage lights to illuminate. Owners know that this is a sign that the undercarriage needs a service and meanwhile they must manually 'wind' the recalcitrant leg down and illuminate the final light. The LAA mandated this SB in March 2010 – see *MOD/330A/003 issue 1*.

There are a few lessons that can be learnt from Toby's spot, the biggest of which is that whenever items are introduced to a system, full checks must be made. In the case of this undercarriage, clearly this was not done otherwise the overly long bolt would have been found.

What should have happened is that the aircraft should have been placed on jacks and each leg should have been watched through its operation to check that there were adequate clearances all round, nothing was snagging and the gear was over-centring properly and moving from stop to stop. In the case of retractable undercarriages, this sort of check must be done annually; Pioneer specialists recommend that full retraction checks should be conducted each 25 flying hours.

Oh, and why the 'Age of Aquarius stuff at the beginning'? Well, I started this month's 'Safety Spot' at home one evening. I had just returned from Jed's (the dog) walk. It's a gin clear night with stars and, of course, the occasional planet, visible from horizon to horizon. I've just watched Venus disappear over the south-westerly horizon and, if I strain my neck a bit, can still see Jupiter in Aquarius though the kitchen window. It's such a lovely evening I cannot stop whistling the tune. Time passes inevitably though, and a day or two has past since this little astronomical magical moment. Brian Hope, the Editor, has been pressing me to finish 'Safety Spot' and, not surprisingly, I've got a different tune in my head now...

If I were a rich man, diddle diddle diddle de...

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	£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
Latest SPARS - April 2009	