SAFETY SPOT

With Malcolm McBride
Airworthiness Engineer

PIPER TAILDRAGGERS – CRACKING & CORROSION

CRACKING AND CORROSION DEMAND TAIL STRUCTURE INSPECTIONS, WHILE UNLATCHED DOORS, NOTABLY GULL-WING, PRESENT PROBLEMS

I was reminded of a couple of safety lessons the other day which are worth passing on… actually, a rather sore patch on my upper thigh caused by the resulting splash of sulphuric acid throbs a message, 'You are a twit, you are a twit.' Lesson one, naturally, is that you shouldn't bring a battery into service straight after disconnection from a battery charger, even if you are in a terrible rush (see accompanying text!). Why? Well, there's an explosion risk due to the possible build-up of hydrogen gas. Lesson two, if you know something important is failing (this battery has been dodgy for a couple of months) then change it, you never know when circumstances will conspire together such that you really need it. I really did need to change my underwear when this battery exploded under the seat of my motorcycle! *(Photo: Malcolm McBride)*

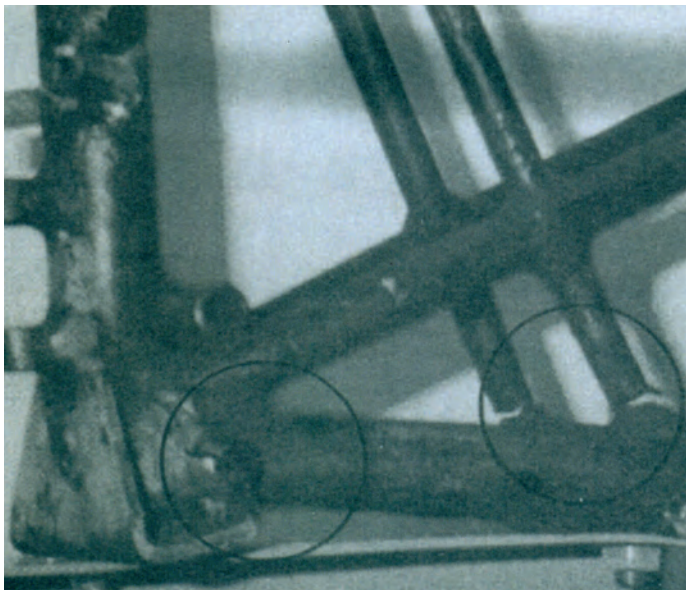
Welcome to your monthly helping of continuing airworthiness issues that have affected our membership; looking out over the airfield this morning I note that there's a definite improvement in the weather. 'Spring is in the air, tra la la.' Actually, I shouldn't really be singing as I'm going through one of those phases where everything seems to be going wrong and a glum face would be more appropriate; could it be a test?

Firstly, the car has had a wobbly, it feels to me like the injector is on the way out but, like most cars these days, everything's controlled electrically and it's impossible to self-diagnose much more than a flat tyre. I'm a bit miffed as, when chatting to the service engineer from the local garage, he seemed to be definitely sure that the problem rested with a low battery capacity (it's been struggling for some time) and a new battery, plus a system reset, will definitely do the trick. "I'll do it for you sir, Saturday morning OK"?

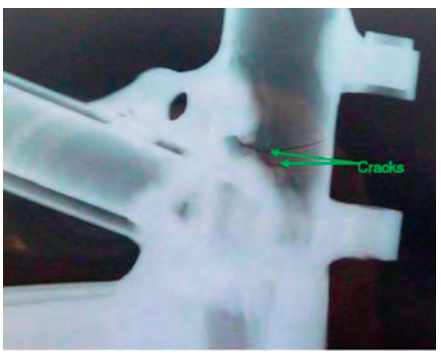
I picked the very clean (for the first time in ages) car up just before the garage closed on Saturday lunchtime... "We've cleared all the fault codes for you and she's driving fine." Wallet considerably thinner, but no hesitation on start-up, I made my way home… I never actually made it. That's not completely true, I made it eventually, but the car didn't as, on the drive home, it lost all power and I ended up sat in a lay-by in a cloud of diesel smoke. Another 'lay-by' resident, this one eating a hamburger, perhaps a duck-burger, sidled up. "Looks like the injector to me, mate."

Anyway, the car's problems are, hopefully, being dealt with by experts and I'm expecting a fairly big bill. No problem with transport to work of course, nice weather, I'll use the bike. I had just better charge up the battery. Life's never easy is it?

You will see from the picture that my tale of woe continued and that I have ended up having to buy two batteries (and a new pair of jeans), one I didn't really need and one I should have bought ages ago. The explosion was due to two things, one, demanding a large current from a battery that had just come off the charger… a lesson, incidentally, worth remembering when you bring your aircraft back into service after the winter lay-up. The second, well, rather embarrassingly, I've known that this battery has been on its last legs for some time.



This rather grainy picture shows cracks found in the structure of a PA-15 (Vagabond) after the fabric was removed. I have spoken to a number of specialists in tube repairs and they tell me that the real problems generally occur in the bottom longerons. This area of the fuselage, as I'm sure that you will be aware, on all taildragger types suffers the compound problems of being quite highly loaded, difficult to inspect and prone to corrosion.
(Photo: Ken Cragie)



One way of seeing through fabric is to have a specialist NDT firm X-Ray the rear fuselage. This picture shows cracking that would otherwise have been missed until the Fin Post finally gave way, possibly jamming the rudder.
(Photo: LAA Library)

PIPER PROBLEMS

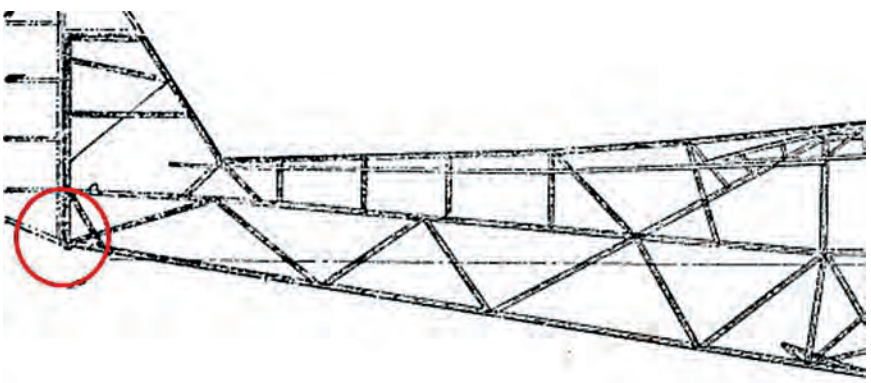
If you are the owner of a Piper taildragger, you will have recently received an LAA Safety Alert advising that you check the area at the rear of the fuselage for corrosion and cracking within the next one hundred hours and then, subsequently each 1,000 hours. Our current Piper owners account for some 150 airframes. I have featured this item in 'Safety Spot' both because we know that there are a similar number of Piper airframes in the UK not currently showing up on our radar, possibly undergoing long-term rebuild, and that the advice given in this Alert would sensibly apply to many other types of LAA machine.

We first got to hear that this issue, known about for many years, had resurfaced after a diligent LAA member sent us FAA Special Airworthiness Information Bulletin (FAA SAIB CE-13-14). I contacted the investigator in charge at the FAA and, whilst he had decided that the recommendations of the bulletin were important, they didn't warrant an Airworthiness Directive. I think that the reason for this decision is that the likely failure mode would only result in loss of tailwheel authority and not loss of the fin or tailplane. Not that the loss of tailwheel authority should be treated lightly of course as, under the right circumstances, a failure here could lead to an accident and possible injury.

Engineers know that this area on any taildragger can be problematic; firstly, it's often really difficult to inspect thoroughly without taking skins off. In the case of Piper types of course, these skins are fabric and removal should be fairly straightforward, but, in reality, it can still be quite a big deal pulling otherwise perfectly serviceable covering off the airframe to get a good look at the structure underneath and so, year after year, this important area of the structure can get overlooked.

The second reason why this area can throw up problems is that it's quite highly loaded, especially in the area that supports the tailwheel, and this can lead to fatigue cracking and subsequent structural failure. Thirdly, just because it is often the lowest point on the airframe, moisture tends to collect here so this area can be very prone to corrosion.

I think that my advice would be that it is certainly a good idea to build into your Tailored Maintenance Schedule a time when you would expect the fabric to come off critical areas to check the integrity of the underlying structure – although, with regard to the LAA Permit fleet, I am less inclined to think that hours flown would be my primary driver in deciding the when and where of this type of particularly deep inspection. I've chatted in this column before about my reasoning for thinking less about hours flown than would normally be expected from an aero engineer but, as you will understand, calendar time must certainly be placed high on the list in decision-making terms when aircraft are averaging less than 50 hours per year.



Here is a general arrangement of the tubular structure found on most Piper taildraggers. FAA SAIB CE-13-14 recommends that, within 100 hours, the area ringed red is thoroughly checked for cracking and corrosion. The recommendation is that this check is subsequently done every 1,000 hours but perhaps this hours-based advice may not be the best approach to creating a Tailored Maintenance Schedule on an LAA machine.
(Illustration: LAA Library)

> "I was very quick in closing what remained of the door!"

In the low utilisation environment, different maintenance issues crop up. Naturally, wear isn't usually a big issue but corrosion, lubricant separation and sedimentation often are. That's why we like a three-year, rolling maintenance schedule, which requires each part of the aircraft to be thoroughly inspected at least every three years, regardless of hours. If you're operating a three-yearly schedule it makes sense to do a 'deep inspection' every two cycles – that's at six years. This applies well to other calendar-based overhauls, for example propellers, magnetos and carburettors.

In any event, if you fly a vintage taildragger, give some thought to the inspection recommended by the FAA for all Piper types. Nothing, absolutely nothing, lasts forever. ›

You can see from this picture that this Wassmer WA52 door is going to need some specialist help before it enters service again. Well done to the, from the picture at least, quite disgruntled pilot, LAA'er John Curtis, for dealing with the in-flight emergency such that there was no further harm done. This is not always the happy outcome when a canopy or door fails for some reason in flight. Major issues subsequent to a door failure can include: serious environmental changes in the cockpit; distraction, loss of aerodynamic control; and a significant loss of performance. These are all very good reasons not to forget to physically check that the door is closed and latched before flight. *(Photo: John Curtis)*

This is what happens (if you're lucky!) if you don't ensure that the rear pin is fully engaged on a Europa aircraft. If luck isn't on your side it is likely that you'll lose your door completely (which is not good for your image when you have to collect your lost property from the police station). To afford a sensible entry size and maximum visibility, the gull wing design on the Europa necessarily needs to be fairly short on structure for its size. These design constraints mean that the door is longitudinally quite easy to twist out of shape. Because the rear pin is behind the shoulder, it's easy to forget to check it before take off and if it isn't in place before flight, the door may fail. *(Photo: Malcolm Gibson)*

WASSMER WA52

I have to be honest, until I received a telephone call from LAAer David Crouchman, the Wassmer WA52, as a type, had passed me by. David runs a flying group centred upon a couple of LAA machines at Popham airfield and was calling me to let us know that they had had a 'mishap' with the door and that some fairly extensive repairs were going to be needed before this aircraft could be returned to flight. David wanted to know the procedure for getting the repair cleared and what forms he would need to fill in. Wassmer sounded German to me although, after checking through our records of the type, I realised that it was actually a 1970s French machine, interestingly one of the first all-composite aeroplanes ever built.

Naturally, my first bit of advice was that the pilot in command at the time of the incident should let the Air Accidents Investigation Branch know about the event; a door getting broken on a small light aircraft isn't exactly the end of the world but, if it happened in flight, then all sorts of bad things could follow.

The Wassmer WA52, codename 'Europa', is a four-seat light aircraft, similar in looks to the ubiquitous PA-28 Cherokee but with a slightly better cruise performance (so I'm told!). We've got three on our books, being signed up after they became orphaned, after the company that bought Wassmer after its demise in the late 70s, Issoire Aviation, gave up the type certificate. In any event, the pilot at the time of the door failure, LAAer John Curtis, was planning to fly from his home aerodrome at Popham to sample the delights of Old Sarum. Here's an extract from his report.

Preparation for the flight was made and all checks were carried out. I had one passenger on board. Take-off from Popham (Runway 26) at 1430 was normal and I climbed to 2,500ft for the flight to Old Sarum. I established contact with Boscombe Zone and proceeded towards my destination under a Basic Service. After about 20 minutes, a loud bang was heard, the side window had smashed and the door partially opened (the door is hinged at its top edge and it is of a gull-wing type). There was a lot of turbulence inside the cabin although the aircraft appeared to be handling normally.

I decided that an immediate landing was the safest option and transmitted a Pan call to Boscombe; I gave them details of the problem and requested an immediate landing at the

Here's Malcolm's broken door hinge, initially thought to be the cause of the door failure but, later, part of the after-shock. *(Photo: Malcolm Gibson)*

nearest airfield, adding that I had Middle Wallop army air base in sight approximately four miles to the north. Boscombe passed details to me and I established contact with Middle Wallop Tower who gave me clearance to their Runway 27. I landed safely at approximately 1500 and taxied to the parking area where I was met by the emergency vehicles and medical staff. There were no injuries to either myself or my passenger.

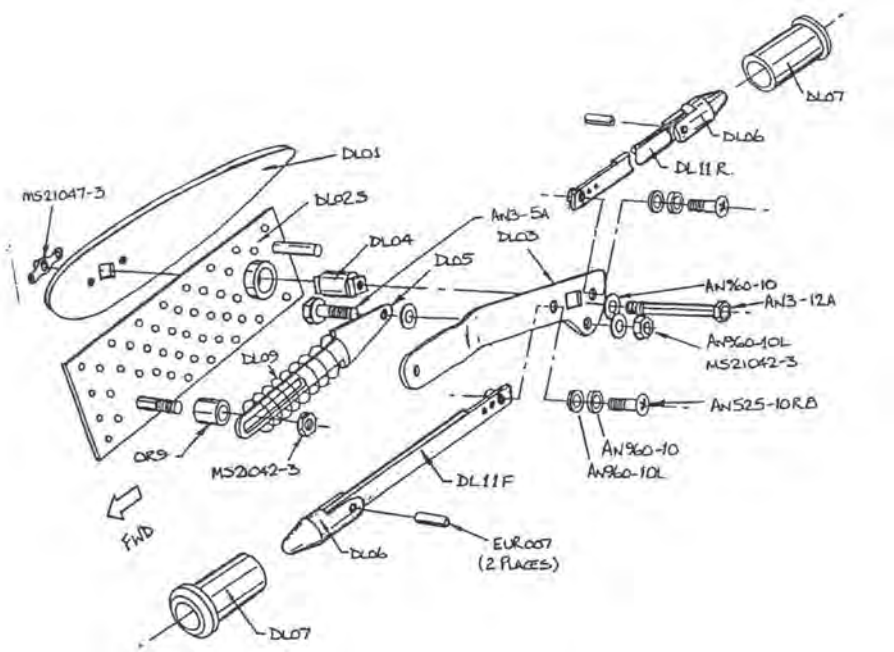
Well done to John for sorting things out by the book and, subsequently, a repair schedule was agreed and the door fixed by composite specialist and LAA Inspector, Tim Dews. Naturally, we asked Tim to try to establish why the Perspex windscreen had suddenly broken and whether this structural deficit could have led to the door opening. Tim couldn't find anything amiss with the door's latching mechanism and even though John was 'nearly' certain that the door was properly closed and locked before the flight it looks like the rear latching pin couldn't have been properly engaged before flight.

The Wassmer WA52 design still looks modern today, certainly in the 1970s this machine would have turned heads. Readers with an eye for design detail will note that the gull-wing doors fitted to the WA52 Europa were quite in vogue at the time and were a huge selling feature of the DeLorean DMC-12 stainless steel 'supercar'. In reality, the design was first used a couple of decades before on the Mercedes W194 (later the 300SL) and, although over a thousand units were sold. it is interesting that, at least until quite recently, Mercedes didn't use this gull-wing on other machines. Certainly the gull-wing design looks futuristic but it does seem to cause difficulties, which include the maintenance of stiffness, both in the door and the structure, and limited accessibility.

One immediate problem of the gull-wing design when compared with the conventional side hinge is that the weight of the door has to be lifted against gravity at each opening and so some assistance is often required – this may introduce the need for gas- or spring-assisted struts and this, in turn, requires sufficient structure to take the load. Because of this weight problem, there can be a great temptation to remove all fuselage structural loads from the door, which allows the door to be made much lighter. The downside to this can be a reduction in component stiffness, thereby introducing the possibility of a door being twisted during closure. When this happens, it is possible for a locking pin to miss its target and, during a subsequent flight, there will be little to resist the suction forces and the door will either twist partially or enough to release the other pin, allowing it to fully open.

John and Tim Dews checked the broken door thoroughly after the event and couldn't find anything amiss with the hinges or locking mechanism, so it looks like the rear locking pin hadn't engaged correctly before flight and, as the door twisted, the Perspex was overloaded and shattered.

When I first came across this issue I thought, to be frank, that it was something about nothing but, after looking through my incident records here, I've noticed that we've had a few incidents lately where doors have sat centre stage. Here's another example where a gull-wing door may not have been closed properly before flight – again, fortunately, the pilot was able to deal with this in-flight emergency calmly and, apart from a damaged door, there was no lasting damage done.



This exploded view of the Europa door latch mechanism clearly demonstrates that nothing is as easy to design as you might think. You can see, from the number of connections, that the accumulation wear could be a problem in this type of mechanism in time, and that proper checking and overhaul must be done regularly if you want to avoid an in-flight failure. *(Illustration: Europa Aircraft)*

EUROPA: DOOR FALIURE

I received a telephone call from LAAer Malcolm Gibson last May, letting me know that he'd had a canopy failure on his Europa and that he thought that there was a possibility that the hinge had failed, possibly due to fatigue, and that it would be a good idea to flag this potential problem up to other Europa owners. I asked Malcolm to write up the incident and take a few pictures of the broken hinge and you can read parts of Malcolm's report here. Take into account, when you read this first-hand account, that Malcolm is an extremely experienced light aircraft and glider pilot.

Hi Malcolm,
Further to our conversation this morning, I've noted down some details of the incident and my thoughts on what may have happened. It is worth mentioning that I hadn't flown the aircraft for some time and that the last occasion was the Permit renewal test flight (with Neil France in the right-hand seat) when we carried out the dive to Vne without incident, so that might be significant.

If you recall, the doors on the Europa are hinged at the top, with a gas strut to hold them up, and a forward and aft shoot-bolt operated on a single lever, which, when closed, is behind a protective plate to prevent inadvertent opening. This event is not unheard of according to Neil France, my Inspector, but usually occurs when the rear shoot-bolt has not engaged in its socket correctly. Thing is, it is pretty obvious when this happens, the rear of the door stands off from the recess and you can easily see the gap.

I carried out two sets of checks (TTMMFFGGHH), once before taxying out and then just before we lined up to take off and did not notice the door was not properly closed, nor was there any rattling or vibration or undue noise during the take-off or during the subsequent 15 minutes or so of flying and manoeuvring before the failure incident.

Once we had finished climbing, most of the time we were flying at speeds of around 90 to 105 knots; I'm pretty sure that it was correctly closed and latched, but of course, it's hard to be 100% certain.

When the door opened, I was having a look to see what the max level flight speed was. The odd thing was, the airspeed would not go above 120 knots, which is probably 10-20 knots less than I have seen previously. Then the door flew up, destroying the Perspex.

Back on the ground, I had a look at the rear hinge, which had broken in the incident. The break is across one face of the hinge. It is quite clean but the aluminium in the fracture looks dull and grainy, maybe that is indicative of existing stress cracking. There does not seem to have been any bending or twisting of the hinge, which you might expect from the force on it as it flew up, nor have any of the fastening screws pulled free. What I am starting to think is that the door may well have been correctly closed and latched, but at some point in the flight, the rear hinge actually failed, allowing the airflow to lift the rear part of the door. When I increased the speed I think the door may have lifted at the rear to such an extent that it was causing enough drag to prevent the level speed going above 120 knots and allowed the rear shoot bolt to come out of its locating hole.

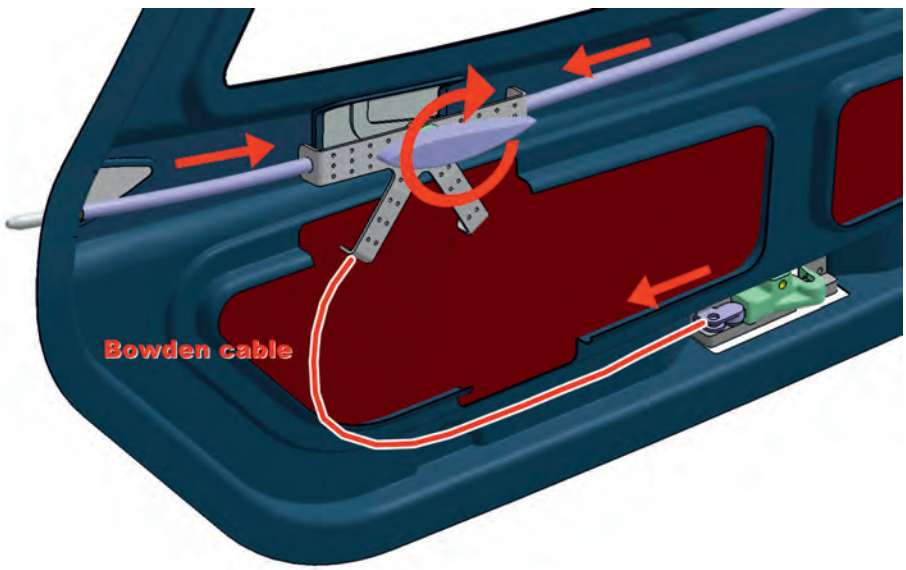
When I spoke with Malcolm, I was having trouble working out how a hinge failure could have led to the door twisting enough to cause the Perspex window to fail; somehow the geometry didn't seem right, so I had a chat with Europa specialist, the LAA's own Andy Draper. Andy got the airframe drawings out ›

and explained, "We've seen a few problems with door failures on Europa aircraft and, in every case so far, it's because the rear locking pin hasn't engaged correctly." I asked whether the mechanism designed to drive the locking pin home was at fault and Andy said that he didn't think so. "The actual operating rods are quite short so there's not much chance of them bending; of course, if they're not set-up correctly then there is the possibility of the pin catching on the side of the door frame and the slack in the system taking the strain. The door would look closed and latched but wouldn't be."

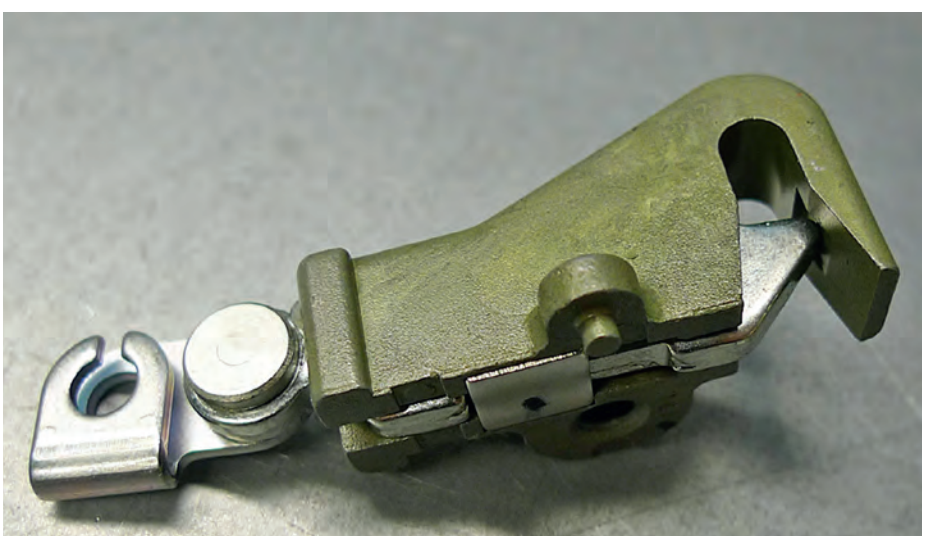
I wrote back to Malcolm letting him know Andy's thoughts and my impression that the failure face in the hinge looked to me more like an overload incident than something that had occurred over a long time. Malcolm wrote back as follows.

Hi Malcolm,
I agree with Andy. I had a look last evening when I took the photos and it looks unlikely that the failure of the rear hinge would allow the rear bolt to pull out, so it cannot have been properly located. I'm still amazed that I didn't spot it whilst doing my checks or that we failed to notice it rattling or vibrating during the flight. Just goes to show, as they say, 35 years flying and finally got caught.

I'm very disappointed in myself for failing to properly latch the door, but having looked at (and tested) the geometry of the latches and hinges, I cannot see what else it could be. I've been thinking about the sequence of the failure and suspect that, as the rear bolt was not in place, a lot of stress was placed on the rear hinge. When I increased speed up to 120 knots, the drag caused by the door trying to lift prevented the normal top-level speed from being attained. The extra force then caused the rear hinge to fail, which allowed the door to fly up. Possibly, the gas strut then gave way, which might have allowed the door frame to 'pivot' around the front hinge, allowing the impact that caused the damage to the forward door support structure (not sure this is possible of course). The Perspex gave way at some point during the event. It all happened within one or two seconds at most – I was very quick in closing what remained of the door! When Neil (France) dismantles the damaged bits, I'll ask him to send them to you if you would like to examine them.



A fairly recent failure of a door on a prototype Pioneer 400 demonstrated the difficulty in designing a fail-safe latching mechanism into a relatively flexible structure. The original design was based upon the earlier, and very successful, Pioneer 300 system which employed, a bit like the Europa, a forward and aft pin. During the first UK test flight at maximum weight of this aircraft, the door came open during take off and the aircraft was seriously damaged. A subsequent investigation revealed that the pins weren't going into their sockets far enough and, with the aircraft at maximum weight, the fuselage movement was enough to release the pins. That's what prototype testing is all about! The manufacturers have since redesigned the door to increase the pin's 'throw' and to add a specially designed safety catch at the base of the door. This picture shows an early sketch of the idea. *(Credit: Pioneer Aircraft)*



This picture shows the final Pioneer 400 bottom latch which was designed to prevent an inadvertent door opening. It is interesting that as VLA types get heavier (the Pioneer 400 is a four-seater), the design problems of the past come back to haunt modern designers and that the solutions that they come up with, in the end, are very similar to those from a different era! *(Photo: Pioneer Aircraft)*

Thanks to Malcolm Gibson for letting us know about this incident and taking the trouble to supply the excellent photos. Both the Wassmer and the Europa failures featured were almost certainly caused because the pilots didn't physically check them before flight; on both types the front pins are easy to check but, to be sure that the rear pins have fully engaged, the captain will need to do a certain amount of gymnastics, especially if a passenger is carried. It's possibly worth mentioning here that the pilot in command of a small light aircraft must never assume that a passenger, however competent they might appear, has closed and locked a door or canopy latch.

DOOR FAILURE FATALITY

Whilst a door opening in flight in an unpressurised aircraft may not appear to be such a disaster, and both the above pilots were able to deal with the emergency well, readers should be aware that this type of failure might have far worse consequences.

In the case of the Wassmer door failing, the environmental effects in the cockpit were very distracting and probably quite frightening. Serious in-flight distractions can lead to simple errors of judgement, which may have disastrous consequences.

Recently, there has been a fatal accident involving a gyroplane where a gull-wing door came open in flight, probably because it wasn't latched correctly before take-off, and the pilot decided to try to hold it closed and fly the aircraft one-handed. Unfortunately this wasn't possible.

Another incident that lies on my desk involves a Rutan Long-EZ that has been destroyed because the canopy came partially open during take-off and the pilot lost control during his attempt to land immediately on the remaining runway. When a canopy opens or comes off in flight the world suddenly changes.

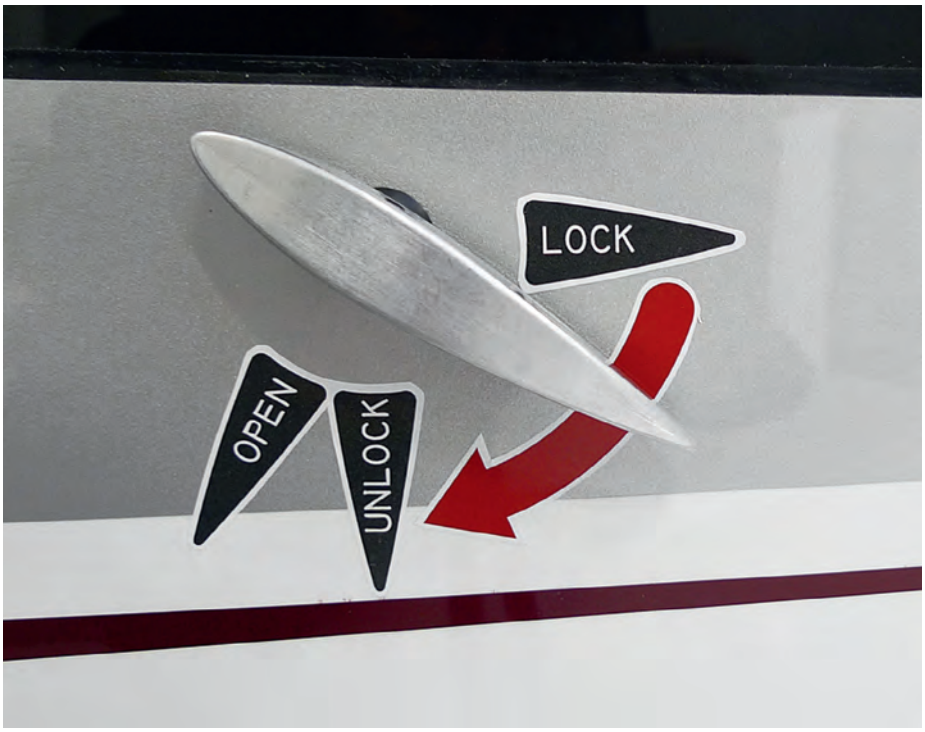
Another feature of a canopy failure could be a loss of performance. This was hinted at in Malcolm's report when he noticed that the max level flight speed was reduced by a significant amount. We know of examples where, after a canopy latch failure, the aircraft was unable to maintain level flight; a recent crash involving a Zenair 601 has been explained in this way.

Space and time prevents me from waxing on much further about inadvertent canopy openings in flight but, looking through my list of recent accidents involving canopies, it might be worth listing a few pointers: first, before flight, physically check that the doors or canopy are correctly closed and latched. Two, during your maintenance checks ensure that the system on your aircraft is working one hundred percent. In other words, don't tolerate sloppy hinges or latches and make sure the system is well-adjusted and lubricated.

You're not going to believe this, but I promise that what I'm about to tell you is completely true. I am literally just finishing off this month's 'Safety Spot', in fact I'm seriously being hassled by our wonderful Editor. "You're late again, McBride, pull your socks up laddie!" – when I receive an Initial Accident Notification from the AAIB letting me know that one of our aircraft has just ended up in a field somewhere in bandit country (Ayrshire!). The pilot, LAAer Allan Marsh, has had to conduct an emergency landing into a cow field because the canopy came off on a flight between Bute and his home airstrip near Cumnock. I've just got off the telephone after chatting with him and he's OK. The field was a bit on the rough side though and Allan's Zenair CH 601 UL has a busted nose leg.

There is a definite truth that incidents, like buses, seem to come in waves. Oh well, that's life.

Fair winds! ■



Here is a picture of the door handle from the Pioneer 400. Note that the first movement operates the door pins but, even in the unlocked position (as you might find if a pin failed to engage for some reason) the door wouldn't open until the bottom latch was released via the Bowden cable. A good safety feature if you ask me. *(Photo: Pioneer Aircraft)*

'Things that go 'bump' in the Flight.' One thing that can spoil your day is a control jam; LAA Inspector Peter Sturgeon sent me this picture and the following tale. Recently I embarked on a cross-country flight into Lincolnshire from my base in Suffolk. Using the most modern means of flight planning, i.e. a map (current issue), ruler, red maker pencil and stop watch, the plan was made. The flight outward was on Sunday 18 February and readers in East Anglia will remember this date because the sun shone on that day! This factor made both legs of the flight most enjoyable and it was easy to follow the red line on the map.

However, when nearing base on the return leg, power was reduced and the aircraft was pitched up slightly to reduce speed. Well, that's the theory, but it didn't happen as planned as, for a heart stopping moment, the elevator controls jammed!

In these circumstances it is natural, after your heart picks up again, to apply more back pressure on the control column. In doing so there was a sudden snap, a freeing of the controls and, well, normal service was resumed.

After landing and some exploration under and behind the seats, the aforesaid ruler appeared, slightly the worse for wear.

It just goes to show, make sure you know what you have in the cockpit inventory and that it is correctly stowed. In this instance it could have been an even bigger bump than the normal landings by this owner! *(Photo: Peter Sturgeon)*

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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