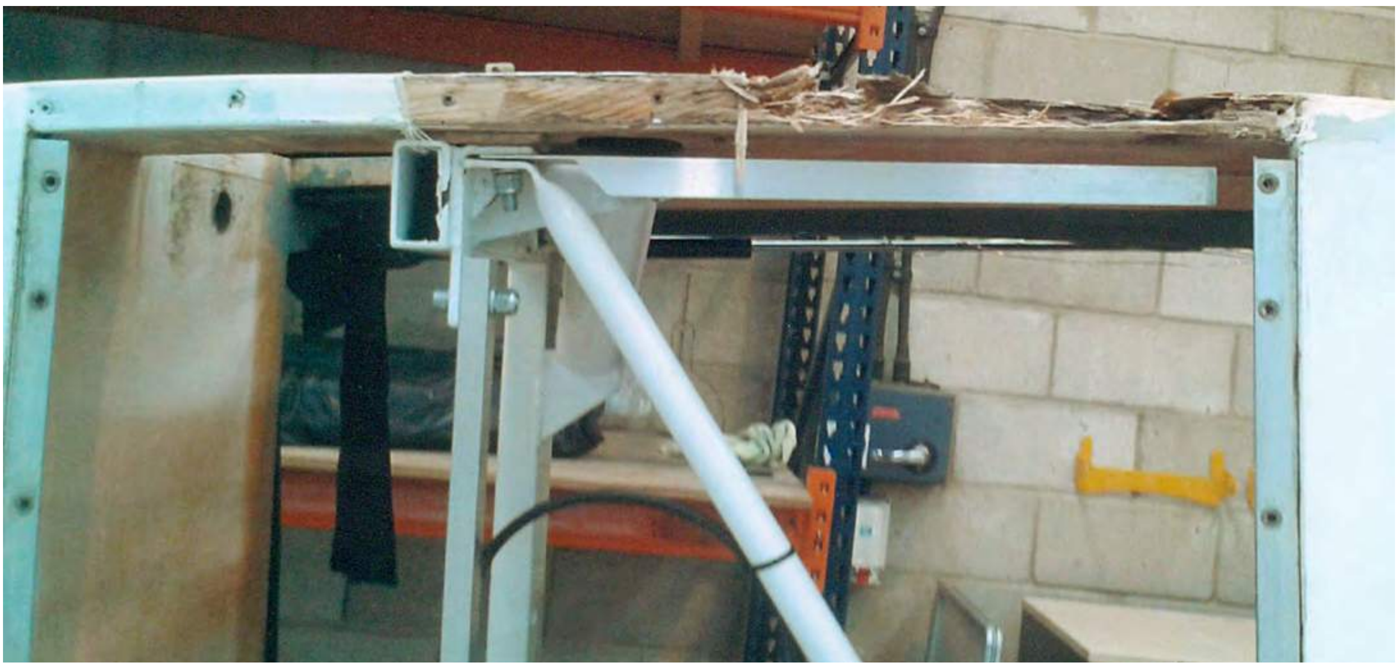
With Malcolm McBride
Airworthiness Engineer

WET, WET, WET AND CAN WE LEARN FROM ACCIDENT STATS

Malcolm warns about the risks involved in storing an aircraft for a protracted period in damp conditions and considers the 2015 LAA accident statistics



Wood is especially vulnerable to water damage – this picture shows the result of fairly long term exposure to standing water. For your interest, this is the fuselage side from a Pioneer 200 microlight aircraft that was never hangered.
(Photo Jed Mackie)

Welcome to this February Safety Spot. I'm just starting to notice that the length of the days is extending, which is very cheering; mind you, after the warmest and wettest pre-Christmas winter on record, the recent drop in temperature has hit rather hard. If you are one of the unlucky folk to have been flooded-out at home during the unusual rainy season many have suffered this year, I do hope that you've managed to put things back in order or at least are well on the way back to normalcy… whatever that means for you. And, unless you own a seaplane, you might consider taking an extra-careful look around your aircraft before you fire her up for its first flight of the season.

Personally, I quite like splodging along a damp river bank on a cold damp day, but I know how horrible it can be in a yacht after an unexpected drenching – trying to get to sleep in damp bedclothes is particularly unappealing; goodness knows how it must feel having a few feet of water in one's living room.

From your aircraft's engineering management perspective, be aware that the very damp conditions experienced over the last few months will have unquestionably had an effect on your flying machine, even if it hasn't been up to its axles in water. The effects of transient condensation can be quite damaging, as it provides the water required for corrosion to take hold if a metal isn't 100% protected. Oxygen, the other necessary component in the 'chemistry' of corrosion, will be available from the atmosphere.

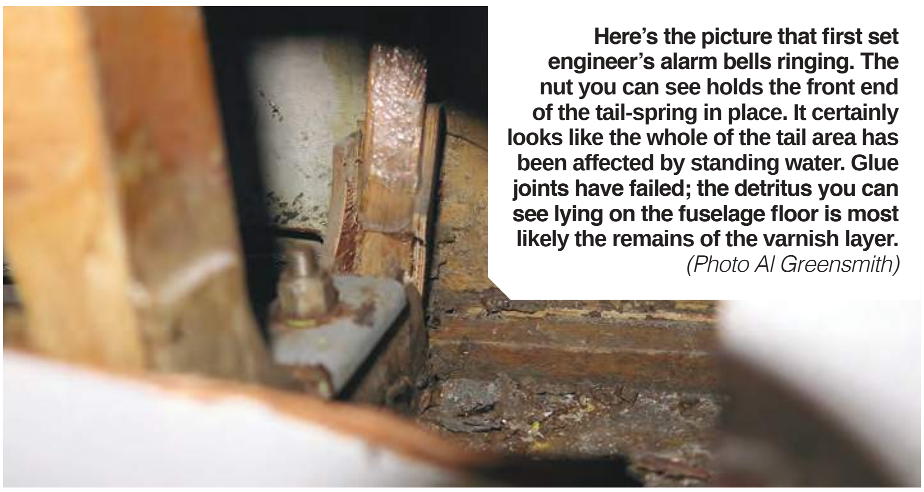
For those pilots who operate a wooden aircraft, it is worth remembering that wood gently balances its moisture content relative to the moisture content of its local environment (relative humidity). During conditions where a high atmospheric water content prevails, for example during the warm/wet Tropical Maritime airflow off the South Atlantic recently embedded into the UK's weather, three important things happen to components made of wood. Firstly they grow, this is very important with regard to the attachment of wooden propellers as we all know, but what of the rest of the aircraft's structure?

The second problem, rather associated with the material's dimensional changes, is that the protection afforded to the wood, varnishes or paints, may not survive. A good protection coat needs to be flexible enough to cope as the wood moves around, but there will be a limit in the growth most coatings can accommodate without cracking, especially when they get older.

The third reason is that the strength of wood reduces considerably as its water content increases. The moisture content of wood (below the fibre saturation point) is a function of both relative humidity and the temperature of the surrounding air. Wood, in service, rarely reaches a moisture equilibrium because it is always 'chasing' an equilibrium; but, most of this change relates to the part of the wood that's close to the surface - the core is slow to react to environmental change.

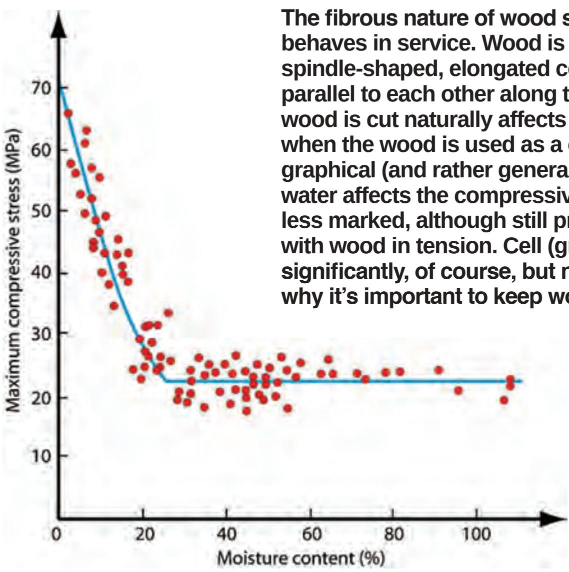
Ideally, wood is seasoned so that its water content (as a percentage) is close to the equilibrium point expected in service. For example, for most woods the equilibrium point at 15°C (59°F) with a relative humidity of 70% is about 14%. Take the relative humidity up to 90% without changing temperature and the moisture content in the wood (once it balances to equilibrium point) will rise to ›

(Left) **We've featured this picture of a Jodel fuselage failure before in Safety Spot (March 2015); following a groundloop incident, damage could clearly be seen. During the incident, the tail was seen to have impacted a concrete post and much of the damage seen may have occurred at this point. Both LAA inspectors and the engineer from the insurance company weren't so sure though and felt that the original cause of the runway departure may have been because part of the structure, weakened by water damage, broke shortly after landing. Looking at the evidence I have to say that I'm minded to agree.** *(Photo Al Greensmith)*



Here's the picture that first set engineer's alarm bells ringing. The nut you can see holds the front end of the tail-spring in place. It certainly looks like the whole of the tail area has been affected by standing water. Glue joints have failed; the detritus you can see lying on the fuselage floor is most likely the remains of the varnish layer. *(Photo Al Greensmith)*

(Above) **The water-damaged Jodel is now being rebuilt from the bottom up. LAA'er Alan Shipp has taken on the challenge and we're keeping an eye on progress here at LAA HQ. This picture shows a typical example of the type of damage that is having to be fixed – the joint between the upright and the longeron has completely failed, note the 'crush' damage to the tailplane attachment block. As wood absorbs water it grows, then metal fittings bolted to the wood structure crush the wood as it tries to swell. When the wood dries out, it shrinks again leaving the fitting loose. Naturally, for the maintainer finding the loose fitting, the temptation is just to tighten up the bolts but come the next drenching the cycle will repeat itself, leading to an ever more crushed and distorted structure. Naturally, the cure is to keep the water out in the first place.** *(Photo Alan Shipp)*



The fibrous nature of wood strongly influences how it behaves in service. Wood is composed mostly from hollow, spindle-shaped, elongated cells which, in life, are arranged parallel to each other along the trunk of the tree. How the wood is cut naturally affects the way these cells are arranged when the wood is used as a construction material. The graphical (and rather general) representation (left) shows how water affects the compressive strength of wood; the effect is less marked, although still present when tests are carried out with wood in tension. Cell (grain) direction affects the results significantly, of course, but nevertheless the graph shows why it's important to keep wooden structures dry.

(Right) **If water is allowed to get in, it will. LAA Inspector, Roger Targett, sent me this picture with the following note: Thought you might like to see a couple of pictures of the prop shaft on an aircraft we're working on at the moment. We had a shock load inspection carried out yesterday, the prop bolt safety wiring left a lot to be desired, but then, on removing the prop, we found paper/cardboard packing on one side to shim the hub over to improve the tracking, leaving a gap allowing corrosion to set up! (Photo Roger Targett)**

In the text I discussed the very great importance of ensuring that your aircraft hasn't been negatively affected by its prolonged winter stand-down. This cylinder barrel, as you can see, has been badly affected by corrosion and it will be an expensive operation bringing the component back to full serviceability. It's a bit of a conundrum working out the best way of preventing this type of problem but LAA Inspector, David Beale, offers some useful tips which I've shared in the text.
(Photo David Beale)

about 21%. I've added a graph which shows the effect on the compressive strength of wood as a function of its moisture content; if this graph doesn't dissuade you from keeping a wooden aircraft outside in wet conditions, I don't know what will! To reiterate, before you fly after the winter break, carefully check your aircraft for signs of water damage; check the drain holes are all clear and that you haven't accumulated a small reservoir in a difficult-to-see space.

Thank you to all those who commented about the January Safety Spot. As we start to approach the new flying season, well, next month will be March, I think that it is worth a reminder that Safety Spot is only as good as the material you give me to put in it and good feedback is essential. LAA'er John Goodale, who flies his Sky Arrow out of Popham, wrote letting me know the problems he had with the battery on an old bus, yes that's bus, he used to operate. Sadly, I don't have the space to copy his letter about this interesting hobby in this Safety Spot, but he pointed out that I'd neglected to mention something in the January issue where I discussed some of the strengths and weaknesses of batteries, especially their non-linear capacity with output current demand. You'll recall, if you read last month's Spot, the nasty Rand KR2 crash. John pointed out that batteries also don't react well to being asked to provide a large current when in a low state of charge. John explained that in this situation it's very easy to 'reverse charge' one of the battery's cells which will greatly reduce its total available current.

This is a really good point and should be taken into account if you're thinking of starting your aircraft's engine after the long winter lay-up. Batteries, for all sorts of reasons, don't like being left in any condition other than fully charged so, if you think that this might apply to your battery, think about putting the battery on charge overnight before you ask it to start your machine. Thanks John, great tale and important advice.

We're still getting good feedback about the story featuring the Aeronca that lost its propeller – regular readers will know that the aircraft's JAP engine suffered a broken crankshaft. Vintage engine enthusiast and LAA Inspector, David Beale, wrote supporting the recent LAA requirement for regular checks and explained that another problem that these older engines suffer is lack of lubrication to the valves. He also offered some advice regarding winter lay-up; here's the 'bones' of his letter…

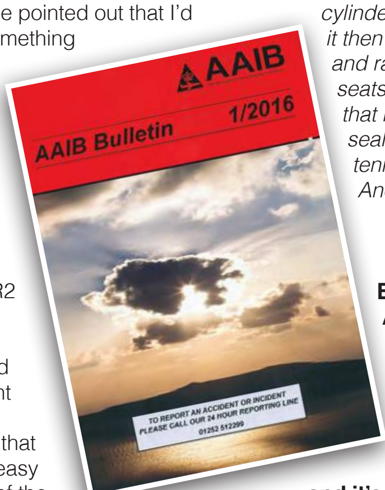
Hi Malcolm, I had a recent new owner of a Taylor Mono with a VW ask me for help over the weekend when it would not start. I diagnosed immediately that the problem was no compression, so a quick squirt of oil in cylinders, wind over, plugs back and it then fired-up almost immediately and ran perfectly thereafter (VW valve seats rust ever so easily). I suggested that he puts some oil in the fuel and seals the exhausts with bags (or tennis balls) as I do on my Mew. Another thing that I do is put an oily (or WD40) soaked rag in the inlet and pull it through one blade every few weeks when it's not being used… but do not do short ground runs as that will lead to internal corrosion.

Another tip you might pass on for those laying-up their aeroplanes over the winter is to put some two-stroke oil in the fuel tank before the final flight of the season; this would help lubricate the fuel system and leave oil film in the engine to help stop corrosion. Two-stroke oil is probably much better than engine oil as is designed to mix with fuel, not separate out, plus it's very low ash and burns without causing deposits (like upper cylinder lubricant).

Warning - do not use more than 50:1 fuel/oil ratio, ideally 100:1 (as many modern two-strokes are happy with), as with oils in fuel as there's a slight risk of running weaker due to a slight increase in viscosity. I wouldn't uses a vegetable (castor) based oil; they may smell nice but they're not compatible with mineral oils used in the rest of the engine!

Thanks David. As I explained earlier, long winter lay-ups can cause problems right through an aircraft and many of these problems have their origin with corrosion. Keeping things well lubricated (or waxed) through the winter may save you a lot of money in the spring.

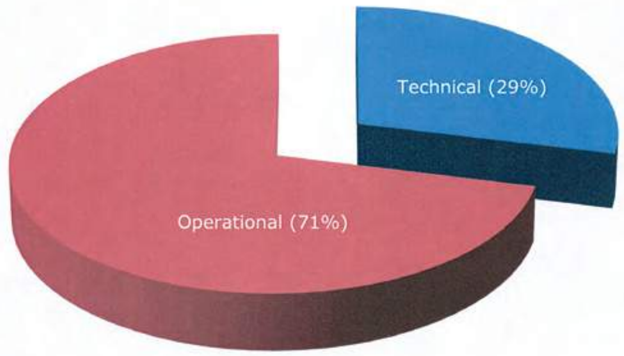
So, what have we got on-the-barrow for your deliberations this month? Well, it's February and all the accident numbers are in for 2015 so let's spend some time together perusing them.

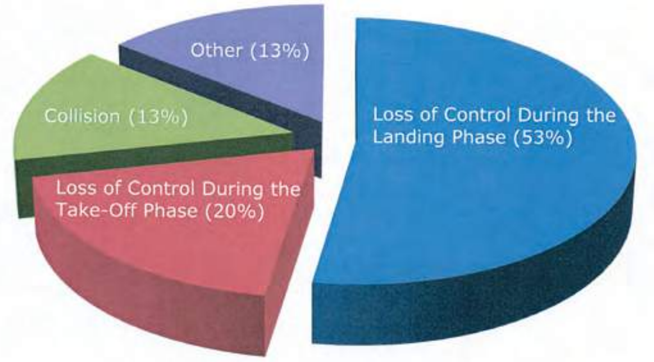


Every month the UK's Air Accident Investigations Branch publishes what's affectionately called the 'Red Top'. If you're a keen sports aviator, it's worth a read-through; I've been reading them for many years now and it's a rare month when I don't learn something new. The AAIB has a very up-to-date website where most of the published reports are accessible, just type AAIB into any search engine.
(Photo LAA Library)

Reportable Accidents in 2015 – A Brief Round-Up

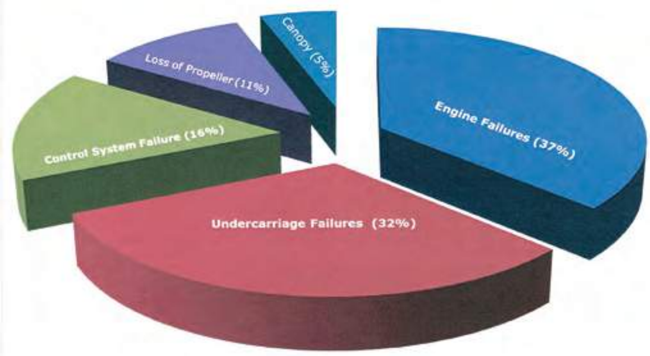
Surely everybody has heard of the phrase, 'Lies, Dammed Lies and Statistics', so I won't waste too much time explaining why we have to be careful not to put too much faith in the accident numbers; this is especially important in the General Aviation segment of aviation, particularly within the Permit to Fly sector. There are many reasons for this, the most important two being the small size of the data-sets and the inevitable gap between the number of reports received and the number of incidents that actually occur. To provide an objective criterion, we only add into our survey incidents





(Above) **In 2015, from a total of 66 reportable incidents or accidents, 47 (71%) were primarily caused by operational reasons and 19 (29%) had, primarily, a technical cause.**
(Photo LAA Engineering)

(Above right) **As would be expected, loss of control, especially when close to the ground, accounted for the majority of our operational events last year.** *(Photo LAA Engineering)*



(Right) **Engine failures and undercarriage problems account for nearly 70% of the reported 'technical' accidents through 2015; we lost two propellers and one canopy overboard, while control system failures included one throttle control failure and one uncommanded pitch trim operation.** *(Photo LAA Engineering)*

or accidents that actually pass the threshold of being legally 'reportable'. In the margins, between reportable and non-reportable incidents, there is often some judgements made 'in the field' about whether or not to pick up the phone.

Recent moves towards de-regulation of some parts of the sports aviation sector have rather confused the issues with regard to the collation of some safety data; for example, we have quite a number of incidents in the recently de-regulated single-seat microlight group, but nowadays these don't feature in this report. Some of the incidents we know about because they've been reported to AAIB, others we know about anecdotally.

One of the primary reasons for reporting an incident is that the feedback provided can be used to alert others to a previously unknown, but latent, issue. Another reason, albeit less reliable for reasons mentioned at the beginning of this round-up, is that trends might be seen early and action taken.

It is clear, looking at the numbers from 2015 against previous years, that our accident/incident rate remains fairly stable, certainly, when one considers the nature of the aviation conducted by LAA members, that's good. We do need to be careful though that we're not measuring apples against pears. For one thing, LAA aircraft on average don't fly as many hours in the year as many similar aircraft flying under a Certificate of Airworthiness. A recent internal survey (July 2015) showed that the average annual hours at Permit renewal was 32.9.

On the one hand, when a person is engaged more often in a dangerous activity, surely they are more likely to have an accident? Well, certainly from a simple risk point of view but in the aviation world we know that regular practice keeps pilots operating at the best possible performance level.

There can be no doubt that there are simply too many individual factors involved in every accident to actually pin down one simple cause. Even political factors need to be taken into account; in other words, what's counted? We know, for example, that there were a number of reportable incidents amongst our fleet during 2015 that were reported but, for a number or reasons, were listed as non-reportable. But then there's no reason to suspect that the errors caused by this would be any higher or lower than in previous years.

I note that safety records are being broken with regard to the accident rate within the commercial passenger sector but, if you look at the numbers more carefully, a few major accidents - accounting for about 375 deaths - have been missed out of the numbers. Why? A human factors judgement was made that the accidents were the result of deliberate action and therefore shouldn't be counted. An unusual judgement when one considers that all accidents have multiple causes - an airborne structure failure caused by a bomb might not reflect a design flaw but somebody was able to plant the bomb and surely that's a system failure somewhere, probably a number of 'somewheres'.

Luckily, the LAA operates within a country that still believes in the principles of a Just Culture, where the object behind finding out what's gone wrong after an accident centres on learning what can be done to prevent similar failures in the future. Some countries have a different approach, where the object of an investigation is to aim blame (and therefore liability). The purpose of the AAIB is to establish, as far as possible, the reason(s) behind accidents and incidents in the UK. Interestingly, the AAIB has its origins in the Accidents Investigation Branch of the Royal Flying Corps, founded in 1915, although nowadays they're now an independent unit within the Department for Transport.

LAA is actively engaged with the AAIB when it comes to looking at accidents and incidents that befall its membership, and this is a two-way arrangement. Something like half of all reports we receive don't cross the threshold of being legally reportable, nonetheless, we still like to hear about these. Often major problems originate from, on the surface, quite minor issues.

You can see, from the attached pie charts, that in 2015 operational incidents form the majority of reportable accidents (71%); this is a slightly higher percentage than the 2014 figure of 60% although, again, loss of control features large in the total. Technical incidents account for 29% of the total, with engine or undercarriage failures neck-and-neck for the top spot. Worryingly, we had two propeller loss incidents in 2015, both caused by a failure of the primary shaft (one crankshaft failure and one failure of the main shaft in a reduction gear).

Thanks to all of you that have participated in our combined efforts to keep our accident rate as low as it is. The LAA has a culture of reporting incidents and accidents, all our flying members know that we owe those that go before us a great deal, not only because it was their expertise that designed the aircraft we fly in, but also because, when things went wrong, they let others know so that the same thing didn't happen again. As the Nun said to the Bishop, let's not lose the habit…

Jabiru UL430 – Hit Obstacle on Approach

As we near the end of this month's Safety Spot I will take the opportunity of sharing three very different types of accidents, the first, featuring a Jabiru microlight aircraft, we have recorded as being an operational – in other words, the pilot simply made a mistake. You can see, from the picture, that the aircraft itself suffered quite an impact and is unlikely to be repairable, even within the LAA's excellent system.

The owner, who was fairly new to type, was finding the landing difficult for some reason. Certainly, most of his previous 450 hours of experience were flown in slightly heavier GA types and the Jabiru UL has been described by some as a little twitchy until you get used to it. He had been operating from a fairly tight strip so he decided that he would fly to an airfield with a longer runway and practice a few landings.

Lining-up for a long final, the pilot concentrated on keeping his approach speed at exactly 60mph, the problem was that he'd forgotten that this particular ›

The pilot of this Jabiru inadvertently caught a mainwheel on a lamp post during the final stages of an approach to an unfamiliar airfield. As you can see, the aircraft was very badly damaged but both occupants, whilst suffering quite serious back injuries, survived the experience and are now both well on the way to a full recovery. Considering the nature of the accident, this Jabiru fuselage has remained pretty intact, perhaps a testament to good design. I briefly discuss this accident in the text and I feature it as an accident that would be listed as purely operational. *(Photo AAIB)*

After a lot of searching, a likely cause of the uncommanded trim action was the very poor wiring to the pitch trim relay – wiggling the wires shorted the circuit. Once this was discovered, the owner took the decision to re-wire the aircraft. *(Photo David Joyce)*

runway was displaced into the field some distance because of some tall street lamps surrounding a small factory unit and had set up an approach to the original position of the runway. He didn't see the 23ft high street lamp that contacted the undercarriage and doesn't remember much else about the incident.

Whilst this incident is operational, so almost by default, pilot error, I do hope that you see that there are other components to this accident. I've taken a look at the plates for this airfield and they're not brilliant, for example, whilst they're marked, there's no specific warning about the obstacles on the approach, even though this is not the first accident at this site. I only say this to remind readers that it's a very rare accident that only has one cause.

I'm glad to say that the pilot and his passenger have now nearly fully recovered and the pilot at least is looking forward to getting behind the controls of another aircraft. Fair play.

Europa Trigear - Runway Excursion

This accident, our second brief delve into the 2015 accident statistics, is an example where a technical failure precipitated an operational one. To start us off, let's review the pilot's description of events.

The aircraft was departing the airstrip on a flight to another aerodrome, a similar flight to one that the pilot had completed two days previously. Following normal pre-flight and pre-departure checks, during which the pilot set the all-flying tailplane trim tab to the take-off position, the aircraft started its take-off roll on 05. The pilot estimated the wind during the take-off to be northerly at 8kt.

During the take-off roll, the pilot reported that he had to apply increasing forward pressure on the control column to maintain pitch control, until the pressure was sufficient that he had to use both hands. The pilot noticed that the cockpit-mounted pitch trim indicator was displaying full nose up trim and that it had changed from the position set prior to commencing the take-off roll.

This picture shows a Europa that's being completely re-wired, it's also having a complete instrument upgrade. This is a good example of an operation incident with a technical initiator. Notice the stick-grip contains unprotected switches, these operate the radio's press-to-talk facility and, relevant here, the pitch trim. The aircraft suffered what the pilot thought was a complete control failure during an otherwise normal take-off. He aborted the take-off fairly promptly but ran out of runway damaging the undercarriage and the propeller. *(Photo David Joyce)*

The pilot closed the throttle and applied the brakes, but as the aircraft decelerated it weather-cocked into the crosswind and departed the runway to the left, coming to rest in a crop of standing wheat approximately 30-40m from the runway edge. The aircraft's propeller and main landing legs were damaged in the accident.

The pilot shut the engine down and both occupants, who were uninjured, departed the aircraft without further incident. The pilot confirmed that the tailplane trim tab was in the full nose-up position.

A post-accident check of the electrically-actuated pitch trim system showed that it operated normally, and the cause of the pitch trim runaway on the accident flight was not identified. The pilot reported that having considered his actions during the accident, he regretted not closing the throttle earlier during the take-off roll, once the problem with the pitch trim became apparent, as this may have reduced the severity of the subsequent runway excursion.

Naturally, I spoke to the pilot who was adamant that he had set the trim to the correct position for take-off and I'm sure that he believes this to be the case. Looking at this incident from rather a narrow perspective, there are four possibilities that should be considered; the first and second are that the pilot was mistaken and he had forgotten to set the correct pitch, or that he had set the pitch trim to the wrong position before take-off. Both these options should be thought about primarily as operational although, to widen the perspective, we should ask whether the pitch trim indicator is appropriate for its task.

The third option here is that the pitch trim was accidentally operated during the beginning of the take-off roll. Notice that this aircraft had stick-mounted pitch trim actuation buttons; could it be that, gripping the control stick, the pilot accidentally activated the pitch trim servo? Again, this scenario is possible and would fit into the operational folder. But are

"Could it be that, gripping the control stick, the pilot accidentally activated the pitch trim servo?"

stick-top pitch trim buttons sensible in this type of aircraft? There have been a number of accidents where this type of stick grip has been implicated, for example, where pilots have rested a chart on the stick and the weight of the chart has been enough to depress the trim switch.

The fourth possible reason is that, for some reason, the servo fired-up on its own. That's definitely a technical cause. As it turned out, a fault was found in the aircraft's wiring which may have been the culprit. So, should we categorise this as an operational incident now we know that there was an electrical fault? Well, that's what we've done, although it has to be said that the aircraft should be able to be flown with a jammed trimmer; part of a pilot's conversion training to type should include an exercise where a completely out of trim situation is rehearsed. This pilot had not had this experience, so when it happened in real life he didn't immediately recognise what was going on.

I do hope that you're beginning to see just how difficult it is to accurately pigeon hole an accident into one or other category. Incidentally, the pilot, in his report, said that he regretted not acting sooner once he realised that there was a problem. Of course, he's making this judgement in retrospect, a fantasy place where nobody ever gets anything wrong, so I advised him not to be hard on himself. After all, his aircraft's very nearly ready to fly again, and it's got a brand new panel (and a correctly wired pitch trim relay!). Perhaps this next example will be easier to categorise, it's just a simple engine failure after all.

ARV Super II – Hewland Engine Failure – Serious Damage on Landing

It might surprise you to know that, as far as legal process is concerned, an engine failure in an aircraft is not in itself a 'reportable' incident, unless the aircraft is damaged during the subsequent forced landing. If it is damaged during the landing, then some would say it's operational, i.e. pilot error. "Hang on a minute," I hear you exclaim. "Surely that can't be fair? Get real - a pilot can't be expected to pull off a perfect field landing every time, whatever the circumstances, whatever the aircraft type." I agree that this sounds a bit harsh and, as a general policy, LAA Engineering likes to hear about all the engine failures suffered by its members, even if the field landing's a greaser. Actually, that's true of any major failure in the engine, drive train, propeller, aircraft's structure or flight control system.

In reality, in many cases an accident must be considered part technical, part operational. In this example, where the engine stopped just as the aircraft levelled-out after climbing away from the airfield, the pilot carried out a very competent field landing only, in the very last few seconds, to be confronted by a tree stump which, as you can see from the attached picture, wrecked the aircraft. So, because the engine stopped, we'll list this as primarily a technical failure, but there were still some operational lessons to be learnt from it.

Like in the last couple of examples, this pilot was new to this type of aircraft; in fact he'd never operated a two-stroke engine before. Now, if you take a look at the scuff marks on the piston (pictured) you'll probably guess that lubrication and temperature probably played a role in this engine failure. History tells us that two-strokes do not like being throttled back quickly after a long climb, this is because the engine gets pretty hot during the climb, ›

Can you guess what this is? The AAIB Investigator charged with the responsibility of working out how the accident had happened couldn't; well, when he first came across it, it wasn't actually attached to the airframe! The Jabiru has a very effective stall-warning system based upon the angle of attack of the wing; when the angle is nearing the stalling angle, an orifice in the leading edge of the wing senses low pressure, sucking air through a neoprene tube connected to a horn. Sucking air through the horn gives an audible warning to the crew, alerting them of the dangerously high angle of attack. The builder of this aircraft decided to use part of a child's trumpet as the horn, rather than the horn supplied in the kit; bet you wouldn't find one of these on a triple seven! `

This picture shows the aftermath of a failed field landing after an engine failure shortly after take-off. It's unlikely, very sadly, that this ARV Super II will ever fly again. I feature this accident because it is primarily a technical failure in the final stage of an otherwise textbook forced landing where the pilot hit an unseen tree stump. *(Photo Andrew Barley)*

probably fairly close to its limit and, if you pull back the throttle quickly, you stop fuel getting to the engine. Because the lubrication oil is carried around the engine by the fuel in this type of engine, closing the throttle effectively starves the engine of oil. Also, as with many engines, the mixture strength with most two strokes is automatically richened at full throttle, for extra cooling, coming back a bit on the throttle weakens the mixture.

Most long-in-the-tooth microlighters who operate two strokes will warn prospective operators of this weakness - I've got a few pistons in my memories box at home just like the one shown in the picture!

From this brief snapshot into three of the many events we're looking at, you will see that there is a common theme running through the, on the surface, widely different events. You'll notice that all three of the pilots were fairly new to their respective aircraft, perhaps demonstrating a weakness in the 'conversion to type' process. Also, it has to be said, none of the mechanical failures in themselves should have led to an accident, although it's easy to see how they did.

OK, out of space and time. Fair Winds. ■

(Above) **The Hewland-powered ARV's engine stopped because the piston 'picked-up' against the barrel wall; two-stroke engines can be prone to this type of failure as I discuss in the accompanying text.** *(Photo Andrew Barley)*

LAA ENGINEERING CHARGES – PLEASE NOTE NEW FEES HAVE APPLIED SINCE 1 APRIL 2015

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 450kg	£450
451-999kg	£550
1,000kg and above	£650
Permit renewal	
Up to 450kg	**£155**
451-999kg	**£200**
1.000kg and above	**£230**
Modification application	
Prototype modification	minimum £60
Repeat modification	minimum £60

Transfer	
(from CofA to Permit or CAA Permit to LAA Permit)	
Up to 450kg	£150
451-999kg	£250
1,000kg 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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