The latest LAA Engineering topics and investigations By **Malcolm McBride**

Safety Spot

Tailplane corrosion, creating a TMS, importance of following the 'drill' and nosewheel damage

Welcome to this February 2019 edition of *Safety Spot*. I hope that all's well with you and those close to you and that you have enjoyed this, at the time of writing at least, fairly benign winter weather.

So far this year – and I'm looking for a bit of wood to touch – has been very quiet from an incident/accident point of view, with only two AAIB Initial Accident Notification sheets in my still nearly empty 2019 book.

Last year's figures are still being examined, but 2018 is looking like it was a pretty good year from the safety point of view for LAA flyers. As usual, and perhaps to be expected, somewhere between 70 and 80 per cent of the incidents recorded involved, primarily, 'operational' causes – mostly loss of control during take-off or landing. 'Technical' failures that led to a 'reportable' accident accounted for only 20 per cent (or so) of the total. Naturally, we're mindful that it's not sensible to bandy-round any statistical analysis where the dataset is very small, this is especially true of course when there are almost too many variables to count (as with most aircraft related incidents and accidents), but a 20:80 split between technical and operational cause really speaks for itself.

Above Peter Bentley's lovingly restored Luscombe 8E Silvaire 'Deluxe' parked on the apron at its home base of, what the owner Peter Bently describes as 'the centre of the Luscombe universe', South Longwood Farm. The LAA database shows 88 Luscombe 'eights' on its books with just over 50 aircraft in (or reasonably close to) full Permit to Fly status. This aircraft first joined the PFA fleet as a US import, like so many, in the late eighties. The Luscombe was the first all-aluminium GA aircraft available to the general public, many examples still flying having been constructed in the early forties. **Photo Peter Bentley**

One LAA pilot very sadly lost their life in an LAA machine in 2018; this sole fatal accident recorded occurred to a single-seat aerobatic aircraft still on the G-register after being newly sold in Sweden. As the Swedish authorities do not investigate 'experimental' aircraft accidents, and the UK AAIB elected not to carry out a 'Field' investigation, the cause of the accident remains uncertain. We do know that this was likely to have been the pilot's first aerobatic sortie since recently acquiring the aircraft. Of course, it goes without saying that our sympathy travels across the sea to the pilot's family.

In this *Safety Spot* I hope to compliment Francis' article (page 50), discussing the need for all aircraft owners to consider creating a Tailored Maintenance Schedule (TMS) for their aircraft. I plan to do this by exploring a deep-maintenance inspection carried out by LAA flyer, Peter Bentley, on his vintage Luscombe 8E.

Peter wrote a really detailed illustrated summary of the work done which, once the full problems of corrosion had been uncovered, required a formal repair approval – I hope to share much of Peter's report with you; no doubt you've flown low over the pictures already.

First, what of the two 'reportable' incidents we've received thus far? Well, the first of the year relates to an incident where a Eurofox being used as a glider tug nosed over on start-up – luckily nobody was hurt in the incident. The second, which I'll come to later, involved a Tipsy Nipper.

Luscombe 8E – Tailplane Corrosion

Luscombe Silvaire owner, Peter Bentley spent some months with his friend, LAA inspector, Owen Watts, renovating the empennage on his lovely machine. Peter was so shocked by what he found when he de-riveted the tailplane skins that he travelled up from his airstrip near Winchester to chat through the repair options available. Essentially it was decided to more or less re-manufacture the tailplane, so I asked Peter if he would write-up his experience for *Safety Spot*, which he has kindly done. Here's Peter's thoughts on the subject of deep maintenance: *Aside from major rebuilds, for the majority of the LAA fleet the annual permit renewal is the most significant regular inspection the aircraft receives. In contrast, the commercial aviation industry is well versed in highly structured maintenance programmes at many different levels. After a certain number of 'cycles' (take-offs and landings), or accumulated hours, or after a certain elapsed time, most commercial aircraft will be taken out of service for deep maintenance. Typically, a commercial-transport jet will undergo*

Above In 2018, Peter decided that it was time to carry out a deep maintenance check on the empennage of his aircraft so, because the inside of the tailplane, most especially of course the fuselage to tailplane forward and aft. attachment points, couldn't be inspected without lifting the aluminium skins, he decided to de-skin the assembly. The pictures above show a first glimpse of a structure built more than 70 years ago. Notice the mouse nest (left)! **Photo Peter Bentley**

Above On the left are the Luscombe's rear attachment brackets hidden within the tailplane. As you can see, they have nearly corroded completely away. Picture right shows the forward attachment bracket which is riveted to the fuselage – this bracket looked OK from the corrosion standpoint, but when a non-destructive, dye-penetrant test was carried out cracking is visible in the forward lug receptacle and between the rivet attachment holes. **Photo: Peter Bentley**

escalating depths of inspections progressing through A, B, C and D, with the D check occurring perhaps every six to 12 years and taking as many as 50,000 man hours and two months to complete.

No-one is going to suggest that aircraft in the LAA fleet need quite this much maintenance, but it is becoming clear that some aircraft, especially the older types, are getting to the point where something more than a simple once a year 'inspection covers off' and a look around with a torch is going to be required. There are no fixed guidelines on how often this deep maintenance needs to be done, but for aged aircraft, once a decade might be a sensible answer.

There is, of course, no need to perform all the work once every ten years. One of the great benefits of an LAA operated aircraft is the ability to write a suitable Tailored Maintenance Schedule (TMS) that spreads the work. A deep inspection of the airframe one year, the powerplant and firewall-forward three years later, and finally a detailed run through instruments, electrical and fuel systems after another three years, would mean that nothing went more than nine years without a thorough check.

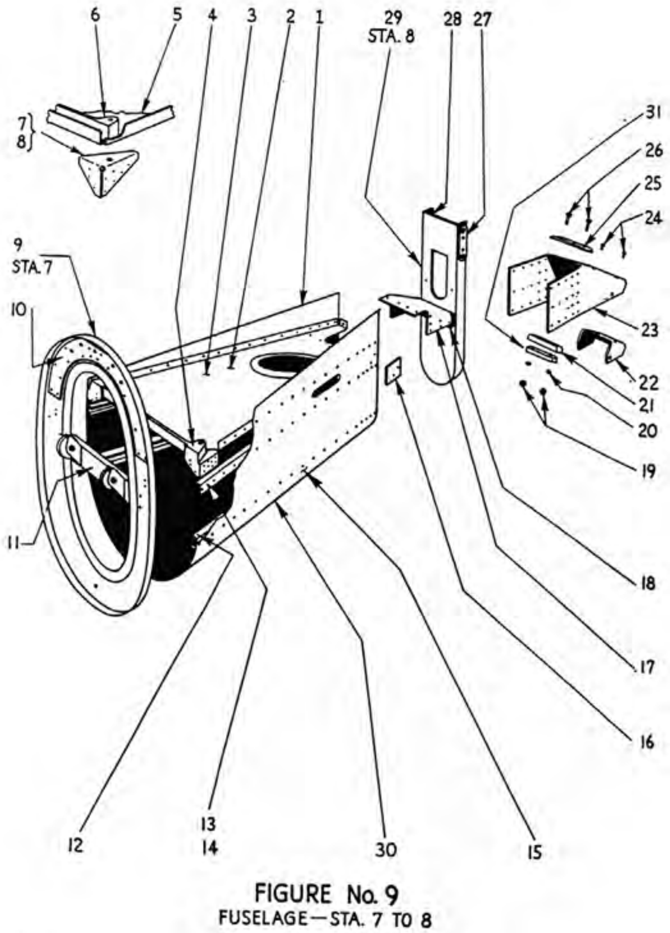
So, what might this work involve? It goes without saying that when one organization works consistently on a single type, they build up some familiarity with the more common defects. The Aeroplane Workshop near Winchester has been working almost exclusively on Luscombes for several years and have recently shared their experience with LAA Engineering. It certainly makes interesting reading and we intend to share the very comprehensive document with all Luscombe owners via the TADS system.

As the first all-aluminum general aviation aircraft available to the general public, the Luscombe has a longer service history than any other all-metal aircraft in the LAA fleet. It can be no surprise that corrosion is an ongoing problem. Specific directives and bulletins have been issued in respect of spar and undercarriage corrosion and, while the majority of these problems have been addressed, aircraft remain in the fleet with some original components in these areas.

Significantly, the early 24ST aluminum used to construct the Luscombe is prone to both surface and exfoliation corrosion. The propensity to corrode appears to be higher than that of later 2024 materials, especially when exposed to damp or 'marine' conditions. There appears to be a particular problem with extrusions and especially the 3/4in x 3/4in x 1/16in used as stringers, reinforcement and doublers around the airframe.

Both the horizontal tail and the fin are often found deteriorated to the extent that it is rare to find either in an unrestored aircraft in anything other than poor condition. Faults found include corroded skins; ribs; spars and internal fittings; cracked ribs and distortion; especially around the various mounting holes in the spars. Horizontal tails have been found filled with mineral-fibre-insulation, presumably as a result of rodent infestation. Moisture retained in the insulation material caused extensive corrosion. Worryingly, infestation is not visually detectable in situ.

How many Jodels or indeed other wooden types of similar vintage have loose glued-joints somewhere in the structure? How can these ▶



Above An exploded view of the Luscombe's empennage 'assembly'; during manufacture an earlier forward connection (items 5, 6, 7 & 8) was replaced with the cast forward tailplane attachment point (item 4). **Photo Luscombe Maintenance Manual**

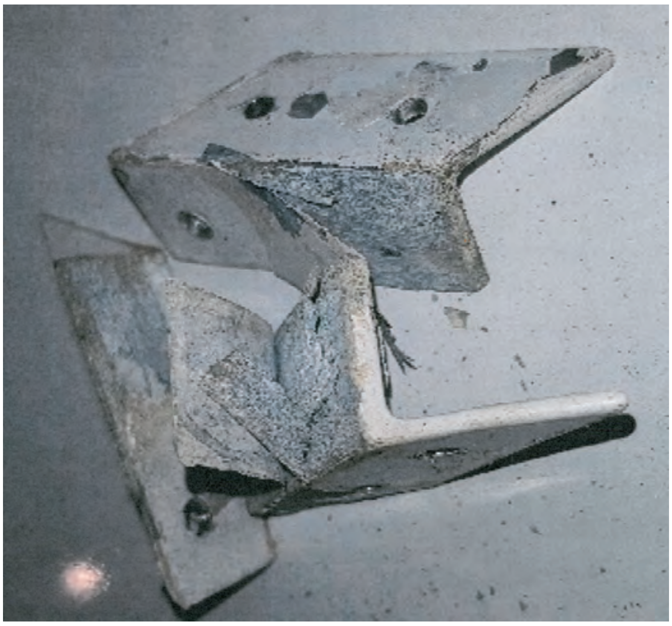
be effectively inspected? Back in the day, when these wooden aircraft were covered with cotton fabric, there would be an inevitable requirement to renew the fabric every ten or 20 years. At that point the structure within would have been inspected and repaired as necessary. With modern synthetic fabrics lasting upwards of 30 years, the structure goes unseen for similar periods. Although no-one wants to unnecessarily remove perfectly serviceable fabric, as time marches on, it will be necessary to determine how to perform the necessary airframe inspections.

Thanks Peter for taking the time to put your thoughts on paper. How to manage the serviceability of any mechanical component can be a tricky matter, maintenance itself has its risks. I remember Dick Stratton when he was the Chief Technical Officer of the British Gliding Association (and I was a very junior BGA Inspector) waxing-on about the importance of avoiding what he described as the 'annual ritual slaughter' of a glider during its Permit renewal. He often described (rather annoyingly) aeronautical airframe or engine fitters as being 'chaps who took a perfectly serviceable component to bits and, unable to put it back together again, turned it into so much rubbish.'

Although I think he was exaggerating, he was making a valid point. Certainly, aircraft that don't do many hours flying per year need a different approach to maintenance than those flying every day. That's why Peter's point about check cycles in the commercial sector shouldn't be treated, in my view at least, as a benchmark of excellence in the Permit to Fly world we operate in.

That said, low-usage does have problems of its own – this hardly needs saying of course. I do agree wholeheartedly with Peter's staged approach to deeper maintenance tasks, although, again, I like the idea of a three-yearly cyclical approach. This frequency gives convenient nodes each three years so, from new, a propeller – for example – might hit an inspection point at six years. Convenient when one looks at, and one must look at, manufacturer's schedules for many of the components on an airframe, propeller or engine.
If you own a Permit to Fly aircraft, and if you're reading this, there's every chance you do, chat through with your LAA inspector how you should start putting together a TMS that suits your environment, your

Top and Above Before/After. The picture (above) shows the tailplane during its refurbishment, note the substantial assembly jig – secure jigging is essential in any situation where aircraft skins are going to be replaced. **Photo Peter Bentley**



Above: To emphasise the fact that corrosion in not limited to the Luscombe aircraft – and that it's not just the Luscombe that contains areas in its structure which are difficult to inspect – here's a picture that arrived in LAA HQ a few weeks ago showing severe corrosion in some MCR-01 (Bambi) aileron attachment brackets. These brackets were only seen because the aircraft was involved in a minor (ish) incident where the aircraft overran the runway and the nose undercarriage was damaged. A subsequent deep inspection for other damage revealed the above. **Photo Nick Stone**

usage, them, you and your beautiful flying machine's original manufacturers. You don't want to be flying around in an aircraft you don't trust. Peter feels quite lucky that the tailplane on his aircraft didn't fall off because the attachments had nearly corroded away, and he had no idea they were in such a terrible state before taking a closer and deeper look.

Tipsy Nipper T.66 RA45 (Series 3) – Engine Failure/ Forced Landing

'Drills' is a good word. I use it after chatting through the second of our 'reportable' incidents with the pilot after the event. He's a serviceman who's quite recently bought the Nipper so that he can enter some RAF aerobatic competitions later this summer. The aircraft's broken now, so this plan has gone out the window, but he wasn't injured in the accident so he's very thankful for that and, perhaps, in true British fashion, is looking forward to mending his machine. Being a serviceman, he realised that not following the correct drill in an emergency situation turned a tricky situation into a crisis. So, let's explore this one a little further.

Our pilot has owned this aircraft for quite a few months and had really started to enjoy her after about 12 hours flying in the local area – lots of circuits and plenty of general handling practice. Rather frustratingly though, weather conditions and time-off from his military duties conspired to work together so that every time he went flying, the low cloud-base meant that he couldn't climb high enough to carry out any rather more advanced handling practice. Then, just after Christmas, better weather and personal free time came together, and he was able to get the machine up to about 4,000ft – his self-briefing before the sortie, always necessary when carrying out this sort of exercise, centred around his approach to establishing the aircraft's stalling characteristics.

During this pre-flight self-briefing he noted that the atmospheric conditions prevailing, dew point, local temperatures and, most importantly, humidity, meant that he was likely to be operating in conditions where there was a high likelihood of carburettor icing. Mindful of this he made a mental note to use the carburettor heater regularly. Also, knowing the VW's poor reputation with regards to carburettor icing, he decided to carry out his manoeuvring within gliding distance of the airstrip. So far, ten out of ten.

After all the exercises had been carried out, our pilot closed the throttle, applied full carburettor heat and began his descent home. As the aircraft passed through two thousand feet, perhaps after four or five minutes in a power-off descent, he opened the throttle to 'clear the engine'. It was at this point that circumstances changed from being 'rather pleasant' to an emergency situation – yes, you've guessed it, the engine 'stopped dead'. This was the point when tried and tested 'drills' came in handy.

Regardless of how much practice you've had for any emergency situation, and as pilots we know that 'practice this you must', it always comes as a bit of a surprise when an emergency occurs. It's an odd feeling when the aircraft's engine stops unexpectedly and, when it does, it takes a few moments to gather your thoughts – some pilots in this circumstance, for reasons difficult to understand, never gather their thoughts and the end result of the essentially manageable situation ends up being the result of a lottery. Naturally, there's always a bit of luck involved in the outcome in any event, but the objective for a pilot in an emergency situation is to reduce the effect of good or bad fortune to an absolute minimum – via pre-practiced drills.

Our man admitted to being a bit flummoxed initially but, after a few hundred feet, he took charge. First, he got the aircraft flying at the best glide speed – he had been taught to first 'feel' the aircraft. This is a good idea as aircraft without power do feel different. He knew where the wind was and, as he was within easy gliding distance to his home airstrip, he didn't have to start thinking about identifying a landing site or designing the best approach to it. What about the rest of the engine failure procedure? Well, 'what's gone wrong – and can it be fixed'? Our pilot already knew in his heart that the problem would be carburettor icing, the fuel was on, as were both ignition switches – there's not much else on a VW after all. Question was, should he try an air start (there's no starter motor fitted in this engine's installation)? It's possible that the ice would clear because of the warmish engine, but this would use up height. Although he had more than sufficient height in hand to get back to the airfield and fly a reduced circuit, should he throw this advantage away? As the height above ground was quickly reducing and his approach plan was working well, he thought, "I was feeling quite good about the whole episode really, I was in complete command of the situation, the aircraft was flying well and, contrary to rumours, the glide angle of the 'Nipper' without an engine seemed pretty good."

The pilot turned toward the runway from a 'high final' turn and, perhaps because of a slightly increased airspeed in the turn, perhaps a bit of turbulence, the propeller bounced round a couple of times and our pilot thought, "I'm high, let's give an air-start a bit of a go".

To summarise, after the unsuccessful air-start our pilot very quickly found himself far too low to attempt a landing on the airfield. Luckily, he was able to squeeze his little craft into a small farm field, though the aircraft inverted after a short landing run, probably due to soft mud jamming the nosewheel and the 'pretty hard' landing. He noted afterwards that he hadn't turned the fuel or electrical power off but, with some help from local people, he was extracted from the aircraft unharmed.

It is worth exploring this incident's critical fail points. First, pilots who fly behind VW engines a lot tell me that it's not wise to carry out long descents with the throttle closed. The carburettor, with its narrowed venturi, is extremely prone to icing, even in quite benign conditions let alone known icing territory. Second, the carburettor heater on many types (including the Ardem VW) is powered by heat generated in the exhaust pipes, in a long descent this deicing heat is simply not there as the pipes have cooled off.

To return to the 'drills' point I was making. Well done to our man for getting the aircraft sorted out – well nearly sorted out – he forgot the pre-landing safety check (harness, hatches, fuel and switches).

Chatting the incident through with him convinced me that he would be a safe pair of hands to fly with, I really liked the way he took charge of the situation, sometimes easier said than done within the mental machinations surrounding stressful events – emphasising the benefit of 'drills' again. But, if you do suffer an engine failure and you've made a plan and things are working-out as you expect, don't mess it up by trying anything fancy at the last minute. Just stick to your plan and concentrate on flying the aircraft right down to the ground.

Jabiru UL-D – Nose Undercarriage Failure

This tale relates to an incident that occurred during the autumn of 2018 and, to be honest, although there were some operational lessons that could have been shared, there was nothing really 'technical' enough to stir my fingers into action on the keyboard. So I just filed the incident in the LOC-L (Loss of Control – Landing) file and moved on.

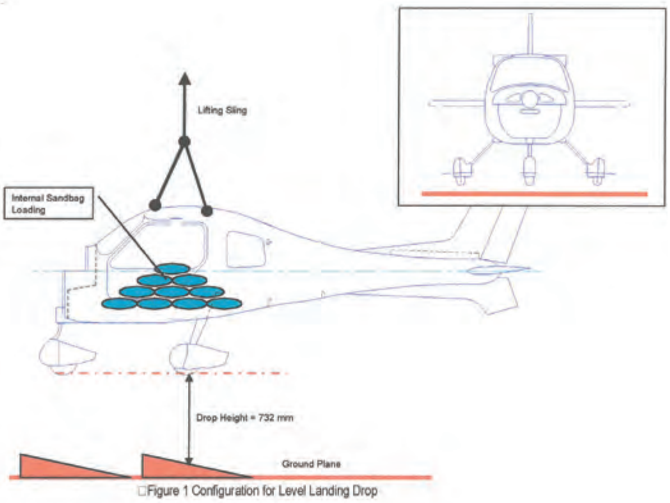
The aircraft involved was Jabiru UL-D two-seat trainer aircraft, although I think the type of aircraft, at least in terms of lessons to share, is not all that important. All pilots occasionally get things wrong during a landing and, if the situation isn't brought under control quickly, damage can result from the inevitable heavy landing or worse, crash. The big lesson here is if you do in any way feel uneasy about your approach, or if, during the final stages of a landing things don't appear to be going as planned – go around and give it another go! There's absolutely nobody (who matters) that would criticise this decision. This tale highlights two different reasons which can lead to a broken aircraft during a landing.

Let's start roughly at the beginning. A pilot was flying a borrowed Jabiru microlight to take a friend up for a bit of a jolly. The flight itself was going very well until the passenger started to feel airsick and the pilot became worried for the health of his charge. ▶

Above Occasionally landings don't go completely to plan, and quite often when this happens there will be damage to a nose undercarriage assembly. The picture on the left shows the result of one such event where the pilot entered what is sometimes described as a Pilot Induced Oscillation (PIO) during a rather rushed landing. Notice that the shock strut (see the red rubber doughnuts) has been significantly bent in overload. Undercarriages are designed to absorb energy so that airframes aren't damaged during landing, or when taxiing over undulating ground. Part of the undercarriage's suspension system includes the suspension afforded by the pneumatic wheel and tyre assembly – the picture on the right shows a pneumatic tyre that's been modified by infilling with a solid rubber compound. The aircraft involved was a Jabiru UL-D factory-built training aircraft and LAA Engineering has written to all UL-D owners operating under an LAA administered Permit, reminding them that changes like this can only be made after a modification application is made and granted. **Photo David Almey**

General view of the deformation of the nose wheel and tyre under the applied limit load conditons

General View of the nose wheel and tyre deformation under the ultimate load conditions

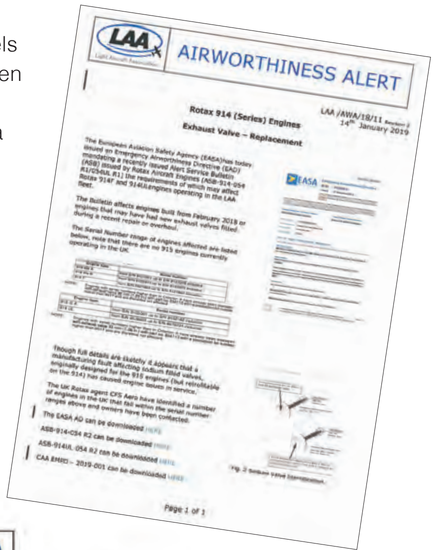


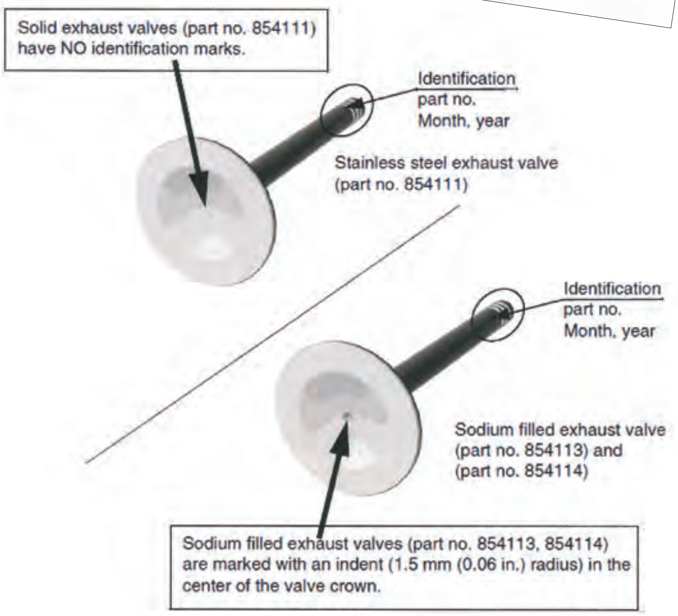
Top and Above Part of the certification process for aircraft is demonstrating that the undercarriage is resilient enough to withstand quite heavy landings at maximum weight. There are a number of very demanding tests that need to be made and the pictures above show just two of them. The sketch shows the basic setup for a drop test, notice that, for the Jabiru SK, the aircraft's undercarriage (and associated airframe structure) needed to withstand a sudden drop of about 0.7 of a metre onto an inclined plane. The picture (top) show a more conventional strength check with the load being applied using a hydraulic press – notice the deformation in a normally inflated tyre during this ultimate load test. **Photo LAA Library**

Quite rightly, the pilot recognised this as being a potentially very risky situation, a bad bout of air sickness is a terrible thing for the sufferer and, especially in the confined space of an aircraft cockpit, a person panicking through illness could lead to aircraft control issues.

The pilot, fearing this, headed straight back to the departure airfield but when on final, he saw another landing aircraft 'well in front and lower', so he decided to go around. This circuit was, as you will imagine, made rather quickly and during final approach the pilot noticed that his speed was much higher than normal.

With plenty of runway ahead, he elected to continue the landing. It didn't go well, which is often the case when a pilot elects to land from an unusual (and unpractised) approach, and the aircraft entered a situation where it appeared to bounce between the main wheels and the nose wheel. This between wheels 'bounce' is quite often because the feedback given via the aircraft's pitch control is out of phase with the aircraft's actual position (and control need) at the time the control input is made – it's called a Pilot Induced Oscillation (PIO) and it's a difficult situation to recover from. It's not unusual that a PIO is brought to an end by a failure of the nose undercarriage.





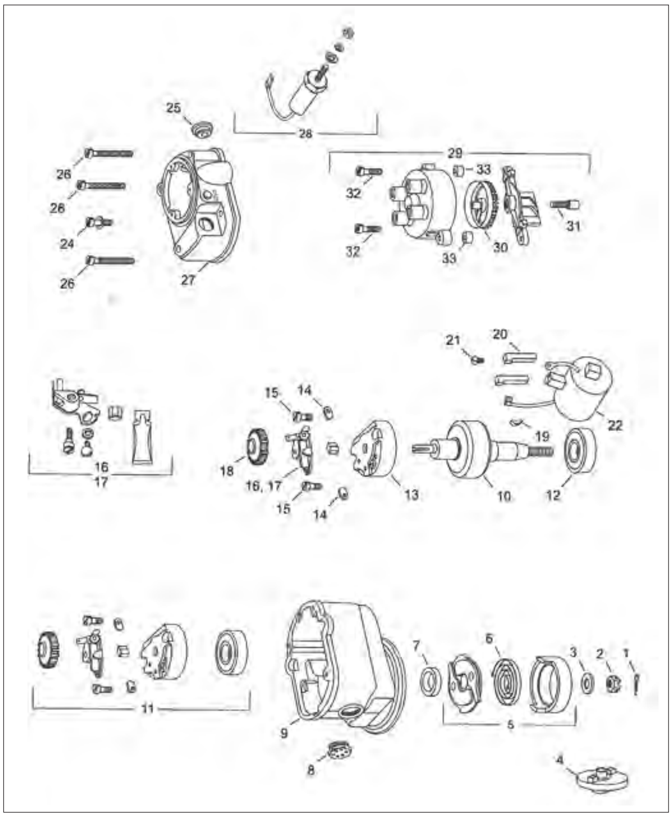
Above LAA Engineering always tries to promulgate important safety information to members; if the issue is type-specific and considered to be safety critical we'll normally write to affected owners directly. When we do this, we'll generally follow this up by issuing an Airworthiness Alert. LAA Airworthiness Alerts can be found in the Engineering section of our website and, if you're an aircraft owner, an LAA Inspector or just interested in the general technical goings-on then it's worth keeping an eye out for new additions. We recently issued this Alert because Rotax Engines discovered that there had been a manufacturing fault in a batch of sodium-filled valves designed for use in their new 915 engine – although also fitted, sometimes retrospectively, in the 914 turbo. This Alert (top) was actually released when Rotax first discovered the problem (December 2018) but EASA decided to mandate Rotax's Bulletin with an AD and then a CAA MPD was raised – all the associated documents can be downloaded via the Airworthiness Alert. **Photos LAA Library/Rotax Engines**

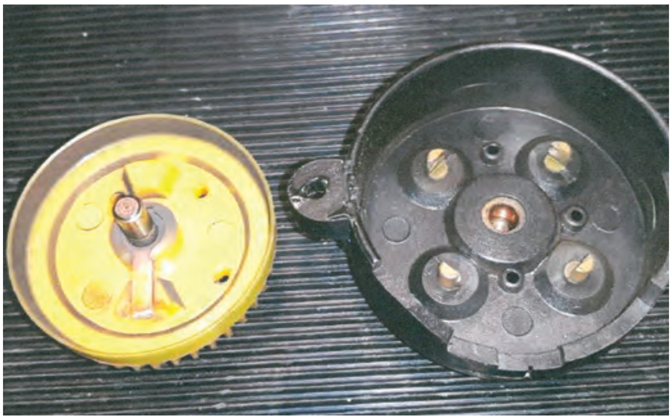
Nobody was hurt and the aircraft suffered only relatively minor damage, triggered by the collapse of the nosewheel undercarriage during the last of the bounces.

When the aircraft was inspected it was discovered that the nosewheel tyre had been replaced with a rubber-filled solid tyre. Further inspection of this by the UK Jabiru agent, Dave Almey, revealed that there was almost no give in this type of tyre, and this lack of give would have undoubtedly changed the suspension characteristics of the nose undercarriage assembly.

I had never heard of a solid aircraft tyre before and, looking at the pictures the owner sent of it, I think that it would be a difficult thing to spot from an inspection point of view. The tyre is completely standard in every other respect (including the impressed information about maximum inflation pressures). Further enquiries, just for interest, revealed that these tyres are modified by a firm here in our neighbouring town of Brackley for use on mobility scooters. I chatted this tyre choice through with the owner who explained that he'd been suffering punctures very regularly and, on the advice of a flying instructor, he chose the solid tyre option.

It is essential that any changes like this are first discussed with your LAA inspector, who will be able to judge whether the proposed change would need some kind of official approval. In this case, it's not likely that the change would be approved as the aircraft would need to go through extensive drop-testing to ensure that the undercarriage, as a system, still worked as it should. Without the added suspension afforded by a pneumatic tyre it's unlikely that the nose undercarriage would survive such a test and would fail – as was seen in the field during this incident! Fair Winds. ■





Right Slick magnetos are common in the GA fleet and only rarely cause trouble, although one issue that was once considered quite rare – slippage of the distributor gear's 'finger' electrode (item 30 in the exploded parts diagram) – appears to have become a more common failure mode. Champion Aerospace recently reissued a Service Bulletin (SB1-15A) suggesting that some magnetos designed for four-cylinder engines may suffer a decrease in service life because of this issue, they'll replace the potentially defective part free of charge. A recent LAA Airworthiness Alert gives full access to this document. First sign of a problem is most likely to be a rough running engine when operating on the defective magneto. Of course, the most common cause of a large mag. drop or single mag. rough running will be a fouled plug, so check the plugs first! **Photos Norvic Aero Engines/Champion Aerospace**

LAA engineering charges – PLEASE NOTE, NEW fees have applied since 1 April 2015

LAA Project Registration		Transfer	
Kit Built Aircraft	**£300**	(from C of A to Permit or CAA Permit to LAA Permit)	
Plans Built Aircraft	**£50**	Up to 450kg	£150
Issue of a Permit to Test Fly		451 to 999kg	£250
Non-LAA approved design only	£40		
Initial Permit issue		1,000kg and above	£350
Up to 450kg	£450	Four-seat aircraft	
451-999kg	£550	Manufacturer's/agent's type acceptance fee	£2,000
1,000kg and above	£650	Project registration royalty	£50
Permit Renewal (can now be paid online via LAA Shop)		Category change	
Up to 450kg	£155	Group A to microlight	£135
451-999kg	£200	Microlight to Group A	£135
1,000kg and above	£230	Change of G-Registration fee	
Factory-built gyroplanes (all weights) Note: if the		Issue of Permit documents following G-Reg change	£45
last Renewal	£250	Replacement Documents	
wasn't administered by the LAA an extra fee of £125 applies		Lost, stolen etc (fee is per document)	£20
Modification application		Latest SPARS – No 17 April 2018	
Prototype modification	min £60	PLEASE NOTE: When you're submitting documents using an	
Repeat modification	min £30	A4-sized envelope, a First Class stamp is insufficient postage.	