Safety Spot
By Malcolm McBride

PIONEER EXHAUST FAILURES, ARPLAST PROP THRUST LOSS & SINKING ROTAX FLOATS

The latest LAA Engineering topics and investigations

Hello again and welcome to *Safety Spot*. Another year, another bonfire night. I must say that I've never been that inspired by fireworks, even as a youngster, at least from what I remember about such distant times. I never looked forward to the family outing to the local sports field, far too cold to stand about watching, well, a bit of fizz, which in my view is more closely associated with sharpening a blade. Judging by the expansion of firework 'spectaculars' throughout the year though, I fear I must be in a minority, but then how many people sharpen blades these days?

Whether you like fireworks or not, I hope that you and those close to you are well and that you've tucked-up your flying machine against the rigours of winter. I'm almost embarrassed to bring the subject up – but then, each spring we hear about the various disasters caused because of a lack of attention to this annual aircraft ownership task.

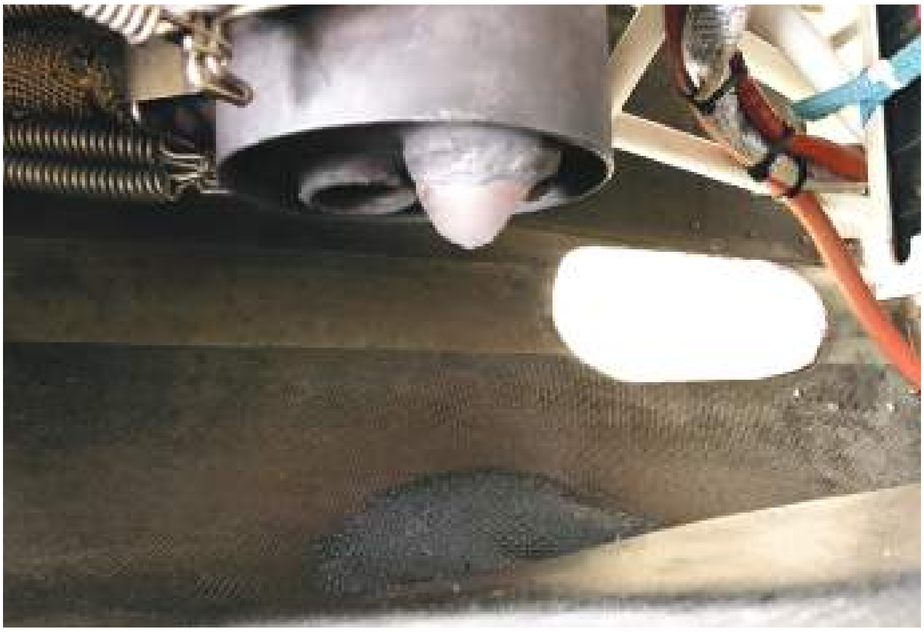
The climate in the UK is, as I'm sure you don't need me to tell you, variable, sometimes in the extreme – writing this in the middle of October the south of England is enjoying near summer temperatures, although it's awfully damp, something like ninety per cent humidity this morning, which are perfect conditions for corrosion.

Also, and I don't want to sound preachy, don't forget to make sure your hangar is up to the winter winds. I know, I say this every autum but last year a couple of really nice RVs were damaged when their hangar collapsed – weight of snow that time, if I remember correctly. The preceding years also saw aircraft becoming victims of unexpected hangar woes.

Actually, problems from the past often return to haunt us. Occasionally, aircraft engineers see an issue for what appears to be the first time, only to be deflated by a pal reminding them that this (or that) has been encountered many times before. So what started the day as an amazing 'spot' could end up being demoted into the ranks of the routine. Maintaining a record of all the past events can be difficult – after all, not every issue surfaces as an *Airworthiness Directive* (*AD*) or *Service Bulletin* (*SB*). Sometimes, an important issue may just end up as a magazine piece – tomorrow's fish and chip paper. To avoid this, each edition of *Safety Spot* is placed on the LAA website. We're currently working on how we might index all the previous *Safety Spots* so that they become more easily 'searchable'. If you think you may be able to help with that, drop me a line to the LAA Engineering mailbox, *engineering@laa.uk.com*

Why, you might ask, am I thinking about this now? Well, later in this *Safety Spot* I'll be discussing an incident involving a loss of thrust during the climb-out. No, we haven't (yet) started to look after turbines, but when I say loss of thrust I mean it. The point is, as you'll read, this loss of thrust issue was caused by something we'd seen before and, believe it or not, had discussed in *Safety Spot*, albeit a fair few years ago. We've fixed part of this communications problem by introducing a small change to the *Type Acceptance Data Sheet* (*TADS*) system, but I'm scratching my head as to how we should improve the indexing of the past *Safety Spots*.

In fact, reviewing my list of subjects I'd like to discuss in this month's offering, and reading through the already edited photos for this edition, of the four individual subjects, three have been discussed before. Here's the first of that trio, problems with exhaust systems…



(Above) **Pioneer 300 Pilot Simon Swift's return flight from Sandown, Isle of Wight, was cut short over the Solent when his cockpit suddenly filled with smoke. In fact, so much of it that he had trouble seeing out of the cockpit. After something of an unwanted adventure, which ended with a successful emergency landing at Popham, Simon removed the engine cowl and immediately saw the smoke's origin. As you can see, the tailpipe had become detached and very hot exhaust gasses were blowing onto the fibreglass lower engine cowl. The smoke generated was directed straight into the cockpit via the ventilation system.** *(Photo:Simon Swift)*

Pioneer 300 CKT exHausT : smoKe in THe CoCKPiT

This story started, as do so many, with a telephone call from an LAA member letting us know that he'd had a bit of an issue with his aircraft. Naturally, our first concern, and the thing we ask about first is, "Are you okay, can we help in any way?" After all, at our heart, we're an Association – brothers in arms, so to speak. Normally, thank goodness, the answer is, "Yes, fine thank you", which is followed by, well, all sorts of questions! That said, I didn't take the initial call but the colleague who did let me know about it via our internal email system. All good thus far.

As it turned out, it wasn't long before we received notification from the Air Accidents Investigation Branch (AAIB) at Farnborough, which had been informed that there'd been a serious incident involving smoke in the cockpit of an aircraft off the south coast via the Mandatory Occurrence Reporting (MOR) system, this response having originated from the Air Traffic Unit which took the PAN call from the pilot, Simon Swift, when he realised there were real problems with his aircraft.

Simon had flown down to the popular Isle of Wight weekend destination, Sandown, earlier in the day – it's a place I like to visit whenever opportunity arises. Actually, it's quite a walk down to Sandown's smashing pier from the airport, as the airfield is actually in Lake – still doable though! If you go, take your walking boots (or a taxi fare) as it seems silly to go all that way and not have a paddle. Here's Simon's report explaining what happened:

'The take-off from Sandown Airport was extremely rough, with the aircraft hitting a ridge in the runway and leaving the ground before the flying speed was achieved. The aircraft returned to the runway, hitting a second ridge and again leaving the runway, and then coming back down with a very heavy bump and sideways drift to the left. The aircraft bounced for a third time before eventually reaching flying speed.

'Fifteen minutes into the flight, the cockpit filled with smoke and a PAN call was made to Solent radar, who guided me to Popham Airfield. Solent telephoned Popham asking them to prepare for my emergency landing. Following the landing at Popham I was met by the fire truck and the aircraft was shut down and allowed to cool before being inspected.

'The cause of the problem was that the tailpipe on the silencer had broken off. The escaping hot gasses burnt a hole in the engine cowling and caused considerable damage to some of the components on the firewall.

'Following recovery of the aircraft to its home airfield, hairline cracks were found on both wings where the leading-edge material covers the wing spar. Further investigation showed that both main undercarriage leg brackets are bent.'

It's more usual to suffer the consequences of a heavy landing, it's a much rarer event having to inspect for damage caused by a rough take-off. Discussing this take-off with Simon after receiving his report (and pictures of the failed exhaust system), this take-off did indeed sound horrendous. At the time of writing, we're still awaiting the results of a full airframe inspection which, not to stress the point, will be pretty much the same as the one required after a heavy landing. We already know that the undercarriage attachments to the main spar are damaged, though the actual cause of the skin cracks is still to be established – fingers crossed it's nothing too horrid.

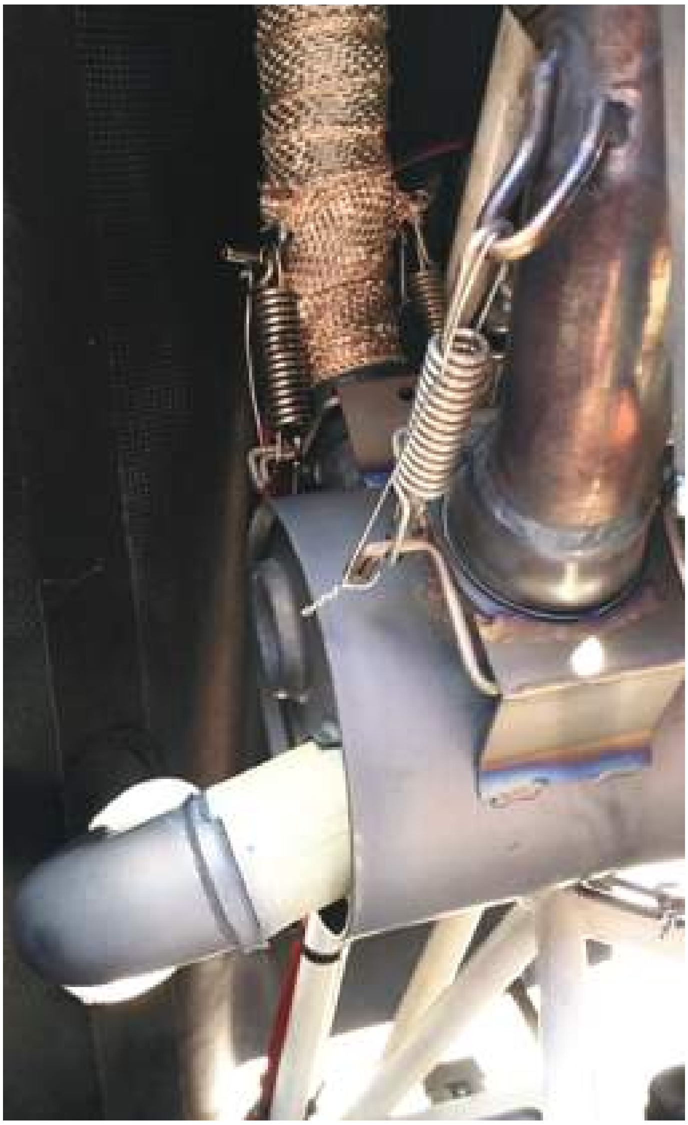
Certainly, I think that Simon did exactly the right thing by getting a PAN call out as soon as possible when smoke started to enter the cockpit. It turned out that the cause of the smoke wasn't, thank goodness, an engine or electrical fire – the hot exhaust gasses were simply blowing straight into the composite which makes up the engine cowl, an effective smoke generator. That just happens to be where the cockpit fresh air is collected via a cowl-mounted NACA duct. Closing the fresh air valve reduced the smoke massively in the cockpit which eased the situation somewhat.

If you find yourself in a difficult in-flight situation, and there are those who have and will, never be too big to ask for help – either with a PAN call to the ATC you're working or D&D on 121.5MHz. That's is true even if you've been a bit of a wally and taken off in below weather minima, expecting a change for the better which hasn't arrived. D&D are there to get you back on the ground safely, as fast as possible, and they know what they're doing.

In fact, Simon was so impressed with the service offered by Solent ATC that he wrote a thank you note – well done to him for that!

You can see, by reviewing the photos, what's happened. Of course, we wouldn't expect an exhaust tailpipe to fall off ›

(Left) **This photo shows the effect heat can have on a battery, see how its casing has been distorted. The scat hose connecting the cockpit air inlet from the duct in the lower cowl can also be seen (now disconnected) top centre. This event highlights why it's essential to check the engine, both visually and mechanically, in your daily cowls-off inspection. Don't be frightened to give the exhaust a bit of a yank, as this type of check will show you if all the expansion slip joints are working and, importantly in this case, whether a crack is growing somewhere in the assembly.** *(Photo: Simon Swift)*



(Left) **On the same day that Simon's cockpit filled with smoke because of a failed exhaust, another Pioneer 300 flyer, LAA'er Michael Foreman, had to cut short his planned flight to the Scilly Isles after he heard a distinct change in engine note during the climb out from Sleap. No smoke this time but, as you can see from the attached photo, again the tail pipe has detached completely from the expansion chamber. This time though, because the pipe itself remained in-situ, there was no further airframe damage.** *(Photo: Michael Foreman)*

(Above) **Alan Bray's nosewheel version of the Kitfox Mk 7, and very smart it looks too. This picture was taken before Alan suffered what can only be described as a 'thrust' failure during a normal departure from his local farm strip. The damaged caused to the airframe during the emergency landing was limited to the nose area and, naturally, the undercarriage. However, the engine, a 100hp, four-stroke Rotax 912 ULS, which is normally limited to 5,800 rpm, was running above 7,000 rpm for some time and will doubtless need some considerable attention before it flies again.** *(Photo: Martin Uzell)*

(Left & below) **after the forced landing suffered by Alan's Kitfox Mk 7, initial investigations as to the cause of the loss of thrust suggested problems with the propeller pitch change mechanism or the gearbox. During LAA Engineering's visit, both these areas were inspected. These pictures show the damaged Arplast PV50 propeller hub – when found, the mechanism indicated that, at impact, the blades were in the fully coarse position, which isn't suggestive of an over-rev situation. Confusingly, although the most probable reason for the apparent loss of drive to the propeller was a drive-train failure, a local inspection of the recently overhauled gearbox didn't show any evidence of failure.** *(Photos: Malcolm McBride)*

because of a few bumps on the runway, most likely a crack had been growing around that welded joint for some time. So perhaps the lesson here is that it's absolutely essential to inspect your aircraft carefully before each day's flying.

Interestingly, on the same day, another Pioneer 300 pilot, Michael Foreman, suffered a very similar exhaust failure – I hope it isn't catching, Michael explained that he's particularly annoyed at not spotting the problem before it turned into a failure, especially as he's in the habit of removing the engine cowl at the end of each day's flying, to check all's well. Cracks can be difficult to spot but putting a bit of muscle into the joint can often reveal relative movement in a part-broken component and, unless you're super-human, you won't break anything.

KITFOX MK 7: ARPLAST PV50 PROPELLER – LOSS OF THRUST

LAA Kitfox builder and flyer, Alan Bray, was on a trip in his aircraft to a flying day at Old Warden – if you haven't been to one of those events you're missing out, so make a date, although it'll have to be in your 2019 diary as they've finished for this year.

Alan flies from a private strip near his home, on the outskirts of Rugby and, returning from a great day out, with the landing strip in sight, he reduced power to begin the decent then, to paraphrase Alan, "All of a sudden, the rpm went to 7,000 but there didn't seem to be any thrust."

Confused, Alan took some time to work out what was actually happening – realising that the cause was most likely the propeller pitch being too fine he selected 'manual' on the propeller controller and selected coarse but that didn't seem to make much difference. Shortly afterwards, the powerplant as a whole "Became very smooth, the propeller was still going round though (there was) still no thrust."

Now, when something unusual happens when you're flying your machine, especially when it's horrible, like a sudden attack of quietness from the front end, take it from me (who's had a fair share of airborne moments) there's a period of emotional inertia. In other words, it takes a period of time for your brain, which is still 'flying from A to B', to catch up with the new reality, one which sees the number of options most definitely reduced. Avoiding the psycho-babble, there's always some latency in effective response in any new situation.

Actually, this lack of ability for humans to cotton-on to an unusual emergency situation quickly is exactly the reason why we train for, and hopefully practise, emergency drills. This practise-effect cuts initial response times in emergency situations to a minimum, thereby giving the pilot the maximum opportunity possible to get the changed situation under control.

As a short diversion, acknowledging that this latency-in-response issue exists in any unusual operational situation is exactly the reason why I get so angry when I read yet another well-meaning (but dangerous) tale advising that there are times when a turn-back after an engine failure after take-off (EFATO) is okay. The 'never turn back' rule wasn't put in place (and is tested at GFT) as, in some circumstances, a skilled pair of hands might be able to get an aircraft through 180° and back onto the runway in one piece, but because skill comes from practice – it isn't an innate property, and you can't rehearse for the unpredictable. You're very likely to walk away from an arrival after an EFATO if you obey the never turn back rule, you aren't likely to survive a stall/spin during indecisive ponderings or a low-level turn-back.

That said, there are bound to be times, and Alan was faced with just such a time, where you might have height enough to work-through possible better options. Partial engine failures, for an example, can be very tricky to deal with, mostly because they complicate a situation and it takes valuable time to evaluate, which you may not have… and, of course, this wasn't an EFATO situation.

Alan lost thrust but the engine, albeit racing away, was working. That's a pretty unusual situation and, as discussed, created an extended latency-in-response. That, in turn, meant both height and speed were lost. In a situation like this, which was effectively an engine failure, the best option is to get the nose down, establish the glide, select a sensible field and concentrate on getting you and the aircraft down in one piece. After all this initial (hopefully well-rehearsed) activity, if there's time (and there probably won't be, unless you're pretty high up), see if you can establish the cause and, if possible, fix the problem.

There's only very rarely a single cause for an incident or accident, even if it initially looks as if there is. Normally, there are many causes. Now, it's often tempting to list-out the components of an incident (causes) and weight each of them against some sort of 'importance index'. But looking at an incident as a whole, you can often see that even if just one component of it was missing then it wouldn't have happened – the holes in the cheese wouldn't have lined up. So, how is it possible to create an 'importance index' as, taking the above into account, each component has an equal value?

Now, incident/accident investigation policy doesn't exist in a vacuum, far from it, and there isn't enough space herein to look into the ins and outs of the various methods used in discussing and managing and recording cause, in the broader environment. Perhaps it's enough to say that the LAA adopts a no-blame (eg a 'just') culture in its investigative activities and we try hard to understand an incident in an holistic (rather than a list-based) way.

So, taking that into account, and having already discussed the first part of the investigation, how did we set-about sorting -out the various component factors into a manageable list? Well, firstly, why did an engineering failure turn into a reportable (in the legal sense) accident?

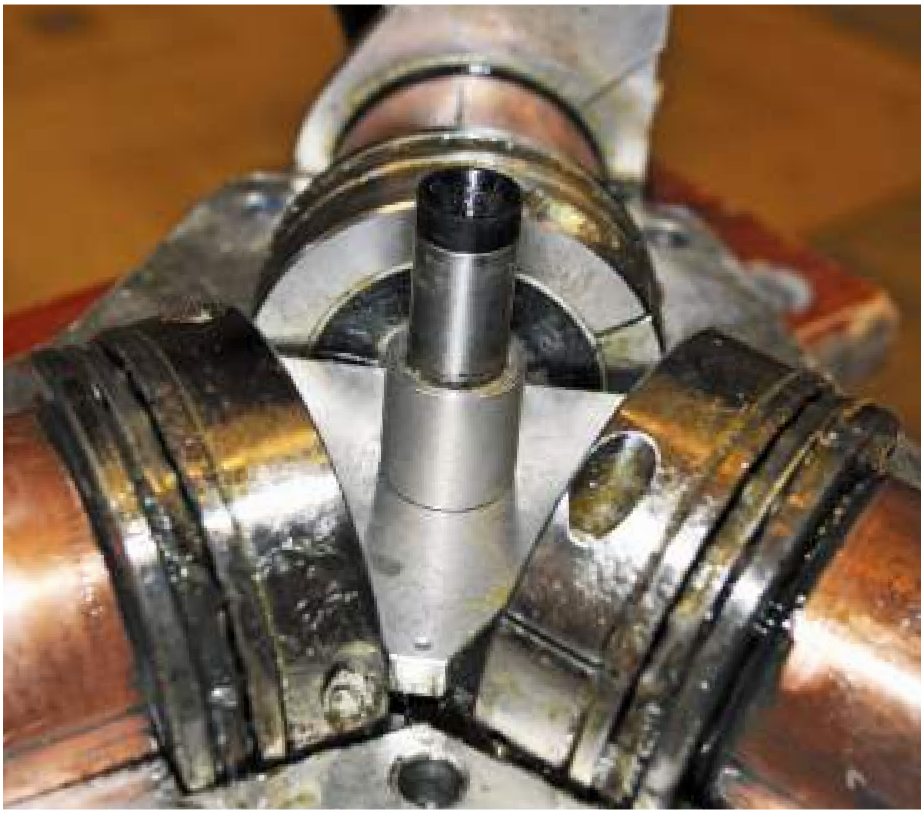
What turns an emergency landing from an event warranting further investigation into one requiring a more formal approach? Principally, of course, the level of the damage to either the aircraft or involved personnel – do either of these rise above a predetermined threshold?

With regards to this incident, the pilot was fine but, sadly, the aircraft got bent. We've discussed this above so there's no point further pushing this, except perhaps, that once a reason for in incident has been established it'd be wasteful not to use it as an example – we all learn from others' mistakes – so, chatting about this (operational) part of the event in *Safety Spot* acts as part of our ongoing response process.

Then, what caused the lack of thrust? In this case, although it took a bit of working out, it was discovered that the lead screw in the prop pitch change mechanism had failed. ›

(Above, from top) **After establishing that the reason for the loss of thrust wasn't, or at least didn't appear to be, a 'super-fine' propeller pitch issue, the drive-train in the gearbox became the prime suspect. Initial visual inspection didn't reveal any obvious issues and the gearbox appeared to be operating normally, so a closer look was necessary.**

A study of the basic gearbox design suggested that there were only two points of failure which could lead to a loss of drive, namely a 'disconnect' of the crankshaft drive gear or the failure of the overload clutch assembly. A mechanical failure in an engine or gearbox usually leaves evidence in the oil and failure products normally collect in the oil filter or, in some engines, if ferrous, on a magnetic drain plug. These three pictures show these areas of interest – note the particles on the drain plug, which are deemed fairly typical in an essentially new assembly – both the oil filter element and the clutch assembly were normal. *(Photo: Malcolm McBride)*



(Above) **This picture shows part of the pitch change mechanism in the Arplast PV50 propeller – the front casting, which contains the drive motor, has been removed. The triangular carriage, seen at the centre, moves forwards and backwards (up and down) as a result of the force generated from the threaded, motor-driven, lead screw (removed here). A single peg in each of the blade roots sits in a slot in the carriage so, as it moves, the blades are forced to rotate, increasing or decreasing the relative blade angle to the airflow as they do so.** *(Photo: Pete Jeffers)*

(Left & below) **The drive mechanism in the Arplast PV50 propeller shown more clearly. The first picture at left shows how the lead screw works – as it rotates it pulls or pushes the carriage forwards or backwards. You can see that the motor has been moved to the side so that the mechanism can be moved manually on the bench, also notice the range-limiting micro-switches. Although the screw thread, as seen in the photo above left, looked very worn, only when it was nearly fully withdrawn, as shown in the photo at left, did the damage to the thread and the failure of the mechanism, become totally obvious.** *(Photos: Alan Bray/ Malcolm McBride)*

I have to say that, initially, when we first read through the pilot's report, a propeller pitch failure did seem the most likely cause but, as is often the case with this sort of investigation, there were a couple of well-signposted blind alleys that needed exploring.

The first of these was that the gearbox had just been returned from the workshops after an overhaul. So although it sounded improbable there was a chance that the gearbox had failed in some way. Added to this, and supporting this gearbox failure theory, was the damaged propeller which, when initially inspected, was found in coarse pitch. The pilot, as you'll remember, had selected coarse pitch manually, thinking that the automatic side of the constant-speed unit had failed.

As it turned out, the gearbox checked out fine but, in a more detailed strip inspection, the lead screw was found to have failed, hence the propeller's natural tendency, as rpm rises and centrifugal effects predominate, to go to full fine (Centrifugal Turning Moment caused the overspeed). Selecting full coarse in the cockpit didn't make any difference to the propeller pitch but, once the engine had stopped developing power (failing due to excessive rpm) the natural tendency of these propellers to go to full coarse (Aerodynamic Turning Moment) at lower rpms took over.

What about the LAA's requirement for a fine-pitch stop? After an accident in 2008, involving a Europa, where a propeller pitch change drive failed and the resulting very fine pitch meant that the propeller lost most of its ability to produce thrust, the LAA already had a requirement that all in-flight variable-pitch propellers must be fitted with stops limiting the 'fineness' of the blade angle, whatever happens to the mechanism that moves it. In other words, even with a complete failure of the control mechanism, the aircraft will still remain flyable.

Incidentally, extending this rule into the 'coarse' end of the spectrum, it should be said that even at maximum cruise pitch settings the aircraft must be able to climb away during a missed approach. This introduces the requirement for coarse-pitch limit stops and, incidentally, it's why there are no in-flight variable-pitch propellers on an aircraft's propeller type list. That's because an air test is required to check these stops out before a propeller can be approved on an individual airframe.

Why wasn't this aircraft fitted with a fine-pitch stop? Although there is a supporting *Airworthiness Information Leaflet* (*MOD/ PROP/08-007*), published in February 2008, detailing a requirement for regular inspections, the owner hadn't seen it. Earlier, I discussed our end-game objective, which is that all pertinent technical information should be available to owners, even if much time has elapsed since its publication. It could be said that this aircraft did take quite a while to turn from a kit to a flying example and that the propeller was purchased at the same time as the kit – so it was an early model, supplied before the incident, which led to the introduction of a fine-pitch stop by the manufacturer – but then, this would just be another component, cause or hole in the cheese, whatever name you give to the many equally important 'bits' of this incident.

So, at the time of writing, we haven't completely sorted out the list of all our responses. Certainly, we've reminded all pilots confronted with an engine failure about the need to *fly the aircraft first* and that's given me the opportunity to pour a bucket of cold water over arguing against the 'never turn back' issue.

We're going to introduce a propeller *TADS* which will be available online and, most probably, we'll be writing to all PV50 owners letting them know about the fine-pitch stop requirements – there's some admin work here as we're going to have to do some research into where these props might be.

Remember, a *Permit to Fly* aircraft flies under the rules laid out in the aircraft's *Operating Limitations* document, and this document may contain a number of propeller options – establishing which one is actually being used will need some work.

I'm sure that you'll be pleased to know that Alan is well on his way to fixing the airframe and the engine is awaiting a strip inspection. He plans to fit a fixed-pitch propeller and is exploring what type to buy as I write.

ROTAX ENGINES: SINKING FLOATS

Time, and word-count marches on, so I'm not able to tell relate, in detail, the full tale of a recent incident which saw an LAA gyroplane flyer, Mark Dowie, end up in France with a rough-running engine. That's a shame because Mark wrote an exciting tale about his trip from Salcombe to Annemasse in France – it sounds like an adventure in its own right, as I'm sure you'll agree. I'm hoping to read about this trip in a future edition of *LA*, here we'll just have to make do with the pertinent facts surrounding the engine issue.

Let's start with Mark's brief report of the incident to the authorities – essentially, it was an early abort during a take-off:

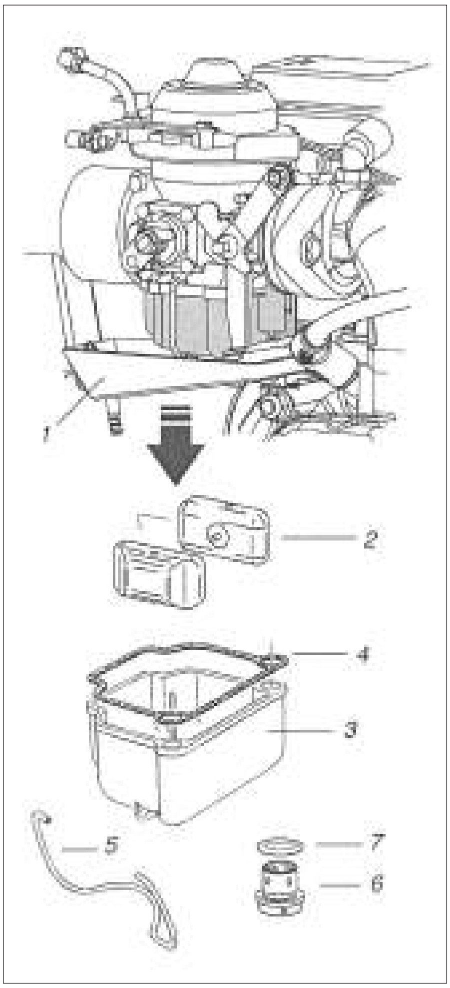
'This incident involved a serious loss of and surging in power on take-off at Annemasse, France, resulting in an aborted take-off at mauw on departure. RTO was initiated at approximately 50mph, approximately 10mph before take-off speed.

'The aircraft is an Autogyro Cavalon, fitted with a Rotax 914UL engine. The aircraft is fourteen months old with 128 hours of total flight time. It's normally flown using UL91 or mogas but, during this cross-country flight, was being flown using Avgas 100LL. The flight manual permits this change in fuel use.

'The aircraft had operated for thirteen hours using Avagas 100LL before the incident. The cause of the power surging and failure to reach beyond 4,300 rpm (normal take-off rpm is 5,800) was the failure of the floats in the LH carburettor. They were overweight and not floating as required.

'These floats had been weighed by a licenced CAA engineer (and were) within limits (total less than 7g) at the annual service in January (83 hours). When they were replaced (115 hours) they were out of limits at 5.21g and 4.37g. The right-hand pair were still within limits at 3.26 and 3.28 but were also replaced as part of the rectification.'

Regular readers of *Safety Spot*, and most owners of Rotax 9 series engines, will already know that there was, some time ago, a small plague of carburettor float failures. However, as we understand it, Rotax established the reason for the individual failures, by all accounts a manufacturing flaw in a batch of floats, and has 'fixed' the issue. Certainly, Mark's report came as a bit of a surprise as ›



(Left & below) **We thought that the problems associated with 'sinking' floats had passed into history but a recent incident involving Cavalon gyroplane demonstrated that isn't the case. Although shrouded in mystery, anecdotes suggested that the reason for the excess of numbers of failures of this important part a few years ago, and the issuance of a number of *Service Bulletins* from the manufacturer, was due to a manufacturing defect in a batch of floats.**

The defect showed itself as an increase in float weight because of fuel absorption in its foam core. The *SB*s produced along the way suggested hours-based checks were necessary, although field experience shows that the failures, when they occur, are random events. This is why LAA Engineering suggest that if Rotax operators notice any change in the behaviour of their engines, especially differences when idling or problems starting, they check their floats first. Most likely the richer mixture, essentially the first effect of a raised fuel level in the float chamber at low rpms, is likely to be causing the problem. *(Photos: Rotax Engines/CFS Aero)* we hadn't received any reports involving sinking floats for ages.

Normally, the first sign that one float is sinking is a richer mixture that side of the engine, which leads to poor starting and rough-running ('hunting') at lower rpms – in other words, there are early signs something's up. Our advice to the very many Rotax users on the LAA fleet has been is that, if your engine starts misbehaving, check the floats first.

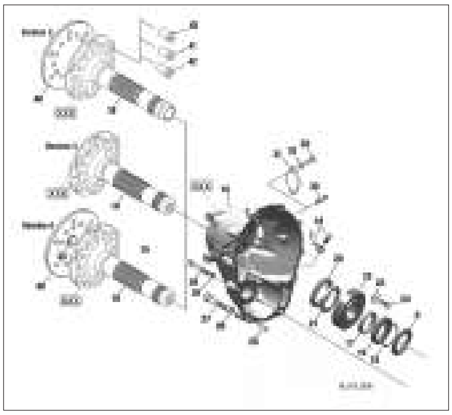
This recent report from Mark opens up the new problem that, when a float fails in some aircraft installations, rough-running can occur at full power, and this is more worrisome. I recently spent some time with the UK Rotax agent who said that, like us, the company hasn't seen a continuing wave of failures nor, importantly, received any reports involving the latest floats (Part Number 861188).

However, as I write these final few words, I've just received a worrying report that some Bristell owners have been suffering rough-running engine issues, which seem to be connected with their floats. Naturally, more research is needed but it might be wise, if you're operating one of the more complex Rotax carburetted engines, to change the floats to the latest type.

If you've recently had a float issue please let us know about it, and how you fixed the problem. And please be honest – if you've used alternate parts let us know if they're suitable. Should you have you've spent some time working with them then they probably are, and we can initiate an approval process (probably using our Standard Mod system)

So, rather than actually fall of the edge of the page, I'd better end this month's finger work-out with my usual blessing: fair winds. ■

(Above & above right) **Here we have a propeller shaft from a Rotax gearbox which suffered excessive and rapid wear shortly after being fitted during a gearbox overhaul. As you can see, this Rotax part is beautifully engineered and should last, if treated kindly, for over a thousand hours in service. Alongside the UK Rotax agents, CFS Aero, the LAA is looking at why this individual part has prematurely failed. Gearbox experts we've talked to are sure that this kind of damage is indicative of a tiny centring misalignment during manufacture. Rotax has replaced the part under their warranty scheme but this incident highlights the need for pilots to keep their engines out of the low rpm rough-running range whenever possible.** *(Photos: Malcolm McBride)*



(Left) **At the time of writing, we're waiting for a response from Rotax HQ about the reason for the premature failure of a member's propeller shaft, as detailed above, although it's interesting to note that the latest edition of the *Illustrated Parts Catalogue* (*IPC*) shows that the company has introduced an 'oiler' directed at the shaft into new gearboxes – see item 44 in this picture.** *(Image: Rotax Engines)*

(Left) **Although many mechanical devices can operate through quite large ranges of movement, normally some tend to do so within a very narrow spread. This narrow range of normal operation will naturally mean that any position-related wear will be focused into a small area. This picture, of the inside of an oil pressure sender unit which stopped working in service, illustrates the issue very clearly. Essentially, this device varies an output voltage by changing the position of the 'wiper' on the rheostat, effectively lengthening or shortening a long length of thin wire – seen at far right. This movement increases or decreases the electrical resistance in the circuit as a response to change in the oil pressure. In the cockpit, the pilot sees an oil pressure gauge but in reality it's a voltmeter! The picture shows that the engine from which this unit was removed operated with a fairly constant oil pressure, probably somewhere around 60 PSI or 9v! Although that's good for the engine, you can see the wear in the rheostat which went 'open circuit' (failure) after 500hr in service.** *(Photo: Pete Jeffers)*

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* (can now be paid online via LAA Shop)**	
Up to 450kg	**£155**
451-999kg	**£200**
1,000kg and above	**£230**
Factory-built gyroplanes (all weights) ***Note: if the last Renewal wasn't administered by the LAA an extra fee of £125 applies***	**£250**
Modification application	
Prototype modification	minimum £60
Repeat modification	minimum £30

Transfer	
(from *C of A* to *Permit* or *CAA Permit* to*LAA Permit*)	
Up to 450kg	£150
451999kg	£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
Latest SPARS – No 17 April 2018	

PLEASE NOTE: When you're submitting documents using an A4-sized envelope, a First Class stamp is insufficient postage.